

MUSKEGON COUNTY HAZARD MITIGATION PLAN UPDATE 2024 – 2029



Multi-Jurisdictional Plan for Muskegon County, Cities, Townships, Villages

Adopted by Muskegon County Board of Commissioners on Date: _____
Muskegon County Marquette Campus, 1903 Marquette Avenue, Muskegon, MI 49442
Board of Commissioners Chairman Charles Nash

Muskegon County Emergency Management
1903 Marquette Ave, Suite J-101, Muskegon, MI 49442 (231) 724-6341
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The Muskegon County Hazard Management Plan is a multi-jurisdictional hazard mitigation plan developed pursuant to the criteria contained in 44CFR Part 201, as authorized by the Disaster Mitigation Act of 2000. This plan is required in order to maintain eligibility to seek federal funding under the Hazard Mitigation Assistance Grant Program. The Muskegon County Hazard Mitigation Plan was originally developed in 2005 by the West Michigan Shoreline Regional Development Commission, in cooperation with the Michigan State Police, Emergency Management and Homeland Security Division.

In 2022, Muskegon County contracted with Newaygo County Emergency Services to update the plan, in cooperation with the Michigan State Police, Emergency Management and Homeland Security Division.

Letter of Transmittal from Chief Elected Official

(Date)

(Organization)

(Name)

(Title)

(Street Address)

(City), MI (Zip Code)

Dear **(Name)**:

Attached is the Muskegon 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 Muskegon County will consider 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.

Any questions and concerns related to content and use of this plan should be directed to Renee Gavin, Director of Muskegon County Emergency Services, at (231) 724-6341.

Sincerely,

Muskegon County
Board of Commissioners

MUSKEGON COUNTY
HAZARD RANKINGS



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INTRODUCTION

Muskegon County is vulnerable to a wide range of natural, technological, and human-related hazards. Managing these many varied threats, and protecting life and property, are the challenges faced by emergency management officials at all levels of government. In order to attain effective emergency management capability, an understanding of the multitude of hazards that confront the County must first be obtained, and then a plan must be developed to systematically address those threats.

The intent of this document is to: 1) serve as the jurisdiction's hazard analysis, to educate local policy makers and emergency service organizations of the area's hazards and vulnerabilities; and 2) to provide a strategy to guide and implement county-wide and community-specific mitigation activities. It is extremely important that the information and strategies detailed in this document be considered by all government, public, and private entities in their development processes. This team approach to hazard mitigation will help ensure a safer and sustainable community.

The Hazard Mitigation Plan for Muskegon County was originally developed and approved in March 2005. The plan was then updated and approved again in 2015. Both times the West Michigan Shoreline Regional Development Commission (WMSRDC) under the guidance of the Muskegon County Local Emergency Planning Committee, the Muskegon County Hazard Mitigation Advisory Team, and Muskegon County Emergency Management developed and updated the plan.

As highlighted under FEMA's regulations and guidance for Hazard Mitigation Planning, the Disaster Mitigation Act of 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), creating the framework for state, local, tribal and territorial governments to engage in hazard mitigation planning to receive certain types of non-emergency disaster assistance. Requirements and procedures to implement hazard mitigation planning provisions may be found in the Code of Federal Regulations, Stafford Act Title 44, Chapter 1, Part 201 (44 CFR Part 201).

Since the Disaster Mitigation Act of 2000 amended the Stafford Act, additional laws have been passed that help to shape hazard mitigation policy. These revisions are included in the Sandy Recovery Improvement Act (SRIA) of 2013, the National Flood Insurance Act of 1968, and the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016. In accordance with these regulations, hazard mitigation plans need to be updated and re-submitted for FEMA approval every five years to maintain eligibility for certain types of non-emergency disaster assistance. In October of 2021, Muskegon County contracted with Newaygo County Emergency Services' Planner to update the plan to its current format.

Questions and comments concerning this document should be addressed to Renee Gavin at the Muskegon County Emergency Services Department, 1903 Marquette, Suite J-101, Muskegon, MI 49442 telephone number (231) 724-6341. The office is the coordinating agency for all emergency management activities in Muskegon County. The mission of the Muskegon County Emergency Services Department, in cooperation with the Emergency Management Division of the Michigan State Police (EMD/MSP) and the Federal Emergency Management Agency (FEMA), is to save lives and protect property in this County. This will be accomplished by having an emergency plan and program that is developed and exercised according to State and Federal guidelines and considers any unique circumstances within Muskegon County.

Hazard Analysis Introduction

The first step in the process of building effective emergency management capability is the preparation of a hazard analysis that provides an understanding of those threats. When coupled with relevant land use and demographic information, a hazard analysis becomes the foundation upon which all emergency planning efforts in the community are built; a powerful planning tool that enables emergency management officials to set priorities and goals for resource allocation towards mitigation (prevention) and preparedness (response) activities.

A hazard analysis provides an understanding of the potential threats facing the community. By pinpointing the location, extent and magnitude of past disasters or emergency situations, and by examining knowledge of new or emerging risks, it is possible to estimate the probability of such events occurring and the vulnerability of people and property. By viewing this information along with relevant land use, economic, and demographic information from a well prepared "community profile," emergency management coordinators can make assumptions about those segments of the community that might be impacted in a given situation. This, in turn, allows them to set priorities and goals for resource allocation and response, recovery, and mitigation activities prior to an incident occurring.

Hazard Mitigation Introduction

Hazard mitigation is any action taken before, during, or after a disaster to permanently eliminate or reduce the long-term risk to human life and property from natural, technological, and man-made hazards. It is an essential element of emergency management, along with preparedness, response, and recovery. There is a cyclical relationship between the four phases of emergency management. A community prepares for a disaster, and then responds when it occurs. Following the response, there is a transition into the recovery process, during which mitigation measures are evaluated and adopted. This, in turn improves the preparedness posture of the community for the next incident and so on. When successful, mitigation will lessen the impacts to such a degree that succeeding incidents will remain incidents and not become disasters.

Hazard mitigation strives to reduce the impact of hazards on people and property through the coordination of resource programs, and authorities so that, at the very least, communities do not contribute to the increasing severity of the problem by allowing repairs and reconstruction to be completed in such a way as to simply restore damaged property as quickly as possible to pre-disaster conditions. Such efforts expedite a return to "normalcy"; however, replication of pre-disaster conditions results in a cycle of damage, reconstruction, and damage again.

Hazard mitigation is needed to ensure that such cycles are broken, that post-disaster repairs and reconstruction take place after damages are analyzed, and that sounder, less vulnerable conditions are produced. Through a combination of regulatory, administrative, and engineering approaches, losses can be limited by reducing susceptibility to damage. Hazard mitigation provides the mechanism by which communities and individual can break the cycle of damage, reconstruction, and damage again.

Recognizing the importance of reducing community vulnerability to natural and technological hazards, Muskegon County is actively addressing the issue through the development and subsequent implementation of this plan. The many benefits to be realized from this effort – protection of the public health and safety, preservation of essential services, prevention of property damage, and preservation

of the local economic base, to mention just a few – will help ensure that Muskegon County remains a vibrant, safe, enjoyable place in which to live, raise a family, and conduct business.

Target Area

The Muskegon County Hazard Mitigation Plan is a “multi-jurisdictional” plan which helps qualify the county and constituent local governments to apply for certain types of hazard mitigation assistance. However, communities must have participated in the development of this plan and adopt it in order to be eligible to apply. So, although the plan was created at the county level, all municipalities within Muskegon County were invited to participate in the plan development at numerous points throughout the planning process. There are seven cities, four villages, and sixteen townships in Muskegon County:

Cities

| | | | |
|---------------|----------------|------------------|----------------|
| Montague City | Muskegon | Muskegon Heights | North Muskegon |
| Norton Shores | Roosevelt Park | Whitehall | |

Villages

| | | | |
|----------|-----------|---------------|---------|
| Casnovia | Fruitport | Lakewood Club | Ravenna |
|----------|-----------|---------------|---------|

Townships

| | | | |
|-----------|-----------|-------------|-------------|
| Blue Lake | Casnovia | Cedar Creek | Dalton |
| Egelston | Fruitland | Fruitport | Holton |
| Laketon | Montague | Moorland | Muskegon |
| Ravenna | Sullivan | Whitehall | White River |

Plan Background

The Muskegon 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 carry out 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 Muskegon County Hazard Mitigation Plan was adopted by Muskegon County in 2006 and fully approved by FEMA in 2006. Further, all 27 jurisdictions within Muskegon County (7 cities, 4 villages and 16 townships) were successful in adopting the county's multi-jurisdictional hazard mitigation plan 2006 edition 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 the 2015 edition of the Hazard Mitigation Plan document. During the 2015 planning process, Montague Township was the only municipality out of the 27 local units that did not submit a letter of participation. Once complete, only 6 townships within Muskegon County were successful in adopting the county's multi-jurisdictional hazard mitigation plan 2015 edition at the local level.

The Muskegon County Hazard Mitigation was originally developed by the West Michigan Shoreline Regional Development Commission (WMSRDC) under the guidance of the Muskegon County Local Emergency Planning Committee, the Muskegon County Hazard Mitigation Advisory Team, and Muskegon County Emergency Management. In 2021, Muskegon County was awarded a Pre-Disaster Mitigation Grant to update the FEMA-approved hazard mitigation plans for Muskegon County and all municipalities within Muskegon County. All 27 local units of government submitted a letter of participation during the current planning process. All planning efforts for this current plan update and facilitation of local adoptions of the plan were managed by Muskegon County Emergency Services and the Newaygo County Emergency Services Planner.

This edition of the Muskegon County Hazard Mitigation Plan was created through cooperation and coordination between Muskegon County Emergency Services, Newaygo County Emergency Services (NCES) Planner, and the Muskegon County Local Emergency Planning Commission. The Contracted NCES Planner assumed responsibility for performing the hazard analysis, which included creation of a community profile and the identification and evaluation of hazards within the county. In addition, the NCES Planner was responsible for ensuring the plan satisfies the requirements of a FEMA-approved hazard mitigation plan. This entailed tasks such as documenting stakeholder and public participation; provision of hazard mitigation strategies; coordinating the development of hazard mitigation goal, objectives, and actions; and facilitating adoption of the plan at the county and local levels of government. Throughout the planning process, Muskegon County Emergency Services, Newaygo County Emergency Services Planner, and the Local Emergency Planning Commission made concerted efforts to engage the public and community stakeholders.

The plan is intended to cover a five-year period and should be updated again in 2029.

2023 PLANNING PROCESS

This section chronicles the steps that were taken to update the Muskegon County Hazard Management Plan, documents the multitude of planning participants, and provides suggestions for how the Plan should be leveraged and maintained. In general, the planning process consisted of the elements listed below.

- 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
- Monitoring and periodic revision of the plan

Step 1 – Letters of Participation

This is a “multi-jurisdictional” plan developed and maintained at the county level with the support and input from constituent local jurisdictions. Therefore, the very first action of the planning process was to request a Letter of Participation from each local unit of government within Muskegon County. Out of 28 jurisdictions (including the County), all chose to submit a letter.

The chart on the following page shows the hazard mitigation participation “status” of each local jurisdiction in Muskegon 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 way during the planning process. The chart also communicates which jurisdictions have adopted the Plan at the local level. For detailed information, please refer to Appendix 3 – Public Participation Documentation.

Muskegon County Hazard Mitigation Plan Jurisdiction Participation

| Jurisdiction | 2011 Adopted Haz Mit Plan | 2015 Adopted Haz Mit Plan | 2021 Letter to Participate | Provided data and feedback | 2024 Adopted Haz Mit Plan | Participant Status as of 2023 |
|-----------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|---------------------------------|-------------------------------------|
| Muskegon County | ✓ | ✓ | ✓ | ✓ | | Continuing |
| Blue Lake Twp | | ✓ | 11/18/2021 | ✓ | | Continuing |
| Casnovia Village | ✓ | | 11/17/2021 | ✓ | | New Participant |
| Casnovia Twp | ✓ | | 05/12/2022 | ✓ | | New Participant |
| Cedar Creek Twp | | | 11/17/2021 | ✓ | | New Participant |
| Dalton Twp | ✓ | | 11/15/2021 | ✓ | | New Participant |
| Egelston Twp | ✓ | | 04/28/2022 | ✓ | | New Participant |
| Fruitland Twp | ✓ | ✓ | 11/23/2021 | ✓ | | Continuing |
| Fruitport Village | ✓ | | 12/21/2021 | ✓ | | New Participant |
| Fruitport Twp | | | 1/14/2022 | ✓ | | New Participant |
| Holton Twp | ✓ | ✓ | 06/16/2022 | ✓ | | Continuing |
| Laketon Twp | ✓ | ✓ | 02/11/2022 | ✓ | | Continuing |
| Lakewood Club Village | | ✓ | 05/04/2022 | ✓ | | Continuing |
| Montague City | ✓ | | 02/07/2022 | ✓ | | New Participant |
| Montague Twp | | | 10/26/2023 | ✓ | | New Participant |
| Moorland Twp | ✓ | | 05/12/2022 | ✓ | | New Participant |
| Muskegon City | | | 03/03/2022 | ✓ | | New Participant |
| Muskegon Twp | ✓ | | 11/07/2023 | ✓ | | New Participant |
| Muskegon Heights City | ✓ | | 05/12/2022 | ✓ | | New Participant |
| North Muskegon City | ✓ | | 11/22/2021 | ✓ | | New Participant |
| Norton Shores City | ✓ | | 11/19/2021 | ✓ | | New Participant |
| Ravenna Village | | | 04/27/2022 | ✓ | | New Participant |
| Ravenna Twp | | | 12/14/2021 | ✓ | | New Participant |
| Roosevelt Park City | | | 03/07/2022 | ✓ | | New Participant |
| Sullivan Twp | ✓ | | 11/30/2021 | ✓ | | New Participant |
| Whitehall City | ✓ | | 11/16/2021 | ✓ | | New Participant |
| Whitehall Twp | ✓ | ✓ | 02/03/2022 | ✓ | | Continuing |
| White River Twp | ✓ | ✓ | 05/05/2022 | ✓ | | Continuing |

Step 2 – Establish an Advisory Team

At the outset of the planning process, Muskegon County Emergency Services assembled an Advisory Team to aid the process of reviewing and updating the Muskegon County Hazard Management Plan. This team consisted of the Local Emergency Planning Committee (LEPC) Section Leaders. These individuals are assigned by the Chief Elected Official and the Emergency Services Manager and have the responsibility for maintaining a functional component of the jurisdiction's emergency plan. Next to the CEO or Manager, these officials are the highest-ranking officials within the emergency management system, managing the critical functional components of the Emergency Plan. This group was utilized at the early stages of the update process; however, as the Update evolved, the full LEPC emerged as the primary advisory body to the Plan Update. The LEPC includes representatives from the following agencies:

- Muskegon County Emergency Services Department, Director Richard Warner and Director Renee Gavin
- Muskegon County Board of Commissioners, Charles Nash
- Local Government Representatives
- Local Chemical Facility Operators, Webb Chemical Chris May and Tom Finkler
- Muskegon County Administration, Administrator Mark Eisenbarth, Deputy Administrator Matthew Farrar, and Executive Assistant Sarah Cooper
- Muskegon County Central Dispatch, Director Jason Wolford
- Muskegon County Citizen Corps, Coordinator Rhona Colbert
- Muskegon County AUXCOMM, Jim Duram and Jim Norton
- Muskegon County Sheriff's Office, Sheriff Michael Poulin
- Muskegon County Police Chiefs, Roger Squires and Tim Kozal
- Muskegon County Fire Chiefs, Deputy Chief Chris Dean
- Muskegon County Hazmat, Chief Tony Gutierrez
- Muskegon County Health Department, Dori Peters
- Trinity Health Muskegon, Dave Ogren
- Region 6 Healthcare Coalition, Luke Aurner and Tim Dickman
- Muskegon County EMS Agencies, Jonathon Degen
- Muskegon County Medical Control Authority, Chad Lawton and Dr Jerry Evans
- Muskegon County Community Environmental Health, Mike Eslick
- State of Michigan Environment, Great Lakes, and Energy

Additional partners to the Advisory Team included designated points of contact from each of the participating jurisdictions governing boards, including:

- Blue Lake Township Supervisor Melonie Arbogast
- Village of Casnovia Clerk Shelley Carr
- Casnovia Township Supervisor Kelli Ashbaugh
- Cedar Creek Township Clerk Lina Aerts
- Dalton Township Clerk Lori Hayes
- Egelston Township Supervisor John Holter
- Fruitland Township Clerk Breann Fagan
- Fruitport Charter Township Clerk Andrea Anderson
- Village of Fruitport Clerk/Treasurer Ann LaCroix
- Holton Township Clerk Jill Coburn

- Laketon Township Supervisor Kim Arter
- Village of Lakewood Club Clerk Wendy Bloem
- City of Montague Deputy Clerk Kelly Markley
- Montague Township Clerk Drew Roesler
- Muskegon Charter Township Clerk Carrie Westbrook
- City of Muskegon Clerk Ann Marie Meisch
- City of Muskegon Heights Clark Sharon Gibbs
- Mooreland Township Clerk Rose Spoelman
- City of North Muskegon City Manager Sam Janson
- City of Norton Shores Clerk Shelly Stibitz
- Ravenna Township Clerk Penny Sherman
- Village of Ravenna Clerk Emily Carrigan
- City of Roosevelt Park Clerk Ann Wisniewski
- Sullivan Township Clerk Elizabeth Spencer
- City of Whitehall Clerk Brenda Bourdon
- Whitehall Township Supervisor Arnold Erb
- White River Township Clerk Patti Sargent

For detailed information, please refer to Appendix 3 – Public Participation Documentation. This includes documentation of the planning participants, such as: LEPC appointees (as of 2021); Advisory Team members; and attendance lists from LEPC meetings where the Hazard Management Plan was discussed during the Update Process.

Step 3 – Identify Hazards and Risks

The hazard analysis is the foundation upon which all emergency planning efforts in the community are built. A hazard analysis provides understanding of the potential threats facing the community. By pinpointing the location, extent, and magnitude of past disasters or emergency situations, and by examining knowledge of new or emerging risks, it is possible to determine the probability of such events occurring and the vulnerability of people and property. When this information is viewed alongside relevant land use, economic, and demographic information from a well prepared “community profile,” emergency managers can make assumptions about those segments of the community that might be impacted by various types of incidents. This, in turn, allows them to set priorities and goals for resource allocation and response, recovery, and mitigation activities prior to an incident occurring. Collectively, these decisions are the cornerstone of the community’s emergency management program, and should guide all decisions pertaining to community emergency management activities.

Community Profile

The development of a community profile is accomplished by identifying and mapping, where appropriate, information that is relevant to hazard mitigation, such as the community’s present land use and development patterns, geography and climate, transportation network, demographic information, key industries, major organizations active in the community, the locations and nature of important community facilities, emergency warning system coverage, and other information that is relevant to the community’s safety and smooth functioning.

Physical Profile – Preliminary data was gathered by West Michigan Shoreline Regional Development Commission and final data was compiled by Muskegon County Emergency Services and the Newaygo County Emergency Services Department Planner. Historical data was provided by various sources including township, cities, and County websites and master plans; the Michigan Historical Center Preservation Office; and the Muskegon County Directory. The Michigan Department of Environment, Great Lakes, and Energy, the Michigan Department of Natural Resources, the Muskegon County Parks and Recreation Master Plan, the Muskegon County Planning Commission, the National Weather Service, and the United States Geological Survey provided a majority of the data and statistics for the Physical Profile of Muskegon County including topography soil and geographical features, land features, elevation, vegetation, soil associations, climate weather patterns, and other physical features.

Social Profile – Preliminary data was gathered by West Michigan Shoreline Regional Development Commission and final data was compiled by the Newaygo County Emergency Services Department. The United States Census Bureau and the 2020 Census provided statistics for developing a social profile of Muskegon County including residents' age, gender, household composition, race, physical disabilities, income, employment, poverty status, and other social features.

During this update, all data for the Community Profile was gathered and compiled by Newaygo County Emergency Services Department. This section was made available to the LEPC for review on May 15, 2023. This section was also posted to the Muskegon County Website on June 14, 2023 for public comment and feedback. <https://co.muskegon.mi.us/1773/Hazard-Mitigation-Plan-and-Community-Pro>

Hazard Identification - Preliminary data was gathered by West Michigan Shoreline Regional Development Commission and final data was compiled by the Newaygo County Emergency Services Department. The 2019 Michigan Hazard Analysis (MSP/EMHSD Publication 103) as a starting point for identifying the hazards in Muskegon County. The 2019 Michigan Hazard Mitigation Plan (MSP/EMHSD Publication 106) was also used in this research. Information was also gathered from local Hazard Specific Plans including hazardous materials site plans. In addition, After Action Reports and Incident Reports from past local emergencies and disasters were reviewed to determine if the community has experienced, or may be susceptible to, specific hazards. Muskegon County Emergency Services also reviewed information obtained from the Functional Capability Assessment Interviews in determining preliminary hazard identification information. Specific hazard information was then obtained by various sources, such as the National Weather Service, United States Army Corps of Engineers, Michigan Department of Natural Resources, and Michigan Department of Environment, Great Lakes, and Energy. Professional evaluations were also used for specific hazard areas such as Public Health and Wildfires.

Community Input and Public Engagement

The value of public involvement lies in sharing responsibility with those who will strongly influence the success or failure of the mitigation effort. Muskegon County has an established Local Emergency Planning Committee (LEPC) which includes representatives from local government, private businesses, and public organizations. Muskegon County Emergency Services and the LEPC provided ongoing guidance and assistance in the plan development. Public meetings where the LEPC specifically discussed hazard mitigation are listed below and in Appendix 3.

- January 11, 2022
- April 12, 2022
- July 12, 2022
- January 10, 2023

- April 11, 2023
- May 15, 2023
- June 13, 2023
- July 11, 2023
- August 8, 2023
- September 12, 2023
- December 12, 2023
- March 12, 2024

Numerous attempts to engage community stakeholders including neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations including community based organizations that work directly with and/or provide support to underserved communities and socially vulnerable populations among others were made during the update of this plan. In addition to input from the LEPC, the Muskegon County Emergency Services website contains a page dedicated to enhancing awareness of hazard management, hazard mitigation, and for providing public access to the Muskegon County Hazard Mitigation Plan. This page can be found at <https://co.muskegon.mi.us/1773/Hazard-Mitigation-Plan-and-Community-Pro>

An electronic survey was developed and posted to the Muskegon County Website in June 2023. The purpose of this survey was to obtain public comment in reviewing the Hazard Analysis. The survey remained available to the public during the drafting stage of the planning process. The original survey was developed with assistance of the Michigan State Police Emergency Management Division. This survey was modified to fit an electronic format and served a number of functions.

First, the broad distribution of the survey via email distribution lists to community stakeholders was intended to raise awareness throughout the community of hazard management planning in Muskegon County, as well as to encourage local input and participation. Second, the survey included a list of historical hazard events, as reported in the previous version of Muskegon 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 existing content of the Plan. Third, the survey provided a prioritized list of hazards identified in the Muskegon County Hazard Management Plan, and asked recipients to rank those hazards according to their own priorities. Although limited 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.

Survey feedback was used to help identify hazards, establish goals and objectives, recommend activities, and prioritize actions. Although the survey produced a meager response rate, it was successful in increasing awareness of hazard mitigation throughout Muskegon 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.

Throughout the planning process, multiple attempts to obtain input from local stakeholders were made. These efforts provided information about hazard mitigation and invited individuals to participate in the plan update. The final draft of the plan was posted to the Muskegon County Website on November 21, 2023 for review and comment at <https://co.muskegon.mi.us/1838/Hazard-Mitigation-Plan-2023-For-Public-R>. In addition, information about the Hazard Mitigation Plan was included in the November monthly communicator on released on December 1st at <https://co.muskegon.mi.us/1749/Muskegon-County-Communicator---Monthly-N> and a public press release. For detailed information, please refer

to Appendix 3 – Public Participation Documentation. This includes documentation on press releases, notices, and communications to stakeholders.

Risk Assessment (Hazard Evaluation)

A Risk Assessment involves the examination of the community's hazards using measures that evaluate such factors as severity, exposure, frequency of events, types and extent of damage scope of impact, etc. Through this evaluation process, hazards are identified in detail and a community's overall risk from those hazards is assessed and often mapped, to identify key areas and to tie in with community's decision-making about future land development. Considering hazard-specific "worst-case" disaster scenarios may help to determine what critical issues the community may face—life safety, public health, loss of critical functions, economic impacts, and short/long term recovery issues—and to plan ways to deal with them.

The evaluation methodology for ranking hazards used by Muskegon County Emergency Services Department relied on risk assessment information, such as historical occurrence, seasonal pattern, and predictability, etc. This information was gleaned from After Action Reports from past emergencies and disasters.

For this edition of the Muskegon County Hazard Mitigation Plan, hazards were evaluated by Muskegon County Emergency Services used the same methodology that was utilized in previous editions of this plan. This section was made available to the LEPC for review on July 11, 2023. This section was also mailed to each municipal jurisdiction on July 24, 2023 for public comment and feedback. This edition has also been updated to include a hazard evaluation for each local jurisdiction within Muskegon County (see Appendix 3 – Public Participation Documentation).

Vulnerability Assessment

A Vulnerability Assessment can help identify risks by comparing areas where the hazards overlap with people and important facilities. An estimate of potential losses, usually expressed in dollar values, will be made, and priorities can be established as to which hazards are most threatening. The highest-priority hazards will be the ones your community should place more emphasis, effort, and funds toward addressing.

When assessing vulnerability, Muskegon County Emergency Services considered points such as population concentrations, age-specific populations and special needs populations, types of structures and housing, etc.

Step 4 – Define Goals & Objectives

Developing clear goals and objectives can help the community clarify problems, issues and opportunities in hazard mitigation as well as other areas. Well-articulated goals and objectives are more likely to succeed. An important part of developing goals and objectives is raising community awareness of the relationship between community development practices and the community's level of hazard vulnerability and risk. Also, raising citizen awareness can help gain support for ongoing mitigation planning efforts.

The Muskegon County LEPC originally established a set of mitigation goals and objectives based on issues identified in the Hazard Analysis and the Risk Assessment (Hazard Evaluation). For the 2015 updated edition of this plan, the inherited goals and objectives were reviewed by the Muskegon County Hazard Mitigation Advisory Team. It was determined that the goals and objectives remain valid,

therefore no significant changes or additions were proposed during this review. The two foremost factors contributing to this conclusion were that: 1) conditions within the county have remained generally the same since the previous edition of this plan; and 2) the results of the hazards evaluation were comparable to the previous hazards evaluation.

Step 5 – Identify Alternatives for Solving Problems

Often, there are different ways that objectives can be met, each of which may have pros and cons, costs and benefits. This step is intended to provide a comprehensive resource for community stakeholders to use in identifying solutions to the community's problems. With this information, Muskegon County Local Emergency Planning Committee identified a broad set of possible hazard mitigation actions from which to select recommended actions for implementation.

Updates conducted on this section in 2014 included review and revision of mitigation alternative descriptions, including how alternatives are being utilized within Muskegon County (the capabilities of the community). Other updates included a revised description of basic mitigation strategies (see table on previous page), and the inclusion of common mitigation funding sources. Appropriate information from the Michigan Hazard Mitigation Plan (MSP/EMHSD Publication 106) was included as well. The same process was used during this update.

Step 6 – Establish Evaluation Criteria

Selecting the appropriate evaluation criteria will help ensure that the proposed range of alternative mitigation measures will be evaluated in a manner that best reflects the values, policies and desires of the community. Once these criteria have been applied, community officials should have a better idea as to which alternatives are the most meritorious and desirable.

Muskegon County Emergency Services in conjunction with the Muskegon County Local Emergency Planning Committee developed evaluation criteria to establish priorities for projects and alternatives. The criteria include, but are not limited to, factors related to potential for hazards, availability of alternate facilities, population density, project equity, project cost effectiveness, available funding, and other considerations.

Step 7 – Select Feasible Mitigation Strategies

Muskegon County Emergency Services and the Muskegon County LEPC applied the evaluation criteria (Step 6) to the broad set of hazard mitigation alternatives (Step 5) in order to identify appropriate actions to be highlighted for implementation. Care was taken to ensure that the Plan's Goals and Objectives will be met by the newly selected "Action Agenda." To facilitate implementation of the Action Agenda, each recommended action was prioritized and further described in terms of the expected timeframe for completion, responsible parties, and potential sources for technical and financial assistance.

For the updated edition of this plan, the previous set of recommended action items (Action Agenda) was reviewed by the Muskegon County LEPC and those local communities that were previously successful in adopting the original Plan. Progress made towards those items was documented and taken into consideration when evaluating whether or not to retain them on the Action Agenda.

Step 8 – Prepare a Draft Plan

Newaygo County Emergency Services in conjunction with Muskegon County Emergency Services and the Muskegon County Local Emergency Planning Committee prepared a draft plan which was submitted to the Michigan State Police Emergency Management and Homeland Security Division (MSP-EMHSD) and the Federal Emergency Management Agency (FEMA) for formal review. The draft plan was then reviewed by the Muskegon County Board of Commissioners and recommended changes were made.

Step 9 – Prepare a Final Draft Plan

Based on necessary changes and recommendations by the Muskegon County Board of Commissioners, MSP-EMHSD and FEMA, a final draft plan was prepared and presented to the Muskegon County Board for adoption. At that point, the timer was set for five years; the date which this Plan must be updated again to remain effective.

Step 10 – Implement Plan

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 will be returned to the Muskegon County Emergency Services for notification to MSP-EMHSD and FEMA. Local jurisdictions that are successful in adopting this Plan will be encouraged to incorporate appropriate recommendations contained within this Plan into their existing planning mechanisms, such as master plans and zoning ordinances.

Muskegon County Emergency Services Manager will use the Hazard Management Plan as the Hazard Analysis and Hazard Mitigation Plan for Muskegon County. The Hazard Management Plan will be utilized to coordinate Hazard Mitigation programs across Muskegon County and guide decisions pertaining to Emergency Management Activities. Muskegon County Emergency Services will also keep local jurisdictions apprised of hazard mitigation funding opportunities, and assist applicants in securing funds as needed.

Step 11 – Monitor and Revise Plan

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 irrelevant 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 edition of the Hazard Mitigation Plan focuses on the period between 2024 and 2029.

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.

The Muskegon County Emergency Services Department will monitor the implementation of the Hazard Management Plan and report annual progress of the plan to members of the Muskegon County Local Emergency Planning Committee (LEPC). Monitoring includes 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 staff and LEPC knowledge, input would be obtained from comments submitted to the Emergency Management office. It would also be obtained from declarations of disasters and emergencies by the President and the Governor and updates on NOAA and NCDC websites.

Muskegon County will comply with the FEMA requirement that the plan be reviewed every five years and updated if necessary. The Muskegon County Emergency Services Manager is responsible for all updates with the assistance from the LEPC. Projects that were completed over that time would be replaced with new ones. Priorities will be re-assessed. Development patterns will be analyzed to see if they have rendered the previous hazard analysis out-of-date.

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.

Continuing 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 all local government offices. The plan will also be made available to the public on the Emergency Management website. All comments will be directed to the Emergency Management Manager who will receive and compile all other forms of correspondence.

During the update of the plan, all methods previously used for assuring public involvement will be utilized again: surveys, contacts with neighboring counties, LEPC meetings, public hearings, etc.

Incorporation into Existing Planning Mechanisms

The County's transmittal of the Hazard Management Plan to local governments requests that they incorporate the document into local land use plans and zoning ordinances, as appropriate. All 27 local units of governments in Muskegon County have an active Land Use / Master Plan and Zoning Ordinance in place as allowed by Michigan law. 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.

MUSKEGON COUNTY COMMUNITY PROFILE

Muskegon County

Muskegon County is located in the western portion of Michigan's Lower Peninsula along Lake Michigan's shoreline. It is bordered by Oceana County to the north, Muskegon County to the northeast, Ottawa County to the south, Kent County to the southeast and Lake Michigan to the west. The county has an area of 499.25 square miles, or approximately 319,520 acres, 26 miles of Lake



Michigan waterfront, 57 inland lakes, and more than 400 miles of river. The 2020 U.S. Census counted 175,511 persons, 66,064 households, and 45,366 families. From 2010 to 2020, the population grew about 2.30%. The population is projected to increase by .6% in 2022. For the 66,064 households counted in 2020, the median income was \$53,478. The county has a population density of 344.9 persons per square mile and there were 74,591 housing units. In terms of race, the 2020 Census states that Muskegon County consists of 81.2% White, 14.0% Black or African American, 1.0% American Indian, .7% Asian, <1% Pacific Islander, and 3.1% from two or more races. 5.8% of the population is Hispanic or Latino.

History and Development

According to information posted at <https://www.co.muskegon.mi.us/770/History-of-Muskegon> as authored by the Muskegon Community College and the Muskegon County Museum, the earliest recorded history of the Muskegon area reflects that it was inhabited by the Ottawa and Pottawatomi tribes. Perhaps the best remembered of the Indian inhabitants of this area was Ottawa Indian Chief Pandalouan. They, and other bands of Native Americans traded at posts along the lower Muskegon River, the lower Grand River, the White River, and the Mouth of Duck Lake. The name "Muskegon" is derived from the Ottawa Indian term "Masquigon" meaning "marshy river" or "swamp". The "Masquigon" river is identified on French maps as early as the late 17th century, suggesting that French explorers and fur traders had reached western Michigan by that time. The first known Frenchmen in the area were Father Jacques Marquette, who traveled through the area in 1675 on his way to St. Ignace, and a party of French soldiers under LaSalle's lieutenant, Henry de Tonty, who passed through in 1679. If the French established trading posts in the area, their locations are not known. The earliest known resident of the county was a fur trader and trapper named Edward Fitzgerald, who settled in the area in 1748. Between 1810 and

1820, several French-Canadian fur traders established posts around Muskegon Lake.

Muskegon County was organized in 1837 from portions of Ottawa (3/4) and Oceana (1/4) Counties. At the time of its incorporation in 1859, Muskegon County had six townships (Muskegon, Norton, Ravenna, White River, Dalton, and Oceana.). The development of the area, with vast numbers of white pines, coincided with its timbering activities during the turn-of-the-century lumber boom. When the lumber industry reached its peak in the 1880's, there were over 47 sawmills on Muskegon Lake's 12 square mile body of water and another 16 on White Lake in northern Muskegon County, establishing Muskegon as the "Lumber Queen" of the Midwest.

Following the lumber era, at the end of the nineteenth century, Muskegon County directed its economic growth to industry; including paper and cement manufacturing, production of chemicals, engines, and bowling equipment. Thousands of emigrants from southern and eastern Europe emigrated to Muskegon to further diversify the ethnic make-up of the community. The County also experienced a mini oil boom in the late 1920's when oil was accidentally discovered in the search for salt. While the City of Muskegon was becoming industrialized the area north and south fostered a number of summer resort communities, drawing tourism. Farmers found favorable soils for the establishment of fruit farms; commodities included apples, peaches, pears blueberries and other fruit crops.

Today the county is a major metropolitan center and a major producer of agricultural products (wheat, corn, dairy, and livestock). The local economy is much more diverse than it was in the twentieth century. The beaches of Lake Michigan and the inland fishing and water sport opportunities make tourism a major part of the economy. The Lake Michigan shoreline is accessible at eleven dune-filled public parks. Travel and tourist related businesses draw visitors from across the lake as well with the Lake Express Services, and Port City Princess. Continued development of water-based tourism and water front housing is re-inventing much of the lakeshore.

The county is also home to a number of state parks, a state game area, and Manistee National Forest. It has over 151,000 acres of forest, of which over 12,000 acres are national forest and over 8,000 acres are dedicated as state game and wildlife areas. The county's outdoor recreation opportunities are year-round with mild summers for water-based recreation, camping, and hiking. Winter brings approximately 80 inches of snow on average for winter outdoor recreation such as snowmobiling, sledding, skating, hockey, and ice fishing. There are also a variety of man-made recreational and tourism destinations that make Muskegon County attractive to visitors including a number of events and festivals.

Historic Figures

The following Historical Figures are several of the most notable citizens highlighted on the Muskegon County Government Website at <https://www.co.muskegon.mi.us/755/Historic-Figures>. These individuals made a significant contribution to the communities in which they resided from. Information on these individuals were provided by the Muskegon Community College and the Muskegon County Museum. These impacts can still be seen around Muskegon County to this day.



Charles and Julia Hackley

(1837 to 1905)

One of Michigan's spectacular rags-to-riches millionaires, lumberman Charles Hackley Born in Michigan City, Indiana in 1837, young Charles left high school at age 15 first to build roads and then to work in the newly developing lumber industry of western Michigan. As a teenager and young adult, he learned saw milling and the buying and selling of pine trees firsthand. By the 1870s, he had his own company and during the 1880s his mills produced an average of 30 million board feet per year, which helped make Michigan the top lumber state in the nation.



What makes Hackley's story especially interesting is that he used much of his \$12 million fortune to help his booming city of Muskegon meet the needs of a population that doubled during both the 1870s and the 1880s.

In 1864, Charles Hackley married Julia Ester Moore. They adopted one son, Charles Moore Hackley, in 1898, and raised a foster daughter, Erie Caughell (Hackley). Julia Hackley joined her husband in his philanthropy work. Julia Hackley had the Muskegon Museum of Art built and endowed. Julia also was instrumental in starting the Julia Hackley Poor Fund and the Julia E Hackley Educational Fund Endowment. These funds are still actively supporting Muskegon today.



Moses J. Jones

(1898 to 1989)

Moses J. Jones was a well-known pastor at Muskegon's John Wesley AME Zion Church for over 36 years. He is best remembered for his "good will dinners" that allowed him to both feed the hungry and at the same time foster interracial harmony. The grandson of slaves, Jones came to Muskegon from Hammond, Indiana in 1936. On a daily basis, Jones would scour bakeries and grocery stores for day old goods to feed to those in need. He would also

connect the underprivileged with just out of fashion suits. When an individual could not afford the relatively cheap suit, Jones would give the suit away for free.

Moses J. Jones also did outreach to the youth establishing a community recreation center in the basement of John Wesley AME Zion Church, where youths had a place to escape the streets and partake in table tennis and join basketball and baseball teams. After Jones died in 1989 the city commissioners paid tribute to his memory by renaming the northern end of Seaway Drive "Moses J. Jones Parkway." It remains there to this day.

Haddon Hubbard "Sunny" Sundblom

(1899-1976)



Born in Muskegon in 1899 to a Swedish-speaking family, Haddon Hubbard "Sunny" Sundblom was a famous American Artist best known for the images of Santa Claus he created for the Coca-Cola Company in the 1930s. So popular were Sundblom's images of Claus that the urban legend soon arose that Sundblom had actually created the modern image of Santa Claus and the images are used by Coca-Cola to this day. Sundblom also created the image of the Quaker Oats man in 1957, which is also used to this day.

Jonathan Walker



Jonathan Walker became a national hero in 1844 when he was tried and sentenced as a slave stealer following an attempt to assist seven runaway slaves find freedom. He was branded on the right hand with the letters SS signifying "Slave Stealer."

He became an ardent abolitionist in the years before the Civil War. At the wars end he moved to Norton Shores and lived the peaceful life of a fruit farmer. Upon his death in 1878 he was buried with full honors in a ceremony attended by 5,000 people. A unique marker in downtown Muskegon marks his final resting place.



Geography and Climate

Location, Communities, and Proximity to Surrounding Cities

Muskegon County is located in the west central region of Michigan's Lower Peninsula. The City of Muskegon, located on the southwest side of Muskegon County, is the county seat and the largest city in Muskegon County with a population of 38,318 (2020 Census). The other six cities include Montague, Muskegon Heights, North Muskegon, Norton Shores, Roosevelt Park, and Whitehall. In addition to the cities, there are four villages within Muskegon County which include Casnovia, Fruitport, Lakewood Club, and Ravenna. Between the seven cities and four villages, many of the needs of the residents of Muskegon County are adequately served. However, the City of Grand Rapids (population 198,917) is located approximately fifteen miles from the county's eastern border, Grand Haven (population 11,011) located approximately five miles from the county's southern border, and Allendale Charter Township (population 26,582), located approximately fifteen miles from the county's southwestern border, also serve as core communities.

Montague City

Montague City sits to the north of White Lake and to the northwest of the City of Whitehall. It lies in the northern portion of Muskegon County and is situated on a hill overlooking the White River and its sister city, Whitehall. Settlement of the area began in 1850 when Nat Sargent built the first house and blacksmith shop. The town was officially incorporated into a village in 1867 and a city in 1935. It was named after Rev. William Ferry Montague.



The 2020 population of the city was 2,417 with an estimated peak seasonal population of 2,577. 1047 residents commuted to work and 461 were school-aged. The city had 1,193 total housing units, of which 1,081 were occupied and 121 were vacant. 92 of the vacant homes were for seasonal, recreational, or occasional use. Important critical facilities of the city include the Montague Police and Fire departments, Montague Maintenance Garage, Montague Area High School and Middle School, St. James Lutheran Church, Montague City Hall, and Muskegon Area District Library Montague Branch. Major infrastructure includes U.S. 31 Business Route and the U.S. 31 Business Route bridge over the White River. *Aludyne is the largest employer in Montague with over 600 employees, followed by Montague Area Public Schools with 137.* White Lake is the most prominent geographic feature of the city.

Muskegon City

The City of Muskegon is located on the shores of Lake Michigan and alongside Muskegon Lake, which connects Muskegon River to Lake Michigan. It lies to the south of the city of North Muskegon, and to the north of Muskegon Heights, Roosevelt Park, and Norton Shores. French explorers named the city in the late 1600's from the Indian word Masquigon meaning "marshy river." The first recorded settlers were Louis Baddaeu and Joseph Troutier, who opened up trading posts in 1834 and 1835. The lumber boom of



the 1860's was good for the town, giving it village status in 1861. City status was obtained in 1869.

In 2020, the city had a total population of 38,318 and an estimated seasonal peak population of 38,818. 11,835 residents commuted to work and 7,617 were school-aged. There were a total of 16,105 housing units in the city, 2,138 of those units were vacant and 13,967 were occupied. Of the vacant homes, 175 are for seasonal, recreational, or occasional use. Critical facilities in the city include the City of Muskegon Police Department, the Muskegon County Sheriff Department, the Marquette, Robinson, and Terrace stations of the Muskegon Fire Department, two public works yards, a pumping station, seventeen community shelters, eight community medical facilities, and five other critical facilities. The city is home to MCC-Muskegon Community College and Baker College along with many major employers. In the city, the top three employers are Trinity Health Partners, the County of Muskegon, and Muskegon Public Schools.

Critical infrastructure consists of four major roads, Michigan Shore railroad, four bridges, two power stations, a water filtration plant, a water, and sewer maintenance facility, two transit systems, a coast guard station, and an army reserve center. Major geographic features of the city include the Lake Michigan shoreline and beach, coastal sand dunes, Muskegon Lake, and Muskegon River. There are also 4-6 small lakes and ponds, 4-6 small creeks, and dense residential, industrial, and commercial areas.

Muskegon Heights City

The City of Muskegon Heights is a southeastern suburb of the Muskegon urban area, incorporated in 1903. It is surrounded by the cities of Norton Shores and Muskegon and lies in the southwestern portion of Muskegon County. Its origin goes back to 1890 when local business leaders were looking to stimulate the economy after the lumber boom ended. They formed the Muskegon Improvement Company and purchased 1,000 acres.



The land was then sold in lots by lottery and the proceeds were used to underwrite new businesses. The successful improvement project, and proximity to the City of Muskegon, precipitated a station spot for the Chicago and Western Michigan Railroad Company in 1902.

The city had a 2020 population of 9,917 with a peak summer population of 10,856. 2,649 commuted to work and 2,720 residents are school-aged. There were 4,842 total housing units, 846 of those were vacant, while 8 of the vacant housing units are for seasonal, recreational, or occasional use. Important critical facilities of the city include the Muskegon Heights Police and Fire departments, Muskegon Heights City Hall, a Muskegon Area District Library Muskegon Heights Branch, and Muskegon County Family Independence Agency (FIA). No major employers were identified within the city. Major infrastructure includes Muskegon Heights Water and Sewer, Muskegon Area Transit System, U.S. 31 Business Route, Michigan Shore railroad. Major geographic features within the city include dense residential and industrial areas and 1-2 small lakes and ponds along with 1-2 small creeks.

North Muskegon City

North Muskegon is located just inland from Lake Michigan to the north of Muskegon City and Muskegon Lake and to the south of Bear Lake. It lies in the southwestern portion of Muskegon County. Like most of the cities and villages in the area, the lumber boom was responsible for the formation of the city. It was originally named Reedsville after the first settler, Archibald Reed, but was later re-named North Muskegon in 1881 when it was deemed a village. City status came in 1891.



The 2010 census population was 3,786 with a peak seasonal population of 3,899. 1,580 commuted and 727 residents were school-aged. The city had a total of 1,834 housing units, 213 of which were vacant. Of those 213, 49 were for seasonal, recreational, or occasional use. Critical Facilities include the city's Police and Fire Departments, the Department of Public Works, City Hall, and Muskegon Area District Library Walker Branch. No major employers were identified within the city. Infrastructure in the city includes Michigan Highway M-120, Michigan Shore railroad, and a power transmission line. Major geographic features consist of Muskegon Lake, Bear Lake, Muskegon River, and dense residential and light commercial areas.

Norton Shores City

Norton Shores is located just to the south of Muskegon around Mona Lake, along Lake Michigan. The city, which was once Norton Township and before that Lake Harbor during the lumber boom, sits in the southwest portion of Muskegon County and is bordered by Ottawa County to the south, Lake Michigan to the west and Fruitport Township to the east. It was named in honor of Colonel Amos Norton a Canadian Patriot implicated in the rebellion of 1837. It was chartered as a city in 1968.



Norton Shores had a 2020 total population of 25,030 and a peak seasonal population of 25,185. 10,477 commuted and 4,561 residents were school-aged. The total number of housing units in the city was 10,939, of which 962 were vacant. Of those 962 vacant, 252 were for seasonal, recreational, or occasional use. Critical facilities include the city's Police Department, three fire stations, a public works yard, a community medical facility, City Hall, and Muskegon Area District Library Norton Shores Branch. Major employers include Meijer Incorporated, and Knoll, GE Aviation and Structural Concepts each employing over 400 people. Major infrastructure in the city includes two highways, Michigan Shore railroad, two prominent bridges over Mona Lake, the Muskegon Heights water filtration plant, a dam at Little Black Lake, Muskegon County Airport, and the United States Coast Guard Air Facility. Lake Michigan's shoreline and coastal sand dunes are major geographic features in the area. Others include Mona Lake, 10-12 other small lakes and ponds, 8-10 creeks, and dense residential and significant commercial and industrial areas.

Roosevelt Park City

Roosevelt Park, a one square mile suburb community, was formed in 1946 and named after President Franklin D. Roosevelt. It was one of the many residential suburbs in the nation that were formed shortly after WWII. It is surrounded by the cities of Muskegon and Norton Shores.



The total population in 2020 was 4,172, with a peak seasonal population of 4,192. 2,989 commute to

work and 918 residents were school-aged. The total number of housing units in the city was 1,741, of which 87 were vacant. Of those 87 vacant, 10 are for seasonal, recreational, or occasional use. Critical facilities in Roosevelt Park include the city's Police Department and City Hall. The city's two major employers are CWC Castings Division of Textron Inc. and Michigan Spring & Stamping. Critical infrastructure consists of the Michigan Shore railroad. Major geographic features include dense residential and moderate commercial areas.

Whitehall City

The city of Whitehall is located in northern Muskegon County just southeast of the city of Montague. It is bordered by Whitehall Township to the east and Fruitland Township to the south. The city is named for its location at the edge of White Lake. The recorded history for Whitehall began around 1859 when Charles Mears, a lumber tycoon, and Giles B. Slocum platted the land. Originally named Mears, the area benefited from its strategic location for floating and distributing lumber. It grew into a village in 1867 and then into a city in 1942.



Whitehall's total population in 2010 was 2,706, with a seasonal peak population of 2,790. 1,190 commuted and 522 residents were school-aged. Whitehall had 1,288 total housing units, 135 of the total housing units were vacant and, of those vacant, 38 were for seasonal, recreational, or occasional use. Critical facilities in the city include police and fire departments, four community medical facilities, City Hall, and the White Lake Community Library. Major employers include Howmet Corporation and Hilite International. Vital or critical infrastructure includes US-31 Business Route, US-31 Business Route bridge over White River, City of Whitehall Water and Sewer, and Mill Pond Dam. Major geographic features in the area include White Lake, 6-8 small lakes and ponds, 6-8 small creeks, and dense residential and light commercial areas.

Casnovia Village

Casnovia Village is located in the eastern most portion of Muskegon County in Casnovia Township. Half of the village is in Kent County (Tyrone Township). The settlement was founded by tavern keeper Lot Fulkerson in 1850 and became a village in 1875. The name Casnovia means “new home” and comes from the Latin root words of casa meaning “home” and nova meaning “new”. The village of Casnovia had a 2010 total population of 319,

with a peak seasonal population of the same amount. 184 commuted to work and 63 residents were school-aged. There were 131 total housing units, 10 of which were vacant, and none used for seasonal recreational or occasional use. The village’s only critical facility is the village hall and there are no major employers or critical infrastructure. There are 1-2 small creeks.



Fruitport Village

The Village of Fruitport is located on the southern border of Fruitport Township in the extreme southern portion of Muskegon County. It is at the end of the north branch of Spring Lake and is bordered by Ottawa County to the south. The town was originally founded by Edward Crow in 1868 and named Crowville. The town was incorporated into a village in 1891. The current name comes from the fact that it is a port, and that the area is fertile fruit growing land. The total population in

2010 for the village was 1,093, and the peak seasonal population was 1,110. 464 commuted and 211 residents were school-aged. There were 476 total housing units, 36 of which were vacant. Of those vacant, 7 were for seasonal, recreational, or occasional use. The village DPW building, and Muskegon Area District Library Fruitport Branch are the only two critical facilities and there is no major infrastructure. Major geographic features include Spring Lake and 2-4 small creeks.



Lakewood Club Village

Lakewood Club is located in the northwest portion of Dalton Township in the northern tier of Muskegon County. The Village originated in 1912 as a resort association founded by the Mayo brothers. It was popular enough by 1914 that a seasonal post office was set up. The post office became permanent in the 1940's when the area became residential. Official village status came in 1967. In 2010, the total population was 1,291, with a peak seasonal population of 1,339. 646 commuted and 303 residents were school-aged. The village is home to 507 total housing units, 49 of which are vacant. Of those that are vacant, 17 are for seasonal, recreational, or occasional use. The lone critical facility is the village hall, and the power transmission line is the only critical infrastructure. Major geographic features include moderately dense residential usage and Fox Lake.



The village is home to 507 total housing units, 49 of which are vacant. Of those that are vacant, 17 are for seasonal, recreational, or occasional use. The lone critical facility is the village hall, and the power transmission line is the only critical infrastructure. Major geographic features include moderately dense residential usage and Fox Lake.

Ravenna Village

Ravenna village is located in Ravenna Township in the southeastern portion of Muskegon County. Like many other towns in the area, Ravenna was settled when the first sawmill was built (1844). In spite of the fact that E.B. Bostwick built it, the town was named after the Ohio hometown of the surveyor who platted the land in 1882. Ravenna was incorporated into a village in 1922. The total population in 2010 was 1,219, with a peak seasonal population of 1,222. 478 commuted and 292 residents



were school-aged. There were 476 total housing units, of which 22 are vacant. Of the 22 vacant, 1 is for seasonal, recreational, or occasional use. There is neither a police precinct nor a fire station in the Village of Ravenna and the only critical facilities are the village hall and Muskegon Area District Library Ravenna Branch. B-35 is the only major road and also the only identified critical infrastructure in the village. The major geographic feature in the village is Crockery Creek.

Blue Lake Township

Blue Lake Township is located in the northern portion of Muskegon County. It is bordered by Dalton Township to the south, Oceana County to the north, Whitehall and Montague townships to the west, and Holton Township to the east. The first supervisor of the township was Austin P. Ware who settled in the area in 1864. The township was incorporated in 1865 and is named after Big Blue Lake which is its largest lake. First settlers were mostly lumbermen, but as lumbering died out many turned to farming.



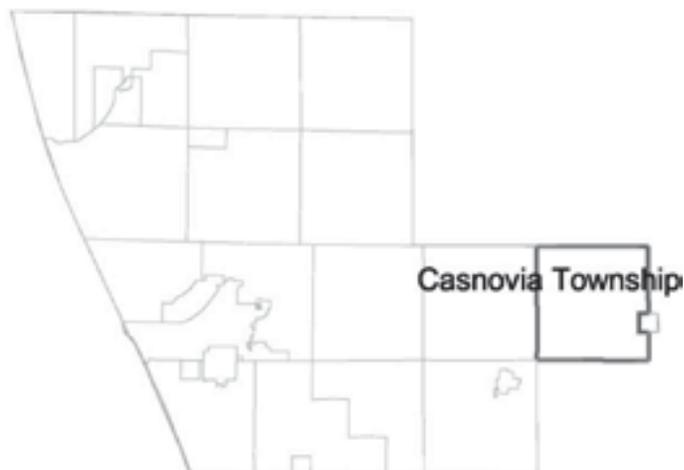
The total population in 2020 for the township was 2,399, with a seasonal peak population of 2,716. 1,045 commuted and 1100 residents were school-aged. There were 991 total housing units, 180 of which were vacant. Of those vacant housing units, 109 were for seasonal, recreational, or occasional use. The township has no police precinct but does have its two fire stations and a township hall. Critical facilities in the township include county roads B- 23and B-86, two dams, and a natural gas pipeline. Scattered rural housing, dense forest, Big Blue Lake, Wolverine Lake, White River, 50-60 small lakes and ponds, and 20-25 small creeks are among the major geographic features in the township.

Blue Lake Township is home to several traditional and fine arts youth camps. Blue Lake Fine Arts Camp is housed on 1,600 acres in the Manistee National Forest The Camp hosts sessions for youth and adults and has an international exchange program. The Camp has diverse programs in music, art, dance, and drama while offering hundreds of performances during its Summer Arts Festival and on its' public radio station.

YMCA Camp Pandalouan is located near Muskegon, Michigan, on over 150 acres of mature oak-pine forest, adjacent to the Manistee National Forest and the White River. on the shores of Big Blue Lake. The Camp hosts summer camps, seasonal events, weekend camps, school programs, and group retreats.

Casnovia Township

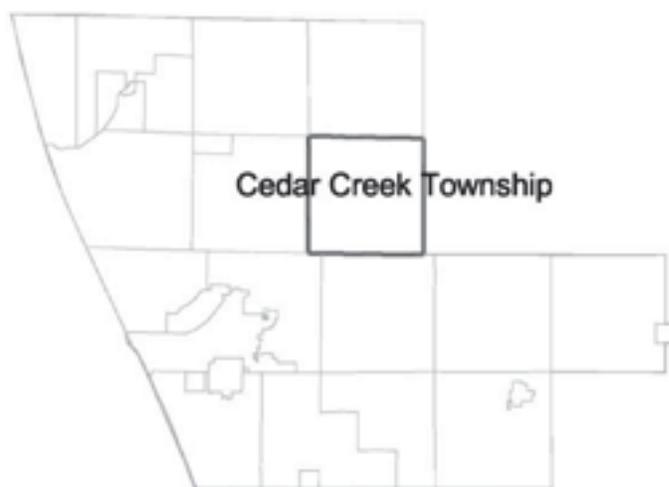
Casnovia is Muskegon County's eastern-most township and is bordered by Muskegon County to the north, Ottawa County to the south and east, and Moorland Township (Muskegon County) to the west. Settlers are believed to have arrived as early as 1848 but the township was not organized until 1852. The first township meeting was held April 4, 1853. The Township is primarily a farming community with acres of cherries, peaches, and apple trees as well as many fields of corn, wheat, soybeans, and hay.



According to the 2020 census the population was 2,793 including the Village of Casnovia and had a peak seasonal population of 2,843. 1,322 commuted and 1175 residents were school-aged. The township has 1,042 total housing units, 124 of which are vacant. Of those 124 vacant housing units, 13 are for seasonal, recreational, or occasional use. The township fire department and the township hall are the only critical facilities identified. Critical infrastructure includes two state highways (M-46 and M-37), one county road (B- 35), and a power transmission line. Major geographic features in the township consist of scattered rural housing and moderate residential areas, moderate forest, moderate farmland, Half Moon Lake which is adjacent to the township park and Moore County Park. There are 14-16 small lakes and ponds, and 20-25 small creeks.

Cedar Creek Township

Cedar Creek Township lies on the eastern side of Muskegon County and is bordered by Muskegon County to the east, Holton Township to the north, Dalton Township to the west, and Egleston Township to the south. It was incorporated in 1861. According to the 2010 census, the total population was 3,186, with a peak seasonal population of 3,403. 1,572 commuted to work and 166 residents were school-aged. There were 1,445 total housing units, 200 of



which were vacant. Of those 200 vacant, 83 are for seasonal, recreational, or occasional use. Critical facilities in the township include the DNR Muskegon Field Office and the township hall. State highway M-120 runs through the township, along with county-designated B-31 and Michigan Shore railroad. There is also a power transmission line and a natural gas pipeline. Major geographic features include scattered rural housing, dense forest, Muskegon River, Hornungs Duck Lake, 26-30 small lakes and ponds, and 12-16 small creeks.#

The Township is a combination of agricultural and rural development nestled around the Manistee National Forest. Within our township, amenities include hiking, biking, or horseback riding on the scenic groomed trails of the Manistee National Forest. The Cedar Creek Motorsport Trail provides access to 22 miles of groomed motor-cross trails. The Muskegon river has boat launches available to launch your kayak or canoe so you can enjoy a day of floating or fishing and Cedar Creek itself is a designated trout stream.

Dalton Township

Dalton Township, incorporated in 1859, is located in the northern portion of Muskegon County and is bordered by Blue Lake Township to the North, Muskegon Township to the south, Cedar Creek Township to the east, and Fruitland Township to the west. B.F. Dow is considered to have been the first permanent settler in the area, Dow established a fruit farm on his property. A. Clug established the first sawmill at Dalton Station in 1866. In 1874 the Chicago and West Michigan Railroad established Califf Station depot in the township.



The total population in 2020 was 9,494 with a peak seasonal population of 9,714. Approximately 2,374 were school-aged. There were 3,748 total housing units, of which 380 were vacant. Of those vacant 150 are for seasonal, recreational, or occasional use. Critical facilities in the township include the fire department, a maintenance and grounds yard, the township hall, Muskegon Area District Library Dalton Branch, and a Muskegon County Road Commission branch. Traversing the township are US-31, M-120, B-23, Michigan Shore railroad, a power transmission line, and a natural gas pipeline. Major geographic features include scattered housing, moderate residential areas, moderate forests, Twin Lake, North Lake, Middle Lake, West Lake, Goose Egg Lake, 24-26 small lakes and ponds, and 8-10 small creeks. There are four local

municipal parks, one county park, two municipal and one private cemetery, one bike trail and one horse trail.

Egelston Township

Egelston Township sits in the southern tier of Muskegon County and is bordered by five townships: Cedar Creek and Bridgeton (Muskegon County) to the north, Sullivan to the south, Moorland to the east, and Muskegon to the west. It was incorporated in 1859. The 2020 census population was 11,128 with a peak seasonal population of approximately 13,000. 4,028 commuted and 4,140 residents were school-aged. The township had 4,198 total housing units, of which 394 are vacant. Of those vacant, 37 are for seasonal, recreational, or occasional use. Over ¼ of the housing supply is comprised of mobile homes.



Critical facilities include the police and fire departments, the township hall, Muskegon Area District Library Egelston Branch, and Muskegon County Road Commission. Infrastructure in the township includes M-46 and B-31, Muskegon County Wastewater Management-Metro Site, Egelston Township Sewer and Maintenance, a power transmission line, a natural gas pipeline, and Muskegon Wastewater Lagoon Dam. Dense forests, sewage lagoons, Wolf Lake, Muskegon River, 5-7 small lakes and ponds, and 8-10 small creeks are among Egelston Township's major geographic features.

Fruitland Township

Fruitland Township, the county's largest township by size, partially contains Michigan's Adventure Amusement Park on its east side and abuts Lake Michigan on its west side. It is bounded by White Lake, Whitehall City and Whitehall Township to the north, Laketon Township to the south, and Lakewood Club Village and Dalton

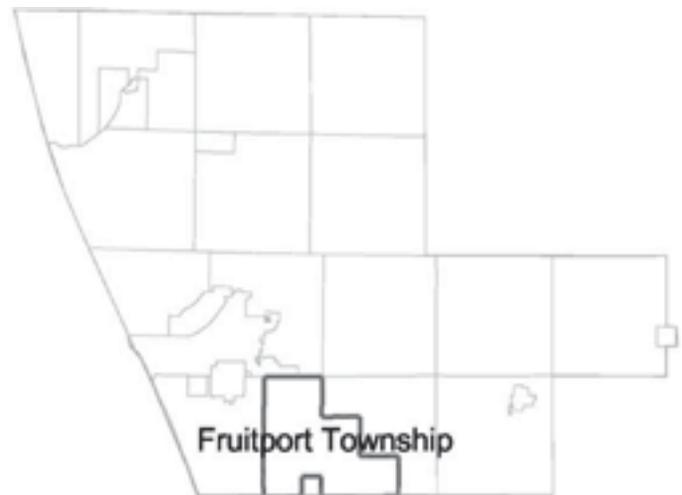


Township to the east. The earliest recorded history indicates that a French-Canadian trader, Joseph LaFramboise, established a trading post at the mouth of Duck Lake in 1790-1800. The township was officially organized by the Muskegon County Board of Supervisors in 1869 and was named for its successful culture of fruits of all kinds.

According to the 2020 Census, there was a total population of 5,793 with a peak seasonal population of 6,554. 2,209 commuted and 1,179 residents were school-aged. The township had 2,592 total housing units, 495 of which were vacant. Of those vacant, 383 are for seasonal, recreational, or occasional use. The township hall is the only critical facility in the township. Critical infrastructure includes US-31 and a power transmission line. Scattered housing and moderate residential areas, moderate forests, the Lake Michigan Shoreline, White Lake, Duck Lake, 10-12 small lakes and ponds, and 8-10 small creeks make up the major geographical features of the township.

Fruitport Charter Township

Fruitport Charter Township is located in the southern portion of Muskegon County and is bordered by Sullivan Township to the east, Muskegon City and Muskegon Township to the north, Ottawa County to the south, and the City of Norton Shores to the west. The first settler arrived in 1836. Captain Edward Craw raised peaches and attracted other settlers to the area. Originally the area was named Crawville. In 1867 the area separated from Norton Township and was incorporated as Fruitport Township in 1869. During a bitterly cold winter around 1874-1875, the extreme temperatures killed nearly all the peach trees.



In 2020, the township had a total population of 13,598, with a peak seasonal population of 14,575. 6,249 commuted and 5,239 residents were school-aged. The total number of housing units was 5,366, 409 of which are vacant. Of those vacant, 51 are seasonal, recreational, or occasional use. The township has its own police and fire departments. The township hall is also a critical facility in the township. Critical infrastructure includes I-96, US-31, B-72, B-31, and the Fruitport Township water and sewer departments along with a natural gas pipeline. Scattered housing and moderate residential areas, moderate forests, Spring Lake, 8-10 small lakes and ponds, and 10-12 small creeks make up the major geographic features in Fruitport Township.

Holton Township

Holton Township is located in the northeastern corner of Muskegon County. It is bordered by Oceana County to the north, Dalton Township to the south, Muskegon County to the east, and Blue Lake Township to the west. Originally an Indian Reservation, it was organized into a township in 1871. In 1871 Settlers Blodgett & Byrne purchased large areas of land which they platted and sold. They erected

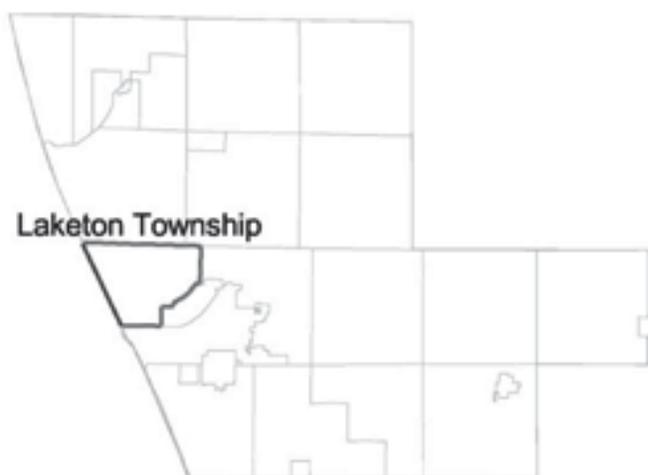
a mercantile and sawmill which was taken down in 1881. Subsequently, a blacksmith shop, grocer, meat market, a wagonmaker, and a boot and shoemaker shop were established by other settlers. A saloon, jeweler, drug store, livery, photographer, and barber shop soon followed.

In the year 2020, the total population was 2,515, with a peak seasonal population of 2,636 with 998 of those residents school aged. There were 1,088 total housing units, 157 of which were vacant. Of those vacant, 48 were for seasonal, recreational, or occasional use. The fire department, township hall, and Muskegon Area District Library Holton Branch make up the important or critical facilities in the township. M-120, B-86, B-31, Michigan Shore railroad, and a power transmission line are all listed as vital or critical infrastructure. Major geographic features in the township include scattered rural housing with moderate residential areas, dense forest, Deer Lake, 14-16 small lakes and ponds, and 10-12 small creeks.



Laketon Township

Laketon Township is located along the shores of Lake Michigan, Muskegon Lake, and Bear Lake, and is bordered by Fruitland Township to the north, Muskegon and North Muskegon to the south, and Muskegon Township to the east. "In the early days, Laketon Township was very rural in nature. Transportation consisted of boats in the summer and sleds or foot travel in the winter to get across the lakes. As more people arrived they began to create paths through



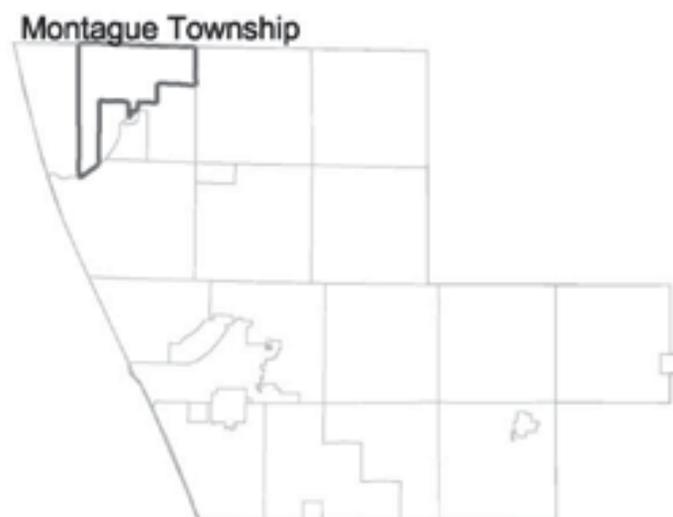
the woods. Territorial legislation required all able-bodied males, except clergymen, ages 21-50 to help work on the roads for a minimum of 2 days and up to a maximum of 50 days per year. The dirt and gravel paths in 1900 led to over 100 miles of roadway covered with either concrete or macadem (a pavement of layers of compacted small stones usually bound with tar or asphalt). In the 1920's this was used to provide good roadways for the growing number of automobiles.”
<http://laketon.org/General-Township-Info/History>

The township, organized in 1865 had a 2020 census population of 7,683 with a peak seasonal population of 7,707. Approximately 1,540 residents are school aged. There are 3,259 total housing units, 286 of which are vacant. Of those 286 vacant units, 81 are used for seasonal, recreational, or occasional use. The township has three community shelters and a township hall listed as critical facilities but has no vital or critical infrastructure. Major geographic features consist of scattered housing and moderate residential areas, moderate forest, Lake Michigan shoreline, coastal sand dunes, Muskegon Lake, Bear Lake, 8-10 small lakes and ponds, and 6-8 small creeks.

Montague Township

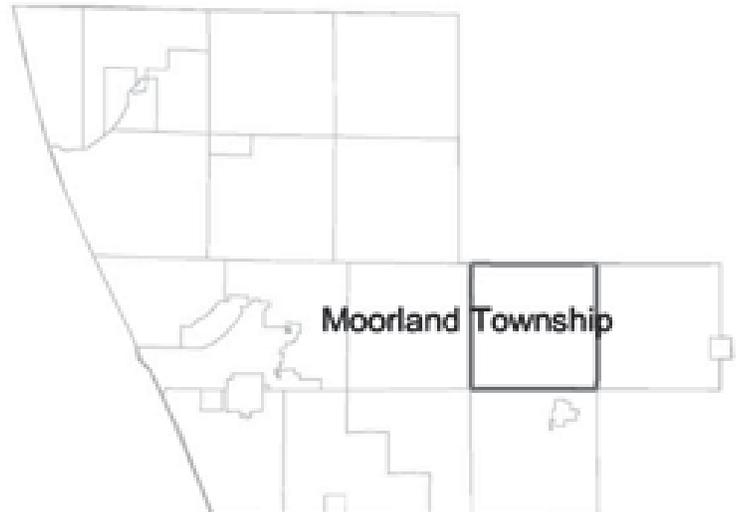
Montague Township is located in the northwest portion of Muskegon County and was incorporated in 1874. It is bordered by Oceana County to the north; White Lake, Whitehall Township, and the cities of Whitehall and Montague to the south; Blue Lake Township to the east; and White River Township to the west.

The 2020 census recorded 1,555 as the total population, 576 are school aged, and the area peak seasonal population of 1,683. There are 691 total housing units, 35 of which are vacant. Of those vacant, 25 are for seasonal, recreational, or occasional use. The only identified important or critical facility is the township hall. Vital or critical infrastructure includes US-31, US-31 Business Route, Old US-31, B-15, and B-86. Other critical infrastructure consists of a power transmission line, Ottiger Field Airport, and a natural gas pipeline. Scattered rural housing and moderate residential areas, moderate forest and farmland, White Lake, White River, 6-8 small lakes and ponds, and 14-16 small creeks are all major geographic features in the township. The Township also has four parks: Montague Township park, Clear Springs Nature Preserve, Henderson Road Nature Center and the Hart-Montague Rail Trail.



Moorland Township

Moorland Township sits in the southeast portion of Muskegon County. It is bordered by Ravenna Township to the south, Casnovia Township to the east, and Egelston Township to the west, and Muskegon County to the north. Settlers arrived in the area as early as 1857 and the township was organized in 1860 when the first officers were elected.



According to the 2020 census, the total population was 1,627, with a peak seasonal population of 1,583. The township has 619 total housing units, of which 44 are vacant. Of those 44 vacant, 3 are for seasonal, recreational, or occasional use. The fire department and the township hall are the two identified critical facilities in Moorland Township. Vital infrastructure includes roads M-46, B-35, Muskegon County Solid Waste Management, a power transmission line, and a natural gas pipeline. Major geographic features in the area include scattered rural housing, moderate forest, moderate farmland, a sewage Lagoon, 3-5 small lakes and ponds, and 10-12 small creeks.

Muskegon Charter Township

Muskegon Charter Township is located near the center of Muskegon County. It is bordered by Dalton and Cedar Creek townships to the north; the cities of Muskegon and North Muskegon and Laketon Township to the west; Fruitport Township to the south; and Egelston Township to the east. In 1837, Muskegon Township was organized as a subdivision of Ottawa County. One of the earliest settlers, Henry Pennoyer, was elected as the first Township Supervisor in 1838.

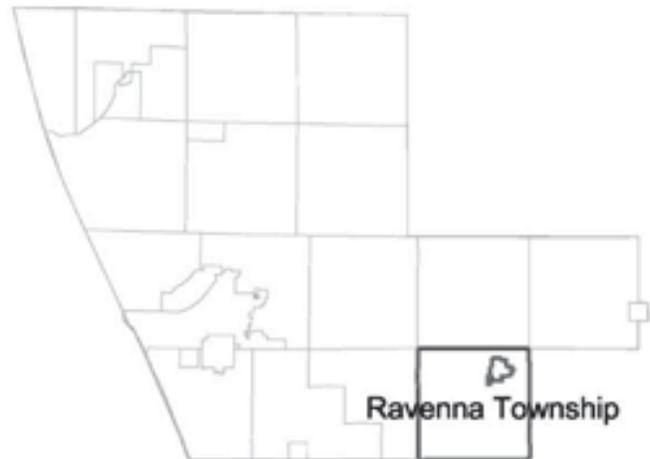


In 2020, Muskegon Township's total population was 17,596 with a peak seasonal population of 17,886. There are 7,385 total housing units, of which 311 are vacant. Of those 311 vacant, 18 are for seasonal, recreational, or occasional use. Muskegon Township has one police precinct, two

fire stations, and one public works yard. It also has eight community shelters, a community medical facility, a township hall, and the Muskegon Area District Library Muskegon Township Branch. The Township is home to 6 public parks. Among its vital or critical infrastructure are US-31, M-120, M-46, Michigan Shore railroad, two bridges along US-31, a power transmission line, and Northside Airport. Major geographic features include scattered housing and moderate residential areas, moderate forest areas, Muskegon River, 4-6 small lakes and ponds, and 8- 10 small creeks.

Ravenna Township

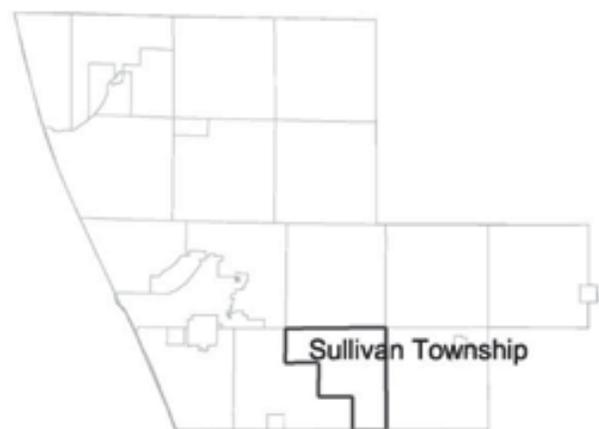
Ravenna Township lies in the southeastern-most portion of Muskegon County. It is bordered by Moorland Township to the north, Ottawa County to the south and east, and Sullivan Township to the west. E.B Bostwick was the first to locate land in the township in 1844. The township was organized in 1849 when the first town meeting was held.



The 2020 census population is 2,952, including the Village, with a peak seasonal population of 2,989. There are 1,108 total housing units in the township, 73 of which are vacant. Of those vacant, 8 are for seasonal, recreational, or occasional use. Important or critical facilities include the fire station, one community shelter, and the township hall. Roads B-72, B-35, and a power transmission line are the listed vital or critical infrastructure in the township. Major geographic features in the area are scattered rural housing, moderate forest, moderate farmland, Crockery Creek, 1-3 small lakes and ponds, and 14-16 small creeks.

Sullivan Township

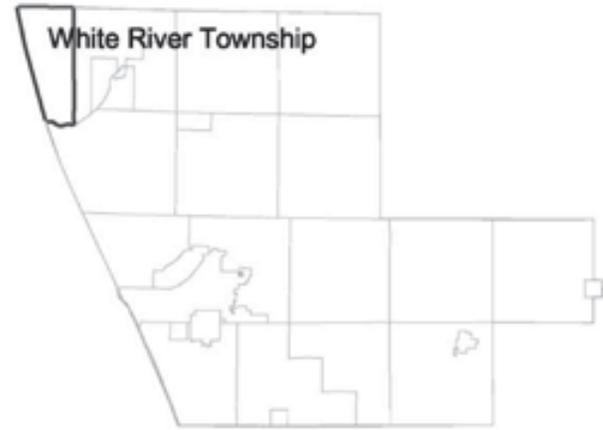
Sullivan Township is located in the southern portion of Muskegon County and was incorporated in 1891. It is bordered by Ottawa County to the south, Egelston Township to the north, Ravenna Township to the east, and Fruitport Township to the west. The 2010 census gives a total population of 2,441, with a peak seasonal population of 2,454. There are 978 total housing units in the township, of which 46 are vacant. Of those vacant, only one is for seasonal, recreational, or occasional use.



The township hall is the only listed critical facility in the township. Critical infrastructure includes roads B-72, B-31, and a power transmission line. Major geographic features in the area include scattered rural housing, moderate forest area, 4-6 small lakes and ponds, and 6- 8 small creeks.

White River Township

White River Township is located in the northwestern corner of Muskegon County. Lake Michigan borders it to the west, Oceana County to the north, White Lake to the south, and Montague Township to the east. It is difficult to get an accurate history of the township because all records were burned in 1859 to make a fresh start, one free of debt, but the date of incorporation (1848) is known. The 2010 census shows a total population for White River Township of 1,335, with a peak seasonal population of 2,195. There are 907 total housing units, of which 383 are vacant. Of those vacant, 340 are for seasonal, recreational, or occasional use. Critical facilities in the township include one community medical facility and the township hall. Vital infrastructure includes county road B-15, and a power transmission line. Major geographic features consist of scattered rural housing, moderate forests, moderate farmland, the Lake Michigan shoreline, White Lake, 6-8 small lakes and ponds, and 10-12 small creeks.

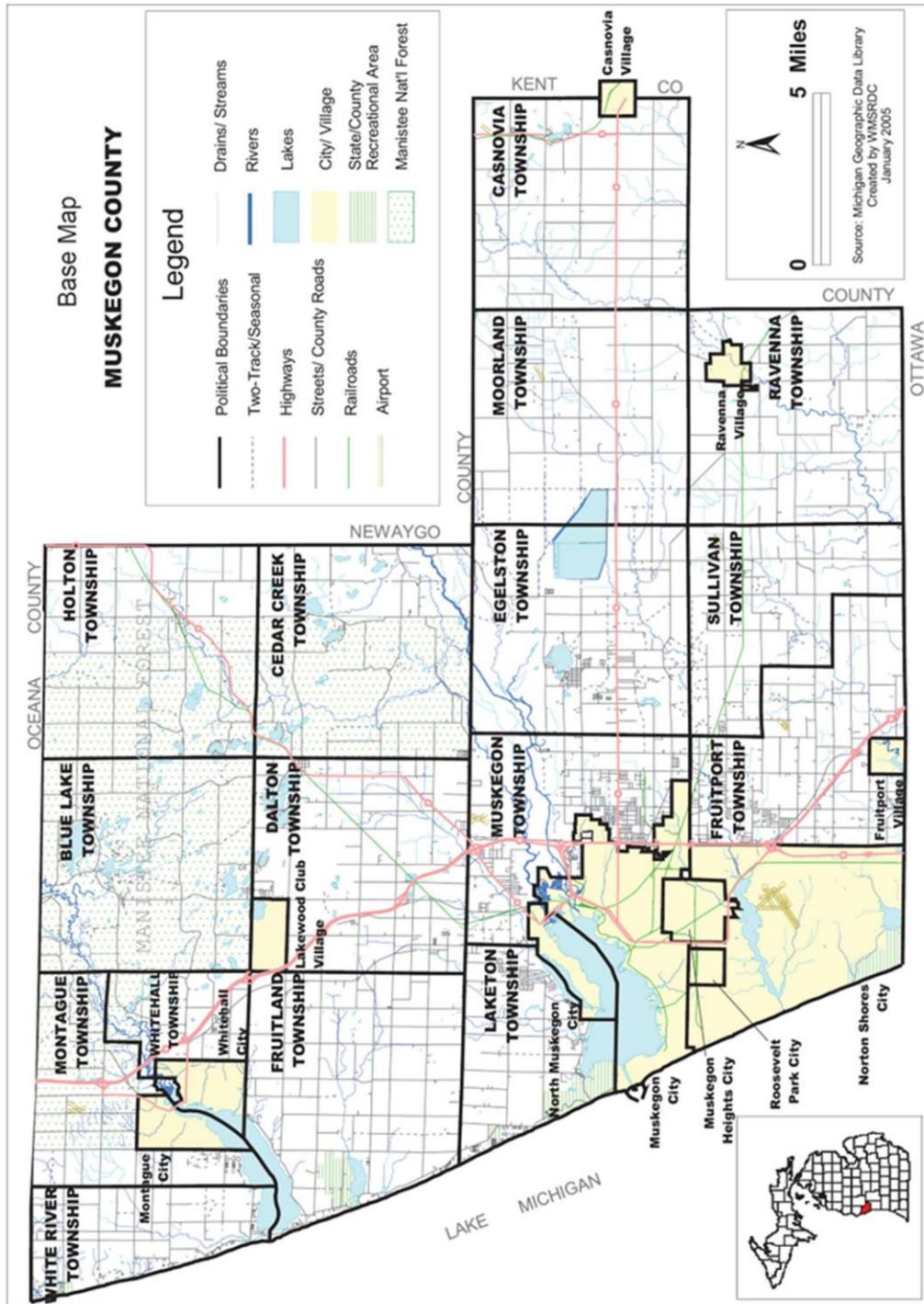


Whitehall Township

Whitehall Township is located in the northwest portion of Muskegon County and is bordered by the City of Whitehall to the west, Montague Township to the north, Fruitland Township to the south, and Blue Lake Township to the east. It was formed in 1874 when Oceana Township was split into two separate townships: Montague to the north and Whitehall to the south. According to the 2010 census, Whitehall Township's total population was 1,739, with a peak seasonal population of 1,787. There are 723 total housing units in the township, 50 of those are vacant. Of those 50 vacant, 19 are for seasonal, recreational, or occasional use. Over ¼ of the housing supply is comprised of mobile homes. Critical facilities include the township hall and Muskegon County



Road Commission Garage. Highway U.S. 31, its bridge over White River, a power transmission line, and the Silver Creek Pond Dam are among vital or critical infrastructure. Major geographic features in the township include scattered housing and moderate residential areas, moderate forests, White River, 4-6 small lakes and ponds, and 2-4 small creeks.



Distance to Major Cities

Muskegon County is situated at the Western end of the Greater Grand Rapids metropolitan area and is a short distance to several regional economic hubs such as:



| | |
|---------------|---------------------|
| Grand Rapids | 40 miles or 64 km |
| Lansing | 100 miles or 160 km |
| Traverse City | 131 miles or 211 km |
| Chicago | 180 miles or 289 km |
| Detroit | 190 miles or 305 km |
| Indianapolis | 260 miles or 418 km |
| Milwaukee | 277 Miles or 446 km |
| Cleveland | 310 miles or 498 km |

Climate and Weather Patterns

The Soil Survey for Muskegon County, the jurisdiction has a quasi-marine or continental climate. However, according to the Great Lakes Integrated Sciences and Assessment (GLISA) Program, Muskegon County is in a Humid Continental climate. Temperatures in this region range from -20°F to 88°F, with an average of five months of temperatures above 80°F. Winters are cold and snowy, with an average of four months of snowfall. Because the county borders Lake Michigan, the lake has a strong impact on the climate in Muskegon throughout the year. The lake increases cloudiness and snowfall during the fall and winter and moderates the temperature throughout most of the year. The area seldom experiences prolonged period of hot, humid weather and extreme cold during the winter. Temperatures rarely exceed 90°F in the summer but temperatures below freezing are often recorded in the winter

The highest temperature ever recorded, according to the Michigan State Climatologist's Office, at Muskegon was 99 degrees On July 7, 2012, July 30, 1913, and August 3, 1964. The lowest temperature ever recorded was -30 degrees in February 11, 1899. At Grand Rapids, the highest temperature of record was 102 degrees in June 1953 and the lowest was -22 degrees in January 1951. The latest freezing temperature ever recorded at Muskegon was on May 20 and at Grand Rapids was on May 27. In fall, the average date of the first 32-degree temperature is October 19 at Muskegon and October 6 at Grand Rapids.

The influence of Lake Michigan on precipitation is shown by the higher precipitation measurements. Average total precipitation per year is 33.42 inches in Muskegon and 38.18 in Grand Rapids. The average number of days with snow cover per year is 80 in Muskegon and 74 in Grand Rapids. Average annual snowfall in Muskegon County is about 91.94 inches, as compared to about 74.40 inches in Grand Rapids.

The 2014 National Climate Assessment reports in the next few decades the Midwest can expect to see an increasing scope, frequency, and intensity of weather-related disasters. This includes more weather extremes such as temperature (heat and cold), heavy downpours, and flooding that will affect infrastructure, health, agriculture, forestry, transportation, air and water quality, and more. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure.

Within Michigan, the frequency and intensity of heat waves are projected to increase by mid-century. Temperatures above 95°F are associated with negative human health impacts and suppressed agricultural yields. These conditions also increase humidity, degrade air quality, and reduce water quality which will increase public health risks.

The frequency of days with very heavy precipitation (the wettest 2% of days) is also projected to increase. Extreme rainfall events and flooding have already increased during the last century. These trends are expected to continue, causing erosion, declining water quality, and negative impacts on transportation, agriculture, human health, and infrastructure.

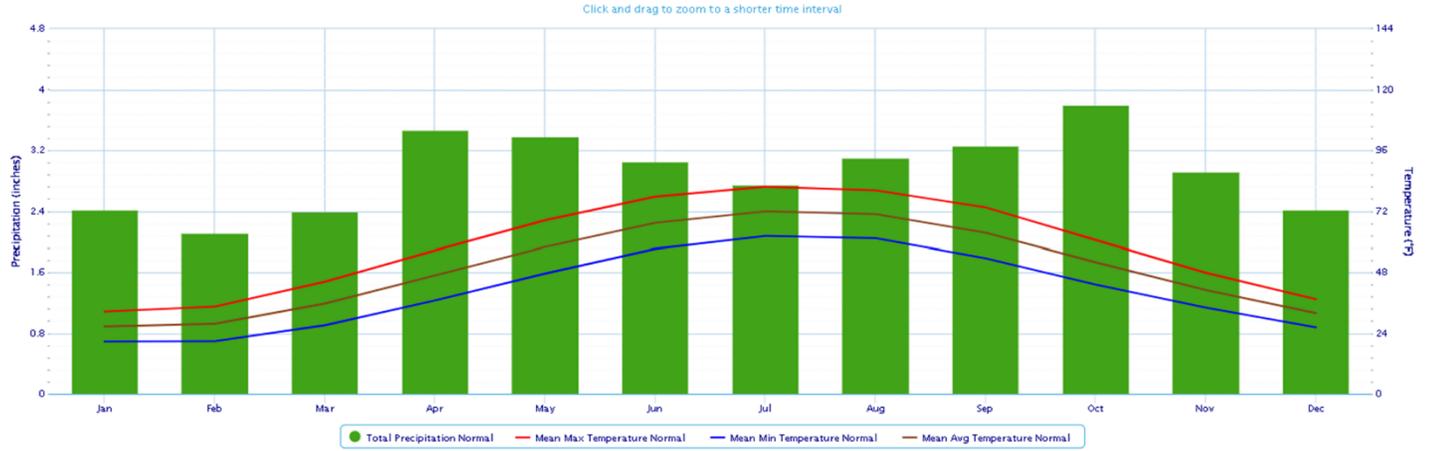
Much of the region's fisheries, recreation, tourism, and commerce depend on the Great Lakes and expansive northern forests. Longer growing seasons and rising carbon dioxide levels are projected to increase yields of some crops, though those benefits will be progressively offset by extreme weather events. Extreme weather events will influence future crop yields more than changes in average temperature or annual precipitation. High temperatures during early spring, for example, can decimate fruit crop production when early heat causes premature plant budding that exposes flowers to later cold injury, as happened in 2002, and again in 2012, to Michigan's \$60 million tart cherry crop. Springtime cold air outbreaks are projected to continue to occur throughout this century. Though adaptation options can reduce some of the detrimental effects, in the long term, the combined stresses associated with climate change are expected to decrease agricultural productivity.

*Table 1: Record Monthly Temperatures in Degrees Fahrenheit for Muskegon, Michigan
Source: US National Weather Service Office, Grand Rapids, Michigan*

Period of record 1896-06-01 to 2023-01-30

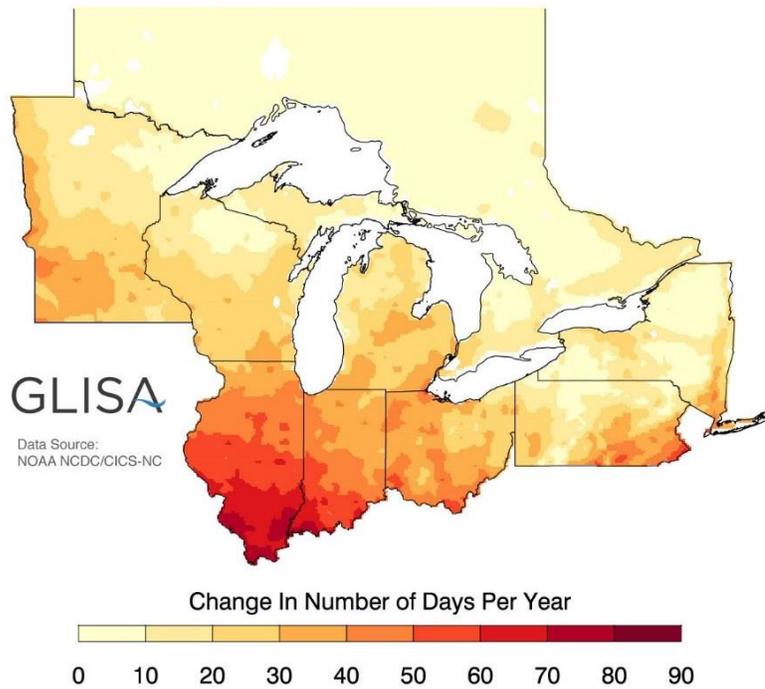
| Month | Record High | Date | Previous Record | Record Low | Date | Previous Record |
|------------------|--------------------|--------------------------|----------------------------------|-------------------|--------------------------|----------------------------------|
| January | 63°F | 01-25-1950 | 59°F 01-24-1950 | -21°F | 1-12-1912 | |
| February | 67°F | 02-11-1999 | 58°F 02-21-1930 | -30°F | 2-11-1899 | |
| March | 82°F | 03-20-2012 03-21-2012 | 77°F 03-27-1967 | -11°F | 3-16-1897 | |
| April | 86°F | 04-29-1970 | 85°F 04-27-1899 | 1°F | 04-07-1982 | 9°F 04-01-1923 |
| May | 96°F | 05-29-2018 | 93°F 05-29-1930 | 22°F | 05-10-1974 05-11-1972 | |
| June | 98°F | 06-20-1995 | 94°F 06-11-1956 06-24-1901 | 31°F | 06-11-1972 | 34°F 06-04-1945 06-08-1949 |
| July | 99°F | 07-07-2012 07-30-1913 | | 39°F | 07-2-2001 | 40°F 07-11-1945 |
| August | 99°F | 08-03-1964 | 96°F 08-24-1947 | 36°F | 8-16-1979 | 40°F 08-15-1929 |
| September | 95°F | 09-1-1953 09-06-1954 | 94°F 09-02-1913 09-03-1953 | 27°F | 09-27-1989 09-28-1991 | 28°F 09-25-1947 09-26-1947 |
| October | 86°F | 10-15-1899 | | 19°F | 10-29-1905 | |
| November | 76°F | 11-2-1961 11-20-1930 | 74°F 11-19-1930 11-01-1935 | -14°F | 11-25-1950 | -8°F 11-24-1950 |
| December | 66°F | 12-03-2012 | 64°F 12-02-1982 | -15°F | 12-31-1976 | -11°F 12-30-1976 |

Monthly Climate Normals (1991–2020) – Muskegon Area, MI (ThreadEx)



| Month | Total Precipitation Normal (inches) | Mean Max Temperature Normal (°F) | Mean Min Temperature Normal (°F) | Mean Avg Temperature Normal (°F) |
|-----------|-------------------------------------|----------------------------------|----------------------------------|----------------------------------|
| January | 2.42 | 32.5 | 20.7 | 26.6 |
| February | 2.11 | 34.5 | 20.8 | 27.7 |
| March | 2.40 | 44.3 | 27.1 | 35.7 |
| April | 3.47 | 56.6 | 36.9 | 46.8 |
| May | 3.38 | 68.4 | 47.5 | 57.9 |
| June | 3.05 | 77.7 | 57.2 | 67.4 |
| July | 2.75 | 81.6 | 62.2 | 71.9 |
| August | 3.10 | 80.2 | 61.3 | 70.8 |
| September | 3.26 | 73.4 | 53.5 | 63.5 |
| October | 3.80 | 60.6 | 43.2 | 51.9 |
| November | 2.92 | 47.8 | 34.1 | 41.0 |
| December | 2.42 | 37.4 | 26.3 | 31.9 |
| Annual | 35.08 | 57.9 | 40.9 | 49.4 |

Projected Change in Number of Days Over 90°F Period: 2041-2070 | Higher Emissions: A2



*Table 2: Record Monthly Precipitation in Inches for Muskegon, Michigan
Source: US National Weather Service Office, Grand Rapids, Michigan
Period of record 1896-06-01 to 2023-01-30*

| JAN | FEB | MAR | APR | MAY | JUN | JUL |
|-------------|------------|-------------|-------------|-------------|-------------|-------------|
| 7.72 | 5.3 | 6.59 | 8.05 | 9.59 | 8.18 | 7.11 |
| 1897 | 1908 | 1976 | 1909 | 2004 | 1921 | 1902 |

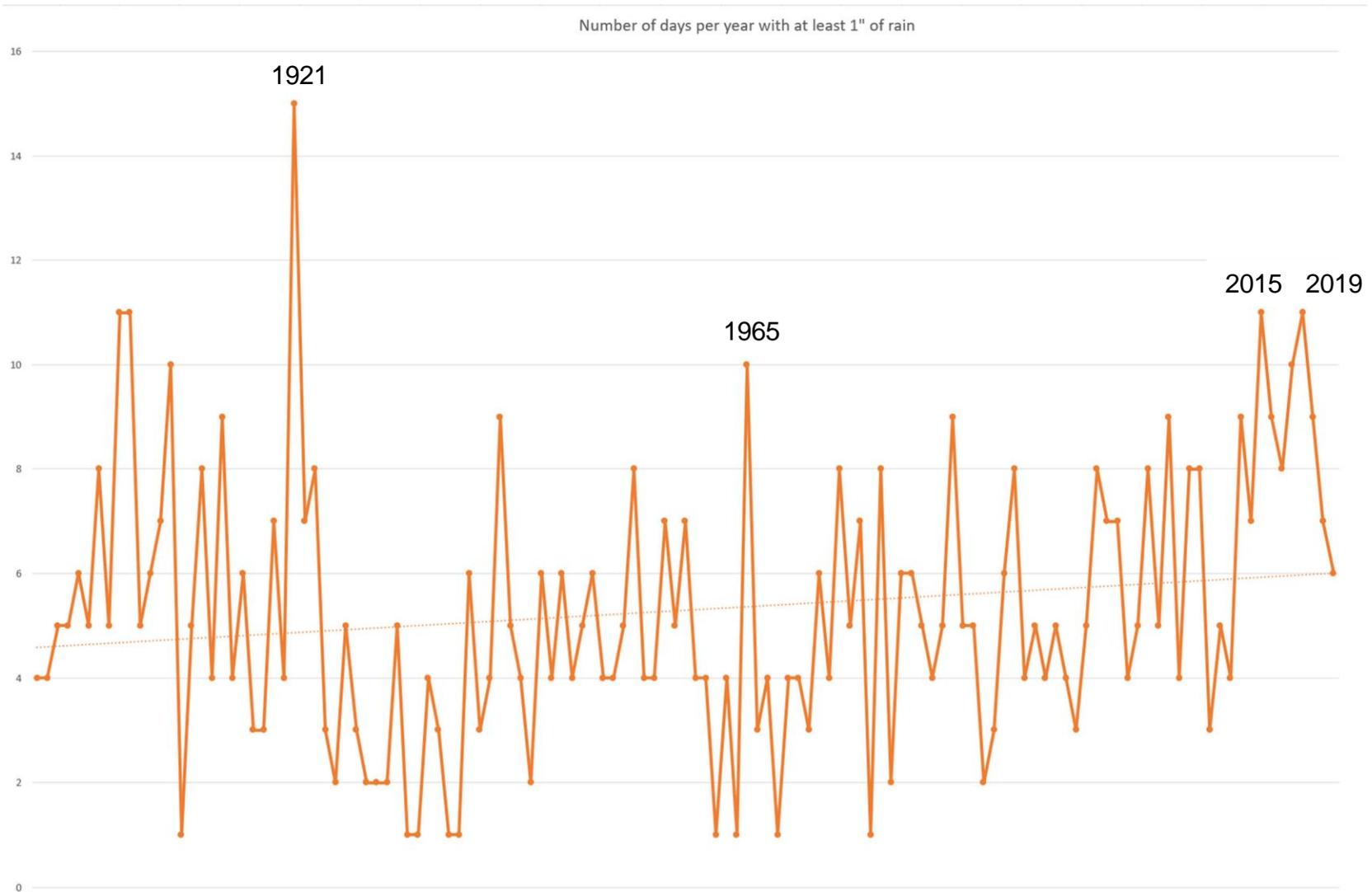
| AUG | SEP | OCT | NOV | DEC | ANNUAL |
|-------------|--------------|-------------|-------------|-------------|--------------|
| 9.88 | 13.55 | 9.25 | 6.77 | 6.99 | 47.97 |
| 1975 | 1986 | 2017 | 2005 | 2008 | 2019 |

*Table 3: Record Daily Precipitation in Inches for Muskegon, Michigan
Source: US National Weather Service Office, Grand Rapids, Michigan
Period of record 1896-06-01 to 2023-01-30*

| JAN | FEB | MAR | APR | MAY | JUN |
|-------------|-------------|-------------|-------------|-------------|-------------|
| 4.90 | 2.12 | 2.92 | 2.66 | 4.01 | 5.08 |
| 01/03/1897 | 02/22/1922 | 03/13/2006 | 04/11/2001 | 05/22/1904 | 06/27/1921 |

| JUL | AUG | SEP | OCT | NOV | DEC |
|-------------|-------------|-------------|-------------|-------------|-------------|
| 3.75 | 4.29 | 4.33 | 3.21 | 2.12 | 2.58 |
| 07/04/1901 | 08/13/2011 | 09/11/1986 | 10/03/1954 | 11/05/1990 | 12/02/1982 |

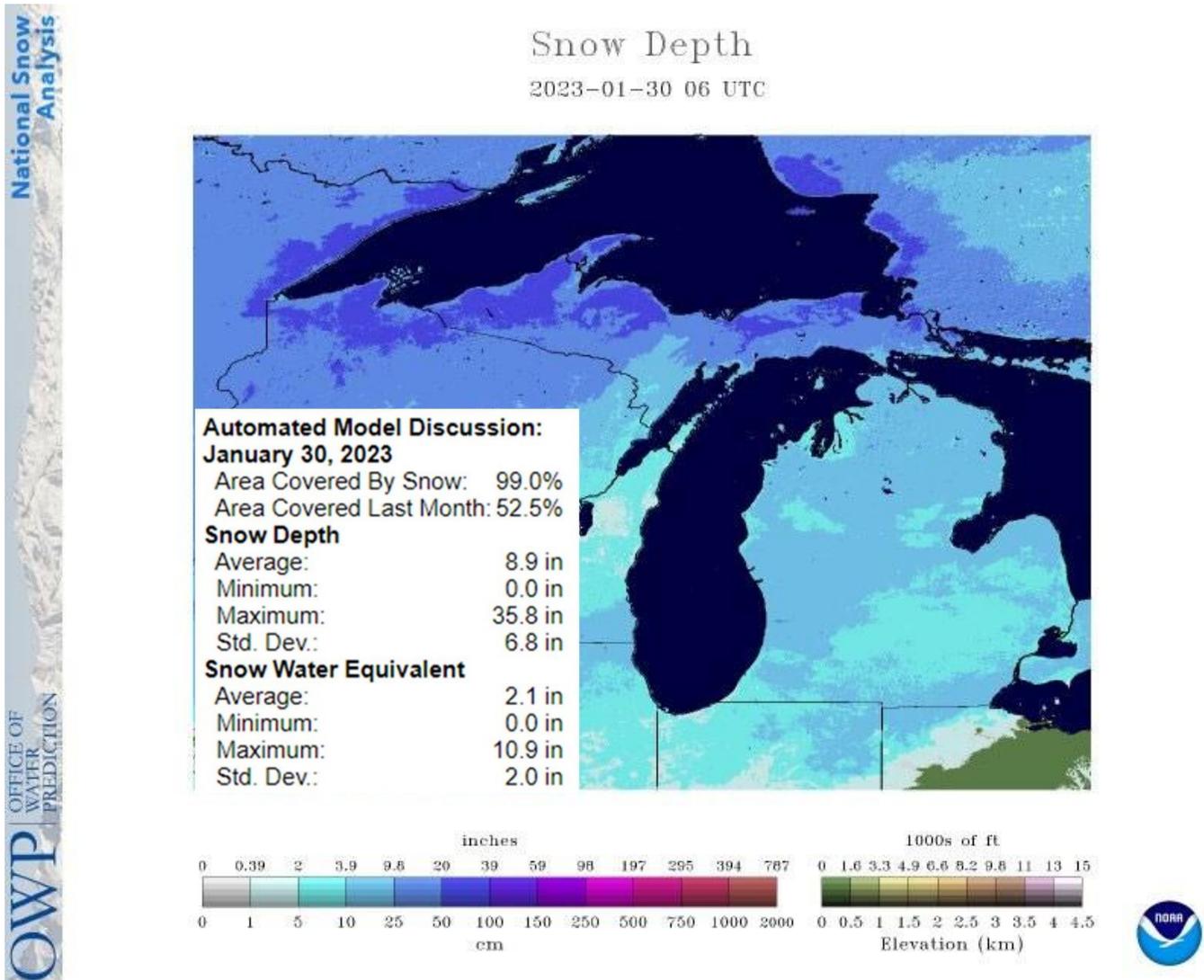
The following demonstrates the frequency of days with at least 1" of rain, broken down by calendar year, starting in 1896. Data is from the US National Weather Service Office in Grand Rapids, Michigan. Since 1896, the average number of days with at least an inch of rain or more is 5 days. However, the average over the last 20 years is 7 days per year of at least an inch of rain (or equivalent snow). This data shows an upward/increasing trend with time, on the order of 2 to 3 extra yearly occurrences over the 20 year duration.



*Table 4: Average Depth of Snow Cover in Inches for Muskegon, Michigan
Source: US National Weather Service Office, Grand Rapids, Michigan*

Period of record 1896-06-01 to 2023-01-30

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|-------|------------|--------------|--------------|-----------|-------------|-----------|-----------|-----------|-----------|-------------|-------------|--------------|
| Mean | 5.5 | 6.1 | 1.6 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 2.6 |
| Max | 22 1979 | 22.4 1959 | 12.3 2014 | 3 1923 | 0.1 1902 | 0 2022 | 0 2022 | 0 2022 | 0 2022 | 0.1 1917 | 4.3 1930 | 13.6 1963 |
| Min | 0 1939 | 0 1939 | 0 2021 | 0 2022 | 0 2022 | 0 2022 | 0 2022 | 0 2022 | 0 2022 | 0 2022 | 0 2020 | 0 1938 |



Source: Interactive Snow Information <http://www.nohrsc.noaa.gov>

Geography and Land Use Patterns

Topography, Soils, and Other Geographical Features

Understanding the local environment and land use patterns help identify changes that can have significant repercussions for people, the economy, and the environment. Some changes have natural causes, such as volcanic eruptions or drought, while other changes on the land, such as resource extraction, agricultural practices, and urban growth, are human-induced processes. There are other types of changes that are a combination of natural and human-induced factors; for example, landslides and floods are fundamentally natural processes that are often intensified or accelerated by human land use practices. In order to understand Muskegon County's topography, soils, and other geographical features, it is important to understand the history behind Michigan and the glacial activity.

The physiography of Muskegon County is mostly a result of the Wisconsin, or latest, glacial period. The glacial ice that once covered the state melted about 8 to 12 thousand years ago. As this ice melted, a covering of raw soil materials was left on the surface of the county. This glacial deposit ranges from about 150 feet to more than 400 feet in thickness.

The present surface of the county ranges from nearly level to rolling and hilly. Along the shore of Lake Michigan is a belt of strongly rolling sand dunes. These dunes are post-glacial in origin but are now generally stationary. After vegetation covers these dunes, a soil profile begins to develop. For several miles inland, smaller dunes are scattered throughout the poorly drained areas of the lake plain.

A wide plain with little relief lies east of the dunes. Rolling to hilly areas are toward the eastern side of the county and in the extreme northwestern part. Parts of the central plain are somewhat broken by stream channels and lake basins. Post-glacial sand dunes dominate the area. Most of the county ranges from 600 to about 800 feet above sea level but a small area in Casnovia Township is more than 800 feet above sea level.

The central plain of Muskegon County is a part of the bed of glacial Lake Chicago. The deposits in this lakebed are sandy, underlain by clayey deposits in many areas. Another broad, gently undulating lake plain is in the northeastern part of the county. This plain is mainly in Holton Township, but it extends into the western part of Newaygo County. The soil material of this lake plain is finer textured than that of the plain in the central part of the county.

The principal morainic areas of the county are most of Casnovia Township; a smaller area north of the valley of the Muskegon River; and an area that begins at a point north of Whitehall and extends for several miles south and east of that town.

Physical Land Features

The bedrock in Muskegon County consists of edges of bowl-like formations that fill the Michigan Basin. Marshall Sandstone underlies the entire County. The Michigan Formation overlies the Michigan Sandstone in the eastern half of the County. This formation is primarily limestone, gypsum, and

dolomite interceded with shale and sandstone. To the east, Bayport Limestone and Parma Sandstone progressively overlie these rocks. In the central part of the County and in some areas in the eastern half, red beds overlie the Michigan, Saginaw, and Grand River Formations. They consist mainly of sandstone, shale, clay and minor beds of limestone and gypsum. Overlying the rock formations is a mall of glacial drift, which was deposited after the Wisconsinian Glaciation. The glacial drift ranges from 200 to 800 feet in thickness. It is coarse gravel to fine lacustrine clay. Many of the soils in the County formed in the drift.

Elevation

The highest elevation is 974 feet above sea level in Casnovia Township west of Half Moon Lake. The lowest elevation in the county is approximately 571 feet at the Lake Michigan Shoreline and along the Muskegon River basin.

Native Vegetation

As with many Michigan communities, Muskegon County was originally covered with a dense forest of deciduous trees. As the county was cleared for farming and development, or the trees removed for timber, the area's forests were replaced by farm fields, open field areas, orchards and smaller forests containing both deciduous and coniferous trees.

Soils Associations

A soil association is an area of land that has a distinctive proportional pattern of soils. Each association consists of one or more major soils and some minor soils and each association has a distinctive pattern of soils, relief, and drainages. The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitability can be identified on the map as well as soils that are not suitable. Because of the small scale, the map is not suitable for selecting a site for a road or building or other structure; however, more detailed maps are available for specific areas for planning purposes. There are eight general soil associations identified for the Muskegon County area as follows:

1. Rubicon-Crosswell-Deer Park Association: Nearly level to steep, well drained and moderately well drained, sandy soils on outwash plains, beach ridges, and dunes
2. Rubicon-Au Gres-Roscommon Association: Gently sloping, well-drained and poorly drained, sandy soils on outwash plains and uplands.
3. Au Gres-Roscommon-Granby Association: Nearly level and slightly depressional, poorly drained, sandy soils on outwash plains, uplands, and lake plains
4. Nester-Ubly-Sums Association: Gently sloping to hilly, well drained, moderately well drained, and poorly drained, loamy soils on lake plains and uplands
5. Belding-Allendale-Rubicon Loamy Substratum-Montcalm Association: Nearly level and gently sloping, poorly drained, and well drained loamy and sandy soils on lake plains
6. Montcalm-Nester-Belding-Kawkawlin Association: Gently sloping to rolling, somewhat poorly drained and well-drained, sandy and loamy soils on lake plains, outwash plains, and glaciated uplands
7. Carlisle-Tawas Association: Nearly level and depressional, poorly drained peats and mucks

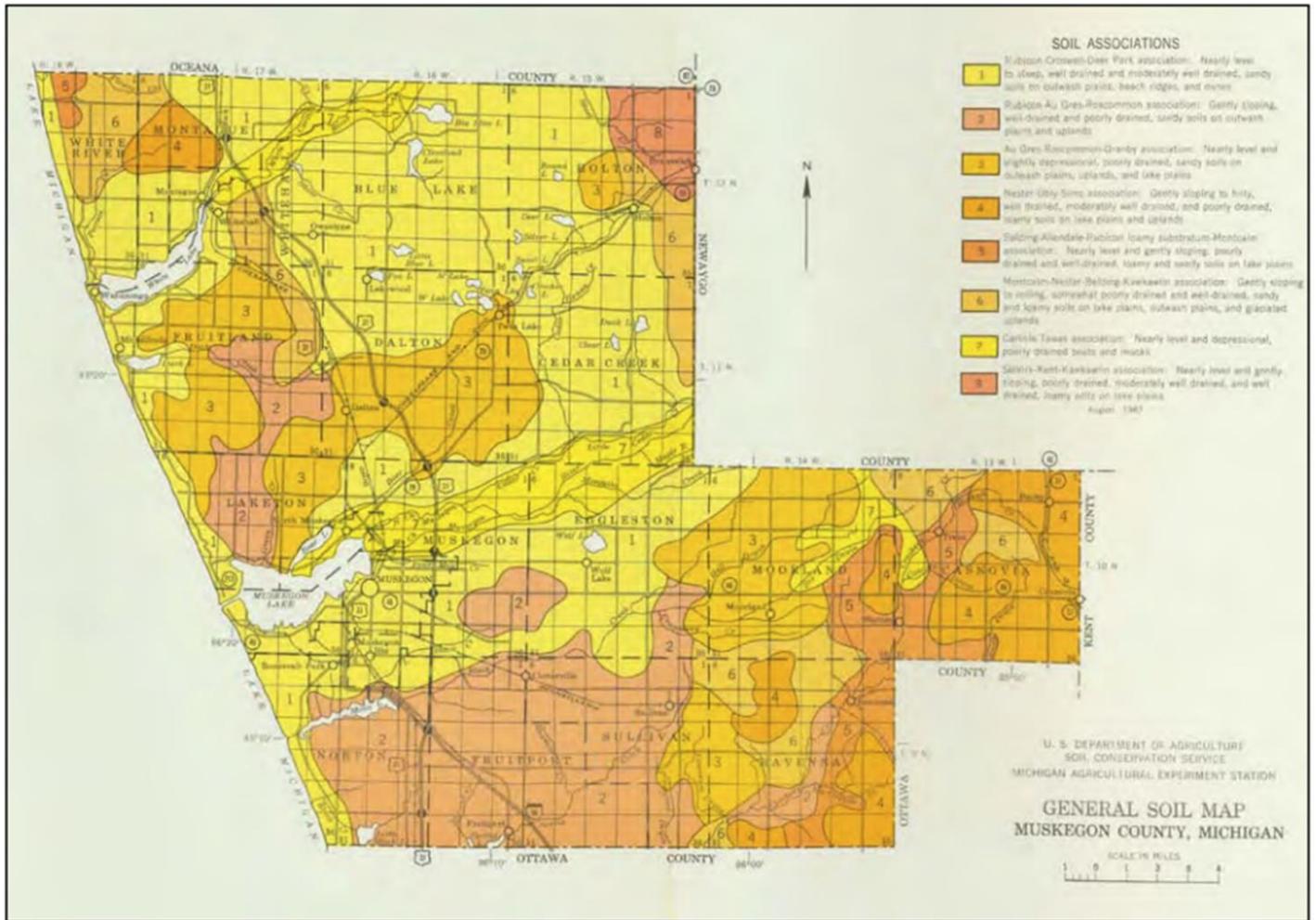
8. Selkirk-Kent-Kawkawlin Association: Nearly level and gently sloping, poorly drained, moderately well drained, and well drained loamy soils on lake plains.

The following table outlines the different soil types and best land uses for those soil types based off the Muskegon County Soil Survey Report published in 1968 as developed by the US Department of Agriculture in cooperation with the Michigan Agricultural Experiment Station.

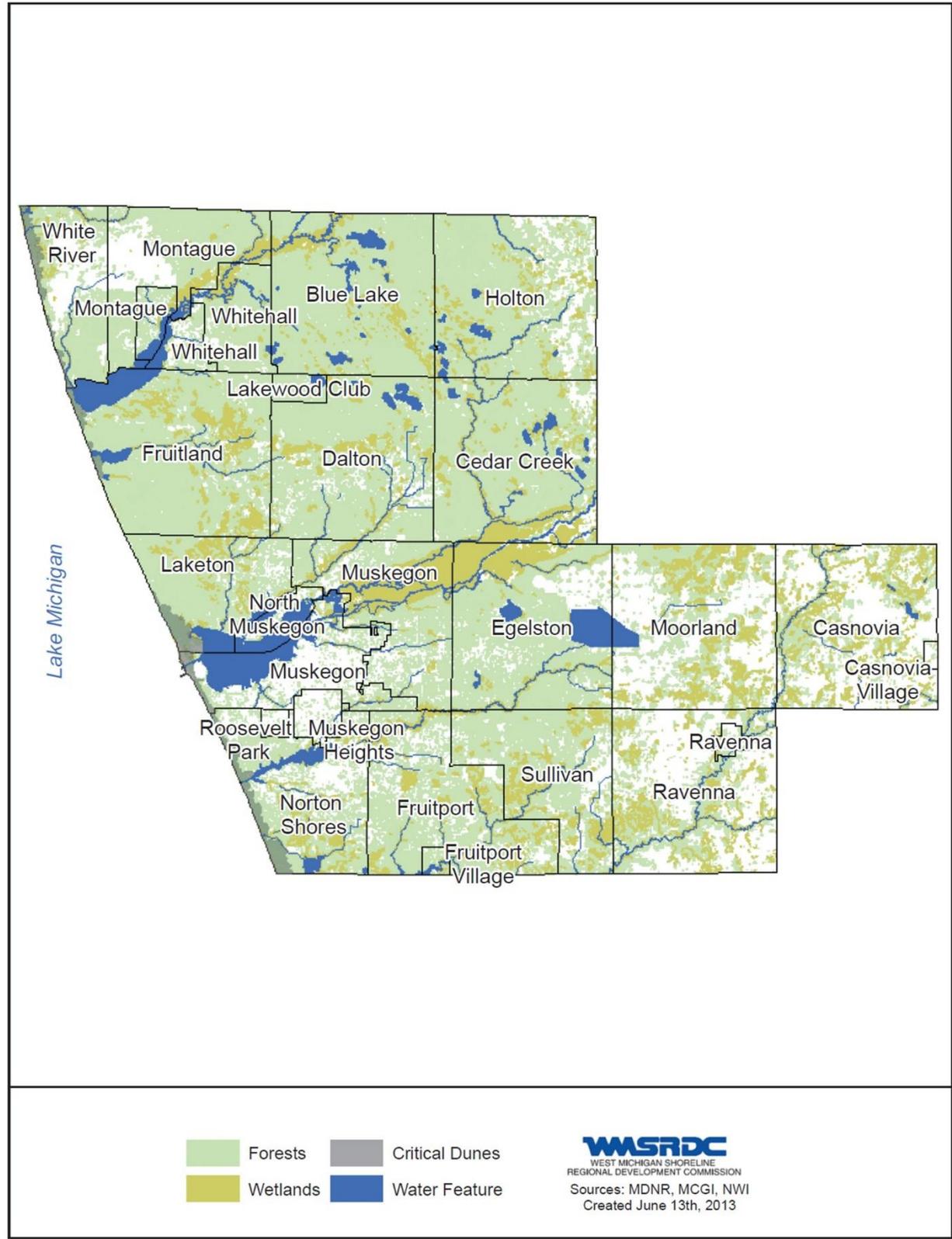
Soil Types Best Suited For Land Uses

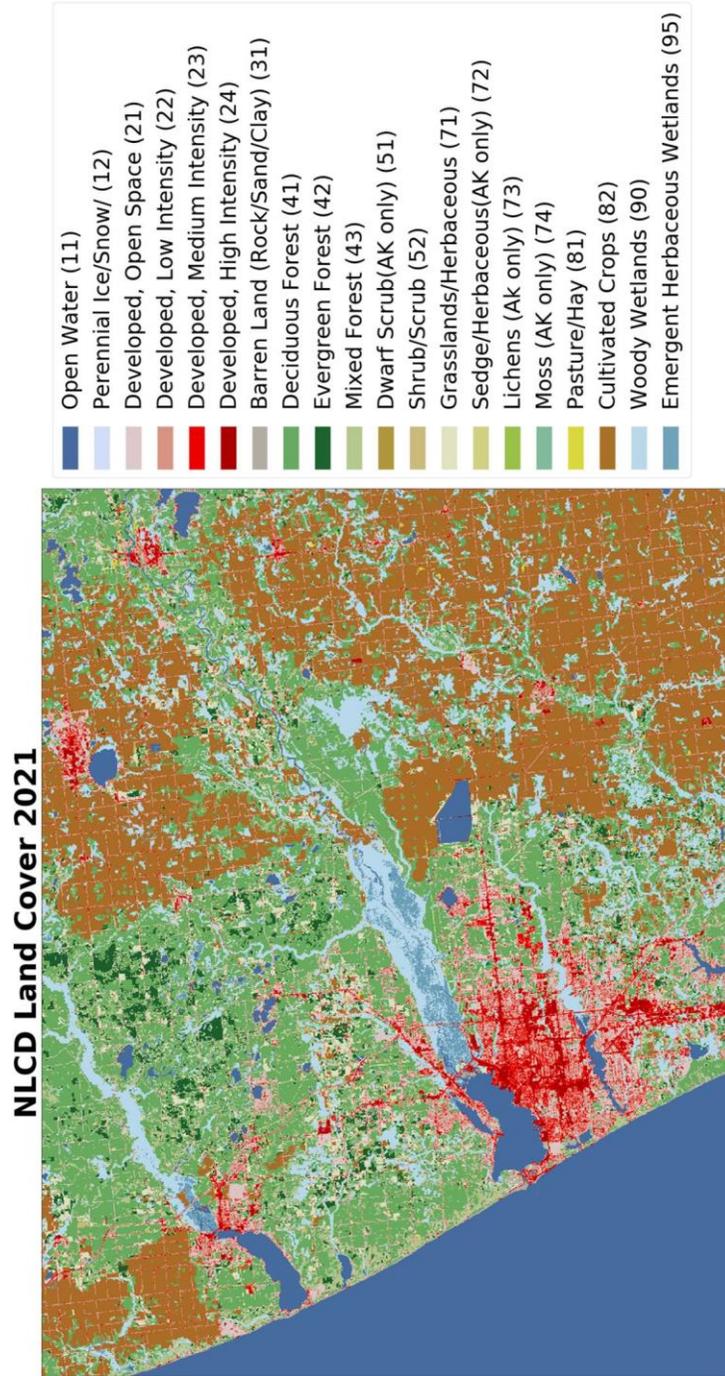
| General Soil Associations | Recreational and Community Development | Farming | Orchards | Woodland | Open Areas | Wetlands |
|----------------------------------|---|----------------|-----------------|-----------------|-------------------|------------------|
| 1 | Good | No | No | Good | | |
| 2 | Good | Poor | No | Good | | |
| 3 | Poor | Poor | No | Good | Best | High Water Table |
| 4 | Poor | Good | Good | Good | | |
| 5 | Poor | General | No | Good | | Wet Soils |
| 6 | Poor | General | No | Good | | |
| 7 | Poor | Specialized | No | No | | Yes |
| 8 | Good | Good | No | Poor | | |

GENERAL SOILS MAP



MUSKEGON COUNTY Natural Features





This information, which was compiled by the USGS, is a part of the National Land Cover Dataset and was based on satellite imagery taken in 1992. Although this information is nearly 30 years old, it paints an accurate picture of the distribution of development, natural vegetation, and agriculture found within Muskegon County.

| Muskegon County Land Cover in Acres | | | | |
|--|----------|----------------------------------|---------------------------|----------|
| <i>land cover categories</i> | <i>%</i> | <i>land cover subcategories</i> | <i>countywide acreage</i> | <i>%</i> |
| Water | 3.90% | open water | 13,147.54 | 3.90% |
| Developed | 9.51% | low intensity residential | 22,981.84 | 6.81% |
| | | high intensity residential | 4,570.66 | 1.36% |
| | | commerce/industry/transport | 4,531.52 | 1.34% |
| Barren | 0.53% | bare rock/sand/clay | 1,357.28 | 0.40% |
| | | quarries/strip mines/gravel pits | 415.43 | 0.12% |
| Vegetated; Natural Forest Upland | 46.12% | deciduous forest | 84,597.22 | 25.08% |
| | | evergreen forest | 37,907.87 | 11.24% |
| | | mixed forest | 33,067.22 | 9.80% |
| Shrubland | 0.06% | Shrubland | 186.37 | 0.06% |
| Non-natural Woody | 0.13% | orchards/vineyards/other | 433.67 | 0.13% |
| Herbaceous Upland | 7.99% | grasslands/herbaceous | 26940.47 | 7.99% |
| Herbaceous Planted/ Cultivated | 24.70% | pasture/hay | 35,479.54 | 10.52% |
| | | row crops | 42,494.32 | 12.60% |
| | | small grains | 1,428.22 | 0.42% |
| | | urban/recreational grasses | 3,929.05 | 1.16% |
| Wetland | 7.07% | woody wetlands | 18,427.19 | 5.46% |
| | | emergent herbaceous wetlands | 5,420.21 | 1.61% |

Estimates based on USGS National Land Cover Dataset, 1992.

Current Land Use

The Muskegon County landscape varies greatly depending on the location. It ranges from highly urbanized, to rural, to natural areas such as shorelines, wetlands, and forests. There are twenty-seven jurisdictions in the county, all of which have planning and zoning authority. The county has a land area of 509 square miles, or 337,088 acres.

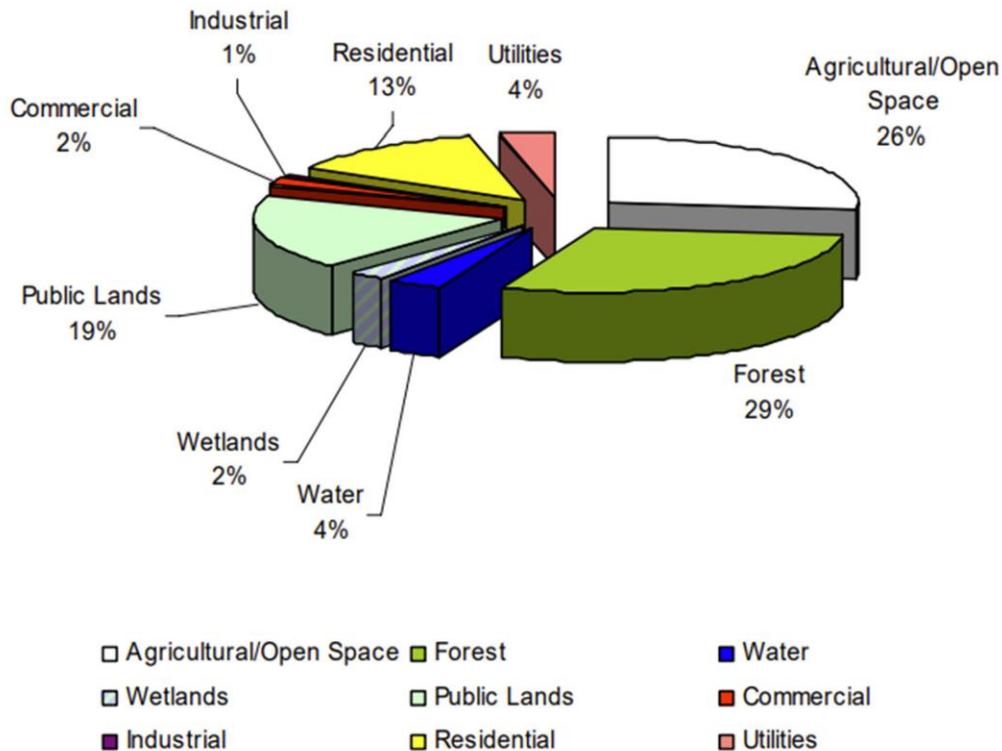
There are 337,088 acres of land in Muskegon County. Of that, nearly 162,200 acres or 48 percent is in forest land. An additional 27 percent is in agricultural or open space uses. Water accounts for 3.7 percent of the surface area and wetlands account for 2.2 percent. These combined uses are more

than 80 percent of the land in the county. Nearly 30 percent of the land is in uses such as forest, water, and state and federal lands that are not likely to be developed.

The largest urban land use in Muskegon County is residential uses, occupying more than 43,000 acres, or 12.9 percent of the land area. Commercial uses account for nearly two percent of the land area and industrial uses account for another one percent. Utilities account for 3.7 percent, largely due to the amount of land at the wastewater treatment facility. Urban land uses in Muskegon County are concentrated near Muskegon Lake and Mona Lake, and near White Lake.

As of the 2020 US Census, the population density was 335 people per square mile. According to the Muskegon Area-wide Plan, the developed area of the county increased by 24 square miles, or 4.7 percent, between 1978 and 1998. While much of the new development occurred in the areas adjacent to existing urban areas, there was also significant new development that was decentralized in nature.

Land Use by Category



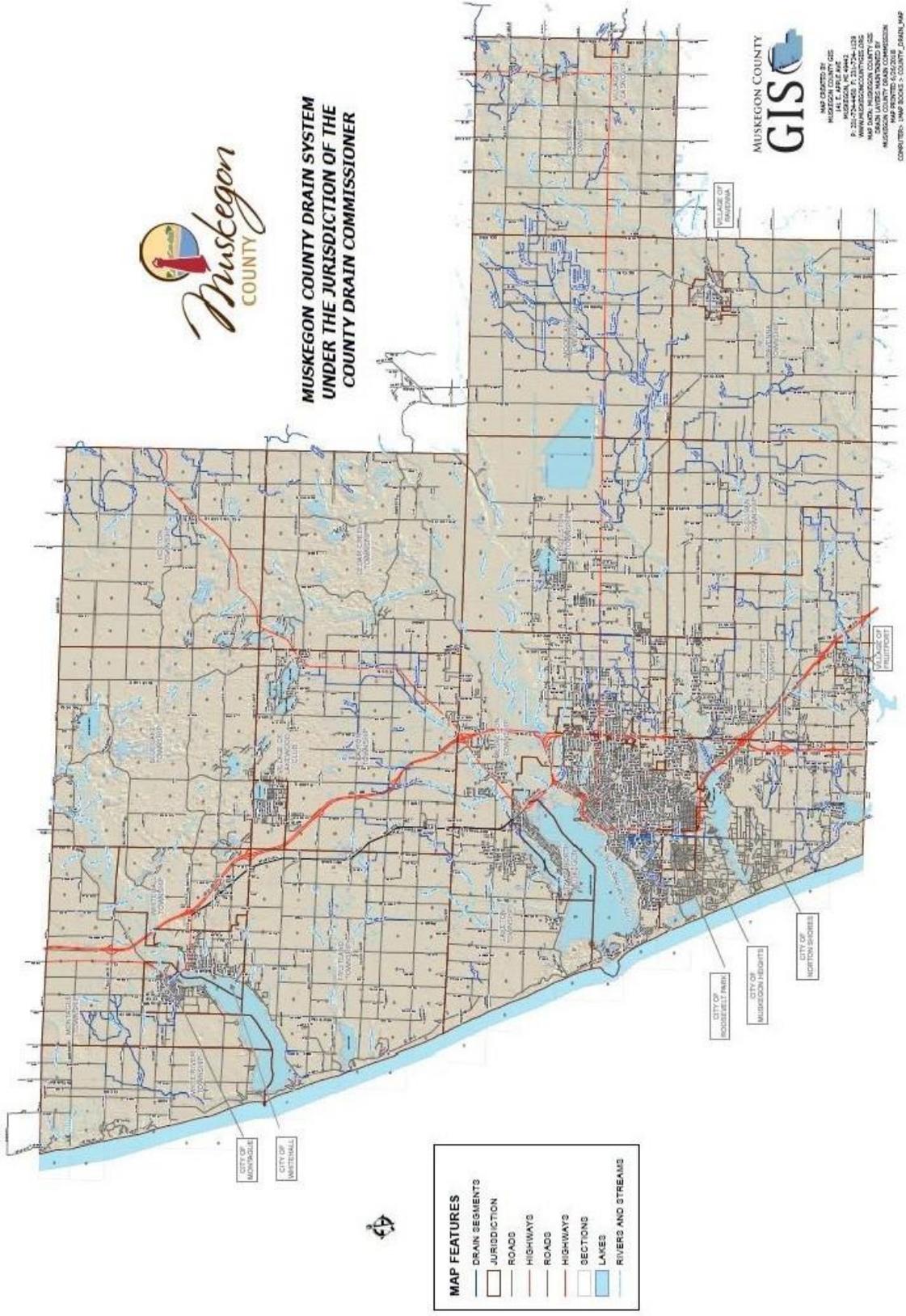
Water Resources

There are numerous inland lakes in Muskegon County. Water accounts for 3.7 percent of the surface area and wetlands account for 2.2 percent of surface area in Muskegon County. The five primary water systems that drain Muskegon County include Grand River, Lake Michigan, Mona Lake/Black Creek, Muskegon Lake/River, and White Lake/River. Crockery Creek and Spring Lake/Norris Creek, both tributaries of the Grand River, drain the southeastern and southern parts of the county. The Mona Lake basin, including Little Black and Black creeks, drains much of the southern half of the county. The Muskegon River bisects the county and empties into Muskegon Lake, an inlet of Lake Michigan. Its main tributary within the county is Cedar Creek, which drains large portions of Cedar Creek and Holton townships. The White River drains much of the northern portion of the county and empties into White Lake, another Lake Michigan inlet. In addition, much of the western area of the county drains directly into Lake Michigan, including the Lake Michigan Shoreline, Duck Lake/Creek, Flower Creek, and Little Black Lake.

The abundant water in the numerous lakes and streams is one of the greatest assets in Muskegon County. The three major lakes, inlets of Lake Michigan, are Muskegon Lake, Mona Lake, and White Lake. Many other lakes, mostly north of the Muskegon River, provide areas for homes, recreation, youth camps, and other recreational facilities. A 1962 inventory lists 262 lakes and ponds in the county covering 11,453 acres.

Muskegon County Rivers

- Muskegon River
- White River
- Carlton Creek
- Rio Grande Creek
- Skeel Creek
- Vincent Creek
- Crockery Creek
- Cedar Creek
- Indian Run
- Robinson Drain
- Brooks Creek
- Mosquito Creek
- Ball Creek
- North Branch Crockery Creek
- Ruddiman Creek
- Sand Creek

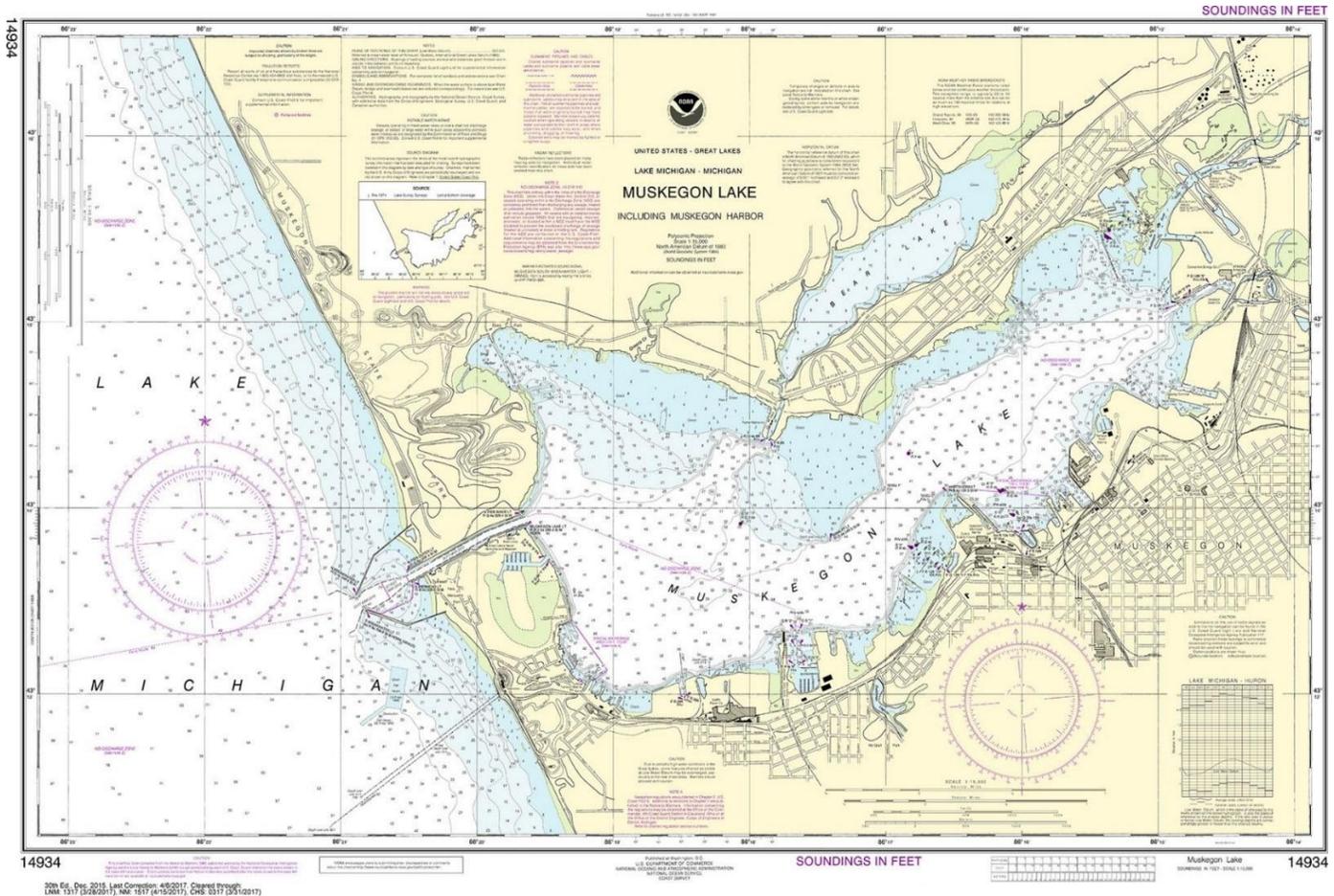


Muskegon County Lakes Over 100 Acres

- [Muskegon Lake](#) 4,150 acres
- [White Lake](#) 2,571 acres
- [County Sewage Pond](#) 850 acres
- [County Sewage Pond](#) 782 acres
- [Mona Lake](#) 695 acres
- [Bear Lake](#) 415 acres
- [Big Blue Lake](#) 330 acres
- [Duck Lake](#) 313 acres
- [Little Black Lake](#) 223 acres
- [Wolf Lake](#) 207 acres
- [Duck Lake](#) 112 acres
- [Twin Lake \(East\)](#) 112 acres
- [Little Blue Lake](#) 102 acres



<https://lakeplace.com/lakefinder/mi/muskegon>



Forest Lands

There are 337,088 acres of land in Muskegon County. Of that, nearly 162,200 acres or forty-eight percent is in forest land (Muskegon County Comprehensive Plan). Of this a majority of the forest lands are private ownership, with almost all owned by small, non-industrial owners. A vast portion of the public ownership consists of the Huron - Manistee National Forest managed by the US Forest Service. The remaining public ownership consists of State, County, and Municipal ownership. Much of this land has been converted into park systems in order to protect the natural resources. The following data is from the various jurisdictions Parks and Recreation Plans.

*Table 5: Public Lands / Parks in Muskegon County over 15 acres
Source: Muskegon County GIS Parcel Data*

| Park Name | Ownership | Acres |
|--------------------------------|------------------------------|----------------------|
| Huron-Manistee National Forest | United States Forest Service | 8,508 acres (Approx) |
| Muskegon State Park | State of Michigan | 1,223 Acres |
| Duck Lake State Park | State of Michigan | 728 Acres |
| Muskegon State Game Area | State of Michigan | 15,338 Acres |
| P.J. Hoffmaster State Park | State of Michigan | 1,200 Acres |
| Blue Lake Park | County of Muskegon | 25 Acres |
| Moore Park | County of Muskegon | 36 Acres |
| Patterson Park | County of Muskegon | 28 Acres |
| Pioneer Park | County of Muskegon | 145 Acres |
| Twin Lake Park | County of Muskegon | 15 Acres |
| Meinert Park | County of Muskegon | 182 Acres |
| Dune Harbor Park | County of Muskegon | 214 Acres |
| White River Flood Plain | City of Whitehall | 200 Acres |
| Durham Park | Whitehall Township | 22.74 Acres |
| Kruse Park | City of Muskegon | 52.3 Acres |
| Smith-Ryerson Park | City of Muskegon | 23 Acres |
| McGraff Park | City of Muskegon | 92 Acres |
| Pere Marquette Beach Park | City of Muskegon | 27.5 Acres |
| Seyferth Park | City of Muskegon | 16 Acres |
| Fisherman's Landing Park | City of Muskegon | 18.6 Acres |
| Veteran's Memorial Park | City of Muskegon | 28 Acres |
| Green Acres Park | City of Muskegon | 29.6 Acres |
| Mona Lake Park | City of Muskegon Heights | 34 Acres |
| Little Black Creek Nature Park | City of Muskegon Heights | 20 Acres |
| Russell Road Property | City of North Muskegon | 35.3 Acres |
| Ross Park | City of Norton Shores | 43 Acres |
| Lake Harbor Park | City of Norton Shores | 189 Acres |
| Park Name | Ownership | Acres |

| | | |
|----------------------------------|---------------------------|------------|
| Black Lake Park | City of Norton Shores | 58 Acres |
| Hidden Cove Park | City of Norton Shores | 20 Acres |
| Riverside Park | Muskegon Charter Township | 30.7 Acres |
| Wesley Ave Park | Muskegon Charter Township | 18 Acres |
| Green Creek Park | Laketon Township | 40 Acres |
| Mullally Memorial Park | Laketon Township | 40 Acres |
| Horton Park | Laketon Township | 60.5 Acres |
| Lang Park | Laketon Township | 20.7 Acres |
| Beegle Sports Park | Dalton Township | 25 Acres |
| Equestrian Natural Area | Dalton Township | 240 Acres |
| Fruitland Township Park | Fruitland Township | 36 Acres |
| Holton Township Park | Holton Township | 74 Acres |
| South Fruitport Park (Parr Park) | Fruitport Township | 20 Acres |
| Pine Park | Fruitport Township | 23 Acres |
| Sheringer Soccer Park | Fruitport Township | 20 Acres |
| Clear Springs Nature Preserve | Montague Township | 100 Acres |
| Henderson Road Nature Center | Montague Township | 163 Acres |
| Montague Township Park | Montague Township | 15 Acres |

In addition to the public parks, within the public forest land, there are 14 well known trail systems utilized recreationally. These trail systems include:

| Trail Name | Trail Length | Location |
|---|--------------|----------------------------|
| Dune Ridge Trail | 4.6 Miles | Muskegon State Park |
| Muskegon Lakeshore Trail | 12.0 Miles | Muskegon, Michigan |
| Homestead Trail | 2.2 Miles | P.J. Hoffmaster State Park |
| Walk-a-Mile Trail | 1.7 Miles | P.J. Hoffmaster State Park |
| Honeymoon Trail | 1.1 Miles | P.J. Hoffmaster State Park |
| Homestead Trail and North Dunes Loop | 3.2 Miles | P.J. Hoffmaster State Park |
| Dune Climb Stairway | 4.1 Miles | P.J. Hoffmaster State Park |
| Lost Lake Trail | 4.5 Miles | Muskegon State Park |
| Mosquito Creek the Faz Track | 2.7 Miles | Muskegon, Michigan |
| Muskegon Winter Sports Complex Loop | 2.5 Miles | Muskegon State Park |
| The Matrix Loop | 4.9 Miles | Muskegon, Michigan |
| Lake Harbor Park Loop | 2.6 Miles | Lake Harbor Park |
| Hearty Hiker Trail and Lost Lake Loop | 3.6 Miles | Muskegon State Park |
| The Fax Track, The Matrix, and Saint's Loop | 10.8 Miles | Muskegon, Michigan |

<https://www.alltrails.com/us/michigan/muskegon/forest>

<https://www.visitmuskegon.org/things-to-do/outdoors/hiking-biking-trails/>

Agriculture

Agriculture began in Muskegon County in about 1845 by the early lumberjacks. As the land was cleared, farms were established but many of them were soon abandoned because the soils were sandy. Growing food for home use was the main concern of the first farmers. Agriculture was stimulated by the influx of settlers and by the building of roads and railroads. Farms increased in number and by 1870 there was a surplus of crops that could be sold outside the county.

According to the 2017 Census of Agriculture, 63,182 acres or about 25% of land in the county was farmland, up 8% from the 2002 Census when 73,918 acres was used as farmland. 72.99% or 58,146.02 acres of farmland was cropland (includes five components: cropland harvested, crop failure, cultivated summer fallow, cropland used only for pasture, and idle cropland), 13.47% or 10,730.61 acres was woodland, and 13.55% or 10,794.34 acres was used for other uses (wetlands, rural residential land, or land generally of low value for agricultural purposes). Of the 58,146.02 acres used for cropland, 43,994 acres were used for corn for grain, forage (land used for all hay and haylage, grass silage, and greenchop), corn for silage, soybeans for beans, and wheat for grain.

Milk and dairy products; fruits, tree nuts, and berries; vegetables, melons, potatoes, and sweet potatoes; and grains, oilseeds, dry beans, and dry peas are also important parts of the agriculture in the county.

*Table 6: Change in Agriculture-Farmstead Land Use and Farm Size
Source: 2017 Census of Agriculture*

| AGRICULTURE-FARMSTEAD LAND USE | 2017 | 2012 | 2007 | 2002 | 1997 | % Change |
|---------------------------------------|-------------|-------------|-------------|-------------|-------------|-----------------|
| Total Number of Farms | 476 | 923 | 951 | 902 | 787 | -7% |
| Total Number of Acres | 63,182 | 125,663 | 133,403 | 135,422 | 131,779 | -15% |
| | | | | | | |
| Total Cropland (Farms) | 704 | 757 | 812 | 813 | 739 | -4.7% |
| Total Cropland (Acres) | 96,749 | 83,384 | 89,457 | 93,491 | 94,890 | 2.0% |
| | | | | | | |
| Total Harvested Cropland (Farms) | 620 | 670 | 649 | 689 | 663 | -6.5% |
| Total Harvested Cropland (Acres) | 86,982 | 76,076 | 74,516 | 72,732 | 74,140 | 17.3% |
| | | | | | | |
| Total Grazing Land (Farms) | 98 | 81 | 206 | 364 | 372 | -73.7% |
| Total Grazing Land (Acres) | 11,982 | 1,632 | 4,907 | 9,607 | 11,257 | 6.4% |
| | | | | | | |
| Average Size of Farm in Acres | 133 | 136 | 140 | 150 | 167 | -8% |

Historic Sites and Districts

According to the National Park Service, the National Register of Historic Places is the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources. To be considered eligible, a property must meet the National Register Criteria for Evaluation. This involves examining the property's age, integrity, and significance. The following are considered during evaluation:

- Is the property old enough to be considered historic (generally at least 50 years old)
- Does the property still look much the way it did in the past?
- Is the property associated with events, activities, or developments that were important in the past?
- Is the property associated with the lives of people who were important in the past?
- Is the property associated with significant architectural history, landscape history, or engineering achievements?
- Does the property have the potential to yield information through archeological investigation about our past?

Within Muskegon County there are a number of properties listed on the National Register of Historic Places and several historic sites in Muskegon County.

| National Register of Historic Places in Muskegon County | | | | |
|---|--|-----------------------------------|--|--------------|
| | Name on Register | Date Listed | Location | City or Town |
| 1 | Amazon hosiery mill | April 15, 1982 (#82002857) | 530-550 W. Western Ave. 43°14'01"N 86°15'25"W | Muskegon |
| 2 | Central Fire Station | March 18, 1999 (#99000341) | 75 W. Walton Ave. 43°14'04"N 86°14'44"W | |
| 3 | Charles H. Hackley House | July 8, 1970 (#70000282) | 484 W. Webster Ave. 43°13'53"N 86°15'32"W | Muskegon |
| 4 | Horatio N. Hovey House | September 8, 1983 (#83000887) | 318 Houston Ave. 43°13'53"N 86°15'05"W | Muskegon |
| 5 | Hume House | January 13, 1972 (#72000646) | 472 W. Webster Ave. 43°13'53"N 86°15'32"W | Muskegon |
| 6 | John C. and Augusta (Covell) Lewis House | December 13, 2010 (#10001027) | 324 S. Mears Ave. 43°24'25"N 86°20'52"W | Whitehall |
| 7 | Muskegon Historic District | September 27, 1972 (#72000647) | Bounded roughly by Clay, Muskegon, 2nd, and 6th Sts. 43°14'00"N 86°15'15"W | Muskegon |
| 8 | Muskegon South Breakwater Light | November 15, 2006 (#06001026) | At south breakwater end in Lake Michigan, 0.4 mi (0.64 km). SW of Muskegon Lake entry channel 43°13'26"N 86°20'48"W | Muskegon |
| 9 | Muskegon South Pierhead Light | February 14, 2006 (#06000036) | Southern pier of the Muskegon Lake entrance channel at Lake Michigan, 500 ft (150 m) from shore 43°13'36"N 86°20'29"W | Muskegon |

| | | | | |
|----|--|---------------------------------|--|-------------------|
| 10 | Muskegon YMCA Building | August 11, 1982 (#82002858) | 297 W. Clay Ave. 43°14'07"N 86°15'02"W | Muskegon |
| 11 | Navigational Structures at White Lake Harbor | May 26, 2000 (#00000535) | Southern end of Lau Rd. 43°22'31"N 86°25'34"W | Whitehall |
| 12 | Spring Creek Site | June 20, 1972 (#72001475) | Address restricted | Egelston Township |
| 13 | SS Clipper | December 8, 1983 (#83003570) | 2098 Lakeshore Dr.[6] 43°13'18"N 86°17'45"W | Muskegon |
| 14 | U.S.S. Silversides | October 18, 1972 (#72000453) | Naval Reserve Center, Fulton and Bluff Sts.  43°13'39"N 86°20'19"W | Muskegon |
| 15 | Union Depot | December 7, 2000 (#00001489) | 610 Western Ave.  43°13'59"N 86°15'28"W | Muskegon |

List of Michigan State Historic Sites in Muskegon County

| | Name on Register | Date Listed | Location | City or Town |
|--|---|-------------------|---|----------------|
| | Bluffton Actors Colony | September | 3428 Lakeshore Drive | Muskegon |
| | Central United Methodist Church | May 18, 1989 | 1011 Second Street | Muskegon |
| | Duquette-Carlson Market | January 27, 1983 | 585 Clay | Muskegon |
| | Evergreen Cemetery | August 21, 1987 | Bounded by Grand, Wood, Pine, and Irvin Streets | Muskegon |
| | Ferry Memorial Church | August 21, 1987 | 8637 Old Channel Trail | Montague |
| | Fruitland District No. 6 School | April 18, 1991 | 6227 South Shore Road | Whitehall |
| | Hackley Public Library | February 15, 1990 | 316 West Webster | Muskegon |
| | Hackley House | April 24, 1970 | (see previous list) | |
| | Hackley-Holt House | February 15, 1990 | 523 West Clay Avenue | Muskegon |
| | Horatio N. Hovey house | July 20, 1982 | (see previous list) | Muskegon |
| | Hume House | August 13, 1971 | (see previous list) | Muskegon |
| | Jean Baptiste Trading Post (Info site sign) | August 3, 1979 | 310 Ruddiman Road | North Muskegon |
| | Lakeside Info Site | August 18, 2004 | 1723 Lakeshore Drive | Muskegon |
| | Lebanon Lutheran Church | February 10, 1983 | 1101 South Mears Avenue | Whitehall |
| | Lumbering on White Lake (info site sign) | August 8, 2006 | 310 Thompson Street | Whitehall |
| | Marsh Field | 2003 | 1800 Peck St | Muskegon |
| | Michigan Theatre Building | April 4, 1978 | 407 West Western Avenue | Muskegon |
| | Mouth Cemetery | November 1, 1988 | 6666 Sunset Lane | Montague |
| | Muskegon Historic District | October 29, 1971 | Bounded roughly by Clay, Muskegon, 2nd, and 6th | Muskegon |
| | Muskegon Log Booming Company (site sign) | August 23, 1956 | 44 Ottawa Street | Muskegon |
| | Muskegon Women's Club | September 3, 1998 | 280 Webster Avenue | Muskegon |
| | Muskegon State Park | July 26, 2009 | 462 North Scenic Drive | Muskegon |

| | | | | |
|--|--|--------------------|----------------------------------|-----------|
| | Old Indian Cemetery | June 13, 1961 | 351 Morris Avenue | Muskegon |
| | Pinchtown (site sign) | April 11, 1991 | 1543 Lake Shore Drive | Muskegon |
| | Lafayette G Ripley House | January 27, 1983 | 8543 Old Channel Trail | Montague |
| | Staples and Covell Mill (site sign) | August 8, 2006 | 310 Thompson Street | Whitehall |
| | Ruth Thompson (info sign) | September 23, 1993 | City Hall, 405 East Colby Street | Whitehall |
| | Torrent House | June 19, 1971 | 315 West Webster | Muskegon |
| | Twin Lake Methodist Church | March 11, 2012 | 5940 Main Street | Twin Lake |
| | Union Depot | May 17, 1978 | 610 Western Avenue | Muskegon |
| | Whipple's Castle | February 22, 1974 | 495 North main | Casnovia |
| | White Lake Yacht Club | August 8, 2006 | 6770 S. Shore Drive | Whitehall |

Parks and Recreation

Muskegon County is County is blessed with many outdoor recreation opportunities, such as State and Federal forests, recreation opportunities provided by local units of government, privately owned recreation opportunities from both commercial providers and individual households and conservancy-owned natural areas. The following is a list of campgrounds in Muskegon County.

| Name of Establishment | Address | City, State, Zip | Number of Sites |
|--------------------------------------|-----------------------------|-------------------------|------------------------|
| Blue Lake County Park | 10701 Nichols Road | Holton, MI 49445 | 25 |
| Camp Lor Ray (Mike Brenner) | 5281 Russell Rd | Twin Lake, MI 49457 | 30 |
| Crockery Creek RV Park | 13812 Apple Ave | Ravenna, MI 49451 | 121 + cabins |
| Duck Creek RV Resort | 1155 W. Riley Thompson Road | Muskegon, MI 49445 | 179 |
| Fisherman's Landing | 501 E Western Ave | Muskegon, MI 49442 | 105 |
| Johnsons Trailer Resort | 8191 Meinert Park Road | Montague, MI 49437 | 86 |
| Lake Sch Nepp A Ho | 390 East Tyler Road | Muskegon, MI 49445 | 100 |
| Muskegon County Fairgrounds | 6621 Heights Ravenna Rd | Fruitport, MI 49451 | unk |
| Trailway Campground | 4540 Dowling St | Montague, MI 49437 | 53 |
| Maranatha | 4759 Lake Harbor Road | Muskegon, MI 49441 | unk |
| Muskegon Elks Campground #274 | 513 W. Pontaluna Rd. | Muskegon, MI 49444 | unk |
| Muskegon KOA Campground | 3500 North Strand | Muskegon, MI 49445 | 96+ |
| Oak Knoll Family Campground | 1522 Fruitvale Road | Holton, MI 49425 | 55 |
| Meinert County Park/Pines Campground | 1563 Scenic Drive | Muskegon, MI 49445 | 67 |
| Pioneer County Park | 1563 Scenic Drive | Muskegon, MI 49445 | 235 |
| White River Campground | 735 Fruitvale Road | Montague, MI 49437 | 498 + cabins |
| Wolf Lake Apartments and Resort | 5451 Harding | Muskegon, MI 49442 | 85 |
| Muskegon State Park | 3560 Memorial Drive | N.Muskegon, MI 49445 | 138 |

| | | | |
|---------------------------|-----------------------|--------------------|-----|
| P J Hoffmaster State Park | 6585 Lake Harbor Road | Muskegon, MI 49441 | 290 |
|---------------------------|-----------------------|--------------------|-----|

For information on things to do in Muskegon County, Muskegon County Convention and Visitors Bureau <https://www.visitmuskegon.org/>. For camping and parks <https://muskegoncountyparks.org/>.

Muskegon County Campgrounds



Anticipated Land Use

The Muskegon County Comprehensive Plan serves as the primary policy guide for local officials considering development proposals, land divisions, capital improvements, and other matters related to land use and development; thus, it provides a stable and consistent basis for decision-making. The county does not enforce any county zoning ordinances leaving much of the land use decisions up to the individual townships and Cities. All 27 local units of government in Muskegon County have an active Land Use/Master Plan and Zoning Ordinance in place

Potential Land Use Conflicts and Known Hazards

Like most communities Muskegon County does have several unique situations that present hazards or land use conflicts. Several should be noted:

- The Cities within Muskegon County, Montague, Muskegon, Muskegon Heights, North Muskegon, Norton Shores, Roosevelt Park, and Whitehall have industry located near retail and residential areas. Although the communities have not had recent significant instances where an unacceptable release of chemicals has occurred, there is a potential to affect a substantial number of residences should an unacceptable release occur.
- M-120, and M-46 are east-west transportation routes I-96 runs between US-31 in Muskegon through Grand Rapids to Detroit. US-31 is a major north-south transportation route that runs from Holland through Muskegon and north to Mackinaw City. In addition to privately operated vehicles, these roads are traveled by commercial truck traffic carrying many different types of hazardous materials.
- The CSX and Genesee & Wyoming Railroad lines run through Grand Haven (Ottawa County), through the heart of Muskegon County and North to Fremont (Newaygo County).
- Muskegon County has many water resources and flooding problems. The three major lakes, inlets of Lake Michigan, are Muskegon Lake, Mona Lake, and White Lake. Many other lakes, mostly north of the Muskegon River, provide areas for homes, recreation, youth camps, and other recreational facilities. Lakes and ponds in the county cover 11,453 acres. The City of Muskegon is also home to West Michigan's largest commercial deep-water port. Many portions of these areas have structures and critical infrastructure within the flood plains of these rivers.
- The eastern shore of Lake Michigan is one of the most agriculturally dense regions of the country. With agriculture playing a major role in Muskegon County, first responders to incidents on farms or food packing and processing facilities may not be aware of potential chemical hazards.

Public Infrastructure

Public infrastructure is addressed in greater detail under Key Community Facilities/Organizations.

Housing Stock

Muskegon County has a total of 74, 867 housing units. Owner-occupied units comprised 75%. The housing profile of the county is much different than that of the state. Compared to the state as a whole, the county has a slightly higher level of homeownership, however major differences should be noted in the percentage of mobile homes and trailers, the percentage of vacant, the age of the home, and home values. The higher percentage of mobile homes versus multiple family housing or apartments creates the potential for additional hazards due to mobile homes being more susceptible to certain types of weather damage related to wind damage from storms or damage from hail. Another important figure to take note of is the difference of vacant housing units between Muskegon County and the State. Muskegon County has approximately 10% of its available housing units vacant compared to Michigan's 14.6%. The following data is from the 2020 US Census converted by Census Reporter.

*Table 7, Housing Data, Muskegon County and the State of Michigan
Sources: Median Values and raw housing data taken from the 2020 U.S. Census*

| HOUSING SUBJECT | Muskegon County | | Michigan | |
|--------------------------------------|------------------------|-------------------|------------------|-------------------|
| | Total | Percentage | Total | Percentage |
| Total Number of Housing Units | 74,867 | 100% | 4,590,528 | 100% |
| Occupied Housing Units | 67,380 | 90% | 3,872,508 | 88.0% |
| Owner-Occupied Housing | 57,512 | 76% | 2,793,342 | 72.2% |
| Renter-Occupied Housing Units | 18,717 | 25% | 1,079,166 | 28.4% |
| Vacant Housing Units | 7,487 | 10% | 659,725 | 5.6% |
| Seasonal or Recreational Units | No data | No data | 263,071 | 5.8% |
| Units in Structure | | | | |
| 1-unit detached | 54,236 | 72.4% | 2,988,818 | 70.6% |
| 2 units or more | 2,114 | 2.8% | 146,414 | 3.9% |
| 3 or 4 units | 2,032 | 2.7% | 118,067 | 2.8% |
| 5 to 9 units | 2,426 | 3.2% | 169,946 | 4.0% |
| 10 to 19 units | 2,139 | 3.0% | 144,848 | 3.4% |
| 20 to 49 units | 1,144 | 1.6% | 237,482 | 5.2% |
| 50 or more | 2,528 | 3.6% | No data | No data |
| Mobile Home | 5,653 | 7.7% | 277,158 | 6.5% |
| Boat, RV, Van, etc. | No data | No data | 7,545 | 0.2% |

Chart from [CensusReporter.org/profiles](https://censusreporter.org/profiles) raw data converted from the 2020 Census

Housing Data, Muskegon County and the State of Michigan
Units & Occupancy

74,867

Number of housing units

Michigan: 4,590,384

United States: 142,148,050

Occupied vs. Vacant



Ownership of occupied units



Show data / Embed

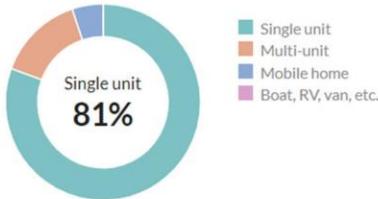
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|----------|-------------------|-------|---------------|----------|-------|-------------------|---------------|-------|---------------------|
| Occupied | 90.4% | ±1.7% | 67,707 ±1,344 | 88.3% | ±0.2% | 4,051,798 ±10,574 | 89.7% | ±0.1% | 127,544,730 ±97,632 |
| Vacant | 9.6% [†] | ±1.8% | 7,160 ±1,331 | 11.7% | ±0.2% | 538,586 ±10,625 | 10.3% | ±0.1% | 14,603,320 ±99,060 |

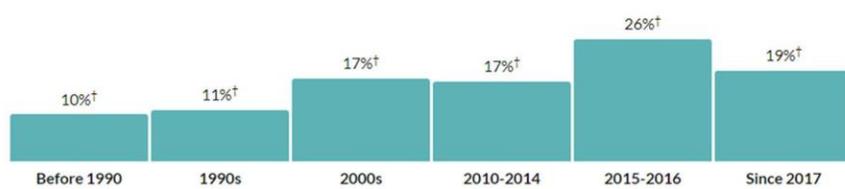
Hide data

Types of structure



Show data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|---------------------|--------------------|-------|-----------------|-----------------|-------|---------------------|---------------|-------|-----------------------|
| Single unit | 80.6% | ±2.3% | 60,332 ±1,761.6 | 76.9% | ±0.3% | 3,529,539 ±15,455.3 | 68% | ±0.1% | 96,627,903 ±128,445.3 |
| Multi-unit | 14.3% [†] | ±2.2% | 10,726 ±1,644 | 17.9% | ±0.3% | 823,550 ±14,785.4 | 26.3% | ±0.1% | 37,345,466 ±112,752.1 |
| Mobile home | 5.1% [†] | ±0.9% | 3,809 ±689 | 5.1% | ±0.1% | 235,720 ±6,543 | 5.6% | ±0% | 8,008,783 ±51,597 |
| Boat, RV, van, etc. | 0% | ±0% | 0 ±181 | 0% [†] | ±0% | 1,575 ±605 | 0.1% | ±0% | 165,894 ±8,067 |

Value

Chart from censusreporter.org/profiles raw data converted from the 2020 Census

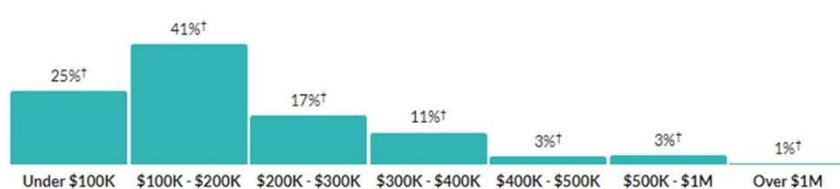
\$165,500

Median value of owner-occupied housing units

about 80 percent of the amount in Michigan:
\$199,100

about three-fifths of the amount in United States:
\$281,400

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|-----------------|--------------------|-------|-----------------|-------------------|-------|-------------------|---------------|-------|----------------------|
| Under \$100K | 24.9% [†] | ±3.1% | 12,684 ±1,642.7 | 20.2% | ±0.4% | 598,809 ±11,703.4 | 13.9% | ±0.1% | 11,604,129 ±59,366 |
| \$100K - \$200K | 40.9% [†] | ±4.1% | 20,798 ±2,224.6 | 30.1% | ±0.4% | 891,802 ±13,242.6 | 20% | ±0.1% | 16,705,771 ±68,694.1 |
| \$200K - \$300K | 16.8% [†] | ±2.3% | 8,535 ±1,220.8 | 23% | ±0.4% | 683,100 ±11,068.8 | 19.5% | ±0.1% | 16,283,130 ±73,915 |
| \$300K - \$400K | 11% [†] | ±2.3% | 5,574 ±1,162 | 12.6% | ±0.3% | 372,950 ±7,853 | 14.9% | ±0.1% | 12,419,326 ±58,191 |
| \$400K - \$500K | 2.7% [†] | ±0.9% | 1,376 ±459 | 6.5% | ±0.2% | 193,724 ±5,934 | 9.6% | ±0.1% | 8,036,844 ±48,498 |
| \$500K - \$1M | 3.1% [†] | ±0.9% | 1,593 ±461.2 | 6.5% | ±0.2% | 192,293 ±6,164.9 | 17% | ±0.1% | 14,149,578 ±60,705.5 |
| Over \$1M | 0.6% [†] | ±0.4% | 290 ±201 | 0.6% [†] | ±0.1% | 19,000 ±2,158 | 2.7% | ±0% | 2,272,758 ±25,636 |

Housing Data, City of Muskegon, and Muskegon County

Units & Occupancy

16,031

Number of housing units

the Muskegon, MI Metro Area: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Show data / Embed

Ownership of occupied units



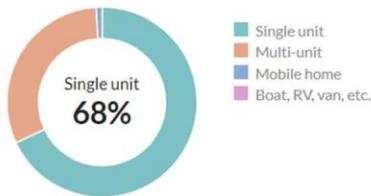
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | Muskegon | | | Muskegon, MI Metro Area | | | Michigan | | |
|----------|--------------------|-------|-------------|-------------------------|-------|-------------|----------|-------|------------------|
| Occupied | 85.9% | ±2.3% | 13,776 ±608 | 88.8% | ±0.9% | 66,122 ±684 | 87.1% | ±0.2% | 3,976,729 ±8,287 |
| Vacant | 14.1% [†] | ±1.8% | 2,255 ±306 | 11.2% | ±0.9% | 8,325 ±649 | 12.9% | ±0.2% | 589,775 ±7,752 |

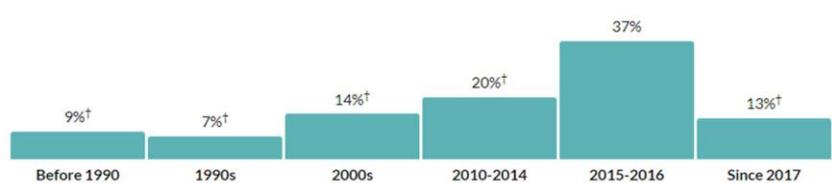
Hide data

Types of structure



Show data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Muskegon | | | Muskegon, MI Metro Area | | | Michigan | | |
|---------------------|--------------------|-------|---------------|-------------------------|-------|---------------|-----------------|-------|------------------|
| Single unit | 68% | ±1.7% | 10,896 ±470.3 | 79.7% | ±1.1% | 59,352 ±861.8 | 76.8% | ±0.2% | 3,506,070 ±7,449 |
| Multi-unit | 31.1% [†] | ±3.2% | 4,978 ±534.5 | 13.2% | ±0.9% | 9,851 ±702.1 | 18% | ±0.2% | 823,992 ±6,998.7 |
| Mobile home | 1% [†] | ±0.6% | 157 ±91 | 7% | ±0.6% | 5,244 ±480 | 5.2% | ±0.1% | 235,036 ±3,566 |
| Boat, RV, van, etc. | 0% | ±0% | 0 ±23 | 0% | ±0% | 0 ±26 | 0% [†] | ±0% | 1,406 ±252 |

Hide data

Charts from Censusreporter.org/profiles raw data converted from the 2020 Census

Value

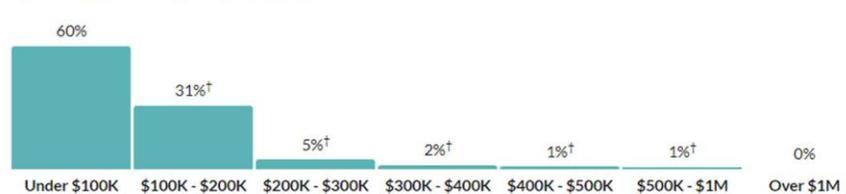
\$84,300

Median value of owner-occupied housing units

about three-fifths of the amount in the Muskegon, MI Metro Area: \$138,700

about half the amount in Michigan: \$172,100

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Muskegon | | | Muskegon, MI Metro Area | | | Michigan | | |
|-----------------|--------------------|-------|--------------|-------------------------|-------|---------------|----------|-------|------------------|
| Under \$100K | 60.2% | ±5% | 4,212 ±434.3 | 31.8% | ±1.7% | 16,154 ±895 | 24.6% | ±0.2% | 707,432 ±5,864.6 |
| \$100K - \$200K | 31.1% [†] | ±4.3% | 2,175 ±330.7 | 43.1% | ±1.6% | 21,889 ±882.6 | 33.5% | ±0.2% | 961,608 ±6,710.2 |
| \$200K - \$300K | 4.5% [†] | ±1.3% | 316 ±96 | 14.2% | ±1.1% | 7,198 ±581.1 | 21% | ±0.2% | 602,204 ±5,618 |
| \$300K - \$400K | 1.9% [†] | ±0.8% | 135 ±55 | 6.4% [†] | ±0.9% | 3,232 ±440 | 10.4% | ±0.1% | 298,236 ±3,413 |
| \$400K - \$500K | 1.2% [†] | ±0.6% | 87 ±42 | 2% [†] | ±0.5% | 989 ±250 | 4.8% | ±0.1% | 138,614 ±3,024 |
| \$500K - \$1M | 0.9% [†] | ±0.8% | 64 ±55.5 | 2% [†] | ±0.4% | 1,018 ±207 | 4.8% | ±0.1% | 136,250 ±2,449 |
| Over \$1M | 0% | ±0% | 0 ±23 | 0.5% [†] | ±0.2% | 238 ±109 | 0.5% | ±0% | 14,482 ±780 |

Housing Data, Muskegon Heights and Muskegon County

Units & Occupancy

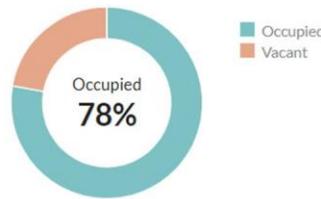
4,582

Number of housing units

the Muskegon, MI Metro Area: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Ownership of occupied units



Show data / Embed

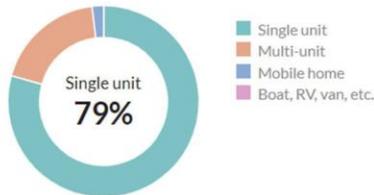
Show data / Embed

Ownership of occupied units (Table B25003) [View table](#)

| Column | Muskegon Heights | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|-----------------|------------------|-------|-------------------------|------|----------|-------|--------|------|-------|-------|-----------|---------|
| Owner occupied | 52.3%† | ±6.3% | 1,867 | ±258 | 76.8% | ±1% | 50,803 | ±840 | 72.2% | ±0.3% | 2,870,693 | ±11,561 |
| Renter occupied | 47.7%† | ±7.5% | 1,700 | ±293 | 23.2% | ±1.1% | 15,319 | ±767 | 27.8% | ±0.2% | 1,106,036 | ±6,260 |

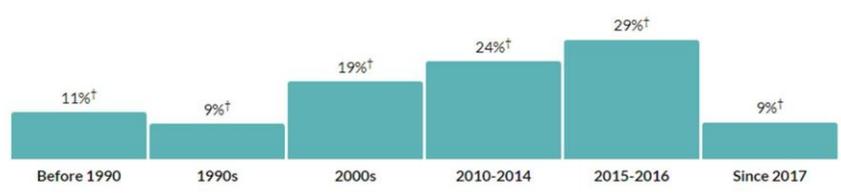
Hide data

Types of structure



Show data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Muskegon Heights | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|---------------------|------------------|-------|-------------------------|--------|----------|-------|--------|--------|-------|-------|-----------|----------|
| Single unit | 79.4% | ±3.5% | 3,636 | ±257.8 | 79.7% | ±1.1% | 59,352 | ±861.8 | 76.8% | ±0.2% | 3,506,070 | ±7,449 |
| Multi-unit | 18.7%† | ±4.5% | 858 | ±210.5 | 13.2% | ±0.9% | 9,851 | ±702.1 | 18% | ±0.2% | 823,992 | ±6,998.7 |
| Mobile home | 1.9%† | ±1% | 88 | ±46 | 7% | ±0.6% | 5,244 | ±480 | 5.2% | ±0.1% | 235,036 | ±3,566 |
| Boat, RV, van, etc. | 0% | ±0% | 0 | ±17 | 0% | ±0% | 0 | ±26 | 0%† | ±0% | 1,406 | ±252 |

Charts from Censusreporter.org/profiles raw data converted from the 2020 Census

Value

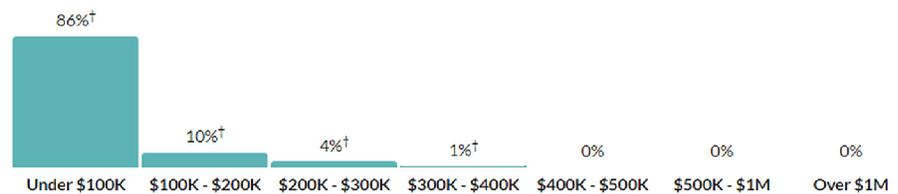
\$45,500

Median value of owner-occupied housing units

about one-third of the amount in the Muskegon, MI Metro Area: \$138,700

about one-quarter of the amount in Michigan: \$172,100

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Muskegon Heights | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|-----------------|------------------|-------|-------------------------|--------|----------|-------|--------|--------|-------|-------|---------|----------|
| Under \$100K | 85.7%† | ±9.6% | 1,599 | ±284.5 | 31.8% | ±1.7% | 16,154 | ±895 | 24.6% | ±0.2% | 707,432 | ±5,864.6 |
| \$100K - \$200K | 9.8%† | ±4.4% | 182 | ±85.8 | 43.1% | ±1.6% | 21,889 | ±882.6 | 33.5% | ±0.2% | 961,608 | ±6,710.2 |
| \$200K - \$300K | 3.8%† | ±2.4% | 71 | ±45.3 | 14.2% | ±1.1% | 7,198 | ±581.1 | 21% | ±0.2% | 602,204 | ±5,618 |
| \$300K - \$400K | 0.8%† | ±1% | 15 | ±19 | 6.4%† | ±0.9% | 3,232 | ±440 | 10.4% | ±0.1% | 298,236 | ±3,413 |
| \$400K - \$500K | 0% | ±0% | 0 | ±17 | 2%† | ±0.5% | 989 | ±250 | 4.8% | ±0.1% | 138,614 | ±3,024 |
| \$500K - \$1M | 0% | ±0% | 0 | ±24 | 2%† | ±0.4% | 1,018 | ±207 | 4.8% | ±0.1% | 136,250 | ±2,449 |
| Over \$1M | 0% | ±0% | 0 | ±17 | 0.5%† | ±0.2% | 238 | ±109 | 0.5% | ±0% | 14,482 | ±780 |

Housing Data, North Muskegon and Muskegon County

Units & Occupancy

1,894

Number of housing units

the Muskegon, MI Metro Area: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Show data / Embed

Ownership of occupied units



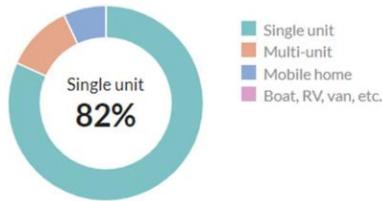
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | North Muskegon | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|----------|----------------|-------|-------------------------|------|----------|-------|--------|------|-------|-------|-----------|--------|
| Occupied | 85.5% | ±3.4% | 1,619 | ±158 | 88.8% | ±0.9% | 66,122 | ±684 | 87.1% | ±0.2% | 3,976,729 | ±8,287 |
| Vacant | 14.5%† | ±6% | 275 | ±116 | 11.2% | ±0.9% | 8,325 | ±649 | 12.9% | ±0.2% | 589,775 | ±7,752 |

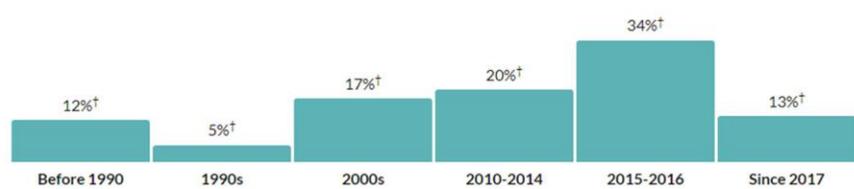
Hide data

Types of structure



Show data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | North Muskegon | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|-------------|----------------|-------|-------------------------|--------|----------|-------|--------|--------|-------|-------|-----------|----------|
| Single unit | 81.8% | ±6.5% | 1,549 | ±185.3 | 79.7% | ±1.1% | 59,352 | ±861.8 | 76.8% | ±0.2% | 3,506,070 | ±7,449 |
| Multi-unit | 11.2%† | ±4.4% | 212 | ±86.1 | 13.2% | ±0.9% | 9,851 | ±702.1 | 18% | ±0.2% | 823,992 | ±6,998.7 |

Value

Charts from [Censusreporter.org/profiles](https://www.censusreporter.org/profiles) raw data converted from the 2020 Census

\$186,200

Median value of owner-occupied housing units

about 1.3 times the amount in the Muskegon, MI Metro Area: \$138,700

about 10 percent higher than the amount in Michigan: \$172,100

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | North Muskegon | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|-----------------|----------------|-------|-------------------------|--------|----------|-------|--------|--------|-------|-------|---------|----------|
| Under \$100K | 11.7%† | ±6.5% | 154 | ±88.3 | 31.8% | ±1.7% | 16,154 | ±895 | 24.6% | ±0.2% | 707,432 | ±5,864.6 |
| \$100K - \$200K | 41.1%† | ±9.1% | 541 | ±137.5 | 43.1% | ±1.6% | 21,889 | ±882.6 | 33.5% | ±0.2% | 961,608 | ±6,710.2 |
| \$200K - \$300K | 20.4%† | ±6.9% | 268 | ±96.4 | 14.2% | ±1.1% | 7,198 | ±581.1 | 21% | ±0.2% | 602,204 | ±5,618 |
| \$300K - \$400K | 10.4%† | ±4.4% | 137 | ±61 | 6.4%† | ±0.9% | 3,232 | ±440 | 10.4% | ±0.1% | 298,236 | ±3,413 |
| \$400K - \$500K | 4.9%† | ±3% | 64 | ±40 | 2%† | ±0.5% | 989 | ±250 | 4.8% | ±0.1% | 138,614 | ±3,024 |
| \$500K - \$1M | 11.6%† | ±4.6% | 153 | ±63.6 | 2%† | ±0.4% | 1,018 | ±207 | 4.8% | ±0.1% | 136,250 | ±2,449 |
| Over \$1M | 0% | ±0% | 0 | ±11 | 0.5%† | ±0.2% | 238 | ±109 | 0.5% | ±0% | 14,482 | ±780 |

Housing Data, Norton Shores and Muskegon County

Units & Occupancy

10,576

Number of housing units

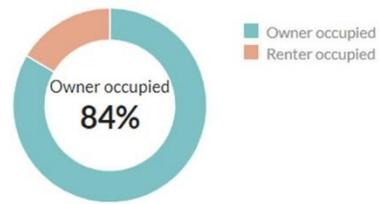
Muskegon County: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Ownership of occupied units



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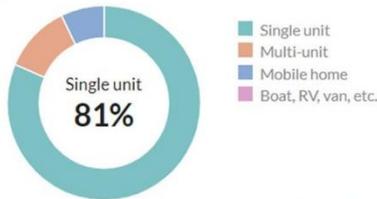
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | Norton Shores | | Muskegon County | | Michigan | |
|----------|-------------------------|------------|-----------------|-------------|-------------|------------------|
| Occupied | 90.3% ±1.3% | 9,551 ±340 | 88.8% ±0.9% | 66,122 ±684 | 87.1% ±0.2% | 3,976,729 ±8,287 |
| Vacant | 9.7% [†] ±2.3% | 1,025 ±246 | 11.2% ±0.9% | 8,325 ±649 | 12.9% ±0.2% | 589,775 ±7,752 |

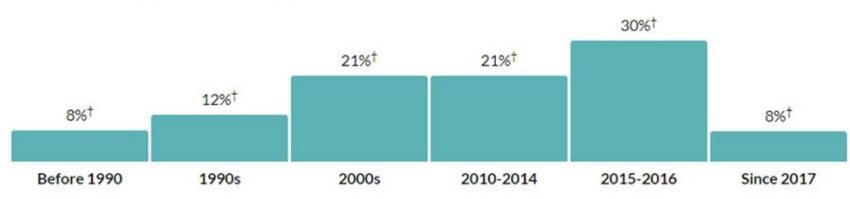
Hide data

Types of structure



Hide data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Norton Shores | | Muskegon County | | Michigan | |
|---------------------|-------------------------|--------------|-----------------|---------------|---------------------|------------------|
| Single unit | 81.5% ±2% | 8,617 ±349.9 | 79.7% ±1.1% | 59,352 ±861.8 | 76.8% ±0.2% | 3,506,070 ±7,449 |
| Multi-unit | 11.3% [†] ±2% | 1,195 ±219.5 | 13.2% ±0.9% | 9,851 ±702.1 | 18% ±0.2% | 823,992 ±6,998.7 |
| Mobile home | 7.2% [†] ±1.3% | 764 ±140 | 7% ±0.6% | 5,244 ±480 | 5.2% ±0.1% | 235,036 ±3,566 |
| Boat, RV, van, etc. | 0% ±0% | 0 ±20 | 0% ±0% | 0 ±26 | 0% [†] ±0% | 1,406 ±252 |

Value

\$165,100

Median value of owner-occupied housing units

about 20 percent higher than the amount in Muskegon County: \$138,700

a little less than the amount in Michigan: \$172,100

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Norton Shores | | Muskegon County | | Michigan | |
|-----------------|--------------------------|--------------|-------------------------|---------------|-------------|------------------|
| Under \$100K | 22.3% [†] ±3.2% | 1,777 ±265.3 | 31.8% ±1.7% | 16,154 ±895 | 24.6% ±0.2% | 707,432 ±5,864.6 |
| \$100K - \$200K | 41.7% [†] ±5.1% | 3,326 ±432.1 | 43.1% ±1.6% | 21,889 ±882.6 | 33.5% ±0.2% | 961,608 ±6,710.2 |
| \$200K - \$300K | 19.6% [†] ±3.3% | 1,564 ±275.8 | 14.2% ±1.1% | 7,198 ±581.1 | 21% ±0.2% | 602,204 ±5,618 |
| \$300K - \$400K | 11% [†] ±2.5% | 875 ±202 | 6.4% [†] ±0.9% | 3,232 ±440 | 10.4% ±0.1% | 298,236 ±3,413 |
| \$400K - \$500K | 2.4% [†] ±1.1% | 190 ±86 | 2% [†] ±0.5% | 989 ±250 | 4.8% ±0.1% | 138,614 ±3,024 |
| \$500K - \$1M | 2.3% [†] ±1.2% | 180 ±96.8 | 2% [†] ±0.4% | 1,018 ±207 | 4.8% ±0.1% | 136,250 ±2,449 |
| Over \$1M | 0.5% [†] ±0.3% | 37 ±23 | 0.5% [†] ±0.2% | 238 ±109 | 0.5% ±0% | 14,482 ±780 |

Housing Data, Montague and Muskegon County

Units & Occupancy

1,142

Number of housing units

the Muskegon, MI Metro Area: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Hide data / Embed

Ownership of occupied units



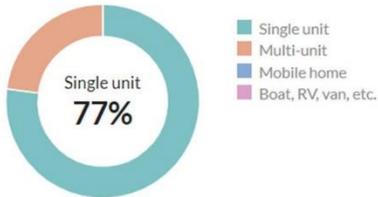
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | Montague | | | Muskegon, MI Metro Area | | | Michigan | | |
|----------|----------|-------|-----------|-------------------------|-------|-------------|----------|-------|------------------|
| Occupied | 88.1% | ±1.8% | 1,006 ±99 | 88.8% | ±0.9% | 66,122 ±684 | 87.1% | ±0.2% | 3,976,729 ±8,287 |
| Vacant | 11.9%† | ±5.6% | 136 ±65 | 11.2% | ±0.9% | 8,325 ±649 | 12.9% | ±0.2% | 589,775 ±7,752 |

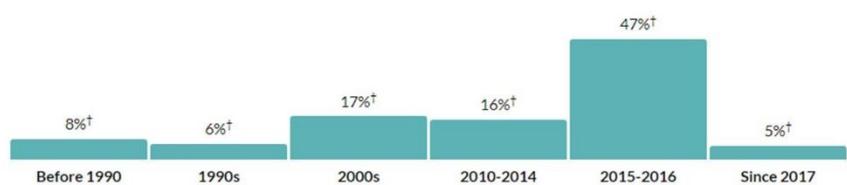
Hide data

Types of structure



Hide data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Montague | | | Muskegon, MI Metro Area | | | Michigan | | |
|---------------------|----------|-------|-----------|-------------------------|-------|---------------|----------|-------|------------------|
| Single unit | 77.1% | ±3.4% | 880 ±93.3 | 79.7% | ±1.1% | 59,352 ±861.8 | 76.8% | ±0.2% | 3,506,070 ±7,449 |
| Multi-unit | 22.9%† | ±7% | 262 ±83.3 | 13.2% | ±0.9% | 9,851 ±702.1 | 18% | ±0.2% | 823,992 ±6,998.7 |
| Mobile home | 0% | ±0% | 0 ±11 | 7% | ±0.6% | 5,244 ±480 | 5.2% | ±0.1% | 235,036 ±3,566 |
| Boat, RV, van, etc. | 0% | ±0% | 0 ±11 | 0% | ±0% | 0 ±26 | 0%† | ±0% | 1,406 ±252 |

Value

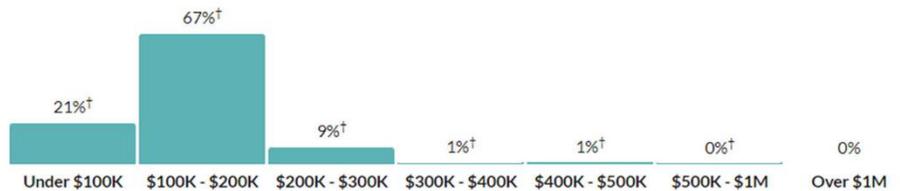
\$141,400

Median value of owner-occupied housing units

about the same as the amount in the Muskegon, MI Metro Area: \$138,700

about 80 percent of the amount in Michigan: \$172,100

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Montague | | | Muskegon, MI Metro Area | | | Michigan | | |
|-----------------|----------|--------|------------|-------------------------|-------|---------------|----------|-------|------------------|
| Under \$100K | 21.2%† | ±6.5% | 154 ±51.3 | 31.8% | ±1.7% | 16,154 ±895 | 24.6% | ±0.2% | 707,432 ±5,864.6 |
| \$100K - \$200K | 66.6%† | ±14.2% | 485 ±121.1 | 43.1% | ±1.6% | 21,889 ±882.6 | 33.5% | ±0.2% | 961,608 ±6,710.2 |
| \$200K - \$300K | 8.7%† | ±3.4% | 63 ±26.2 | 14.2% | ±1.1% | 7,198 ±581.1 | 21% | ±0.2% | 602,204 ±5,618 |
| \$300K - \$400K | 0.6%† | ±1% | 4 ±7 | 6.4%† | ±0.9% | 3,232 ±440 | 10.4% | ±0.1% | 298,236 ±3,413 |
| \$400K - \$500K | 1%† | ±1% | 7 ±7 | 2%† | ±0.5% | 989 ±250 | 4.8% | ±0.1% | 138,614 ±3,024 |
| \$500K - \$1M | 0.4%† | ±1.7% | 3 ±12.1 | 2%† | ±0.4% | 1,018 ±207 | 4.8% | ±0.1% | 136,250 ±2,449 |
| Over \$1M | 0% | ±0% | 0 ±11 | 0.5%† | ±0.2% | 238 ±109 | 0.5% | ±0% | 14,482 ±780 |

Housing Data, Roosevelt Park and Muskegon County

Units & Occupancy

2,008

Number of housing units

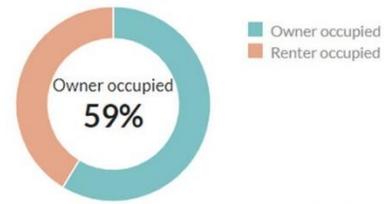
the Muskegon, MI Metro Area: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Ownership of occupied units



Hide data / Embed

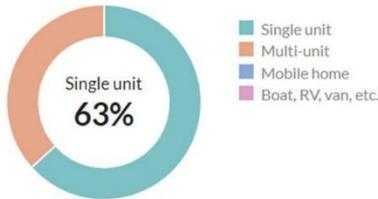
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | Roosevelt Park | | | Muskegon, MI Metro Area | | | Michigan | | |
|----------|----------------|--------|------------|-------------------------|-------------|-------------|------------------|--|--|
| Occupied | 91.9%† | ±11.4% | 1,846 ±148 | 88.8% ±0.9% | 66,122 ±684 | 87.1% ±0.2% | 3,976,729 ±8,287 | | |
| Vacant | 8.1%† | ±6.2% | 162 ±125 | 11.2% ±0.9% | 8,325 ±649 | 12.9% ±0.2% | 589,775 ±7,752 | | |

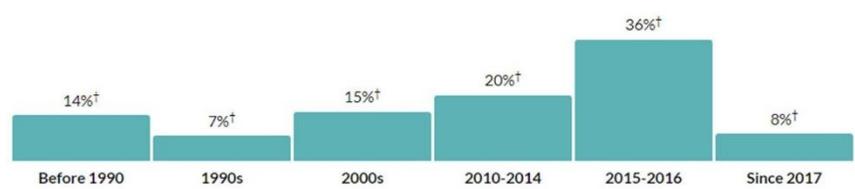
Hide data

Types of structure



Hide data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Roosevelt Park | | | Muskegon, MI Metro Area | | | Michigan | | |
|---------------------|----------------|-------|--------------|-------------------------|---------------|-------------|------------------|--|--|
| Single unit | 63.4% | ±5.9% | 1,272 ±168.3 | 79.7% ±1.1% | 59,352 ±861.8 | 76.8% ±0.2% | 3,506,070 ±7,449 | | |
| Multi-unit | 36.7%† | ±7.1% | 736 ±159 | 13.2% ±0.9% | 9,851 ±702.1 | 18% ±0.2% | 823,992 ±6,998.7 | | |
| Mobile home | 0% | ±0% | 0 ±11 | 7% ±0.6% | 5,244 ±480 | 5.2% ±0.1% | 235,036 ±3,566 | | |
| Boat, RV, van, etc. | 0% | ±0% | 0 ±11 | 0% ±0% | 0 ±26 | 0%† ±0% | 1,406 ±252 | | |

Value

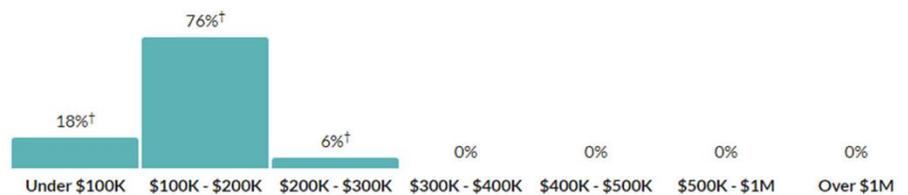
\$133,000

Median value of owner-occupied housing units

a little less than the amount in the Muskegon, MI Metro Area: \$138,700

about three-quarters of the amount in Michigan: \$172,100

Value of owner-occupied housing units



Hide data / Embed

Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Roosevelt Park | | | Muskegon, MI Metro Area | | | Michigan | | |
|-----------------|----------------|--------|------------|-------------------------|---------------|-------------|------------------|--|--|
| Under \$100K | 17.7%† | ±6.8% | 192 ±76.4 | 31.8% ±1.7% | 16,154 ±895 | 24.6% ±0.2% | 707,432 ±5,864.6 | | |
| \$100K - \$200K | 76.1%† | ±14.7% | 824 ±182.8 | 43.1% ±1.6% | 21,889 ±882.6 | 33.5% ±0.2% | 961,608 ±6,710.2 | | |
| \$200K - \$300K | 6.2%† | ±3.6% | 67 ±39.6 | 14.2% ±1.1% | 7,198 ±581.1 | 21% ±0.2% | 602,204 ±5,618 | | |
| \$300K - \$400K | 0% | ±0% | 0 ±11 | 6.4%† ±0.9% | 3,232 ±440 | 10.4% ±0.1% | 298,236 ±3,413 | | |
| \$400K - \$500K | 0% | ±0% | 0 ±11 | 2%† ±0.5% | 989 ±250 | 4.8% ±0.1% | 138,614 ±3,024 | | |
| \$500K - \$1M | 0% | ±0% | 0 ±15.6 | 2%† ±0.4% | 1,018 ±207 | 4.8% ±0.1% | 136,250 ±2,449 | | |
| Over \$1M | 0% | ±0% | 0 ±11 | 0.5%† ±0.2% | 238 ±109 | 0.5% ±0% | 14,482 ±780 | | |

Housing Data, Whitehall and Muskegon County

Units & Occupancy

1,127

Number of housing units

the Muskegon, MI Metro Area: 74,447

Michigan: 4,566,504

Occupied vs. Vacant



Hide data / Embed

Ownership of occupied units



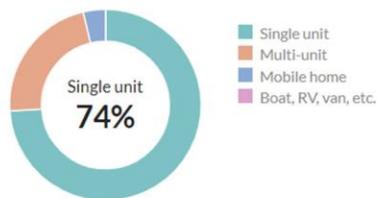
Show data / Embed

Occupied vs. Vacant (Table B25002) [View table](#)

| Column | Whitehall | Muskegon, MI Metro Area | Michigan |
|----------|---------------------------|-------------------------|-------------|
| Occupied | 93.8% [†] ±14.5% | 88.8% ±0.9% | 87.1% ±0.2% |
| Vacant | 6.2% [†] ±4.7% | 11.2% ±0.9% | 12.9% ±0.2% |

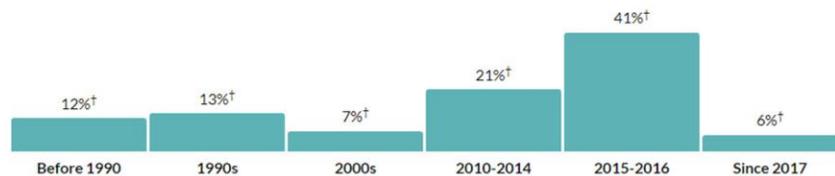
Hide data

Types of structure



Hide data / Embed

Year moved in, by percentage of population



Show data / Embed

Types of structure (Table B25024) [View table](#)

| Column | Whitehall | Muskegon, MI Metro Area | Michigan |
|---------------------|--------------------------|-------------------------|---------------------|
| Single unit | 74% ±6.9% | 79.7% ±1.1% | 76.8% ±0.2% |
| Multi-unit | 22.3% [†] ±5.7% | 13.2% ±0.9% | 18% ±0.2% |
| Mobile home | 3.7% [†] ±3.4% | 7% ±0.6% | 5.2% ±0.1% |
| Boat, RV, van, etc. | 0% ±0% | 0% ±0% | 0% [†] ±0% |

Value

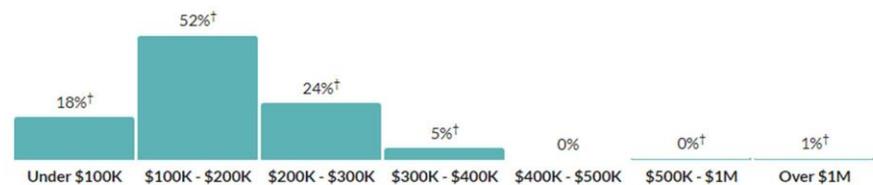
\$169,800

Median value of owner-occupied housing units

about 25 percent higher than the amount in the Muskegon, MI Metro Area: \$138,700

about the same as the amount in Michigan: \$172,100

Value of owner-occupied housing units



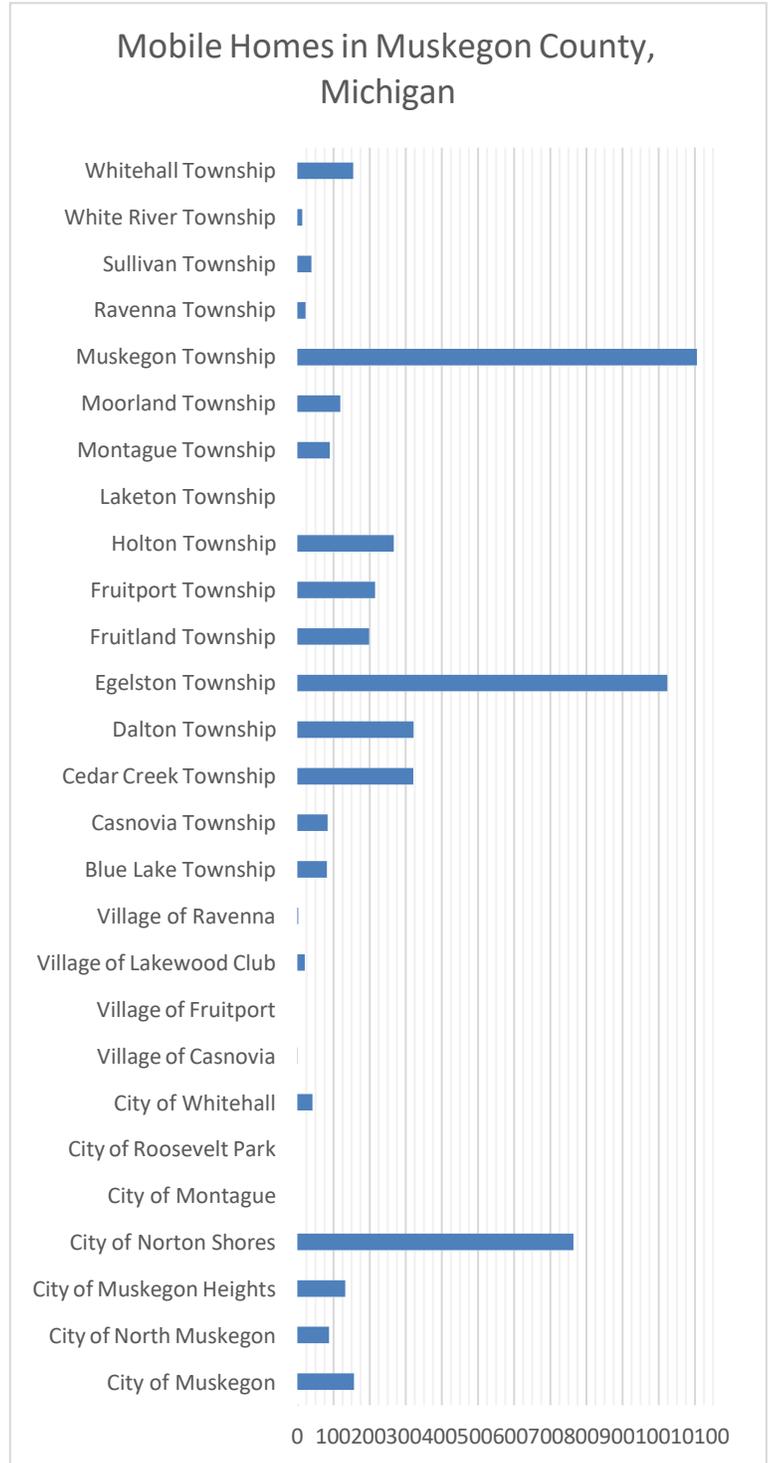
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Value of owner-occupied housing units (Table B25075) [View table](#)

| Column | Whitehall | Muskegon, MI Metro Area | Michigan |
|-----------------|---------------------------|-------------------------|-------------|
| Under \$100K | 18% [†] ±7.4% | 31.8% ±1.7% | 24.6% ±0.2% |
| \$100K - \$200K | 52.2% [†] ±13.9% | 43.1% ±1.6% | 33.5% ±0.2% |
| \$200K - \$300K | 23.9% [†] ±6.5% | 14.2% ±1.1% | 21% ±0.2% |
| \$300K - \$400K | 4.9% [†] ±2.7% | 6.4% [†] ±0.9% | 10.4% ±0.1% |
| \$400K - \$500K | 0% ±0% | 2% [†] ±0.5% | 4.8% ±0.1% |
| \$500K - \$1M | 0.4% [†] ±1.8% | 2% [†] ±0.4% | 4.8% ±0.1% |
| Over \$1M | 0.6% [†] ±1% | 0.5% [†] ±0.2% | 0.5% ±0% |

Table 8, Mobile Homes Distribution in Muskegon County

| MUSKEGON COUNTY MOBILE HOMES DISTRIBUTION | | |
|--|----------------------|----------------------|
| COMMUNITY | # Mobile Homes | % Mobile Homes |
| Muskegon County | 5,269 | 100% |
| City of Muskegon | 157 | 3.0% |
| City of North Muskegon | 88 | 1.7% |
| City of Muskegon Heights | 133 | 2.5% |
| City of Norton Shores | 764 | 14.5% |
| City of Montague | 0 | 0.0% |
| City of Roosevelt Park | 0 | 0.0% |
| City of Whitehall | 42 | 0.8% |
| Village of Casnovia | 1 | 0.0% |
| Village of Fruitport | 0 | 0.0% |
| Village of Lakewood Club | 21 | 0.4% |
| Village of Ravenna | 3 | 0.1% |
| Blue Lake Township | 82 | 1.6% |
| Casnovia Township | 84 | 1.6% |
| Cedar Creek Township | 321 | 6.1% |
| Dalton Township | 322 | 6.1% |
| Egelston Township | 1,024 | 19.4% |
| Fruitland Township | 199 | 3.8% |
| Fruitport Township | 215 | 4.1% |
| Holton Township | 267 | 5.1% |
| Laketon Township | 0 | 0.0% |
| Montague Township | 90 | 1.7% |
| Moorland Township | 119 | 2.3% |
| Muskegon Township | 1106 | 21.0% |
| Ravenna Township | 23 | 0.4% |
| Sullivan Township | 39 | 0.7% |
| White River Township | 14 | 0.3% |
| Whitehall Township | 155 | 2.9% |



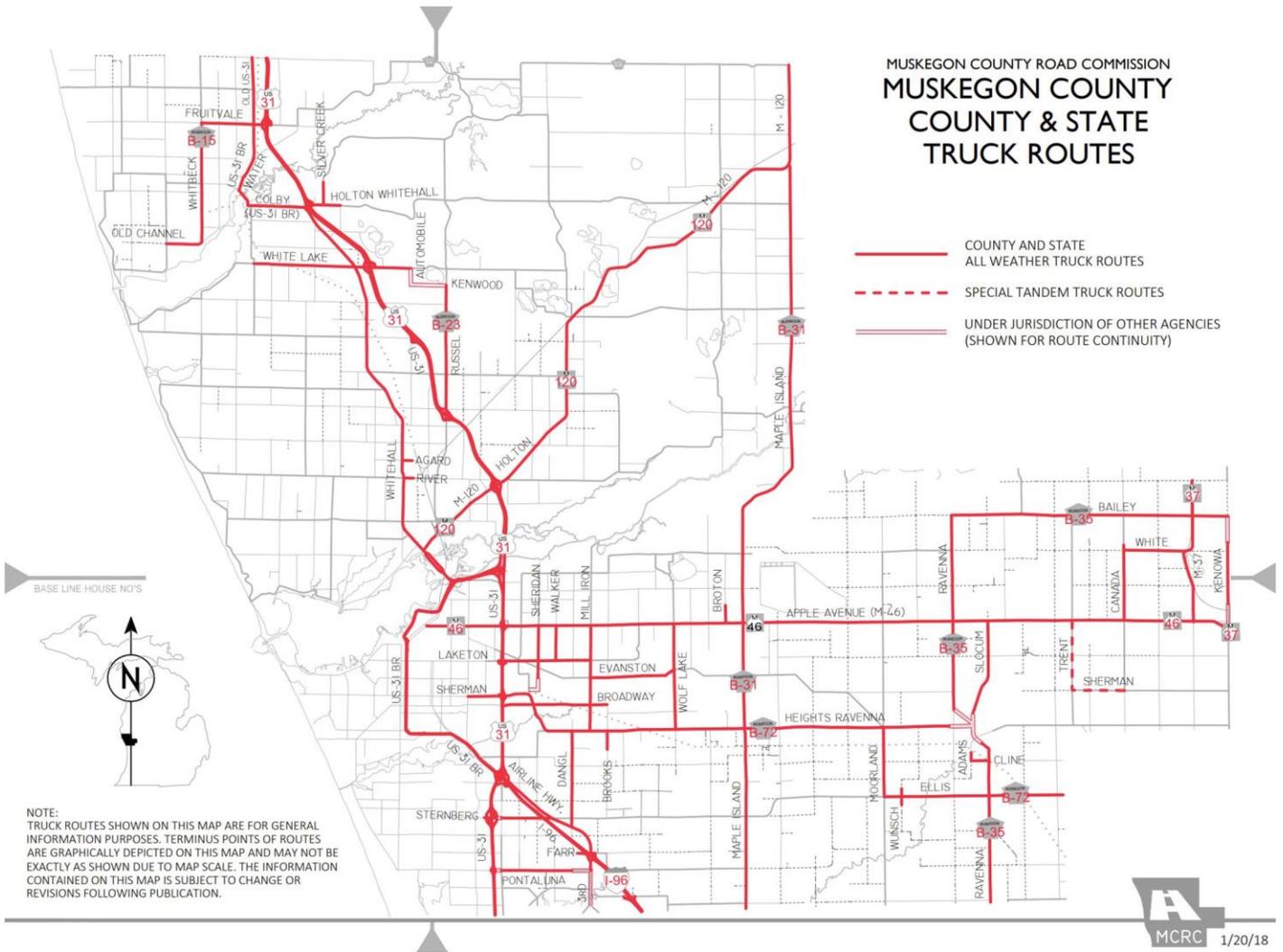
source: Census Reporter

Transportation Network

Highways and Roads

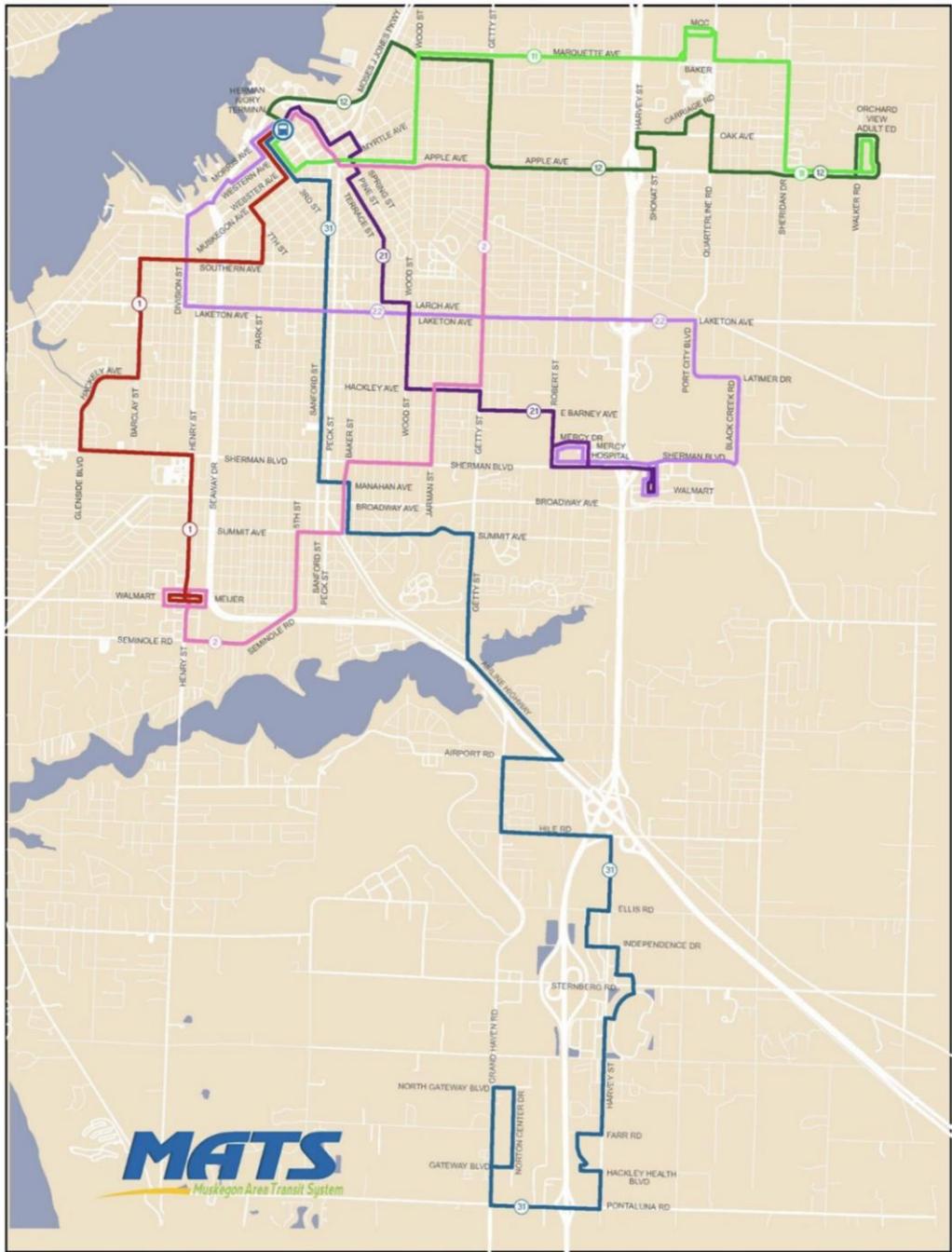
Several modes of transportation are available within Muskegon County, however movement into, out of, and within the county is primarily by private automobile. Muskegon County is serviced by eleven trunk lines that take advantage of easy access to major highways such as I-96, M-37, M46, M120, and US31 to reach destinations in Michigan and beyond. The Muskegon County Road Commission maintains local roads and bridges and contracts with MDOT for snow and debris removal on State roads. Roads include a mix of both paved and graveled surfaces.

Major local connectors or “Class A” roads include the following routes:



Local Transit Service

The Muskegon Area Transit System (MATS) is the primary provider of mass transportation in Muskegon County, Michigan. Service is provided from Monday through Friday along seven fixed routes in the Muskegon Metro area. Fixed routes 1, 2, 11, 12, 21, 22, and 31 continue to be serviced as of 2023. Connecting routes are also available with Harbor Transit to connect with Grand Haven, Spring Lake, and Ferrysburg. MATS ADA Complementary Paratransit Service also provides pre-scheduled, curb-to-curb demand response service for those with an ADA certified disability. For ADA eligibility, passengers must apply each year.



Airports

Conveniently located 15 minutes from downtown Muskegon, the Muskegon County Airport provides space for major commercial airlines, executive charter services, and private hangars. United Express provides daily service to Chicago. Check out the flight schedule at the Muskegon County Airport's website! The airport has two runways: Runway 6/24 and runway 14/32. Both runways are asphalt/porous friction courses. Runway 6/24 is 6,501 ft by 150 ft at an elevation of 621.2 feet. Runway 14/32 is 6,100 ft by 150 ft at an elevation of 627.4 feet. Both runways are lighted by high intensity runway edge lights. 100 Low Lead Jet-A fuel is available at the airport as well as hangars and tie-downs for parking. Major airframe service and powerplant service is also available.

