NEWAYGO COUNTY

HAZARD MANAGEMENT PLAN

2020 - 2025

DATE

To Whom It May Concern,

Attached is the Newaygo County Hazard Management Plan, which combines the Newaygo County Hazard Analysis with the Newaygo County Hazard Mitigation Plan. This document has been developed by Newaygo County Emergency Services Department and in conjunction with representatives from the State of Michigan, local governments, involved public safety agencies, affected businesses, and interested members of the public. The plan provides the process for evaluation land use and development in Newaygo County from a hazard mitigation perspective, which will protect lives and property in the community. This correspondence serves notice that it is my expectation that all future development decisions in Newaygo County will consider hazard vulnerability reduction as a standard business practice. The intent of the hazard analysis and mitigation plan is not to limit development, but to ensure that all development avoids the possibility for damage from natural, technological, and man-made hazards to the extent practicable.

Questions and concerns related to content and use of this document should be directed to the Newaygo County Emergency Services Department.

Sincerely,

Abigail B. Watkins, Director
Newaygo County Emergency Services

INTRODUCTION

Newaygo 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.

This document was originally developed in 2006 from local information suggested according to Michigan State Police – Emergency Management and Homeland Security Division Pub 201A Hazard Analysis Guidance Tool and formatted to a similar manner utilized by Newaygo County Emergency Service's Local Hazard Analysis for Newaygo County.

In addition, modifications to the document have been made to satisfy Section 104 of the Disaster Mitigation Act of 2000 (42 USC 5165), which states that local governments applying for pre- and post-disaster mitigation funds must have approved local mitigation plans. Pursuant to these requirements, this document received FEMA approval in 2008 and in 2015. Following adoption of the document on the county level, five townships in Newaygo County were successful in adopting it at the local level as well.

Questions and comments concerning this document should be addressed to the Newaygo County Emergency Services Department, 306 S North Street, PO Box 885, White Cloud MI 49349, telephone number (231) 689-7354. The office is the coordinating agency for all emergency management activities in Newaygo County, and is responsible for continually monitoring and updating the Newaygo County Emergency Action Guidelines and directing numerous other disaster related activities. These responsibilities are done in conjunction with the Local Emergency Planning Team and its Hazard Mitigation Subcommittee.

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, Newaygo 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 Newaygo County remains a vibrant, safe, enjoyable place in which to live, raise a family, and conduct business.

Target Area

The Newaygo County Hazard Management 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

Newaygo County were invited to participate in the plan development at numerous points throughout the planning process. There are four cities, one village, and twenty-four townships in Newaygo County:

Cities

Fremont	Grant	Newaygo	White Cloud

Villages

Hesperia

Townships

Ashland	Croton	Goodwell	Monroe
Barton	Dayton	Grant	Norwich
Beaver	Denver	Home	Sheridan
Big Prairie	Ensley	Lilley	Sherman
Bridgeton	Everett	Lincoln	Troy
Brooks	Garfield	Merrill	Wilcox

Plan Background

This plan was developed pursuant to the Hazard Mitigation Act of 2000 and was partially funded under pre-disaster mitigation funds under the Hazard Mitigation Program Grant. In 2004, Newaygo County began the Hazard Mitigation Planning Process by contracting with West Michigan Shoreline Regional Development Commission (WMSRDC) to collaborate with Newaygo County Emergency Services, the Newaygo County Local Emergency Planning Team (LEPT), and an ad hoc steering committee in the development of the Hazard Mitigation Plan.

Emergency Services provided on-going guidance and assistance in the plan development, with local input from the ad hoc steering committee. Additional input was provided though a mail survey sent in March 2004 to 143 individuals and agencies affiliated with Newaygo County. The survey mailing reached a broad spectrum of local, county, regional, and state officials, such as county departments, the county board, regional commissioners, county road commissioners, county and local planning commissioners, local zoning officials, city mayors and managers, township supervisors, law enforcement, fire chiefs, public works, school superintendents, social service agencies, and chambers of commerce.

The survey responses were helpful in identifying hazards, vulnerable areas, and potentially hazardous situations within the county. For example, survey responses identified underground natural gas storage fields in Goodwell Township; conveyed concern for a lack of emergency resources in the county (just four ambulances for entire county); and identified the Merrill Township railroad chemical spill that occurred in 1979. Feedback from this survey guided the establishment of goals and objectives, the recommendation of activities, and the prioritization of actions contained within this plan.

In 2006, a final draft plan was developed by WMSRDC and submitted to the Federal Emergency Management Agency (FEMA) for preliminary approval. Final approval by FEMA is contingent on formal adoption of the jurisdiction encompassed by a plan, which in this case was Newaygo County. After review of the Hazard Mitigation Plan by the Newaygo County Board of Commissioners, it was

determined not to formally adopt the original plan submitted by West Michigan Shoreline Regional Development Commission due to concern the plan did not fully meet the needs of Newaygo County.

In 2007, Newaygo County Emergency Services Department worked with the Newaygo County Local Emergency Planning Team, which meets on a month basis, to develop a revision of the original Hazard Mitigation Draft to meet the needs of Newaygo County. The Newaygo County LEPT is the permanent Emergency Management advisory body serving the functions of the Homeland Security Local Planning Team (LPT), SARA Title III Hazardous Materials Local Emergency Planning Committee (LEPC), Hazard Mitigation Council, and Citizen Corps Council to provide a forum for representatives of local government, private businesses, and public organizations to participate in community emergency planning and preparedness activities. Representatives of the committee include Newaygo County Board of Commissioners, Newaygo County Administration, Newaygo County Emergency Services, City and Township Representatives, Newaygo County Central Dispatch, Newaygo County Sheriff's Department, Newaygo County Police Chiefs Association, Newaygo County Fire Chiefs Association, Newaygo County Medical Control Authority, Private EMS companies, District 10 Public Health Department, Newaygo County Road Commission, Newaygo County Community Mental Health, Newaygo County Department of Human Services, Newaygo County Commission on Aging, American Red Cross, Newaygo County Regional Educational Services Agency, and private companies including Gerber Products, AT&T, Consumer's Energy, etc.

In 2008, the plan was adopted by the Newaygo County Board of Commissioners and then received FEMA final approval on June 30, 2008. After that, the townships of Ashland, Barton, Bridgeton, Garfield, and Goodwell were the only municipalities in the county to successfully adopt the plan. Newaygo County Emergency Services made further updates to the plan, resulting in the 2009 Edition.

2015 Plan Update

The intent of this plan revision was to work with those familiar with Newaygo County to describe the County, and to identify a clear process for minimizing the effects of natural disasters (weather, forest fires, etc.) or emergencies related to the County's built environment (transportation, structural fires, etc.).

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." In 2011, Oceana County was awarded a grant to update the FEMA-approved hazard mitigation plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. The West Michigan Shoreline Regional Development Commission (WMSRDC) was hired to work with each county to perform the updates and facilitate local adoptions of the plans.

This edition of the Newaygo County Hazard Management Plan was created through cooperation and coordination between Newaygo County Emergency Services and WMSRDC. Newaygo County assumed responsibility for performing the hazard analysis, which included creation of a community profile and the identification and evaluation of hazards within the county. WMSRDC 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, Newaygo County Emergency Services and WMSRDC 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 2020.

2020 Plan Update

Again, the intent of this plan revision was to work with those familiar with Newaygo County to describe the County, and to identify a clear process for minimizing the effects of natural disasters (weather, forest fires, etc.) or emergencies related to the County's built environment (transportation, structural fires, etc.).

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." In 2019, Newaygo County was awarded a Pre-Disaster Mitigation Grant to update the FEMA-approved hazard mitigation plans for Newaygo County and all municipalities within Newaygo County. All planning efforts for plan updates and facilitation of local adoptions of the plan was managed by Newaygo County Emergency Services.

This edition of the Newaygo County Hazard Management Plan was created through cooperation and coordination between Newaygo County Emergency Services and the Newaygo County Local Emergency Planning Team. Newaygo County 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 County 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, Newaygo County Emergency Services and the Local Emergency Planning Team 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 2025.

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PLANNING PROCESS

This section chronicles the steps that were taken to update the Newaygo 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; and
- 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 Newaygo County. Out of thirty jurisdictions (including Newaygo County), just five chose not to submit a letter.

The chart on the following page shows the hazard mitigation participation "status" of each local jurisdiction in Newaygo 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.

Newaygo County Hazard Mitigation Plan Jurisdiction Participation								
Jurisdiction	**2006 Hazard Mitigation Plan Participant***	**Adopted 2007 Newaygo Co Hazard Management Plan****	**2011 Letter to Participate**	**2015 Hazard Plan Update Participant**	**Adopted 2015 Newaygo Co Hazard Management Plan**	**2019 Letter to Participate**	**Participant Status**	**Adopted 2020 Newaygo Co Hazard Management Plan**
Newaygo Co.	✓	✓	✓	✓	✓	✓	Continuing	
Ashland Twp		✓				✓	New Participant	
Barton Twp		✓	✓			✓	Continuing	
Beaver Twp				✓		✓	New Participant	
Big Prairie Twp			✓	✓		✓	Continuing	
Bridgeton Twp	✓	✓	✓	✓		✓	Continuing	
Brooks Twp	✓		✓			✓	Pending	
Croton Twp			✓	✓		✓	Continuing	
Dayton Twp			✓			✓	Continuing	
Denver Twp			✓			✓	New Participant	
Ensley Twp			✓	✓		✓	Continuing	
Everett Twp						✓	New-Participant	
Fremont City			✓			✓	Continuing	
Garfield Twp		✓	✓			✓	Continuing	
Goodwell Twp	✓	✓	✓	✓		✓	Continuing	
Grant City			✓	✓		✓	Continuing	
Grant Twp	✓		✓			✓	New Participant	
Hesperia Village			✓			✓	New Participant	
Home Twp			✓			✓	Continuing	
Lilley Twp			✓			✓	New-Participant	
Lincoln Twp	✓		✓	✓		✓	Continuing	
Merrill Twp	✓					✓	New-Participant	
Monroe Twp			✓			✓	Continuing	
Newaygo City			✓	✓		✓	Continuing	
Norwich Twp			✓			✓	Continuing	
Sheridan Twp	✓			✓		✓	Continuing	
Sherman Twp	✓		✓	✓		✓	Continuing	
Troy Twp			✓			✓	New-Participant	
White Cloud City	✓		✓			✓	Continuing	
Wilcox Twp			✓			✓	New-Participant	

** Newaygo County Hazard Mitigation Plan (draft) met FEMA Disaster Mitigation Act requirements on 3/16/06*

*** Newaygo County Hazard Management Plan approved by FEMA on 6/30/08*

Step 2 – Establish an Advisory Team

At the outset of the planning process, Newaygo County Emergency Services assembled an Advisory Team to aid the process of reviewing and updating the Newaygo County Hazard Management Plan. This team consisted of the Local Emergency Planning Team (LEPT) Section Leaders. These individuals are assigned by the Chief Elected Official and the Emergency Services Director and have the responsibility for maintaining a functional component of the jurisdiction's emergency plan. Next to the CEO or Director, 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 LEPT emerged as the primary advisory body to the Plan Update. The LEPT includes representatives from the following agencies:

- Newaygo County Emergency Services Department
- Newaygo County Board of Commissioners
- Local Government Representative
- Newaygo County Administration
- Newaygo County Central Dispatch
- Newaygo County Equalization Department
- Newaygo County Sheriff's Office
- Newaygo County Police Chief's Association
- Michigan State Police Hart Post
- Newaygo County Fire Chief's Association
- Newaygo County Road Commission
- Spectrum Health Gerber Memorial Hospital
- Life EMS
- District 10 Public Health Department
- Newaygo County Community Mental Health
- Newaygo County MSU Extension Office
- Newaygo County Department of Human Services
- American Red Cross
- Newaygo County Commission on Aging
- Newaygo County Regional Educational Service Agency
- Newaygo County Citizen Corps
- Newaygo County Information Technology

Annex C includes documentation of the planning participants, such as: LEPT appointees (as of 2019); Advisory Team members; and attendance lists from LEPT 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 Newaygo County Emergency Services Department. Historical data was provided by various sources including township, cities, and County websites and master plans; the Michigan Historical Center Preservation Office; and the Newaygo County 2019 Directory compiled by the Newaygo County Clerk's Office. The Michigan Department of Environmental Quality, the Michigan Department of Natural Resources, the Newaygo County Parks and Recreation Master Plan of 2018, the Newaygo 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 Newaygo 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 2010 Census provided statistics for developing a social profile of Newaygo 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 LEPT for review on October 15, 2019. This section was also posted to the Newaygo County Website on November 1, 2019 for public comment and feedback.

Hazard Identification

Newaygo County Emergency Services reviewed the 2019 Michigan Hazard Analysis (MSP/EMHSD Publication 103) as a starting point for identifying the hazards in Newaygo County. The 2019 Michigan Hazard Mitigation Plan (MSP/EMHSD Publication 106) was also used in this research. Information from local Hazard Specific Plans including the Muskegon River Dams Failure and Flooding Evacuation Plan and Newaygo County Community Wildfire Protection Plan were utilized. 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. Newaygo 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 Environmental Quality. Professional evaluations were also used for specific hazard areas such as Public Health and Wildfires.

Community Input

The value of public involvement lies in sharing responsibility with those who will strongly influence the success or failure of the mitigation effort. Newaygo County has an established Local Emergency Planning Team (LEPT) which includes representatives from local government, private businesses, and public organizations. Monthly meetings consist of General and Activity meetings focused around Newaygo County Emergency Services Annual Activity Schedule. General sessions are utilized to summarize activities and progression to include both Emergency Management functions and Homeland Security functions, while Activity meetings focus on specific projects. All LEPT members, community officials, and the general public are invited to attend and participate in both General and Activity meetings. Meeting agendas are distributed to Local Emergency Planning Team members in advance and meeting minutes are distributed shortly after the meeting.

Newaygo County Emergency Services also regularly distributes Informational Letters detailing Emergency Management Activities within Newaygo County to numerous governmental and response agencies County-wide, including representatives from all of the cities, village, and townships in Newaygo County. In addition, the Emergency Services website contains a page dedicated to enhancing awareness of hazard management, hazard mitigation, and for providing public access to the Newaygo County Hazard Management Plan.

Stakeholder Involvement – Numerous attempts to engage the community were made during the update of this plan. An electronic survey was developed and posted to the Newaygo County Website in November 2019. 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 to community stakeholders was intended to raise awareness throughout the community of hazard management planning in Newaygo 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 Newaygo 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 Newaygo County Hazard Management Plan, and asked recipients to rank those hazards according to their own priorities. Although feedback obtained from this section was inherently subjective, it was useful for gauging community opinion and was taken into consideration when the hazard rating and rankings were revisited during this Plan Update.

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 Newaygo 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.

Attempts to obtain input from local stakeholders were made at other points in the Planning Process as well. These efforts provided information about hazard mitigation and invited individuals to participate in the Plan Update. The Newaygo County Local Emergency Planning Team is charged by the Newaygo County Board of Commissioners as being the Hazard Mitigation advisory body for Newaygo County. Key stakeholders appointed to this body met regularly throughout the planning process and provided guidance and input throughout. In addition, routine updates were provided to the Newaygo County Board of Commissioners throughout the planning process. Finally, letters of Participation and explanation of the planning process were sent on Monday, November 4, 2019 to all municipal governments within Newaygo County. Additional follow-up communications were sent to the municipal governments several times throughout the planning process. Detailed information and communications to stakeholders can be found in Annex C.

Public Engagement – The Newaygo County LEPT hosted a public meeting to discuss hazard mitigation at the beginning of the planning process at its September 19, 2019 meeting. The meeting featured a presentation about the hazard mitigation planning process. On November 19, 2019, a news article was posted in Near North Now publicly announcing the planning process and requesting public assistance with updating the Hazard management Plan. The public was invited to comment upon and discuss the survey that was distributed and made available on the County's website.

As LEPT meetings are open to the public, this body was used to obtain public engagement throughout the planning process. Meeting notices are posted with the Newaygo County Clerk and meeting invitations are emailed to the LEPT members and all local elected officials in Newaygo County. These communications invited recipients to review the Community Profile, Hazard Analysis, and Hazard Evaluation sections, which were posted on the Newaygo County Emergency Services website prior to the meetings. Invitees were offered an opportunity to comment on the drafted sections by attending the public meeting or by submitting written comments prior to the meeting. The meeting also featured a work session, whereas a proposed set of hazard mitigation action items were reviewed, discussed, and prioritized.

Lastly, the County's website, www.countyofnewaygo.gov, offered an opportunity for the public to become familiar with hazard mitigation and participate in the plan development. This website provided general information about hazard mitigation; offered a link to the latest approved edition of the county's Hazard Management Plan; and provided access to surveys and draft sections for public review.

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 Newaygo 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 Newaygo County Hazard Management Plan, hazards were evaluated by Newaygo County Hazard Management using same methodology that was used in the previous edition of this plan. This edition has also been updated to include a hazard evaluation for each local jurisdiction within Newaygo County (see Annex B).

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, Newaygo 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 Newaygo County LEPT 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 Newaygo 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, Newaygo County Local Emergency Planning Team 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 Newaygo 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.

Newaygo County Emergency Services in conjunction with the Newaygo County Local Emergency Planning Team 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 cost, available funding, and other considerations.

Step 7 – Select Feasible Mitigation Strategies

Newaygo County Emergency Services and the Newaygo County LEPT 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 Newaygo County LEPT 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

West Michigan Shoreline Regional Development Commission in conjunction with Newaygo County Emergency Services and the Newaygo County Local Emergency Planning Team 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 Newaygo County Board of Commissioners and recommended changes were made.

Step 9 – Prepare a Final Draft Plan

Based on necessary changes and recommendations by the Newaygo County Board of Commissioners, MSP-EMHSD and FEMA, a final draft plan was prepared and presented to the Newaygo 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 Newaygo 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.

Newaygo County Emergency Services Director will use the Hazard Management Plan as the Hazard Analysis and Hazard Mitigation Plan for Newaygo County. The Hazard Management Plan will be utilized to coordinate Hazard Mitigation programs across Newaygo County and guide decisions pertaining to Emergency Management Activities. Newaygo 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. The Plan focuses on the period between 2015 and 2020.

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 Newaygo County Emergency Services Department will monitor the implementation of the Hazard Management Plan and report annual progress of the plan to members of the Newaygo County Local Emergency Planning Team (LEPT). 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 LEPT knowledge, input would be obtained from comments submitted to the Emergency Services 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.

Newaygo County will comply with the FEMA requirement that the plan be reviewed every five years and updated if necessary. The Newaygo County Emergency Services Director is responsible for all updates with the assistance from the LEPT. 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 Services office and at all local government offices. The plan will also be made available to the public on the Emergency Services website. All comments will be directed to the Emergency Services Director 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, LEPT 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. Almost all communities in Newaygo County have adopted land use plans and regularly update them (the communities without plans include: Goodwell Township, Lincoln Township, and Troy Township). 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.

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NEWAYGO COUNTY COMMUNITY PROFILE

Newaygo County

Named after Chippewa Indian Chief Naw-wa-goo, who was a signer on the treaty of Saginaw in 1812, Newaygo County is located “in the heart of the Muskegon River Valley” in the west central part of Michigan’s Lower Peninsula. Newaygo County is composed largely of rural residential and national forest and is traversed by M-20, M-37, and M-82. According to the U.S. Census Bureau, the county has a total area of 861 square miles and is the 36th largest in the state. The county seat is located in White Cloud. With 234 natural lakes and 356 miles or rivers and streams, tourism, along with agriculture and manufacturing, are the primary drivers of the Newaygo County economy. The Muskegon River continues to be the main attraction for summer cottage residents and fishermen, who find it nearly the best source anywhere in Michigan for steelhead in the spring and salmon in the fall. Newaygo County offers many opportunities for hunting, fishing, camping, canoeing, and boasts an impressive recreational trail system contained within the Manistee National Forest.

Historical Overview

Establishment and Early Growth

Settlement of the area began in 1836 when Michel Charleau, a French Fur Trader, took a group of Chicago businessmen interested in land and timber up the Muskegon River. When they reached the banks of what is now known as the City of Newaygo, the party observed the great expanse of white pines. Determining the area would provide a good business opportunity, they established claims on the junction of the Muskegon River and the mouth of a creek which they named Pennoyer Creek. Soon plans were developed for the first saw mill on Pennoyer Creek, thus launching the first permanent settlement in the County. On September 1, 1837, Pennoyer Mill was complete and began operation, floating lumber to Muskegon on rafts then shipping the lumber to Chicago. The lumber boom soon followed in the late 1800’s, significantly impacting the physical and cultural landscape of Newaygo. Its location on the Muskegon River upstream from Muskegon, a major lumber town at the time, along with its proximity to vast amounts of timber, encouraged settlement of the area and ultimately put the county on the map.

The boundaries for Newaygo County were set in 1840, but being unorganized, it was attached to Kent County to the south. Newaygo County became a separate County and formally organized in 1851. During the first elections in 1851 the Probate Court, Sheriff, and Clerk's Offices were established. Jacob Barnhard was the first judge of probate court, James Berry was the first Sheriff, and Loyal Palmer was the first Clerk. During the 1855 elections the Treasurer, Prosecuting Attorney, and Surveyor's Offices were established. John Swartout was the first Treasurer, Edgar Gray was the first Prosecuting Attorney, and William Utley was the first Surveyor. The Drain Commissioners office was established in 1869 and the Judge of Circuit Court was established in 1876. Charles Carmichael was the first drain commissioner and Michael Brown was the first Judge of Circuit Court. The first marriage records were filed in the clerk's office in 1851, and the first birth and death records were filed in 1867.

Newaygo was the first County Seat and a brick courthouse was built in 1886. There are many legends and stories concerning the name chosen for the County. It is believed that the name was derived from an Ottawa Indian brave, Nah-way-go, who had a reputation for bravery and strength and was known for his courage on the battlefield. He was seen and admired by the area's first white settlers.

As the settlements grew, roads were constructed and in 1849, the first state road was built from Croton and Newaygo to Muskegon. In 1854, a state road was built from Newaygo to Grand Rapids and facilitated the construction of the Big Red Mill at Newaygo. The Grand Rapids, Newaygo, and Lake Shore Rail Road came to Newaygo in 1872, connecting the city with Grand Rapids. In 1875 the rail road was extended to White Cloud.

A group of settlers, led by Daniel Weaver, first settled in the Fremont area in 1855. The Weaver homestead served as the first post office and public school in the area. In November 1855, Fremont Township was established and named in honor of John C. Fremont, a western explorer and Republican Party candidate for US President. Weaver and his fellow settlers cleared the dense timber in order to farm. In the early 1870's, more immigrant families came to Fremont from the Holland and Muskegon areas, growing the Dutch community. Lumbering became a major industry and a railroad spur linked Fremont to the national rail network.

Settlement and growth came late to the future County Seat, White Cloud. Prior to 1870, there was no real growth. However, construction of the railroad in 1875 spurred new growth. When lumberman Wilcox and Morgan came to the area, there was already a settlement there, Alleyton, started by Mr. Alleyton. Wilcox and Morgan started a second settlement across the river called Morgan Station. In 1872, lumbering operations started on the White River and fast growth came to the area. At the request of the postal officials, Morgan Station was renamed White Cloud and in 1872, the Village was incorporated. Both settlements continued to grow and by 1882, they had 136 school age children. Alleyton grew larger and faster and was considered the more elegant of the two. By 1880, it had 550 residents, and 32 businesses.

In the southern portion of Newaygo County, Grant Center was established in 1882. During that year Andrew J. Squier built the first saw mill and a railroad station was built on the Pere Marquette Railroad. Grant Center was incorporated in 1893, with the name shortened to Grant in 1899. The community was named after President and Civil War General Ulysses S. Grant. Similar to other communities within Newaygo County, Grant was centered around the lumbering industry. During the community's early years, 20,000 board feet of lumber and 30,000 shingles per day were shipped out of Grant. In 1885, Squier was producing 1,000,000 board feet of lumber per year. In 1872 and 1873, nine million feet of logs were shipped to Grand Rapids from Newaygo County, most of which came from the Ashland Station (2 miles south of present day Grant) at the rate of 100,000 a day.

Fire was extremely detrimental to early settlements in Newaygo County. In 1871, Fremont experienced a major forest fire that caused extensive damage, especially to the lumber mills. In 1883 a massive fire destroyed the City of Newaygo, leaving only two buildings standing. Soon thereafter, White Cloud became the County seat. On July 4, 1894, after already suffering from one fire, another struck, wiping out the Village of White Cloud. It was never rebuilt, and little remains to indicate its former existence.

When the lumbering era began in the early 1800's in Michigan, it was expected to last hundreds of years. However, within approximately fifty years, the vast softwood timber resources in the Lower Peninsula, including those in Newaygo County were harvested and the slash burned over more than once. Some believe that more logs were floated down the Muskegon River than any other river in the world. It is estimated that only one out of every three trees were actually harvested, the rest having been destroyed by forest fires. The forests and the soils were forever changed as a result of clear cutting, forest fires and farming.

By the early 1890's, with the vast timber resources depleted, lumbering moved out of the area. By the last quarter of the 19th century, some of the easier to drain wetlands were converted to farmland. In the early 20th century, Rice Lake in Grant Township was drained and its lakebed is now used for specialty crops. As the logging industry slowed and farming increased, a canning factory established in Fremont to market the produce, grew into a major enterprise known today as Gerber Products.
With the lumbering era over, other industries began to replace the economic focus of the area. In 1898, the marl beds just north of Newaygo were acquired by D.L. Stivens of Newaygo Manufacturing Company and a group of Grand Rapids businessmen and a cement company was formed. By 1902, the first barrels were shipped.

Not all of the land that was originally settled was suitable for farming and many farms were later abandoned. Much of this land reverted to the Federal Government and today is managed as part of the Manistee National Forest. Today, the United States Forest Service owns approximately 108,000 acres or almost 20% of the County. Other farmland was purchased for recreational uses. Forest products from the second growth forests and recreation are the chief resources of the northern two-thirds of the County. In the southern third of the County, farming and industry has evolved. With some of the largest

muck farms located in the eastern half of the County, Grant is known as the onion capital of the world. There are also significant apple and peach orchards. The County's two hydroelectric dams on the Muskegon River produce enough kilowatts of electricity to power a city of 23,000 people. Both Croton Dam and Hardy Dam are on the National Register of Historic Places. Croton was constructed in 1906-07 and was the first hydro facility in the nation to use 110,000 volt transmission lines. Hardy went into service in 1931 and at the time was the tallest earthen dam in the world. Today it is still Michigan's tallest earthen dam and provides a 3,800 acre reservoir that is enormously popular for outdoor recreation. Newaygo County's three largest cities incorporate all these major uses. The City of Newaygo is known for its angling opportunities for chinook salmon, steelhead and brown trout, as well as boating, canoeing and kayaking. Fremont is the home of the world's leader in baby food, Gerber Products. White Cloud, with its motto emphasizing its recreation activities, "Where the North Begins and the Pure Water Flow" is the County Seat.

Notable Citizens and Events

Daniel Gerber (1873 - 1952) and Gerber Products

Gerber traces its origins to the Fremont Canning Company, a small packager of peas, beans, and fruits in rural Michigan begun by Frank Gerber and his father in 1901. At that time, Gerber also served as a partner in his father's tannery. When the tannery closed in 1905, Gerber focused all his efforts on building the canning company. By 1914 he had expanded his plant to permit year-round production. Three years later, with the death of his father, Gerber became president of the company and saw its sales exceed $1 million for the first time. Following a brief postwar dip in profits, Fremont Canning experienced steady growth during the 1920s.

In 1927, Mrs. Gerber began hand-straining solid food for her seven-month-old daughter and suggested the work could be easily done at the Fremont Canning Company, where the Gerber family produced a line of canned fruits and vegetables. Experiments with strained baby foods began shortly thereafter, and Sally Gerber became the company's first baby food analyst. Soon workers in the plant requested samples for their babies.

By late 1928, strained peas, prunes, carrots and spinach, not to mention beef vegetable soup, were ready for the national market. At that time, national distribution was nearly unheard of, meaning that the foods would only be available in a few stores in every area of the country. To compensate, the Gerber's launched an advertising campaign featuring a coupon and the now-famous Gerber Baby. The ads appeared in publications from The Journal of the American Medical Association to Good Housekeeping. Grocers who had been skeptical were now placing orders by the dozen. Within six months, Gerber Baby Foods were on grocery store shelves across the nation.

In 1952, The Gerber Foundation was established and provided $14,700 in support to various organizations that first year, including organizations such as the American Red Cross, Americas Future, 4-H Clubs, Boys and Girls Clubs, the United Negro College Fund, and the National Fire Protection Association, among others. Small grants were also awarded to various community agencies within those communities where Gerber Products Company had a presence. Since the Foundation has provided millions of dollars to enhance the quality of life of infants and young children in nutrition, care, and development, remains as the guiding beacon for Foundation giving. Beginning in 1953, scholarships were provided to a wide variety of institutions across the United States as well as to dependents of Gerber Products Company Associates.

In addition to the Gerber Foundation, the Gerber Life Insurance Company was formed as a subsidiary of Gerber Products Company in 1967. It is one of the top direct-response marketing insurance companies and a leading producer of juvenile life insurance. As of today, Gerber Life Insurance Company has more than $9 billion of life insurance in force and insures more than 2 million people throughout the United States and Puerto Rico.

By 1973, Gerber was the world's largest supplier of baby foods with sales of $278 billion. Gerber also added non-baby food products to the company's line including lotions, vaporizers, toys, and Gerber Baby ware, an extensive line of shirts, socks, crib sheets, and other baby gear. Daniel Gerber is now listed as one of the Twentieth Century Great American Business Leaders.

William Herman Bolthouse (1915 - 2004) and Bolthouse Farms

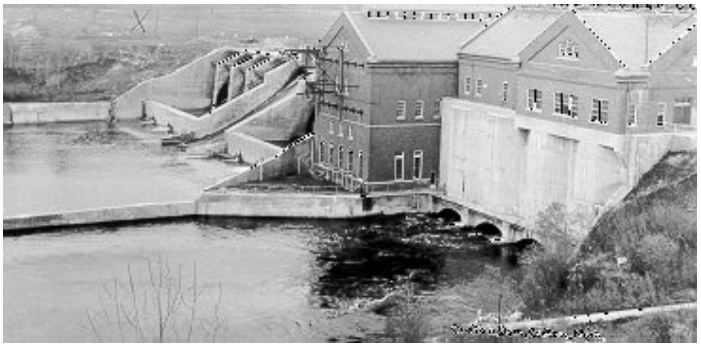
In 1915, William’s parents launched a small vegetable farm in Grant, Michigan. Once William graduated from High School in 1931, he began working on the family farm. William married Helen Adeline Humphreys on January 11, 1938. Shortly after their marriage, his father deeded that Grant farm to William and Helen, which starred one of the more successful agribusiness ventures in the United States.

From the very beginning the company was known for quality and innovation. Vegetable varieties were continually improved, and the company advanced from field packing celery to storing onions for off-season supply. Before long, local canneries relied on William Bolthouse for carrots, celery, spinach, and onions. These local canneries soon were companies like Gerber Products, The Campbell Soup Company, and H.J. Heinz. By 1950 Bolthouse Farms® was a leading supplier of Carrots with the green tops attached were the standard in the 1940’s and 50’s, but customers were interested in the added convenience of modern packaging. In 1954 William Bolthouse incorporated his business and in 1959 he built a fresh carrot cellophane packing facility. With quality recognized by customers, the company began marketing to the newly emerging chain stores and supermarkets. Even today the trade calls whole, bagged carrots “cellos!”

By the 1970's the chain stores and supermarkets had become reliant on the quality of Bolthouse carrots, but there was one problem– customers wanted fresh carrots year-round. William H. Bolthouse, began searching America for just the right location to harvest carrots every day. In 1972, he decided that Bakersfield, California had the right combination of sun, soil, and climate. Growing carrots in Bakersfield was anything but the "conventional wisdom" back then. To the surprise of many, the new packing plant grew quickly as customers enjoyed superior carrot quality in any season of the year.

In 1985 William H Bolthouse turns the company over to his son, William J. Bolthouse. According to the business research company, Hoover's, with 2,100 employees Bolthouse Farms is one of the United States' leading producers of carrots and is also a leading producer of super-premium refrigerated products. In 2005, the Bolthouse family sold the company to private equity firm Madison Dearborn Partners LLC, who owned the company until 2012 when Campbell Soup Company bought Bolthouse Farms for $1.55 billion. The location in Grant, Michigan remained open until June of 2010.

Croton Dam



In 1904, the Croton Dam was commissioned by The Grand Rapids-Muskegon Power Company, a subsidiary of William A. Foote and James B. Foote's Jackson Electric Light Works. The Foote brothers were responsible for other hydroelectric projects in Michigan including the Trowbridge Dam on the Kalamazoo River, the Webber Dam on the Grand River, and the Rogers Dam on the Muskegon River.

The construction on the Croton Dam began in June of 1907. William D. Fargo was assigned to oversee the project as the Chief Engineer. Fargo had developed new methods for construction of earth embankment dams on foundations of soft soils, which made use of hydraulic sluicing. The Croton Dam is one of the earliest examples of the use of this technique east of the Mississippi River. The chief advantage of the hydraulic sluicing method was its cost. The total cost of constructing the 370-foot-long (110 m) embankment, which contained 104,000 cubic yards (80,000 m3) of material, was only $7,076, or about 7 cents per cubic yard of material moved. Fargo also used this method to construct a fill of 20,000 cubic yards (15,000 m3) for a highway bridge crossing the Muskegon River immediately downstream from the dam. The fill Fargo built for the highway bridge approach cost roughly the same.

In order to achieve efficient power transmission over 50 miles (80 km) to Grand Rapids, a 100,000-volt high voltage line was built, then the highest-voltage transmission line in the world. Dr. Charles Steinmetz, the "wizard" of General Electric, visited the site and conducted tests

on the transmission lines in 1908. The line voltage was increased to 110,000 volts in early 1909.

The plant and its 110,000 volt transmission line (the highest voltage used at that time) attracted international attention. Curious spectators rode excursion trains to the site, where they received a tour of the dam and powerhouse, as well as a grand dinner. When the plant went into full service in September 1907 it represented the latest advances in electrical generation and transmission. Engineers from Russia, England, France, Italy, Japan, and India came to tour the plant when it opened.

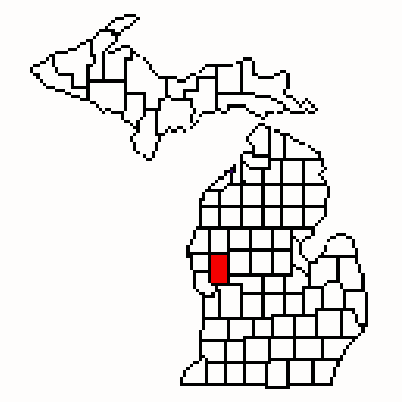
The Croton Hydroelectric Generating Dam has been in continuous operation since it opened in 1907. The 40 foot high dam impounds 7.2 billion gallons of water in its 1,209 acre reservoir. Currently owned and operated by Consumers Energy, the Croton Dam is capable of generating 8,850 kilowatts of electricity at peak outflow, enough to serve a community of about 6,000 residential customers. This facility is listed in the National Register of Historic Places.

Hardy Dam

Located in Big Prairie Township, the Hardy Hydroelectric Generating 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 4,000 acres. The Hardy Dam is capable of generating 30,000 kilowatts of electricity which is enough power to serve a community of 16,600 people.

Constructed from 1929 to 1931, on a site once known as the Oxbow, the Hardy Hydroelectric Plant was built by Consumers Power Company. The plant was named for George Hardy, a partner in the firm that financed Consumers' projects from 1911 through 1928. The complex includes a Spanish Colonial Revival-style powerhouse and intake tower, an oil house, and a dormitory. It originally included four operator's houses on the eastern bank of the pond, which were Sears-Roebuck kit homes. Due to advancements in fossil fuel steam generating plants, this was the last conventional hydroelectric plant built by Consumers. The Hardy plant in listed in the National Register of Historic Places.

Geography and Climate



Location, Communities, and Proximity to Surrounding Cities

Newaygo County is located in the west central region of Michigan's Lower Peninsula. The City of White Cloud, located in the center of Newaygo County, which is the county seat and the third largest city in Newaygo County with a population of 1,381. The other three Cities includes Fremont, located in the south-west area of the county with the largest population of 4,128, Newaygo, located south-central along the Muskegon River, with the second largest population of 1,689, and Grant, located in the southern most point of the county, with the smallest population of 850. Fremont, White Cloud, Newaygo, and Grant serve many of the needs of the county residents, however, the City of Grand Rapids (population 193,710) located approximately twenty five miles from the county's southern border, Big Rapids (population 10,313) located ten miles from the county's east boarder, and Muskegon (population 39,259), located approximately fifteen miles from the county's southwestern border, also serve as core communities.

City of Fremont

The City of Fremont is located along M-82 with the south half of the city located in Sheridan Township and the north half of the city located in Dayton Township, all which lie in the south west portion of Newaygo County. Known as the Baby Food Capital of the World, the city of Fremont has a rich history. Fremont was first settled and became a township in 1855. By the mid-1870s, the Gerber family moved to the area and opened a tannery. The city's history and economic growth have been intertwined with the family ever since. By the 1920s, the Gerber's founded a baby food company using the area's rich agricultural resources. Due to the presence of Gerber Foods and the proven demand for its products, Fremont experienced gradual, controlled growth throughout the 20th Century. Due to this progressive growth, the city has been able to provide and maintain public services when and where they were necessary.

According to *Michigan Works! West Central, m*ajor employers in Fremont include:

- Spectrum Health Gerber Memorial Hospital (692 employees)
- Nestle Gerber Products Company (564 employees)
- Fremont Public Schools (417 employees)
- Meijer (350 Employees)
- Gerber Life Insurance (331 employees)
- Newaygo County Regional Educational Services Agency (331 Employees)
- MPH Trucking and Logistics (200 Employees)

- Wal-Mart Stores, Inc. (195 employees)
- Newaygo Medical Care Facility (160 Employees)
- Fremont Insurance (130 Employees)
- Transitional Health Services (123 employees)
- DURA Automotive Systems (104 employees)

City of Newaygo

The City of Newaygo is located at the junction of M-37 and M-82 with the east half of the city located in Brooks Township and the west half of the city located in Garfield Township, all which lie in the south-central portion of Newaygo County along the Muskegon River. The City of Newaygo is the oldest community in the County. The Penoyer and Brooks families were among the first settlers to Newaygo. They founded Newaygo's first saw mill known as the "Big Red Mill". The rail service came through Newaygo in 1873, connecting with metropolitan Grand Rapids, Chicago, and Detroit. In 1883 a massive fire destroyed Newaygo, leaving only two buildings standing. The architectural influence existing today is of the late Victorian style. The proximity of the Muskegon River was the driving force of Newaygo's early economy, with mills, lumbering, and recreation developing nearby. Although not as populated or geographically large as Fremont, this area has seen steady growth in recent years due to easy access and close proximity to Grand Rapids.

Major employers in Newaygo include:

- Magna Mirrors (1,000 employees)
- Newaygo Public Schools (321 employees)
- Bucher Hydraulics (262 Employees)
- GM Wood Products Inc (110 Employees)

The City of White Cloud

The City of White Cloud is located at the junction of M-37 and M-20 with the south half of the city located in Everett Township and the north half located in Wilcox Township, which is in the center of Newaygo County. White Cloud is the community seat and hosts all county government offices including County Administration, Central Dispatch, the Sheriff Department, Jail, Community Mental Health, Department of Human Services, and Emergency Services. Major employers include:

- County of Newaygo (288 employees)
- White Cloud Public Schools (207 employees)
- Harbison Walker International (120 employees)
- Family Health Care (98 employees)
- Newaygo County Department of Human Services (76 employees)

The City of Grant

The City of Grant is the smallest city in Newaygo County and home to one of the few remaining wooden water towers in the State of Michigan. Grant is located on M-37 in Newaygo County's southern townships of Ashland and Grant. The City is located on a major Michigan Highway that acts as a popular direct route for travel between Grand Rapids and Traverse City. Many of the city's residents commute to Grand Rapids, Muskegon, and Fremont for employment, making Grant a 'bedroom community.' Although the City limits are smaller than some surrounding communities, the Grant Area is the fastest growing area in Newaygo County. Grant Public Schools is the largest school district in Newaygo County with an enrolled student population of 2,217 students in 2011. In 2006, Family Health Care built a new facility on the corner of M-37 and State Street to service the Grant Community brining prominent healthcare professionals into the area. Farming is also a prominent employer in the area. With some of the largest muck farms located in the eastern half of the County, Grant is known as the onion capital of the world. There are also significant apple and peach orchards around the area. Major Employers in the area include:

- Grant Public Schools (316 employees)
- Gene's Family Market, 33 East State St (73 employees)
- Family Health Care (65 Employees)
- Wilbur Ellis (30 Employees)
- Quality Finishing Systems (25 Employees)

The Village of Hesperia

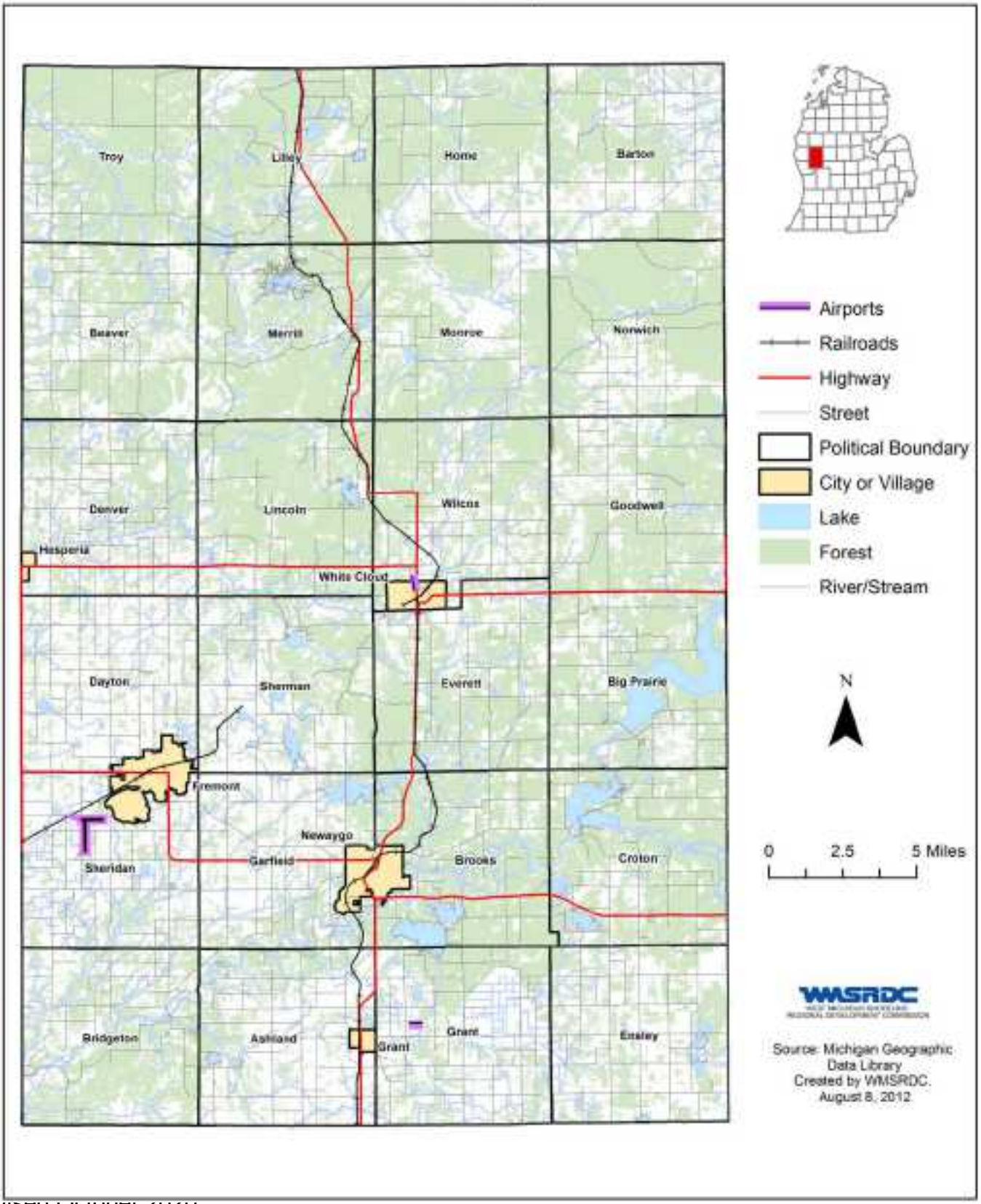
The Village of Hesperia is located in Newaygo County's western township of Denver and extends into Oceana County. Hesperia is the only village in Newaygo County. Situated on the White River along M-20, Hesperia was named from Hesperides in Greek Mythology, meaning blissful garden located in the western part of Greece. In 1856 Booth Perry settled the area followed shortly thereafter by Pat McFarland and Alex McLaren. The village of Hesperia was platted in 1866 and became a village in 1883.

Major employers in Hesperia include:

- Hesperia Community Schools (207 employees)

Newago County

Base Map



Distance to Major Cities

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

Muskegon	15 miles or 24 km
Grand Rapids	25 miles or 40 km
Traverse City	75 miles or 121 km
Lansing	110 miles or 176 km
Detroit	190 miles or 305 km
Chicago	220 miles or 353 km
Indianapolis	280 miles or 451 km
Cleveland	310 miles or 498 km

Climate and Weather Patterns

The climate of Newaygo County is highly varied due to topographical variations and the proximity of the county to Lake Michigan. The climatologically records of the county are not considered the most reliable because the report gives data that are from Personal Weather Stations (PWS) located in the county uploaded to Weather Underground. These stations do not contain official National Weather Service data. Any records from these stations are then compared to the National Weather Service stations located in Grand Rapids and Muskegon. Table 1 through Table 6 provides a monthly overview of the county's weather patterns based on climate data. Tables 1 through 3 are temperature data from the Fremont Weather Station and Tables 4 through 6 are precipitation data from the National Weather Service in Grand Rapids with combined averages taken from Grand Rapids and Muskegon data sets.

Overall, the climate of Newaygo County provides a four season location for winter, spring, summer and fall activities. In the winter, Newaygo County occasionally receives major winter storms and is often affected by Lake Effect Snow from Lake Michigan. Snowfall is often sufficient for extensive winter activities including cross country skiing, snowmobiling, sledding, tobogganing and snow shoeing. Winter temperatures are sufficiently cold to provide safe ice for ice fishing and ice skating. February is normally the county's coldest month and August is normally the warmest. May usually has the highest

level of precipitation and February normally has the least. Snow depth within the county is normally greatest in January.

During spring and summer months, Newaygo County's climate provides ample opportunities for many types of outdoor recreation including mushroom picking, open water fishing, turkey hunting, 9 wildlife viewing, boating, non-motorized trail use (e.g. hiking, bicycling, equestrian, etc.), off-road vehicle use and camping. In the summer, Newaygo County's lakes and rivers are critical recreation resources. County parks on Hardy Pond, the Muskegon River and Pettibone Lake provide welcome breaks from the heat for campers, swimmers, anglers, boaters and those just seeking the cool blue of inland waters. With over 300 lakes and hundreds of miles of rivers and streams, there are water based recreation opportunities for almost every taste. Prevailing winds are normally from the southwest. During fall, the mixture of Newaygo county's softwood (pine, fir, cedar) forests and hardwoods (oak, maple, aspen, etc.) provide a tremendous spectacle of color for sightseers; Other outdoor recreation opportunities such as trail use, hunting, fishing, wildlife viewing, camping and boating are available.

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 will 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
Source: Weather Underground Weather Station in Fremont, Michigan

Month	Record High	Date	Previous Record	Record Low	Date	Previous Record
January	63°F	01-25-1950	59°F (1-24-1950)	-16°F	1-3-1918	
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) (03-30-1967)	-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	93°F	05-29-1962	90°F (05-10-1930)	22°F	05-10-1974	
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 09-06-1957	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	89°F	10-18-1910		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	64°F	12-02-1982	63°F (12-06-1951) (12-05-2001)	-15° F	12-31-1976	-11°F (12-30-1976)

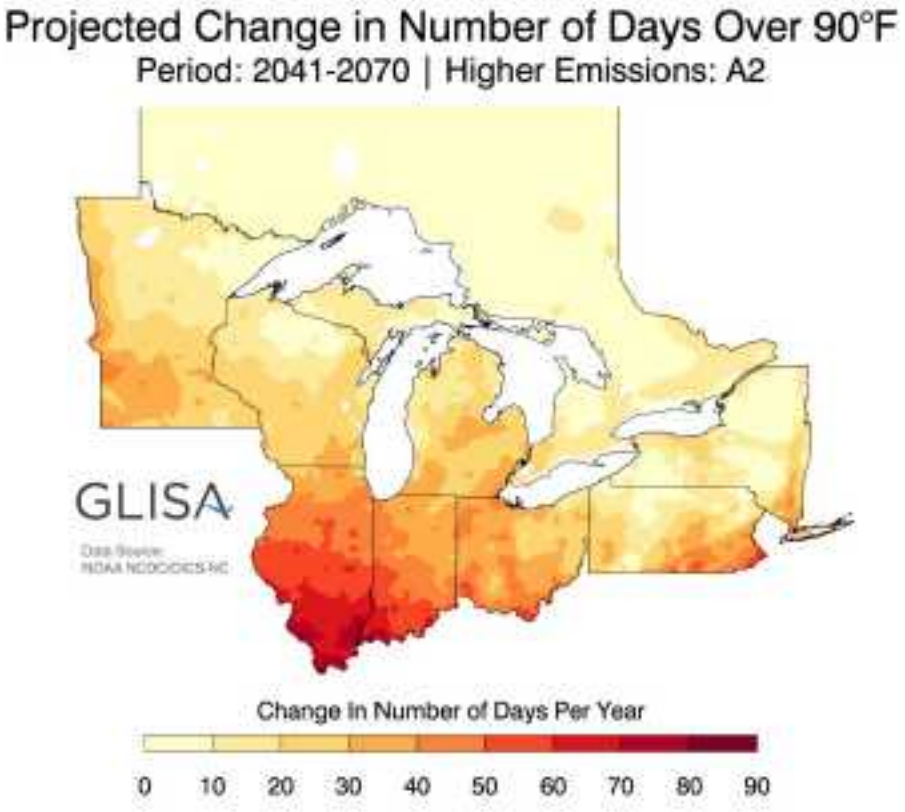


Table 2: Average Daily High in Degrees Fahrenheit
Source: Weather Underground Weather Station in Fremont, Michigan
US Climate Data Fremont, Michigan

MONTH	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total Average
January	27	27	29	39	34	32	24	30	26	36	32	**31**
February	28	34	35	33	25	30	33	32	31	36	30	**32**
March	42	46	39	45	49	40	43	52	38	56	36	**44**
April	56	60	62	61	54	61	55	62	54	56	50	**57**
May	65	68	64	67	73	66	67	70	68	71	71	**68**
June	76	73	83	77	81	77	75	76	76	78	76	**77**
July	80	79	82	84	82	66	75	82	84	90	79	**80**
August	82	75	81	81	81	81	75	83	79	78	78	**79**
September	72	77	77	69	77	74	73	68	70	71	71	**73**
October	59	60	62	56	66	60	53	61	62	56	59	**59**
November	48	47	49	48	46	46	50	48	47	46	42	**47**
December	38	35	30	41	35	33	32	31	37	38	28	**34**

MONTH	2014	2015	2016	2017	2018	2019						Total Average
January	21	25	32	35	31	26						**28**
February	22	19	36	42	32	29						**30**
March	32	37	49	45	41	38						**40**
April	53	56	55	58	56	54						**55**
May	65	68	70	62	74	64						**67**
June	77	74	79	78	78	74						**77**
July	74	77	83	82	84	84						**81**
August	77	78	83	78	78	79						**79**
September	70	75	76	78	74	59						**72**
October	56	61	64	64	55							**60**
November	38	53	54	45	37							**45**
December	35	44	34	32	35							**36**

Table 3: Average Daily Low in Degrees Fahrenheit
Source: Weather Underground Weather Station in Fremont, Michigan
US Climate Data Fremont, Michigan

MONTH	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total Average
January	15	14	19	29	23	21	9	21	15	24	19	**19**
February	14	18	23	20	14	15	20	22	18	24	15	**18**
March	24	32	20	28	30	25	27	31	25	39	22	**28**
April	35	38	38	39	36	38	36	40	36	34	33	**37**
May	45	49	44	48	50	43	47	50	49	49	49	**48**
June	53	56	63	56	58	58	56	58	56	55	56	**57**
July	60	60	62	64	61	62	54	64	64	63	59	**61**
August	62	56	61	61	63	59	58	63	60	67	56	**61**
September	51	53	55	51	54	55	52	52	51	48	51	**52**
October	40	43	43	39	49	40	40	40	42	39	41	**41**
November	35	34	33	34	32	33	36	34	34	31	29	**33**
December	26	22	23	30	25	21	23	23	28	27	17	**24**

MONTH	2014	2015	2016	2017	2018	2019						Total Average
January	8	11	22	25	15	12						**16**
February	8	0	24	26	18	14						**15**
March	11	20	31	29	22	19						**22**
April	33	33	26	38	26	33						**32**
May	45	48	46	42	50	44						**46**
June	57	53	55	57	57	53						**55**
July	54	57	61	60	60	61						**59**
August	56	58	62	56	58	56						**58**
September	48	56	56	53	53	44						**52**
October	40	42	45	46	39							**42**
November	26	36	37	32	27							**32**
December	24	33	25	21	25							**26**

2018 Temperatures for Fremont, Michigan
Source: http://www.weatherspark.com/history

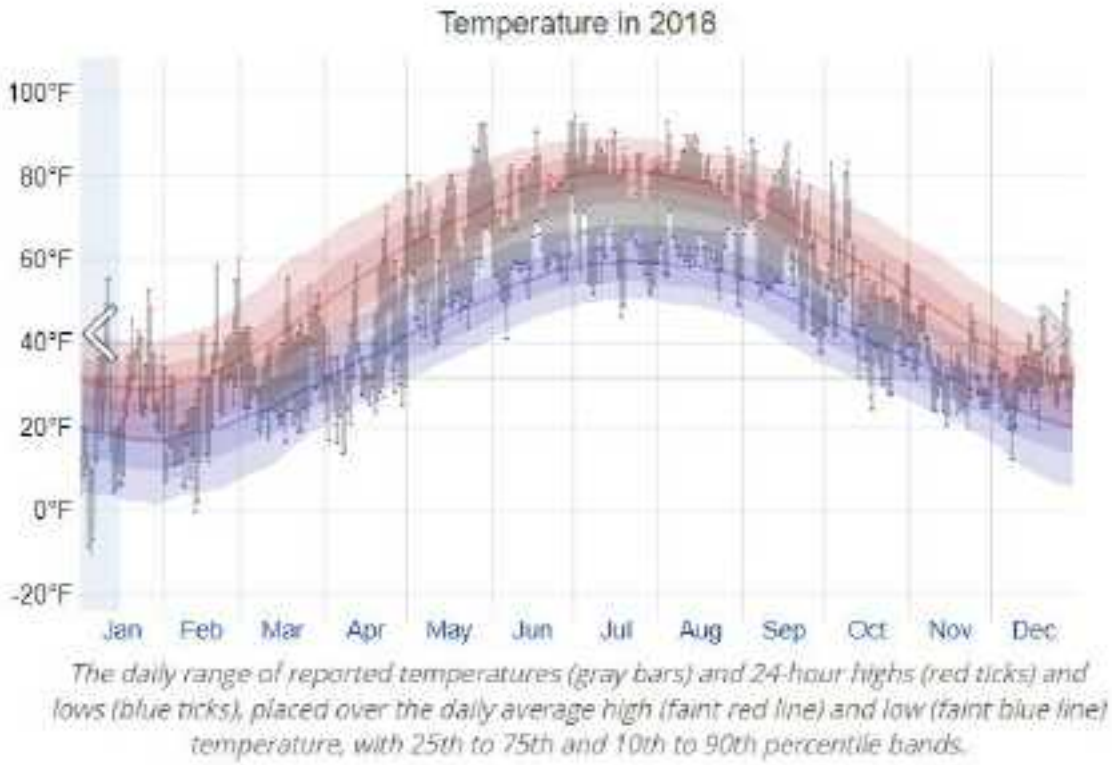


Table 4: Record Precipitation in Inches for Muskegon
Source: Weather Underground Weather Station in Fremont, Michigan

Month	Record Precipitation	Date	Record Daily Snowfall	Date
January	1.46	01-26-1978	21.7	01-26-1978
February	2.53 2.12	02-20-2018 02-22-1922	14.2	02-01-1965
March	1.98	03-02-1976	10.5	03-02-2002
April	2.66	04-11-2001	11.0	04-16-1961
May	4.10	05-22-1904	5.0	05-09-1923
June	5.08	05-27-1921	-	-
July	3.75	07-04-1901	-	-
August	4.29	08-13-2011	-	-
September	4.06 4.33	09-10-1986 09-11-1986	T	-
October	3.21	10-03-1954	4.70	10-27-1967
November	2.12	11-05-1990	16.00	11-14-1908
December	2.58	12-02-1982	14.80	12-17-1963

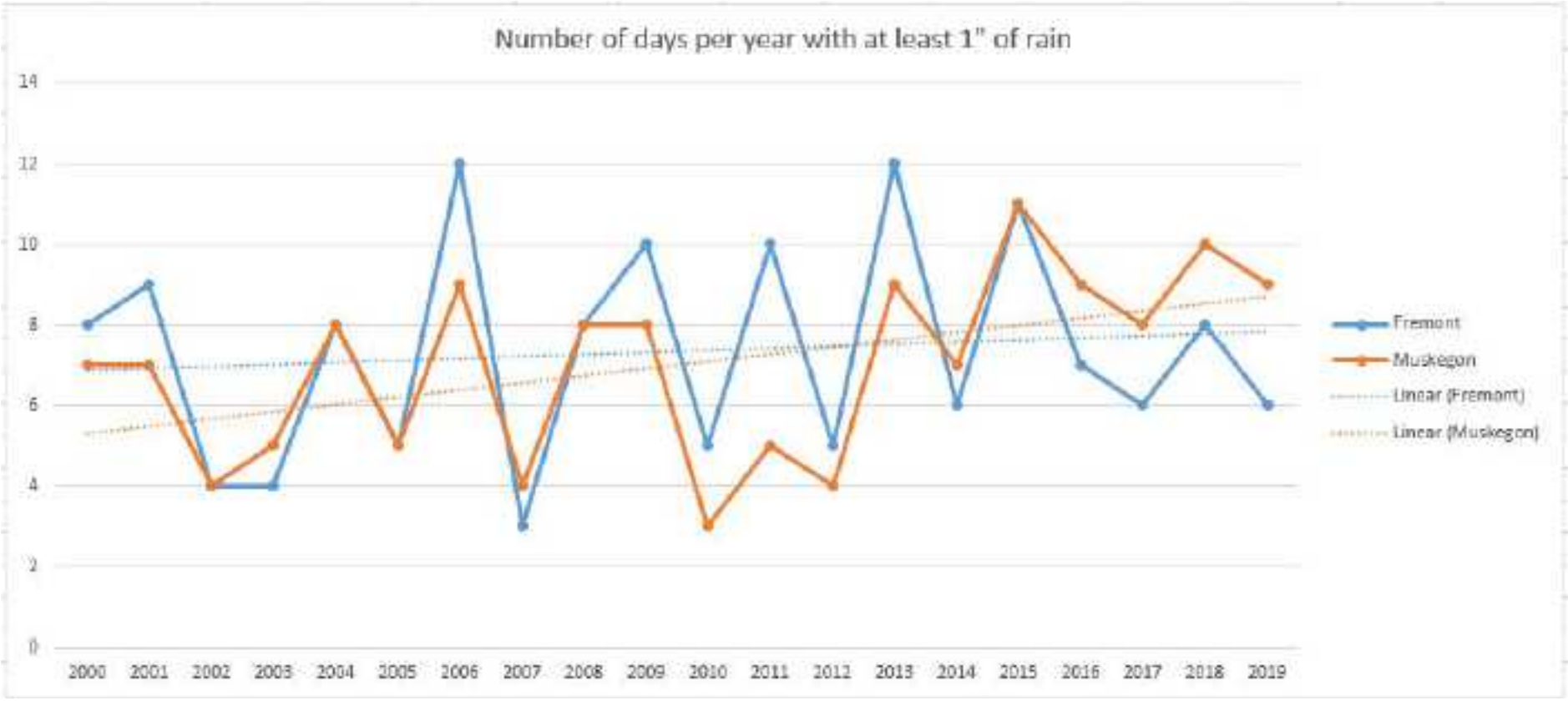
There is no single reporting station in Fremont (or anywhere else in Newaygo County) that has been in operation continuously since the early 20th century, making it practically impossible to make definitive historical records. Therefore, the closest comparable station Muskegon, Michigan is listed.

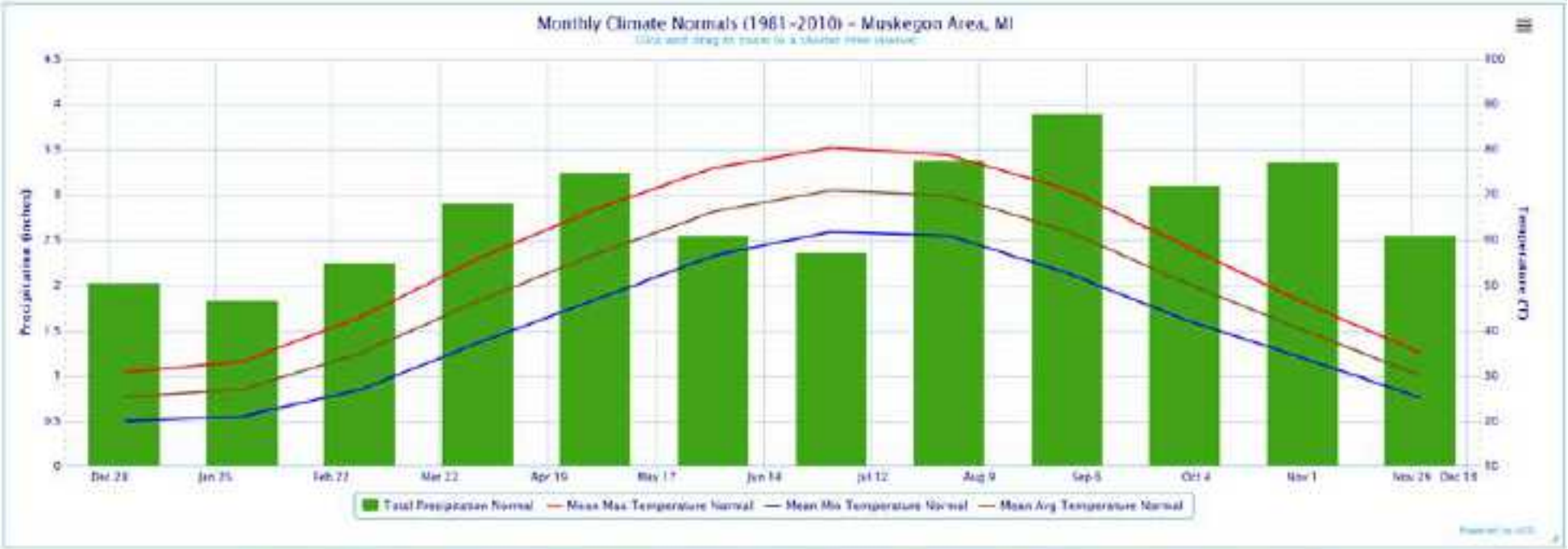
Table 5: Daily Average Precipitation in Inches for Grand Rapids
Source: National Weather Service

MONTH	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total Average
January	0.06	0.09	0.27	0.27	0.62	0.16	0.07	0.03	0.07	0.10	0.16	**0.17**
February	0.04	0.09	0.16	0.21	1.66	0.19	0.13	0.94	0.10	0.07	0.13	**0.34**
March	0.10	0.28	0.13	0.35	0.14	0.11	0.09	0.03	0.12	0.11	0.04	**0.14**
April	0.25	0.19	0.09	0.27	0.21	0.11	0.17	0.10	0.20	0.09	0.31	**0.18**
May	0.33	0.51	0.21	0.36	0.08	0.07	0.07	0.11	0.11	0.08	0.14	**0.19**
June	0.13	0.29	0.45	0.21	0.12	0.19	0.15	0.21	0.10	0.09	0.15	**0.19**
July	0.24	0.22	0.22	0.51	0.06	0.16	0.05	0.13	0.18	0.09	0.09	**0.18**
August	0.27	0.25	0.26	0.19	0.13	0.04	0.16	0.06	0.16	0.08	0.06	**0.15**
September	0.39	0.11	0.45	0.28	0.07	0.29	0.07	0.15	0.09	0.05	0.06	**0.18**
October	0.21	0.39	0.12	0.32	0.11	0.11	0.22	0.08	0.12	0.21	0.16	**0.19**
November	0.45	0.23	0.36	0.27	0.03	0.09	0.05	0.07	0.10	0.02	0.12	**0.16**
December	0.13	0.15	0.12	0.25	0.12	0.24	0.10	0.06	0.08	0.10	0.09	**0.13**

MONTH	2014	2015	2016	2017	2018	2019						Total Average
January	0.03	0.06	0.07	0.11	0.07	0.09						**0.07**
February	0.04	0.04	0.10	0.07	0.18	0.12						**0.09**
March	0.03	0.03	0.16	0.11	0.04	0.07						**0.07**
April	0.08	0.14	0.13	0.21	0.10	0.14						**0.13**
May	0.09	0.11	0.10	0.05	0.18	0.19						**0.12**
June	0.16	0.13	0.04	0.16	0.08	0.15						**0.12**
July	0.12	0.07	0.18	0.04	0.07	0.13						**0.10**
August	0.1	0.12	0.26	0.06	0.21	0.11						**0.14**
September	0.12	0.08	0.08	0.02	0.20	0.24						**0.12**
October	0.18	0.11	0.20	0.31	0.18							**0.20**
November	0.14	0.09	0.11	0.09	0.09							**0.10**
December	0.05	0.11	0.10	0.06	0.06							**0.08**

The following demonstrates the frequency of days with at least 1" of rain, broken down by calendar year, starting in 2000. Data is from a NWS observer in Fremont, as well as the airport in Muskegon. The average over the last 20 years is 7 days per year of at least an inch of rain (or equivalent snow). Both locations show an upward/increasing trend with time, on the order of 1 to 3 extra yearly occurrences over the 20 year duration.





Month	Total Precipitation Normal	Mean Max Temperature Normal	Mean Min Temperature Normal	Mean Avg Temperature Normal
January	2.00	30.9	20.1	25.4
February	1.63	33.2	21.1	27.1
March	2.25	43.0	27.0	35.0
April	2.91	55.9	37.3	46.6
May	3.25	66.9	46.9	56.9
June	2.55	76.0	56.6	66.3
July	2.37	80.4	61.9	71.1
August	3.39	78.6	61.0	69.9
September	3.69	71.3	52.8	62.1
October	3.11	58.8	42.5	50.7
November	3.36	46.4	34.0	40.2
December	2.55	35.1	25.3	30.2

Table 6: Average Depth of Snow Cover in Inches
Source: National Weather Service

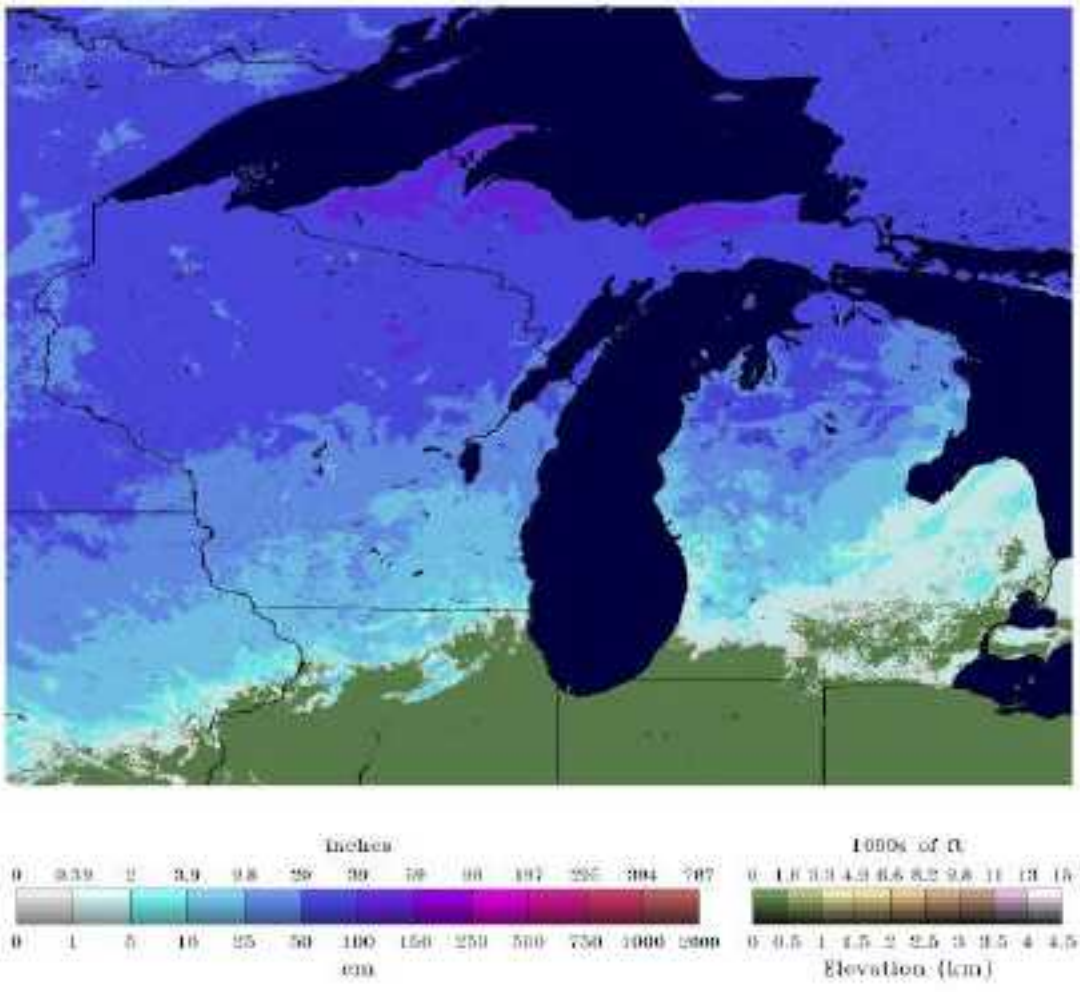
MONTH	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total Average
January	3	8	5	1	3	4	8	5	7	3	2	**5**
February	6	11	3	1	11	10	4	5	13	1	6	**6**
March	3	0	3	0	4	2	0	1	1	0	2	**1**
April	0	0	0	0	0	0	0	0	0	0	0	**0**
May	0	0	0	0	0	0	0	0	0	0	0	**0**
June	0	0	0	0	0	0	0	0	0	0	0	**0**
July	0	0	0	0	0	0	0	0	0	0	0	**0**
August	0	0	0	0	0	0	0	0	0	0	0	**0**
September	0	0	0	0	0	0	0	0	0	0	0	**0**
October	0	0	0	0	0	0	0	0	0	0	0	**0**
November	0	0	2	0	0	2	0	0	0	0	0	**0**
December	1	1	4	1	3	6	4	2	0	1	5	**3**

MONTH	2014	2015	2016	2017	2018	2019						Total Daily Average
January	1	4	2	1	3	3						**2**
February	1	8	1	1	3	4						**3**
March	1	2	1	0	0	2						**1**
April	0	0	0	0	0	0						**0**
May	0	0	0	0	0	0						**0**
June	0	0	0	0	0	0						**0**
July	0	0	0	0	0	0						**0**
August	0	0	0	0	0	0						**0**
September	0	0	0	0	0	0						**0**
October	0	0	0	0	0	0						**0**
November	1	0	0	0	1							**0**
December	0	0	4	3	0							**1**

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

National Snow 2018-2019 Analysis

OWP Office of Water Prediction



Automated Model Discussion:
March 10, 2019

Area Covered By Snow:	81.4%
Area Covered Last Month:	72.7%
Snow Depth	
Average:	15.9 in
Minimum:	0.0 in
Maximum:	61.9 in
Std. Dev.:	13.3 in
Snow Water Equivalent	
Average:	4.3 in
Minimum:	0.0 in
Maximum:	20.9 in
Std. Dev.:	3.8 in

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 0extraction, 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 Newaygo County's topography, soils, and other graphical features, it is important to understand the history behind Michigan and the glacial activity.

As recently as 12,000 years ago, major glacial activity impacted Newaygo County's topography. The underlying bedrock, except for one small area, is covered by 50 to 500 feet of glacial material. Large ridges, or end moraines, developed along the front of the glacier as it halted in its retreat toward the north-east. These moraines are from a quarter of a mile to one and a half miles in width and from ten feet in height to 40 feet. The moraines form a concentric pattern that extends from the northeastern corner of the county toward the southwestern part. Level to undulating ground moraines formed as materials carried by the glacier were deposited. The outwash plains in the county are the old gravelly and sandy channels of swift streams that formed as the glacier melted.

Physical Land Features

The bedrock in Newaygo County consists of edges of bowlike 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 Wisconsonian 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.

The present surface features in the County generally are the result of glacial action. Two major physiographic regions are recognized in the County, one consists of several outwash plains and lake plains in nearly level valleys having definite boundaries. Glacial melt-water streams, which were much larger than the current rivers and streams, deposited outwash material in the valleys. The abandoned melt-water channels are filled with organic deposits in some areas and kettle lakes in others. As the ice receded and the levels of the glacial lakes dropped, the valleys were incised and terraces formed along the present streams and rivers. The other physiographic region consists of rolling and hilly moraines rising from the nearly level valleys or plains. Streams and rivers have greatly modified the surface in

Newaygo County. The predominant water feature is the valley of the Muskegon River, which exits the southwestern part of the County.

Elevation

The highest elevation is 1,300 feet above sea level in the far northeastern part of the County.
The lowest elevation in the county is approximately 633 feet in the City of Newaygo near the Muskegon River.

Native Vegetation

As with many Michigan communities, Newaygo 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 Newaygo County area as follows:

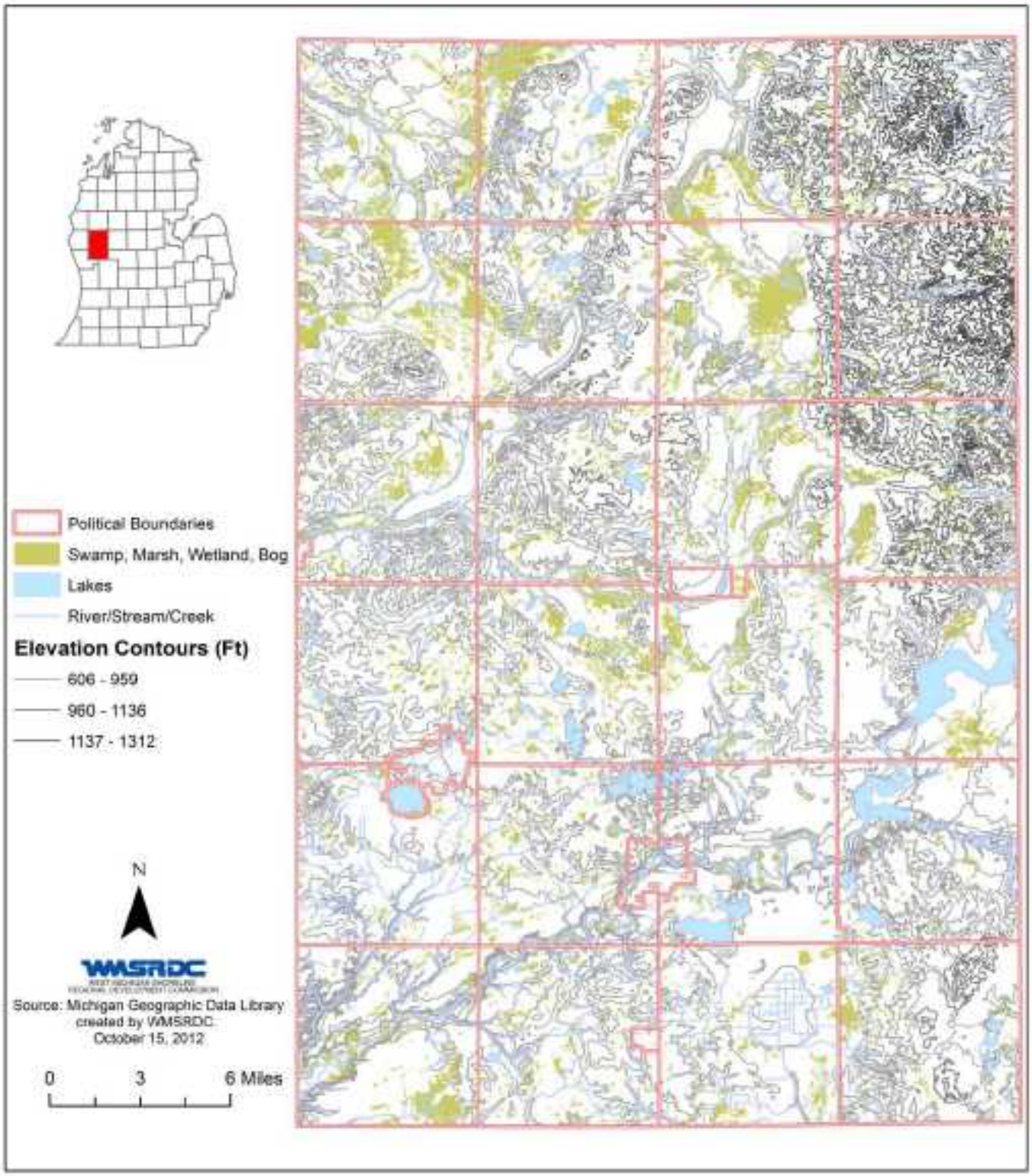
1. Plainfield-Grattan-Brems Association: Nearly level to steep, excessively drained and moderately well-drained, sandy soils on outwash plains and moraine.
2. Cosad-Del Rey-Sickles Association: Nearly level and gently undulating, somewhat poorly drained and poorly drained, sandy and loamy soils on lake plains.
3. Glendora-Abscota-Algansee Association: Nearly level and gently undulating, very poorly drained, somewhat poorly drained, and moderately well drained, sandy and loamy soils on flood plains.
4. Marlette-Metea-Sprinks Association: Nearly level to steep, moderately well-drained and well drained, loamy and sandy soils on moraines.
5. Coloma-Spinks-Matea Association: Nearly level to steep, excessively drained and well drained, sandy soils on moraines.
6. Toogood-Boyer Association: Nearly level to steep, somewhat excessively drained to moderately drained, sandy soils on outwash plains and terraces.
7. Adrian-Carlisle-Martisco Association: Nearly level, very poorly drained, organic soils on lake plains and outwash plains.
8. Pipestone-Covert-Kingsville Association: Nearly level and gently undulating, somewhat poorly drained, moderately well drained, and poorly drained, sandy soils on outwash plains.

Some of the soils in the County are well suited to development. These include the less sloping, well drained soils in the Plainfield-Grattan-Brems, Coloma-Spinks-Metea, and Toogood-Boyer associations. The Cosad-Del Rey-Sickles and Marlette-Metea-Spinks associations are better suited to farming than the other associations. Most of the soils in the County are well suited or fairly well suited for woodlands. Many soils are well suited to parks and other recreational areas. Un-drained areas of Adrian and other poorly drained or very poorly drained soils provide habitat for many species of wildlife and are good nature study areas.

GENERAL SOILS MAP

Newago County

Natural Terrain Map



Current Land Use

Newaygo County encompasses more rural characteristics than urban characteristics with a little over 80% of its population located in the townships. The majority of the residential, retail, and industrial development has occurred in the County's four cities, Fremont, Grant, Newaygo, and White Cloud.

Water Resources

Newaygo County has abundant surface and ground water resources. The ground water is a source of good quality drinking water for the residents of the County. Newaygo County is comprised of 234 natural lakes and ponds, 356 miles of rivers and streams covering 12,543 acres, which provide outstanding recreational opportunities. Most of the larger natural lakes are in the southern half of the County and within 10 miles of the City of Newaygo. The areas around the lakes have been intensively developed for residential uses. As a result, some of the lakes are sandy and are used intensely for residential and agricultural purposes that generate effluent from septic systems and livestock wastes, causing water quality concerns. Recent efforts have been implemented to upgrade sewage treatment in many Newaygo County waterfront areas. Another challenge is algae blooms from agricultural nutrient inputs. Again, best management practices of applying appropriate amounts of fertilizer and vegetative buffers between crop fields and waterways are being implemented, but some problems still persist. Fortunately, most of the lakes have high-quality water. Lakes with water quality challenges include Hess, Fremont, Peterson, and Hesperia Lakes. The smaller lakes in the public forest areas provide a wide variety of recreational opportunities and activities. The numerous unnamed bodies of water scattered throughout the County provide habitat for many species of wetland wildlife.

Table 7: Newaygo County Lakes over 100 Acres

Lake Name	Lake Size in Acres
Hardy Dam Pond	3,750 (2,845 in County)
Croton Pond	1235
Hess Lake	1125
Fremont Lake	790
Pickerel Lake	318
Brooks Lake	293
Ryerson Lake	262
Bills Lake	204
Woodland Lake	202
Diamond Lake	181
Pettit Lake	169
Kimball Lake	153
Nichols Lake	143
Robinson Lake	137
Newaygo Lake	127
Crystal Lake	125
Pickerel Lake	122
Sylvan Lake	113

Source: http://lakelocate.com/

Newaygo County is drained by several rivers. The northern part of the County is drained by the Pere Marquette and Little Pere Marquette Rivers. The White River originates in the central plain in the County and flows west through White Cloud to Lake Michigan. The Muskegon River drains a large area of the middle and southern parts of the county flowing in a southwesterly direction through Newaygo. Crockery Creek and the Rogue River, which are in the southernmost part of the County, flow south into the Grand River Basin.

Forest Lands

Sixty-one percent of Newaygo County's 537 thousand acres of land is forested (MSU Extension 2006). Of this 62% is in private ownership, almost all owned by small, non-industrial owners. Of the 38% in public ownership, the vast majority is part of the Manistee National Forest managed by the US Forest Service. Oak-hickory, beech-maple and lowland hardwoods make up 79% of the forest land in the county. Pine types (white, red and jack) are predominant on 15% of the forested acreage.

Farming

The diversity of soils and conditions appropriate for a wide variety of truck and vegetable crops helped create the conditions that made Gerber in Fremont a worldwide leader in baby foods. Because many of the soils are suitable for cropland, the climate is favorable, and the markets for farm products are nearby, farming probably will continue to be an important part of the economy in Newaygo County. Newaygo County covers 552,000 acres. Based on the 2017 Agriculture Census, 136,232 acres of (a quarter) of Newaygo County was farmland. This is an increase of 8% since 2012. However, there has been an 8% decrease in the number of farms in Newaygo County since 2012 to 850 total number of farms. Since much of the prime farmland is located in the southwest and southerly portions of the County, which is also closest to the Muskegon and Grand Rapids metropolitan areas, it is anticipated that there will be increased pressure from non-farm land use development in the future. However, the nature of soils in these areas also has serious erosion limitations and these characteristics will influence future land uses. The following tables reflects the change in agriculture and farmstead land use from 1997 to 2017 and the current land use and farm size.

Table 8: 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	850	*923*	*951*	*902*	787	8%
Total Number of Acres	*136,232*	*125,663*	*133,403*	135,422	131,779	3.4%
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	**160**	**136**	**140**	**150**	**167**	-4.2%

Table 9: Agriculture-Farmstead Land Use and Farm Size
Source: 2017 Census of Agriculture

AGRICULTURE-FARMSTEAD LAND USE	Number of Farms	Acres	Total Farms%	Total Acres %
Total	**850**	**136,232**		
Total Cropland	704	96,749	82.82%	71.0%
Total Harvested Cropland	620	86,749	72.94%	63.68%
Total Grazing Land	98	11,982	11.53%	8.8%
Farm Size in Acres				
Farms by size - 1 to 9 acres	66	261	7.76%	0.19%
Farms by size - 10 to 49 acres	327	8,331	38.47%	6.12%
Farms by size - 50 to 69 acres	89	5,359	10.47%	3.93%
Farms by size – 70 to 99 acres	107	8,625	12.59%	6.33%
Farms by size – 100 to 139 acres	69	8,124	8.12%	5.96%
Farms by size – 140 to 179 acres	39	6,124	4.59%	4.50%
Farms by size - 180 to 219 acres	29	5,720	3.41%	4.20%
Farms by size – 220 to 259 acres	23	5,434	2.71%	3.99%
Farms by size – 260 to 449 acres	43	15,680	5.06%	11.51%
Farms by size - 500 to 999 acres	29	19,703	3.41%	14.46%
Farms by size - 1,000 to 1,999 acres	24	33,060	2.82%	24.27%
Farms by size - 2,000 acres or more	5	19,811	0.59%	14.54%
Average Size of Farm in Acres		**160**		

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 Newaygo County there are four properties listed on the National Register of Historic Places and several historic sites in Newaygo County, however, there are no registered Historical Districts at this time that have been established.

Table 10: Places Listed in the National Register of Historical Places
Source: National Register of Historic Places, National Park Service.gov

Site Name (as listed in register)	Site Address	*City*	Property Type	Period of Significance	Date Listed in National Register	Record Number	NRIS Item Number
Croton Dam Mound Group	Address Restricted	Croton Township	Prehistoric Site	500-999 BC	06/23/2009	358182	08000846
Hardy Hydroelectric Plant	6928 E. 36th Street	Big Prairie Twp.	Power plant	1925-1949	12/01/1997	426923	97001479
Croton Hydroelectric Plant	Croton Dam Road	Croton Township	Power plant	1900-1924	08/16/1979	377986	79001165
Toft Lake Village Site	Address Restricted	Croton Township	Prehistoric Site	0-1499 AD	06/20/1972	363688	72001476
Fremont High School (former)	204 E. Main	Fremont	School Building	1926-2012	09/04/2013	Not listed	13000669

Table 11: Places Listed in the State of Michigan Register of Historical Places

Site Name (as listed in register)	Site Address	*City*	Property Type	Period of Significance	Date Listed in State Register	Site ID Number
Big Prairie Grange No. 935 Hall	1968 Elm Avenue	Goodwell Township	Grange hall	1901-1930	03/28/1985	P24316
Croton Congregational Church	Croton-Hardy Dr. and Division St.	Croton	Church	1871-1911	01/22/1987	P24317
Oak Grove District No. 3 Schoolhouse	6382 East 80th	Croton Township	Schoolhouse	1920-1968	06/30/1988	P24319
Ensley Windmill Tower	4634 South Luce Avenue	Fremont	Windmill	1826-1865	07/26/1978	P24322
First Christian Reformed Church	201 North Decker Avenue	Fremont	Church (Demolished)	1901-1930	01/20/1984	P24309
Gerber, Cornelius, Cottage	6480 West Cottage Grove	Fremont	Frame house	1866-1900	10/23/1979	P24310
City of Grant Depot and Water Tower	Between Lincoln and Pine Streets	Grant	Railroad Depot / Water tower	1866-1900	06/10/1980	P24311
Weaver, Daniel, House	84 South Cook Street	Hesperia	Frame house	1866-1900	09/26/1987	P24323
Penoyer's Sawmill and Dam	Penoyer Creek	Newaygo	Ruin Sawmill	1826-1865	08/22/1985	P24312
Saint Mark's Episcopal Church	30 Justice Street	Newaygo	Church	1866-1900	09/21/1983	P24313
Woods, John F., Residence	59 Bridge Street	Newaygo	Brick house	1826-1865	06/10/1980	P24314
Birch Grove School	3962 North Felch	White Cloud	Schoolhouse	1866-1900	10/02/1980	P24321
White Cloud Village Hall	1084 Wilcox	White Cloud	Courthouse (Demolished)	1901-1930	03/16/1982	P24315

Source: Michigan Historical Center, State Historic Preservation Office

Parks and Recreation

Newaygo 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 Newaygo County provided by the District 10 Public Health Department Environmental Officer.

Name of Establishment	Address	City, State, Zip	Number of Sites
Benton Lake Campground (NFS)	5308 Forest Road	Brohman, MI 49312	25
Big Bend Park	2000 Beech Avenue	White Cloud, MI 49349	230
Brooks Lake M.H. Club (Private)	2263 Spruell	Newaygo, MI 49337	15
Brush Lake Campground (NFS)	6 Mile (Forest Rd 5534)	White Cloud, MI 49349	7
Chapel of the Three Crosses	879 E Yoder Lane	White Cloud, MI 49349	15
Chinook Campground	5471 W 112th Street	Grant, MI 49327	168
Cindy Lou's Hide A Way	6245 N Comstock Road	Hesperia, MI 49421	22
Consumers Power Employee Hardy Dam Club (Private)	8000 16th Street	White Cloud, MI 49349	45
Croton Dam Float Trips	5355 Croton Drive	Newaygo, MI 49337	24
Croton Township Campground	7683 Croton Hardy Drive	Newaygo, MI 49337	160
Dan Raymond Park (Private)	6971 W 112th Street	Grant, MI 49327	8
Diamond Lake (aka Camp Swampy)	3351 N Mundy Road	White Cloud, MI 49349	100
Ed Henning County Park	500 Croton Drive	Newaygo, MI 49337	84
Fremont Lake Park	933 Cottage Grove	Fremont, MI 49412	94
Green Jug Resort	1190 Bingham Avenue	White Cloud, MI 49349	15
Happy Campers Campground	5380 Croton Drive	Newaygo, MI 49337	25
Heights Hide A Way	4424 Parson Road	Fremont, MI 49412	13
Hess Lake Mobile Home	825 E 88th Street	Newaygo, MI 49337	34
Highbank Lake Campground (NFS)	Roosevelt Drive / 15 Mile	Bitely, MI 49309	9
Hungerford Lake Campground (NFS)	Forest Rt 5134	Big Rapids, MI 49307	48
Hungerford Hills Farms	7616 Hungerford Lake	Big Rapids, MI 49307	50
K and K Camping LLC (Private)	7701 Whitneyville Rd	White Cloud, MI 49349	13
Indian Lake Campground (NFS)	Nagek Drive	Brohman, MI 49312	6
Leisure Time RV Park	4799 South Spruce	White Cloud, MI 49349	94
Little Switzerland Resort	254 Pickeral Lake Drive	Newaygo, MI 49337	80
Lonesome Lake Campground	318 W 18 Mile Road	Bitely, MI 49309	50
Minnie Pond Campground (NFS)	9570 Forest Road	Hesperia, MI 49421	11
Mystery Creek Campground	9570 S Wisner Avenue	Newaygo, MI 49337	85
Newaygo State Park	2793 Beech Street	Newaygo, MI 49337	99
Nichols Lake Park South (NFS)	Forest Route 5140	Brohman, MI 49312	29
Oxbow Park	2973 Cottonwood	Newaygo, MI 49337	197
Pettibone Lake Park (NFS)	490 W Pettibone Drive	Bitely, MI 49309	16
Pickeral Lake Campground	12666 N Woodbridge	Bitely, MI 49309	46
Salmon Run Campground	8845 Felch Avenue	Grant, MI 49327	94
Sandy Beach Campground	6926 30th Avenue	White Cloud, MI 49349	220
Shelley Lake Campground (NFS)	5450 Forest Road	Brohman, MI 49312	8
Shi Lo Cum	2940 N Felch Avenue	White Cloud, MI 49349	35

Sportsman Park Campground	2500 Sportsman Drive	White Cloud, MI 49349	86
Timbers Edge Campground	4345 North Warner	Hesperia, MI 49421	50
Twinwood Lake Campground (NFS)	5488 Forest Rd	White Cloud, MI 49349	5
Walkup Lake Campground (NFS)	Cleveland Drive	Bitely, MI 49309	127
White Cloud City Campground	680 Wilcox	White Cloud, MI 49349	99
Woods and Water Campground	4495 South Spruce	White Cloud, MI 49349	375
		TOTAL	1,995

For additional information on Newaygo County's parks and recreation opportunities, please visit the Newaygo County Convention and Visitors Bureau at http://www.newaygocountytourism.or

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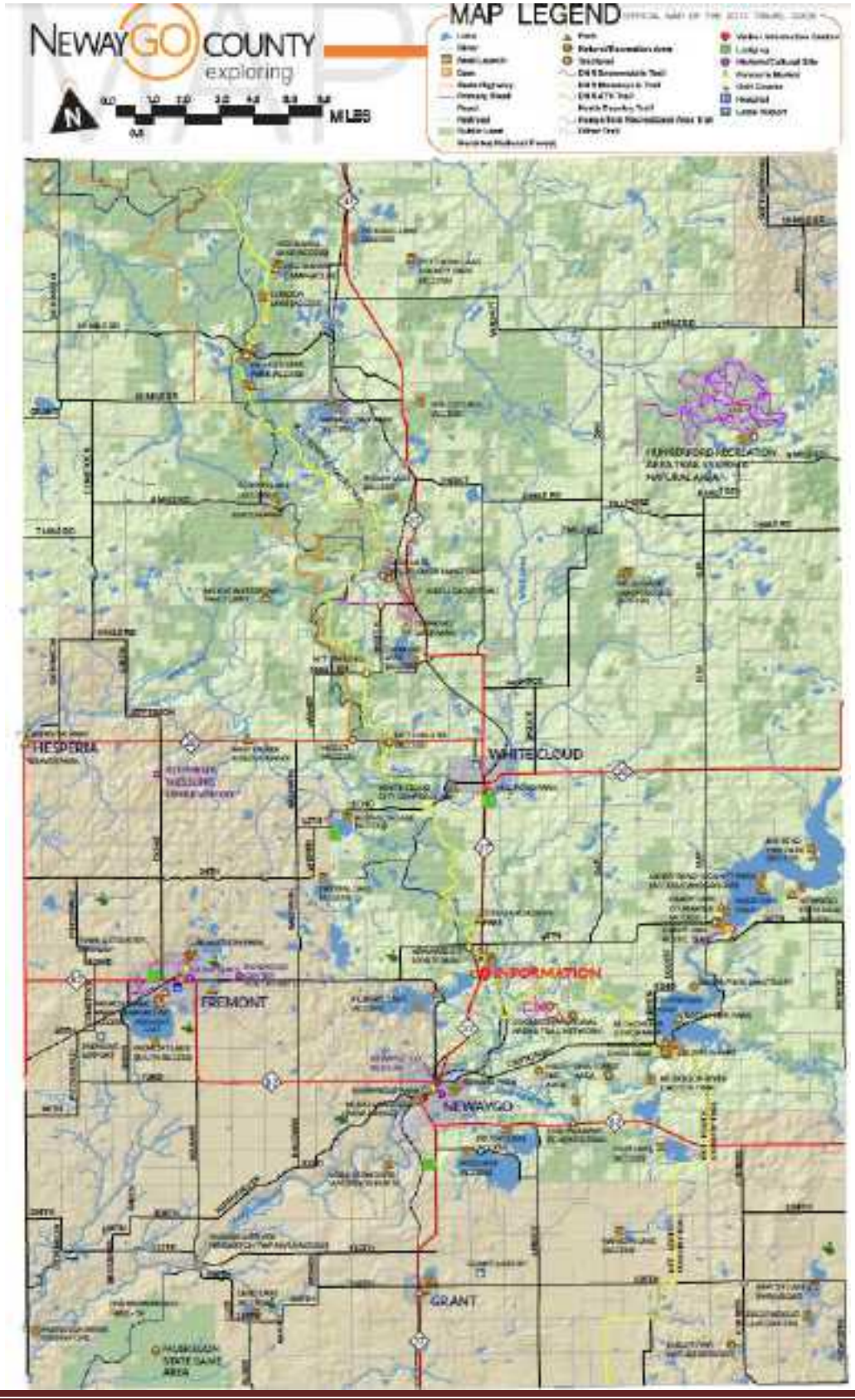
Newaygo County Campgrounds and Trails



Anticipated Land Use

Newaygo County has a county-wide Parks and Recreation land use plan which 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 of the Communities in Newaygo County have zoning ordinances and all but Troy Township has Land Use Plans.

Potential Land Use Conflicts and Known Hazards

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

- All four cities within Newaygo County, Fremont, Newaygo, Grant, and White Cloud 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, it is a great potential to affect a substantial amount of residences should an unacceptable release occur.

- M-20, and M-82 are heavily traveled east-west transportation routes and M-37 is a major north-south transportation route. These routes run through all of the Cities and Village of Hesperia in the County. In addition to privately operated vehicles, these roads are traveled by commercial truck traffic carrying many different types of hazardous materials.

- The Marquette Railroad operates on CSX Transportation's rail lines running through the center of the county parallel to M-37. The rail line cuts through the heart of Grant, Newaygo and White Cloud. With several road to rail crossing throughout the county, surprisingly there is no history of car/train accidents.

- Newaygo County has many water resources and flooding problems. There are 356 miles of rivers and streams within Newaygo County. The Muskegon River runs Northeast to Southwest through the center of the county. The City of Newaygo lies along the river banks along with numerous campgrounds and recreational businesses. The White River originates in the central part of the County and flows westward. The Pere Marquette and Little Pere Marquette River drain in the north east part of the county. Many portions of these areas have structures and critical infrastructure within the flood plains of these rivers.

- With agriculture playing a major role in Newaygo County, first responders to fires on farms may not be aware of potential chemical hazards. Another issue with farms is the stealing of Anhydrous Ammonia to make Methamphetamine and creating good potential for a release.

Public Infrastructure

Like most rural communities public infrastructure does not extend throughout the county. Many residences provide their own water and sewer through the use of wells and septic systems. Some industry does the same. Larger companies without municipal services normally have a second high capacity well in order to service their fire protection system. Public infrastructure is addressed in greater detail under Key Community Facilities/Organizations.

Housing Stock

Newaygo County has a total of 25,075 housing units. 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 Newaygo County and the State. Newaygo County has approximately 26.6% of its available housing units vacant compared to Michigan's 14.6%. However, 73% of the vacant housing in Newaygo County is seasonal and vacation homes. This can be problematic for the county during winter months since vacant homes can create problems such as broken pipes or gas leaks if they go uncared for.

Table 12, Housing Data, Newaygo County and the State of Michigan provides a summary of Newaygo County's housing stock and how it compares to the State of Michigan as a whole.

Table 12, Housing Data, Newaygo County and the State of Michigan
Sources: Median Values and raw housing data taken from the 2010 U.S. Census

	Newaygo County		Michigan	
HOUSING SUBJECT	**Total**	**Percentage**	**Total**	**Percentage**
Total Number of Housing Units	**25,075**	**100%**	**4,532,233**	**100%**
Occupied Housing Units	18,406	73.4%	3,872,508	85.4%
Owner-Occupied Housing	15,170	82.4%	2,793,342	72.1%
Renter-Occupied Housing Units	3,236	17.6%	1,079,166	27.9%
Vacant Housing Units	6,669	26.6%	659,725	14.6%
Seasonal or Recreational Units	4,885	19.5%	263,071	5.8%
Units in Structure				
1-unit detached	18,287	72.9%	3,249,245	71.8%
1-unit attached	154	0.6%	203,734	4.5%
2 units	281	1.1%	118,013	2.6%
3 or 4 units	216	0.9%	117,982	2.6%
5 to 9 units	369	1.5%	190,285	4.2%
10 to 19 units	268	1.1%	154,922	3.4%
20 or more units	209	0.8%	237,482	5.2%
Mobile Home	5,284	21.1%	253,248	5.6%
Boat, RV, Van, etc.	16	0.1%	743	0.0%
Age of Housing				
Built 2005 or later	652	2.8%	168,214	3.7%
Built 2000 to 2004	652	2.8%	319,691	7.1%
Built 1990 to 1999	2,168	9.3%	580,791	12.8%
Built 1980 to 1989	2,168	9.3%	449,484	9.9%
Built 1970 to 1979	1,954	8.4%	691,913	15.3%
Built 1960 to 1969	3,044	13.1%	551,778	12.2%
Built 1950 to 1959	4,439	19.1%	708,476	15.7%
Built 1940 to 1949	3,237	14.0%	368,881	8.2%
Built 1939 or earlier	4,086	17.6%	686,156	15.2%
Total Housing	**25,084**		**4,525,654**	
Home Values				
Less than $50,000	2,203	14.0%	409,930	15.1%
$50,000 to $99,999	4,097	26.0%	707,551	26.1%
$100,000 to $149,999	4,271	27.1%	555,568	20.5%
$150,000 to $199,999	2,3687	15.1%	444,042	16.4%
$200,000 to $299,999	1,700	10.8%	355,727	13.1%
$300,000 to $499,999	803	5.1%	163,110	6.0%
$500,000 to $999,999	226	1.4%	53,442	2.0%
$1,000,000 or more	65	0.4%	16,910	0.6%
Median Value	**$115,800**		**$118,100**	

Table 13, Housing Data, City of Fremont and Newaygo County
Sources: Median Values and raw housing data taken from the 2010 U.S. Census

	City of Fremont		Newaygo County	
HOUSING SUBJECT	**Total**	**Percentage**	**Total**	**Percentage**
Total Number of Housing Units	**2,112**	**100%**	**25,084**	**100%**
Occupied Housing Units	1,816	86.0%	18,406	73.4%
Owner-Occupied Housing	1,301	71.6%	15,170	82.4%
Renter-Occupied Housing Units	515	28.4%	3,236	17.6%
Vacant Housing Units	296	14.0%	6,669	26.6%
Seasonal or Recreational Units	31	1.5%	4,885	19.5%
Units in Structure				
1-unit detached	1,353	64.1%	18,287	72.9%
1-unit attached	28	1.3%	154	0.6%
2 units	97	4.6%	281	1.1%
3 or 4 units	68	3.2%	216	0.9%
5 to 9 units	176	8.3%	369	1.5%
10 to 19 units	105	5.0%	268	1.1%
20 or more units	31	1.5%	209	0.8%
Mobile Home	254	12.0%	5,284	21.1%
Boat, RV, Van, etc.	0	0.0%	16	0.1%
Age of Housing				
Built 2005 or later	2	0.1%	652	2.8%
Built 2000 to 2004	287	13.6%	652	2.8%
Built 1990 to 1999	285	13.5%	2,168	9.3%
Built 1980 to 1989	249	11.8%	2,168	9.3%
Built 1970 to 1979	178	8.4%	1,954	8.4%
Built 1960 to 1969	175	8.3%	3,044	13.1%
Built 1950 to 1959	411	19.5%	4,439	19.1%
Built 1940 to 1949	99	4.7%	3,237	14.0%
Built 1939 or earlier	426	20.2%	4,086	17.6%
Total Housing	**2,112**		**25,084**	
Home Values				
Less than $50,000	235	18.1%	2,203	14.0%
$50,000 to $99,999	346	26.6%	4,097	26.0%
$100,000 to $149,999	421	32.4%	4,271	27.1%
$150,000 to $199,999	212	16.3%	2,3687	15.1%
$200,000 to $299,999	42	3.2%	1,700	10.8%
$300,000 to $499,999	33	2.5%	803	5.1%
$500,000 to $999,999	12	0.9%	226	1.4%
$1,000,000 or more	0	0.0%	65	0.4%
Median Value	**$107,200**		**$115,800**	

Table 14, Housing Data, City of Newaygo and Newaygo County
Sources: Median Values and raw housing data taken from the 2000 U.S. Census

	City of Newaygo		Newaygo County	
HOUSING SUBJECT	**Total**	**Percentage**	**Total**	**Percentage**
Total Number of Housing Units	**957**	**100%**	**25,075**	**100%**
Occupied Housing Units	868	90.7%	18,406	73.4%
Owner-Occupied Housing	436	50.2%	15,170	82.4%
Renter-Occupied Housing Units	432	49.8%	3,236	17.6%
Vacant Housing Units	89	9.3%	6,669	26.6%
Seasonal or Recreational Units	18	1.9%	4,885	19.5%
Units in Structure				
1-unit detached	475	49.6%	18,287	72.9%
1-unit attached	0	0.0%	154	0.6%
2 units	29	3.0%	281	1.1%
3 or 4 units	80	8.4%	216	0.9%
5 to 9 units	53	5.5%	369	1.5%
10 to 19 units	73	7.6%	268	1.1%
20 or more units	138	14.4%	209	0.8%
Mobile Home	109	11.4%	5,284	21.1%
Boat, RV, Van, etc.	0	0.0%	16	0.1%
Age of Housing				
Built 2005 or later	3	0.3%	652	2.8%
Built 2000 to 2004	164	17.1%	652	2.8%
Built 1990 to 1999	187	19.5%	2,168	9.3%
Built 1980 to 1989	110	11.5%	2,168	9.3%
Built 1970 to 1979	90	9.4%	1,954	8.4%
Built 1960 to 1969	58	6.1%	3,044	13.1%
Built 1950 to 1959	107	11.2%	4,439	19.1%
Built 1940 to 1949	37	3.9%	3,237	14.0%
Built 1939 or earlier	201	21.0%	4,086	17.6%
Total Housing	**957**		**25,084**	
Home Values				
Less than $50,000	78	17.9%	2,203	14.0%
$50,000 to $99,999	186	42.7%	4,097	26.0%
$100,000 to $149,999	122	28.0%	4,271	27.1%
$150,000 to $199,999	33	7.6%	2,3687	15.1%
$200,000 to $299,999	14	3.2%	1,700	10.8%
$300,000 to $499,999	3	0.7%	803	5.1%
$500,000 to $999,999	0	0.0%	226	1.4%
$1,000,000 or more	0	0.0%	65	0.4%
Median Value	**$88,600**		**$115,800**	

Table 15, Housing Data, City of White Cloud and Newaygo County
Sources: Median Values and raw housing data taken from the 2000 U.S. Census

	City of White Cloud		Newaygo County	
HOUSING SUBJECT	**Total**	**Percentage**	**Total**	**Percentage**
Total Number of Housing Units	**614**	**100%**	**25,075**	**100%**
Occupied Housing Units	530	86.3%	18,406	73.4%
Owner-Occupied Housing	305	57.5%	15,170	82.4%
Renter-Occupied Housing Units	225	42.5%	3,236	17.6%
Vacant Housing Units	84	13.7%	6,669	26.6%
Seasonal or Recreational Units	10	1.6%	4,885	19.5%
Units in Structure				
1-unit detached	394	64.2%	18,287	72.9%
1-unit attached	2	0.3%	154	0.6%
2 units	28	4.6%	281	1.1%
3 or 4 units	11	1.8%	216	0.9%
5 to 9 units	79	12.9%	369	1.5%
10 to 19 units	22	3.6%	268	1.1%
20 or more units	22	3.6%	209	0.8%
Mobile Home	56	9.1%	5,284	21.1%
Boat, RV, Van, etc.	0	0.0%	16	0.1%
Age of Housing				
Built 2005 or later	9	1.5%	652	2.8%
Built 2000 to 2004	16	2.6%	652	2.8%
Built 1990 to 1999	80	13.0%	2,168	9.3%
Built 1980 to 1989	104	16.9%	2,168	9.3%
Built 1970 to 1979	103	16.8%	1,954	8.4%
Built 1960 to 1969	68	11.1%	3,044	13.1%
Built 1950 to 1959	90	14.7%	4,439	19.1%
Built 1940 to 1949	47	7.7%	3,237	14.0%
Built 1939 or earlier	97	15.8%	4,086	17.6%
Total Housing	**614**		**25,084**	
Home Values				
Less than $50,000	54	17.7%	2,203	14.0%
$50,000 to $99,999	132	43.3%	4,097	26.0%
$100,000 to $149,999	68	22.3%	4,271	27.1%
$150,000 to $199,999	4	1.3%	2,3687	15.1%
$200,000 to $299,999	32	10.5%	1,700	10.8%
$300,000 to $499,999	12	3.9%	803	5.1%
$500,000 to $999,999	0	0.0%	226	1.4%
$1,000,000 or more	3	1.0%	65	0.4%
Median Value	**$86,100**		**$115,800**	

Table 16, Housing Data, City of Grant and Newaygo County
Sources: Median Values and raw housing data taken from the 2010 U.S. Census

	City of Grant		Newaygo County	
HOUSING SUBJECT	**Total**	**Percentage**	**Total**	**Percentage**
Total Number of Housing Units	**378**	**100%**	**25,075**	**100%**
Occupied Housing Units	315	83.3%	18,406	73.4%
Owner-Occupied Housing	178	56.5%	15,170	82.4%
Renter-Occupied Housing Units	137	43.5%	3,236	17.6%
Vacant Housing Units	63	16.7%	6,669	26.6%
Seasonal or Recreational Units	2	0.5%	4,885	19.5%
Units in Structure				
1-unit detached	200	52.9%	18,287	72.9%
1-unit attached	18	4.8%	154	0.6%
2 units	15	4.0%	281	1.1%
3 or 4 units	41	10.8%	216	0.9%
5 to 9 units	20	5.3%	369	1.5%
10 to 19 units	33	8.7%	268	1.1%
20 or more units	12	3.2%	209	0.8%
Mobile Home	39	10.3%	5,284	21.1%
Boat, RV, Van, etc.	0	0.0%	16	0.1%
Age of Housing				
Built 2005 or later	5	1.3%	652	2.8%
Built 2000 to 2004	53	14.0%	652	2.8%
Built 1990 to 1999	52	13.8%	2,168	9.3%
Built 1980 to 1989	45	11.9%	2,168	9.3%
Built 1970 to 1979	49	13.0%	1,954	8.4%
Built 1960 to 1969	12	3.2%	3,044	13.1%
Built 1950 to 1959	41	10.8%	4,439	19.1%
Built 1940 to 1949	32	8.5%	3,237	14.0%
Built 1939 or earlier	89	23.5%	4,086	17.6%
Total Housing	**378**		**25,084**	
Home Values				
Less than $50,000	39	21.9%	2,203	14.0%
$50,000 to $99,999	61	34.3%	4,097	26.0%
$100,000 to $149,999	45	25.3%	4,271	27.1%
$150,000 to $199,999	17	9.6%	2,3687	15.1%
$200,000 to $299,999	16	9.0%	1,700	10.8%
$300,000 to $499,999	0	0.0%	803	5.1%
$500,000 to $999,999	0	0.0%	226	1.4%
$1,000,000 or more	0	0.0%	65	0.4%
Median Value	**$92,100**		**$115,800**	

Table 17, Housing Data, Village of Hesperia and Newaygo County (Portions of the Village are in Oceana County)

Sources: Median Values and raw housing data taken from the 2010 U.S. Census

	Village of Hesperia		Newaygo County	
HOUSING SUBJECT	**Total**	**Percentage**	**Total**	**Percentage**
Total Number of Housing Units	**466**	**100%**	**25,075**	**100%**
Occupied Housing Units	424	91.0%	18,406	73.4%
Owner-Occupied Housing	293	69.1%	15,170	82.4%
Renter-Occupied Housing Units	131	30.9%	3,236	17.6%
Vacant Housing Units	42	9.0%	6,669	26.6%
Seasonal or Recreational Units	6	1.4%	4,885	19.5%
Units in Structure				
1-unit detached	335	71.9%	18,287	72.9%
1-unit attached	3	0.6%	154	0.6%
2 units	20	4.3%	281	1.1%
3 or 4 units	0	0.0%	216	0.9%
5 to 9 units	50	10.7%	369	1.5%
10 to 19 units	25	5.4%	268	1.1%
20 or more units	18	3.9%	209	0.8%
Mobile Home	15	3.2%	5,284	21.1%
Boat, RV, Van, etc.	0	0.0%	16	0.1%
Age of Housing				
Built 2005 or later	0	0.0%	652	2.8%
Built 2000 to 2004	16	3.4%	652	2.8%
Built 1990 to 1999	49	10.5%	2,168	9.3%
Built 1980 to 1989	35	7.5%	2,168	9.3%
Built 1970 to 1979	66	14.2%	1,954	8.4%
Built 1960 to 1969	75	16.1%	3,044	13.1%
Built 1950 to 1959	76	16.3%	4,439	19.1%
Built 1940 to 1949	59	12.7%	3,237	14.0%
Built 1939 or earlier	90	19.3%	4,086	17.6%
Total Housing	**466**		**25,084**	
Home Values				
Less than $50,000	46	15.7%	2,203	14.0%
$50,000 to $99,999	138	47.1%	4,097	26.0%
$100,000 to $149,999	60	20.5%	4,271	27.1%
$150,000 to $199,999	36	12.3%	2,3687	15.1%
$200,000 to $299,999	5	1.7%	1,700	10.8%
$300,000 to $499,999	4	1.4%	803	5.1%
$500,000 to $999,999	4	1.4%	226	1.4%
$1,000,000 or more	0	0.0%	65	0.4%
Median Value	**$92,000**		**$115,800**	

Table 18, Mobile Homes Distribution in Newaygo County
Sources: Raw housing data taken from the 2010 U.S. Census

NEWAYGO COUNTY **MOBILE HOMES DISTRIBUTION**		
COMMUNITY	**# Mobile Homes**	**% Mobile Homes**
Newaygo County *	5,284	100%
City of Fremont	254	4.8%
City of Newaygo	109	2.1%
City of White Cloud	56	1.1%
City of Grant	39	0.7%
Village of Hesperia	15	
Ashland Township	256	4.8%
Barton Township	145	2.7%
Beaver Township	116	2.2%
Big Prairie Township	807	15.3%
Bridgeton Township	296	5.6%
Brooks Township	394	7.5%
Croton Township	401	7.6%
Dayton Township	63	1.2%
Denver Township	272	5.1%
Ensley Township	222	4.2%
Everett Township	299	5.7%
Garfield Township	119	2.3%
Goodwell Township	77	1.5%
Grant Township	275	5.2%
Home Township	62	1.2%
Lilley Township	185	3.5%
Lincoln Township	154	2.9%
Merrill Township	172	3.3%
Monroe Township	86	1.6%
Norwich Township	43	0.8%
Sheridan Township	6	0.1%
Sherman Township	108	2.0%
Troy Township	85	1.6%
Wilcox Township	183	3.5%

* total of cities and townships; village total already included with township totals

source: U.S. Census Bureau

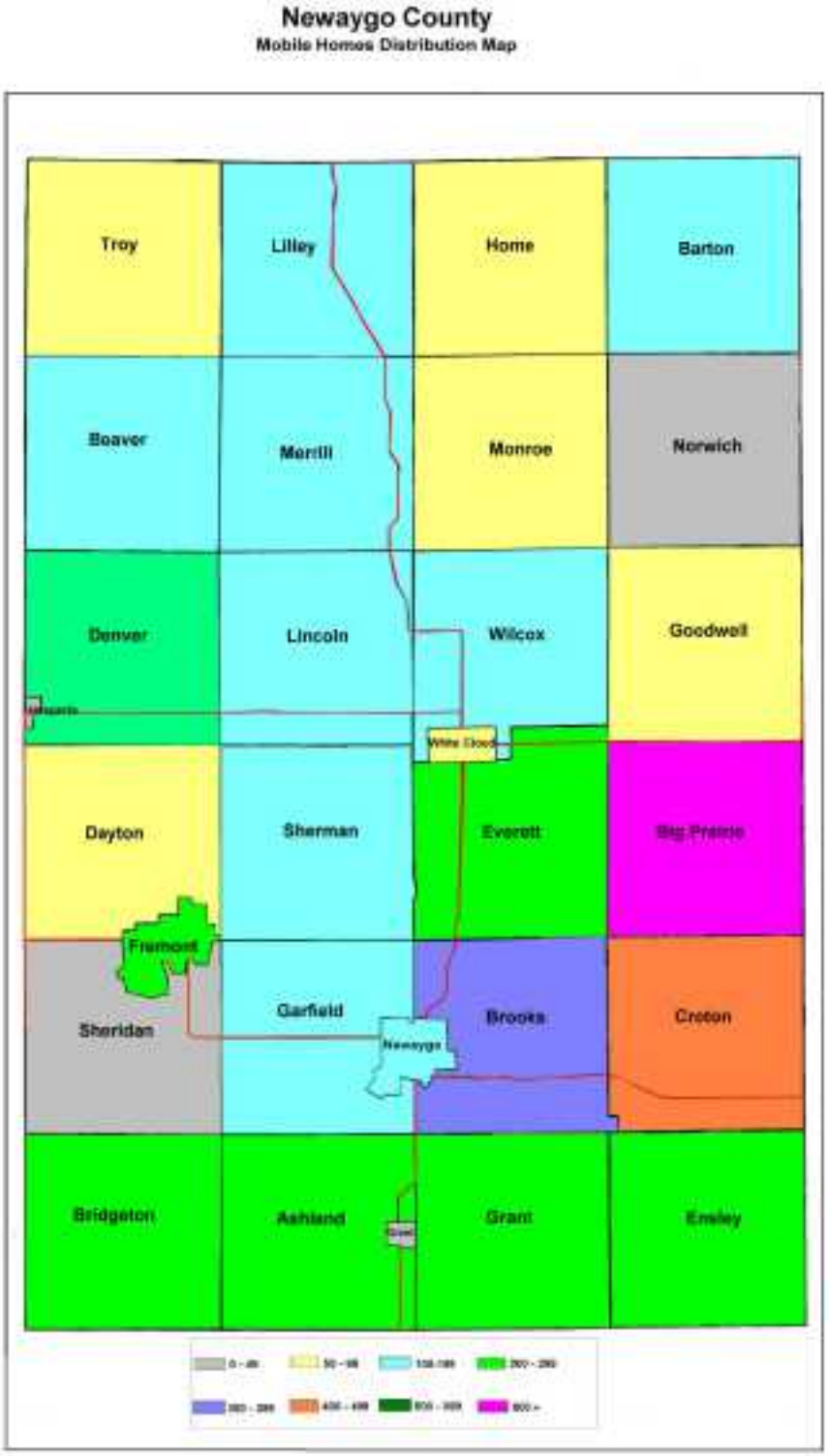
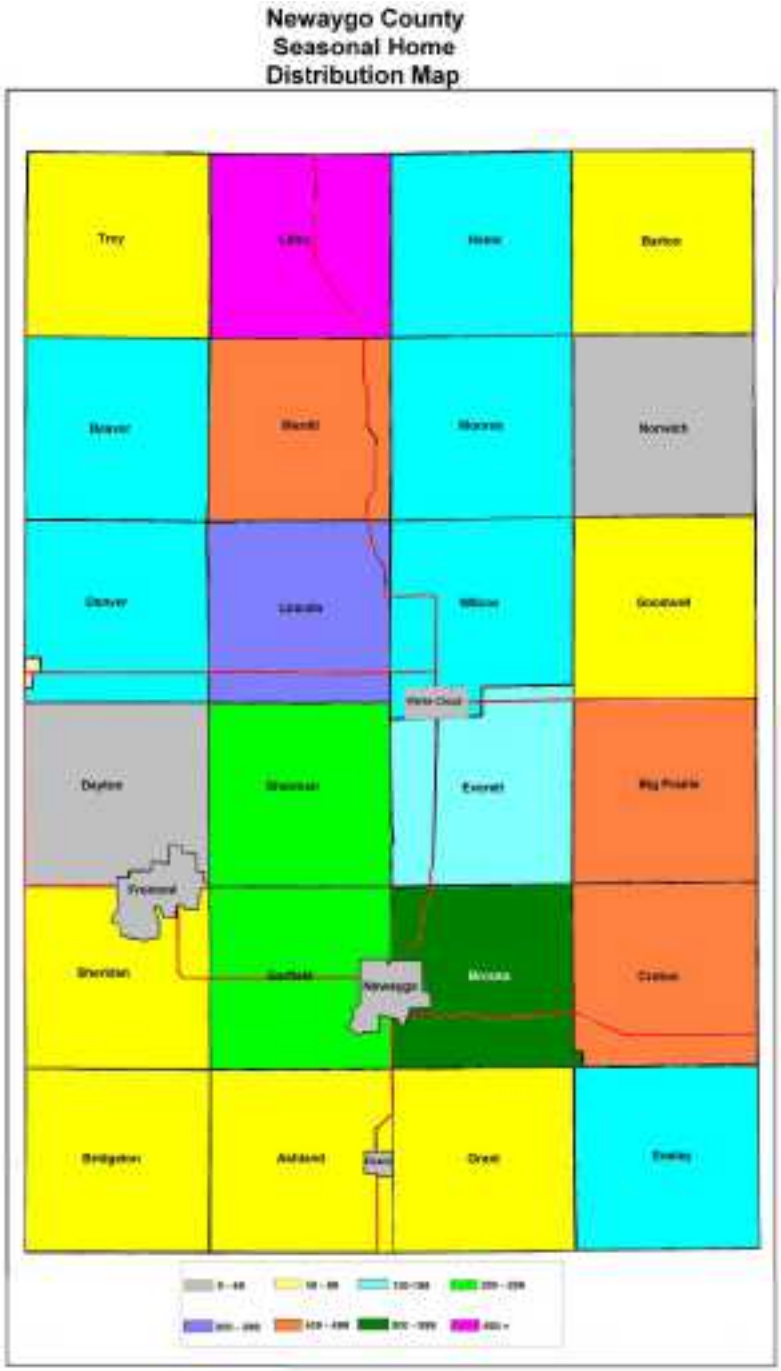


Table 19, Seasonal Homes Distribution in Newaygo County
Sources: Raw housing data taken from the 2010 U.S. Census

NEWAYGO COUNTY **SEASONAL HOMES DISTRIBUTION**		
COMMUNITY	# Seasonal Homes	% Seasonal Homes
Newaygo County	**4,885**	**100%**
City of Fremont	31	0.6%
City of Newaygo	18	0.4%
City of White Cloud	10	0.2%
City of Grant	2	0.0%
Village of Hesperia	6	
Ashland Township	89	1.8%
Barton Township	91	1.9%
Beaver Township	100	2.0%
Big Prairie Township	455	9.3%
Bridgeton Township	82	1.7%
Brooks Township	573	11.7%
Croton Township	473	9.7%
Dayton Township	35	0.7%
Denver Township	100	2.0%
Ensley Township	110	2.3%
Everett Township	111	2.3%
Garfield Township	212	4.3%
Goodwell Township	94	1.9%
Grant Township	69	1.4%
Home Township	138	2.8%
Lilley Township	629	12.9%
Lincoln Township	314	6.4%
Merrill Township	450	9.2%
Monroe Township	170	3.5%
Norwich Township	25	0.5%
Sheridan Township	57	1.2%
Sherman Township	228	4.7%
Troy Township	94	1.9%
Wilcox Township	125	2.6%

* total of cities and townships; village total already included with township totals

source: U.S. Census Bureau



Transportation Network

Highways and Roads

Several modes of transportation are available within Newaygo County, however movement into, out of, and within the county is primarily by private automobile. Four state highways serve the county. M-37 runs the entire length of Newaygo County from North to South and connects Grand Rapids, Grant, Newaygo, White Cloud, Baldwin, and Traverse City. M-37 also connects to M-20 and M-82 in Newaygo County. M-20 runs the east to west and connects Mt Pleasant, Big Rapids, White Cloud, Hesperia, and Hart. M-82 also runs east to west and connects Howard City, Newaygo, Fremont, and Muskegon. The Newaygo 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. North-South Roads west of M-37 are named after Presidents of the United States and east of M-37 are named after trees. East-West Roads north of M-20 are Mile Roads and south of M-20 are 10ths.

