Crawford County
HAZARD MITIGATION PLAN

2021

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CRAWFORD COUNTY
HAZARD MITIGATION PLAN
2021

Crawford County, Michigan

Prepared for:

Crawford County
and the
Jurisdictions in Crawford County

Prepared by:

Crawford County Emergency Management
200 W. Michigan Ave
Grayling, Michigan 49738

and

Northeast Michigan Council of Governments
80 Livingston Boulevard, Suite U-108
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Gaylord, Michigan 49734

Adopted Insert Date

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Chapter 1 Introduction

Introduction

Throughout the world communities are impacted by natural, technological, and human-related hazards. Natural hazards occur when the natural processes of the environment interact with the resources and assets in the communities. These hazards include storms, floods, and wildfires. In 2018, the National Weather Service reported the United States experienced 530 fatalities, 1,378 injuries, $35,849,320,000 in property damage, and $5,102,540,000 in crop damage due to natural hazards. Technological hazards take place when the existing technology fails. These types of hazards include hazardous material spills, structure fires, infrastructure failures, and transportation accidents. The final hazard, human-related, occurs as a product of human activities, such as chemical or biological attacks and cyber-attacks. Depending on many characteristics, such as geographical location and land use practices, these hazards have the potential to cause death, injuries, damage to property, infrastructure and the environment, and disruption to economic and social activities. These hazards also have the potential to become disasters. However, governments, organizations, businesses, and the public can reduce the impacts from hazards through hazard mitigation efforts.

Hazard mitigation planning allows communities to create long-term plans to reduce or eliminate the impacts that hazards have on the community's population, economy, and natural environment. These plans identify and inventory potential hazards, assess the risks and vulnerabilities from hazards, and develop hazard mitigation strategies. Through plan preparation and mitigation efforts, communities are able to better protect public safety and facilities, remove structures from hazard prone areas, accelerate recovery time after disasters, increase hazard education and awareness, and create partnerships.

The Stafford Act, as amended by the Disaster Mitigation Act of 2000, requires state, tribal, and local governments to develop and adopt FEMA-approved hazard mitigation plans to receive certain types of non-emergency disaster assistance. Every five years, jurisdictions must update their plans and re-submit them for FEMA approval to maintain eligibility. The Northeast Michigan Council of Governments (NEMCOG) assisted seven counties in the Northeastern Lower Peninsula of Michigan to update their 2014 hazard mitigation plans.

In Crawford County, NEMCOG worked with the Emergency Manager and Local Emergency Planning Committee (LEPC) to review and update Crawford County's 2014 Hazard Mitigation Plan. The plan update focused on natural, technological, and human-related hazards to increase public awareness about hazards and hazard mitigation, maintain the county's grant eligibility, maintain the county's compliance with state and federal legislative requirements for hazard mitigation plans, and to develop projects and policies that can be implemented to reduce or prevent future disasters and improve public safety.

Summary of Plan Contents

The 2021 Crawford County Hazard Mitigation Plan Update identifies the county's hazards, analyzes the hazards based on the county's current conditions, assesses its risk and vulnerability, identifies the communities' goals and objectives, identifies, evaluates and prioritizes the alternatives for hazard mitigation strategies, selects and recommends feasible mitigation strategies, and documents the plan's progress towards mitigating its hazards. The hazard mitigation strategies within the plan are intended to be integrated into other planning documents.

Specific Plan Updates

Chapter 1: Introduction

- Reviewed and updated the summary of plan contents, specific plan updates, and planning process sections.

Chapter 2: Environment

- Reviewed and updated information in the climate, discharge permits, and sites of environmental contamination sections.

Chapter 3: Community Profile

- Reviewed and updated population and housing demographics, and economic indicators.

Chapter 4: Land Use Characteristics

- Reviewed and made minor changes to the chapter.

Chapter 5: Community Services and Facilities

- Reviewed and updated the county government, minor civil divisions, public safety (law enforcement, emergency medical services, fire and emergency services), medical facilities, utility services, schools, special populations, governmental facilities: Camp Grayling, public transportation, community events, and natural landmarks and cultural resources sections.

Chapter 6: Hazard Identification and Assessments

- Reviewed and updated all of the natural, technological, and human-related hazards. A section on PFAS was added to the technological hazard section.
- Combined the Hazard Identification and Hazard Risk and Vulnerability Assessments.
- Reviewed and updated the hazard priority risk index.

Chapter 7: Goals and Objectives

- Reviewed and updated the goals and objectives. A goal and its corresponding objectives regarding geographic information system (GIS) data sets was added.

Chapter 8: Mitigation Strategies and Priorities

- Reviewed and updated the mitigation actions and implementation strategies. Several action items were moved to the all-hazard mitigation action table, five hazard actions were removed from the plan, and two actions items were added regarding PFOA/PFAS.

Chapter 9: Plan Maintenance

- Reviewed and made minor changes to the chapter.

Planning Process in Crawford County

In 2005, Crawford County prepared its first Hazard Mitigation Plan and updated it in 2014. In 2019, NEMCOG began working with the Emergency Manager and the LEPC to review and update Crawford County's 2014 Hazard Mitigation Plan. The LEPC is made up of representatives from local governments, law enforcement, fire departments, community organizations, and local, state and federal agencies (Table 1-1).

Table 1-1 Crawford County LEPC Membership	
Name	**Title**
Douglas Pratt	Crawford EMC
Mike Arwood	Grayling Public Safety
Glen Ballard	Frederic Fire Department/Asst EMC/PIO
Doug Baum	City of Grayling
Jim Beehler	Facility Operator
Doug Bourgeois	Beaver Creek Fire Chief
Jeff Freiburger	Arauco
Charles Detiege	Arauco
Edward Goscicki	Frederic Deputy Chief
Michael DeCastro	MSP EMHSD Region 7
Travis House	Law Enforcement-MSP LT
Phil Lewis	South Branch Fire Chief
Craig Sharp	Michigan Department of Natural Resources
Brian Flickinger	EGLE
Bob Dixon	Grayling Building Department
Bret Haner	District Health Department
Shawn Kraycs	Sheriff, Crawford County Sheriff's Office
Kathi Moss	Facility Operator, Weyerhauser
Paul Olmstead	Crawford County Building Department
Rich Sajdak	Facility Operator, Georgia Pacific
Tony Nash	Facility Operator, ADJ
Shelly Pinkelman	Crawford County Board of Commissioners
Meghan Powers	Disaster Program Manager, American Red Cross
Mike Janisse	Michigan Department of Natural Resources

Community Involvement

The local jurisdictions, stakeholders, and public were involved during the drafting phase of the hazard mitigation plan and during the completion of the draft plan before its adoption. Information was disseminated to the communities and public through public meetings, news releases, and email. Representatives from Crawford County, the City of Grayling, Beaver Creek Township, Frederic Township, Grayling Township, Lovells Township, Maple Forest Township, and South Branch Township participated in updating the hazard mitigation tables and reviewing the draft plan (Table 1-2).

The planning process educated community leaders and residents about hazard awareness, which assisted communities in making informed decisions. Additionally, the process strengthened partnerships between local governments, planning commissions, emergency services, public agencies and private entities. These partnerships facilitate communication and allow for the pooling of resources.

Table 1-2 Jurisdiction Participation Status		
Jurisdiction	**Representative**	**Participation Status**
City of Grayling	Doug Baum, City Manager	Continuing Participant
Beaver Creek Township	Kim VanNuck, Supervisor	Continuing Participant
Frederic Township	Bill Johnson, Supervisor	Continuing Participant
Grayling Township	Robert Dixon, Building/Zoning Official; Lacey Stephan, Supervisor	Continuing Participant
Lovells Township	Gary Neumann, Supervisor	Continuing Participant
Maple Forest Township	Tom Coors, Supervisor	Continuing Participant
South Branch Township	Laurie Luck, Supervisor	Continuing Participant
Other Agencies		
Name	**Title**	**Agency**
John Huspen	Conservation Officer	Michigan Department of Natural Resources
Michael Bentley	Environmental Health Safety Coordinator	Weyerhaeuser
Pete Nicholson		MMR

Public Participation Survey

The Emergency Manager and LEPC commissioned a regionwide survey to gain input and feedback regarding the perceptions and opinions about natural, technological, and human-related hazards, and the preferred methods and techniques to reduce risk and losses from hazards. The region includes Alpena, Alcona, Crawford, Montmorency, Oscoda, Otsego, and Presque Isle Counties. The regionwide survey was available online and hard copies were available at the Crawford County Emergency Management Office for the public, neighboring jurisdictions, and stakeholders from August 12, 2019 through November 19, 2019. Press releases were issued to inform the communities about the availability of the survey in *The Alpena News, Weekly Choice, The Montmorency County Tribune,* and the *Petoskey News*. On August 12, 2019, a link to the survey and a request to forward the link to other individuals was sent to the LEPC, Crawford County Board of Commissioners, and the local jurisdictions' manager, supervisors, and clerks as well as the surrounding counties and local governments.

Fifty-five completed surveys were received for Alpena, Alcona, Crawford, Montmorency, Oscoda, Otsego, and Presque Isle Counties (see results below). See Appendix A for the survey results specific to individuals residing in Crawford County and a link to the regionwide survey. Participants were asked a number of different questions, including their concern levels for natural, technological, and human-related hazards, their perception of the county's preparedness level for each hazard, identification of community assets, and their approval/disapproval of various mitigation approaches. Lastly, participants were asked to provide suggestions to improve hazard mitigation. The county evaluated and incorporated both the regional survey results and the county specific survey results during the plan update.

Approximately 65.5% of respondents have not received information about how to make their household safer from natural, technological, or human-related hazards. The respondents who had received information indicated it came from the American Red Cross, FEMA, the Alpena County Emergency Management Office, Otsego County Emergency Management Office, USDA/Forest Service, DTE Energy, the Firewise program, insurance companies and CERT. The majority of respondents indicated the internet, mail, and television were the most effective ways to distribute

information, followed by radio, newspaper, and public workshops/meetings. About 60.0% of respondents indicated they have not experienced a hazard event in the last five years. The respondents who had experienced a hazard indicated they had experienced flooding, snowstorms/winter storms, a hurricane, and straight-line winds/windstorms.

Natural Hazards
Respondents are very concerned or somewhat concerned about the following hazards:

- Snow/ice storms: 78.2%
- Windstorm/high winds: 72.7%
- Extreme cold: 65.5%
- Wildfires: 56.4%
- Tornadoes: 43.6%

Respondents are not very concerned or not concerned about the following hazards:

- Drought: 50.9%
- Floods: 49.1%
- Extreme heat: 41.8%

Approximately 38.2% of respondents were neutral regarding their concern for thunderstorms. Additionally, respondents indicated they were concerned about milfoil in the lakes, earthquakes, mass shootings and disease outbreaks.

Respondents feel the region is best prepared to handle snow/ice storms (74.6%), extreme cold (69.1%), thunderstorms (65.5%), and windstorms/high winds (40.0%). Respondents are unsure if the region is prepared to handle drought (49.1%), extreme heat (40.7%), tornadoes (40.0%), and wildfires (36.4%). About 40.7% of respondents were evenly split (least prepared or unsure) in how prepared the region is to handle flooding.

Technological Hazards
Respondents are very concerned or somewhat concerned about the following hazards:

- Communications failures: 81.8%
- Power failures: 80.0%
- Structural fires: 78.2%
- Oil and gas accidents: 74.5%
- Hazardous material spills: 69.1%
- Road accidents: 67.3%
- Water or wastewater treatment system failures: 44.4%
- Air transportation accidents: 43.6%

Respondents are not very concerned or not concerned about the following hazards:

- Railroad accidents: 66.0%
- Dam failures: 61.1%
- Water transportation accidents: 52.7%
- Terrorism/sabotage: 43.6%

Respondents feel the region is best prepared to handle road accidents (81.8%), structural fires (70.4%), power failures (54.6%), hazardous material spills (48.2%), and oil and gas accidents (48.2%). Respondents feel the region is least prepared to handle terrorism/sabotage (65.5%), water transportation accidents (45.5%), communications failures (38.9%), and air transportation

accidents (36.4%). Respondents were unsure how prepared the region is to handle dam failures (53.7%), railroad accidents (51.9%), and water or wastewater treatment system failures (47.3%).

Human-Related Hazards
Respondents are very concerned or somewhat concerned about the following hazard:

- Cyber-attacks: 59.3%

Respondents are not very concerned or not concerned about the following hazard:

- Chemical or biological attacks: 47.3%

Respondents feel the region is least prepared to handle cyber-attacks (58.2%) and chemical or biological attacks (55.6%).

Community Assets
Respondents ranked the following community assets from the most vulnerable to the least vulnerable to the hazard impacts:

1. Human (death/injuries)
2. Infrastructure (damage or loss of bridges, utilities, schools, etc.)
3. Economic (business closures, job losses, etc.)
4. Environmental (damage or loss of forests, waterways, etc.)
5. Governance (ability to maintain order and/or provide public amenities and services)
6. Cultural/Historic (damage or loss of libraries, museums, fairgrounds, etc.)

Regulatory Approaches
Respondents supported the following approaches to reduce risk and loss associated with disasters:

- Improving the disaster preparedness of local schools (98.2%)
- Taking steps to safeguard the local economy following a disaster (96.4%)
- Creating an inventory of at-risk buildings and infrastructure (94.4%)
- Making their home more disaster-resilient (89.1%)
- Disclosing natural hazard risks on real estate transactions (87.3%)
- Policies to prohibit development in areas subject to natural hazards (83.3%)
- Protecting historical or cultural structures (71.7%)
- The use of tax dollars to reduce risk and losses from natural disasters (70.4%)
- Regulatory approaches (68.5%)
- Non-regulatory approaches (57.4%)

Respondents recommended increasing public outreach and education efforts, improving wildfire protection, bringing specialists into the communities to assist in mitigating hazards, enforcing reasonable and consistent fire codes, increasing funding to enhance essential public safety services, developing a rapid marine response to boaters in danger on Lake Huron, increasing milfoil awareness at local lakes, providing training opportunities, increasing security for cyber communications, installing broadband throughout the entire counties, limiting oil transport under/through/on the Great Lakes, being proactive with trimming and removing trees, strengthening local government partnerships, and increasing support for emergency services.

Meetings

During the preparation of the draft plan, LEPC meetings were held for participants to provide input and feedback through facilitated discussions that gained a consensus (Appendix B). Notices of the

public meetings were sent to LEPC members and local community officials. In addition to the LEPC meetings and discussions, additional meetings were held.

NEMCOG Board of Directors' Meetings

On April 18, 2019, NEMCOG staff gave a brief status update about the hazard mitigation process to the NEMCOG Board of Directors. Attendees included Dan Gauthier (Alcona County Board of Commissioner), Dave Karschnick (Alpena County Board of Commissioner), John Wallace (Cheboygan County Board of Commissioner), James Kargol (Emmet County Board of Commissioner), Kyle Yoder (Oscoda County Board of Commissioner, Chair), Robert Pallarito (Otsego County Board of Commissioner), Carl Altman (Presque Isle County Board of Commissioner, Vice Chair), Adam Poll (City of Alpena Planning and Development Director), Marisue Moreau (Northeast Michigan Consortium/Michigan Works!), Robert Heilman (NEMCOG Board of Directors' Chair), Doug Baum (City of Grayling, Crawford County, Manager), Dave Post (Village of Hillman, Montmorency County, Manager), Bill Wishart (City of Gaylord, Otsego County, Mayor), Norman Brecheisen (Livingston Township, Otsego County, Supervisor), and NEMCOG staff, Diane Rekowski, Theresa Huff, Karen Cole, and Christina McEmber.

On December 19, 2019, NEMCOG staff provided a status of county hazard mitigation plan updates and explained the approval process. Attendees included Dan Gauthier (Alcona County Board of Commissioner), Dave Karschnick (Alpena County Board of Commissioner), Daryl Peterson (Montmorency County Board of Commissioner), Kyle Yoder (Oscoda County Board of Commissioner, Chair), Robert Pallarito (Otsego County Board of Commissioner), Carl Altman (Presque Isle County Board of Commissioner, Vice Chair), Adam Poll (City of Alpena Planning and Development Director), Marisue Moreau (Northeast Michigan Consortium/Michigan Works!), Robert Heilman (NEMCOG Board of Directors' Chair), Bruno Wojcik (Briley Township, Montmorency County, Supervisor), Scott McLennan (City of Rogers City, Presque Isle County, Mayor), Doug Baum (City of Grayling, Crawford County, Manager), Dave Post (Village of Hillman, Montmorency County, Manager), Norman Brecheisen (Livingston Township, Otsego County, Supervisor), and NEMCOG staff, Diane Rekowski, Theresa Huff, Karen Cole, Steve Schnell, Nico Tucker, Denise Cline and Christina McEmber.

County Emergency Manager Meeting

On April 29, 2019, NEMCOG and the Emergency Manager discussed the hazard mitigation plan update and set up input meetings.

Kick off Meeting

On May 22, 2019, NEMCOG provided an overview of the hazard mitigation planning process and information about the grant match. Chapter 5: Community Services and Facilities was reviewed and updated. All jurisdictions in Crawford County were invited multiple times to the meeting to guide the planning process but did not attend. Attendees included Doug Pratt, Ed Goscicki, John Huspen, and NEMCOG staff, Christina McEmber.

Plan Review and Update Meetings

On October 16, 2019, NEMCOG met with the LEPC to provide a brief overview of the hazard mitigation planning process, current plan status, and grant match. A special meeting was scheduled for November 13, 2019. Attendees include Paul Olmstead, Robert Dixon, Tony Nash, Rich Sajdak, Carol Rabineau, Ron Rabineau, Doug Bourgeois, Mike Arwood, Allen Ballard, Charles Detiege, Kathi Moss, and NEMCOG staff, Christina McEmber.

On November 13, 2019, NEMCOG met with the LEPC to review and update the 2014 Crawford County Hazard Mitigation Plan. The committee reviewed and updated the county's hazard rankings

based on their social impact, likelihood of occurrence, and administrative potential. The LEPC elevated the county's risk for transportation accidents, added Per- and Polyfluoroaklyl Substances (PFAS) as a hazard, and reduced the county's risk for Sabotage/Terrorism/Nuclear Attack.

The committee also reviewed and updated the plan's goals and objectives and determined a goal and its corresponding objectives regarding the county's geographic information system should be added. Finally, the committee reviewed the hazard mitigation actions and implementation strategies. The committee determined if the actions were still relevant and updated the action's priority ranking, responsible agency, funding source, application, current progress, and future status. Several action items were moved to the all-hazard mitigation action table, five hazard actions were deemed to be no longer relevant in the county (and will be removed from future plans), two strategies were added regarding PFAS, and multiple action items were determined to be ongoing projects. Attendees included Rich Sajdak, Charles Detiege, Doug Pratt, Ed Goscicki, Mike Arwood, Allen Ballard, Michael Bentley, Bret Haner, and NEMCOG staff, Christina McEmber.

On January 15, 2020, NEMCOG met with the LEPC to review the county's hazard rankings. No other changes were deemed necessary. The committee also received the updated hazard mitigation actions and implementation strategies tables. Attendees included Robert Dixon, LTC Frank Laurence, SFC Matthew Boyd, Tony Nash, Major Quin M. Rogers, SFC Link Hibcamig, LTC Shawn G. Abbe, Ron Rabineau, Carol Rabineau, Allen Ballard, Doug Pratt, Charles Detige, Rich Sajdak, Bret Haner, Kathi Moss, and NEMCOG staff, Christina McEmber.

On July 22, 2020, NEMCOG met with the LEPC to schedule a public meeting for the hazard mitigation plan and to discuss the updates per the State of Michigan's review of another county's plan that were relevant to Crawford County's Hazard Mitigation Plan. Attendees included Doug Bourgeois, Ed Goscicki, Allen Ballard, Doug Pratt, Susan Huffman, Doug Baum, Charles Detiege, Megan Powers, and NEMCOG staff, Christina McEmber.

On October 21, 2020, NEMCOG met with the LEPC to discuss the updates per FEMA's review of another county's plan that were relevant to Crawford County's Hazard Mitigation Plan. Attendees include Doug Bourgeois, Allen Ballard, Bret Haner, Doug Pratt, Susan Huffman, Mike Arwood, Rich Sajdak, Tony Nash, Kathi Moss, Charles Detiege, Shawn Kraycs, Pete Nicholson, and NEMCOG staff, Christina McEmber.

Draft Plan

The draft 2021 Crawford County Hazard Mitigation Plan was made available to local governments, agencies, and the public for review and comment. A public notice was sent to the local newspaper informing the residents about the draft plan and where it could be reviewed. The draft plan was posted on Crawford County's website and NEMCOG's website. The draft plan was also emailed to the local jurisdictions' manager, supervisors, clerks, Board of Commissioners, and the surrounding jurisdictions for review and comment.

On August 5, 2020, a public hearing was held to receive comments and suggestions on the draft plan. No comments or suggestions were received in the meeting or by phone, email, and mail.

The draft plan was submitted to the Michigan State Police and FEMA for approval before adoption by the Crawford County Board of Commissioners and local jurisdictions.

INSERT DATE, the Crawford County LEPC approved a motion to recommend adoption of the 2021 Crawford County Hazard Mitigation Plan by the Crawford County Board of Commissioners and all local municipalities within Crawford County.

Plan Adoption

INSERT DATE, the 2021 Crawford County Hazard Mitigation Plan received "approvable pending adoption" status from the State and FEMA. A public notice was sent to the local newspaper informing residents when the County Board of Commissioners would be considering adoption of the draft plan. **INSERT DATE,** NEMCOG presented the 2021 Crawford County Hazard Mitigation Plan to the Crawford County Board of Commissioners for adoption and the plan was adopted (Appendix C). After adoption by the County, the local jurisdictions were notified about the county's adoption of the plan and were requested to also adopt the plan (Appendix C).

Incorporation of Plans, Studies, and Technical Information

NEMCOG staff reviewed relevant plans, maps, studies, and reports. Federal, state, regional, and local government sources were reviewed to update the county's community profile. These sources included the U.S. Census Bureau, zoning ordinances, master plans, recreation plans, capital improvement plans, parcel maps, aerial photography, Michigan Department of Natural Resources' Michigan Resource Information System land use/land cover information (MIRIS), USGS topographic maps, the National Oceanic and Atmospheric Administration's National Centers for Environmental Information Data Center (NOAA), the USDA's Soil Surveys, NRCS soils maps, Michigan Department of Transportation, Michigan Hazard Analysis, Michigan Hazard Mitigation Plan, local hazard analysis, flood insurance rate maps, emergency management plans, Michigan Department of Environment, Great Lakes, and Energy, U.S. Forest Service, Michigan State Police Emergency Management and Homeland Security Division, and the Bureau of Fire Services.

GIS was used as a public education and decision tool throughout the planning process. Data sets were used to analyze existing conditions and potential future scenarios. Specialized maps, such as community hazards, land cover/use, and infrastructure, were used during the drafting phase of the plan. The maps assisted in identifying community characteristics, vulnerable populations, and hazard areas.

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Chapter 2 Environment

Overview

Crawford County encompasses 556.1 square miles in Michigan's north-central Lower Peninsula. It is located approximately 35 miles inland from Lake Michigan and approximately 50 miles inland from Lake Huron. The County is bordered by Otsego, Oscoda, Roscommon, and Kalkaska Counties and is composed of a city and six townships (Figure 2-1):

- City of Grayling (county seat)
- Grayling Township
- Frederic Township
- Maple Forest Township
- Lovells Township
- South Branch Township
- Beaver Creek Township

Figure 2-1 Location of Crawford County's Townships and City

Climate

Crawford County experiences four seasons characterized by warm summers, cold winters, and cool springs and falls. Summers are characterized by high humidity and warm temperatures with the warmest days occurring during July. The temperature ranges between 15 degrees Fahrenheit and 66 degrees Fahrenheit in the spring and between 49 degrees Fahrenheit and 80 degrees Fahrenheit in the summer. The county experiences an average annual precipitation of 33.58 inches with 62% of the precipitation falling between April and September. The majority of the thunderstorms occur during June, July, and August. Soil moisture replenishment plays a vital role in the success of the area's agriculture. While drought occurs periodically, the Palmer Drought Index indicated drought conditions reached extreme severity 2% of the time.

As the prevailing westerly winds move across the region, the area is likely to experience lake effect snow. The temperature ranges between 8 degrees Fahrenheit and 30 degrees Fahrenheit in the winter and between 25 degrees Fahrenheit and 69 degrees Fahrenheit in the fall. On average, 127 days of the year have at least one inch of snow on the ground according to the *Soil Survey of Crawford County, Michigan.* However, the number of days varies each year. The average snowfall is 105 inches in the county. The frost dates begin on June 21 and end on August 31. According to the *Soil Survey of Crawford County, Michigan*, the highest recorded temperature was on June 28, 1887 at 106 degrees Fahrenheit, while the lowest temperature on record was on February 17, 1979 at -42 degrees Fahrenheit.

According to the National Aeronautics and Space Administration, Earth's climate has been warming over the past century at an unprecedented rate due to human activities. Carbon dioxide and other gases are trapping heat, which is causing the earth to warm. According to the *Planning for Community Resilience in Michigan: A Comprehensive Handbook*, Michigan is predicted to experience more frequent and severe storms, increases in winter and spring precipitation, less precipitation as snow and more as rain, reduce ice cover on the Great Lakes, an extended growing season, more flooding events with risks of erosion, an increase in the frequency and length of severe heat events, and an increase in drought and wildfires. Since Crawford County's 2014 Hazard Mitigation Plan Update, Crawford County has seen an increase of 11.2 inches of snowfall and an increase of 1.63 inches of precipitation. Information on severe weather can be found in Chapter 6: Hazard Identification.