Airport Operational Statistics

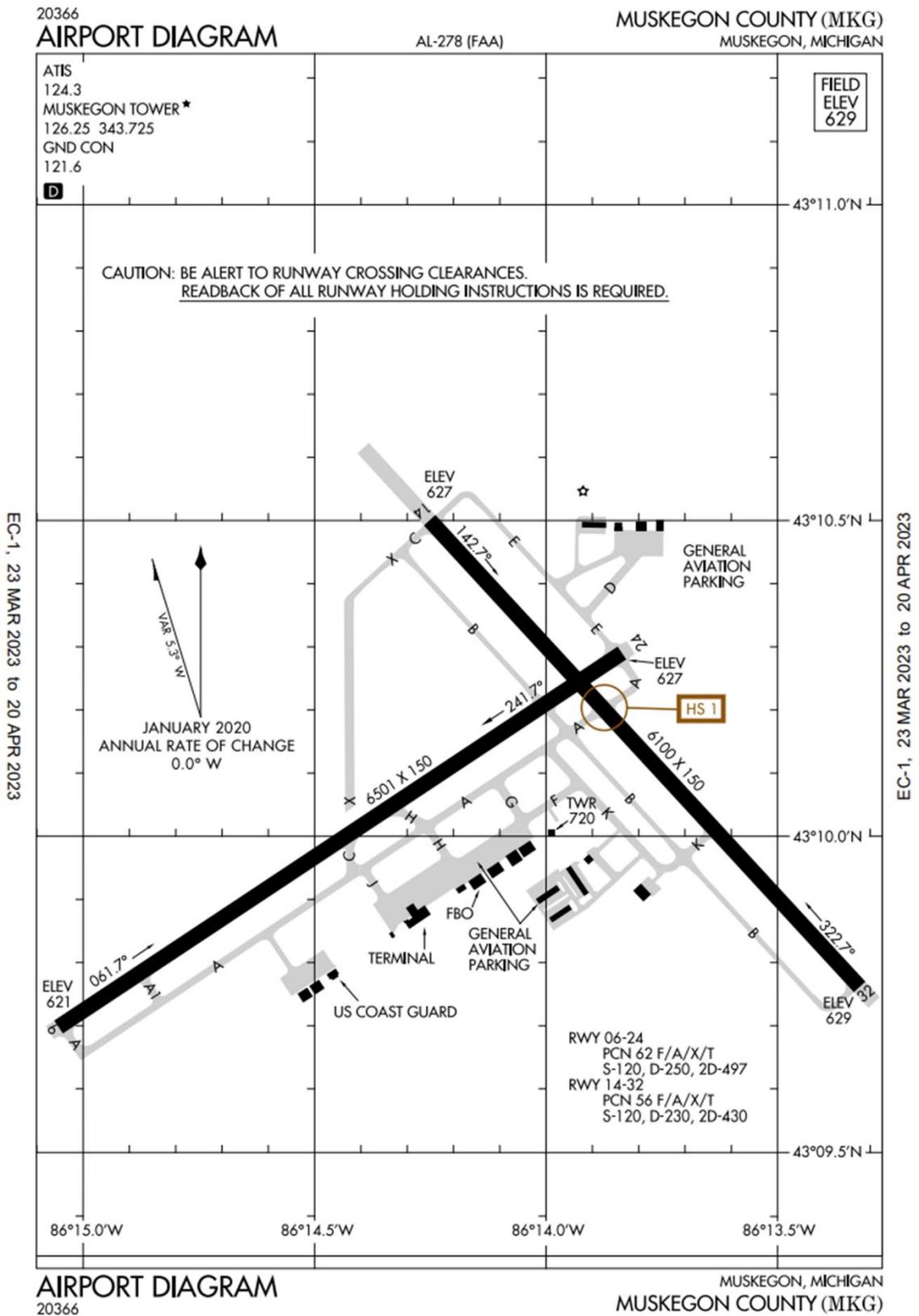
| | |
|--|--|
| Aircraft based on the field: 81 Single engine airplanes: 57 Multi engine airplanes: 16 Jet airplanes: 5 Helicopters: 2 Military aircraft: 1 | Aircraft operations: avg 63/day * 70% transient general aviation 14% commercial 14% local general aviation 1% military <1% air taxi * for 12-month period ending 31 December 2021 |
|--|--|

Data obtained from airnav.com/airport/KMKG

In addition to Muskegon County Airport, there are six major airports that are located within two hours of Muskegon County.

| Airport Name | Distance from County |
|--|----------------------|
| Gerald R. Ford International Airport | 45 Miles |
| Traverse City Cherry Capital Airport | 75 Miles |
| MBS International Airport | 83 Miles |
| Kalamazoo Battle Creek International Airport | 98 Miles |
| Lansing Capital Region International Airport | 85 Miles |
| Chicago O'Hare International Airport | 122 Miles |
| Bishop (Flint) International Airport | 152 Miles |
| Detroit Metropolitan International Airport | 195 Miles |

Muskegon County Airport, MKG



Rail Service and Water Ports

Muskegon County does not have a passenger rail service. The rail service in Muskegon County is provided by both CSX Transportation and the Michigan Shore Railroad. These rail lines are commercial transportation servicing the Port of Muskegon, to Fremont, Michigan in Newaygo County, and south towards Holland.

For passenger rail service, there are 22 Amtrak Stations in Michigan. The Grand Rapids, Holland, South Haven, and Benton Harbor stations are the closest connections to Muskegon County. Amtrak provides passenger rail connections to areas such as Detroit, Ann Arbor, Point Edward/Sarnia, and Chicago.

There are 6 water ports on Lake Michigan, one of which is located in Muskegon County. The Port of Muskegon offers five commercial docking facilities providing a variety of shipping, logistics support, storage, towing, and ship repair services for corporations. Convenient options are available to deliver and receive goods from the Port of Muskegon, and move those goods to market, nationally and internationally.

Muskegon Lake is the largest natural deep-water port in West Michigan. The Port of Muskegon handles over 1 million tons of freight, aggregate, coal and salt every year. In addition to the Port of Muskegon's commercial port facilities, 12 recreational marinas operate on Muskegon Lake and over 20 charter fishing operations call Muskegon Lake home. White Lake, about 7.5 nautical miles north of the Muskegon Lake Channel, has 8 recreational marinas and 12 charter fishing operators. A scenic cruise ship, the Aquastar, offers leisure and dinner cruises on Muskegon Lake and Lake Michigan from its berth on Muskegon Lake. This beautiful freshwater harbor also hosts cruise ships, The Pearl Mist, Victory Cruise Lines, and Le Champlain.

Building on its tradition as a Port City, Muskegon County is also serviced by the Lake Express Ferry, a high-speed ship carrying passengers and vehicles across Lake Michigan from Milwaukee to Muskegon in just 2.5 hours, offering two runs every day during its May to October Season. To learn more about the Lake Express Ferry or to purchase tickets, visit the [Lake Express website](#).



Population Characteristics

Current and Historical Data

The 2020 census shows that since 1990 Muskegon County is currently growing at a comparable rate than the state average, however this has not always been true. From the 1920 through the 1950 Census, Muskegon County grew at a faster rate than the State. The population decline occurred during WWI and a time of disease, such as the Spanish Flu, Small Pox, and Consumption. Table 9, Past Population Comparison, Muskegon County and the State of Michigan 1810-2020 shows Muskegon County's population during each census, the percentage change in Muskegon County's population, and the percentage change in Michigan's population.

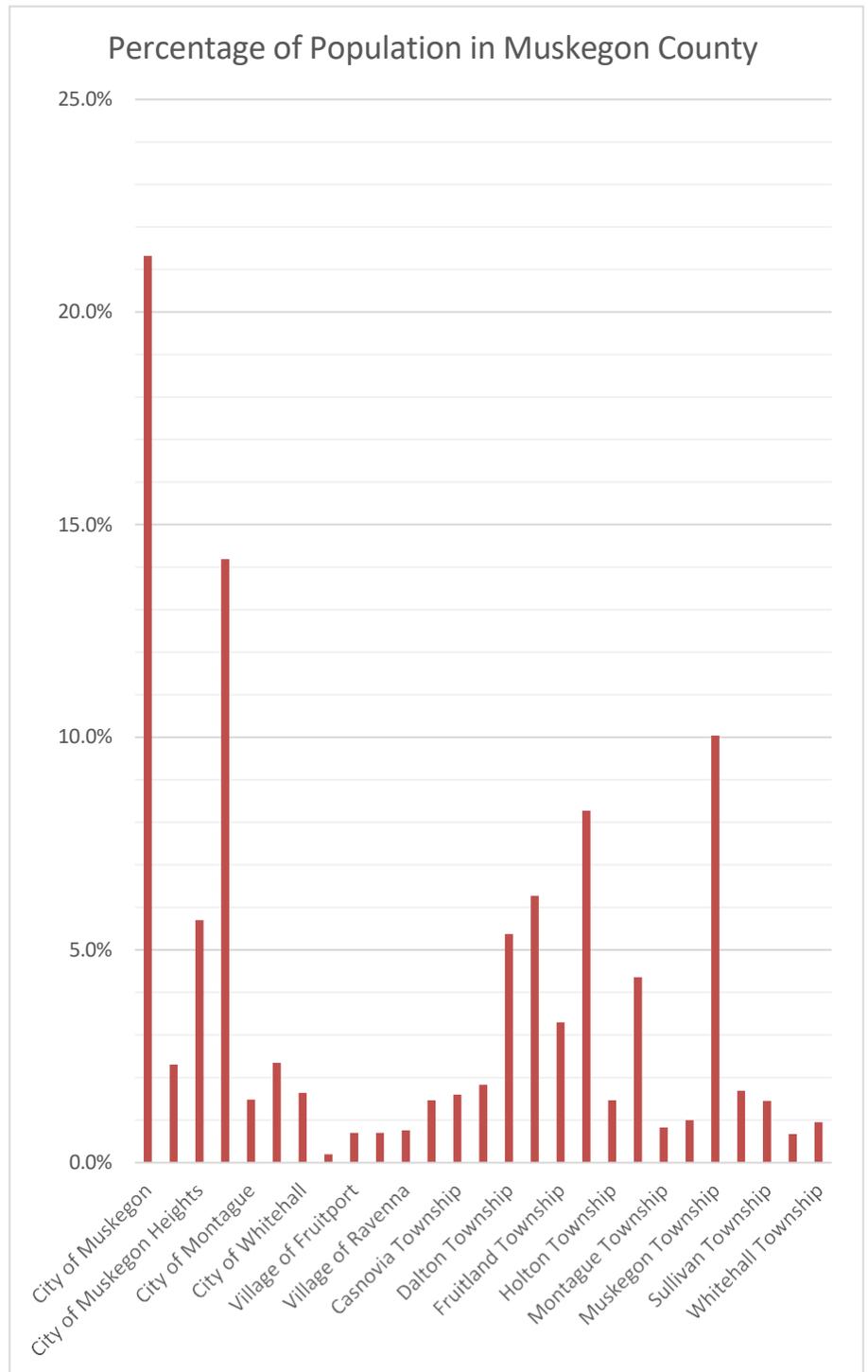
Table 9: Past Population Comparison, Muskegon County and the State of Michigan 1810-2020
Sources: Population figures and other raw data taken from U.S. Census Historical Data

| YEAR | Muskegon County | | Michigan | |
|--------------------|-----------------|-------------------|------------|-------------------|
| | Population | Percentage Change | Population | Percentage Change |
| 1810 | | | 4,762 | |
| 1820 | | | 8,896 | 46.47% |
| 1830 | | | 31,639 | 71.88% |
| 1840 | | | 212,267 | 85.09% |
| 1850 | | | 397,654 | 46.62% |
| 1860 | | | 749,113 | 46.92% |
| 1870 | | | 1,184,059 | 36.73% |
| 1880 | | | 1,036,937 | -14.19% |
| 1890 | | | 2,093,890 | 50.48% |
| 1900 | 37,036 | -7.40% | 2,420,982 | 13.51% |
| 1910 | 40,577 | 9.60% | 2,810,173 | 13.85% |
| 1920 | 62,362 | 53.70% | 3,668,412 | 23.40% |
| 1930 | 84,630 | 35.70% | 4,842,325 | 24.24% |
| 1940 | 94,501 | 10.45% | 5,256,106 | 7.87% |
| 1950 | 121,545 | 22.25% | 6,371,766 | 17.51% |
| 1960 | 149,943 | 18.94% | 7,823,194 | 22.78% |
| 1970 | 157,426 | 4.75% | 8,875,083 | 13.45% |
| 1980 | 157,589 | 0.10% | 9,262,078 | 4.36% |
| 1990 | 159,384 | 1.13% | 9,295,297 | 0.36% |
| 2000 | 170,484 | 6.51% | 9,938,444 | 6.92% |
| 2010 | 172,188 | 0.99% | 9,883,640 | -0.55% |
| 2020 | 175,824 | 2.07% | 10,077,331 | 1.92% |
| Estimate July 2021 | 176,511 | 0.39% | 10,062,512 | -0.15% |

Table 10, Population Distribution in Muskegon County
Sources: Raw population data taken from the 2021 U.S. Census Population Estimates

| MUSKEGON COUNTY POPULATION DISTRIBUTION | | |
|--|---------|-------------|
| COMMUNITY | Pop. | % of County |
| Muskegon County | 176,511 | 100% |
| City of Muskegon | 37,632 | 21.3% |
| City of North Muskegon | 4,063 | 2.3% |
| City of Muskegon Heights | 10,058 | 5.7% |
| City of Norton Shores | 25,040 | 14.2% |
| City of Montague | 2,607 | 1.5% |
| City of Roosevelt Park | 4,142 | 2.3% |
| City of Whitehall | 2,894 | 1.6% |
| Village of Casnovia | 343 | 0.2% |
| Village of Fruitport | 1,231 | 0.7% |
| Village of Lakewood Club | 1,232 | 0.7% |
| Village of Ravenna | 1,335 | 0.8% |
| Blue Lake Township | 2,583 | 1.5% |
| Casnovia Township | 2,817 | 1.6% |
| Cedar Creek Township | 3,231 | 1.8% |
| Dalton Township | 9,487 | 5.4% |
| Egelston Township | 11,070 | 6.3% |
| Fruitland Township | 5,816 | 3.3% |
| Fruitport Township | 14,602 | 8.3% |
| Holton Township | 2,585 | 1.5% |
| Laketon Township | 7,686 | 4.4% |
| Montague Township | 1,454 | 0.8% |
| Moorland Township | 1,753 | 1.0% |
| Muskegon Township | 17,718 | 10.0% |
| Ravenna Township | 2,976 | 1.7% |
| Sullivan Township | 2,558 | 1.4% |
| White River Township | 1,188 | 0.7% |
| Whitehall Township | 1,673 | 0.9% |

source: Census Reporter



Projected Population

Based on data from “The Economic and Demographic Outlook for Michigan through 2050” prepared by the University of Michigan Institute for Research on Labor, Employment, and the Economy for the Michigan Department of Transportation Bureau of Transportation Planning, it is projected Muskegon County will continue to grow at a slower rate than the statewide average through the year 2050.

| Region/County | Population Change 2020-2050 | Employment Change 2019 – 2050 | Share of Population Age 65+ 2020 Census | Share of Population Age 65+ 2050 Forecast |
|------------------------|------------------------------------|--------------------------------------|--|--|
| Michigan | 4.5% | 6.2% | 17.7% | 22.4% |
| Muskegon County | 1.2% | 0.4% | 17.6% | 21.1% |

Household Distribution

Household Distribution can influence a community’s needs since the distribution often identifies unique community traits. Muskegon County has several household characteristics that may influence hazard planning. The following graphics shows the County has a higher proportion of family households than Michigan. Within the overall category of family households, Muskegon County has a higher percentage of married couples than the state, a lower proportion of female householders with no spouse and lower percentage of male householders with no spouse comparison to Michigan as a whole.

Households

67,707

Number of households

Michigan: 4,051,798

United States: 127,544,730

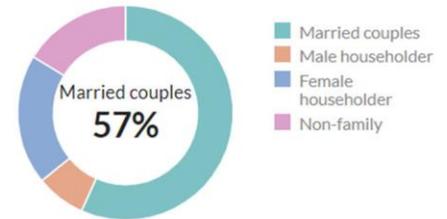
2.5

Persons per household

a little higher than the figure in Michigan: 2.4

about the same as the figure in United States: 2.5

Population by household type



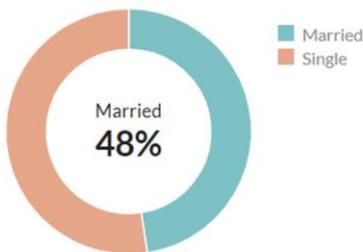
Show data / Embed

Population by household type (Table B11002) [View table](#)

| Column | Muskegon County | | Michigan | | United States | | | | | | | |
|--------------------|-----------------|-------|----------|--------|---------------|-------|-----------|---------|-------|-------|-------------|----------|
| Married couples | 56.7% | ±3.2% | 96,933 | ±5,526 | 59.4% | ±0.4% | 5,843,466 | ±34,620 | 59.9% | ±0.1% | 194,254,000 | ±329,890 |
| Male householder | 7.4% | ±2.3% | 12,705 | ±3,849 | 6.3% | ±0.2% | 620,161 | ±23,371 | 6.4% | ±0.1% | 20,792,710 | ±178,517 |
| Female householder | 19.6% | ±3% | 33,526 | ±5,094 | 15.4% | ±0.4% | 1,516,371 | ±34,497 | 16.1% | ±0.1% | 52,269,764 | ±253,899 |
| Non-family | 16.3% | ±1.6% | 27,847 | ±2,707 | 18.9% | ±0.2% | 1,859,064 | ±23,698 | 17.5% | ±0% | 56,816,420 | ±135,260 |

Hide data

Marital status



* Universe: Population 15 years and over

Hide data / Embed

Marital status, by sex



Show data / Embed

Table B12001 [View table](#)

| Column | Muskegon County | | Michigan | | United States | | | | | | | |
|---------|-----------------|-------|----------|----------|---------------|-------|-----------|-----------|-------|-------|-------------|------------|
| Married | 47.6% | ±2.1% | 68,230 | ±3,028.2 | 48.9% | ±0.3% | 4,053,122 | ±21,403.7 | 49.7% | ±0.1% | 135,007,954 | ±161,355.3 |
| Single | 52.4% | ±2.2% | 75,194 | ±3,186.2 | 51.1% | ±0.3% | 4,234,065 | ±22,777.6 | 50.3% | ±0.1% | 136,392,243 | ±159,028.6 |

Chart from Censusreporter.org/profiles raw data converted from the 2020 Census

Household Data, City of Muskegon and Muskegon County

Households

13,776

Number of households

Muskegon County: 66,122

Michigan: 3,976,729

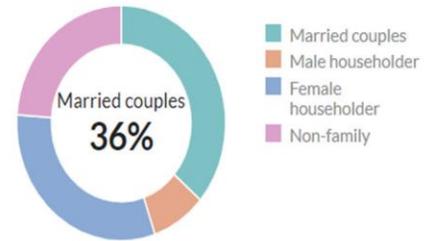
2.4

Persons per household

about 90 percent of the figure in Muskegon County: 2.6

a little less than the figure in Michigan: 2.5

Population by household type



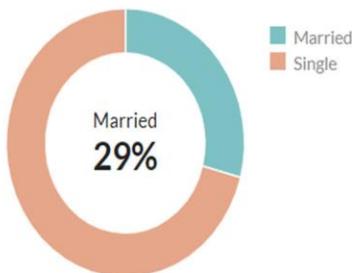
[Hide data / Embed](#)

Population by household type (Table B11002) [View table](#)

| Column | Muskegon | | Muskegon County | | Michigan | | | | | | | |
|--------------------|--------------------|-------|-----------------|--------|-------------------|-------|--------|--------|-------|-------|-----------|---------|
| Married couples | 36.3% | ±3.4% | 11,816 | ±1,111 | 57.7% | ±1.1% | 97,801 | ±1,950 | 59.3% | ±0.3% | 5,833,416 | ±25,647 |
| Male householder | 8.5% [†] | ±2% | 2,750 | ±638 | 6.8% [†] | ±0.9% | 11,580 | ±1,467 | 6.4% | ±0.1% | 629,652 | ±13,145 |
| Female householder | 31.4% | ±3.1% | 10,202 | ±1,006 | 19.6% | ±1% | 33,282 | ±1,721 | 15.8% | ±0.2% | 1,559,326 | ±17,247 |
| Non-family | 23.9% [†] | ±2.7% | 7,766 | ±868 | 15.8% | ±0.7% | 26,762 | ±1,118 | 18.5% | ±0.1% | 1,822,918 | ±9,556 |

[Hide data](#)

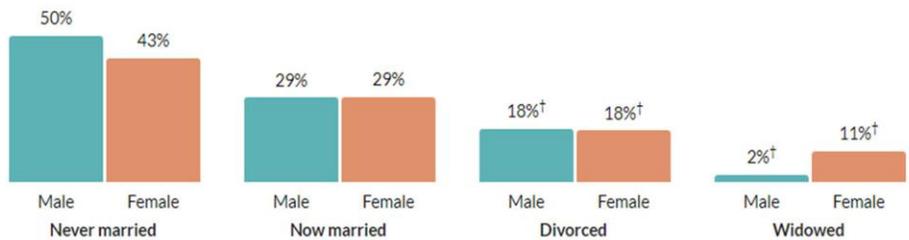
Marital status



* Universe: Population 15 years and over

[Hide data / Embed](#)

Marital status, by sex



[Show data / Embed](#)

Table B12001 [View table](#)

| Column | Muskegon | | Muskegon County | | Michigan | | | | | | | |
|---------|----------|-------|-----------------|--------|----------|-------|--------|----------|-------|-------|-----------|-----------|
| Married | 29.1% | ±1.4% | 8,868 | ±461.8 | 47.7% | ±0.8% | 67,813 | ±1,167.7 | 48.8% | ±0.2% | 4,036,203 | ±13,485.6 |
| Single | 70.9% | ±2.4% | 21,577 | ±863.2 | 52.3% | ±0.9% | 74,366 | ±1,341.6 | 51.2% | ±0.2% | 4,232,380 | ±13,667.3 |

Chart from [Censusreporter.org/profiles](https://censusreporter.org/profiles) raw data converted from the 2020 Census

Household Data, City of Muskegon Heights and Muskegon County

Households

3,567

Number of households

the Muskegon, MI Metro Area: 66,122

Michigan: 3,976,729

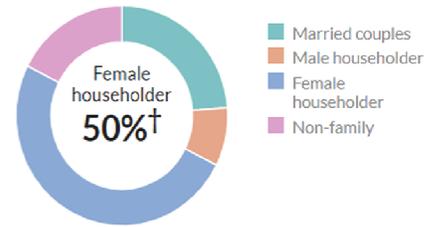
2.8

Persons per household

about 10 percent higher than the figure in the Muskegon, MI Metro Area: 2.6

about 10 percent higher than the figure in Michigan: 2.5

Population by household type



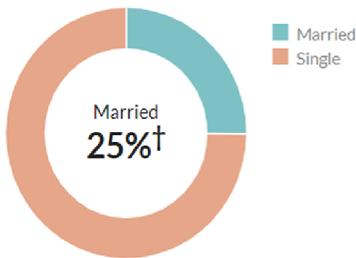
[Hide data / Embed](#)

Population by household type (Table B11002) [View table](#)

| Column | Muskegon Heights | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|--------------------|------------------|-------|-------------------------|------|----------|-------|--------|--------|-------|-------|-----------|---------|
| Married couples | 23.8%† | ±5.7% | 2,377 | ±566 | 57.7% | ±1.1% | 97,801 | ±1,950 | 59.3% | ±0.3% | 5,833,416 | ±25,647 |
| Male householder | 8.6%† | ±3.3% | 856 | ±333 | 6.8%† | ±0.9% | 11,580 | ±1,467 | 6.4% | ±0.1% | 629,652 | ±13,145 |
| Female householder | 50.1%† | ±6% | 4,993 | ±595 | 19.6% | ±1% | 33,282 | ±1,721 | 15.8% | ±0.2% | 1,559,326 | ±17,247 |
| Non-family | 17.5%† | ±3.8% | 1,748 | ±376 | 15.8% | ±0.7% | 26,762 | ±1,118 | 18.5% | ±0.1% | 1,822,918 | ±9,556 |

[Hide data](#)

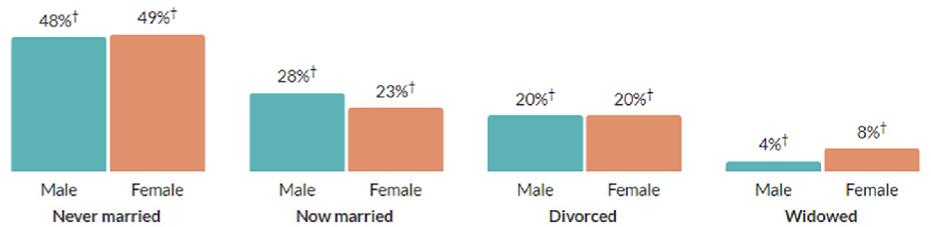
Marital status



* Universe: Population 15 years and over

[Hide data / Embed](#)

Marital status, by sex



[Show data / Embed](#)

Table B12001 [View table](#)

| Column | Muskegon Heights | | Muskegon, MI Metro Area | | Michigan | | | | | | | |
|---------|------------------|-------|-------------------------|--------|----------|-------|--------|----------|-------|-------|-----------|-----------|
| Married | 25.1%† | ±3.3% | 1,818 | ±249.4 | 47.7% | ±0.8% | 67,813 | ±1,167.7 | 48.8% | ±0.2% | 4,036,203 | ±13,485.6 |
| Single | 74.9% | ±6% | 5,424 | ±496.8 | 52.3% | ±0.9% | 74,366 | ±1,341.6 | 51.2% | ±0.2% | 4,232,380 | ±13,667.3 |

Chart from [Censusreporter.org/profiles](https://censusreporter.org/profiles) raw data converted from the 2020 Census

Household Data, City of North Muskegon and Muskegon County

Households

1,619

Number of households

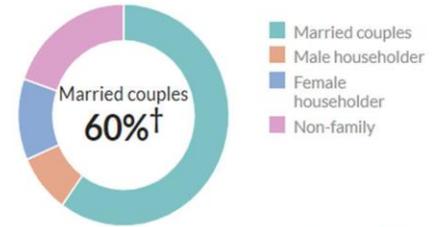
the Muskegon, MI Metro Area: 66,122
Michigan: 3,976,729

2.5

Persons per household

a little less than the figure in the Muskegon, MI Metro Area: 2.6
about the same as the figure in Michigan: 2.5

Population by household type



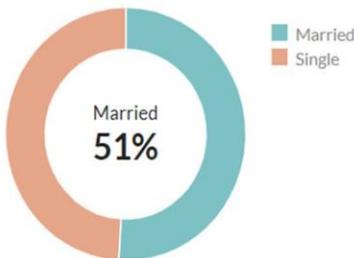
[Hide data / Embed](#)

Population by household type (Table B11002) [View table](#)

| Column | North Muskegon | | Muskegon, MI Metro Area | | Michigan | |
|--------------------|--------------------|-------|-------------------------|------|-------------------|-------|
| Married couples | 59.9% [†] | ±7.7% | 2,398 | ±311 | 57.7% | ±1.1% |
| Male householder | 8.5% [†] | ±7.1% | 342 | ±284 | 6.8% [†] | ±0.9% |
| Female householder | 11.8% [†] | ±6.1% | 474 | ±245 | 19.6% | ±1% |
| Non-family | 19.7% [†] | ±5.4% | 789 | ±216 | 15.8% | ±0.7% |

[Hide data](#)

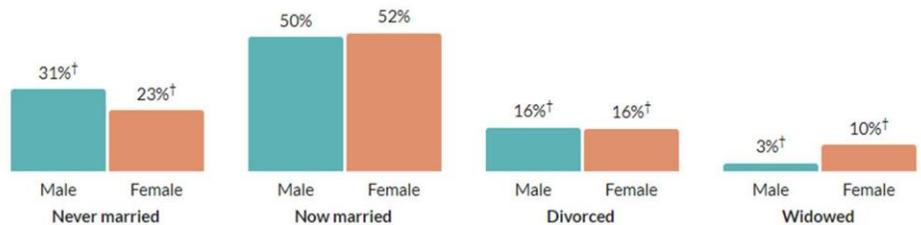
Marital status



* Universe: Population 15 years and over

[Hide data / Embed](#)

Marital status, by sex



[Show data / Embed](#)

Table B12001 [View table](#)

| Column | North Muskegon | | Muskegon, MI Metro Area | | Michigan | |
|---------|--------------------|-------|-------------------------|--------|----------|-------|
| Married | 50.9% | ±4.2% | 1,725 | ±164.8 | 47.7% | ±0.8% |
| Single | 49.1% [†] | ±8.1% | 1,663 | ±285.9 | 52.3% | ±0.9% |

Chart from [Censusreporter.org/profiles](https://censusreporter.org/profiles) raw data converted from the 2020 Census

Household Data, City of Norton Shores and Muskegon County

Households

9,551

Number of households

Muskegon County: 66,122

Michigan: 3,976,729

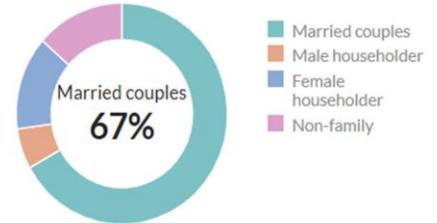
2.6

Persons per household

about the same as the figure in Muskegon County:
2.6

a little higher than the figure in Michigan: 2.5

Population by household type



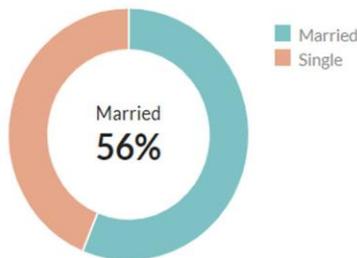
[Hide data / Embed](#)

Population by household type (Table B11002) [View table](#)

| Column | Norton Shores | | Muskegon County | | Michigan | | | | | | | |
|--------------------|--------------------|-------|-----------------|------|-------------------|-------|--------|--------|-------|-------|-----------|---------|
| Married couples | 66.9% | ±3.5% | 16,652 | ±875 | 57.7% | ±1.1% | 97,801 | ±1,950 | 59.3% | ±0.3% | 5,833,416 | ±25,647 |
| Male householder | 5.9% [†] | ±2.4% | 1,469 | ±603 | 6.8% [†] | ±0.9% | 11,580 | ±1,467 | 6.4% | ±0.1% | 629,652 | ±13,145 |
| Female householder | 13.7% [†] | ±2.6% | 3,402 | ±638 | 19.6% | ±1% | 33,282 | ±1,721 | 15.8% | ±0.2% | 1,559,326 | ±17,247 |
| Non-family | 13.5% [†] | ±1.6% | 3,371 | ±406 | 15.8% | ±0.7% | 26,762 | ±1,118 | 18.5% | ±0.1% | 1,822,918 | ±9,556 |

[Hide data](#)

Marital status



* Universe: Population 15 years and over

[Hide data / Embed](#)

Marital status, by sex



[Show data / Embed](#)

Table B12001 [View table](#)

| Column | Norton Shores | | Muskegon County | | Michigan | | | | | | | |
|---------|---------------|-----|-----------------|--------|----------|-------|--------|----------|-------|-------|-----------|-----------|
| Married | 56.2% | ±2% | 11,302 | ±471.6 | 47.7% | ±0.8% | 67,813 | ±1,167.7 | 48.8% | ±0.2% | 4,036,203 | ±13,485.6 |
| Single | 43.8% | ±3% | 8,795 | ±625.8 | 52.3% | ±0.9% | 74,366 | ±1,341.6 | 51.2% | ±0.2% | 4,232,380 | ±13,667.3 |

Chart from [Censusreporter.org/profiles](https://censusreporter.org/profiles) raw data converted from the 2020 Census

Household Data, City of Montague and Muskegon County

Households

1,006

Number of households

the Muskegon, MI Metro Area: 66,122
Michigan: 3,976,729

2.6

Persons per household

about the same as the figure in the Muskegon, MI Metro Area: 2.6
a little higher than the figure in Michigan: 2.5

Population by household type



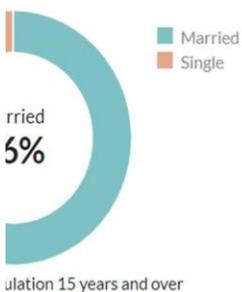
[Hide data / Embed](#)

Population by household type (Table B11002)

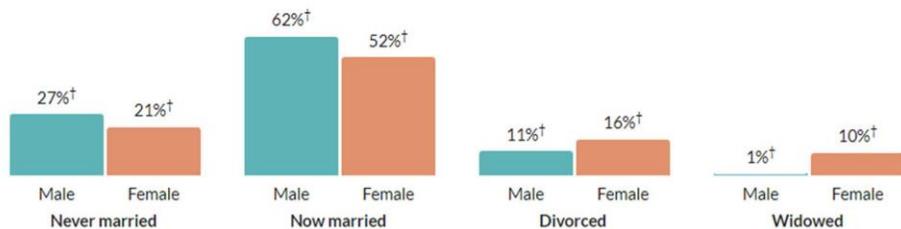
| | Montague | | Muskegon, MI Metro Area | | Michigan | | Column | | | | | | |
|--------------------|--------------------|--------|-------------------------|------|-------------------|-------|--------|--------|-------|-------|-----------|---------|--------------------|
| Married couples | 67% [†] | ±14.6% | 1,737 | ±474 | 57.7% | ±1.1% | 97,801 | ±1,950 | 59.3% | ±0.3% | 5,833,416 | ±25,647 | Married couples |
| Male householder | 5.6% [†] | ±3.8% | 145 | ±102 | 6.8% [†] | ±0.9% | 11,580 | ±1,467 | 6.4% | ±0.1% | 629,652 | ±13,145 | Male householder |
| Female householder | 14.2% [†] | ±4.5% | 367 | ±131 | 19.6% | ±1% | 33,282 | ±1,721 | 15.8% | ±0.2% | 1,559,326 | ±17,247 | Female householder |
| Non-family | 13.2% [†] | ±2.5% | 342 | ±86 | 15.8% | ±0.7% | 26,762 | ±1,118 | 18.5% | ±0.1% | 1,822,918 | ±9,556 | Non-family |

[Hide data](#)

Marital status



Marital status, by sex



Marital status



* Universe: Pop

[Hide data / Embed](#)

[Show data / Embed](#)

Table B1200

| | Montague | | Muskegon, MI Metro Area | | Michigan | | Column | | | | | | |
|---------|--------------------|-------|-------------------------|--------|----------|-------|--------|----------|-------|-------|-----------|-----------|---------|
| Married | 56.4% | ±2.9% | 1,063 | ±124.5 | 47.7% | ±0.8% | 67,813 | ±1,167.7 | 48.8% | ±0.2% | 4,036,203 | ±13,485.6 | Married |
| Single | 43.6% [†] | ±4.8% | 821 | ±124.8 | 52.3% | ±0.9% | 74,366 | ±1,341.6 | 51.2% | ±0.2% | 4,232,380 | ±13,667.3 | Single |

Chart from Censusreporter.org/profiles raw data converted from the 2020 Census

Household Data, City of Roosevelt Park and Muskegon County

Households

1,846

Number of households

the Muskegon, MI Metro Area: 66,122

Michigan: 3,976,729

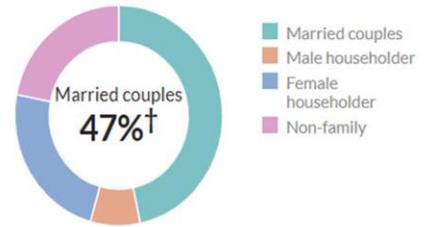
2.2

Persons per household

about 90 percent of the figure in the Muskegon, MI Metro Area: 2.6

about 90 percent of the figure in Michigan: 2.5

Population by household type



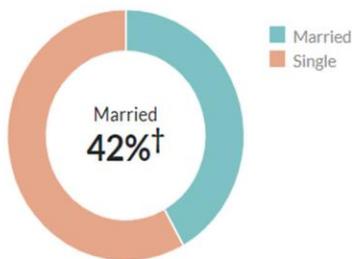
Hide data / Embed

Population by household type (Table B11002) [View table](#)

| Column | Roosevelt Park | | Muskegon, MI Metro Area | | Michigan | | | |
|--------------------|--------------------|-------|-------------------------|------|-------------------------|---------------|-------------|-------------------|
| Married couples | 46.7% [†] | ±9.4% | 1,917 | ±388 | 57.7% ±1.1% | 97,801 ±1,950 | 59.3% ±0.3% | 5,833,416 ±25,647 |
| Male householder | 7.7% [†] | ±4.8% | 317 | ±196 | 6.8% [†] ±0.9% | 11,580 ±1,467 | 6.4% ±0.1% | 629,652 ±13,145 |
| Female householder | 23.7% [†] | ±7.1% | 972 | ±291 | 19.6% ±1% | 33,282 ±1,721 | 15.8% ±0.2% | 1,559,326 ±17,247 |
| Non-family | 21.9% [†] | ±5.6% | 901 | ±228 | 15.8% ±0.7% | 26,762 ±1,118 | 18.5% ±0.1% | 1,822,918 ±9,556 |

Hide data

Marital status



* Universe: Population 15 years and over

Hide data / Embed

Marital status, by sex



Show data / Embed

Table B12001 [View table](#)

| Column | Roosevelt Park | | Muskegon, MI Metro Area | | Michigan | | | |
|---------|--------------------|-------|-------------------------|--------|-------------|-----------------|-------------|---------------------|
| Married | 41.9% [†] | ±4.7% | 1,493 | ±174.7 | 47.7% ±0.8% | 67,813 ±1,167.7 | 48.8% ±0.2% | 4,036,203 ±13,485.6 |
| Single | 58.1% [†] | ±9.1% | 2,070 | ±332.4 | 52.3% ±0.9% | 74,366 ±1,341.6 | 51.2% ±0.2% | 4,232,380 ±13,667.3 |

Chart from Censusreporter.org/profiles raw data converted from the 2020 Census

Household Data, City of Whitehall and Muskegon County

Households

1,057

Number of households

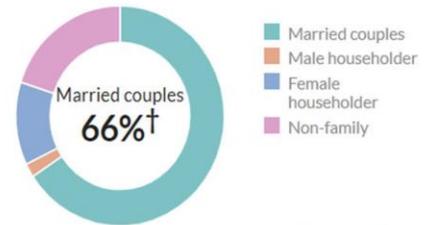
the Muskegon, MI Metro Area: 66,122
Michigan: 3,976,729

2.6

Persons per household

about the same as the figure in the Muskegon, MI Metro Area: 2.6
a little higher than the figure in Michigan: 2.5

Population by household type



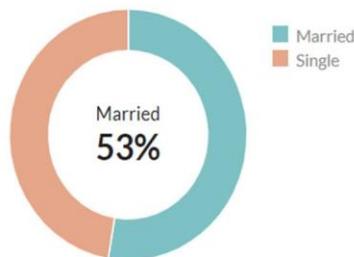
Hide data / Embed

Population by household type (Table B11002) [View table](#)

| Column | Whitehall | | Muskegon, MI Metro Area | | Michigan | | | |
|--------------------|-----------|--------|-------------------------|------|-------------|---------------|-------------|-------------------|
| Married couples | 65.8%† | ±10.4% | 1,808 | ±291 | 57.7% ±1.1% | 97,801 ±1,950 | 59.3% ±0.3% | 5,833,416 ±25,647 |
| Male householder | 2%† | ±2.3% | 56 | ±62 | 6.8%† ±0.9% | 11,580 ±1,467 | 6.4% ±0.1% | 629,652 ±13,145 |
| Female householder | 12.2%† | ±6.7% | 335 | ±185 | 19.6% ±1% | 33,282 ±1,721 | 15.8% ±0.2% | 1,559,326 ±17,247 |
| Non-family | 20%† | ±8.2% | 551 | ±225 | 15.8% ±0.7% | 26,762 ±1,118 | 18.5% ±0.1% | 1,822,918 ±9,556 |

Hide data

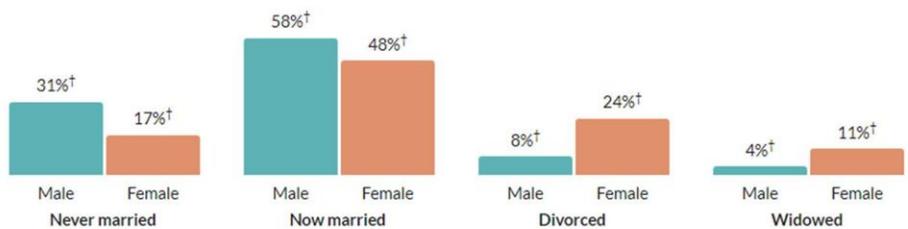
Marital status



* Universe: Population 15 years and over

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Marital status, by sex



Show data / Embed

Table B12001 [View table](#)

| Column | Whitehall | | Muskegon, MI Metro Area | | Michigan | | | |
|---------|-----------|-------|-------------------------|--------|-------------|-----------------|-------------|---------------------|
| Married | 52.7% | ±4.9% | 1,131 | ±140.8 | 47.7% ±0.8% | 67,813 ±1,167.7 | 48.8% ±0.2% | 4,036,203 ±13,485.6 |
| Single | 47.3%† | ±8.6% | 1,015 | ±201.6 | 52.3% ±0.9% | 74,366 ±1,341.6 | 51.2% ±0.2% | 4,232,380 ±13,667.3 |

Chart from Censusreporter.org/profiles raw data converted from the 2020 Census

Age, Gender, Racial, Non-English Speaking, Special Needs, and Educational Data

In addition to population totals, U.S. Census data provides insight into other social characteristics of our country, state, and of Muskegon County’s residents. Tables 28 through 35 provide a quick snapshot of many of these characteristics. Once again, for comparison purposes, statistics for the State of Michigan are also included.

Age Distribution

Age distribution of a county can influence the types of facilities and programs within the county. Age distribution within Muskegon County closely mirrors that of the state as a whole. The median age for Muskegon County and the State of Michigan is 40. Overall, Muskegon County has very similar age population ranges as the State of Michigan and the United States. The largest difference is ages 20-29. A smaller percentage of citizens are in their twenties, 12.2%, compared to the State, 13.1%, and a larger percentage of citizens are over the age of eighty, 4.2%, compared to the State, 3.8%. These statistics are important in identifying the number of special needs populations or vulnerable facilities such as schools, nursing homes, and extended care facilities within the County. Special needs populations are an important consideration in disaster planning and response due to the need for additional support and assistance beyond standard care.

Age

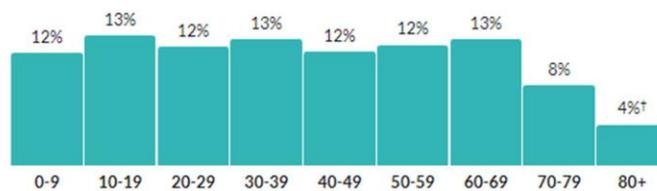
39.8

Median age

about the same as the figure in Michigan: 40.2

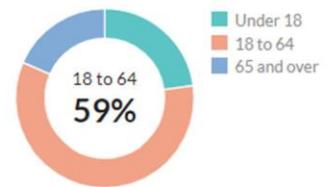
a little higher than the figure in United States: 38.8

Population by age range



Show data / Embed

Population by age category



Show data / Embed

Population by age range (Table B01001) [View table](#)

| Column | Muskegon County | | Michigan | | United States | | | | | | | |
|--------|-----------------|-------|----------|----------|---------------|-------|-----------|-----------|-------|-----|------------|-----------|
| 0-9 | 11.7% | ±0.9% | 20,602 | ±1,513.1 | 11.3% | ±0.1% | 1,131,553 | ±10,506.8 | 11.7% | ±0% | 38,672,058 | ±73,096.7 |
| 10-19 | 13.4% | ±1% | 23,596 | ±1,692.9 | 12.8% | ±0.1% | 1,288,086 | ±11,682.4 | 13.2% | ±0% | 43,645,580 | ±83,716 |
| 20-29 | 12.2% | ±0.9% | 21,601 | ±1,561 | 13.1% | ±0.1% | 1,316,885 | ±12,386.4 | 13.1% | ±0% | 43,483,096 | ±84,740.9 |
| 30-39 | 13.1% | ±0.8% | 23,056 | ±1,316.4 | 12.6% | ±0.1% | 1,264,306 | ±9,888.8 | 13.7% | ±0% | 45,350,083 | ±75,738.2 |
| 40-49 | 11.8% | ±0.7% | 20,787 | ±1,290.1 | 11.8% | ±0.1% | 1,181,072 | ±9,373.1 | 12.4% | ±0% | 41,144,488 | ±71,588 |
| 50-59 | 12.5% | ±0.7% | 22,000 | ±1,171.9 | 13.2% | ±0.1% | 1,321,930 | ±9,088.7 | 12.7% | ±0% | 42,032,544 | ±62,242.5 |
| 60-69 | 13% | ±1.1% | 22,959 | ±1,946.5 | 13.3% | ±0.1% | 1,335,832 | ±13,703 | 12.1% | ±0% | 40,025,667 | ±89,747.2 |
| 70-79 | 8.2% | ±0.7% | 14,531 | ±1,198.6 | 8.2% | ±0.1% | 825,071 | ±9,287.3 | 7.6% | ±0% | 25,299,187 | ±58,986.1 |
| 80+ | 4.2%† | ±0.6% | 7,379 | ±1,000.9 | 3.8% | ±0.1% | 386,076 | ±7,586.9 | 3.7% | ±0% | 12,241,042 | ±48,452 |

Chart from [Censusreporter.org/profiles](https://censusreporter.org/profiles) raw data converted from the 2020 Census

Gender Distribution

Most communities have a higher proportion of females since they have a longer life expectancy. According to the 2020 United States Census, In Michigan, females account for 50.5% of the population and males account for 49.5% of the population. In Muskegon County, females account for 50.6% of Muskegon County's population and males account to 49.4% of the population. Throughout Muskegon County, all cities have a higher female population, with the exception of the City of Muskegon which has a larger male population due to the County Jail.

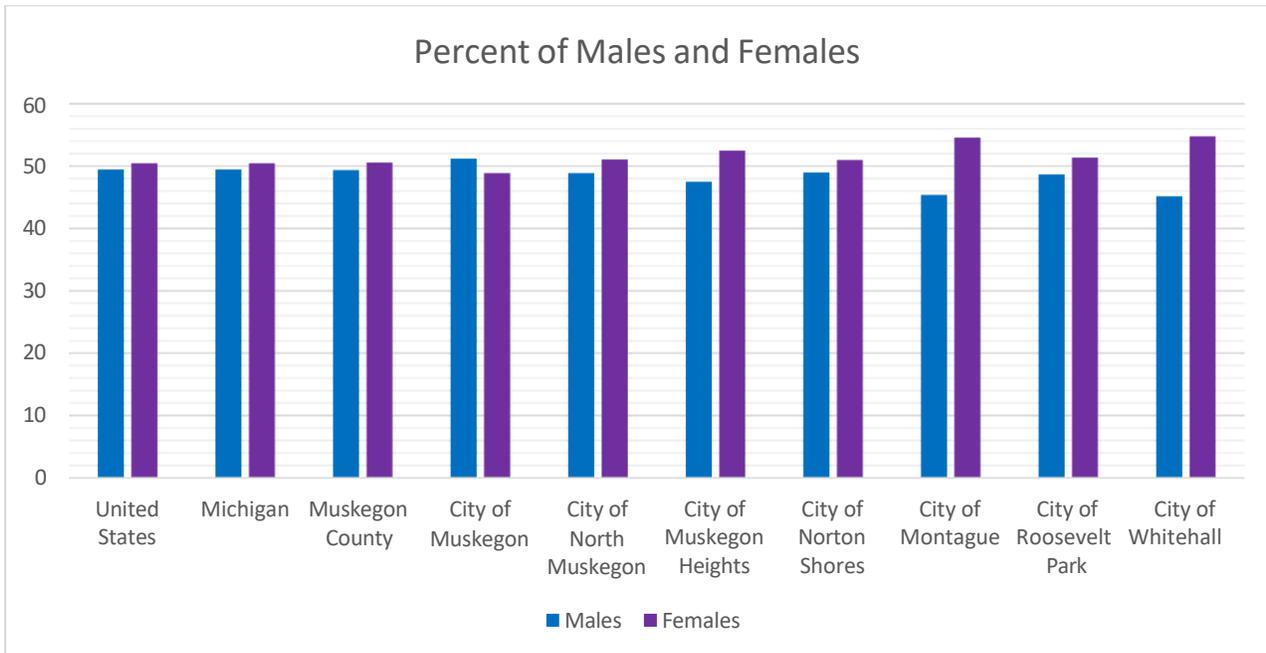


Table 11: Gender Distribution within Muskegon County and the State of Michigan
Source: 2020 U.S. Census, American Fact Finder

| MUSKEGON COUNTY GENDER DISTRIBUTION | | | | |
|--|-------------|--------------------|-------------|--------------------|
| COMMUNITY | # Males | % Total Population | # Females | % Total Population |
| United States | 164,350,700 | 49.5 | 167,543,040 | 50.5 |
| Michigan | 4,983,325 | 49.5 | 5,079,187 | 50.5 |
| Muskegon County | 87,190 | 49.4 | 89,321 | 50.6 |
| City of Muskegon | 19,250 | 51.2 | 18,382 | 48.9 |
| City of North Muskegon | 1,986 | 48.9 | 2,077 | 51.1 |
| City of Muskegon Heights | 4,779 | 47.5 | 5,282 | 52.5 |
| City of Norton Shores | 12,263 | 49 | 12,777 | 51 |
| City of Montague | 1,184 | 45.4 | 1,423 | 54.6 |
| City of Roosevelt Park | 2,015 | 48.7 | 2,127 | 51.4 |
| City of Whitehall | 1,307 | 45.2 | 1,587 | 54.8 |

Racial Distribution

The racial distribution of Muskegon County is different than Michigan’s distribution. Overall, Muskegon County is more diverse than the state as a whole, with the exception of the Asian ethnicity. Muskegon County is predominantly a White Community, with a smaller percentage of Black, Hispanic, and Two+ ethnicities.

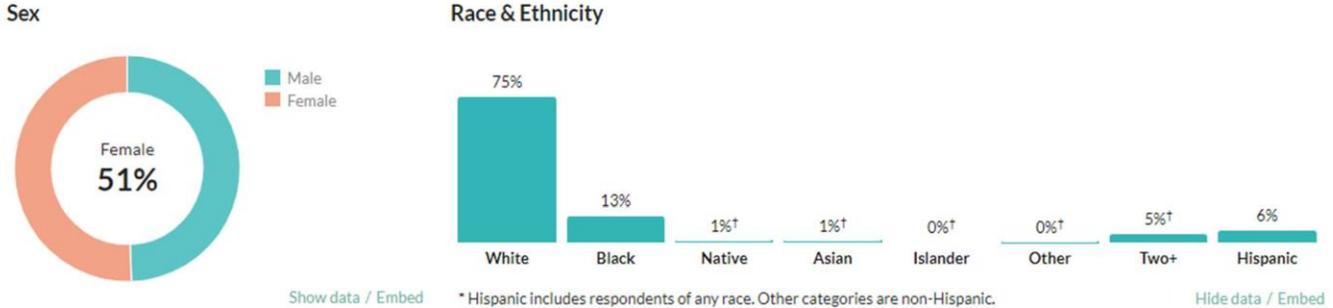


Table B03002 [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|----------|-----------------|-------|----------------|----------|-------|-------------------|---------------|-----|---------------------|
| White | 74.6% | ±0.7% | 131,714 ±1,182 | 72.9% | ±0.1% | 7,322,792 ±10,462 | 58.1% | ±0% | 192,753,890 ±51,353 |
| Black | 13.3% | ±0.7% | 23,483 ±1,155 | 13.2% | ±0.1% | 1,329,383 ±10,103 | 11.8% | ±0% | 39,269,296 ±75,127 |
| Native | 0.7%† | ±0.3% | 1,237 ±558 | 0.3% | ±0% | 33,724 ±2,697 | 0.5% | ±0% | 1,749,871 ±19,372 |
| Asian | 0.5%† | ±0.2% | 923 ±287 | 3.2% | ±0.1% | 320,300 ±6,126 | 5.7% | ±0% | 18,889,050 ±44,721 |
| Islander | 0%† | ±0% | 36 ±62 | 0%† | ±0% | 2,249 ±757 | 0.2% | ±0% | 558,717 ±13,214 |
| Other | 0.2%† | ±0.1% | 266 ±201 | 0.4%† | ±0.1% | 44,432 ±5,481 | 0.6% | ±0% | 1,845,426 ±41,715 |
| Two+ | 4.5%† | ±1% | 7,979 ±1,715 | 4.4% | ±0.2% | 438,215 ±14,955 | 4.3% | ±0% | 14,298,433 ±87,621 |
| Hispanic | 6.2% | ±0% | 10,873 ±0 | 5.6% | ±0% | 559,716 ±511 | 18.8% | ±0% | 62,529,064 ±8,134 |

Chart from Censusreporter.org/profiles raw data converted from the 2020 Census

Primary Language

The primary language spoken at home is less diverse than Michigan as a whole. A higher percentage of Muskegon County households speak English at home compared to the State of Michigan.

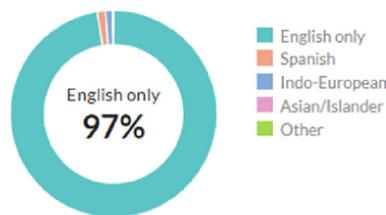
Language

N/A

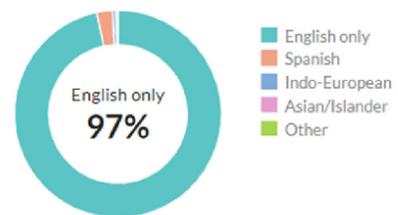
Persons with language other than English spoken at home

* ACS 2021 5-year data

Language at home, children 5-17



Language at home, adults 18+



Hide data / Embed

Show data / Embed

Language at home, children 5-17 (Table B16007) [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|----------------|-----------------|-------|-------------|----------|-------|------------------|---------------|-------|--------------------|
| English only | 97.5% | ±1.9% | 29,239 ±574 | 89.6% | ±0.5% | 1,438,442 ±8,066 | 78.7% | ±0.1% | 43,122,756 ±59,583 |
| Spanish | 1.3%† | ±1.4% | 389 ±409 | 3.8% | ±0.3% | 60,298 ±4,266 | 14.8% | ±0.1% | 8,118,810 ±56,894 |
| Indo-European | 1.1%† | ±1.4% | 341 ±405 | 2.2%† | ±0.2% | 35,681 ±3,826 | 3% | ±0.1% | 1,662,388 ±27,136 |
| Asian/Islander | 0% | ±0% | 0 ±181 | 1.2%† | ±0.2% | 19,185 ±2,607 | 2.3% | ±0% | 1,243,850 ±18,976 |
| Other | 0.1%† | ±0.2% | 30 ±50 | 3.3%† | ±0.4% | 52,352 ±5,806 | 1.2% | ±0.1% | 666,229 ±26,493 |

Language at home, adults 18+ (Table B16007) [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|----------------|-----------------|-------|------------------|----------|-------|---------------------|---------------|-------|------------------------|
| English only | 96.7% | ±0.7% | 131,826 ±1,060.1 | 90.2% | ±0.2% | 7,121,462 ±15,360.3 | 78.3% | ±0.1% | 202,355,308 ±144,991.6 |
| Spanish | 2.5%† | ±0.8% | 3,364 ±1,068.6 | 2.8% | ±0.1% | 219,633 ±7,837.3 | 12.8% | ±0% | 33,136,131 ±91,241.9 |
| Indo-European | 0.5%† | ±0.3% | 703 ±363.2 | 3.1% | ±0.1% | 242,083 ±9,782.4 | 3.9% | ±0% | 10,140,516 ±74,685.4 |
| Asian/Islander | 0.3%† | ±0.2% | 366 ±223.2 | 1.8% | ±0.1% | 138,983 ±6,174.4 | 3.7% | ±0% | 9,671,724 ±54,463.1 |
| Other | 0%† | ±0.1% | 29 ±187.3 | 2.2% | ±0.1% | 176,713 ±9,737.6 | 1.2% | ±0% | 3,114,788 ±48,256.8 |

Chart from censusreporter.org/profiles raw data converted from the 2020 Census

Physical Disabilities

Special needs populations or individuals with physical disabilities can require additional assistance in the event of certain emergencies such as power outages or severe weather. Disability data is collected during the annual Disability Statistics Compendium.

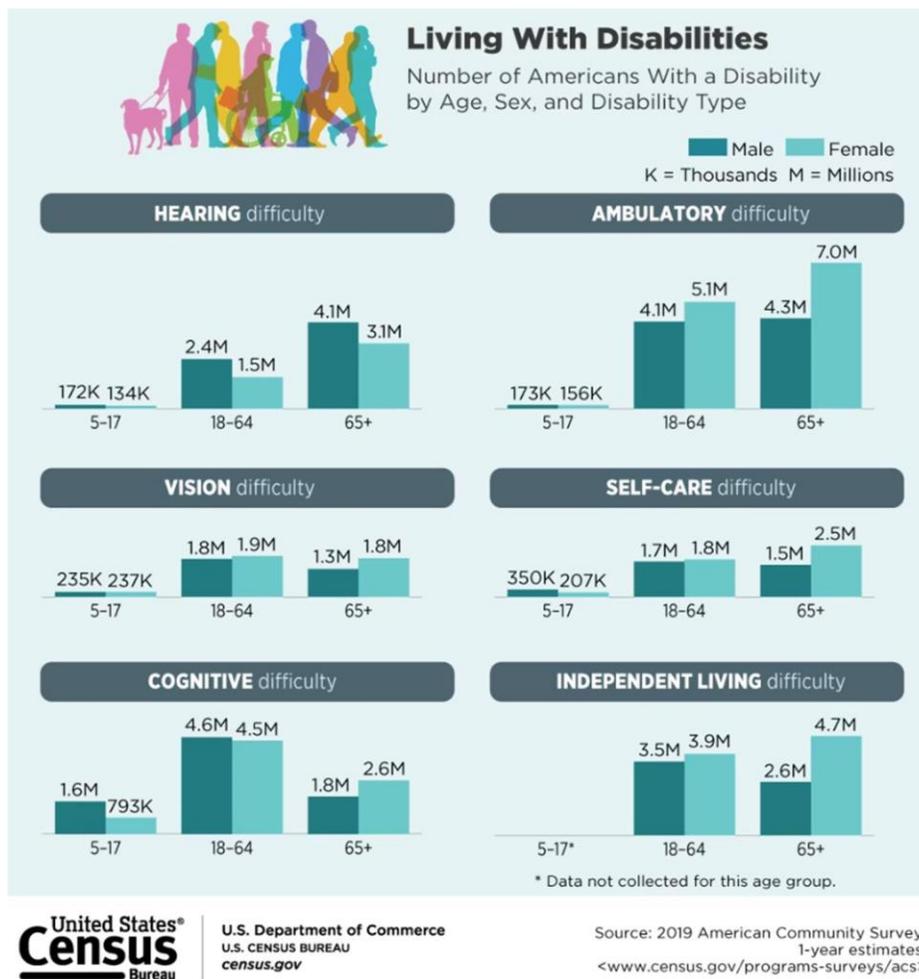
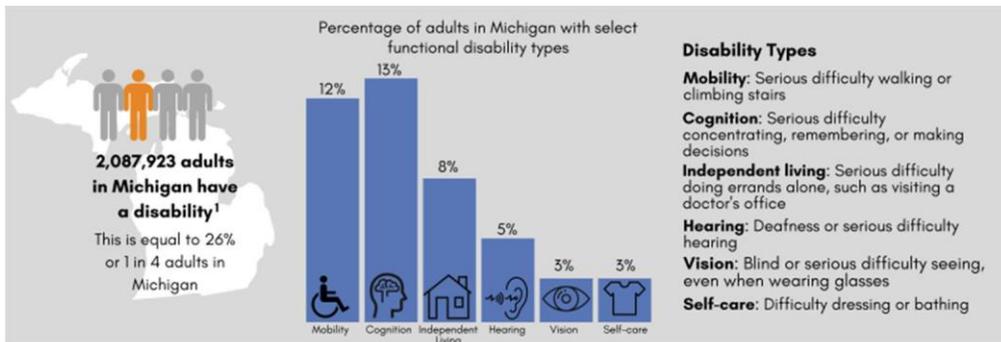


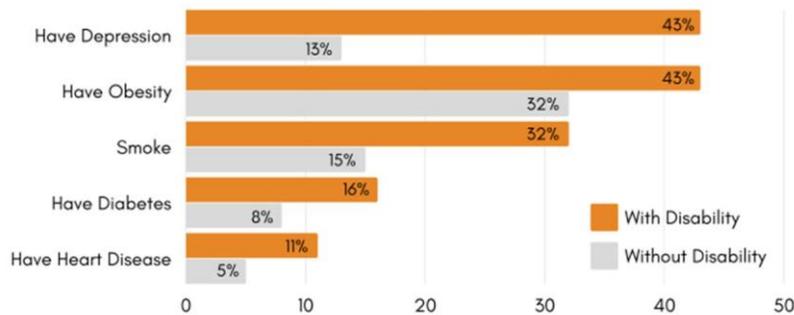
Table 12: Population with Physical Disabilities

Source: 2019 State Report for Annual Disability Statistics Compendium

| | Muskegon County | | | Michigan | | |
|--|-----------------|-------------------|--------------|------------------|-------------------|--------------|
| | Total | With a Disability | Percent | Total | With a Disability | Percent |
| Total civilian non-institutionalized Population | 168,479 | 25,712 | 15.3% | 9,855,966 | 1,401,370 | 14.2% |

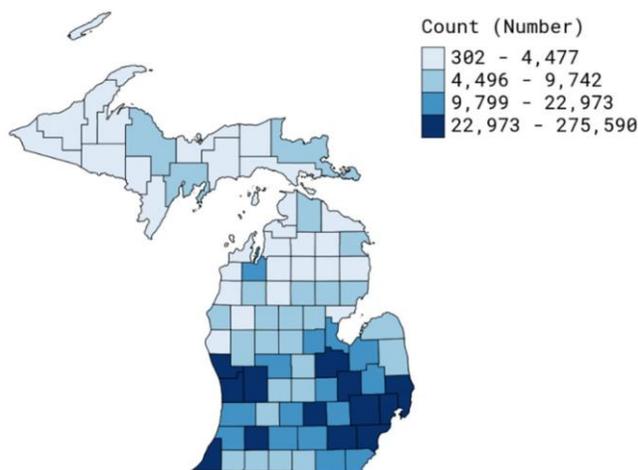


Adults with disabilities in Michigan experience health disparities and are more likely to...¹



Visit [dhds.cdc.gov](https://www.dhds.cdc.gov) for more disability and health data across the United States.

Count of People with Disabilities for Michigan, by County: 2019



Education

Educational attainment is important for several reasons, many of which lead to quality of life issues. Muskegon County has a slightly higher population in High School and individuals with some college as compared to the State of Michigan. However, Muskegon County has a much lower group of individuals who have obtained their bachelor's degrees and attended Post-Grad school.

Educational attainment

92%

High school grad or higher

about the same as the rate in Michigan: 92%

a little higher than the rate in United States: 89.4%

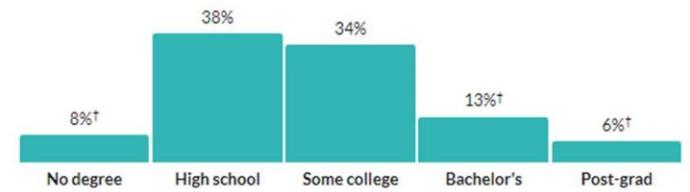
19.6%

Bachelor's degree or higher

about three-fifths of the rate in Michigan: 31.7%

about three-fifths of the rate in United States: 35%

Population by highest level of education



* Universe: Population 25 years and over

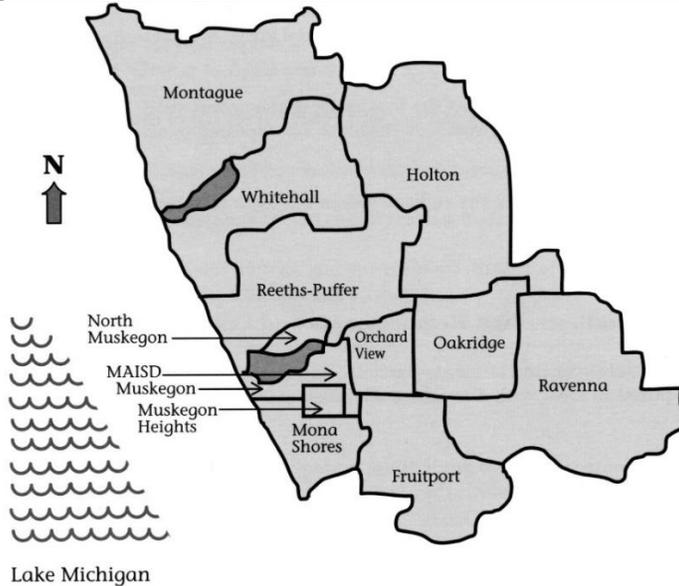
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Population by highest level of education (Table B15002) [View table](#)

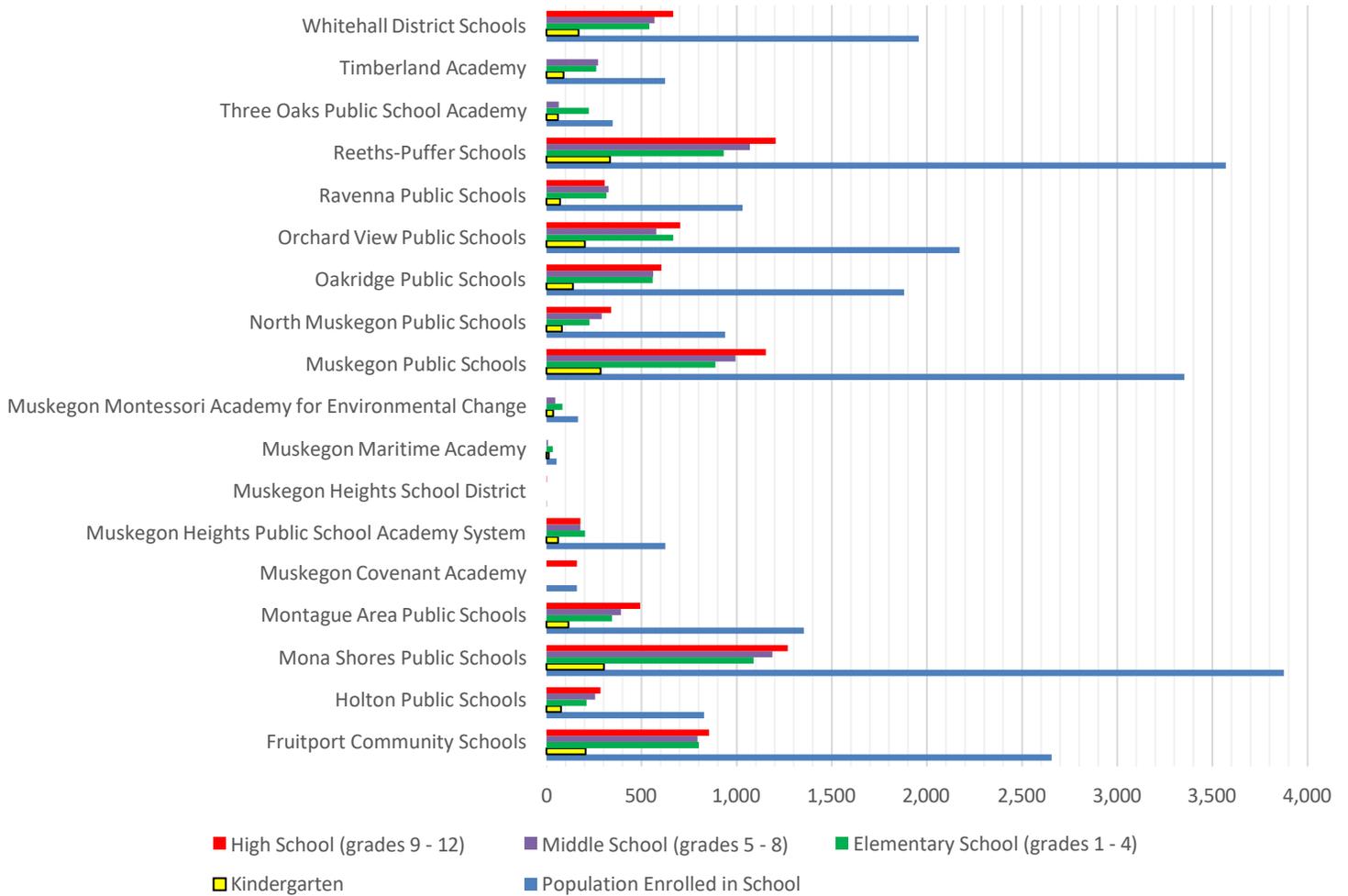
| Column | Muskegon County | | Michigan | | United States | |
|--------------|-----------------|-----------------|-------------|---------------------|---------------|-----------------------|
| No degree | 8%† ±1.4% | 9,661 ±1,638.2 | 8% ±0.2% | 560,298 ±11,833.4 | 10.6% ±0% | 24,272,481 ±96,015.4 |
| High school | 38% ±2.1% | 46,073 ±2,517.8 | 28.7% ±0.2% | 2,003,265 ±15,744.5 | 26.3% ±0.1% | 59,996,344 ±138,160.2 |
| Some college | 34.4% ±2.6% | 41,684 ±3,119 | 31.6% ±0.3% | 2,200,162 ±21,985.5 | 28.1% ±0.1% | 64,021,176 ±151,882.1 |
| Bachelor's | 13.4%† ±1.5% | 16,215 ±1,821.2 | 19.2% ±0.2% | 1,338,162 ±14,351.6 | 21.3% ±0.1% | 48,482,060 ±131,798.1 |
| Post-grad | 6.3%† ±1% | 7,593 ±1,167.8 | 12.5% ±0.2% | 870,008 ±12,880.6 | 13.8% ±0% | 31,421,403 ±102,466.5 |

Within Muskegon County there are 18 different active school districts registered with the State of Michigan Department of Education. Twelve of these districts are public schools, while six are private schools. Overall, there are a total of 25,590 students registered in K-12 schools for the 2022-2023 school year within Muskegon County.

| | Population Enrolled in School | Kindergarten | Elementary School (grades 1 - 4) | Middle School (grades 5 - 8) | High School (grades 9 - 12) |
|-----------------|-------------------------------|--------------|----------------------------------|------------------------------|-----------------------------|
| Muskegon County | 25,590 | 1,482 | 7,379 | 7,583 | 8,216 |



Muskegon County School Districts Enrollment 2022-2023 School Year



Source: MI School Data from the Michigan Department of Education 2022-2023 School Year

In addition to K-12 schools, Muskegon County also has two colleges actively serving the County as of the 2021-2022 academic year. Both schools offer undergraduate programs, and no schools offer graduate programs. The 2023 average tuition & fees of the schools in Muskegon County, Michigan is \$11,090 for Michigan residents and \$16,369 for out-of-state students.

One of the three colleges is Muskegon Community College (MCC), a public community college offering 49 associate degree programs and 33 certificate programs. The college's main campus is located on a 111-acre campus in Muskegon, with extension centers in Ottawa County. MCC was founded as Muskegon Junior College in 1926 and has been continually accredited by the Higher Learning Commission since 1929. The community college district was created via the Michigan Constitution of 1963 along with an elected board of trustees and the college moved to its current campus location, an Alden B. Dow designed facility that opened to the public in 1967. In 1995, the Stevenson Center for Higher Education opened; it comprised a consortium of Ferris State

University, Grand Valley State University, and Western Michigan University, designed to increase access to educational opportunities for Muskegon residents. In 2010 the Outdoor Learning Lab, a focal point of green technology and center for MCC's new Alternative and Renewable Energy certificate program, opened. Several new or expanded buildings were constructed or commissioned from 2014. Per the MI School Data, 5,375 students are enrolled in Baker College during the 2021-2022 school year.

The other college located in Muskegon County is Baker College, a private 4-year college situated on 63 wooded acres just minutes away from the shore of Lake Michigan. Students take classes in modern classrooms and labs equipped with the latest tools and technology professionals use on the job. With small class sizes, students benefit from individualized attention from instructors. The Baker College of Muskegon also features many quiet areas for students to study, a recreation center, an Academic Resource Center, a café, fitness center, and more. They also offer a variety of on-campus housing styles as an option for students who prefer not to commute to campus. Per the MI School Data, 6,127 students are enrolled in Baker College during the 2021-2022 school year across all of their campuses in Michigan.

The Culinary Institute of Michigan is a three-story facility for students in Baker College's culinary programs. This facility is located near their main campus. Culinary students also gain real-world, hands-on experience by running their restaurant, COURSES, and their on-site pastry and coffee shop, The Sweet Spot, both of which are open to the public.

There are also several vocational or technical schools within Muskegon County. Although these schools are mostly technical certificate programs and a non-degree granting school, some schools now offer online undergraduate degree programs. Ross Medical Education Center, located in Roosevelt Park, is a private college offering an online Associate of Applied Science Degrees. These programs include Medical Building Administrative Specialist, Medical Office Management, Medical Assistant, Dental Assistant, Nursing Assistant, and more. Nuvo College of Cosmetology, now a part of the Moored Beauty Schools, is located in Norton Shores. This is a private school to train students in the technical field of cosmetology.

Outside of Muskegon County, there are a variety of higher education programs available within a short driving distance.

| University Name | Location | Type |
|-------------------------------|--------------------------|---------|
| Cornerstone University | Grand Rapids, Michigan | Private |
| Central Michigan University | Mount Pleasant, Michigan | Public |
| Ferris State University | Big Rapids, Michigan | Public |
| Grand Valley State University | Allendale, Michigan | Public |
| Michigan State University | East Lansing, Michigan | Public |
| Western Michigan University | Kalamazoo, Michigan | Public |
| Davenport University | Grand Rapids, Michigan | Private |

In addition, Muskegon County is also within two hours of eighteen Colleges and Community Colleges.

| College Name | Location | Type |
|------------------------------------|-------------------------|---------|
| Alma College | Alma, Michigan | Private |
| Aquinas College | Grand Rapids, Michigan | Private |
| Calvin College | Grand Rapids, Michigan | Private |
| Hope College | Holland, Michigan | Private |
| Kalamazoo College | Kalamazoo, Michigan | Private |
| Baker College | Muskegon, Michigan | Private |
| Grace Bible College | Grand Rapids, Michigan | Private |
| Great Lakes Christian College | Lansing, Michigan | Private |
| Kuyper College | Grand Rapids, Michigan | Private |
| Grand Rapids Community College | Grand Rapids, Michigan | Public |
| Kalamazoo Valley Community College | Kalamazoo, Michigan | Public |
| Kellogg Community College | Grand Rapids, Michigan | Public |
| Lansing Community College | Lansing, Michigan | Public |
| Mid-Michigan Community College | Harrison, Michigan | Public |
| Montcalm Community College | Sidney, Michigan | Public |
| North Western Community College | Traverse City, Michigan | Public |
| West Shore Community College | Ludington, Michigan | Public |

Many of the Colleges and all of the Universities offer student housing in dorms and apartment complexes. Due to being at school for an extended period of time, many students often change their residency to the city when they are going to school, decreasing the population enrolled in College or Graduate School in areas that do not have large educational facilities with housing.

Economic Characteristics

Current and Projected Economic Activity

Data from the US Census Economic Characteristics, Census of Agriculture, and Muskegon County Economic Development office were used to describe Muskegon County's current and projected economy. Muskegon County is unique in that it has both an agricultural and manufacturing economic base, and employment in the county's retail sector is increasing.

Employment Sectors and Major Employers

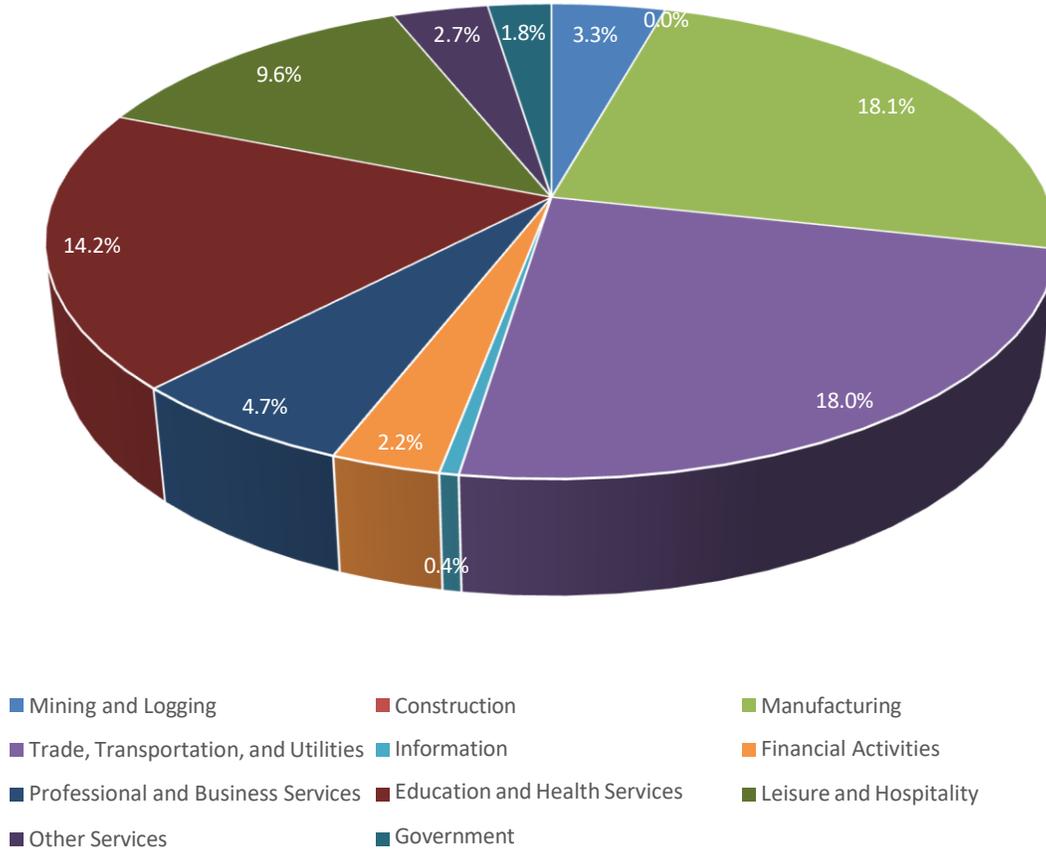
County Business Patterns, published by the U.S. Census Bureau, provide a snapshot view of the employment pattern within a community. As stated earlier, it is important to remember that County Business Patterns do not account for self-employed individuals, railroad employees, many governmental employees, and probably most important in Muskegon County's situation, agricultural production employees.

*Table 13: Employment Status in Muskegon County compared to the State of Michigan
Source: Bureau of Labor Statistics, February 2023*

| EMPLOYMENT INDUSTRY | Muskegon County | | Michigan | |
|---|---------------------------|------------|---------------------------|------------|
| | Estimated number employed | Percentage | Estimated number employed | Percentage |
| Civilian Labor Force population 16 years and over | 76.8 | 100% | 4,842.4 | 100% |
| Civilian employed population 16 years and over | 72.8 | 94.8% | 4,635.4 | 95.7% |
| Mining and Logging | 2.5 | 3.3% | 7.3 | 0.2% |
| Construction | | 0.0% | 189.4 | 3.9% |
| Manufacturing | 13.9 | 18.1% | 610.1 | 12.6% |
| Trade, Transportation, and Utilities | 13.8 | 18.0% | 811.1 | 16.7% |
| Information | 0.3 | 0.4% | 57.6 | 1.2% |
| Financial Activities | 1.7 | 2.2% | 228.2 | 4.7% |
| Professional and Business Services | 3.6 | 4.7% | 660.7 | 13.6% |
| Education and Health Services | 10.9 | 14.2% | 673.0 | 13.9% |
| Leisure and Hospitality | 7.4 | 9.6% | 415.1 | 8.6% |
| Other Services | 2.1 | 2.7% | 161.5 | 3.3% |
| Government | 1.4 | 1.8% | 602.4 | 12.4% |
| Total Non-Farm | 63.5 | 82.7% | 4,416.4 | 91.2% |

Number of persons in Thousands

Muskegon County Employment by Industry



Talent

What are the largest job counts by occupation?



According to the Muskegon Lakeshore Chamber of Commerce, Muskegon County has a total of 4,997 businesses. In 2022, the leading industries in Muskegon County were Manufacturing, Health Care, Social Services, Retail, and Education.



How many employees do businesses in Muskegon County have?



Major Employers

Muskegon County has limited major employers throughout the county. All major employers are located within the Cities of Fremont, Grant, Muskegon, and White Cloud. A majority of the employers within the county are under 100 employees.

*Table 14, Muskegon County Employers with Over 100 Employees
Source: Muskegon Lakeshore Chamber of Commerce*

| Company | Location | Approx # Of Employees | Product/Service |
|--|------------------|----------------------------------|---|
| Adac Automotive | Muskegon | 900 | Automotive supplies / door handles |
| Aludyne | Montague | 377 | Aluminum Foundries |
| Bennett Pump | Spring Lake | 150 | Pump and Pumping Equipment |
| Betten Baker Chevrolet GMC Cadillac Buick | Muskegon | 232 | Automotive sales and services |
| Brunswick Bowling Products | Muskegon | 150 | Bowling manufacturer |
| Cannon-Muskegon Corporation | Muskegon | 175 | Nonferrous Sec Smelt/Refine/Alloying |
| Catholic Charities of West MI | Muskegon | 229 | Community and Social Service Org. |
| City of Muskegon | Muskegon | 224 | Government municipality |
| Cole's Quality Foods Inc | Muskegon | 140 | Bread, Commercial Bakeries |
| Eagle Alloy, INC | Muskegon | 275 | Primary Metal Manufacturing |
| EPI Breads | Norton Shores | 260 | Commercial Bakery |
| Family farm and Home | Muskegon | 250 | Retail Stores |
| Fruitport Community Schools | Fruitport | 460 | Schools |
| GE Aviation | Muskegon | 666 | Aircraft engine and engine parts |
| Goodwill Industries of West MI | Muskegon | 194 | Community and social service org. |
| Hackley Community Care | Muskegon Heights | 230 | Health and nutrition services |
| Hazekamp Premier Foods | Muskegon | 190 | Meat processing and distribution |
| HealthWest | Muskegon | 400 | Community and social services org. |
| Heart and Hands in Home Care | North Muskegon | 120 | Home Healthcare |
| HGA Support Services | Muskegon | 104 | Community and social services org. |
| Hilite International | Whitehall | 287 | Fluid power cylinder and actuator |
| Holton Public Schools | Holton | 105 | Schools |
| Howmet Aerospace Inc. | Whitehall | 2,900 | Primary Metal Manufacturing |
| Howmet Aerospace Inc., Research Center | Whitehall | 164 | Primary Metal Manufacturing |
| Howmet Aerospace Inc., Thermatech | Whitehall | 162 | Primary Metal Manufacturing |
| Howmet Aerospace Inc., Ti-Cast | Whitehall | 186 | Primary Metal Manufacturing |
| Howmet Aerospace Inc., Whitehall Casting, Plant 1 and 3 | Whitehall | 894 | Primary Metal Manufacturing |
| Howmet Aerospace Inc., Whitehall Casting, Plant 10 | Whitehall | 518 | Primary Metal Manufacturing |
| Johnston Boiler Co. | Ferrysburg | 100 | Miscellaneous Manufacturing |
| Kaydon Corporation | Norton Shores | 130 | Fabricated Metal Product Manufacturing |
| La Colombe | Norton Shores | 120 | Coffee & draft latte manufacturer |
| Lakeside Surfaces Inc | Muskegon | 140 | Furniture & Related Product Manufacturing |
| Lowe's Home Improvement | Muskegon | 190 | Retail Stores |
| Mastertag | Montague | 140 | Electronic and precision equipment |
| McDonald's - Colby St | Whitehall | 100 | Fast Service Dining |
| Meijer - Muskegon Area | Muskegon | 105 | Grocery & Hardware |
| Meijer - North Muskegon | North Muskegon | 105 | Grocery & Hardware |
| Meijer - Norton Shores | Muskegon | 105 | Grocery & Hardware |
| Company | Location | Approx # Of Employees | Product/Service |

Muskegon County

Hazard Mitigation Plan

| | | | |
|---|------------------|-------|---|
| Metal Arc, Inc. | Muskegon | 130 | Furniture & Related Product Manufacturing |
| MillerKnoll | Norton Shores | 376 | Furniture & Related Product Manufacturing |
| MOKA | Muskegon | 280 | Community & Social Service Organizations |
| Mona Shores Public Schools | Muskegon | 520 | Schools |
| Montague Area Public Schools | Montague | 175 | Schools |
| Motion Dynamics Corporation | Fruitport | 245 | Fabricated Metal Product Manufacturing |
| Muskegon Area Intermediate School District | Muskegon | 400 | Schools |
| Muskegon Community College | Muskegon | 209 | Adult & Vocational Education |
| Muskegon County | Muskegon | 1300 | Municipalities |
| Muskegon Heights Public School Academy System | Muskegon Heights | 139 | Schools |
| Muskegon Public Schools | Muskegon | 739 | Schools |
| Muskegon Surgical Associates, PC | Muskegon | 100 | Physicians & Surgeons |
| Newkirk Electric Associates, Inc. | Muskegon | 600 | Plumbing & Electrical |
| Nichols, Division of Imperial Dade | Norton Shores | 160 | Distribution |
| Northern Boiler & Mechanical Contractors | Muskegon | 100 | Repair & Maintenance |
| Oakridge Public Schools | Muskegon | 231 | Schools |
| Orchard View Schools | Muskegon | 330 | Schools |
| Port City Group a division of PACE Industries | Muskegon | 475 | Fabricated Metal Product Manufacturing |
| Prein & Newhof, Inc. | Norton Shores | 150 | Engineering |
| Quality Tool & Stamping Co., Inc. | Muskegon Heights | 150 | Fabricated Metal Product Manufacturing |
| Ravenna Public Schools | Ravenna | 130 | Schools |
| Reeths-Puffer Schools | Muskegon | 358 | Schools |
| RENK America | Muskegon | 307 | Transportation Equipment Manufacturing |
| Republic Services | Muskegon | 100 | Waste Disposal & Recycling |
| SAF-HOLLAND, Inc. | Muskegon | 185 | Transportation Equipment Manufacturing |
| Sam's Club 6562 | Muskegon | 100 | Grocery & Hardware |
| Sanctuary at McAuley | Muskegon | 152 | Assisted Living Centers & Nursing Homes |
| Scherdel Sales & Technology | Muskegon | 155 | Transportation Equipment Manufacturing |
| Shoreline Vision | Muskegon | 134 | Physicians & Surgeons |
| Structural Concepts | Norton Shores | 530 | Furniture & Related Product Manufacturing |
| Subway, Inc. - GNS Corporate Office | Norton Shores | 100 | Business Consultants |
| Sun Chemical | Muskegon | 130 | Chemical Manufacturing |
| Textron | Muskegon | 330 | Transportation Equipment Manufacturing |
| Tramec Sloan Fleet Engineers Division | Muskegon | 150 | Transportation Equipment Manufacturing |
| Trinity Health Muskegon | Muskegon | 3,457 | Hospitals & Urgent Care |
| Walmart - Henry Street | Muskegon | 350 | Grocery & Hardware |
| Webb Chemical Service Corp. | Muskegon Heights | 103 | Chemical Manufacturing |
| Wesco, Inc. | Muskegon | 865 | Gas & Convenience Stores |
| Whitehall District Schools | Whitehall | 285 | Schools |

Table 15, Neighboring Jurisdictions Employers serving Muskegon County with Over 100 Employees

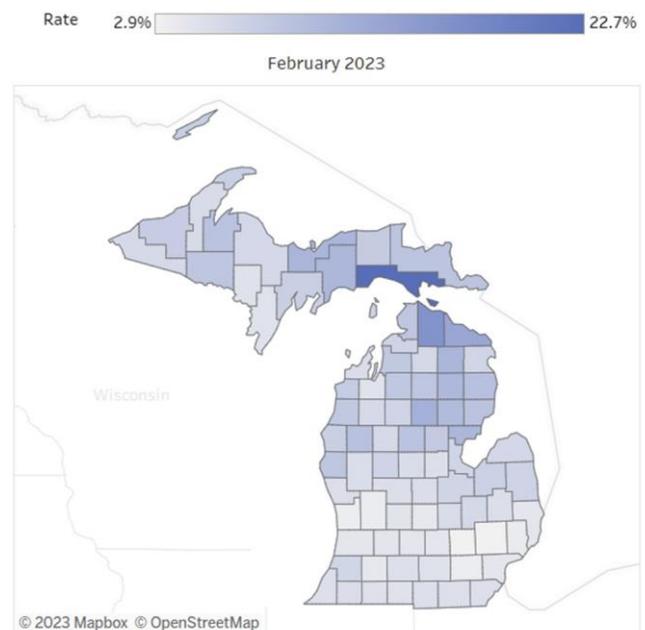
Source: Muskegon Lakeshore Chamber of Commerce

| Company | Location | Approx # Of Employees | Product/Service |
|--|------------------------|-----------------------|---|
| Allen Edwin Homes | Spring Lake, Ottawa Co | 105 | Metal Stamping |
| BDO USA, LLP | Grand Rapids, Kent Co | 104 | Financial Services |
| Bennett Pump | Spring Lake, Ottawa Co | 150 | Pump and Pumping Equipment |
| Corewell Health | Fremont, Newaygo Co. | 16,039 | Hospitals and Urgent Care |
| Custer Inc | Grand Rapids, Kent Co | 100 | Office equipment, furniture, and supplies |
| DISHER | Zeeland, Ottawa Co | 120 | Business consultants |
| EV Construction | Holland, Ottawa Co | 132 | Builders and Construction |
| Landscape Design Services, Inc. | Holland, Ottawa Co | 110 | Landscape and Lawn Care |
| Progressive AE | Grand Rapids, Kent Co | 200 | Architects |
| Rockford Construction | Grand Rapids, Kent Co | 100 | Developers |
| Shape Corporation | Grand Haven, Ottawa Co | 1,700 | Fabricated Metal Product Manufacturing |
| Turning Leaf Behavioral Health Services, Inc. / New Leaf Management, LLC | Lansing | 225 | Assisted Living Centers & Nursing Homes |
| Wolverine Building Group | Grand Rapids, Kent Co | 111 | Developers |
| WOOD TV | Grand Rapids, Kent Co | 133 | Media |

Unemployment Data

Muskegon County has historically experienced a slightly higher unemployment rate than the State of Michigan. These facts are illustrated in Table 16, Muskegon County Employment Statistics, 2002-2023.

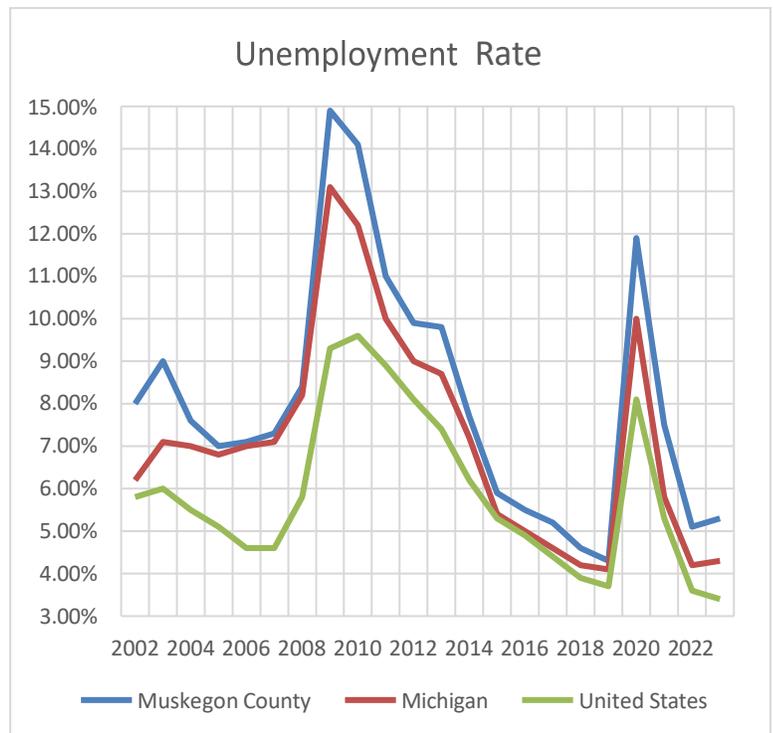
Jobless Rates by County



Source: Local Area Unemployment Statistics, Michigan Center for Data and Analytics, Michigan Department of Technology, Management & Budget.

Table 16: Muskegon County Employment Statistics, Annual Jobless Rate 2002-2023
 Sources: Michigan Department of Energy, Labor, and Economic Growth, Labor Market Information Data Explorer

| Year | Muskegon County | MI | United States |
|------|-----------------|-------|---------------|
| 2002 | 8.0% | 6.2% | 5.8% |
| 2003 | 9.0% | 7.1% | 6.0% |
| 2004 | 7.6% | 7.0% | 5.5% |
| 2005 | 7.0% | 6.8% | 5.1% |
| 2006 | 7.1% | 7.0% | 4.6% |
| 2007 | 7.3% | 7.1% | 4.6% |
| 2008 | 8.4% | 8.2% | 5.8% |
| 2009 | 14.9% | 13.1% | 9.3% |
| 2010 | 14.1% | 12.2% | 9.6% |
| 2011 | 11.0% | 10.0% | 8.9% |
| 2012 | 9.9% | 9.0% | 8.1% |
| 2013 | 9.8% | 8.7% | 7.4% |
| 2014 | 7.7% | 7.2% | 6.2% |
| 2015 | 5.9% | 5.4% | 5.3% |
| 2016 | 5.5% | 5.0% | 4.9% |
| 2017 | 5.2% | 4.6% | 4.4% |
| 2018 | 4.6% | 4.2% | 3.9% |
| 2019 | 4.3% | 4.1% | 3.7% |
| 2020 | 11.9% | 10.0% | 8.1% |
| 2021 | 7.5% | 5.8% | 5.3% |
| 2022 | 5.1% | 4.2% | 3.6% |
| 2023 | 5.3% | 4.3% | 3.4% |



Socio-Economic Levels

Socio-Economic statistics such as median household income, per capita income, and the number of individuals living below poverty level all indicate that Muskegon County closely resembles the State of Michigan. In 2021, Muskegon County’s Median Household Income was \$55,462, which is slightly lower than Michigan’s Median Household Income of \$63,498. The County also has a lower per capita income than the State. In addition, the county is about 10 percent higher than the persons below poverty line in Michigan. The percentage of residents below the poverty level in the County is 14.2% and the persons below the poverty line in Michigan’s is 13.1%.

Income

\$27,278

Per capita income

about three-quarters of the amount in Michigan: \$35,353

about two-thirds of the amount in United States: \$38,332

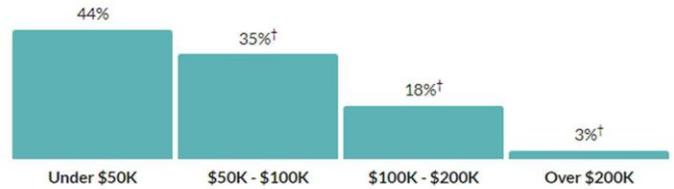
\$55,462

Median household income

about 90 percent of the amount in Michigan: \$63,498

about 80 percent of the amount in United States: \$69,717

Household income



Show data / Embed

Household income (Table B19001) [View table](#)

| Column | Muskegon County | | | | Michigan | | | | United States | | | |
|-----------------|-----------------|-------|--------|----------|----------|-------|-----------|-----------|---------------|-------|------------|------------|
| Under \$50K | 43.6% | ±3.9% | 29,523 | ±2,684.2 | 39.6% | ±0.5% | 1,603,972 | ±20,207.2 | 36.5% | ±0.1% | 46,510,495 | ±128,378.1 |
| \$50K - \$100K | 35.4%† | ±3.7% | 23,974 | ±2,514.2 | 31.3% | ±0.4% | 1,268,969 | ±17,732.4 | 29.6% | ±0.1% | 37,720,152 | ±107,083.7 |
| \$100K - \$200K | 18.1%† | ±2.2% | 12,231 | ±1,505.7 | 22.4% | ±0.3% | 905,537 | ±12,995.8 | 24.2% | ±0.1% | 30,837,651 | ±97,102.1 |
| Over \$200K | 2.9%† | ±1.1% | 1,979 | ±709 | 6.8% | ±0.2% | 273,320 | ±6,137 | 9.8% | ±0.1% | 12,476,432 | ±60,207 |

Hide data

Poverty

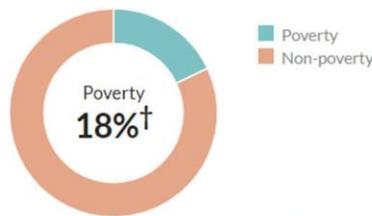
14.2%

Persons below poverty line

about 10 percent higher than the rate in Michigan: 13.1%

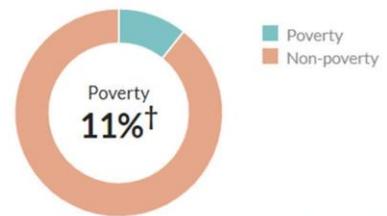
about 10 percent higher than the rate in United States: 12.8%

Children (Under 18)



Show data / Embed

Seniors (65 and over)



Hide data / Embed

Seniors (65 and over) (Table B17001) [View table](#)

| Column | Muskegon County | | | | Michigan | | | | United States | | | |
|-------------|-----------------|-------|--------|----------|----------|-------|-----------|----------|---------------|-------|------------|-----------|
| Poverty | 10.7%† | ±2.6% | 3,418 | ±824.8 | 9.3% | ±0.3% | 165,605 | ±5,449.5 | 10.3% | ±0.1% | 5,623,616 | ±38,389.1 |
| Non-poverty | 89.3% | ±4.9% | 28,399 | ±1,019.8 | 90.7% | ±0.5% | 1,621,690 | ±6,189.9 | 89.7% | ±0.1% | 49,118,178 | ±44,581.4 |

Chart from Censusreporter.org/profiles raw data converted from the 2020 Census

Key Community Facilities and Organizations

Key Private and Non-Profit Service Organizations

In Muskegon County there are 182 registered non-profit organizations, many of which may prove to be beneficial in both the mitigation and recovery phases of disaster response. In addition, due to consolidation of services, some organizations serve a multi-county geographic area and are located outside of Muskegon County. Table 44, Key Private and Non-Profit Service Organizations Serving Muskegon County lists some of primary organizations benefiting the entire county.

Table 44, Key Private and Non-Profit Service Organizations Serving Muskegon County

| Organization & Location | Primary Focus |
|--|--|
| <p>AgeWell Services 275 Clay Ave #100 Muskegon, MI 49440 Phone: 231.755.0434 1.800.442.6769 https://agewellservices.org/</p> | AgeWell Services provides programs in Muskegon, Ottawa and Oceana counties. A 501 (c)(3) non-profit formerly known as Nutritional Services for Older Americans (NSOA) and Meals on Wheels. The agency began in 1973 and has expanded from a nutrition program to offer a complete array of wellness opportunities for older adults. |
| <p>American Red Cross West Michigan Regional Office 3886 Broadmoor Ave SE Grand Rapids, MI 49512 Phone: 616.456.8661 www.redcross.org/local/michigan.html</p> | The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disaster and helps people prevent, prepare for, and respond to emergencies. It does this through services that are consistent with its Congressional Charter and the Fundamental Principles of the International Red Cross and Red Crescent Movement. |
| <p>Child Abuse Council of Muskegon County 1781 Peck St Muskegon, MI 49441 231.728.6410 www.childabusecouncil.org</p> | The mission of the Child Abuse Council of Muskegon County is to prevent and treat child abuse and neglect through education, child advocacy, and community collaboration. |
| <p>Community Access Line of the Lakeshore (CALL) 2-1-1 PO Box 1101 Muskegon, MI 49443 Phone: 231.733.1155 www.call-211.org</p> | Community Access Line of the Lakeshore's (CALL) is a nonprofit agency whose mission is to increase access to community resources through information and referral services. The 2-1-1 line is available 24/7/365 and connects people with local human services. CALL 2-1-1 also partners with local emergency management and state government to assist with emergency public information sharing needs. |
| <p>Community Foundation for Muskegon County 425 W Western Ave STE 200, Muskegon, MI 49440 Phone: 231.722.4538 https://muskegonfoundation.org/</p> | The Vision of the Community Foundation for Muskegon County is to be a leader in community philanthropy and build a vibrant community with opportunities for all. The Foundation is committed to promoting acceptance, inclusiveness, and cultural competence in its practices for governance and administration, community leadership, grantmaking, philanthropic services, and personnel and employment policies. |

| | |
|--|---|
| <p>Convention and Visitors Bureau 610 W. Western Ave, Muskegon, MI 49440 Phone: 231.724.3100 https://www.visitmuskegon.org/</p> | <p>Visit Muskegon is the official destination marketing organization for Muskegon County, Michigan. Our mission is to increase tourism and tourism related economic development through marketing, destination development and group sales. Visit Muskegon is funded by Muskegon county-wide accommodation taxes, paid by visitors to our lodging establishments.</p> |
| <p>Disability Network West Michigan 27 E Clay Ave Muskegon, MI 49442 Phone: 231.722.0088 Website: https://disabilitynetworkwm.org/</p> | <p>Disability Network West Michigan provides independent living resources for people with disabilities in Muskegon, Oceana, Newaygo, Lake, and Mason Counties. They also assist in facilitating workplace accessibility, transportation, eliminating barriers to employment and assisting with social security benefits.</p> |
| <p>Every Woman's Place 1221 W Laketon Ave, Muskegon, MI 49441 Phone: 231.759.7909 www.everywomansplace.org/</p> | <p>Every Woman's Place (EWP) is a dual service agency providing comprehensive services to all individuals impacted by domestic violence, sexual assault, sex trafficking and stalking in Muskegon County, Michigan. EWP is for all victims/survivors, without exception with residential and non-residential services</p> |
| <p>Feeding America West Michigan Administration 1950 Waldorf St NW #10B Grand Rapids, MI 49544 Phone: 616.784.3250 www.feedwm.org</p> | <p>Feeding America West Michigan is a hunger-relief organization whose mission is to gather and distribute food to relieve hunger and increase food security in West Michigan and the Upper Peninsula. The organization serves residents through an expansive hunger-relief network consisting of hundreds of food pantries and meal programs across 40 counties.</p> |
| <p>The Hope Project 1516 Peck St Muskegon, MI 49441 Phone: 231.747.8555 https://www.hopeprojectusa.org/</p> | <p>The Hope Projects Vision is to end suffering from sex trafficking. Their mission is to support the healing of girls and women who have survived sex trafficking and prevent further cases through mentoring and education.</p> |
| <p>Kids Food Basket Muskegon 1537 Getty St Muskegon, MI 49442 Phone: 231.747.8575 Website: https://kidsfoodbasket.org/</p> | <p>Kids Food basket works collaboratively to meet the needs of every child and family we serve, we aim to pursue a hunger-free West Michigan in a way that promotes the experiences and passion of our local community.</p> |
| <p>Love Inc of Muskegon County 1051 Peck St Muskegon, MI 49440 Phone: 231.773.3448 https://loveincofmuskegon.com/</p> | <p>Love INC is a national ministry carried out by more than 9,000 churches in over 150 affiliates across the United States. Love INC reaches out to vulnerable community members living in poverty and provides tangible assistance, encouragement, and hope. Services include money management classes, resale store, food pantry, delivery truck, ramp ministry, and the Clearinghouse.</p> |

| | |
|---|---|
| <p>Mission for Area People 2500 Jefferson St Muskegon, MI 49444 Phone: 231.733.9672 https://www.missionforareapeople.org/</p> | <p>MAP is a nonprofit, faith-based agency dedicated since 1967 to serving the poor and underserved residents of Muskegon County through our healthy choice food pantry, Jefferson St. community garden, free clothing pantry, rent and utility assistance and the medical support fund. This agency helps neighbors in need; the low income, unemployed, homeless, and lower income working people of Muskegon County who have an emergency need.</p> |
| <p>Muskegon YMCA 1115 Third St Muskegon, MI 49441 Phone: 231.722.9622 www.muskegonymca.org</p> | <p>The Muskegon YMCA promotes youth development, healthy living and social responsibility through programs and activities addressing community health and wellness needs. The Y serves over 10,000 individuals annually through outreach programs at over 25 sites throughout Muskegon County.</p> |
| <p>Sacred Suds/ Community enCompass 1105 Terrace St., Muskegon, MI 49442 Phone 231.728.3117. http://www.communityencompass.org/</p> | <p>Projects include Bethany Housing, HARA – Muskegon County, Youth Empowerment project (YEP), C.A.T.C.H Camp, Muskegon Prescribes Food For Health (MPFH), Mclaughlin Grows Urban Farm, Community Supported Agriculture, Compost Program, Sacred Suds, Christmas Store, and “I Am Neighbor”</p> |
| <p>Salvation Army 1221 Shonot St Muskegon, MI 49442 Phone: 231.773.3284 https://centralusa.salvationarmy.org/Muskegon/</p> | <p>The Salvation Army is an international non-profit church-based organization that houses programs such as youth programs, missing persons, emergency disaster relief, adult rehabilitation, elderly services, utility assistance, and donations centers.</p> |
| <p>Senior Resources Tanglewood Park 560 Seminole Rd Muskegon, MI 49444 Phone: 231.733.3585 www.seniorresourceswmi.org</p> | <p>Senior resources is the Area Agency on Aging that supports independence, dignity, and well-being of older adults and adults with disabilities in Muskegon, Oceana and Ottawa counties to deliver services aimed to keep individuals in their own homes or a family member’s home as they age; provides care management services; and administers grant-based funds and the Muskegon County Senior Millage.</p> |
| <p>Step Up P.O. Box 1626 Muskegon, MI 49443 Phone: n/a Website: https://www.stepupmuskegon.org/home</p> | <p>Step Up was formally organized in May of 2015 after the founding board members learned of the significant number of youth in our community aging out of the foster care system. These youth, like other foster youth throughout Michigan, age out of their foster homes at age 18. Less than 50% of former foster youth maintain strong, supportive relationships with their foster families. When they age out, they are expected to live on their own.</p> |
| <p>Muskegon Rescue Mission 2735 E Apple Avenue Muskegon, MI 49442 Phone: 231.727.6090 https://muskegonmission.org/</p> | <p>Muskegon Rescue Mission is able to address the root cause of distress by relieving the immediate needs of our hurting neighbors, and offers the spiritual nourishment necessary to effect true and lasting change.</p> |

| | |
|---|---|
| <p>Muskegon YMCA 1115 Third St Muskegon, MI 49441 Phone: 231.722.9622 www.muskegonymca.org</p> | <p>The Muskegon YMCA promotes youth development, healthy living and social responsibility through programs and activities addressing community health and wellness needs. The Y serves over 10,000 individuals annually through outreach programs at over 25 sites throughout Muskegon County.</p> |
| <p>Pound Buddies 3279 E Laketon Ave Muskegon, MI 49442 Phone: 231.724.6500 www.poundbuddies.org</p> | <p>Pound Buddies is a nonprofit agency and Muskegon County's largest and only open admission shelter. They admit all dogs regardless of breed, age, health or disposition-not just dogs that are excellent candidates for adoption and is licensed to care for a limited number of cats Pound Buddies also provides all Animal Care and Control for Muskegon County..</p> |
| <p>United Way of the Lakeshore 31 E Clay Ave Muskegon, MI 49442 Phone: 231.722.3134 www.unitedwaylakeshore.org</p> | <p>United Way of the Lakeshore Through United Way, communities tackle tough challenges and work with private, public, and nonprofit partners to boost education, economic mobility, and health resources. United Way volunteers, donors and advocates to make a difference at the local level and serves as a "community safety net" for those in need.</p> |
| | |

Public Safety Serving Muskegon County

Like most rural communities with limited resources, Muskegon County has adapted its public safety systems to meet local needs. The existing strength of local public safety has been a focus toward advancement of services provided to the public, resulting in progressive and advanced capabilities compared to jurisdictions of comparable size.

Emergency Management

The purpose of the Emergency Services Department is to direct the jurisdiction's efforts in the prevention of, preparedness for, response to, and recovery from emergencies, disasters, and threats within the County of Muskegon with the goal of saving lives, preventing property damage, and minimizing damage to the environment. In January of 2007, Muskegon County Emergency Services began a dedicated, full-time emergency management program. Under direction of the Chairperson of the Muskegon County Board of Commissioners, the Emergency Services Department provides support to the jurisdiction's emergency services system by coordinating necessary planning, training, exercising, and resource management.

Muskegon County Emergency Management

1903 Marquette Ave,
Muskegon, MI 49442
Phone: 231.724.6341 Fax: 231.777.9940
[https://www.co.muskegon.mi.us/204/Emergency-
Management](https://www.co.muskegon.mi.us/204/Emergency-Management)

Central Dispatch

Muskegon County Central Dispatch is the central point of contact for all public warning and responder communications within Muskegon County. Muskegon Central Dispatch 9-1-1 proudly serves approximately 172,000 people of Muskegon County and coordinates emergency response among 15 Fire Agencies, 11 Police Agencies, and 2 Ambulance Services. Muskegon Central Dispatch 9-1-1 employs over 30 people.

Muskegon Central Dispatch 911

770 Terrace St,
Muskegon, MI 49440
Phone: 231.722.3524

Website:

<https://mcd911.net/about/>

Law Enforcement

Muskegon County is served entirely by both, the Muskegon County Sheriff's Department and Michigan State Police Post 61. Their efforts are supported by 9 municipal police departments.

Michigan State Police – Grand Rapids Post No. 61

2290 4 Mile Rd NW,
Grand Rapids, MI 49544

Phone: 616.866.4411 Fax: 616.866.4783

Website: <https://www.michigan.gov/msp/posts/sixth-district---west>

Muskegon County Sheriff Department

990 Terrace St,
Muskegon, MI 49442
Phone: 231.724.6351

<https://www.co.muskegon.mi.us/1709/Sheriffs-Office>

Fruitport Police Department

5825 Airline Rd,
Fruitport, MI 49415

Phone: 231.865.8477 Fax: 231.865.2173

<https://www.cityoffremont.net/235/Police-Department>

City of Muskegon Police Department

933 Terrace St.,
Muskegon, MI 49440

Phone: 231.724.6903 Fax: 231.724.2043

<https://muskegon-mi.gov/city-services/public-safety-inspections/police/>

Muskegon Township Police Department

1990 E Apple Ave.,
Muskegon, MI 49442

Phone: 231.777.1666 Fax: 231.777.4912

<https://muskegontwpmi.gov/police-department/>

Muskegon Heights Police Department

| | | |
|--|---|--|
| | <p>2715 Baker St, Muskegon, MI 49444 Phone: 231.733.8900 https://muskegonheights.us/police</p> | |
| | <p>Montague Police Department 8778 Ferry St #1, Montague, MI 49437 Phone: 231.893.0810 Fax: 231.893.3903 https://cityofmontague.org/about/police-department/</p> | |
| | <p>North Muskegon Police Department 1114 Ruddiman Dr., North Muskegon, MI 49445 Phone: 231.744.4313 Fax: https://www.northmuskegon.org/departments/police-dept/</p> | |
| | <p>Norton Shores Police Department 4814 Henry St, Muskegon, MI 49441 Phone: 231.733.2691 Fax: 231.798.1968 https://nortonshores.org/police</p> | |
| | <p>Roosevelt Park Police Department 900 Oakridge Rd, Muskegon, MI 49441 Phone: 231.755.3721 Fax: https://rooseveltpark.org/police/</p> | |
| | <p>Whitehall Police Department 404 E Colby Street, Whitehall, MI 49461 Phone: 231.894.4048 Fax: 231.893.4708 https://cityofwhitehall.org/city-hall/police-department/</p> | |

Fire Services

Muskegon County is served by twelve Fire Departments as well as The Department of Natural Resources Muskegon office. Capabilities among departments are similar in provision of fire suppression and technical rescue capabilities. Due to limited manpower and equipment, all departments have an existing mutual aid system which is regularly utilized.

| | |
|--|--|
| <p>Blue Lake Township Fire Department St 1 1491 Owasippe Rd, Twin lake MI 49457 Phone: 231.894.5926 https://www.facebook.com/BLTFD/</p> | <p>Muskegon Charter Township Fire Dept St 2 1699 N Getty St. Muskegon, MI 49442 Phone: 231-744-4365 https://muskegontwp.org/fire-department</p> |
| <p>Blue Lake Township Fire Department St 2 796 East White Lake Dr, Twin Lake MI 49457 Phone: 231.894.5926 https://www.facebook.com/BLTFD/</p> | <p>Muskegon Fire Department Central Station 770 Terrace St Muskegon, MI 49440 Phone: 231.724.6792 Fax: 231.724.6985 https://muskegon-mi.gov/city-services/public-safety-inspections/fire/</p> |

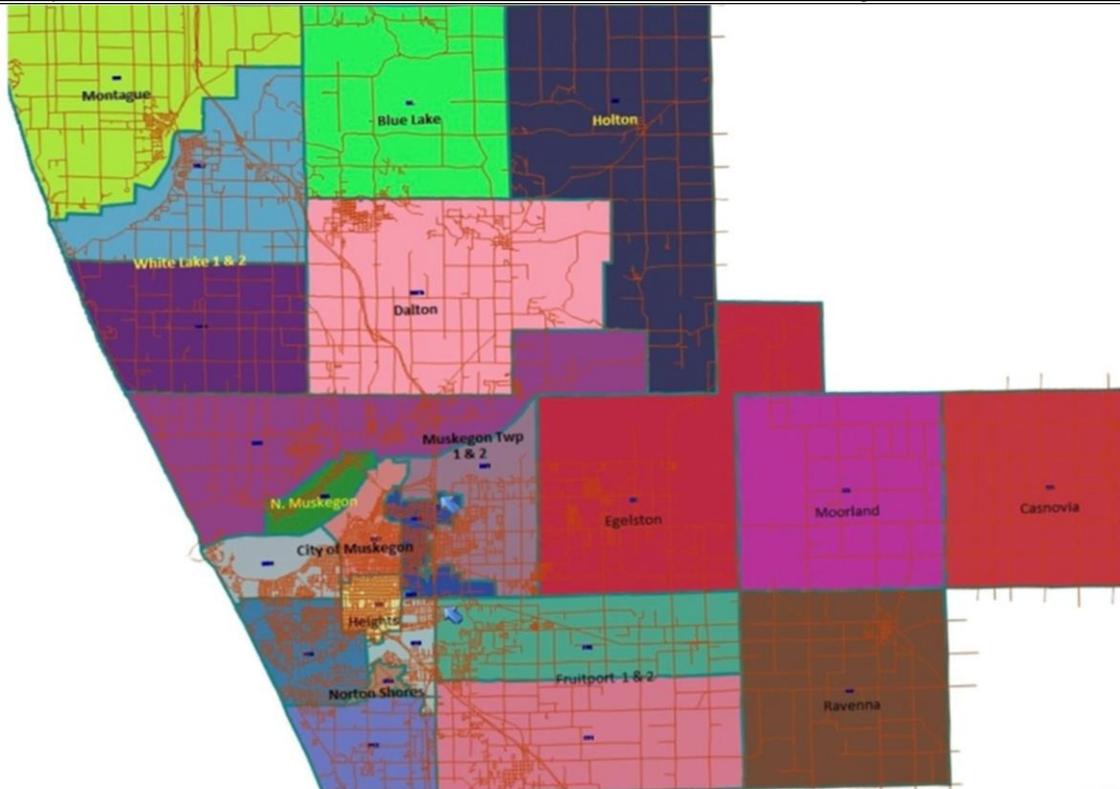
| | |
|---|---|
| <p>Casnovia Township Fire Department 17569 Bailey Rd, Bailey MI Phone: 231.332.6721 https://casnoviatownshipmi.gov/fire-department/</p> | <p>Muskegon Fire Department St 4 1836 Robinson St, Muskegon, MI 49441 231.724.4208 https://muskegon-mi.gov/city-services/public-safety-inspections/fire/</p> |
| <p>Dalton Township Fire Department 1650 E Riley-Thompson Rd, Muskegon, MI 49445 Phone: 231.332.6710 Township Fax: 231.766.2636 https://daltontownship.org/fire-department/</p> | <p>Muskegon Fire Department St 5 1477 Marquette Ave, Muskegon, MI 49442 231.724.4209 https://muskegon-mi.gov/city-services/public-safety-inspections/fire/</p> |
| <p>Egelston Township Fire Department 5380 E Apple Ave, Muskegon, MI 49442 Phone: 231.788.2254 www.egelstontwp.org/Departments/FireDepartment.aspx</p> | <p>Muskegon Heights Fire Department 2715 Baker St Muskegon, MI 49444 Phone: 231.733.2189 https://muskegonheights.us/fire-department/</p> |
| <p>Fruitport Township Fire Department St 1 3638 Black Creek Rd. Muskegon, MI 49444 Phone: 231.773.9312 https://fruitporttownship-mi.gov/stations-and-apparatus/</p> | <p>North Muskegon Fire Department 1102 Ruddiman Dr North Muskegon, MI 49445 Phone: 231-744-1766 https://cityofnorthmuskegon.com/departments/fire-dept/</p> |
| <p>Fruitport Township Fire Department St 2 5815 Airline Hwy Fruitport, MI 49415 Phone: 231.865.6106 https://fruitporttownship-mi.gov/stations-and-apparatus/</p> | <p>Norton Shores Fire Department Station 1 1577 Seminole Road., Norton Shores, MI 49441 Phone: 231.780.2885 Fax:231.747.7924 https://nortonshores.org/fire</p> |
| <p>Holton Township Fire Department 6590 Holton Whitehall Rd Holton MI 49425 Phone: 831.821.2168 https://holtontownship.com/departments/fire-department/</p> | <p>Norton Shores Fire Department Station 2 3920 Airline Rd., Norton Shores, MI 49444 Phone: 231.739.6597 Fax: 231.747.7924 https://nortonshores.org/fire</p> |
| <p>Michigan DNR Muskegon Office 7550 Messinger Rd, Twin lake, MI 49457 Phone: 231.788.5062 www.michigan.gov/dnr/managing-resources/forestry/fire</p> | <p>Norton Shores Fire Department Station 3 1100 E. Pontaluna Rd. Norton Shores, MI 49444 231.798.2255 Fax: 231.747.7924 https://nortonshores.org/fire</p> |
| <p>Montague Fire District 5085 Wilcox St., Montague MI 49437 Phone: 231.893.3311 https://cityofmontague.org/about/fire-department/</p> | <p>Norton Shores Fire Department Station 4 Provides Muskegon County Airport Coverage 115 Sinclair Drive, Norton Shores, MI 49441 Phone: 231.798.2255 Fax: 231.747.7924</p> |

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| | https://nortonshores.org/fire |
| Moorland Township Fire Department 12416 E Apple Ave, Ravenna, MI 49451 Phone: 231.853.2213 www.moorlandtwp.com/FireDepartment.aspx | Ravenna Area Fire Department 3763 Blackmer Rd., Ravenna, MI 49451 Phone: 231.853.6196 Fax: 231.853.5155 www.ravennatwp.com/fire-department/ |
| Muskegon Charter Township Fire Dept St 1 1117 S Walker Rd. Muskegon, MI 49442 Phone: 231.773.4316 https://muskegontwp.org/fire-department | White Lake Fire Authority 1300 Delaney Dr., Whitehall, MI 49461 Phone: 231-893-6503 https://whitelakefireauthority.com/ |

Muskegon County Fire Departments Full Time and Part Paid Staffing

| Fire Department | Full Time Staff | Paid On Call Staff |
|------------------------------|-----------------|--------------------|
| Blue Lake Township | | x |
| Casnovia FD | | x |
| Dalton Township FD | x | x |
| Egelston Township FD | x | x |
| Fruitport Area FD | x | x |
| Holton Township FD | | x |
| Montague FD | | x |
| Moorland FD | | x |
| Muskegon FD | x | |
| Muskegon Charter Township FD | x | x |
| Muskegon Heights FD | x | |
| North Muskegon FD | x | x |
| Norton Shores FD | x | x |
| Ravenna Area FD | | x |
| White Lake FD | x | x |

Muskegon County Fire Departments Coverage Map



Emergency Medical Services (EMS)

Muskegon County is served by two private EMS services, Trinity Health EMS (Pro Med), and White Lake Ambulance.

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|--|
| <p style="text-align: center;">Trinity Health EMS 965 Fork St, Muskegon MI 49412 Phone: (231) 720-1804 https://www.promed.org/</p> |
| <p style="text-align: center;">White Lake Ambulance Authority Whitehall Township Station 8220 Whitehall Rd, Whitehall, MI 49461 Montague Fire District 5085 Wilcox St, Montague, MI 49437 Phone: (231) 894-4306 Fax: (231) 893-0249 https://whitelakeems.com/</p> |

Health Care – Hospitals, Primary Care, Urgent Care

Muskegon County has one hospital, Trinity Health Muskegon Hospital. Built between 2016-2019, the hospital is an energy-efficient, green facility comprised of 10 stories featuring 267 rooms; a new Emergency Department; state-of-the-art surgical and procedural areas; and a host of modern

amenities and technologies. The hospital provides a complete range of laboratory, medical and surgical services. Trinity Health Medical Group is a multi-specialty physician network that employs more than 500 physicians and advanced practice professionals in Grand Rapids, Grand Haven, Muskegon and the Lakeshore.

| | |
|--|--|
| Trinity Health Muskegon Hospital 1500 E Sherman Blvd, Muskegon MI 49444 Phone: 231.672.2000 www.trinityhealthmichigan.org/location/trinity-health-muskegon-hospital | |
| Trinity Health Medical Group Primary Care – Muskegon Campus 1223 Mercy Dr, Muskegon, MI 49444 Phone: 231.672.3177 | Trinity Health Medical Group Primary Care & Geriatrics, Sherman Pavilion 1150 E Sherman Blvd, Muskegon, MI 49444 Phone: 231.672.6740 |
| Trinity Health Medical Group Primary Care & Pediatrics, North Muskegon 2006 Holton Rd, Muskegon, MI 49445 Phone: 231.672.3333 | Trinity Health Medical Group Family Medicine – Fruitport 3443 Farr Rd, Fruitport, MI 49415 Phone: 231.672.2900 |
| Trinity Health Medical Group Primary Care, Norton Shores 3570 Henry St, Muskegon, MI 49441 Phone: 231.672.7000 | Trinity Health Medical Group Primary Care – Lakes Village 6401 Prairie St, Norton Shores, MI 49444 Phone: 231.672.3177 |
| Trinity Health Urgent Care Sherman 1670 E Sherman Blvd, Muskegon, MI 49444 Phone: 231.672.3600 | Trinity Health Urgent Care North Muskegon 2006 Holton Rd, Muskegon, MI 49444 Phone: 231.672.3333 |

Corewell Health also serves the Muskegon County community. Corewell Health built a Spectrum Health Integrated Care Campus in North Muskegon in 2016. It is home to a range of coordinated health services from diagnostics to primary and specialty care. Corewell Health also has an Advance Primary Care practice in Muskegon for those who are 64 years-of-age and older.

| | |
|--|--|
| Corewell Health Integrated Care Campus North Muskegon 2009 Holton Rd, Muskegon, MI 49445 Phone: 231.291.8300 | Spectrum Health Medical Group, Advanced (64+) Primary Care, Muskegon 2558 Henry St, Muskegon, MI 49441 Phone: 231.291.8150 |
|--|--|

Health Care – Pediatrics

Muskegon County has three independent pediatric practices that provide comprehensive care for children from birth to age 18. The hospital-associated primary care offices as well as the Federally Qualified Health Centers also offer pediatric care.

| | |
|--|---|
| <p>Muskegon Pediatrics 888 Terrace St, Ste 101, Muskegon, MI 49440 Phone: 231.638.4120 www.muskegonpediatrics.com</p> | <p>Port City Pediatrics 1455 Farr Rd, Norton Shores, MI 49444 Phone: 231.739.8502 www.portcitypediatrics.com</p> |
| <p>Shoreline Pediatrics 2680 Vulcan St, Muskegon, MI 49444 Phone: 231.777.2732 www.shorelinepeds.com</p> | |

Health Care – Federally Qualified Health Centers

Muskegon County has two Federally Qualified Health Centers (FQHC). FQHCs qualify for funding under Section 330 of the Public Health Service Act (PHS) and for enhanced reimbursement from Medicare and Medicaid. FQHCs serve an underserved area or population and provide healthcare services on a sliding fee scale.

Hackley Community Care Center is the larger of the two FQHCs in Muskegon County. Hackley Community Care (HCC) employs over 300 staff board-certified physicians and mid-level providers. Their health care providers specialize in primary medical services, OB and Women’s health, mental health, dental services, school-based health programs and pharmacy services.

| | |
|---|---|
| <p>Hackley Community Care Center Medical Baker Site 2700 Baker St, Muskegon, MI 49444 Phone: 231.737.1335 www.hackleycommunitycare.org</p> | <p>Hackley Community Care Center Medical Leahy Site 1675 Leahy St, Ste 103, Muskegon, MI 49442 Phone: 231.737.1335</p> |
| <p>Hackley Community Care Center Integrated Health Clinic Site (HealthWest) 376 E Apple Ave, Muskegon, MI 49442 Phone: 231.737.1335</p> | <p>Hackley Community Care Center OB/Women’s Health/Pediatrics Forest Site 172 E Forest Ave, Muskegon, MI 49442 Phone: 231.737.1335</p> |
| <p>Hackley Community Care Center Muskegon Teen Health Center Muskegon High School 80 W Southern Ave, Muskegon, MI 49441 Phone: 231.733.6868</p> | <p>Hackley Community Care Center Oakridge Teen Health Center Oakridge Middle School 251 S Wolf Lake Rd, Muskegon, MI 49442 Phone: 231.733.6868</p> |
| <p>Hackley Community Care Center NowCare (Urgent Care) 1550 Clinton St, Muskegon, MI 49442 Phone: 231.737.1335</p> | |

Muskegon Family Care Center is the smaller of the two FQHCs in Muskegon County. Muskegon Family Care offers a full range of comprehensive primary care services, including immunizations, well-child care and family planning.

Muskegon Family Care Center
 2201 S Getty St,
 Muskegon, MI 49444
 Phone: 231.739.9315
www.mfc-health.org

Health Care – Tribal

The Little River Band of Ottawa Indians, Health Services operates two health clinics in Muskegon County. Services include family medicine, laboratory, radiology, pharmacy, a foot and ankle clinic as well as behavioral health. All direct care services are available to Tribal Members, descendants, or a member of any Federally Recognized Tribe. The service area includes Manistee, Mason, Wexford, Lake, Oceana, Newaygo, Kent, Muskegon, and Ottawa.

| | |
|--|---|
| <p>Little River Health Center Harvey 4905 S Harvey St, Norton Shores, MI 49444 Phone: 231.398.6601 www.lrboi-nsn.gov</p> | <p>Little River Health Center Ellis 1478 E Ellis Rd, Muskegon, MI 49444 Phone: 231.398.6601 www.lrboi-nsn.gov</p> |
|--|---|

Health Care – Veterans

The Veteran’s Affairs (VA) Battle Creek Health Center operates a satellite clinic In Muskegon County. The outpatient facility offers primary care and specialty health services, including mental health services, treatment for hearing loss (audiology), nutritional counseling, palliative care, laboratory services, treatment for post-traumatic stress disorder (PTSD), and more. A new facility is under construction and expected to open in Spring 2024.

Muskegon VA Clinic
 5000 Hakes Dr,
 Muskegon, MI 49441
 Phone: 231.798.4445
www.va.gov/battle-creek-health-care/locations/muskegon-va-clinic/

Road Commission and Department of Public Works

Muskegon County Road Commission services all state and county roads within Muskegon County. All municipal Department of Public Works services only municipal roads and infrastructure.

| | |
|---|---|
| Muskegon County Road Commission 7700 E Apple Ave, Muskegon, MI 49442 Phone: 231.788.2381 Fax: 231.788.5793 http://www.muskegoncountyroads.org/ | |
| Muskegon Department of Public Works 1350 E Keating Ave, Muskegon MI 49442 Phone: 231.724.4100 https://muskegon-mi.gov/city-services/public-works/ | City of Norton Shores Public Works 1174 E Mt Garfield Rd, Norton Shores, MI 49441 Phone: 231.799.6804 Fax: https://nortonshores.org/public-works |
| Muskegon Heights Public Works 3124 Wood St, Muskegon Heights MI 49444 Phone: 231.332.6762 Fax: https://muskegonheights.us/public-works/ | Montague Department of Public Works 4976 Bowen Street, Montague, MI 49437 Phone 231.893.2235 https://cityofmontague.org/about/department-of-public-works/ |
| North Muskegon Heights Public Works 2681 Celery Ln, Muskegon MI 49445 Phone: 231.744.3022 https://www.northmuskegon.org/departments/public-works/ | Roosevelt Park DPW 900 Oak Ridge Rd, Roosevelt Park, MI 49441 Phone: 231.755.3721 https://rooseveltpark.org/city-hall/public-works/ |
| Whitehall Department of Public Works 2055 Warner St, Whitehall, MI 49461 Phone: 231.894.4157 Fax: 231.894.6937 https://cityofwhitehall.org/city-hall/public-works-department/ | |

Government Offices and Facilities

Government facilities provide services to the public, such as the distribution of Public Information and the continuity of governmental operations including supporting the Incident Command System and key decision making processes. There are seven cities, sixteen township governments and four villages within Muskegon County. There are also six unincorporated communities. They include Bailey, Brunswick, Holton, Twin lake, Wabaningo, and Wolf lake.

County of Muskegon

1903 Marquette Ave
Muskegon, MI 49442
Phone: 231.724.6520

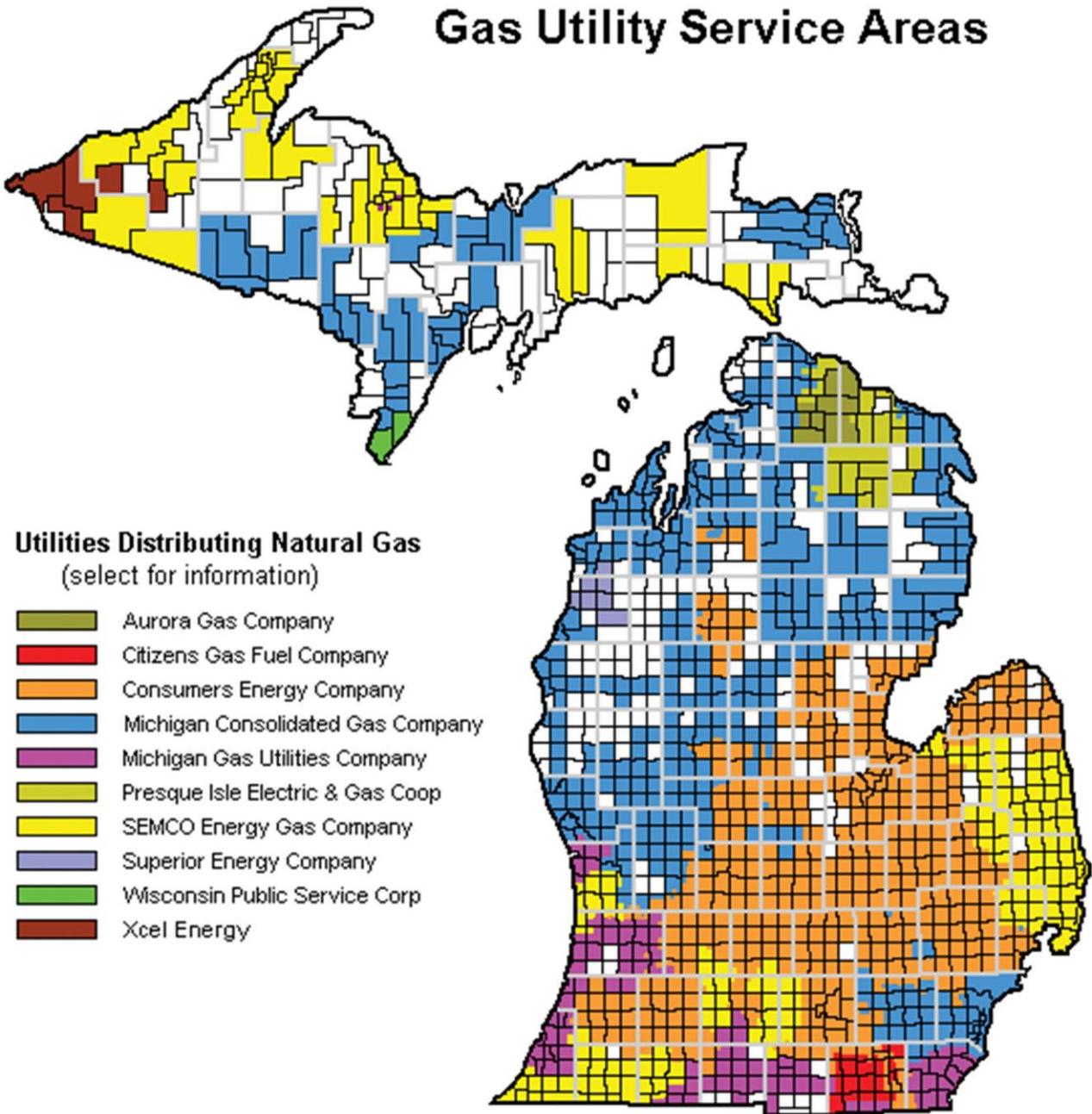
<https://co.muskegon.mi.us/27/County-Government>

Cities

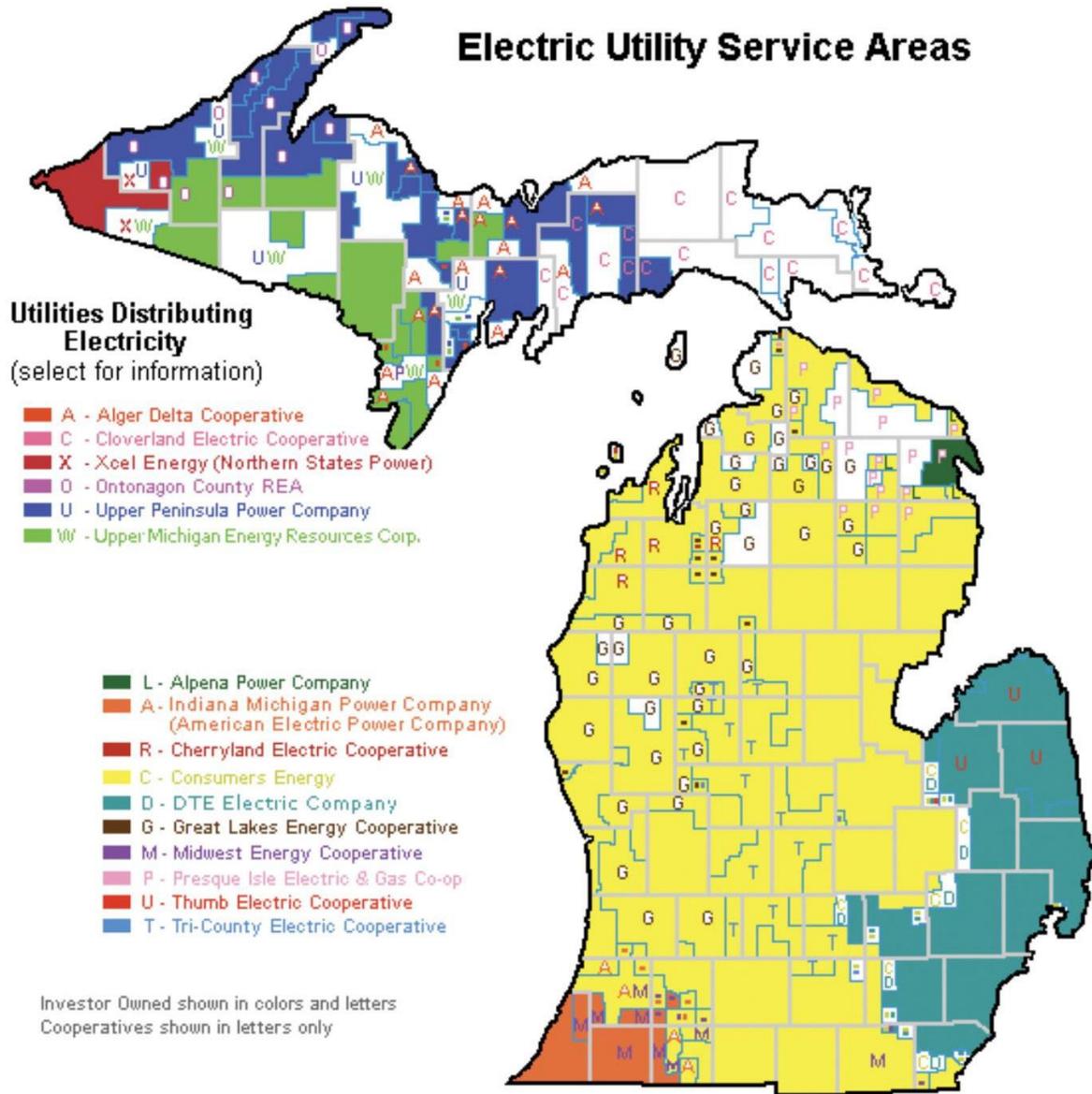
| | |
|--|---|
| <p>City of Montague 8778 Ferry St., Montague, MI 49437 Phone: 231.893.1155 Fax: 231.894.9955 www.cityofmontague.org</p> | <p>City of Muskegon Heights 2724 Peck St, Muskegon Heights, MI 49444 Phone: 231.733.8999 www.cityofmuskegonheights.org</p> |
| <p>City of Muskegon 933 Terrace St Muskegon MI 49440 Phone: 231.724.6705 Fax: 231.724.4178 https://muskegon-mi.gov/</p> | <p>City of North Muskegon 1502 Ruddiman Dr., Muskegon, MI 49445 Phone: 231.744.1621 Fax: 231.744.0367 www.cityofnorthmuskegon.com</p> |
| <p>City of Norton Shores 4814 Henry St, Norton Shores, MI 49441 Phone: 231.798.4391 Fax: 231.798.7103 www.nortonshores.org</p> | <p>City of Roosevelt Park 900 Oak Ridge Rd, Muskegon, MI 49441 Phone: 231.755.1442 Fax: 231.755.1442 www.rooseveltpark.org</p> |
| <p>City of Whitehall 405 E Colby St, Whitehall, MI 49461 Phone: 231.894.4048 Fax: 231.893.4708 www.cityofwhitehall.org</p> | |
| Townships | |
| <p>Blue Lake Township 1491 Owasippe Rd, Twin Lake, MI 49457 Phone: 231.894.6335 Fax: 231.893.3511 www.bluelaketownship.org</p> | <p>Casnovia Township 245 S. Canada Rd, Casnovia MI 49318 Phone 616.675.4064 Fax: 616.675.5611 https://casnoviatownshipmi.gov/</p> |
| <p>Cedar Creek Township 6556 Sweeter Rd, Twin Lake, MI 49457 Phone: 231.821.0014 Fax: 231.821.2725 www.cedarcreektownship.org</p> | <p>Dalton Township 1616 E. Riley Thompson Rd, Muskegon, MI 49445 Phone: 231.766.3043 Fax: 231.766.2636 www.daltontownship.org</p> |
| <p>Egelston Township 5428 E. Apple Ave., Muskegon, MI 49442 Phone: 231.788.2308 Fax: 231.788.5248 www.egelstontwp.org</p> | <p>Fruitport Township 5865 Airline Rd, Fruitport, MI 49415 Phone: 231.865.3151 Fax: 231.865.3118 www.fruitporttownship-mi.gov</p> |
| <p>Fruitland Township 4545 Nestrom Rd, Whitehall, MI 49461 Phone: 231.766.3208 Fax: 231.766.3027</p> | <p>Holton Township 6511 Holton Whitehall Rd, Holton, MI 49425 Phone: 231.821.2168 Fax: 231.821.2293</p> |

| | |
|--|--|
| www.fruitlandtwp.org | www.holtontownship.com |
| Laketon Township 2735 W Giles Rd., Muskegon, MI 49445 Phone: 231.744.2454 Fax: 231.744.2506 www.laketon.org | Montague Township 8915 Whitbeck Road, Montague, MI 49437 Phone: 231.894.4414 Fax: 231.894.1901 www.montaguetownship.com |
| Moorland Township 12416 E. Apple Ave, Ravenna, MI 49451 Phone: 231.853.2015 Fax: 231.853.5013 www.moorlandtwp.com | Muskegon Charter Township 1990 Apple Ave, Muskegon, MI 49442 Phone: 231.777.2555 Fax: 231.777.4912 www.muskegontwp.org |
| Ravenna Township 3770 Blackmer Road, Ravenna, MI 49451 Phone: 231.853.6205 Fax: 231.853.5155 www.ravennatwp.com | Sullivan Township 8138 Hts Ravenna Rd, Ravenna, MI 49451 Phone: 231.853.6900 Fax: 231.853.8702 www.sullivantownship.com |
| White River Township 7386 Post Road, Montague, MI 49437 Phone: 231.894.9216 Fax: 231.894.1906 https://whiterivertwp.com/ | Whitehall Township 7644 Durham Rd, Whitehall, MI 49461 Phone: 231.893.2095 Fax: 231.894.6660 www.whitehalltwp.org |
| Villages | |
| Village of Casnovia 141 N. Main St, Casnovia, MI 49318 Phone: 616.675.4780 Fax: 616.675.4780 www.casnoviavillage.org | Village of Fruitport 45 N Second St, Fruitport, MI 49415 Phone: 231.865.3577 Fax: 231.865.6789 www.villageoffruitport.com |
| Village of Lakewood Club 6681 Automobile Rd, Twin Lake, MI 49457 Phone: 231.894.9008 Fax: 231.893.8217 www.villageoflakewoodclub.org | Village of Ravenna 12090 Crockery Creek Dr, Ravenna, MI 49451 Phone 231.853.2360 Fax: 231.853.6443 https://ravennami.com/ |
| Unincorporated Communities | |
| Bailey Bailey is an unincorporated community on M-37 in the northeast corner of the township at. The zip code is 49303 | Brunswick Brunswick is a small unincorporated community in section 13 of the township of Holton. The zip code is 49425 |
| Holton Holton is a small community about 15 miles northeast of Muskegon at the corner of Holton Township. The zip code is 49425 | Twin Lake The Twin Lake Census Designated Place – CDP includes the area surrounding Twin Lakes, North Lake, and West Lake. The zip code is 49457 |
| Wabaningo Wabaningo is a small community where The White Lake flows through a short navigation channel into Lake Michigan. The zip code is 49463 | Wolf Lake Is located in Egelston Township. This Census Designated Place – CDP includes the entire shore line of Wolf Lake and a bit south. |

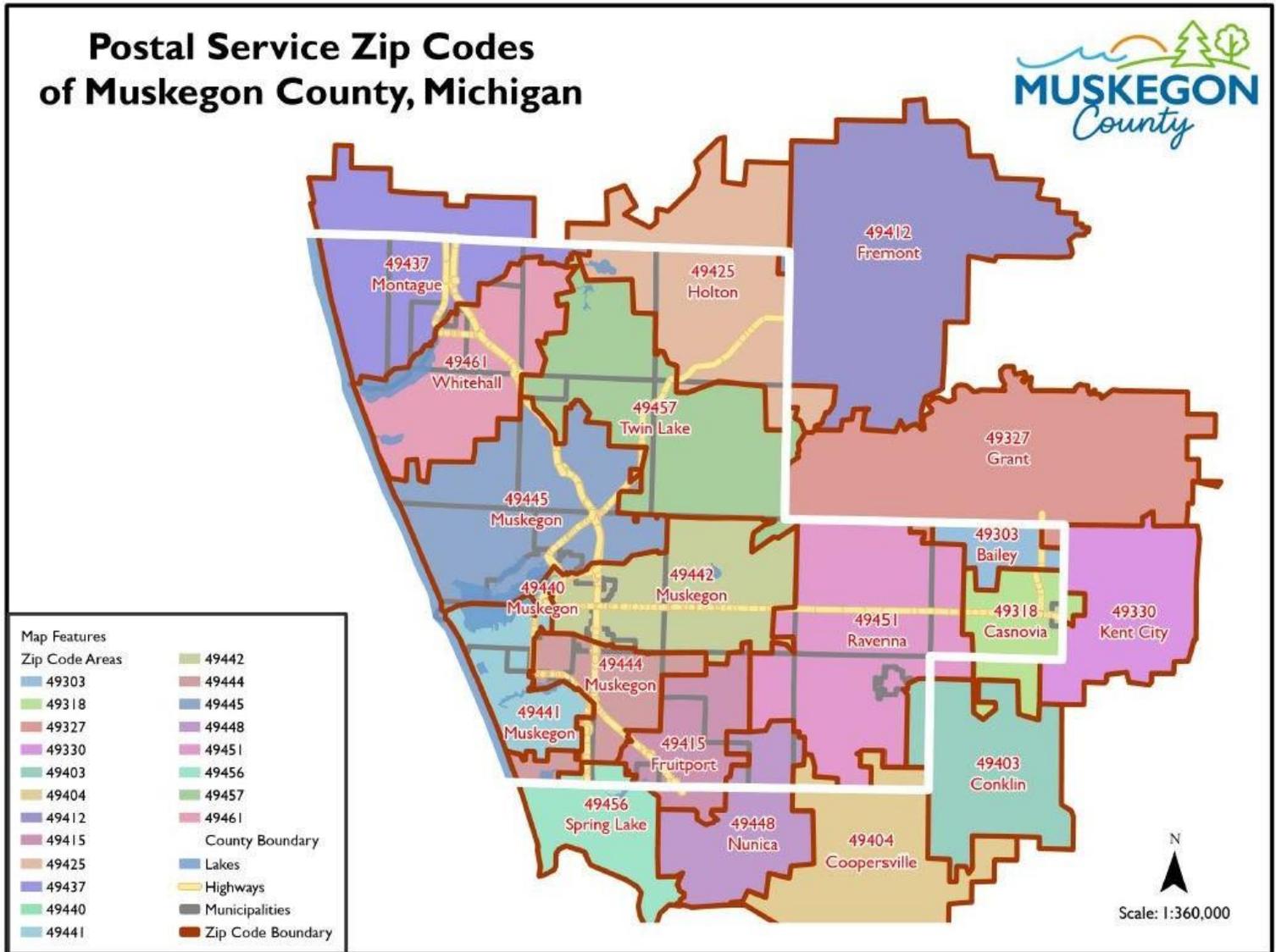
Utilities for Muskegon County



Electric Company Service Area for Muskegon County



Zip Codes for Muskegon County



Media Resources Serving Muskegon County

| TELEVISION STATIONS | |
|---|---|
| <p>WWZM TV 13 (ABC Affiliate) 643 3 Mile Rd NW Walker, MI 49544 Phone: 616.785.1313 http://www.wzzm13.com</p> | <p>WOOD TV 8 (NBC Affiliate) Phone: 616.456.8888 Fax: 616.771.9676 https://www.woodtv.com/</p> |
| <p>WWMT TV 3 (CBS Affiliate) 590 W Maple St, Kalamazoo, MI 49008 Phone: (269) 388-9339 www.wwmt.com</p> | <p>FOX 17 WXMI (FOX Affiliate) 3117 Plaza Dr NE, Grand Rapids, MI 49525 Phone: 616.364.1717 www.foxonline.com</p> |
| <p>Muskegon Public TV Channel 96 #1374 W Norton Ave, Muskegon, Michigan, 49441 (Comcast, ROKU, and Fire TV) Phone: (231) 343-7755 www.channel96muskegon.com</p> | <p>WGVU Public Radio and Television 301 Fulton Street West Grand Rapids, MI 49504 Phone: 231.331.6666 https://www.wgvu.org/</p> |
| RADIO STATIONS | |
| <p>iHeart Media – Grand Rapids 93.7, 96.1, 101.3, 101.7, 104.5, 105.7, 106.9, 1230, 1300 77 Monroe Ctr NW, Grand Rapids, MI 49503 Phone: (616) 459-1919 www.iheartmedia.com</p> | <p>Townsquare Media in Grand Rapids 95.7, 97.9, 98.7, 100.5, 104.9 37 Ottawa Ave NW, Grand Rapids, MI 49503 Phone: (616) 451-4800 www.townsquaremedia.com</p> |
| <p>iHeart Media – Muskegon 107.9, 1090 3565 Green St, Muskegon, MI 49444 Phone: (616) 459-1919 www.iheartmedia.com</p> | <p>West Michigan Community Help Network 103.7 1877 Peck St, Muskegon, MI 49441 Phone: (231) 727-5007 www.1037thebeat.com</p> |
| <p>Grand Haven Radio 92.1, 93.1, 94.9, 1370 One South Harbor Dr, Grand Haven, MI 49417 Phone: (616) 842-8110 www.wqhn.com</p> | <p>Cumulus Media – Muskegon 92.5, 97.5, 98.3, 100.1 3375 Merriam St, Muskegon Heights, MI 49444 Phone: (231) 796-7000 www.cumulusmedia.com</p> |
| <p>Cornerstone University 91.3 3181 Bradford St NE, Grand Rapids, MI 49525 Phone: (616) 942-1500 www.wcsq.org</p> | <p>Cumulus Media – Grand Rapids 94.5, 96.9, 105.3, 106.1, 107.3 60 Monroe Ctr NW, Grand Rapids, MI 49503 Phone: (616) 774-8461</p> |

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| | www.cumulusmedia.com |
| Blue Lake Public Radio WBLU 88.9 GR, WBLV 90.3 Muskegon 300 E Crystal Lake Rd, Twin Lake MI 49457 800.221.3796 https://bluelake.org/radio/ | Shoreline Broadcasting 100.9 950 W Norton Ave, Ste 300, Muskegon, MI 49441 Phone: (231) 737-9337 www.muskegonradio.com |
| Real Gold Radio 98.9 (Oldies) P.O. Box 123, Whitehall, MI 49461 Phone: 231-981-5389 Fax: 231.981.5389 | Muskegon Public Radio Channel https://muskegonchannel.com/radio O'Riley Media Group 6420 Fiske Road, Twin Lake MI 49457 (231) 343-7755 |
| NEWSPAPERS | |
| MLIVE Media Group/Muskegon Chronicle 169 Monroe Ave NW Suite 200, Grand Rapids, MI 49503 Phone: 800.878.1400 www.mlive.com/muskegon | White Lake Beacon 432 E Spring St Whitehall, MI 49461 Phone: (231) 894-5356 www.shorelinemedia.net/white_lake_beacon |
| Fruitport Area News/Paper and Digital 4491 East Pontaluna Rd, Fruitport MI 49415 231.865.3134 http://www.fruitportareanews.com/ | Muskegon Tribune PO Box 4183, Muskegon, MI 49444 Phone: (231) 724-0927 www.muskegontribune.com |
| Ravenna Independent 500 S Ravenna Rd, Ravenna, MI 49451 Phone: (231) 853-2065 www.ravennaindependent.com | Positively Muskegon https://positivlymuskegon.blogspot.com/ O'Riley Media Group 6420 Fiske Road, Twin Lake MI 49457 (231) 343-7755 |

Special Events

Throughout the United States, there are festivals, concerts, fairs, sporting events, and many other large and small events that gather or have the potential to gather large crowds. Communities often use these festivals and special events as a way of generating large income and promoting themselves to potential visitors. In Muskegon County, here are some of the special events that occur in each community annually. To see the current event lineup as well as other things to see and do in the county go here: <https://www.visitmuskegon.org/events/>

Table 46 Primary special events occurring in Muskegon County.

| Muskegon County Festivals and Events | Month Approximate Date |
|---|-----------------------------------|
| Snowfest | February |
| West Michigan Ironman Football | March-May |
| Muskegon Museum of Art "Free Thursdays" | Recurring on Thursdays |
| St Patrick's Day Parade | March |
| Montague Farmers Market | May-October |
| Muskegon Farmers market Summer Season | May-November |
| Fruitport Old Fashioned Days | May |
| Blessing of the Boats | May |
| Southern Soul Blues festival – Frauenthal Center | May |
| Annual Pine Street Market | May |
| Greater Muskegon Memorial Day Parade (Twin Lake) | May |
| Muskegon Heights Farmers Market | June-October |
| Parties in the Park/Hackley Park | June-August |
| Muskegon Clippers Baseball Season starts | June |
| Taste of White Lake | June |
| Annual Antique Tractor and Engine Show/ Muskegon County Fairgrounds | June |
| Carnival at Mart Dock | June |
| Muskegon CareAffaire and Run for Wings 5k benefitting Wings of Mercy | June |
| West Michigan Juneteenth Celebration | June |
| Muskegon Pride Festival | June |
| Muskegon County Community Picnic (Fruitport) | June |
| 32 nd Annual Antique Tractor and Engine Show (Fairgrounds) | June |
| Black Business Expo (VanDyk Mortgage Convention Center) | June |
| Spring into Summer Craft and Vendor Show | June |
| Trinity Health Seaway Run and Expo | June |
| Muskegon Township Parks and Rec vendor and Craft Show | June |
| Muskegon Heights Festival at Rowan Park | June |
| 44 th Annual Arts and Crafts Festival (Whitehall) | June |
| Taste of Muskegon | June |
| Lakeshore Art Festival | July |

| | |
|---|-----------------|
| White Lake 4 th of July Parade & Fireworks | July 4th |
| Egelston Wolf Lake Festival | July |
| Muskegon Bike Time | July |
| Ravenna Dog Daze/Cruise Night | July |
| Rebel Road | July |
| Cruz'n Classic Car Show Montague/Whitehall | July |
| Holton Days | July |
| Muskegon County Youth Fair | July |
| Muskegon Heights Festival in the Park | July |
| Muskegon County Youth Fair | July |
| Burning Foot Beer Festival | August |
| Great Lakes Surf festival | August |
| Unity Christian Music Festival | August |
| Northside Summer Spectacular | August |
| Norton Shores Arts and Drafts Festival | August |
| Roosevelt Park Day | August |
| Shoreline Jazz festival | August |
| Labor Day Parades | September |
| Michigan Irish Music Festival at Heritage Landing | September |
| Muskegon County Latino Festival | September |
| Muskegon Polish Festival | September |
| Muskegon Lumber jacks Hockey | September-April |
| Depot to Depot | October |
| Montague Pumpkin Fest | October |
| Muskegon Farmer's Market Winter Season | December-April |
| Muskegon Risers Soccer | December-March |
| White Lake Christmas Parade | December |

For more information on recurring and other events go to www.visitmuskegon.org

Hazard Analysis Introduction

Purpose

The hazard analysis is the foundation upon which all emergency planning efforts in the community are built. In fact, preparing a good hazard analysis and community profile is the first step that the community's emergency planning team should take in building an effective emergency management program. A hazard analysis provides an understanding of the potential threats facing the community. By pinpointing the location, extent and magnitude of past disasters or emergency situations, and by examining knowledge of new or emerging risks, it is possible to determine the probability of such events occurring and the vulnerability of people and property. Coupled with relevant land use, economic and demographic information from a well prepared "community profile," Emergency Management Directors/Coordinators can make assumptions about those segments of the community that might be impacted by various types of incidents. This, in turn, allows them to set priorities and goals for resource allocation and response, recovery and mitigation activities prior to an incident occurring. Collectively, these decisions are the cornerstone of the community's emergency management program and should guide all decisions pertaining to community emergency management activities.

Hazard Analysis Development

One of the most effective methods of developing a community hazard analysis is to divide the task into three distinct, but equally important tasks. The first step is to identify those hazards to which the community is susceptible. The second step is to develop a community profile of the community's major land use, demographic and economic trends and patterns to determine which segments of the community might be impacted. The third and final step is the actual analysis of the information, that is, determining the level of community vulnerability based on the identified hazards and existing community trends and patterns. Coupling this information with the results of the community's Capability Assessment can help identify the community's strengths and weaknesses, and provides the basis for the community emergency management program.

Step 1: Hazards Identification

All local hazard analysis in the State of Michigan should be based on EMHSD PUB - 103, "Michigan Hazard Analysis." This document presents a comprehensive study of the various types of disasters and emergencies that have confronted the State of Michigan, as well as those hazards that have the potential to occur. From this document, it is possible to identify potential community hazards and gather information about the community's potential exposure and vulnerability to those hazards. Although this provides an excellent overview hazards from a statewide perspective, it is important to build upon this information to more specifically focus on the local jurisdiction. This requires local research conducted through local libraries, historical organizations,

newspapers, broadcast media, chambers of commerce, insurance companies and other community entities (even private citizens) that may be able to provide insight and information about past disaster events and local hazard areas. The Emergency Management Director/Coordinator must also review previous hazard analysis and identify changes in the community. The information should be recorded on a map or maps to provide an accurate geographic portrayal of the community's hazard base.

Step 2: Community Profile

A community profile provides information about key segments or elements of the community's makeup. It examines the land use pattern, the transportation network, demographic breakdown of the population, key industries, locations of key community facilities, major community organizations, and other information that is relevant to the community's existence. Simply put, preparing a community profile requires answers to the 5 W's of the jurisdiction. Who are we, where are we located, what do we do, and when, and why do we exist, what is the community's main "reason for being"? Answers to many of these questions have already been prepared by other community agencies, such as the planning department, chamber of commerce, economic development authority, aging office, community college or university, school district, etc. In most cases, this information can be utilized from information acquired from those organizations after adaptation into the proper format. As initially locating the information is critical, broadening the search for information also helps complete the job faster and generates support and "buy-in" for the end product from agencies assisting in the information gathering. This information is recorded on a map or maps (as per the hazard identification step outlined above) to indicate the geographic relationship of key facilities, population distributions and land use patterns to the identified hazards.

Step 3: Analysis of Hazards and Vulnerability

The third step in the process, the actual "analysis" portion of the hazard analysis, comes when the hazard identification information is combined with the community profile. At this point, it is possible to determine and "analyze" the potential impact of these hazards on the community, or vulnerability. This requires a lot of "what ifs" to be asked. It is in answering the "what ifs" that the community can determine where its strengths and weaknesses lie in its capability to respond to, recover from and mitigate the consequences of the hazards to which it is susceptible. When matched with the community's Capability Assessment this analysis allows the community to determine its strengths and weaknesses, and then design an emergency management program that is tailored to its needs and resources.

Hazard Identification

The Muskegon County Hazard Analysis has been developed by Muskegon County Emergency Management, the Local Emergency Planning Team, and community officials to provide a documented description of the community's identified hazard's, possible risk, and potential vulnerabilities to support local emergency planning and mitigation activities. The 2019 Michigan Hazard Analysis (MSP EMHDS Publication 103) was utilized as the guiding document in the development of each of the Hazard Sections. This Hazard Analysis has been extensively revised from the previous 2006 and 2015 editions to mirror the revised 2019 Michigan Hazard Analysis. These changes make the plan not only compliant with FEMA planning standards, but with larger EMAP standards as well, with a full consideration of natural hazards, technological hazards, human-related hazards, as well as greater linkages between hazard mitigation and the other phases of emergency management—preparedness, response, and recovery.

Although addressing 35 identified types of hazards within the 2019 Michigan Hazard Analysis, local planning considerations have resulted in Muskegon County's existing hazards being organized into 13 major hazard classes. This method has allowed for an effective planning approach for a variety of reasons. First, the Muskegon County Emergency Operations Plan is an all-hazard document dependent on implementation of emergency functions, not related to specific hazard response. In example, many flood hazards require similar planning, response, and mitigation measures despite their specific type. Second, Muskegon County is a moderately sized jurisdiction with its population and resources concentrated in villages and cities, creating a need to generalize hazards. Concentrating on the primary local considerations for the entire hazard class allows for a more efficient planning process than otherwise analyzing each of the individual hazards.

The following relates Muskegon County's Hazard Classes to the Michigan Hazard Analysis 2019 Document.

| Muskegon County Hazard Analysis | Michigan Hazard Analysis | |
|--|---|--|
| Natural Hazards: Weather Hazards | | |
| Thunderstorm | <ul style="list-style-type: none"> • Thunderstorm • Lightning | <ul style="list-style-type: none"> • Hail |
| Tornados | <ul style="list-style-type: none"> • Tornadoes | <ul style="list-style-type: none"> • Severe Winds |
| Extreme Temperatures | <ul style="list-style-type: none"> • Cold | <ul style="list-style-type: none"> • Heat |
| Severe Winter Weather | <ul style="list-style-type: none"> • Snowstorms | <ul style="list-style-type: none"> • Ice and Sleet Storms |
| Natural Hazards: Hydrologic Hazards | | |
| Flooding | <ul style="list-style-type: none"> • Riverine Flooding • Urban Flooding | <ul style="list-style-type: none"> • Urban Flooding • Dam and Levee Failures |

| Muskegon County Hazard Analysis | Michigan Hazard Analysis | |
|---|---|---|
| Drought | <ul style="list-style-type: none"> • Drought | |
| Natural Hazards: Ecological Hazards | | |
| Wildfires | <ul style="list-style-type: none"> • Wildfires | |
| Invasive Species | <ul style="list-style-type: none"> • Invasive Species (aquatic and terrestrial) | |
| Natural Hazards: Geologic Hazards | | |
| Geologic Hazards | <ul style="list-style-type: none"> • Impacting Object | <ul style="list-style-type: none"> • Space Weather |
| Technological Hazards: Industrial Hazards | | |
| Fires | <ul style="list-style-type: none"> • Structural Fires | <ul style="list-style-type: none"> • Industrial Fires |
| Hazardous Materials | <ul style="list-style-type: none"> • Fixed Site (Industrial Accidents) • Transportation • Oil and Natural Gas Well Accidents | <ul style="list-style-type: none"> • Nuclear Power Plant Emergencies • Petroleum and Natural Gas Pipeline Accidents |
| Technological Hazards: Infrastructure Problems | | |
| Infrastructure Failure | <ul style="list-style-type: none"> • Infrastructure Failures | <ul style="list-style-type: none"> • Energy Emergencies |
| Transportation | <ul style="list-style-type: none"> • Major Transportation Accidents (air, rail, highway, marine) | |
| Human Related Hazards | | |
| Public Health | <ul style="list-style-type: none"> • Public Health Emergencies | |
| Criminal Incidents | <ul style="list-style-type: none"> • Civil Disturbances • Cyber-attack | <ul style="list-style-type: none"> • Terrorism & similar activities • Nuclear Attack |

Non-significant Hazards

Earthquakes

In the early 1800s there were several mild earthquakes reported in Southern Lower Michigan. With limited documentation the exact number is difficult to determine, however, no severely destructive earthquakes have ever been documented in Michigan. According to the Michigan Hazard Analysis, Michigan is not located in an area subject to major earthquake activity. Although there are fault lines in the bedrock of Michigan, they are now considered relatively stable. Based on recent scientific studies, portions of southern lower Michigan could be expected to receive minor damage were such an earthquake to occur. Muskegon County is outside the earthquake threat zone.

Nuclear Power

Currently, Michigan has three operational commercial nuclear power plants which include The Enrico Fermi 2 Plant near Monroe just south of Wayne County, The Donald C. Cook plant near Bridgman in Berrien County, and the Palisades Plant near Covert in Van Buren

County. A fourth plant, the Big Rock Point plant near Charlevoix, was closed in 1997 and is now decommissioned, but spent fuel is still stored on-site in dry casks which will probably remain there a while. The Davis-Besse nuclear power station near Toledo, Ohio has several Michigan Counties within its Secondary Emergency Planning Zone, requiring coordination between Michigan and Ohio. In addition, nuclear research facilities can produce / use radioactive materials, as well as other hazardous substances. Muskegon County is outside of the Emergency Planning Zone for all Nuclear Power Plants located in Michigan.

Hazard Section Organization

Each of the following hazard sections are formatted to contain similar information as described below:

Hazard Definition

This section briefly defines the hazard.

Hazard Description

This section provides a general description summary of each hazard taken from a statewide perspective. This portion has been utilized from information provided by MSP-EMHSD Pub 103 2019 Michigan Hazard Analysis and MSP-EMD Pub207 Local Hazard Mitigation Planning Workbook.

Hazard Analysis

This section provides information on threats, vulnerabilities, historical occurrences, and key points of concerns as it relates to both the State of Michigan and Muskegon County. This allows for planners to focus mitigation, planning, and response efforts on specific areas of vulnerabilities, risk, resources, etc. that have been identified through the hazard analysis process.

SEVERE THUNDERSTORM AND TORNADES

Severe Thunderstorm and Tornadoes

Severe Thunderstorms are weather systems accompanied by strong winds (greater or equal to 58 mph), lightning, heavy rain, hail (greater than or equal to 1" diameter – quarter size), and possibly contain tornadoes. Tornadoes are a violently whirling column of air extending downward to the ground from a cumulonimbus cloud.

Hazard Description

Thunderstorms form when a shallow layer of warm, moist air is overrun by a deeper layer of cool, dry air. Cumulonimbus clouds, frequently called "thunderheads," are formed in these conditions. These clouds are often enormous (up to six miles or more across and 40,000 to 50,000 feet high) and may contain tremendous amounts of water and energy. That energy is often released in the form of high winds, excessive rains, lightning, and possibly hail and tornadoes.

Thunderstorms are typically short-lived (often lasting no more than 30-40 minutes) and fast moving (30-50 miles per hour). Strong frontal systems, however, may spawn one squall line after another, composed of many individual thunderstorm cells. Severe thunderstorms may also cause severe flood problems because of the torrential rains that they may bring to an area. Thunderstorms sometimes move very slowly and can thus dump a tremendous amount of precipitation onto a location. Flooding can result, including flash floods, "urban flooding," and riverine flooding.

The following are specific thunderstorm hazards:

Hail:

A condition where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth. Hail is a product of the strong thunderstorms that frequently move across the state. As one of these thunderstorms passes over, hail usually falls near the center of the storm, along with the heaviest rain. Sometimes, however, 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. Hailstones range in size from a pea to a golf ball, but hailstones larger than baseballs have occurred in 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 often precedes the occurrence of a tornado.

Lightning:

The discharge of electricity from within a thunderstorm. Although lightning is often perceived as a minor hazard, it damages many structures and kills and injures more people in the U.S. 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 that lightning presents. Michigan ranks second in the nation in both lightning-related deaths and lightning-related injuries.

Severe Winds (Windstorms):

According to the National Weather Service (NWS), winds 58 miles per hour or greater are classified as a windstorm. Windstorms are a fairly common occurrence in many areas in Michigan. Along the Great Lakes shoreline, strong winds occur with regularity, and gusts of over 74 miles per hour (hurricane velocity) do occasionally occur in conjunction with a storm front. Severe windstorms can cause damage to homes and businesses, power lines, trees and agricultural crops, and may require temporary sheltering of individuals without power for extended periods of time. Windstorms occur in all areas of Michigan, although more often along the lakeshore and in central and southern lower Michigan.

Tornadoes

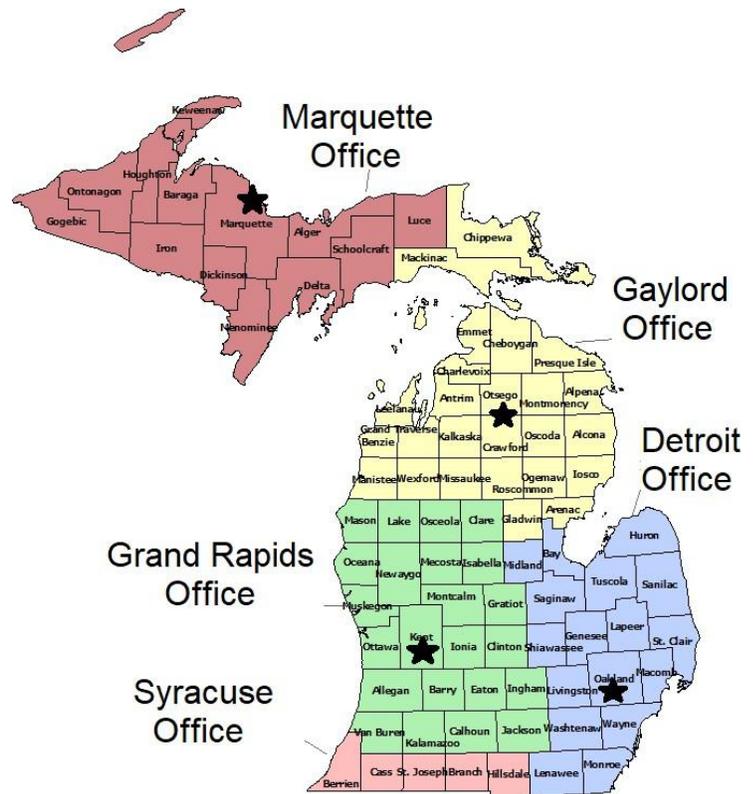
A violently whirling column of air extending downward to the ground from a cumulonimbus cloud. The funnel cloud associated with a tornado may have winds up to 300 miles per hour and an interior air pressure that is 10-20 percent below that of the surrounding atmosphere. The typical length of a tornado path is approximately 16 miles but tracks much longer than that - some even up to 200 miles - have been reported. Tornado path widths are generally less than one-quarter mile wide. Historically, tornadoes have resulted in the greatest loss of life of any natural hazard, with the mean national annual death toll being 111 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year. Michigan averages approximately 18 tornadoes per year, most occurring in the southern Lower Peninsula.

Severe Thunderstorm Hazard Analysis:

Severe thunderstorms can occur anytime in Michigan, although they are most frequent during the warm spring and summer months from April through September. Various areas in Michigan are subject to an average of at least 20 thunderstorm days per year, and up to just over 40 thunderstorm days per year in the state's southwestern corner. Severe thunderstorms have some degree of predictability and are closely monitored by the National Weather Service.

In addition to daily forecasts, which predict the probability of rainy or stormy weather, the NWS system of Watches and Warnings helps communities understand when there is a potential risk of severe thunderstorms, or if severe thunderstorms are imminent. When the NWS issues a "Severe Thunderstorm Watch," it means that thunderstorms with large hail and damaging winds are possible in your area. When the NWS issues a "Severe Thunderstorm Warning," it signifies that severe thunderstorm (with the damaging winds and hail) are in your area or are imminent.

The National Weather Service (NWS) has five offices that serve Michigan and are responsible for monitoring and providing predictions and bulletins for the entire state. The five offices are in Grand Rapids, Detroit, Gaylord, Marquette, and Syracuse (Indiana). These stations provide information on severe weather watches and warnings, but also provide useful Doppler Radar images that track the movement of thunderstorms in your area. The Syracuse office covers portions of southwest Michigan (www.weather.gov/iwx); the Grand Rapids station covers the remainder of southwest Michigan (www.weather.gov/grr); the Detroit station covers Southeast Michigan (www.weather.gov/dtx); the Gaylord station covers the north central portion of the Lower Peninsula and the eastern edge of the Upper Peninsula (www.weather.gov/apx); and the Marquette station examines the majority of the Upper Peninsula (www.weather.gov/mqt).



National Weather Service Doppler Weather Radar can now more easily detect severe weather events that threaten life and property—including storms that are likely to produce damaging hail. Most significantly, the lead time and specificity of warnings for severe weather have greatly improved since the early 2000s. The National Weather Service (NWS) Doppler Weather Radar Network (WSR-88D) has undergone many upgrades since 2010 in the Service Life Extension Program that will keep the system operational well into the 2030s. Upgrades include additional technology to detect atmospheric particle size and movement (dual polarization) that aids the NWS in detecting severe winds, large hail, and tornado structure. Doppler technology calculates both the speed and the direction of wind motion inside of severe storms. The system allows forecasters to identify conditions leading to severe weather, as well as information on the direction and speed of storms once they form.

Severe Thunderstorm Hazards in Michigan

As the map below indicates, various areas in Michigan are subject to an average of at least 20 thunderstorm days per year, and up to just over 40 days per year in the state's southwestern corner. The Lower Peninsula, in general, is subject to approximately 28-40 thunderstorm days per year, while the Upper Peninsula average is closer to 20-30 thunderstorm days per year. This map is based upon data from various National Weather Service (NWS) stations within (and near) Michigan.

Since thunderstorms bring the potential for dangerous hail, lightning, straight-line winds, and tornados, it is necessary to further examine each of those hazards in the following sections of this annex.

Thunderstorm Hazards



Hail Hazards

As a product of the strong thunderstorms that frequently move across the state, the size of hail is usually proportional to the intensity of the storm cell that generates it. As a thunderstorm passes over, hail usually falls near the center of the storm, along with the heaviest rain. Sometimes, a thunderstorm's strong winds can occur at high altitudes and blow the hailstones away from the storm's center, causing an unexpected hazard at places that otherwise might not appear threatened.

Most hailstones reported in Michigan range in size from a pea ($\frac{1}{4}$ " diameter) to a golf ball ($1\frac{3}{4}$ " diameter), but hailstones larger than baseballs ($2\frac{3}{4}$ " diameter) have occurred with the most severe thunderstorms. In 2009, the official threshold that denotes severe hail events was increased from 0.75" to 1.00". The following table provides the official classifications of hail magnitude, as often used in weather reporting and event records. Some statistics cover multiple categories of hail magnitude (by combining table cells together).

| Descriptive size of hail | Diameter | Number of MI events (1996-2017) | Impacts: | Areas of occurrence |
|--------------------------|--------------------------|---------------------------------|--|---|
| Pea | $\frac{1}{4}$ " (6mm) | Too many to include | Minimal structural impacts, but crop damages can be severe. | Every county in Michigan |
| Marble or mothball | $\frac{1}{2}$ " (13mm) | | | |
| Penny or dime | $\frac{3}{4}$ " (19mm) | | | |
| Nickel | 0.9" (22mm) | Too many to include | Old threshold for severe hail, raised to 1" in 2009. | Every county in Michigan |
| Quarter | 1" (25mm) | | | |
| Half-dollar | $1\frac{1}{4}$ " (32mm) | } 1213 | \$70.1M property damage, \$3.55M in crop damage | Every county in Michigan |
| Walnut or ping-pong ball | $1\frac{1}{2}$ " (38mm) | } 501 | | |
| Golf ball | $1\frac{3}{4}$ " (44mm) | } | \$229M property damage, \$3.71M crop damage, 3 inj. | Almost all counties throughout the state |
| Hen's egg | 2" (51mm) | 68 | \$28.846 million in property damage, \$730,000 in crop damages, 1 injury | More than half of MI counties located across the entire state |
| Tennis ball | $2\frac{1}{2}$ " (64mm) | 12 | | |
| Baseball | $2\frac{3}{4}$ " (70mm) | 14 | | |
| Tea cup | 3" (76mm) | 12 | Dmgs: \$12M prop., \$2.8M crop | Marquette, Midland... |
| Grapefruit | 4" (102mm) | 2 | \$800K in property damage | Gogebic, Jackson |
| Softball | $4\frac{1}{2}$ " (114mm) | 1 | \$32.6M in property damage | Ogemaw County |
| TOTAL: | | 4,069 | \$376M property, \$13M crop | All MI counties |

Sources: Two left columns—Coenraads 2006:224, the rest—NCEI Storm Events database (to 4-30-2017), with edits.

Although damaging hail is much less frequent than thunderstorms, since only a fraction of all thunderstorms produce damaging hail, there is still an unusual aspect to the types of events that cause damages to occur. Hail is most likely for severe thunderstorms that also produce great amounts of precipitation, but although damaging hail has occurred in every part of Michigan, the events producing the largest-sized hail are not always reported to be damaging, and much smaller-sized hail often causes far greater negative impacts. The vast majority of reported property damage in Michigan stems from just a few events. The important thing to note is that both the Upper Peninsula and the Lower Peninsula have endured extensive damage from rare but large hail events.

Even if most of Michigan's citizens experience hail only as a curiosity that seems infrequent and harmless, those who are involved in agricultural production are aware of the harm that hail can cause to their crops. Many kinds of produce are vulnerable to damage, whether fruit or vegetable: potatoes, beans, tomatoes, corn, soybeans, apples, peaches, grapes, plums, cherries, and raspberries have all been damaged or destroyed by hailstorms in Michigan.

Property damage often involves hail impacts upon motor vehicles, but widespread damage to the roofs and siding of homes can also occur. Even though automobiles can be protected in garages, some hail is large enough to cause damage to built structures themselves. Thus, in

addition to the other types of thunderstorm hazards (lightning, winds and tornadoes, and excessive precipitation), serious damage can come from severe hail.

A major damaging hail event can be expected in Michigan multiple times per year, although the typical county will see such impacts only over the course of several years. Statistics since that time indicate that approximately 50% of the severe thunderstorms that produce hail have occurred during the months of June and July, and nearly 80% have occurred during the prime growing season of May through August. As a result, the damage to crops from hail can be extensive.

There have been 5 injuries in Michigan due to hail events since the beginning of 1996. These involved persons who were outdoors and directly exposed to the impact of hailstones. Two of the injuries occurred in a sailboat during a hailstorm in 1999. Another was a motorcyclist who received a minor injury when struck on the mouth. The other injury documented on NCDC involved a person who was attempting to move a vehicle into a shelter and was thus exposed.

The National Weather Service forecasts of severe thunderstorms usually gives enough warning time to allow residents to take appropriate action to reduce the effects of hail damage on vehicles and some property. However, it is harder to prevent damage to crops. More details about specific Michigan events, and resulting damages, is provided in the subsection, below, about significant Michigan hailstorms. At least \$300 million in property and crop damage has occurred from hail events in Michigan since 1996.

The following are significant hailstorms in Michigan since 1985:

Case: May 1985 - Lower Peninsula (western and eastern counties)

In May 1985, severe thunderstorms accompanied by hail struck the western and eastern counties of the Lower Peninsula, causing great damage. Two-inch hail was reported in Cass County and \$2 million in damages to fruit crops were reported in Kent County.

Case: March 27, 1991 - Lower Peninsula (central and southern counties)

On March 27, 1991, severe thunderstorms and accompanying high winds and hail caused considerable damage across a large portion of central and southern Lower Michigan, damaging homes, businesses, farms, and some public facilities. A total of three deaths and 27 injuries were attributed to the storms. Egg to baseball-sized hail, some exceeding 2.5" in diameter, was reported in the vicinity of Buchanan in Berrien County. In Kalamazoo and Portage in Kalamazoo County, softball size hail, up to 4.5" in diameter, did extensive damage to automobiles, windows and trees.

Case: June 24, 1998 - Lower Peninsula (central and southern counties)

On June 24, 1998 two tracts of severe thunderstorms crossed the state moving east to west—one tract stretched across central Lower Michigan, while the other moved into the southern portion of the state. The more northerly thunderstorms produced large amounts of hail in several counties, ranging from dime to quarter sized hail up to baseball size (2.75” in diameter) hail. Damage was widespread, but not overly severe. However, in Petoskey, hail (2.5” in diameter) caused \$100,000 in damage to cars on two lots west of town. In Ingham County, near Onondaga, baseball-sized hail damaged auto glass and roofs, but specific damage figures were not available.

Case: April 5, 2010 – Southwestern Michigan

Severe thunderstorms produced large hail and winds greater than 80 mph. The most significant damage occurred in the southern portions of Kalamazoo County, with damages estimated at \$125 million, but Van Buren County was also struck heavily, with damages estimated at \$50 million. To the west-southwest of Schoolcraft (Kalamazoo County), the siding of many homes was destroyed on their west-facing sides, where they were battered by large hail of about 1.75 inches in diameter. The estimated damages from this storm event include strong wind effects, not just hail impacts.

Case: April 26, 2011 – Southern Lower Peninsula (especially Ionia, Kalamazoo, Kent, and Montcalm Counties)

Several thunderstorm supercells produced large hail reported as up to 2” in diameter. An EF-0 tornado near Burnips (Allegan County) and an injurious lightning strike in Portage (Kalamazoo County) also occurred during this weather event. Hail damages included areas northeast of Belding (Ionia County, \$4 million), south of Stanton (Montcalm County, \$1 million), across northern Kalamazoo County (\$4 million), and in Kent County (\$2 million).

Hail Hazards in Muskegon County

Within Muskegon County there has been 59 recorded hail events which have caused \$885,000 in property damage and \$170,000 in crop damage from 1950 through September of 2021 according to the National Centers for Environmental Information Storm Event Database.

Hail Events in Muskegon County

| Date | Location | Hail Size | Property Damage | Crop Damage |
|------------|-------------|-----------|-----------------|-------------|
| 05/13/1956 | Fruitport | 4.00 | 0.00K | 0.00K |
| 04/25/1957 | Muskegon Co | 1.00 | 0.00K | 0.00K |
| 07/22/1960 | Muskegon Co | 0.75 | 0.00K | 0.00K |
| 03/19/1963 | Muskegon Co | 1.00 | 0.00K | 0.00K |
| 05/14/1972 | Muskegon Co | 0.75 | 0.00K | 0.00K |
| 06/17/1978 | Muskegon Co | 2.00 | 0.00K | 0.00K |
| 06/25/1978 | Muskegon Co | 1.75 | 0.00K | 0.00K |
| 10/03/1979 | Muskegon Co | 1.75 | 0.00K | 0.00K |
| 04/08/1980 | Muskegon Co | 1.00 | 0.00K | 0.00K |

| | | | | |
|---------------|----------------|------|----------------|----------------|
| 03/31/1981 | Muskegon Co | 1.00 | 0.00K | 0.00K |
| 04/16/1982 | Muskegon Co | 1.00 | 0.00K | 0.00K |
| 06/11/1986 | Muskegon Co | 1.00 | 0.00K | 0.00K |
| 07/04/1990 | Muskegon Co | 0.75 | 0.00K | 0.00K |
| 07/04/1990 | Muskegon Co | 1.00 | 0.00K | 0.00K |
| 07/04/1990 | Muskegon Co | 1.75 | 0.00K | 0.00K |
| 03/27/1991 | Muskegon Co | 0.75 | 0.00K | 0.00K |
| 04/26/1994 | Muskegon | 0.75 | 0.00K | 0.00K |
| 02/26/1996 | Lakewood Club | 0.75 | 0.00K | 0.00K |
| 04/12/1996 | Montague | 1.00 | 0.00K | 0.00K |
| 05/12/2000 | Twin Lake | 1.00 | 50.00K | 0.00K |
| 04/11/2001 | Holton | 0.75 | 10.00K | 10.00K |
| 04/11/2001 | Fruitport | 1.75 | 50.00K | 25.00K |
| 04/11/2001 | Twin Lake | 0.75 | 10.00K | 10.00K |
| 05/15/2001 | Muskegon Co | 1.00 | 70.00K | 70.00K |
| 05/15/2001 | Whitehall | 1.00 | 25.00K | 25.00K |
| 06/11/2001 | Norton Shores | 0.75 | 10.00K | 10.00K |
| 09/07/2001 | Muskegon | 0.75 | 15.00K | 0.00K |
| 04/18/2002 | Montague | 0.88 | 10.00K | 5.00K |
| 07/21/1003 | Muskegon | 0.75 | 25.00K | 10.00K |
| 08/03/2003 | Fruitport | 0.75 | 10.00K | 5.00K |
| 08/03/2003 | Whitehall | 0.75 | 10.00K | 5.00K |
| 08/03/2003 | Muskegon | 1.75 | 25.00K | 10.00K |
| 08/03/2003 | Muskegon | 0.75 | 10.00K | 5.00K |
| 03/01/2004 | Muskegon | 0.75 | 0.00K | 0.00K |
| 05/10/2004 | Whitehall | 0.75 | 0.00K | 0.00K |
| 06/23/2004 | Muskegon | 0.75 | 10.00K | 10.00K |
| 06/23/2004 | Muskegon | 0.75 | 10.00K | 10.00K |
| 08/02/2004 | Whitehall | 0.75 | 5.00K | 5.00K |
| 03/30/2005 | Muskegon | 0.75 | 10.00K | 0.00K |
| 09/22/2005 | Muskegon | 0.75 | 5.00K | 5.00K |
| 09/06/2006 | Brunswick | 0.88 | 10.00K | 5.00K |
| 10/02/2006 | Muskegon | 0.88 | 10.00K | 10.00K |
| 07/26/2007 | Muskegon | 1.00 | 10.00K | 0.00K |
| 07/26/2007 | Muskegon Lake | 0.75 | 10.00K | 5.00K |
| 01/07/2008 | Norton Shores | 0.75 | 0.00K | 0.00K |
| 07/02/2008 | Whitehall | 0.88 | 0.00K | 0.00K |
| 07/02/2008 | Muskegon Lake | 1.0 | 0.00K | 0.00K |
| 07/02/2008 | Dalton | 1.5 | 0.00K | 0.00K |
| 07/02/2008 | Muskegon Lake | 1.0 | 0.00K | 0.00K |
| 10/26/2008 | Muskegon | 0.75 | 0.00K | 0.00K |
| 06/21/2011 | Muskegon | 1.00 | 0.00K | 0.00K |
| 07/11/2011 | Twin Lake | 2.00 | 0.00K | 0.00K |
| 05/03/2012 | Twin Lake | 0.75 | 0.00K | 0.00K |
| 07/31/2012 | Norton Shores | 0.75 | 0.00K | 0.00K |
| 04/12/2014 | North Muskegon | 1.00 | 0.00K | 0.00K |
| 08/02/2015 | Muskegon Lake | 1.0 | 5.00K | 0.00K |
| 08/29/2019 | Twin Lake | 1.75 | 25.00K | 0.00K |
| 04/07/2020 | Whitehall | 1.75 | 500.00K | 0.00K |
| 09/12/2021 | Muskegon Lake | 1.00 | 0.00K | 0.00K |
| TOTALS | | | 885.00K | 170.00K |

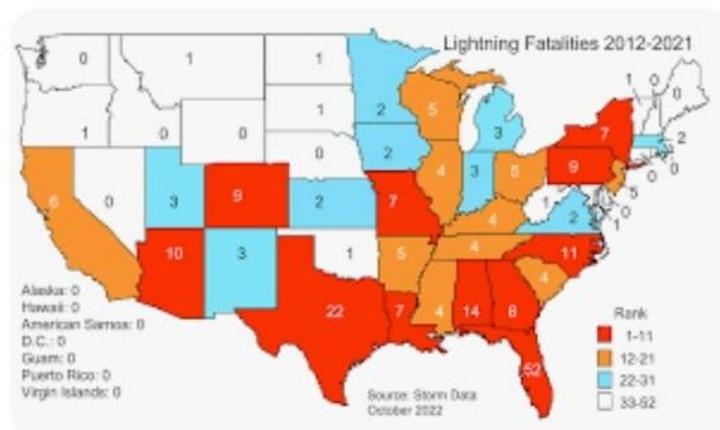
Lightning Hazards

Lightning is a random and unpredictable product of a thunderstorm's tremendous energy. The energy in the storm 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. Most lightning stays within the clouds, but about 20% of it involves contact with the ground. 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, there are about 2,000 thunderstorms occurring at any given time, and those thunderstorms cause approximately 100 lightning strikes upon the ground each second. In the United States, approximately 100,000 thunderstorms occur each year, and every one of those storms generates lightning. A single thunderstorm can produce hundreds or even thousands of lightning strikes. However, many persons in the general public still perceive lightning as a minor hazard. That perception lingers even though lightning damages many structures and even causes more deaths 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-fiftieth of an ampere of electric current to contract chest muscles and stop breathing, and one-hundredth of an amp can disrupt a human heartbeat. Lightning can also cause severe skin burns that can lead to death if complications from infection set in.

According to the National Weather Service records from 2012 through 2021, Michigan has incurred only 3 lightning fatalities, ranking 22nd nationally.



Within a detailed analysis of lightning deaths in the United States from 2006 through 2018, the National Lightning Safety Council the overall breakdown of lightning fatalities into four primary categories. Of the 446 lightning deaths between 2006 and 2021, leisure activities were responsible for 282, almost two-thirds (63%) of the deaths. During the period, there were 68 fatalities (15%) related to routine daily or weekly activities, and 84 fatalities (19%) related to work.

Looking further into the overall breakdown of the types of leisure-related deaths, Leisure activities contributed to 63% of the overall deaths from lightning fatalities. Water-related activities include fishing, boating, swimming, or just relaxing at a beach or lake. Sports-related activities contributed another 14%. Sports-related fatalities include soccer, golf, running, baseball, and football. Other activities that contributed to the deaths in the leisure category included camping (8%); riding bikes, motorcycles and ATVs (6%); social gatherings (6%); hiking (4%); walking (4%); relaxing outside the home (6%); tourism (2%); children's play (2%); horseback riding (2%); and "Other" (11%). The "Other" category included: hunting, building a tree house, building a cabin, building a deer blind, taking a work break, picking berries, watching a car race, watching the storm, watching a fire, watching a swollen river, getting a book out of a vehicle, visiting a local park, attending a rock festival, searching for arrowheads, working on a trail, visiting a college campus, mud bogging, moving a hammock, and moving a bike, and grilling. (Lightning Safety Council.org).

Work-related activities contributed to 19% of the total lightning fatalities. Farming and ranching contributed most (25%) to the work-related deaths. Additional fatal activities included roofing (20%), construction (18%), lawn care (10%), military work (4%), and other (24%). Included in the "Other" category were deaths related to barge work, loading and washing trucks, surveying, door-to-door sales, logging, mail delivery, tornado rescue, utility repair, building maintenance, pruning trees, inspecting seawalls, washing oil disposal tanks, working at an amusement park, working on a billboard, lifeguarding (2), and attending beach/umbrellas.

| <u>Activity</u> | <u># of Deaths (%)</u> |
|-------------------------------------|--------------------------|
| Fishing | 40 (9%) |
| Beach | 28 (6%) |
| Camping | 22 (5%) |
| Farming or ranching | 21 (5%) |
| Riding bike, motorcycle, or ATV | 19 (4%) |
| Boating | 19 (4%) |
| Social gathering | 17 (4%) |
| Roofing | 17 (4%) |
| Head to/from or waiting for vehicle | 15 (3%) |
| Yardwork | 15 (3%) |
| Construction | 15 (3%) |
| <u>Tie: Soccer/Golf</u> | <u>Each 13 (6%)</u> |
| Total | 254 (57%) |

Table 3.6 The top twelve activities that contribute most to lightning deaths.

Most (73% of) damaging lightning strikes occur during the heavy thunderstorm-risk months of June (21%), July (30%), and August (22%), according to National Oceanic and Atmospheric Administration (NOAA) and the National Lightning Safety Institute (NLSI) from 35 years of data in the period from 1959-1994. They also found that the most likely time of day when damaging strikes are reported is during the late afternoon hours between 2pm and 6pm. Although 91% of incidents involved only a single victim suffering injury or death, the remaining 9% of incidents involved multiple simultaneous victims.

Although Michigan's counties experience from about 20 to 40 thunderstorm days per year, there are a smaller number of known damaging lightning events per year (about 14 such events per year, on average). Michigan's average deaths from lightning are approximately 1 per year, and injuries average about 5 per year. Property damage from major events totals over \$17 million since 1996 – averaging nearly \$1 million per year. (Data from the National Climatic Data Center have been used to calculate these statistics.) 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.

As one might expect in a state with a high number of lightning deaths and injuries, lightning incidents involving one individual are fairly common in Michigan. However, lightning incidents involving groups of individuals also take place. Over the past 35 years, numerous lightning incidents in Michigan have resulted in multiple injuries:

Case: July 20, 1994: Muskegon County.

Lightning killed a dog and caused \$50k property damage,

Case: September 19, 1997 – (Midland, Van Buren, Barry, and Kalamazoo Counties)

Lightning struck a farm near Coleman (Midland County), killing 4 horses and doing \$10,000 in damage. Lightning also damaged 2 houses in Waterford Township (Oakland County) and an apartment building in Westland (Wayne County). The South Haven Community Hospital (Van Buren County) received a direct lightning strike on its radio tower, disabling communications there (\$200,000 damage). A young boy received minor injuries at Hastings (Barry County) when lightning struck near him. Lightning started a house fire in Climax Township (Kalamazoo County), resulting in \$20,000 of damage.

Case: June 16, 1998 – (Wayne, Washtenaw, Kent Counties)

A severe thunderstorm developed, and a great amount of lightning was produced. A man was killed by lightning when walking to his car in Detroit, and a woman and boy were injured by a lightning strike at a Little League game in Taylor (Wayne County). A transmitting antenna for a radio station in the Hudson Mills area (Washtenaw County) was struck and had to be replaced (about \$100,000 damage). A Livonia residence suffered significant damage from a lightning strike (about \$2,000 in damage). In Alto (Kent County), lightning started a fire that destroyed a new educational building at a church.

Case: July 21, 1998 – (Muskegon, Kent, Macomb, and Wayne Counties)

Severe thunderstorms brought severe winds and frequent lightning to both the east and west parts of the southern Lower Peninsula. In the west, the counties of Muskegon, Kent, and Ottawa suffered more than a half-million dollars of damage from lightning strikes, which caused several major fires. In Muskegon County, lightning caused an attic fire in a house (\$40,000 damage) in Muskegon Township, a fire in a storage building in Egelston Township, and power outages that affected 7,500 persons. In Kent County, more than \$500,000 in damage resulted from a lightning-caused fire that heavily damaged an apartment building in Grand Rapids, destroying six apartments on the top floor and damaging at least 10 additional apartments when the roof caved in. 15,000 homes lost electricity throughout the Grand Rapids metro area, mostly caused by lightning strikes. The southeastern part of the state was even more heavily impacted by these thunderstorms, resulting in state and federal disaster declarations in Wayne and Macomb County. The storms produced over 4,300 cloud-to-ground lightning strikes, some of which caused fires that destroyed a house and an apartment building, leaving 16 persons homeless and causing \$275,000 in damage in Sterling Heights (Macomb County). In Waterford Township (Oakland County), a woman was hospitalized after being struck by lightning in a park.

Case: July 15, 2010 – Vestaburg (Montcalm County)

Lightning struck four young persons between 9 and 18 years of age at a baseball diamond near Vestaburg. Fortunately, all survived the incident, but their injuries required special emergency care, including emergency medical flights to the appropriate care facilities.

Case: September 21, 2010 – Kent County

Various fire departments reported that about a dozen house fires were ignited, in an area from Ada south to Caledonia, by lightning strikes produced by severe storms during the late afternoon. Total damages were estimated at \$500,000.

Severe Wind Hazards

Severe winds, or straight-line winds, sometimes occur during severe thunderstorms and other weather systems, and can be very damaging to communities. Often, when straight-line winds occur, the presence of the forceful winds, with velocities over 58 mph, may be confused with a tornado occurrence. Severe winds have the potential to cause loss of life from breaking and falling trees, property damage, and flying debris, but tend not to cause as many deaths as tornadoes do. However, the property damage from straight line winds can be more widespread than a tornado, usually affecting multiple counties at a time. In addition to property damage to buildings (especially less sturdy structures such as storage sheds, outbuildings, etc.), there is a risk of infrastructure damage from downed power lines due to falling limbs and trees. Large scale power failures, with hundreds of thousands of customers affected, are common during straight-line wind events.

Another dangerous aspect of straight-line winds is that they occur more frequently beyond the April to September time frame than is seen with the other thunderstorm hazards. It is not rare to see severe winds ravage parts of the state in October and November—some winter storm events in Michigan have produced wind-speeds of 60 and 70 miles per hour. Stark temperature contrasts seen in colliding air masses along swift-moving cold fronts can occur during practically any month.

Figures from the National Weather Service indicate that severe winds occur more frequently in the southern half of the Lower Peninsula than any other area of the state. On average, severe wind events can be expected 2-3 times per year in the Upper Peninsula, 3-4 times per year in the northern Lower Peninsula, and 5-7 times per year in the southern Lower Peninsula. It must be emphasized that this refers to winds from thunderstorms and other forms of severe weather, but **not** tornadoes.

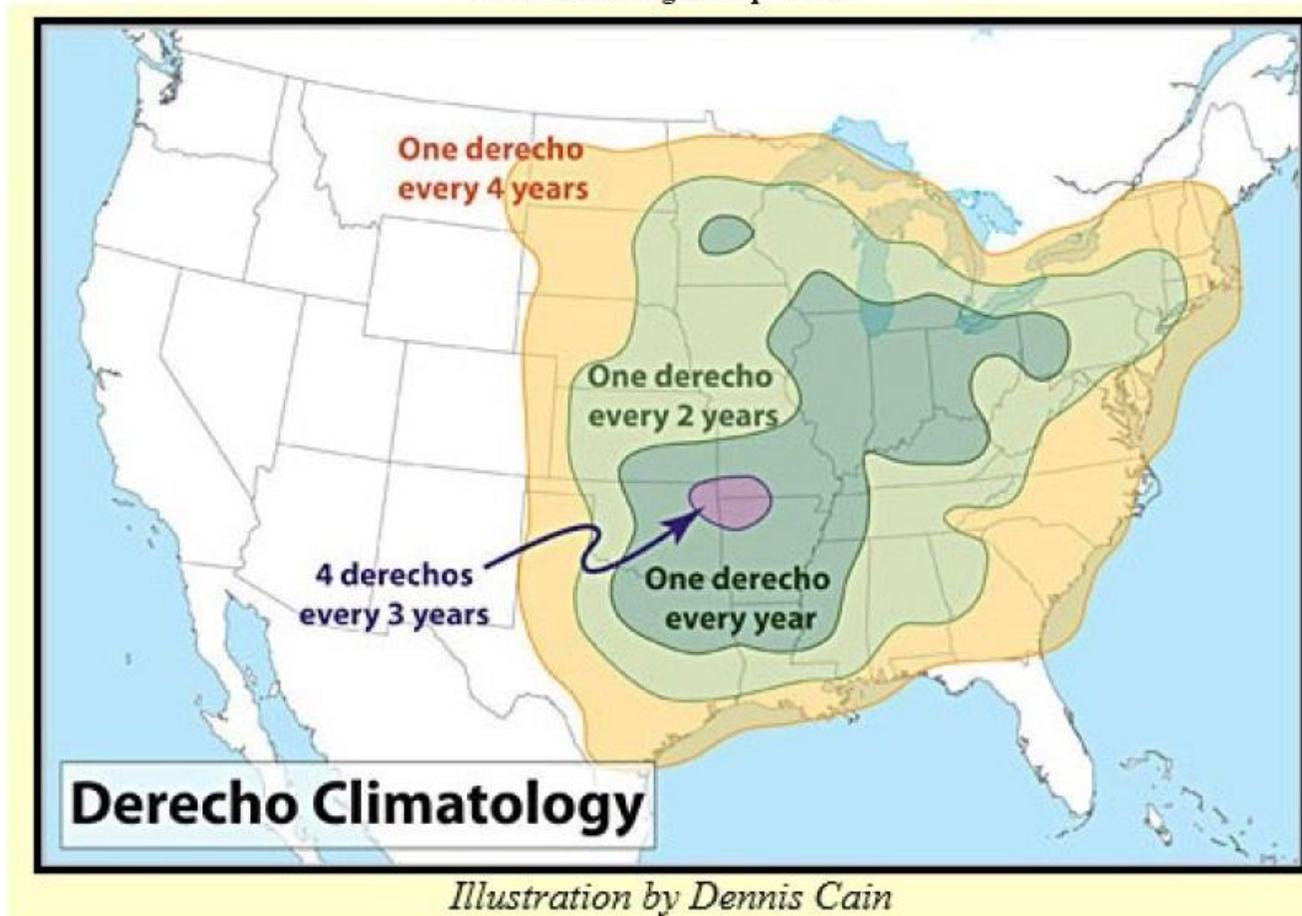
The property damage from straight line winds can be just as extreme as that of a tornado, since the damage from straight line winds is more widespread and usually affects multiple counties. In addition to property damage to buildings (especially less sturdy structures such as storage sheds, outbuildings, etc.), there is a risk for infrastructure damage from downed power lines due

to falling limbs and trees. Large-scale power failures, with hundreds of thousands of customers affected, are common during straight-line wind events.

Severe winds spawned by thunderstorms or other storm events have had devastating effects on Michigan, resulting in 36 deaths, about 270 injuries, and nearly \$1.5 billion in damage to public and private property and agricultural crops since 1996. 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.

Derechos are usually large-scale storm systems that travel hundreds of miles and are many counties wide. The damage path of a derecho often exceeds 250 miles in length, with damage reports typically stretching across many states. Derechos can happen any time of the year, but are most common in Michigan during the warmer half of the year. Wind speeds in derechos can exceed 100 mph at times and often result in damage that is more widespread than most other storms and tornadoes in Michigan. The following map gives an indication of the pattern of Derecho frequency across the United States.

Derecho Average Frequencies



The following are brief synopses significant Severe Wind Events in Michigan:

Case: August 20-Sept 6, 1975: Statewide major disaster declaration by president.

Case: July 15-20, 1980 – Southern Lower Michigan

Wind-related damages were so severe in the southern Lower Peninsula from July 15-20, 1980 that a Presidential Major Disaster Declaration was granted for 10 counties. Over 300,000 electrical customers were left without power, some for several days. During the recovery process, almost \$6.8 million in public and private assistance was made available to affected local jurisdictions and to residents in the affected areas. Four million dollars in low-interest disaster loans were made available through the Small Business Administration.

Case: April 30, 1984 – Lower Michigan

On April 30, 1984, a windstorm struck the entire Lower Peninsula, resulting in widely scattered damage, 1 death, and several injuries. Wind gusts measured up to 91 miles per hour in some areas. Damage was widely scattered, but extensive, with 6,500 buildings, 300 mobile homes, and 5,000 vehicles being damaged. Over 500,000 electrical customers lost power. In addition, 10 to 16-foot waves on Lake Michigan caused severe shore erosion, collapsing some cottages and driving many boats aground.

Case: March 27, 1991 – Central and Southern Lower Michigan

On March 27, 1991, severe thunderstorms and accompanying high winds caused considerable damage across a large portion of central and southern Lower Michigan, damaging homes, businesses, farms, and some public facilities. In addition to numerous tornado impacts (q.v.), three deaths and 21 injuries were attributable to straight-line winds, and power was lost to 450,000 electrical customers (many for up to one week). The storms also caused hail in some areas. Eighteen of the wind injuries occurred in Branch County, where several houses and mobile homes were destroyed, business windows were blown out, and a truck and car were blown off of the I-69 expressway. In Berville (St. Clair County), a man died of a heart attack while trapped inside a mobile home blown off its foundation.

Case: July 13-15, 1995 – Statewide

From July 13-15, 1995, severe thunderstorms damaged numerous areas of Michigan. These storms, which produced winds up to 100 miles per hour with damaging golf-ball-sized hail and severe lightning, damaged hundreds of structures, and downed thousands of trees and power lines statewide. Damage was widespread, but the impacts were not severe or extensive enough in any one location to require supplemental disaster assistance. The strong winds produced widespread power outages. More than 400,000 electrical customers in southeast Michigan lost power due to the storms. In Roscommon County, over 100,000 trees were toppled by the winds. Wind gusts in that area were estimated in the 85-100 miles per hour range. A girl was killed when her pontoon boat flipped over while she attempted to return it to its dock. A stranded ORV-

rider died of a heart attack before rescuers could cut a path through debris-blocked trails. One person was killed in Huron County when a barn collapsed between Bad Axe and Harbor Beach. Damages were reported in the following counties: Antrim, Clare, Crawford, Genesee, Gladwin, Gratiot, Huron, Ionia, Isabella, Kalkaska, Leelanau, Lenawee, Livingston, Mackinac, Mecosta, Midland, Monroe, Montcalm, Newaygo, Oceana, Ogemaw, Otsego, Roscommon, Saginaw, Sanilac, Shiawassee, St. Clair, Tuscola, Washtenaw, and Wexford.

Case: April 6-7, 1997 – West Michigan

On April 6-7, 1997, an intense early-spring low-pressure system moving across the Great Lakes brought gale force winds to much of Lower Michigan. Wind gusts of 50-70 miles per hour created 10-to-15-foot waves on the Lake Michigan shoreline, causing widespread wind damage and lakeshore beach erosion. Private damage was estimated at \$5 million, with specific damages reported in the counties of Clinton, Ionia, Kent, Montcalm, Muskegon, Osceola, Ottawa, and Van Buren. The winds downed numerous trees and power lines across the region, caused roof and structural damage to many buildings, and resulted in power outages for nearly 200,000 Consumers Energy electrical customers. The U.S. Army Corps of Engineers estimated that the severe beach erosion involved as much as 20 feet of beach loss in some areas. The beach erosion was due in part to the unusually high Great Lakes water levels, which were nearly 38 inches above average. One injury was later reported in this severe wind event.

Case: May 29, 31, 1998 – Southern Lower Peninsula

On May 31, 1998, a derecho raced across the Lower Peninsula around 4:30am, producing widespread 60 to 90 mph wind gusts that caused extensive tree and structural damage and left over 861,000 homes and businesses without electricity. Consumers Energy reported the derecho as the most destructive weather event in its history, leaving over 600,000 of its customers without power. There were four storm-related fatalities and 145 injuries (mostly minor) reported in the state. Statewide, approximately 250 homes and 34 businesses were destroyed and 12,250 homes and 829 businesses were damaged. Damage estimates totaled over \$166 million. The highest wind gusts reached 120 to 130 mph in Spring Lake (Ottawa County) and Walker (Kent County), 100 mph in portions of Montcalm County (including Cody Lake and Stanton), and 90 mph in Rockford (Kent County) and Zeeland (Ottawa County). It took up to 10 days to fully restore power to certain areas, including the City of Walker and portions of Montcalm and Gratiot Counties. A Presidential Disaster Declaration was declared for 13 counties. Significant damages were reported in the counties of Barry, Bay, Calhoun, Clare, Clinton, Genesee, Gratiot, Huron, Ingham, Ionia, Isabella, Kent, Lake, Lapeer, Macomb, Mason, Mecosta, Midland, Montcalm, Muskegon, Newaygo, Oakland, Oceana, Oscoda, Ottawa, Saginaw, Sanilac, Shiawassee, St. Clair, Tuscola, and Wayne.

Case: July 31-August 2, 2002 – Central Michigan and Upper Peninsula

During the last day in July, severe weather hit central Michigan and the Upper Peninsula. The National Weather Service issued tornado warnings for seven counties in central Michigan. Funnel clouds were reported along a 120-mile stretch extending from Howard City to Onaway. Golf ball-size hail fell in Escanaba and thunderstorms soaked Houghton with 1.25" of rain in a two-hour period. About 14,000 Upper Peninsula Power Company customers lost electricity for several days due to 70 mile per hour winds that toppled trees and power lines in the western Upper Peninsula. Some Houghton customers were blacked out when high winds tore the metal roof off a Frito-Lay warehouse, and it sliced through nearby power lines. From Tuesday night through mid-day Thursday, the National Weather Service issued 44 severe weather warnings for various parts of the Upper Peninsula. Property damage from straight-line winds was noted in the counties of Allegan, Barry, Calhoun, Clare, Ingham, Ionia, Kalamazoo, Kent, Mecosta, Montcalm, Newaygo, Ottawa, and Van Buren.

Case: June 6 to 8, 2008 – much of the Lower Peninsula

Numerous thunderstorms produced damaging winds of up to 65 knots. The strongest winds were reported at Howell and Saginaw. The greatest damages occurred in the Saginaw area, where 12,000 residents lost electricity. Two miles north of Carrollton, dozens of trees were blown down, some knocking down power lines, some falling onto houses, some blocking roads, and one falling onto a car and injuring its two occupants. An entire roof was blown off a commercial building near the intersection of Stevens and Hamilton. Storm systems continued to cause wind damage during the next two days. A derecho swept across many counties in the southern Lower Peninsula, involving winds as high as 74 knots (at Marine City). There were also tornadoes and hail associated with this system. Damages were estimated at \$17 million (both property and crops), and the storm systems were associated with 7 deaths and 3 injuries. More than 10,000 persons were without power for a week or more. This was the worst such wind event of the decade. Thousands of trees were lost, and great property damage was caused as they toppled onto houses and cars. Three casualties were caused by straight-line winds. One mile west of Spring Lake, a car was struck by a tree while it was being driven, killing the driver and injuring the passenger. A pedestrian was also killed by a falling tree, a mile southeast of Harrisburg. Numerous power lines were down, and boats were overturned in the water. The following counties reported wind-related casualties, property damage, and/or crop damage: Arenac, Bay, Branch, Cass, Clinton, Dickinson, Genesee, Gladwin, Gogebic, Huron, Kent, Lapeer, Lenawee, Livingston, Macomb, Marquette, Midland, Missaukee, Monroe, Montcalm, Oakland, Ogemaw, Ottawa, Saginaw, Sanilac, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, and Wayne.

Severe Wind Hazards in Muskegon County

From 1950 – 2022, there were over 127 Severe Thunderstorm events or windstorms in Muskegon County. Since 1950 severe thunderstorms in Muskegon County have resulted in \$29.8 million dollars in damage to property and \$5 million in damage to crops. With severe thunderstorms, there is also the threat of hail and lightning. Since 1950, there has been 68 hail

events reported with \$965,000 in property damage and \$260,000 in crop damage. The Muskegon Chronicle reported lightning strikes caused 2 separate fires in the area and resulted in power outages affecting 7,500 people in the Muskegon service area. A house fire at 2862 Evanston Avenue in Muskegon Township was caused by a lightning strike. The fire burned the attic and damage was estimated at \$40,000. Lightning was also the cause of a fire at an 18-unit storage building at Boxer Store and Lock in Egelston Township.

Based on historical occurrence, Muskegon County experiences an estimated average of 2 or more thunderstorm events causing wind or lightning damage per year. Most severe thunderstorms within Muskegon County bring down trees, do minor damage to homes (siding, shingles, windows, etc.) and bring down power poles. However, several significant storms include:

Case: April 6, 1997

An intense early spring low pressure system moving across the Great Lakes brought gale force westerly winds to all of Lower Michigan behind a strong cold front. Winds increased to sustained speeds of 35 to 45 miles per hour out of the west shortly after a frontal passage. Frequent wind gusts of 50 to 70 miles per hour were common. Damage estimates from the storm reached \$5.0 million. The winds downed trees and power lines and resulted in roof damage to area homes and businesses. Between 180,000 and 200,000 Consumers Energy customers lost power across the state Sunday evening.

Case: May 31, 1998

One of the worst severe straight-line wind events struck Michigan on May 31, 1998. This particular derecho, a widespread and long-lived, violent convectively induced straight-line windstorm that is associated with a fast-moving band of severe thunderstorms striking Michigan's Lower Peninsula. The derecho event produced widespread 60 to 90 mph wind gusts with wind gusts were estimated up to 130 mph from Grand Haven to Walker. All of the southern half of Lower Michigan was greatly affected by this storm. Extensive tree, home, building, and vehicles damage occurred. An estimated \$10 million in damages in the Grand Haven and Spring Lake areas. 70,000 Muskegon County customers lost electricity for days. Several residents and visitors to shoreline campgrounds were injured in the storm. The City of Muskegon documented approximately \$300,000 in expenses during cleanup from the storm.

Case: May 8, 2000 Western Michigan

Thunderstorms developed during the evening and into the early morning hours in a highly unstable air mass across southern lower Michigan. One isolated severe thunderstorm developed during the early evening hours in Baldwin, producing one inch hail. There were several reports of three quarters to one inch hail in Muskegon. A 60 mph wind gust was observed in Holton Township in Muskegon County, where several large tree limbs were blown down. Trees were

also blown down in Holt (Ingham County), and several power lines were blown down in Lansing (Ingham County). The storm caused 50k in damage.