Major local connectors or "Class A" roads include the following list:

Old M-20 East
(May not be Class A in Mecosta County)

- 9 Mile from Cypress to Mecosta County
- Cypress from 8 Mile to 9 Mile
- 8 Mile from Elm to Cypress
- Elm from 8 Mile to Polk
- Polk/Fillmore from Oak to Elm

Old M-20 West

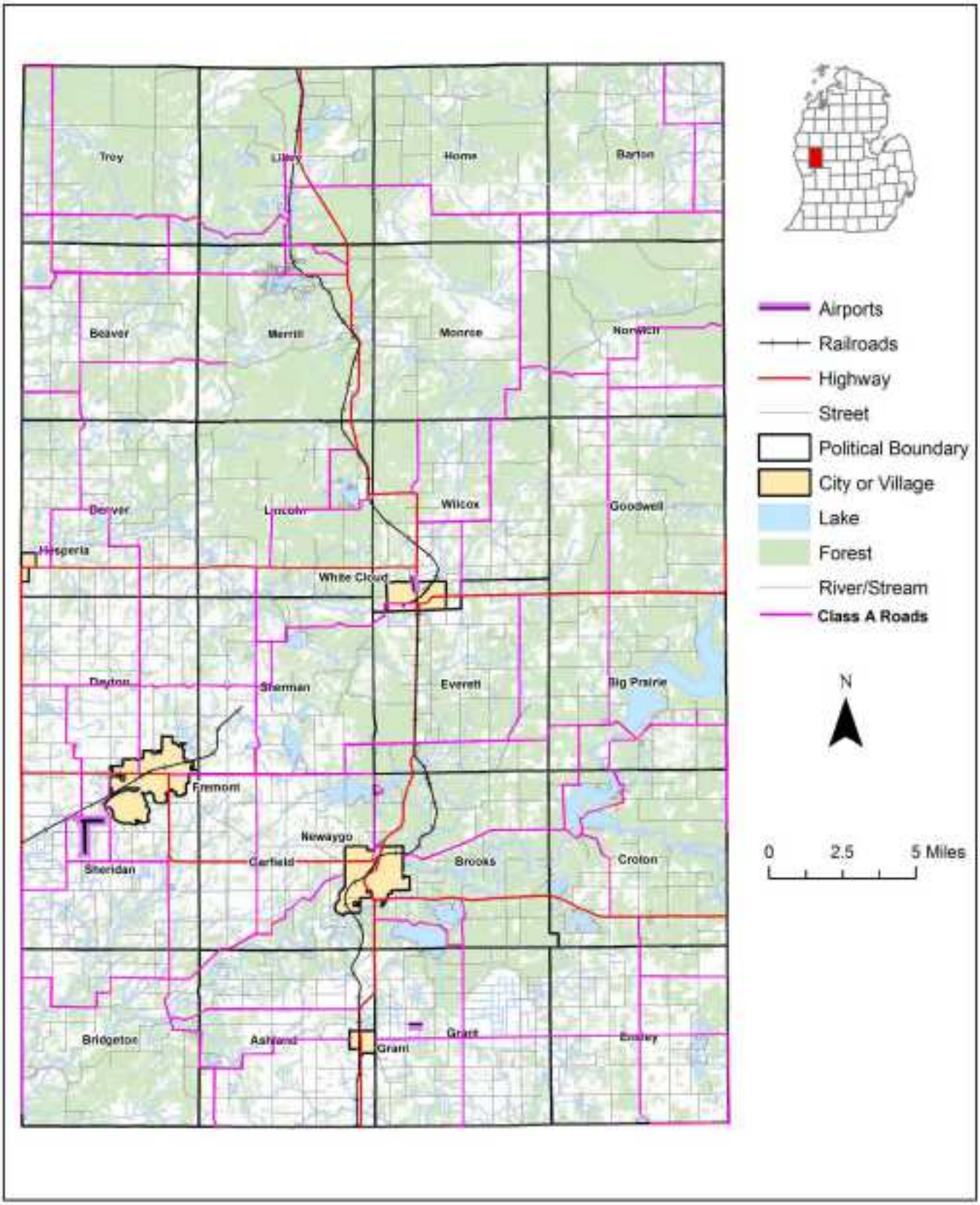
- Echo Dr. west out of White Cloud to Bingham
- Bingham from Echo to 12th St.
- 12th St. from Bingham to Wisner
- Wisner from 12th St. to 24th St.
- 24th St. from Wisner to Baldwin
- Baldwin from 24th St. to 72nd St. (M-82)
- 16th St. from M-37 to Walnut
- 40th St. from M-37 to Gordon
- Gordon from 40th St. to 48th St.
- 48th St. from Gordon to Warner
- Stone from 1 Mile (M-20) to 48th St.
- Green Ave. from 48th St. (M-82) south to 64th St.
- Oak from Fillmore to 7 Mile
- 7 Mile from Oak to Thornapple
- Thornapple from 6 Mile to 7 Mile
- 6 Mile from Thornapple to Poplar
- Poplar from 6 Mile to Monroe
- Monroe from Poplar to M-37

- Warner from 72nd (M-82) to White River

- 104th St. from Maple Island to Dickinson
- Dickinson from 104th St. to 112th St.
- 112th St. from Dickinson to Fitzgerald
- 128th St. from Alger to Bagley
- Bagley from 128th St. to 124th St.
- 124th St. from Bagley to Wisner
- Wisner from 124th St. to 120th St.
- Moore from Alger to Croswell
- 120th St. from Cypress to Elder
- Spruce from M-82 to Moore
- Green Ave. south of 48th (M-82) south to Lake Dr.

Newago County

Class A Road Map



Local Transit Service

There is no transit Service in Newaygo County.

Airports

The Newaygo County has three airports within the County. The White Cloud Airport is located just 1 Mile north of the City of White Cloud on M-37 and is owned and operated by the City of White Cloud. The airport is primarily used for business, flight school, and industry and does not have scheduled flights. The airport has one runway: Runway 18/36. Runway 18/36 is an asphalt runway 2917 ft. by 60 ft. at an elevation of 915.0 ft. lighted by medium intensity runway edge lights. 100 Low Lead Aviation Fuel is available at the airport as well as hangars and tie-downs for parking.

The Fremont Municipal Airport is 3 miles south west of the City of Fremont and is owned and operated by the City of Fremont. The airport is primarily used for business, glider operations, and industry and does not have scheduled flights. The airport has two asphalt runways, runway 18/36 and runway 9/27. Runway 18/36 is 6,498 feet by 100 feet at an elevation of 769.7 ft. with a weight bearing capacity of 30,000 lbs. and is marked with runway lights. Runway 9/27 is 3502 feet by 75 feet at an elevation of 766.9 feet with a weight bearing capacity of 16,000 lbs. on a single wheel and is marked with medium intensity runway edge lights. 100 Low Lead Aviation Fuel and Jet A Fuel are both available along with hangars and tie-downs for parking.

Grant Airport is located 2 miles north east of Grant and is privately owned by David Koopman from Grant. The airport has one turf runway, Runway 9/27, 2,517 feet by 120 feet at an elevation of 815.0 feet marked with low intensity runway edge lights. The airport does not have fuel, however it does have tie-downs for parking.

There are six major airports that are located within two hours of Newaygo County.

Airport Name	Distance from County
Muskegon County Airport	15 Miles
Gerald R. Ford International Airport	25 Miles
Traverse City Cherry Capital Airport	75 Miles
MBS International Airport	83 Miles
Kalamazoo Battle Creek International Airport	85 Miles
Lansing Capital Region International Airport	85 Miles
Bishop (Flint) International Airport	135 Miles
Detroit Metropolitan International Airport	185 Miles

Rail Service and Water Ports

Newaygo County does not have either passenger rail service or a water port. There are 22 Amtrak Stations in Michigan, with the closest in Grand Rapids which is approximately 25 miles outside the county. There are 6 water ports on Lake Michigan, with the closest in Muskegon which is approximately 15 miles outside the county.

Population Characteristics

Current and Historical Data

The 2010 census shows since 1970 Newaygo County is currently growing at a faster rate than the state average, however this has not always been true. From the 1900 through the 1970 Census, Newaygo County grew at a slower rate than the state through 1970 and declined in population twice during the early 1900's. The population decline occurred during WWI and a time of disease, such as the Spanish Flu, Small Pox, and Consumption. Table 20, Past Population Comparison, Newaygo County and the State of Michigan 1850-2010 shows Newaygo County's population during each census since 1850, the percentage change in Newaygo County's population, and the percentage change in Michigan's population.

Table 20: Past Population Comparison, Newaygo County and the State of Michigan 1850-2010
Sources: Population figures and other raw data taken from U.S. Census Historical Data
Percentages calculated by Newaygo County Emergency Services

	Newaygo County		Michigan	
YEAR	**Population**	**Percentage Change**	**Population**	**Percentage Change**
1850	510			
1860	2,760	81.52%		
1870	7,294	62.16%		
1880	14,688	101.37%		
1890	20,476	29.59%		
1894	19,125	-7.06%		
1900	17,673	-8.21%	2,420,982	
1910	19,220	8.75%	2,810,173	16.08%
1920	17,378	-9.25%	3,668,412	30.54%
1930	17,029	-2.00%	4,842,325	32.00%
1940	19,286	13.25%	5,256,106	8.55%
1950	21,567	11.83%	6,371,766	21.23%
1960	24,160	12.02%	7,823,194	22.78%
1970	27,992	15.86%	8,875,083	13.45%
1980	34,917	24.74%	9,262,078	4.36%
1990	38,202	9.41%	9,295,297	0.36%
2000	47,874	25.84%	9,938,444	6.92%
2010	48,460	1.22%	9,883,640	-0.55%

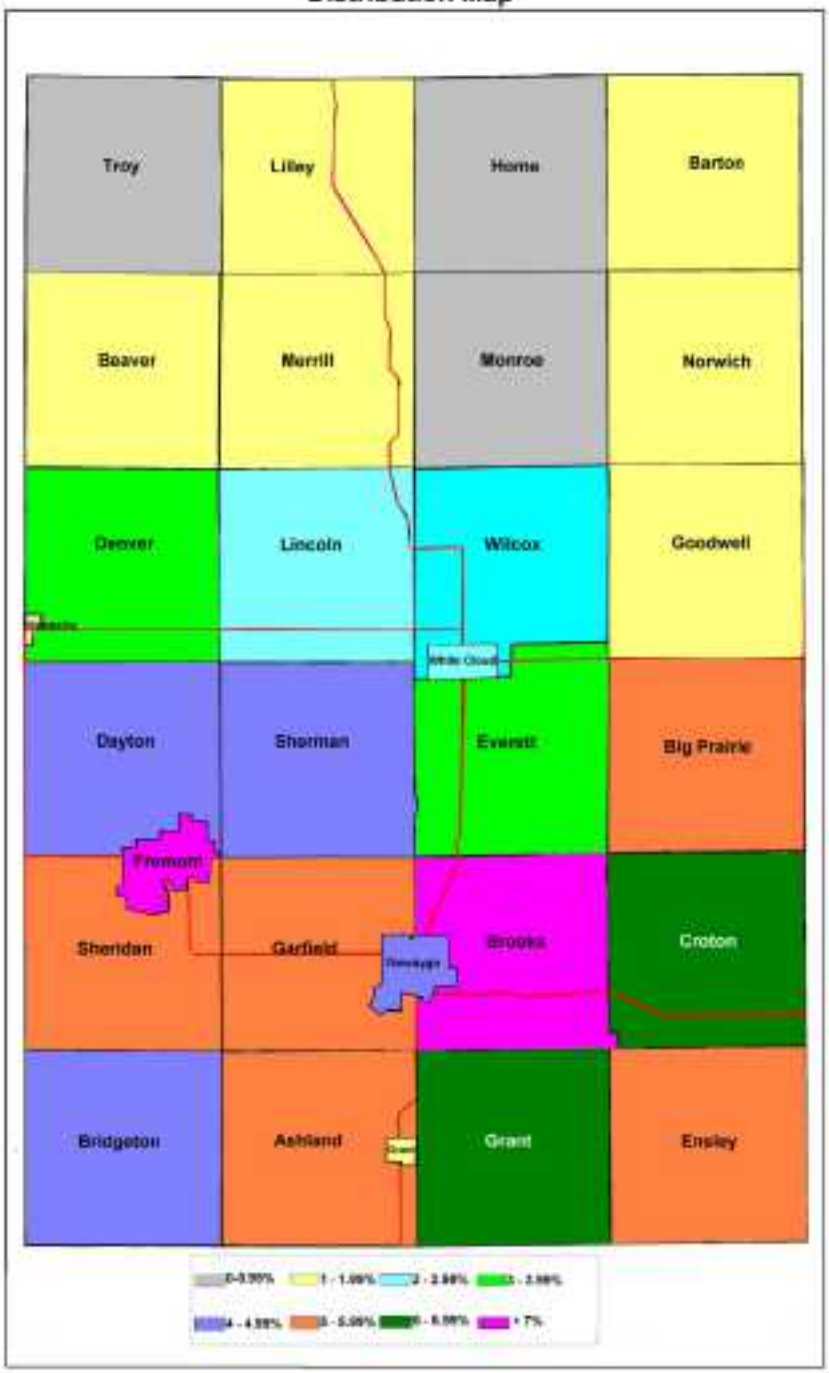
Table 21, Population Distribution in Newaygo County
Sources: Raw population data taken from the 2010 U.S. Census

NEWAYGO COUNTY **POPULATION DISTRIBUTION**		
COMMUNITY	Population	% Population
Newaygo County	**48,460**	**100%**
City of Fremont	4,081	8.42%
City of Newaygo	1,976	4.08%
City of White Cloud	1,408	2.91%
City of Grant	894	1.84%
Village of Hesperia	954	
Ashland Township	2,773	5.72%
Barton Township	717	1.48%
Beaver Township	509	1.05%
Big Prairie Township	2,573	5.31%
Bridgeton Township	2,141	4.42%
Brooks Township	3,510	7.24%
Croton Township	3,228	6.66%
Dayton Township	1,949	4.02%
Denver Township	1,928	3.98%
Ensley Township	2,635	5.44%
Everett Township	1,862	3.84%
Garfield Township	2,537	5.24%
Goodwell Township	547	1.13%
Grant Township	3,294	6.80%
Home Township	232	0.48%
Lilley Township	797	1.64%
Lincoln Township	1,275	2.63%
Merrill Township	667	1.38%
Monroe Township	320	0.66%
Norwich Township	607	1.25%
Sheridan Township	2,510	5.18%
Sherman Township	2,109	4.35%
Troy Township	283	0.58%
Wilcox Township	1,098	2.27%

* total of cities and townships; village total already included with township totals

source: U.S. Census Bureau

Newaygo County Population Percentage Distribution Map



Seasonal Population Trends

In the spring and summer months, Newaygo County experiences a significant population increase due to seasonal residences, summer youth camps, and numerous recreational activities. The following is an estimated population during the peak months. The population estimate for seasonal homes is based on the number of seasonal homes in Newaygo County times the average household size reported in the 2010 US Census. The data for the number of campsites in Newaygo County is from the District 10 Public Health Department Environmental Office. The data for the Youth Camps, Hotels, and Bed and Breakfasts are based on their total reported capacity.

	Newaygo County Population	Newaygo County % Change
2010 Census Total	48,460	
Seasonal Homes (4,885 Homes x 2.60 Persons per household)	12,701	+ 26.2%
Campsites (1,995 sites x 4 Persons per campsite)	7,980	+ 21.7%
Youth Camps 6 Camps	1,448	+ 3.0%
Hotels and Bed & Breakfasts 23 Facilities	1,024	+ 2.1%
Outdoor recreational activities (Muskegon River, Parks, and special events)		
Projected Increase	**71,523**	+47.6%

Projected Population

Based on data from “The Economic and Demographic Outlook for Michigan through 2040” 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 Newaygo County will continue to grow at a faster rate than the statewide average through the year 2040.

Household Distribution

Household Distribution can influence a community's needs since the distribution often identifies unique community traits. Newaygo County has several household characteristics that may influence hazard planning. Table 20 shows the County has a higher proportion of family households than Michigan. Within the overall category of family households, Newaygo 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.

Table 22: Household and Family Characteristics of Newaygo County and the State of Michigan
Source: 2010 U.S. Census

	Newaygo County		Michigan	
Households By Type	**Total**	**Percentage**	**Total**	**Percentage**
Total households	**18,406**	**100%**	**3,872,508**	**100%**
Family households (families)	13,162	71.5%	2,554,073	66%
Male Householder	9,937	54.0%	1,774,864	45.8%
Female Householder	3,225	17.5%	779,209	20.1%
Nonfamily households	5,244	28.5%	1,318,435	34.0%
Male householder	2,698	14.7%	618,903	16.0%
Living Alone	2,120	11.5%	483,093	12.5%
Female householder	2,546	13.8%	699,532	18.1%
Living Alone	2,161	11.7%	596,585	15.4%
Husband-Wife Families	**10,363**	**100%**	**1,857,127**	**100%**
With related children under 18 years	4,036	38.9%	773,630	41.7%
With own children under 18 years	3,696	35.7%	730,892	39.4%
Under 6 years only	635	6.1%	151,340	8.1%
Under 6 and 6 to 17 years	804	7.8%	150,573	8.1%
6 to 17 years only	2,257	21.8%	428,979	23.1%
Female householder, no husband present families	**1,832**	**100%**	**511,583**	**100%**
With related children under 18 years	1,194	65.2%	328,376	64.2%
With own children under 18 years	1,036	56.6%	284,562	55.6%
Under 6 years only	221	12.1%	57,710	11.3%
Under 6 and 6 to 17 years	183	10.0%	50,892	9.9%
6 to 17 years only	632	34.5%	1758,960	34.4%
Average Household size	**2.60**		**2.49**	
Average Family size	**3.04**		**3.05**	

Table 23: Household and Family Characteristics of City of Fremont and Newaygo County
Source: 2010 U.S. Census

	City of Fremont		Newaygo County	
Households By Type	**Total**	**Percentage**	**Total**	**Percentage**
Total households	**1,781**	**100%**	**18,406**	**100%**
Family households (families)	1,107	62.2%	13,162	71.5%
Male Householder	719	40.4%	9,937	54.0%
Female Householder	388	21.8%	3,225	17.5%
Nonfamily households	674	37.8%	5,244	28.5%
Male householder	238	13.4%	2,698	14.7%
Living Alone	200	11.2%	2,120	11.5%
Female householder	436	24.5%	2,546	13.8%
Living Alone	396	22.2%	2,161	11.7%
Husband-Wife Families	**776**	**100%**	**10,363**	**100%**
With related children under 18 years	286	36.9%	4,036	38.9%
With own children under 18 years	272	35.1%	3,696	35.7%
Under 6 years only	62	8.0%	635	6.1%
Under 6 and 6 to 17 years	68	8.8%	804	7.8%
6 to 17 years only	142	18.3%	2,257	21.8%
Female householder, no husband present families	**263**	**100%**	**1,832**	**100%**
With related children under 18 years	183	69.6%	1,194	65.2%
With own children under 18 years	171	65.0%	1,036	56.6%
Under 6 years only	45	17.1%	221	12.1%
Under 6 and 6 to 17 years	32	12.2%	183	10.0%
6 to 17 years only	94	35.7%	632	34.5%
Average Household size	**2.27**		**2.60**	
Average Family size	**2.88**		**3.04**	

Table 24: Household and Family Characteristics of City of Newaygo and Newaygo County
Source: 2010 U.S. Census

	City of Newaygo		Newaygo County	
Households By Type	**Total**	**Percentage**	**Total**	**Percentage**
Total households	**786**	**100%**	**18,406**	**100%**
Family households (families)	502	63.9%	13,162	71.5%
Male Householder	299	38.0%	9,937	54.0%
Female Householder	203	25.8%	3,225	17.5%
Nonfamily households	284	36.1%	5,244	28.5%
Male householder	101	12.8%	2,698	14.7%
Living Alone	77	9.8%	2,120	11.5%
Female householder	183	23.3%	2,546	13.8%
Living Alone	164	20.9%	2,161	11.7%
Husband-Wife Families	**312**	**100%**	**10,363**	**100%**
With related children under 18 years	154	49.4%	4,036	38.9%
With own children under 18 years	144	46.2%	3,696	35.7%
Under 6 years only	27	8.7%	635	6.1%
Under 6 and 6 to 17 years	37	11.9%	804	7.8%
6 to 17 years only	80	25.6%	2,257	21.8%
Female householder, no husband present families	**159**	**100%**	**1,832**	**100%**
With related children under 18 years	105	66.0%	1,194	65.2%
With own children under 18 years	99	62.3%	1,036	56.6%
Under 6 years only	31	19.5%	221	12.1%
Under 6 and 6 to 17 years	16	10.1%	183	10.0%
6 to 17 years only	52	32.7%	632	34.5%
Average Household size	**2.51**		**2.60**	
Average Family size	**3.10**		**3.04**	

Table 25: Household and Family Characteristics of City of White Cloud and Newaygo County Source: 2010 U.S. Census

	City of White Cloud		Newaygo County	
Households By Type	**Total**	**Percentage**	**Total**	**Percentage**
Total households	**467**	**100%**	**18,406**	**100%**
Family households (families)	294	63.0%	13,162	71.5%
Male Householder	174	37.3%	9,937	54.0%
Female Householder	120	25.7%	3,225	17.5%
Nonfamily households	173	37.0%	5,244	28.5%
Male householder	71	15.2%	2,698	14.7%
Living Alone	52	11.1%	2,120	11.5%
Female householder	102	21.8%	2,546	13.8%
Living Alone	89	19.1%	2,161	11.7%
Husband-Wife Families	**180**	**100%**	**10,363**	**100%**
With related children under 18 years	77	42.8%	4,036	38.9%
With own children under 18 years	72	40.0%	3,696	35.7%
Under 6 years only	17	9.4%	635	6.1%
Under 6 and 6 to 17 years	23	12.8%	804	7.8%
6 to 17 years only	32	17.8%	2,257	21.8%
Female householder, no husband present families	**86**	**100%**	**1,832**	**100%**
With related children under 18 years	63	73.3%	1,194	65.2%
With own children under 18 years	56	65.1%	1,036	56.6%
Under 6 years only	14	16.3%	221	12.1%
Under 6 and 6 to 17 years	7	8.1%	183	10.0%
6 to 17 years only	35	40.7%	632	34.5%
Average Household size	**2.59**		**2.60**	
Average Family size	**3.20**		**3.04**	

Table 26: Household and Family Characteristics of City of Grant and Newaygo County
Source: 2010 U.S. Census

	City of Grant		Newaygo County	
Households By Type	**Total**	**Percentage**	**Total**	**Percentage**
Total households	**361**	**100%**	**18,406**	**100%**
Family households (families)	229	63.4%	13,162	71.5%
Male Householder	130	36.0%	9,937	54.0%
Female Householder	99	27.4%	3,225	17.5%
Nonfamily households	132	36.6%	5,244	28.5%
Male householder	44	12.2%	2,698	14.7%
Living Alone	33	9.1%	2,120	11.5%
Female householder	88	24.4%	2,546	13.8%
Living Alone	82	22.7%	2,161	11.7%
Husband-Wife Families	**148**	**100%**	**10,363**	**100%**
With related children under 18 years	73	49.3%	4,036	38.9%
With own children under 18 years	69	46.6%	3,696	35.7%
Under 6 years only	20	13.5%	635	6.1%
Under 6 and 6 to 17 years	13	8.8%	804	7.8%
6 to 17 years only	36	24.3%	2,257	21.8%
Female householder, no husband present families	**62**	**100%**	**1,832**	**100%**
With related children under 18 years	46	74.2%	1,194	65.2%
With own children under 18 years	41	66.1%	1,036	56.6%
Under 6 years only	12	19.4%	221	12.1%
Under 6 and 6 to 17 years	11	17.7%	183	10.0%
6 to 17 years only	18	29.0%	632	34.5%
Average Household size	**2.46**		**2.60**	
Average Family size	**3.06**		**3.04**	

Table 27: Household and Family Characteristics of Village of Hesperia and Newaygo County
Source: 2010 U.S. Census

	Village of Hesperia		Newaygo County	
Households By Type	**Total**	**Percentage**	**Total**	**Percentage**
Total households	**382**	**100%**	**18,406**	**100%**
Family households (families)	231	60.5%	13,162	71.5%
Male Householder	160	41.9%	9,937	54.0%
Female Householder	71	18.6%	3,225	17.5%
Nonfamily households	151	39.5%	5,244	28.5%
Male householder	52	13.6%	2,698	14.7%
Living Alone	45	11.8%	2,120	11.5%
Female householder	99	25.9%	2,546	13.8%
Living Alone	88	23.0%	2,161	11.7%
Husband-Wife Families	**152**	**100%**	**10,363**	100%
With related children under 18 years	65	42.8%	4,036	38.9%
With own children under 18 years	56	36.8%	3,696	35.7%
Under 6 years only	4	2.6%	635	6.1%
Under 6 and 6 to 17 years	14	9.2%	804	7.8%
6 to 17 years only	38	25.0%	2,257	21.8%
Female householder, no husband present families	**51**	**100%**	**1,832**	100%
With related children under 18 years	44	86.3%	1,194	65.2%
With own children under 18 years	37	72.5%	1,036	56.6%
Under 6 years only	14	27.5%	221	12.1%
Under 6 and 6 to 17 years	5	9.8%	183	10.0%
6 to 17 years only	18	35.3%	632	34.5%
Average Household size	**2.45**		**2.60**	
Average Family size	**3.14**		**3.04**	

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 Newaygo 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 Newaygo County closely mirrors that of the state as a whole. The median age for Newaygo County is 36 while the median age for the State of Michigan is 35. Newaygo County has a larger percentage of citizens under the age of twenty, 31.7%, compared to the State, 29.0%, and a similar percentage of citizens over the age of sixty-five, 12.8%, compared to the State, 12.3%. 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 need for additional support and assistance beyond standard care.

Table 28: Age Distribution within Newaygo County and the State of Michigan
Source: 2010 U.S. Census, American Fact Finder

	Newaygo County		Michigan	
AGE CATEGORY	**Total**	**Percentage**	**Total**	**Percentage**
	48,460		**9,883,640**	
Under 5 years	3,018	6.2%	596,286	6.0%
5 to 9 years	3,230	6.7%	637,784	6.5%
10 to 14 years	3,533	7.3%	675,216	6.8%
15 to 19 years	3,594	7.4%	739,599	7.5%
20 to 24 years	2,616	5.4%	669,072	6.8%
25 to 29 years	2,453	5.1%	589,583	6.0%
30 to 34 years	2,509	5.2%	574,566	5.8%
35 to 39 years	2,712	5.6%	612,493	6.2%
40 to 44 years	3,120	6.4%	665,481	6.7%
45 to 49 years	3,897	8.0%	744,581	7.5%
50 to 54 years	3,821	7.9%	765,452	7.7%
55 to 59 years	3,438	7.1%	683,186	6.9%
60 to 64 years	2,991	6.2%	568,811	5.8%
65 to 69 years	2,415	5.0%	418,625	4.2%
70 to 74 years	1,954	4.0%	306,811	5.8%
75 to 79 years	1,345	2.8%	244,085	2.0%
80 to 84 years	958	2.0%	200,855	2.0%
85 years and over	856	1.8%	191,881	1.9%
Median Age	**40.9**		**38.9**	

Gender Distribution

Most communities have a higher proportion of females since they have a longer life expectancy. According to the 2010 United States Census, In Michigan, females account for 50.9% of the population and males account for 49.1% of the population. In Newaygo County, females account for 49.7% of Newaygo County's population and males account to 50.3% of the population. Throughout Newaygo County, all cities and the Village of Hesperia have a higher female population, with the exception of the City of White Cloud which has a larger male population due to the County Jail.

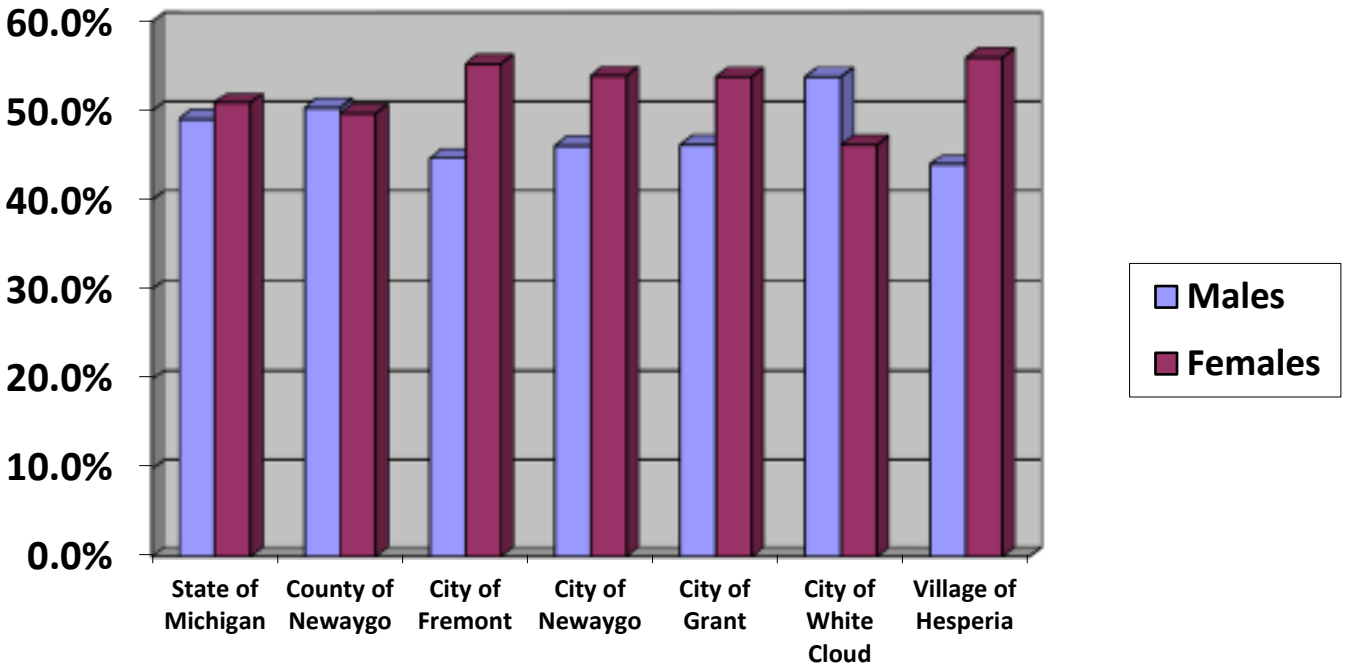


Table 29: Gender Distribution within Newaygo County and the State of Michigan
Source: 2010 U.S. Census, American Fact Finder

NEWAYGO COUNTY **GENDER DISTRIBUTION**				
COMMUNITY	**# Males**	**% Total Population**	**# Females**	**% Total Population**
State of Michigan	4,848,114	49.1%	5,035,526	50.9%
Newaygo County *	24,390	50.3%	24,070	49.7%
City of Fremont	1,825	44.7%	2,256	55.3%
City of Newaygo	910	46.1%	1,066	53.9%
City of White Cloud	758	53.8%	650	46.2%
City of Grant	413	46.2%	481	53.8%
Village of Hesperia	420	44.0%	534	56.0%

Racial Distribution

The racial distribution of Newaygo County is different than Michigan's distribution. Overall, Newaygo County is less diverse than the state as a whole. Newaygo County is predominantly a White Community, with a small percentage of African American, American Indian, and Asian.

Table 30: Racial Characteristics of Newaygo County and the State of Michigan
Source: 2010 U.S. Census

	Newaygo County		Michigan	
RACE	**Total**	**Percentage**	**Total**	**Percentage**
Total Population	48,460		9,883,640	
One race	47,632	98.3%	9,653,321	97.7%
White	45,625	94.1%	7,803,120	78.9%
Black or African American	495	1.0%	1,400,362	14.2%
American Indian and Alaska Native	372	0.8%	62,007	0.6%
Asian	187	0.4%	238,199	2.4%
Asian Indian	28	0.1%	77,132	0.8%
Chinese	47	0.1%	44,496	0.5%
Filipino	33	0.1%	22,047	0.2%
Japanese	11	0.0%	10,911	0.1%
Korean	23	0.0%	24,186	0.2%
Vietnamese	10	0.0%	16,787	0.2%
Other Asian [1]	35	0.1%	42.640	0.4%
Native Hawaiian and Other Pacific	11	0.0%	2,607	0.0%
Native Hawaiian	1	0.0%	753	0.0%
Guamanian or Chamorro	4	0.0%	521	0.0%
Samoan	0	0.0%	359	0.0%
Other Pacific Islander [2]	6	0.0%	791	0.0%
Some other race	942	1.9%	147,029	1.3%
Two or more races	828	1.7%	230,319	2.3%

Primary Language

The primary language spoken at home is less diverse than Michigan as a whole. A higher percentage of Newaygo County households speak English at home compared to the State of Michigan. Data for Newaygo County was not collected in the 2010 census, therefore data from the 2000 census was utilized.

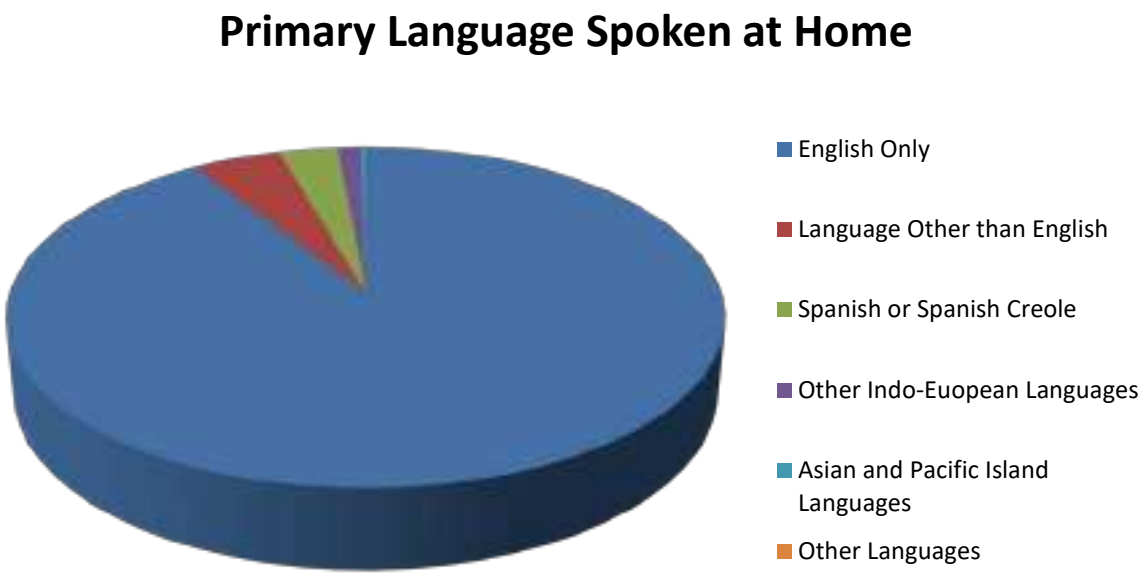


Table 31: English Speaking Households
Source: 2000 and 2010 U.S. Census

	Newaygo County		Michigan	
LANGUAGE SPOKEN AT HOME	**Total**	**Percentage**	**Total**	**Percentage**
Population 5 years and over	**44,614**	**100%**	**9,305,604**	**96.8%**
English only	42,488	95.2%	8,477,438	91.1%
Language other than English	2,126	4.8%	828,202	8.9%
Speak English less than 'very well	785	1.8%	298,153	36.0%
Spanish or Spanish Creole	1,418	3.2%	266,659	2.9%
Speak English less than "very well"	536	1.2%	99,197	37.2%
Other Indo-European languages	570	1.3%	277,618	3.0%
Speak English less than "very well"	172	0.4%	81,620	29.4%
Asian and Pacific Island languages	118	0.3%	133,973	1.4%
Speak English less than "very well"	70	0.2%	58,397	43.6%
Other Languages			148,942	1.6%
Speak English less than "very well"			58,683	39.4%

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. Compared to the State of Michigan, Newaygo County has a higher percentage of people with a physical disability.

Table 32: Population with Physical Disabilities
Source: 2010 US Census of Population

	Newaygo County			Michigan		
	Total	With a Disability	Percent	Total	With a Disability	Percent
Total civilian non-institutionalized Population	**47,900**	**8,186**	**17.1%**	**9,790,070**	**1,308,397**	**13.4%**
Population under 5 Years	**3,041**	**88**	**2.9%**	**603,086**	**4,324**	**0.7%**
With a hearing difficulty		39	1.3%		2,536	0.4%
With a vision difficulty		67	2.2%		2,450	0.4%
Population 5 to 17 Years	**9,182**	**863**	**9.4%**	**1,767,900**	**110,408**	**6.2%**
With a hearing difficulty		84	0.9%		12,464	0.7%
With a vision difficulty		223	2.4%		13,954	0.8%
With a cogitative difficulty		641	7.0%		87,782	5.0%
With an ambulatory difficulty		22	0.2%		11,993	0.7%
With a self-care difficulty		84	0.9%		16,903	1.0%
Population 18 to 64 Years	**28,497**	**4,384**	**15.4%**	**6,116,348**	**706,577**	**11.6%**
With a hearing difficulty		1,263	4.4%		139,393	2.3%
With a vision difficulty		612	2.1%		108,330	1.8%
With a cogitative difficulty		1,903	6.7%		304,685	5.0%
With an ambulatory difficulty		2,245	7.9%		360,804,	5.9%
With a self-care difficulty		726	2.5%		133,872	2.2%
With an independent living difficulty		1,575	5.5%		263,123	4.3%
Population 65 years and over	**7,180**	**2,851**	**39.7%**	**1,302,736**	**284,088**	**37.4%**
With a hearing difficulty		1,533	21.4%		207,241	15.9%
With a vision difficulty		594	8.3%		82,493	6.3%
With a cogitative difficulty		697	9.7%		124,106	9.5%
With an ambulatory difficulty		1,713	23.9%		305,953	23.5%
With a self-care difficulty		562	7.8%		109,123	8.4%
With an independent living difficulty		1,011	14.1%		212,508	16.3%

Education

Educational attainment is important for several reasons, many of which lead to quality of life issues. Newaygo County has a slightly higher population 3 years and over enrolled in school.

Table 33: School Enrollment, Newaygo County and the State of Michigan
Source: 2010 U.S. Census, 2008 – 2010 American Community Survey 3 Year Estimates

	Newaygo County			Michigan		
SCHOOL ENROLLMENT	**Total**	**Public**	**Private**	**Total**	**Public**	**Private**
Population 3 years and over enrolled in school	**11,941**	**87.0%**	**13.0%**	**2,737,830**	**86.7%**	**13.3%**
Nursery school, preschool	858	88.3%	11.7%	149,336	65.7%	34.3%
Kindergarten	694	93.7%	6.3%	130,865	88.1%	11.9%
Elementary School (grades 1-4)	2,555	89.0%	11.0%	515,725	89.2%	10.8%
Elementary School (grades 5-8)	2,893	91.4%	8.6%	544,035	90.1%	9.9%
High School (grades 9-12)	3,138	90.5%	9.5%	598,414	91.7%	8.3%
College, Undergraduate	1,563	68.3%	31.7%	669,881	83.8%	16.2%
Graduate, Professional School	240	64.2%	35.8%	129,574	76.0%	24.0%

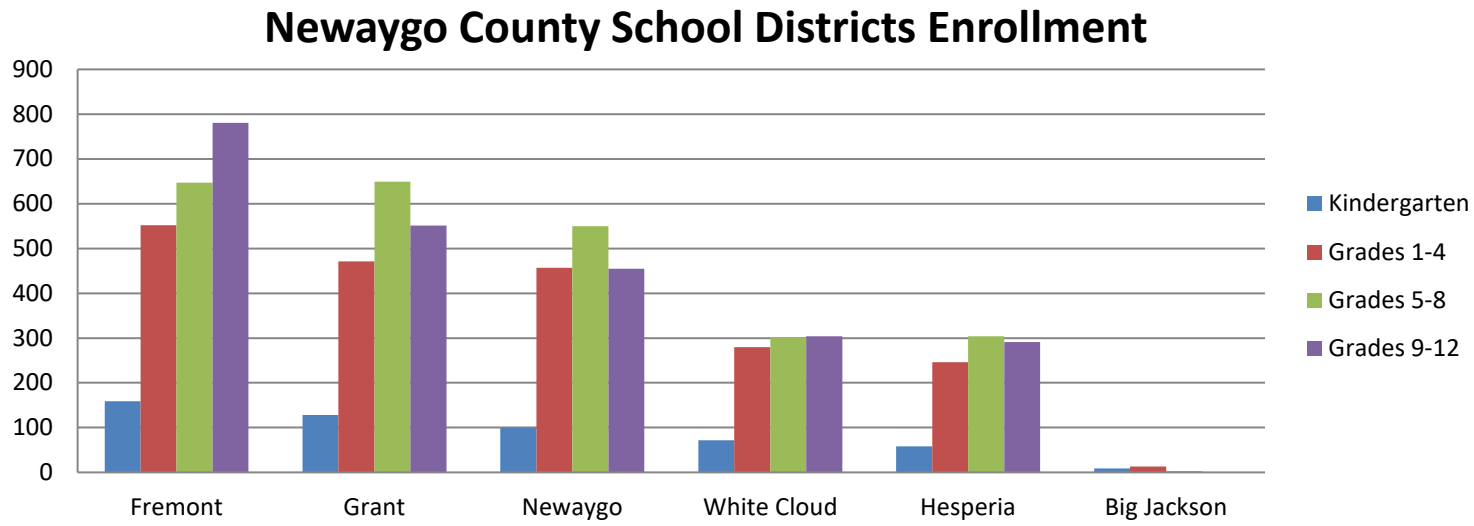


Table 34: Newaygo County School Districts Enrollment
Source: MI School Data from the Michigan Department of Education 2018-2019 School Year

	Newaygo County					
SCHOOL ENROLLMENT	**Fremont**	**Grant**	**Newaygo**	**White Cloud**	**Hesperia**	**Big Jackson**
Population enrolled in school	**2,139**	**1,799**	**1,562**	**957**	**899**	**25**
Kindergarten	159	128	100	72	58	9
Elementary School (grades 1-4)	552	471	457	280	246	13
Middle School (grades 5-8)	647	649	550	301	304	3
High School (grades 9-12)	781	551	455	304	291	

NEWAYGO COUNTY

In Newaygo County in 2000, there was 10.6% of the population 18 and over enrolled in College or Graduate School. In 2010, there was 4.9% of the population 18 and over enrolled in College or Graduate School. The percentage of the population enrolled in College or Graduate School is low due to several contributing factors. First, there are seven universities located within two hour of Newaygo County. These Universities offer a wide variety of two-four year degrees as well as Masters and Doctorate Degrees.

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, Newaygo 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
Muskegon Community College	Muskegon, 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.

A review of data from the 2010 Untied States Census shows that Newaygo County has a slightly higher percentage of high school graduates that the State of Michigan but a lower percentage of population has higher education (Some college with no degree, Associate's Degree, Bachelor's Degree, or a graduate or professional degree).

Table 35: Educational Attainment, Newaygo County and the State of Michigan
Source: 2010 U.S. Census, 2008 – 2010 American Community Survey 3 Year Estimates

	Newaygo County		Michigan	
EDUCATIONAL ATTAINMENT	**Total**	**Percentage**	**Total**	**Percentage**
Population 18 to 24	**3,842**	**100%**	**973,162**	**100%**
Less than high school graduate	1,099	28.6%	150,840	15.5%
High School graduate or GED	1,541	40.1%	276,378	28.4%
Some college or associate's degree	1,076	28.0%	467,118	48.0%
Bachelor's degree or higher	126	3.3%	77,853	8.0%
Population 25 years and over	**32,667**	**100%**	**6,560,571**	**100%**
Less than 9th grade	1,241	3.8%	236,180	3.6%
9th to 12th grade, no diploma	3,528	10.8%	531,406	8.1%
High School Graduate or GED	12,936	39.6%	2,033,777	31.0%
Some college, no degree	8,101	24.8%	1,587,658	24.2%
Associate's Degree	2,515	7.7%	537,967	8.2%
Bachelor's Degree	2,744	8.4%	1,016,888	15.5%
Graduate or Professional Degree	1,568	4.8%	629,815	9.6%
Percent High School graduate or higher		85.4%		88.4%
Percent bachelor's degree or higher		13.3%		25.0%

Economic Characteristics

Current and Projected Economic Activity

Data from the US Census Economic Characteristics, Census of Agriculture, and Newaygo County Economic Development office were used to describe Newaygo County's current and projected economy. Newaygo 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 Newaygo County's situation, agricultural production employees.

Table 36: 2010 Employment Status in Newaygo County compared to the State of Michigan
Source: 2008 – 2010 American Community Survey, and 2011 American Community Survey

	Newaygo County		Michigan	
EMPLOYMENT INDUSTRY	**Estimated number employed**	**Percentage**	**Estimated number employed**	**Percentage**
Civilian employed population 16 years and over	19,039	100%	4,191,878	100%
Agriculture, forestry, fishing, hunting, and mining	1,077	5.7%	56,829	1.4%
Construction	1,399	7.3%	194,973	4.7%
Manufacturing	3,595	18.9%	712,636	17.0%
Wholesale Trade	386	2.0%	103,602	2.5%
Retail Trade	2,186	11.5%	494,540	11.8%
Transportation and warehousing and utilities	1,223	6.4%	173,714	4.1%
Information	271	1.4%	65,919	1.6%
Finance and insurance, and real estate and rental leasing	1,001	5.3%	221,325	5.3%
Professional, scientific, and management, and administrative, and waste management services	1,166	6.1%	381,172	9.1%
Educational services, and health care and social assistance	3,591	18.9%	1,023,530	24.4%
Arts, entertainment, and recreation, and accommodation, and food services	1,297	6.8%	400,644	9.6%
Other services, except public administration	1,165	6.1%	206,364	4.9%
Public Administration	682	3.6%	156,630	3.7%

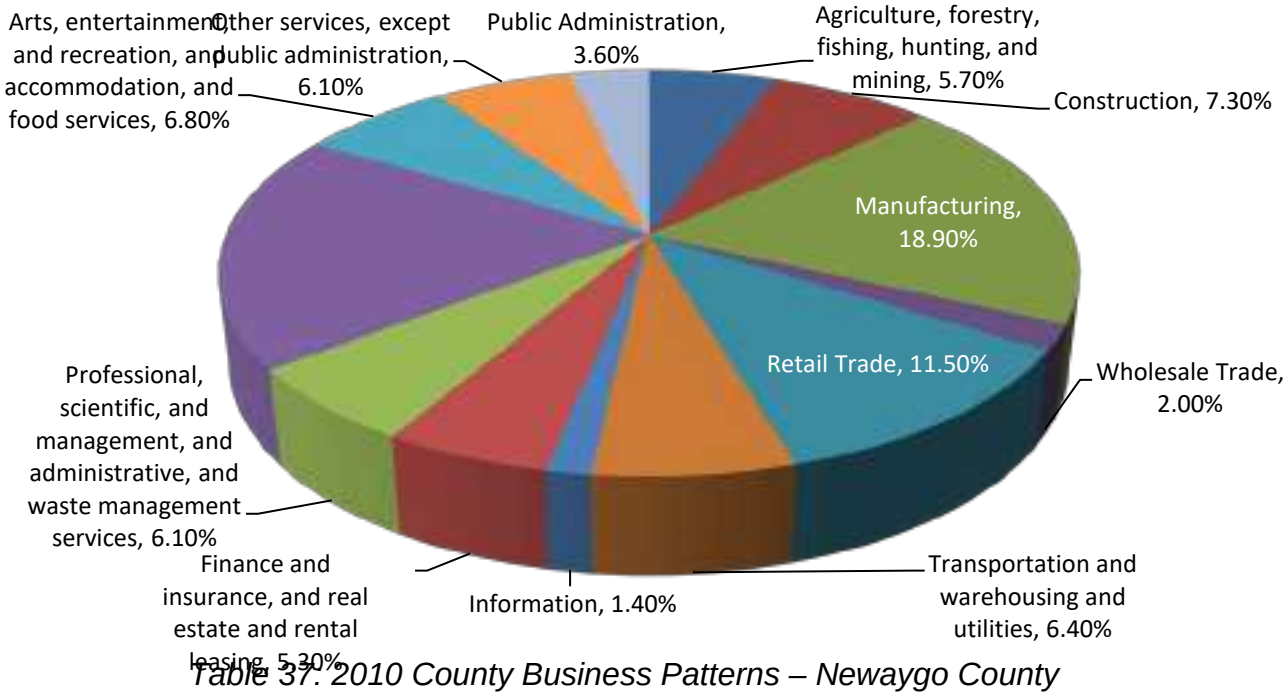


Table 37: 2010 County Business Patterns – Newaygo County
Source: 2010 US Census Economic Characteristics

	Newaygo County	
INDUSTRY	**Number of Establishments**	**Number of Paid Employees**
Total for all sectors	816	8,705
Agriculture, forestry, fishing and hunting, and mining	8	20 - 99
Mining, quarrying, and oil and gas extrication	1	0 – 19
Utilities	4	20 – 99
Construction	84	232
Manufacturing	40	1 778
Wholesale Trade	36	242
Retail Trade	147	1,459
Transportation and warehousing	14	100 – 249
Information	7	20 – 99
Finance and insurance	40	625
Real estate and rental and leasing	22	66
Professional, scientific, and technical services	56	358
Management of companies and enterprises	3	100 – 249
Administrative and support and waste management and remediation services	33	322
Educational Services	4	38
Health care and social assistance	78	1,663
Arts, entertainment, and recreation	10	20 – 99
Accommodation and food services	80	866
Other services (except public administration)	123	515
Industries not classified	26	20 - 99

Major Employers

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

Table 38, Newaygo County Employers with Over 100 Employees
Source: The Right Place

Company	Location	Approximate # Of Employees	Product/Service
Magna Mirrors	Newaygo	1,000	Automotive doors & mirrors
Spectrum Health Gerber Memorial	Fremont	692	Health Care Services
Gerber Products Company	Fremont	564	Baby Food
Fremont Public Schools	Fremont	417	School/Education
Meijer	Fremont	350	Retail/Grocery
Gerber Life Insurance Company	Fremont	331	Life Insurance
Newaygo County Regional Educational Services Agency	Fremont	331	School/Education
Newaygo Public Schools	Newaygo	321	School/Education
Grant Public Schools	Grant	316	School/Education
White Cloud Public Schools	White Cloud	207	School/Education
Hesperia Community Schools	Hesperia	207	School/Education
MPH Trucking and Logistics	Fremont	200	Logistics
County of Newaygo	White Cloud	288	County Government
Wal-Mart	Fremont	195	Retail Department Store
Family Health Care	White Cloud and Grant	163	Health Care Services
Newaygo Medical Care Facility	Fremont	160	Medical
Bucher Hydraulics	Newaygo	147	Manufacturing
Fremont Insurance	Fremont	130	Insurance
Harbison Walker International	White Cloud	114	Refractory Products
GM Wood Products Inc	Newaygo	110	Wood
Transitional Health Services	Fremont	105	Health Care Services
Dura Automotive Systems, Inc	Fremont	104	Metal Stampings

Unemployment Data

Newaygo County has historically experienced a slightly higher unemployment rate than the State of Michigan. These facts are illustrated in Table 39, Newaygo County Employment Statistics, 2002-2019.

Table 39: Newaygo County Employment Statistics, Annual Jobless Rate 2002-2019
Sources: Michigan Department of Energy, Labor, and Economic Growth, Labor Market Information Data Explorer

Unemployment Rate	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Newaygo County	7.9%	8.8%	7.9%	7.4%	7.1%	7.8%	9.0%	13.6%	12.7%	10.3%
Michigan	6.2%	7.1%	7.1%	6.8%	6.9%	7.1%	8.3%	13.4%	12.7%	10.3%
Unemployment Rate	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**		
Newaygo County	9.2%	8.9%	7.2%	5.5%	4.9%	4.9%	4.3%	4.2%		
Michigan	9.1%	8.8%	7.2%	5.4%	5.0%	4.6%	4.1%	4.1%		

Agriculture

According to the 2017 Census of Agriculture, Newaygo County is ranked within the top 25 counties within the state for total market value of agriculture products sold and is ranked within the top 15 for Value of livestock, poultry, and their products. For additional information, see Table 40.

Table 40: Newaygo County Farming Facts- Ranking
Source: 2017 Census of Agriculture County Profile

ITEM	**Quantity**	**State Rank**
Market Value of Agricultural Products Sold ($1,000)		
Total Value of Agriculture Products Sold	128,314	24
Value of Crops including Nursery and greenhouse	48.256	33
Value of Livestock, poultry, and their products	80,058	13
Value of Sales by Commodity Group ($1,000)		
Grains, oilseeds, dry beans, and dry peas	18.665	37
Tobacco	-	
Cotton and Cotton Seed	-	
Vegetables, Melons, Potatoes, and sweet potatoes	15,568	11
Fruits, tree nuts, and berries	9,487	11
Nursery, greenhouse, floriculture, and sod	1,627	38
Cut Christmas Trees and short rotation woody crops	55	38
Other crops and hay	2,854	25
Poultry and eggs (Turkeys)	46	50
Cattle and Calves	15,224	13
Milk and other dairy products from cows	56,904	11
Hogs and pigs	(D)	21
Sheep, goats, and their products	184	25
Horses, ponies, mules, burros, and donkeys	383	12
Aquaculture	(D)	6
Other animals and other animal products	(D)	3

Top Livestock inventory items		
Turkeys	162	
Broilers and other meat type chickens	1,871	
Cattle and Calves	31,396	
Goats	1,344	
Hogs and Pigs	9,617	
Deer	3,625	
Horses and Ponies	1,442	
Layers	3,446	
Top Crop Items (Acres)		
Forage – land used for all hay and haylage, grass silage, and greenchop	25,194	9
Corn for Grain	19,713	34
Corn for Silage	12,812	8
Vegetables Harvested for Sale	7,553	10
Soybeans for Beans	16,064	39

Table 41: Newaygo County Farming Facts Economic Characteristics
Source: 2017 Census of Agriculture County Profile

Economic Characteristics	**Quantity**	**Percent of Total**
Farms by Value of Sales		
Less than $2,500	365	43
$2,500 to $4,999	84	10
$5,000 to $9,999	79	9
$10,000 to $24,999	118	14
$25,000 to $49,999	62	7
$50,000 to $99,999	24	3
$100,000 or more	118	14
		% Change since 2012
Total Farm Production Expenditures	$106,131,000	+10%
Average Per farm ($)	$150,958	+19%
Net Cash Farm Income of Operation	$25,634,000	+13%
Net Average per farm ($)	$30,158	+23%

Table 42: Newaygo County Farming Facts Operator Characteristics
Source: 2017 Census of Agriculture County Profile

Operator Characteristics	**Quantity**
Principal operators by primary occupation:	**1,421**
Farming:	391
Other:	560
Principal Operators by Gender:	
Male	942
Female	479
Average Age of Principal Operator in Years	**55.2**
All Operators by Race	
White	1,410
Black or African American	-
American Indian or Alaska Native	7
Native Hawaiian or other Pacific Islander	-
Asian	-
More than One Race	4
All operators of Spanish, Hispanic, or Latino Origin	21

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 Newaygo County closely resembles the State of Michigan. In 2010, Newaygo County's Median Household Income was $40,874, which is slightly lower than Michigan's Median Household Income of $46,847. The County also has a lower per capita income than the State. In addition, the percentage of residents below the poverty level in the County, 19.5% is higher than Michigan's rate of 16.7%. Table 43, Socio-Economic Levels provides both Newaygo County data, and for comparison purposes, data for the State of Michigan as a whole.

Table 43: Socio-Economic Levels, Newaygo County and Michigan
Source: 2010 U.S. Census

	Newaygo County		Michigan	
INCOME IN 2010	**Total**	**Percentage**	**Total**	**Percentage**
Households	**18,692**	**100%**	**3,803,957**	**100%**
Less than $10,000	1,568	8.4%	316,593	8.3%
$10,000 to $14,999	1,378	7.4%	228,217	6.0%
$15,000 to $24,999	3,032	16.2%	462,501	12.2%
$25,000 to $34,999	2,233	11.9%	430,994	11.3%
$35,000 to $49,999	2,931	15.7%	565,538	14.9%
$50,000 to $74,999	3,851	20.6%	710,581	18.7%
$75,000 to $99,999	1,902	10.2%	444,684	11.7%
$100,000 to $149,999	1,034	5.5%	411,284	10.8%
$150,000 to $199,999	401	2.1%	130,037	3.4%
$200,000 or more	362	1.9%	103,847	2.7%
Median household income (dollars)	**$40,874**		**$46,847**	
Per Capita Income	**$20,161**		**$24,624**	
Percentage of all people whose income in the past 12 months is below the poverty level	**19.5%**		**16.7%**	

Key Community Facilities and Organizations

Key Private and Non-Profit Service Organizations

In Newaygo 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 Newaygo County. Table 44, Key Private and Non-Profit Service Organizations Serving Newaygo County lists some of primary organizations benefiting the entire county.

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

Organization & Location	Primary Focus
American Red Cross Muskegon Office 313 West Webster Avenue Muskegon, MI 49440 Phone: (231) 726-3555 Phone: (800) 813-8111 Fax: (231) 722-4126 Website: Http://www.arcmon.org	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. The American Red Cross is the foremost volunteer emergency service organization in the United States, with more than 1,300 chapters nationwide, 38 Blood Services regions, 18 Tissue Services centers, plus hundreds of stations on U.S. military installations around the world.
Salvation Army 1215 Fulton Street E Grand Rapids, MI 49503 Phone: (616) 459-3433 Fax: (616) 356-1009 Website: http://www.sawmni.org	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.
Commission on Aging 93 Gibbs Street, PO Box 885 White Cloud, MI 49349 Phone: (231) 689-2100 Fax: (231) 689-0871 Website: https://www.countyofnewaygo.com/CommissionOnAging.aspx	The mission of the Commission on Aging is to address critical needs of the Newaygo County elderly (age 60 and older) and to make their lives more comfortable, more meaningful, and to make every attempt to assist them in remaining in their homes as long as possible. Services provided include adult day care, older adult respite services, health and wellness, homemaker, home repair, meals, Medicare and Medicaid Assistance Program, transportation, and information.
TrueNorth Community Services 6308 S Warner Ave, PO Box 149 Fremont, MI 49412 Phone: (231) 924-0641 Fax: (231) 924-5594 Website: https://www.truenorthservices.org/	TrueNorth Community Services is a private, nonprofit organization supported through individual donations, foundations and grants, and funding from the federal government and the State of Michigan. A majority of their programs are available to Newaygo County residents only but direct or fiduciary support is also provided to a total of 15 Michigan counties. TrueNorth Community Services offer more than 60 comprehensive programs and services that fall within four core areas of focus including addressing rural poverty, ensuring youth thrive, building vibrant communities, and providing innovative rural nonprofit leadership.

Fremont Area Community Foundation 4424 W 48th Street, PO Box B Fremont MI 49412 Phone: (231) 924-5350 Fax: (231) 924-5391 Website: https://facommunityfoundation.org/	The Fremont Area Community Foundation is a public charity and community foundation serving the Newaygo County, Michigan area. The mission of the Foundation is to improve the quality of life for the people of Newaygo County. Since 1972, the Foundation has received $60 million in gifts and made $166 million in grants to benefit the Newaygo County area, a 276% return on donors' gifts. The net value of the Foundation's endowment funds was $171 million as of December 2009.
Love Inc of Newaygo County 11 W 96th Street Grant, MI 49327 Phone: (231) 652-4099 Fax: (231) 652-4079 Website: https://loveincnewaygo.com/	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.
Newaygo County Community Emergency Response Team and Medical Reserve Corps 306 North Street, PO Box 885 White Cloud, MI 49349 Phone: (231) 689-7354 Fax: (231) 689-7305 Website: http://www.countyofnewaygo.com/emergencyservices.aspx	The CERT and MRC programs are partner programs with Citizen Corps, a national network of volunteers dedicated to ensuring hometown security. The Community Emergency Response Team (CERT) Program educates people about disaster preparedness for hazards that may impact their area and trains them in basic disaster response skills. The Medical Reserve Corps (MRC) Program coordinates the skills of practicing and retired physicians, nurses and other health professionals as well as other citizens interested in health issues, who are eager to volunteer to address their community's ongoing public health needs and to help their community during large-scale emergency situations. Both volunteer programs are managed by the Newaygo County Emergency Services Department.
Bellwether Harbor 7645 West 48th Street Fremont, MI 49412 Phone: (231) 924-9230 Fax: (231) 924-2012 Website: http://www.bellwetherharbor.org	Bellwether Harbor is a non-profit organization helping animals and people make a connection through education, training, and adoption.
Lake Haven Rescue 551 Pickerel Lake Drive Newaygo, MI 49337 Phone: (231) 652-7507 Website: http://www.lakehavenrescue.org/	Lake haven is an all-volunteer private, non-profit animal rescue shelter dedicated to the care and adoption of homeless and or injured dogs, cats, kittens, and puppies in the West Michigan Area. Services include animal rescue, necessary medical care, temporary shelter, adoption, and low-cost spay/neuter program.

Public Safety Serving Newaygo County

Like most rural communities with limited resources, Newaygo 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 Services

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 Newaygo with the goal of saving lives, preventing property damage, and minimizing damage to the environment. In January of 2007, Newaygo County Emergency Services began a dedicated, full-time emergency management program. Under direction of the Chairperson of the Newaygo 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.

Newaygo County Emergency Services Department
306 S North Street, PO Box 885, White Cloud, MI 49349
Phone: (231) 689-7354 Fax: (231) 689-7305
Website: http://www.countyofnewaygo.com/emergencyservices.aspx

Central Dispatch

Newaygo County Central Dispatch is the central point of contact for all public warning and responder communications within Newaygo County. All County emergency response agencies are served by Newaygo County Central Dispatch, which has been a great benefit to mutual aid ventures within the County.

Newaygo County Central Dispatch
1018 Newell Street, PO Box 885, White Cloud, MI 49349
Phone: (231) 689-5288 Fax: (231) 689-7348
Website: https://www.countyofnewaygo.com/Dispatch.aspx

Law Enforcement

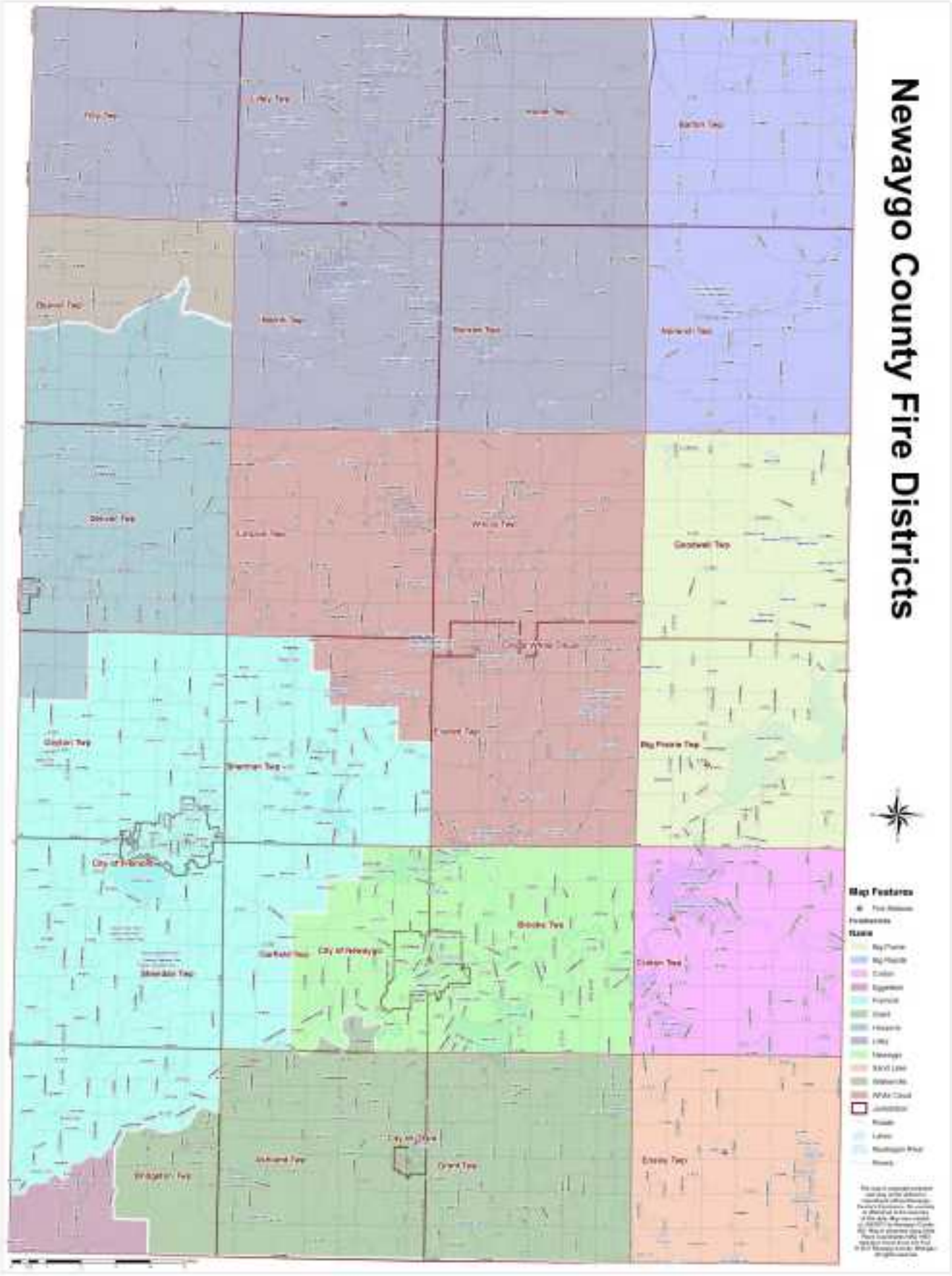
Newaygo County is served entirely by both, the Newaygo County Sheriff's Department and Michigan State Police Post 62. Their efforts are supported by 5 municipal police departments serving the communities of Fremont, Grant, Newaygo, White Cloud, and Hesperia.

Michigan State Police – Hart Post No. 62 3793 W Polk Road, Hart MI 49420 Phone: (231) 873-2171 Fax: (231) 8737700 Website: http://www.michigan.gov/msp
Newaygo County Sheriff Department 1035 James Street, White Cloud, MI 49349 Phone: (231) 689-6623 Fax: (231) 689-7273 Website: https://www.countyofnewaygo.com/SheriffsDepartment.aspx
City of Fremont Police Department 101 E Main Street, Fremont MI 49413 Phone: (231) 924-2100 Fax: (231) 924-2400 Website: https://www.cityoffremont.net/235/Police-Department
City of Newaygo Police Department 28 State Road, PO Box 308, Newaygo MI 49337 Phone: (231) 652-1655 Fax: (231) 652-6589 Website: https://newaygocity.org/fire-police.php
City of Grant Police Department 280 South Maple St, PO Box 435, Grant MI 49327 Phone: (231) 834-7212 Fax: (231) 834-9288 Website:
City of White Cloud Police Department 12 S Charles Street, White Cloud MI 49349 Phone: (231) 689-1696 Fax: (231) 689-2001 Website: http://www.cityofwhitecloud.org/directory/police-department-2/
Hesperia Police Department 33 E Michigan St, PO Box 366, Hesperia, MI 49421 Phone: (231) 854-6205 Fax: (231) 854-0263 Website:

Fire Services

Newaygo County is served by twelve volunteer Fire Departments. 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.

Station 11: Fremont Fire Department 101 E Main Street Fremont MI 49412 Phone: (231) 924-2103 Fax: (231) 924-2015	**Station 12: Newaygo Fire Department** 177 Cooperative Dr., PO Box 243 Newaygo MI 49337 Phone: (231) 652-7788 Fax: (231) 652-7077
Station 13: Ashland Grant Fire Department 62 W State Road, PO Box 422 Grant MI 49327 Phone: (231) 834-5733 Fax: (231) 652-5753	**Station 14: Croton Fire Department** 6431 S Elm Ave Newaygo MI 49337 Phone: (231) 652-3757 Fax: (231) 652-3750
Station 15: Big Prairie Fire Department 2815 S Elm Ave White Cloud MI 49349 Phone: (231) 689-1494 Fax: (231) 652-5518	**Station 17: Lilley Township Fire Department** 10730 Prospect Ave Bitely, MI 49309 Phone: (231) 745-4741 Fax: (231) 745-4741
Station 18: White Cloud Area Fire Department 1301 E Washington Street, PO Box 911 White Cloud MI 49349 Phone: (231) 689-6830 Fax: (866) 866-0611	**Station 19: Hesperia Fire Department** 8320 E M 20 Hesperia MI 49421 Phone: (231) 854-3965 Fax: (231) 854-9539
Walkerville Fire Department (Oceana County) 134 S East Street Walkerville MI 49459 Phone: (231) 873-4540 Fax: (231) 873-7088	**Sand Lake Fire Department (Kent County)** 2 Maple Street Sand Lake, MI 49343 Phone: (616) 799-5538 Fax: (616) 636-8444
Big Rapids City Fire Department (Mecosta County) 435 N Michigan Ave Big Rapids MI 49307 Phone: (231) 527-0005 Fax: (231) 592-5570	**Egelston Township Fire Department (Muskegon County)** 5428 E Apple Ave Muskegon, MI 49442 Phone: (231) 788-2254 Fax: (231) 788-5248


Newaygo County Fire Districts
Map Features

Emergency Medical Services (EMS)

Newaygo County is served by two private EMS services, Life EMS and Pro Med, and one county owned EMS Agency, Mecosta County EMS. Troy Township, Beaver Township, and Denver Township are serviced by Pro Med. Barton Township and Norwich Township are serviced by Mecosta County EMS. The remaining jurisdictions are serviced by Life EMS who maintains ambulance bases in Fremont, Grant, and White Cloud.

Life EMS 33 N Westwood, Ave, Fremont MI 49412 Phone: (231) 928-5433 Fax: (231) 924-2218 Website: http://www.lifeems.com
Mecosta County EMS 14485 Northland Drive, Big Rapids, MI 49307 Phone: (231) 796-2626 Fax: (231) 796-0231 Website: http://www.co.mecosta.mi.us/ambulance.asp

Medical First Responder Services (MFR)

Newaygo County is serviced by seven medical first responder departments, all of which are fire departments except Lilley First Responders. These departments are trained to provide advanced first aid and can administer oxygen.

Station 11: Fremont Fire Department 101 E Main Street, Fremont MI 49412 Phone: (231) 924-2103 Fax: (231) 924-2015	**Station 12: Newaygo Fire Department** 177 Cooperative Dr., PO Box 243, Newaygo MI 49337 Phone: (231) 652-7788 Fax: (231) 652-7077
Station 13: Ashland Grant Fire Department 62 W State Road, PO Box 422, Grant MI 49327 Phone: (231) 834-5733 Fax: (231) 652-5753	**Station 14: Croton Fire Department** 6431 S Elm Ave, Newaygo MI 49337 Phone: (231) 652-3757 Fax: (231) 652-3750
Station 15: Big Prairie Fire Department 2815 S Elm Ave White Cloud MI 49349 Phone: (231) 689-1494 Fax: (231) 652-5518	**Station 17: Lilley Township Fire Department** 10730 Prospect Ave Bitely, MI 49309 Phone: (231) 745-4741 Fax: (231) 745-4741
Station 19: Hesperia Fire Department 8320 E M 20 Hesperia MI 49421 Phone: (231) 854-3965 Fax: (231) 854-9539	**Sand Lake Fire Department (Kent County)** 2 Maple Street, Sand Lake, MI 49343 Phone: (616) 799-5538 Fax: (616) 636-8444

Health Care

Newaygo County has one hospital, Spectrum Health Gerber Memorial Hospital, serving the community. Spectrum Health Gerber Memorial Hospital is a 49-bed not-for-profit community hospital that offers a complete range of medical and surgical services. Medical providers for Spectrum Health Gerber Memorial include physicians in Newaygo County who have practicing privileges at Spectrum Health Gerber Memorial Hospital, consultants who are the specialists from practices in Grand Rapids and Muskegon, emergency staff who are board certified in emergency medicine and contracted from Spectrum Health in Grand Rapids, mid-level practitioners (physician assistants, certified registered nurse anesthetists, nurse practitioners and psychologists), and occupational medicine physicians who focus on illness and injury related to the workplace. SHGM is among an elite group of hospitals to receive the Governor's Award of Excellence for Improving Care in the Hospital Setting and in the Emergency Department – 2003, 2004, 2007 and 2009.

<table>
<tr><td colspan="2">Spectrum Health Gerber Memorial Hospital
212 S Sullivan Street, Fremont MI 49412
Phone: (231) 924-3300
Website: http://www.spectrumhealth.org/gerber</td></tr>
<tr><td>Spectrum Health Internal Medicine and Pediatrics
204 W Main Street, Fremont, MI 49412
Phone: (231) 924-1800</td><td>Spectrum Health Rural Health Clinic – Hesperia
78 N Division Ave, Hesperia MI 49421
Phone: (213) 854-6415</td></tr>
<tr><td>Spectrum Health Rural Health Clinic – Grant
230 S Maple Street, Grant, MI 49327
Phone: (231) 834-5995</td><td>Spectrum Health Gerber Memorial Obstetrics and Gynecology
212 S Sullivan Ave, Fremont MI 49412
Phone: (231) 924-1212</td></tr>
<tr><td>Spectrum Health Medical Group - Fremont
230 W Oak Street, Fremont MI 49412
Phone: (231) 924-4200
Fax: (231) 924-4064
Website: http://www.shmg.org</td><td>Spectrum Health Medical Group - Newaygo
211 W Pine Lake Drive, Newaygo MI 49337
Phone: (231) 652-1631
Fax: (231) 652-2566
Website: http://www.shmg.org</td></tr>
<tr><td>Family Health Care - Grant Clinic
11 North Maple, Grant MI 49327
Phone: (231) 834-0444
Website: Http://www.familyhealthcare.org</td><td>Family Health Care White Cloud Clinic
1035 E Wilcox, White Cloud MI 49349
Phone: (231) 689-5943
Website: Http://www.familyhealthcare.org</td></tr>
</table>

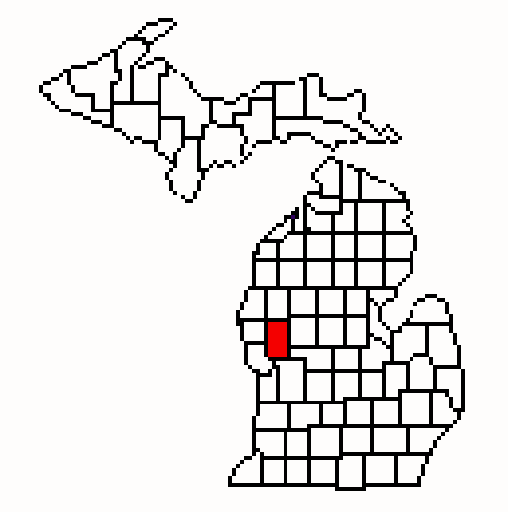
Road Commission and Department of Public Works

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

<table>
<tr><td colspan="2">Newaygo County Road Commission
935 One Mile Road, White Cloud MI 49349
Phone: (231) 689-6682 Fax: (231) 689-5994
Website: http://www.newaygoroads.org</td></tr>
<tr><td>Fremont Department of Public Works
101 E main Street, Fremont MI 49412
Phone: (231) 924-2101
Fax: (231) 924-2888
Website: http://www.cityoffremont.net</td><td>Newaygo Department of Public Works
8233 South Mundy Ave, Newaygo MI 49337
Phone: (231) 924-2101
Website: http://www.newaygocity.org</td></tr>
<tr><td>Grant Department of Public Works
280 South Maple St, PO Box 435, Grant MI 49327
Phone: (231) 834-7462
Website: http://www.cityofgrantmi.com/cityoffices/publicworksdepartment.html</td><td>White Cloud Department of Public Works
12 N Charles Street, PO Box 607, White Cloud, MI 49349
Phone: (231) 689-1194
Website: http://www.cityofwhitecloud.org</td></tr>
<tr><td>Hesperia Department of Public Works
33 E Michigan Ave, Hesperia, MI 49421-0366
Phone: (231) 854-6205 Fax: (231) 854-0263
Website: http://www.hesperiami.com/services.htm</td><td></td></tr>
</table>

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 four cities, one village, and twenty-four township governments within Newaygo County.



County of Newaygo 1087 E Newell Street, PO Box 885, White Cloud, MI 49349 Phone: (231) 689-7200 Fax: (231) 689-7205 Website: http://www.countyofnewaygo.com	
City of Fremont 101 E Main Street, Fremont, MI 49412 Phone: (231) 924-2101 Fax: (231) 924-2888 Website: http://www.cityoffremont.net	**City of Newaygo** 28 N State Road, PO Box 308, Newaygo, MI 49337 Phone: (231) 652-1657 Fax: (231) 652-1650 Website: http://www.newaygocity.org
City of White Cloud 12 N Charles Street, PO Box 607, White Cloud, MI 49349 Phone: (231) 689-1194 Fax: (231) 689-2001 Website: http://www.cityofwhitecloud.org	**City of Grant** 280 S. Maple Street, PO Box 435, Grant, MI 49327 Phone: (231) 834-7904 Fax: (231) 834-5984 Website:

Village of Hesperia
33 E Michigan Ave, Hesperia, MI 49421-0366
Phone: (231) 854-6205 Fax: (231) 854-0263
Website: http://www.webdesignfiles.com/hesperia/

Ashland Township 2019 W 120th St, Po Box 457, Grant MI 49327 Phone: (231) 834-7535 Fax: (231) 834-0446 Website: http://www.ashtwp.com	**Barton Township** 12110 N Beech Ave, Paris, MI 49338 Phone: (231) 796-6867 https://www.facebook.com/pages/Barton-Township-Michigan/104151336288071
Beaver Township 7991 N Dickerson Ave, Bitley, MI 19309 Phone: (231) 837-2425 https://www.facebook.com/pages/Beaver-Township-Newaygo-County-Michigan/103811542991620	**Big Prairie Township** 2815 S Elm Street, White Cloud, MI 49349 Phone: (231) 689-1385 Fax: (231) 652-7930 Website: http://www.bigprairietownship.org
Bridgeton Township 11830 S Warner Ave, Grant, MI 49327 Phone: (231) 834-0014 Fax: (231) 924-2457 Website: http://www.bridgetoncommunity.com	**Brooks Township** 490 Quarterline Rd, PO Box 625, Newaygo MI 49337 Phone: (231) 652-6763 Fax: (231) 652-6721 Website: http://www.brookstownship.org
Croton Township 5833 E Division Street, Newaygo MI 49337 Phone: (231) 652-4301 Fax: (231) 652-7250 Website: http://www.crotontownship.org	**Dayton Township** 3215 S Stone Road, Fremont, MI 49412 Phone: (231) 924-9509 Fax: (231) 924-9509 Website: http://www.daytontownship.com
Denver Township 8333 W 1 Mile Road, Hesperia MI 49421 Phone: NA	**Ensley Township** 7163 E 120th Street, Sand Lake, MI 49343 Phone: (616) 636-8510 Fax: (616) 636-4773 Website: http://www.ensleytownship.org
Everett Township 1516 E 8th Street, PO Box 979 White Cloud, MI 49349 Phone: (231) 689-1082 Fax: (231) 689-1519 http://www.everetttownship.com/	**Garfield Township** 7190 S Bingham Ave, Newaygo MI 49337 Phone: (231) 652-4251 Fax: (231) 652-4207 Website: http://www.garfieldtownship.org
Goodwell Township 2465 N Cypress Ave, White Cloud MI 49349 Phone: NA Fax: (231) 689-1289 http://goodwelltownship.com/Home_Page_9K7H.php	**Grant Township** 1617 E 120th Street, Grant MI 49327 Phone: (231) 834-8033 Fax: (231) 834-0241 Website: http://www.granttownship.net
Home Township 11253 N Walnut Ave, Bitely MI 49309 Phone: NA	**Lilley Township** 10722 N Bingham Ave, Bitely, MI 49309 Phone: (231) 745-9658 Fax: (231) 745-4179
Lincoln Township 1988 N Wisner Ave, PO Box 593 White Cloud, MI 49349 Phone: (231) 689-2070 Fax: (231) 689-8924 http://www.lincolntownship.net/zoning--permits.html	**Merrill Township** 1585 W 11 Mile Road, Bitely MI 49309 Phone: (231) 745-7661 Fax: (231) 745-4105 Website: http://www.merrilltownship.com
Monroe Township 4141 E Fillmore Street, White Cloud MI 49349 Phone: (231) 689-6958 Fax: (231) 689-6958 https://www.monroemitwp.com/	**Norwich Township** 7213 N Cypress Ave, Big Rapids MI 49307 Phone: NA Fax: (231) 796-3363 https://norwichtwp.org/
Sheridan Charter Township	**Sherman Township**

6360 Township Pkwy, PO Box 53 Fremont, MI 49412 Phone: (231) 924-2566 Fax: (231) 924-8734 http://www.sheridanchartertownship.com/	2410 S Wisner Ave, PO Box 153, Fremont MI 49412 Phone: (231) 924-7164 Website: http://www.shermantownship.org
Troy Township 10350 N Dickerson Ave, Walkerville MI 49459 Phone: (231) 873-9000	**Wilcox Township** 1795 Evergreen Dr, PO Box 728 White Cloud MI 49349 Phone: (231) 689-1825 Fax: (231) 689-1828

Local Units of Government and Services Provided

The quality and availability of services varies widely within the County as the result of being mostly rural communities. Table 45, Local Units of Government and Municipal Services, identifies all local units of government within Newaygo County and the municipal services that are available.

Table 45, Local Units of Government and Municipal Services
Compiled by: Newaygo County Emergency Services

Utility Service	City of Fremont	City of Newaygo	City of White Cloud	City of Grant	Village of Hesperia
Natural Gas	DTE Energy	DTE Energy	DTE Energy	DTE Energy	DTE Energy
Electricity	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy
Sanitary Sewer System	City of Fremont	City of Newaygo	W.C.Sherman Utilities	City of Grant	Village of Hesperia
Water Supply System	City of Fremont	City of Newaygo	W.C.Sherman Utilities	City of Grant	Village of Hesperia
Central Storm water Control	City of Fremont	City of Newaygo	City of White Cloud	City of Grant	Village of Hesperia
Local Telephone Service	AT&T	AT&T	AT&T	AT&T	Frontier
Cellular Phone Service	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T
Fiber Optic Cable TV and Internet Access	Comcast NCATS	Charter NCATS	MI Cable Partners Inc NCATS	Charter NCATS	NCATS
Waste Services	Republic Services	A-Waste	Yes	A-Waste	Yes
Recycling	Weekly Curb Side	Recycling for Newaygo Co.	Recycling for Newaygo Co.	Weekly Curbside available	Recycling for Newaygo Co
Refuse	City of Fremont	City of Newaygo	None	City of Grant	Village of Hesperia
Snow Removal (Roads)	City of Fremont	City of Newaygo (Except M-37)	City of White Cloud (Except M-37)	City of Grant (Except M-37)	Village of Hesperia (Except M-20)
Emergency Services					
Law Enforcement	City of Fremont	City of Newaygo	City of White Cloud	City of Grant	Village of Hesperia
Fire Department	Station 11	Station 12	Station 18	Station 13	Station 19
Medical First Responder	Station 11	Station 12	None	Station 13	None
EMS	Life EMS	Life EMS	Life EMS	Life EMS	Life EMS
Zoning					
Local Ordinances	Yes	Yes	Yes	Yes	Yes

Master Plan	Yes	Yes	Yes	Yes	Yes

Utility Service	Ashland Township	Barton Township	Beaver Township	Big Prairie Township	Bridgeton Township
Natural Gas	DTE Energy	None	None	DTE Energy	None
Electricity	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy
Sanitary Sewer System	None	None	None	None	None
Water Supply System	None	None	None	None	None
Central Storm Water Control	None	None	None	None	None
Local Telephone Service	AT&T	AT&T	Frontier	AT&T and Frontier	AT&T and Frontier
Cellular Phone Service	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T
Fiber Optic Cable TV and Internet Access	NCATS Broadband	None	None	None	Partial NCATS Broadband
Waste Services	5 Corners Transfer Station	Private	Private	Private	Private
Recycling	None	None	None	None	None
Refuse	None	None	None	None	None
Snow Removal (Roads)	Road Commission	Road Commission	Road Commission	Road Commission	Road Commission
Emergency Services					
Law Enforcement	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP
Fire Department	Station 13	Big Rapids City	Station 19 Walkerville Fire	Station 15	Station 11 Station 13 Egelston Twp.
Medical First Responder	Station 13	None	None	Station 15	Station 11 Station 13 Egelston Twp.
EMS	Life EMS	Mecosta EMS	Life EMS	Life EMS	Life EMS
Zoning					
Local Ordinances	Yes	Yes	Yes	Yes	Yes
Master Plan	Yes	Yes	Yes	Yes	Yes

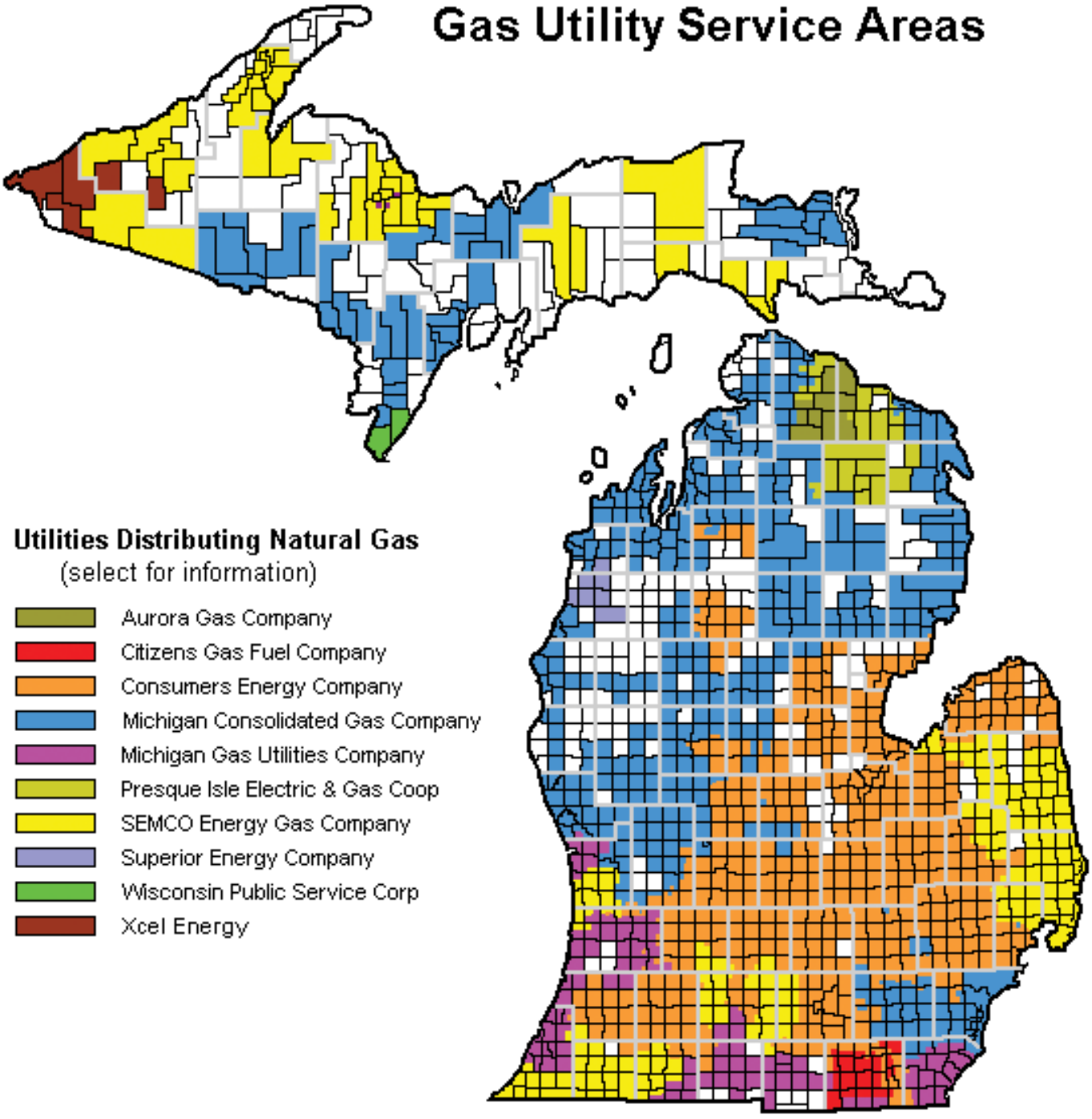
Utility Service	Brooks Township	Croton Township	Dayton Township	Denver Township	Ensley Township
Natural Gas	DTE Energy	DTE Energy	DTE Energy	DTE Energy	DTE Energy
Electricity	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy
Sanitary Sewer System	Small portion City of Newaygo and COLA	None	None	None	None
Water Supply System	Small portion City of Newaygo and COLA	None	None	None	None
Central Storm Water Control	None	None	None	None	None
Local Telephone Service	AT&T	AT&T and Frontier	AT&T and Frontier	AT&T and Frontier	AT&T and Frontier
Cellular Phone Service	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T
Fiber Optic Cable TV and Internet Access	Partial Charter and NCATS Broadband	None	NCATS Broadband	NCATS Broadband	NCATS Broadband
Waste Services	Private	Transfer Station	Private	Private	Private
Recycling	Recycling for Newaygo Co.	Transfer Station	Recycling for Newaygo Co.	Recycling for Newaygo Co.	None
Refuse	None	None	None	None	None
Snow Removal (Roads)	Road Commission	Road Commission	Road Commission	Road Commission	Road Commission
Emergency Services					
Law Enforcement	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP
Fire Department	Station12	Station 14	Station 11	Station 19	Sand Lake Fire
Medical First Responder	Station 12	Station 14	Station 11	None	Sand Lake Fire
EMS	Life EMS	Life EMS	Life EMS	Life EMS	Life EMS
Zoning					
Local Ordinances	Yes	Yes	Yes	Yes	Yes
Master Plan	Yes	Yes	Yes	Yes	Yes

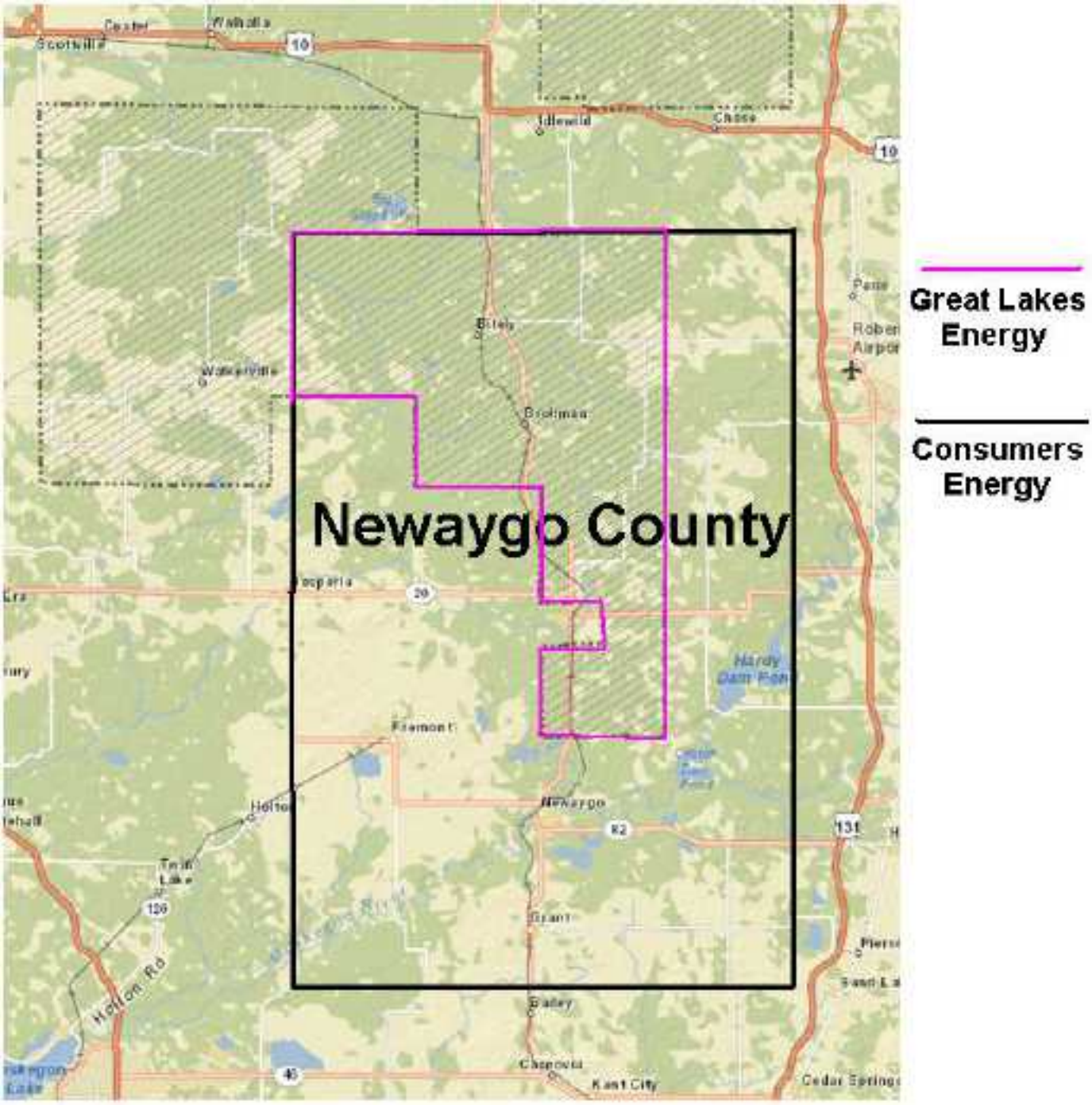
Utility Service	Everett Township	Garfield Township	Goodwell Township	Grant Township	Home Township
Natural Gas	DTE Energy	DTE Energy	None	DTE Energy	None
Electricity	Consumers Energy and Great Lakes Energy	Consumers Energy	Consumers Energy	Consumers Energy	Consumers Energy
Sanitary Sewer System	Small Portion COLA	Small portion COLA	None	Small portion City of Grant	None
Water Supply System	Small Portion COLA	Small Portion COLA	None	Small portion City of Grant	None
Central Storm Water Control	None	None	None	None	None
Local Telephone Service	AT&T	AT&T	AT&T and Frontier	AT&T	AT&T
Cellular Phone Service	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T
Fiber Optic Cable TV and Internet Access	Small portion NCATS Broadband	NCATS Broadband	None	NCATS Broadband	None
Waste Services	Private	Private	Private	Private	Private
Recycling	Recycling for Newaygo Co.	Recycling for Newaygo Co.	None	Recycling for Newaygo Co.	None
Refuse	None	None	None	None	None
Snow Removal (Roads)	Road Commission	Road Commission	Road Commission	Road Commission	Road Commission
Emergency Services					
Law Enforcement	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP
Fire Department	Station 18	Station 11 Station 12	Station 15	Station 13	Station 17
Medical First Responder	None	Station 11 Station 12	Station 15	Station 13	Lilley First
EMS	Life EMS	Life EMS	Life EMS	Life EMS	Life EMS
Zoning					
Local Ordinances	Yes	Yes	Yes	Yes	Yes
Master Plan	Yes	Yes	Yes	Yes	Yes

Utility Service	Lilley Township	Lincoln Township	Merrill Township	Monroe Township	Norwich Township
Natural Gas	None	None	None	DTE Energy	DTE Energy
Electricity	Great Lakes Energy	Consumers Energy	Great Lakes Energy	Great Lakes Energy	Consumers Energy
Sanitary Sewer System	None	None	None	None	None
Water Supply System	None	None	None	None	None
Central Stormwater Control	None	None	None	None	None
Local Telephone Service	AT&T	AT&T	AT&T	AT&T	AT&T
Cellular Phone Service	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T
Fiber Optic Cable TV and Internet Access	None	None	None	None	None
Waste Services	Transfer Station	Private	Transfer Station	Private	Private
Recycling	None	None	None	None	None
Refuse	None	None	None	None	None
Snow Removal (Roads)	Road Commission	Road Commission	Road Commission	Road Commission	Road Commission
Emergency Services					
Law Enforcement	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP
Fire Department	Station 17	Station 18	Station 17	Station 17	Big Rapids City
Medical First Responder	Lilley First	None	Lilley First	Lilley First	None
EMS	Life EMS	Life EMS	Life EMS	Life EMS	Mecosta EMS
Zoning					
Local Ordinances	Yes	Yes	Yes	Yes	Yes
Master Plan	Yes	Yes	Yes	Yes	Yes

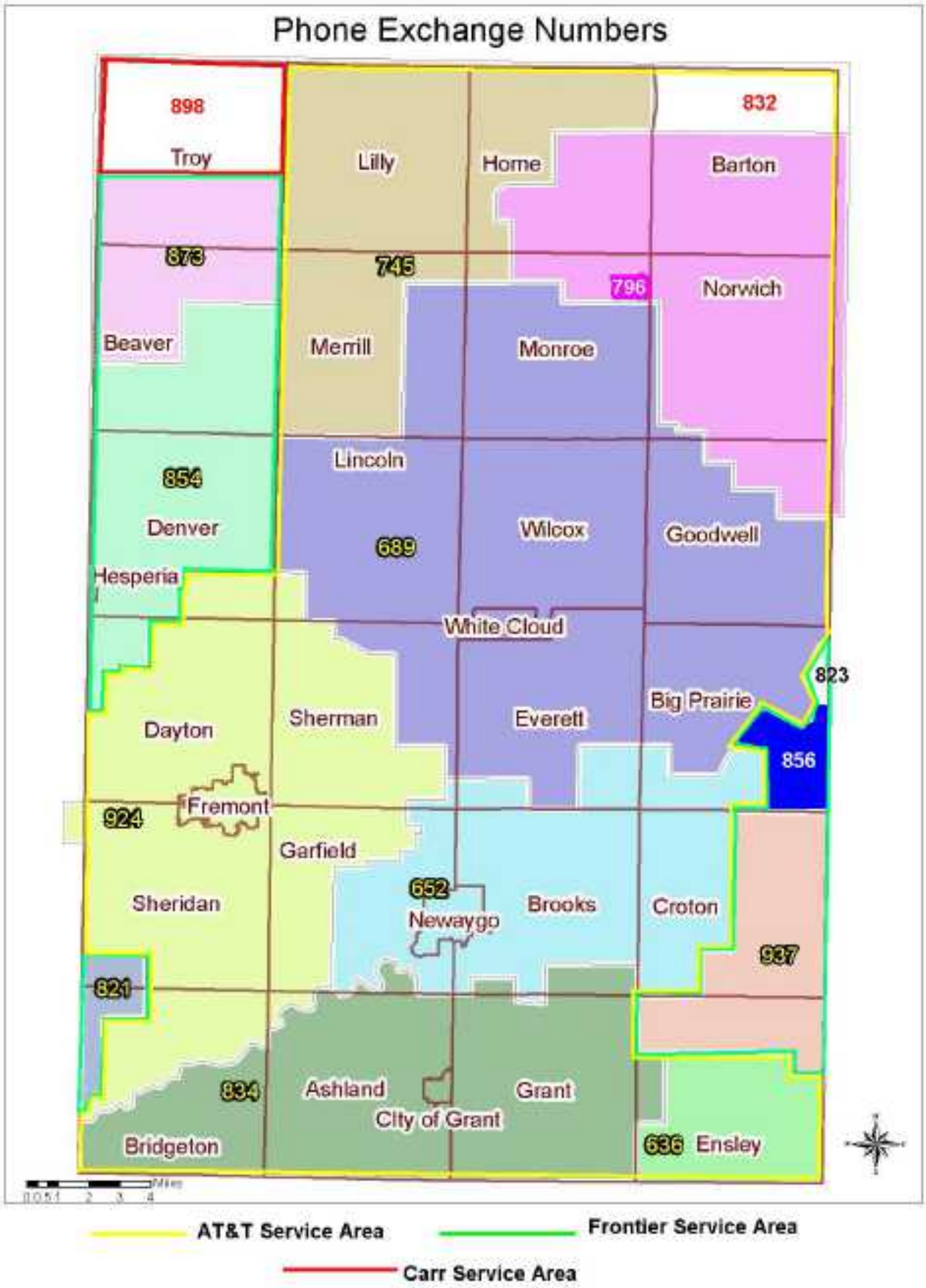
Utility Service	Sheridan Township	Sherman Township	Troy Township	Wilcox Township
Natural Gas	DTE Energy	DTE Energy	None	DTE Energy
Electricity	Consumers Energy	Consumers Energy	Great Lakes Energy	Great Lakes Energy
Sanitary Sewer System	Small portion City of Fremont	W.C.Sherman Utilities	None	None
Water Supply System	Small portion City of Fremont	W.C.Sherman Utilities	None	None
Central Storm Water Control	None	None	None	None
Local Telephone Service	AT&T and Frontier	AT&T	Frontier and Carr	AT&T
Cellular Phone Service	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T	Verizon, Sprint, and AT&T
Fiber Optic Cable TV and Internet Access	NCATS Broadband and partial Comcast	NCATS Broadband and partial Comcast	None	None
Waste Services	Private	Private	Private	Transfer Station
Recycling	Recycling for Newaygo Co.	Recycling for Newaygo Co.	None	Recycling for Newaygo Co.
Refuse	None	None	None	None
Snow Removal (Roads)	Road Commission	Road Commission	Road Commission	Road Commission
Emergency Services				
Law Enforcement	Sheriff MSP	Sheriff MSP	Sheriff MSP	Sheriff MSP
Fire Department	Station 11	Station 11 Station 18	Station 17	Station 18
Medical First Responder	Station 11	Station 11	Lilley First	None
EMS	Life EMS	Life EMS	Life EMS	Life EMS
Zoning				
Local Ordinances	Yes	Yes	Yes	Yes
Master Plan	Yes	Yes	No	Yes

Utilities for Newaygo County



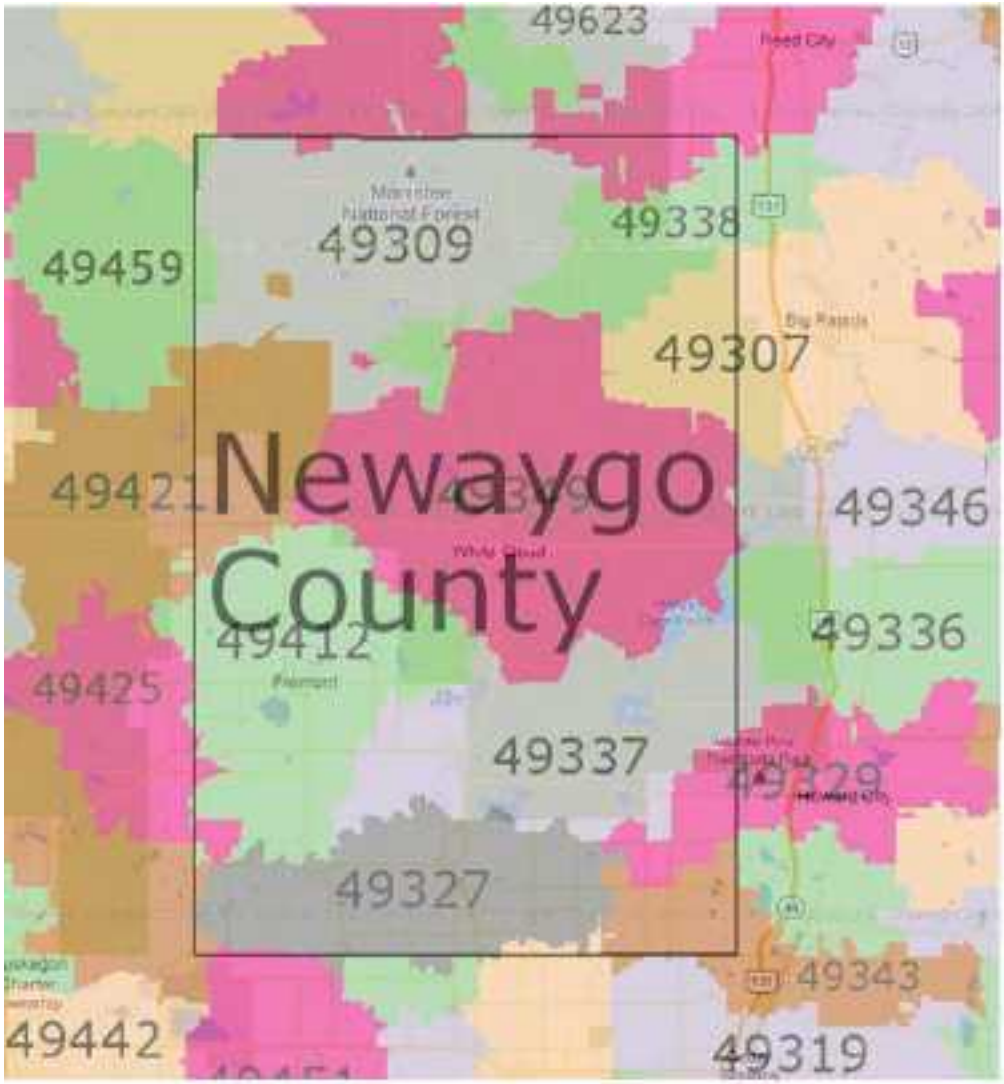


Electric Company Service Area for Newaygo County


Phone Exchange Numbers
898
Troy
Lilly
Home
832
Barton
873
745
796
Norwich
Beaver
Merrill
Monroe
Lincoln
854
Denver
689
Wilcox
Goodwell
Hesperia
White Cloud
823
Big Prairie
Dayton
Sherman
Everett
856
Fremont
924
Garfield
652
Sheridan
Newaygo
Brooks
Croton
937
821
834
Ashland
Grant
City of Grant
Bridgeton
636
Ensley
AT&T Service Area
Frontier Service Area
Carr Service Area

Zip Codes for Newaygo County

Zip Code	City
49309	BITELY
49312	BROHMAN
49327	GRANT
49337	NEWAYGO
49349	WHITECLOUD
49412	FREMONT
49413	FREMONT
49304	BALDWIN
49421	HESPERIA
49459	WALKERVILLE
49677	REED CITY
49338	PARIS
49307	BIG RAPIDS
49336	MORLEY
49329	HOWARD CITY
49343	SAND LAKE



Media Resources Serving Newaygo County

TELEVISION STATIONS	
WWZM TV 13 (ABC Affiliate) **Phone: (616) 599-1300** **Fax: (616) 784-8367** **Website: http://www.wzzm13.com** Primary service point for Newaygo County. Weekly news consists of 4 hours of Local daily news at 5:00 am, 6:00 am, 12:00 pm, 5:30 pm, 6:00 pm and 11:00 pm. Deadlines are at least 1 hour before broadcast.	**WOOD TV 8 (NBC Affiliate)** **Phone: (616) 771-9633** **Fax: (616) 456-5755** **Website: http://www.woodtv.com** Primary service point for Newaygo County. Weekly news consists of 4 ½ hours of Local daily news at 5:00 am, 6:00 am, 12:00 pm, 5:00 pm, 6:00 pm and 11:00 pm. Deadlines are at least 1 hour before broadcast.
WWMT TV 3 (CBS Affiliate) **Phone: (269) 388-8322** **Phone: (269) 388-4302** **Website: http://www.wwmt.com** Tertiary service point for Newaygo County. Weekly news consists of 5 ½ Hours of Local daily news at 5:00am, 6am, 7am, 12pm, 5pm, 5:30 pm, 6:00 pm, and 11pm. Deadlines are at least 1 hour before broadcast	**FOX 17 WXMI (FOX Affiliate)** **Phone: (616) 364-1717** **Fax: (616) 364-6018** **Website: Http://www.fox17online.com** Secondary service point for Newaygo County. Weekly news consists of 3 hours of Local daily news at 6:00 am and 10:00 pm. Deadlines are at least 1 hour before broadcast.
WWTV TV 9 &10 (CBS Affiliate) **Phone: (231) 775-3478 x 3301** **Fax: (231) 775-2731** **Website:** https://www.9and10news.com/ Secondary service point for Newaygo County. The station transmits to 249,450 households. Weekly news consists of 5 Hours of Local daily news at 5:00am, 6:00 am, 12pm, 5pm, 6:00 pm and 11pm. Deadlines are at least 1 hour before broadcast.	**WPBN TV 7 & 4 (NBC Affiliate)** **Phone: (231) 946-2504** **Fax: (231) 947-0354** **Website: http://www.upnorthlive.com** Tertiary service point for Newaygo. Weekly news consists of 3 ½ Hours of Local daily news at 5:00am, 6:00 am, 11am, 5pm, 6:00 pm, and 11pm. Deadlines are at least 1 hour before broadcast.
RADIO STATIONS	
WOOD RADIO (STAR 105.7 FM Grand Rapids) **Phone: (616) 459-1919** **Fax: (616) 732-3330** **Website: http://www.westmichiganstar.com** Primary Emergency Alert System Radio Station.	**WLNT RADIO (95.7 FM Grand Rapids)** **Phone: (616) 451-4800** **Website: http://www.mychannel957.com** Secondary Emergency Alert System Radio Station.
WKAR RADIO (90.5 FM East Lansing) **Phone: (517) 432-9527** **Fax: (517) 353-7124** Statewide Emergency Alert System Radio Station. https://www.wkar.org/	**WYBR & WBRN Radio (102.3 FM / 109.0 FM / 1460 AM Big Rapids)** **Phone: (231) 796-7000** **Fax: (231) 796-7951** **Website: http://www.wybr.com** Tertiary service point for Newaygo County (small audience).

NEWSPAPERS

TIMES INDICATOR (Fremont)

44 West Main Street, PO Box 7 Fremont MI 49412

Phone: (231) 924-4400

Fax: (231) 924-4066

Website: http://www.timesindicator.com/

Primary service point for Newaygo County. Weekly publication on Wednesdays. Deadlines are by Friday at noon.

Hi Lites Shoppers Guide

1212 Locust Street, Fremont MI 49412

Phone: (231) 924-0630

Fax: (231) 924-5580

Website: http://www.hi-lites.net

Serving the Area since 1947, the Hi-lites shoppers guide only publishes advertisements/notices, sales, and classified ads. Weekly publication on Sundays. Deadlines are Thursday by 5:30 PM.

PIONEER NEWS (Big Rapids / Paris)

115 North Michigan Ave, Big Rapids MI 49307

Phone: (231) 592-8360

Fax: (231) 796-1152

Website: http://www.bigrapidsnews.com

The Pioneer is a 6-day a week newspaper covering Big Rapids, greater Mecosta County, Osceola County and parts of Lake and Newaygo Counties. The Pioneer is a division of the Pioneer Group.

LAKE COUNTY STAR

851 Michigan Ave, Baldwin MI 49304

Phone: (231) 745-4635

Fax: (231) 745-7733

Website: http://www.lakecountystar.com

The Lake County Star is a weekly newspaper based in Baldwin, the county-seat of Lake County. The Lake County Star is a division of the Pioneer Group. The Thursday publication has been serving the news and advertising needs of Lake County since 1873. (Northern Newaygo County)

MUSKEGON CHRONICLE (Muskegon)

Phone: (800) 783-3161 X 3

Fax: (231) 722-2552

Email: news@muskegonchronicle.com

City of Muskegon and Muskegon County with a section for Newaygo and Oceana County News. Daily publications. Deadlines are due by 9 am. A part of the MLIVE Media group.

Grand Rapids Press (Grand Rapids)

Phone: (616) 222-5455

Fax: (616) 222-5269

Email: localnews@grpress.com

Secondary service point for Newaygo County, Daily publications. Deadlines are due by 9am. A part of the MLIVE Media group.

SOCIAL MEDIA

Facebook

Http://www.facebook.com

Is a free Social Networking website that allows users to send messages and post information in their personal profiles. The information is shared quickly and is a convenient way to distribute press releases, Amber Alerts, road closings, and other emergency information. In addition, it allows for two way communications with other users to allow for better situational awareness.

Twitter

Http://www.twitter.com

Is a free Social Networking website enabling it users to send and receive messages known as tweets. Tweets are text based posts up to 140 characters displayed on the author's profile page and delivered to the author's subscribers who are known as followers. All users can send and receive tweets via the Twitter website, Short Message Service (SMS), or external applications.

Near North Now – Online Newspaper

https://www.nearnorthnow.com/

Is an online, local newspaper that allows users access to top stories within Newaygo County along with sports, community information, and more. Information can be released quickly (an hour or less) with the cooperation of the editors on their website and posted to Facebook.

MLIVE

http://www.mlive.com

The MLive media group is home to eight newspaper companies including Ann Arbor News, the Bay City Times, Flint Journal, The Grand Rapids Press, Jackson Citizen Patriot, Kalamazoo Gazette, Muskegon Chronicle, and the Saginaw News. MLive posts Digital editions of their newspaper online to their website.

Websites

Http://www.coutnyofnewaygo.com

Newaygo County Information and Technology Department can post press releases on the home page of the County of Newaygo's Website.