Topography and Geology

Most of the county is nearly level or gently rolling. Local differences in elevation are slight, in a few places exceeding 100 feet, although the hills and plateau-like ridges appear to rise above adjacent sand plains. Slopes of hilly land are long and expansive, or choppy, smooth and rounded. There are no steep slopes except along watercourses.

The retreating continental glaciers formed the moraines, till plains and outwash plains in Crawford County. Moraines are linear, hilly ridges that represent the former position of a glaciers edge and are made up of unconsolidated sand, gravel, rock, and clay. There are three moraines located north (north to south trend) and south (east to west trend) of Grayling with three complementary till plains. Till plains are the level areas located between moraines and consist of unconsolidated sand, gravel, rock, and clay. There is also a till plain located through the central part of the county where the Au Sable River and its tributaries have cut narrow, shallow trenches. Outwash plains are water-laid deposits formed from the melting glacier consisting of stratified deposits of sand, gravel, rock, and clay. The only outwash plain is located in Beaver Creek and South Branch Townships.

Crawford County's bedrock consists of Napoleon Formation (sandstone) and Michigan Formation (interbedded layers of shale sandstone and limestone). In the northern part of the county, the bedrock is covered by glacial drift ranging from 600 to 800 feet thick, while in the southern part it is less than 200 feet thick. The bedrock formations contain economic deposits of gas and oil, which have resulted in intensive exploration and numerous producing wells. Oil and gas wells are concentrated on the west side of Beaver Creek Township, in the northern portion of Frederic Township, in the northwest portion of Maple Forest Township, and in the northwest portion and along the eastern boundary of Lovells Township.

Soils

The Natural Resources Conservation Service completed a detailed soil survey of Crawford County and the soil survey maps were acquired from the Michigan Center for Geographic Information. These sources were used to analyze the soil conditions and found the county's soils range in texture, natural drainage, slope, and other characteristics.

Hydric Soils and Steep Slopes

Soil types and slopes are two important factors that should be considered when planning for land use types and intensity. The cost to develop areas with hydric soils and steep slopes is greater than the cost of developing in less constrained areas since hydric soils and steep slopes have severe building constraints and special design considerations, such as erosion control measures, slope stabilization, and on-site water retention. Also, the location of excessively drained soils and steeply sloped areas influence wildfire behavior since pine forests and jack pine forests grow on sandy, droughty soils and steep slopes make it difficult for firefighting equipment to access an area (Figure 2-2).

Hydric soils are located adjacent to streams and creeks and are classified as poorly drained and very poorly drained (Figure 2-2). During part of the growing season, these soils are saturated and will not support heavy equipment for the deployment of fire suppression equipment, building site development, and sanitary facilities. The high-water table may classify these soils as wetlands and require a wetland permit for development.

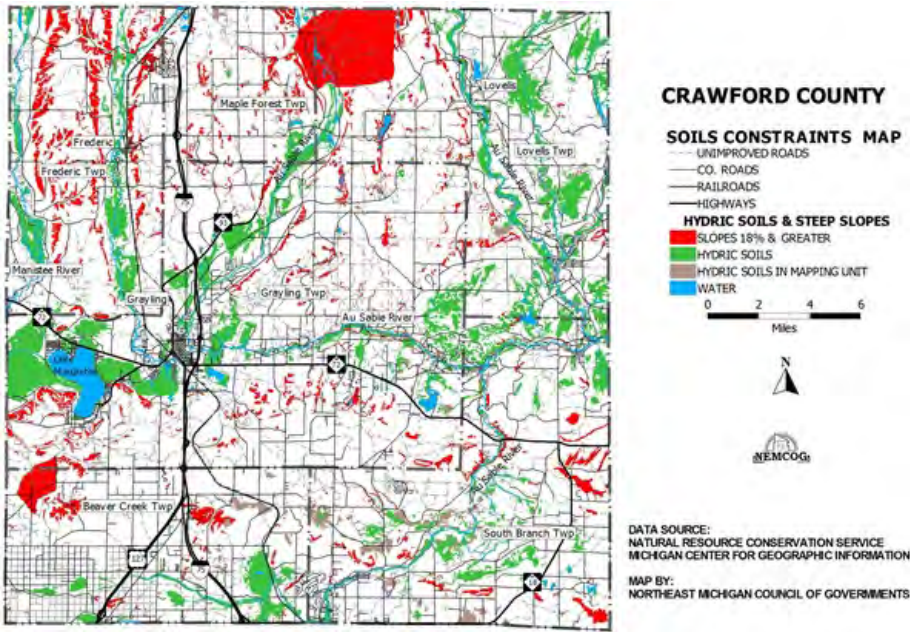

Figure 2-2 Location of Hydric Soils and Steep Slopes

Soil Drainage Class

Drainage class refers to the frequency and duration of wet periods. Alterations in the water regime by human activities, either through drainage or irrigation, are not considered unless they have significantly changed the soil morphology. The USDA's *Soil Survey of Crawford County, Michigan,* recognizes seven natural soil drainage classifications (Figure 2-3).

Crawford County's soil drainage classes are predominantly excessively drained and somewhat excessively drained. These soils support vegetation that can tolerate droughty conditions and include jack, red and white pine; northern pin, red and white oak; bigtooth and quaking aspen; paper birch and red maple. Jack pine and northern pin oak are most commonly found on the sandy, excessively drained soils.

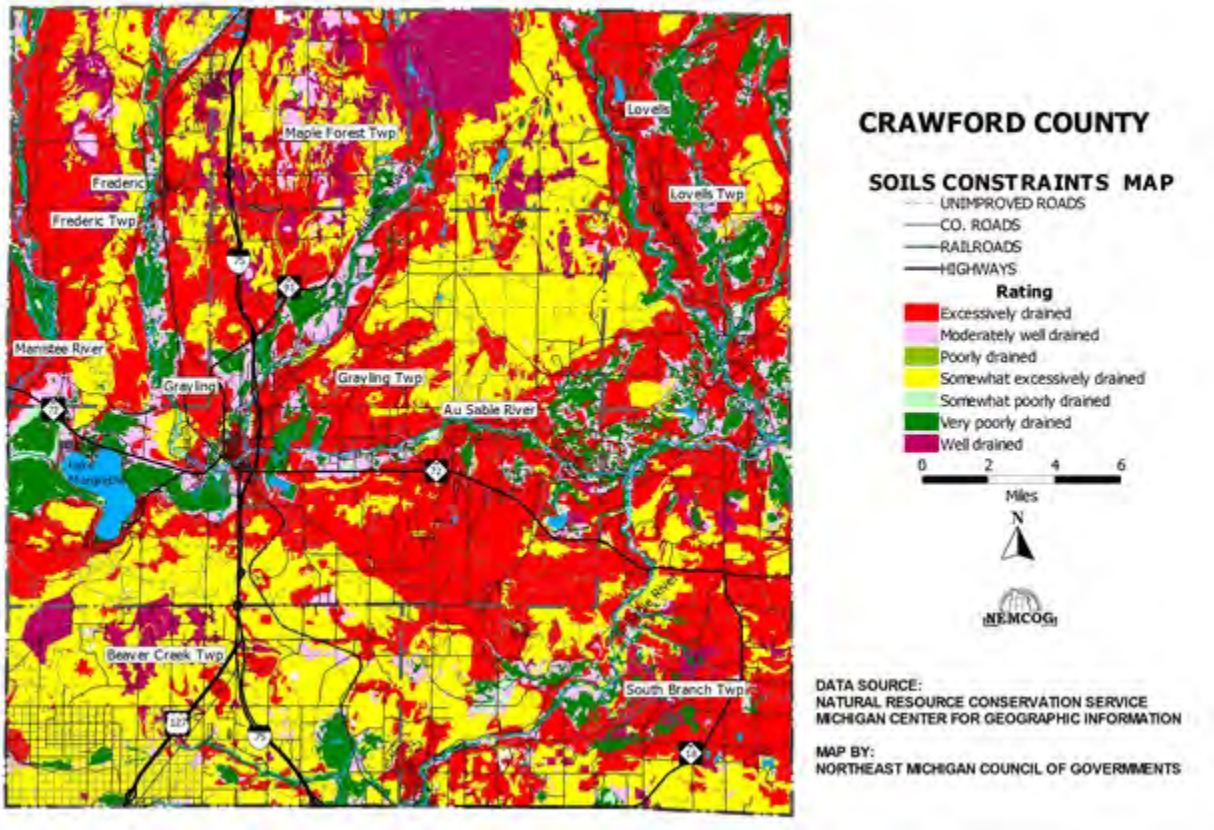

Figure 2-3 Crawford County's Soil Drainage Classification

Water Resources

There are 45 miles of inland shoreline in Crawford County with approximately 25 miles open to the public. Crawford County has 53 lakes that are one acre or larger and seven lakes over 100 acres. The majority of the lakes are less than 50 acres. Lake Margrethe (Grayling Township) is the largest water body in the county with a surface area of 1,928 acres, an average depth of 16 feet, and a maximum depth of 65 feet. The lake is located at the headwaters of the Manistee River Watershed (drains to Lake Michigan) and is a popular recreation and tourism location (Figure 2-4). The Manistee River drains the western portion of the county. The county is predominantly located in the Au Sable Watershed, which drains to Lake Huron. Other significant lakes include Shupac Lake, Shellengarger Lake and Jones Lake. Lovells Township is bisected by three rivers that converge in the southwest portion of the township. South Branch Township is bisected in the northern portion of the township by the Au Sable River. The Manistee and Au Sable Rivers bisect Frederic Township.

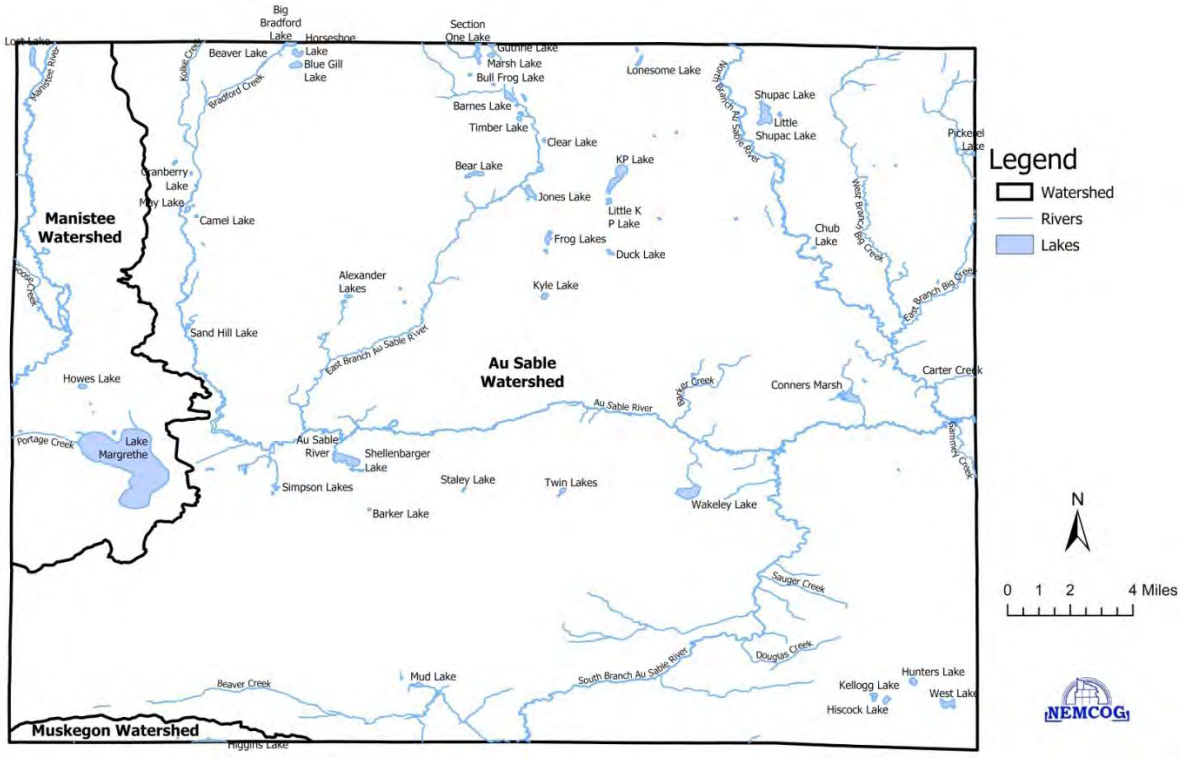

Figure 2-4 Crawford County Watersheds

Forests

Approximately 90% of Crawford County is forested with 52% owned by the state, 32% owned privately, and 16% owned federally (e.g., Au Sable State Forest and the Huron National Forest). Most of the public land is managed under a multi-use recreation concept and has areas determined to be refuges for the Kirtland Warbler. Better wildfire control and reforestation efforts have increased the amount of forestland in the county. Military forestlands are not managed for commercial forest production.

The Michigan Resource Information System's 1978 Land Cover/Use Inventory (MIRIS) and the Michigan Department of Natural Resources' pre-settlement vegetation maps were used to analyze the forest types in the county to assist in defining the vulnerable areas and populations. A review of the county's pre-settlement vegetation shows extensive areas were covered with jack pine-red pine forest, white pine-red pine forest, Pine Barrens and pine/oak barrens, which were replaced by aspen and oak over time (Figure 2-5). Today's major forest stands are composed of Jack Pine (27%), Oak/Hickory Group (23%) and Aspen (21%), which dramatically increases the area's wildfire risk. Other forest stands include the Maple/Beech/Birch Group (12%), Black Spruce (6%), Balsam Fir (4%), and Red Pine (4%). There are also smaller acreages of Eastern White Pine, White Spruce, Northern White Cedar, White Pine/Red Oak/White Ash, and Paper Birch. According to MIRIS, residential developments have been placed in areas dominated by Jack Pine and Red Oak, which indicates wildfire susceptibility (Figure 2-6).

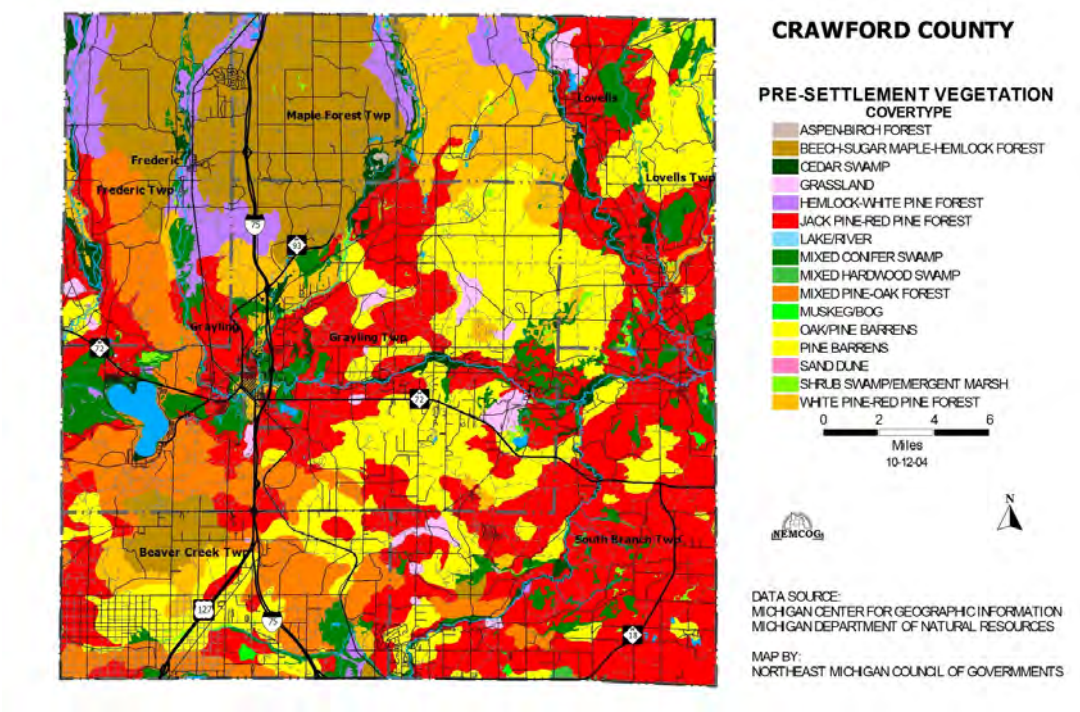

Figure 2-5 Crawford County's Pre-settlement Vegetation

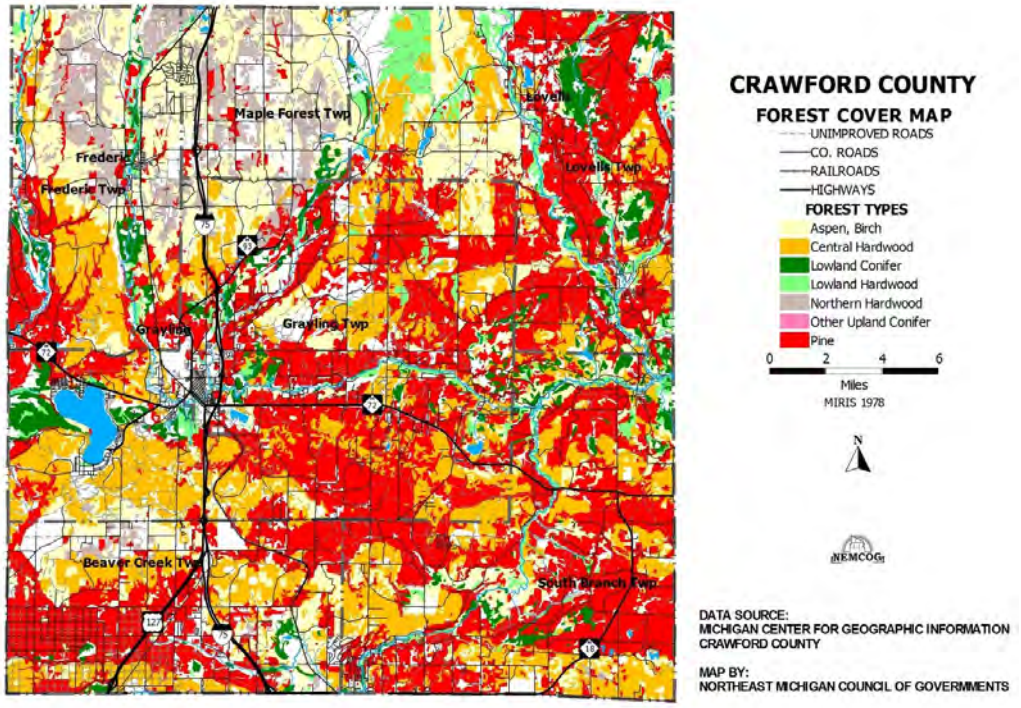

Figure 2-6 Forest Cover Types

Discharge Permits

Surface Water Permits

The State of Michigan controls the discharge of pollutants from waste and wastewater into Michigan's surface waters through the National Pollutant Discharge Elimination System (NPDES) permitting process. This process imposes effluent limitations and other necessary conditions to protect the environment and meet State and Federal regulations. Three NPDES permits have been issued in Crawford County (Table 2-1).

Table 2-1 National Pollutant Discharge Elimination System Permits in Crawford County

Site Name	Address	Site Type	Permit Number	Expiration Date
MDOT	M-72, Frederic, Grayling, and Bear Twps, Crawford and Kalkaska Counties	Construction Site	MIR115115	6/7/2023
Mich ANG-Camp Grayling	Building 100A- State Maintenance Shop	Industrial	MIS110546	4/1/2021
Mich ARNG-Grayling Mates	1400 North Down River Road	Industrial	MIS410164	4/1/2019

Source: Michigan Department of Environment, Great Lakes, and Energy

Groundwater Discharge Permit

The State of Michigan regulates the discharge of wastes and wastewaters into the ground or groundwater system through the groundwater discharge permit program. Field staff review effluent and groundwater data and inspect discharge facilities. The issuance of a groundwater permit does not authorize the violation of local, state, or federal regulations, nor does it remove the obligation to obtain other permits or government approvals. According to the Michigan

Department of Environment, Great Lakes, and Energy (EGLE), there are eleven groundwater discharge permits issued in Crawford County (Table 2-2).

Table 2-2 Groundwater Discharge Permits in Crawford County

Site Name	Address	Site Type	Permit Number	Expiration Date
Beaver Creek Grayling Twps UA WWTP	8888 S. Grayling Road	Municipal Sanitary-Public	GW1810281	12/1/2020
DNR-Parks & Rec-Hartwick	4216 Ranger Road	Campground	GW1010014	3/1/2015
Georgia-Pacific Chemicals LLC	4113 West Four Mile Road	Industrial	GW1010160	3/1/2019
Grayling WWTF	2926 Millikin Drive	Municipal Sanitary-Public	GW1810242	9/1/2019
Higgins Lake WWTF	11731 Legion Camp Road	Municipal Sanitary-Public	GW1810193	12/1/2018
Kirtland Community College - Grayling	4800 West 4 Mile Road	-	GW1110779	2/1/2021
MDMA-Camp Grayling-MATES	2450 North Down River Road	Industrial	GW1810156	5/1/2019
MDMVA-Camp Grayling	Environmental Office, Building 100A	Campground	GW1810158	2/1/2021
MDNR-North Higgins Lake	11747 North Higgins Lake Drive	Campground	GW1510055	4/1/2020

Source: Michigan Department of Environment, Great Lakes, and Energy, Retrieved May 2019

Air Discharge (Renewable Operating Permit/ Title V) Permits

The State of Michigan administers the Renewable Operating Permit (ROP) system to regulate air emissions for facilities that emit more than a certain amount of air contaminants. According to EGLE, there are four renewable operating permits issued in Crawford County:

- Arauco
- Weyerhaeuser NR Company
- Grayling Generating Station Limited Partnership
- City Environmental Services, Inc. of Waters
- Jaguar Energy-Frederic 15 Gas Plant

Sites of Environmental Contamination

The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended regulates facilities of environmental contamination in Michigan. The Remediation and Redevelopment Division of EGLE works toward managing and revitalizing sites of environmental contamination to protect the environment. The division administers two programs: Environmental Remediation (release of hazardous substances from facilities) and Leaking Underground Storage Tanks (release of hazardous substances from underground storage tanks).

The facility inventory database has information for Sites of Environmental Contamination (Part 201), Leaking Underground Storage Tanks (Part 213), and Baseline Environmental Assessments (BEA). The Baseline Environmental Assessments document the existing contamination and allows a facility to be acquired and/or operated without being held liable for the existing contamination. In Crawford County, the facility inventory database reports the following:

- 41 sites with completed Baseline Environmental Assessments (BEA)

- 38 sites listed as Sites of Environmental Contamination (Part 201)
- 16 sites listed as Leaking Underground Storage Tanks (Part 213)

Chapter 3 Community Profile

Population

According to the U.S. Census Bureau, Crawford County's population has experienced a 3.2% decline between 2000 and 2017 (Table 3-1). The majority of the county's population is concentrated in the City of Grayling and Grayling Township. However, the city and Grayling Township have experienced population declines since 2000. There are also population centers in South Branch, Beaver Creek, and Frederic Townships. Since 2000, South Branch and Frederic Townships have also seen a population decline; while, Beaver Creek has experienced a population increase. Maple Forest and Lovells Townships have also experienced an increase in their populations since 2000.

Table 3-1 Population for Crawford County & its Municipalities, 2000-2017

Municipality	2000 Population	2010 Population	2017 Population	Percent Change 2000-2017
Crawford County	**14,273**	**14,074**	**13,821**	**-3.2%**
City of Grayling	1,952	1,884	1,813	-7.1%
Beaver Creek Township	1,486	1,736	1,803	21.3%
Frederic Township	1,401	1,341	1,305	-6.9%
Grayling Township	6,516	5,827	5,720	-12.2%
Lovells Township	578	626	601	4.0%
Maple Forest Township	498	653	773	55.2%
South Branch Township	1,842	2,007	1,806	-2.0%

Source: U.S. Census Bureau

Seasonal Population Estimate

Since the seasonal population fluctuates based on the county's tourism and local events, it is difficult to determine the number of seasonal residents and visitors. However, an approximate estimate for the number of seasonal residents can be obtained by multiplying the number of seasonal housing units (4,614) by the average number of persons per household (2.26) to get a seasonal population estimate of 10,428 persons. When the seasonal population estimate is combined with the U.S. Census Bureau's population figure, the county's population becomes approximately 24,249 persons. Unfortunately, this estimate does not include seasonal visitors who stay in motels, campgrounds, or family homes. For example, the Au Sable River Marathon attracts as many as 50,000 visitors to the county who are not accounted for in the estimate.

Age Distribution

The median age of the county's residents increased from 40.6 years in 2000 to 50.0 years in 2017; while the median age for the State increased from 32.5 to 39.6 years (Figure 3-1). Since the county is aging at a faster rate than the State, it appears the county's residents are aging in place and will need accessible social, emergency response, and medical services.