Case: August 22, 2000 – Muskegon County

Severe Thunderstorms and high winds caused \$150k in property damage across the county. Severe thunderstorms produced numerous reports of wind damage through the evening. A small airplane was flipped over by severe thunderstorm wind gusts (the plane was not tied down at the time). There were also numerous reports of downed trees and power lines.

Case: April 22, 2001 - Western Michigan

Severe thunderstorms produced extensive damage across Muskegon County causing \$150,000 of property damage.

Case; May 15, 2001 - Numerous Counties

Three quarters inch hail was reported at Blue Lake Township (Muskegon county). One inch hail was reported by spotters at Duck Lake (Muskegon county). Flash flooding became the primary weather problem. Flash flooding occurred across much of Kent, Oceana and Muskegon counties, where many primary and secondary roads as well as basements of homes were flooded. This storm caused 10k in damage.

Case: August 21, 2002 - Norton Shores

An isolated severe thunderstorm blew down a tree in Norton Shores. The tree fell down on and injured two people who were taking a walk through woods near Lake Michigan. Law enforcement in Fruitport reported that several tree limbs and power lines were blown down. This event resulted in 10k in damage.

Case: October 30, 2004 – Muskegon County

A high wind event caused scattered downed trees and power lines due to gusty winds of around 58 to 60 m.p.h. The wind knocked out power to about 100,000 people statewide. Overall, the high winds caused \$1.2 M in property damage across 23 counties including Muskegon County.

Case: August 9, 2009 – Muskegon County

Severe thunderstorms and winds caused \$2M in property damage. Fruitport took the brunt of the storm with wind gusts of 70 to 80 mph lasting for about 10 minutes. Hundreds of trees were blown down many taking down utility lines and poles in the process. Approximately one dozen homes were heavily damaged by falling trees. Extensive damage to utilities was reported with numerous lines and poles snapped.

Case: November 17, 2013 – Several Counties

Severe thunderstorms developed in the afternoon with a cold front following the line of storms. The storm winds blew down trees and produced multiple brief EF-0 tornados along more than a

50-mile path from Muskegon County northeast through Newaygo County into Mecosta County. This event caused numerous power outages and straight-line wind damage. Most of the damage was to trees with some damage to buildings and fences amounting to around \$50,000 in damage in Newaygo County.

Case: April 12, 2014 - City of Muskegon

Severe thunderstorms with damaging wind gusts developed near a warm front during the midafternoon and continued through evening. There were numerous reports of straight line wind damage with wind gusts of up to 75 to 85 mph. Hail as large as the size of quarters was also reported. Numerous trees were blown down in and near Muskegon. Numerous windows were blown out of area homes and businesses. 30,000 people in and near Muskegon lost power. Wind gusts with severe storms were estimated at up to 85 mph. A 60-mph wind gust was measured at the Muskegon airport. Damages were estimated at 1M.

Tornado Hazards

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 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 200+ 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, but those few minutes can result in tremendous damage and devastation. Historically, tornadoes have resulted in tremendous loss of life, with the mean national annual death toll being 87 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year.

Although tornadoes are most commonly reported between 3pm and 9pm, they can occur at any time. Although they generally exist at the trailing edge of a thunderstorm, it is possible for them to be present in other locations and less readily recognized weather patterns.

Tornado intensity is measured on the Enhanced Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings, and other man-made structures. The Enhanced Fujita Scale rates the intensity of a tornado based on damage 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 is presented in the table below.

The Enhanced Fujita Scale of Tornado Intensity

| EF-Scale Number | Intensity Descriptor | Wind Speed (mph) | Type/Intensity of Damage |
|------------------------|-----------------------------|-------------------------|---|
| EF0 | Gale tornado | 65-85 | Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards. |
| EF1 | Weak tornado | 86-110 | Moderate damage. [The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed. |
| EF2 | Strong tornado | 111-135 | Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated. |
| EF3 | Severe tornado | 136-165 | Severe damage. Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown. |
| EF4 | Devastating tornado | 166-200 | Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated. |
| EF5 | Incredible tornado | Over 200 | Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged; incredible phenomena will occur. |

NOTE: When describing tornadoes, meteorologists often classify the storms as follows:
 EF0 and EF1 = weak tornado; EF2 and EF3 = strong tornado; EF4 and EF5 = violent tornado
 (Source: The Tornado Project; National Climatic Data Center)

According to the National Weather Service (NWS), since 1950 the vast majority of tornadoes, about 74% of tornados in the United States were classified as weak tornadoes (EF0 or EF1 intensity). Approximately 24% were classified as strong tornadoes (EF2 or EF3 intensity), and only 3% were classified as violent tornadoes (EF4 or EF5 intensity). Unfortunately, those violent tornadoes, while few in number, caused about 65% of all tornado-related deaths nationally. Strong tornadoes accounted for another 33% of tornado-related deaths, while weak tornadoes caused only 1% of tornado-related deaths. If the data prior to 1950 is examined, the percentage of deaths attributable to violent tornadoes climbs drastically. That is largely due to the fact that tornado forecasting and awareness programs were not yet established. As a result, it was much more likely for death tolls from a single tornado to reach several hundred.

Records indicate that tornadoes in Michigan have been deadlier than in many other tornado-prone states. That is influenced by the high death toll associated with the June 8, 1953 and April 11, 1965 tornadoes. Several Michigan tornadoes have hit relatively densely populated areas, increasing their fatalities. Seasonally, the table below provides a good indicator of when deaths had occurred, based upon about 55 years of events. During that period, about 96% of the state's tornado-related deaths occurred in the months of April, May and June. June has been Michigan's most deadly tornado month, with 54% of all deaths. If the June 8, 1953 tornado death toll of 115 people is excluded, April becomes the deadliest tornado month, with 77 deaths (32% of the total). Note that a tornado can sometimes appear during colder months.

Tornado Related Deaths in Michigan, by Month 1950 – August 2019

| Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Total |
|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|-------|
| 0 | 0 | 3 | 77 | 23 | 132 | 3 | 1 | 1 | 3 | 1 | 0 | 244 |

Source: National Climatic Data Center

National Weather Service data indicates that Michigan has experienced 1,166 tornadoes and 244 related deaths during the period from 1950 to 2019, an average of 18 tornadoes per year and property damages averaging more than \$17 million per year. The greatest number of tornadoes per year during that period occurred in 1974, with 39 tornadoes (8 of which occurred on April 3). The least number occurred in 1959, with only 2 tornadoes.

The following are brief synopses significant tornados in Michigan:

Case: June 8, 1953 – Flint (Genesee County)

The June 8, 1953 Flint tornado, Michigan's worst storm to date (and classified as F5), is ranked 10th on the top ten list of single killer tornadoes that have occurred in the United States. It was also the last single tornado, until the May 2011 Joplin, MO EF5 tornado, to cause over 100 deaths in the U.S. The storm began its destructive path approximately two miles north of Flushing, moved east-northeast and devastated the north part of Flint before ending two miles north of Lapeer. The tornado obliterated homes on both sides of Coldwater Road for about one mile. It was there that most of the deaths occurred and the damage swath was over one-half mile wide. There were multiple deaths in at least 20 families. The final death toll stood at 115 in Flint alone, along with 785 injuries and total damage estimated at \$19 million. Several tornadoes touched down in other locations in Michigan on that day as well, resulting in an additional six deaths and 129 injuries statewide.

Case: April 3, 1956 – Hudsonville/Standale (Ottawa and Kent Counties)

In 1956, a category F5 tornado struck first at Hudsonville, then traveled northeast and plowed through both Ottawa and Kent Counties, killing 14 and injuring 200. (Some sources cite 17 deaths and 300 injuries.) Over 700 homes were destroyed. Numerous other tornadoes classified

as F4 took their toll on other counties such as Manistee (2 killed, 24 injured), Grand Traverse, Benzie, and Allegan.

Case: April 11, 1965 - Southern and Central Michigan

The April 11, 1965 Palm Sunday tornado outbreak, which affected many other states in the Midwest, had a particularly devastating impact on Michigan. As the following table indicates, a total of 23 tornadoes touched down in 14 southern and central Michigan counties, resulting in

53 fatalities, 798 injuries, and \$51 million in damage to public and private property. Many of the tornadoes were rated F3 and F4 in intensity (strong and violent tornadoes), which undoubtedly contributed to the high death and injury tolls. Across the Midwest, this storm system spawned over 50 tornadoes that collectively killed 256 people and caused an estimated \$200 million in property damage. In addition to Michigan, the other states that were affected by the storms included Indiana, Illinois, Ohio and Wisconsin.

April 11, 1965 (Palm Sunday) Tornado Outbreak: Michigan Impacts

| County | Number of Tornadoes | Deaths | Injuries | Tornado Intensity |
|--------------------------|----------------------------|---------------|-----------------|--------------------------|
| Allegan | 1 | 1 | 9 | F1 |
| Barry | 2 | 0 | 5 | F1 and F3 |
| Bay | 1 | 0 | 2 | F2 |
| Branch | 2 | 18 | 400 | F3 and F4 |
| Clinton | 1 | 1 | 8 | F4 |
| Gratiot | 4 | 0 | 1 | all F2 |
| Hillsdale | 2 | 6 | 94 | F3 and F4 |
| Kalamazoo | 1 | 0 | 17 | F3 |
| Kent | 2 | 5 | 142 | both F4 |
| Lenawee | 2 | 9 | 83 | F3 and F4 |
| Monroe | 3 | 13 | 39 | F3 and F4 |
| Montcalm | 1 | 0 | 0 | F2 |
| Ottawa | 1 | 0 | 0 | F4 |
| Shiawassee | 1 | 0 | 0 | F4 |
| Tuscola | 1 | 0 | 0 | F2 |
| STATEWIDE TOTALS: | 25 | 53 | 800 | |

Source: The Tornado Project / NCEI Storm Events Online Database

Case: March 27, 1991 – Central and Southern Lower Michigan

On March 27, 1991 severe thunderstorms and accompanying high winds caused considerable damage across a large portion of central and southern Lower Michigan, damaging homes, businesses, farms, and some public facilities. A total of three deaths and 27 injuries were attributed to the storms, and power was lost to 450,000 electrical customers (many for up to one week). The storms also produced numerous tornadoes across many Northern Lower Peninsula counties. Ogemaw, Iosco, and Alcona Counties were particularly hard-hit, and suffered a total of more than \$5 million in property damage from F3 tornadoes that traveled dozens of miles. Damage to homes and businesses was estimated at over \$30 million, with almost all of those losses covered by private insurance.

Case: July 13-15, 1995 – Statewide

From July 13-15, 1995 severe thunderstorms damaged numerous areas of Michigan. These storms, which produced winds up to 100 miles per hour with damaging golf ball-sized hail and severe lightning, damaged hundreds of structures and downed thousands of trees and power lines statewide. Damage was widespread, but the impacts were not severe or extensive enough in any one location to require supplemental disaster assistance. The strong winds produced widespread power outages. More than 400,000 electrical customers in southeast Michigan lost power due to the storms. In Roscommon County, over 100,000 trees were toppled by the winds. Wind gusts in that area were estimated in the 85-100 miles per hour range. One person was killed when her pontoon boat flipped over while attempting to return to its dock. One person was killed in Huron County when a barn collapsed between Bad Axe and Harbor Beach.

Case: October 6, 1998 - Big Rapids (Mecosta County)

On October 6, 1998 a series of strong thunderstorms traveled through several counties in central Lower Michigan. The City of Big Rapids, in Mecosta County, was hardest hit by the storms. Officials from the National Weather Service determined that an “F-1 mini tornado,” with winds reaching 80-90 miles per hour, had struck the Ferris State University campus, damaging several buildings and numerous surrounding residences and vehicles. The storm also downed trees and power lines in the area and injured seven people. The storm track was approximately 150 feet wide and one mile long. The storm dumped nearly 3 inches of rain in the Big Rapids area, flooding many streets and parking areas. In nearby Clare County, the storm destroyed one home, damaged ten others, and injured three people.

Case: July 18, 2010 – Kent County

On July 18, 2010 a NWS storm survey team concluded that a series of wet micro bursts across southwestern Kent County had produced wind gusts ranging from 60 up to 80 mph, brought down several trees and power lines in the Wyoming and Cutlerville areas, and flipped over and destroyed 8 wood and metal sheds at a store near Cutlerville. A tornado damaged a home and broke or uprooted several trees just northeast of Wayland. A roof was lifted off of a garage in Wyoming, a shed was destroyed, and some structural damage occurred to one home, due to wind gusts estimated to be as much as 80 mph.

Case: July 6, 2014 – Kent and Ionia Counties

Late night tornadoes injured six people south of Grand Rapids and caused more than \$4.5 million in property damage. Winds reached 110 mph and the event was classified as an EF1 tornado, plus three additional EF0 tornadoes later on. The strongest tornado was on the ground for about 10 minutes, damaging and pushing down numerous trees, structures, and power lines. The trail of destruction began in the Byron Center area and tracked northeast into Wyoming and Kentwood.

Case: July 13-14, 2015 – Kent and Newaygo County

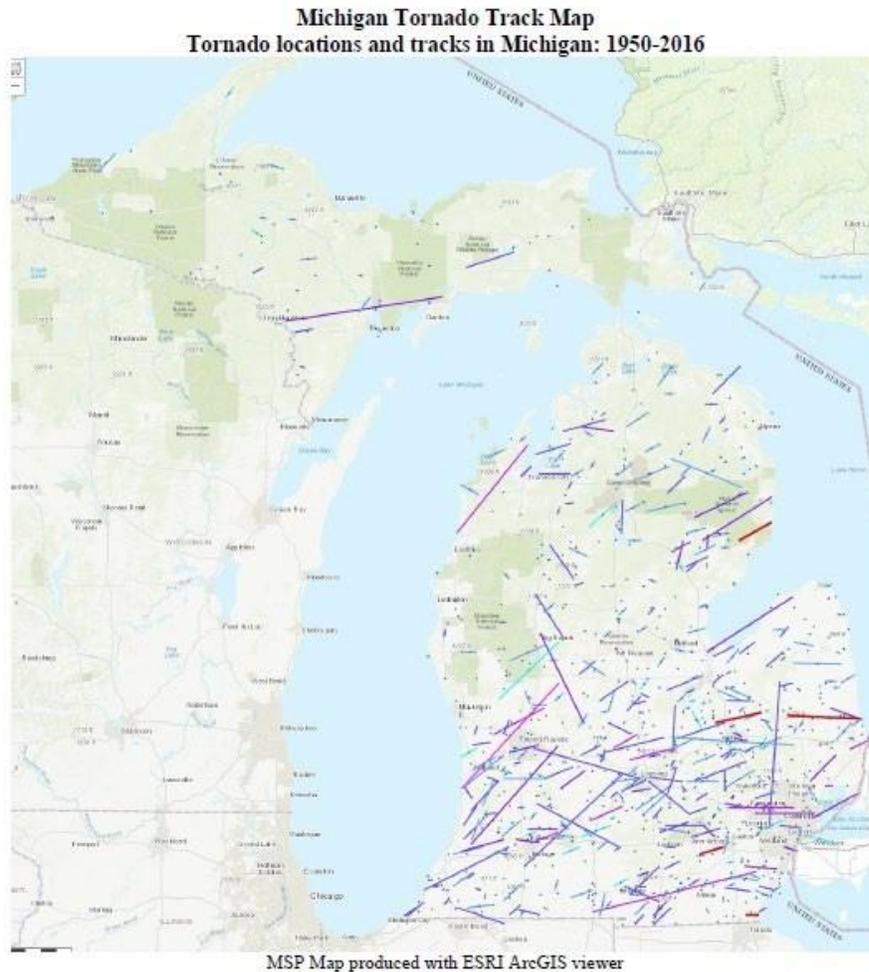
Severe thunderstorms developed during the late evening hours of July 13th and continued into the early morning hours of July 14th, resulting in several reports of wind damage including downed trees and power lines. A NWS storm survey concluded that an EF-0 tornado touched down about a third of a mile southwest of 84th street and Morse Lake Road in Alto. The tornado had a maximum path width of 50 yards and was on the ground for about 2 minutes. Peak wind speeds were estimated at 75 to 85 mph. It caused roof damage to one home and snapped and uprooted several trees. The Newaygo county road commission reported that around 50 large trees were blown down across mainly the northern half of Newaygo County. There were no injuries.

Case: August 20, 2016 – Ottawa County

Six tornadoes struck southwest Michigan on August 20th. An EF-1 tornado touched down just southwest of Bangor on August 20th and tracked northeast through town. The entire city lost power as well as hundreds of trees. Multiple structures in Bangor were damaged as well. The second tornado of the day began 6 miles southeast of Fennville and tracked to 4 miles northeast of Hamilton and was rated EF-1. The day's third tornado, also rated EF-1, began 2 miles northwest of Burnips in extreme north-central Allegan County and tracked to 2 miles southeast of Jamestown in extreme southeast Ottawa County. The day's fourth tornado was rated an EF-0 and touched down near 44th Street and Ivanrest Ave SW in Grandville and continued on the ground along a varying path through Grandville and Wyoming before lifting near the intersection of Nagel Avenue SW and Chicago Drive SW. The fifth tornado was also an EF-0 and it touched down in Kent County near Perkins Avenue NE between Leonard Street NE and Knapp Street NE. The final tornado of the day was an EF-1 that touched down just east of the small town of Orleans and moved northeast where it crossed M-44. It crossed into Montcalm County from Ionia County before lifting near Sheridan.

Case: April 4, 2017 – Kent County

An isolated EF1 tornado developed over extreme southeastern Kent County during the evening hours of April 10th. Dozens of large trees were snapped or uprooted and three barns were heavily damaged. An NWS storm survey confirmed that an EF1 tornado occurred with peak winds of 90 mph, travelled 3.32 miles with a path width of 220 yards.



NOTE: Different sources of information do provide different numbers.

Tornado Hazards in Muskegon County

Since 1950, Muskegon County has experienced 8 tornadoes causing \$78,000 property damage. Two significant tornadoes in Muskegon County include an F2 in 1965 and an F1 in 1967.

Other Muskegon County Tornado Events include:

F2 on 09/04/1965 causing \$25,000 of property damage in Sullivan Township

F1 on 04/16/1967 causing \$3,000 of property damage in Whitehall

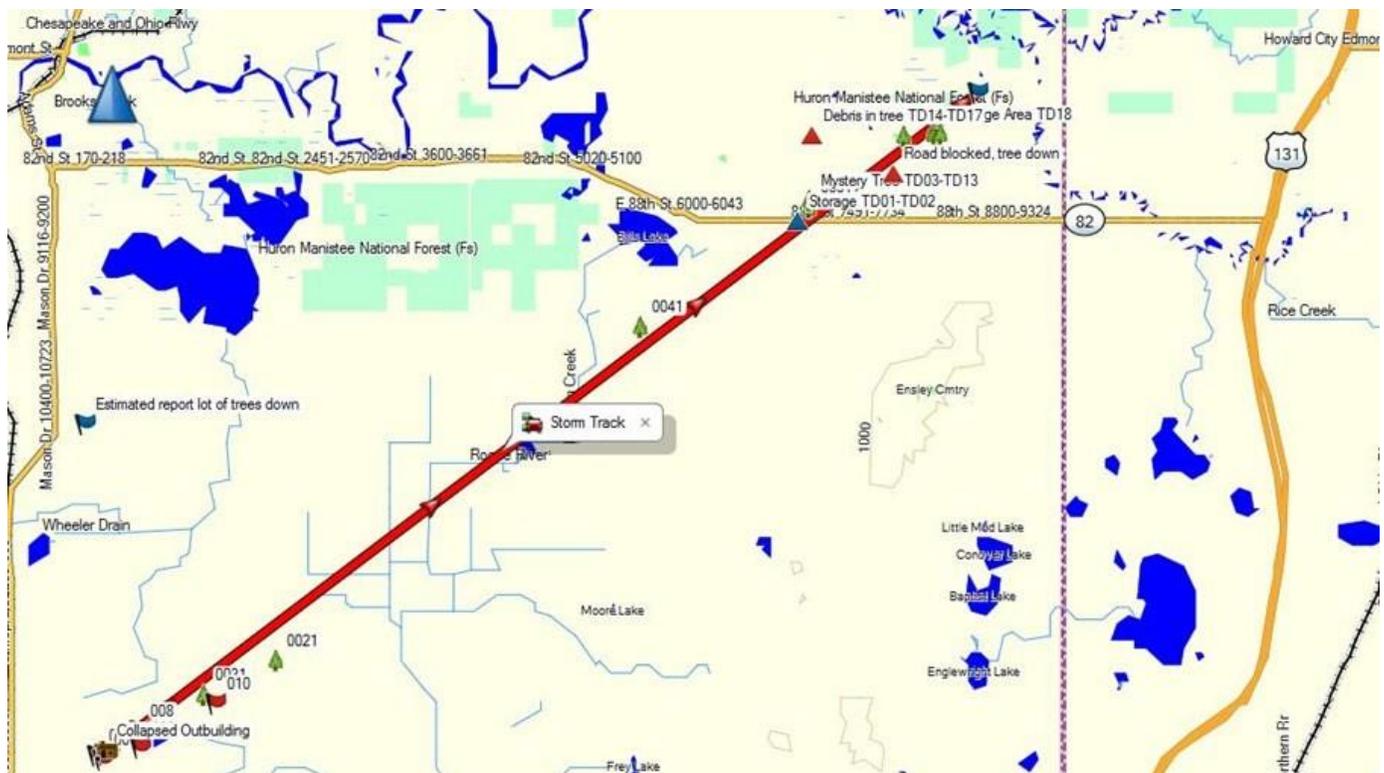
EF0 on 11/17/2013 causing \$50,000 property of damage in Casnovia Township

Case: November 17, 2013

A severe thunderstorm produced multiple brief EF-0 tornadoes along a more than 50-mile path from Muskegon county northeast through Newaygo county into Mecosta county. The tornadoes were on the ground for very short periods of time. Mostly tree damage was incurred but there was also damage to several buildings and fences.



Damage path from November 17, 2013 EF0 Tornado



Local Vulnerability and Impacts

The most limited capability with severe thunderstorms and high winds is local warning systems. Warning systems in Muskegon County are currently very limited in their ability to alert the major populace to an emergency of widespread potential. Outdoor warning sirens are designed to warn the public of a specific hazard such as tornado. They are only designed for outdoor notification and cover

a 1-2 mile radius around the siren. In Muskegon County there are seven existing Tornado Sirens. Due to Dispatch changing over to a new 800 MHz system, they will no longer have the ability to control or activate these sirens. Muskegon County uses the Code Red notification system Sign up for Muskegon County Code Red here: <https://public.coderedweb.com/CNE/en-US/A9A25FDEA4C0>

Additional systems implemented to augment warning consisting of strategically placed tone alert monitors and Code Red and other notification systems, similarly are of limited effectiveness. As such, the primary mass population warning system remains the media outlets of television and radio media coverage which covers a large percentage of the population, however, is limited due to requiring the target audience's to be already monitoring those channels. Adding to their limitation, these systems are reliant on fully functioning local infrastructure such as communications systems, electrical power, and telephone service.

The combination of high population concentrations, limited warning, and temporary/unfamiliar facilities results in increased vulnerability from thunderstorm hazards to the high number of people who attend any one of Muskegon County's popular special seasonal events. It is impractical to list and detail all of Muskegon County's facilities and resources that could significantly limit local response should they become a casualty of a severe thunderstorm effect. However, it is important to note that many of the vulnerabilities identified in other hazard sections are equally vulnerable to the effects of severe thunderstorm hazards due to its unpredictability, limited mitigation potential, and large magnitude. Three primary areas of vulnerability for Severe Thunderstorms within Muskegon County are:

1. Local Special Events
2. Campgrounds
3. Mobile Home Communities

Across all jurisdictions within Muskegon County there is similar vulnerability for Severe Thunderstorms.

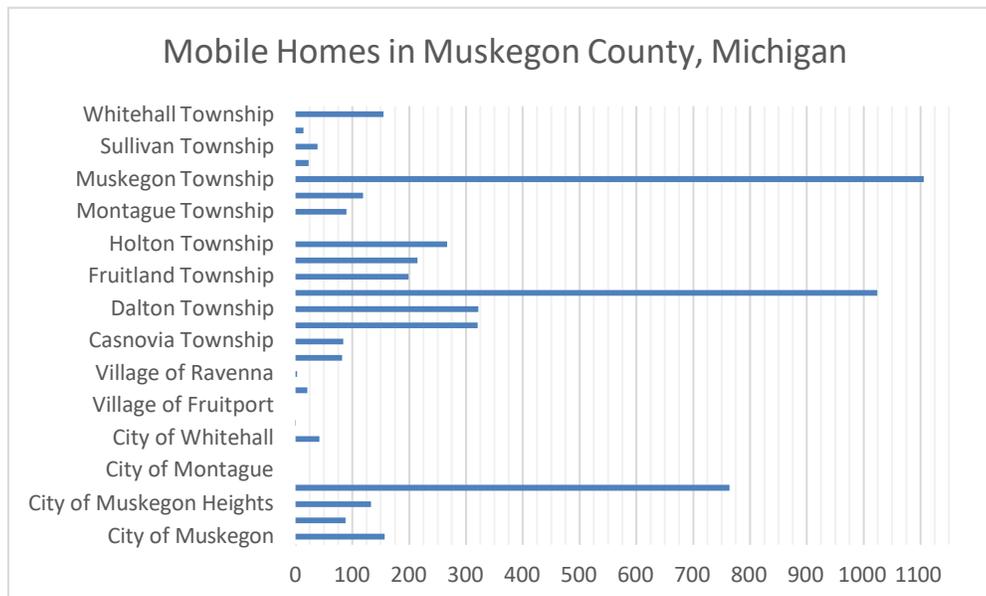
Local Special Events within Muskegon County vulnerable for Severe Thunderstorms

| City of Muskegon | Month | Approximate Date |
|-------------------------------------|--------------|-----------------------------------|
| Muskegon County Black History Month | Feb | 5th |
| Hackley Day Community Celebration | May | Thurs 25th |
| Lakeshore Art Festival | June | Fourth weekend, Sat - Sun |
| Taste of Muskegon | June | Second Weekend Fri and Sat |
| Wings over Muskegon | July | 6 th – 9 th |
| Muskegon County Fair | July | |
| Unity Christian Music Festival | Aug | Second Wed through Sat |
| The Great Lakes Surf Festival | Aug | Second Saturday |
| Burning Foot Beer Festival | Aug | 26 th |
| Michigan Irish Music Festival | Sept | |
| Muskegon County Latino Festival | Sept | 9th |
| Muskegon Farmers Market | Dec-Apr | Saturdays |
| Muskegon Farmers Market | May-Nov | Tues, Thurs, Sat |

Campgrounds within Muskegon County

| Name | Location | |
|--------------------------------------|---------------------------|-----------------------|
| Blue Lake County Park | 10701 Nichols Road | Holton, MI 49445 |
| Camp Lor Ray (Mike Brenner) | 5281 Russell Rs | Twin Lake, MI 49457 |
| Crockery Creek RV Park | 13812 Apple Ave | Ravenna, MI 49451 |
| Duck Creek RV Resort | 1155 W. Riley Thompson Rd | Muskegon, MI 49445 |
| Fisherman's Landing | 501 E Western Ave | Muskegon, MI 49442 |
| Johnsons Trailer Resort | 8191 Meinert Park Road | Montague, MI 49437 |
| Lake Sch Nepp A Ho | 390 East Tyler Road | Muskegon, MI 49445 |
| Muskegon County Fairgrounds | 6621 Heights Ravenna Rd | Fruitport, MI 49451 |
| Trailway Campground | 4540 Dowling St | Montague, MI 49437 |
| Maranatha | 4759 Lake Harbor Road | Muskegon, MI 49441 |
| Muskegon Elks #274 | 513 W. Pontaluna Rd. | Muskegon, MI 49444 |
| Muskegon KOA | 3500 North Strand | Muskegon, MI 49445 |
| Oak Knoll Family Campground | 1522 Fruitvale Road | Holton, MI 49425 |
| Meinert County Park/Pines Campground | 1563 Scenic Drive | Muskegon, MI 49445 |
| Pioneer County Park | 1563 Scenic Drive | Muskegon, MI 49445 |
| White River Campground | 735 Fruitvale Road | Montague, MI 49437 |
| Wolf Lake Apartments and Resort | 5451 Harding | Muskegon, MI 49442 |
| Muskegon State Park | 3560 Memorial Drive | N. Muskegon, MI 49445 |
| P J Hoffmaster State Park | 6585 Lake Harbor Road | Muskegon, MI 49441 |

Muskegon County mobile homes distribution (wind vulnerable structures)



Mobile homes/Manufactured homes are not designed to withstand the force of a tornado or even straight-line winds common in severe storms, it's important that you leave to find shelter elsewhere.

To reduce or prevent damage or destruction from high winds you can wind proof a mobile home by:

1. Inspecting and improving anchors and tie-downs.
2. Reinforcing the wall joints at the floor and ceiling.
3. Strengthening the wall sheeting and reinforce the fastening of siding and roofing.

| MUSKEGON COUNTY MOBILE HOMES DISTRIBUTION | | |
|--|-------------------------------|-------------------------------|
| COMMUNITY | # Mobile Homes | % Mobile Homes |
| Muskegon County | 5,269 | 100% |
| City of Muskegon | 157 | 3.0% |
| City of North Muskegon | 88 | 1.7% |
| City of Muskegon Heights | 133 | 2.5% |
| City of Norton Shores | 764 | 14.5% |
| City of Montague | 0 | 0.0% |
| City of Roosevelt Park | 0 | 0.0% |
| City of Whitehall | 42 | 0.8% |
| Village of Casnovia | 1 | 0.0% |
| Village of Fruitport | 0 | 0.0% |
| Village of Lakewood Club | 21 | 0.4% |
| Village of Ravenna | 3 | 0.1% |
| Blue Lake Township | 82 | 1.6% |
| Casnovia Township | 84 | 1.6% |
| Cedar Creek Township | 321 | 6.1% |
| Dalton Township | 322 | 6.1% |
| Egelston Township | 1,024 | 19.4% |
| Fruitland Township | 199 | 3.8% |
| Fruitport Township | 215 | 4.1% |
| Holton Township | 267 | 5.1% |
| Laketon Township | 0 | 0.0% |
| Montague Township | 90 | 1.7% |
| Moorland Township | 119 | 2.3% |
| Muskegon Township | 1106 | 21.0% |
| Ravenna Township | 23 | 0.4% |
| Sullivan Township | 39 | 0.7% |
| White River Township | 14 | 0.3% |
| Whitehall Township | 155 | 2.9% |

source: Census Reporter

SEVERE WINTER WEATHER

Severe Winter Weather

A storm that generates sufficient quantities of snow, ice, or sleet to result in hazardous conditions and/or property damage. These storms are often accompanied by high winds, cold temperatures, and low visibility. Severe winter weather hazards include snowstorms, blizzards, and extreme cold, ice, and sleet storms.

Severe Winter Weather Hazard Description

While the danger from winter weather varies across the country, nearly all Americans, regardless of where they live, are likely to face some type of severe winter weather at some point in their lives. Winter storms can range from a moderate snow over a few hours to a blizzard with blinding, wind-driven snow that lasts for several days. Many winter storms are accompanied by dangerously low temperatures and sometimes by strong winds, icing, sleet and freezing rain.

Heavy snows can shut down towns and cities for a period of a few days if snow is persistent and cannot be cleared in a timely fashion. Roof failures may occur as the weight and volume of snow cause damage to homes and buildings. Urban areas are especially susceptible to outages and problems with snow removal, while rural areas may have inaccessible roads for some time but have residents that are more prepared to handle power outages and temporary isolation. Motorists and passengers in cars can be stranded in rural areas and die of exposure because of inadequate preparation for conditions. One of the primary concerns is the winter weather's ability to knock out heat, power and communications services to your home or office, sometimes for days at a time. Heavy snowfall and extreme cold can immobilize an entire region.

The following are specific severe winter weather hazards:

Snowstorms and Blizzards:

Snowstorms are defined as a period of rapid 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 bearing enormous amounts of snow. Most of the snow accompanying a blizzard is in the form of fine, powdery particles of snow which are wind-blown in such great quantities that, at times, visibility is reduced to only a few feet. Blizzards have the potential to result in property damage and loss of life. Just the cost of clearing the snow can be enormous. As a result of being surrounded by the Great Lakes, Michigan experiences large differences in snowfall in relatively short distances. The average annual snowfall accumulation in different areas ranges from 30 to 200 inches of snow. The highest accumulations are in the northern and western parts of the Upper Peninsula. Since winter storms tend to move from west to east, the western parts of the state usually have greater amounts of snow than the eastern parts.

Ice and Sleet Storms:

An ice storm is a storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or property damage. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is small frozen rain drops (ice pellets) that bounce when hitting the ground or other objects. Sleet does not stick to trees and wires, but sleet in sufficient depth does cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with a surface, coating the ground, trees, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. When electric lines are downed, power may be out for several days, resulting in significant economic losses and the disruption of essential services in affected communities. Often times, ice storms are accompanied by snowfall, in which the ice is camouflaged and covered up by snow, creating treacherous transportation conditions. Both storms occur when the temperature is close to 32°F but are far more severe when the temperature is in the 20s.

Extreme Cold

Prolonged periods of very low temperatures, often accompanied by other extreme meteorological conditions such as high winds, etc. Extreme temperatures - whether it be extreme heat or extreme cold - share a commonality in that they both primarily affect the most vulnerable segments of society such as the elderly, children, impoverished individuals, and people in poor health. The major threats of extreme cold are hypothermia (also a major medical emergency) and frostbite. Michigan is subject to both temperature extremes.

Severe Winter Weather Hazard Analysis

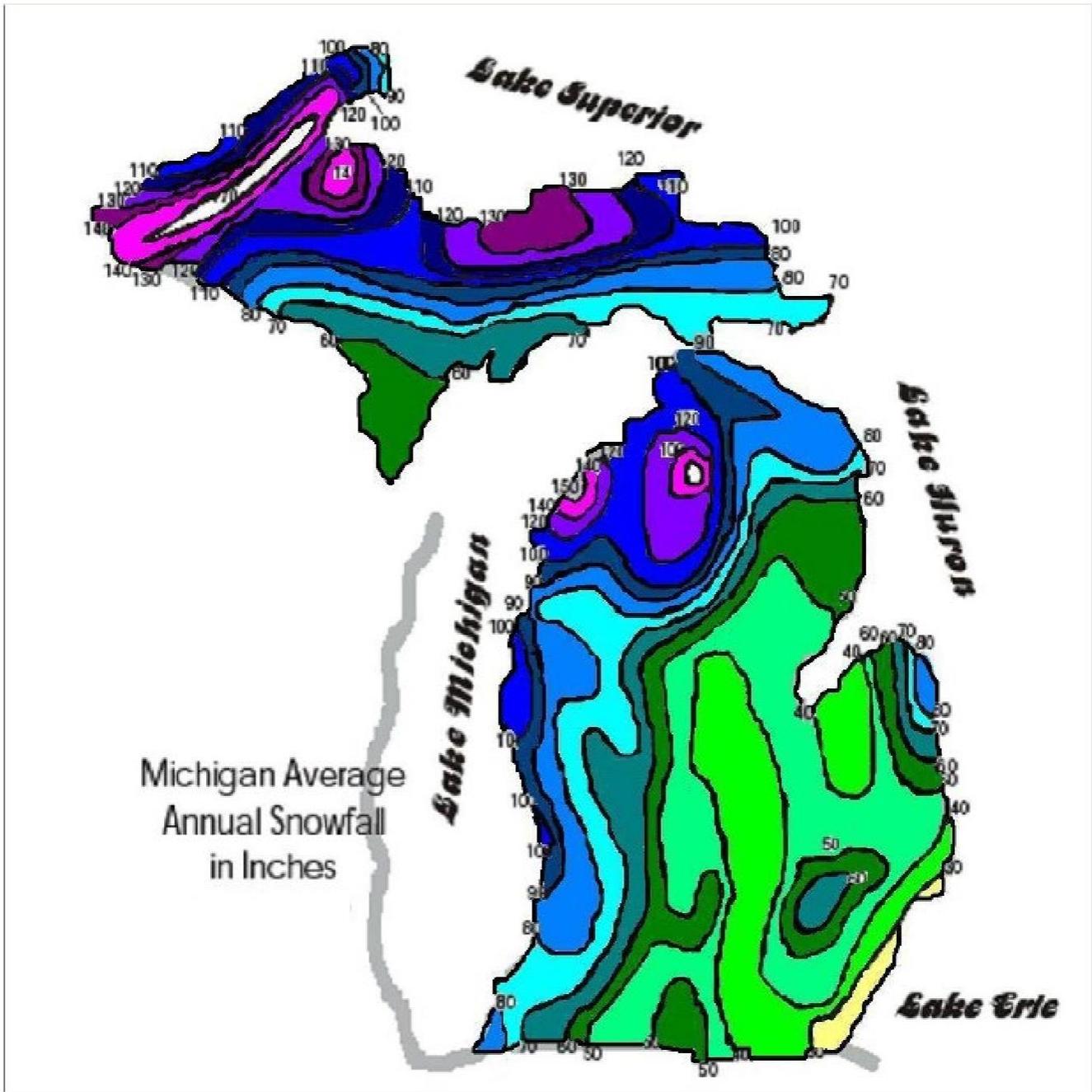
Most of the severe winter weather events that occur in Michigan have their origin as Canadian and Arctic cold fronts that move across the state from the west or northwest, although some of the most significant winter storms have their origins from the southwest, in combination with Arctic air masses. Winter storm hazards plague Michigan annually from November to March, with the state being vulnerable to snowstorms and ice and sleet storms. No area of the state is immune to severe winter conditions that can clog or paralyze the transportation network, cause widespread power outages, and slow normal daily activities to a standstill. Each community should be prepared for the harsh landscape created by snow and ice extremes.

The snowfall map that follows shows that the western Upper Peninsula experiences the most snowstorms and snowfall in Michigan each year. The western half of the Lower Peninsula also experiences heavy snowfall and a relatively large 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 larger snowfall amounts in the western part of the state. More detailed information can be found at the State Climatologist's web site:

https://climate.geo.msu.edu/climate_mi/ .

Michigan Average Annual Snowfall

Source: Michigan Committee for Severe Weather Awareness



Severe Winter Weather in Michigan

In general, the snowstorm season of the Southern Lower Peninsula runs from November to April each year. (Although snow occasionally does fall outside of this “season,” such snowfall would be comparatively light, rather than the sort of snowstorm event that is here being considered as a hazard.) This does not mean that all of these months necessarily receive significant snowfall each year. Instead, the “season” denotes the part of each year when a significant snowstorm may occur. A significant snowstorm is here defined as at least several inches of snow accumulation in a single event.

Michigan sees a major regional or statewide snowstorm approximately every 5 years. Local events are more frequent. There is an average of about 1.6 major storm events in Michigan each year. Many ice storm deaths are actually caused by automobile accidents, heart attacks from overexertion, downed power lines, carbon monoxide poisoning, and other secondary effects that may be difficult to distinguish from other causes. In terms of property damage, major ice storm events have, according to NCDC records, caused more than \$200 million in damages since 1993 (averaging \$16.4 million per year), and the April 2003 ice storm was particularly severe, reportedly causing \$161 million in damage.

Climate Change Considerations

The effect of climate change upon Michigan is expected to cause an increase in the amount of precipitation during the next few decades. Even though the length of Michigan winters has been decreasing, the season remains an intense one, and periods of deep freeze may actually become more likely as temperature differences narrow between the arctic, polar, and tropical air masses during the Northern Hemisphere’s winter season. During the winter months, the increase in precipitation means that snowfall events will tend on average to be more intense. More snowfall is likely to happen at a time, in the form of significant snowstorm events (e.g. 8 or more inches, higher snowdrifts, cancelled school sessions, etc.).

Michigan meteorologist Paul Gross notes that “contrary to what most would expect, the warming climate is causing an increase in snowfall in those winters where the storm track brings more frequent winter storms to the Great Lakes. In Detroit, for example, five of the ten all-time snowiest winters have occurred since 2004, two of the top-five highest combined snowfall in back-to-back winters have occurred since 2007, the all-time snowiest start of a season through the end of January occurred in 2013-2014 and, as of the date of this report, the winter of 2013-2014 was already in the top five for most consecutive days with at least one inch of snow on the ground.”

The following are brief synopses of significant severe winter weather events in Michigan since 1976 as outlined from the 2019 Michigan Hazard Analysis.

Case: January 26-28, 1967 – Mid-Michigan

From January 26-28, 1967 a snowstorm dumped 24 inches of snow in Mid-Michigan, causing Lansing and other area communities to virtually come to a standstill. The storm contributed to 17 deaths across the region. Hundreds of motorists were stranded in their cars and had to be rescued by the National Guard and local law enforcement. The heavy snowfall caused the collapse of roofs on numerous homes and businesses and shut down public transportation services. Several public shelters were opened to accommodate those stranded by the snow or without heat or electricity due to downed power lines.

Case: March 2-7, 1976 - Central Lower Michigan

During the period from March 2-7, 1976 an ice storm with accompanying high winds and tornadoes struck a 29-county area in the central Lower Peninsula. This storm, one of the worst to ever hit the state, caused over \$56 million in damage, and widespread power outages. The storm impacts were so severe that a Presidential Major Disaster Declaration was granted for the 29 affected counties, to assist in the recovery from the storm.

Case: January 26-27, 1978 – Statewide

On January 26-27, 1978 a severe snowstorm struck the Midwest, and Michigan was at the center of the storm. Dubbed a “white hurricane” by some meteorologists, the storm measured 2,000 miles by 800 miles and produced winds with the same strength as a small hurricane and tremendous amounts of snow. In Michigan, up to 34 inches of snow fell in some areas, and winds of 50-70 miles per hour piled the snow into huge drifts. At the height of the storm, it was estimated that over 50,000 miles of roadway were blocked, 104,000 vehicles were abandoned on the highways, 15,000 people were being cared for in mass care shelters, and over 390,000 homes were without electric power. In addition, 38 buildings suffered partial or total roof collapse. Two days after the storm, over 90% of the state's road system was still blocked with snow, 8,000 people were still being cared for in shelters, 70,000 vehicles were stranded, and 52,000 homes were still without electricity. This storm resulted in a Presidential Emergency Declaration for the entire state, to provide assistance with snow clearance and removal operations.

Case: January 1, 1985 - Southern Lower Michigan

On January 1, 1985 a severe ice storm struck a 13-county area in the southern Lower Peninsula. Freezing rain accumulating up to one inch in thickness downed tree limbs, trees and power lines, blocked roads, and caused widespread power outages. There were three deaths and eight injuries directly related to the ice storm. Approximately 13,000 homes and 260 businesses sustained damage or were destroyed, with losses estimated at nearly \$25 million. Another 160 businesses lost inventory as a result of the storm damage and power outages. Over 430,000 electrical customers were without power, some for as long as 10 days. At the height of the power outage, 28 public shelters were opened to provide shelter to nearly 1,000 residents without power or heat. Several nursing homes and adult foster care facilities had to be evacuated due to the loss of power and heat. Total public and private damage from this ice storm was estimated at nearly \$50 million. A Governor's Disaster Declaration was issued to mobilize state resources to assist in the storm response and recovery.

Case: January 10-12, 1997 – Western Lower Peninsula

During a three-day period from January 10-12, 1997, heavy snow of 12 inches or more was reported in all areas of Ottawa and Kent Counties. In neighboring Allegan County, the snow was measured at 28 inches on Friday evening and 40 inches by Saturday afternoon. Far to the north, Grand Traverse County received 12 to 18 inches. Throughout the affected area, schools were used as emergency shelters for stranded motorists. Secondary roads across the area were blocked from Friday night into Saturday, and interstates were also closed for a few hours late Friday into Saturday. From the 10th through 12th, traffic accidents occurred at the rate of 50 to 100 per county, per day.

Case: January 2-4, 1999 – Southern Lower Michigan

In the early morning hours of January 2, 1999, a severe winter storm moved across the western and southern portions of Michigan. The storm grew in intensity and size, producing record or near-record snowfall that affected much of the southern two-thirds of the Lower Peninsula by the late evening hours of January 3. High winds and frigid temperatures created blizzard conditions that lasted until late in the day on January 4 in some areas. Subsequent storms over the next several days dumped an additional foot of snow in many areas of the state, resulting in snowfall of historic proportions in several Michigan communities. Combined, these winter storms produced the worst winter conditions to hit Michigan since the statewide blizzard that occurred in January 1978 (see description above).

The effects of the blizzard on the city of Detroit were the focus of national media attention. Detroit and surrounding communities received nearly two feet of snow during the blizzard. The unusually intense snowfall, coupled with the frigid temperatures and blowing and drifting snow, severely hampered snow removal operations within Detroit. The City's inability to plow residential streets created public health and safety concerns in many areas due to lack of access for police, fire, and other emergency vehicles. The unplowed streets and sidewalks also forced the Detroit school system to close for several days, idling more than 180,000 students. The heavy snowfall collapsed numerous commercial building roofs in Detroit and throughout southeast Michigan. In addition, ice dams on residential roofs were a widespread problem, damaging tens of thousands of structures. The record snowfall also hampered mail delivery, affected the ability of residents to travel to and from work, and negatively impacted business activity and tourism. At Detroit Metropolitan Airport, the severe winter conditions forced the cancellation of hundreds of flights over the three-day period from January 2-4, stranding thousands of travelers without adequate accommodations. Numerous planes landed at the airport, only to sit on the runway apron for hours at a time – unable to unload passengers because the snow could not be cleared from the gates fast enough or there simply were not enough open gates or personnel to handle the large influx of planes. This situation also drew the attention of the national media and cast a negative shadow over the airline and airport operations. A Presidential Emergency Declaration was granted for the 31 Michigan counties that received record or near-record snowfall, making available Federal snow removal assistance under the Federal Emergency Management Agency's (FEMA) Public Assistance Grant Program.

Case: December 11-31, 2000 – Central and Southern Lower Peninsula

In the early morning hours of December 11, 2000, a severe winter storm moved through the state, inflicting its heaviest effects on the southern two-thirds of the Lower Peninsula before moving out of the state on the morning of December 12. That storm produced record or near-record 24-hour snowfall levels in 31 counties, paralyzing the entire region. High winds and frigid temperatures created blizzard conditions that lasted until late in the day on December 13 in some areas. The storm produced great hardships for many Michigan communities. Schools across much of the southern Lower Peninsula were closed for several days, the storm forced the cancellation of hundreds of airline flights, and many businesses were forced to close at the height of the Christmas shopping season (the most profitable shopping period of the year). Damage in Genesee County was estimated at \$1.1 million, as the roof of a manufacturing company collapsed and injured one person. During the storm, up to 200 cars were stranded on I-75 south of Flint. A Richmond home (Macomb County) burned down because firefighting

vehicles were unable to reach it. Around Caro (Tuscola County), 41 automobile accidents took place, including an 18-car pile-up that required responders to make use of snowmobiles. 16.3" of snow had fallen around Caro.

Another series of winter storms the following week dumped an additional foot or more of snow across the same area, increasing snow depths in many counties to two feet or more. The tremendous snow depths caused a host of public health and safety concerns across the region. The snow fell at such a steady rate in many areas that public works crews worked at maximum capacity for two weeks—often around the clock—just to keep pace. The weight of the accumulated snow caused numerous collapsed roofs on homes and businesses, and ice dams and water seepage damaged thousands of structures well into January 2001. In addition, several house fires erupted when water from melting snow and ice seeped into electric meter boxes. The cumulative effects of the heavy snowfall, high winds, and severe cold temperatures that began on December 11 caused problems across the region for the next several weeks. The sheer volume of snow made it difficult to handle, and the process of clearing it out of the way became difficult and expensive, as there was almost no place to put it. Many communities used the majority of their annual snow-removal budget and their road salt supply to combat these storms.

The winter storms of December 2000 produced the worst winter conditions to hit Michigan since the statewide blizzards that occurred in January 1978 and January 1999. In Flint and Saginaw, the December 2000 snowfall set an all-time record for ANY month. In many other areas, it set all-time records for the month of December. A Presidential Emergency Declaration was granted for the 39 Michigan counties that received record or near-record snowfall or incurred significant cumulative effects, making available Federal snow removal assistance under FEMA's Public Assistance Grant Program. These counties were: Allegan, Barry, Bay, Berrien, Branch, Calhoun, Cass, Clare, Clinton, Eaton, Genesee, Gladwin, Gratiot, Hillsdale, Huron, Ingham, Ionia, Isabella, Jackson, Kalamazoo, Kent, Lapeer, Livingston, Macomb, Mecosta, Midland, Montcalm, Muskegon, Oakland, Osceola, Ottawa, Saginaw, St. Clair, St. Joseph, Sanilac, Shiawassee, Tuscola, Van Buren, Washtenaw.

Case: April 3-5, 2003 - West and Central Lower Michigan

A major ice storm affected much of southern Lower Michigan, causing hundreds of thousands of people to lose power. The weight of the ice brought down thousands of trees and limbs and hundreds of power lines. Many people across the area lost power for several days and some who lived in outlying areas were without power for a week. The ice storm resulted in several million dollars' worth of damage across the area. Up to an inch of ice was reported in the Lansing area, and numerous reports of a quarter to one inch of ice were received in the vicinity of I-96. It was one of the biggest ice storms to affect lower Michigan in the last 50 years.

Case: February 16, 2006 – Central Lower Michigan

A major ice storm affected much of central Lower Michigan. There were numerous reports of ice accumulations up to one inch. This glazing caused widespread tree damage and thousands of power outages. Some people were without power for several days, resulting in the opening of numerous temporary shelters due to the extreme cold in the wake of the ice storm. Total damages were in excess of \$2 million.

Case: February 3-4, 2007 – Southwest Lower Peninsula

The combination of lake-effect snow (and snow already on the ground) with very strong winds resulted in blizzard conditions across the western Lower Peninsula on February 3rd. The maximum snowfall total for a twelve-hour period was eight inches, and the maximum snowfall total for a 24-hour period was 12 inches. The highest snowfall total for the entire event was 17 inches, in Grandville (Ottawa County). The Gerald R. Ford International Airport in Grand Rapids (Kent County) reported visibility at or under a quarter mile, from 9:30 a.m. through 8 p.m. on Saturday February 3rd. Numerous other observation sites across the western Lower Peninsula also reported blizzard conditions. The blizzard conditions resulted in numerous road closures, power outages, and car accidents.

Case: February 1-2, 2011 – Southern Lower Peninsula

From February 1-2, 2011, a major winter storm occurred throughout much of the Lower Peninsula. The blizzard included 10 to 15 inches of snow and wind gusts over 40 mph, producing whiteout conditions and snowdrifts of 3 to 5 feet. Thunder accompanied the snow in some areas, with snowfall rates exceeding two inches per hour. Many businesses, schools (including major universities), and some government offices were closed the next day. Most main roads were plowed by the next day, but some side streets were not cleared for a couple more days.

Case: January 28 to February 2, 2019 – Statewide Winter Emergency

A series of heavy snowfall events began this week-long event. On Monday, January 28, much of the state faced the start of a blizzard, with snowfall ranging up to over a foot in depth as sustained winds began (with gusts up to 40 mph) and were soon accompanied by a dangerous drop in temperatures. An extremely large number of schools throughout the state were closed as a result of the snowfall, and then remained closed for most of the week as the combination of sustained subzero temperatures and strong winds produced dangerously low wind-chill values throughout the state. Wind-chill values below -30 degrees Fahrenheit were common throughout Michigan for multiple days, and often dipped below -40. In addition to numerous local states of emergency, non-essential State Government offices were closed for more than half a day on Monday, and for the entire day on Wednesday and Thursday. Governor Gretchen Whitmer's State of Emergency declaration took effect on January 29, anticipating the dangerous impacts of the deep freeze that had been forecast by the National Weather Service. At least three deaths were attributed to weather exposure, and special shelters and over a hundred warming centers were activated at many locations around the state. Additional hospitalizations took place, not just as a direct result of the cold, but also to treat for carbon monoxide exposures resulting from makeshift efforts to heat residents' homes. Hundreds of local and county government offices were closed for at least one or two days during the week, as well. Driving conditions were treacherous and slow. Highway M-40, southeast of Holland (Allegan County) became backed up. A 24-car pileup occurred on I-196 near Zeeland (Ottawa County), resulting in the temporary closure of that expressway. Other expressway closures occurred during the event, including I-496 and northbound US-127 in Lansing, US-131 in Allegan County, and M-37 South of White Cloud, in Newaygo County.

The Muskegon River in Newaygo County, just over the County line (near Muskegon county) reached a moderate flood level in Bridgeton Township and the City of Newaygo, as the result of an ice jam. Some infrastructure problems also arose from water main and pipe breaks, in places such as Lansing's

Complex (Ingham County) and the northern half of the City of Newaygo (placed under a boil water advisory), and substantially lowered the water quality in Escanaba (Delta County). Many rivers experienced ice jams that threatened some areas with floods as well—Benzie County's Platte River near the Village of Honor threatened 20 homes and cottages, Berrien County near M-139 saw minor flooding near Riverfront Campground and in Niles. Excessive delays were reported at the Detroit Metropolitan Airport (Wayne County), as well as the Blue Water Transit bus system (St. Clair County) shutting down from January 30 to 31. Visibility was often a problem, with white-out conditions resulting from the blizzard.

On Wednesday, January 30, at 10:33am, a fire occurred at an important Consumer's Energy facility in Armada Township (Macomb County), and when the impacts of this fire were calculated to eventually lead toward natural gas shortages, the head of that major utility, followed by the Governor, appealed to both residential and industrial customers to voluntarily reduce their use of natural gas. By voluntarily reducing thermostat levels to the recommended 65 degrees or below, until the end of the day on January 31, and temporarily scaling back production activities at certain facilities, this collective effort succeeded in preventing the complete interruption of gas delivery that otherwise was expected to occur. The problem did not involve a supply of natural gas, but only the constraints that the fire had caused in the ability to deliver that gas throughout the state's network. Temporary power failures occurred in some locations, affecting thousands of residents and businesses but fortunately not lasting very long. Other midwestern states also authorized state emergency and disaster declarations during this event. By Friday, February 1, temperatures went back above zero, and Michigan's State of Emergency expired on February 2, 2019.

Severe Winter Weather in Muskegon County

According to the NOAA National Centers for Environmental Information the most days of the year Muskegon County will have snow is 40 days. Annual average snowfall amounts for Muskegon County is approximately 93 inches. NOAA records, the most snow that Muskegon county, Michigan has ever received in a single calendar year is 182.4 inches which occurred in 1962. Muskegon County can be impacted by system snow (snowstorms) in addition to lake effect snow bands from Lake Michigan. Due to the geographic nature of the County and its close proximity to Lake Michigan) Muskegon County is frequently faced with severe snow and/or ice storms, and periods of extremely low temperatures.

According to the US National Weather Service Office, the following chart highlights the average first accumulating snowfall dates for snowfall amounts of greater than or equal to 0.1 inches in Grand Rapids, Lansing, and Muskegon.

1+ Inch Snows Later Than April 26

Muskegon

| | |
|-----|----------------|
| 5.0 | May 9, 1923 |
| 4.0 | April 30, 1907 |
| 4.0 | May 10, 1902 |
| 3.0 | April 29, 1909 |
| 2.5 | April 28, 1912 |
| 1.6 | April 30, 1963 |
| 1.6 | April 28, 1961 |
| 1.5 | April 28, 1979 |

Grand Rapids

| | |
|-----|-----------------|
| 5.5 | May 9, 1923 |
| 5.5 | May 10, 1902 |
| 3.6 | April 30, 1963 |
| 3.0 | May 2, 1929 |
| 2.2 | April 29, 1909 |
| 2.1 | April 30, 1907 |
| 1.7 | May 3 - 4, 1954 |

Lansing

| | |
|------|-----------------|
| 11.5 | May 9, 1923 |
| 4.0 | April 29, 1909 |
| 4.0 | May 1, 1866 |
| 3.0 | May 1, 1875 |
| 2.6 | May 2 - 3, 1929 |
| 2.2 | April 27, 1950 |
| 2.0 | May 10, 1902 |

Bloomingtondale

| | |
|-----|----------------|
| 3.0 | April 27, 1950 |
| 3.0 | May 2, 1929 |
| 2.6 | April 27, 2019 |
| 2.0 | April 30, 1963 |
| 2.0 | May 2, 1940 |
| 2.0 | May 9, 1923 |

Kalamazoo

| | |
|-------|---|
| 4.5 | April 27, 1950 |
| 4.0 | May 2, 1929 |
| 4.0 | May 9, 1923 |
| 1 - 2 | April 27, 2019 (unofficial, estimated) |
| 1.0 | May 3, 1907 |

Hastings

| | |
|-----|----------------|
| 4.4 | May 9, 1923 |
| 3.5 | May 14, 1895 |
| 3.0 | April 27, 1950 |
| 3.0 | May 10, 1902 |
| 1.0 | May 4, 1900 |

NOAA / National Weather Service 

First Snowfall Date Statistics

Average First Accumulating Snowfall Date

| Snowfall Amount | Grand Rapids Area | Lansing Area | Muskegon Area |
|-----------------|-------------------|--------------|---------------|
| 0.1" | November 7 | November 7 | November 13 |
| 1" | November 20 | November 21 | November 25 |
| 3" | December 3 | December 15 | December 7 |

NOAA Snowfall Totals Per Season in Muskegon County

| SEASON | Snow (inches) |
|-----------|---------------|
| 2022–2023 | 60.1 |
| 2021–2022 | 58.1 |
| 2020–2021 | 41.8 |
| 2019–2020 | 51.8 |
| 2018–2019 | 77.2 |
| 2017–2018 | 105.4 |
| 2016–2017 | 49.0 |
| 2015–2016 | 61.9 |
| 2014–2015 | 92.2 |
| 2013–2014 | 132.8 |
| 2012–2013 | 98.7 |
| 2011–2012 | 55.6 |
| 2010–2011 | 104.8 |
| 2009–2010 | 73.7 |
| 2008–2009 | 148.2 |
| 2007–2008 | 110.6 |
| 2006–2007 | 87.0 |
| 2005–2006 | 74.1 |
| 2004–2005 | 91.2 |
| 2003–2004 | 65.8 |
| 2002–2003 | 56.5 |
| 2001–2002 | 51.3 |
| 2000–2001 | 88.3 |
| 1999–2000 | 43.4 |

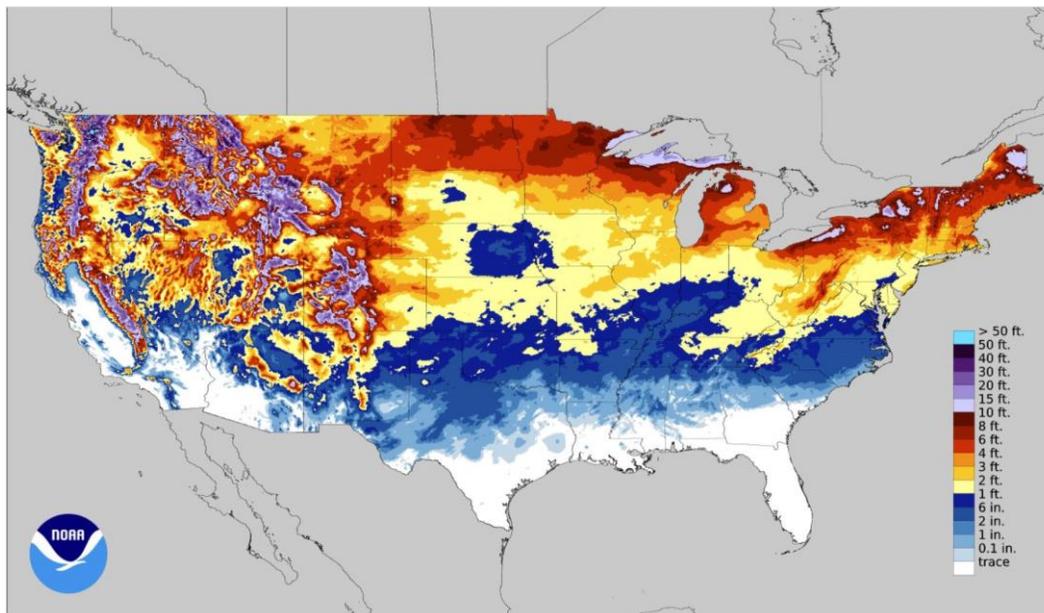
Muskegon County is frequently faced with severe snow and/or ice storms, and periods of extremely low temperatures. Based on historical occurrence, Muskegon County experiences an estimated average of 4 or more events per year. Although the majority of the population has grown accustomed to these emergencies and prepare appropriately, the hazards still pose significant risk to the jurisdiction due to its frequency, intensity, wide area effect, and long duration. The combination of these health

and economic factors have resulted in snow and ice storms emergencies and account for 6 of Muskegon County's 11 Presidential Declarations of Emergency/Disaster and 1 Governor's Declaration since 1953.

- March 20, 1976, Ice Storm
- January 26-31, 1977, Blizzard
- January 26-27, 1978, Blizzard
- January 2-15, 1999, Blizzard
- December 11 -31, 2020, Blizzard
- February 24, 2019, Blizzard / Extreme Cold

Since 2016, the US National Weather Service Grand Rapids Office classifies Winter Weather Advisories as snow accumulations under 8 inches, especially if spread out over 12-36 hours. Wind gusts 45-57 mph or sustained 30 - 40 mph, Ice for less than $\frac{3}{4}$ -1 inch, and wind chills -15 to -25 degrees also fall into the advisory category. Prior to 2016, the threshold was under 6 inches of snow in 24 hours.

National Snowfall Analysis: accumulation from 2021-09-30 to 2022-07-26
Issued 2022-07-31 13:41:50 UTC



Since 2016, the US National Weather Service Grand Rapids Office classifies Winter Storm Warnings as snow accumulations greater than 8 inches in less than 12 hours. Wind chills less than -25 degrees, ice or more than $\frac{3}{4}$ -1 inch, and wind gusts more than 58 mph or sustained 40-50 mph. Blizzards are classified as 35 mph gusts, snow, blowing snow, and visibility near zero.

Since 1997, through 11/30/2023, 57 Ice Storm, Winter Storm, and Winter Weather events have been recorded in the NOAA Storm Events Database for Muskegon County causing \$2.3 million in property damage. Noteworthy severe winter storm events which impacted Muskegon County include:

Case: October 26, 1997

An early season winter storm which tracked south of Michigan, across Indiana and Ohio, produced a band of heavy, wet snow across much of southwest, south central, and central Lower Michigan. This was the first measurable snowfall of the season and because of significant foliage still left on the trees, limbs and branches were more vulnerable to bending and snapping under the added weight of the heavy snow. This resulted in numerous power outages and reports of property damage from downed trees. At the height of the storm, which occurred late Sunday evening, October 26th into early Monday morning, October 27th, power outages affected 333,000 utility customers statewide. Of these, approximately 195,000 occurred in the Grand Rapids metropolitan area alone. Total property damage was estimated at \$1.2 Million area wide. The hardest hit areas included the northwest and northeast sections of the city of Grand Rapids, northern Kent County including Sparta and Rockford, and the city of Kalamazoo. Because of widespread power outages, some of which lasted between 36 and 72 hours, the American Red Cross opened emergency shelters to take care of senior citizens and others vulnerable to the cold. The storm closed many schools and businesses on Monday, October 27th. Many remained closed on October 28th due to power still being out. Many weather-related traffic accidents were reported during the storm, with many cars in ditches and skidding off the road. Large tree limbs falling on vehicles resulted in significant property damage, much of which was not available in damage cost estimates. No injuries were directly related to the storm, however several injuries and one fatality occurred in traffic accidents judged to be weather-related. Snowfall accumulations ranged from 2 to 8 inches. The heaviest snow fell in a band from northeast Ottawa County across northwest Kent County, western Montcalm County, eastern Mecosta County, into eastern Osceola County. This storm resulted in \$1.5 Million in damage across the State.

Case: April 5, 2003

A major ice storm affected much of southern lower Michigan, causing hundreds of thousands of people to lose power. The weight of the ice brought down thousands of trees and limbs and hundreds of power lines. Many people across the area lost power for several days and some people who live in outlying areas were without power for a week. The ice storm resulted in several million dollars' worth of damage across the area. The ice storm came in three stages. The first period of freezing rain during the afternoon hours of the 3rd resulted in up to a quarter of an inch of ice across Osceola and Isabella counties, in central lower Michigan. The second period of freezing rain came during the nighttime hours of the 3rd into the morning hours of the 4th, when ice accumulations of a quarter to three quarters of an inch occurred across much of central lower Michigan, north of Grand Rapids. The heaviest period of freezing rain with thunderstorms came during the very late afternoon and evening hours, with the counties in the vicinity of I-96 receiving the heaviest ice accumulation. Up to an inch of ice was reported in the Lansing area, and numerous reports of a quarter to as much as an inch of ice were received in the vicinity of I-96. This was one of the biggest ice storms to affect lower Michigan in the last 50 years. When all was said and done with, most counties across central and southern lower Michigan ended up receiving a total of at least a half an inch of ice, with reports of total ice accumulation of an inch quite common, and even up to near an inch and a half of ice in some locations. This storm resulted in \$4.9 Million in damage across the State and \$200,000 in damage in Muskegon County.

Case: Winter of 2013-2014

The winter of 2013-2014 broke many temperature and snow records for Western Michigan. Overall, Grand Rapids had its second snowiest winter in records dating back to the late 1800s with 110.7 inches of snowfall. This winter season also went down on the record books for being one of the coldest winters. According to Wikipedia the 2013–14 North American cold wave was an extreme weather event extending from December 2013 to April 2014, and was also part of an unusually cold winter affecting parts of Canada and the Eastern United States. The event consisted of 2 episodes, the first one in December 2013 and the second in early 2014, both caused by southward shifts of the North Polar Vortex. Record cold temperatures also extended well into March.

Case: November 17, 2014

The cold air and a favorable atmospheric setup for lake-effect snow led to a prolonged and record-breaking early season snowfall across much of the Great Lakes. Due to strong winds, the greatest snow amounts were recorded further inland. Synoptic and lake effect snow continued November 17-21 and the snow was heavy at times, resulting in hazardous travel conditions through the week. Total snowfall from November 13-21 reached 3 feet from north central Allegan County north to eastern Ottawa County. Total snowfall reports in excess of 2 feet were common along the US-131 corridor. Temperatures across Southwest Lower Michigan averaged well below normal, snowfall was above to well above normal. A number of daily temperature, snowfall, and precipitation records were also set. As much as two and a half feet of snow fell across southern Newaygo County from November 17-21, resulting in very hazardous travel conditions. From December 6–10, the first wave of record-breaking cold air pushed into the Eastern U.S., before the temperatures returned to a more stable range. On January 2, an Arctic cold front initially associated with a nor'easter, tracked across Canada and the United States, resulting in heavy snowfall. Temperatures fell to unprecedented levels, and low temperature records were broken across the United States. Business, school, and road closures were common, as well as mass flight cancellations. Altogether, more than 200 million people were affected, in an area ranging from the Rocky Mountains to the Atlantic Ocean and extending south to include roughly 187 million residents of the Continental United States.

Case: February 13, 2015

An arctic cold front moved through Southwest Michigan late in the evening on the 13th, bringing a burst of snow during the late afternoon and evening hours of the 13th. Behind the cold front during the early morning hours of the 14th, lake effect snow showers developed. The heaviest snow from this part of the storm was also west of US-131. Ludington got nearly a foot of snow from this system. Strong winds developed by mid-morning on the 14th, frequently gusting to between 35 mph and 45 mph across the area. Winds gusted to over 50 mph along the Lake Michigan shoreline. The wind and snow diminished during the evening as the snow bands shifted toward the lake shore. Impacts from the storm included several roads near Lake Michigan drifting shut. Numerous accidents were reported, particularly west of US-131.

Case: April 14, 2018

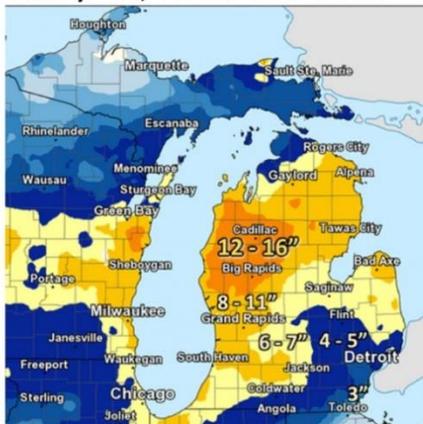
A significant late season winter storm brought a mix of high winds, heavy rain, sleet, and freezing rain. The highest wind gusts occurred on the 14th and heavy sleet and freezing rain developed during the early

morning hours of the 15th through the early to mid-afternoon hours of the 15th. Numerous accidents and slide-offs were reported across the region, including on I-94 during the early afternoon hours of the 15th. Michigan State Police requested weather conditions for an investigation into a serious head on accident on M-21 that shut the road down in both directions. Medical support from AeroMed was requested from Grand Rapids but denied due to hazardous weather conditions. Road conditions were poor in the morning into the afternoon with sleet-packed roads and ice coated roads where freezing rain was prevalent. Total ice accumulations ranged from around a tenth of an inch to about half an inch. Total sleet accumulations reached 1 to 2 inches in some areas. Numerous flights were either delayed or cancelled. A total of 450,000 customers were impacted by power outages across Michigan, with 110,000 Consumers Energy Customers being impacted. Power was restored to the majority of Consumers Power customers by the evening hours of the 15th. Muskegon County recorded \$100,000 in property damage from this storm.

Case: January 28 – February 24, 2019

During this timeframe, two Winter Storm Warnings, one Ice Storm Warning, and 1 Blizzard Warning were issued. A series of heavy snowfall events began this week-long event. On Monday, January 28, much of the state faced the start of a blizzard, with snowfall ranging up to over a foot in depth as sustained winds began (with gusts up to 40 mph) and were soon accompanied by a dangerous drop in temperatures. An extremely large number of schools throughout the state were closed as a result of the snowfall, and then remained closed for most of the week as the combination of sustained subzero

January 28, 2019 Snowfall Totals



temperatures and strong winds produced dangerously low wind-chill values throughout the state. Wind-chill values below -30 degrees Fahrenheit were common throughout Michigan for multiple days, and often dipped below -40. In addition to numerous local states of emergency, non-essential State Government offices were closed for more than half a day on Monday, and for the entire day on Wednesday and Thursday. Governor Gretchen Whitmer's State of Emergency declaration took effect on January 29, anticipating the dangerous impacts of the deep freeze that had been forecast by the National Weather Service.

On February 5, 2019, an ice storm hit the Muskegon County area causing \$2 million in property damages. Two periods of freezing rain from February 5th through February 7th resulted in significant ice accumulation on the order of a half to three quarters of an inch across portions of central lower Michigan. This resulted in thousands of downed trees, limbs and power lines. Approximately one hundred and fifty thousand people lost power. Schools in the area were closed for days.

Vulnerability and Community Impacts

All of Muskegon County is vulnerable to severe winter weather and old temperatures. Severe storms can lead to power outages, downed trees and branches, hypothermia, injuries and loss of life. In addition, severe winter storms can immobilize large areas, with rural areas particularly impacted by impassable roads. Although not as dramatic, smaller and more frequent lake effect events also cause

regular concern to Muskegon County due to their immediate effects on the jurisdiction and its infrastructure.

First, the county's diverse nature makes travel limitations an immediate and major concern. Even relatively small amounts of snow and ice can quickly limit travel on main routes, make secondary routes difficult to navigate, and render private roads virtually impassible. Emergency units such as ambulance, fire services, and law enforcement resources are often overwhelmed due to the response challenges resulting from the slower and more hazardous emergency responses to the dramatically increased number of weather-related emergency calls.

State Trunklines of M-46 (5 Lanes), US-31, and I-96 are utilized as the main trunk lines and primary traffic routes through Muskegon County by commuters and to/from its major communities by residents. These highways are heavily relied upon for routine and emergency travel. During severe winter events, it becomes even more critical that these routes remain navigable for emergency services and travelers. As state highways, primary responsibility for maintenance of these roadways fall upon the Michigan Department of Transportation who has contracted with Muskegon County Road Commission to maintain these roads. These routes are the primary priority with the goal of pavement bare from ice and snow using overtime as necessary.

The second priority is the additional State Trunklines of M-46 (2 Lane), M-37, M-120, and Business 31. These routes are contracted to be maintained by the Muskegon County Road Commission. These routes are the second priority with the goal of pavement bare from ice and snow wide enough for one wheel track in each direction only using overtime as necessary. This priority becomes elevated to priority one if snow is drifting.

Although not primary routes for commuters, primary county roads are heavily relied upon by citizens and emergency agencies for inter-county travel and access to the primary highways. During severe winter emergencies, these become critical as many secondary roads can easily become impassible by passenger and emergency vehicles. As county roadways, the responsibility for maintenance of these routes belongs to the Muskegon County Road Commission. When severe winter weather occurs, these routes are the third and fourth priority to be maintained. This occurs only after there is sufficient capacity to keep main trunk lines open.

Secondary roads through Muskegon County, including local grave roads and subdivisions, provide critical traffic routes for citizens from the various communities and areas to access the primary and secondary routes. As emergency locations are unpredictable, it becomes a priority to maintain these roads during severe winter events to the best resources allow as many tertiary roads become unusable to passenger and emergency vehicle traffic. These roadways are the last priority to maintain.

Secondly, the nature of snow and ice storms frequently results in equally severe secondary emergencies. These include infrastructure failures, transportation accidents, and structure fires. Although these secondary effects are discussed in their independent sections, it is important to note that their response severity would be magnified by the primary existing snow and ice conditions.

Finally, the extended duration and large area of effect can easily strain the community's economic and financial resources due to travel route maintenance, loss of work and school days, and limited consumer activity. Periods of extremely low temperatures often accompany snow and ice storms, however, are also an independent hazard of unique nature. Of primary concern is the immediate health potential to lethally affect vulnerable persons such as the elderly, disabled or ill, and young children. This is complicated due to the fact that during such periods, many fixed income families begin to rely on auxiliary and unsafe heating devices resulting in increases in residential structural fires and carbon monoxide poisonings. Longer duration events can additionally overcome local human services agencies such as the American Red Cross, Department of Health and Human Services, and local churches who provide heating assistance to needing families.

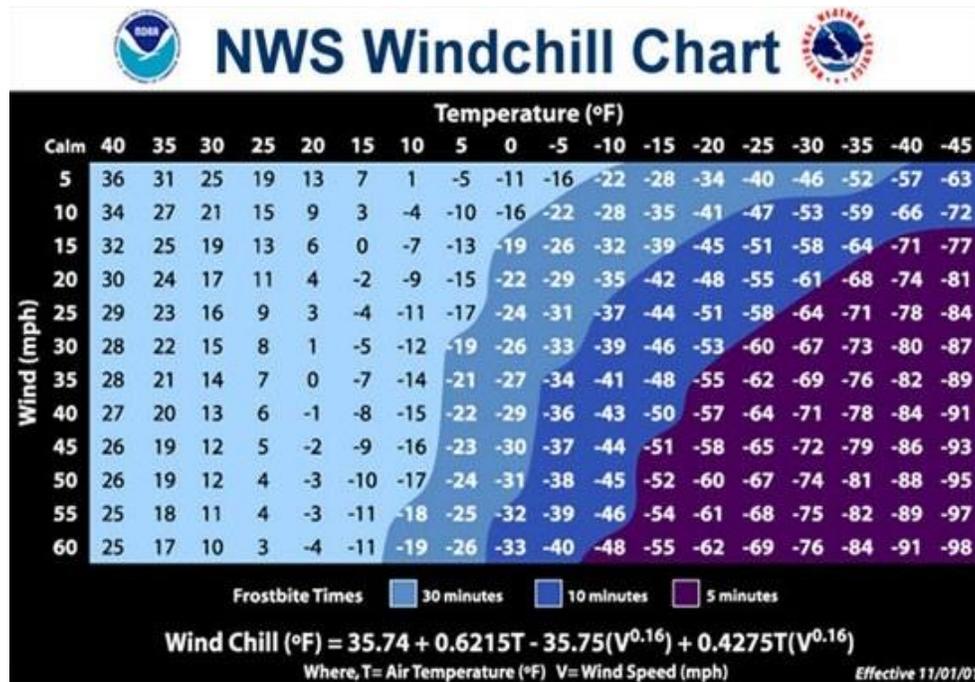
Extreme Low Temperatures

Prolonged periods of very low temperatures can last more than a week and cause loss of life among vulnerable populations, damage to infrastructure, and disruptions to schools and businesses. Vulnerabilities to extreme cold events can be elevated by lengthy power outages caused by severe winter weather. Extreme cold is primarily associated with the wintery months from November to early April, and is categorized by temperatures remaining near or below 0°F.

Although all counties in Michigan are susceptible to harsh subfreezing temperatures, counties in the North Central and Upper Peninsula of the state typically have more annual days of extreme cold than the southern portions of Michigan, and a similarly more frequent occurrence of sustained low temperatures persisting for multiple days in a row. Periods of extreme cold are risky for those in both rural and urban areas. Frostbite and hypothermia is common in rural areas where people are trapped outdoors and cannot adjust successfully to the temperatures. Even indoors, hypothermia is a concern for individuals living in inadequately heated apartments or rooms (below 68 °F) for lengthy periods of time. Loss of life can occur with either of these situations. Damage to buildings and pipelines can also occur as a result of extreme cold, resulting in expensive repairs and possibly days of business and school shutdowns.

Extreme Low Temperature Hazard Warning Description

- **Wind Chill Warning** - Extreme wind chills that are life threatening are imminent or occurring, criteria vary significantly over different county warning areas.^[17]
- **Wind Chill Advisory** - Dangerous wind chills making it feel very cold are imminent or occurring, criteria vary significantly over different county warning areas.^[18]
- **Wind Chill Watch** - Extreme wind chills that are life threatening are possible, criteria vary significantly over different county warning areas.



Extreme Low Temperature Hazard Analysis

Each year in the United States, approximately 700 persons die as a result of severe cold temperature-related causes. This is substantially higher than the average of 175 heat-related deaths each year. It should be noted that a significant number of cold-related deaths are not the direct result of “freezing” conditions. Rather, many deaths are the result of illnesses and diseases that are negatively impacted by severe cold weather, such as stroke, heart disease and pneumonia. It could convincingly be argued that, were it not for the extreme cold temperatures, death would not have occurred at the time that it did due to the illness or disease alone. There are, in various parts of Michigan, an average of between 3 and 50 (or more) days per year at or below 0° Fahrenheit. Michigan also tends to have between 90 and 180 (or more) days per year in which the temperature is below the freezing point.

Hypothermia (the unintentional lowering of core body temperature), and frostbite (damage from tissue being frozen) are probably the two conditions most closely associated with cold temperature-related injury and death. Hypothermia is usually the result of over-exposure to the cold and is generally thought to be clinically significant when core body temperature reaches 95 degrees or less. As body temperature drops, the victim may slip in and out of consciousness, and appear confused or disoriented. Treatment normally involves warming the victim (preferably performed by trained medical personnel) but frostbitten areas should not be rubbed. Although frostbite damage itself rarely results in death (which may occur due to hypothermia instead), in extreme cases it can result in the amputation of the affected body tissue.

Periods of extreme cold are risky for those in both rural and urban areas. Frostbite and hypothermia is 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 apartments or rooms. Loss of life can occur with either of these situations. Damage to buildings and

pipelines can also occur in bitter cold conditions, resulting in expensive repairs and potential days of business and school shutdowns.

To mitigate the effects of the unfavorable cold temperatures, communities should make sure that housing codes are appropriate and that adequate furnaces are in place in apartment dwellings. Inspections of vulnerable and outdated infrastructure should be made in the fall season, before winter sets in. In addition, proper insulation of piped areas can prevent water main breaks.

In the wind chill chart, extremely low apparent temperatures can also be associated with an amount of exposure time that it takes to cause frostbite. Cells of the table that have darker shadings denote wind chill temperatures that can produce frostbite in 10 minutes or less. Cells with lighter shadings are associated with frostbite times of 30 minutes or less. Unshaded cells in the table should require longer exposure times to cause frostbite. Again, the chart displays only two factors that contribute heavily to risk, but risk can be increased for an individual in particular circumstances. For example, people should be aware that the drier air (common to winter weather) also allows a more rapid drop in temperature than is the case with warm summer air. As a cold front moves in, or as daytime high temperatures for the day change to nighttime low temperatures, the corresponding drop in temperature can be much greater when the humidity is low. People who are outdoors can rapidly find themselves in danger of hypothermia.

Hypothermia usually occurs in one of two sets of circumstances. One situation involves hypothermia associated with prolonged exposure to cold while participating in outdoor sports such as skiing, hiking or camping. Most victims of this form of hypothermia tend to be young, generally healthy individuals who may lack experience in dealing with extreme cold temperatures. The second situation involves a particularly vulnerable person who is subjected to only moderate, indoor cold stress. A common example would be that of an elderly person living in an inadequately heated home. In such circumstances, hypothermia may not occur until days or perhaps weeks after the cold stress begins. Isolated rural locations may involve difficulties in reaching a heated space, or a designated warming shelter.

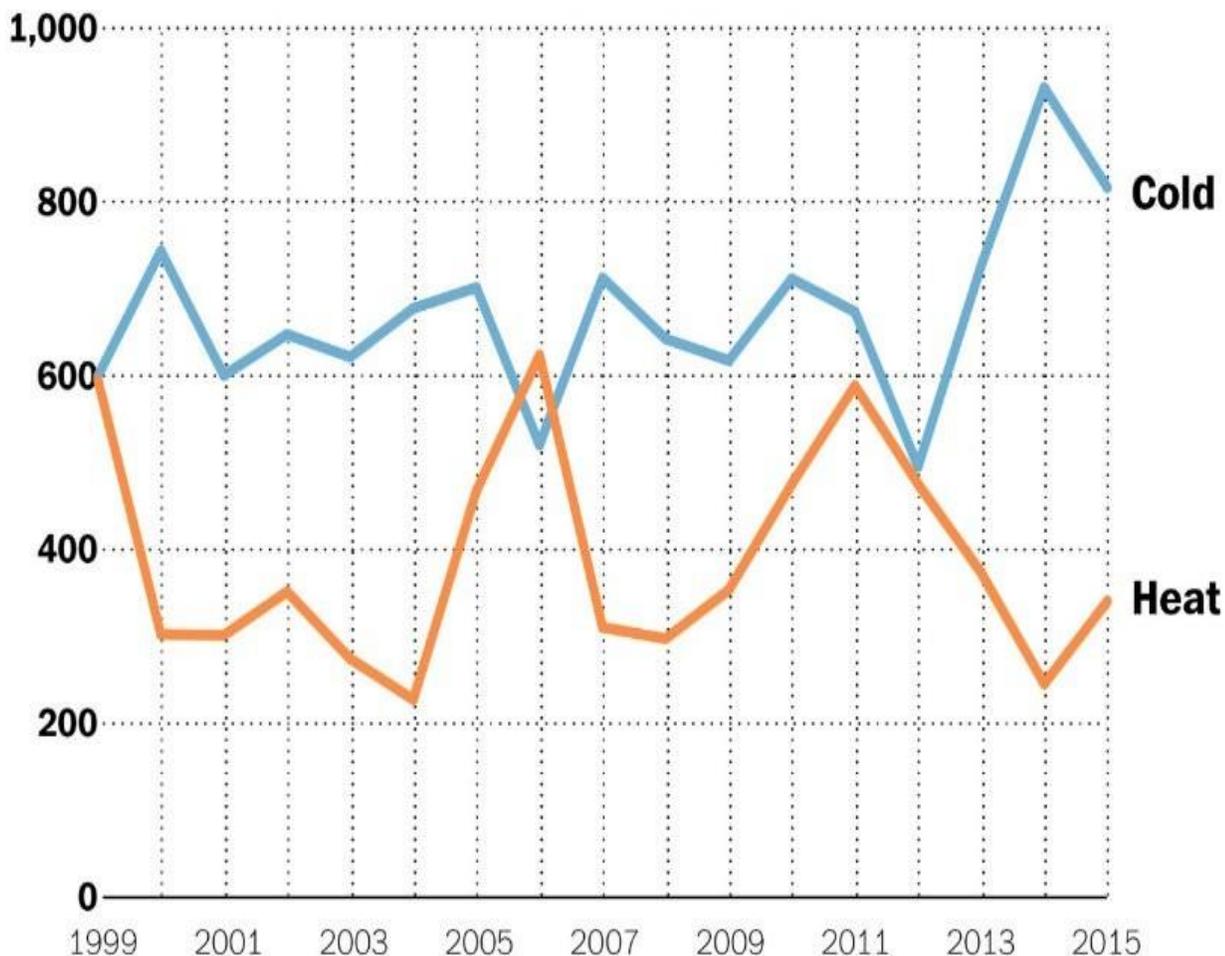
Deaths due to extreme winter cold are often not associated with a particular weather event. Rather, they are the result of a one-time over-exposure to severe cold weather (a hiker lost in the woods, or car failure in a rural area), or more commonly from continuous exposure to moderate cold temperatures by vulnerable persons (such as the elderly). In some cases, hypothermia deaths can be linked to severe winter weather such as snowstorms or blizzards, where the victim is caught unprepared for the extreme cold temperatures. As mentioned earlier, many cold temperature-related deaths involve the exacerbation of an existing, serious medical condition such as heart disease or pneumonia. In Michigan, approximately 70% of weather-related fatalities (about 40 deaths per year) are attributed to exposure to the cold (according to the Michigan Department of Community Health and the National Weather Service). The following table from the CDC gives an indicator for the nation as a whole.

The special vulnerability of elderly persons to hypothermia has become apparent. Over half of the hundreds who die each year due to cold exposure are 60 years of age or older, even though this age group only represents about 20% of the country’s population. This remarkable statistic may be due, in part, to an impaired perception of cold as well as the voluntarily setting of thermostats to relatively low temperatures. In addition, high energy costs and the relative poverty among some elderly people may discourage their setting thermostats high enough to maintain adequate warmth (just as it may cause others to limit their use of fans and air conditioning during summer heat waves). Because many elderly people live alone and do not have regular visitors, the cold conditions may persist for several days or weeks, thus allowing hypothermia to set in.

Extreme Cold Temperatures in Michigan

Extreme cold temperatures are a universal hazard in Michigan. Whereas heat waves tend to impact urban centers more than suburban or rural areas, cold temperatures are an “equal opportunity” killer. Every community in Michigan is vulnerable, regardless of location or size. It must also be noted that many of the agricultural sectors of Michigan are vulnerable to crop losses because of extreme cold events. A couple of severe recent events have involved unusually warm temperatures, which plant life may treat as a return of Spring, followed by a re-freeze when the plants have made themselves more vulnerable and which can therefore be devastating to them.

Deaths from hypothermia (excessive cold) and hyperthermia (excessive heat) in the U.S.



Case: February 10 to 13, 1899 – Central and Western Lower Peninsula

Record low temperatures occurred multiple days in a row. At Baldwin (Lake County), four days in a row had record low temperatures: -36, -49, -48-, and -37-degrees Fahrenheit. Grand Rapids also noted four days in a row that set all-time records: -21, -21, -23, and -24 degrees. At Big Rapids (Mecosta County), three days in a row set records: -33 degrees, -36 degrees, and -34 degrees. Similarly, Hastings and Muskegon also set records for three days in a row: the former with -26, -31, and -24, and the latter with -30, -29, and -22 degrees.

Case: April 27, 2012 – Lower Michigan – Late Freeze

A killing freeze caused extreme damage to agriculture in the Lower Peninsula, particularly in the fruit belt of its northwest. Traverse City saw low temperatures of 25 degrees on April 27th, 31 degrees on the 28th, and 26 degrees on the 29th. Although these values were not greatly colder than normal lows, because of a stretch of unprecedented warmth in mid-March which had included five consecutive 80-degree days (17th-21st) that had caused fruit trees to bud out far ahead of schedule, these trees were left vulnerable when more normal April temperatures returned. The tart cherry crop was a total loss, while other orchard fruits such as sweet cherries, apples, pears, and peaches saw losses of more than 90% of the expected crop. Total losses were estimated at \$132.8 million, with the following estimated breakdowns from NOAA, provided by county: Leelanau \$37.5 million, Benzie \$15 million, Grand Traverse \$15 million, Antrim \$10 million, Manistee \$10 million, Berrien \$8 million, Charlevoix \$7.5 million, Emmet \$5 million, Cass \$4 million, and \$1.3 million each for Bay, Genesee, Huron, Lapeer, Lenawee, Livingston, Macomb, Midland, Monroe, Oakland, Saginaw, Sanilac, Shiawassee, St. Clair, Tuscola, and Washtenaw.

Case: Early 2014 – Statewide

Several times during the 2013-2014 winter season, very low temperatures were felt across the state, for periods of time that placed many persons at risk. This sometimes coincided with ice storms, power failures, propane shortages, and transportation blockages that caused the effects of the extreme cold temperatures to be more pronounced. The media made the term “polar vortex” popular during these extreme temperature events. On January 5 through 9, 2014, much of the Upper Peninsula endured an air mass that was far below normal winter temperatures, with wind chill values consistently between 30 and 50 degrees below zero. The worst was at Ironwood (a wind chill reading of 54 below zero), where the highest temperature on the day of January 6 was 15 degrees below zero. Various Upper Peninsula schools were closed for two to three days during this cold spell (and later during the month and season). The deep cold reached many other Michigan counties by January 6, and although the wind chill values there were less extreme than the Upper Peninsula’s, they were still dangerously low, such as -33°F at West Branch, Houghton Lake, Cassopolis, and Hillsdale. Actual temperatures were below zero, with Detroit Metropolitan Airport bottoming out at -14°F on January 6 and 7 (both of which were record lows for that location on those dates).

Case: January 28 to February 2, 2019 – Statewide Winter Emergency

A series of heavy snowfall events began this week-long event. On Monday, January 28, much of the state faced the start of a blizzard, with snowfall ranging up to over a foot in depth as sustained winds began

(with gusts up to 40 mph) and were soon accompanied by a dangerous drop in temperatures. An extremely large number of schools throughout the state were closed as a result of the snowfall, and then remained closed for most of the week as the combination of sustained subzero temperatures and strong winds produced dangerously low wind-chill values throughout the state. Wind-chill values below -30 degrees Fahrenheit were common throughout Michigan for multiple days, and often dipped below -40. In addition to numerous local states of emergency, non-essential State Government offices were closed for more than half a day on Monday, and for the entire day on Wednesday and Thursday. Governor Gretchen Whitmer's State of Emergency declaration took effect on January 29, anticipating the dangerous impacts of the deep freeze that had been forecast by the National Weather Service. At least three deaths were attributed to weather exposure, and special shelters and over a hundred warming centers were activated at many locations around the state. Additional hospitalizations took place, not just as a direct result of the cold, but also to treat for carbon monoxide exposures resulting from makeshift efforts to heat residents' homes. Hundreds of local and county government offices were closed for at least one or two days during the week, as well.

Driving conditions were treacherous and slow. Highway M-40, southeast of Holland (Allegan County) became backed up. A 24-car pileup occurred on I-196 near Zeeland (Ottawa County), resulting in the temporary closure of that expressway. Other expressway closures occurred during the event, including I-496 and northbound US-127 in Lansing, US-131 in Allegan County, and M-37 South of White Cloud, in Newaygo County. Newaygo County also saw the Muskegon River reach a moderate flood level in Bridgeton Township and the City of Newaygo, as the result of an ice jam. Some infrastructure problems also arose from water main and pipe breaks, in places such as Lansing's Capitol Complex (Ingham County) and the northern half of the City of Newaygo (placed under a boil water advisory), and substantially lowered the water quality in Escanaba (Delta County). Many rivers experienced ice jams that threatened some areas with floods as well—Benzie County's Platte River near the Village of Honor threatened 20 homes and cottages, Berrien County near M-139 saw minor flooding near Riverfront Campground and in Niles. Excessive delays were reported at the Detroit Metropolitan Airport (Wayne County), as well as the Blue Water Transit bus system (St. Clair County) shutting down from January 30 to 31. Visibility was often a problem, with white-out conditions resulting from the blizzard.

On Wednesday, January 30, 2019 at 10:33am, a fire occurred at an important Consumer's Energy facility in Armada Township (Macomb County), and when the impacts of this fire were calculated to eventually lead toward natural gas shortages, the head of that major utility, followed by the Governor, appealed to both residential and industrial customers to voluntarily reduce their use of natural gas. By voluntarily reducing thermostat levels to the recommended 65 degrees or below, until the end of the day on January 31, and temporarily scaling back production activities at certain facilities, this collective effort succeeded in preventing the complete interruption of gas delivery that otherwise was expected to occur. The problem did not involve a supply of natural gas, but only the constraints that the fire had caused in the ability to deliver that gas throughout the state's network. Temporary power failures occurred in some locations, affecting thousands of residents and businesses but fortunately not lasting very long. Other midwestern states also authorized state emergency and disaster declarations during this event. By Friday, February 1, temperatures went back above zero, and Michigan's State of Emergency expired on February 2, 2019.

Case: April 2-May 30, 2021 – Frost and freeze event resulting in crop damage

Antrim, Grand Traverse, Leelanau and St. Joseph counties experienced a several day frost and freeze event that affected many fruit crops, mainly in areas away from Lake Michigan. Early peach varieties showed pink on April 1. Bloom began on April 10. The April 21 and 22 freezes caused widespread damage, significantly reducing crop on some peach varieties while leaving others untouched in a few locations. As a result of the freezes, the peach crop was light to average across the region. The April freezes caused moderate to severe damage to cherries. The damage varied significantly around the region with some sites losing most of their crop while leaving nearby orchards untouched.

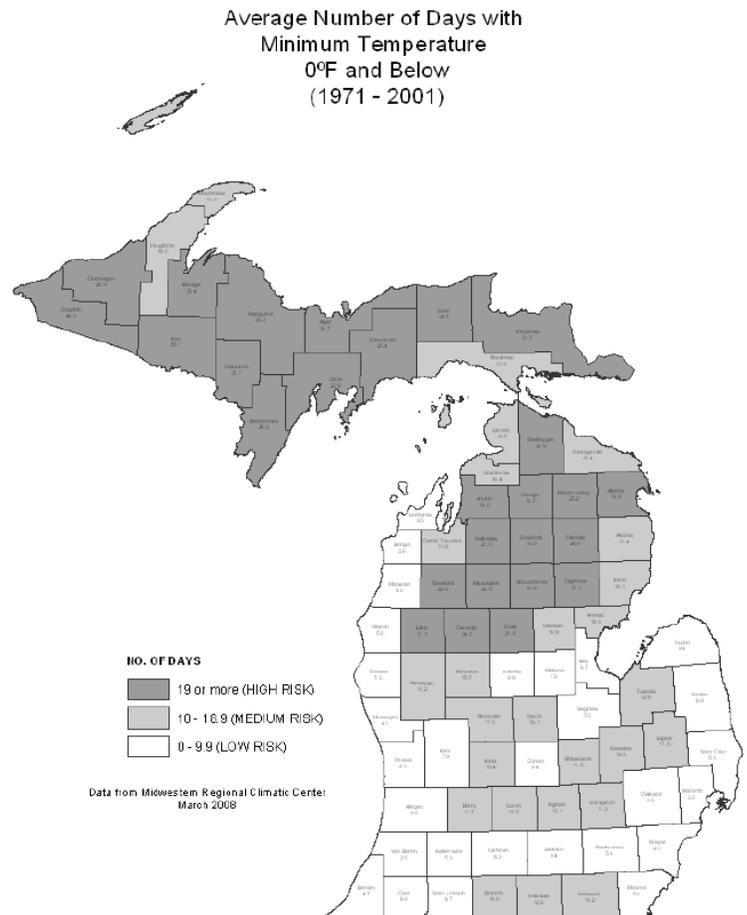
Vulnerability and Impacts

All of Muskegon County is insulated by Lake Michigan, reducing the likelihood of prolonged minimum temperatures below 0°F. However, extreme cold and wind chill can lead to hypothermia and frostbite, which can be life-threatening conditions if left untreated.

In addition, loss of heating source and/or use of alternative heating sources can result in fatal carbon monoxide poisoning. Loss of heat can also result in frozen and broken water pipes. The young and elderly are most susceptible to extreme temperatures. There are similar levels of exposure across all areas of Muskegon County when it comes to the risk of Severe Winter Weather and extreme cold temperatures. Below is additional information on expected thresholds based on historical occurrences, population impacts, and facilities at most risk.

Extreme Cold Temperatures in Muskegon County

Source: US National Weather Service,
Grand Rapids Office
Climate Record Period 1896 to 2023



| Month | Record Low | Date | Previous Record |
|-----------|------------|--------------------------|-----------------------------------|
| January | -16°F | 1-3-1918 | |
| February | -30°F | 2-11-1899 | |
| March | -11°F | 3-16-1897 | |
| April | 1°F | 04-07-1982 | 9°F (04-01-1923) |
| May | 22°F | 05-10-1974 | |
| June | 31°F | 06-11-1972 | 34°F (06-04-1945) (06-08-1949) |
| July | 39°F | 07-2-2001 | 40°F (07-11-1945) |
| August | 36°F | 8-16-1979 | 40°F (08-15-1929) |
| September | 27°F | 09-27-1989 09-28-1991 | 28°F (09-25-1947) (09-26-1947) |
| October | 19°F | 10-29-1905 | |
| November | -14°F | 11-25-1950 | -8°F (11-24-1950) |
| December | -15°F | 12-31-1976 | -11°F (12-30-1976) |

Monthly Lowest Min Temperature for Muskegon Area in Degrees Fahrenheit

Source: US National Weather Service, Grand Rapids Office

Monthly Lowest Min Temperature for Muskegon Area, MI (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|
| 2003 | 3 | 4 | -3 | 16 | 31 | 35 | 50 | 51 | 38 | 28 | 20 | 15 | -3 |
| 2004 | -1 | 0 | 12 | 24 | 31 | 41 | 51 | 42 | 34 | 28 | 19 | 0 | -1 |
| 2005 | -10 | 7 | 1 | 28 | 29 | 50 | 47 | 50 | 46 | 27 | 13 | 2 | -10 |
| 2006 | 17 | 2 | 17 | 25 | 33 | 45 | 49 | 50 | 37 | 27 | 22 | 18 | 2 |
| 2007 | 3 | 1 | 5 | 21 | 35 | 38 | 49 | 49 | 39 | 29 | 17 | 16 | 1 |
| 2008 | 3 | -5 | 7 | 21 | 32 | 44 | 50 | 48 | 43 | 28 | 18 | 8 | -5 |
| 2009 | -4 | 4 | 5 | 22 | 31 | 41 | 49 | 41 | 40 | 27 | 27 | 14 | -4 |
| 2010 | 2 | 7 | 16 | 30 | 28 | 46 | 49 | 50 | 45 | 29 | 24 | 11 | 2 |
| 2011 | -8 | 1 | 13 | 22 | 32 | 50 | 58 | 53 | 38 | 28 | 26 | 22 | -8 |
| 2012 | 9 | 13 | 19 | 27 | 38 | 45 | 53 | 51 | 40 | 31 | 26 | 19 | 9 |
| 2013 | 3 | 0 | 8 | 21 | 28 | 38 | 49 | 47 | 39 | 34 | 18 | 9 | 0 |
| 2014 | -1 | -7 | -5 | 22 | 30 | 44 | 49 | 46 | 38 | 29 | 18 | 13 | -7 |
| 2015 | -5 | -9 | 4 | 21 | 35 | 41 | 50 | 49 | 41 | 30 | 18 | 24 | -9 |
| 2016 | 2 | 6 | 7 | 17 | 33 | 43 | 49 | 55 | 50 | 32 | 22 | 10 | 2 |
| 2017 | 9 | 15 | 14 | 27 | 31 | 45 | 54 | 47 | 40 | 29 | 20 | -6 | -6 |
| 2018 | -3 | 3 | 18 | 14 | 41 | 46 | 51 | 53 | 43 | 27 | 22 | 19 | -3 |
| 2019 | -12 | 1 | 6 | 26 | 34 | 44 | 51 | 48 | 47 | 29 | 18 | 12 | -12 |
| 2020 | 15 | 9 | 16 | 24 | 23 | 42 | 55 | 49 | 37 | 29 | 24 | 16 | 9 |
| 2021 | 10 | -9 | 14 | 17 | 29 | 44 | 49 | 54 | 44 | 30 | 19 | 18 | -9 |
| 2022 | 2 | 3 | 14 | 25 | 38 | 44 | 53 | 52 | 39 | 31 | 22 | 7 | 2 |
| 2023 | 11 | 10 | 18 | 23 | 36 | 45 | 56 | 47 | 46 | 35 | M | M | 10 |
| Mean | 2 | 3 | 10 | 23 | 32 | 43 | 51 | 49 | 41 | 29 | 21 | 12 | -2 |
| Max | 17 2006 | 15 2017 | 19 2012 | 30 2010 | 41 2018 | 50 2011 | 58 2011 | 55 2016 | 50 2016 | 35 2023 | 27 2009 | 24 2015 | 10 2023 |
| Min | -12 2019 | -9 2021 | -5 2014 | 14 2018 | 23 2020 | 35 2003 | 47 2005 | 41 2009 | 34 2004 | 27 2018 | 13 2005 | -6 2017 | -12 2019 |

Age

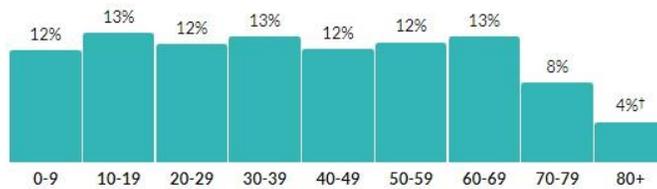
39.8

Median age

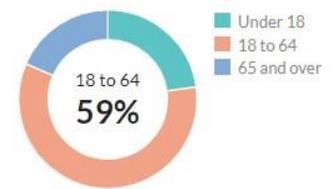
about the same as the figure in Michigan: 40.2

a little higher than the figure in United States: 38.8

Population by age range



Population by age category



Show data / Embed

Show data / Embed

Population by age range (Table B01001) [View table](#)

| Column | Muskegon County | | | Michigan | | | United States | | |
|--------|-----------------|-------|-----------------|----------|-------|---------------------|---------------|-----|----------------------|
| 0-9 | 11.7% | ±0.9% | 20,602 ±1,513.1 | 11.3% | ±0.1% | 1,131,553 ±10,506.8 | 11.7% | ±0% | 38,672,058 ±73,096.7 |
| 10-19 | 13.4% | ±1% | 23,596 ±1,692.9 | 12.8% | ±0.1% | 1,288,086 ±11,682.4 | 13.2% | ±0% | 43,645,580 ±83,716 |
| 20-29 | 12.2% | ±0.9% | 21,601 ±1,561 | 13.1% | ±0.1% | 1,316,885 ±12,386.4 | 13.1% | ±0% | 43,483,096 ±84,740.9 |
| 30-39 | 13.1% | ±0.8% | 23,056 ±1,316.4 | 12.6% | ±0.1% | 1,264,306 ±9,888.8 | 13.7% | ±0% | 45,350,083 ±75,738.2 |
| 40-49 | 11.8% | ±0.7% | 20,787 ±1,290.1 | 11.8% | ±0.1% | 1,181,072 ±9,373.1 | 12.4% | ±0% | 41,144,488 ±71,588 |
| 50-59 | 12.5% | ±0.7% | 22,000 ±1,171.9 | 13.2% | ±0.1% | 1,321,930 ±9,088.7 | 12.7% | ±0% | 42,032,544 ±62,242.5 |
| 60-69 | 13% | ±1.1% | 22,959 ±1,946.5 | 13.3% | ±0.1% | 1,335,832 ±13,703 | 12.1% | ±0% | 40,025,667 ±89,747.2 |
| 70-79 | 8.2% | ±0.7% | 14,531 ±1,198.6 | 8.2% | ±0.1% | 825,071 ±9,287.3 | 7.6% | ±0% | 25,299,187 ±58,986.1 |
| 80+ | 4.2%† | ±0.6% | 7,379 ±1,000.9 | 3.8% | ±0.1% | 386,076 ±7,586.9 | 3.7% | ±0% | 12,241,042 ±48,452 |

Chart from censusreporter.org/profiles raw data converted from the 2020 Census

| MUSKEGON COUNTY POPULATION DISTRIBUTION | | | | | |
|---|---------|-------------|------------|-----------|-----------|
| COMMUNITY | Pop. | % of County | Median Age | % Under 9 | % Over 70 |
| Muskegon County | 176,511 | 100% | 39.8 | 12% | 12% |
| City of Muskegon | 37,632 | 21.3% | 36 | 12% | 8% |
| City of North Muskegon | 4,063 | 2.3% | 45.1 | 11% | 16% |
| City of Muskegon Heights | 10,058 | 5.7% | 31.8 | 18% | 8% |
| City of Norton Shores | 25,040 | 14.2% | 40.1 | 14% | 14% |
| City of Montague | 2,607 | 1.5% | 34.4 | 20% | 9% |
| City of Roosevelt Park | 4,142 | 2.3% | 33.2 | 14% | 10% |
| City of Whitehall | 2,894 | 1.6% | 35.5 | 19% | 16% |
| Village of Casnovia | 343 | 0.2% | | | |
| Village of Fruitport | 1,231 | 0.7% | | | |
| Village of Lakewood Club | 1,232 | 0.7% | | | |
| Village of Ravenna | 1,335 | 0.8% | | | |
| Blue Lake Township | 2,583 | 1.5% | 42.7 | 9% | 9% |
| Casnovia Township | 2,817 | 1.6% | 34.8 | 17% | 7% |
| Cedar Creek Township | 3,231 | 1.8% | 43.5 | 16% | 8% |
| Dalton Township | 9,487 | 5.4% | 40.4 | 12% | 9% |
| Egelston Township | 11,070 | 6.3% | 37.5 | 13% | 7% |
| Fruitland Township | 5,816 | 3.3% | 56.3 | 4% | 19% |
| Fruitport Township | 14,602 | 8.3% | 44 | 12% | 13% |
| Holton Township | 2,585 | 1.5% | 42.7 | 11% | 12% |
| Laketon Township | 7,686 | 4.4% | 48 | 8% | 11% |
| Montague Township | 1,454 | 0.8% | 48.6 | 5% | 13% |
| Moorland Township | 1,753 | 1.0% | 41 | 14% | 11% |
| Muskegon Township | 17,718 | 10.0% | 40.4 | 10% | 13% |
| Ravenna Township | 2,976 | 1.7% | 38.1 | 11% | 10% |
| Sullivan Township | 2,558 | 1.4% | 45.6 | 14% | 16% |
| White River Township | 1,188 | 0.7% | 54.2 | 11% | 21% |
| Whitehall Township | 1,673 | 0.9% | 45.8 | 11% | 13% |

Skilled Nursing and Assisted Living Facilities

Adult Foster Care Homes in Muskegon County

| Facility Name | Phone | Address | City | Capacity |
|--|------------|---------------------------|-----------|----------|
| Woodland Gardens | 2313667092 | 4791 E Mt Garfield Rd | Fruitport | 6 |
| Agape Home At Blueberry Fields | 2318653400 | 4747 E. Mount Garfield Rd | Fruitport | 18 |
| Shaffer House AFC | 2318653444 | 171 Dennis Street | Fruitport | 6 |
| Cottage House Retreat | 2313750060 | 2171 Monte Dr. | Fruitport | 6 |
| Walker Road Home | 2313667148 | 6646 Walker Road | Fruitport | 6 |
| Forest Trail | 2317880700 | 3088 S. Hilton Park Rd. | Fruitport | 4 |
| Cedar Creek Personal Care 2 | 6168210281 | 8842 Cedar Creek Drive | Holton | 12 |
| Cedar Creek Personal Care Home I | 2318210281 | 8840 Cedar Creek Drive | Holton | 12 |
| Watersedge | 2312921695 | 8127 Old Channel Trail | Montague | 6 |
| Seminole Shores Assisted Living Center | 2317802944 | 850 Seminole Road | Muskegon | 129 |
| Christian Care Assisted Living | 2317773494 | 1530 McLaughlin Avenue | Muskegon | 105 |
| The Cove at Lake Woods | 2317772511 | 1776 Vulcan Street | Muskegon | 80 |
| Dayspring Assisted Living Residence | 2317802229 | 572 Lake Forest Lane | Muskegon | 72 |
| Hume Home of Muskegon | 2317551715 | 1244 W Southern Avenue | Muskegon | 34 |
| Christian Care | 2317227165 | 2053 S. Sheridan | Muskegon | 21 |
| Sanctuary at the Oaks #2 | 2316722700 | 2nd Floor | Muskegon | 20 |
| Sanctuary at the Oaks #1 | 2316722700 | 1st Floor | Muskegon | 20 |
| Chestnut Fields Retirement Community | 2317982220 | 5425 Chestnut Dr. | Muskegon | 20 |
| The Agape Home | 2317730328 | 4445 S. Brooks Road | Muskegon | 20 |
| Walker House AFC | 2317283102 | 125 Delaware | Muskegon | 15 |
| Pioneer House | 2317772920 | 1390 Brusse Avenue | Muskegon | 12 |
| Terrace Manor | 2317227442 | 1148 Terrace Street | Muskegon | 12 |
| Chestnut Fields Retirement Community | 2317982220 | 5467 Chestnut Drive | Muskegon | 12 |
| Golden Years Personal Care Home | 2317882160 | 6274 MacArthur Road | Muskegon | 12 |
| Fa-Ho-Lo Family | 2317881806 | 1585 S. Wolf Lake Road | Muskegon | 8 |
| Northridge | 2317605195 | 788 Marquette Ave. | Muskegon | 7 |
| Glenside Manor AFC | 2317590453 | 2479 Hadden | Muskegon | 6 |
| Samaritas-Ducey | 2317777061 | 1271 Ducey Avenue | Muskegon | 6 |
| Mill Iron | 2317735355 | 1123 Mill Iron Road | Muskegon | 6 |
| Amanda CLF | 2315578308 | 4021 Amanda Street | Muskegon | 6 |
| Sheridan AFC | 2317735355 | 4144 Sheridan Drive | Muskegon | 6 |
| Lilac Street Home | 2317883750 | 1901 Lilac Street | Muskegon | 6 |
| Loving Orchards | 2314577758 | 922 Orchard | Muskegon | 6 |
| Brooks CLF | 2317736593 | 599 S. Brooks Road | Muskegon | 6 |
| Mary's House | 2317809144 | 862 Forest Park Road | Muskegon | 6 |
| Joseph's House | 2317809084 | 866 Forest Park Road | Muskegon | 6 |
| | | | | |

| Facility Name | Phone | Address | City | Capacity |
|--------------------------------------|------------|---------------------------|------------------|----------|
| Lawrence Home | 2317735355 | 1228 Lawrence Avenue | Muskegon | 6 |
| Brookmere Home | 2317670583 | 3086 Creekview Lane | Muskegon | 6 |
| Virginia's House | 2317885156 | 391 Whispering Oaks Drive | Muskegon | 6 |
| Eastwood Cottage I | 2315636306 | 1137 East St. | Muskegon | 6 |
| Eastwood Cottage II | 2315636433 | 1147 East St. | Muskegon | 6 |
| Cassadee | 2317739782 | 1095 Langeland | Muskegon | 6 |
| HealthWest Crisis Residential Center | 2317246040 | 1364 Terrace St. | Muskegon | 6 |
| Black Creek Cove | 6168424949 | 2315 E. Broadway Ave. | Muskegon | 6 |
| Light House Retreat | 2317477751 | 1357 Terrace | Muskegon | 6 |
| Samaritas --Mararebecah Lane | 2317775767 | 2760 Mararebacah Lane | Muskegon | 3 |
| Bracey Home | 2313295493 | 1345 Marquette Avenue | Muskegon | 1 |
| J.B.C. Home | 2317370015 | 2508 McIlwraith Street | Muskegon Heights | 6 |
| Morning Glory AFC | 2317337893 | 2325 Peck St. | Muskegon Heights | 6 |
| Baker Haven Home | 2317606222 | 2145 Baker Street | Muskegon Heights | 6 |
| C.M.L. Homes | 2319038555 | 2424 Peck St. | Muskegon Hts. | 6 |
| Northcrest Assisted Living Community | 2317442447 | 2650 Ruddiman Street | North Muskegon | 86 |
| Ruddiman Home | 2317446362 | 224 Ruddiman | North Muskegon | 6 |
| Hansen Safe | 2317448213 | 1635 Hansen Street | North Muskegon | 4 |
| Samaritas - Horton Road | 2317442610 | 1231 Horton Road | North Muskegon | 3 |
| Beacon Home at Morton Terrace | 2317332751 | 3929 Hess Street | Norton Shores | 12 |
| Winicki AFC | 2317554998 | 2646 Lebouef Street | Norton Shores | 6 |
| Crescent AFC Home | 2318944975 | Suite 201 | Norton Shores | 6 |
| Harbor Pines | 2317984895 | 6459 Harbor Pines Lane | Norton Shores | 6 |
| Beachwood Dunes | 2317397523 | 6571 Henry St. | Norton Shores | 6 |
| Graceland | 2318945044 | 1775 Seminole Rd. | Norton Shores | 6 |
| Tibbet House Elder Care Home | 6166754241 | 3492 Main St. | Ravenna | 6 |
| Crockery Creek Elder Care | 2316851129 | 12291 Crockery Creek | Ravenna | 6 |
| Hallstrom Castle Assisted Living | 2318284664 | 5638 Holton Rd | Twin Lake | 20 |
| Paul's Place AFC | 2317445336 | 3475 E. Tyler | Twin Lake | 6 |
| Twin Lake Assisted Living | 2317888609 | 3790 E. McMillan Rd. | Twin Lake | 6 |
| Families Manor | 2312060358 | 2330 Riverwood Dr. | Twin Lake | 6 |
| Riverwood | 2317735355 | 2743 S Riverwood | Twin Lake | 6 |
| Beacon Home At Blue Lake | 2694278400 | 6780 Blue Lake Rd. | Twin Lake | 6 |
| Terra Nova | 2318935709 | 505 Lakewood Rd. | Twin Lake | 4 |
| White Lake Assisted Living | 2318938730 | 6827 Whitehall Road | Whitehall | 64 |
| Beacon Home at Lakeview | 2318940501 | 403 S. Mears Ave. | Whitehall | 12 |
| Legacy Of Caring | 2318938088 | 1302 Warner Street | Whitehall | 10 |

| Facility Name | Phone | Address | City | Capacity |
|--------------------------|------------|---------------------------|-------------------|--------------|
| Oak Creek Home | 2318931462 | 137 W. Holton Whitehall R | Whitehall | 6 |
| River St. Home | 2318934150 | 620 E. River St. | Whitehall | 6 |
| Slocum Street Home | 2318945794 | 817 Slocum Street | Whitehall | 6 |
| Bush Creek Manor | 2318930322 | 1023 Alice Street | Whitehall | 6 |
| Kelly's Kare AFC | 2318933626 | 7888 Whitehall Road | Whitehall | 6 |
| Pinewood Retirement Home | 2317663807 | 3234 Nestrom | Whitehall | 6 |
| Oxford Circle | 2317669286 | 3293 Orshal Rd. | Whitehall | 4 |
| Skyline Home | 2317663583 | 3297 Orshal Road | Whitehall | 4 |
| Sophia Street Home | 2318949098 | 814 Sophia Street | Whitehall | 3 |
| | | | TOTAL BEDS | 1,157 |

Long Term Care Facilities in Muskegon County

| Facility Name | Address | City | Capacity |
|--|-----------------------|----------------|------------|
| SKLD Muskegon | 1061 West Hackley Ave | Muskegon | 107 |
| Lake Woods Nursing and Rehabilitation Center | 1684 Vulcan St | Muskegon | 90 |
| Christian Care Nursing Center | 2053 S Sheridan Drive | Muskegon | 49 |
| Roosevelt Park Nursing and Rehabilitation Center | 1300 W Broadway Ave | Muskegon | 39 |
| Harbor Hospice | 1050 W Western Ave | Muskegon North | 8 |
| Hillcrest Nursing and Rehabilitation Community | 695 Mitzi St | Muskegon | 39 |
| SKLD Whitehall | 916 East Lewis St | Whitehall | 125 |
| Total Beds | | | 457 |

FLOODING

Flooding

To cover or submerge a place or area with water.

Flooding Hazard Description

Flood hazards in Michigan include dam failures, riverine flooding, urban flooding, and Great Lakes shoreline flooding, and erosion. Thunderstorms, snowstorms, and ice/sleet storms produce precipitation that can cause or exacerbate flooding—either immediately or when the frozen precipitation melts. Ice can build up and block critical parts of drainage-ways and thus cause flooding. Similarly, woody debris from severe winds, wildfires, or invasive species can cause trees, utility poles, etc., to build up and jam streams or drains. Extreme cold has caused freeze events in which pipes and water mains have broken and caused floods. Human related hazards such as terrorism, sabotage, or civil disturbances may cause water-related infrastructure to be disabled and thus cause or worsen floods as well. Floods can also cause landslides and subsidence problems.

Floods cause extensive property damage each year, reduced quality of life, and even injuries and deaths. 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. During floods, 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, fires, and the release of hazardous materials.

Every year, flooding causes more than \$2 billion of property damage in the U.S. Michigan flood disasters cause an average of more than \$100 million in property damage annually. In a high-risk (“Special Flood Hazard”) area, a home has at least a 26% chance of being damaged by a flood during the course of a 30-year mortgage, compared to a 9% chance of being damaged by fire.

Riverine Flooding

Riverine flooding is defined as the periodic overflowing of rivers, streams, and channels—due to inadequate drainage capacity, drainage system failures, ice or log jams, accumulated sediments, erosion, or meandering—that results in nearby property damage, safety issues, disruption of infrastructure function and services, and/or decreased quality of life.. Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of recorded history. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for serious flooding because rainfall that used to soak into the ground or take several days to reach a river or stream via a natural drainage basin now quickly runs off streets, parking lots, and rooftops, and through man-made channels and pipes. Some developments have also encroached into flood plain areas and thus impeded the carrying capacity of the drainage area. Floods can also result when vital drainage channels become clogged with ice, logs, or debris.

Urban Flooding

Not all flooding occurs within recognized floodplain areas, or adjacent to rivers and lakes. In some cases, melting snow or other runoff waters pool in low-lying areas, damaging structures and inhibiting the function of roads and infrastructure. In other cases, some type of breakdown in an area's pumping or drainage infrastructure may result in a damaging flood. This type of flooding typically occurs in well-developed urban or suburban areas, and therefore is often called urban flooding. It tends to occur due to either (1) a breakdown in infrastructure or (2) inadequate planning and design standards on the part of builders, developers, engineers, architects, and planners.

Dam Failures:

Dam failures are defined as the collapse or failure of an impoundment that results in downstream flooding. Dam failures can result in loss of life and extensive property or natural resource damage for miles downstream from the dam. Failure of a dam does not only occur during flood events, which may cause overtopping of a dam. Failure can also result from poor operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation. The Michigan Department of Environmental Quality (MDEQ) has documented approximately 302 dam failures in Michigan since 1888.

The worst recorded dam failure in U.S. history occurred in Johnstown, Pennsylvania, in 1889. More than 2,200 people were killed when a dam upstream from Johnstown failed, sending a huge wall of water downstream which completely inundated the town.

Great Lakes Shoreline Flooding

Michigan has over 3,200 miles of coastline (the longest freshwater coastline in the world), and about 4.7 million persons live in the state's 41 shoreline counties. Wind, waves, water levels, and human activities constantly affect the communities along the shores of the Great Lakes. Shoreline flooding and erosion are natural processes, occurring at high, average, and even low Great Lakes water levels. However, during periods of high water, flooding and erosion are more obvious, causing serious damage to homes and businesses, roads, water and wastewater treatment facilities, and other structures in coastal communities. Low lake levels can also pose a hazard, as cargo ships are more prone to running aground and the shorelines may also become more polluted from lake bottom debris. Long-term and seasonal variations in precipitation and evaporation rates primarily control the Great Lakes water levels and their fluctuations.

Erosion

Soil erosion is defined as the displacement of the upper layer of soil. This natural process is caused by the dynamic activity of erosive agents, that is, water, ice, snow, air, plants, animals and humans. Erosion of soil and other land may eventually cause damage to the roads, structures, and infrastructure that relies on it for stability and support. For example, occasional reports have been received of a house near a river, whose foundation has become at-risk after decades of supporting Earth that has been cut away and moved downstream by the flowing water. Stabilization measures are required in order to keep the house's foundation from becoming destabilized, or even the entire slope of the hillside from eventually giving way in a

landslide event. Such things are well-known on Michigan's Great Lakes shores, where the extensive forces of the lake waters cause erosion to occur far more rapidly and dramatically than most of Michigan's rivers (please refer to the chapter on Great Lakes Shoreline Hazards in this document, for more information). Although riverine erosion does not normally result in a community-level disaster or emergency event, structures and infrastructure that are at-risk from erosion may nevertheless benefit from the application of hazard mitigation funds for their protection. There can actually be cases in which erosion eventually makes infrastructure exposed and vulnerable, and leads to local emergency events if a road or bridge collapse eventually occurs. The most common events of this type involve the erosion of the land surrounding an undersized culvert or pipe, eventually causing the water to completely break down the integrity of the land that supports a roadway or bridge, making an important transportation route impassable and sometimes causing deaths during its collapse. There are other cases in which a water main, gas line, or underground utility cables can eventually become exposed and vulnerable to freezing weather, breakage and leaks, or the inflow of water, causing an infrastructure breakdown.

Riverine Flooding Hazard Analysis

Floodprone areas are found throughout the state, as every lake, river, stream and open drain has a floodplain. The type of development that exists within the floodplain will determine whether or not flooding will cause damage. The Michigan Department of Environmental Quality (MDEQ) estimates that about 6% of Michigan's land – roughly the size of the southeast Michigan counties of Wayne, Oakland, Macomb, Washtenaw, and Monroe combined – is floodprone, including about 200,000 buildings. The southern half of the Lower Peninsula contains the areas with the most flood damage potential. Michigan statewide expected annual losses from flooding are estimated at more than \$100 million.

The primary fluvial flood sources include the connecting waters between the Great Lakes (Detroit River, St. Clair River, and St. Marys River), thousands of miles of rivers and streams, and hundreds of inland lakes. Michigan can be divided into 63 major watersheds (including 23 component watersheds for various important branches and tributaries) and lakeshed areas along the shoreline, as shown in the map at the beginning of the flood hazards section. All of these watersheds experience flooding, usually with fewer problems in the higher-elevation headwater areas and greater problems in downstream urban areas. Flooding can occur on various branches of rivers, creeks, and other water channels. The following watersheds have experienced the most extensive flooding problems or have significant damage potential: 1) Clinton River; 2) Ecorse River; 3) Grand River; 4) Huron River; 5) Kalamazoo River; 6) Muskegon River; 7) Saginaw River; 8) Rifle River; 9) River Raisin; 10) Rouge River; 11) St. Joseph River; and 12) Whitefish River. The flooding is not restricted to the main branches of these rivers.

Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Ice jams are also a cause of flooding in winter and early spring. Log jams can also cause streams and rivers to be clogged up, and the backed-up waters to overflow the stream's banks. Either ice jams or log jams can cause dangerous flash flooding to occur if the makeshift dam-effect caused by the ice or logs suddenly gives way. Severe thunderstorms may cause flooding during

the summer or fall, although these are normally localized and have more impact on watercourses with smaller drainage areas.

Riverine Flooding in Michigan

In Michigan, significant flooding tends to occur each year, although the locations of flood events tend to vary with precipitation patterns. Some of Michigan's largest disaster declarations have involved flooding, although widespread urban floods have recently caused more damage than riverine flooding. Michigan has experienced 14 flood disasters since 1975 which resulted in both a Presidential Major Disaster Declaration and a Governor's Disaster Declaration (opening up the full range of federal and state supplemental disaster assistance). That averages about one major disaster every three years, but the average during the 21st Century has increased to about one every two years. A slightly lower number of additional events have resulted only in a Governor's Disaster Declaration (activating state supplemental and limited federal disaster assistance). Combined, these flood disasters have caused billions of dollars in damage to homes, businesses, personal property, and agriculture. These disasters include all types of floods.

The following brief synopses describe Michigan flood events in the past few decades in which flood impacts predominantly occurred in or near identified floodplains that surround rivers, other drainage channels, and inland lakes (or as a result of jams or failures in watershed drainage channels). Events which were predominantly pluvial or urban in nature (involving excessive runoff, ponding, and failures of urban storm sewer systems) will be emphasized within the next section. Many other damaging flood events have occurred at the local level, without qualifying for a governor's disaster declaration, and some of these are included in the following descriptions

Case: April 1975 – Southern Lower Michigan: Federal Disaster #465

A series of intense thunderstorms struck southern Lower Michigan in the last two weeks of April 1975, spawning several tornadoes and causing widespread flooding over a 21 county area. Total public and private damage was nearly \$58 million. A Presidential Major Disaster Declaration was granted for the 21 affected counties.

Case: September 1975 – West Central / Central Lower Michigan: Federal Disaster #486

During the last week of August and first week of September 1975, intense thunderstorms and severe winds pounded a 16-county area in west-central and central Lower Michigan. Intense rainfall accompanying these storms caused widespread flooding, resulting in nearly \$3 million in public and private damage. A Presidential Major Disaster Declaration was granted for the 16 affected counties.

Case: September 1986 – Central Lower Michigan: Federal Disaster #774

Beginning on September 10, 1986 a slow-moving low-pressure system moved across the middle of the Lower Peninsula. In a 24-hour period, the intense rainstorm produced rainfall ranging from 8 to 17 inches over an area 60 miles wide and 180 miles long. In Big Rapids, 19" of rain fell from September 9 to 12. The storm resulted in thousands of people being evacuated due to flooding. Five people were killed and 89 injured. (Up to ten were killed, if indirect effects are included.) About 30,000 homes suffered basement and structural damage and 3,600 miles of roadways were impassable as a result of the failure of four primary bridges and hundreds of secondary road bridges and culverts. The heavy

rainfall resulted in 11 dam failures and 19 others that threatened with failure, resulting in about 1,500 people being evacuated downstream of the dams. The failure and threatened failure of these dams was primarily the result of inadequate spillway capacity. Most of the dams were constructed without an emergency spillway and didn't have an adequate inspection and maintenance program. The excessive rainfall resulted in the design capacity of the dam being exceeded, causing failure of the dam or intentional breaching of the embankment to save certain portions of the structure. Fortunately, no deaths or injuries were attributable to this series of dam failures. Over \$300 million in damage resulted from the flood. This was the worst flood in Michigan in 50 years. Thirty (30) counties were included in the Presidential Major Disaster Declaration granted for this flood.

Case: June 1997 – West Michigan

On June 20-21, 1997 a series of intense thunderstorms passed through West Michigan, spawning heavy rainfall that flooded many areas in Allegan, Ottawa, Barry, and Van Buren counties. Flood and wind damage was particularly severe in Allegan County, which reported four injuries, five homes destroyed and 234 damaged, and 37 businesses damaged. Damage to public facilities, roads and bridges, and culverts and drainage channels totaled nearly \$1.5 million. Ottawa County officials reported damage to 111 homes and five businesses, in addition to nearly \$700,000 in public damages. On June 27, 1997, a Governor's Disaster Declaration was granted to Allegan and Ottawa counties to provide supplemental state assistance for the public damage. The SBA provided low-interest disaster loans to those home and business owners that suffered uninsured damage from the flooding or wind.

Case: May-June 2004 – Southern Lower Michigan

In May 2004, a stationary front over Iowa, Wisconsin, and Michigan brought severe thunderstorms and heavy rains, which caused widespread flooding over Southern Lower Michigan. Much of the rainfall occurred in saturated areas that had experienced well-above average precipitation for the month of May. Over a 36-hour period (12 am May 22nd to 8 am May 23rd), 2 to 6 inches of rain fell across Southeast Michigan. Backyards were submerged under several feet of water. About 100 homes in Macomb County had damage of about \$100,000 each. Road and bridge damage was expected to cost \$10 million to repair. Total rainfall over the Grand River basin from May 20th through June 3rd varied from four to as much as seven inches. It was the biggest and longest duration flooding event in the past ten to twenty years across southwestern and south-central Lower Michigan. It was the wettest May on record in Lansing and Muskegon and the third wettest May on record in Grand Rapids. A Presidential Major Disaster Declaration was granted to 23 counties in Southern Lower Michigan.

Case: June 2008 – Lower Peninsula: Federal Disaster #1777

Beginning on June 6, severe weather impacted twelve counties and two major population centers in the southwest and central Lower Peninsula. The National Weather Service reported two flash floods that exceeded the "100-year" threshold, confirmed three EF1 tornadoes, and also noted severe thunderstorms with winds exceeding 100 mph. Rainfall totals were estimated between 7 and 12 inches, exceeding the "100-year" rainfall values of 3.5 inches in less than 6 hours. Flash flooding washed out roads, flooded crops, and caused moderate flooding of rivers and streams. A large severe thunderstorm squall line affected Southwest Michigan on June 8, with four counties experiencing winds of 75 to 100 mph. Disaster declarations were requested and received in July, for 11 full counties.

April - May 2013 – Western Lower and Upper Peninsulas: Federal Disaster #4121

Record flooding occurred during the month of April, most directly caused by an accumulation of heavy rains and resulting in disaster declarations for numerous counties across the western portions of the state (plus the cities of Grand Rapids and Ionia, which were both specifically named in the Governor's disaster declaration). Hundreds of homes were flooded, more than 300 roads were closed, and the preliminary damage assessments totaled more than 32 million dollars. The flooding was exacerbated by the melting of significant snowpack—especially in the Western and Central Upper Peninsula. According to the NCDC website in 2014, the following damage amounts were sustained by each of the following counties: \$5 million in Allegan, \$5 million in Barry, \$5 million in Calhoun, \$3 million in Clare, \$5 million in Clinton, \$3 million in Eaton, \$1 million in Gogebic, \$3 million in Gratiot, \$2.9 million in Houghton, \$5 million in Ingham, \$7 million in Ionia, \$3 million in Isabella, \$3 million in Jackson, \$5 million in Kalamazoo, \$3 million in Lake, \$625,000 in Marquette, \$3 million in Mason, \$3 million in Mecosta, \$1.4 million in Midland, \$3 million in Montcalm, \$5 million in Muskegon, \$5 million in Newaygo, \$3 million in Oceana, \$550,000 in Ontonagon, \$3 million in Osceola, \$5 million in Ottawa, \$1.3 million in Saginaw, and \$3 million in Van Buren.

Climate Change Considerations

One of the Michigan trends connected with climate change is to experience increasing amounts of precipitation. Moreover, this precipitation is considered more likely to take the form of acute (and severe) weather events. As mentioned in the winter weather sections, a larger proportion of snow precipitation occurring in snowstorm events can cause more extensive snow accumulation which, under unlucky temperature patterns, may add to the drainage burdens of the normal melting and rainfall patterns of the spring season. In short, spring flood risks are likely to worsen, as are ice jam related winter flood risks.

Riverine Flooding in Muskegon County

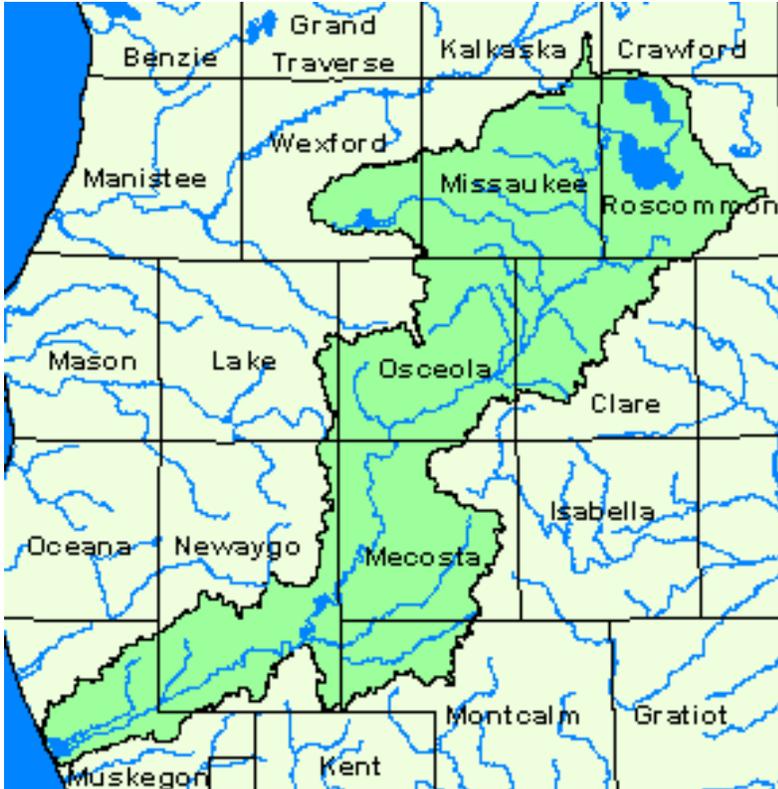
Like many Michigan communities, Muskegon County is permeated with numerous lakes, rivers, and streams of varying sizes. There are numerous inland lakes in Muskegon County. Water accounts for 3.7 percent of the surface area and wetlands account for 2.2 percent of surface area in Muskegon County.

The five primary water systems that drain Muskegon County include Grand River, Lake Michigan, Mona Lake/Black Creek, Muskegon Lake/River, and White Lake/River. Crockery Creek and Spring Lake/Norris Creek, both tributaries of the Grand River, drain the southeastern and southern parts of the county. The Mona Lake basin, including Little Black and Black creeks, drains much of the southern half of the county. The Muskegon River bisects the county and empties into Muskegon Lake, an inlet of Lake Michigan. Its main tributary within the county is Cedar Creek, which drains large portions of Cedar Creek and Holton townships. The White River drains much of the northern portion of the county and empties into White Lake, another Lake Michigan inlet. In addition, much of the western area of the county drains directly into Lake Michigan, including the Lake Michigan Shoreline, Duck Lake/Creek, Flower Creek, and Little Black Lake.

Naturally, these have resulted in a significant amount of seasonal and permanent housing development along the scenic waterways and have added to the area's popularity in recreational activities. Along

with the role that the water base has played in the jurisdiction's development, it has also resulted in a significant flooding risk to those same areas of the population. Minor flooding occurs annually along the low-lying areas of the Muskegon River and White River, which regularly affect the permanent and seasonal residences in the associated sub-divisions.

The Muskegon River



The Muskegon River Watershed begins in north-central lower Michigan, flowing from Higgins and Houghton Lakes, southwesterly to the City of Muskegon and discharging into central Lake Michigan. The watershed incorporates over 2,350 square miles of land with approximately 94 tributaries flowing directly into the Muskegon River. Most of the watershed is contained within eight counties: Roscommon, Missaukee, Clare, Osceola, Mecosta, Montcalm, Newaygo, and Muskegon. The Muskegon River is the main stem river within the Muskegon River Watershed. The river is 212 miles long and drops 575 feet in elevation between its sources and the river mouth.

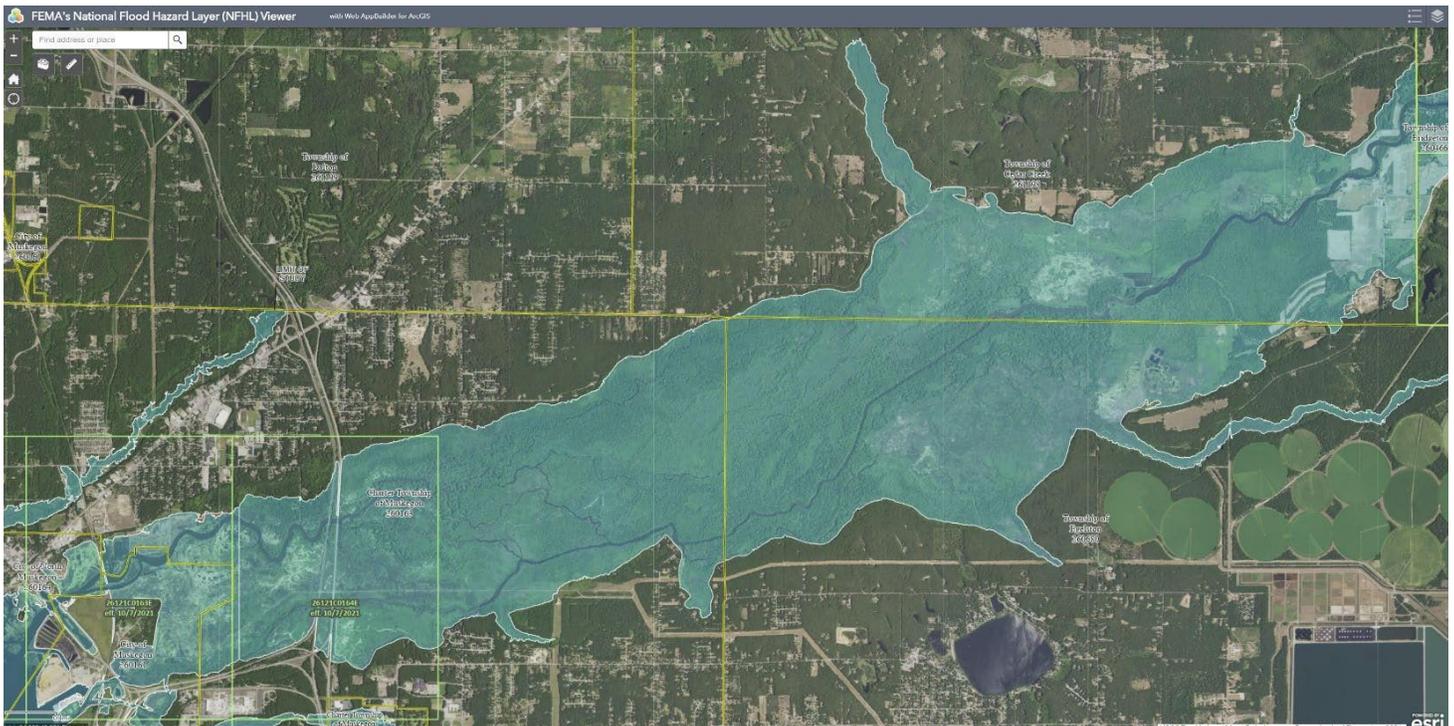
There are numerous dams and impoundments in the Muskegon River watershed. Many dams are not registered with the State of Michigan and are established on tributary streams. Four dams are currently located on the Muskegon River and include Reedsburg Dam (constructed in 1940), Rogers Dam (constructed in 1906), Hardy Dam (constructed in 1931), and Croton Dam (constructed in 1907). The Rogers Dam is located in Mecosta County while the Hardy Dam and Croton Dams are both located within Newaygo County.

Lower Muskegon River Watershed

The lower Muskegon River watershed is a unique drowned river mouth that flows into Lake Michigan at a shoreline that is part of the world's largest assemblage of freshwater sand dunes. Until restoration was undertaken, historic sawmill debris, foundry sand and slag filled 798 acres, or 25%, of Muskegon Lake's open water and emergent wetlands and 74% of the shoreline was hardened with wood pilings, sheet metal and concrete. The NOAA-GLC partnership recently completed and is currently working on projects to remove nearly 26 acres of sediment and mill debris, create and soften 7000 feet of shoreline, re-establish fish passage, and hydrologically reconnect and restore more than 65 acres of emergent wetlands and 44 acres of open water wetlands. This restoration will provide habitat for native fish, turtles, frogs, songbirds, mammals, migrating birds and waterfowl including native lake bottom communities. The GLC is working

with the West Michigan Shoreline Regional Development Commission, the Grand Valley State-Annis Water Resources Institute, the Michigan Department of Environmental Quality, the U.S. Environmental Protection Agency and other project partners to complete this work. Learn more here: <https://www.glc.org/work/aocs/muskegondraft>

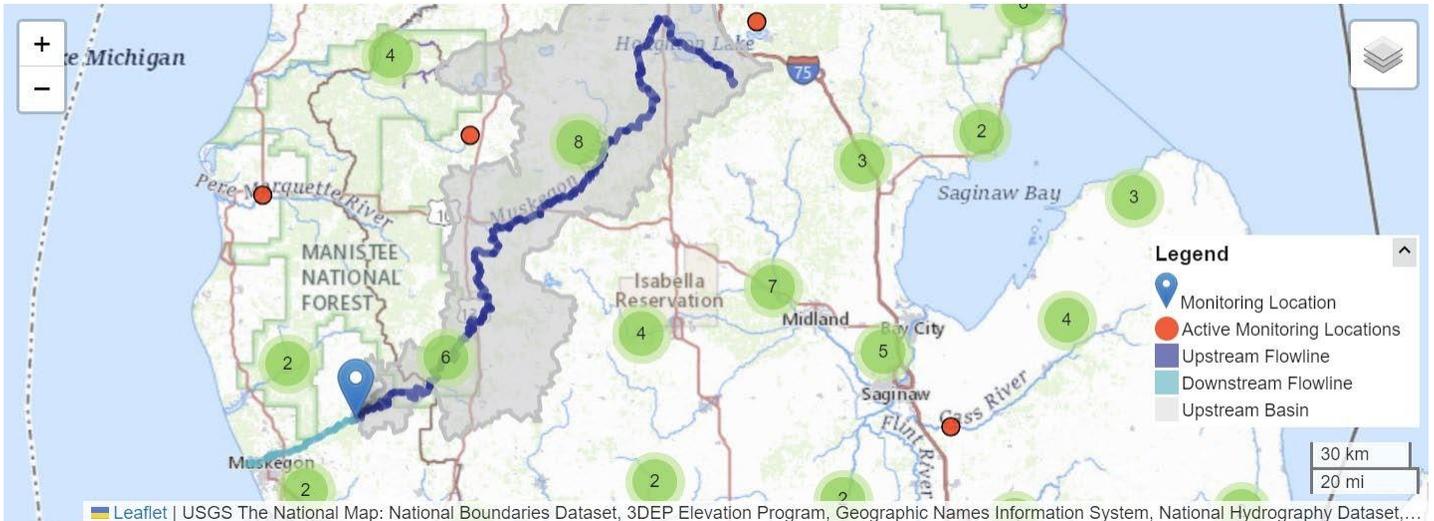
This project demonstrates the benefits of ecological restoration on community revitalization; a 2011 study by Grand Valley State University determined that over 15 years, dollars invested in restoration would result in a 6-to-1 return to the local economy. These economic benefits have already been felt through an uptick in local tourism, recreation and job creation. A follow-up socioeconomic study was implemented by Grand Valley State University and published in 2019. This study confirmed much of the results of the 2011 study and found an estimated 485,000 additional annual visits to the lake following restoration, an 11% increase, and a total value of increased home values due to shoreline restoration estimated at \$7.9 million. The total value of additional recreation following restoration was estimated at \$27.9 million annually, this represents an estimated 4% increase annually for Muskegon County.



USGS River Gauges on the Muskegon River

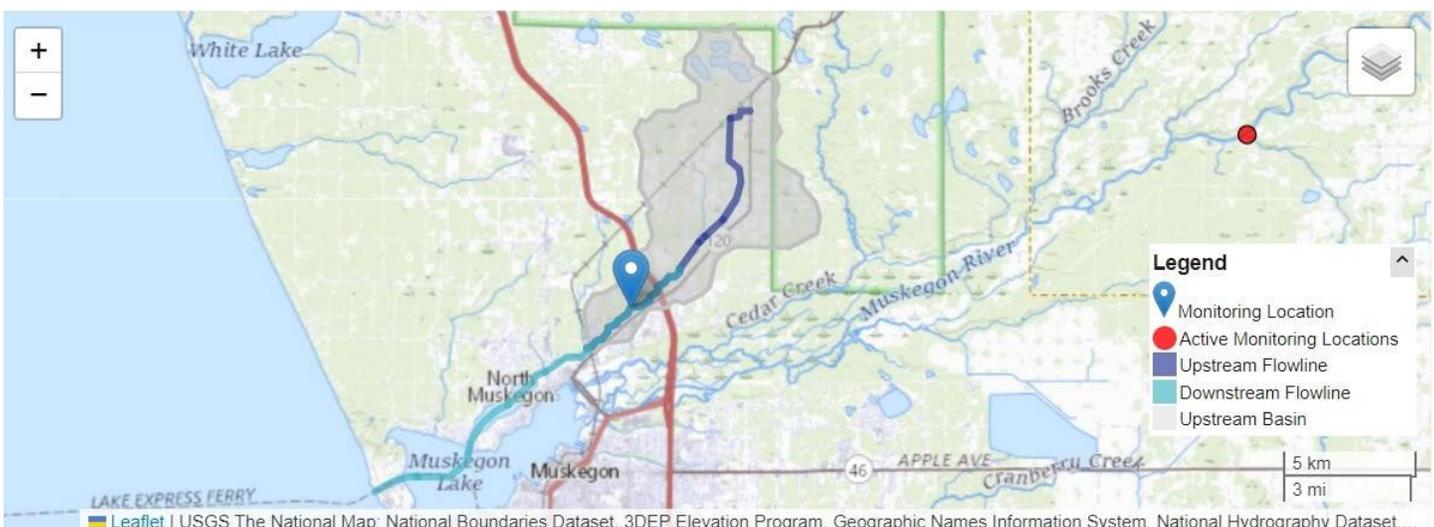
A system of United States Geological Survey (USGS) stream gauges exists across Michigan and is linked with a real-time remote monitoring system through the internet (www.waterwatch.usgs.gov). Most gauges commonly measure the height and volume of water flowing through rivers. Live updates and old records from the gauges are available online. Local, State, and Federal agencies rely on the data for flood forecasting and issuing permits. Along the Muskegon River there are four USGS stream gauges. One is located in Osceola County in the City of Evart, and three are located in Newaygo County below the Croton Dam. There are no stream gages located in Muskegon County.

The closest monitoring gage is located at Warner Bridge in Newaygo County's Bridgeton Township. This location is approximately 5 ½ miles from the Muskegon County boarder at Maple Island. While this streamgage is not located in Muskegon County, it still provides accurate impact readings and warnings to the residents living in the low lying area of Maple Island and Cedar Creek Township.



USGS River Gauge Near Bear Creek - USGS 04122100

Bear Creek covers 2.8 square miles in Muskegon County. The headwaters begin in the Twin Lakes area and travels southeasterly, discharging into Muskegon Lake. The USGS stream gauge is located on N Getty Road near North Muskegon. While there are no established flood warning levels for this creek, it is a good gauge to correlate with how the flows into the Muskegon River are impacting the residents and infrastructure along the river.



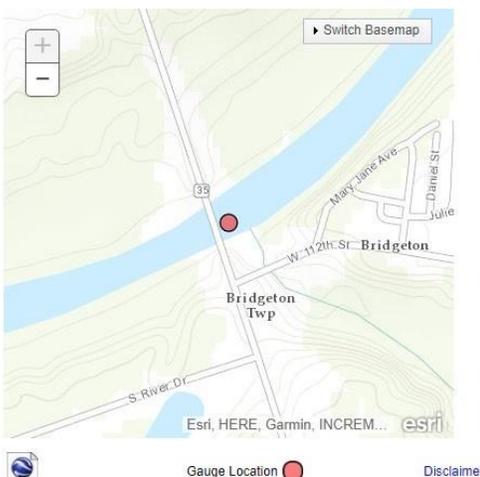
USGS 04122025 Muskegon River at Bridgeton, MI Flood Impacts (Established 2017)

| | | |
|-------------------------|-------|--|
| Near Flood Stage | 12 Ft | |
| Flood Stage | 13 Ft | Minor Flooding – Minimal property damage, public inconvenience |
| Moderate Flooding Stage | 16 Ft | Moderate Flooding – Some inundation, possible evacuations |
| Major Flood Stage | 17 Ft | Major Flooding – Extensive inundation and evacuations |

| | |
|------|--|
| 17.0 | Expect Maple Island Bridge in Bridgeton Township to close. Expect water over Maple Island Road in Bridgeton Township. Expect Major flooding downstream from the City of Newaygo in Leisure Land Subdivision, Freight Hill Subdivision, Bell Meadow Subdivision, Bridgeton Flats, and Main Street in Bridgeton Township. |
| 16 | Expect water to be over South River Drive near Maple Island and Main Street in Bridgeton Township. Expect Moderate flooding downstream from the City of Newaygo in Leisure Land Subdivision, Freight Hill Subdivision, Bell Meadow Subdivision, Bridgeton Flats, and Main Street in Bridgeton Township. |
| 15.5 | Expect flood water to begin surrounding cottages and homes downstream from the city of Newaygo in the areas of Bell Meadow Subdivision and Main Street in Bridgeton Township. Expect minor flooding in Leisure Land Subdivision and Freight Hill Subdivision in Bridgeton Township. Expect all Public River Access Sites to be closed. |
| 15 | Flood water begins surrounding properties downstream from the City of Newaygo in the areas of Fright Hill Subdivision and 9230 Main Street in Bridgeton Township. Expect minor flooding in Leisure Land Subdivision. Expect all public River Access Sites to be closed. |
| 14 | Flood water begins surrounding cottages and homes downstream from the City of Newaygo in the areas of Leisure Land Subdivision in Bridgeton Township. |
| 13 | Flood water begins approaching cottages and homes downstream from the City of Newaygo in the areas of Leisure Land Subdivision in Bridgeton Township. |
| 12 | River is bankfull. River begins to exceed its banks and minor flooding begins in low lying areas along the river. |

Historical Crests for the USGS Gauge at Bridgeton

| Rank | Date | Gauge Height | Stream Flow |
|------|------------|--------------|-------------|
| 1 | 2/21/2018 | 16.82 feet | 10,600 CFS |
| 2 | 03/16/2019 | 15.84 feet | 9,360 CFS |
| 3 | 05/19/2020 | 15.81 feet | 9,390 CFS |
| 4 | 10/03/2019 | 14.55 feet | 7,920 CFS |
| 5 | 10/25/2017 | 14.09 feet | 7,450 CFS |
| 6 | 04/30/2020 | 14.09 feet | 7,410 CFS |
| 7 | 6/24/2017 | 13.98 feet | 7,270 CFS |
| 8 | 2/5/2019 | 13.97 feet | *ICE Jam |
| 9 | 12/31/2019 | 13.48 feet | 6,750 CFS |
| 10 | 04/19/2019 | 13.41 feet | 6,670 CFS |
| 11 | 03/13/2020 | 12.64 feet | 5,880 CFS |
| 12 | | | |



Latitude/Longitude Disclaimer: The gauge location shown in the above map is the approximate location based on the latitude/longitude coordinates provided to the NWS by the gauge owner.

The USGS Streamgage for the Muskegon River was originally located in the City of Newaygo from 1964 through 1993. While the gauge was at this location, the flood stage was 11.0 feet. During this 29 year period there were 12 flooding events. The following graph shows the Peak Streamflow on the Muskegon River at Newaygo, MI from the USGS:

| Water Year | Date | Gage Height (Feet) | Flood Height above FS | Stream Flow (CFS) |
|------------|--------------------|--------------------|-----------------------|-------------------|
| 1964 | May 01, 1964 | 9.42 | | 4,580 |
| 1965 | April 12, 1965 | 11.05 | 0.05 | 7,190 |
| 1966 | December 15, 1965 | 10.34 | | 6,050 |
| 1967 | December 10, 1966 | 10.97 | | 7,060 |
| 1968 | June 28, 1968 | 9.72 | | 5,130 |
| 1969 | July 1, 1969 | 13.98 | 2.98 | 9,550 |
| 1970 | June 3, 1970 | 12.08 | 1.08 | 5,900 |
| 1971 | April 17, 1971 | 12.31 | 1.31 | 7,220 |
| 1972 | April 20, 1972 | 10.59 | | 5,190 |
| 1973 | March 9, 1973 | 10.67 | | 6,390 |
| 1974 | May 18, 1974 | 11.01 | 0.01 | 7,020 |
| 1975 | September 2, 1975 | 12.75 | 1.75 | 9,800 |
| 1976 | March 30, 1976 | 13.37 | 2.37 | 10,800 |
| 1977 | March 13, 1977 | 9.78 | | 5,170 |
| 1978 | April 11, 1978 | 10.20 | | 5,800 |
| 1979 | April 2, 1979 | 10.40 | | 6,100 |
| 1980 | March 21, 1980 | 9.94 | | 5,410 |
| 1981 | February 24, 1981 | 9.87 | | 5,300 |
| 1982 | April 3, 1982 | 10.06 | | 5,590 |
| 1983 | December 4, 1982 | 10.50 | | 6,720 |
| 1984 | June 17, 1984 | 10.54 | | 6,300 |
| 1985 | December 30, 1984 | 11.06 | 0.06 | 7,090 |
| 1986 | September 12, 1986 | 19.54 | 8.54 | 23,200 |
| 1987 | October 1, 1986 | 12.88 | 1.88 | 9,940 |
| 1988 | April 4, 1988 | 10.57 | | 6,280 |
| 1989 | April 2, 1989 | 11.83 | 0.83 | 8,290 |
| 1990 | March 14, 1990 | 10.50 | | 6,170 |
| 1991 | April 16, 1991 | 10.95 | | 6,870 |
| 1992 | November 1, 1991 | 11.28 | 0.28 | 7,400 |
| 1993 | April 21, 1993 | 10.57 | | 6,280 |

When the gauge was moved to Croton in 1995, the flood stage dropped to 9.0 feet. Trends have been regularly tracked by local and state officials through various methods including a local spotting system and an electronic river gauge installed on the Muskegon River. Utilizing this information, emergency officials have been able to anticipate routine flooding activity and severity with relatively high accuracy. From 1996-2019, a 23 year period, there were 11 flooding events. The following graph shows the Peak Streamflow on the Muskegon River at Croton, MI from the USGS:

| Water Year | Date | Gage Height (Feet) | Flood Height above FS | Stream Flow (CFS) |
|------------|-------------------|--------------------|-----------------------|-------------------|
| 1996 | June 24, 1996 | 8.42 | | 5,780 |
| 1997 | Jan 5, 1997 | 8.23 | | 5,410 |
| 1998 | April 2, 1998 | 9.12 | 0.12 | 7,130 |
| 1999 | June 15, 1999 | 7.56 | | 4,150 |
| 2000 | May 19, 2000 | 8.33 | | 6,080 |
| 2001 | May 18, 2001 | 8.49 | | 6,390 |
| 2002 | March 10, 2002 | 8.67 | | 6,620 |
| 2003 | May 12, 2003 | 6.84 | | 3,420 |
| 2004 | May 24, 2004 | 10.45 | 1.45 | 9,580 |
| 2005 | April 4, 2005 | 9.10 | 0.10 | 7,080 |
| 2006 | March 14, 2006 | 9.42 | 0.42 | 7,630 |
| 2007 | March 24, 2007 | 8.45 | | 6,020 |
| 2008 | June 9, 2008 | 8.78 | | 6,550 |
| 2009 | December 29, 2008 | 8.89 | | 6,730 |
| 2010 | October 31, 2009 | 8.63 | | 6,300 |
| 2011 | April 29, 2001 | 10.64 | 1.64 | 9,970 |
| 2012 | May 5, 2012 | 8.49 | | 6,150 |
| 2013 | April 19, 2013 | 11.11 | 2.11 | 11,000 |
| 2014 | April 15, 2014 | 12.89 | 3.89 | 15,600 |
| 2015 | April 10, 2015 | 8.79 | | 6,560 |
| 2016 | March 31, 2016 | 9.98 | 0.98 | 8,660 |
| 2017 | October 25, 2017 | 9.04 | 0.04 | 7,230 |
| 2018 | February 21, 2018 | 11.55 | 2.55 | 12,300 |
| 2019 | March 15, 2019 | 10.08 | 1.08 | 9,180 |
| 2020 | May 19, 2020 | 10.33 | 1.33 | 9,680 |

USGS 04122100 Bear Creek near Muskegon, MI Historical Crests in relation to Muskegon River

Bear Creek normal flows range from 10 – 11 feet.

Muskegon River at Croton normal flows range from 4 – 5 feet

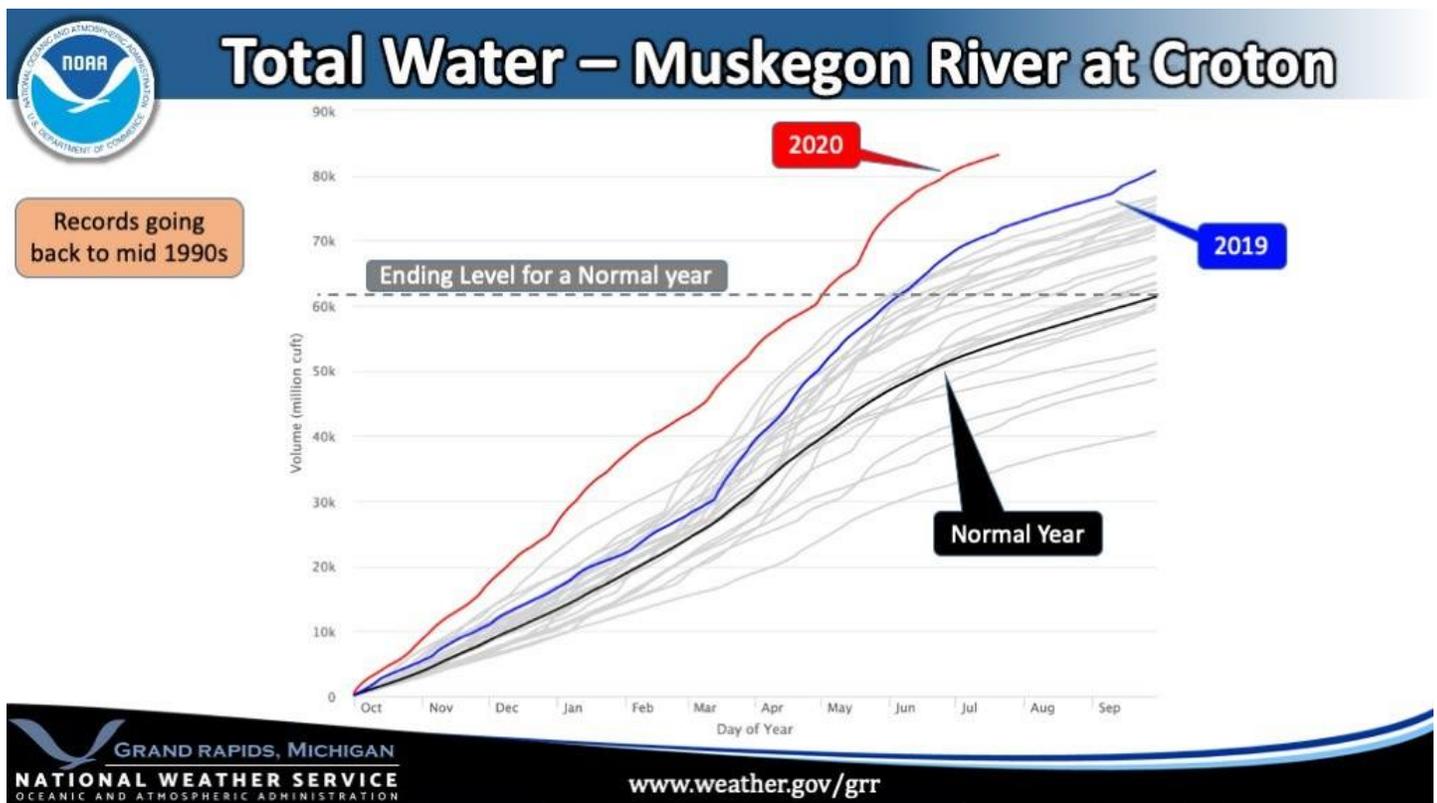
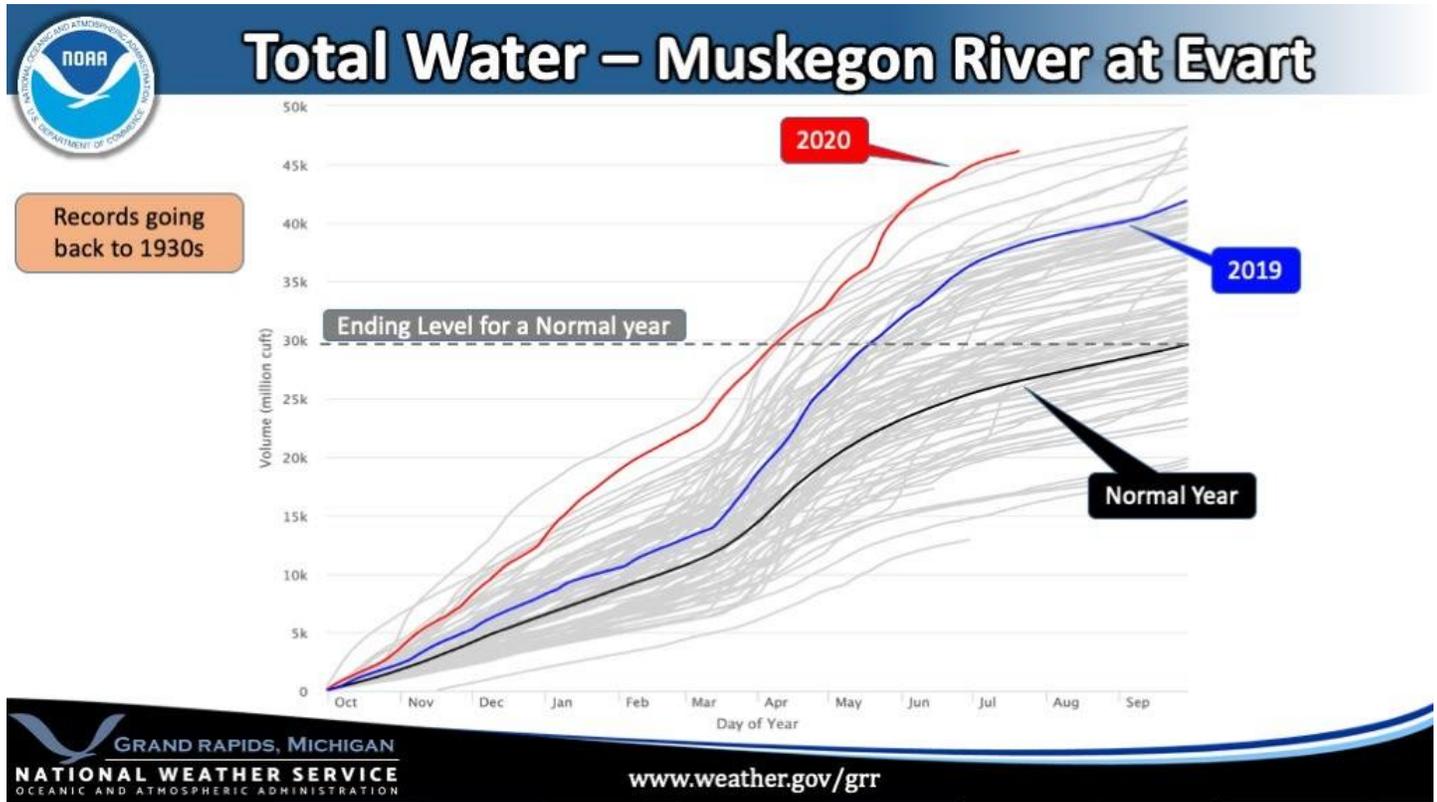
| Rank | Date | Gauge Height | Muskegon River Height | Muskegon River Flooded |
|------|------------|-------------------|-----------------------|------------------------|
| 1 | 08/20/1980 | 16.29 Ft (Record) | | |
| 2 | 02/21/1994 | 16.19 Ft | | |
| 3 | 03/15/2019 | 16.14 Ft | 10.08 Ft | YES |
| 4 | 04/29/2020 | 16.11 Ft | 8.79 Ft | YES |
| 5 | 10/01/1981 | 16.05 Ft | | |
| 6 | 12/28/2008 | 16.02 Ft | 8.89 Ft | YES |
| 7 | 01/30/2013 | 15.88 Ft | 9.88 Ff | YES |
| 8 | 09/30/1986 | 15.50 Ft | | |
| 9 | 04/14/2014 | 15.36 Ft | 12.89 FT | YES |
| 10 | 02/19/1981 | 15.32 Ft | | |
| 11 | 02/14/1984 | 15.23 Ft | | |
| 12 | 02/21/2018 | 15.23 Ft | 11.55 FT | YES |
| 13 | 04/10/2015 | 15.20 Ft | 8.85 FT | YES |
| 14 | 04/15/1991 | 15.15 Ft | 10.95 FT | YES |
| 15 | 08/19/1978 | 15.11 Ft | | |
| 16 | 04/12/2001 | 15.00 Ft | 7.38 FT | NO |
| 17 | 03/05/2004 | 14.99 Ft | 8.40 FT | YES |
| 18 | 12/03/1982 | 14.98 Ft | 10.50 FT | YES |
| 19 | 02/22/1997 | 14.92 Ft | 7.82 FT | NO |
| 20 | 03/13/2006 | 14.91 Ft | 8.89 FT | YES |
| 21 | 06/09/2008 | 14.84 Ft | 8.78 FT | YES |
| 22 | 11/30/1991 | 14.80 Ft | | |
| 23 | 02/25/1985 | 14.70 Ft | | |
| 24 | 10/04/1986 | 14.70 Ft | | |
| 25 | 05/10/1990 | 14.58 Ft | | |
| 26 | 04/23/1999 | 14.51 Ft | | |
| 27 | 04/20/1993 | 14.49 Ft | | |
| 28 | 04/26/1979 | 14.41 Ft | | |
| 29 | 01/31/1988 | 14.38 Ft | | |
| 30 | 04/21/2000 | 14.26 Ft | 7.50 FT | NO |

Frequency of Flooding on the Muskegon River

Raw Data shows the frequency of flooding events in Muskegon County are increasing. In a report developed by the Federal Emergency Management Agency, the 2008 ASFPM Working Group on Dams, and the 2012-13 Dam Risk Reduction Committee, “*A Strategy to Reduce the Risks and Impact of Dams on Floodplains*,” identifies there are clear trends toward more heavy precipitation in a short amount of time, particularly in the Northeast and Midwest. The Muskegon River Watershed Research Partnership also released several bulletins in with projections suggesting a shifting future climate change to a warmer and wetter climate. Muskegon River models responded to the climate change with increased flows during spring flood period and also during much of the drier summer and late fall. Annual flood flows throughout the watershed show an increase in magnitude on average from 20-42% relative to 1998. In the main stem of the lower river (below Croton Dam) average increases ranged from 17-33%. Data trends also are showing an increase in average annual total precipitation.

Muskegon River below Croton Dam

| Year | Events over 5,000 CFS (Bank full) | Events over 7,000 CFS (Flood Stage) | # Days 24 hour rainfall over 1 inch | Annual Total Precipitation in inches |
|----------------|--|--|--|---|
| 2000 | 1 | 0 | 8 | |
| 2001 | 3 | 0 | 9 | |
| 2002 | 1 | 0 | 4 | |
| 2003 | 0 | 0 | 4 | |
| 2004 | 3 | 2 | 8 | |
| 2005 | 2 | 1 | 5 | |
| 2006 | 4 | 1 | 12 | |
| 2007 | 2 | 0 | 3 | |
| 2008 | 4 | 0 | 8 | 45.98 (Record) |
| 2009 | 6 | 0 | 10 | |
| 2010 | 0/ | 0 | 5 | 28.82 |
| 2011 | 3 | 1 | 10 | 36.91 |
| 2012 | 2 | 0 | 5 | 34.87 |
| 2013 | 4 | 2 | 12 | 43.69 |
| 2014 | 3 | 1 | 6 | 36.41 |
| 2015 | 3 | 0 | 10 | 39.99 |
| 2016 | 2 | 1 | 7 | 36.29 |
| 2017 | 5 | 2 | 6 | 36.44 |
| 2018 | 3 | 1 | 10 | 42.23 |
| 2019 | 5 | 4 | 11 | 47.97 (Record) |
| 2020 | 5 | 1 | 1 | 36.30 |
| 2021 | 0 | 0 | 7 | 30.92 |
| 2022 | 1 | 0 | 6 | 32.58 |
| 2023 | 2 | 0 | | |
| Average | 3 | Less than 1 | 7 | 37.93 |



Frequency of Heavy Rainfall in Muskegon County

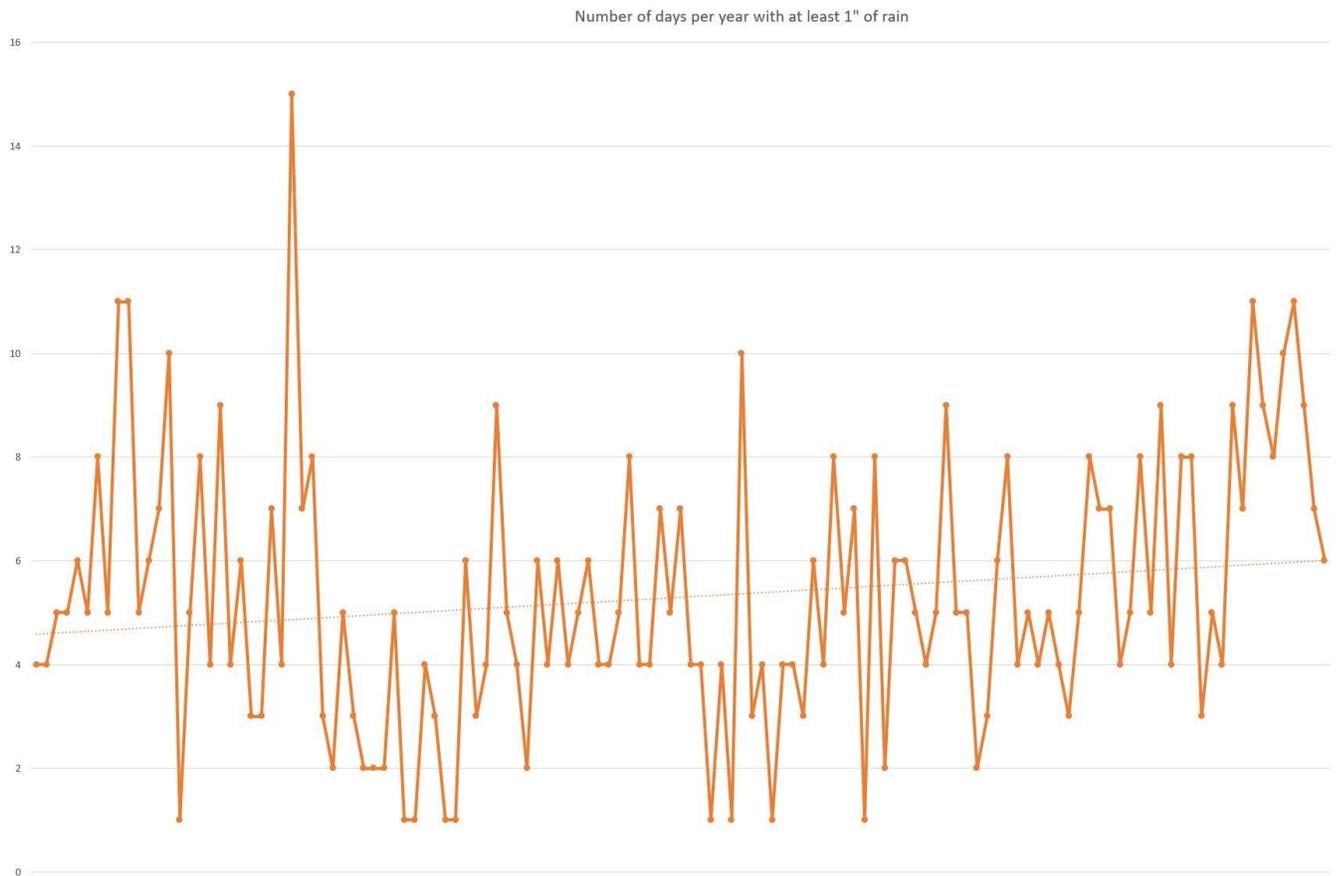
The frequency of days with very heavy precipitation (the wettest 2% of days) is also projected to increase. Extreme rainfall events and flooding have already increased during the last century. These trends are expected to continue, causing erosion, declining water quality, and negative impacts on transportation, agriculture, human health, and infrastructure.

The 2014 National Climate Assessment reports in the next few decades the Midwest can expect to see an increasing scope, frequency, and intensity of weather related disasters. This includes more weather extremes such as temperature (heat and cold), heavy downpours, and flooding that will affect infrastructure, health, agriculture, forestry, transportation, air and water quality, and more. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure.

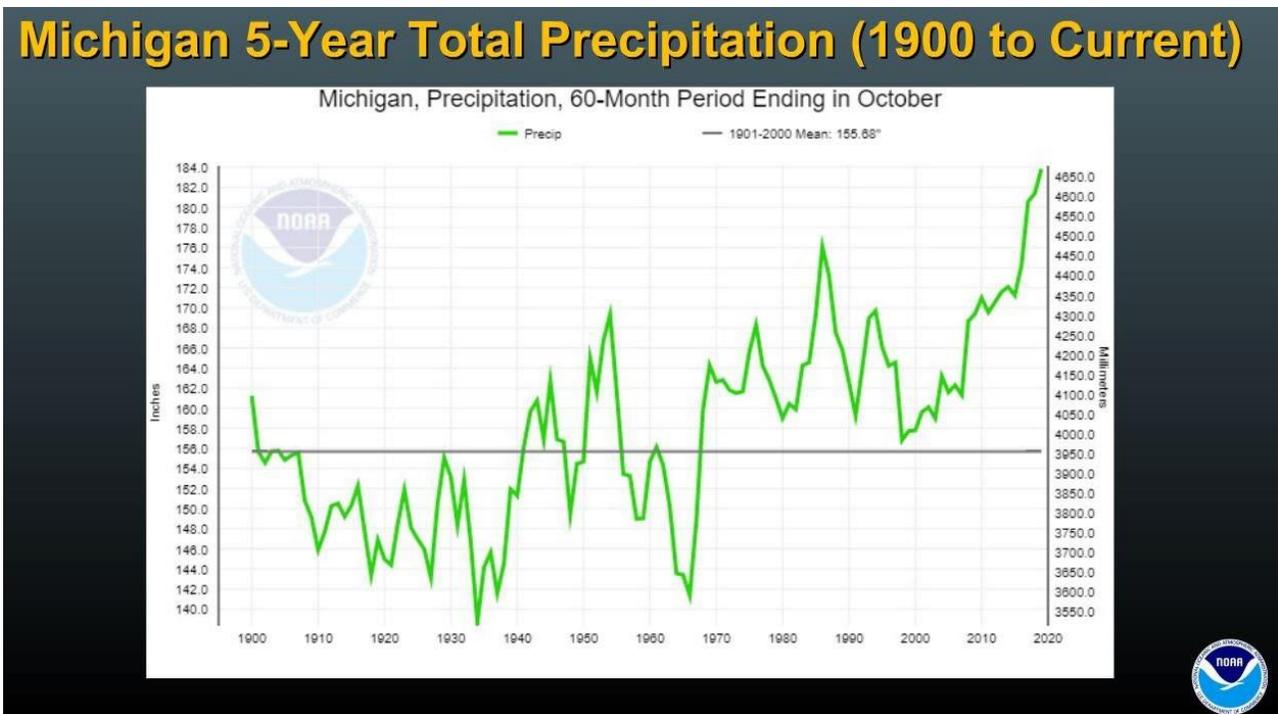
Record Daily Precipitation in Inches for Muskegon, Michigan
Source: US National Weather Service Office, Grand Rapids, Michigan
Period of record 1896-06-01 to 2023-01-30

| JAN | FEB | MAR | APR | MAY | JUN |
|-------------|-------------|-------------|-------------|-------------|-------------|
| 4.90 | 2.12 | 2.92 | 2.66 | 4.01 | 5.08 |
| 01/03/1897 | 02/22/1922 | 03/13/2006 | 04/11/2001 | 05/22/1904 | 06/27/1921 |
| JUL | AUG | SEP | OCT | NOV | DEC |
| 3.75 | 4.29 | 4.33 | 3.21 | 2.12 | 2.58 |
| 07/04/1901 | 08/13/2011 | 09/11/1986 | 10/03/1954 | 11/05/1990 | 12/02/1982 |

The following demonstrates the frequency of days with at least 1" of rain, broken down by calendar year, starting in 1896. Data is from the US National Weather Service Office in Grand Rapids, Michigan. Since 1896, the average number of days with at least an inch of rain or more is 5 days. However, the average over the last 20 years is 7 days per year of at least an inch of rain (or equivalent snow). This data shows an upward/increasing trend with time, on the order of 2 to 3 extra yearly occurrences over the 20 year duration.

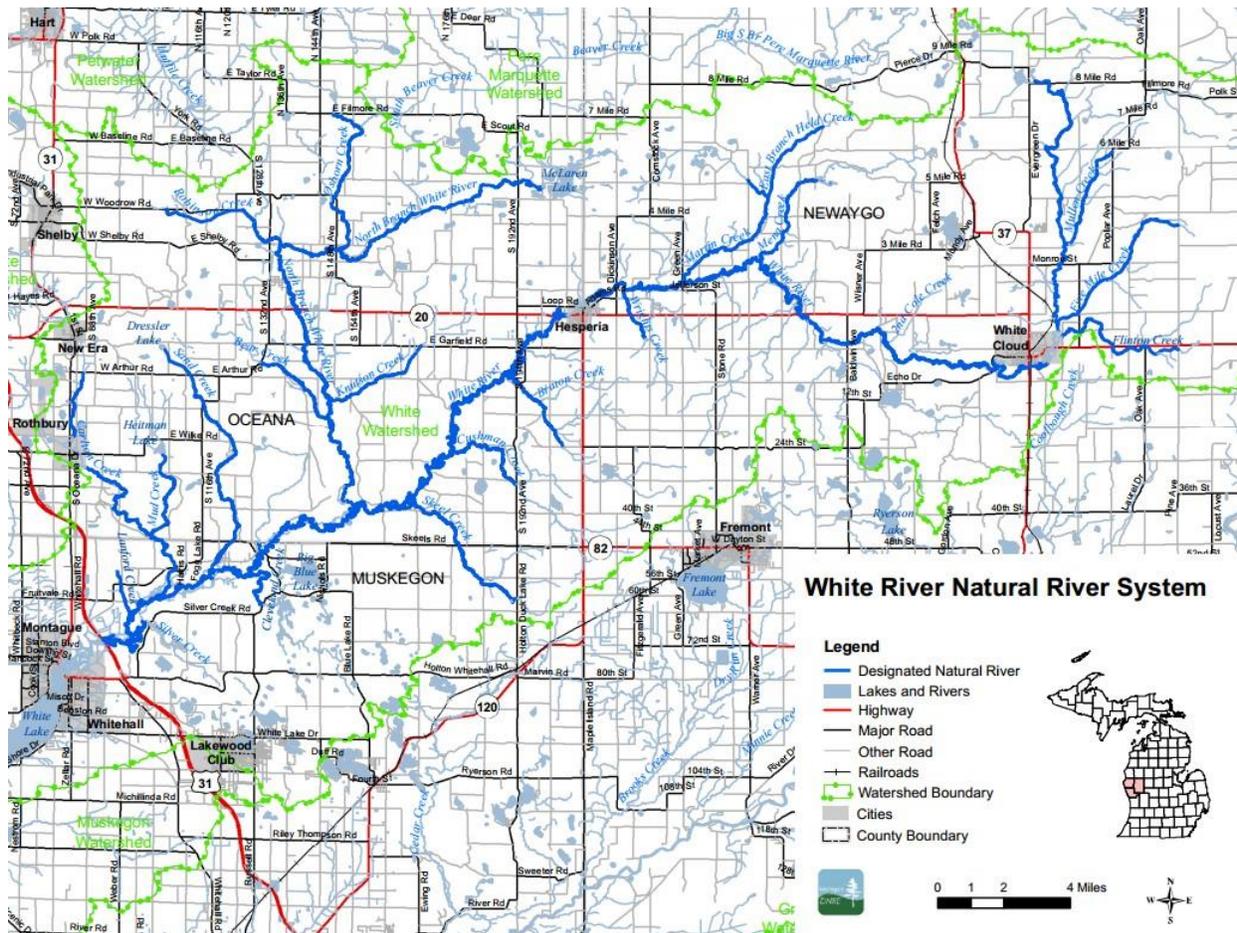


The following chart from the US National Weather Service Office in Grand Rapids, Michigan shows Michigan's 5 year Total Precipitation trends since 1900.



The White River

The White River Watershed is located in west central Michigan and is approximately 83 miles long from its start in northeastern Newaygo County to its mouth at White Lake and eventually, Lake Michigan. It covers 344,166 acres and spans three counties: Muskegon, Newaygo, and Oceana. The White River is divided into two branches, the North Branch and the South Branch. The North Branch has headwaters in central Oceana County while the South Branch originates in eastern Newaygo County.



The White River rises from the extensive Oxford Swamp in north central Newaygo County and flows in a southwesterly direction into White Lake then into Lake Michigan, near the towns of Whitehall and Montague. The White River system drains a surface area of approximately 300,000 acres and includes about 253 miles of streams. The USGS Stream gauge monitoring is located on Bevins Road near Whitehall in Muskegon County.

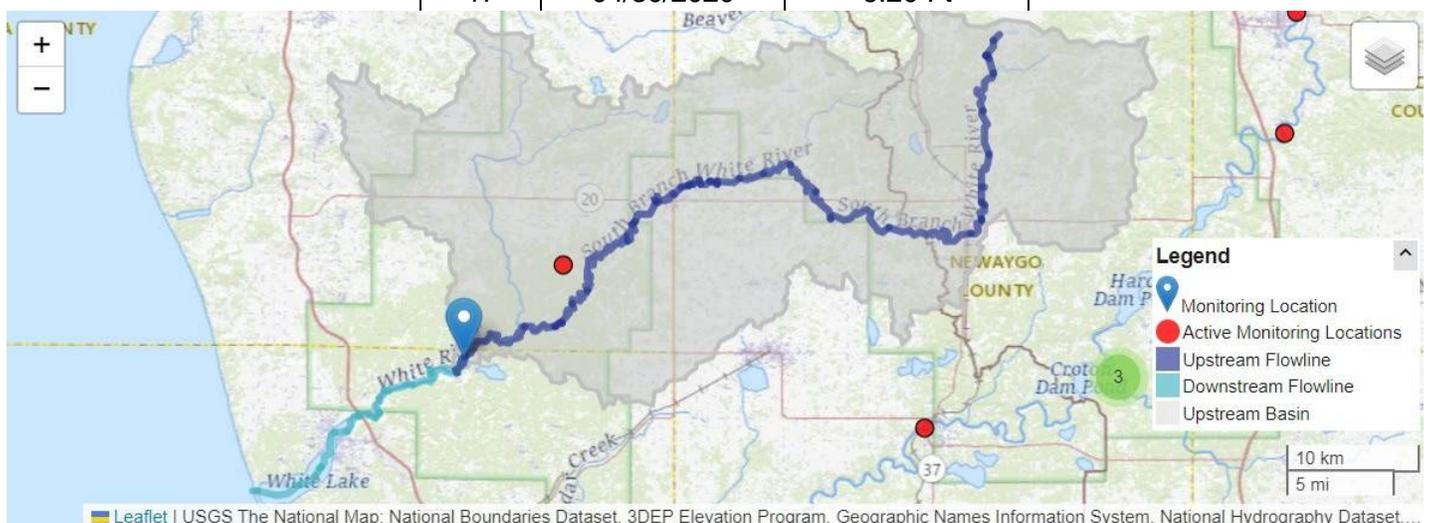
USGS 04122200 White River near Whitehall, MI Flood Impacts

| | | |
|-------------------------|--------|--|
| Near Flood Stage | 5.0 Ft | |
| Flood Stage | 6.0 Ft | Minor Flooding – Minimal property damage, public inconvenience |
| Moderate Flooding Stage | 7.0 Ft | Moderate Flooding – Some inundation, possible evacuations |
| Major Flood Stage | 8.0 Ft | Major Flooding – Extensive inundation and evacuations |

| | |
|-----|--|
| 7.5 | Expect moderate flooding of farmlands and cottages along the river. High water reaches the first flood of some homes and canoe liveries along the river. |
| 6 | Expect minor flooding of several cottages, canoe liveries, and farmland along the river. |
| 5 | River is bankfull. River begins to exceed its banks and minor flooding begins in low lying areas along the river. |

Historical Crests for the USGS Gauge at Whitehall

| Rank | Date | Gauge Height |
|------|------------|--------------|
| 1 | 09/01/1975 | 7.46 Ft |
| 2 | 09/13/1986 | 7.33 Ft |
| 3 | 03/05/1976 | 7.20 Ft |
| 4 | 12/29/2008 | 6.90 Ft |
| 5 | 04/14/2014 | 6.86 Ft |
| 6 | 04/17/1967 | 6.76 Ft |
| 7 | 03/15/2019 | 6.73 Ft |
| 8 | 04/10/2015 | 6.64 Ft |
| 9 | 02/21/2018 | 6.62 Ft |
| 10 | 02/01/2013 | 6.61 Ft |
| 11 | 05/17/1974 | 6.46 Ft |
| 12 | 04/17/1982 | 6.38 Ft |
| 13 | 10/03/2019 | 6.38 Ft |
| 14 | 04/25/1976 | 6.33 Ft |
| 15 | 05/09/2004 | 6.33 Ft |
| 16 | 02/22/1994 | 6.27 Ft |
| 17 | 04/30/2020 | 6.20 Ft |



Based on historical occurrence, on average Muskegon County experiences and estimated 2 – 3 flooding events per year. While most of these events may be urban flooding or minor riverine flooding, the following are summaries of major flooding events in Muskegon County:

Case: September 1986 Flood

The Muskegon River Flood of 1986 impacted Central Lower Michigan. Beginning on September 10, 1986, a slow moving low-pressure system moved across the middle of the Lower Peninsula. The greatest rainfall ranged from 8 to 13 inches with more than 10 inches of rain falling over 2 days within a 3,500 square mile area. Flooding was most prevalent in the Muskegon, Little Muskegon, Pere Marquette, Chippewa, Cass and Tittabawassee River Basins. This flood resulted in 6 deaths and 89 injuries. The flooding caused 11 dams to fail, flooded 30,000 homes, and made 3,600 miles of roadways impassable. Damage was estimated to be in excess of \$500 million (1986 dollars). A 30-county area of the state was declared a Federal Disaster Area. The city of Vassar suffered extensive damage with a large portion of the central business district inundated by 8 feet of water for 3 days. Four primary road bridges and hundreds of secondary road bridges and culverts failed.

Case: April 2014 Flooding on the Muskegon River and White River

The combination of a very significant snowpack that gradually melted and multiple rounds of severe thunderstorms with heavy rainfall resulted in significant flooding in eight counties. Generally 5 to 8 inches of rainfall occurred over the Muskegon River Basin from April 12 – 14th. Hundreds of homeowners were evacuated for close to one week. Some homes had over 6 feet of water on the first floor living space. River access sites were closed and several parks sustained extensive damage. The flood caused over \$4 million in private damages and \$587,000 in public damages. Muskegon County was included in a Governor's Disaster Declaration along with 7 other counties for this event. This event resulted in the fifth highest historical crest on the White River.

Case: May 28, 2019 - WHITEHALL, MI

Ongoing high-water issues resulted in the closure of a section of business route U.S. 31 connecting Whitehall and Montague. The four-lane roadway and bridge was shut down due to flooding. That section is the only crossing over the White River and White Lake, other than the U.S. 31 freeway, to which traffic was detoured 7 miles around the closure.



Case: June 18, 2019 - Muskegon Lake

A news article written by Joe LaFurgey for WoodTV 8 documented the following information - One neighborhood along Muskegon Lake is dealing with flooded streets and soaked basements. John Ledsworth has, more or less, abandoned ship. The carpet in his boathouse on the south shore is soaked by Muskegon Lake, which has inched up to his front deck. Fortunately for him, the damage has been minimal compared to others in the neighborhood. "It's inconvenient. It's financially stressful. I know some people down the street ... it's 12, 14 inches in their basement," Ledsworth said.

Fighting the floodwater is a losing battle. The ground is saturated, forcing the water through cracks in basement floors and foundations. Residents try to block it and pump it out. Like many of his neighbors, Peterson pumps the water from his sump crock out to the storm sewer. From there, it goes into Muskegon Lake and eventually right back into his basement.

Muskegon City Manager Frank Peterson admits that there's not much the city can do. It recently pumped floodwater into the sanitary sewer systems so it could make flood-related repairs to Edgewater Street, but that's not a permanent fix. Water pumped into the sanitary system goes to the county sewer treatment plant, where it has to be treated, and that's expensive. Peterson estimated that pumping through the summer would cost just under a quarter of a million dollars. "It would be unfair to all of the ratepayers of Muskegon to essentially pay with their sewer bills to pump clean water otherwise into the sanitary and then pump it out to the county wastewater plant," Peterson said. While he admits the nuisance for some residents is an expensive mess for others, Peterson's advice to his neighbors is to do the best they can to keep the water at bay. Chronic high water and flooding has prompted the city of Muskegon to run 24-hour pumps on a low-lying residential street that runs alongside Muskegon Lake, where portions of the community's bike path also are underwater. Sandbags are placed along the shoreline to try to keep the water at bay.

Urban Flooding Hazard Analysis

A combination of excessive rainfall and/or snowmelt, saturated ground, and inadequate drainage can easily result in water with no safe place to go. The water will flow downhill to find the lowest elevations available—areas that are often not in an officially recognized floodplain but that flood regularly because of this runoff. This type of flooding is increasingly common in Michigan, as development outstrips the ability of the drainage infrastructure to properly carry and disperse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. Other cases involve the ponding of waters across roads or in other low-lying areas. These additional types of flooding have now been given a separate chapter within this document.

"Urban flooding" may involve low-lying areas that collect runoff waters even though they are not adjacent to drains or bodies of water. This risk varies with the topography, soil types, runoff rates, drainage basin size, drainage channel sizes, and impervious ground surfaces in each area. Other kinds of urban flooding stem from flaws or shortcomings in existing sewer infrastructure. Some flood events may come from undersized or poorly designed sewer systems that cannot always process the amounts of precipitation and runoff that affects an area. Other events may have less to do with system design than with the collective effects of land use and development trends, illegal diversion of water, or actions that plug storm drains or otherwise interfere with system function.

The drainage systems within every Michigan county, plus most of its municipalities, are limited in the amount of water that they can successfully handle within a particular time-frame. Although much water eventually soaks into the ground and is delayed by natural plant growth as it falls, the increasing amount of paved and built-up land surfaces in Michigan tends to instead cause waters to quickly drain downhill

at a rate that can overwhelm the existing drain systems in many areas. Some areas never had much drainage, but as long as these low-lying areas do not contain structures or important infrastructure, they can flood or act as wetlands and thus provide a natural benefit to detain and cleanse natural water runoff. The real problem exists where waters collect across roads, in basements, and even throughout the downtown areas within cities. In some cases, this occurs at the same time as riverine and lake flooding, but there are many flood impacts that occur outside of recognized floodplain areas. Water that normally might take several days to reach a river or stream under natural drainage conditions now quickly runs off of streets, parking lots, and rooftops, and through man-made channels and pipes that in some cases are under-sized. Some developments have also encroached into flood-plain areas and have therefore impeded the water storage and carrying capacity in part of the natural drainage area. This hazard also includes inadequacies or failures in the constructed components of drainage systems, which can cause water or sewer back-ups into basements, or sewer overflows of untreated waters into the environment.

Urban Flooding in Michigan

Michigan's 21st Century trends have demonstrated that it is now just as important to consider broader types of urban flooding, especially urban flood hazards which have produced two of Michigan's most damaging natural disasters in each decade of the new century (federal disaster #1346 in September 2000 and federal disaster #4195 in August 2014), both causing widespread damage throughout Metropolitan Detroit. Similar problems occur in many other urban areas, as well as less severe impacts within rural areas of the state. It is now documented that a great amount of our country's flood damage occurs outside of NFIP-recognized floodplain areas. In other words, many flood impacts occur in places that are far from streams and lakes.

Although the most severe urban floods do not happen every year in the same locations, some of the worst events are focused upon the most central infrastructure within Michigan's largest urban areas being overwhelmed. Michigan's cities act as vital hubs in transportation, trade, communication, and other key economic functions, but large cities have historically been built adjacent to rivers and coasts, in relatively low-lying locations toward which water tends to flow during its downhill journey toward the Great Lakes. Therefore, urban floods are often inundating the very areas that serve as our most important economic hubs. Even a small city can cause large-scale shutdowns in huge industries such as the automotive sector, because many manufacturing processes rely upon the timely supply of key industrial parts from plants located in small cities.

Note: Many of the following events could also have been listed above under Riverine Flooding and nay of the events in that section could have also been listed here.

Urban Flooding in Muskegon County

With the increase in heavy rainfall events, areas not within recognized floodplain areas, or adjacent to rivers and lakes are also experiencing an increase in flooding. In some cases, melting snow or other runoff waters pool in low-lying areas, damaging structures and inhibiting the function of roads and infrastructure. In other cases, some type of breakdown in an area's pumping or drainage infrastructure may result in a damaging flood.

Within Muskegon County, several areas experiencing urban flooding issues include the City of Muskegon, the City of North Muskegon, the City of Muskegon Heights, the City of Roosevelt Park, the City of Norton Shores, the City of Montague, the City of Whitehall, the Village of Casnovia, the Village of Fruitport, the Village of Lakewood Club, and the Village of Ravenna. In these areas, there is a risk for vehicle accidents from hydroplaning, storm water damaging businesses, and storm water seeping into basements causing damage to contents and structures. As most of these areas are not within an identified floodplain, most jurisdictions do not participate in the National Flood Insurance Program. Therefore homeowners and businesses in these areas cannot get flood insurance to cover any losses from urban flooding.

Case: May 17, 2020 – Muskegon County

Muskegon County received an historically high 3.35 inches of rainfall Tuesday through Sunday resulting in at least 1,400 Muskegon County residents have reported damage to their homes in the aftermath of historic rainfall earlier this week that left many parts of Michigan flooded. The National Weather Service office in Grant Rapids reported this was the second heaviest 24 hour rainfall total at Muskegon in the month of May. The all time record, with the period of record starting in 1896, for a single day in May is 4.10 inches which occurred on May 22, 1904.

Due to flooding, Muskegon County officials declared a local state of emergency for the event. County officials officially signed off on a local declaration of emergency because high water levels on Lake Michigan and local lakes, combined with significant rain over the weekend, caused flooding across residential neighborhoods and commercial corridors alike. The declaration specifically cites flooding that took place on Sunday, May 17, across Norton Shores, Muskegon Heights, Muskegon, Fruitport Township, Egleston Township, Twin Lake, Muskegon Township, North Muskegon, Montague and Whitehall. Infrastructure, including drains and roads, have been flooded, and some businesses have reported flooding as well, according to the release from county officials. Five roads were shut down because of the water levels, and two were closed because of broken culverts. Local streams and creeks are also flooding, including Bear Creek, which extends from the northeast of Bear Lake, running parallel to Holton Road in north Muskegon, and continuing up towards the Twin Lake area. Although the high water issue is countywide, the most affected areas are Fruitport Township, Laketon Township, Fruitland Township, and Dalton Township, because of their lower elevations, as well as Laketon Township's wetland climate. In August, city crews worked to install concrete blocks and a new berm to raise Edgewater between Windward Drive and Brighton Avenues, but still left part of the roadway unprotected. The integrity of the water mains is a point of concern that has caught the attention of Muskegon County's Emergency Management Department and the U.S. Army Corps of Engineers. The latter agency has advised the county that losing the mains could become a serious issue for all three municipalities.

Dam Failure Hazard Analysis

A dam is a structure that stretches across a stream or other water body in order to control its flow or to convert the energy within the water into more convenient forms, such as electricity. The impounded waters may be used for agriculture, flood-control, artificial lakes, municipal water supplies, or for energy generation. Some dams have become obsolete, and should be removed to restore the natural water

flow through the area. Otherwise, neglected dams will eventually fail, and would then be likely to cause a flash flood downstream, through the sudden release of their impounded waters. Some dams are constructed by wildlife instead of humans, but can pose similar risks. Damlike obstacles can accidentally arise through the accumulation of logs, debris, or ice at a particular location, temporarily blocking waters (often causing floods nearby) but potentially vulnerable to giving way and thereby causing a flash flood downstream.

A dam failure can result in loss of life, and in extensive property or natural resource damage for miles downstream from the dam. Dam failures occur not only during flood events, which may cause overtopping of a dam, but also as a result of poor operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation.

The worst recorded dam failure in U.S. history occurred in Johnstown, Pennsylvania on the afternoon of May 31, 1889. More than 2,200 persons were killed when the South Fork Dam on the Conemaugh River upstream from Johnstown failed, sending 20 million tons of water downstream in a huge wall of water (at times 60-70 feet high) moving at 40 miles per hour and laden with debris. Johnstown was completely inundated, and the Conemaugh Valley was again the site of dam failures in May of 1977 when nearly 12 inches of rain fell in a 10-hour period, causing six dams surrounding Johnstown to fail, resulting in heavy property losses and the deaths of 45 persons. The storm that caused the dam failures was said to be at least a “5,000-year” event, in terms of its intensity.

Dam Failure Hazards in Michigan

Dams in Michigan are regulated by Part 307, Inland Lake Levels, and Part 315, Dam Safety, of The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. There are 2,500 dams in the state, 813 of which are regulated by Part 315, and 235 are regulated by Part 307. Dams are regulated by Part 315 when they are over 6 feet in height and over 5 acres are impounded during the design flood. Dams are regulated by Part 307 when a circuit court issues an order establishing the level at which the lake is to be maintained. There are also 99 hydroelectric dams in Michigan that are regulated by the Federal Energy Regulatory Commission (FERC) under the Federal Power Act.

State of Michigan classifies dams into three different categories:

1. High Hazard Potential: Failure may cause serious damage to inhabited homes, agricultural buildings, campgrounds, recreational facilities, industrial or commercial buildings, public utilities, main highways or class I carrier railroads, or where environmental degradation would be significant, or where danger to individuals exists with the potential for loss of life. (Sec.31503 [11])
2. Significant Hazard: failure may cause damage limited to isolated inhabited homes, agricultural buildings, structures, secondary highways, short line railroads, or public utilities, where environmental degradation may be significant, or where and danger to individuals exists. (Sec. 31505 [5])
3. Low Hazard: failure may cause damage limited to agriculture, uninhabited buildings, township or county roads, where environmental degradation would be minimal, and danger to individuals is slight or nonexistent. (Sec. 31504 [2])

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) has documented approximately 302 dam failures in Michigan since 1888. The following is a brief summary of some of the more recent incidents:

Case: 2002-2004: Upper Peninsula Flooding and Dam Failures

A pattern of flooding and dam failures occurred in the Western and Central Upper Peninsula for several years in a row. In April of 2002, several dams in Gogebic County were breached by floodwaters, with the City of Wakefield being especially affected. The city's water treatment, wastewater treatment, and electric plant were all in danger of inundation and shutdown, and the State Police Post there was evacuated due to flooding. The Wood Dam (Presque Isle Wildlife Dam) was breached and an embankment to its north partially eroded, allowing waters to flow through. In Gogebic County, 48 homes were destroyed, 91 suffered major damage, and 27 endured minor damage; 7 businesses were destroyed, and 11 were damaged. A federal Disaster Declaration was issued by the president. In Marquette County, two dams were at maximum levels, but held during that 2002 event. In May of the next year, however, Marquette County was the one to suffer from flooding, as a series of dikes and dams failed, starting with the Silver Lake dike, and caused excessive water to flood low-lying areas in the City of Marquette. Marquette County declared a local state of emergency, and damages were estimated at about \$3.2 million, of which \$1,000,000 was caused to the failed dike and downstream dams themselves. The Governor ordered the evacuation of persons living along waterways in the Dead River Basin area and its tributaries downstream of Silver Lake. Although the U.S. Small Business Administration issued a "Declaration of Economic Injury," no federal Disaster Declaration was approved for this event. In 2004, similar flooding threatened to occur, but did not have quite the same level of impact as had happened in the previous two years.

Case: September 13, 2008 – Berrien County

On September 11, heavy rainfall struck the area as the remnants of Hurricane Ike and Tropical Storm Lowell finally reached the southern portion of Michigan. Over the next few days, rainfall totals across Berrien and Cass Counties exceeded 12 inches, and an earthen portion of the Niles Dam suffered a breach. Downstream residents were evacuated, as a precaution. The main flood impacts were felt upon the area's roads, especially in the Niles area, through September 15.

Case: May 31, 2010 – Kent County

After severe storms and heavy rainfall battered the area, a retaining wall was washed out and caused numerous homes to flood, about one mile south of Rockford. Property damage from the storm's impact was estimated at \$200,000. Various roads were also flooded over and washed out.

Case: October 6, 2012 – Dam Failure and Flash Flood (Grand Traverse County)

East of the town of Grawn, a temporary dam and de-watering structure had been in place alongside the Brown Bridge Dam on the Boardman River, to assist in drawing down the small lake behind the dam (Brown Bridge Pond) before the dam's permanent removal. This temporary dam failed and caused the release of all remaining water, causing road closures and home evaluations within the hour. A total of 53 homes sustained varying degrees of damage. Docks, small footbridges, and some small outbuildings were destroyed. Total damages were estimated at \$1.8 million.

April 15, 2014 – Roscommon County

During the annual spring thaw, water levels were high in the area, and the Wraco Lodge Dam on Wolf Creek gave way, sending flood waters across several major roads and resulting in approximately \$60,000 in property damage to them. The resulting road closures included Old 27 near the Clare County Line, Waco and Rollway Roads, Newaygo and Townline Roads, and County Road 402. Floodwaters were just inches away from reaching the level of the U.S.-127 Bridge.

May 17 – 20, 2020 – Edenville and Sanford Dam Failures (Midland County)

A stalled low-pressure system and frontal boundary across the southern Great Lakes region brought record rainfall to southeast Michigan beginning the morning of May 17, 2020 and continuing into the afternoon hours of May 19, 2020. As a result, several rivers across the region flooded including significant flooding occurring along the Saginaw River and historic flooding along the Tittabawassee River in Midland County. The heavy rain in the Tri-Cities region resulted in the catastrophic failures of the Edenville and Sanford dams northwest of the city of Midland, resulting in the issuance of rare Flash Flood Emergencies for record-breaking flooding along the Tittabawassee River that resulted in several structures and roads flooded, and the evacuation of at 10,000 residents of the city of Midland. The heavy rain also resulted in several road closures across the rest of the region as well.

In addition to the heavy rainfall, a tight pressure gradient resulting from the area of low pressure further exacerbated already high Great Lakes water levels and enabled strong east to northeast winds to produce significant lakeshore flooding along the shorelines of Lake Huron (particularly Saginaw Bay), Lake St. Clair, and western Lake Erie. Significant river flooding once again occurred along the St. Clair River as well in portions of Macomb and St. Clair counties.

While a stalled low-pressure system bringing soaking rainfall often occurs at least once or twice during the spring months in the vicinity of southeast Michigan, the combination of heavy rainfall, significant lakeshore and river flooding, and the resultant dam failures in Midland county make this event historically significant.

Dam Hazards in Muskegon County

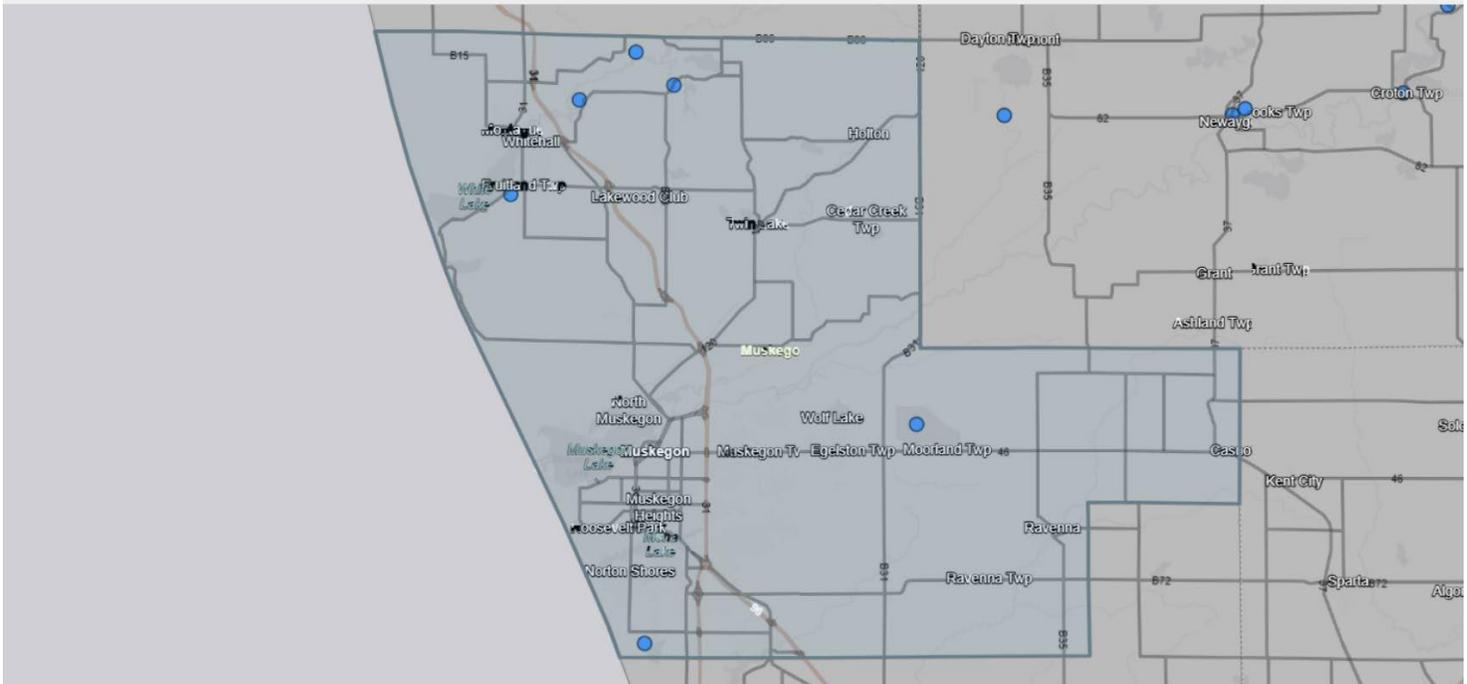
Within Muskegon County there are (6) High Hazard Dams registered in the United States Army Corps of Engineers National Inventory of Dams. These dams are regulated under Part 315, Dam Safety, of The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Private dam owners are responsible for more than 65% of the nation's dams with the average age of dams more than 53 years old. As dams get older, deterioration increases and repair costs rise. Common problems include deteriorating metal pipes and structural components, sediment filled reservoirs, and increased volume of runoff into the reservoir upstream from a change in land use. Many private dam owners lack the financial resources necessary for adequate dam maintenance. The average age of the Dams in Muskegon County is 91 years old.

Dams of Muskegon County, Michigan

6 Total Dams 91 years Average Dam Age 100% High Hazard Potential Dams with an EAP 0% Federally Regulated Dams
0% Dams with Hydropower 100% State-Regulated Dams

BROWSE THESE DAMS



The following are a list of known private dams in Muskegon County from the National Inventory of Dams, US Army Corps of Engineers.

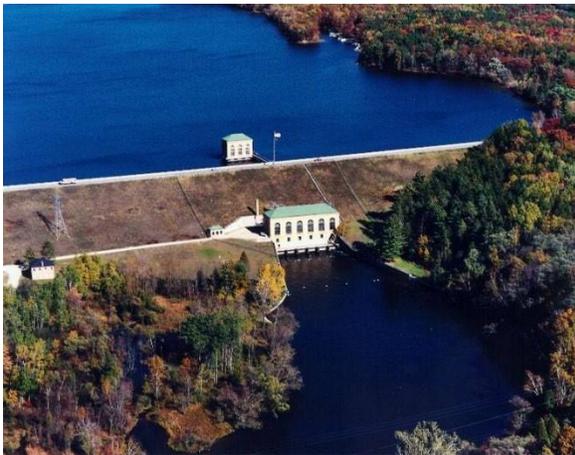
| NAME | NIDID | OWNER NAME | OWNER TYPE | River or Stream Name | LOCATION | YEAR COMPLETE | Height (Ft) | MAX STORAGE (Acres) | MAX DISCHARGE (CFS) | Last Inspected | EAP DATE |
|------------------------------|---------|------------------------------------|------------|---------------------------|--------------------|---------------|-------------|---------------------|---------------------|----------------|----------|
| Cleveland Lake Dam | MI00741 | Owasippe Scout Reservation | Private | Cleveland Creek | Blue Lake Township | 1960 | 21 | 1,344 | 590 | 12/07/2016 | 01/17 |
| Browns Pond Dam | MI00228 | Blue Lake Township | Local Gov. | Sand Creek | Blue Lake Township | 1844 | 16.4 | 125 | 230 | 05/08/2015 | 06/19 |
| Silver Creek Pond | MI00232 | Randall Webster | Private | Silver Creek | Montague Township | 1950 | 10 | 80 | 70 | 11/13/2002 | N/A |
| Whitehall Millpond Dam | MI00669 | William Bartholomew | Private | Mill Pond Creek | Fruitland Township | 1940 | 14 | 60 | 260 | 09/20/2016 | N/A |
| Muskegon Waste Water Lagoons | MI00613 | Muskegon County | Local Gov. | Black and Mosquito Creeks | Mooreland Township | 1973 | 21 | 20,616 | N/A | 11/08/2019 | 02/16 |
| Little Black Lake Dam | MI01687 | Muskegon County Drain Commissioner | Local Gov | Little Black Creek | Lakewood Club | 1927 | 10 | 933 | N/A | 07/25/2017 | N/A |

Although not located in Muskegon County, if the following dam experienced a catastrophic failure, would significantly impact Muskegon County.