Special Events

Throughout the United States, at any given time of year, 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. As of October 2019, Pure Michigan has 421 registered special events for the 2019 Calendar Year and 167 registered special events for the 2020 Calendar Year across Michigan. In Newaygo County, there are annual special events which occur in each community brining in large crowds. Table 46 is a list of the primary special events occurring in Newaygo County.

Table 46, Newaygo County Festivals and Events
Compiled by: Newaygo County Emergency Services

City of Fremont	Month	Approximate Date
Fremont Area Home and Garden Show	March	Third weekend
Family Health and Safety Expo	May	Third weekend
National Baby Food Festival	July	Third week, Wednesday - Saturday
Newaygo County Agricultural Fair	August	First full week, Saturday - Saturday
Fremont Harvest Festival	October	First weekend, Saturday - Sunday
Fremont Farmers Market	June – September	Saturdays and Tuesdays
City of Newaygo	**Month**	**Approximate Date**
Winterfest	January	Last Weekend, Tuesday - Saturday
Troutfest	April	Fourth Weekend
Memorial Day Festival	May	Memorial Day Weekend
PowerPaddle Canoe and Kayak Races	June	Second Weekend
Newaygo County Kids Day	June	Father's Day Weekend, Saturday
Newaygo Farm Market	July – October	
July 4th Celebration	July	July 4th timeframe
Riverstock Festival	August	Second Weekend, Friday - Sunday
Logging Festival	September	Labor Day Weekend
Holiday Festival	December	First Weekend, Friday - Sunday
City White Cloud	**Month**	**Approximate Date**
Winter Carnival	March	First Saturday
Kids Free Fishing Day	June	First Saturday
White Cloud Homecoming	June	Father's Day weekend, Friday - Sunday
Airport Fly-in and Pancake Breakfast	June	Father's Day
Pow Wow Days	August	First weekend, Saturday - Sunday
City of Grant	**Month**	**Approximate Date**
Grant Festival	August	Third weekend, Friday - Saturday
Community Christmas	December	Second Saturday
Village of Hesperia	**Month**	**Approximate Date**
Hesperia Family Fun Festival	July	July 4th Holiday, 4 days
Croton Township	**Month**	**Approximate Date**
Dam to Dam Ice Fishing Contest	February	DNR Free Fishing Weekend
Hooking Up Heroes	June	Second Saturday
Croton Dam Annual 4th Celebration	July	July 4th Holiday, 4 days
Hot Boat Weekend	September	First weekend after Labor Day

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 Newaygo County Hazard Analysis has been developed by Newaygo County Emergency Services, 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 2007 and 2012 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 Newaygo 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 Newaygo 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, Newaygo 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 Newaygo County's Hazard Classes to the Michigan Hazard Analysis 2019 Document.

Newaygo County Hazard Analysis	Michigan Hazard Analysis	
Natural Hazards: Weather Hazards		
Thunderstorm	• Thunderstorm • Lightning	• Hail
Tornados	• Tornadoes	• Severe Winds
Extreme Temperatures	• Cold	• Heat
Severe Winter Weather	• • Snowstorms	• Ice and Sleet Storms •

Newaygo County Hazard Analysis	Michigan Hazard Analysis	
Natural Hazards: Hydrologic Hazards		
Flooding	• Riverine Flooding • Great Lakes Shoreline	• Urban Flooding • Dam and Levee Failures
Drought	• Drought	•
Natural Hazards: Ecological Hazards		
Wildfires	• Wildfires	
Invasive Species	• Invasive Species (aquatic and terrestrial)	
Natural Hazards: Geologic Hazards		
Geologic Hazards	• Impacting Object	• Space Weather
Technological Hazards: Industrial Hazards		
Fires	• Structural Fires	• Industrial Fires
Hazardous Materials	• Fixed Site (Industrial Accidents) • Transportation • Oil and Natural Gas Well Accidents	• Nuclear Power Plant Emergencies • Petroleum and Natural Gas Pipeline Accidents
Technological Hazards: Infrastructure Problems		
Infrastructure Failure	• Infrastructure Failures	• Energy Emergencies
Transportation	• Major Transportation Accidents (air, rail, highway, marine)	
Human Related Hazards		
Public Health	• Public Health Emergencies	
Criminal Incidents	• Civil Disturbances • Cyber-attack	• 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. Newaygo 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. Newaygo 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 Newaygo 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 TORNADOES

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. Tornados 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, 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 thunderstorms (with the damaging winds and hail) are in your area or are imminent.

The 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.

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 (¼" diameter) to a golf ball (1¾" diameter), but hailstones larger than baseballs (2¾" 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	¼" (6mm)	Too many to include	Minimal structural impacts, but crop damages can be severe.	Every county in Michigan
Marble or mothball	½" (13mm)			
Penny or dime	¾" (19mm)	Too many to include	Old threshold for severe hail, raised to 1" in 2009.	Every county in Michigan
Nickel	0.9" (22mm)			
Quarter	1" (25mm)	} 1213	$70.1M property damage, $3.55M in crop damage	Every county in Michigan
Half-dollar	1¼" (32mm)	}		
Walnut or ping-pong ball	1½" (38mm)	} 501	$229M property damage, $3.71M crop damage, 3 inj.	Almost all counties throughout the state
Golf ball	1¾" (44mm)	}		
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	2½" (64mm)	12		
Baseball	2¾" (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	4½" (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 Newaygo County
Within Newaygo County there has been 48 recorded hail events which have caused $325,000 in property damage and $235,000 in crop damage from 1950 through August 2019 according to the National Centers for Environmental Information Storm Event Database.

Hail Events in Newaygo County

Date	Location	Hail Size	Property Damage	Crop Damage
8/30/1958	NEWAYGO CO.	1.75 in.	0.00K	0.00K
7/31/1963	NEWAYGO CO.	1.00 in.	0.00K	0.00K
5/25/1973	NEWAYGO CO.	1.00 in.	0.00K	0.00K
6/17/1975	NEWAYGO CO.	1.00 in.	0.00K	0.00K
7/10/1975	NEWAYGO CO.	0.75 in.	0.00K	0.00K
6/8/1985	NEWAYGO CO.	0.75 in.	0.00K	0.00K
5/17/1986	NEWAYGO CO.	0.75 in.	0.00K	0.00K
6/11/1986	NEWAYGO CO.	1.00 in.	0.00K	0.00K
8/6/1993	Ensley Center	0.75 in.	0.00K	0.00K
4/26/1994	Bridgeton	0.75 in.	0.00K	0.00K
9/25/1994	Bridgeton	0.75 in.	0.00K	0.00K
7/15/1995	Bitely	0.88 in.	0.00K	0.00K
6/20/1997	CROTON	0.88 in.	0.00K	0.00K
6/11/1999	WHITE CLOUD	0.75 in.	0.00K	0.00K
5/12/2000	BRUNSWICK	0.88 in.	40.00K	0.00K
5/12/2000	NEWAYGO	0.88 in.	30.00K	10.00K
7/22/2003	WHITE CLOUD	0.75 in.	25.00K	10.00K
5/6/2004	HESPERIA	0.88 in.	20.00K	20.00K
5/8/2004	NEWAYGO	1.00 in.	20.00K	20.00K
5/8/2004	NEWAYGO	0.88 in.	20.00K	20.00K
5/23/2004	BROHMAN	0.75 in.	15.00K	15.00K
6/23/2004	NEWAYGO	1.00 in.	10.00K	10.00K
9/3/2004	NEWAYGO	0.88 in.	5.00K	5.00K
1/12/2005	FREMONT	0.88 in.	5.00K	5.00K
4/22/2006	WHITE CLOUD	0.88 in.	5.00K	5.00K
6/28/2006	FREMONT	0.75 in.	5.00K	5.00K
6/28/2006	BITELY	0.75 in.	5.00K	5.00K
7/9/2006	WHITE CLOUD	1.00 in.	5.00K	5.00K
7/9/2006	BIG PRAIRIE	1.00 in.	5.00K	5.00K
9/6/2006	GRANT	0.75 in.	10.00K	5.00K
9/6/2006	FREMONT	0.75 in.	15.00K	5.00K
10/2/2006	BITELY	1.00 in.	10.00K	10.00K
10/2/2006	VOLNEY	0.88 in.	10.00K	10.00K
10/2/2006	NEWAYGO	1.00 in.	10.00K	10.00K
10/2/2006	GRANT	1.00 in.	10.00K	10.00K
10/2/2006	WOODVILLE	0.75 in.	10.00K	10.00K
6/2/2007	BROHMAN	0.88 in.	0.00K	0.00K
7/9/2007	ENSLEY CENTER	0.88 in.	5.00K	0.00K
1/7/2008	CROTON	0.75 in.	0.00K	0.00K
7/2/2008	NEWAYGO	1.00 in.	0.00K	0.00K
7/2/2008	CROTON	1.00 in.	0.00K	0.00K
6/21/2011	WHITE CLOUD ARPT	1.00 in.	0.00K	0.00K
5/20/2013	OXBOW	1.00 in.	0.00K	0.00K
5/30/2013	NEWAYGO	1.25 in.	0.00K	0.00K
5/2/2018	BISHOP	0.88 in.	0.00K	0.00K
8/29/2019	FREMONT MUNI ARPT	1.75 in.	10.00K	10.00K
8/29/2019	FREMONT MUNI ARPT	2.50 in.	10.00K	25.00K
TOTALS			325.00K	235.00K

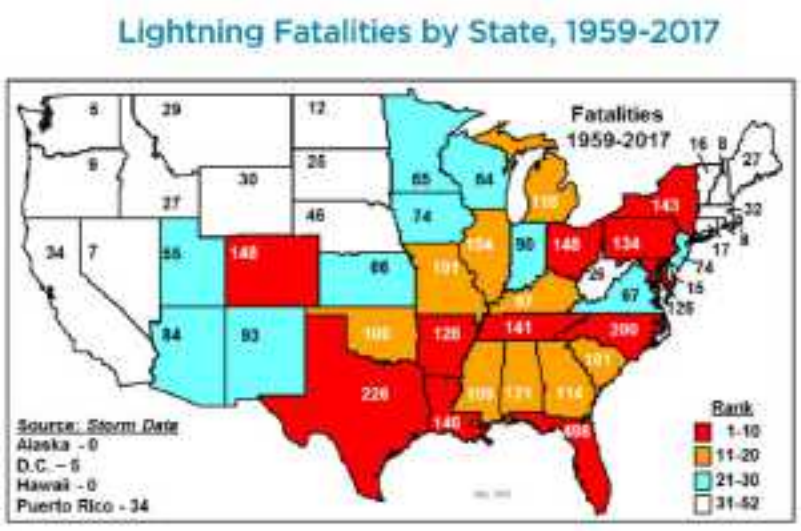
Lightning Hazards

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 1959 through 2017, Michigan has incurred 110 lightning fatalities, ranking 14th nationally.



Within in a detailed analysis of lightning deaths in the United States from 2006 through 2018, the National Lightning Safety Council found of the 396 lightning deaths between 2006 and 2018, leisure activities were responsible for 244, almost two-thirds (62%) of the deaths. During the same period, there were 64 fatalities (16%) related to routine daily or weekly activities, and 72 fatalities (18%) related to work. The remaining 16 fatalities (4%) resulted in unknown circumstances.

Looking further into the overall breakdown of the types of leisure-related deaths, 35% were a result of water related activities including Water-related activities include fishing, boating, swimming, or just relaxing at a beach or lake. Sports-related activities contributed another 13%. 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 (7%); social gatherings (7%); hiking (4%); walking (4%); relaxing outside the home (3%); tourism (2%); children's play (2%); horseback riding (2%); and "other" (9%). The "Other" category included: hunting, building a tree house, building a cabin, 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, waiting in a parking lot, walking to a car from a local park, attending a rock festival, searching for arrowheads, and getting better cell phone reception.

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: June 20, 1979 – Camp Grayling (Crawford County)
Forty-five National Guardsmen were injured and three of them hospitalized when lightning struck a mess tent during a training mission.

Case: September 19, 1997 – Southern Lower Peninsula (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 – Southern Lower Peninsula (Wayne, Washtenaw, and Kent Counties)
A severe thunderstorm developed, and a great amount of lighting 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 – Southern Lower Peninsula (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.

Lightning Hazards in Newaygo County
Within Newaygo County there has been 1 recorded lightning events which have caused $100,000 in property damage from 1950 through August 2019 according to the National Centers for Environmental Information Storm Event Database. This event occurred on June 5, 2008 when an isolated severe thunderstorm resulted in a report of one-inch diameter hail. In addition, a lightning strike resulted in a gas well fire in Ensley Center in Newaygo County, resulting in significant damage.

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.

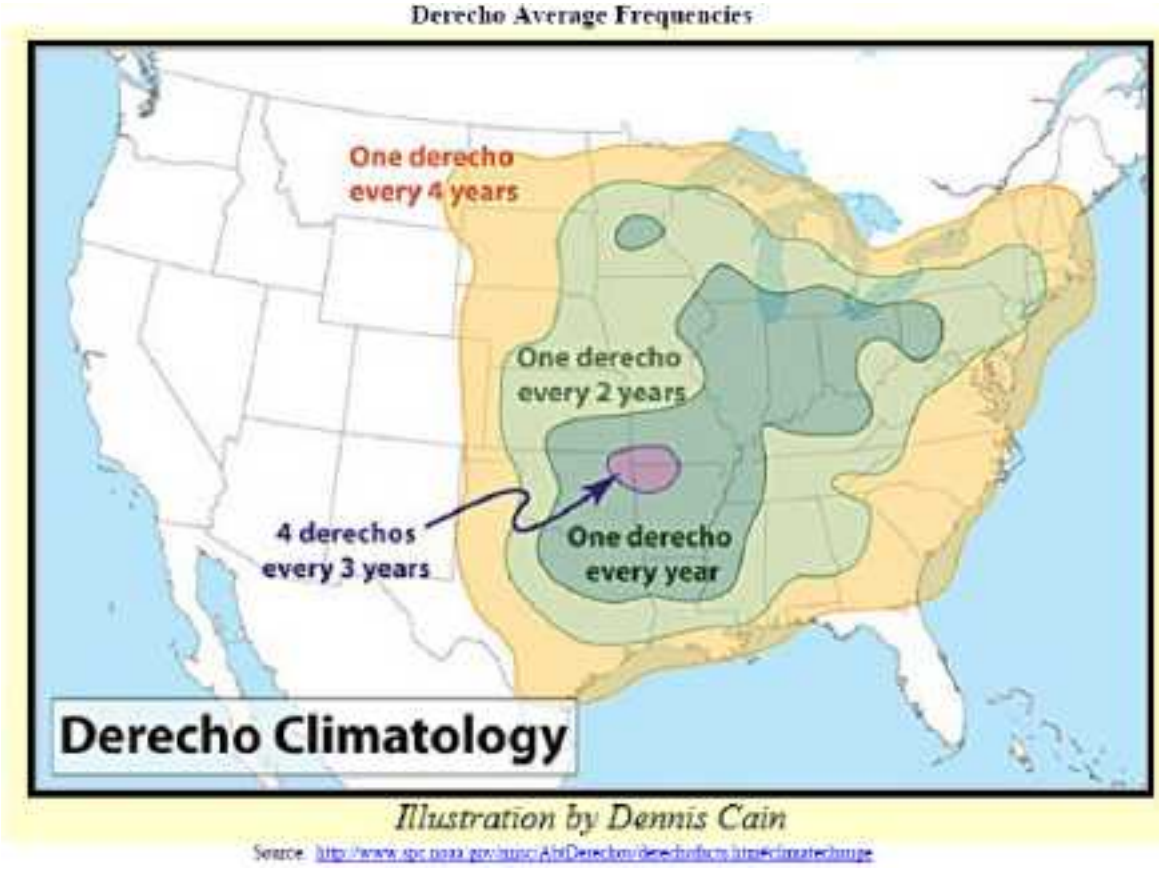
Another dangerous aspect of straight-line winds is that they occur more frequently beyond the April to September time frame than is seen with the other thunderstorm hazards. It is not rare to see severe winds ravage parts of the state in October and November—some winter storm events in Michigan have 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.



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

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 7, 1991 – Southern Lower Michigan

On July 7, 1991, a line of severe thunderstorms with very high winds crossed the southern Lower Peninsula. The National Weather Service recorded wind speeds of 60-70 miles per hour, with gusts in several locations exceeding 80 miles per hour. Several million dollars in damage occurred, and over one million electrical customers (more than 10% of the State's population) were left without power, some for several days. In addition, thousands of downed power lines caused significant public safety concerns and burdened an already difficult restoration process. Property damages were tallied in the counties of Ingham, Kent, and Oakland. In Lapeer County, a mobile home was tipped over, windows were blown out of several homes, and numerous trees and power lines were blown down.

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: July 2, 1997 – South-Central and Southeast Michigan

On July 2, 1997, a series of intense thunderstorms went through south-central and southeast Michigan, spawning severe straight-line winds, several tornadoes, and heavy rainfall. In some areas, the straight-line winds reached speeds of 70-100 miles per hour, causing significant structural damage and massive amounts of debris. Severe storms, tornadoes, and associated impacts caused a total of 7 deaths and 106 injuries. The tornadoes and straight-line winds downed thousands of trees and power lines, which knocked out power to 350,000 electrical customers. A Presidential Major Disaster Declaration was granted for the five-county area most severely impacted by the storm event. Straight-line wind damage was severe within the counties of Berrien, Calhoun, Cass, Clinton, Eaton, Gratiot, Ingham, Macomb, Midland, Saginaw, Washtenaw, and Wayne. (See the Tornadoes section for additional details on the tornadoes associated with these severe thunderstorms.)

Case: May 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.

Case: March 8, 2017 – Southern Lower Peninsula
Widespread wind peaked at 60 to 70 mph across the southern Lower Peninsula, without being a part of thunderstorm systems. These strong winds alone caused electric power failures that affected as many as 1 million Michigan residents. Numerous trees and tree limbs had fallen across power lines, and damaged homes and buildings. Two persons in Clare County were killed by a tree falling onto their vehicle while driving on M-115 near the Osceola county line in Freeman Township. Total damages amounted to about $525 million across the following counties: Allegan ($12M), Baraga ($60K), Barry ($10M), Bay ($7M), Calhoun ($10M), Clare ($5M), Clinton ($10M), Eaton ($10M), Genesee ($25M), Gratiot ($10M), Huron ($7M), Ingham ($10M), Ionia ($10M), Iron ($40K), Isabella ($10M), Jackson ($10M), Kalamazoo ($13M), Kent ($15M), Lake ($5M), Lapeer ($10M), Lenawee ($15M), Livingston ($25M), Macomb ($30M), Mason ($5M), Mecosta ($10M), Midland ($7M), Monroe ($15M), Montcalm ($10M), Muskegon ($15M), Newaygo ($10M), Oakland ($35M), Oceana ($10M), Osceola ($5M), Ottawa ($15M), Saginaw ($23M), Sanilac ($7M), Shiawassee ($7M), St. Clair ($25M), Tuscola ($7M), Van Buren ($10M), Washtenaw ($25M), and Wayne ($25M).

Severe Wind Hazards in Newaygo County
From 1950 – 2019, there were over 83 Severe Thunderstorm events or wind storms in Newaygo County causing five deaths, over $2 million in property damage and $50,000 in crop damage. With severe thunderstorms, there is also the threat of hail and lightning. Since 1950, there has been 42 hail events reported with $295,000 in property damage and $200,000 in crop damage, and there has been 1 lightning storm with $4,000 in property damage when lightning struck a house and ignited a fire that damaged the upper story in the Fremont area.

Based on historical occurrence, Newaygo County experiences an estimated average of 4 or more thunderstorm events causing wind or lightning damage per year. Most severe thunderstorms within Newaygo 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. Nearly 70,000 customers were still without power Monday morning at 5 AM EDT.

Case: May 31, 1998

A strong line of thunderstorms moved through west and central Michigan. Michigan State Police EMD's Damage and Injury Assessment Report indicated $1,237,000 in public damage costs, 48 homes destroyed, 690 homes damaged, and 15 businesses damaged across Newaygo County. Newaygo County declared a local state of emergency and was granted a Governor's disaster declaration to activate state assistance for the county. On June 24th, President Clinton granted a Major Disaster Declaration for Newaygo County, making federal disaster assistance available. The widespread and severe damage which occurred with the fast-moving line of thunderstorms during the early morning hours of Sunday, May 31st, was caused primarily by strong straight-line winds and isolated wet microburst winds. 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 formed in South Dakota on the evening of Saturday, May 30th, and raced eastward at 70 mph across Minnesota, Iowa, and Wisconsin, before striking Michigan's Lower Peninsula around 4:30 am EDT Sunday morning, May 31st. The derecho event produced widespread 60 to 90 mph wind gusts, which caused extensive tree and structural damage and left over 861,000 homes and businesses without electricity across Michigan's Lower Peninsula. Consumers Energy reported the derecho event was the most destructive weather event in its history, leaving over 600,000 of its customers without power

Case: April 11, 2001

Severe thunderstorms produced extensive damage across Newaygo County including roof damage from blown off shingles on a home 5 miles north of White Cloud at 11:57 p.m. It was reported to the National Weather Service of numerous trees were blown down along M-37 between Newaygo and White Cloud. Minor roof damage to a house occurred 3 miles northeast of Fremont. In White Cloud, 8 trees were blown down, each of which was 2 feet in diameter. Overall, the storm cause $100,000 of property damage in Newaygo County.

Case: March 9, 2002

A very strong area of low pressure produced numerous reports of wind gusts over 60 m.p.h. across southern lower Michigan, with sustained winds of 30 to 40 m.p.h. High wind damage across the area ranged from downed trees and power lines to property damage. The storm caused $485,000 of property damage across 19 counties including Newaygo County.

Case: October 30, 2004

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 Newaygo County.

Case: July 17, 2006
A Severe Thunderstorm with 60 mph winds knocked down numerous power lines and trees causing $110,000 in property damage and $10,000 in crop damage.

Case: October 4, 2006
A slow moving low pressure system and its attendant cold front brought an early October severe thunderstorms episode with numerous reports of large hail and high winds of 52 mph causing $30,000 in property damage and $10,000 in crop damage.

Case: June 8, 2008
Trained spotters reported that estimated wind gusts to 70 mph blew down many trees around the intersection of Peach and 120th.NWS storm survey teams determined that one EF1 tornado struck Osceola County. Another EF1 tornado struck Eaton County and continued into extreme western Ingham County before dissipating. Extensive damage was documented in association with both tornadoes. Severe thunderstorms also produced numerous reports of wind damage and large hail.

Case: July 11, 2011
Two separate bow echoes moved across western lower Michigan during the morning hours of July 11, producing numerous reports of wind damage. The first bow echo moved onshore north of Muskegon shortly after daybreak. The second bow echo proved to be more destructive as it raced east from northern Illinois across far southern Lake Michigan and southern lower Michigan, resulting in numerous reports of downed trees and power lines. One person lost his life in Cutlerville when a tree fell in the garage he was in. Several trees and power lines were blown down in Grant, Croton and east of White Cloud. There was a 40 mile path of intermittent downburst win damage. Winds were estimated to be from 40-70 mph.

Case: July 30, 2012
Severe thunderstorms produced several reports of damaging wing gusts across portions of Newaygo County. Large trees fell on a home. Other large trees were also blown over. Two deaths were reported with this storm.

Case: November 17, 2013

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

Severe thunderstorms with damaging wind gusts developed near a warm front during the mid-afternoon hours of April 12th and continued through the late afternoon and evening hours. 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. Roofs were blown off multiple structures and campers were blown over. Hundreds of trees were blown down across southern and northern Newaygo County. This storm caused damage to hundreds of homes in Ashland, Grant, Ensley, Lilley, Home, and Barton Townships.

Case: August 28, 2018 – Newaygo County

A line of severe thunderstorms impacted lower Michigan during the evening hours of August 28th, 2018. Strong winds of 50 to 60 mph were common along the line with pockets of intense damaging winds of 75 to 90 mph. There were also two tornadoes embedded within the strongest winds near Baldwin and Idlewild. The most extensive damage was along US-10 from Ludington to Reed City, with separate areas of intense damage near Big Rapids and Le Roy. Numerous trees were blown down across portions of Newaygo County.

Case: July 20, 2019 – Newaygo, Lake, Mason County

A round of severe storms resulted in numerous reports of downed trees and power lines. Peak wind gusts were estimated at up to around 70 to 80 mph. In addition 6 to 10 inches of rain fell across much of Mason and Lake Counties. There were several road washouts, a few culvert failures, and a couple of bridge washouts. At least 48 homes were damaged by water in Lake County. Trees were blown down county wide and Croton in Newaygo County was especially hard hit.

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 the violently rotating columns of wind known as funnel clouds. Michigan lies at the northeastern edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Missouri, Illinois, Indiana, and Ohio. Most of a tornado's destructive force is exerted by the powerful winds that knock down walls and lift roofs from buildings in the storm's path. The violently rotating winds then carry debris aloft that can be blown through the air as dangerous missiles.

A tornado may have winds up to 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 damaged caused, not by its size. It is important to remember that the size of a tornado is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be extremely strong, and vice versa. It is very difficult to judge the intensity and power of a tornado while it is occurring. Generally, that can only be done after the tornado has passed, using the Enhanced Fujita Scale as the measuring stick. The Enhanced Fujita Scale 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 had 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: July 2, 1997 – South-Central and Southeast Michigan

On July 2, 1997 a series of intense thunderstorms went through south-central and southeast Michigan, spawning severe straight-line winds, several tornadoes, and heavy rainfall. In some areas, the straight-line winds reached speeds of 70-100 miles per hour, causing significant structural damage and massive amounts of debris. The severe storms and the associated impacts caused a total of 16 deaths and 120 injuries. The tornadoes and straight-line winds downed thousands of trees and power lines, which knocked out power to 350,000 electrical customers. A Presidential Major Disaster Declaration was granted for the five county area most severely impacted by the storm event.

Case: May 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 146 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.

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 persons. 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 persons.

Case: October 18-19, 2007 – Lower Peninsula

A tornado occurred at night, and based on extensive damage to buildings and trees, it was classified EF2, with top winds estimated between 120 and 130 mph. The tornado began just northeast of Mason around 10:28 pm EDT and moved northeast at 40 to 45 mph through the City of Williamston between 10:40 and 10:45 pm. Approximately 100 structures were damaged in a subdivision on the south side of Williamston. Two fatalities occurred about 4 miles northeast of Williamston, where a modular home and its two occupants were flipped into a pond. The tornado then moved into Shiawassee County, where 1 person was injured. Additional tornado impacts were felt after midnight in Genesee, Tuscola, and Huron Counties. Total property damages were more than $15 million. A tornado outbreak also rocked the Northern Lower Peninsula from dinnertime into the early evening of October 18, 2007. Six tornadoes on one day marked a new record for the Northern Lower Peninsula. A tornado fatality occurred in Kalkaska—the first in the Northern Lower Peninsula since March 30 1976, when a single death had occurred in Ogemaw County. The impacted northern counties were Alcona, Alpena, Cheboygan, Kalkaska, and Oscoda.

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 persons 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.

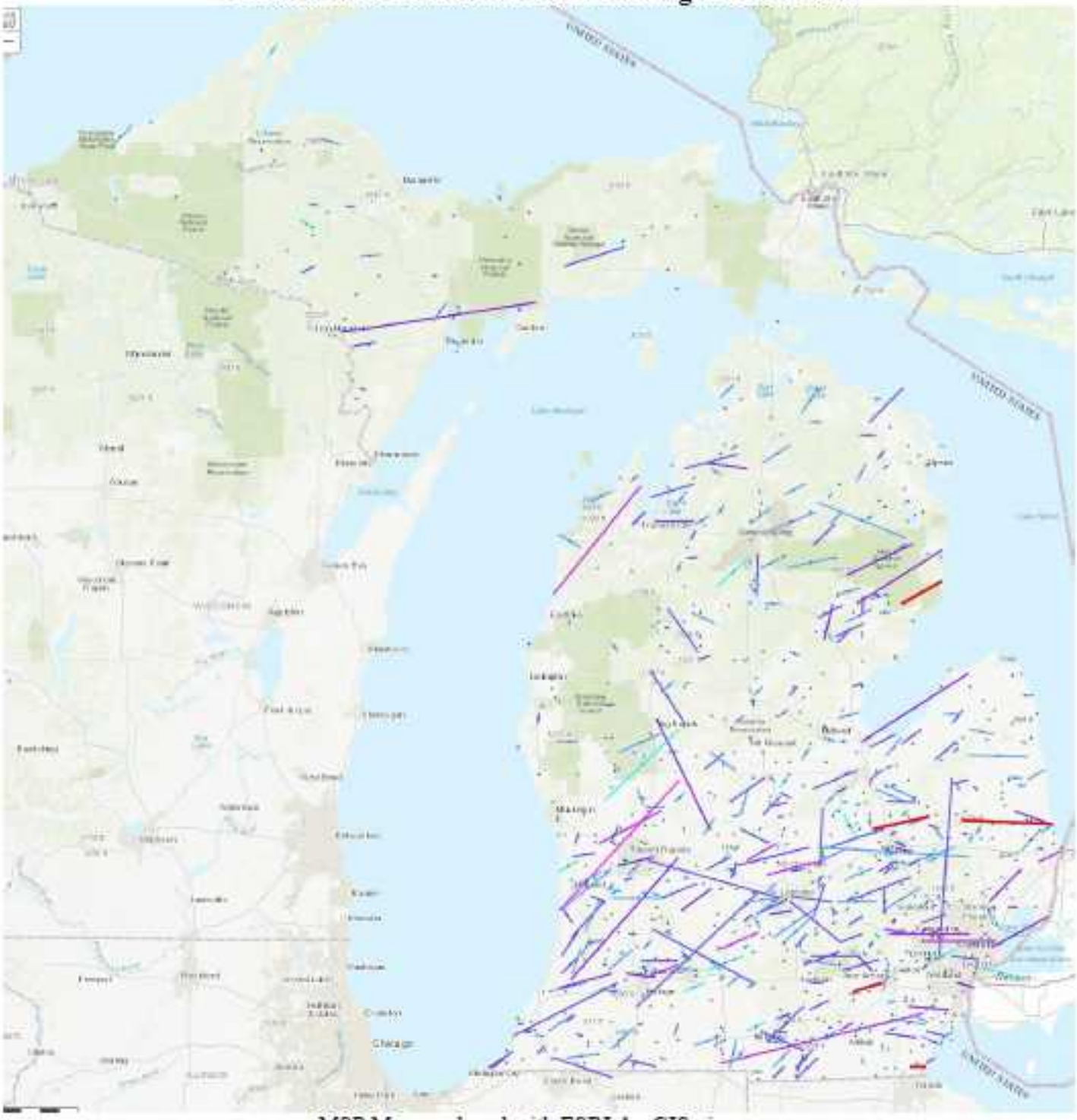
Case: August 20, 2016 – Ottawa County

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.

Michigan Tornado Track Map
Tornado locations and tracks in Michigan: 1950-2016



MSP Map produced with ESRI ArcGIS viewer

NOTE: Different sources of information do provide different numbers.

Tornado Hazards in Newaygo County

Since 1950, Newaygo County has experienced 13 tornadoes causing 3 injuries and 2 deaths, $190,000 property damage, and $10,000 crop damage from tornadoes since 1950. Two significant tornados in Newaygo County include a F2 Tornado that struck Newaygo on September 26, 1951 at 2100, injuring three and killing one. On June 17, 1975 another F2 Tornado struck the County killing one person.

Other Newaygo County Tornado Events include:
F1 on 4/28/1964 at 1415 causing $25,000 of property damage
F1 on 8/10/1971 at 1410 causing $3,000 of property damage
F1 on 4/12/1979 at 1820 causing $25,000 of property damage
F1 on 5/25/1989 at 0043 causing $25,000 of property damage
F1 on 6/2/1990 at 1759 causing $25,000 of property damage
F1 pm 9/14/1990 at 0805 causing $25,000 of property damage
F0 on 3/27/1991 at 1702 causing no property damage
F0 on 7/1/1999 at 1300 causing $10,000 of property damage
F0 on 8/1/2002 at 2105 causing $2,000 of property damage in Grant
F0 on 6/29/2005 at 1620 causing $10,000 of crop damage
EF0 on 11/17/13 at 1500 causing $50,000 property of damage

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

The most limited capability with severe thunderstorms and high winds is local warning systems. Warning systems in Newaygo 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 Newaygo County there are eight Tornado Sirens.

NEWAYGO TORNADO SIREN LOCATIONS

Location	Address	Activation	Population
Fremont DPW	805 Oak Street, Fremont	Tornado Only	4,224
Newaygo (North)	40 Centerline Road, Newaygo	Tornado Only	1,670
Newaygo (South)	355 Clay Street, Newaygo	Tornado Only	
Grant Fire Department	62 W State Street, Grant	Fire and Tornado	**881**
Croton Township	6464 S Croton-Hardy Drive, Newaygo	Fire and Tornado	1,200
Big Prairie Fire Department	2815 S Elm Street	Fire and Tornado	600
Lilley Fire Department	10730 N Prospect, Bitely	Fire and Tornado	400
Hesperia Village Hall	33 E Michigan Street, Hesperia	Tornado Only	954

Additional systems implemented to augment warning consisting of strategically placed tone alert monitors and Nixle Alert and Notification System, 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 Newaygo County's popular special seasonal events. It is impractical to list and detail all of Newaygo 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 Newaygo County are:

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

Local Special Events within Newaygo County vulnerable for Severe Thunderstorms

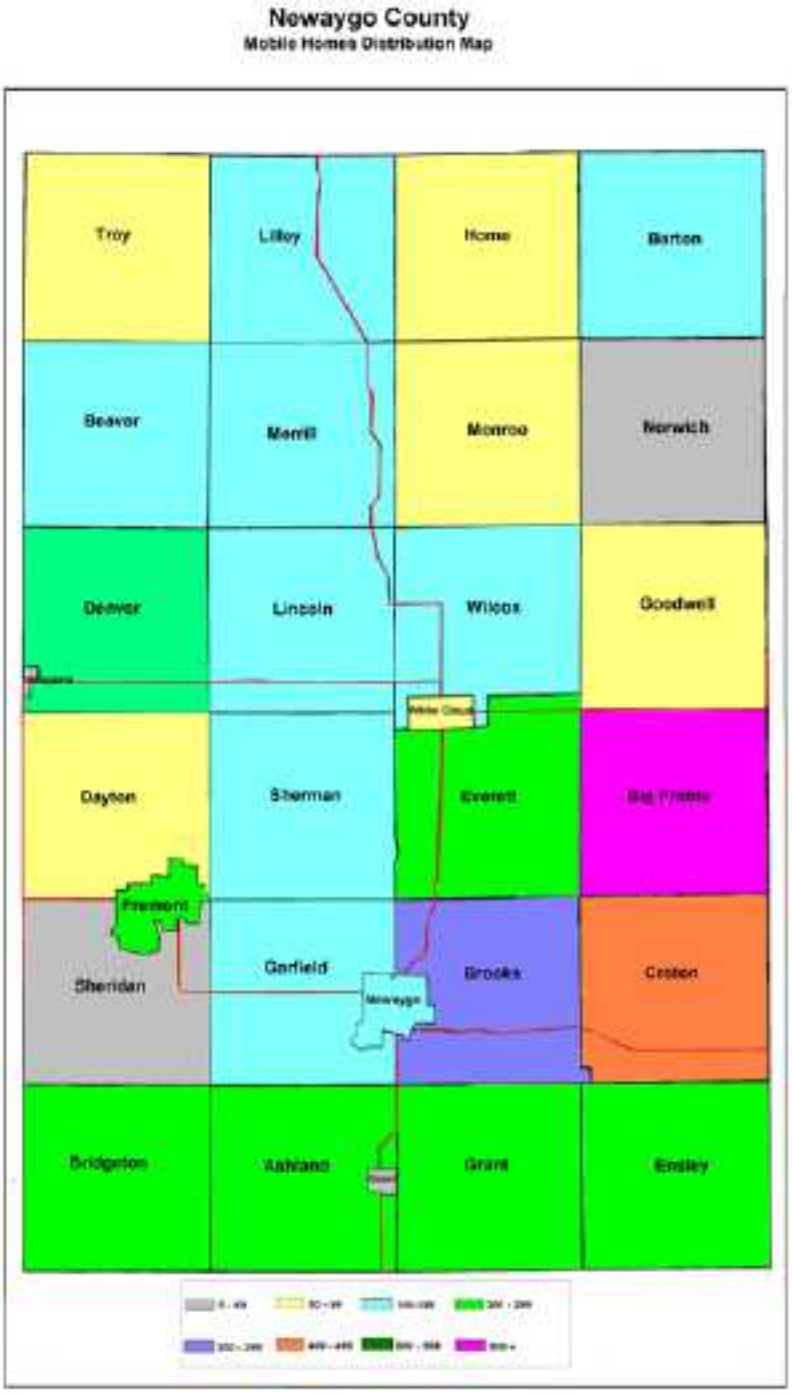
City of Fremont	Month	Approximate Date	Daily Attendance
National Baby Food Festival	July	Third week, Wed – Sat	4,000
Newaygo County Agricultural Fair	August	First full week, Sat – Sat	1,200
Fremont Harvest Festival	October	First weekend, Sat - Sun	2,000
Fremont Farmers Market	June – Sept	Saturdays and Tuesdays	200
City of Newaygo	**Month**	**Approximate Date**	
Memorial Day Festival	May	Memorial Day Weekend	1,000
Power Paddle Canoe and Kayak Races	June	Father's Day Weekend	300
Newaygo County Kids Day	June	Father's Day Weekend, Sat	1,200
Newaygo Farm Market	July – Oct		500
July 4th Celebration	July	July 4th timeframe	1,000
Riverstock Festival	August	Second Weekend, Fri - Sun	1,000
Logging Festival	September	Labor Day Weekend	2,000
City White Cloud	**Month**	**Approximate Date**	
Winter Carnival	March	First Saturday	500
Kids Free Fishing Day	June	First Saturday	800
White Cloud Homecoming	June	Father's Day weekend, Fri - Sun	500
Pow Wow Days	August	First weekend, Sat - Sun	1,000
City of Grant	**Month**	**Approximate Date**	
Grant Festival	August	Third weekend, Fri - Sat	1,200
Village of Hesperia	**Month**	**Approximate Date**	
Hesperia Family Fun Festival	July	July 4th Holiday, 4 days	1,500
Croton Township	**Month**	**Approximate Date**	
Hooking Up Heroes	June	Second Saturday	300
Freedom Fest	July	July 4th Holiday, 4 days	1,200
Hot Boat Weekend	September	First weekend after Labor Day	4,000

Campgrounds within Newaygo County

Name of Establishment	Address	City, State, Zip	Number of Sites
Big Bend Park	2000 Beech Avenue	White Cloud, MI 49349	230
Brooks Lake M.H. Club	2263 Spruell	Newaygo, MI 49337	15
Chinook Campground	5471 W 112th Street	Grant, MI 49327	168
Croton Dam Float Trips	5355 Croton Drive	Newaygo, MI 49337	24
Croton Township Campground	7683 Croton Hardy Drive	Newaygo, MI 49337	160
Dan Raymond Park	6971 W 112th Street	Grant, MI 49327	8
Diamond Lake (aka Camp Swampy)	3351 N Mundy Road	White Cloud, MI 49349	100
Ed Henning County Park	500 Croton Drive	Newaygo, MI 49337	84
Fremont Lake Park	933 Cottage Grove	Fremont, MI 49412	94
Green Jug Resort	1190 Bingham Avenue	White Cloud, MI 49349	15
Happy Campers Campground	5380 Croton Drive	Newaygo, MI 49337	25
Heights Hide A Way	4424 Parson Road	Fremont, MI 49412	13
Hess Lake Mobile Home	825 E 88th Street	Newaygo, MI 49337	34
Hungerford Hills Farms	7616 Hungerford Lake	Big Rapids, MI 49307	50
K&K Camping (private)	7701 Whitneyville Rd	Newaygo, MI 49337	13
Leisure Time RV Park	4799 South Spruce	White Cloud, MI 49349	94
Little Switzerland Resort	254 Pickeral Lake Drive	Newaygo, MI 49337	80
Lonesome Lake Campground	318 W 18 Mile Road	Bitely, MI 49309	50
Mystery Creek Campground	9570 S Wisner Avenue	Newaygo, MI 49337	85
Newaygo State Park	2793 Beech Street	Newaygo, MI 49337	99
Oxbow Park	2973 Cottonwood	Newaygo, MI 49337	197
Pickeral Lakeside Campground	12666 N Woodbridge	Bitely, MI 49309	46
Salmon Run Campground	8845 Felch Avenue	Grant, MI 49327	94
Sandy Beach Campground	6926 30th Avenue	White Cloud, MI 49349	220
Shi Lo Cum	2940 N Felch Avenue	White Cloud, MI 49349	35
Sportsman Park Campground	2500 Sportsman Drive	White Cloud, MI 49349	86
Timbers Edge Campground	4345 North Warner	Hesperia, MI 49421	50
White Cloud City Campground	680 Wilcox	White Cloud, MI 49349	99
Woods and Water Campground	4495 South Spruce	White Cloud, MI 49349	375

Newaygo County has a high volume of wind vulnerable structures such as manufactured homes, trailers, and poorly constructed homes, they are spread over a significant distance due to the jurisdiction's rural nature.

NEWAYGO COUNTY MOBILE HOMES DISTRIBUTION		
COMMUNITY	# Mobile Homes	% Mobile Homes
Newaygo County *	5,284	100%
City of Fremont	254	4.8%
City of Newaygo	109	2.1%
City of White Cloud	56	1.1%
City of Grant	39	0.7%
Village of Hesperia	15	
Ashland Township	256	4.8%
Barton Township	145	2.7%
Beaver Township	116	2.2%
Big Prairie Township	807	15.3%
Bridgeton Township	296	5.6%
Brooks Township	394	7.5%
Croton Township	401	7.6%
Dayton Township	63	1.2%
Denver Township	272	5.1%
Ensley Township	222	4.2%
Everett Township	299	5.7%
Garfield Township	119	2.3%
Goodwell Township	77	1.5%
Grant Township	275	5.2%
Home Township	62	1.2%
Lilley Township	185	3.5%
Lincoln Township	154	2.9%
Merrill Township	172	3.3%
Monroe Township	86	1.6%
Norwich Township	43	0.8%
Sheridan Township	6	0.1%
Sherman Township	108	2.0%
Troy Township	85	1.6%
Wilcox Township	183	3.5%
* total of cities and townships; village total already included with township totals		source: U.S. Census Bureau



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.

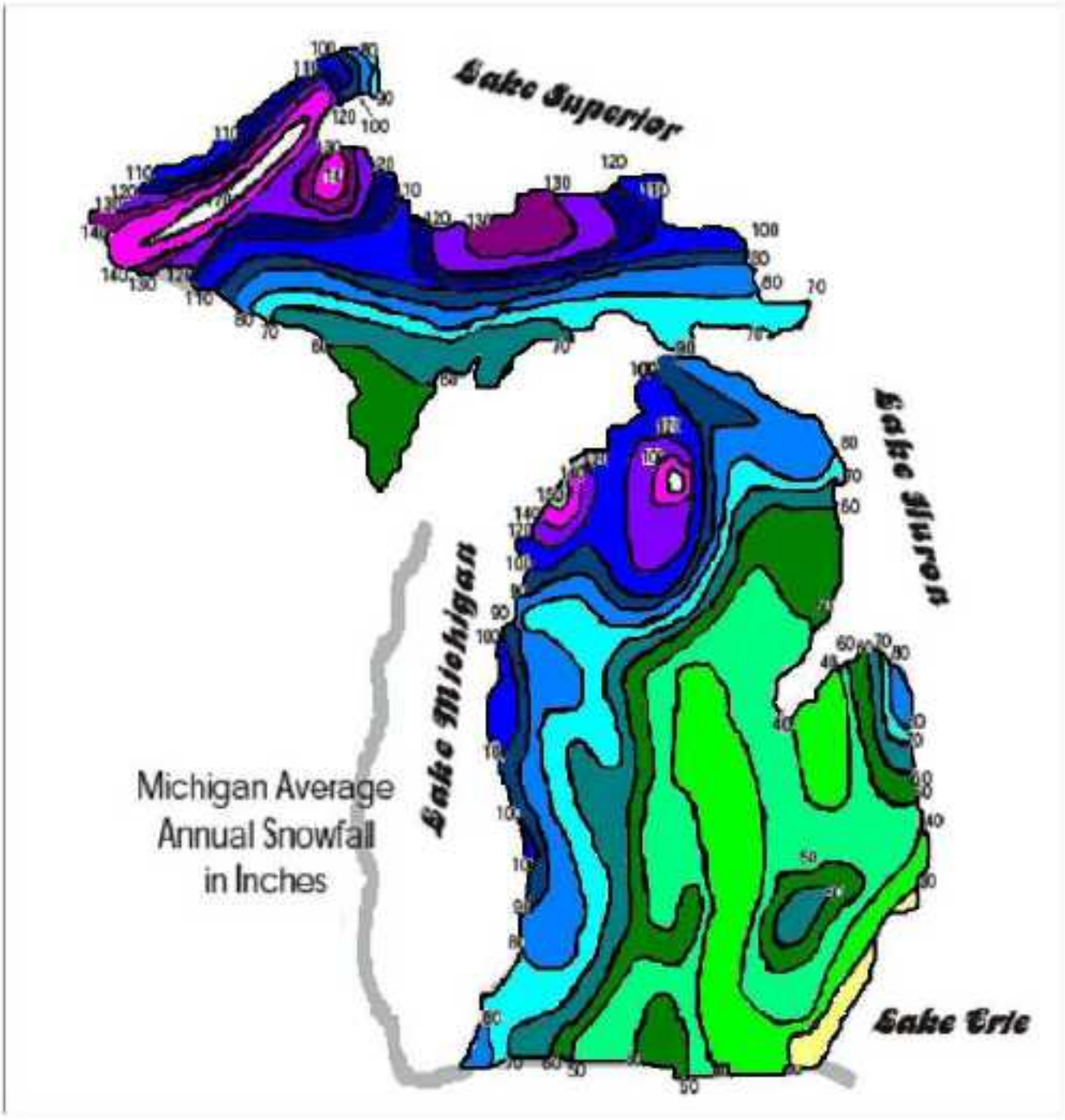
Severe Winter Weather Hazard Analysis

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: December 9-11, 2009 – Northern Lower Peninsula

From December 9 to 11, 2009, heavy snowfall and blizzard conditions were common across all of Northern Michigan. The snow transitioned to lake-effect snow that night and lasted into the 11th in some of the snow belts. Gaylord had its 2nd-largest three-day snowfall since 1950, with 21.8 inches. There was a considerable amount of wind, with some gusts over 50 mph, causing blowing and drifting snow. Almost all school districts were closed on the 9th, and some schools called off classes for three consecutive days. Numerous traffic accidents were reported.

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: November 29-30, 2011 – Central Southern Lower Peninsula

A snowstorm dumped 8 to 10 inches of snow across multiple counties in central Michigan. The heavy wet snow, plus strong winds, caused many trees, limbs, and power lines to fall, leaving 30,000 persons without power. Numerous traffic accidents occurred, and a gas station awning collapsed in Haslett (Ingham County) under the weight of the snow. Property damages totaled $1 million in each of the following counties: Jackson, Calhoun, Ingham, Eaton, and Clinton. In Eaton County, two fallen trees partially blocked Billwood Highway in Windsor Township.

Case: February 24-25, 2016 – Western and Central Southern Lower Peninsula
A major winter storm produced heavy wet snow overnight. Total accumulations across many Lower Peninsula Counties ranged from 6 to 14 inches, which caused scattered power outages as a result of snow weighing down branches near utility lines. An estimated $175,000 in property damage was shared (i.e. $25,000 each) across the following counties: Barry, Calhoun, Eaton, Ingham, Jackson, Kalamazoo, Van Buren.

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 additional 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, 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 Newaygo County

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.

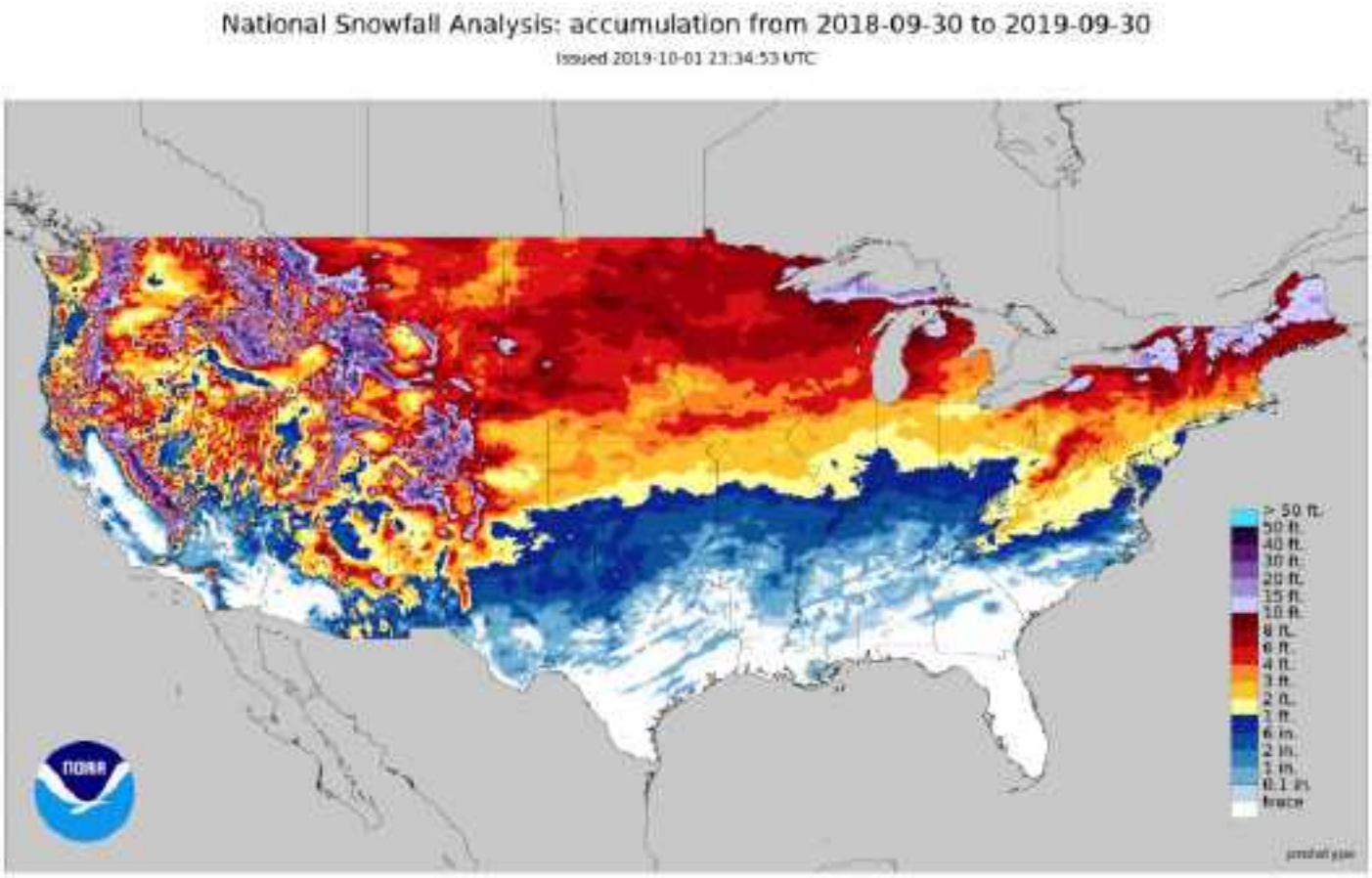
According to the NOAA National Centers for Environmental Information the most days a year Newaygo County will have snow is 52 days. Annual average snowfall amounts for Newaygo County is approximately 75 inches. Newaygo County can be impacted by system snow (snow storms) in addition to lake effect snow bands from Lake Michigan. Due to the geographic nature of the County (close proximity to Lake Michigan) the west side of the county near Fremont and Hesperia can see higher snowfall totals than the central or eastern part of the county near White Cloud, Newaygo, and Grant.

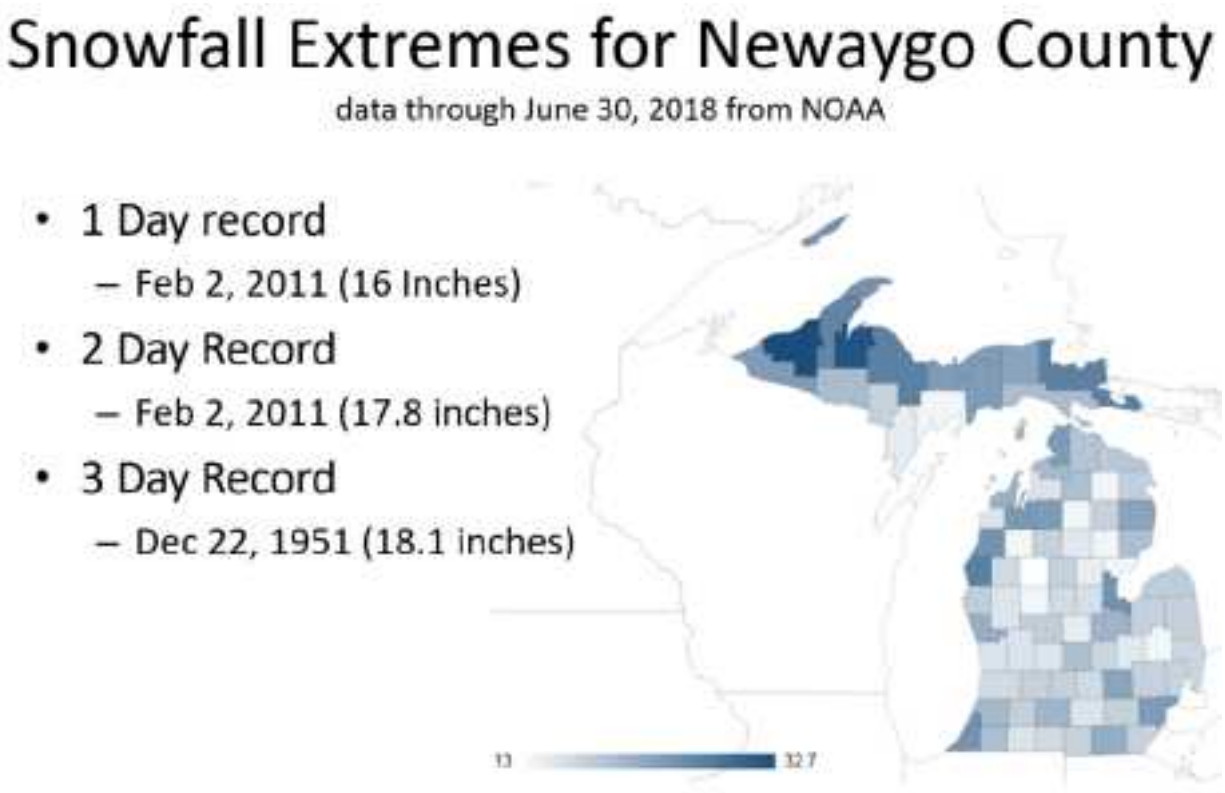
NOAA National Snowfall Analysis

Approximate accumulation in Inches for Newaygo County

		From	To
2019 to 2020 Season	12	9/30/2019	11/22/2019
2018 to 2019 Season	72	9/30/2018	9/30/2019
2017 to 2018 Season	60	9/30/2017	9/30/2018
2016 to 2017 Season	48	9/30/2016	9/30/2017
2015 to 2016 Season	60	9/30/2015	9/30/2016
2014 to 2015 Season	84	9/30/2014	9/30/2015
2013 to 2014 Season	92	9/30/2013	9/30/2014
2012 to 2013 Season	72	9/30/2012	9/30/2013
2011 to 2012 Season	72	9/30/2011	9/30/2012
2010 to 2011 Season	96	9/30/2010	9/30/2011
2009 to 2010 Season	72	9/30/2009	9/30/2010
2008 to 2009 Season	92	9/30/2008	9/30/2009
Average	75		

The highest annual snowfall for Muskegon is 93.7 inches, Grand Rapids is 74.9 inches, and Lansing is 51.1 inches.





Newaygo County is frequently faced with severe snow and/or ice storms, and periods of extremely low temperatures. Based on historical occurrence, Newaygo 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 4 of Newaygo County's 7 Presidential Declarations of Emergency/Disaster since 1953 and 1 Governor's Declaration of Emergency.

- March 20, 1976, Ice Storm
- January 26-31, 1977, Blizzard
- January 26-27, 1978, Blizzard
- January 2-15, 1999, Blizzard
- February 24, 2019, Blizzard

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 ¾-1 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.

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 ¾-1 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.

The following is Newaygo County's Warning History since 2001.

Winter Weather Advisory (under 8" in 24 hrs)

- 2019 (through 12/5): 20
- 2018: 12
- 2017: 22
- 2016: 19 (Under 6" in 24 hours)
- 2015: 11
- 2014: 18
- 2013: 24
- 2012: 10
- 2011: 16
- 2010: 7
- 2009: 11
- 2008: 22
- 2007: 21
- 2006: 10
- 2005: 16
- 2004: 16
- 2003: 15
- 2002: 14
- 2001: 11
- AVERAGE: 16 Events Annually

Winter Storm Warning (Over 8" in 24 hrs)

- 2019 (through 12/5): 2
- 2018: 1
- 2017: 2
- 2016: 5 (Over 6" in 24 Hours)
- 2015: 3
- 2014: 2
- 2013: 2
- 2012: 3
- 2011: 4
- 2010: 2
- 2009: 3
- 2008: 9
- 2007: 10
- 2006: 5
- 2005: 6
- 2004: 5
- 2003: 2
- 2002: 3
- 2001: 2
- AVERAGE: 4 Events Annually

Ice Storm Warnings: None Since 2000.

Blizzard Warning: 1 in 2009, 1 in 2019 (2009 might have been a Winter Storm Warning if issued after NWS change in 2016)

From 1950 - 2019, there has been 87 total winter weather events totaling $13,425,000 in property damage. Several significant storms include:

Case: January 12, 1993
Snow began across central Lower Michigan late in the evening of the 12th and quickly spread north across northern Lower Michigan during the early morning hours of the Wednesday the 13th. The combination of heavy snow, northeast winds of 15 to 25 mph and temperatures in the lower to mid-20s

created near blizzard conditions at times most of Wednesday. The snow tapered to flurries by early evening hours of Wednesday with total snowfall ranging from six to twelve inches. The heavy snow led to downed power, telephone and cable T.V lines across this area. Almost 20,000 people lost power from the heavy snow. Numerous traffic accidents occurred with one serious injury. Most of the schools were closed over central Lower Michigan due to the heavy snowfall. This storm resulted in $50,000 in damage.

Case: April 2, 1993

A late season winter storm was tracked across central Indiana during the evening hours of March 31st and through central Ohio during the overnight hours of April 1st. This storm brought a wintry mix to Lower Michigan on April 1st and 2nd. Rain began across most of lower Michigan during the evening hours of March 31st with only flurries reported across northeastern Lower Michigan. Rain changed to freezing rain across central Lower Michigan from Bay City, Saginaw and Midland to Lansing, and Flint after midnight on the 1st. All the rain and freezing rain across east central and southeast Lower Michigan changed to snow after sunrise on the 1st as the precipitation remained all snow across northeast lower Michigan. By the time the snow ended on the 2nd, a general 4 to 7 inch snowfall occurred across the eastern one-third of Lower Michigan. The combination of wind gusts to 40 mph and ice accumulations of up to 0.25 inches caused numerous power outages in central lower Michigan in the Tri-city area of Bay City, Midland and Saginaw. Up to 57,000 customers were without power. Numerous schools also were closed across these areas due to the icy road conditions. This storm resulted in $50,000 in damage.

Case: January 29, 1994

Snow developed over southwest Lower Michigan just after Midnight on the 27th. The snow mixed with, then changed to, sleet and freezing rain. Overnight on the 27th and into the morning hours of the 28th, occasional rain continued over the southern half of Lower Michigan while occasional freezing rain continued over the north half of Lower Michigan. During the rest of the 28th, the area of freezing rain changed to snow across Lower Michigan. Over central and northern Lower Michigan the snow became heavy by mid-afternoon. Snowfalls of six to eight inches were common over the north half of Lower Michigan. As for ice accumulations over Lower Michigan during the freezing rain, around a quarter inch accumulated over the south third of lower Michigan, from 0.50 to 0.80 inches accumulated over central and northeast Lower Michigan. This resulted in numerous outages. Detroit Edison reported 50,000 people affected by power outages. Consumers Power County reported 2,000 customers without power. More than 150 schools canceled classes across the state. This storm resulted in $5 Million in damage across the State.

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 area 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.

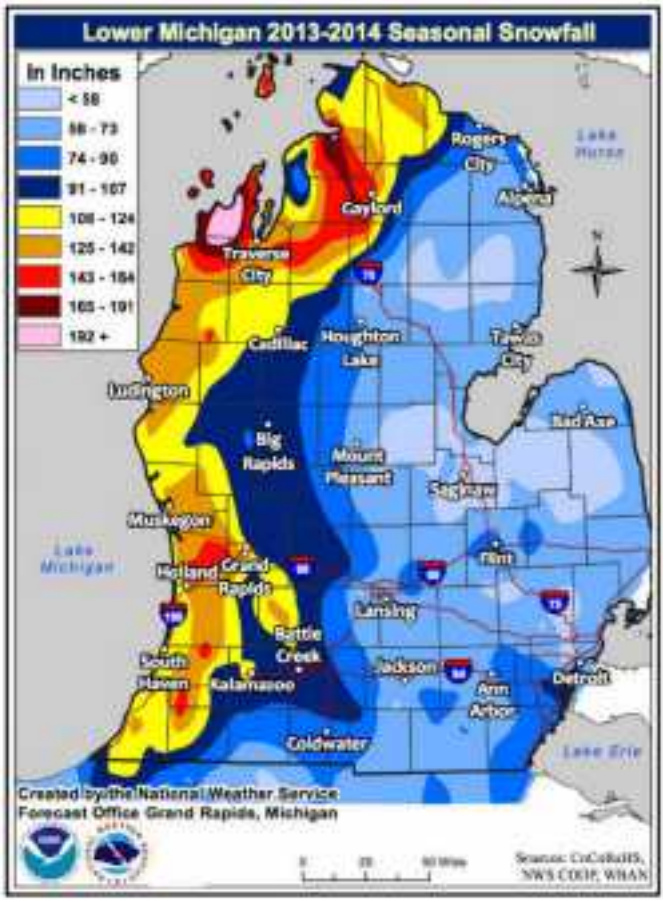
Case: February 16, 2006

A major ice storm developed across much of central lower Michigan producing around a quarter to half inch of ice accumulation between Route 10 and I-96. Thousands of homes lost power from just north of Grand Rapids to Lansing north to Route 10 and many areas did not have power for three to five days. There were numerous reports of downed trees and power lines all across that area. Just north and northwest of that area precipitation mainly fell in the form of snow, and six to eight inches of snow fell across northern Mason and Lake counties. This storm resulted in $1 Million in damage across the State.

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: March 23, 2016

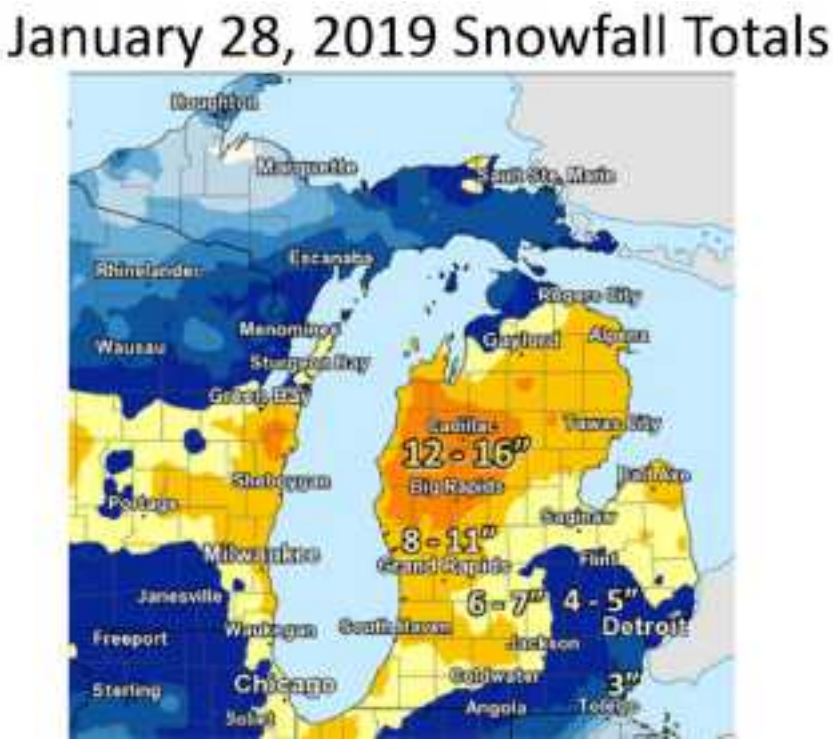
A late winter storm brought around a a tenth to as much as four tenths of an inch of freezing rain and ice accumulation to central lower Michigan. In addition, heavy wet snow and sleet was also reported. Newaygo County received a quarter of an inch of ice accumulation on trees and road signs.

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.

Case: January 28 – February 24, 2019

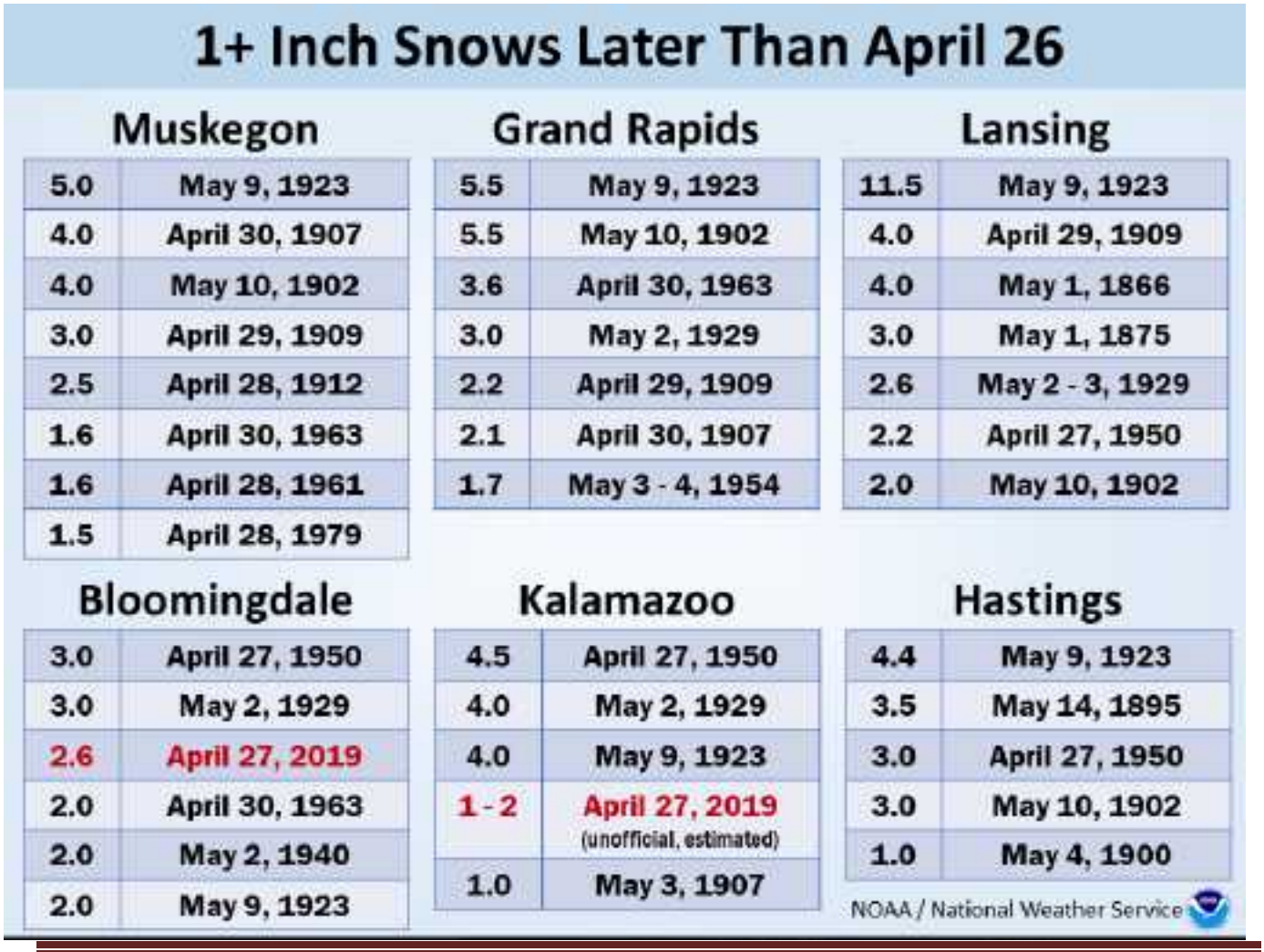
During this timeframe, two Winter Storm Warnings, one Ice Storm Warning, and 1 Blizzard Warning were issued. A series of heavy snowfall events began this week-long event. On Monday, January 28, much of the state faced the start of a blizzard, with snowfall ranging up to over a foot in depth as sustained 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 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 additional 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.

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. In addition, some infrastructure problems also arose from water main and pipe breaks in the northern half of the City of Newaygo which was placed under a boil water advisory. From there 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. Newaygo County experienced approximately $1,000,000 in property damage as a result of this storm. Finally, Blizzard conditions developed on Sunday February 24th with moderate to heavy snow and blowing snow due to wind gusts of 45 to 50 mph that resulted in near zero visibilities at times.

Although not as dramatic, smaller and more frequent events also cause regular concern to Newaygo County due to their immediate effects on the jurisdiction and its infrastructure.



First, the county's rural 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.

M-37, M-20, and M-82 are utilized as the main trunk lines and primary traffic routes through Newaygo 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 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 Newaygo County Road Commission to maintain these roads.

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 Newaygo County Road Commission. When severe winter weather occurs, these routes are no longer maintained and focus turns to keeping the main trunk lines open.

Secondary roads through Newaygo County 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.

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.

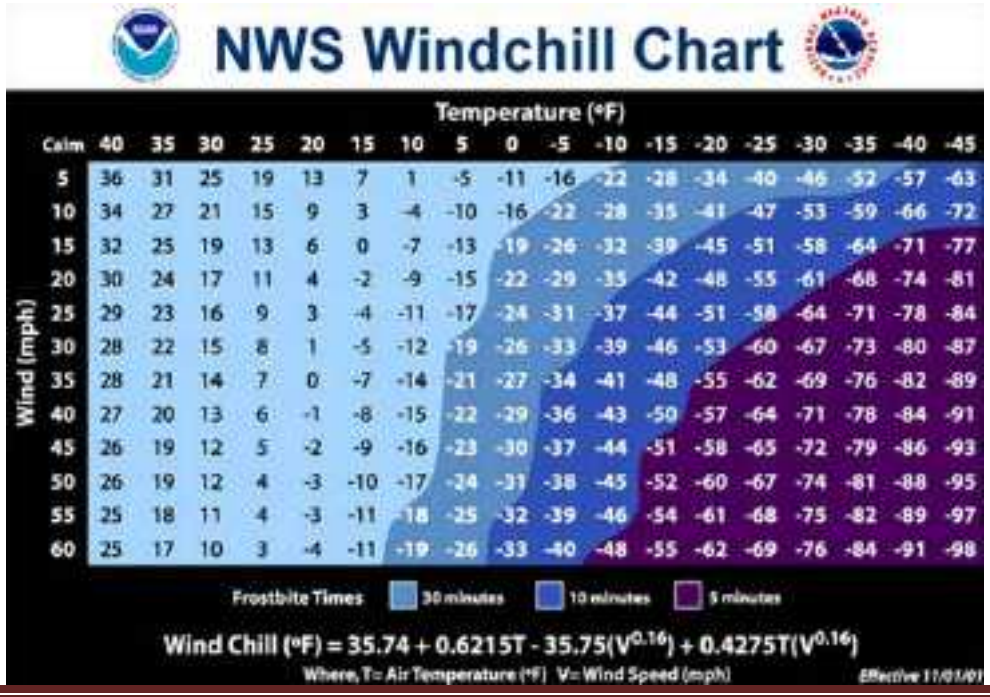
Extreme Low Temperatures

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 in 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 in 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.

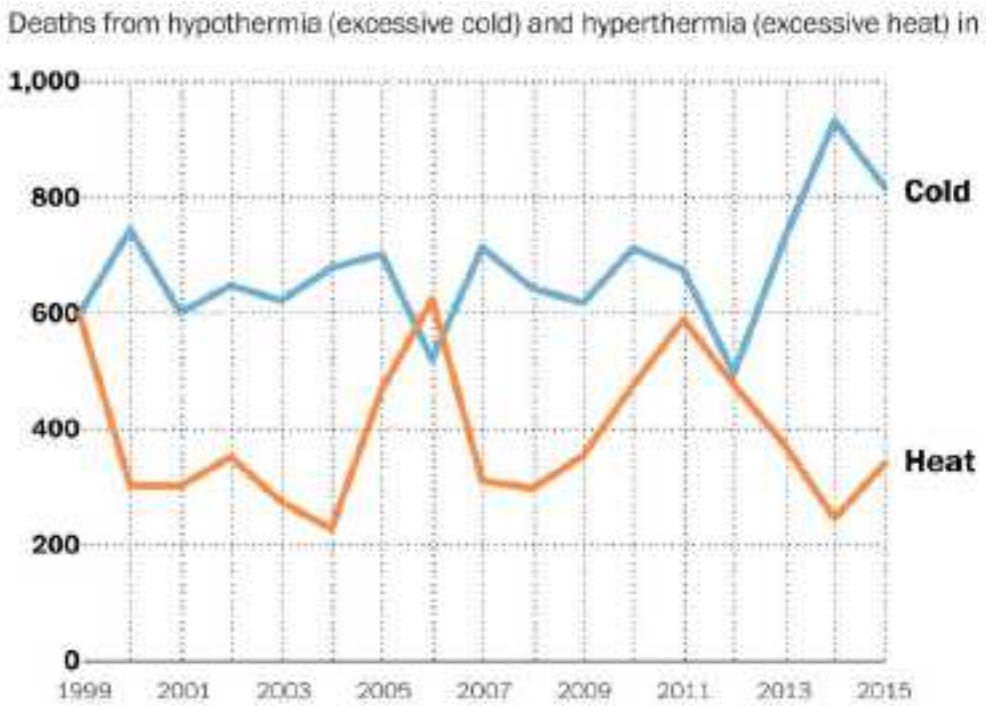
To mitigate the effects of the unfavorable cold temperatures, communities should make sure that housing codes are appropriate and that adequate furnaces are in place in apartment dwellings. Inspections of vulnerable and outdated infrastructure should be made in the fall season, before winter sets in. 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. Persons 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 a 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.

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: February 17, 1979 – Northern Michigan

This was one of the coldest days that ever occurred in Michigan, in terms of the widespread presence (across 14 monitoring locations) of top-ten coldest temperatures. At Trout Lake (Chippewa County), the low was -43 degrees. At Harrisville (Alcona County), it was -20 degrees. To the west, at Traverse City, the temperature went down to -37. At Standish (Arenac County), the low was -24 degrees, and at Houghton Lake, it was -34. December 1993 to May 1994 – Upper Peninsula and Northern Lower Peninsula This was the deep freeze disaster that was federally declared (#1028) and can be read about in the corresponding disaster report that appears in Attachment F of the 2011 Michigan Hazard Mitigation Plan. Ten counties (Gogebic, Ontonagon, Houghton, Marquette, Delta, Schoolcraft, Chippewa, Mackinac, Cheboygan, and Charlevoix) were declared disaster areas when record low temperatures caused the freezing and breakage of more than 3,200 water and sewer lines. Service to 18,700 homes was disrupted. Public costs were estimated at more than $12 million.

Case: December 9, 1995 – Detroit

Winds averaged 20 to 25 mph and resulted in Wind Chill Temperatures of -30 to -35 degrees. Three deaths occurred from hypothermia in Detroit—two at street locations and one in a van. (The next morning, a man was also found frozen to death near his disabled vehicle 30 miles southeast of Ontonagon, where overnight low temperatures were -15 degrees and wind chill temperatures reached -60.)

Case: January 2003 – Lower Peninsula

Temperatures averaged well below normal across the Great Lakes region for much of January. For a three week period, the temperature never rose above freezing. Temperatures fell below zero for several nights during this period. Frozen pipes and water main breaks occurred in many areas of Detroit and its suburbs. The cities of Flint (Genesee County) and Saginaw also had several reports of water main breaks. Several area schools had to cancel classes due to frozen pipes. Many homeless shelters were filled to capacity and area hospitals reported dozens of cases of frostbite. Three deaths were attributed to this cold spell—a homeless man found in a Detroit alley, a homeless man in Roseville (Macomb County), and an elderly Wayne County woman with Alzheimer's disease who had wandered from her home and was found frozen behind her garage.

Case: February 3 to 6, 2007 – Southeast Michigan

The worst cold wave event since the 1990s struck the region on February 3 and did not let up until February 6. Temperatures went as low as -7 at Saginaw and -5 at Flint, and winds of 15 to 25 mph included gusts of up to 35 mph. Wind Chill Temperatures ranged from -15 to -25 throughout almost the entire event, causing nearly every school district to cancel classes for one to two days. Hospitals reported numerous cold-related illnesses and frostbite cases. Area homeless shelters were filled to capacity. One death was attributed to the bad weather. Frozen pipes and water main breaks occurred throughout the area, and flooding occurred in cases where these involved sprinkler system pipes. Total damages were estimated at $425,000. According to AAA, there were more than 20,000 vehicle service calls from Michigan due to the cold weather—more than had been seen for nearly 10 years.

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: Mid-Late February, 2015 – Northwest Lower Peninsula, then Upper Peninsula

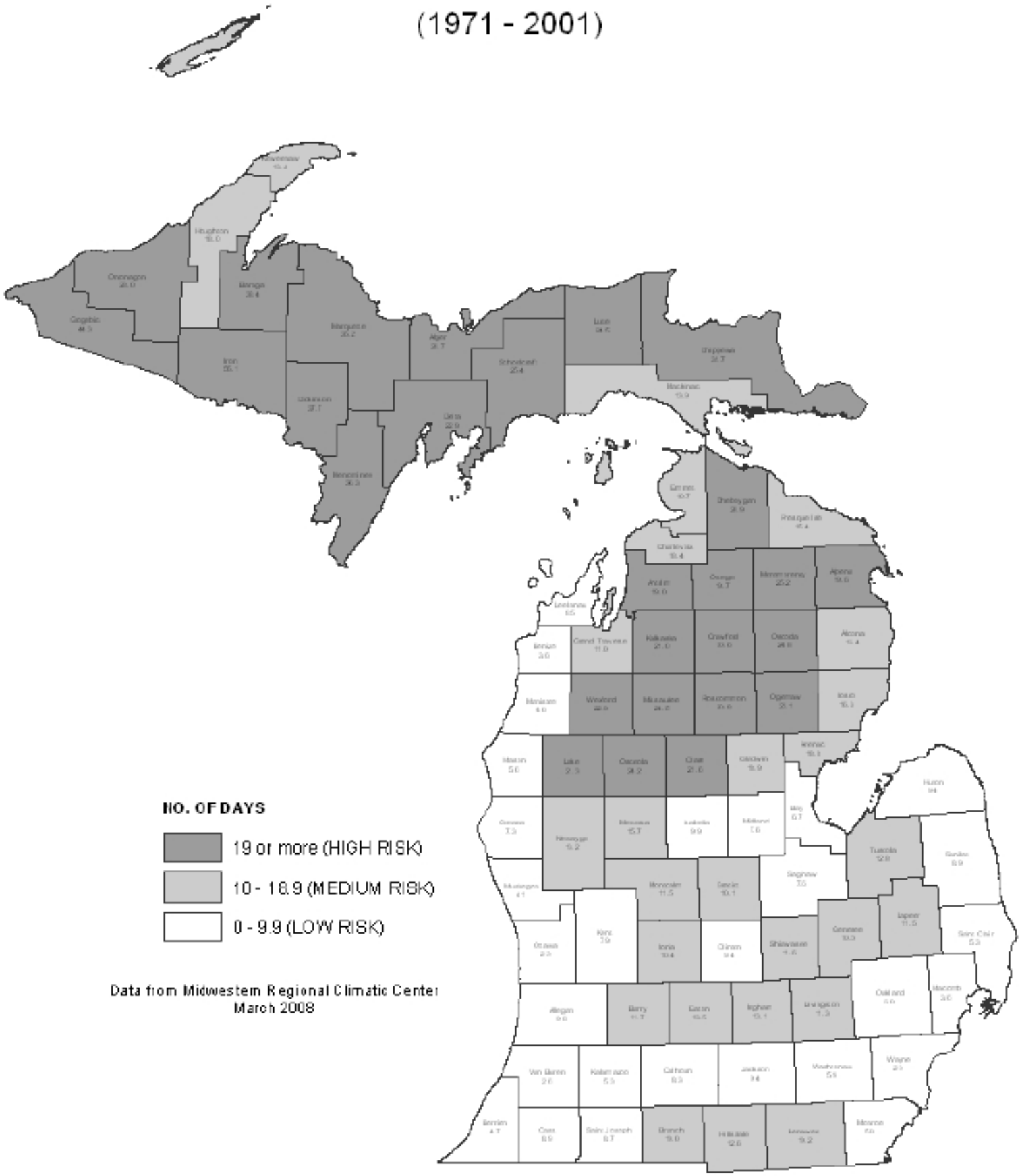
February 13 to 14 saw the coldest air of the winder entering the Traverse Bay region and causing wind chills from -30 to -40, with the Upper Peninsula going as much as 10 degrees below that. After a couple milder days, February 18 then saw a very cold Arctic air mass move in across the Upper Peninsula, causing schools to close for three days across much of the peninsula as gusty winds combined with sub-zero temperatures. Wind chill values were in the -25 to -35 range in various areas from February 18 to 20, and included many counties in the Northern Lower Peninsula on February 19, which saw even colder wind chills in the -30 to -40 range (the lowest at -43 near the City of Cadillac, in Wexford County.) Subsequent warming was felt on February 21, but similar cold returned on subsequent mornings from February 22 to 23. Arctic air returned again on the morning of February 26 and caused schools to close. The southernmost regions of the state did not feel these extremes.

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 additional 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, 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.

Average Number of Days with Minimum Temperature 0ºF and Below (1971 - 2001)



Extreme Cold Temperatures in Newaygo County

Source: Weather Underground Weather Station in Fremont, Michigan

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)

Average Daily Low in Degrees Fahrenheit
Source: Weather Underground Weather Station in Fremont, Michigan

MONTH	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total Average
January	15	14	19	29	23	21	9	21	15	24	19	**19**
February	14	18	23	20	14	15	20	22	18	24	15	**18**
March	24	32	20	28	30	25	27	31	25	39	22	**28**
April	35	38	38	39	36	38	36	40	36	34	33	**37**
May	45	49	44	48	50	43	47	50	49	49	49	**48**
June	53	56	63	56	58	58	56	58	56	55	56	**57**
July	60	60	62	64	61	62	54	64	64	63	59	**61**
August	62	56	61	61	63	59	58	63	60	67	56	**61**
September	51	53	55	51	54	55	52	52	51	48	51	**52**
October	40	43	43	39	49	40	40	40	42	39	41	**41**
November	35	34	33	34	32	33	36	34	34	31	29	**33**
December	26	22	23	30	25	21	23	23	28	27	17	**24**

MONTH	2014	2015	2016	2017	2018	2019						Total Average
January	8	11	22	25	15	12						**16**
February	8	0	24	26	18	14						**15**
March	11	20	31	29	22	19						**22**
April	33	33	26	38	26	33						**32**
May	45	48	46	42	50	44						**46**
June	57	53	55	57	57	53						**55**
July	54	57	61	60	60	61						**59**
August	56	58	62	56	58	56						**58**
September	48	56	56	53	53	44						**52**
October	40	42	45	46	39							**42**
November	26	36	37	32	27							**32**
December	24	33	25	21	25							**26**

Age Distribution within Newaygo County and the State of Michigan
Source: 2010 U.S. Census, American Fact Finder

	Newaygo County		Michigan	
AGE CATEGORY	**Total**	**Percentage**	**Total**	**Percentage**
	48,460		**9,883,640**	
Under 5 years	3,018	6.2%	596,286	6.0%
5 to 9 years	3,230	6.7%	637,784	6.5%
10 to 14 years	3,533	7.3%	675,216	6.8%
15 to 19 years	3,594	7.4%	739,599	7.5%
20 to 24 years	2,616	5.4%	669,072	6.8%
25 to 29 years	2,453	5.1%	589,583	6.0%
30 to 34 years	2,509	5.2%	574,566	5.8%
35 to 39 years	2,712	5.6%	612,493	6.2%
40 to 44 years	3,120	6.4%	665,481	6.7%
45 to 49 years	3,897	8.0%	744,581	7.5%
50 to 54 years	3,821	7.9%	765,452	7.7%
55 to 59 years	3,438	7.1%	683,186	6.9%
60 to 64 years	2,991	6.2%	568,811	5.8%
65 to 69 years	2,415	5.0%	418,625	4.2%
70 to 74 years	1,954	4.0%	306,811	5.8%
75 to 79 years	1,345	2.8%	244,085	2.0%
80 to 84 years	958	2.0%	200,855	2.0%
85 years and over	856	1.8%	191,881	1.9%
Median Age	**40.9**		**38.9**	

Skilled Nursing and Assisted Living Facilities

Facility Name:	**Transitional Health Services**
Phone Number:	(231) 924-3990
Address:	4554 West 48th Street, Fremont MI 49412
Contact Name:	Karen Whitmer, Administrator
After Hours Number:	C 231-714-7054
Capacity:	***129 Beds***
Services:	Skilled Nursing and Secured Dementia Facility
Notes:	Generated Facility, Connected to Fire Department Alarm

Facility Name:	**Newaygo County Medical Care Facility**
Phone Number:	(231) 924-2020
Address:	4465 West 48th Street, Fremont MI 49412
Contact Name:	Executive Director, Elizabeth Lee-Arvey C 231-924-2020
After Hours Number:	Mike (maint. director) 616-299-5104
Capacity:	***116 Beds***
Services:	Skilled Nursing and Assisted Living Facility
Notes:	Generator/Secured main doors and secured dementia unit

Facility Name:	**Fountain View Retirement Village Fremont**
Phone Number:	(231) 924-5050
Address:	102 Hillcrest Ave, Fremont MI 49412
Contact Name:	Director of Resident Care- Shelly McDonald (231) 924-5050
After Hours Number:	Administrator Amanda Beecham 231-519-0166
Capacity:	***20 Beds***
Services:	Aged - Physically Handicapped
Notes:	No Gen -> Harrington

Facility Name:	**Fountain View Retirement Village Grant**
Phone Number:	(231) 834-8202
Address:	50 South Maple Street, Grant MI 49327
Contact Name:	Admin- Sarah Maxim-Gerard
After Hours Number:	C (616) 450-2795
Capacity:	30 Beds
Services:	Aged – Alzheimer's. Assisted Living
Notes:	Secured Dementia unit/Fire dept. connected alarm

Facility Name:	**Green Acres of Fremont**
Phone Number:	231-335-2060
Address:	801 E. Main St Fremont MI 49412
Contact Name:	Kelly Nelson Regional Director
After Hours Number:	C 616-232-9363
Capacity:	40 Beds
Services:	Alzheimer's, Dementia, Elderly, Diabetes
Notes:	Assisted living + Nurse + Generator + Evac plan to church across the street

Facility Name:	**The Brook Retirement Community**
Phone Number:	231-652-9800
Address:	318 W Cooperative Drive, Newaygo MI 49337
Contact Name:	Manager Dianne Stilson 231-823-2650
After Hours Number:	Nurse Nancy Robins 231-629-1741 Maintenance Gale Billow 616-901-9461
Capacity:	44 Units (some have room for 2 beds)
Services:	Assisted Living, Independent Living, and Memory Care
Notes:	

Newaygo County AFC Homes and Nursing Homes

AFC Homes	Phone	Address	City	Capacity
Countryside AFC	(231) 924-3352	6116 W Pat Street	Fremont	6
The Cottages at Martin Lake	(231) 928-8820	3088 S Van Wagoner	Fremont	6
Deerfield AFC	(231) 924-6790	209 Meadow Hill Lane	Fremont	12
Rex Street Home	(231) 924-5268	1034 Rex Street	Newaygo	6
Dallas AFC	(231) 924-4775	7003 Baldwin Road	Newaygo	10
Fishers AFC	(231) 652-9201	1032 E 88th Street	Newaygo	2
Kilchermans AFC	(231) 834-2936	7 Aurthur Street	Grant	6
Oakview AFC	(231) 689-6832	979 S Oakview St	White Cloud	6
Purdy's AFC	(231) 689-0620	2930 1 Mile Road	White Cloud	6
Morgan Street	(231) 689-0034	104 Morgan Street	White Cloud	6
The Masters Home AFC	(231) 689-0022	240 N Webster	White Cloud	6
Woodland Park Manor	(231) 745-7374	8835 North 21st Ave	Bitely	6
				78

Apartments

Facility Name:	**Greenfield Manor**
Phone Number:	(231) 924-5447
Address:	228 Dewitt Ave, Fremont MI 49412
Contact Name:	
After Hours Number:	Stratford Group (800) 225-7982
Capacity:	***26 Total Units***
Unit Description:	22 one bedroom, 4 two bedroom
Notes:	Max: 60 People,

Facility Name:	**Meadow Hills North Apartments**
Phone Number:	(231) 924-3729
Address:	216 Meadow Hills Lane, Fremont MI 49412
Contact Name:	
After Hours Number:	
Capacity:	**48 Total Units**
Unit Description:	4 three bedroom, 24 one bedroom, 20 2 bedroom
Notes:	Family Population

Facility Name:	**Peachtree Village Apartments**
Phone Number:	(231) 924-5447
Address:	1102 State Street #10, Fremont MI 49412
Contact Name:	
After Hours Number:	
Capacity:	**20 Total Units**
Unit Description:	12 one bedroom, 8 two bedroom
Notes:	Max: 56 People, Family Population

Facility Name:	**Apple Ridge Apartments**
Phone Number:	(231) 924-5447
Address:	318 DeWitt Ave, Fremont MI 49412
Contact Name:	
After Hours Number:	
Capacity:	**32 Total Units**
Unit Description:	16 one bedroom, 16 two bedroom
Notes:	Max: 96 People

Facility Name:	**Oak Creek Village Apartments**
Phone Number:	(231) 924-5447
Address:	1101 W Main Street, Fremont MI 49412
Contact Name:	
After Hours Number:	
Capacity:	**32 Total Units**
Unit Description:	20 one bedroom, 12 two bedroom
Notes:	Max: 88 People

Facility Name:	**Locust Hill Apartments**
Phone Number:	(231) 924-5283
Address:	1047 State Street, Fremont MI 49412
Contact Name:	
After Hours Number:	
Capacity:	**48 Total Units**
Unit Description:	40 two bedroom/8 three bedroom
Notes:	Max: 184, Family Population,

Facility Name:	**Wedgewood Apartments**
Phone Number:	(231) 924-3729
Address:	216 Meadowhills Lane, Fremont, MI (Managed at Meadowhills North Apartments)
Contact Name:	
After Hours Number:	
Capacity:	**20 Total Units**
Unit Description:	20 one bedroom
Notes:	Elderly & Disabled

Facility Name:	**Daisybrook Apartments**
Phone Number:	(616) 437-3798
Address:	512 N Darling, Fremont MI 49412
Contact Name:	
After Hours Number:	
Capacity:	**12 Units Total**
Unit Description:	4 two bedroom apartments, 4 two bedroom townhouse, 4 houses/3 buildings
Notes:	

Facility Name:	**Autumn Grove Apartments**
Phone Number:	(231) 652-4410
Address:	620 West Brooks Street, Newaygo MI 49337
Contact Name:	
After Hours Number:	
Capacity:	***24 Total Units***
Unit Description:	8 one bedroom, 16 two bedroom
Notes:	Max: 80 People, Family population

Facility Name:	**Edgeview Apartments**
Phone Number:	(231) 652-7757
Address:	290 East 82nd Street, Newaygo MI 49337
Contact Name:	
After Hours Number:	
Capacity:	***36 Total Units***
Unit Description:	16 one bedroom, 16 two bedroom, 4 three bedroom
Notes:	Max: 120 People, Family Population

Facility Name:	**Woodview Apartments**
Phone Number:	(231) 652-1671
Address:	782 W Brooks Street, Newaygo MI 49337
Contact Name:	
After Hours Number:	
Capacity:	**66 Total Units**
Unit Description:	61 one bedroom, 5 two bedroom
Notes:	Max: 142 People, 62 or older unless disabled + Generator

Facility Name:	**Wildwood North Apartments**
Phone Number:	(231) 652-1500
Address:	157 E Barton Street #9, Newaygo MI 49337
Contact Name:	
After Hours Number:	
Capacity:	**18 Total Units**
Unit Description:	16 one bedroom, 2 two bedroom
Notes:	Max: 36 People, 62 or older unless disabled

Facility Name:	**Pine Lake Village Apartments**
Phone Number:	(231) 652-7900
Address:	139 W Pine Lake Dr, Newaygo MI 49337 Apt A
Contact Name:	
After Hours Number:	
Capacity:	**112 Total Units**
Unit Description:	3 one bedroom, 85 two bedroom, 24 three bedroom
Notes:	Max: 490 People, Family Population

Facility Name:	**Grant Community Senior Center Housing**
Phone Number:	(231) 834-5352
Address:	10 N Lake Street, Grant MI 49327
Contact Name:	Number below goes to live operator after hours
After Hours Number:	
Capacity:	***24 Total Units***
Unit Description:	
Notes:	

Facility Name:	**Eastfield Village**
Phone Number:	(231) 652-7900
Address:	226 S. Endeavor Blvd, Grant MI 49327
Contact Name:	Managed by Pine Lake Village Apts
After Hours Number:	
Capacity:	**46 Total Units**
Unit Description:	one bedroom, two bedroom
Notes:	Family Population

Facility Name:	**Lakeview Apartments**
Phone Number:	(231) 652-1232
Address:	136 N Lake Street, Grant MI 49327
Contact Name:	
After Hours Number:	
Capacity:	**9 Total Units**
Unit Description:	8 two bedroom, 1 studio
Notes:	Max: 33 People, Family Population

Facility Name:	**Sand Hill Apartments**
Phone Number:	(231) 689-1710
Address:	92 N Lester Street, White Cloud MI 49349
Contact Name:	
After Hours Number:	
Capacity:	24
Unit Description:	
Notes:	Elderly and Disabled

Facility Name:	White Cloud Meadows
Phone Number:	(231) 689-1710 M & Th 3p-8p
Address:	102 N Lester Ave, White Cloud, MI 49349
Contact Name:	
After Hours Number:	
Capacity:	32
Unit Description:	
Notes:	Family Population

Facility Name:	**Fremont Townhouses**
Phone Number:	(231) 924-3729
Address:	1220 State St. Fremont, MI (Managed at Meadowhills North Apartments)
Contact Name:	
After Hours Number:	
Capacity:	***12 Total Units***
Unit Description:	4 two bedroom, 8 three bedroom
Notes:	Family Population

Facility Name:	**Woodridge Apartments**
Phone Number:	1 800 398-5170 corporate
Address:	70 N. Lester St., White Cloud, MI 49349
Contact Name:	Tracy
After Hours Number:	231-689-5662
Capacity:	
Unit Description:	
Notes:	Has Knox box

Facility Name:	**Silverwood Manor Senior Apartments**
Phone Number:	(231) 854-2402
Address:	140 Town Place Ct., Hesperia, MI 49421
Contact Name:	
After Hours Number:	
Capacity:	
Unit Description:	
Notes:	

Facility Name:	Town Place Apartments
Phone Number:	(231) 854-2402
Address:	120 Town Place Ct, Hesperia, MI 49421
Contact Name:	
After Hours Number:	
Capacity:	
Unit Description:	
Notes:	Family Population

Facility Name:	**The Gateway Senior Apartments**
Phone Number:	(231) 928-1255
Address:	204 E. Main St, Fremont, MI 49412
Contact Name:	
After Hours Number:	
Capacity:	
Unit Description:	
Notes:	

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.

April 12, 2014 – Newaygo and Osceola Counties

About 400 homes along the Muskegon River were impacted by flooding as snowfall and rainfall caused the river levels to rise greatly. About $4 million in property damage was estimated in Newaygo County, and $3 million in Osceola County. Significant road damage also resulted. A governor’s disaster declaration was proclaimed for floods in these two counties, although the storm event also involved a great deal of wind damage in and around these areas.

Climate Change Considerations

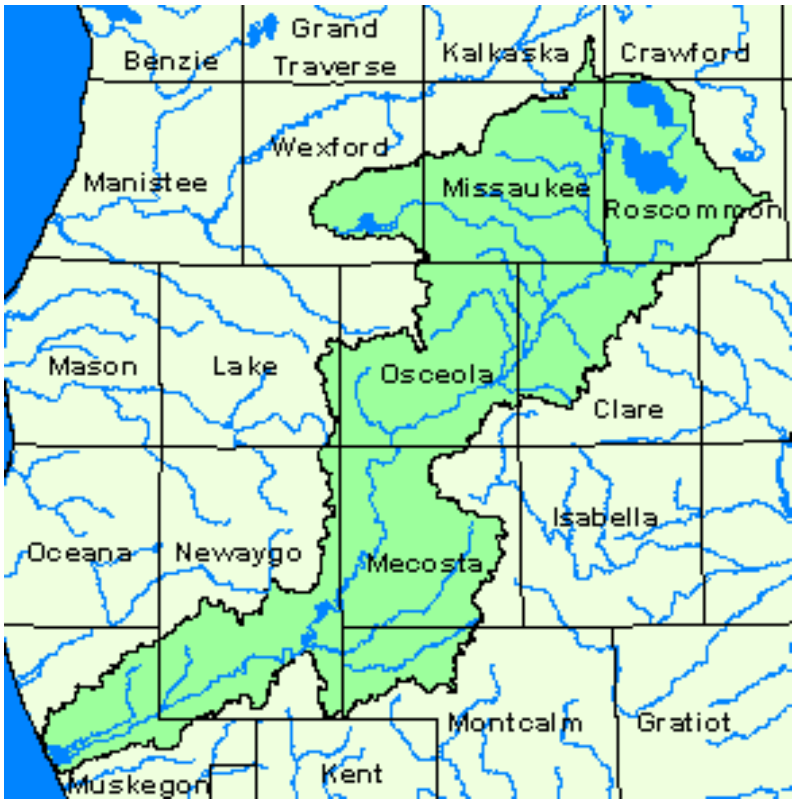
One of the Michigan trends connected with climate change is to experience increasing amounts of precipitation. Moreover, this precipitation is considered more likely to take the form of acute (and severe) weather events. As mentioned in the winter weather sections, a larger proportion of snow precipitation 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 Newaygo County

Like many Michigan communities, Newaygo County is permeated with numerous lakes, rivers, and streams of varying sizes, including 234 natural lakes and ponds, 356 miles of rivers and streams covering 12,543 acres. 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

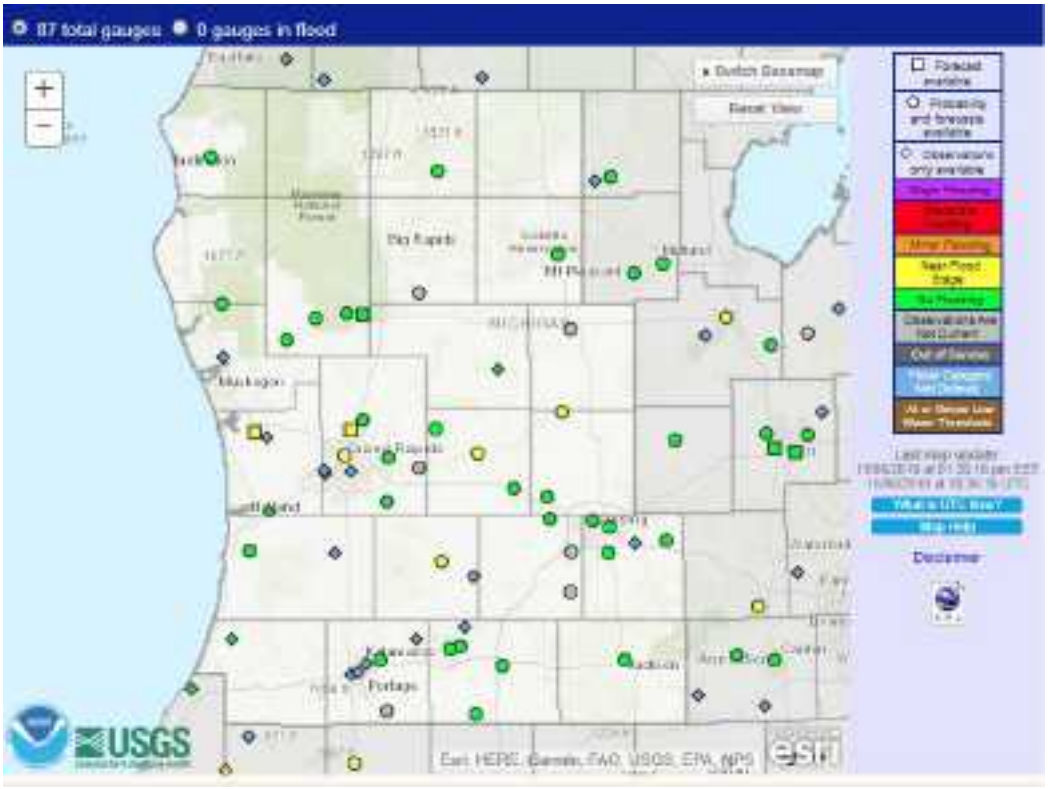


The Muskegon River Watershed begins in north-central lower Michigan, flowing from Higgins and Houghton Lakes, southwesterly to the City of Muskegon and discharging into central Lake Michigan. The watershed incorporates over 2,350 square miles of land with approximately 94 tributaries flowing directly 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 Hardy Dam and Croton Dams are both located within Newaygo 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.

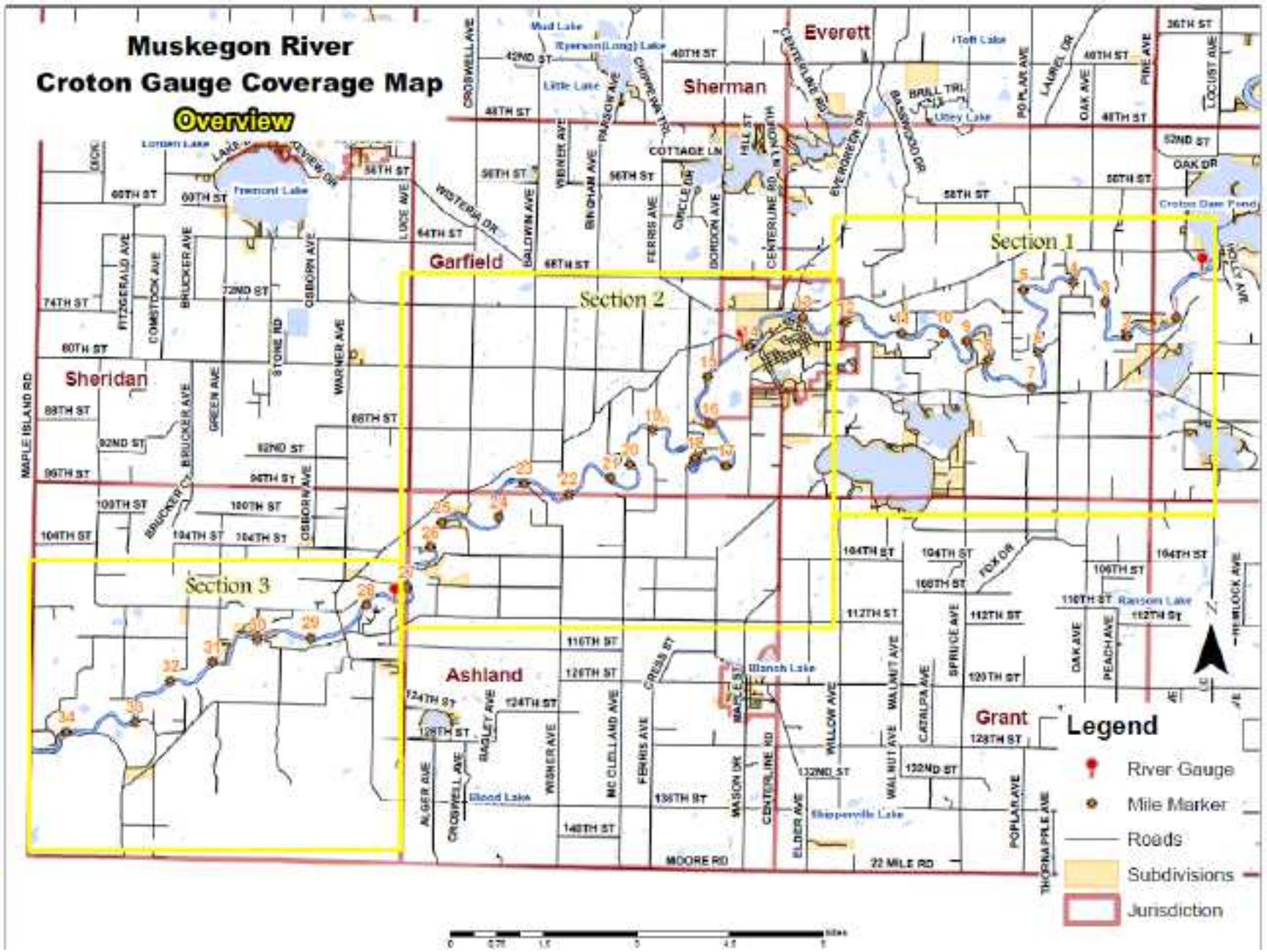


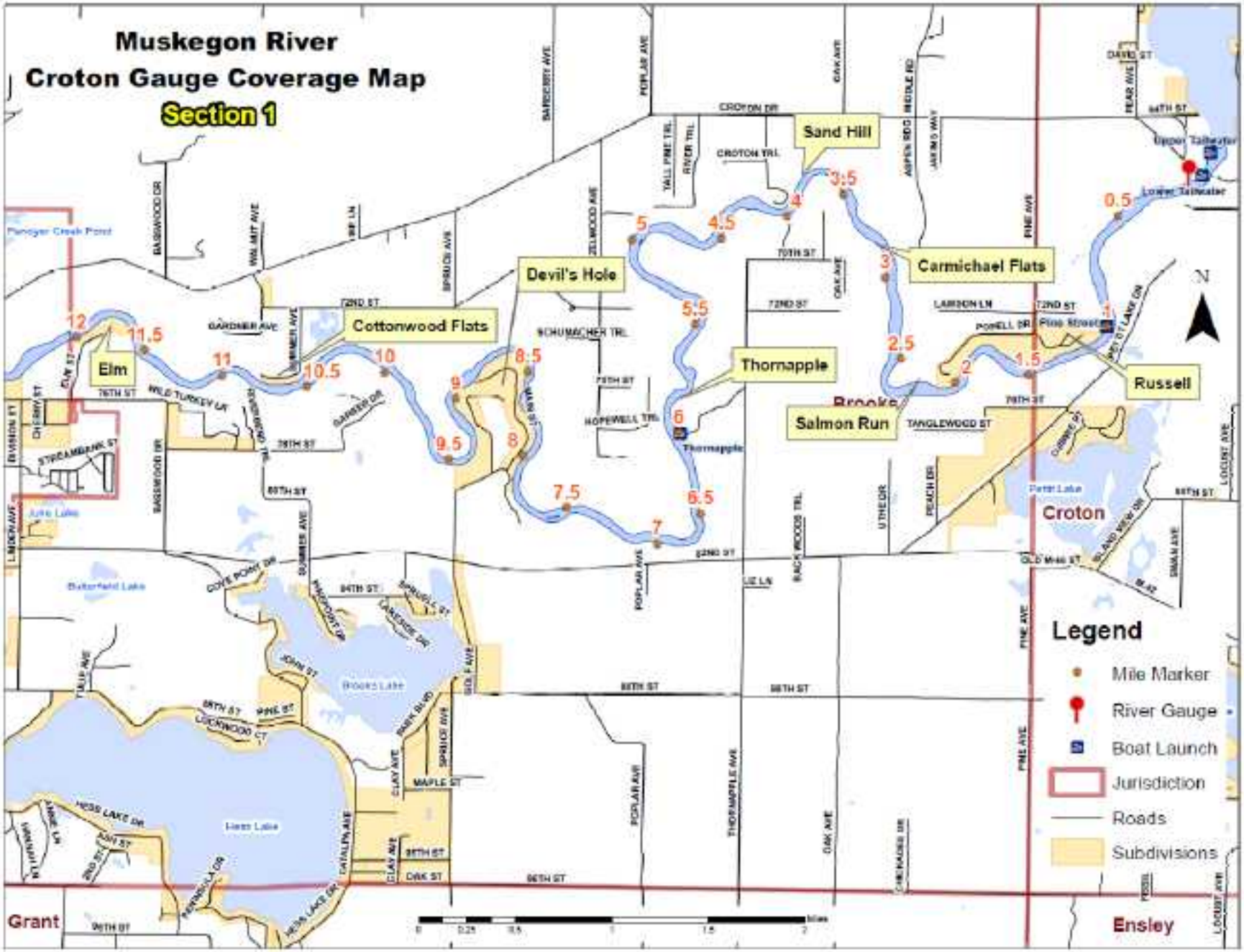
Correlation between the USGS River Gauges on the Muskegon River

During flooding conditions it takes approximately 2.5 hours for water to flow from Croton to Newaygo and approximately 13.0 hours for water to flow from Croton to Bridgeton. The Newago Gauge reads approximately 2.7 feet more than the Croton Gauge. The Bridgeton Gauge reads approximately 4.8 feet more than the Croton Gauge.

Formulas	Clear	Heavy Rain
Thornapple	= to Croton	= to Croton
Newaygo	Croton + 2.4'	Croton + 2.7
Newbridge in Newaygo	Croton + 2.4'	Croton + 2.7
Anderson Flats (Felch)	Croton + 2.4'	Croton + 3.4'
Bridgeton	Croton +3.9'	Croton +4.8'
Maple Island	Croton + 2.9'	Croton + 3.9'

The clear formulas are based on the river being held steady for over 3 days and observing the gauges. Heavy rain accounts for the rises at Croton, as well as other sources feeding into the river.


Muskegon River
Croton Gauge Coverage Map
Overview
Section 1
Section 2
Section 3
Everett
Sherman
Garfield
Sheridan
Ashland
Grant
Legend
River Gauge
Mile Marker
Roads
Subdivisions
Jurisdiction


Muskegon River
Croton Gauge Coverage Map
Section 1
Sand Hill
Carmichael Flats
Devil's Hole
Cottonwood Flats
Thornapple
Salmon Run
Elm
Russell
Croton
Grant
Ensley
Brooks Lake
Hess Lake
Legend
Mile Marker
River Gauge
Boat Launch
Jurisdiction
Roads
Subdivisions

USGS 04121970 Muskegon River at Croton, MI Flood Impacts (Established in 1994)

Near Flood Stage	8 Ft	
Flood Stage	9 Ft	Minor Flooding – Minimal property damage, public inconvenience
Moderate Flooding Stage	11 Ft	Moderate Flooding – Some inundation, possible evacuations
Major Flood Stage	12 Ft	Major Flooding – Extensive inundation and evacuations

13.0	Flood water begins surrounding properties on Russel Road in Croton Township… Cottonwood Flats and Gould Subdivision in Brooks Township... Expect Major flooding of cottages and homes downstream from Croton in the areas of Devil's Hole, Muskegon Blvd, 3740 and 3710 E Croton Drive, and 6812 S Thornapple Ave in Brooks Township. Expect Main Street in Brooks Township to be closed… Expect all public River Access Sites to be closed.
12.0	Expect major flooding of cottages and homes downstream from Croton in the areas of Devil's Hole, Muskegon Blvd, 3740 and 3710 E Croton Drive, and 6812 S Thornapple Ave in Brooks Township. Expect Main Street in Brooks Township to be closed. Expect minor flooding in the areas of Salmon Run in Brooks Township. Expect all public River Access Sites to be closed.
11	Expect moderate flooding of cottages and homes downstream from Croton in the areas of Devil's Hole, Muskegon Blvd, 3740 and 3710 E Croton Drive, and 6812 S Thornapple Ave in Brooks Township. Expect water to begin coming over Main Street in Brooks Township. Expect water to begin surrounding homes downstream from Croton in the areas of Salmon Run in Brooks Township. Expect all public River Access Sites to be closed.
10	Flood water begins surrounding cottages and homes downstream from Croton in the areas of Devil's Hole, Muskegon Blvd, 3740 and 3710 E Croton Drive, and 6812 S Thornapple Ave in Brooks Township. Expect all public River Access Sites to be closed.
9.0	Expect minor flooding of low lying areas along the river downstream from Croton.
8.0	River is at 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 Croton

Rank	Date	Gauge Height	Stream Flow
1	9/12/1986	16.80 feet	(Calculated)
2	4/15/2014	12.87 feet	15,100 cfs
3	2/21/2018	11.55 Feet	12,300 cfs
4	4/19/2013	11.11 feet	11,000 cfs
5	4/29/2011	10.64 feet	9,970 cfs
6	5/24/2004	10.45 feet	9,580 cfs
7	5/19/2020	10.33 feet	9,680 cfs
8	3/15/2019	10.08 feet	9,180 cfs
9	3/31/2016	9.98 feet	8,660 cfs
10	1/30/2013	9.88 feet	7,100 cfs
11	2/23/2018	9.63 feet	8,010 cfs
12	5/10/2004	9.52 feet	7,810 cfs
13	3/14/2006	9.42 feet	7,630 cfs
14	10/02/2019	9.21 feet	7,530 cfs
15	4/2/1998	9.12 feet	7,130 cfs
16	4/4/2005	9.10 feet	7,080 cfs
17	10/25/2017	9.04 feet	7,230 cfs

Muskegon River
Croton Gauge Coverage Map
Section 2
Garfield
Newaygo
Newbridge/Sarrell
Cronk Dr
Brooks
Anderson Flats
Old Woman's Bend
Pepperridge
Sugarbush
Ashland
Legend
River Gauge
Mile Marker
Roads
Subdivisions
Jurisdiction

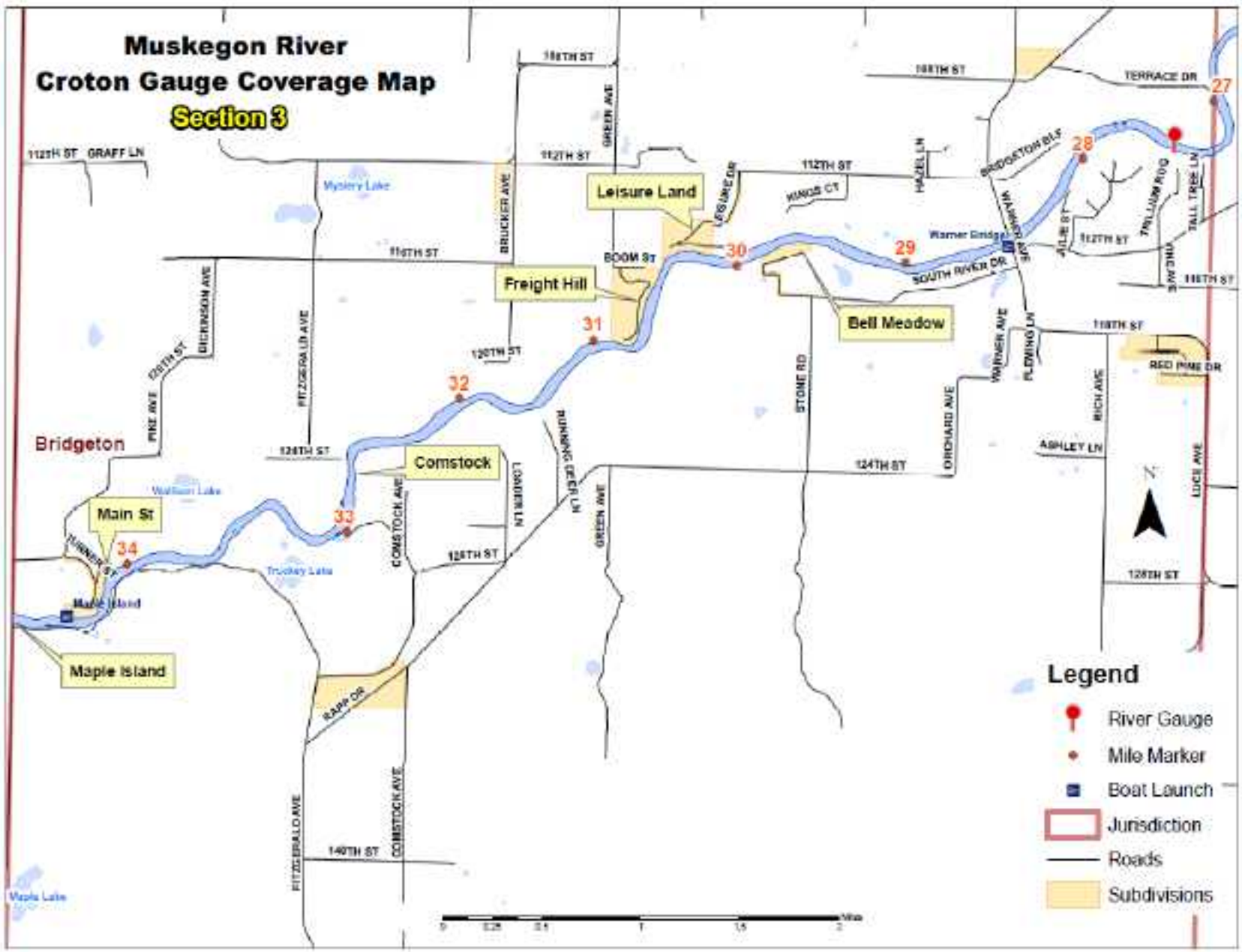
USGS 04122001 Muskegon River at Bridge Street at Newaygo, MI Flood Impacts
(Functional from 1964 through 1993. Re-established in 2017)

Near Flood Stage	10 Ft	
Flood Stage	11 Ft	Minor Flooding – Minimal property damage, public inconvenience
Moderate Flooding Stage	14 Ft	Moderate Flooding – Some inundation, possible evacuations
Major Flood Stage	15 Ft	Major Flooding – Extensive inundation and evacuations

15.0	Expect the Bridge Street Bridge in the City of Newaygo to close. Expect major flooding downstream from the City of Newaygo in the areas of Anderson Flats and Old Women's Bend in Garfield Township and Sycamore Flats, 100th Ave, and Sugarbusg Lane in Ashland Township. Expect moderate flooding on Sarrell Street in the City of Newaygo. Expect Flech Ave near the Anderson Flats area to be closed. Expect all public River Access sites to be closed.
14.0	Flood water begins surrounding homes on Sarrell Street in the City of Newaygo. Moderate flooding downstream from the City of Newaygo in the areas of Anderson Flats and Old Women's Bend in Garfield Township and Sycamore Flats, 100th Ave, and Sugarbusg Lane in Ashland Township. Expect Flech Ave near the Anderson Flats area to be closed. Expect all public River Access sites to be closed.
13.0	Flood water begins surrounding cottages and homes downstream from the City of Newaygo in the areas of Sugarbush Lane and 100th Avenue in Ashland Township. Expect minor flooding in Anderson Flats and Old Women's Bend in Garfield Township and Sycamore Flats in Ashland Township. Expect water to come over Felch Ave near Salmon Run Campground and South River Lane. Expect all public River Access Sites to be closed.
12	Flood water begins surrounding cottages and homes downstream from the City of Newaygo in the areas of Sycamore Flats in Ashland Township.
11	Flood water continues to exceed its banks and minor flooding begins in low lying areas along the river.
10	River is bank full. River begins to exceed its banks and minor flooding begins in low lying areas along the river.