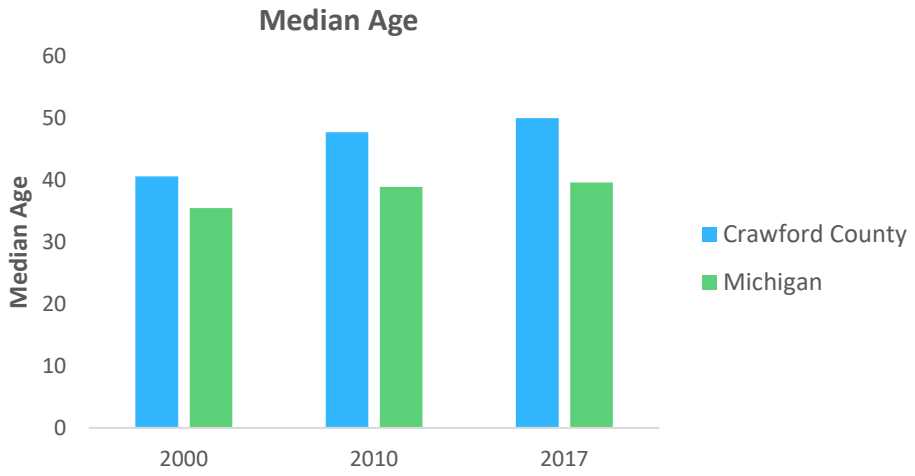

Figure 3-1 Median Age 2000-2017

According to the U.S. Census Bureau, the 45-64 years old age group is the most populous group in the county and all of its municipalities, while the second most populous group is aged 65 years or older for the county and all of its municipalities except for the City of Grayling (Table 3-2). In the City of Grayling, the second most populous age group is the 25-44 years old age group.

Table 3-2 Age Distribution by Municipality for Crawford County, 2017

Municipality	< 5 Years	%*	5-19 Years	%*	20-24 Years	%*	25-44 Years	%*	45-64 Years	%*	65 Years and older	%*	Median Age
City of Grayling	147	8.1	298	16.4	158	8.7	431	23.7	444	24.5	335	18.5	40.4
Beaver Creek Township	70	3.9	247	13.6	142	7.9	242	13.4	699	38.8	403	22.4	51.7
Frederic Township	48	3.7	267	20.4	94	7.2	176	13.5	446	34.2	274	21.0	47.6
Grayling Township	281	4.9	944	16.6	177	3.1	1,176	20.6	1,714	30.0	1,428	25.0	49.6
Lovells Township	3	0.5	67	11.2	2	0.3	80	13.4	231	38.4	218	36.2	59.5
Maple Forest Township	19	2.5	178	23.1	37	4.8	118	15.3	263	34.0	158	20.4	48.4
South Branch Township	25	1.4	247	13.6	74	4.1	253	14.0	707	39.1	500	27.7	53.4
Crawford County	**593**	**4.3**	**2,248**	**16.3**	**684**	**4.9**	**2,476**	**17.9**	**4,504**	**32.5**	**3,316**	**24.0**	**50.0**
Michigan	**571,999**	**5.8**	**1,910,417**	**19.3**	**723,180**	**7.3**	**2,396,359**	**24.1**	**2,748,380**	**27.7**	**1,575,233**	**15.8**	**39.6**

*Figure shows the percentage each age grouping represents of the local unit's total population.
Source: U.S. Census Bureau

Disability Status

Disabled status data is estimated by the American Community Survey and is based on a sample (Table 3-3). A person was classified as having a disability if they had a sensory, physical, mental, self-care, going outside the home, or an employment disability. Approximately 39.2% of Crawford County's population is classified as having some type of disability. The most common disabilities among the 18-64 years old age group are ambulatory and cognitive disabilities.

Table 3-3 Disability Status in Crawford County	
Status Type	**Number of Persons**
Population under 5 years with a disability	**0**
With a hearing difficulty	0
With a vision difficulty	0
Population 5-17 years with a disability	**211**
With a hearing difficulty	9
With a vision difficulty	24
With a cognitive difficulty	145
With an ambulatory difficulty	16
With a self-care difficulty	17
Population 18-64 years with a disability	**2,942**
With a hearing difficulty	326
With a vision difficulty	317
With a cognitive difficulty	672
With an ambulatory difficulty	808
With a self-care difficulty	263
With an independent living difficulty	556
Population 65+ years with a disability	**2,261**
With a hearing difficulty	657
With a vision difficulty	178
With a cognitive difficulty	249
With an ambulatory difficulty	668
With a self-care difficulty	171
With an independent living difficulty	338
Source: American Community Survey 2017	

Housing Stock

According to the U.S. Census Bureau, Crawford County has 11,178 housing units with 6,025 occupied units and 5,153 vacant units (Table 3-4). Out of the vacant units, 4,614 units are classified as seasonal, which means Crawford County has a high percentage of seasonal housing units. Frederic (50.0%), Lovells (70.6%), and South Branch (52.4%) Townships have the greatest amount of housing units classified as seasonal, while the City of Grayling has a very low percentage of seasonal housing units. Grayling Township has the most housing units at 4,260 units, while Maple Forest Township has the least amount of housing units at 511.

Table 3-4 Housing County and Occupancy Status in Crawford County, 2017						
Municipality	**Total**	**Occupied**	**Vacant**	**Percent Vacant**	**Seasonal**	***Percent Seasonal**
Crawford County	**11,178**	**6,025**	**5,153**	**46.1**	**4,614**	**41.3**
Beaver Creek Township	1,364	804	560	41.1	508	37.2
Frederic Township	1,201	543	658	54.8	601	50.0
City of Grayling	857	734	123	14.4	40	4.7
Grayling Township	4,260	2,483	1,777	41.7	1,531	35.9
Lovells Township	1,100	304	796	72.4	777	70.6
Maple Forest Township	511	312	199	38.9	170	33.3
South Branch Township	1,885	845	1,040	55.2	987	52.4
Source: US Census Bureau *Percent of total housing						

Selected Economic Indicators for Crawford County

According to the U.S. Census Bureau, the number of employed people has decreased from 5,197 persons in 2015 to 5,107 persons in 2017. The Census Bureau also reports the labor force has decreased from 6,117 persons in 2010 to 5,727 persons in 2017. Additionally, the county's unemployment rate has been decreasing since 2013 (Figure 3-2).

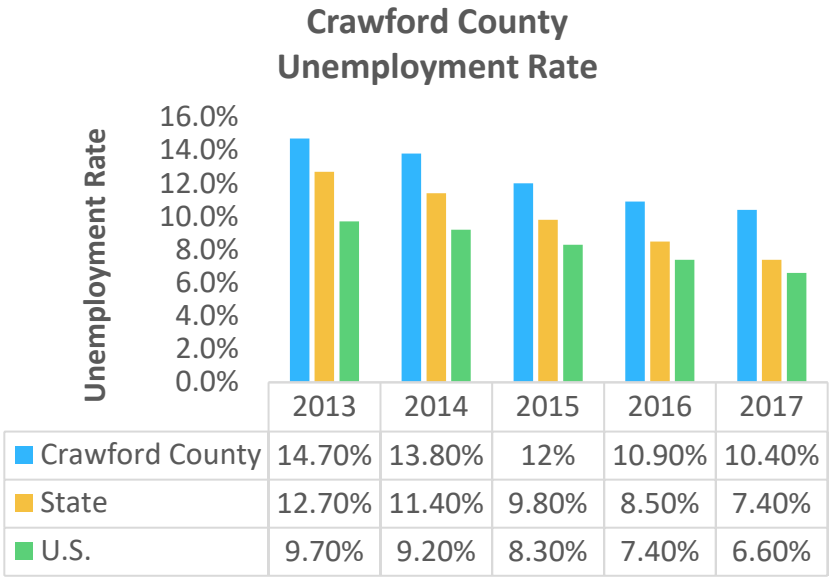

Figure 3-2 Unemployment Rate in Crawford County

Median Income

Median household income is a reliable measure of the economic health of families. In the eight counties in Northeast Michigan, there median income has steadily increased over the past several decades. However, the median income in Northeast Michigan lags behind the State. The U.S. Census Bureau reports that Crawford County's median household income was $42,666 in 2017 (Table 3-5). Overall, the county's median household income has remained relatively stable with a small drop between 2010 and 2013.

Table 3-5 Northeast Michigan Median Household Income	
Place	**2017**
Alcona County	$39,424
Alpena County	$40,954
Cheboygan County	$42,876
Crawford County	$42,666
Montmorency County	$39,152
Oscoda County	$36,833
Otsego County	$50,823
Presque Isle County	$43,758
State of Michigan	$52,668
United States	$57,652
Source: U.S. Census Bureau-American Community Survey	

Poverty Rates

Crawford County has a higher poverty rate than the other counties in Northeast Michigan. In 2017, 11.4% of the county's families were living in poverty with the percentage increasing to 23.5% if children were present (Table 3-6). When a female head of household is present, the percentage increases to 42.9% and to 58.9% if there are children under 18 in the household. According to the U.S. Census Bureau, there are 314 families with a female householder with children living in poverty in the county.

Table 3-6 Crawford County Poverty Rates 2017	
Category	**Percent**
Families	11.4%
All families w/related children under 18	23.5%
Married couple families	4.0%
Married couple families w/related children under 18	3.9%
Female householder, no husband present	42.9%
Female householder, no husband present w/ related children under 18	58.9%
Householder 65+ years	3.8%
Source: U.S. Census Bureau– American Community Survey	

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Chapter 4 Land Use Characteristics

Land Division Patterns

The county's land use and development were analyzed through the existing land division patterns. Most of the private ownership is divided into tracts that are 10 acres or smaller (Figure 4-1). Large tracts of private ownership, such as hunt/fish clubs, are scattered throughout the county. Small tracts and subdivisions are located near rivers, around lakes that lie along major highways, within recreational developments, and around the City of Grayling.

Additionally, the amount of public land determines the community's character and location for future developments (Figure 4-2, Table 4-1). Over 70% of the county's total land area is public land (this includes land owned by cities, townships, the county, the federal government, and the state government, but excludes water). Since the last plan update, the Arauco Plant opened in Grayling Township; otherwise, minimal development has occurred throughout the county.

Table 4-1 Crawford County Public Land Ownership

Ownership	Acres	Percent of Total
State of Michigan	116,734	32%
Military	97,294	27%
USA	41,433	12%
Other Public	1,246	>1%
Water	3,031	>1%
Source: NEMCOG		

Land Cover/Use

The Michigan Land Cover Dataset (part of the National Land Cover Dataset (NLCD)) was used to develop the county's land cover/use inventory. The NLCD was compiled from satellite imagery in 1992 to produce consistent land cover data for the United States. This approach utilized low resolution satellite imagery and computer-generated image interpretation to develop a generalized land cover map for planning purposes in Crawford County (Figure 4-3). The approach did not involve field checking or manual boundary adjustments. Due to the scale, low density urban development and development in dense forestland was not delineated. The data shows 86.3% of the county's total acreage is forested, 7.1% is non-forested, and approximately 3% is urban land uses (e.g., commercial/industrial, extractive, recreational, and residential uses) (Table 4-2).

Table 4-2 Crawford County General Land Use

Land Cover/Use	Acres	Square Miles	Percent of Total Area
Agriculture	3,957	6.18	1.1%
Commercial/Industrial/Transportation	2,679	4.18	0.7%
Extractive/Transitional	8,278	12.93	2.3%
Lowland Forests	43,959	68.68	12.2%
Non-Forested Uplands	25,719	40.18	7.1%
Recreational	460	0.71	0.13%
Residential	472	0.73	0.13%
Upland Forests	266,861	416.97	74.1%
Surface Water (lakes and rivers)	4,005	6.25	1.1%
Wetlands	3,904	6.10	1.1%
Total	**360,294**	**562.95**	**100%**

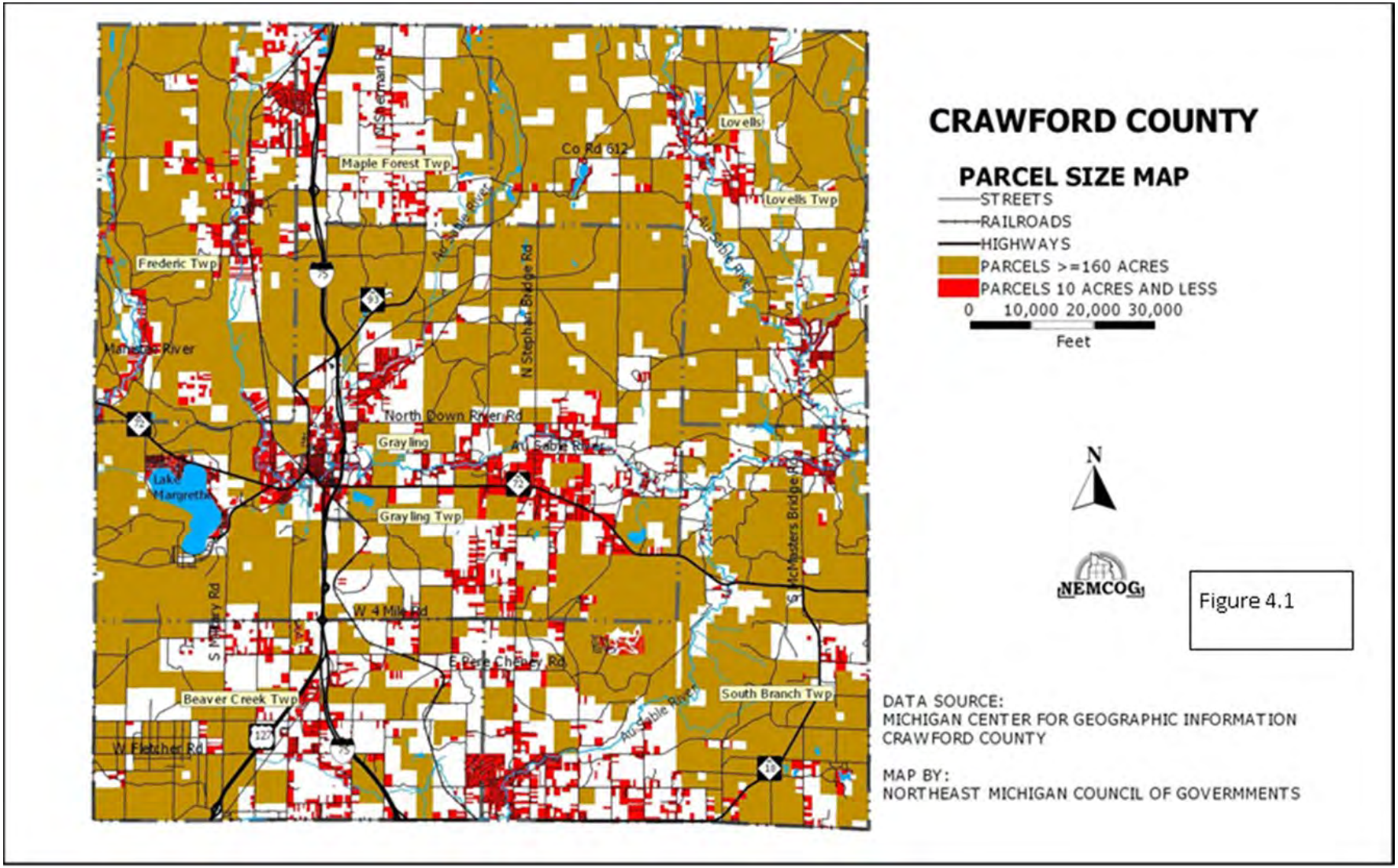

Figure 4-1 Parcel Sizes in Crawford County

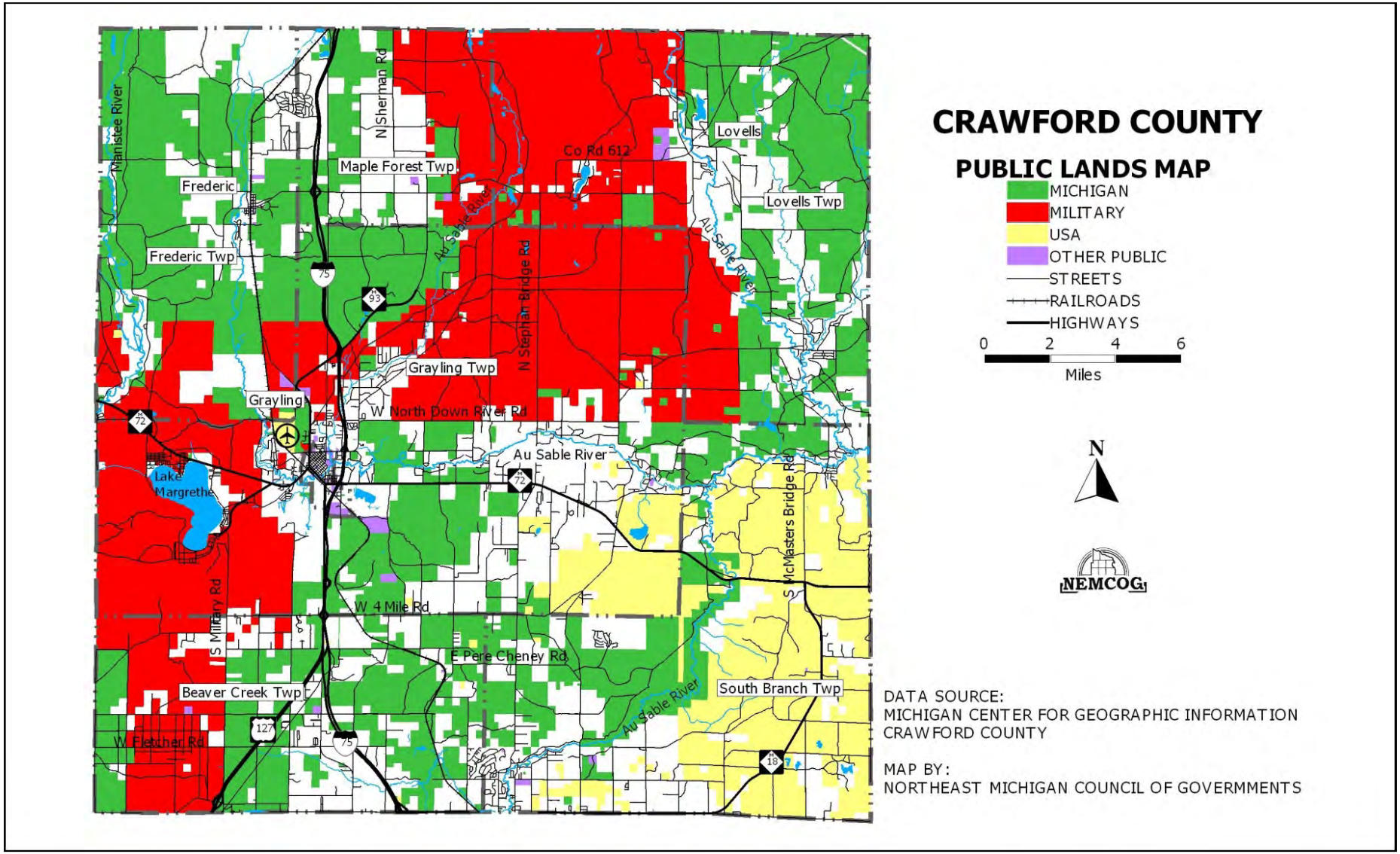

Figure 4-2 Public Lands in Crawford County

Residential
This category consists of single-family dwellings, single family duplexes, multi-family units, condominiums, mobile homes, and mobile home parks. Approximately 0.13% (472 acres) of the county's land is used for residential purposes. According to the U.S. Census Bureau, the number of housing units in the county increased by 0.8% between 2010 and 2017, which indicates more of the county's land is being used for residential purposes. Residential developments tend to be concentrated in and around the City of Grayling, Frederic Township, around the north and east shores of Lake Margrethe (Grayling Township), along the Manistee River in Frederic Township, along the Au Sable River in Grayling Township, and along the South Branch of the Au Sable River in South Branch Township. Residential is the predominant land cover in the City of Grayling.

Commercial/Industrial/Transportation
Commercial/Industrial/Transportation land uses include primary/central business districts, shopping centers/malls, secondary/neighborhood business districts (e.g., commercial strip development), industrial development, transportation, oil and gas, communication and utility facilities, and highways. This category makes up 0.7% (2,679 acres) of Crawford County's land use. Commercial/Industrial facilities are located in the City of Grayling, Frederic Township, along M-72, along I-75, and in Beaver Creek Township around the I-75 and US 27 junction.

Extractive/Transitional
This category includes quarries, strip mines, gravel pits, transitional lands (e.g., forest clear cuts, agriculture lands transitioning to forest lands, and changes from natural causes (e.g., fires or floods)), and areas of bare rock, sand or clay with little vegetation. Approximately 2.3% (8,278 acres) of Crawford County's land area is extractive/transitional land use.

Recreational
Land uses in this category include public parks and campgrounds, golf courses, schools, churches, and public buildings. Recreational land uses make up approximately 0.13% (460 acres) of the county's land area.

Agriculture
With only 3,957 acres classified as farmland, agriculture operations make up a relatively small portion (1.1%) of the county's land use. The largest concentration of agricultural land is in Maple Forest Township. There are also smaller areas in Beaver Creek and South Branch Townships. Agriculture land is primarily used for pastureland, hay, and growing crops. A small amount of land is used for livestock.

Non-Forested Uplands
This land use category includes areas that support grasses or shrubs, and lands used by Camp Grayling (Grayling Township) for artillery and bombing ranges. Non-forested uplands make up 7.1% (25,719 acres) of the county's land area. Typical grass species include quack grass, Kentucky bluegrass, upland and lowland sedges, reed canary grass and clovers. Typical shrub species include blackberry and raspberry briars, dogwood, willow, sumac and tag alder.

Upland Forests
Upland forests make up 74.1% (266,861 acres) of the county's land area. While some of this land may have been converted to other uses since 1990, it is still the largest land use in the county. The predominant species include jack, white, red, and scotch pines, sugar and red maple, elm, beech, yellow birch, cherry, basswood, white ash, and aspen. Upland forests are the predominant land cover in Lovells, South Branch, Maple Forest, Beaver Creek, Frederic, and Grayling Townships. These townships have large tracts of jack pine and oak.

Lowland Forests

Approximately 12.2% (43,959 acres) of the county's land area consists of lowland forests, which includes ash, elm and soft maple, cottonwood, balm-of-Gilead, cedar, tamarack, black and white spruce, and balsam firs. Lowland forests are found near rivers and lakes.

Wetlands

Wetlands support high water tables, hydric soils and hydrophytic vegetation. This category accounts for 1.1% (3,904 acres) of the county's land area and includes marshes, mudflats, wooded swamps, shrub wetlands, wet meadows, open bogs, emergent wetlands and floating vegetation situated on the shallow margins of bays, lakes, rivers, ponds, and streams.

Surface Water (lakes and rivers)

Surface water makes up 1.1% (4,005 acres) of the county's land use. If combined with the wetland and lowland forest land uses, the county's water and wetland resources make up 14.6% of the area and should be considered in land use planning.

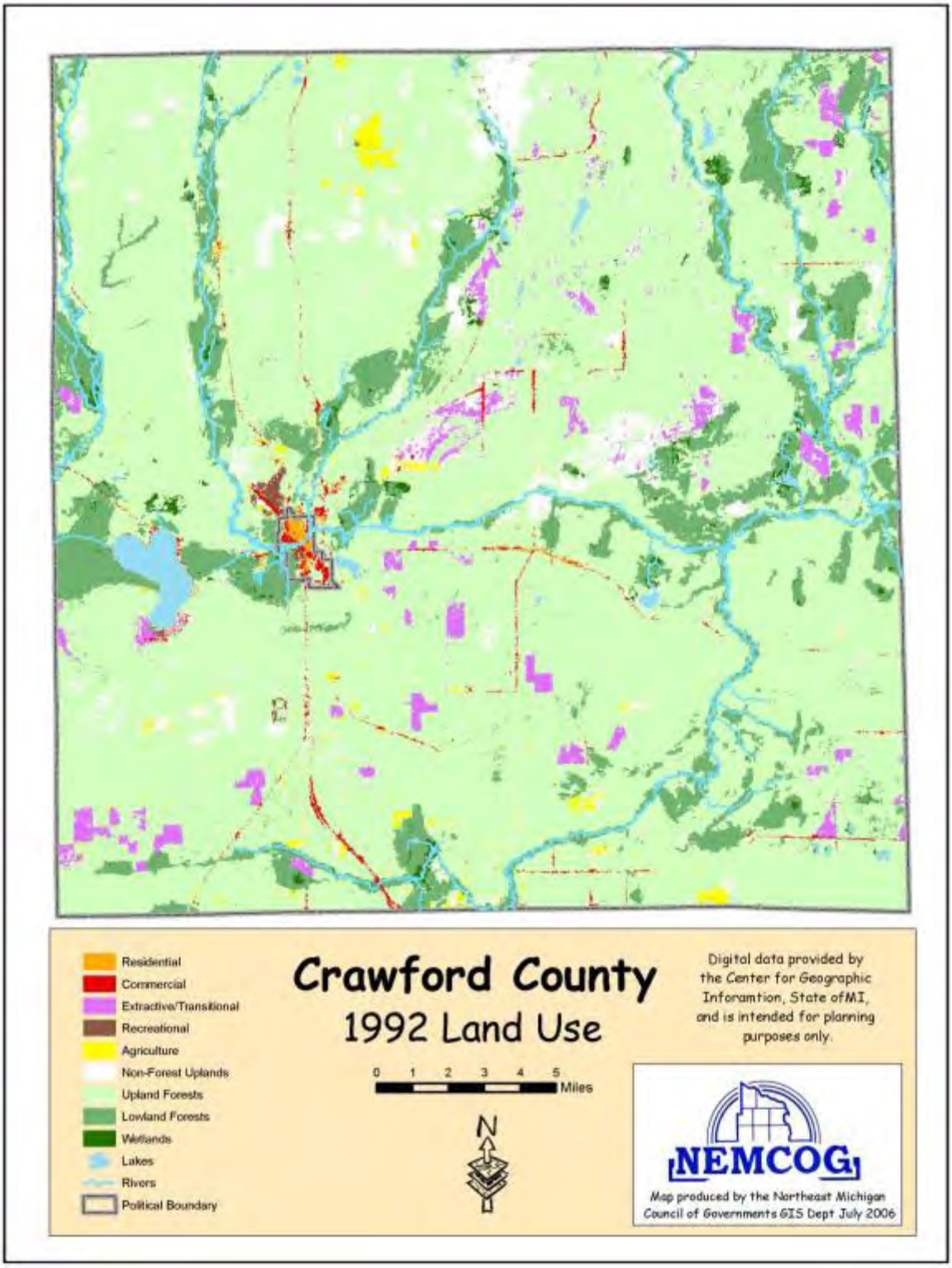

Figure 4-3 Crawford County 1992 Land Use

Chapter 5
Community Services and Facilities

Overview
Community services and facilities play an important role in maintaining and improving quality of life. The location and level of some services, such as public water, public wastewater, and fiber optic lines, determine the types and intensities of development within a community. These services may be sufficient for the needs of the current population; however, a hazard event may require the construction of new services and facilities. This construction is costly and is best avoided through future planning. The majority of the population and infrastructure in Crawford County is located in and around the City of Grayling and Grayling Township (Figure 5-1).