Hardy Dam, Newaygo County

Located in Big Prairie Township, the Hardy Hydroelectric Dam is the third largest earthen-filled dam in the world, and the largest east of the Mississippi River. Its impoundment forms Michigan's largest inland lake with over 50 miles of shoreline and a reservoir of 3,902 acres. The average annual cubic feet per second of flow through the dam is 1,460. The Hardy Dam is capable of generating 30,000 kilowatts of electricity which is enough power to serve a community of 16,600 people.

The Hardy Dam is owned and operated by Consumers Energy. Because of its size and operation, the dam is licensed by the Federal Energy Regulatory Commission (FERC). This license governs plant operation, dam safety, and land management and recreation. The Hardy Dam is not designed and cannot operate as a flood control structure under the FERC License. The dam operates in a peaking mode, with pond levels maintained within +/- 0.5 feet of the 822.0 feet surface water level on a daily basis (except during drawdown and refill). Annually, from January until the end of April, the Hardy Dam may be drawn down up to -12 feet below 822.0 feet +/- 0.5 feet. The maximum depth of the drawdown is based on a winter snow survey conducted with the National Weather Service. The pond must be refilled back to full levels by May 1st. Rates of drawdown and refill must not exceed 1 foot in a 24 hour period.



of

The Hardy Dam is listed as a High Hazard Dam by the Michigan DEQ. This dam is noteworthy not only because of the large amounts of water impounded behind it, but also because of its location upstream from the populated and agriculture areas along the Muskegon River near the City of Newaygo and in Muskegon County. A failure on this dam would likely result in extensive damage and complete loss homes, businesses, bridges, and critical infrastructure from the dam to Lake Michigan. All bridge crossings from the Hardy Dam to Lake Michigan are expected damaged or completely lost,

making travel around the impacted roadways and bridges impossible. There would be no safe crossings for 50 miles from Lake Michigan until US 131. In addition, a failure of the Hardy Dam would cause a failure of the Croton Dam. Within Muskegon County, emergency evacuations would be conducted for approximately 500 homes and over 100 businesses within Cedar Creek Township, Muskegon Charter Township, North Muskegon, and the City of Muskegon.

Great Lakes Shoreline Hazard Analysis

Shoreline flooding and erosion are natural processes, occurring at high, average, and even low Great Lakes water levels. However, during periods of high water, flooding and erosion are more obvious, causing serious damage to homes and businesses, roads, water and wastewater treatment facilities, and other structures in coastal communities. Great Lake water levels go through complicated cycles that are not easy to predict. The time between period of high and low water levels can vary widely.

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 land draining into the Great Lakes is so vast, changes in the amount of water running into the lakes from precipitation within the basin has an enormous effect on water levels. Following long periods of above-average yearly precipitation, there is an accompanying rise in water levels. This rise 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. The same holds true for below-average yearly precipitation. The reduced flow of runoff water eventually results in lower Great Lakes water levels.

Shoreline erosion hazards involve the loss of property as the supporting sand or soil is removed by wind and wave action. Worst-case scenarios tend to involve inhabited structures that, over the years, have had adjacent lands eroded away and now stand perilously close to lake waters or shoreline cliffs. The foundation of a structure, or underground utility pipes in the area, may become fully exposed and vulnerable to weather, extreme temperatures, water damage, or other sources of risk. Roads and structures may be just one storm away from falling into the lake when the shoreline is significantly eroded to the extent that it reaches a structure's foundation and the area's important infrastructure.

Shoreline Hazards in Michigan

Michigan has over 3,200 miles of coastline, the longest freshwater coastline in the world. About 4.7 million persons live in the state's 41 shoreline counties. Wind, waves, water levels, and human activities constantly affect the communities along the shores of the Great Lakes. Generally, low-lying lands along the coastline are prone to shoreline flooding during both high and low lake water periods. The Michigan Department of Environmental Quality (MDEQ) has designated 41 communities on Michigan's shoreline as flood risk areas, meaning that they have floodplain-like areas with at least a 1% annual chance of a designated flood level being exceeded. These designations allow the mapping of flood-prone areas in a manner similar to riverine flooding, but these shoreline areas may suffer from additional damages caused by the added effects of wave action and seiche activities on the Great Lakes. The MDEQ estimates that approximately 10% of Michigan's Great Lakes shoreline is flood-prone, involving lands encompassing more than 45,000 acres and located in 30 counties.

Another frequent situation in Michigan involves shoreline roadways whose banks erode and cause the road surface to crack, become unstable, or more prone to deposits of sand, snow, water and ice from nearby beaches and water bodies. The costs of delayed traffic and detours can be counted as harmful

shoreline effects. Travel on shoreline highways can also be made treacherous by sand, mists, and snow blown in by wind gusts.

The following brief synopses describe Michigan Great Lakes Shoreline Hazard Events in the past few decades in which flood and erosion impacts occurred:

Case: July 4, 1929 – Grand Haven (Ottawa County)

After an early-morning storm had passed, tens of thousands of persons gathered for an Independence Day celebration in the Grand Haven State Park. Later in the day, a 6-meter wave surged over the Grand Haven pier, sweeping persons into the Lake as the water retreated. Strong rip currents near the shore carried away several more persons, and a total of 10 were killed that day.

Case: November 11, 1940 – Lake Michigan Seiche

Enormous waves were generated by a huge storm system, with winds blowing in from the southwest and reaching speeds of up to 75 mph. The northern shore of Lake Michigan was reported to have sustained considerable damage from the push of water during the resulting seiche. Five vessels and 66 lives were lost (including 57 deaths from the sinking of two freighters that are also listed in the Transportation Incidents section of this document). A car ferry was damaged and driven ashore at Ludington.

Case: 1972-1973 – High Lake Levels and Shoreline Floods

During 1972-73, high water levels caused flooding in over 30 counties, resulting in more than \$50 million in public and private damage. Thousands of persons were forced to evacuate their homes. Similar high water-level flooding had also occurred in the early 1950s and late 1960s, also resulting in millions of dollars' worth of damage to shoreline communities.

Case: 1985-1986 – High Lake Levels and Shoreline Floods

Record-high lake levels in 1985-86 culminated in a Governor's disaster declaration for 17 shoreline counties. The USACE implemented its Advance Measures Program, and the State of Michigan implemented three unique shoreline flooding and erosion mitigation programs aimed at reducing future flood impacts on shoreline communities and homeowners. (See Programs and Initiatives section.) After a mid-1980s storm event and high waves along the shore of Lake Michigan, Saugatuck Township residents found that a large section of Lakeshore Drive had crumbled away, southwest of Douglas. At least a couple hundred feet of paved road was missing, causing access problems for some area homes, and a very long detour for those used to driving into town along that route. The road has not been rebuilt, but some erosion-control methods were later installed to help waters drain into the lake without carrying much of the shoreline with it. See also the 2008 event listed below.

Case: 1997-1998 – High Lake Levels and Shoreline Floods

The high-water period in 1997-98 resulted in the Great Lakes being at or near the record levels set in the mid-1980s. In response to the threat of severe shoreline flooding and erosion, the U.S. Army Corps of Engineers (USACE), at the request of the Governor, implemented its Advance Measures Program to assist Michigan shoreline communities in their flood and erosion mitigation efforts. (See Programs and Initiatives section for more details.) More than 20 Michigan jurisdictions took advantage of this

program. Storms in 1998 reportedly caused shoreline erosion damage in New Buffalo (Berrien County), and subsequent years' events have added to the concerns at that location.

Case: 2000s – Low Lake Levels

Low water levels existed in Lakes Michigan, Huron, and Erie, after 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 middle Great Lakes (Michigan, Huron, and Erie) each dropped by almost five feet. Water levels in Lakes Michigan and Huron remained below their long-term annual average until 2014, and have again risen above that long-term average since that time.

Case: August to September 2007 – Muskegon County Water Level Recession

Local reports described drought-related effects upon marine traffic in the Muskegon area. A super-freighter became stuck in the mouth of Muskegon Harbor and was reported as the second large ship to run aground within the space of a month, in the same location. Shipping officials stated that additional dredging was needed in Great Lakes ports because of low water levels.

Case: October 31, 2014 – Halloween Storm on Lake Michigan (Berrien County)

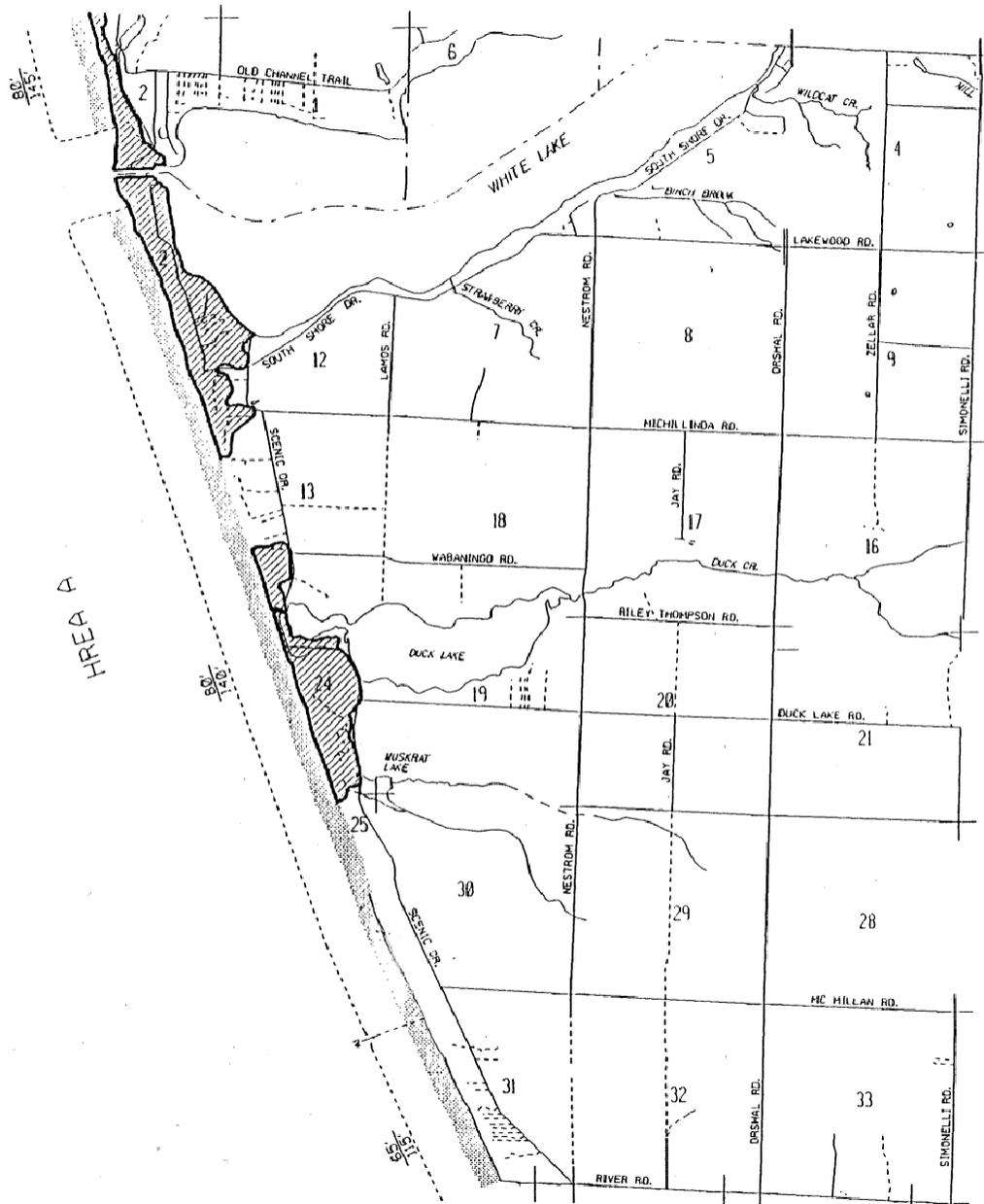
Severe weather caused enormous waves to appear in the Great Lakes. Lake Superior reported 7.9-foot waves, and a buoy at the southern end of Lake Huron recorded 15.4-foot waves, but it was Lake Michigan that reached an extreme level, with a buoy near Holland recording a wave that was 21.7 feet, the second-tallest ever recorded at that location. Wind speeds were around 60 mph at the time. Many of the reported impacts were felt in Indiana, just south of the Michigan border, but New Buffalo (Berrien County) saw a retaining wall destroyed, which exposed a home's foundation on the edge of the lake, and led to its demolition.

Shoreline Hazards in Muskegon County

Currently around 250 miles of shoreline are designated as high-risk erosion areas along the shorelines of Lakes Michigan, Superior and Huron. Township maps show the locations and setbacks for each of the areas.

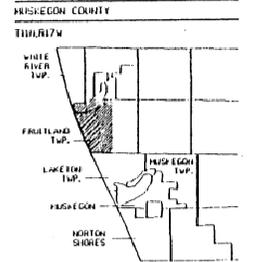
Local townships provided the property tax identification numbers at the time of the high risk erosion area designation. Due to parcel splits and combinations the property tax identification numbers may change yet the designation runs with the land so the resulting parcels are also designated and will require a permit for regulated structures. Within Muskegon County, Fruitland Township, Laketon Township, the City of Muskegon, City of Norton Shores, and White River Township are included as high-risk areas.

If, after using one of the sites to determine if your property is in a high risk erosion area, there are questions about whether the property is in a high risk erosion area please contact local EGLE staff. <https://www.michigan.gov/egle/about/organization/water-resources/shoreland-management/high-risk-erosion-areas/maps>



Fruitland Township

HIGH RISK EROSION AREAS & CRITICAL DUNE AREAS



HIGH RISK EROSION AREAS
 THE NUMBER REPRESENTS, IN FEET, THE 30 YEAR PROJECTED RECESSSION DISTANCE.
 100' THE NUMBER REPRESENTS, IN FEET, THE 60 YEAR PROJECTED RECESSSION DISTANCE.
 HIGH RISK EROSION AREA (including a longitudinal)

THESE AREAS ARE LEGALLY DEFINED BY THE SEVERANCE PROTECTION AND MANAGEMENT ACT, 1976 P.A. 245, AS APPLICABLE AS BEING GREAT LAKES SHORELAND AREAS DOCUMENTED TO RECEIVE AN AVERAGE OF ONE FOOT OR MORE PER YEAR.

- CRITICAL DUNE AREAS**
- BARRIER DUNES
BARRIER DUNE FORMATIONS DESIGNATED PURSUANT TO 1976 P.A. 222
 - AREAS NOT INCLUDED IN DESIGNATED BARRIER DUNE FORMATIONS THAT ARE COMPOSED PRIMARILY OF DUNE SAND AND EXHIBIT SEVERAL DUNE LIKE CHARACTERISTICS.
 - EROSION DUNE ASSOCIATED PLUME COMUNITIES OUTSIDE DESIGNATED DUNE FORMATIONS, MICHIGAN NATURAL FEATURES INVENTORY REFERENCE CODE INDICATED.

SOURCE
 STATE OF MICHIGAN ACT 245 RECESSSION RATE MAPS & ATLAS OF CRITICAL DUNE AREAS
INFORMATION
 MICHIGAN DEPARTMENT OF NATURAL RESOURCES
 BARE AND WATER MANAGEMENT DIVISION
 P.O. BOX 30020
 LANSING, MI 48203
 (517) 373 1518

GREAT LAKES INFORMATION SYSTEM
 MICHIGAN DEPARTMENT OF NATURAL RESOURCES
 LAND AND WATER MANAGEMENT DIVISION
 800-241-94
 distributed 08-19-93

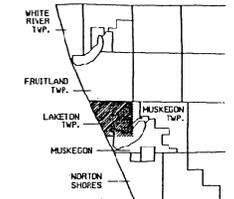


May 3, 2017

Fruitland Township references include 180 parcels at High Risk Erosion areas.

LAKETON TOWNSHIP
HIGH RISK EROSION AREAS & CRITICAL DUNE AREAS

MUSKEGON COUNTY
 T10K1R17M



HIGH RISK EROSION AREAS

THE NUMBER REPRESENTS, IN FEET, THE 30 YEAR PROJECTED RECESSED DISTANCE. THE NUMBER REPRESENTS, IN FEET, THE 60 YEAR PROJECTED RECESSED DISTANCE.

HIGH RISK EROSION AREA (shading alongshore)

THESE AREAS ARE LEGALLY DEFINED BY THE SHORELANDS PROTECTION AND MANAGEMENT ACT, 1978 P.A. 245, AS AMENDED, AS BEING GREAT LAKES SHORELAND AREAS DOCUMENTED TO RECEDE AN AVERAGE OF ONE FOOT OR MORE PER YEAR.

CRITICAL DUNE AREAS

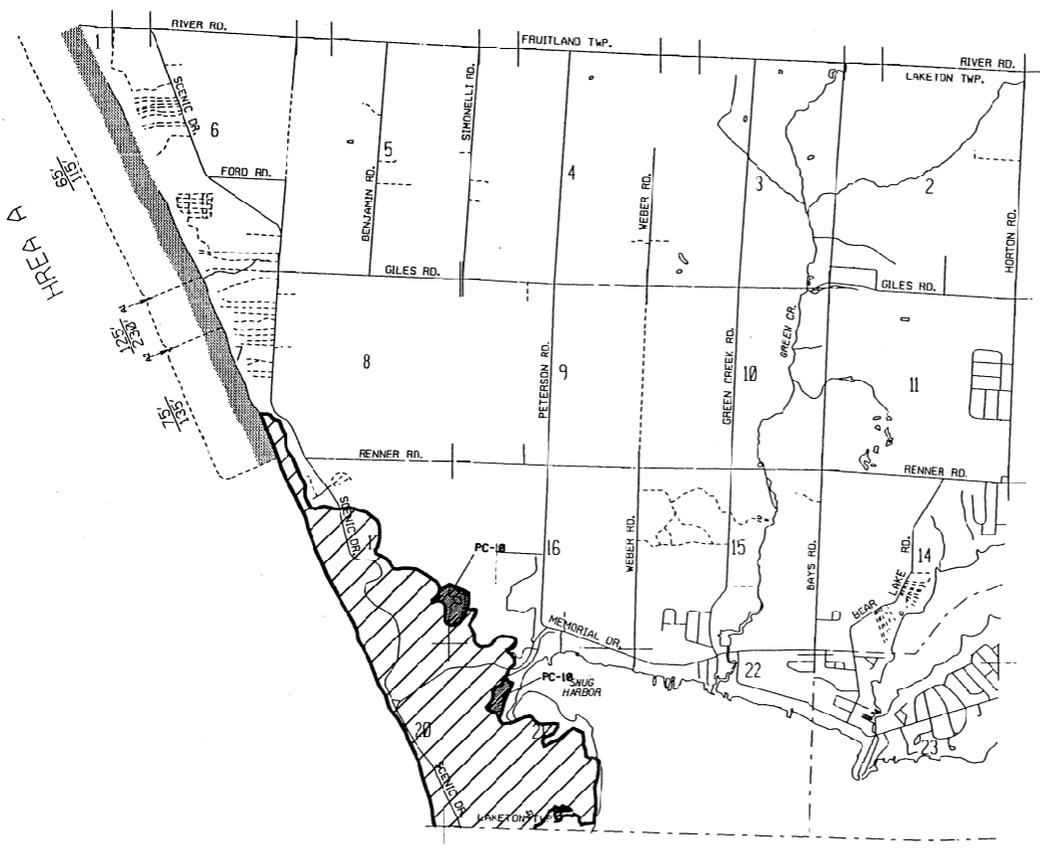
- BARRIER DUNES**
 BARRIER DUNE FORMATIONS DESIGNATED PURSUANT TO 1976 P.A. 222
- AREAS NOT INCLUDED**
 BARRIER DUNE FORMATIONS THAT ARE COMPOSED PRIMARILY OF DUNE SAND AND EXHIBIT SEVERAL DUNE-LIKE CHARACTERISTICS.
- EXEMPLARY DUNE**
 ASSOCIATED PLANT COMMUNITIES OUTSIDE DESIGNATED DUNE FORMATIONS, MICHIGAN NATURAL FEATURES INVENTORY REFERENCE CODE INDICATED.

SOURCE
 STATE OF MICHIGAN ACT 245 RELESSION RATE MAPS & ATLAS OF CRITICAL DUNE AREAS

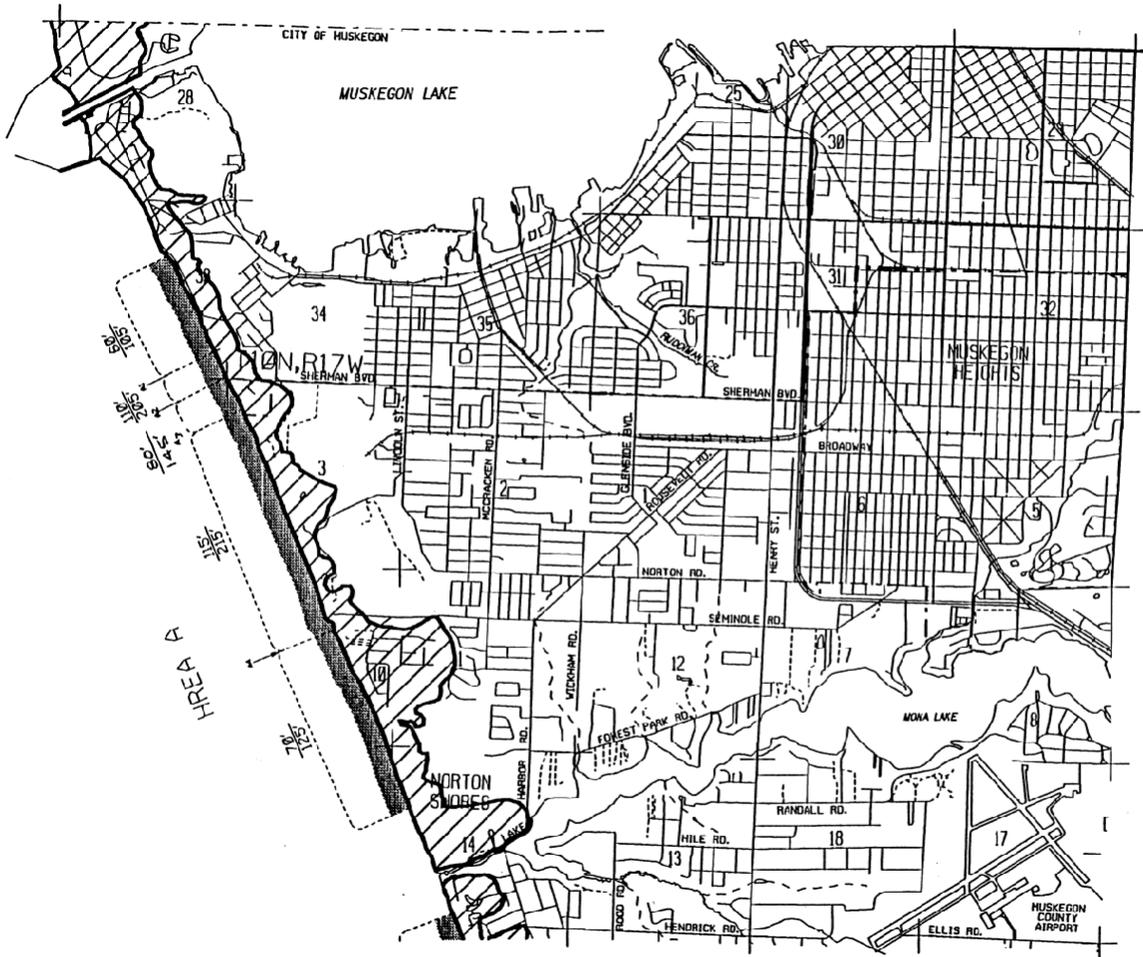
INFORMATION
 MICHIGAN DEPARTMENT OF NATURAL RESOURCES
 LAND AND WATER MANAGEMENT DIVISION
 P.O. BOX 30028
 LANSING, MI 48209
 (517) 373-1528



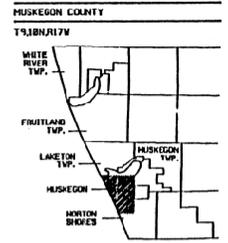
08-04-93
 amended 08-28-93



Laketon Township references include 99 parcels at High Risk Erosion areas.



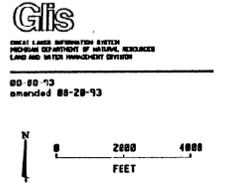
CITIES OF MUSKEGON AND NORTON SHORES
HIGH RISK EROSION AREAS & CRITICAL DUNE AREAS



HIGH RISK EROSION AREAS
 THE NUMBER REPRESENTS, IN FEET, THE 20 YEAR PROJECTED RECESION DISTANCE.
 THE NUMBER REPRESENTS, IN FEET, THE 60 YEAR PROJECTED RECESION DISTANCE.
 HIGH RISK EROSION AREA (shading alongshore)
 THESE AREAS ARE LEGALLY DEFINED BY THE SHORELANDS PROTECTION AND MANAGEMENT ACT, 1976 P.A. 246, AS AREAS, AS BEING GREAT LAKES SHORELAND AREAS DESIGNATED TO RECEDE AN AVERAGE OF ONE FOOT OR MORE PER YEAR.

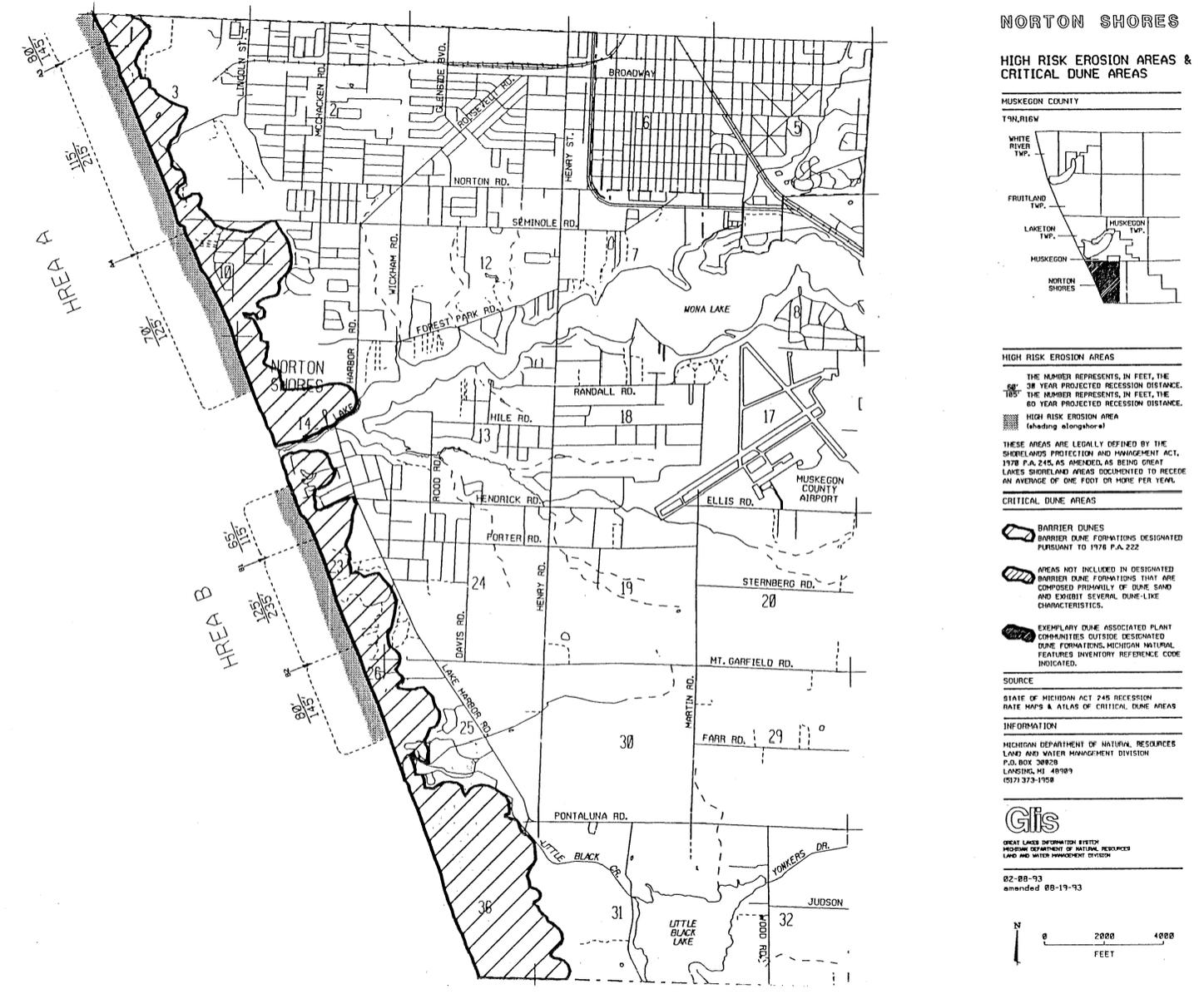
CRITICAL DUNE AREAS
 BARRIER DUNES
 BARRIER DUNE FORMATIONS DESIGNATED PURSUANT TO 1976 P.A. 222
 AREAS NOT INCLUDED IN DESIGNATED BARRIER DUNE FORMATIONS THAT ARE COMPOSED PRIMARILY OF DUNE SAND AND EXHIBIT TYPICAL DUNE-LIKE CHARACTERISTICS.
 EXCEPT ANY DUNE ASSOCIATED PLANT COMMUNITIES OUTSIDE DESIGNATED DUNE FORMATIONS. HIGHLY NATURAL FEATURES INVENTORY REFERENCE CODE INDICATED.

SOURCE
 STATE OF MICHIGAN ACT 246 RECESION RATE MAPS & ATLAS OF CRITICAL DUNE AREAS
INFORMATION
 MICHIGAN DEPARTMENT OF NATURAL RESOURCES
 LAND AND WATER MANAGEMENT DIVISION
 P.O. BOX 30828
 LANSING, MI 48909
 (313) 373-1708



May 3, 2017

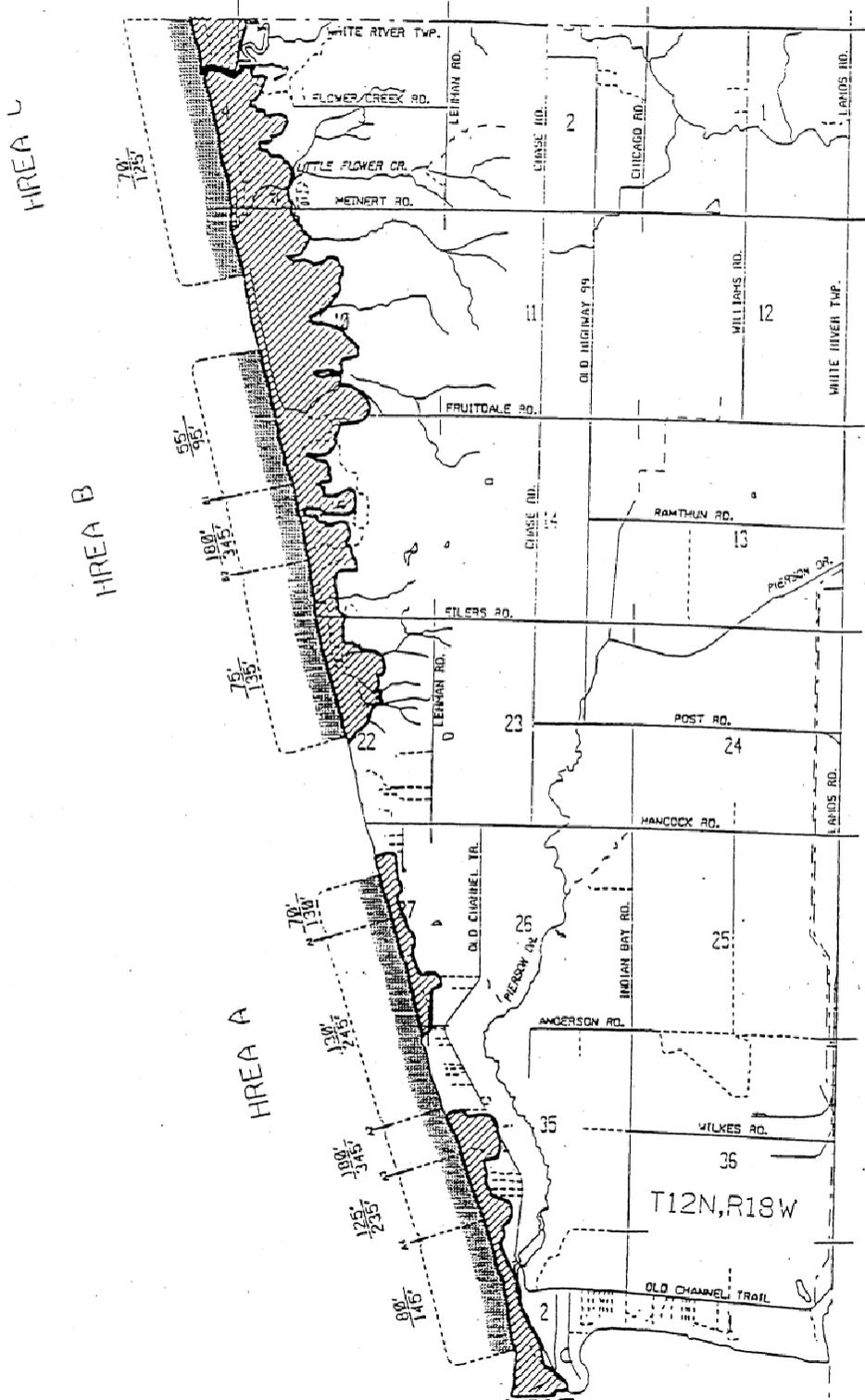
City of Muskegon references include 5 parcels at High Risk Erosion areas.



City of Muskegon references include 97 parcels at High Risk Erosion areas.

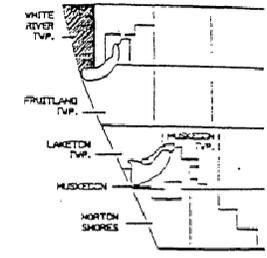
WHITE RIVER TOWNSHIP

HIGH RISK EROSION AREAS & CRITICAL DUENE AREAS



MUSKEGON COUNTY

T12N,R18W



HIGH RISK EROSION AREAS

THE NUMBER REPRESENTS, IN FEET, THE 20 YEAR PROJECTED RECESION DISTANCE. THE NUMBER REPRESENTS, IN FEET, THE 80 YEAR PROJECTED RECESION DISTANCE.

 HIGH RISK EROSION AREA
 CRITICAL DUENE AREA

THESE AREAS ARE LEGALLY DEFINED BY THE SHORELANDS PROTECTION AND MANAGEMENT ACT, 1978 P.A. 245 AS AMENDED AS BEING GREAT LAKES SHORELAND AREAS DOCUMENTED TO RECESS AN AVERAGE OF ONE FOOT OR MORE PER YEAR.

CRITICAL DUENE AREAS

 BARRIER DUENE
 BARRIER DUENE FORMATIONS DESIGNATED PURSUANT TO 1978 P.A. 222

 AREAS NOT INCLUDED IN DESIGNATED BARRIER DUENE FORMATIONS THAT ARE COMPOSED PRIMARILY OF DUNE SAND AND EXHIBIT SEVERAL DUNE-LIKE CHARACTERISTICS.

 DUNE PLANT DUENE ASSOCIATED PLANT COMMUNITIES OUTSIDE DESIGNATED DUENE FORMATIONS, INCLUDING NATURAL FEATURES INVENTORY REFERENCE CODE INDICATED.

SOURCE

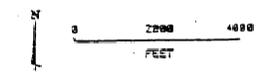
STATE OF MICHIGAN ACT 248 RECESION RATE MAPS & ATLAS OF CRITICAL DUENE AREAS INFORMATION

MICHIGAN DEPARTMENT OF NATURAL RESOURCES LAND AND WATER MANAGEMENT DIVISION
 P.O. BOX 30003
 LANSING, MI 48290
 (313) 373-1958



GREAT LAKES INFORMATION SYSTEM
 MICHIGAN DEPARTMENT OF NATURAL RESOURCES
 LAND AND WATER MANAGEMENT DIVISION

88-18-93
 amended 12-03-03



White River Township references include 151 parcels at High Risk Erosion areas.

Floodplain Mapping and the National Flood Insurance Program

The primary source of floodplain mapping information in Michigan is the Flood Insurance Rate Maps (FIRMs), which are developed by the Federal Emergency Management Agency ([FEMA](#)). As of September 2018, there were 20,302 active flood insurance policies in Michigan. This figure reveals a 20% decline since 2010, yet officials from FEMA and the MDEQ had already estimated that only 15% of all flood-prone structures in Michigan eligible to purchase flood insurance actually had flood insurance around that time. Furthermore, since only about half of all local communities in Michigan have chosen to participate in the NFIP, there are thousands of structures that are flood-prone, but are not eligible to purchase flood insurance through this program. (There were 881 participating communities as of September 17, 2018, although this does mark an increase from 867 communities at the end of 2010.) A [community status book](#) may be obtained from FEMA identifying the communities which have a floodplain map developed under the [National Flood Insurance Program](#).

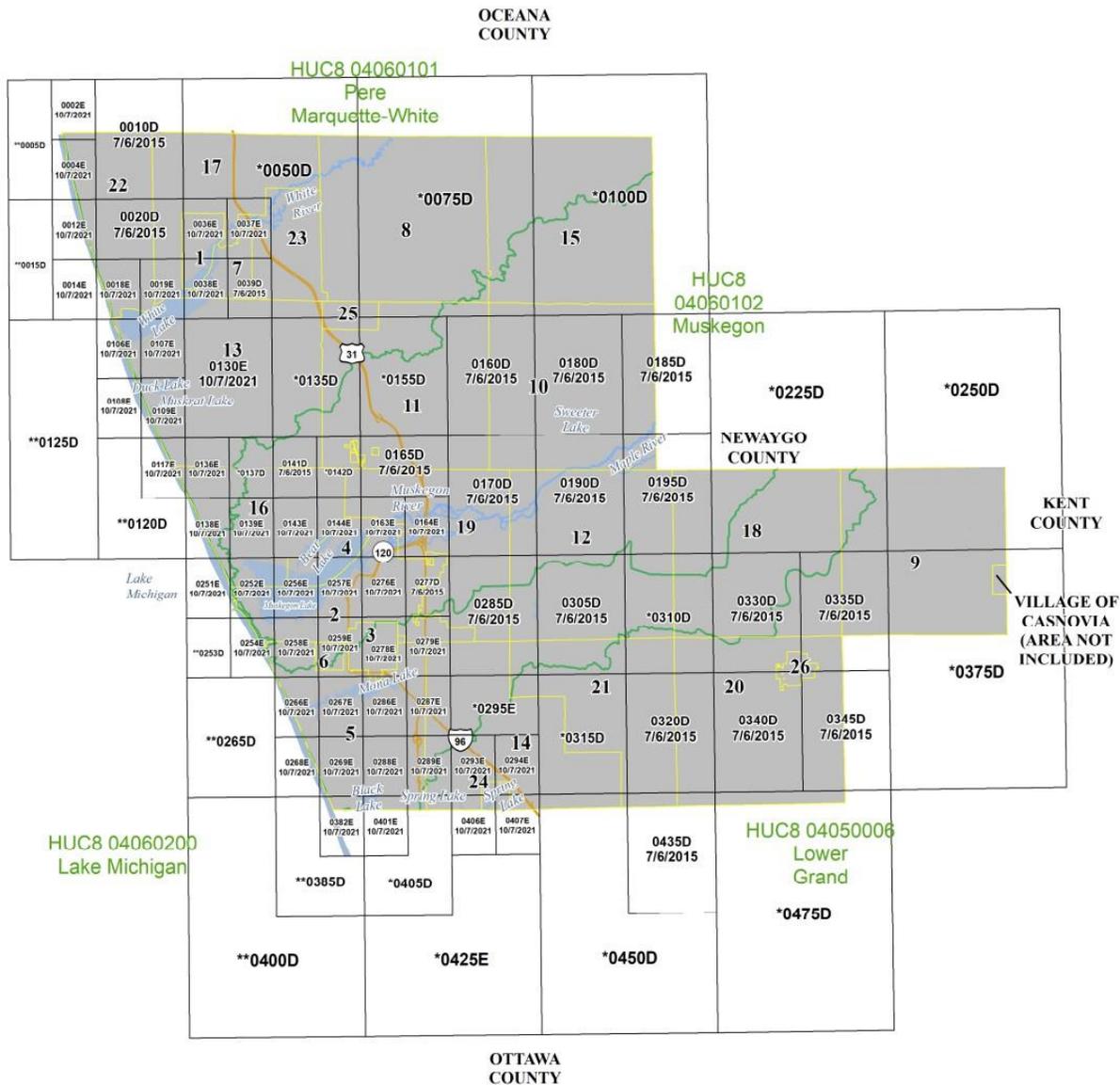
A majority of the following data comes from the 2021 FEMA report:

<https://map1.msc.fema.gov/data/26/S/PDF/26121CV000B.pdf?LOC=92a817c3bd5a7ce0458d3a3dadfc8042>

The following information for Muskegon County was provided by Mr. Matthew Occhipinti the NFIP Coordinator for the State of Michigan Department of Environment, Great Lake, and Energy on October 24, 2023. Information available at the time included CID, Community Name, Number of Variances, Number of Repetitive Losses, CAD Date, CAV Date, Number of BCX Claims, Total Population, LOMCS, Number of Policies, FIRM Date, and CRS Community. Information was also provided for the NFIP Insurance Report including CID, Community Name, total premium, V Zone, A Zone, number of policies, total coverage, total claims since 1978, and total paid since 1978. Data for Muskegon County from this information is listed below.

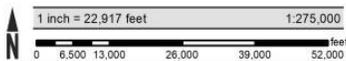
At the time this plan was written information on Severe Repetitive Loss was not provided by the State NFIP Coordinator as was unable to be obtained elsewhere. When communities adopt the National Flood Insurance Program they also accept the FIRM maps or FIRM map revisions. Dates listed for the initial FIRM date and FIRM revision is considered the adoption date of the local floodplain regulations.

Within the State of Michigan, regulation of the floodplain is managed by the Michigan Department of Environment, Great Lakes, and Energy Water Resources Division. Muskegon County is covered by the Water Resources Division Office out of Grand Rapids, Michigan. All implementation and enforcement of floodplain management regulations to regulate and permit development in the special flood hazard areas including permitting procedures is the responsibility of the EGLE Water resources division. This also includes management and regulation of substantial improvements / substantial damage provisions after an event. At times these decisions may be coordinated with the local zoning authority or drain commissioner, however, EGLE retains the legal authority under Public Act 451 Michigan Statutes and Rules of the Natural Resources and Environmental Protection Act of 1994 as amended. Part 31 Rule 13 addresses the Floodplains and Floodways management while Part 323 addresses Shorelines protection Management and part 353 addresses Sand Dunes Protection management.



| KEY NUMBER | COMMUNITY | CID | KEY NUMBER | COMMUNITY | CID | KEY NUMBER | COMMUNITY | CID |
|------------|--------------------------|--------|------------|-------------------------------|--------|------------|------------------------------|--------|
| 1 | City of Montague | 260160 | 10 | Township of Cedar Creek | 261198 | 19 | Charter Township of Muskegon | 260163 |
| 2 | City of Muskegon | 260161 | 11 | Township of Dalton | 261199 | 20 | Township of Ravenna | 260731 |
| 3 | City of Muskegon Heights | 260162 | 12 | Township of Egelston | 260680 | 21 | Township of Sullivan | 261207 |
| 4 | City of North Muskegon | 260164 | 13 | Township of Fruitland | 260265 | 22 | Township of White River | 260299 |
| 5 | City of Norton Shores | 260165 | 14 | Charter Township of Fruitport | 261200 | 23 | Township of Whitehall | 261208 |
| 6 | City of Roosevelt Park | 261206 | 15 | Township of Holton | 261203 | 24 | Village of Fruitport | 261201 |
| 7 | City of Whitehall | 260166 | 16 | Township of Laketon | 260159 | 25 | Village of Lakewood Club | 261204 |
| 8 | Township of Blue Lake | 261196 | 17 | Township of Montague | 261240 | 26 | Village of Ravenna | 260464 |
| 9 | Township of Casnovia | 261197 | 18 | Township of Moorland | 261205 | | | |

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before October 7, 2021.



Map Projection:
Universal Transverse Mercator Zone 16 N;
North American Datum 1983

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
[HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

MUSKEGON COUNTY, MICHIGAN (All Jurisdictions)

PANELS PRINTED:

0002, 0004, 0010, 0012, 0014, 0018, 0019, 0020, 0036, 0037, 0038, 0039, 0106, 0107, 0108, 0109, 0117, 0130, 0136, 0138, 0139, 0141, 0143, 0144, 0160, 0163, 0164, 0165, 0170, 0180, 0185, 0190, 0195, 0251, 0252, 0254, 0256, 0257, 0258, 0259, 0266, 0267, 0268, 0269, 0276, 0277, 0278, 0279, 0285, 0286, 0287, 0288, 0289, 0293, 0294, 0305, 0320, 0330, 0335, 0340, 0345, 0382, 0401, 0406, 0407, 0435



FEMA

MAP NUMBER
26121CIND0B
MAP REVISED
OCTOBER 7, 2021

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
** PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY

Muskegon County Communities Participating in the National Flood Program
(as of 11/20/2019)

| CID | Community Name | Initial Identif. | Initial FHBM Date | FHBM Revision | Initial FIRM Date | FIRM Revision |
|--------|--------------------------|------------------|-------------------|---------------|-------------------|--|
| 261196 | Blue Lake Township* | 07/06/2015 | | | 07/06/2015 | |
| 261197 | Casnovia Township* | 07/06/2015 | | | 07/06/2015 | |
| 261198 | Cedar Creek Township | 07/06/2015 | | | 07/06/2015 | |
| 261199 | Dalton Township* | 07/06/2015 | | | 07/06/2015 | |
| 260680 | Egelston Township | 08/19/1977 | 08/19/1977 | | 08/01/1986 | 07/06/2015 |
| 260265 | Fruitland Township | 06/28/1974 | 06/28/1974 | 06/25/1976 | 09/01/1986 | 07/07/2021 07/06/2015 |
| 261200 | Fruitport Charter Twp | 07/06/2015 | | | 07/06/2015 | 10/07/2021 |
| 261201 | Fruitport Village | 07/06/2015 | | | 07/06/2015 | 10/07/2021 |
| 261203 | Holton Township* | 07/06/2015 | | | 07/06/2015 | |
| 260159 | Laketon Township | 08/02/1974 | 08/02/1974 | 06/25/1976 | 04/03/1978 | 10/07/2021 07/06/2015 |
| 261204 | Lakewood Club Village* | 07/06/2015 | | | 07/06/2015 | |
| 260160 | City of Montague | 06/14/1974 | 06/14/1974 | 06/25/1976 | 05/01/1978 | 10/07/2021 07/06/2015 |
| 261240 | Montague Township | 07/06/2015 | | | 05/01/1978 | 10/07/2021 |
| 261205 | Mooreland Township | 07/06/2015 | | | 07/06/2015 | |
| 260163 | Muskegon Charter Twp | 09/06/1974 | 09/06/1974 | 07/02/1976 | 08/01/1977 | 10/07/2021 07/06/2015 02/15/1984 |
| 260161 | City of Muskegon | 06/07/1974 | 06/07/1974 | 06/25/1976 | 06/01/1977 | 10/07/2021 07/06/2015 |
| 260162 | City of Muskegon Heights | 06/28/1974 | 06/28/1974 | 07/23/1976 | 02/18/1981 | 10/07/2021 07/06/2015 |
| 260164 | City of North Muskegon | 05/31/1974 | 05/31/1974 | | 05/02/1977 | 10/07/2021 07/06/2015 |
| 260165 | City of Norton Shores | 09/15/1977 | | | 09/15/1977 | 10/07/2021 07/06/2015 11/18/1977 |
| 260731 | Ravenna Township | 05/17/1989 | | | 05/17/1989 | 07/06/2015 |
| 260464 | Village of Ravenna | 07/06/2015 | | | 07/06/2015 | |
| 261206 | City of Roosevelt Park* | 07/06/2015 | | | 07/06/2015 | 10/07/2021 |
| 261207 | Sullivan Township | 07/06/2015 | | | 07/06/2015 | |
| 260299 | White River Township | 10/08/1976 | 10/08/1976 | | 01/16/1981 | 10/07/2021 07/06/2015 11/04/1992 |
| 260166 | City of Whitehall | 08/23/1974 | 08/23/1974 | 03/05/1976 | 10/15/1980 | 10/07/2021 07/06/2015 |
| 261208 | Whitehall Township | 07/06/2015 | | | 07/06/2015 | 10/07/2021 |

*No Special Flood Hazard Areas Identified as of October 7, 2021

Muskegon County Listing of NFIP Jurisdictions

| Community | CID | HUC-8 Sub-Basin(s) | Located on FIRM Panel(s) | If Not Included, Location of Flood Hazard Data |
|--|--------|------------------------------|---|--|
| Blue Lake, Township of ¹ | 261196 | 04060101, 04060102 | 26121C0050D ² , 26121C0075D ² | |
| Casnovia, Township of ¹ | 261197 | 04050006, 04060101 | 26121C0225D ² , 26121C0250D ² , 26121C0335D, 26121C0375D ² | |
| Casnovia, Village of | 260965 | 04050006 | N/A | Kent County (All Jurisdictions) FIS Report |
| Cedar Creek, Township of | 261198 | 04060102 | 26121C0075D ² , 26121C0100D ² , 26121C0160D, 26121C0170D, 26121C0180D, 26121C0185D, 26121C0190D, 26121C0195D | |
| Dalton, Township of ¹ | 261199 | 04060101, 04060102 | 26121C0075D ² , 26121C0135D ² , 26121C0142D ² , 26121C0155D ² , 26121C0160D, 26121C0165D, 26121C0170D | |
| Egelston, Township of | 260680 | 04050006, 04060101, 04060102 | 26121C0170D, 26121C0190D, 26121C0195D, 26121C0285D, 26121C0305D, 26121C0310D ² | |
| Fruitland, Township of | 260265 | 04060101, 04060102, 04060200 | 26121C0018E, 26121C0019E, 26121C0038E, 26121C0039D, 26121C0050D ² , 26121C0106E, 26121C0107E, 26121C0108E, 26121C0109E, 26121C0117E, 26121C0130E, 26121C0135D ² , 26121C0136E, 26121C0137D ² , 26121C0141D, 26121C0142D ² | |
| Fruitport, Charter Township of | 261200 | 04050006, 04060101 | 26121C0279E, 26121C0285D, 26121C0287E, 26121C0289E, 26121C0293E, 26121C0294E, 26121C0295E ² , 26121C0315D ² , 26121C0405D ² , 26121C0406E, 26121C0407E, 26121C0450D ² | |
| Fruitport, Village of | 261201 | 04050006 | 26121C0293E, 26121C0294E, 26121C0406E, 26121C0407E | |
| Holton, Township of ¹ | 261203 | 04060101, 04060102 | 26121C0075D ² , 26121C0100D ² | |
| Laketon, Township of | 260159 | 04060101, 04060102, 04060200 | 26121C0117E, 26121C0136E, 26121C0137D ² , 26121C0138E, 26121C0139E, 26121C0141D, 26121C0142D ² , 26121C0143E, 26121C0144E, 26121C0251E, 26121C0252E, 26121C0256E | |
| Lakewood Club, Village of ¹ | 261204 | 04060101 | 26121C0050D ² , 26121C0075D ² , 26121C0135D ² , 26121C0155D ² | |
| Montague, City of | 260160 | 04060101 | 26121C0019E, 26121C0020D, 26121C0036E, 26121C0038E | |

| Community | CID | HUC-8 Sub-Basin(s) | Located on FIRM Panel(s) | If Not Included, Location of Flood Hazard Data |
|--------------------------------------|--------|--|---|--|
| Montague, Township of | 261240 | 04060101 | 26121C0010D, 26121C0019E, 26121C0020D, 26121C0036E, 26121C0037E, 26121C0038E, 26121C0050D ² | |
| Moorland, Township of | 261205 | 04050006, 04060101, 04060102 | 26121C0195D, 26121C0225D ² , 26121C0310D ² , 26121C0330D, 26121C0335D | |
| Muskegon, Charter Township of | 260163 | 04060101, 04060102 | 26121C0142D ² , 26121C0144E, 26121C0163E, 26121C0164E, 26121C0165D, 26121C0170D, 26121C0276E, 26121C0277D, 26121C0278E, 26121C0279E, 26121C0285D | |
| Muskegon, City of | 260161 | 04060101, 04060102, 04060200 | 26121C0142D ² , 26121C0144E, 26121C0163E, 26121C0164E, 26121C0165D, 26121C0251E, 26121C0252E, 26121C0254E, 26121C0256E, 26121C0257E, 26121C0258E, 26121C0259E, 26121C0276E, 26121C0277D, 26121C0278E, 26121C0279E, 26121C0285D | |
| Muskegon Heights, City of | 260162 | 04060101, 04060102 | 26121C0259E, 26121C0278E, 26121C0286E | |
| North Muskegon, City of | 260164 | 04060102 | 26121C0143E, 26121C0144E, 26121C0163E, 26121C0256E, 26121C0257E | |
| Norton Shores, City of | 260165 | 04050006, 04060101, 04060102, 04060200 | 26121C0254E, 26121C0258E, 26121C0259E, 26121C0266E, 26121C0267E, 26121C0268E, 26121C0269E, 26121C0278E, 26121C0279E, 26121C0286E, 26121C0287E, 26121C0288E, 26121C0289E, 26121C0382E, 26121C0401E, 26121C0405D ² | |
| Ravenna, Township of | 260731 | 04050006, 04060101 | 26121C0310D ² , 26121C0320D, 26121C0330D, 26121C0335D, 26121C0340D, 26121C0345D, 26121C0435D, 26121C0475D ² | |
| Ravenna, Village of | 260464 | 04050006 | 26121C0330D, 26121C0335D, 26121C0340D, 26121C0345D | |
| Roosevelt Park, City of ¹ | 261206 | 04060101, 04060102 | 26121C0258E, 26121C0259E | |
| Sullivan, Township of | 261207 | 04050006, 04060101 | 26121C0285D, 26121C0295E ² , 26121C0305D, 26121C0310D ² , 26121C0315D ² , 26121C0320D, 26121C0435D, 26121C0450D ² | |
| White River, Township of | 260299 | 04060101, 04060200 | 26121C0002E, 26121C0004E, 26121C0010D, 26121C0012E, 26121C0014E, 26121C0018E, 26121C0019E, 26121C0020D | |
| Whitehall, City of | 260166 | 04060101 | 26121C0036E, 26121C0037E, 26121C0038E, 26121C0039D | |

| Community | CID | HUC-8 Sub-Basin(s) | Located on FIRM Panel(s) | If Not Included, Location of Flood Hazard Data |
|------------------------|--------|--------------------|--|--|
| Whitehall, Township of | 261208 | 04060101 | 26121C0037E, 26121C0039D, 26121C0050D ² | |

¹ No Special Flood Hazard Areas Identified

² Panel Not Printed

| County | Total Coverage | Total Premium | Total Policies | Total A Zone | Total Claims Since 1978 | Total Paid since 1978 |
|----------|----------------|---------------|----------------|--------------|-------------------------|-----------------------|
| Muskegon | \$25,470,000 | \$65,184 | 103 | 39 | 138 | \$869,274 |

NFIP In Muskegon County, Michigan as of 10/20/2023

| Participating Communities | No. Policies | A-Zone | \$ Amount of Coverage | Number of Repetitive Losses | Total claims since 1978 | Total Paid since 1978 |
|---------------------------|--------------|--------|-----------------------|-----------------------------|-------------------------|-----------------------|
| Blue Lake Township* | | | | | | |
| Casnovia Township* | | | | | | |
| Cedar Creek Township | 2 | 2 | \$263,000 | 0 | 0 | \$0 |
| Dalton Township* | 1 | 0 | \$350,000 | 0 | 0 | \$0 |
| Egelston Township | 5 | 1 | \$1,056,000 | 0 | 7 | \$39,290 |
| Fruitland Township | 7 | | \$2,109,000 | 0 | 7 | \$19,257 |
| Fruitport Charter Twp | 2 | 1 | \$247,000 | 0 | 0 | \$0 |
| Fruitport Village | | | | | | |
| Holton Township* | | | | | | |
| Laketon Township | 5 | 3 | \$1,096,000 | 2 | 11 | \$79,170 |
| Lakewood Club Village* | | | | | | |
| City of Montague | 5 | 2 | \$1,712,000 | 0 | 8 | \$81,846 |
| Montague Township | | | | | | |
| Mooreland Township | | | | | | |
| Muskegon Charter Twp | 1 | 1 | \$500,000 | 0 | 4 | \$41,559 |
| City of Muskegon | 14 | 4 | \$3,308,000 | 6 | 38 | \$223,348 |
| City of Muskegon Heights | 3 | 1 | \$556,000 | | 3 | \$0 |
| City of North Muskegon | 31 | 7 | \$7,862,000 | 0 | 8 | \$118,231 |
| City of Norton Shores | 23 | 17 | \$4,501,000 | 5 | 36 | \$161,629 |
| Ravenna Township | 2 | 0 | \$560,000 | 0 | 1 | \$14,091 |
| Village of Ravenna | | | | | | |
| City of Roosevelt Park* | | | | | | |
| Sullivan Township | | | | | | |
| City of Whitehall | 1 | | \$1,000,000 | 0 | 3 | \$387 |
| White River Township | 1 | | \$350,000 | 0 | 12 | \$90,466 |

Sources:

- Policies and Coverage: <http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13>
- Repetitive Losses: Matt Occhipinti, NFIP Coordinator, Michigan EGLE - Water Resources Division

Since 1978, about \$88.4 million in claims have been paid due to flooding in Michigan. It should be remembered that officially claimed flood losses are only a small percentage of the total losses that are occurring from flood events. The flood insurance losses provide a good indication of where flooding problems currently exist, but they do not provide a good estimate of the total losses that are actually occurring.

The “Community Rating System” allows participating communities to earn discounts for their residents’ flood insurance premiums. The following communities (as of October, 2010) are all CRS participants that have earned discounts of between 5% and 25% on the policy premiums for their NFIP-insured properties:

CRS Class 5 (25% discounts earned): Midland City (Midland County)

CRS Class 6 (20% discounts earned): Ann Arbor City (Washtenaw County), Vassar City (Tuscola County)

CRS Class 7 (15% discounts earned): Dearborn Heights City (Wayne County), Novi City (Wayne County), Saginaw Township (Saginaw County), Shelby Township (Macomb County), Sterling Heights City (Macomb County)

CRS Class 8 (10% discounts earned): Brooks Township (Newaygo County), Detroit City (Wayne County), Gibraltar City (Wayne County), Grand Haven Township (Ottawa County), Hamburg Township (Livingston County), Luna Pier City (Monroe County), Portage City (Kalamazoo County), Rockwood City (Wayne County), Taymouth Township (Saginaw County), Zilwaukee City (Saginaw County)

CRS Class 9 (5% discounts earned on NFIP policy premiums): Bedford Township (Monroe County), Commerce Township (Oakland County), Fraser Township (Bay County), Plainfield Township (Kent County), Richfield Township (Genesee County), Saugatuck City (Allegan County), Taylor City (Wayne County)

In addition, the following communities are in Class 10, and do not currently receive any discount:

CRS Class 10 (Rescinded) City of Farmington Hills (Oakland County), Park Township (Ottawa County), Sumpter Township (Wayne County)

DROUGHT AND EXTREME TEMPERATURES (HEAT)

Drought

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

Drought Hazard Description

Drought originates in a natural reduction in the amount of water available over an extended period of time, usually a season or more in length. Drought is a normal part of an area's climate, including areas with high and low average rainfall. A drought involves a level of precipitation or runoff that is substantially below an area's norms. In low rainfall areas, drought differs from normal arid conditions in that the extent of aridity exceeds even that which is usual 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 refer to and makes it difficult to assess when and where one is likely to occur.

Drought differs from other natural hazards in several ways. First, in the lack of an exact beginning and endpoint for a drought, whose effects may accumulate slowly and linger even after the event is generally thought of as being over. Second, the lack of a clear-cut definition of drought can make it difficult to confirm whether one actually exists, and if it does, its degree of severity. Third, drought impacts are often less obvious than other natural hazards, and they are typically spread over a much larger geographic area. Fourth, due primarily to the aforementioned reasons, most communities do not have in place any contingency plans for addressing drought. This lack of pre-planning can hinder support for drought mitigation capabilities that would otherwise effectively increase awareness and reduce drought impacts.

Drought may also be associated with extreme heat lasting for more than one week. Extreme heat in Michigan occurs during the warm months from May to September, and is marked by temperatures above 90°F. This can cause loss of life among vulnerable populations, damage to infrastructure, disruptions to schools and businesses, and contribute to drought conditions. Extreme heat can occur independent of drought and a drought can occur without extreme heat.

Drought Hazard Analysis

Droughts can cause many severe impacts on communities and regions, including: 1) water shortages for human consumption, industrial, business and agricultural uses, power generation, recreation and navigation; 2) a drop in the 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) declines in tourism in areas with water-related attractions and amenities; 7) declines 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 different 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 time scales. A **hydrologic** drought involves the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels. 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 (<http://www.drought.unl.edu/dm/monitor.html>) uses four classifications of severity, from the least intense category (D1) to the most intense (D4), with an additional (D0) category 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 areas and labeling their intensity. While not the only way to characterize droughts, the U.S. Drought Monitor is convenient and their classification levels have recently been used in various reports and assessments of drought conditions. Short-term indicators are on the level of 1-3 months, while long-term indicators focus on a duration of 6 to 60 months.

Palmer 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: U.S. Drought Monitor web site <http://drought.unl.edu/dm/classify.htm>

In addition, the U.S. Drought Monitor uses two general drought categories in assessing an event—an A to denote agricultural effects on crops, pastures, and grasslands, and an H to denote hydrologic effects on water supplies such as rivers, groundwater, and reservoirs.

Drought in Michigan

Despite the thousands of miles of rivers and streams in the state, Michigan has experienced occasional drought conditions. Most common are agricultural droughts, with severe soil-moisture deficits, which have had serious consequences for crop production, particularly when coupled with extreme summer temperatures. Also, various water bodies, both inland lakes and the Great Lakes themselves, cyclically go through periods of low-water levels. Michigan has emerged from its latest such period and is now experiencing high water levels. (See the section on Flooding Hazards for more information about these trends in water levels.)

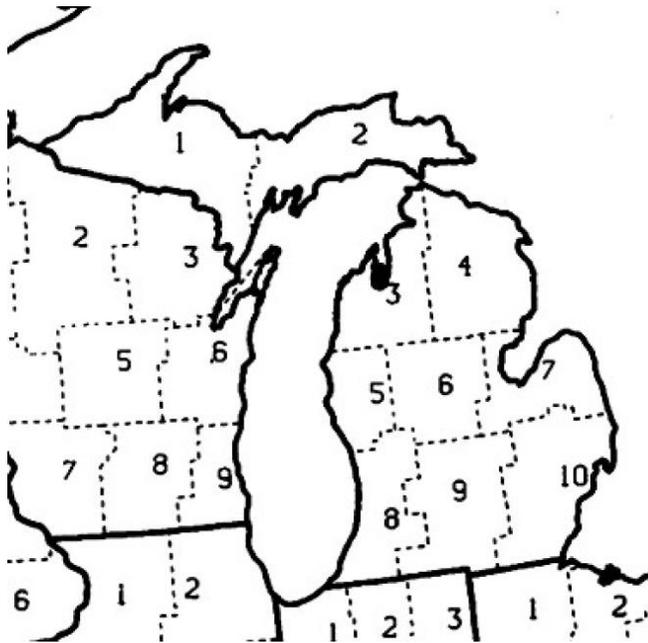
Drought can be a “low-profile” hazard that does not get a lot of public attention in Michigan, compared with other parts of the United States. Nevertheless, parts of Michigan have tended to experience significant drought conditions about 20% of the time on average (depending upon how it is measured). Even if the occurrence of drought appears at first to be of lesser concern for a community, it is important to include a consideration of the drought hazard in local hazard mitigation planning, since plans are an excellent way to deal with gradual or longer-term hazards such as drought.

When a drought takes place, there are many impacts that can result from the extended dry period. These impacts can be classified as economic, social, and environmental. Of great significance is the economic loss of crop production through lower yields, poorer crop quality, and reduced productivity of the land. (Michigan’s fruit production is especially vulnerable to lesser yields, as was seen in a 2001 drought event that caused the destruction of one-third of the state’s fruit and vegetable crop.) Timber production is also reduced, through exacerbated risks from forest fires and tree diseases, and fisheries have lesser amounts of fish as water quality tends to degrade. Lessened production in the agricultural sector leads to income losses for farmers and industries dependent on agricultural products. Lower hydrologic levels lead to water shortages for municipalities and potential production limits or shutdowns in industries and businesses that depend on large volumes of water. Tourism becomes hampered by lower lake and river depths, due to the recreational difficulties and inconveniences that are caused. Severe and prolonged droughts could have catastrophic effects on the economy, in cases when adverse conditions lead to disruptions in the regional and national economy and when widespread economic losses affect the supply and distribution of goods and services.

In 2007, all 83 counties received drought disaster declarations from the U.S. Department of Agriculture due to crop losses from drought. In the Muskegon harbor, two freighters became stuck, with low water levels increasing the need for dredging activities and causing ships to unintentionally run aground on the sandy harbor bottom. These events occurred in August and September of 2007, at the same time that drought conditions were present in Michigan. At the beginning of August, three counties (Allegan, Kalamazoo, and Van Buren) were judged to be at D2 (severe drought) status. Twelve other counties in

Southwest Michigan were evaluated as having D1 (moderate drought) conditions. Several others were considered to have abnormally dry (D0) status. Wildfire dangers were similarly escalated, due to these dry conditions, with fire danger levels in Southern Michigan ranging from “high” to “extreme.” (Usually fire dangers become less significant after a spring “green up,” but this year was an exception due to the drought effects.) Water flows in various rivers and creeks were far below normal—in many cases only about 60% of their usual rates. In addition to various Red Flag Warnings, by mid-August the Michigan Department of Natural Resources released a proclamation prohibiting the use of fire on or adjacent to forest lands for 75 counties in Michigan. In late August, drought conditions worsened, with 23 Northern Michigan counties at moderate (D1) drought status and two (Chippewa and Mackinac) at severe (D2) drought status. Although some rainfall in early September allowed the fire restriction proclamation to be rescinded in 23 southern Michigan counties, it remained in effect for 52 of the more northern counties. By late September, drought conditions had been alleviated somewhat by additional rainfall, except for the Upper Peninsula, which still had severe drought (D2) status in seven of its western counties, and moderate (D1) drought status for 5 of its eastern counties. (Source: Law Enforcement Information Network messages)

Information from the National Centers for Environmental Information (NCEI) is available for the current tracking and historical research of drought events in Michigan, but since dry conditions in one region may be balanced (in a statewide average) by wet conditions in another region, it is appropriate to look



at specific regions rather than the state as a whole, to assess the presence and severity of drought conditions from the historical data. For this plan, 124 years of data was analyzed (from 1895 to 2018) for each of the 10 climate divisions illustrated in the map. To assist with local planning efforts, the counties contained within these 10 climate divisions are hereby listed, and although historical data can at this time only be provided for the divisions as a whole, a summary of the most severe events from NCEI records have been included for each of the ten Climate Divisions. Following this is an overarching description of incidents and trends shown in historical drought records for Michigan.

The following are significant droughts affecting Michigan:

Division 1: Baraga, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Marquette, Menominee, and Ontonagon Counties. The most extreme drought was in January 1977, when the Palmer Drought Severity Index (PDSI) hit a record low of -7.33 (the all-time record for Michigan). Lengthy drought

incidents (at least 8 months long) took place in 1895-1896 (10 months), 1908-1909 (10 months), 1910-1911 (16 months), 1921-1922 (8 months), 1925-1926 (11 months), 1930-1931 (12 months), 1933-1934 (9 months), 1948-1949 (12 months), 1963-1964 (9 months), 1976-1977 (8 months), 1986-1987 (12 months), 1989-1990 (13 months), 1998 (9 months), 2006-2008 (22 months), 2008-2009 (12 months), 2011-2012 (12 months).

Division 2: Alger, Chippewa, Delta, Luce, Mackinac, and Schoolcraft Counties. The most extreme drought was in October 1948, when the Palmer index hit a record low of -5.65. Lengthy drought incidents took place in 1895-1896 (12 months), 1909-1911 (24 months), 1914-1915 (8 months), 1925-1926 (13 months), 1930-1931 (13 months), 1933-1934 (8 months), 1947-1948 (13 months), 1955-1956 (11 months), 1962-1964 (17 months), 1989-1990 (8 months), 1997-1999 (20 months), 2005-2007 (23 months).

Division 3: Antrim, Benzie, Charlevoix, Emmet, Grand Traverse, Kalkaska, Leelanau, Manistee, Missaukee, and Wexford Counties. The most extreme drought was in February 1931, when the Palmer index hit a record low of -6.52. Lengthy drought incidents took place in 1895-1896 (15 months), 1910-1911 (8 months), 1913-1914 (11 months), 1914-1915 (8 months), 1921-1922 (8 months), 1925-1926 (9 months), 1930-1931 (13 months), 1935-1936 (20 months), 1955-1956 (9 months), 1963-1964 (10 months), 1976-1977 (11 months), and 1998-1999 (11 months).

Division 4: Alcona, Alpena, Cheboygan, Crawford, Iosco, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle, and Roscommon Counties. The most extreme drought was in February 1931, when the Palmer index hit a record low of -6.13. Lengthy drought incidents took place in 1895-1896 (15 months), 1908-1911 (37 months), 1913-1915 (21 months), 1925-1926 (10 months), 1930-1931 (12 months), 1948-1949 (17 months), 1955-1956 (12 months), 1963-1964 (8 months), 1976-1977 (11 months), 1989-1990 (8 months), 1998-1999 (11 months), and 1999-2001 (21 months).

Division 5: Lake, Mason, Muskegon, Newaygo, and Oceana Counties. The most extreme drought was in February 1931, when the Palmer drought severity index hit a record low of -6.06. Lengthy drought incidents took place in 1895-1896 (15 months), 1901-1902 (11 months), 1910-1911 (14 months), 1921-1922 (9 months), 1925-1926 (13 months), 1930-1931 (13 months), 1934 (9 months), 1956-1957 (8 months), 1963-1964 (19 months), 1971-1972 (11 months), 1976-1977 (10 months), and 2002-2003 (12 months).

Division 6: Clare, Gladwin, Gratiot, Isabella, Mecosta, Midland, Montcalm, and Osceola Counties. The most extreme drought was in February 1931, when the Palmer index hit a record low of -6.22. Lengthy drought incidents took place in 1895-1896 (15 months), 1910-1911 (18 months), 1930-1931 (14 months), 1934-1935 (9 months), 1936-1937 (13 months), 1963-1964 (15 months), and 1976-1977 (9 months).

Division 7: Arenac, Bay, Huron, Saginaw, Sanilac, and Tuscola Counties. The most extreme drought was in April 1931, when the Palmer index hit a record low of -6.25. Lengthy drought incidents took place in 1930-1931 (17 months), 1934-1935 (16 months), 1936-1937 (11 months), 1963-1965 (18 months), 1976-1977 (8 months), and 1998-1999 (12 months).

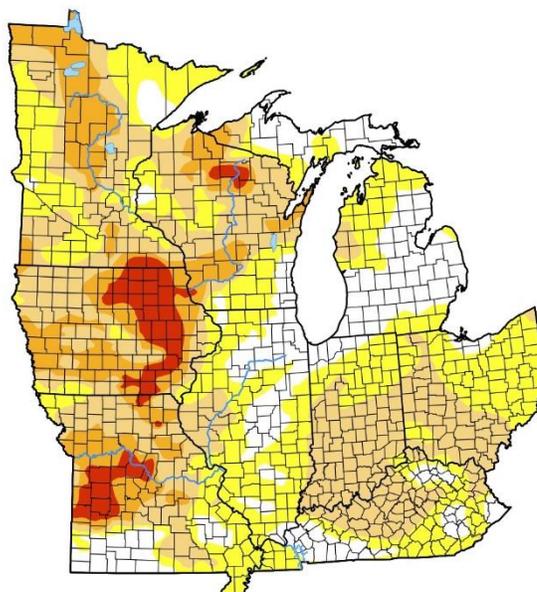
Division 8: Allegan, Berrien, Cass, Kalamazoo, Kent, Ottawa, and Van Buren Counties. The most extreme drought was in February 1931, when the Palmer index hit a record low of -6.45. Lengthy drought incidents took place in 1901-1902 (8 months), 1913-1914 (9 months), 1920-1921 (8 months), 1930-1932 (27 months), 1962-1965 (30 months), 1999-2000 (9 months), and 2005 (8 months).

Agricultural Disaster Declarations Involving Drought 2012-2018

| Number | Declared | Description | Counties | In Area 1 | In Area 2 | In Area 3 | In Area 4 |
|---|------------|--|----------|-----------|-----------|-----------|-----------|
| S3275 | 7-12-2012 | Drought | 5 | 0 | 0 | 5 | 0 |
| S3303 | 7-25-2012 | Drought | 10 | 0 | 0 | 10 | 0 |
| S3332 | 8-8-2012 | Drought | 1 | 0 | 0 | 1 | 0 |
| S3344 | 8-15-2012 | Drought | 2 | 0 | 0 | 2 | 0 |
| S3370 | 8-29-2012 | Drought and heat | 83 | 15 | 29 | 34 | 5 |
| S3380 | 9-5-2012 | Heat, frost, freeze, and drought | 5 | 0 | 0 | 5 | 0 |
| S3384 | | Drought and heat | 3 | 0 | 0 | 3 | 0 |
| S3623 | 1-23-2014 | Drought and colder-than-normal temperatures | 5 | 0 | 5 | 0 | 0 |
| S3636 | | Rain, drought, and cooler-than-normal temperatures | 25 | 0 | 22 | 3 | 0 |
| S3807 | 3-25-2015 | Rain, drought, and colder-than-normal temperatures | 19 | 0 | 19 | 0 | 0 |
| S3936 | 11-25-2015 | Drought, rain, hail, and high winds | 24 | 5 | 19 | 0 | 0 |
| S4132 | 1-9-2017 | Drought | 51 | 5 | 25 | 16 | 5 |
| 12 TOTAL EVENTS Declared by the U.S. Secretary of Agriculture: | | | | 3 | 6 | 10 | 2 |

Midwest

[Home](#) / [Midwest](#)



Map released: Thurs. October 19, 2023

Data valid: October 17, 2023 at 8 a.m. EDT

Intensity

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data

Authors

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The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying [text summary](#) for forecast statements.

According to the US Geological Survey mild droughts are common in Michigan, but severe droughts are infrequent and generally of short duration. The even distribution of precipitation and moderate humidity are helpful in meeting the large demand for moisture by crops. Although rainfall is abundant during the summer, runoff is decreased because of increased evapotranspiration and absorptive capacity of soils. A majority of the severe droughts occurred in the late 1800s and early 1900s. These droughts were prolonged and statewide. In the summer of 1871, there was a prolonged drought over much of the Great Lakes Regions, and again in May through September of 1891 which devastated Michigan's Lumber industry. The most severe drought on record was during the 1930's. The recurrence interval of the 1930-37 drought was 50-70 years, depending upon locality.

More recent droughts and heat waves have caused considerable damage to agriculture and related industries in several areas of the United States. In rural agricultural areas and the heavily forested areas drought brings on a host of other problems to address. Agricultural areas are highly vulnerable to drought conditions that impact the quantity or quality of crops, livestock, and other agricultural activities. These areas often depend heavily on agricultural production for their economic needs. A prolonged drought can seriously impact local and regional income, which in turn has a rippling effect on the other components of the economy. Drought can also cause long-term problems that can negatively affect the very viability of some agricultural operations.

Drought in Muskegon County

Muskegon 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.

A review of historic drought events reveals that Muskegon 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 Muskegon 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 the risk of wildfire, and also affect the drinking water supply.

According to NCDC records, Muskegon 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.

Extreme Temperatures, Heat

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

Extreme Heat Hazard Description

Prolonged periods of extreme temperatures, whether extreme summer heat or extreme winter cold, can pose severe and life-threatening problems for Michigan's citizens. Although they differ in their initiating conditions, the two hazards share a commonality in that they both tend to have a special impact on the most vulnerable segments of the population—the elderly, young children and infants, impoverished individuals, and persons who are in poor health. Due to their different characteristics, extreme summer heat and extreme winter cold hazards will mostly be discussed separately in this section. For both types of temperature extremes, however, a longer hot or cold spell makes the temperature effects much more severe on vulnerable populations—a longer duration tends to produce more severe effects.

Extreme Heat Hazard Analysis

Extreme Summer Heat is characterized by a combination of very high temperatures and humid conditions. When persisting over a long period of time, this phenomenon is commonly called a heat wave. The major threats of extreme summer heat are heat exhaustion and heatstroke (a major medical emergency). Heat exhaustion is a less severe condition than heatstroke, but it causes problems involving dizziness, weakness and fatigue. Heat exhaustion is often the result of fluid imbalance due to increased perspiration in response to the intense heat. Treatment generally consists of restoring fluids and staying indoors in a cooler environment until the body returns to normal. If heat exhaustion is not addressed and treated, it can advance to heatstroke, so medical attention should be sought immediately. Heatstroke symptoms include a high body temperature (it can be 106 degrees or higher), dry skin, inadequate perspiration, paleness or reddening, confusion or irritability, and seizures. The victim may become delirious, stuporous, unconscious, or even comatose. Cooling is essential to preventing permanent neurological damage or death.

Other, less serious risks associated with extreme summer heat are often exercise-related and include heat cramps (an imbalance of fluids that occurs when people unaccustomed to heat exercise outdoors) and heat syncope (a loss of consciousness by persons not acclimated to hot weather). Periods of hot weather also entail risks of dehydration, even for those who are not engaged in demanding physical activities. Non-caffeinated fluids should be consumed to maintain adequate hydration.

A useful set of general principles to recognize is that evaporation is a cooling mechanism for our bodies. Evaporation of moisture (i.e. perspiration) doesn't occur as rapidly when the surrounding air already has a relatively high moisture content (humidity). Thus, humidity inhibits evaporation and produces a feeling of greater heat, while winds assist the evaporation of perspiration from skin and thus tend to produce a feeling of greater coolness. It can therefore be difficult for the body to precisely gauge actual outdoor temperatures—it rather senses the potential for heat gain or loss. A period of extreme heat is more debilitating when the air humidity is high, and a period of extreme cold is similarly more dangerous

when coupled with strong winds. For these reasons, temperature alone is usually only a limited indicator of the weather’s likely threat to human health, and additional factors should also be considered. The additional factors of humidity and wind speed have provided the basis for two additional means of describing the extent of extreme temperatures’ impact—the Heat Index (HI) and the Wind Chill Temperature Index (WCT).

The following tables indicate the way that temperature, humidity, and wind speed probably feels to the human body, and suggest the types of temperature effects relevant to Michigan’s climate. Although some of the resulting heat numbers may at first seem outrageous to describe Michigan temperatures, some of the extremes are actually comparable to what is felt in a sauna, which is often set at more than 140 degrees. Like saunas, such heat should not be felt by the body for more than brief periods of time, and since one of the body’s cooling reactions is to increase the rate of blood circulation, this also adds to the burden placed on the heart muscle, and can be too much strain for some persons to bear.

NOAA's National Weather Service

Heat Index

Temperature (°F)

| | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 |
|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 40 | 80 | 81 | 83 | 85 | 88 | 91 | 94 | 97 | 101 | 105 | 109 | 114 | 119 | 124 | 130 | 136 |
| 45 | 80 | 82 | 84 | 87 | 89 | 93 | 96 | 100 | 104 | 109 | 114 | 119 | 124 | 130 | 137 | |
| 50 | 81 | 83 | 85 | 88 | 91 | 95 | 99 | 103 | 108 | 113 | 118 | 124 | 131 | 137 | | |
| 55 | 81 | 84 | 86 | 89 | 93 | 97 | 101 | 106 | 112 | 117 | 124 | 130 | 137 | | | |
| 60 | 82 | 84 | 88 | 91 | 95 | 100 | 105 | 110 | 116 | 123 | 129 | 137 | | | | |
| 65 | 82 | 85 | 89 | 93 | 98 | 103 | 108 | 114 | 121 | 128 | 136 | | | | | |
| 70 | 83 | 86 | 90 | 95 | 100 | 105 | 112 | 119 | 126 | 134 | | | | | | |
| 75 | 84 | 88 | 92 | 97 | 103 | 109 | 116 | 124 | 132 | | | | | | | |
| 80 | 84 | 89 | 94 | 100 | 106 | 113 | 121 | 129 | | | | | | | | |
| 85 | 85 | 90 | 96 | 102 | 110 | 117 | 126 | 135 | | | | | | | | |
| 90 | 86 | 91 | 98 | 105 | 113 | 122 | 131 | | | | | | | | | |
| 95 | 86 | 93 | 100 | 108 | 117 | 127 | | | | | | | | | | |
| 100 | 87 | 95 | 103 | 112 | 121 | 132 | | | | | | | | | | |

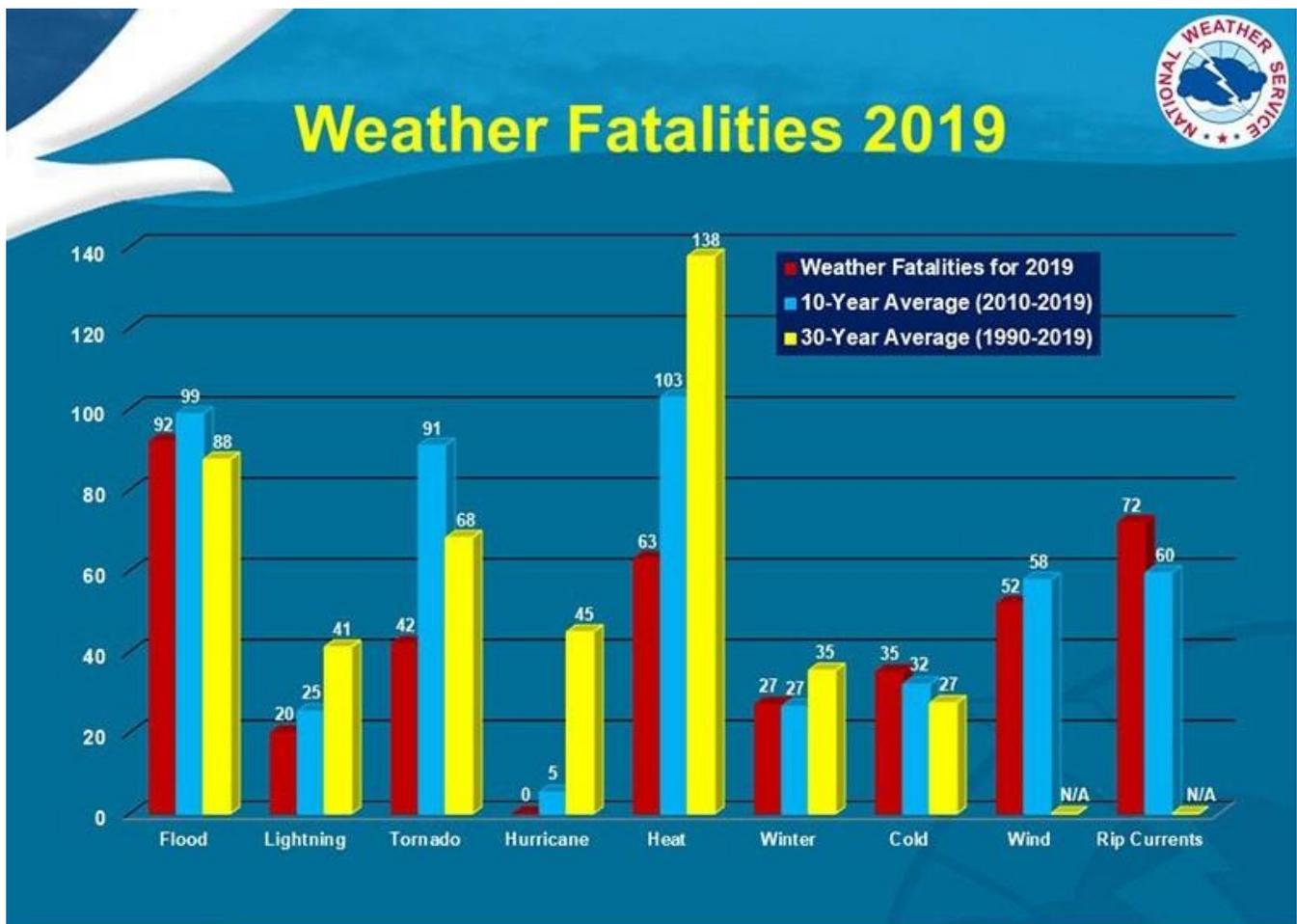
Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

- Caution
- Extreme Caution
- Danger
- Extreme Danger

Extreme Temperatures, Heat in Michigan

In Michigan, heat advisories will tend to be announced when the heat index is calculated to exceed 105 degrees in an area for a period of at least 3 hours in duration. It should be noted, however, that the temperature inside of vehicles without air conditioning can be dozens of degrees hotter than the outdoor temperature—an outdoor temperature might be “only” 100 degrees Fahrenheit, but people may then get into a car that exceeds 130 degrees. People vary in the conditions in which they operate (and in their capacity to tolerate extreme temperatures), and can find themselves in circumstances that threaten their health even if no official temperature advisory has been issued.

Heat waves tend to have stagnant atmospheric conditions that trap pollutants in urban areas and thus compound the health effects faced by urban residents. Because the combined effects of high temperatures, high humidity, and trapped pollution are focused more intensely in urban centers, heatstroke and heat exhaustion are a greater problem in sizeable cities than in suburban or rural areas. Nationwide, approximately 136 deaths per year are attributed to extreme heat (a total of 2,225 from 2000 through 2018, according to (<http://www.nws.noaa.gov/om/hazstats/images/70-years.pdf>)). Of these deaths, 8 occurred in Michigan.

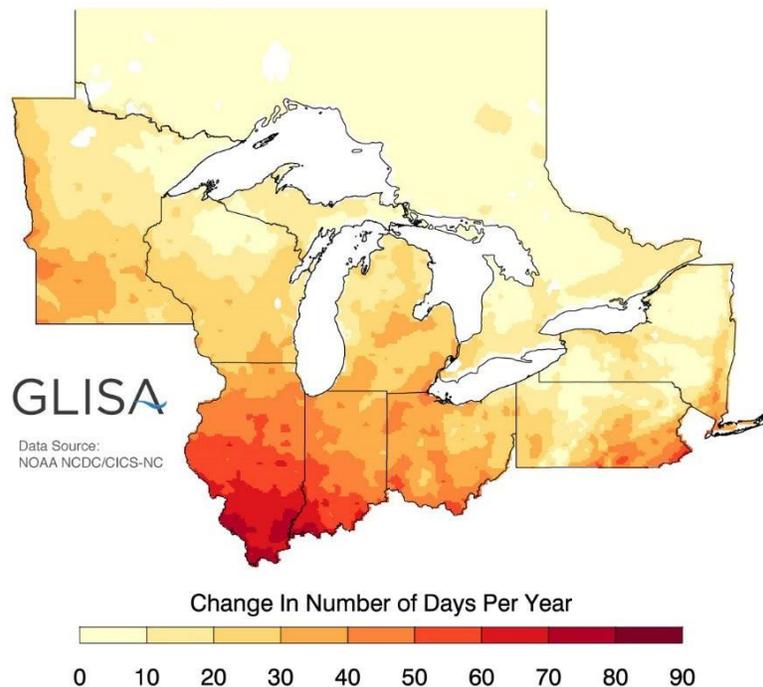


Extreme summer heat is also hazardous to livestock and agricultural crops, and it can cause water shortages, exacerbate fire hazards, and prompt excessive demands for energy. Roads, bridges, railroad tracks and other infrastructure are susceptible to damage from extreme heat (due to the effects of thermal expansion of materials). Scorching weather also puts a strain on the energy demands for an area, as the use of air conditioning increases greatly. Possible shutdowns of schools, colleges, and industries can occur during these times.

The 2014 National Climate Assessment reports in the next few decades the Midwest can expect to see an increasing scope, frequency, and intensity of weather related disasters. This includes more weather extremes such as temperature (heat and cold), heavy downpours, and flooding that will affect infrastructure, health, agriculture, forestry, transportation, air and water quality, and more. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure.

Within Michigan, the frequency and intensity of heat waves are projected to increase by mid-century. Temperatures above 95°F are associated with negative human health impacts and suppressed agricultural yields. These conditions also increase humidity, degrade air quality, and reduce water quality which will increase public health risks.

Projected Change in Number of Days Over 90°F Period: 2041-2070 | Higher Emissions: A2



The following are notable extreme heat events which have occurred in Michigan

Case: July 1936

During the second week of July 1936, a terrible heat wave struck Michigan, and particularly Detroit, with temperatures exceeding 100 degrees for up to seven days in a row (this varied by location—for example, Detroit had 7, West Branch and Alpena had 6, and Traverse City had 5). The temperature peaked at 112 degrees in Mio, setting a state record that still stands today. The extreme heat was an “equal opportunity” killer, causing many healthy adults to succumb to the heat at work or in the streets. Also, because most people relied on iceboxes to keep their food fresh, many heat-related deaths and illnesses occurred when the ice melted, causing the food to spoil. Statewide, 570 people died from heat-related causes, including 364 in Detroit. Nationally, the heat wave caused 5,000 deaths. Notice that these casualties disproportionately affected the large city of Detroit, and that Michigan was over-represented in terms of its population (11.4% of the national deaths were in Michigan).

Case: Summer 1988

The 1988 drought/heat wave in the Central and Eastern U.S. also greatly impacted Michigan. Nationwide, the drought caused an estimated \$40 billion in damages from agricultural losses, disruption of river transportation, water supply shortages, wildfires, and related economic impacts. The heat wave that accompanied the drought conditions was particularly long in Michigan – 39 days with 90 degree or better heat – eclipsing the previous record of 36 days recorded in the “dust bowl” days of 1934. During that 39-day stretch, the temperature in Southeast Michigan topped the 100 degree mark on 5 occasions, including a peak of 104 degrees on June 25. Nationwide, the 1988 drought/heat wave caused an estimated 5,000 to 10,000 deaths. (Again, the range of estimates is due largely to varying interpretations of “heat-related” death.)

Case: June – August 2001

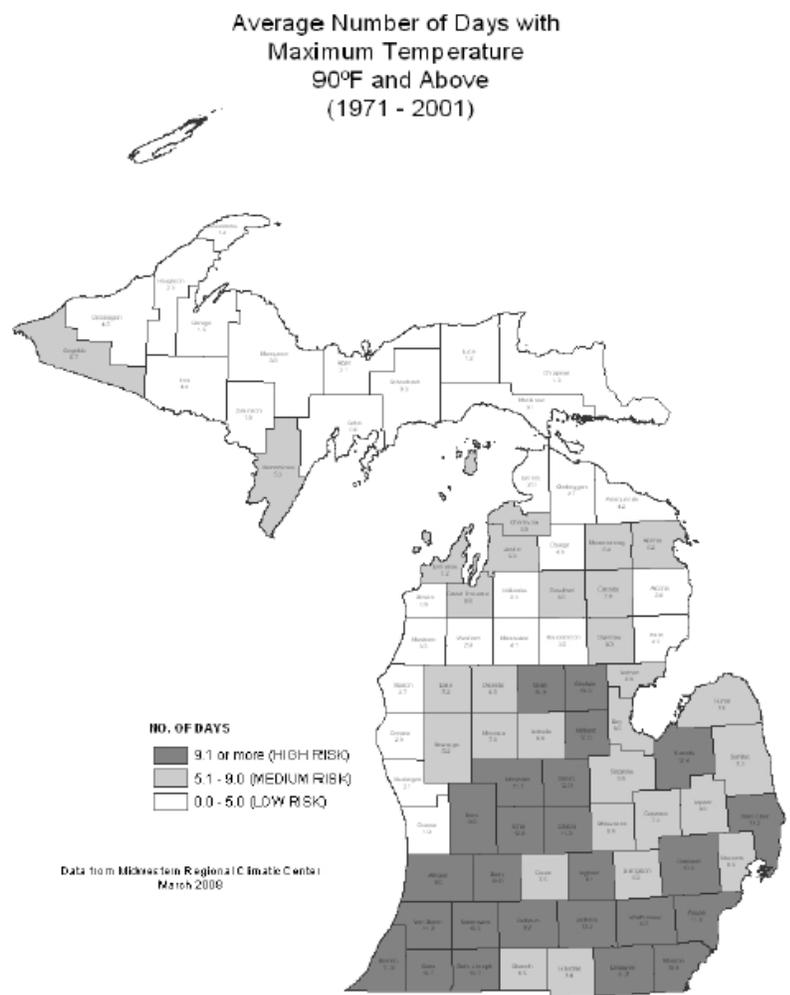
Extreme heat and humidity in the Midwest and Central Plains during parts of June, July and August sent heat stress index readings soaring well above 100 degrees Fahrenheit on many days. Communities across the region were forced to open “cooling centers” and take other steps in an attempt to avoid heat related deaths among vulnerable segments of the population. Despite those efforts, heat-related deaths occurred in many areas – and unfortunately Michigan was no exception. In mid-June, three elderly residents of a Detroit-area nursing home died and five more were hospitalized due to heat-related stress. (Note: the deaths prompted a bill within the Michigan Legislature to require all nursing homes in Michigan to have air conditioning in resident rooms and common areas.) On August 1 and August 8, heat advisories were issued for many counties in the southern Lower Peninsula, with heat indices at 105 degrees for some jurisdictions on the former date, and 110 degrees for some jurisdictions on the latter date. The National Climatic Data Center reports one death and 200 “injured” during early August, from excessive heat.

Case: Summer 2006

The National Climatic Data Center reports that 315 “injuries” occurred as a result of heat in Michigan—75 occurring on May 29, and 240 in late July and early August, although most of the latter were mild cases involving dehydration, some heat exhaustion, and only 6 known cases of heat stroke. A 5 day period of temperatures at or above 90 degrees started on July 29 for Southeastern Michigan. The heat index averaged between 105 and 110 degrees, and various temperature records were tied. A large number of cooling centers were provided for residents in need, and preparedness was very good, perhaps because the earlier May 29 event had provided a milder warning event that alerted communities to the potential for heat problems. In that earlier case, on Memorial Day, temperatures went as high as the mid-90s (with a temperature of 98 reported at Midland), and outdoor parade events caused many to swoon and be treated for dehydration and heat exhaustion.

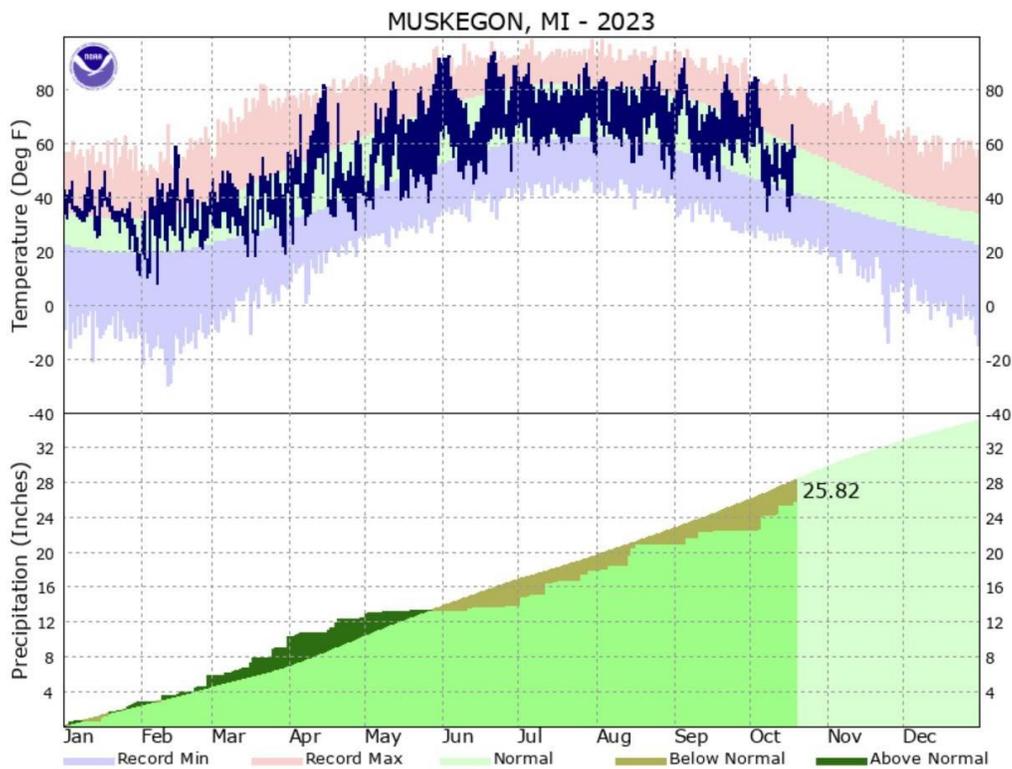
Extreme Temperatures, Heat in Muskegon County

While Muskegon County does not have a large history of extreme heat, data from the Midwestern Region Climatic Center from 1971 to 2001 shows that Muskegon County has a low risk for the average number of days with maximum temperatures at or above 90°F to be between 0 and 5.



Record Monthly Temperatures in Degrees Fahrenheit
 Source: US National Weather Service Office, Grand Rapids, Michigan
 Climate Period from 1896 to 2023

| Month | Record High | Date | Previous Record |
|-----------|-------------|--|-----------------------------------|
| January | 63°F | 01-25-1950 | 59°F (1-24-1950) |
| February | 67°F | 02-11-1999 | 58°F (02-21-1930) |
| March | 82°F | 03-20-2012 03-21-2012 08/06/1918 | 77°F (03-27-1967) (03-30-1967) |
| April | 86°F | 04-29-1970 | 85°F (04-27-1899) |
| May | 96°F | 05-29-2018 | 93°F (05-29-1962) |
| June | 98°F | 06-20-1995 | 94°F (06-11-1956) (06-24-1901) |
| July | 99°F | 07-30-1913 | |
| August | 99°F | 08-03-1964 | 96°F (08-24-1947) |
| September | 95°F | 09-1-1953 09-06-1957 | 94°F (09-02-1913) (09-03-1953) |
| October | 89°F | 10-18-1910 | |
| November | 76°F | 11-2-1961 11-20-1930 | 74°F (11-19-1930) (11-01-1935) |
| December | 64°F | 12-02-1982 | 63°F (12-06-1951) (12-05-2001) |



Monthly Highest Max Temperature for Muskegon Area, MI (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------------|------|------|------|------|------|------|------|------|------|------|------|------|--------|
| 2000 | 53 | 66 | 73 | 69 | 83 | 85 | 86 | 87 | 87 | 79 | 70 | 39 | 87 |
| 2001 | 42 | 55 | 55 | 80 | 80 | 89 | 89 | 89 | 84 | 71 | 62 | 63 | 89 |
| 2002 | 51 | 62 | 60 | 84 | 81 | 88 | 90 | 89 | 89 | 77 | 63 | 53 | 90 |
| 2003 | 45 | 43 | 66 | 77 | 75 | 90 | 89 | 89 | 86 | 79 | 64 | 50 | 90 |
| 2004 | 57 | 55 | 73 | 77 | 82 | 87 | 87 | 85 | 85 | 72 | 58 | 51 | 87 |
| 2005 | 59 | 49 | 74 | 76 | 79 | 91 | 93 | 90 | 87 | 81 | 65 | 41 | 93 |
| 2006 | 53 | 45 | 67 | 76 | 87 | 91 | 90 | 89 | 80 | 76 | 61 | 52 | 91 |
| 2007 | 50 | 40 | 76 | 77 | 87 | 90 | 90 | 89 | 91 | 83 | 57 | 52 | 91 |
| 2008 | 58 | 50 | 59 | 78 | 76 | 86 | 86 | 87 | 89 | 80 | 72 | 61 | 89 |
| 2009 | 36 | 52 | 65 | 78 | 78 | 92 | 83 | 89 | 83 | 67 | 71 | 50 | 92 |
| 2010 | 47 | 39 | 76 | 78 | 89 | 85 | 90 | 92 | 85 | 77 | 65 | 58 | 92 |
| 2011 | 57 | 53 | 61 | 78 | 86 | 92 | 94 | 88 | 90 | 80 | 64 | 52 | 94 |
| 2012 | 56 | 54 | 82 | 72 | 90 | 92 | 99 | 95 | 89 | 76 | 70 | 66 | 99 |
| 2013 | 59 | 47 | 55 | 81 | 87 | 85 | 92 | 87 | 87 | 76 | 67 | 58 | 92 |
| 2014 | 43 | 46 | 64 | 70 | 85 | 88 | 85 | 86 | 81 | 75 | 60 | 50 | 88 |
| 2015 | 40 | 39 | 59 | 76 | 82 | 81 | 91 | 88 | 86 | 70 | 70 | 63 | 91 |
| 2016 | 46 | 54 | 66 | 78 | 88 | 87 | 90 | 89 | 87 | 80 | 70 | 52 | 90 |
| 2017 | 62 | 62 | 65 | 80 | 83 | 90 | 88 | 87 | 92 | 82 | 59 | 61 | 92 |
| 2018 | 56 | 60 | 56 | 75 | 96 | 91 | 94 | 92 | 87 | 83 | 51 | 52 | 96 |
| 2019 | 47 | 52 | 61 | 80 | 81 | 87 | 90 | 86 | 85 | 77 | 54 | 58 | 90 |
| 2020 | 49 | 50 | 57 | 72 | 90 | 97 | 92 | 91 | 81 | 75 | 75 | 54 | 97 |
| 2021 | 43 | 46 | 74 | 80 | 85 | 89 | 89 | 90 | 87 | 79 | 61 | 63 | 90 |
| 2022 | 42 | 46 | 68 | 80 | 91 | 93 | 88 | 91 | 86 | 80 | 71 | 57 | 93 |
| 2023 | 50 | 59 | 57 | 82 | 92 | 94 | 90 | 91 | 92 | 85 | M | M | 94 |
| Mean | 50 | 51 | 65 | 77 | 85 | 89 | 90 | 89 | 87 | 78 | 64 | 55 | 92 |
| Max | 62 | 66 | 82 | 84 | 96 | 97 | 99 | 95 | 92 | 85 | 75 | 66 | 99 |
| | 2017 | 2000 | 2012 | 2002 | 2018 | 2020 | 2012 | 2012 | 2023 | 2023 | 2020 | 2012 | 2012 |
| Min | 36 | 39 | 55 | 69 | 75 | 81 | 83 | 85 | 80 | 67 | 51 | 39 | 87 |
| | 2009 | 2015 | 2013 | 2000 | 2003 | 2015 | 2009 | 2004 | 2006 | 2009 | 2018 | 2000 | 2004 |

Climate data from the US National Weather Service, Grand Rapids, Michigan office.

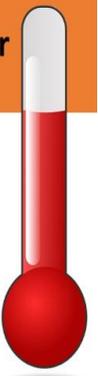
Case: June-July 2020 – Michigan

Temperatures in June and July of 2020 were close to breaking records of consecutive high heat days of 90 degrees or above. Muskegon broke their record number of 90 degree days in a row, reaching nine between June 29 and July 7, 2020.



Consecutive Days of 90 Degrees or Greater

| | Current Streak | Record Number |
|--------------|----------------|---------------|
| Grand Rapids | 7 | 11 (1901) |
| Lansing | 4 | 12 (1897) |
| Muskegon | 0 | 9 (2020) |
| Kalamazoo | 9 | 14 (1964) |



GRAND RAPIDS, MI
 NATIONAL WEATHER SERVICE

Updated Thursday, July 9, 2020 at 2:30 AM

At risk populations from drought and extreme heat:

Droughts and extreme heat affect life safety and public health in several ways. Health problems can arise from poor water quality, poor food quality, and increased dust in the air. In addition, droughts make fires more likely, spread more quickly, and make them more challenging. In addition, poor air quality and a lack of water may reduce residents’ engagement in recreational activities, reducing overall mental and physical well-being (NDMC, 2023).

Small children, the elderly, and certain other groups including people with chronic diseases, low-income populations, and outdoor workers have higher risk for heat-related illness. Extreme heat events can trigger a variety of heat stress conditions, such as heat stroke. Heat stroke is the most serious heat-related disorder. It occurs when the body becomes unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. This condition can cause death or permanent disability if emergency treatment is not given. https://www.cdc.gov/climateandhealth/pubs/extreme-heat-final_508.pdf

Age

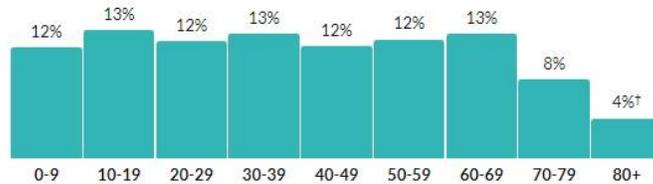
39.8

Median age

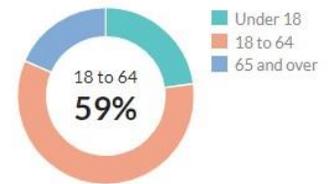
about the same as the figure in Michigan: 40.2

a little higher than the figure in United States: 38.8

Population by age range



Population by age category



Show data / Embed

Show data / Embed

Population by age range (Table B01001) [View table](#)

| Column | Muskegon County | | Michigan | | United States | | | | | | | |
|--------|-----------------|-------|----------|----------|---------------|-------|-----------|-----------|-------|-----|------------|-----------|
| 0-9 | 11.7% | ±0.9% | 20,602 | ±1,513.1 | 11.3% | ±0.1% | 1,131,553 | ±10,506.8 | 11.7% | ±0% | 38,672,058 | ±73,096.7 |
| 10-19 | 13.4% | ±1% | 23,596 | ±1,692.9 | 12.8% | ±0.1% | 1,288,086 | ±11,682.4 | 13.2% | ±0% | 43,645,580 | ±83,716 |
| 20-29 | 12.2% | ±0.9% | 21,601 | ±1,561 | 13.1% | ±0.1% | 1,316,885 | ±12,386.4 | 13.1% | ±0% | 43,483,096 | ±84,740.9 |
| 30-39 | 13.1% | ±0.8% | 23,056 | ±1,316.4 | 12.6% | ±0.1% | 1,264,306 | ±9,888.8 | 13.7% | ±0% | 45,350,083 | ±75,738.2 |
| 40-49 | 11.8% | ±0.7% | 20,787 | ±1,290.1 | 11.8% | ±0.1% | 1,181,072 | ±9,373.1 | 12.4% | ±0% | 41,144,488 | ±71,588 |
| 50-59 | 12.5% | ±0.7% | 22,000 | ±1,171.9 | 13.2% | ±0.1% | 1,321,930 | ±9,088.7 | 12.7% | ±0% | 42,032,544 | ±62,242.5 |
| 60-69 | 13% | ±1.1% | 22,959 | ±1,946.5 | 13.3% | ±0.1% | 1,335,832 | ±13,703 | 12.1% | ±0% | 40,025,667 | ±89,747.2 |
| 70-79 | 8.2% | ±0.7% | 14,531 | ±1,198.6 | 8.2% | ±0.1% | 825,071 | ±9,287.3 | 7.6% | ±0% | 25,299,187 | ±58,986.1 |
| 80+ | 4.2%† | ±0.6% | 7,379 | ±1,000.9 | 3.8% | ±0.1% | 386,076 | ±7,586.9 | 3.7% | ±0% | 12,241,042 | ±48,452 |

Muskegon County 2020 Census Data from Census Reporter

<https://censusreporter.org/profiles/05000US26121-muskegon-county-mi/>

WILDFIRES

An uncontrolled fire in grasslands, brushlands, or forested areas.

Hazard Description

Annually the Federal Government spends billions of dollars to suppress wildfires. The most immediate dangers from wildfires are the destruction of homes and timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area. Impacts from wildfires include the increased potential for flooding, debris flows, and landslides and smoke and other emissions contain pollutants that can cause significant health problems. Short term effects include destruction of timber, forage, wildlife habitats, scenic vistas, and watersheds. Long term effects include reduced access to recreational areas, destruction of community infrastructure and cultural and economic resources. Forests cover approximately one-half of Michigan's total land bases. As a result, much of the state is vulnerable to wildfire. In addition, development in and around forests and grasslands is increasing rapidly, making public safety a primary consideration in wildfire mitigation and suppression efforts.

Wildfire statistics help to illustrate past U.S. wildfire activity. Nationwide data compiled by the National Interagency Fire Center (NFIC) indicate that the number of annual wildfires is variable but has decreased slightly over the last 30 years and that the number of acres burned annually, while also variable, generally has increased. Every year since 2000, an average of 72,400 wildfires burned an average of 7.0 million acres. This figure is nearly double the average annual acreage burned in the 1990s (3.3 million acres), although a greater number of fires occurred annually in the 1990s (78,600 on average).

According to the National Interagency Fire Center:

- More land has been affected by wildfires in recent years than at any time since the 1960's.
- In 2018, the United States reported 58,083 wildland fires that burned 8,767,492 acres of land.
- The U.S. Federal Government spent \$3,143,256,000 to suppress these fires, which is the most expensive response cost on record (1985 to present).
- A total of 25,790 structures were destroyed by wildfires in 2018 including 18,137 residences, 6,927 minor structures, and 229 commercial/mixed residential structures. This is well above the annual average of 2,701 residences, 1,379 minor structures, and 64 commercial/mixed residential structures destroyed by wildfire with this year ranking 1st (and more than double the previous record) in total structures lost (data from 1999 to present).
- In 2015 and 2017, wildfires burnt more than 10 million acres of land. These large of impacts have not been seen since 1952 when over 14 million acres of land burnt.
- Only two fires have burned over a million acres. The Taylor Complex Fire of 2004 burned over 1.3 million acres. The greater Yellowstone National Park fire of 1988 burned more than 1.2 million acres.
- Wildfire severity has increased, and the fire frequency has decreased during the past 200 years
- Many species depend on wildfires to improve habitat, recycle nutrients, and maintain diverse communities.

Annual Wildfires and Acres Burned

Year-to-date statistics

| | | |
|-----------------------|---------------|------------------|
| 2022 (1/1/22-9/01/22) | Fires: 48,331 | Acres: 6,153,171 |
| 2021 (1/1/21-9/01/21) | Fires: 43,017 | Acres: 4,946,000 |
| 2020 (1/1/20-9/01/20) | Fires: 40,161 | Acres: 4,063,267 |
| 2019 (1/1/19-9/01/19) | Fires: 33,680 | Acres: 4,071,070 |
| 2018 (1/1/18-9/01/18) | Fires: 45,579 | Acres: 6,939,284 |
| 2017 (1/1/17-9/01/17) | Fires: 46,648 | Acres: 7,378,212 |
| 2016 (1/1/16-9/01/16) | Fires: 40,630 | Acres: 4,623,046 |
| 2015 (1/1/15-9/01/15) | Fires: 43,931 | Acres: 8,397,886 |
| 2014 (1/1/14-9/01/14) | Fires: 38,647 | Acres: 2,753,089 |
| 2013 (1/1/13-9/01/13) | Fires: 35,287 | Acres: 3,848,380 |
| 2012 (1/1/12-9/01/12) | Fires: 44,524 | Acres: 7,724,955 |

10-year average Year-to-Date

2012-2021 Fires: 40,783 Acres: 5,391,685

Source: National Interagency Fire Center (NIFC)

Hazard Analysis

Forests cover approximately 55% (20.4 million acres) of Michigan's total land area. These vast forests provide Michigan with the largest state-owned forest system in the United States. In addition, Michigan has the fifth largest quantity of timberland acreage, with 19.3 million acres of hardwoods and softwoods. That vast forest cover is a boon for both industry and recreation. However, it also makes many areas of Michigan highly vulnerable to wildfires.

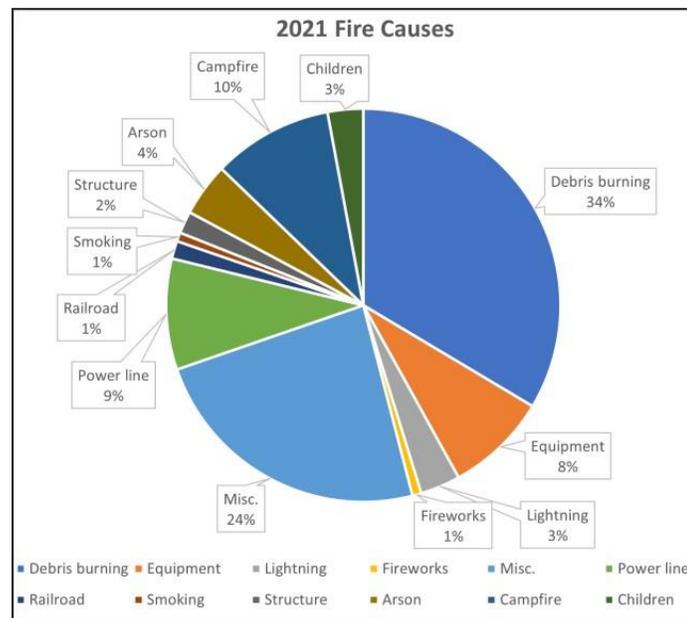
Although Michigan's landscape has been shaped by wildfire, the nature and scope of the wildfire threat has changed. Michigan's landscape has changed substantially over the last several decades due to wildland development, and so the potential danger from wildfires has become more severe. Increased development in and around rural areas (more than a 60% increase in the number of rural homes since the 1980s) has increased the potential for loss of life and property from wildfires. (The map at the end of this section shows the wildland / urban interface areas of highest concern in Michigan.) There are

simply not enough fire suppression forces available in rural areas to protect every structure from a disastrous wildfire.

Contrary to popular belief, lightning strikes are **not** the primary cause of wildfires in Michigan. Recently, only about 4% of all wildfires in Michigan were caused by lightning strikes, and most other causes have been attributed to human activity. Most 2021 fires were ignited on weekends and were caused by people. The most common cause, consistent with previous years, was burning of yard waste. This led to 34% of fires, including those started by brush burning or fires that escaped burn barrels. The immediate danger from wildfires is the destruction of property, timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area.

According to the Michigan Department of Natural Resources – MDNR, 2021 statistics indicate the leading causes of wildfires were:

1. Debris burning (34%)
2. Miscellaneous (24%)
refers to fires where a cause could not be determined.
3. Campfires (10%)
4. Equipment (8%)
5. Power Line (9%)
6. Arson (4%)
7. Children (3%)
8. Lightning (3%)
9. Structural Fires (2%)
10. Fireworks (1%)
11. Railroad (1%)
12. Smoking (1%)



<https://www.michigan.gov/dnr/-/media/Project/Websites/dnr/Documents/FRD/fire/Wildland-fire-report.pdf?rev=0de6a8b7103345349e9416e9b12dbfca>

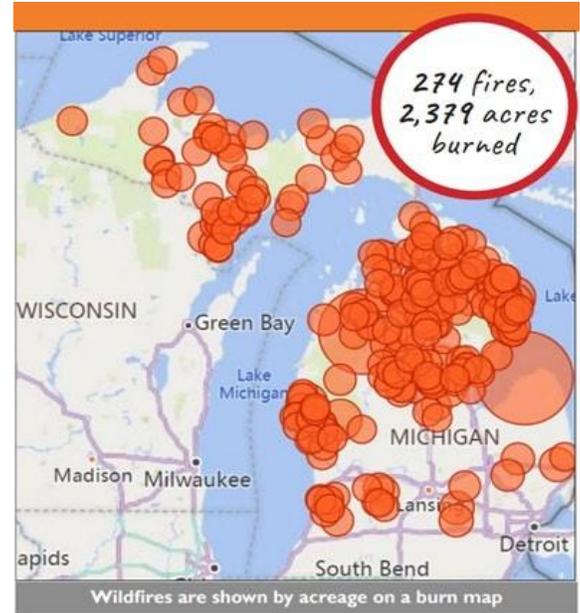
Wildfire Hazards in Michigan

The forests of northern Michigan are rich in history. In the late 1800s logging was at its peak and these forests were quickly cut and cleared. In 1909, the Huron National Forest was established, and the Manistee National Forest was formed in 1938. In 1945, these two National Forests were administratively combined. Working hand in hand with the Michigan Department of Natural Resources and other partners, the Forest Service has changed the "lands that nobody wanted" to healthy forests again.

The Huron-Manistee National Forest strives to maintain an excellent fire management program. Working with local volunteer fire departments, the Michigan Department of Natural Resources and other National Forests, Forest Fire Crews work hard at suppressing wildfires. But fire suppression is only one

part of Forest Service fire management. In coordination with local communities' forest fire personnel have used the Fire Wise program, educating homeowners on how to protect their homes from urban interface fires. Forest employees also work with media on updating the public about current fires, burn permits, and any burning bans that may be in effect.

Michigan DNR fire management staff responded to 274 fires in 2021, an increase from the previous two years. These wildfires burned nearly 2,379 acres. Eighty percent of fires originated on private property. Significant fires include the 378-acre Colfax Fire and 130-acre Miller Drop Zone Fire, both in the northern Lower Peninsula. Multiple DNR units and partners responded to the Superior Cedar Products Fire in Carney, which resulted in a State of Emergency declaration in Menominee County. The Brittle Fire was the largest the DNR helped respond to, aiding federal partners. It burned 5,600 acres on federal lands starting April 23 in the Huron-Manistee National Forest. Of the 574 commercial and residential structures and outbuildings threatened by wildland fire, most were saved; just 20 outbuildings were destroyed.



Michigan has experienced many destructive wildfires. Thousands of homes (during Michigan's first century) and millions of acres of forest have been destroyed by wildfires. According to Michigan Department of Natural Resources (MDNR) and U.S. Forest Service records, over 5.8 million acres of forest in Michigan were burned between 1910 and 1949, an average of 145,000 acres per year. By comparison, it was reported that between 1950 and 1996, the MDNR and U.S. Forest Service were involved in suppressing over 46,100 wildfires that burned 390,000 acres of forest, which averages only 8,300 acres burned per year. In 2018, there were 431 wildland fires, burning 3,786 acres. This drastic reduction in the acres of timber burned was largely the result of (1) increased use of specialized equipment to suppress the fires, and (2) intensified efforts toward fire prevention.

The following list summarizes some of the largest and most severe wildfires that have occurred in Michigan to date.

Case: October 1871 - Lower Peninsula

The State's first recorded catastrophic fire occurred in the fall of 1871, after a prolonged drought over much of the Great Lakes region in the summer of 1871. The drought had left debris from logging and land clearing tinder dry, and as a result numerous fires burned throughout the state. These fires continued to smolder until, on October 8th of that year, gale and hurricane force winds fanned a series of fires across much of the northern Lower Peninsula. Because this tremendously destructive wildfire occurred at the same time as the great wildfires that struck Peshtigo, Wisconsin (which killed 1,300

people in a single night, and also affected Menominee County in the Upper Peninsula) and the Great Chicago Fire (which destroyed much of central Chicago), the Michigan wildfire received little publicity. However, the 1871 Michigan wildfire killed 200 people and burned 1.2 million acres. When the winds finally subsided, the fire's swath stretched from Lake Michigan across to Lake Huron. The most heavily affected area, north of Saginaw Bay, had an area 40 miles square that was completely destroyed, with over 50 people killed. The worst of the fire was over by October 19, although the fire wasn't completely extinguished for over a month.

Case: May 1, 2018 – Crawford, Wexford, and Newaygo Counties

The Michigan Department of Natural Resources sent fire crews to respond to wildfires overnight on May 1st, including three major blazes in Crawford, Wexford, and Newaygo counties. The fire in Crawford County occurred at approximately 4pm along I-75, about 7 miles south of Grayling. The fire was estimated to be just over 44 acres in size, and a stretch of I-75 was shut down for about an hour and a half. The fire in Wexford County occurred at approximately 5pm in Haring Township, about 5 miles north/northwest of Cadillac. Called the "Bond Mill Pond Fire," it was estimated to be about 79 acres, mostly involving state forest lands. The fire caused the evacuation of 79 residents, who were all allowed to return that same evening. The U.S. Forest Service provided helicopter support for the fire suppression efforts and dumped 1,600 gallons of water before being grounded due to high winds. The fire in Newaygo County occurred at approximately 6:45pm, just over 6 miles east of Newaygo, south of M-82. This "Oak Fire" was located primarily on federal lands and estimated at 105 acres in size. It was contained by around 1am. Two residents were evacuated, and 15 structures were threatened, but excellent work by 11 local volunteer fire departments, U.S. Forest Service crews, and MDNR fire crews resulted in all the structures being saved.

Case: Aug 2021 Isle Royale County - Horne Fire

300 acres around the area around Monument rock burned

Case: May 11, 2022 Montmorency, Cheboygan Counties – Blue lakes Fire

A lightning strike ignited a fire that smoldered for several days before igniting nearby fuels (leaves, grass, bushes). The fire consumed 2,516 acres.

Wildfire Hazards in Muskegon County

According to the Muskegon Conservation District, forest covers approximately half of Muskegon 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; particularly in portions of the Manistee National Forest and in the county's many camping areas. A majority of the forest land is in private ownership and is often intermixed with publicly owned lands in the county. There are also wooded areas of higher risk where fairly steep slopes exist (see the topographic maps in Appendix B), such as along the Lake Michigan shoreline.

Nearly 8 percent of Muskegon County's land area is owned by state or federal entities according to

Muskegon County Blueways and Greenways Plan written by WMSRDC in 2010. Therefore, the county has state and federal assistance for wildfire response in and around those areas. The Michigan Department of Natural Resources reported a total of 235 wildfires that burned 2,089 acres between 1981 and 2000. Between 2000 and 2010, and additional 16 fires were reported burning an additional 587 acres. Over this 30-year period, the county annually averaged about 8 wildfires and nearly 89 burned acres per year. Since many minor wildfires over Muskegon's landscape may go unreported to the MDNR, these statistics likely underscore the actual amounts.

While Muskegon County has not experienced a wildfire of that magnitude in recent memory, smaller scale wildfires happen numerous times each year. The following case is one example.

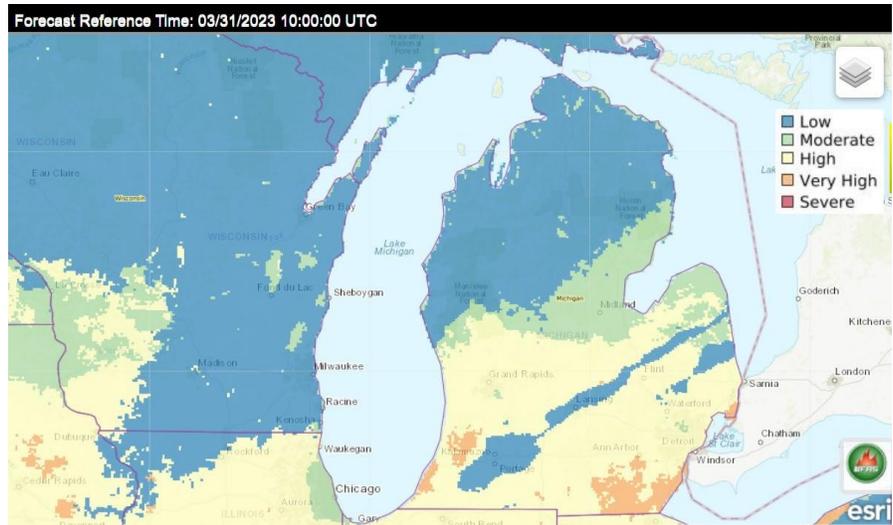
Case: April 2008, White River Township

A young boy playing with a magnifying glass started a fire that consumed 10 acres of dune grass along Lake Michigan. There were no injuries, and the only property damaged may have been some boardwalks leading to the Lake Michigan beach. The incident required the efforts of two-dozen firefighters from the Montague Fire District, White Lake Fire Authority, and Grant Township in Oceana County.

Frequency of Occurrence: Recent trends, such as above average temperatures, low water levels, below average precipitation (both rain and snow), and the occasional addition of fuel to the forests from the fallen trees by windstorms 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 Muskegon 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. Muskegon 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 Muskegon 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.

The forest types of greatest concern in Muskegon County are: jack pine, Scotch pine, jack pine-oak, red pine, and oak. The forest types are listed with the most hazardous type first and so on to the least hazardous of the species of concern. The jack pine-dominated stands have the greatest potential for high-intensity wildfire and are considered one of the most volatile fuel types occurring in the United States or Canada.



WFAS - Severe Fire Danger Mapping System <https://m.wfas.net/>

History of Grass/Brush Fires in Muskegon County January 2015-December 2022

| Municipality | Fire Dept | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | FD Totals |
|--|---|------|------|------|------|------|------|------|------|-----------|
| Blue Lake Township | Blue Lake Township | 3 | 2 | 1 | 2 | 0 | 4 | 2 | 1 | 15 |
| Casnovia Township + Casnovia Village | Casnovia Fire Department | 1 | 1 | 1 | 2 | 0 | 0 | 3 | 3 | 11 |
| Dalton Township + Cedar Creek + Lakewood Club Village | Dalton Township | 10 | 4 | 5 | 3 | 0 | 11 | 8 | 3 | 44 |
| Egelston Township | Egelston Township | | | | | | | | 5 | 5 |
| Fruitport Township + Fruitport Village + Sullivan Township | Fruitport Area Fire Department | 8 | | 2 | 5 | 4 | 10 | 10 | 11 | 50 |
| Holton Township | Holton Township | 2 | 3 | 5 | 3 | 0 | 5 | 10 | 1 | 29 |
| Montague City + Montague Village + White River Townsjip | Montague Fire District | | | | | | | | | |
| Moorland Township | Moorland Township Fire Department | 0 | 0 | 2 | 0 | 3 | 2 | 2 | 1 | 10 |
| Muskegon City | Muskegon Fire Department | 7 | 6 | 4 | 9 | 10 | 22 | 7 | 16 | 81 |
| Muskegon Charter Township | Muskegon Charter Township Fire Department | 10 | 14 | 14 | 25 | 18 | 17 | 32 | 18 | 148 |
| Muskegon Heights City | Muskegon Heights Fire Department | 2 | 3 | 1 | 4 | 2 | 7 | 3 | 5 | 27 |
| North Muskegon City | North Muskegon Fire Department | | | | | | | | | |
| Norton Shores City + Roosevelt Park City | Norton Shores Fire Department | 8 | 6 | 14 | 12 | 7 | 5 | 9 | 15 | 76 |
| Ravenna Village + Ravenna Township | Ravenna Area Fire Department | 2 | 2 | 3 | 1 | 0 | 1 | | | 9 |
| Whitehall City + Whitehall Township + Fruitland Township | White Lake Fire Authority | 11 | 0 | 0 | 1 | 8 | 7 | 5 | 1 | 33 |
| TOTALS PER Year | | 64 | 41 | 52 | 67 | 52 | 91 | 91 | 80 | 538 |

Blank field = no data received

Wildfire Vulnerabilities and Impacts:

Wildfires can significantly impact human safety, including physical injury, death, and/or respiratory issues. Wildfires directly threaten human life due to the risk of injury or death. In addition, the smoke from wildfires can cause respiratory problems, particularly for individuals with pre-existing conditions such as asthma or chronic obstructive pulmonary disease (COPD). Wildfires can significantly impact property damage and critical facilities in various ways. One way is through direct damage to structures, where wildfires can damage homes, businesses, and other structures, leading to property loss and potentially rendering them unsafe or unusable. In addition, wildfires can also damage critical infrastructure such as roads, bridges, and utility lines, impacting access to affected areas and essential services.

FIRES

Structural Fires

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

Hazard Description

Structure fires are any instance of an uncontrolled burning which results in structural damage to residential, commercial, industrial, or other properties in developed areas. Structural fires can be started by cooking accidents, electrical faults, fuel leaks, children playing with lighters or matches, and accidents involved an open flame from candles, cigarettes, etc. The leading cause of home fires and home injuries is unattended cooking. The leading cause of fire deaths is structural fires originating from smoking material starting upholstered furniture or mattress/bedding on fire.

Hazard Analysis

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. Each year in the United States, fires result in approximately 5,000 deaths and 25,000 injuries requiring medical treatment. According to some sources, structural fires cause more property damage and loss of life than all types of natural disasters combined. Direct property losses due to fire exceed \$9 billion per year, and much of that figure is the result of structural fires.

According to the National Fire Protection Association Fire Analysis and Research Division, the following are fire loss statistics in the United States during 2020:

- 1,388,500 fires were responded to by public fire departments
- 490,500 fires occurred in residential structures (35%)
- 3,500 civilian fire deaths occurred
- 2,730 civilian fire deaths occurred in residences (78%).
- 13,000 civilian injuries occurred as the result of fire
- An estimated \$21.9 billion in property damage occurred as a result of fire.
- \$12.1 billion of property damage occurred in structure fires
- 2014-2018 an estimated 52,260 were intentionally set
- Intentionally set fires caused an estimated 400 civilian deaths, 950 civilian injuries, and \$815 million in direct property damage each year

Unfortunately, although the United States has made great strides in lessening deaths and injuries caused by other types of disasters, structural fires are worse problems in this country than in many

other industrialized countries (even those with a more densely developed population pattern). Overall trends for residential building fires and losses for the *10-year period of 2009 to 2018* show the following:

- A 4% increase in fires
- A 13% increase in deaths
- A 19% decrease in injuries
- A 0.04% decrease in dollar loss
- Cooking is the leading cause of residential building fires for the 10-year period
- An 18% increase in residential cooking fires (2018 there were 192,700 cooking fires)
- A 30% decrease in residential heating fires (2018 there were 35,700 heating fires)
- A 17% increase in residential other unintentionally or carelessly set fires (2018 there were 28,600 unintentionally or carelessly set fires)
- A 2% decrease in residential electrical malfunction fires (2018 there were 25,700 electrical fires)

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, overall trends in the leading fire death causes for the 10-year period of 2009 to 2018 show the following:

- Other unintentional, careless was the leading cause of residential fire deaths in nine years out of the 10-year period, and there was a 33% increase in residential other unintentionally or carelessly set fire deaths. In 2018, 16 reported multi-fatality fire incidents (resulting in two, four or five deaths each) may have contributed to the increase in the estimate of fire deaths.
- Smoking was the second leading cause of residential fire deaths in 2018, and there was a 4% increase in residential smoking fire deaths. In 2018, seven reported multi-fatality fire incidents (including one resulting in six deaths) may have contributed to the increase in the estimate of fire deaths.
- A 58% increase in residential cause-under-investigation fire deaths.

“In many ways, 2020 was an anomaly. With the COVID-19 pandemic, many businesses were shuttered. Some people worked remotely, some continued normal work, and still others lost their jobs. Overall, people spent more time at home. An Acosta report released in September 2020 noted that 55 percent of shoppers were eating at home more often during the pandemic than before it began.¹ The Outdoor Foundation reported that 53 percent of Americans at least six years of age engaged in outdoor recreation at least once during 2020. This was the highest outdoor recreational participation rate ever recorded. These are examples of how people's behaviors and routines changed during the pandemic. While we do not yet have national data on the causes of fires in 2020, increases and decreases in various activities were likely associated with the corresponding changes in related fires.” - Fire Loss in the United States During 2020 Report from nfpa.org.

Structure Fires in Michigan

More than one-quarter (26 percent) of the reported fires in 2016–2020 occurred in home structures. In addition, three-quarters (75 percent) of the civilian fire deaths and almost three-quarters (74 percent) of the reported civilian fire injuries during that time were caused by home structure fires.

Unfortunately, Michigan has not been immune to large structural fires that resulted in a significant loss of life. Michigan has not had a catastrophic structural fire disaster in recent years that resulted in a significant loss of human life or significant injury. However, in any given year it is not uncommon for several multiple-casualty residential structural fires to occur throughout the state. Despite the best efforts of fire officials in fire safety education and prevention, deadly residential fires continue to occur year after year.

NFPA “Home Structure Fires” <https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Building-and-life-safety/oshomes.pdf>

In 2021, local fire departments responded to an estimated 1.35 million fires in the United States. These fires caused 3,800 civilian fire deaths and 14,700 reported civilian fire injuries. The property damage caused by these fires was estimated at \$15.9 billion. On average, a fire department responded to a fire somewhere in the US every 23 seconds in 2021. A home structure fire was reported every 93 seconds, a home fire death occurred every three hours and eight minutes, and a home fire injury occurred every 47 minutes. More than one-third of the fires (486,500, or 36 percent) occurred in or on structures. Most of the fire losses were caused by these fires, including 3,010 civilian fire deaths (79 percent); 12,600 civilian fire injuries (86 percent); and \$12.7 billion in direct property damage (80 percent).

NFPA "Fire Loss in the United States During 2021" <https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States>

Significant Structure Fires in Michigan

Case: State Office Building Fire 1951

February 8, 1951: Although it did not result in any loss of life, the arson fire at the State Office Building in Lansing was another significant structural fire that had a profound impact on Michigan. That fire, which caused close to \$7 million in damage and burned for a week—destroyed thousands of irreplaceable state records and archives, including the Michigan Library. The fire was started by a young employee who thought having a criminal record would prevent him from being drafted into the Korean War.

Case: Herbruck’s Poultry Ranch Fire 2005

August 2005: Another example of a catastrophic fire that did not result in any loss of human life is the blaze at a poultry farm in Berlin Township, Ionia County. The fire destroyed an egg-production building at one of the state’s largest poultry farms, causing the death of over 250,000 chickens and \$5 million in damage. Sixteen fire departments from four counties responded to the fire that destroyed the 150-by-600-foot building, which housed egg-laying hens.

Case: Grand Rapids Condominium Fire 2008

On January 20, 2008 a massive structural fire in Grand Rapids resulted in the destruction of over 100 condominium units in two adjacent buildings. Around 200 individuals escaped the building, and although nobody was injured, four persons had to be rescued.

Although structural fires occur every day in both large cities and small towns in Michigan, what was significant about these particular fires was the level of impact they had on the communities. In some cases, the very lifeblood of the community's business and retail districts was destroyed or severely damaged, affecting not only the structures themselves, but also the community's economy as well. Some of the affected businesses never reopened. (Note: please refer also to the section on Wildfires, for more information about some of these events.)

Michigan Fatal Fire Statistics 2019-2021

| Year | # of Deaths | # of Fires | % change in deaths from previous year | % change in # of fires from previous year |
|------|-------------|------------|---------------------------------------|---|
| 2022 | TBD | TBD | TBD | TBD |
| 2021 | 107 | 94 | 12% Decrease | 6% Increase |
| 2020 | 122 | 101 | 21% Increase | 13% Increase |
| 2019 | 102 | 90 | 27% Decrease | 11% Decrease |

Structure Fires in Muskegon County

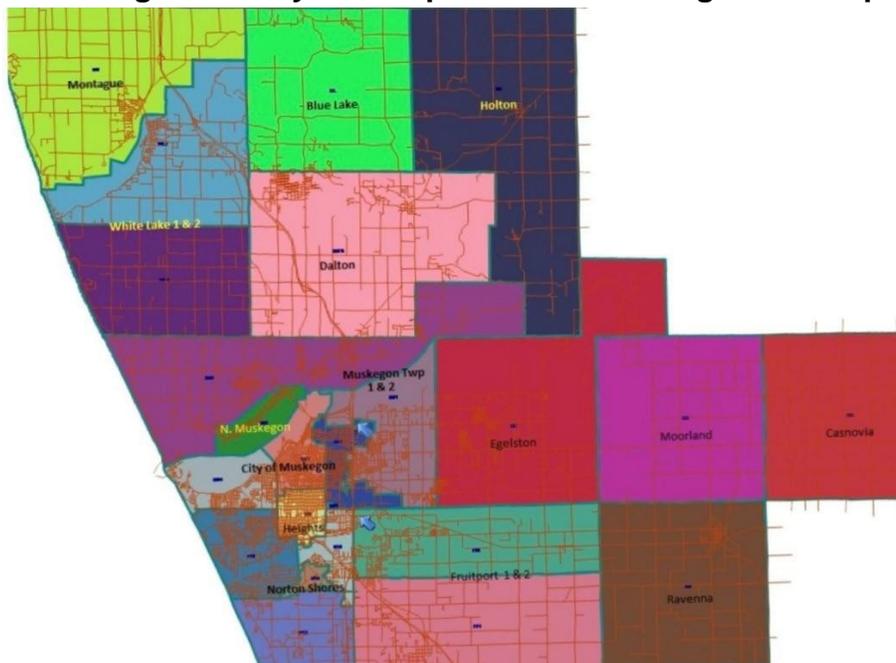
Muskegon County is served with fire suppression services from 15 local fire departments funded by townships and cities. Each department is staffed by full time, part time, or paid on-call personnel (or a combination). Paid on-call staff are activated on a per call basis to respond to emergencies as required. Fire chiefs' association meetings have contributed to fostering inter-department coordination, mutual aid, and cooperative efforts. Although the volunteer nature of Fire departments has posed a continual challenge in several aspects of fire suppression capabilities in key areas of administration, personnel, training, and pre-planning, the system has served the jurisdiction with a high level of pride and professionalism since its establishment.

Trends in this area point towards staffing shortages, with increasing call volume. This can seriously impact response times as well as responder wellness. Expansion of Fire services (most fire departments are running more medical calls than fires) is becoming inevitable. Challenges include the loss of experienced long-serving firefighters, securing funding for updated equipment, payroll, as well as recruiting new people, training and retaining them. Volunteer departments are especially vulnerable to staff turnover with new employees getting trained and sometimes leaving for full time departments.

| Fire Department | Full Time Staff | Paid On Call Staff |
|----------------------|-----------------|--------------------|
| Blue Lake Township | | x |
| Casnovia FD | | x |
| Dalton Township FD | x | x |
| Egelston Township FD | x | x |
| Fruitport Area FD | x | x |

| | | |
|------------------------------|----------|----------|
| Holton Township FD | | X |
| Montague FD | | X |
| Moorland FD | | X |
| Muskegon FD | X | |
| Muskegon Charter Township FD | X | X |
| Muskegon Heights FD | X | |
| North Muskegon FD | X | X |
| Norton Shores FD | X | X |
| Ravenna Area FD | | X |
| White Lake FD | X | X |

Muskegon County Fire Departments Coverage Area Map



Despite the independent multi-department system, Muskegon County's fire hazards remain a primary countywide concern. Based on historical occurrence, on average each jurisdiction within Muskegon County has an estimated four or more structure fires annually. Muskegon County's major fire hazard concerns lies in critical economic, societal, and/or historic sites such as large businesses, downtown areas, and service facilities (i.e. schools, hospital, etc.).

Case: 1874 The Pine Street Fire

A fire destroyed a lumber mill.

Case: December 3, 1888, Muskegon

Sparks from the tugboat Nellie caught the Hackley/Hume mill property on fire. 7.5 million board feet of lumber was destroyed.

Case: 1891 Muskegon

Fire destroyed many blocks of downtown Muskegon.

Case: May 1908 Muskegon, Grand Trunk Depot, Western Ave/Eighth St

Likely caused by a lightning, fire broke out in the depot and freight warehouse. It was rebuilt later that year.

Case: January 8th, Muskegon, 1913 Elks Temple (formerly Grand Opera House) Western/Second

Fire consumed most of the building and it was rebuilt in 1914.

Case: March 1936 Muskegon, The Occidental Hotel Western/Third St

The older section of the hotel facing Western avenue was destroyed by fire.

Case: February 23, 1946 Muskegon

Downtown fire destroys eight stores. A fire discovered in the Wm. D. Hardy & Company store at 9 p.m. Friday wiped out two-thirds of an entire block in the heart of the Western Avenue shopping district. The fire that raged for hours unchecked took all the buildings from the Montgomery Ward & Company store on the west to Second Street.

Case: December 31, 2010 – Twin Lake, Muskegon County An early morning fire destroyed a Twin Lake tire business with damage estimates of over \$325,000. A fire started in a pole barn which had several tires inside it, providing extra fuel for the fire once it started. City water was not available on the scene so responding fire crews set up reservoirs at three sites and used tanker trucks to shuttle water in from other areas. Ten fire departments were used to battle the blaze.

Case: June 9, 2016 Burger King Muskegon Township

a passer-by reported "flames on the roof" of the restaurant at 2190 Holton Road, though at that point the fire was coming from the roof vent. By the time firefighters arrived moments later, it had started to burn the wooden roof deck and roof joists. The restaurant closed until repairs were made.

Case: January 17, 2017 North Green Creek Road Muskegon Township

A fire that started in the engine compartment of a parked van caused considerable damage to an attached residential garage a second van and another motor vehicle were parked in the garage as were a snowmobile, large garden tractor and multiple other tools and items.

Case: February 14, 2017 Whitehall, MI

A heavy metals fire in a dust collector prompted the evacuation of a plant at Arconic. About 30 employees were evacuated from plant No. 4 after the fire was discovered.

Case: April 9, 2017 ACEMCO Corp Muskegon Norton Shores MI

About a dozen workers at Acemco Incorporated called 911 after they noticed fire in a ventilation stack near a welding station.

Case: April 11, 2017 Garage Fire 900 Block N. Green Creek Muskegon Township

A passerby spotted smoke and flames coming from the unattached garage and called 911. Six motorcycles, several of them reportedly vintage, were lost in the fire.

Case: December 1, 2017 Whitehall

The single-story home sustained significant damage.

Case: February 14, 2018 Dunstan Animal Clinic Norton Shores

No animals or staff were injured in a fire at an animal clinic. Workers believe a vacuum system may have somehow malfunctioned and started the fire. The building sustained some interior damage from flames and smoke.

Case: March 23, 2018 Fusion Fluid Equipment Whitehall township

Roof caught fire. No other information available.

Case: July 6, 2018 Muskegon Heights

A fire broke out in the attic of a home on Lemul St. Everyone escaped injury.

Case: October 19, 2018 Muskegon 1600 block of Glade Street

Three people and two firefighters were hospitalized after a fire. Crews arrived at the home to find three residents trapped on the second floor where the fire had started. One of the three people hanging out the windows fell from a second floor, knocking a firefighter off a ladder. Five people who were hospitalized suffered non-life-threatening injuries. The two firefighters and the three victims were all transported to the hospital. They were all in stable condition.

Case: February 9, 2019 Muskegon Heights 700 block of E. Hovey Avenue

The fire broke out west of S. Getty Street. A mother and two children escaped through a window. Only minor injuries were reported.

Case: March 12, 2019 Muskegon Heights 2400 block of Manz Street

After their house caught fire, the family's dog woke up the family to alert them. The two adults and five kids inside escaped without injury.

Case: March 19, 2019 Muskegon 1700 block of Smith Street

A Muskegon woman was arrested for arson at a home that sustained significant damage.

Case: April 9, 2019 Muskegon E. Laketon in Muskegon.

No injuries were reported and four departments in total were brought into help.

Case: April 22 2019 Muskegon Heights Lakeside Warehouse Storage at Broadway and Temple

The structure was a former factory that has been modified to be a storage facility. The fire started in a garbage truck that was inside the facility. Firefighters were able to stop the fire from spreading to other parts of the building.

Case: May 7, 2019 Muskegon Heights

The fire was reported at an abandoned apartment complex formerly an adult foster care home prior to being condemned and closed.

Case: July 10 2019 Muskegon

An argument at a party led to an individual been asked to leave because he was intoxicated. That individual later returned to the residence and set it on fire by throwing two Molotov cocktails – glass bottles filled with gasoline and a rag that was lit. People inside the home at the time were able to safely evacuate.

Case: July 31, 2019 Muskegon Township Kerkstra Portables and Septic

A semi inside the business caught fire, causing widespread damage to the building. A natural gas line was fueling the fire, making it hard to put out. The business was a complete loss, but no one was hurt.

Case: August 19, 2019 Muskegon Heights

A woman was killed in a fire at her home. The victim was found just inside the home. She was pronounced dead at the scene.

Case: October 16, 2019 Muskegon Heights Park Street

Firefighters put out a suspicious fire in a long vacant home.

Case: October 25, 2019 Greenwood/McCracken St Muskegon

Firefighters responded to a house fire. The majority of the damage was contained to the upstairs of the home.

Case: November 19, 2019 House blown off foundation 1900 block Barnes

A father and his 17-year-old were hospitalized after they were rescued from beneath debris when their Egelston Township house exploded. The injuries involved burns and other traumatic injuries.

Case: December 21, 2019 Muskegon, Emerson Avenue near Roberts

Fire Department responded to a report of a house fire. All occupants escaped safely including 3 children trapped inside who were rescued by firefighters.

Case: January 1, 2020 E River Road, Cedar Creek Township

An 87-year-old woman was taken to a hospital to be treated for burns and smoke inhalation. She died at the hospital. Investigators say the cause of the fire was related to the use of candles inside and it was an accident.

Case: February 23, 2020 Muskegon Heights

Police are investigating a fire that an elderly woman was barely able to escape from. The fire started Saturday night at a home on 8th Street after police say a 13-year-old boy shot a flare gun through a window and set curtains on fire.

Case: February 26, 2020 Norton Shores, 2100 block of Leif Avenue

Firefighters were called just after 6 a.m. to a report of fire in the attic. When firefighters reached the scene, they encountered heavy smoke coming from the back of the single-story house. Three people were inside the house but escaped safely.

Case: March 17, 2020 Muskegon Heights, Superior Street

An explosion and fire occurred at the home. After putting out the fire, crews found a body underneath a collapsed piece of the roof.

Case: May 5, 2020 Muskegon, 1600 block of Montague Avenue

Illegal drug activity is the suspected cause of a house explosion and fire. 3 occupants escaped.

Case: June 18 2020 Norton Shores, 1800 block of Ritter Hills Road

The fire appeared to have started in the attic. Neighbors noticed smoke and notified two residents who were able to safely escape.

Case: July 31, 2020 Muskegon Marquette Avenue

Multiple fire departments helped put out a house fire that broke out on Marquette between Langley and S Getty Street.

Case: August 20, 2020 Muskegon, 1600 Block Beidler Street

Four residents escaped a house fire that started in the front of their home. Unknown cause.

Case: August 26, 2020 Muskegon Kinsey Street near West Hackley Avenue

The fire started in an attached garage and spread to the 1 ½-story house. A German shepherd and two cats died in a house fire, but a small dog and cat were rescued.

Case: October 9, 2020 Muskegon Heights, Maffett Street and E Delano Avenue

When crews arrived, the house was fully engulfed in flames. The home was vacant at the time of the fire.

Case: October 18, 2020 Muskegon, Jiroch Street

A two-story home was leveled by flames. The occupants were not home at the time of the fire.

Case: December 24, 2020 Muskegon

A Christmas Eve house fire destroyed a couple's home and killed their two dogs.

Case: January 4 2021 Muskegon

Investigators suspect that a fire that completely destroyed a three-story apartment building started on a kitchen stove. The building was the Porter School until 1954 and was later converted into apartments.

Case: January 5, 2021 Muskegon Heights, 2800 block of Temple Street

One person and two dogs are dead as the result of a fire that leveled a Muskegon Heights home.

Case: January 4, 2021 Valley Street and Laketon Avenue

Fire crews responded to an apartment fire. The fire resulted in "total loss" of the building. Ten of the 11 units were occupied, and many residents lost everything.

Case: January 29, 2021 Muskegon Heights, Glad Street

A pregnant woman and her dog are safe with the help of a stranger. The woman was inside sleeping when she heard crackling noise, and saw the house was on fire. She was able to get out through the back yard with a dog and started to call for help. That's when a stranger broke down the side of the fence and was able to get them all to safety. Fire officials say the home is a total loss.

Case: March 16 2021 Muskegon Heights

There was an attempt made to rescue a man trapped inside, but there was too much fire to continue with the rescue. The house was destroyed resulting in 1 fatality.

Case: March 27 2021 Muskegon Dollar General on Laketon Avenue

Multiple fire agencies responded to the fire. Crews evacuated the building.

Case: March 29, 2021 Norton Shores, 2800 block of Valk St.

Initial dispatch information advised a fire on the outside of the home, believed to have been started by a bonfire.

Case: June 5 2021 Norton Shores

A home health aide rescued the two residents who narrowly escaped flames, smoke and exploding oxygen tanks.

Case: June 14, 2021 Muskegon, W. Laketon

Firefighters responded overnight to a blaze at a single-family home. The first arriving unit found the fire going throughout the home with multiple exposures and wires down in the front yard.

Case: July 31, 2021 Dalton Township Los Lagos Restaurant in Twin Lakes

No one was injured but the building was a complete loss.

September 21, 2021 Irwin Street, Muskegon Irwin near Leahy

Firefighters responded to find a dwelling fully involved and spreading to neighboring homes. Crews deployed multiple hose lines to protect the other homes and were able to prevent much more damage. One firefighter required treatment from Paramedics.

Case: December 12, 2021 Montague Township, Sikkenga Rd between Eilers Rd and W Fruitvale Rd

The barn fire smoke could be seen from several miles away.

Case: December 25, 2021 Montague Whitehall Products

A fire started at the company. Responders said they were able to preserve multiple areas of the building. Multiple fire departments responded to Whitehall Products in Montague after it caught fire for the second night in a row.

Case: December 28, 2021 Norton Shores

House fire that started in the dryer. The residents escaped but 1 dog was killed in the fire.

Case: April 7, 2022 Laketon Township, North Green Creek Rd

An early morning house fire caused the roof of the home to cave in, destroying the dwelling. A man and a cat were inside the house at the time of the fire, but both made it out okay.

Case: April 10, 2022 Muskegon, Whitehall Rd

Fire at this home has been ruled an arson and may be connected to another house fire nearby on the same day. The owners of the two homes are related. Suspect was found deceased nearby due to a self-inflicted gunshot wound.

Case: April 10, 2022 Muskegon, North Peterson Rd

Fire at this home has been ruled an arson and may be connected to another house fire nearby on the same day. The owners of the two homes are related. Suspect was found deceased near the Whitehall Rd home.

History of Structure Fires in Muskegon County January 2015-December 2022

| Municipality | Fire Dept | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | FD Totals |
|--|---|------|------|------|------|------|------|------|------|-----------|
| Blue Lake Township | Blue Lake Township | 3 | 6 | 3 | 1 | 1 | 6 | 5 | 1 | 26 |
| Casnovia Township + Casnovia Village | Casnovia Fire Department | 6 | 5 | 2 | 2 | 0 | 0 | 5 | 3 | 23 |
| Dalton Township + Cedar Creek Township + Lakewood Club Village | Dalton Township | 11 | 14 | 10 | 5 | 3 | 10 | 8 | 8 | 69 |
| Egelston Township | Egelston Township | | | | | | | | 8 | 8 |
| Fruitport Township + Fruitland Village + Sullivan Township | Fruitport Area Fire Department | 10 | | 8 | 8 | 8 | 12 | 7 | 14 | 67 |
| Holton Township | Holton Township | 5 | 8 | 5 | 3 | 0 | 5 | 10 | 6 | 42 |
| Montague City + Montague Township + White River Township | Montague Fire District | | | | | | | | | |
| Moorland Township | Moorland Township Fire Department | 0 | 0 | 1 | 3 | 3 | 2 | 3 | 4 | 16 |
| Muskegon City | Muskegon Fire Department | 151 | 110 | 146 | 125 | 101 | 140 | 116 | 168 | 1057 |
| Muskegon Charter Township + Laketon Township | Muskegon Charter Township Fire Department | 13 | 8 | 15 | 16 | 13 | 14 | 15 | 25 | 119 |
| Muskegon Heights City | Muskegon Heights Fire Department | 26 | 23 | 6 | 22 | 22 | 23 | 26 | 17 | 165 |
| North Muskegon City | North Muskegon Fire Department | | | | | | | | | |
| Norton Shores City + Roosevelt Park City | Norton Shores Fire Department | 20 | 32 | 28 | 31 | 19 | 27 | 25 | 30 | 212 |
| Ravenna Township + Ravenna Village | Ravenna Area Fire Department | 2 | 6 | 0 | 3 | 1 | 1 | | | 13 |
| Whitehall City + Whitehall City + Fruitland Township | White Lake Fire Authority | 15 | 10 | 8 | 14 | 19 | 15 | 8 | 14 | 103 |
| | TOTALS PER Year | 262 | 222 | 232 | 233 | 190 | 255 | 228 | 298 | 1920 |

Blank field = no data received

Scrap Tire Fires

A large fire that burns scrap tires being stored for recycling or reuse.

Hazard Description

Tire fires are described as any instance of uncontrolled burning at scrap tire storage or recycling site. Each year in the U.S., an estimated 290 million vehicle tires have to be disposed of. Michigan alone generates 10 million scrap tires annually. Many of these scrap tires end up in disposal sites (legal or illegal), some of which may have several hundred thousand tires. Although responsible means of storage and disposal have become more common, tire dumps of the last forty years still present environmental and safety hazards.

Tire disposal sites can be fire hazards due to the large quantity of “fuel” onsite, coupled with the fact that the shape of a tire allows air to flow into the interior of a tire pile, rendering standard firefighting practices nearly useless. Flowing burning oil released by the burning tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue, which can leach into the soil, creating long-term environmental problems.

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 can be significant; and 4) the extreme heat from the fire converts a standard passenger vehicle tire into about two gallons of oily residue, which can then leach into the soil or migrate to streams.

Hazard Analysis

In May 2020, the State of Michigan has identified a total of 55 non-compliant scrap tire collection sites containing a total of about 550,000 tire equivalents (unburied ones 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 2.2 million. The department estimates that most of the remaining tires could be disposed of before the program's ending date in December 2015.

Scrap Tire Fires in Michigan

Scrap tire fires have occurred in Michigan in the past. Over the past several years, there has been a decrease in both the frequency and severity of fires at scrap tire disposal sites due to the cleanup of existing stockpiles and an increase in compliance at collection sites. Unfortunately, fire departments are generally ill-equipped and untrained to handle these incidents when they do occur. This is especially true in rural areas where many scrap tire disposal sites are located. Scrap tire fires occur often enough to present a major concern to those communities that have quantities of tires stored at disposal sites within or adjacent to their borders. Given the right set of circumstances, the potential is always there for a major fire that may require evacuation, sheltering, large amounts of fire suppression assistance, and both short and long-term environmental monitoring. Large scrap tire fires can also be very costly for the owner/operator and the affected local jurisdiction(s), as the fires are difficult to extinguish and typically require a large emergency response personnel presence at the fire scene (often for an extended period of time).

In recent history, the following incidents stand out as examples of the adverse impacts that can occur when fire breaks out at a scrap tire disposal site.

Case: October 30, 1987 – Kent County

A large fire broke out at a scrap tire disposal site in Kent County containing over one million tires. It was estimated that the blaze was contained to about a fifth of the ten-acre site and a fire break was established with bulldozers. Firefighters ultimately concluded that the best course of action was to allow the contained portion of the fire to burn, and that applying water would add no benefit. Nearby residents were evacuated during the early stages of the fire.

Case: July 30, 1996 – Clare County

A fire broke out at a scrap tire storage facility located in Redding Township in Clare County. Over the course of the fire, 14 fire departments responded, along with representatives from the EPA and Michigan Department of Environmental Quality (MDEQ). Fortunately, the fire was contained to 250,000

of the 4.2 million tires on the ten-acre site, and was extinguished the following day, some 32 hours after it began.

Case: 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.

Case: 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.

Case: June 13, 2003 – Clare County

A large fire broke out at a scrap tire disposal site in Clare County. It was estimated that 135,000 of the 850,000 tires at the site had caught on fire. The fire response and pollution control efforts would have been much more difficult without the \$250,000 in funds awarded to Clare County through the DEQ Scrap Tire Grant Program in 2002. The lanes constructed between the tire piles had bought firefighters enough time to prevent the fire from spreading into the remaining piles. Otherwise, they would have been dealing with a much larger fire. This fire occurred at the same location as the scrap tire fire of 1996, when 250,000 tires were involved.

Case: July 23, 2008 – Ottawa County

A scrap yard fire, fueled by 1,000 tires, kept fire departments from Spring Lake Township, Coopersville, Fruitport, Ferrysburg, Ottawa County, Marne and Grand Haven Township busy for several hours and sent thick plumes of black smoke over the area. This fire in Nunica was first reported at around 3:45 pm and was caused by sparks from workers who were cutting off an automobile's catalytic converter. The blaze was confined to roughly a 50-by-50-foot area. Because the nearest hydrant was about 2,000 feet away, water had to be trucked in. In all, 70,000 gallons of water were poured onto the fire before it was brought under control after 90 minutes. No structures were damaged by the fire and no injuries occurred. Because of possible oil contamination from melting tires, the Department of Environmental Quality was notified.

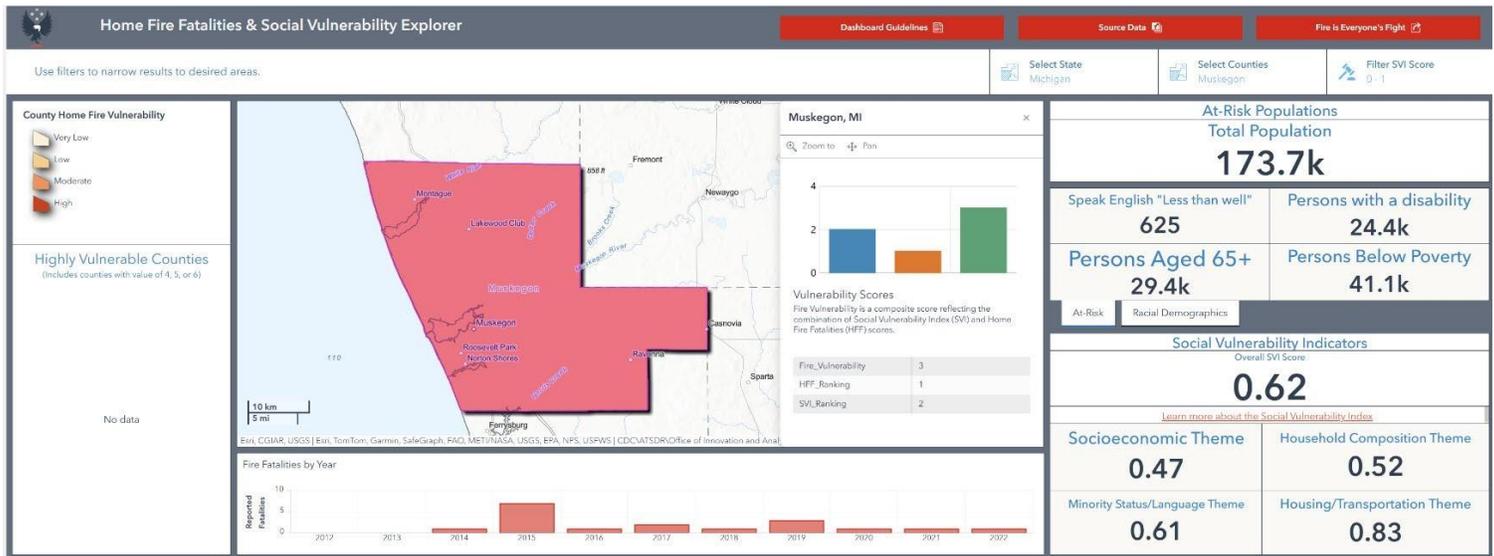
Case: December 31, 2010 – Muskegon County

An early morning fire destroyed a Twin Lake tire business on December 31, 2010 with damage estimates over \$325,000. The fire started on the west end of a 100-by-60 foot pole barn construction building. The building had several tires inside it which provided extra fuel for the fire after it started. City water was not available on the scene so responding fire crews set up water reservoirs at three sites and used tanker trucks to shuttle water in from other areas. A tanker task force involving 10 area fire departments was used to battle the blaze. Assisting Dalton Township were fire departments from the townships of Muskegon, Blue Lake, Holton, Fruitport, and Egelston, along with the North Muskegon and Fremont city departments, the White Lake Fire Authority and Montague Fire District.

Structure Fire Vulnerability and Impacts:

Since 2012 the US Fire Administration (USFA) has collected information on home fire fatalities compiled through a daily internet search of U.S. news media reports to help raise awareness about the danger of fire and the frequency of home fire deaths. This data, along with the CDC's Social Vulnerability Index, helps communities better understand the fire problem and create targeted efforts to address fire prevention within vulnerable communities and at-risk groups.

The following is from FEMA's Home Fire Fatalities and Social Vulnerability Explorer for Muskegon County, Michigan.



HAZARDOUS MATERIALS

Hazardous Material Incidents

Any solid, liquid, or gas that can cause harm to humans and other living organisms due to its being radioactive, flammable, explosive, toxic, corrosive, a biohazard, an oxidizer, an asphyxiant, or capable of causing severe allergic reactions.

Hazard Description

Hazardous materials are highly regulated by the government to reduce risk to the public, property, and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use and disposal of these materials, accidental releases are bound to occur. A reportable hazardous material incident is one in which all three of the following conditions apply: 1) a material is present that is suspected to be something other than ordinary combustible by-product material; 2) the material is in such a state, quantity or circumstance that, if left unattended, it is presumed to pose a threat to life, health, property or the environment; and 3) special hazardous material resources were dispatched or used, or should have been dispatched or used, for assessing, mitigating or managing the situation.

The following are specific types of hazardous materials incidents:

Fixed Site:

An uncontrolled release of hazardous materials from a fixed site can pose a risk to health, safety, property, and the environment. Hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other community facilities. Hazardous materials are materials or substances, which, because of their chemical, physical, or biological nature, pose a potential threat to life, health, property, and the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases.

Industrial Accidents

Industrial accidents differ from hazardous material incidents in the scope and magnitude of offsite impacts. An industrial accident is a fire, explosion, or other severe accident (especially if it involves hazardous materials) at an industrial facility that results in serious damage, injury, or loss of life. 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. In addition, industrial accidents

can cause 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.

Transportation Incidents:

An uncontrolled release of hazardous materials that during transport can pose a risk to health, safety, property, or the environment. All modes of transportation - highway, railroad, seaway, airway, and pipeline - are carrying thousands of hazardous material shipments daily through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people.

The U.S. Department of Transportation regulates the transportation and shipping of over 18,000 different materials. Areas most at risk are within a 1-to-5-mile radius of a major transportation route along which hazardous material shipments move. All areas in Michigan are potentially vulnerable to a hazardous material transportation incident, although the heavily urbanized and industrialized areas in southern Michigan are particularly vulnerable due to the highly concentrated population, the large number of transportation routes that crisscross the area, and the large number of hazardous material shipments that occur daily.

Petroleum and Natural Gas Pipeline Accidents:

Petroleum and Natural Gas Pipeline Accidents are an uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline. As a major petroleum and natural gas consumer in the United States, vast quantities of petroleum and natural gas are transported through and stored in Michigan. Though often overlooked as a threat because much of the petroleum and gas infrastructure in the state is located underground, petroleum and gas pipelines can leak, erupt, or explode, causing property damage, environmental contamination, injuries, and loss of life.

In addition to these hazards, there is also a danger of hydrogen sulfide release. Hydrogen sulfide is an extremely poisonous gas that is also explosive when mixed with air temperatures of 500 degrees or above. In addition to pipelines, these dangers can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has high sulfur content.

Oil and Natural Gas Well Accidents:

Oil and Gas Well Accidents are defined as an uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells. Oil and natural gas are produced from fields 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.

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 H₂S

| | |
|----------------------|--|
| 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, pain in the eyes and drowsiness after 15-30 minutes, followed by throat irritation after 1 hour. Several hours of exposure results in gradual increase in severity of these 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 | Immediate unconsciousness, with early cessation of respiration and death following within 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. In the vicinity of a coal mine, an old well can be a conduit for explosive gas to enter the mine, a serious mine safety problem. Also, where coal mining has occurred, an old well can allow acidic mine water to discharge at the surface.

Hazard Analysis

Both fixed site and transport-related hazardous material incidents involve the potential for evacuation (or sheltering in place), with significant problems possible for special populations in hospitals, schools, nursing homes, and other critical facilities. Areas at most risks are within a 1-to-5-mile radius of identified hazardous material sites. Many communities have detailed plans and procedures in place for responding to incidents at fixed sites, but releases can still cause severe harm to people, property, and the environment if proper mitigation actions are not taken in a timely manner.

Certain types of extremely hazardous substances may cause a public health emergency, and result in the need of triage, mass treatment, and congregate care. In addition to the direct impacts of the hazardous material event itself, transportation incidents may affect transportation infrastructure in the area and cause extensive delays in travel and the conduct of business.

The world's deadliest hazardous material incident occurred on December 4, 1984, in Bhopal, India. A cloud of methyl isocyanate gas, an extremely toxic chemical, escaped from a Union Carbide chemical plant, killing 2,500 people and injuring tens of thousands more. This incident triggered historical Federal legislation intended to minimize such disasters from occurring in the United States.

Though often overlooked, petroleum and natural gas pipelines pose a real threat in many Michigan communities. Petroleum and natural gas pipelines can leak or fracture 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.

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 (H₂S) release. These dangers (fully explained in the Oil and Natural Gas Well Accidents section) can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has a 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.

Hazardous Materials Incidents in Michigan

Michigan has not experienced such a large-scale hazardous material release involving mass casualties as that which occurred in Bhopal, India. This can be attributed, in large part, to the steps taken by government and private industry to carefully regulate those processes and practices that could cause an accidental hazardous material release. Michigan's population density is also lower, and its zoning and planning personnel tend to separate conflicting land uses from each other. Bhopal's 2001 population density was 12,655 persons per square mile, whereas Michigan's highest population density (according to the 2010 census) is the city of Hamtramck, at 10,751 persons per square mile. Bhopal's population was reported as totaling 1.5 million in 2001—Michigan's smaller and more widely spaced urban developments tend to make it less vulnerable to the most severe types of impacts, as do the regulations it currently has in place to oversee the handling of extremely hazardous substances.

Michigan has also been fortunate not to have a large-scale, serious hazardous material transportation incident. However, Michigan has had numerous smaller-scale hazardous material transportation incidents that required a response by local fire departments and hazardous material teams, and many events also required evacuations and other protective actions. Those types of incidents, while problematic for the affected community, are fairly commonplace. They 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 almost all hazardous material transportation incidents are the result of an accident or other human error. Rarely are they caused simply by mechanical failure of the carrying vessel. As a major manufacturer, user, and transporter of hazardous materials, Michigan will always be vulnerable to the threat of a serious hazardous material transportation incident.

The Michigan Hazard Analysis highlights significant accidents and their impacts in Michigan. Here is a synopsis of some of those incidents:

Case: May 1990 - City of Grant (Newaygo County) In May 1990, the Newaygo County Health Department investigated a complaint of a taste and odor problem associated with a private water supply well in Grant, Michigan. Laboratory results of a sample collected from the well indicated the presence of several volatile organic compounds (VOCs). The presence of contaminants in the well prompted the health department to sample other wells in the area. The sampling results identified over 40 residential wells contaminated with various VOCs. The primary contaminant in the area was determined to be tetrachloroethylene (PCE), a known human carcinogen that is a common solvent often utilized in dry cleaning operations. The results of a limited investigation by the state in 1990 identified a potential source. Further investigation revealed that a garage at the rear of the source property had formerly been used for dry cleaning operations where spent PCE was discharged to a floor drain for disposal.

Sampling confirmed the presence of PCE in soils surrounding and beneath. The DEQ installed and operated a soil vapor extraction (SVE) remediation system from December 1995 to July 1999 and removed over 500 pounds of PCE from the soils to eliminate the direct contact and indoor air inhalation hazards and minimize additional groundwater impacts. In May and October 2017, a return to the site areas for monitoring revealed additional properties affected by the plume. The DEQ installed soil vapor extraction (SVE) remediation systems at those properties also. The operation and maintenance of the mitigation systems, as well as the annual sampling performed to assess the effectiveness of the systems operations, will be performed under the statewide vapor mitigation contract. The need for additional activities to address the vapor intrusion pathway associated with this site will be assessed on a continuous basis to ensure that unacceptable exposure will not occur to potential receptors.

Case: June 23, 1999 - Lake County A broken gas main near the intersection of US-10 and M-37 in Pleasant Plains Township, Lake County, forced the evacuation of nearby residences (including senior and low-income housing complexes) until the main could be repaired.

Case: May 27, 2002 – Potterville A horizontal break in a railroad track running through Potterville caused the derailment of 35 cars from a 58-car Canadian National Railroad freight train. Nine cars contained liquid propane, two of which leaked the gas. About 2,200 citizens were evacuated for up to four days. Canadian National Railroad reimbursed residents who could document losses such as missed work, spoiled food, and hotel stays.

Case: July 7, 2006 - Tustin (Osceola County) A semi-truck overturned on US-131 in an accident involving ethanol fuel near Tustin in Osceola County. Both lanes of the highway were shut down. Over 2,000 gallons of fuel contaminated the soil, resulting in about 10,000 gallons of sludge being removed by the hazardous materials teams.

Case: September 15, 2007 – Lowell (Kent County) A fire and an explosion destroyed several connected buildings at a Lowell factory. The fire affected a quantity of 10% solution of sulfuric acid that was between 5 and 10 thousand gallons. There was a concern over the effect on groundwater, and on the Lowell municipal water supply. The blaze sent black and gray smoke billowing high into the evening sky, visible at least 10 miles away, and attracted hundreds of onlookers. A half-dozen area fire departments, from as far as East Grand Rapids and Belding, helped Lowell firefighters battle the blaze. There was at least one reported injury.

Case: February 26, 2008 - Grand Rapids (Kent County) A natural gas explosion occurring at 3:30pm on February 26, 2008, resulted in the collapse of a two-story building. Seven persons were injured, and five neighboring businesses suffered damage. A fire burned well into the night, due to an inability to shut off the natural gas until 9:30pm because the fire wouldn't allow access. Three quarters of the city's firefighters were involved in the effort, with neighboring departments covering calls in the city. A gas leak was also detected under the road.

Case: June 5, 2008 (Dart Oil Fire) Lightning from a Severe Thunderstorm hit a pole nearby the Dart Oil natural gas well located at South Cypress Ave and 96th Street in Ensley Township igniting the tank on fire. Flames leaped 60 feet into the air after the strike, but the oil eventually burned itself out. The tank is used to capture sludge that drips off from a natural gas well.



Case: May 16, 2010 – Kentwood (Kent County) A natural gas leak caused a four-unit apartment to explode, resulting in four injuries. The gas leak occurred in a vacant apartment in the complex. The scene resembled that of a tornado, with debris scattered nearby, shards of broken window glass littered on the ground, lumber lodged into a neighbor's garage, and siding propelled through a neighbor's window.

Case: 2000 and 2014 Campbell, Wyatt, and Cannon Pipeline Leak (Newaygo County)

In 2000, the DEQ and Grant Fire Department responded to a crude petroleum leak in the Muskegon River near Bell Meadow Subdivision. The leak was coming from a decommissioned 6–8-inch pipe that was once a transmission line owned by Campbell, Wyatt, and Cannon running from near Big Rapids to the Muskegon Refinery. The line crosses the Muskegon River in Section 14 of Bridgeton



Township and is exposed on the bottom of the river. As the pipe is no longer in service, it only contained residual crude oil. In an attempt to stop the leak, the DEQ contracted with Northern A-1 to cap the line and suction off any remaining crude oil.

Case: June 29th, 2014 – (Newaygo County) A property owner on Bell Meadow Subdivision contacted Newaygo County Emergency Services reporting an oil leak going into the river. After further investigation, the DEQ believes the leak is residual oil from contaminated ground and is being seeped into the river because of high ground water and deteriorating condition of the transmission line. With the assistance of Grant Fire Department and DNR Officer Ginn, absorbent booms and pads were placed to keep the sheen from spreading. The DEQ is currently working to resolve the leak permanently by removing any contaminated soil in addition to the section of the pipe running along the bottom of the Muskegon River.

Hazardous Materials in Muskegon County

Regardless of their type or classification, it is a fact that every Muskegon County citizen could potentially be affected by a hazardous materials incident, whether they live or work in a rural or urban community. This obviously results in a high level of risk. Muskegon County benefits from having a local response team to deal with these types of incidents.

Muskegon County Hazardous Materials Response Team

In order to respond to situations involving hazardous materials, the Muskegon County Hazardous Materials Response Team was created in 1982. The team consists of highly trained personnel who possess unique skills and equipment necessary to investigate areas where CBRNE (chemical, biological, radiological, nuclear, or explosive) materials may be present.

The Muskegon County Hazardous Materials Response Team serves Muskegon, Oceana, and Newaygo Counties under mutual aid agreements for hazardous materials emergency response and training. The Team has the capability to respond within Region 6 or anywhere within the State of Michigan. Capabilities include the ability to handle transportation accidents, chemical spills in business and manufacturing facilities, and acts of terrorism involving Weapons of Mass Destruction. The team takes corrective actions to stop or mitigate the release of hazardous materials, while safeguarding the welfare of citizens, emergency response personnel and the environment. The team also provides guidance and assistance to first responding fire companies at the scene of hazardous materials incidents. Each hazmat team member is certified as NFPA 472 Hazardous Materials Technicians and has over 200 hours of training. Team members also participate in on-going training for special situations, such as highway transportation emergencies and railroad tank car incidents.

Primary concerns in Muskegon County for hazardous materials, are identified sites that are required to meet regulatory requirements of the Superfund Amendment and Reauthorization Act (SARA) due to their quantity and type of extremely hazardous substances (EHS). Facilities

identified that must maintain a safety data sheet (SDS) in accordance with the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR 1910.1200 must submit the hazardous chemical inventory report if a hazardous chemical present at the facility meets or exceeds the reporting threshold. These Facilities are classified as SARA Title III 312 sites. Although they generally pose less risk than identified SARA Title III 302 sites, these facilities still pose a significant level of risk to their communities.

The following facilities have been identified as containing Extremely Hazardous Substances (EHS) at or above established reporting quantities as identified by the United States Environmental Protection Agency (EPA). As such, off-site response plans have been developed and are annually revised by the Emergency Management Department, Emergency Planning Committee, Site Coordinator, and local fire department. These plans are additionally designed to meet Firefighter Right to Know and MIOSHA HAZWOPER requirements.

Extremely Hazardous Substances (EHS) Facilities in Muskegon County:

- ADAC AUTOMOTIVE – Muskegon (2 SITES)
- AGS COMPANY AUTOMOTIVE – MUSKEGON HEIGHTS
- ALTA EQUIPMENT COMPANY – NORTON SHORES
- BAILEY WAREHOUSE - BAILEY
- CYTIVA – MUSKEGON TOWNSHIP
- BRUNSWICK BOWLING PRODUCTS - MUSKEGON
- CAMERON INTERNATIONAL – EGELSTON TOWNSHIP
- COLE’S QUALITY FOODS – MUSKEGON
- CONCEP METAL PRODUCTS - SPRING LAKE
- DIVERSIFIED MACHINE MONTAGUE - MONTAGUE
- FLEET ENGINEERS INC - MUSKEGON
- FRONTIER COMMUNICATIONS – MUSKEGON (SEVERAL SITES)
- FRONTIER COMMUNICATIONS – MUSKEGON HEIGHTS
- FRONTIER COMMUNICATIONS – NORTH MUSKEGON
- FRONTIER COMMUNICATIONS – WHITEHALL
- GREAT LAKES FINISHING - MUSKEGON
- HONEYWELL – MUSKEGON
- HOWMET CORPORATION – WHITEHALL (SEVERAL SITES)
- GE AVIATION - MUSKEGON
- JOHNSON TECHNOLOGY – NORTON SHORES
- KNOLL INC – MUSKEGON TOWNSHIP
- RENK- MUSKEGON
- MICHIGAN SPRING AND STAMPING – ROOSEVELT PARK
- MUSKEGON HEADEND, PAY CENTER, TECH OPS – NORTON SHORES
- PORT CITY CASTINGS CORP – MUSKEGON

- QUALITY PLATING CO INC – MUSKEGON HEIGHTS
- SAF – HOLLAND INC – MUSKEGON
- SAMS CLUB – MUSKEGON
- SHORELINE DIVISION – MUSKEGON
- SNAPPY APPLE FARMS – CASNOVIA
- STRUCTURAL CONCEPTS CORP – NORTON SHORES
- SUN CHEMICAL CORPORATION – EGELSTON TOWNSHIP
- TGW SYSTEMS INC – SPRING LAKE
- TOWER LABORATORIES – MONTAGUE
- WACKER NEUSON – NORTON SHORES
- WEBB CHEMICAL SERVICE CORP INC – MUSKEGON HEIGHTS

It is unknown how many more businesses and farms throughout the county utilize, store, or transport reportable quantities of Extremely Hazardous Substances (EHS) and who are not reporting under the Community Right-to-Know law, therefore, the above list is not all inclusive.

Naturally, hazardous materials utilized at local fixed sites don't just magically appear and disappear. They simply must arrive and leave the community through some method. As such, regular shipments of hazardous materials travel through Muskegon County on primary and secondary local transportation routes on a regular, daily basis. Primary highways such as M-37, M-46, and US-31, I-96 are not only utilized for transportation of shipments to and from local business/industry but are also heavily utilized for transportation of shipments to statewide and neighboring jurisdiction facilities. Secondary routes, such as local county roads, provide concern, as they are necessary to transport shipments either to or from local businesses to the main highways. Although these routes are secondary roads, many of these are located in populated or vulnerable areas.

In addition, several hazardous materials are shipped on Michigan Shore and Mid-Michigan rail lines (owned by Genesee and Wyoming Holding Company) as well as Pere Marquette Railway on the eastern edge of Muskegon County. These materials include Calcium Carbonate, Hot Asphalt, and other petroleum products.

Muskegon County also has natural gas and petroleum pipeline infrastructure running through the County. Large compressor stations, pipelines, and other resources make the jurisdiction's pipeline emergencies a concern on a statewide basis. The 200,000 miles of oil pipelines traversing this country represents an estimated \$200 to \$400 billion investment in an infrastructure that is vital to our economy, safety, and standard of living. The nation's pipelines are a transportation system that enables the safe movement of extraordinary quantities of energy products to industry and consumers, literally fueling our economy and way of life. The arteries of the Nation's energy infrastructure, as well as the safest and least costly ways to transport energy products, our oil and gas pipelines provide the resources needed for national

defense, heat and cool our homes, generate power for business and fuel an unparalleled transportation system. The United States has the largest network of energy pipelines – both oil and natural gas -- of any nation in the world. The oil pipeline network alone in the U.S. is more than 10 times larger than that in Europe.

Based on historical occurrences, Muskegon County experiences a hazardous materials incident on average, approximately once every two to three years. Muskegon County has 15 miles of 10-inch Marathon pipeline, pumping gasoline from Indiana to the company's northernmost Michigan terminal in North Muskegon. And just south of Muskegon County, Wolverine Pipeline Co. operates an eight-inch pipeline from Niles to its Ferrysburg terminal. Muskegon County soil also holds 38.5 miles of high-pressure natural-gas transmission pipelines owned by MichCon, a subsidiary of DTE Energy. That total does not count gathering or distribution pipelines, such as lines that deliver gas to a customer's home or business.



Devoogd/Muskegon Chronical retrieved 2-23-2022
 from https://www.mlive.com/news/muskegon/2010/10/what_lies_beneath_large_gas_pi.html

The following are hazardous materials incidents which have occurred in Muskegon County:

Case: February 22, 1986 - Muskegon (Muskegon County) A Muskegon County pipeline break occurred when an 8-inch high-pressure Marathon Oil pipeline ruptured, spilling thousands of gallons of gas into streams feeding Ruddiman Creek. Gas vapors also caused some minor house explosions that forced dozens of Lakeside-Glenside residents to flee. No one was injured in the incident, although the environment suffered damage. This line is no longer in use.

Case: April 22, 1990 – Egelston Township (Muskegon County) A release of phosphorus oxychloride from a plant created a toxic plume that covered a two-mile area, forcing the evacuation of 1,000 people from two mobile home parks.

Case: December 2, 1996, Muskegon (Muskegon County) the NOAA research vessel (R/V) Halcyon sank at the West Michigan Dock and Market Pier in approximately 30 feet of water. The 60-foot Halcyon, owned and operated by the NOAA Great Lakes Environmental Research Laboratory (GLERL), had 2,400 gallons of diesel and four 55-gallon drums of antifreeze and waste oil onboard when she sank. The drums floated off the vessel, remained in the slip area, and were recovered. It was presumed that fuel was leaking out of the fuel-tank vents because silver and rainbow sheens were observed in the area. Containment boom was deployed around the vessel on December 3. No sheens were observed beyond the immediate slip area throughout the incident.

Case: June 4, 1999 - Whitehall (Muskegon County) At a tannery, a tanker truck driver unloaded (unknowingly) a shipment of sodium hydrosulfide solution into a storage tank normally used exclusively for ferrous sulfate solution, creating a chemical reaction that produced hydrogen sulfide – a poisonous gas. The truck driver was pronounced dead at the scene after having been overcome by the hydrogen sulfide gas. An employee of the tannery was rendered unconscious by the gas, but regained consciousness in time to avoid lasting, serious injury. Eleven employees at the tannery were evacuated. Total property damage was in excess of \$411,000.

Case: April 12, 2000 – Egelston Township (Muskegon County) A chemical plant explosion that injured 10 people was believed to be caused by tetranitromethane, once used to make rocket fuel. Although the plant never produced the chemical, it may have been an unintended by-product of the company's herbicide production. The explosion shook buildings more than a mile from the plant and hurled sections of steel I-beams onto the roof of a nearby factory more than 200 yards away. The cleanup operation forced the evacuation of businesses within a one-half mile safety zone.

Case: August 28, 2007 - Muskegon (Muskegon County) A house exploded after a contractor accidentally struck a natural gas line. Fortunately, no one was inside the home when the incident occurred. The explosion also caused damage to a neighbor's house.

Case: July 21, 2010 - Ravenna (Muskegon County) A man was killed in a propane leak explosion that destroyed his mobile home. The man had attempted to convert a kitchen stove from natural gas to propane, but a leak later occurred, resulting in the explosion while he was sleeping.

Case: January 20, 2012 Egelston Township (Muskegon County) Emergency officials say no one was endangered by a minor, quickly controlled spill of liquid hydrochloric acid. According to Egelston Township Fire Department officials, approximately 10 gallons of the acid spilled inside the company's diked area around 10:30 p.m. Sun's safety workers called local emergency authorities and contained and cleaned up the spill before outside agencies arrived.

Case: June 11, 2014 (Muskegon County) The chemical exposure at a wave pool at Michigan's Adventure resulted from the inadvertent mixing of two common household pool chemicals, muriatic acid, and sodium hypochlorite. 50 people received care, 28 of them were taken to two separate hospitals. At least two of the patients assisted by emergency responders were lifeguards.

Case: February 14, 2017, Whitehall (Muskegon County) - A heavy metals fire in a dust collector prompted the evacuation of a plant at Arconic (formerly Alcoa). The fire, discovered by employees, occurred when a spark ignited titanium, copper and brass particles collected in a large dust collection system. Such fires occur a couple of times a year and the plant keeps a dry chemical for fire suppression on site.

Case: March 15, 2017 - Muskegon (Muskegon County) Muskegon Casting corporation explosion all 40 employees escaped. It is believed that the fire began when a propane tank used to melt materials malfunctioned. Employees grabbed fire extinguishers, but quickly realized the blaze was too big and evacuated, he said. The fire began in the north end of the plant where the automotive castings are produced. It spread throughout the sprawling, 75,000-square-foot plant, reducing the building to rubble and destroying finished products stored on wooden pallets that were ready to ship.

Case: May 22, 2017- Norton Shores, MI (Muskegon County) HCl (Sulfuric Acid) Spill The spill occurred after a bulk transport container containing 220 gallons of sulfuric acid fell from a forklift and leaked. The Muskegon County Hazmat team, Webb Chemical, and Youngs environmental were involved in containment and clean up. Two people were severely injured.

Case: May 5, 2017 – Muskegon, MI (Muskegon County) Muskegon Catholic Central

Numerous students and staff reported feeling ill and having trouble breathing. They were evacuated from the building and Muskegon County Haz mat team responded. The substance was determined to be pepper/OC spray.

Case: August 25, 2017 - Unknown White Powder Musk Correctional Facility –

Muskegon (Muskegon County) Was discovered in the mail room addressed to an inmate. Possibly a controlled substance.

Case: September 9, 2017 - Whitehall (Muskegon County)

Chlorine vapors with a patient. Pool Chemical incident resulting in chlorine gas release inside a residence in Whitehall. Pt was transported for evaluation, and chemical mixture was removed and disposed of.

Case: November 11, 2017 - Dalton Twp (Muskegon County) Fuel spill occurred from a box truck accident. No other details.

Case: May 21, 2018 - Dalton Twp (Muskegon County) a large diesel fuel spill from the saddle tanks of a tandem trailer semi that rolled over during a fatal collision on M120. The driver was ejected during the crash and buried underneath the gravel that was spilled the tandem trailers.

Case: December 5 2018 - Norton Shores (Muskegon County) 1700 block of W Sherman Blvd. 3 transformers were taken down and leaking oil into a storm drain from a car vs pole accident. It tested negative for PCBs and leak was traced downstream and boomed to prevent further travel.

Case: January 20, 2019 - Egelston Township (Muskegon County) - six-hour leak of anhydrous ammonia. The release from a chiller unit began at 3 p.m., lasted some six hours and released some 1,400 pounds of anhydrous ammonia into the air at the pigment plant. No one was injured in the incident and no employee or neighborhood was endangered.

Case: January 21, 2019 - Norton Shores (Muskegon County) About 35 employees were inside the plant at 2875 Lincoln in Norton Shores, 10 of whom were near the furnace, when the explosion occurred just after 5 p.m. The furnace located in the north end of the plant. An adjacent furnace was not involved. The explosion sprayed molten metal all over the plant's interior, causing a fire to rage inside. Norton Shores Fire Chief David Purchase said firefighters could not enter the plant to attack the fire due to the molten metal and extreme amount of smoke.

Case: January 22, 2019 - Whitehall (Muskegon County) - Arconic Plant #10 had a line rupture spraying potash in a room. The release was contained to that room, and the line was shut down, and clean up company mitigated the product released.

Case January 24, 2019 - Muskegon Twp (Muskegon County) Chemical odor in a residence, reporting symptoms of irritation to eyes and nasal passage, further investigation revealed a malfunctioning furnace that was not exhausting properly.

Case: March 26, 2019, Holton, MI (Muskegon County) Fuel spill resulting from a vehicle accident.

Case: April 22, 2019 - Muskegon Heights (Muskegon County) 500 W Broadway, Garbage truck fire inside a commercial storage building, that damaged the saddle tank, and was actively leaking diesel fuel after fire extinguishment.

Case: May 6, 2019 - Muskegon (Muskegon County) 1300 blk Keating Ave During the household hazardous waste collection day, a container labeled radioactive was received at the County Facility on Keating. Rad monitoring of the container was conducted, and contents were not emitting any forms of radiation.

Case: May 7, 2019, Mooreland Twp (Muskegon County) 2500 block of Mooreland, Fertilizer Spill due to a vehicle accident.

Case: December 30, 2019 - Muskegon Heights (Muskegon County) Sulfuric Acid Spill 90 gallons of sulfuric acid spilled at Quality Plating. The highly corrosive and toxic acid leaked onto the ground after a bulk transport container fell from a forklift outside the plant. Muskegon Heights firefighters responded to the call and quickly took measures to isolate the spill with absorbent material, preventing it from entering storm drains. Neutralizing material was spread on the spilled acid. The Muskegon County Hazardous Materials Response Team was assisted by Webb Chemical.

Case: January 29, 2020 - Muskegon (Muskegon County) Muskegon fire fighters were called to a hazardous materials spill at a construction site Wednesday afternoon. Crews were building a new event center in downtown Muskegon when they believe they struck an oil well.

Case: August 19, 2020 - Norton Shores (Muskegon County) 372 Randall Rd, Fuel spill from a boat fire.

Case: August 29, 2020 - Muskegon Twp (Muskegon County) Semi-Tractor accident with fuel leak. A crash in a construction zone with backed up traffic, involved a motorcycle, a semi-tractor trailer and multiple other vehicles. One person died and another was severely injured. The semi-tractor trailer leaked 200 gallons of fuel following the crash.

Case: September 3, 2020 - Norton Shores (Muskegon County) 3139 McCracken, Vehicle accident involving power poles with possible PCBs.

Case: December 29, 2020 - Norton Shores (Muskegon County) 2860 McCracken, Fire at a Knoll Chemical Facility.

Case: June 23, 2021 - Norton Shores (Muskegon County) Semi-Tractor accident with Fuel Spill. One person injured after crashing a semi-truck into a bridge on US-31 southbound. US-31 southbound was closed between Sherman Boulevard and Airline Highway for several hours due to the crash.

History of Hazmat Incidents in Muskegon County January 2015-December 2022

| Municipality | Fire Dept | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | FD TOTALS |
|--|---|------|------|------|------|------|------|------|------|-----------|
| Blue Lake Township | Blue Lake Township | 4 | 4 | 1 | 6 | 1 | 2 | 4 | 5 | 27 |
| Casnovia Township + Casnovia Village | Casnovia Fire Department | 1 | 1 | 4 | 3 | 0 | 0 | 1 | 0 | 10 |
| Dalton Township + Lakewood Club Village + part of Cedar Creek Township | Dalton Township | 7 | 2 | 5 | 4 | 1 | 12 | 6 | 14 | 51 |
| Egelston Township | Egelston Township/Bridgeton in Newaygo County | | | | | | | | 4 | 4 |
| Fruitport Township + Fruitport Village + Sullivan Township | Fruitport Area Fire Department | 5 | | 5 | 10 | 7 | 18 | 11 | 20 | 76 |
| Holton Township | Holton Township | 2 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 6 |
| Montague City + Montague Village + White River Township | Montague Fire District | | | | | | | | | |
| Moorland Township | Moorland Township Fire Department | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 4 |
| Muskegon City | Muskegon Fire Department | 48 | 34 | 46 | 45 | 55 | 81 | 70 | 83 | 462 |
| Muskegon Charter Township + Laketon Township | Muskegon Charter Township Fire Department | 22 | 20 | 22 | 33 | 31 | 28 | 31 | 27 | 214 |
| Muskegon Heights City | Muskegon Heights Fire Department | 11 | 19 | 1 | 11 | 10 | 23 | 32 | 36 | 143 |
| North Muskegon City | North Muskegon Fire Department | | | | | | | | | |
| Norton Shores City + Roosevelt Park | Norton Shores Fire Department | 18 | 17 | 20 | 17 | 19 | 16 | 23 | 40 | 170 |
| Ravenna Village + Ravenna Township | Ravenna Area Fire Department | 0 | 0 | 0 | 1 | 0 | 2 | | | 3 |
| Whitehall City + Whitehall Township + Fruitland Township | White Lake Fire Authority | 16 | 10 | 7 | 15 | 15 | 9 | 12 | 13 | 97 |
| | TOTALS PER Year | 134 | 108 | 111 | 145 | 140 | 194 | 190 | 245 | 1267 |

Blank field = no data received

Hazardous Materials Vulnerability and Impacts:

One of the most significant risks to health and safety is exposure, which can cause health effects from minor irritations to severe injuries or illnesses. Evacuations or shelter in-place orders may be necessary to protect the public from exposure to hazardous materials. Additionally, hazardous materials can pose fire or explosion hazards, either alone or in combination with other substances, posing risks of injury or death to responders and nearby individuals. Lastly, hazardous materials released into the environment can contaminate soil, air, and water, which can have long-term effects on human health and the environment.

INFRASTRUCTURE FAILURE

Infrastructure Failure

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

Hazard Description

Public and private utility infrastructure provides 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 inter-related systems fails 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. When the water or wastewater treatment systems in a community are inoperable, serious public health problems arise that must be addressed immediately to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur.

All of these situations can lead to disastrous public health and safety consequences if immediate actions are not taken. Typically, it is the most vulnerable segments of society - the elderly, children, ill or frail individuals, etc., that are most heavily impacted by an infrastructure failure. If the failure involves more than one system, or is large enough in scope and magnitude, whole communities and even regions can be negatively impacted.

Hazard Analysis

Infrastructure failures can occur at any time and in any place in the state of Michigan and have the potential to affect hundreds of thousands of people. The risk of failure grows each year, as physical and technological infrastructure gets steadily more complex, and the interdependency between various facets of infrastructure (like pipelines, telecommunications lines, and roads) becomes more intertwined. Additionally, more vulnerable and aging infrastructure (rail lines, electrical components, bridges, roads, sewers, etc.) is in need of repair. Because of these reasons, large-scale disruptions in various components of infrastructure are likely. Major disruptions could lead to widespread economic losses, limit security, and altered ways of life.

As the Nation'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 many components have far exceeded their useful service life. This creates a situation of increasing risk from infrastructure-

related disasters, either as a primary event, or as a secondary event from 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 severe public health and safety concerns.

Infrastructure Failure in Michigan

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.

Two recent major engineering studies provide a glimpse of the extent of the infrastructure repair and rebuilding effort required just for Michigan to keep up with current and anticipated demand. The first study, completed by the American Society of Civil Engineers (ASCE) in 2009, found the results listed below.

Key Infrastructure Facts

- 38% of Michigan's roads are in poor or mediocre condition, rated the 3rd worst state in the United States.
- In 2005, 39% of Michigan's urban highways were congested, compared to 23% in 2000.
- Michigan Department of Transportation will have a 15% decline in funding between 2008 and 2011.
- Michigan has the 8th worst road system in the nation, based on overall performance.
- Michigan is 6th in the nation in the total cost of road miles needed.
- A total of 23,000 road lane miles will need to be repaired or replaced by 2015, while expected funding will pay for only 876 lane miles, just 4% of what is needed.
- 25% of Michigan's bridges are structurally deficient or functionally obsolete.
- By 2030, unless additional roadway capacity is added, rush hour travel in major urban areas will take up to 50% longer to complete in Michigan.
- Driving on crumbling roads costs Michigan motorists a total of \$2.6 billion per year.
- An additional 30% of Michigan roads will decline to fair or poor condition over the next decade.

- Under current funding mechanisms, Michigan stands to lose nearly \$1 billion in federal funds each year, because its transportation agencies will not have enough revenue to provide the required matching funds.
- Michigan's drinking water infrastructure needs \$11.3 billion over the next 20 years.
- Michigan's wastewater infrastructure needs \$6 billion over the next 20 years.
- Michigan Department of Environmental Quality estimates that less than 40% of the State's storm water infrastructure has even been reviewed for its impact on water quality.
- 52% of Michigan's schools have at least one inadequate building feature.
- There are 84 high hazard dams in Michigan. A high hazard dam is defined as a dam whose failure would cause a loss of life or significant property damage.
- A significant portion of the state's primary water distribution system is nearly 100 years old, with 80% of the city of Detroit's piping system having been installed before 1940.
- In 2007 alone, 26 billion gallons of raw or partially treated sewage spilled into surface waters in the state of Michigan, and 23 billion gallons, or 88% of the state total of sewage spilled into surface waters, were located in Detroit.

The ASCE study found a common thread nationwide of an increase in demands on public infrastructure without a corresponding increase in funding to perform the necessary maintenance and repairs on facilities, and to re build aging or dilapidated facilities.

Unfortunately, Michigan has had its share of infrastructure failures, mostly due to the effects of natural disasters such as snow and ice storms, severe cold, windstorms, tornadoes, and floods. Michigan has had numerous widespread and severe electrical power outages, caused mostly by severe weather such as windstorms or ice and sleet storms. In addition, Michigan has had several power outages in recent years that left upwards of 500,000 people (roughly 5% of the State's population) without power for periods lasting from several hours to several days at a time. Fortunately, most of those occurred during months when severe cold temperatures were not a problem. If they had occurred during the cold winter months, there certainly would have been a potential for loss of life – especially among the elderly and other more vulnerable members of society. The following are incidents highlighted in the 2012 Michigan Hazard Analysis.

Case: July 7, 1991 Electric Power Infrastructure Failure

One of the major electrical blackout events due to storms was on July 7, 1991 when a powerful wind storm affected a large portion of central North America and knocked out power to over 1 million customers from Iowa to Ontario. Almost the entire lower half of the lower peninsula of Michigan was affected by the derecho, with wind gusts of 65 to 85 mph. Electrical power was cut off to around 850,000 customers in Michigan alone, which was the largest number of customers to lose power from a single storm up to that time.

Case: Winter of 1993/94 Northern Michigan Water Supply and Sewer Infrastructure Failures

The underground freeze disaster in northern Michigan in 1994 provided an indication of how vulnerable our public water and sewer infrastructure can be to the adverse effects of natural phenomena. Due to a prolonged period of severe cold weather that caused ground frost to greatly increase beyond normal depths, municipal water and sewer systems in ten counties partially failed, disrupting service to over 18,000 homes and businesses and causing over \$7 million in infrastructure damage. Some of the homes and businesses were without normal water and sewer service for several weeks. At final count, over 3,200 water and sewer lines had been frozen and/or broken, making this infrastructure failure not only unusual but also unprecedented in U.S. history in terms of scope and magnitude. This disaster showed how vulnerable our underground infrastructure can be when the “right” set of natural conditions occurs. Furthermore, these types of disasters may occur with greater frequency in the future, as our public infrastructure ages and thus becomes more fragile (and since most systems are not built to be “disaster resistant/disaster proof” in the first place).

Case: January 1, 2000 Statewide Y2K – Electric Power Infrastructure Failure

The most anticipated electric power failure in the history of humankind never actually occurred. The much-celebrated year 2000 (commonly known as Y2K) computer conversion crisis was considered by many to be the biggest “non-event” ever. Actually, several years of mitigation and preparedness efforts had paid off on the morning of January 1, 2000, when the electric power grid and other critical public utility systems remained operational – stemming fears that there would be widespread power outages, resource shortages, and economic and social chaos. The electrical grid in Michigan and across the country continued to operate on January 1 and beyond, without so much as a hiccup – a testament to the proactive efforts of the electric power industry.

Case: August 2003 Northeastern United States Electrical Blackout

On Aug. 14, 2003, most residents of the northeast United States and Ontario were hit by the largest blackout in North America's history. Electricity was cut to 50 million people, bringing darkness to customers from New York to Michigan. Some essential services remained in operation in most of these areas, although backup generation in some cities was not up to the task. The phone systems remained operational in most areas; however, the increased demand by people phoning home left many circuits overloaded. Water systems in several cities lost pressure, forcing boil-water advisories. Cellular telephones experienced significant service disruptions as their transmission towers were overloaded with a sudden increase in the volume of calls. Television and radio stations mostly remained on the air, with the help of backup generators, or by relaying their broadcasts through the Grimsby transmission towers, which were online throughout the blackout. Most interstate rail transportation in the United States was shut down, and the power outage's impact on international air transportation and financial markets was widespread. Meanwhile, the reliability and vulnerability of all electrical power grids

were called into question. Total costs of the blackout have been estimated at between 4 and 10 billion dollars.

Case: Flint Water Crisis – Lead and other contaminants

In 2013 the city changed five-decade practice of piping treated water for its residents from Detroit in favor of a cheaper alternative: temporarily pumping water from the Flint River until a new water pipeline from Lake Huron was built. Although the river water was highly corrosive, Flint officials failed to treat it, and lead leached out from aging pipes into thousands of homes. Soon after residents started complaining that the water from their taps looked, smelled, and tasted foul. Despite protests by residents lugging jugs of discolored water, officials maintained that the water was safe. Water samples collected from 252 homes through a resident-organized effort indicated citywide lead levels had spiked, with nearly 17 percent of samples registering above the federal “action level” of 15 parts per billion (ppb), the level at which corrective action must be taken. More than 40 percent measured above 5 ppb of lead, which the researchers considered an indication of a “very serious” problem. September 2015 a Flint pediatrician, found The incidence of elevated blood-lead levels in children citywide had nearly doubled since 2014—and nearly tripled in certain neighborhoods. In Flint, nearly 9,000 children were supplied lead-contaminated water for 18 months.

The city’s switch from Detroit water to the Flint River coincided with an outbreak of Legionnaires’ disease (a severe form of pneumonia) that killed 12 and sickened at least 87 people between June 2014 and October 2015. The third-largest outbreak of Legionnaires’ disease recorded in U.S. history—as well as the discovery in 2014 of fecal coliform bacteria in city water—was likely a result of the city’s failure to maintain sufficient chlorine in its water mains to disinfect the water. Ironically, the city’s corrective measure—adding more chlorine without addressing other underlying issues—created a new problem: elevated levels of total trihalomethanes (TTHM), cancer-causing chemicals that are by-products of the chlorination of water.

In early 2016, a coalition of citizens and groups - Concerned Pastors for Social Action, NRDC, and the ACLU of Michigan—sued the city and state officials in order to secure safe drinking water for Flint residents. In November 2016, a federal judge ordered the implementation of door-to-door delivery of bottled water to every home without a properly installed and maintained faucet filter. In March of 2017 as part of a major settlement, the city was required to replace the city’s thousands of lead pipes with funding from the state, and guaranteeing further funding for comprehensive tap water testing, a faucet filter installation and education program, free bottled water through the following summer, and continued health programs to help residents deal with the residual effects of Flint’s tainted water.

Modern science shows that even low levels of lead can impair the brain development of fetuses, infants, and young children. The damage can reverberate for a lifetime, reducing IQ and physical growth and contributing to anemia, hearing impairment, cardiovascular disease, and

behavioral problems. Large doses of lead exposure in adults has been linked to high blood pressure, heart and kidney disease, and reduced fertility.

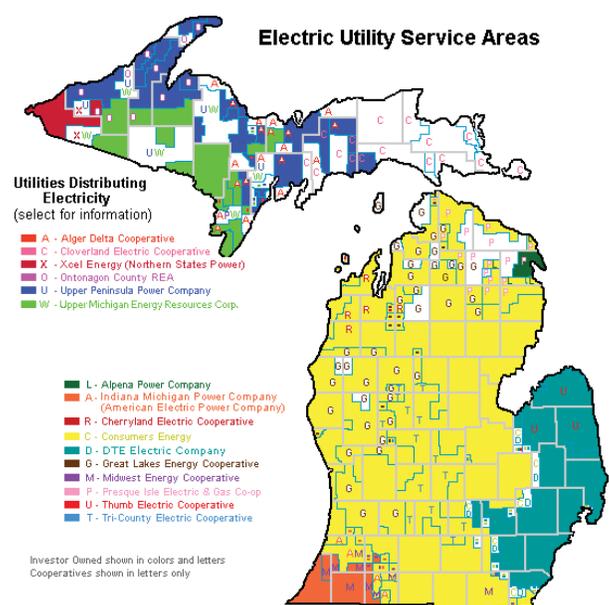
Pure lead pipes, solder, and fittings were banned from U.S. water systems in 1986 (it was only in 2014 that allowable lead levels in plumbing and fixtures dropped to 0.25 percent), and national regulations for lead testing and treatment of public water supplies were established in 1991 with the Lead and Copper Rule. While action by the water utility is required once the level of lead in public water supplies reaches 15 ppb (as measured at the 90th percentile of samples collected), the EPA acknowledges that “there is no safe level of exposure to lead.” Independent tests conducted in fall 2015 revealed that nearly 17 percent of samples from hundreds of Flint homes measured above the 15 ppb federal lead action level, with several samples registering above 100 ppb.

Infrastructure Failure in Muskegon County edit

Due to older utility systems, Muskegon County has historically been affected by localized infrastructure failures of critical electrical, telephone, and public safety communications services. Based on historical occurrence, Muskegon County on average, experiences hundreds of infrastructure failures annually. Despite the majority of these occurrences being brief in nature and of limited effects, they have clearly demonstrated the potential of significant public safety and economic concerns posed by larger magnitude incidents. Primary concern for this hazard focuses on the lack of critical back-up systems to facilitate an effective response to such incidents.

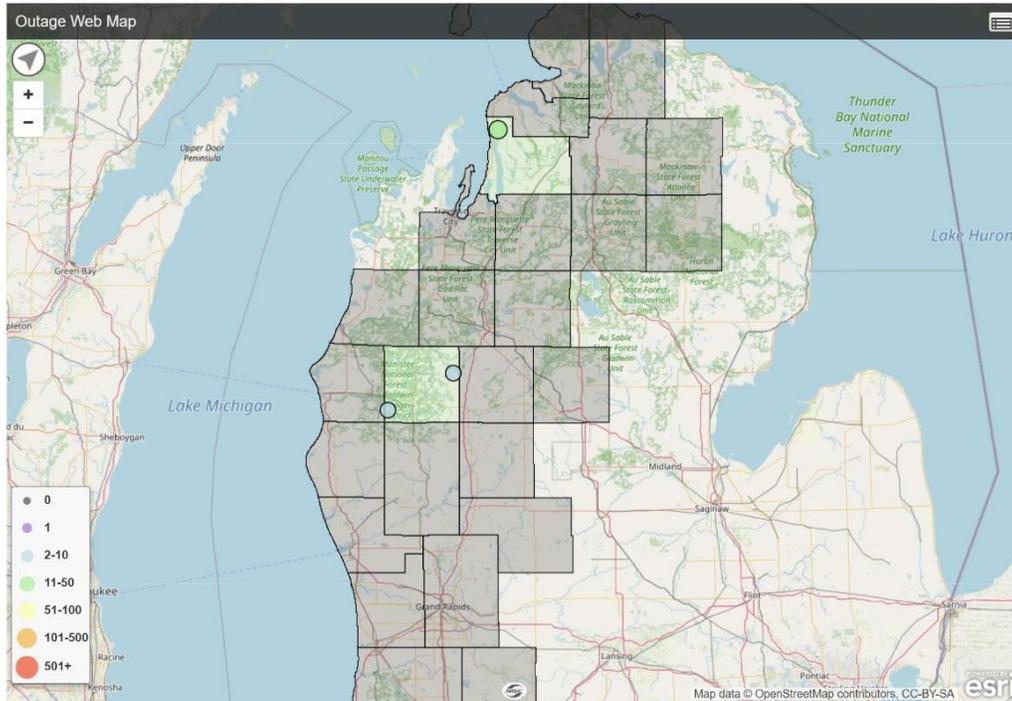
Electrical infrastructure failure is not only a common occurrence in Muskegon County but is also an identified consequence of many other local hazards. This has resulted in intense concerns by emergency management and response officials focused on the lack of generator capability at critical facilities identified as shelters (primarily schools). Muskegon County is serviced by two private electric companies, Great Lakes Energy and Consumers Energy.

These companies own the distribution lines and infrastructure to provide electricity to the public. Great Lakes Energy has 1,865 customers in Muskegon County. Consumers Energy has 83,706 Customers in Muskegon County. ITC Transmission is also a private company that owns a majority of the transmission lines and electrical substations within Muskegon County. Great Lakes Energy and Consumers Energy utilize ITC Transmissions’ infrastructure to distribute power to end users.

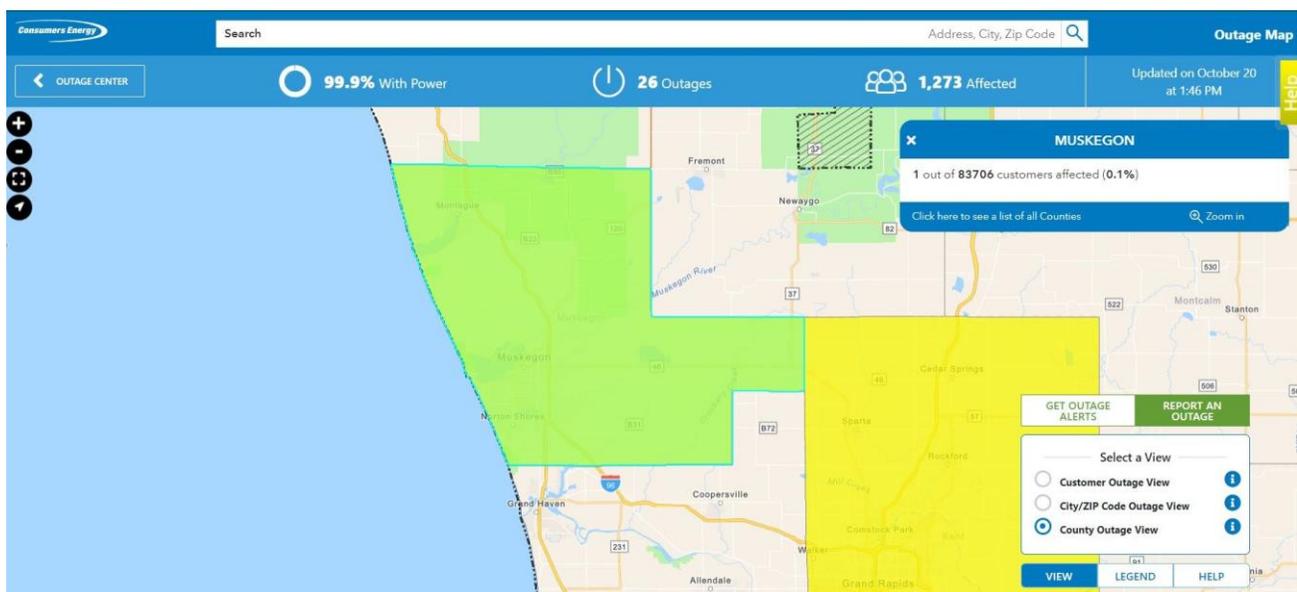


Both Great Lakes Energy and Consumers Energy maintain online outage maps where the public can access information on current outages. Information is listed via county and zip code. Consumers Energy’s website also contains status information on the outage and estimated restoration times.