Historical Crests for the USGS Gauge at Newaygo

Rank	Date	Gauge Height	Stream Flow
1	9/12/1986	19.54 feet	23,200 cfs
2	2/21/2018	15.13 feet	10,900 cfs
3	1/31/2019	14.52 feet	N/A Ice Jam
4	7/1/1969	13.98 feet	9,550 cfs
5	5/19/2020	13.53 feet	9,280 cfs
6	3/16/2019	13.46 feet	9,220 cfs
7	3/30/1976	13.37 feet	10,800 cfs
8	10/1/1986	12.88 feet	9,940 cfs
9	9/2/1975	12.75 feet	9,800 cfs
10	4/17/1971	12.31 feet	7,220 cfs
11	10/02/2019	12.18 feet	7,680 cfs
12	6/3/1970	12.08 feet	5,900 cfs
13	10/25/2017	11.87 feet	7,510 cfs
14	4/2/1989	11.83 feet	8,290 cfs
15	6/24/2017	11.65 feet	7,170 cfs
16	4/30/2020	11.46 feet	6,880 cfs
17	12/31/2019	11.34 feet	6,730 cfs


Muskegon River
Croton Gauge Coverage Map
Section 3
Leisure Land
Freight Hill
Bell Meadow
Comstock
Bridgeton
Main St
Maple Island
Wolf Lake
Mystery Lake
Truckey Lake
Maple Lake
Warner Bridge
27
28
29
30
31
32
33
34
112TH ST
116TH ST
120TH ST
124TH ST
128TH ST
132ND ST
136TH ST
140TH ST
SOUTH RIVER DR
BOOM ST
TERRACE DR
RED PINE DR
ASHLEY LN
Legend
River Gauge
Mile Marker
Boat Launch
Jurisdiction
Roads
Subdivisions

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			

The USGS from 1964 through 1993, the Muskegon River gauge below the Croton Dam was located within the City of Newaygo. 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:

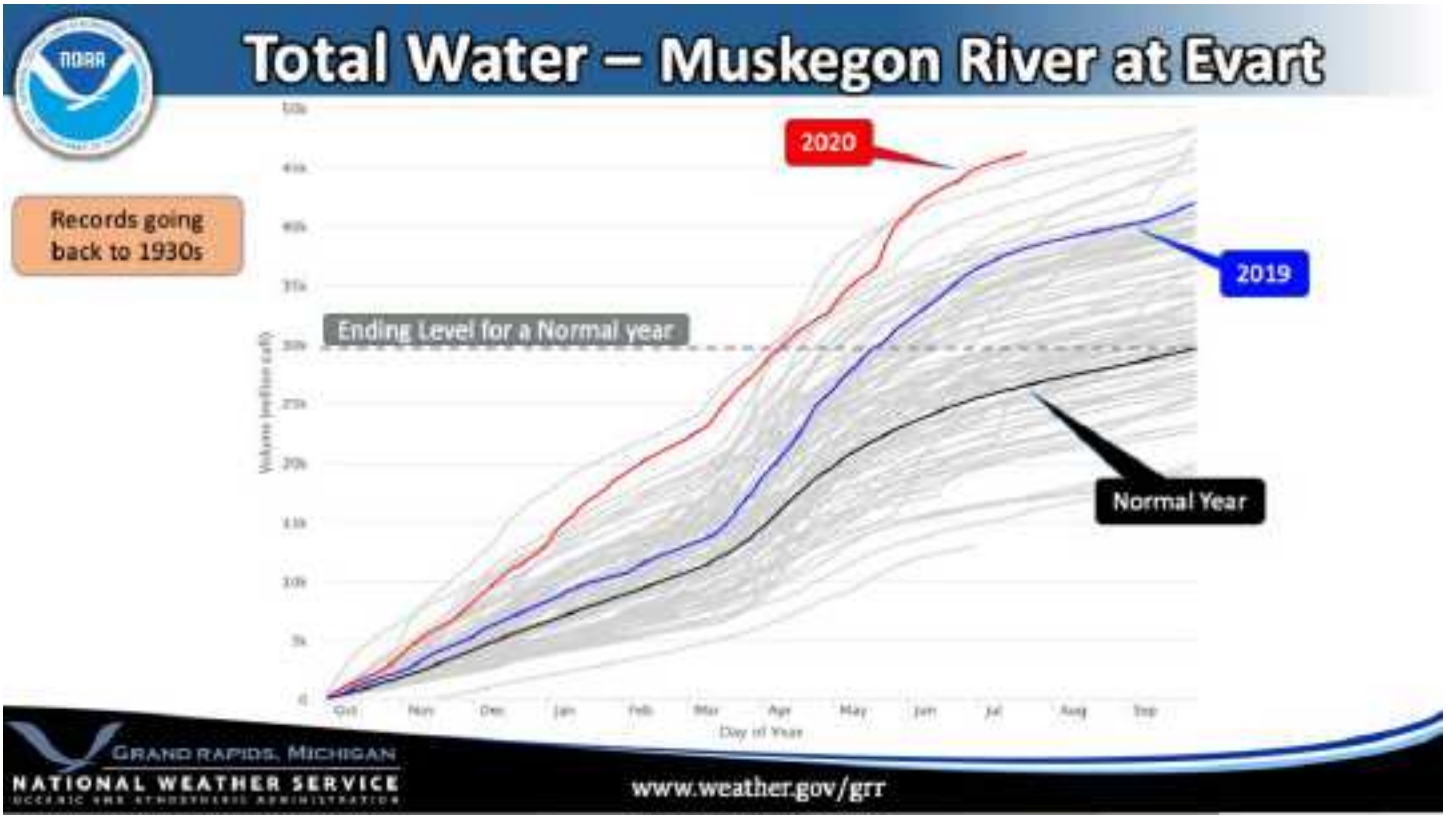
Water Year	Date	Gage Height (Feet)	Flood Height above FS	Stream Flow (CFS)
1996	June 24, 1996	8.42		5,780
1997	Jan 5, 1997	8.23		5,410
1998	April 2, 1998	9.12	0.12	7,130
1999	June 15, 1999	7.56		4,150
2000	May 19, 2000	8.33		6,080
2001	May 18, 2001	8.49		6,390
2002	March 10, 2002	8.67		6,620
2003	May 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

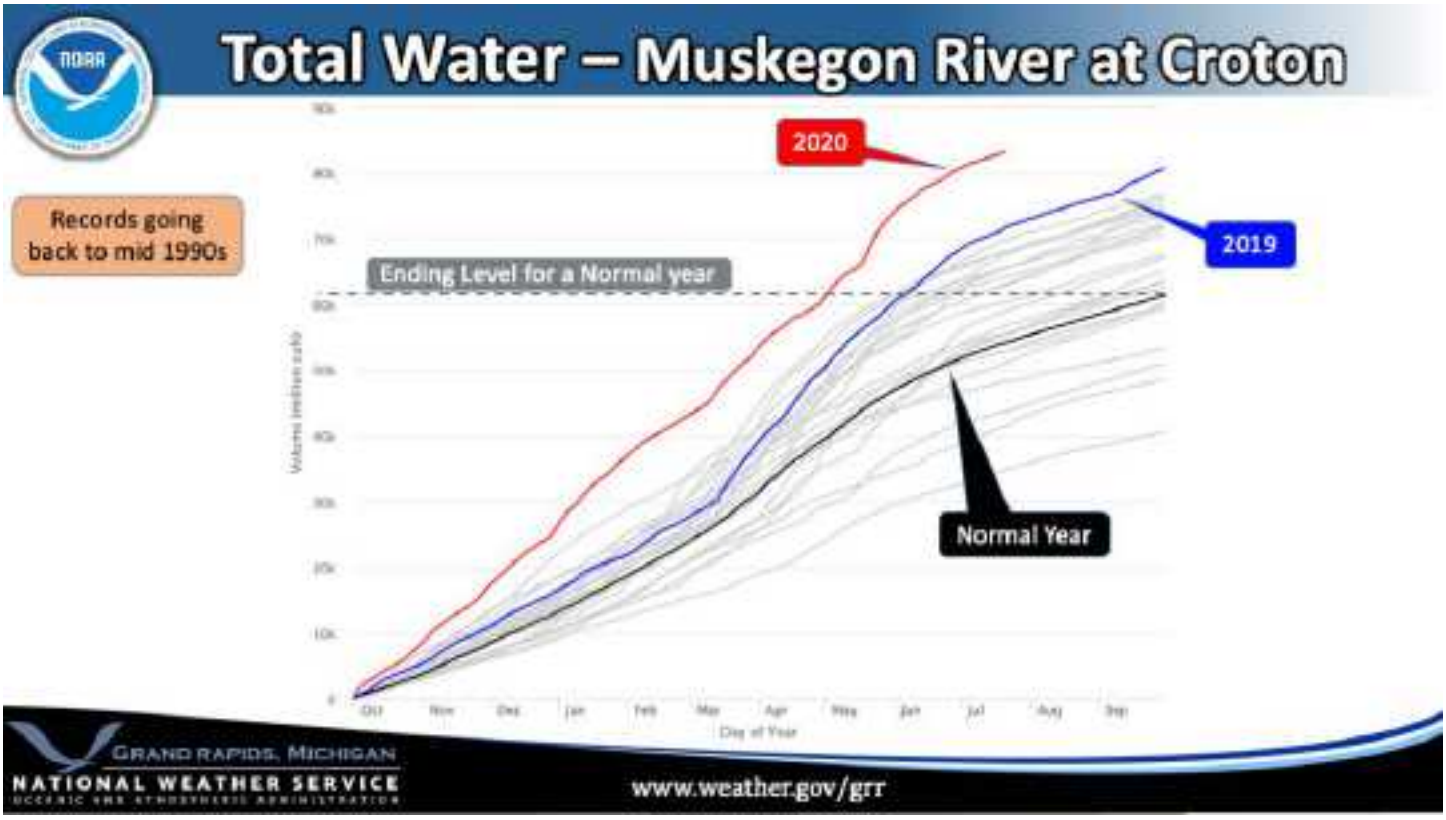
Frequency of Flooding on the Muskegon River

Raw Data shows the frequency of flooding events in Newaygo 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. From 1971 to 2000, average annual precipitation was 33.05 inches for Fremont, Michigan.

Muskegon River below Croton

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
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	
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	8	39.98
2019	5	4	7	45.92
2020	5	1		
Average	**3**	**Less than 1**	**7**	**37.93**

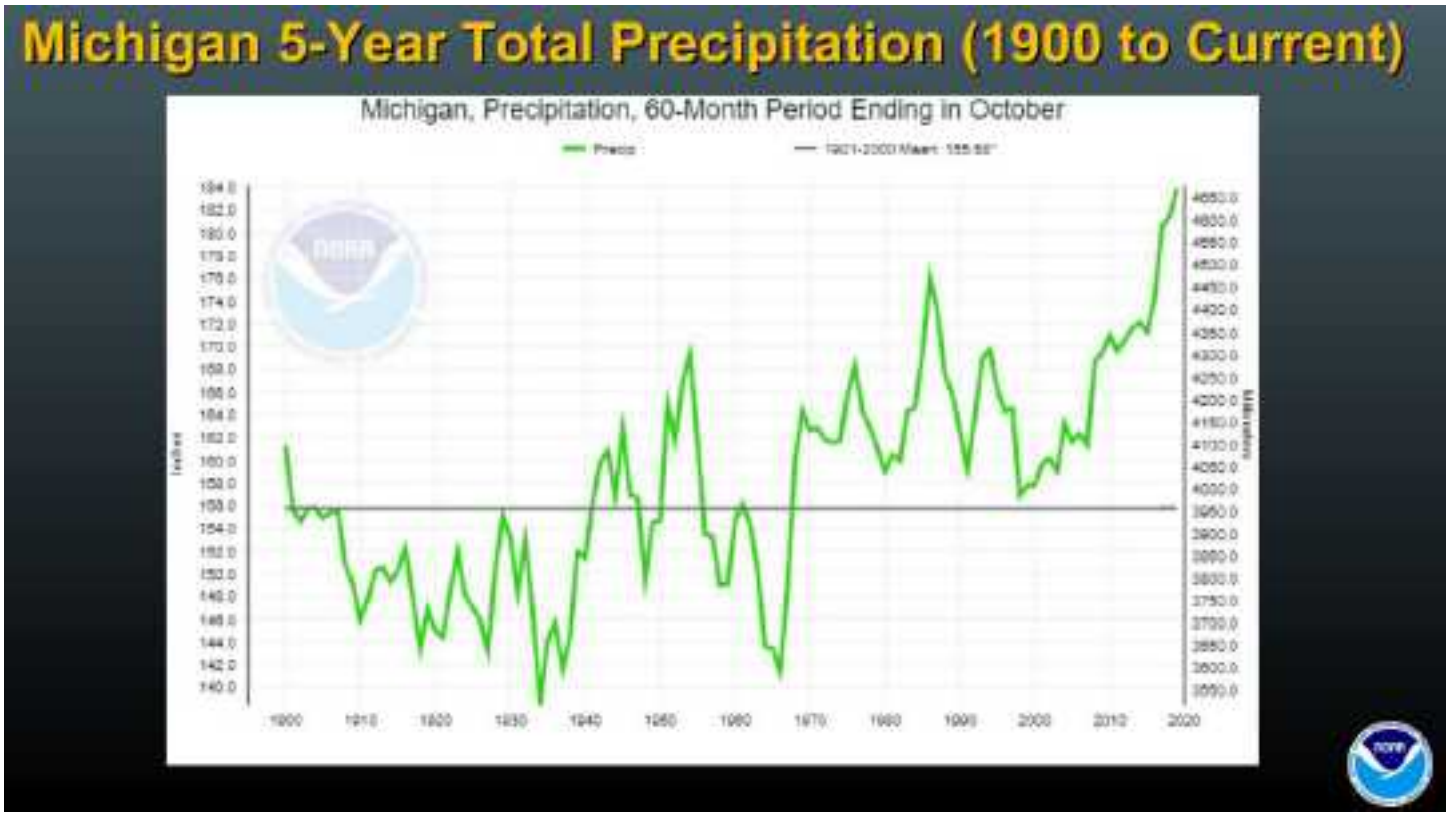

Total Water – Muskegon River at Evart
Records going back to 1930s
2020
2019
Ending Level for a Normal year
Normal Year
Day of Year
GRAND RAPIDS, MICHIGAN
NATIONAL WEATHER SERVICE
www.weather.gov/grr


Total Water – Muskegon River at Croton
Records going back to mid 1990s
2020
2019
Ending Level for a Normal year
Normal Year
Day of Year
GRAND RAPIDS, MICHIGAN
NATIONAL WEATHER SERVICE
www.weather.gov/grr

Frequency of Heavy Rainfall in Newaygo County

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.

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 frequency of days with very heavy precipitation (the wettest 2% of days) is 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 following is Highest Precipitation by day records for Fremont, Michigan.

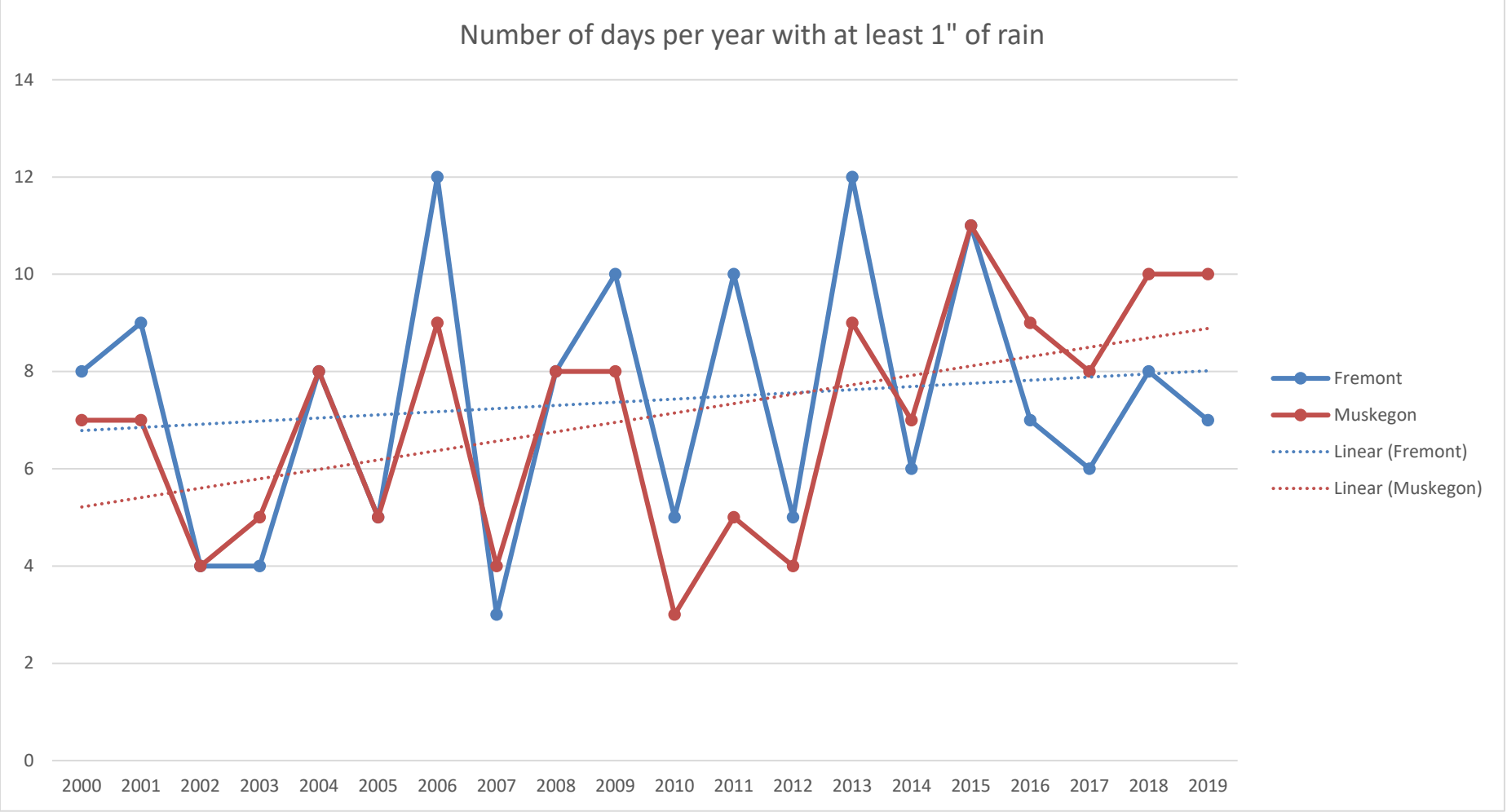
Highest Precipitation by Day for FREMONT 4 WSW, MI

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

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.67 2019	0.28 2016	0.60 2012	1.15 2008	1.79 2009	0.70 2004	0.43 2016	0.44 2013	0.00 2019	0.94 2018	1.10 2013	0.38 2004
2	1.16 2005	0.79 2011	0.77 2004	0.19 2000	0.63 2019	0.46 2001	0.27 2018	1.22 2002	1.48 2018	3.98 2019	0.56 2004	0.69 2018
3	0.47 2004	1.00 2016	0.62 2002	1.46 2006	0.82 2018	0.66 2018	1.38 2008	0.36 2015	2.22 2010	2.70 2006	0.78 2003	0.17 2007
4	0.43 2015	0.42 2018	0.18 2015	1.47 2011	0.60 2016	0.76 2002	2.00 2007	0.29 2002	0.71 2011	1.48 2013	0.77 2003	0.53 2011
5	0.24 2006	0.47 2008	1.54 2004	0.49 2014	0.47 2016	0.29 2007	0.43 2003	0.38 2008	3.24 2008	0.71 2002	2.32 2003	0.33 2006
6	0.21 2013	0.49 2019	0.14 2004	0.56 2010	0.30 2003	1.00 2008	0.11 2003	0.65 2019	0.51 2018	0.74 2018	1.89 2005	0.34 2008
7	0.15 2017	0.46 2008	0.20 2004	0.64 2006	0.40 2014	0.97 2006	1.40 2015	0.30 2018	0.50 2010	0.51 2009	0.66 2013	0.38 2004
8	0.70 2019	0.74 2013	1.01 2009	1.51 2015	2.21 2004	1.19 2008	0.23 2008	0.75 2009	2.56 2016	0.70 2008	0.30 2008	1.11 2004
9	0.33 2015	1.67 2001	1.03 2009	0.85 2002	2.46 2004	1.61 2008	0.63 2002	2.54 2009	1.84 2015	1.15 2004	1.36 2005	0.66 2009
10	0.37 2016	0.31 2010	1.03 2006	2.45 2015	1.21 2004	1.55 2019	0.10 2003	0.69 2012	1.44 2013	0.36 2012	0.66 2000	0.68 2003
11	1.16 2014	0.25 2018	0.50 2013	1.20 2008	1.16 2006	0.55 2014	0.49 2003	0.59 2012	0.77 2014	1.58 2018	1.02 2006	0.27 2009
12	0.43 2018	0.61 2009	1.05 2010	2.23 2001	0.90 2002	1.35 2015	1.34 2006	0.64 2005	1.54 2000	0.46 2019	0.36 2015	0.58 2010
13	1.16 2005	0.35 2019	1.41 2006	3.85 2014	2.21 2014	1.52 2015	0.53 2017	1.15 2011	1.59 2019	0.41 2001	0.41 2005	0.33 2001
14	0.20 2006	0.61 2005	0.45 2019	1.57 2014	1.46 2009	0.50 2015	1.07 2015	0.57 2011	0.85 2008	2.80 2001	0.60 2008	1.49 2015
15	0.27 2004	0.11 2015	1.33 2019	0.85 2019	3.21 2001	0.95 2017	1.00 2010	0.26 2000	0.77 2008	0.97 2017	0.36 2005	0.56 2008
16	0.04 2014	0.38 2012	0.60 2016	0.81 2012	0.85 2001	1.03 2013	0.80 2010	0.27 2001	0.54 2010	1.23 2016	0.86 2017	0.71 2012
17	0.81 2017	1.18 2006	0.11 2016	0.37 2004	0.18 2000	0.32 2014	0.71 2015	0.67 2017	0.30 2016	0.62 2006	0.57 2000	0.27 2008
18	0.50 2006	0.65 2008	0.24 2008	1.56 2013	1.04 2000	0.68 2014	1.28 2006	0.34 2017	0.34 2012	1.08 2012	1.69 2013	0.45 2002
19	0.73 2005	0.38 2013	0.18 2013	1.13 2002	0.68 2000	1.47 2012	0.80 2015	2.92 2001	0.83 2015	0.76 2002	1.28 2003	0.42 2008
20	0.20 2000	1.34 2018	0.23 2004	1.21 2011	0.55 2004	0.54 2009	0.70 2019	0.47 2007	0.49 2002	1.21 2011	0.41 2004	0.52 2012
21	0.68 2006	1.04 2018	0.62 2011	1.63 2000	0.35 2013	0.86 2000	0.60 2019	1.67 2018	0.94 2000	0.28 2010	0.25 2000	0.60 2012
22	0.26 2008	0.32 2009	1.97 2007	0.19 2001	0.76 2004	2.07 2011	1.64 2001	2.54 2002	0.48 2010	0.51 2019	0.31 2002	0.28 2006
23	0.83 2018	0.11 2004	0.92 2011	0.31 2011	1.32 2013	1.82 2017	0.90 2010	1.75 2000	0.98 2000	1.56 2017	0.56 2010	1.13 2006
24	0.20 2012	1.02 2017	0.81 2016	0.44 2013	0.81 2004	1.18 2010	1.01 2016	0.23 2015	1.05 2006	2.60 2017	1.18 2014	0.61 2008
25	0.52 2014	0.87 2001	0.94 2016	0.55 2004	0.47 2019	0.31 2019	0.98 2016	0.31 2001	0.24 2011	0.95 2001	0.52 2014	0.39 2014
26	0.23 2017	0.26 2007	0.57 2004	2.16 2009	0.42 2011	0.09 2008	1.19 2012	0.67 2003	2.01 2005	0.72 2012	0.22 2018	0.40 2009
27	0.18 2014	1.63 2009	0.29 2018	0.89 2007	1.16 2015	0.92 2016	0.79 2006	4.03 2018	0.33 2003	1.33 2019	2.12 2015	0.34 2015
28	0.28 2004	0.17 2005	1.24 2014	1.07 2011	0.58 2019	0.84 2010	1.33 2011	1.95 2004	0.97 2009	0.49 2015	0.66 2004	1.06 2008
29	1.09 2013	0.29 2012	1.00 2009	0.50 2016	0.72 2013	1.22 2017	1.97 2016	0.61 2018	0.86 2005	0.63 2003	0.96 2016	1.27 2015
30	2.04 2013	- -	0.23 2002	0.55 2017	0.75 2008	0.53 2005	0.16 2002	1.17 2019	0.45 2015	0.94 2009	0.95 2006	0.13 2001
31	0.29 2013	- -	0.83 2016	- -	0.88 2004	- -	2.04 2012	1.51 2001	- -	1.13 2009	- -	0.38 2005

Period of record: 2000-01-01 to 2019-11-21

The following demonstrates the frequency of days with at least 1" of rain, broken down by calendar year, starting in 2000. Data is from a NWS observer in Fremont, as well as the airport in Muskegon. The average over the last 20 years is 7 days per year of at least an inch of rain (or equivalent snow). Both locations show an upward/increasing trend with time, on the order of 1 to 3 extra yearly occurrences over the 20 year duration.



United States Geological Survey Flood Inundation Mapper Program for the Muskegon River

The USGS Flood Inundation Mapping (FIM) Program helps communities protect lives and property by providing tools and information to help them understand their local flood risks and make cost-effective mitigation decisions. The USGS Flood Inundation Mapping Program has two main functions. First, the USGS partners with local communities to develop a flood inundation map library. This library contains a set of maps that shows where flooding may occur over a range of water levels in the community's local stream or river. This information can be utilized for preparedness, timely response, recovery, mitigation and planning, and environmental and ecological assessments.

The second function of the Flood Inundation Mapping program is to provide online access to flood inundation maps along with real-time streamflow data, flood forecasts, and potential loss estimates. Once a community's map library is complete, it is uploaded to the USGS FIM Mapper, an online public mapping application. The FIM Mapper allows users to explore the full set of inundation maps that shows where flooding would occur given a selected stream condition. Users can also access historical flood information and potential loss estimates based on the severity of the flood. The FIM Mapper helps communities visualize potential flooding scenarios, identify areas and resources that may be at risk, and enhance their local response effort during a flooding event.

In 2016, Newaygo County received a Hazard Mitigation Grant to implement a new flood warning system for approximately 35 miles of the Muskegon River in Newaygo County utilizing the United States Geological Survey (USGS) Flood Inundation Mapper System. Through this implementation, two additional streamgages were added on the Muskegon River in 2017 and a Flood Inundation Map Library was published in 2020. Please see Flood Inundation Maps Appendix for additional information.

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. There is no USGS stream gauge monitoring in Newaygo County on the White River. Water levels are measured manually by staff gauges painted onto bridges located at M-37 bridge at the White River in White Cloud and the M-20 bridge at the White River east of Hesperia.

Based on historical occurrence, on average Newaygo 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 Newaygo County:

Case: September 1986 Flood

Beginning on September 10, 1986 a slow moving low-pressure system moved across the middle of the Lower Peninsula. In a 48 hour period, the intense rainstorm produced 14 inches of rainfall over a widespread area. The storm resulted in thousands of people being evacuated due to flooding. Many dams failed or threatened failure during this event including the White Cloud Dam, Croton Dam, and Hardy Dam in Newaygo County. About thousands of homes suffered basement and structural damage and hundreds of roadways were impassable as a result of the failure of bridges and culverts. Across the State, over $300 million in damage resulted from the flood. This was the worst flood in Michigan in 50 years and is still the worst flood in Newaygo County. Thirty (30) counties were included in the Presidential Major Disaster Declaration granted for this flood.

Case: February and May 2001 Flash Flooding

Extensive flooding began on the 9th of February as a result of the combination of heavy rain and melting snow. Numerous roads were closed across all of southwestern and south central lower Michigan, including portions of M-37 in Lake county. A dozen roads were washed out or closed across Newaygo County. There were also many reports of standing water in low lying areas and poor drainage areas. The event transitioned into a river flood event across the area. 10 forecast points on 8 different rivers went above flood stage. However, no lives were lost, and only minor property damage occurred. The event caused $100k in property damage.

In May, thunderstorms developed during the morning hours of the 15th, producing several reports of large hail and high winds. It was also a record rainfall event for the Grand Rapids area, and 4 to 5 inches of rain fell in less than 6 hours across much of southwestern and south central lower Michigan. Again, flash flooding became the primary problem. There were numerous reports received of flooded roads, basements, and flooding of small creeks and streams. Fortunately, however, the flash flooding and flooding did not cause any fatalities. Newaygo County was included in a Governor's Disaster Declaration for this event.

Case: May 2004 Flood

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. The Muskegon River at Newaygo crested at 12.49 feet at 4 p.m. on 5/24. Flood stage is 11 feet. It was the 6th highest crest in history.

Backyards were submerged under several feet of water. 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 the southern Lower Peninsula. Macomb County damages were estimated at $100 million, and damages of about $1 million each were reported for the counties of Clare, Gratiot, Isabella, Lake, Mason, Mecosta, Montcalm, Newaygo, Oceana, and Osceola.

Case: April 2013 Flooding on the Muskegon River

The Muskegon River Basin received two heavy rainfall events close together in April of 2013, causing moderate to major flooding. The first rainfall event occurred on April 8 – 12, dumping 3.8 inches of rain across the state. The second event occurred on April 17-19, dumping an additional 4.45 inches of rain over an already saturated ground and swollen rivers. The Muskegon River below the Croton Dam peaked on April 19, 2013 at 11.11 feet. Hundreds of homeowners were evacuated for several days to a week. River access sites were closed for a week due to unsafe river conditions and the high flows over an extended period of time caused massive erosion and sedimentation issues, destroyed spawning beds, and caused other environmental issues. The flood caused approximately $1.5 Million in damages to 109 homes and $175,000 in damages to roads and bridges. Newaygo County was included in a Presidential Disaster Declaration along with 19 other counties for this event.

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. Newaygo County was included in a Governor's Disaster Declaration along with 7 other counties for this event. In addition, due to the extensive home damage, Newaygo County received a disaster declaration under the Small Business Administration which opened up loan interest loans to assist homeowners with recovery.

Case: February 2018 Flood

A slow release of a snow pack, containing one to over two inches of water, occurred in the days leading to the event which started the process of river rises in many areas. Low pressure tracked from northwest Iowa into northern Lower Michigan, which ushered in a rapid warmup and equally rapid release of any remaining water in the snowpack. Several rounds of rain occurred between the 19th and 21st of February across the region. Rainfall amounts ranged from 2 to 4 inches, fed by record high precipitable water levels (by February standards) in the 1.3 to 1.5 inch range. This event was among the top 3 heaviest winter rainfall events to occur over frozen ground.

In Newaygo County, the flood caused significant rises on the White River and the Muskegon River. It was the third highest crest on record for the Muskegon River below Croton. On the White River, water flowed over the emergency spillway causing significant damage to the White Cloud and Hesperia Dams. Estimated public damages to roads and infrastructure was $177,989.00 and private damages to homes and businesses were estimated to be $456,450.00. Newaygo County received a Governor's Disaster Declaration for this event.

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.

<u>Urban Flooding in Michigan</u>

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.

Case: April 1973 – Lower Peninsula (Federal Disaster #371 – 14 counties)
A series of severe storms produced a great deal of precipitation during the Spring thaw season. The resulting floods resulted in a major disaster declaration for 14 counties across much of the Lower Peninsula—from Iosco to Berrien, and from Huron County down to Wayne County. Arenac, Bay, Macomb, Monroe, Saginaw, St. Clair, Tuscola, Sanilac, and St. Clair Counties were part of the disaster area. The Detroit Metropolitan region was heavily affected, as was the Upper Peninsula county of Menominee and the southeastern county of Van Buren. Many of these same southeastern and Saginaw Bay area counties had been affected by the December 1972 event just a few months before.

Case: October 1, 1981 – Southern Lower Peninsula
News articles reported a large event that did not show up in official disaster-declaration records. Heavy rains on October 1 reportedly caused floods that resulted in more than $250 million in damages across 28 counties in southern Michigan. Floods were noted at 22 forecast points. During that morning, all freeways in the Detroit Metropolitan area were closed for several hours. Approximately 300 washed-out sections of rural roads and 30 damaged bridges were noted. One fatality was also reported during this event. Over 500 persons were evacuated from their homes, 60 persons were rescued from a flooded motel in Farmington, and 485 families were assisted by the American Red Cross.

September 1985 – East Central Michigan (Federal Disaster #744 – 6 counties)
A year earlier, on September 5, 1985 severe thunderstorms struck east central Michigan, resulting in flooding in a six-county area. As much as 7.45 inches of rain fell in Genesee County, which was hardest hit. The heavy rainfall caused flash flooding in many areas. Damage occurred primarily from overbank flooding on major rivers and streams. In addition, widespread flooding occurred in residential areas due to

overburdened stormwater drainage systems. Over 2,500 homes were damaged, many roads were washed out and bridges damaged, and extensive agricultural damage occurred. Total public and private damage was estimated at $63 million. A Presidential Major Disaster Declaration was granted for the six counties of Alcona, Genesee, Iosco, Lapeer, Saginaw, and Shiawassee.

September 2000 – Wayne and Oakland Counties (Federal Disaster #1346)

A Presidential Major Disaster Declaration was granted to Wayne and Oakland Counties for urban flooding and sewer backups caused by intense rainfall on September 10 and 11, 2000. Although much damage took the form of basement flooding, which is not the type of flooding that is normally easy to see and broadcast through the mass media, this was one of the largest Michigan disasters ever to occur in terms of the sheer amounts of documented damages to homes in Detroit and its surrounding cities. The event was denoted as federal disaster number 1346, and hazard mitigation funds made available to Michigan as a result of this disaster were instrumental in allowing local hazard mitigation plans to be developed in most areas of the state.

August 11 to 13, 2014 – Metropolitan Detroit (Federal Disaster #4121 – 3 counties)

Excessive rainfall occurred from a storm that was concentrated over the metropolitan area and thus had severe impacts upon the most densely populated areas within Wayne, Oakland, and Macomb Counties, where a disaster was then declared. Four to six inches of rain fell during a 4-hour period, an amount that overwhelmed storm sewer systems and expressway pumps. All the major expressways serving the central urban area were affected, and their closures caused huge transportation issues during the Monday afternoon rush hour. It was estimated that 1,000 cars were stalled and abandoned within flooded areas, while rescues had to be performed. About 75,000 homes and businesses were damaged, more than 3,000 of which involved major damage. Road and bridge damages also occurred, with total losses calculated at $1.8 billion across the metropolitan area. This event was very similar to the major disaster of September 2000, but with severe transportation impacts added on top of the widespread basement flooding, plus 2 deaths. Official FEMA damage estimates calculated the damages in 2014 as less severe than in the 2000 event by using changed standards that discounted huge amounts of damage to basements with unfinished areas. Despite this downgraded estimate of qualifying flood impacts, the event inspired new metropolitan coordination efforts around shared funding of regional stormwater systems. This event also had impacts beyond the central metropolitan area, based upon reports from Bay, Genesee, and Saginaw counties of roads that were flooded to depths up to 3 feet.

June 16 to July, 2018 – Western Upper Peninsula (Federal Disaster #4381 – 3 counties)

Starting on June 16, a storm system produced historically heavy rainfalls of nearly seven inches in parts of Gogebic, Houghton, and Menominee Counties, and most of that rainfall occurred within a 6-hour overnight period in the early morning of June 17. An official with the National Weather Service estimated that this level of precipitation can be described as a “1000-year event,” using the current probability estimation methods. The three-day totals were recorded as potentially as high as 8.4 inches in Houghton County, 7.82 inches in Gogebic County, and 5.63 inches in Menominee County. The most severe problems resulted from the area’s hilly topography, especially in Houghton County, in which unusual amounts of debris were carried by the rapid runoff waters. Sediment and rocks were loosened

and washed down hills, resulting in damaged buildings and infrastructure through direct forces plus scouring effects. A 12-year old boy in Houghton died after the basement wall of his Canal Road home collapsed under these flood impacts. Entire city blocks in Houghton saw their paved street surfaces crumble and become impassable under the impacts of the flash flood. Numerous additional roads and homes were also damaged in diverse locations throughout the three counties. A Governor's disaster declaration in June was followed up by a subsequent second declaration on July 12, and then by a federal disaster declaration. The FEMA Preliminary Damage Assessment process identified 172 homes with minor damage, 50 with major damage, and 3 considered destroyed. Over 200 roads were closed during the disaster, some of which seriously inhibited emergency response capabilities. Road damages were estimated at $40 million. Houghton County also had to deal with serious damages to approximately 50 miles of off-road trails that formed an important part of the area's winter tourist economy as well as alternative transportation routes for snow vehicles during conditions in which excessive snows inhibit or prevent normal road travel. The damaged trails were important for recreational as well as functional transportation needs in an area that receives much more snow than most of the state does. Many homes, yards, basements, stream beds, streets, and roads were filled with material from areas washed out by rain runoff and flood waters. The trail system damage involved 151 washed-out areas, involving additional damages estimated at more than $20 million. Unfortunately, only 1% of the affected households were covered by flood insurance that would have provided compensation for the kinds of damages sustained in this event. The federal disaster declaration had been approved to provide Public Assistance, but not Individual Assistance of the type that these households would have wanted. An unsuccessful appeal was attempted to try to have the declaration include Individual Assistance. Total damages were estimated to be at least $100 million.

Urban Flooding in Newaygo 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 Newaygo County, several areas experiencing urban flooding issues include the City of Fremont, The City of Newaygo, the City of Grant, the City of White Cloud, and the Village of Hesperia. 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: March 2019 Flood

On Thursday March 14, 2019 three rounds of thunderstorms combined to drop approximately 1.5 inches of rain on much of Newaygo County. In addition, the ground was frozen and approximately 4 inches of snow water equivalent was contained in the snowpack. About 2.5 inches of this snow water melted and joined the rainfall runoff. These 3 factors all resulted in rapid and significant flooding across

parts of the county that resulted in more than 50 homes and 9 businesses flooded, as well as the closure of more than 100 roads and the complete washout of more than 30 roads. A series of private dams on Penoyer Creek were also damaged. In addition, in the days after the storm, minor flooding developed along the Muskegon River that resulted in the flooding of an additional 105 homes. Damages from this storm across the county were more than $1.7 Million. The Governor declared a State of Emergency for the community as a result of this emergency.

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.

<u>Dam Failure Hazards in Michigan</u>

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 Dan 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)

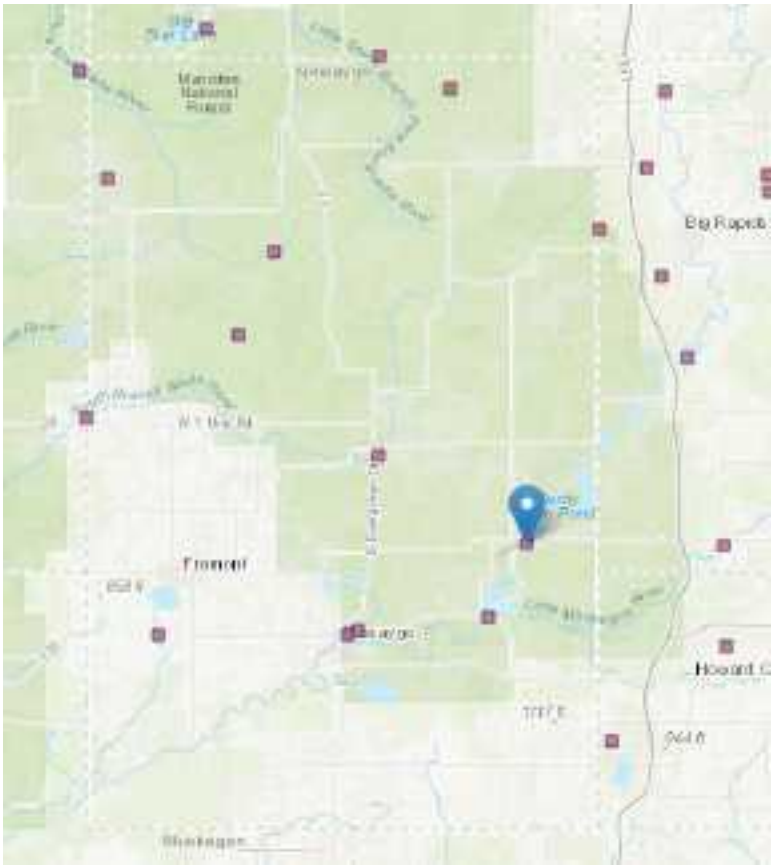
East of the town of Grawn, a temporary dam and de-watering structure had been in place alongside the Brown Bridge Dam on the Boardman River, to assist in drawing down the small lake behind the dam (Brown Bridge Pond) before the dam's permanent removal. This temporary dam failed and caused the release 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.

<u>Dam Hazards in Newaygo County</u>

Within Newaygo County there are (2) Hydroelectric Dams owned and operated by Consumers Energy. These dams are regulated by the Federal Energy Regulatory Commission. In addition, there are 1 municipally owned dams and 8 privately owned dams as 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.

Hardy Dam

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.

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 loss of life and/or damage to structures, roads, utilities, crops and the environment. In addition, a failure of the Hardy Dam would cause a failure of the Croton Dam.

Croton Dam

The Croton Hydroelectric Generating Dam has been in continuous operation since 1907. Its impoundment, the Croton Pond, is 1,290 acres with a mean depth of 18 feet. The average annual cubic feet per second of flow through the dam is 1,871. The dam is capable of generating 8,800 kilowatts of electricity, enough to serve a community of about 4,900 people. The plant is located in Newaygo County's Croton Township and is the site of the great salmon migration.

The Croton 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 Croton Dam is not designed and cannot operate as a flood control structure under the FERC License. The dam operates in a re-regulation mode, with pond levels maintained at 722.0 feet surface water level on a daily basis. With Hardy at full or minimum pond level, flows from Croton are to approximate the inflows from Rodgers Dam plus the Little Muskegon River. During the Hardy drawdown or refill periods, Croton is to release the projected daily average flow from Hardy plus the Little Muskegon River. Rates of drawdown and refill must not exceed 1 foot in a 24 hour period.

The Croton Dam is also 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 loss of life and/or damage to structures, roads, utilities, crops and the environment.

White Cloud Dam

The White Cloud Dam is located on the White River in the City of White Cloud. The dam was built in 1872 and is 18.89 foot high, 950 foot long earthen embankment with three spillways. The dam's impoundment is 475 acres. The Principal Spillway and the Secondary Spillway control the impoundment elevation and flow during normal conditions. The Emergency Spillway is an overflow structure, designed to overtop when the other spillways cannot adequately pass the flow through the dam. The dam structure supports State Street in the City of White Cloud. The dam is presently owned and operated by the City of White Cloud.

The White Cloud Dam is listed as a High Hazard Dam by the Michigan EGLE. This dam is noteworthy because of its location upstream from M-37 and the Marquette Railroad Bridge just south of the City of White Cloud. A failure on this dam would likely result in loss of life and/or damage to structures, roads, utilities, crops and the environment. It is unknown if a failure of the White Cloud Dam would cause a failure of the Hesperia Dam.

The following are a list of known private dams in Newaygo County from the National Inventory of Dams, US Army Corps of Engineers.

NAME	NIDID	OWNER NAME	ADDRESS	LOCATION	YEAR COMPLETE	Height (Ft)	MAX STORAGE (Acres)	MAX DISCHARGE (CFS)	HAZARD POTENTIAL
Minnie Lake Dam (Mena Creek)	MI82402	USDA FS	Alger Ave	Lincoln Township	1939	13	264	1,132	Low
Henkin Pond Dam	MI01759	Steve F Pagura	N. Dickinson Ave	Troy Township	1966	18	66	36	
Clayton Dam	MI00312	Leonard Kurello	West 9 Mile Road (Woodland	Merrill Township	1955	10	200	N/A	
Peace Creek Dam	MI00406	Grass Lake Hunting Club	13453 Pine Street	Home Township	1965	16	179	620	
Rowe Dams No. 1 (Penoyer Creek)	MI00234	Mark Coe	171 Curve Street, Newaygo	City of Newaygo	1888	13	65	400	
Rowe Dams No. 2 (Penoyer Creek)	MI00235	Mark Coe	171 Curve Street, Newaygo	City of Newaygo	1915	14	65	250	
Peterson Dam	MI02119	Thomas Merritt	7124 Robinwood	Sheridan Township	N/A	9	108	300	
Minnie Lake Dam (Mena Creek)	MI00185	Huron Manistee National Forest	W 2 Mile Road, Manistee National Forest	Lincoln Township	1939	10	264	1,000	
White Cloud Dam	MI00526	City of White Cloud	Silver Street	City of White Cloud	1872	18.9	475	2,600	High

The following brief synopses describes Newaygo County's Dam Failure Hazard Events:

Event: White Cloud Dam 1910
The White Cloud Dam was originally constructed in 1872. It was destroyed by flooding in 1910 and reconstructed the same year.

Event: White Cloud Dam September 1986
The White Cloud dam failed in September 1986 during severe flooding. The dam was reconstructed in 1990, with the addition of the roller compacted concrete overflow spillway to increase the dam's spillway capacity.

Event: Three White Cloud Dam Overtopping Incidents
During the February 2018, March 2019, and October 2019 flooding events the White Cloud Dam overtopped causing minor damage to the dam.

Event: Rowe Dams on Penoyer Creek March 2019
Due to a heavy rainfall event and deferred maintenance, all Penoyer Creek dams sustained heavy damage. Rowe Dam#2 overtopped and an emergency drawdown was conducted to prevent complete collapse of the dam. Once the drawdown was completed, emergency stabilization took place to lessen further damage. Currently, the dam owner is working to EGLE and a Dam Engineer to determine the next course of action. The reservoir remains drawn down as the dam is no longer functioning as designed.

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.

<u>Shoreline Hazards in Newaygo County</u>

Newaygo County is not a Great Lakes Shoreline community, therefore is minimally impacted by shoreline hazards. However, erosion on riverbanks of the Muskegon River and the Little Muskegon River has began impacting some homes. During the April 2013 flood, several properties along the Little Muskegon River in Croton Township experienced significant bank erosion due to sandy soils collapsing. One home was deemed no longer safe to occupy and had to be demolished. Again during the April 2014 flood, several more properties experienced bank collapse, this time on the Muskegon River in Brooks and Garfield Townships. One of the homes was deemed no longer safe to occupy and had to be demolished. Another is still actively being monitored and working on mitigating the property by relocating the structure.

Several locations continue to actively be monitored for additional erosion, which is threatening homes. A majority of these properties are located in Brooks Township along the Muskegon River's high banks. Some homeowners have attempted to work with outdoor restoration companies to stabilize the banks utilizing natural ground covers, however, additional mitigation efforts will need to be evaluated in order to protect the structures from future loss.

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.

The flowing Newaygo County map displays the NFIP mapped and unmapped areas within the County. Specific NFIP floodplain Maps are contained within the NFIP Appendix. All maps were revised by the NFIP and re-adopted in February of 2015.

County	Total premium	Policies	A Zone Policies	Total Coverage	Claims since 1978	Total Paid since 1978
Newaygo	$89,225	91	58	$16,413,500	125	$2,823,203

Newaygo County Communities Participating in the National Flood Program

(as of 11/20/2019)

CID	Community Name	Init FHBM Identified	Init FIRM Identified	Current Eff. Map Date	Reg Emer Date
260694A	Ashland Township	5/19/1978	09/01/1986	2/18/15	09/01/1986
260466A	Bridgeton Township	10/22/1976	09/04/1986	02/18/1915	09/04/1986
260467A	Brooks Township	07/18/1975	07/03/1986	02/15/2015	07/03/1986
260468A	Croton Township	03/10/1978	09/30/1978	02/18/2015(M)	09/30/1988
261402A	Dayton Township		02/18/2015	02/18/2015(M)	12/15/2015
261042A	Ensley Township		02/18/2015	(NSFHA)	02/18/2015
261404A	Everett Township		02/18/2015	02/18/2015	02/18/2016
260167A	City of Fremont	05/31/1974	08/10/1979	02/18/2015(M)	08/10/1979
260469A	Garfield Township	08/08/1975	09/29/1986	02/15/2015	09/29/1986
260485A	Village of Hesperia	07/11/1975	08/01/1986	08/04/2014(M)	08/01/1986
261379A	Lilley Township		02/18/2015	02/18/2015	02/18/2016
260828A	Lincoln Township		09/27/1991	02/18/2015	02/21/1996
260340A	City of Newaygo	09/12/1975	02/18/2015	02/18/2018	05/25/1984
261899A	Sheridan Township		02/18/2015	02/18/2015(M)	12/07/2015
261384A	Sherman Township		02/18/2015	02/18/2015(M)	02/18/2015
260470A	City of White Cloud	04/11/1975	09/01/1986	02/18/2015(M)	09/01/1986
261013A	Wilcox Township		02/18/2015	02/18/2015(M)	02/18/2015

Sources:

- Participating Communities: http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book
- 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

NFIP In Newaygo County, Michigan
As of 06/30/2019

Participating Communities	Number of Insurance Policies (2014)	Number of Insurance Policies (2019)	$ Amount of Insurance Coverage	Number of Repetitive Losses (2014)	Number of Repetitive Losses (2019)
Ashland Township	14	17	2,618,100	3	2
Bridgeton Township	24	22	3,555,300	8	8
Brooks Township	33	27	5,230,600		1
Croton Township	22	6	1,820,000		0
Dayton Township		9	1,680,000		0
Ensley Township					0
Everett Township					0
City of Fremont	1	3	705,000		0
Garfield Township	7	6	1,028,000	3	3
Village of Hesperia	3	2	288,800		0
Lilley Township					0
Lincoln Township	15	6	867,000		0
City of Newaygo	5	2	310,000		1
Sheridan Township		2	365,000		0
Sherman Township		1	350,000		0
City of White Cloud	2	3	552,000		0
Wilcox Township					0

Newaygo County Communities NOT Participating in the National Flood Program

CID	Community Name	Init FHBM Identified	Init FIRM Identified	Current Eff. Map Date	Reg Emer Date
	Barton Township				
	Beaver Township				
	Big Prairie Township				
	Denver Township				
	Goodwell Township				
	Grant Township				
	Home Township				
	Merrill Township				
	Monroe Township				
	Norwich Township				
	Troy Township				
	City of Grant				

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 TEMPREATURES (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.)

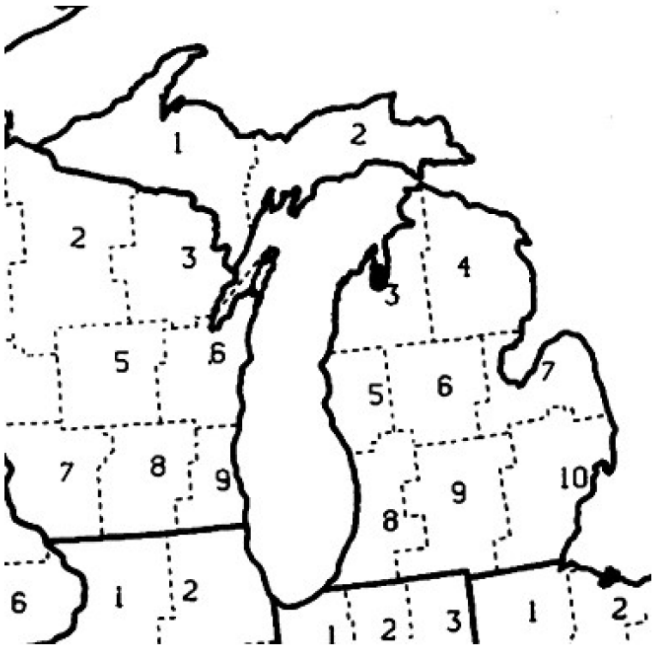
Drought can be a “low-profile” hazard that does not get a lot of public attention in Michigan, compared with other parts of the United States. Nevertheless, parts of Michigan have tended to experience significant drought conditions about 20% of the time on average (depending upon how it is measured). 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).

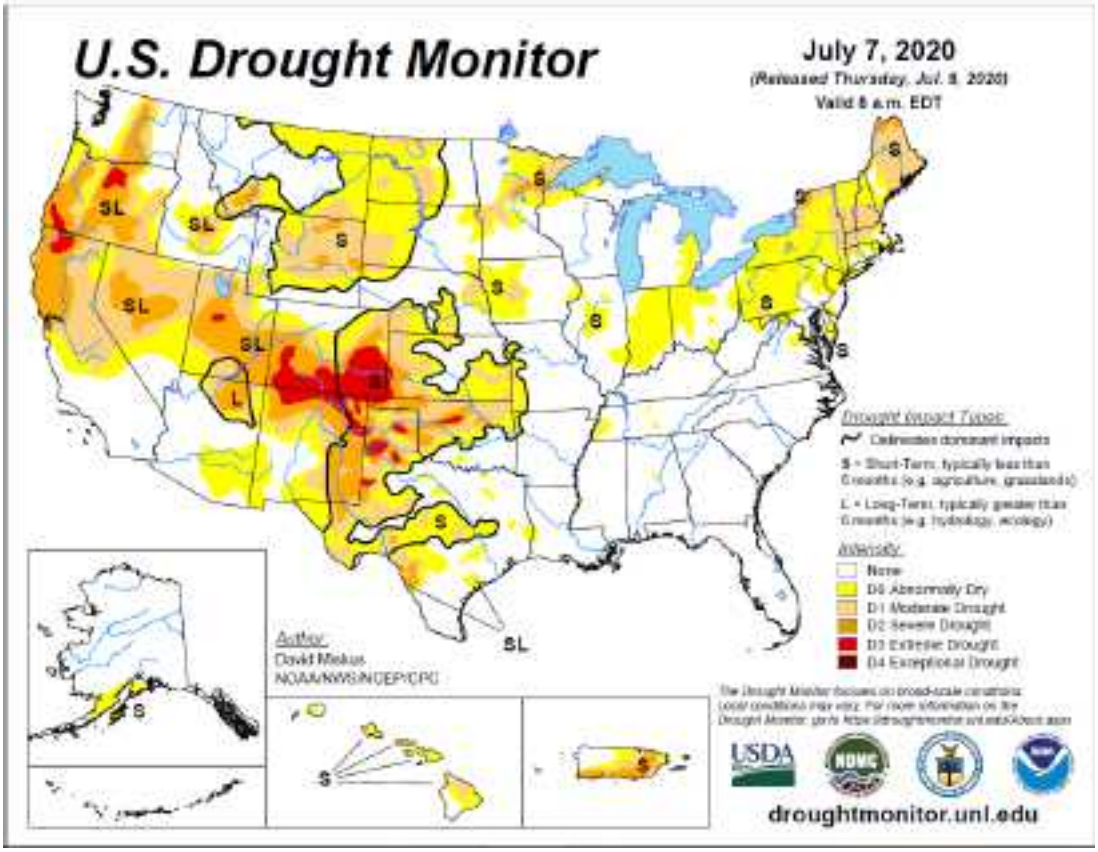
Division 7: Arenac, Bay, Huron, Saginaw, Sanilac, and Tuscola Counties. The most extreme drought was in April 1931, when the Palmer index hit a record low of -6.25. Lengthy drought incidents took place in 1930-1931 (17 months), 1934-1935 (16 months), 1936-1937 (11 months), 1963-1965 (18 months), 1976-1977 (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**

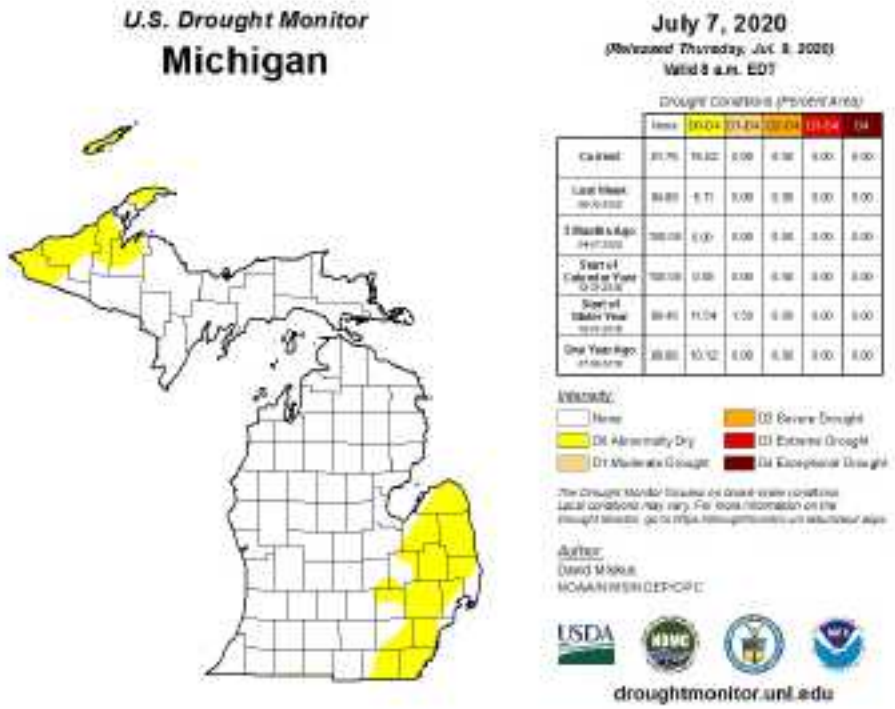


Drought in Newaygo County

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 similar to Newaygo County, drought brings on a host of other problems to address. The agricultural areas of Newaygo County 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.

In Newaygo County's forested regions, drought can adversely impact timber production and some tourism and recreational enterprises. This can also cause a drop in income, which impacts other economic sectors. The biggest problem drought presents, is the increased threat of wildfire. Newaygo County is heavily forested and very vulnerable to drought-related wildfire threats. The 1976 Seney fire illustrated that a drought-impacted landscape can quickly turn a small fire into a raging, out of control conflagration.



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

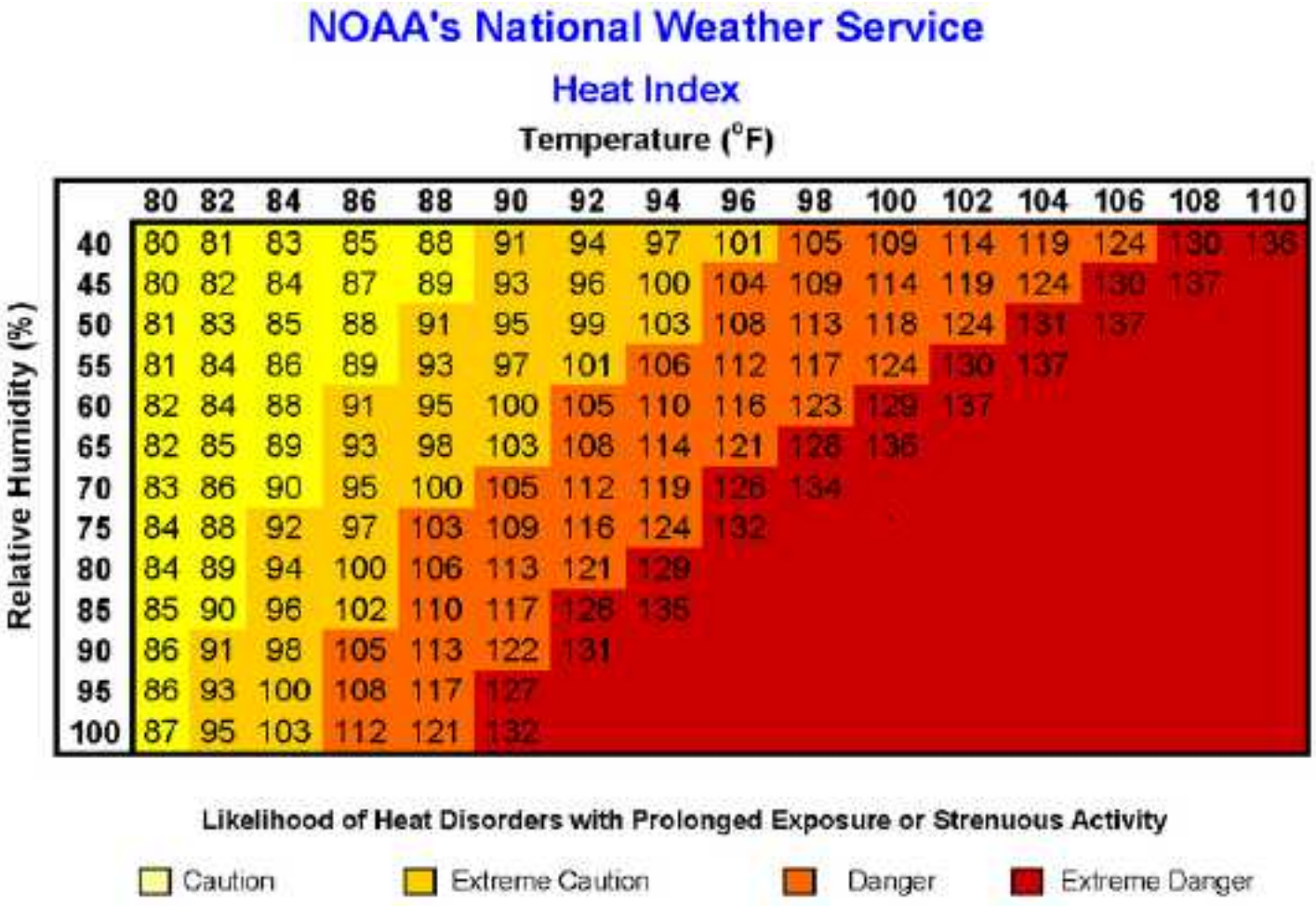
Extreme Summer Heat is characterized by a combination of very high temperatures and humid conditions. When persisting over a long period of time, this phenomenon is commonly called a heat wave. The major threats of extreme summer heat are heat exhaustion and heatstroke (a major medical emergency). Heat 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).

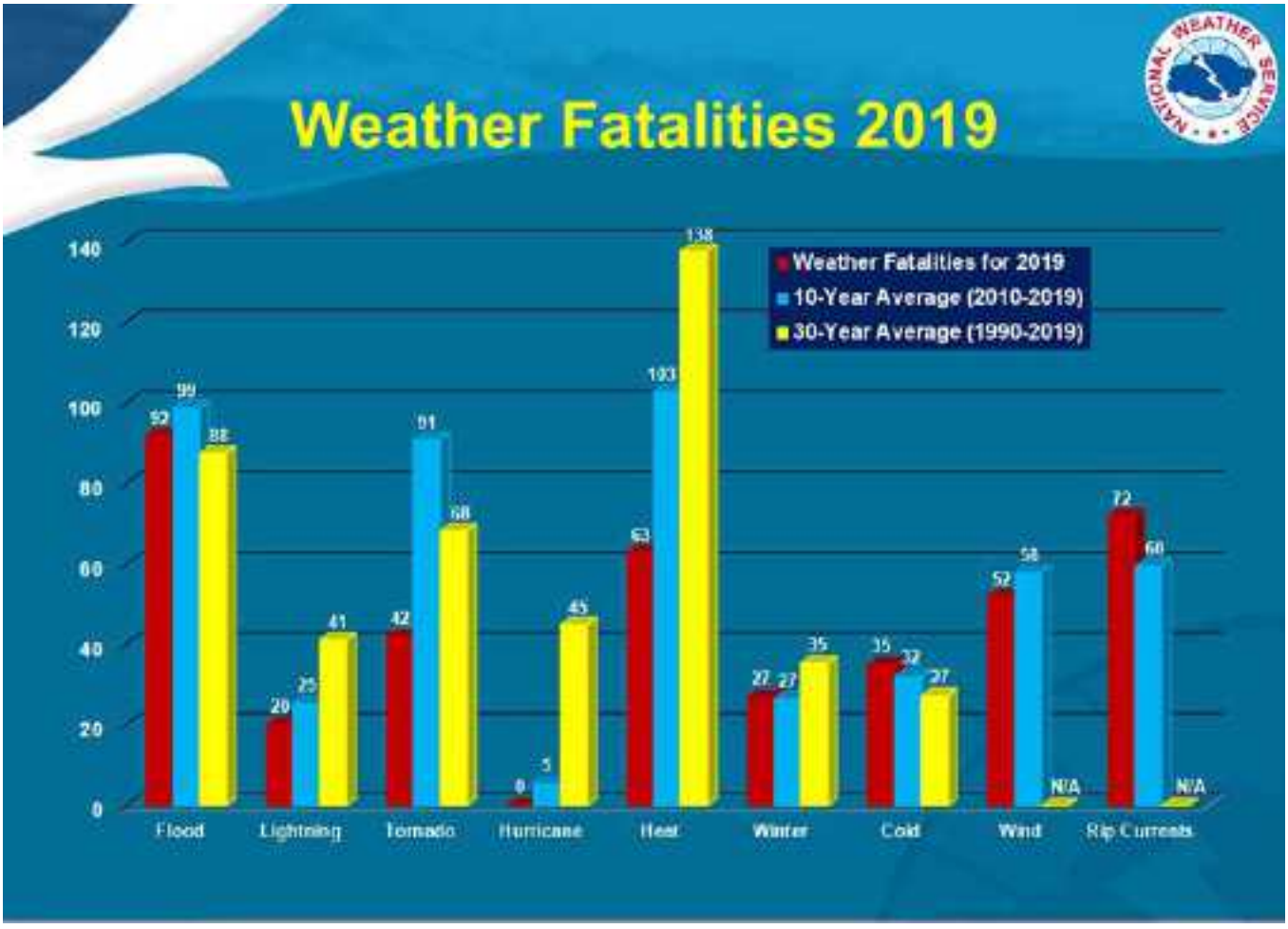
The following tables indicate the way that temperature, humidity, and wind speed probably feels to the human body, and suggest the types of temperature effects relevant to Michigan's climate. Although some of the resulting heat numbers may at first seem outrageous to describe Michigan temperatures, some 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.



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.

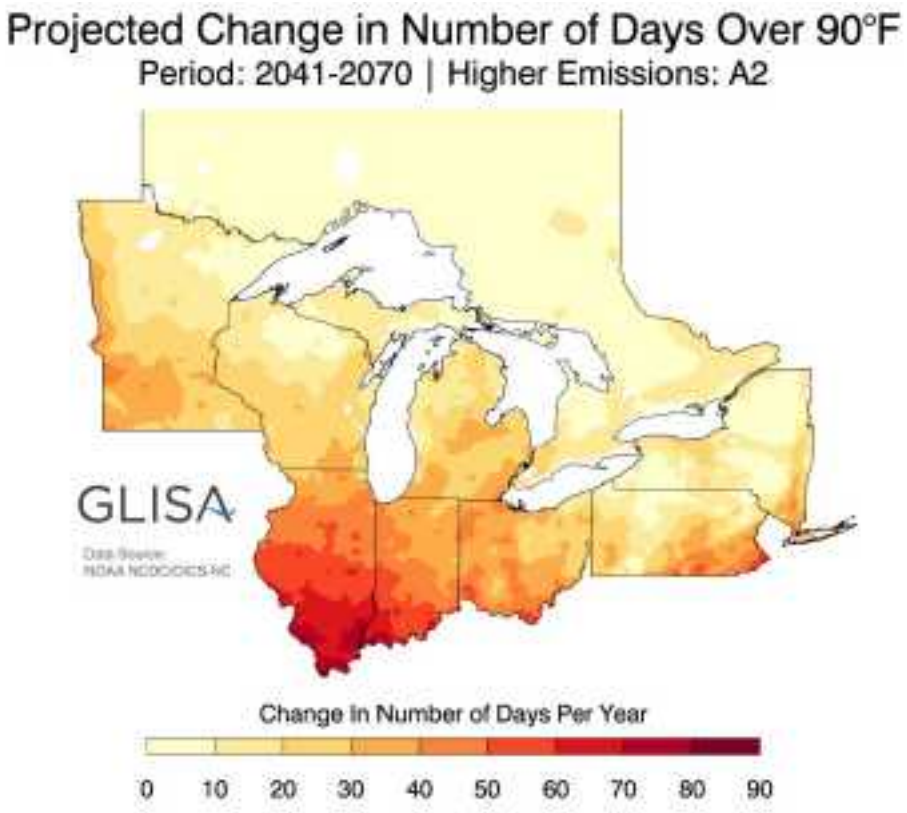
Heat waves tend to have stagnant atmospheric conditions that trap pollutants in urban areas and thus compound the health effects faced by urban residents. Because the combined effects of high temperatures, high humidity, and trapped pollution are focused more intensely in urban centers, heatstroke and 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.



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.

Case: July 4, 2010 – Southeast Michigan

A heat wave lasted for five days across the Metropolitan Detroit region. Two heat deaths were reported: one an elderly man without air conditioning in Grosse Pointe Farms (Wayne County), and the other a middle-aged homeless woman who died of hyperthermia in her car in Waterford Township (Oakland County). High temperatures were all in the low 90s each day, with heat indices in the upper 90s, but evening temperatures did not go below 70 degrees to help people recover from the effects of heat.

Case: July 17, 2011 to July 22, 2011 – Southeast Michigan (Oakland and Wayne Counties)

A mid-July heat wave helped cap off the warmest month on record at Detroit. Three direct deaths were reported due to the heat wave, as heat indices were above 100 degrees. A 37-year-old Highland Township (Oakland County) man died from several factors including an enlarged heart, obesity and hyperthermia. A 60- year-old man died in Wayne County from hyperthermia, as he was found in his car with the windows rolled up. A 57-year-old man was also found dead due to hyperthermia in his Redford Township (Wayne County) group home.

Case: June 28 to July 7, 2012 – Southeast Michigan (Wayne, Oakland, Macomb, Washtenaw, Genesee, Saginaw)

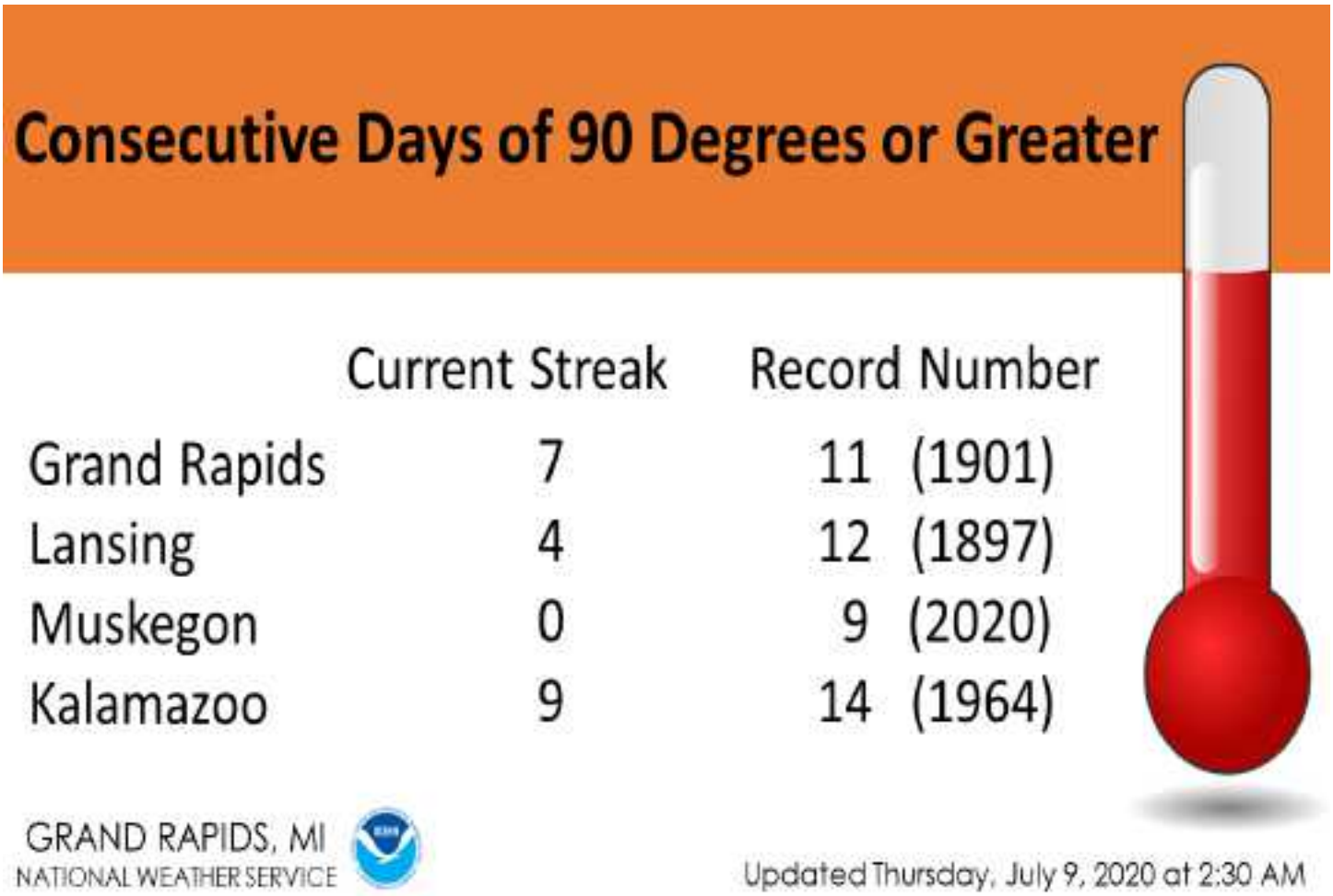
High temperatures climbed to around 100 degrees across much of southeast Michigan during the afternoon hours of June 28th, with heat indices climbing between 100 and 110 degrees. This led to an increase in heat-related hospitalizations. Temperatures slowly came down during the evening hours, with drier air slowly filtering in. Although Friday June 29th ended up being hot, with high temperatures in the low to mid 90s, the dry air helped to keep heat indices short of 100 degrees. This was followed almost immediate by an extended heat wave that gripped southeast Michigan during the first week of July, with temperatures topping out around 100 degrees on multiple days. Detroit set a record high on July 4th, reaching 102 degrees. Heat indices peaked around 110 degrees on July 4th and July 6th. Although no known heat deaths were reported, over 700 heat-related emergency room visits were reported statewide. Southeast Michigan tallies included 39 heat injuries in Wayne County, 28 in Oakland County, 20 in Macomb County, 13 in Genesee County, 10 in Saginaw County, and 5 in Washtenaw County.

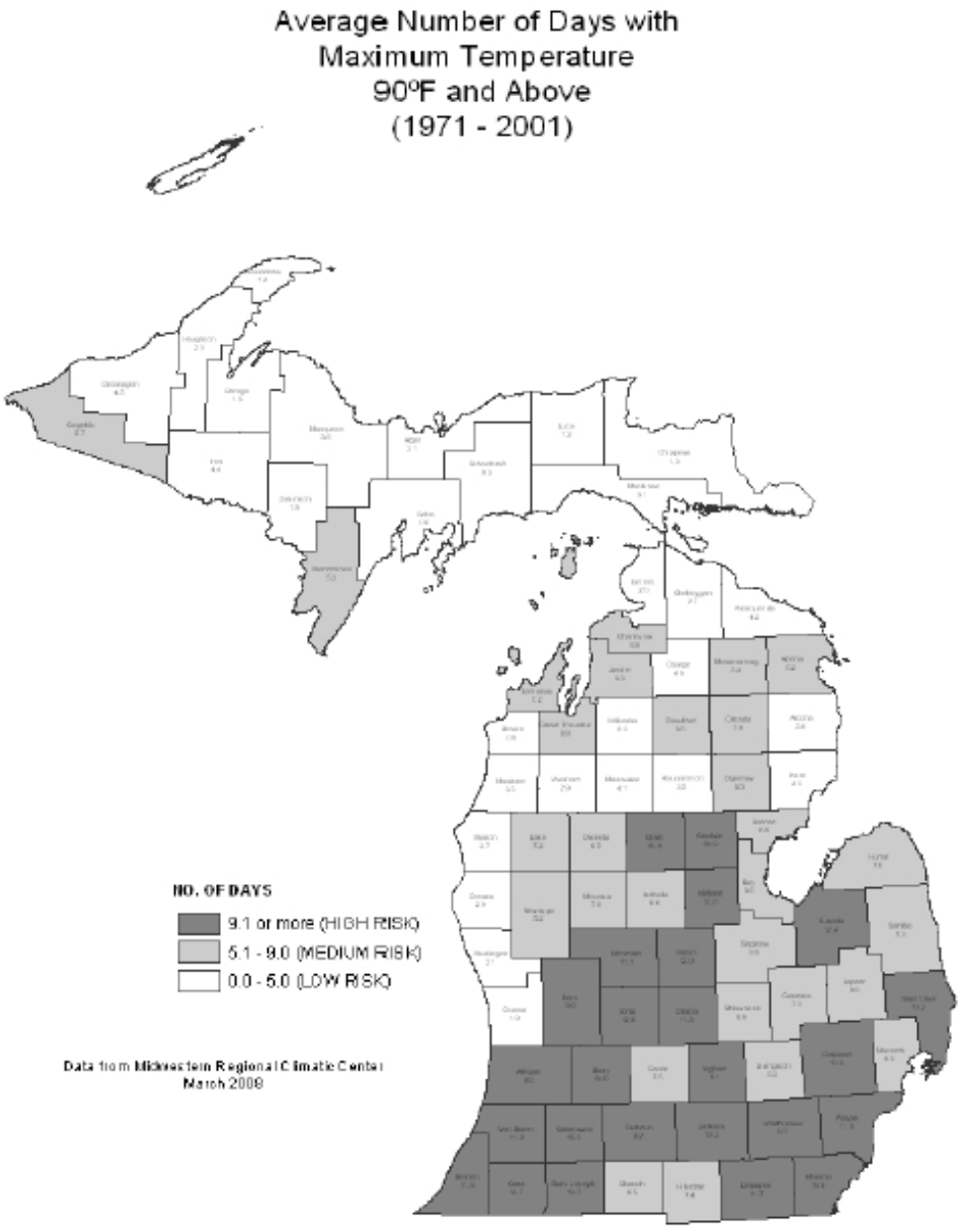
Case: July 14-19, 2013 – Southeast Michigan (Wayne, Oakland, Macomb, Washtenaw, Genesee, Saginaw)

A six-day heat wave impacted Southeast Michigan from July 14 through 19, with high temperatures ranging from the upper 80s to mid-90s. Heat Indices were mostly in the 90s, but Detroit Metro area hospitals reported an increase of 173 heat related illnesses during this stretch—80 in Wayne County, 50 in Oakland County, 25 in Macomb County, and 6 in each of Washtenaw, Genesee, and Saginaw Counties.

Case: June-July 2020 – Michigan

Temperatures in June and July of 2020 expect to get 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.



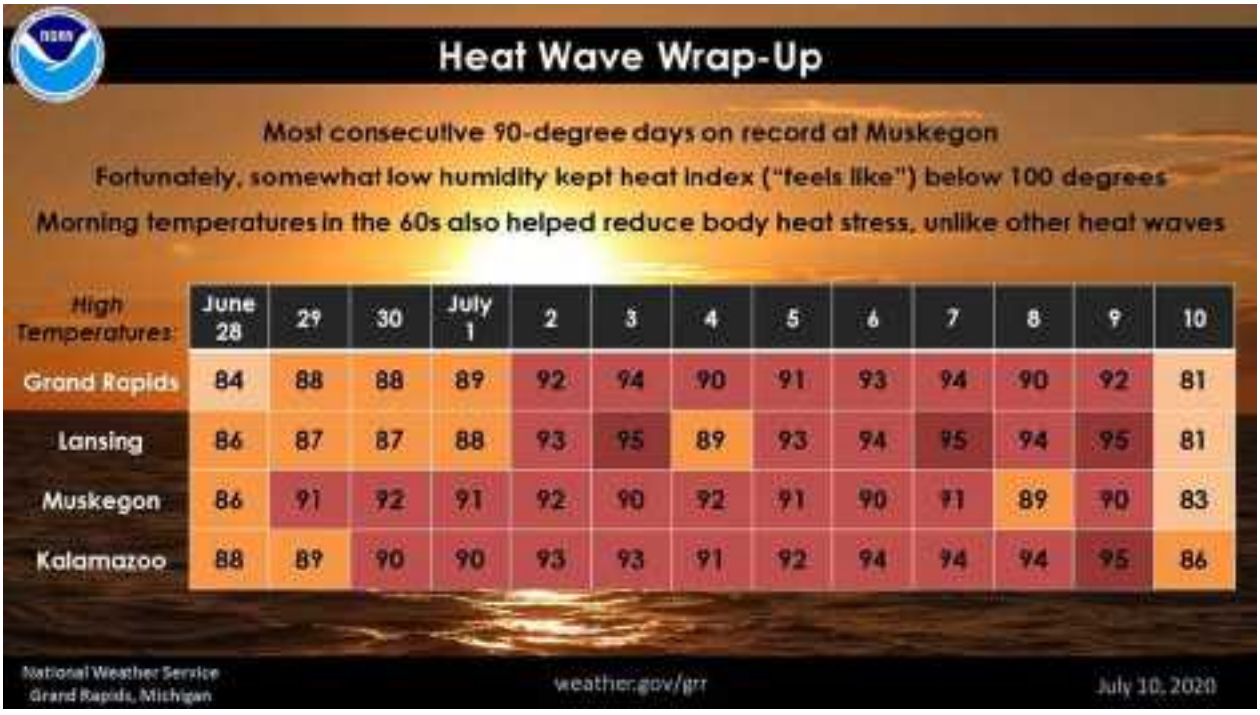


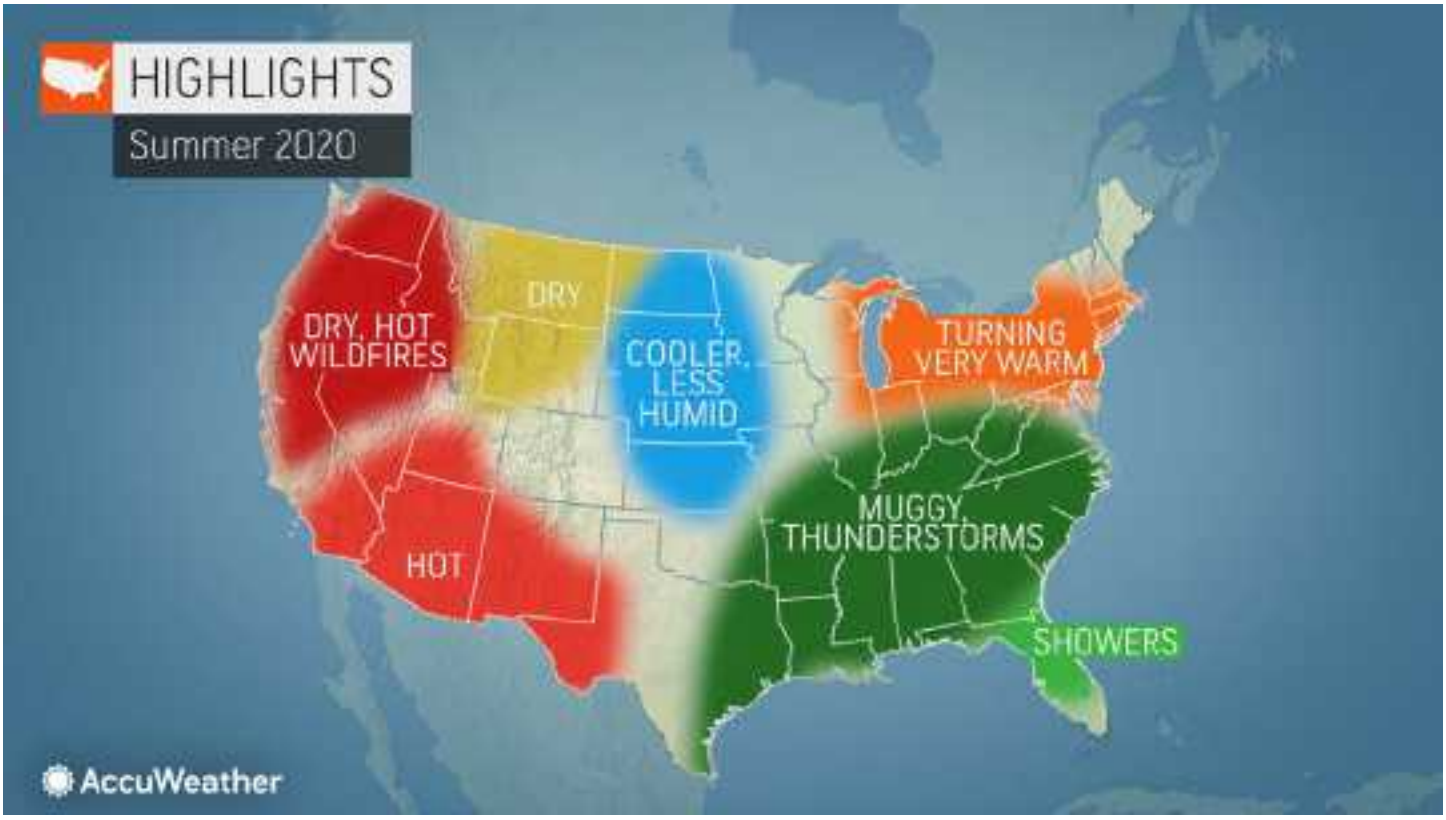
Extreme Temperatures, Heat in Newaygo County

While Newaygo County does not have a large history of extreme heat, data from the Midwestern Region Climatic Center from 1971 to 2001 show Newaygo County has a medium risk for the average number of days with maximum temperatures at or above 90°F to be between 5 and 9.

Record Monthly Temperatures in Degrees Fahrenheit
Source: Weather Underground Weather Station in Fremont, Michigan

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	77°F (03-27-1967) (03-30-1967)
April	86°F	04-29-1970	85°F (04-27-1899)
May	93°F	05-29-1962	90°F (05-10-1930)
June	98°F	06-20-1995	94°F (06-11-1956) (06-24-1901)
July	99°F	07-07-2012 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)





At risk populations from extreme heat:

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

WILDFIRES

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, and 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.

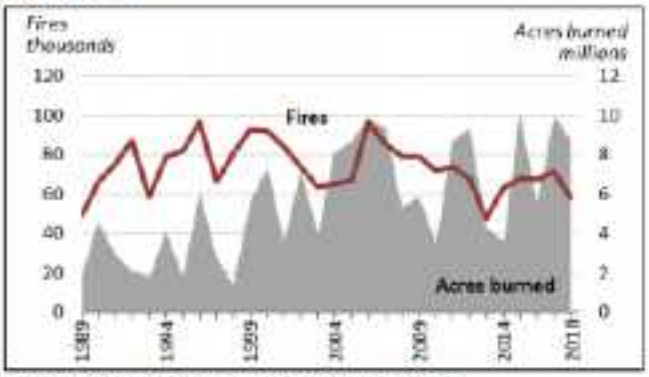
- Wildfire severity has increased and the fire frequency has decreased during the past 200 years
- Many species depend on wildfires to improve habitat, recycle nutrients, and maintain diverse communities.
- Land management agencies light “prescribed fires” under controlled conditions for specific management objectives

Annual Wildfires and Acres Burned

	2014	2015	2016	2017	2018
Number of Fires (thousands)					
Federal	13.0	13.8	12.6	15.2	12.5
FS	*6.8*	*7.1*	*5.7*	*6.6*	*5.6*
DOI	*6.1*	*6.6*	*6.8*	*7.3*	*7.0*
Nonfederal	50.6	54.4	55.2	56.4	45.6
Total	**63.6**	**68.2**	**67.7**	**71.5**	**58.1**
Acres Burned (millions)					
Federal	2.15	7.41	3.00	6.3	4.6
FS	*0.87*	*1.92*	*1.25*	*2.9*	*2.3*
DOI	*1.24*	*5.47*	*1.70*	*3.3*	*2.3*
Nonfederal	1.4	2.72	2.51	3.7	4.1
Total	**3.60**	**10.13**	**5.51**	**10.0**	**8.8**

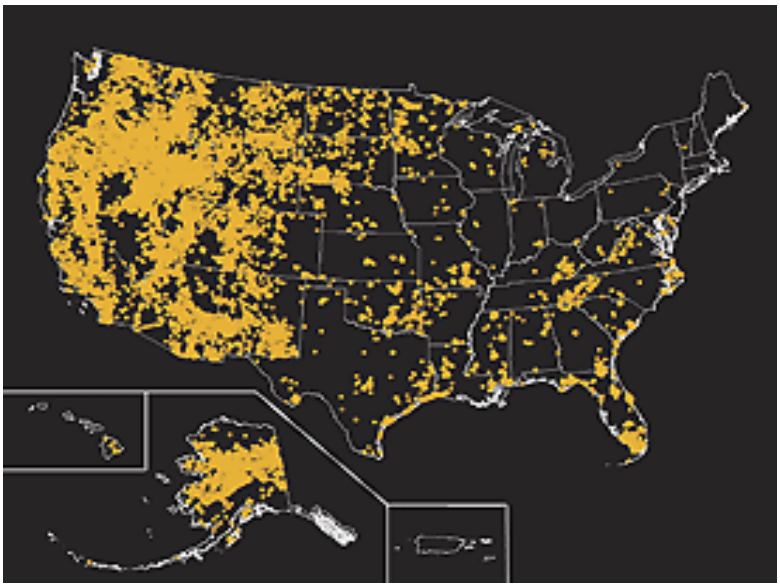
Source: National Interagency Fire Center (NIFC).
Notes: *Federal* includes fires that began on land managed by the Forest Service (FS), Department of the Interior (DOI), and other federal agencies (not listed). *Nonfederal* includes all other lands. Column totals may not add due to rounding.

(1988-2017)



Source: National Interagency Fire Center (NIFC).
Note: Data reflect wildland fires and acres burned nationwide, including wildland fires on federal and nonfederal lands.

This map shows locations that experienced wildfires greater than 250 acres, from 1980 to 2003. Map not to scale. Sources: Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Indian Affairs, National Park Service, and the USGS National Atlas



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. Outdoor debris burning is the leading cause of wildfires in Michigan. Most Michigan wildfires occur close to where people live and recreate, which puts both people and property at risk. 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 2017 MDNR information, the leading causes of wildfires from the previous ten years were:

1. Debris burning (32%)
2. Equipment (17%)
3. Unknown (11%)
4. Miscellaneous (10%)
5. Campfires (9%)
6. Arson (6%)
7. Lightning (4%)
8. Fireworks (2%)
9. Structural Fires (2%)
10. Smoking (1%)

<u>Wildfire Hazards in Michigan</u>

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 1990 - Grayling (Crawford County)
In May 1990, a wildfire near Grayling in Crawford County (known as the Stephan Bridge Road fire) burned 76 homes and 125 other structures, 37 vehicles and boats, and over 5,900 acres of forestland, resulting in property losses of $5.5 million. The timber losses totaled another $700,000. The fire originated from a controlled burning of a pile of brush and timber accumulated from recently cleared land. The burning was initiated while snow covered the ground, and it had been presumed that the fire was completely extinguished. However, the pile rekindled approximately seven weeks later, and on May 8, ignited the Stephan Bridge Road fire. Strong winds and dry conditions helped spread the fire at a rate beyond that which could be controlled by human intervention. At one point in the fire, the rate of spread was an astonishing 277 feet per minute. Fortunately, the combination of human fire suppression and a passing weather front that produced rainfall finally contained the fire before it could do any additional damage. There were no fatalities as a result of this fire, and only one firefighter was injured from smoke inhalation. However, the property losses were significant.

Case: 2000 - Mio (Oscoda County), Torch Lake Township / Lake Linden (Houghton County)
A wildfire that began on April 30 near Mio and was fed by extremely dry conditions consumed nearly 5,200 acres in the Huron-Manistee National Forest before being contained a week later. Nearly 300

firefighters and two aerial water tankers were deployed to suppress the fire. The fire prompted the evacuation of approximately 30 persons for a short time. Fortunately, the fire did not cause any injuries or structural damage. About a month later, on June 6, a brush fire set on a blueberry farm near Rice Lake in Torch Lake Township, Houghton County, got out of control and eventually burned over 350 acres before being contained the next day. Firefighters from the MDNR and 15 local fire departments, plus two aerial water tankers, were called to fight the blaze. The fire forced the evacuation of over 20 homes and cottages, and at one point was one-half mile wide and almost one mile long. Brisk winds pushed the fire to within one-quarter mile of homes along the shoreline of Lake Superior. However, no structures were lost and no injuries were reported.

Case: April 24, 2008 – Crawford County

Called the "Four Mile Road Fire," the cause may have been some sparks from a passing train. A Red Flag warning had been in effect when the fire started a few miles south-southeast of Grayling. The weather was warm, dry, and windy, and the fire quickly expanded to the northwest, crossing I-75 (which was closed for several hours) and eventually burning 1,300 acres. On the far south side of Grayling, a gas station and motel were threatened, but spared damage. About a half-dozen cabins near Simpson Lakes were lost (about two miles south of downtown Grayling), and $287,000 in damage was sustained by the Grayling Game Club. Total property damages from the event were estimated at $750,000, and MDNR response costs and timber damages were about $619,000. Fifty homes were evacuated, and power was lost in Grayling. By the evening, winds and temperatures went down and several periods of rain during the night helped the fire to be extinguished.

Case: May 18 to 26, 2010 – Crawford and Kalkaska Counties

A debris fire expanded out of control and resulted in the "Meridian Boundary Fire" by about 1:30pm on May 18. A total of 8,800 acres were eventually burned by this fire, which took until May 26 to reach 95% containment. Twelve residences were destroyed, six were damaged, and 36 outbuildings were either destroyed or damaged, resulting in total property damages of about $825,000. Also on May 18, in adjacent Kalkaska County, the "Range 9 Fire" started when a controlled burn on an artillery range became uncontrolled as winds increased through the area. The Range 9 Fire burned 1,100 acres of mostly grassy areas on the Camp Grayling grounds, but also crossed over the boundary line at one point and destroyed 4 seasonal homes in Blue Lake Township, resulting in an estimated $125,000 in property damage. By late evening on the same date, that smaller fire was under control.

May 20 to 31, 2012 – Luce County "Duck Lake Fire"

About $12 million in property damage resulted from the Duck Lake Wildfire in Luce County, which was ignited by lightning strikes from a line of thunderstorms. The fire started 14 miles north of Newberry and the simultaneous Pine Creek North Wildfire seriously affected large parts of the Seney National Wildlife Refuge. Fanned by strong south winds, the fire spread rapidly toward the shoreline of Lake Superior and forced people in the Pike Lake, Bodi Lake, Culhane Lake, and Little Lake Harbor areas to evacuate. Major roads across that area were closed. A total of 136 structures were burned (including one store and one motel) and the wildfire affected 21,069 acres before it was fully contained in mid-June. The

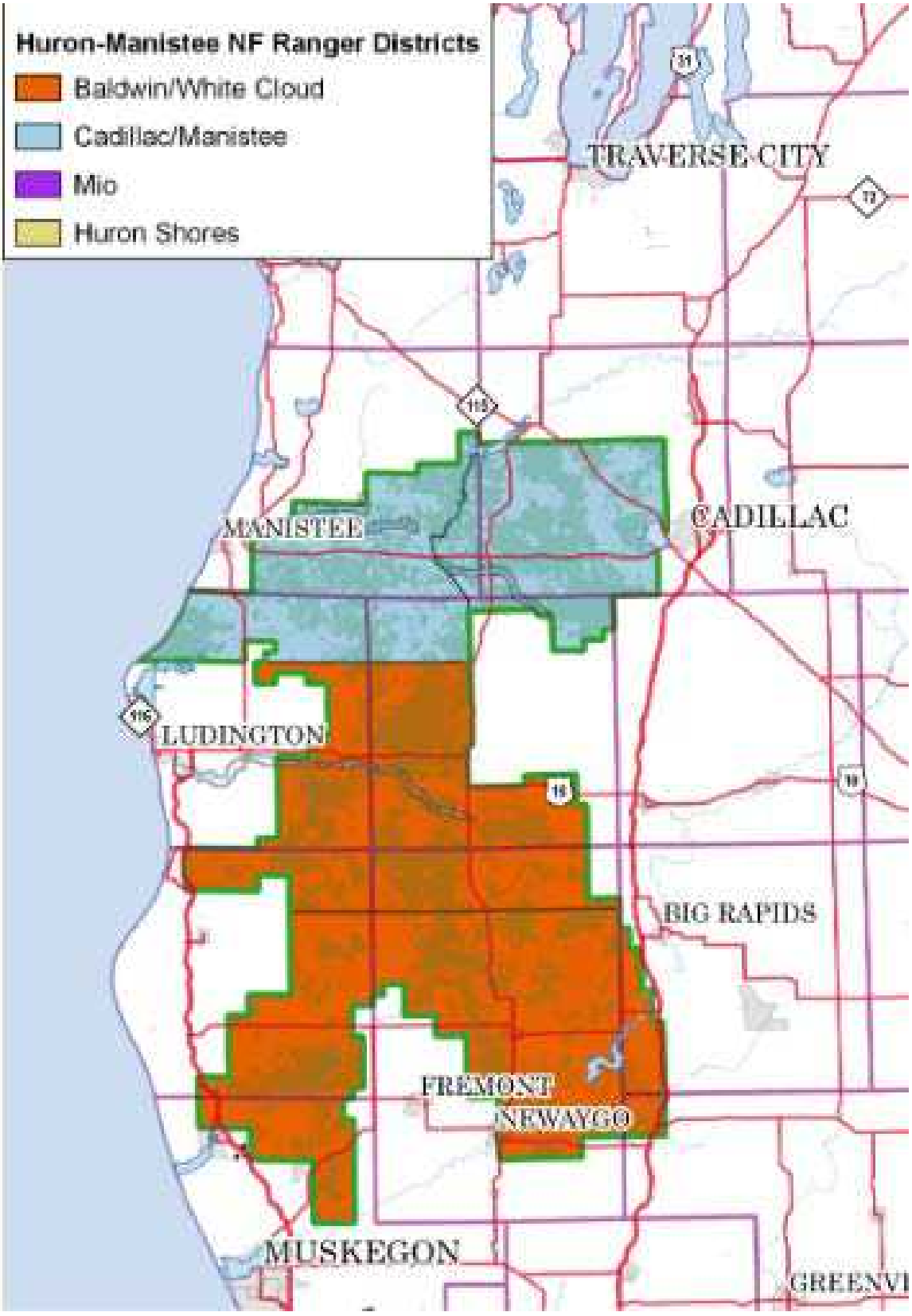
Duck Lake event was the third largest in modern Michigan history. About $600,000 in resources were expended to fight the fire. A governor's state of disaster was declared for Luce and Schoolcraft Counties on May 25.

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.

Wildfire Hazards in Newaygo County
Sixty-one percent of Newaygo County's 537 thousand acres of land is forested (MSU Extension 2006). Of this 62% is in private ownership, almost all owned by small, non-industrial owners. Of the 38% in public ownership, the vast majority is part of the Manistee National Forest managed by the US Forest Service. Oak-hickory, beech-maple and lowland hardwoods make up 79% of the forestland in the county. Pine types (white, red and jack) are predominant on 15% of the forested acreage.

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.


Huron-Manistee NF Ranger Districts
Baldwin/White Cloud
Cadillac/Manistee
Mio
Huron Shores
TRAVERSE CITY
MANISTEE
CADILLAC
LUDINGTON
BIG RAPIDS
FREMONT
NEWAYGO
MUSKEGON
GREENVI

The threat of wildfire is a key challenge of spring, especially in the northern part of the county where the vegetation (red, white and jack pine and oak) is on dry, sandy sites. There is danger prior to and at the beginning of spring green up. Recreation areas are in direct contact with vegetation and need to be especially careful with sources of ignition such as cigarettes, motorized recreational equipment and campfires.

In the spring of 1994 A Type I Incident Management Team was mobilized from the United States Forest Services for the County Line Fire on the Huron-Manistee National Forest on 24 April. This fire started on the border of Lake and Newaygo Counties and threatened the community of Baldwin, Michigan. The fire burned eight mobile homes before being controlled at 330 ha (820 acres).

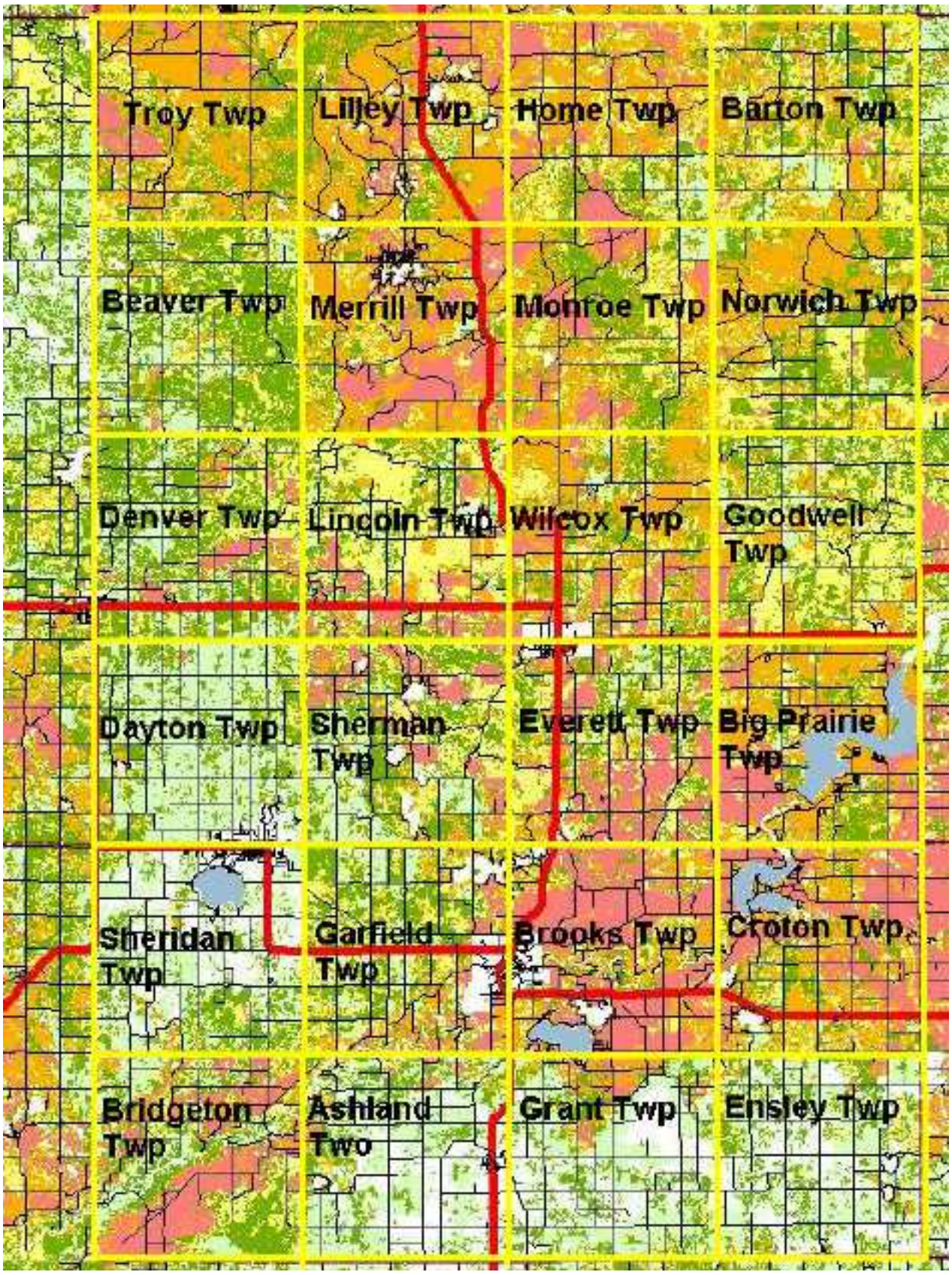
Based on historical occurrence, on average an estimated 2 – 3 smaller wildfire events occur annually. The following data came from the Fuels Management Specialist with the Huron Manistee National Forest.

The types of wildfire behavior of greatest concern in Newaygo County are crown fires and high-intensity surface fires. Crown fires are characterized by sustained burning through the forest canopy, often independent of a surface fire. Crown fires burn primarily the needles and small branches of trees. Crown fires are able to move very swiftly, spot long distances, and release large amounts of heat energy, and therefore are very difficult to control.

High-intensity surface fires are different from a crown fire in that the greatest amount of burning is taking place on the forest floor and lower shrub layers, with occasional torching of individual or small clumps of trees. Like crown fires, high-intensity surface fires have the potential to move swiftly, spot long distances, and release large amounts of heat energy. However, since the heat energy comes primarily from larger surface fuels spread across the forest floor, this energy is spread over a wider area and is sustained for a longer period of time. This type of surface fire is also very difficult to control.

The forest types of greatest concern in Newaygo 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. Contained on the following is a fuels map from the National Forest Service:

Newaygo County Fuels Map

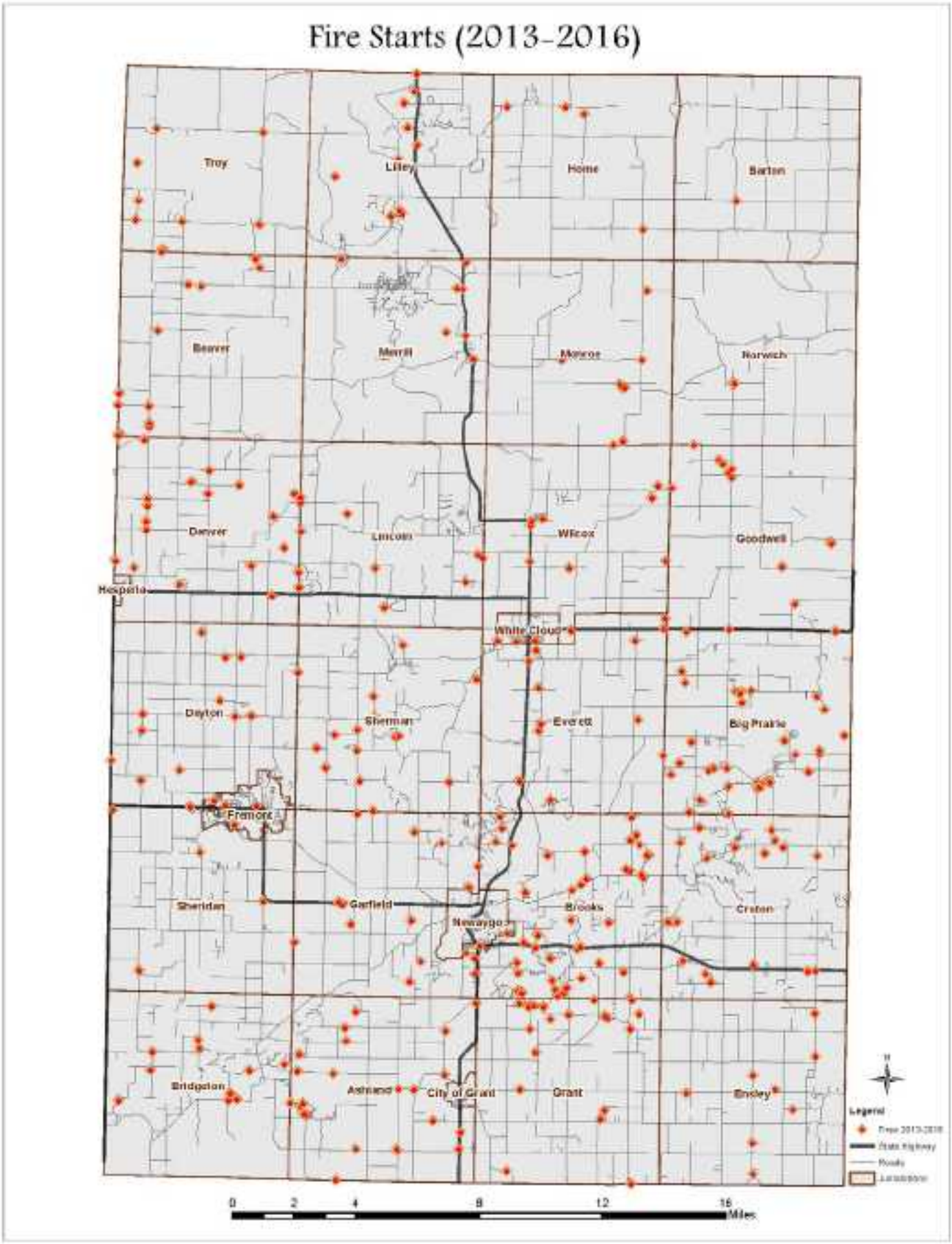


History of Wildland Fire Occurrence for Newaygo County

(Grass, Woods, and Illegal Burn Fire Starts)

Township	*Fire Dept*	*2013*	*2014*	*2015*	*2016*	*NFS*	*Total*
Ashland	Station 13 – Grant Fire	3	2	12	6	0	**23**
Barton	Big Rapids City Fire	0	1	2	3	1	**7**
Beaver	Station 19 – Hesperia Fire Walkerville Fire	6	2	1	1	3	**13**
Big Prairie	Station 15 – Big Prairie Fire	8	3	16	3	12	**42**
Bridgeton	Station 11 – Fremont Fire Station 13 - Grant Fire	4	1	4	0	0	**9**
Brooks	Station 12 – Newaygo Fire	4	7	11	8	24	**54**
Croton	Station 14 – Croton Fire	12	4	21	5	15	**57**
Dayton	Station 11 – Fremont Fire Station 19 – Hesperia Fire	5	1	8	1	0	**15**
Denver	Station 19 – Hesperia Fire	4	2	4	3	6	**19**
Ensley	Sand Lake Fire	3	1	2	3	0	**9**
Everett	Station 18 – White Cloud Fire	9	7	6	6	11	**39**
Garfield	Station 11 –Fremont Fire Station 12 – Newaygo Fire	1	5	6	5	1	**15**
Goodwell	Station 15 – Big Prairie Fire	1	3	3	0	3	**13**
Grant	Station 13 – Grant Fire	3	1	4	7	6	**21**
Home	Station 17 – Lilley Fire	1	0	2	2	2	**7**
Lilley	Station 17 – Lilley Fire	5	1	2	2	7	**17**
Lincoln	Station 18 – White Cloud Fire	3	1	3	1	8	**18**
Merrill	Station 17 – Lilley Fire	0	1	1	0	4	**6**
Monroe	Station 17 – Lilley Fire	0	0	0	3	4	**7**
Norwich	Big Rapids City Fire	2	1	4	1	1	**9**
Sheridan	Station 11 – Fremont Fire	1	3	0	0	0	**4**
Sherman	Station 11 – Fremont Fire Station 18 – White Cloud Fire	5	2	5	1	1	**14**
Troy	Walkerville Fire Station 17 – Lilley Fire	5	0	1	2	6	**14**
Wilcox	Station 18 – White Cloud Fire	5	1	9	3	9	**27**

Township	Fire Dept	2017	2018	2019	2020	Total
Ashland	Station 13 - Grant Fire	3	7	5	0	15
Barton	Big Rapids City Fire	0	1	0	0	1
Beaver	Station 19 - Hesperia Fire Walkerville Fire	1	1	2	0	4
Big Prairie	Station 15 - Big Prairie Fire	5	1	4	0	10
Bridgeton	Station 11 - Fremont Fire Station 13 - Grant Fire	5	2	7	0	14
Brooks	Station - 12 Newaygo Fire	3	4	6	0	13
Croton	Station 14 - Croton Fire	8	2	2	0	12
Dayton	Station 11- Fremont Fire Station 19 - Hesperia Fire	5	7	0	0	12
Denver	Station 19 - Hesperia Fire	2	2	0	0	4
Ensley	Sand Lake Fire	6	4	2	0	12
Everett	Station 18 - White Cloud Fire	0	0	0	0	0
Fremont	Station 11- Fremont Fire	0	1	0	0	1
Garfield	Station 11- Fremont Fire Station 12 - Newaygo Fire	2	4	3	0	9
Goodwell	Station 15 - Big Prairie Fire	1	1	1	0	3
Grant	Station 13 - Grant Fire	7	7	1	0	15
Grant City	Station 13 - Grant Fire	0	0	0	0	0
Home	Station 17 - Lilley Fire	0	1	2	0	3
Lilley	Station 17 - Lilley Fire	5	0	4	0	9
Lincoln	Station 18 - White Cloud Fire	1	3	4	0	8
Merrill	Station 17 - Lilley Fire	2	1	2	0	5
Monroe	Station 17 - Lilley Fire	1	1	0	0	2
Newaygo	Station 12 - Newaygo Fire	3	1	1	0	5
Norwich	Big Rapids City Fire	1	0	2	0	3
Sheridan	Station 11 - Fremont Fire	3	1	2	0	6
Sherman	Station 11 - Fremont Fire Station 18 - White Cloud Fire	7	7	3	0	17
Troy	Station 17 - Lilley Fire	0	1	0	0	1
White Cloud	Station 18 - White Cloud Fire	0	0	0	0	0
Wilcox	Station 18 - White Cloud Fire	1	6	3	0	10


Fire Starts (2013-2016)
Troy
Lilley
Home
Barton
Beaver
Merrill
Monroe
Norwich
Denver
Lincoln
Wilcox
Goodwell
Hesperia
White Cloud
Dayton
Sherman
Everett
Big Prairie
Fremont
Sheridan
Garfield
Brooks
Croton
Newaygo
Bridgeton
Ashland
City of Grand
Grant
Ensley
N
Legend
0 2 4 8 12 16
Miles

Wildland Urban Interface Areas in Newaygo County

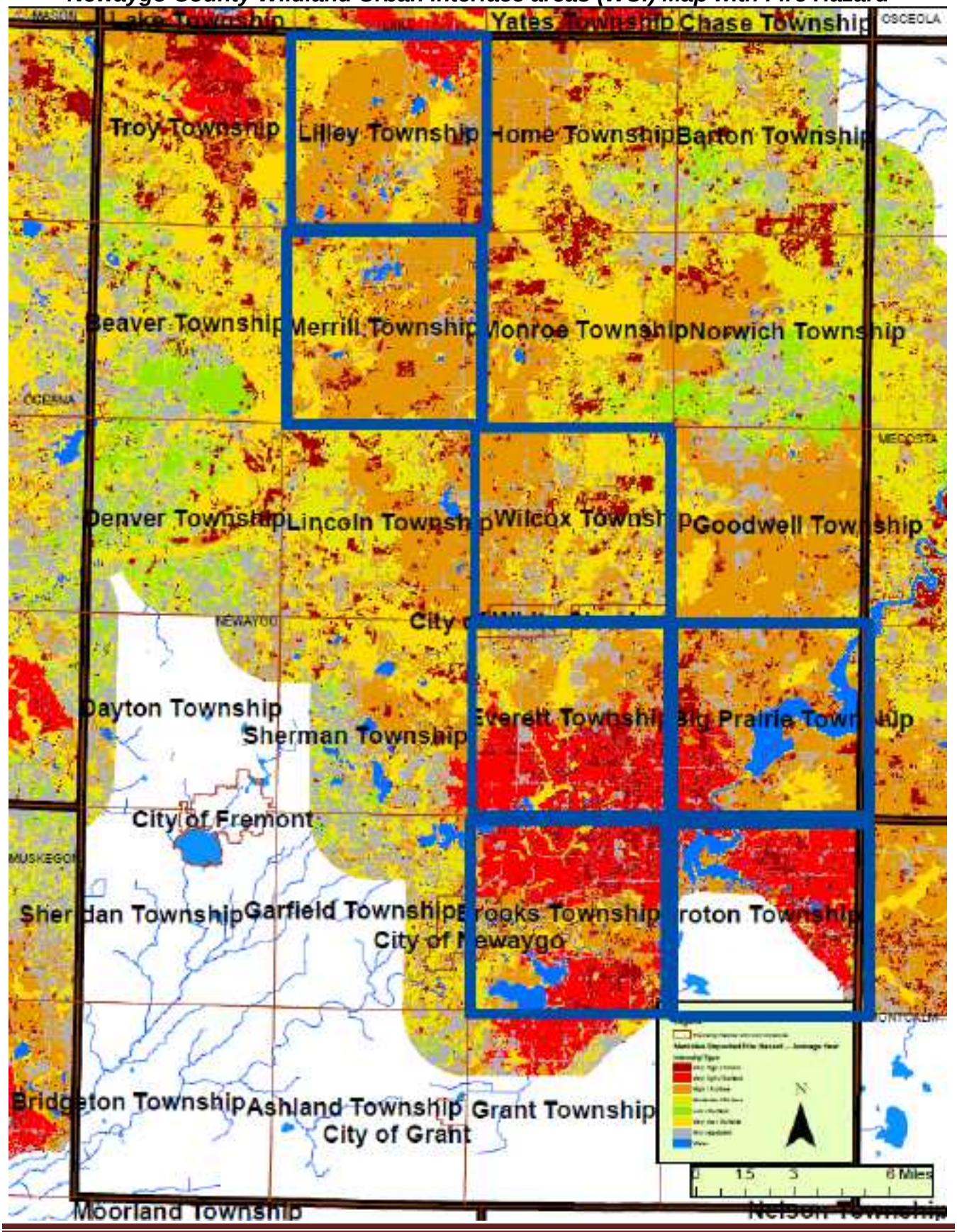
Wildland Urban Interface areas are broadly defined as areas where homes are built near or among lands prone to wildfire. These lands include forests, grasslands, shrub lands, and other natural areas that have not been significantly modified by agriculture or human development. More specifically, Wildland Urban Interface areas are lands with a higher housing density, more than one housing unit per 40 acers, which are adjacent to natural areas or where wildlands dominate the landscape.