County Government
The Crawford County Board of Commissioners meets on the fourth Thursday of each month, unless posted otherwise in the County Building at 200 W. Michigan Ave., Grayling, Michigan. The county is represented by seven commissioners. There are many county departments, including county clerk, building & safety, administrator controller, treasurer, sheriff, emergency management, transit authority, environmental monitoring, MSU extension service, conservation district chapter, District 10 Health Department, and housing commission.

Minor Civil Divisions
Crawford County has six townships and one city.

Township Governments

- Beaver Creek Township is located at 8888 S. Grayling Road in Grayling
- Frederic Township is located at 6470 Manistee Street in Frederic
- Grayling Township is located at 2090 Viking Way in Grayling
- Lovells Township is located at 8405 Twin Bridge Road in Grayling
- Maple Forest Township is located at N. Sherman Road in Frederic
- South Branch Township is located at 5245 M-18 in Roscommon

City Government

- The City of Grayling is located at 1020 City Boulevard in Grayling

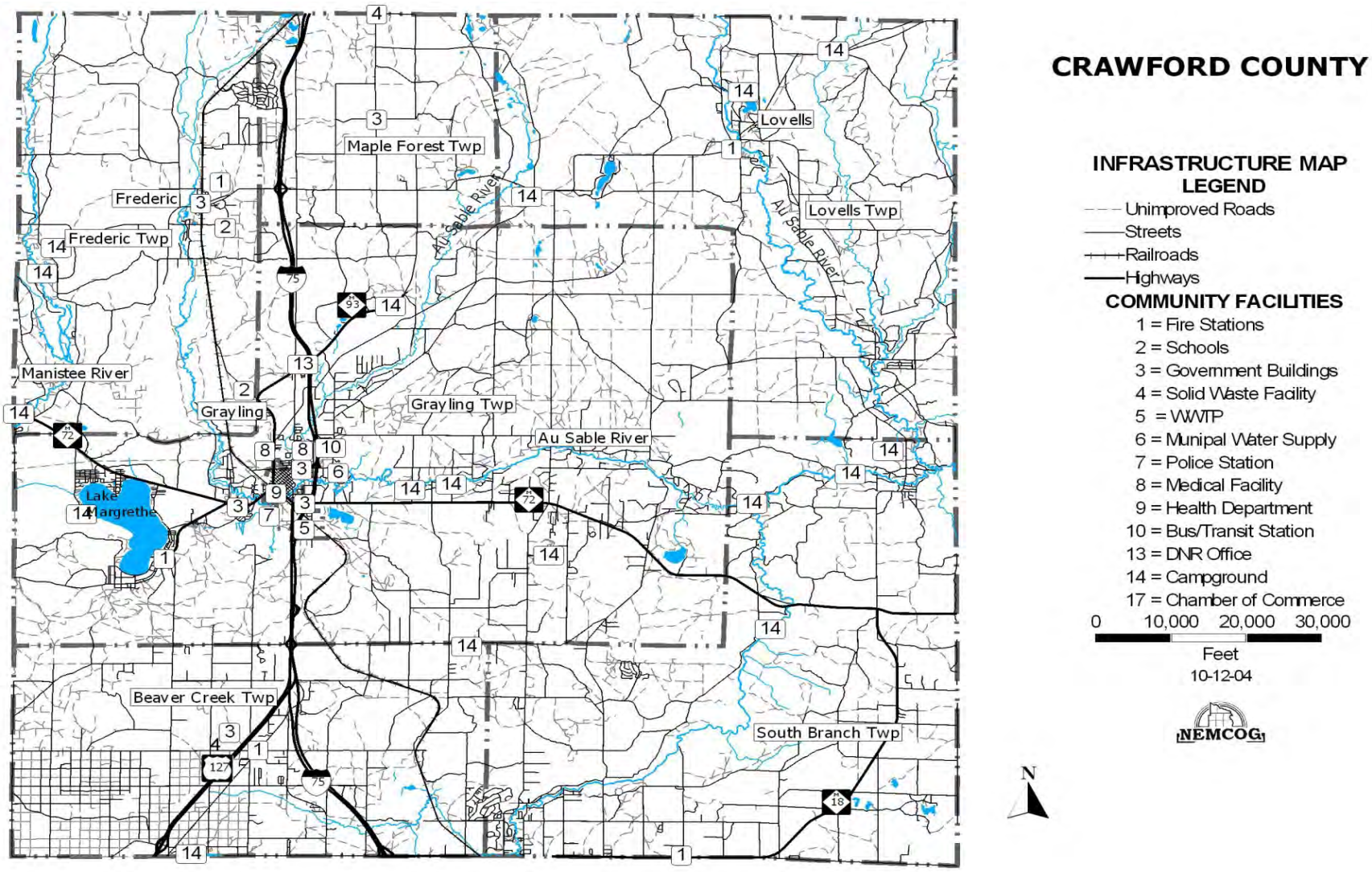

Figure 5-1 Crawford County Critical Facilities and Infrastructure

Public Safety

Currently, Crawford County is installing infrastructure in Frederic to better utilize AT&T First Net since the one tower in Camp Grayling becomes overwhelmed during emergency events. AT&T First Net is the first public safety broadband network dedicated to first responders and those that support them. It provides public safety interoperability between agencies and allows for communication between first responders during heavy network congestion.

Law Enforcement

Crawford County has two local law enforcement agencies in Grayling: the Crawford County Sheriff's Office located at 200 W. Michigan Avenue and the City of Grayling Police Department located at 1020 City Boulevard. The sheriff's office operates the 911 system, which is co-located in the sheriff's office and county jail. Michigan State Police Troopers assigned to the Houghton Lake Post and the Kalkaska Detachment patrol the county and begin and end their shifts at the Michigan State Police Crime Lab on the I-75 Business Loop in Grayling. Camp Grayling's law enforcement only handles military personnel issues.

There are two Conservation Officers within the county that enforce boating, canoeing, kayaking, hunting, and fishing regulations. They also protect federal and state land, respond to fires, and assist other law enforcement agencies with other law enforcement matters and/or investigations.

Emergency Medical Services

Mobile Medical Response (MMR) units are located in Beaver Creek Township (full time satellite stations) and the City of Grayling (primary station). South Branch Township and Frederic Township maintain their own local emergency medical services.

Fire and Emergency Services

Crawford County has eight fire departments (five local departments, one department in Camp Grayling, and two DNR field offices). The local fire departments provide fire protection in the county, while Camp Grayling's fire department only provides fire protection to Camp Grayling residents. However, the Camp Grayling fire department will assist local fire departments with wildland fires.

- **Frederic Township Fire Department**, 6547 Frederic St. in Frederic
    - Paid fire department covering 108 square miles and covering 486 square miles for EMS
    - Provides fire protection to approximately 2,096 persons
    - Provides emergency medical services to approximately 7,974 persons
    - Provides fire and advanced life support to Maple Forest and Lovells Townships
    - Staff: 18 full time and 20 paid on-call
    - Equipment: 152 brush truck, 121 engine 1500 GPM with 1,000 gallons of water, 122 Engine/Rescue, 1250 Pump/750 gallons of water, 131 tanker of 3,000 gallons, 1 ORV with a 50-gallon tank of water, 2 snowmobile rescue unites, 1 heavy rescue/hazmat, 6 basic to advanced life support ambulances, 1 mobile command trailer, 1 mass casualty trailer, 1 CERT trailer

- **Grayling City-Township Fire Department**, 1041 City Blvd. in Grayling
  - Partially paid/some paid fire department covering 180 square miles
  - Providing fire protection to approximately 8,468 persons
  - Medical response provided by MMR and Station 1-Frederic EMS
  - Staff/Volunteers: 21
  - Equipment: 2,000 Gallon Type 1 Tanker/Pumper, Type 1 Engine, 2-person cab, Type 1 Engine, 5 person cab, jaws/ice rescue, 2,000 gallon type 1 tanker, medical assist vehicle, personal transport truck, water point type, GPM Trash Pump Truck, 75' Type 1 Aerial/Engine, Jaws Command Truck-Tahoe
- **Lovells Township Fire Department**, 8405 Twin Bridge Rd. in Grayling
  - Partially paid fire department covering 108 square miles
  - Provides fire protection to approximately 626 persons
  - Provides fire and first responder services to the entire township
  - Staff: 15
  - Equipment: 1 small fire truck (on a Ford F-550 chassis), 1 large fire truck, 1 pumper truck with 3,000-gallon capacity, and 1 medical response vehicle
- **South Branch Township Fire Department**, 5245 N. M-18 in Roscommon
  - Partially paid fire department covering 108 square miles
  - Provides fire protection to approximately 2,000 persons
  - Provides ambulance protection within the fire department
  - Staff: 2 Full time Fire Fighter/ EMTs, and 17 Paid on-call firefighters, 2 paramedics, 10 EMT-B, 1 MFR
  - Equipment: 1250 Gal. Main Engine, 1250 Gal. Engine/2000 Gal. Tender, 500 Gal. Tender/2000 Gal., 2000 Gal. Tender, Water Point Truck, Command Unit, Light Brush Truck 300 Gal., 6X6 5 Ton Wildfire Truck, 6X6 2 ½ Ton Wildfire Truck, Basic Ambulance
- **Beaver Creek Fire Department**, 8972 S. Grayling Rd. in Grayling
  - Partially paid fire department covering 72 square miles
  - Provides fire protection to approximately 2,000 persons
  - Staff: 4 full time and 9 paid on-call
  - Equipment: 1250 gpm / 1000-gallon Class A Apparatus, 1250 gpm / 1000-gallon Class A Apparatus, 500 gpm / 2000-gallon Tender, and a rescue vehicle equipped with Medical First Response, trench rescue equipment and is used to pull the Snowmobile rescue trailer, 200 gal / 50GPM 4-wheel Drive Grass Truck, Ford E350 15 seat van used as the command vehicle and used to tow the confined space trailer
- **Camp Grayling Fire Department**
  - Fire suppression funded through the military and provides fire protection to Camp Grayling residents only
  - Contracts with Frederic Township and Grayling Fire Departments for structure fire suppression
  - Seasonal crew from May to September for first response on wildfire suppression
- **DNR Grayling Field Office,** 1955 Hartwick Pines Rd. in Grayling
  - Covers the northern two thirds of the county
  - Staff: 1 Fire Supervisor, 2 Full time Fire Officers, 4 fire line qualified firefighters
  - Equipment: 2 Tractor-plows, 1 skidder with 500 gal of water and plow unit, 3 large water units, and 1 small water unit
- **DNR Roscommon Field Office**, 8717 North Roscommon Rd. in Roscommon
  - Covers the southern one-third of the county
  - Staff: 1 Fire Supervisor, 2 Full time Fire Officers, 2 fire line qualified firefighters
  - Equipment: 1 Tractor plow, 2 large water units, and 1 small water unit

Water Sources for Fire Suppression

Outside the City of Grayling, fire departments rely on water tenders to fight structure fires and wildfires. In rural areas, the proximity to population centers and the accessibility of surface waters are considered when strategically determining the location of water sources that minimize travel times. Local fire departments supplied maps with locations of developed water sources, which were used to develop a Water Supply Map for Crawford County (Figure 5-2).

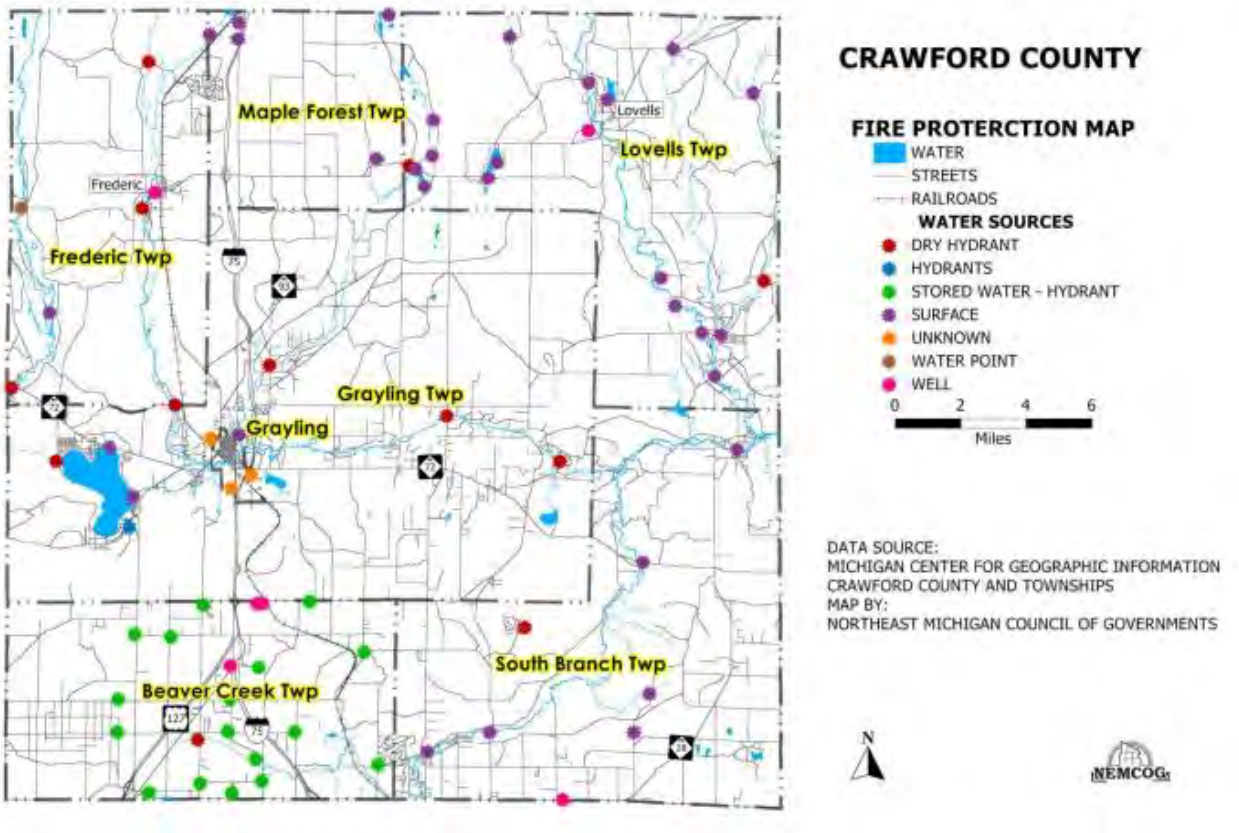

Figure 5-2 Location of Fire Suppression Water Sources

Early Warning & Siren Systems

Crawford County has one active siren with a 1.5-mile warning radius in the Village of Frederic that can be set off remotely. The City of Grayling does not have a siren warning system. However, there is a request on file with the State of Michigan for grant money to erect 10 warning sirens around the county. Camp Grayling and the Grayling AAF Airport have sirens; however, they can only be set off by military personnel.

The county uses RAVE, Hyper-Reach, and a reverse 911 system to warn the public about emergency situations. The warning system is integrated into the National Weather Service's NOAA Weather Radio Alert System and the National Emergency Alert System. The closest NOAA transmitter is in Otsego County and provides spotty coverage in Crawford County. Additionally, the Emergency Alert System broadcasts over area radio and television stations; however, many residents have satellite TV, which generally does not broadcast local information. The Emergency Management Office has also distributed weather alert radios to schools, medical facilities, emergency service agencies, and governmental centers.

Medical Facilities

Munson Healthcare Grayling is an 81-bed facility located at 1100 E. Michigan Avenue in Grayling and serves the residents and visitors of Crawford, Roscommon, and Oscoda Counties. The hospital's emergency department triages and treats trauma patients and others with emergency needs. The hospital also serves the Camp Grayling National Guard training center. Military and law enforcement personnel train year-round and about 200 camp attendees are treated in the hospital's Emergency Department each year. The Troop Medical Clinic is located at Camp Grayling and can only attend to military related medical issues. The clinic has a full-time staff during the summer months but is closed during the winter unless the troop is active.

District Health Department #10 is located at 501 Norway Street in Grayling. The Health Department provides home healthcare services, environmental health services, and personal health services.

Northern Lakes Community Mental Health Authority provides services to adults with mental illness, persons with intellectual and developmental disabilities, and children with serious emotional disturbance. It is located at 204 Meadows Drive in Grayling.

The Region 7 Healthcare Coalition covers the northern portion of Michigan's Lower Peninsula. Some of the coalition's responsibilities include functioning as the regional resource for hospitals and medical control authorities, coordinating the efforts to develop a comprehensive all-hazards medical preparedness plan, and coordinating the efforts to enhance the medical system and its services.

To activate the Region 7 Medical Coordination Center:

- Dial 1-989-732-5141
- During your call include your name and contact number, your agency or hospital, the reason for requesting the resource, the exact location where you need the resource delivered, and who will accept and sign for the resource.

Public Water Supply

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) is the primary enforcement authority for the Federal Safe Drinking Water Act under the Michigan Safe Drinking Water Act. EGLE has regulatory oversight for all public water supplies that include approximately 1,500 community and 11,000 non-community water supplies. The program also regulates drinking water well drilling for approximately 25,000 new domestic wells drilled each year. In Crawford County, groundwater is the only source of drinking water.

Private Wells: Most of Crawford County is served by private wells with about 2,645 wells supplying water to residents. If drinking water comes from a private well, the owner is responsible for the water's safety. Environmental Protection Agency rules do not apply to private wells, but the agency recommends well owners have their water tested annually.

Community Water Systems: There are five active community water systems in Crawford County that serve 2,776 people. The City of Grayling's community water system is maintained by the City of Grayling Department of Public Works and supplies drinking water to 1,952 people.

Utilities

Crawford County's utility system is composed of private suppliers for electric, natural gas, and telecommunications, and publicly owned and operated water and wastewater systems (Table 5-1). However, there are areas that lack utility services due to the large amount of public land. For on-site wells and septic systems, District Health Department #10 regulates and maintains a permitting system.

Table 5-1 Utility Systems in Crawford County		
Utility	**Company**	**Service Area**
Natural Gas	DTE	Beaver Creek Township, Frederic Township, Grayling Township, Maple Forest Township, South Branch Township
No Natural Gas		Lovells Township
Electricity	Consumers and Great Lakes Energy	Beaver Creek Township, Frederic Township, Grayling Township, Lovells Township, Maple Forest Township, South Branch Township
Telecommunications	Telephone: Frontier, AT&T, Verizon	Countywide with pockets of unserved areas
Water and Sewer	City of Grayling Department of Public Works	City of Grayling
	On-site private wells and on-site septic systems	Areas of the county not within the City of Grayling
Source: Michigan Department of Licensing & Regulatory Affairs (Michigan Public Service Commission)		

Educational System

The majority of Crawford County is located within the Crawford AuSable School District, while South Branch Township and a portion of Beaver Creek Township are located in Roscommon Area Public Schools (Table 5-2).

Table 5-2 Crawford County School Systems	
Crawford AuSable School District	
School Name	**Students and Staff**
Grayling High School	486 students, 28 teachers
Grayling Middle School	348 students, 23 teachers
Grayling Elementary	693 students, 45 teachers
Great Lakes Online Education	52 students
Roscommon Area Public Schools	
School Name	**Students and Staff**
Roscommon High School	449 students, 24 teachers
Roscommon Middle School	326 students, 18 teachers
Roscommon Elementary School	259 students, 19 teachers
Private Schools	
School Name	**Students and Staff**
Calvary Baptist Academy	46 students
Grayling Adventist Elementary School	9 students, 1 teacher
Source: Crawford Ausable School District, Roscommon Area Public Schools, Public and Private School Review, SchoolDigger.com	

Special Populations

Nursing homes and adult foster care facilities have residents with special medical needs, which present challenges when evacuating residents (Table 5-3). Grayling Nursing & Rehab Community provides 24-hour skilled nursing care, adaptive equipment, balance training, comprehensive rehabilitation programs, and customized care plans. Crawford Continuing Care Center/ Mercy Manor is a short-term rehabilitation center attached to the Grayling Hospital. The center provides comprehensive, customized care plans to meet the needs of each resident. Northern Pines Assisted Living provides affordable senior living in Grayling and Beaver Creek Townships, and Roscommon and Crawford Counties. Services include assisted living, independent living, respite, short term care, and memory care services. Jones Lake Adult Foster Care Home provides services to developmentally disabled persons. Wargo's manor provides services to aged, developmentally disabled, and mentally ill persons. The Brook of Grayling offers independent living or assisted living to older adults and provides a memory care program to people living with Alzheimer's disease or a related dementia. Three Oaks Adult Foster Care Home at 1086 AuSable Trail had its license revoked on January 8, 2019.

Table 5-3 Special Populations

Nursing Homes		
Name	**Address**	**Information**
Grayling Nursing & Rehab Community	331 Meadows Drive Grayling, MI	Beds: 72 Staff: 50
Crawford Continuing Care Center/Mercy Manor	1100 Michigan Ave. Grayling, MI	Beds: 39 Staff: 600
Northern Pines Assisted Living	130 Mary Ann St. Grayling, MI	Capacity: 13-20
Adult Foster Care/Assisted Living Facilities		
Name	**Address**	**Information**
Jones Lake Adult Foster Care Home	3464 Jones Lake Road Grayling, MI	Capacity: 1-6 Staff: 1-2 License: Adult Small Group Home
Wargo's Manor	808 Chestnut Grayling, MI	Capacity: 7-12 Staff: 1-2 License: Adult Medium Group Home
The Brook of Grayling	503 Rose St. Grayling, MI	Capacity: 24 Apartments Staff: 10

Source: NEMCOG, Michigan Department of Licensing and Regulatory Affairs

Governmental Facilities: Camp Grayling

Camp Grayling is the largest National Guard training center in the country, encompassing 147,000 acres (Figure 5-3). The City of Grayling is adjacent to the Air National Guard Base. Camp Grayling's training facility and ranges are located in Grayling Township. There are military ranges in the northeast corner of Maple Forest Township and in the northwest corners of Lovells and South Branch Townships. Camp Grayling supports a wide cross-section of military personnel, including active-duty and National Guard forces. This training complex provides units from all branches of service under the DOD opportunities to train and qualify at nearly every activity necessary for

national defense. Nonmilitary organizations and international partners also use the ranges and other facilities. The total housing capacity of the camp is approximately 13,649 personnel.