Great Lakes Energy - <https://www.gtlakes.com/power-outages/>



Consumers Energy - <http://www.consumersenergy.com/outagemap>



<https://www.michigan.gov/mpsc/consumer/electricity/customer-outage-history>

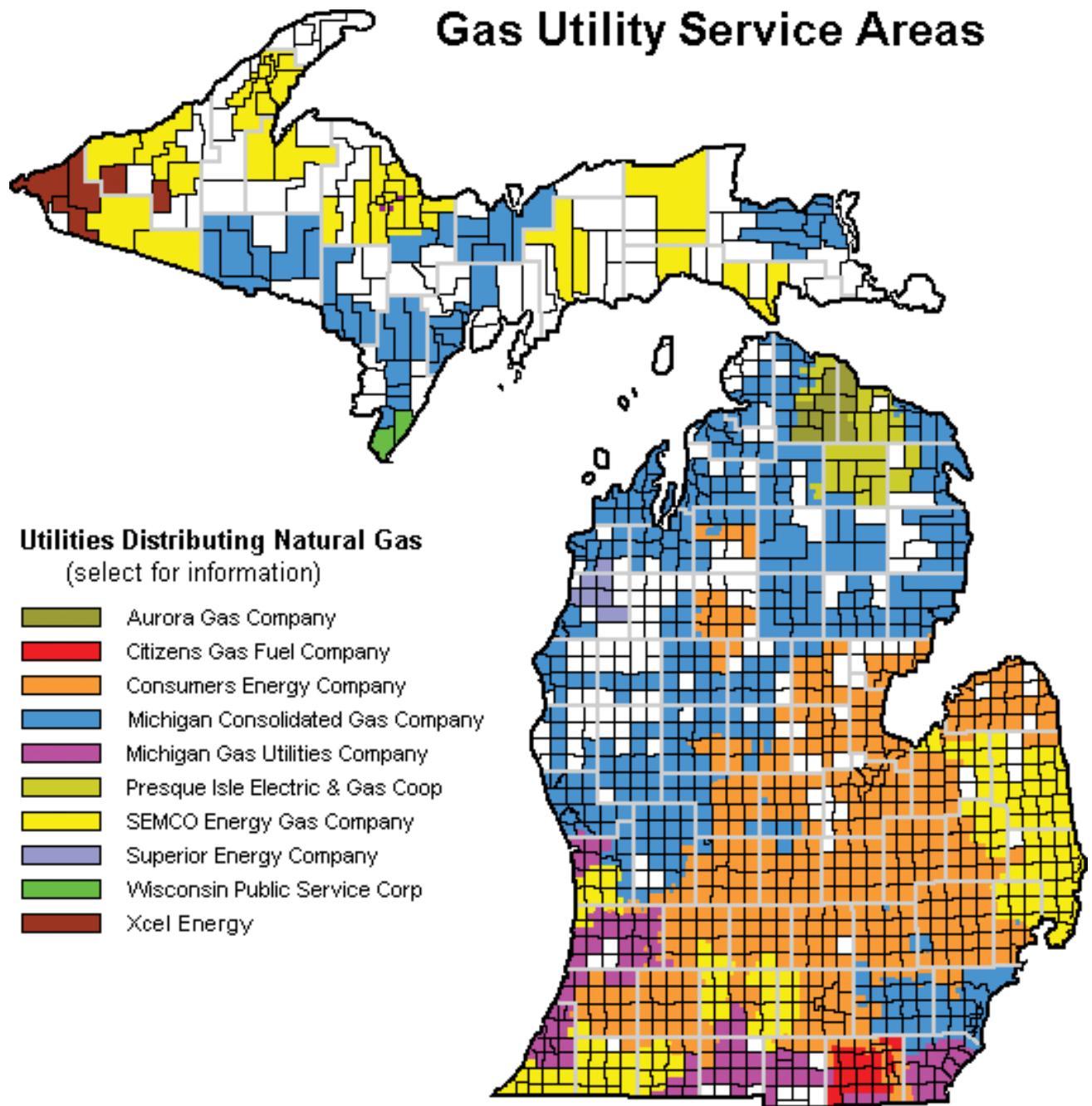
Storm outage data for January 2023 through August 2023 is shown below for the utilities regulated by the MPSC. This data will be updated as final numbers are received from the utility reports submitted in U-21122. Initial reported outages are denoted by an asterisk (*).

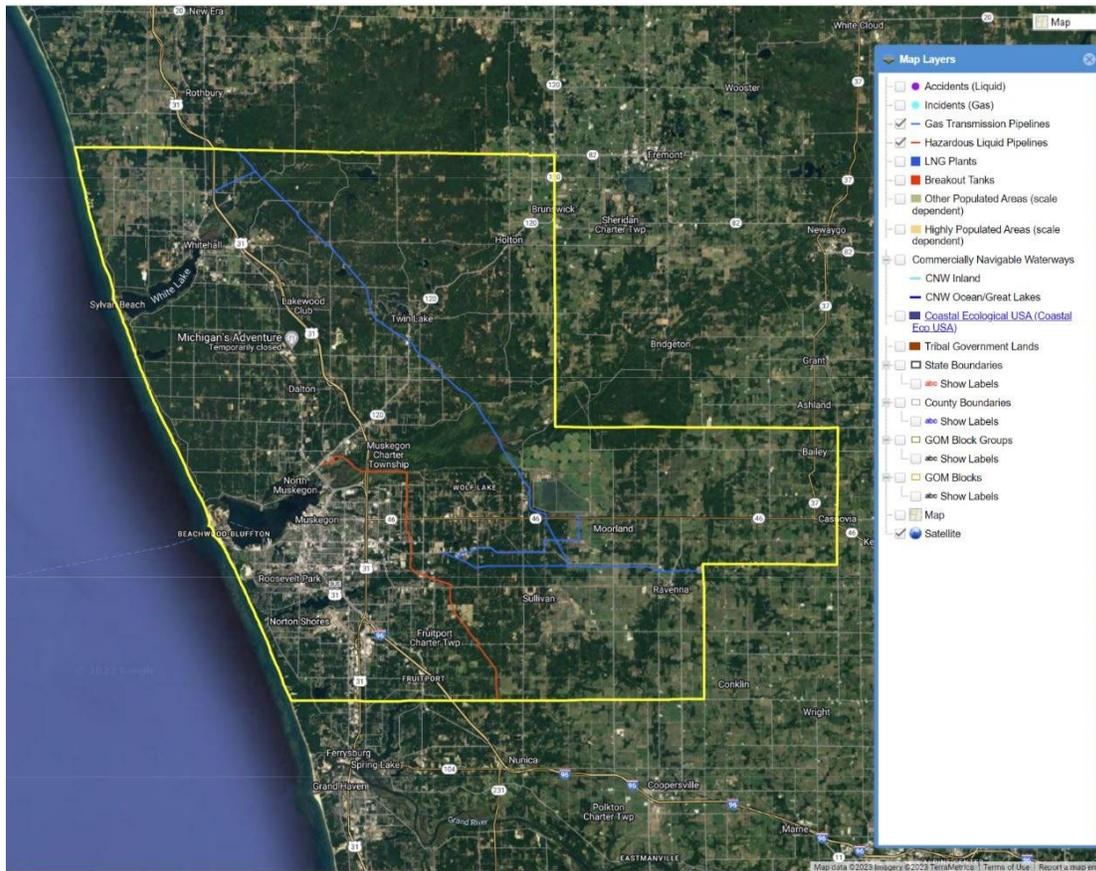
2023 Utility Outages

| Start Date of Event | Utility | Total Outages |
|---------------------|---------|---------------|
| 8/26/2023* | CE | 195,988 |
| 8/26/2023* | DTE | 317,179 |
| 8/15/2023* | I&M | 9,000 |
| 7/26/2023* | CE | 28,000 |
| 7/26/2023* | DTE | 153,000 |
| 7/26/2023* | UMERC | 7,500 |
| 7/26/2023* | NSPW | 745 |
| 7/20/2023* | CE | 36,000 |
| 7/20/2023* | DTE | 90,354 |
| 7/1/2023* | CE | 28,000 |
| 6/25/2023 | CE | 47,166 |
| 6/29/2023 | CE | 24,459 |
| 6/25/2023 | DTE | 162,866 |
| 5/1/2023 | UMERC | 7,513 |
| 5/1/2023 | UPPCO | 23,359 |
| 4/30/2023 | NSPW | 741 |
| 4/17/2023 | NSPW | 719 |
| 4/5/2023 | CE | 27,116 |
| 4/1/2023 | CE | 10,247 |
| 3/25/2023 | DTE | 56,808 |
| 3/10/2023 | CE | 7,258 |
| 2/22/2023 | DTE | 866,257 |
| 2/22/2023 | CE | 484,557 |
| 2/15/2023 | DTE | 41,506 |
| 2/15/2023 | CE | 33,372 |

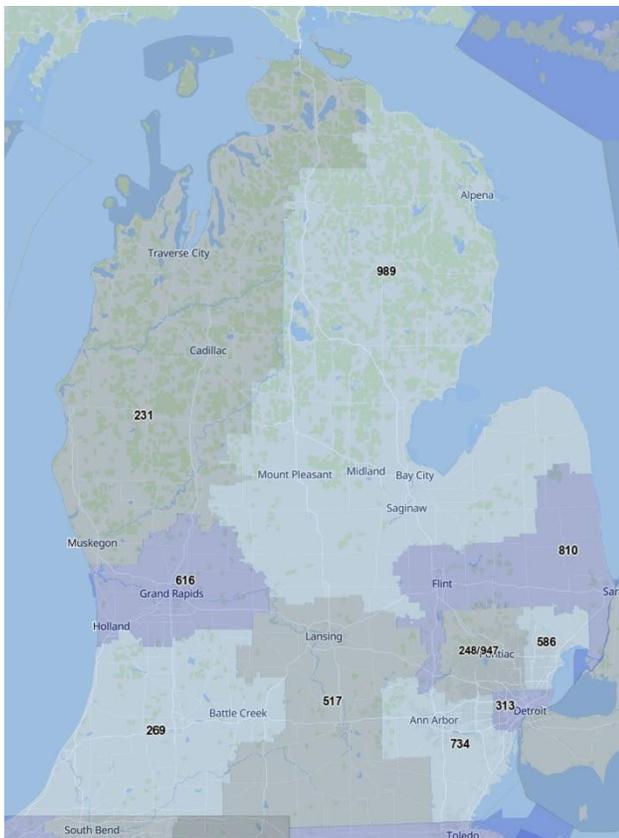
* Initial Report - Will be updated with final numbers

Muskegon County is a diverse community with more urban areas located close to the Michigan Lakeshore and more rural areas located elsewhere. In the more rural areas of the county, majority of the homes are heated using propane or wood. Residences in these areas rely on local distributors to provide them services. In more populated areas of Muskegon County, Michigan Consolidated Gas Company (MichCON) now known as DTE is the natural gas distributor servicing the area.





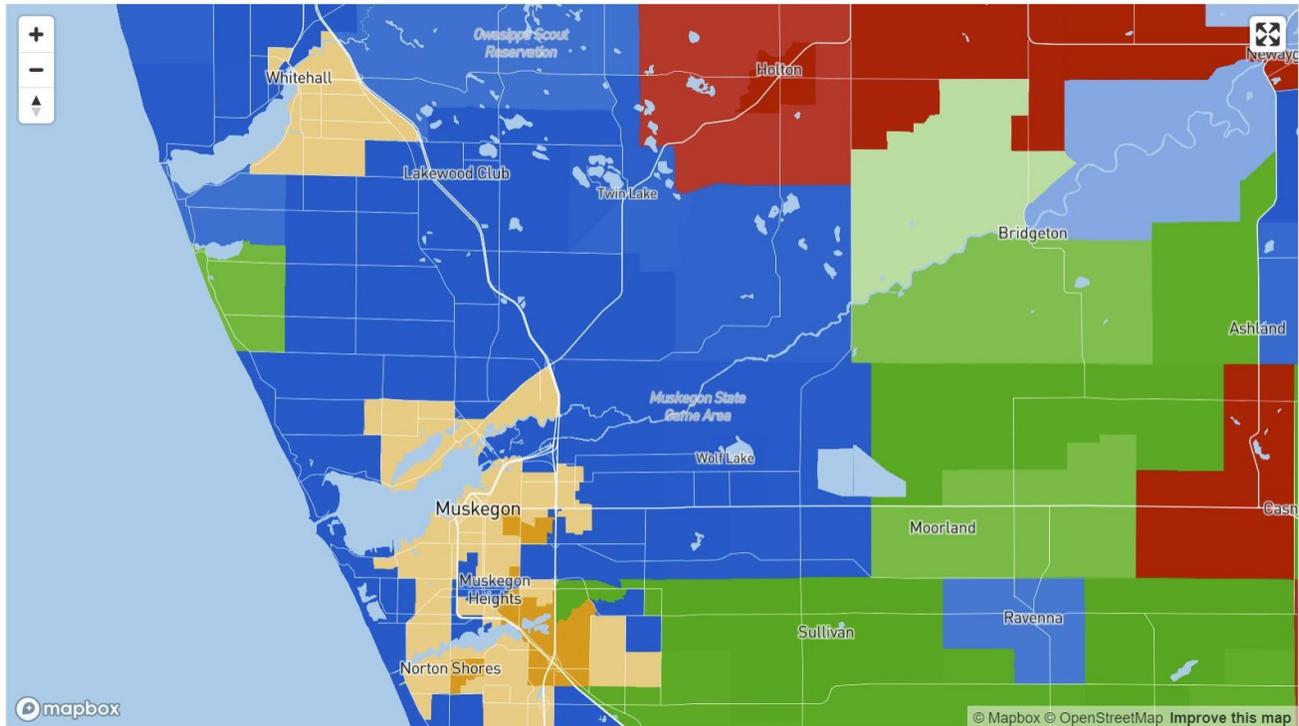
Map Showing Pipelines in: Muskegon, MI



Local, landline telephone service within Muskegon County is provided by two private companies, AT&T and Frontier Communications. Telephone Area Codes near Muskegon County include 231 and 616. Although many residences are choosing to no longer maintain local telephone service and are reliant on cell phones, most of the vulnerable populations still maintain landline communications. During a telephone outage or power outage, it becomes increasingly difficult to alert and notify the public of emergencies and hazards within their area. This requires local emergency officials to utilize more direct and labor intensive warning and public information mechanisms such as door-to-door notification.

Fastest Cell Service Down to the Muskegon Neighborhood

The map below shows where Verizon, AT&T, or T-Mobile are faster in Muskegon, MI. Areas with no clear winner are shown as ties. Overall, Muskegon ranks #1214 out of 2555 cities for the fastest mobile internet network speeds in Michigan.



Best Muskegon Cell Provider Key



The western parts of the city feature better overall coverage for faster data. The opposite is true in the northwestern areas of Muskegon where mobile data speeds are generally slower.

<https://bestneighborhood.org/mobile-and-cell-muskegon-mi/>

Water Systems in Muskegon County

In the more rural portions of Muskegon County, many residences within Muskegon County rely on privately owned well and septic systems for water and waste water. For the rest of the county there are twenty four municipal water and waste water systems within Muskegon County maintained by city or local authority boards. These system provide services to a population of 112,652 people.

Changes to the Michigan Safe Drinking Water Act were approved in 2018. The rule now requires:

- The removal of all lead service lines in Michigan. Water supplies are required to replace an average of 5 percent of their lead services line every year for the next 20 years unless an alternative schedule is approved by EGLE.
- Communities locate and prioritize lead service lines for removal.
- The Action Level for lead in drinking water be lowered from the current level of 15 parts per billion (ppb) to 12 ppb on January 1, 2025.
- The banning of partial lead service line replacements.
- Complete service line material inventories be submitted to EGLE by January 1, 2025.

The testing changes also now require that lead sampling must be taken from both the first liter and fifth liter water draw. By testing that fifth liter of water, it shows lead results that might be farther upstream in the water supply that is coming into homes.

Case: January 2005 Muskegon County Water Main Failure

In January of 2005, most of the residents of the city of Muskegon Heights lost water service for a brief time. The cause of the failure was determined to be a broken water main.

Case: March 2007 Muskegon County Sewer Main Break

On Friday March 2, 2007 a break occurred in a 66 inch underground sewer main in Muskegon Township, resulting in flood damage to several homes and sending 25 million gallons of raw sewage into Muskegon Lake. The county hired crews to repair the ruptured pipe as soon as possible. Around 30 homes had to be evacuated. The county spent \$85 million to replaced eleven miles of underground sewer main.



| Public Water Supply ID | System Name | County | Population | Last Monitoring Period End | Lead 90th Percentile (ppb) | Includes 5th liter? | Sampling Next Due (subject to change) |
|------------------------|-----------------------------------|----------|------------|----------------------------|----------------------------|---------------------|---------------------------------------|
| MI0001018 | BUTTERFIELD WOODS SUBDIVISION | MUSKEGON | 65 | 2022-12-31 | 1 | N | 2025-09-30 |
| MI0002507 | FRUITPORT TOWNSHIP | MUSKEGON | 9,355 | 2022-12-31 | 3 | N | 2025-09-30 |
| MI0003215 | HOLTON COTTAGES | MUSKEGON | 34 | 2022-12-31 | 0 | N | 2025-09-30 |
| MI0003925 | BLUE LAKE RESIDENCES | MUSKEGON | 212 | 2022-12-31 | 9 | N | 2025-09-30 |
| MI0004470 | MONTAGUE | MUSKEGON | 2,479 | 2021-12-31 | 8 | Y | 2024-09-30 |
| MI0004570 | MUSKEGON | MUSKEGON | 37,213 | 2020-12-31 | 4 | Y | 2023-09-30 |
| MI0004577 | MUSK CO NORTHSIDE WATER SYSTEM | MUSKEGON | 5,133 | 2020-12-31 | 2 | N | 2023-09-30 |
| MI0004580 | MUSKEGON HEIGHTS | MUSKEGON | 9,917 | 2020-12-31 | 3 | Y | 2023-09-30 |
| MI0004590 | MUSKEGON CO EASTSIDE WATER SYSTEM | MUSKEGON | 7,135 | 2020-12-31 | 2 | N | 2023-09-30 |
| MI0004780 | NORTH MUSKEGON | MUSKEGON | 3,786 | 2020-12-31 | 3 | Y | 2023-09-30 |
| MI0004850 | NORTON SHORES | MUSKEGON | 23,994 | 2020-12-31 | 3 | Y | 2023-09-30 |
| MI0005610 | RAVENNA | MUSKEGON | 1,219 | 2022-12-31 | 2 | N | 2023-09-30 |
| MI0005800 | ROOSEVELT PARK | MUSKEGON | 3,831 | 2021-12-31 | 2 | Y | 2024-09-30 |
| MI0007064 | WHITE LAKE ASSISTED LIVING CENTER | MUSKEGON | 26 | 2021-12-31 | 0 | N | 2024-09-30 |
| MI0007100 | WHITEHALL | MUSKEGON | 2,706 | 2020-12-31 | 8 | Y | 2023-09-30 |
| MI0040355 | APPLE CARR VILLAGE | MUSKEGON | 1,125 | 2020-12-31 | 0 | N | 2023-09-30 |
| MI0040356 | ARLINGTON WOODS | MUSKEGON | 1,650 | 2021-12-31 | 0 | N | 2024-09-30 |
| MI0040357 | CRYSTAL DOWNS MOBILE VILLAGE | MUSKEGON | 260 | 2020-12-31 | 0 | N | 2023-09-30 |
| MI0040359 | EDGEWOOD MOBILE HOME PARK | MUSKEGON | 162 | 2020-12-31 | 0 | N | 2023-09-30 |
| MI0040361 | MAPLE ISLAND ESTATES | MUSKEGON | 320 | 2022-12-31 | 1 | N | 2025-09-30 |
| MI0040363 | TIMBERLINE ESTATES | MUSKEGON | 755 | 2020-12-31 | 0 | N | 2023-09-30 |
| MI0040577 | PINE ISLAND LAKE REC PARK | MUSKEGON | 75 | 2020-12-31 | 2 | N | 2023-09-30 |
| MI0040600 | EGELCRAFT MOBILE HOME PARK | MUSKEGON | 1,125 | 2020-12-31 | 0 | N | 2023-09-30 |
| MI0040650 | WEST PINE ISLAND | MUSKEGON | 75 | 2020-12-31 | 0 | N | 2023-09-30 |

<https://www.michigan.gov/mileadsafe/Data-reports/water-supply-lead-results>

Case: PFAS 2018 Muskegon County Airport and Mona Lake

Muskegon County Airport is located at 99 Sinclair Drive. Based on Federal Aviation guidelines, the airport was required to conduct regular firefighting training using firefighting foam, also known as Aqueous Film Forming Foam (AFFF). Given this historical information and the presence of residential drinking water wells, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) requested that Muskegon County sample residential wells in the vicinity of former firefighting training areas. Residential well sampling began in August 2018. Per- and polyfluoroalkyl substances (PFAS) were detected at concentrations exceeding the Lifetime Health Advisory in several of the homes in the initial residential well sample area. The sample area has been expanded several times in order to identify the limits of PFAS impact.

Mona Lake is located adjacent to the airport. Several small creeks flow to the west and northwest from the airport. Groundwater flow direction varies throughout the site. Dominant flow directions are to the north, northwest, and west. In August 2020 surface water samples were collected by EGLE as part of a 2020 assessment of Mona Lake watershed. These results are included due to their proximity to Muskegon County Airport. PFOS was detected in that sample at a concentration of 14.7 ppt. The three surface water samples with PFAS concentrations below Criteria were collected from the creek system west/southwest of Muskegon County Airport

The Michigan Department of Health and Human Services (DHHS) conducted sampling and resampling of residential drinking water wells. Based upon the results of the August to October 2022 sampling of drinking water wells, which detected PFAS above criteria in the drinking well water at four additional homes, the sample area was expanded to include additional homes in the area east of the airport.

Public Health Muskegon County is offered point-of-use filters to each house in the drinking water well sample area with detections of any PFAS compound. In April 2022, EGLE awarded a grant to the City of Norton Shores for the city to install watermains to provide city water connections to an estimated 76 homes near Muskegon County Airport that are currently serviced by well water. Construction of the watermains is expected to begin in 2023.

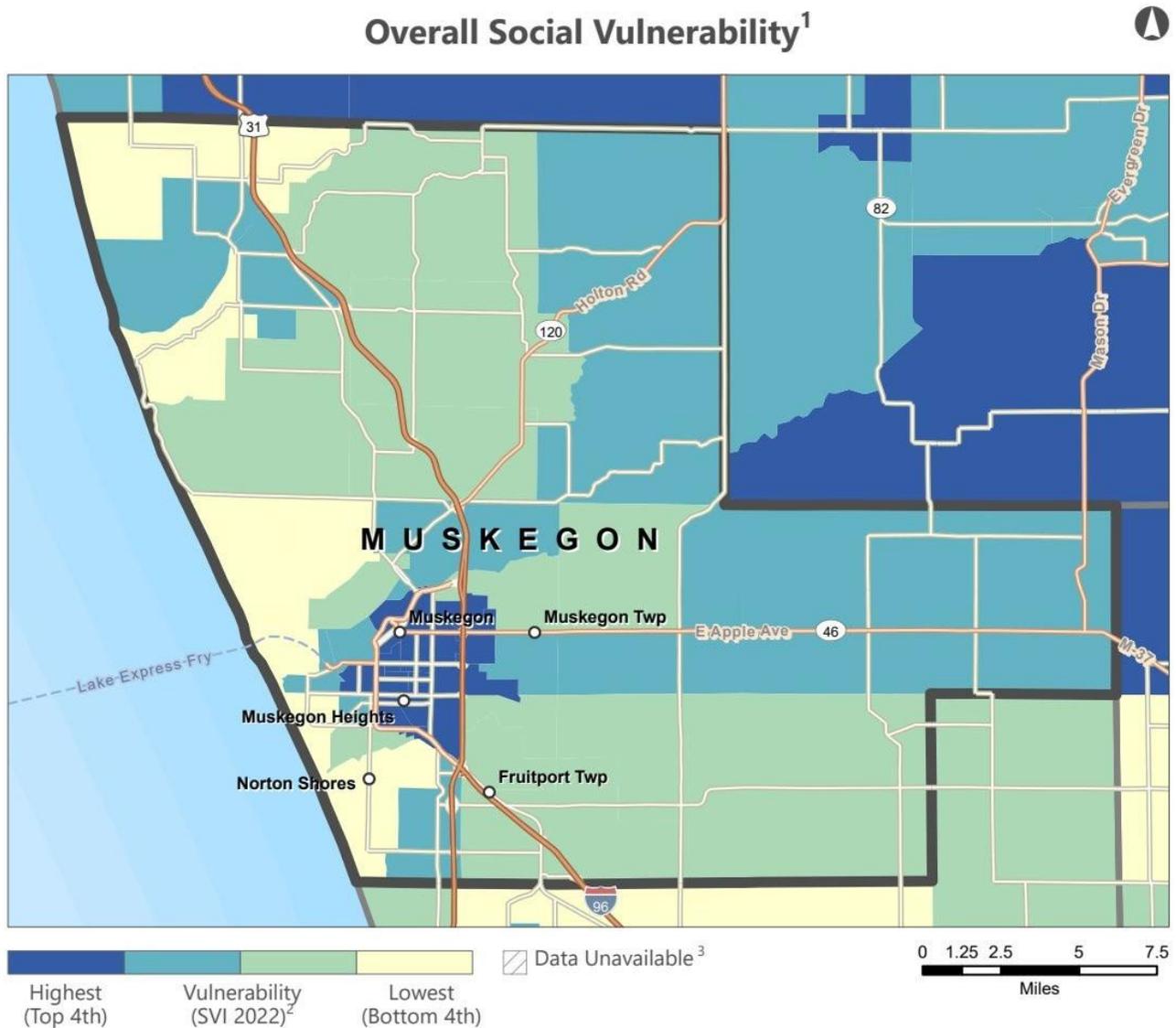
<https://www.michigan.gov/pfasresponse/investigations/sites-aoi/muskegon-county/muskegon-county-airport-area>

Infastructure Failure Vulnerabilities and Impacts:

Failure of infastructure systems from communications, transportation, electric, water, sewer, and gas can have a variety of public health and safety impacts. Communications system failures can lead to delays in public safety response. Electrical system failures can lead to electrical fires, carbon monoxide poisoning, and disruption in critical services shuch as hospitals, emergency response services, and water and wastewater facilities. Disruption of Water and Wastewater systems can include exposure to raw sewage, contamination of drinking water, and the spread of waterborne diseases such as cholera, typhoid, and hepatitis A. In additiion to the immediate danger caused by an infastrcture system failure, there can also be long term impacts on health and safety, the property, and the local economy.

CDC/ATSDR Social Vulnerability Index 2022

MUSKEGON COUNTY, MICHIGAN



TRANSPORTATION ACCIDENTS / MASS CASUALTY INCIDENTS

Transportation Accidents

A crash or accident involving a land, air, or water-based commercial passenger carrier causing a situation that stresses the emergency medical services resources and health care system.

Hazard Description

In the United States, transportation is facilitated by road, air, rail, and waterways. According to the Bureau of Transportation Statistics, 75.7% of passenger miles traveled occur by passenger vehicles including cars, trucks, vans, and motorcycles. The remaining was handled by planes, trains, and buses. During the Covid-19 pandemic the use of transportation, public and private was reduced. New modes of transportation have become more popular, including public share e-bikes and e-scooters. On shared bikes and scooters in the United States, 84 million trips were taken in 2018, more than double the 35 million trips taken in 2017 and up from 320,000 as recently as 2010 [NACTO 2019].

| 2020 Mode of Passenger Transport | Passenger Miles (millions) |
|----------------------------------|--|
| Highway-total | 4,934,519 (down from 5,579,126 in 2019) |
| Passenger vehicles, motorcycles | 4,325,535 |
| Trucks | 302,141 |
| Buses | 306,843 |
| Air Carriers | 304,253 |
| Rail – Total | 10,781 |
| Ferry boat | 411 |

Roadway Transportation

Passenger transportation is dominated by a network of over 3.9 million miles of highways. The overwhelming majority of roads in the United States are owned and maintained by state and local governments. The Interstate Highway System is partly funded by the federal government but owned and maintained by individual state governments. There are a few private highways in the United States, which use tolls to pay for construction and maintenance. However, a vast majority of the roads are local private roads, serving remote or insular residents.

A major roadway transportation accident has the potential to create a local emergency event, or to seriously strain or overwhelm local response and medical services. It would involve a commercial passenger bus, a local public transit bus, a school bus, or a church van. Although these modes of transportation have good safety records, an accident has a high potential of creating numerous injuries and shutting down portions of major roadways for an extended period of time.

Roadway Transportation Accidents

More than 130 certified intercity carriers provide passenger, charter, commuter, and special bus service directly to 220 Michigan communities. Of these carriers, six offer regular route service. Michigan's intercity rail passenger system consists of 568 route miles, along three corridors, serving 22 Michigan communities. Although these modes of land transportation have an excellent safety record, the combination of large numbers of passengers, unpredictable weather conditions, potential mechanical problems, and human error always leaves open the potential for a transportation accident involving mass casualties. Such an incident could occur with any of the aforementioned transportation modes, in any of the communities served by these systems. 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.

Buses Involved in Fatal Crashes in the United States by Type

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| School | 98 | 102 | 114 | 91 | 99 | 88 | 73 | 82 | 84 |
| Intercity | 41 | 34 | 44 | 32 | 34 | 17 | 13 | 15 | 15 |
| Transit | 68 | 78 | 82 | 79 | 93 | 98 | 97 | 86 | 78 |
| Van-Based | 25 | 30 | 28 | 9 | 14 | 6 | 31 | 30 | 32 |
| Other | 10 | 7 | 10 | 21 | 18 | 19 | 16 | 23 | 22 |
| Unknown | 3 | 2 | 4 | 4 | 5 | 6 | 4 | 2 | 1 |
| | 245 | 253 | 282 | 236 | 263 | 234 | 234 | 238 | 232 |

Data from the National Highway Traffic Safety Administration

Transportation in Michigan

Michigan has a diversified economy based on agriculture, manufacturing, tourism, services, and professional trades. More automobiles and trucks are produced in Michigan than in any other state. Michigan is the nation's top producer of office furniture, a major source of information technology and software, and a national leader in machine tools, chemicals, and plastics. Michigan is also one of the nation's leading agricultural producers, consistently ranking number one in several product categories. Michigan has a well-developed, multi-modal transportation system that supports the state's diversified economic activities. The highway system consists of a network of interstate, federal, state, and local routes that connect Michigan communities to major metropolitan areas and economic markets around the country. Michigan has 19 airports that offer commercial passenger jet service to major domestic and international destinations. Freight railroad lines link Detroit and other metropolitan areas with Chicago and other major manufacturing and business centers in the United States and Canada. Michigan also offers 40 Great Lakes ports to facilitate waterborne commerce. Each year, Michigan's transportation system helps move 240 million tons of cargo by truck, rail, air, and ship. – EMD Pub. 106

Transportation Accidents in Michigan

As the following listings indicate, passenger transportation accidents occur with some regularity in Michigan. Fortunately, Michigan's recent transportation accidents have not been as deadly as accidents in many other parts of the country or around the world, but the possibility always exists for a major accident that results in multiple casualties. The following are incidents highlighted from the Michigan Hazard Analysis.

Case: October 28, 1942, Hamtramck (Wayne County) School Bus/Passenger Train Collision

During the morning of October 28, 1942, a major transportation accident occurred in Hamtramck when a school bus collided with a passenger train. The accident resulted in 16 fatalities and 27 injuries, and of the total of 45 bus passengers, only three were not injured. The driver of the bus claimed he did not see the approaching train because of an overcrowded doorway blocking clear visibility. The majority of the fatalities occurred near the back of the bus, many of them were children headed for school.

Case: March 4, 1987, Detroit (Wayne County) Passenger Airplane Crash

On March 4, 1987, a plane bound from Cleveland to Detroit crashed and skidded into three ground vehicles and caught fire. The cause of the accident was the captain's inability to control the airplane while descending on the final approach for landing. Nine of the 22 passengers died from a post-crash fire, lack of fire-blocking material, and poorly designed aircraft components.

Case: August 16, 1987, Romulus (Wayne County) Passenger Airplane Crash

Michigan's worst commercial passenger airplane crash, and the seventh worst in U.S. aviation history occurred on August 16, 1987, at Detroit Metropolitan Airport. In that incident, Northwest Airlines Flight 255 was unable to gain sufficient altitude at takeoff and crashed into nearby highway I-94, killing 156 passengers and crew. A small child was the lone survivor. A Governor's Disaster

Declaration was granted to the City of Romulus and numerous state resources were mobilized to assist in the recovery.

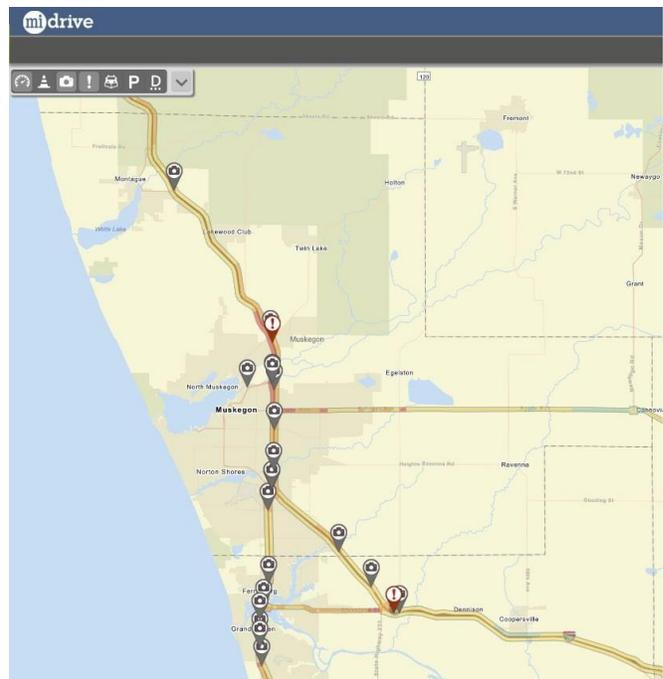
Case: July 9, 1999, Harrison (Clare County) Passenger Bus Accident A tour bus filled with international exchange students slid off of rain-slicked highway U.S. 27 near Harrison, injuring 40 passengers. Most of the injured were treated and released at a nearby hospital. One passenger was hospitalized overnight, with an eye injury.

Case: June 4, 2007, Lake Michigan Passenger Airplane Crash A plane carrying a team of surgeons and technicians from Milwaukee to Ann Arbor crashed into Lake Michigan. All six passengers died in the incident, including the two pilots, two University of Michigan surgeons, and two technicians due to prepare an organ for transplant surgery at the University of Michigan Health System hospital in Ann Arbor that same afternoon. The National Transportation Safety Board said that one of the pilots had reported severe difficulty steering the plane because of trouble with its trim system, which controls bank and pitch.

Transportation Accidents in Muskegon County

Muskegon County is an urban population center, located near major transportation routes, has an airport, and marine passenger ferry service, the probability of a transportation accident involving an air, land, or water-based commercial passenger carrier is highly likely. Muskegon County does have 13 public school systems operating transportation services for students, one municipal airport, a freight train railway system, and five state highways (US-31, I-96, M-20, M-37, M-46 and M-120) within the jurisdiction increasing the risk of a localized transportation accident. Based on historical occurrence, Muskegon County, on average experiences approximately three or four transportation accidents causing a mass casualty incident annually.

The major concern with transportation and mass casualty incidents in the jurisdiction results directly from limited ambulance and medical resources. Currently, Muskegon County only has two full-time advanced life support EMS/Ambulance agencies; ProMed and White Lake Ambulance. There is one hospital, Trinity Health Muskegon, dedicated to serve Muskegon County with a trauma center and burn surge center. Trinity Health Muskegon is a level two trauma hospital and has 67 ED beds and 354 hospital beds. Out of County (10-30 miles) patient transfers to medical facilities that can provide more advanced services do occur frequently, further



limiting available ambulance resources. Patients in need of level one trauma care are sent to Spectrum Health in Grand Rapids.

An incident with as few as between seven and ten patients has the potential to overwhelm existing medical service capabilities and prevent continued regular essential emergency medical services to the community. Incidents of higher magnitude require significant mutual aid from surrounding jurisdictions, EMS agencies, and hospitals and possibly warrant the declaration of a local state of emergency.

There are historical areas of concern for producing mass casualty incidents stem mainly from major transportation routes and special events. The following are highlighted examples of several mass causality incidents resulting from transportation accidents within Muskegon County.

Case: January 21, 2002, Muskegon County School Bus Accident One person was killed and nearly two dozen high school students were injured when a school bus collided with two cars. About 22 persons were taken to area hospitals with injuries.

Case: July 22, 2015, Egelston Township A car with three occupants, was traveling westbound on Evanston (Avenue) and pulled into the path of a southbound pickup truck with two occupants. Three in the car were killed. Two occupants of the southbound vehicle were transported to Hackley Hospital with unknown injuries.

Case: February 4, 2016, Sullivan Township A 10-year-old and 16-year-old died, and three others were hospitalized following a crash. They were on their way to school when their vehicle hit an oncoming westbound car.

Case: September 6, 2016, Dalton Township A van, was passing a semi-truck when its rear driver's-side tire blew out, causing the driver to lose control. The van rolled several times in the median before wrapping around the tree. One passenger sustained critical injuries and two others were killed.

Case: November 19, 2016, Cedar Creek Township A driver was driving east on Ryerson Road when he crossed the intersection into the path of a southbound vehicle. The man, his 26-year-old passenger and the other driver were transported to Hackley Hospital in Muskegon, where the driver later succumbed to his injuries. The second driver and the passenger are listed as having non-life-threatening injuries.

Case: November 6, 2017, Dalton Township An SUV crossed the centerline and crashed with a box truck heading north. The driver declined medical attention. Two in the SUV were killed, and one was injured.

Case: June 23, 2020, Dalton Township Holton Road and Pillion Road. A U.S. Postal Service vehicle was driving north on Holton Road and was waiting to make a left turn near Pillion Road. An SUV rear ended the postal truck, pushing it into the path of a minivan that was driving south. A family was riding in the minivan. One person died in the crash. A total of six children were injured and hospitalized in the crash, two seriously. Three adults were hospitalized.

Case: April 5, 2021, Egelston Township A driver drove off the road hitting two twelve-year-old girls who were riding horses. Two others riding additional horses were missed. Both horses were killed, and both the riders were injured, one seriously.

Case: May 23, 2021, Norton Shores Seven out of the nine occupants of a vehicle were injured in a rollover crash on US 31 south of Airline Road. A van was southbound on US 31 when cars began to brake suddenly in front of them. The driver lost control of the van, which overturned several times in the ditch. Two people were ejected from the van. One of the children who was ejected from the van received a broken leg. Another child suffered a broken arm. The others who were injured received minor cuts and scrapes.

Case: August 30, 2021 Fruitland Township (Muskegon County) Two car crash resulted in injuries to a 19-year-old driver and a child in car seat, 38-year-old driver killed.

Case: November 8, 2021, Fruitport township A single vehicle crash at the intersection of S. Sheridan Road and Airline Highway resulted in the death of the driver. Two passengers were hospitalized with injuries.

Case: February 16, 2022, Egelston Township One person died and four were injured in a two-vehicle crash at M-46 (Apple Ave) and Carr Rd.

Fatal Motor Vehicle Traffic Crashes

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| National | 31,006 | 30,202 | 30,056 | 32,538 | 34,748 | 34,560 | 33,919 | 32,244 | 38,824 |
| Michigan | 870 | 881 | 806 | 893 | 980 | 937 | 905 | 902 | 1,010 |
| Muskegon | 15 | 11 | 13 | 16 | 18 | 16 | 16 | 25 | 23 |

Data from the National Highway Traffic Safety Administration and MSP Traffic Crash Reporting Unit

Railway Transportation

Passenger trains were the dominant mode of transportation until the mid-twentieth century. The introduction of jet airplanes on major U.S. routes and the completion of the Interstate Highway system accelerated a decline in intercity rail passenger demand during the 1960s, resulting in the sharp curtailment of passenger service by private railroads. This led to the creation of National Railroad Passenger Corporation (branded as Amtrak) by the federal government in 1971 to maintain limited intercity rail passenger service in most parts of the country.

Amtrak operates a nationwide rail network, serving more than 500 destinations in 46 states, the District of Columbia and three Canadian provinces, on more than 21,400 miles of routes. It is the nation's only high-speed intercity passenger rail provider, operating at speeds up to 150 mph (241 kph). Nearly half of all trains operate at top speeds of 100 mph (160 kph) or greater.

Installation of Positive Train Control and infrastructure improvements allowed for increased speeds and faster travel times in the Midwest. In Michigan, Wolverine and Blue Water trains now reach top speeds of 110 mph (177 kph) on a 45-mile section of railroad between Kalamazoo and Albion owned by Michigan, which complements 110 mph service west of Kalamazoo.

According to Amtrak, during fiscal year 2021 customers took nearly 12.2 million trips. This was a 42% increase over the year's goal; more than half of all trips occurred in the second half of the year. On an average day, customers made more than 33,300 trips on Amtrak trains.

According to the US Department of Transportation, there are about 5,800 train-car crashes each year in the United States, most of which occur at railroad crossings. These accidents result in roughly 600 deaths and injure about 2,300.

Safety Tips for Train Crossings:

- Freight trains don't always travel at fixed times. Always expect a train at each highway-rail intersection.
- All train tracks are private property. Never walk on tracks; it is an illegal trespass and highly dangerous.
- By the time a locomotive engineer sees a trespasser or vehicle on the tracks it's too late. It takes the average freight train traveling at 55 mph more than a mile — the length of 18 football fields — to stop. Trains cannot stop quickly enough to avoid a collision.
- The average locomotive weighs about 400,000 pounds or 200 tons; it can weigh up to 6,000 tons. This makes the weight ratio of a car to a train proportional to that of a soda can to a car. We all know what happens to a soda can hit by a car.
- Trains have the right of way 100 percent of the time over emergency vehicles, cars, police, and pedestrians.
- A train can extend three feet or more beyond the steel rail, putting the safety zone for pedestrians well beyond the three-foot mark. If there are rails on the railroad ties always assume the track is in use, even if there are weeds or the track looks unused.

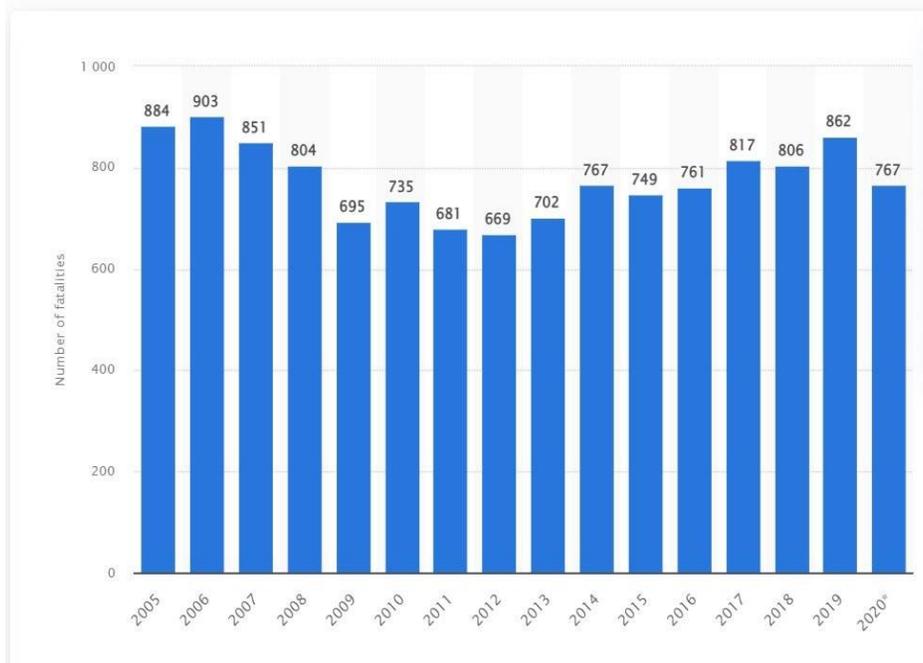
Source: Operation Lifesaver <https://oli.org/>



Retrieved from https://www.michigan.gov/documents/mdot/Michigan_Railroad_History_506899_7.pdf

Retrieved 4-20-2022 from: <https://www.statista.com/statistics/428213/number-of-fatalities-in-rail-accidents-in-the-united-states/>

Fatalities in U.S. railroad accidents from 2005 to 2020



High Speed Rail

High-speed rail service between Detroit and Chicago provides special challenges for communities located along that rail corridor. Although the rail infrastructure is greatly enhanced with state-of-the-art safety improvements, the possibility of a high-speed collision between the train and an automobile or truck will still exist. Of special concern are the 360 public and private at-grade crossings in place along the 279-mile corridor. An at-grade crossing always involves the potential for a collision between the train and a vehicle attempting to drive across the tracks.

The U.S. Department of Transportation, through the Federal Railroad Administration, regulates the speed at which trains operate over highway/railroad at-grade crossings. These regulations allow trains to operate at up to 110 miles per hour over highway-railroad at-grade crossings with conventional warning devices only (cross buck signs, side of street and/or overhead flashing lights, and/or gates). At speeds between 110 and 125 miles per hour, positive barriers must be installed at highway-railroad crossings. At speeds above 125 miles per hour, all highways and railroads must be grade separated. These regulations were developed by evaluating the risk of accident damage, using the following philosophy:

- Up to 110 miles per hour: The highway vehicle occupant is most at-risk.
- 110 to 125 miles per hour: Possible injury to the train's occupants, due to rapid deceleration.
- Above 125 miles per hour: Greater likelihood of injury to train occupants, and the train may be derailed.

Amtrak, and high-speed train manufacturers, have done computer simulations of accidents that could cause a significant rapid deceleration (similar to a highway vehicle-train accident). These simulations predict only minor injuries to the train's occupants. Based on the passenger train accident history in the state, the FRA regulations, and the computer simulations, the likelihood of a serious passenger rail transportation accident that results in significant casualties appears to be low. However, any collision between a train and a vehicle could result in casualties. Over a 10-year period from 2000 to 2009, there were 787 collisions in Michigan between trains and vehicles. It is only prudent that communities along the rail corridor be prepared to handle a mass casualty passenger rail accident as a worst-case scenario, and to plan for that contingency in their emergency preparedness efforts.

Transportation Accidents by Railroad in the United States

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|-----------------|--------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|--------------|
| Crossing | 458 | 517 | 533 | 502 | 533 | 499 | 586 | 554 | 522 |
| Railroad | 9,091 | 9,551 | 9,964 | 9,771 | 9,342 | 9,864 | 9,624 | 9,524 | 6,800 |
| Total | 9,549 | 10,068 | 10,497 | 10,273 | 9,965 | 10,363 | 10,210 | 10,068 | 7,322 |

Fatal Train Accidents in Michigan

Case: December, 1989 Fenton, MI A driver tried to beat the train resulting in a collision with the train. Three of the four occupants of the car died.

Case: October 12-1908 Metz, MI A train sent to rescue the inhabitants of Metz, MI derailed in the middle of the 1908 forest fires. There were at least 17 casualties from the train. As the fire approached the town of Metz, MI, 30-40 men women and children climbed onto an open metal flat car to escape the oncoming forest fires. About a mile out of town the train emerged from a wooded area where other train cars and wooden posts and forest products were stacked for shipment. The posts and other wood products were on fire along with the railroad ties the tracks sat upon. The train went off the tracks due to the heat of the fire which warped the tracks. Those on the train cars tried to flee into an open field. Half of the occupants of the train were found deceased. The wooden cars burned up and the one metal flat car got so hot, it cremated those who had not fled. Those 12 included three adults and nine children. The town of Metz was destroyed. <https://project.geo.msu.edu>

Case: June, 1994 Wexford County MI Driver drove into the train and was killed, although the crossing was well marked.

Case: June, 1995 Fenton Township A driver died in collision with train at the crossing.

Case: July 9, 2009 Canton Township, Detroit, MI An AMTRAK passenger train with 170 passengers hit a car that went around a gate. All five teenagers in the car were killed.

Case: February 16, 2012 A train struck a vehicle that went around the descended gates at crossing. The driver sustained fatal injuries in the impact.

Case: February 2014 Argentine Township, MI Two men were killed when the pickup truck they were in crossed a private drive crossing and collided with the train.

Case: March 3, 2015 Liberty Township, Wexford County, MI Sleet, and freezing rain may have contributed to this accident. The driver drove into the train at the crossing and was killed.

Case: June 25, 2021 Detroit, MI A driver tried to beat the train but collided with it. He died.

Case: February 9, 2022 Milford, MI (Oakland County) A 64-year-old Milford woman died after failing to stop at railroad crossing and collided with the train.

See here for more incidents and information: <http://www.michiganrailroads.com/wrecks-wreck-outfits>

Air Transportation

The United States has an advanced air transportation infrastructure which utilizes approximately 5,000 paved runways and houses seventeen of the world's busiest airports. Civilian airlines are all privately owned and financed while most airports are owned and operated by local government authorities or privately owned. Circumstances that can result in an air transportation accident include collision with another aircraft while in flight or during taxi operations, mechanical problems during flight, and complications during takeoff or landing. Almost any accident occurring during flight results in multiple fatalities of passengers, fire, and issues with protection of evidence.

Air Transportation Accidents

Statistics from the NTSB and the airline industry show that the majority (over 60%) of airplane crashes and accidents occur during the takeoff or landing phases of a flight. In spite of this passengers have a 95% chance of surviving an accident. <https://www.businessinsider.com/why-airplane-takeoff-landing-are-dangerous-flight-2019>

As a result, developed areas that are adjacent to major airports, and along airport flight paths, are particularly vulnerable to this hazard. Accordingly, the greater the number of landings and takeoffs, the greater the probability of a crash or accident. 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.

According to MDOT statistics, in 2010 these airports collectively handled over 28.2 million passengers (24.4 million from Detroit Metro alone). Nineteen airports have a greater probability of experiencing a commercial passenger airplane crash or accident, either at the airport or in the immediate vicinity of the airport, since these are the main takeoff and landing spots for such commercial flights.

Transportation Accidents by Air in the United States

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Air Carrier | 27 | 22 | 31 | 28 | 30 | 33 | 31 | 40 | 14 |
| Commuter | 3 | 6 | 3 | 4 | 9 | 6 | 2 | 9 | 5 |
| Air Taxi | 39 | 45 | 35 | 39 | 29 | 44 | 40 | 33 | 40 |
| General | 1,471 | 1,223 | 1,222 | 1,211 | 1,269 | 1,234 | 1,275 | 1,220 | 1,085 |
| Total | 1,540 | 1,296 | 1,291 | 1,282 | 1,337 | 1,317 | 1,348 | 1,302 | 1,144 |

Air Transportation Accidents in Muskegon County

Muskegon County Airport is a public-use airport located in Norton Shores. The airport is owned and operated by Muskegon County. Commercial passenger airlines offer daily connecting flights to regional locations such as Chicago-O'Hare. Muskegon County Airport was the

recipient of both the 2007-2008 and 2008-2009 *Balchen/Post Awards* for outstanding achievement in snow and ice control in the small commercial service airport category.

FLIGHT PLANNING INFORMATION



NPAIS Non-Primary Commercial Service Airport

MKG is a public-use, FAA certified Part 139 airport, with a control tower, two runways, and an all-weather, 24-hour precision ILS approach capability.

FAA AERONAUTICAL INFORMATION SERVICE

General Aviation Operations

MKG is one of Michigan's busiest municipal airports and home to 84 private aircraft. The field sees greater than 30,000 local operations per year.

Runway & Location

- **Runways:** 6/24 - 6501'x150' & 14/32 - 6100'x150'
- **FAA Identifier:** MKG
- **LAT/LONG:**
43-10-03.6182N 086-14-07.5794W
43-10.060303N 086-14.126323W
43.1676717,-86.2354387
- **Elevation:** 628.5 ft. / 191.6 m (surveyed)
- **Variation:** 04W (1995)
- **From City:** 4 Miles S of Muskegon, MI
- **Time Zone:** UTC -5 (UTC -4 during Daylight Saving Time)
- **Zip Code:** 49441

Operations

- **Airport Use:** Open to the Public
- **Control Tower:** Yes
- **ARTCC:** Chicago Center
- **FSS:** Lansing Flight Service Station
- **NOTAMs Facility:** MKG (NOTAM-D service available)
- **Wind Indicator:** Lighted
- **Segmented Circle:** No
- **Lights:** WHEN ATCT CLSD ACTVT MALS R WY 24; REIL R WY 06; HIRL R WY 06/24 - CTAF. VASI R WY 06 & 24 OPR CONSLY.
- **Beacon:** White-Green (lighted land airport) operates sunrise to sunset.
- **Fire and Rescue:** ARFF index A (Index B available on request. Contact the airport manager)

Communications

- **CTAF:** 126.25
- **UNICOM:** 122.95
- **ATIS:** 124.3
- **WX ASOS:** Phone 231-798-1317
- **Muskegon Ground:** 121.6 [0600-2300]
- **Muskegon Tower:** 126.25 343.725 [0600-2300]
- **Great Lakes Approach & Departure:** 119.8

General

- **Full-Service FBO:** Executive Air Transport
- **Fuel Available:** 100LL & JET-A
- **Parking, Hangars and Tiedowns** are available
- **Airframe Service:** Major
- **Powerplant Service:** Major
- **Landing Fee:** \$15
- **Owner:** MUSKEGON COUNTY
- **Airport Manager:** KENNETH EFTING - Phone 231-798-4596

The following are examples of Air Transportation Accidents which occurred in Muskegon County:

Case: June 30, 1981, Muskegon A twin-engine Cessna when the aircraft crashed near Muskegon on June 30, 1981, killing two.

Case: August 1, 1983, Muskegon North American AT-6D Michigan Fatal Crash Map. No other details.

Case: Dec 6, 1983, White Lake Township Michigan Fatal Crash Map. Cessna T210 no other details.

Case: August 22, 1984, Twin Lake Michigan Fatal Crash Map. Cessna 150A no other details.

Case: June 20, 1986, Nunica Michigan Fatal Crash Map. Cessna 1721 No other details.

Case: July 16, 1986, Norton Shores A plane crash along the Lake Michigan shoreline killed three of six people on board. The private plane veered past two homes Wednesday and crashed into the heavily wooded sand dunes on the shore, police said. The three others on the Cessna 441 Conquest twin-engine turboprop were taken to hospitals. Two were listed in critical condition. The aircraft was found nose-down and leaning against a tree in a heavily wooded gully. It missed hitting two homes, and debris from the crash was scattered all along the gully.

Case: December 11, 1990, North Muskegon A Taylorcraft BC12-D1 went down. The cause of the crash was determined to be pilot in command did not maintain sufficient airspeed and stalled. Contributing factors were fuel starvation and the fuel tank selector was improperly positioned.

Case: June 6, 1991, Muskegon Cessna U206 Crash was caused by inadequate remedial actions of the pilot after exhausting all the fuel from the selected tank. Other factors included Inadequate training and lack of familiarity with the plane.

Case: May 4, 1993, Muskegon, MI An Aerospatiale American Eagle plane with 41 passengers and three crew members had a tail strike landing mishap, due to misjudging flare, pitch of the aircraft exceeded 10 degrees nose up resulting in aft fuselage contacting the runway. No one was injured.

Case: May 20, 2000, Muskegon During an aerial pesticide (Bt) spraying operation contracted aerial applicator experienced an accident involving a fixed-wing ag spraying aircraft, fatally injuring the pilot. A witness reported that as the pilot positioned the aircraft to begin spraying, two very loud bangs were heard and fire broke out in the engine as the plane continued to lose altitude and one side of the wing struck the tree canopy, impacted the ground in flames. It is not known if the plane, or any part of the plane was on fire before impact or afterwards.

Case: October 4, 2000, Muskegon A Moseler RAF 2000 GTX SE Gyroplane, N1187Z, owned and operated by a private pilot was destroyed on impact with terrain and a post-crash fire near Muskegon, Michigan. The 14 CFR Part 91 personal flight was not on a flight plan. The pilot, who was the sole occupant, was fatally injured.

Case: August 19, 2003, Muskegon A Beech 1900D, N79SK, aircraft operated by Skyway Airlines as flight 1411, sustained substantial damage during an on-ground collision with a deer

while landing at the Muskegon County Airport. The two flight crew members and ten passengers were not injured.

Case: June 2, 2004, Muskegon An aircraft crashed into Muskegon Lake in Muskegon County, MI. The Pilot was spraying a 65-acre campground (Muskegon State Park) with a full load of BT (250-300 lbs). There was a loud "bang" and the propeller stopped moving. The pilot crashed into Muskegon Lake. Although the plane sank in 11 feet of water, fishermen aided the pilot, who was taken to a nearby hospital and treated for hypothermia. Turbine blade failure is suspected as a likely cause of the accident.

Case: May 1, 2007, Fruitport A Luscombe 8A, N1120B, was substantially damaged during a forced landing to a field following a loss of engine power during takeoff from the Flying-A-Ranch Airport. The certificated flight instructor (CFI) and dual student received serious injuries. During the climb the engine lost power. The flight instructor failed to use carburetor heat during takeoff in icing conditions. A factor was the power line pole.

Case: October 13, 2007, Muskegon A Mooney M20E airplane, N1261X, piloted by a private pilot, was substantially damaged during an in-flight collision with a tree and terrain after takeoff from Muskegon County Airport. The pilot reported a loss of engine power during initial climb after takeoff and was in the process of executing a forced landing at the time of the accident. The pilot sustained minor injuries.

Case: April 19, 2010, Muskegon True Flight Holdings LLC AA-5B The airplane sustained substantial damage when the bird struck the right wing causing the pilot to make emergency landing.

Case: July 24, 2010, Muskegon A Beech A24R, N24584 impacted the terrain after a loss of engine power during the initial climb after departing from the Muskegon County Airport. The airline transport pilot was seriously injured. The airplane was destroyed by a postimpact fire.

Case: September 11, 2011, Muskegon A Piper PA-16, N5383H, veered off runway and ground looped during takeoff. The private pilot and the flight instructor were not injured. The airplane sustained substantial damage to the left wing.

Case: March 10, 2015, Muskegon Cessna 208B The pilot reported that he flew an autopilot coupled approach to minimums in instrument meteorological conditions. The pilot determined he was right of the runway and as he maneuvered to realign the airplane with the runway, he struck elements of the approach light system. The airplane sustained substantial damage to the horizontal stabilizer.

Case: May 1, 2015, Ravenna A homebuilt gyrocopter, N5606X was destroyed when it collided with power lines after a loss of engine power while maneuvering. The private pilot, who was the sole occupant, sustained serious injuries.

Case: January 1, 2019, Muskegon 1979 Cessna 310R The pilot escaped injury when he crash-landed at the Muskegon County Airport. The pilot was practicing touch-and-go landings in his twin-engine 1979 Cessna 310R when the crash occurred. The pilot indicated that "he forgot to put the landing gear down." The aircraft had extensive damage to the bottom and both propellers.

Case: September 9, 2019, Whitehall A Cessna C-150 airplane, N9492U, impacted a water tower in Whitehall, Michigan. The pilot was fatally injured. The airplane was destroyed by the impact and a post-crash fire. The airplane was operated by the pilot as a Title 14 Code of Federal Regulations Part 91 personal flight. Visual meteorological conditions were reported at the accident site at the time of the accident, and the flight was not operated on a flight plan. The flight originated from Fremont Municipal Airport (FFX), Fremont, Michigan. According to local law enforcement officials, witnesses observed the airplane flying straight and level prior to impact with a 180 ft tall municipal water tower. The witnesses also reported the engine appeared to be operating normally at a high-power setting when the impact occurred.

Waterway Transportation

Although the least used method of transportation, the United States has 25,482 miles of navigable inland channels, exclusive of the Great Lakes. In Michigan, there are 20 commercial marine passenger ferries operating from Michigan's Great Lakes shoreline communities. Most of these marine ferry services operate on a seasonal basis (typically May through November). Vessel sizes vary, but it is not uncommon for 100-200 passengers or more to be on board many of the ferries at the peak of tourist season. In a typical year, these ferries make thousands of trips across Great Lakes waters. Although the vessels have an excellent safety record and must pass rigorous Coast Guard inspections, the potential for an accident is always present. Accidents in other states or countries involving similar vessels validate the need for rigorous emergency preparedness actions to prevent loss of life in an open water setting such as the Great Lakes. For instance, the Ethan Allen tour boat that capsized in Lake George, New York, in 2005 took the lives of 20 senior citizens.

Hazard Analysis

The one commonality all transportation accidents share, whether air, land, or water-based, is that they can result in mass casualties. Air transportation accidents, in particular, can result in tremendous numbers of deaths and injuries, and major victim identification and crash scene management problems. Water transportation accidents, on the other hand, may require a significant underwater rescue and recovery effort that few local jurisdictions may be equipped or trained to handle.

Michigan Waterway Transportation

Within Michigan there are 18 marine passenger ferry services. These services have a good safety record, having never suffered a serious accident that resulted in loss of life or property in recent history. Nonetheless, given the large number of trips that are made over Great Lakes waters every year, the possibility of a water transportation accident involving one of these vessels is still a possibility. Furthermore, should such an accident occur, the often-turbulent Great Lakes waters, coupled with the potentially large number of passengers on board, could pose tremendous obstacles to carrying out an effective water rescue and recovery operation.

The U.S. Coast Guard, local law enforcement marine safety units, and the ferry operator would provide primary rescue response to a Great Lakes marine passenger ferry accident. These agencies are highly trained and skilled in water rescue operations, but their resources may not be sufficient or their efforts timely enough to save everyone should a fully loaded ferry sink. Even with on-board life-saving equipment, some loss of life might be inevitable—especially in inclement weather and/or rough lake waters. In addition, hypothermia is a real concern—even in balmy Great Lakes waters in the middle of summer.

Transportation Accidents by Water in the United States

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---------------------|--------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Vessel | 5,298 | 5,727 | 6,048 | 3,330 | 2,400 | 2,254 | 2,423 | 3,131 | 2,553 |
| Recreational | 4,515 | 4,062 | 4,064 | 4,158 | 4,463 | 4,291 | 4,145 | 4,168 | 5,265 |
| Total | 9,813 | 9,789 | 10,112 | 7,488 | 6,863 | 6,545 | 6,568 | 7,299 | 7,818 |

Drowning is the cause of death in 79 percent* of all boating-related fatalities.

In 2020, there were 181 Michigan boating accidents reported, including:

- 33 fatalities - only 21% of people were wearing a life jacket.
- 20 drownings.
- \$2,188,237 of property damage.

Important safety tips

Appropriately wearing the correct fitting life jacket and riding with an operator who has successfully completed an accredited boater safety education program reduces the risk of recreational boating accidents and drowning. The top five contributing factors in boating accidents are:

- Operator inattention.
- Improper lookout.
- Operator inexperience.
- Excessive speed.
- Alcohol use.

Wear a life jacket

- Accidents happen, be prepared. Life jackets float - you don't.
- Drowning was reported as the cause of death in 79 percent* of all fatalities - meaning that four out of five people died from drowning.
- 86 percent* of people who drowned in a recreational boating accident were not wearing a life jacket.

Boat sober

- Alcohol use is the leading known contributing factor in fatal boating accidents. Where the primary cause was known, it was listed as the leading factor in 23 percent* of deaths.
- Alcohol can impair a boater's judgment, balance, vision, and reaction time. It can also increase fatigue and susceptibility to the effects of cold-water immersion.

Check your boat before going out on the water

- Make sure the boat is properly equipped and equipment is in good working condition.
- In addition to legally required equipment such as life jackets and fire extinguishers, always carry a first-aid kit, nautical charts, and an anchor.
- Make sure navigation lights work properly.
- Ensure the cabin of your vessel has appropriate ventilation to prevent carbon dioxide poisoning.

Have a float plan

Inform someone who is not boating with you about the details of your trip, including:

- Where you will be boating and the route you plan to travel.
- How long you will be gone.
- When you plan to return.
- Schedule check-in times.
- Phone numbers for the local emergency dispatch center and U.S. Coast Guard in case you don't return on time.

Stay alert

- Watch for other boats, swimmers, skiers, and objects in the water. This is especially true when operating in crowded waterways, at night and when visibility is restricted.
- Be aware of commercial fishing nets and buoys. Orange flagging may indicate a net is located in the water. Nets can also break away and float at the surface of the water, causing entanglements with boats.

Carry a cell phone or marine radio

Be prepared to call for help if:

- You are involved in or witness an accident.
- Your boat or the boat of another becomes disabled.

- You need medical assistance Retrieved 4/27/2022 from <https://www.michigan.gov/dnr/things-to-do/boating/safety>

Waterway Transportation Accidents in Michigan

Michigan has more than 11,000 inland lakes. Some lakes have special rules for boating, such as where motorboats and high-speed boating are allowed. This is not a comprehensive list but highlights some of the accidents that have occurred in Michigan.

Case: June 17, 2019 Barry County, MI Gun Lake An occupant fell off the boat and was injured when the propellor cut off his leg. Two Metro Detroit doctors and others nearby who were able to pull the victim from the water and apply a tourniquet to help stop the bleeding. Their actions saved his life.

Case: August 27, 2019 Alpena Township, Long Lake. A 90-year-old man was found in the water next to his boat. It was determined he drowned.

Case: July 4 2020 Kalamazoo County, MI Gull Lake An intoxicated boater hit and killed a swimmer. The operator was sentenced to prison time.

Waterway Transportation Accidents in Muskegon County

Muskegon Harbor is one of the most diverse harbors in the Great Lakes. Muskegon's "Blue Economy" is host to commercial port operations, cruise ships, scientific freshwater and fisheries research, maritime history museums, marinas, and all types of water recreation activities! The Muskegon Lake water depth allows for safe nautical routes. The federally designed channel connecting Lake Michigan to Muskegon Lake welcomes all vessel sizes and types, commercial and pleasure. Muskegon is a popular cruise ship port and provides high speed ferry services to Milwaukee Wisconsin from May to October. <https://www.muskegon.org/choose-muskegon/port-information/>

Lake Express Ferry

Featuring the most daily crossings on Lake Michigan, the Lake Express high speed ferry has two daily departures from Milwaukee and Muskegon in Spring and Fall and our Summer schedule adds evening crossings on popular travel days. Whether you're in a car, on a motorcycle or bike or walking on and off, the Lake Express ferry features quick and easy loading and unloading and time-saving 2-1/2 crossing times so you can enjoy more of your destination and none of the traffic hassles of driving around Lake Michigan. <https://www.lake-express.com/schedule/>

- The Lake Express Ferry can carry up to 250 passengers and 46 vehicles including 12 motorcycles and 20 bicycles. The ferry offers classic and premier seating, food and beverages, a business class cabin, modern restrooms, and a smoke-free environment.

Cruise Ships

June through September 3 different Cruise Ships rotate docking in Muskegon.

- Pearl Seas Cruises Pearl Mist can accommodate up to 210 passengers.
- Victory Cruise Lines Victory I and II can accommodate up to 202 passengers
- Windstar Cruises Le Champlain can accommodate up to 184 passengers

Case: July 4 1959 Lake Michigan/Muskegon outer harbor *The Highway 16* (aka Navy tank landing ship USS LST-393) ferried new cars across Lake Michigan. It was returning from one such trip when it struck a 25-foot cabin cruiser, killing six people.

Case: June 10, 2002 Mona Lake A two boat collision knocked one occupant into the lake. That person was later recovered, found deceased by divers.

Case: September 3, 2016 Muskegon Lake A 17-foot aluminum fishing boat powered by a 150-horsepower motor on Muskegon Lake went airborne for nearly 20 feet and came to rest 100 offshore in the trees. Three people onboard were not seriously injured.

Case: August 5, 2019 Muskegon's South Pier A boat struck the south pier in Muskegon. Three people onboard suffered minor injuries while the remaining four were uninjured. The vessel struck the south breakwater arm just after 10:20 p.m. Speed and high lake levels carried the boat high onto the rock riprap where it remained until the next afternoon when it was removed.

Transportation Accidents Vulnerability and Impacts:

Transportation accidents can have significant public health and life safety impacts, including loss of life, injuries and trauma, public safety concerns, and community impact. Fatalities resulting from transportation accidents can include passengers, transportation crew members, and by standards near the accident. Depending on the scope of the accident, the loss of life can profoundly affect the families and loved ones of the victims and the broader community affected by the accident. Survivors of transportation accidents may suffer various injuries, ranging from minor to severe, which can have long-lasting physical and psychological effects, requiring medical treatment, rehabilitation, and support services.

Transportation accidents also pose public safety concerns due to the potential for collateral damage or injuries to people near the accident. Depending on the circumstances and location of the accident, nearby communities may be exposed to risks such as fires, fuel spills, or debris hazards. Emergency responders and authorities work to mitigate these risks and ensure the public's safety in the aftermath of an accident. In addition, the emotional toll, economic consequences, and recovery efforts following an accident can affect the overall well-being and resilience of the community, leading to a profound impact on the communities in which they occur.

PUBLIC HEALTH

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.

Hazard Description

Public health emergencies can take many forms - disease epidemics, large-scale incidents of food or water contamination, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, or large-scale infestations of disease-carrying insects or rodents. Public health emergencies can occur as primary events by themselves, or they may be secondary events another disaster or emergency, such as a flood, tornado, 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.

Perhaps the greatest emerging public health threat would be the intentional release of a radiological, chemical, or biological agent with the potential to adversely impact a large number of people. Such a release would most likely be an act of sabotage aimed at the government or a specific organization or segment of the population. Fortunately, to date Michigan has not experienced such a release aimed at mass destruction. However, Michigan has experienced hoaxes and it is probably only a matter of time before an actual incident of that nature and magnitude does occur. If and when it does, the public health implications – under the right set of circumstances – could be staggering.

Hazard Analysis

The primary types of public health impacts involve the threat or presence of either 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).

Communicable disease outbreaks or epidemics have the potential to rapidly overwhelm the local healthcare system. Medical resources may become overwhelmed and unable to deal with any additional needs. 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).

Influenza is an example of a potential public health emergency of very large proportions. No one knows when the influenza virus might “shift” its structure to produce a virus to which no one will be immune. Influenza can exact a terrible toll on communities. During a typical influenza season, approximately

1,188 deaths in Michigan are expected. However, during the next influenza pandemic (a worldwide epidemic), as many as 10 to 100 times that many might die, without an adequate and well-organized public/community health care system to combat the disease. As hard as the world public health community is trying to conduct influenza surveillance in order to provide the most advance notice possible if pandemic influenza were to strike it would likely do so very early in the season and spread so rapidly that preparation would need to be done on an emergency basis.

In the northern hemisphere, the normal flu season starts in November and ends in May. Flu viruses are amenable to chilly weather, and therefore predominate around the winter season in temperate climates. (Contagion may also be assisted by persons spending more time in indoor areas with less ventilation from outside.)

The world's worst influenza pandemic—the “Spanish flu” of 1918-19—resulted in 500,000 to 675,000 deaths in the United States and 20 to 40 million worldwide. More than 25 million Americans—nearly one quarter of the population at the time—fell ill. Scientists speculate that the virus that caused that pandemic may have percolated for several years within humans, or possibly pigs, until it grew strong enough to kill millions worldwide. The virus spread rapidly—moving around the world in a matter of a few months—in a time period in which there was much less movement of people than there is today. The virus reached Michigan in the fall of 1918. Over 8,000 of the 2.8 million state residents fell ill and half of those eventually succumbed to the disease. In retrospect, the spread of the illness was felt to be exacerbated by behavior of important officials who had misguided concerns that the effects of “panic” might be more harmful than the disease itself—a notion that proved disastrous. The pandemic had an unusual aspect, however, in that many of those who died were persons who had been young and healthy, whereas the normal pattern for influenza deaths is to take a higher toll among those who are elderly or have compromised immune systems. (Note: As a sheer numerical comparison, the 1918-19 influenza pandemic worldwide death tolls came close to equaling the death tolls of the medieval Black [Bubonic] Plague that struck in the 6th, 14th, and 17th centuries. The number of U.S. deaths from the pandemic exceeded the number of U.S. soldiers killed on the battlefield in World Wars I and II, the Korean War, and the Vietnam War combined).

Two other major influenza pandemics occurred during the 20th century—the 1957-58 “**Asian flu**” that killed 70,000 in the United States, and the 1968-69 “**Hong-Kong flu**” that resulted in 34,000 U.S. deaths—each spreading with the same rapidness as the 1918-19 pandemic. The possibility is always there that another pandemic could occur at any time. The speed and frequency of modern global travel could greatly exacerbate the spread and potential impacts of future pandemics, forcing public health officials to race against the clock to prevent the death tolls experienced in past pandemics.

Influenza viruses are designated with letters and numbers. Three main groups exist (A, B, and C), and Influenza A contains those viruses that have the capacity to cause human pandemics. Within that main classification are more specific letter-number designations that specify two types of proteins on the outer part of the virus— hemagglutinin (H) and neuraminidase (N). There are 16 known types of H and 9 known varieties of N, and combinations of these protein types distinguish various strains of the Influenza A virus from each other. As of 2009, only three combinations—H1N1, H2N2, and H3N2—

have been involved in viruses confirmed to spread directly from person to person. However, it is possible for other virus strains, such as those found in birds or swine, to change and become capable of infecting other species. In 1976, a swine flu outbreak occurred among humans stationed at the Fort Dix military facility in New Jersey, and was addressed with a mass vaccination program, although the vaccine itself was found to have a small (1 in 100,000) risk of causing the serious Guillain-Barré syndrome.

In 2005, an outbreak of influenza A (H5N1), also known as "**avian flu**" or "**bird flu**," was reported in several countries throughout Asia. First identified in 1997 Hong Kong, cases of avian influenza A (H5N1) in birds were later confirmed in Cambodia, China, Hong Kong, Indonesia, Japan, Laos, Pakistan, South Korea, Thailand, and Vietnam. Human cases of avian influenza were reported in Thailand and Vietnam. In an investigation, it was not determined that the avian flu was spread from person to person. The outbreak of avian influenza prompted the killing of more than 25 million birds in Asia. This strain of avian influenza A (H5N1) was not found in the United States. However, in February 2004, different strains of avian flu were detected among several flocks of birds in the U.S., and state officials ordered the destruction of hundreds of thousands of birds. The avian influenza strain found in Delaware was H7N2, in Pennsylvania the strain was H2N2, and the H5N2 strain was found in Texas. The strain found in Texas was determined to be "highly pathogenic" to birds. However, the strain of avian influenza in Texas was not the same as the strain in Asia.

The World Health Organization (WHO) announced a substantial risk of an influenza epidemic in the near future. One of the primary concerns is that the virus could quickly spread across the World. In response, many countries have begun planning in anticipation of an outbreak. During the spring of 2009, a new influenza virus was identified. Studies showed that this new virus was different from what had normally circulated throughout the world. Humans are especially vulnerable because their immune systems had not been previously exposed to this virus, therefore allowing limited immune response. H1N1 (also called "swine flu," in this case) has exhibited atypical presentation in human populations.

Over 90% of detected cases are in persons under 65 years of age. In comparison to other flu viruses, hospitalizations and deaths associated with H1N1 are dramatically higher in children and young adults. Also of concern, the virus has demonstrated the ability to develop resistance to antiviral medications. Thousands of cases of influenza-like illness were reported in Michigan during the last week of October 2009 alone. However, according to an Associated Press wire report (of September 29, 2010) regarding CDC recent studies, that strain of the "swine flu" no longer represented a major threat in the United States because most citizens came to show signs of immunity.

In addition to Influenza another outbreak occurred in 2014-2016 of Ebola. Ebola Virus Disease (EVD) is a rare and deadly disease in people and nonhuman primates. The viruses that cause EVD are located mainly in sub-Saharan Africa. People can get EVD through direct contact with an infected animal (bat or nonhuman primate) or a sick or dead person infected with Ebola virus. In The 2014–2016 outbreak in West Africa was the largest and most complex Ebola outbreak since the virus was first discovered in 1976. There were more cases and deaths in this outbreak than all others combined. It also spread between countries, starting in Guinea then moving across land borders to Sierra Leone and Liberia. A total of 28,616 cases of EVD and 11,310 deaths were reported in Guinea, Liberia, and Sierra Leone.

There were an additional 36 cases and 15 deaths that occurred when the outbreak spread outside of these three countries. Overall, eleven people were treated for Ebola in the United States during the 2014-2016 epidemic.

PFAS

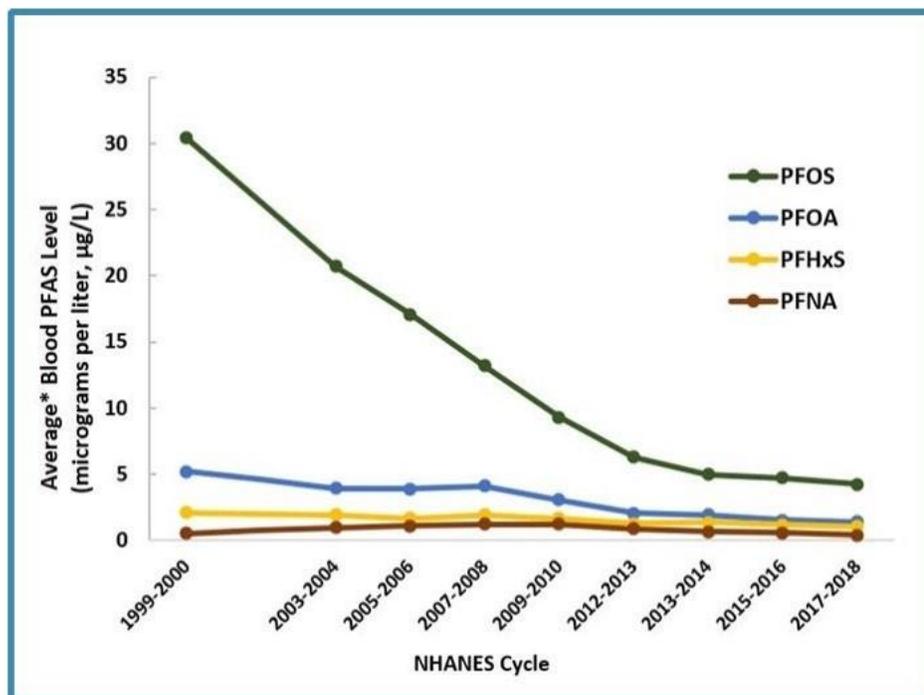
According to the Centers For Disease Control, PFAS are man-made chemicals that have been used in industry and consumer products worldwide since the 1940s. They have been used to make nonstick cookware, water-repellent clothing, stain resistant fabrics and carpets, some cosmetics, some firefighting foams, and products that resist grease, water, and oil.

<https://www.atsdr.cdc.gov/pfas/health-effects/index.html>

Many scientific articles have been published about PFAS exposure and health effects. While it is difficult to show that substances directly cause health conditions in humans, scientific studies have shown that exposure to some PFAS in the environment may be linked to harmful health effects in humans and animals. More research is needed to better understand the health effects of PFAS exposure.

Data Source

Centers for Disease Control and Prevention. National Report on Human Exposure to Environmental Chemicals, Biomonitoring Data Tables for Environmental Chemicals. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.



Biological Agents

“Amerithrax” - Soon after the terrorist attacks of 9/11, letters laced with anthrax began appearing in the U.S. mail. Five Americans were killed and 17 were sickened in what became the worst biological attacks in U.S. history. The Amerithrax Task Force—which consisted of roughly 25 to 30 full-time investigators from the FBI, the U.S. Postal Inspection Service, and other law enforcement agencies, as well as federal prosecutors from the District of

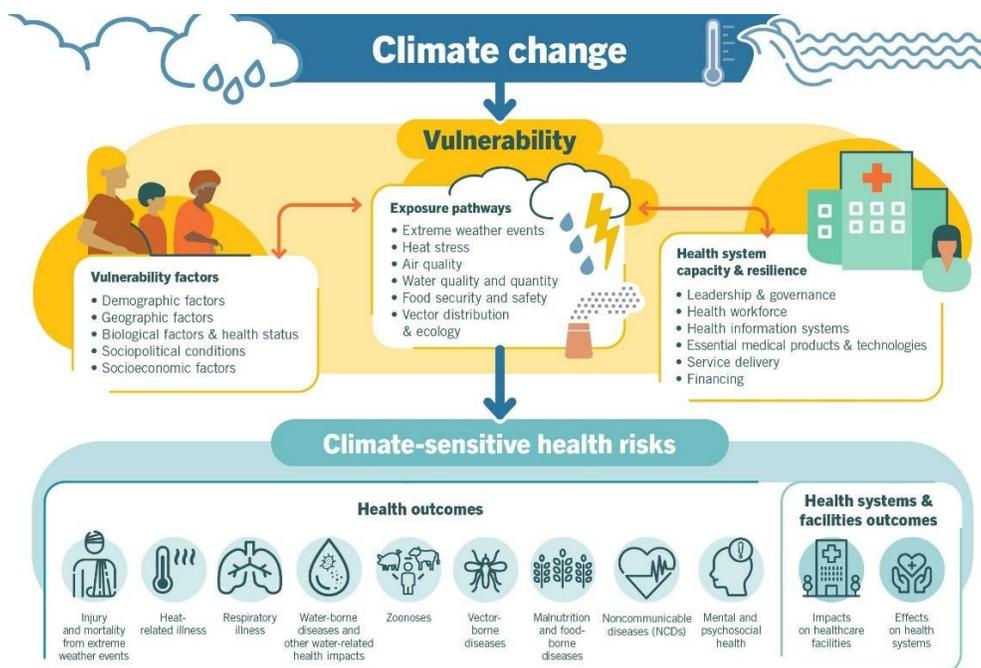
Columbia and the Justice Department’s Counterterrorism Section—expended hundreds of thousands

of investigator work hours on this case. Their efforts involved more than 10,000 witness interviews on six different continents, the execution of 80 searches, and the recovery of more than 6,000 items of potential evidence during the course of the investigation.

<https://www.fbi.gov/history/famous-cases/amerithrax-or-anthrax-investigation>.

Climate Change

According to the World Health Organization, Climate change is the single biggest health threat facing humanity, and health professionals worldwide are already responding to the health harms caused by this unfolding crisis. Climate change is already impacting health in a myriad of ways, including by leading to death and illness from increasingly frequent extreme weather events, such as heatwaves, storms and floods, the disruption of food systems, increases in zoonoses and food-, water- and vector-borne diseases, and mental health issues. Furthermore, climate change is undermining many of the social determinants for good health, such as livelihoods, equality and access to health care and social support structures. These climate-sensitive health risks are disproportionately felt by the most vulnerable and disadvantaged, including women, children, ethnic minorities, poor communities, migrants or displaced persons, older populations, and those with underlying health conditions.



https://cdn.who.int/media/images/default-source/health-and-climate-change/risk-pathways-climate-health.jpg?sfvrsn=3ba05b0_5&Status=Master

Public Health Emergencies within Michigan

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 may be less than was feared. 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**. Although foot-and-mouth disease is a highly contagious disease that only affects animals, a widespread outbreak such as that which occurred in parts of the United Kingdom in the spring of 2001 could have significant public health implications for humans as well, due to the potentially large numbers of dead animal carcasses that would have to be disposed of to prevent disease outbreaks. The Michigan Department of Agriculture and Rural Development, in conjunction with numerous other federal, state and local agencies and the agriculture industry, continues to monitor the foot-and-mouth disease situation and take the necessary steps to prevent the introduction and spread of the disease in the United States.

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. It peaked in Michigan in 2002 with 644 reported cases, including 51 deaths. There has been a decline in reported cases every year since then.

Although no area in Michigan (or elsewhere) is immune to public health emergencies, areas with high population concentrations will always be more vulnerable to the threat. In addition, the more vulnerable members of society—the elderly, children, impoverished individuals, and persons in poor health—are also more at risk than the general population.

Michigan is fortunate in that it has 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 multi-jurisdictional response is required, the emergency management system in Michigan can be utilized to enhance coordination and effectiveness of the response and recovery effort.

The following are brief synopses of some of the more significant public health emergencies that have occurred in Michigan and other parts of the United States in recent years as highlighted in the Michigan Hazard Analysis:

Case: 1973 Chemical Contamination (Polybrominated Biphenyl Contamination)

One of Michigan's most serious statewide public health emergencies occurred in 1973 when a chemical company inadvertently sent bags of a fire retardant containing polybrominated biphenyl (PBB), a highly

toxic chemical, along with a shipment of livestock feed supplement to Michigan Farm Bureau Services. After being mixed with the livestock feed, the contaminated mixture was distributed statewide for use by farmers in feeding livestock herds. The result was an environmental and public health disaster of unprecedented magnitude in Michigan. Thousands of cattle and other animals died from the poisoning and serious questions were raised regarding the long-term effects of this contamination on all Michigan residents.

Case: Spring 1997 Michigan Foodborne Pathogenic Contamination (Hepatitis A Outbreak)

In the spring of 1997, almost 300 cases of hepatitis A occurred in at least four Michigan school districts. A rapid epidemiological investigation by local, state and federal epidemiologists linked this outbreak to frozen strawberries distributed through the national school lunch program. Tracing of the implicated strawberries identified 13 different lots sent to several states in addition to Michigan. Several hundred Michigan schools were potentially affected. A massive program was instituted to evaluate risk at schools that received the frozen strawberries, to inform parents about immune globulin prophylaxis, and to provide it to recently exposed children. The prompt and insightful epidemiological investigation and rapid, well-organized response of the Michigan local health department system helped to prevent the occurrence of additional illnesses and to reduce community anxiety.

Case: November 2008 Holland, MI Norovirus Outbreak

About 420 Hope College students, faculty, and staff reported coming down with an illness from a noro-like virus in November 2008. Symptoms included diarrhea, nausea, and vomiting for 24 to 48 hours. The outbreak prompted the school and county health officials to close the campus and cancel activities starting November 7th, with students who stayed on campus restricted from gathering. Campus security and Holland police were asked to break up any parties or other student gatherings both on and off campus. The campus reopened four days later on November 11th and students were given a bag with plastic gloves, disposable wipes and bleach-based cleaning spray for sanitizing their rooms. Hand sanitizer dispensers were placed in about 40 locations on the Hope College campus to aid in the attempt to stop the spread of the norovirus outbreak.

Case: 2008 Multiple States Foodborne Pathogenic Contamination (Salmonella Outbreak)

In November 2008, Michigan joined a rapidly expanding investigation of a nationwide outbreak of Salmonella Typhimurium, which ultimately exceeded 700 cases from 46 U.S. States and from Canada. A total of 38 confirmed cases with onset dates between October 2008 and February 2009 were identified in Michigan from 15 widely dispersed counties in the lower peninsula of the State. Of these, there were 12 reported hospitalizations. Two unusual features of both the Michigan and nationwide outbreak were noted very early in the investigation—the predominantly young distribution of the cases and the high frequency of exposure in institutional settings such as elementary schools, colleges, long term care facilities, and correctional centers. https://www.michigan.gov/documents/mdch/2009-2010_Influenza_Season_Summary_331957_7.pdf

Case: H1N1 Flu 2009-2010

From April 26, 2009 to May 29, 2010, 11,599 individual cases were reported into the Michigan Disease Surveillance System (MDSS). These cases occurred in two “waves” of activity, the first from the

beginning of May 2009 through the beginning of July 2009 and the second during mid-September 2009 to mid-December 2009 (Figure 3). By comparison, 1557 cases were reported during the 2008-2009 influenza season. Five pediatric influenza-associated mortalities were reported to MDCH for the 2009-2010 influenza season; 84 adult mortalities were reported

Case: Lyme Disease 2016-2017

Lyme disease is caused by the bacterium *Borrelia burgdorferi* and is transmitted by the blacklegged/deer tick. It is the most commonly reported vector-borne disease in the United States and it is spreading across the state of Michigan. Typical clinical signs include flu-like symptoms however, if left untreated may spread to joints, the heart, and/or the nervous system. The majority of cases can be treated successfully with antibiotics. Finding and removing ticks promptly can prevent Lyme disease. In 2016, there were 164 reported cases of Lyme disease in humans in Michigan. In 2017, there were more than 300 human cases of Lyme disease reported, and approximately two out of three cases reported exposure in Michigan. <http://www.mcgi.state.mi.us/midiseasemapper>

Case: Statewide Hepatitis A outbreak 2016-2019

August of 2016 – July 2019, 865 people in Michigan contracted a Hepatitis A strain that passes from person to person. 700 were hospitalized and 27 died. Cases by Area: Detroit 172, Wayne County 145, Macomb County 221, Oakland County 119, St. Clair County 33, Ingham County 26, Genesee 24, Washtenaw and Monroe 18, and 15 in Shiawassee County.

Case: Eastern Equine Encephalitis 2019

EEE is a rare disease that is caused by a virus spread by infected mosquitoes. The EEE virus can cause inflammation of the brain encephalitis). In the United States, approximately 5-10 EEE cases in humans are reported annually. It is one of the most severe mosquito-borne diseases in the United States. According to the Centers for Disease Control and Prevention (CDC), approximately one-third of the human cases of EEE are fatal. Michigan experienced its largest-ever outbreak of Eastern Equine Encephalitis (EEE), Eastern Equine encephalitis virus (EEE) infected 10 Michigan residents (1 Barry, 2 Berrien, 1 Calhoun, 2 Cass, 3 Kalamazoo, and 1 Van Buren) with 6 fatalities. EEE has also infected 49 animals (2 Allegan, 5 Barry, 1 Berrien, 3 Calhoun, 4 Cass, 1 Genesee, 1 Eaton, 1 Houghton, 5 Jackson, 9 Kalamazoo, 2 Kent, 1 Lapeer, 1 Leelanau, 1 Livingston, 1 Montcalm, 1 Newaygo, 7 St. Joseph, 1 Tuscola, and 2 Van Buren). <https://www.mmdhd.org/eee/>

Case: West Nile virus (WNV) 2019

has sickened 12 Michigan residents (1 Bay, 2 City of Detroit, 1 Genesee, 1 Kent, 2 Macomb, 1 Marquette, 1 Oakland, 1 Presque Isle and 2 Wayne) and routine testing of the blood supply identified WNV in 5 Michigan blood donors. https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_76752---,00.html

Case: Influenza 2019-2020

The flu season in the United States started in September 2019 and projected to be the worst in a decade. At least 250,000 people have been hospitalized with flu complications with 26 million Americans infected with a mortality of 14,000 (includes an unprecedented number of deaths of 105

Children) as of February 2020. <https://www.cnn.com/2020/01/30/health/flu-deadly-virus-15-million-infected-trnd/index.html>

Case: Coronavirus (2019-nCoV) 2019-2023

First detected in December 2019 in the central Chinese city of Wuhan linked to a food market with live animals. Coronaviruses are a group of viruses that can cause a range of symptoms including a runny nose, cough, sore throat and fever. Some are mild, while others are more likely to lead to pneumonia. They're usually spread through direct contact with an infected person. The coronavirus gets its name from the crown-like spikes on its surface, according to the Centers for Disease Control and Prevention. (Corona is Latin for crown.) Including the newly identified form of the virus, there are a total of seven coronaviruses that can infect humans, the CDC says. There is no specific treatment for the new virus, and no vaccine to prevent it.

The outbreak is coinciding with massive travel in and out of China in advance of the Lunar New Year on Jan. 25, and prompted the CDC last week to start screening passengers arriving from Wuhan at New York's John F. Kennedy International Airport, the San Francisco International Airport and Los Angeles' LAX. On Tuesday, the CDC announced that it would be screening passengers at two additional airports: Atlanta's Hartsfield–Jackson and Chicago's O'Hare. All passengers whose flights originate in Wuhan will be rerouted to one of these five airports. <https://www.nbcnews.com/health/health-news/1st-case-coronavirus-china-confirmed-u-s-n1119486>

Wuhan coronavirus compared to other major viruses

| VIRUS | YEAR IDENTIFIED | CASES | DEATHS | FATALITY RATE | NUMBER OF COUNTRIES |
|------------|-----------------|--------|--------|---------------|---------------------|
| Ebola** | 1976 | 33,577 | 13,562 | 40.4% | 9 |
| Nipah | 1998 | 513 | 398 | 77.6% | 2 |
| SARS | 2002 | 8,096 | 774 | 9.6% | 29 |
| MERS* | 2012 | 2,494 | 858 | 34.4% | 28 |
| COVID-19** | 2020 | 60,349 | 1,370 | 2.2% | 26 |

Sources: CDC; World Health Organization; New England Journal of Medicine; Malaysian Journal of Pathology

*As of November 2019 **As of February 13, 2020

BUSINESS INSIDER

As of December 9, 2022, there have been 643,875,406 confirmed cases of 2019-nCoV globally resulting in about 6,630,082 deaths. The United States has a total of 99,587,851 cases with 1,086,737 deaths. Michigan has had 2,950,361 cases with 40,327 deaths. Muskegon County has had 47,171 cases with 698 deaths.

<https://www.nbcnews.com/health/health-news/coronavirus-u-s-map-where-virus-has-been-confirmed-across-n1124546>

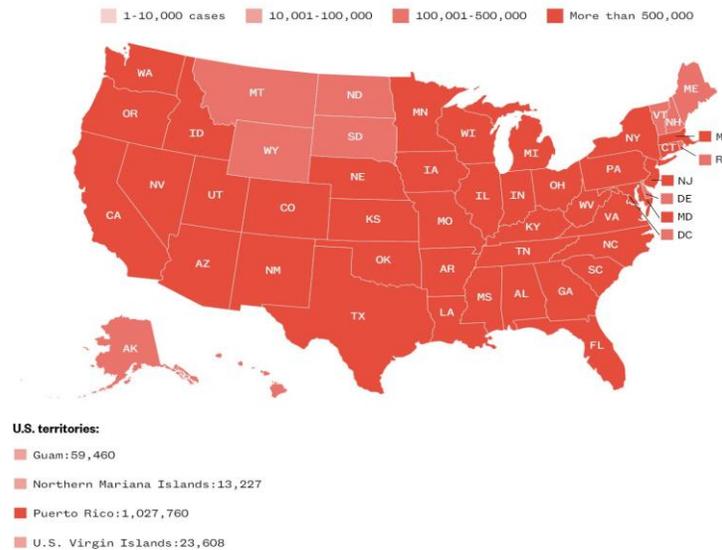
99,587,851 1,086,737

Confirmed cases in U.S.

Deaths in U.S.

Confirmed cases of coronavirus in the United States

Hover over a state to see how many confirmed cases and deaths there are across the country.



Currently, there is no licensed medication to cure COVID-19. A few medicines have been approved to treat COVID-19. Antibiotics aren't effective against viral infections such as COVID-19. A variety of drugs to help treat Covid have been developed. December 31, 2019 — The first cluster of people sick with what is now called COVID-19 is reported in Wuhan, China. The U.S. government comes together with private, non-governmental, and academic organizations to begin work on COVID-19 vaccines.

On December 11, 2020 — The FDA grants an emergency use authorization (EUA) to the Pfizer-BioNTech mRNA vaccine for people age 16 and older. December 18, 2020 — The FDA grants an EUA to the Moderna mRNA vaccine for people age 18 and older. March 2022 — Data show that the U.S. COVID-19 vaccination program is estimated to have prevented 2 million deaths, 17 million hospitalizations, and 66 million infections through March 2022. Vaccination is also estimated to have saved nearly \$900 billion in health. [https://covid19.nih.gov/nih-strategic-response-covid-19/decades-making-mrna-covid-19-vaccines care costs](https://covid19.nih.gov/nih-strategic-response-covid-19/decades-making-mrna-covid-19-vaccines-care-costs).

Case: Candida Auris 2021-2023

The fungus first emerged in the state in 2021. The state health department in Michigan reported about 199 patients have contracted Candida auris, an emerging fungus that the CDC says, "presents a serious global health threat" because it is difficult to identify with standard laboratory procedures, is resistant to anti-fungal drugs and causes outbreaks in hospitals and can lead to "severe illness." The fungus, a type of yeast, is usually found in health care facilities and has led to severe illness and sometimes death in hospitalized patients. Most of the cases are in Detroit and Wayne County, according to the Michigan Department of Health and Human Services. Other areas with confirmed infections include Oakland, Ingham, Livingston and Washtenaw counties, according to state data.

Case: Avian Influenza

Highly pathogenic avian influenza (HPAI), commonly called “bird flu,” is a virus found among various species of birds. HPAI viruses can infect domestic poultry, which includes chickens, turkeys, pheasants, quail, ducks, geese, and guinea fowl. For more information on current detections in domestic poultry across the U.S., please visit the U.S. Department of Agriculture’s webpage.

HPAI infects a wide variety of other birds, including wild migratory waterfowl. The Centers for Disease Control (CDC) considers the risk to people from these HPAI infections in wild and domestic birds to be low. In 2022, widespread outbreaks occurred across the nation and Michigan. Multiple flocks were affected in Macomb, Menominee, Livingston, Washtenaw, Saginaw, Wexford, Branch, Oakland, Ingham, Tuscola, Lapeer, Genessee, Sanilac and Eaton counties. Approximately 35,100 turkeys were affected.

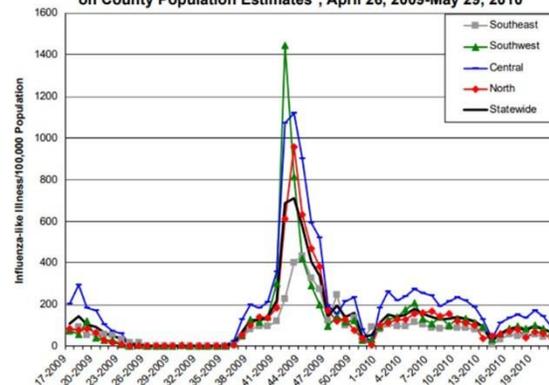
Public Health Emergencies within Muskegon County

Most Public Health Emergencies will not be isolated to Muskegon County but impact the entire state or Country as well. Muskegon County Public Health Department located at: 165 E Apple Ave, 2nd Floor at the Muskegon County South Campus, is committed to providing timely, accurate, and practical information to the citizens to assist them in taking appropriate precautions and actions to protect self and family in a public health emergency.

Case: 2009-2010 H1N1 in Muskegon County

The 2009-2010 influenza season (defined as April 26, 2009 to May 29, 2010) saw the emergence and progression of a worldwide pandemic due to an influenza A (H1N1) virus. This virus was originally labeled as swine origin, but it is a human-adapted triple re-assortant virus, consisting of swine, avian and human influenza genes. The 2009 influenza A (H1N1) pandemic was the first influenza pandemic in 40 years.

Figure 4. Rates of Aggregate Influenza-like Illness per 100,000 Population, Based on County Population Estimates*, April 26, 2009-May 29, 2010



The 2009-2010 influenza season had a markedly elevated level of activity compared to not only the 2008-2009 influenza season, but any previous influenza seasons in which similar surveillance methods were in place. The first pandemic influenza A (H1N1) virus isolated at the Michigan Department of Community Health (MDCH) Bureau of Laboratories was announced on April 27, 2009. While a small peak of pandemic influenza A (H1N1) activity was seen at the end of May during the first pandemic wave, the true peak of the season occurred in late October during the second pandemic wave. Pandemic influenza A (H1N1) viruses predominated during this season; other influenza virus subtypes were virtually nonexistent. Michigan reported “widespread” statewide influenza activity, the highest level of reporting to the Centers for Disease Control and Prevention (CDC), for seven straight weeks from the week ending October 17, 2009 through the week ending November 28, 2009. Peak activity in Michigan during fall 2009 occurred slightly later than most other states.

Case: 2019 Eastern Equine Encephalitis 2019

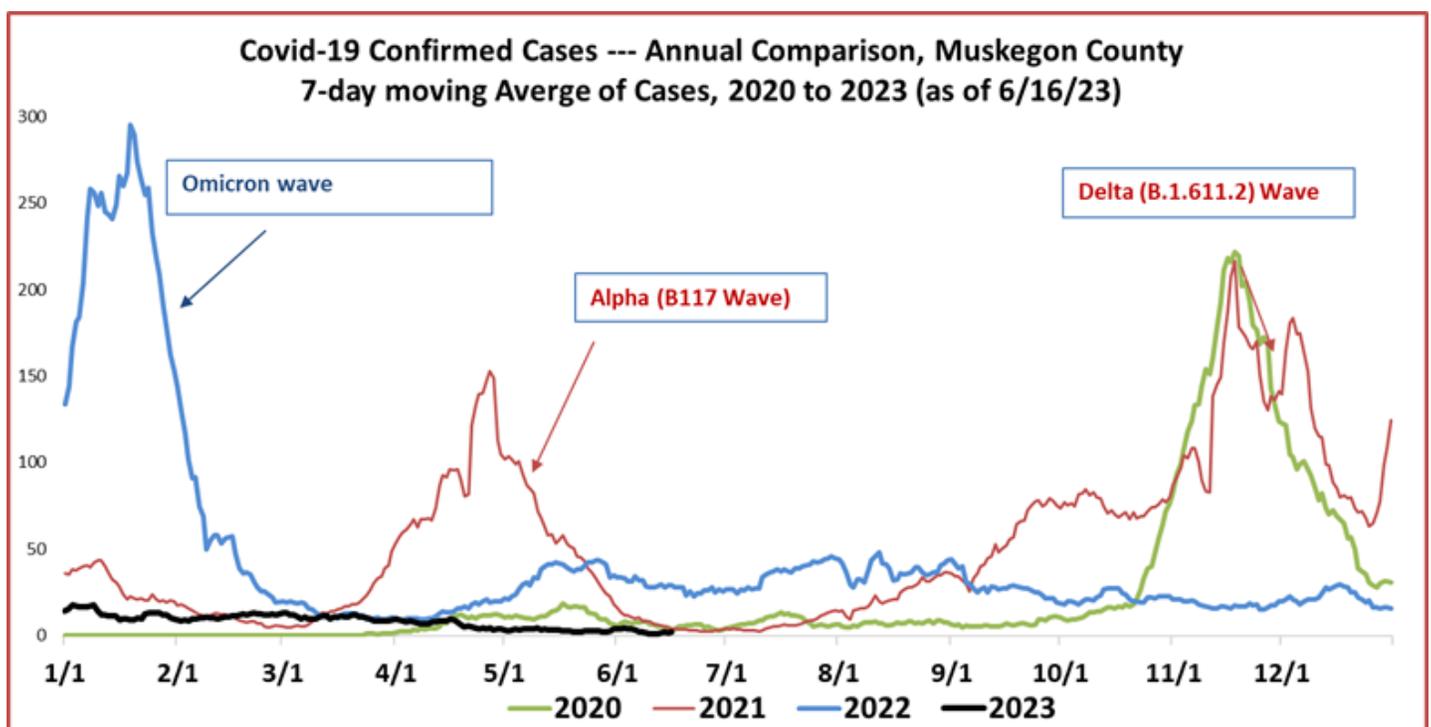
Eastern Equine Encephalitis is a rare disease that is caused by a virus spread by infected mosquitoes. The EEE virus can cause inflammation of the brain encephalitis). In the United States, approximately 5-10 EEE cases in humans are reported annually. It is one of the most severe mosquito-borne diseases in the United States. According to the Centers for Disease Control and Prevention (CDC), approximately one-third of the human cases of EEE are fatal. Michigan experienced its largest-ever outbreak of Eastern Equine Encephalitis (EEE), Eastern Equine encephalitis virus (EEE) infected 10 Michigan residents (1 Barry, 2 Berrien, 1 Calhoun, 2 Cass, 3 Kalamazoo, and 1 Van Buren) with 6 fatalities. EEE has also infected 49 animals (2 Allegan, 5 Barry, 1 Berrien, 3 Calhoun, 4 Cass, 1 Genesee, 1 Eaton, 1 Houghton, 5 Jackson, 9 Kalamazoo, 2 Kent, 1 Lapeer, 1 Leelanau, 1 Livingston, 1 Montcalm, 1 Newaygo, 7 St. Joseph, 1 Tuscola, and 2 Van Buren).<https://www.mmdhd.org/eee/>

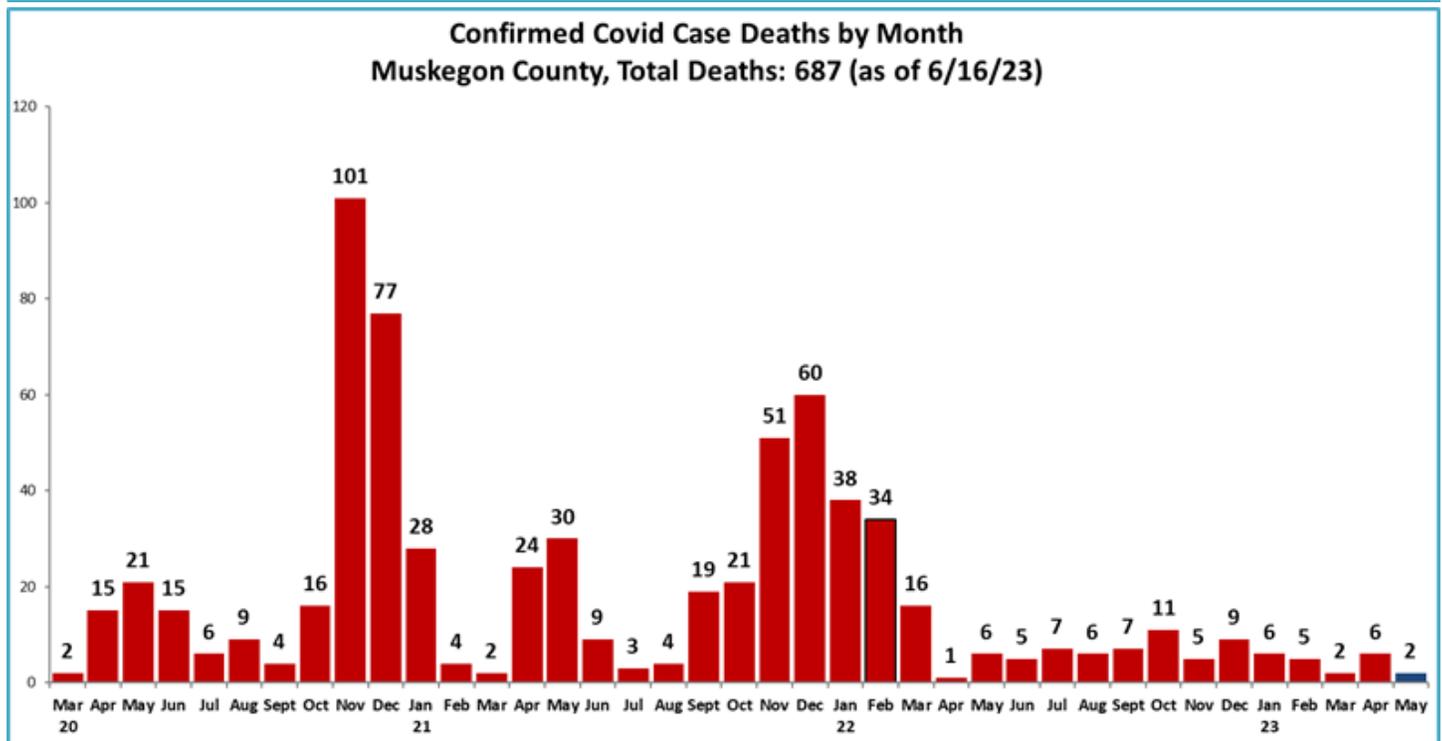
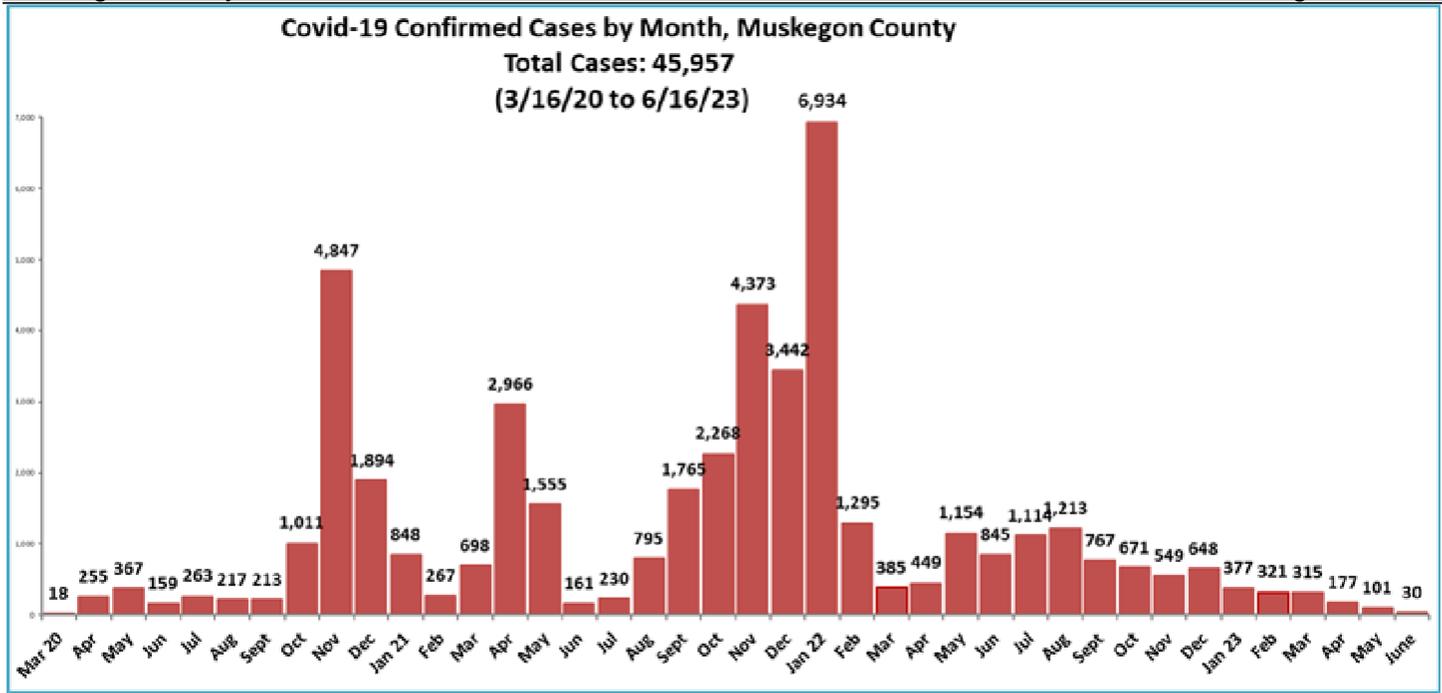
Case: Coronavirus Disease 2019-2022

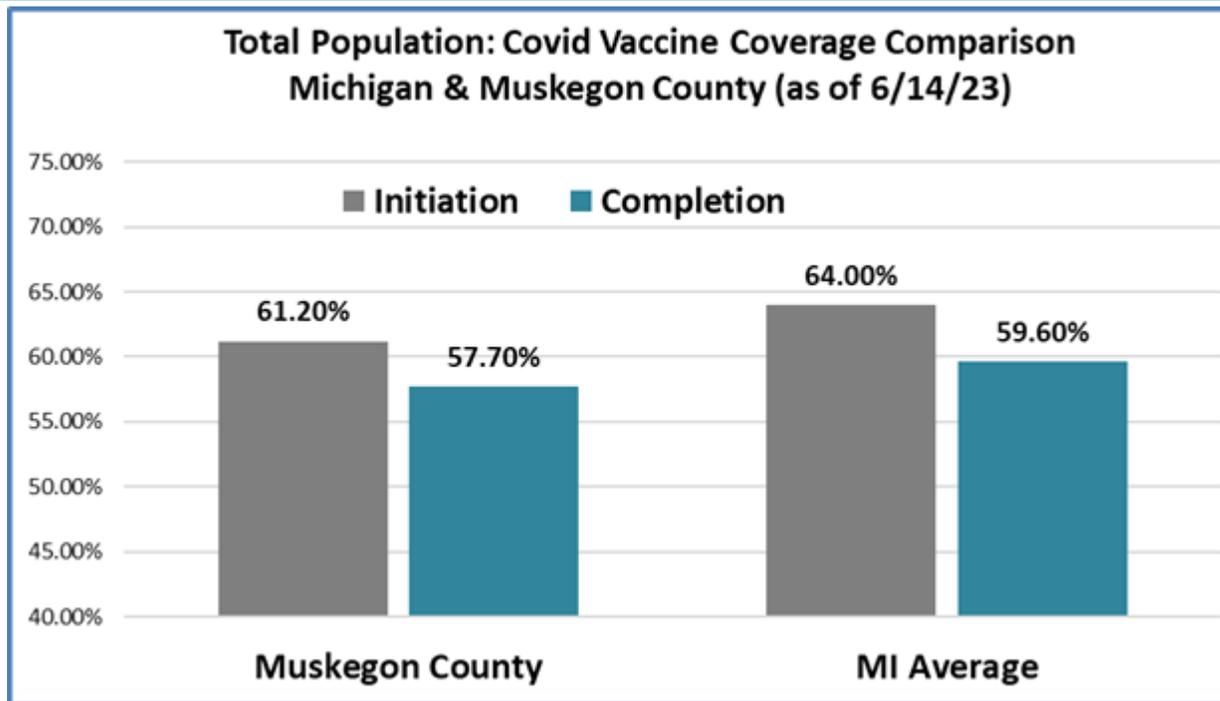
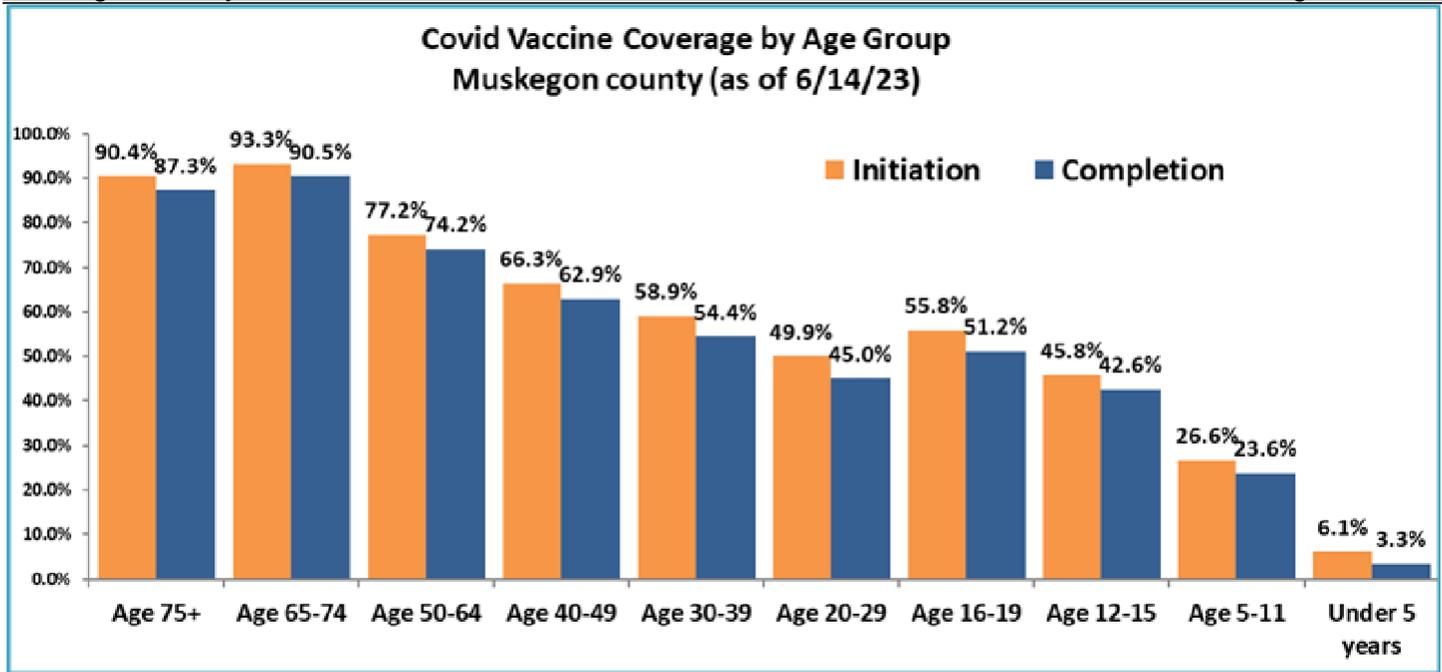
According to the CDC, COVID-19 (coronavirus disease 2019) is a disease caused by a virus named SARS-CoV-2. It can be very contagious and spreads quickly. Over one million people have died from COVID-19 in the United States.

COVID-19 most often causes respiratory symptoms that can feel much like a cold, the flu, or pneumonia. COVID-19 may attack more than your lungs and respiratory system. Other parts of your body may also be affected by the disease. Most people with COVID-19 have mild symptoms, but some people become severely ill.

Some people including those with minor or no symptoms will develop Post-COVID Conditions – also called “Long COVID.”







Case: Avian Influenza 2022

In May 2022, the state has found avian influenza at a commercial turkey farm in eastern Muskegon County, forcing the farm to kill its stock in an effort to prevent the virus from spreading. The farm was located in Mooreland Township. According to the Michigan Department of Agriculture and Rural Development, this was the first confirmed case of bird flu at a commercial poultry operation in Michigan. To protect other flocks, the state placed the premises under quarantine and 35,000 turkeys at the facility were “euthanized” to prevent the spread.

In June 2022, at least 40 cormorants have been found dead within 100 yards of each other at Dune Harbor County Park in Norton Shores. The Michigan DNR believe this was a result of Avian Influenzas outbreak. No people were found to be ill as a direct result of the deceased birds.

Emerging Public Health Concerns - The Opioid Crisis, Vaping and Mental Health

Seasonal respiratory Syncytial Virus (RSV)

In the United States, the timing of seasonal respiratory syncytial virus (RSV) epidemics (October–April) was disrupted during the COVID-19 pandemic. In the United States, respiratory syncytial virus (RSV) infections cause an estimated 58,000–80,000 hospitalizations among children aged <5 years and 60,000–160,000 hospitalizations among adults aged ≥65 years each year. U.S. RSV epidemics typically follow seasonal patterns, peaking in December or January but the COVID-19 pandemic disrupted RSV seasonality during 2020–2022. <https://www.cdc.gov/mmwr/volumes/72/wr/mm7214a1.htm>
In April of 2023 the FDA approved vaccines for children and in May of 2023 the FDA approved Abrysvo (Pfizer) a vaccine for RSV for individuals 60 years and older.
<https://www.immunize.org/timeline/>

The Opioid Crisis 1990-2020

Every day, more than 130 people in the United States die after overdosing on opioids. The misuse of and addiction to opioids—including prescription pain relievers, heroin, and synthetic opioids such as fentanyl—is a serious national crisis that affects public health as well as social and economic welfare. The Centers for Disease Control and Prevention estimates that the total "economic burden" of prescription opioid misuse alone in the United States is \$78.5 billion a year, including the costs of healthcare, lost productivity, addiction treatment, and criminal justice involvement.
<https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis>.

According to the Michigan Department of Health and Human Services, Opioid overdoses surged during the COVID-19 pandemic. Dr. Joneigh S. Khaldun, chief deputy for health and chief medical executive for the State of Michigan said, "Opioid overdoses kill far too many Michiganders, and it's a double tragedy that the pandemic has exacerbated this crisis." COVID-19 resulted in these patients declining transport to the emergency department of hospitals. Press release July 29, 2020.
[Michigan.gov/Opioids](https://www.michigan.gov/Opioids)

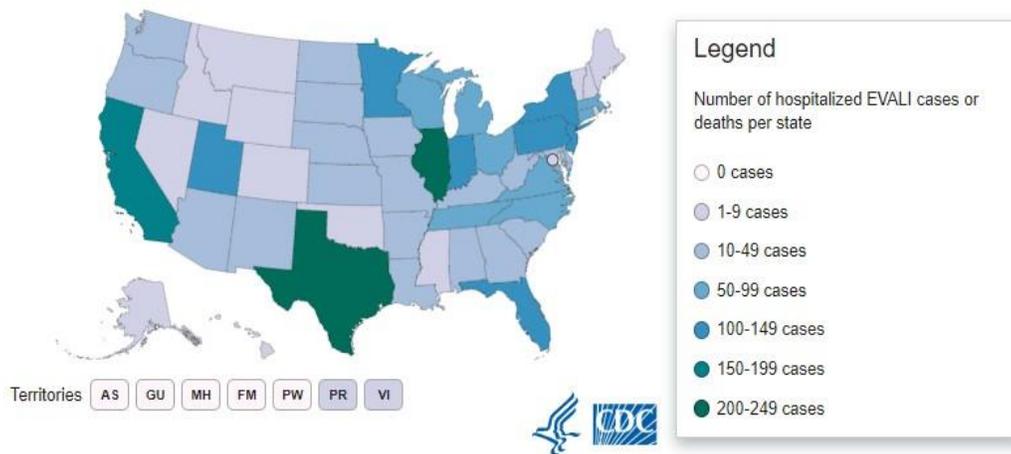
Outbreak of Lung Injury due to Vaping/E-Cigarette/related products 2019-2020

National outbreak of vaping, e-cigarette product use resulting in lung injury peaked August-September 2019. A total of 2,807 hospitalized cases or deaths have been reported to CDC from all 50 states, the District of Columbia, and two U.S. territories (Puerto Rico and U.S. Virgin Islands). 68 deaths have been confirmed in 29 states and the District of Columbia (as of February 18, 2020). The age range for deaths is 15-75 years of age. All patients have reported using e-cigarette products.

Based on reports from several states, patients have experienced respiratory symptoms (cough, shortness of breath, or chest pain), and some have also experienced gastrointestinal symptoms (nausea, vomiting, or diarrhea) or non-specific constitutional symptoms (fatigue, fever, or weight

loss). Symptoms typically develop over a period of days but sometimes can manifest over several weeks. Gastrointestinal symptoms sometimes preceded respiratory symptoms. Fever, tachycardia, and elevated white blood cell count have been reported in the absence of an identifiable infectious disease. Many patients have sought initial care in ambulatory settings, some with several visits, before hospital admission.

Number of Hospitalized EVALI Cases or Deaths Reported to CDC as of January 21, 2020



https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html#what-is-new

Mental Health

New mental health issues have emerged among some special populations, such as:

- Veterans who have experienced physical and mental trauma
- People in communities with large-scale psychological trauma caused by natural disasters
- Older adults, as the understanding and treatment of dementia and mood disorders continues to improve

According to the World Health Organization, 1 in 4 people are affected by a mental disorder at some point in their lives. By 2030 depression will be the leading cause of disease burden globally. 900,000 people commit suicide each year. Suicide is the second most common cause of death among young people. 3 out of 4 people with severe mental disorders receive no treatment.

On May 27, 2013, the World Health Assembly adopted the Comprehensive Mental Health Action Plan 2013–2020 that has great potential to change the direction of mental health in countries around the world in the next 8 years. This action plan and the accompanying resolution—a first in the history of WHO—represent a formal recognition of the importance of mental health for WHO's 194 member states. It is also a commitment by all member states to take specified actions to improve mental health and to contribute to the attainment of a set of agreed global targets.

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(13\)61139-3/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)61139-3/fulltext)

CRIMINAL INCIDENTS

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

Terrorism Hazard Description

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.

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.

Terrorism Hazard Analysis

In April of 2019, Michigan State Police released this statement "It is important, however, for everyone to remain vigilant as we go about our daily lives. First and always, if you see something, say something", along with a list of Seven Signs of Terrorism to look out for:

- 1) Surveillance: Someone recording or monitoring activities. The use of cameras (either still or video), note taking, drawing diagrams, annotating on maps, or using binoculars or other vision-enhancing devices.
- 2) Elicitation: Attempts to gain information about military operations, capabilities, or people. Elicitation attempts may be made by mail, fax, telephone, or in person. This also includes the

comings and goings of private business, places of worship or public buildings. Questions may be about security alarms, which doors are locked or deliveries both packages and U.S. Mail.

- 3) Tests of security: Any attempts to measure reaction times to security breaches or to penetrate physical security barriers or procedures in order to assess strengths and weaknesses. This includes private security or the police.
- 4) Acquiring supplies: Purchasing or stealing explosives, weapons, ammunition, etc. Acquiring military or other uniforms, decals, flight manuals, passes or badges (or the equipment to manufacture such items) or other controlled items.
- 5) Suspicious persons out of place: People who don't seem to belong in the workplace, neighborhood, business establishment, or anywhere else. Includes suspicious border crossings and stowaways aboard ship or people jumping ship in port.
- 6) Dry run/trial run: Putting people into position and moving them around according to their plan without actually committing the terrorist act. This is especially true when planning a kidnapping, but it can also pertain to bombings. An element of this activity could also include mapping out routes and determining the timing of traffic lights and flow.
- 7) Deploying assets: People and supplies getting into position to commit the act. This is a person's last chance to alert authorities before the terrorist act occurs.
https://www.tctimes.com/news/michigan-state-police-tweet-warning-signs-for-terrorism/article_65d7c0fc-653c-11e9-904c-bb92d94c6056.html

Terrorism in the United States

Terrorists intend to use fear as a weapon to achieve their goals. This approach allows a small, weak group to potentially influence the actions of an entire nation or government. Terrorists lack the power to achieve their ultimate aims through the direct use of force, but by staging relatively small attacks in a spectacular fashion, they hope to have a major political impact. Their goals are effectively summarized by the proverb "Kill one, frighten 10,000." Terrorism can be an effective strategy for a weak group to use when fighting a strong opponent.

Terrorism has been used for thousands of years, but modern terrorism developed in the 19th Century. The United States has suffered from terrorist attacks for more than a century: U.S. President William McKinley was assassinated by an anarchist terrorist in 1901, the Los Angeles Times building was destroyed in 1910, and Wall Street was bombed in 1920. Racial and religiously motivated terrorism continued throughout the 20th century. A new wave of terrorism was instigated in the 1960s by left-wing radicals. This was followed by right-wing extremist terrorism in the 1980s and 1990s. All of these attacks were conducted by American domestic terrorists against other Americans.

The United States has also been the target of terrorists from other countries. Conflict in the Middle East led to many attacks on American targets overseas, primarily by Palestinian nationalist terrorists, as well as groups supported by Libya and Iran. Hijackings, kidnappings, and bombings of Americans occurred throughout the 1970s and 1980s, and into the 1990s. By the mid-Nineties the danger had shifted toward attacks by violent Islamic extremist groups such as al-Qaeda. Al-Qaeda successfully moved their

terrorist campaign inside of the United States homeland with the World Trade Center bombing in 1993 and the devastating 9/11 attacks in 2001.

Incidents in the United States

Case: Oklahoma City Federal Building Bombing (1995)

On April 19, 1995, the Alfred P. Murrah Federal Building in Oklahoma City, Oklahoma, was attacked by a large truck bomb. The attack killed 168, injured more than 680, destroyed the building, and caused widespread destruction over a sixteen-block area. Although initially suspected of being carried out by international terrorists, the attackers were in fact anti-government domestic terrorists, one of whom had extensive Michigan connections. This attack is an example of right-wing anti-government terrorism. It also demonstrates the extensive destruction that can be caused to large buildings which lack adequate target hardening and security measures.

Case: May 1, 2010 New York City Times Square Car Bombing Attempt: A car bomb was placed at Time Square but failed to detonate. Several days later, a Pakistani-American male was arrested in connection with the bombing attempt. He also had ties with the Taliban.

Case: April 15, 2013 Boston Marathon Bombing: Two bombs were detonated near the finish line of the 2013 Boston Marathon, killing at least three people, and leaving more than 180 others injured. Two suspects were identified. 1 was killed during a shootout with police in Watertown, Massachusetts in the early hours of April 19, and the other arrested nearby about 18 hours later. The two also shot and killed a police officer in Cambridge prior to the police chase.

Case: December 2, 2015 San Bernadino CA A married couple, stormed a county health department's holiday banquet, fatally shooting 14 people and injuring 22 others while leaving a failed pipe bomb at the scene. Both perpetrators were shot and killed four hours later in a shootout with police forces. The pair pledged allegiance to Islamic State of Iraq and the Levant on the day of the shooting.

Case: June 12 2016 Orlando Pulse Nightclub 49 people were killed when an alleged lone-wolf gunman entered the Pulse gay nightclub. Hostages were taken and the perpetrator, was killed by local SWAT units. The FBI classified the attack as an act of "domestic terrorism" motivated by "Islamic leanings".

Case: October 31, 2017 New York, NY Motor Vehicle attack A pickup truck rammed into pedestrians near the World Trade center in New York, killing eight people and injuring 11 others. An ISIS flag and a note that read "Islamic State lives forever" in Arabic were found near the truck. The attacker was self-radicalized, and he had followed the Islamic State group's advice on social media on how to carry out vehicular attacks.

Case: October 1 - November 2018 United States A registered Republican Party member from Aventura, Florida sent mail bombs to various Democratic Party politicians and liberal media

personalities and individuals including the CNN Headquarters across the United States. The perpetrator was arrested on October 26, 2018 and one year later in 2019 plead guilty to 65 felony counts such as using weapons of mass destruction in a terrorist attack.

Case: June 17, 2019 Dallas, TX A gunman attacked the Earle Cabell Federal Building and Courthouse in Dallas, Texas, United States. No law enforcement officers, or civilians were injured in the shooting, though one person sustained a superficial injury when she was taking cover; the only casualty was the shooter who was killed by security. The gunman appears to have self-radicalized online, posting memes from an extremist far right organization including ideas about the Confederate States and Nazism, combining eco-friendly and libertarian ideas with far-right authoritarianism.

Case: August 3, 2019 El Paso, TX A mass shooting took place at a Walmart store. Twenty-two people were killed, and 24 others were injured. A single gunman is suspected of committing the shooting. He was apprehended by police shortly afterward and arrested. The FBI is investigating the shooting as an act of domestic terrorism and a possible hate crime. The attacker released a manifesto before the attack, expressing support for and inspiration by the Christchurch mosque shootings, along with worry about Hispanic invasion, automation, large corporations, and environmental degradation. He quoted that "Hispanics will take control of the local and state government of my beloved Texas, changing policy to better suit their needs.

Terrorism in Michigan

Case: Bath School Disaster (1927)

On May 18, 1927, the Bath Consolidated School in Bath, Michigan, was the target of an attack with explosives. The bomber was probably motivated by personal revenge against the local school district (stemming from a taxation issue), and so this event is classified as criminal, rather than as a terrorist attack. Although many of the explosives failed to detonate, the bombs in the school killed dozens of students and teachers. The bomber also destroyed his home and farm with explosives. Immediately after the school attack, the bomber approached the rescue operations scene and detonated an explosive device carried in his vehicle, killing himself, local officials, and several bystanders. The final death toll was 45, with 58 additional persons injured. The Bath Disaster remains the second most deadly U.S. bombing attack, after the Oklahoma City Bombing, as well as the most lethal attack on an American school. This case also provides early examples of such tactics now in common use by terrorists, including a secondary device, suicide bombing, and car bomb.

Case: Michigan State University Agriculture Building Arson (1999)

On December 31, 1999, environmental terrorists affiliated with the Earth Liberation Front (ELF) set fire to the Agriculture Biotechnology Support Project, located in a classroom and office building at Michigan State University. The university was targeted because of its work on genetically modified crops. The fire was set when there were few people in the building. Damages to the building and research equipment totaled approximately \$1 million. Four domestic terrorists from Michigan and Ohio were later tried and convicted in federal court for carrying out this attack. This attack, a similar attack against

Michigan State in 1992, and an attempted attack against the Michigan Technological University Forestry Center in 2001 are all typical of attacks by environmental terrorist groups. These attacks generally are designed to cause property damage but few deaths and injuries. These attacks also demonstrate the vulnerability of universities and research centers to terrorist attack.

Case: Northwest Airlines Flight 253 Bombing Attempt (2009)

On Christmas Day 2009, an individual attempted to destroy Northwest Airlines Flight 253, approaching Detroit Metropolitan Airport. The weapon used was an explosive device provided by the “al-Qaeda in the Arabian Peninsula” terrorist group and hidden in his underwear. The device was small and easy to conceal but was capable of damaging or destroying the airliner. The explosive failed to detonate properly and instead ignited and burned, he was then subdued by the plane’s passengers and crew.

Case: Highway Shootings (2012)

During October 2012, a man shot at cars as they drove along and near a Michigan highway corridor in Oakland, Ingham, Shiawassee, and Livingston counties, over the span of several days. The first car was shot in Commerce Township on October 16th. On that same day, four more shootings occurred in Wixom. On the next day, another Commerce Township shooting took place near the same location as the first day. The northernmost shooting occurred in Perry on October 18th. On that same day, there were eight shootings near the I-96 exit in Webberville. There was also an October 18th shooting in Howell, and six shootings in Wixom. About a week later, on October 27th, two shootings occurred along Grand River and I-96 in the area of Fowlerville, and a driver on I-96 reported being injured by a bullet (the only such instance reported). During his trial, the shooter claimed that shooting at vehicles was connected to a condition of mental illness. Investigators connected him with 24 shooting incidents in the area. In 2014, a Livingston County jury convicted him of terrorism, and he was sentenced to 16 to 40 years. This was in addition to a sentence of at least 6 years received in Oakland County. It is possible that additional charges may be sought in Ingham and Shiawassee County. NOTE: Media headlines often simplified these incidents by referring to them as involving “The I-96 Shooter,” even though most incidents did not involve Interstate traffic.

Case December 30, 2018

A 32-year-old White Cloud, MI man entered St. Patrick-St Anthony Catholic Parish Church in Grand Haven, MI and assaulted a parishioner that was setting up for Mass. The suspect broke a chair and used pieces of it to assault the victim. The victim fought back and called police. When police arrived and arrested him, they found he had placed Jumbo fireworks in multiple locations inside and outside the building. He had not lit them. Services were cancelled for that day.

Case: Kidnapping Plot November 2020

Nine individuals are accused of aiding with conspiring to kidnap Whitmer before the November 2020 Election. They are accused of providing materials to support terrorist acts, attempting to commit a felony as an associate or member of gang, and gun charges. Investigators have described three of the accused as anti-government extremists who were angry over coronavirus policies and restrictions

imposed by the governor during the first year of the COVID-19 pandemic. Two of the suspects are founding members of the Wolverine Watchmen, which authorities described as “an anti-government, anti-law enforcement militia group.”

Terrorism in Muskegon County

Muskegon County has had limited history and experience with major criminal incidents, recent trends in school and workplace violence, domestic and international terrorism, and other man-made criminal actions have resulted in a new hazard concern for local officials. Local issues regarding such events have generally resulted from high profile national events and focused on the following potential: 1) school violence; 2) workplace violence; 3) sabotage/arson; 4) Prison Uprisings; 5) domestic/international terrorism. Based on historical occurrence, Muskegon County experiences a terrorism incident approximately once every decade.

In the late 1990's, high profile school violence events in Jonesboro, Arkansas and Columbine, Colorado resulted in a nationwide epidemic of school emergencies causing significant social, political, and economic issues throughout the United States. Locally, Muskegon County schools have experienced bomb threats and resulted in dramatic local efforts at school safety. Despite national attention on school violence diminishing, this hazard remains a primary aspect of the emergency management environment and local planning efforts focused on all-hazards safety for such public facilities.

After a school shooting incident in Oxford, MI where the suspect and his parents are charged with terrorism (a departure from what has happened in the past) copycat threats prompt several W. MI districts to close with more than 100 cancelations statewide

In December 2021, the Muskegon County Prosecutor's Office, in conjunction with the School Safety Task Force, authorized charges against nine students for a variety of threats made involving local schools. These offenders range in age from 12 to 14. The charges against them include Disturbing the Peace, Intentional Threats Against a School or Student, Attempted False Report or Threat of Terrorism, and False Report or Threat of Terrorism. The affected school districts are Mona Shores, Muskegon, Muskegon Heights, Reeths Puffer, Oakridge, and Whitehall.

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.

Civil Disturbances Hazard Description

Civil disturbances can be separated into several sub-categories of disturbance that could affect a community. Since most of these types of disturbance share similarities with each other, and the classifications presented here are not absolute and mutually exclusive, it is recommended that this entire section be studied as a whole. The descriptions that follow, while roughly organized by type of disturbance, provide information of interest in evaluating and understanding all types of civil disturbance, and therefore should not be treated as independent subsections or read in isolation from each other.

1. Disturbances that center around a particular facility: the facility could be a prison, a courthouse or other center of government, a stadium or other public meeting place, where large numbers of people may at some point gather in a disruptive fashion that is threatening to the community, its businesses, residents, or quality of life. Typically, a risk assessment would examine the history of the facility, and similar facilities in other communities. Such historical information might identify particular conditions that may cause collective behavior to get out of hand. The degree to which a community contains facilities and conditions that have been associated with civil disturbances will indicate the amount of risk that it faces from civil disturbances.
2. Disturbances that arise in general areas experiencing conflict and hardship: This refers to neighborhoods or regions that have experienced one or more economic, social, or political stresses such as poverty, ethnic intimidation, corruption, and/or the notable presence of illegal activities. These ongoing conflicts and challenges may sometimes flare up into more widespread and blatant conflicts and unrest. The important things to recall about these sorts of civil disturbances is that it is the presence of these conflicts and problems (rather than a particular ethnic or demographic composition) that eventually generates broader disturbances. Care must be taken not to inappropriately "profile" areas based on the characteristics of their residents.
3. Disturbances that interfere with normal business functions: Sometimes, protests are organized in a way that is deliberately designed to disrupt the normal operations of one or more businesses and may also happen to disrupt surrounding business operations or traffic flows nearby. Many such incidents are political, and eventually addressed through court actions or legislative proceedings. Labor negotiations may have associated employee unrest, including strikes. Protesters may object to the existence of specific facilities or businesses, or their location in a specific area, and while seeking to make such a business or its associated activities illegal, may attempt to take more direct action against its employees or patrons. Typically, the perceived harm from such businesses are either from environmental impacts or injury to persons, or social impacts concerning the image or moral standards associated with an area. In other cases, a

political demonstration may not have anything to do with the sorts of facilities or businesses in an area, but merely seeks the most crowded and inconvenient location so as to maximize the attention that it receives.

There is no specific "formula" recommended here for analyzing civil disturbance hazards, but it is probably helpful to include a historical approach that specifically addresses the social conflicts and political controversies affecting disturbance-prone areas of a community. The various costs of past events (crowd control, vandalism, arson, business disruption and closures, injuries, diverted traffic, negative economic impacts) can be estimated along with their past frequency (e.g., three times in the past hundred years) so as to produce an estimated annual cost. The history of cities with similar conditions can also be analyzed in this way because the risk of a disturbance may be present even though there have not yet been any historic local events. This is particularly true for communities with newly developed facilities, in rapidly growing areas, or experiencing significant social and economic changes. Their risk of civil disturbance may be increasing but there is not yet a local history of incidents that can be generalized from.

Impact on the Public

Civil disturbance impacts may include deaths and injuries, disruption of services, and short- and long-term damage to a community's tranquility and reputation (which may also affect its property values). Temporary or permanent business closures may be caused by broken windows, looting, arson, etc. Fear (and its associated security costs) may discourage visitors, shoppers, and tourists, and further cause economic impacts on the area (and associated declines in its property values). Direct property damage can be expected to cause inconvenience, at the very least, to area residents and businesses, and there is a further problem of impeded access to the area's services, and to residents' own personal property.

Impact on Public Confidence in State Government

If discontent underlies a disturbance, some persons may generalize, displace, or attribute the source of their discontent to local or state governments. Some discontent may actually be aimed toward government policies involving the environment, housing, land use, wealth distribution, taxation, military conscription, foreign affairs, labor issues, infrastructure provision, civil rights, or other issues. Although government programs often exist that attempt to address these types of concerns and to ensure that particular values (e.g., civil rights) are respected and supported throughout the jurisdiction, widespread or widely publicized disturbances or demonstrations may undermine the effectiveness of governmental programs and thus weaken public confidence in government. Other types of civil disturbance, such as wild festivities after a sporting event, may undermine public confidence in government if a pattern develops in which illegal behaviors become repetitive and widespread.

Impact on Responders

Frustration and anger may be displaced toward responders, and many citizens may not understand the nature of the motivations, rights, or responsibilities involved in either protest or policing actions.

Responders may face unwarranted hostility from citizens, for many reasons, and response activities may be impeded by disruptions taking place. Response, medical facilities, communications, or transport capabilities may be overwhelmed. Psychological impacts on responders may arise from role conflicts and the nature of some of the participants involved in the disturbance (which has some differences when compared with “ordinary crime”).

Impact on the Environment

Civil disturbances that stem from labor unrest (or other problems with industrial relations) may involve sabotage that causes the release of harmful substances or otherwise damages the ecosystem in an area. Civil disturbances that involve disruptive forms of collective behavior may include the lighting of fires that release toxins, especially when non-traditional manufactured items are used as fuels. Damage to property may, accidentally or deliberately, include sites that contain hazardous materials. Unruly crowds may disrupt or prevent needed maintenance activities by utility repairmen or industrial workers and thus inadvertently cause environmental problems to occur because of resulting infrastructure failures.

Civil Disturbances Hazard Analysis

Violent protests, disturbances, and riots have occurred throughout our nation’s history. The Stamp Act Riots in the American Colonies in the 1760s, the “Boston Tea Party,” and the Revolution itself involved riots and insurrection, as discontent escalated into organized international conflict. Though these events have occurred in the past, they are not considered an acceptable part of ordinary modern life. 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. Communications technologies were also important in swelling the numbers of “Cedar Fest” revelers in recent East Lansing disturbances. 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.

Civil Disturbance in Michigan

Case: 1980s-early 1990s East Lansing and Mt. Pleasant Civil Disturbances

Several clashes between large groups of students and police occurred in East Lansing in the late 1980s over an annual street party known as “Cedarfest.” Injuries and property damage resulted from these disturbances, which also involved the use of tear gas to try to disperse rowdy and hostile crowds. Central Michigan University in Mt. Pleasant was also witness to a series of similar parties turned into riots in the 1980s and early 1990s, with the resulting clashes often involving hundreds of students and police.

Case: April-May 2020, Michigan

In response to Governor Whitmer's stay at home orders to prevent the spread of **COVID-19**. April 15th operation gridlock involved 4000 cars that blocked the traffic areas around the Capitol in Lansing. On April 30th another demonstration occurred where armed protestors entered the Capital building. On May 20th, hairdressers and barbers descended upon the capitol lawn to give free haircuts, protesting the continued closures of their businesses. 300 people participated in the demonstration; seven protestors were cited for disorderly conduct. Officials across the country had ruled hair salons, barbershops, and other personal care services to be non-essential, and experts have cautioned that services like haircuts cannot be performed without the type of close contact that could risk spreading the virus.

Case: May 25th, 2020, Michigan

The death of George Floyd, a black man at the hands of a white Minneapolis police officer, spurred protests across the country. Some of these protests led to violence and rioting. Protests occurred in Ann Arbor, Bad Axe, Cassopolis, Dearborn, Detroit, Flint, Grand Rapids, Kalamazoo, Lansing and East Lansing, Lincoln park and Allen park, Mount Pleasant, Pittsfield Township, Port Huron, Saginaw, Sterling Heights, Traverse City, troy, Warren, Ypsilanti, Houghton, Marquette, Sault Ste. Marie.

Police violence

At a protest in Grand Rapids, a viral video showed Grand Rapids Police pepper spraying a protester and then immediately firing a tear gas canister into their head. The Grand Rapids Police Department announced on June 2 that they would conduct an internal investigation into the incident. At a June 2 protest in Grand Rapids, some water bottles were thrown at police, with police later shooting one man with a non-lethal projectile in the arm, choke slamming one protester and then slammed the head of another protester against the road after they were arrested.

Protester violence

Protestors in Detroit smashed police cruiser windows along Michigan Avenue on May 29. More than 100 buildings were damaged in Grand Rapids on May 30 and 31, while fires were set to several cars. Protests in Lansing resulted in thousands of dollars in damage on May 31.

https://en.wikipedia.org/wiki/George_Floyd_protests_in_Michigan

Muskegon County is mostly rural and suburban in nature. Although the history of civil unrest is minimal, the potential for a civil unrest event is still there. Local risk consists of 1) major employers with a moderate number of employees to cause a labor dispute; 2) large county jail housing over 542 inmates; 3) a moderate court size with the potential for high profile judicial proceedings; 4) a moderately diverse population with moderate potential for disagreements between special interest groups; 5) close proximity to college universities including Ferris State University and Grand Valley State University.

Civil Unrest in Muskegon County

One significant riot is known to have occurred in Muskegon's past. On August 5, 1919, streetcar riders revolted against a rate increase from six cents to seven cents. The rioters destroyed 13 street cars and

\$100,000 to \$125,000 (approximately \$1.3 to \$1.5 million today) in damage. The streetcar service of the City of Muskegon was interrupted and suspended while awaiting the repair of the property of the traction company for a period of two weeks.

In 1930, a bomb exploded in the empty Regent Theater in downtown Muskegon during a union dispute. No serious labor-industrial disputes have occurred Muskegon County since then; however there have been sporadic and non-violent strike incidences. In 1976, the Muskegon Area Labor Management Committee (MALMC) was established with the mission of developing and strengthening good labor-management relationships by providing educational and interactive opportunities outside the collective bargaining agreement.

Case: February 28, 2022 Muskegon

The Muskegon City Commission's approved the sale of land to a company that does medical testing on animals. No Violence occurred, as demonstrators gathered before a commission meeting and the asked for the sale to not move forward and became heated as people spoke about it during public comment. City leaders say the transaction will bring jobs and economic investment.

Violent Crimes

Crime of violence means an offense that has an element the use, attempted use, or threatened use of physical force against the person or property of another or any other offense that is a felony and that, by its nature, involves a substantial risk that physical force against the person or property of another may be used in the course of committing the offense. 18 U.S. Code §16 – Crime of violence defined.

Violent Crimes Hazard Description

Violent crime is composed of four offenses: murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault. Violent crimes are defined in the Uniform Crime Reporting (UCR) Program as those offenses which involve force or threat of force. The data presented in *Crime in the United States* reflect the Hierarchy Rule, which requires that only the most serious offense in a multiple-offense criminal incident be counted. The descending order of UCR violent crimes are: murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault.

The cause of violent crimes may be attributed to many factors. According to a Police Executive Research forum document from 2009, police chiefs from across the country believe the following are the top ten factors contributing to violent crime:

1. Gangs 82 %
2. Juveniles / youth crime 80 %
3. Economy / poverty / unemployment 74 %
4. Impulsive violence / disrespect issues 74 %
5. Release of offenders from correctional institutions 69 %
6. Drugs-Cocaine 67 %

7. Poor parenting 63 %
8. Increased availability of guns 55 %
9. Reduced cooperation from witnesses / victims (not in top 10 last year) 37 %
10. Educational system-increasing dropout rates (not in top 10 last year) 36 %

Source: <http://www.policeforum.org/library/critical-issues-in-policing-series/VCrime&EconomyI.pdf>

Violent Crimes Hazard Analysis

The following information and statistics are from the United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2018 Crime in the United States Data available at <http://www.fbi.gov/stats-services/crimestats>

- An estimated 1,206,836 violent crimes reported to law enforcement, including:
 - 16,214 murders
 - 101,151 forcible rapes
 - 282,061 robberies
 - 807,410 aggravated assaults.
 - Violent Crimes increased 4.7 percent over 2014 figures.
- 36.9 percent of robberies occurred on streets or highways. 1.6 percent occurred at banks.
- Aggravated assaults accounted for 62.6 percent of reported violent crimes
- Firearms were used in 69.3 percent of the murders reported

Table 1: Crime in the United States

Source: United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2018 Crime in the United States Data

| Year | Violent crime | Murder and nonnegligent manslaughter | Forcible rape | Robbery | Aggravated assault |
|-------------------|---------------|--------------------------------------|---------------|---------|--------------------|
| 1993 | 1,926,017 | 24,526 | 106,014 | 659,870 | 1,135,607 |
| 1994 | 1,857,670 | 23,326 | 102,216 | 618,949 | 1,113,179 |
| 1995 | 1,798,792 | 21,606 | 97,470 | 580,509 | 1,099,207 |
| 1996 | 1,688,540 | 19,645 | 96,252 | 535,594 | 1,037,049 |
| 1997 | 1,636,096 | 18,208 | 96,153 | 498,534 | 1,023,201 |
| 1998 | 1,533,887 | 16,974 | 93,144 | 447,186 | 976,583 |
| 1999 | 1,426,044 | 15,522 | 89,411 | 409,371 | 911,740 |
| 2000 | 1,425,486 | 15,586 | 90,178 | 408,016 | 911,706 |
| 2001 ² | 1,439,480 | 16,037 | 90,863 | 423,557 | 909,023 |
| 2002 | 1,423,677 | 16,229 | 95,235 | 420,806 | 891,407 |
| 2003 | 1,383,676 | 16,528 | 93,883 | 414,235 | 859,030 |
| 2004 | 1,360,088 | 16,148 | 95,089 | 401,470 | 847,381 |

| | | | | | |
|-------------------|-----------|--------|----------|---------|---------|
| 2005 | 1,390,745 | 16,740 | 94,347 | 417,438 | 862,220 |
| 2006 | 1,435,123 | 17,309 | 94,472 | 449,246 | 874,096 |
| 2007 | 1,422,970 | 17,128 | 92,160 | 447,324 | 866,358 |
| 2008 | 1,394,461 | 16,465 | 90,750 | 443,563 | 843,683 |
| 2009 | 1,325,896 | 15,399 | 89,241 | 408,742 | 812,514 |
| 2010 | 1,251,248 | 14,722 | 85,593 | 369,089 | 781,844 |
| 2011 ³ | 1,206,005 | 14,661 | 84,175 | 354,746 | 752,423 |
| 2012 | 1,214,462 | 14,827 | *84,376 | 354,520 | 760,739 |
| 2013 | 1,168,298 | 14,319 | *113,695 | 345,093 | 726,777 |
| 2014 | 1,153,022 | 14,164 | 118,027 | 322,905 | 731,089 |
| 2015 | 1,199,310 | 15,883 | 126,134 | 328,109 | 764,057 |
| 2016 | 1,250,162 | 17,413 | 132,414 | 332,797 | 802,982 |
| 2017 | 1,247,917 | 17,294 | 135,666 | 320,596 | 810,319 |
| 2018 | 1,206,836 | 16,214 | 139,380 | 282,061 | 807,410 |

*Change in numbers due to change in definition

Violent Crimes in Michigan

The following information and statistics are from the United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2012 Crime in Michigan Data available at <http://www.fbi.gov/stats-services/crimestats>.

Table 2: Crime in Michigan

Source: United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2022 Crime in the United States by State Data

|  Federal Bureau of Investigation Crime Data Explorer | | Violent crime | Murder and non-negligent manslaughter | Forcible rape | Robbery | Aggravated assault |
|---|--|----------------------|--|----------------------|----------------|---------------------------|
| Year | | | | | | |
| 2011 | | 43,731 | 617 | 4,344 | 10,263 | 28,507 |
| 2012 | | 44,922 | 689 | 4,589 | 10,434 | 29,210 |
| 2013 | | 41,241 | 631 | 3,236 | 10,241 | 27,133 |
| 2014 | | 38,956 | 532 | 3,016 | 8,206 | 27,202 |
| 2015 | | 37,369 | 572 | 3,024 | 7,821 | 25,952 |
| 2016 | | 40,851 | 586 | 3,173 | 7,116 | 29,976 |
| 2017 | | 41,123 | 567 | 3,333 | 6,486 | 30,737 |
| 2018 | | 40,929 | 550 | 3,670 | 5,652 | 31,057 |
| 2019 | | | | | | |
| 2020 | | | | | | |

| | | | | | |
|--------------------------|-----|------|------|------|-----|
| 2021 | | | | | |
| 2022 | | | | | |
| Percent change 2012-2018 | -6% | -11% | -16% | -45% | +9% |

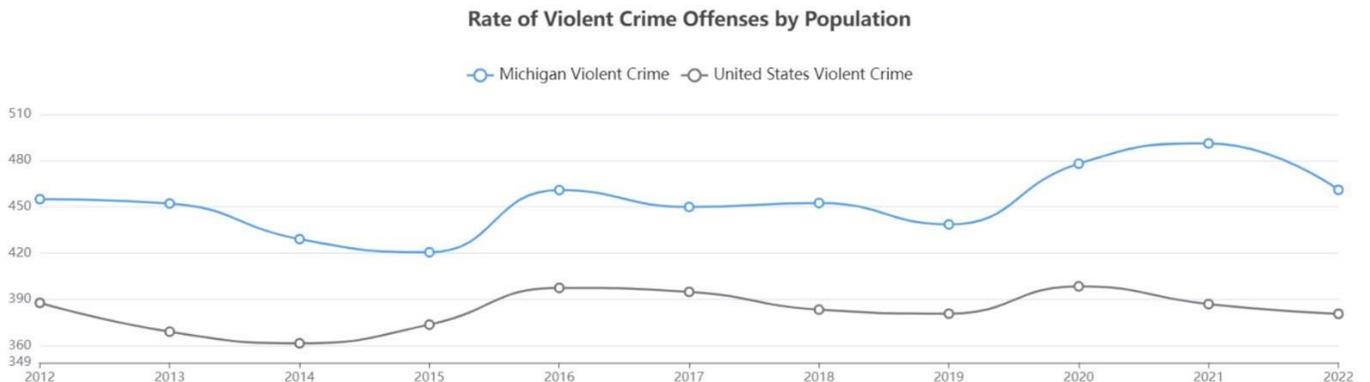
Violent Crimes in Muskegon County

The following information and statistics are from the Muskegon County Sheriff’s Office Reporting Database from 2012 to 2022. This data only includes reports taken by the Muskegon County Sheriff’s Office. It does not cover the cities of Muskegon Heights, Muskegon, North Muskegon, Montague, Norton Shores, Roosevelt Park, Whitehall, Muskegon Township, and the Village of Fruitport which all maintain their own police department.

Summary Crime Reported by the Muskegon County Sheriff's Office 2012-2022



Incidents Reported by the Muskegon County Sheriff's Office



Rate per 100,000 people, by year

| Year | Violent crime | Homicide | Forcible rape | Robbery | Aggravated assault |
|------|---------------|----------|---------------|---------|--------------------|
| 2011 | 38 | 0 | 13 | 2 | 23 |
| 2012 | 49 | 0 | 17 | 1 | 31 |
| 2013 | 47 | 1 | 12 | 3 | 31 |
| 2014 | 39 | 1 | 14 | 1 | 23 |
| 2015 | 57 | 0 | 21 | 1 | 35 |
| 2016 | 58 | 0 | 23 | 1 | 34 |
| 2017 | 62 | 0 | 24 | 6 | 32 |
| 2018 | 77 | 0 | 33 | 6 | 38 |
| 2019 | 63 | 1 | 27 | 2 | 33 |
| 2020 | 83 | 1 | 32 | 2 | 48 |
| 2021 | 74 | 0 | 30 | 1 | 43 |
| 2022 | 51 | 1 | 24 | 2 | 24 |

Individual local police department statistics can be viewed by visiting <https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/crime-trend>

The following are violent crimes of note in Muskegon County:

Case: March 10, 2016 Norton Shores

Police investigated a series of Armed robberies that occurred in Norton Shores, Roosevelt Park, Muskegon Heights, and City of Muskegon

Case: August 22, 2016 Norton Shores Armed Robbery at First Merit Bank

Case: August 15, 2016 Norton Shores - Investigated a Homicide, 1400 E. Sherman Blvd.

Case: September 20, 2016 Norton Shores Police and Fire investigated an arson in the 1800 block of Channel which is the Maranatha complex. Several buildings have burned due to Arson over a ten-year period.

Case: December 9, 2016- Norton Shores Police investigated a drive by shooting that resulted in a homicide at the intersection of Henry street and Norton Ave.

Case: August 4, 2017 D'Anthony Keenan Murder - Anthony Blamer of Fremont was found guilty of second-degree murder in connection with the shooting death of D'Anthony Keenan of Muskegon on August 4, 2017. Blamer was also found guilty of felony firearm – committing a felony while in possession of a firearm.

Blamer then allegedly drove the SUV and Keenan's body to the Fremont area, where he left them at a carpool lot. Detectives say he returned the next day with a chainsaw and removed Keenan's head and hands. His motive, authorities said, was to slow the identification of the victim. Keenan's body, without the head and hands, was discovered on August 5, 2017 along a two-track in the Manistee National Forest by two men scouting duck hunting areas. Blamer later led law enforcement to the head and hands in Oceana County.

October 2021 The man charged with a homicide that happened inside a Muskegon Heights gas station was in court for a preliminary hearing Wednesday. The alleged incident occurred in October of 2021 where the suspect was caught on camera fighting a man inside the gas station. It is alleged that the suspect shot and killed a 27-year old man.

Case: December 15, 2021 Norton Shores Homicide at the MI Bar. One person was shot and killed, and two others wounded.

March 22, 2022 A man was found dead Tuesday night. The incident happened at a Trailer Park in Egleston Township. Authorities were called to area around 11:10 p.m. on reports of shots fired. Upon arrival, deputies found a man suffering from multiple gunshot wounds. He was pronounced dead at the scene.

April 2, 2022 Muskegon A 54-year-old man was stabbed outside an apartment building on Terrace Street. The suspect 57, was arrested and charged, but charges were later dropped after he died of natural causes.

April 18, 2022 a 31 year old male, was shot on Emerald Avenue during an apparent robbery. Months after the shooting, in September, an 18 year old male was arrested and charged with open murder.

April 18, 2022 A 20 was shot in his apartment on Glen Oaks Drive during a robbery. Arrests have been made related to the investigation, but no one has yet been charged with the killing. The investigation is still ongoing. Police do not believe there is a connection between the two April 18 homicides.

May 20, 2022 A 44-year-old man was shot and killed during a domestic argument by another individual. The incident occurred on 7th Street. The suspect died by suicide before officers arrived. The case is no longer active.

June 14, 2022 a 15-year-old boy was shot and killed on Catawba Avenue. Police said the incident appears to be a result of negligent handling of a firearm. One subject has been arrested related to the incident.

June 23, 2022, a 63 year old man, was shot and killed in his apartment on Dowd Street. A neighbor was mishandling his firearm causing it to go off. The Victim was struck when the bullet entered his apartment. Police suspect the shooting to be unintentional and an arrest has been made.

June 27, 2022, A 36 year old man was shot and killed on Houston Avenue. Two suspects have been arrested related to the shooting.

July 2022, A 43 year old mother from Norton Shores, is accused of intently torturing her own child. That 15 year old child only weighed 69 pounds (31.3 kilograms) when he was found dead in July. A medical examiner determined the boy died from malnourishment and hypothermia.

Sept. 1, 2022, A 44-year-old Muskegon man died in a shooting during a large fight in the 300 block of Amity Avenue. No arrests have been made.

October, 2022, Investigators arrested a 62-year-old man a day after responding to the scene near Laketon Avenue and Getty Street. First-responders found 30-year-old mother of four—dead in her driveway from a gunshot wound to the head.

Criminal Incidents Vulnerability and Impacts

Criminal incidents can significantly impact public health and safety with physical and emotional injuries, including death, trauma, and long-term psychological effects on survivors, witnesses, and the wider community. In addition to the immediate physical and emotional impacts, criminal incidents can have broader societal impacts, including increased fear and anxiety, decreased sense of safety and security, and adverse effects on mental health and well-being.

Criminal incidents can cause significant property damage and disrupt critical infrastructure. Depending on the location and circumstances of the shooting, property damage may include damage to buildings, vehicles, or other physical assets. In some cases, shootings may cause fires or explosions, further exacerbating the damage. In addition to physical property damage, criminal incidents can disrupt critical infrastructure, such as transportation systems, utilities, and communication networks. For example, a shooting in or near a transportation hub could cause delays or closures of train or bus lines, while a shooting near a utility facility could disrupt power or water supplies.

Criminal incidents can have significant economic impacts, both short and long-term. In the short term, the cost of responding to and investigating a criminal incident can be substantial and may strain local and state budgets. In addition, businesses and tourism in the affected area may suffer, resulting in decreased economic activity and job losses. For example, a shooting in a tourist destination may lead to cancellations of trips and events, which can have a ripple effect on local businesses. In the long term, property values in the affected area may decline, making it more difficult for homeowners and businesses to sell or lease their properties

Celestial Impacts (Space Weather)

Celestial Impacts

An impact or threatened impact from solar geomagnetic storms, coronal mass ejections, or similar phenomena that may damage or destroy Earth's electronic satellite systems, interfere with radio communications and navigation systems, create health risks for air travelers, and disrupt electrical utility and pipeline systems.

Space Weather and Celestial Impacts Hazard Description

Space weather is a term that describes the patterns of emissions from our Sun. Ordinary radiation emissions can be considered calm “weather,” but there are periodic flare-ups and blasts of much greater energies that send charged particles that impact upon the Earth’s atmosphere and magnetosphere. These solar geomagnetic storms can cause widespread failures of important satellite, electronic, communication, navigation, guidance and electric power systems—which have all formed a very important part of our modern technology and lifestyles. This hazard is considered fairly likely in the near term to cause notable disruptive effects, large economic impacts, and even some direct health risks to persons who are flying in aircraft in the far northern or southern areas of the planet, where the exposure to charged particles occurs in greater quantities.

A sunspot cycle exists, in which sunspot activity periodically 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 those 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. Within the documented cycles so far, the time interval between a minimum and maximum has been as long as 14 years and as short as 8 years.

The Earth’s atmosphere serves as a shield for us against many types of particles and radiation zipping across space, and Earth is also surrounded by 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.

Another type of solar disturbance is a coronal mass ejection (CME), in which built-up pressures cause a sudden outward burst of gases (and accompanying magnetic fields) at tremendous speeds, with impacts that reach far across interplanetary space. Like solar flares, CME events are a cause of

geomagnetic storm events on Earth (usually 1 to 4 days after the solar event), and they occur more frequently during periods with more sunspots. One of the additional effects of space weather involves increased exposure to ionizing radiation (e.g., harmful x-rays), especially among 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.

An important type of impact involves the interference or disruption of modern electronic and communications systems, including those upon which our modern aviation networks rely. Solar flares and storms are important because of 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.

On the ground, disrupted power systems can result in widespread power failures, and the movement of the mass of charged particles in geomagnetic storms can cause induced currents to flow within pipelines, unless special design features have inhibited such currents. An increase in ions (charged particles) that interact with the Earth's magnetosphere and then strike our upper atmosphere can cause a glow within the evening skies (which, in the northern hemisphere, includes the famous aurora borealis). Such "northern lights" become increasingly prominent, and extend farther to the south, during the most active solar storms. Government agencies actively monitor space weather, but for those who have not heard any government reports, their warning of solar storm activity may come from noticing these brighter glows in the night sky—especially in most Michigan locations where such "northern lights" are not normally seen.

Space Weather and Celestial Impacts Hazard Analysis

Space weather can be very expensive for those who use or rely upon satellites. Electronic circuits can malfunction and cause interruptions or complete losses in operational capacity. Space missions may also need to be delayed, in order to ensure their safety and success. Communication disruptions can inhibit navigation and hinder the safe management of air and sea traffic.

Induced electric currents occur within conductive materials when magnetized material of sufficient moves nearby and has a sufficiently powerful charge. The induced currents from space weather can affect electrical utility systems and pipeline infrastructure, potentially weakening and damaging these systems as well increasing the chance of electronic malfunctions.

Three space weather scales are in use by NOAA/NWS to summarize the intensity and estimated potential impacts of three different types of space weather effects. Each uses a 5-category classification scheme, and the three scales denote: (1) geomagnetic storm intensity (G-scale), (2) solar radiation storms (S-scale), (3) radio blackouts (Rscale). Weaker events are given a number of 1 on the scale, and extreme events are rated as a 5. In this document, selected material is summarized below. For more detailed information, please refer to the NOAA web site at <https://www.swpc.noaa.gov/>.

The space weather hazard appears 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. Geomagnetic storm impacts tend last 1 to 2 days, and to occur between 15 and 90 hours after a coronal mass ejection event, which can allow a little bit of warning time, as spacecraft such as the Advanced Composition Explorer (ACE) can now measure the strength of an event and report back in time for notification to allow perhaps 15 to 20 minutes of advance warning time for protective response actions to occur.

Impact on the Public, Property, Facilities, and Infrastructure

Space weather impacts can result in transportation delays and communication interference, and some cases may result in fatal transportation accidents, large economic losses, and widespread power supply interruptions. Key facilities for electrical infrastructure have been affected in the past, but the industry has reported many improvements during the past 30 years, to reduce the chance of a widespread blackout as a result of a major solar storm. Most personal property is not damaged by these events, although radio function and digital communications may often be temporarily impaired. The key built infrastructure that is most at-risk in Michigan appears to be some of its pipelines and power grids.

Impact on the Economic Condition of the State

Although Michigan would not be expected to feel space weather impacts by itself, in isolation from other states, there is the possibility that particular infrastructure failures might happen to occur specifically within Michigan. Thus, although temporary communication disruptions might be felt throughout the entire continent at the same time, particular utility systems might happen to fail within Michigan and have a disproportionate impact within the state. This would be a likely source of economic impact. Although an event like Quebec's massive 1989 power loss is reportedly less likely now, as a result of precautions taken by electric utilities, some disruption in plane flight schedules, utility function, and communication systems is likely to have an economic impact. Although the level of impact is too difficult to predict, the particular timing of the disruption might happen to have an unusually negative effect on some particular industry within Michigan.

If high-technology Michigan companies have their satellites taken out of service by the effects of a very severe event, the effects might be too expensive for such businesses to bear, while the other businesses they serve could similarly find that key processes are interrupted and therefore result in costs far more than had been planned (or budgeted to accommodate). Important tourist attractions might rely upon digital communications technologies that are then

disrupted by space weather. Some pipeline services might be impacted and cause other types of cascading effects, if there is an unexpected gap in the supply of fuel for energy, industrial production, or digital information processing (although the latter should allow more potential for running off of back-up power systems. Many high-technology economic sectors rely upon efficient satellite relays for their operation.

Airline scheduled and flight paths would also be disrupted during a major event. The longest impacts would involve the replacement of satellites and vulnerable utility system components. The potential for extensive power outages and electronic system disruptions could make this one of the least well-known but potentially most economically damaging types of hazards that might occur in the near future. A limited general awareness of this hazard, as well as the relative scarcity of its most extreme events (the standard having been set in 1859), may explain why advance planning and hazard mitigation activities have rarely been seen.

Impact on the Environment

It has been speculated that space weather may be connected with global climate, but this is primarily due to the possibly coincidental occurrence of a “Little Ice Age” (lower average temperatures in America and Europe) during the same time that the Maunder minimum in solar activity was observed. The specific mechanisms that would underlie such a connection have not yet been figured out and therefore such a link should probably still be considered to be purely speculative. On the favorable side, solar activity helps to shield us from some of the biologically damaging cosmic rays that come from elsewhere in the universe.

Impact on Responders, Continuity of Operations, and Continued Delivery of Services

The impacts of space weather include interruptions in the function of radios, satellites, electronics, and even power supply systems that may be needed for emergency response. Response activities that involve electronic navigation technologies and Global Positioning Systems may need to fall back upon the use of less technologically advanced means to accomplish their mission, but in most cases, such “legacy systems” either no longer exist or are simply unable to handle the operations of the newer technology. In a severe event, it is likely that some sort of service interruptions would occur within sectors that rely upon radio or satellite communication, transportation, and navigation systems. Although this might potentially include numerous types of businesses that cannot all be listed here, FEMA has noted that these systems are vital for emergency response activities.

Impact on Public Confidence in State Governance

The potential impacts of space weather will require greater public awareness in order to build an understanding about existing weaknesses and the expense that might be involved in correcting those weaknesses, where possible. If a major event does bring down one or more important systems (for example, satellite communications), some might question whether it was wise to have placed so much reliance upon any particular system that was revealed to be vulnerable.

International Celestial Impacts

NOTE: Although many of the events listed here occurred out of state, some of them were large enough to have direct impacts upon Michigan, due to the sheer magnitude of the impacts. A couple of events date back to the 19th Century and indicate the possible magnitude. One event, a “close call”, whose impact could have been very large if it had occurred one week earlier than it had. Thus, some of these events are included because they help to indicate the range of threat posed by the hazard—events outside of Michigan usually represent the largest known events or threats, while events involving Michigan tend to represent the typical level of recorded impacts in the state.

Case: March through October, 1847 – United Kingdom

Twelve years prior to the Carrington Event (see below), an “anomalous current” had been reported on British telegraph lines in the vicinity of Derby, Rugby, and Birmingham, which may have been the first detected effect from geomagnetic storms upon electronic infrastructure. It occurred in conjunction with a brilliant aurora that was observed on March 19 of that year. Other disturbances were reported, one on September 24 being reported as nation-wide, from South Devon up to Scotland.

Case: August 28 to September 2, 1859 – International, “Carrington Event”

After a couple days of visibly expanded auroras in the sky, telegraph disruptions were also noted in diverse parts of the world. On September 1, a large solar flare was briefly observed by astronomer Richard Carrington, and also independently recorded by Richard Hodgson. Just before dawn of the next day, however, brilliant auroras were visible in skies around the world, telegraph systems severely malfunctioned, and various damages (and minor injuries) resulted from sparks and equipment failures.

This was the first solar flare observation, and it was also clearly seen that the phenomenon was connected with malfunctions in electronic communications systems on Earth. No solar flare of this magnitude has been seen in the 150 years since this occurred. Based upon evidence from arctic ice, it was estimated that the 1859 solar geomagnetic storm was the most intense in the past 500 years, nearly twice as much as the second-largest event. (Even though certain intensities have since been matched, no storm since has been able to simultaneously match this one, on all types of intensity measures.) Were such an event to happen again today, it has been estimated that tens of billions of dollars in damage would be done to more than 1,000 satellites that orbit the Earth. These satellites are essential for the safe and smooth operation of airlines, spacecraft, and various communications systems.

Case: May 16, 1921 – International, “Great Storm”

An extremely strong geomagnetic storm occurred—the strongest such storm since 1859. According to one study, if a storm of this magnitude were to occur today, it could result in large-scale electrical blackouts that would affect more than 130 million persons across the northwestern U.S. (including Michigan) and the Pacific Northwest. These figures were based upon estimates of regions susceptible to power grid collapse, and the 1921 storm was considered to be about 10 times as strong as the one that did cause power failures in 1989. Extra-high-voltage transformers were considered to be a

particular vulnerability in these projected blackout areas, with places like New Hampshire, New Jersey, and Pennsylvania at particularly high risk in the interconnected grid. This has been estimated as a level of event that has a 1% annual chance of occurring in an average year.

Case: August 4, 1972 – Illinois

A huge solar flare ended up causing the failure of long-distance telephone communications across Illinois. AT&T redesigned its power system for transatlantic cables as a result of this event. Electric grid disturbances were also reported in widespread locations around North America. This event involved the fastest “transit time” of ejected solar material that had been measured. Recently, a paper reported that these storms had an effect upon U.S. military operations, including the unintended detonation of many of its DST mines within the wartime Southeast Asian operational area (Knipp, Fraser, Shea, and Smart, 2018). In some ways, this may have been the most severe event seen during the space age. Had astronauts been in space at the time, it would have been dangerous for them.

Case: March 13, 1989 – Canada and Eastern United States

Geomagnetic storms caused by a huge solar flare involved various disruptions in the transmission of electrical power, causing a widespread blackout across most of Quebec and affecting 6 million persons for a period of up to 9 hours. Specifically, when five transmission lines went down, the system was unable to withstand the loss of their 21,350-megawatt load and collapsed within the subsequent 90 seconds. The blackout closed schools and businesses, shut down the Montreal Metro Airport, and delayed flights from other airports. Street traffic backups took place since traffic signals and traffic control systems no longer functioned smoothly. Workers in downtown Montreal were stranded in dark offices, stairwells, and elevators. Elsewhere, power surges caused by the geomagnetic storm (geomagnetically induced currents, or GICs) caused power transformers in New Jersey to be overloaded and damaged. The functioning of long-distance telephone cables were also affected by auroral currents, major power substations experienced voltage swings, generators went offline, and the U.S. Air Force temporarily lost its ability to track satellites. Costs from the loss of power exceeded \$100 million, including stalled production processes, idled workers, and spoiled products. This was considered to be the strongest geomagnetic storm of the space age, and it has been reported that the broader power grid covering the Northeastern and Midwestern U.S. was “within seconds of collapse.”

Case: January 1994 – Canada

Inclement space weather caused electric charges to build up and then discharge within the electronic components of two expensive communications satellites. One satellite was disabled for about 7 hours, due to damage to its control electronics. A second satellite went out of service entirely, when its backup systems also became damaged, requiring 6 months of service before its functions were restored. The satellite disruptions prevented news information from being electronically delivered to 100 newspapers and 450 radio stations. Television and data services to more than 1,600 remote communities broke down with the second satellite failure. Telephone service in 40 communities was also interrupted. Total costs of the event were estimated at between 50 and 70 million U.S. dollars.

Case: January 11, 1997 – International

A satellite that had cost \$200 million was incapacitated by the impact of a coronal mass ejection. After efforts to restore the satellite's function failed, it was officially decommissioned.

Case: April-May, 1998 – International

The failure of the attitude control system of an expensive Galaxy IV satellite (the cost of such satellites is usually on the order of \$200 to \$250 million) disrupted the function of about 45 million electronic paging devices. Various other satellite problems were noted, and researchers eventually concluded that these problems were "caused, or at least exacerbated by" the impacts of geomagnetic conditions originating from "highly disturbed" solar conditions. Although the satellite problems occurred in May, weeks of problematic space weather that had started back in April was considered to have eventually led up to May's events.

Case: October 19 to November 7, 2003 – International, "Halloween Storms"

Geomagnetic storms took place in late October and November, and although power grid operators had learned from the March 1989 event and were better able to withstand the storms' effects, there were some heavy impacts upon the aviation sector from this event. The Federal Aviation Administration had implemented a WAAS (Wide Area Augmentation System) to better guide navigation and aviation system control, and a part of what WAAS supports is the ability of air traffic to maintain safe distances from each other. The vertical navigation component of WAAS was disabled for approximately 30 hours across most of the United States during the late October storms. These "Halloween storms" interrupted GPS function, blocked high-frequency radio, damaged power transformers in South Africa, and forced emergency procedures to be implemented at nuclear plants in Canada and the northeastern United States.

Case: January 2005 – International

Space weather at this time included solar radiation storms. In addition to the loss of HF radio communications, such storms can cause elevated radiation exposure to persons in aircraft flying at high latitudes (e.g. across polar regions). The use of polar routes has increased dramatically since the 1990s, since such routes can reduce travel time and fuel costs (by avoiding strong wintertime headwinds). Aircraft must divert to lower-latitude routes during such radiation events, resulting in delays, increased flight times, missed connections, higher costs, and greater fuel consumption.

Case: 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.

Case: December 6, 2006 – International

A burst of solar radio wave energy caused a disruption in the function of GPS units across the entire sunlit side of the Earth (the Western hemisphere in this case). Some users of navigation systems found their capacities disrupted for many minutes, which was of particular significance for military aircraft.

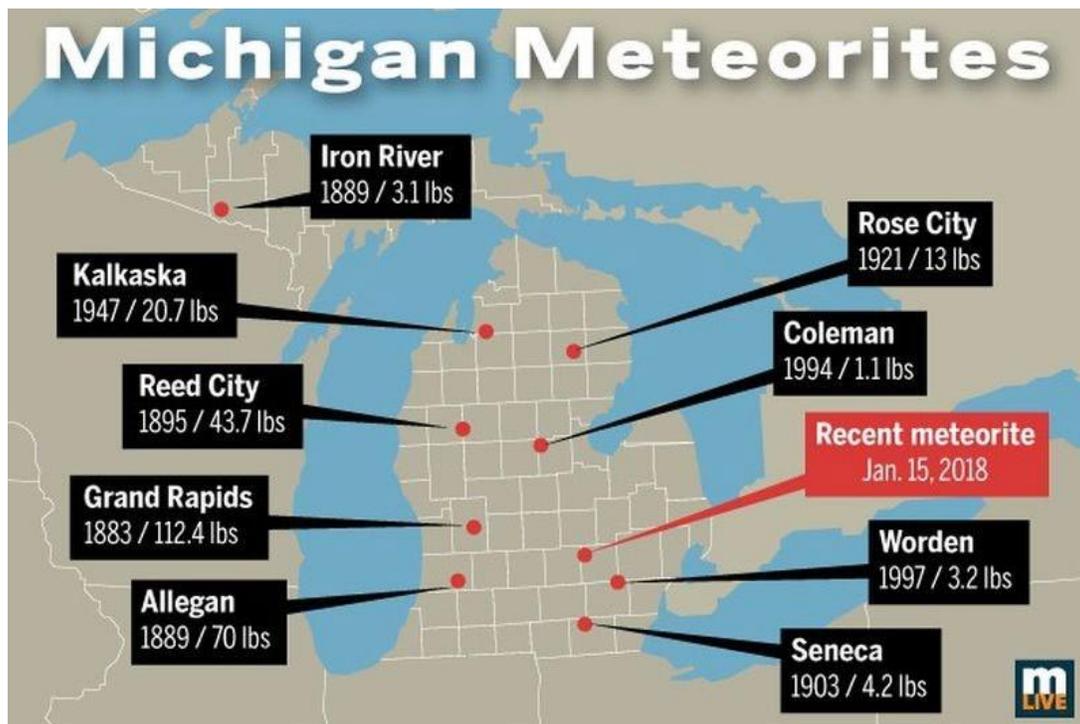
Case: July 23, 2012 – International

The STEREO solar observatory (see below) detected and measured one of the largest solar storms ever recorded. The trajectory of the emissions were fortunately not directed at Earth during the time of the event, or it would have resulted in the type of extreme storm that has here been estimated as a “worst-case scenario.” It has been calculated that if the solar eruption had taken place just one week earlier, then the Earth would have been aligned to receive the impacts, and the results would have been equivalent to another “Carrington Event” (see 1859 entry, above) but with far more extensive electronic systems and investments at risk than had been true in the past.

Celestial Impacts in Michigan**Case: Calvin Township, 30 miles northeast of South Bend, Ind.**

450 million years ago a space rock longer than three football fields smashed into the earth leaving a 5-mile-wide meteor crater in rural, southwest Michigan.

<https://www.freep.com/story/news/local/michigan/2018/02/01/michigan-crater-meteor-targets/1057426001/> Retrieved 1-13-2022



https://www.mlive.com/weather/2018/01/michigan_is_no_stranger_to_met.html Retrieved 1-13-2022

Case: Worden, MI

In 1997 a meteorite actually hit a garage and car in Worden, MI. The image above is provided by the University of Michigan Museum of Natural History. The meteorite was small in size but blasted right through the roof of a garage. Here you can see the damage to the car in the garage. A model of this meteorite and damage to the car are on display at Cranbrook Institute of Science.”



https://www.mlive.com/weather/2018/01/michigan_is_no_stranger_to_met.html Retrieved 1-13-2022

Celestial Impacts in Muskegon County

Case: April 21, 2014

Girl finds meteorite in her Muskegon, MI backyard day after April 20 meteor shower. https://www.youtube.com/watch?v=yAGynbJ_WpM Retrieved 1-13-2022

Case: Jan 18, 2018 Meteorite pieces found by hunters in Michigan

a meteor shower occurred with one large piece causing a sonic boom as it entered the atmosphere. Meteorite debris were found on a frozen lake north of Ann arbor. https://www.mlive.com/news/ann-arbor/2018/01/post_76.html Retrieved 1-13-2022

ABOUT METEORITES AND OTHER IMPACTING OBJECTS

Impacting Objects

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

Impacting Objects Hazard Description

Among the potential celestial impact hazards are the potential the effects of large masses impacting upon the Earth's atmosphere or surface. Most such forces are extraterrestrial in origin—meteors or meteorites that were originally asteroids or comets from elsewhere in the solar system—but consideration also needs to be given to the crashing of human space vehicles and artificial satellites. First, natural objects will be considered, that can forcefully explode in the atmosphere as meteors, or that reach the ground to impact as meteorites. <https://cneos.jpl.nasa.gov/sentry/>

Meteors

Meteors burn up in the atmosphere, but in the process may cause strong winds and explosive blast forces to then strike the Earth's surface. It must be emphasized that even in cases where a large meteor does not actually strike our planet's surface, the explosive energies from its 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. This was demonstrated in the 2013 event in Chelyabinsk, Russia, in which about 1,000 persons throughout the metro area were injured, primarily as a result of glass windows that were shattered by the meteor's shock wave.

Meteorites are physical objects that have at least partially survived their plunge through the atmosphere and then actually strike the ground or sea at the Earth's surface. Any massive, fast-moving objects 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, shoreline floods, severe winds, and infrastructure failures. Fortunately, events of that magnitude are extremely rare, and highly unlikely to occur within the timeframe of this plan. However, an extensive discussion of impacting physical objects is given here to inform readers about the full range of potential impacts, from the trivial to the catastrophic. In the unlikely event that a very serious incident does occur, or threaten to occur, readers can have some background knowledge to better understand the hazard.

Then there is a set of cases involving unusual events such as which loud sonic booms or flaming fireballs are seen in the sky and reported to law enforcement and emergency management agencies. This chapter seeks to assist such agencies (and the general public) in better understanding and recognizing these events and being able to explain them to others. Trivial meteor events are observed routinely during every year's well-studied meteor showers, when Earth is passing through parts of its orbit in which numerous small particles had been left by passing comets, and which then harmlessly burn up in the atmosphere, visible as small points of moving light that are often referred to as "shooting stars." But less frequent bolide events, in which a larger meteor hits the atmosphere with such force that it violently flares up, often with an accompanying sonic boom, and literally appears as a giant fireball, explosion, or bright pulse of light as it continues to plunge toward the ground. In Michigan, this occurred most recently in January 2018, and eventually was confirmed to be a small meteorite whose rocky and fragmented remains were found (the area of which is called a strewn field), scattered within Livingston County near Hamburg.

Although it has been estimated that a serious impact from a physical body upon the Earth occurs approximately once every 50 to 100 years, the fact that much more of the Earth has been covered by human developments within the recent past has caused increasing concern over this hazard. When Earth's population was much smaller, events had tended to occur in areas with few if any inhabitants, so that it was very difficult to find any confirmed cases of an injury directly caused by a meteorite. However, the well-known theoretical risk of impacts became reality

across the Chelyabinsk (Russia) metropolitan area on February 15, 2013, in which the force of the blast wave from a meteor caused shattered windows, and more than 1,500 injuries. One of the lessons learned from Chelyabinsk is that even though the type of damage was mostly minor (since windows are easy to replace), many of the injuries might have been prevented if there had been a greater public awareness of the concept of a blast wave.

Upon seeing a huge flash of light in the sky, an informed observer could potentially recognize that the observed light may really just be an initial warning indicator of the full event. Light travels faster than any massive objects, and so a flash of light from a distant explosion will necessarily be seen before the arrival of the impact forces of a blast wave and its accompanying strong winds. For this is effectively what happens during a large meteor event—an explosive blast occurs in the atmosphere as a meteor plunges through it. When traveling at supersonic speed through the atmosphere, a meteor will generate a loud “sonic boom” just like a fast jet plane. But if the meteor is large enough, then the force of the displaced air from that blast may continue to travel to the Earth’s surface, to strike those who are still watching the meteor.

Even though most visible meteors are harmless because they are relatively small and far away, the actual size and distance of the meteor is often too difficult for ordinary observers to determine. Therefore, those who witness a sizeable blast in the sky should be aware of the potential for the light to be followed by a sonic boom and also potentially by an explosive blast wave and strong winds. Instead of staying near windows or in the open, gazing upward, some injuries could have been prevented by people going into interior rooms away from windows that face the event. The same protective principle also applies to any large explosive event, whether an industrial accident, natural gas pipeline blast, tanker explosion, or a detonated bomb. Distant observers might only experience a moment’s delay before being struck with blast force, heat, and winds from the explosion, and might have been able to use that moment to take cover to protect themselves.

Since most of the Earth’s surface is covered by ocean waters, most meteorites would be expected to strike an ocean rather than a continent. However, there is still the potential for a large-enough ocean strike to be widely damaging, if the meteorite is fast and massive enough to create tsunamis and seismic activities as a result of its impact. Fortunately, this kind of event is also extremely rare, but is something that those who live in coastal areas should be aware of. For example, a strong impact on one side of Lake Michigan could cause waters to eventually swell over the property on the other side of the lake.

Extensive evidence of previous celestial impacts upon Earth has been discovered, including evidence of a large ancient crater site located in southwest Michigan, but the vast majority of Earth’s past impacts have had their evidence erased from normal observation by the ongoing geological processes that take place over time. Even the largest of impact sites would no longer be evident to normal observation after a period of about 200 million years (usually much, much less). Such an amount of time is less than 5% of the Earth’s overall age, but it has been found

that impacts used to occur much more frequently during the earlier periods in Earth's history (i.e., nearer to the period of planetary formation) than they do in recent geological periods.

The vast majority of meteorites began as either asteroids or comets before striking the Earth. Each type of body has different characteristics and risks associated with it, described in the following paragraphs. An unknown quantity of other objects might also be able to strike the Earth, originating from beyond the solar system, but the risks from such impacts cannot readily be known and are probably very low within the near future. One example, however, was seen in October 2017. Named Oumuamua, it was the first and only known interstellar object to be detected and measured as it passed through the solar system. Its closest approach to the Sun (about 24 million miles) had occurred on September 9, 2017, and the dimensions of its elongated shape included a length that was initially estimated at 800 meters long, but a later study reached a dissenting conclusion involving a length of no more than 440 meters. Nevertheless, that magnitude is more than enough to have posed a serious threat if it were to strike the Earth or its atmosphere. Such objects were then estimated to pass through the solar system perhaps once or twice per year, most of which would have gone by completely undetected.

Asteroids

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 in its orbit around the Sun. Asteroids that have paths located near enough to Earth's orbit are classified as Near-Earth Objects (NEOs). Four major types of NEOs have been defined (Amors, Apollos, Atens, and Altiras), two of which (Apollos and Atens) have paths that cross over Earth's orbit. As of early 2019, there were nearly 20,000 NEOs identified. Of these identified NEOs, nearly 2,000 were classified as Potentially Hazardous Asteroids (PHAs—having the potential to come within 466,000 miles of the Earth's orbit; by comparison, the average distance of the moon is 238,900 miles).

NASA's NEO discovery and tracking program had originally sought to identify all nearby objects that have a diameter of 1 kilometer or larger. As of February 16, 2019, nearly 900 such objects had been identified. The NASA mandate was later expanded to try to document 90% of all NEOs that have a diameter of at least 140 meters (459 feet), and the tally of those objects has just exceeded 8,500. For current figures, please refer to the Discovery Statistics site at <https://cneos.jpl.nasa.gov/stats/totals.html>.

Fortunately, most of these objects pose no near-term risk to the Earth. Those that have even a minor chance of eventually striking Earth (i.e., within the next several decades) receive further study to better pinpoint the precise trajectory of the object over time. The result of such additional study eventually confirms that there is no impact expected, although surprises still arise from as-yet unclassified NEOs that are suddenly detected nearby ("near misses").

One near-Earth asteroid that had been identified as meriting careful monitoring is 101955 Bennu (1999 RQ36). It was made the target of a space mission and has recently been reached by the NASA spacecraft OSIRIS-Rex, which has begun scouting the asteroid for the best locations where it can land and collect information about the asteroid's composition and structure. This project will provide new information expected to help inform any future asteroid impact mitigation activities that might become necessary in the future. For up-to-date information on this mission, please refer to the website at <https://www.asteroidmission.org/>.

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 about 700 million miles from the Sun, and well beyond the main asteroid belt) 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 though comets are 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 velocity upon the Earth for any object orbiting the Sun would be no more than 44.5 miles per second—160,000 miles per hour—but that the maximum measured velocity of any known meteorite so far was 64,000 miles per hour (seen as a fireball across the western U.S. on April 22, 2012 and later named the Sutter's Mill meteorite).

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.

Impacting Objects Hazard Analysis

A couple of scales have been developed to numerically summarize the extent of risk associated with comets and asteroids. One scale is called the Palermo scale, but since that is tricky to interpret, the Torino Scale has instead been featured in media reports since its initial presentation at a United Nations conference in 1995, and it was adopted by the International Astronomical Union in 1999. Both scales take into consideration the amount of destructive energy that an impact could cause, and the probability of such an impact occurring. It is common for newly discovered objects to have their initial classifications on these scales subsequently downgraded, as additional information is collected that more precisely

defines the exact path of the object. In other words, an object that is initially classified as having some potential of an impact, and thus being worthy of closer study, is usually later reclassified as additional information reveals that little or no significant impact potential exists. Objects with lower numbers on the Torino scale indicate little or no concern. Within the past 20 years, only one object (99942 Apophis) had temporarily been classified as high as a 4 on the Torino scale. Being an asteroid large enough to cause regional devastation if it struck, Apophis had initially been estimated to have a 1-in-45,000 chance of striking the Earth on April 13, 2036, but as more information was obtained about its trajectory, that estimate was downgraded to only a 0.000009 probability, as is currently classified as 0 on the Torino scale. The asteroid's approach will eventually be spectacular to observe, though, as it is predicted to come as close as 18,300 miles away from the Earth's surface as it passes. (In Celestial terms, this is a very near miss, because that distance is smaller than the circumference of the Earth.) Below is the official explanation of Torino Scale ratings, which only apply to potential impacts up to 100 years in the future. In addition to numerical categories from 0 to 10, the scale is also color-coded in five categories, from white to red.

THE TORINO IMPACT HAZARD SCALE:

No Hazard (White Zone)

0: The likelihood of a collision is zero, or is so low as to be effectively zero. Also applies to small objects such as meteors and bodies that burn up in the atmosphere, as well as infrequent meteorite falls that rarely cause damage.

Normal (Green Zone)

1: A routine discovery in which a pass near the Earth is predicted that poses no unusual level of danger. Current calculations show the chance of collision is extremely unlikely with no cause for public attention or public concern. New telescopic observations very likely will lead to re-assignment to Level 0.

Meriting Attention by Astronomers (Yellow Zone)

2: A discovery, which may become routine with expanded searches, of an object making a somewhat close but not highly unusual pass near the Earth. While meriting attention by astronomers, there is no cause for public attention or public concern as an actual collision is very unlikely. New telescopic observations very likely will lead to reassignment to Level 0.

3: A close encounter, meriting attention by astronomers. Current calculations give a 1% or greater chance of collision capable of localized destruction. Most likely, new telescopic observations will lead to re-assignment to Level 0. Attention by the public and by public officials is merited if the encounter is less than a decade away.

4: A close encounter, meriting attention by astronomers. Current calculations give a 1% or greater chance of collision capable of regional devastation. Most likely, new telescopic

observations will lead to re-assignment to Level 0. Attention by the public and by public officials is merited if the encounter is less than a decade away.

Threatening (Orange Zone)

5: A close encounter posing a serious but still uncertain threat of regional devastation. Critical attention by astronomers is needed to determine conclusively whether or not a collision will occur. If the encounter is less than a decade away, governmental contingency planning may be warranted.

6: A close encounter by a large object posing a serious but still uncertain threat of a global catastrophe. Critical attention by astronomers is needed to determine conclusively whether or not a collision will occur. If the encounter is less than three decades away, governmental contingency planning may be warranted.

7: A very close encounter by a large object, which if occurring this century, poses an unprecedented but still uncertain threat of a global catastrophe. For such a threat in this century, international contingency planning is warranted, especially to determine urgently and conclusively whether or not a collision will occur.

Certain Collisions (Red Zone)

8: A collision is certain, capable of causing localized destruction for an impact over land or possibly a tsunami if close offshore. Such events occur on average between once per 50 years and once per several 1000 years.

9: A collision is certain, capable of causing unprecedented regional devastation for a land impact or the threat of a major tsunami for an ocean impact. Such events occur on average between once per 10,000 years and once per 100,000 years.

10: A collision is certain, capable of causing global climatic catastrophe that may threaten the future of civilization as we know it, whether impacting land or ocean. Such events occur on average once per 100,000 years, or less often.

Note: A color graphic of the current Torino Scale is available at https://cneos.jpl.nasa.gov/sentry/torino_scale.html.

The Palermo Technical Impact Hazard Scale is a bit different, with values less than -2 reflecting events for which no consequences are likely, values between -2 and 0 indicating situations that merit careful monitoring, and values above zero indicating situations that merit some level of concern. This document presents only the Torino scale in its entirety, since that scale was developed for general public-information uses.

About 40,000 to 60,000 tons of extraterrestrial material falls onto the Earth each year, but most of it is mere dust. Slightly larger materials fall during regular cycles called meteor showers, but again most of

it is small enough to harmlessly burn up (through ablation) as it hits the Earth's atmosphere at high speeds. During meteor showers, the material is typically leftover debris from comets that had crossed the Earth's orbit in the past, and most such material is very small and harmless to us. Material that does survive ablation in the atmosphere and strike the Earth's surface will land in random locations, and since 70% of the Earth's surface is water, these meteorites mostly go unnoticed by ordinary people.

The general risk to Michigan is actually statistically calculable, by considering the proportion of the Earth's total surface area that is occupied by Michigan's land area. This is approximately 2.9×10^{-4} , or 0.00029. The frequency of global impact events can then be multiplied by this factor to estimate the frequency of impact events directly upon Michigan's land area. This results in the following estimates, on average, for different sizes of impacts upon Michigan's land itself:

- About 1 to 5 impacts per year that are larger than 100 grams (golf-ball size) – This may kill an individual that is struck, but since most space is not occupied by a person at any particular moment, such a thing is exceptionally rare, and (until the 2013 Chelyabinsk event) there have only been a couple of confirmed meteorite injuries worldwide. Instead, such incidents are more likely to simply cause limited property damage to a car or home, although their appearance in the sky can appear impressive and be accompanied by a sonic boom. Example: the Washtenaw County strike of 1997 (described in the "Significant Events" section).
- About one impact per century involving an object of more than 100kg (220 pounds), and about one impact every 1700 years involving an object of more than 1000kg (about 2200 pounds) – These types of events would result in loud sounds and bright flare-ups in the sky, leaving a field of fragments strewn across an area that is miles across, but actual damages are likely to be only moderate unless a dense urban area or critical facility happens to be struck. Example: The Park Forest, IL event of 2003.
- About one impact every 350,000 years involving an object of more than 100,000kg (about 220,000 pounds) – This is the type of impact that resembles an atomic blast, exploding brightly in the sky and producing a very strong blast wave and severe winds that would cause extensive building damages and collapse at ground level, and would flatten forest lands. Example: the Tunguska, USSR event of 1908.

Although that last type of event is so rare that it need not be of general concern for Michigan, the probability of such an event affecting some part of the U.S. and potentially causing a national emergency is a bit larger, but still remote. It is most probable that the next such event will occur elsewhere in the world (on the order of about one or two events per century) and, although potentially devastating to that area, Michigan's role would probably only involve the voluntary donation of humanitarian aid to the disaster area.

One foreseeable scenario could involve an asteroid impact in the ocean, which causes tsunami impacts upon a nearby coastline of the U.S. Waves could be more than 100 feet high from the impact of an

asteroid with a diameter of 1300 feet, although that scale of event would only be expected about once in 80,000 years. These types of large events—the kind that would actually form sizeable craters and cause catastrophic national or global impacts (including major seismic and volcanic effects and global cooling from gaseous effects and dust, smoke, and particulates deposited into the atmosphere)—are rare enough that no extensive description will be provided here.

Since meteors flare up brightly in the sky, some persons have speculated about whether meteorites could then cause wildfires to start up. As it turns out, this is generally not the case. The flaring fireballs are caused by ablation, as the very fast meteors encounter the atmosphere and friction generates heat, but a great amount of material typically burns away very quickly during this process, followed by miles of additional falling before ground impact, during which time the contact with blowing air exerts a cooling effect. The vast majority of meteorites are actually cool when they strike the ground. In general, wildfires will not be caused by meteorites, and in view of these principles, the weight of evidence goes against the hypothesis that any of Michigan's historic wildfires were of meteoritic origin.

In cases involving an official alert about an impending impact or potential impact, many persons would need information that allows them to understand the nature of the threat, and the techniques that may be used to prevent or mitigate its impacts. For example, there is an enormous difference between an alert that provides only a few weeks of notification, and one that has identified a need for action over the course of several decades.

A National Near-Earth Object Preparedness Strategy and Action Plan was published in June 2018 as a result of extensive coordination between NASA, FEMA, and many other agencies. It calls for the development of communications plans and processes, to be implemented at the federal level. For more details within this document itself, please see <https://www.whitehouse.gov/wp-content/uploads/2018/06/National-Near-Earth-Object-Preparedness-Strategy-and-Action-Plan-23-pages-1MB.pdf>.

It should be realized that although the atmosphere and air around us seems to be “light” and only a small obstacle to movement under normal conditions, that air nevertheless has enough substance to sustain heavy aircraft in flight, to hold aloft huge thunderstorm clouds full of rain, allow fast-moving winds to cause damage, and so on. A meteor crashing into our atmosphere thus encounters enormous physical resistance, and releases tremendous amounts of energy as the result of the friction and impacts of plunging through large quantities of ever-thickening air layers at enormous speeds. This energy can result in large (and loud) blast waves, even if the meteor's trajectory is oblique enough to cause it to “bounce off” the atmosphere, rather than plunging through it and hitting the ground.

It is likely that the next major meteorite 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 area and its surroundings. If a major impact happens to occur in North America, then 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.

Several recent bolide events have been documented in the Great Lakes area but have caused no known damage to the state's area during its European historical era over the past four centuries. It is possible that certain unexplained seismic events reported in the Upper Peninsula more than two centuries ago may have been caused by celestial impacts. For the most part, however, the meteorite hazard is important to know about mainly for preparedness and informational usefulness, rather than due to an actual pattern of severe damaging effects upon Michigan.

Impacting Objects in Michigan

NOTE: Although many of the events listed here had occurred outside of Michigan, some of them were nevertheless large enough to have direct impacts upon Michigan, due either to the sheer magnitude of the impacts or to the widespread nature of an alert. Some of the listed events occurred an extremely long time ago, while some are extremely small but recent events within Michigan, to give an indication of the range and magnitude of what is possible. Some events merely describe "close calls" and events whose limited impact at the time would have been much greater had occurred at a slightly different time or location. (Our current development density is much greater and involves much larger populations than had been present in the past.)

Case: Approximately 1.8 billion years ago – Sudbury, Ontario

One of the largest known impacts took place around Sudbury, Ontario, leaving impact effects that measure 155 miles in diameter. The impact site's geological structure had been discovered in 1883 but not fully explained until 1964. Debris ejected from the impact site was thrown as far as the Midwestern U.S., including Michigan. This was an impact of global significance. The heat directly generated by this cataclysmic impact would have killed any humans within at least 500 miles from the impact site (which includes all of Michigan), if humans had been living in the area at the time.

Case: Approximately 450 million years ago – Cass County

An impacting object struck what is now southeastern Cass County (Calvin Township), and left effects that are still geologically detectable today. The event is known as the Calvin 28 crypto-explosive disturbance, and the Calvin impact area is about 5 miles in diameter, located mid-way between the Village of Vandalia and the Michigan-Indiana State Line. About the same time (in geologic terms), a much larger impact occurred on what is now the northern coast of Lake Superior (the Slate Islands in Ontario) and formed an impact structure about 19 miles in diameter. The map above shows the Cass County impact area (Source: University of New Brunswick's Earth Impact Database website).

Case: Approximately 65 million years ago – Global

A large impact on the Yucatan peninsula of Mexico took place at the end of the Cretaceous (geological) period. The impact area is known as Chicxulub, and although it is not evident to ordinary observers today, the ancient impact structure was geologically measured at approximately 100 miles in diameter. The Chicxulub impact has been considered to be a direct or contributing cause of the extinction of many prominent species of life on Earth at the time, including the large reptilian dinosaurs. There may be galactic cycles that make major, species-threatening impacts more likely during certain periods of time than others, with mass extinctions seeming to correlate with intervals of between 26 and 32 million

years in length (over the past 250 million years), perhaps caused by some celestial event that sweeps Oort Cloud or Kuiper Belt objects from the outer parts of the Solar System toward Earth, or by the effects of a nearby star going supernova.

Certain regions of the Milky Way Galaxy, which the Sun passes through on a grand cycle that repeats every 225 to 250 million years as it orbits the galaxy's center, may expose the Earth to more celestial bodies than are normally seen in the Solar System during the more stable, intervening time periods. Since the most recent mass extinction period was about 11 million years ago, there is no expected threat of this type during our lifetimes. Recently, evidence has been claimed for an even larger impact site, at around the same time, off the west coast of India. A surge in volcanic activity took place in the same geological time frame as the impact events and thus may have been a result of them.

Case: July 1, 1770 – International, “Lexell’s Comet” *Lexell’s comet (D/1770 L1)* was computed by astronomers as having passed only about 1.4 million miles from Earth (less than 6 times the average distance of the Moon, or about 1.5% of the distance to the Sun). This was the nearest such Earth encounter to be measured astronomically rather than in terms of its actual impact effects as a meteorite (until the very recent tracking of smaller and slower objects).

Now considered to be a “lost comet,” its orbital period had been calculated at the time (by Lexell) to be 5.6 years, eventually leading to the idea that space objects may be propelled toward Earth by a gravitational encounter with Jupiter—a circumstance that is one of the potential sources of comet and asteroid impact threats that would provide little or no advance warning. The comet was initially observed on June 15, 1770 and was last observed moving away from the Sun on October 3 of the same year.

Case: September 17, 1966 – Lake Huron Bolide

A bolide event occurred over Lake Huron, Michigan, involving an air blast estimated as the equivalent of 1/3 ton of TNT, approximately 8 miles above the surface of the water. Although no material from a meteorite was found to help determine more information about the size and characteristics of this meteor, this is not surprising since the location of the event probably placed any meteorite remnants at the bottom of Lake Huron.

The bolide illuminated the whole of south-western Ontario and adjacent regions at about 8:48 pm, as it was seen traveling northwest across Lake Erie and the tip of Ontario, toward Lake Huron. At least a dozen loud “detonations” were reported from the Ontario area near the lake a few minutes after the fireball’s passage. Astronomers later calculated that the meteor was about 8 miles up as it crossed over Lake Huron, and probably reached the lake’s surface fewer than 18 miles west of the city of Kincardine, Ontario. The meteor was traveling about 10.6 miles per second (38,000 miles per hour) and was brightly luminous for at least 10 seconds.

Case: January 1978 – International, “Cosmos 954” Satellite Crash

A Soviet satellite, Cosmos 954, which had been launched in September of 1977, was being monitored by U.S. agencies and by November was found to have a decaying orbit. By January, it had become

apparent that the satellite had lost its attitude stabilization system. Such satellites were known to be powered by small nuclear reactors, using fuel that was 90 percent enriched Uranium-235. Thus, whenever and wherever this satellite fell to Earth, it had the potential to contaminate things and persons coming into contact with it.

The U.S. National Security Council arrived at an estimate that there was only about a 1 in 10,000 chance that a human would be injured in the crash, but because of the political aspects of an enemy nation's nuclear satellite crashing onto friendly territory, it became important to treat the incident with more weight than what that small risk might normally be credited with. Operation Morning Light was thus created, in December of 1977, with the Department of Energy given lead responsibility for the possibility of a domestic crash site. Even though a crash site for the projected landing orbit was only supposed to have an 8% chance of being on land, plans were made for such a contingency, which would involve the finding of radioactive debris, decontamination of affected land areas, and the treatment of any persons within an unsafe distance of such debris.

After about 10 days of careful inquiries with the Soviet government, various types of confirmation were received about the satellite's nature and condition. On January 24, the satellite entered the atmosphere over Queen Charlotte Island, British Columbia, and at 6:53 am, finally crashed near the Great Slave Lake, just north of the Province of Alberta, in Canada. Aircraft and Nuclear Energy Search Teams were then dispatched to Canada, to assist with clean-up operations.

Case: September 1, 1997 – Salem Township (Washtenaw County), Meteorite After numerous persons reported a bright daylight meteor and sonic booms, the meteoric object broke up into at least three parts. One meteorite (called the "Worden Meteorite") then struck a residential garage roof (in Salem Township, midway between the villages of Salem and Brookville), as the family was nearby working in their back yard. They had heard a whistling sound passing overhead, and then investigated a boom and crash, finding the garage full of plaster dust, pieces of drywall, and insulation. There was a dent in the roof of a car that was parked in the garage, and the meteorite itself was found on the floor nearby, along with a couple of associated fragments. The large meteorite weighed about 1.5kg, and its dimensions were about 6 inches long, 4 inches wide, and an inch thick.

Case: Feb 1, 2003 – National, Space Shuttle Columbia Explosion Debris Fields

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 be reported to authorities upon discovery).

Case: March 26, 2003 – "Park Forest Meteorites" in Suburban Chicago, Illinois

Hundreds of small meteorites fell across residential areas in the suburbs of Chicago. Although meteors were visible from Michigan and the meteorites landed fairly close to Michigan territory, it must be noted that this event is highly unusual, having been described as "the most densely populated region to be

hit by a meteorite shower in modern times.” 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, the largest of them 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 comparable to that size, or larger, across a couple of square miles of neighborhoods.

Case: June 27, 2011 – International, Near-Earth Object

An asteroid designated as 2011 MD passed only 7,600 miles above the Earth’s surface. It was discovered by LINEAR, and its size was less than 20 meters in diameter. The object was close enough to markedly change its trajectory as it passed.

Case: November 1, 2016 – International, Near-Earth Object

This was another “near miss” event, involving asteroid 2016 VA, which was discovered only the day that it approached Earth. It passed by at a distance of about 48,000 miles, four times closer than the moon. The size of that Aten asteroid was estimated as similar to the one that landed near Chelyabinsk in 2013.

Case: January 16, 2018 – Southern Michigan Bolide and Meteorites

A meteor flared up very visibly within the early night sky. In some places, loud sonic booms were reported. Five miles southwest of New Haven (Macomb County), a seismic measurement of magnitude 2.0 was reported at approximately the same time as the meteor passed by, which might indicate the loudness of the sounds from the sonic booms (although a 2.0 seismic event is very weak, as described in the chapter on Earthquakes, q.v.). Although the bolide had been reported by hundreds of persons from seven states, this was predominantly a Michigan event. A strewn field with multiple meteorite fragments was soon found within Hamburg Township (Livingston County), and the meteorite samples found there are named Hamburg, after that community. All meteorite fragments were quite small, the largest of them weighing 102 grams. Twenty meteorite pieces were found, with an estimated total mass of 1 kilogram. No known damage resulted from this event.

Case: March-April, 2018 – Tiangong-1 Space Station Alert

In March, the orbit of a Chinese space station, Tiangong-1, had decayed enough that it was clear that it was plummeting into the atmosphere and that some of its debris could survive the re-entry process, posing a hazard if it struck one of Earth’s land areas. In addition to the problems of life and property damage from any large metal components as they landed, Tiangong’s corrosive fuel, hydrazine, would have posed a contamination risk if tainted fragments fell in populated areas. The likeliest paths for Tiangong’s decaying orbits had been calculated and showed that there was a higher chance of debris falling within particular mid-latitude zones of the Earth, which included the most heavily populated parts of southern Michigan.

It was estimated that some parts of the space station might weigh as much as 220 pounds when crashing to Earth. Therefore, the State Emergency Operations Center went into a monitoring mode to

be ready to coordinate activities if Tiangong's impact area did turn out to involve Michigan. The Michigan Satellite Reentry Response and Recovery Plan was utilized and updated in March, and fortunately it became clear by early April that the actual crash site would not be in Michigan. The remains of the Tiangong-1 space station all landed safely in the South Pacific Ocean on April 2.

Case: December 18, 2018 – Bering Sea Bolide

The most powerful meteor since the 2013 Chelyabinsk event occurred above the Bering Sea. A meteor exploded into a large fireball and unleashed energy that was calculated to be 10 times that of the 1945 atomic bomb detonation at Hiroshima. The uninhabited area meant that no harmful effects occurred to persons or property. The event was documented by two NASA instruments on a satellite, and these images were widely distributed in media reports and at NASA's website.

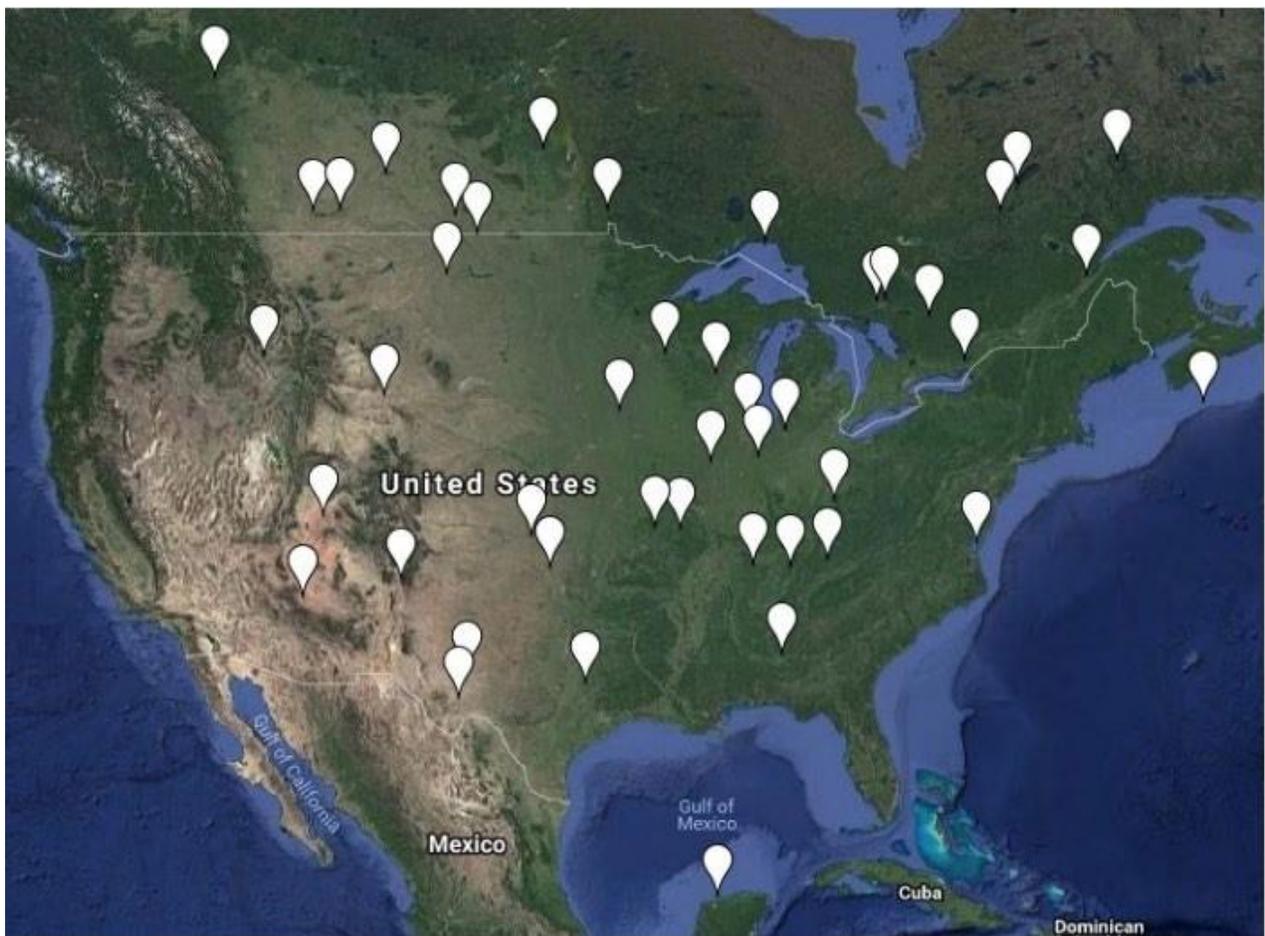


Image showing identified impact crater sites across a portion of North America Source: The Earth Impact Database website: http://www.passc.net/EarthImpactDatabase/New%20website_05-2018/NorthAmerica.html

INVASIVE SPECIES

Invasive Species

A species whose introduction to Michigan causes or is likely to cause economic or environmental harm, or harm to human health, to an extent that outweighs the species' known benefits. This chapter includes a consideration of harmful contagious diseases that may have similar impacts.