Within Newaygo County, seven Wildland Urban Interface (WUI) areas have been identified. Utilizing townships as a geographical boundary for a Wildland Urban Interface Community allowed the local communities latitude in setting local priorities and activities related to fire risk reduction and buffer zones. These activities include; fire protection and preparedness, hazardous fuels reduction, restoration of healthy forests, fire prevention and ecosystem based planning. Each Wildland Urban Interface (WUI) community will serve as a planning area boundary for implementation of the Newaygo County Wildland Fire Protection Plan. Projects can overlap between Wildland Urban Interface (WUI) communities and cross different jurisdictions where agreements are in place. The map below shows Newaygo Counties' six Wildland Urban Interface (WUI) areas and boundaries. Detailed descriptions of each Wildland Urban Interface community can be found starting on page 118.

One significant benefit for Newaygo County communities is establishing localized definitions and boundaries for their specific Wildland Urban Interface areas (WUI). Without a written Community Wildfire Protection Plan, the Wildland Urban Interface is limited by statute to within ½ mile of a community's boundary or within 1 ½ miles when mitigating circumstances exist, such as sustained steep slopes or geographic features aiding in creating a fire break. Another benefit is expedited National Environmental Policy Act (NEPA) procedures for federal agencies implementing fuel reduction projects identified in a Community Wildfire Protection Plan fuels treatments can occur along evacuation routes regardless of their distance from the community. At least 50 percent of funds when appropriated under the Healthy Forest Restoration Act must be used within Wildland Urban Interface areas (WUI) as defined by a Community Wildfire Protection Plan or by the limited definition provided by the Healthy Forests Restoration Act when no Community Wildfire Protection Plan exists. Community Wildfire Protection Plans provide a context for prioritizing fuel treatments projects in a cross-boundary, landscape-scale manner that was envisioned in the National Fire Plan and 10-Year Comprehensive Strategy.

Another important reason for completion of a Community Wildfire Protection Plan is that federal agencies must give specific consideration to fuel reduction project implementation plans identified in the Newaygo County Community Wildfire Protection Plan. If a federal agency proposes fuel treatment methods in an area addressed by this community plan, but the community identifies a different treatment method, the federal agencies must also evaluate the community's recommendation as part of the federal agencies environmental assessment process

Newaygo County Wildland Urban Interface areas (WUI) Map with Fire Hazard



The following list summarizes some of the largest and most severe wildfires that have occurred in Newaygo County to date.

Case: April 1994: County Line Fire. USFS mobilized a Type I Incident Management Team. Eight mobile homes and 820 acres burned in Lake County near the Newaygo County border.

Case: May 1, 2018 Oak/M-82 wildfire. This105-acre fire was primarily on federal land, contained at around 1 a.m. on May 2, but not before it engulfed many mature pine and oak trees. Two homes were evacuated, and 15 structures were threatened, but all structures were saved. The fire caused a short closure of M-82 between Elm and Spruce.

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 2018:

- 1,318,500 fires were responded to by public fire departments
- 379,600 fires occurred in residential structures (30%)
- 3,655 civilian fire deaths occurred
- 2,790 civilian fire deaths occurred in residences (76%).
- 15,200 civilian injuries occurred as the result of fire
- An estimated $25.6 billion in property damage occurred as a result of fire.
- $13.2 billion of property damage occurred in structure fires
- An estimated 26,000 fires were intentionally set resulting in 180 civilian deaths
- Intentionally set structure fires resulted in an estimated $480 million in property damage.

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.

Structure Fires in Michigan

Michigan's fire experience generally mirrors the national fire situation. According to statistics compiled by the Fire Marshal Division of the Michigan Department of Licensing and Regulatory Affairs for 2003, nearly 19,000 structural fires occurred in Michigan, resulting in 161 deaths and 624 injuries. The dollar loss for all fires was estimated at over $230 million. The Fire Marshal Division estimated that a structural fire occurred in Michigan about every 28 minutes in 2003. Michigan's fire death rate of 15.4 persons per million puts it toward the middle of all states in the nation in 2006. Michigan's fire death rate is ranked third in the Midwest, behind Missouri and Indiana as of 2007.

During the period from 1975-2009, the number of reported fires in Michigan (both structural and nonstructural) has trended downwards from a high of just over 80,000 to the current low of around

40,000, with yearly numbers fluctuating within this range. The number of structural fires represents approximately 35-40% of those yearly totals. Although fire risks are clearly a major concern, most of the incidents are of a limited scale and do not threaten or harm an entire community. This analysis will focus on major fires that do cause a severe impact to local communities—as disaster events.

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.

Case: Calumet Italian Hall 1913

December 24, 1913: Not an actual fire, but the threat of a fire caused the suffocation deaths of 73 persons (mostly children) in Calumet's Italian Hall when someone attending a party there yelled "Fire!", sending masses of party goers in a mad rush for the exit. Although there was no fire, 73 persons died while attempting to escape down a stairwell that had doors that opened inward. The perpetrator of the tragic false fire alarm was never identified.

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.

Case: Marquette County Wildfire 2009

In May 2009 about 777 acres and 33 structures, including houses and outbuildings, burned in Marquette County, southwest of Ishpeming, and caused about 500 persons to be evacuated.

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.)

Structure Fires in Newaygo County

Newaygo County is served with fire suppression services from 11 local fire departments funded by townships and cities. Each is staffed by paid on-call personnel who 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 the system 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.

Despite the independent multi-department system, Newaygo County's fire hazards remain a primary countywide concern. Based on historical occurrence, on average each jurisdiction within Newaygo County has an estimated four or more structure fires annually. As a small community, Newaygo 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.)

Historically, when Newaygo County was first established, large fires plagued it. In 1867, the first serious fire in the history of the county occurred and the Newaygo Company's Mill burned; this was called The Big Red Mill. It was rebuilt in 1869 at a cost of $40,000. In 1883 a massive fire destroyed The City Newaygo, leaving only two buildings standing and completely relocating the County Seat from Newaygo to White Cloud. More recently, most structural fires are residences and can be handled by one two three departments and do not require a lot of outside mutual aid support.

Case: Northern Trails Bar and Grill Fire 2007

On, Monday July 16, 2007 Northern Trails Bar and Grill was destroyed by fire. The fire was spotted around 6:15 am by a Newaygo County Sheriff's Deputy patrolling the area. Fire departments from Kent County, Mecosta County, Montcalm County, and Newaygo County responded to the fire. The fire was ruled as arson. This fire was connected to a second restaurant fire in Croton (Mr. Pibs) the following week.

Case: Pine Lake Village Apartment Complex Fire 2010
On Sunday, August 15, 2010, a medical oxygen tank exploded around 8pm in a unit of Pine Lake Village Apartments in the 100 block of West Pine Lake in Newaygo. The explosion ignited a fire which heavily damaged 4 units within the apartment complex. Through response efforts from the local fire department, the building was saved along with the exposure buildings. Newaygo Fire Department, Fremont Fire Department, White Cloud Fire Department, and Grant Fire Department responded to the fire.

Case: July 3rd, 2018
An orchard warehouse and cider processing building in Grant (Newaygo County) was destroyed by fire. 20 Fire departments along with local, state and federal resources responded to assist.

Case: October 1, 2018
Morley Fire Department responded to a structure fire in northern Deerfield Township around 4:30 a.m. Monday, Oct. 1. While firefighters responded to that fire, two other fires were reported in the area, with another in northern Montcalm County. Firefighters from Lakeview, Mecosta Township, Morton Township, Big Rapids Township, Big Rapids Department of Public Safety, Big Prairie Township in Newaygo County and Maple Valley in Montcalm County responded to assist.

Case: January 30, 2019,
140-year-old Smugglers Cove Restaurant caught on fire. 4 fire departments responded. The building was deemed unsalvageable and was torn down.

Photo by Ryan Pendergast

Case: February 7, 2019 Ensley Township, Mobile home fire, Occupant escaped and survived with 2nd degree burns and two pets lost.

Case: November 29, 2019 East 128th St Structure Fire, Ensley Township, homeowner killed.

History of Structure Fires in Newaygo County 2017-July 2020

Jurisdiction	Fire Dept	2017	2018	2019	2020	Total
City of Fremont	Station 11- Fremont Fire	10	2	9	3	24
City of Grant	Station 13 - Grant Fire	0	0	1	0	1
City of Newaygo	Station 12 - Newaygo Fire	2	2	1	1	6
City of White Cloud	Station 18 - White Cloud Fire	0	0	0	0	0
Ashland Township	Station 13 - Grant Fire	3	8	4	1	16
Barton Township	Big Rapids City Fire	0	1	0	1	2
Beaver Township	Station 19 - Hesperia Fire Walkerville Fire	2	1	1	2	6
Big Prairie Township	Station 15 - Big Prairie Fire	7	3	1	2	13
Bridgeton Township	Station 11 - Fremont Fire Station 13 - Grant Fire	3	3	3	3	12
Brooks Township	Station - 12 Newaygo Fire	2	7	5	2	16
Croton Township	Station 14 - Croton Fire	5	10	4	0	19
Dayton Township	Station 11- Fremont Fire Station 19 - Hesperia Fire	2	2	2	1	7
Denver Township	Station 19 - Hesperia Fire	3	1	5	1	10
Ensley Township	Sand Lake Fire	3	2	5	5	15
Everett Township	Station 18 - White Cloud Fire	0	0	0	2	2
Garfield Township	Station 11- Fremont Fire Station 12 - Newaygo Fire	5	4	5	0	14
Goodwell Township	Station 15 - Big Prairie Fire	0	2	0	0	2
Grant Township	Station 13 - Grant Fire	1	5	2	0	8
Home Township	Station 17 - Lilley Fire	1	1	0	1	3
Lilley Township	Station 17 - Lilley Fire	2	1	2	3	8
Lincoln Township	Station 18 - White Cloud Fire	3	0	1	4	8
Merrill Township	Station 17 - Lilley Fire	1	2	0	0	3
Monroe Township	Station 17 - Lilley Fire	2	1	1	0	4
Norwich Township	Big Rapids City Fire	0	3	0	0	3
Sheridan Township	Station 11 - Fremont Fire	2	7	4	2	15
Sherman Township	Station 11 - Fremont Fire Station 18 - White Cloud Fire	2	2	6	0	10
Troy Township	Station 17 - Lilley Fire	4	1	1	0	6
Wilcox Township	Station 18 - White Cloud Fire	6	0	4	0	10
Total		**71**	**71**	**67**	**34**	

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).

Scrap Tire Disposal Sites in Michigan: November 2009

County	Sites	Tires	County	Sites	Tires
Alpena	2	100,250	Livingston	1	1,000
Arenac	1	37,341	Marquette	1	3,000
Bay	1	700	Mecosta	1	8,000
Benzie	1	10,000	Menominee	1	2,000
Calhoun	2	5,700	Midland	2	121,100
Cass	1	37,000	Monroe	2	7,500
Chippewa	1	500	Montcalm	1	2,000
Clare	1	700	Newaygo	2	27,000
Crawford	1	10,000	Oakland	2	20,633
Dickinson	1	499	Oceana	1	11,000
Eaton	1	300	Osceola	2	2,385,000
Genesee	2	152,000	Ottawa	1	100,000
Grand Traverse	1	1,499	St. Clair	3	9,400
Gratiot	1	2,500	St. Joseph	2	48,000
Hillsdale	1	1,300	Sanilac	2	11,000
Houghton	2	117,500	Shiawassee	1	1,000
Ingham	1	500	Tuscola	2	12,700
Iosco	1	4,800	Wayne	22	168,977
Ionia	1	3,000	Van Buren	2	3,000
Jackson	2	6,600	**Total**	76	3,435,499

Source: Department of Environmental Quality, Waste and Hazardous Materials Division

NOTE: Inventory totals compiled for tire quantities are approximated and will vary from year to year, as new tires are brought in and others are recycled or otherwise disposed of.

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: *December 29, 1995 to January 20, 1996 – Grand Traverse County*

A tire fire burned at a re-treading facility in Grawn near Traverse City. Initial fire response was delayed due to attempts by employees at the recycling center to extinguish the blaze without outside assistance. Over the course of the event, surrounding subdivisions were evacuated. The fire engulfed 100,000 tires spread over a three-acre site. Personnel from numerous area fire departments, as well as the U. S. Environmental Protection Agency (EPA) and U. S. Coast Guard, were involved in the containment and suppression effort. In all, 451 responders from 30 separate agencies assisted with the fire over its 22-

day duration. The long duration of this fire was testimony to the difficulty of extinguishing fires of this nature.

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 a100-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.

Local Structural Scrap Fire Analysis:

With strong zoning and ordinances in all townships, scrap tire piles and junkyards have not been a significant fire and blight concerns. The State Department of Environmental Quality Waste Division has addressed many problems associated with these hazards by providing for grants to clean up Scrap Tire Sites. To date, Newaygo County has received several grants totaling over $85,000 to clean up two sites. There are, however, three known sites within the County which have around a combined total of an estimated 27,000 tires.

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 general 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 is capable of posing 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 is capable of posing 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 on a daily basis 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 1-5 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 criss-cross the area, and the large number of hazardous material shipments that occur on a daily basis.

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 H_2S

10 ppm	Beginning eye irritation
50-100 ppm	Slight conjunctivitis and respiratory tract irritation after 1 hour exposure
100 ppm	Coughing, eye irritation, loss of sense of smell after 2-15 minutes. Altered respiration, 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: Z37.2-1972

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 1-5 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 result in a public health emergency, and a resulting need for triage, mass treatment, and congregate care. In addition to the direct impacts of the hazardous material event itself, transportation incidents may directly affect the 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.

However, Michigan has had numerous petroleum or natural gas pipeline accidents in recent years that resulted in injury, loss of life, or significant property damage. Since 1996, the MPSC has investigated over 100 incidents involving pipelines, and at least half of those incidents involved injury, loss of life, or significant property damage. A majority of the state's major natural gas storage facilities are located in the central part of the Lower Peninsula. Natural gas is piped into those storage facilities from Michigan wells, and from large transmission pipelines that originate in Canada, the southwestern United States, and the Gulf of Mexico area.

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

Following are brief synopses of the more significant accidents and their impacts as highlighted in the 2012 Michigan Hazard Analysis:

Case: September 7, 1950 Big Rapids (Mecosta County)
A newly installed natural gas pipeline exploded near Big Rapids because of a flaw in the line. Two barns were destroyed and many windows were shaken. The ensuing fire was seen from 50 miles away.

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.

Case: April 22, 1990 – Egelston Twp. (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: May 13, 1994, and August 1996 Manistee and Mason Counties
An accident occurred when a blown gasket released hydrogen sulfide emissions after a seal in a compressing station in Mason County's Victory Township failed. The incident resulted in 11 people requiring emergency hospital treatment (four of them children) and the death of 10 cattle. Another similar incident occurred two years later when a release of 5,500 cubic feet of natural gas containing 900 ppm of poisonous H2S occurred in Manistee Township. The release, which occurred while workers were attempting to plug a well, caused several citizens in the neighborhood to lose consciousness and collapse. Eleven victims were treated at the hospital; at least one of them sustained serious lung damage. Others were being treated for symptoms of asthma, skin irritations and neuropsychological problems. From 1980 to 1998,

other injuries and evacuations have occurred in Manistee and Mason Counties as a result of H2S releases. At least 10 separate accidental releases of H2S from pipelines and processing plants caused at least 262 people in Manistee and Mason Counties to evacuate their homes (five since 1995), caused at least 22 people to have been injured and seek medical treatment since 1994, and caused 35 cattle to be killed in Mason County since 1994. Many more have suffered respiratory and skin complications, and all are bearing the psychological burden of repeated evacuations.

Case: December 11, 1998 – Osseo (Hillsdale County) – Fireworks Plant Explosion
On December 11, 1998 an explosion at the Independence Professional Fireworks Company manufacturing plant near Osseo, in Hillsdale County, killed seven employees and leveled one building at the site. The blast, which occurred in a fireworks shell assembly room, sent debris flying in all directions for about 300 yards and could be heard for at least 20 miles. Fifteen other workers escaped serious injury in the explosion. Subsequent investigations by the Federal Bureau of Alcohol, Tobacco and Firearms, the Michigan State Police Fire Marshal Division, and the Michigan Occupational Safety and Health Administration (MIOSHA) were unable to determine a definitive cause of the explosion. This explosion was the worst industrial accident in Michigan in 20 years.

Case: February 1, 1999 – Dearborn (Wayne County) – Automobile Plant Boiler Explosion
On February 1, 1999 an explosion in one of several large boilers at the Ford Motor Company Rouge Power Plant killed six workers, critically injured another 14, and caused extensive structural damage. State officials who investigated the accident concluded that human error played a major part in the explosion, when a work crew failed to shut off one of two gas mains leading to the boiler's furnace. That error caused a buildup of natural gas in the boiler that was somehow ignited and caused the explosion. The force of the explosion split open the 60-foot high furnace, blew off the roof of the power plant, ignited fires on five floors, and sprayed surrounding workers with super-heated water that caused severe burns. The blast, which forced the shutdown of the Rouge Complex and other Ford plants for several days, was the second worst industrial accident in Michigan in 20 years and the deadliest at an automobile plant in over 50 years. It also turned out to be the most expensive workplace disaster in U.S. history, with final costs of at least $1 billion. The seven-month probe by state officials was the largest and most complex in the history of state workplace safety investigations.

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: 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: April 12, 2000 – Egelston Twp. (Muskegon County)
On April 12, 2000 two explosions occurred in rapid succession at a chemical plant in Muskegon, resulting in 10 workers sustaining injuries and flattening part of the plant's production area. The explosion is believed to have been caused by the chemical 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 first, smaller blast occurred in a two-inch stainless steel pipe leading from a building to the wet well. The second, larger blast occurred below grade in the southwest quadrant of the wet well. The explosions 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 around the plant.

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: December 2006 Mecosta County
In December, 2006 a gas well burst into an explosion in Mecosta County, resulting in the evacuation of several nearby residents. The issue was later resolved, with no additional threat to public safety.

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: 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: May 16, 2010 Kentwood (Kent County)
A natural gas leak caused a four-unit apartment to explode on May 16, 2010, resulting in 4 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: 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: July 26, 2010 Calhoun & Kalamazoo Counties Enbridge Pipeline Disaster
On July 26, 2010, an oil spill was discovered by the owners of an oil pipeline, Enbridge Energy Partners L.P., during a maintenance activity at a pumping station located on the south edge of the City of Marshall. The 30-inch pipeline normally transported 190,000 barrels per day from Griffith, Indiana, to Sarnia, Ontario, and passes through Calhoun County and several other Michigan counties. Oil from the pipeline leaked into the Talmadge Creek and then into the Kalamazoo River and began to flow downstream toward Lake Michigan. Enbridge Energy

officials shut down the pipeline pumps and closed valves located upstream and downstream from the leak site to stem the flow of additional oil and try to contain the spill. Based on company estimates, up to 19,500 barrels of crude oil had leaked from the pipeline (approximately 800,000 gallons).

Calhoun County declared a local state of emergency and several downstream communities, including Kalamazoo County, took emergency response actions in coordination with Calhoun County. The State Emergency Operations Center in Lansing was activated and a number of state departments and support organizations convened there to monitor the incident and coordinate state response activities with involved governmental agencies and company officials. Representatives of the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Transportation Safety Board, U.S. Department of Transportation and other federal agencies quickly convened at the incident site and began working with company, local and state officials (under a Unified Command structure) to develop and implement a spill containment, recovery, and clean-up plan and protection strategy for the environment and affected local residents.

A coordination facility was established in the City of Marshall and contractors where brought in for environmental restoration and product recovery. Aggressive product recovery efforts were instituted to expedite oil containment and environmental clean-up. Wildlife rescue and rehabilitation operations were also implemented to aid in protecting animals and aquatic life from harm, and saving wildlife that had been adversely impacted by the spill. Health advisories were issued to protect the public from harm, and some of the nearby residents were evacuated for a time until the air quality improved within the area. A number of contracted cleanup crews were brought in to perform clean-up and product recovery work.

On September 27, the repaired oil pipeline was restarted by company officials, with the approval of the U.S. Department of Transportation. New oil again flowed through the pipeline, initially at a reduced pressure level but then at full capacity again. Clean-up and product recovery efforts are still ongoing. The unified command center remained operational for an extended period of time, due to the long-term nature of product recovery and environmental clean-up operations.

Hazardous Materials Incidents in Newaygo County

Regardless of their type or classification, it is a fact that every Newaygo 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.

Newaygo County's primary vulnerability concern for hazardous materials incidents directly results from the lack of local hazardous materials response capability. Although local emergency services expend great efforts to plan and train in such emergencies to the best of

their abilities, the fact remains that there is no quantifiable level of hazardous materials response team within the jurisdiction. Lack of this essential equipment in detection, personal protection, containment, and decontamination, etc. has resulted in the need to call contracted hazmat teams from nearby Counties for response and cleanup, requiring 1 ½ to 2 ½ hour response time.

Although virtually every business, industry, and household contains some levels of hazardous materials, of primary concern in Newaygo County 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 by the Michigan Department of Environmental Quality (MDEQ) as containing Extremely Hazardous Substances (EHS) above identified Threshold Planning Quantities (TPQ) are classified as SARAIII 302 sites. Facilities identified by the Michigan Department of Environmental Quality (MDEQ) as containing Extremely Hazardous Substances (EHS) at established reporting quantities are classified as SARAIII 312 sites. Although less than identified SARAIII 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 Environmental Protection Association (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.

- CERES SOLUTIONS COOPERATIVE – FREMONT CO-OP (FREMONT)
- GOODWELL COMPRESSOR STATION – ANR (WHITE CLOUD)
- GERBER PRODUCTS (FREMONT)
- MAGNA MIRRORS (NEWAYGO)
- AT&T (GRANT)
- AT&T (NEWAYGO)
- AT&T (FREMONT)
- AT&T (WHITE CLOUD)
- FRONTEER COMMUNCATIONS (HESPERIA)
- CHARTER COMMUNICATIONS (GRANT)
- HARBISON WALKER INTERNATIONAL - NORTH AMERICAN REFACTORIES (WHITE CLOUD)
- WILBUR-ELLIS (GRANT)
- CEDAR VALLEY PACKING (GRANT)
- RICE LAKE FARMS (GRANT)

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 Newaygo County on primary and secondary local transportation routes on a regular, daily basis. Primary highways such as M-37, M-20, and M-82 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 through the southwestern portion of the County by Marquette Railway on a daily basis. This includes Calcium Carbonate, Hot Asphalt, and other petroleum products. The line is one of the busiest in the state of Michigan traveling through the Cities of Grant, Newaygo, and White Cloud. The other line is a C&O Railway ending at the City of Fremont in Gerber Products.

Newaygo 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, Newaygo County experiences a hazardous materials incident on average, approximately once every two to three years. The following are hazardous materials incidents which have occurred in Newaygo County:

Case: February 4, 1978 Woodland Park (Newaygo County)
A Dow Chemical train derailed caused a chemical spill of approximately 30,000 gallons of ethylene oxide, carbolic acid, methylene chloride, and phropheline oxide. A total of 50 persons were evacuated from the vicinity of the accident scene. According to the Merrill Township Master Plan, recent tests conducted by 24 Hour News 8 in the area show chemical levels of the potential carcinogen 1,1-DCE (used to make plastics and flame-retardant coatings) to be more than twice the level for safe drinking water and that the chemical has spread to the southwest, toward East Lake. Additional tests conducted by a consultant hired by CSX have found traces of vinyl chloride in East Lake. Vinyl chloride is a known carcinogen and is created when 1,1-DCE breaks down in the environment. The Environmental Protection Agency (EPA) says 1,1-DCE might cause cancer in humans. This chemical can damage the nervous system, liver, and lungs. Unconfirmed anecdotal evidence shows that many people who lived around the train derailment site died of cancer within a few years of the derailment.

The biggest concern for Merrill Township is human exposure through drinking the groundwater. Clean-up efforts on the groundwater were stopped in 1998 after it became apparent that they were not working. Since this time, monitoring wells are showing chemical levels up to 137 times higher than the safe level for drinking. Another investigation several years ago indicated that the contamination had spread uphill and upstream to the north, crossing 11 Mile Road.

Case: June 22, 1979 Newaygo (Newaygo County)
A freight train derailment caused a chlorine leak that eventually sealed itself. A total of 300 persons were evacuated as a precautionary measure.

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: October 21, 2000 Woodland Park (Newaygo County)
A propane explosion on October 21, 2000, demolished a summer home in Woodland Park and killed 4 members of a family, just minutes after they had arrived at the home for a weekend visit. Two other family members survived the blast, which may have originated in the basement of the home.

Case: May 24, 2007 (Wesco Tanker Truck)
A tanker truck carrying 13,000 gallons of gasoline and ethanol turned onto its side while swerving to miss a deer on 80th Street west of Warner Ave. The tanker truck rolled into a ditch spilling gasoline and ethanol contaminating soil and a nearby stream. No one was hurt during the accident or response.

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 2012 Oil Well Head Leak (Beaver Township)
An oil well head located at approximately 9552 E Filmore Rd, Hesperia MI was found to be leaking crude oil. There was a 12 foot by 15 foot pool of oil around the well head, approximately

80 yards from a creek. The owner and installer of the well is Well Masters out of Rothberg, Michigan. DEQ worked with the EPA and Newaygo County Emergency Services to clean up the spill.

Case: 2000 and 2014 Campbell, Wyatt, and Cannon Pipeline Leak (Bridgeton Township)

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

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.

Case: July 22, 2018 and October 9 2018

First occurrence- Owner of refrigerated food packing facility called 911 to report a fire in the compressor room and an ammonia leak from the refrigeration system. The hazmat team responded, refrigeration contractor and consumers energy responded. The system was shut down, leak repaired. Second occurrence – a small ammonia leak. Fire responded, and owner contacted engineering contract service. It was repaired. Both unintentional releases no injuries.

Newaygo County Hazardous Materials Incidents

Township	Fire Dept	2017	2018	2019	2020	Total
Ashland	Station 13 - Grant Fire	1	0	0	0	1
Barton	Big Rapids City Fire	0	0	0	0	0
Beaver	Station 19 - Hesperia Fire Walkerville Fire	1	0	0	0	1
Big Prairie	Station 15 - Big Prairie Fire	7	0	0	0	7
Bridgeton	Station 11 - Fremont Fire Station 13 - Grant Fire	4	0	0	0	4
Brooks	Station - 12 Newaygo Fire	6	1	0	0	7
Croton	Station 14 - Croton Fire	6	0	0	0	6
Dayton	Station 11- Fremont Fire Station 19 - Hesperia Fire	1	1	0	0	2
Denver	Station 19 - Hesperia Fire	0	0	0	0	0
Ensley	Sand Lake Fire	1	1	0	0	2
Everett	Station 18 - White Cloud Fire	0	0	0	0	0
Fremont	Station 11- Fremont Fire	17	4	0	0	21
Garfield	Station 11- Fremont Fire Station 12 - Newaygo Fire	5	0	0	0	5
Goodwell	Station 15 - Big Prairie Fire	1	0	0	0	1
Grant	Station 13 - Grant Fire	2	0	0	0	2
Grant City	Station 13 - Grant Fire	0	0	0	0	0
Home	Station 17 - Lilley Fire	0	0	0	0	0
Lilley	Station 17 - Lilley Fire	2	1	0	0	3
Lincoln	Station 18 - White Cloud Fire	0	0	0	0	0
Merrill	Station 17 - Lilley Fire	1	0	0	0	1
Monroe	Station 17 - Lilley Fire	0	0	0	0	0
Newaygo	Station 12 - Newaygo Fire	2	0	0	0	2
Norwich	Big Rapids City Fire	0	0	0	0	0
Sheridan	Station 11 - Fremont Fire	2	0	0	0	2
Sherman	Station 11 - Fremont Fire Station 18 - White Cloud Fire	5	0	0	0	5
Troy	Station 17 - Lilley Fire	0	0	0	0	0
White Cloud	Station 18 - White Cloud Fire	0	0	0	0	0
Wilcox	Station 18 - White Cloud Fire	4	0	0	0	4

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: December 1989 Monroe County Water Supply Infrastructure Failure

The December 15, 1989 water emergency in Monroe was the result of a water intake in Lake Erie being blocked by ice build-up and Zebra Mussel crustaceans. Officials issued water conservation and boil-water advisories, and schools and most large businesses were closed. Local hospitals limited their activity to emergencies only and referred new patients to out-county hospitals. The hospitals operated on bottled water for the duration of the incident. The fire service was also adversely impacted, invoking mutual aid and stationing tankers throughout the city in case a fire occurred. The city eventually completed an emergency hookup with the Toledo, Ohio water system, which helped alleviate most of the water supply problems. The city

also had three pumps drawing water from the River Raisin and pumping it to the water treatment facility. Emergency measures continued for three days. By December 18, the flow of water was back to normal. This incident showed how a vast public infrastructure system can be made inoperable – and thousands of people inconvenienced or even imperiled – by something as small as an aquatic mollusk.

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: 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 $38 million to replace eight and a half miles of underground sewer main.

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 aspart 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.

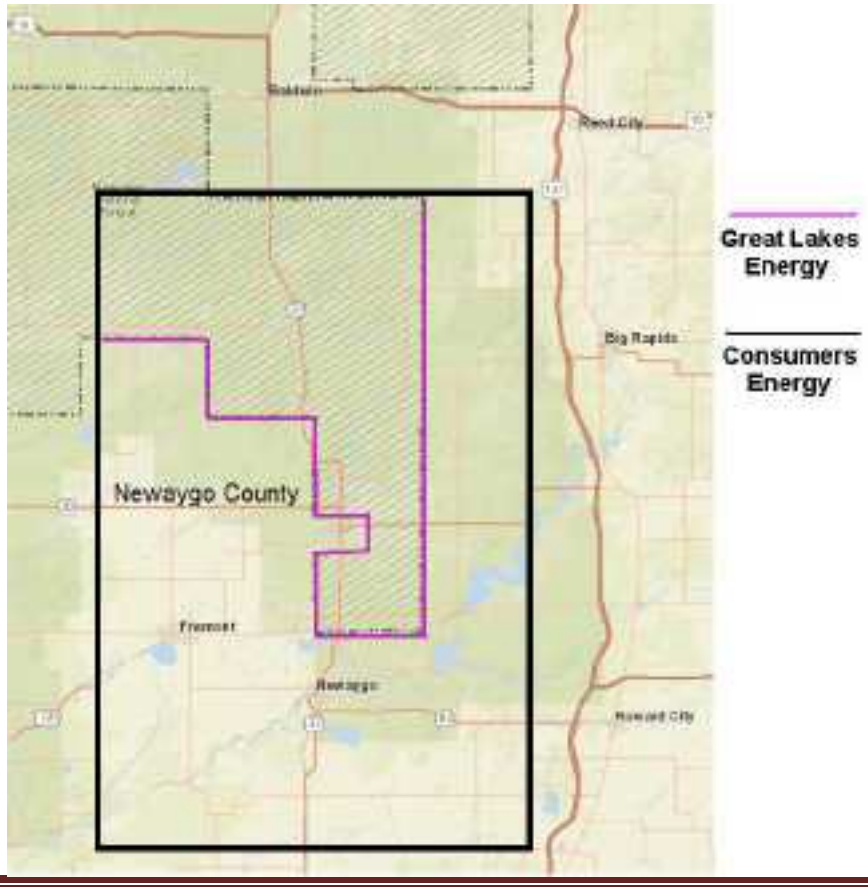
Pure lead pipes, solder, and fittings were banned from U.S. water systems in 1986 (it was only in 2014 that allowable lead levels in plumbing and fixtures dropped to 0.25 percent), and national regulations for lead testing and treatment of public water supplies were established in 1991 with the Lead 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 Newaygo County

Due to older utility systems, Newaygo County has historically been affected by localized infrastructure failures of critical electrical, telephone, and public safety communications services. Based on historical occurrence, Newaygo 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.

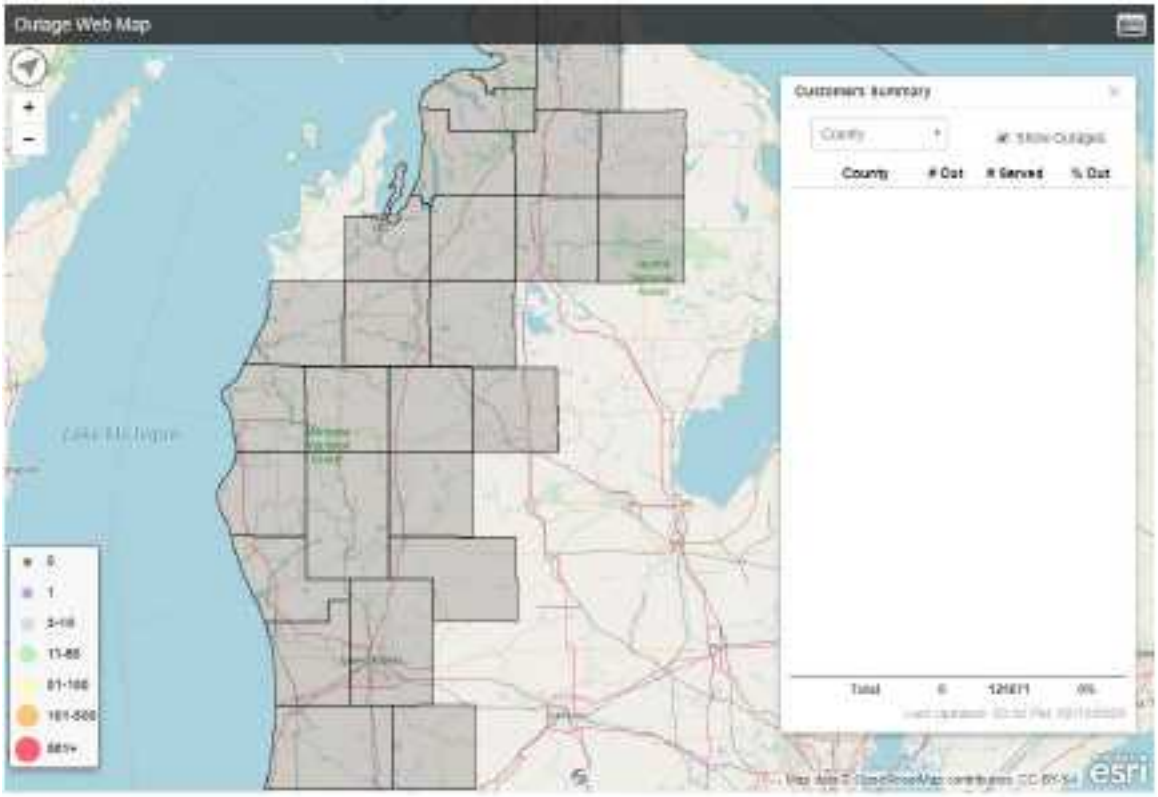
Electrical infrastructure failure is not only a common occurrence in Newaygo County but is also an identified consequence of many other local hazards. This has resulted in intense concerns by emergency management and response officials focused on the lack of generator capability at critical facilities identified as shelters (primarily schools). Newaygo 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. ITC Transmission is also a private company that owns a majority of the transmission lines and electrical substations within Newaygo County. Great Lakes Energy and Consumers Energy utilize ITC Transmissions' infrastructure to distribute power to end users.

Electric Company Service Area for Newaygo County



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

Newaygo County Outages and Customer Count by Month (Consumers Energy)

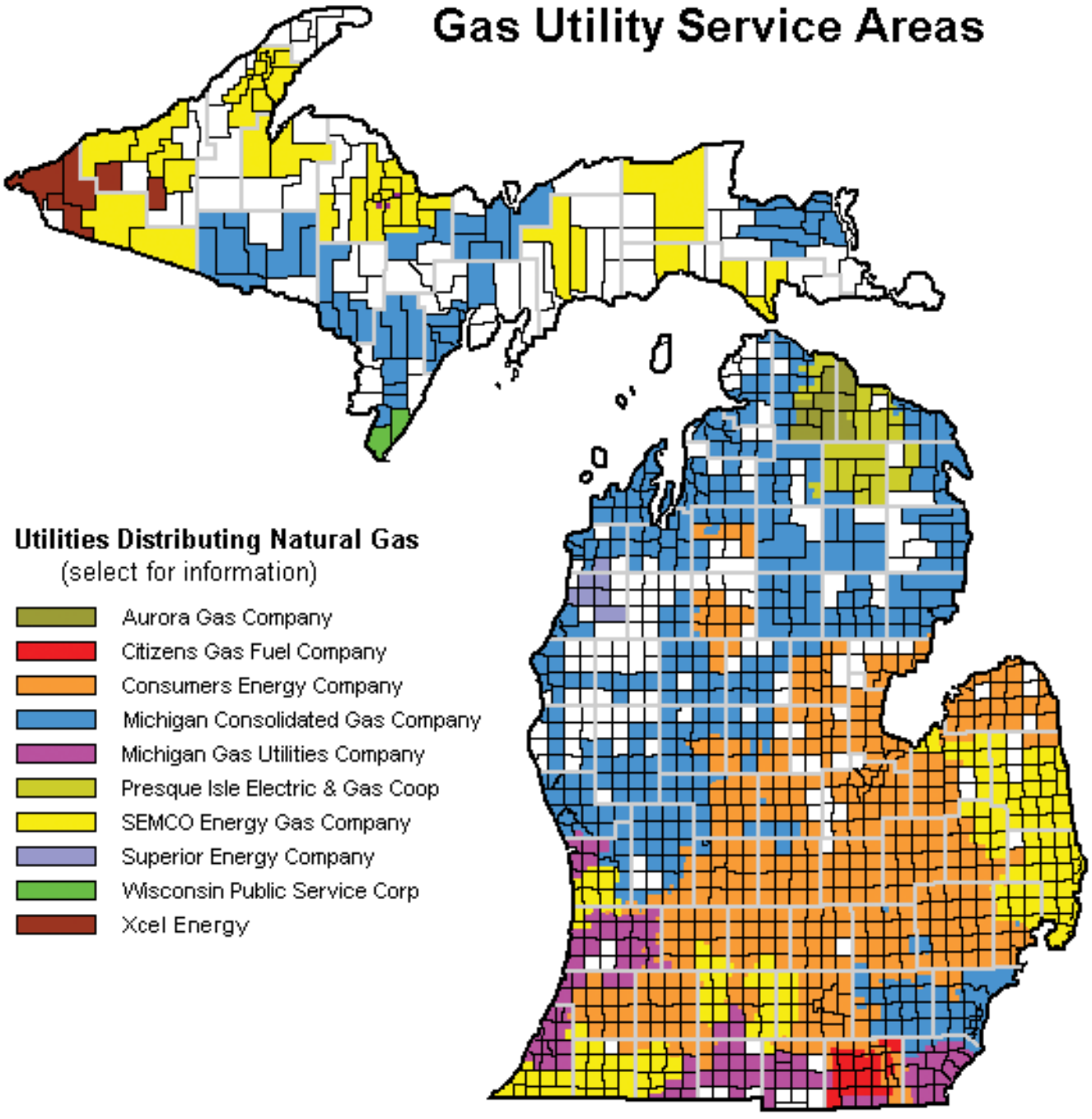
Year	Month	# Incidents	# Customers	County Name
2009	January	26	325	NEWAYGO
2009	February	15	344	NEWAYGO
2009	March	43	1,039	NEWAYGO
2009	April	37	545	NEWAYGO
2009	May	35	564	NEWAYGO
2009	June	48	936	NEWAYGO
2009	July	46	304	NEWAYGO
2009	August	107	6,473	NEWAYGO
2009	September	49	1,987	NEWAYGO
2009	October	134	3,851	NEWAYGO
2009	November	27	263	NEWAYGO
2009	December	42	1,889	NEWAYGO
2009 Totals		**609**	**18,520**	
Year	**Month**	**# Incidents**	**# Customers**	**County Name**
2010	January	18	203	NEWAYGO
2010	February	15	4,580	NEWAYGO
2010	March	33	2,028	NEWAYGO
2010	April	42	1,647	NEWAYGO
2010	May	62	2,573	NEWAYGO
2010	June	55	1,930	NEWAYGO
2010	July	81	2,302	NEWAYGO
2010	August	66	1,606	NEWAYGO
2010	September	243	10,344	NEWAYGO
2010	October	185	6,630	NEWAYGO
2010	November	47	5,197	NEWAYGO
2010	December	49	1,174	NEWAYGO
2010 Totals		**896**	**40,214**	
Year	**Month**	**# Incidents**	**# Customers**	**County Name**
2011	January	16	146	NEWAYGO
2011	February	54	5,569	NEWAYGO
2011	March	149	8,522	NEWAYGO
2011	April	64	1,315	NEWAYGO
2011	May	39	1,882	NEWAYGO
2011	June	131	5,670	NEWAYGO
2011	July	261	13,535	NEWAYGO
2011	August	136	6,674	NEWAYGO
2011	September	276	18,904	NEWAYGO
2011	October	49	6,847	NEWAYGO
2011	November	49	2,053	NEWAYGO
2011	December	27	474	NEWAYGO

2011 Totals		1251	71,591	

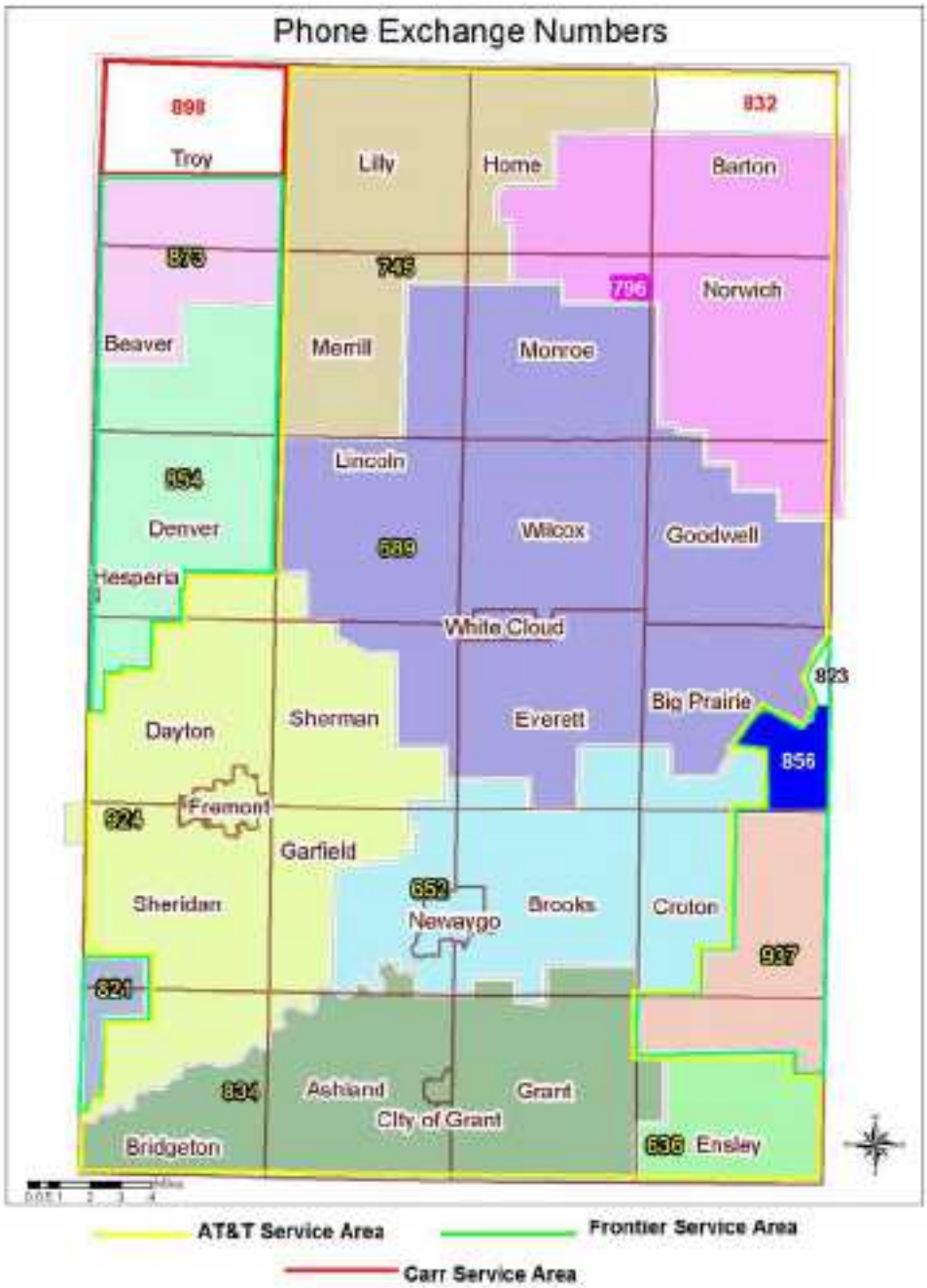
Newaygo County Outages and Customer Count by Month (Consumers Energy)

Year	Month	# Incidents	# Customers	County Name
2012	January	43	741	NEWAYGO
2012	February	15	384	NEWAYGO
2012	March	135	7,015	NEWAYGO
2012	April	63	3,907	NEWAYGO
2012	May	118	3,125	NEWAYGO
2012	June	62	1,831	NEWAYGO
2012	July	293	13,521	NEWAYGO
2012	August	50	4,010	NEWAYGO
2012	September	63	304	NEWAYGO
2012	October	55	1,311	NEWAYGO
2012	November	20	1,217	NEWAYGO
2012	December	39	2,752	NEWAYGO
2012 Totals		**956**	**40,118**	
Year	**Month**	**# Incidents**	**# Customers**	**County Name**
2013	January	73	5,950	NEWAYGO
2013	February	17	175	NEWAYGO
2013	March	14	91	NEWAYGO
2013	April	77	4,488	NEWAYGO
2013	May	68	9,786	NEWAYGO
2013	June	45	929	NEWAYGO
2013	July	67	1,936	NEWAYGO
2013	August	70	1,556	NEWAYGO
2013	September	43	602	NEWAYGO
2013	October	60	1,259	NEWAYGO
2013	November	152	4,179	NEWAYGO
2013	December	38	332	NEWAYGO
2013 Totals		**724**	**31,283**	
Year	**Month**	**# Incidents**	**# Customers**	**County Name**
2014	January	53	7,609	NEWAYGO
2014	February	30	1,516	NEWAYGO
2014	March	23	1,298	NEWAYGO
2014	April	213	7,785	NEWAYGO
2014	May	77	816	NEWAYGO
2014	June	119	1,575	NEWAYGO
2014	July	44	1,033	NEWAYGO
2014	August	43	645	NEWAYGO

As many areas within Newaygo County are rural in nature, a 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 Newaygo County, Michigan Consolidated Gas Company (MichCON) is the natural gas distributor servicing the area.



Local telephone service within Newaygo County is provided by three private companies, AT&T, Frontier Communications, and CAAR. 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.



Being rural in nature, many residences within Newaygo County rely on privately owned well and septic systems for water and waste water. However, there are six municipal water and waste water systems within Newaygo County maintained by city or local authority boards. The City of Fremont maintains 3 water towers and 8 well houses as a part of their Water Supply and Treatment to the City of Fremont. The City of Grant and the City of Newaygo both maintain a single water tower and treatment facility. The City of White Cloud maintains three wells and two water towers. The Sherman Twp/White Cloud Sewer Authority manages the 1.1 million gallon per year waste water treatment facility just west of the City of White Cloud. The Chain of Lakes also maintains a Sewer Authority serving portions of Everett, Brooks, and Garfield Townships around Sylvan, Emerald, Pickerel, and Kimball Lakes.

It is rare to have a water or sewer interruption, however, in the spring of 2014, both the City of White Cloud and the City of Newaygo experienced water main breaks due to extreme winter weather causing a disruption in service to both communities.

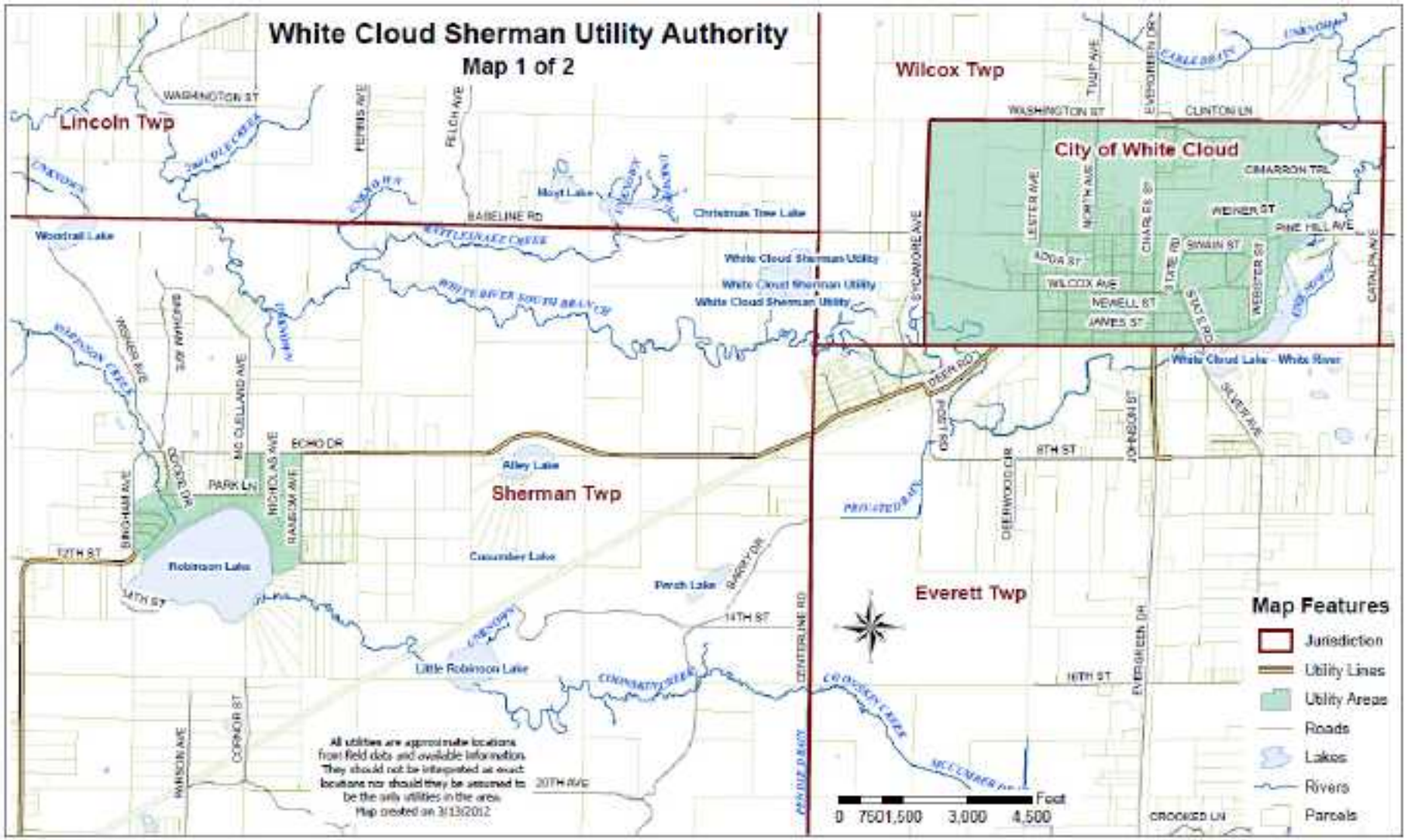
Water Quality in Newaygo County

Changes to the Michigan Safe Drinking Water Act were approved in 2018. The rule now requires:

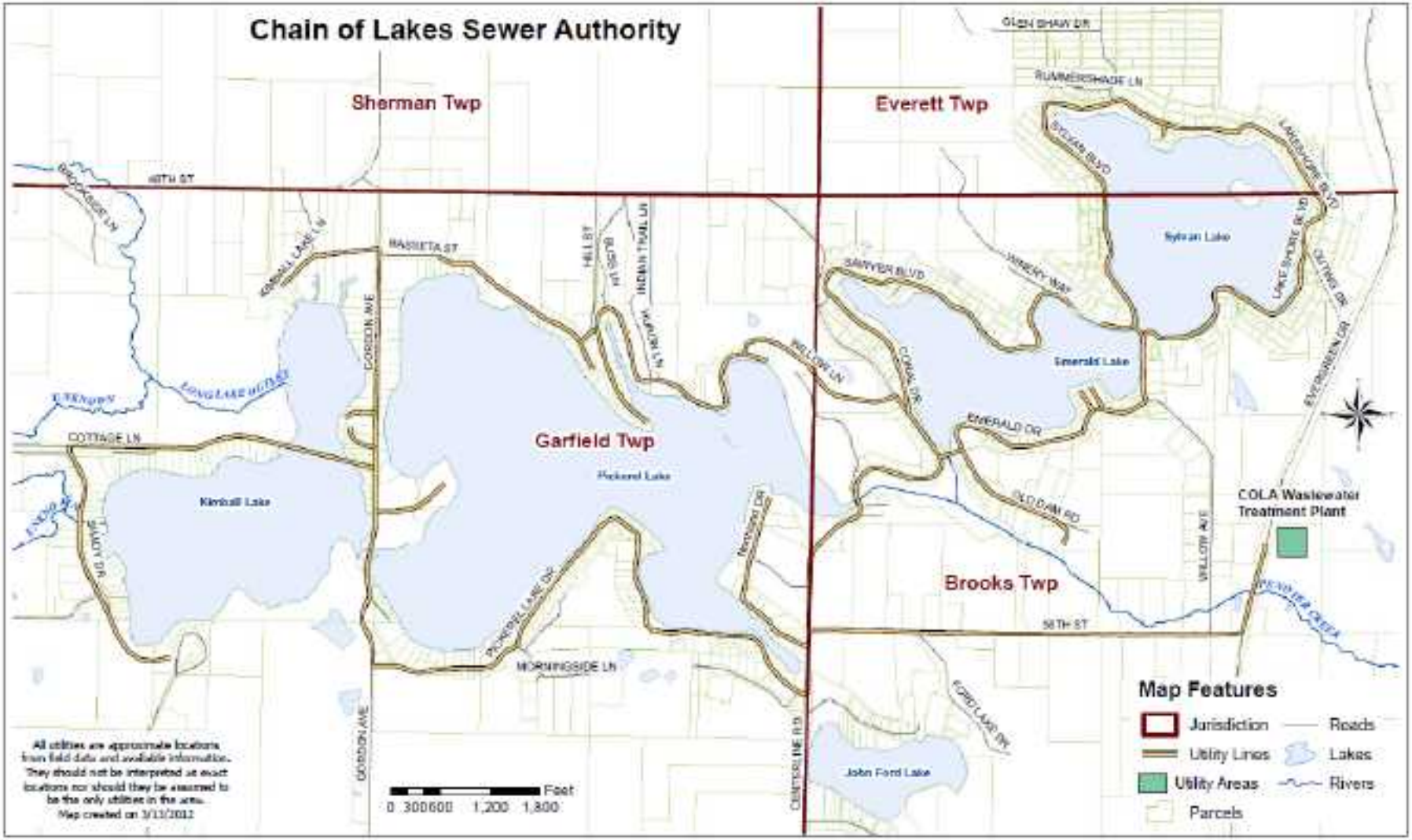
- The removal of all lead service lines in Michigan. Water supplies are required to replace an average of 5 percent of their lead services line every year for the next 20 years unless an alternative schedule is approved by EGLE.
- Communities locate and prioritize lead service lines for removal.
- The 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.

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)
MI0002490	FREMONT	NEWAYGO	4,083	2018-12-31	2	N	2020-09-30
MI0002823	GRANT	NEWAYGO	854	2019-12-31	2	N	2022-09-30
MI0003130	HESPERIA	NEWAYGO	954	2017-12-31	2	N	2020-09-30
MI0004710	NEWAYGO	NEWAYGO	1,976	2018-12-31	5	N	2021-09-30
MI0007060	WHITE CLOUD	NEWAYGO	1,408	2018-12-31	4	N	2021-09-30
MI0040368	LAKE FOREST PARK	NEWAYGO	185	2017-12-31	0	N	2020-09-30
MI0040369	FOUR SEASONS TRAILER PARK	NEWAYGO	140	2017-12-31	1	N	2020-09-30
MI0040370	HESS LAKE RV AND MOBILE HOME PARK	NEWAYGO	160	2018-12-31	0	N	2021-09-30
MI0040587	EVERGREEN VILLAGE MH PARK	NEWAYGO	248	2017-12-31	2	N	2020-09-30


White Cloud Sherman Utility Authority
Map 1 of 2
Lincoln Twp
Wilcox Twp
Sherman Twp
Everett Twp
City of White Cloud
WASHINGTON ST
BASELINE RD
CLINTON LN
CIMARRON TRL
WEINER ST
PINE HILL AVE
SWAIN ST
ADA ST
WILCOX AVE
NEWELL ST
JAMES ST
LESTER AVE
NORTH AVE
CHARLES ST
STATE RD
WEBSTER ST
SYCAMORE AVE
CATALPA AVE
EVERGREEN DR
TULIP AVE
DEER RD
8TH ST
JOHNSON ST
DEERWOOD DR
QUEEN AVE
ECHO DR
PARK LN
MC CLELLAND AVE
HIGHLAND AVE
RANSOM AVE
BINGHAM AVE
12TH ST
14TH ST
16TH ST
20TH AVE
CONNOR ST
IVANSON AVE
CENTERLINE RD
PRIVATE DRIVE
CROOKED LN
Woodrail Lake
Mint Lake
Christmas Tree Lake
Alley Lake
Cucumber Lake
Perch Lake
Robinson Lake
Little Robinson Lake
White Cloud Sherman Utility
White Cloud Lake - White River
All utilities are approximate locations from field data and available information. They should not be interpreted as exact locations nor should they be assumed to be the only utilities in the area.
Map created on 3/13/2012
0 750 1,500 3,000 4,500 Feet
Map Features
Jurisdiction
Utility Lines
Utility Areas
Roads
Lakes
Rivers
Parcels

White Cloud
Sherman Utility Authority
Map 2 of 2
Sherman Twp
Crystal Lake
Robinson Lake
Cucumber Lake
Little Robinson Lake
Boles Lake
Kemperman Lake
Bird Lake
Long Lake
Little Lake
FERRY ST
22ND ST
24TH ST
40TH ST
WISNER AVE
CONNER ST
PARSON AVE
FERRIS AVE
SHERMAN AVE
Map Features
Jurisdiction
Utility Lines
Utility Areas
Roads
Lakes
Rivers
Parcels
Feet
0 750 1,500 3,000
All utilities are approximate locations from field data and available information. They should not be interpreted as exact locations nor should they be assumed to be the only utilities in the area.
Map created on 3/13/2013


Chain of Lakes Sewer Authority
Sherman Twp
Everett Twp
Garfield Twp
Brooks Twp
Kimball Lake
Packard Lake
Sylvan Lake
Emerald Lake
John Ford Lake
COLA Wastewater Treatment Plant
Map Features
Jurisdiction
Utility Lines
Utility Areas
Parcels
Roads
Lakes
Rivers
All utilities are approximate locations from field data and available information. They should not be interpreted as exact locations nor should they be assumed to be the only utilities in the area.
Map created on 3/11/2011
Feet
0 300600 1,200 1,800

TRANSPORTATION ACCIDENTS / MASS CASUALTY INCIDENTS

Transportation Accidents

A crash or accident involving an air, land, 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, 86% of passenger miles traveled occur by passenger vehicles including cars, trucks, vans, and motorcycles. The remaining 14% was handled by planes, trains, and buses.

Mode of passenger transport	Passenger-miles (millions)	Percent
Highway — total	**4,884,557**	**88.79%**
Passenger vehicles, motorcycles	4,520,810	82.18%
Trucks	222,836	4.05%
Buses	162,908	2.96%
Air Carriers	**583,689**	**10.61%**
Rail — total	**30,972**	**0.56%**
Transit	16,118	0.29%
Commuter	9,473	0.17%
Intercity/Amtrak	5,381	0.10%
All other modes (e.g., ferryboats)	**2,091**	0.04%
Source: 2005 estimates by the Bureau of Transportation Statistics[1]		

The following are specific types of transportation accidents:

Roadway Transportation Accidents

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 Unites States, which use tolls to pay for construction and maintenance. However, a vast majority of the roads are local private roads, generally 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.

Railway Transportation Accidents

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 serves most major cities but, outside of the Northeast, California, and Illinois, often by only few trains per day. Amtrak does not serve several major destinations, including Las Vegas, Nevada, and Phoenix, Arizona.

According to Amtrak, during FY 2013, the railroad welcomed aboard nearly 31.6 million passengers, the largest annual total in its history, and the 10th annual ridership record in the last 11 years. Each day, an average of more than 86,000 passengers ride more than 300 Amtrak trains. More than half of its trains operate at tops speeds of 100 mph or greater. In December 2012, 135 miles of right of way between Kalamazoo and Dearborn, was purchased by Michigan. It is operated, maintained and dispatched by Amtrak, and is being improved for the state of Michigan as an integral part of our Michigan District. Much of the line will be upgraded for service at speeds of up to 110 mph (177 kph).

Air Transportation Accidents

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.

Waterway Transportation Accidents

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.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012
School	111	111	118	109	116	89	116	98	101
Intercity	35	38	33	35	20	38	36	41	34
Transit	85	83	105	113	92	77	84	68	77
Van-Based	0	0	0	0	0	0	0	25	30
Other	26	34	22	16	12	9	11	10	7
Unknown	22	14	27	8	11	8	4	3	2
	279	**280**	**305**	**281**	**251**	**221**	**251**	**245**	**251**

Data from the National Highway Traffic Safety Administration

Railway Transportation Accidents

The new high-speed rail service between Detroit and Chicago will provide special challenges for communities located along that rail corridor. Although the rail infrastructure will be greatly enhanced and state-of-the-art safety improvements will be instituted, 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

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crossing	548	571	551	564	506	428	453	443	446
Railroad	11,438	11,245	10,861	11,158	10,529	9,311	9,578	9,423	9,011
Total	**11,986**	**11,816**	**11,412**	**11,722**	**11,035**	**9,739**	**10,031**	**9,866**	**9,457**

Air Transportation Accidents

Statistics from the NTSB and the airline industry show that the majority (over 75%) of airplane crashes and accidents occur during the takeoff or landing phases of a flight. As a result, developed areas that are adjacent to major airports, and along airport flight paths, are particularly vulnerable to this hazard. Accordingly, the 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

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Air Carrier	30	40	33	28	28	30	29	31	27
Commuter	4	6	3	3	7	2	6	4	4
Air Taxi	66	65	52	61	58	47	30	50	37
General	1,619	1,671	1,523	1,654	1,569	1,480	1,440	1,470	1,471
Total	**1,719**	**1,782**	**1,611**	**1,746**	**1,662**	**1,559**	**1,505**	**1,555**	**1,539**

Waterway Transportation Accidents

Within Michigan there are 20 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. 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

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Vessel	4,962	4,977	4,598	4,694	4,756	4,458	5,285	5,837	5,298
Recreational	4,904	4,969	4,967	5,191	4,789	4,730	4,604	4,588	4,515
Total	**9,866**	**9,946**	**9,565**	**9,885**	**9,545**	**9,188**	**9,889**	**10,425**	**9,813**

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 2012 Michigan Hazard Analysis.

Case: October 28, 1942 Hamtramck (Wayne County) School Bus and 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, and 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: 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: June 4, 2007 Lake Michigan Passenger Airplane Crash
An unfortunate incident occurred when 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.

Buses Involved in Fatal Crashes in the Michigan by Type

	2004	2005	2006	2007	2008	2009	2010	2011	2012
School	5	5	3	3	3	0	2	2	5
Intercity	1	2	0	0	0	0	2	0	2
Transit	2	0	6	3	6	4	3	4	1
Van-Based	0	0	0	0	0	0	0	1	1
Other	0	0	0	1	0	0	1	2	0
Unknown	2	1	0	0	0	0	0	0	0
	10	**8**	**9**	**7**	**9**	**4**	**8**	**9**	**9**

Data from the National Highway Traffic Safety Administration

Train Accidents and Vehicle–Rail Crashes in Michigan: 1990-2009

Year	Vehicle-Rail Crashes	Fatalities
1990	203	N/A
1991	176	N/A
1992	153	N/A
1993	133	N/A
1994	147	N/A
1995	121	N/A
1996	119	N/A
1997	124	N/A
1998	90	N/A
1999	110	N/A
2000	125	N/A
2001	97	9
2002	80	7
2003	104	7
2004	89	9
2005	67	4
2006	57	6
2007	61	3
2008	54	4
2009	44	10

The 2009 total of 44 vehicle-train crashes marked a decrease of 64.8 percent over the preceding 10 year period.

Transportation Accidents in Newaygo County

As Newaygo County is not an urban population center, located near a major transportation route or airport, or located near a marine passenger ferry service, the probability of a transportation accident involving an air, land, or water-based commercial passenger carrier is limited. However, Newaygo County does have five public school systems operating transportation services for students, two municipal airports, a freight train railway system, and three state highways (M-20, M-37, and M-82) within the jurisdiction increasing the risk of a localized transportation accident. Based on historical occurrence, Newaygo County, on average exercise approximately 2 – 3 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, only 3 full-time advanced life support ambulance units and 1 hospital are dedicated to serve Newaygo County. Additionally, the rural

nature of the local hospital which allows limited emergency room services (20 rooms, with a surge capacity of 24) and requires frequent out of County (>30 miles) patient transfers to medical facilities that can provide more advanced services, potentially further limiting available ambulance resources.

As such, an incident with as few as 7-10 patients has the potential to overwhelm our 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 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 Newaygo County.

Case: October 2006 Amish Buggy MCI
In October of 2006, there was an Amish Buggy accident at 48 St and Wisner Avenue east of the City of Fremont. An Intoxicated driver hit an Amish Buggy carrying a family of seven. All 7 people in the buggy were injured and 1 of them died from their injuries.

Case: October 2, 2007 Grant Public Schools Bus Accident
Two Grant Public School buses collided in front of the Grant High School on 120th Ave after school. 12 Patients of High School Age were transported to Gerber Memorial Hospital for treatment of minor injuries.

Case: Friday, November 7, 2008 Newaygo Public Schools Bus Accident
Six children suffered minor injuries and were treated at Gerber Memorial Hospital after a Newaygo Public Schools bus and a truck collided at the corner of M-37 and M-82 in the city of Newaygo. The truck was heading southbound on M-37 and approached a traffic light on westbound M-82. The school bus, which had the right-of-way, was westbound on Croton Drive and turned south on to M-37 causing the accident.
Newaygo County contains no divided freeways and 3 Michigan State highways (M-20, M-37, and M-82). Additionally, many additional county and side roads have equal potential for producing a vehicle incident of significant magnitude to warrant a mass casualty response, especially during hazardous weather.

Case: March 8, 2014 head on veh crash Sheridan Township/Maple Island/96th 2 injured 1 killed

Case: July 26, 2014 Fatal Two Vehicle Head on Collision in Garfield Township
An 18 year old driver traveling on 48th Street crossed into incoming traffic and hit another vehicle head on near Wisner Ave. The diver of the first vehicle was transported to Spectrum Health Butterworth in Grand Rapids in stable condition. The driver of the second vehicle died from his injuries. His female passenger was transported to Spectrum Health Butterworth Hospital in Grand

Rapids in critical condition. Four children passengers in the second vehicle were in stable condition, and a fifth child passenger was treated and released at Spectrum Health Gerber Memorial Hospital.

Case: September 30, 2014 M-37/Foss Livestock truck roll over (100 pigs), driver uninjured, unk # of livestock injured and killed

Case: September 24, 2015 3 vehicle crash Elm/120th 3 injured 1 killed

Case: May 20, 2016 2 veh crash Grant Township 22 mile Rd/Elder 3 injured 1 killed

Case: May 13, Rollover crash 104th/Cypress in Ensley Township
One of the vehicles ran the stop sign hitting the other. Three people were sent to the hospital, one with a serious head injury after being ejected.

Case: August 11, 2018 Vehicle with pontoon boat crash 1 injured 1 killed

Case: March 9, 2019 2 vehicle crash East Baseline Rd/South Elm
A pick-up truck collided with an SUV the 18 year old driver and 14 year old passenger were not injured. 5 people in the SUV were transported to the hospital with one of them, a 2 year old girl, pronounced dead at the scene.

Case: April 3, 2019, 128th Ave Ashland township car pedestrian crash
3 children injured and their dog killed

Case: June 29, 2019 Vehicle rear-ends tractor South Stone Road/W 24th St., Newaygo County
A 44 year old driver rear-ended a tractor pulling farm equipment. The driver was taken to the hospital with injuries along with the 43 old passenger who was pronounced dead. The driver of the tractor also suffered minor injuries. 2 injured 1 killed

Case: August 19, 2019 Dayton Township head on crash, 32nd st near Fremont
31 year old Muskegon man crossed the center line striking an oncoming vehicle. His pregnant passenger was injured and suffered a miscarriage. The occupants in the other vehicle were not injured. 2 injured 1 killed.

Case: March 4, 2020 Newaygo County M-20 at Locust Avenue
Two vehicle crash, three people injured and transported to hospitals one sent via Aeromed. Resulted in significant traffic issues/back up due to the road being closed for a time.

Case: July 29, 2020 Newaygo County Dayton Township West 24th Street at South Dickinson Ave
An SUV with five people inside ran a stop sign and hit another car with four people inside. The driver of the SUV was airlifted and listed in critical condition at Spectrum Health Butterworth

Hospital, police say. Investigators say five other people were treated and released from area hospitals. An infant, who was fastened in a child safety seat, was unharmed.

Fatal Motor Vehicle Traffic Crashes

	2004	2005	2006	2007	2008	2009	2010	2011	2012
National	38,444	37,252	38,648	37,435	34,174	30,862	30,296	29,867	30,800
Michigan	1,159	1,129	1,086	1,087	980	872	942	889	938
Newaygo	13	11	10	11	8	6	6	9	10

Data from the National Highway Traffic Safety Administration

Air Transportation Accidents in Newaygo County
April 5, 1985 Plane Crash White Cloud
June 17, 1992 Plane Crash Troy Township no further info
September 25, 1997 Fremont, pilot and passenger killed
February 3, 2001 Plane Crash, Troy Township Pilot interviewed no further info
July 20, 2001 Plane Crash, Fremont, 2 injured, pilot and passenger
August 23, 2001 Plane Crash, Newaygo pilot killed
May 20, 2002: Plane Crash, Grant, MI 1 person (pilot) on board no injuries.
August 28, 2002 Plane Crash, 1 person (pilot) on board killed.
July 15, 2005 Plane Crash, White Cloud
May 28, 2006 Plane Crash, unk pilot and passenger (not the owner) no injuries reported
July 22, 2006 Plane Crash, Troy Township experimental plane no injuries reported
September 24, 2009 Plane Crash, Troy Township 1 occupant no injuries reported
December 25, 2010 Plane Crash, Troy Township Pilot interviewed no injuries reported
January 30, 2011 Plane Crash, Newaygo, MI 1 person (pilot) on board no injuries.
April 10, 2011 Plane Crash, Troy Township occupant interviewed no other information
May, 27, 2011 Plane Crash Fremont, 2 on board 1 injured
May 18, 2013 Plane Crash Fremont, 1 occupant no injuries
July 2, 2018 Plane Crash Troy Township, 1 occupant no injuries

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.

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 2012 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) 2019-2020

First detected in December in 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

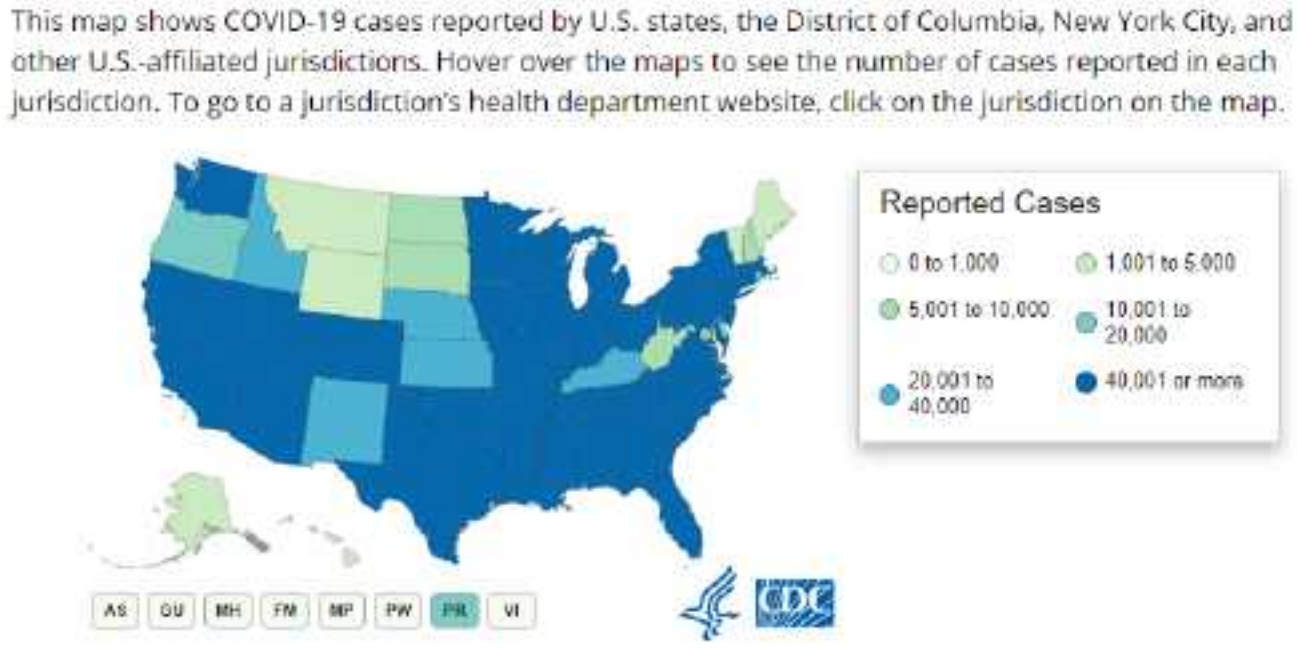
VIRUS	YEAR IDENTIFIED	CASES	DEATHS	FATALITY RATE	NUMBER OF COUNTRIES
Ebola**	1976	33,577	13,562	40.4%	9
Nipah	1998	513	398	77.6%	2
SARS	2002	8,096	774	9.6%	29
MERS*	2012	2,494	858	34.4%	28
COVID-19**	2020	60,349	1,370	2.2%	26

Sources: CDC; World Health Organization; New England Journal of Medicine; Malaysian Journal of Pathology

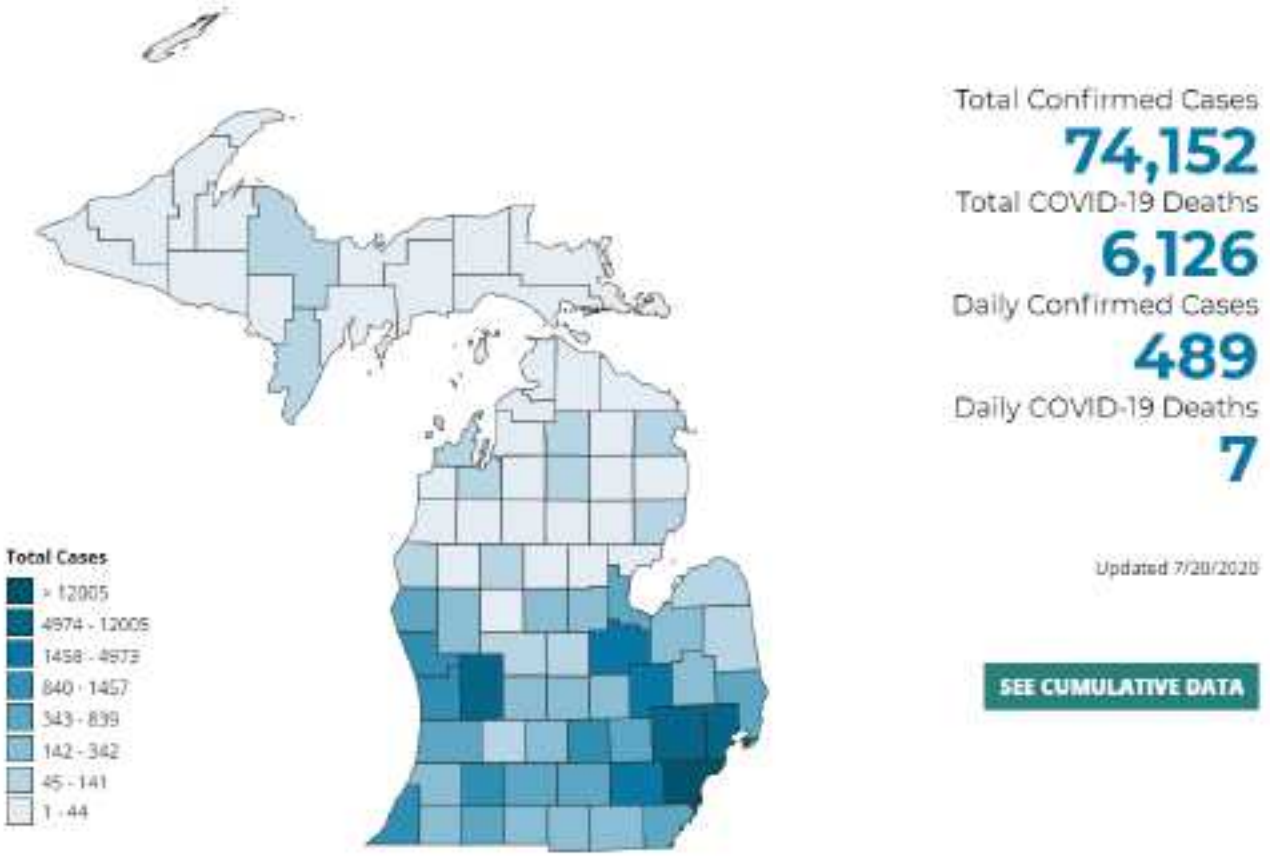
*As of November 2019 **As of Feburary 13, 2020

BUSINESS INSIDER

As of August 3, 2020, there are 17,918,582 cases *2019-nCoV* globally resulting in about 686,703 deaths. The Unites States has a total of 4,649,102 cases with 154,471 deaths. Michigan has 83,386 cases with 6,212 deaths. In Newaygo County the case count is 239 cases with no deaths.



COVID CASES IN MICHIGAN
https://www.michigan.gov/coronavirus



Public Health Emergencies within Newaygo County

Newaygo County's concerns with Public Health emergencies result from a moderately low economic profile of the community and limited public health resources. Newaygo County contains extremely limited health care facilities including 1 rural hospital, 5 ambulances, less than 20 physician centers, and a public health department with limited resources and manpower. During even "usual" outbreaks of common illnesses, these resources become stretched to their maximum capabilities.

A contributing factor to this hazard lies in Newaygo County's position as a relatively moderate to low-income community with many families who are unable to take all steps necessary to insure primary health. This results in many citizens without current vaccinations, living in less than primary health conditions, and other factors (such as being unable to repair critical sanitary systems upon malfunction). In addition to Public Health emergencies, these factors are considered during planning other hazards that could be affected as a result of disease outbreaks, such as Mass Fatality Incidents and CBRNE Terrorism.

Most Public Health Emergencies will not be isolated to Newaygo County, but impact the entire state or Country as well. District Health Department 10 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. The following table is a list of diseases that may soon reach pandemic proportions.

Possible Future Pandemics (diseases that may possibly attain pandemic proportions)	
Disease	**Description**
Lassa fever	The infection is endemic in West African countries, causing many deaths. Outbreaks of the disease have been observed in Nigeria, Liberia, Sierra Leone, Guinea, and Central African Republic.
Rift Valley fever	Rift Valley fever is a viral zoonosis causing fever. It is spread by the bite of infected mosquitoes. Approximately 1% of human sufferers die of the disease. Among livestock the fatality level is significantly higher.
Ebola virus	Ebola hemorrhagic fever is a very rare, but severe, mostly fatal infectious disease occurring in humans and other primates, caused by the Ebola virus. It was first discovered in 1976. Epidemics with 50 to 80% mortality have occurred in the Democratic Republic of the Congo, Gabon, Uganda and Sudan.
Marburg virus	The Marburg virus is the causative agent of Marburg hemorrhagic fever. Both the disease and virus are related to Ebola and originate in the same part of Africa (Uganda and Eastern Congo). The zoonosis is of unknown origin, but some scientists believe it may be hosted by bats.
Bolivian haemorrhagic fever	The Bolivian haemorrhagic fever, also known as black typhus, is a hemorrhagic fever and zoonotic infectious disease occurring in Bolivia. First identified in 1959, black typhus is caused by the machupo virus.
Avian flu	In November 2004 the director for the western region of the World Health Organization said that an influenza pandemic was inevitable and called for urgent plans to combat the virus. The Centers for Disease Control (CDC) claims that a flu pandemic could kill more than 200,000 people in the United States.

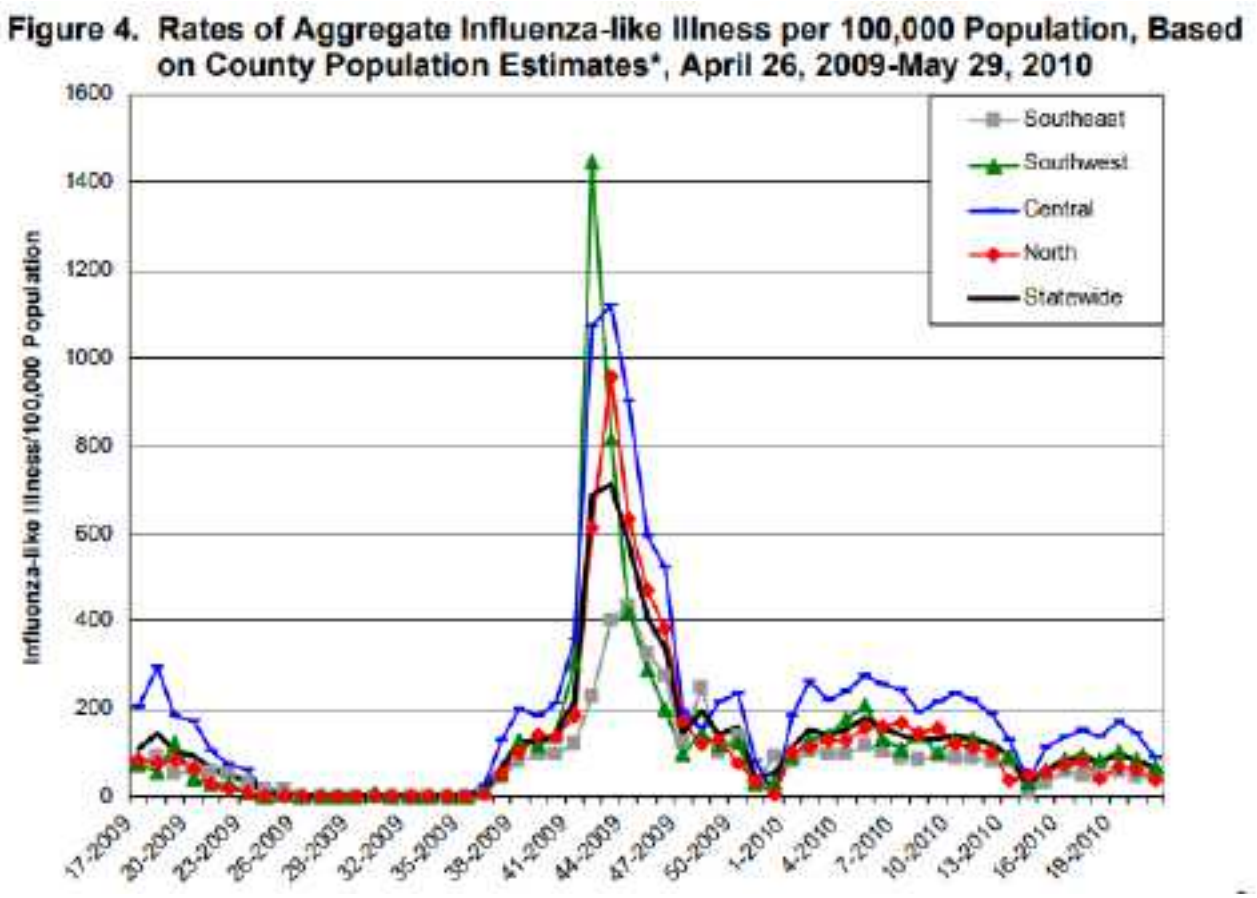
Source: Wikipedia online encyclopedia

Case: 2009-2010 H1N1 in Newaygo 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.

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 Dissease 2019

The virus causing coronavirus disease 2019 (COVID-19), is in a family of viruses call Coronaviridae. Although COVID-19 is in the same family of viruses that cause annual illness like the common cold, COVID-19 is much different. People with COVID-19 have reported a wide range of symptoms – from mild symptoms to severe illness. Symptoms may appear 2-14 days after exposure to the virus. Roughly 18-19% of the cases have been asymptomatic and most people who get COVID-19 recover from it thanks to supportive care.

This is an ongoing worldwide pandemic and the situation is changing daily. This is a much more serious disease than the flu. As there is still a lot unknown about this disease including it is unknown if you can get it once or multiple times. It is also taking a long time for people to recover from COVID-19. It is unknown if people will completely heal or have ongoing health problems as a result of COVID. Currently, there is no licensed medication to cure COVID-19 and no vaccine.

As testing capacity increases, considering confirmed new cases, testing rates, and percent positivity gives us a fuller picture of COVID-19 in Newaygo County. Under these conditions and stable testing practices, trends in daily cases can be cautiously interpreted as trends in transmission of the virus. Leaders can then make informed decisions about lifting social distancing and other transmission control measures.

Total Positive Lab Confirmed Cases

The total positive lab confirmed cases represent the number of individuals who have received a positive COVID-19 lab test. While it is expected more individuals have had the virus but were not officially diagnosed, this number still helps us understand throughout the pandemic how many were confirmed with having COVID-19 and the trajectory of positive cases. Michigan's first confirmed case was on March 9, 2020. Newaygo County's first lab confirmed case was on March 23, 2020. To date, Newaygo County has a total of 212 positive lab confirmed cases.

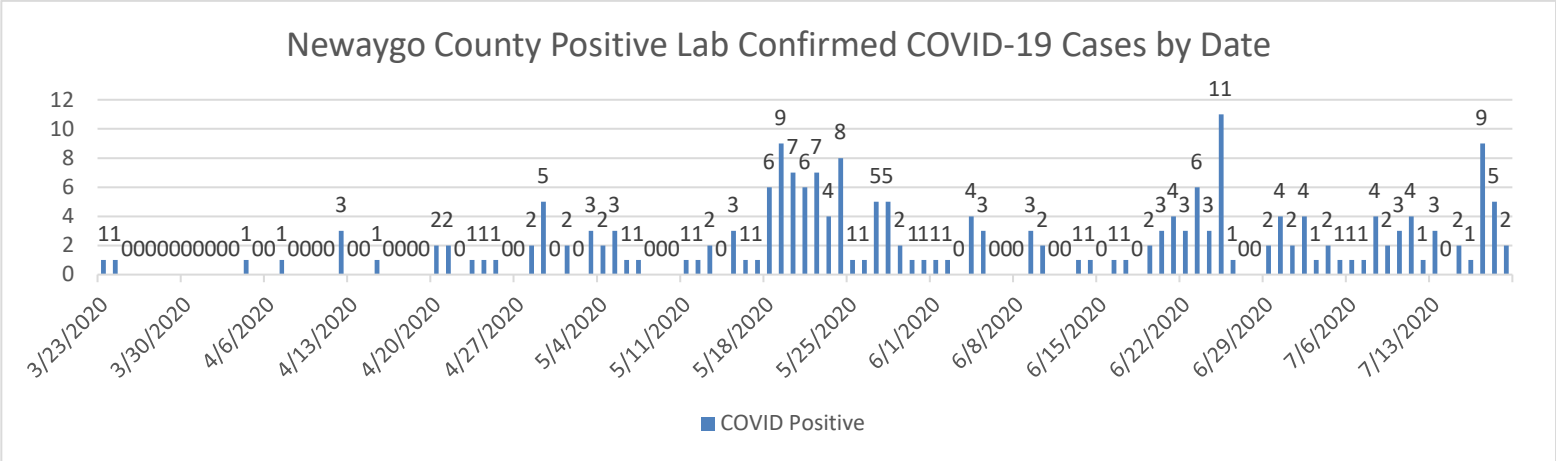
On average, Newaygo County has a total of 2 positive lab confirmed cases per day. By evaluating the total new cases over a 14 day period, can help determine spikes in cases. In Newaygo, the daily positive case counts over a 14 day period to date are:

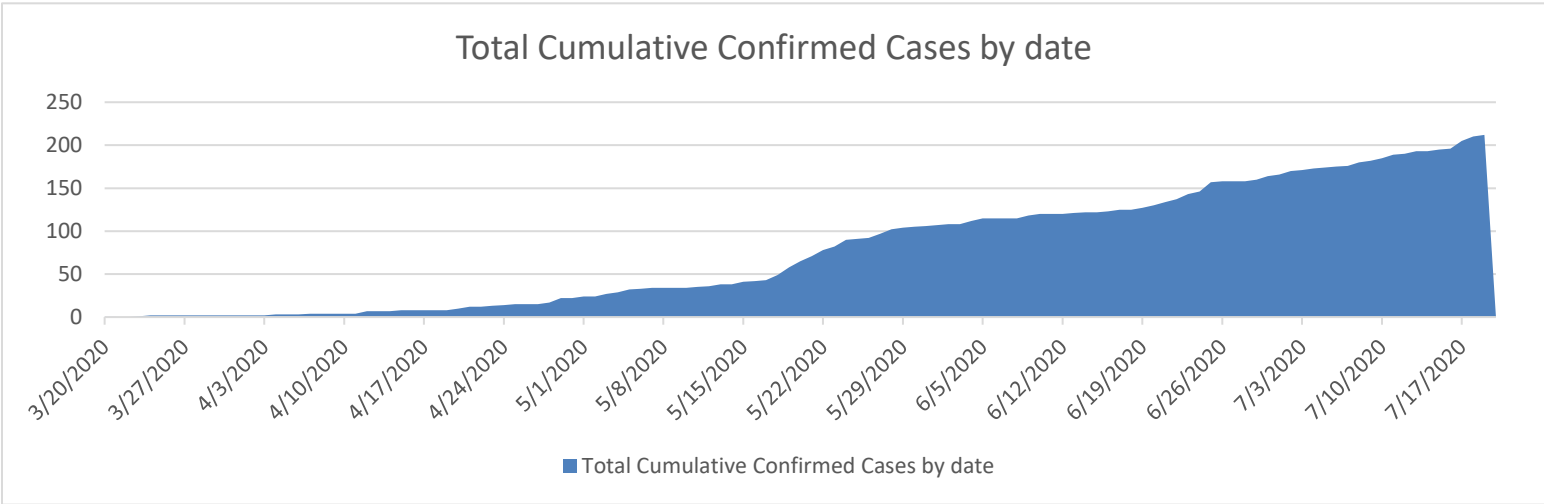
03/23/2020 – 04/05/2020 3 Total Positive Lab Confirmed Cases
04/06/2020 – 04/19/2020 5 Total Positive Lab Confirmed Cases
04/20/2020 – 05/03/2020 19 Total Positive Lab Confirmed Cases
05/04/2020 – 05/17/2020 16 Total Positive Lab Confirmed Cases
05/18/2020 – 05/31/2020 63 Total Positive Lab Confirmed Cases
06/01/2020 – 06/14/2020 16 Total Positive Lab Confirmed Cases
06/15/2020 – 06/28/2020 35 Total Positive Lab Confirmed Cases
06/29/2020 – 07/12/2020 32 Total Positive Lab Confirmed Cases

Information about daily total positive lab confirmed cases can be found at https://www.michigan.gov/coronavirus and at https://www.dhd10.org/

Percentage of Positive Lab Tests

The percentage of positive lab tests represents the daily total of positive lab confirmed cases divided by the total daily number of tests administered in Newaygo County. Percent positively can help identify if an increase in cases is simply the result of expanded testing or it is signals

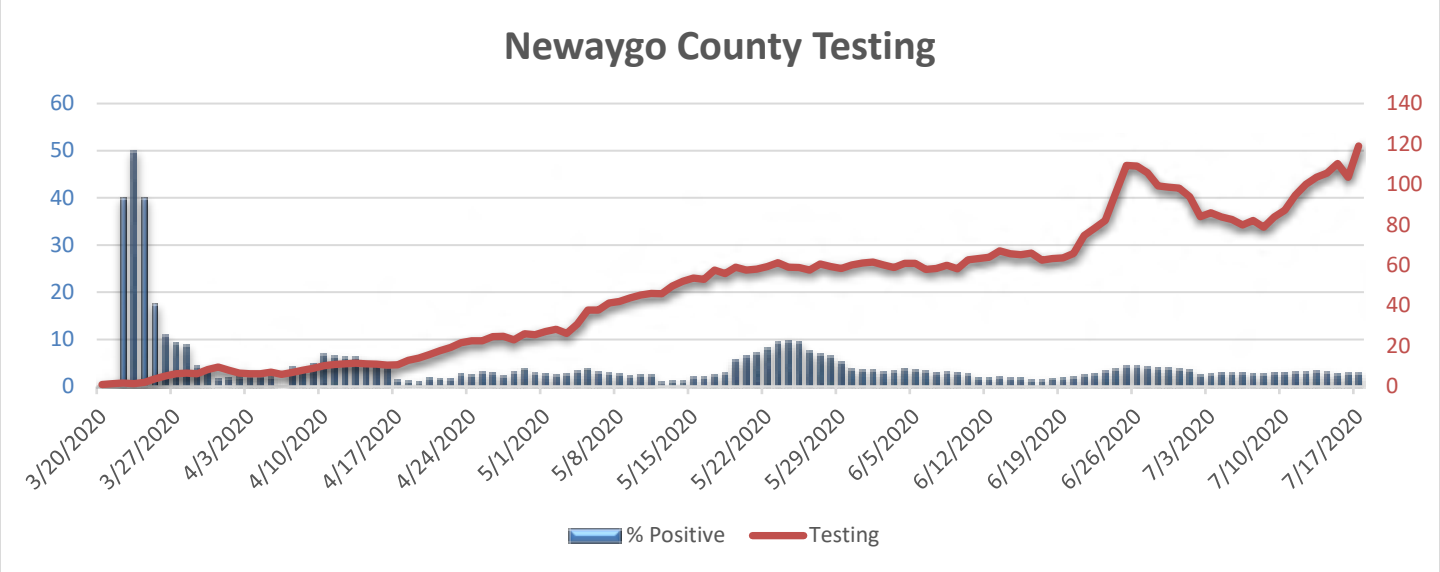




increased transmission of the virus. Specifically, if a rise in cases is the result of increased testing, the percent positive line could look flat or like it is decreasing over the time period when cases increased. If a rise in cases is the result of increased transmission, the line could appear to be increasing over the same period. The World Health Organization has set a recommendation for a 5% positivity rate.

During the onset of the pandemic, on March 20, 2020, the total number of COVID-19 tests administered in 1 day across the State of Michigan was 517 with a 20.6% of test results returning positive. As of July 17, 2020, the State of Michigan administered 22,900 COVID-19 tests with

3.3% of test results returning positive. In Newaygo County, 119 COVID-19 tests were administered with 2.8% of tests returning positive.



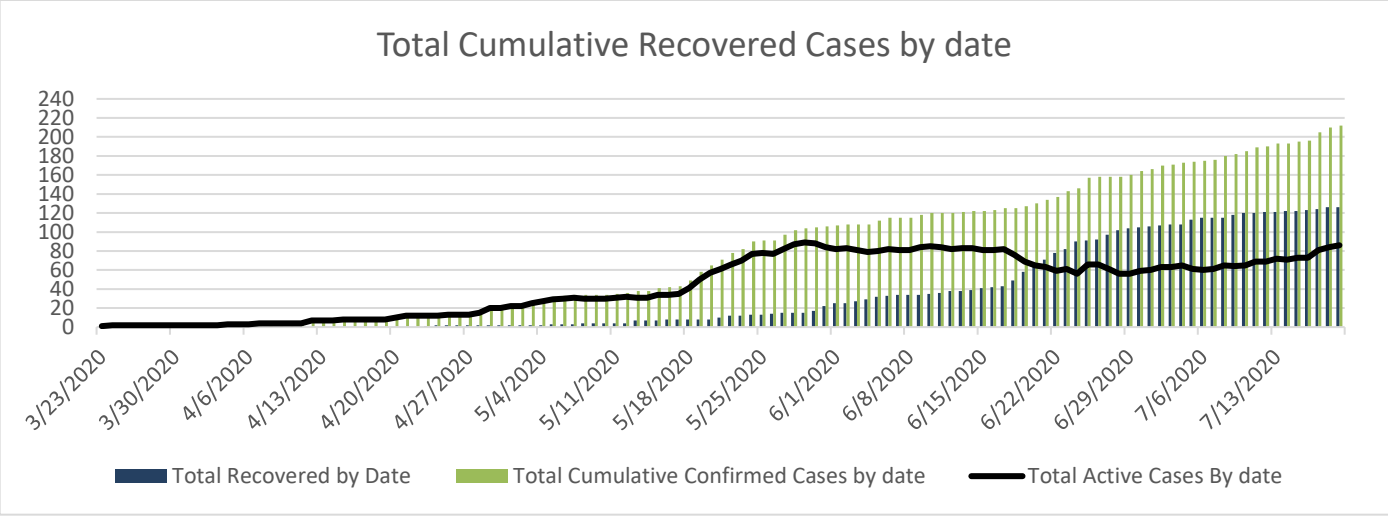
Total Number of Recovered Cases

The total number of recovered COVID-19 cases are based on the number of confirmed cases alive after 30 days from the confirmed date. By subtracting the total number of recovered cases from the total positive lab confirmed COVID-19 cases, we are able to determine the total number of active COVID-19 cases within Newaygo County. Active cases represent the total number of currently infected with COVID-19 and are capable of spreading the virus to others. Evaluating trends of active cases can help identify if community spread is increasing or decreasing.

As of 07/19/2020, Newaygo County had 86 cases. The highest number of active cases to date has been 89 cases on 05/29/2020.

Hospital System Capacity

Being a critical access hospital - a designation given to eligible rural hospitals by the Centers for Medicare and Medicaid Services for facilities designed to reduce the financial vulnerability of rural



hospitals and improve access to healthcare by keeping essential services in rural communities, Spectrum Health Gerber Memorial has 24 inpatient beds (Med/Surg), 11 Intensive Care Unit beds, and 6 ventilators. Currently, on a daily average, the hospital is treating 1 – 2 inpatients whom are COVID-19 positive. Locally, we have seen only 1 serious case to date – a 23 year old who was intubated and transferred to Grand Rapids.

Emerging Public Health Concerns - The Opioid Crisis, Vaping and Mental Health

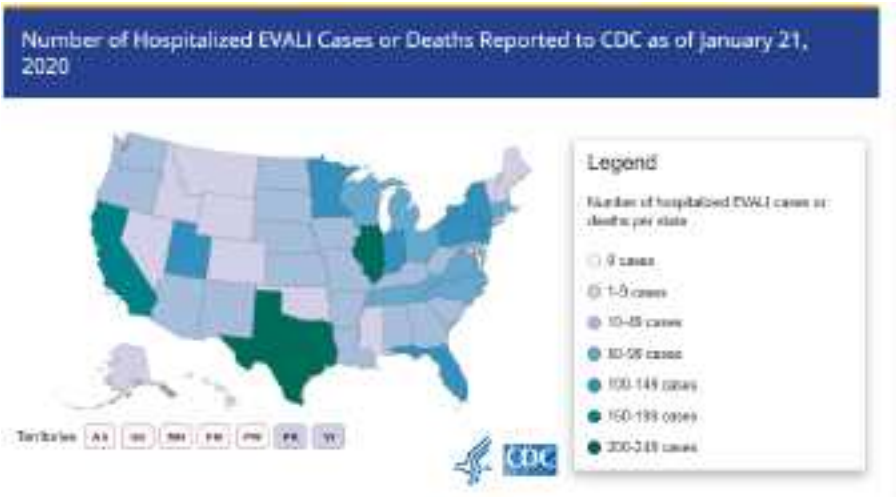
The Opioid Crisis 1990-2020

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. Also, 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

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.



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
- For more info: https://www.healthypeople.gov/2020/topics-objectives/topic/mental-health-and-mental-disorders

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

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.

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: 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: 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, Umar Farouk Abdulmutallab 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 Mr. Abdulmutallab, who was then subdued by the plane’s passengers and crew. This attack demonstrates the potential effectiveness of even small bombs when used

against vulnerable targets such as aircraft. It also demonstrates that international terrorism may be directed at targets in Michigan.

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: Grocery Store Attacks May 2016

A man in Ann Arbor was arrested after spraying a liquid mixture of animal poison, water and hand cleaner on self-serve food bars in grocery stores. Over two weeks’ time he targeted a number of grocery stores in the Ann Arbor Area as well as a dozen or more stores in Flint. He was arrested and charged with two counts of poisoning drink, medicine, or water supply. In spite of being found fit for trial he was not guilty by reason of insanity and involuntarily committed to a treatment facility.

Case: Stabbing attack at Flint Airport June 2017

A 51 year old Montreal man, a native of Tunisia, had a mission to kill and be killed. He researched “Gay Clubs” and “Baker College in Flint” and “Aeroport” on his laptop. He drove into the US via Champlain, New York and arrived in Flint five days later. He tried to buy a gun but failed. Instead he went to Bishop International Airport in Flint, spent some time wandering around outside of the security checkpoints, He then used a knife he had brought with him, to stab Lieutenant Jeff Neville with the plan to take the officer’s gun and start shooting. Lt Neville was injured but continued to fight and was aided by a maintenance employee and other officers who coincidentally were in a law enforcement meeting in a nearby conference room. The attacker only succeeded in injuring the officer who was hospitalized, had surgery and has since recovered. The suspect admitted to planning the attack due to his hatred of the United States. During his trial he told the judge he wants to commit another act of terrorism, only do it "better" by killing people. He regrets not killing Jeff Neville during the attack and not having a machine gun to kill more people. He was convicted of committing violence at an international airport, interfering with airport security and committing an act of terrorism transcending national boundaries and will spend the rest of his life in prison. https://www.abc12.com/content/news/Amor-Ftouhi-gets-prison-for-Bishop-International-Airport-stabbing-508751021.html

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.

Terrorism in Newaygo County
Although Newaygo 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, Newaygo 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, Newaygo County's largest schools of Fremont, Grant, Newaygo, White Cloud, and Hesperia 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.

Case: Gerber Products Mailroom Incident (2007)
Since Gerber Products was founded in the early 1920's, it has become Newaygo County's largest employer with close to 1,500 employees between the administrative building, the plant, bank, and insurance company. Gerber offers about 300 food products for babies, toddlers and infants as well as a baby care line, wellness products and life insurance. Gerber is active in more than 50 countries. In 2006, Gerber had un-audited net sales of USD $1.6 billion and operating income of USD $307 million. The Gerber Plant in Fremont supplies product throughout the United States and Canada.

In 1994, Gerber merged with Sandoz Laboratories. In 1996, Sandoz merged with CIBA-Geigy to form Novartis, one of the largest pharmaceutical companies in the world. When Novartis merged Gerber in 1996 it moved Gerber's corporate office to Parsippany, New Jersey. Since 1994 when Gerber Products merged with Sandoz Laboratories, big corporations have controlled a majority of all employment decisions from a remote location for the Fremont facility causing tension amongst local employees unsure if there would be layoffs or other changes in job status locally.

On April 12, 2007 Novartis announced that it would sell Gerber to Nestle, the world's largest food and drink company for $5.5 billion, giving Nestle Corporation the largest share of the global baby food market. Gerber Products is the largest employer in Newaygo County and it dominates the United States baby food market with a 70 percent share according to Morgan Stanley.

The same day as the sale to Nestle, an employee opening mail reported having a reaction, burning eyes and skin and a scratchy throat, to an unknown powdery substance contained in one envelope with a threatening note and no return address. Based on the conditions surrounding the threat, the Regional Response Teams from Muskegon and Grand Rapids who are specially trained to deal with Chemical, Biological, Radiological, Nuclear or energetic devices related to potential terrorist activities, were activated along with the F.B.I. to respond to the scene to assist first responders with the Incident. 12-15 employees exposed to the unknown substance, later identified by the Michigan State Police Crime Lab in July as Capsaicin, which is a brown powder that is used in pepper spray, were decontaminated and given courses of Ciprofloxacin and Doxycycline were given as a precautionary measure. After further investigation, it is believed the sale of Gerber Products to Nestle and the letter mailed from Boston containing the Capsaicin were not related. The investigation was turned over to the FBI.

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.

<u>Civil Disturbance in Michigan</u>

Case: Detroit Connor's Creek Labor Strike and uprising (April 18, 1894)

During the depression of the 1890s, an excavation project for a water main, just east of the city's boundary at the time, was manned by some 300 workers, who revolted at the conditions for wage reimbursement that the city Water Board had set (estimated at only about one-third of already established wage rates). The workers demanded a higher wage, and stayed on the site throughout that day and the next, to prevent any other workers from being brought in to replace them. On the third day, men arrived from the Wayne County Sheriff's Office, but only succeeded in annoying the workers. A project foreman was attacked by a worker, and the scene quickly exploded into violent chaos when gunshots followed the attack. The mob of workers with picks and shovels surged around the armed lawmen and the project's foremen. Although the violence lasted only a few minutes (resulting in the beating of the foremen and law enforcement officers), there were about 20 serious injuries, and a total of three persons ended up dead from gunshot wounds. By the end of the day, 21

persons had been arrested. Mass meetings took place on April 22, at which many thousands of ethnic workers gathered to press for policy changes.

Case: 1981 Jackson, Marquette, and Ionia Counties Prison Uprising

The second major prison uprising in Michigan occurred over the Memorial Day weekend in 1981 at the State Prison of Southern Michigan in Jackson, Marquette Branch Prison in Marquette, and the Michigan Reformatory in Ionia. The uprisings, which occurred on May 22 at Jackson and Ionia, and again on May 26 at Jackson and Marquette, were thought to be related. Although all three facilities were damaged, the State Prison of Southern Michigan incurred the worst damage.

The disturbances began when officials from the Michigan Corrections Organization at the State Prison of Southern Michigan attempted to take administrative control of the prison and lock down prisoners over the Memorial Day weekend. Rioting broke out at the facility, which then spread to the Michigan Reformatory in Ionia later in the day. The situation temporarily settled over the weekend, but rioting began again on May 26 at the State Prison of Southern Michigan, which then spread to Marquette Branch Prison. Both disturbances were quelled later in the evening, but only after major physical damage had been inflicted on the facilities.

The final damage figures for the two days of rioting were significant. The May 22 disturbances at the State Prison of Southern Michigan and the Michigan Reformatory resulted in 67 inmates and 27 staff members being injured, many requiring hospitalization. The May 26 disturbances saw an additional 44 staff members injured, along with 42 inmates. Fortunately, no lives were lost in either disturbance. The physical damage to the three facilities totaled $5 million, with another $4.1 million in riot-related costs incurred. Damages at the State Prison of Southern Michigan included fire and smoke damage to eight cell blocks, destruction of eight modular units, and damage to the academic vocational building, the inmate store, and the food service facility. The master key system also had to be replaced.

At the Michigan Reformatory, two cell blocks were damaged, in addition to the prison chapel, the food service building, and the school. The master key system also had to be replaced at this facility as well. At the Marquette Branch Prison, two vocational education buildings were destroyed, and the industries building, service building, and six cell blocks were damaged. It took many months for the damage at the three facilities to be totally repaired and services brought back to normal. In the end, legal and disciplinary actions were taken against 19 corrections personnel and numerous inmates for their roles in the two disturbances.

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: June 16-17, 2003 Benton Harbor Riot

The city of Benton Harbor erupted into riots on June 16-17, 2003, after a motorcyclist being chased by police crashed into an abandoned house and died. Two nights of violence brought hundreds of police to the area to calm the citizens who felt exasperated with community conditions and circumstances. Rioters

roamed a six to eight block area, setting fires and attacking passers-by, police officers, and firefighters. One person was shot in the shoulder and others were beaten and stabbed. In all, about 15 people were injured. It was estimated that about 23 homes were damaged or destroyed by fire. A total of about 10 people were arrested.

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 on 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, chokeslamming 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

May 30th two peaceful protests occurred, in Kalamazoo. On June 2nd, 25 downtown businesses were damaged, two patrol cars were burned, an officer was injured, and six people were arrested.

Civil Disturbance in Newaygo County

Although, Newaygo County is mostly rural in nature and 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 amount of employees to cause a labor dispute; 2) large county jail housing over 250 inmates both federal and local 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. Local vulnerability focuses on political and religious organizations which have strong ties in Newaygo County and have created dispute among residence in the past.

Case: Scott Allen Woodring July 7, 2003

According to Wickipedia Encyclopedia, the Michigan Militia was a loosely organized paramilitary organization founded by Norman Olson of Alanson, Michigan. The organization formed around 1994 in response to perceived encroachments by the Federal Government on the rights of citizens during the early Clinton Administration. The organization declined during the late 1990's and in the years after the Oklahoma City Bombing, the MMC slowly declined and the leadership fell into infighting. The organization was essentially defunct on a statewide basis by 2000 breaking up into smaller, more radical groups.

On July 7, 2003 the Michigan State Police found itself in a 14-hour standoff with a barricaded gunman, who had an affiliation to the Michigan Militia in Newaygo County. The standoff began the previous day when officers attempted to serve a solicitation of prostitution warrant on a male. The suspect indicated he had a gun and held officers at bay. The Michigan State Police Emergency Response Unit was called to assist at the scene and attempted an entry after deploying tear gas inside the home. Trooper Kevin M. Marshall and seven other members of the Emergency Support (ES) Team entered the home in an attempt to arrest the suspect. Upon entry, the ES Team members were met by heavy rifle fire grazing one officer and striking Trooper Kevin Marshall four times. One of the rounds penetrated his bullet proof vest and one of the others struck him just below the vest.

Although the house was surrounded by dozens of law enforcement officers, the suspect was able to escape undetected after the shooting. A cache of weapons and survival gear was found in the rubble of his house, which caught fire and burned during the raid. The suspect was shot and killed one week later after police received information on his whereabouts. The Michigan State Police Emergency Response Team arrived at the scene and located the suspect in a car. They ordered the man to stay inside the car but he exited with a semi-automatic rifle. He was shot and killed when he pointed the rifle at the officers. This standoff received national media attention and created a firestorm of dispute and dissension among Michigan Militia Members. **For additional information, please see the Officer Down Memorial Page for Trooper Kevin Michael Marshall at http://www.odmp.org/officer/16910-trooper-kevin-michael-marshall**

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 many 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 2018 Crime in the United States by State Data

Year	**Violent crime**	Murder and non-negligent manslaughter	Forcible rape	Robbery	Aggravated assault
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
Percent change 2012-2018	-6%	-11%	-16%	-45%	+9%

Violent Crimes in Newaygo County

The following information and statistics are from the Newaygo County Sheriff's Office Reporting Database from 2012 to 2018. This data only includes reports taken by the Newaygo County Sheriff's Office. It does not cover the cities of Fremont, Newaygo, Grant, and White Cloud which maintain their own police department.

Table 3: Crime in Newaygo County
Source: Newaygo County Sheriff's Office

Year	**Violent crime**	Murder and non-negligent manslaughter	Forcible rape	Robbery	Aggravated assault
2012	53	2	16	0	35
2013	66	1	14	3	48
2014	84	1	31	2	50
2015	50	0	20	0	30
2016	55	0	18	0	37
2017	81	1	40	2	38
2018	55	0	18	0	37
Percent Change 2012-2018	+4%	-100%	+13%	0%	+6%

Table 4: Crime in Michigan by City, City of Fremont
Source: United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2018 Crime in the United States by State Data

Year	**Violent crime**	Murder and non-negligent manslaughter	Forcible rape	Robbery	Aggravated assault
2011	NR				
2012	3	0	1	0	1
2013	5	0	2	1	2
2014	9	0	5	0	4
2015	12	0	4	0	8
2016	12	0	6	2	4
2017	7	0	2	0	5
2018	7	0	1	1	5
Percent Change 2012-2018	+133%	0%	0%	+100%	+400%

Table 5: Crime in Michigan by City, City of Newaygo
Source: United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2018 Crime in the United States by State Data

Year	**Violent crime**	Murder and non-negligent manslaughter	Forcible rape	Robbery	Aggravated assault
2011	19	2	1	0	16
2012	4	0	2	0	2
2013	18	0	11	0	7
2014	10	0	1	1	8
2015	4	0	2	0	2
2016	12	0	5	0	7
2017	6	0	5	0	1
2018	7	0	4	0	3
Percent Change 2012-2018	-63%	-100%	+300%	0%	-81%

Table 6: Crime in Michigan by City, City of White Cloud
Source: United States Department of Justice and Federal Bureau of Investigation Criminal Justice Information Services Division 2018 Crime in the United States by State Data

Year	**Violent crime**	Murder and nonnegligent manslaughter	Forcible rape	Robbery	Aggravated assault
2011	5	1	1	0	3
2012	8	0	2	0	6
2013	8	0	3	0	5
2014	9	0	3	0	6
2015	6	0	1	0	5
2016	8	0	3	0	5
2017	6	0	4	0	2
2018	7	0	2	0	5
Percent Change 2012-2018	+40%	-100%	+100%	0	+67%

The following are violent crimes of note in Newaygo County:

Case: July 1989 Shannon Siders Murder

Shannon Sider was 18 years old when she was murdered. A hunter found her mutilated, decomposing body in the Manistee National Forest near Newaygo three months after her death. The case was deemed an "unsolvable" cold case.

In 2011, a cold case team of investigators revisited the case resulting in two convictions in May of 2015. A Newaygo County jury convicted Matthew Wayne Jones, 46, of first-degree murder. His younger brother, 44-year-old Paul Michael Jones, was found guilty of second-degree murder. They were still teens when they killed Siders. On the night Siders disappeared, investigators say the brothers spent several hours driving around "partying'' with Siders and several other teens. The brothers eventually drove her to a secluded location and sought sexual favors from her. The pair became enraged when she declined their advances. They took turns raping and beating her and eventually beat her to death, court records show.

Case: August 16, 2012 B&E Armed Robbery

3 people wearing masks broke into a Newaygo County Home, assaulted the occupants and stole money and property. 1 Victim was treated at the hospital and released.

Case: May 28th 2013 B&E Armed Robbery

3 individuals in masks broke into the home and assaulted 2 occupants with a metal pipe and tied them up.

Case: September 2, 2014 Home Explosion during Search Warrant

On 9/2/2014, the Michigan State Police, Central Michigan Enforcement Team, and Newaygo County Emergency Response Team was preparing to serve a search warrant at a suspected methamphetamine cooking operation in Sheridan Township on 96th street between Dickinson and Maple Island Roads. Officers attempted to communicate with the suspect inside the home and ordered him to exit. While trying to make contact with the suspect, the home burst into flames following an explosion inside the home. The suspect was found conscious in the debris and taken to the hospital. No officers were injured during this incident.

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. Investigators say the murder happened after Blamer and Keenan met in North Muskegon so Blamer could install a stereo system in the other man's SUV. Detectives said Blamer claimed he and Keenan argued over money, at which point Keenan drew a gun. Blamer reportedly said the gun went off as the men struggled and Keenan was accidentally shot in the head. Authorities said Blamer added that the gun was fired repeatedly and Keenan was shot multiple times inside the SUV.

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.

Case: January 7, 2020 Multi State Crime Case

On 01/07/20, White Cloud Police Department Officers arrested 25 year old, Sam Nabil Al-Qadhi of Dearborn, MI. and 22 year old, Seth Reuben Goldgrab of Detroit, MI. Both are suspected of multi-county crime sprees where it's alleged they used fraudulent credit cards and stolen identities to purchase alcohol, large quantities of cigarettes, and other tobacco related items.

In November of 2019, White Cloud Police Department took a report of (at that time an unknown) suspect using what's been confirmed as stolen credit card information to purchase alcohol and large quantities of cigarettes. In that case they identified two separate victims from the State of Iowa that had their identities and credit card information stolen. They identified Sam Nabil Al-Qadhi as the suspect in the November case.

White Cloud Police Department's investigation shows that in the early morning hours of 01/07/20 the two suspects went to three gas station/convenience stores in Kent County and then traveled into Newaygo

County. They confirmed that the suspects used what's suspected to be stolen credit cards and identities to purchase large quantities of cigarettes in the Cities of Grant and Newaygo. A Wesco employee in White Cloud refused sales to the suspects and contacted White Cloud Police Department. The officers located the suspects and started an investigation.

Suspects Sam Nabil Al-Qadhi and Seth Reuben Goldgrab were lodged at the Newaygo County Jail. At the scene of the traffic stop we were assisted by the Newaygo County Sheriff's Office and the Michigan State Police. On 01/09/20, Sam Nabil Al-Qadhi was arraigned on multiple counts of the following charges: Computers – using to commit a crime, identity theft, and illegal sale/use/possession of financial transaction devices. Seth Reuben Goldgrab was arraigned on multiple counts of the following charges: Computers – using to commit a crime, identity theft, illegal sale/use/possession of financial transaction devices, and controlled substance possession Oxycodone, Dextroamphetamine, Hydrocodone.