Camp Grayling has an Urban Operations training site, which is used to train soldiers to handle combat in urban environments during all four seasons. The Michigan Army National Guard mixes live training at the installation with virtual capabilities using simulation software. Camp Grayling also provides a large ground training area, an air-to-ground range, and a large airspace. Camp Grayling consists of a Range 30 Complex, Range 40 Complex, small arms ranges, Grayling Army Airfield, special use and protected airspace, and a MATES facility that houses tracked vehicles and M1 tanks. For more information, The Joint Land Use Study for Camp Grayling and Alpena Combat Readiness Training Center can be found at: *http://www.discovernortheastmichigan.org/jlus.asp.*

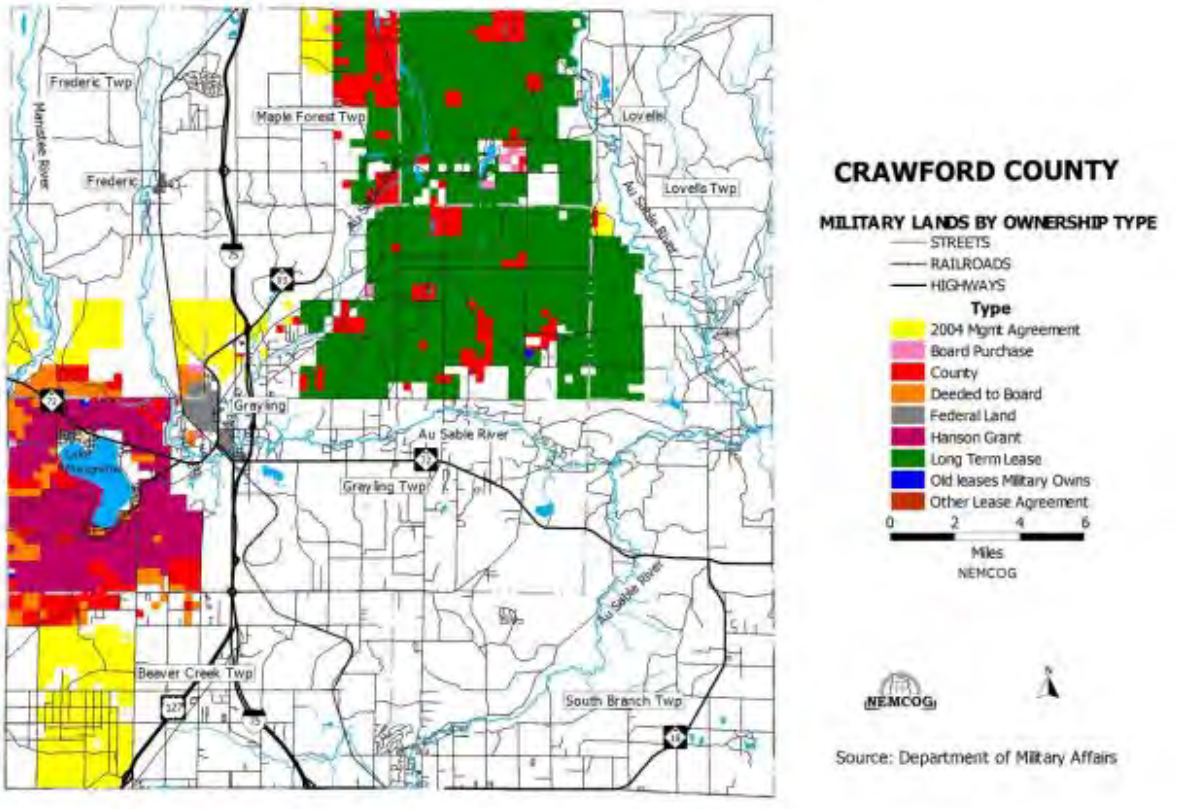

Figure 5-3 Military Lands by Ownership Type

Roadways

In Crawford County, Interstate 75 is the major north-south highway and M-72 is the major east-west route that travels through the City of Grayling (Figure 5-4). Other major roads include US-127 that runs north-south and connects with I-75 in Beaver Creek Township; M-18 that runs north-south on the eastern edge of Crawford County and connects with M-72; County Road 612 that runs east-west along the northern portion of the county to connect the Village of Frederic and Lovells; and Old-27 that parallels I-75 through the county to connect the Village of Frederic and the City of Grayling. Grayling Township is bisected by I-75 and M-72. Other primary county roads include North Down River Road, W. 4 Mile Road, E. Pere Cheney Road, W. Fletcher Road, Chase Bridge Road, S. Military Road, S. McMaster Bridge Road, Lovells Road, N. Sherman Road, County Road 502, Old 144 Road, N. Higgins Lake Road, Grayling Road, Manistee River Road, and Twin Bridge Road.

Public Transportation

The Crawford County Transportation Authority (CCTA) is the only transit service available in the county. The CCTA is a demand response, dial-a-ride service with sixteen wheelchairs lift equipped buses and three vans. According to the Michigan Department of Transportation, CCTA has 26 employees. In 2017, CCTA travelled 432,427 vehicle miles and logged 25,127 vehicle hours. In 2018, CCTA had 8,485 passengers.

Rail Service

Lake State Railway Company currently operates the north-south railroad that runs 29 miles through the western part of the county. The railroad runs parallel to the I-75 corridor between Bay City and Gaylord (Figure 5-4). New spur sidings at 4 Mile Road are used to store chemicals related to the forest product industries. The City of Grayling, and Frederic and Grayling Townships are bisected by the Lake State Rail Line.

Airport

The only airport in Crawford County is the Grayling AAF Airport at the Grayling Army Airfield. The multiple runway airport is owned and operated by the U.S. Government (Figure 5-4).

Community Events

- Annual Christmas Walk, November 20
- Men Who Cook, May 19
- Frederic Music Festival, Last full weekend of June
- AuSable River Marathon, last full weekend of July
- Independence Day Celebration, July 4
- Hartwick Pines Black Iron Days, August
- Lovells Bridge Walk, August
- Northern Strike, military event open one day for the public, Mid-August
- Thanksgiving Dinner at AAF, Thanksgiving Day

Natural Landmarks and Cultural Resources

Crawford County's greatest attraction is its natural resources. People travel to the county to relax, snowmobile, canoe, kayak, ride ORVs, hunt, and fish. Campgrounds are located throughout the county and include Trails Campground, Yogi Bear Campground, Lake Marguerite Campground, Goose Creek Trail Camp, Hartwick Pines State Park, Upper Manistee River State Forest Campground and Canoe Camp, Camp Au Sable (private Lutheran owned camp), and Manistee River Bridge Campground. During severe weather, staff is sent to Goose Creek Campground and Manistee River Campground to notify campers. The trout streams along the Au Sable River attract anglers who visit local businesses, such as the Old Au Sable Fly Shop and Gates Au Sable Lodge. The North and South Branches of the Au Sable River do not have liveries and are protected for fishing. Currently, researchers are determining how to cool the Au Sable River to re-introduce artic grayling.

Other Crawford County landmarks and resources:

- Grayling Fish Hatchery: Visitors can enjoy self-guided tours and fishing for trout.
- Ghost Towns (communities of Deward and Pere Cheney): These communities have little remaining; however, there have been reports of paranormal activity that attract people.
- Mason Tract Chapel and Durant's Castle: The Chapel and Castle are popular tourist attractions on the Mason Tract Pathway.
- Hanson Hills: The Grayling Recreation Authority runs and maintains the downhill ski operation and provides year-round sports programs for youth and adults.
- Hartwick Pines State Park, Visitors Center & Logging Museum: This state park attracts tourists with its old growth pine forest and logging museum.

- Hanson House: Currently a bed and breakfast, this house was built in 1890 as the home for lumber baron Rasmus Hanson and his family.
- Douglas House: Constructed in 1916, it was used as a hotel for wealthy travelers. In 1996, the house became a sporting lodge known as North Branch Outing Club.

Figure 5-4 Transportation Network

Community Capability

Overview

Currently, the communities in Crawford County have a limited number of staff and financial resources. For example, none of the communities have planners, foresters, floodplain managers, public works engineers, transportation engineers, or civil engineers on staff. The City of Grayling has a manager and staff to support day to day operations. Therefore, the communities have limited capabilities in implementing the hazard mitigation action and implementation strategies. However, all agencies, communities, and organizations use a combination of staff, elected officials, appointed officials (e.g., planning commission) and contractual services to provide some level of prevention and educational activities. To fully implement the hazard mitigation plan, the communities in Crawford County would need additional staff and funding.

Planning and Zoning

Beaver Creek, Maple Forest, Frederic, South Branch, Grayling and Lovells Townships and the City of Grayling have exercised their authority under state statutes to administer their own planning and zoning and have their own zoning ordinances. These communities have a zoning administrator, a planning commission, and a zoning board of appeals. The planning commissions are responsible for overseeing the planning and zoning activities, such as the master plan, recreation plan, and zoning ordinance. Crawford County's Planning Commission updated their Master Plan in 2014. The county does not enforce zoning at the county level. The Township Boards, City Council and County Board are the governing bodies responsible for managing finances and making policy decisions.

Planning and Zoning are the principal tools used by local communities to manage growth, preserve community character, direct development away from hazardous areas, protect property values, enhance economic viability, and provide developers with the flexibility to arrange structures on properties and incorporate Firewise development standards into their designs. Since planning and zoning are not retroactive, they have minimal effect on older developments. Additionally, they have the potential to create public controversy, variance requests, and zoning modifications. However, planning and zoning are used to establish and implement a community's goals and desired future. Building codes can work with and against planning and zoning since the codes provide guidance on how to build in both compatible and incompatible land use areas.

The master plan analyzes the existing conditions of a community, incorporates public input, and generates goals to establish the community's desired future. It includes a section on the future land use of the community, which is designed to guide land use decisions over time. The future land use section contains information about the future land use categories, important resource areas in need of protection, special issue areas (e.g., utility service areas, waterfront development, roads, etc.), compatible and incompatible land uses, and a map that depicts the development types and densities envisioned by the community. Zoning, capital improvement plans, and recreation plans implement the master plan.

Zoning ordinances and zoning maps are local laws that regulate how property can be developed and are primarily used by communities to implement their master plans through the regulation of development types, intensity and location. Communities can use zoning to implement hazard mitigation strategies for land use development, such as developing standards for private/public road construction, driveway standards, and creating development requirements.

Capital improvement plans guide communities' major public expenditures for the next five years. These expenditures include creating access roads and fire breaks and reducing wildfire fuels projects. Capital improvement plans can be used to create a project timeline to implement hazard mitigation strategies.

Public Safety

Crawford County has an active Emergency Management Office and Local Emergency Planning Committee. The county operates a countywide 911 system and the Sheriff's Office operates under the County Board of Commissioners.

Local agencies and units of government have fire suppression crews. All communities provide fire and rescue services either on their own or through a cooperative agreement. The U.S. Forest Service and Michigan DNR have foresters who conduct forest and fuels management on public lands. Forestry consultants and the Crawford County Conservation District provide forest management assistance on private lands.

Infrastructure

Crawford County's drain commissioner works with communities and landowners regarding drainage and flooding issues. The County Road Commission works in conjunction with the townships to manage the local road network, while MDOT is responsible for State and Federal highways.

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Chapter 6 Hazard Identification and Assessments

Overview

Crawford County is vulnerable to a wide range of natural, technological, and human-related hazards. Emergency management officials are challenged with managing these threats to protect life and property. In order to be effective at mitigating, preparing for, responding to, and recovering from all hazards, the types of hazards facing a county should be identified and understood. Hazard identification provides communities with a realistic base to plan for mitigation, preparedness, response, and recovery activities.

Crawford County's risk and vulnerability assessments were determined by its community profile, hazard identification, hazard maps, community input, and the weighted hazard ranking process recommended in *Publication #207*. However, it should be noted the assessments are not reliable predictors for the occurrence of any hazard. The assessments were used to determine if a hazard poses a risk to the county, inform the mitigation goals and objectives, and to guide emergency management officials in setting annual priorities and goals for resource allocation, mitigation strategies, and preparedness techniques.

According to the National Oceanic and Atmospheric Administration's National Centers for Environmental Information data center (NOAA), the county has had 212 storm events with approximately $4.6 million in estimated damages between January 1950 and April 2019.

Natural Hazards

Wildfires

Description

A wildfire is an unplanned, uncontrolled fire in grassland, brushland, or forested areas. Wildfires can occur in any forest type under dry conditions; however, some forest types are more susceptible to wildland fires. For example, jack and red pine forest stands have a high risk for wildfires, while oak and white pine forest stands have a moderate risk. The primary cause of wildfires is from human activities, specifically burning outdoor debris. Wildfires cause destruction to property and timber resources, injure or cause loss of life to wildlife and persons living or recreating in wildfire prone areas. Long-term effects include scorched and barren land, soil erosion, landslides/mudflows, water sedimentation, and loss of recreational opportunities.

Historically, Michigan's landscape has been shaped by wildfire; however, over the last several decades, the landscape has transformed from wildlands to residential developments. With the increase in residential development in and around rural areas prone to wildfires, there is an increase in the potential for loss of life and property damage. Unfortunately, rural areas do not have enough fire suppression forces available to protect every structure from wildfires.

In Michigan, approximately 600 wildfires are reported each year with the majority occurring in April, May and June. In 2018, the Michigan DNR reported there were 301 fires throughout the State and as of June 2019, there were 168 fires. In Northeast Michigan, the large amount of permanent

and seasonal homes and the increase in tourists during the driest (most vulnerable) times of year greatly increase the wildfire risks.

Location

Approximately 90% of Crawford County is dominated by high-risk forests, such as jack pine (27%), oak and hickory (23%), and aspen (21%) (Figure 6-1). When these high-risk forests are combined with the county's high risk ignition sources (e.g., National Guard training exercises, recreation activities, etc.), Crawford County has one of the highest wildfire hazard areas in Michigan. In addition, high value infrastructure (e.g., residential areas, Camp Grayling facilities and ranges, and oil and gas fields) is located in the Wildland-Urban Interface (WUI), which makes all of the county's communities highly vulnerable to wildfires.

In 2001, multiple federal agencies developed a list of WUI communities in the vicinity of federal lands that have a high wildfire risk. In Crawford County, the City of Grayling and Beaver Creek, Frederic, Grayling, Lovells, and South Branch Townships were on the list (Federal Register, August 17, 2001). In addition, the State of Michigan developed a comprehensive list of communities that have a high wildfire risk.

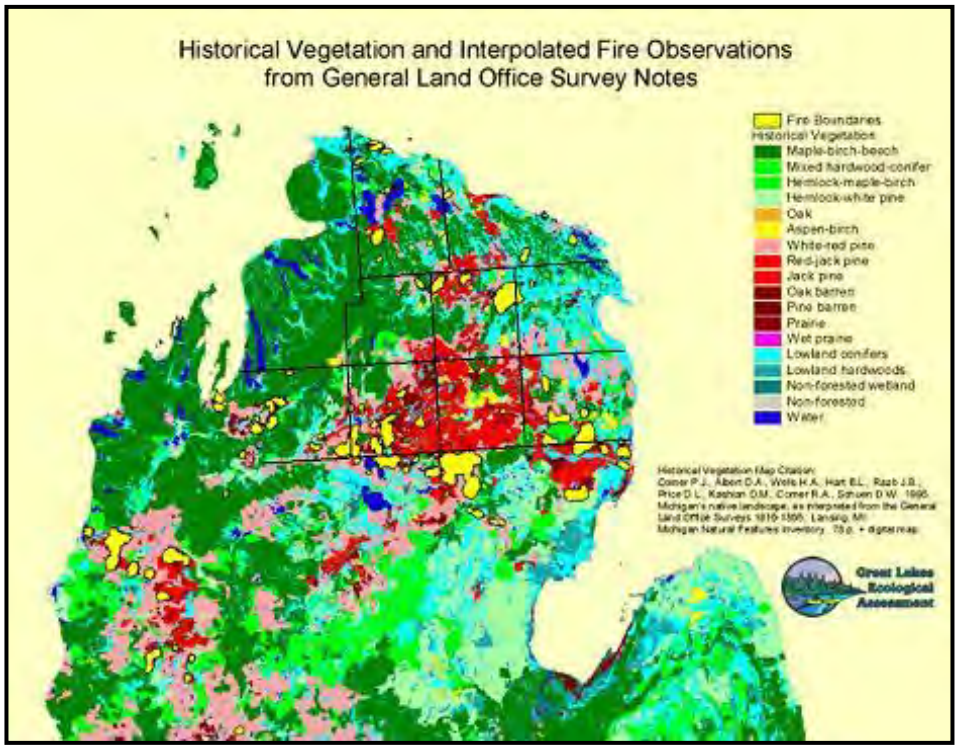


Figure 6-1 Historic Vegetation and Fire Observations

Previous Occurrences and Probability of Future Occurrences

On May 9, 1990, the Governor declared a wildfire emergency for Crawford County. From 2001 to 2012, the Michigan DNR reported there were 224 wildfires in Crawford County that burned 11,819 acres with seven wildfires greater than 50 acres in size (not including wildfires suppressed by the U.S. Forest Service or local fire departments). Between 2013 and 2018, the Michigan DNR's Wildland Fire Interactive Map reports Crawford County has had 106 wildland fire incidents that burned 5,571 acres (Figure 6-2). Table 6-1 provides information about the most significant fire incidents near Grayling and Mio, Michigan. Fires from Mio, Michigan were included since Oscoda

County is adjacent to Crawford County and fires in either county can cross political boundary lines. Since Crawford County has had 330 wildfires in the last 18 years, the data shows approximately 1 event will occur every 0.05 years.

Table 6-1 Significant Fire Incidents near Grayling, Michigan and Mio, Michigan		
Location/Name of Fire	**Date**	**Event**
Fletcher Road Fire	May 8, 1968	A wildfire was ignited by a pipeline welding crew. The fire burned 4,216 acres and crowned over 75% of the trees in Kalkaska and Crawford Counties. The fire "jumped" across Fletcher Road and burned at a rate of approximately 2 miles per hour. A million-dollar gas refinement facility was at risk by the fire but was protected by responders. The pipeline company paid more than $90,000 in damages for the timber losses.
Mack Lake Fire	May 1980	A wildfire destroyed 44 homes and buildings in Oscoda County. 1,500 people were evacuated, one firefighter died, and it caused $2 million in total property and timber loss, burned 24,000 acres.
Stephan Bridge Road Fire (occurred simultaneously with Indian Glens Fire)	May 1990	A wildfire was ignited near Grayling in Crawford County when a pile of ashes from a brush and timber fire rekindled. Strong winds and dry conditions spread the fire. The fire burned 76 homes, 125 structures, 37 vehicles and boats, and over 5,900 acres of forestland with property losses resulting in $5.5 million, including $700,000 in total timber losses. There were no fatalities and 1 injury. Over 8 miles were burned in less than 4 hours.
Billman Fire (Indian Glens) (occurred simultaneously with Stephan Bridge Fire)	May 1990	615 acres burned; 5 houses and 15 outbuildings damaged or lost
Luzerne Fire	1992	687 acres burned; destroyed several homes
Northern Lower Peninsula	May 1999	The Michigan DNR fought nearly 40 wildfires that were fueled by dry conditions. In Oscoda County, an 850-acre fire burned in the Huron-Manistee National Forest.
No Pablo Fire	2000	5,200 acres burned
Sunrise Fire	2000	180 acres burned; 1 outbuilding damaged or lost
Mio (Oscoda County)	April 30-first week of May 2000	Extremely dry conditions caused a wildfire near Mio that consumed approximately 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. The fire prompted the evacuation of approximately 30 persons but did not cause any injuries or structure damage.

Table 6-1 Significant Fire Incidents near Grayling, Michigan and Mio, Michigan		
Location/Name of Fire	**Date**	**Event**
Oscoda County	April 30- May 1, 2006	A brush fire ignited a wildfire in Hughes Lake and southeast winds spread the fire northwest. Almost 300 personnel fought the fire (crews were flown in from New Mexico and Montana). Approximately 5,950 acres of timber and brushland were burned south of M-72, east of M-18, and west of M-33. 16 structures and 7 vehicles were destroyed with property damage estimated at $600,000 (not including firefighting costs that were greater than $800,000). Evacuations were ordered for southeast Crawford County.
Staley Lake Fire	2008	80 acres burned
Four Mile Road Fire	April 24, 2008	Sparks from a passing train ignited a fire south-southeast of Grayling in Crawford County. The fire expanded to the northwest, crossing I-75 and burned 1,300 acres. South of downtown Grayling, half a dozen cabins near Simpson Lakes were lost. 50 homes were evacuated, and power was lost in Grayling. The Grayling Game Club sustained $287,000 in damages, Michigan DNR response costs and timber damages were about $619,000, and property damages were about $750,000.
Meridian Boundary Fire/Range 9 Fire	May 18-26, 2010	The fire occurred from a debris fire on May 18 and was not controlled until May 26. It burned 8,800 acres in Crawford and Kalkaska Counties, destroyed 12 residences, damaged 6 residences, and either destroyed or damaged 36 outbuildings, resulting in about $825,000 of property damages. The Range 9 Fire occurred when a controlled burn on an artillery range become uncontrolled due to winds and burned 1,100 acres of grassy areas in Camp Grayling. It also destroyed 4 seasonal homes, resulting in property damage estimated at $125,000. The Range 9 Fire was extinguished on May 18.
Howes Lake Fire	2011	817 acres burned; 2 outbuildings damaged or lost; burned in a residential area
Stephan Bridge Road and S. Horseshoe Trail Fire	May 2020	A fire occurred on May 22 along M-72 between Stephan Bridge Road and S. Horseshoe Trail (8 miles east of Grayling). Over 100 acres burned; 70 homes evacuated near Grayling. Two outbuildings were destroyed. A dozen units responded. No injuries.
Source: Michigan Department of Natural Resources, 2019 Michigan Hazard Analysis		

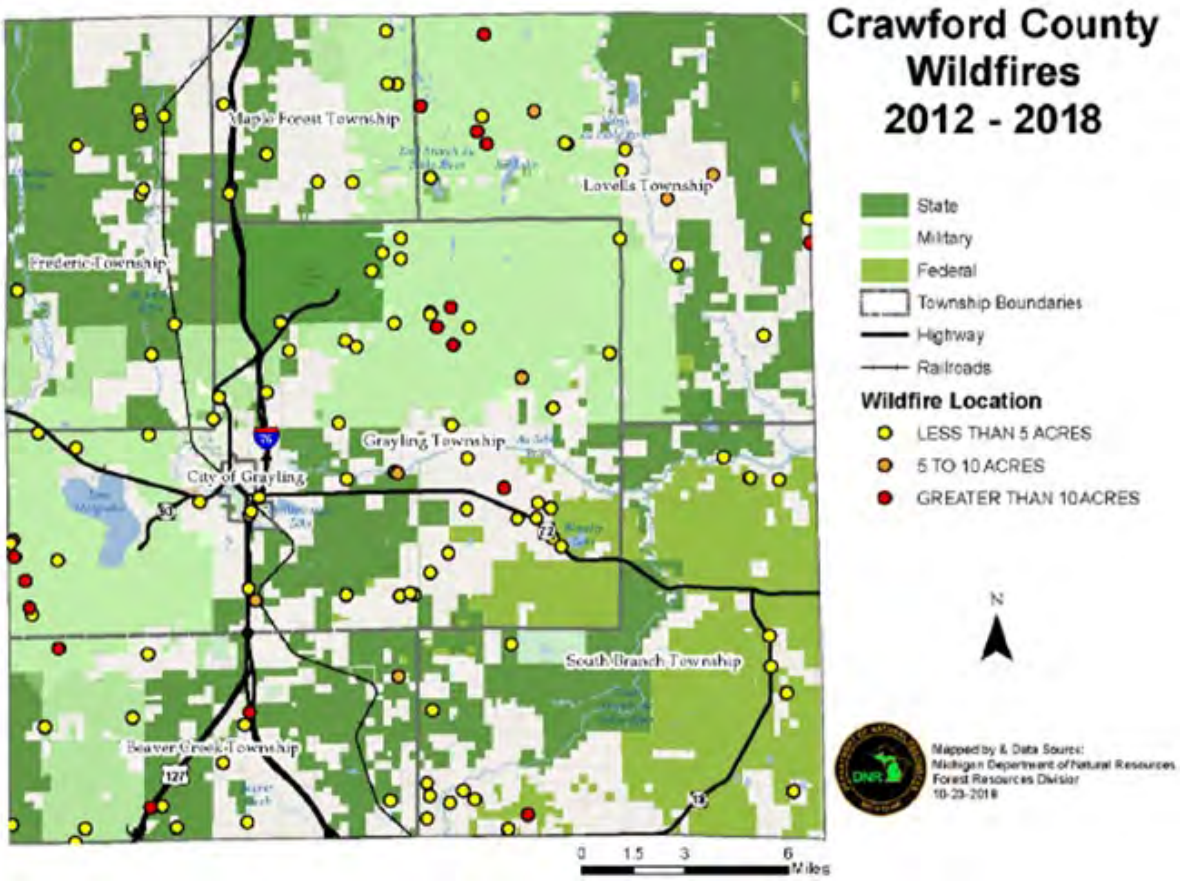


Figure 6-2 Location of Wildfires between 2012-2018

Extent

Extent can be measured by the number of acres burned and the cost of property damage. In Crawford County, the costliest fire occurred in May 1990. The Stephan Bridge Road Fire and the Billman Fire (Indian Glens Fire) occurred simultaneously. The Stephan Bridge Road Fire burned over eight miles in less than four hours, which resulted in the fire burning 76 homes, 125 structures, 37 vehicles and boats, and 5,900 acres of forestland. Property damages resulted in $5.5. million, including $700,000 in total timber losses. This fire did not have any deaths, but one injury. The Billman Fire (Indian Glens Fire) burned 615 acres, five houses, and 15 outbuildings. Other significant wildfires included Fletcher Road Fire, Four Mile Road Fire, and Meridian Boundary Fire/Range 9 Fire. The Fletcher Road Fire burned 4,216 acres at a rate of approximately two miles per hour. Four Mile Road Fire burned 1,300 acres, and half a dozen cabins. The fire caused fifty homes to be evacuated, caused a power outage in Grayling, and cost over $1.6 million in response costs and property damages. The Meridian Boundary Fire/Range 9 Fire burned for nine days. The Meridian Boundary Fire burned 8,800 acres, 54 residences and outbuildings, and caused $825,000 in property damages. The Range 9 Fire burned 1,100 acres, 4 seasonal homes, and caused $125,000 in property damage.

Vulnerability Assessment

All of the county's existing and future buildings and populations are at-risk to wildfires. Additionally, neighboring counties are also at-risk since wildfires can spread across political boundaries. Pre-settlement data shows Crawford County has a history of wildfires with extensive areas of jack pine (pyrophytic plants)-red pine forest, white pine-red pine forest, Pine Barrens, and pine/oak barrens. Today, about 27% of the county's upland forests are jack pine, about 23% are

oak/hickory, and about 21% are aspen, which are forests that increase the area's wildfire risks. Multiple federal agencies found that all of the county's communities except Maple Forest Township have a high risk from wildfires since the community centers and rural residential developments are located in high wildfire risk forest types. According to Michigan Resource Information System's 1978 Land Cover/Use Inventory, residential developments have been placed in areas dominated by Jack Pine and Red Oak, which indicates wildfire susceptibility (Figure 2-6). Wildfires burn property and structures, which results in high damage costs. Additionally, wildfires can cause death or injuries for people who become trapped in the fire or who are fighting the fire. Wildfires can cause a loss in timber production and agricultural revenue from the fire damaging timber supplies and agricultural products and killing livestock. Communication and power infrastructure can be damaged by wildfires, which would result in power outages, reduced/a loss of warning notifications to the public, and the inability to call for emergency services. Also, residents and businesses may have to evacuate and find shelter.