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). This chapter includes a consideration of harmful contagious diseases that may have similar levels of impact upon Michigan's ecology or economy. Invasive species typically fall into two broad categories—**terrestrial** (able to live in Michigan's land area) and **aquatic** (able to live within Michigan's water bodies).

Human actions have been an important consideration as a means of invasive species' sudden introduction (thus distinguishing the situation from natural shifts in the distribution of species), but a human-related cause may not be relevant to the extent of impact that results. Nationally, the current environmental, economic, and health costs of invasive species have been estimated as exceeding the costs of all other natural disasters combined, and Michigan's own potential costs have been estimated as extremely serious.

Invasive species can be transported in many ways, such as on animals, vehicles, ships, commercial goods, produce, and clothing. Although non-native 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. After its arrival, an invasive species becomes capable of establishing a breeding population in its new location and becomes a pest by threatening local biodiversity and causing or threatening human health impacts, significant economic costs, and/or harmful ecological effects to an extent that outweighs its known benefits. 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 non-native 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 Spongy Moth (renamed from Spongy 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

Hazard Analysis

Hundreds of new species from other countries are introduced intentionally or accidentally into the United States each year. These invasive species may arrive on our shores in a variety of ways. Transportation efficiencies that make it possible to travel around the globe in hours rather than weeks make it possible for 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 clearance 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 and animal infestations. For example, certain diseases could wipe out large segments of an animal population, creating a potentially serious agricultural disaster and a potential public health emergency (often with a need to dispose of many animal carcasses) properly and rapidly.

Similarly, a widespread insect infestation, such as that of the Emerald Ash Borer, has created 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) and subject to damaging collapses, especially during high wind events or periods with ice and snow accumulation. Falling trees or limbs can bring down power lines, cause damage to public and private structures, and cause injuries or even death.

Impact on the Public, Property, Facilities, and Infrastructure

The emerald ash borer had caused extensive damage to trees in Michigan, and those weakened trees have often (1) collapsed and caused property damage, including utility line impacts, and (2) required removal, at considerable expense. A disaster declaration request had been 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. Similar terrestrial species include the Asian Long-Horned Beetle and the Cedar Long-Horned Beetle, although aquatic species and some microbes are also of concern, since they may disrupt or impede forestry, horticulture, and fishing for Michigan residents, tourists, and industries. The most severe potential impact is now estimated to be posed by the invasion of Asian Carp into the Great Lakes. It has been reported that entire summer tourist industries could go into serious decline as a result of such an event, including fishing, swimming, and boating-related activities. Property damage had occurred as

a result of the Emerald Ash Borer impacts, and lessened property values may eventually result from a full-scale Asian Carp problem. Some facilities have been affected by Zebra Mussels, but a greater impact has probably now been seen from the return of cyanobacteria problems (i.e., harmful algal blooms) within Lake Erie, which caused a temporary shutdown of the Toledo drinking water supply.

Impact on the Economic Condition of the State

An Asian Carp invasion into the Great Lakes is expected to cause a serious and dramatic decline in Michigan's major summer tourism sector, to the degree that such an invasive species is expected to interfere with swimming, boating, and water-skiing activities, and to proliferate at the expense of valuable Great Lakes fisheries. The Emerald Ash Borer had caused a regional impact without any of the compensation that had been requested of FEMA. A quarantine area needed to be imposed and enforced, with regard to the transport of firewood and similar lumber that could pose risks of spreading the insect to harm new areas, but this only slowed the spread of infestation, and the quarantine was repealed by the director of MDARD on October 1, 2018.

Impact on Responders, Continuity of Operations, and Continued Delivery of Services

The invasive species hazard is a less familiar one for the general public, generally long-term and insidious in its effects, and rooted in an understanding of the biological sciences. Most emergency management training does not focus on the topic. Emergency management consideration of invasive species is recent and therefore needs to be increased. MSP/EMHSD has recently been strengthening coordination with the U.S. Geological Survey, which has specialized offices dealing with this hazard. An Ann Arbor USGS office deals with Great Lakes aquatic species, and a separate USGS office in Fort Collins, Colorado, deals with terrestrial species. The most damaging Emerald Ash Borer event probably affected some operations and services as a result of damages from falling trees, but such effects were generally minor compared with the direct physical damages.

Impact on the Environment

Terrestrial and aquatic forms of invasive species both pose problems for the ecosystems in which they are introduced. Whether invasive species are brought to an area on purpose or by accident, these non-native life forms can alter the existing ecosystem and decrease an area's biodiversity. Like many hazards that affect Michigan's environment, invasive species have both direct and indirect impacts. The Zebra Mussel, for example, has been invading Michigan's water bodies since the mid 1980's and is responsible for eating the microscopic food supply that is vital to the existing ecosystem. Further, the Zebra Mussel attaches to water intake pipes and screens used for drinking water and industrial plants. Not only do these pests cause environmental problems, but they cause secondary economic impacts to a community as well. Similarly, the Emerald Ash Borer, a non-native insect, is responsible for killing millions of Ash Trees in Michigan, which changes the biodiversity of the forest and diminishes wildlife habitats. Dead trees pose problems for the human-built environment, as well, pulling down nearby wires and damaging structures.

Impact on Public Confidence in State Governance

Terrestrial species are likely to have more general public awareness than aquatic ones, and thus more likely to be a cause for dissatisfaction or loss of public confidence in government. Although there have been well-publicized aquatic species of concern (e.g., Zebra Mussels, Asian Carp), people tend to be more aware of the impacts of terrestrial species, unless their recreational or business activities are more heavily curtailed by aquatic ones. The most recent widespread terrestrial species of concern has been the Emerald Ash Borer insect—trees killed by these insects are prone to collapse, causing property damage, blocked roads, broken utility lines, etc. Citizens and businesses that are more heavily connected with agriculture and tourist industries are more likely to be aware of the impact of invasive species, and thus more likely to express doubts about government policies.

Climate Change Considerations

Different patterns of wildlife have already been concerned as a result of the lengthening average growing season in Michigan. Species that had previously been found only in warmer areas to the south have started to appear in Michigan. Although the definition of invasive species specifically refers to human species introduction, to distinguish these patterns from naturally occurring ones, species transported by human action can be more likely to survive (and thus to become invasive) as climatic changes occur.

NOTE: The following lists and descriptions provide examples of invasive species that pose some threat to Michigan or have already affected Michigan. For each of these categories, at least several other species could have been included. Some of these species, such as the Spongy Moth, are already well-established throughout the state, but the text provides information about the kinds of impacts that can result from the invasive species hazard.

Much additional information can be found at <https://www.misin.msu.edu/> and <http://www.invasive.org/>.

A Michigan watch list has been established and can be found at online at the following web site: https://www.michigan.gov/invasives/0,5664,7-324-68002_74188---,00.html. Species on the watch list have been identified as posing an immediate and significant threat to Michigan's natural resources. The species have either not been confirmed in the wild in Michigan or have just a limited known distribution. Any occurrence of these species should be reported.

Examples of Potentially Threatening Terrestrial Invasive Species

(Note: These are just a few of the species that are currently on a Michigan watch list.)

Asian Long-Horned Beetle (*Anoplophora glabripennis*)

Hosts: Several species of hardwood trees found in Michigan. Its favorite host is the Norway maple, although it has been found in other maple species, horse chestnut, elm, box elder, mulberry and poplar trees.

Symptoms: Dark, wet areas on branches and trunks or white foamy sap are often the first symptoms seen in infested trees. The sap often attracts bees, wasps and hornets.

Damage: Trees infested are first weakened, and then die. Damage from these insects and secondary pests will kill a tree within a few years.

Control/Treatment: Prohibited in Michigan. The only known way to eradicate the beetle is to cut down and burn infested trees.

Balsam Woolly Adelgid (*Adelges piceae*)

Hosts: All true firs.

Symptoms: Small white masses on tree, stunted shoots, formation of galls, tree crown turns red.

Damage: Feeding on the branches of the crown and main stem, causing mortality in 2-6 years.

Control/Treatment: Spraying of individual trees from the ground with lindane has proved effective for control. The spray, prepared by mixing 2.5 pints of 10% emulsifiable concentrate per 100 gallons of water, is applied as a bark drench with a hydraulic sprayer from May through June and September through October to control crawlers. Treatment will reduce populations to below the tree-killing level, and some treated trees may remain generally free from aphids for at least 2 years. Spraying is warranted only in accessible areas supporting relatively high-value trees.

Hemlock Woolly Adelgid (*Adelges tsugae*)

Hosts: Eastern Hemlocks.

Symptoms: Small white cottony masses at the base of the needles. Needles turn grayish green and drop off. There is a lack of new buds, and low vigor.

Damage: Feeding on twigs by nymphs cause the trees to die within 1-4 years.

Control/Treatment: Horticulture oils that smother the insects have been the best insecticidal treatment. The oils are non-toxic to the trees, as opposed to soap, which is an otherwise effective treatment. However, the least harmful cure may be the introduction of



Japanese ladybugs. Deadly hemlock pest targeted by new Muskegon Conservation District task force.
<https://www.mlive.com/news/muskegon/2022/02/deadly-hemlock-pest-targeted-by-new-muskegon-conservation-district-task-force.html>

Thousand Canker Disease of Walnut (*Pityophthorus juglandis* and *Geosmithia morbida*)

Hosts: Black walnut and other walnut species.

Symptoms: Infected trees show wilting, curling, and yellowing of leaves on one or more branches in their upper portions, as a fungus from the walnut twig beetles progressively affects the tree's health.

Damage: Causes thousands of small cankers on and under the bark, disrupting the flow of nutrients to the branches. Tree mortality is directly proportional to the number of feeding sites present on the tree.

Control/Treatment: There is no practical treatment, once infected. Landowners should remove affected trees to prevent spread to nearby trees.

Examples of Potentially Threatening Aquatic Invasive Species

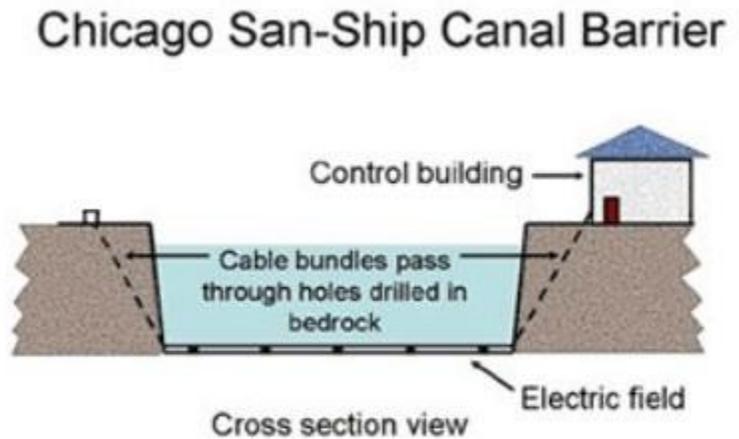
Asian Carp (Ctenopharyngodon Idella Grass Carp, Hypophthalmichthys nobilis Bighead Carp, Mylopharyngodon piceus Black Carp, and Hypophthalmichthys molitrix Silver Carp)

Hosts: Asian carp made their way into the Mississippi River from Arkansas fish farms in the 1970s as a result of flooding and have steadily swum upstream for years at a pace of 40 to 50 miles a year. Asian carp are currently in the Illinois River and only miles away from entering the Great Lakes. **Symptoms:** Decline in native fish species. There are four different species of Asian carp that have invaded the Mississippi River: grass (Ctenopharyngodon idella), bighead (Hypophthalmichthys nobilis), black (Mylopharyngodon piceus), and silver (Hypophthalmichthys molitrix). All three species of Asian carp pose a problem to the waterways by devastating habitats and destroying water quality. However, the bighead and silver carp are of the greatest concern, due to their size. These fish can each grow to be 50 to 100 pounds. Although great attention has been focused on these fish recently, dreissenid mussels have already invaded the Great Lakes and caused extensive impacts. (A description of mussels also appears in this section.)

Damage: Researchers expect that Asian carp would disrupt the food chain that supports the native fish of the Great Lakes. Due to their large size, ravenous appetites, and rapid rate of reproduction, these fish could pose a significant risk to the Great Lakes Ecosystem. If bighead or silver carp enter the great lakes, the economic impacts on the fishing industry would be devastating, putting the Midwest's multi-billion dollar-a-year fishing industry at risk. Also, silver carp have been known to cause injuries to boaters, as they jump out of the water.

Control/Treatment: Prohibited in Michigan. To prevent the species from entering the Great Lakes, the U.S. Army Corps of Engineers, U.S. EPA, State of Illinois, International Joint Commission, Great Lakes Fishery Commission, and U.S. Fish and Wildlife Service constructed a temporary electronic dispersal barrier on the Chicago Sanitary and Ship Canal near Romeoville, Illinois, which was activated in April 2002. In late October 2004, construction began on a second, more permanent barrier. The new barrier, completed in February 2005, stretches two rows of electrodes across the canal approximately 220 feet apart. The electrodes pulse DC current into the water, causing fish to turn back rather than pass through the electric current. The electric current poses no threat to humans. A model of the Chicago Canal Barrier can be seen below. In November 2009, evidence of the presence of Asian carp was detected beyond the electric barrier, which left only a single lock/dam on the Calumet River between the carp's detected location and Lake Michigan. Due to the major ecological threat to Lake Michigan and to recreational boaters, the U.S. Army Corps of Engineers shut down one of the electric barriers for maintenance in December 2009. The Illinois Department of Natural Resources responded to the situation by dumping 2,200 gallons of the toxin rotenone into the canal. Rotenone is deadly for fish but not harmful to humans, animals, or most other aquatic life. The intentional fish kill cost \$3 million and produced about 90 total tons of dead fish, but only one carp was found in the Lockport Lock and Dam area. In June 2010, a 19-pound Asian carp was found near the shore of Lake Michigan, in Lake Calumet, about six miles downstream from Lake Michigan, by a commercial fisherman hired by the state of Illinois to do routine fish sampling in the area. The fish confirmed existing DNA evidence suggesting that the Asian carp had indeed breached the electric barrier on the Chicago Sanitary and

Ship Canal, which had been considered the last line of defense for Lake Michigan. One type of Asian Carp was recently found within the Great Lakes watershed area, but as grass carp, it was not of the type whose impact is of such widespread concern.



Chicago Sanitary and Ship Canal Dispersal Barrier System (Source: U.S. Geological Survey)

Many other species exist that could become harmfully invasive if they reached Michigan. Although the watch list assesses the most likely risks, any other threatening species must also be identified and reported, so that proper preventive or response activities can occur as quickly as possible.

Significant Invasive Species Incidents and Threats

Example of Risks from a non-Watch List Species

Khapra Beetle (*Trogoderma granarium*)

Hosts: The beetle prefers hot, dry conditions and can be found in areas where grain and other potential food is stored, such as pantries, malhouses, grain and fodder processing plants, and stores of used grain sacks or crates.

Symptoms: Destruction of grains and seeds. They can multiply quickly in stored items such as crackers, wheat, flour, and baby cereal and rapidly spread to warehouses, storage bins, and mills.

Damage: The beetles can potentially cause severe harm to the agriculture crop industry such as grains and seeds including wheat, soybean, barley, corn, and rice.

Control/Treatment: Fumigation with methyl bromide in containers to quarantining shipments until treatment. Powdered neem has been used to control the beetle in wheat stores in India. On November 23, 2018, agricultural specialists found these beetles infesting a bag of seeds that a woman was attempting to bring into the state when traveling by plane from Iraq. There was no indication that the woman was aware of the seed infestation, as she planned to sow her garden with them, but the resulting agricultural damage from such an oversight could have been severe.

Examples of Recent and Active Problems within Michigan

Dreissenid Mussels (including Zebra Mussels and Quagga Mussels) (family Dreissenidae)

Hosts: Freshwater lakes and streams

Symptoms: By firmly attaching to hard surfaces, dreissenid mussels have clogged water-intake pipes and fouled hard-shelled animals such as clams and snails. In addition, zebra mussels have reduced plankton populations, as colonies of mussels filter large volumes of water for food, potentially depleting food resources of larval and planktivorous fishes such as smelt, chub, and alewife. Transfer of suspended material to the lake bottom in mussel waste products also leads to increased water clarity and increased growth of aquatic plants. Although clear water is often considered aesthetically pleasing, this clarity indicates that drastic changes have occurred at the base of the food web and that energy flows through the ecosystem has been altered. The mass media has given a great deal of attention to the zebra mussel, but quagga mussel infestations are actually far more extensive in the Great Lakes. Both zebra and quagga mussels belong to the same genus, dreissenid mussels, but quagga mussels are more tolerant of colder and deeper waters than zebra mussels are. Quagga mussels were first spotted in the Great Lakes around 1990 and have devoured so much plankton that the food web is being altered.

Damage: Communities along the affected lakes and rivers rely on these waters for drinking, industrial water supplies, transportation, commercial fishing and shelling, and recreation. Rapidly expanding populations of dreissenid mussels could ultimately affect many of these activities, in addition to changing the structure of the ecosystem.

Control/Treatment: Restricted in Michigan. Applications of hot water and bleach have been used for control. A new method involving bacteria is being refined.

Dutch Elm Disease

Hosts: Elm trees

Symptoms: Trees infected by elm bark beetles first show wilting, curling, and yellowing of leaves on one or more branches in the upper portion of the tree, as a fungus from the beetles progressively affects the tree's health.

Damage: Large trees may survive and show progressively more symptoms for one or more years. Trees infected through root grafts wilt and die rapidly; this frequently occurs in the spring, soon after the trees have leafed out, and progresses from the base of the tree upward.

Control/Treatment: Dutch elm disease control has involved two different but related programs: (1) community-wide sanitation programs designed to reduce the level of elm bark beetles (principal carriers of the Dutch elm disease fungus); and (2) prevention of the spread of the disease through natural root grafts from infected trees to adjacent healthy trees. There are probably no community-wide programs being used any more, with a shift toward disease management involving the planting of different species of trees. There is no way to eliminate Dutch elm disease once it begins, but different species such as Siberian elms are resistant to the disease. This disease is still active in Michigan Elm Trees.

Emerald Ash Borer (EAB) (*Agrilus planipennis*)

Hosts: White, black, and green ash trees.

Symptoms: Typically, the upper third of a tree will die back first, followed by the rest during the next year. This is often followed by a large number of shoots or sprouts arising below the dead portions of the trunk. The adult beetles typically make a D-shaped exit hole when they emerge. Tissue produced by the tree in response to larval feeding may also cause vertical splits to occur in the bark. Distinct S-shaped tunnels may also be apparent under the bark. Adults are dark metallic green in color, 1/2 inch in length and 1/16 to 1/8 of an inch wide and are only present from mid-May until late July. Larvae are creamy white in color and are found under the bark.

Damage: The adult beetles feed on ash foliage but cause little damage. The larvae feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Many trees appear to lose about 30 to 50 percent of their canopy in one year and the tree is often killed after 2-3 years of infestation. Most of the devastation in Michigan has occurred in the southeastern Lower Peninsula, where about 20 million trees have been killed. Fallen trees have caused extensive property damage. A quarantine area had been imposed by state government in 2002, in an effort to slow the spread of this pest, but by 2018, EAB had spread to 79 of Michigan's 83 counties, and suspected to be present to some degree in the remaining four. Therefore, the quarantine was lifted by Governor Snyder on October 1, 2018.

Control/Treatment: Treatment options for controlling infected or at-risk trees include systemic insecticides applied as soil injections, systemic insecticides applied as trunk injections, noninvasive systemic sprays, and protective cover sprays. If properly applied, these treatment options can prevent EAB larvae from taking over the ash tree about 70% of the time. Treatment also proves to be successful when managing at-risk trees in areas where EAB has been identified. More information on the EAB can be found on the MDARD's website: www.michigan.gov/eab.

Spongy Moth (*Lymantria dispar*)

Hosts: Tree foliage.

Symptoms: The egg mass is usually laid within a few feet of the female pupa casing. They are covered by a dense coating of hairs.

Damage: During high population levels, total defoliation can occur. During the months of June and July, defoliating populations cover sidewalks, homes, children's play equipment and other objects, making outdoor activity in residential and recreational areas almost impossible. For Michigan's nursery industry, additional expense and pesticide use are required. For the forest products industry, high Spongy Moth populations mean the potential loss of wood fiber from reduced production (due to tree stress or mortality).

Control/Treatment: Counties may get involved in the Michigan Cooperative Suppression Program. The only pesticide used in the Cooperative Suppression Program is *Bacillus thuringiensis*, most commonly referred to as Bt.

Plum Pox Virus (PPV) Hosts: Peach, plum, nectarine, apricot, almond, cherry.

Symptoms: Discolored viral rings on leaves and fruit. **Damage:** Smaller deformed fruit and reduced

fruit production.

Control/Treatment: Control and prevention measures include field surveys, use of certified nursery materials, use of virus-resistant plants (when available), control of aphids, and the elimination of infected trees in nurseries and orchards. A team of scientists from the United States and France has genetically engineered a PPV-resistant plum (known as C5), and this resistance can be transferred through hybridization to other plum trees. This provides a source of germplasm for future breeding programs worldwide. Similar success has not yet occurred in attempts to genetically modify other *Prunus* species. First found in North America in 1999 (in Pennsylvania), this was confirmed in Michigan for the first time in July 2006, in a Berrien County location, resulting in a large-scale survey and eradication effort. A PPV quarantine was issued by the Michigan Department of Agriculture on March 12, 2007. As of a decade later, the problem seems to have been resolved with that eradication effort and quarantine.



Dutch Elm Disease



Emerald Ash Borer



Spongy Moth



The Plum Pox Virus

Sea Lamprey (*Petromyzon marinus*)

Hosts: Found in both fresh water and saltwater habitats, they breed in freshwater streams and lakes and were first discovered in the Great Lakes in the 1800s.

Symptoms: Sea lampreys prey on a wide variety of fish. The lamprey uses its suction-cup like mouth to attach itself to the skin of a fish (possibly for days) and rasps away tissue with its sharp probing tongue and many hooked teeth, arranged in numerous rows. Secretions in the lamprey's mouth prevent the victim's blood from clotting, and the lamprey sucks the victim's blood. Victims (usually smaller ones) typically die from excessive blood loss or infection. Mature sea lampreys average 2 to 2½ feet long, up to a maximum of about 3 feet. Sea



lampreys are considered a pest in the Great Lakes region and were introduced as an invasive species in the 1800s, originating from the inland Finger Lakes and Lake Champlain in New York and Vermont.

Sea lampreys created a problem for key predator fish species including lake trout, lake white fish, and lake herring. The elimination of these key predator fish allowed the alewife, another invasive species, to explode in population, having adverse effects on many native fish species. **Damage:** The introduction of the sea lamprey to Lake Superior caused serious declines in fish populations, and an alteration of the ecosystem. The lake trout played a vital role in the Lake Superior ecosystem because it is considered an apex predator, which means that the entire system relies on its presence to be diverse and healthy. As an apex predator was removed from the system, the entire system felt the effects all the way down the food chain. The sea lamprey is an aggressive predator by its nature, which gives it a competitive advantage in a lake system where it has no predators and its prey lack defenses against it. The sea lamprey played a large role in the drastic decline of the Lake Superior lake trout population. One sea lamprey can upset an ecosystem and food chain by eating an estimated 40 pounds of fish or more in its lifetime. This resulted in an unbalanced relationship between predators and prey in the Great Lakes' Ecosystem.

Control/Treatment: Control efforts to mitigate the destructive effects of the sea lamprey have included the use of electric currents, chemicals, and barriers. In 1958, scientists found a chemical (still used today) that selectively killed sea lamprey larvae in their spawning streams and brought the lamprey under control. In 1986, DNR fish managers, technicians and engineers designed a new lamprey barrier which let fish migrate through to spawn but captured the lamprey. The new barrier was expected to reduce the number of lamprey beyond it to nearly zero. Lamprey numbers in Lake Michigan are currently only about 10 percent of their peak numbers in the 1950s. Today, biologists and researchers are still looking for new ways to stop the spread of lampreys in lakes, streams, and rivers. It is the hope of the Great Lakes Fishery Commission that at least some of this scientific work on the sea lamprey, including genetic and pheromone studies, will result in a more effective management technique that could one day drastically reduce the need for chemical treatments of spawning grounds. Several million dollars are spent each year on environmentally friendly control methods. Native predatory fish, like the whitefish and lake trout, have been restocked by fisheries professionals to help maintain a healthy level of these species.



A couple of invasive aquatic species: Asian carp and zebra mussel.

Wild Hogs or Boar (*Sus scrofa*)

Feral swine are defined as free-ranging pigs and are considered to be an aggressive public nuisance. They have been known to attack and chase humans. They can become infected with, and may transmit, diseases that affect human health, domestic livestock, and wildlife, such as brucellosis, tuberculosis,

bubonic plague, tularemia, anthrax, and trichinosis. In Michigan, pseudorabies-positive feral swine were removed from private land in 2008. Feral swine have the potential to cause great economic harm to the domestic swine industry if they were to transmit such disease to commercial swine. The appearance of feral swine may vary greatly, as they can originate from several subspecies, including the Russian Boar, the wild Eurasian boar, escaped domestic swine, and quite often a mix of domestic and wild-type breeds. These animals can weigh up to 400 pounds, may be covered in coarse hair, may have tusks, and are known to travel in groups. Females in warm states produce two large litters of 8 to 10 piglets per year. In Michigan, feral swine are known to survive the harsh winters. Feral swine tend to follow creeks and drains between food sources. They favor agricultural crops, but when the crops are harvested in the fall, they turn to wildlife food plots, acorns, and other mast foods. Feral swine are known to eat ground nesting birds, small mammals, and grubs. **Damage:** Feral swine can tear up the landscape, killing wildlife and pets, damaging farm crops and wildlife habitats, and scavenging uncovered garbage. Their devastating effect on crops accounts for up to \$1.5 billion in annual damages nationally. Unlike most animals, feral swine don't stop at just eating crops. They also root holes in the ground as deep as a foot, destroying the crops. Wild hogs can damage as much as 10 percent of a farmer's crop. To date, the Department of Natural Resources has logged 288 unofficial feral swine sightings by residents in almost every county in Michigan. Since 1999, national experts have estimated that, if unchecked, the feral swine population could become established statewide and cause economic hardship for farmers, and for businesses that cater to wildlife enthusiasts.

Control: On May 13, 2010, the Michigan Legislature amended Public Act 328 of 1976 (Domestic Animals Running at Large) by allowing people to pursue and harvest feral swine at any time. The law does the following: (1) declares swine running at large on public or private property to be a public nuisance, (2) permits a local animal control officer or a law enforcement officer to kill swine running at large on public or private property, (3) permits a person with a concealed weapon permit or a valid hunting license to kill swine running at large on public property, and (4) permits a property owner or other authorized person to kill swine running at large on private property. In the last case, the landowner does not need a hunting license. Michigan residents who see or shoot a feral pig are asked to report it to the Michigan Department of Natural Resources at (517) 336-5030. USDA Wildlife Services (517-336-1928) and the Wildlife Conservancy (517-641-7677) have feral swine traps available for the use of landowners who are experiencing feral swine damage. The animals will be trapped, removed, and tested for disease, then euthanized and disposed of.

In December 2010, the Michigan Department of Natural Resources classified feral swine as an invasive, exotic or prohibited species under Public Act 451, the state's Natural Resources and Environmental Protection Act of 1994, but the Director's order does not go into effect until April of 2011.

Partners: The Feral Swine Working Group is an interagency team of veterinarians, biologists, and policy personnel within the state and federal governments, Michigan State University, and from numerous stakeholder groups, including the Michigan Animal Control Association, Michigan Farm Bureau, Michigan Pork Producers Association, Michigan United Conservation Clubs, Michigan Corn Growers Association, the Nature Conservancy, United Deer Farmers of Michigan, the Michigan Hunting Dog Federation, and the Michigan Wildlife Conservancy.

Invasive Plant Species in Michigan

Numerous online resources provide more information about plants, such as the NRCS database at <http://plants.usda.gov/java/>. Please refer to the information in the MDNR publication “Meeting the Challenge of Invasive Plants: A Framework for Action,” which can be found at the following website: http://www.michigan.gov/documents/dnr/Invasives_strategy_final_289799_7.pdf.

The Muskegon Lake Watershed Partnership also has lots of information on a variety of invasive Species in the Muskegon County Area. <https://muskegonlake.org/about/> You can also find a list of other organizations tasked with collaboration on invasive species at the bottom of their website under quick links.

Animal Diseases

There are many animal diseases that have the potential to impact Michigan. Diseases from outside Michigan or the United States have the potential to cause widespread mortality in livestock, wildlife, and companion animals. They could result in huge economic losses (primarily through trade restrictions), require significant resources to be allocated for response, and in some cases could also threaten public health. For more information, please refer to the Reportable Animal Diseases documents of the Department of Agriculture and Rural Development. (One introductory link is: https://www.michigan.gov/mdard/0,4610,7-125-48096_48097---,00.html.) Chronic Wasting Disease is an example of a wildlife disease that requires a heightened response, when detected. Foot and Mouth Disease is an example of a livestock disease that would also require a heightened response from Michigan agencies.

Chronic Wasting Disease (CWD)

This is a prion disease of the brain. The infectious agent contaminates the environment and is transmitted from one animal to another. Hosts: Deer and elk are affected by this brain disease that is present in several western states and in Minnesota and Wisconsin. It was also detected in one Michigan location in 2008 (at an enclosed deer breeding facility in Kent County). Mule deer, white-tailed deer, and Rocky Mountain Elk are the only three species of the family Cervidae that are known to be naturally susceptible to CWD. However, it is very likely that other subspecies of *C. elaphus* are susceptible to the disease. Although no other deer in Michigan have tested positive for CWD (outside of the isolated Kent County case), it remains a major concern due to the large wild population of deer in the state.

Symptoms: Emaciation, wide stance, lowered head, droopy ears and excessive salivation.

Damage: Animal fatalities

Control/Treatment: Chronic wasting disease is both transmissible and infectious, but most details of its transmission remain to be determined. No treatment is available for animals affected with CWD. Once clinical signs develop, CWD is invariably fatal. Affected animals that develop pneumonia may respond temporarily to treatment with antibiotics, but ultimately the outcome is still fatal. Similarly, no vaccine is available to prevent CWD infection in deer or elk.

Foot and Mouth Disease

Hosts: This infectious virus spreads on surfaces and in the air, and impacts cattle, swine, sheep, goats, deer, and other cloven-hoof ruminant animals. It does not currently exist in Michigan or the United States and has not existed in the U.S. since 1929. However, the disease is of great concern because it is highly contagious and would have grave economic consequences for Michigan's livestock industry.

Symptoms: In cattle, blisters inside the mouth that lead to excessive secretion of stringy or foamy saliva and to drooling; and blisters on the feet that may rupture and cause lameness. Adult animals may suffer weight loss from which they do not recover for several months, as well as swelling in the testicles of mature males. In cows, milk production can decline significantly. **Damage:** Though most animals eventually recover from FMD, the disease can lead to myocarditis (inflammation of the heart muscle) and death, especially in newborn animals. Some infected animals do not suffer from or show signs of the disease, but they are carriers of FMD and can transmit it to others.

Control/Treatment: The Michigan Department of Agriculture and Rural Development (MDARD) licenses and regulates Michigan's 500 livestock dealers, truckers, livestock sales, and auction markets to help monitor animal health and ensure the safe and humane handling of animals. The MDARD also monitors and controls the interstate and intrastate shipment of animals and animal products, to eradicate and control the spread of disease. If this disease were discovered in the United States, it would trigger national and state response plans and require rapid and coordinated response in order to control the disease and protect the nation's livestock industry.



Two threatening animal diseases: Chronic wasting disease and foot and mouth disease.

Programs and Initiatives

Note: These listings highlight the breadth of existing programs and initiatives currently under way, but are not intended to be comprehensive.

Michigan Aquatic Nuisance Species (ANS) Program

In 1996, Michigan developed its first comprehensive ANS state management plan to provide guidance on actions for the prevention, control, and impact-management for ANS that have invaded, or may invade, Michigan waters. This state management plan was updated in 2002, and includes a summary of accomplishments, goals, and activities. The MDNR was awarded funding through the Great Lakes Restoration Initiative in 2010, to update and continue the implementation of the plan. A core team of

staff members and managers from the Fisheries, Wildlife, Water Resources, Recreation, and Law Enforcement Divisions (of the DNR and DEQ), as well as representatives from the Pesticide and Plant Pest Management Divisions (of the Department of Agriculture and Rural Development) and the Project Planning Division (of MDOT) are currently in the initial stages of updating the state management plan. The 2013 plan is accessible at <https://www.michigan.gov/deq/0,4561,7-135-3313-276823--,00.html>.

These efforts include the Asian Carp Control Strategy, which includes studies performed by the U.S. Army Corps of Engineers. The USACE Asian Carp Study stems from a nearly \$80-million initiative from the White House Council on Environmental Quality in 2007, involving a multi-pronged federal attack against Asian Carp. The Asian Carp study examines the possibility of permanently shutting down the Chicago waterway system that links Lake Michigan to the Mississippi River Basin and coordinating state efforts in response to the Asian carp threat. Although some actions may be taken before the study is completed, a final recommendation on how to stop the movement of the Asian Carp and other related species is expected to be made by 2013. However, the USACE has been accused of moving too slowly to prevent Asian carp and other exotic species from invading the Great Lakes. The USACE will release a short list of possible solutions in 2013 to quicken the process. The USACE will pick up the pace under a revised strategy in which it no longer will devise a single preferred method. Instead, the agency will put forward several options and leave it to congress and the public to decide.

Proposed Legislation to Prevention Asian Carp Invasion

Due to Asian Carp being detected beyond established barriers and less than six miles from direct access to the Great Lakes, a bill (The Permanent Prevention of Asian Carp Act) was created to direct the U.S. Army Corps of Engineers to study the watersheds of the Illinois, Chicago, and Calumet Rivers, and their tributaries, that drain directly into Lake Michigan, to determine the feasibility and best means of implementing the hydrologic separation of the Great Lakes and Mississippi River basins to prevent the introduction or establishment of populations of aquatic nuisance species along that pathway. In 2010, this bill was introduced in the U.S. House of Representatives (H.R. 5625) and the U.S. Senate, but it was merely referred to committee (and thus “died”). Numerous similar legislative efforts have suffered similar fates or otherwise not been acted upon, such as the Asian Carp Prevention Act of 2013. The latest congressional bill is H.R. 4001, the Defending Against Aquatic Invasive Species Act of 2014, which was rated as having a slightly higher chance of making progress than the earlier efforts.

The Sea Lamprey Control Program

Administered by the Great Lakes Fishery Commission, this program may be the best example of integrated pest management in North America. The program costs over \$20 million per year, but has been tremendously successful in protecting the multi-billion-dollar Great Lakes fishery for millions of persons who fish or are involved in a related sector of the economy. Sea lamprey control efforts have resulted in a 90% reduction in sea lamprey populations in most areas of the Great Lakes. <http://www.glfc.org/control.php>

National Strategy and Implementation Plan for Invasive Species Management

The National Strategy and Implementation Plan for Invasive Species Management was developed by a team of researchers and specialists. This plan is responsible for preparing the Forest Service to deal with the ecological and economic problems associated with the types of invasive species that affect the nation. The plan maps out a strategic direction for Forest Service programs, which include Research and Development, International Programs, State and Private Forestry, and the National Forest System.

Animal and Plant Health Inspection Service

The Animal and Plant Health Inspection Service (APHIS) is responsible for protecting and promoting U.S. agricultural health, administering the Animal Welfare Act, and carrying out wildlife damage management activities. The APHIS mission is an integral part of U.S. Department of Agriculture's (USDA) efforts to provide the nation with safe and affordable food. In recent years, the scope of APHIS' protection function has expanded beyond pest and disease management. Because of its technical expertise and leadership in assessing and regulating the risks associated with agricultural imports, APHIS has assumed a greater role in the global agricultural arena. Now, the agency must respond to other countries' animal and plant health import requirements and negotiate science-based standards to ensure that America's agricultural exports, worth over \$50 billion annually, are protected from unjustified trade restrictions. In response to needs expressed by the American people and Congress, APHIS' protection role also includes wildlife damage management, the welfare of animals, human health and safety, and ecosystems vulnerable to invasive pests and pathogens. In carrying out its diverse protection responsibilities, APHIS makes every effort to address the needs of all those involved in the U.S. agricultural sector.

The United States Geological Survey (USGS)

The U.S. Geological Survey plays an important role in federal efforts to combat invasive species in natural and seminatural areas. USGS services include the early detection and assessment of newly established invaders, the monitoring of invading populations, contributions to the understanding of the ecology of invaders and the understanding of factors involved in the resistance of habitats to invasion. The USGS is also involved in the development and testing of prevention, management, and control methods. USGS science centers conduct research relevant to invasive species in Michigan, and these are located at La Crosse, Wisconsin (the Upper Midwest Environmental Science Center), and Ann Arbor, Michigan (the Great Lakes Science Center). Each state in the U.S. is also home to a USGS Water Science Center, some of which conduct or support research relevant to invasive species in the Great Lakes.

The USGS maintains databases that may assist with the monitoring and reporting of invasive species occurrences, as well as provide information on their control. An example of these resources is the Nonindigenous Aquatic Species Database, at <http://nas.er.usgs.gov>. Sophisticated modeling capabilities, to predict the potential distribution of invasive species, are also available through the National Institute of Invasive Species Science in Fort Collins, Colorado.

NOAA Great Lakes Environmental Research Laboratory (GLERL)

This agency includes research on aquatic invasive species and focuses on the biological and ecological effects of these species in the Great Lakes, and on the prevention of new species introductions. GLERL houses the NOAA National Center for Research on Aquatic Invasive Species (NCRAIS), which helps to coordinate the agency's aquatic invasive species outreach efforts across the U.S.

Eastern Michigan University Detroit River International Wildlife Refuge Study

Researchers from Eastern Michigan University made an effort to study and help contain the spread of invasive species at the Detroit River International Wildlife Refuge, along 5,700 acres of the Detroit River and Lake Erie. In November 2010, EMU was awarded \$487,000 by a program that is part of the National Oceanic and Atmospheric Administration. The purpose is to expand upon work that had examined the spread of *Phragmites australis* (which impairs the refuge's economic and environmental viability), that had set up monitoring points, looked at efforts to control the reed, and also measured effects on water quality. The purple loosestrife and reed canary grass are among the invasive plant species that also might be studied. For the next phase of the project, researchers plan to use a combination of on-the-ground surveys, water quality analysis, and remote satellite detection of invasive species to study their spread. Locations will be mapped, and data will be presented in a new way that is designed to help refuge officials in making management decisions.

Michigan Invasive Plant Council

The Michigan Invasive Plant Council (MIPC) is a non-profit organization that spans a wide array of groups, including government agencies, commercial enterprises, conservation organizations, educational institutions, and the gardening public. MIPC is an affiliate organization of the Southeast Exotic Pest Plant Council, and its mission is to protect Michigan from the threat of invasive species. The council develops and publishes an invasive species list; facilitates the exchange of information concerning the management, control, and monitoring of invasive plants; provides a forum for all interested parties to discuss issues relating to invasive plants; serves as an educational, advisory, and technical support council for all aspects of invasive plants and related issues; and helps to prevent future introductions of new invasive plants.

Emerald Ash Borer (EAB) Awareness Week

EAB Awareness Week provides information on the steps that everyone can take to prevent the spread of EAB infestation, as well as fostering a cooperative spirit between citizens, communities, government, and industry to reduce the risk that the insect poses to the 700 million ash trees blanketing the state. During the week and throughout the year, the Michigan Department of Agriculture and Rural Development (MDARD) urges Michigan residents and visitors to learn about EAB, be on the look-out for and immediately report possible signs of infestation and adhere to policies regarding the transport of ash trees, materials, and all firewood. Each spring, many outreach, education and compliance activities are planned (or will be highlighted) to help increase awareness and understanding of the EAB. The EAB Awareness week is typically held during the last week in May.

Michigan Chronic Wasting Disease Task Force-Final Report

In 2003, Governor Granholm signed an executive order creating a task force to address the threat of Chronic Wasting Disease in Michigan's deer and elk populations. The task force includes five members appointed by the Governor, who serve as the voting members of the task force. The directors of the Department of Agriculture (now MDARD), Community Health, Natural Resources, Environmental Quality, State Police, and Transportation serve as non-voting members of the task force. In October of 2003, the task force presented its findings and recommendations in a report delivered to the Governor. Please see https://www.michigan.gov/dnr/0,4570,7-350-79136_79608_90516---,00.html.

Michigan Cooperative Suppression Program – Spongy Moth Infestations

The main goal of the Cooperative Suppression Program is to provide technical and funding assistance to county governments. This allows them the opportunity to provide protection from severe Spongy Moth populations. The objectives are 1) to reduce the risk of severe defoliation and 2) to reduce the nuisance created by large caterpillar numbers. A county, interested in participating in the Cooperative Suppression Program, enters into an agreement with MDARD to conduct the program. MDARD provides training, technical support and operational guidelines to the county. The training and guidelines are used to identify areas for treatment. The State of Michigan enters into a contract with an applicant for treatment of the qualified areas and the county is granted up to 50% cost-share for the cost of conducting the program.

Aquatic Invasive Species Awareness Week

In a continued effort to raise public awareness about the negative impacts caused by aquatic invasive species, the State of Michigan has established the Aquatic Invasive Species (AIS) Awareness Week, usually the second week in June. An aquatic invasive species is defined as a waterborne, non-native organism that threatens the diversity or abundance of native species, the ecological stability of impacted waters, or threatens a commercial, agricultural, aquacultural, or recreational activity. The AIS Awareness Week recognizes that Michigan's expansive shorelines and inland waters draw millions of tourists and recreational users each year, and that appropriate preventive steps must be taken to protect the state's water resources from invasive aquatic species. The AIS Awareness Week is sponsored by the MDEQ, working in collaboration with other state and federal agencies as well as private and nonprofit organizations.

Some Hazard Mitigation Alternatives for Invasive Species

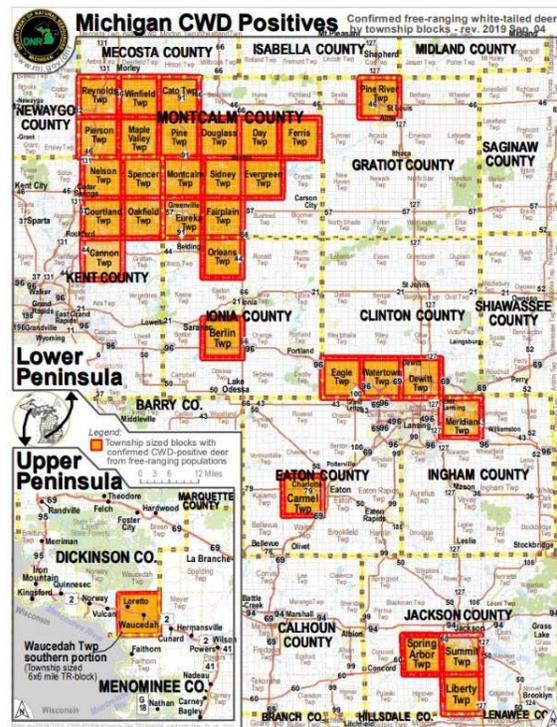
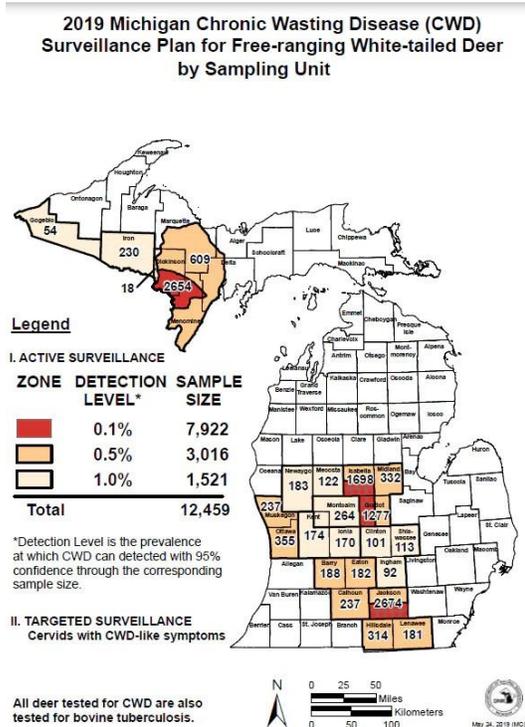
- Restrictions on the import and transport of species carriers.
- Adjustments to hunting, fishing, and other policies and regulations related to wildlife populations.
- Use of barriers to prevent invasive species travel.
- Use of competing species or other population control techniques.

Examples of Recent and Active Invasive Species Hazards within Muskegon County

Case: Chronic Wasting Disease 2020

In 2019 Michigan had 19 counties that have been placed into the CWD management area. Those counties included Barry, Calhoun, Clinton, Eaton, Gratiot, Hillsdale, Ingham, Ionia, Isabella, Jackson, Kent, Lenawee, Mecosta, Midland, Montcalm, Muskegon, Newaygo, Ottawa, and Shiawassee counties. Barry, Lenawee, and Midland counties were new additions.

The state Michigan defines an invasive species as species “not native whose



of a that is and

introduction causes harm, or is likely to cause harm to Michigan’s economy, environment, or human health.” Invasive plant species are a major threat to the habitat around Muskegon Lake, and their impacts are wide-ranging.

The Muskegon Conservation District was formed in 1938 and provides technical assistance to public and private landowners for forestry management, fish and wildlife, stormwater protection, native landscaping, and stream bank restoration. According to the Muskegon Conservation District species of concern include:

- Phragmites
- Narrowleaf & Hybrid Cattail
- Japanese Knotweed
- Oriental Bittersweet
- Japanese Honeysuckle
- Spotted Knapweed
- Black Locust
- Garlic Mustard

- Autumn Olive
- Tree of Heaven
- Purple Loosestrife

For More information about the Muskegon Conservation District: <https://muskegoncd.org/about-us/>
While phragmites australis is native to Michigan, an invasive non-native, European variety of phragmites is becoming widespread and is threatening the ecological health of wetlands and the Great Lakes coastal shoreline.

It has been estimated that more than 209 invasive species have been either intentionally or accidentally introduced to the Great Lakes basin. Invasive species have negative ecological, economic, social, and public health impacts. They have been widely identified as a serious threat to global and local biodiversity. Once established, they often out-compete native species for limited resources such as food and habitat, alter and damage existing habitat, and displace native species. The displacement of native populations by invasive species alter food webs, nutrient dynamics, and natural processes of native and local fauna and flora. It has been recognized that invasive species are a significant factor in the decline of over 47% of the federally listed endangered species. Their impacts are found in our waterways, along our roadsides, in our wilderness areas and in both rural and urban communities. The cost to control invasive species and the damages they inflict upon public and private property and natural resources in the U.S. has been estimated between \$137 to \$210 billion annually. The Muskegon Conservation District recognizes these threats and is working to limit the spread of existing invasions and limit their associated impacts. <https://muskegoncd.org/projects-programs/exotic-invasive-species/>

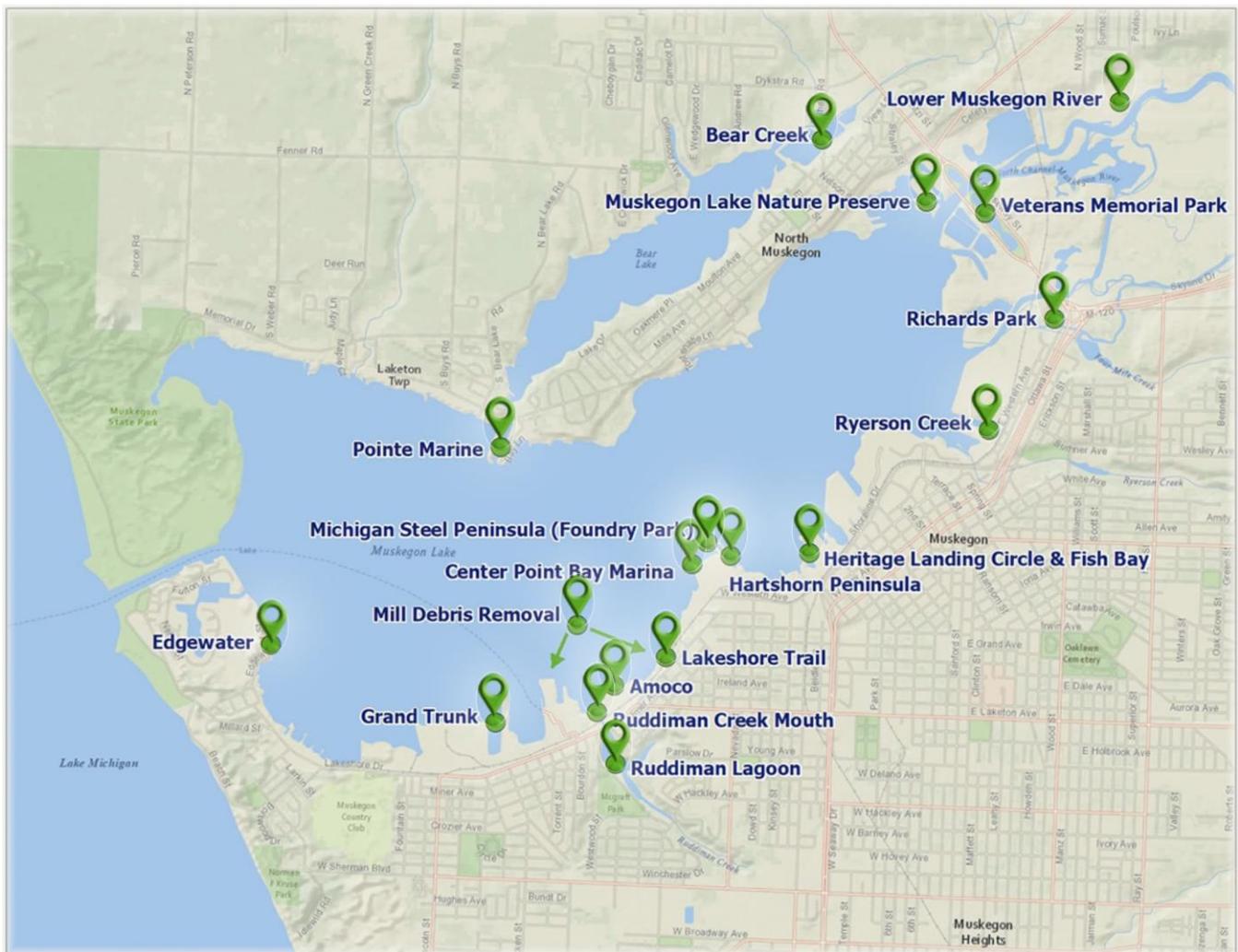
Muskegon Lake

Muskegon Lake is a 4,149 acre inland coastal lake located on the west shoreline of Michigan's lower peninsula and connected to Lake Michigan by a deep-draft navigation channel. Since the late 1800s when Muskegon Lake was a center of the lumber era, several other industries were based there including chemical and petrochemical companies, foundries, a coal-fired power plant, and a paper mill. Muskegon Lake has suffered water quality concerns and habitat degradation from extensive shoreline filling and sediment contamination from compounds such as mercury and polycyclic aromatic hydrocarbons. Multiple NOAA offices join an already active community of partners working on these issues in Muskegon Lake. NOAA's National Ocean Service, NOAA Fisheries, and the Great Lakes Environmental Research Laboratory have implemented numerous projects that are already yielding measurable results. This work, to date, has achieved more than 40 percent of the fish and wildlife habitat restoration targets for Muskegon Lake as identified by the community. Over 20 individual sites have been restored in the immediate Muskegon Lake watershed. Restoration has included the removal of contaminated sediments, historic foundry fill and concrete, and slab wood from lumber operations. This historical fill has been replaced with clean topsoil and thousands of native trees, shrubs, grasses, and wildflowers. Various habitat structures have been installed, including large woody debris, osprey nesting platforms, and birdhouses. State, federal, and local partners have worked together to restore these sites. Restoration has

occurred on both public and private property. Since 2006...

- 24,073 linear feet of restored shoreline
- 89 acres of emergent wetland restored
- 70 acres of open water wetlands restored
- 24 acres of upland buffer restored

<https://www.glc.org/wp-content/uploads/Habitat-NOAA-MuskegonAOC-Factsheet-2015.pdf>



Restored sites in Muskegon <https://muskegoncd.org/>

Hazards Evaluation Methodology

Although the MSP-EMD Pub201A Hazard Analysis Guidance Tool was utilized and followed as closely as possible, the following adjustments were necessary in order to make this document easy to utilize in the local emergency planning process utilized by Muskegon County Emergency Services.

Hazard Classification

Local planning considerations have resulted in Muskegon County's existing hazards being organized into major hazard classes. This method allows for focused evaluation and management of 13 hazard considerations while actually addressing 35 hazards identified in the MSP-EMD Pub 103 Michigan Hazard Analysis. This method has allowed for an effective planning approach for a variety of reasons.

First, the Muskegon County Emergency Operations Plan is an all-hazard document dependent on implementation of emergency functions, not related to specific hazard response. In example, many flood hazards require similar planning, response, and mitigation measures despite their specific type. Second, Muskegon County is a moderately sized jurisdiction with its population and resources concentrated in villages and cities, creating a need to generalize hazards. Concentrating on the primary local considerations for the entire hazard class allows for a more efficient planning process than otherwise analyzing each of the individual hazards.

The following relates Muskegon County's Hazard Classes to the Michigan Hazard Analysis 2019 Document.

| Muskegon County Hazard | Michigan Hazard Analysis | |
|--|--|--|
| Natural Hazards: Weather Hazards | | |
| Thunderstorm | <ul style="list-style-type: none"> • Thunderstorm • Lightning | <ul style="list-style-type: none"> • Hail |
| Tornados | <ul style="list-style-type: none"> • Tornadoes | <ul style="list-style-type: none"> • Severe Winds |
| Severe Winter Weather | <ul style="list-style-type: none"> • Snowstorms • Extreme Cold | <ul style="list-style-type: none"> • Ice and Sleet Storms • |
| Natural Hazards: Hydrologic Hazards | | |
| Flooding | <ul style="list-style-type: none"> • Riverine Flooding • Great Lakes Shoreline | <ul style="list-style-type: none"> • Urban Flooding • Dam and Levee Failures |
| Drought | <ul style="list-style-type: none"> • Drought | <ul style="list-style-type: none"> • Extreme Heat |

| Muskegon County Hazard | Michigan Hazard Analysis | |
|---|--|--|
| Natural Hazards: Ecological Hazards | | |
| Wildfires | <ul style="list-style-type: none"> • Wildfires | |
| Invasive Species | <ul style="list-style-type: none"> • Invasive Species (aquatic and terrestrial) | |
| Natural Hazards: Geologic Hazards | | |
| Geologic Hazards | <ul style="list-style-type: none"> • Impacting Object • Space Weather | |
| Technological Hazards: Industrial Hazards | | |
| Fires | <ul style="list-style-type: none"> • Structural Fires • Industrial Fires | |
| Hazardous Materials | <ul style="list-style-type: none"> • Fixed Site (Industrial Accidents) • Nuclear Power Plant Emergencies • Transportation • Petroleum and Natural Gas Pipeline Accidents • Oil and Natural Gas Well Accidents | |
| Technological Hazards: Infrastructure Problems | | |
| Infrastructure Failure | <ul style="list-style-type: none"> • Infrastructure Failures • Energy Emergencies | |
| Transportation | <ul style="list-style-type: none"> • Major Transportation Accidents (air, rail, highway, marine) | |
| Human Related Hazards | | |
| Public Health | <ul style="list-style-type: none"> • Public Health Emergencies | |
| Criminal Incidents | <ul style="list-style-type: none"> • Civil Disturbances • Terrorism & similar activities • Cyber-attack • Nuclear Attack | |

Hazard / Emergency Level Evaluations

All hazards were evaluated according to their emergency effect on the local jurisdiction. This has been defined as an emergency or disaster condition requiring significant level of coordination among local government, public, and private entities. This would be further defined locally as a Muskegon County Emergency Services "Alert" condition.

An example that demonstrates the difference between the local effect and standard state definition is best represented in the area of transportation accidents and mass casualty incidents. Although Muskegon County rarely gets large airplane or bus accidents, frequently all EMS units and hospital capacity are dedicated to a single incident due to only having a maximum of 5 available ambulances housed between 4 different EMS services and 8 emergency care beds. As such, although the jurisdiction doesn't frequently experience any large bus, airplane, or railway accidents, it frequently experiences small incidents that involve a 75%-100% capability response.

Multi-jurisdictional and Single Jurisdictional Hazard Evaluations

Based on the affected area, all hazards were broken down into two categories, Multi-jurisdictional or single jurisdictional. Multi-jurisdictional hazards impact a large area and are wide spread. These hazards were only ranked on Muskegon County's Hazard Analysis. These hazards include:

- Thunderstorm
- Tornado
- Severe Winter Weather
- Public Health
- Drought
- Geologic

Single jurisdictional hazards impact a small area and are isolated or are increased on geography of jurisdiction. These hazards are ranked on the Muskegon County's Hazard Analysis and the individual local jurisdiction's hazard analysis. These hazards include:

- Infrastructure Failure
- Flooding
- Hazardous Materials
- Fires
- Wildfires
- Transportation
- Criminal

Evaluation Benchmarks

Once again, although MSP-EMHSD Pub201A was followed as closely as possible, several benchmarks had to be modified to accurately reflect their contribution to hazard ranking. Most noticeably, Population Impact, Economic Effects, and Collateral Damage were evaluated on their relation value (High, Medium, Low, None).

Evaluation Benchmark Weighting For Hazard Ranking

The benchmarks are also weighted according to their effect to local response efforts. A percentage is given to each benchmark to calculate the value of response organizations capability to handle the response locally or if the hazard will tax local response systems and require the need for mutual aide.

Hazard Ranking

As each hazard is unique in its dynamics, any of the listed hazards can be equally devastating in its occurrence. As such, the hazard rankings are listed for planning purposes only. They are in no way a scientific result demonstrating that one hazard should be focused on more than any other. Instead, it is important for the jurisdiction to focus on the most potentially hazardous aspects of the hazard itself. In example, tornadoes occur with minimal warning time but strike a small area. Flooding occurs with a slower time of onset yet affects a

larger area. As such, local efforts should be focused on improving tornado warning systems and flooding mitigation measures and implemented appropriately.

Advanced Hazards Profile and Evaluation

Evaluation Measures and Benchmark Factors for each Measure

This model uses a common set of 10 evaluation measures and 44 corresponding benchmark factors to evaluate each hazard facing the community. Those measures are:

- 1) Historical occurrence
- 2) Affected area
- 3) Speed of onset
- 4) Population impact (casualties)
- 5) Economic effects
- 6) Duration
- 7) Seasonal pattern
- 8) Predictability
- 9) Collateral damage potential
- 10) Availability of warnings.

Each corresponding benchmark factor has been assigned a specific point value (10, 7, 4 or 1 point), based on each individual factor's relative severity and negative impacts. Following is a synopsis of each hazard evaluation measure and benchmark factor used in this analysis:

(Note: The Michigan Hazard Analysis, EMD Pub. 103, serves as the baseline for information, supplemented by locally-obtained information.)

Historical Occurrence

Historical occurrence measures the frequency with which a particular hazard occurs in Michigan communities. The more frequently a hazard event occurs, the more potential there is for damage and negative impact on a community. The specific benchmark factors used in the historical occurrence analysis are:

Excessive Occurrence, indicating the hazard event is likely to occur 4 or more times in one year;

High Occurrence, indicating the hazard event is likely to occur 2-3 times per year;

Medium Occurrence, indicating the hazard event is likely to occur 1 time per year;

Low Occurrence, indicating the hazard event occurs less than 1 time per year (i.e., once every 4 years).

Weighted Value is 20%

Benchmark factor point values are:

| 1 pt Low <1 event / yr | 4 pts Medium 1 event / yr | 7 pts High 2-3 events / yr | 10 pts Excessive 4+ events / yr |
|------------------------------|---------------------------------|----------------------------------|---------------------------------------|
|------------------------------|---------------------------------|----------------------------------|---------------------------------------|

Affected Area

Each hazard affects a geographic area. For example, a blizzard might affect an entire state or even several states, while a flood might only affect a portion of a county or municipality. Although size of the affected area is not always indicative of the destructive potential of the hazard (a tornado is a good example), generally the larger the affected area, the more problematic the hazard event is on a community. The specific benchmark factors used in the affected area analysis are:

Large Area, if a hazard event has the potential to impact 3 more townships in a county, or 1/2 of a municipality;

Small Area, if the hazard event could impact 1 or 2 townships in a county, or 1/4 of a municipality;

Multiple Sites, if the hazard event could impact more than 1 village, city, or other sites within 1 township, or more than 1 neighborhood or other site within a municipality;

Single Site, if the hazard event is likely to only impact only 1 village, city or other site within a county, or 1 neighborhood or other site within a municipality.

Weighted Value is 20%

Benchmark factor values are:

| 1 pt Single Site | 4 pts Multiple Sites | 7 pts Small Area | 10 pts Large Area |
|---------------------|-------------------------|---------------------|----------------------|
|---------------------|-------------------------|---------------------|----------------------|

Speed of Onset

Speed of onset refers to the amount of time it typically takes for a hazard event to occur. Speed of onset is an important evaluation measure because the faster an event occurs, the less time local governmental agencies typically have to warn the potentially impacted population of appropriate protective actions. The specific benchmark factors used in the speed of onset analysis are:

Minimal or No Warning, indicating that the hazard event could occur without any advance notice or warning;

Less than 12 Hours, indicating the hazard event generally allows less than 12 hours advance notice before occurring;

12-24 Hours, indicating the hazard event generally allows 12-24 hours advance notice before occurring;

Greater than 24 Hours, indicating the hazard event generally allows more than 24 hours advance notice before occurrence.

Weighted value is 10%

Specific benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|------|-------|-------|--------|
|------|-------|-------|--------|

> 24 Hours

12 – 24 Hours

< 12 Hours

Minimal / None

Casualty Effects

Casualty Effects refers to the number of casualties (deaths and injuries) that can be expected if a particular hazard event occurs. Specific benchmark factors used in the population impact analysis are:

High Impact, indicating 10 or more casualties can be expected;

Medium Impact, indicating 6-10 casualties can be expected;

Low Impact, indicating 1-5 casualties can be expected;

No Impact (none), indicating that no casualties can be expected.

Weighted Value is 10%

Specific benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|---------------|------------------|-------------------|----------------|
| None | Low | Medium | High |
| No Casualties | 1 – 5 Casualties | 6 – 10 Casualties | 10+ Casualties |

Economic Effects

Economic effects are the monetary damages incurred from a hazard event, and include both public and private damage. Direct physical damage costs, as well as indirect impact costs such as lost business and tax revenue, are included as part of the total monetary damages. Specific benchmark factors used in the economic effects impact analysis are:

Significant Effects, indicating over \$100,000 in monetary damages incurred;

Medium Effects, indicating \$50,001-\$100,000 in monetary damages incurred;

Low Effects, indicating \$10,000-\$50,000 in monetary damages incurred;

Minimal Effects, indicating less than \$10,000 in monetary damages incurred.

Weighted value is 10%

Specific benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|-----------|---------------------|----------------------|------------|
| Minimal | Low | Medium | High |
| <\$10,000 | \$10,000 - \$50,000 | \$50,000 - \$100,000 | >\$100,000 |

Note: An alternative to this economic effects measure would be in a relational potential.

Duration

Duration refers to the time period the hazard event is actively present and causing damage (often referred to as the “time on the ground”.) Duration is not always indicative of the damaging potential of a hazard event (a tornado is a good example). However, in most cases, the longer an event is “active” and thus causing damage, the greater the total damages will be. Specific benchmark factors used in the duration analysis are:

Long Duration, indicating the hazard event is likely to last longer than 1 week;

Medium Duration, indicating the hazard event is likely to last from 1 day to 1 week;

Short Duration, indicating the hazard event is likely to last from 12-24 hours;

Minimal Duration, indicating the hazard event is likely to last less than 12 hours.

Weighted value is 5%

Specific benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|-----------|---------------|----------------|----------|
| Minimal | Short | Medium | Long |
| <12 Hours | 12 – 24 Hours | 1 Day – 1 Week | > 1 Week |

Seasonal Pattern

Seasonal pattern refers to the time of year in which a particular hazard event can reasonably be expected to occur. Some hazard events can occur at any time of the year, while others occur primarily during one particular season (i.e., blizzards in winter). Oftentimes, hazard patterns coincide with peak tourism seasons and other times of temporary population increases, greatly increasing the vulnerability of the population to the negative impacts of certain hazard events. The specific benchmark factors used in the seasonal pattern analysis are:

Year-round Occurrences, indicating the hazard event can occur at any time of the year;

Three Season Occurrences, indicating the hazard event can realistically occur during 3 seasons of the year;

Two Season Occurrences, indicating the hazard event can realistically occur during 2 seasons of the year;

One Season Occurrences, indicating the hazard event realistically occurs during only 1 season of the year.

Weighted value is 5%

Benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|----------|-----------|-----------|------------|
| 1 Season | 2 Seasons | 3 Seasons | Year Round |

Predictability

Predictability refers to the ease with which a particular hazard event can be predicted - in terms of time of occurrence, location, and magnitude. Predictability is important because the more predictable a hazard event is, the more likely it is a community will be able to warn the potentially impacted population and take other preventive measures to minimize loss of life and property. The specific benchmark factors used in the predictability analysis are:

Unpredictable, indicating the hazard is extremely difficult, if not impossible, to predict in terms of time of occurrence, location and magnitude;

Somewhat Predictable, indicating the time of occurrence, location and magnitude of the hazard can be predicted at less than 50% accuracy;

Fairly Predictable, indicating the time of occurrence, location and magnitude of the hazard can be predicted at 50% or greater accuracy;

Highly Predictable, indicating the time of occurrence, location and magnitude of the hazard is predictable virtually 100% of the time.

Weighted value is 5%

Benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|---------------------------|---------------------------|-----------------------------|-------------------------------|
| Highly Predictable | Fairly Predictable | Somewhat Predictable | Unpredictable |
| 100% Accuracy | 50% Accuracy | <50% Accuracy | Difficult / Impossible |

Collateral Damage

Collateral damage refers to the possibility of a particular hazard event causing secondary damage and impacts. For example, blizzards and ice storms can cause power outages, which can cause loss of heat, which can lead to hypothermia and possible death or serious injury. Generally, the more collateral damage a hazard event causes, the more serious a threat the hazard is to a community. The specific benchmark factors used in the collateral damage analysis are:

High Possibility, indicating there is a great likelihood (76% or greater chance) that a particular hazard event will cause secondary hazard events and damage;

Good Possibility, indicating there is a higher than average likelihood (50-75% chance) that a particular hazard event will cause secondary hazard events and damage;

Some Possibility, indicating there is a less than average likelihood (less than 50% chance) that a particular hazard event will cause secondary hazard events and damage;

No Possibility, indicating there is virtually no likelihood (0% chance) that a particular hazard event will cause secondary hazard events and damage.

Weighted value is 10%

Benchmark factor point values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|-----------------------|-------------------------|-------------------------|-------------------------|
| No Possibility | Some Possibility | Good Possibility | High Possibility |
| 0% Chance | <50% Chance | 50% - 75% Chance | >76% Chance |

Availability of Warnings

Availability of warnings indicates the ease with which the public can be warned of a hazard. This measure does not address the availability of warning systems in a community, per se. Rather, it looks at the overall availability of warning in general for a particular hazard event. For example, a community might receive warning that a flood will occur within 24 hours, but receive no warning when a large structural fire occurs. Generally, hazards that have little or no availability of warning tend to be more problematic for a community from a population protection and response standpoint. The specific benchmark factors used in the availability of warnings analysis are:

Warnings Available, indicating that the nature of the hazard is such that warning of the hazard event is always available (100% of the time) and received in a timely manner;

Warnings Sometimes Available, indicating that the nature of the hazard is such that warning of the hazard event is available most of the time (50-99% of the time) and received in a timely manner;

Warnings Generally Not Available, indicating that the nature of the hazard is such that warning of the hazard event is generally not available much of the time (>50% of the time) and generally not received in a timely manner;

Warnings Unavailable, indicating that the nature of the hazard is such that warning of the hazard event is not available (0% of the time).

Weighted value is 5%

Benchmark factor values are:

| 1 pt | 4 pts | 7 pts | 10 pts |
|---------------------|--------------------------|------------------------|--------------------|
| Available | Sometimes | Generally Not | Unavailable |
| 100% of time | 50% – 99% of time | <50% of time | 0% of time |

EVALUATION MEASURES AND BENCHMARK FACTORS SUMMARY

Historical Occurrence

| | |
|----------------------|--------|
| Excessive Occurrence | 10 pts |
| High Occurrence | 7 pts |
| Medium Occurrence | 4 pts |
| Low Occurrence | 1 pt |

Speed of Onset

| | |
|-----------------------|--------|
| Minimal/No Warning | 10 pts |
| Less than 12 Hours | 7 pts |
| 12 – 24 Hours | 4 pts |
| Greater than 24 Hours | 1 pt |

Economic Effects

| | |
|---------------------|--------|
| Significant Effects | 10 pts |
| Medium Effects | 7 pts |
| Low Effects | 4 pts |
| Minimal Effects | 1 pt |

Seasonal Pattern

| | |
|--------------------------|--------|
| Year Round Occurrences | 10 pts |
| Three Season Occurrences | 7 pts |
| Two Season Occurrences | 4 pts |
| One Season Occurrence | 1 pt |

Collateral Damage

| | |
|------------------|--------|
| High Possibility | 10 pts |
| Good Possibility | 7 pts |
| Some Possibility | 4 pts |
| No Possibility | 1 pt |

Affected Area

| | |
|----------------|--------|
| Large Area | 10 pts |
| Small Area | 7 pts |
| Multiple Sites | 4 pts |
| Single Site | 1 pt |

Casualty Impact

| | |
|---------------|--------|
| High Impact | 10 pts |
| Medium Impact | 7 pts |
| Low Impact | 4 pts |
| No Impact | 1 pt |

Duration

| | |
|------------------|--------|
| Long Duration | 10 pts |
| Medium Duration | 7 pts |
| Short Duration | 4 pts |
| Minimal Duration | 1 pt |

Predictability

| | |
|----------------------|--------|
| Unpredictable | 10 pts |
| Somewhat Predictable | 7 pts |
| Predictable | 4 pts |
| Highly Predictable | 1 pt |

Availability Of Warnings

| | |
|-------------------------|--------|
| Warnings Unavailable | 10 pts |
| Generally Not Available | 7 pts |
| Somewhat Available | 4 pts |
| Warnings Available | 1 pt |

The following table reveals the results of the quantitative evaluation of the Muskegon County hazards evaluation conducted for the 2023 edition of this plan. Similar evaluations were also conducted for municipal jurisdictions in the county, and can be found in the Hazards Profile and Evaluations Appendix.

Hazards Profile and Evaluation – County of Muskegon, Michigan

| Evaluation Criteria | Infrastructure Failure | Flooding / Dam Failure | Wildfires | Thunderstorm | Criminal | Public Health | Severe Winter Weather | Fires | Hazardous Materials | Transport | Geologic Hazards | Tornado | Drought |
|--------------------------|---|---|---|---|---|--|---|--|---|--|--|---|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pt x 20%= 0.8 | High 2 - 3 events/yr 7 pts x 20%= 1.4 | Excessive 4+ events/yr 10 pts x20% = 2.0 | Excessive 4+ events/yr 10 pts x20% = 2.0 | Medium 1 event/yr 4 pt x 20%= 0.8 | Excessive 4+ events/yr 10 pts x20% = 2.0 | Low >1 event/yr 1 pt x20%= 0.2 | Low >1 event/yr 1 pt x 20%= 0.2 | Low >1 event/yr 1 pt x20%= 0.2 |
| Affected Area | Large Area >3 Juris. 10 pts x 20% = 2.0 | Large Area >3 Juris. 10 pts x 20% = 2.0 | Small Area 2-3 Juris. 7 pts x 20%= 1.4 | Large Area >3 Juris. 10 pts x 20% = 2.0 | Large Area >3 Juris. 10 pts x 20% = 2.0 | Large Area >3 Juris. 10 pts x20% = 2.0 | Large Area >3 Juris. 10 pts x20% = 2.0 | Single Site <1 City 1 pt x 20%= 0.2 | Multiple Sites > 1 Neighbor.. 4 pts x 20%= 0.80 | Single Site <1 City 1 pt x 20%= 0.2 | Large Area >3 Juris. 10 pts x20% = 2.0 | Multiple Sites > 1 Neighbor.. 4 pts x 20%= 0.80 | Large Area >3 Juris. 10 pts x20% = 2.0 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Some <12 Hours 7 pts x 10% = 0.7 | Some <12 Hours 7 pts x 10% = 0.7 | High >24 Hours 1 pt x 10% = 0.1 | High >24 Hours 1 pt x 10% = 0.1 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Some <12 Hours 7 pts x 10% = 0.7 | Minimal No Warning 10 pts x10% = 1.0 | High >24 Hours 1 pt x10% = 0.1 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | High Impact >10 injured 10 pts x10% = 1.0 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | High Impact >10 injured 10 pts x10% = 1.0 | High Impact >10 injured 10 pts x10% = 1.0 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Medium <10 injured 7 pts x10%= 0.7 | Medium <10 injured 7 pts x10%= 0.7 | None No casualties 1 pt x 10% = 0.10 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| conomic Effects | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Low \$10k - \$50k 4 pts x 10% = 0.4 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Long > 1 Week 10 pts x5%= 0.5 | Long > 1 Week 10 pts x5%= 0.5 | Minimal <12 Hours 1 pt x 5%= 0.05 | Medium <1 Week 7 pts x5%= 0.35 | Long > 1 Week 10 pts x5%= 0.5 | Medium <1 Week 7 pts x5%= 0.35 | Short <24 Hours 4 pts x 5%= 0.2 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= 0.05 | Minimal <12 Hours 1 pt x 5%= 0.05 | Minimal <12 Hours 1 pt x 5%= 0.05 | Long > 1 Week 10 pts x5%= 0.5 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.20 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat Predictable 7 pts x 5% = 0.35 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.20 |
| Collateral Damage | Some Poss. <50% 4 pts x 10%= 0.4 | High Poss. >75% 10 pts x10%= 1.0 | Good <75% 7 pts x10%= 0.70 | High Poss. >75% 10 pts x10%= 1.0 | Good <75% 7 pts x10%= 0.70 | High Poss. >75% 10 pts x10%= 1.0 | High Poss. >75% 10 pts x10%= 1.0 | Some Poss. <50% 4 pts x 10%= 0.4 | Some Poss. <50% 4 pts x 10%= 0.4 | Some Poss. <50% 4 pts x 10%= 0.40 | High Poss. >75% 10 pts x10%= 1.0 | High Poss. >75% 10 pts x10%= 1.0 | Good <75% 7 pts x10%= 0.70 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Generally Not <50% 7 pts x5%= 0.35 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Available 100% 1 pt x 5%= 0.05 | Available 100% 1 pt x 5%= 0.05 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Generally Not <50% 7 pts x5%= 0.35 | Available 100% 1 pt x 5%= 0.05 |
| Hazard Score | 8.65 | 8.20 | 8.20 | 8.05 | 8.05 | 7.75 | 7.45 | 6.70 | 6.55 | 6.25 | 6.25 | 5.65 | 5.65 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |

It should be noted that the hazard rankings resulting from this evaluation are different from the rankings within the previous editions of this plan due to the grouping of Hazards. In 2014 and in 2006, Winter Storms and Severe Winds remained the top 1 and 2 hazards in Muskegon County. This was replaced by Public Health and Infrastructure Failure in 2023. This was a direct result of the Worldwide pandemic that took place in 2020 and the increased failures across multiple sectors as a result of aging infrastructure. Other significant changes also include the promotion of Criminal #3 (previously #23) and Transportation Accidents #5 (previously #21) and the demotion of Severe Winter Weather #8 (previously #1).

| 2023 Rank | Hazard | 2014 Rank | Change |
|-----------|------------------------|-----------|--------|
| 1 | Public Health | 12 | ▲ 11 |
| 2 | Infrastructure Failure | 3 | ▲ 1 |
| 3 | Criminal | 23 | ▲ 20 |
| 4 | Thunderstorms | 2 | ▼ 2 |
| 5 | Transport | 21 | ▲ 16 |
| 6 | Fires | 3 | ▼ 3 |
| 7 | Hazardous Materials | 11 | ▲ 3 |
| 8 | Severe Winter Weather | 1 | ▼ 7 |
| 9 | Flooding / Dam Failure | 5 | ▼ 4 |
| 10 | Tornado | 12 | ▲ 2 |
| 11 | Wildfires | 7 | ▼ 4 |
| 12 | Drought | 7 | ▼ 5 |
| 13 | Geologic Hazards | 25 | ▲ 12 |

| 2014 Rank | Hazard | 2006 Rank | Change |
|------------|-----------------------------------|------------|---------------|
| 1 | Winter Storms | 1 | - no change - |
| 2 | Severe Winds | 2 | - no change - |
| 3 | Fire – Structural | t3 | - no change - |
| 3 | Infrastructure Failures | 5 | ▲ 2 |
| 5 | Extreme Temperatures | t3 | ▼ 2 |
| 5 | Flooding: Riverine/Urban | 10 | ▲ 5 |
| 7 | Drought | 8 | ▲ 1 |
| 7 | Great Lakes Shoreline | 17 | ▲ 10 |
| 7 | Lightning | 11 | ▲ 4 |
| 7 | Wildfire | 7 | - no change - |
| 11 | HAZMAT – Fixed Site | 6 | ▼ 5 |
| 12 | Catastrophic Incidents | - | new hazard |
| 12 | Dam Failure | 9 | ▼ 3 |
| 12 | Hail | 13 | ▲ 1 |
| 12 | HAZMAT – Transportation | 14 | ▲ 2 |
| 12 | Pipeline Accidents | 16 | ▲ 4 |
| 12 | Public Health Emergencies | 12 | - no change - |
| 12 | Tornadoes | 18 | ▲ 6 |
| 19 | Energy Emergencies | - | new hazard |
| 20 | Fog | - | new hazard |
| 21 | Invasive Species | - | new hazard |
| 21 | Transportation Accidents | 15 | ▼ 6 |
| 23 | Civil Disturbances | 20 | ▼ 3 |
| 23 | Oil/Natural Gas Well Accidents | 19 | ▼ 4 |
| 25 | Celestial Impacts | - | new hazard |
| 26 | Fire – Scrap Tires | not ranked | - |
| 26 | Subsidence | 21 | ▼ 5 |
| 26 | Terrorism & Similar Criminal Acts | not ranked | - |
| not ranked | Earthquake | not ranked | - |
| not ranked | Nuclear Attack | not ranked | - |
| not ranked | Nuclear Power Emergencies | not ranked | - |

Hazards Profile and Evaluation – County of Muskegon, Michigan

| Evaluation Criteria | Public Health | Infrastructure Failure | Criminal | Thunderstorm | Transport / MCI | Fires | Hazardous Materials | Severe Winter Weather | Flooding / Dam Failure | Tornado | Wildfires | Drought |
|--------------------------|---|---|--|---|---|---|---|---|--|---|---|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | High 2-3 events/yr 7 pts x 20%= 1.4 | Low >1 event/yr 1 pt x 20%= 0.2 | High 2-3 events/yr 7 pts x 20%= 1.4 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Large Area >3 Juris. 10 pts x20% = 2.0 | Large Area >3 Juris. 10 pts x 20% = 2.0 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Large Area >3 Juris. 10 pts x 20% = 2.0 | Single Site <1 City 1 pt x 20%= 0.2 | Single Site <1 City 1 pt x 20%= 0.2 | Single Site <1 City 1 pt x 20%= 0.2 | Large Area >3 Juris. 10 pts x20% = 2.0 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Small Area 2-3 Juris. 7 pts x 20%= 1.4 | Single Site <1 City 1 pt x 20%= 0.2 | Large Area >3 Juris. 10 pts x20% = 2.0 |
| Speed of Onset | High >24 Hours 1 pt x 10% = 0.1 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Low <12 Hours 7 pts x 10% = 0.7 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | High >24 Hours 1 pt x 10% = 0.1 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | High >24 Hours 1 pt x10% = 0.1 |
| Casualty Effects | High Impact >10 injured 10 pts x10% = 1.0 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | High >\$100k 10 pts x10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | High >\$100k 10 pts x10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Long > 1 Week 10 pts x5%= 0.5 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Long > 1 Week 10 pts x5%= 0.5 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¼ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¼ Year 1 Season 1 pt x 5%= .05 | ¼ Year 3 Seasons 7 pts x5%= 0.35 | ¼ Year 3 Seasons 7 pts x5%= 0.35 | ¼ Year 3 Seasons 7 pts x5%= 0.35 | ¼ Year 3 Seasons 7 pts x5%= 0.35 |
| Predictability | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= 0.35 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Somewhat <50% Accuracy 7 pts x5%= 0.35 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 |
| Collateral Damage | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | High Poss. >75% 10 pts x5%= 0.5 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 |
| Availability of Warnings | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Available 100% 1 pt x 5%= .05 | Generally Not <50% 7 pts x5%= 0.35 | Generally Not <50% 7 pts x5%= 0.35 | Generally Not <50% 7 pts x5%= 0.35 | Most of the time >75% 4 pts x 5%= 0.2 |
| Hazard Score | 7.85 | 7.55 | 7.55 | 6.95 | 6.95 | 6.35 | 6.35 | 5.9 | 5.6 | 5.6 | 5.15 | 5.15 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

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. Raising citizen awareness can also help gain support for ongoing mitigation planning efforts.

The following goals and objectives were established for hazard mitigation efforts in Muskegon County in the inaugural edition of the Muskegon County Hazard Mitigation Plan (approved by FEMA in 2006). They were based the county’s hazard analyses and input from LEPC members, government officials, government departments, planning and zoning officials, emergency responders, schools, correctional facilities, the public, and other interested entities.

For the 2023 updated edition of this plan, the inherited goals and objectives were reviewed by the Muskegon County Local Emergency Planning Committee Meeting. It was determined that the goals and objectives remain valid, as therefore no significant changes or additions were proposed during this review. The two foremost factors contributing to this conclusion were that: 1) conditions within the county have remained generally the same since the previous edition of this plan; and 2) the results of the hazards evaluation were comparable to the previous hazards evaluation.

The overall goal of hazard mitigation is to 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 other 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 protect existing buildings and facilities from hazards.

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 the identified goals and objectives to succeed, they must be integrated into and compatible with other community goals. They must also be divided into attainable components, or actions, which can be prioritized so local officials can better focus their attention on developing alternatives.

The following sections guide and encourage concrete actions to be taken and contain alternatives which can be utilized by the county to accomplish hazard mitigation. In addition, the following sections explain how action items are selected from these alternatives and list the action items.

HAZARD MITIGATION ALTERNATIVES

The identification of risks and vulnerabilities, paired with established goals and objectives, should lead planners directly to consider 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 action that will definitely be implemented. Rather, it 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. Alternatives for mitigating hazards can be organized into the following basic strategies:

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. | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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.

Updates conducted on this section in 2023 included review and revision of mitigation alternative descriptions, including how alternatives are being utilized within Muskegon County (the capabilities of the community). Other updates included a revised description of basic mitigation strategies (see table on previous page), and the inclusion of common mitigation funding sources. Appropriate information from the Michigan Hazard Mitigation Plan (MSP/EMHSD Publication 106) was included as well.

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 Muskegon County. Planning, zoning, and code-enforcement officials usually administer preventive measures.

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.

Each municipality within Muskegon County employs or contracts their own building inspector, a plumbing inspector, a mechanical inspector, and an electrical inspector to enforce codes throughout their jurisdiction. All municipalities currently enforce the 2015 Michigan Residential, the 2015 Michigan Building code, the 2015 Michigan Rehab Code, along with the 2015 Michigan Plumbing, Mechanical, and Energy codes, the 2017 National Electrical Code, and the 2021 Michigan Fire Code with Michigan Amendments. Building codes such as these provide the basis for good building safety programs, especially protection from fire and electrical hazards, and 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, <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.

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.

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.

As of the 2021 Census Reporter, of the 74,867 number of housing units about 5.1% of all housing units in Muskegon County are mobile homes. This is down from the 6.6% reported by the 2010 U.S. Census.

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 suitable 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.

Comprehensive Planning

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 Muskegon Area-wide Plan (MAP), a comprehensive plan for Muskegon County, was updated in 2013. According to the MAP, all 27 local units of government in Muskegon County have an active Land Use/Master Plan and Zoning Ordinance in place as allowed by Michigan Law. Therefore, the MAP can serve as a coordinating influence throughout the county. It was developed with considerable public and governmental input and recommends a "Smart Growth" approach to future development within the county, wherein consideration is given not only to natural resources but also to the availability of existing services. One of the MAP "Visions" is to "encourage and promote land use and growth patterns that sustain and improve quality of life in Muskegon County, while maintaining a strong sense of place, community, and responsibility."

Zoning

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.

Muskegon County does not oversee zoning; therefore all municipalities in the county are responsible for establishing their own ordinance. Each municipality has its own zoning official.

Capital Improvements

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.

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. Muskegon County elects a Drain Commissioner every four years. 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;
- Minimum water pressures adequate for firefighting; and
- Lots with building sites above the flood level.

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.

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.

Muskegon County contains one river currently included in the Michigan Natural Rivers Program (White River), and one river that is under consideration for inclusion into the Natural Rivers Program (Muskegon 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.

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. 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 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. As of December 2014, there were thirteen jurisdictions in Muskegon County participating in the NFIP, including: the cities of Fremont, Muskegon, and White Cloud; the Village of Hesperia; and the townships of Ashland, Bridgeton, Brooks, Croton, Ensley, Garfield, Lincoln, Sherman, and Wilcox.

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. The code officially "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”.

Stormwater runoff regulations supplement other efforts to regulate development by requiring developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. In general, 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.

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.

Site Modifications (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 including short grass, thinned trees, removal of low-hanging branches, selection of fire-resistant vegetation, etc. is also helpful in keeping wildfires away. The need for local homeowners to “fireproof” their properties is probably the county’s primary wildfire vulnerability.

Flooding is another hazard that can be kept away from a building. Four common methods to accomplish this 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. Following the flooding of September 1986, Muskegon County experienced both an acquisition project and a relocation project. In Everett Township, a parcel was acquired and flood-damaged structures were demolished. In the City of Muskegon, a wastewater treatment plant was relocated out of the floodplain.

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. They can assure that driveways are wide, high, and level enough and bridges are strong enough for fire equipment to access the property particularly in hilly areas where space can be limited, and can clearly display their addresses so that fire fighters can identify them. Homeowners can also make sure that adequate water supply has been identified for fire-fighters.

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 such as 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 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 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. Another option is "Retrofitting" trees that hang over power lines, as mentioned later in the discussion on Urban Forestry.

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 may be "living" fences, composed of 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.

Insurance

Insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild and 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.

Critical facilities should be inventoried and proper insurance coverage should be reviewed and insured. 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.

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.

The community can be the focal point of a project, such as floodplain property acquisition. Most funding programs require a local public agency to sponsor the project. The county or a municipality could process the funding application, work with the owners, and/or provide some or the entire local share. In some cases, the local government would be the ultimate owner of the property, but in other cases a public agency could assume ownership and maintenance responsibilities. The West Michigan Land Conservancy is an organization that can help by purchasing and holding certain lands until a government agency or other party can take possession.

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 approval for a home improvement project. For example, if a person were to apply for a permit for major rehabilitation, the community could require that the service box be moved above the

base flood elevation or that separate ground fault interpreter circuits be installed in the basement. An extreme mandate would be to “Fill Your Basement With Water”. If the mandate were 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 MSP-EMHSD mitigation funding programs. (As of October 2013, Muskegon County had experienced 14 repetitive losses: 3 in Ashland Township, 8 in Bridgeton Township, and 3 in Garfield 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 a disaster declaration, FEMA, the MSP Emergency Management and Homeland Security Division, and the Michigan DNR may provide guidance on how to qualify and apply for these funds.

Common Hazard Mitigation Sources

| Program | Eligibility | Eligible Activities | Program Type / Cost Share |
|---|--|---|---|
| <p>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.</p> | <p>Eligible Subapplicants:</p> <ul style="list-style-type: none"> · State agencies · Tribal governments · Local governments · Private nonprofit orgs | <ul style="list-style-type: none"> · 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 | <p>Disaster Based (Stafford Act Major Disaster Declaration Required)</p> <p>75% Federal 25% Non-Federal</p> |
| <p>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.</p> | <p>Eligible Subapplicants:</p> <ul style="list-style-type: none"> · State agencies · Tribal governments · Local governments · Universities | <ul style="list-style-type: none"> · 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 | <p>Annual Appropriation</p> <p>75% Federal 25% Non-Federal</p> <p>90% Federal 10% Non-Federal if subgrantee is a small impoverished community</p> |
| <p>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.</p> | <p>Eligible Subapplicants:</p> <ul style="list-style-type: none"> · State agencies · Tribal governments · Local governments | <ul style="list-style-type: none"> · 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 | <p>Annual Appropriation</p> <p>75% Federal 25% Non-Federal</p> |
| <p>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.)</p> | <p>Eligible Subapplicants:</p> <ul style="list-style-type: none"> · State agencies · Tribal governments · Local governments | <ul style="list-style-type: none"> · 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 | <p>Annual Appropriation</p> <p>100% Federal</p> |
| <p>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.</p> | <p>Eligible Subapplicants:</p> <ul style="list-style-type: none"> · State agencies · Tribal governments · Local governments | <ul style="list-style-type: none"> · Property acquisition / structure demolition or relocation · Structure elevation · Mitigation reconstruction · Dry floodproofing of historic residential structures · Minor localized flood reduction projects | <p>Annual Appropriation</p> <p>75% Federal 25% Non-Federal</p> |
| <p>*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.</p> | | | |

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

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 through 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; and
- Farmland protection.

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 (U.S. EPA) 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 (MDEQ)).

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 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.

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 Muskegon County within their borders, including: Duck Creek Watershed Partnership, Lower Grand River Organization of Watersheds, Mona Lake Watershed Council, Muskegon Lake Watershed Partnership, Muskegon River Watershed Assembly, White Lake Public Advisory Council, and White River Watershed Partnership.

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 MDEQ. *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.

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 sponsored by local communities can be quite effective.

Urban Forestry

The major damage caused by winds and snow/ice/sleet storms is to trees. Downed trees and branches break utility lines and damage buildings, 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”. “Tree City USA” is a program 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. The City of Fremont is the only municipality in Muskegon County to achieve the “Tree City USA” endorsement.

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.

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.

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 Muskegon County, as contained in its "Atlas of Critical Dune Areas" (www.michigan.gov/deq under "sand dunes"). There are designated areas in the City of Muskegon, the City of Norton Shores, Fruitland Township, Laketon Township and White River Township.

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 residential/wildlands intermix) and increased erosion potential. It can also assist in assuring fire-fighting access to development.

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 Muskegon County Emergency Services in White Cloud. These measures can be divided into four stages:

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

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. Muskegon County has two river monitoring stations located in Croton Township on the Muskegon River and the Little Muskegon River. There is also an electronic flood gauge at the Croton Dam, which can be accessed by telephone.

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 NWS is the prime agency for detecting meteorological threats, such as tornadoes and thunderstorms, and uses a transmitter located south of Hesperia to relay weather information to Muskegon County. Severe weather warnings are first transmitted through the NOAA Weather Radio System and then subsequently relayed 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, generally in the spring, through cooperation of Muskegon County Emergency Services, fire departments, and NWS office in Grand Rapids.

The NWS is also the prime agency for predicting winter storms. Severe snowstorms can often be forecasted days in advance of the expected event, which allows time for warning and preparation. Though more difficult, the NWS can also forecast ice storms.

In summation, Muskegon 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, Muskegon County Emergency Services and NWS use their formal organization of weather spotters.

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 Weather 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 evaluated, updated to include new technologies, and expanded to include warnings to people with “special needs” continually 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 if it is just calling in firefighters.

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.

Muskegon County does not own or maintain any type of outdoor warning system (sirens). Municipal fire stations are responsible for the installation and operation of fire department sirens which could also be used as warning sirens. Sirens in Muskegon County are located in Blue Lake Township, Lakewood Club Village, Norton Shores (Muskegon County Airport; air crash only), Montague, Muskegon Heights, and Whitehall.

Muskegon County utilizes and maintains a variety of available warning tools to alert and notify the general public of emergency events and/or hazardous situations. Warning tools include, but are not limited to, Code Red Mass Notification System, NOAA Weather Radios, Emergency Alert System (EAS), Tone Alert Monitors, Tornado Sirens, door-to-door notification, and other specialized systems including Nixle, websites, email, and social media. Depending on the nature of the incident, emergency services personnel will reference established guidance within the Muskegon County Emergency Operations Plan to determine the appropriate warning tools to utilize. Regardless of the situation, the primary warning tool for Muskegon County is CodeRed. CodeRed connects public safety agencies to their community residents via text, web, and email to distribute alerts, advisories, and community messages. Alerts can be sent out to the entire area or a predefined contact list. CodeRed is integrated into IPAWS and has the capability to automate NWS Rebroadcasts and link social media accounts together.

The NWS established the “StormReady” program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. Muskegon County aims to become a StormReady community. 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>.

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.

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 warming and cooling centers when extreme temperatures occur; having volunteers check on those needing assistance when there are infrastructure failures; sending vulnerable people (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. 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. They should consider the possibility of “mutual aid” and utilize volunteer groups such as Radio Amateur Civil Emergency Services (RACES) and Muskegon County Amateur Radio Emergency Services (ARES). The organizations are collectively referred to as Auxiliary Communications (AuxComm). 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 Muskegon County Emergency Action Guidelines (EAG) document, updated in March 2023, 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 Muskegon County departments and local communities. The EAG is 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.

The Incident Command System is required for Muskegon 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 computerized layers of mapped 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. Muskegon County has a developed GIS program which has been integrated into Muskegon County operations, including Emergency Services.

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 the owner or operator adequately prepares them, the community's emergency response efforts will be better supported.

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 assistance both public and private, and evaluation, testing 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 a 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.

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.

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 NWS 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 to places and people where it is needed (such as wildfire hazard information 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.

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. Muskegon County Emergency Services 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. District health department reports may also prove to be valuable resources for local hazard information.

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.

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.

Existing Authorities, policies, programs, funding, and resources

The following table highlights what existing authorities, policies, programs, functions, and resources each participating jurisdiction has available to support local mitigation strategies. One of the primary sources for the information below was the Muskegon County Area-Wide Comprehensive Plan which can be located here: <https://wmsrdc.org/wp-content/uploads/2015/08/MAP-Document.pdf>

| Jurisdiction | Muskegon County Area-Wide Plan | Master Land Use Plan | Local Zoning Ordinances | State Construction Code | Parks and Recreation Plan | Stormwater Management Plan | Lake Watershed Mgt Plan Participant | NFIP Zoning | Capital Use Plan (Separate) | Ful Time Staff |
|-----------------------|--------------------------------|----------------------|-------------------------|-------------------------|---------------------------|----------------------------|-------------------------------------|-------------|-----------------------------|----------------|
| Muskegon County | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Blue Lake Twp | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | |
| Casnovia Village | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | |
| Casnovia Twp | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | |
| Cedar Creek Twp | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| Dalton Twp | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| Egelston Twp | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| Fruitland Twp | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ |
| Fruitport Village | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| Fruitport Twp | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| Holton Twp | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ |
| Laketon Twp | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| Lakewood Club Village | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | ✓ |
| Montague City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Montague Twp | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | |
| Moorland Twp | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | |
| Muskegon City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Muskegon Twp | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Muskegon Heights City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| North Muskegon City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Norton Shores City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Ravenna Village | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | | ✓ |
| Ravenna Twp | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | |
| Roosevelt Park City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| Sullivan Twp | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | |
| Whitehall City | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Whitehall Twp | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| White River Twp | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |

*Note: Some communities have a Comprehensive Plan that covers land use, local zoning, and capital use into one plan.

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 with limited financial and professional resources, such as Muskegon. In addition, many of Muskegon 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 such as feasibility, cost effectiveness, equity, etc. 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. For each goal, there are several objectives; and under each objective, there are several potential action items. These potential action items are “snapshots” of some of the alternatives discussed in the previous chapter. From this set of potential actions, the highest priority action items are selected and presented as a “Recommended Action Agenda” in the Plan Implementation chapter.

For the updated edition of this plan, many of the potential action items remain the same. A few action items were added or removed, and other minor revisions were made to improve the readability of the action items. 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.

Potential Action Items:

- 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 to provide better protection to occupants against extreme temperatures.
- 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.
- 3) Utilize the Institute for Business and Home Safety (IBHS) guidelines provided through the “FORTIFIED” programs to guard new and existing structures against hazards, and consider incorporating them into existing codes.
- 4) Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.
- 5) Assess the need to strengthen anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway.
- 6) Assure proper location, installation, cleaning and maintenance of septic tanks, particularly in the floodplain/floodway and around lakes.

Objective 1.2 Incorporate hazard mitigation into land use and capital improvement planning and development activities.

Potential Action Items:

- 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.

- 8) Action Item 8. Incorporate the Muskegon Area-wide Plan's "Smart Growth" principles (supporting the link between resource protection and development and a collaborative approach for infrastructure and services) into comprehensive plans and land use plans.
- 9) 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.

Potential Action Items:

- 10) 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).
- 11) Enforce the existing Michigan Drain Code requirement for "set-back" from the drain channel, thereby assuring proper carrying capacity of the drain.
- 12) 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.
- 13) 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.
- 14) Enforce Michigan's Sand Dune and Shorelands Protection and Management Programs that control development in high-risk erosion areas and protect dunes.
- 15) 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 other plans and ordinances that protect natural resources so that they can, in turn, provide hazard protection.

Potential Action Items:

- 16) Develop a Stormwater Management Plan to identify best management practices (BMP's), and to assess the efficacy of local stormwater ordinances and rules.

- 17) 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.
- 18) 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.
- 19) 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.

Potential Action Items:

- 20) 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.
- 21) 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.
- 22) 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).
- 23) 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.
- 24) Employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.
- 25) Create firebreaks, wherein brush and other fuel is cleared away, in wildland areas.
- 26) Identify and prioritize fuel reduction projects, especially for developments in wildland-urban interface (WUI) areas.
- 27) Adopt and enforce local ordinances that require burn permits and restrict campfires and outdoor burning.

- 28) 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 facilities from hazards.

Potential Action Items:

- 29) Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.
- 30) 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.
- 31) 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.
- 32) 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.
- 33) 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.

Potential Action Items:

- 34) Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).
- 35) 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.
- 36) 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.
- 37) 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.

Potential Action Items:

- 38) 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.
- 39) 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.
- 40) 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.
- 41) 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.
- 42) Establish a voluntary floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.
- 43) Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.
- 44) Investigate the availability of resources and need for creating firebreaks and the availability of resources for acquiring land as necessary to achieve continuity of needed 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.**

Potential Action Items:

- 45) Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination.
- 46) Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.
- 47) Maintain a description of the public warning process and coordinate actions in a section of the Muskegon County Emergency Action Guidelines (EAG).
- 48) Maintain the "Code Red" telephone emergency notification system to assure immediate warnings to Muskegon County residents or target groups of pending and existing hazards and actions they can take to protect themselves.

- 49) 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.
- 50) 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.
- 51) 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.
- 52) Utilize the NWS “Turn Around Don’t Drown” system to warn motorists and pedestrians to not enter or cross flooded areas, and install PVC markers alongside roads to illustrate dangerous water levels.

Objective 3.2 Protect infrastructure and services.

Potential Action Items:

- 53) Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading lines or running power to new developments.
- 54) 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.
- 55) Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, municipal wells, municipal buildings, road commissions, hospitals and medical centers, nursing home facilities, schools, and shelters.
- 56) Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.
- 57) Establish safe and appropriate locations for temporary debris disposal sites.
- 58) Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.
- 59) 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.

Potential Action Items:

- 60) 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
- 61) Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.
- 62) 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.
- 63) 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.
- 64) 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.
- 65) Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.
- 66) Continue to maintain, and acquire as necessary, firefighting and rescue equipment; including dry fire hydrants in rural areas and specialized equipment for water and ice rescue, limited access areas, and snow-blocked areas.
- 67) Construct and/or designate storm shelters/tornado shelters in parks, campgrounds, mobile home parks, and developments that do not have shelters. Consider retrofitting existing or constructing public buildings, industrial sites, and other large businesses or complexes to include shelters.
- 68) Coordinate with the Muskegon Conservation District, local watershed councils, and lake improvement boards to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.
- 69) Adopt the recommendations and strategies of the "Firewise" program, which include encouraging all residents living in the wildland/urban interface area to become acquainted with Firewise mitigation strategies to protect their property from wildfire hazards and recommending to production companies and land owners that they employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.
- 70) 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.

Potential Action Items:

- 71) Utilize volunteer communication networks by amateur radio operators (RACES and Muskegon County ARES) to facilitate communication during emergencies when phone lines may be inoperable.
- 72) 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.
- 73) 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.
- 74) Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.
- 75) 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.

Potential Action Items:

- 76) 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.
- 77) 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.
- 78) 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.
- 79) 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. For example, inform the general public about the Code Red telephone emergency notification system and encourage citizens and visitors to register.
- 80) Provide local schools with information for the classroom regarding severe weather hazards and how families can prepare for and respond to them.

- 81) Incorporate safety strategies for severe weather events in driver education classes and materials.
- 82) 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.
- 83) 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.
- 84) Research availability of local and Michigan-based recovery “vendors” for post-disaster goods and services (e.g., cleaning, drying, pumps, repairs, construction supplies, portable refrigeration units, disaster recovery experts) to support disaster recovery efforts.
- 85) Identify and advertise a list of available heated and cooled shelters to the elderly and other special populations who may be at risk to extreme temperature events.
- 86) 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.
- 87) Through coordination with the County 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.

Potential Action Items:

- 88) Participate in programs such as NFIP, CRS, Firewise, Tree City USA, StormReady, etc. and respond to concerns regarding program requirements and obstacles to participation.
- 89) 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.
- 90) 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.
- 91) Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

- 92) 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.
- 93) 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.

Potential Action Items:

- 94) 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.
- 95) 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).
- 96) 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.
- 97) Utilize the County Geographic Information System (GIS) capabilities to support pre-disaster planning (such as flood stage forecast maps, and maps showing the locations of secluded, gated, and seasonal homes), disaster response, and post-disaster recovery activities.
- 98) 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.

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 the previous chapter. 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 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.

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 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 items 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.

PLAN IMPLEMENTATION

This chapter contains a review of completed Action Items, Ongoing or In-Progress Action Items, and Pending Action Items. In addition, this chapter also contains the revised Action Agenda for this updated 2024 edition.

Revised Action Agenda for 2024 - 2029

The action items highlighted in this section were selected from the list of potential hazard mitigation actions presented in the chapter entitled “Potential Hazard Mitigation Actions” and are presented below as the Action Agenda for 2024-2029. 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. Each action item includes the following information to help facilitate implementation:

Review of Hazard Mitigation Progress

To identify any mitigation progress that had been made on the 2014 Action Agenda, discussions were held with county officials and the LEPC / Advisory Team during a scheduled meeting. Muskegon County Emergency Services, the LEPC / Advisory Team members, and the chief elected official of each township had an opportunity to review each action item and provide input on whether each item was Complete, Ongoing or In-Progress, Action Pending, Incomplete or Unknown within his or her jurisdiction. If a particular action item was incomplete, the respondent was encouraged to explain why.

Summary of Completed Hazard Mitigation Projects

Completed projects require no further action by the Muskegon County Emergency Services Department except for periodic scheduled review and revision or if significant change in conditions or capabilities occur requiring substantial updates or improvements. 16 Potential Action Items have been completed.

Potential 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.

Building Code Effectiveness Grading Schedule, a program administered by ISO which evaluates building departments in jurisdictions across the country pertaining to their building code adoption and enforcement and grades them on a scale of 1 to 10. In the 2019 National Building Code Assessment report, the state average score for both commercial and residential is a class 4.

Norton Shores City - Building Division participated in the BCEGS each 5 year cycle.

Trinity Health Partners, Muskegon also participates in may programs associated with hospital accreditation.

Potential Action Item #6 Assure proper location, installation, cleaning and maintenance of septic tanks, particularly in the floodplain/floodway and around lakes.

This is overseen by the Muskegon County Health Department through implementation of their routine environmental health programs.

Potential 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.

Local master plans and ordinances regulate this. The County of Muskegon has no authority over this item.

Norton Shores City – 2001 Conservation Design Ordinance and 2000 Comprehensive Plan (updated in 2008 and 2014).

Trinity Health Partners, Muskegon noted mitigation strategies include opportunities to improvement wetlands near their Mercy campus and optimizing the use of adjacent open land around all of their facility locations. In addition, as they build, consider the environment and ways to minimize the impact to it.

Potential Action Item #8 Action Item 8. Incorporate the Muskegon Area-wide Plan’s “Smart Growth” principles (supporting the link between resource protection and development and a collaborative approach for infrastructure and services) into comprehensive plans and land use plans.

Some communities have and others have not. The County of Muskegon has no authority over this item.

Potential Action Item #10 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).

Norton Shores adopted a 2011 low impact design ordinance.

Potential Action Item #13 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.

This is a local control issue under individual municipalities (cities, villages, and townships).

Potential Action Item #14 Michigan’s Sand Dune and Shorelands Protection and Management Programs that control development in high-risk erosion areas and protect dunes.

The County of Muskegon has no authority over Critical Dunes division of EGLE.

Potential Action Item #15 Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).

This is a local control issue under individual municipalities (cities, villages, and townships).

Potential Action Item #16 Develop a Stormwater Management Plan to identify best management practices (BMP’s), and to assess the efficacy of local stormwater ordinances and rules.

In 2017 the County Board adopted ordinance #2017-296, Storm Water Runoff & Post-Construction Control Ordinance.

Potential Action Item #23 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.

The County of Muskegon has purchased several sites adjacent to Muskegon River and Bear creek to restore flood plans and native habitat/vegetation. Removed dykes on former celery flats to increase flood plan area.

Potential Action Item #27 Adopt and enforce local ordinances that require burn permits and restrict campfires and outdoor burning.

If the local city, township, or village does not have a local ordinance, state law allows burning grass and leaves in municipalities with populations less than 7,500 unless prohibited by local ordinance. Under state law burning of yard debris is prohibited within 1,400 feet of an incorporated city or village limit under EGLE air quality rules. In addition, under state law open burning can only take place on days where the DNR is issuing permits. The County of Muskegon participates in the Michigan Department of Natural Resources Burn Permits management System. This system will notify the public if open burning is permitted or not. Under this system, additional information can be obtained by selecting the County of Muskegon.

| County Name | Township Name | Burning Permits Issued | Guidelines and Restrictions |
|-------------|---------------|------------------------|---|
| MUSKEGON | BLUE LAKE | Yes | All Day |
| MUSKEGON | CASNOVIA | Yes | All Day |
| MUSKEGON | CEDAR CREEK | Yes | All Day |
| MUSKEGON | DALTON | no | Permits can only be issued for logs and brush when burning takes place greater than 1400 feet from any city or village limit. Burning of grass and leaves is not allowed under DEQ rules. |
| MUSKEGON | EGELSTON | No | No burning permits issued |
| MUSKEGON | FRUITLAND | No | Burn Permits are issued locally by calling 231-893-6503 |
| MUSKEGON | FRUITPORT | No | Recreational fires only-contact 773-9312 for rules. |
| MUSKEGON | HOLTON | Yes | All Day |
| MUSKEGON | LAKETON | No | Permits can only be issued for logs and brush when burning takes place greater than 1400 feet from any city or village limit. Burning of leaves and grass is not allowed under DEQ rules. |
| MUSKEGON | MONTAGUE | No | Permits can only be issued for logs and brush when the burning takes place greater than 1400 feet from any city or village limit. Burning of leaves and grass is not allowed under DEQ rules. |
| MUSKEGON | MOORLAND | No | Call the Fire station at 231-853-2213 to confirm permit. |
| MUSKEGON | MUSKEGON | No | Permits can only be issued for logs and brush when the burning takes place greater than 1400 feet from any city or village limit. Burning of leaves and grass is not allowed under DEQ rules. |
| MUSKEGON | RAVENNA | Yes | All Day |
| MUSKEGON | SULLIVAN | Yes | All Day |
| MUSKEGON | WHITE RIVER | Yes | All Day |
| MUSKEGON | WHITEHALL | No | Burn permits are issued locally by calling 231-893-6503 |

Potential Action Item #35 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.

FEMA conducted NFIP FIRM Revisions in 07/06/2015 in the County of Muskegon. All 26 municipalities have a community ID and 15 of the municipalities participated in FIRM revisions again in October of 2021. As of October 2023, 15 municipalities have residents with Flood Insurance Policies, for a total of 103 policies Countywide.

Potential Action Item #49 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.

Under the Homeland Security Grant, Muskegon County received and distributed NOAA all hazards radios to vulnerable populations across the county.

Potential Action Item #55 Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, municipal wells, municipal buildings, road commissions, hospitals and medical centers, nursing home facilities, schools, and shelters.

This has been completed for assets under the County of Muskegon's control. Pump stations (water and sewer) have back up power or the County has portable generators available

Potential Action Item #62 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.

Local fire departments and emergency responders have a Mutual Aid agreement.

Potential Action Item #65 Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

Water systems are required to perform a reliability study every 5 years by a licensed engineer. All recommendations are implemented.

Summary of In-Progress or On-Going Hazard Mitigation Projects for FY 2024 – FY 2029

26 Potential Action Items are considered in-progress or on-going by the Muskegon County Emergency Services Department. These projects require active facilitation, incorporation, and coordination or are being continuously implemented by the communities within Muskegon County.

Potential Action Item #9 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.

Norton Shore City – Detention / retention ponds are typically used on new developments for storm water management.

Dalton Township noted they have a lack of resources to address this item.

Potential Action Item #11 Enforce the existing Michigan Drain Code requirement for “set-back” from the drain channel, thereby assuring proper carrying capacity of the drain.

Potential Action Item #12 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.

The County of Muskegon maintains a Soil, Erosion, and Sedimentation Control program.

Potential Action Item #17 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.

Potential Action Item #18 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.

Trees fall under the local jurisdictions and the Road Commission. Some cities have the Tree City USA designation. The County does have a timber improvement program at its 11,000 acre wastewater treatment plant.

Potential Action Item #20 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.

Local units of government and the Road Commission have jurisdiction of road storm water systems under PA51.

Norton Shores storm systems are sized when installed and reviewed if / when additional development has an impact on a particular sewer.

Potential Action Item #22 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).

Potential Action Item #25 Maximize the participation of property owners in protecting their properties from natural hazards.

Norton Shores building division enforces the MI Residential Code 2015 for wind shear and 60 lb ground snow loads among all other current code requirements.

Potential Action Item #28 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.

County does now have a hazardous materials drop off center and holds recycling events for tires and electronics.

Potential Action Item #39 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.

County department of Veterans Affairs offers this service.

Potential Action Item #43 Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.

Potential Action Item #45 Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination.

Potential Action Item #46 Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Potential Action Item #48 Maintain the “Code Red” telephone emergency notification system to assure immediate warnings to Muskegon County residents or target groups of pending and existing hazards and actions they can take to protect themselves.

Potential Action Item #50 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.

Potential Action Item #51 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.

Potential Action Item #58 Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.

Potential Action Item #59 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.

Potential Action Item #66 Continue to maintain, and acquire as necessary, firefighting and rescue equipment; including dry fire hydrants in rural areas and specialized equipment for water and ice rescue, limited access areas, and snow-blocked areas.

Potential Action Item #68 Coordinate with the Muskegon Conservation District, local watershed councils, and lake improvement boards to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Potential Action Item #91 Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

Potential Action Item #92 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.

Potential Action Item #94 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.

Potential Action Item #95 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).

Potential Action Item #97 Utilize the County Geographic Information System (GIS) capabilities to support pre-disaster planning (such as flood stage forecast maps, and maps showing the locations of secluded, gated, and seasonal homes), disaster response, and post-disaster recovery activities.

Potential Action Item #98 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.

Summary of Pending Hazard Mitigation Projects for FY 2024 – FY 2029

Potential 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 to provide better protection to occupants against extreme temperatures.

The County of Muskegon does not maintain local building codes or a Building Inspectors Office. This is maintained by each municipality. However, within the State of Michigan building codes are not maintained locally, but at a Statewide level. Currently, the state of Michigan has adopted the 2015 version of the International Building Code. This will be updated to the 2021 version in 2024.

Potential Action Item #36 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.

Potential Action Item #47 Maintain a description of the public warning process and coordinate actions in a section of the Muskegon County Emergency Action Guidelines (EAG).

Potential Action Item #60 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

Potential Action Item #61 Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.

Potential Action Item #70 Meet the criteria to become a NWS-approved "Storm Ready" community.

Potential Action Item #73 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.

Potential Action Item #83 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.

Potential Action Item #84 Research availability of local and Michigan-based recovery “vendors” for post-disaster goods and services (e.g., cleaning, drying, pumps, repairs, construction supplies, portable refrigeration units, disaster recovery experts) to support disaster recovery efforts.

Potential Action Item #85 Identify and advertise a list of available heated and cooled shelters to the elderly and other special populations who may be at risk to extreme temperature events.

Potential Action Item #86 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.

Summary of Incomplete or Unknown Status of Hazard Mitigation Projects

Due to change in administrative leadership, transition of elected officials, and a lack of available documentation, the status of the following Hazard Mitigation potential projects is unknown. In review of these projects by the County’s Local Emergency Planning Committee and County Administration, the projects are considered still relevant, but it is unknown if any municipal jurisdiction(s) took any action on these items and what their status is. Therefore, these potential projects remain in the plan as incomplete or unknown.

Potential 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, and consider incorporating them into existing codes.

Potential Action Item #4 Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.

Potential Action Item #5 Assess the need to strengthen anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway.

Potential Action Item #19 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.

Potential Action Item #21 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.

Potential Action Item #29 Encourage property owners and public facility operators to increase their property’s resilience and resistance to hazards.

Potential Action Item #30 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.

Potential Action Item #31 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.

Potential Action Item #32 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.

Potential Action Item #33 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.

Potential Action Item #34 Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).

Potential Action Item #37 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.

Potential Action Item #38 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.

Potential Action Item #40 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.

Potential Action Item #41 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.

Potential Action Item #42 Establish a voluntary floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.

Potential Action Item #44 Investigate the availability of resources and need for creating firebreaks and the availability of resources for acquiring land as necessary to achieve continuity of needed firebreak areas.

Potential Action Item #52 Utilize the NWS “Turn Around Don’t Drown” system to warn motorists and pedestrians to not enter or cross flooded areas, and install PVC markers alongside roads to illustrate dangerous water levels.

Potential Action Item #53 Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading lines or running power to new developments.

Power line relocation is the responsibility of the requestor and is very expensive. MPSI regulates this.

Potential Action Item #54 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.

Potential Action Item #56 Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

Potential Action Item #57 Establish safe and appropriate locations for temporary debris disposal sites.

Potential Action Item #63 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.

Potential Action Item #64 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.

Potential Action Item #67 Construct and/or designate storm shelters/tornado shelters in parks, campgrounds, mobile home parks, and developments that do not have shelters. Consider retrofitting existing or constructing public buildings, industrial sites, and other large businesses or complexes to include shelters.

Potential Action Item #69 Adopt the recommendations and strategies of the "Firewise" program, which include encouraging all residents living in the wildland/urban interface area to become acquainted with Firewise mitigation strategies to protect their property from wildfire hazards and recommending to production companies and land owners that they employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

Potential Action Item #71 Utilize volunteer communication networks by amateur radio operators (RACES and Muskegon County ARES) to facilitate communication during emergencies when phone lines may be inoperable.

Potential Action Item #72 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.

Potential Action Item #74 Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

Potential Action Item #75 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.

Potential Action Item #76 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.

Potential Action Item #77 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.

Potential Action Item #78 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.

Potential Action Item #79 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. For example, inform the general public about the Code Red telephone emergency notification system and encourage citizens and visitors to register.

Potential Action Item #80 Provide local schools with information for the classroom regarding severe weather hazards and how families can prepare for and respond to them.

Potential Action Item #81 Incorporate safety strategies for severe weather events in driver education classes and materials.

Potential Action Item #82 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.

Potential Action Item #87 Through coordination with the County Health Department, increase public awareness of the causes, symptoms and protective actions for disease outbreaks and other potential public health emergencies.

Potential Action Item #88 Participate in programs such as NFIP, CRS, Firewise, Tree City USA, StormReady, etc. and respond to concerns regarding program requirements and obstacles to participation.

Potential Action Item #89 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.

Potential Action Item #90 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.

Potential Action Item #93 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.

Potential Action Item #96 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.

Mitigation Programs and Capabilities

Several important state capabilities are delivered through FEMA programs and grants. These may directly fund a State's overall emergency management program or are specifically dedicated to funding hazard mitigation projects where the State Emergency Management Agency or other state partners act as a State Administrative Agency (SAA). In Michigan, direct assistance for Michigan's emergency management program is provided via the Emergency Management Preparedness Grant (EMPG), which includes funding for several core capabilities (such as mitigation). Many programs where Emergency Management and Homeland Security Department (EMHSD) is the SAA are grouped together as primary Hazard Mitigation Assistance (HMA) Programs and additional FEMA Programs and Grants.

Primary Hazard Mitigation Assistance Programs

References to HMA programs can be best thought of as an umbrella term for several specific grant programs that have been grouped together by FEMA and summarized under their HMA fact sheet.

Building Resilient Infrastructure and Communities (BRIC)

The Building Resilient Infrastructure and Communities (BRIC) Program was authorized by The Disaster Recovery Reform Act, Section 1234; amended Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act). BRIC provides funding for states, local communities, and tribes to implement long-term hazard mitigation measures that reduce or eliminate risk to people and property from natural hazards and their effects. The program's guiding principles are to support communities through capability and capacity building; encourage and enable innovation, promote partnerships, and enabling large infrastructure hazard mitigation projects. Funding for BRIC is made available annually. The majority of BRIC funding is available on a nationally competitive basis, but FEMA may reserve a portion of the funding as a set aside available to states and tribes.

BRIC is a state administered, cost-sharing program. Mitigation measures under BRIC are funded primarily on a 75% federal / 25% non-federal basis but in some instances may fund up to 90% federal share. Applications for BRIC grants are made via the federal FEMA GO system. The Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) reviews all of the applications received within the State of Michigan and prioritizes applications. FEMA makes final project selections and approvals.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) Program is a result of the federal National Flood Insurance Reform Act (NFIRA). The purpose of the NFIRA is to improve the financial condition of the National Flood Insurance Program (NFIP) and to reduce the federal expenditures for federal disaster assistance to flood damaged properties. With the passage of the NFIRA, Congress authorized the establishment of a federal grant program to provide financial assistance to states and local communities for flood mitigation planning and activities, resulting in the FMA Program. The somewhat related Repetitive Flood Claims (RFC) Program is now defunct but may still be referenced to in historical portions of this plan.

The FMA is a state administered, cost-sharing program through which FEMA provides assistance to reduce the risk of flood damage to structures insurable under the NFIP. FEMA encourages the State to assist the local community in prioritizing mitigation activities outlined in their hazard mitigation plan and to fund projects that will greatly reduce the risk of flood damage to buildings, manufactured homes, and other NFIP-insurable structures.

Mitigation of substantially damaged and repetitive loss structures is a high priority. Most mitigation measures under the FMA are funded on a 75% federal / 25% non-federal basis but in some instances for repetitive and severe repetitive loss properties cost can be 90% or 100% federal. The Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) reviews all of the applications received within the State of Michigan and prioritizes applications. FEMA determines final project approvals.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) was created by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 93-288, as amended). The HMGP provides funding for states and local communities to implement long-term hazard mitigation measures that reduce or eliminate risk to people and property from natural hazards and their effects. Funding for Michigan's HMGP is made available following a federal Major Disaster Declaration in the state. The amount available to the State for HMGP projects is based on 15% of the federal funds expended on the Public and Individual Assistance programs for the disaster, with an option to increase that amount to 20% with an approved "enhanced" state mitigation plan in place. The objective of the HMGP is to protect lives and property and significantly reduce or eliminate future disaster expenditures.

HMGP grants can be awarded to eligible applicants throughout the state, regardless of the boundaries of the disaster declaration. Eligible applicants include state agencies, local governments, certain private non-profit organizations, and tribes or authorized tribal organizations. Federal funds are typically available for up to 75% (but in some cases up to 90%) of eligible project costs, but *only* for those applicants that have in place or are covered under an approved hazard mitigation plan that meets the requirements of the federal Disaster Mitigation Act (DMA) of 2000. The remainder of the cost for the project is the responsibility of the applicant.

The HMGP can be used to fund projects to protect either public or private property. Examples of the types of projects that can be funded by the HMGP include, but are not limited to:

- Voluntary acquisition or elevation of flood-prone structures
- Stormwater management projects that reduce flood risk
- Protective measures for utility infrastructure
- Vegetation management for dune restoration or wildfire prevention
- Construction of safe rooms
- Retrofitting structures for wind protection
- Development of community hazard mitigation plans (or the update of an existing hazard mitigation plan)
- Project scoping activities to develop cost-effective hazard mitigation projects

Applicants must apply for the HMGP through the Michigan State Police Emergency Management and Homeland Security Division (MSP/EMHSD). The Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) will set priorities for the HMGP following a disaster declaration. Based on those priorities, notification of available funding will be made to appropriate entities and organizations. The MCCERCC will review and prioritize eligible applications. Selected formal project applications will then be submitted by the MSP/EMHSD to FEMA for final funding approval. A wildfire focused grant is also available, known as HMGP Post Fire.

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) Program provides funding to states and local communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property. The PDM was authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by Section 102 of the Disaster Mitigation Act of 2000. The PDM is an annually appropriated, nationally competitive grant program.

States, local communities, and tribes can receive grants for mitigation activities such as planning and the implementation of projects identified through the evaluation of natural hazards. FEMA will set priorities for each appropriation of the PDM. Annual, nationally competitive application cycles for the PDM ended following the fiscal year 2019 application cycle. However, funding of PDM projects has continued through fiscal year 2023 through congressionally directed spending. These mitigation measures are funded on a 75% federal / 25% non-federal basis. Congress is responsible for directing PDM funding to specific projects through the annual federal budget. Once Congress identifies projects for funding, applications for PDM grants are made via the federal E-Grants system. FEMA makes final project approval decisions.

Safeguarding Tomorrow Revolving Loan Fund Program

The Safeguarding Tomorrow Revolving Loan Fund (STRLF) Program was authorized by Section 205 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended (Pub. L. No. 93-288) (42 U.S.C. § 5135) and the Safeguarding Tomorrow through Ongoing Risk Mitigation Act (Pub. L. No. 116-284). The STRLF provides funding for states and tribes to establish a revolving loan fund for issuing long-term, low interest loans to communities and tribes for implementing hazard mitigation measures to reduce risk from natural hazards. Fiscal year 2023 was the first year of the grant program and \$50 million was made available nationally. Michigan submitted a grant application which was selected for funding. An additional \$450 million is expected to be made available for fiscal years 2024-2027.

Communities will be given an opportunity to submit project proposals annually through an on-line form. Interested communities with an eligible proposal will then be asked to submit a loan application. The Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) will review and score the applications against pre-established criteria outlined in Michigan's STRLF Intended Use Plan. The program will offer an opportunity for selecting projects that reduce risk but may not be successful

in competing for grant funds through FEMA's other HMA programs. The low interest loans will have a maximum 1% interest rate and will be able to be paid of over a 20-year period (30 years for loans issued to low-income areas).

Other FEMA Programs and Grants

Other select FEMA programs and grants with a nexus to mitigation planning include the following:

Fire Management Assistance Grant Program

The Fire Management Assistance Grant (FMAG) Program is available to local, state, and tribal governments for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands (which threaten destruction at a level that would constitute a major disaster). The process is initiated when a state submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" exists. Before a grant can be awarded, a state must demonstrate that total eligible costs for the declared fire meet or exceed either the individual fire cost threshold, which is applied to single fires, or the cumulative fire cost threshold, which recognizes numerous smaller fires burning throughout a state. Michigan's recent history with successfully fighting forest fires has meant that the cost threshold has not been met, and there is not currently a strong opportunity for the state as a whole to use the program. This program is optional for the state, and the MHMP is not currently FMAG compliant.

High Hazard Potential Dams Grant Program

The High Hazard Potential Dams (HHPD) Grant Program is not administered by Michigan State Police Emergency Management and Homeland Security Department (MSP/EMHSD). While this program is optional for the state, it has been successfully used in the past and the MHMP is currently HHPD compliant.

Homeland Security Grant Program

The Homeland Security Grant Program (HSGP) includes a suite of risk-based grants to assist state, local, tribal, and territorial efforts in preventing, protecting against, mitigating, responding to and recovering from acts of terrorism and other threats. This grant provides grantees with the resources required for implementation of the National Preparedness System and working toward the National Preparedness Goal of a secure and resilient nation. While these grants are typically thought of as "preparedness" grants, they may still sometimes selectively apply to mitigation activities.

National Flood Insurance Program and the Risk Map Program

FEMA is responsible for providing the regulatory tools of the previously mentioned National Flood Insurance Program (NFIP), which makes flood insurance available to communities that have agreed to manage their floodplains in a manner geared towards minimizing future losses from flood damage. The NFIP is delivered directly by FEMA or through a network of companies who can write a policy under their own name (with FEMA still underwriting losses). FEMA provides information on how homeowners can understand flood zones and maps to help them decide if flood insurance is right for them. Risk MAP, which focuses on mapping, assessment, and planning, is another flood related FEMA program.

ACTION AGENDA 2023-2028

| Objective | Target Date | Goal 1: Promote growth in a sustainable, hazard-free manner. Objective / Implementation Action | Primary Hazard Addressed | Primary Jurisdiction(s) |
|-----------|-------------|--|--------------------------------------|---------------------------|
| 1.1 | | Incorporate hazard provisions in building code standards, ordinances, and procedures. | | |
| 1 | 2025 | 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 to provide better protection to occupants against extreme temperatures. | All Hazards | All municipalities |
| 1.2 | | Incorporate hazard mitigation into land use and capital improvement planning and development activities | | |
| | ONG | 9. 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. | All Hazards | All municipalities |
| 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. | | |
| | ONG | 11. Enforce the existing Michigan Drain Code requirement for “set-back” from the drain channel, thereby assuring proper carrying capacity of the drain. | Flooding and Dam Failure | County Drain Commissioner |
| | ONG | 12. 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. | Flooding and Dam Failure | County DPW |
| 1.4 | | Research, recommend, adopt, and enforce other plans and ordinances that protect natural resources so they can, in turn, provide hazard protection | | |
| | ONG | 17. 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. | Hazardous Materials | All municipalities |
| | ONG | 18. 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. | Climate related hazards and wildfire | All municipalities |
| Objective | Target Date | Goal 2: Protect existing and new properties. Objective / Implementation Action | Primary Hazard Addressed | Primary Jurisdiction(s) |
| 2.1 | | Use the most cost-effective approaches to keep hazards away from existing buildings and facilities | | |
| | ONG | 20. 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. | Flooding and Dam Failure | All municipalities |

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| | ONG | 22. 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). | Flooding and Dam Failure | All municipalities |
| | ONG | 25. Maximize the participation of property owners in protecting their properties from natural hazards. | All Hazards | All municipalities |
| | ONG | 28. 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. | Fire, Wildfire, and Hazmat | All municipalities |
| 2.2 | | Use the most cost-effective approach to protect existing buildings and facilities from hazards | | |
| 2.3 | | Maximize insurance coverage to provide financial protection against hazard events | | |
| | 2026 | 36. 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. | Flooding and Dam Failure | All municipalities |
| 2.4 | | Maximize the resources for investment in hazard mitigation, including the use of outside sources of funding | | |
| | ONG | 39. 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. | Climate related hazards | All municipalities |
| | ONG | 43. Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs. | Flooding and Dam Failure | All municipalities |
| Objective | Target Date | Goal 3: Protect public health and safety Objective / Implementation Action | Primary Hazard Addressed | Primary Jurisdiction(s) |
| 3.1 | | Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology. | | |
| | ONG | 45. Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination. | All Hazards | County of Muskegon |
| | ONG | 46. Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness. | All Hazards | County of Muskegon |
| 8 | 2025 | 47. Maintain a description of the public warning process and coordinate actions in a section of the Muskegon County Emergency Action Guidelines (EAG). | All Hazards | County Emergency Management |
| 2 | ONG | 48. Maintain the "Code Red" telephone emergency notification system to assure immediate warnings to Muskegon County residents or target groups of pending and existing hazards and actions they can take to protect themselves. | All Hazards | County Emergency Management |
| 4 | ONG | 50. 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. | Flooding and Dam Failure | County of Muskegon |
| | ONG | 51. 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. | Public Health Emergencies | County of Muskegon |
| 3.2 | | Protect infrastructure and services | | |

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| 5 | ONG | 58. Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events. | Climate related hazards | All Jurisdictions |
| | ONG | 59. 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. | Climate related hazards | All Jurisdictions |
| 3.3 | | Build and support local capacity, commitment, and partnerships to continuously become less vulnerable to hazards | | |
| 3 | 2024 | 60. 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. | All Hazards | All Jurisdictions |
| | 2029 | 61. Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan. | All Hazards | County Administration |
| 6 | ONG | 66. Continue to maintain, and acquire as necessary, firefighting and rescue equipment; including dry fire hydrants in rural areas and specialized equipment for water and ice rescue, limited access areas, and snow-blocked areas. | All Hazards | All Jurisdictions |
| | ONG | 68. Coordinate with the Muskegon Conservation District, MC Drain Commission, local watershed councils, and lake improvement boards to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands. | Flooding and Dam Failure | County of Muskegon |
| | 2027 | 70. Meet the criteria to become a NWS approved "Storm Ready" community. | Climate related hazards | All jurisdictions |
| 3.4 | | Enlist support of committed volunteers to safeguard the community, before, during and after a disaster | | |
| | 2028 | 73. 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. | Climate related hazards | County Emergency Management |
| Objective | Target Date | Goal 4: Increase public understanding, support, and participation in hazard mitigation Objective / Implementation Action | Primary Hazard Addressed | Primary Jurisdiction(s) |
| 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 | | |
| 7 | 2027 | 83. 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. | Fire, Wildfire, and Hazmat | All jurisdictions |
| | 2028 | 84. Research availability of local and Michigan-based recovery "vendors" for post-disaster goods and services (e.g., cleaning, drying, pumps, repairs, construction supplies, portable refrigeration units, disaster recovery experts) to support disaster recovery efforts. | All Hazards | All jurisdictions |
| | 2025 | 85. Identify and advertise a list of available heated and cooled shelters to the elderly and other special populations who may be at risk to extreme temperature events. | All Hazards | All jurisdictions |
| | 2026 | 86. 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 | Climate related hazards | All jurisdictions |

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| | | resistance into the construction of new homes and major home renovation projects. | | |
| 4.2 | | Encourage local communities, agencies, organizations and businesses to participate in the hazard mitigation process | | |
| | ONG | 91. Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds. | All Hazards | All jurisdictions |
| | ONG | 92. 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. | Infrastructure Hazards | All jurisdictions |
| 4.3 | | Encourage cooperation and communication between planning and emergency management officials | | |
| | ONG | 94. 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. | Hazardous Materials | All jurisdictions |
| | ONG | 95. 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). | All Hazards | All jurisdictions |
| | ONG | 97. Utilize the County Geographic Information System (GIS) capabilities to support pre-disaster planning (such as flood stage forecast maps, and maps showing the locations of secluded, gated, and seasonal homes), disaster response, and post-disaster recovery activities. | All Hazards | All jurisdictions |
| | ONG | 98. 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. | All Hazards | All jurisdictions |

Action Plan Caveats

- When identifying the primary agency or jurisdiction(s) responsible for implementing and administering each action, if a specific agency or jurisdiction is not identified and it states “All Municipalities” the responsibility falls to the Office of the Jurisdiction. This includes but is not limited to the Board of Commissioners, County Administration, City Council, City Manager, Village Council, and Township Board of the jurisdiction.
- The Muskegon County Hazard Mitigation Plan considers all of the objectives in the Action Plan as important. As part of its official guidance, FEMA additional requires that the plan further evaluate the objectives to prioritize some implementation actions over others. The Muskegon County Local Emergency Planning Committee therefore selected some objectives as being of “highest priority” (as opposed to standard priority) after holding a special meeting on the topic on March 12, 2024. Objectives that achieved a consensus were selected, with those that aligned with the prioritized hazards contained in the Hazard Analysis portion of this document, being an especially important factor. The following **8** implementation actions were ultimately chosen as being of the highest priority: 1, 48, 60, 50, 58, 66, 83, and 47.
- Funding for Action Plan related activities, where program specific, are noted in the following pages.
- Details on how the Action Plan will be monitored in order to track progress is include in the Planning Process section (starting on page 12) and in the Plan Implementation section (starting on page 460).

Appendix 1:
COMMUNITY PROFILES

MUSKEGON COUNTY

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| 1. | major geographic features: | <ul style="list-style-type: none"> - 344.9 persons per square mile - 147.3 housing units per square mile - 27 miles of Lake Michigan shoreline, Muskegon Lake, White Lake, Mona Lake - White River, Muskegon River - Manistee National Forest - Hart-Montague Bicycle Trail - Musketawa Trail |
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| 2. | Population Concentrations |
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| a. | group homes: | <ul style="list-style-type: none"> - Agape Home at Blueberry Fields, 4747 E. Mount Garfield Rd, Fruitport, MI (capacity 18) - Airline Road Home, 4752 Airline Rd, Muskegon, MI (capacity 6) - Amanda CLF, 4021 Amanda St, Muskegon, MI (capacity 6) - Annette Street Home, 2475 Annette Ave, Muskegon, MI (capacity 6) - Baker Haven Home, 2145 Baker St, Muskegon Heights, MI (capacity 6) - Benston Road Home, 7468 Whitehall Rd, Whitehall, MI (capacity 6) - Big Bear AFC Home, 1690 Sanford St, Muskegon, MI (capacity 6) - Bracey Home, 1345 Marquette Ave, Muskegon, MI (capacity 1) - Brandel AFC, 1559 S. Sheridan, Muskegon, MI (capacity 5) - Broadway Home, 2315 E. Broadway Ave, Muskegon, MI (capacity 6) - Brookmere Home, 3086 Creekview Ln, Muskegon, MI (capacity 6) - Brooks CLF, 599 S. Brooks Rd, Muskegon, MI (capacity 6) - Bush Creek Family Manor, 1126 Alice St, Whitehall, MI (capacity 3) - Bush Creek Manor, 1023 Alice St, Whitehall, MI (capacity 6) - C.M.L. Homes, 2424 Peck St, Muskegon Heights, MI (capacity 4) - Cedar Creek Personal Care 2, 8842 cedar Creek Dr, Holton, MI (capacity 12) - Cedar Creek Personal Care Home I, 8840 Cedar Creek Dr, Muskegon, MI (capacity 12) - Chestnut Fields Retirement Community, 5425 Chestnut Dr, Muskegon, MI (capacity 20) - Christian Care Senior Community, 1530 McLaughlin Ave, Muskegon, MI (capacity 105) - Clark AFC Home, 909 Ducey Ave, Muskegon, MI (capacity 5) - Clouds of Joy AFC, 2216 Baker St, Muskegon Heights, MI (capacity 5) - Country Style AFC, 6427 Blackmer Rd, Ravenna, MI (capacity 2) - Crockery Creek Elder Care, 12291 Crockery Creek, Ravenna, MI (capacity 6) - Crystal Lake Home, 7875 Whitehall Rd North, Whitehall, MI (capacity 6) - Dayspring Assisted Living Residence, 572 Lake Forest Ln, Muskegon, MI (capacity 48) - Donna's View, 2140 Jefferson, Muskegon Heights, MI (capacity 6) - Ducey CLF, 1271 Ducey Ave, Muskegon, MI (capacity 6) - E and L AFC, 1924 Maryland Blvd, Muskegon, MI (capacity 6) - East Side Manor, 1439 East St, Muskegon, MI (capacity 4) - FA-HO-LO Family, 1585 S. Wolf Lake Rd, Muskegon, MI (capacity 8) - Families Manor, 2330 Riverwood Dr, Twin Lake, MI (capacity 6) - Friendly Haven, 7665 E. Ryerson Rd, Holton, MI (capacity 4) - Gibson Garfield East, 4791 Mount Garfield Rd, Fruitport, MI (capacity 12) - Glenside Manor AFC, 2479 Hadden St, Muskegon, MI (capacity 6) - Golden Years Personal Care Home, 6274 MacCarthur Rd, Muskegon, MI (capacity 12) - Hansen Safe, 1635 Hansen St, North Muskegon, MI (capacity 4) - Hume Home of Muskegon, 1244 W. Southern Ave, Muskegon, MI (capacity 34) - Indian Bay Residence, 8770 Indian Bay Rd, Montague, MI (capacity 10) - J.B.C. Home, 2508 McIlwraith St, Muskegon Heights, MI (capacity 6) - Jefferson House AFC, 1311 Jefferson St, Muskegon, MI (capacity 6) - Joseph's House, 866 Forest Park Rd, Muskegon, MI (capacity 6) |
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- Kelly's Kare AFC, 7888 Whitehall Rd, Whitehall, MI (capacity 6)
- Kenneth L. Brinks Residence, 155 E. Apple Ave (capacity 16)
- Krzykwa AFC, 305 E. Colby, Whitehall, MI (capacity 4)
- Lakeside Manor, 2314 Harrison Ave, Muskegon, MI (capacity 6)
- Lakeview, 403 S. Mears Ave, Whitehall, MI (capacity 12)
- Lawrence Home, 1228 Lawrence Ave, Muskegon, MI (capacity 6)
- Light House Retreat, 1357 Terrace, Muskegon, MI (capacity 5)
- Lightfoot House, 381 Houston Ave, Muskegon, MI (capacity 16)
- Lilac Street Home, 1901 Lilac St, Muskegon, MI (capacity 6)
- Little Bear AFC Home, 1698 Sanford St, Muskegon, MI (capacity 6)
- Luthern Social Services, 1635 Hansen
- Marcoux Home, 1465 Marcoux Ave, Muskegon, MI (capacity 6)
- Mary's House, 862 Forest Park Rd, Muskegon, MI (capacity 6)
- Mcintyre Home, 2760 Mararebacah Ln, Muskegon, MI (capacity 3)
- Morning Glory AFC, 2325 Peck St, Muskegon Heights, MI (capacity 6)
- Morris Manor, 23 Strong Ave, Muskegon, MI (capacity 6)
- Morton Terrace AFC, 3929 Hess St, Muskegon, MI (capacity 12)
- Muskegon Adult Foster Care Home, 309 E. Hackley Ave, Muskegon Heights, MI (capacity 12)
- MZ DZ, 501 S Sheridan Ave, Muskegon, MI (capacity 4)
- Northcrest Assisted Living Center, 2650 Ruddiman St, North Muskegon, MI (capacity 86)
- Northridge, 788 Marquette Ave, Muskegon, MI (capacity 7)
- Oak Creek Home, 137 W. Holton Road, Whitehall, MI (capacity 6)
- Oxford Circle, 3293 Orshal Rd, Whitehall, MI (capacity 4)
- Palmer Adult Foster Care Home, 1916 Continental St, Muskegon, MI (capacity 4)
- Park Place Personal Care, 1383 Park St, Muskegon, MI (capacity 6)
- Parkside Home, 1443 Quarterline Rd, Muskegon, MI (capacity 7)
- Patti's Place, 2255 Pillon Rd, Twin Lake, MI (capacity 4)
- Paul's Place AFC, 3475 E Tyler, Twin Lake, MI (capacity 6)
- Pauley AFC, 480 Apple Ave, Muskegon, MI (capacity 6)
- Pinewood Retirement Home, 3234 Nestrom, Whitehall, MI (capacity 6)
- Pioneer House, 1390 Brusse Ave, Muskegon, MI (capacity 12)
- Plan B Adult Foster Care, Muskegon, MI (capacity 6)
- Priority AFC, 6832 Post Rd, Montague, MI (capacity 3)
- Rescued Dreams, 2812 Sixth St, Muskegon Heights, MI (capacity 6)
- River St Home, 620 E River St, Whitehall, MI (capacity 6)
- Riverwood, 2743 S Riverwood, Twin Lake, MI (capacity 6)
- Ruddiman Home, 224 Ruddiman, North Muskegon, MI (capacity 6)
- Sanctuary at the Oaks #1, 1740 Village Dr 1st Floor, Muskegon, MI (capacity 20)
- Sanctuary at the Oaks #2, 1740 Village Dr 2nd Floor, Muskegon, MI (capacity 20)
- Seminole Shores Assisted Living Cntr, 850 Seminole Rd, Muskegon, MI (capacity 129)
- Shaffer House AFC, 171 Dennis St, Fruitport, MI (capacity 6)
- Sheridan AFC, 4144 Sheridan Dr, Muskegon, MI (capacity 6)
- Skyline Home, 3297 Orshal Rd, Whitehall, MI (capacity 4)
- Slocum Street Home, 817 Slocum St, Whitehall, MI (capacity 6)
- Sophia Street Home, 814 Sophia St, Whitehall, MI (capacity 3)
- Spring Street Manor AFC, 121 W Spring St, Whitehall, MI (capacity 5)
- Stacy's AFC, 2648 Ninth Street, Muskegon Heights, MI (capacity 5)
- Sternberg Road Home, 897 W Sternberg Rd, Muskegon, MI (capacity 6)
- Terra Nova, 2745 W White Lake Dr, Whitehall, MI (capacity 3)
- Terrace Manor, 1148 Terrace St, Muskegon, MI (capacity 12)
- The Agape Home, 4445 S Brooks Rd, Muskegon, MI (capacity 20)
- The Cove, 1776 Vulcan St, Muskegon, MI (capacity 80)
- Virginia's House, 391 Whispering Oaks Dr, Muskegon, MI (capacity 5)
- Walker House AFC, 125 Delaware, Muskegon, MI (capacity 15)

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| | | <ul style="list-style-type: none"> - Walker Road Home, 6646 Walker Rd, Fruitport, MI (capacity 6) - West Fruitport Home, 2289 W. Fruitport Road, Spring Lake, MI (capacity 6) - White Lake Assisted Living, 6827 Whitehall Rd, Whitehall, MI (capacity 38) - Winicki AFC, 2646 LeBouef St, Norton Shores, MI (capacity 6) - Wood Ridge, 1231 Horton Rd, North Muskegon, MI (capacity 3) |
| <p>b.</p> | <p>large apartment buildings:</p> | <ul style="list-style-type: none"> - Amazon Apartments, 550 W Western Ave, Muskegon, MI (129 units) - Barclay Senior Village, 2081 Barclay St, Muskegon, MI (70 units) - Barclay Townhouses, 2081 Barclay St, Muskegon, MI (54 units) - Barclay Village, 2081 Barclay St, Muskegon, MI (92 units) - Bayview Tower, 864 Spring St, Muskegon, MI (200 senior units) - Bear Creek Apts., 91 E Giles Rd, Muskegon, MI (38 units) - Beverly Hills Apartments, 415 Mitzi St, North Muskegon, MI (138 units) - Blue Lake Residences LP, 7190 Progress Dr, Twin Lake, MI (68 units) - Brittany Hills Apartments, 1269 Witham Apt G, North Muskegon, MI - Catalina Shores, 5970 Avalon Dr, Muskegon, MI (88 units) - Channel View Apartments, 8050 Cook St, Montague, MI (56 units) - Chesapeake Landing Apartments, 2690 Chesapeake Dr, Muskegon, MI (88 units) - Christian Manor, 1480 McLaughlin Ave, Muskegon, MI (42 units) - Columbia Court, 65 E. Columbia Ave, Muskegon Heights, MI (89 units) - Countryside Manor, 3199 S Slocum Rd, Ravenna, MI (11 senior units) - Creekside, 3796 S Ravenna Rd, Ravenna, MI (32 units) - East Park Manor, 615 E. Hovey Ave, Muskegon Heights, MI (200 units) - East Side Court, 615 E. Hovey Ave, Muskegon Heights, MI (50 units) - Eastwood Village Apartments, 2243 E. Apple Ave, Muskegon, MI (69 units) - Harbour Pointe Apartments, 8673 Ferry St, Montague, MI (34 units) - Hartford Terrace, 1080 Terrace St, Muskegon, MI (160 units) - Hidden Cove Apartments, 3975 Grand Haven Rd, Norton Shores, MI (54 units) - Jefferson Towers, 1077 Jefferson St, Muskegon, MI (156 senior units) - Lake Forest Apartments, 581 Lake Forest Ln, Norton Shores, MI (252 units) - M.A. Houston Towers, 3020 Peck St, Muskegon Heights, MI (52 senior units) - Mona Shores Apartments, 3711 Henry St, Muskegon, MI (36 units) - Muskegon Townhouses, 919 Marquette Ave, Muskegon, MI (213 units) - Nelson Place, 350 Houston Ave, Muskegon, MI (101 units) - Roosevelt Park Apartments, 3224 Maple Grove, Muskegon, MI (48 units) - Park Terrace, 1290 W Hackley Ave, Muskegon, MI (150 units) - Park Woods Apts, 924 Shonat St, Muskegon, MI (100 senior units) - Pine Grove Manor, 1764 E. Apple Ave, Muskegon, MI (172 senior units) - Quail Meadow, 725 Meadow Ln, Muskegon, MI (120 units) - Renaissance Place Apartments, 570 W. Clay Ave, Muskegon, MI (24 senior units) - Royale Glen Townhomes, 1085 Royale Glen Dr, Muskegon, MI (78 units) - Shoreline Landing, 959 Flette St, Norton Shores, MI (210 units) - Shawl Apartments, 225 S Hall St, Whitehall, MI (40 units) - Shawl II, Senior Housing of Montague, 8363 Cook St, Montague, MI (25 units) - The Reserve at Norton Shores, 1523 Norton Shores Ln, Norton Shores, MI (150 units) - The Hamptons of Norton Shores, 909 Hamptons Ct, Muskegon, MI (104 units) - The Shores of Roosevelt Park, 3050 Maple Grove Rd, Muskegon, MI (302 units) - The Village at Park Terrace, 1350 W. Hackley Ave, Muskegon, MI (122 senior units) - Tiffany Woods Apartments, 3298 Roosevelt Rd, Muskegon, MI (302 units) - Trinity Village I, 2250 Valley St, Muskegon, MI (30 units) - Trinity Village II, 2250 Valley St, Muskegon, MI (30 units) - Trinity Manor, 347 Shonat St, Muskegon, MI (45 senior units) - Village at Jackson Hill, 557 McClaren Ave, Muskegon, MI (50 units) - Wells Villa, 2818 Woodcliffe Dr, Muskegon, MI (104 units) - West Shore Apartments, 1201 E. Colby Rd, Whitehall, MI (48 units) - Whitehall Apartments, 1123 E Colby St, Whitehall, MI (48 units) |

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| <p>c.</p> | <p>schools:</p> | <ul style="list-style-type: none"> - Baker College, 1903 Marquette Ave (4,467 students, 500 full & part-time employees) - Cavalry Christian School, 5873 Kendra Rd (200 students, 30 staff) - Fruitport Community Schools <ul style="list-style-type: none"> - Fruitport Community High School, 357 N 6th Ave (894 students) - Fruitport Middle School, 3113 Pontaluna (703 students) - Beach Elementary, 2741 Heights Ravenna (390 students) - Edgewood Elementary, 3255 Pontaluna Rd (558 students) - Shettler Elementary, 2187 Shettler Rd (396 students) - Holton Public Schools <ul style="list-style-type: none"> - Holton High School, 6477 Syers Rd (265 students, 28 staff) - Holton Middle School, 6245 Syers Rd (211 students, 15 staff) - Holton Elementary, 6500 4th St (389 students, 45 staff) - Mona Shores Public Schools (2005 estimates) <ul style="list-style-type: none"> - Mona Shores High School, 1121 Seminole Rd (1,315 students, 72 staff) - Mona Shores Middle School, 1700 Woodside Rd (884 students, 47 staff) - Cambell Elementary, 1355 Greenwich Rd (380 students, 26 staff) - Churchill Elementary, 961 Porter Rd (360 students, 20 staff) - Lincoln Park Elementary, 2951 Leon St (445 students, 24 staff) - Ross Park Elementary, 121 Randall Rd (395 students, 28 staff) - Montague Public Schools <ul style="list-style-type: none"> - Montague Area High School, 4900 Stanton Blvd (373 students, 40 staff) - R.R. Oehrli Elementary, 4859 Knudsen St (604 students, 60 staff) - Nellie B Chisholm Middle School, 4700 Stanton Blvd (345 students, 38 staff) - Montague Area Childhood Center, 5161 Dicey St (175 students, 24 staff) - Muskegon Area Intermediate School District (MAISD) <ul style="list-style-type: none"> - Wesley School, 915 Wesley Ave (200 students, 100 staff) - Career Tech Center, 200 Harvey St (700 students, 45 staff) - Muskegon Catholic High School & Middle School, 1145 W Laketon Ave (459 students, 40 staff) - Muskegon Christian Elementary School, 1220 Eastgate St (233 students, 35 staff) - Muskegon Community College, 221 S Quarterline Rd (5,067 students, 544 full & part-time employees) - Muskegon Heights Public School Academy System <ul style="list-style-type: none"> - Muskegon Heights High School, 2441 Sanford St (300 estimated students) - Muskegon Heights Middle School, 55 E Sherman St (300 estimated students) - Edgewood Elementary School, 3028 Howden St (300 estimated students) - M.L. King Jr Elementary School, 600 E Barney Ave (300 estimated students) - Muskegon Public Schools <ul style="list-style-type: none"> - Muskegon High School, 80 W Southern Ave (1000 students, 114 staff) - Muskegon Middle School, 1150 Amity Ave (618 students, 64 staff) - Lakeside Elementary, 2312 Denmark St (594 students, 67 staff) - Marquette Elementary, 480 Bennett St (584 students, 84 staff) - Moon Elementary, 1826 Hoyt (393 students, 49 staff) - Nelson Elementary School, 550 W Grand Ave (529 students, 82 staff) - Oakview Elementary, 1420 Madison St (539 students, 61 staff) - Muskegon Community Education, 571 Apple Ave (97 students, 32 staff) - North Muskegon Public Schools <ul style="list-style-type: none"> - North Muskegon High School, 1600 Mills Ave (276 students, 23 staff) - North Muskegon Middle School, 1600 Mills Ave (223 students, 23 staff) - North Muskegon Elementary, 1600 Mills Ave (498 students, 29 staff) - Oakridge Public Schools <ul style="list-style-type: none"> - Oakridge High School, 5493 Hall Rd (493 students, 51 staff) - Oakridge Middle School, 251 S Wolf Lake Rd (296 students, 36 staff) - Oakridge Upper Elementary, 481 S Wolf Lake Rd (471 students, 42 staff) - Oakridge Lower Elementary, 5290 Bryn Mawr PI (660 students, 61 staff) |
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| | | <ul style="list-style-type: none"> - Oakridge Alternative Education (56 students, 7 staff) - Orchard View Schools <ul style="list-style-type: none"> - Orchard View High School, 16 N Quarterline Rd (657 students, 58 staff) - Orchard View Middle School, 35 S Sheridan Rd (560 students, 53 staff) - Orchard View Elementary, 2310 Marquette (747 students, 45 staff) - Orchard View Early Elementary, 2820 MacArthur Rd (422 students, 57 staff) - Ravenna Public Schools <ul style="list-style-type: none"> - Ravenna High School, 2700 S Ravenna Rd (342 students, 23 staff) - Ravenna Middle School, 2766 S Ravenna Rd (345 students, 26 staff) - Beechnau Elementary School, 12322 Stafford St (390 students, 41 staff) - Reeths-Puffer Schools <ul style="list-style-type: none"> - Reeths-Puffer High School, 1545 N Roberts Rd (1,178 students, 92 staff) - Reeths-Puffer Middle School, 1911 W Giles Rd (645 students, 46 staff) - Reeths-Puffer Elementary, 874 E Giles Rd (487 students, 39 staff) - Central Elementary, 1807 W Giles Rd (413 students, 38 staff) - McMillan Elementary, 2885 Hyde Park Rd (200 students, 26 staff) - Pennsylvania Elementary School, 2500 Pennsylvania (38 students, 2 staff) - Twin Lake Elementary, 3175 5th St (269 students, 25 staff) - Reeths-Puffer Intermediate School, 1500 N Getty Rd (577 students, 46 staff) - Three Oaks Academy, 1212 Kingsley St (325 students, 35 staff) - Timberland Charter Academy, 2574 McLaughlin Ave (500 students, 54 staff) - Western Michigan Christian High School, 455 E Ellis Rd (330 students, 48 staff) - Whitehall District Schools <ul style="list-style-type: none"> - Whitehall High School, 3100 White Lake Drive (640 students, 50 staff) - Whitehall Middle School, 401 S Elizabeth St (455 students, 40 staff) - Ealy Elementary, 425 E Sophia St (455 students, 40 staff) - Shoreline Elementary, 205 Market St (500 students, 50 staff) |
| d. | childcare facilities: | Refer to individual city, village and township profiles |
| e. | large office buildings: | <ul style="list-style-type: none"> - Comerica Building, 801 W Norton - Michael E. Kobza Hall of Justice, 990 Terrace St. - Park Row Mall Tower, 950 W. Norton - Terrace Plaza, 316 Morris Ave. |
| 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: | <ul style="list-style-type: none"> - Mercy Health Partners (3,657 employees) - Alcoa Howmet, 1 Misco Drive, Whitehall, MI (2,060 employees) - County of Muskegon, 990 Terrace St, Muskegon, MI (1,028 employees) - Muskegon Public Schools, 349 Terrace St, Muskegon, MI (941 employees) - Meijer (866 employees) - Target Stores, 5057 Harvey, Norton Shores, MI (125 employees) - ADAC Automotovie, 2050 Port City Blvd, Muskegon, MI (750 employees) - G.E. Aviation, 2034 Latimer Dr, Muskegon, MI (553 employees) - G.E. Aviation, 6060 Norton Center Dr, Norton Shores, MI (322 employees) - Port City Group, 1985 E Laketon Ave, Muskegon, MI (493 employees) - Knoll, 2800 Estes St, Norton Shores, MI (403 employees) - L-3 Combat Propulsion Systems, 76 S Getty St, Muskegon, MI (380 employees) - Eagle Alloy, 5142 Evanston Ave, Muskegon, MI (361 employees) - SAF Holland, 1950 Industrial Blvd, Muskegon, MI (330 employees) - Kautex-CWC Textron, 1085 W Sherman Blvd, Muskegon, MI (280 employees) - Diversified Machine Inc, 5353 Wilcox St, Montague, MI (270 employees) |

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| | <ul style="list-style-type: none"> - Hines Corporation, 1218 E Pontaluna Rd, Norton Shores, MI (270 employees) - Hilite International, 2001 Peach St, Whitehall, MI (250 employees) - Structural Concepts, 888 E Porter Rd, Norton Shores, MI (245 employees) - Metal Technologies, 3800 Adams Rd, Ravenna, MI (220 employees) - Muskegon Community College, 221 S Quarterline Rd, Muskegon, MI (211 employees) - Sun Chemical, 5025 Evanston Ave, Muskegon, MI (182 employees) - Brunswick, 525 W Laketon Ave, Muskegon, MI (175 employees) - Kaydon, 2860 McCracken St, Norton Shores, MI (175 employees) - Cannon Muskegon, 2875 Lincoln St, Norton Shores, MI (170 employees) - Coles, 1188 Lakeshore Dr, Muskegon, MI (147 employees) - Baker College, 1903 Marquette Ave, Muskegon, MI (143 employees) - ACEMCO, 7297 Enterprise Dr, Spring Lake, MI (125 employees) - TGW Ermanco, 5566 Grand Haven Rd, Muskegon, MI (124 employees) - Mastertage International, 9751 U.S. 31 Business, Montague, MI (120 employees) - Michigan Spring & Stamping, 2700 Wickham St, Muskegon, MI (115 employees) - Michigan's Adventure, 4750 Whitehall Rd, Muskegon, MI |
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| 3. Population Shifts | |
| a. daily: | <ul style="list-style-type: none"> - 67,269 commute to work with an average commuting time of 20.8 minutes - 36,376 school-aged children |
| b. seasonal: | <ul style="list-style-type: none"> - 73,561 total housing units: 65,616 occupied/7,945 vacant - Of the vacant, 2,004 (25.2%) are for seasonal, recreational, or occasional use |

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| 4. Important or Critical Public and Private Facilities | |
| a. police precincts: | <ul style="list-style-type: none"> - Montague Police Department, 5085 Wilcox St - City of Muskegon Police Department, 980 Jefferson St - Muskegon Central Dispatch, 770 Terrace St - Muskegon County Sheriff Department, 25 W Walton Ave - Muskegon Heights Police Department, 2715 Baker St - North Muskegon Police Department, 1114 Ruddiman Dr - Norton Shores Police Department, 4814 Henry St - Roosevelt Park Police Department, 900 Oak Ridge Rd - Whitehall Police Department, 405 E Colby St - Egelston Township Police Department, 5380 E Apple Ave - Muskegon Township Police Department, 1990 E Apple Ave |
| b. fire stations: | <ul style="list-style-type: none"> - Montague Fire Department, 8660 Water St - Muskegon Fire Department, 770 Terrace St - Marquette Station (Muskegon FD), 1477 Marquette Ave - Robinson Station (Muskegon FD), 1836 Robinson St - Muskegon Heights Fire Department, 2715 Baker St - North Muskegon Fire Department, 1102 Ruddiman Dr - Norton Shores Fire Station #1, 1577 Seminole Rd - Norton Shore Fire Station #2, 3920 Airline Rd - Norton Shores Fire Station #3, 1100 E Pontaluna - Whitehall Fire Department- White Lake Fire Authority, 115 S Baldwin St - Blue Lake Township Fire Department, 1491 Owasippe Rd - Blue Lake Fire Department #2, 796 White Lake Dr - Casnovia Township Fire Department, 17569 Bailey Rd - DNR Muskegon Field Office, 7550 E Messinger Rd - Dalton Township Fire Department, 1650 E Riley Thompson Rd - Egelston Township Fire Department, 5380 E Apple Ave - Fruitport Township Fire Department (2 stations), 3368 Black Creek Rd., 5815 Airline Rd |

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| | | <ul style="list-style-type: none"> - Holton Fire Department, 6590 Holton-Whitehall Rd - Moorland Township Fire Department, 12416 E Apple Ave - Muskegon Township Fire Department, 1117 S Walker Rd - Muskegon Township Fire Department #2, 1699 N Getty St - Ravenna Area Fire Department, 3763 Blackmer Rd |
| c. | public works yards: | <ul style="list-style-type: none"> - Dalton Maintenance, 1618 E. Riley Thompson - Department of Public Works, 990 Terrace St. (Muskegon) - Department of Public Works, 2113 Lake Ave.(North Muskegon) - Montague Maintenance Garage, 4976 Bowen St. - Muskegon Public Works and Utility Department, 1350 E. Keating Ave. - Muskegon Township Highway Department, 103 S. Quarterline - Norton Shores Public Works Garage, 85 E. Mount Garfield Rd. |
| d. | pumping stations: | <ul style="list-style-type: none"> - Seven stations across county |
| e. | community shelters: | <ul style="list-style-type: none"> - American Red Cross, 313 W. Webster, Muskegon, MI - Bethesda Baptist Church, 575 Getty, Muskegon, MI - Bluffton Elementary School, 1875 Waterworks Rd, Muskegon, MI - Bunker Middle School, 2312 Denmark St, Muskegon, MI - Central United Methodist Church, 1011 2nd St, Muskegon, MI - Christ Temple Apostolic Church, 412 E Sherman Blvd, Muskegon, MI - Dr. Martin Luther Lutheran Church, 1860 E Hile Rd, Muskegon, MI - Fellowship Reformed Church, 4200 E Apple Ave, Muskegon, MI - First Congregational Church, 1201 Jefferson St, Muskegon, MI - Forest Park Covenant Church, 3815 Henry St, Muskegon, MI - Fruitland Evangelical Covenant Church, 4283 Weber Rd, Whitehall, MI - Greater Muskegon Catholic High School, 1145 E Laketon Ave, Muskegon, MI - Holy Trinity Church of God in Christ, 2140 Valley St, Muskegon, MI - Lakeside Baptist Church, 2250 Denmark, Muskegon, MI - Marquette Elementary School, 480 Bennett St, Muskegon, MI - McMillan Elementary, 2885 Hyde Park Rd, Muskegon, MI - Montague High School, 4900 Stanton Blvd, Montague, MI - Muskegon Community College, 221 S Quarterline Rd, Muskegon, MI - Muskegon High School, 80 W Southern Ave, Muskegon, MI - Nelson School, 550 W Grand Ave, Muskegon, MI - Oakview School, 1420 Madison St, Muskegon, MI - Ravenna SR High School, 2766 S Ravenna Rd, Ravenna, MI - Reeths-Puffer High School, 1545 N Roberts, Muskegon, MI - Reeths-Puffer Intermediate School, 1500 N Getty St, Muskegon, MI - Reeths-Puffer Middle School, 1911 W Giles Rd, Muskegon, MI - Steele Middle School, 1150 Amity Ave, Muskegon, MI - St Gregory's Episcopal, 1200 Seminole Rd, Muskegon, MI - St Luke's Lutheran Church, 1655 W. Norton Ave, Muskegon, MI - St Paul's Episcopal Church, 1006 Third St, Muskegon, MI - Torrent House, 315 W Webster Ave, Muskegon, MI - Western Michigan Christian High School, 455 Ellis Rd, Muskegon, MI - YMCA, 900 W Western, Muskegon, MI |
| f. | medical facilities, hospitals: | <ul style="list-style-type: none"> - Accessible Health Center Urgent, 4478 Dowling St - Mercy Health Partners Hackley Campus, 1700 Clinton St (186 beds) - Mercy General Health Partners, 1500 E Sherman Blvd, 1700 Oak Ave (196 beds) - Community Mental Health of Muskegon County <ul style="list-style-type: none"> -New mental health center, 376 Apple Ave - Kenneth L. Brinks Residence, 155 E Apple Ave - Lifeskills, 97 E Apple Ave - Club Interaction, 1470 Peck St |

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| | | <ul style="list-style-type: none"> - Wesley/Roberts Center, 1175 Wesley Ave - Norton Redi-Med, 747 W Norton Ave - Mercy Health Partners – Lakes Village, 6401 Prairie St - Lakeshore Medical Associates PC, 905 E Colby St - Community Mental Health of Muskegon County Whithall Adult Activity Center, 511 E Colby St - Pro Med Ambulance, 965 Fork St - White Lake Ambulance Authority, 119 S Baldwin 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: | <ul style="list-style-type: none"> - I-96 - US-31 - State Highways: M-37, M-46, M-120 - County Roads: B-15, B-23, B-31, B-35, B-72, B-86 - Michigan Shore Railroad - Bridges: US-31 over White River; US-31 over Muskegon River; M-120 over Muskegon River; Railroad over Muskegon River; Henry St. over Mona Lake; Lake Harbor Rd. over Mona Lake |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | <ul style="list-style-type: none"> - Cleveland Lake Dam (Cleveland Creek), Brown’s Pond Dam (Sand Creek), Little Black Lake Dam, Mill Pond Dam (Mill Pond Creek), Muskegon Wastewater Lagoon Dam (Black and Mosquito Creeks), Silver Creek Pond Dam (Silver Creek) - Power Transmission Line (Casnovia Twp, Cedar Creek Twp, City of Montague, City of Muskegon, City of North Muskegon, Dalton Twp, Egelston Twp, Fruitland Twp, Holton Twp, Montague Twp, Moorland Twp, Muskegon Twp, Ravenna Twp, Sullivan Twp, Village of Lakewood Club, White River Twp, Whitehall Twp) - B.C. Cobb Gas & Coal Generating Plant, 101 SR-120 - City of Muskegon Water and Sewer Maintenance, 1350 E. Keating Ave. - City of Muskegon Water Filtration Plant, 1900 Beach St. - City of Muskegon Heights Water Filtration, 2323 Seminole Rd. - City of Whitehall Water and Sewer - Egelston Township Sewer and Maintenance, 5360 E. Apple Ave. - Fruitport Township Water Department, 6543 Airline Rd - Fruitport Township Sewer Department, 2810 E. Mt. Garfield - Muskegon County Solid Waste Management, 9366 E. Apple Ave. - Muskegon County Wastewater Management - Metro Site, 8301 White Rd. - Muskegon Heights Water and Sewer - Sixteen Sanitary Lift Stations in the county |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Natural Gas Pipelines (Blue Lake Twp, Cedar Creek Twp, Dalton Twp, Egelston Twp, Holton Twp, Sullivan Twp, Montague Twp, Moorland Twp, Whitehall Twp) - Oil Pipeline (City of Muskegon, City of Muskegon Heights, City of North Muskegon, City of Norton Shores, City of Roosevelt Park, Fruitport Township, Sullivan Township) - Greyhound Bus Terminal, 351 Morris Ave. - Landing Strip, Jensen Rd. and Cloverville Rd. - Midget Private Airport, 4821 Cady Rd. |

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| | <ul style="list-style-type: none"> - Muskegon Area Transit System Terminal, 2624 Morris Ave - Muskegon County Airport, 99 Sinclair Dr. - Northside Airport, 2151 River Rd. - Ottiger Airport, 10770 Sikkenga Rd. - United States Coast Guard Air Facility, 689 Airport Rd. - United States Coast Guard Station, 1555 Beach St. - United States Army Reserve Center, 1430 Parslow Dr. |
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| 6. | Socio-Economic Profile of Sector |
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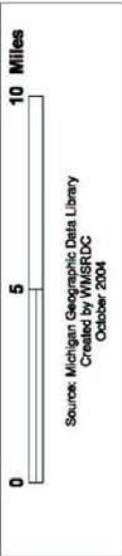
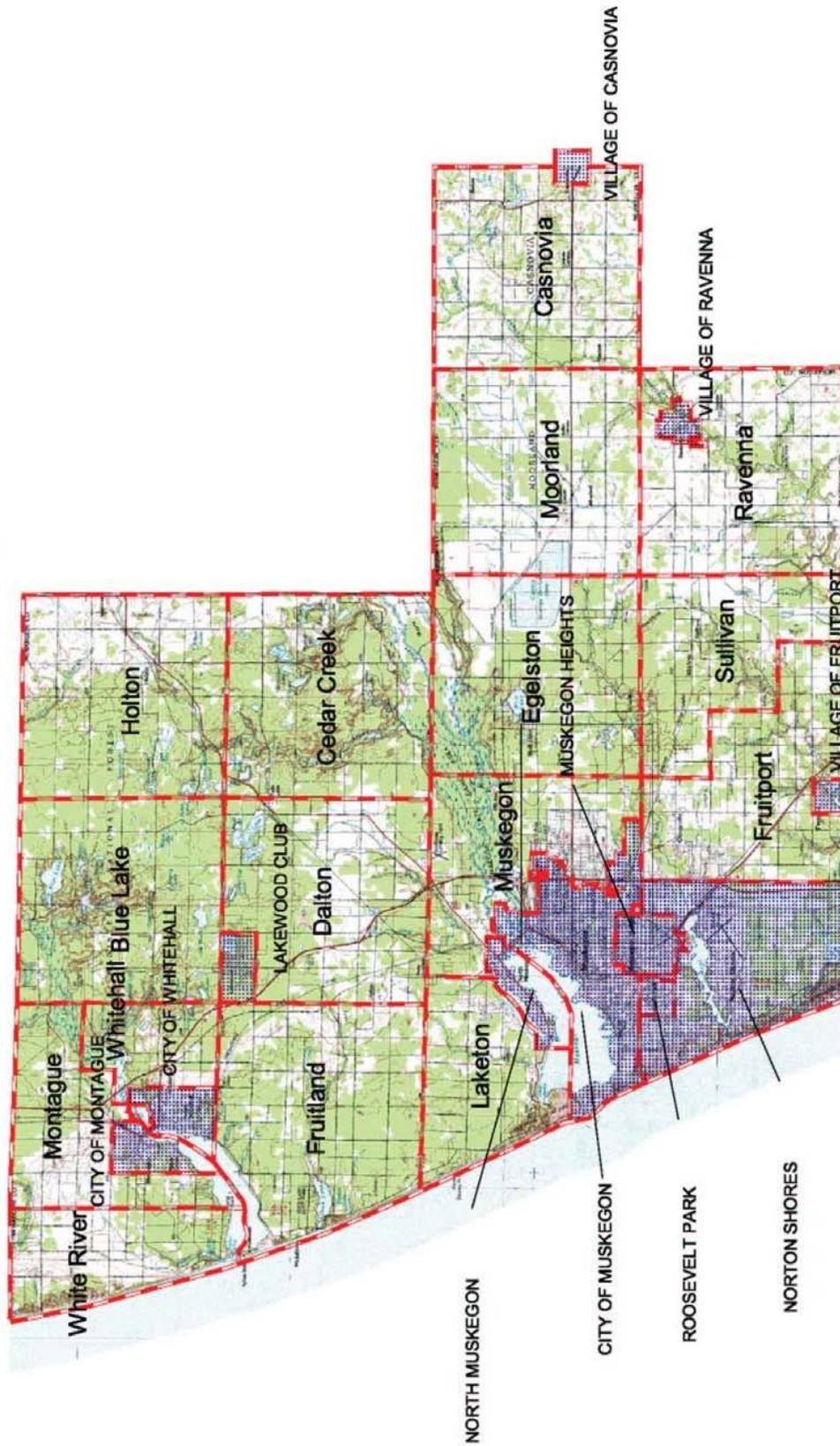
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|--------------------------------|--|---|------------------------------|---------------|--------------------------------|---------------|--------------------|---------------|---------------------------|-----------------|---------------------|---------------|--------|-----------------|
| a. | total population (night): | 172,188 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 177,258 | | | | | | | | | | | | |
| c. | percent over 65: | 13.6 | | | | | | | | | | | | |
| d. | percent under 18: | 24.8 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 75.1 | | | | | | | | | | | | |
| f. | percent below poverty level: | 14.5 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 22.3 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Agricultural:</td> <td style="text-align: right;">\$115,088,300</td> </tr> <tr> <td>Commercial:</td> <td style="text-align: right;">\$752,802,200</td> </tr> <tr> <td>Industrial:</td> <td style="text-align: right;">\$238,909,000</td> </tr> <tr> <td>Residential:</td> <td style="text-align: right;">\$3,182,341,250</td> </tr> <tr> <td>Utility (Personal):</td> <td style="text-align: right;">\$457,344,700</td> </tr> <tr> <td style="text-align: right;">Total:</td> <td style="text-align: right;">\$4,746,485,450</td> </tr> </table> | Agricultural: | \$115,088,300 | Commercial: | \$752,802,200 | Industrial: | \$238,909,000 | Residential: | \$3,182,341,250 | Utility (Personal): | \$457,344,700 | Total: | \$4,746,485,450 |
| Agricultural: | \$115,088,300 | | | | | | | | | | | | | |
| Commercial: | \$752,802,200 | | | | | | | | | | | | | |
| Industrial: | \$238,909,000 | | | | | | | | | | | | | |
| Residential: | \$3,182,341,250 | | | | | | | | | | | | | |
| Utility (Personal): | \$457,344,700 | | | | | | | | | | | | | |
| Total: | \$4,746,485,450 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Total Losses since 01/01/78:</td> <td style="text-align: right;">90</td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td style="text-align: right;">\$349,483</td> </tr> <tr> <td>Policies In-Force:</td> <td style="text-align: right;">170</td> </tr> <tr> <td style="text-align: right;">Total Insurance In-Force:</td> <td style="text-align: right;">33,303,000</td> </tr> </table> | Total Losses since 01/01/78: | 90 | Total Payments since 01/01/78: | \$349,483 | Policies In-Force: | 170 | Total Insurance In-Force: | 33,303,000 | | | | |
| Total Losses since 01/01/78: | 90 | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | \$349,483 | | | | | | | | | | | | | |
| Policies In-Force: | 170 | | | | | | | | | | | | | |
| Total Insurance In-Force: | 33,303,000 | | | | | | | | | | | | | |
| j. | location of floodplains: | Refer to individual city, village and township profiles | | | | | | | | | | | | |

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| 7. | Emergency Warning System Coverage |
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|-----------|---|---|
| a. | siren locations and/or description of warning system: | <ul style="list-style-type: none"> - Webster Well, 8660 Water St, Montague - Scharmer Water Tower, 8195 Scharmer Dr, Montague - Muskegon Heights Fire Department, 2715 Baker St, Muskegon Heights - Muskegon County Airport, 115 Sinclair Dr - Siren in 400 Block of S Warner St, Whitehall - Siren at Benston & S Division St, Whitehall - Siren in 200 Block of E Colby St, Whitehall - Siren at Kenwood & Auburn Rd, Lakewood Club - Siren at 1491 Owasippe Rd, Blue Lake |
| b. | percent of population covered by warning sirens or system: | - One mile radius |

(Note: Map showing warning siren locations and approximate system coverage is contained in Part D.)

Muskegon County



CITY OF MONTAGUE

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 922.3 persons per square mile - 461.7 housing units per square mile - Moderate dense residential area, light commercial - White Lake - 2 to 4 small creeks - Hart-Montague Bicycle Trail |
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| 2. | Population Concentrations |
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|-----------|--|---|
| a. | group homes: | - None Identified |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Channel View Apartments, 8050 Cook St (54 family units) - Harbour Pointe, 8673 Ferry St (34 elderly units) - Senior Housing Association of White Lake II, 8363 Cook (25 elderly units) |
| c. | schools: | <ul style="list-style-type: none"> - Montague Area High School, 4900 Stanton Blvd (373 students, 40 staff) - Nellie B. Chisholm Middle School (Montague Area Schools), 4700 Stanton Blvd (345 students, 38 staff) - R. R. Oehrli Elementary (Montague Area Schools), 4859 Knudsen St (604 students, 24 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Janet Hams, 8543 Old Channel Trail (capacity 12) - Good Shepherd Preschool, St. James Church, 8945 Stebbins Rd (capacity 24) - Montague Kid's Stop, 4859 Knudsen (capacity 50) - Montague Area Childhood Center, 9151 Dicey (capacity 82) |
| 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) | <ul style="list-style-type: none"> - Montague High School Football Stadium, 4900 Stanton Blvd - Ellenwood Landing Marina, 8560 Ellenwood Dr. (187 seasonal and 20 transient slips) - Harbor Hill Landing, 8166 Old Channel Trail (18 seasonal slips) - Maple Beach Yacht Club, 4770 Goodrich St (66 slips) - Little Harbor Yacht Club, 4650 Goodrich St (84 seasonal slips) - Trailway Campground, 4540 Dowling St (55 sites) - Montague City Museum, Church St and Meade St (summer weekends) - Montague Mountain Inn, 9075 Water St (7 rooms) - Weathervane Inn, 4527 Dowling St (23 rooms) - Montague Farmers Market, Water & Church St (Saturdays-May, then every Wednesday & Saturday – Labor Day) - Montague 4th of July Parade & Fireworks - White Lake Community Music Shell, Launch Ramp Rd (summer concerts) |
| g. | major employers: | - Diversified Machine Inc, 5353 Wilcox St (270 employees) |

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| 3. | Population Shifts |
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| a. | daily: | <ul style="list-style-type: none"> - 865 commute with an average commuting time of 21.3 minutes - 494 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,182 total housing units: 1,006 occupied/176 vacant - Of the vacant, 92 (52.3%) are seasonal recreational or occasional use |

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| 4. | Important or Critical Public and Private Facilities | | |
| a. | police precincts: | - Montague Police Department, 8778 Ferry St. | |
| b. | fire stations: | - Montague Fire Department, 5085 Wilcox St. | |
| c. | public works yards: | - Montague Maintenance Garage, 4976 Bowen St. | |
| d. | pumping stations: | - Two | |
| e. | community shelters: | - Montague Area High School, 4900 Stanton Blvd | |
| f. | community medical facilities, hospitals: | - Accessible Health Center Urgent, 4478 Dowling St | |
| 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) | - Montague City Hall, 8778 Ferry St. - Montague Branch – Muskegon County Library, 8778 Ferry St. | |
| 5. | Vital or Critical Infrastructure | | |
| a. | roads, railroads, and bridges: | - US-31 Business Route - US-31 Business Route bridge over White River | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line - 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): | | 2,361 |
| b. | peak population (seasonal): | | 2,577 |
| c. | percent over 65: | | 16.1 |
| d. | percent under 18: | | 25.2 |
| e. | percent of homeowners: | | 70.2 |
| f. | percent below poverty level: | | 9.4 |
| g. | percent with disability or mobility limitation: | | 19 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Utility (Personal): Total: | \$0 \$9,337,600 \$5,211,100 \$56,800,600 \$17,791,200 \$89,140,500 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | 7 \$78,853 4 \$\$876,000 |
| j. | location of floodplains: | - White Lake shoreline, White River, Koon Creek, and Buttermilk Creek | |

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| 7. | Emergency Warning System Coverage | |
| a. | siren locations and/or description of warning system: | - Webster Well, 8660 Water St - Scharmer Water Tower, 8195 Scharmer Dr |
| b. | percent of population covered by warning sirens or system: | - One mile radius |
| (Note: Map showing warning siren location and system coverage is contained in Part D.) | | |

Land Use and Natural Features Map (USGS Quad.)

City of Montague



0 0.5 1 Miles

Source: Michigan Geographic Data Library
Created by WMSRDC
October 2004

CITY OF MUSKEGON

| | | |
|-----------|-----------------------------------|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 2,702.4 persons per square mile - 1,133.4 housing units per square mile - Dense residential, industrial and commercial areas - Lake Michigan shoreline and beach - Coastal sand dunes - Muskegon Lake - Muskegon River - 4 to 6 small lakes and ponds, 4 to 6 small creeks |
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Big Bear AFC Home, 1690 Sanford St (capacity 6) - Bracey Home, 1345 Marquette Ave (capacity 1) - Chestnut Fields Retirement Community, 5425 Chestnut Dr (capacity 20) - Clark AFC Home, 909 Ducey Ave (capacity 5) - Ducey CLF, 1271 Ducey Ave (capacity 6) - Glenside Manor AFC, 2479 Hadden St (capacity 6) - Hume Home of Muskegon, 1244 W Southern Ave (capacity 34) - Jefferson House AFC, 1311 Jefferson St (capacity 6) - Kenneth L. Brinks Residence, 155 E. Apple Ave (capacity 16) - Lakeside Manor, 2314 Harrison Ave (capacity 6) - Lawrence Home, 1228 Lawrence Ave (capacity 6) - Light House Retreat, 1357 Terrace (capacity 5) - Lightfoot House, 381 Houston Ave (capacity 16) - Little Bear AFC Home, 1698 Sanford St (capacity 6) - Marcoux Home, 1465 Marcoux Ave (capacity 6) - Morris Manor, 23 Strong Ave (capacity 6) - Northridge, 788 Marquette Ave (capacity 7) - Palmer Adult Foster Care Home, 1916 Continental St (capacity 4) - Park Place Personal Care, 1383 Park St (capacity 6) - Pauley AFC, 480 Apple Ave (capacity 6) - Sanctuary at the Oaks #1, 1740 Village Dr 1st Floor (capacity 20) - Sanctuary at the Oaks #2, 1740 Village Dr 2nd Floor (capacity 20) - Terrace Manor, 1148 Terrace St (capacity 12) - The Cove, 1776 Vulcan St (capacity 80) - Walker House AFC, 125 Delaware (capacity 15) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Nelson Place, 350 Houston Ave (101 units) - Trinity Village II, 2250 Valley St (30 units) - Trinity Village I, 2250 Valley St (30 units) - Jefferson Towers, 1077 Jefferson St (156 senior units) - Amazon Apartments, 550 W Western Ave (129 units) - Renaissance Place Apartments, 570 W Clay Ave (24 senior units) - Muskegon Townhouses, 919 Marquette Ave (213 units) - Bayview Tower, 864 Spring St (200 units) - Royale Glen Townhomes, 1085 Royale Glen Dr (78 units) - The Village at Park Terrace, 1290 W Hackley Ave (122 senior units) - Park Terrace, 1290 W Hackley Ave (150 units) - Village at Jackson Hill, 557 McClaren Ave (50 units) - Barclay Village, 2081 Barclay St (92 units) - Trinity Manor, 347 Shonat St (45 senior units) - Trinity Manor, 347 Shonat St (46 units) |

| | | |
|-----------|--|---|
| | | <ul style="list-style-type: none"> - Hartford Terrace, 1080 Terrace St (160 units) - Barclay Townhouses, 2081 Barclay St (54 units) - Barclay Senior Village, 2081 Barclay St (70 senior units) |
| c. | schools: | <ul style="list-style-type: none"> - Baker College, 1903 Marquette Ave (4,467 students, 500 employees) - Head Start of Muskegon/Oceana, 1017 Wesley - Muskegon Catholic High School & Middle School, 1145 W. Laketon Ave (459 students, 40 staff) - Muskegon Christian Elementary, 1220 Eastgate St (233 students, 35 staff) - Muskegon Community College, 221 S Quarterline Rd (5,067 students, 544 employees) - Muskegon Public Schools <ul style="list-style-type: none"> - Muskegon High School, 80 W Southern Ave (1000 students, 114 staff) - Muskegon Middle School, 1150 Amity Ave (618 students, 64 staff) - Glenside Elementary, 1213 W Hackley Ave - Lakeside Elementary, 2312 Denmark St (594 students, 67 staff) - Marquette Elementary, 480 Bennett St (584 students, 84 staff) - Moon Elementary, 1826 Hoyt (393 students, 49 staff) - Nelson Elementary School, 550 W Grand Ave (529 students, 82 staff) - Oakview Elementary, 1420 Madison St (539 students, 61 staff) - Muskegon Community Education, 571 Apple Ave (97 students, 32 staff) - Three Oaks Academy, 1212 Kingsley St (325 students, 35 staff) - Wesley School (MAISD), 915 Wesley Ave (200 students, 100 staff) - Career Tech Center (MAISD), 200 Harvey St (700 students, 45 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Cynthia Niemeyer, 1535 5th St (capacity 12) - Tiny Toes Childcare, 2396 Blodgett St (capacity 12) - Sally Ann Truss, 213 Broadmoor St (capacity 12) - Elva Walker, 1536 Park St (capacity 12) - Redha Karla Ali, 1688 Elwood St (capacity 12) - Rebecca Sue Smith, 1367 Flower (capacity 12) - B's Big Adventure Daycare, 549 Marlane St (capacity 12) - Tamara Warren, 1322 Francis (capacity 12) - Terri Carter, 1916 Hoyt (capacity 12) - Corky's Day Care, 832 Orchard Ave (capacity 12) - Solutions Unlimited- TOO, 1753 Madison (capacity 30) - Helping Hands Learning Center A, 1198 Spring St (capacity 35) - Muskegon Catholic Preschool- Small Blessings, 1145 W Laketon (capacity 46) - Muskegon Pub Sch P K Marquette, 480 Bennett St (capacity 47) - Bright Beginnings Preschool and Day Care, 1220 Eastgate St (capacity 75) - Advanced Beginnings C.O.G.I.C. Learning Center, 2140 Valley St (capacity 96) - Muskegon Pub Sch Pre K Nelson, 550 W Grand Ave (capacity 100) - Muskegon Middle School, 1150 Amity Ave (capacity 100) - Muskegon Pub Sch Pre K Oakview, 1420 Madison St (capacity 100) - Glenside Head Start & Kid's World Learning Center, 1213 W Hackley Ave (capacity 248) |
| e. | large office buildings: | <ul style="list-style-type: none"> - Terrace Plaza, 316 Morris Ave - Michael E. Kobza Hall of Justice, 990 Terrace St - 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) | <ul style="list-style-type: none"> - L.C. Walker Arena, 955 4th St (6,000 capacity) - Frauenthal Theater, 425 W. Western Ave (1,800 capacity) - Beardsley Theater, 425 W. Western Ave (170 capacity) - Heritage Landing, (Coast West Music Festival- July 1-6; Unity Christian Music Festival – August; Michigan Irish Music Festival - September) Shoreline Dr. - Bike Time, Western Ave, Mid-July - McGraft Park Amphitheater, Wickham and Glen Ave |

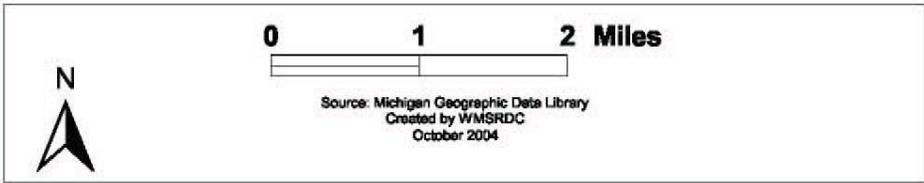
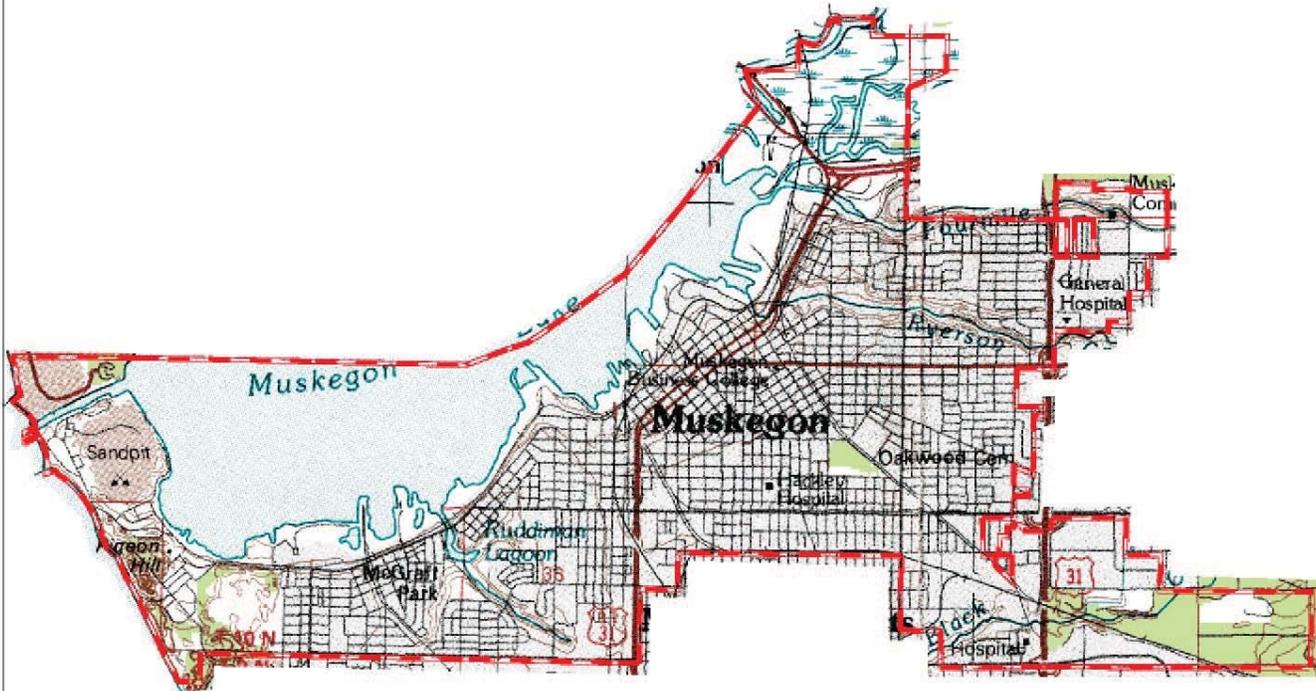
| | | |
|-----------------------------|-------------------------|--|
| | | <ul style="list-style-type: none"> - Muskegon High School Football Stadium, 80 W. Southern Ave - Muskegon County Museum, 430 W. Clay Ave - Muskegon Museum of Art, 296 W. Webster Ave - Milwaukee Clipper Museum, Lakeshore & McCracken - Lake Express Car Ferry (Milwaukee-Muskegon), Lakeshore Drive at Great Lakes Marina (46 cars, 250 passengers) - Port City Princess, Hartshorn Marina (150 passengers) - USS Silversides Submarine Museum, 1346 Bluff St - Muskegon County Jail, 25 W. Walton Ave. (370 capacity, 46 officers) - Muskegon Correctional Facility, 2400 S. Sheridan (1,306 capacity, 304 staff) - Earnest C. Brooks Correctional Facility, 2500 S. Sheridan Rd (1,224 capacity, 508 staff) - West Shoreline Correctional Facility, 2500 S. Sheridan Rd (960 capacity, shares staff with Brooks Facility) - Christian Care Nursing Center, 1275 Kenneth St (49 beds) - Deboer Nursing Home, 1684 Vulcan St. (90 beds) - Heartland Health Care Center - Knollview, 1061 W. Hackley Ave (107 beds) - McAuley Place A Mercy Living Center, 1380 E. Sherman Blvd (98 beds) - University Park - A Mercy Living Center, 570 Harvey St (99 beds) - Muskegon Country Club, 2801 Lakeshore Dr (18 holes) - University Park Golf Course, 2100 Marquette Ave (9 holes) - Balcom Marina, 2964 Lakeshore Dr (72 seasonal and 6 transient slips) - Bluffton Bay Marina, 3040 Lakeshore Dr (100 slips) - Great Lakes Marina, 1920 Lakeshore Dr (250 seasonal and 20 transient slips) - Harbor Towne Marina, 3429 Fulton Ave (242 seasonal and 20 transient slips) - Hartshorn Municipal Marina, 920 W. Western Ave (146 seasonal and 43 transient slips) - Lakeshore Yacht Harbour, 1200 Lakeshore Dr (63 seasonal slips) - Muskegon Yacht Club, 3198 Edgewater (70 slips) - Pigeon Key Marina, 3545 Marina View Pt - Terrace Point Marina, 722 Terrace Point (112 seasonal and 14 transient slips) - Torresen Marine, 3126 Lakeshore Dr (150 seasonal and 10 transient slips) - Holiday Inn, 939 3rd St. (200 rooms) - Shoreline Inn & Suites, 750 Terrace Point Rd(140 rooms) - Fisherman's Landing, 538 Western Ave (39 campsites) - Dunes Mobile Home Park, 2481 W Sherman Blvd |
| g. | major employers: | <ul style="list-style-type: none"> - Mercy Health Partners - County of Muskegon, 990 Terrace St (1,028 employees) - Muskegon Public Schools, 349 W Webster Ave (941 employees) - ADAC Automotive, 2050 Port City Blvd (750 employees) - G.E. Aviation, 2034 Latimer Drive (553 employees) - Port City Group, 1985 E Laketon (493 employees) - SAF Holland, 1950 Industrial Blvd (330 employees) - Brunswick, 525 W Laketon Ave (175 employees) - Coles, 1188 Lakeshore Dr (147 employees) - Baker College, 1903 Marquette Ave (143 employees) |
| 3. Population Shifts | | |
| a. | daily: | <ul style="list-style-type: none"> - 11,835 commute with an average commuting time of 18.3 minutes - 7,617 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 16,105 total housing units: 13,967 occupied/2,138 vacant - Of the vacant, 175 (8.2%) are for seasonal recreational or occasional use |

| 4. | Important or Critical Public and Private Facilities | |
|----|--|--|
| a. | police precincts: | <ul style="list-style-type: none"> - City of Muskegon Police Department, 980 Jefferson St. - Muskegon Central Dispatch, 770 Terrace St. - Muskegon County Sheriff Department, 25 W. Walton Ave. |
| b. | fire stations: | <ul style="list-style-type: none"> - Muskegon Fire Department, 770 Terrace St. - Marquette Station (Muskegon FD), 1477 Marquette Ave. - Robinson Station (Muskegon FD), 1836 Robinson St. |
| c. | public works yards: | <ul style="list-style-type: none"> - Department of Public Works, 990 Terrace St. - Muskegon Public Works and Utility Department, 1350 E. Keating Ave. |
| d. | pumping stations: | <ul style="list-style-type: none"> - One |
| e. | community shelters: | <ul style="list-style-type: none"> - American Red Cross, 313 W Webster - Bethesda Baptist Church, 575 Getty - Bluffton Elementary School, 1875 Waterworks Rd - Bunker Middle School, 2312 Denmark St - Central United Methodist Church, 1011 2nd St - Greater Muskegon Catholic High School, 1145 E Laketon Ave - Holy Trinity Church of God in Christ, 2140 Valley St - Lakeside Baptist Church, 2250 Denmark - Marquette Elementary School, 480 Bennett St - Muskegon Community College, 221 S Quarterline Rd - Muskegon High School, 80 W Southern Ave - Nelson School, 550 W Grand Ave - Oakview School, 1420 Madison St - Steele Middle School, 1150 Amity Ave - St Paul's Episcopal Church, 1006 Third St - Torrent House, 315 W Webster Ave - YMCA, 900 W Western |
| f. | community medical facilities, hospitals: | <ul style="list-style-type: none"> - Mercy Health Partners Hackley Campus, 1700 Clinton St. (186 beds) - Mercy General Health Partners, 1500 E Sherman, 1700 Oak (196 beds) - Community Mental Health of Muskegon County <ul style="list-style-type: none"> - New mental health center, 376 E. Apple Ave. - Kenneth L. Brinks Residence, 155 E. Apple Ave. - Lifeskills, 97 E. Apple Ave. - Club Interaction, 1470 Peck St. - Wesley/Roberts Center, 1175 Wesley Ave. - Pro Med Ambulance, 965 Fork St. |
| g. | historic sites: | <ul style="list-style-type: none"> - Amazon Hoisery Mill, 530-550 W Western Ave - Bluffton Actors Colony Commemorative Designation, Water Works St - Central United Methodist Church, 1011 Second St - Duquette-Carlson Market, 585 Clay - Evergreen Cemetery, Bounded by Grand, Wood, Pine, and Irvin - Ferris Business College Informational Deisignation, 141 Hartford - Hackley Public Library, 316 W Webster Ave - Hackley, Charles H, House, 484 W Webster Ave - Hackley-Holt House, 523 W Clay Ave - Hartshorn Curtain Roller Company, 1150 W Western Ave - Hovey, Horatio N., House, 318 Houston Ave - Hume House, 472 W Webster Ave - Indian Cemetery, Morris Ave between 1st & 2nd St - Michigan Theater Building, 407 W Western Ave - Muskegon Central Fire Station, 75 Walton Ave - Muskegon Historic District, Bounded by Clay, Muskegon, 2nd, and 6th St - Muskegon Woman's Club, 280 Webster Ave |

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|---------------------|--|---|---------------|-----|-------------|---------------|-------------|---------------|--------------|---------------|---------------------|---------------|--------|---------------|
| | | <ul style="list-style-type: none"> - Muskegon YMCA 297 W Clay Ave - Pinchtown Informational Designation, corner of Laketon & Lakeshore - Muskegon Log Booming Company Informational Site, Richards Park - S.S. Milwaukee Clipper, Grand Trunk Carferry Dock - Torrent House, 315 W Webster - Union Depot, 610 W Western Ave - USS Silversides, Muskegon Channel- Fulton & Bluff St | | | | | | | | | | | | |
| h. | other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | <ul style="list-style-type: none"> - Muskegon City Hall, 933 Terrace St. - Blind and Physically Handicapped Library, 97 E. Apple Ave. - Hackley Public Library, 316 W. Webster Ave. - Muskegon County Emergency Services, 131 E. Apple Ave. - County of Muskegon Community Corrections, 131 E Apple Ave | | | | | | | | | | | | |
| 5. | Vital or Critical Infrastructure | | | | | | | | | | | | | |
| a. | roads, railroads, and bridges: | <ul style="list-style-type: none"> - US-31 - US-31 Business Route - M-46 - B-72 - Michigan Shore Railroad - Michigan Shore Railroad Bridge over Muskegon River North Branch - Michigan Shore Railroad Bridge over Muskegon River South Branch - M-120 bridge over Muskegon River - Lakeshore Drive bridge over Ruddiman Creek | | | | | | | | | | | | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | <ul style="list-style-type: none"> - B.C. Cobb Gas & Coal Generating Plant, 101 SR-120 - Water Filtration Plant, 1900 Beach St. - City of Muskegon Water and Sewer Maintenance, 1350 E. Keating Ave. - Sanitary Lift Stations: Three - Power Transmission Line | | | | | | | | | | | | |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Greyhound Bus Terminal, 351 Morris Ave. - Muskegon Area Transit System, 2624 Morris Ave - Oil Pipeline - United States Coast Guard Station, 1555 Beach St. - United States Army Reserve Center, 1430 Parslow Dr. | | | | | | | | | | | | |
| 6. | Socio-Economic Profile of Sector | | | | | | | | | | | | | |
| a. | total population (night): | 38,401 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 38,818 | | | | | | | | | | | | |
| c. | percent over 65: | 11.6 | | | | | | | | | | | | |
| d. | percent under 18: | 23.3 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 52.5 | | | | | | | | | | | | |
| f. | percent below poverty level: | 27.8 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 28.1 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Agricultural:</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>Commercial:</td> <td style="text-align: right;">\$143,167,500</td> </tr> <tr> <td>Industrial:</td> <td style="text-align: right;">\$111,320,300</td> </tr> <tr> <td>Residential:</td> <td style="text-align: right;">\$327,218,300</td> </tr> <tr> <td>Utility (Personal):</td> <td style="text-align: right;">\$103,850,900</td> </tr> <tr> <td style="text-align: right;">Total:</td> <td style="text-align: right;">\$685,557,000</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$143,167,500 | Industrial: | \$111,320,300 | Residential: | \$327,218,300 | Utility (Personal): | \$103,850,900 | Total: | \$685,557,000 |
| Agricultural: | \$0 | | | | | | | | | | | | | |
| Commercial: | \$143,167,500 | | | | | | | | | | | | | |
| Industrial: | \$111,320,300 | | | | | | | | | | | | | |
| Residential: | \$327,218,300 | | | | | | | | | | | | | |
| Utility (Personal): | \$103,850,900 | | | | | | | | | | | | | |
| Total: | \$685,557,000 | | | | | | | | | | | | | |

| | | | |
|---|---|---|-------------|
| i. | flood insurance coverage: | Total Losses since 01/01/78: | 27 |
| | | Total Payments since 01/01/78: | \$39,733 |
| | | Policies In-Force: | 22 |
| | | Total Insurance In-Force: | \$4,628,700 |
| j. | location of floodplains: | - Lake Michigan shoreline, Muskegon Lake shoreline, Muskegon River, Ryerson Creek, Ruddiman Lagoon, and Four Mile 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 | |

City of Muskegon



CITY OF MUSKEGON HEIGHTS

| | | |
|-----------|--|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 3,403.1 persons per square mile - 1,517.9 housing units per square mile - Dense residential and industrial areas - 1 to 2 small lakes and ponds, 1 to 2 small creeks |
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Baker Haven Home, 2145 Annette Ave (capacity 6) - C.M.L. Homes, 2424 Peck St (capacity 4) - Clouds of Joy AFC, 909 Ducey Ave (capacity 5) - Donna's View, 2140 Jefferson (capacity 6) - Morning Glory AFC, 2325 Peck (capacity 6) - Muskegon Adult Foster Care Home, 309 E Hackley Ave (capacity 12) - Rescued Dreams, 2812 Sixth St (capacity 6) - Stacy's AFC, 2648 Ninth Street (capacity 5) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Wells Villa, 2818 Woodcliffe Dr (104 units) - M.A. Houston Towers, 3020 Peck St (52 senior units) - East Park Manor, 615 E Hovey Ave (200 units) - Columbia Court, 65 E Columbia Ave (89 units) - East Side Court, 615 E Hovey Ave (50 units) |
| c. | schools: | <ul style="list-style-type: none"> - Muskegon Heights High School, 2441 Sanford St (300 (est) students) - Muskegon Heights Middle School, 55 E Sherman (300 (est) students) - Edgewood Elementary School, 3028 Howden St (300 (est) students) - M.L. King Jr Elementary School, 600 E Barney Ave (300 (est) students) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Bobbie Hampton, 3028 Leahy (capacity 12) - Thomas Denise Lavette, 2913 Leahy (capacity 12) - Right Start Learning Center, 2325 Lemuel (capacity 30) - Caring Hands Day Care Center, 440 Sherman Blvd (capacity 30) - Bed Buggs Child Development Center, 2244 Peck St (capacity 45) - Dr. Martin Luther King Jr Elementary, 600 E Barney St (capacity 245) - Little Hands Learning Center, 3355 Merriam St (capacity 60) |
| 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) | <ul style="list-style-type: none"> - Muskegon Heights High School Football Stadium, 2427 Jefferson St. - Muskegon Heights Festival, Rowan Park- June 13-15 - Cornerhouse Motor Inn, 3350 Glade St. (23 rooms) - Heights Motel, 3300 Hoyt St. - Red Roof Inn & Suites, 150 Seaway Dr. (129 rooms) - Mona Lake Mobile Home Park, 3527 Hoyt Street |
| g. | major employers: | - Muskegon Heights Public School Academy System |
| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 2,649 commute with an average commuting time of 16.8 minutes - 2,720 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 4,842 total housing units: 3,996 occupied/846 vacant - Of the vacant, 8 (1.0%) are for seasonal recreational or occasional use |

| 4. Important or Critical Public and Private Facilities | |
|--|--|
| a. police precincts: | - Muskegon Heights Police Department, 2715 Baker St. |
| b. fire stations: | - Muskegon Heights Fire Department, 2715 Baker St. |
| c. public works yards: | - None Identified |
| d. pumping stations: | - None Identified |
| e. community shelters: | - Christ Temple Apostolic Church, 412 E Sherman Blvd |
| 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) | - Muskegon Heights City Hall, 2724 Peck St. - Muskegon Heights Library, 2808 Sanford St. - Muskegon County FIA, 2700 Baker St. |

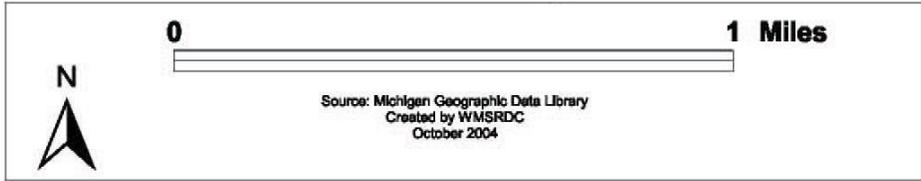
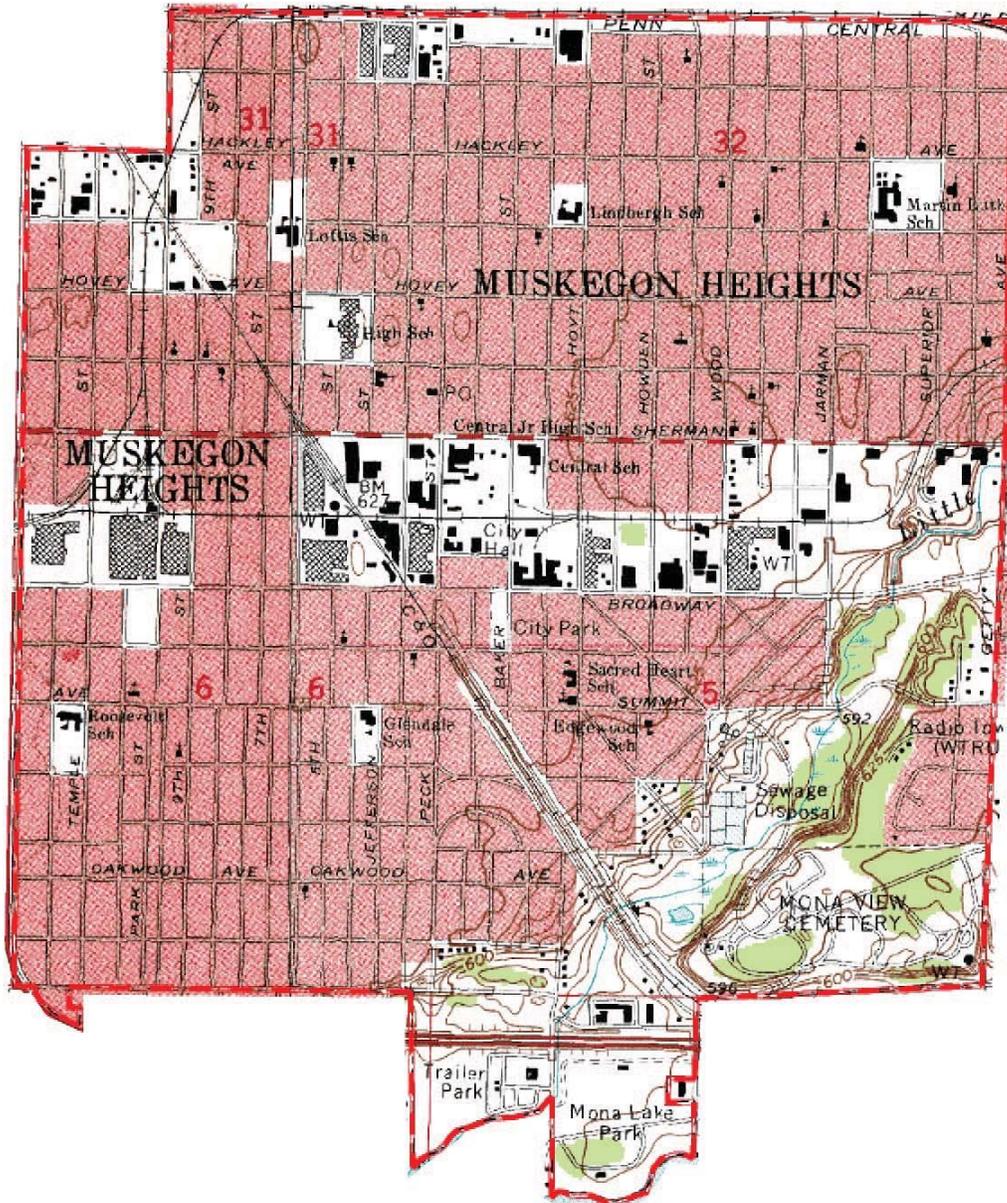
| 5. Vital or Critical Infrastructure | |
|---|--|
| a. roads, railroads, and bridges: | - US-31 Business Route - Michigan Shore Railroad |
| b. dams, power stations, water treatment plants, sanitary lift stations, etc. | - Muskegon Heights Water and Sewer - Sanitary Lift Stations: Four |
| c. other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Muskegon Area Transit System, 2624 6 th St. - Oil Pipeline |

| 6. Socio-Economic Profile of Sector | | | | | | | | | | | | | |
|---|---|------------------------------|-----|--------------------------------|--------------|--------------------|---------------|---------------------------|---------------|---------------------|--------------|--------|---------------|
| a. total population (night): | 10,856 | | | | | | | | | | | | |
| b. peak population (seasonal): | 10,877 | | | | | | | | | | | | |
| c. percent over 65: | 9.6 | | | | | | | | | | | | |
| d. percent under 18: | 32.3 | | | | | | | | | | | | |
| e. percent that are homeowners: | 51.1 | | | | | | | | | | | | |
| f. percent below poverty level: | 42 | | | | | | | | | | | | |
| g. percent with disability or mobility limitation: | 32.1 | | | | | | | | | | | | |
| h. estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table border="0"> <tr> <td>Agricultural:</td> <td>\$0</td> </tr> <tr> <td>Commercial:</td> <td>\$23,053,400</td> </tr> <tr> <td>Industrial:</td> <td>\$111,320,300</td> </tr> <tr> <td>Residential:</td> <td>\$327,218,300</td> </tr> <tr> <td>Utility (Personal):</td> <td>\$21,659,900</td> </tr> <tr> <td>Total:</td> <td>\$483,251,900</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$23,053,400 | Industrial: | \$111,320,300 | Residential: | \$327,218,300 | Utility (Personal): | \$21,659,900 | Total: | \$483,251,900 |
| Agricultural: | \$0 | | | | | | | | | | | | |
| Commercial: | \$23,053,400 | | | | | | | | | | | | |
| Industrial: | \$111,320,300 | | | | | | | | | | | | |
| Residential: | \$327,218,300 | | | | | | | | | | | | |
| Utility (Personal): | \$21,659,900 | | | | | | | | | | | | |
| Total: | \$483,251,900 | | | | | | | | | | | | |
| i. flood insurance coverage: | <table border="0"> <tr> <td>Total Losses since 01/01/78:</td> <td>2</td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td>N/A</td> </tr> <tr> <td>Policies In-Force:</td> <td>3</td> </tr> <tr> <td>Total Insurance In-Force:</td> <td>\$1,008,000</td> </tr> </table> | Total Losses since 01/01/78: | 2 | Total Payments since 01/01/78: | N/A | Policies In-Force: | 3 | Total Insurance In-Force: | \$1,008,000 | | | | |
| Total Losses since 01/01/78: | 2 | | | | | | | | | | | | |
| Total Payments since 01/01/78: | N/A | | | | | | | | | | | | |
| Policies In-Force: | 3 | | | | | | | | | | | | |
| Total Insurance In-Force: | \$1,008,000 | | | | | | | | | | | | |
| j. location of floodplains: | - Mona Lake shoreline, Black Creek | | | | | | | | | | | | |

| 7. Emergency Warning System Coverage | |
|---|--|
| a. siren locations and/or description of warning system: | - Siren at Muskegon Heights Fire Department, 2715 Baker St |
| b. percent of population covered by warning sirens or system: | - One mile radius |

(Note: Map showing warning siren location and system coverage is contained in Part D.)