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 that calmer periods regularly give way to more turbulent periods. As to the regularity of the sunspot cycle itself, although it has been found that the average amount of time between a solar minimum and a solar maximum is about 11 years, the actual length varies quite a bit within each cycle. 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. Currently, as of early 2019, sunspot cycle number 24 (since a starting point in 1755) is almost over, having started in a solar minimum reached in December 2008, proceeded through a solar maximum that was reached in

April 2014, and now reaching a new minimum again as the count of observed sunspots has dropped to nearly zero.

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 http://www.swpc.noaa.gov/NOAAscales/.

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.

Celestial Impacts in Michigan

NOTE: Although many of the events listed here occurred out of state, some of them were nevertheless 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, to give an indication of the magnitude of what is possible. One event describes 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 Newaygo County

Many of the events occurred out of state, but some of them were large enough to have direct impacts upon Michigan, due to the sheer magnitude of the impacts. Although there are no recorded impacts in Newaygo County, there is an indication of the magnitude of what is possible. One event describes a "close call" whose impact could have been very large if it had occurred one week earlier than it had. Thus, these events help to indicate the range of threat posed by the hazard.

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.

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 time-frame 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 an ancient large 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 dimeter 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, the vast majority 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 results 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 x 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. 312 Natural Hazards – Geological (Meteorites and Other Impacting Objects)

- 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)

Impacting Objects in Newaygo County

Many of the events occurred out of state, but some of them were large enough to have direct impacts upon Michigan, due to the sheer magnitude of the impacts. Although there are no recorded impacts in Newaygo County, there is an indication of the magnitude of what is possible. One event describes a "close call" whose impact could have been very large if it had occurred one week earlier than it had. Thus, these events help to indicate the range of threat posed by the hazard.

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 gypsy moth and emerald ash borer to crabgrass, dandelions, and German cockroaches, annually costing well over a billion dollars to control. Some even pose human health risks. Others, like the zebra mussel, threaten widespread disruption of ecosystems and the displacement or loss of native plants and animals.

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 properly and rapidly dispose of many animal carcasses).

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 Gypsy 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.

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

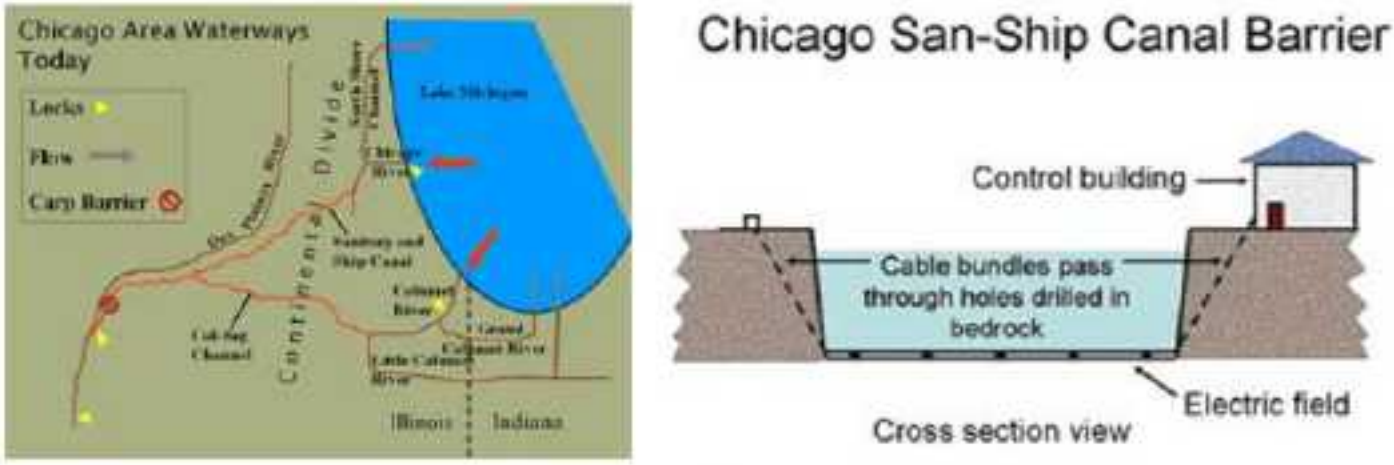
Asian Carp (Ctenopharyngodon Idella Grass Carp, Hypophthalmichthys nobilis Bighead Carp, Mylopharyngodon piceus Black Carp, and Hypophthalmichthys molitrix Silver Carp)

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, malthouses, 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.

Gypsy 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 gypsy 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.

From left to right: Dutch Elm disease, emerald ash borer, gypsy moth, the plum pox virus

Sea Lamprey (Petromyzon marinus)

Hosts: Found in both fresh water and salt water 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.

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 – Gypsy 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 gypsy 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

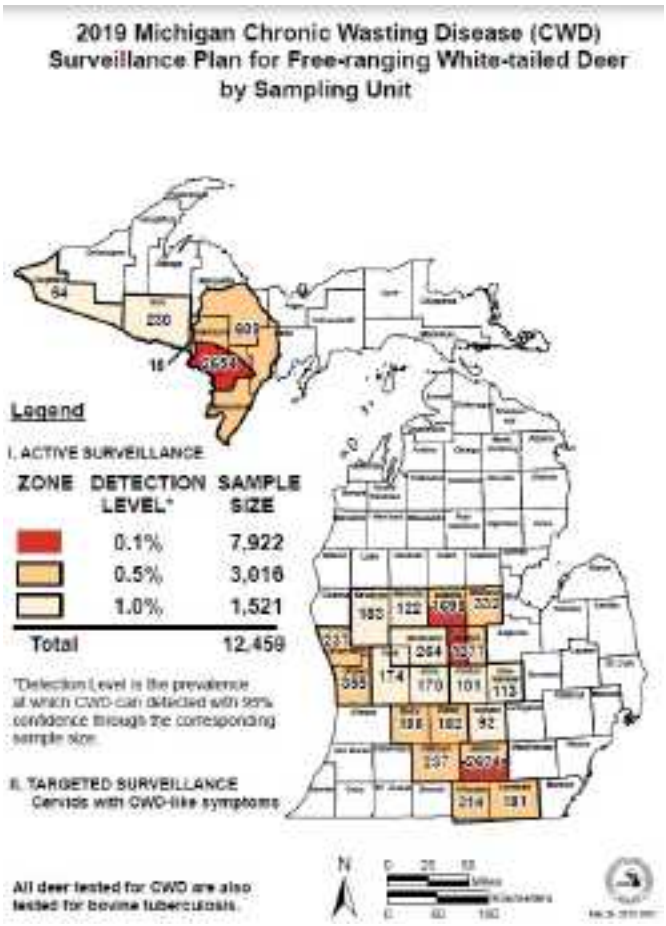
- Restrictions on the import and transport of species carriers.
- Adjustments to hunting, fishing, and other policies and regulations related to wildlife populations.
- Use of barriers to prevent invasive species travel.

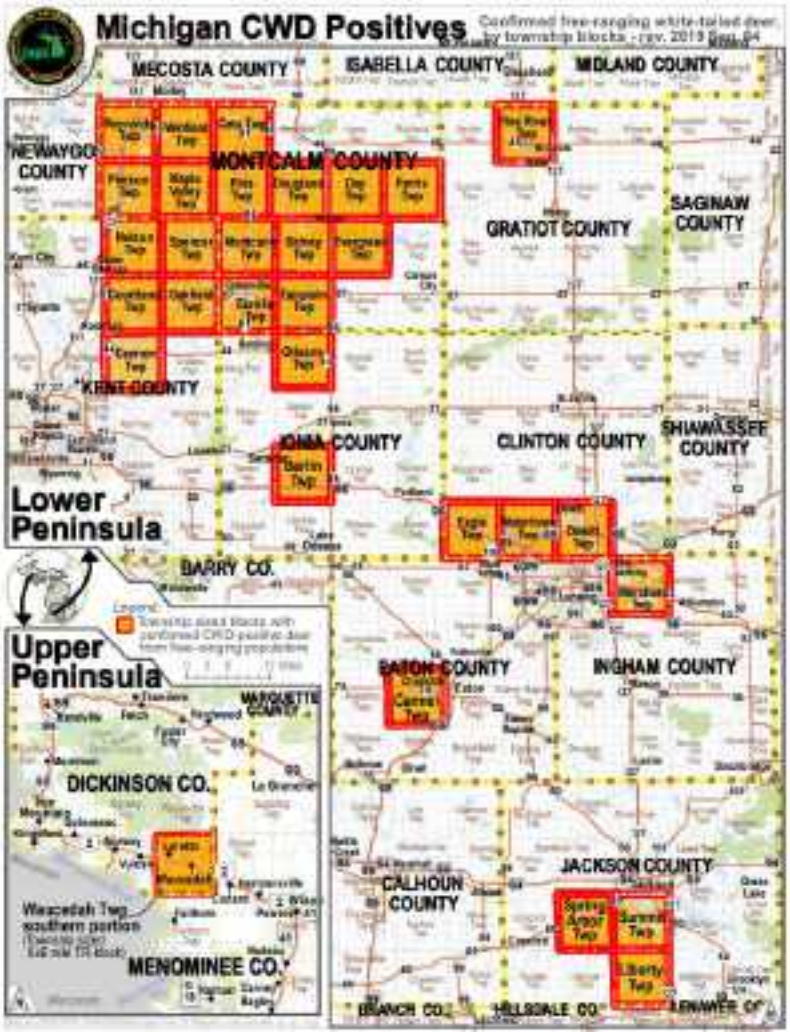
- Use of competing species or other population control techniques.

Newaygo County Invasive Species Hazards

Case: Chronic Wasting Disease 2020

In 2018, the Michigan Department of Natural Resources tested 3,527 free ranged deer in Newaygo County and in 2019 the Michigan Department of Natural Resources tested 1,961 free ranged deer in Newaygo County. 0 deer tested positive for CWD either year.





On January 14, 2020, the Michigan Department of Agriculture and Rural and Development (MDARD) confirmed chronic wasting disease (CWD) in three white-tailed deer from a Newaygo County deer far. All three deer were four-and-a-half years old. The samples were submitted for routine testing as part of the state's CWD surveillance program for farmed deer.

To date, CWD has not been detected in free-ranging deer in Newaygo County. As part of MDARD's disease response, an investigation will be conducted to rule out exposure of any other farmed deer.

Since 2008, CWD has been detected in four additional privately-owned cervid facilities from Kent, Mecosta, and Montcalm Counties. The deer farm in Newaygo County is the fifth Michigan farm in which CWD has been detected.

CWD is a fatal neurological disease that affects white-tailed deer, mule deer, elk, and moose. CWD can be transmitted directly from one animal to another, as well as indirectly through the environment. Infected animals may display abnormal behavior, progressive weight loss and physical debilitation. To date, there have been no reported cases of CWD infection in humans. However, as a precaution, the U.S. Centers for Disease Control and the World Health Organization recommend that infected animals not be consumed as food by either humans or domestic animals.

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 Newaygo County Emergency Services.

Hazard Classification

Local planning considerations have resulted in Newaygo 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 Newaygo 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, Newaygo 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 Newaygo County's Hazard Classes to the Michigan Hazard Analysis 2019 Document.

Newaygo County Hazard Analysis	Michigan Hazard Analysis	
Natural Hazards: Weather Hazards		
Thunderstorm	• Thunderstorm • Lightning	• Hail
Tornados	• Tornadoes	• Severe Winds
Severe Winter Weather	• Snowstorms • Extreme Cold	• Ice and Sleet Storms •
Natural Hazards: Hydrologic Hazards		
Flooding	• Riverine Flooding • Great Lakes Shoreline	• Urban Flooding • Dam and Levee Failures
Drought	• Drought	• Extreme Heat

Newaygo County Hazard Analysis	Michigan Hazard Analysis	
Natural Hazards: Ecological Hazards		
Wildfires	• Wildfires	
Invasive Species	• Invasive Species (aquatic and terrestrial)	
Natural Hazards: Geologic Hazards		
Geologic Hazards	• Impacting Object	• Space Weather
Technological Hazards: Industrial Hazards		
Fires	• Structural Fires	• Industrial Fires
Hazardous Materials	• Fixed Site (Industrial Accidents) • Transportation • Oil and Natural Gas Well Accidents	• Nuclear Power Plant Emergencies • Petroleum and Natural Gas Pipeline Accidents
Technological Hazards: Infrastructure Problems		
Infrastructure Failure	• Infrastructure Failures	• Energy Emergencies
Transportation	• Major Transportation Accidents (air, rail, highway, marine)	
Human Related Hazards		
Public Health	• Public Health Emergencies	
Criminal Incidents	• Civil Disturbances • Cyber-attack	• Terrorism & similar activities • 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 Newaygo 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 Newaygo 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 Newaygo 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 Newaygo 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	4 pts	7 pts	10 pts
Low	**Medium**	**High**	**Excessive**
<1 event / yr	**1 event / yr**	**2-3 events / yr**	**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	4 pts	7 pts	10 pts
Single Site	**Multiple Sites**	**Small Area**	**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 0% Chance	**Some Possibility <50% Chance**	**Good Possibility 50% - 75% Chance**	**High Possibility >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 sae. 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

Affected Area	
Large Area	10 pts
Small Area	7 pts
Multiple Sites	4 pts
Single Site	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

Casualty Impact	
High Impact	10 pts
Medium Impact	7 pts
Low Impact	4 pts
No Impact	1 pt

Economic Effects	
Significant Effects	10 pts
Medium Effects	7 pts
Low Effects	4 pts
Minimal Effects	1 pt

Duration	
Long Duration	10 pts
Medium Duration	7 pts
Short Duration	4 pts
Minimal Duration	1 pt

Seasonal Pattern	
Year Round Occurrences	10 pts
Three Season Occurrences	7 pts
Two Season Occurrences	4 pts
One Season Occurrence	1 pt

Predictability	
Unpredictable	10 pts
Somewhat Predictable	7 pts
Predictable	4 pts
Highly Predictable	1 pt

Collateral Damage	
High Possibility	10 pts
Good Possibility	7 pts
Some Possibility	4 pts
No Possibility	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 Newaygo County hazards evaluation conducted for the 2020 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 Newaygo, Michigan

Evaluation Criteria	**Infrastructure Failure**	**Flooding / Dam Failure**	**Wildfires**	**Thunderstorm**	**Criminal**	**Public Health**
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**
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**
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**
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**
Economic 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**
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**
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**
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**
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**
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**
Hazard Score	**8.65**	**8.20**	**8.20**	**8.05**	**8.05**	**7.75**
Rank	**1**	**2**	**3**	**4**	**5**	**6**

Evaluation Criteria	**Severe Winter Weather**	**Fires**	**Hazardous Materials**	**Transport**	**Geologic Hazards**	**Tornado**	**Drought**
Historical Occurrence	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 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	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**	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**
Economic Effects	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**	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	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	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	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	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	**7.45**	**6.70**	**6.55**	**6.25**	**6.25**	**5.65**	**5.65**
Rank	**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. In 2014, Flooding and Dam Failure replaced Infrastructure Failure as the #1 hazard in Newaygo County due to increased flooding occurrences. During this hazard evaluation, Infrastructure Failures returned to the #1 hazard due to the increased failures across multiple sectors as a result of aging infrastructure. Other significant changes also

include the promotion of Criminal #5 (previously #8) and Public Health #6 (previously #11) and the demotion of Tornados #12 (previously #5).

2020 Rank	Hazard	2014 Rank	2008 Rank	Change
1	Infrastructure Failure	2	1	↑1
2	Flooding / Dam Failure	1	2	↓1
3	Wildfires	3	6	-
4	Thunderstorms	4	3	-
5	Criminal	8	11	↑3
6	Public Health	11	10	↑5
7	Severe Winter Weather	6	7	↓1
8	Fires	7	8	↓1
9	Hazardous Materials	9	4	-
10	Transport	9	9	-
11	Geologic Hazards	-	-	-
12	Tornado	5	4	↓7
13	Drought	12	12	↓1

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 Newaygo County in the inaugural edition of the Newaygo County Hazard Management Plan (approved by FEMA in 2008). They were based on input from county officials, local media, emergency management officials, fire and police officials, local planning and zoning officials, elected officials, and critical facility managers as well as from LEPT members.

For the 2020 updated edition of this plan, the inherited goals and objectives were reviewed by the Newaygo County Hazard Mitigation Advisory Team. 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 – Protect public health and safety.

Objective 1.1 Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology.

Objective 1.2 Protect infrastructure and services.

Objective 1.3 Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.

Objective 1.4 Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

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 – Promote growth in a sustainable, hazard-free manner.

Objective 3.1 Incorporate hazard provisions in building code standards, ordinances, and procedures.

Objective 3.2 Incorporate hazard mitigation into land use and capital improvement planning and development activities.

Objective 3.3 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 3.4 Research, recommend, adopt and enforce other plans and ordinances that protect natural resources so that they can, in turn, provide hazard protection.

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

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

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

Updates conducted on this section in 2020 included review and revision of mitigation alternative descriptions, including how alternatives are being utilized within Newaygo 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 Newaygo 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.

Newaygo County currently enforces the 2015 Michigan Residential, the 2015 Michigan Building code, the 2015 Michigan Rehab Code, along with the 2015 Michigan Plumbing, Mechanical, and Energy codes, and the 2017 National Electrical 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. The county employs a building inspector, a plumbing inspector, a mechanical inspector, and an electrical inspector to enforce codes throughout the county. Refer to the following table for a list of communities covered by Newaygo County Inspection Services. The county Building Official and plan reviewer is also responsible for reviewing and approving all the FEMA and NFIP requests for substantial improvement costs for notices of determination.

Newaygo County Inspection Services

	Ashland T.	Barton T.	Beaver T.	Big Prairie T.	Bridgeton T.	Brooks T.	Croton T.	Dayton T.	Denver T.	Ensley T.	Everett T.	Garfield T.	Goodwell T.	Grant T.	Home T.	Lilley T.	Lincoln T.	Merrill T.	Monroe T.	Norwich T.	Sheridan T.	Sherman T.	Troy T.	Wilcox T.	Fremont	Grant	Newaygo	White Cloud	Hesperia
Building, Mechanical, Electrical & Plumbing	x		x	X	x	x	x		x				x	x	x			x	x	x			x	x		x			x
Mechanical & Plumbing		x								x																			
Not Serviced								x			x	x				x	x				x	x			x		x	x	

Services provided as of July 23, 2020 - Source: Newaygo County Building Inspector's Office

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

uniformity of application and implementation of rules governing the construction, use, and occupancy of buildings and structures.

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

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

The ISO administers the Building Code Effectiveness Grading Schedule (BCEGS), a program designed to foster better building code enforcement and thereby reduce natural hazard damage. Local building departments are "graded" on their building codes and how those codes are enforced, with special emphasis on mitigation of losses from natural hazards. Communities with good codes and code enforcement programs in place will receive a better grade than those communities that don't, and property owners in the higher-graded communities will be rewarded with homeowners' insurance premium credits. ISO began implementing the program in states with high exposure to wind (hurricane) hazards, then moved to states with high seismic exposure, and then continued through the rest of the country.

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 2010-2012 American Community Survey 3-year Estimates, about 21% of all housing units in Newaygo County are mobile homes. This is down from the 23.8% reported by the 2000 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 Newaygo County Master Plan (2010) provides county and local decision makers with common guidelines for future development. Although the Master Plan promotes land use and development policy and proposes land use arrangements, it has no regulatory power. It must therefore be implemented by county and local decisions, public facility and infrastructure improvements, and the actions of private property owners. All local governments in Newaygo County have adopted master plans, with exception of Goodwell, Lincoln, and Troy townships.

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.

Newaygo 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. Newaygo 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.

The White River is the lone Newaygo County river currently included in the Michigan Natural Rivers Program. The county also has tributaries of another natural river, the Pere Marquette.

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

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

Resource Protection

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas as development occurs so that these areas can, in turn, provide hazard protection. For instance, watersheds, floodplains, and wetlands can reduce run-off from rainwater and snow melt in pervious areas; reduce overland flood flow and store floodwaters; remove and filter excess nutrients, pollutants and sediments; absorb flood energy and reduce flood scour; and recharge groundwater. These natural benefits can be preserved though regulatory steps for protecting natural areas or natural functions. General regulatory programs are discussed in the section on Preventive Measures. This section covers resource protection programs and standards, including the following:

- Wetland protection;
- Erosion and sedimentation control;
- River restoration;
- Best management practices;
- Dumping regulations;
- Urban forestry; 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 Newaygo County within their borders, including: Muskegon River Watershed Assembly, Pere Marquette River Watershed 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.

The Brooks Lake Improvement Board is one example of an organization that promotes BMP’s in Newaygo County.

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 Newaygo 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.

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 Newaygo 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. Newaygo 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 Newaygo 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 Newaygo 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, Newaygo 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 though 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, Newaygo 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.

The Newaygo County civil defense warning system includes nine sirens which are listed in the table below. All sirens may be operated by the fire districts themselves and four of them can also be activated by Newaygo County Central Dispatch. These locations include: Ashland-Grant Fire District (from 7:00 am to 2:00 pm only), Croton Township Fire Department, and Lilley Township Fire Department.

Newaygo County Warning Sirens

Fremont DPW	805 Oak Street, Fremont	Tornado Only
Newaygo (North)	40 Centerline Road	Tornado Only
Newaygo (South)	355 Clay Street	Tornado Only
Grant Fire Department	62 W State Street, Grant	Fire and Tornado
Croton Township	6464 S Croton-Hardy Drive, Newaygo	Fire and Tornado
Big Prairie Fire Department	2815 S Elm Street	Fire and Tornado
Lilley Fire Department	10730 N Prospect, Bitely	Fire and Tornado
Hesperia Village Hall	33 E Michigan Street, Hesperia	Tornado Only

Newaygo 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, 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 Newaygo County Emergency Operations Plan to determine the appropriate warning tools to utilize. Regardless of the situation, the primary warning tool for Newaygo County is Nixle. Nixle connects public safety agencies to their community residents via text, web, and email to distribute out alert, advisories, and community messages. Alerts can be sent out to the entire area or a predefined contact list. Nixle 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. Newaygo County received its StormReady certification on November 3, 2016 and renewed the certification on November 2019. 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 heating and cooling shelters 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 also consider the possibility of "mutual aid" and utilize volunteer groups such as Radio Amateur Civil Emergency Services (RACES) and the Medical Reserve Corps (MRC) of Newaygo County. The mission of the MRC is to be the catalyst for trained medical and supportive service volunteers to serve Newaygo County when disasters or emergencies strike. The MRC, consisting of medical, health-

related and other professionals, is designed to supplement local emergency plans and resources already in place in Newaygo County.

Newaygo County utilizes and maintains an Emergency Operations Plan to for dealing with existing and potential emergency incidents within Newaygo County. In accordance with Michigan Public Act 390, this plan sets forth the emergency response organizational structure and management system under which Newaygo County will operate. It describes how different government and non-government entities will interact with each other to respond effectively during any disaster or emergency situation. In addition, this plan assigns various emergency objectives and responsibilities that may need to be performed when circumstances call for response and recovery measures outside the realm of normal operations. Newaygo County's Emergency Operations Plan meets planning guidance established by the Michigan State Police Emergency Management and Homeland Security Division. The introduction, program policy, and basic plan sections are pubic documents available online and the functional and hazard-specific annexes are secured documents containing checklists, attachments, forms, and guidance to mitigate, prevent, prepare for, respond to, and recover from incidents.

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. Newaygo County has a developed GIS program which has been integrated into Newaygo 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. Newaygo 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.

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 Newaygo. In addition, many of Newaygo County's top hazards are natural and weather-related and cannot be easily mitigated. Nothing can be done to eliminate severe winds or snow/ice/sleet storms or to alter their frequency, intensity or spatial distribution across the landscape. Mitigation actions associated with natural hazards must focus on limiting the impacts on the populations or structures that are being affected. For instance, power failures caused by severe winds and snow/sleet/ice storms can be reduced by several mitigation activities and the impacts on residents and properties from the power failures can be alleviated.

The potential actions in this section are presented because they may potentially help to save lives and protect communities and important agencies, rather than because they are considered pure "mitigation actions" distinct from other types of emergency management actions. However, in the final selection of strategies for any hazard mitigation plan, care should be taken to ensure the inclusion of at least some strategies that are clearly hazard mitigation. That is, a true hazard mitigation strategy is an effort to prevent hazard impacts, or to take advance, proactive steps toward the long-term reduction of the impacts of hazards on a community. If some of these take place during the response or recovery phases of a disaster, or happen to also increase an agency's preparedness, the existence of such overlap is primarily of academic interest so long as the community's safety is being served. On occasion, specific criteria for hazard mitigation must be met to satisfy the requirements of a given grant. Thus it is useful to be aware of both the distinctions and the overlap between hazard mitigation and other types of emergency management activities.

Identification of a possible mitigation measure does not necessarily mean that it can or even should be implemented. Implementation (and the desirability) of a mitigation measure is highly dependent on a number of factors – environmental, social, economic and political. Just because a measure may reduce or eliminate the effects of a hazard does not necessarily mean that it should be implemented. There may be extenuating factors or circumstances that could (or even should) preclude its implementation. Those decisions will be made in the local and state political arenas and in the land use / land development decision-making processes. Typically, mitigation measures will be implemented if they are able to balance environmental, social, economic and political factors, and are cost-effective. It does not make sense to implement a measure that will not be supported by state and/or local officials and the citizenry, or that cannot be economically justified. Although implementability cannot (and should not) always be the final litmus test for a potential mitigation measure, it certainly should be considered when identifying and developing measures. In general, those mitigation opportunities that could not pass this basic litmus test have been excluded from this plan.

The following potential actions are presented according to the county's hazard mitigation Goals and Objectives. 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.
Protect public health and safety.

Objective 1.1 Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology.

Potential Action Items:

1) Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination.

2) Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

3) Maintain a description of the public warning process and coordinate actions in a section of the Newaygo County Emergency Operations Plan (EOP).

4) 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.

5) 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.

6) 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.

7) 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 1.2 Protect infrastructure and services.

Potential Action Items:

8) Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading lines or running power to new developments.

9) 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.

10) 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.

11) Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

12) Establish safe and appropriate locations for temporary debris disposal sites.

13) Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.

14) 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 1.3 Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.

Potential Action Items:

15) Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.

16) 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.

17) 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.

18) Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

19) 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.

20) 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.

21) Coordinate with the Newaygo 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.

22) 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.

23) Meet the criteria to become a NWS-approved "Storm Ready" community.

Objective 1.4 Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

Potential Action Items:

24) Utilize volunteer communication networks by amateur radio operators (RACES) to facilitate communication during emergencies.

25) 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.

26) Coordinate with local volunteer organizations such as Newaygo County Community Services' Medical Reserve Corps and local amateur radio operator groups to supplement local emergency plans; aid emergency responders; and also to address the needs of elderly, disabled, homebound, and other special-needs groups during and after severe weather conditions.

27) Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

28) 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 2.
Protect existing and new properties.

Objective 2.1 Use the most cost-effective approaches to protect existing buildings and facilities from hazards.

Potential Action Items:

29) 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.

30) 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.

31) 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).

32) 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.

33) Employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

34) Create firebreaks, wherein brush and other fuel is cleared away, in wildland areas.

35) Maintain the Newaygo County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations.

Objective 2.2 Use the most cost-effective approaches to protect existing buildings and facilities from hazards.

Potential Action Items:

36) Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

37) 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.

38) 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.

39) 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.

40) 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:

41) Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).

42) 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.

43) 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.

44) 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:

45) 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.

46) 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.

47) Establish a voluntary floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.

48) Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.

49) 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.
Promote growth in a sustainable, hazard-free manner.

Objective 3.1 Incorporate hazard provisions in building code standards, ordinances, and procedures.

Potential Action Items:

50) 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.

51) 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.

52) 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.

53) Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.

54) Assess the need to strengthen anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway.

55) Assure proper location, installation, cleaning and maintenance of septic tanks, particularly in the floodplain/floodway and around lakes.

Objective 3.2 Incorporate hazard mitigation into land use and capital improvement planning and development activities.

Potential Action Items:

56) 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.

57) 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 3.3 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:

58) 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).

59) Enforce the existing Michigan Drain Code requirement for “set-back” from the drain channel, thereby assuring proper carrying capacity of the drain.

60) 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.

61) 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.

62) Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).

Objective 3.4 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:

63) Develop a Stormwater Management Plan to identify best management practices (BMP’s), and to assess the efficacy of local stormwater ordinances and rules.

64) 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.

65) 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.

66) 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 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:

67) 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.

68) 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.

69) 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.

70) 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.

71) 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.

72) 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.

73) 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.

74) 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.

75) Through coordination with the District Health Department, increase public awareness of the causes, symptoms and protective actions for disease outbreaks and other potential public health emergencies.

Objective 4.2 Encourage local communities, agencies, organizations and businesses to participate in the hazard mitigation process.

Potential Action Items:

76) Participate in programs such as NFIP, CRS, Firewise, Tree City USA, StormReady, etc. and respond to concerns regarding program requirements and obstacles to participation.

77) 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.

78) 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.

79) Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

80) 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.

81) 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:

82) Assist Newaygo County Emergency Services in its activities related to developing and continually revising Emergency Operations Plan (EOP) detailing coordinated response plans of emergency responders.

83) Strengthen the role of the LEPT in the land development process, with input into land use plans, comprehensive plans, and zoning ordinances.

84) 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.

85) 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 PRIORITZE 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

The 2007 edition of this hazard mitigation plan included 15 action items that were recommended for implementation and then assigned to the appropriate jurisdictions within Newaygo County. The 2015 edition of this hazard mitigation plan included 17 action items that were recommended for implementation and then assigned to the appropriate jurisdictions with Newaygo County. 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 2020 edition.

Review of Hazard Mitigation Progress

To identify any mitigation progress that had been made on the 2015 Action Agenda, discussions were held with county officials and the LEPT / Advisory Team during a scheduled meeting. Newaygo County Emergency Services, the LEPT / 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 Newaygo 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. 19 Potential Action Items have been completed.

Potential Action Item #1 Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination. Identified as a new item on the 2014 Action Agenda.

> Newaygo County Emergency Services in coordination with the local warning coordinator and the Local Emergency Planning Team evaluate the public warning system every 2 – 3 years or after an incident as a part of the After Action Report and Improvement Plan. Newaygo County utilizes a leveled warning system to allow officials to appropriately select and utilize available warning mechanisms to alert and notify targeted audiences of emergency conditions. The goal is to quickly make the information common knowledge and current. This system was evaluated again in February 2020. Newaygo County utilizes the following public warning systems:

NIXLE

Nixle connects public safety agencies to their community residents via text, web, and email to distribute out alert, advisories, and community messages. Qualifying agencies can use Nixle Connect Plus to author and send geographically targeted emergency messages via FEMA's Integrated Public Alert & Warning System (IPAWS). IPAWS encompasses multiple alert networks including the Wireless Emergency Alert (WEA) and the Emergency Alert System (EAS) to provide rapid, multi-channel distribution of your most critical messages.

TONE ALERT MONITORS (Public safety, vulnerable facilities, scanner monitors)
Activation of local public safety pagers (fire & ems), vulnerable facility alert monitors, and general public radio scanners by 9-1-1 or EOC notifies public safety and monitoring audience with audible tone and voice message. Highly effective for public safety personnel, of limited effectiveness for vulnerable entities and public
WARNING SIRENS (Entire populations within audible range of City sirens)
Activation of existing warning sirens for concentrated populations Alerts via high volume wail for up to 1 mile radius. Provides an attention getting signal to 1 mile radius of the targeted audience
PERSONAL NOTIFICATIONS (Affected hazard area)
Door to door visits or vehicle public address system notifications to area homes and businesses by emergency responders Notifies high percentage of population within a defined area or vulnerable audience with direct message. Highly effective in absence of other alerting systems or situations needing personal contact
NOAA WEATHER RADIO (County and regional monitors and systems tied into NOAA alerts)
Activation of NOAA Weather radio monitors & associated systems alerts monitors with audible tone and subsequent voice announcement as well as through various other services (i.e. website, weather systems). Is the recognized standard for all-hazards warning nationwide and is tied into multiple local, state, and regional warning services
EMERGENCY ALERT SYSTEM and/or BROADCAST MEDIA (TV & Radio audience)
Allows the activation of all or selected local television, cable, and radio broadcasters for issuance of a transcripted emergency message to all viewing/listening audiences. Utilized to broadcast information to all viewing/listening media audiences which provides a quick and comprehensive message to a large audience.
WIRELESS EMERGENCY ALERT SYSTEM
National system which allows customers who own an enabled mobile device to receive geographically-targeted, text-like messages alerting them of imminent threats to safety in their area.
OTHER AUXILIARY SYSTEMS (Audience Specific)
Utilization of auxiliary systems including broadcast fax, E-mail, L.E.I.N., WebEOC, and MIHAN can provide specialized alert and notification to target specific audiences via a variety of message formats. See specific mechanism for details.

Potential Action Item #2 Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Newaygo County utilizes a three tiered warning system. Level I is targeted alerts, Level II is comprehensive alerts, and Level III are IPAWS alerts. The purpose is to quickly make the information common knowledge and current. Based on this system, no improvements have been deemed necessary at this time.

	LEVEL I - TARGETED	***LEVEL II - COMPREHENSIVE***	***LEVEL III - IPAWS***
Purpose	To alert and notify a local, defined location, or identified population of emergency events and/or hazardous situations	For rapid dissemination of alerts and public information to a variety of public warning systems to make the alert and information common knowledge.	For issuance of critical public alerts and warnings of severe urgency disseminated to all available warning systems and the widest range of audience.
Target Audience	• Response Agencies • Critical Officials • Reporting Authorities • Defined locations and or populations	• General public within Newaygo County and surrounding areas	• Mass population within Newaygo County and surrounding areas

Available Warning Systems	• Nixle Engage and call trees • Tone Alert Monitors • Sirens • Personal Notifications	• NOAA Weather Alert Radios • Nixle Engage • Facebook and Twitter rebroadcasts • TV, Radio, Print Media • 2-1-1	• Emergency Alert System • Wireless Emergency Alerts • NOAA Weather Alert Radios • Nixle Engage • TV, Radio, Print Media • Facebook and Twitter rebroadcasts
Warning Priority	Community Level or Advisory Level Messages	Advisory or Alert Level Messages	Highest Alert Level Message. Extreme urgency
Message Type	• Written messages through text, email, or phone • Audible alerts • Information can be generic or specific for a defined location and/or population	• Written message with be relayed to a variety of different systems for rebroadcast	• IPAWS message format required to enable common alerting protocols
Advantages	• Systems can reach a targeted audience • Systems are capable of delivering mass text messages and emails to a defined group containing specific information • Systems can be rapidly activated • At risk populations are familiar with these systems	• Rapid dissemination of alerts to a large audience • Systems are interconnected and will automatically rebroadcast information • Systems are monitored by Public Information Agencies which can continue to disseminate out the most accurate, and up to date information.	• High level warnings to alert the public about imminent, dangerous conditions • Activates all available warning systems, including non-local subscribers
Precautions	• Heavy reliance on cell phone and Internet infrastructure. • Systems are independent and must be activated separately • Personal notifications can be labor intensive	• Will reach a large audience regardless of location • If information is of Immediate and Severe urgency, an additional issuance of an IPAWS message via Nixle will be required. • Verbal challenge code is required	• Activates every available warning system and without isolation of systems • Less detailed, location specific information is communicated • Federal guidelines must be followed • Only authorized IPAWS users can send out a warning message • An IPAWS Password is required
Activation	• Local System users can activate the system • Tone Alert Monitors and Sirens can be activated through Central Dispatch	• System is activated through Grand Rapids NWS • See the Rapid Warning Protocol for additional info	• Newaygo County utilizes Nixle as its IPAWS aggregate. • Only Emergency Management staff are trained and authorized to send out an IPAWS message.
Notes:		Message needs to be verified	Requires IPAWS password

Potential Action Item #3 Maintain a description of the public warning process and coordinate actions in a section of the Newaygo County Emergency Operations Plan (EOP).

The purpose of the Newaygo County Emergency Operations Plan is to save lives, minimize damage, and enhance emergency response operations during any incident within Newaygo County. This plan sets forth the emergency response organizational structure and management system under which Newaygo County will operate. It describes how different government and non-government entities will interact with each other to respond effectively during any disaster or emergency situation. In addition, this plan assigns various emergency objectives and

responsibilities that may need to be performed when circumstances call for response and recovery measures outside the realm of normal operations.

The Newaygo County Emergency Operations Plan is organized into Functional Sections. These sections describe the actions required to respond to or recover from any emergency or crisis. One of these functional sections is Warning. This entire functional section is designed to direct the alert and notification of emergency events or hazardous situation to the public, response agencies, and critical officials by the utilization of warning systems. The plan is updated every 2 years and is scheduled to be re-authorized in January 2021.

Potential Action Item #4 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.

As a part of the FY 2008 Homeland Security Grant, over 100 Midland WR300 NOAA Weather Radios and 50 Midland HH-50 NOAA Weather Radios were purchased and distributed to Commission on Aging clients, Campgrounds, schools, daycares, and government buildings within Newaygo County. This project ran from October of 2012 through January 2020.

Potential Action Item #5 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.

Prior to 2011, the only stream gauging station on the Muskegon River in Newaygo County was located just below the Croton Dam USGS 04121970 MUSKEGON RIVER NEAR CROTON, MI. This stream gauge was originally located in Newaygo and was moved to its current location in 1994. This stream gauge is funded by Consumers Energy Hydro Generation Program.

In coordination with the US National Weather Service Hydrologist in Grand Rapids, Michigan, and the Michigan Department of Natural Resources, 4 manual staff gauges were placed on the Muskegon River at DNR river access sites located at High Rollaway (Thornapple Ave), Newaygo Bridge (Sarrell Street), Anderson Flats (Felch Ave), and Maple Island Bridge (Main Street). The purpose of these manual staff gauges was to provide better monitoring downstream from Croton of water levels. Although valuable for routine monitoring, these staff gauges proved difficult to access during flooding conditions and in some cases were overtopped by flood waters.

In 2016, Newaygo County received a Hazard Mitigation Grant to implement a new flood warning system for approximately 35 miles of the Muskegon River in Newaygo County utilizing the United States Geological Survey (USGS) Flood Inundation Mapper System. Through this implementation, two additional streamgages were added on the Muskegon River in 2017: USGS 04122001 MUSKEGON RIVER AT BRIDGE STREET AT NEWAYGO, MI and USGS 04122025 MUSKEGON RIVER AT BRIDGETON, MI. Purchase of these USGS stream gauges were made

possible by the Fremont Area Community Foundation. Annual operating and maintenance expenses were funded by Consumers Energy Foundation, USGS Collaborative Funding, and County of Newaygo from 2017 – 2020. Consumers Energy Hydro Generation Program are not committed to funding these USGS Stream gauges from 2020 – 2025.

The USGS Flood Inundation Mapping (FIM) Program helps communities protect lives and property by providing tools and information to help them understand their local flood risks and make cost-effective mitigation decisions. The USGS Flood Inundation Mapping Program has two main functions. First, the USGS partners with local communities to develop a flood inundation map library. This library contains a set of maps that shows where flooding may occur over a range of water levels in the community's local stream or river. This information can be utilized for preparedness, timely response, recovery, mitigation and planning, and environmental and ecological assessments.

The second function of the Flood Inundation Mapping program is to provide online access to flood inundation maps along with real-time streamflow data, flood forecasts, and potential loss estimates. Once a community's map library is complete, it is uploaded to the USGS FIM Mapper, an online public mapping application. The FIM Mapper allows users to explore the full set of inundation maps that shows where flooding would occur given a selected stream condition. Users can also access historical flood information and potential loss estimates based on the severity of the flood. The FIM Mapper helps communities visualize potential flooding scenarios, identify areas and resources that may be at risk, and enhance their local response effort during a flooding event.

Newaygo County's Flood Inundation Map Library is expected to be published in October of 2020.

Potential Action Item #6 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.

The District Health Department currently utilizes the Michigan Disease Surveillance System (MDSS), which is an online statewide database to assist with disease surveillance, outbreak management, syringe service programs (SSP), and disease trend reporting. This tool is currently assisting in Michigan's Response to the COVID-19 Outbreak. The Outbreak Management System tool within MDSS is assisting with case identification, contract tracing, and monitoring data. Data from this system can then be extracted by State and Local Health Departments to communicate the status of the situation to the general public as deemed necessary. IE: https://www.michigan.gov/coronavirus/ and https://www.dhd10.org/coronavirus/

Potential Action Item #12 Establish safe and appropriate locations for temporary debris disposal sites.

As a component of the Newaygo County Emergency Operations Plan, within the Public Works Functional Section, Attachment 7 outlines the Debris Management Plan for Newaygo County and identifies locations, resources, and requirements for removal of debris from private property and public property.

Potential Action Item #13 Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.

As a component of the Newaygo County Emergency Operations Plan, within the Public Works Functional Section, Attachment 2 identifies local public works resource capabilities to respond to widespread weather events within Newaygo County. In addition to local resources, Newaygo County Road Commission is a part of the West Michigan Public Works Mutual Aid agreement with over 10 counties. Finally, Newaygo County is a part of the MDOT Grand Region and can obtain additional state resources is needed to respond to widespread weather events.

Potential Action Item #22 - 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.

The following are completed projects under this action item:

Lilley Township: Houseman Lake Road Access Project, September 2011 ($9,340.00)
The purpose of this project was to create safer ingress and egress to 24 properties around Houseman Lake by creating more open roadways through the removal of hazardous trees and brush. Project was completed by funding obtained through the Michigan Department of Natural Resources.

Before

After

Brooks Township: Oak Road Fuels Reduction Project, September 2012 ($44,920.00)
June 2016 and September 2016 additional work was completed ($24,100.00)

The purpose of this project was to reduce hazardous fuels surrounding the area east and west of Oak Ave north of East Croton Drive in Brooks Township by physically removing Scotch pine around 14 properties. The project treated approximately 137 acres. An additional 16 acres was treated in June of 2016 that was unable to be completed during the initial project. In addition, all previously treated material was chipped and hauled off site. Funding was through the U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III.

Before

After

Big Prairie Township: Hardy Pines Fuels Reduction Project, September 2012 ($14,130)

The purpose of this project was to create a fuel break surrounding the Hardy Pines Subdivision on 4th Street in Big Prairie Township by physically removing Scotch pine surrounding the subdivision. The project treated approximately 20 acres surrounding 34 lots. Funding was through the U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III.

Before

After

Croton Township: Chestnut Ave Fuels Reduction Project, May 2014 ($98,300) and June 2016 ($22,000)

The purpose of this project was to create a fuel break and defendable spaces around homes near the Chestnut Ave area in Croton Township by physically removing Scotch pine and establishing an old fire lane. The initial project treated 20 parcels. In 2016, an additional 10 acres was treated in this project area. Funding was through the U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III and the FY2015 Cooperative Forestry Assistance Act of 1978 Grant Funding.

Before

After

Croton Township: Margaret Ave Fuels Reduction Project, May 2014 ($14,950)

The purpose of this project was to create a fuel break and defendable spaces around homes on S Margaret Ave in Croton Township by physically removing Scotch pine and establishing a fuel break. The project treated 7 parcels. Funding was through the U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III and the FY2015 Cooperative Forestry Assistance Act of 1978 Grant Funding.

Before

After

Brooks Township: Barberry Ave Fuels Reduction Project, June 2016 ($27,600)
March 2017 ($59,000)

The purpose of this project was to create a fuel break and defendable spaces around homes on Barberry Ave in Brooks Township by physically removing Scotch pine on approximately 30 acres. After the initial project, a second project was completed in 2017 treating 5 parcels and approximately 46 acres on the north east side of Barberry Ave. Funding was through the FY2015 Cooperative Forestry Assistance Act of 1978 Grant Funding.

Before

After

Before

After

Lilley Township: Pickerel Woods Association Fuels Reduction Project, September 2018 ($100,650) July 2020 ($48,000)

The purpose of this project was to reduce hazardous fuels by removing a large concentration of Jack Pine along 15 Mile Road and Pickeral Woods Trail and creating a safe ingress and egress by removing restricting obstacles within 5 feet of either side of Pickeral Woods Trail. The area treated was approximately 238 acres impacting 20 residents on a one lane roadway. After the initial project, a second project was completed in 2020 by treating 9 parcels and approximately 10 acres on Old Ferris L. Funding was through the FY2015 Cooperative Forestry Assistance Act of 1978 Grant Funding and the U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III.

Before

After

Potential Action Item #23 Meet the criteria to become a NWS-approved "Storm Ready" community.

The NWS established the "StormReady" program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. Newaygo County received its StormReady certification on November 3, 2016 and renewed the certification on November 2019. 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.

Potential Action Item #25 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.

As a part of the Newaygo County "StormReady" program and the Newaygo County Emergency Operations Plan Severe Weather Hazard Specific Annex, Newaygo County has a designated Skywarn Coordinator who communicates information from amateur radio operators to the US National Weather Service Office in Grand Rapids, Michigan, Newaygo County Central Dispatch, and the Newaygo County Emergency Services Department.

Potential Action Item #35 Maintain the Newaygo County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations. This item was identified on the 2014 Action Agenda.

A Community Wildfire Protection Plan is a planning and prioritization process that helps communities establish local priorities to protect property and critical infrastructure from the risk of wildfire. Community Wildfire Protection Plans can take a variety of forms, based on the needs of the community involved in their development. They may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection—or all of the above. The 2010 Edition of the Newaygo County Community Wildfire Protection Plan covered hazard mitigation and community preparedness. The 2017 Edition of the Newaygo County Community Wildfire Protection plan has been updated to now include wildfire response and structure protection.

The benefits of having a Community Wildfire Protection Plan include access to funding resources such as the National Fire Plan, which provides millions of dollars annually to help states and

communities with community fire planning, hazardous fuels reduction, and wildfire prevention across the nation. In addition, the United States Forest Service and the Bureau of Land Management may be able to expedite the implementation of fuel treatments identified in a Community Wildfire Protection Plan though alternative environmental compliance options offered under the Health Forests Restoration Act.

This plan is required to be updated every 5 years and is scheduled to be completed in 2022.

Potential Action Item #40 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.

Newaygo County's original VHF communications infrastructure for Newaygo County Central Dispatch was located at the Jail Tower located at 1035 E James Street, White Cloud, MI 49349 FCC Registration Number 1239150. This free standing lattice tower was erected in the 1970's and was 49 Meters (161 feet) tall. Control Stations located on this tower included VHF Law Main, Life EMS, Fire South, Pro Med, Fire North, Consumers Energy, Jail, School Emergency, and 5 MPSCS 800 MHz as well as one repeater, EMS TAC. This tower was dismantled in February of 2010.

In addition to this tower, Newaygo County also owned and maintained the Sports Park Tower located at 4684 S Evergreen Ave, Newaygo, MI 49337 FCC Registration Number 1212219. This tower is a 97.5 Meter (320 ft) Guyed Tower manufactured by Rohn Industries. Repeaters located at this tower included VHF Fire South, VHF Law Main, VHF LEIN, Life EMS, EMS MED, and Tele-Rad. This tower is still standing currently with no active repeaters.

In 2012, a structural tower analysis was conducted by Paul J. Ford Company Structural Engineers. The structural analysis of this tower was completed according to the recommendations of the "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", ANSI/TIA-222-G. This standard recommends that the tower be designed for a minimum 90 mph 3-second gust of wind (at 33 ft above grade) for Newaygo County. They also considered a reduced design wind gust of 40 mph with a simultaneous 0.75 inch solid radial ice accumulation. The guyed tower was analyzed as a three-dimensional space truss using finite element software. The final results of this analysis identified the tower did not meet the minimum code requirements and required reinforcing. It also identified the tower was overstressed by up to 47.1%.

Due to existing communications structures not meeting the structural standards, In 2015, as a part of a Public Safety Answering Point (PSAP) grant, Newaygo County Central Dispatch constructed a new communications tower located at 1018 E Newell Street, White Cloud MI 49349 FCC registration number 1293862. This lattice tower is 48.7 meters (132 Feet) tall and meets all grounding and structural standards. All control stations were moved from the Jail Radio room to the new Central Dispatch Radio Room. This tower supports the EMS Tac Repeater,

now designated First Responders, a microwave data connection linking Newaygo County 911 with Mason/Oceana County 911, the VFIRE 800MHz radio patch, Consumers Energy, Fire North, South, West and East, Life EMS and Schools Emergency base stations and 6 MPSCS 800 MHz base stations.

In 2017, all communications infrastructure was removed from the Sports Park Tower and relocated to a private tower owned by T&W Electronics in Grand Rapids, Michigan. This tower is located at Centerline Road in Newaygo, Michigan, 49337 FCC Registration Number 1060514. This guyed tower was constructed in December of 1990 and is 127.4 meters (418 Feet) tall. This tower meets all of the grounding and structural standards. In addition it meets the painting and lighting specifications in FCC paragraphs 1, 3, 12, and 21.

Potential Action Item #42 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. This item was identified on the 2014 Action Agenda.

Participating Communities	Number of Insurance Policies (2014)	Number of Insurance Policies (2019)	$ Amount of Insurance Coverage (2014)	$ Amount of Insurance Coverage (2019)	Number of Repetitive Losses (2014)	Number of Repetitive Losses (2019)
Ashland Twp	14	17	1,827,500	2,618,100	3	2
Bridgeton Twp	24	22	3,410,300	3,555,300	8	8
Brooks Township	33	27	5,750,100	5,230,600		1
Croton Township	22	6	4,371,900	1,820,000		0
Dayton Township		9		1,680,000		0
Ensley Township						0
Everett Township						0
City of Fremont	1	3	350,000	705,000		0
Garfield Twp	7	6	793,100	1,028,000	3	3
Village of Hesperia	3	2	327,700	288,800		0
Lilley Township						0
Lincoln Township	15	6	1,559,000	867,000		0
City of Newaygo	5	2	935,100	310,000		1
Sheridan Twp		2		365,000		0
Sherman Twp		1		350,000		0
City of White Cloud	2	3	387,000	552,000		0
Wilcox Township						0

*NFIP Data as of 06/30/2019

Potential Action Item #43 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.

Since 2011 Brooks Township has participated in the National Flood Insurance Program Community Rating System. At that time, they met the criteria for a CRS Class 8 rating. The floodplain management activities implemented by their community quality residents for a 10 percent discount in the premium cost of flood insurance for NFIP policies issued or renewed in Special Flood Hazard areas. This savings is a tangible result of the flood mitigation activities Brooks Township implements to protect lives and reduce property damage. Each year, the community must verify that it is continuing to perform the activities that are being credited by the CRS by submitting an annual recertification. In addition, a community can continue to improve its Class rating by undertaking new mitigation and floodplain management activities that earn even more points. Brooks Township continues to renew CRS rating, which currently remains at a Class 8.

Potential Action Item #44 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.

During threat and risk assessments or field damage assessments, Newaygo County Emergency Services actively communicates with property owners and public facility operators on various hazards which may impact their properties and suggestions on additional insurance riders they may want to consider adding to protect their property. Luckily, no critical facilities are located within the Muskegon River or White River Floodplains and all are located in an area of minimal risk. The only risk for these facilities is for urban flooding, wide-area flooding, or flooding as a result of dam failure.

Potential Action Item #76 Participate in programs such as NFIP, CRS, Firewise, Tree City USA, StormReady, etc. and respond to concerns regarding program requirements and obstacles to participation.

- 17 out of 29 municipal jurisdictions participate in the National Flood Insurance Program (NFIP).
- 1 jurisdiction participates in the Community Rating System (Brooks Township)
- 7 jurisdictions are identified as Wildland Urban Interface Communities and actively participate in Newaygo County's Wildfire Mitigation Program.
- Sixty-one percent of Newaygo County's 537 thousand acres of land is forested (MSU Extension 2006). Of this, 62% is in private ownership, almost all owned by small, non-industrial owners. Of the 38% in public ownership, the vast majority is part of the Manistee National Forest managed by the US Forest Service.
- Newaygo County received its StormReady certification on November 3, 2016 and renewed the certification on November 2019.

Potential Action Item #82 Assist Newaygo County Emergency Services in its activities related to developing and continually revising Emergency Operations Plan (EOP) detailing coordinated response plans of emergency responders.

The Newaygo County Local Emergency Planning Team was established in 2007 by the Newaygo County Board of Commissioners via Resolution 04-012-07 as the permanent Emergency Management advisory body serving the functions of the Homeland Security Local Planning Team (LPT), SARA Title III Hazardous Materials Local Emergency Planning Committee (LEPC), Citizen Corps Council, and Hazard Mitigation Planning Council to provide a forum for representatives of local government, private businesses, and public organizations to participate in community emergency planning and preparedness activities. This provides for a consistent approach to activities by an established team of officials involved in all aspects of emergency management.

The Local Emergency Planning Team (L.E.P.T.) is composed of community agency officials assigned key roles in the jurisdictions emergency plan and chaired by the Emergency Services Director, is a primary component of the jurisdiction's multi-disciplined, community approach to emergency management. This group meets regularly, as needed, and/or at the request of the CEO or Director to develop procedures for mitigation, preparedness, response and recovery from emergencies or disasters. At a minimum, the Local Emergency Planning Team meets bi-monthly to specifically review the EOP and ensure that it is current and operationally ready. The team also directs training and exercising (testing) of the plan.

Potential Action Item #85 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. This item was identified on the 2014 Action Agenda.

All of Newaygo County's shelter sites are maintained in the National Shelter System Website. This allows the American Red Cross to track shelter capabilities, facility resources, and facility use agreements across Newaygo County. A listing of these designated facilities, their capabilities, and emergency contact information is also maintained within the Newaygo County Emergency Operations Plan. Each site is categorized into a primary shelter location, secondary shelter location, or tertiary shelter location based on location, capacity, and facility resources available. Of the 20 pre-identified Red Cross Shelter sites within Newaygo County, only 4 have a generator.

Summary of In-Progress or On-Going Hazard Mitigation Projects

32 Potential Action Items are considered in-progress or on-going by the Newaygo County Emergency Services Department. These projects require active facilitation, incorporation, and coordination or are being continuously implemented by the communities within Newaygo County.

Potential Action Item #7 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.

As of 2017, Newaygo County Emergency Services has incorporated the NWS "Turn Around Don't Drown" message into all public information and warning messages as it relates to flooding. In addition, some areas have been identified for the potential to add roadside markers but have not been installed yet.

Potential Action Item #10 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 item was identified on the 2014 Action Agenda.

During the renovations and expansion of the Newaygo County Jail in 2009-2010, the existing generator located at the jail was relocated to the Newaygo County Administration Building in order to provide backup generation for all the information and technology infrastructure on the Newaygo County Campus. As a part of the renovations and expansions a new generator was placed at the Newaygo County Jail. With this addition, the only buildings on the Newaygo County campus which do not have access to a permanent generator are the Newaygo County Courthouse, Newaygo County DBH building where the Emergency Operations Center is located, and the Newaygo County Commission on Aging Building which is identified as a Red Cross Community Shelter Site.

Of the 20 pre-identified Red Cross Shelter sites within Newaygo County, only 4 have a generator.

Brooks Twp – Applied for "Risk Reduction" grant from Michigan Township Participating Plan (PAR Plan) in fall 2013, but did not receive the grant.

Potential Action Item #14 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. This item was identified on the 2014 Action Agenda.

Strong coordination and collaboration between the Newaygo County Road Commission, Newaygo County Drain Commission, local Townships, and cities ensure maintenance and prevention projects are incorporated into road improvement projects.

Potential Action Item #16 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.

A component of Newaygo County Board of Commissioners Resolution #01-005-15 Establishing Emergency Management and Homeland Security Policy and Organization for Newaygo County, the Newaygo County Emergency Services Department is charged with ensuring all emergency plans are maintained in accordance with current standard of the County Emergency Operations Plan. In addition, the Emergency Services Department is charged with maintaining and progressing capabilities to implement assigned emergency responsibilities as identified with the County Emergency Operations Plan.

Potential Action Item #17 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.

Newaygo County Emergency Services and the Newaygo County Equalization Department are responsible for the Damage Assessment Functional Section of the County's Emergency Operations Plan. As a part of this process, the two departments ensure adequate training for personnel responsible for implementing critical tasks, such as damage assessment. The Newaygo County Emergency Operations Plan Damage Assessment Functional Section outlines the required damage assessment processes as identified by the State of Michigan and FEMA. Training is held at least annually in this area. The last training was conducted on January 2020.

Potential Action Item #19 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. This item was identified on the 2014 Action Agenda.

Within the Newaygo County Emergency Operations Plan Fire Services Functional Section, Attachment 3 describes the fire services capabilities (including personnel, equipment, apparatus, and specialty resources) located locally within Newaygo County. All 9 departments serving Newaygo County actively participate in the Newaygo County Fire Chiefs Association and Firefighter Training Committee. The purpose of this group is to create and maintain relationships and cooperation between all emergency services fields within Newaygo County and to provide education and resource opportunities to its members to improve fire service and firefighting operations. Through this association in addition to local departmental budgets, Newaygo County is able to acquire and maintain and necessary capabilities for fire and rescue.

Potential Action Item #20 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. This item was identified on the 2014 Action Agenda.

In 2011, Newaygo County Emergency Services began coordinating with local campgrounds to develop campground emergency plans including designated storm shelters, notification methods, and evacuation routes. This program was expanded to vulnerable sites including schools, churches, and the Newaygo County fairgrounds and is encompassed in the County's Threat and Risk Assessment Review Team process.

Potential Action Item #24 Utilize volunteer communication networks by amateur radio operators (RACES) to facilitate communication during emergencies.

A component of Newaygo County Board of Commissioners Resolution #01-005-15 Establishing Emergency Management and Homeland Security Policy and Organization for Newaygo County, the Newaygo County Emergency Services Department is charged with ensuring the development, coordination, and maintenance of a self-sufficient Community Emergency Response Team (CERT) and Medical Reserve Corps (MRC) programs in Newaygo County. Through this volunteer program, interested team members are crossed trained as Amateur Radio Operators and encouraged to obtain the required training, competencies, and screening processes needed to become communications operations within the Emergency Operations Center.

Potential Action Item #26 Coordinate with local volunteer organizations such as Newaygo County Community Services' Medical Reserve Corps and local amateur radio operator groups to supplement local emergency plans; aid emergency responders; and also to address the needs of elderly, disabled, homebound, and other special-needs groups during and after severe weather conditions.

A component of Newaygo County Board of Commissioners Resolution #01-005-15 Establishing Emergency Management and Homeland Security Policy and Organization for Newaygo County, the Newaygo County Emergency Services Department is charged with ensuring the development, coordination, and maintenance of a self-sufficient Community Emergency Response Team (CERT) and Medical Reserve Corps (MRC) programs in Newaygo County. Under the direction of the Newaygo County Emergency Services Department, the Community Emergency Response Team (CERT) and Medical Reserve Corps (MRC) programs trains volunteer team members in basic response skills. Team members also help with non-emergency projects that help improve the safety of the community. All volunteers are respected members of the team and an integral part of the county's Emergency Management System. Newaygo County maintains an open roster for up to a 40 person team with an average of 32 participating volunteers.

Potential Action Item #27 Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

As a part of the Newaygo County "StormReady" program and the Newaygo County Emergency Operations Plan Severe Weather Hazard Specific Annex, Newaygo County has a designated

Skywarn Coordinator who communicates information from amateur radio operators to the US National Weather Service Office in Grand Rapids, Michigan, Newaygo County Central Dispatch, and the Newaygo County Emergency Services Department. In addition, the Skywarn Coordinator works with the US National Weather Service Office in Grand Rapids, Michigan to deliver Skywarn Training annually in order to train new weather spotters or refresh training for existing spotters. Many of the Newaygo County Community Emergency Response Team (CERT) and Medical Reserve Corps (MRC) volunteers participate in this training and are certified Skywarn spotters.

Potential Action Item #28 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.

The Muskegon River Clean-up Company, LLC, was scheduled hold their 9th annual Muskegon River Clean-up on August 1, 2020. This event was cancelled due to the COVID-19 outbreak. The event typically starts at the Bridgeton Township Launch Site on Warner Ave and cumulates at the Maple Island Launch Site on Main Street. This event usually draws between 300 and 500 people.

Over the past 8 years, 24,583 beverage containers, 60 to 70 tires, a few tons of green treated lumber, over 600 flip flops, and countless phones, sunglasses and lighters have been removed from the river. Some of the stranger items removed were 2 sewing machines, a bowling ball, a large electric motor, a 9.8hp outboard and a metal bed. Last year alone, the group removed 4,326 beverage containers, 1 chair, 1 milk can, 114 flip flops, 25 pairs of goggles and glasses, 18 lighters, 1 cell phone, 12 tires, 1 garbage can, miscellaneous animal bones, scrap iron and treated wood, along with general trash. The Muskegon River Clean-up Company, LLC recycles what items they can and that money is used to help fund the following year's event. They have cleaned this area for 8 years now and still continue to get a dump truck full of trash each year. This event is supported by the Bridgeton Township Board, West Michigan Wildlife Association, and the Muskegon Watershed Assembly.

In addition to this event, Newaygo County Board of Public Works obtains funding through private donors, corporate donations, funding from the County of Newaygo, in addition to grants through Michigan Department of Environmental Great Lakes, and Energy (EGLE) Household Hazardous Waste Program to hold an annual Household Hazardous Waste Clean-up. This one-day event takes place annually at the Newaygo County Road Commission in White Cloud. Household hazardous waste (HHW) includes products that we purchase and use every day in our homes that can harm us or the environment if they are not handled properly. This includes materials such as paint, used oil, antifreeze, batteries, pesticides, cleaners, sharps, old TV monitors, and tires are collected and disposed of properly.

In the past 24 years the Household Hazardous Waste Collection Day has processed over 325,000 pounds of household hazardous waste in Newaygo County. The cost of the cleanup event varies depending on the total weight of household hazardous waste collected, the type of items collected (tires are expensive to dispose of), and transportation to the location the waste

is being disposed of. In 2018 the cost of the event was $37,464.92 and in 2019 the cost of the event was $24,982.35.

Potential Action Item #33 Employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

Since 2011, Newaygo County has expended $462,990 in various sources of State and Federal Funds to conduct a dozen Wildfire Fuels Reduction Projects treating over 360 acres within Big Prairie Township, Croton Township, Brooks Township, and Lilley Township. In 2018, Newaygo County received the highest national recognition for the communities efforts in wildfire mitigation, The Wildfire Mitigation Awards are sponsored by the National Association of State Foresters, the International Association of Fire Chiefs, the National Fire Protection Association, and the USDA Forest Service.

Newaygo County will continue these fuels reduction projects into the future utilizing $119,576.00 of funds awarded to the community under the FY2019 Cooperative Forestry Assistance Grant and additional funds from U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III.

Potential Action Item #34 Create firebreaks, wherein brush and other fuel is cleared away, in wildland areas.

Since 2011, Newaygo County has expended $462,990 in various sources of State and Federal Funds to conduct a dozen Wildfire Fuels Reduction Projects treating over 360 acres within Big Prairie Township, Croton Township, Brooks Township, and Lilley Township. In 2018, Newaygo County received the highest national recognition for the communities efforts in wildfire mitigation, The Wildfire Mitigation Awards are sponsored by the National Association of State Foresters, the International Association of Fire Chiefs, the National Fire Protection Association, and the USDA Forest Service.

Newaygo County will continue these fuels reduction projects into the future utilizing $119,576.00 of funds awarded to the community under the FY2019 Cooperative Forestry Assistance Grant and additional funds from U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III.

Potential Action Item #36 Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

During threat and risk assessments or field damage assessments, Newaygo County Emergency Services actively communicates with property owners and public facility operators on various hazards which may impact their properties and suggestions on how to mitigate those hazards. The following is an example from a private structure along the Muskegon River in Ashland Township. The before photo was taken during a flooding event in April of 2011. This structure was substantially damaged in a flood in 2013. The after photo was taken during a flood in 2014 post mitigation.

Before

After

Potential Action Item #37 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.

The Newaygo County Building Department has adopted the 2015 Michigan Rehabilitation Code in addition to the 2015 Michigan Residential Code, the 2015 Michigan Building Code, the 2015 Michigan Mechanical Code, 2015 Michigan Plumbing Code, the 2015 Michigan Energy Code, and the 2017 National Electrical Code with Michigan amendments. Townships and cities serviced by Newaygo County are enforced under these codes.

Potential Action Item #38 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.

The Newaygo County Building Department has adopted the 2015 Michigan Rehabilitation Code in addition to the 2015 Michigan Residential Code, the 2015 Michigan Building Code, the 2015 Michigan Mechanical Code, 2015 Michigan Plumbing Code, the 2015 Michigan Energy Code, and the 2017 National Electrical Code with Michigan amendments. Townships and cities serviced by Newaygo County are enforced under these codes.

Potential Action Item #41 Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).

During threat and risk assessments or field damage assessments, Newaygo County Emergency Services actively communicates with property owners and public facility operators on various hazards which may impact their properties and suggestions on additional insurance riders they may want to consider adding to protect their property. As an example, in 2014 Dayton Township was not a participating in the National Flood Insurance Program. The township joined the program in 2015. As most property owners were unaware of their flooding risk, many did not sign up for coverage until after the 2019 March Flooding Event, when 9 property owners joined the program.

Potential Action Item #45 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. This item was identified on the 2014 Action Agenda.

Newaygo County has leveraged the following federal programs for mitigation projects:

- Post 1986 floods, Garfield Township participated in a mitigation grant to buyout 14 properties destroyed during the flood. These properties were located in a high risk flood area in Section 35 of Garfield Township and is known as Old Womens Bend and Anderson Flats.
- FY 2004, FY2011, FY 2018 Pre-Disaster Hazard Mitigation Programs to create, update, and maintain the Newaygo County Hazard Management Plan.
- FY 2015 Hazard Mitigation Grant Program for the Newaygo County Flood Warning Project.
- An application has been submitted under the FY 2019 Hazard Mitigation Grant Program for the Hindes Drain Project.

Potential Action Item #46 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.

Within Newaygo County the following programs are available to assist those with special needs with home repairs, weatherization, and heating costs to address hazards for persons and properties:

TrueNorth Community Services has a long history of serving the residents of Newaygo County, Michigan. Organized in 1949, the original intent was to provide the youth of Newaygo County with various educational opportunities. A fund was established to provide low-interest loans for needy and deserving young people to further their education, the re-payment of which was designated for future loans.

In 1952, the Children's Christmas Fund was established to provide young people with clothing and toys. The program received support from individuals and organizations throughout the county. In that same year, the program was expanded to include scholarships for deserving young talent in the field of music.

During 1971, a committee was formed to the purpose of guiding the transition of the Fremont Foundation toward the establishment of two, separate and autonomous, organizations: (a) a community foundation entitled The Fremont Community Foundation for the purpose of the receipt and investing of all funds to provide grants for the benefit of the community and (b) an operational non-profit public charity, entitled Newaygo County Community Services (NCCS), for the purpose of administering and implementing various programs and services for the benefit of

Newaygo County residents. The two organizations were officially recognized in February of 1972.

In recent years, state funders have been moving toward funding larger geographic regions. This trend has impacted Newaygo County Community Services' work to provide programs and services to Newaygo County. Today, such cross-collaborations, partnerships and alliances are more important than ever to secure funding to address complex public issues that spill over traditional geographic boundaries. To address the changing environment, in March 2011 Newaygo County Community Services became TrueNorth Community Services. Capitalizing on the combined energies of local people and strong collaborations with other community organizations, TrueNorth Community Services focuses on four core competencies: addressing rural poverty, ensuring our youth thrive, building vibrant rural communities, and providing innovative rural nonprofit leadership. Assistance programs run under TrueNorth include the Center for Non-profit housing, food and medical programs, heat and energy, housing assistance, and others.

In addition to these local programs,

Potential Action Item #49 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.

Since 2011, Newaygo County has expended $462,990 in various sources of State and Federal Funds to conduct a dozen Wildfire Fuels Reduction Projects treating over 360 acres within Big Prairie Township, Croton Township, Brooks Township, and Lilley Township. In 2018, Newaygo County received the highest national recognition for the communities efforts in wildfire mitigation, The Wildfire Mitigation Awards are sponsored by the National Association of State Foresters, the International Association of Fire Chiefs, the National Fire Protection Association, and the USDA Forest Service.

Newaygo County will continue these fuels reduction projects into the future utilizing $119,576.00 of funds awarded to the community under the FY2019 Cooperative Forestry Assistance Grant and additional funds from U.S. Department of Agriculture Forest Service Secure Rural Schools and Community Self Determination Act of 2000 Title III.

Potential Action Item #67 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. This item was identified on the 2014 Action Agenda.

Newaygo County Emergency Services utilizes FEMA Distribution Center for obtaining free publications and resources for Ready.gov materials and the National Flood Insurance Program. These materials are distributed at annual community events throughout the year including Family Health and Safety Day (May), Newaygo County Kids Day (June), National Baby Food Festival (July), Newaygo County Fair Kids Day (August), and White Cloud Kids Day (August). In

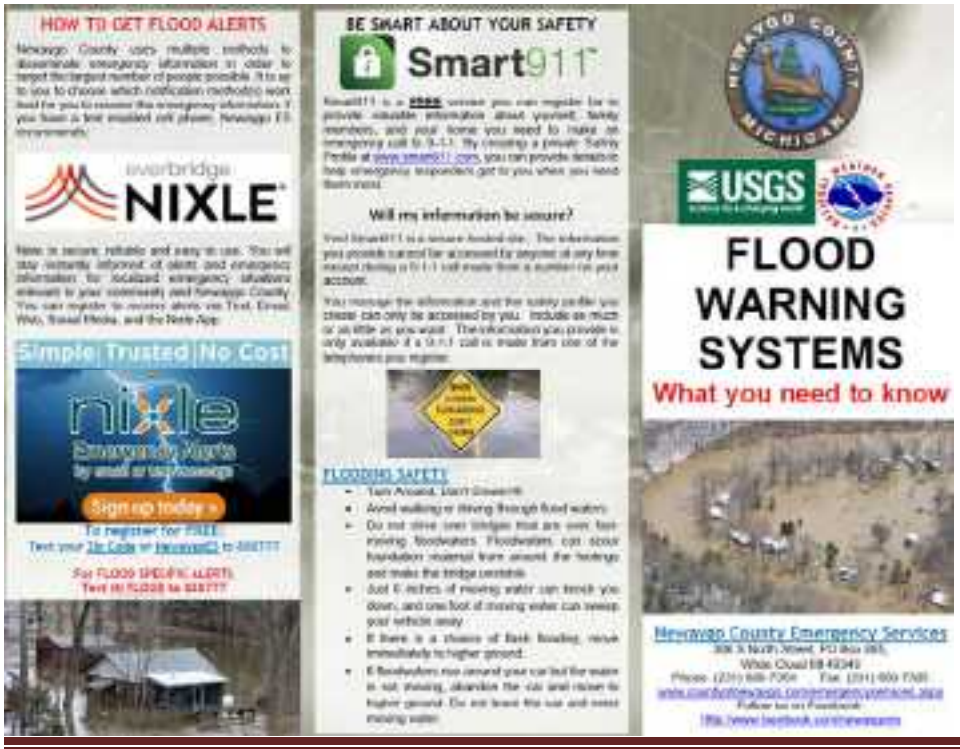
addition, these materials are distributed out to homeowners post flooding event during the damage assessment process or at the Multi Agency Resource Center (MARC).

Firewise materials and fire safety educational materials are obtained through the National Fire Protection Association. These materials are directly distributed to homeowners in Wildland Urban Interface Areas when wildfire mitigation projects are being developed. These materials are also available for distribution during annual community events.

Potential Action Item #68 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. This item was identified on the 2014 Action Agenda.

Since 2011, 5 community meetings have been held with floodplain residents on the Muskegon River. These Community Meetings have been staffed with representatives from various local, state, and federal agencies who have provided the most current information about flood monitoring and communications resources, flood warning, flood response, and mitigation resources. These meetings were held on May 23, 2011, March 8, 2012, April 25, 2013, March 20, 2014 and March 15, 2018.

In February 2018 Newaygo County was able to develop, print, and distribute a Flood Warning System Brochure. 2,500 copies were printed from funds allocated under the FY 2015 Hazard Mitigation Grant Newaygo County Flood Inundation Mapper Warning System Project. This information was distributed at the March 15, 2018 community meeting.



Newaygo County Emergency Services is working with the National Forest Service to develop a similar brochure for Wildfire prevention, mitigation, and warning tools available within Newaygo County.

Potential Action Item #69 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.

What are we doing to complete this action item?

Potential Action Item #70 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.

Newaygo County Emergency Services utilizes FEMA Distribution Center for obtaining free publications and resources for Ready.gov materials and the National Flood Insurance Program. These materials are distributed at annual community events throughout the year including Family Health and Safety Day (May), Newaygo County Kids Day (June), National Baby Food Festival (July), Newaygo County Fair Kids Day (August), and White Cloud Kids Day (August). In addition, these materials are distributed out to homeowners post flooding event during the damage assessment process or at the Multi Agency Resource Center (MARC).

Potential Action Item #71 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.

Firewise materials and fire safety educational materials are obtained through the National Fire Protection Association. These materials are directly distributed to homeowners in Wildland Urban Interface Areas when wildfire mitigation projects are being developed. These materials are also available for distribution during annual community events.

In addition, during Newaygo County Emergency Services coordinates with the local Department of Natural Resources Fire Services Officer and the US National Weather Service Grand Rapids on elevated wildfire danger days. Fire risk, burning restrictions, what to avoid, and safety tips are communicated out to the public via Nixle.

Potential Action Item #72 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.

Within the Newaygo County Emergency Operations Plan, a multitude of public and private response and recovery resources are identified in various sections of the functional annexes and hazard specific annexes. This resource information also includes contact information and resource ordering information. This information is continuously changing as capabilities and needs change. Resource information is updated on a routine basis both pre and post incident.

Potential Action Item #73 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.

Within Newaygo County, heating and cooling centers are managed locally by the individual municipality, facility, or church. These locations are not pre-designated and are identified based on need and capability during an incident. Due to limited resource capabilities and regionalization, the American Red Cross and Salvation Army do not sponsor or run these centers. If a municipality, facility, or church chooses to open a heating or cooling center and notifies Newaygo County Emergency Services, the information can be shared Countywide with the public utilizing Nixle.

For large scale incidents, the Newaygo County Emergency Operations Plan Human Services Functional Section outlines community sheltering considerations. These considerations are used to evaluate the need for determining if a Red Cross sponsored Community Emergency Shelter is needed. These considerations are as follows:

1. Is there an identified need?
    a. Is there a specific population impacted by the incident (ie: adult foster care home, assisted living facility, apartment complex, etc.)
    b. Is there an alternate location the public can go (ie: family, friends, neighbors, motel/hotel, campground, etc.)
2. Is there an evacuation?
    a. Is there a recommended evacuation area due to a hazard (ie: floodplain, wildfire, etc)
    b. Can the public safely shelter in their homes and sustain basic needs (ie: is the area safe or are structures damaged)
3. Is there a Critical Infrastructure Failure?
    a. Is there a utility failure that would cause secondary issues (loss of heat, electricity, sewer/septic or water)
    b. Are emergency ingress and egress available to the area
4. Is the incident Widespread impacting a large population?
    a. Is the incident impacting more than 5,000 people potentially creating a widespread need for sheltering (ie: multiple townships impacted, widespread power outages more than 5,000 customers, etc)

   b. Is the incident impacting less than 5,000 people generating a limited or unknown need for sheltering (ie: River flooding impacting one area, storm damage impacting one township, isolated power outages less than 5,000 customers, etc).
5. Is the duration of the incident greater than 24 hours?
   a. Is the duration of the incident (including initial recovery) expected to be lengthy (greater than 72 hours)
   b. Is the duration of the incident within the recommended timeframe the public is expected to be prepared to take care of themselves (under 72 hours)

Potential Action Item #75 Through coordination with the District Health Department, increase public awareness of the causes, symptoms and protective actions for disease outbreaks and other potential public health emergencies.

Utilizing Nixle, Newaygo County Emergency Services is able to distribute information from the District Health Department to the public within Newaygo County. This information is disseminated when a virus or disease, which has the capability for human to human spread or animal to human spread, is identified in or near Newaygo County. Information shared can range based on the needs to the incident and information the public should be aware and educated on.

An example of this coordination was the information sharing that took place in September 2019 for Eastern Equine Encephalitis (EEE). Information was shared via Nixle from the Michigan Department of Health and Human Services (MDHHS) on EEE to residents within Ensley Township, where a case was identified within a horse. This was the first case of EEE in a horse in Newaygo County in over 10 years and the second since 1942. Facts on EEE and the risk in humans was shared. In addition, when the Michigan Department of Health and Human Services (MDHHS) chose to conduct aerial spraying to combat the mosquito-borne disease, additional information was shared via Nixle and door-to-door informational flyers in the areas to be impacted.

Another example of this coordination is the ongoing initiatives that started in March 2020 for Coronavirus Disease COVID-19. To date 30 informational messages have been disseminated through Nixle including information on signs and symptoms, how to limit the spread, how to get tested, protective actions, resources and services available, current status of case counts in addition to a variety of other information. The goal of this dissemination is to create common understanding of the disease, its risks, and how to limit spread.

Potential Action Item #78 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 #79 Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds. This item was identified on the 2014 Action Agenda.

Newaygo County Emergency Services maintains an email distribution list of all municipal city managers, township clerks, and township supervisors. When Emergency Services is notified of available Hazard Mitigation Funding opportunities the email is shared with this distribution group. This notification typically takes place one or twice a year, depending on what funding opportunities become available.

Potential Action Item #80 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.

Consumers Energy has a Public Safety Outreach Program in addition to a Community Affairs Program. The Public Safety Outreach team works with public safety officials to ensure coordination and effective emergency response during utility related emergencies. This coordination can include providing an Incident Command System (ICS) trained liaison to the local Emergency Operations Center to align on priorities and ensure effective communications. The Community Affairs Team are company ambassadors, community advocates, and facilitators. They inform, listen, volunteer, coach, and facilitate. They act as liaisons for the company and the communities they operate in. Other utility providers have similar programs. Newaygo County Road Commission and local Public Works Departments are actively tied into these programs to help foster collaboration and coordination between operations.

Potential Action Item #84 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.

Newaygo County has a designated GIS coordinator within the Information and Technology Department. Since the late 90's, GIS has become an integral part of county functions. The Newaygo County GIS office started out with the conversion of paper parcel maps into applications that are used by a wide range of township, city, county, state, and federal agencies and departments. The County's GIS data is made available to the public, free of charge, in our online County Map Viewer.

Within Newaygo County Emergency Services, the GIS coordinator has created a variety of different map overlays to assist with pre-planning, response, and recovery operations. A separate, secured online database has been created for access to these overlays which include Damage Assessment Disaster Surveys data from the Newaygo County Vulnerable Populations guide such as adult foster care homes, apartments, camps and campgrounds, churches, day care centers, hotels, mobile home communities, schools, skilled nursing facilities, etc, in addition to specific hazard layers for the Muskegon River Flooding and Dam Failure.

Summary of Pending Hazard Mitigation Projects

Potential Action Item #15 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 #21 Coordinate with the Newaygo 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 #29 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.

Potential Action Item #30 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 #31 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). This item was identified on the 2014 Action Agenda.

Potential Action Item #32 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.

Summary of Incomplete or Unknown Status of Hazard Mitigation Projects

Potential Action Item #8 Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading lines or running power to new developments.

Potential Action Item #9 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 #11 Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

Potential Action Item #18 Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

Potential Action Item #39 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 #47 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 #48 Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.

Potential Action Item #50 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 treme temperatures.

Potential Action Item #51 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. This item was identified on the 2014 Action Agenda.

Potential Action Item #52 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 #53 Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.

Potential Action Item #54 Assess the need to strengthen anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway.

Potential Action Item #55 Assure proper location, installation, cleaning and maintenance of septic tanks, particularly in the floodplain/floodway and around lakes.

Potential Action Item #56 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. This item was identified on the 2014 Action Agenda.

Potential Action Item #57 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.

Potential Action Item #58 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). This item was identified on the 2014 Action Agenda.

Potential Action Item #59 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 #60 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.

Potential Action Item #61 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.

Potential Action Item #62 Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).

Potential Action Item #63 Develop a Stormwater Management Plan to identify best management practices (BMP's), and to assess the efficacy of local stormwater ordinances and rules.

Potential Action Item #64 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 #65 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.

Potential Action Item #66 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 #74 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.

Potential Action Item #77 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 #81 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 #83 Strengthen the role of the LEPT in the land development process, with input into land use plans, comprehensive plans, and zoning ordinances.

2007 Action Agenda

STATUS REPORT

2007 Action Items	Status as of 2014				Comments
	Complete	Ongoing or In-Progress	Pending	Incomplete or Unknown	
#10. 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.		✓		✓	**Brooks Twp –** Applied for "Risk Reduction" grant from Michigan Township Participating Plan (PAR Plan) in fall 2013, but did not receive grant.
#13. Continue and refine State, County, and local road maintenance programs (including management of bridges and vegetation), assure that road commissions have adequate equipment (including road barriers, sand bags, portable lighting, etc.) to respond to widespread weather events, and promote living snow fences beside highways and other roads to decrease snow on roads (focusing on residential developments with limited road access).				X	**Newaygo Co. Em. Services –** Unsure / unaware. **Brooks Twp –** These activities are handled by the Newaygo County Road Commission.
#18. Obtain extra fire fighting and rescue equipment; including dry fire hydrants in rural areas and specialized equipment for water and ice rescue, limited access areas (such as urban/forest intermix areas), and snow-blocked areas.		✓			**Brooks Twp –** Newaygo Fire District member, along with Newaygo City and Garfield Twp. Each provides funding for personnel, equipment and supplies. Special equipment owned by the district includes 4-wheel drive limited access response vehicle, water rescue boat, rescue basket, ice water suits, and multi-purpose wildfire helmets.
#19. Construct and/or designate storm shelters/tornado shelters in parks, campgrounds, mobile home parks, and communities that do not have shelters. Consider retrofitting existing or constructing public buildings, industrial sites and other large businesses or complexes (such as strip malls, fairgrounds, and other vulnerable public areas) to include shelters.		✓			**Newaygo Co. Em. Services –** Worked with local municipal and public campgrounds to develop campground emergency plans including designated storm shelters, notification methods, and evacuation routes. **Brooks Twp –** Township Hall is a designated shelter as defined in the agreement between the township and the Red Cross.
#31. Maximize the participation of property owners in protecting their properties from natural hazards.		✓			**Newaygo Co. Em. Services –** Newaygo County has an active Firewise project within identified Community Wildfire Protection Areas and works directly with homeowners to promote ways to floodproof homes along the Muskegon River.
#37. Encourage municipalities to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.			✓		**Newaygo Co. Em. Services –** Newaygo County's revised Flood Inundation Maps will be approved in 2015. During the current review process, no jurisdictions can request to be added to the NFIP until the new maps are approved. **Brooks Twp –** We provide information on the township's website about the NFIP and flood conditions, and keep record of all building elevation certificates received at the township.
#38. Encourage municipalities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities (such as the adoption of this plan) to reduce the cost of NFIP flood insurance.	✓		✓		**Newaygo Co. Em. Services –** Brooks Township is a part of the CRS. Further action is pending map revisions. Seed above for additional comments. **Brooks Twp –** We stay current on CRS minimum standards through review of bulletins issues to reduce the cost of flood insurance.
#40. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Program; to address community needs for hazard mitigation.		✓			**Newaygo Co. Em. Services –** A number of townships will be seeking assistance following the completion of this plan update. **Bridgeton Twp –** FMA plan adopted in 2008.
#46. Encourage participation in ISO's Building Code Effectiveness Grading Schedule (BCEGS), as recognized by FEMA for the Community Rating System of the NFIP.				X	
#51. Incorporate mitigation provisions into comprehensive plans and land use plans, especially as they address open space preservation and development restrictions (particularly in flood plains and the hydraulic shadows of dams).	✓				**Brooks Twp –** The township's Master Plan, updated in 2013, addresses the need for open space preservation and development restrictions.

#53. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances as they restrict or direct development; with consideration given to dams, flood plains, soil type and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).	✓				**Brooks Twp –** The township's Zoning Ordinance contains regulations for land use and structures that are within the various zoning districts. Building setbacks vary depending upon whether the structures are near a water body and topographical factors are also addressed. The township is currently in the process of establishing a PUD for a development on Petit Lake.
#62. Distribute already produced information on hazards and cost-effective mitigation actions individuals can implement to county residents and/or targeted groups most likely to experience significant impacts due to natural hazards, including the actions identified in Objective 2.2.		✓			**Newaygo Co. Em. Services –** Newaygo County Emergency Services does this on a regular basis for targeted populations living in the floodplain along the Muskegon River and in identified Community Wildfire Protection Areas. **Brooks Twp –** The township posts information from FEMA and the county about flood hazard mitigation on its website.
#63. Produce and distribute local emergency preparedness and safety information concerning all natural hazards to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.), as described in Objective 2.2. Include local resources for hazard information such as fire stations and local radio call numbers.		✓			**Newaygo Co. Em. Services –** Newaygo County Emergency Services utilizes the Newaygo County Community Emergency Response Team and Medical Reserve Corps to distribute preparedness and safety information to the public during special events such as Newaygo County Kids Day, Gerber Babyfood Festival, Community Health and Safety Day, etc. **Brooks Twp –** Lack of resources.
#71. Assist local communities in participating in programs mentioned in Objectives 1.1,1.4, and 2.3 (NFIP, CRS, Firewise Communities/USA, Tree City USA, BCEGS, Fortified…for safer living, Storm Ready, TADD, etc.) and assess and respond to concerns regarding program requirements and obstacles to participation.		✓			
#80. Coordinate with American Red Cross to ensure the countywide availability and public awareness of designated and accessible emergency shelters; with consideration given to the seasonal populations in homes, cabins and mobile homes without basements; and assure facilities are inspected, certified, and have back-up power.	✓				**Newaygo Co. Em. Services –** Identified within the Newaygo County Emergency Operations Plan. **Brooks Twp –** The township hall is a designated American Red Cross Shelter.

ACTION AGENDA 2015-2019

Action Item 1. Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination. Evaluation should consider warning for slow onset as well as short onset hazards, new technologies, public views of the warning system and the effect this has on response to warnings, disseminating warnings to people with "special needs", redundancies, and effective methods of risk communication.

Priority Level:

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
Newaygo County Emergency Services (NCES); Newaygo County 911 Central Dispatch.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Protecting public health and safety is one of the four main goals of this plan. Maintaining an effective and reliable public warning system is one of the best ways to accomplish that goal. This action item is new for the 2014 Action Agenda.

Action Item 10. 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.

Priority Level:

Timeframe: 2015; or as funding becomes available

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Critical facility managers.

Potential Technical/Financial Assistance Sources:
MI State Police-Emergency Management Homeland Security Division (MSP-EMHSD).

Comments:
Though many facilities in Newaygo County have generators, some remain in need of backup power. To help accomplish this action item, NCES might consider conducting an inventory of critical facilities that need a generator.

Action Item 14. Continue to refine state, county and local road, bridge and culvert maintenance / vegetation management programs to maintain visibilities, provide for living snow fences, reduce erosion, slow stormwater runoff, and maintain the structural integrity of transportation infrastructure.

Priority Level:

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Newaygo County Road Commission.

Potential Technical/Financial Assistance Sources:

MDOT; Newaygo Conservation District.

Comments:
NCES should work through the Newaygo County LEPT to identify opportunities to incorporate hazard mitigation provisions into management programs to protect new and existing infrastructure and enhance public safety.

Action Item 19. 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 (such as urban/forest intermix areas), and snow-blocked areas.

Priority Level:

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Local fire departments.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Homeland Security Grant Program (HSGP).

Comments:
Improving the capabilities of first responders will provide a way to lessen or perhaps shorten the duration of a disaster's impacts.

Action Item 20. 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 (such as strip malls, fairgrounds, and other vulnerable public areas) to include shelters.

Priority Level:

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
NCES.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; American Red Cross.

Comments:
Steps have been taken by NCES to make sure that public and private campgrounds have emergency plans in place (including designated shelters). This action item remains a priority for Newaygo County.

Action Item 31. 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).

Priority Level:

Timeframe: 2016

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Newaygo County Road Commission; Newaygo County Drain Commission.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD.

Comments:
This plan identifies Flooding as the #1 hazard in Newaygo County. Structural projects should be considered to protect existing structures and infrastructure from this hazard. This action item is new for the 2014 Action Agenda.

Action Item 35. Maintain the Newaygo County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations.

Priority Level:

Timeframe: Review CWPP annually; Implement CWPP Action Plan as funding allows

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Local fire departments; Townships located within the CWPP-identified wildland-urban interface (WUI): Big Prairie, Brooks, Croton, Everett, Lilley, and Merrill.

Potential Technical/Financial Assistance Sources:
USDA-Forest Service; Michigan DNR; MSU Extension.

Comments:
The Newaygo County CWPP is due for a 5-year update in 2015. This action item is new for the 2014 Action Agenda.

Action Item 36. Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

Priority Level:

Timeframe: Following adoption of this plan

Applicable Governmental Unit(s)/Responsible Person(s):
County building inspectors; Local elected officials; Local zoning officials.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; NCES.

Comments:
Hazard mitigation concepts and strategies will be incorporated into the day-to-day activities of elected officials, zoning officials, and building inspectors; especially those activities that involve interaction with local land owners and facility operators. Local officials should refer to the Hazard Mitigation Alternatives chapter for information about potential mitigation strategies. Examples include the promotion of Firewise principles for property maintenance, and the proper anchoring of objects located within floodplain areas.

Action Item 42. Encourage and assist municipalities that are at risk to flooding, or that have been exposed to flooding in the past, to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.

Priority Level:

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):

NCES; Municipalities that currently do not participate in the NFIP: City of Grant, and townships of Barton, Beaver, Big Prairie, Dayton, Denver, Everett, Goodwell, Grant, Home, Lilley, Merrill, Monroe, Norwich, Sheridan and Troy.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDEQ NFIP Coordinator.

Comments:
All municipalities are eligible to participate in the program, so long as the minimum requirements are met. NFIP flood insurance can only be acquired in communities that participate in the program.

Action Item 45. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Program; to address community needs for hazard mitigation.

Priority Level:

Timeframe: As funding becomes available, especially following a disaster declaration

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Local units of government that adopt this Hazard Mitigation Plan.

Potential Technical/Financial Assistance Sources:
Federal Emergency Management Agency (FEMA); MSP-EMHSD.

Comments:
HMGP funding opportunities are made available following a disaster declaration. Annual funding opportunities may be made available through the PDM and FMA programs, which are nationally competitive.

Action Item 51. Contact Insurance Services Office (ISO) to request a copy of the community's Building Code Effectiveness Grading Scale (BCEGS), and work to improve the BCEGS rating through improvements to building codes and enforcement.

Priority Level:

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
Newaygo County Building Inspector; cities of Newaygo and White Cloud; townships of Barton, Big Prairie, Dayton, Ensley, Everett, Garfield, Lilley, Lincoln, Sheridan, and Sherman.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
A free copy of a community's BCEGS report is available upon the request of a community's chief elected official or building official. This information can be used to identify deficiencies in existing building codes and enforcement. Addressing those deficiencies can enhance the resiliency of new and rehabilitated structures.

Action Item 56. Incorporate mitigation provisions into comprehensive plans and land use plans; such as identification of acceptable land uses and densities based on consideration of flood-prone areas, soil types, topography, and etc.

Priority Level:

Timeframe: To be completed when land use plans are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Land use planning helps provide rationale for local rules and policies, so it is important to integrate principals of hazard mitigation into this process. Following adoption of this plan, local units of government and the county will be encouraged to consider the contents of this hazard mitigation plan when writing or updating local plans. State law in Michigan requires that master plans must be reviewed, and updated if necessary, every five years.

Action Item 58. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances as they restrict or direct development; with consideration given to dams, flood plains, soil type and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).

Priority Level:

Timeframe: To be completed when zoning ordinances are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Following adoption of this plan, local units of government and the county will be encouraged to consider the contents of this plan when writing or updating local ordinances. Zoning is an effective tool for mitigating hazards because it can be used to direct new development away from known hazardous areas, such as floodplains. Resources such as the IBHS suite of FORTIFIED programs can provide additional guidance for increasing the resistance of new and existing structures to hazards.

Action Item 67. Obtain and distribute available information on hazards and cost-effective mitigation actions individuals can implement (for example, Firewise pamphlets), and post-disaster repair and cleanup guidance.

Priority Level:

Timeframe: Seasonally, as budget allows

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Local units of government.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; FEMA; MSUE; NFIP; American Red Cross; Salvation Army.

Comments:
Mitigation and disaster recovery information may be distributed via social media, public meetings, newsletters, etc. NCES will consider distributing such information in the days and weeks ahead of a given season; e.g. the distribution of fire safety information in the early spring.

Action Item 68. Produce and distribute local emergency preparedness and safety information to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.). Include local resources for information such as fire stations, local radio stations and utilities.

Priority Level:

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Newaygo County Departments.

Potential Technical/Financial Assistance Sources:
HMGP; HSGP; MSP-EMHSD; Utilities.

Comments:
Many county departments are constantly implementing this action item. It is stated here to support efforts that are currently in effect, and to encourage NCES to distribute pertinent information through 211, social media, public meetings, etc.

Action Item 79. Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

Priority Level:

Timeframe: As hazard mitigation funding becomes available

Applicable Governmental Unit(s)/Responsible Person(s):
NCES.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD.

Comments:
NCES would be a resource to help facilitate awareness of state and federal funding opportunities for hazard mitigation. This action item is new for the 2014 Action Agenda.

Action Item 85. Coordinate with American Red Cross to ensure the countywide availability and public awareness of designated and accessible emergency shelters; with consideration given to the seasonal populations in homes, cabins and mobile homes without basements; and assure facilities are inspected, certified, and have back-up power.

Priority Level:

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
NCES; Communities identified in this plan as not having a community shelter designated by the American Red Cross: City of Grant, and townships of Beaver, Big Prairie, Bridgeton, Dayton, Denver, Ensley, Everett, Garfield, Home, Lincoln, Monroe, Sherman, Troy, and Wilcox.

Potential Technical/Financial Assistance Sources:
American Red Cross.

Comments:
Determinations must be made as to which communities listed above are in need of a designated community shelter.

Action Agenda 2015-2019

List of Hazard Mitigation Actions Applicable to Governmental Units

ACTION AGENDA	Action Item	Warning System	Generators	Road Maintenance	Fire/Rescue Equipment	Storm Shelters	Structural Projects	CWPP	Owner Participation	NFIP Participation	Federal Programs	BCEGS	Comprehensive Planning	Zoning	Distribute Mitigation Info	Local Pre-paredness Info	Funding Notification	Community Shelters
	Action Item #	**1**	**10**	**14**	**19**	**20**	**31**	**35**	**36**	**42**	**45**	**51**	**56**	**58**	**67**	**68**	**79**	**85**
APPLICABLE LOCAL GOVERNMENT	**Newaygo County**	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•
	Fremont City				•			•	•			•	•	•	•			
	Grant City				•			•	•	•			•	•	•			•
	Newaygo City				•			•	•				•	•	•			
	White Cloud City				•			•	•			•	•	•	•			
	Hesperia Village				•			•	•				•	•	•			
	Ashland Twp.								•				•	•	•			
	Barton Twp.								•	•		•	•	•	•			
	Beaver Twp.								•	•			•	•	•			•
	Big Prairie Twp.				•			•	•	•		•	•	•	•			•
	Bridgeton Twp.								•				•	•	•			•
	Brooks Twp.							•	•				•	•	•			
	Croton Twp.				•			•	•				•	•	•			
	Dayton Twp.								•	•		•	•	•	•			•
	Denver Twp.								•	•			•	•	•			•
	Ensley Twp.								•			•	•	•	•			•
	Everett Twp.							•	•	•		•	•	•	•			•
	Garfield Twp.								•			•	•	•	•			•
	Goodwell Twp.								•	•			•	•	•			
	Grant Twp.								•	•			•	•	•			
	Home Twp.								•	•			•	•	•			•
	Lilley Twp.				•			•	•	•		•	•	•	•			
	Lincoln Twp.								•			•	•	•	•			•
	Merrill Twp.							•	•	•			•	•	•			
	Monroe Twp.								•	•			•	•	•			•
	Norwich Twp.								•	•			•	•	•			
	Sheridan Twp.								•	•		•	•	•	•			
	Sherman Twp.								•			•	•	•	•			•
	Troy Twp.								•	•			•	•	•			•
	Wilcox Twp.								•				•	•	•			•

Applicable to any local government that adopts this Hazard Management Plan

Revised Action Agenda for 2020 - 2025

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 2015-2019. The selection process was guided by criteria described in the chapter entitled "Evaluation Criteria to Select and Prioritize Action Items." All items on this revised Action Agenda are considered to be of the highest priority. Implementation of these action items may be appropriate on the county level and / or the local level. The "List of Hazard Mitigation Actions Applicable to Governmental Units" at the end of the chapter assigns action items to appropriate jurisdictions within Newaygo County. Each action item includes the following information to help facilitate implementation:

Priority Level

All identified action items are considered priorities within this Hazard Mitigation Plan. In order to help structure implementation of the Plan, a further prioritization of high, medium, or low is assigned to each measure. This is intended to convey a sense of importance relative to the other action items from a countywide perspective.

Timeframe

Generally identifies when an action item might begin. Where appropriate, prerequisite activities are discussed.

Applicable Governmental Unit(s) / Responsible Person (s)

Identifies key players for initiating and implementing each action. Often the work will be shared by a number of individuals and agencies.

Potential Technical / Financial Assistance

Identifies common sources of technical and financial assistance. In many cases, identified parties will provide referrals to currently available or specialized assistance and / or guidance. Detail provided is not intended to be exhaustive because opportunities for assistance may come and go; such as following a disaster declaration. **Refer to the Michigan Hazard Mitigation Plan MSP/EMHSD Pub. 106 for a detailed listing of potential federal and state funding sources for hazard-specific measures.**

Comments

Additional details or helpful information about the action item. This feature was added for the revised edition of this plan.

43°48'51.69"N

85°52'30.51"W

85°50'37.03"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°46'45.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:51:08 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 61 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LILLEY MICHIGAN	261379	0061

MAP NUMBER
26123C0061D
EFFECTIVE DATE
02/18/2015

43°48'51.69"N

85°50'38.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°46'45.87"N

85°48'44.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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SCALE

N

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GCS, Geodetic Reference System 1980;
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **62** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LILLEY MICHIGAN	261379	0062

MAP NUMBER
26123C0062D
EFFECTIVE DATE
02/18/2015

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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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.

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **63** OF **551**

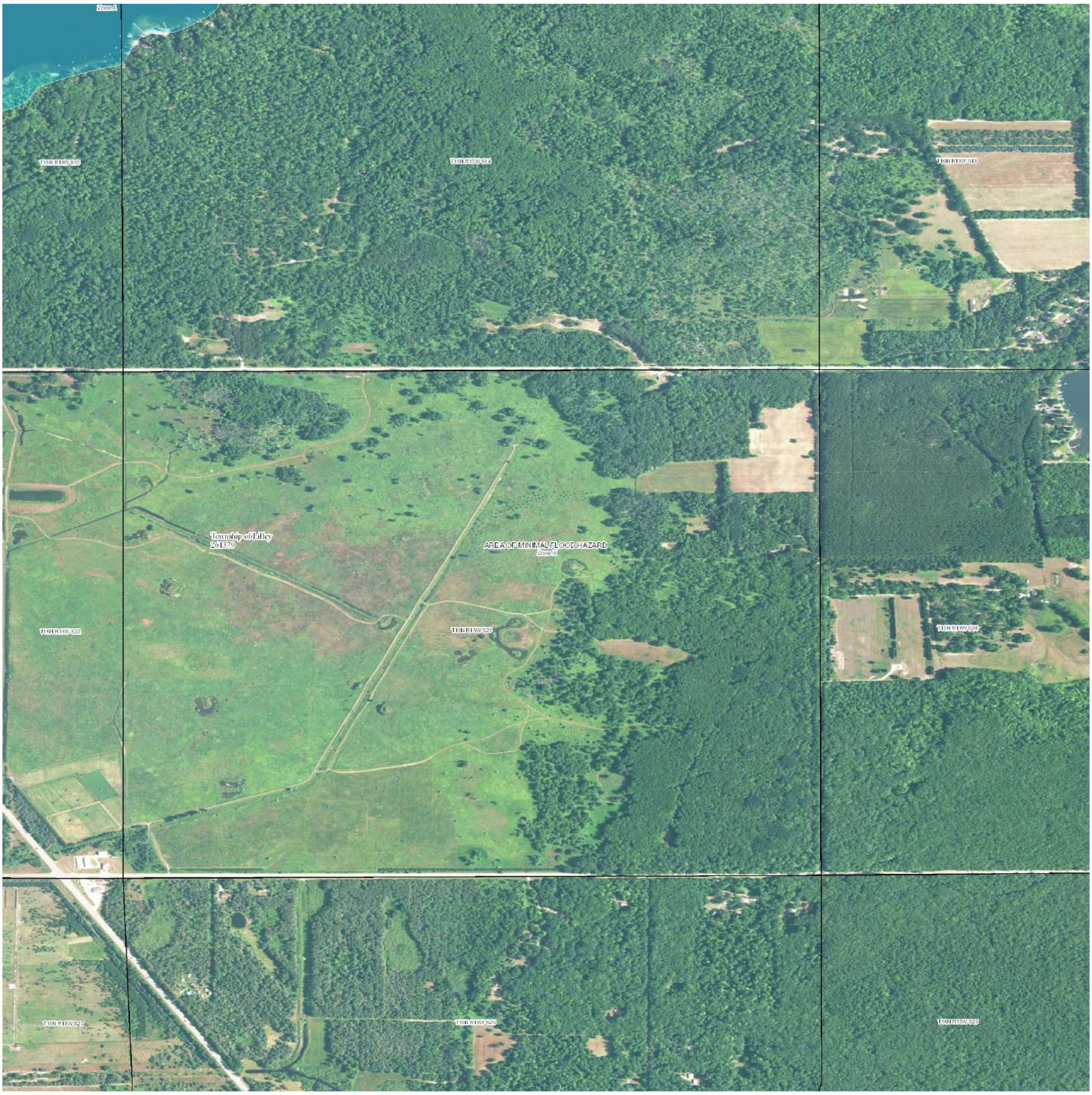
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LILLEY MICHIGAN	261379	0063

MAP NUMBER
26123C0063D
EFFECTIVE DATE
02/18/2015

43°46'59.19"N

85°50'38.01"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°44'53.37"N

85°48'44.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:49:13 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **64** OF **551**

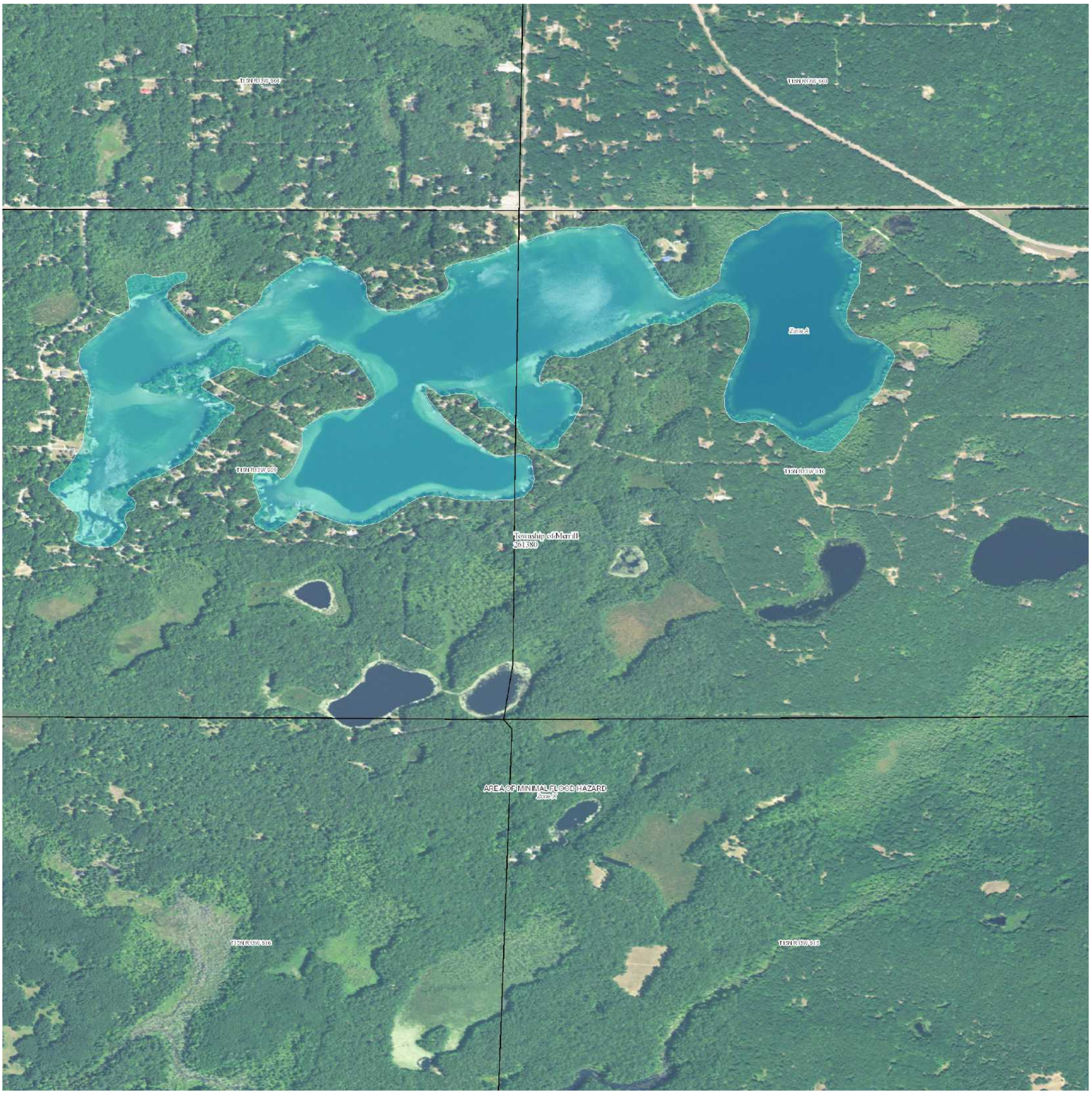
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LILLEY MICHIGAN	261379	0064

MAP NUMBER
26123C0064D
EFFECTIVE DATE
02/18/2015

43°43'14.19"N

85°52'30.51"W



85°50'37.03"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°41'8.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:47:39 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

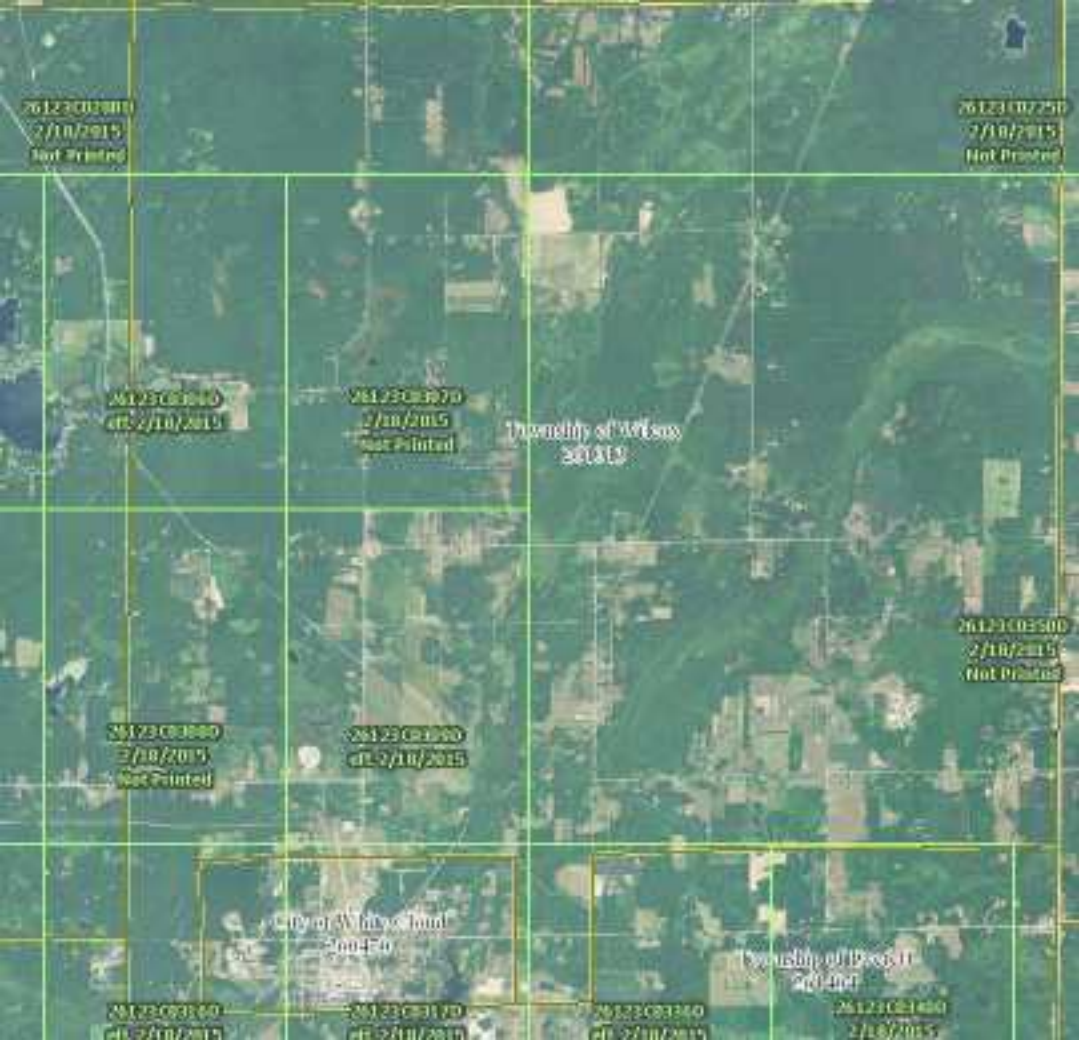
NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 178 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF MERRILL MICHIGAN	261380	0178

MAP NUMBER
26123C0178D
EFFECTIVE DATE
02/18/2015


26123C02800
2/10/2015
Not Printed
26123C02250
2/10/2015
Not Printed
26123C03870
2/10/2015
Not Printed
Township of Wilson
26123
26123C03500
2/10/2015
Not Printed
26123C03880
2/10/2015
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City of White Cloud
26123
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26123C03870
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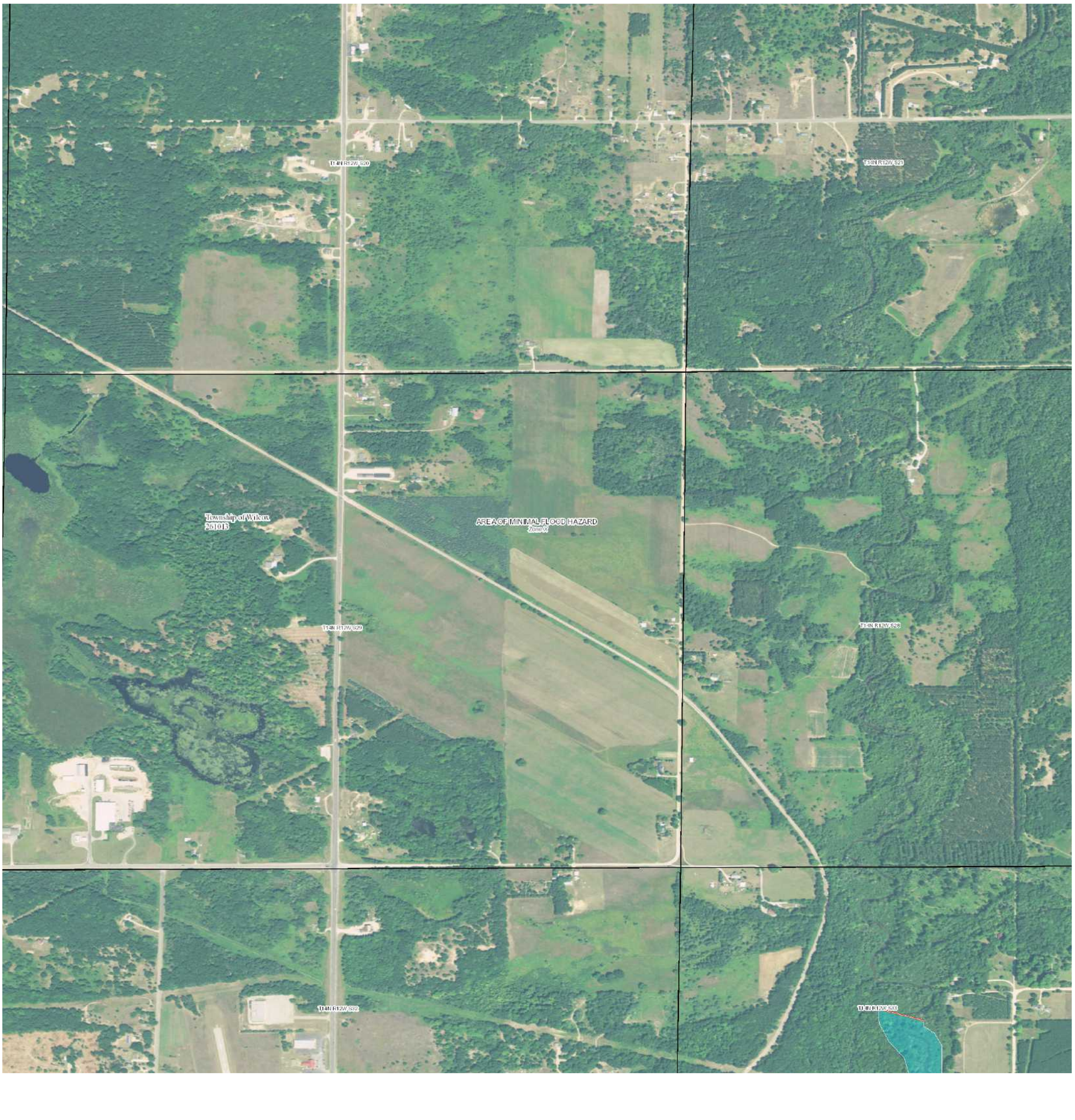
26123C03400



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:22:55 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

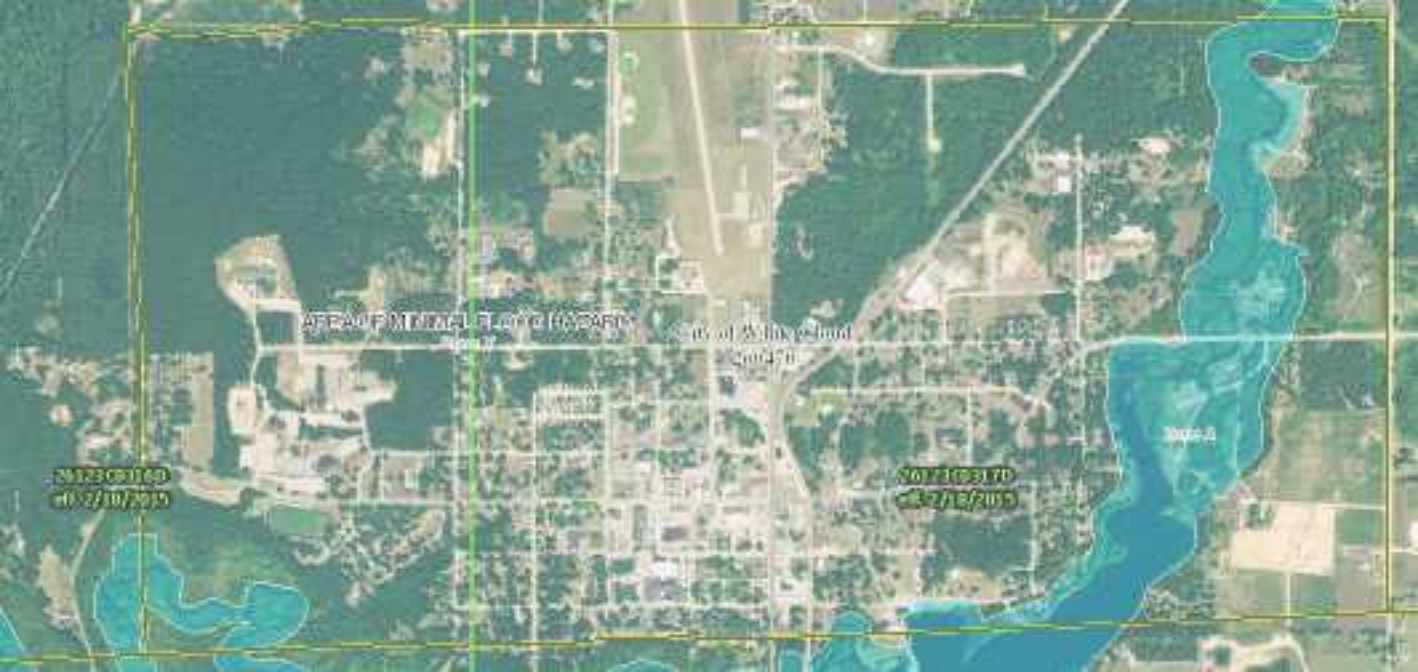
NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 309 OF 551

Panel Contains:

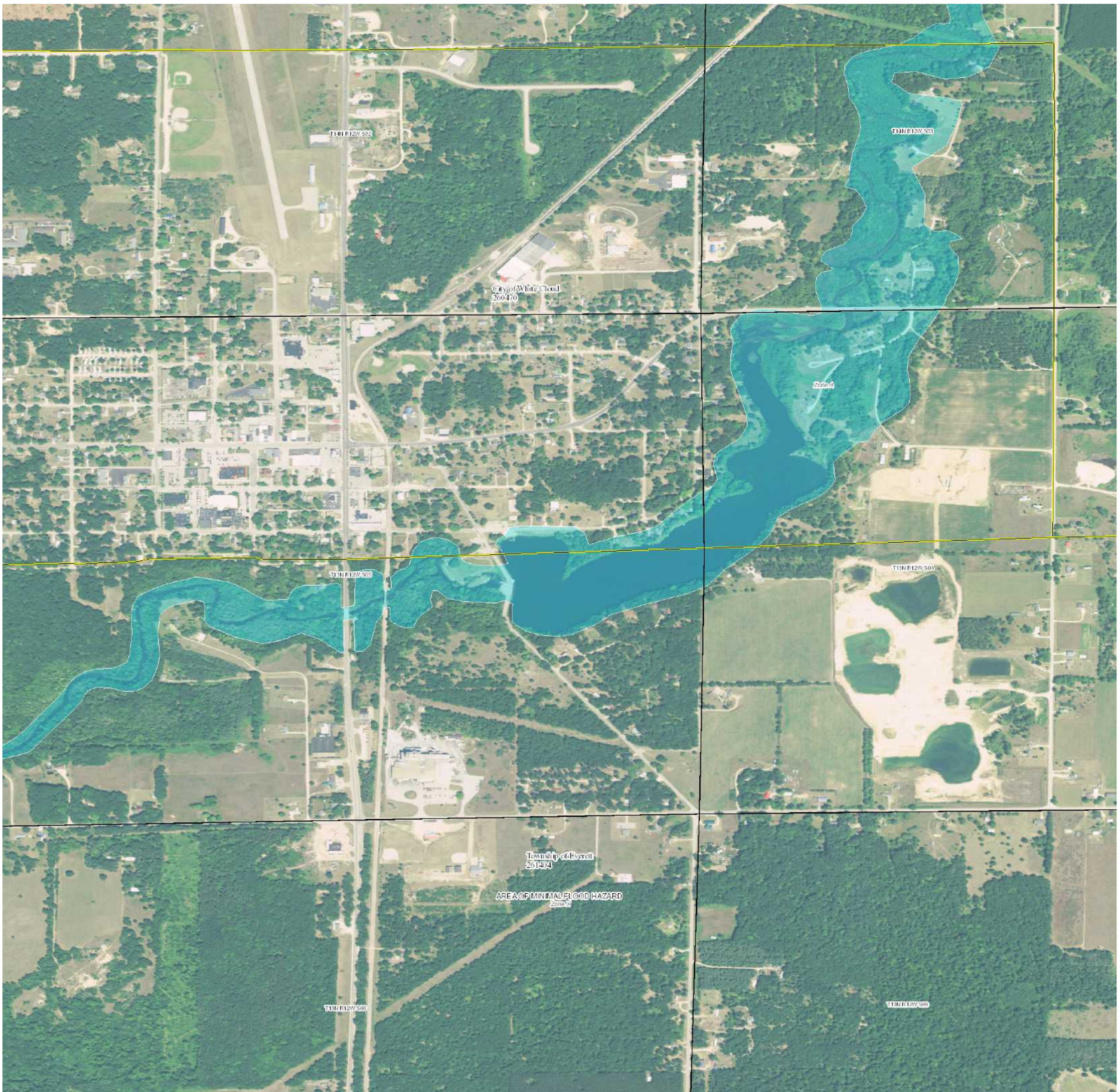
COMMUNITY	NUMBER	PANEL
TOWNSHIP OF WILCOX MICHIGAN	261013	0309

MAP NUMBER
26123C0309D
EFFECTIVE DATE
02/18/2015



43°33'51.69"N

85°46'53.01"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°31'45.87"N

85°44'59.52"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:17:42 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 317 OF 551

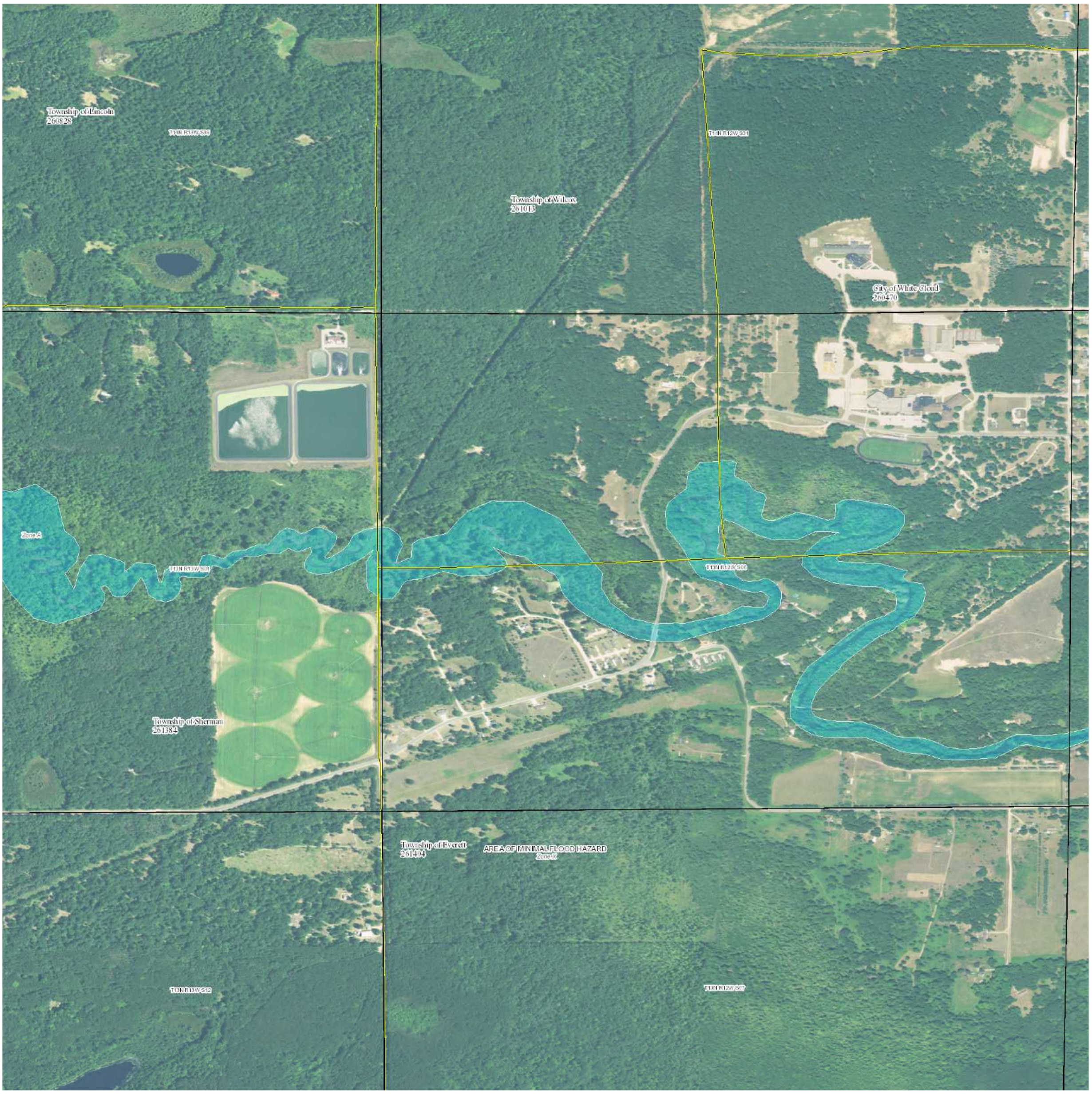
Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF WHITE CLOUD MICHIGAN	260470	0317
TOWNSHIP OF WILCOX MICHIGAN	261013	0317
TOWNSHIP OF EVERETT MICHIGAN	261404	0317

MAP NUMBER
26123C0317D
EFFECTIVE DATE
02/18/2015

43°33'51.69"N

85°48'45.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°46'52.03"W

43°31'45.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:21:54 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

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GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **316** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF WHITE CLOUD MICHIGAN	260470	0316
TOWNSHIP OF LINCOLN MICHIGAN	260828	0316
TOWNSHIP OF SHERMAN MICHIGAN	261384	0316
TOWNSHIP OF WILCOX MICHIGAN	261013	0316
TOWNSHIP OF EVERETT MICHIGAN	261404	0316

MAP NUMBER
26123C0316D
EFFECTIVE DATE
02/18/2015

2612308920
off. 2/18/2015
2612308810
off. 2/18/2015
2612308720
off. 2/18/2015
2612308630
off. 2/18/2015
2612308950
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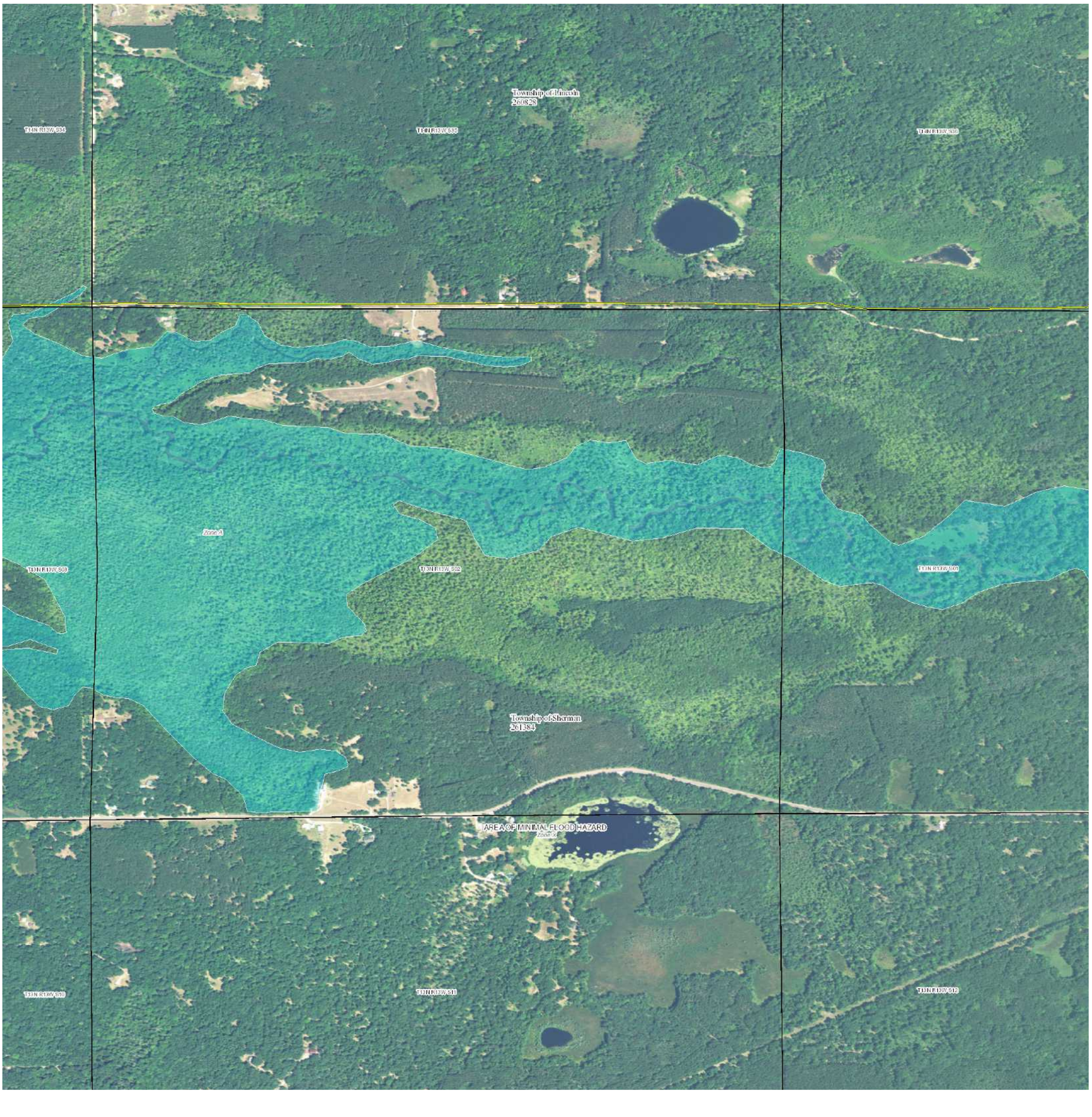
2/18/2015
not Printed



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **312** OF **551**

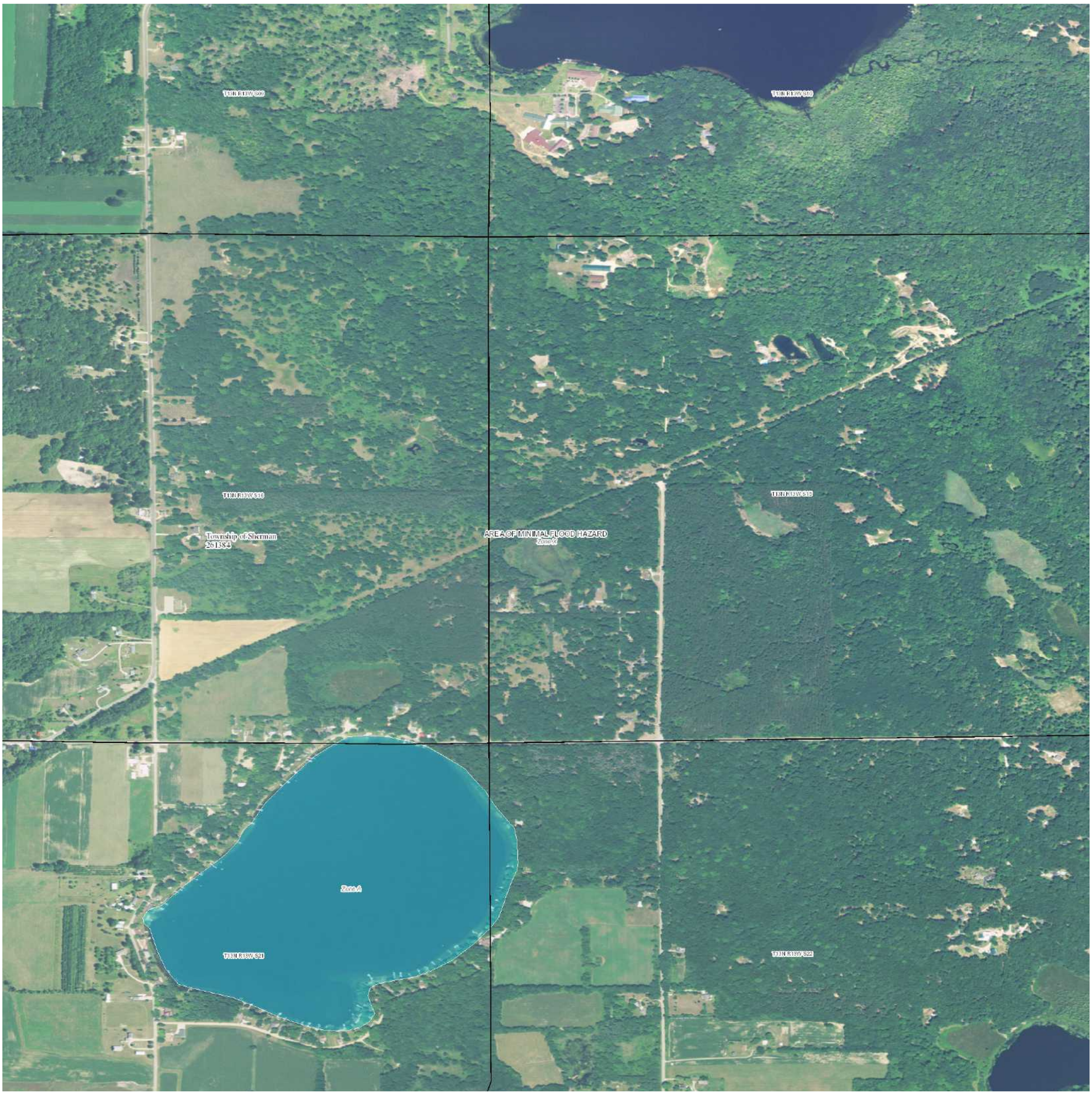
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0312
TOWNSHIP OF SHERMAN MICHIGAN	261384	0312

MAP NUMBER
26123C0312D
EFFECTIVE DATE
02/18/2015

43°31'59.19"N

85°52'30.51"W



85°50'27.03"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°29'53.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:19:57 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

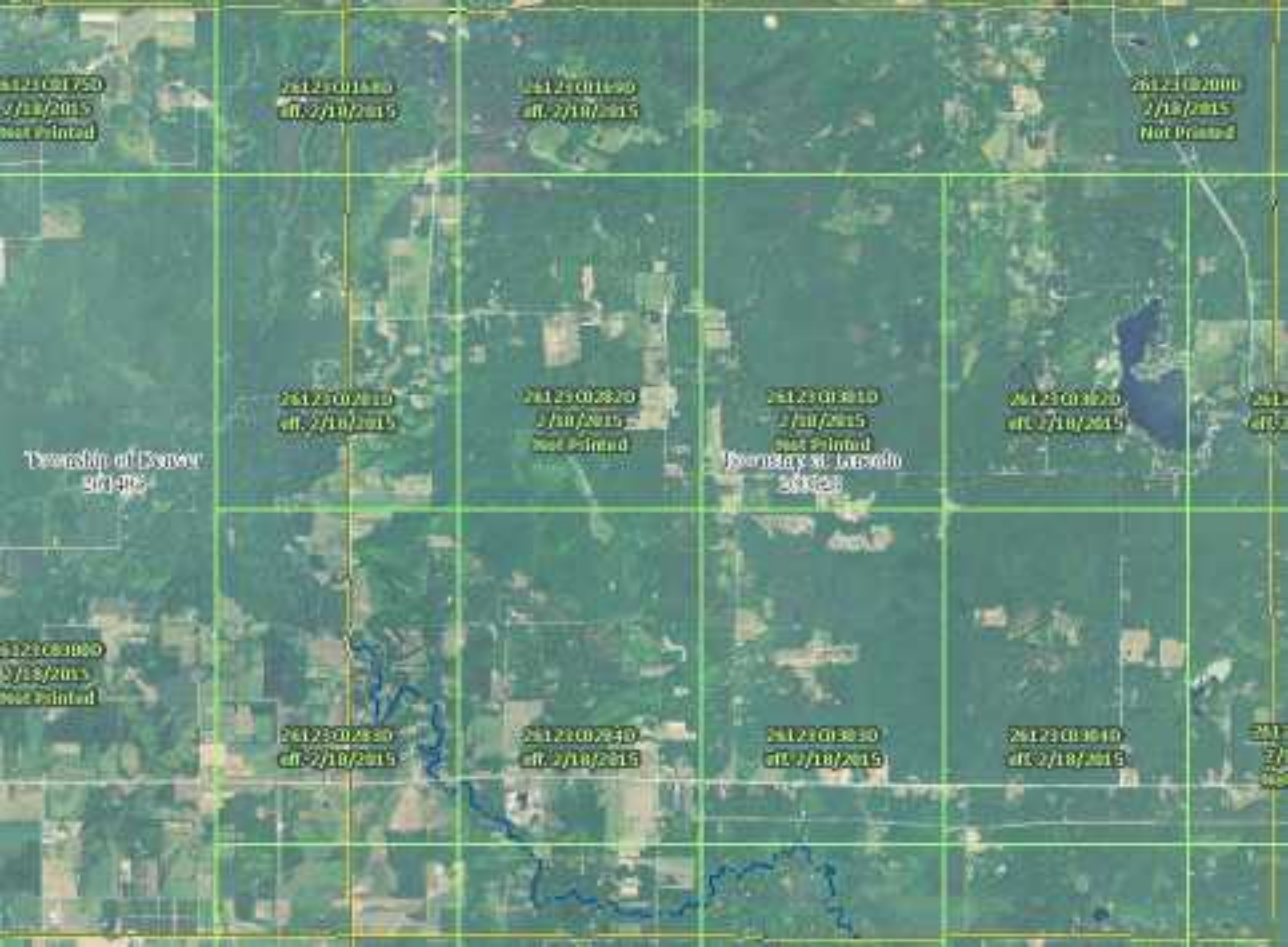
NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 313 OF 551

Panel Contains:

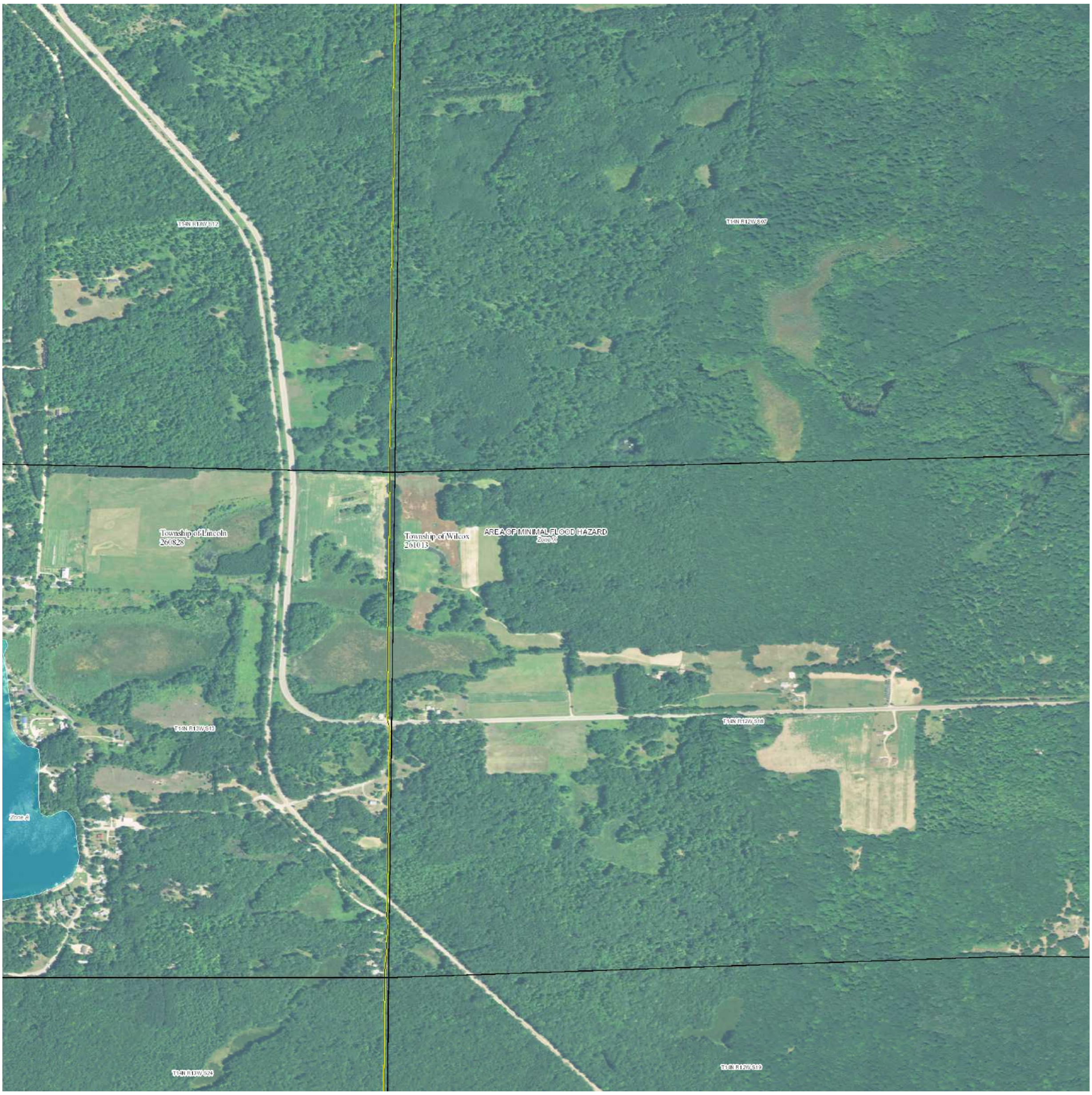
COMMUNITY	NUMBER	PANEL
TOWNSHIP OF SHERMAN MICHIGAN	261384	0313

MAP NUMBER
26123C0313D
EFFECTIVE DATE
02/18/2015


Township of Denver
Township of St. Lucrain

43°37'36.69"N

85°48'45.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°35'30.87"N

85°52'03.13"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:45:08 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 306 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0306
TOWNSHIP OF WILCOX MICHIGAN	261013	0306

MAP NUMBER
26123C0306D
EFFECTIVE DATE
02/18/2015

43°37'36.69"N

85°50'38.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°48'44.53"W

43°35'30.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:39:08 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 302 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0302

MAP NUMBER
26123C0302D
EFFECTIVE DATE
02/18/2015

43°35'44.19"N

85°50'38.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°48'44.53"W

43°33'38.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:25:20 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **304** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0304

MAP NUMBER
26123C0304D
EFFECTIVE DATE
02/18/2015

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 311 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0311
TOWNSHIP OF SHERMAN MICHIGAN	261384	0311

MAP NUMBER
26123C0311D
EFFECTIVE DATE
02/18/2015

43°35'44.19"N

85°52'30.51"W

85°50'32.07"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°33'38.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 303 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0303

MAP NUMBER
26123C0303D
EFFECTIVE DATE
02/18/2015

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°31'45.87"N

85°52'29.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 292 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0292
TOWNSHIP OF SHERMAN MICHIGAN	261384	0292

MAP NUMBER
26123C0292D
EFFECTIVE DATE
02/18/2015

43°35'44.19"N

85°56'15.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°33'38.37"N

88°54'22.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:31:46 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **283** OF **551**

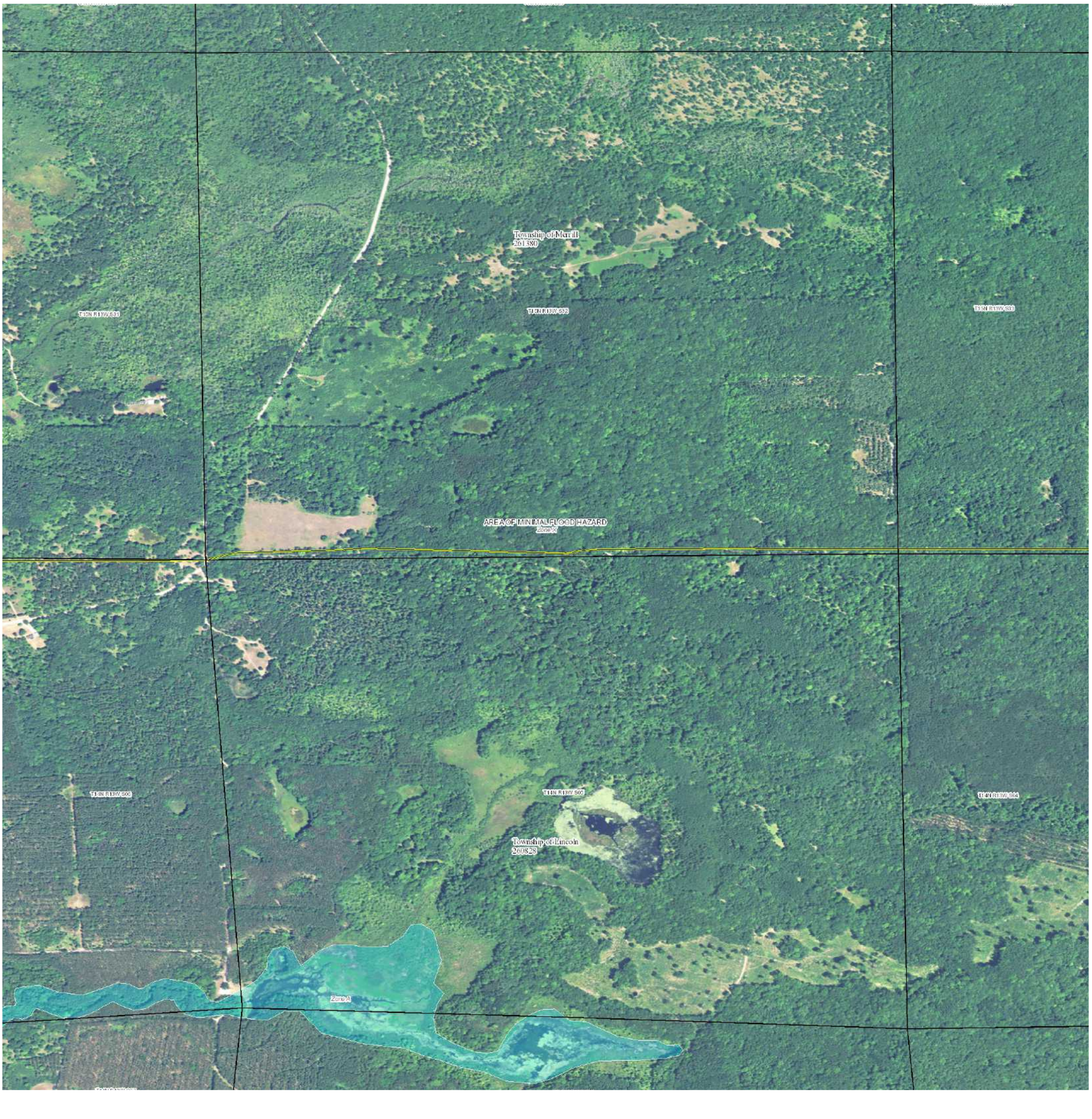
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF DENVER MICHIGAN	261403	0283
TOWNSHIP OF LINCOLN MICHIGAN	260828	0283

MAP NUMBER
26123C0283D
EFFECTIVE DATE
02/18/2015

43°39'29.19"N

85°54'23.01"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°37'23.37"N

85°52'29.52"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **169** OF **551**

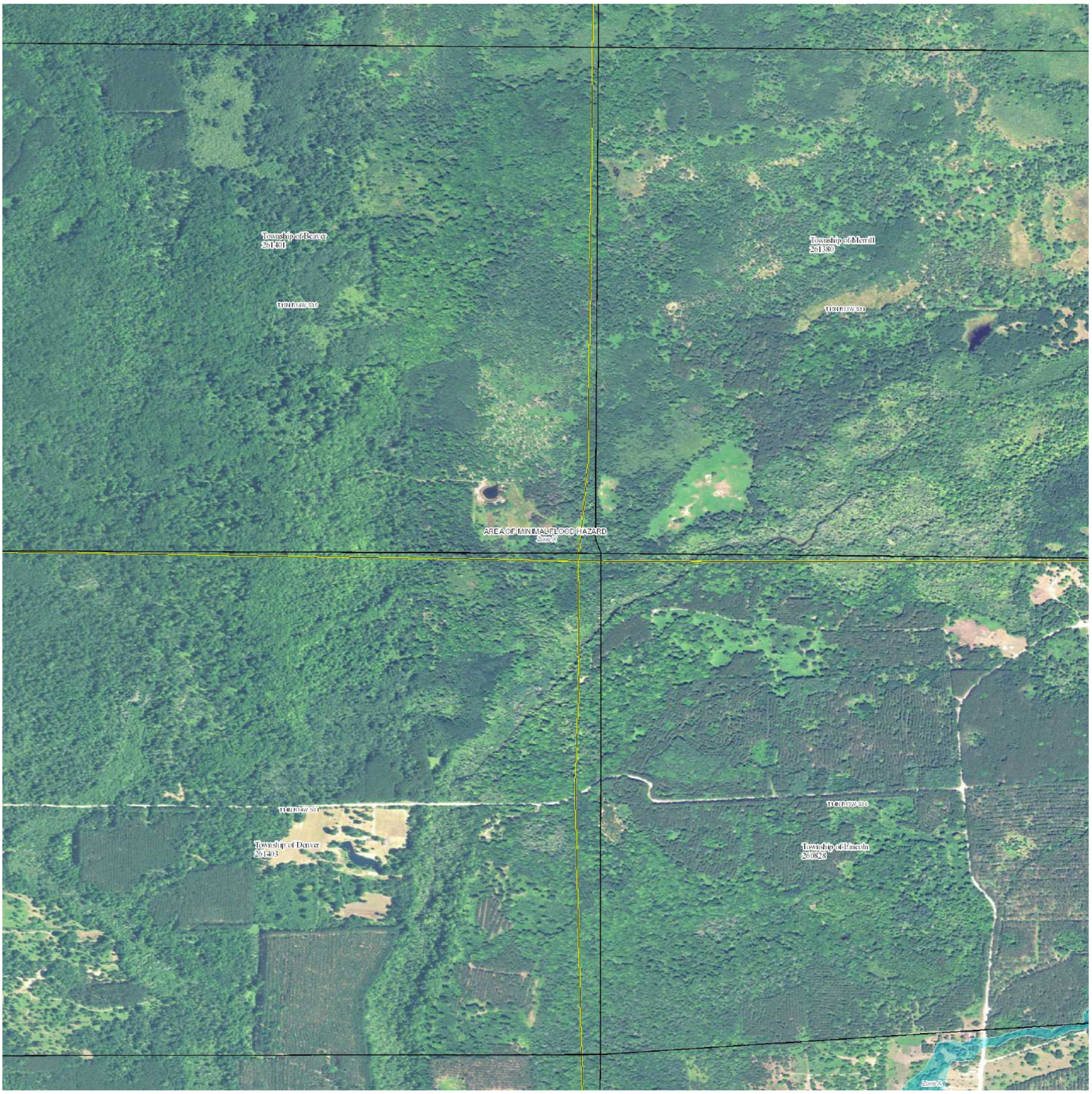
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF MERRILL MICHIGAN	261380	0169
TOWNSHIP OF LINCOLN MICHIGAN	260828	0169

MAP NUMBER
26123C0169D
EFFECTIVE DATE
02/18/2015

43°39'29.19"N

85°56'15.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°54'20.03"W

43°37'23.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:36:46 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **168** OF **551**

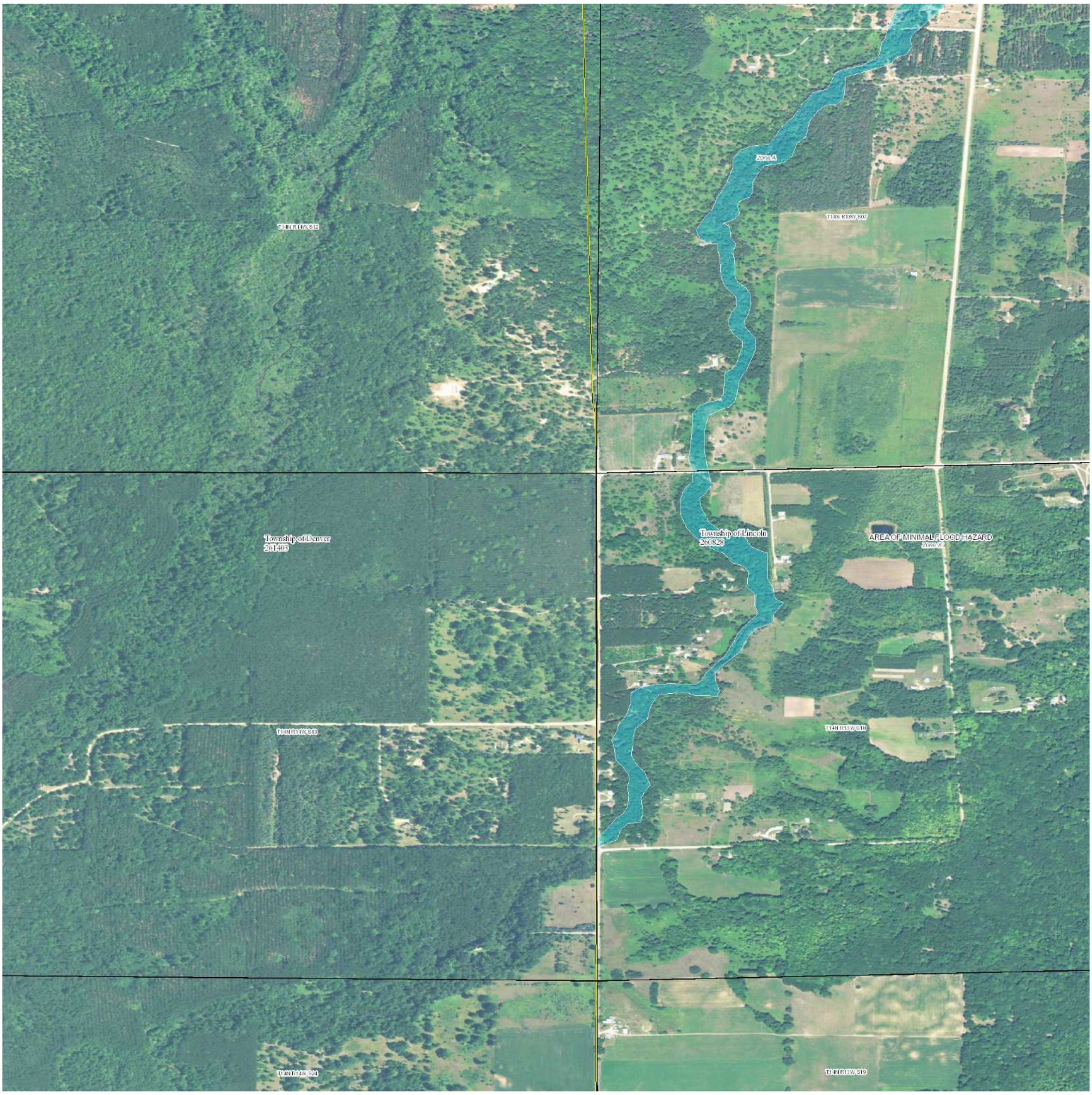
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF MERRILL MICHIGAN	261380	0168
TOWNSHIP OF DENVER MICHIGAN	261403	0168
TOWNSHIP OF LINCOLN MICHIGAN	260828	0168
TOWNSHIP OF BEAVER MICHIGAN	261401	0168

MAP NUMBER
26123C0168D
EFFECTIVE DATE
02/18/2015

43°37'36.69"N

85°56'15.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°35'30.87"N

85°54'22.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **281** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF DENVER MICHIGAN	261403	0281
TOWNSHIP OF LINCOLN MICHIGAN	260828	0281

MAP NUMBER
26123C0281D
EFFECTIVE DATE
02/18/2015

261230B390
2/18/2015
261230B160
2/18/2015
261230B170
2/18/2015
261230B360
2/18/2015
261230B400
2/18/2015
Not Printed
261230B180
2/18/2015
Not Printed
261230B190
2/18/2015
261230B380
2/18/2015
261230B420
2/18/2015
261230B450
2/18/2015
Not Printed
261230B430
2/18/2015
Not Printed

43°33'51.69"N

85°45'0.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°31'45.87"N

85°43'7.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

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GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **336** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF WILCOX MICHIGAN	261013	0336
TOWNSHIP OF EVERETT MICHIGAN	261404	0336

MAP NUMBER
26123C0336D
EFFECTIVE DATE
02/18/2015

43°31'59.19"N

85°45'0.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°29'53.37"N

85°43'7.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 338 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF EVERETT MICHIGAN	261404	0338

MAP NUMBER
26123C0338D
EFFECTIVE DATE
02/18/2015

43°31'59.19"N

85°46'53.01"W

85°44'59.52"W

43°29'53.37"N

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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 http://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 beordered or obtained directly from the website.

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:15:06 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 319 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF EVERETT MICHIGAN	261404	0319

MAP NUMBER
26123C0319D
EFFECTIVE DATE
02/18/2015

43°30'6.69"N

85°46'53.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°28'0.87"N

85°44'59.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 432 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF EVERETT MICHIGAN	261404	0432

MAP NUMBER
26123C0432D
EFFECTIVE DATE
02/18/2015

43°35'44.19"N

85°54'23.01"W

85°52'29.53"W

43°33'38.37"N

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **284** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF LINCOLN MICHIGAN	260828	0284

MAP NUMBER
26123C0284D
EFFECTIVE DATE
02/18/2015

43°35'9.79"N

86°31'.44"W

86°17.95"W

43°33'3.97"N

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:33:34 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

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GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

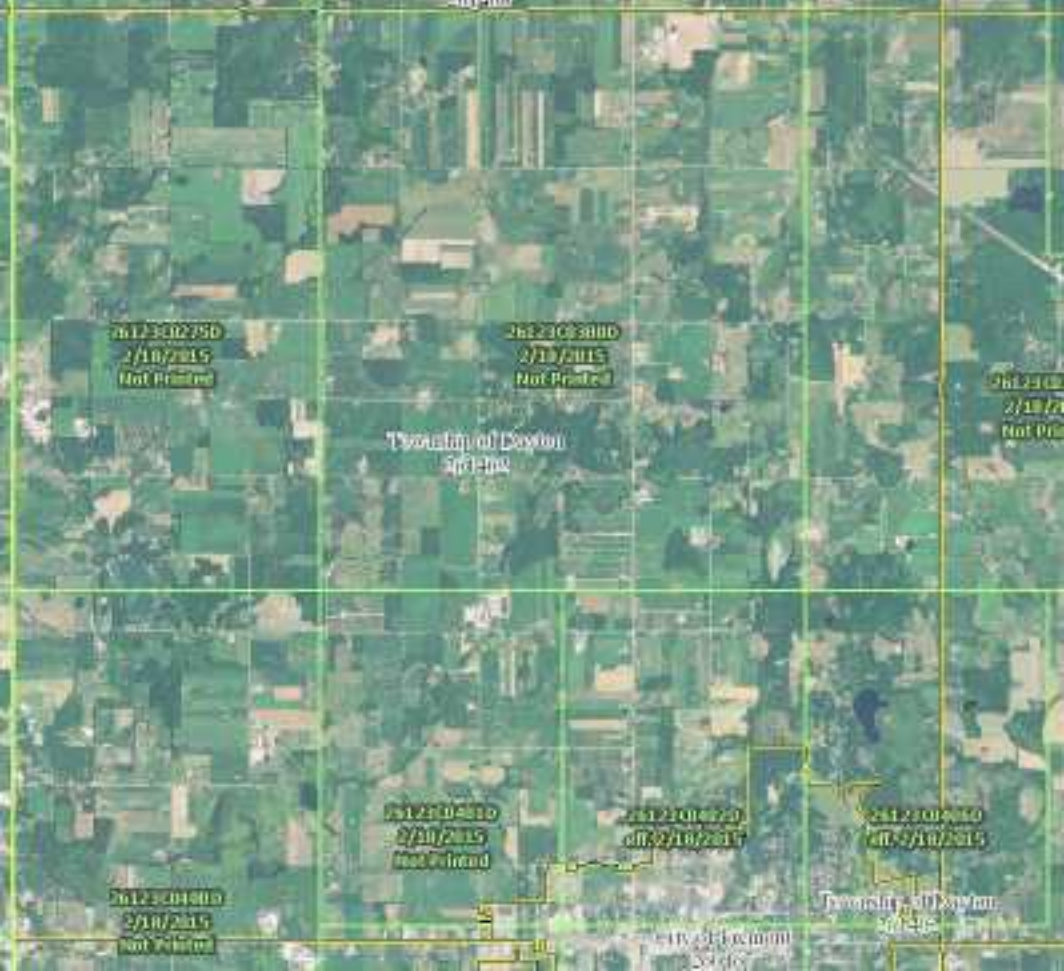
OCEANA COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 350 OF 450

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF NEWFIELD MICHIGAN	260697	0350
TOWNSHIP OF DENVER MICHIGAN	261403	0350
VILLAGE OF HESPERIA MICHIGAN	260485	0350

MAP NUMBER
26127C0350C
EFFECTIVE DATE
08/04/2014


Township of Dayton
Township of Dayton

43°30'6.69"N
85°58'8.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°56'14.53"W
43°28'0.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **402** OF **551**

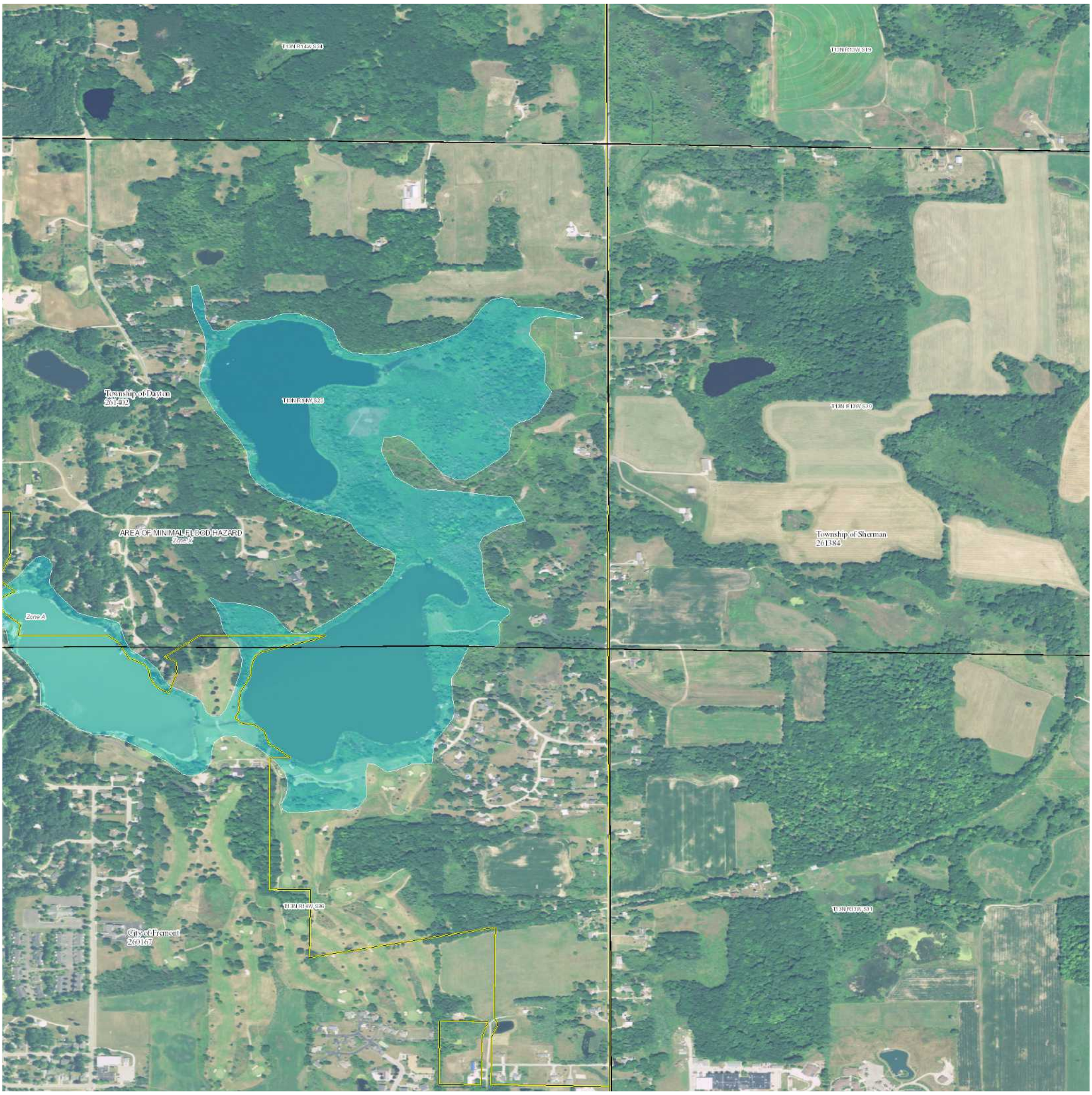
Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF FREMONT MICHIGAN	260167	0402
TOWNSHIP OF DAYTON MICHIGAN	261402	0402

MAP NUMBER
26123C0402D
EFFECTIVE DATE
02/18/2015

43°30'6.69"N

85°56'15.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°28'0.87"N

85°54'22.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 406 OF 551

Panel Contains:

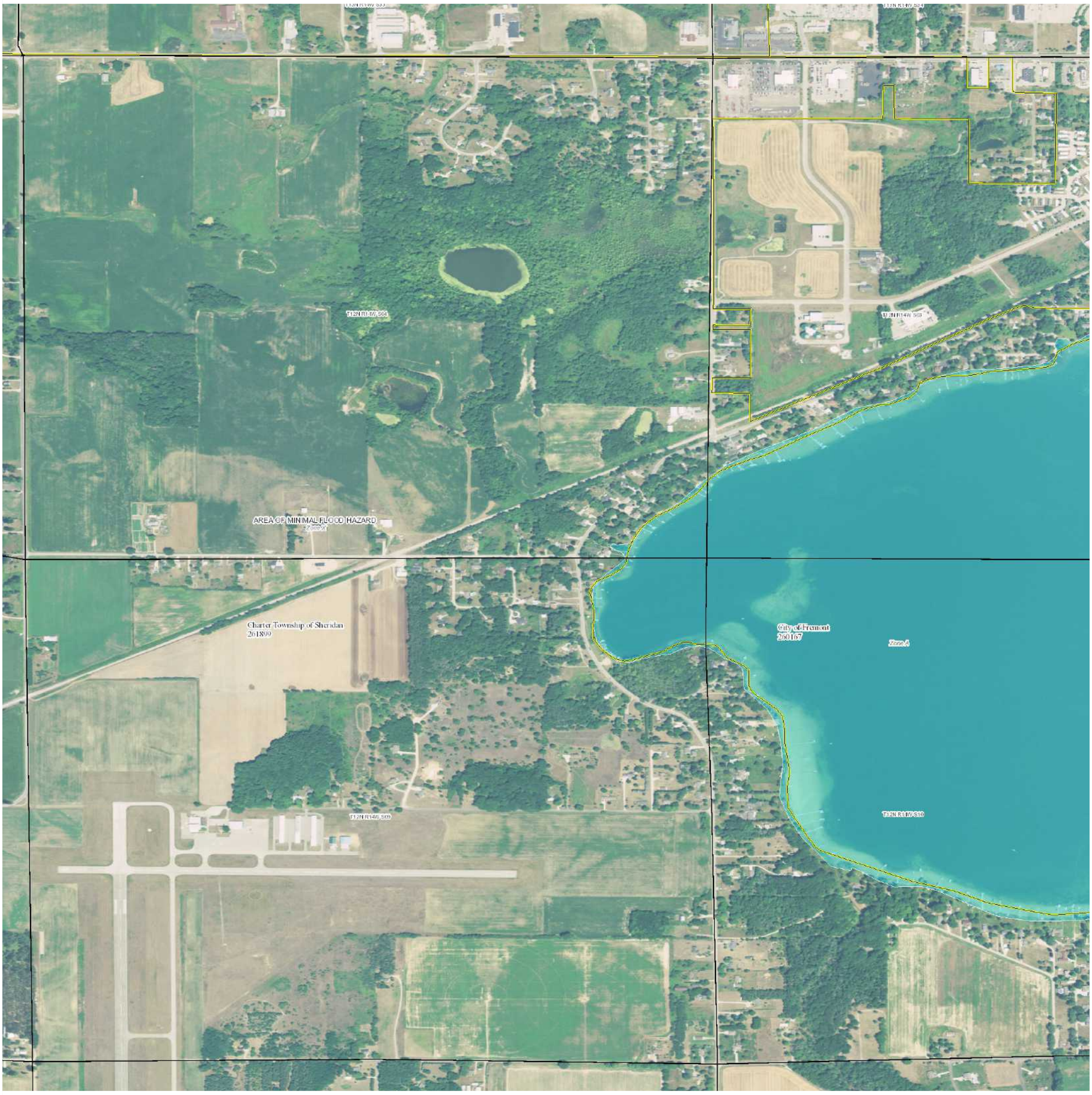
COMMUNITY	NUMBER	PANEL
CITY OF FREMONT MICHIGAN	260167	0406
TOWNSHIP OF DAYTON MICHIGAN	261402	0406
TOWNSHIP OF SHERMAN MICHIGAN	261384	0406

MAP NUMBER
26123C0406D
EFFECTIVE DATE
02/18/2015

AREA OF MINIMAL FLOOD HAZARD

43°28'14.19"N

86°0'0.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°26'8.37"N

85°58'7.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **403** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
CHARTER TOWNSHIP OF SHERIDAN MICHIGAN	261899	0403
CITY OF FREMONT MICHIGAN	260167	0403
TOWNSHIP OF DAYTON MICHIGAN	261402	0403

MAP NUMBER
26123C0403D
EFFECTIVE DATE
02/18/2015

43°28'14.19"N

85°58'8.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°26'8.37"N

85°56'14.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 12:04:56 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 404 OF 551

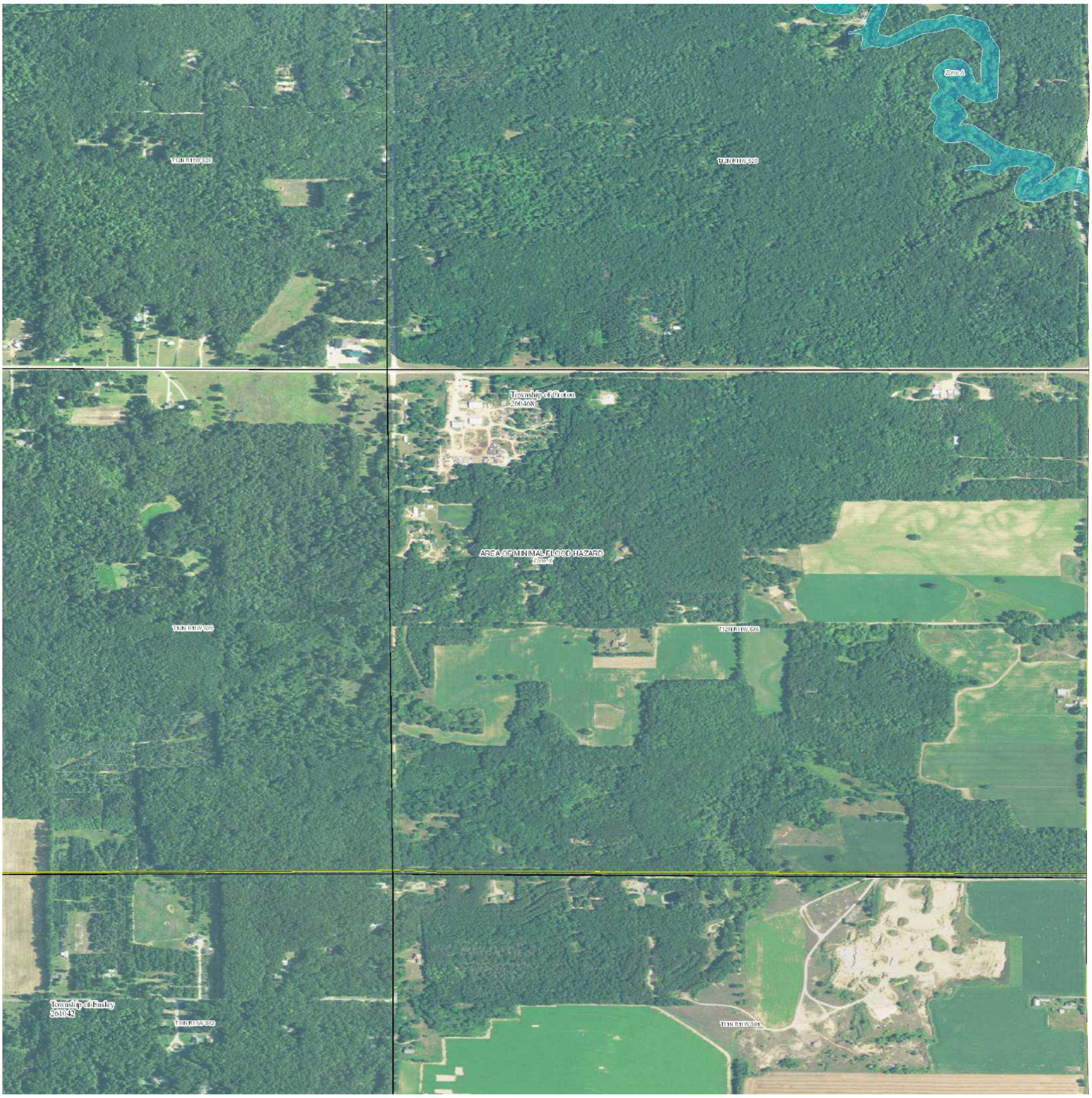
Panel Contains:

COMMUNITY	NUMBER	PANEL
CHARTER TOWNSHIP OF SHERIDAN MICHIGAN	261899	0404
CITY OF FREMONT MICHIGAN	260167	0404

MAP NUMBER
26123C0404D
EFFECTIVE DATE
02/18/2015

43°24'29.19"N

85°35'38.19"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°22'23.37"N

85°33'44.71"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 (B) — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- (8) — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **489** OF **551**

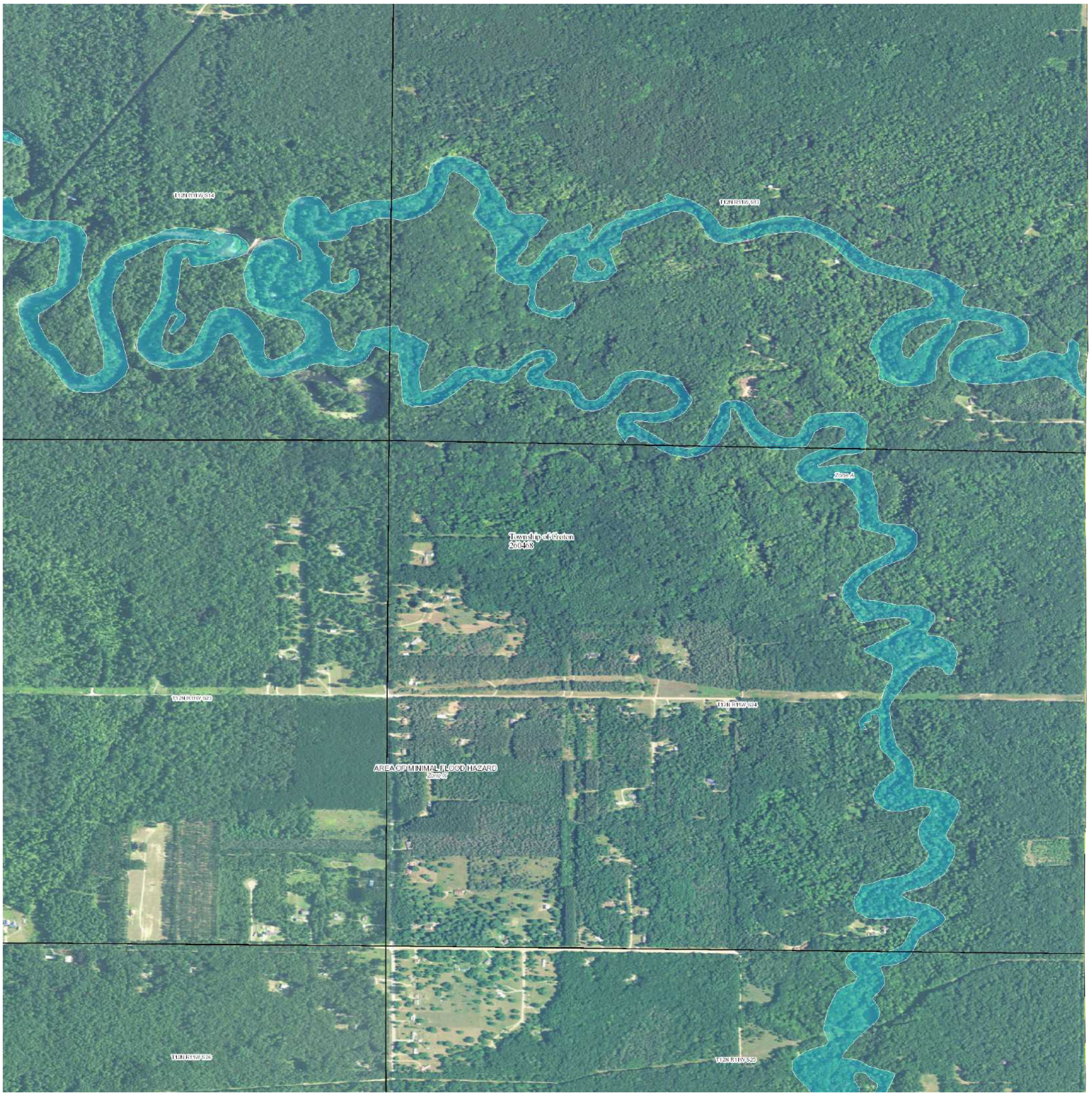
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ENSLEY MICHIGAN	261042	0489
TOWNSHIP OF CROTON MICHIGAN	260468	0489

MAP NUMBER
26123C0489D
EFFECTIVE DATE
02/18/2015

43°26'21.69"N

85°35'38.14"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°33'44.66"W

43°24'15.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **487** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF CROTON MICHIGAN	260468	0487

MAP NUMBER
26123C0487D
EFFECTIVE DATE
02/18/2015

43°26'21.69"N

85°37'30.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°24'15.87"N

85°35'37.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:57:45 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **486** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF CROTON MICHIGAN	260468	0486

MAP NUMBER
26123C0486D
EFFECTIVE DATE
02/18/2015

43°28'14.19"N

85°37'30.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°32'52.07"W

43°26'8.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:56:24 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

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GCS, Geodetic Reference System 1980;
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 478 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BIG PRAIRIE MICHIGAN	260465	0478
TOWNSHIP OF CROTON MICHIGAN	260468	0478

MAP NUMBER
26123C0478D
EFFECTIVE DATE
02/18/2015

43°26'21.69"N

85°39'23.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°24'15.87"N

85°37'29.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:42:03 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
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Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 467 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF CROTON MICHIGAN	260468	0467

MAP NUMBER
26123C0467D
EFFECTIVE DATE
02/18/2015

43°28'14.19"N

85°39'23.01"W

85°37'29.53"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°26'8.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:55:11 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 459 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BIG PRAIRIE MICHIGAN	260465	0459
TOWNSHIP OF CROTON MICHIGAN	260468	0459

MAP NUMBER
26123C0459D
EFFECTIVE DATE
02/18/2015

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:53:36 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 458 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BIG PRAIRIE MICHIGAN	260465	0458
TOWNSHIP OF CROTON MICHIGAN	260468	0458
TOWNSHIP OF BROOKS MICHIGAN	260467	0458
TOWNSHIP OF EVERETT MICHIGAN	261404	0458

MAP NUMBER
26123C0458D
EFFECTIVE DATE
02/18/2015

43°26'21.69"N

85°41'15.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°24'15.87"N

85°38'22.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:37:50 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 466 OF 551

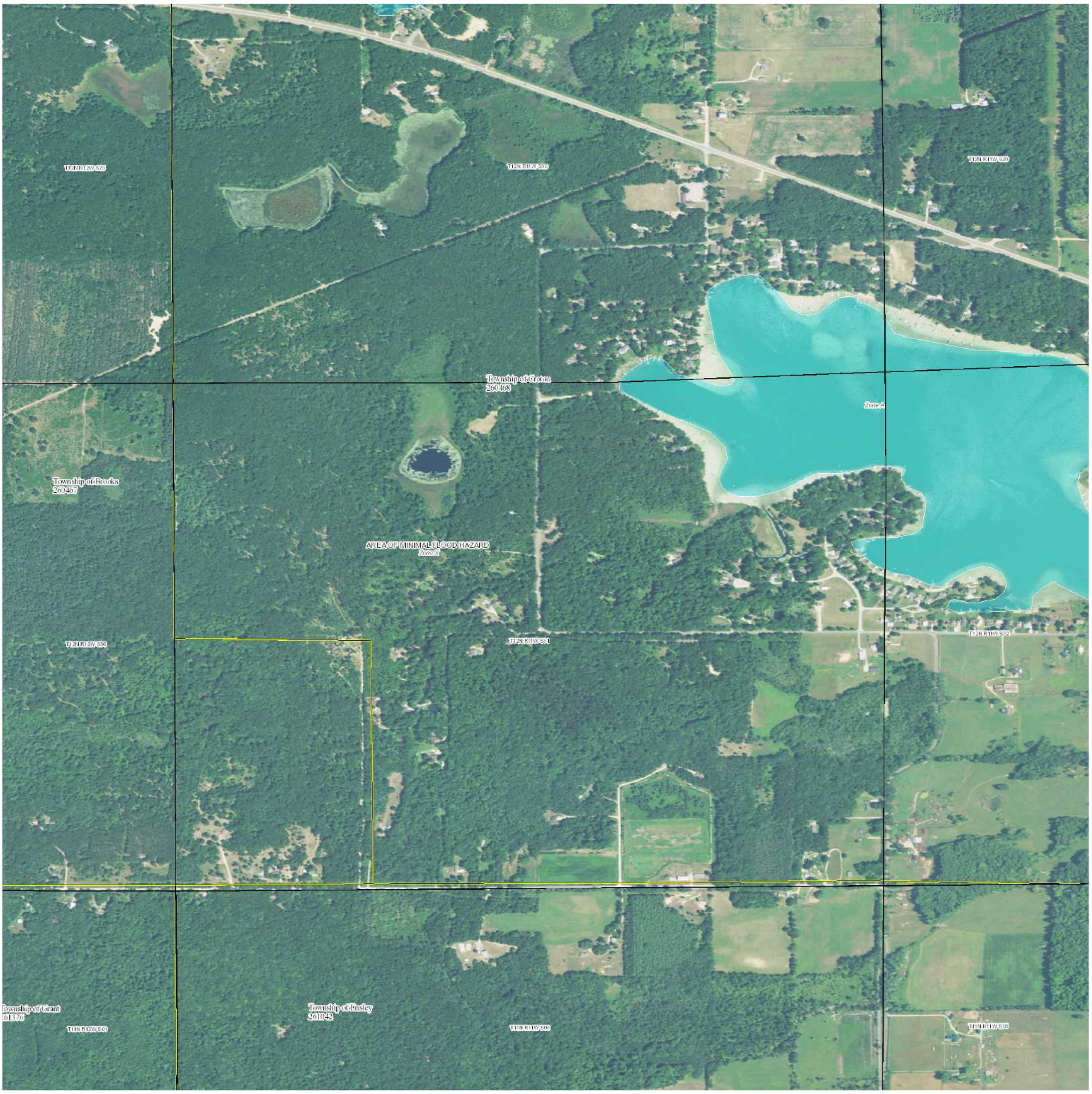
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF CROTON MICHIGAN	260468	0466
TOWNSHIP OF BROOKS MICHIGAN	260467	0466

MAP NUMBER
26123C0466D
EFFECTIVE DATE
02/18/2015

43°24'29.19"N

85°41'15.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°38'22.03"W

43°22'23.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
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Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **468** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ENSLEY MICHIGAN	261042	0468
TOWNSHIP OF GRANT MICHIGAN	261376	0468
TOWNSHIP OF CROTON MICHIGAN	260468	0468
TOWNSHIP OF BROOKS MICHIGAN	260467	0468

MAP NUMBER
26123C0468D
EFFECTIVE DATE
02/18/2015

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:40:03 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 469 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ENSLEY MICHIGAN	261042	0469
TOWNSHIP OF CROTON MICHIGAN	260468	0469

MAP NUMBER
26123C0469D
EFFECTIVE DATE
02/18/2015

Township of Hawke
26457

43°26'21.69"N

85°43'8.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°41'14.53"W

43°24'15.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **462** OF **551**

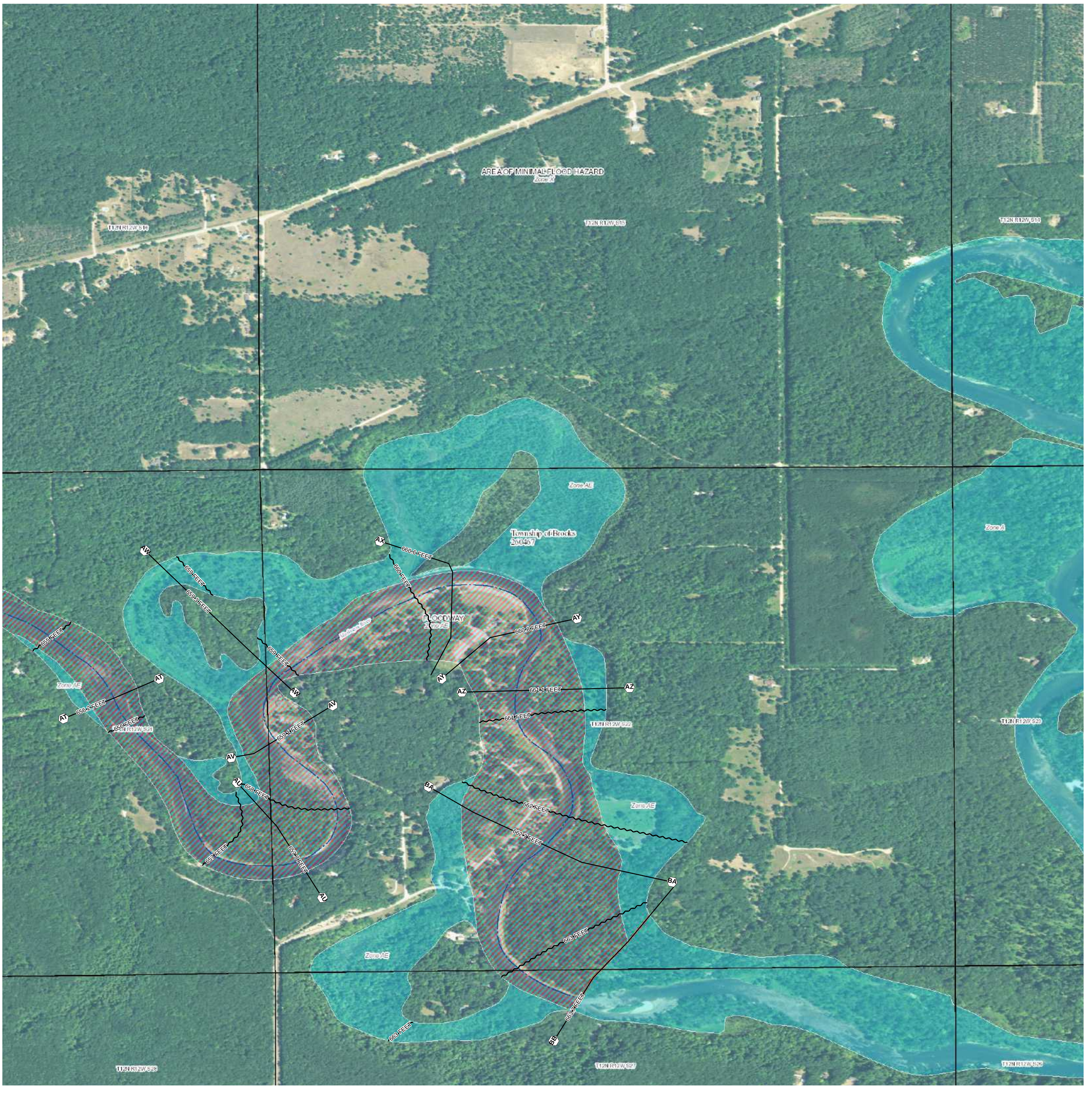
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BROOKS MICHIGAN	260467	0462

MAP NUMBER
26123C0462D
EFFECTIVE DATE
02/18/2015

43°26'21.69"N

85°45'0.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°43'7.03"W

43°24'15.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:35:44 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **461** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BROOKS MICHIGAN	260467	0461

MAP NUMBER
26123C0461D
EFFECTIVE DATE
02/18/2015

43°26'21.69"N

85°46'53.01"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°24'15.87"N

85°44'59.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:31:49 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 442 OF 551

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF NEWAYGO MICHIGAN	260340	0442
TOWNSHIP OF BROOKS MICHIGAN	260467	0442

MAP NUMBER
26123C0442D
EFFECTIVE DATE
02/18/2015

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:30:38 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

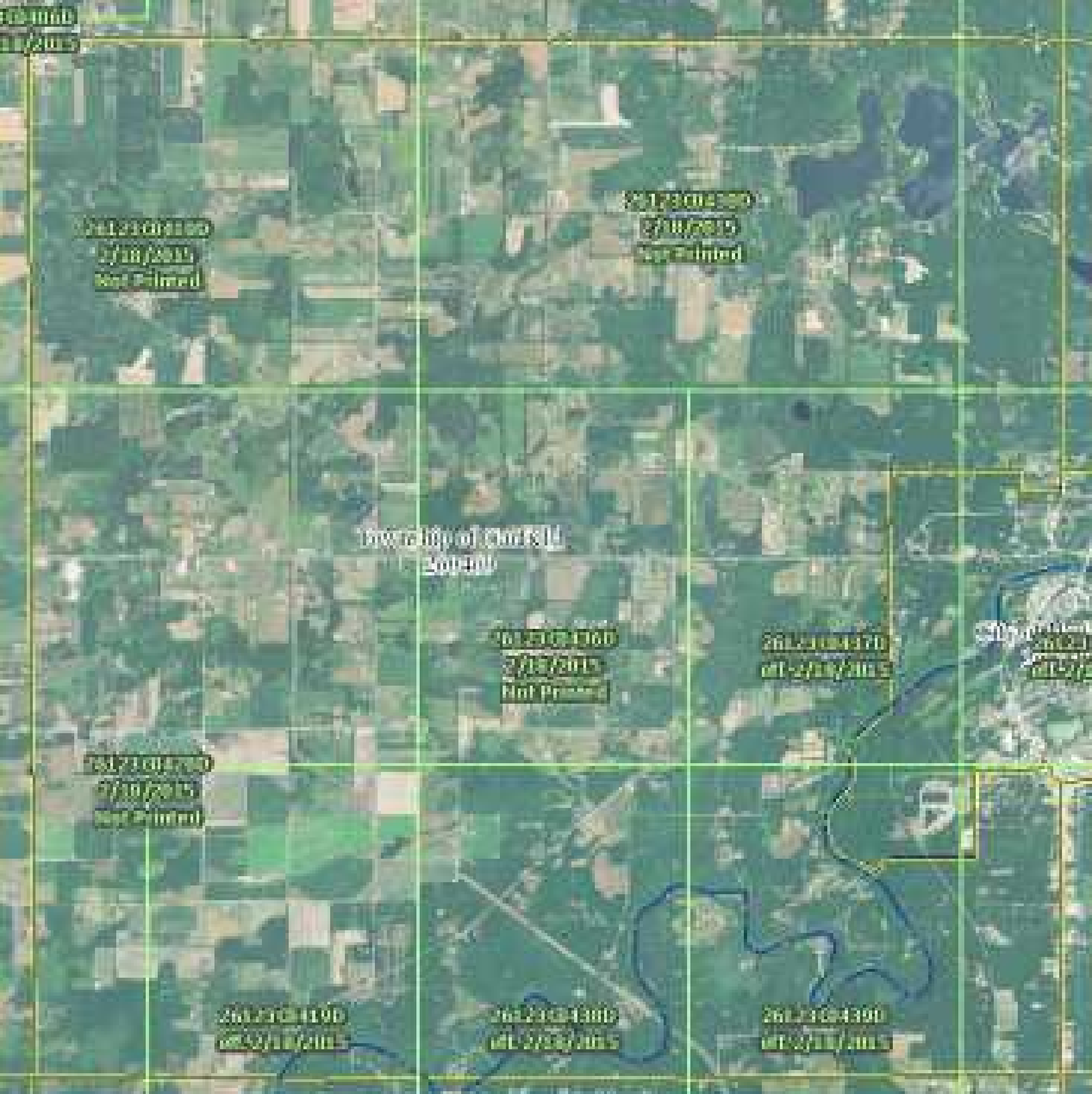
NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **441** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF NEWAYGO MICHIGAN	260340	0441
TOWNSHIP OF BROOKS MICHIGAN	260467	0441
TOWNSHIP OF GARFIELD MICHIGAN	260469	0441

MAP NUMBER
26123C0441D
EFFECTIVE DATE
02/18/2015


261330
7/18/2015
Not Printed
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7/18/2015
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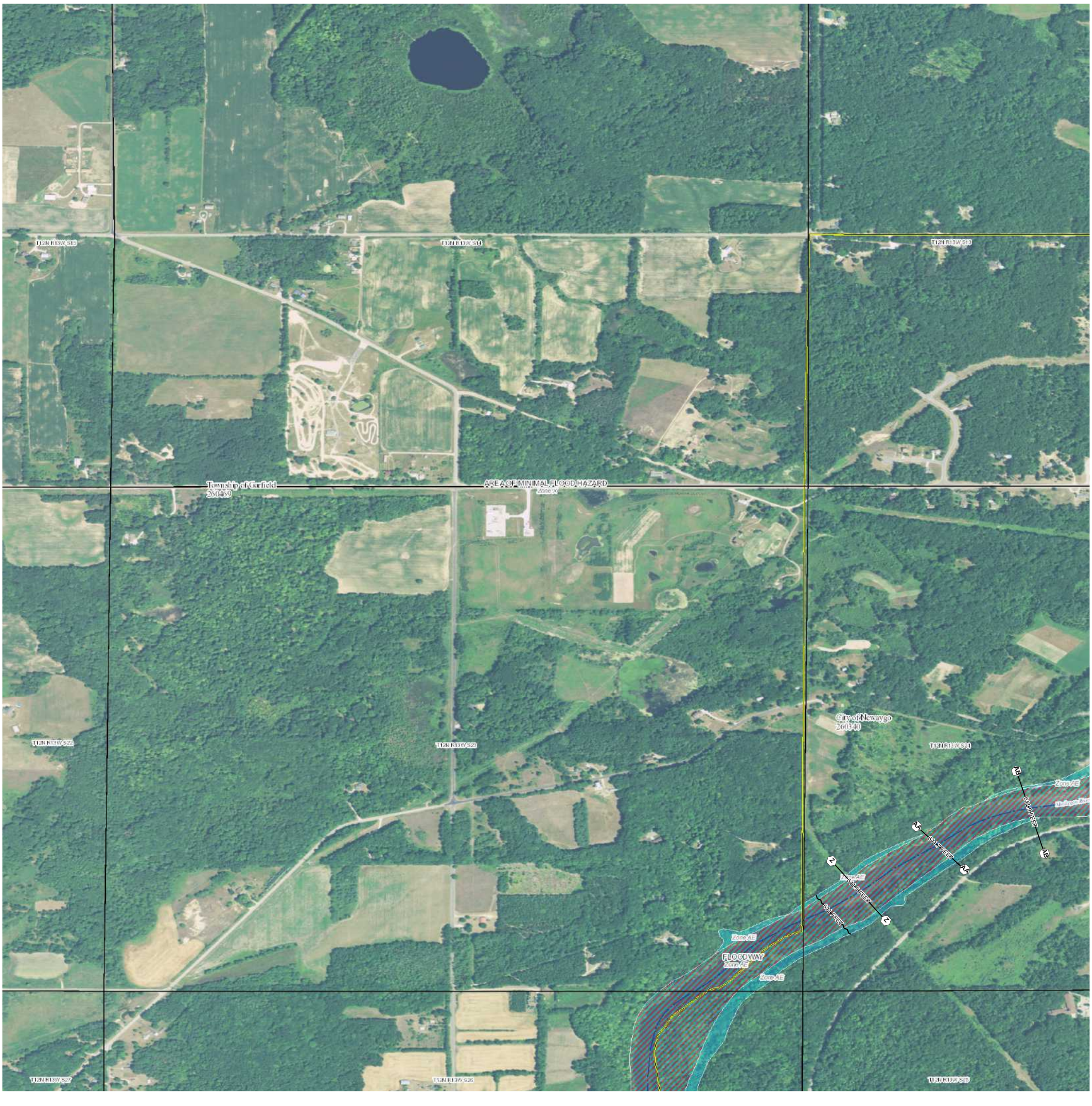
261330
7/18/2015
Not Printed
261330
7/18/2015
Not Printed



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:29:35 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 437 OF 551

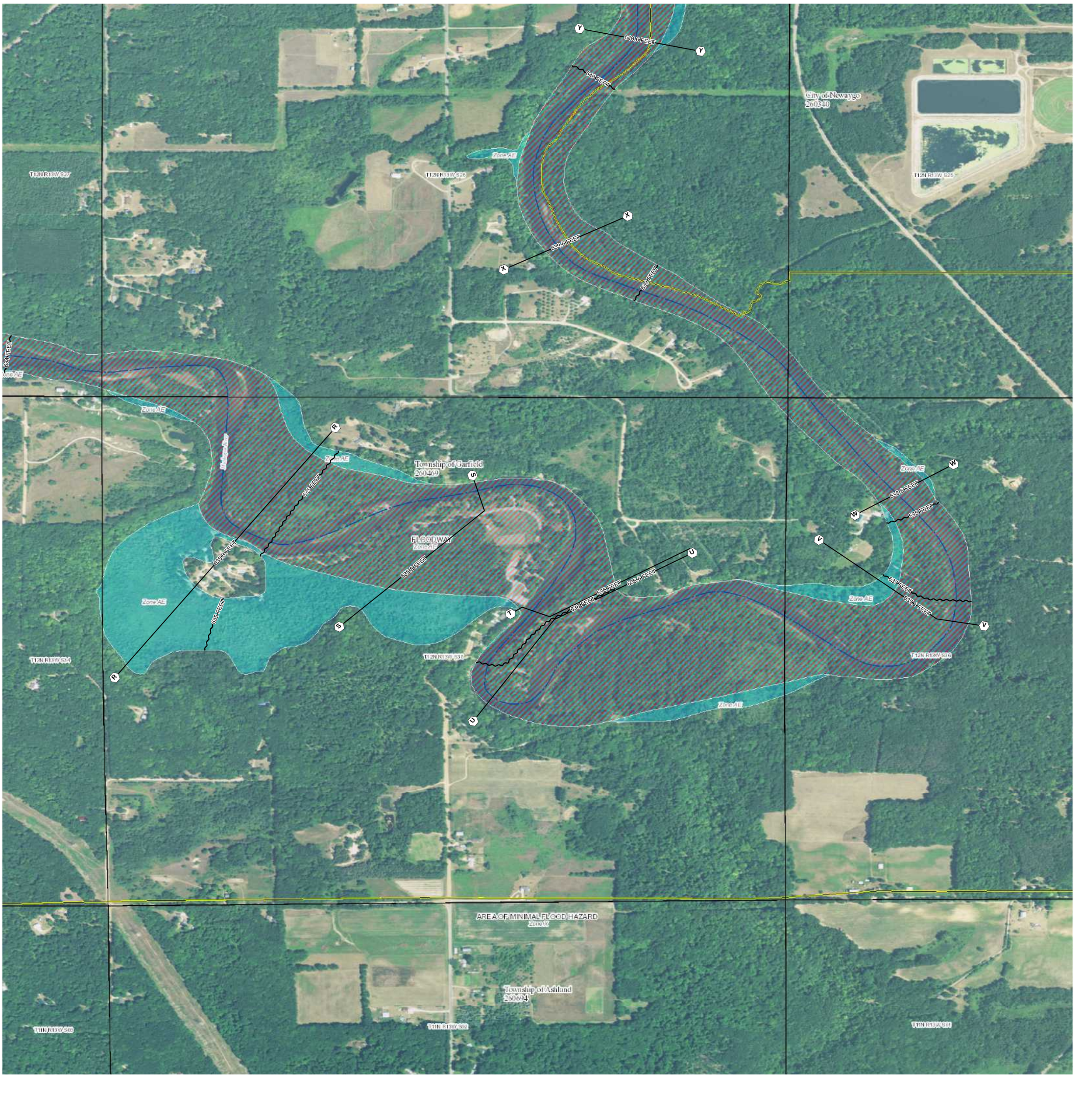
Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF NEWAYGO MICHIGAN	260340	0437
TOWNSHIP OF GARFIELD MICHIGAN	260469	0437

MAP NUMBER
26123C0437D
EFFECTIVE DATE
02/18/2015

43°24'29.19"N

85°50'38.01"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°22'23.37"N

85°48'44.53"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:28:13 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 439 OF 551

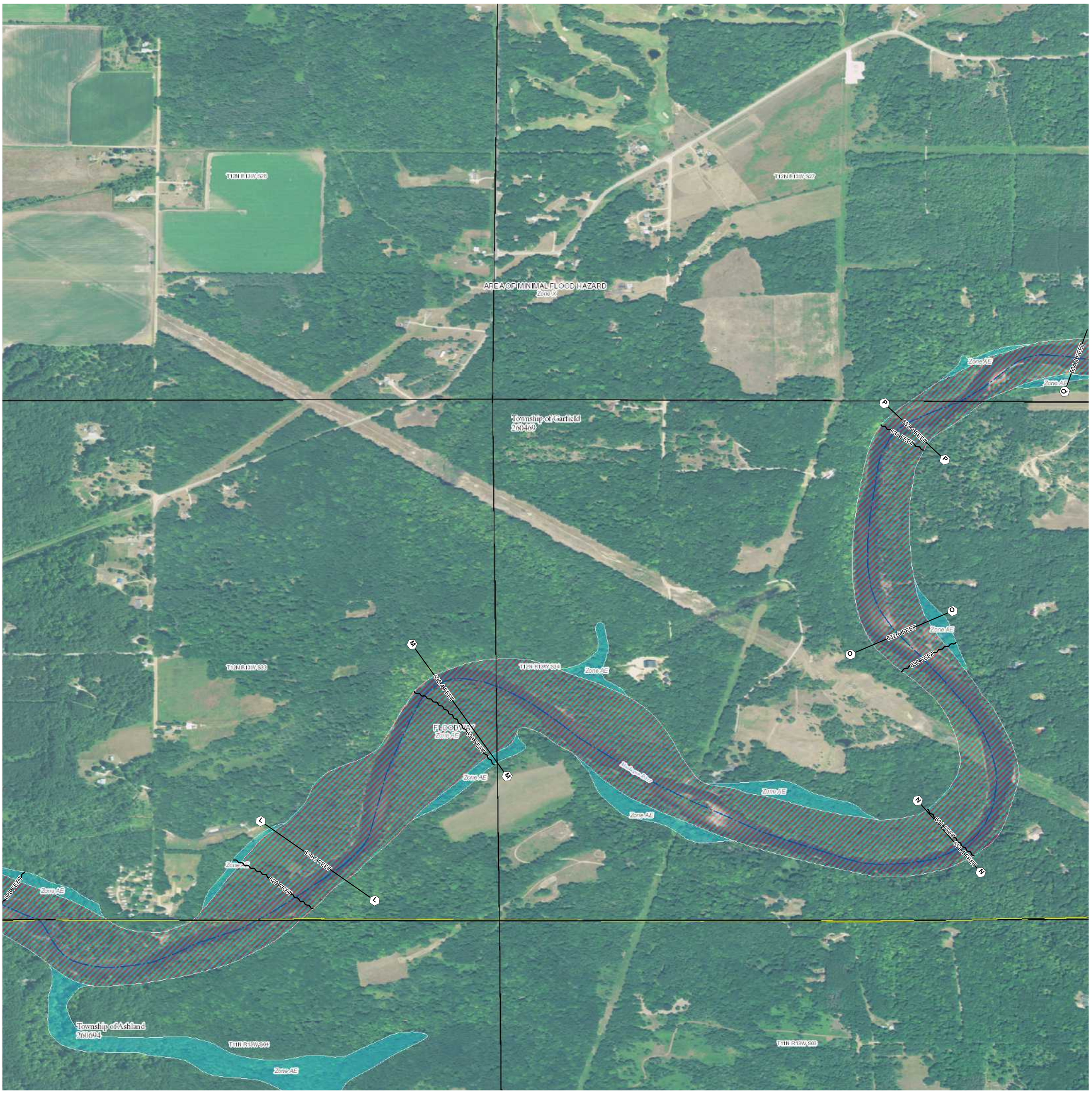
Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF NEWAYGO MICHIGAN	260340	0439
TOWNSHIP OF GARFIELD MICHIGAN	260469	0439
TOWNSHIP OF ASHLAND MICHIGAN	260694	0439

MAP NUMBER
26123C0439D
EFFECTIVE DATE
02/18/2015

43°24'29.19"N

85°52'30.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°52'27.03"W

43°22'23.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:26:25 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 438 OF 551

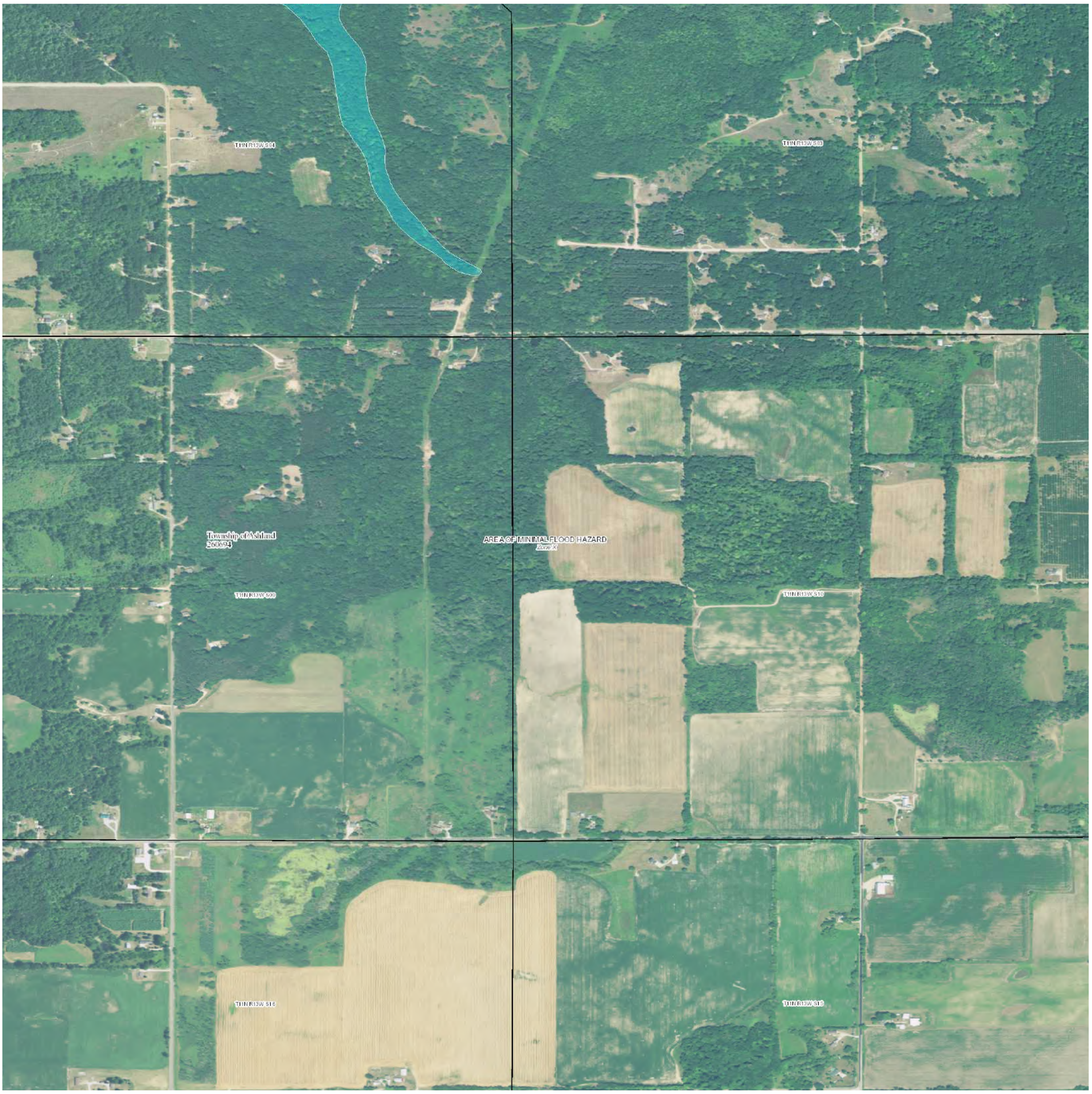
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF GARFIELD MICHIGAN	260469	0438
TOWNSHIP OF ASHLAND MICHIGAN	260694	0438

MAP NUMBER
26123C0438D
EFFECTIVE DATE
02/18/2015

43°22'36.69"N

85°52'30.51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°20'30.87"N

85°50'32.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:27:14 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **551** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ASHLAND MICHIGAN	260694	0551

MAP NUMBER
26123C0551D
EFFECTIVE DATE
02/18/2015

43°24'29.19"N

85°54'23.01"W

T12N R13W S30

T12N R13W S29

T12N R13W S28

Township of Garfield
260469

AREA OF MINIMAL FLOOD HAZARD
Zone X

T12N R13W S31

T12N R13W S32

T12N R13W S33

Zone AE

627 FEET

Zone AE

Zone AE

J

626.7 FEET

J

K

628.1 FEET

K

629 FEET

626 FEET

Zone AE

FLOODWAY
Zone AE

Township of Ashland
260694

T11N R13W S06

T11N R13W S05

T11N R13W S04

624 FEET

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°52'29.53"W

43°22'23.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — 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 http://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 beordered 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.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:25:31 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **419** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF GARFIELD MICHIGAN	260469	0419
TOWNSHIP OF ASHLAND MICHIGAN	260694	0419

MAP NUMBER
26123C0419D
EFFECTIVE DATE
02/18/2015

26123004200
2/10/2015
Not Printed
26123004100
26123004300
26123004300
26123005310
26123005320
26123005310
Township of Ashland
26123005350
2/10/2015
Not Printed
26123005330
26123005340

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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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.

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:24:09 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **532** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ASHLAND MICHIGAN	260694	0532

MAP NUMBER
26123C0532D
EFFECTIVE DATE
02/18/2015

43°20'44.19"N

85°56'15.51"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°18'38.37"N

85°54'22.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 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.

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:19:46 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL 533 OF 551

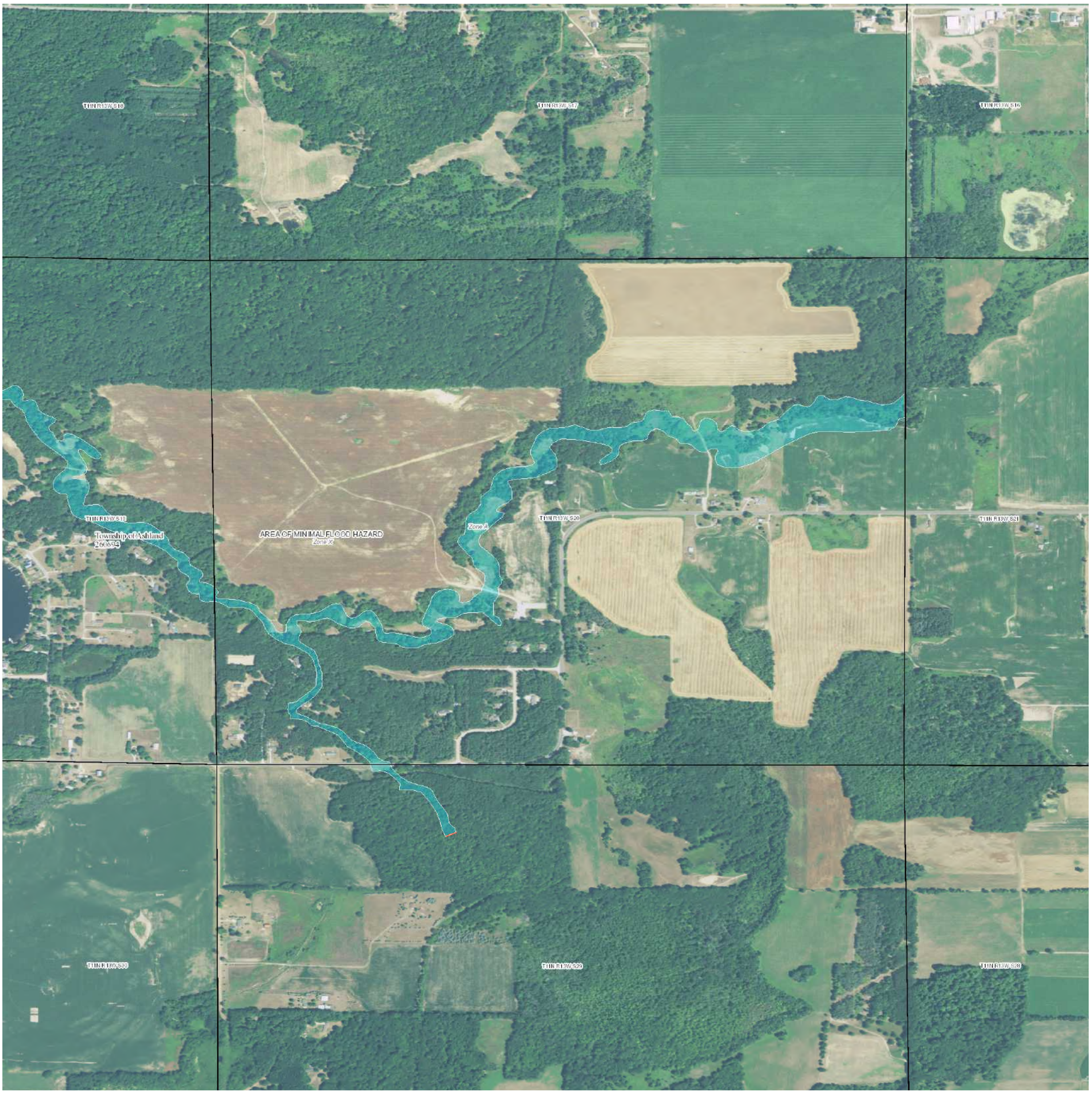
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ASHLAND MICHIGAN	260694	0533
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0533

MAP NUMBER
26123C0533D
EFFECTIVE DATE
02/18/2015

43°20'44.19"N

85°54'23.01"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°52'29.53"W

43°18'38.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 2:40:50 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **534** OF **551**

Panel Contains:

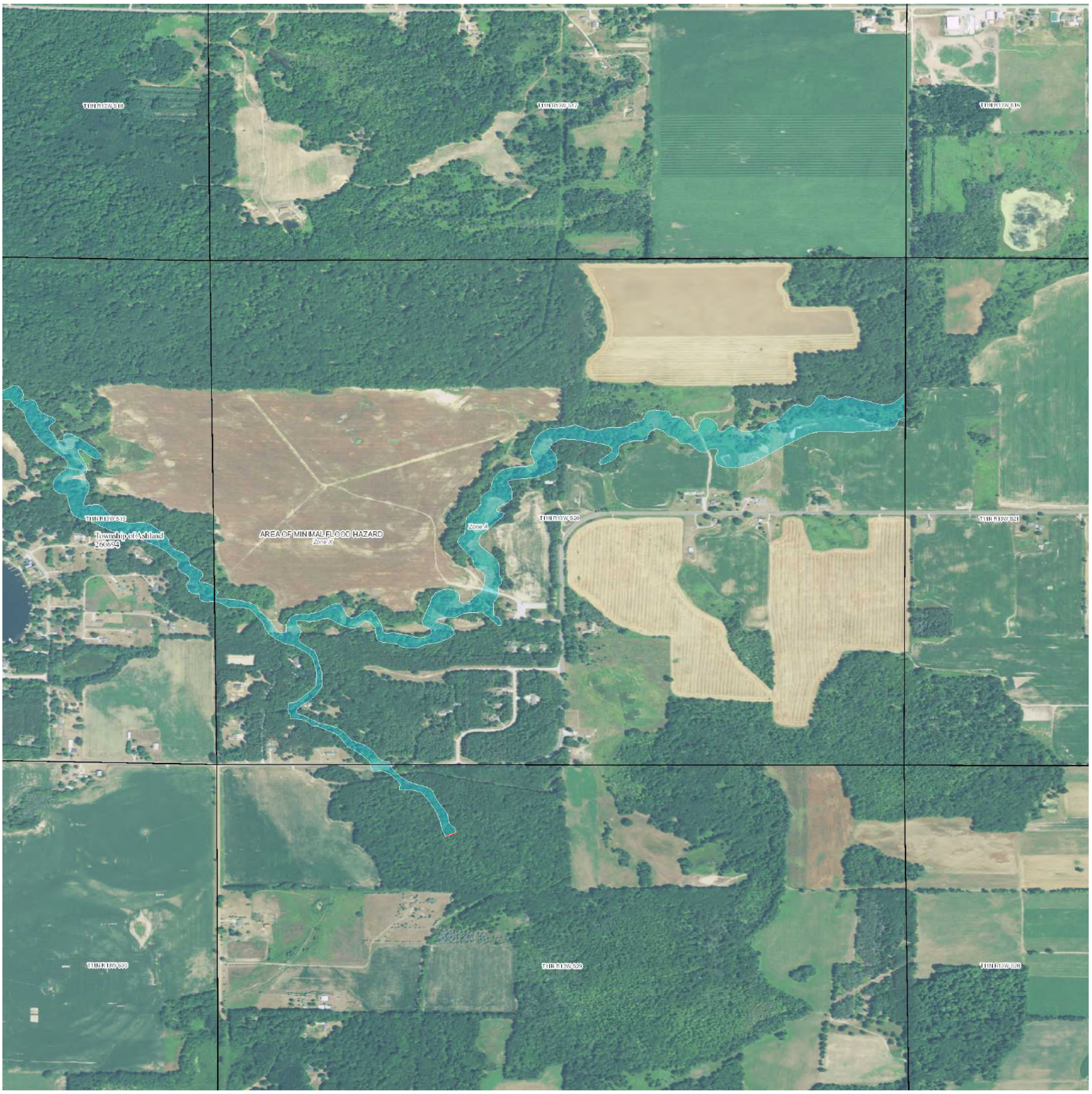
COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ASHLAND MICHIGAN	260694	0534

MAP NUMBER
26123C0534D
EFFECTIVE DATE
02/18/2015

26123C0100
2/18/2015
Not Printed
26123C0150
2/18/2015
Not Printed
26123C0200
2/18/2015
Not Printed
26123C0100
2/18/2015
Not Printed
26123C0250
eff. 2/18/2015
26123C0270
eff. 2/18/2015
26123C0310
eff. 2/18/2015
Township of Bridgeton
26123C0290
eff. 2/18/2015
26123C0250
eff. 2/18/2015
26123C0270
eff. 2/18/2015
26123C0310
eff. 2/18/2015
26123C0250
2/18/2015
Not Printed
26123C0300
2/18/2015
Not Printed

43°20'44.19"N

85°54'23.01"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°52'29.53"W

43°18'38.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

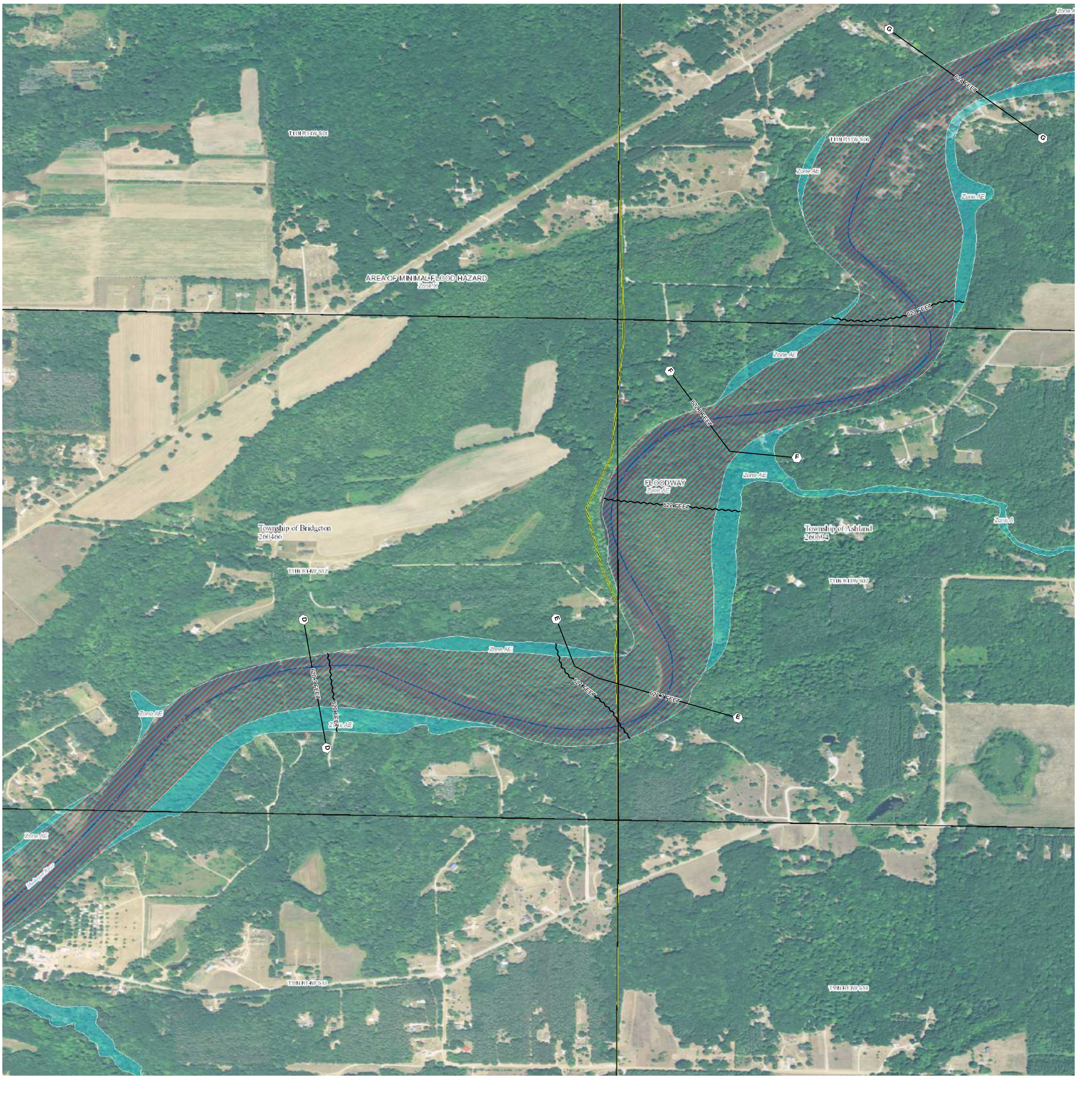
NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **534** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ASHLAND MICHIGAN	260694	0534

MAP NUMBER
26123C0534D
EFFECTIVE DATE
02/18/2015



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **531** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF ASHLAND MICHIGAN	260694	0531
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0531

MAP NUMBER
26123C0531D
EFFECTIVE DATE
02/18/2015

43°22'36.69"N

85°58'8.01"W

T11N R14W S03

T11N R14W S02

T11N R14W S01

AREA OF MINIMAL FLOOD HAZARD
Zone X

Township of Bridgeton
260466

T11N R14W S10

T11N R14W S11

T11N R14W S12

T11N R14W S15

T11N R14W S14

T11N R14W S13

Zone AE

Muskegon River

FLOODWAY
Zone AE

Zone A

A

B

C

61.8 FEET

61.9 FEET

619.9 FEET

619.5 FEET

61.9 FEET

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

85°56'14.52"W

43°20'30.87"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **527** OF **551**

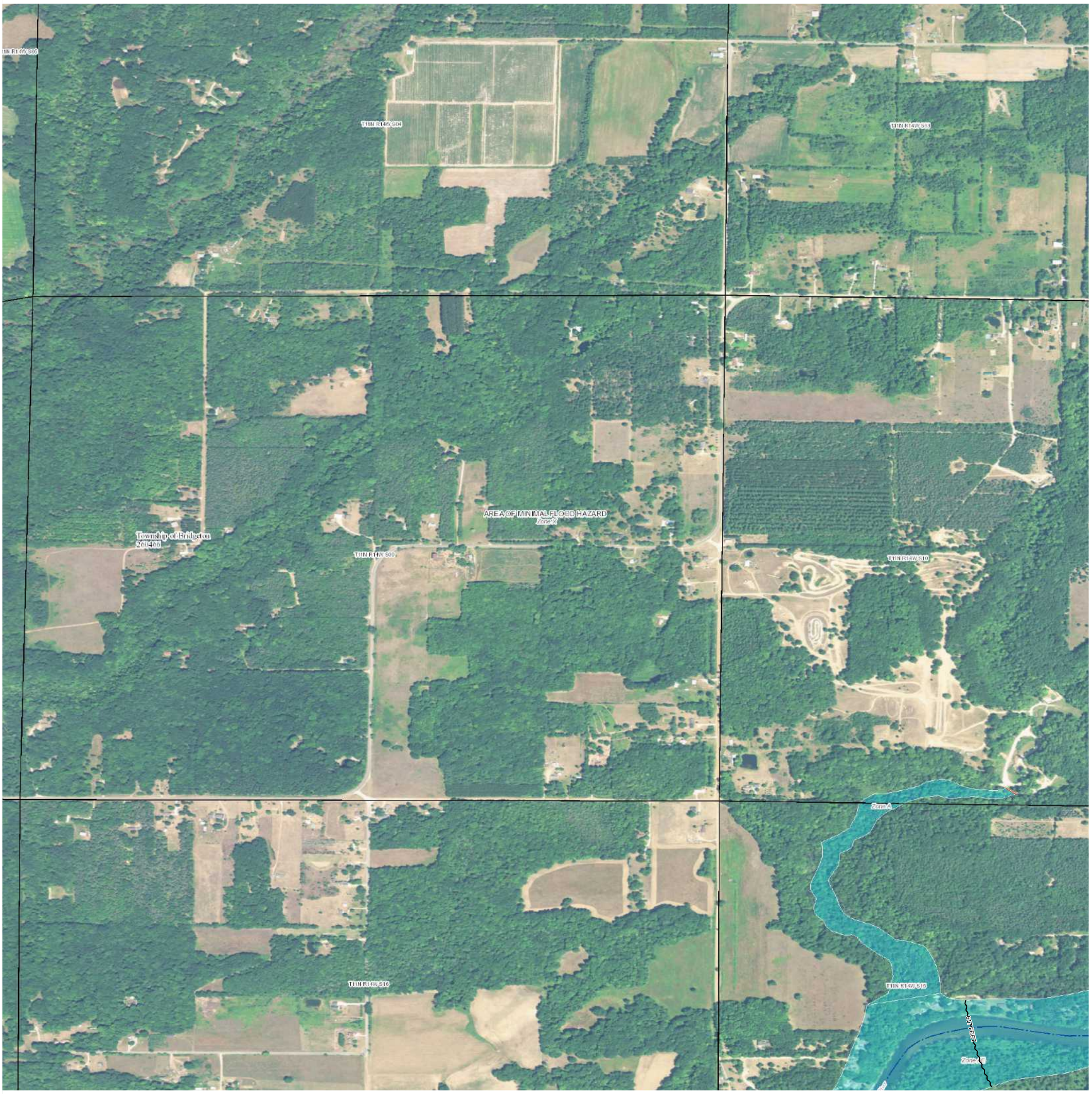
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0527

MAP NUMBER
26123C0527D
EFFECTIVE DATE
02/18/2015

43°22'36.69"N

86°00'51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°20'30.87"N

85°58'7.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:13:42 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **526** OF **551**

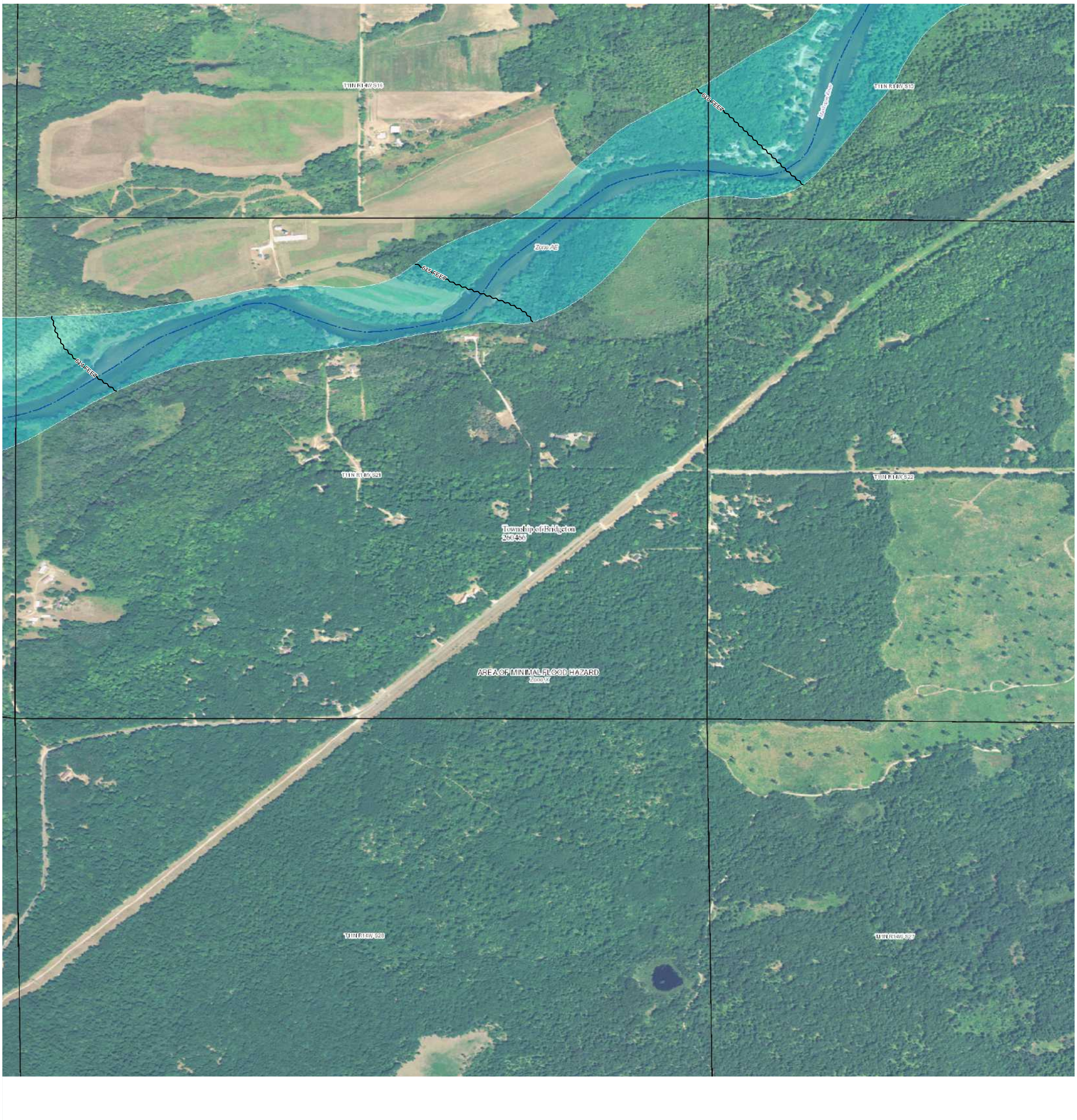
Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0526

MAP NUMBER
26123C0526D
EFFECTIVE DATE
02/18/2015

43°20'44.19"N

86°00'51"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°18'38.37"N

86°00'7.03"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:06:52 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

N

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GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **528** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0528

MAP NUMBER
26123C0528D
EFFECTIVE DATE
02/18/2015

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **11/18/2019 11:03:17 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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SCALE

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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **509** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0509

MAP NUMBER
26123C0509D
EFFECTIVE DATE
02/18/2015

43°20'44.19"N

86°3'3.34"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

86°1'9.85"W

43°18'38.37"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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SCALE

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0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **508** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0508
TOWNSHIP OF CEDAR CREEK MICHIGAN	261198	0508

MAP NUMBER
26123C0508D
EFFECTIVE DATE
02/18/2015

43°19'13.75"N

86°33'.21"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

43°17'7.93"N

86°31'.27"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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SCALE

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Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
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1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

NEWAYGO COUNTY, MICHIGAN ALL JURISDICTIONS

PANEL **516** OF **551**

Panel Contains:

COMMUNITY	NUMBER	PANEL
TOWNSHIP OF EGELSTON MICHIGAN	260680	0516
TOWNSHIP OF BRIDGETON MICHIGAN	260466	0516
TOWNSHIP OF CEDAR CREEK MICHIGAN	261198	0516

MAP NUMBER
26123C0516D
EFFECTIVE DATE
02/18/2015

Hazards Evaluation for County of Newaygo

Hazard	Flooding / Dam Failure					
Historical Occurrence (Frequency event is likely to occur)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	Low	**Medium**	**High**	**Excessive**	**20%**	1.4
	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=7 pts x 20%	
	Evaluation Data	Since 2000, Newaygo County has an average of 3 High Flow events over 5,000 CFS every year (Flood Advisory) and an average of less than 1 flooding event over 7,000 CFS every year (Flood Warning). However, in 2016 there were 2 Flood Advisories and 1 warning, in 2017 there were 5 Flood Advisories and 2 Warnings, in 2018 there were 3 Flood Advisories and 1 Warning, and in 2019 there were 5 Flood Advisories and 4 Warnings. In 2019 there was also 1 low hazard dam failure.				
Affected Area (Size of geographic area event can impact)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Single Site	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	2.0
	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 10 pts x 20%	
	Evaluation Data	River Flooding (Muskegon River) impacts 5 townships and 1 City. River Flooding (White River) impacts 4 townships, 1 City, and 1 Village. Widespread Area Flooding (low lying ground, ditches, roadways, creeks, and streams) can impact any township, city, or village in Newaygo County.				
Speed of Onset (Amount of time it takes for the incident to occur)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	> 24 hours notice	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	0.4
	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 4 pts x 10%	
	Evaluation Data	The Weather Prediction Center issues Excessive Rainfall Forecasts 3 days in advance. Once heavy rain falls over the area, depending on conditions, it takes approximately 12 -24 hours to impact the rivers. Widespread Area Flooding takes approximately less than 12 hours to impact low lying ground, ditches, roadways, creeks and streams.				
Casualty Effects (Deaths and Injuries)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	None	**Low**	**Medium**	**High Impact**	**10%**	1.0
	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 10 pts x 10%	
	Evaluation Data	Floods are the most common natural hazard in the United States in terms of number of lives lost and property damage. Most flooding deaths are due to driving or walking through flood waters. In Michigan, from 2010-2018, 4 people lost their lives from flooding. During the 1986 flood, 5 people were killed and 89 were injured.				
Economic Effects (Public and Private Damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Minimal	**Low**	**Medium**	**Significant Effects**	**10%**	1.0
	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 10 pts x 10%	
	Evaluation Data	Since 2000, Newaygo County has had 17 flooding events totaling in over $12 million in damages. The most recently Federally Declared Flooding Event in 2013 caused $5 million in damages alone.				