In 2019, Crawford County adopted its Community Wildfire Protection Plan, which can be found at the following website: https://www.crawfordco.org/wp-content/uploads/2019/09/2019-Crawford-County-Community-Wildifre-Protection-Plan.pdf. The Community Wildfire Protection Plan's goals and objectives are included in Chapter 8 of this plan.

Hailstorms

Description

Hailstorms occur when a severe thunderstorm produces hail that falls to the ground. Hail is formed when the updrafts of the storm carries water droplets above the freezing level, where they form into rounded or irregular lumps of ice that range from the size of a pea to the size of a grapefruit. When the weight of the hail is no longer supported by the air, it falls to the ground and has the potential to batter crops, dent automobiles, and injure people and wildlife. Sometimes, large hail appears before a tornado since it is formed in the area of a thunderstorm that tornadoes are most likely to form.

According to the *2019 Michigan Hazard Mitigation Plan*, Michigan has on average 191 hailstorms, an expected annual statewide loss of about $16.6 million, no deaths, and approximately 1 injury per year. Despite damaging hail occurring in every part of Michigan, the areas of the state most prone to severe thunderstorms (e.g., the southern half of the Lower Peninsula) are also most prone to large and damaging hail. The majority of the hailstorms occur during the growing season from May through August when crops have the greatest potential to be damaged by hail.

According to the *2012 Michigan Hazard Analysis,* the National Weather Service began recording Michigan's hail activity in 1967. The National Weather Service issues forecasts for severe thunderstorms with sufficient warning time to allow residents to take appropriate action to reduce the effects of hail damage to vehicles and some property. However, little can be done to prevent damage to crops. For example, during September 26-27, 1998, a line of severe thunderstorms moved across northern Lower Michigan producing hail up to 2" in diameter, destroying an estimated 30,000-35,000 bushels of apples at area farms, and damaging several homes and vehicles.

Measuring Hailstorms

Hailstorms are categorized using the TORRO Hailstorm Intensity Scale, which ranges from H0 (Hard Hail) to H10 (Super Hailstorms).

Location
Hailstorms are regional events that frequently accompany thunderstorms and are not confined to geographic boundaries. The severity of hailstorms may range across the affected areas. All of Crawford County is at risk to the occurrence and impacts from hailstorms. According to the National Weather Service, Crawford County is in an area of the United States that has on average one day of hailstorm events per year.

Previous Occurrences and Probability of Future Occurrences
Between July 1980 and April 2019, Crawford County had 44 hailstorms reported to NOAA with no deaths, injuries, or property and crop damages. There were four events with the largest reported hail at 1.75 inches (1980, two events in 1989, and 1995). With 44 events reported in the past 40 years, Crawford County experiences approximately one event every 0.9 years. However, not all hailstorm events and damages may have been reported to NOAA, which means the number of events and damages may be higher.

Extent
The greatest extent hail reported in Crawford County was 1.75 inches, which is correlates to H6 (Destructive) on the TORRO Hailstorm Intensity Scale. According to the scale, hailstones of this size are equivalent to a golf ball and can damage ground aircraft and brick walls.

Vulnerability Assessment
All existing and future buildings, exposed infrastructure, and populations are at risk from hailstorms since hail causes damage to roofs, brick walls, glass, landscaping, crops, and cars. Hail can also damage roads, sidewalks, bridges, and above ground utilities. Hail has the potential to cause injury and death, and populations are advised to take shelter when an event occurs.

Tornadoes

Description
A tornado is a violently rotating column of air that extends from a thunderstorm to the ground and can occur any time during the day and year. It can only be seen if water droplets, dust, and debris form a funnel. The funnel cloud can have winds that reach up to 300 miles per hour with an interior air pressure that is 10-20% below the surrounding atmosphere's pressure. The length of a tornado path is approximately 16 miles, but there have been tracks reported up to 200 miles. Tornado path widths are generally less than one-quarter mile wide. These storms are the most violent of the atmospheric storms since they have the potential to destroy buildings, uproot trees, hurl objects, and cause loss of life. According to NOAA/the National Weather Service's Storm Prediction Center, tornadoes cause approximately 60 deaths and hundreds of millions of dollars in property damage each year.

According to the *2019 Michigan Hazard Mitigation Plan*, Michigan is located on the northern fringe of the nation's tornado belt and has a statewide expected annual loss of about $19.6 million due to tornadoes. Michigan also has an average of 18 tornadoes, approximately 4 deaths, and approximately 50 injuries per year. Between 1999 and 2019, Michigan has had 314 reported tornado events with 52.9% as EF0 (weak) or EF1 (moderate), 38.9% reported as F0 or F1 (weak), 6.7% as EF2 (significant) or EF3 (severe), and 1.6% as F2 (strong). In Northern Michigan, tornadoes are most likely to occur during the summer months, although some have occurred in the spring and fall.

Measuring Tornadoes
Prior to 2007, the United States used the Fujita Scale to measure the intensity of tornadoes (Table 6-2). The Fujita Scale used mathematical interpolation to assign wind estimate guesses to a damage scale. In 2007, the United States began using the Enhanced Fujita Scale to measure the intensity of tornadoes since the wind estimates are more associated with the degree of tornado storm damage than the Fujita Scale (Table 6-2).

Table 6-2 Fujita Scale and Enhanced Fujita Scale

Fujita Scale	Fujita Scale Wind Estimate (MPH)	Enhanced Fujita Scale	Enhanced Fujita Scale Wind Estimate (MPH)
F0	< 73	EF0	65-85
F1	73-112	EF1	86-110
F2	113-157	EF2	111-135
F3	158-206	EF3	136-165
F4	207-260	EF4	166-200
F5	261-318	EF5	Over 200

Source: National Oceanic and Atmospheric Administration/National Weather Service Storm Prediction Center, May 2019

Location
Tornadoes are a regional event that are not confined to geographic boundaries and can affect several areas at one time. Also, the magnitude of tornadoes may range across the affected areas. All of Crawford County is at risk to the occurrence and impacts from tornadoes. It should be noted that it is impossible to predict where and with what magnitude a tornado will touchdown.

Previous Occurrences and Probability of Future Occurrences
Between 1973 and 2014, Crawford County has had eleven reported tornadoes, which caused about $497,750 in property damage (Table 6-3). The county's most destructive tornado occurred on April 19, 1975, causing $250,000 in property damage and fourteen injuries. This data shows approximately 1 event will occur every 4.27 years. However, it should be noted that the majority of the events occurred between 1973 and 1998. Historical data shows Grayling, Frederic, South Branch, and Beaver Creek Townships have higher risks for tornadoes (Table 6-3).

Extent
Based on the Fujita Scale, Crawford County's most damaging tornadoes occurred in Grayling Township and Frederic Township with winds ranging from 113-157 mph. The tornado in Grayling Township did not have any deaths, injuries, or property and crop damages. The tornado in Frederic Township had no deaths or crop damages, 14 injuries, $250,000 in property damages. According to the Enhanced Fujita Scale, Crawford County's most damaging tornadoes occurred in South Branch Township and Frederic Township with winds ranging from 86-110 mph. The tornado in South Branch Township did not have any deaths, injuries, or crop damages. However, it had $60,000 in property damages. The tornado in Frederic Township had no deaths, injuries, or crop damages, and $85,000 in property dames. Despite all of these events ranging between 86-157 mph, future tornadoes may have greater wind speeds.

Table 6-3 Crawford County Tornado Events, May 1973-April 2019							
Date	**Time**	**Location**	**F-Scale**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
5/20/1973	1900 CST	Grayling Township	F2	0	0	$0	$0
4/19/1975	55 CST	Frederic Township	F2	0	14	$250,000	$0
9/7/1985	1805 CST	Lovells Township	F1	0	0	$2,500	$0
7/9/1987	1315 EST	Grayling Township	F1	0	0	$250	$0
8/30/1993	1635 EST	Beaver Creek Township	F1	0	0	$50,000	$0
7/5/1994	1917 EST	Beaver Creek Township	F1	0	0	$50,000	$0
7/2/1997	1400 EST	South Branch Township	F1	0	0	$0	$0
5/31/1998	455 EST	Maple Forest Township	F0	0	0	$0	$0
6/25/1998	1947 EST	Camp Grayling (Grayling Township)	F0	0	0	$0	$0
6/18/2012	2028 EST-5	South Branch Township	EF1	0	0	$60,000	$0
9/1/2014	1316 EST-5	Frederic Township	EF1	0	0	$85,000	$0
Source: National Oceanic and Atmospheric Administration, National Centers for Environmental Information, Retrieved May 2019							

Vulnerability Assessment

All of Crawford County's existing and future buildings, population, and infrastructure are at-risk and vulnerable to tornadoes. Buildings and above ground infrastructure in a tornado's path will be damaged and/or destroyed. Older buildings and light construction structures (houses) have a greater risk of damage. Buildings adjacent to a tornado's path may have no to little damage dependent on the amount and type of debris hurled from a tornado at the adjacent buildings. Through a FEMA study in 1999, it was found that mobile homes, homes with crawlspaces, and building with large spans (schools, gyms, factories, theaters, etc.) are more susceptible to damage from tornadoes. Schools are vulnerable to tornadoes due to the number of students and employees in the buildings. Tornadoes can close roads due to debris on the road or road damage/destruction from the tornado. Tornadoes can cause injuries or death when people are in or near the tornado's path (picked up by the tornado or struck by debris). Individuals in buildings may have injuries or die if they are trapped in a building struck by a tornado or are struck by debris or falling objects. Tornadoes can contaminate water supplies, cause fires, and cause hazardous material spills (pipeline or septic tanks) or gas leaks. If a tornado damages businesses or infrastructure, it will cause economic losses in the county since businesses will have to close and the cost of repairs will impact the business. Tornadoes can also cause power outages. Governments will have to spend money for search and rescue teams, shelters, and clean-up efforts. Also, structural and vegetative debris storage areas may become filled to capacity.

Severe Winds (Derecho)

Description

A derecho is a long-lived windstorm that is associated with fast-moving severe thunderstorms that occur during the spring or summer; however, they can occur any time of the year. According to The National Severe Storms Laboratory, winds in excess of 58 mph are considered to be a derecho.

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.

According to the *2019 Michigan Hazard Mitigation Plan*, the statewide average annual number of severe wind events is 395 with 2 average annual deaths, 13 average annual injuries, and an expected annual loss of $51.3 million. Windstorms occur in all areas of Michigan, although more often along the lakeshore and in central and southern Lower Michigan. 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. Along the Great Lakes shoreline, strong winds regularly occur and occasionally have gusts over 74 mph hour when in conjunction with a storm front according to the Michigan Department of State Police's *Local Hazard Mitigation Planning Workbook*.

In the Northern Lower Peninsula, *the 2019 Michigan Hazard Mitigation Plan* states on average there are 2 average annual events, 0.2 average annual deaths, 2.6 average annual injuries, and approximately $4.7 million in property and crop damage per year. For example, during September 26-27, 1998, Northern Lower Michigan experienced severe thunderstorms that produced strong winds that damaged or destroyed homes, businesses and public facilities, and downed trees and power lines.

On April 30, 1984, another windstorm struck the entire Lower Peninsula and resulted in winds up to 91 mph in some areas. The storm caused severe shore erosion, and damaged 6,500 buildings, 300 mobile homes, and 5,000 vehicles. The storm also resulted in one death, several injuries, and over 500,000 customers without power.

Another storm event that moved across Michigan occurred on November 10-11, 1998. This storm was the strongest storm ever recorded in the Great Lakes with wind gusts of 50-80 mph and a peak gust of 95 mph reported on Mackinac Island. It damaged buildings, downed trees and power lines, killed one person, and left over 500,000 people without power. By the morning of November 11, the winds had pushed so much water into Lake Huron that the water level on Saginaw Bay bottomed out 50" below chart datum, which exposed and dried up half of the bay bed. As the wind died down, the water level in the Saginaw Bay rose to its normal level.

Measuring Severe Winds
The Beaufort Wind Scale is used to describe wind strength through observation. Table 6-4 shows the Beaufort Wind Scale.

Location
Severe winds are a regional event that is not confined to geographic boundaries and can affect several areas at one time. Also, the severity of the winds may range across the affected areas. All of Crawford County is at risk to the occurrence and impacts from severe winds.

Previous Occurrences and Probability of Future Occurrences
According to the USDA's *Soil Survey of Crawford County, Michigan,* thunderstorms occur about 30 days each year. The majority of strong winds are associated with thunderstorms that occur during the spring and summer months. Since 1967, there have been 63 high wind and thunderstorm wind events reported to NOAA for Crawford County. The most severe windstorm in Crawford County occurred on September 4, 2014 with wind speeds up to 70 mph. The event did not have any deaths, injuries, or crop damage. However, it caused $35,000 in property damages and downed trees in

Table 6-4 Beaufort Wind Scale			
Force	**Wind Speed (knots)**	**Description**	**Specifications for use on Land**
0	Less than 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind varies
2	4-6	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Dust, leaves, and loose paper lifted; small tree branches move
5	17-21	Fresh Breeze	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	-
12	64+	Hurricane	-

northern Crawford County. The costliest severe wind event occurred on August 2, 2015 with 58 mph winds that caused $1.2 million in property damages, and no deaths, injuries, or crop damage. This event caused downed trees that downed power lines, and damaged cars, homes, and businesses. Since there have been 63 high wind and thunderstorm wind events reported in the last 53 years, the data shows approximately 1 event would occur every 0.8 years.

Extent

Winds are measured by wind speed and the amount of damage. The most severe windstorm in Crawford County occurred on September 4, 2014 with wind speeds up to 70 mph. The event resulted in $35,000 in property damages. However, on August 2, 2025, a severe windstorm with 58 mph winds caused $1.2 million in property damages. However, it should be noted that stronger winds and higher damage estimates are possible.

Vulnerability Assessment

All existing and future buildings and populations are at-risk to severe winds. Severe winds have the potential to blow shingles, siding, awnings, and other features off buildings. Falling trees and tree limbs can damage structures as well as cause timber damage that would result in a loss of timber production. Severe winds can pick up objects and hurl them through the air, which may result in damage to structures or harm to people. Sometimes, structures can be blown off their foundations. Severe winds can also blow down communication infrastructure, utility poles, and aboveground power lines. Businesses may have to close due to power outages.

Lightning

Description

Lightning is a discharge of electricity in the atmosphere between the clouds, air, or ground to equalize the charged regions in the atmosphere. It is still being debated how the electrical charges build up in the clouds. Lightning generally occurs during thunderstorms; however, it can occur

without a thunderstorm, such as during intense forest fires and heavy snowstorms. Lightning that occurs without nearby rain is most likely to cause forest fires.

In the United States, approximately 100,000 thunderstorms occur annually according to the *2019 Michigan Hazard Analysis*. According to the National Weather Service Storm Data, in the last 10 years (2009-2018), the U.S. has averaged 27 lightning fatalities and 243 injuries. The *2019 Michigan Hazard Analysis* reports on average, lightning damages more structures, and kills and injures more people in the U.S. per year than tornadoes or hurricanes despite being perceived as a minor hazard.

The *2019 Michigan Hazard Analysis* compiled the following statistics from NOAA and the National Lightning Safety Institute (NLSI) for the period of 1959-1994:

- The majority of lightning strikes had one victim (91%)
- The majority of lightning strikes occurred during the summer months: June (21%), July (30%), and August (22%)
- Most lightning strikes occur between 2 p.m. and 6 p.m.

The NLSI estimates that 85% of lightning victims are children and young men (ages 10-35 years) engaged in recreation or work-related activities. Approximately 10% of lightning strike victims die, and 25% of survivors suffer serious long-term after-effects, such as memory and attention deficits, sleep disturbance, fatigue, dizziness, and numbness. Additionally, the NLSI estimated that annual lightning damage to property exceeds $4-5 billion in the United States.

Michigan's lightning deaths and injuries are fairly consistent with the national trends in terms of location of deadly or injury-causing strikes (Table 6-5, Table 6-6). According to the National Weather Service records through the mid-2000s, Michigan has incurred 101 lightning deaths, 711 lightning injuries, and 810 lightning casualties (deaths and injuries combined). During 1959-1995, Michigan was ranked 2nd nationally (behind Florida) in lightning injuries and 12th nationally in lightning deaths. During 1998-2008, Michigan was ranked 13th in the number of lightning deaths.

Table 6-5 Michigan Lightning-Related Deaths between 1959-July 2005

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

Source: Storm Data, National Climatic Data Center; 2019 Michigan Hazard Analysis

Table 6-6 Michigan Lightning-Related Injuries between 1959-July 2005

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

Source: Storm Data, National Climatic Data Center; 2019 Michigan Hazard Analysis

Location
Lightning is not confined to geographic boundaries and is a regional event. Since lightning occurs randomly, it is impossible to predict where lightning will occur and how severe it will be. All of Crawford County is at risk to the occurrence and impacts from lightning.

Previous Occurrences and Probability of Future Occurrences
According to NOAA, Crawford County had one lightning event with one injury on August 2, 2006. A soldier at Camp Grayling was struck by lightning as he exited a car in an open field. He suffered burns on one hand. Since one event has occurred in the past 14 years, approximately one event would occur every 14 years. However, it should be noted that not all lightning events may have been reported since events with injuries, deaths, and extensive damages tend to be the only ones reported. Therefore, the number of lightning events and damages may be higher.

Extent
One method to measure lightning extent is by flash density even though not all flashes result in a lightning strike. In Crawford County, there are 1.5 to 6 flashes per square mile per year on average according to Vaisala, Inc. Another way to measure lightning extent is by the amount of damage reported. Unfortunately, the medical costs were not reported for the one lightning event in Crawford County.

Vulnerability Assessment
All existing and future buildings, exposed infrastructure, tall trees, and populations are at risk from lightning events since it may cause structural and wildland fires, loss of electrical and telecommunications equipment, and damage to buildings or vehicles from falling trees struck by lightning. People that work outside or participate in outdoor recreation activities are at a higher risk to be struck by lightning.

Drought

Description
Drought is a consequence of a natural reduction in the amount of expected precipitation over an extended period of time, usually a season or more in length. Drought differs from normal arid conditions found in low rainfall areas since the aridity is a permanent characteristic in the arid areas. The severity of a drought depends on its location, duration, geographical extent, and the water supply demands from human activities and vegetation. Due to the multi-faceted nature of drought, it is difficult to define it and assess when and where it will occur.

Some of the severe impacts droughts have on communities and regions include:

- Water shortages for human consumption, power generation, recreation and navigation, and industrial, business and agricultural uses
- Reduction in quality and quantity of crops
- Reduction of water quality in lakes, streams, and other natural water bodies
- Malnourished wildlife and livestock
- Increase in wildfires and wildfire-related losses
- Decline in tourism in areas dependent on water-related activities
- Decline in land values due to the impact of drought conditions on the economic or functional use of the property
- Reduction in tax revenue due to income losses from the agriculture, retail, tourism, and other industry sectors

- Increase in insect infestations, plant disease and wind erosion
- Potential loss of life due to food shortages, extreme heat, fire, increased pollutant concentrations in surface water, and diminished sewage flows

According to the *2012 Michigan Hazard Analysis*, drought is a natural part of Michigan's climate and can be exacerbated by the heat during the warmer months. The *2019 Michigan Hazard Mitigation Plan* states Michigan has 3 average annual drought events with no deaths or injuries and has greater than $7 million in annual property and crop damage. The most common type of drought is agricultural drought, where severe soil-moisture deficits lead to serious consequences for crop production.

In the late 1980's, the central and eastern portions of the United States, including Michigan, experienced a drought that caused an estimated $40 billion in damages from agricultural losses, river transportation disruption, water supply shortages, wildfires, and other related economic impacts. Communities instituted temporary water use restrictions and a state task force was formed to study the drought and formulate mitigation strategies. In June 1988, the Governor issued a statewide outdoor burning ban to prevent potential wildfires. Between 1989 and 1990, the Northeastern Lower Peninsula experienced drought conditions for eight months in a row.

Between 1998 and 2003, Michigan experienced another drought that caused an estimated $6-9 billion in damage from Texas to the Carolinas, over $1 billion in damage in the Eastern U.S. in 1999, and over $4 billion in damages and costs in the South-Central and Southeastern U.S. in 2000. The northeastern and southwestern areas of the Lower Peninsula experienced 9 to 10 months of drought conditions between 1999 and 2000. In 2001, the drought/heat wave damaged or destroyed one-third of Michigan's fruit, vegetable, and field crops, which resulted in a U.S. Department of Agriculture Disaster Declaration for 82 of the state's counties. In addition, Southeast Michigan experienced water shortages, which resulted in local officials issuing periodic water usage restrictions. In September 2002, Michigan communities were under water use restrictions and the agricultural yields were estimated to be less than 50%, while counties in eastern Michigan were declared agricultural disaster areas.

Measuring Droughts

Two main methods to measure drought are the Palmer Drought Severity Index (PDSI) and the U.S. Drought Monitor. The PDSI was the first comprehensive drought index and the U.S. Drought Monitor is a newer index that combines quantitative measures with input from experts in the field.

The Palmer Drought Severity Index (PDSI) responds to weather conditions that have been abnormally dry or abnormally wet and is calculated with precipitation and temperature data, and the local available water content of the soil. The index's scale ranges from -6.0 (dry) to +6.0 (wet), where zero is normal. Crawford County has one station that maintains PDSI information. The station shows Crawford County's inland areas are currently experiencing a moderate wet period (Figure 6-3).

The U.S. Drought Monitor classifies droughts into four categories from least intense (D1) to most intense (D4) and has an additional category for drought watch (D0). Drought watch (D0) results in short-term dryness with slowed planting, slowed crop and pasture growth, and some lingering water deficits. Moderate Drought (D1) results in some crop and pasture damage, low streams, reservoirs, or wells, some water shortages, and voluntary water-use restrictions. Severe Drought (D2) results in crop or pasture losses, common water shortages, and water restrictions. Extreme Drought (D3) results in crop and pasture losses, widespread water shortages and water

restrictions. Exceptional Drought (D4) results in water emergencies with widespread crop and pasture losses, and a shortage of water in reservoirs, streams, and wells.

Figure 6-3 Palmer Drought Severity Index for Grayling
Source: The National Drought Mitigation Center's Drought Risk Atlas

Location
A drought is a regional event that is not confined to geographic boundaries and can affect several areas at one time. Also, the severity of the drought may range across the affected areas. All of Crawford County is at risk to drought occurrence and impacts. The largest concentration of agricultural land is in Maple Forest Township with smaller areas in Beaver Creek and South Branch Townships.

Previous Occurrences and Probability of Future Occurrences
The amount of precipitation received each year has the potential to inform the impact drought may have on the county. Crawford County's average annual precipitation is 33.58 inches, and its average annual snowfall is 105 inches.

In Michigan, droughts are monitored and analyzed through its ten climate divisions. According to the *2019 Michigan Hazard Analysis,* Crawford County is part of Climate Division 4, along with Alcona, Alpena, Cheboygan, Iosco, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle, and Roscommon Counties. The U.S. Drought Monitor for Climate Division 4 shows the division's area tends to be abnormally dry with some moderate and severe droughts throughout the years (Figure 6-4). Between 1895 and 2018, 51% of the years did not have any drought months in Climate Division 4 according to the *2019 Michigan Hazard Analysis*. The most extreme drought in this climate division occurred in February 1931 with a Palmer Index of -6.13. The division also had droughts in the following time periods: 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).

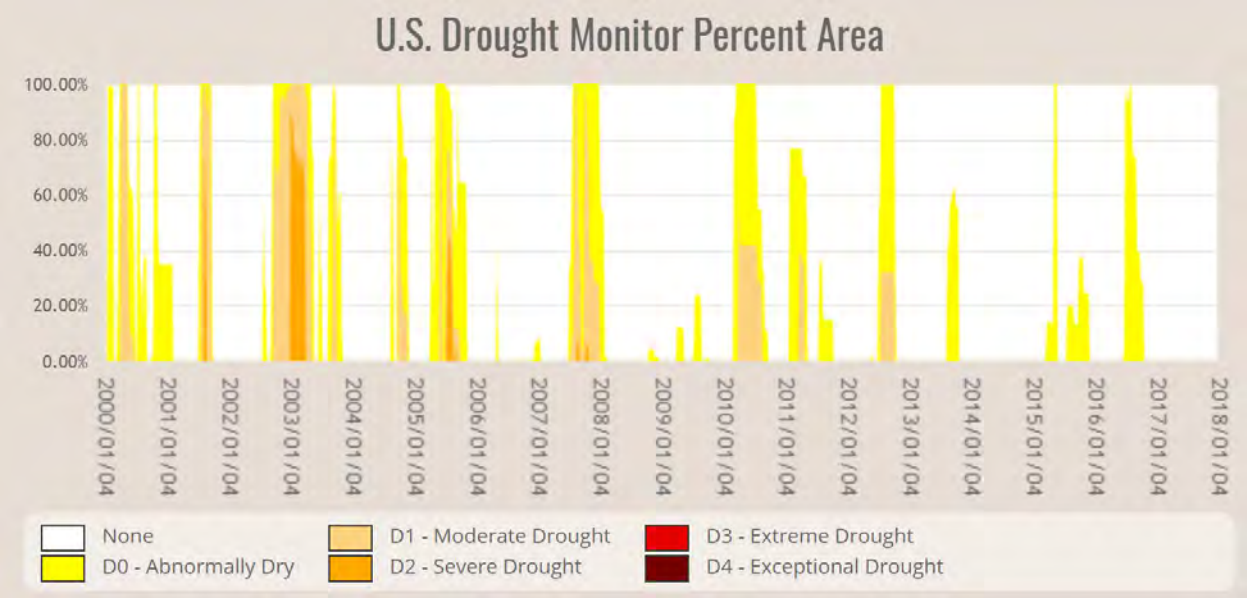


Figure 6-4 U.S. Drought Monitor Percent Area for Climate Division 4
Source: The National Drought Mitigation Center's Drought Risk Atlas

On March 2, 1977, Crawford County received a Presidential Drought Emergency Declaration during the 1976-77 drought in the Great Plains, Upper Midwest, and West. The drought conditions contributed to wildfires, crop damage, and low Great Lakes levels in Michigan.