City of Muskegon Heights



CITY OF NORTH MUSKEGON

| | | |
|-----------|--|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 2,151.1 persons per square mile - 1,042 housing units per square mile - Dense residential, light commercial areas - Muskegon Lake - Bear Lake - Muskegon River |
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Northcrest Assisted Living Center, 2650 Ruddiman Dr. (capacity 86) - Ruddiman Home, 224 Ruddiman (capacity 6) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Beverly Hills Apartments, 415 Mitzi St. (60 units) |
| c. | schools: | <ul style="list-style-type: none"> - North Muskegon High School, 1600 Mills (276 students, 23 staff) - North Muskegon Middle School, 1600 Mills (223 students, 23 staff) - North Muskegon Elementary, 1600 Mills (498 students, 29 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Dawn Dick, 606 W Sunset (capacity 12) - Laurie LeMieux, 922 Central Ave (capacity 12) - Susan Lloyd, 419 Oaknoll Dr (capacity 12) - Little Norse Daycare, 2108 Ruddiman Ave (capacity 12) - North Muskegon Lighthouse Learning Center, 1600 Mills (capacity 51) - Maple Tree Inc, 1825 Ruddiman Dr (capacity 75) |
| e. | large office buildings: | <ul style="list-style-type: none"> - 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) | <ul style="list-style-type: none"> - North Muskegon High School Football Stadium, 511 Eimer Ave. - Hillcrest Nursing Centre, 695 Mitzi St. (62 beds) - Pointe Marine, 350 Cihak Rd. (124 seasonal and 6 transient slips) - Causeway Motel, 440 Whitehall Rd. |
| g. | major employers: | <ul style="list-style-type: none"> - None Identified |
| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 1,580 commute with an average commuting time of 19.7 minutes - 727 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,834 total housing units: 1,621 occupied/213 vacant - Of the vacant, 49 (21.2%) are for seasonal recreational or occasional use |
| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | <ul style="list-style-type: none"> - North Muskegon Police Department, 1114 Ruddiman Dr. |
| b. | fire stations: | <ul style="list-style-type: none"> - North Muskegon Fire Department, 1102 Ruddiman Dr. |
| c. | public works yards: | <ul style="list-style-type: none"> - Department of Public Works, 2113 Lake Ave. |
| d. | pumping stations: | <ul style="list-style-type: none"> - None Identified |
| e. | community shelters: | <ul style="list-style-type: none"> - None Identified |
| f. | community medical facilities, hospitals: | <ul style="list-style-type: none"> - None Identified |
| g. | historic sites: | <ul style="list-style-type: none"> - Jean Baptiste Recollect Trading Post Informational Site, SE Corner of Ruddiman and Bear Lake Rd |

| | | |
|-----------|--|---|
| h. | other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | <ul style="list-style-type: none"> - North Muskegon City Hall, 1502 Ruddiman Dr. - Walker Memorial Library, 1522 Ruddiman Dr. - Erickson's, 2217 Lake Ave. |
|-----------|--|---|

| | |
|-----------|---|
| 5. | Vital or Critical Infrastructure |
|-----------|---|

| | | |
|-----------|---|---|
| a. | roads, railroads, and bridges: | <ul style="list-style-type: none"> - M-120 - Michigan Shore Railroad - Whitham Rd. bridge over Bear Lake |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | <ul style="list-style-type: none"> - Power Transmission Line - Sanitary Lift Stations: One |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Oil Pipeline and Storage Tanks |

| | |
|-----------|---|
| 6. | Socio-Economic Profile of Sector |
|-----------|---|

| | | | | | | | | | | | | | | |
|--------------------------------|---|--|------------------------------|-----|--------------------------------|--------------|--------------------|-------------|---------------------------|---------------|---------------------|-------------|--------|---------------|
| a. | total population (night): | 3,786 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 3,899 | | | | | | | | | | | | |
| c. | percent over 65: | 20.6 | | | | | | | | | | | | |
| d. | percent under 18: | 22.7 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 76.1 | | | | | | | | | | | | |
| f. | percent below poverty level: | 7.9 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 15.1 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Agricultural:</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>Commercial:</td> <td style="text-align: right;">\$14,912,200</td> </tr> <tr> <td>Industrial:</td> <td style="text-align: right;">\$1,275,900</td> </tr> <tr> <td>Residential:</td> <td style="text-align: right;">\$124,361,300</td> </tr> <tr> <td>Utility (Personal):</td> <td style="text-align: right;">\$5,655,900</td> </tr> <tr> <td style="text-align: right;">Total:</td> <td style="text-align: right;">\$146,205,300</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$14,912,200 | Industrial: | \$1,275,900 | Residential: | \$124,361,300 | Utility (Personal): | \$5,655,900 | Total: | \$146,205,300 |
| Agricultural: | \$0 | | | | | | | | | | | | | |
| Commercial: | \$14,912,200 | | | | | | | | | | | | | |
| Industrial: | \$1,275,900 | | | | | | | | | | | | | |
| Residential: | \$124,361,300 | | | | | | | | | | | | | |
| Utility (Personal): | \$5,655,900 | | | | | | | | | | | | | |
| Total: | \$146,205,300 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Total Losses since 01/01/78:</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td style="text-align: right;">N/A</td> </tr> <tr> <td>Policies In-Force:</td> <td style="text-align: right;">55</td> </tr> <tr> <td style="text-align: right;">Total Insurance In-Force:</td> <td style="text-align: right;">\$13,266,000</td> </tr> </table> | Total Losses since 01/01/78: | 3 | Total Payments since 01/01/78: | N/A | Policies In-Force: | 55 | Total Insurance In-Force: | \$13,266,000 | | | | |
| Total Losses since 01/01/78: | 3 | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | N/A | | | | | | | | | | | | | |
| Policies In-Force: | 55 | | | | | | | | | | | | | |
| Total Insurance In-Force: | \$13,266,000 | | | | | | | | | | | | | |
| j. | location of floodplains: | - Muskegon Lake shoreline, Bear Lake shoreline, and Muskegon River | | | | | | | | | | | | |

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| 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 |

CITY OF NORTON SHORES

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 1,032.4 persons per square mile - 470.7 housing units per square mile - Dense residential, moderate commercial areas - Lake Michigan shoreline and beach - Coastal sand dunes - Mona Lake, Black Lake - 10 to 12 small lakes and ponds, 8 to 10 small creeks |
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Dayspring Assisted Living Residence, 572 Lake Forest Ln (capacity 48) - E and L AFC, 1924 Maryland Blvd (capacity 6) - Joseph's House, 866 Forest Park Rd (capacity 6) - Mary's House, 862 Forest Park Rd (capacity 6) - Morton Terrace AFC, 3929 Hess St (capacity 12) - Seminole Shores Assisted Living Center, 850 Seminole (capacity 129) - Sternberg Road Home, 897 W Sternberg Rd (capacity 6) - Winicki AFC, 2646 LeBouef St (capacity 6) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Lake Forest Apartments, 581 Lake Forest Ln (252 units) - Hidden Cove Apartments, 3975 Grand Haven Rd (54 units) - Mona Shores Apartments, 3711 Henry St (36 units) - The Reserve at Norton Shores, 1523 Norton Shores Ln (150 units) - Shoreline Landing, 959 Flette St (210 units) - The Hamptons of Norton Shores, 909 Hamptons Ct (104 units) |
| c. | schools: | <ul style="list-style-type: none"> - Mona Shores High School, 1121 Seminole Rd (1,315 students, 72 staff(2005 est)) - Mona Shores Middle School, 1700 Woodside Rd (884 students, 47 staff (2005 est)) - Churchill Elementary (Mona Shores Schools), 961 Porter Rd (360 students, 20 staff (2005 est)) - Lincoln Park Elementary (Mona Shores Schools), 2951 Leon St (445 students, 24 staff (2005 est)) - Ross Park Elementary (Mona Shores Schools), 121 Randall Rd (395 students, 28 staff (2005 est)) - Western Michigan Christian High School, 455 E. Ellis Rd (330 students, 48 staff) - Mona Shores Preschool, 3374 McCracken St - St. Mark Lutheran Preschool, 4475 Henry St |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Melissa Bush, 5155 Gay St (capacity 12) - Raquel Szymanski, 963 Donna Ave (capacity 12) - Jumpstart Child Care Center, 2417 Sherman Blvd (capacity 30) - Diana Thieu Vachirasudlekha, 547 Aue Rd (capacity 12) - Cuddly Cubs Child Care, 830 E Sternberg Rd (capacity 12) - Janet Stefanich, 2943 Austin (capacity 12) - Sunshine Day Care, 4556 Grand Haven Rd (capacity 23) - Mona Shores and Lincoln Park Childcare, 2951 Leon St (capacity 35) - Ross Park Head Start and GSRP, 121 Randall Rd (capacity 38) - Mona Shores and Churchill Childcare, 961 Porter Rd (capacity 50) - Michigan Dunes Montessori Inc, 5248 Henry St (capacity 100) - Mona Shores/ Ross Park Child Care, 121 Randall Rd (capacity 200) |

| | | |
|----|--|---|
| e. | large office buildings: | - Comerica Building, 801 W Norton |
| f. | other: (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas) | <ul style="list-style-type: none"> - Maranatha Bible and Missionary Conference, 4759 Lake Harbor Rd. - Mona Shores High School Football Field, 1121 Seminole Rd. - Shoreline Soccer Club, 6875 Norton Pines Drive (up to 6,000 spectators per week) - Mona Shores Performing Arts Center, 1121 Seminole Rd. (850 capacity) - Cinema Carousel Theatre, 4289 Grand Haven Rd. (2,500 capacity) - Plaza 1 & 2 Theatre, 3450 Henry St. - Getty-4 Drive In Theater, 920 Summit (capacity 1,200 cars, closed winters) - Muskegon Elk's Campground, 5447 Lake Harbor Rd. - P.J. Hoffmaster State Park, 6585 Lake Harbor Rd. (293 campsites) - Oak Ridge Golf Course, 513 Pontaluna Rd. (18 holes) - Alpine Motel, 4262 Airline Rd. (18 rooms) - Baymont Inn, 4677 S. Harvey St. (61 rooms) - Bel-Aire Motel, 4240 Airline Rd. (18 rooms) - Fairfield Inn, 5214 Martin Rd. (100 rooms) - Hampton Inn, 1401 E. Ellis Rd. (81 rooms) - Motel Haven, 4344 Airline Rd. - Seaway Motel, 631 W. Norton Ave. (29 rooms) - Chateau Norton Shores Mobile Home Community, 3223 Bailey Ave - Hillcrest Mobile Home Park, 3290 Getty Street - Nomad Trailer Park, 2701 Huizenga - The Oaks Mobile Home Park, 3240 Getty - Pontaluna Shores Mobile Home Park, 1281 Pontaluna Rd - Dunes Mobile Home Park, Sherman Blvd |
| g. | major employers: | <ul style="list-style-type: none"> - Meijers Inc., 700 W. Norton Ave. (550 employees) - Knoll, 2800 Estes St (403 employees) - Hines Corporation, 1218 E Pontaluna Rd (270 employees) - Structural Concepts, 888 E Porter Rd (245 employees) - Kaydon, 2860 McCracken St (175 employees) - Cannon Muskegon, 2875 Lincoln St (170 employees) - ACEMCO, 7297 Enterprise Dr (125 employees) - TGW Ermanco, 5566 Grand Haven Rd (124 employees) - GE Aviation, 6060 Norton Center Dr (322 employees) - Target Stores, 5057 Harvey St (125 employees) |

3. Population Shifts

| | | |
|----|------------------|---|
| a. | daily: | <ul style="list-style-type: none"> - 10,477 commute with an average commuting time of 18.0 minutes - 4,561 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 10,939 total housing units: 9,977 occupied/962 vacant - Of the vacant, 252 (26.2%) are for seasonal recreational or occasional use |

4. Important or Critical Public and Private Facilities

| | | |
|----|----------------------------|---|
| a. | police precincts: | - Norton Shores Police Department, 4814 Henry St. |
| b. | fire stations: | <ul style="list-style-type: none"> - Norton Shores Fire Station #1, 1577 Seminole Rd. - Norton Shores Fire Station #2, 3920 Airline Rd. - Norton Shores Fire Station #3, 1100 E. Pontaluna |
| c. | public works yards: | - Norton Shores Public Works Garage, 85 E. Mount Garfield Rd. |
| d. | pumping stations: | - One |

| | | |
|-----------|--|--|
| e. | community shelters: | - Forest Park Covenant Church, 3815 Henry St - St Gregory's Episcopal, 1200 Seminole Rd - St Luke's Lutheran Church, 1655 W Norton Ave - Western Michigan Christian High School, 455 Ellis Rd |
| f. | community medical facilities, hospitals: | - Norton Redi-Med, 747 W. Norton Ave - Mercy Health Partners – Lakes Village, 6401 Prairie St |
| 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) | - Norton Shores City Hall, 4814 Henry St. - Norton Shores Library, 705 Seminole Rd. - Norton Shores Department of Public Works, Mt Garfield Rd |

| | | |
|-----------|---|---|
| 5. | Vital or Critical Infrastructure | |
| a. | roads, railroads, and bridges: | - US-31 - US-31 Business Route - Michigan Shore Railroad - Henry St. Bridge over Mona Lake, ¼ mile south of Seminole Rd. - Lake Harbor Rd Bridge over Mona Lake - Black Lake Rd Bridge |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - City of Muskegon Heights Water Filtration, 2323 Seminole Rd. - Sanitary Lift Stations: One - Little Black Lake Dam |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Muskegon County Airport, 99 Sinclair Dr. - Oil Pipeline - United States Coast Guard Air Facility, 689 Airport Rd. |

| | | | |
|-----------|---|---|--|
| 6. | Socio-Economic Profile of Sector | | |
| a. | total population (night): | | 23,994 |
| b. | peak population (seasonal): | | 24,596 |
| c. | percent over 65: | | 17.8 |
| d. | percent under 18: | | 22 |
| e. | percent that are homeowners: | | 81.6 |
| f. | percent below poverty level: | | 4.9 |
| g. | percent with disability or mobility limitation: | | 20.1 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Utility (Personal): Total: | \$0 \$182,917,500 \$49,049,600 \$576,927,100 \$72,165,800 \$881,060,000 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | 24 \$94,165 45 \$6,006,300 |
| j. | location of floodplains: | Black Lake, Mona Lake, and Black Creek | |

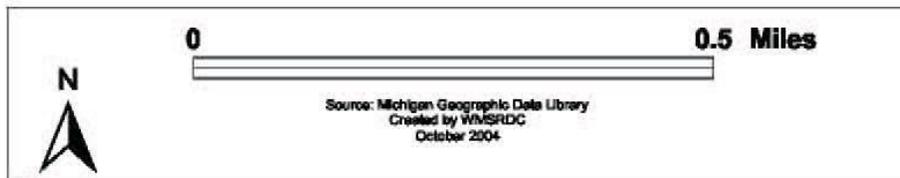
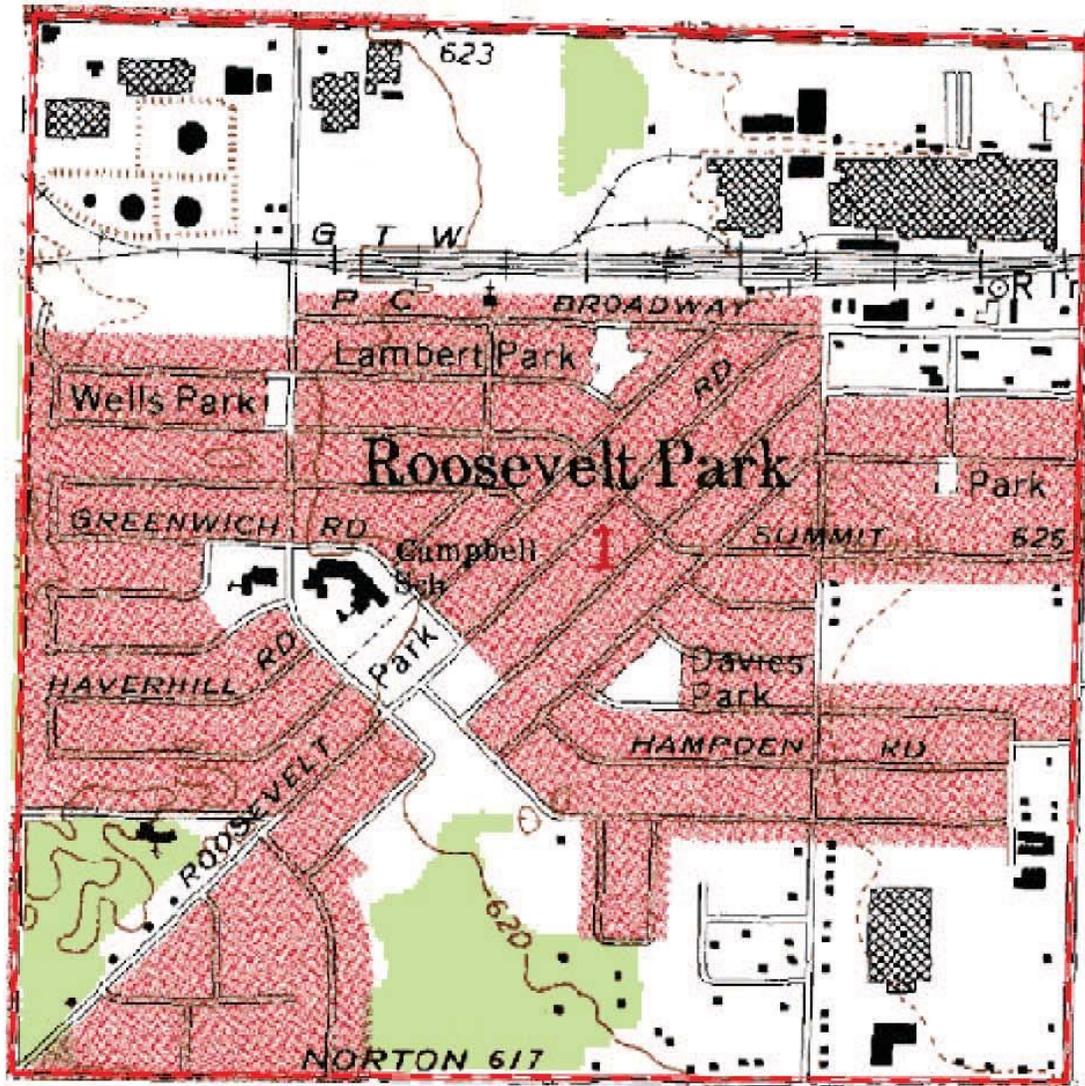
| | | |
|--|---|---|
| 7. | | Emergency Warning System Coverage |
| a. | siren locations and/or description of warning system: | - Siren at Muskegon County Airport, 115 Sinclair Dr. (air crash only) |
| b. | percent of population covered by warning sirens or system: | - One mile radius |
| (Note: Map showing warning siren location and system coverage is contained in Part D.) | | |

CITY OF ROOSEVELT PARK

| | | |
|-----------|--|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 3,719.4 persons per square mile - 1,868.9 housing units per square mile - Dense residential, moderate commercial areas |
| 2. | Population Concentrations | |
| a. | group homes: | - None Identified |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - The Shores of Roosevelt Park, 3050 Maple Grove Rd. (302 units) - Roosevelt Park Apartments, 3224 Maple Grove Rd. (48 units) - Tiffany Woods Apartments, 3298 Roosevelt Rd. (302 units) |
| c. | schools: | - Campbell Elementary (Mona Shores Schools), 1355 Greenwich Rd. (380 students, 26 staff (2005 est)) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Mona Shores and Campbell Child Care, 1355 Greenwich Rd (capacity 30) - West Shore Lutheran, 3225 Roosevelt Rd (capacity 114) |
| e. | large office buildings: | - Park Row Mall Tower, 950 W. Norton |
| f. | other: (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas) | <ul style="list-style-type: none"> - Roosevelt Park Nursing Centre, 1300 W. Broadway Ave. (69 beds) - The Nursing Home Group, 1380 W. Broadway Ave. - A Victory Inn & Suites, 2967 Henry St. (111 rooms) - Roosevelt Park Days, Roosevelt Park- August 24 |
| g. | major employers: | <ul style="list-style-type: none"> - CWC Castings Division of Textron Inc., 1085 W. Sherman Blvd. (280 employees) - Michigan Spring & Stamping, 2700 Wickham St (115 employees) |
| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 1,584 commute with an average commuting time of 15.2 minutes - 764 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,925 total housing units: 1,731 occupied/194 vacant - Of the vacant, 10 (5.2%) are for seasonal recreational or occasional use |
| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | - Roosevelt Park Police Dept, 900 Oak Ridge Rd. |
| 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) | - City of Roosevelt Park, 900 Oak Ridge Rd. |

| | | | |
|-----------|---|---|--------------------------------------|
| 5. | Vital or Critical Infrastructure | | |
| a. | roads, railroads, and bridges: | - Michigan Shore 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) | - Oil Pipeline | |
| 6. | Socio-Economic Profile of Sector | | |
| a. | total population (night): | | 3,831 |
| b. | peak population (seasonal): | | 3,853 |
| c. | percent over 65: | | 17.2 |
| d. | percent under 18: | | 23.8 |
| e. | percent that are homeowners: | | 63.7 |
| f. | percent below poverty level: | | 11.3 |
| g. | percent with disability or mobility limitation: | | 19.4 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: \$0 Commercial: \$39,958,900 Industrial: \$3,223,700 Residential: \$53,644,300 Utility (Personal): \$13,344,500 Total: \$110,171,400 | |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |
| 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 | |

City of Roosevelt Park



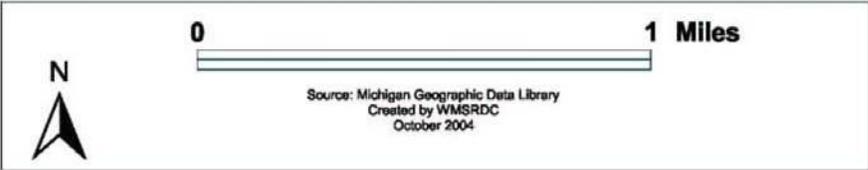
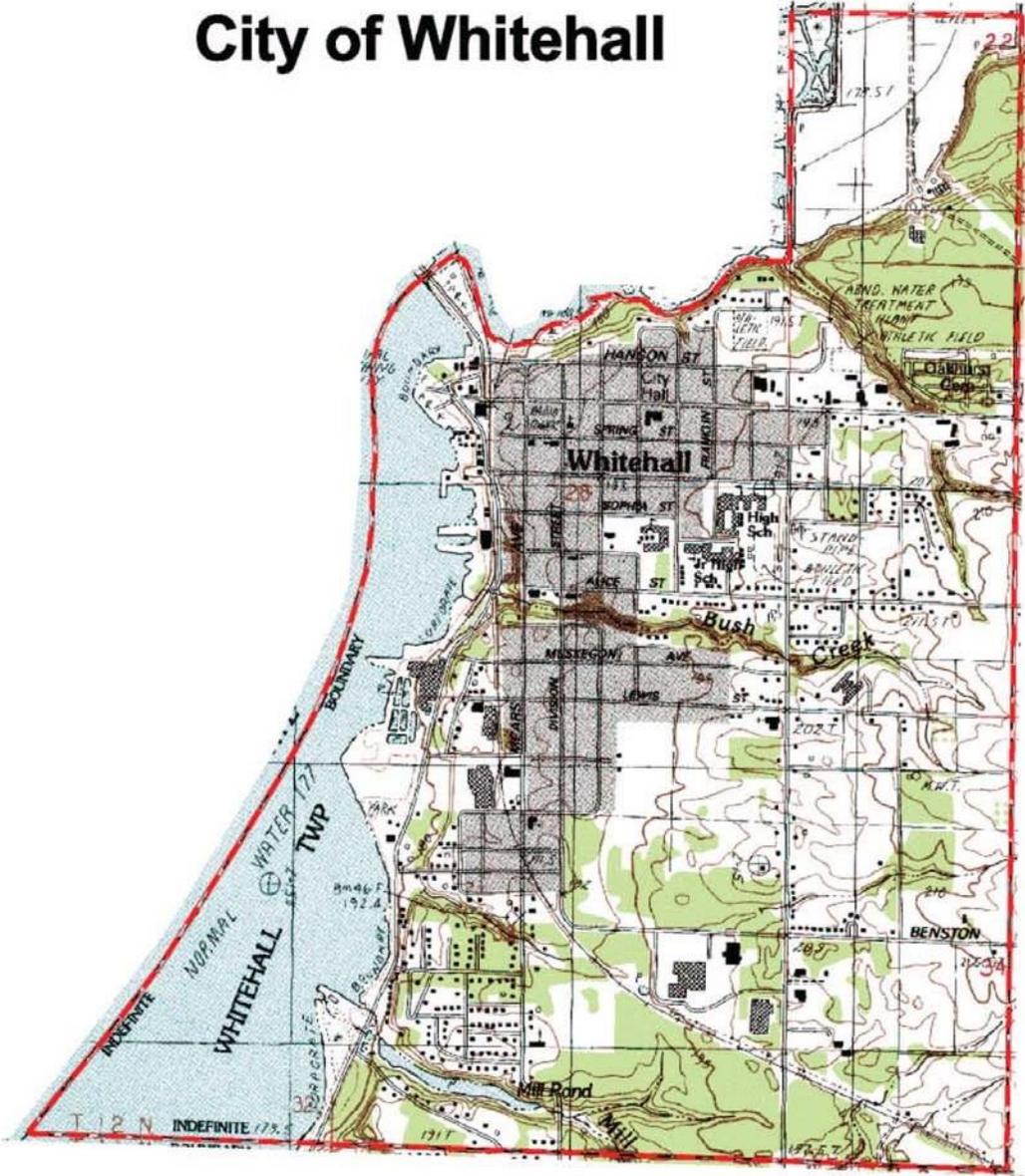
CITY OF WHITEHALL

| | | |
|-------------------------------------|--|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 867.3 persons per square mile - 412.8 housing units per square mile - Dense residential and light commercial areas - White Lake - 6 to 8 small lakes and ponds, 6 to 8 small creeks |
| 2. Population Concentrations | | |
| a. | group homes: | <ul style="list-style-type: none"> - Krzykwa AFC, 305 E. Colby (capacity 4) - Lakeview, 403 S Mears Ave (capacity 12) - River St Home, 620 E River St (capacity 6) - Slocum Street Home, 817 Slocum St (capacity 6) - Sophia Street Home, 814 Sophia St (capacity 3) - Spring Street Manor AFC, 121 W Spring St (capacity 5) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - West Shore Apartments, 1201 E Colby Rd (48 units) - Whitehall Apartments, 1123 E Colby St (48 units) - Shawl Apartments, 225 S Hall St (40 units) |
| c. | schools: | <ul style="list-style-type: none"> - Whitehall High School, 3100 White Lake Drive (640 students, 50 staff) - Whitehall Middle School, 401 S. Elizabeth St. (455 students, 40 staff) - Ealy Elementary (Whitehall Schools), 425 E. Sophia St. (455 students, 40 staff) - Shoreline Elementary (Whitehall Schools), 205 Market St. (500 students, 50 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Special Blessings Daycare, 916 S Livingston St (capacity 12) - Venema Jennifer Lyne, 106 Tulgeywood (capacity 12) - Happy Apples Child Development Center, 115 W Lewis St (capacity 23) - Buttons and Bows Preschool, W L Congregational, 1809 S Mears Ave (capacity 24) - Bright Futures ELC, 2860 Albers Dr (capacity 48) - Kid's Stop-Ealy Elementary, 425 Sophia St (capacity 60) - Shoreline Elementary, 205 Market (capacity 90) - WLACE- Community Services Bldg, 541 E Slocum (capacity 110) |
| e. | 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) | <ul style="list-style-type: none"> - Howmet Theater, 304 S. Mears (400 capacity) - Whitehall Sr. High School Football Stadium, 541 E. Slocum St. - Heartland Health Care Center - Whitehall, 918 E. Lewis St. (125 beds) - Whitehall Family Education Center, 1101 S. Mears Ave. (26 capacity) - Whitehall Learning Center, 117 S. Division St. (32 capacity) - Crosswinds Marina, 302 Lake St. (96 seasonal and 10 transient slips) - White Bay Marina, 220 Lake St. (89 seasonal and 5 transient slips) - White Lake Municipal Marina, 100 N Lake St. (50 seasonal and 35 transient slips) - Whitehall Landing, 410 Lake St. (180 seasonal and 35 transient slips) - Lake Land Motel, 1002 E. Colby St. (12 rooms) - Maple Tree Inn, 323 S. Mears Ave. - White Lake Motel, 305 E. Colby St. (20 rooms) |
| g. | major employers: | <ul style="list-style-type: none"> - Alcoa Howmet, 1 Misco Dr (2,060 employees) - Hilite International, 2001 Peach St (250 employees) |

| | | |
|---|---|-------|
| 3. | Population Shifts | |
| a. daily: | - 1,190 commute with an average commuting time of 16.4 minutes - 522 school-aged children | |
| b. seasonal: | - 1,288 total housing units: 1,153 occupied/135 vacant - Of the vacant, 38 (28.1%) are for seasonal recreational or occasional use | |
| 4. | Important or Critical Public and Private Facilities | |
| a. police precincts: | - Whitehall Police Department, 405 E. Colby St. | |
| b. fire stations: | -Whitehall Fire Department- White Lake Fire Authority (includes Fruitland and Whitehall townships) 115 S Baldwin St | |
| c. public works yards: | - None Identified | |
| d. pumping stations: | - Three | |
| e. community shelters: | - None Identified | |
| f. community medical facilities, hospitals: | - Lakeshore Medical Associates PC, 905 E. Colby St. - Community Mental Health of Muskegon County - Whitehall Adult Activity Center, 511 E. Colby St. - White Lake Ambulance Authority, 119 S Baldwin St. | |
| g. historic sites: | - Swedish Evangelical Lutheran Church of Whitehall, 1101 S Mears Ave - Thompson, Ruth, Commemorative Designation, 405 E Colby St | |
| h. other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | - City of Whitehall, 405 E. Colby St. - White Lake Community Library, 3900 W. White Lake Dr. | |
| 5. | Vital or Critical Infrastructure | |
| a. roads, railroads, and bridges: | - US-31 Business Route - US-31 Business Route bridge over White River | |
| b. dams, power stations, water treatment plants, sanitary lift stations, etc: | - City of Whitehall Water and Sewer - Sanitary Lift Stations: Five - Mill Pond Dam (Mill Pond Creek) | |
| 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): | | 2,706 |
| b. peak population (seasonal): | | 2,790 |
| c. percent over 65: | | 20.8 |
| d. percent under 18: | | 22.7 |
| e. percent that are homeowners: | | 64.6 |
| f. percent below poverty level: | | 10.5 |
| g. percent with disability or mobility limitation: | | 20.7 |

| | | | |
|--|---|---|---------------|
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: | \$0 |
| | | Commercial: | \$17,405,300 |
| | | Industrial: | \$654,400 |
| | | Residential: | \$42,417,200 |
| | | Utility (Personal): | \$45,811,700 |
| | | Total: | \$106,288,600 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: | 2 |
| | | Total Payments since 01/01/78: | \$387 |
| | | Policies In-Force: | 3 |
| | | Total Insurance In-Force: | \$610,200 |
| j. | location of floodplains: | - White Lake, Mill Pond, and White River & tributaries | |
| 7. Emergency Warning System Coverage | | | |
| a. | siren locations and/or description of warning system: | <ul style="list-style-type: none"> - Siren in 400 Block of S Warner St - Siren at Benston & S Division St - Siren in 200 Block of E Colby St | |
| b. | percent of population covered by warning sirens or system: | - One mile radius | |
| (Note: Map showing warning siren location and system coverage is contained in Part D.) | | | |

City of Whitehall



VILLAGE OF CASNOVIA

| | | |
|--|--|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 295.4 persons per square mile - 121.3 housing units per square mile - 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: | - 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 <i>(also included in Casnovia Township)</i> | | |
| a. | daily: | <ul style="list-style-type: none"> - 184 commute with an average commuting time of 27.6 minutes - 63 school-aged children |
| b. | seasonal: | - 131 total housing units: 121 occupied/10 vacant; of the 10 vacant, 0 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: | - Whipple's Castle, 389 North Main |
| h. | other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | - Village of Casnovia, 141 N. Main St. |
| 5. Vital or Critical Infrastructure | | |
| a. | roads, railroads, and bridges: | <ul style="list-style-type: none"> - M-37/M-46 (junction) - Marquette Rail 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 |
|-----------|---|-------------------|

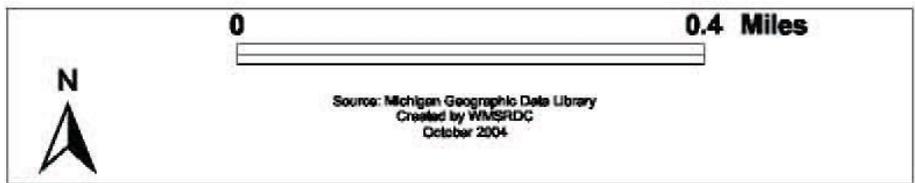
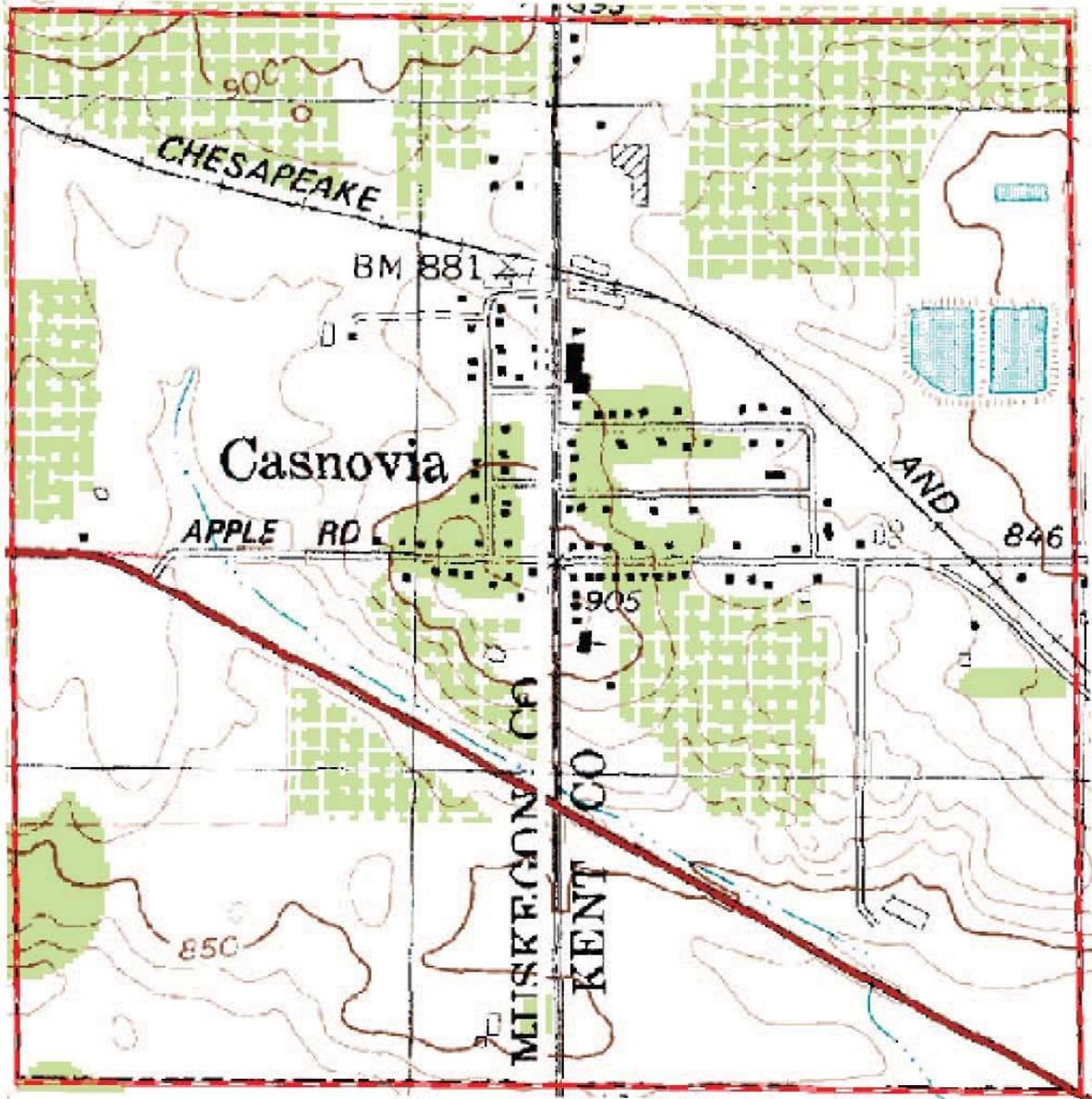
| | |
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| 6. | Socio-Economic Profile of Sector |
|-----------|---|

| | | | |
|-----------|--|---|--|
| a. | total population (night): | <i>(also included in Casnovia Township)</i> | 319 |
| b. | peak population (seasonal): | <i>(also included in Casnovia Township)</i> | 319 |
| c. | percent over 65: | | 12.9 |
| d. | percent under 18: | | 77.7 |
| e. | percent that are homeowners: | | 82.6 |
| f. | percent below poverty level: | | 10.4 |
| g. | percent with disability or mobility limitation: | | 17.6 |
| h. | estimated property insurance coverage: (Real Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Total: | 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: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |

| | |
|-----------|--|
| 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 |

Village of Casnovia



VILLAGE OF FRUITPORT

| | | |
|-----------|-----------------------------------|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 1,201.1 persons per square mile - 523.1 housing units per square mile - Spring Lake - 2 to 4 small creeks |
|-----------|-----------------------------------|--|

2. Population Concentrations

| | | |
|-----------|--|---|
| a. | group homes: | - Shaffer House AFC, 171 Dennis St (capacity 6) |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | <ul style="list-style-type: none"> - Fruitport Community High School, 357 N. 6th Ave (894 students) - Edgewood Elementary, 3255 Pontaluna Rd. (558 students) |
| 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) | <ul style="list-style-type: none"> - Fruitport Community High School Football Stadium, 357 N. 6th Ave. - Fruitport Old Fashion Days- May 22-27 |
| g. | major employers: | - None Identified |

3. Population Shifts *(also included in Fruitport Township)*

| | | |
|-----------|------------------|---|
| a. | daily: | <ul style="list-style-type: none"> - 464 commute with an average commuting time of 18.3 minutes - 211 school-aged children |
| b. | Seasonal: | <ul style="list-style-type: none"> - 476 total housing units: 440 occupied/36 vacant - Of the vacant, 7 (19.4%) 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) | <ul style="list-style-type: none"> - Village of Fruitport, 45 N. 2rd Ave. - Fruitport District Library, 47 Park St. |

5. Vital or Critical Infrastructure

| | | |
|-----------|---|---|
| a. | roads, railroads, and bridges: | - 3 rd Ave Bridge & Bridge St (Norris 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 |
|-----------|---|-------------------|

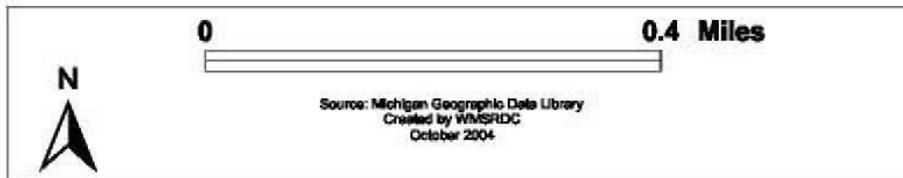
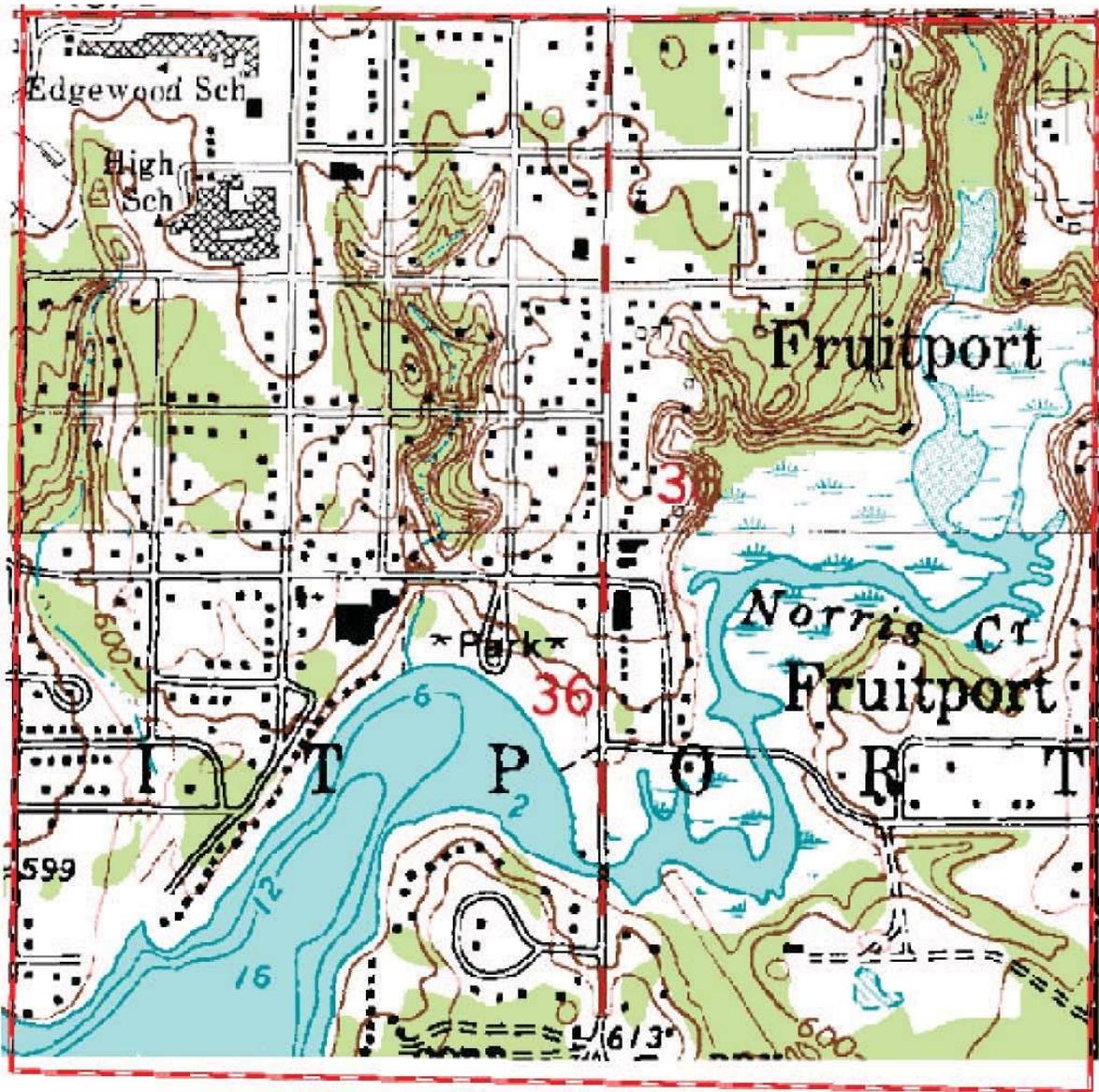
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|-----------|---|
| 6. | Socio-Economic Profile of Sector |
|-----------|---|

| | | | |
|-----------|--|---|--------------------------------------|
| a. | total population (night): | <i>(also included in Fruitport Township)</i> | 1,093 |
| b. | peak population (seasonal): | <i>(also included in Fruitport Township)</i> | 1,110 |
| c. | percent over 65: | | 16.3 |
| d. | percent under 18: | | 22.5 |
| e. | percent that are homeowners: | | 82.6 |
| f. | percent below poverty level: | | 5.9 |
| g. | percent with disability or mobility limitation: | | 17.5 |
| h. | estimated property insurance coverage: (Real Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Total: | 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: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |

| | |
|-----------|--|
| 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 |

Village of Fruitport



VILLAGE OF LAKEWOOD CLUB

| | | |
|-----------|--|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 675.9 persons per square mile - 265.4 housing units per square mile - Fox Lake |
| 2. | Population Concentrations | |
| a. | group homes: | - None Identified |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | - None Identified |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Jaime Bishop, 645 W Englewood (capacity 12) - Vicki Esch, 6581 Automobile Rd (capacity 12) - Shelly Carnes, 6689 Automobile Rd (capacity 12) - Kuddly Kidz Daycare, 444 W Madison Ave (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) | - None Identified |
| g. | major employers: | - None Identified |
| 3. | Population Shifts <i>(also included in Dalton Township)</i> | |
| a. | daily: | <ul style="list-style-type: none"> - 646 commute with an average commuting time of 21.6 minutes - 303 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 507 total housing units: 458 occupied/49 vacant - Of the vacant, 17 (34.7%) 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) | - Village of Lakewood Club, 6681 Automobile Rd. |
| 5. | Vital or Critical Infrastructure | |
| a. | roads, railroads, and bridges: | - None Identified |

| | | |
|-----------|---|---------------------------|
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - None Identified |

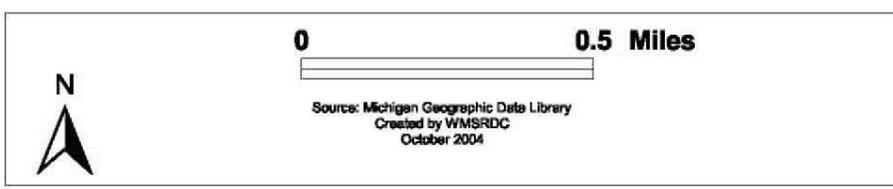
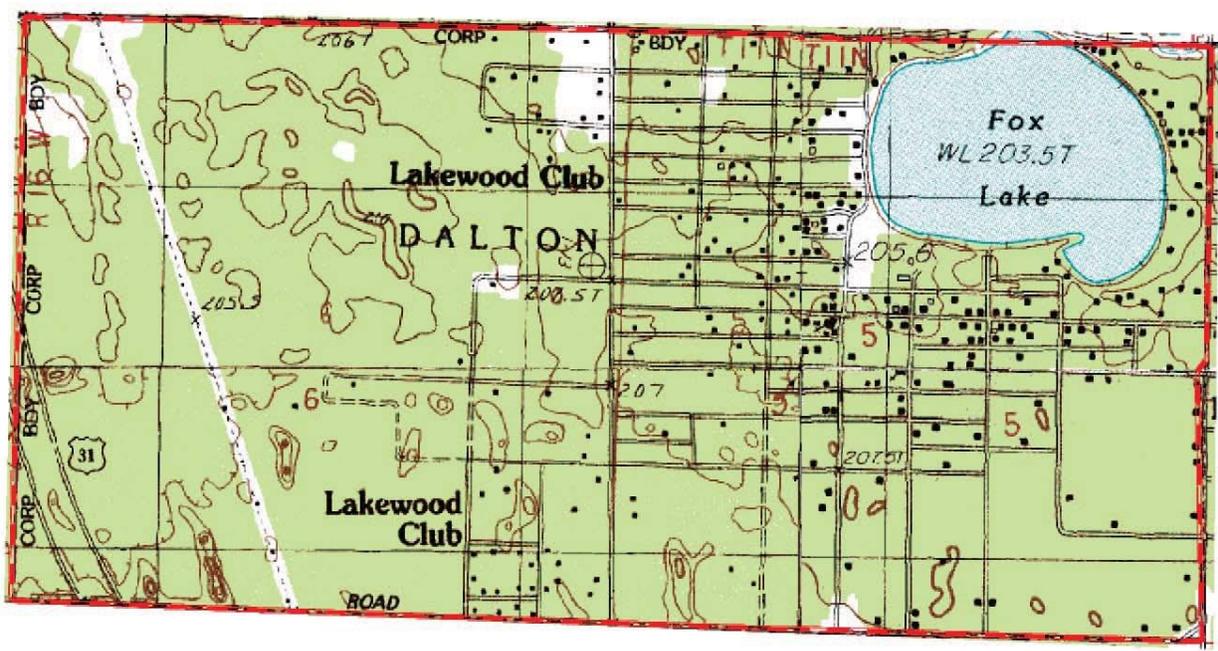
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| 6. Socio-Economic Profile of Sector | | |
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| | | | |
|-----------|--|---|--------------------------------------|
| a. | total population (night): | (also included in Dalton Township) | 1,291 |
| b. | peak population (seasonal): | (also included in Dalton Township) | 1,339 |
| c. | percent over 65: | | 5.7 |
| d. | percent under 18: | | 30.4 |
| e. | percent that are homeowners: | | 93.4 |
| f. | percent below poverty level: | | 12.1 |
| g. | percent with disability or mobility limitation: | | 22.5 |
| h. | estimated property insurance coverage: (Real Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Total: | 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: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |

| | | |
|---|--|--|
| 7. Emergency Warning System Coverage | | |
|---|--|--|

| | | |
|-----------|---|--------------------------------|
| a. | siren locations and/or description of warning system: | - Siren at Kenwood & Auburn Rd |
| b. | percent of population covered by warning sirens or system: | N/A |

Village of Lakewood Club

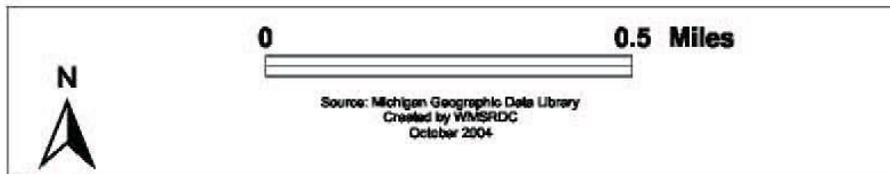


VILLAGE OF RAVENNA

| | | |
|---|--|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 1,007.4 persons per square mile - 393.4 housing units per square mile - 2 to 4 small creeks |
| 2. Population Concentrations | | |
| a. | group homes: | - Crockery Creek Elder Care, 12291 Crockery Creek (capacity 6) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Creekside Apartments, 3796 S Ravenna Rd (31 family units) - Countryside Manor, Slocum Rd (12 elderly units) |
| c. | schools: (Contacted Jeanie on 3/12/13) | - Beechnau Elementary School (Ravenna Public Schools), 12322 Stafford St. (390 students, 41 teachers) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Ages and Stages Child Care, 12335 Stafford St (capacity 52) - Beechnau Preschool, 12322 Stafford St (capacity 42) - Ravenna Head Start, 12322 Stafford St (capacity 20) - St Catherine Preschool, 3376 Thomas St (capacity 18) - Tracy Porter, 3601 Thomas 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) | - None Identified |
| g. | major employers: | - None Identified |
| 3. Population Shifts <i>(also included in Ravenna Township)</i> | | |
| a. | daily: | <ul style="list-style-type: none"> - 478 commute with an average commuting time of 26.0 minutes - 292 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 476 total housing units: 454 occupied/22 vacant - Of the vacant, 1 (4.5%) is 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) | <ul style="list-style-type: none"> - Village of Ravenna, 12090 Crockery Creek Dr. - Muskegon County Library - Ravenna Branch, 12278 Stafford St. |

| | | | |
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| 5. | Vital or Critical Infrastructure | | |
| a. | roads, railroads, and bridges: | - B-35 | |
| 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 Ravenna Township, | 1,219 |
| b. | peak population (seasonal): | (also included in Ravenna Township) | 1,222 |
| c. | percent over 65: | | 13.5 |
| d. | percent under 18: | | 29 |
| e. | percent that are homeowners: | | 78.9 |
| f. | percent below poverty level: | | 3.6 |
| g. | percent with disability or mobility limitation: | | 13.9 |
| h. | estimated property insurance coverage: (Real Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Total: | 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: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | - Flood hazard areas along Crockery Creek and tributaries | |
| 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 | |

Village of Ravenna



BLUE LAKE TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 69.7 persons per square mile - 28.3 housing units per square mile - Scattered rural housing - Densely forested (Manistee National Forest) - Big Blue Lake - Wolverine Lake - White River - 50 to 60 small lakes and ponds, 20 to 25 small creeks |
|-----------|-----------------------------------|---|

| | | |
|-----------|--|---|
| 2. | Population Concentrations | |
| a. | group homes: | - Oak Creek Home, 137 W Holton Road (capacity 6) |
| b. | large apartment buildings: | - Blue Lake Residences LP, 7190 Progress Dr. (68 family units) |
| c. | schools: | - None Identified |
| d. | childcare facility: | - 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) | <ul style="list-style-type: none"> - Blue Lake County Park, 10701 Nichols Rd. (25 campsites) - Happy Mohawk Canoe Livery, 735 Fruitvale Rd. - Oak Knoll Family Campground, 1522 E. Fruitvale Rd. (60 campsites) - White River Campground, 735 W. Fruitvale Rd. (227 campsites) - Blue Lake Fine Arts Camp, 300 E. Crystal Lake Rd. - Boy Scouts of America - Camp Gerber Ranger, 1733 Owasippe Rd. - Camp Pandalouan, 1243 E. Fruitvale Rd. - Owasippe Scout Reservation, 9900 Russell Rd. - Pioneer Trails, 1421 E Fruitvale (camp) |
| g. | major employers: | - None Identified |

| | | |
|-----------|--------------------------|--|
| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 1,045 commute with an average commuting time of 28.1 minutes - 615 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 975 total housing units: 822 occupied/153 vacant - Of the vacant, 109 (71.2%) are for seasonal recreational or occasional use |

| | | |
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| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | - None Identified |
| b. | fire stations: | <ul style="list-style-type: none"> - Blue Lake Township Fire Dept, 1491 Owasippe Rd. - Blue Lake Township Fire Dept, 796 White Lake Dr. |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - None Identified |
| f. | medical facilities, hospitals: | - None Identified |

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|--|--|---|------------------------------|-----|--------------------------------|-----------|--------------------|-----|---------------------------|--------------|---------------------|-------------|--------|--------------|
| 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) | - Blue Lake Township Hall, 1491 Owasippe Rd. | | | | | | | | | | | | |
| 5. Vital or Critical Infrastructure | | | | | | | | | | | | | | |
| a. | roads, railroads, and bridges: | - B-23, B-86 | | | | | | | | | | | | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Cleveland Lake Dam (Cleveland Creek) - Brown's Pond Dam (Sand Creek) - Power Transmission Line | | | | | | | | | | | | |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Natural Gas Pipeline | | | | | | | | | | | | |
| 6. Socio-Economic Profile of Sector | | | | | | | | | | | | | | |
| a. | total population (night): | 2,399 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 2,716 | | | | | | | | | | | | |
| c. | percent over 65: | 8.8 | | | | | | | | | | | | |
| d. | percent under 18: | 29.7 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 85.2 | | | | | | | | | | | | |
| f. | percent below poverty level: | 16.6 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 22.4 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table border="0"> <tr> <td>Agricultural:</td> <td>\$0</td> </tr> <tr> <td>Commercial:</td> <td>\$927,200</td> </tr> <tr> <td>Industrial:</td> <td>\$0</td> </tr> <tr> <td>Residential:</td> <td>\$66,357,100</td> </tr> <tr> <td>Utility (Personal):</td> <td>\$2,280,500</td> </tr> <tr> <td>Total:</td> <td>\$69,564,800</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$927,200 | Industrial: | \$0 | Residential: | \$66,357,100 | Utility (Personal): | \$2,280,500 | Total: | \$69,564,800 |
| Agricultural: | \$0 | | | | | | | | | | | | | |
| Commercial: | \$927,200 | | | | | | | | | | | | | |
| Industrial: | \$0 | | | | | | | | | | | | | |
| Residential: | \$66,357,100 | | | | | | | | | | | | | |
| Utility (Personal): | \$2,280,500 | | | | | | | | | | | | | |
| Total: | \$69,564,800 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table border="0"> <tr> <td>Total Losses since 01/01/78:</td> <td></td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td></td> </tr> <tr> <td>Policies In-Force:</td> <td></td> </tr> <tr> <td>Total Insurance In-Force:</td> <td></td> </tr> </table> <i>Not participating in the NFIP</i> | Total Losses since 01/01/78: | | Total Payments since 01/01/78: | | Policies In-Force: | | Total Insurance In-Force: | | | | | |
| Total Losses since 01/01/78: | | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | | | | | | | | | | | | | | |
| Policies In-Force: | | | | | | | | | | | | | | |
| Total Insurance In-Force: | | | | | | | | | | | | | | |
| j. | location of floodplains: | N/A | | | | | | | | | | | | |
| 7. Emergency Warning System Coverage | | | | | | | | | | | | | | |
| a. | siren locations and/or description of warning system: | - Siren at 1491 Owasippe Rd | | | | | | | | | | | | |
| b. | percent of population covered by warning sirens or system: | - One mile radius | | | | | | | | | | | | |
| (Note: Map showing warning siren location and system coverage is contained in Part D.) | | | | | | | | | | | | | | |

Blue Lake Township



CASNOVIA TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 78.6 persons per square mile - 28.6 housing units per square mile - Scattered rural housing and moderate residential areas - Moderately forested, moderate farmland - Half Moon Lake - 14 to 16 small lakes and ponds, 20 to 25 small creeks |
|-----------|-----------------------------------|---|

| | |
|-----------|----------------------------------|
| 2. | Population Concentrations |
|-----------|----------------------------------|

| | | |
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| a. | group homes: | - None Identified |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | - None Identified |
| d. | childcare facilities: | - Julie Klinger, 17950 Apple (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) | - The Redneck Kountry Club RV Campground |
| g. | major employers: | - None Identified |

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| 3. | Population Shifts <i>(numbers include Village of Casnovia)</i> |
|-----------|--|

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|-----------|------------------|--|
| a. | daily: | <ul style="list-style-type: none"> - 1,322 commute with an average commuting time of 30.4 minutes - 692 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,022 total housing units: 944 occupied/78 vacant - Of the vacant, 13 (16.7%) are for seasonal recreational or occasional use |

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| 4. | Important or Critical Public and Private Facilities |
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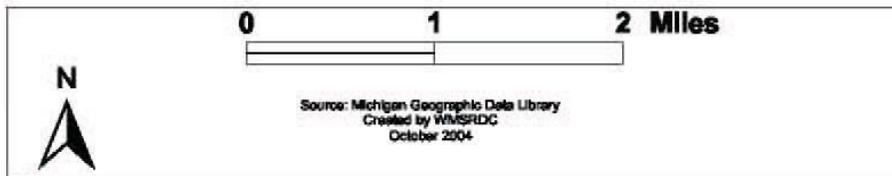
| | | |
|-----------|--|---|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - Casnovia Township Fire Department, 17569 Bailey Rd. |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - None Identified |
| 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) | - Casnovia Township Hall, 245 Canada Rd. |

| | | |
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| 5. | Vital or Critical Infrastructure | |
| a. | roads, railroads, and bridges: | - M-46, M-37 - B-35 - Marquette Rail Railroad |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line - Great Lakes Co-op |
| 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 Casnovia) 2,805 | | | | | | | | | | | | |
| b. | peak population (seasonal): | (numbers include Village of Casnovia) 2,843 | | | | | | | | | | | | |
| c. | percent over 65: | 9.9 | | | | | | | | | | | | |
| d. | percent under 18: | 29.2 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 87.3 | | | | | | | | | | | | |
| f. | percent below poverty level: | 7.1 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 17.2 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">Agricultural:</td> <td style="text-align: right;">\$29,586,300</td> </tr> <tr> <td>Commercial:</td> <td style="text-align: right;">\$2,259,700</td> </tr> <tr> <td>Industrial:</td> <td style="text-align: right;">\$970,000</td> </tr> <tr> <td>Residential:</td> <td style="text-align: right;">\$43,802,900</td> </tr> <tr> <td>Utility (Personal):</td> <td style="text-align: right;">\$3,295,700</td> </tr> <tr> <td>Total:</td> <td style="text-align: right;">\$79,914,600</td> </tr> </table> | Agricultural: | \$29,586,300 | Commercial: | \$2,259,700 | Industrial: | \$970,000 | Residential: | \$43,802,900 | Utility (Personal): | \$3,295,700 | Total: | \$79,914,600 |
| Agricultural: | \$29,586,300 | | | | | | | | | | | | | |
| Commercial: | \$2,259,700 | | | | | | | | | | | | | |
| Industrial: | \$970,000 | | | | | | | | | | | | | |
| Residential: | \$43,802,900 | | | | | | | | | | | | | |
| Utility (Personal): | \$3,295,700 | | | | | | | | | | | | | |
| Total: | \$79,914,600 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">Total Losses since 01/01/78:</td> <td rowspan="4" style="text-align: center; vertical-align: middle;"><i>Not participating in the NFIP</i></td> </tr> <tr> <td>Total Payments since 01/01/78:</td> </tr> <tr> <td>Policies In-Force:</td> </tr> <tr> <td>Total Insurance In-Force:</td> </tr> </table> | Total Losses since 01/01/78: | <i>Not participating in the NFIP</i> | Total Payments since 01/01/78: | Policies In-Force: | Total Insurance In-Force: | | | | | | | |
| Total Losses since 01/01/78: | <i>Not participating in the NFIP</i> | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | | | | | | | | | | | | | | |
| Policies In-Force: | | | | | | | | | | | | | | |
| Total Insurance In-Force: | | | | | | | | | | | | | | |
| j. | location of floodplains: | N/A | | | | | | | | | | | | |

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| 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.) | | |

Casnovia Township



CEDAR CREEK TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 90.5 persons per square mile - 40 housing units per square mile - Densely forested (Manistee National Forest and Muskegon State Game Area in southern portion) - Muskegon River - Hornungs Duck Lake - 26 to 30 small lakes and ponds, 12 to 16 small creeks |
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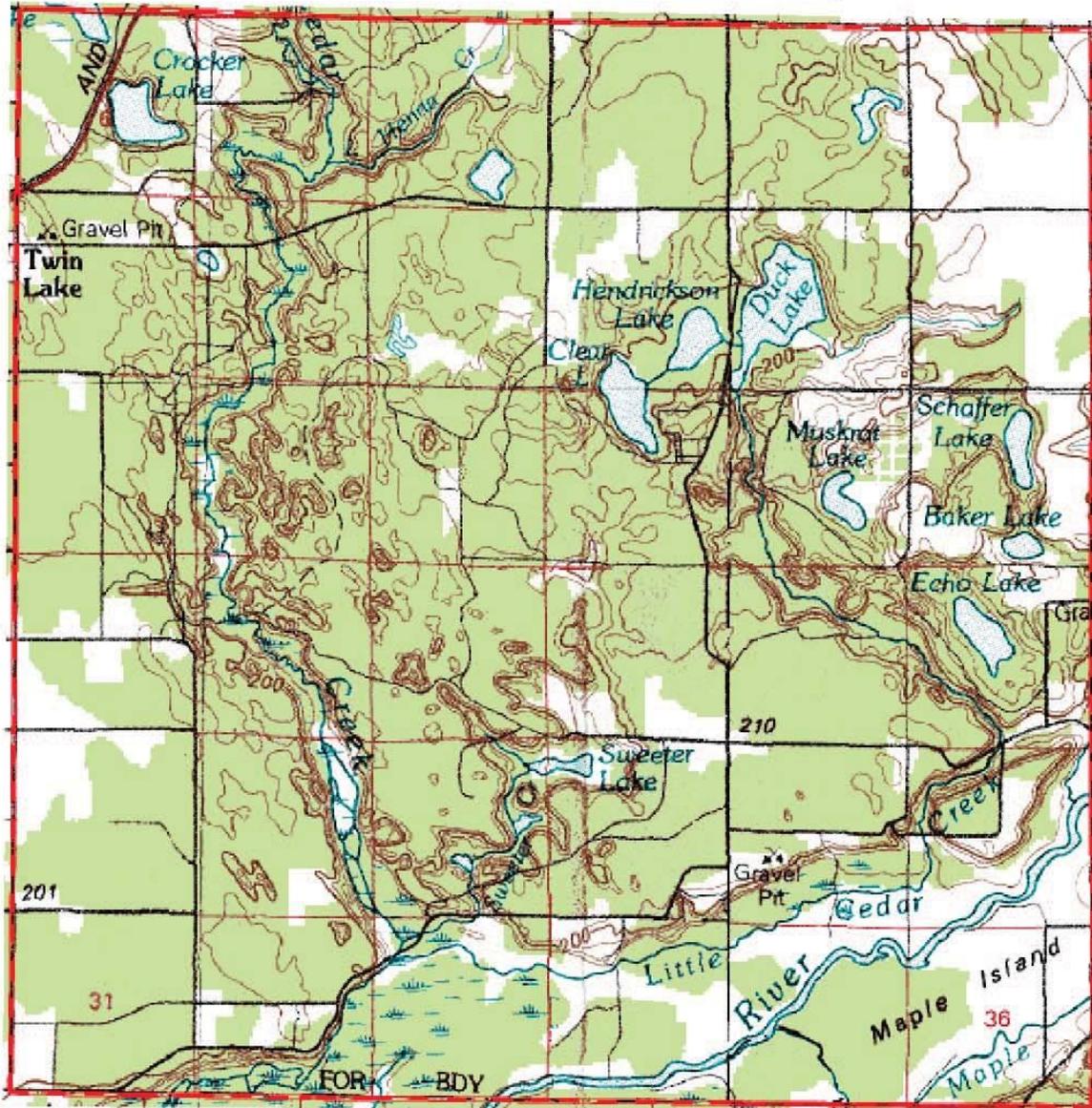
| | | |
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| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Friendly Haven, 7665 E Ryerson Rd (capacity 4) - Paul's Place AFC, 3475 E Tyler (capacity 6) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Cedar Creek Apartments, 2226 Dalson Rd. (32 family units) |
| c. | schools: | <ul style="list-style-type: none"> - None |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Darlene Potter, 4298 E River Rd (capacity 12) - Wooly Lambs Education and Daycare (capacity 45) |
| e. | large office buildings: | <ul style="list-style-type: none"> - 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) | <ul style="list-style-type: none"> - Wooly Lambs Education and Daycare, 3529 E. Tyler Rd. (45 capacity) - YMCA Camp Pinewood, 4230 Obenauf Rd. - Stonegate Golf Club, 4100 Sweeter Rd. |
| g. | major employers: | <ul style="list-style-type: none"> - None Identified |

| | | |
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| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 1,572 commute with an average commuting time of 26.8 minutes - 652 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,409 total housing units: 1,207 occupied/202 vacant - Of the vacant, 83 (41.1%) are for seasonal recreational or occasional use |

| | | |
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| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | <ul style="list-style-type: none"> - None Identified |
| b. | fire stations: | <ul style="list-style-type: none"> - DNR Muskegon Field Office, 7550 E Messinger Rd |
| c. | public works yards: | <ul style="list-style-type: none"> - None Identified |
| d. | pumping stations: | <ul style="list-style-type: none"> - None Identified |
| e. | community shelters: | <ul style="list-style-type: none"> - None Identified |
| f. | community medical facilities, hospitals: | <ul style="list-style-type: none"> - None Identified |
| g. | historic sites: | <ul style="list-style-type: none"> - None Identified |
| h. | other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | <ul style="list-style-type: none"> - Cedar Creek Township Hall, 6556 Sweeter Rd. - Michigan State Government Department of Natural Resources, 7600 Messinger Rd. |

| | | | |
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| 5. | Vital or Critical Infrastructure | | |
| a. | roads, railroads, and bridges: | - M-120 - B-31 - Michigan Shore Railroad | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line | |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Natural Gas Pipeline | |
| 6. | Socio-Economic Profile of Sector | | |
| a. | total population (night): | | 3,186 |
| b. | peak population (seasonal): | | 3,403 |
| c. | percent over 65: | | 12.1 |
| d. | percent under 18: | | 24.3 |
| e. | percent that are homeowners: | | 89.5 |
| f. | percent below poverty level: | | 15.1 |
| g. | percent with disability or mobility limitation: | | 25.8 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Utility (Personal): Total: | \$4,601,900 \$5,014,200 \$0 \$58,510,400 \$2,334,600 \$70,461,100 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |
| 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 | |

Cedar Creek Township



DALTON TOWNSHIP

| | | |
|-----------|-----------------------------------|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 260.5 persons per square mile - 105 housing units per square mile - Moderate residential areas - Moderately forested - Twin Lakes - 7 small lakes and ponds, 3 small creeks |
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| 2. | Population Concentrations |
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| | | |
|-----------|--|---|
| a. | group homes: | <ul style="list-style-type: none"> - Families Manor, 2330 Riverwood Dr (capacity 6) - Patti's Place, 2255 Pillon Rd (capacity 4) - Riverwood, 2743 S Riverwood (capacity 6) |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | - Twin Lake Elementary (Reeths-Puffer Schools), 3175 5 th St. (269 students, 25 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Tricia Slatton, 862 Agard Rd (capacity 12) - Marjorie Mura, 508 E Riley Thompson Rd (capacity 12) - Erin Wilks, 5019 Automobile Rd (capacity 12) - Leah Nummerdor, 2331 Beattie Rd (capacity 12) - Julie Grinwis & Connie Grinwis, 3118 N Riverwood Dr (capacity 12) - Kimberly Kay Stanhope, 2536 Cove Rd (capacity 12) - Reeths Puffer-Twin Lake Head Start & Kids Stop, 3175 Fifth St (capacity 45) - The Hop Inc Your Neighborhood Child Care Center, 2495 Holton Rd (capacity 59) |
| 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) | <ul style="list-style-type: none"> - Thunderbird Raceway, 350 W Riley Thompson Rd - Lake Sch-Nepp-A-Ho Campground, 390 E. Tyler Rd. (100 campsites) - Muskegon KOA, 3500 Strand Rd. (96 campsites) - Camp Lor-Ray, 5281 Russell Rd - Twin Lake County Park, 6231 Main St. - Chase Hammond Golf Course, 2454 Putnam Rd. (18 holes) |
| g. | major employers: | - Michigan's Adventure, 4750 Whitehall Rd |

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| 3. | Population Shifts <i>(numbers include Village of Lakewood Club)</i> |
|-----------|---|

| | | |
|-----------|------------------|--|
| a. | daily: | <ul style="list-style-type: none"> - 4,149 commute with an average commuting time of 22.8 minutes - 2,094 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 3,748 total housing units: 3,368 occupied/380 vacant - Of the vacant, 150 (39.5%) are for seasonal recreational or occasional use |

| | |
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| 4. | Important or Critical Public and Private Facilities |
|-----------|--|

| | | |
|-----------|----------------------------|---|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - Dalton Township Fire Department, 1650 E. Riley Thompson |
| c. | public works yards: | - Dalton Maintenance, 1618 E. Riley Thompson |

| | | |
|----|--|--|
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - Twin Lake Elementary, 3175 Fifth St - Fifth Reformed Church, 1800 E River 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) | - Dalton Township Hall, 1616 E. Riley Thompson Rd. - Dalton Township Library, 3175 5 th St. - Muskegon County Road Commission, 5333 Holton Rd |

5. Vital or Critical Infrastructure

| | | |
|----|---|---|
| a. | roads, railroads, and bridges: | - US-31 - M-120 - B-23 - Michigan Shore Railroad |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Midget Private Airport, 4821 Cady Rd. - Natural Gas Pipeline |

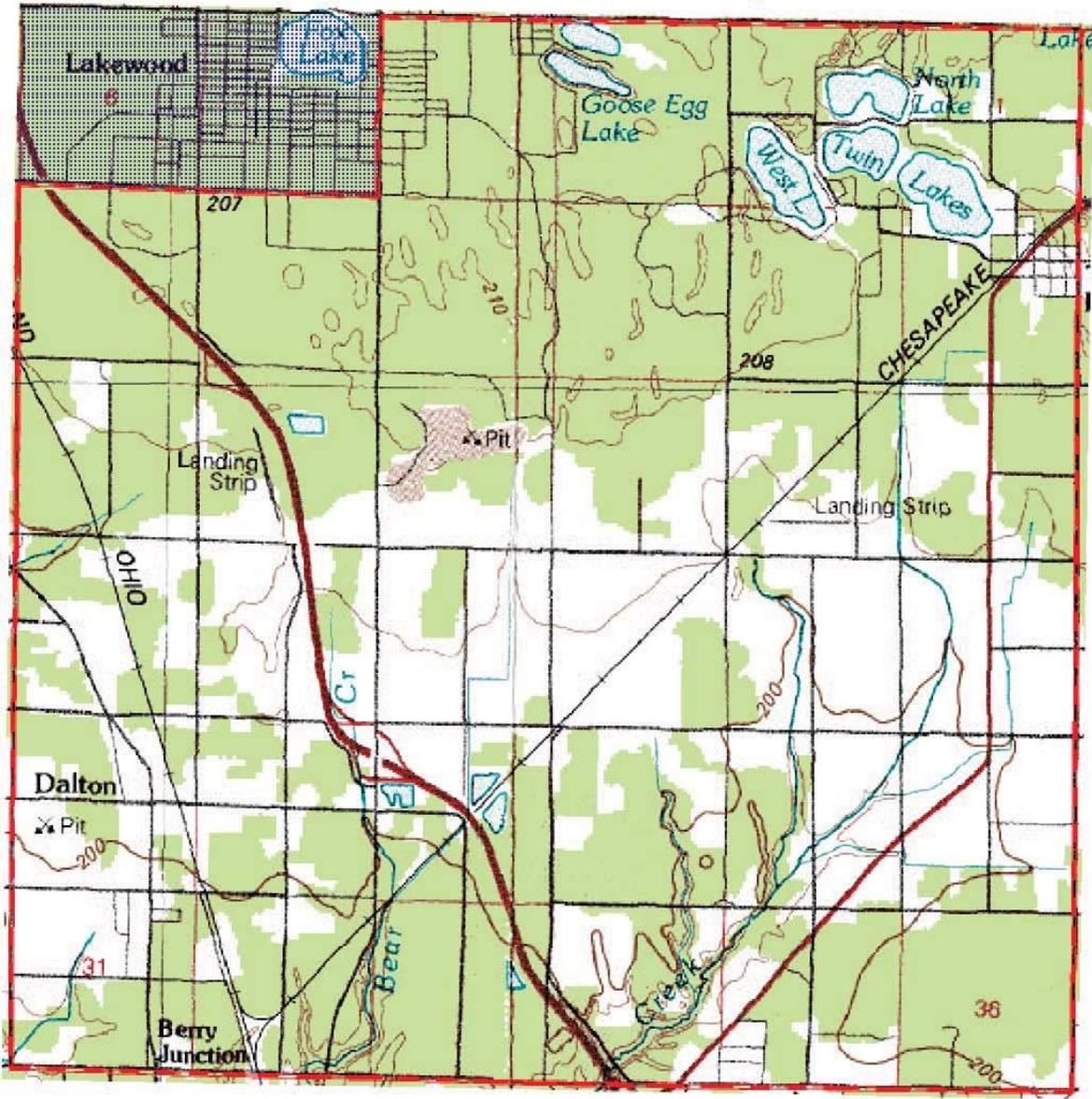
6. Socio-Economic Profile of Sector

| | | | |
|----|---|---|--|
| a. | total population (night): | (numbers include Village of Lakewood Club) | 9,300 |
| b. | peak population (seasonal): | (numbers include Village of Lakewood Club) | 9,714 |
| c. | percent over 65: | | 9.7 |
| d. | percent under 18: | | 27.5 |
| e. | percent that are homeowners: | | 90.5 |
| f. | percent below poverty level: | | 7.7 |
| g. | percent with disability or mobility limitation: | | 20.9 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Utility (Personal): Total: | \$0 \$19,222,600 \$1,431,100 \$187,248,900 \$16,867,800 \$224,770,400 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |

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 |

Dalton Township



EGELSTON TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 283.1 persons per square mile - 110.9 housing units per square mile - Densely forested (Muskegon State Game Area in northern half) - Muskegon County Water Management Sewage Lagoons - Wolf Lake and Muskegon River - 5 to 7 small lakes and ponds, 8 to 10 small creeks |
|-----------|-----------------------------------|---|

| | |
|-----------|----------------------------------|
| 2. | Population Concentrations |
|-----------|----------------------------------|

| | | |
|-----------|--|--|
| a. | group homes: | - None Identified |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | <ul style="list-style-type: none"> - Oakridge High School, 5493 Hall Rd. (493 students, 51 staff) - Oakridge Middle School, 251 S. Wolf Lake Rd. (296 students, 36 staff) - Oakridge Upper Elem., 481 S. Wolf Lake Rd. (471 students, 42 staff) - Oakridge Lower Elem., 5290 Bryn Mawr Pl. (660 students, 61 staff) - Oakridge Alternative Education, (56 students, 7 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Creative Child Preschool, 4200 Apple Ave (capacity 20) - Dawn Lewis, 1167 Ellison Rd (capacity 12) - Grandma Shirley's DayCare, 4410 E Laketon Ave (capacity 12) - Little Ones, 4775 E Apple Ave (capacity 16) - Oakridge Lower Elementary, 120 N Park St (capacity 140) - Sanda Kay Morence, 4260 White 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) | <ul style="list-style-type: none"> - Oakridge High School Football Stadium, 5493 Hall Rd. - Gonyons Child Care Center, 622 Chatterson Rd. (18 capacity) - Wolf Lake Resort & Campground, 5451 Harding Ave. - Apple Carr Village I Mobile Home Community, 516 Courtland Ln - Apple Carr Village II Mobile Home Community, 516 Courtland Ln - Apple Carr Village III Mobile Home Community, 516 Courtland Ln - Egelcraft Mobile Home Park, 4065 South Ironwood - Eglecraft Mobile Home Park, 4158 Sawgrass Trail Lot 281 - Maple Island Estates Mobile Home Community, 7321 White Road Lot 74 - Egelston-Wolf Lake Festival, Flickema Park- July 12-13 |
| g. | major employers: | <ul style="list-style-type: none"> - Eagle Alloy, 5142 Evanston Ave (361 employees) - Sun Chemical, 5025 Evanston Ave (182 employees) |

| | |
|-----------|--------------------------|
| 3. | Population Shifts |
|-----------|--------------------------|

| | | |
|-----------|------------------|--|
| a. | daily: | <ul style="list-style-type: none"> - 4,028 commute with an average commuting time of 23.2 minutes - 2,272 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 3,882 total housing units: 3,620 occupied/262 vacant - Of thevacant, 37 (14.1%) are for seasonal recreational or occasional use |

| | |
|-----------|--|
| 4. | Important or Critical Public and Private Facilities |
|-----------|--|

| | | |
|-----------|--------------------------|---|
| a. | police precincts: | - Egelston Township Police Department, 5380 E. Apple Ave. |
|-----------|--------------------------|---|

| | | |
|-----------|--|--|
| b. | fire stations: | - Egelston Township Fire Department, 5380 E. Apple Ave. |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - Muskegon County Waste Management, Metro Site, 8301 White Rd. |
| e. | community shelters: | - Oakridge Middle School, 251 S Wolf Lake 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) | - Egelston Township Hall, 5428 E. Apple Ave. - Egelston Township Library, 5428 E. Apple Ave. - Muskegon County Road Commission, 7700 E. Apple Ave. |

5. Vital or Critical Infrastructure

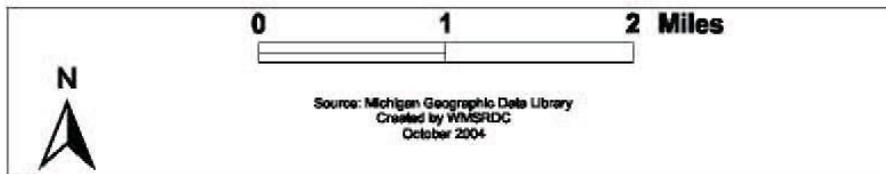
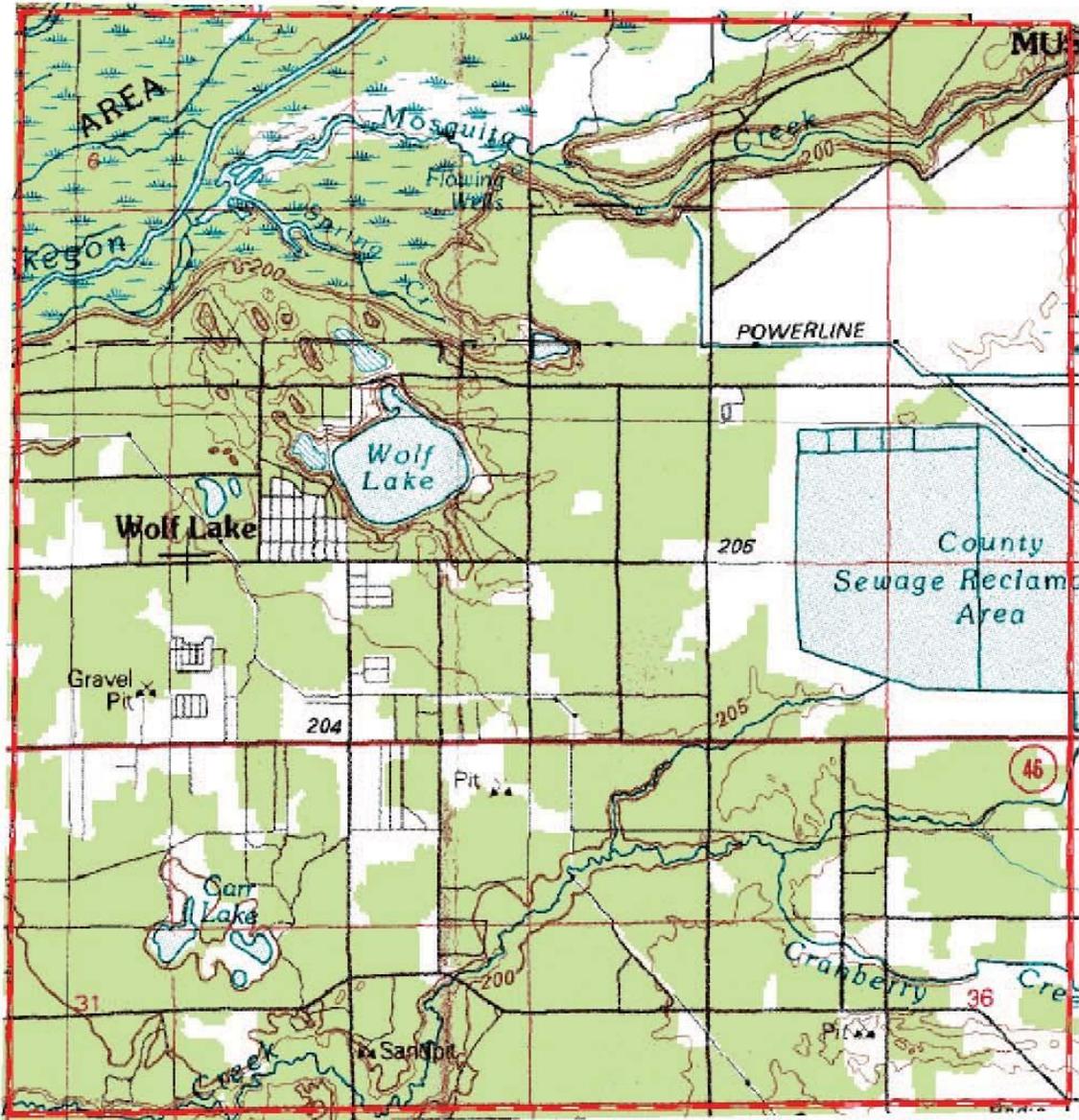
| | | |
|-----------|---|---|
| a. | roads, railroads, and bridges: | - M-46 - B-31 |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Muskegon County Wastewater Management - Metro Site, 8301 White Rd. - Egelston Township Sewer and Maintenance, 5360 E. Apple Ave. - Sanitary Lift Stations: One - Power Transmission Line - Muskegon Wastewater Lagoon Dam (Black and Mosquito Creeks) |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Natural Gas Pipeline |

6. Socio-Economic Profile of Sector

| | | | |
|-----------|---|---|---|
| a. | total population (night): | | 9,909 |
| b. | peak population (seasonal): | | 10,010 |
| c. | percent over 65: | | 1,165 |
| d. | percent under 18: | | 26.7 |
| e. | percent that are homeowners: | | 88.4 |
| f. | percent below poverty level: | | 10.8 |
| g. | percent with disability or mobility limitation: | | 20.7 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Utility (Personal): Total: | \$0 \$20,194,500 \$11,561,400 \$139,401,200 \$23,242,100 \$194,399,200 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | 2 \$18,496 6 \$631,000 |
| j. | location of floodplains: | - Black Creek, Carr Lake area, Mosquito Creek, Maple River, and Muskegon River & tributaries | |

| | | |
|--|---|-------------------|
| 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.) | | |

Egelston Township



FRUITLAND TOWNSHIP

| | | |
|-----------|-----------------------------------|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 151.9 persons per square mile - 71 housing units per square mile - Moderately forested - Lake Michigan shoreline and beach - Coastal sand dunes - White Lake - Duck Lake - 10 to 12 small lakes and ponds, 8 to 10 small creeks |
|-----------|-----------------------------------|--|

| | | |
|-----------|--|---|
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Oxford Circle, 3293 Orshal Rd (capacity 4) - Pinewood Retirement Home, 3234 Nestrom (capacity 6) - Skyline Home, 3297 Orshal Rd (capacity 4) - Terra Nova, 2745 W White Lake Dr (capacity 3) - White Lake Assisted Living, 6827 Whitehall Rd (capacity 38) |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | - McMillan Elementary (Reeths-Puffer Schools), 2885 Hyde Park Rd. (200 students, 26 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Cookie's Kids Daycare, 1936 W Bard Rd (capacity 12) - Raquel Heylmun, 3135 White Lake Dr (capacity 12) - Reeths Puffer McMillan Elementary, 2885 Hyde Park Rd (capacity 58) - Robin Carpenter, 5187 Duck Lake 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) | <ul style="list-style-type: none"> - Michigan's Adventure Amusement Park, 4750 Whitehall Rd. - South Shore Marina, 6806 S. Shore Dr. (boat rentals) - Bent Pine Golf Club, 2480 Duck Lake Rd. (18 holes) - Lincoln Golf Club, 4907 Whitehall Rd. (18 holes) - White Lake Golf Club, 6777 S. Shore Dr. (18 holes) - Duck Lake State Park, 5849 W. Michillinda Rd. - Lakeside Inn Resort, 5700 N. Scenic Dr. (35 units, 3 apartments, 1 cottage) |
| g. | major employers: | - None Identified |

| | | |
|-----------|--------------------------|--|
| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 2,209 commute with an average commuting time of 25.3 minutes - 1,179 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 2,592 total housing units: 2,097 occupied/495 vacant - Of the vacant, 383 (77.4%) are for seasonal recreational or occasional use |

| | | |
|-----------|--|--|
| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | - None Identified |
| b. | fire stations: | - (covered by White Lake Fire Authority) |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |

| | | |
|-----------|--|---|
| e. | community shelters: | - Duck Creek Learning Center, 4600 Gibson Rd. - Fruitland Evangelical Covenant, 4283 N. Weber Rd. - McMillan Elementary, 2885 Hyde Park Rd. |
| f. | community medical facilities, hospitals: | - None Identified |
| g. | historic sites: | - Fruitland District No. 6 School, 6227 South Shore Rd |
| h. | other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | - Fruitland Township Hall, 4545 Nestrom Rd. |

5. Vital or Critical Infrastructure

| | | |
|-----------|---|---------------------------|
| a. | roads, railroads, and bridges: | - US-31 |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission 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): | 5,543 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 6,554 | | | | | | | | | | | | |
| c. | percent over 65: | 9.7 | | | | | | | | | | | | |
| d. | percent under 18: | 29.0 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 89 | | | | | | | | | | | | |
| f. | percent below poverty level: | 9.3 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 17 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table border="0"> <tr> <td>Agricultural:</td> <td>\$2,458,100</td> </tr> <tr> <td>Commercial:</td> <td>\$10,582,400</td> </tr> <tr> <td>Industrial:</td> <td>\$0</td> </tr> <tr> <td>Residential:</td> <td>\$260,538,500</td> </tr> <tr> <td>Utility (Personal):</td> <td>\$10,027,600</td> </tr> <tr> <td>Total:</td> <td>\$283,606,600</td> </tr> </table> | Agricultural: | \$2,458,100 | Commercial: | \$10,582,400 | Industrial: | \$0 | Residential: | \$260,538,500 | Utility (Personal): | \$10,027,600 | Total: | \$283,606,600 |
| Agricultural: | \$2,458,100 | | | | | | | | | | | | | |
| Commercial: | \$10,582,400 | | | | | | | | | | | | | |
| Industrial: | \$0 | | | | | | | | | | | | | |
| Residential: | \$260,538,500 | | | | | | | | | | | | | |
| Utility (Personal): | \$10,027,600 | | | | | | | | | | | | | |
| Total: | \$283,606,600 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table border="0"> <tr> <td>Total Losses since 01/01/78:</td> <td>3</td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td>\$12,880</td> </tr> <tr> <td>Policies In-Force:</td> <td>15</td> </tr> <tr> <td>Total Insurance In-Force:</td> <td>\$2,571,800</td> </tr> </table> | Total Losses since 01/01/78: | 3 | Total Payments since 01/01/78: | \$12,880 | Policies In-Force: | 15 | Total Insurance In-Force: | \$2,571,800 | | | | |
| Total Losses since 01/01/78: | 3 | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | \$12,880 | | | | | | | | | | | | | |
| Policies In-Force: | 15 | | | | | | | | | | | | | |
| Total Insurance In-Force: | \$2,571,800 | | | | | | | | | | | | | |
| j. | location of floodplains: | - Lake Michigan shoreline, White Lake shoreline, Duck Lake shoreline, Muskrat Lake shoreline and tributaries | | | | | | | | | | | | |

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 |

Fruitland Township



FRUITPORT CHARTER TOWNSHIP

| | | |
|-----------|--|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 453.3 persons per square mile - 179.6 housing units per square mile - Moderately forested - Spring Lake - 8 to 10 small lakes and ponds, 10 to 12 small creeks |
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Agape Home at Blueberry Fields, 4747 E Mount Garfield Rd (capacity 18) - Airline Road Home, 4752 Airline Rd (Capacity 6) - Amanda CLF, 4021 Amanda St (capacity 6) - Broadway Home, 2315 E Broadway (capacity 6) - Brookmere Home, 3086 Creekview Ln (capacity 6) - Plan B Adult Foster Care, 2171 Monte Ave (capacity 6) - Sheridan AFC, 4144 Sheridan Dr (capacity 6) - The Agape Home, 4445 S Brooks Rd (capacity 20) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Catalina Shores, 5970 Avalon (88 units) |
| c. | schools: | <ul style="list-style-type: none"> - Fruitport Middle School, 3113 Pontaluna (703 students) - Beach Elementary, 2741 Heights Ravenna (390 students) - Shettler Elementary, 2187 Shettler Rd. (396 students) - Cavalry Christian School, 5873 Kendra Rd. - Eagle's Nest Preschool, 5873 Kendra Rd. - Broadway Baptist School, 2892 Oak Lane |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Sandra A Liphard, 2756 E Sternberg Rd (capacity 12) - Shannon L Donley, 6701 Beech Creek Dr (capacity 12) - Marla PUNCHES, 3180 S Dangl Rd (capacity 12) - CJS Playhouse, 4445 S Virginia Dr (capacity 12) - Janet Boyer, 3648 W Fuller Dr (capacity 12) - Cathy Chandler, 3278 Hts Ravenna Rd (capacity 12) - Robin Liphard, 1816 Pontaluna Rd (capacity 12) - Grace Lutheran Preschool, 2651 Shettler Rd (capacity 18) - Eagle's Nest Preschool, 5873 Kendra Rd (capacity 25) - Shettler Elementary School, 2187 E Shettler Rd (capacity 45) - Fruitport Early Childhood Center, 3113 E Pontaluna Rd (capacity 90) - Edgewood Elementary School, 3255 E Pontaluna Rd (capacity 122) |
| e. | large office buildings: | <ul style="list-style-type: none"> - 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) | <ul style="list-style-type: none"> - Lakeshore Sports Center (2 ice rinks, 1 indoor soccer field), 4470 Airline Rd. - Fruitport Golf Club, 6330 S. Harvey St. (18 holes) - West Wind Golf Course, 2540 E. Hile Rd. (two, 18 hole courses) - The Lakes Mall, 5600 S. Harvey St. - Comfort Inn, 1675 E. Sherman Blvd. (117 rooms) - El Royal Motel, 4610 Airline Rd. (31 rooms) - Clover Estates Mobile Home Park, 3239 Clover Parkway - Hidden Oaks Mobile Home Community, 14787 Apple Rd - Muskegon County Fairgrounds, 6621 Heights Ravenna Rd |

| | | |
|-----------|-------------------------|--|
| g. | major employers: | <ul style="list-style-type: none"> - Mercy Health Partners-Lakes Village, 6401 Prairie St - Meijer-Fruitport, 5326 S Harvey St - Lakes Mall, 5600 S Harvey St |
|-----------|-------------------------|--|

| | | |
|-----------|---|---|
| 3. | Population Shifts <i>(numbers include Village of Fruitport)</i> | |
| a. | daily: | <ul style="list-style-type: none"> - 6,249 commute with an average commuting time of 20 minutes - 2,938 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 5,389 total housing units: 5,103 occupied/286 vacant - Of the vacant, 51 (17.8%) are for seasonal recreational or occasional use |

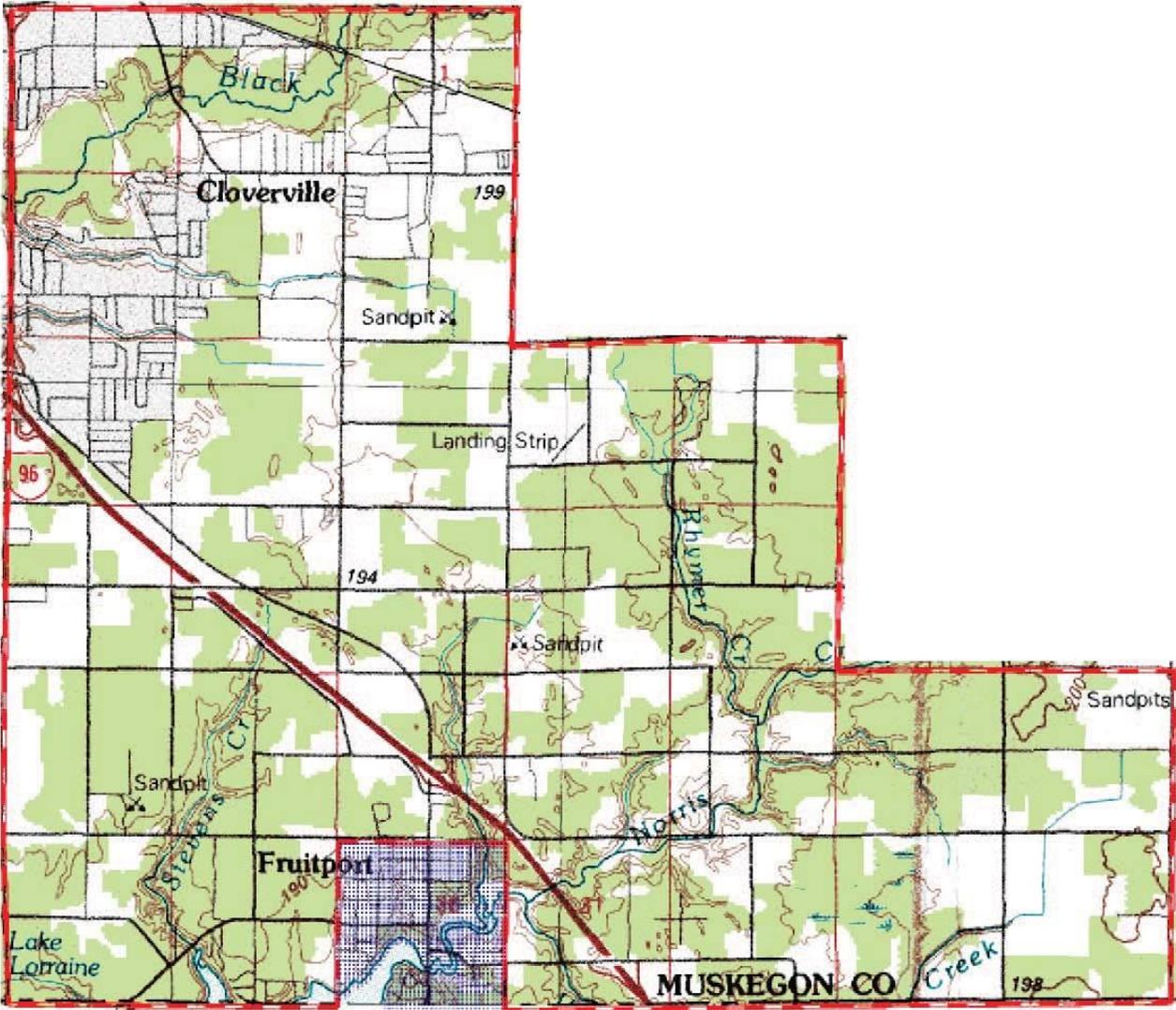
| | | |
|-----------|--|--|
| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | - None Identified |
| b. | fire stations: | <ul style="list-style-type: none"> - Fruitport Township Fire Department #1, 5815 Airline Rd. - Fruitport Township Fire Department #2, 3368 Black Creek Rd. |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - Fruitport Middle School, 3113 Pontaluna 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) | - Fruitport Township Hall, 5865 Airline Rd. |

| | | |
|-----------|---|---|
| 5. | Vital or Critical Infrastructure | |
| a. | roads, railroads, and bridges: | <ul style="list-style-type: none"> - I-96 - US-31 - B-72, B-31 |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | <ul style="list-style-type: none"> - Fruitport Township Water Dept, 6543 Airline Rd - Fruitport Township Sewer Dept, 2810 E. Mt. Garfield |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Oil Pipeline - Landing Strip, Jenson Rd. and Cloverville Rd. |

| | | | |
|-----------|--|---|--------|
| 6. | Socio-Economic Profile of Sector | | |
| a. | total population (night): | <i>(numbers include Village of Fruitport)</i> | 13,598 |
| b. | peak population (seasonal): | <i>(numbers include Village of Fruitport)</i> | 13,733 |
| c. | percent over 65: | | 13.6 |
| d. | percent under 18: | | 24.7 |
| e. | percent that are homeowners: | | 89.1 |
| f. | percent below poverty level: | | 6.5 |
| g. | percent with disability or mobility limitation: | | 15 |

| | | | |
|-----------|---|---|---|
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: Commercial: Industrial: Residential: Utility (Personal): Total: | \$5,305,800 \$126,164,000 \$4,453,700 \$321,631,400 \$29,661,100 \$487,216,000 |
| i. | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> |
| j. | location of floodplains: | N/A | |
| | | | |
| 7. | Emergency Warning System Coverage | | |
| a. | siren locations and/or description of warning system: | - None | |
| b. | percent of population covered by warning sirens or system: | N/A | |
| | | | |

Fruitport Township



HOLTON TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 71.4 persons per square mile - 29.8 housing units per square mile - Densely forested (Manistee National Forest) - Deer Lake - 14 to 16 small lakes and ponds, 10 to 12 small creeks |
|-----------|-----------------------------------|---|

| | |
|-----------|----------------------------------|
| 2. | Population Concentrations |
|-----------|----------------------------------|

| | | |
|-----------|--|--|
| a. | group homes: | <ul style="list-style-type: none"> - Cedar Creek Personal Care 2, 8842 Cedar Creek (capacity 12) - Cedar Creek Personal Care Home I, 8840 Cedar Creek (capacity 12) |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | <ul style="list-style-type: none"> - Holton High School, 6477 Syers Rd. (265 students, 28 staff) - Holton Middle School, 6245 Syers Rd. (211 students, 15 staff) - Holton Elementary, 6500 4th St. (389 students, 45 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Catherine Jo VanTreese, 8130 Brunswick Rd (capacity 12) - Jerrica Warner, 5985 Brunswick Rd (capacity 12) - Holton Head Start, Box 159 Fourth St (capacity 19) - Holton Preschool, 8894 Holton-Duck Lake Rd (capacity 32) |
| 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) | <ul style="list-style-type: none"> - Holton High School Football Stadium, 6477 Syers Rd. - Pine Island Estates Mobile Home Community, 3545 Pinewood Tr. - West Pine Island Estates Mobile Home Community, 3534 Pinewood |
| g. | major employers: | - None Identified |

| | |
|-----------|--------------------------|
| 3. | Population Shifts |
|-----------|--------------------------|

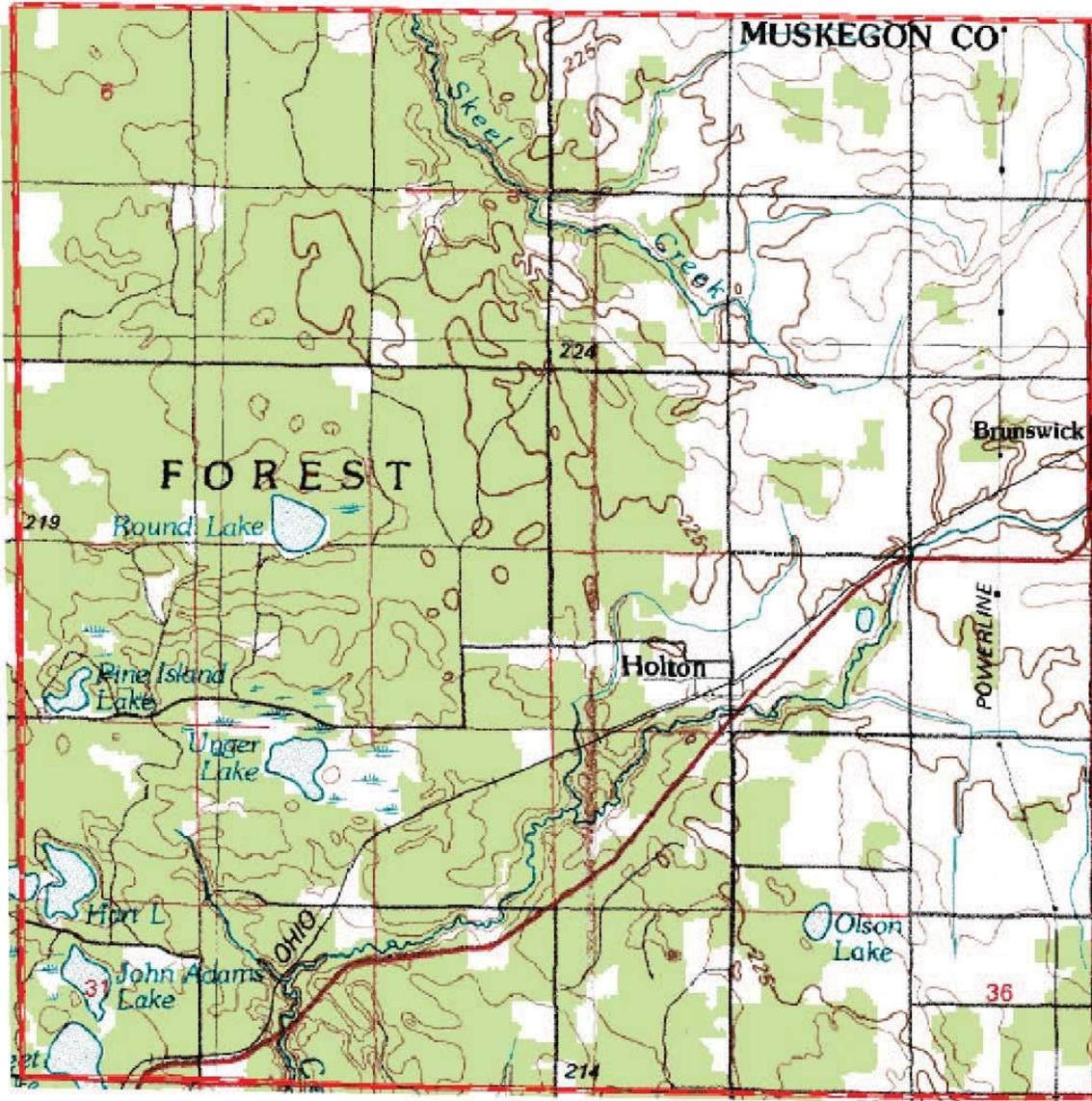
| | | |
|-----------|------------------|---|
| a. | daily: | <ul style="list-style-type: none"> - 961 commute with an average commuting time of 25.5 minutes - 541 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,050 total housing units: 916 occupied/134 vacant - Of the vacant, 48 (35.8%) are for seasonal recreational or occasional use |

| | |
|-----------|--|
| 4. | Important or Critical Public and Private Facilities |
|-----------|--|

| | | |
|-----------|--|---|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - Holton Fire Department, 6590 Holton-Whitehall 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) | <ul style="list-style-type: none"> - Holton Township Hall, 6511 Holton Whitehall Rd. - Muskegon County Library - Holton Branch, 8667 Main St. |

| 5. Vital or Critical Infrastructure | | | | |
|---|---|---|---|--------------------------------------|
| a. | roads, railroads, and bridges: - M-120 - B-86, B-31 - Michigan Shore Railroad | | | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. - Power Transmission Line | | | |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) - Natural Gas Pipeline | | | |
| 6. Socio-Economic Profile of Sector | | | | |
| a. | total population (night): 2,515 | | | |
| b. | peak population (seasonal): 2,646 | | | |
| c. | percent over 65: 12.8 | | | |
| d. | percent under 18: 24 | | | |
| e. | percent that are homeowners: 84.4 | | | |
| f. | percent below poverty level: 12.2 | | | |
| g. | percent with disability or mobility limitation: 26.5 | | | |
| h. | <table border="0"> <tr> <td>estimated property insurance coverage: (Real and Personal Equalized Valuations)</td> <td> Agricultural: \$11,891,100 Commercial: \$3,350,100 Industrial: \$0 Residential: \$42,052,900 Utility (Personal): \$3,414,000 Total: \$60,708,100 </td> </tr> </table> | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: \$11,891,100 Commercial: \$3,350,100 Industrial: \$0 Residential: \$42,052,900 Utility (Personal): \$3,414,000 Total: \$60,708,100 | |
| estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: \$11,891,100 Commercial: \$3,350,100 Industrial: \$0 Residential: \$42,052,900 Utility (Personal): \$3,414,000 Total: \$60,708,100 | | | |
| i. | <table border="0"> <tr> <td>flood insurance coverage:</td> <td> Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: </td> <td> <i>Not participating in the NFIP</i> </td> </tr> </table> | flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> |
| flood insurance coverage: | Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> | | |
| j. | location of floodplains: N/A | | | |
| 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 | | | |

Holton Township



LAKETON TOWNSHIP

| | | |
|-----------|-----------------------------------|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 437.2 persons per square mile - 183.7 housing units per square mile - Moderately forested - Lake Michigan shoreline and beach - Coastal sand dunes - Muskegon Lake - Bear Lake - 8 to 10 small lakes and ponds, 6 to 8 small creeks |
|-----------|-----------------------------------|--|

2. Population Concentrations

| | | |
|-----------|--|--|
| a. | group homes: | <ul style="list-style-type: none"> - Hansen Safe, 1635 Hansen St (capacity 4) - Wood Ridge, 1231 Horton Rd (capacity 3) - Luthern Social Services, 1635 Hansen |
| b. | large apartment buildings: | - Brittany Hills Apartments, 2565 Memorial Drive |
| c. | schools: | <ul style="list-style-type: none"> - Reeths-Puffer Middle School, 1911 W. Giles (645 students, 46 staff) - Central Elementary, 1807 W. Giles (413 students, 38 staff) - Pennsylvania Elementary School, 2500 Pennsylvania (38 students, 2 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Carolyn Jean Zietlow, 1491 Hansen St (capacity 12) - Jodi Bowen, 4234 W Giles Rd (capacity 12) - Hayley Gouine, 3696 Kern Rd (capacity 12) - Danielle Santose, 1186 N Robinhood Dr (capacity 12) - Central Elementary, 1807 W Giles Rd (capacity 44) |
| 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) | <ul style="list-style-type: none"> - Muskegon State Park, 3560 Memorial Dr. (247 campsites) - Muskegon Winter Sports Complex, Muskegon State Park - Pioneer County Park, 1563 N. Scenic Dr. (240 campsites) - Snug Harbor Motel, 3492 Memorial Dr. - Pines Motel, 1507 Whitehall Rd. - Bear's Den Motel, 2165 Whitehall Rd. - Maple Ridge School (one room schoolhouse), 1659 N. Buys Rd. |
| g. | major employers: | - None Identified |

3. Population Shifts

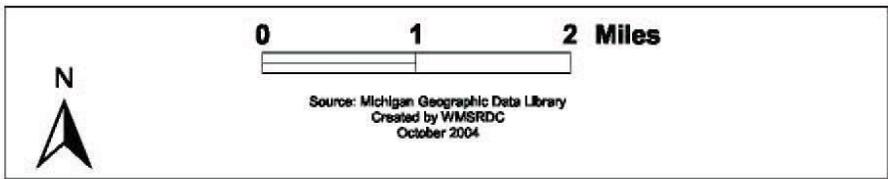
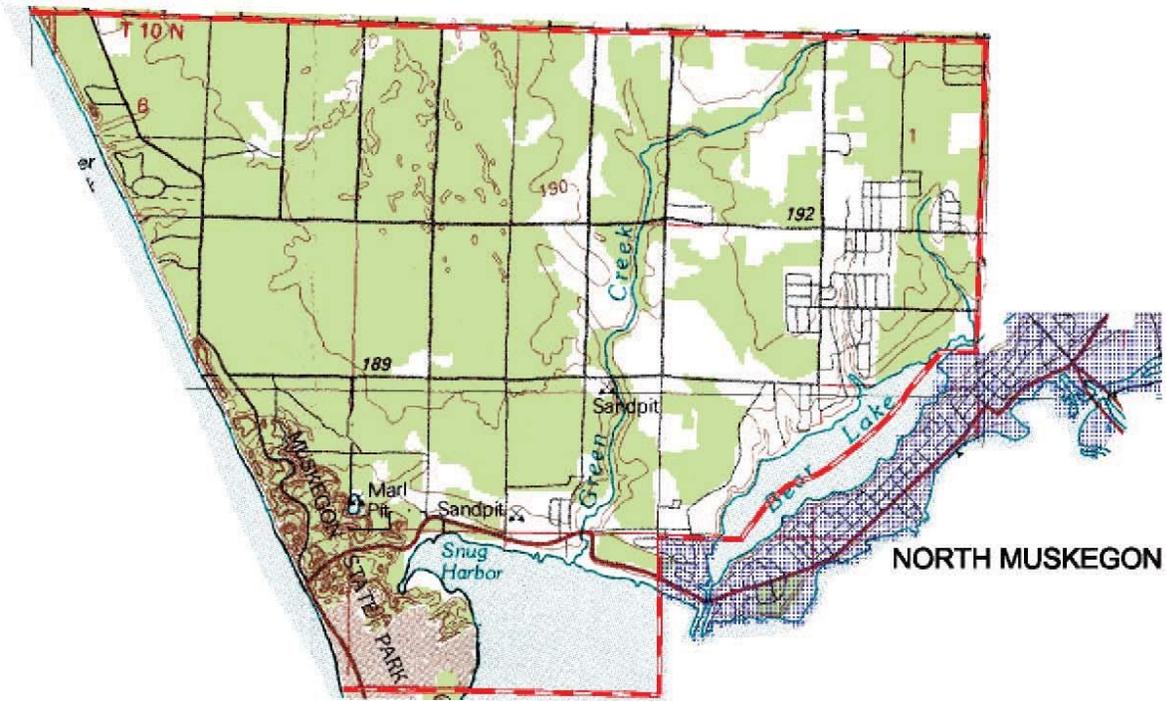
| | | |
|-----------|------------------|---|
| a. | daily: | <ul style="list-style-type: none"> - 3,488 commute with an average commuting time of 22 minutes - 1,652 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 3,178 total housing units: 2,922 occupied/256 vacant - Of the vacant, 81 (31.6%) 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: | - Reeths-Puffer Middle School, 1911 W. Giles 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) | - Laketon Township Hall, 2735 W. Giles 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): | 7,563 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 7,773 | | | | | | | | | | | | |
| c. | percent over 65: | 14.8 | | | | | | | | | | | | |
| d. | percent under 18: | 23.9 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 90.4 | | | | | | | | | | | | |
| f. | percent below poverty level: | 4.6 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 18.4 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table border="0"> <tr> <td>Agricultural:</td> <td>\$0</td> </tr> <tr> <td>Commercial:</td> <td>\$5,112,000</td> </tr> <tr> <td>Industrial:</td> <td>\$0</td> </tr> <tr> <td>Residential:</td> <td>\$218,315,800</td> </tr> <tr> <td>Utility (Personal):</td> <td>\$5,461,800</td> </tr> <tr> <td>Total:</td> <td>\$228,889,600</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$5,112,000 | Industrial: | \$0 | Residential: | \$218,315,800 | Utility (Personal): | \$5,461,800 | Total: | \$228,889,600 |
| Agricultural: | \$0 | | | | | | | | | | | | | |
| Commercial: | \$5,112,000 | | | | | | | | | | | | | |
| Industrial: | \$0 | | | | | | | | | | | | | |
| Residential: | \$218,315,800 | | | | | | | | | | | | | |
| Utility (Personal): | \$5,461,800 | | | | | | | | | | | | | |
| Total: | \$228,889,600 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table border="0"> <tr> <td>Total Losses since 01/01/78:</td> <td>7</td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td>\$33,629</td> </tr> <tr> <td>Policies In-Force:</td> <td>5</td> </tr> <tr> <td>Total Insurance In-Force:</td> <td>\$823,000</td> </tr> </table> | Total Losses since 01/01/78: | 7 | Total Payments since 01/01/78: | \$33,629 | Policies In-Force: | 5 | Total Insurance In-Force: | \$823,000 | | | | |
| Total Losses since 01/01/78: | 7 | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | \$33,629 | | | | | | | | | | | | | |
| Policies In-Force: | 5 | | | | | | | | | | | | | |
| Total Insurance In-Force: | \$823,000 | | | | | | | | | | | | | |
| j. | location of floodplains: | - Lake Michigan shoreline, Muskegon Lake shoreline, Bear Lake shoreline, and Green Creek & tributaries | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | |

Laketon Township



MONTAGUE TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 84.7 persons per square mile - 36.2 housing units per square mile - Moderately forested, moderate farmland - White Lake - White River - 6 to 8 small lakes and ponds, 14 to 16 small creeks - Hart-Montague Bicycle Trail |
|-----------|-----------------------------------|---|

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) | - Montgomery Inn, 10233 Old Highway 31 |
| g. | major employers: | - Mastertag International, 9751 U.S. 31 Business (120 employees) |

3. Population Shifts

| | | |
|-----------|------------------|--|
| a. | daily: | <ul style="list-style-type: none"> - 799 commute with an average commuting time of 24.3 minutes - 336 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 684 total housing units: 618 occupied/66 vacant - Of the vacant, 32 (48.5%) are for seasonal recreational or occasional use |

4. Important or Critical Public and Private Facilities

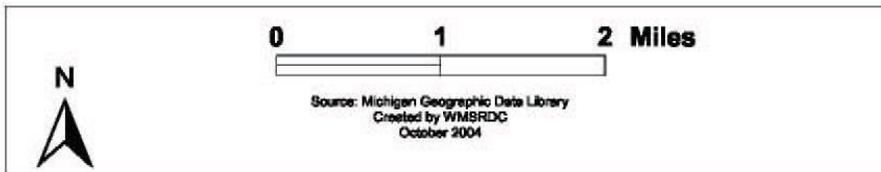
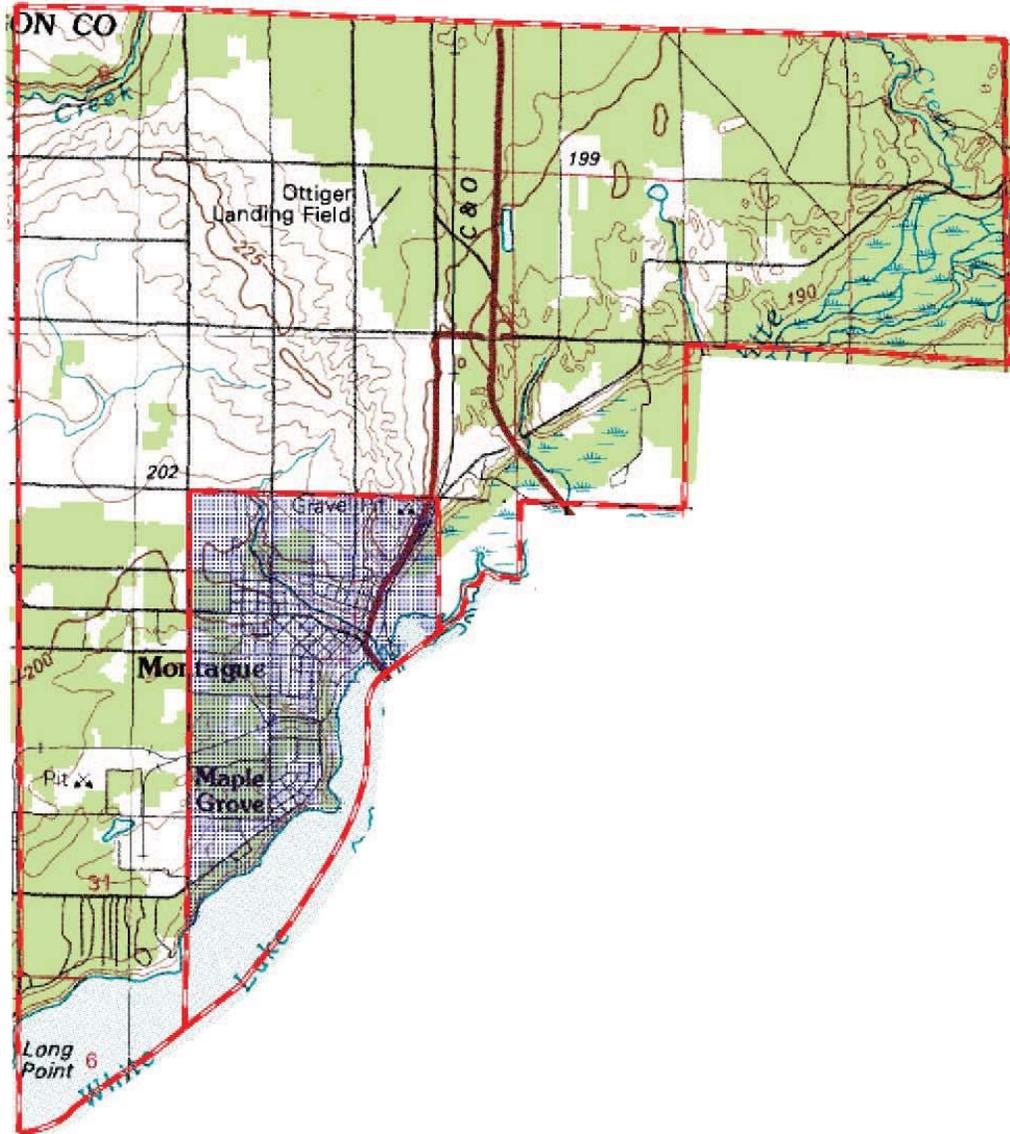
| | | |
|-----------|--|---|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - None Identified |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - None Identified |
| f. | community medical facilities, 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) | - Montague Township Hall, 8915 Whitbeck Rd. |

| | | |
|-----------|---|--|
| 5. | Vital or Critical Infrastructure | |
| a. | roads, railroads, and bridges: | - US-31 - US-31 Business Route - Old US-31 - B-15, B-86 |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Ottiger Airport, 10770 Sikkenga Rd. - Natural Gas Pipeline |

| | | | | | | | | | | | | | | |
|--------------------------------|---|--|------------------------------|-------------|--------------------------------------|--------------------------------|-------------|--------------------|--------------|---------------------------|---------------------|-------------|---------------|---------------------|
| 6. | Socio-Economic Profile of Sector | | | | | | | | | | | | | |
| a. | total population (night): | 1,600 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 1,712 | | | | | | | | | | | | |
| c. | percent over 65: | 15.4 | | | | | | | | | | | | |
| d. | percent under 18: | 23.4 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 89.2 | | | | | | | | | | | | |
| f. | percent below poverty level: | 11.3 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 17.9 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Agricultural:</td> <td style="text-align: right;">\$8,234,200</td> </tr> <tr> <td>Commercial:</td> <td style="text-align: right;">\$3,886,700</td> </tr> <tr> <td>Industrial:</td> <td style="text-align: right;">\$962,400</td> </tr> <tr> <td>Residential:</td> <td style="text-align: right;">\$44,094,900</td> </tr> <tr> <td>Utility (Personal):</td> <td style="text-align: right;">\$6,222,500</td> </tr> <tr> <td>Total:</td> <td style="text-align: right;">\$63,400,700</td> </tr> </table> | Agricultural: | \$8,234,200 | Commercial: | \$3,886,700 | Industrial: | \$962,400 | Residential: | \$44,094,900 | Utility (Personal): | \$6,222,500 | Total: | \$63,400,700 |
| Agricultural: | \$8,234,200 | | | | | | | | | | | | | |
| Commercial: | \$3,886,700 | | | | | | | | | | | | | |
| Industrial: | \$962,400 | | | | | | | | | | | | | |
| Residential: | \$44,094,900 | | | | | | | | | | | | | |
| Utility (Personal): | \$6,222,500 | | | | | | | | | | | | | |
| Total: | \$63,400,700 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Total Losses since 01/01/78:</td> <td></td> <td rowspan="4" style="text-align: center; vertical-align: middle;"><i>Not participating in the NFIP</i></td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td></td> </tr> <tr> <td>Policies In-Force:</td> <td></td> </tr> <tr> <td>Total Insurance In-Force:</td> <td></td> </tr> </table> | Total Losses since 01/01/78: | | <i>Not participating in the NFIP</i> | Total Payments since 01/01/78: | | Policies In-Force: | | Total Insurance In-Force: | | | | |
| Total Losses since 01/01/78: | | <i>Not participating in the NFIP</i> | | | | | | | | | | | | |
| Total Payments since 01/01/78: | | | | | | | | | | | | | | |
| Policies In-Force: | | | | | | | | | | | | | | |
| Total Insurance In-Force: | | | | | | | | | | | | | | |
| j. | location of floodplains: | N/A | | | | | | | | | | | | |

| | | |
|-----------|---|-------------------|
| 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 |

Montague Township



MOORLAND TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 43.3 persons per square mile - 17 housing units per square mile - Moderately forested, moderate farmland - Sewage Lagoon (Muskegon County Wastewater Management System) - 3 to 5 small lakes and ponds, 10 to 12 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) | - Moss Ridge Golf Club, 13545 Apple Ave. (18 holes) |
| g. | major employers: | - None Identified |

| | |
|-----------|--------------------------|
| 3. | Population Shifts |
|-----------|--------------------------|

| | | |
|-----------|------------------|--|
| a. | daily: | <ul style="list-style-type: none"> - 658 commute with an average commuting time of 30.1 minutes - 327 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 618 total housing units: 574 occupied/44 vacant - Of the vacant, 3 (6.8%) are for seasonal recreational or occasional use |

| | |
|-----------|--|
| 4. | Important or Critical Public and Private Facilities |
|-----------|--|

| | | |
|-----------|--|--|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - Moorland Township Fire Department, 12416 E. Apple Ave. |
| 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) | - Moorland Township Hall, 12416 E. Apple Ave. |

| | |
|-----------|---|
| 5. | Vital or Critical Infrastructure |
|-----------|---|

| | | |
|-----------|---------------------------------------|--|
| a. | roads, railroads, and bridges: | <ul style="list-style-type: none"> - M-46 - B-35 |
|-----------|---------------------------------------|--|

| | | |
|----|---|---|
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Muskegon County Solid Waste Management, 9366 E. Apple Ave. - Power Transmission Line |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Natural Gas Pipeline |

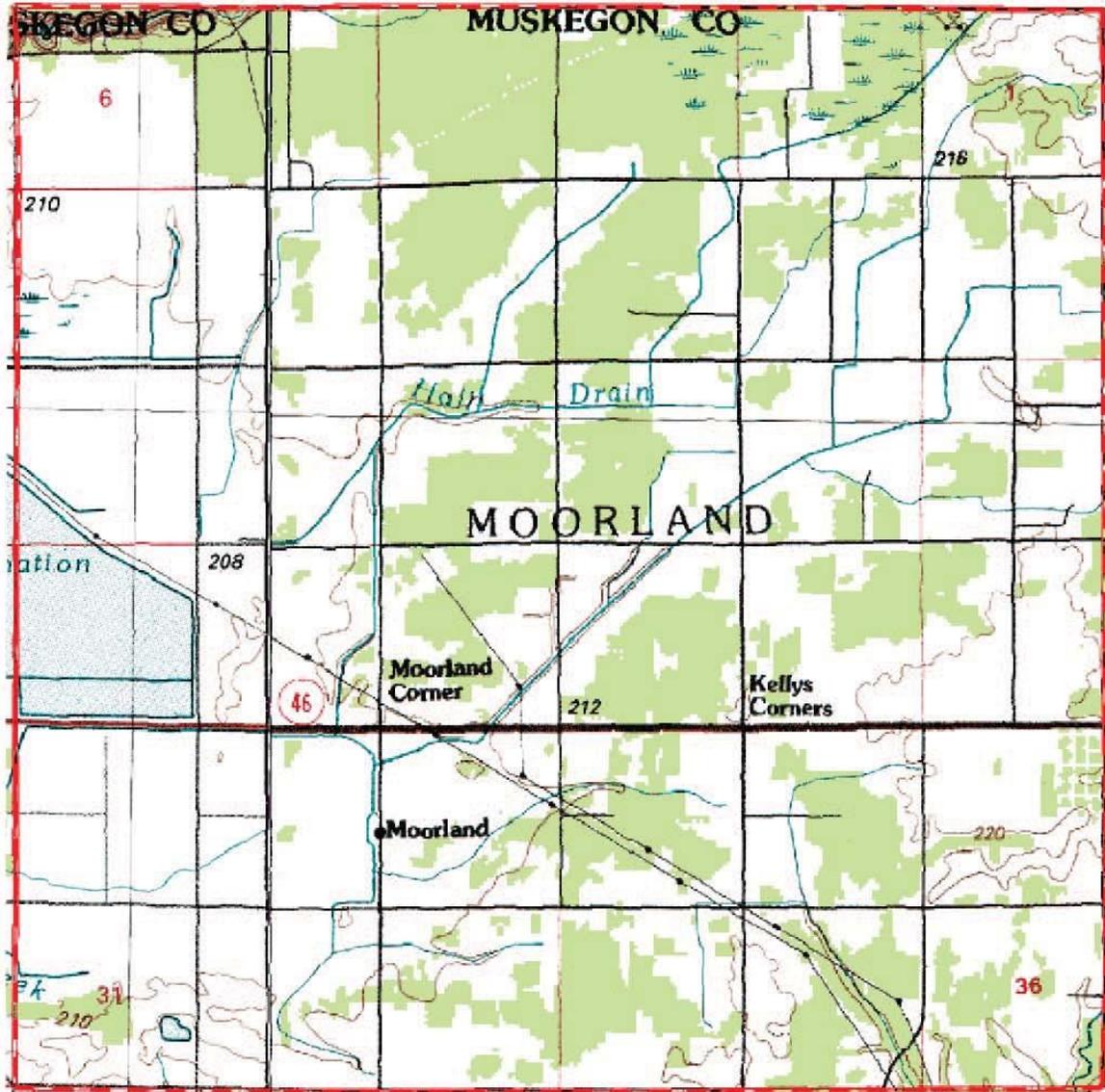
| | | |
|-----------|---|--|
| 6. | Socio-Economic Profile of Sector | |
|-----------|---|--|

| | | | | | | | | | | | | | | |
|--------------------------------|---|---|------------------------------|--|--------------------------------|--------------------|---------------------------|-----------|--------------|--------------|---------------------|-------------|--------|--------------|
| a. | total population (night): | 1,575 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 1,583 | | | | | | | | | | | | |
| c. | percent over 65: | 11.7 | | | | | | | | | | | | |
| d. | percent under 18: | 24.4 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 89.5 | | | | | | | | | | | | |
| f. | percent below poverty level: | 9.9 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 21.2 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr><td style="padding-left: 20px;">Agricultural:</td><td style="text-align: right;">\$11,105,100</td></tr> <tr><td style="padding-left: 20px;">Commercial:</td><td style="text-align: right;">\$1,709,800</td></tr> <tr><td style="padding-left: 20px;">Industrial:</td><td style="text-align: right;">\$725,900</td></tr> <tr><td style="padding-left: 20px;">Residential:</td><td style="text-align: right;">\$30,298,100</td></tr> <tr><td style="padding-left: 20px;">Utility (Personal):</td><td style="text-align: right;">\$2,340,900</td></tr> <tr><td style="padding-left: 20px;">Total:</td><td style="text-align: right;">\$46,179,800</td></tr> </table> | Agricultural: | \$11,105,100 | Commercial: | \$1,709,800 | Industrial: | \$725,900 | Residential: | \$30,298,100 | Utility (Personal): | \$2,340,900 | Total: | \$46,179,800 |
| Agricultural: | \$11,105,100 | | | | | | | | | | | | | |
| Commercial: | \$1,709,800 | | | | | | | | | | | | | |
| Industrial: | \$725,900 | | | | | | | | | | | | | |
| Residential: | \$30,298,100 | | | | | | | | | | | | | |
| Utility (Personal): | \$2,340,900 | | | | | | | | | | | | | |
| Total: | \$46,179,800 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border-collapse: collapse;"> <tr><td style="padding-left: 20px;">Total Losses since 01/01/78:</td><td rowspan="4" style="text-align: center; vertical-align: middle;"><i>Not participating in the NFIP</i></td></tr> <tr><td style="padding-left: 20px;">Total Payments since 01/01/78:</td></tr> <tr><td style="padding-left: 20px;">Policies In-Force:</td></tr> <tr><td style="padding-left: 20px;">Total Insurance In-Force:</td></tr> </table> | Total Losses since 01/01/78: | <i>Not participating in the NFIP</i> | Total Payments since 01/01/78: | Policies In-Force: | Total Insurance In-Force: | | | | | | | |
| Total Losses since 01/01/78: | <i>Not participating in the NFIP</i> | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | | | | | | | | | | | | | | |
| Policies In-Force: | | | | | | | | | | | | | | |
| Total Insurance In-Force: | | | | | | | | | | | | | | |
| j. | location of floodplains: | N/A | | | | | | | | | | | | |

| | | |
|-----------|--|--|
| 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 |

Moorland Township



MUSKEGON CHARTER TOWNSHIP

| | | |
|-------------------------------------|-----------------------------------|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 749.6 persons per square mile - 302.1 housing units per square miles - Moderately forested (Muskegon State Game Area) - Muskegon River - 4 to 6 small lakes and ponds, 8 to 10 small creeks |
| 2. Population Concentrations | | |
| a. | group homes: | <ul style="list-style-type: none"> - Annette Street Home, 2475 Annette Ave (capacity 6) - Brandel AFC, 1559 S Sheridan (capacity 5) - Christian Care Senior Community, 1530 McLaughlin Ave (capacity 105) - East Side Manor, 1439 East St (capacity 4) - Lilac Street Home, 1901 Lilac St (capacity 6) - MZ DZ, 501 S Sheridan Ave (capacity 4) - Parkside Home, 1443 Quarterline Rd (capacity 7) - Pioneer House, 1390 Brusse Ave (capacity 12) |
| b. | large apartment buildings: | <ul style="list-style-type: none"> - Arbor Crossings Apartments, 834 S. Sheridan Rd. (108 family units) - Bear Creek Apts., 91 E Giles Rd. (38 units) - Chesapeake Landing Apartments, 2690 Chesapeake Dr (88 units) - Christian Manor, 1480 McLaughlin Ave (42 units) - Creekwood Estates, 2000 Creekwood Dr. (96 family units) - Eastwood Village Apartments, 2243 E. Apple Ave. (69 units) - Park Woods Apartments, 924 Shonat St. (70 elderly, 30 family units) - Pine Grove Manor, 1764 E. Apple Ave. (172 elderly units) - Pioneer House, 1390 Brusse Ave. (12 elderly units) - Quail Meadow Apartments, 725 Meadow Ct. (120 family units) |
| c. | schools: | <ul style="list-style-type: none"> - Reeths-Puffer High School, 1545 N. Roberts (1,178 students, 92 staff) - Reeths-Puffer Intermediate School, 1500 N. Getty (577 students, 46 staff) - Reeths-Puffer Elementary, 874 E. Giles Rd. (487 students, 39 staff) - Orchard View High School, 16 N Quarterline (657 students, 58 staff) - Orchard View Middle School, 35 S. Sheridan Rd. (560 students, 53 staff) - Orchard View Elementary, 2310 Marquette (747 students, 45 staff) - Orchard View Early Elementary, 2820 MacArthur (422 students, 57 staff) - Timberland Charter Academy, 2574 McLaughlin (500 students, 54 staff) |
| d. | childcare facilities: | <ul style="list-style-type: none"> - Marcy Lynn Skidmore, 2811 MacArthur Rd (capacity 12) - Cynthia Goforth-Trevino, 121 S Brooks Rd (capacity 12) - Winter Sun Schoolhouse, Suite F, 1500 Whitehall Rd (capacity 72) - Beatrice Louise Siuda, 2270 Vine Ave (capacity 12) - Robin Wilson, 1026 Wesley Ave (capacity 12) - Michelle Macomber, 1856 Sheridan Dr (capacity 12) - Alaina Kay Skidmore, 107 S Walker Rd (capacity 12) - Audra Macomber, 3232 Macarthur (capacity 12) - Angel Hernandez, 1920 Barbara St (capacity 12) - Barbara Lynn Slater, 516 Harold St (capacity 12) - Cheryl Taylor, 1863 Kregel Ave (capacity 12) - Lori J McKinstry, 3760 Hall Rd (capacity 12) - Michelle Beeckman, 1721 Roberts Rd (capacity 12) - Kelly Perez, 2600 Becker Rd (capacity 12) - Rebecca Walker, 2068 Rambling Oak Dr (capacity 12) - Little Learners Preschool Inc, First Lutheran Church, 1206 Whitehall Rd |

| | | |
|-----------|--|---|
| | | (capacity 18) - Reeths-Puffer Elementary (RPE), 874 E Giles (capacity 36) - Orchard View Community Care, Bldg A-101, 834 Sheridan (capacity 43) - Cardinal Elementary, 2310 Marquette (capacity 100) - Orchard View Early Elementary, 2820 MacArthur Rd (capacity 123) - Orchard View Community Ed Center, 1074 Shonat (capacity 137) |
| 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) | - Kalamazoo Probation Enhancement, 985 Barney - Sheridan Christian Care, 2053 S. Sheridan - Reeths-Puffer High School Football Stadium, 1545 N. Roberts Rd. - Orchard View High School Football Stadium, 2310 Marquette Ave. - Softball World, 878 S. Mill Iron Rd - Eagle Island Golf Club, 800 S. Mill Iron Rd. (9 holes) - Northside Motel, 1145 Whitehall Rd. - Arlington Estates Mobile Home Community, 2222 Marlette - Arlington Estates North Mobile Home Community, 3785 Evanston Ave - Park Meadows Mobile Home Community, 210 East Giles |
| g. | major employers: | - Meijer- North Muskegon, 1800 Holton Rd - L-3 Combat Propulsion Systems, 76 S Getty St (380 employees) |
| 3. | Population Shifts | |
| a. | daily: | - 6,992 commute with an average commuting time of 19.3 minutes - 3,888 school-aged children |
| b. | seasonal: | - 7,191 total housing units: 6,807 occupied/384 vacant - Of the vacant, 18 (4.7%) are for seasonal recreational or occasional use |
| 4. | Important or Critical Public and Private Facilities | |
| a. | police precincts: | - Muskegon Township Police Department, 1990 E. Apple Ave. |
| b. | fire stations: | - Muskegon Township Fire Department, 1117 S. Walker Rd. - Muskegon Township Fire Department #2, 1699 N. Getty St. |
| c. | public works yards: | - Muskegon Township Highway Department, 103 S. Quarterline |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - Reeths-Puffer High School, 1545 N. Roberts Rd. - Reeths-Puffer Intermediate, 1500 N. Roberts Rd. |
| f. | community medical facilities, hospitals: | - Brookhaven Medical Care Facility, 1890 E. Apple Ave. (218 beds) |
| 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) | - Muskegon Township Hall, 1990 E. Apple Ave. |
| 5. | Vital or Critical Infrastructure | |
| a. | roads, railroads, and bridges: | - US-31 - M-120 - M-46 - Michigan Shore Railroad - US-31 bridge over Muskegon River North & South Branches |

| | | |
|-----------|---|---|
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | <ul style="list-style-type: none"> - Sanitary Lift Stations: 785 Whitehall, 3200 MacArthur, 2943 Becker, 1990 Apple, 1527 DeBaker, 1940 Northside - Power Transmission Line |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Northside Airport, 2151 River Rd. - Oil Pipeline |

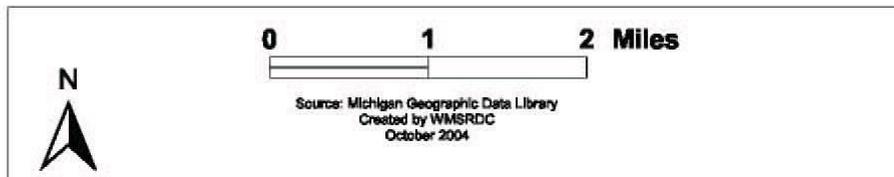
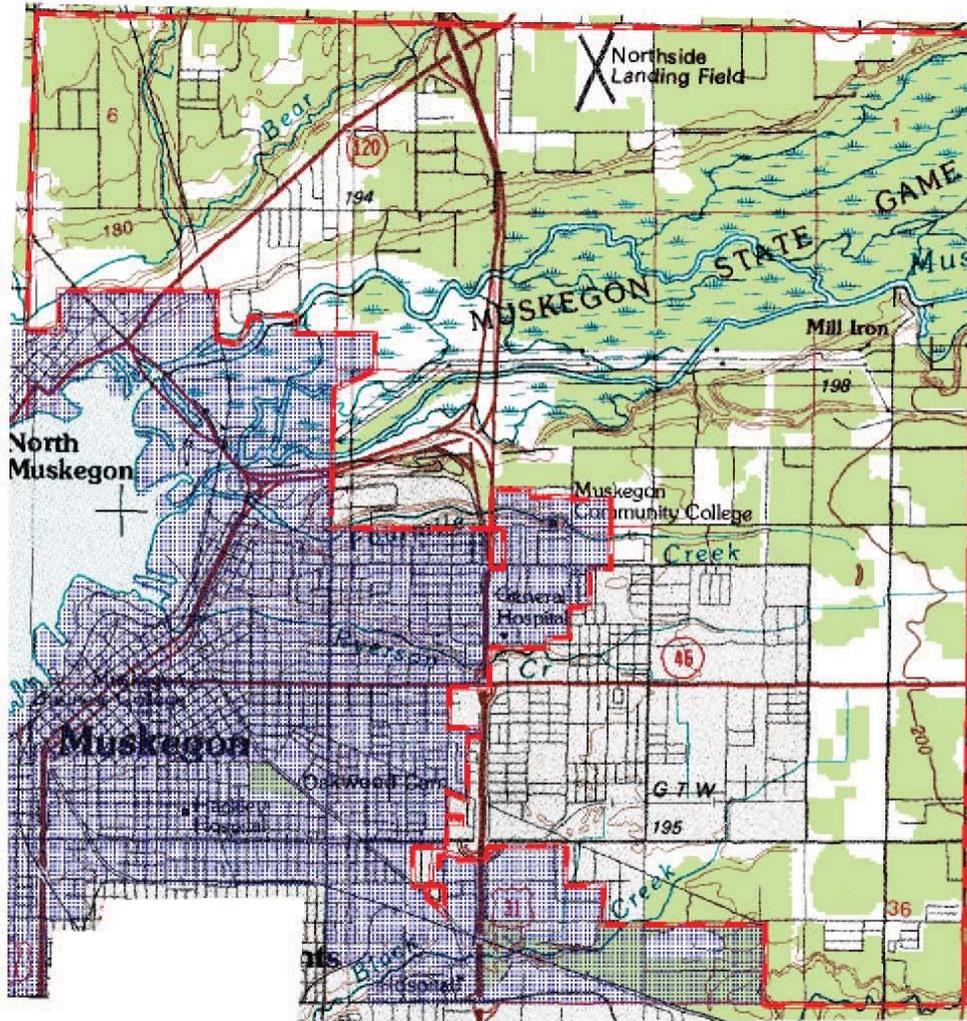
| | |
|-----------|---|
| 6. | Socio-Economic Profile of Sector |
|-----------|---|

| | | | | | | | | | | | | | | |
|--------------------------------|---|---|------------------------------|-----|--------------------------------|--------------|--------------------|--------------|---------------------------|---------------|---------------------|--------------|--------|---------------|
| a. | total population (night): | 17,840 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 17,886 | | | | | | | | | | | | |
| c. | percent over 65: | 14.2 | | | | | | | | | | | | |
| d. | percent under 18: | 26.3 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 78.8 | | | | | | | | | | | | |
| f. | percent below poverty level: | 16.7 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 22 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%; text-align: right;">Agricultural:</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td style="text-align: right;">Commercial:</td> <td style="text-align: right;">\$90,389,600</td> </tr> <tr> <td style="text-align: right;">Industrial:</td> <td style="text-align: right;">\$17,474,600</td> </tr> <tr> <td style="text-align: right;">Residential:</td> <td style="text-align: right;">\$225,900,900</td> </tr> <tr> <td style="text-align: right;">Utility (Personal):</td> <td style="text-align: right;">\$51,445,700</td> </tr> <tr> <td style="text-align: right;">Total:</td> <td style="text-align: right;">\$385,210,800</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$90,389,600 | Industrial: | \$17,474,600 | Residential: | \$225,900,900 | Utility (Personal): | \$51,445,700 | Total: | \$385,210,800 |
| Agricultural: | \$0 | | | | | | | | | | | | | |
| Commercial: | \$90,389,600 | | | | | | | | | | | | | |
| Industrial: | \$17,474,600 | | | | | | | | | | | | | |
| Residential: | \$225,900,900 | | | | | | | | | | | | | |
| Utility (Personal): | \$51,445,700 | | | | | | | | | | | | | |
| Total: | \$385,210,800 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%; text-align: right;">Total Losses since 01/01/78:</td> <td style="text-align: right;">3</td> </tr> <tr> <td style="text-align: right;">Total Payments since 01/01/78:</td> <td style="text-align: right;">\$40,449</td> </tr> <tr> <td style="text-align: right;">Policies In-Force:</td> <td style="text-align: right;">5</td> </tr> <tr> <td style="text-align: right;">Total Insurance In-Force:</td> <td style="text-align: right;">\$746,400</td> </tr> </table> | Total Losses since 01/01/78: | 3 | Total Payments since 01/01/78: | \$40,449 | Policies In-Force: | 5 | Total Insurance In-Force: | \$746,400 | | | | |
| Total Losses since 01/01/78: | 3 | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | \$40,449 | | | | | | | | | | | | | |
| Policies In-Force: | 5 | | | | | | | | | | | | | |
| Total Insurance In-Force: | \$746,400 | | | | | | | | | | | | | |
| j. | location of floodplains: | - Black Creek, Little Black Creek, Four Mile Creek, Bear Creek, and Muskegon River & tributaries | | | | | | | | | | | | |

| | |
|-----------|--|
| 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 |

Muskegon Township



RAVENNA TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 80 persons per square mile - 35.4 housing units per square mile - Moderately forested, moderate farmland - Crockery Creek - 1 to 3 small lakes and ponds, 14 to 16 small creeks |
|-----------|-----------------------------------|---|

| | |
|-----------|----------------------------------|
| 2. | Population Concentrations |
|-----------|----------------------------------|

| | | |
|-----------|--|--|
| a. | group homes: | - Country Style AFC, 6427 Blackmer Rd (capacity 2) |
| b. | large apartment buildings: | - None Identified |
| c. | schools: | <ul style="list-style-type: none"> - Ravenna High School, 2700 S. Ravenna Rd. (342 students, 23 staff) - Ravenna Middle School, 2766 S. Ravenna Rd. (345 students, 26 staff) |
| d. | childcare centers: | - 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) | <ul style="list-style-type: none"> - Ravenna High School Football Stadium, 2700 S. Ravenna Rd. - Ravenna Golf Course, 11566 Heights Ravenna Rd. (18 holes) |
| g. | major employers: | - Metal Technologies- Ravenna Ductile Iron, 3800 Adams Rd (220 employees) |

| | |
|-----------|---|
| 3. | Population Shifts <i>(numbers include Village of Ravenna)</i> |
|-----------|---|

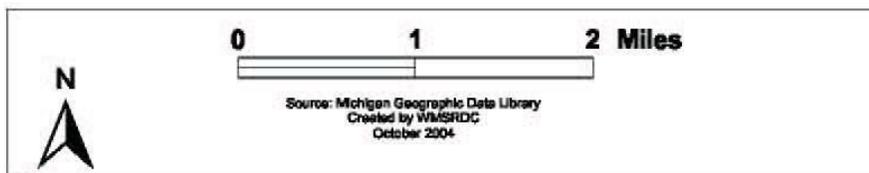
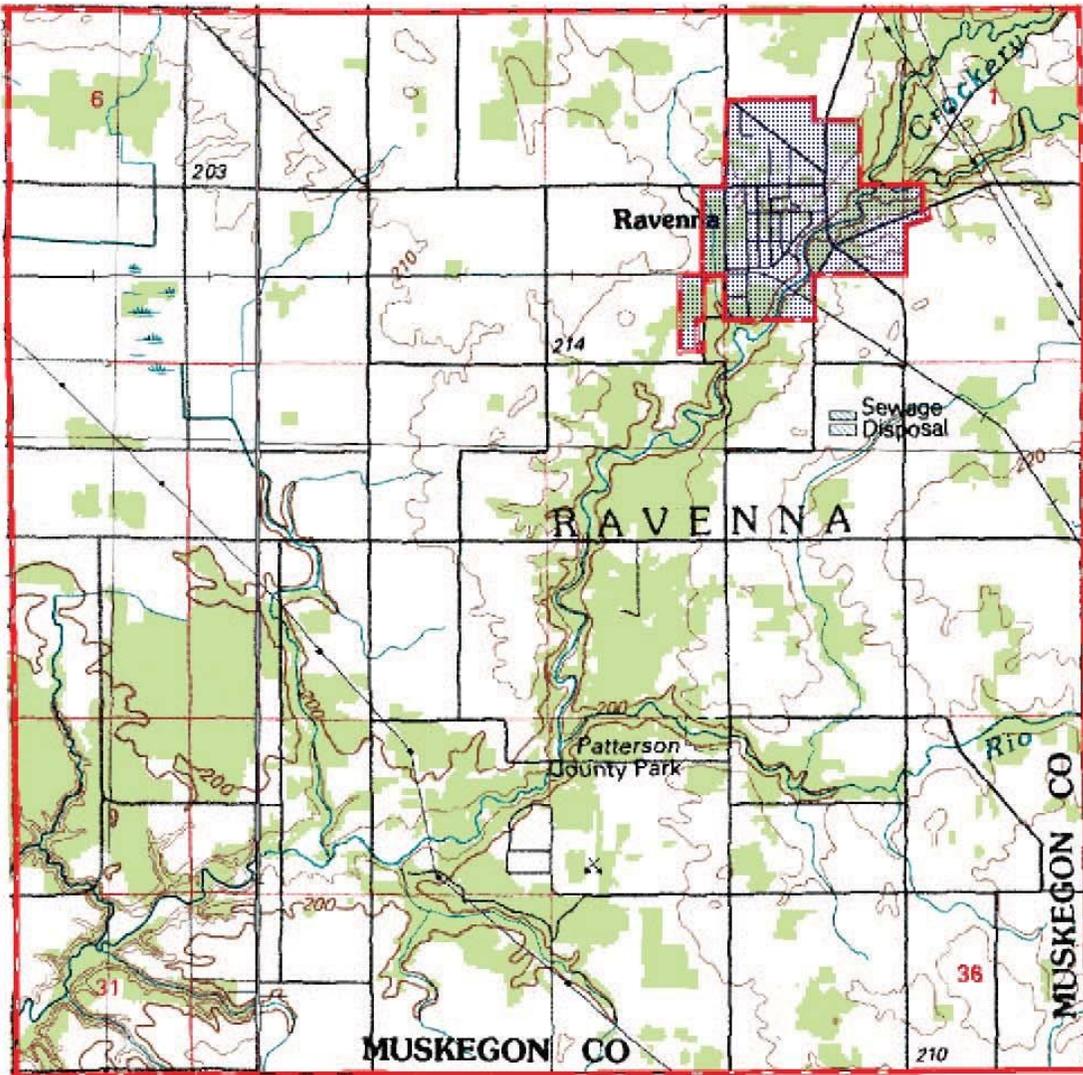
| | | |
|-----------|------------------|---|
| a. | daily: | <ul style="list-style-type: none"> - 1,286 commute with an average commuting time of 25.1 minutes - 695 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 1,100 total housing units: 1,038 occupied/62 vacant - Of the vacant, 8 (12.9%) are for seasonal recreational or occasional use |

| | |
|-----------|--|
| 4. | Important or Critical Public and Private Facilities |
|-----------|--|

| | | |
|-----------|--|---|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - Ravenna Area Fire Department, 3763 Blackmer Rd. |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - Ravenna Jr/Sr High School, 2766 S Ravenna 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) | - Ravenna Township Hall, 3770 Blackmer Rd. |

| | | | |
|-----------|---|--|-------|
| 5. | Vital or Critical Infrastructure | | |
| a. | roads, railroads, and bridges: | - B-72, B-35 | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line | |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | - Natural Gas Pipeline | |
| 6. | Socio-Economic Profile of Sector | | |
| a. | total population (night): | (numbers include Village of Ravenna) | 2,905 |
| b. | peak population (seasonal): | (numbers include Village of Ravenna) | 2,927 |
| c. | percent over 65: | | 12.8 |
| d. | percent under 18: | | 28.3 |
| e. | percent that are homeowners: | | 84.5 |
| f. | percent below poverty level: | | 3.5 |
| g. | percent with disability or mobility limitation: | | 16.2 |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: \$28,851,800 Commercial: \$4,903,500 Industrial: \$2,252,100 Residential: \$51,020,000 Utility (Personal): \$10,136,500 Total: \$97,163,900 | |
| i. | flood insurance coverage: | Total Losses since 01/01/78: 1 Total Payments since 01/01/78: \$14,091 Policies In-Force: 2 Total Insurance In-Force: \$420,000 | |
| j. | location of floodplains: | - Crockery Creek, Rio Grande Creek, North Branch Smith Drain, and Tidioute Drain | |
| 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 | |

Ravenna Township



SULLIVAN TOWNSHIP

| | | |
|-----------|-----------------------------------|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 101.3 persons per square mile - 40.6 housing units per square mile - Moderately forested - 4 to 6 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: | - None Identified |
| d. | childcare facilities: | - Vickie Alsteens, 5054 Heights-Ravenna 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) | - Muskegon County Fairgrounds, 6621 Heights Ravenna Rd. (Early July) |
| g. | major employers: | - None Identified |

3. Population Shifts

| | | |
|-----------|------------------|---|
| a. | daily: | <ul style="list-style-type: none"> - 1,114 commute with an average commuting time of 22.7 minutes - 499 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 978 total housing units: 932 occupied/46 vacant - Of the vacant, 5 (10.9%) are for seasonal recreational or occasional use |

4. Important or Critical Public and Private Facilities

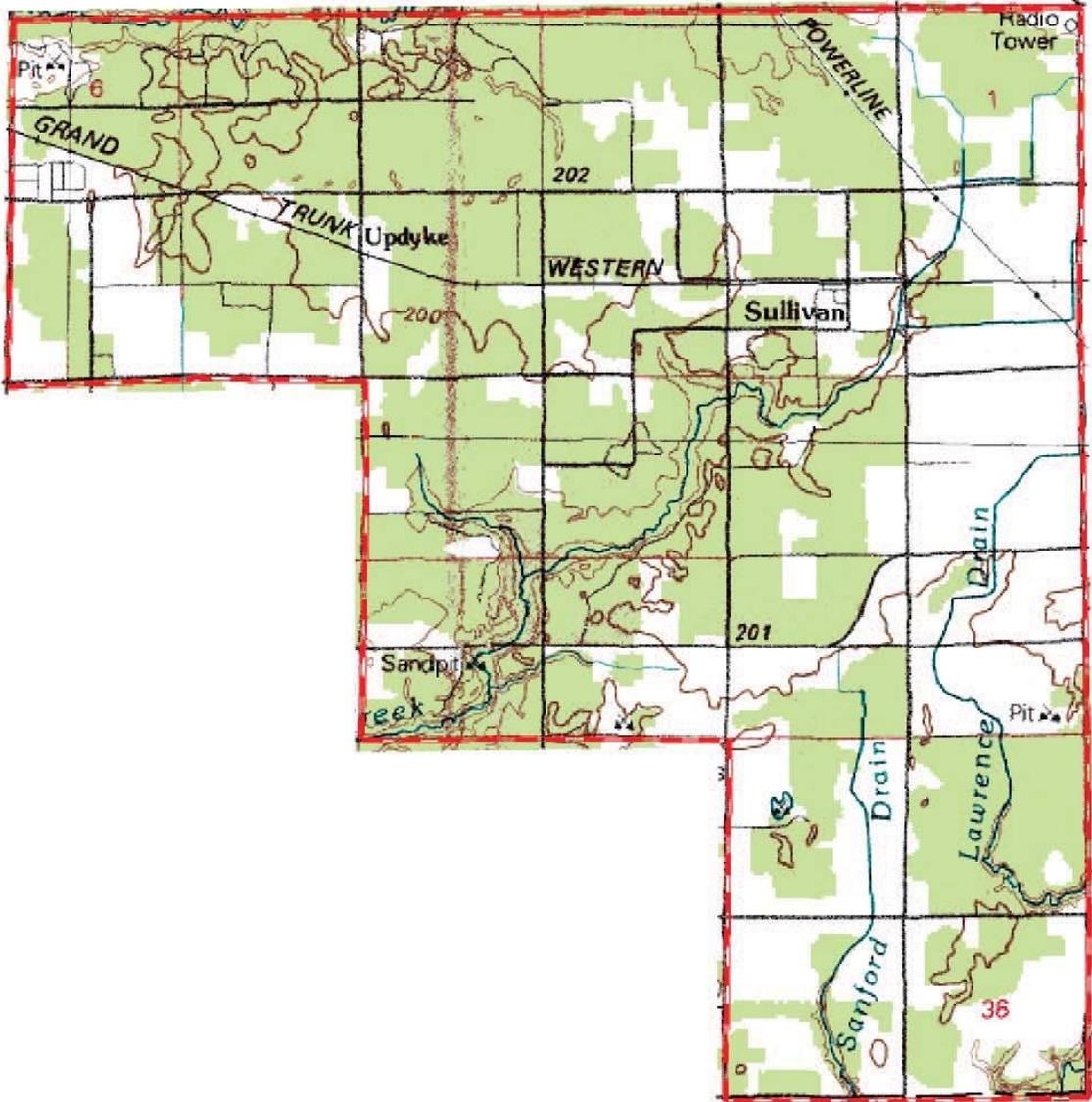
| | | |
|-----------|--|--|
| a. | police precincts: | - None Identified |
| b. | fire stations: | - None Identified |
| c. | public works yards: | - None Identified |
| d. | pumping stations: | - None Identified |
| e. | community shelters: | - None Identified |
| f. | community medical facilities, 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) | - Sullivan Township Hall, 8138 Heights Ravenna Rd. |

5. Vital or Critical Infrastructure

| | | |
|-----------|---|--|
| a. | roads, railroads, and bridges: | - B-72, B-31 |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission Line |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Natural Gas Pipeline - Oil Pipeline |

| 6. Socio-Economic Profile of Sector | | | | | | | | | | | | | | |
|---|--|---|--------------------------------------|--------------------------------------|--------------------------------|--------------------|---------------------------|-----|--------------|--------------|---------------------|-------------|--------|--------------|
| a. | total population (night): 2,441 | | | | | | | | | | | | | |
| b. | peak population (seasonal): 2,454 | | | | | | | | | | | | | |
| c. | percent over 65: 14.1 | | | | | | | | | | | | | |
| d. | percent under 18: 22.5 | | | | | | | | | | | | | |
| e. | percent that are homeowners: 93.2 | | | | | | | | | | | | | |
| f. | percent below poverty level: 6.4 | | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: 24.2 | | | | | | | | | | | | | |
| h. | <table border="0"> <tr> <td rowspan="6"> estimated property insurance coverage: (Real and Personal Equalized Valuations) </td> <td>Agricultural:</td> <td>\$5,311,800</td> </tr> <tr> <td>Commercial:</td> <td>\$1,051,500</td> </tr> <tr> <td>Industrial:</td> <td>\$0</td> </tr> <tr> <td>Residential:</td> <td>\$58,702,400</td> </tr> <tr> <td>Utility (Personal):</td> <td>\$2,085,000</td> </tr> <tr> <td>Total:</td> <td>\$67,150,700</td> </tr> </table> | estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: | \$5,311,800 | Commercial: | \$1,051,500 | Industrial: | \$0 | Residential: | \$58,702,400 | Utility (Personal): | \$2,085,000 | Total: | \$67,150,700 |
| estimated property insurance coverage: (Real and Personal Equalized Valuations) | Agricultural: | | \$5,311,800 | | | | | | | | | | | |
| | Commercial: | | \$1,051,500 | | | | | | | | | | | |
| | Industrial: | | \$0 | | | | | | | | | | | |
| | Residential: | | \$58,702,400 | | | | | | | | | | | |
| | Utility (Personal): | | \$2,085,000 | | | | | | | | | | | |
| | Total: | \$67,150,700 | | | | | | | | | | | | |
| i. | <table border="0"> <tr> <td rowspan="4">flood insurance coverage:</td> <td>Total Losses since 01/01/78:</td> <td rowspan="4"><i>Not participating in the NFIP</i></td> </tr> <tr> <td>Total Payments since 01/01/78:</td> </tr> <tr> <td>Policies In-Force:</td> </tr> <tr> <td>Total Insurance In-Force:</td> </tr> </table> | flood insurance coverage: | Total Losses since 01/01/78: | <i>Not participating in the NFIP</i> | Total Payments since 01/01/78: | Policies In-Force: | Total Insurance In-Force: | | | | | | | |
| flood insurance coverage: | Total Losses since 01/01/78: | | <i>Not participating in the NFIP</i> | | | | | | | | | | | |
| | Total Payments since 01/01/78: | | | | | | | | | | | | | |
| | Policies In-Force: | | | | | | | | | | | | | |
| | Total Insurance In-Force: | | | | | | | | | | | | | |
| j. | location of floodplains: N/A | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | |

Sullivan Township



WHITE RIVER TOWNSHIP

| | | |
|-----------|--|--|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 84 persons per square mile - 57 housing units per square mile - Moderately forested, moderate farmland - Lake Michigan shoreline and beach - Coastal sand dunes - White Lake - 6 to 8 small lakes and ponds, 10 to 12 small creeks |
| 2. | Population Concentrations | |
| a. | group homes: | <ul style="list-style-type: none"> - Indian Bay Residence, 8770 Indian Bay Rd (capacity 10) - Priority AFC, 6832 Post Rd (capacity 3) |
| 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) | <ul style="list-style-type: none"> - Meinert County Park/Pines Campground, 8390 Meinert Park Rd. (67 campsites) - Old Channel Trail Golf Course, 8242 Old Channel Trail (27 holes) |
| g. | major employers: | - None Identified |
| 3. | Population Shifts | |
| a. | daily: | <ul style="list-style-type: none"> - 650 commute with an average commuting time of 28.8 minutes - 246 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 907 total housing units: 524 occupied/383 vacant - Of the vacant, 340 (88.8%) 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: | - Community Mental Health of Muskegon County – Indian Bay Residence, 8770 Indian Bay Rd. |
| g. | historic sites: | - Mouth Cemetery, 6666 Sunset Lane |
| h. | other: (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage) | - White River Township Hall, 7386 Post Rd. |

| | | | | | | | | | | | | | | |
|----------------------------------|---|--|------------------------------|-------------|--------------------------------|-------------|--------------------|-------------|----------------------------------|--------------------|---------------------|-------------|---------------|----------------------|
| 5. | Vital or Critical Infrastructure | | | | | | | | | | | | | |
| a. | roads, railroads, and bridges: | - B-15 | | | | | | | | | | | | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | - Power Transmission 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): | 1,335 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 2,195 | | | | | | | | | | | | |
| c. | percent over 65: | 21 | | | | | | | | | | | | |
| d. | percent under 18: | 21.3 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 95.4 | | | | | | | | | | | | |
| f. | percent below poverty level: | 3.8 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 16.3 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Agricultural:</td> <td style="text-align: right;">\$7,742,200</td> </tr> <tr> <td>Commercial:</td> <td style="text-align: right;">\$5,450,800</td> </tr> <tr> <td>Industrial:</td> <td style="text-align: right;">\$2,477,800</td> </tr> <tr> <td>Residential:</td> <td style="text-align: right;">\$129,954,850</td> </tr> <tr> <td>Utility (Personal):</td> <td style="text-align: right;">\$1,328,200</td> </tr> <tr> <td>Total:</td> <td style="text-align: right;">\$146,953,850</td> </tr> </table> | Agricultural: | \$7,742,200 | Commercial: | \$5,450,800 | Industrial: | \$2,477,800 | Residential: | \$129,954,850 | Utility (Personal): | \$1,328,200 | Total: | \$146,953,850 |
| Agricultural: | \$7,742,200 | | | | | | | | | | | | | |
| Commercial: | \$5,450,800 | | | | | | | | | | | | | |
| Industrial: | \$2,477,800 | | | | | | | | | | | | | |
| Residential: | \$129,954,850 | | | | | | | | | | | | | |
| Utility (Personal): | \$1,328,200 | | | | | | | | | | | | | |
| Total: | \$146,953,850 | | | | | | | | | | | | | |
| i. | flood insurance coverage: | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Total Losses since 01/01/78:</td> <td style="text-align: right;">9</td> </tr> <tr> <td>Total Payments since 01/01/78:</td> <td style="text-align: right;">\$16,801</td> </tr> <tr> <td>Policies In-Force:</td> <td style="text-align: right;">5</td> </tr> <tr> <td>Total Insurance In-Force:</td> <td style="text-align: right;">\$1,146,000</td> </tr> </table> | Total Losses since 01/01/78: | 9 | Total Payments since 01/01/78: | \$16,801 | Policies In-Force: | 5 | Total Insurance In-Force: | \$1,146,000 | | | | |
| Total Losses since 01/01/78: | 9 | | | | | | | | | | | | | |
| Total Payments since 01/01/78: | \$16,801 | | | | | | | | | | | | | |
| Policies In-Force: | 5 | | | | | | | | | | | | | |
| Total Insurance In-Force: | \$1,146,000 | | | | | | | | | | | | | |
| j. | location of floodplains: | - Lake Michigan shoreline, White Lake shoreline, Sadony Bayou, Pierson Drain, Flower Creek, Little Flower 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 | | | | | | | | | | | | |

White River Township

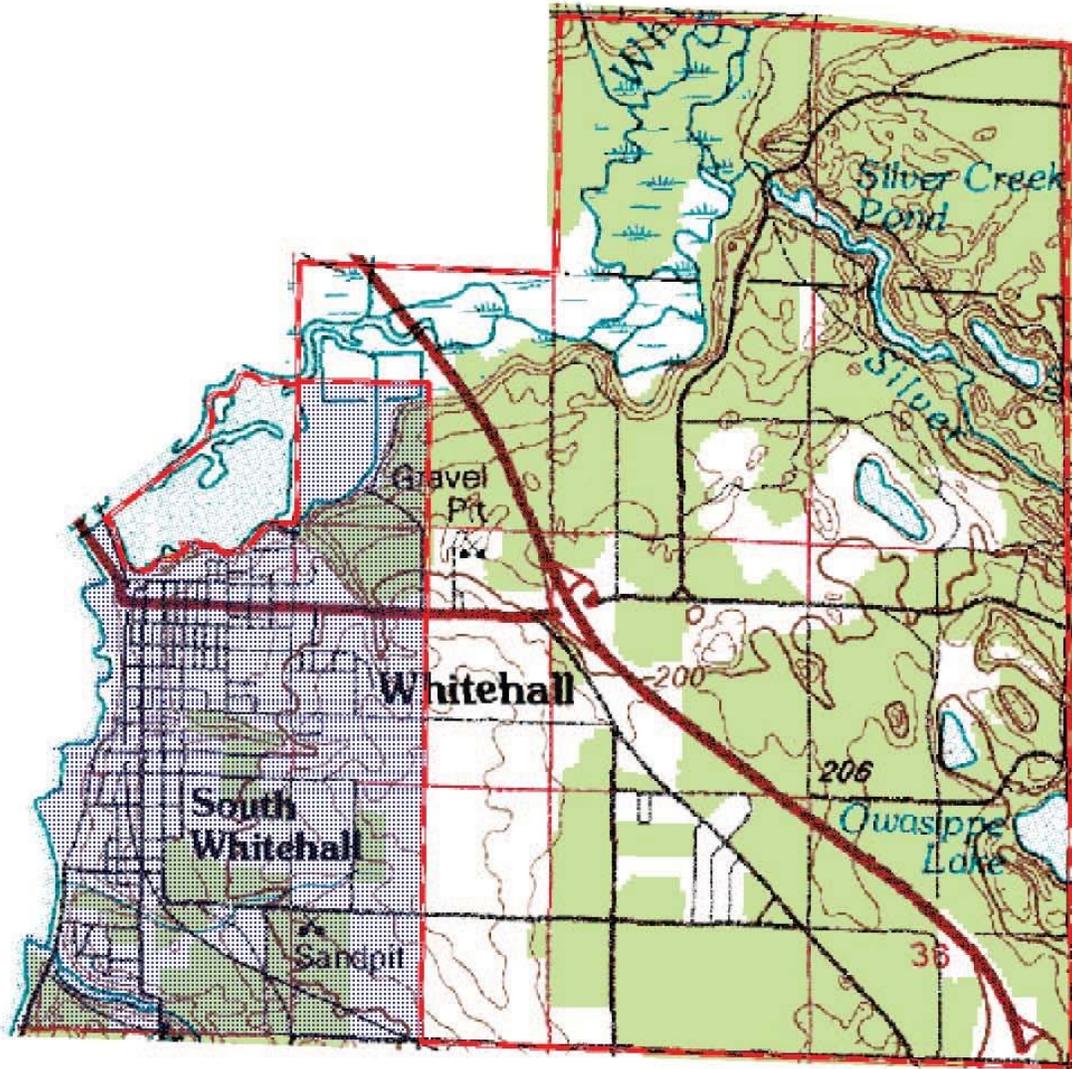


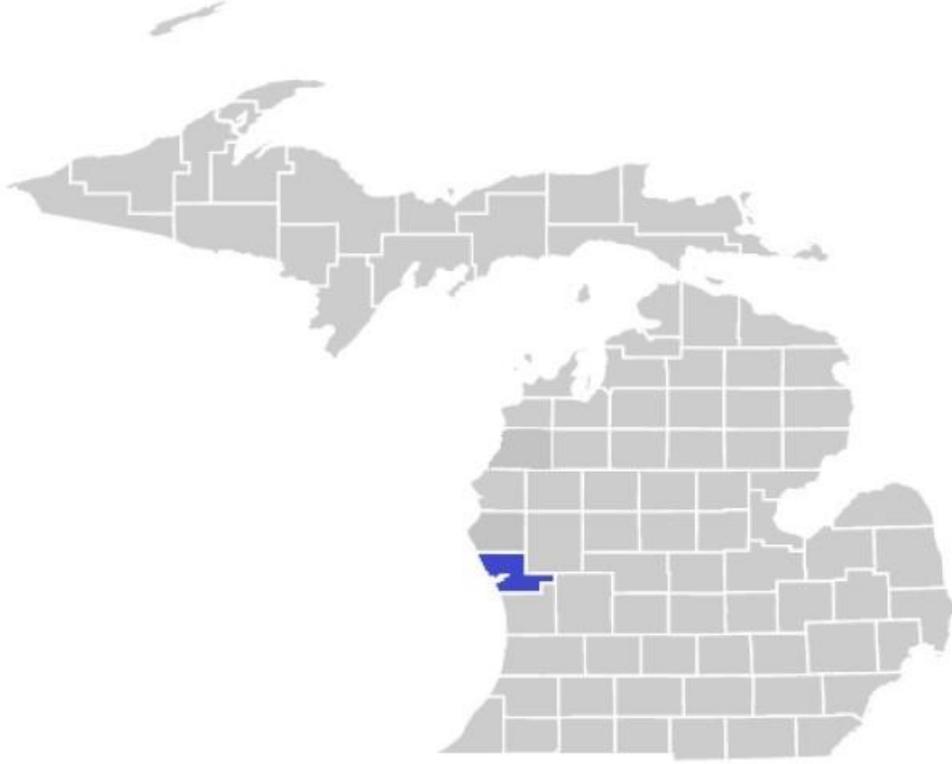
WHITEHALL TOWNSHIP

| | | |
|---|--|---|
| 1. | major geographic features: | <ul style="list-style-type: none"> - 185 persons per square mile - 76.9 housing units per square mile - Moderately forested - White River - 4 to 6 small lakes and ponds, 2 to 4 small creeks |
| 2. Population Concentrations | | |
| a. | group homes: | <ul style="list-style-type: none"> - Benston Road Home, 7468 Whitehall Rd (capacity 6) - Bush Creek Family Manor, 1126 Alice St (capacity 3) - Bush Creek Manor, 1023 Alice St (capacity 6) - Crystal Lake Home, 7875 Whitehall Rd North (capacity 6) - Kelly's Kare AFC, 7888 Whitehall Rd (capacity 6) |
| 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) | <ul style="list-style-type: none"> - North Star Cinema, 8171 Whitehall Rd. (350 capacity) - Hickory Knoll Golf Courses, 3065 Alice St. (four, 9 hole courses) - Muskegon County Juvenile Detention Center, 1830 W. White Lake Dr. - Ramada Inn, 2865 Holton Whitehall Rd. (66 rooms) - Super 8 Motel, 3080 Colby Rd. (54 rooms) - Best Western Inn & Suites, 2822 N. Durham Rd. (68 rooms) - Crystal Downs Mobile Village, 2701 Crystal Lake Rd - Edgewood Trailer Park, 7415 Whitehall |
| g. | major employers: | - Sunset Waste Services, 3278 E Colby (100 employees) |
| 3. Population Shifts | | |
| a. | daily: | <ul style="list-style-type: none"> - 801 commute with an average commuting time of 21.9 minutes - 345 school-aged children |
| b. | seasonal: | <ul style="list-style-type: none"> - 723 total housing units: 673 occupied/50 vacant - Of the vacant, 19 (38%) 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: | - 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) | <ul style="list-style-type: none"> - Whitehall Township Hall, 7644 Durham Rd. - Muskegon County Road Commission Garage, 7050 Whitehall Rd. - White Lake Excavating, 2571 Holton-Whitehall Rd | | | | | | | | | | | | |
| 5. Vital or Critical Infrastructure | | | | | | | | | | | | | | |
| a. | roads, railroads, and bridges: | <ul style="list-style-type: none"> - US-31 - US-31 bridge over White River | | | | | | | | | | | | |
| b. | dams, power stations, water treatment plants, sanitary lift stations, etc. | <ul style="list-style-type: none"> - Power Transmission Line - Silver Creek Pond Dam (Silver Creek) | | | | | | | | | | | | |
| c. | other (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services) | <ul style="list-style-type: none"> - Natural Gas Pipeline | | | | | | | | | | | | |
| 6. Socio-Economic Profile of Sector | | | | | | | | | | | | | | |
| a. | total population (night): | 1,739 | | | | | | | | | | | | |
| b. | peak population (seasonal): | 1,787 | | | | | | | | | | | | |
| c. | percent over 65: | 14.2 | | | | | | | | | | | | |
| d. | percent under 18: | 23 | | | | | | | | | | | | |
| e. | percent that are homeowners: | 91.2 | | | | | | | | | | | | |
| f. | percent below poverty level: | 4.3 | | | | | | | | | | | | |
| g. | percent with disability or mobility limitation: | 15.6 | | | | | | | | | | | | |
| h. | estimated property insurance coverage: (Real and Personal Equalized Valuations) | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding-left: 20px;">Agricultural:</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td style="padding-left: 20px;">Commercial:</td> <td style="text-align: right;">\$17,405,300</td> </tr> <tr> <td style="padding-left: 20px;">Industrial:</td> <td style="text-align: right;">\$654,400</td> </tr> <tr> <td style="padding-left: 20px;">Residential:</td> <td style="text-align: right;">\$42,417,200</td> </tr> <tr> <td style="padding-left: 20px;">Utility (Personal):</td> <td style="text-align: right;">\$6,920,800</td> </tr> <tr> <td style="padding-left: 40px;">Total:</td> <td style="text-align: right;">\$67,397,700</td> </tr> </table> | Agricultural: | \$0 | Commercial: | \$17,405,300 | Industrial: | \$654,400 | Residential: | \$42,417,200 | Utility (Personal): | \$6,920,800 | Total: | \$67,397,700 |
| Agricultural: | \$0 | | | | | | | | | | | | | |
| Commercial: | \$17,405,300 | | | | | | | | | | | | | |
| Industrial: | \$654,400 | | | | | | | | | | | | | |
| Residential: | \$42,417,200 | | | | | | | | | | | | | |
| Utility (Personal): | \$6,920,800 | | | | | | | | | | | | | |
| Total: | \$67,397,700 | | | | | | | | | | | | | |
| i. | flood insurance coverage: Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force: | <i>Not participating in the NFIP</i> | | | | | | | | | | | | |
| j. | location of floodplains: | N/A | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | |

Whitehall Township



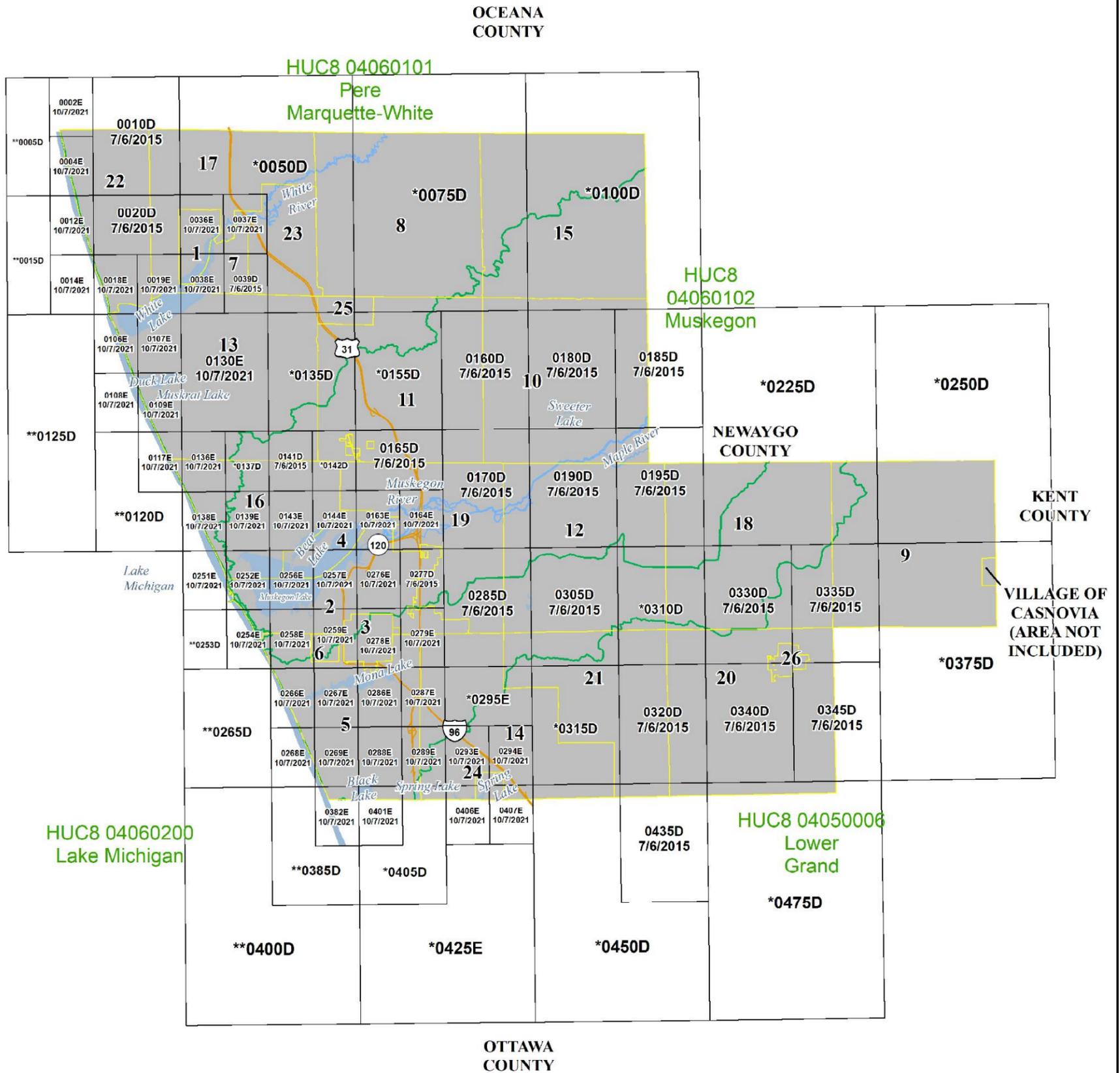


MUSKEGON COUNTY, MICHIGAN

ALL JURISDICTIONS

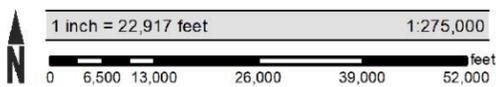
| COMMUNITY NAME | NUMBER | COMMUNITY NAME | NUMBER |
|--------------------------------|--------|-------------------------------|--------|
| BLUE LAKE, TOWNSHIP OF* | 261196 | MOORLAND, TOWNSHIP OF | 261205 |
| CASNOVIA, TOWNSHIP OF* | 261197 | MUSKEGON, CHARTER TOWNSHIP OF | 260163 |
| CEDAR CREEK, TOWNSHIP OF | 261198 | MUSKEGON, CITY OF | 260161 |
| DALTON, TOWNSHIP OF* | 261199 | MUSKEGON HEIGHTS, CITY OF | 260162 |
| EGELSTON, TOWNSHIP OF | 260680 | NORTH MUSKEGON, CITY OF | 260164 |
| FRUITLAND, TOWNSHIP OF | 260265 | NORTON SHORES, CITY OF | 260165 |
| FRUITPORT, CHARTER TOWNSHIP OF | 261200 | RAVENNA, TOWNSHIP OF | 260731 |
| FRUITPORT, VILLAGE OF | 261201 | RAVENNA, VILLAGE OF | 260464 |
| HOLTON, TOWNSHIP OF* | 261203 | ROOSEVELT PARK, CITY OF* | 261206 |
| LAKETON, TOWNSHIP OF | 260159 | SULLIVAN, TOWNSHIP OF | 261207 |
| LAKEWOOD CLUB, VILLAGE OF* | 261204 | WHITE RIVER, TOWNSHIP OF | 260299 |
| MONTAGUE, CITY OF | 260160 | WHITEHALL, CITY OF | 260166 |
| MONTAGUE, TOWNSHIP OF | 261240 | WHITEHALL, TOWNSHIP OF | 261208 |

Figure 1: FIRM Index



| KEY NUMBER | COMMUNITY | CID | KEY NUMBER | COMMUNITY | CID | KEY NUMBER | COMMUNITY | CID |
|------------|--------------------------|--------|------------|-------------------------------|--------|------------|------------------------------|--------|
| 1 | City of Montague | 260160 | 10 | Township of Cedar Creek | 261198 | 19 | Charter Township of Muskegon | 260163 |
| 2 | City of Muskegon | 260161 | 11 | Township of Dalton | 261199 | 20 | Township of Ravenna | 260731 |
| 3 | City of Muskegon Heights | 260162 | 12 | Township of Egelston | 260680 | 21 | Township of Sullivan | 261207 |
| 4 | City of North Muskegon | 260164 | 13 | Township of Fruitland | 260265 | 22 | Township of White River | 260299 |
| 5 | City of Norton Shores | 260165 | 14 | Charter Township of Fruitport | 261200 | 23 | Township of Whitehall | 261208 |
| 6 | City of Roosevelt Park | 261206 | 15 | Township of Holton | 261203 | 24 | Village of Fruitport | 261201 |
| 7 | City of Whitehall | 260166 | 16 | Township of Laketon | 260159 | 25 | Village of Lakewood Club | 261204 |
| 8 | Township of Blue Lake | 261196 | 17 | Township of Montague | 261240 | 26 | Village of Ravenna | 260464 |
| 9 | Township of Casnovia | 261197 | 18 | Township of Moorland | 261205 | | | |

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before October 7, 2021.



Map Projection:
Universal Transverse Mercator Zone 16 N;
North American Datum 1983

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

[HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP INDEX

MUSKEGON COUNTY, MICHIGAN (All Jurisdictions)

PANELS PRINTED:

0002, 0004, 0010, 0012, 0014, 0018, 0019, 0020, 0036, 0037, 0038, 0039, 0106, 0107, 0108, 0109, 0117, 0130, 0136, 0138, 0139, 0141, 0143, 0144, 0160, 0163, 0164, 0165, 0170, 0180, 0185, 0190, 0195, 0251, 0252, 0254, 0256, 0257, 0258, 0259, 0266, 0267, 0268, 0269, 0276, 0277, 0278, 0279, 0285, 0286, 0287, 0288, 0289, 0293, 0294, 0305, 0320, 0330, 0335, 0340, 0345, 0382, 0401, 0406, 0407, 0435



FEMA

MAP NUMBER
26121CIND0B
MAP REVISED
OCTOBER 7, 2021

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
** PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

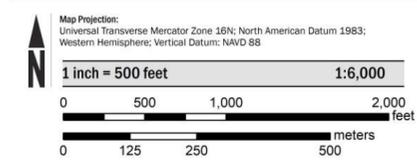
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

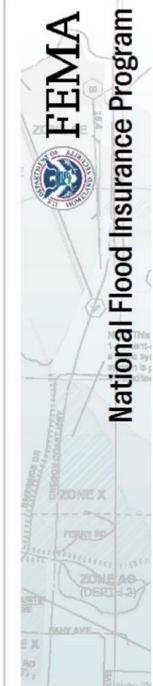
LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA or between the shoreline and the LiMWA for areas where VE Zones are not identified will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

SCALE



PANEL LOCATOR



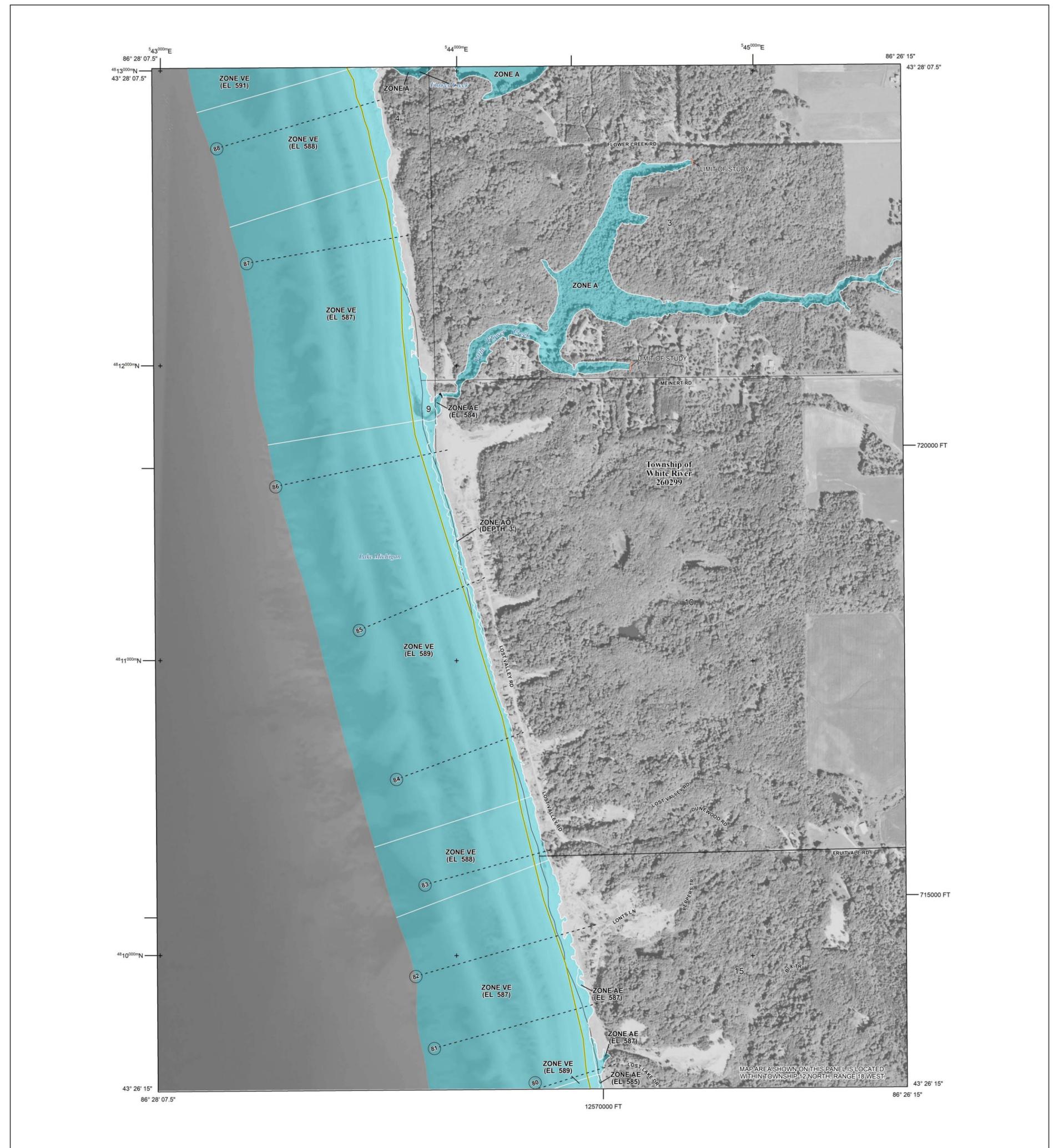
**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 2 of 475

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0002 E

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0002E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, AS9 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

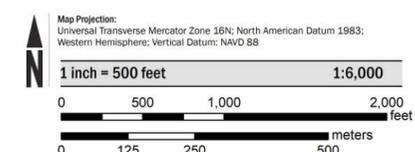
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthorectified imagery dated 2014.

LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LIMWA). The LIMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LIMWA, or between the shoreline and the LIMWA for areas where VE Zones are not identified, will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LIMWA)

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 4 of 475

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

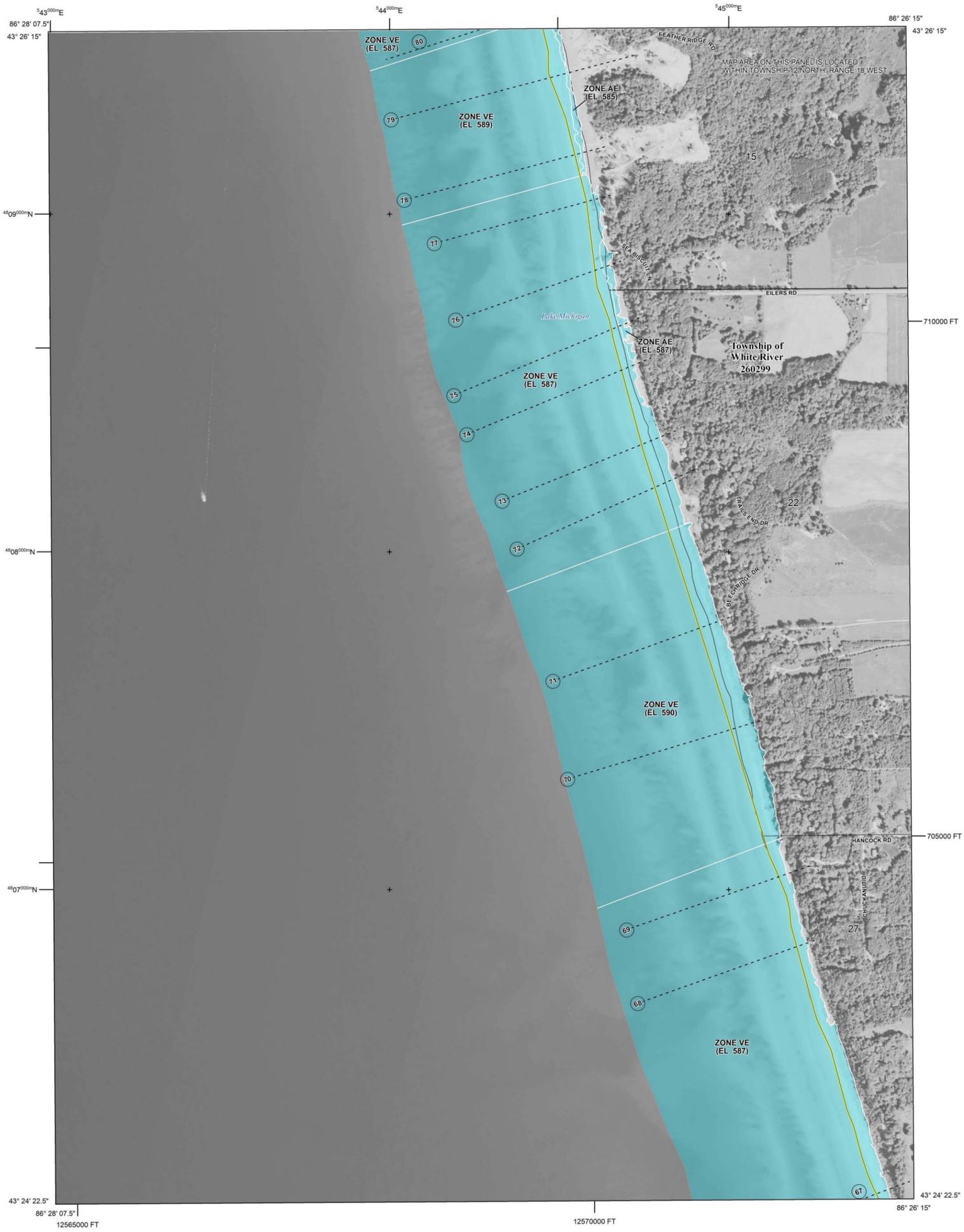
Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0004 E

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0004E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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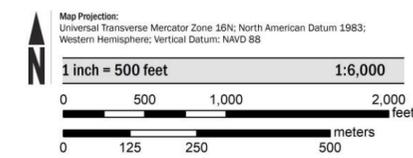
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Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1999), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP

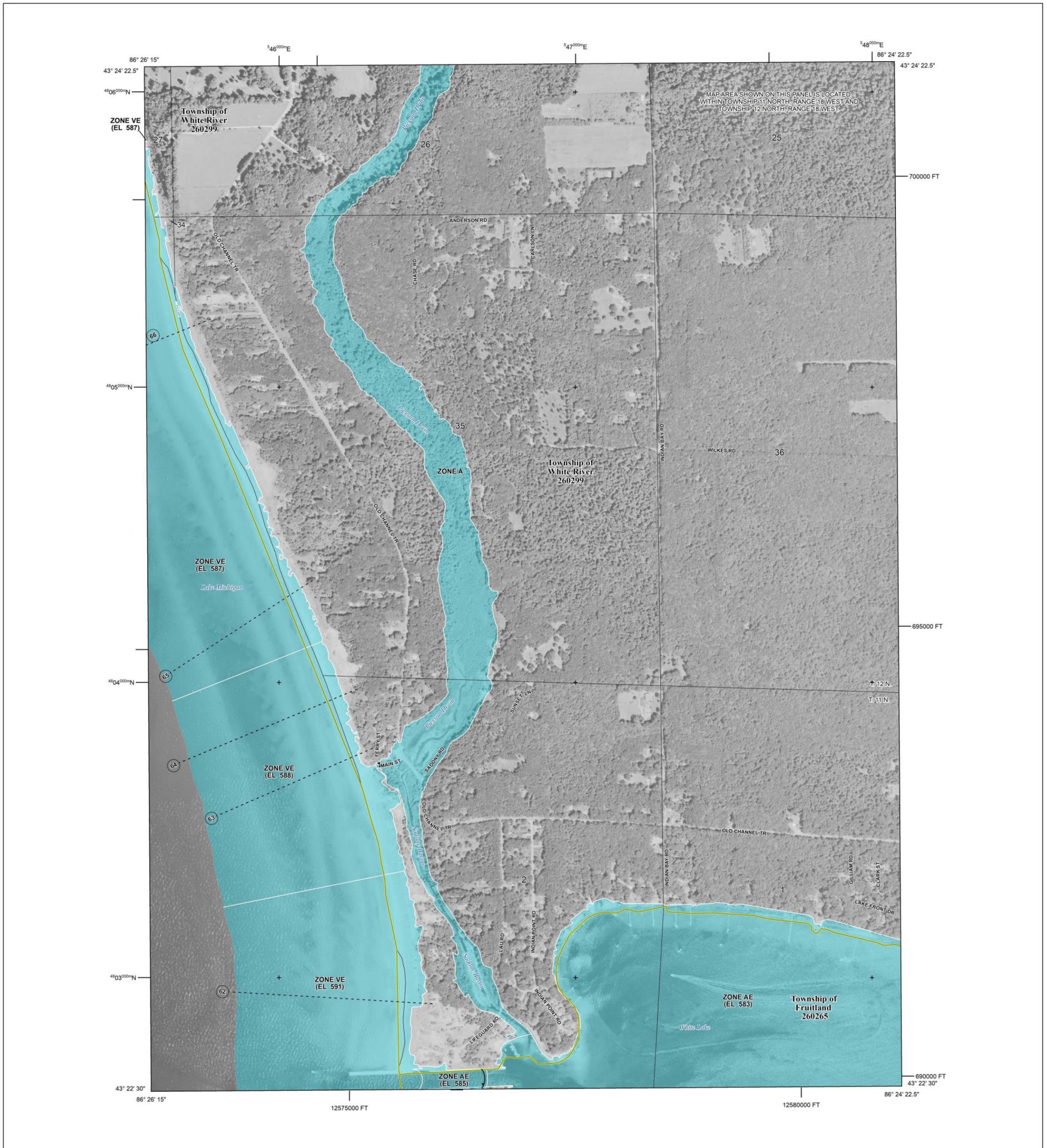
MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions



PANEL 12 OF 475

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 WHITE RIVER, TOWNSHIP 260299 0012 E

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0012E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

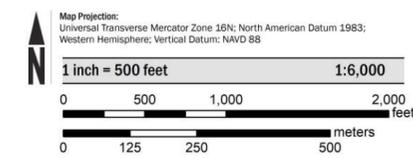
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-686-6620.