Hazard	Flooding / Dam Failure					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.5
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 10 pts x 5%	
	Evaluation Data	On average, most flood waters stay elevated for less than 1 week. However, during the 2013 flood, water remained elevated for 13 days. During the 2014 flood, water remained elevated for 8 days. During the 2018 flood, water remained elevated for 7 days. Worst case events and dam failures can actively cause damages for longer than 1 week.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.5
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	Flooding can occur any time of the year. Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Newaygo County has recorded flood events every month of the year with the exception of August and November.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.2
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 4pts x 5%	
	Evaluation Data	The Weather Prediction Center issues Excessive Rainfall Forecasts 3 days in advance. On average, for every 1 inch of rain that falls upstream in Mecosta County the Muskegon River will raise 1 foot. Due to the frequency of flooding events which have occurred, in addition to new warning system capabilities, the events are fairly predictable with knowledge of where the water will go, how deep it will be in low lying areas, and what impacts will be to structures.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	1.0
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 10 pts x 10%	
	Evaluation Data	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. 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.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.2
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 4pts x 5%	
	Evaluation Data	Due to advanced warning systems for floods and monitored dams, the public can be warned in advance in order to take protective measures.				
				Hazard Score Total		8.20

Hazards Evaluation for County of Newaygo

Hazard	Infrastructure Failure					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	= 10 pts x 20%	2.0
	Evaluation Data	Public and private utility infrastructure failures can occur at any time and in any place in Michigan and have the potential to affect hundreds of thousands of people. Each month there can be dozens to hundreds of incidents.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 10 pts x 20%	2.0
	Evaluation Data	Most failures are isolated and impact a small area. However, some failures when caused by severe weather can be widespread and impact multiple townships and cities. 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.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 10 pts x 10%	1.0
	Evaluation Data	Infrastructure failures can occur at any time and in any place with little to no warning. These events can occur as a primary event or as a secondary event from floods, windstorms, snow and ice storms, or other natural or technological hazards. When these events occur as a secondary hazard, the risk for failure may be noted in warning messages, but the location, impact, and duration is unknown until it occurs.				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 4 pts x 10%	0.4
	Evaluation Data	Infrastructure failures can lead to disastrous public health and safety consequences if immediate actions are not taken. 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.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 10 pts x 10%	1.0
	Evaluation Data	On average, most infrastructure failures have low economic effects because they are isolated and short lived. However, during larger events when public damages occur and communities need to replace damaged older utility systems (water, sewer, etc), damages can be well over $100,000.00. in the spring of 2014, both the City of White Cloud and the City of Newaygo experienced water main breaks due to extreme winter weather causing a disruption in service to both communities.				

Hazard	Infrastructure Failure					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.35
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 7 pts x 5%	
	Evaluation Data	On average, Infrastructure Failures last 1 day to 1 week. Due to redundancies in place, it is very rare to have a service interruption for longer than 1 week.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.5
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	=10 pts x 5%	
	Evaluation Data	Infrastructure failures can occur any time of the year, however records show the most vulnerable time for power outages is in the spring and summer due to thunderstorms.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.5
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	=10 pts x 5%	
	Evaluation Data	When these events occur as a secondary hazard, the risk for failure may be noted in warning messages, but the location, impact, and duration is unknown until it occurs.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.40
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 4 pts x 10%	
	Evaluation Data	Infrastructure systems are independent, yet inter-related. 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. A failure of one of these system may cause a cascading failure of others if the system is not restored in a timely manner.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.5
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 10 pts x 5%	
	Evaluation Data	Advance warning is typically not available for infrastructure failures. Monitoring systems and public information is typically released after the failure has already occurred.				
				Hazard Score Total		8.65

Hazards Evaluation for County of Newaygo

Hazard	Wildfires					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	= 10 pts x 20%	2.0
	Evaluation Data	From 2013 - 2016, Newaygo County averaged 91 grass, woods, and illegal burns per year.				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 7 pts x 20%	1.4
	Evaluation Data	Most wildfires in Newaygo County impact a single site or neighborhood and are under 100 acres in size. However, Newaygo County has 7 identified high risk wildland urban interface areas where wildfires can spread rapidly. The risk of a larger fire impacting 1 or 2 townships is greater in these locations.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 10 pts x 10%	1.0
	Evaluation Data	Burn bans and Red Flag Warnings are issued for hazardous fire conditions which may be present in the area. This indicates the speed of which fire may grow once it ignites however it does not indicate when or where a fire ignites and what it may impact as it spreads.				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 4 pts x 10%	0.40
	Evaluation Data	In 2018, 1.3 % of fire related deaths and 2.9% of fire related injuries in Michigan resulted from Outdoor fires. Casualties from Wildfire can result from burnover, heat attack, vehicle accidents, or deadfall. Modern firefighting methods have helped contain fires and limit injuries and deaths.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 10 pts x 10%	1.0
	Evaluation Data	In Michigan, more recent fires have been much smaller and contained by modern firefighting methods with better records of the destruction they caused. Almost all of the thousands of yearly fires in the state are only a few acres, although 100-200 homes are damaged each year by these small fires. Damage or loss of 1 or more structures can cause well over $100,000 in private damages.				

Hazard	Wildfires					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.50
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 10pts x 5%	
	Evaluation Data	Most wildfires in Michigan are resolved quickly in under 12 hours. However, larger wildfires in Newaygo County (April 1994 and May 2018) lasted 1 day to 1 week and high intensity fires such as the Four Mile Road Fire in Crawford County, the Meridian Boundary Fire in Kalkaska County, and the Duck Lake Fire in Luce County lasted more than 1 week. As Newaygo County contains a large portion of the Huron Manistee National Forest, a large wildfire does have the potential to last more than 1 week.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.35
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 7pts x 5%	
	Evaluation Data	Wildfires can occur in Newaygo County in the Spring, Summer, and Fall before green-up and when vegetation is dry.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.50
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 10 pts x 5%	
	Evaluation Data	Wildfires are unpredictable. They can spread quickly and be difficult to contain. Burn bans and Red Flag Warnings are issued for hazardous fire conditions which may be present in the area. This indicates the speed of which fire may grow once it ignites however it does not indicate when or where a fire ignites and what it may impact as it spreads.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.70
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 7 pts x 10%	
	Evaluation Data	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. Secondary risks from wildfire include erosion, infrastructure damage and failure, and traffic accidents from smoke and low visibility.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.35
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	=7pts x 5%	
	Evaluation Data	Wildfires can spread very quickly and conditions can change rapidly making it difficult to warn to public in advance of hazardous wildfire conditions in which emergency protective measures need to be taken. Often, if warnings are issued for an area, there is limited lead time to prepare.				
				Hazard Score Total	8.20	

Hazards Evaluation for County of Newaygo

Hazard	Thunderstorms					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=10 pts x 20%	2.0
	Evaluation Data	In general, Newaygo County has 32 - 36 Thunderstorm days per year				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	=10 pts x 20%	2.0
	Evaluation Data	Isolated thunderstorms can impact a small area while stronger thunderstorms can impact a large, widespread area across multiple counties.				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	=7 pts x 10%	0.70
	Evaluation Data	The NWS Storm Prediction Center issues thunderstorm and severe thunderstorm outlooks 3 days in advance, giving advance notice when conditions are favorable for thunderstorms, severe thunderstorms, hail, and tornadoes. Severe thunderstorm watches are issued when conditions become favorable for organized severe thunderstorms or tornadoes to develop. Once storms develop, there is typically several hours advance notice they will impact Newaygo County.				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 4 pts x 10%	0.40
	Evaluation Data	According to the National Weather Service records from 1959 through 2017, Michigan has incurred 110 lightning fatalities. Michigan's average deaths from lightning are approximately 1 per year, and injuries average about 5 per year. On July 30, 2012, Severe thunderstorms produced several reports of damaging wing gusts across portions of Newaygo County. Large trees fell on a home. Other large trees were also blown over. Two deaths were reported with this storm.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	=10 pts x 10%	1.0
	Evaluation Data	From 1950 – 2019, there were over 83 Severe Thunderstorm events or wind storms in Newaygo County causing five deaths, over $2 million in property damage and $50,000 in crop damage. With severe thunderstorms, there is also the threat of hail and lightning. Since 1950, there has been 42 hail events reported with $295,000 in property damage and $200,000 in crop damage, and there has been 1 lightning storm with $4,000 in property damage when lightning struck a house and ignited a fire that damaged the upper story in the Fremont area.				

Hazard	Thunderstorms					
Duration (How long is the event actively causing damages)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	Minimal	**Short**	**Medium**	**Long**	**5%**	
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 1 pt x 5%	0.05
	Evaluation Data	Thunderstorms are typically short lived often lasting no more than 30-40 minutes and fast moving (30 - 50 mph). Strong frontal systems may spawn one squall line after another composed of many individual thunderstorm cells.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	=10 pts x 5%	0.50
	Evaluation Data	Severe thunderstorms can occur anytime in Michigan, although they are most frequent during the warm spring and summer months from April through September.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	=4 pts x 5%	0.2
	Evaluation Data	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.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 10 pts x 10%	1.0
	Evaluation Data	Thunderstorms can bring hail, severe winds, lightning, heavy rain and tornadoes with them causing direct damage to homes and business, power lines, trees and agricultural crops. Indirectly, thunderstorms can cause flooding and dam failures, infrastructure failure, transportation accidents, and wildfires.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 4pts x 5%	0.2
	Evaluation Data	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.				
				Hazard Score Total	8.05	

Hazards Evaluation for County of Newaygo

Hazard	Tornados					
	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	= 1 pt x 20%	0.20
	Evaluation Data	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. Since 1950, Newaygo County has experienced 13 tornadoes causing 3 injuries and 2 deaths, $190,000 property damage, and $10,000 crop damage from tornadoes since 1950. Two significant tornados in Newaygo County include a F2 Tornado that struck Newaygo on September 26, 1951 at 2100, injuring three and killing one. On June 17, 1975 another F2 Tornado struck the County killing one person.				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 4 pts x 20%	0.80
	Evaluation Data	Tornadoes are typically on the ground for short periods of time (a few minutes) and affect a narrow path (less than one quarter mile wide) that typically track 16 miles. Some storms can produce multiple tornadoes causing longer damage paths. IE: In 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.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 10pts x 10%	1.0
	Evaluation Data	The National Storm Prediction Center does issue Tornado Watches in advance when conditions are favorable for tornadoes to occur. This typically occurs for less than 6 hours in advance of storms. Tornado Warnings are issued by the local NWS forecast office when the radar detects strong rotation or a trained spotter identifies a funnel cloud or tornado. However, a vast majority of Michigan tornadoes are typically classified as weak tornadoes (EF0 or EF1) with winds 65 -110 MPH. These tornadoes are typically enbeded in severe thunderstorms and labeled as spin-up tornadoes as they occur with very little to no notice and are gone just as quickly. All of Newaygo County's tornadoes fall into this category.				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 7pts x 10%	0.70
	Evaluation Data	Historically, Michigan has experienced several devastating, violent tornadoes. In 1953 the F5 Flint Tornado killed 115 people and injured 785 people. In 1956 the F4 Hudsonville Tornado killed 14 people and injured 200. In 1965, the F3 and F4 Palm Sunday Tornado Outbreak killed 53 and injured 800. Since upgrades to storm prediction, radar technology, and advance warning systems, casualties have significantly decreased. Since 1950, Newaygo County has experienced 13 tornadoes causing 3 injuries and 2 deaths, $190,000 property damage, and $10,000 crop damage from tornadoes since 1950. Two significant tornados in Newaygo County include a F2 Tornado that struck Newaygo on September 26, 1951 at 2100, injuring three and killing one. On June 17, 1975 another F2 Tornado struck the County killing one person.				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 7 pts x 10%	0.70
	Evaluation Data	Since 1950, Newaygo County has experienced 13 tornadoes causing 3 injuries and 2 deaths, $190,000 property damage, and $10,000 crop damage from tornadoes since 1950. Most tornado damages in Newaygo County range from $25,000 to $50,000. However, Tornadoes do have the the potential to cause mass destruction in a short amount of time.				

Hazard	Tornados					
Duration (How long is the event actively causing damages)	✔ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.05
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 1 pt x 5%	
	Evaluation Data	Tornadoes are on the ground for very short periods of time (on average just a few minutes)				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	✔ 7 pts	☐ 10 pts	Weight	Score
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.35
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	=7 pts x 5%	
	Evaluation Data	Tornadoes in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the polar regions to generate severe thunderstorms. These thunderstorms often produce the violently rotating columns of wind known as funnel clouds. In Newaygo County, tornadoes have occurred in March, April, May, June, July, August, September, and November.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☐ 4 pts	☐ 7 pts	✔ 10 pts	Weight	Score
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.50
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	=10 pts x 5%	
	Evaluation Data	Michigan tornadoes are typically enbeded in severe thunderstorms and labeled as spin-up tornadoes as they occur with very little to no notice and are gone just as quickly. All of Newaygo County's tornadoes fall into this category and have occurred with little to no advance notice. It is also difficult to predict in advance the time, location, and magnitude of when these tornadoes occur.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☐ 7 pts	✔ 10 pts	Weight	Score
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	1.0
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 10 pts x 10%	
	Evaluation Data	Tornadoes causing direct damage to homes and business, power lines, trees and agricultural crops. Indirectly, tornadoes can cause infrastructure failure, hazardous materials spills, and transportation accidents.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☐ 4 pts	✔ 7 pts	☐ 10 pts	Weight	Score
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.35
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	=7 pts x 5%	
	Evaluation Data	Although the National Weather Service does have an enhanced radar system and advance warning for tornadoes, a vast majority of Michigan tornadoes are typically classified as weak tornadoes (EF0 or EF1) with winds 65 -110 MPH. These tornadoes are typically enbeded in severe thunderstorms and labeled as spin-up tornadoes as they occur with very little to no notice and are gone just as quickly.				
				Hazard Score Total	5.65	

Hazards Evaluation for County of Newaygo

Hazard	Severe Winter Weather					
Historical Occurrence (Frequency event is likely to occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Low	**Medium**	**High**	**Excessive**	**20%**	2.0
	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	= 10 pts x 20%	
	Evaluation Data	Newaygo County averages 16 Winter Weather Advisories (Under 8" in 24 hours) and 4 Winter Storm Warnings (Over 8" in 24 hours) annually. Blizzard Warnings are rare. The last Blizzard Warning was issued in 2009. From 1950 to 2019, there has been a total of 87 winter weather events totaling $13,425,000 in property damage.				
Affected Area (Size of geographic area event can impact)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Single Site	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	2.0
	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 10 pts x 20%	
	Evaluation Data	Severe winter weather impacts a large, widespread area.				
Speed of Onset (Amount of time it takes for the incident to occur)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	> 24 hours notice	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	0.10
	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	=1 pt x 10%	
	Evaluation Data	Severe winter weather is a slow moving event allowing ample time for the National Weather Service to issue out advanced warnings. In addition, winter storms can range from moderate snow over a few hours to heavy snow that lasts for several days sometimes accompanied by strong winds, ice, sleet, or freezing rain.				
Casualty Effects (Deaths and Injuries)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	None	**Low**	**Medium**	**High Impact**	**10%**	0.40
	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 4 pts x 10%	
	Evaluation Data	Winter storm hazards can cause roof failures, power outages, and transportation accidents. Nationally, an average of 37 people lose their lives to winter weather annually. 2003 was the last winter storm death in Michigan. Many 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.				
Economic Effects (Public and Private Damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Minimal	**Low**	**Medium**	**Significant Effects**	**10%**	1.0
	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	=10 pts x 10%	
	Evaluation Data	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. In Newaygo County, from 1950 - 2019, there has been 87 total winter weather events totaling $13,425,000 in property damage.				

Hazard	Severe Winter Weather					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.35
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 7 pts x 5%	
	Evaluation Data	On average, Winter storm events can last from several hours to several days. On rare occasion, extreme cold temperature events during a polar vortex can last more than 1 week.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.35
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 7 pts x 5%	
	Evaluation Data	In general, the snowstorm season of the Southern Lower Peninsula runs from November to April each year. However, early season snowstorms can occur in mid to late October and late season snowstorms can occur in early May. Therefore, snowstorms can occur in Fall, Winter, and Spring.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.20
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	=4 pts x 5%	
	Evaluation Data	Winter Weather are fairly predictable and risk is known, sometimes, several days in advance. However, the closer it gets to the event occurring, the more accurate the forecast is.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	1.0
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	=10 pts x 10%	
	Evaluation Data	Most winter weather comes with the high possibility of secondary damages including infrastructure failure, transportation accidents, and flooding.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.05
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 1 pt x 5%	
	Evaluation Data	Due to their slow moving nature, severe winter weather is foretasted well in advance.				
				Hazard Score Total	7.45	

Hazards Evaluation for County of Newaygo

Hazard	Fires					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=10 pts x 20%	2.0
	Evaluation Data	Over 50 structure fires occur in Newaygo County annually.				
	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 1pt x 20%	0.2
	Evaluation Data	Structure fires typically impact 1 site or neighborhood				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 10pts x 10%	1.0
	Evaluation Data	Structure Fires occur with no advance notice or warning				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 4pts x 10%	0.40
	Evaluation Data	Newaygo County has had 3 fire fatalities since 2018 - 2018: 58 Year Old Male Died as a result of a smoking fire 2019: 73 Year Old Male Died from an unknown fire cause 2019: 59 Year Old Male Died from an unknown fire cause All homes were single family homes and the reported areas of origin were living rooms. It is unknown if smoke alarms were in use at the homes. In addition, Newaygo County has had a history of apartment complex fires, business fires, and congregate living center fires. Although these fires caused evacuations of the buildings, very few casualties resulted from these fires.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 10 pts x 10%	1.0
	Evaluation Data	Structure fires are very destructive and cause substantial private damage.				

Hazard	Fires					
Duration (How long is the event actively causing damages)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.20
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 4 pts x 5%	
	Evaluation Data	Almost all structure fires are minimal in duration (under 12 hours) however, large residential and commercial fires are short lived and are extinguished in under 24 hours.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	Structure fires can occur any time of the year				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.50
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 10 pts x 5%	
	Evaluation Data	Structure fires are unpredictable				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.40
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 4pts x 10%	
	Evaluation Data	There is some possibility of secondary damages from structure fires if the fire is in a commercial building containing chemicals or critical infrastructure it could cause a hazardous materials spill or critical infrastructure failure. IE: July 3, 2018, an orchard warehouse and cider processing building in Grant was destroyed by fire causing an anhydrous ammonia leak.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.50
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 10 pts x 5%	
	Evaluation Data	The public can not be warned in advance of a structure fire, only warned after a fire has occurred.				
				Hazard Score Total		6.70

Hazards Evaluation for County of Newaygo

Hazard	Criminal					
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=4 pts x 20%	0.8
	Evaluation Data	Newaygo County Sheriff's Office averages 63 violent crimes annually (2012-2018). Violent crime is composed of four offenses: murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault. Most of these crimes are dealt with internally by law enforcement officials and do not require an enhanced level of coordination. At times these events can lead to civil disturbances and potentially terrorism. However, it is rare for a terrorism or civil disturbance to occur.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 10pts x 20%	2.0
	Evaluation Data	Most criminal events effect 1 site or neighborhood. However, civil disturbances events such as protests and riots in addition to terrorism related events have the capacity to impact a large area.				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 7 pts x 10%	0.70
	Evaluation Data	Most violent crimes have no notice to minimal warning. Protest, riots, and civil unrest typically have more notice as individuals are communicating with each other to organize the event. Terrorism based crimes typically have some indicators but may not be recognized in advance.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 10 pts x 10%	1.0
	Evaluation Data	Criminal incidents including violent crimes, civil disturbances, and terrorism all run the risk of multiple casualties and deaths.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	=10 pts x 10%	1.0
	Evaluation Data	Criminal incidents have significant damages associated with them.				

Hazard	Criminal					
Duration	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
(How long is the event actively causing damages)	**Minimal**	**Short**	**Medium**	**Long**	**5%**	0.35
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 7pts x 5%	
	Evaluation Data	The duration of criminal incidents can vary greatly depending on the nature of the crime. Terrorism based incidents and civil disturbances have a tenancy to be longer in duration than violent crimes, which are typically short lived.				
Seasonal Pattern	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
(Time of Year the event can occur)	**1 Season**	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	Crimes can take place at any point throughout the year				
Predictability	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
(Ease of prediction for the time of occurrence, location, and magnitude)	**> Highly Predictable**	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.50
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 10 pts x 5%	
	Evaluation Data	Although there are advanced signs of crimes, terrorism, and civil disturbances which may be able to be detected stopping the crime - it is extremely difficult to predict the time of occurrence, location, and magnitude in advance until the crime occurs				
Collateral Damage	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
(Possibility of secondary damages and impacts)	**No possibility**	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.70
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 7 pts x 10%	
	Evaluation Data	The goal of terrorism, civil disturbances, and violent crimes is often to cause disruption by creating secondary damages and impacts to infrastructure and transportation. This hazard also has the potential to cause hazardous materials incidents and mass casualty.				
Availability of Warnings	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
(Public can be warned of hazard in a timely manner)	**Available**	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.50
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 10 pts x 5%	
	Evaluation Data	Warning for this hazard only occurs after the incident has started. In many cases, warning is not available at any point throughout the duration of the incident.				
				Hazard Score Total	8.05	

Hazards Evaluation for County of Newaygo

Hazard	Hazardous Materials					
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=4 pts x 20%	0.80
	Evaluation Data	Most hazardous materials events are minor in nature and do not require and enhanced level of support or response by technical teams and resources. These incidents are considered routine in nature and handled by the local fire department. On average, departments handle 5 - 10 routine calls each year. Larger incidents rising to the level of				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	=4 pts x 20%	0.80
	Evaluation Data	Most hazardous materials incidents only impact 1 neighborhood or site. Worst case scenarios they can impact up to a 1 mile radius.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 10 pts x 10%	1.0
	Evaluation Data	Hazardous materials incident have a rapid onset with minimal notice of when they will occur. They can be fixed site incidents or occur due to transpiration accidents.				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 7pts x 10%	0.70
	Evaluation Data	Hazardous materials incidents have the potential to cause direct and secondary causalities depending on the extremely hazardous substance released.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 10 pts x 10%	1.0
	Evaluation Data	Hazardous materials incidents are extremely costly to respond to and recover from. Often special resources are needed in order to prevent contamination and remediation at the site.				

Hazard	Hazardous Materials					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.35
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	=7 pts x 5%	
	Evaluation Data	Although some incidents may last longer in duration, m ost hazardous materials incidents last between 1 day to 1 week when they are actively releasing toxins and extremely hazardous substances into the environment causing damages.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	Hazardous materials incidents can occur year round				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.50
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 10pts x 5%	
	Evaluation Data	Hazardous materials incidents are unpredictable. It is unknown the location of the spill (unless at a fixed site), the time of occurrence, the amount of the release, the duration of the incident, or the impact it will have on the neighborhood.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.40
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 4pts x 10%	
	Evaluation Data	At times, hazardous materials incidents can cause infrastructure failure (ie: drinking water contamination) and transportation failure (ie: long term re-routes due to closures or road damage).				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.35
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 7pts x 5%	
	Evaluation Data	Some fixed sites containing hazardous materials have public warnings tied to monitoring systems within their facility. Although most sites do not have the capability to warn the public until well after an incident occurs.				
				Hazard Score Total		6.55

Hazards Evaluation for County of Newaygo

Hazard	Transportation Accidents					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	2.0
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=10 pts x 20%	
	Evaluation Data	On average, Newaygo county has 9 fatal motor vehicle traffic accidents annually.				
	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	0.20
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 1 pt x 20%	
	Evaluation Data	Often, transportation accidents involve only a singe site.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	1.0
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 10pts x 10%	
	Evaluation Data	Transportation accidents are no notice events				
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	0.70
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	=7pts x 10%	
	Evaluation Data	Historically, transportation accidents in Newaygo County typically have a low number of casualties because there is no freeway going through the jurisdiction. However, with M-82, M-37, M-20, and M-120, there is a risk of bus accidents, horse and buggy accidents, and multiple vehicle accidents with multiple passengers that has the capability to cause 6-10 casualties or more.				
	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	0.40
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	=4pts x 10%	
	Evaluation Data	Transportation accidents typically have a low damage cost. Damages are typically vehicles, however, sometimes infrastructure can also be damaged (roadways, power poles, etc).				

Hazard	Transportation Accidents					
Duration (How long is the event actively causing damages)	☑ **1 pt**	☐ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.05
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	=1 pt x 5%	
	Evaluation Data	Although recovery for larger accidents may take longer, transportation accidents are quick events which do not cause damage for more than 12 hours.				
Seasonal Pattern (Time of Year the event can occur)	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☑ **10 pts**	**Weight**	**Score**
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	Transportation accidents occur throughout the year				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☑ **10 pts**	**Weight**	**Score**
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.50
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 10 pts x 5%	
	Evaluation Data	Transportation accidents are no notice events				
Collateral Damage (Possibility of secondary damages and impacts)	☐ **1 pt**	☑ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.40
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 4pts x 10%	
	Evaluation Data	Transportation accidents do have some possibility of causing infrastructure failures and hazardous materials releases.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☑ **10 pts**	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.50
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 10 pts x 5%	
	Evaluation Data	There are no advance warning systems for transportation accidents. .5				
				Hazard Score Total		6.25

Hazards Evaluation for County of Newaygo

Hazard	Public Health					
	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=7pts x 20%	1.4
	Evaluation Data	In the last 10 years, the number and impacts of public health emergencies have been increasing: 2009 H1N1, 2014 - 2016 Ebola, 2016 - 2019 Hepatitis A Outbreak, Seasonal Influenza, Opioid Crisis, 2020 Coronavirus, 2019 West Nile virus and Easter Equine Encephalitis virus, Norovirus and salmonella outbreaks.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	=10 pts x 20%	2.0
	Evaluation Data	Public health emergencies are widespread and sometimes world wide.				
	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the incident to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 1 pt x 10%	0.10
	Evaluation Data	There are various systems in place world wide, across the United States, within the State, and locally to identify, monitor, and track various diseases and viruses that may impact the public. Public health emergencies are slow moving and occur over a very long timeframe.				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 10 pts x 10%	1.0
	Evaluation Data	Public health emergencies can cause widespread, high amount of casualties (infected/sick and deaths)				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred	= 10 pts x 10%	1.0
	Evaluation Data	Due to their duration, public health emergencies have a significant economic impact when it comes to economic losses (loss of business, loss of life, etc)				

Hazard	Public Health					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.50
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 10pts x 5%	
	Evaluation Data	Public Health emergencies are very long in duration and can last years.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10pts x 5%	
	Evaluation Data	Public Health				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.20
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 4pts x 5%	
	Evaluation Data	Although we know the disease or virus we are dealing with, it is difficult to forecast the number of casualties, impacts to the economy, and emergency protective measures needed in order to manage the incident. The scope and magnitude of the event can drastically change based on the resources available to mitigate the spread of the disease or virus.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	1.0
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 10 pts x 10%	
	Evaluation Data	Public health emergencies have a high possibility of causing a mass casualty incident which overwhelms the health care system and morgue resources. Public health emergencies also have a high possibility of causing infrastructure failures, collapse of supply chains, and failures of essential functions due a high percentage of the work force being ill at the same time.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.05
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 1 pt x 5%	
	Evaluation Data	Advanced warnings are available for public health emergencies through the world health, CDC, state, and local health departments				
				Hazard Score Total	7.75	

Hazards Evaluation for County of Newaygo

Hazard	Drought					
Historical Occurrence (Frequency event is likely to occur)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	Low	**Medium**	**High**	**Excessive**	**20%**	
	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	= 1 pt x 20%	0.20
	Evaluation Data	Drought is a low-profile hazard that does not get a lot of public attention in Michigan. However, parts of Michigan have a tendency to experience significant drought conditions about 20% of the time. Currently, Newaygo County is abnormally dry D0 and is close to a moderate drought D1. Extreme temperature incidents (heat advisories, excessive heat watches, excessive heat warnings, and 90 degree days) do not occur often, but are increasing in frequency. Muskegon set a record this year with 9 consecutive days. Grand Rapids had 6 days. Record in 11 days set in 1901. Kalamazoo had 8 consecutive days. Record is 14 days set in 1964. The last consecutive 90 degree days were in 2012 and 2013.				
Affected Area (Size of geographic area event can impact)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Single Site	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 10 pts x 20%	2.0
	Evaluation Data	Drought and extreme temperatures impact a large area.				
Speed of Onset (Amount of time it takes for the incident to occur)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	> 24 hours notice	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	= 1 pt x 10%	0.10
	Evaluation Data	Droughts and extreme temperature events are slow moving and take time to occur.				
Casualty Effects (Deaths and Injuries)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	None	**Low**	**Medium**	**High Impact**	**10%**	
	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 4 pts x 10%	0.40
	Evaluation Data	Extreme heat kills more people in the united states than any other hazard. A 30 year average shows 138 people die annually. However, Newaygo County does not have a history of heat related casualties outside of heat exhaustion and occasional heat stroke.				
Economic Effects (Public and Private Damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	Minimal	**Low**	**Medium**	**Significant Effects**	**10%**	
	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred		1.0
	Evaluation Data	Drought and extreme heat can have significant impacts and damage to crops, livestock, and infrastructure being overloaded. Drought can also lead to wildfires. In 2007, all 83 counties received drought disaster declarations from the U.S. Department of Agriculture due to crop losses from drought.				

Hazard	Drought					
Duration (How long is the event actively causing damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.50
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 10 pts x 5%	
	Evaluation Data	Drought and extreme temperatures can last longer than 1 week. The longer the duration - the greater the impact. 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).				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	Drought can occur year round but is more frequent in the Spring, Summer, and Fall. Since 2012 there have been 12 agricultural disaster declarations involving drought. These occurred in January, March, July, August, September, and November.				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☑ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.20
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 4 pts x 5%	
	Evaluation Data	As drought and extreme temperatures are slow moving events, they are fairly easy to predict and have able advance notice.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	0.70
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 7pts x 10%	
	Evaluation Data	Drought and extreme temperatures can cause infrastructure failures and wildfires. It also has the capability to cause a mass casualty incident due to heat exhaustion and heat stroke.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.05
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 1 pt x 5%	
	Evaluation Data	The US drought monitor and US National Weather Service monitor daily weather conditions in addition to forecast long term seasonal conditions and issue out advanced warnings when conditions are favorable for extreme heat and drought.				
				Hazard Score Total		5.65

Hazards Evaluation for County of Newaygo

Hazard	Geologic Hazards					
Historical Occurrence (Frequency event is likely to occur)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	☐ Weight	Score
	Low	**Medium**	**High**	**Excessive**	**20%**	0.20
	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr	=1 pt x 20%	
	Evaluation Data	The last case of celestial impacts impacting MI was on July 23, 2012. The last case of impacting objects impacting MI was on April 2018.				
Affected Area (Size of geographic area event can impact)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	Single Site	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	2.0
	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City	= 10 pts x 20%	
	Evaluation Data	Celestial impacts and impacting objects are large enough to have direct impacts on an extremely large geographical area. They can range in size from multiple states, to multiple countries, to worldwide impacts.				
Speed of Onset (Amount of time it takes for the incident to occur)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	Weight	Score
	> 24 hours notice	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	0.70
	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning	=7 pts x 10%	
	Evaluation Data	There are various types of celestial impacts (solar weather and disturbances) and impacting objects. Some occur with no advance notice - geomagnetic storms, coronal mass ejection, etc with take 8 minutes to reach earth; and some occur with ample advance notice - meteors, asteroids, comets, and other impacting objects. Even with ample advanced notice, the specific location impacted can very greatly from its likeliest paths. I: March-April 2018 Tiangong 1 Space Station Alert was expected to have debris falling within a particular mid-latitude zone which included southern Michigan. However, the remains of the space station all landed safely in the South Pacific Ocean on April 2.				
Casualty Effects (Deaths and Injuries)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
	None	**Low**	**Medium**	**High Impact**	**10%**	0.10
	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected	= 1 pt x 10%	
	Evaluation Data	There are no recorded deaths and injuries from these type of events in recent history. However, a large impacting object event could cause mass casualties in a very large area (up to 500 miles) and kill everything in ts radius. The likelihood of this type of event is marginal at best. 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.				
Economic Effects (Public and Private Damages)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	Weight	Score
	Minimal	**Low**	**Medium**	**Significant Effects**	**10%**	1.0
	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred		
	Evaluation Data	Geomagnetic storms and coronal mass ejections can cause damage to communications infrastructure and electrical systems. Impacting objects can cause damage to structures, infrastructure, and the environment. In addition, depending on the type of impacting object (ie: space stations, space shuttles, satellites, etc) it can also cause hazardous material spills. 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). The investigation and clean up from this incident cost almost $400 million.				

Hazard	Geologic Hazards					
Duration (How long is the event actively causing damages)	☑ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	0.05
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week	= 1 pts x 5%	
	Evaluation Data	Although it can take a long time to recover, these events occur quickly.				
Seasonal Pattern (Time of Year the event can occur)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	1 Season	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	0.50
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year	= 10 pts x 5%	
	Evaluation Data	These events can occur year round				
Predictability (Ease of prediction for the time of occurrence, location, and magnitude)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	> Highly Predictable	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	0.35
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict	= 7 pts x 5%	
	Evaluation Data	here are various types of celestial impacts (solar weather and disturbances) and impacting objects. Some occur with no advance notice - geomagnetic storms, coronal mass ejection, etc with take 8 minutes to reach earth; and some occur with ample advance notice - meteors, asteroids, comets, and other impacting objects. Even with ample advanced notice, the specific location impacted can very greatly from its likeliest paths. I: March-April 2018 Tiangong 1 Space Station Alert was expected to have debris falling within a particular mid-latitude zone which included southern Michigan. However, the remains of the space station all landed safely in the South Pacific Ocean on April 2.				
Collateral Damage (Possibility of secondary damages and impacts)	☐ 1 pt	☐ 4 pts	☐ 7 pts	☑ 10 pts	**Weight**	**Score**
	No possibility	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	1.0
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur	= 10 pts x 10%	
	Evaluation Data	Geomagnetic storms and coronal mass ejections can cause damage to communications infrastructure and electrical systems. Impacting objects can cause damage to structures, infrastructure, and the environment. In addition, depending on the type of impacting object (ie: space stations, space shuttles, satellites, etc) it can also cause hazardous material spills.				
Availability of Warnings (Public can be warned of hazard in a timely manner)	☐ 1 pt	☐ 4 pts	☑ 7 pts	☐ 10 pts	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	0.35
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time	= 7 pts x 5%	
	Evaluation Data	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				
				Hazard Score Total	6.25	

Hazards Evaluation for County of Newaygo

Hazard	Invasive Species					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	☐ Weight	Score
Historical Occurrence	**Low**	**Medium**	**High**	**Excessive**	**20%**	
(Frequency event is likely to occur)	<1 event / yr	1 event / yr	2-3 events / yr	4+ events / yr		
	Evaluation Data	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. 2020 - Gypsy Moth Infestation				
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Affected Area	**Single Site**	**Multiple Sites**	**Small Area**	**Large Area**	**20%**	
(Size of geographic area event can impact)	1 neighborhood or site	More than 1 neighborhood or site	1 or 2 townships or ¼ a City	3 or more townships or ½ a City		
	Evaluation Data					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Speed of Onset	**> 24 hours notice**	**12 – 24 hours notice**	**< 12 hours notice**	**Minimal or No Warning**	**10%**	
(Amount of time it takes for the occur to occur)	More than 24 hours advance notice	12 – 24 advance notice	< 12 hours advance notice	No advance notice or warning		
	Evaluation Data					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Casualty Effects	**None**	**Low**	**Medium**	**High Impact**	**10%**	
(Deaths and Injuries)	No casualties expected	1 – 5 Casualties expected	6 – 10 Casualties expected	10+ Casualties (deaths and injuries) expected		
	Evaluation Data					
	☐ 1 pt	☐ 4 pts	☐ 7 pts	☐ 10 pts	Weight	Score
Economic Effects	**Minimal**	**Low**	**Medium**	**Significant Effects**	**10%**	
(Public and Private Damages)	Under $10,000	$10,000 - $50,000	$50,000 - $100,000	Over $100,000 in monetary damages incurred		
	Evaluation Data					

Hazard	Invasive Species					
Duration **(How long is the event actively causing damages)**	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
	Minimal	**Short**	**Medium**	**Long**	**5%**	
	Lasts <12 Hours	Lasts 12 – 24 Hours	Lasts 1 Day – 1 Week	Lasts longer than 1 Week		
	Evaluation Data					
	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
Seasonal Pattern **(Time of Year the event can occur)**	**1 Season**	**2 Seasons**	**3 Seasons**	**Year Round**	**5%**	
	Occurs during only 1 season of the year	Occurs during 2 seasons of the year	Occurs during 3 seasons of the year	Can occur any time of the year		
	Evaluation Data					
	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
Predictability **(Ease of prediction for the time of occurrence, location, and magnitude)**	**Highly Predictable**	**Fairly Predictable**	**Somewhat Predictable**	**Unpredictable**	**5%**	
	100% accuracy	> 50% accuracy	< 50% accuracy	Extremely difficult to impossible to predict		
	Evaluation Data					
	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
Collateral Damage **(Possibility of secondary damages and impacts)**	**No possibility**	**Some Possibility**	**Good Possibility**	**High Possibility**	**10%**	
	0% chance	< 50% chance	50% - 75% chance	> 76% chance secondary hazard events and damage will occur		
	Evaluation Data					
Availability of Warnings **(Public can be warned of hazard in a timely manner)**	☐ **1 pt**	☐ **4 pts**	☐ **7 pts**	☐ **10 pts**	**Weight**	**Score**
	Available	**Sometimes**	**Generally Not**	**Unavailable**	**5%**	
	100% of the time	50% - 99% of the time	<50% of the time	0% of the time		
	Evaluation Data					
			Hazard Score Total			

Hazards Profile and Evaluation – County of Newaygo, 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**
Economic 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**

Hazards Profile and Evaluation – County of Newaygo, Michigan

Evaluation Criteria	**Criminal**	**Infrastructure Failure**	**Flooding / Dam Failure**	**Wildfires**	**Thunderstorm**	**Public Health**	**Severe Winter Weather**	**Fires**	**Hazardous Materials**	**Geologic Hazards**	**Transport**	**Drought**	**Tornado**
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**	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 x20% = **2.0**	Excessive 4+ events/yr 10 pts x20% = **2.0**	Medium 1 event/yr 4 pt x 20%= **0.8**	Low >1 event/yr 1 pt x20%= **0.2**	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**
Affected Area	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 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 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**	Large Area >3 Juris. 10 pts x20% = **2.0**	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**
Speed of Onset	Some <12 Hours 7 pts x 10% = **0.7**	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**	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**	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**	Minimal No Warning 10 pts x10% = **1.0**
Casualty Effects	High Impact >10 injured 10 pts x10% = **1.0**	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**	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**	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**	Medium <10 injured 7 pts x10%= **0.7**
Economic 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**	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**
Duration	Medium <1 Week 7 pts x5%= **0.35**	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**	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**	Long > 1 Week 10 pts x5%= **0.5**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**
Predictability	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**	Fairly Predict. >50% Accuracy 4 pts x 5%= **0.2**	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**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	Good <75% 7 pts x10%= **0.70**	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**	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**	High Poss. >75% 10 pts x10%= **1.0**	Some Poss. <50% 4 pts x 10%= **0.40**	Good <75% 7 pts x10%= **0.70**	High Poss. >75% 10 pts x10%= **1.0**
Availability of Warnings	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**	Generally Not <50% 7 pts x5%= **0.35**	Most of the time >75% 4 pts x 5%= **0.2**	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**	Generally Not <50% 7 pts x5%= **0.35**	Unavailable No Warnings 10 pts x5%= **0.5**	Available 100% 1 pt x 5%= **0.05**	Generally Not <50% 7 pts x5%= **0.35**
Hazard Score	**9.25**	**8.65**	**8.20**	**8.20**	**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**

Hazards Profile and Evaluation – City of Fremont, Michigan

Evaluation Criteria	Criminal	Infrastructure Failure	Fires	Flooding / Dam Failure	Hazardous Materials	Wildfires	Transport
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**	Low >1 event/yr 1 pt x 20%= **0.2**	Medium 1 events/yr 4 pts x 20%= **.8**	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**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	High Impact >10 injured 10 pts x10% = **1.0**	No Impact 0 injured 1 pt x10%= **0.1**	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**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	High Poss. >75% 10 pts x5%= **0.5**	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**	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**	Generally Not <50% 7 pts x5%= **0.35**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**8.15**	**7.40**	**6.35**	**6.35**	**6.25**	**5.40**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – City of Grant, Michigan

Evaluation Criteria	Criminal	Infrastructure Failure	Wildfires	Flooding / Dam Failure	Hazardous Materials	Transport	Fires
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 pt x 20%= **0.2**	Low <1 event/yr. 1 pt x 20%= **0.2**	Low >1 event/yr. 1 pt x 20%= **0.2**	Low 1 events/yr. 1 pts x 20% = **.1**
Affected Area	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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 x10% = **1.0**	Minimal No Warning 10 pts x 10% = **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	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**	High Impact >10 injured 10 pts x10% = **1.0**	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**
Economic Effects	High >$100k 10 pts x10% = **1.0**	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**
Duration	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**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**	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**	¾ Year 3 Seasons 7 pts x5%= **0.35**	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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**
Availability of Warnings	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**	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	**8.15**	**7.40**	**6.95**	**6.35**	**5.25**	**4.25**	**3.95**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – City of Newaygo, Michigan

Evaluation Criteria	**Infrastructure Failure**	**Criminal / Violent Crime**	**Flooding / Dam Failure**	**Wildfires / Outdoor Fires**	**Hazardous Materials**	**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**	Medium 1 event/yr 4 pts x 20%= **0.8**	Low 1 event/yr 4 pts x 20%= **0.8**	Medium 1 event/yr 4 pts x 20%= **0.8**	High 2-3 events/yr 7 pts x 20% = **1.4**	Medium 1 event/yr 4 pts x 20%= **0.8**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	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 pts 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**	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**
Casualty Effects	No Impact 0 injured 1 pt x10%= **0.1**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	Most of the time >75% 4 pts x 5%= **0.2**	Generally Not <50% 7 pts x5%= **0.35**	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	**7.40**	**7.20**	**6.95**	**6.35**	**6.05**	**5.75**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – City of White Cloud, Michigan

Evaluation Criteria	Infrastructure Failure	Criminal	Flooding / Dam Failure	Wildfires	Hazardous Materials	Transport	Fires
Historical Occurrence	Excessive 4+ events/yr 10 pts x 20% = **2.0**	Excessive 4+ events/yr 10 pts x 20%= **1.0**	Medium 1 event/yr 4 pts x 20%= **0.8**	Low <1 events/yr 1 pt x 20% = **.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**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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 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**	Minimal No Warning 10 pts x10% = **1.0**
Casualty Effects	No Impact 0 injured 1 pt x10%= **0.1**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	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**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**	High >$100k 10 pts x10% = **1.0**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**	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**	¾ Year 3 Seasons 7 pts x5%= **0.35**	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**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**
Availability of Warnings	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**	Generally Not <50% 7 pts x5%= **0.35**	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	**7.40**	**7.15**	**6.95**	**5.75**	**5.65**	**4.85**	**4.05**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Ashland Township, Michigan

Evaluation Criteria	Infrastructure Failure	Wildfires / Outdoor Fires	Criminal / Violent Crime	Flooding / Dam Failure	Fires	Hazardous Materials	Transport
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 4 pts x 20%= **0.8**	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**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	No Impact 0 injured 1 pt x10%= **0.1**	Medium <10 injured 7 pts x10%= **0.7**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	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**
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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	High Poss. >75% 10 pts x5%= **0.5**	High Poss. >75% 10 pts x5%= **0.5**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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	**7.40**	**7.20**	**7.10**	**6.95**	**6.35**	**5.25**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Barton Township, Michigan

Evaluation Criteria	Criminal	Infrastructure Failure	Flooding / Dam Failure	Hazardous Materials	Fires	Transport	Wildfires
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 pt x 20%= **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**	Low < 1 event/yr 1 pt x 20% = **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**	Low <1 event/yr 1 pt x 20% = **0.2**
Affected Area	Multiple Site > Neighborhood 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**
Speed of Onset	Minimal No Warning 10 pts x10% = **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 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	High Impact >10 injured 10 pts x10% = **1.0**	No Impact 0 injured 1 pt x10%= **0.1**	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**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**
Economic Effects	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**	Minimal <$10k 1 pt x 10% = **0.1**	Medium <$100k 7 pts x10%= **0.7**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	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**	Minimal <12 Hours 1 pt x 5%= **0.05**	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**	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**
Predictability	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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**
Availability of Warnings	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**	Generally Not <50% 7 pts x5%= **0.35**
Hazard Score	**8.15**	**6.80**	**6.35**	**5.65**	**4.55**	**4.25**	**4.00**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Beaver Township, Michigan

Evaluation Criteria	Infrastructure Failure	Wildfires	Flooding / Dam Failure	Hazardous Materials	Fires	Criminal	Transport
Historical Occurrence	High 2 – 3 events/yr 7 pts x 20% = **1.4**	Moderate 1 events/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**	Moderate 1 events/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**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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**
Casualty Effects	No Impact 0 injured 1 pt x10%= **0.1**	Medium <10 injured 7 pts x10%= **0.7**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	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**
Seasonal Pattern	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**	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**
Predictability	Unpredictable Difficult 10 pts x5%= **0.5**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	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**	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	High Poss. >75% 10 pts x5%= **0.5**	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**	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**6.80**	**6.35**	**6.35**	**6.25**	**5.75**	**5.75**	**4.25**
Rank	**1**	**2**	**3**	**6**	**4**	**5**	**7**

Hazards Profile and Evaluation – Big Prairie Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Infrastructure Failure	Wildfires / Outdoor Fires	Flooding / Dam Failure	Hazardous Materials	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**	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**	High 2-3 events/yr 7 pts x 20% = **1.4**	Low <1 event/yr 1 pts x 20%= **0.2**
Affected Area	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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 x10% = **1.0**	Minimal No Warning 10 pts x 10% = **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	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**	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**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	High >$100k 10 pts x10% = **1.0**	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**
Duration	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**	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**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	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**	Unavailable No Warnings 10 pts x5%= **0.5**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**8.15**	**7.40**	**6.95**	**6.35**	**6.25**	**6.20**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Bridgeton Township, Michigan

Evaluation Criteria	Infrastructure Failure	Wildfires / Outdoor Fires	Criminal / Violent Crime	Flooding / Dam Failure	Fires	Hazardous Materials	Transport
Historical Occurrence	Excessive 4+ events/yr 10 pts x 20% = **2.0**	Excessive 4+ events/yr 10 pts x 20% = **2.0**	Excessive 4+ event/yr 10 pts x 20%= **1.0**	Medium 1 event/yr 4 pts x 20%= **0.8**	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**
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 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	No Impact 0 injured 1 pt x10%= **0.1**	Medium <10 injured 7 pts x10%= **0.7**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	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**
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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	High Poss. >75% 10 pts x5%= **0.5**	High Poss. >75% 10 pts x5%= **0.5**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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	**7.40**	**7.20**	**7.15**	**6.95**	**6.35**	**5.25**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Brooks Township, Michigan

Evaluation Criteria	Infrastructure Failure	Wildfires / Outdoor Fires	Criminal / Violent Crime	Flooding / Dam Failure	Hazardous Materials	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+ event/yr 10 pts x 20%= **1.0**	Medium 1 event/yr 4 pts x 20%= **0.8**	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**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Multiple Site > Neighborhood 4 pts x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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 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	No Impact 0 injured 1 pt x10%= **0.1**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	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**	High Impact >10 injured 10 pts x10% = **1.0**
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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	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**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	High Poss. >75% 10 pts x5%= **0.5**	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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	**7.40**	**7.20**	**7.15**	**6.95**	**6.85**	**6.35**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Croton Township, Michigan

Evaluation Criteria	Infrastructure Failure	Flooding / Dam Failure	Hazardous Materials	Wildfires / Outdoor Fires	Criminal / Violent Crime	Fires	Transport / MCI
Historical Occurrence	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**	High 2-3 events/yr 7 pts x 20% = **1.4**	Excessive 4+ event/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**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	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**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	Fairly Predict. >50% Accuracy 4 pts x 5%= **0.2**	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**
Collateral Damage	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**	Good <75% 7 pts x5%= **0.35**	High Poss. >75% 10 pts x5%= **0.5**	Minimal Poss. <10% 1 pt x 5%= **0.05**	Some Poss. <50% 4 pts x 5%= **0.2**
Availability of Warnings	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**	Generally Not <50% 7 pts x5%= **0.35**	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	**7.40**	**6.95**	**6.65**	**6.60**	**6.35**	**6.35**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Dayton Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Infrastructure Failure	Wildfires / Outdoor Fires	Flooding / Dam Failure	Fires	Hazardous Materials	Transport
Historical Occurrence	Excessive 4+ event/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 pt x 20%= **0.2**	High 2-3 events/yr 7 pts x 20% = **1.4**	Medium <1 event/yr 1 pts 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**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	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**	High Impact >10 injured 10 pts x10% = **1.0**	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**
Economic Effects	High >$100k 10 pts x10% = **1.0**	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**
Duration	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**	Long > 1 Week 10 pts x5%= **0.5**	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**
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**	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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**	High Poss. >75% 10 pts x5%= **0.5**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	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**	Unavailable No Warnings 10 pts x5%= **0.5**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**8.15**	**7.40**	**6.95**	**6.35**	**5.75**	**5.65**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Denver Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Flooding / Dam Failure	Infrastructure Failure	Wildfires	Fires	Transport	Hazardous Materials
Historical Occurrence	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**	Medium 1 event/yr 4 pts x 20% = **0.8**	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	Multiple Sites > Neighborhood 4 pt x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**
Speed of Onset	Minimal No Warning 10 pts x10% = **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 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	High Impact >10 injured 10 pts x10% = **1.0**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**	High >$100k 10 pts x10% = **1.0**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**	Medium <1 Week 7 pts x5%= **0.35**
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**	Fairly Predict. >50% Accuracy 4 pts x 5%= **0.2**	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**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	Most of the time >75% 4 pts x 5%= **0.2**	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**8.15**	**6.95**	**6.80**	**6.35**	**5.75**	**4.85**	**4.65**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Ensley Township, Michigan

Evaluation Criteria	Infrastructure Failure	Wildfires / Outdoor Fires	Criminal / Violent Crime	Fires	Flooding / Dam Failure	Hazardous Materials	Transport
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**	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	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	No Impact 0 injured 1 pt x10%= **0.1**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	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**	High Impact >10 injured 10 pts x10% = **1.0**
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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	High Poss. >75% 10 pts x5%= **0.5**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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	**7.40**	**6.95**	**6.55**	**6.35**	**6.35**	**5.65**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Everett Township, Michigan

Evaluation Criteria	**Wildfires / Outdoor Fires**	**Flooding / Dam Failure**	**Infrastructure Failure**	**Criminal / Violent Crime**	**Transport**	**Hazardous Materials**	**Fires**
Historical Occurrence	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**	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%= **0.2**	Low <1 event/yr 1 pt x 20% = **0.2**
Affected Area	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	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%= **0.4**	Single Site < Neighborhood 1 pt x 20%= **0.2**
Speed of Onset	Minimal No Warning 10 pts x10% = **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 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	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	No Impact 0 injured 1 pt x10%= **0.1**	High Impact >10 injured 10 pts x10% = **1.0**	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**
Economic Effects	Medium <$100k 7 pts x10%= **0.7**	High >$100k 10 pts x10% = **1.0**	Low <$50k 4 pts x 10% = **0.4**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**	High >$100k 10 pts x10% = **1.0**	High >$100k 10 pts x10% = **1.0**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	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**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**
Seasonal Pattern	¾ Year 3 Seasons 7 pts x5%= **0.35**	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**	Year Round 4 Seasons 10 pts x5%= **0.5**
Predictability	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	Unpredictable Difficult 10 pts x5%= **0.5**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	Good <75% 7 pts x5%= **0.35**	High Poss. >75% 10 pts x5%= **0.5**	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**
Availability of Warnings	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**	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	**7.20**	**6.95**	**6.80**	**6.35**	**4.85**	**4.65**	**4.55**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Garfield Township, Michigan

Evaluation Criteria	Infrastructure Failure	Criminal / Violent Crime	Flooding / Dam Failure	Wildfires / Outdoor Fires	Fires	Hazardous Materials	Transport
Historical Occurrence	Excessive 4+ events/yr 10 pts x 20% = **2.0**	Medium 2-3 events/yr 7 pts x 20%= **1.4**	Medium 1 event/yr 4 pts x 20%= **0.8**	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**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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**
Casualty Effects	No Impact 0 injured 1 pt x10%= **0.1**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	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**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	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**
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**	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**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	Most of the time >75% 4 pts x 5%= **0.2**	Generally Not <50% 7 pts x5%= **0.35**	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	**7.40**	**6.95**	**6.95**	**6.95**	**6.35**	**5.25**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Goodwell Township, Michigan

Evaluation Criteria	Infrastructure Failure	Flooding / Dam Failure	Criminal / Violent Crime	Wildfires / Outdoor Fires	Hazardous Materials	Fires	Transport / MCI
Historical Occurrence	Excessive 4+ events/yr 10 pts x 20% = **2.0**	Low <1 event/yr 1 pts x 20%= **0.2**	Low <1 event/yr 1 pts x 20%= **0.2**	Low <1 events/yr 1 pts x 20% = **0.2**	Low <1 event/yr 1 pts x 20%= **0.2**	Low <1 events/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**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	Fairly Predict. >50% Accuracy 4 pts x 5%= **0.2**	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**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	Some Poss. <50% 4 pts x 5%= **0.2**
Availability of Warnings	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**	Generally Not <50% 7 pts x5%= **0.35**	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	**7.40**	**6.35**	**5.75**	**5.75**	**5.65**	**4.55**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Grant Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Infrastructure Failure	Wildfires / Outdoor Fires	Fires	Flooding / Dam Failure	Hazardous Materials	Transport
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**	Low >1 event/yr 1 pt x 20%= **0.2**	Low <1 event/yr 1 pts x 20%= **0.2**	Medium 1 event/yr 4 pts x 20%= **0.8**
Affected Area	Multiple Sites > Neighborhood 4 pt x 20%= **0.8**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	High >$100k 10 pts x10% = **1.0**	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**
Duration	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**	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	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**
Hazard Score	**8.15**	**7.40**	**7.20**	**6.35**	**6.35**	**5.65**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Home Township, Michigan

Evaluation Criteria	Wildfires	Infrastructure Failure	Flooding / Dam Failure	Criminal	Fires	Hazardous Materials	Transport
Historical Occurrence	Low <1 events/yr 1 pts 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**	Low >1 event/yr 1 pt x 20%= **0.2**	Low <1 event/yr 1 pts x 20% = **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**
Affected Area	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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**
Casualty Effects	Medium <10 injured 7 pts x10%= **0.7**	No Impact 0 injured 1 pt x10%= **0.1**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Medium <$100k 7 pts x10%= **0.7**	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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	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**
Seasonal Pattern	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**	Year Round 4 Seasons 10 pts x5%= **0.5**
Predictability	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	Some Poss. <50% 4 pts x 5%= **0.2**	Some Poss. <50% 4 pts x 5%= **0.2**
Availability of Warnings	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**6.95**	**6.80**	**6.35**	**5.75**	**5.75**	**5.65**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Lilley Township, Michigan

Evaluation Criteria	Wildfires	Infrastructure Failure	Fires	Flooding / Dam Failure	Criminal	Hazardous Materials	Transport
Historical Occurrence	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**	Excessive 4+ events/yr 10 pts x 20%= **2.0**	Low >1 event/yr 1 pt x 20%= **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**
Affected Area	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 10 pt x 20%= **2.0**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Medium <$100k 7 pts x10%= **0.7**	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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
Seasonal Pattern	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**	Year Round 4 Seasons 10 pts x5%= **0.5**
Predictability	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**	Unpredictable Difficult 10 pts x5%= **0.5**	Unpredictable Difficult 10 pts x5%= **0.5**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	Good <75% 7 pts x5%= **0.35**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	High Poss. >75% 10 pts x5%= **0.5**	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	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**7.55**	**6.80**	**6.35**	**6.35**	**5.75**	**5.65**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Lincoln Township, Michigan

Evaluation Criteria	**Criminal / Violent Crime**	**Flooding / Dam Failure**	**Infrastructure Failure**	**Wildfires**	**Fires**	**Transport**	**Hazardous Materials**
Historical Occurrence	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**	Medium 1 events/yr 4 pts x 20% = **0.8**	Medium 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**
Affected Area	Multiple Sites > Neighborhood 4 pt x 20%= **0.8**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**
Speed of Onset	Minimal No Warning 10 pts x10% = **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 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	High Impact >10 injured 10 pts x10% = **1.0**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**	High >$100k 10 pts x10% = **1.0**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**	Medium <1 Week 7 pts x5%= **0.35**
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**	Fairly Predict. >50% Accuracy 4 pts x 5%= **0.2**	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**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Good <75% 7 pts x5%= **0.35**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	Most of the time >75% 4 pts x 5%= **0.2**	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**8.15**	**6.95**	**6.80**	**6.35**	**6.15**	**4.85**	**4.65**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Merrill Township, Michigan

Evaluation Criteria	Wildfires	Infrastructure Failure	Fires	Flooding / Dam Failure	Criminal	Hazardous Materials	Transport
Historical Occurrence	Medium 1 events/yr 4 pts x 20% = **0.8**	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 pt x 20%= **0.2**	Excessive 4+ events/yr 10 pt x 20%= **2.0**	Low <1 event/yr 1 pt x 20%= **0.2**	Low <1 event/yr 1 pt x 20%= **0.2**
Affected Area	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Multiple Sites > Neighborhood 4 pt x 20%= **0.8**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Medium <$100k 7 pts x10%= **0.7**	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**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
Seasonal Pattern	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**	Year Round 4 Seasons 10 pts x5%= **0.5**
Predictability	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**	Unpredictable Difficult 10 pts x5%= **0.5**	Unpredictable Difficult 10 pts x5%= **0.5**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	Good <75% 7 pts x5%= **0.35**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	High Poss. >75% 10 pts x5%= **0.5**	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	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**6.35**	**6.80**	**4.55**	**6.35**	**8.15**	**5.65**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Monroe Township, Michigan

Evaluation Criteria	Infrastructure Failure	Flooding / Dam Failure	Criminal	Fires	Hazardous Materials	Wildfires	Transport
Historical Occurrence	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**	Medium 1 events/yr 4 pts x 20% = **0.8**	Low >1 event/yr 1 pt x 20%= **0.2**	Low <1 events/yr 1 pts x 20% = **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	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**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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**	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**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**
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**	High >$100k 10 pts x10% = **1.0**	Medium <$100k 7 pts x10%= **0.7**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	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**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	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**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	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**	Generally Not <50% 7 pts x5%= **0.35**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**6.80**	**6.35**	**5.75**	**5.75**	**5.65**	**5.55**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Norwich Township, Michigan

Evaluation Criteria	Infrastructure Failure	Flooding / Dam Failure	Criminal	Wildfires	Hazardous Materials	Fires	Transport
Historical Occurrence	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**	Low <1 event/yr 1 pts x 20% = **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**	Low <1 events/yr 1 pts x 20% = **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**
Affected Area	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	Fairly Predict. >50% Accuracy 4 pts x 5%= **0.2**	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**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	Some Poss. <50% 4 pts x 5%= **0.2**
Availability of Warnings	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**	Generally Not <50% 7 pts x5%= **0.35**	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	**6.80**	**6.35**	**5.75**	**5.75**	**5.65**	**4.55**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Sheridan Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Infrastructure Failure	Fires	Flooding / Dam Failure	Wildfires / Outdoor Fires	Hazardous Materials	Transport
Historical Occurrence	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**	Low >1 event/yr 1 pt x 20%= **0.2**	Medium 1 events/yr 4 pts x 20% = **0.8**	Low <1 event/yr 1 pts 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**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	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	High Impact >10 injured 10 pts x10% = **1.0**	No Impact 0 injured 1 pt x10%= **0.1**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	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**	Medium <$100k 7 pts x10%= **0.7**	High >$100k 10 pts x10% = **1.0**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Short <24 Hours 4 pts x 5%= **0.2**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	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**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**
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**	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	**7.55**	**7.40**	**6.35**	**6.35**	**6.35**	**5.65**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Sherman Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Wildfires	Flooding / Dam Failure	Infrastructure Failure	Hazardous Materials	Fires	Transport
Historical Occurrence	High 2-3 event/yr 7 pt x 20%= **1.4**	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 4 pts x 20%= **0.8**	High 2-3 events/yr 7 pts x 20% = **1.4**	Medium 1 event/yr 4 pts x 20%= **0.8**
Affected Area	Multiple Sites > Neighborhood 4 pts x 20%= **0.8**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	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**
Speed of Onset	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 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**
Casualty Effects	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	No Impact 0 injured 1 pt x10%= **0.1**	High Impact >10 injured 10 pts x10% = **1.0**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	High >$100k 10 pts x10% = **1.0**	Medium <$100k 7 pts x10%= **0.7**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**
Seasonal Pattern	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**	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**
Predictability	Unpredictable Difficult 10 pts x5%= **0.5**	Somewhat <50% Accuracy 7 pts x5%= **0.35**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	Good <75% 7 pts x5%= **0.35**	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	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**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**7.55**	**7.55**	**6.95**	**6.80**	**6.65**	**5.75**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Troy Township, Michigan

Evaluation Criteria	Infrastructure Failure	Criminal	Flooding / Dam Failure	Wildfires	Hazardous Materials	Fires	Transport
Historical Occurrence	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**	Low <1 events/yr 1 pt x 20% = **0.2**	Low >1 event/yr 1 pt x 20%= **0.2**	Medium 1 events/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**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Small Area 1/4 Juris. 7 pts x 20%= **1.4**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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 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**	Minimal No Warning 10 pts x10% = **1.0**
Casualty Effects	No Impact 0 injured 1 pt x10%= **0.1**	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	Low <$50k 4 pts x 10% = **0.4**	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**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Short <24 Hours 4 pts x 5%= **0.2**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	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**	Unpredictable Difficult 10 pts x5%= **0.5**
Collateral Damage	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**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	Most of the time >75% 4 pts x 5%= **0.2**	Generally Not <50% 7 pts x5%= **0.35**	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	**6.80**	**6.35**	**6.35**	**5.75**	**5.65**	**5.15**	**4.25**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Hazards Profile and Evaluation – Wilcox Township, Michigan

Evaluation Criteria	Criminal / Violent Crime	Flooding / Dam Failure	Infrastructure Failure	Fires	Hazardous Materials	Wildfires	Transport
Historical Occurrence	High 2-3 events/yr 7 pts x 20%= **1.4**	Medium 1 event/yr 4 pts x 20%= **0.8**	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 1 pt x 20%= **0.2**	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**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Large Area >1/2 Juris. 10 pts x 20% = **2.0**	Single Site < Neighborhood 1 pt x 20%= **0.2**	Multiple Sites > Neighborhood 4 pts x 20%= **0.4**	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**	Medium 12-24 Hours 4 pts x 10% = **0.4**	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**
Casualty Effects	High Impact >10 injured 10 pts x10% = **1.0**	High Impact >10 injured 10 pts x10% = **1.0**	No Impact 0 injured 1 pt x10%= **0.1**	Low Impact <5 injured 4 pts x 10% = **0.4**	High Impact >10 injured 10 pts x10% = **1.0**	Medium <10 injured 7 pts x10%= **0.7**	High Impact >10 injured 10 pts x10% = **1.0**
Economic Effects	High >$100k 10 pts x10% = **1.0**	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**	Medium <$100k 7 pts x10%= **0.7**	Minimal <$10k 1 pt x 10% = **0.1**
Duration	Medium <1 Week 7 pts x5%= **0.35**	Long > 1 Week 10 pts x5%= **0.5**	Short <24 Hours 4 pts x 5%= **0.2**	Short <24 Hours 4 pts x 5%= **0.2**	Medium <1 Week 7 pts x5%= **0.35**	Medium <1 Week 7 pts x5%= **0.35**	Minimal <12 Hours 1 pt x 5%= **0.05**
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**	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**	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**
Collateral Damage	High Poss. >75% 10 pts x5%= **0.5**	High Poss. >75% 10 pts x5%= **0.5**	Some Poss. <50% 4 pts x 5%= **0.2**	Minimal Poss. <10% 1 pt x 5%= **0.05**	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**	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**	Generally Not <50% 7 pts x5%= **0.35**	Unavailable No Warnings 10 pts x5%= **0.5**
Hazard Score	**6.95**	**6.95**	**6.80**	**5.75**	**5.65**	**5.20**	**4.85**
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**

ANNEX C: PUBLIC PARTICIPATION DOCUMENTATION

Meetings for the purpose of obtaining public input and participation in the process of updating the Newaygo County Hazard Management Plan.

NEWAYGO COUNTY BOARD MEETINGS

September 12, 2018

Newaygo County Board of Commissioners – Background of Newaygo County's Hazard Management Plan and approval of NOI

November 14, 2018

Newaygo County Board of Commissioners Public Safety Committee – Review and recommendation to the Finance Committee to approve the Grant Application to update the Hazard Management Plan

November 21, 2018

Newaygo County Board of Commissioners Finance Committee Review and approval of the Grant Application to update the Hazard Management Plan

November 28, 2018

Newaygo County Board of Commissioners Review and approval of the Grant Application to update the Hazard Management Plan

August 14, 2019

Newaygo County Board of Commissioners Public Safety Committee – Update on the grant application process and request for information submitted to FEMA

October 16, 2019

Newaygo County Board of Commissioners Finance Committee – Acceptance of the grant agreement

October 23, 2019

Newaygo County Board of Commissioners – Acceptance of the grant agreement

November 13, 2019

Newaygo County Board of Commissioners public safety committee – update on the planning process to the board

- Emergency Services Deputy Director Renee Gavin began working on the project on October 28, 2019.

- Letters of Participation were sent on Monday, November 4. 2019 to all municipal governments within Newaygo County. See attached example.
- The Community Profile was reviewed and updated with the assistance of the Local Emergency Planning Team on October 15, 2019. On November 1, 2019, it was posted on the Newaygo County Website for public comment and feedback.
- Emergency Services Deputy Director Renee Gavin is currently reviewing and updating the community survey to gather additional information and feedback on the Hazard Analysis Sections of the plan. Once the community survey is updated, it will be posted on the County's Website and mailed to all municipal governments and community partners.
- The department will then begin working on updating the 12 existing hazard annexes which include: Thunderstorms, Tornados, Severe Winter Weather, Flooding, Drought, Wildfires, Fire, Hazardous Materials, Infrastructure Failure, Transportation, Public Health and Criminal Incidents. In order to align with the 2019 State's Hazard Analysis, Newaygo County will be adding an additional hazard annex of Celestial Impacts including impacting object and space weather.

December 11, 2019

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board

- To date, NCES has received 8 Letters of Participation with 1 pending (see attached tracking sheet). These letters were sent on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up with each municipality will be done in January 2020.
- The draft Community Profile and Hazard Analysis Plan Survey have been posted on the Newaygo County Website for public comment and feedback. To date, 5 responses have been received on the survey.
- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project
- The department has prepared the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes for review at the Local Emergency Planning Team Meeting on Tuesday, December 17, 2019.

January 8, 2020

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board

- To date, NCES has received 9 Letters of Participation with 1 pending (see attached tracking sheet). These letters were sent on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up with each municipality will be done in January 2020.

- The draft Community Profile and Hazard Analysis Plan Survey have been posted on the Newaygo County Website for public comment and feedback. To date, 7 responses have been received on the survey.
- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project
- The Local Emergency Planning Team reviewed the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes on Tuesday, December 17, 2019.
- The Drought and extreme temperatures, celestial impacts, and hazardous materials annexes will be reviewed by the Local Emergency Planning Team on Tuesday, January 21, 2020.

February 12, 2020

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board to the board

- To date, NCES has received 17 Letters of Participation with 1 pending and 2 Declines to Participate in the Program (see attached tracking sheet).
- Initial letters were sent to on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up continues with each municipality with a weekly report being sent with updated by the County Administrator.
- Follow-up is needed with Beaver Township, Brooks Township, Denver Township, City of Grant, Grant Township, Village of Hesperia, Lilley Township, Troy Township, and Wilcox Township.
- The draft Community Profile and Hazard Analysis Plan Survey have been posted on the Newaygo County Website for public comment and feedback. To date, 7 responses have been received on the survey.
- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project
- The Local Emergency Planning Team reviewed the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes on Tuesday, December 17, 2019.
- The Local Emergency Planning Team reviewed Drought and extreme temperatures, celestial impacts, and hazardous materials annexes on Tuesday, January 21, 2020.
- Criminal, Public Health, and Infrastructure Failure annexes will be reviewed by the Local Emergency Planning Team on Tuesday, February 18, 2020.

March 11, 2020

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board

- To date, NCES has received 22 Letters of Participation in the Program (see attached tracking sheet). Both jurisdictions who initially declined have sent Letters of Participation after additional communications from Deputy Director Gavin.
- Initial letters were sent to on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up continues with each municipality with a weekly report being sent with updated by the County Administrator.
- 8 jurisdictions have not yet elected to participate in the planning process and adoption of the completed plan. They are Beaver Township, Denver Township, Grant Township, Village of Hesperia, Lilley Township, Merrill Township, Troy Township, and Wilcox Township.
- The draft Community Profile and Hazard Analysis Plan Survey have been posted on the Newaygo County Website for public comment and feedback. To date, 8 responses have been received on the survey.
- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project
- The Local Emergency Planning Team reviewed the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes on Tuesday, December 17, 2019.
- The Local Emergency Planning Team reviewed Drought and extreme temperatures, celestial impacts, and hazardous materials annexes on Tuesday, January 21, 2020.
- Criminal, Public Health, and Infrastructure Failure annexes were reviewed by the Local Emergency Planning Team on Tuesday, February 18, 2020.
- Structure Fire annex will be reviewed by the Local Emergency Planning Team on Tuesday, March 17, 2020 along with the County Hazard Rankings.

July 8, 2020

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board

- To date, NCES has received 22 Letters of Participation in the Program (see attached tracking sheet). Both jurisdictions who initially declined have sent Letters of Participation after additional communications from Deputy Director Gavin.
- Initial letters were sent to on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up continues with each municipality with a weekly report being sent with updated by the County Administrator.
- June 22nd, 2020, reminder emails to encourage participation in the hazard mitigation planning process were sent to 8 jurisdictions - Beaver Township, Denver Township, Grant Township, Lilley Township, Merrill Township, Troy Township, Wilcox Township, and the Village of Hesperia.

- 1 Participation Letter was received from Lilley Township. We have 7 jurisdictions who have not yet elected to participate in the planning process and adoption of the plan when it is finished.
- The draft Community Profile and Hazard Analysis Plan Survey have been posted on the Newaygo County Website for public comment and feedback. To date, 8 responses have been received on the survey.
- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project
- The Local Emergency Planning Team reviewed the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes on Tuesday, December 17, 2019.
- The Local Emergency Planning Team reviewed Drought and extreme temperatures, celestial impacts, and hazardous materials annexes on Tuesday, January 21, 2020.
- Criminal, Public Health, and Infrastructure Failure annexes were reviewed by the Local Emergency Planning Team on Tuesday, February 18, 2020.
- Structure Fire annex is pending along with the County Hazard Rankings which need to be reviewed by the LEPT when we are able to meet again.

August 12, 2020

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board

- To date, NCES has received 23 Letters of Participation in the Program (see attached tracking sheet). Both jurisdictions who initially declined have sent Letters of Participation after additional communications from Deputy Director Gavin.
- Initial letters were sent to on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up continues with each municipality with a weekly report being sent with updated by the County Administrator.
- June 22nd, 2020, reminder emails to encourage participation in the hazard mitigation planning process were sent to 7 jurisdictions - Beaver Township, Denver Township, Grant Township, Merrill Township, Troy Township, Wilcox Township, and the Village of Hesperia.
- Deputy Director Gavin attended the Troy Township Meeting on 08/03/2020 and is scheduled to attend the Wilcox Township Meeting on 08/27/2020 and the Grant Township Meeting on 09/07/2020.
- 1 Participation Letter was received from Merrill Township. We have 6 jurisdictions who have not yet elected to participate in the planning process and adoption of the plan when it is finished.
- The draft Community Profile, Hazard Analysis Plan Survey, and Hazard Analysis have been posted on the Newaygo County Website for public comment and feedback.

- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project
- The Local Emergency Planning Team reviewed the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes on Tuesday, December 17, 2019.
- The Local Emergency Planning Team reviewed Drought and extreme temperatures, celestial impacts, and hazardous materials annexes on Tuesday, January 21, 2020.
- Criminal, Public Health, and Infrastructure Failure annexes were reviewed by the Local Emergency Planning Team on Tuesday, February 18, 2020.
- At the LEPT Meeting scheduled for August 18, 2020, the County Hazard Rankings will be reviewed by the LEPT.

September 9, 2020

Newaygo County Board of Commissioners Public Safety Committee – update on the planning process to the board

- To date, NCES has received 25 Letters of Participation in the Program (see attached tracking sheet). Both jurisdictions who initially declined have sent Letters of Participation after additional communications from Deputy Director Gavin.
- October 2019 Participation Rate = 1/30
- February 2020 Participation Rate = 22/30
- June 2020 Participation Rate = 23/30
- August 2020 Participation Rate = 25/30
- Initial letters were sent to on Monday, November 4. 2019 to all municipal governments within Newaygo County. Personal follow-up continues with each municipality with a weekly report being sent with updated by the County Administrator.
- 5 jurisdictions have not yet elected to participate in the planning process and adoption of the plan when it is finalized. They are: Beaver Township, Denver Township, Grant Township, Village of Hesperia, and Troy Township.
- Deputy Director Gavin attended the Troy Township Meeting on 08/03/2020 and the Wilcox Township Meeting on 08/27/2020. She is scheduled to attend the Grant Township Meeting on 09/07/2020.
- Personal phone calls were made on 08/31/2020 to the remaining 5 jurisdictions and follow-up emails with additional information were sent.
- The draft Community Profile, Hazard Analysis Plan Survey, and Hazard Analysis have been posted on the Newaygo County Website for public comment and feedback.
- Talking points have been prepared for the Board to share with municipal elected officials when discussing the project

- The Local Emergency Planning Team reviewed the Flood, Winter Weather, Thunderstorms, Tornados, and Wildfire hazard annexes on Tuesday, December 17, 2019.
- The Local Emergency Planning Team reviewed Drought and extreme temperatures, celestial impacts, and hazardous materials annexes on Tuesday, January 21, 2020.
- Criminal, Public Health, and Infrastructure Failure annexes were reviewed by the Local Emergency Planning Team on Tuesday, February 18, 2020.
- The Local Emergency Planning Team reviewed the County Hazard Rankings on August 18, 2020.
- The Local Emergency Planning Team is scheduled to review the Hazard Mitigation goals and objectives, action items, and implementation plan on Tuesday, September 15, 2020.

NEWAYGO COUNTY LEPT MEETINGS

September 17, 2019 *Newaygo County LEPT Meeting*

Attendees

Abby Watkins, Newaygo County ES	Jerry Buffenbarger, HWI
Bryan Kolk, County Commissioner	Burt Cooper, County Commissioner
Chris Wren, Administrator	Justin MacLean, COA
Bob Eichenberg, Fire	Troy Wisely, CMH
Dawn Locke, DHHS	Kerri Wiseman, SHGM
Amanda Lutz, SHGM	Phil Smalligan, 911/fire chiefs
Rick Bacheller, FHC	Christi McWatters, SHVNA
Randy Wright, FPD	Orville Theaker, MSP
Renee Gavin, NCES	

Hazard Mitigation Planning process educational session provided an overview of the purpose, history, function, and impacts of a Hazard Mitigation plan.

October 15, 2019 *Newaygo County LEPT Meeting*

Attendees

Abby Watkins, Newaygo County ES	Burt Cooper, County Commissioner
Chris, Wren, County Administrator	Bryan Kolk, County Commissioner
Phil Smalligan, 911/fire chiefs	Justin MacLean, COA
Christie McWatters, SHGM VNA	Ryan Doornbos, Newaygo PD
Dawn Locke, DHHS	Greg Johnson, Transitional Health Services
Troy Wiseley, NCCMH	Renee Gavin, NCES
Bob Eichenberg, Fire	Cade Hall, 911
Karen Ripke, DHD 10	

Review of the Hazard mitigation Planning process and review of the draft Community Profile for the 2020 edition.

December 17, 2019 *Newaygo County LEPT Meeting*

Attendees

Abby Watkins, Newaygo County ES	Burt Cooper, County Commissioner
Chris, Wren, County Administrator	Bryan Kolk, County Commissioner
Phil Smalligan, 911/fire chiefs	Justin MacLean, COA
Christie McWatters, SHGM VNA	Ryan Doornbos, Newaygo PD
Dawn Locke, DHHS	Greg Johnson, Transitional Health Services
Troy Wiseley, NCCMH	Renee Gavin, NCES
Bob Eichenberg, Fire	Cade Hall, 911
Karen Ripke, DHD 10	

Newaygo County Emergency Services provided updates on the planning process. In addition, the LEPT discussed and reviewed the following Hazard Specific Annexes:

- *Flood Hazard Specific Annex*
- *Winter Weather Hazard Specific Annex*
- *Wildfire Hazard Specific Annex*
- *Thunderstorms and Tornados Hazard Specific Annex*

January 21, 2020 *Newaygo County LEPT Meeting*

Abby Watkins, Newaygo County ES	Burt Cooper, County Commissioner
Chris, Wren, County Administrator	Bryan Kolk, County Commissioner
Phil Smalligan, 911/fire chiefs	Justin MacLean, COA
Kerri Wiseman, SHGM	Katrina Hernandez, Newaygo State Parks, MIDNR
Dawn Locke, DHHS	Lloyd Walerczyk, Newaygo PD
Troy Wiseley, NCCMH	Renee Gavin, NCES
Orville Theaker, MSO EMHSD	Amanda Lemkuil, SHGM
Chad Palmiter, NCSO	Melanie Doughty. Admin

Newaygo County Emergency Services provided updates on the planning process. In addition, the LEPT discussed and reviewed the following Hazard Specific Annexes:

- Celestial Impacts Hazard Annex
- Drought and Extreme Temperatures Hazard Annex
- Hazardous Materials Hazard Annex

February 18, 2020 *Newaygo County LEPT Meeting*

Attendees

Abby Watkins, Newaygo County ES	Burt Cooper, County Commissioner
Chris, Wren, County Administrator	Bryan Kolk, County Commissioner
Phil Smalligan, 911/fire chiefs	Karen Ripke, DHD 10 (and student Rose)
Amanda Lemkuil, SHGM	Katrina Hernandez, Newaygo State Parks, MIDNR

Bob Eichenberg	Lloyd Walerczyk, Newaygo PD
Troy Wiseley, NCCMH	Renee Gavin, NCES
Orville Theaker, MSO EMHSD	Tim Rodwell, Fremont PD
Tim Bailey, NCSO	Melanie Doughty. Admin
Christi McWatters	Rick Bachellor, FHC
Jerry Buffenbarger, HW	Gayle Davis, ARC
Jeff Stockhill, Life EMS	Dale Twing, Drain Commissioner

Newaygo County Emergency Services provided updates on the planning process. In addition, the LEPT discussed and reviewed the following Hazard Specific Annexes:

- *Public Health Hazard Annex*
- *Infrastructure Failure Hazard Annex*
- *Criminal Hazard Annex*

A. Hazard Analysis Newaygo County Hazard Ranking Evaluation
- Full Draft Hazard Analysis is posted to the County's Website for review
- PowerPoint Presentation on Hazard Rankings for Public Input

August 18, 2020 *Newaygo County Virtual LEPT Meeting*

Attendees

Abby Watkins, Newaygo County ES	Burt Cooper, County Commissioner
Chris, Wren, County Administrator	Bryan Kolk, County Commissioner
Phil Smalligan, 911/fire chiefs	Jeff Labun, CMH
Amanda Lemkuil, SHGM	Jeff Nawrot, ARC
Orville Theaker, MSO EMHSD	Kerri Wiseman, Spectrum Health Gerber
Tim Rodwell, Fremont PD	Melanie Doughty. Admin
Renee Gavin, NCES	Karen Ripke, DHD10
Dawn Locke, DHHS	Rick Bachellor, FHC
Kayla Senkowski	Lisa Walker, Home Healthcare
Jeff Stockhill, Life EMS	

*Newaygo County Emergency Services provided updates on the planning process. In addition, the full hazard analysis with all the hazard specific annexes was posted to the County's Website for review. During the meeting the LEPT discussed and evaluated Newaygo County Hazard Ranking*s.

September 15, 2020

Attendees

Abby Watkins, Newaygo County ES	Burt Cooper, County Commissioner
Chris, Wren, County Administrator	Bryan Kolk, County Commissioner
Phil Smalligan, 911/fire chiefs	Susan Gatrell, Spectrum Health Gerber
Amanda Lemkuil, SHGM	Jeff Nawrot, ARC

Justin Mcclean COA	Kerri Wiseman, Spectrum Health Gerber
Tim Rodwell, Fremont PD	Melanie Doughty. Admin
Renee Gavin, NCES	Chad Palmiter, Undersheriff
Troy Wiseley, CMH	Lisa Walker, Home Healthcare
Jeff White, MSP Post Commander	

Newaygo County Emergency Services provided updates on the planning process. In addition, the full hazard analysis with all the hazard specific annexes was posted to the County's Website for review. During the meeting the LEPT discussed and evaluated the Hazard mitigation goals and objectives, action items, and implementation plan.

CITIES, TOWNSHIP, VILLAGE COMMUNICATIONS

Throughout the planning process, multiple communications were made to City, Township, and Village governing bodies and planning committees. The following pages detail communications and outreach, press releases, and signed letters of participation from all communities within Newaygo County.

PUBLIC PARTICIPATION IN NEWAYGO COUNTY HAZARD MITIGATION PLAN

Date	Who	What
10/15.2019	LEPT-Local Emergency Planning Team	Reviewed planning process and community profile
10/16/2019	Abby Watkins and Renee Gavin	10/10/2019 Contacted Julie Burrell with The Right Place for updates to Major Employers and # of Employees/received data 10/16/2019
10/30/2019	Newaygo County IT	Request IT post Community profile and hazard Analysis on Newaygo County Website for Public Input (done)
11/1/2019	Renee Gavin	Updated Community profile posted on County website -> IT
11/1/2019	Renee Gavin	Drafted Letters to Townships, Cities, and Village within Newaygo County Requesting Participation
11/4/2019	Renee Gavin	Drafted Letters Mailed
11/7/2019	Abby Watkins and Renee Gavin	Community Survey Document updated. Working with IT to post community survey on Newaygo County Website to gather information
11/12/2019	City of Fremont	Received Letter indicating they will participate in Hazard Mit Update Process
11/12/2019	City of White Cloud/City of Fremont	Received Letter indicating they will participate in Hazard Mit Update Process from City of White Cloud and City of Fremont
11/12/2019	Ensley Township	Received Letter indicating they will participate in Hazard Mit Update Process
11/12/2019	Newaygo County Sheriff	Requested information from Law Enforcement for Criminla Annex update (email to Sheriff/Undersheriff)
11/12/2019	Renee Gavin	Begin Updating Hazard Annexes
11/13/2019	Public Safety Meeting 1030am	Public Safety Meeting 10:30am (see above items) Present at meeting: Commissioner Burt Cooper (D-1), Commissioner Bryan Kolk (D-2), Commissioner Chuck Trapp (D-3), County Clerk Jason Vanderstelt, County Administrator Chris Wren, Sheriff Bob Mendham, Undersheriff Chad Palmiter, NCES Director Abby Watkins, NCES Deputy Director Renee Gavin
11/13/2019	Renee Gavin	Emailed Drain Commission re: infrastructure incidents/Hazard annex seeking input/Information on infrastructure
11/13/2019	Renee Gavin	Community Affairs Manager - Consumers Energy, seeking data on outages Aug 2014-Present
11/13/2019	Renee Gavin	City of White Cloud re: infrastructure incidents/Hazard annex seeking input/Information on infrastructure
11/13/2019	Renee Gavin	email to Newaygo County Road Commission Seeking input/Information on infrastructure
11/13/2019	Renee Gavin	Discussion Re letters with County Comission at Public Comission meeting Reviewed Community survey document prior to public dissemination https://forms.office.com/Pages/ResponsePage.aspx?id=FphJxb9yaEu0ITdZSCbc1t03a5ULdxJCkxRvak4PlzZUMjRCUVkzN0dJVzFKUFJRR1lVVVhBM1RKNi4u
11/13-14/20	Renee Gavin	Review of MHMP of 4/2019
11/15/2019	City of White Cloud	Received letter of participation from: City of White Cloud
11/19/2019	Press Release sent to local media	Press release to public "Newaygo County Approves Hazard Mitigation Grant" Contains links to: Community Profile and Community Survey Newaygo County Website
11/20/2019	Norwich Township	Received letter of participation from: Norwich Township
11/20/2019	North Newaygo Amish Church	Sent hard copy of community profile/survey to North Newaygo Amish Church representative requesting input from Amish Community
11/20/2019	LEPT, Fire Chiefs, Law Enforcement	Shared Press release to LEPT, Fire Chiefs, Law via email
11/20/2019	NCES	Disseminated Press release to public ***"Newaygo County Approves Hazard Mitigation Grant"*** via Nixle, FaceBook, Twitter which includes request for input on community profile and community survey
11/20/2019	Near North Now	Press release published in Near North Now
11/20/2019	City of Newaygo	Received letter of participation from City of Newaygo
11/22/2019	Big Prairie Township	Received letter of participation from Big Prairie Township
11/25/2019	Sheridan Township	Received letter of participation from Sheridan Township
11/27/2019	Times Indicator	Press release published in Times Indicator ***"Local people asked to help with county's new Hazard Management Plan."***
11/27/2019	Croton Township	Received Phone call from Deb (Township Clerk) at Croton Township indicating they would be participating and returning letter of participation after the holidays.

12/2/2019	Bridgeton Township	Received letter of participation from Bridgeton Township
12/3/2019	Renee Gavin	Review MEMP/MHMPWildfire/NCWildfire, Vul population Directory
12/4/2019	Renee Gavin	Review MEMP/MHMPWildfire/NCWildfire, Vul population Directory/Update Vulnerable Populations Directory
12/9/2019	Ashland Township	Received letter of participation from Ashland Township
12/11/2019	Renee Gavin	Finished Update of Vulnerable Populations Directory
12/17/2019	LEPT-Local Emergency Planning Team	LEPT meeting reviewed flood, t-storm/tornado, wildfire, winter weather sections of NCHMP
12/17/2019	Commissioner Bryan	Received info from Commissioner Bryan Kolk from Hazard Analysis Survey
12/17/2019	Renee Gavin	Hazard annexes reviews and updating
12/18/2019	Renee Gavin	Hazard annexes reviews and updating
12/19/2019	Renee Gavin	Hazard annexes reviews and updating
12/20/2019	Renee Gavin	Hazard annexes reviews and updating
1/7/2020	Renee Gavin	Add Space Weather Hazard Annex to Plan
1/8/2020	Renee Gavin	Phone calls to:Barton+Kyle Luce/Beaver+Allen Ward/Brooks+Jennifer Badgero/Croton+Debbra Wright/Dayton+Brian Frens/Denver+Kristin Smith
1/8/2020	Renee Gavin	Phone calls to: Everett + Judy Maike/Garfield+Kristin Melvin/Goodwell+Jennifer Wozniak/ Grant Township+Gladys Veltkamp/
1/8/2020	Renee Gavin	Phone calls: Home+Diane Reinke-> Dave Vandergoot/Lilley+FrancesNelson/Lincoln+SharonNoggle/Merrill+JanetOsmolinski/Monroe+NancyStone
1/8/2020	Renee Gavin	Phone Calls: Norwich+AngelaBarnes/Sheridan+MargaretKolk/Sherman+JamieKukal/Troy+KimHill/Wilcox+TeressaHamilton/Hesperia+VickiBurrell/
1/8/2020	Renee Gavin	work on Space Weather Hazard Annex
1/9/2020	Goodwell Township Clerk	Phone call from Clerk asking about Participation letter, returned call to her on 1/13/2020 and explained it
1/10/2020	Renee Gavin	work on Space Weather Hazard Annex
1/13/2020	Barton Township/Norwich	Received letter of participation from Barton Township and Norwich Township
1/13/2020	Renee Gavin	Add Celestial Impacts/Invasive Species to plan
1/14/2020	Ashland Grant Fire Dept	Received requested information on Hazmat/Fire incidents (added to Hazmat annex) 2018-208 and 2018-301
1/14/2020	Renee Gavin	Celestial Impacts/Invasive Species/Public Health
1/16/2020	Renee Gavin	Celestial Impacts/Invasive Species/Public Health
1/21/2020	Garfield Township/Dayton	Received letter of participation from Garfield Township and Dayton Township
1/21/2020	LEPT	LEPT update and review of Drought Extreme Temps/Celestial Impacts/Hazmaterials
1/23/2020	Sherman Township/Lincoln	Received letter of participation from Sherman Township and Lincoln Township
1/23/2020	Renee Gavin	continuing work on annexes
2/3/2020	Everett Township	Received letter of participation from Everett Township
2/6/2020	Goodwell Township	Received letter from Goodwell Township Declining participation due to no forseeable hazards
2/6/2020	Renee Gavin	Criminal/Public Health/Infrastructure annexes
2/7/2020	Monroe Township	Received letter of participation from Monroe Township
2/7/2020	Renee Gavin	Criminal/Public Health/Infrastructure annexes
2/11/2020	Renee Gavin	Criminal/Public Health annexes
2/13/2020	Croton Township	Received letter of participation from Croton Township
2/13/2020	Renee Gavin	Criminal/Public Healthannexes
2/14/2020	Renee Gavin	Draft letters to Townships Clerks and Supervisors including hazards rankings for each/given to mail room (probably mailed 2/28/2020)
2/18/2020	Home Township	Received letter of participation from Home Township
2/18/2020	LEPT	LEPT meeting review Criminal Public Health/Infrastructure Annexes
2/19/2020	Renee Gavin	Review and create spreadsheet of public participation

2/20/2020	Renee Gavin	Collect documentation of all the above actions into binder/Review Planning process to evaluate current status
2/21/2020	Renee Gavin	Received Participation letter from Brooks Towship
2/26/2020	Renee Gavin	Call from Goodwell Clerk with questions/provided information/encouragement to participate in plan. Advised will come talk to board if needed. Sent email with participation history. Explained this is not new but a continuing process/Every 5 years update.
3/2/2020	Renee Gavin	Received participation letters from Goodwell and City of Grant
3/9/2020	Renee Gavin	Sent Update on participation to Chris and Abby
3/9/2020	Renee Gavin	Sent Survey link/request to CERT/MRC team for input to Haz Mit Plan
3/9/2020	Renee Gavin	Sent Survey link/request to Newaygo County All Staff for input to Haz Mit Plan
3/9/2020	Renee Gavin	Emailed remaining townships reminder to participate with survey links
6/22/2020	Renee Gavin	Emailed reminer with Q&A and Hazard analysis to: Beaver, Denver, Grant twshp, Hesperia, Lilley, Merrill, Troy, Wilcox.
6/22/2020	Renee Gavin	Sent email update to Abby -> Commission
6/22/2020	Renee Gavin	Sent copies of participation request letters (like originally sent out)
6/26/2020	Renee Gavin	Received participation letter from Lilley Township
7/29/2020	Renee Gavin	Beaver, Denver, Grant twshp, Hesperia, Merrill, Troy, Wilcox are remaining holdouts
7/30/2020	Renee Gavin	Email to Troy township indicating I will attend their Board meeting on August 3rd to discuss Haz Mit Plan and answer any questions
7/30/2020	Renee Gavin	Email to Grant Township indicating I will attend their Board meeting on September 7th to discuss Haz Mit Plan and answer any questions
7/30/2020	Renee Gavin	Email to Wilcox Township indicating I will attend their Board meeting on August 27th to discuss Haz Mit Plan and answer any questions
7/30/2020	Renee Gavin	Email to Grant Township indicating I will attend their Board meeting on August 3rd to discuss Haz Mit Plan and answer any questions
7/30/2020	Renee Gavin	Email to Abby Re attending Board meetings of above townships to discuss Haz Mit Plan and answer any questions
8/3/2020	Renee Gavin	Received letter of participation from Merrill Township: Beaver, Denver, Grant twshp, Hesperia, Troy, Wilcox are remaining holdouts
8/3/2020	Renee Gavin	Attended Board Meeting at Troy Township, discussed Haz Mit Plan, participation and adoption via resolution, answered questions, also answered election question on way home (Kim asked Q, I called Amanda Hunter, she answered, I relayed info to Kim Hill)
8/11/2020	Renee Gavin	Received email from Gladys Veltkamp/Grant Towsnhip indicating that meeting will be held Sept 14th due to holiday. I am unable to attend this meeting due to a conflict.
8/19/2020	Renee Gavin	Sent out reminder letters to Beaver, Denver, Grant twshp, Troy, Wilcox (Hesperia does not have a quorem)
8/20/2020	Renee Gavin	Emailed Gladys to tell her I will not be at Grant Township Sept 14th mtg duie to a conflict in schedule.
8/27/2020	Renee Gavin	Attended Wilcox Township Meeting explained Haz Mit Plan
8/31/2020	Renee Gavin	Received email request for copy of reminder letter/sent to Wilcox Clerk Teressa Hamilton. Received signed copy back via email.
8/31/2020	Renee Gavin	Made phone calls to those who ave not yet opted in.
8/31/2020	Renee Gavin	Beaver Township Allen Ward conversation w/ Follow up email.
8/31/2020	Renee Gavin	Denver Township Supervisor Mike Anderson (left voicemail message)
8/31/2020	Renee Gavin	Grant Township Supervisor VanSingel Left voicemail message
8/31/2020	Renee Gavin	Troy Township Supervisor Janice Vest follow up call, Left message.
8/31/2020	Renee Gavin	Hesperia Village called and talked to Vicki Burrell and email her copies. She says the Board situation has been resolved and she will follow up on this
9/4/2020	Renee Gavin	Received Letter of participation from Denver Township Supervisor Mike Anderson
9/8/2020	Abby Watkins	Received Letter of participation from Beaver Township Supervisor Allen Ward
9/9/2020	Renee Gavin	Updated Info to BOC/Filed letters/updated participation spreadsheet
9/9/2020	Renee Gavin	Phone calls to Grant Township (Gladys Veltkamp says she faxed it (we do not have it)). Emailed her my cell so I can pick up hard copy tomorrow.
9/9/2020	Renee Gavin	Call to Troy Township Supervisor Janice Vest says Kim Hill has letter for me. Gave them my cell phone to contact me for a meet up.
9/9/2020	Renee Gavin	Call to Hesperia Village Vicki Burrell, left message with my contact information

9/9/2020	Renee Gavin	Met Kim Hill at Clerks Office to receive Troy Township Letter of Participation (two left, Grant Township and Hesperia Village) RECEIVED LETTER
9/10/2020	Renee Gavin	Received Participation Letter from Gladys Veltkamp for Grant Township
9/11/2020	Renee Gavin	Received Participation Letter from Vicki Burrell Village of Hesperia

Near North Now

Reducing the Risk When Hazards Hit

11/19/2019 0 Comments

Near North Now

Photo by Alexander Butler, courtesy of NC Emergency Services

Newaygo County Approves Hazard Mitigation Grant; Your Help Needed in Updating the Plan

Newaygo County, – On Wednesday, October 23, 2019, the Newaygo County Board of Commissioners approved a FEMA Pre-Disaster Hazard Mitigation Grant in

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 plan is required to be updated every five years and will expire in August 2020.

Hazard mitigation is an important part of being a disaster resilient community. 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. Examples of hazard mitigation activities include voluntary acquisition or elevation of flood prone structures, creation of defensible spaces around wildland urban interface areas, protective measures for utility infrastructure, storm water management projects that reduce flood risk, etc. The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses.

Maintaining a FEMA approved Hazard Mitigation Plan has positive, local impacts within the County. In December 2016, Newaygo County was awarded $239,316.00 in grants to implement a new flood warning system for approximately 35 miles of the Muskegon River in Newaygo County utilizing the United States Geological Survey (USGS) Flood Inundation Mapper System. As a part of the project an additional two river gages, which were funded by the Fremont Area Community Foundation, were installed in Newaygo and Bridgeton. Newaygo County was eligible to apply for this Hazard Mitigation Grant because our community maintains a Hazard Mitigation Plan.

Newaygo County is requesting assistance from the public with the updates to the Newaygo County Hazard Management Plan. Your participation will enable Newaygo County Emergency Services to collect and compile the most up-to-date community data and information. A draft Community Profile has been developed and posted to the County of Newaygo's Website for review at http://www.countyofnewaygo.com/. In addition, a short survey has been created to gather additional information on different hazard events which have occurred in Newaygo County. Anyone with the following link can respond to the survey: https://forms.office.com/Pages/ResponsePage.aspx?id=FphJxb9yaEu0ITdZSCbc1t03a5ULdxJCkxRvak4PlzZUMjRCUVkzN0dJVzFKUFJRR1lVVVhBM1RKNi4u

Like 0 Tweet

0 Comments

Leave a Reply.

Newaygo County Hazard Mitigation Plan
Jurisdiction Participation

Jurisdiction	2006 Hazard Mitigation Plan Participant*	Adopted 2007 Newaygo Co Hazard Management Plan**	2011 Letter to Participate	2016 Hazard Plan Update Participant	Adopted 2015 Newaygo Co Hazard Management Plan	2019 Letter to Participate	Participant Status	Adopted 2020 Newaygo Co Hazard Management Plan
Newaygo Co.	✓	✓	✓	✓	✓	✓	Continuing	
Ashland Twp		✓				✓		
Barton Twp		✓	✓			✓	Continuing	
Beaver Twp				✓		✓		
Big Prairie Twp			✓	✓		✓	Continuing	
Bridgeton Twp	✓	✓	✓	✓		✓	Continuing	
Brooks Twp	✓		✓			✓	Pending	
Croton Twp			✓	✓		✓	Continuing	
Dayton Twp			✓			✓	Continuing	
Denver Twp			✓			✓		
Ensley Twp			✓	✓		✓	Continuing	
Everett Twp						✓		
Fremont City			✓			✓	Continuing	
Garfield Twp		✓	✓			✓	Continuing	
Goodwell Twp	✓	✓	✓	✓		✓	Continuing	
Grant City			✓	✓		✓	Continuing	
Grant Twp	✓		✓			✓		
Hesperia Village			✓			✓		
Home Twp			✓			✓	Continuing	
Lilley Twp			✓			✓		
Lincoln Twp	✓		✓	✓		✓	Continuing	
Merrill Twp	✓					✓		
Monroe Twp			✓			✓	Continuing	
Newaygo City			✓	✓		✓	Continuing	
Norwich Twp			✓			✓	Continuing	
Sheridan Twp	✓			✓		✓	Continuing	
Sherman Twp	✓		✓	✓		✓	Continuing	
Troy Twp			✓			✓		
White Cloud City	✓		✓			✓	Continuing	
Wilcox Twp			✓			✓		

* *Newaygo County Hazard Mitigation Plan (draft) met FEMA Disaster Mitigation Act requirements on 3/16/06*

** *Newaygo County Hazard Management Plan approved by FEMA on 6/30/08*

Received
12/9/19

Today's date December 6, 2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Shelly Boerema

Clerk Shelly Boerema
Ashland Township
2019 W. 120th Street
P.O. Box 457
Grant,MI 49327
231-834-7535

Today's date

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Pam Rosendall - Clerk

Clerk Pamela Rosendall
Barton Township
8230 E. 14 Mile RD
Paris, MI 49338
231-796-4584
Rosendallpam@gmail.com

Please insert date 8-2-20

Received 9/8/20

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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, Allen Ward

Supervisor Allen Ward
Beaver Township
5846 11 Mile Rd
Bitely, MI 49309

Received
11/22/19

BIG PRAIRIE TOWNSHIP
2815 S. ELM AVE.
WHITE CLOUD, MICHIGAN 49349

November 18,2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Judith Baker

Clerk Judith Baker
Big Prairie Township
5160 S. Croton hardy Dr.
Newaygo, MI 49337-7108

Tony Alvesteffer – Bridgeton Township Supervisor
5750 West 104th Street,
Fremont, MI 49412
Telephone: 231-557-3412 Email: iraqalves@yahoo.com

Received
12-2-19
RG

November 25, 2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S. North Street, PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Ms. Gavin,

Bridgeton Township is responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo County Hazard Management Plan. We are happy to assist you and would 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.

Also, your department is always invited to our monthly Township Board meetings that are held on the 2ND Monday of every month beginning at 7:00pm.

Sincerely,

Tony Alvesteffer – Bridgeton Township Supervisor

Brooks Township

Rec'd 2/21/2020

February 18, 2020

Renee Gavin
Deputy Director
Newaygo County Emergency Services

Subject: Newaygo County Hazard Management Plan.

Dear Renee,

I am responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo County Hazard Management Plan. We are happy to assist and are willing to participate in keeping our community resilient and our residents safe

Sincerely,

Cory J. Nelson
Brooks Township Supervisor

Office Address. P.O. Box 625 • 490 Quarterline Road • Newaygo, MI 49337
Phone: 231-652-6763 • Fax. 231-652-6771
Web: www.brookstownship.org

Rec. Feb 13
RK

CROTON TOWNSHIP

5833 E. Division St. Newaygo, MI 49337 • Phone 231-652-4301 • Fax 231-652-7250
Web: www.crotontownship.org • E-mail: croton@crotontownship.org

February 11, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Debbra Wright,
Croton Township Clerk

Supervisor M. Heinzman * Clerk D. Wright * Treasurer K. Edwards * Trustee B. Nottelmann * Trustee J. Shepherd

RETURN LETTER

Today's date January 9, 2020

Received 1/21/20

Deputy Director Renee Gavin

Newaygo County Emergency Services

306 S North St. PO Box 885

White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Jean Stroven

Clerk Jean Stroven

Dayton Township

P.O. Box 68

Fremont, MI 49412

Received 9/4/2020 RG

Please insert date

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Supervisor Mike Anderson
Denver Township
P.O. Box 408
Hesperia, MI 49421

Today's date Received 11/12/19 RMC

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Cynthia Harwood

Clerk Cynthia Harwood
Ensley Township
7163 120th Ave
Sand Lake, MI 49343

Everett Township

Received 2/3/20

White Cloud, Michigan 49349

January 28, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S. North St
P O Box 885
White Cloud, MI 49349

RE: Newaygo County Hazard Management Plan

Dear Deputy Director Gavin,

Everett Township Board Trustee Richard Long has volunteered to participate in the planning and review process in order to assist in the updating of the Newaygo County Hazard Management Plan.

Trustee Richard Long's contact information is:
Address: 866 E. 8th Street, White Cloud, MI 49349
Phone # (616)460-1311

Please keep him informed as to how he can assist you in those efforts.

Thank you,

pK Chaffee

Clerk Pamela Chaffee
Everett Township
1516 E. 8th Street
White Cloud, MI 49349

Cc: file, Board

FREMONT
Michigan

"NOW AND ALWAYS – A Fine City • A Great Community"

Received 11/12/19 RMC

November 8, 2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S. North St, PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Vicci TerVeer

Vicci TerVeer, City Clerk
City of Fremont
101 E. Main Street
Fremont, MI 49412

Cc: Todd Blake, City Manager
Brian Hettinger, DPW Supervisor

101 E. Main Street • Fremont, MI 49412 • Phone: 231-924-2101 • Fax: 231-924-2888 • Website www.cityoffremont.net

GARFIELD TOWNSHIP
7190 S. Bingham Avenue – Newaygo, Michigan 49337 – Phone (231) 652-4251 – Fax (231) 652-4207

Received 1/21/20

January 14, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Clerk Kristin Melvin
Garfield Township
7190 Bingham Ave
Newaygo, MI 49337-9117

Newaygo County Emergency Services
306 S North Street, PO Box 885 White Cloud, MI 49349
Phone: (231) 689-7354 Fax: (231) 689-7305

Rec 3/2/20

Today's date 2-26-2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Reminder: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Gina Warmbein

Supervisor Gina Warmbein
Goodwell Township
756 N. Elm
White Cloud, MI 49349

CITY OF GRANT
280 S. Maple St. P.O. Box 435 ♦ Grant, MI 49327 ♦ Phone: (231) 834-7904 ♦ Fax: (231) 834-5984

Rec 3/2/20

February 20, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 North St, PO Box 885
White Cloud MI 49349

RE: Newaygo County Hazard Management Plan

Dear Renee,

In response to your request, the City of Grant would like to participate in the update of the Newaygo County Hazard Management Plan. We would like to better understand how the hazard profile and evaluation was created for our community profile so that we can continue to keep our community resilient and our residents safe.

Please keep us informed as to how we can assist you in these efforts. I can be reached by telephone at (231) 834-7904.

Sincerely,

Kasey Jernberg

Kasey Jernberg
City Manager
City of Grant
PO Box 435
280 S Maple St
Grant, MI 49327

"The City of Grant is an Equal Opportunity Provider, and Employer"

Grant Township

NEWAYGO COUNTY
1617 E 120TH ST
GRANT, MICHIGAN 49327
PH 231-834-8033 • FAX: 231-834-0288
www.granttownship.net

Received 9/10/20 RG

September 1, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St. PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We (Grant Township, Newaygo County) are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo County Hazard Management Plan. We are happy to assist and would 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,

Gladys M VeltKamp
Grant Township Clerk
1617 E 120th St
Grant MI 49327

Village of Hesperia

Office of Village Clerk
P.O. Box 366, Hesperia, Michigan 49421

Phone:
231-854-6205
Fax:
231-854-0263

Received
9-11-20
RB

September 11, 2020

Newaygo County Emergency Services
306 S. North Street
P.O Box 885
White Cloud, MI 49349

RE: Newaygo County Hazard Management Plan

Dear Ms. Gavin:

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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

Vicki R Burrell
Vicki R. Burrell

The Village of Hesperia is an Equal Opportunity Provider and Employer

Received 2/18/20 RG

February 10, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North Street, PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Teri Ouderkirk

Teri Ouderkirk

Home Township Clerk
9819 Oak Ave,
Paris, Mi 49338

Lilley Township

Lilley
Received
6/29/20

June 26, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management

Dear Renee,

We are responding to your request for partici[illegible]ning and review process in order to assist in the updating of the Newaygo 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,

Fran Nelson

Clerk Fran Nelson
Lilley Township
352 Ford St
Bitely, MI 49309

Bob Bouwens, Supervisor | Fran Nelson, Clerk | Kathryn Way, Treasurer | Judith Hoving, Trustee | Gerald V. Anderson, Trustee

Received 1/23/20

January 5, 2020
Deputy Director Renee Gavin
Newaygo County Emergency Services
306 North ST. PO Box 885
White Cloud, MI 49349

Re. Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the up dating of the Newaygo County Hazard Management Plan. We are happy to assist and would 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 Sharon Noggle
Lincoln Township
2776 N. Baldwin
White Cloud, MI 49349

Rec 8/3/20

MERRILL TOWNSHIP

1585 West 11 Mile Road

Bitely, Michigan 49309

****

Tom Wenstrom: Supervisor, Tabatha Glezman: Clerk Victoria Gibbs: Treasurer

Harold Yancey: Trustee Pete Morgan: Trustee

July 29, 2020

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 South North Street
White Cloud, MI 49349

RE: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Tabatha Glezman
Merrill Township Clerk

Today's date 12/12/19

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Nancy Stone

Clerk Nancy Stone
Monroe Township
4141 E. Fillmore Rd
White Cloud, MI 49349

Received 11/20/19

28 STATE ROAD
PO BOX 308
NEWAYGO, MICHIGAN 49337

PHONE (231) 652-1657
FAX (231) 652-1650
www.newaygocity.org

November 18, 2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St., PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Kim Goodin

Kim Goodin
City Clerk
City of Newaygo
kgoodin@newaygocity.org
231-652-1657 Ext. 213

The City of Newaygo is an equal opportunity provider.

Received 1/13/2020

TOWNSHIP OF NORWICH
6952 HUNGERFORD LAKE DRIVE
BIG RAPIDS, MICHIGAN 49349

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

January 8, 2020

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Angela M. Barnes
Norwich Township Clerk

am

Sheridan Charter Township

A place to be proud of

Received 11/25/19

November 22, 2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St.
PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request of participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Maggie Kolk

Maggie Kolk, Clerk
Sheridan Charter Township

P.O. Box 53 • Fremont, MI 49412 • Phone (231) 924-2566 • Fax (231) 924-8734
Email: sheridan@ncats.net • Website: sheridanchartertownship.com

January 20, 2020

Received 1/23/20

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North ST, PO Box 885
White Cloud, MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

This letter is to document that Sherman Township, Newago County, intends to participate in the planning and review process of updating the Newaygo County Hazard Management Plan. Please keep us informed as to how we can assist.

Sincerely,

Jamie Kukal, clerk
Sherman Township
2168 S Wisner Ave
Fremont, MI 49412

Rec 9/9/20

Today's date 9-8-20

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Kimberly A. Hill

Clerk Kimberly Hill
Troy Township
9653 N. Comstock Avenue
Bitely, MI 49309

THE CITY OF
WHITE CLOUD
A TRAIL FOR EVERY SEASON
MICHIGAN

PO BOX 607 WHITE CLOUD, MI 49349 PHONE: 231.689.1194

November 12, 2019

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 N. North St, PO Box 885
White Cloud, MI 49349

RE: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Kelli Arnold
Clerk, City of White Cloud

Rec 8/31/20

Deputy Director Renee Gavin
Newaygo County Emergency Services
306 S North St, PO Box 885
White Cloud MI 49349

Re: Newaygo County Hazard Management Plan

Dear Renee,

We are responding to your request for participation in the planning and review process in order to assist in the updating of the Newaygo 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,

Teressa Hamilton

Clerk Teressa Hamilton
Wilcox Township
P.O. Box 728
White Cloud, MI 49349-0728

REFERENCES

Many resources, documents, and websites were researched and referenced during the development of this plan. The following resources were most helpful during this process:

AGENCIES & ORGANIZATIONS

West Michigan Shoreline Regional Development Commission
Newaygo County Planning Commission
Newaygo County Road Commission
Newaygo County Clerk's Office
Michigan State Police, Emergency Management and Homeland Security Division
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Historical Center Preservation Office
American Red Cross, Lakeshore & West Shore Chapter
United States Census Bureau
United States Geological Survey
National Weather Service, Grand Rapids
Newaygo County Fire Chiefs Association
Federal Emergency Management Agency, National Flood Insurance Program
Newaygo County Local Emergency Planning Team
Muskegon County Local Emergency Planning Team
Gerber Memorial Hospital
Huron Manistee National Forest Forestry Division
Pipeline and Hazardous Materials Safety Administration
Wolverine Power Company
Consumers Energy

DOCUMENTS

Newaygo County Parks and Recreation Plan 2018-2022
Newaygo County Community Wildfire Protection Plan 2017
Muskegon River Dam Failure and Flooding Emergency Evacuation Plan 2018
Newaygo County 2018 Master Plan
Michigan Hazard Analysis (2019)
Michigan Hazard Mitigation Plan (updated 2019)

WEB SITES

National Climatic Data Center: http://www.ncdc.noaa.gov/
FEMA www.fema.gov
Michigan Geographic Data Library: www.mcgi.state.mi.us/mgdl/
MLIVE: www.mlive.com

STATE AGENCY MITIGATION FUNDING PROGRAMS

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Extreme Temperatures	Wildfire	Dam Failure	Riverine Flooding	Great Lakes Shoreline Flooding	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
MICHIGAN DEPARTMENT OF AGRICULTURE																
Conservation Reserve Enhancement Program						X					X				X	X
Intercounty Drain Program (available to drain commissioners only)					X	X										X
MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY																
Coastal Management Program							X								X	X
Michigan Great Lakes Protection Fund							X								X	
State Revolving Fund (Loan)						X									X	
Wetland Program Development (also see 66.461 in CFDA)						X	X								X	
MICHIGAN DEPT. OF NATURAL RESOURCES																
Land & Water Conservation Fund						X	X								X	
Michigan Habitat Improvement Fund Project Grants						X									X	
Michigan Natural Resources Trust Fund				X		X									X	
Michigan Volunteer Fire Assistance				X											X	
Recreational Trails Program Grants						X	X								X	
Community Forestry Program											X	X	X		X	X
MICHIGAN DEPARTMENT OF STATE POLICE																
Emergency Management Performance Grants (also see 97.042 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Flood Mitigation Assistance (also see 97.029 in CFDA)						X	X								X	
Hazard Mitigation Grant Program (also see 97.039 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Federal Disaster Assistance to Individuals and Households in Presidential Declared Disaster Areas (also see 97.048 in CFDA)		X		X		X	X	X			X	X			X	
Presidential Declared Disaster Assistance - Disaster Housing Operations For Individuals And Households (also see 97.049 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Presidential Declared Disaster Assistance To Individuals And Households - Other Needs (also see 97.050 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Disaster Grants-Public Assistance (Presidentially Declared Disasters) (also see 97.036 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pre-Disaster Mitigation (also see 97.047 in CFDA)			X	X		X	X				X	X			X	
Severe Loss Repetitive Program (also see 97.110 in CFDA)						X	X								X	
Repetitive Flood Claims (also see 97.092 in CFDA)						X	X								X	
MICHIGAN DEPARTMENT OF TRANSPORTATION																
Transportation Economic Development Fund						X	X								X	
MICHIGAN ECONOMIC DEVELOPMENT CORP																
Community Development Block Grant Program (also see 14.218,14.219, 14.228 in CFDA)						X	X								X	
Urban Land Assembly						X	X								X	
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY																
CDBG Housing Resource Fund (Inc HOME) (also see 14.239 in CFDA)						X	X		X		X	X			X	
Home/Property Improvement Loans						X	X		X		X	X			X	
MICHIGAN DEPARTMENT OF TREASURY																
Michigan Finance Authority-Local Gov't Loan Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Michigan Finance Authority-State Aid Note	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Temperatures	Wildfire	Dam Failure	Riverine Flooding	Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet	Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
10.054 Emergency Conservation Program	X					X					X	X				X	
10.069 Conservation Reserve Program						X					X	X				X	X
10.072 Wetlands Reserve Program						X	X									X	X
10.202 Cooperative Forestry Research				X							X	X				X	
10.410 Very Low to Moderate Income Housing Loans			X	X		X	X	X	X	X	X	X				X	
10.411 Rural Housing Site Loans and Self Help Housing and Development Loans						X	X									X	
10.417 Very Low Income Housing Repair Loans/Grants			X	X		X	X	X	X	X	X	X				X	
10.445 Direct Housing Natural Disaster (Very Low/Low Income Loans)				X		X	X		X	X	X	X				X	
10.652 Forestry Research						X	X				X	X				X	
10.664 Cooperative Forestry Assistance				X												X	
10.760 Water & Waste Disposal Sys. for Rural Comm.						X	X									X	
10.763 Emergency Community Water Assistance Grants	X					X	X									X	
10.766 Community Facilities Loans & Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
10.768 Business and Industry Loans	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
10.770 Water/Waste Disposal Loans/Grants						X	X									X	
10.773 Rural Business Opportunity Grants						X	X									X	
10.850 Rural Electrification Loans and Loan Guarntees										X	X	X	X	X		X	
10.901 Resource Conservation and Development	X	X	X	X		X	X										X
10.902 Soil and Water Conservation	X	X	X	X		X	X										X
10.904 Watershed Protection and Flood Prevention					X	X	X									X	X
10.913 Farm and Ranch Land Protection Program						X	X									X	
10.914 Wildlife Habitat Incentive Program						X	X									X	
11.300 Investments for Public Works and Economic Development Facilities					X	X	X									X	
11.303 Economic Development Technical Assistance						X	X									X	X
11.307 Economic Adjustment Assistance					X	X	X				X	X				X	
11.419 Coastal Zone Mgmt. Administration Awards							X										X
11.462 Hydrologic Research	X				X	X	X									X	
11.463 Habitat Conservation							X									X	
11.477 Fisheries Disaster Relief	X			X	X	X	X									X	
11.478 Center for Coastal Ocean Research_Coastal Ocean Program							X									X	
11.550 Public Telecommunication Facilities-Planning & Construction												X				X	
12.101 Beach Erosion Control Projects							X									X	
12.102 Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works					X	X	X									X	
12.103 Emergency Operations Flood Response & Post-Flood Response					X	X	X									X	
12.104 Flood Plain Management Services					X	X	X										X
12.105 Protection of Essential Highways, Highway Bridge Approaches, and Public Works					X	X	X									X	
12.106 Flood Control Projects					X	X	X									X	
12.108 Snagging and Clearing for Flood Control					X	X	X									X	
12.109 Protection, Clearing and Straightening Channels						X	X									X	
12.111 Emergency Advance Measures for Flood Protection					X	X	X									X	
14.218 Community Development Block Grants/Entitlement Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.228 Community Development Block Grants-State's Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES (CONT.)

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Temperatures	Wildfire	Dam Failure	Riverine Flooding	Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet	Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
14.218 Community Development Block Grants/Entitlement Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.219 Community Development Block Grants -Small Cities Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.228 Community Development Block Grants-State's Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.239 HOME Investment Partnerships Program						X	X		X	X	X	X				X	
14.246 Community Development Block Grant/Brownfileds Economic Development Initiative						X	X				X	X				X	
14.250 Rural Housing and Economic Development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.511 Community Outreach Partnership Center Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15.623 North American Wetlands Conservation Fund						X	X									X	
15.904 Historic Preservation Fund Grants-In-Aid						X	X	X	X	X	X	X	X	X	X		X
15.916 Outdoor Recreation-Acquisition, Development and Planning (Land and Water Conservation Fund Grants)						X	X									X	
15.918 Disposal of Federal Surplus Real Property for Parks, Recreation, and Historic Monuments						X	X										
15.921 Rivers, Trails, and Conservation Assistance						X	X										X
47.041 Engineering Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
59.008 Disaster Assistance Loans		X		X		X	X	X	X	X	X	X	X	X	X	X	
66.461 Regional Wetlands Program Development Grants						X	X									X	
66.469 Great Lakes Program							X									X	
81.042 Weatherization Assistance for Low-Income Persons			X													X	
97.018 National Fire Academy Training Assistance				X													X
97.022 Flood Insurance						X	X										X
97.023 Community Assistance Program - State Support Services Element (NFIP)						X	X										X
97.024 Emergency Food and Shelter National Board Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.026 Emergency Management Institute-Training Assistance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
97.028 Emergency Management Institute-Resident Education Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
97.029 Flood Mitigation Assistance						X	X									X	
97.030 Community Disaster Loans	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.031 Cora Brown Fund	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.036 Disaster Grants - Public Assistance (Presidentially Declared Disasters)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.037 Disaster Housing Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.039 Hazard Mitigation Grant Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.041 National Dam Safety Program					X												X
97.042 Emergency Management Performance Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.044 Assistance to Firefighters Grant				X												X	
97.045 Cooperating Techincal Partners						X	X									X	
97.046 Fire Management Assistance Grant				X												X	
97.047 Pre-Disaster Mitigation		X		X		X	X	X			X	X				X	
97.048 Disaster Housing Assistance to Individuals and Households in Presidential Declared Disaster Areas	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.049 Presidential Declared Disaster Assistance - Disaster Housing Operations for Individuals and Housholds	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.050 Presidential Declared Disaster Assistance to Individual and Households - Other Needs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.092 Repetitive Flood Claims						X	X									X	
97.110 Severe Repetitive Loss Program						X	X									X	