Due to the limited amount of data available for droughts, an exact probability is difficult to calculate. However, based on the U.S. Drought Monitor Index, Crawford County experienced drought in 16 out of the 18 years on record, which equates to an 88% chance that a drought will occur each year. It is difficult to predict future occurrences of drought in the county since multiple factors, such as climate change, precipitation, humidity, and temperature can influence drought conditions. However, droughts are more likely to occur in the summer months when the higher temperatures increase evaporation rates. Based on the data from the U.S. Drought Monitor Index, abnormally dry conditions are predicted for future drought occurrences in the county, which would result in slowed planting, slowed crop and pasture growth, and some water deficits.

Extent
Generally, the county experiences abnormally dry conditions that fall into the drought watch category of the U.S. Drought Monitor. The most severe droughts occurred in 2001, 2003, 2005, and 2007. Despite not experiencing exceptional droughts, the county does have the potential to experience them in the future.

Vulnerability Assessment
It is difficult to quantify drought conditions since droughts do not have specific boundaries and are dependent on the weather-related factors. In Crawford County, impacts from droughts include an increased potential for wildfires, a reduction in farm products, a reduction in timber production, and loss of tourism. Drought conditions may increase the risk for wildfires, which would require residents to be warned and/or evacuated. Droughts can also impact the county's public health through the reduction of the quality and quantity of available water for drinking, business operations, and recreational, agricultural, and forestry management activities. While droughts have not been severe enough to fully deprive the county of water, it is possible. Additionally, droughts

may impact food prices and may result in food product shortages since limited farming occurs in the county.

Ice and Sleet Storms

Description

Ice and sleet storms are storms that generate sufficient quantities of ice or sleet that result in hazardous conditions and/or property damage. Ice storms occur when cold rain freezes on contact with the surface and coats the ground, trees, buildings, and overhead wires with ice. Often, ice storms are accompanied by snowfall, which sometimes causes extensive damage, treacherous conditions, and power loss. On the other hand, sleet storms are small ice pellets that bounce when hitting the ground or other objects. It does not stick to trees or wires but can cause hazardous driving conditions. When electric lines are down, households are inconvenienced, and communities experience economic loss and the disruption of essential services.

According to the *2019 Michigan Hazard Mitigation Plan*, Michigan has 16 average annual ice and sleet storm events with 0.2 average annual deaths, 0.5 average annual injuries, and $11.4 million in average annual property and crop damage.

Location

Ice and sleet storms are a regional event that is not confined to geographic boundaries and can affect several areas at one time. Also, the severity of the ice and sleet storms may range across the affected areas. All of Crawford County is at risk to the occurrence and impacts from ice and sleet storms.

Previous Occurrences and Probability of Future Occurrences

According to NOAA, Crawford County had one ice storm on February 24, 2001 that did not have any deaths, injuries, or property and crop damages. This event did not have downed trees or power outages since the weight of the ice was able to be sustained, but roads were extremely icy.

Since one event has occurred in the past 19 years, approximately one event would occur every 19 years. However, it should be noted that not all ice and sleet storms may have been reported based on the lack of injuries, deaths, and extensive damages. Also, ice and sleet storms may have been reported as other hazards. Therefore, the number of ice and sleet storm events and damages may be higher.

Extent

Ice and sleet storms can be measured based on the amount of damages. The event in Crawford County did not have any deaths, injuries, or damages.

Vulnerability Assessment

Walking can cause injuries from falls that may result in fractures or broken bones. Ice accumulation can cause damage to communication and power infrastructure, which can result in power outages. Icy roads can cause traffic accidents, which may result in injuries and loss of life. Heating shelters and evacuations may be required if power outages last a long time. Power outages and ice covered roads can limit access to food and basic supplies since businesses would have to close and the roads would not be travelable.

Snowstorms

Description

Snowstorms are periods of rapid snow accumulation with high winds, cold temperatures, and low visibility that have the potential to shut down towns and cities. Blizzards are the most perilous snowstorms and are characterized by low temperatures, strong winds, and enormous amounts of fine, powdery snow. Snowstorms have the potential to reduce visibility, cause property damage, and loss of life. Lake-effect snow occurs when the cold air from the high latitudes of North America move across the warm Great Lakes. The heat and moisture from the Great Lakes rises into the cold air where it cools and condenses into snow clouds. The prevailing wind direction determines which areas will receive lake-effect snow (Figure 6-5).

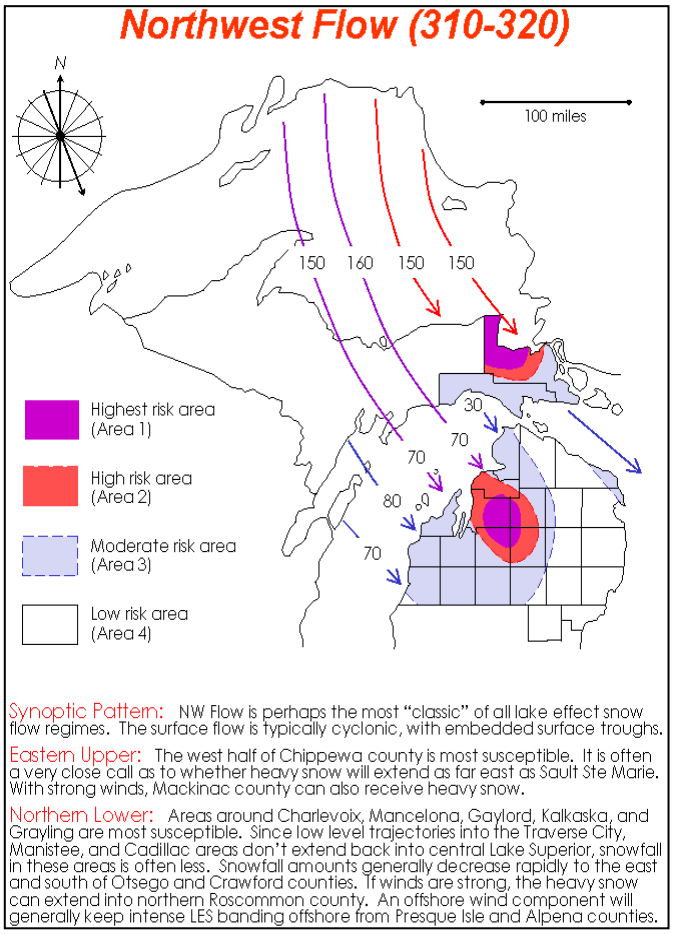


Figure 6-5 Lake Effect Snow Vulnerability from Northwest Flow

According to the *2019 Michigan Hazard Analysis,* Michigan has 360 snowstorms with 0.1 average annual deaths, 0.1 average annual injuries, and $1.9 million in average annual property and crop damage. Michigan experiences large differences in snowfall over short distances due to the Great Lakes. The average annual snowfall accumulation ranges from 30 to 200 inches with the highest accumulations in the northern and western parts of the Upper Peninsula. In Lower Michigan, the highest snowfall accumulations occur near Lake Michigan and in the higher elevations of northern Lower Michigan. For example, the average snowfall ranges from 141 inches in the Gaylord area to 105 inches in the Grayling area.

Location

Snowstorms are regional events that are not confined to geographic boundaries and can affect several areas at one time with varying severity depending on factors such as elevation and wind patterns. All of Crawford County is at risk to the occurrence and impacts from snowstorms.

Previous Occurrences and Probability of Future Occurrences

Since 1997, there have been 82 winter storm events reported in Crawford County, including heavy snowstorms, blizzards, lake-effect snow, winter weather, and winter storms. There have been fourteen winter weather events reported since the 2014 plan update. These storm events are expected to occur several times per year. Crawford County does not experience intense lake effect snows experienced further north along the I-75 corridor since it is located on the southeastern edge of Lower Michigan's Snow Belt. Crawford County received a Presidential Emergency Declaration in

January 1999 for a snowstorm and blizzard. The winter storm events have not had any deaths, injuries or crop damage. There were three events that ranged in property damages from $10,000-$200,000 (2003, two events in 2012).

In the last 23 years, there have been 82 winter storm events in Crawford County. It should be noted winter storm events refer to heavy snowstorms, blizzards, lake-effect snow, winter weather, and winter storms. This data shows approximately one event will occur every 0.2 years though the number and intensity fluctuate from year to year.

Extent
Snowstorms can be measured based on snowfall accumulations or damages. The average annual snowfall in Crawford County is 105 inches. On March 2, 2012, Crawford County had $200,000 in property damages caused by heavy snow.

Vulnerability Assessment
All existing and future buildings and populations are at-risk for snowstorms. Downed trees and branches can cause damage to buildings and other structures. The weight of snow on roofs can cause the roofs to collapse and ice dams can cause water damage to buildings. Additionally, cold temperatures can freeze pipes in buildings that can rupture and leak. Salting can cause damage to the roads and sidewalks. The weight of snow accumulations on communication and power infrastructure can cause power outages. Shoveling snow can cause heart attacks. During and immediately after a snowstorm, the driving conditions are dangerous since blowing snow, ice, and slush can create slippery roads. Blizzards can create whiteout conditions that result in low to no visibility. Stranded motorists may get hypothermia or frostbite. Heating shelters and evacuations may be required if power outages last a long time. Power outages and snow-covered roads can limit access to food and basic supplies since businesses would have to close and the roads would not be travelable.

Extreme Temperatures (Extreme Heat and Extreme Cold)

Description
Prolonged periods of very high or very low temperatures are often accompanied by other extreme meteorological conditions, such as high humidity, drought, heavy snowfall, or high winds. Extreme heat or extreme cold primarily affect the most vulnerable segments of the population, such as the elderly, children, impoverished individuals, and people in poor health.

Nationwide, there have been approximately 175 deaths per year that are attributable to extreme heat according to the *2019 Michigan Hazard Analysis.* The threats from extreme heat are heatstroke, sunstroke, muscle cramps, fatigue, and heat exhaustion. It is hazardous to livestock and agricultural crops, causes water shortages, exacerbates fire hazards, exacerbates respiratory problems, prompts excessive energy demands, and causes infrastructure failures. Urban areas experience the most serious extreme heat with the combined high temperatures and high humidity that produce a heat-island effect. According to the *2019 Michigan Hazard Mitigation Plan*, Michigan has 11 average annual extreme heat events with 0.4 average annual deaths and 41 average annual injuries.

In the United States, approximately 700 people die each year as a result of severe cold temperature-related causes according to the *2019 Michigan Hazard Analysis*, with a significant number of deaths occurring due to illnesses or disease that are negatively impacted by severe cold weather, such as

stroke, heart disease, and pneumonia. Exposure to extreme cold temperatures can be life threatening and can cause hypothermia and frostbite. According to the *2019 Michigan Hazard Mitigation Plan*, Michigan has 35 average annual extreme cold events with one death, 9.4 average annual injuries, and $6.4 million in average annual property and crop damage. Extreme cold affects transportation modes and power utilities, resulting in dead vehicle batteries and loss of power/heat.

Measuring Extreme Temperatures (Extreme Heat and Extreme Cold)
Extreme heat is measured with the National Weather Service's Heat Index Chart (Figure 6-6). The chart uses relative humidity and air temperature to determine the likelihood of heat disorders with prolonged exposure or strenuous activity. Individuals are unable to shed excess heat from their bodies when they experience prolonged exposure to hot temperatures, which results in heat disorders.

Extreme cold is measured with the windchill index, which is a measure of the rate of heat loss from exposed skin caused by the combined effects of wind and cold. As the wind increases, heat is carried away from the body and reduces the external and internal body temperatures. Figure 6-7 shows the NOAA Wind Chill Chart as it corresponds to various temperatures and wind speeds.

Location
Extreme temperatures are a regional event that are not confined to geographic boundaries and range in severity across the affected areas. All of Crawford County is at risk to the occurrence and impacts from extreme temperatures.

Previous Occurrences and Probability of Future Occurrences
A comparison between average maximum/minimum temperatures and extreme maximum/minimum temperatures assists in understanding the risk for extreme temperatures in the county. Figure 6-8 shows the average maximum temperatures and extreme maximum temperatures in Crawford County between 1891 and 2020 from the Western Regional Climate Center, Grayling, MI Station (203391). Figure 6-9 shows the average minimum temperatures and extreme minimum temperatures in Crawford County between 1891 and 2020 from the Western Regional Climate Center, Grayling, MI Station (203391).

Crawford County has had two extreme heat events in 2001 and 2018. The events did not have any deaths, injuries, or property/crop damages. The events consisted of hot and humid conditions that caused outdoor events to be modified and attendance at outdoor events to be lower than normal. Since 2018, there have been two extreme heat events in Crawford County. This data shows approximately one extreme heat event would occur every 9.5 years.

Between 2007 and 2019, there have been five extreme cold events reported in Crawford County. The events did not have any deaths, injuries, or property/crop damages. The low temperatures caused schools to close. However, since cold temperatures typically occur during winter months and are coupled with blustery winds and snowstorms, many events may have gone unrecorded or reported as other hazards. Since 2007, there have been five extreme cold events in Crawford County. This data shows approximately one event would occur every 2.6 years.

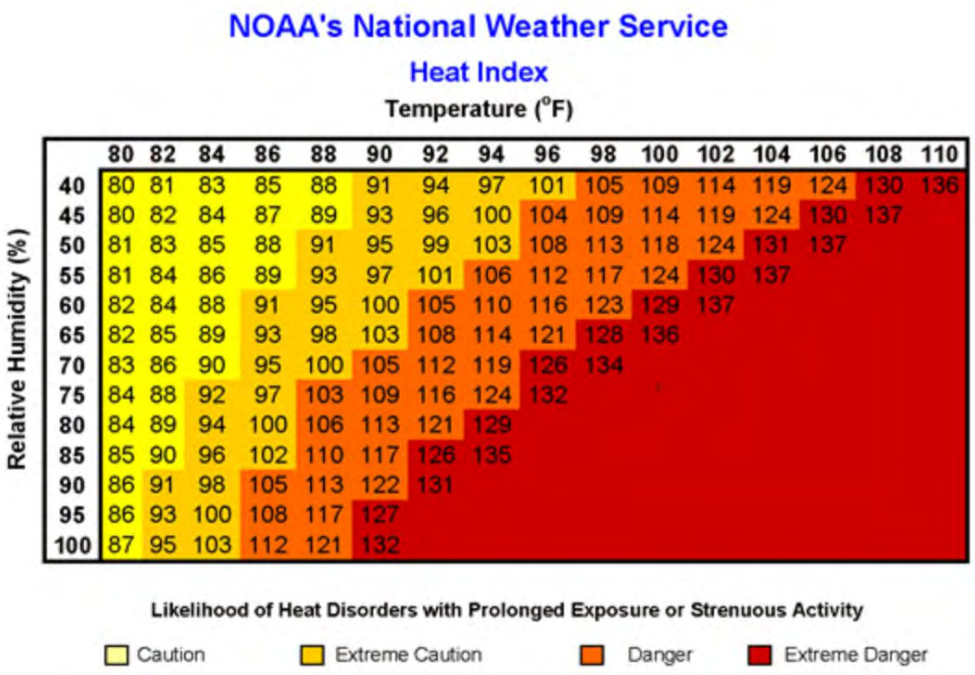


Figure 6-6 National Weather Service Heat Index

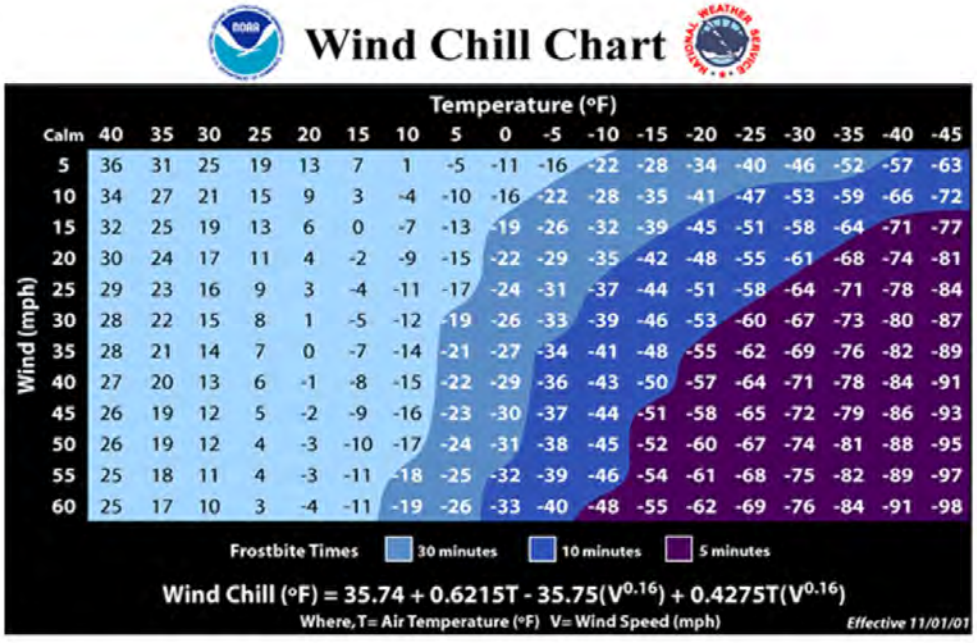


Figure 6-7 Wind Chill Chart

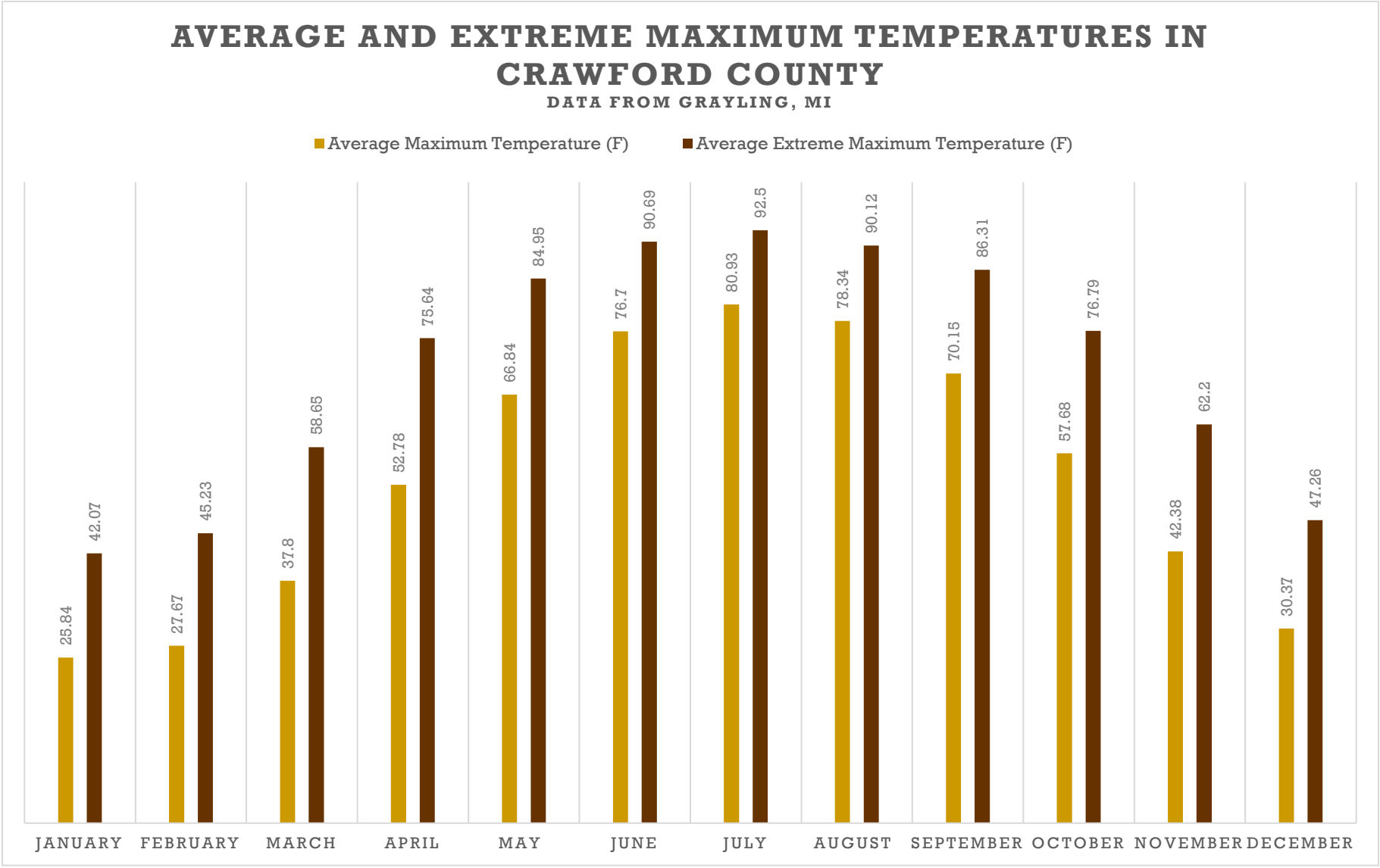


Figure 6-8 Average and Extreme Maximum Temperatures

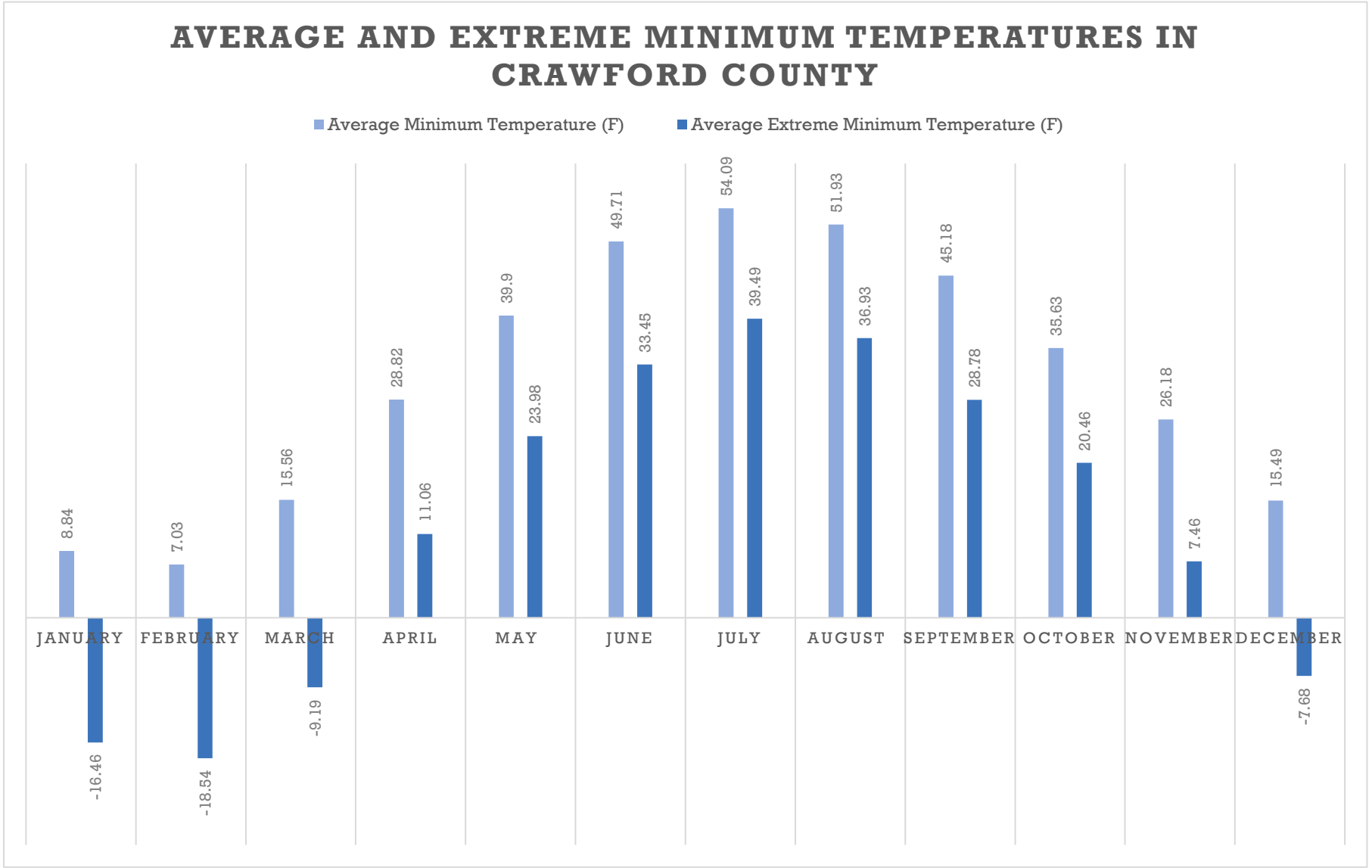


Figure 6-9 Average and Extreme Minimum Temperatures

Extent
Extreme heat temperatures can be defined by record highs and the National Weather Service Heat Index. On July 12, 1936, the highest recorded temperature was 104 degrees Fahrenheit in Grayling, Michigan. This temperature correlates to danger and extreme danger of having a heat disorder from prolonged exposure or strenuous activity (Figure 6-6). However, it should be noted that hotter events are possible.