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LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA or between the shoreline and the LiMWA for areas where VE Zones are not identified will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

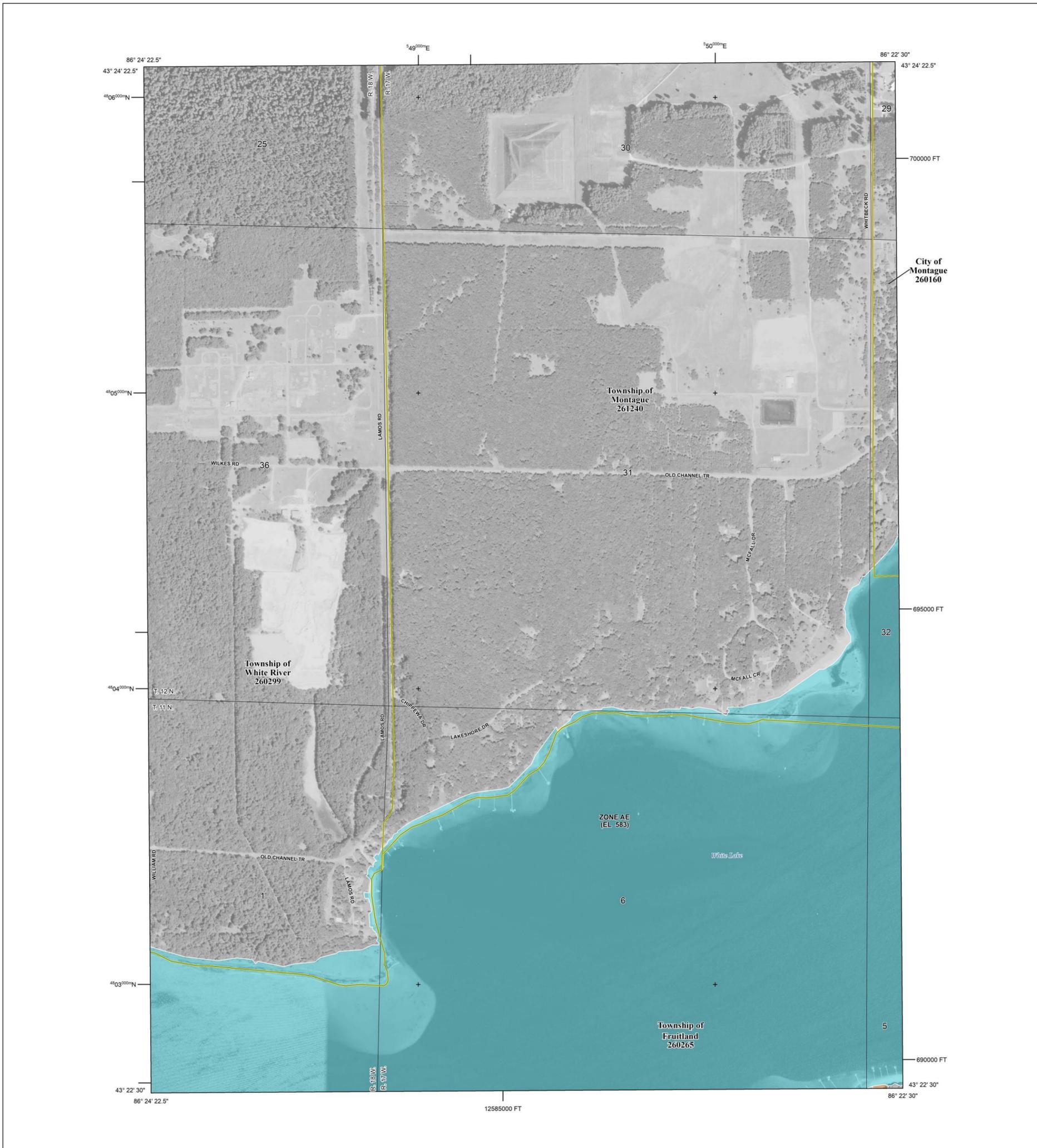
PANEL 18 OF 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP | 260265 | 0018 | E |
| OF WHITE RIVER, TOWNSHIP | 260299 | 0018 | E |
| OF | | | |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0018E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) 18.2, 17.5 |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) 513 |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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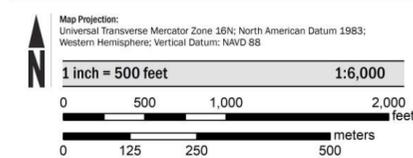
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SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

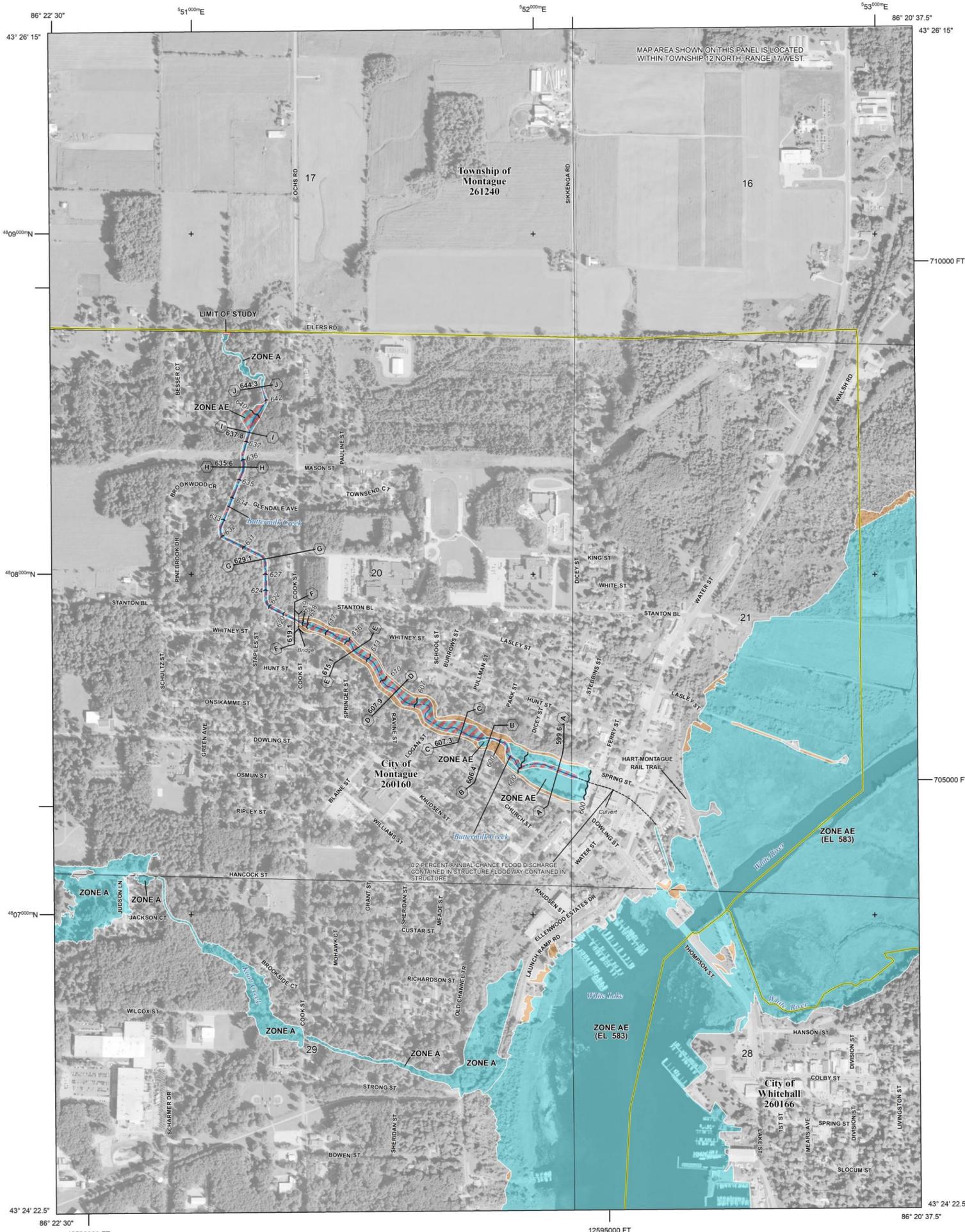
PANEL 19 OF 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0019 | E |
| MONTAGUE, CITY OF | 260160 | 0019 | E |
| MONTAGUE, TOWNSHIP OF | 261240 | 0019 | E |
| WHITE RIVER, TOWNSHIP OF | 260299 | 0019 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0019E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

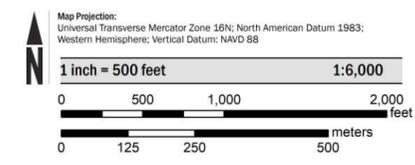
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-686-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR

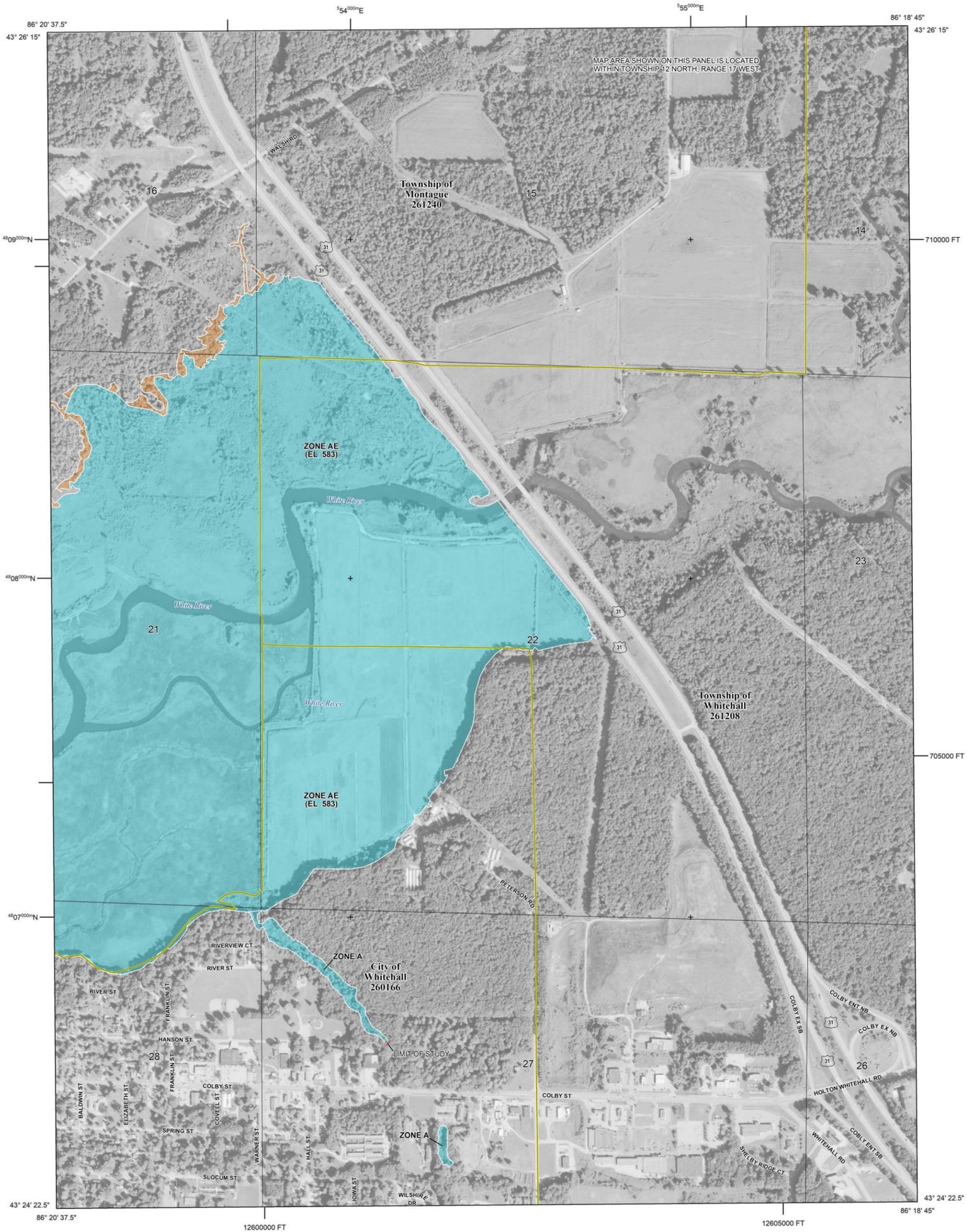


NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP
 MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 36 OF 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-----------------------|--------|-------|--------|
| MONTAGUE, CITY OF | 260160 | 0036 | E |
| MONTAGUE, TOWNSHIP OF | 261240 | 0036 | E |
| WHITEHALL, CITY OF | 260166 | 0036 | E |

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0036E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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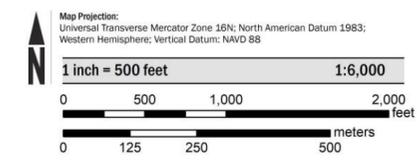
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1999), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN

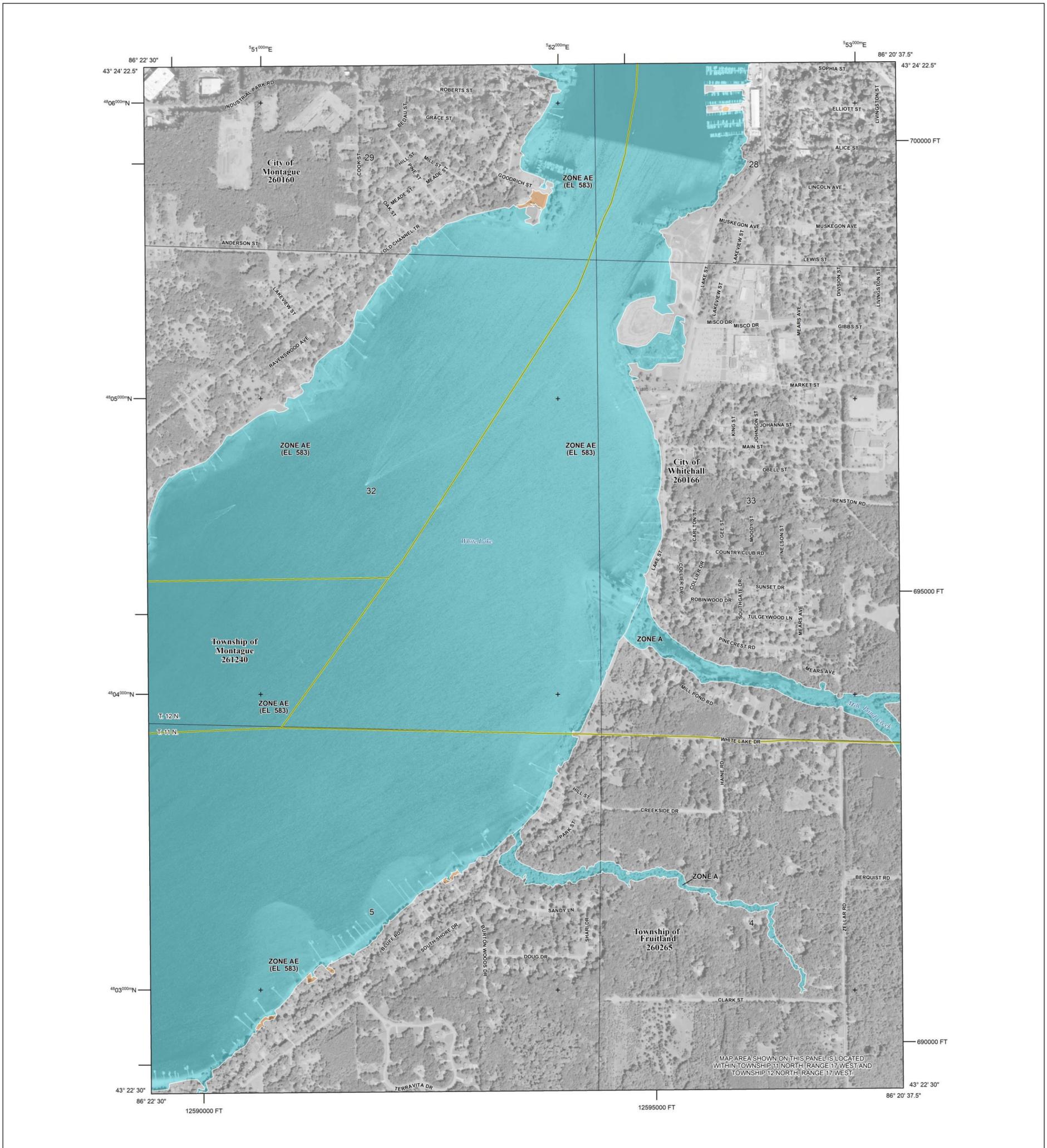
Panel 37 of 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| MONTAGUE, TOWNSHIP OF | 261240 | 0037 | E |
| WHITEHALL, CITY OF | 260166 | 0037 | E |
| WHITEHALL, TOWNSHIP OF | 261208 | 0037 | E |

Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| MONTAGUE, TOWNSHIP OF | 261240 | 0037 | E |
| WHITEHALL, CITY OF | 260166 | 0037 | E |
| WHITEHALL, TOWNSHIP OF | 261208 | 0037 | E |

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0037E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|--|--|
| | Without Base Flood Elevation (BFE) Zone A, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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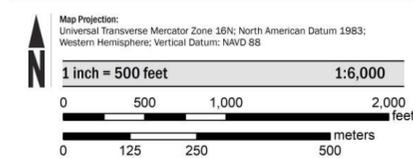
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Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1999), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

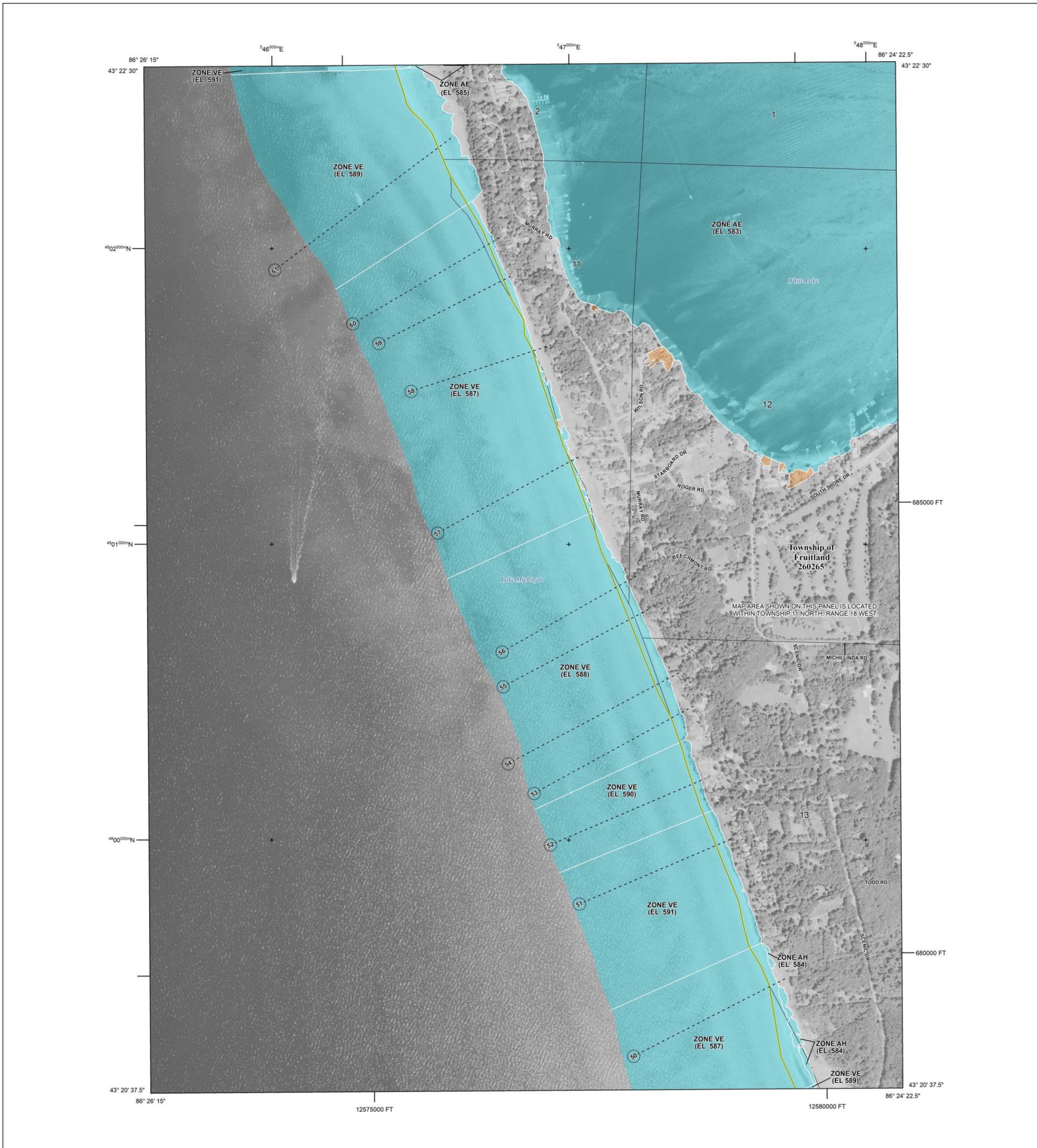
PANEL 38 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0038 | E |
| MONTAGUE, CITY OF | 260160 | 0038 | E |
| MONTAGUE, TOWNSHIP OF | 261240 | 0038 | E |
| WHITEHALL, CITY OF | 260166 | 0038 | E |

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0038E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| OTHER FEATURES | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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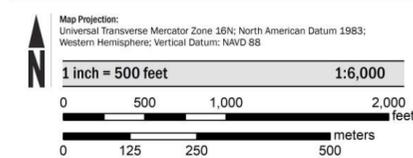
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1999), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP
 MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 106 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0106 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0106E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) 18.2, 17.5 |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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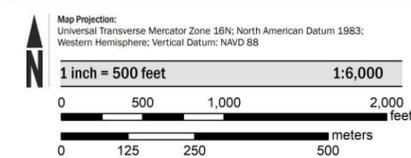
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1999), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

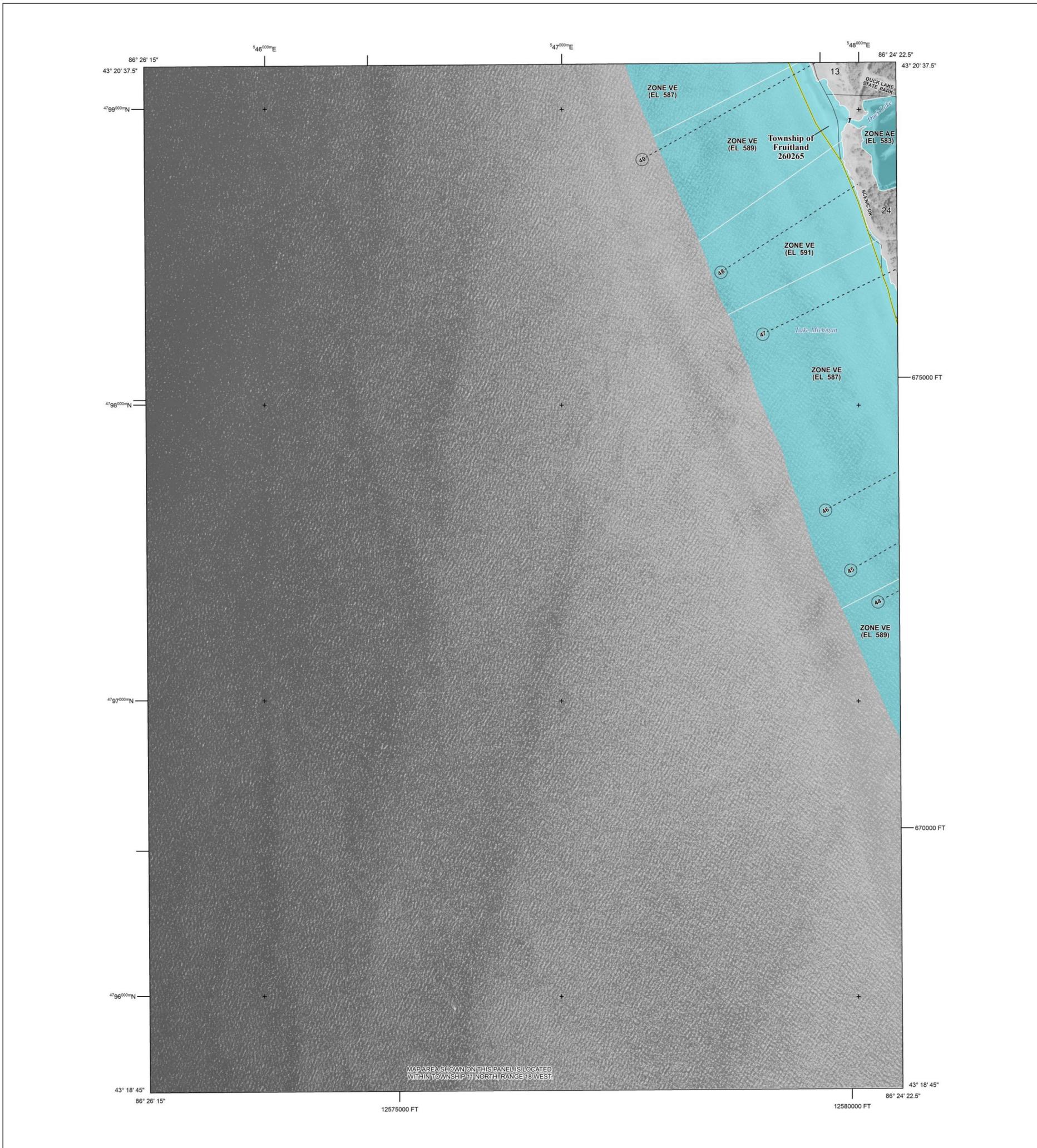
PANEL 107 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0107 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0107E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | | |
|-----------------------------|--|---|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | | With BFE or Depth Zone AE, AO, AH, VE, AR |
| OTHER AREAS OF FLOOD HAZARD | | Regulatory Floodway |
| | | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| OTHER AREAS | | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | | NO SCREEN Area of Minimal Flood Hazard Zone X |
| GENERAL STRUCTURES | | Channel, Culvert, or Storm Sewer |
| | | Levee, Dike, or Floodwall |
| OTHER FEATURES | | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | | Coastal Transect |
| | | Coastal Transect Baseline |
| | | Profile Baseline |
| OTHER FEATURES | | Hydrographic Feature |
| | | Base Flood Elevation Line (BFE) |
| OTHER FEATURES | | Limit of Study |
| | | Jurisdiction Boundary |

NOTES TO USERS

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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

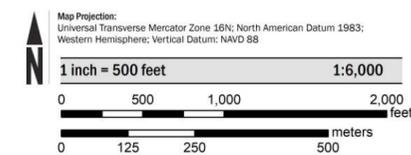
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1999), and USDA National Agricultural Imagery Program orthophotography dated 2014.

LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA or between the shoreline and the LiMWA for areas where VE Zones are not identified will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP
 MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

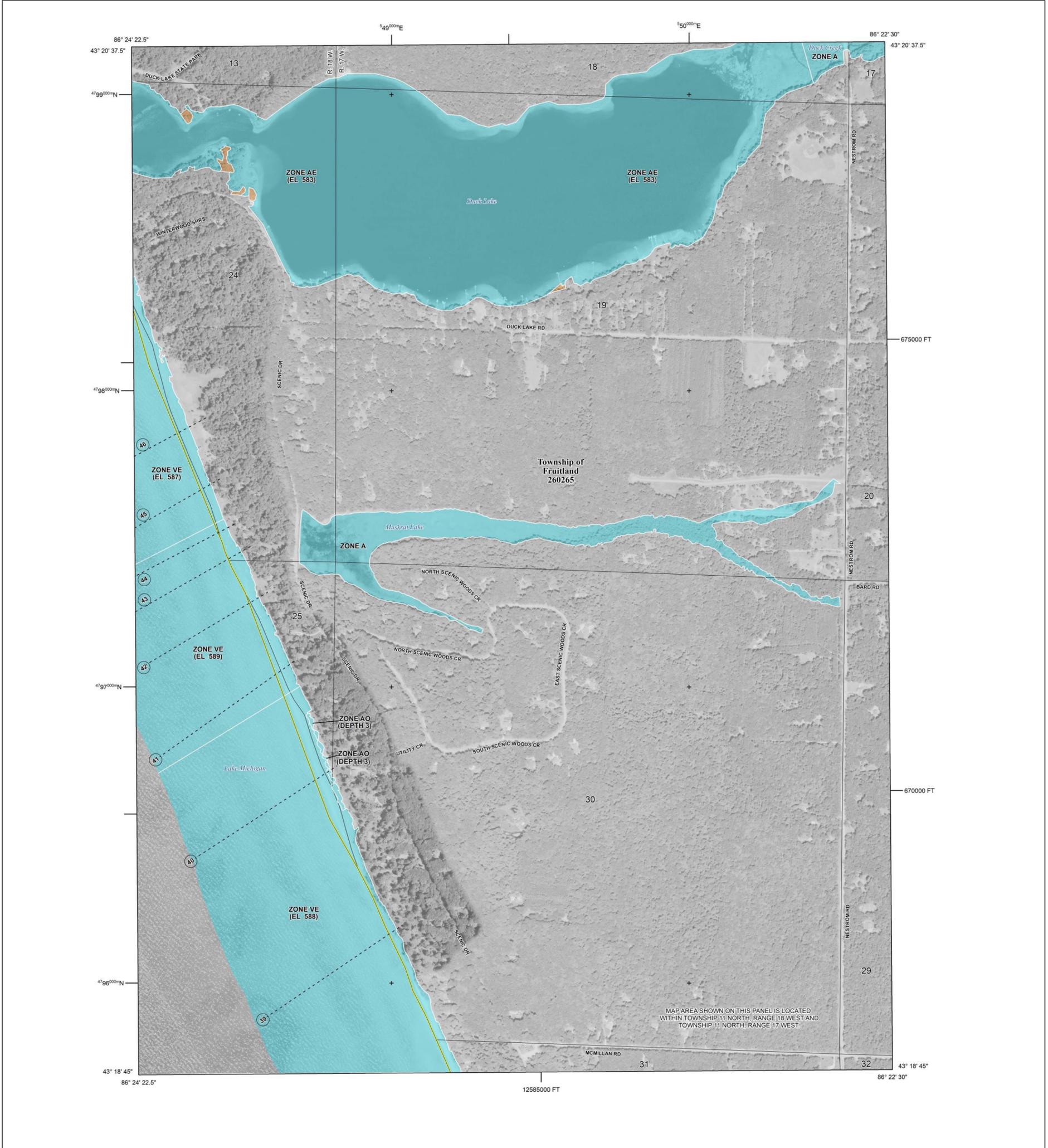
PANEL 108 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0108 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0108E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, AS9 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
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| | Limit of Study |
| | Jurisdiction Boundary |

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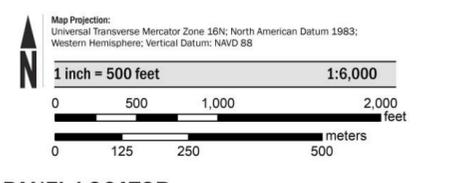
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Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

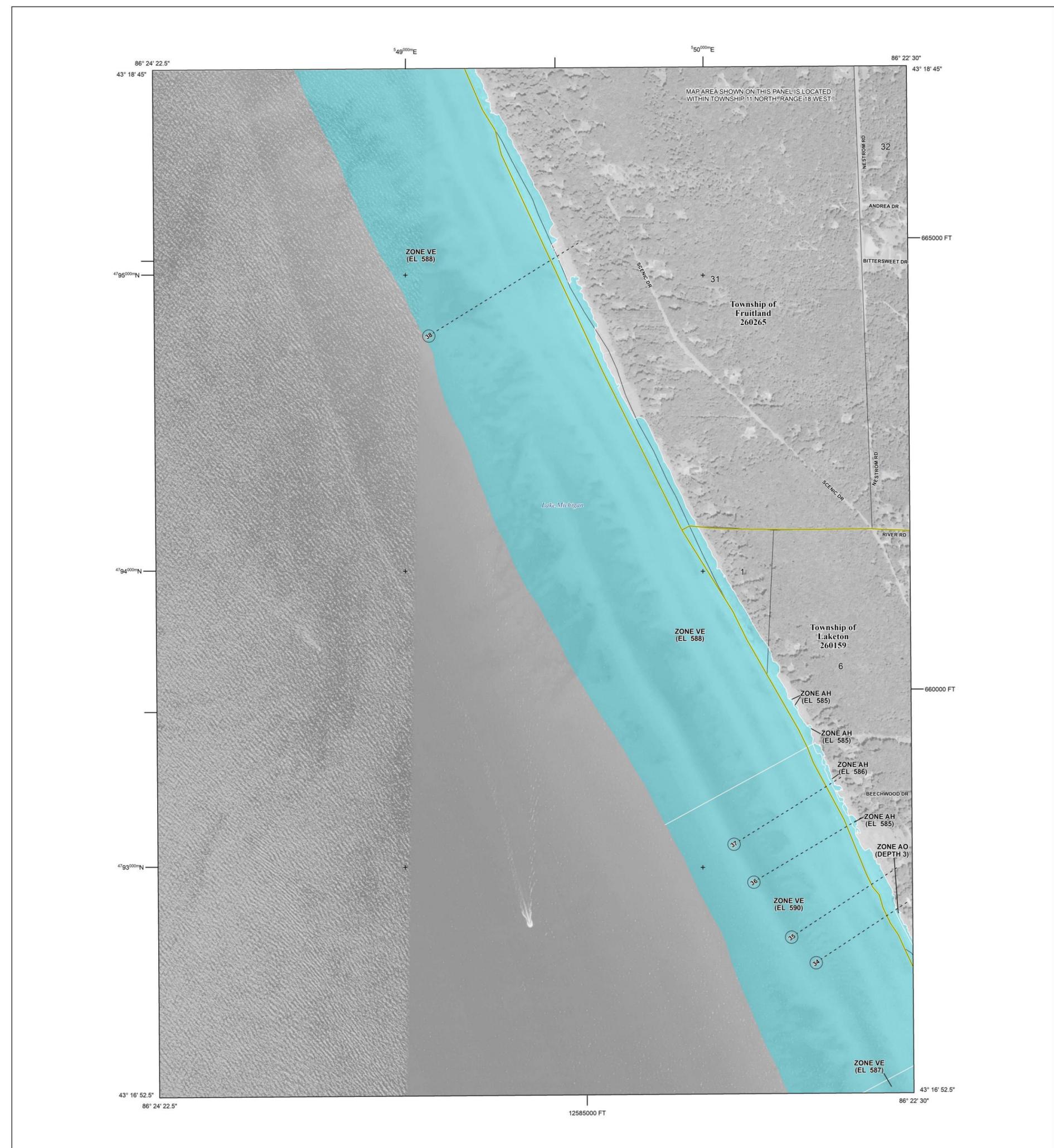
PANEL 109 of 475

Panel Contains:
 COMMUNITY NUMBER PANEL SUFFIX
 FRUITLAND, TOWNSHIP OF 260265 0109 E

VERSION NUMBER
2.6.2.0

MAP NUMBER
26121C0109E

MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

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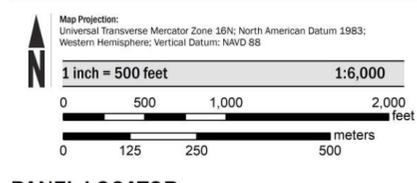
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

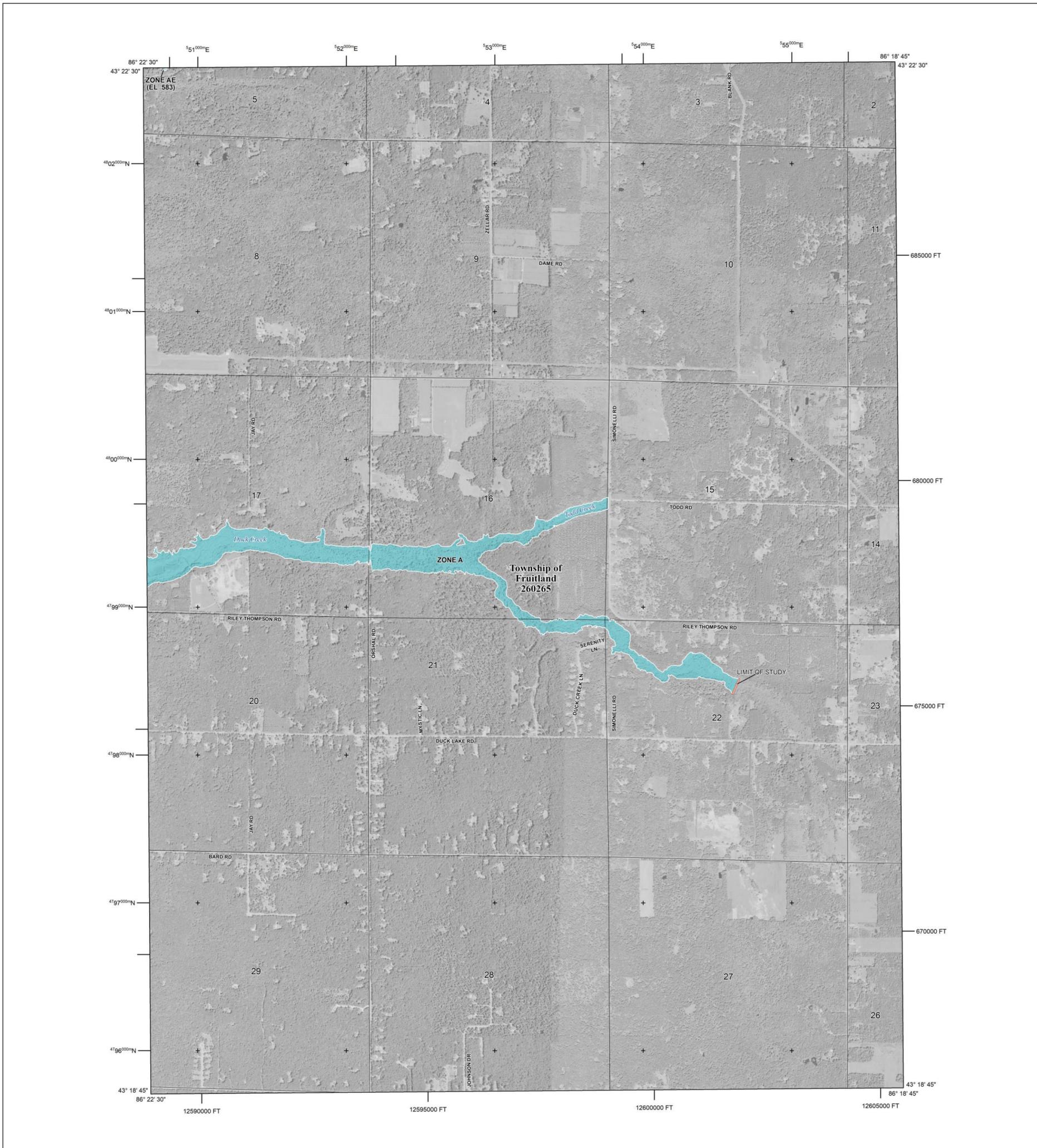
MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 117 OF 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0117 | E |
| LAKETON, TOWNSHIP OF | 260159 | 0117 | E |

Panel Contains:

VERSION NUMBER
 2.6.2.0
 MAP NUMBER
 26121C0117E
 MAP REVISED
 OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

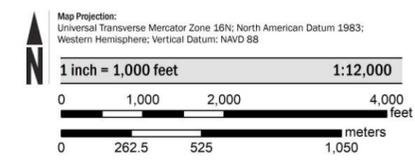
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

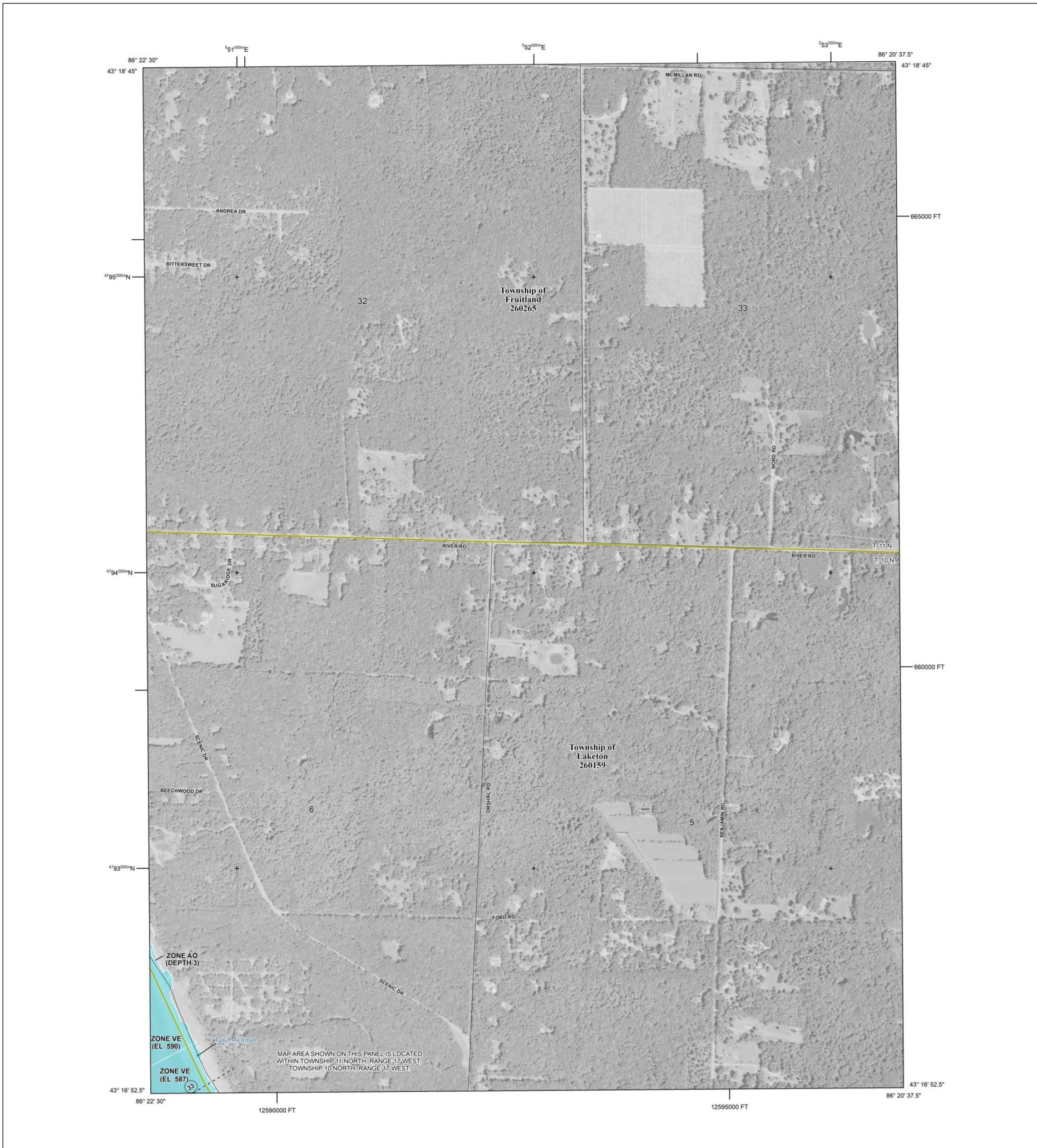
PANEL 130 of 475



| | | | |
|------------------------|--------|-------|--------|
| COMMUNITY | NUMBER | PANEL | SUFFIX |
| FRUITLAND, TOWNSHIP OF | 260265 | 0130 | E |

Panel Contains:

VERSION NUMBER
 2.6.2.0
 MAP NUMBER
 26121C0130E
 MAP REVISED
 OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | | |
|-----------------------------|--|---|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | | With BFE or Depth Zone AE, AO, AH, VE, AR |
| OTHER AREAS OF FLOOD HAZARD | | Regulatory Floodway |
| | | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| OTHER AREAS | | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | | NO SCREEN Area of Minimal Flood Hazard Zone X |
| GENERAL STRUCTURES | | Channel, Culvert, or Storm Sewer |
| | | Levee, Dike, or Floodwall |
| OTHER FEATURES | | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | | Coastal Transect |
| | | Coastal Transect Baseline |
| | | Profile Baseline |
| OTHER FEATURES | | Hydrographic Feature |
| | | Base Flood Elevation Line (BFE) |
| OTHER FEATURES | | Limit of Study |
| | | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered directly from the website.

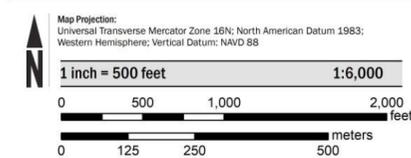
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To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR

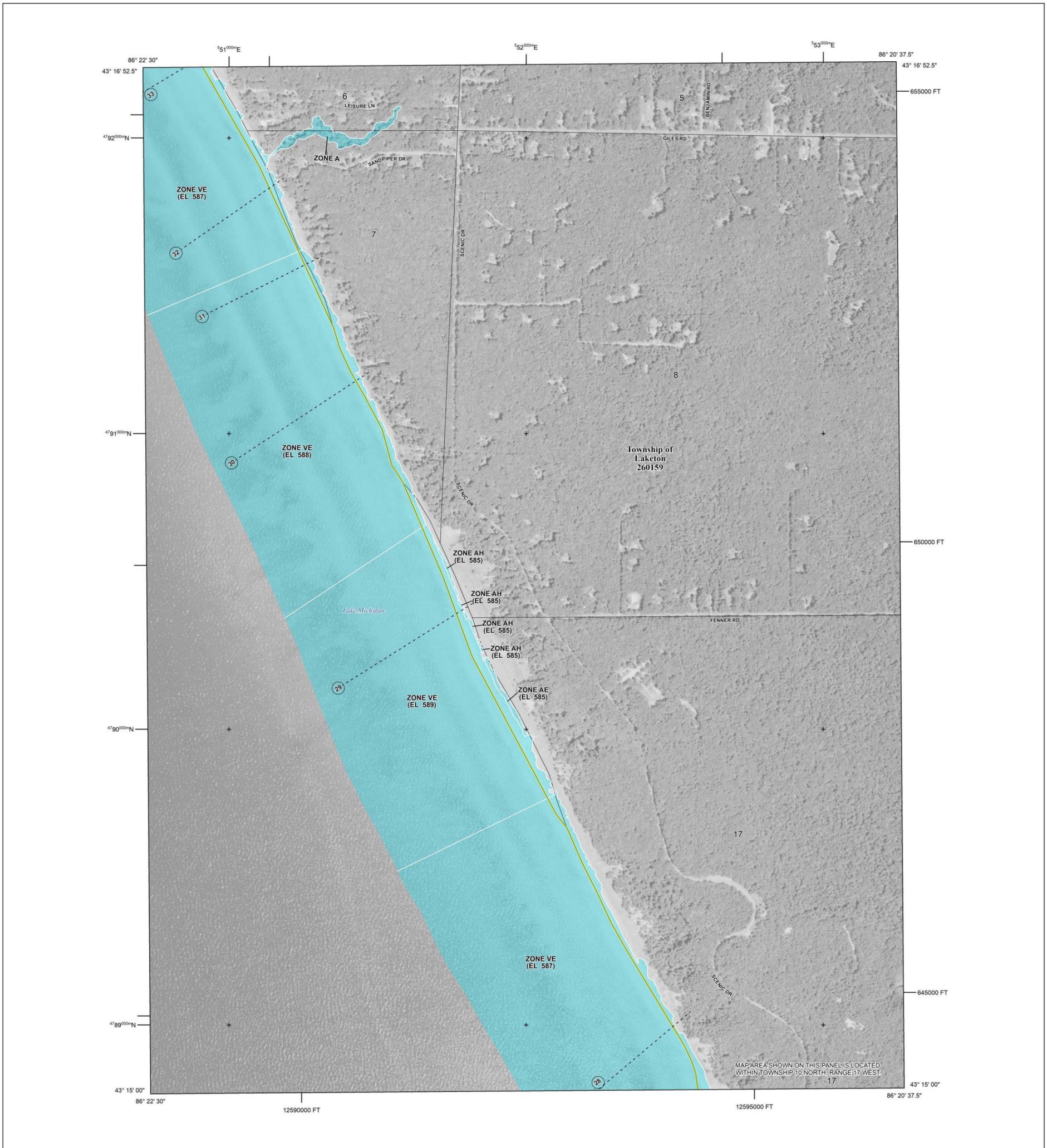


NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP
 MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 136 of 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| FRUITLAND, TOWNSHIP OF | 260265 | 0136 | E |
| LAKETON, TOWNSHIP OF | 260159 | 0136 | E |

Panel Contains:
 VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0136E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, AS9 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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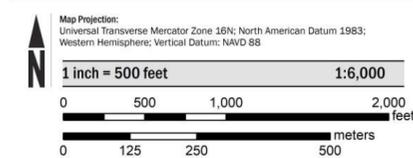
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SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

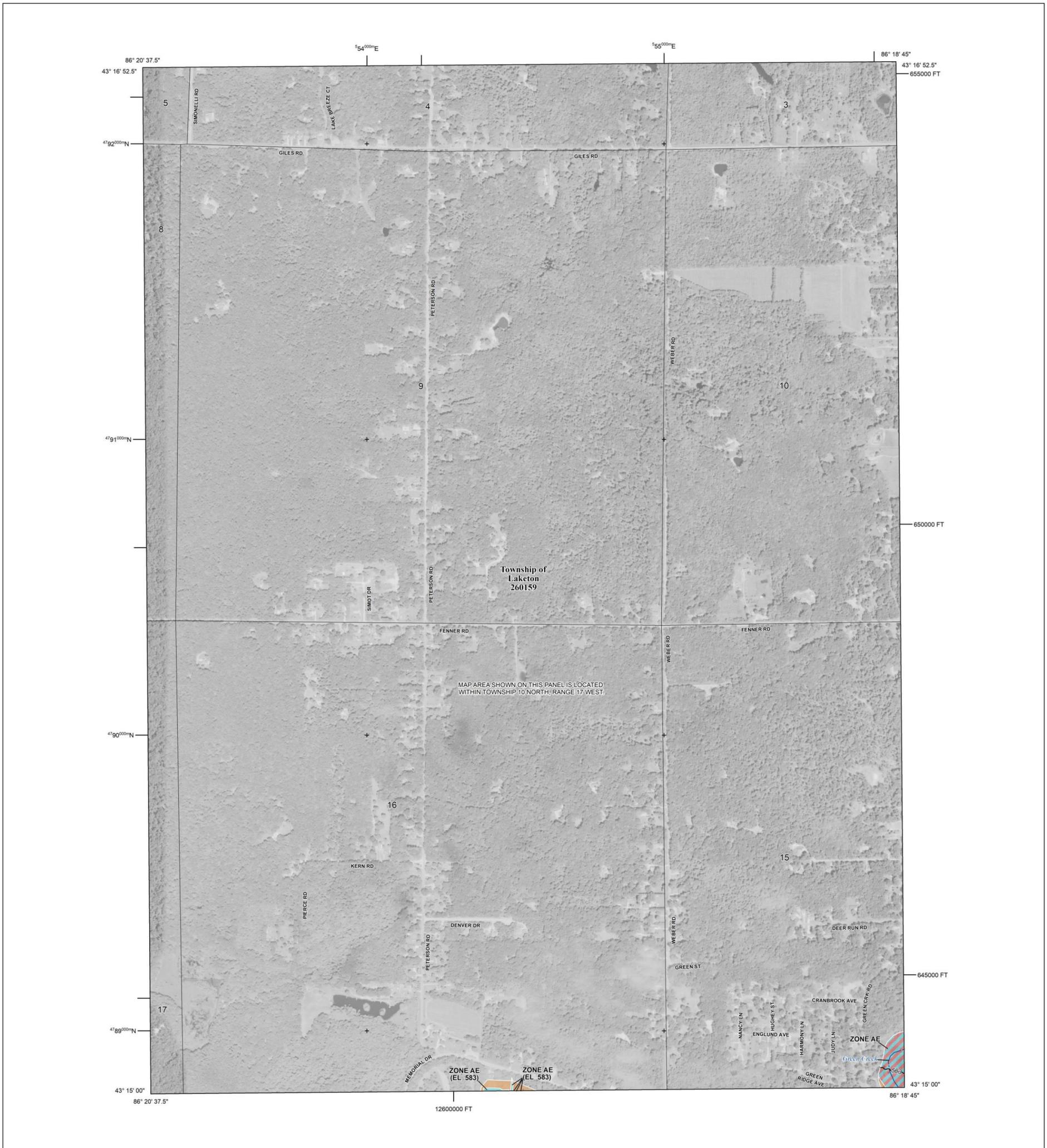
PANEL 138 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|----------------------|--------|-------|--------|
| LAKETON, TOWNSHIP OF | 260159 | 0138 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0138E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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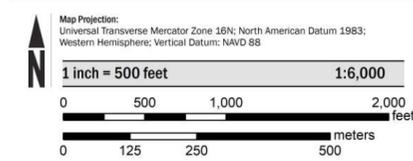
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Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

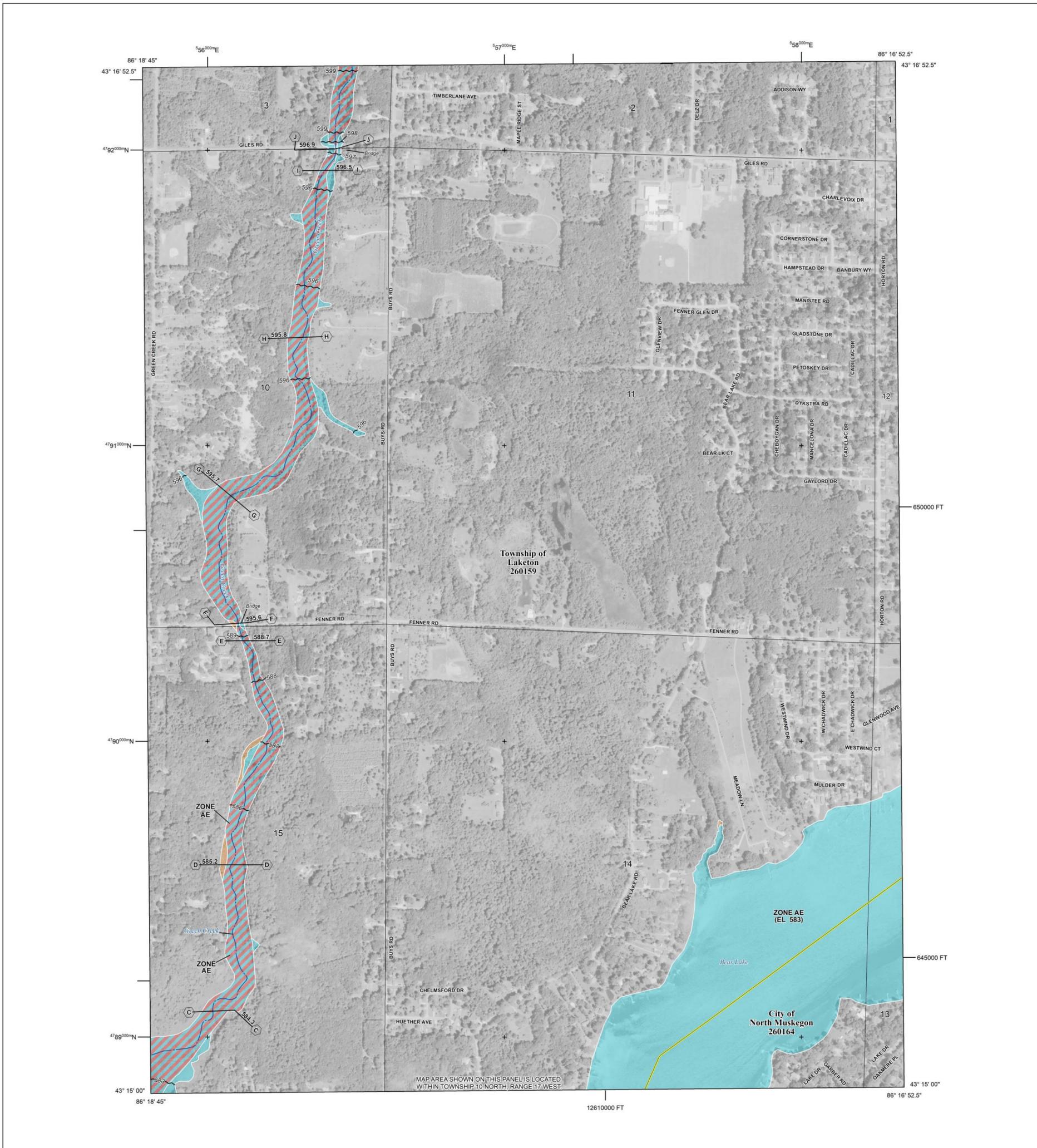
PANEL 139 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|----------------------|--------|-------|--------|
| LAKETON, TOWNSHIP OF | 260159 | 0139 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0139E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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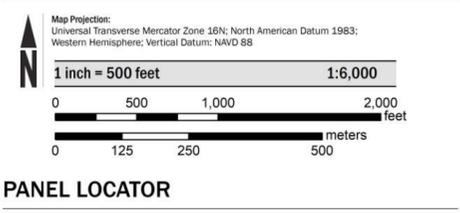
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

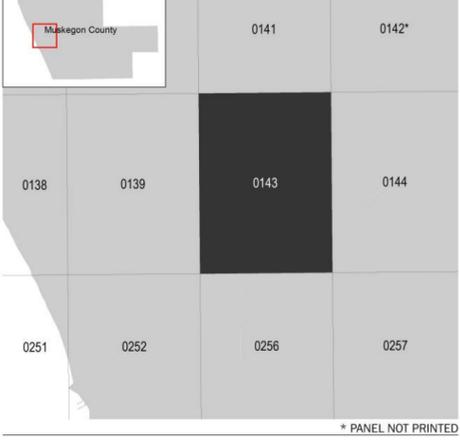
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



FEMA
 National Flood Insurance Program

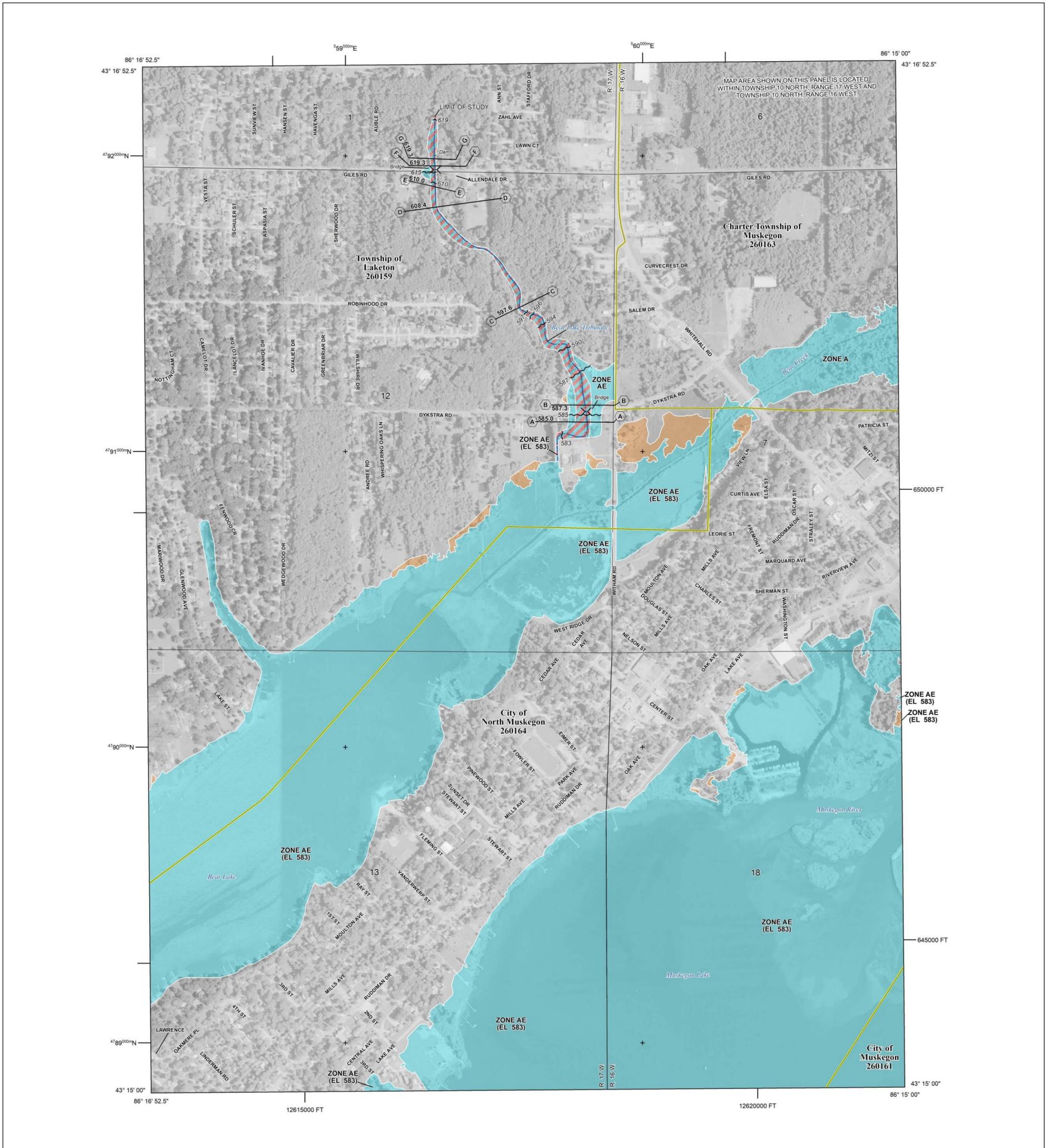
NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP
 MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 143 of 475

Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------|--------|-------|--------|
| LAKETON, TOWNSHIP OF | 260159 | 0143 | E |
| NORTH MUSKEGON, CITY OF | 260164 | 0143 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0143E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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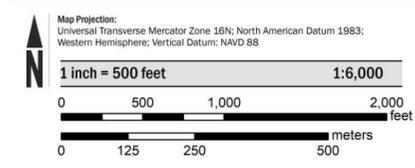
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

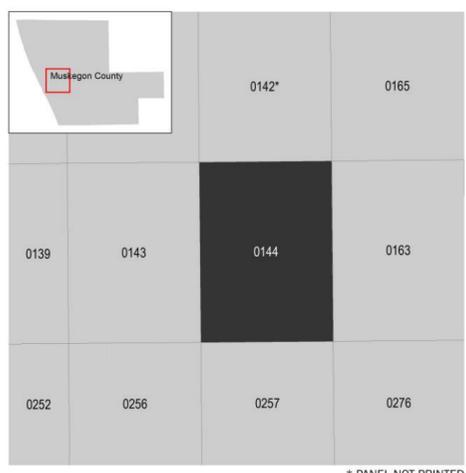
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-688-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

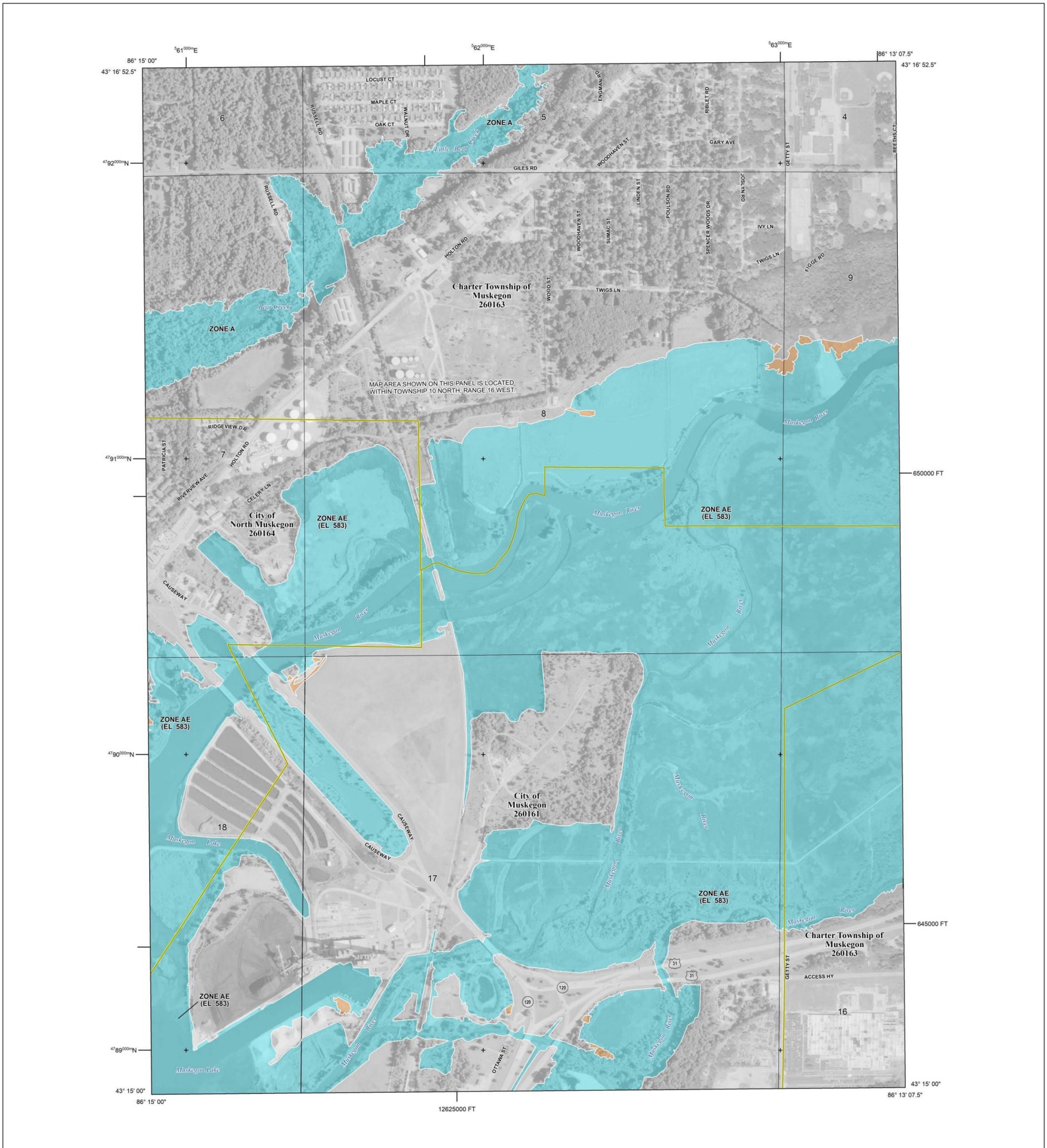
MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 144 of 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF MUSKEGON | 260163 | 0144 | E |
| LAKETON TOWNSHIP OF MUSKEGON | 260159 | 0144 | E |
| MUSKEGON, CITY OF | 260161 | 0144 | E |
| NORTH MUSKEGON, CITY OF | 260164 | 0144 | E |

Panel Contains:

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0144E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | | |
|------------------------------------|--|---|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE) Zone A, A99 |
| | | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | | Channel, Culvert, or Storm Sewer |
| | | Levee, Dike, or Floodwall |
| | | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | | Coastal Transect |
| | | Coastal Transect Baseline |
| | | Profile Baseline |
| | | Hydrographic Feature |
| OTHER FEATURES | | Base Flood Elevation Line (BFE) |
| | | Limit of Study |
| | | Jurisdiction Boundary |

NOTES TO USERS

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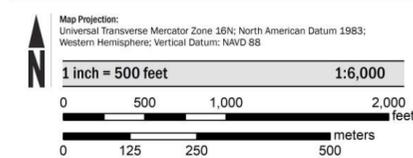
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

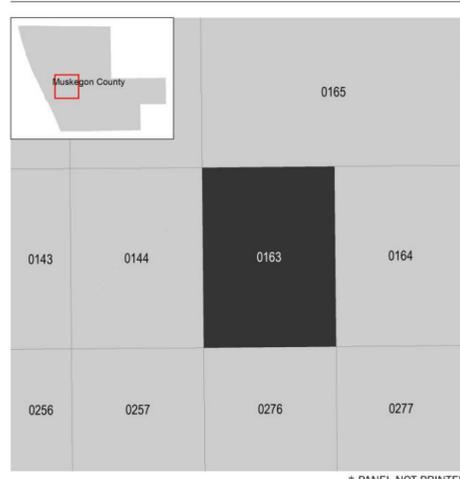
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-686-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

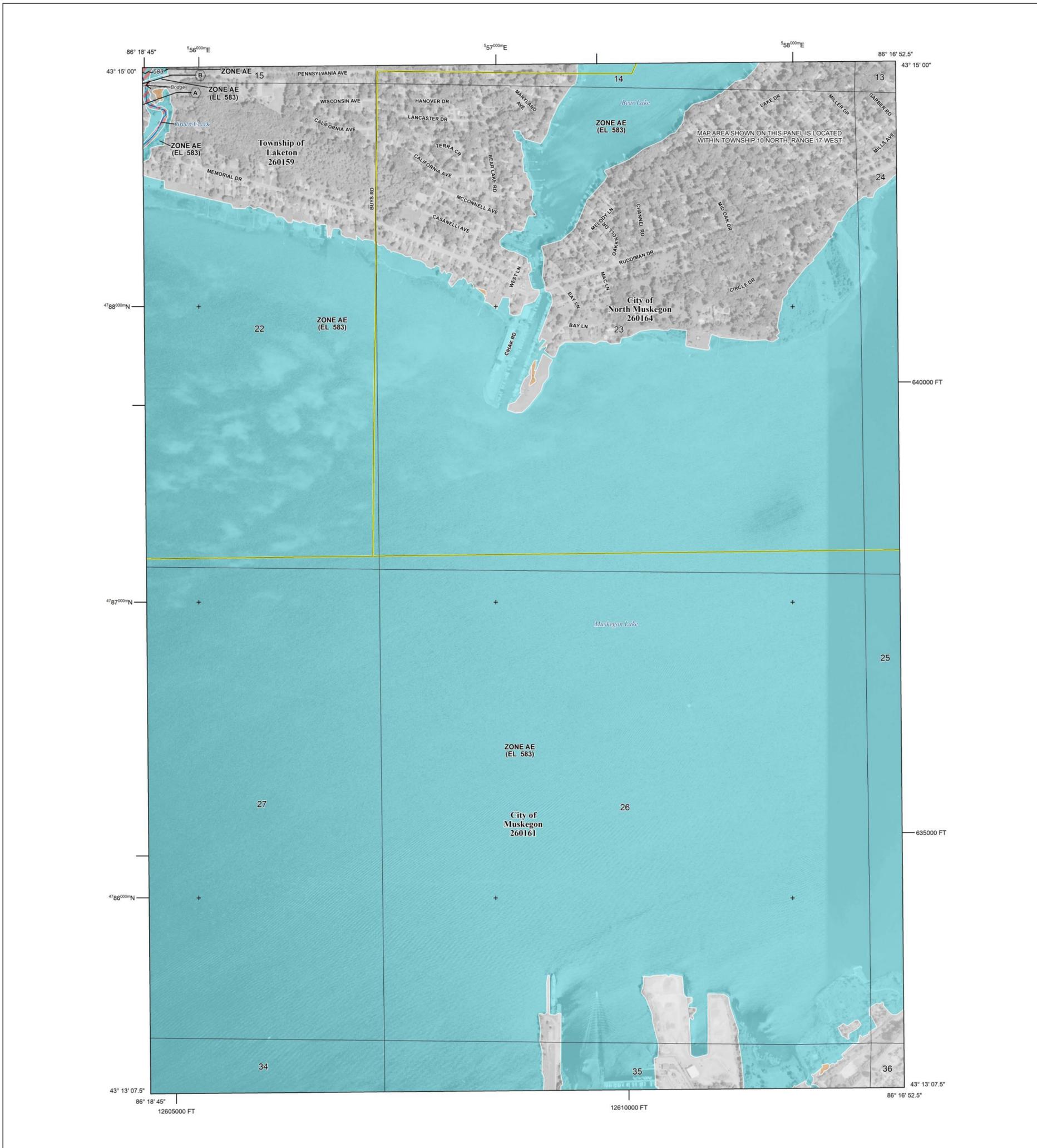
PANEL 163 OF 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF MUSKEGON | 260163 | 0163 | E |
| MUSKEGON CITY OF | 260161 | 0163 | E |
| NORTH MUSKEGON, CITY OF | 260164 | 0163 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0163E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

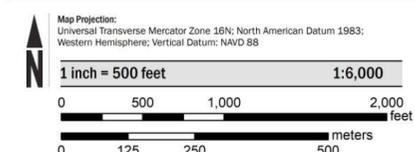
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthorectified imagery dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

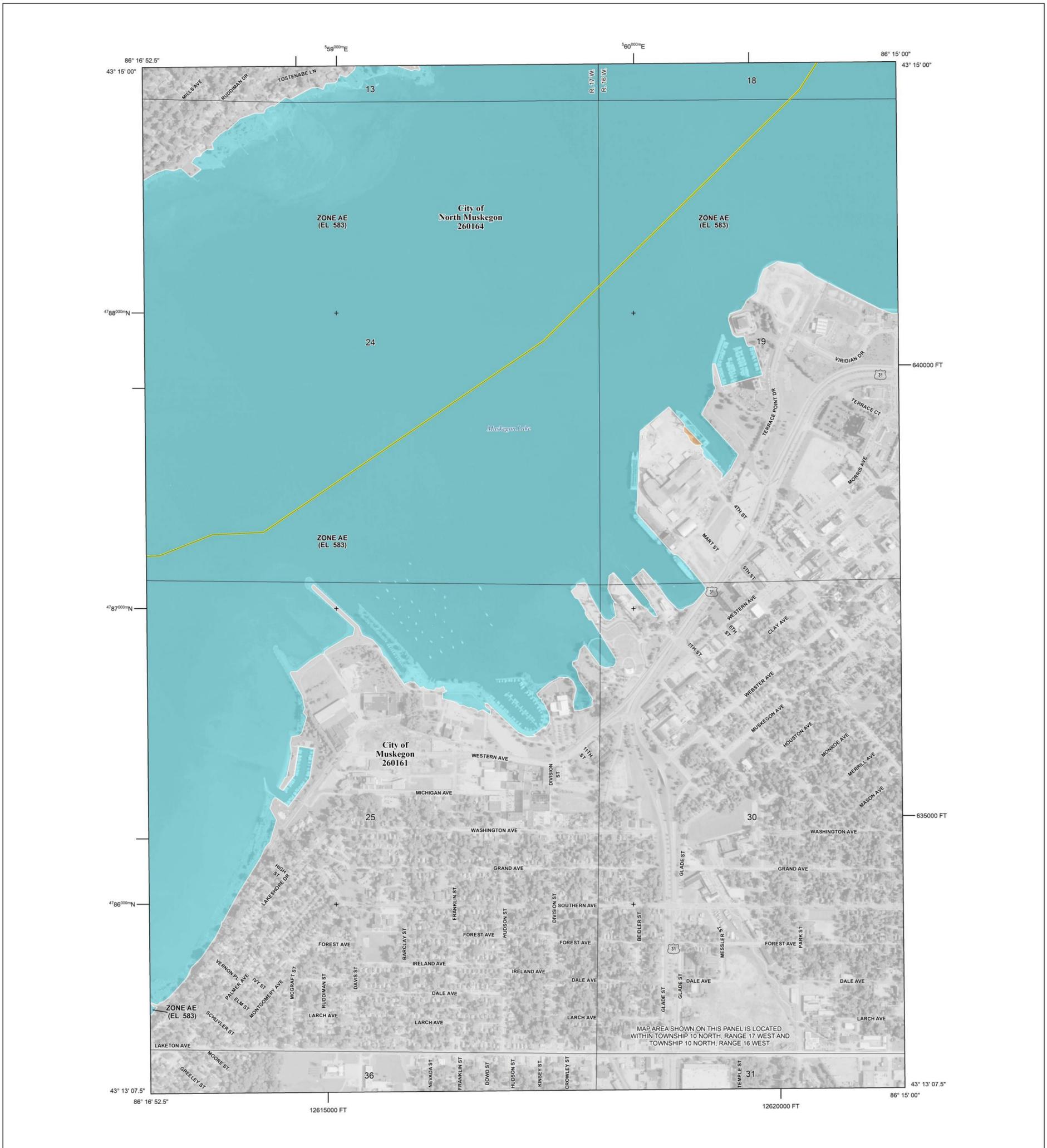
PANEL 256 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------|--------|-------|--------|
| LAKETON, TOWNSHIP OF | 260159 | 0256 | E |
| MUSKEGON, CITY OF | 260161 | 0256 | E |
| NORTH MUSKEGON, CITY OF | 260164 | 0256 | E |

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0256E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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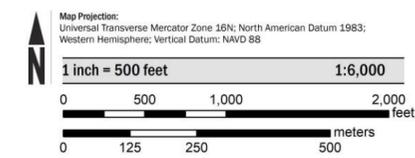
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

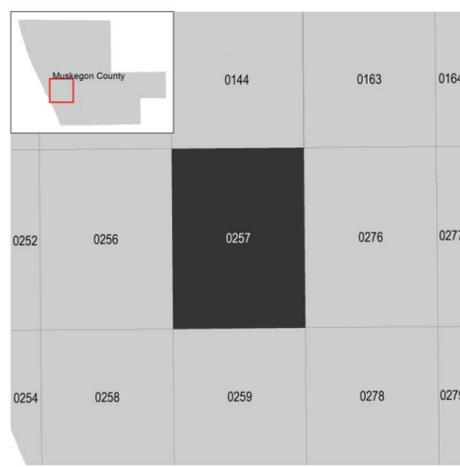
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-438-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthorectified imagery dated 2014.

SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP
 MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

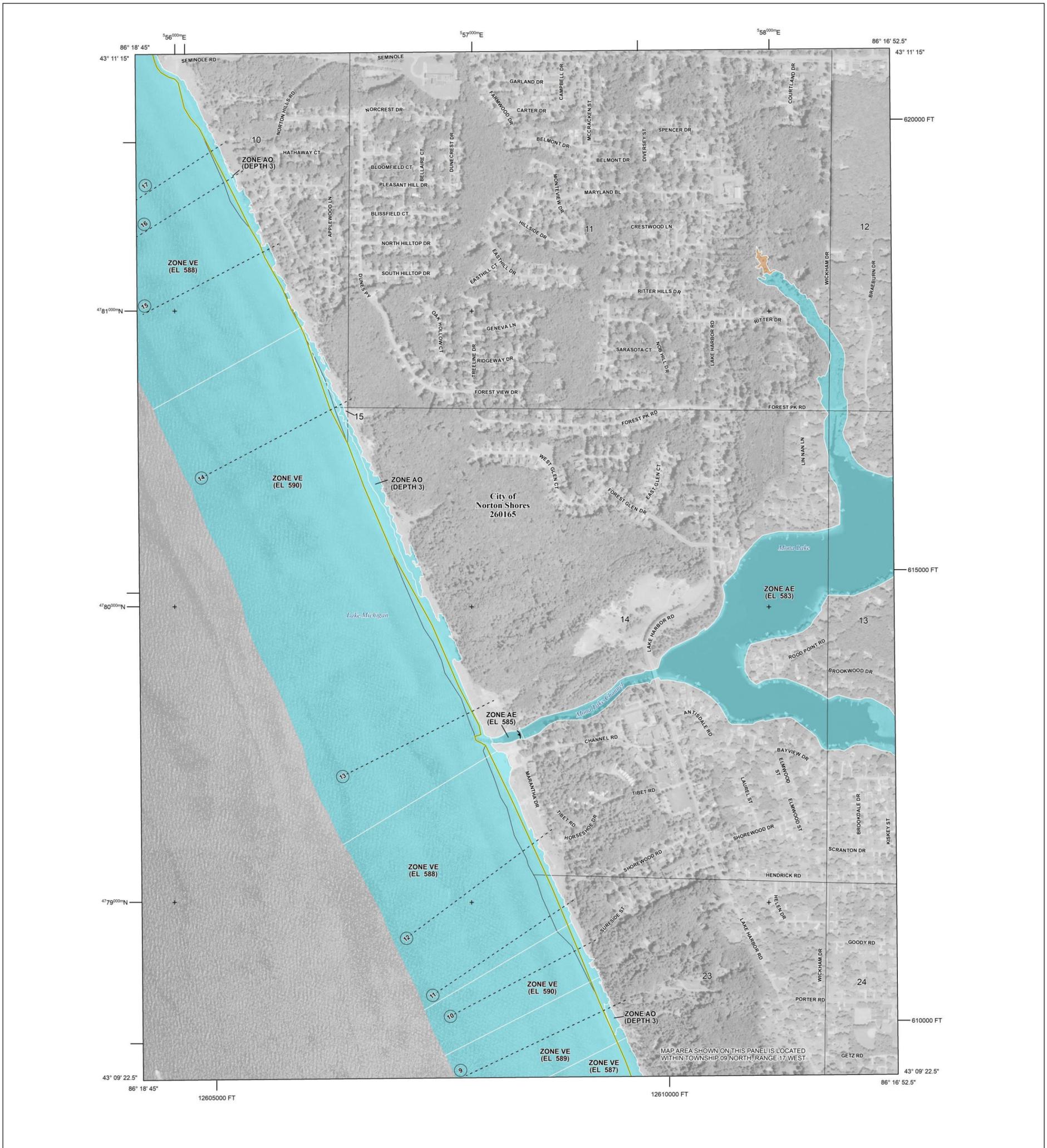


PANEL 257 of 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------|--------|-------|--------|
| MUSKEGON, CITY OF | 260161 | 0257 | E |
| NORTH MUSKEGON, CITY OF | 260164 | 0257 | E |

Panel Contains:

VERSION NUMBER
 2.6.2.0
 MAP NUMBER
 26121C0257E
 MAP REVISED
 OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|--|--|
| | Without Base Flood Elevation (BFE) Zone A, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

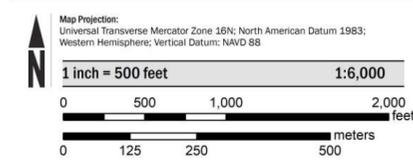
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-686-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LIMWA). The LIMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LIMWA or between the shoreline and the LIMWA for areas where VE Zones are not identified will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LIMWA)

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

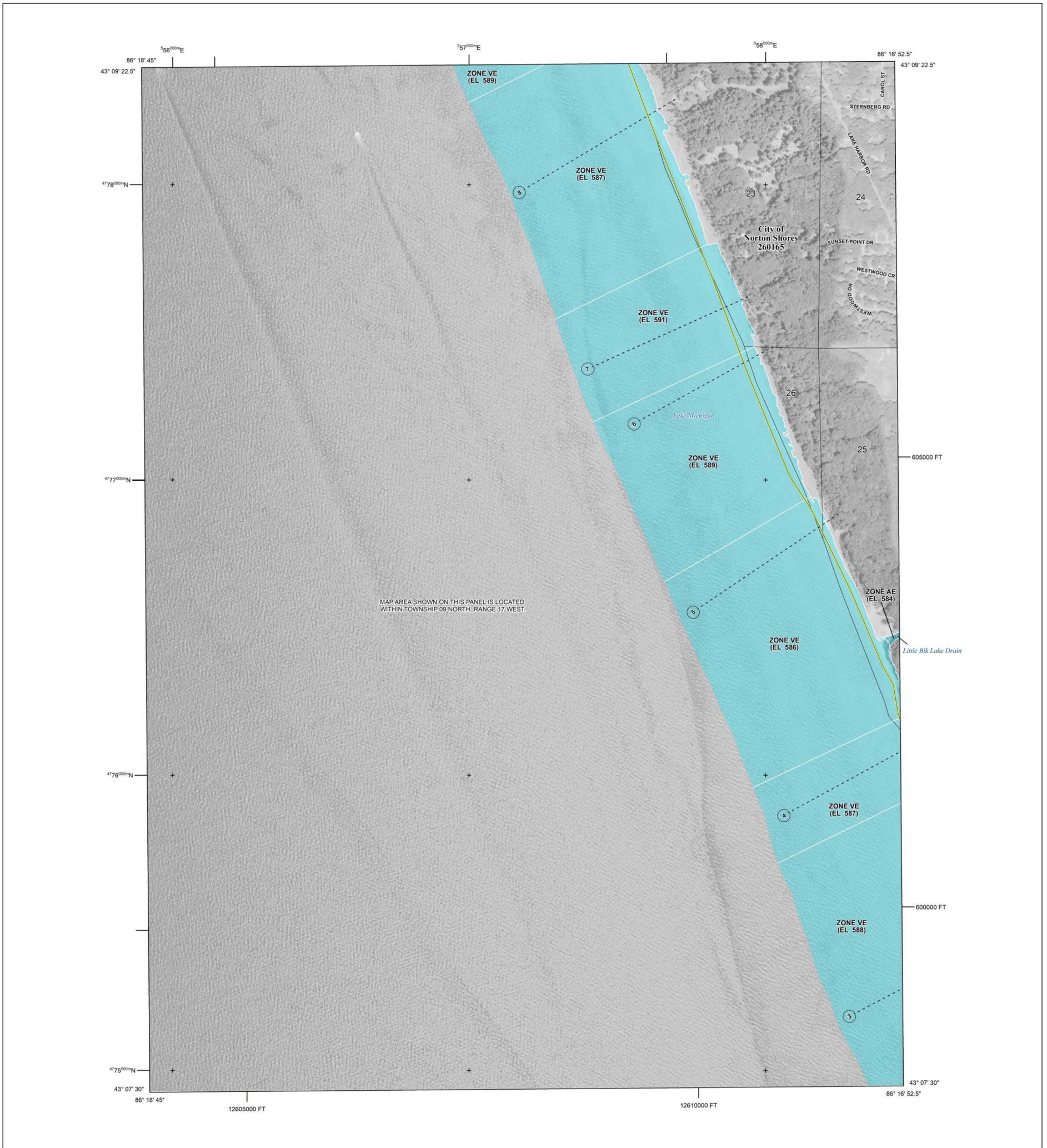
PANEL 266 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| NORTON SHORES, CITY OF | 260165 | 0266 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0266E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) 18.2 17.5 |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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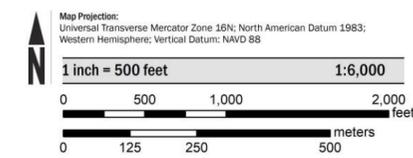
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



* PANEL NOT PRINTED



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

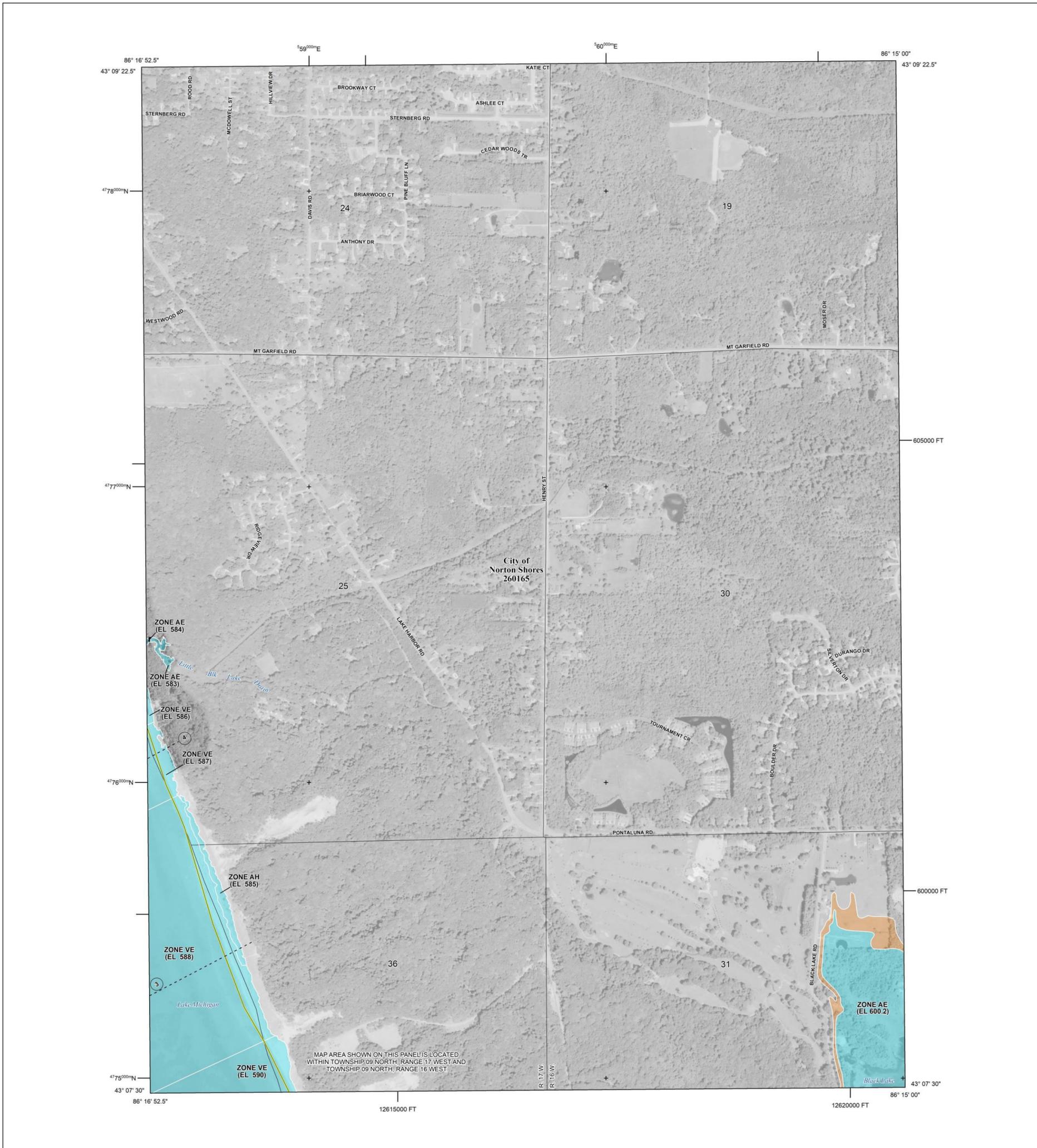
PANEL 268 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| NORTON SHORES, CITY OF | 260165 | 0268 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0268E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

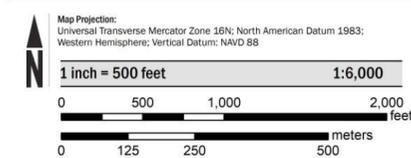
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthorectified imagery dated 2014.

LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LIMWA). The LIMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LIMWA or between the shoreline and the LIMWA for areas where VE Zones are not identified will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LIMWA)

SCALE



PANEL LOCATOR



* PANEL NOT PRINTED



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

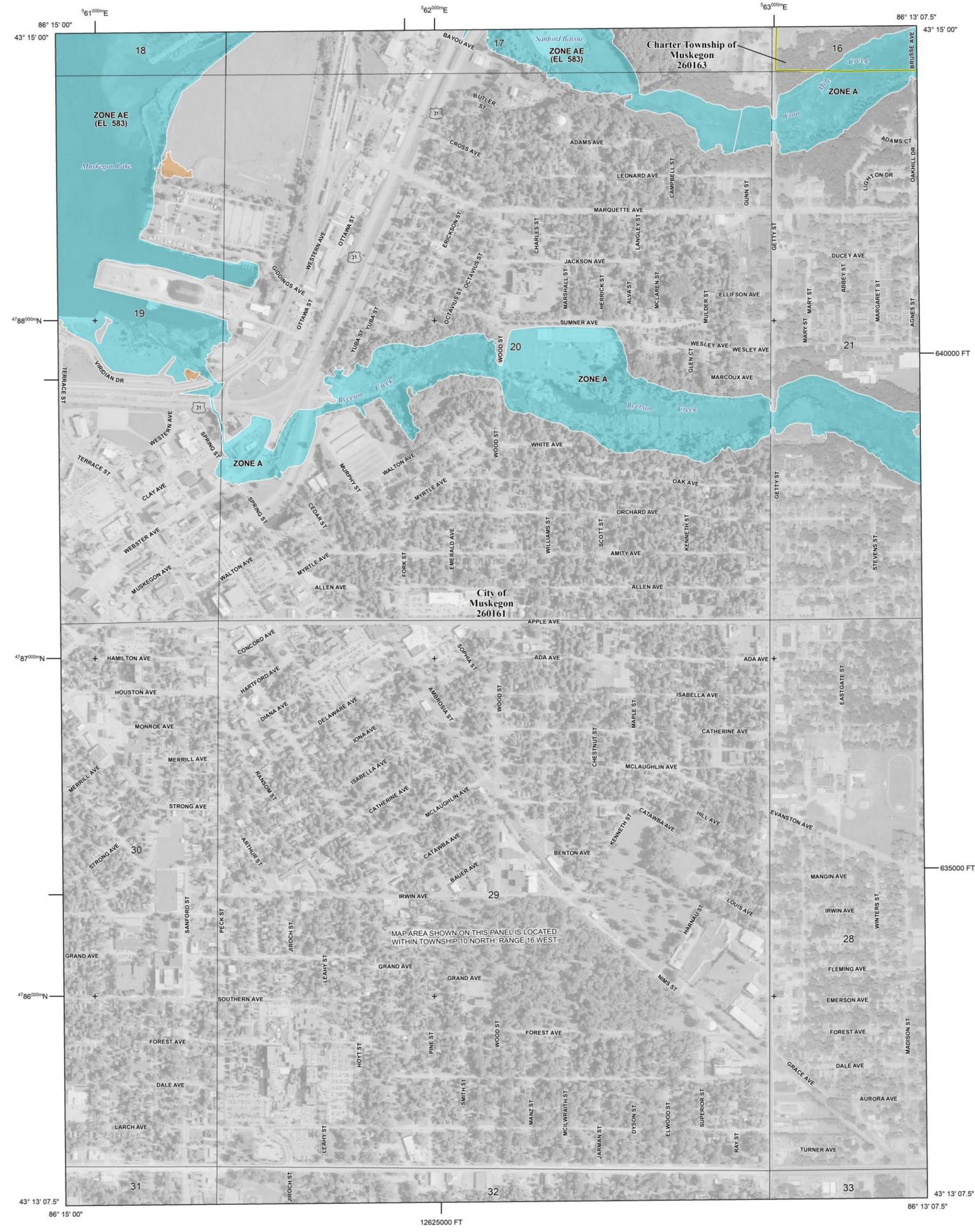
PANEL 269 of 475



Panel Contains:

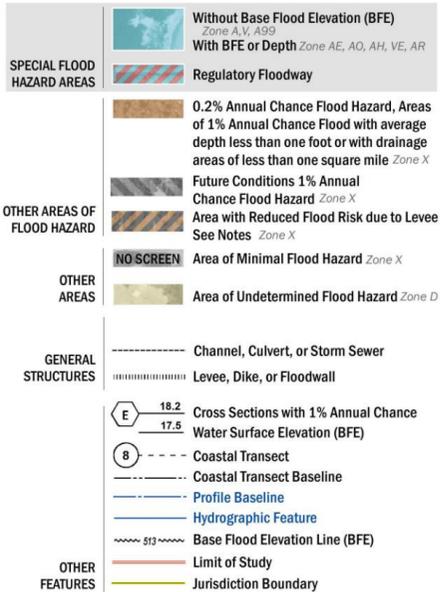
| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| NORTON SHORES, CITY OF | 260165 | 0269 | E |

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0269E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)



NOTES TO USERS

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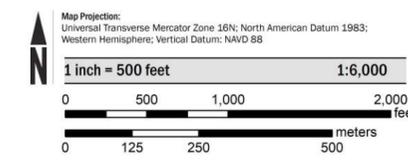
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

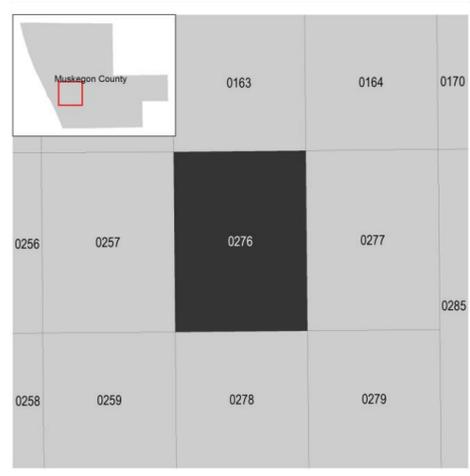
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-686-6620.

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SCALE



PANEL LOCATOR



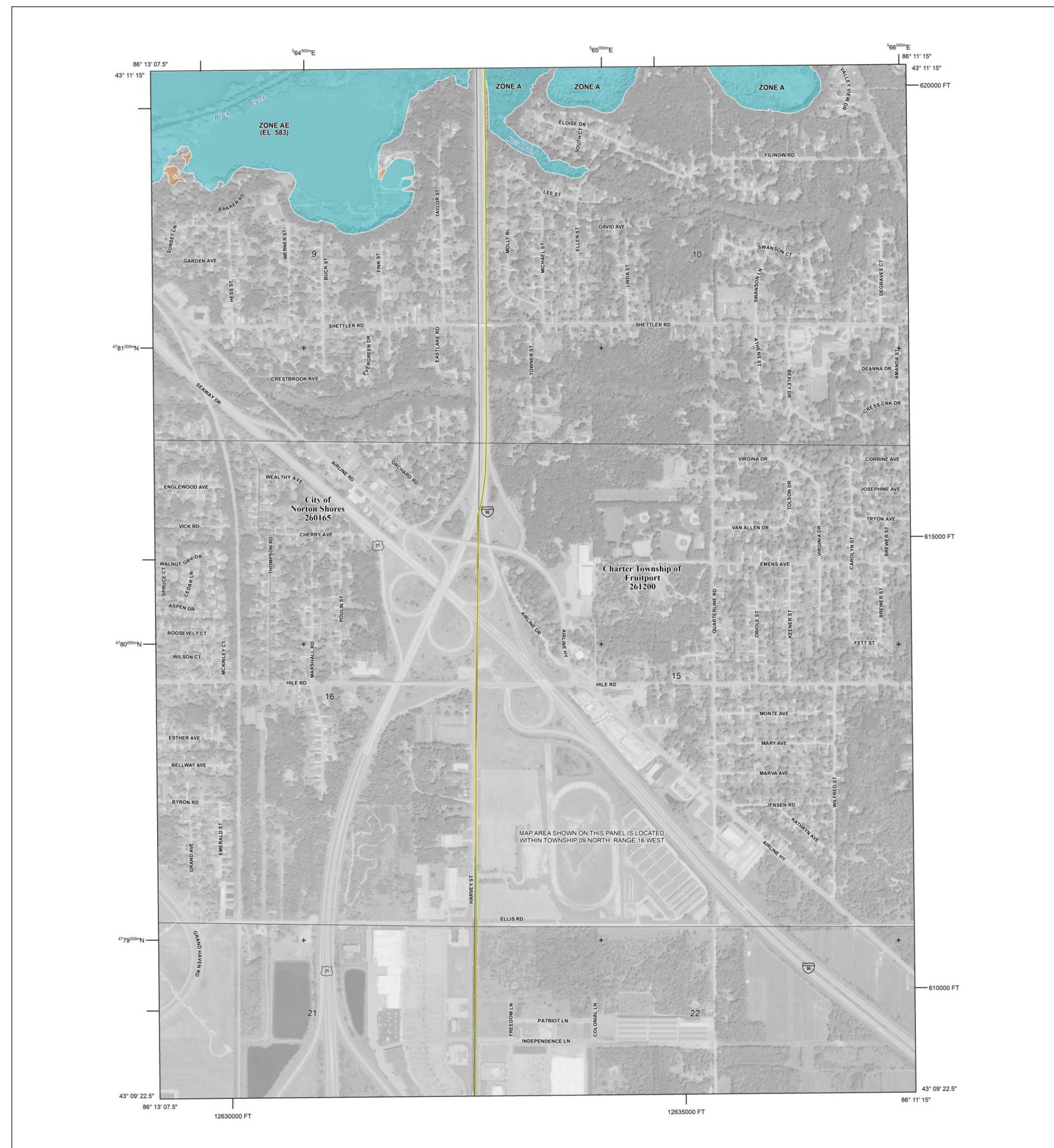
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

Panel 276 of 475

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF MUSKEGON | 260163 | 0276 | E |
| MUSKEGON, CITY OF | 260161 | 0276 | E |

Panel Contains:

VERSION NUMBER: 2.6.2.0
 MAP NUMBER: 26121C0276E
 MAP REVISED: OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

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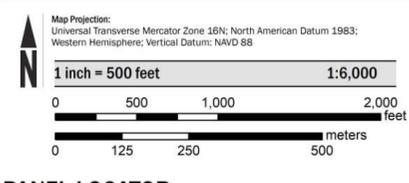
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

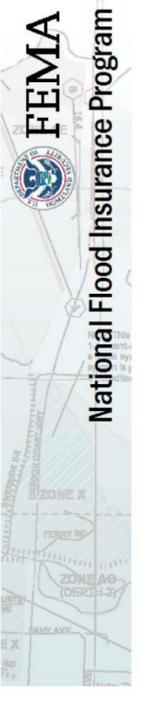
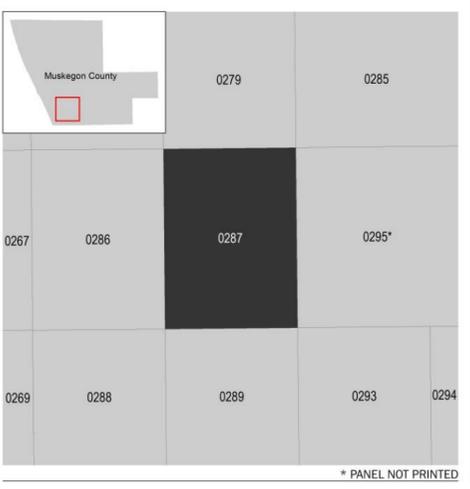
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 287 of 475

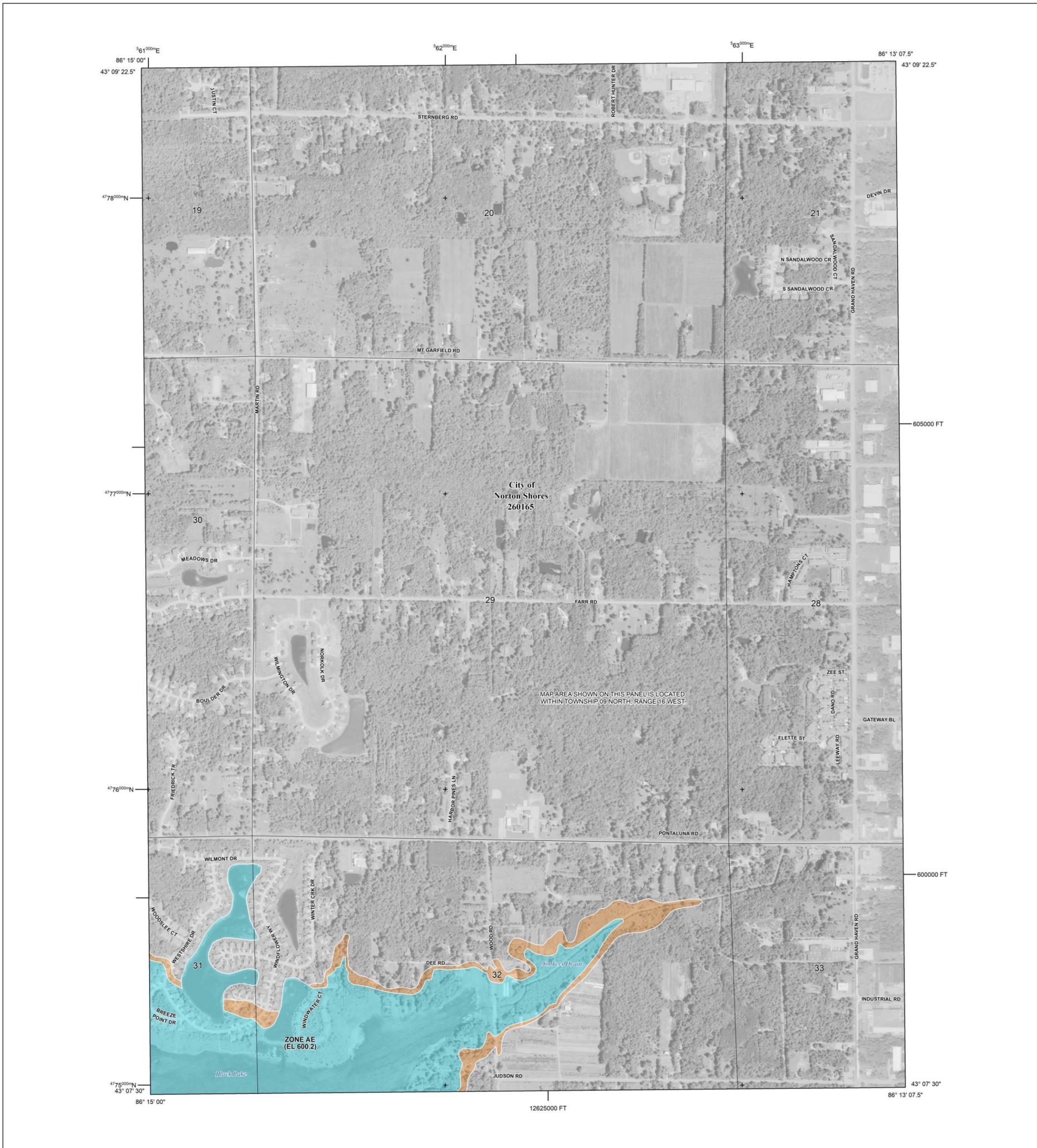
| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0287 | E |
| NORTON SHORES, CITY OF | 260165 | 0287 | E |

Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0287 | E |
| NORTON SHORES, CITY OF | 260165 | 0287 | E |



VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0287E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|--|--|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

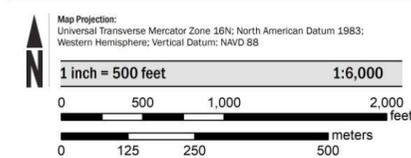
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthorectified imagery dated 2014.

SCALE



PANEL LOCATOR



* PANEL NOT PRINTED



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 288 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| NORTON SHORES, CITY OF | 260165 | 0288 | E |

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0288E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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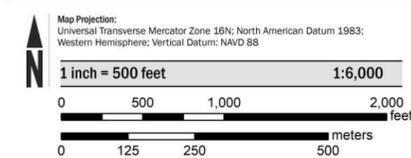
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 289 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0289 | E |
| NORTON SHORES, CITY OF | 260165 | 0289 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0289E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://msc.fema.gov)

| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP), in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

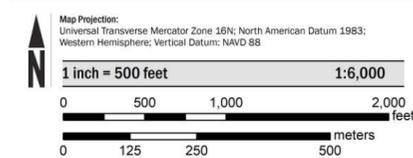
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

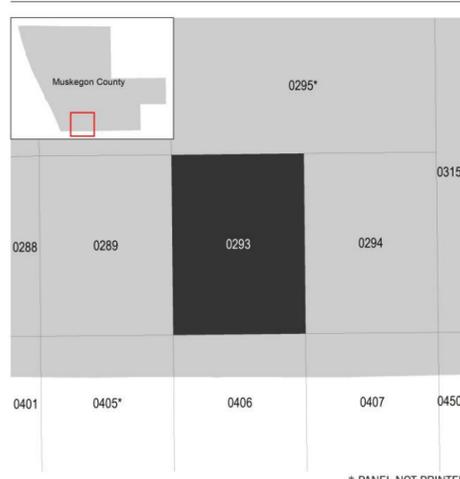
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthorectified imagery dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

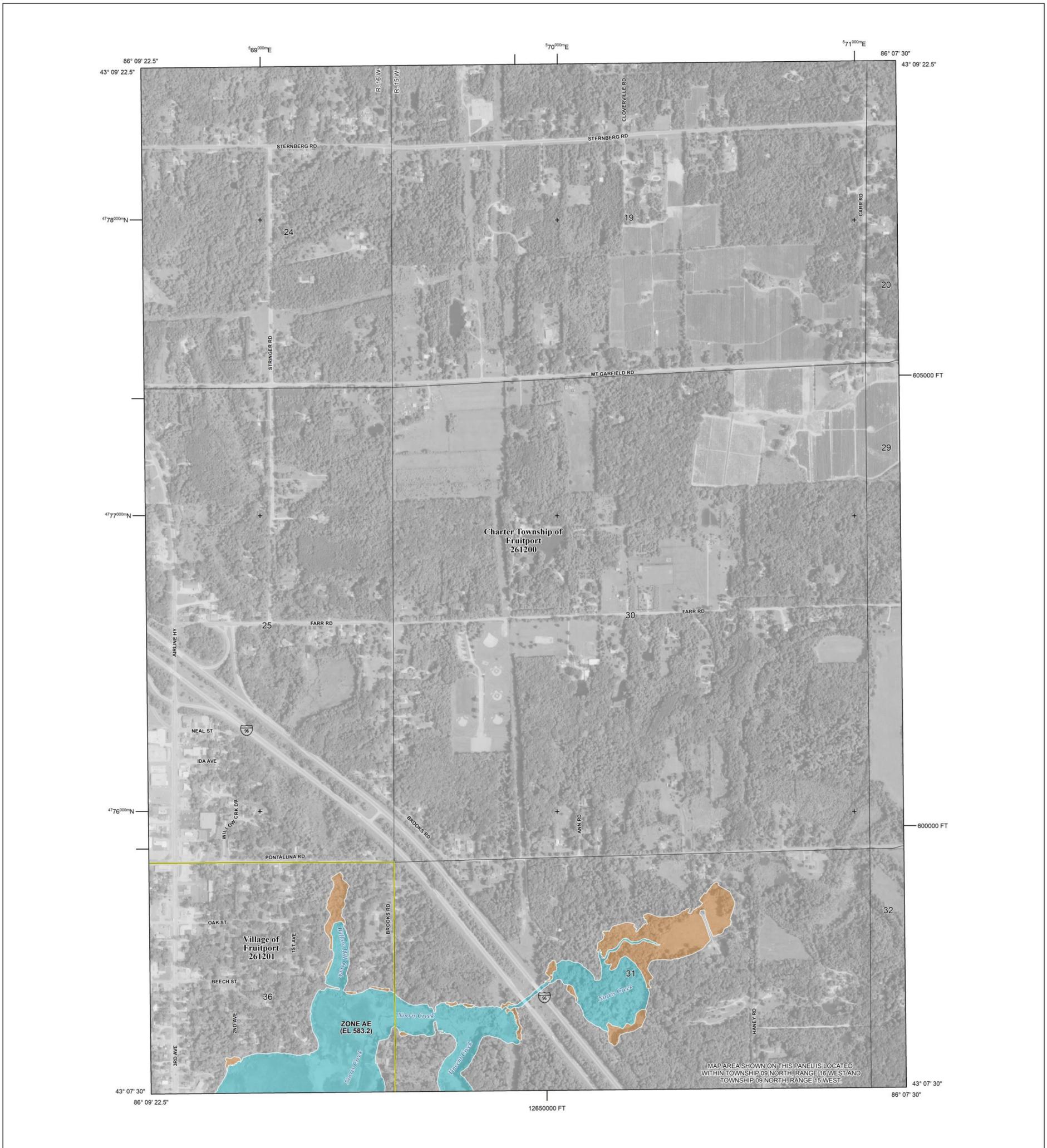
PANEL 293 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0293 | E |
| FRUITPORT VILLAGE OF | 261201 | 0293 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0293E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | |
|--|---|
| | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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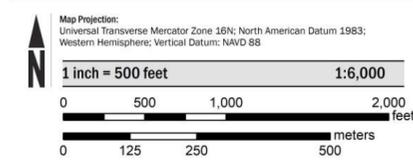
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For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

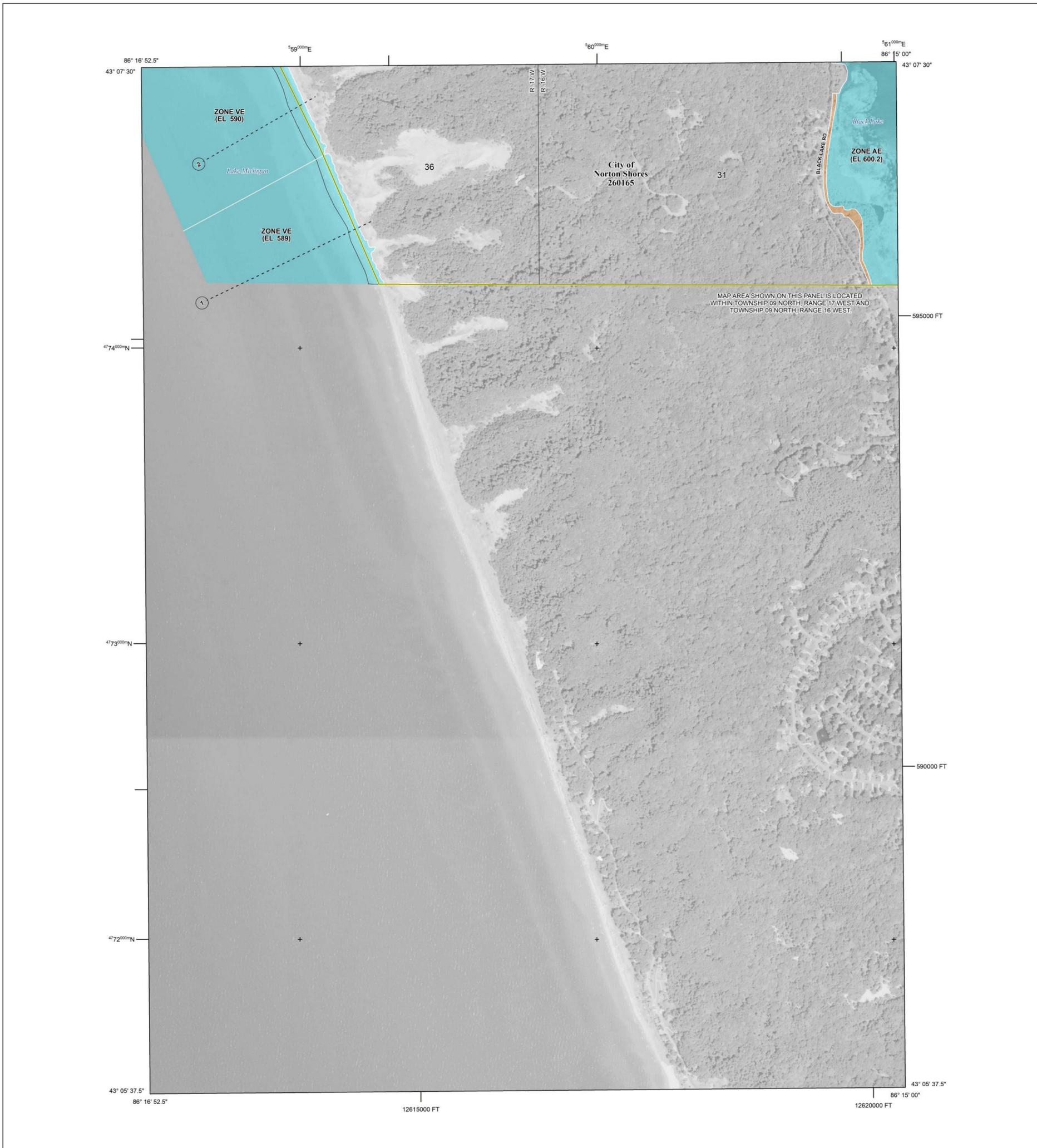
PANEL 294 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0294 | E |
| FRUITPORT, VILLAGE OF | 261201 | 0294 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0294E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

| | | |
|-----------------------------|--|---|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | | With BFE or Depth Zone AE, AO, AH, VE, AR |
| OTHER AREAS OF FLOOD HAZARD | | Regulatory Floodway |
| | | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| OTHER AREAS | | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| | | NO SCREEN Area of Minimal Flood Hazard Zone X |
| GENERAL STRUCTURES | | Channel, Culvert, or Storm Sewer |
| | | Levee, Dike, or Floodwall |
| OTHER FEATURES | | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | | Coastal Transect |
| | | Coastal Transect Baseline |
| | | Profile Baseline |
| | | Hydrographic Feature |
| | | Base Flood Elevation Line (BFE) |
| | | Limit of Study |
| | | Jurisdiction Boundary |

NOTES TO USERS

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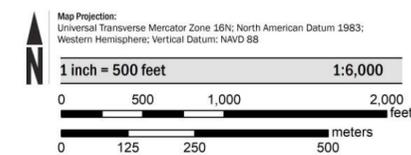
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Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

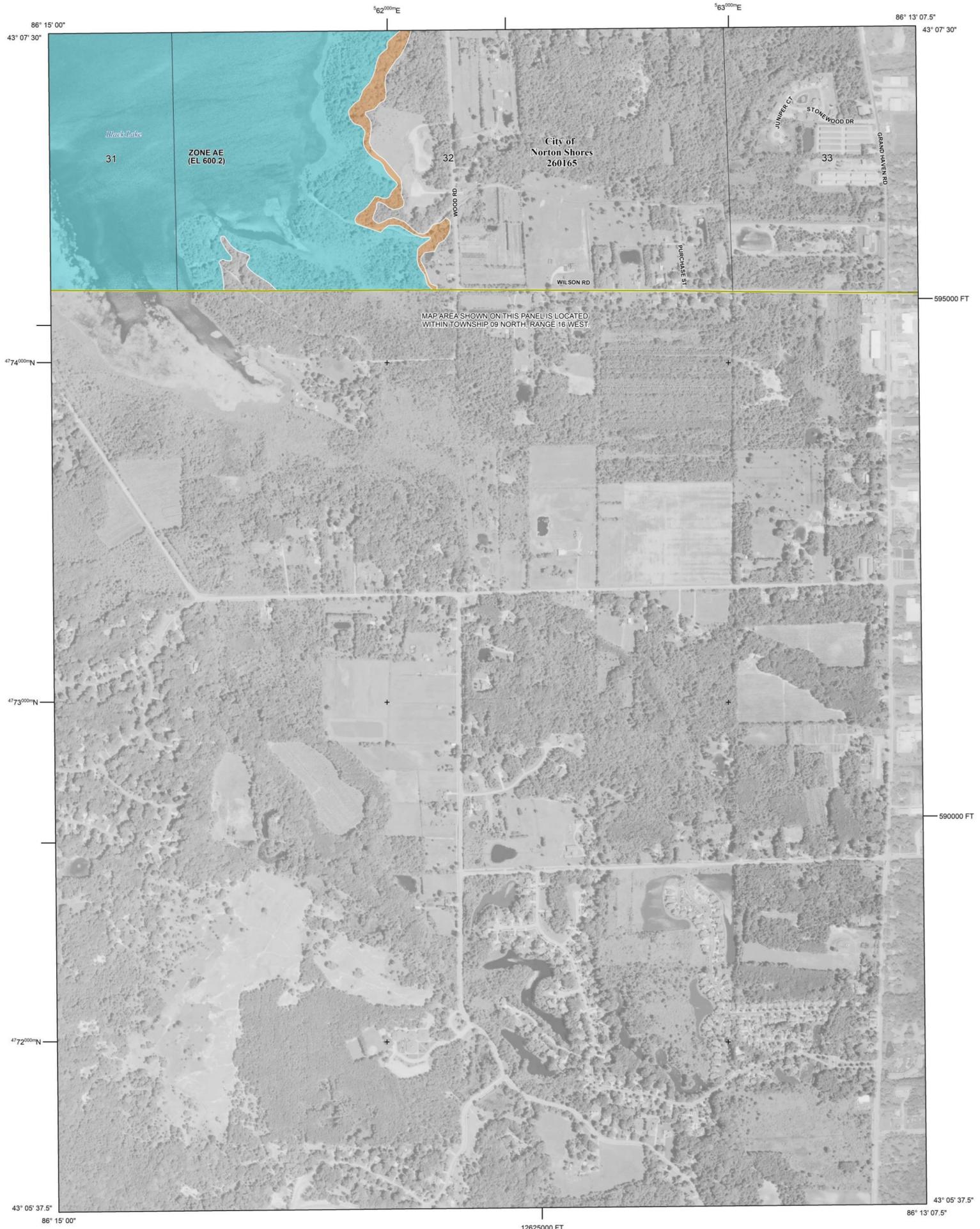
PANEL 382 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|------------------------|--------|-------|--------|
| NORTON SHORES, CITY OF | 260165 | 0382 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0382E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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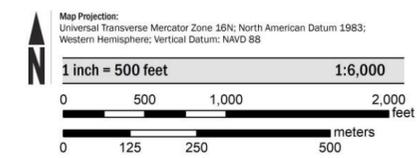
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Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



* PANEL NOT PRINTED



NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

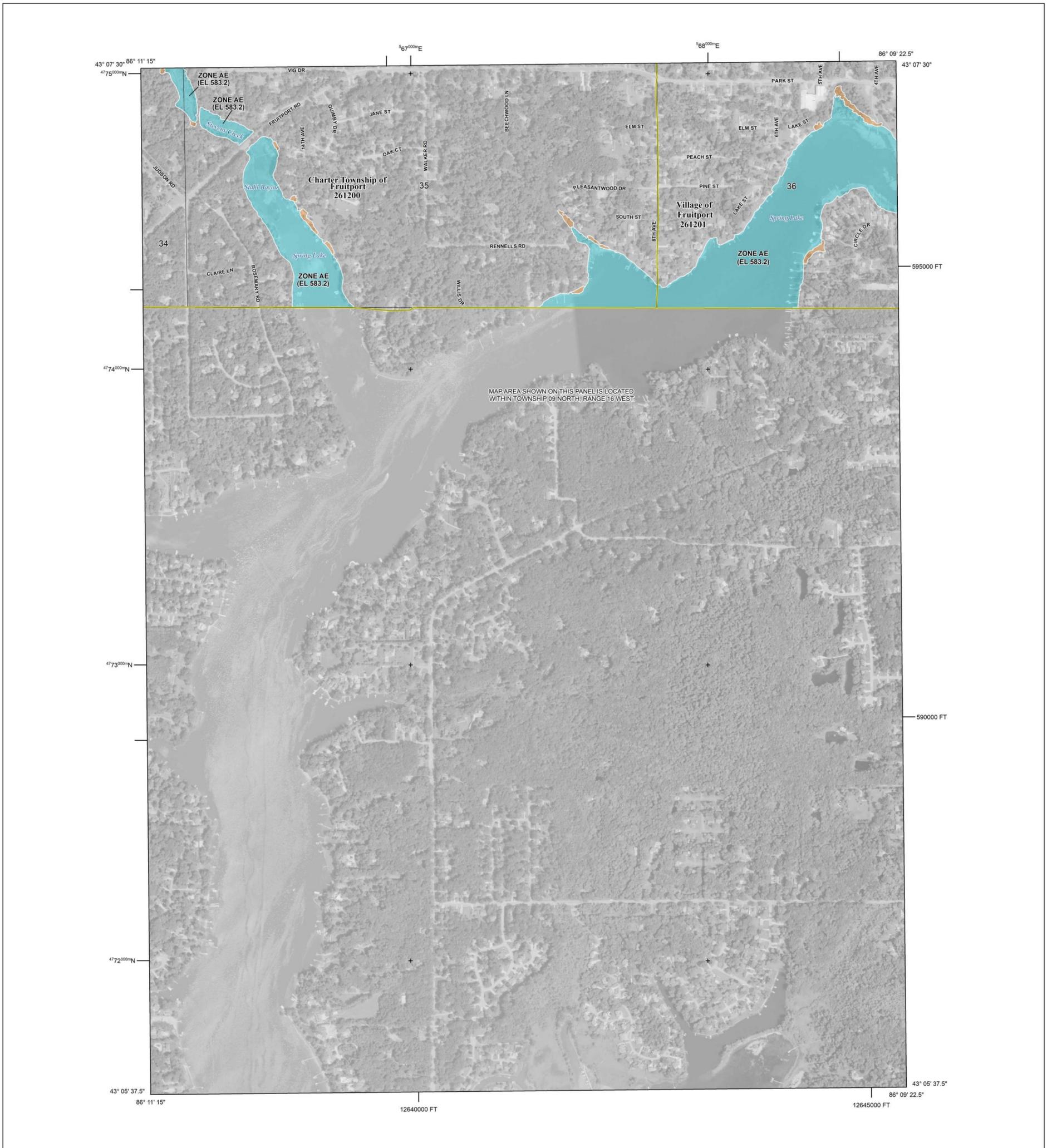
PANEL 401 of 475



| | | | |
|------------------------|--------|-------|--------|
| COMMUNITY | NUMBER | PANEL | SUFFIX |
| NORTON SHORES, CITY OF | 260165 | 0401 | E |

Panel Contains:

VERSION NUMBER
2.6.2.0
 MAP NUMBER
26121C0401E
 MAP REVISED
OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| OTHER FEATURES | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

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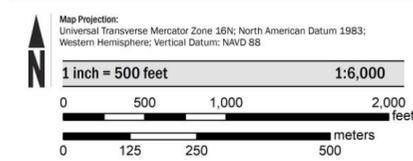
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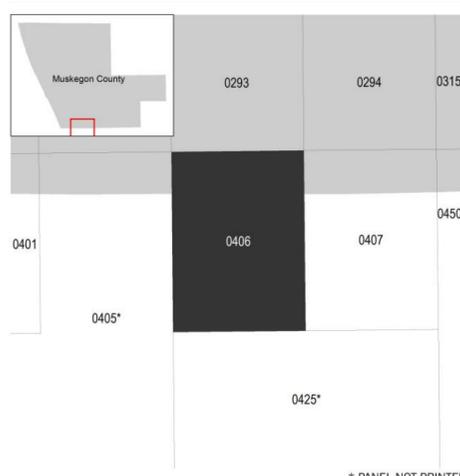
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SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM FLOOD INSURANCE RATE MAP

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

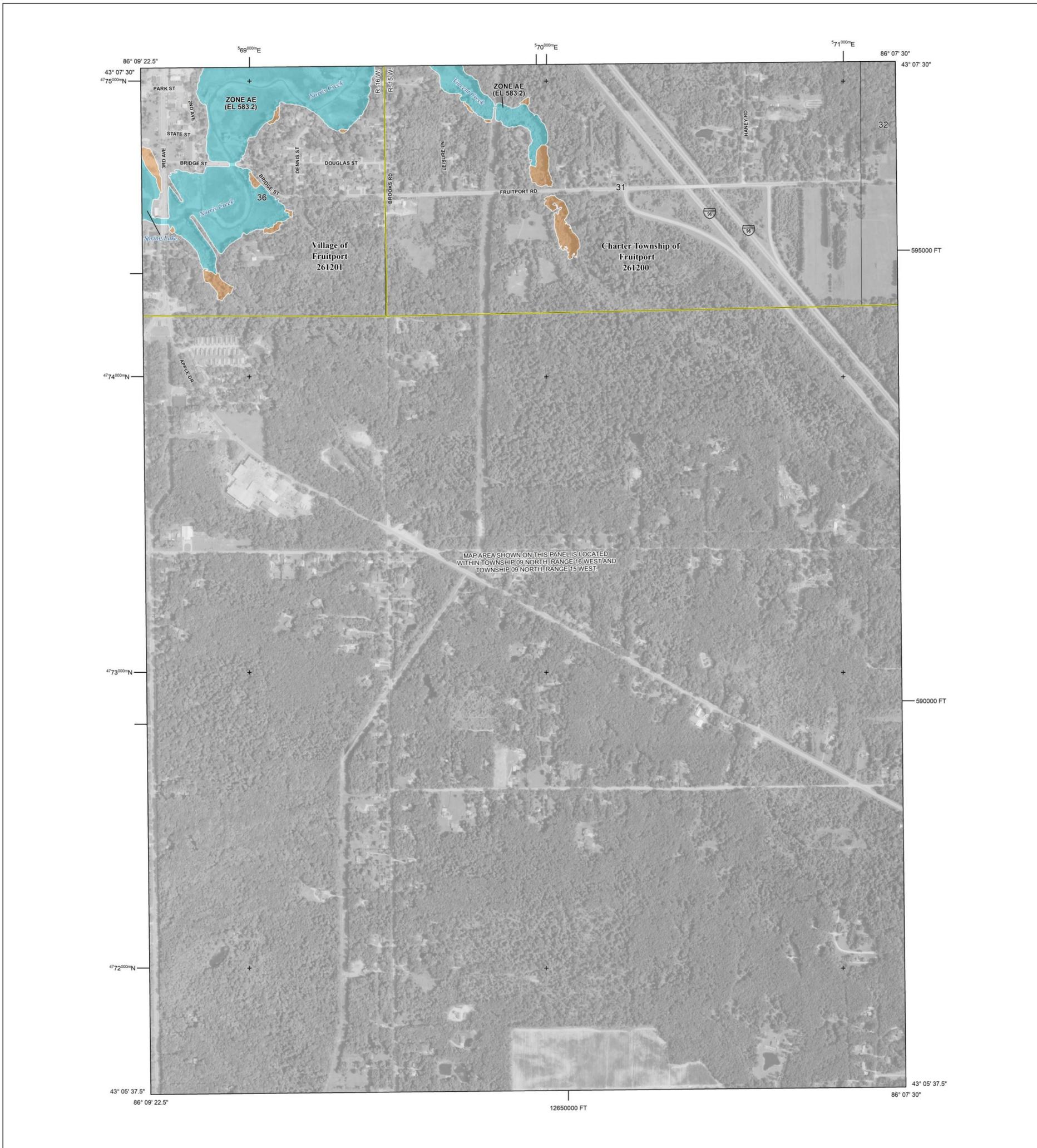
PANEL 406 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0406 | E |
| FRUITPORT, VILLAGE OF | 261201 | 0406 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0406E
 MAP REVISED OCTOBER 7, 2021



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
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| | |
|------------------------------------|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes Zone X |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| | Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| OTHER FEATURES | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

NOTES TO USERS

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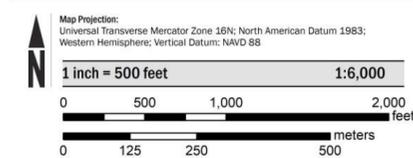
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To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on the FIRM was derived from USGS (1991, 2018), Michigan Geographic Data Library (1998), and USDA National Agricultural Imagery Program orthophotography dated 2014.

SCALE



PANEL LOCATOR



* PANEL NOT PRINTED



**NATIONAL FLOOD INSURANCE PROGRAM
 FLOOD INSURANCE RATE MAP**

MUSKEGON COUNTY, MICHIGAN
 All Jurisdictions

PANEL 407 of 475



Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-------------------------------|--------|-------|--------|
| CHARTER TOWNSHIP OF FRUITPORT | 261200 | 0407 | E |
| FRUITPORT VILLAGE OF | 261201 | 0407 | E |

VERSION NUMBER 2.6.2.0
 MAP NUMBER 26121C0407E
 MAP REVISED OCTOBER 7, 2021

Hazards Profile and Evaluation – City of Montague, Michigan

| Evaluation Criteria | Infrastructure Failure | Fires | Criminal / Violent Crime | Flooding / Dam Failure | Hazardous Materials | Transport / MCI | Wildfires |
|--------------------------|--|--|--|--|--|--|--|
| Historical Occurrence | High 2-3 events/yr 7 pts x 20% = 1.4 | High 2-3 events/yr 7 pts x 20% = 1.4 | Medium 1 event/yr 4 pts x 20%= 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 | Low >1 event/yr 1 pt x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= 0.8 |
| Affected Area | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x10%= 0.7 | Medium <\$100k 7 pts x10%= 0.7 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 |
| Hazard Score | 5.6 | 5.45 | 4.85 | 4.7 | 4.4 | 4.25 | 3.95 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – City of Muskegon, Michigan

| Evaluation Criteria | Hazardous Materials | Fires | Wildfires / Outdoor Fires | Infrastructure Failure | Criminal / Violent Crime | Transport / MCI | Flooding / Dam Failure |
|--------------------------|--|--|---|---|---|--|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | Medium 1 event/yr 4 pts x 20%= 0.8 |
| Affected Area | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Small Area 1/4 Juris. 7 pts x 20%= 0.35 | Small Area 1/4 Juris. 7 pts x 20%= 0.35 | Single Site < Neighborhood 1 pt x 20%= 0.20 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Small Area 1/4 Juris. 7 pts x 20%= 0.35 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | High >\$100k 10 pts x 10% = 1.0 | High >\$100k 10 pts x 10% = 1.0 | Medium <\$100k 7 pts x 10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 | High >\$100k 10 pts x 10% = 1.0 |
| Duration | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x 5%= 0.35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Somewhat <50% Accuracy 7 pts x 5%= 0.35 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x 5%= 0.35 | Good <75% 7 pts x 5%= 0.35 | Good <75% 7 pts x 5%= 0.35 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Generally Not <50% 7 pts x 5%= 0.35 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Generally Not <50% 7 pts x 5%= 0.35 |
| Hazard Score | 6.65 | 6.05 | 6.05 | 5.9 | 5.6 | 5.6 | 4.7 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – City of Muskegon Heights, Michigan

| Evaluation Criteria | Criminal | Infrastructure Failure | Fires | Hazardous Materials | Transport / MCI | Wildfires | Flooding / Dam Failure |
|--------------------------|---|---|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | High 2-3 events/yr 7 pts x 20%= 1.4 | High 2-3 events/yr 7 pts x 20%= 1.4 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | Medium <10 injured 7 pts x10%= 0.7 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Medium <1 Week 7 pts x5%= .35 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | ¾ Year 3 Seasons 7 pts x5%= 0.35 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= 0.35 |
| Collateral Damage | Good <75% 7 pts x5%= 0.35 | Minimal Poss. <10% 1 pt x 5%= .05 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally, Not <50% 7 pts x5%= 0.35 | Most of the time >75% 4 pts x 5%= 0.2 |
| Hazard Score | 8.75 | 7.1 | 6.8 | 5.9 | 5.45 | 4.55 | 3.05 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – City of North Muskegon, Michigan

| Evaluation Criteria | Infrastructure Failure | Flooding / Dam Failure | Transport / MCI | Hazardous Materials | Wildfires / Outdoor Fires | Criminal / Violent Crime | Fires |
|--------------------------|---|---|--|--|---|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | Medium 1 event/yr 4 pts x 20%= 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 | Minimal <\$10k 1 pt x 10% = 0.1 | High >\$100k 10 pts x10% = 1.0 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= 0.35 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 6.95 | 6.35 | 5.6 | 5.45 | 5.3 | 4.4 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – City of Norton Shores, Michigan

| Evaluation Criteria | Hazardous Materials | Fires | Infrastructure Failure | Wildfires | Criminal / Violent Crime | Transport / MCI | Flooding / Dam Failure |
|--------------------------|---|---|---|---|---|---|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20% = 0.8 | Low >1 event/yr 1 pt x 20% = 0.8 | Medium 1 event/yr 4 pts x 20% = 0.8 |
| Affected Area | Single Site < Neighborhood 1 pt x 20% = 0.2 | Single Site < Neighborhood 1 pt x 20% = 0.2 | Multiple Sites > Neighborhood 4 pts x 20% = 0.8 | Single Site < Neighborhood 1 pt x 20% = 0.2 | Multiple Sites > Neighborhood 4 pts x 20% = 0.8 | Single Site < Neighborhood 1 pt x 20% = 0.2 | Multiple Sites > Neighborhood 4 pts x 20% = 0.8 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10% = 0.1 | No Impact 0 injured 1 pt x 10% = 0.1 | No Impact 0 injured 1 pt x 10% = 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10% = 0.1 |
| Economic Effects | Medium <\$100k 7 pts x 10% = 0.7 | High >\$100k 10 pts x 10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10% = 0.7 | Medium <\$100k 7 pts x 10% = 0.7 |
| Duration | Short <24 Hours 4 pts x 5% = 0.2 | Minimal <12 Hours 1 pt x 5% = .05 | Short <24 Hours 4 pts x 5% = 0.2 | Minimal <12 Hours 1 pt x 5% = .05 | Minimal <12 Hours 1 pt x 5% = .05 | Minimal <12 Hours 1 pt x 5% = .05 | Medium <1 Week 7 pts x 5% = 0.35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | ¾ Year 3 Seasons 7 pts x 5% = 0.35 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | ¾ Year 3 Seasons 7 pts x 5% = 0.35 |
| Predictability | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5% = 0.2 | Some Poss. <50% 4 pts x 5% = 0.2 | Some Poss. <50% 4 pts x 5% = 0.2 | Some Poss. <50% 4 pts x 5% = 0.2 | Some Poss. <50% 4 pts x 5% = 0.2 | Some Poss. <50% 4 pts x 5% = 0.2 | High Poss. >75% 10 pts x 5% = 0.5 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Generally Not <50% 7 pts x 5% = 0.35 | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Most of the time >75% 4 pts x 5% = 0.2 |
| Hazard Score | 6.2 | 6.05 | 5.6 | 5.15 | 4.85 | 4.85 | 4.7 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – City of Roosevelt Park, Michigan

| Evaluation Criteria | Hazardous Materials | Fires | Infrastructure Failure | Wildfires | Criminal / Violent Crime | Flooding / Dam Failure | Transport / MCI |
|--------------------------|--|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Medium <\$100k 7 pts x 10%= 0.7 | High >\$100k 10 pts x 10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= 0.05 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= 0.05 | Minimal <12 Hours 1 pt x 5%= 0.05 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= 0.05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x 5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Generally Not <50% 7 pts x 5%= 0.35 | Unavailable No Warnings 10 pts x 5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.5 |
| Hazard Score | 6.2 | 6.05 | 5.6 | 5.15 | 4.85 | 4.7 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – City of Whitehall, Michigan

| Evaluation Criteria | Hazardous Materials | Fires | Infrastructure Failure | Wildfires | Criminal / Violent Crime | Flooding / Dam Failure | Transport / MCI |
|--------------------------|--|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Medium <\$100k 7 pts x 10%= 0.7 | High >\$100k 10 pts x 10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= 0.05 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= 0.05 | Minimal <12 Hours 1 pt x 5%= 0.05 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= 0.05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x 5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Generally Not <50% 7 pts x 5%= 0.35 | Unavailable No Warnings 10 pts x 5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.5 |
| Hazard Score | 6.2 | 6.05 | 5.6 | 5.15 | 4.85 | 4.7 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Blue Lake Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Fires | Hazardous Materials | Transport / MCI | Wildfires / Outdoor Fires | Flooding / Dam Failure | Criminal / Violent Crime |
|--------------------------|---|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | Low <1 event/yr 1 pts x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low <1 event/yr 1 pts x 20%= 0.2 | Low <1 event/yr 1 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ³ / ₄ Year 3 Seasons 7 pts x5%= 0.35 | ³ / ₄ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.4 | 5.6 | 5 | 3.95 | 3.65 | 3.65 | 3.5 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Casnovia Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Transport / MCI | Fires | Hazardous Materials | Flooding / Dam Failure | Wildfires / Outdoor Fires | Criminal / Violent Crime |
|--------------------------|---|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Low <1 event/yr 1 pts x 20%= 0.2 | Low <1 event/yr 1 pts x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= .8 | Low <1 event/yr 1 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10%= 0.7 | Medium <\$100k 7 pts x 10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Minimal <\$10k 1 pt x 10% = 0.1 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 |
| Hazard Score | 7.4 | 6.05 | 5.0 | 3.8 | 3.65 | 3.65 | 3.5 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Cedar Creek Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires / Outdoor Fires | Hazardous Materials | Fires | Flooding / Dam Failure | Criminal / Violent Crime | Transport / MCI |
|--------------------------|---|---|--|--|---|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Medium <10 injured 7 pts x 10%= 0.7 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10%= 0.7 | Medium <\$100k 7 pts x 10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.2 | Generally Not <50% 7 pts x 5%= 0.35 | Unavailable No Warnings 10 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.2 |
| Hazard Score | 7.1 | 6.2 | 6.05 | 5.3 | 5.15 | 3.95 | 3.95 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Dalton Township, Michigan

| Evaluation Criteria | Hazardous Materials | Fires | Wildfires | Criminal | Transport / MCI | Infrastructure Failure | Flooding / Dam Failure |
|--------------------------|---|---|---|---|---|---|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2 – 3 events/yr 7 pts x 20% = 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2 – 3 events/yr 7 pts x 20% = 1.4 | High 2 – 3 events/yr 7 pts x 20% = 1.4 | Medium 1 event/yr 4 pts x 20% = 0.8 |
| Affected Area | Single Site < Neighborhood 1 pt x 20% = 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Medium <10 injured 7 pts x 10% = 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10% = 0.1 | No Impact 0 injured 1 pt x 10% = 0.1 |
| Economic Effects | Medium <\$100k 7 pts x 10% = 0.7 | High >\$100k 10 pts x 10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10% = 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10% = 0.7 |
| Duration | Minimal <12 Hours 1 pt x 5% = .05 | Medium <1 Week 7 pts x 5% = .35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | ¾ Year 3 Seasons 7 pts x 5% = .35 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | ¾ Year 3 Seasons 7 pts x 5% = .35 |
| Predictability | Unpredictable Difficult 10 pts x 5% = 0.5 | Somewhat <50% Accuracy 7 pts x 5% = .35 |
| Collateral Damage | Minimal Poss. <10% 1 pt x 5% = .05 | Good <75% 7 pts x 5% = .35 | Minimal Poss. <10% 1 pt x 5% = .05 | Good <75% 7 pts x 5% = .35 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5% = 0.5 | Most of the time >75% 4 pts x 5% = 0.2 |
| Hazard Score | 5.9 | 5.9 | 5.45 | 5.6 | 5.3 | 4.7 | 3.8 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Egelston Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Transport / MCI | Criminal / Violent Crime | Wildfires / Outdoor Fires | Fires | Hazardous Materials | Flooding / Dam Failure |
|--------------------------|---|--|---|--|--|--|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2 – 3 events/yr 7 pts x 20% = 1.4 | Medium 1 event/yr 4 pts x 20%= 0.8 | Moderate 1 events/yr 4 pts x 20% = 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= 0.8 |
| Affected Area | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | Minimal <\$10k 1 pt x 10% = 0.1 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | Medium <\$100k 7 pts x10%= 0.7 | Minimal <\$10k 1 pt x 10% = 0.1 |
| Duration | Medium <1 Week 7 pts x5%= .35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= .35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= .35 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= .35 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Good <75% 7 pts x5%= .35 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= .35 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 |
| Hazard Score | 6.95 | 5.75 | 5.75 | 5.15 | 4.4 | 4.25 | 3.05 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Fruitland Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Fires | Flooding / Dam Failure | Criminal / Violent Crime | Transport / MCI |
|--------------------------|---|---|--|--|---|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 6.35 | 5.9 | 5.45 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Fruitport Charter Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Fires | Flooding / Dam Failure | Criminal / Violent Crime | Transport / MCI |
|--------------------------|---|---|--|--|---|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 6.35 | 5.9 | 5.45 | 4.85 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Holton Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Fires | Hazardous Materials | Criminal | Transport / MCI | Wildfires | Flooding / Dam Failure |
|--------------------------|---|--|---|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Low >1 event/yr 1 pt x20%= 0.2 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | High 2-3 events/yr 7 pts x 20%= 1.4 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= .35 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | ¾ Year 3 Seasons 7 pts x5%= 0.35 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= 0.35 |
| Collateral Damage | Minimal Poss. <10% 1 pt x 5%= .05 | Good <75% 7 pts x5%= 0.35 | Good <75% 7 pts x5%= 0.35 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally, Not <50% 7 pts x5%= 0.35 | Most of the time >75% 4 pts x 5%= 0.2 |
| Hazard Score | 7.1 | 6.8 | 6.05 | 5.4 | 4.85 | 4.35 | 3.05 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Laketon Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Fires | Flooding / Dam Failure | Criminal / Violent Crime | Transport / MCI |
|--------------------------|---|---|--|--|---|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Medium <10 injured 7 pts x 10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10%= 0.7 | High >\$100k 10 pts x 10% = 1.0 | High >\$100k 10 pts x 10% = 1.0 | High >\$100k 10 pts x 10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Medium <1 Week 7 pts x 5%= 0.35 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x 5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x 5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Generally Not <50% 7 pts x 5%= 0.35 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 6.35 | 5.9 | 5.45 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Montague Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Fires | Flooding / Dam Failure | Criminal / Violent Crime | Transport / MCI |
|--------------------------|---|---|--|--|---|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 6.35 | 5.9 | 5.45 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Moorland Township, Michigan

| Evaluation Criteria | Criminal / Violent Crime | Infrastructure Failure | Fires | Hazardous Materials | Transport / MCI | Wildfires / Outdoor Fires | Flooding / Dam Failure |
|--------------------------|---|---|--|--|--|--|---|
| Historical Occurrence | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2 – 3 events/yr 7 pts x 20% = 1.4 | Low >1 event/yr 1 pt x 20%= 0.2 | Low >1 event/yr 1 pt x 20%= 0.2 | Moderate 1 events/yr 4 pts x 20% = 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 |
| Affected Area | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | Minimal No Warning 10 pts x10% = 1.0 | No Impact 0 injured 1 pt x10%= 0.1 | Minimal No Warning 10 pts x10% = 1.0 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 |
| Duration | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <1 Week 7 pts x5%= .35 | Medium <\$100k 7 pts x10%= 0.7 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= .35 | ¾ Year 3 Seasons 7 pts x5%= .35 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= .35 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 |
| Collateral Damage | Minimal Poss. <10% 1 pt x 5%= .05 | Good <75% 7 pts x5%= .35 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= .35 | High Poss. >75% 10 pts x5%= 0.5 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= .35 | Most of the time >75% 4 pts x 5%= 0.2 |
| Hazard Score | 6.25 | 6.1 | 5.15 | 4.25 | 3.95 | 3.95 | 3.05 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Muskegon Charter Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Criminal | Fires | Hazardous Materials | Transport / MCI | Wildfires | Flooding / Dam Failure |
|--------------------------|---|---|---|---|---|---|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Low >1 event/yr 1 pt x 20% = 0.2 |
| Affected Area | Small Area 1/4 Juris. 7 pts x 20% = 1.4 | Small Area 1/4 Juris. 7 pts x 20% = 1.4 | Single Site < Neighborhood 1 pt x 20% = 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | No Impact 0 injured 1 pt x 10% = 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Medium <10 injured 7 pts x 10% = 0.7 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10% = 0.1 | No Impact 0 injured 1 pt x 10% = 0.1 |
| Economic Effects | Medium <\$100k 7 pts x 10% = 0.7 | Low <\$50k 4 pts x 10% = 0.4 | High >\$100k 10 pts x 10% = 1.0 | High >\$100k 10 pts x 10% = 1.0 | Medium <\$100k 7 pts x 10% = 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10% = 0.7 |
| Duration | Medium <1 Week 7 pts x 5% = .35 | Minimal <12 Hours 1 pt x 5% = .05 | Minimal <12 Hours 1 pt x 5% = .05 | Short <24 Hours 4 pts x 5% = 0.2 | Minimal <12 Hours 1 pt x 5% = .05 | Minimal <12 Hours 1 pt x 5% = .05 | Medium <1 Week 7 pts x 5% = 0.35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | Year Round 4 Seasons 10 pts x 5% = 0.5 | ¾ Year 3 Seasons 7 pts x 5% = 0.35 | ¾ Year 3 Seasons 7 pts x 5% = 0.35 |
| Predictability | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Unpredictable Difficult 10 pts x 5% = 0.5 | Somewhat <50% Accuracy 7 pts x 5% = 0.35 |
| Collateral Damage | Minimal Poss. <10% 1 pt x 5% = .05 | Some Poss. <50% 4 pts x 5% = 0.2 | Good <75% 7 pts x 5% = 0.35 | Some Poss. <50% 4 pts x 5% = 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Unavailable No Warnings 10 pts x 5% = 0.5 | Generally, Not <50% 7 pts x 5% = 0.35 | Most of the time >75% 4 pts x 5% = 0.2 |
| Hazard Score | 7.1 | 6.95 | 6.8 | 6.5 | 5.45 | 5.15 | 3.05 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Ravenna Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Fires | Transport / MCI | Hazardous Materials | Wildfires / Outdoor Fires | Flooding / Dam Failure | Criminal / Violent Crime |
|--------------------------|---|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Low <1 event/yr 1 pts x 20%= 0.2 | Low <1 event/yr 1 pts x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= .8 | Low <1 event/yr 1 pts x 20%= 0.2 | Low <1 event/yr 1 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ³ / ₄ Year 3 Seasons 7 pts x5%= 0.35 | ³ / ₄ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.4 | 5.0 | 3.95 | 3.8 | 3.65 | 3.65 | 3.5 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Sullivan Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Flooding / Dam Failure | Fires | Criminal / Violent Crime | Transport / MCI |
|--------------------------|---|---|--|---|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x 10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 5.9 | 5.65 | 5.45 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – White River Township, Michigan

| Evaluation Criteria | Hazardous Materials | Fires | Infrastructure Failure | Wildfires | Criminal / Violent Crime | Flooding / Dam Failure | Transport / MCI |
|--------------------------|--|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20% = 1.4 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 |
| Affected Area | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Multiple Sites > Neighborhood 4 pts x 20%= 0.8 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Medium <\$100k 7 pts x 10%= 0.7 | High >\$100k 10 pts x 10% = 1.0 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x 10%= 0.7 | Medium <\$100k 7 pts x 10%= 0.7 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= 0.05 | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= 0.05 | Minimal <12 Hours 1 pt x 5%= 0.05 | Medium <1 Week 7 pts x 5%= 0.35 | Minimal <12 Hours 1 pt x 5%= 0.05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x 5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Generally Not <50% 7 pts x 5%= 0.35 | Unavailable No Warnings 10 pts x 5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x 5%= 0.5 |
| Hazard Score | 6.2 | 6.05 | 5.6 | 5.15 | 4.85 | 4.7 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Whitehall Township, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Flooding / Dam Failure | Criminal / Violent Crime | Fires | Transport / MCI |
|--------------------------|---|---|--|---|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 5.9 | 5.45 | 5.35 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Village Of Casnovia, Michigan

| Evaluation Criteria | Infrastructure Failure | Fires | Transport / MCI | Hazardous Materials | Wildfires / Outdoor Fires | Criminal / Violent Crime | Flooding / Dam Failure |
|--------------------------|---|--|--|--|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | High 2-3 events/yr 7 pts x 20%= 1.4 | Low <1 event/yr 1 pts x 20%= 0.2 | Low <1 event/yr 1 pts x 20%= 0.2 | Medium 1 event/yr 4 pts x 20%= 0.8 | Low <1 event/yr 1 pts x 20%= 0.2 | Low <1 event/yr 1 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x 10% = 1.0 |
| Casualty Effects | No Impact 0 injured 1 pt x 10%= 0.1 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x 10%= 0.1 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x 10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 | Minimal <\$10k 1 pt x 10% = 0.1 | Low <\$50k 4 pts x 10% = 0.4 |
| Duration | Short <24 Hours 4 pts x 5%= 0.2 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x 5%= 0.35 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 | Year Round 4 Seasons 10 pts x 5%= 0.5 | ¾ Year 3 Seasons 7 pts x 5%= 0.35 |
| Predictability | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 | Unpredictable Difficult 10 pts x 5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 |
| Availability of Warnings | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 | Unavailable No Warnings 10 pts x 5%= 0.5 |
| Hazard Score | 7.4 | 4.9 | 3.95 | 3.8 | 3.65 | 3.5 | 3.0 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Village of Fruitport, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Flooding / Dam Failure | Criminal / Violent Crime | Fires | Transport / MCI |
|--------------------------|---|---|--|---|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 5.9 | 5.45 | 5.35 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Village of Lakewood Club, Michigan

| Evaluation Criteria | Infrastructure Failure | Wildfires | Hazardous Materials | Flooding / Dam Failure | Criminal / Violent Crime | Fires | Transport / MCI |
|--------------------------|---|---|--|---|--|--|--|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.8 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Medium 1 event/yr 4 pts x 20%= 0.2 |
| Affected Area | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Large Area >1/2 Juris. 10 pts x 20% = 2.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 |
| Casualty Effects | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <10 injured 7 pts x10%= 0.7 | No Impact 0 injured 1 pt x10%= 0.1 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Medium <\$100k 7 pts x10%= 0.7 | High >\$100k 10 pts x10% = 1.0 | High >\$100k 10 pts x10% = 1.0 | Minimal <\$10k 1 pt x 10% = 0.1 | High >\$100k 10 pts x10% = 1.0 | Medium <\$100k 7 pts x10%= 0.7 |
| Duration | Medium <1 Week 7 pts x5%= 0.35 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Medium <1 Week 7 pts x5%= 0.35 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= 0.35 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= 0.35 | Some Poss. <50% 4 pts x 5%= 0.2 | High Poss. >75% 10 pts x5%= 0.5 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= 0.35 | Unavailable No Warnings 10 pts x5%= 0.5 | Most of the time >75% 4 pts x 5%= 0.2 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 |
| Hazard Score | 7.85 | 7.1 | 6.65 | 5.9 | 5.45 | 5.35 | 4.25 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Hazards Profile and Evaluation – Villager of Ravenna, Michigan

| Evaluation Criteria | Infrastructure Failure | Criminal / Violent Crime | Fires | Hazardous Materials | Transport / MCI | Wildfires / Outdoor Fires | Flooding / Dam Failure |
|--------------------------|---|---|--|--|--|--|---|
| Historical Occurrence | Excessive 4+ events/yr 10 pts x 20% = 2.0 | Low >1 event/yr 1 pt x 20%= 0.2 | High 2 – 3 events/yr 7 pts x 20% = 0.8 | Low >1 event/yr 1 pt x 20%= 0.2 | Low >1 event/yr 1 pt x 20%= 0.2 | Moderate 1 events/yr 4 pts x 20% = 0.8 | Medium 1 event/yr 4 pts x 20%= 0.8 |
| Affected Area | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Small Area 1/4 Juris. 7 pts x 20%= 1.4 | Single Site < Neighborhood 1 pt x 20%= 0.2 |
| Speed of Onset | Minimal No Warning 10 pts x 10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Single Site < Neighborhood 1 pt x 20%= 0.2 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Medium 12-24 Hours 4 pts x 10% = 0.4 |
| Casualty Effects | No Impact 0 injured 1 pt x10%= 0.1 | Minimal No Warning 10 pts x10% = 1.0 | Minimal No Warning 10 pts x10% = 1.0 | Low Impact <5 injured 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | No Impact 0 injured 1 pt x10%= 0.1 |
| Economic Effects | Low <\$50k 4 pts x 10% = 0.4 | Low Impact <5 injured 4 pts x 10% = 0.4 | No Impact 0 injured 1 pt x10%= 0.1 | Medium <\$100k 7 pts x10%= 0.7 | Low <\$50k 4 pts x 10% = 0.4 | Low <\$50k 4 pts x 10% = 0.4 | Minimal <\$10k 1 pt x 10% = 0.1 |
| Duration | Medium <1 Week 7 pts x5%= .35 | Minimal <\$10k 1 pt x 10% = 0.1 | Medium <\$100k 7 pts x10%= 0.7 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Minimal <12 Hours 1 pt x 5%= .05 | Short <24 Hours 4 pts x 5%= 0.2 |
| Seasonal Pattern | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | Year Round 4 Seasons 10 pts x5%= 0.5 | ¾ Year 3 Seasons 7 pts x5%= .35 | ¾ Year 3 Seasons 7 pts x5%= .35 |
| Predictability | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Unpredictable Difficult 10 pts x5%= 0.5 | Somewhat <50% Accuracy 7 pts x5%= .35 | Fairly Predict. >50% Accuracy 4 pts x 5%= 0.2 |
| Collateral Damage | Some Poss. <50% 4 pts x 5%= 0.2 | Minimal Poss. <10% 1 pt x 5%= .05 | Minimal Poss. <10% 1 pt x 5%= .05 | Some Poss. <50% 4 pts x 5%= 0.2 | Some Poss. <50% 4 pts x 5%= 0.2 | Good <75% 7 pts x5%= .35 | High Poss. >75% 10 pts x5%= 0.5 |
| Availability of Warnings | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Unavailable No Warnings 10 pts x5%= 0.5 | Generally Not <50% 7 pts x5%= .35 | Most of the time >75% 4 pts x 5%= 0.2 |
| Hazard Score | 6.55 | 5.65 | 4.55 | 4.05 | 3.95 | 3.95 | 3.05 |
| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**2022 MEETING SCHEDULE
LOCAL EMERGENCY PLANNING COMMITTEE (LEPC)
COMMUNITY RIGHT TO KNOW**

Tuesday, January 11, 2022

Tuesday, April 12, 2022

Tuesday, July 12, 2022

Tuesday, October 11, 2022

NOTE: All meetings start at 10:30 a.m. at the Emergency Operations Center, 1611 Oak, unless otherwise noted.

PUBLIC IS INVITED TO ATTEND

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**Mark Eisenbarth, County Administrator
Michael Kobza Hall of Justice
990 Terrace Street
Muskegon, MI, 49442
231-724-6505**

**Muskegon County Emergency Management
1611 Oak Street
Muskegon, MI, 49442
231-724-6341**

LOCAL EMERGENCY PLANNING COMMITTEE MEETING
Tuesday, January 11, 2022
10:30 AM
Emergency Operations Center
Or

AGENDA

- I. Attendance & Call to Order
- II. Approval of Minutes of previous meeting
- III. Additions to the Agenda
- IV. Status Report (Chairman)
- V. Standing Committee Reports
 - A. Planning – Site Plans
 - B. Emergency Management – Hazard Mitigation Plan update
 - C. HAZMAT – Anthony Gutierrez
 - E. Training Fire Dept. – Chief Dean
- VI Presentations - None
- VII. Other Business –
- VIII. Comments (Public/members)
- IX. Adjournment

AMERICAN DISABILITY ACT POLICY:

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Mark Eisenbarth, Administrator
Michael E. Kobza Hall of Justice
Fourth Floor 990 Terrace Street.
Muskegon, MI 49442
Phone: (231) 724-6520.

**If you are unable to attend please call 724-6341
Next LEPC meeting is scheduled for April 12, 2022, 10:30 A.M.
Emergency Operations Center**

Member/Group Represented

**Jim Duram/EMD (MCRACES)
Jim Norton/EMD (MCRACES)
Rhona Colbert/CERT/MRC
/Elected Official
Susie Hughes/Elected Official
Chris May/Facility Operator (Webb Chemical)
Tom Finkler/Facility Operator (Webb Chemical)
/Facility Operator (Honeywell)
/Facility Operator (Honeywell)**

Chris Dean/Fire

**Tony Gutierrez/Hazmat
Chad Crook/EMS
Jonathon Degen/EMS
Jerry Evans/Health Organization
Dori Peters/Public Health
Chad Lawton/Health Organization
Dave Ogren/Hospital
Michael Poulin/Law (County)
Jeff Lewis/Law (Urban)
Roger Squires/Law (Rural)
Mike Eslick/Environmental Health
David Wierzbicki/DEQ**

LOCAL EMERGENCY PLANNING COMMITTEE MEETING

Tuesday, January 12, 2022

MINUTES

PRESENT: Richard Warner, Emergency Manager; Bob Grabinski, Chair LEPC; Rhona Colbert, Citizen Corps; Rich Popisil, BASF(call in); Chad Lawton, Muskegon County Medical Control; Susie Hughes, Muskegon County Commissioner, Karla Betten, Senior Resources; Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT; Brad Walters, HAZMAT; Renee Gavin, Newaygo County Emergency Management Deputy Director; Dennis Lord, City of Muskegon Public Safety; Dave Glotzbach, Muskegon Township Fire Chief; Chris May, Webb Chemical; Tom Finkler, Webb Chemical; Steve Shuksfa, 5-Alarm; Dave Wierzbicki, EGLE.

- I. **CALL TO ORDER:** Meeting was called to order 10:30 a.m. by Chairman Bob Grabinski
- II. **MINUTES APPROVAL OF PREVIOUS MEETING:** Motion- Susie Hughes, Second- Chad Lawton
- III. **ADDITIONS TO THE AGENDA:** Add 5 Alarm Representative to presentation.
- IV. **STATUS REPORT:** (Chairman) Bob Grabinski - Nothing to report
- V. **STANDING COMMITTEE REPORTS**
 - A. **Planning:** BASF is still for sale according to Rich Popisil and have a couple of offers to purchase the property.
 - B. **Emergency Manager:** Rich Warner introduced Renee' Gavin who is currently updating and working on site plans for Muskegon County.
 - C. **HAZMAT:** HAZMAT had a call out in Newaygo County according to Chris Dean the spokesperson for HAZMAT. The group received the grant funded Level 4 Level A suits and 16 Flash gear suits for the Hazmat team air canisters.
 - D. **TRAINING Fire Department:** Chris Dean, Muskegon County Fire Chiefs rep, explained the fire academy has been completed. The fire academy is looking for a bigger place to house the academy. There may be grant funding available.
- VI. **PRESENTATION:** Steve Shuksfa, who is the representative for 5-Alarm, was introduced and gave an overview of grant items he just delivered.

VII. OTHER BUSINESS: No new business

VIII. COMMENTS: (Public Members)

IX. ADJOURNMENTS: Motion - Susie Hughes, Second- Chris Dean. Meeting was adjourned at 11:00.

LOCAL PLANNING TEAM MEETING

Tuesday, January 12, 2021

Minutes

PRESENT: Rich Warner, Muskegon County Emergency Manager; James Norton, Muskegon County RACES; Rhona Colbert, Muskegon County Citizen Corps; Bob Grabinski, LEPC Chair; Mark Eisenbarth, Muskegon County Administrator; Shane Brown, Muskegon County Sheriff Department, Orville Theaker, Michigan State Police.

NOTE: THIS MEETING DID NOT MEET THE QUOROM REQUIREMENTS. INFORMATION WAS PASSED OUT TO THOSE IN ATTENDANCE AT THE MEETING.

Attendance and Call to Order- Emergency Manager Rich Warner called the meeting to order at 11:05 a.m.

Approval of Minutes of previous meeting : Previous recorded minutes were on a phone that had died. The ap did not transfer to the new phone.

Additions to the Agenda- No Additions

Projects- Last quarter asked for suggestions that would benefit the county as a whole and not individual agencies or departments. For the FY17grant fund which is \$97,000.00 is now complete.

The FY18 and FY19 Grants were discussed as well.

New Business- Drew Nichols will now be representing the Muskegon County Road Commission.

Other Business- The new schedule is posted for the 2021 meetings. Zoom Meetings will be in place through July maybe longer. The start time for these meetings is 10:30 a.m.

Those meetings are:

Tuesday, January 12, 2021

Tuesday, April 13, 2021

Tuesday, July 13, 2021

Tuesday, October 12, 2021

Comments- No comments

Adjournment- Rich adjourned the meeting at 11:45 a.m.

LOCAL EMERGENCY PLANNING COMMITTEE MEETING
Tuesday, April 12, 2022
10:30 AM
Emergency Operations Center
Or

AGENDA

- I. Attendance & Call to Order
- II. Approval of Minutes of previous meeting
- III. Additions to the Agenda
- IV. Status Report (Chairman)
- V. Standing Committee Reports
 - A. Planning – Site Plans
 - B. Emergency Management – Hazard Mitigation Plan update
 - C. HAZMAT – Anthony Gutierrez
 - E. Training Fire Dept. – Chief Dean
- VI Presentations - None
- VII. Other Business –
- VIII. Comments (Public/members)
- IX. Adjournment

AMERICAN DISABILITY ACT POLICY:

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Michael E. Kobza Hall of Justice
Fourth Floor 990 Terrace Street.
Muskegon, MI 49442
Phone: (231) 724-6520.

**If you are unable to attend please call 724-6341
Next LEPC meeting is scheduled for July 12, 2022, 10:30 A.M.
Emergency Operations Center**

Member/Group Represented

**Jim Duram/EMD (MCRACES)
Jim Norton/EMD (MCRACES)
Rhona Colbert/CERT/MRC
/Elected Official
Susie Hughes/Elected Official
Chris May/Facility Operator (Webb Chemical)
Tom Finkler/Facility Operator (Webb Chemical)
/Facility Operator (Honeywell)
/Facility Operator (Honeywell)**

Chris Dean/Fire

**Tony Gutierrez/Hazmat
Chad Crook/EMS
Jonathon Degen/EMS
Jerry Evans/Health Organization
Dori Peters/Public Health
Chad Lawton/Health Organization
Dave Ogren/Hospital
Michael Poulin/Law (County)
Jeff Lewis/Law (Urban)
Roger Squires/Law (Rual)
Mike Eslick/Environmental Health
David Wierzbicki/DEQ**

LOCAL EMERGENCY PLANNING COMMITTEE MEETING
Tuesday, January 10, 2023
10:30 AM
Emergency Operations Center

AGENDA

- I. Attendance & Call to Order
- II. Approval of Minutes of previous meeting
- III. Additions to the Agenda – Chair resignation
- IV. Status Report (Chairman) – Officer
- V. Standing Committee Reports
 - A. Planning – Site Plans
 - B. Emergency Management – Hazard Mitigation Plan update, HEMP update
 - C. HAZMAT – Anthony Gutierrez
 - E. Training Fire Dept. – Chief Dean
- VI. Presentations - None
- VII. Other Business –
- VIII. Comments (Public/members)
- IX. Adjournment

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Mark Eisenbarth, Administrator

1903 Marquette Ave.
Muskegon, MI 49442

Phone: (231) 724-6520.

If you are unable to attend please call 724-6341
Next LEPC meeting is scheduled for April 11, 2023, 10:30 A.M.
Emergency Operations Center

Member/Group Represented

Jim Duram/EMD (MCRACES)
Jim Norton/EMD (MCRACES)
Rhona Colbert/CERT/MRC
/Elected Official
S/Elected Official
Chris May/Facility Operator (Webb Chemical)
Tom Finkler/Facility Operator (Webb Chemical)
/Facility Operator (Honeywell)
/Facility Operator (Honeywell)

Chris Dean/Fire

Tony Gutierrez/Hazmat
Chad Crook/EMS
Jonathon Degen/EMS
Jerry Evans/Health Organization
Dori Peters/Public Health
Chad Lawton/Health Organization
Dave Ogren/Hospital
Michael Poulin/Law (County)
Jeff Lewis/Law (Urban)
Roger Squires/Law (Rural)
Mike Eslick/Environmental Health
David Wierzbicki/DEQ

LOCAL EMERGENCY PLANNING COMMITTEE MEETING

Tuesday, July 12, 2022

MINUTES

PRESENT: Richard Warner, Emergency Manager; Bob Grabinski, Chair LEPC; Rhona Colbert, Citizen Corps; Orville Theaker, Michigan State Police Emergency Management; Rich Popisil, BASF(call in); Susie Hughes, Muskegon County Commissioner, Brandi Waldman, Senior Resources; Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT; Renee' Gavin, Newaygo County Emergency Management Deputy Director; Andy Rush, City of Muskegon Public Safety; James Norton, Muskegon County Emergency Communications Services MC RACES; Jim Wolffis, Muskegon County Emergency Communications Services MC RACES; Dori Peters, Public Health Muskegon; Tom Finkler, Webb Chemical; Chris May, Webb Chemical; Dave Wierzbecki, EGLE IMS, Dave Gloztbach, Muskegon Township Fire.

- I. **CALL TO ORDER:** Meeting was called to order at 10:30 am by Chairman Bob Grabinski
- II. **MINUTES APPROVAL OF PREVIOUS MEETING:** Motion- Susie Hughes Second- Rhona Colbert
- III. **ADDITIONS TO THE AGENDA:** None
- IV. **STATUS REPORT:** (Chairman) Bob Grabinski – A new fiscal year is beginning for many townships. The County's mitigation plan for the first time is completed with 100 percent participation.
- V. **STANDING COMMITTEE REPORTS**
 - A. **Site Plans:** Rich Warner Site Plans have been reviewed and sent into the State. Muskegon County submitted 47 plans to the State. The County will get paid \$35.00 per plan, depending on funding availability. No new plans to send in. Bob said a new chemical company has now moved into Muskegon County, taking over an existing facility with new hazardous materials. A site plan will have to be developed for this company.
 - B. **Emergency Manager:** Rich asked Renee' Gavin to give an update on the progress of the new Hazard Mitigation Plan for Muskegon County. Renee' is working on the different areas of the Hazard Mitigation Plan including the Hazardous Materials section. Renee' asked for the committee to help review the Hazard Materials section to satisfy the requirement of a public review. The committee reviewed the 23-page section which included the County's the incident reports. The data is based on past occurrences to help predict what may happen in the future. Renee' added the Muskegon County HAZMAT team to this section as they experienced some funding

support earlier in the year. The team is not only an essential part of Muskegon County but also covers outlying counties who do not have a Hazmat team.

In reviewing some of the facilities, Renee' asked the committee if they see any changes to the names of businesses to send those corrections to her. Also reviewed were incidences in the County beginning in 1986. Rich said a special meeting will be held August 9th to review some of the sections of this plan. A notice will be sent out to the committee. Rich stated the County has purchased Baker College and all County departments will be combined under one roof.

- C. HAZMAT:** Chris Dean reported the Hazmat team is doing annual training with Muskegon Fire Department to get them familiar with the equipment that HAZMAT uses. This training is specifically with Decontamination. If HAZMAT is deployed the fire departments become the backup, setting up the standardized Decom system so the HAZMAT team can go right into specialty mode and make entry. This training is also provided to the Fire Academy recruits as well. Level suit training will be coming up.

- D. TRAINING Fire Department:** Chris Dean said the Fire Academy was completed in June. They are getting ready for the next year of recruits. Chad Lawton said the training is offering Medical First Responder training to the recruits. They are working with Mason County to provide this training.

- E. PRESENTATION: None**

- F. OTHER BUSINESS:** No new business. Orville stated there was a software program to HAZMAT but determined it was not needed.

VI. COMMENTS: (Public Members)

- VII. ADJOURNMENTS:** Motion –
Susie Hughes, Second- .Rhona Colbert Supported.
Meeting was adjourned at 10:53 am

LOCAL EMERGENCY PLANNING COMMITTEE MEETING
Tuesday, August 9, 2022
10:30 AM
Emergency Operations Center

AGENDA

- I. Attendance & Call to Order
- II. Approval of Minutes of previous meeting – N/A
- III. Additions to the Agenda
- IV. Status Report (Chairman) – N/A
- V. Standing Committee Reports
 - A. Planning – Site Plans - N/A
 - B. Emergency Management – Hazard Mitigation Plan update
 - C. HAZMAT – Anthony Gutierrez
 - E. Training Fire Dept. – Chief Dean – N/A
- VI. Presentations - None
- VII. Other Business – None
- VIII. Comments (Public/members)
- IX. Adjournment

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Michael E. Kobza Hall of Justice
Fourth Floor 990 Terrace Street.
Muskegon, MI 49442
Phone: (231) 724-6520.

**If you are unable to attend please call 724-6341
Next LEPC meeting is scheduled for TBD, 10:30 A.M.
Emergency Operations Center**

Member/Group Represented

**Jim Duram/EMD (MCRACES)
Jim Norton/EMD (MCRACES)
Rhona Colbert/CERT/MRC
/Elected Official
Susie Hughes/Elected Official
Chris May/Facility Operator (Webb Chemical)
Tom Finkler/Facility Operator (Webb Chemical)
/Facility Operator (Honeywell)
/Facility Operator (Honeywell)**

Chris Dean/Fire

**Tony Gutierrez/Hazmat
Chad Crook/EMS
Jonathon Degen/EMS
Jerry Evans/Health Organization
Dori Peters/Public Health
Chad Lawton/Health Organization
Dave Ogren/Hospital
Michael Poulin/Law (County)
Jeff Lewis/Law (Urban)
Roger Squires/Law (Rual)
Mike Eslick/Environmental Health
David Wierzbicki/DEQ**

**2023 MEETING SCHEDULE
LOCAL EMERGENCY PLANNING COMMITTEE (LEPC)
COMMUNITY RIGHT TO KNOW**

Tuesday, January 10, 2023

Tuesday, April 11, 2023

Tuesday, July 11, 2023

Tuesday, October 10, 2023

NOTE: All meetings start at 10:30 a.m. at the Emergency Operations Center, 1611 Oak, unless otherwise noted.

PUBLIC IS INVITED TO ATTEND

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Mark Eisenbarth, County Administrator

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Muskegon, MI, 49442
231-724-6505**

**Muskegon County Emergency Management
1611 Oak Street
Muskegon, MI, 49442
231-724-6341**

LOCAL EMERGENCY PLANNING COMMITTEE MEETING

Tuesday, January 10, 2023

MINUTES

PRESENT: Richard Warner, Emergency Manager, Acting Chair LEPC; Rhona Colbert, Citizen Corps; Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT; Renee' Gavin, Newaygo County Emergency Management Deputy Director; Dori Peters, Public Health Muskegon; Tom Finkler, Webb Chemical; Dave Wierzbecki, EGLE IMS, Dave Gloztbach, Muskegon Township Fire; Matthew Farrar, Muskegon County Administration; Tom VanBrugan, Muskegon County, Muskegon County GIS Administrator; Jason Wolford, Executive Director MCD 9-1-1.

- I. **CALL TO ORDER:** Meeting was called to order at 10:30 am by (Acting Chairman) Richard Warner
- II. **MINUTES APPROVAL OF PREVIOUS MEETING:** Motion- Chris Dean, Second - Dori Peters
- III. **ADDITIONS TO THE AGENDA:** Bob Grabinski resigned in a letter as the LEPC Chairperson. Richard Warner will become the interim chair until there is a quorum.
- IV. **STATUS REPORT:** (Active Chairman) Richard Warner – Election of some officers will be coming up. Chad Lawton is currently Vice Chair and Rhona Colbert is Secretary. Richard is thinking about pairing down the list of representatives as attendance has been dismal even prior to COVID.
- V. **STANDING COMMITTEE REPORTS**
 - A. **Site Plans:** No new site plans to report
 - B. **Emergency Manager:** Richard Warner -The HEMP operational grant was submitted along with all the supporting documents for \$1410 monies used for LEPC and HAZMAT was denied. Since this operational funding was denied, Richard reached out to the State and asked for funding for HAZMAT training and was approved. Richard turned the floor over to Renee Gavin who is currently contracted to update Muskegon County's Hazards Mitigation site plans. The site plan has to be completed which has an April 19, 2023 in order for the new requirements not to be added to the mitigation process. The deadline for the Plan is December 2023. The Hazard Mitigation Site Plan gets revised every 5 years from the date the last one was submitted. Renee is asking for more meetings to engage the public for information and opinions.

C. HAZMAT: Nothing new to report.

D. TRAINING Fire Department: Nothing new to report

E. PRESENTATION: None

F. OTHER BUSINESS: No new business.

VI. COMMENTS: (Public Members)

VII. ADJOURNMENTS: Motion –Chris Dean, Second – Dori Peters

Meeting was adjourned at 11:00 am

LOCAL EMERGENCY PLANNING COMMITTEE MEETING

April 17, 2023

MINUTES

PRESENT: Richard Warner, Emergency Manager, Acting Chair LEPC; Rhona Colbert, Citizen Corps; Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT; Renee' Gavin, Newaygo County Emergency Management Deputy Director; Dori Peters, Public Health Muskegon; Tom Finkler, Webb Chemical; Dave Gloztbach, Muskegon Township Fire; Matthew Farrar, Muskegon County Administration; Tom VanBrugan, Muskegon County, Muskegon County GIS Administrator; Jason Wolford, Executive Director MCD 9-1-1, Jim Norton, Muskegon County RACES.

- I. **CALL TO ORDER:** Meeting was called to order at 10:03 am by (Acting Chairman) Richard Warner
- II. **MINUTES APPROVAL OF PREVIOUS MEETING:** Motion- Chris Dean, Second - Jason Wolford
- III. **ADDITIONS TO THE AGENDA:** Election of LEPC chair (Moved to May meeting)
- IV. **STATUS REPORT:** (Active Chairman) Richard Warner –Chad Lawton is currently Vice Chair and Rhona Colbert is Secretary. Committee membership is being reviewed.
- V. **STANDING COMMITTEE REPORTS**
 - A. **Site Plans:** No new site plans to report
 - B. **Emergency Manager:** Richard Warner - Richard turned the floor over to Renee Gavin who is currently contracted to update Muskegon County's Hazards Mitigation site plans. Renee is asking for more meetings to engage public input for information and opinions. See below (Other Business) for LEPC meeting dates. This site's Hazard Mitigation Plan must be reviewed and updated every 5 years from the date the last plan was submitted to FEMA. Reimbursement funding for any disaster from FEMA is dependent on this plan. In the plan the county's vulnerabilities are addressed in case of a declaration of disaster and the resources available to the county in case of said disaster. A requirement is for all cities, townships, villages, fire, law enforcement, within those areas to adopt this plan as they are the public stakeholders. Those that do not adopt this plan will not be eligible for reimbursement. The following are points of the presentation Renee is currently working on:
 - A review of the history of Muskegon County the physical and social profile for cities, townships, and municipalities.

- Transportation – what is current regarding mass transit plus mass casualty events that have occurred in the county. Trains, airports, public busing, ferries, and ships. How many ports are available.
- Weather - review history of weather-related incidents- tornados, derechos, ice storms, straight line winds and thunderstorms.
- Geography - the contour of the map where Muskegon County can determine the degree of damage from thunderstorms, hail, etc, Forest lands, walking trails, agriculture, and historical sites are in the plan also.
- Water resources- lakes and rivers within the county are considered.
- Parks and Campgrounds – how many vulnerabilities are addressed.
- Land Use- Housing Data, manufacturing (over100 employees), agricultural, nursing homes and assisted living centers, plus shortages of housing is included.
- Population Status – population per jurisdiction is needed. Language, physical disabilities and can be identified.
- Business infrastructure – Location and per employee amount of over 100 employees.
- HAZMAT – how many chemical companies and chemical transportation is of importance.

C. HAZMAT: Nothing new to report.

D. TRAINING Fire Department: Nothing new to report

E. PRESENTATION: see above

F. OTHER BUSINESS: Schedule of times for meetings: 10:00 am start time

June 13,2023

July 11, 2023

August 8,2023

September 12, 2023

October 10, 2023

December 12, 2023

VI. COMMENTS: NONE

VII. ADJOURNMENTS: Motion –Chris Dean, Second – Rhona Colbert

Meeting was adjourned at 11:15 am

LOCAL EMERGENCY PLANNING COMMITTEE

Hazard Mitigation Monthly Meeting

August 08, 2023

MINUTES

Time: 10:00 am

PRESENT: Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT, LEPC Chair; Rhona Colbert, Muskegon County Citizen Corps; Renee' Gavin, Muskegon County Emergency Services Manager; Mike Eslick, Public Health Muskegon County; Dori Peters, Coordinator Public Health Muskegon County; Scott Sinclair, Lieutenant - Muskegon Heights; James Duram, Muskegon County MCEMD; Dave Wierzbicki, EGLE; Matt Farrar, Muskegon County Deputy Administrator; Thomas VanBruggen, GIS Administrator; Roger Squires, Whitehall Police Chief; Joseph Knop; Blue Lake Township Fire Chief; Arnold Erb, Whitehall Township Supervisor; Sara Cooper, Muskegon County Admin.; Joe Kinnucan, Deputy Chief – Norton Shores Fire Department.

- I. **ATTENDANCE & CALL TO ORDER:** LEPC Chair - Christopher Dean called the meeting to order at 10:05 a.m.
- II. **MINUTES APPROVAL OF PREVIOUS MEETING:** Motion - Dori Peters, Second – Joe Kinnucan.
- III. **STATUS REPORT –** Christopher Dean introduced Renee' Gavin as the new Muskegon County Emergency Manager.
- IV. **HAZMAT REPORT STATUS REPORT:** Christopher indicated that there was a Regional Hazmat meeting in Grand Rapids and was unable to attend but Renee' attended and gave a report that the meeting attendees talked about trainings and the incident of the plane crash at Hardy Pond.

V. EMERGENCY PLAN UPDATE/ PRESENTATION: RENEE GAVIN

In July's meeting we discussed what methodology was used. Based on criteria the Evaluation Criteria set by FEMA all criteria Nationwide is gathered the same and scored based on the following areas: Historical Occurrences, Affected Areas, Speed of Onset, Casualty Effects, Economic Effects, Duration, Seasonal Patterns, Predictability, Collateral Damage, and Availability of Warnings. Renee went through in detail the Evaluation Criteria and explained the significance and how it is used to help grade and rank each of the hazards Muskegon County and its municipalities experiences. In July, the group in attendance helped to rank Muskegon County's hazards. Renee' then added up how we ranked each of the criteria above. Renee' also mentioned based on the numbers scored the top three rankings are: Public Health, Infrastructure Failure, and Criminal Activity. The other rankings in order are Thunderstorms, MCI or Transportation Accidents, Fires, HAZMAT, Hazardous Weather, Flooding or Dam Failure, Wildfire, and Drought. After the survey is completed and returned from each municipality the final ranking portion of this plan can be completed.

VI. OTHER BUSINESS: None

VII. COMMENTS: (PUBLIC/MEMBERS) None

VIII. ADJOURNMENTS: Motion – Chief Squires, Second – Jim Duram

Meeting was adjourned at 11:49 am

LOCAL EMERGENCY PLANNING COMMITTEE

Hazard Mitigation Monthly Meeting

September 12, 2023

MINUTES

Time: 10:00 am

PRESENT: Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT, LEPC Chair; Rhona Colbert, Muskegon County Citizen Corps; Renee' Gavin, Muskegon County Emergency Services Manager; Dori Peters, Coordinator Public Health Muskegon County; Chad Lawton, Muskegon County Med Control Authority; Dave Wierzbicki, EGLE; Matt Farrar, Muskegon County Deputy Administrator; Roger Squires, Whitehall Police Chief; Chris May, Webb Chemical; Jason Wolford, 911 Central Dispatch; Honeywell. Bob Grabinski, Muskegon Twp Representative.

ATTENDANCE & CALL TO ORDER: LEPC Chair - Christopher Dean called the meeting to order at 10:08 a.m. Roll call completed.

- I. **MINUTES APPROVAL OF PREVIOUS MEETING:** Motion - Chief Squires, Second – Jason Wolford.
- II. **STATUS REPORT/ CHAIRPERSON REPORT –** Christopher Dean introduced Renee'. Renee' is wrapping up the Hazard Mitigation Plan to send off to the State and Federal government for approval. There is 4 Goals and objectives under the 4 Goals that needed to be completed and the group helped Renee' review those Goals and Objectives.
- III. **HAZMAT REPORT STATUS REPORT:** Christopher indicated that there is an upcoming exercise with Webb Chemical with be hosting. A couple of other HAZMAT teams will participate to. This will take
- IV. **EMERGENCY PLAN UPDATE/ PRESENTATION: RENEE GAVIN* Refer to Status Report Above.**
The purpose of this meeting is to go over and discuss the Goals and Objectives of the Hazard Mitigation Plan
- V. **OTHER BUSINESS:** None
- VI. **COMMENTS: (PUBLIC/MEMBERS)** Comment: Renee noted updated information
- VII. **ADJOURNMENTS:** Motion – Chad Lawton, Second – Dori Peters
Meeting was adjourned at 11:49 am

Local Emergency Planning Committee Meeting
Tuesday, December 12, 2023
10:00am
Muskegon County Marquette Campus – Board Room/Auditorium
1903 Marquette Avenue, Muskegon, MI 49442

Call to Order

The meeting was called to order at 10:00am by Renee Gavin, Muskegon County Emergency Management Services Manager.

Roll Call

Present: Andy Garceau, Honeywell Facility Operator
Chad Lawton, Health Organization
Chris May, Webb Chemical Facility Operator
Dave Wierzbicki, EGLE
Dori Peters, Coordinator Public Health Muskegon County
Jason Wolford, MCD 9-1-1
Mike Eslick, Public Health Muskegon County
Renee' Gavin, Muskegon County Emergency Services Manager
Roger Squires, Rural Law – Whitehall Police Chief, LEPC Vice-Chair

Excused: Arnold Erb, Whitehall Township Supervisor
Chad Crook, EMS
Charles Nash, Muskegon County Board of Commissioners Board Chair
Chris Dean, Muskegon Heights Fire Department Chief/HAZMAT, LEPC Chair
James Duram, Muskegon County MCEMD
Jerry Evans, Health Organization
Jim Norton
Joe Kinnucan, Deputy Chief – Norton Shores Fire Department
Jonathon Degen, EMS
Joseph Knop, Blue Lake Township Fire Chief
Rhona Colbert, Muskegon County Citizen Corps, LEPC Secretary
Scott Sinclair, Lieutenant - Muskegon Heights
Sheriff Michael Poulin, Muskegon County Sheriff's Department
Tim Kozal, Urban Law
Tom Finkler, Webb Chemical Facility Operator
Tony Gutierrez, Hazmat

Also Present: Lt. Orville Theaker, MSP
Ivy Wiltenburg, Muskegon County Chief Deputy Clerk
Matt Farrar, Muskegon County Administration Deputy Administrator
Sara Cooper, Muskegon County Administration CRC/EA
Thomas VanBruggen, Muskegon County GIS Administrator
Wade VandenBosch, Muskegon County Public Works Director

Approval of the Agenda

ACTION: Moved by Jason Wolford Second by Dori Peters

VOICE VOTE: Passed

Approval of Minutes

ACTION: Moved by Dori Peters, Second by Mike Eslick to postpone the approval the minutes of August 8, 2023 & September 2023

VOICE VOTE: Passed

Public Comment (on agenda item)

Status Report

Emergency Management: Hazard Mitigation Plan Update

Items for Consideration/New Business

LEPC23/12-01: Move to approve the proposed 2024 LEPC/LEPT Meeting Structure

ACTION: Moved by Jason Wolford, Second by Squires

VOICE VOTE: Passed

Unfinished Business

None

Public Comment

Increased terrorism attacks in the US

Mail Safety

2024 Membership List

Bylaws Update

Final Board Comment

None

Adjournment

The meeting was adjourned at 11:00am by Renee Gavin, Muskegon County Emergency Management Services Manager.

**2024 (LEPC)
MEETINGS SCHEDULE**

LEPC - LOCAL EMERGENCY PLANNING COMMITTEE

| | | |
|----------|---------|-----------|
| Tuesday, | Jan 9, | 10a-1045a |
| Tuesday, | Mar 12, | 10a-1045a |
| Tuesday, | May 14, | 10a-1045a |
| Tuesday, | Jul 9, | 10a-1045a |
| Tuesday, | Sep 10, | 10a-1045a |
| Tuesday, | Dec 10, | 10a-1045a |

NOTE:

Meetings are held in the Muskegon County Emergency Services Offices/EOC in J-Wing at the Muskegon County Complex (Formerly Baker College) 1903 Marquette Ave, J-Wing, Muskegon, MI 49442 unless otherwise noted. Please enter at door 38. LEPC Meetings start at 10:00am.

PUBLIC IS INVITED TO ATTEND

The County of Muskegon will provide necessary auxiliary aids and services, such as signers for the hearing impaired and audio tapes of printed materials being considered at the meeting, to individuals with disabilities who want to attend the meeting. Please give the County of Muskegon a 24-hour notice. Individuals with disabilities requiring auxiliary aids or services should contact the County of Muskegon by writing or calling the following:

Mark Eisenbarth, County Administrator

**1903 Marquette Ave.
Muskegon, MI, 49442
231-724-6505**

Muskegon County Emergency Management
1903 Marquette Ave. Suite J-101
Muskegon, MI, 49442
231-724-6341

LOCAL EMERGENCY PLANNING COMMITTEE MEETING
Tuesday, March 12, 2024
10:00 AM
Muskegon County Marquette Campus

Minutes

I. Attendance & Call to Order

Chair Dean called the meeting to order at 10:08 a.m.

Rich Pospisiil (CYTIVA), John Krohn (CYTIVA), Rona Colbert (Citizens Corps), Cheryl Mosher (TH EMS), Jason Wolford (Central Dispatch), Dorie Peters (MCPH), Tom VanBruggen (MCPW), Joe Knop (Blue Lake Fire Chief), Brad Walters (HazMAT), Chris May (Webb Chemical), Chad Lawton (MCMCA), Chris Dean (MH Fire Chief), and Dave Wierzbicki (EGLE)

II. **Action Item** Approval of Minutes of January 2024

M/S Lawton/ Wolford. Voice vote unanimous.

III. Additions to the Agenda

Chair accepted the agenda as presented.

IV. Status Report (Chairman)

Chair thanked all that contributed to the new bylaws. Also stated the new bylaws are in-line with state and federal rules and guidelines

V. Emergency Management: Hazard Mitigation Plan Update/Discussion/Action item

Renee reported the state is reviewing the HMP. Stated the state has changed its format to mirror the Federal rules.

Discussed the action items. The state would like to reduce the number of items to 5 or 8 with a target date of completion, which hazard it addresses, and in which municipality.

Discussion ensued on the priorities. Members will list their priorities and give them to Renee.

VI. HAZMAT

Brad Walter reported on the recent updates including the FTIR device and its replacement. The cost is estimated at \$48,000. Working to raise the funds. HAZMAT has a new Facebook page. The HAZMAT informational/promotional video was played and posted to Facebook.

VII. New Business

a. Review and discussion of LEPC Bylaws

Updated bylaws were reviewed. Recently changed to follow the Open Meetings act. Discussion ensued. Minor changes were suggested.

b. Action on bylaws/revise or vote to approve

- c. Discussion on Membership/Voting Members
- d. Action on voting members

Discussed adding a County Commissioner as a voting member.

- VIII. Other Business
- IX. Comments (Public/Members)
- X. Adjournment

Chair adjourned the meeting at 10:44 a.m.

AMERICAN DISABILITY ACT POLICY:

The County of Muskegon will provide necessary reasonable auxiliary aids and services, such as signers for the hearing impaired and, audiotapes of printed materials being considered at the meeting, to individuals with disabilities who want to attend the meeting, upon twenty-four (24) hour notice to the County of Muskegon. Individuals with disabilities requiring auxiliary aids or services should contact the County of Muskegon by writing or calling the following:

Mark Eisenbarth, Administrator
Muskegon County Marquette Campus- Auditorium/Board Room
1903 Marquette Avenue, Muskegon, MI 49442.
Phone: (231) 724-6520
If you are unable to attend please call (231) 724-6341

Next LEPC meeting Tuesday March 12, 2024

Muskegon County Marquette Campus
1903 Marquette Avenue, Muskegon, MI 49442
MC Emergency Services EOC J-Wing

Other LEPC meeting dates:

Proposed dates

Tuesday January 9, 2024 10a-1045a
Tuesday March 12, 2024 10a-1045a
Tuesday July 9, 2024 10a-1045a
Tuesday Sep 10, 2024 10a-1045a
Tuesday Dec 10, 10a- 1045a

Current Member/Group Represented

Jim Duram/EMD (MCRACES)
Jim Norton/EMD (MCRACES)
Rhona Colbert/CERT/MRC
Charles Nash/Elected Official
Chris May/Facility Operator (Webb Chemical)

Tom Finkler/Facility Operator (Webb Chemical)
Facility Operator (Honeywell)/
Facility Operator (Honeywell)
Jason Wolford (911)
Chris Dean/Fire
Tony Gutierrez/Hazmat
Chad Crook/EMS
Jonathon Degen/EMS
Jerry Evans/Health Organization
Dori Peters/Public Health
Chad Lawton/Health Organization
Dave Ogren/Hospital
Michael Poulin/Law (County)
Tim Kozal/Law (Urban)
Roger Squires/Law (Rural)
Mike Eslick/Environmental Health
David Wierzbicki/EGLE



Blue Lake Township

1491 OWASIPPE ROAD

TWIN LAKE, MICHIGAN 49457

PHONE: 231/894-6335

FAX: 231/893-3511

www.bluelaketownship.org

November 18, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Supervisor Melonie Arbogast
Blue Lake Township
1491 Owasippe Road
Twin Lake, MI 49457
supervisor@bluelaketownship.org
Phone: 231-894-6335 ext. 1



Village of Casnovia

141 N. Main St.

Casnovia, MI 49318

616-675-4780

November 17, 2021

Ms. Renee Gavin
Hazard Mitigation Planner
Newaygo County Emergency Services
306 S. North St.
P.O. Box 885
White Cloud, MI 49349

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Shelley Carr, Clerk
Village of Casnovia



Blue Lake Township

1491 OWASIPPE ROAD

TWIN LAKE, MICHIGAN 49457

PHONE: 231/894-6335

FAX: 231/893-3511

www.bluelaketownship.org

November 18, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

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Please keep us informed as to how we can assist you in these efforts.

Sincerely,

A handwritten signature in cursive script that reads "Melonie L. Arbogast". The signature is written in black ink and is located below the "Sincerely," text.

Supervisor Melonie Arbogast
Blue Lake Township
1491 Owasippe Road
Twin Lake, MI 49457
supervisor@bluelaketownship.org
Phone: 231-894-6335 ext. 1



Village of Casnovia

141 N. Main St.

Casnovia, MI 49318

616-675-4780

November 17, 2021

Ms. Renee Gavin
Hazard Mitigation Planner
Newaygo County Emergency Services
306 S. North St.
P.O. Box 885
White Cloud, MI 49349

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

A handwritten signature in cursive script that reads "Shelley Carr".

Shelley Carr, Clerk
Village of Casnovia



Casnovia Township Offices
245 South Canada Rd. / Casnovia, MI 49318

May 12, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud, MI 49349 esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Kelli Ashbaugh, Casnovia Township Supervisor
245 S Canada Road
Casnovia, MI 49318

November 17, 2021
INSERT TODAY'S DATE HERE

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Junda M Aerts, Supervisor

Clerk Stephanie Kuziak
Cedar Creek Township
6556 Sweeter Road
Twin Lake, MI 49457

DALTON TOWNSHIP



November 15, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Clerk Lori Hayes

Dalton Township
1616 E Riley Thompson Road
Muskegon, MI 49445

EGELSTON TOWNSHIP



April 28, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North St., P.O. Box 885
White Cloud, Mi. 49349
esdeputydirector@co.newaygo.mi.us

5428 E. APPLE AVE
MUSKEGON, MI 49442

Phone: 231-788-2308
Fax: 231-788-5248

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can in these efforts.

Sincerely,

A handwritten signature in black ink, appearing to read 'John Holter', is written over a horizontal line.

Supervisor John Holter
Egelston Township
5428 E. Apple Ave.
Muskegon, Mi. 49442



Fruitland Township
White River Light Station Museum

FRUITLAND TOWNSHIP

4545 Nestrom Road • Whitehall, Michigan 49461

P: (231) 766-3208 | F: (231) 766-3027

www.fruitlandtwp.org

11/23/21

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,


Clerk Breann Fagan
Fruitland Township
4545 Nestrom Road
Whitehall, MI 49461

Township Board:

Jeff Marcinkowski (Supervisor) | Breann Fagan (Clerk) | Deborah Pachman (Treasurer)

Trustees:

Lori Lundell | Marcia Jeske | Michael Holman | Vicki Graham



FRUITPORT CHARTER TOWNSHIP

5865 Airline Road
Fruitport, MI 49415

Andrea Anderson
Clerk

Telephone (231)865-3151
Fax (231)865-3118

January 14, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North St., PO Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts. Your contact person will be our Public Safety Director, Brian Michelli at Brian.Michelli@mcd911.net.

Sincerely,

Andrea Anderson

ESTABLISHED 1869



VILLAGE OF
FRUITPORT

December 21, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Ann LaCroix
Clerk/Treasurer
Fruitport Village
45 N. 2nd Avenue
Fruitport, MI 49415



P.O. BOX 328 6511 HOLTON WHITEHALL ROAD
HOLTON, MICHIGAN 49425

PH. (231) 821-2168

FAX: (231) 821-2293

June 16, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

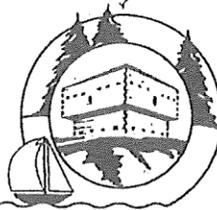
We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

A handwritten signature in cursive script that reads "Jill Coburn".

Clerk Jill Coburn
Holton Township
6511 Holton Whitehall Road
Holton, MI 49425-0328



LAKETON TOWNSHIP

February 11, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

RE: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

A handwritten signature in cursive script that reads "Kim M. Arter".

Kim M. Arter
Supervisor
Laketon Township
2735 W. Giles Rd.
Muskegon, mi 49445

**VILLAGE OF LAKEWOOD CLUB
6681 AUTOMOBILE RD.
TWIN LAKE, MI 49457
Phone (231) 894-9008
Fax (231) 893-8217
www.villageoflakewoodclub.org**

May 4, 2022

Hazard Mitigation Planner
Renee Gavin
Newaygo County Emergency Services
306 S. North St, PO Box 885
White Cloud, MMI 49349
esdeputydirector@co.newaygo.mi.us

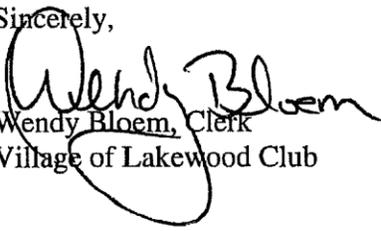
Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,


Wendy Bloem, Clerk
Village of Lakewood Club

February 7th, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

A handwritten signature in black ink, appearing to read 'Kelly Markley', with a long horizontal flourish extending to the right.

Deputy Clerk Kelly Markley
City of Montague
8778 Ferry Street
Montague, MI 49437



**Montague Township Hall
8915 Whitbeck Road
Montague, Michigan 49437
231-894-4414**

Jeff King, Supervisor
Drew Roesler, Clerk
Tracy Korthase, Treasurer
Jay Goodrich, Trustee
Jake Seaver, Trustee

Office Hours Tuesdays 10 – 4; Email tkorthase@montaguetownship.com; Website: montaguetownship.com

October 26, 2023

Hazard Mitigation Planner Renee Gavin
Muskegon County Emergency Services

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

A handwritten signature in cursive script that reads "Drew Roesler".

Drew Roesler, Clerk
8915 Whitbeck Road
Montague MI 49437

November 7, 2023

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,



Clerk Carrie Westbrook
Muskegon Charter Township
1990 Apple Ave
Muskegon, MI 49442

Affirmative Action
(231)724-6703
FAX (231)722-1214

essor/
lization Co.
(231)724-6386
FAX (231)724-1129

Cemetery/Forestry
(231)724-6783
FAX (231)724-4188

City Manager
(231)724-6724
FAX (231)722-1214

Clerk
(231)724-6705
FAX (231)724-4178

Comm. & Neigh.
Services
(231)724-6717
FAX (231)726-2501

Computer Info.
Technology
(231)724-4126
FAX (231)722-4301

Engineering
(231)724-6707
FAX (231)727-6904

Finance
(231)724-6713
FAX (231)726-2325

Fire Department
(231)724-6795
(231)724-6985

Human Resources
Co. (Civil Service)
(231)724-6442
FAX (231)724-6840

Income Tax
(231)724-6770
FAX (231)724-6768

Mayor's Office
(231)724-6701
FAX (231)722-1214

Planning/Zoning
(231)724-6702
FAX (231)724-6790

Police Department
(231)724-6750
FAX (231)722-5140

Public Works
(231)724-4100
FAX (231)722-4188

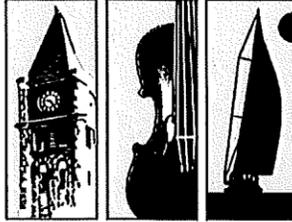
SafeBuilt
(Inspections)
(231)724-6715
FAX (231)728-4371

Treasurer
(231)724-6720
FAX (231)724-6768

er Billing
)724-6718
FAX (231)724-6768

Water Filtration
(231)724-4106
FAX (231)755-5290

MUSKEGON



West Michigan's Shoreline City
www.shorelinecity.com

March 3, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North Street, PO Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Clerk Ann Marie Meisch
Muskegon City
933 Terrace Street
Muskegon, MI 49443-0536



City of
MUSKEGON HEIGHTS

2724 Peck Street
Muskegon Heights, Michigan 49444

Phone (231) 733-8999
Fax (231) 733-5229

May 12, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North Street, PO. Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

RE: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,



Sharon Gibbs, City Clerk
Muskegon Heights
2724 Peck Street
Muskegon Heights, MI 49444

Moorland Township
12416 E. Apple Ave.
P.O. Box 368
Ravenna, MI 49451
(231) 853-2015

Moorlandtwp.com



Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North St., PO Box 885
White Cloud, MI 49349

May 12, 2022

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Thanks,



Rose Spoelman
Clerk, Moorland Township
clerk@moorlandtwp.com

RS/bv

TOWNSHIP BOARD

Dan Nutt, Supervisor; Rose Spoelman, Clerk; Sabra Guy, Treasurer; Anita Knapp, Trustee; Jake Tyers, Trustee



City of North Muskegon
1502 Ruddiman Drive
North Muskegon, MI 49445-3098
Phone: 231.744.1621 • Fax: 231.744.0367
www.northmuskegon.org

November 22, 2021

Renee Gavin, Hazard Mitigation Planner
Newaygo County Emergency Services
306 S. North St., PO Box 885
White Cloud, MI 49349

RE: Muskegon County Hazard Mitigation Plan

Ms. Gavin:

Please accept this letter as confirmation that the City of North Muskegon will participate in the planning and review process of the Muskegon County Hazard Mitigation Plan.

As of 2019, Ms. Clausen is no longer employed with the City. Please update our records:

City Manager Sam Janson
City Clerk Maria Boersma

Sincerely,

A handwritten signature in black ink, appearing to read "Sam Janson".

Sam Janson
City Manager

Cc: Richard Warner, Muskegon County Emergency Manager

November 19, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. The Norton Shores Fire Department would be happy to assist and participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,



Clerk Shelly Stibitz
Norton Shores City
4814 Henry Street
Norton Shores, MI 49441

ec: Bob Gagnon, Fire Chief

| | | | | | |
|---|--------------------------------------|-------------------------------------|-------------------------------------|------------------------------------|-----------------------------------|
| Administration/City Clerk (231) 798-4391 | Assessing Division (231) 799-6806 | Building Division (231) 799-6801 | Finance/Treasurer (231) 799-6805 | Fire Prevention (231) 799-6809 | Fire Department (231) 798-2255 |
| Parks/Recreation (231) 799-6802 | Planning/Zoning (231) 799-6800 | Police Department (231) 733-2691 | Public Works (231) 799-6803 | Streets Division (231) 798-2156 | Water/Sewer (231) 799-6804 |

Ravenna Township

3770 Blackmer Road
Ravenna, MI 49451

Phone: 231-853-6205
Fax: 231-853-5155

December 14, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S. North St, PO Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,



Penny Sherman
Ravenna Township Clerk

Village of Ravenna

12090 CROCKERY CREEK DRIVE • RAVENNA, MICHIGAN 49451 • TELEPHONE (231) 853-2360 • FAX (231) 853-6443

April 27th, 2022

Hazard Mitigation Planner Renee Gavin

Newaygo County Emergency Services

306 S North St. PO Box 885

White Cloud MI 49349

esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep up informed as to how we can assist you in these efforts.

Sincerely,



Clerk Emily Carrigan

12090 Crockery Creek Drive

Ravenna, MI 49451



City of Roosevelt Park
A Proud Community

March 7, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud, MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Clerk Ann Wisniewski

Roosevelt Park City
900 Oak Ridge Road
Roosevelt Park, MI 49441

November 30, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in updating the Muskegon County Hazard Mitigation Plan. We, at Sullivan Township, would be happy to assist and would like to participate in keeping our community resilient and safe.

Please keep us informed on how we can assist you in these efforts.

Thank You,



Elizabeth Spencer
Sullivan Township Clerk
8138 Hts Ravenna Rd
Ravenna, MI 49451

November 16, 2021

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,

Brenda Bourdon

Clerk Brenda Bourdon
Whitehall City
405 E Colby Street
Whitehall, MI 49461

Ph. 231.894.4048
Fx. 231.893.4708



WHITEHALL TOWNSHIP

7644 Durham Rd., Whitehall, MI 49461

Phone: 231-893-2095 Fax: 231-894-6660 Web: Whitehalltp.org

February 3, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Muskegon County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Management Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely

Arnold Erb
Supervisor

May 5, 2022

Hazard Mitigation Planner Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349
esdeputydirector@co.newaygo.mi.us

Re: Muskegon County Hazard Mitigation Plan

Dear Renee,

We are responding to your request for participation in the planning and review process to assist in the updating of the Muskegon County Hazard Mitigation Plan. We are happy to assist and would very much like to participate in keeping our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts.

Sincerely,



Clerk Patti Sargent
White River Township
7386 Post Road
Montague, MI 49437

MUSKEGON HAZARD MITIGATION PUBLIC PARTICIPATION/ACTION

| DATE | WHO | WHAT |
|------------|-----|---|
| 11/5/2021 | RG | Start working on Muskegon Plan/Go to Muskegon get badge/fob/copy of current plan/read through of plan mileage = 48 (home to 199 |
| 11/8/2021 | RG | Create Muskegon County Municipality Mailing list/draft letters/conversation w RW re letters |
| 11/8/2021 | RG | Start working on Community Profile |
| 11/13/2021 | RG | Create Structure plan parts |
| 11/15/2021 | RG | Finish letters/Get missing email addresses/print letters/stuff envelopes/CC RW |
| 11/15/2021 | RG | Mailed letters/sent out emails |
| 11/15/2021 | RW | IT has added the community profile to the Musk EM website. |
| 11/16/2021 | RG | Received letter of participation back from Whitehall City |
| 11/18/2021 | RG | Received letter of participation back from Norton Shores FD |
| 11/18/2021 | RG | Received letter of participation back from Dalton Township |
| 11/19/2021 | RG | Received letter of participation back from City of Montague |
| 11/22/2021 | RG | Received letter of participation back from Norton Shores |
| 11/22/2021 | RG | Received letter of participation back from Blue Lake Township |
| 11/23/2021 | RG | Received letter of participation back from the Village of Casnovia |
| 11/23/2021 | RG | Received letter of participation back from Laketon Township |
| 11/24/2021 | RG | Received letter of participation back from City of North Muskegon |
| 11/29/2021 | RG | Received letter of participation back from Whitehall Township 2nd letter on 2/3/22 |
| 11/29/2021 | RG | Received letter of participation back from Fruitland Township |
| 12/6/2021 | RG | Received letter of participation back from Sullivan Township |
| 12/6/2021 | RG | Created Databases of Fire/Police contacts (to contact for data collection) |
| 12/13/2021 | RG | Mailed letters to FD PDs 36 pages 24 envelopes seeking data on incidents |
| 12/15/2021 | RG | Working on plan parts/cover/etc/received data from Sobocinski/the last plan was adopted by these municipalities <ul style="list-style-type: none"> -County of Muskegon Fema approval letter -Blue Lake Township No Fema letter (unk why) -Fruitland Township Fema approval letter -Holton Township Fema approval letter fully approved -Laketon Township Fema approval letter fully approved -Vill Lakewood Club Fema approval letter fully approved -Whitehall Township Fema approval letter fully approved -White River Township Fema approval letter fully approved |
| 12/16/2021 | RG | Received letter of participation back from Ravenna Township |
| 12/21/2021 | RG | Received letter of participation back from Village of Fruitport |
| 12/21/2021 | RG | received data/info from Chief John Gale |
| 12/22/2021 | RG | Musk Haz mat section /data search online |
| 12/27/2021 | RG | Off due to holiday 12/27/21-1/2/22 |
| 1/3/2022 | RG | Work on Community Profile |
| 1/6/2022 | RG | Musk County history research/online/historical book |
| 1/6/2022 | RG | Call from Shelley Carr requesting presentation to board at upcoming meeting (aiming for March 14) discuss w RW Tues |
| 1/7/2022 | RG | Made appt to stop in Muskegon at for tues mirning at 9a before LEPT in Muskegon for info/community profile/photos Mileage = 48 |
| 1/7/2022 | RG | Request from RW for update on HAZ MIT Planning Progress/drafted and emailed to him |
| 1/11/2022 | RG | Attended LEPC meeting Haz Mit (intro RG) Mileage = 48 |
| 1/13/2022 | RG | Sent Celestial Impacts section to RW |
| 1/14/2022 | RG | Update on who has not yet responded to RW |
| 1/20/2022 | RG | Received participation letter from Fruitport Charter Township |
| 1/31/2022 | RG | Received participation letter from Cedar Creek Township |
| 2/2/2022 | RG | Picked up {articipation letter from MCEM office North Muskegon |
| 2/8/2022 | RG | Update RW and ME on participants and Non-Participants. |
| 2/8/2022 | RG | Conversations with Joseph Knop Blue lake/Steve Hammond Muskegon FD |
| 2/8/2022 | RG | Develop presentation For Casnovia Village for March 14. |
| 2/9/2022 | ME | Spoke to City mgrs of Muskegon, Roosevelt park and Muskegon Township super. They say they are all in. |
| 2/9/2022 | ME | ME Forwarded letters to Casnovia Township, Egelston Township, Holton Township (declined) + |
| 2/9/2022 | ME | Lakewood Club Village, Montague Township, Moorland Township, Muskegon Charter Township + |
| 2/9/2022 | ME | Muskegon City, Muskegon Heights, Ravenna Village, Roosevelt Park |
| 2/14/2022 | RG | Received participation letter from Laketon Township (again) |
| 2/14/2022 | RG | Received participation letter from City of Montague (again) |
| 2/26/2022 | RG | Zoom meeting with Mark Eisenbarth re: Holton township/etc |

2/18/2022 RG Received Requested Fire Department Data Dalton Township FD

2/18/2022 RG Received Requested Fire Department Data Blue Lake Township FD

2/18/2022 RG Received Requested Fire Department Data Muskegon Charter Township FD

2/18/2022 RG Received Requested Fire Department Data Muskegon FD

2/18/2022 RG Received Requested Fire Department Data White Lake FA

2/18/2022 RG Received Requested Fire Department Data Norton Shores FD

2/18/2022 RG Provided an update to Muskegon County re received data from above departments

2/18/2022 RG Sent ME and RW presentation for Casnovia Village

2/24/2022 RG Met with Muskegon Historian Ron Pesch re MCHMP Community Profile **Mileage = 48**

3/1/2022 RG Reached out to Charles Nash re Community Profile.

3/2/2022 RG contacted railways for Haz mat info (Jon Cool-> Charles Hunter) cc RW ME

3/3/2022 RG Continuing work on multiple plan sections

3/3/2022 RG Follow up with Muskegon Heights City Manager via email re participation letter

3/3/2022 RG Follow up with Muskegon City Manager via email re participation letter

3/3/2022 RG Follow up with Muskegon Charter Township via email re participation letter

3/3/2022 RG Follow up with Roosevelt Park via email re participation letter

3/3/2022 RG **Received participation Letter from City of Muskegon**

3/3/2022 RG Railways declined to give info -> Brenna Roos

3/8/2022 RG **Received participation Letter from City Roosevelt Park**

3/8/2022 RG Sent participation update to ME RW AW

3/8/2022 RG Discussion with RW re LEN and Police Chiefs mtg on 3-9-2022

3/9/2022 RG Update from RW on Police Chiefs meeting

3/14/2022 RG + RW Give preparedness and haz Mit educational presentation to Village of Casnovia Board meeting **Mileage = 36**

3/16/2022 RG R was Out of the office for a vacation 3/16-3/22

3/28/2022 RW Received some data from RW from Muskegon City police -> Incidents/went through and highlighted usable info will have to do a search on dates or other info

3/28/2022 RG Worked on transportation accidents annex

3/29/2022 RG Worked on transportation accidents annex (updated data in charts)

3/30/2022 RG Worked on transportation accidents annex/prep for update meeting with MS Admin/EM

3/30/2022 RG Follow up on casnovia questions from presentation (short email to Shelley Carr)

3/30/2022 RG Ask MC Admin/EM if I can do hazards analysis presentation at next LEPC mtg

3/30/2022 RG Virtual Update Meeting with ME/RW 2p

4/12/2022 RG RG Attend LEPC mtg at Muskegon EOC **Mileage = 48**

4/13/2022 RG Continue working on Annexes

4/21/2022 RG (Musk Haz Mit) Haz Mit Planning process webinar with Mike Sobocinski

4/26/2022 RG Email to Jennifer Hodges re participation letter.

4/26/2022 RG Updated this database with activities carried out by Mark Eisenbarth and Richard Warner

4/26/2022 RG Phone calls to municipalities re: need their participation letters

4/26/2022 RG **Casnovia Township/office closed/emailed copy of November request letter**

4/26/2022 RG **Egelston I called supervisor John Holter, talked with him. He says resend and he will take care of it.**

4/26/2022 RG **Village of Lakewood Club (office closed/sent email to Sikkenga and Bloem**

4/26/2022 RG **Montague Township emailed copy of November request letter**

4/26/2022 RG **Moorland Township emailed copy of November request letter**

4/26/2022 RG **Muskegon Township emailed copy of November request letter**

4/26/2022 RG **Muskegon heights emailed copy of November request letter**

4/26/2022 RG **Ravenna Village copy of November request letter**

4/26/2022 RG **White River Township copy of November request letter**

4/27/2022 RG **Received participation letter from Ravenna Village**

4/27/2022 RG MCHM Update meeting with ME & RW

4/28/2022 RG **Received participation Letter from Egelston**

5/4/2022 RG Finished Transportation annex

5/4/2022 RG Schedule update to ME RW (gone to conference next week)

5/4/2022 RG Discusiion with Robert Grabinski re getting on agenda for township board meeting to encourage participation from Holton Township

5/9/2022 RG **Received participation Letter from White River Township**

5/9/2022 RG Work on presentation for Holton Township Board

5/13/2022 RG **Received participation Letter from City of Muskegon Heights**

5/13/2022 RG Called Kelly Ashbaugh back from Casnovia Township re haz Mit participation letter

5/20/2022 RG **2 envelopes/6 pieces paper resend Montague letters via usps and email Plus postage**

5/21/2022 RG **Received participation Letter from Montague Township**

| | | |
|----------------|----|--|
| 6/1/2022 | RG | Work on Holton Township meeting handout/prep/discussion regarding angles/research |
| 6/6/2022 | RG | Work on Holton Township hazards |
| 6/7/2022 | RG | Holton Township hazards |
| 6/7/2022 | RG | Email to ME and RW requesting information/Email to IT Mark Hansen re community profile/survey posting on website |
| 6/7/2022 | RG | Print 10 copies (20 pages) of handout for Holton mtg |
| 6/9/2022 | RG | Worked on Community profiles of municipalities using census + data |
| 6/13/2022 | RG | Zoom meeting with Mark Hanson re: community profile on website etc. |
| 6/14/2022 | RG | Attended Holton Township Board Meeting and talked about importance of the plan and participation Mileage = 59 |
| 6/15/2022 | RG | Send copy of participation letter request to Holton Township secretary |
| 6/16/2022 | RG | Continuing work on Community profiles |
| 6/20/2022 | RG | Received Holton Township Participation Letter |
| 6/22/2022 | RG | Continuing work on Community profiles |
| 6/22/2022 | RG | Draft update for ME and RW fro 6/29/2022 update mtg |
| 6/27/2022 | RG | Continuing work on Community profiles |
| 6/27/2022 | RG | Update meeting with Mark Eisenbarth and Richard Warner 10a-1039/after mtg emailed docs and emailed Mark Hanson re: IT request |
| 7/12/2022 | RG | Extra scheduled LEPC mtg went over Celestial Impacts, Hazmat and Fires requested info Mileage = 48 |
| 8/23/2022 | RG | Updated sections (hazmat) with info from mtg |
| 8/24/2022 | RG | Draft update for ME and RW fro 8/31/2022 update mtg/sent |
| 8/26/2022 | RG | Printed Local Mitigation Planning handbook (2-sided) - 81 sheets of paper |
| 8/29/2022 | RG | Printed JUST RELEASED NEW Local MitigationPolicy guide (2-sided) - 40 sheets of paper |
| 8/29/2022 | RG | Review changes in requirements |
| 8/29/2022 | RG | Scheduled zoom mtg for tomorrow |
| 8/30/2022 | RG | MCHM update mtg/sent sections Cover/Comm profile/celestial impacts/hazmat/MCI |
| 9/1/2022 | RG | Wildfire data print 4 sheets of paper |
| 9/1/2022 | RG | Transportation accidents final tweaks |
| 9/2/2022 | RG | Started wildfire section |
| 9/6/2022 | RG | wildfire section |
| 9/14/2022 | RG | wildfire section/call to DNR Muskegon field office (no answer) |
| 9/14/2022 | RG | Conversation with Richard Warner re: Leo from city of Muskegon |
| 9/14/2022 | RG | Phone calls Leo Evans DPW director - City of Muskegon Re: move waterlines (future project) |
| 9/14/2022 | RG | Received information from Leo Evans via email re: above conversation |
| 9/14/2022 | RG | wildfire section |
| 9/15/2022 | RG | wildfire section |
| 9/20/2022 | RG | wildfire section |
| 9/21/2022 | RG | Trying to track down Community Wildfire protection plan for MC/get Jim Durham's tx |
| 9/21/2022 | RG | Was there one done by WMRSDC? Oceana and mason have one from 2015 |
| 9/22/2022 | RG | MCHM mtg 9a? Prep for mtg/finish up wildfires section today and tomorrow |
| 9/22/2022 | RG | Meeting to be rescheduled/emailed update and wildfire section |
| 9/22/2022 | RG | wildfire section |
| 9/23/2022 | RG | Looking for CWPP...MC does not have one |
| 10/3/-10/21/22 | RG | Renee out of town for trainings and conferences 10/3/22-10/21/22 |
| 10/25/2022 | RG | Working with Sara Cooper to schedule virtual mtgs for planning with admin |
| 11/7/2022 | RG | RW request to PD data at Chiefs mtg |
| 11/7/2022 | RG | MCHM mtg/shared new policy guide for planning/asked about old plan objectives and goals |
| 11/8/2022 | RG | MCHM mtg recap/request press release and publicizing/sent examples |
| 11/8/2022 | RG | Request for website tweaks from RW and IT...also request for draft press release, publicize old community profile from Mark Hansen |
| 11/8/2022 | RG | Request for PD district coverage map/request for info from PD's |
| 11/16/2022 | RG | request meeting with Richard Nash |
| 11/16/2022 | RG | Request for data from PD's |
| 11/16/2022 | RG | Request for meeting with Charles Nash |
| 11/23/2022 | RG | Received sig events info from Sheriff Poulin |
| 1/9/2023 | RG | Request for review and response and publicizing haz mit plan https://www.co.muskegon.mi.us/1773/Hazard-Mitigation-Plan |
| 1/9/2023 | RG | Work on presentation for LEPC in Musk provide an overview of the purpose, history function, and impacts of the Muskegon County Haz |
| 1/10/2023 | RG | LEPC mtg Muskegon Community Profile Mileage = 48 |
| 1/22/2023 | RG | Received sig events from John Gale/Norton Shores |
| 1/27/2023 | RG | Request info on large apt buildings (sent to PD's by RW) |
| 1/27/2023 | RG | Request for list of shelters in Muskegon county/request for public works yards, lift stations (CP) |
| 1/27/2023 | RG | Request congregate living facilities (also looked up on LARA (just needed confirm) |
| 1/30/2023 | RG | Received congregate Living facilities information |

| | | |
|----------------|----|---|
| 1/30/2023 | RG | Meeting with Rich Warner re MCHM |
| 2/1/2023 | RG | Received review of schools information |
| 2/4/2023 | RG | received 2022 data from fruitport FD |
| 3/2/2023 | RG | mtg Muskegon w RW/cancelled |
| 3/2/2023 | RG | emails from Leo Evans and Peter Wills re when will plan be done need to apply for grants |
| 3/8/2023 | RG | Printed 71 pages |
| 3/27/2023 | RG | MCHM update mtg with Musk Admin/virtual |
| 4/1/2023 | RG | Request/discussion re public participation requirements RW and ME |
| 4/5/2023 | RG | Request for list of employers over 100 employees to Cindy Larsen/received 4/7/2023 |
| 4/11/2023 | RG | LEPC mtg Muskegon rescheduled to 15th |
| 4/12/2023 | RG | Request FD data |
| 4/13/2023 | RG | Request info and review on Key Community facilities and Non-profits (community Profile) |
| 4/15/2023 | RG | LEPC mtg Muskegon Mileage = 48 |
| 4/15/2023 | RG | Presentation to LEPC due to lack of understanding re MCHM and the process |
| 4/19/2023 | RG | Request for publicizing of old community profile |
| 4/27/2023 | RG | MCHM update mtg with Musk Admin/virtual |
| 4/27/2023 | RG | Request for new county logo |
| 4/30/2023 | RG | Request for FD data |
| 5/2/2023 | RG | Request review from FD's regarding stations information (is it correct?) (Comm Profile) |
| 5/3/2023 | RG | Tom Verbruggen created new map for Dam failure for Muskegon County |
| 5/9/2023 | RG | Request review/corrections of contact info/addresses for FD's in Community profile |
| 5/9/2023 | RG | Requested NFPA reports from FD's |
| 5/9/2023 | RG | Confirm LEPC and after mtg |
| 5/9/2023 | RG | Received some Fruitport NFPA reports |
| 5/9/2023 | RG | Received 1 new MC Logo |
| 5/15/2023 | RG | LEPC mtg Muskegon Review Community Profile Mileage = 48 |
| 5/15/2023 | RG | Received info requested from Dori peters re Public Health section |
| 5/15/2023 | RG | Request for review and response and publicizing haz mit plan with press release and social media sharing |
| 5/16/2023 | RG | Received additional new MC Logos |
| 5/25/2023 | RG | MCHM update mtg |
| 6/13/2023 | RG | LEPC mtg Muskegon Mileage = 48 |
| 6/14/2023 | RG | Mark Hansen added Haz Mit plan survey to MC website |
| 6/22/2023 | RG | MCHM update mtg |
| 6/30-7/4 | RG | Off for the holiday |
| 7/5-7/10 | RG | Continue working on plan sections and Hazard rankings |
| 7/11/2023 | RG | LEPC mtg Muskegon went over Muskegon County hazard rankings document Mileage = 48 |
| 7/12/2023 | RG | Continue working on plan sections and Hazard rankings |
| 7/20/2023 | RG | Chris Dean -> Muskegon heights hazard rankings meeting |
| 7/20/2023 | RG | Alan Styles and Jeff Martin Zoom go over Dalton Township Hazard Rankings |
| 7/20-7/24/2023 | RG | Continue working on plan sections and Hazard rankings |
| 7/24/2023 | RG | Sent hazard rankings and letters to sara Cooper for distribution. |
| 7/25-7/26 | RG | Continue working on plan sections and Hazard rankings |
| 7/27/2023 | RG | MCHM update mtg |
| 8/1/2023 | RG | Continue working on plan sections and Hazard rankings |
| 8/8/2023 | RG | LEPC mtg Muskegon Mileage = 48 |
| 8/17/2023 | RG | Report requested from SOM...working on it |
| 8/18/2023 | RG | Report requested from SOM...working on it |
| 8/24/2023 | RG | MCHM update mtg |
| 10/17/2023 | AW | Incorporated information from Muskegon County Health Department in the Public Health Section of the Hazard Analysis |
| 10/30/2023 | AW | Updated information graphic on Hazard Rankings |
| 11/3/2023 | AW | Incorporated information from Muskegon County Administration in the plan implementation section |
| 11/7/2023 | AW | Incorporated feedback from Muskegon Township in the community profile and missing participation letters from the municipalities |