Extreme cold temperatures can be defined by record lows and the National Weather Service Wind Chill Index. On February 17, 1979, the lowest recorded temperature was -42 degrees Fahrenheit in Grayling, Michigan. This temperature correlates to frostbite exposure of 5-10 minutes (Figure 6-7). However, it should be noted that colder events are possible.

Vulnerability Assessment
All of Crawford County's existing and future buildings, population, and infrastructure are at-risk and vulnerable to extreme temperatures (extreme heat and extreme cold).

Extreme heat has little effect on buildings and infrastructure. However, in rare cases, buildings can collapse or buckle. Utility infrastructure can fail and cause power outages or put stress on utility service due to an increase in the usage of air-conditioning units. Heat can also cause pavement to expand. Elderly adults, and young children are more susceptible to heat disorders since older adults are more likely to be on medications or have chronic illnesses that affect their body's ability to regulate heat, and young children rely on others to keep them cool and hydrated. Athletes and outdoor workers are also susceptible since they are more likely to become dehydrated. Low income populations are susceptible since they may not have or be able to afford an air conditioning system for their home. Extreme heat negatively impacts air quality by increasing the amount of pollutants in the air, which can aggravate existing respiratory illnesses, and can decrease lung function after long-term exposure to high temperatures. Water quality is impacted by heating up waterbodies or heating up the runoff that drains into them. This hotter water may degrade the water resources as well as kill fish, macroinvertebrates, and vegetation.

Extreme cold temperature events can cause pipes to freeze and burst in buildings, broken water mains, and stress to concrete and asphalt, which is costly to repair. After exposure to extreme cold temperatures, individuals may get frostbite or hypothermia, or they could die. Elderly, children, and individuals without access to an adequate heat source are considered to be at a higher risk to the impacts from extreme cold events. Additionally, extreme cold events could cause power outages and potentially result in carbon monoxide-related deaths due to the indoor usage of gas-powered furnaces and alternative heating sources. Risks for structural fires also increase with the use of alternative heating and power sources. Business and school operations would be disrupted since people are advised to remain indoors to reduce their exposure.

Earthquakes

Description
An earthquake usually occurs without warning when the earth suddenly starts shaking from the breaking and shifting of underground rock. Earthquakes range in intensity from slight tremors to great shocks and can last from a few seconds to several days. As of yet, scientists are not able to predict exactly when or where an earthquake will occur. However, earthquakes generally occur along faults. Casualties usually result from falling objects and debris. Earthquakes have the potential to contaminate water supplies, damage transportation systems, disrupt communication

systems, electric power lines, and gas, sewer and water mains, and cause other hazards, such as fires and hazardous material spills.

According to the USGS, Michigan has felt several mildly damaging earthquakes from the New Madrid Seismic Zone and upstate New York since the late 1700s. Unfortunately, the exact number is difficult to determine due to varying scientific opinion. Based on scientific studies, portions of southern Michigan could receive minor damage, such as damage to natural gas and petroleum pipelines if an earthquake occurred in the New Madrid Seismic Zone.

Measuring Earthquakes
Earthquakes are measured by their magnitude (size of the earthquake) and intensity (effect of an earthquake on the Earth's surface). The U.S. Geological Survey (USGS) no longer uses the Richter scale to measure the magnitude of an earthquake. Instead, the USGS uses the Moment Magnitude scale since it provides more accurate estimates for a wider range of earthquakes than the Richter scale. In the United States, the Modified Mercalli Intensity scale is used to determine the intensity of an earthquake, which ranks observed effects on a scale ranging from I (not felt) to X (extreme).

Location
Michigan is not located in an area subject to major earthquake activity and has not had a severely destructive earthquake documented. Although there are fault lines in the bedrock in Michigan, such as the one running through Otsego County into Montmorency County and the one running through Otsego County into Crawford County, the fault lines are considered to be inactive. Unfortunately, these fault lines are poorly mapped according to the U.S. Geological Survey (USGS).

Previous Occurrences and Probability of Future Occurrences
There have been no recorded occurrences of an earthquake in Crawford County. However, the county has a potential of an occurrence due to hydraulic gas fracturing. In 2014, the USGS linked hydraulic gas fracturing with an increase in earthquakes in areas that did not previously have them. According to EGLE, there are over 12,000 wells that do hydraulic fracturing in Michigan, with the majority located in Otsego, Montmorency, Alpena, and Alcona Counties. Since the injections for wastewater drilling impact the risk of an earthquake, EGLE has procedures to locate injection wells away from faults. Since Crawford County has not had a previous occurrence of an earthquake, no further analysis will occur at this time.

Extent
Crawford County has not had previous occurrences of an earthquake. However, there is a potential of an earthquake due to hydraulic gas fracturing. To prevent these type of earthquakes, EGLE has established procedures to locate injection wells away from fault lines.

Vulnerability Assessment
If an earthquake occurs in the winter, many areas in the state could be severely impacted by fuel shortages. Damage would probably be negligible in well-designed and constructed buildings. However, poorly designed and constructed buildings could suffer considerable damage under the right circumstances.

Riverine and Urban Flooding

Description

Riverine flooding occurs when rivers, streams, and lakes overflow into adjacent floodplains due to prolonged, intense rainfall, rapid snowmelt or ice jams. Flooding can damage or destroy property, disable utilities, destroy crops and agricultural lands, make roads and bridges impassable, and cause public health and safety concerns. Floods occur in the early spring, in the winter due to ice jams, and during the summer or fall from severe thunderstorms. Flooding caused by severe thunderstorms has a greater impact on watercourses with smaller drainage areas.

Urban flooding occurs when water flows into low-lying areas because development has occurred in the floodplains and the natural landscape is no longer able to properly disperse the water due to the increased area of impervious surfaces such as paved surfaces and building rooftops. This flooding occurs from a combination of excessive rainfall, snowmelt, saturated ground, and inadequate drainage, and is becoming more common in Michigan. Urban flooding also has the potential to overflow onto docks or other structures that have electricity running to them, which increases the risk for an electric shock drowning. Additionally, storm and sanitary sewers are unable to handle the water flows associated with storm events.

According to the *2012 Michigan Hazard Analysis*, Michigan tends to have a major flood event every two years with minor local flood events occurring annually. The 2012 plan also reports the annual flood-related damages are estimated to be between $60 and $100 million. From 1975-2010, Michigan experienced eleven flood disasters that resulted in both a Presidential Major Disaster Declaration and a Governor's Disaster Declaration, and nine that resulted only in a Governor's Disaster Declaration.

Location

FEMA mapped the principal flood hazard areas in Crawford County and completed a Countywide Flood Insurance Study and County Flood Insurance Rate Maps in April 2012. The principal flooding hazard potential is located along the Au Sable and Manistee Rivers, and around Lake Margrethe, Shellenbarger Lake, and Simpson Lakes. Figure 6-10 shows areas with a 100-year flood potential in orange.

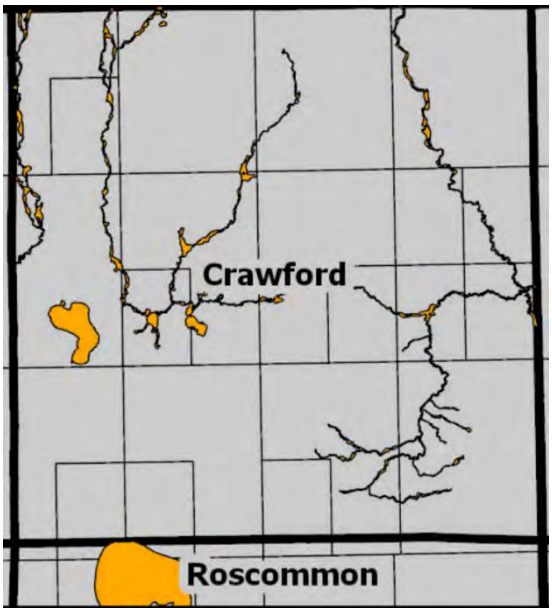


Figure 6-10 Crawford County 100-year Flood Potential

Previous Occurrences and Probability of Future Occurrences
According to NOAA, Crawford County has had one reported flood event in the City of Grayling. This flash flood event occurred on July 17, 2006 when the drainage system on Michigan Avenue was unable to handle the stormwater runoff and the water backed up into storefronts. The event caused $6,000 in property damages. Based on this data, approximately one event would occur every 14 years. It should be noted that the number of flooding events may increase due to the changing climate conditions. Additionally, Crawford County received a Presidential Major Disaster Emergency Declaration for flooding, rains, and tornadoes in 1975.

Extent
The extent of flooding can be measured by the amount of property damage. On July 17, 2006, the county experienced a flood event that caused $6,000 in property damages. The event occurred from an infrastructure failure. In the future, the county may see an increase in flood events from an increase in precipitation due to climate change, the backwater effect from the Great Lakes high water levels, and the soil moisture content. The county's wetlands assist in preventing floods through the collection and storage of stormwater and floodwaters.

Vulnerability Assessment
Existing buildings may experience flooding if they are located in the county's floodplains. These buildings have the potential to be damaged, destroyed, and compromised. Within Crawford County's floodplain area designated as Zone A (areas subject to inundation by the 1% annual chance flood event), there are approximately 478 structures. The vast majority of these structures are single-family housing units while under 20 of the structures are classified as commercial. In addition, there are approximately 140 road segments that intersect these floodplain areas across the county.

The number of structures within the specified flood zone was obtained by downloading GIS shapefiles from the FEMA Flood Map Service Center and using ArcGIS to overlay the flood zones onto aerial imagery. The structures falling within the zones were counted using a visual survey. However, it should be noted that only structures which are visible were counted. Structures which are not visible due to leaf-on aerial imagery are not included in this estimate. It should be assumed that the number of actual structures within these flood zones could be between 20-30% higher than the estimate.

Structures that have flooded may develop mold, have foundation damage, and may rot. The presence of mold will increase the health risk for people with breathing conditions. Businesses may have to close to fix damages and potentially lay off employees. Floodwaters can conceal dangerous conditions, such as damaged electrical wires, debris, and diseases. Electrical wiring on docks may become damaged from a flood, which increases the risk for electric shock. The contaminants and pollutants in floodwaters can degrade watersheds, and cause diseases, infections, and injuries to people traversing or playing in the waters. Flooding can damage roads and bridges, overflow sewers, and cause vehicles to crash. Roads may be closed for extended periods of time, which would impact traffic flow and emergency response times. Floodwaters can also cause erosion along inland lakes and streams, which can degrade habitats. Depending on the severity of flooding, residents may be evacuated.

National Flood Insurance Program
In 1968, Congress created the National Flood Insurance Program (NFIP) to reduce the impact of flooding on private and public structures by providing affordable insurance. The program is

administered by FEMA and requires participating communities to adopt and enforce floodplain management ordinances that meet or exceed the NFIP minimum requirements. In addition, if communities participate in the Community Rating System (CRS), residents and business owners can receive reduced flood insurance premiums.

When NFIP was created, it included discounted policies that paid at rates that do not reflect the true flood risk of the properties. The Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) required FEMA to eliminate certain subsidies and it set limits on the amount that rates may increase. However, the Homeowner Flood Insurance Affordability Act of 2014 repealed some of the provisions in BW-12 and included gradual rate increases to properties receiving subsidized rates until the premium reaches its full-risk rate, adding a surcharge to all policies, and having a Flood Insurance Advocate to advocate for fair treatment of NFIP policyholders.

According to the FEMA Community Status Book Report, the City of Grayling, and Beaver Creek, Frederic, Grayling, Lovells, Maple Forest, and South Branch Townships are participating in the NFIP. As of October 2019, Crawford County does not have any properties on the repetitive loss list according to the official FEMA/NFIP database.

Technological Hazards

Per- and Polyfluoroaklyl Substances (PFOA/PFAS)

Description
Per- and Polyfluoroaklyl Substances (PFAS) are manmade chemicals used in manufacturing and industrial applications, firefighting foams, and common household and consumer products (e.g., carpeting, waterproof clothing, upholstery, food paper wrappings, etc.). PFAS contaminates the water system when products containing them are used or spilled on the ground, in lakes and rivers, or when PFAS in the air condenses to form precipitation. People are primarily exposed to PFAS through the ingestion of contaminated drinking water and food products. Skin contact is not considered harmful. Over time, PFAS can accumulate in the environment and human body.

Recently, experts have become concerned about the potential effects that high concentrations of PFAS have on human health. The U.S. Environmental Protection Agency (EPA) has classified PFAS as emerging contaminants on the national landscape and has set a lifetime health advisory (LHA) level for two PFAS chemicals in drinking water: perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFOA and PFOS concentrations below 70 parts per trillion (ppt) are not expected to be harmful. None of the other PFAS chemicals have a set health advisory level.

In 2017, the Michigan PFAS Action Response Team (MPART) was formed as a temporary body to protect public health and investigate the sources and location of PFAS. Since 2017, the team has identified several Michigan counties, cities, and towns that have PFAS. In 2019, MPART was established as an enduring body to address PFAS contamination through research, identification, recommendations, and implementation of response actions, protect public health, ensure the safety of Michigan's land, air, and water, provide the Director of EGLE and other state agencies with recommendations, and facilitate inter-agency coordination. MPART has a local public health department advisory committee to ensure the consistency and coordination of evaluation and response actions to the public health impacts of PFAS in impacted communities. MPART also has a citizen's advisory workgroup that communicates to citizens throughout the state.

The Michigan PFAS Readiness Plan discusses the preparedness and response actions to handle PFAS in Michigan's municipal drinking water and to ensure coordination between state and local agencies. More information about Michigan's PFAS response can be found at the following website: www.michigan.gov/pfasresponse.

Location and Occurrences

Grayling Army Airfield

The Grayling Army Airfield is a 923-acre area owned by the United States Army in Grayling, Michigan. In 2017, the groundwater samples at the airfield tested positive for PFOA and PFOS. AECOM and EGLE began testing residential wells and District Health Department #10 began providing filters to households with drinking water samples that had greater than 70 ppt. of PFOA and PFOS detected. EGLE collected 43 environmental boring samples and began monitoring well installations (73 monitoring wells at 20 locations). In 2019, the Restoration Advisory Board was set up and Phase III of the remedial investigation began.

As of November 2019, 717 samples of drinking water and 502 samples of groundwater were taken (Figure 6-11). Out of these samples, 472 samples of drinking water and 233 samples of groundwater did not detect PFOS or PFOA, 17 samples detected PFOS and PFOA above the 70-ppt. advisory level, and 237 samples detected concentrations ranging between 0.56 and 694.2 ppt. Other PFAS analytes were detected in the samples; however, there are no federal or state standards for these analytes.

EGLE will continue to test, monitor, and schedule new residential sampling requests. AECOM will continue to install additional monitoring wells down gradient from the airfield. The Army and Army National Guard will continue to explore more effective interim actions, meet with municipal leaders on a regular basis, and keep the community informed. Camp Grayling staff will monitor the environmental factors at the camp and airfield to ensure safety, compliance with state and federal regulations, and to detect and remedy potential problems.

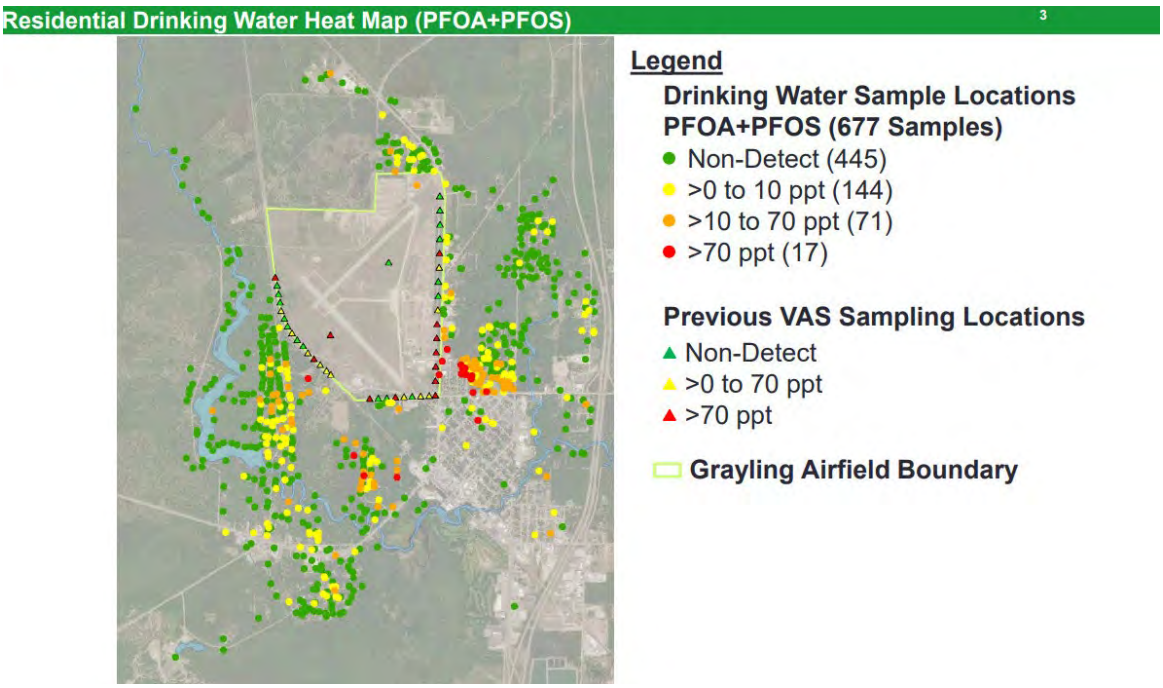


Figure 6-11 Residential Drinking Water Heat Map for the Grayling Army Field

Lake Margrethe
Lake Margrethe has residential and recreational structures around it, including a state forest campground on its west side and the Camp Grayling Joint Maneuvering Training Center on its south side. AECOM collected foam and water samples from Lake Margrethe, samples of drinking water from residential wells, and a drinking water sample from a hand pump (Figure 6-12). Monitoring wells were installed at five locations on the southeast side of the lake. EGLE tested the foam samples to find elevated levels of PFAS in some of the foam and is trying to determine the source of PFAS in the lake and the potential impacts to residents. District Health Department #10 recommends people avoid swallowing the foam or lake water and have provided 125 households with filters and one household with a water cooler. A Restoration Advisory Board was set up.

As of November 2019, there have been 490 drinking water samples taken. Out of these samples, 424 samples did not detect PFOS or PFOA, two samples had detections greater than 70ppt, and 63 samples detected concentrations of PFOS and PFOA below 70 ppt. Other PFAS analytes were detected in the samples; however, there are no federal or state standards for these analytes.

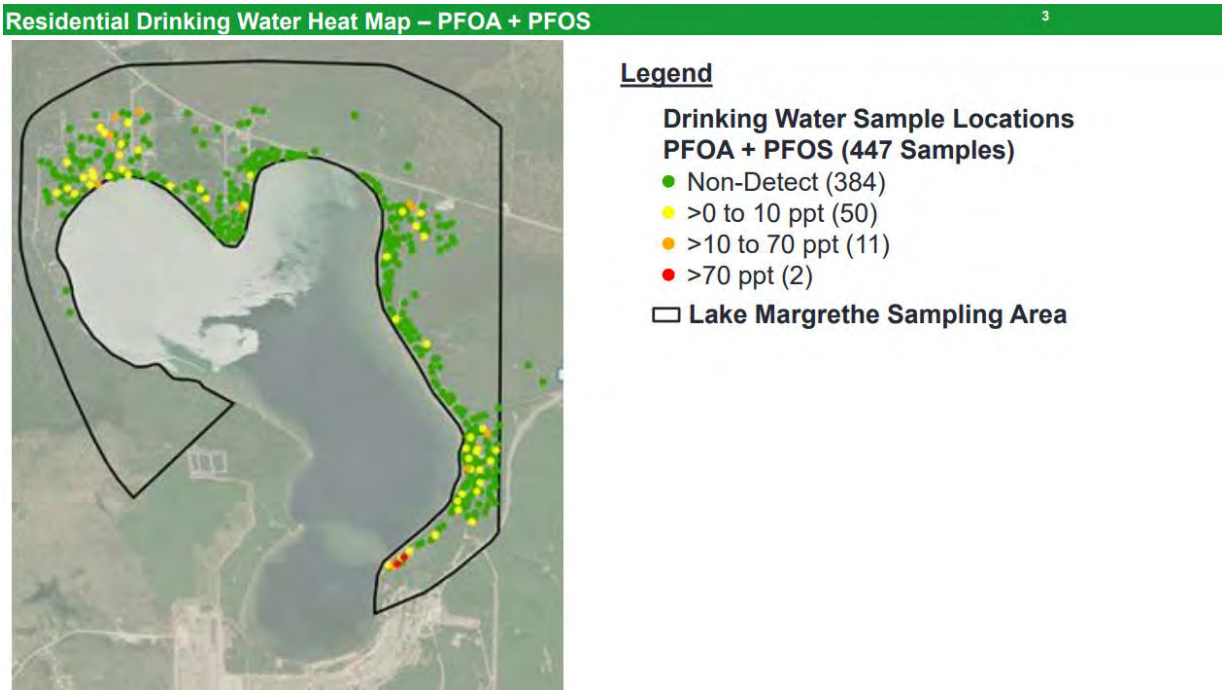


Figure 6-12 Residential Drinking Water Heat Map for Lake Margrethe

MATES at Range 30
The MATES facility is part of Camp Grayling's 147,000-acre property. The Army National Guard's (ARNG) Preliminary Assessment Report and associated interviews did not identify any releases of aqueous film forming foam (AFFF) at the facility.

In 2018, twelve previously existing monitoring wells were sampled by the ARNG in cooperation with the Michigan Department of Military and Veteran's Affairs. The highest result was 150.5ppt of PFOS and PFOA. The groundwater was also sampled at the MATES facility. In addition, the ARNG facility sampled 23 private residential drinking water wells based on their close proximity to the MATES facility (Figure 6-13). Out of those samples, 19 did not detect PFOS or PFOA and four had

levels below 70 ppt. Other PFAS analytes were detected in the samples; however, there are no federal or state standards for these analytes. AECOM will continue to monitor and schedule new residential sampling requests.

Extent

The drinking water and groundwater in the City of Grayling and Grayling Township are impacted by PFOA/PFAS. The extent can be measured by the number of drinking water (residential) and groundwater samples that have been tested. As of October 5, 2020, the Grayling Army Airfield has received 731 drinking water (residential) samples and 937 groundwater samples. Out of these samples, 29 drinking water (residential), and 104 groundwater samples were above the PFOS criteria, and 68 drinking water (residential) and 90 groundwater samples were above the PFOA criteria. As of December 1, 2020, Lake Margarethe has received 505 drinking water (residential, Type I & II) samples, 146 groundwater samples, and 16 surface water samples. Out of these samples, 6 drinking water (residential, Type I & II) samples, 69 groundwater, and 4 surface water

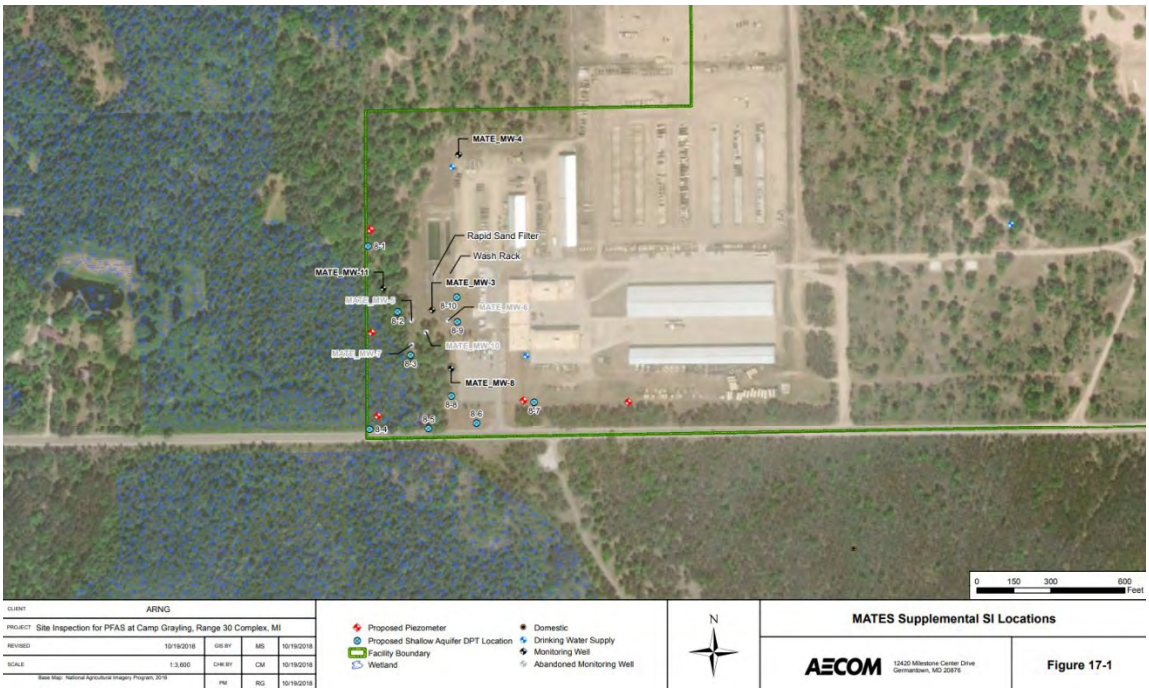


Figure 6-13 Site Inspection for PFAS at the MATES at Range 30 Complex

samples were above PFOS criteria and 7 drinking water (residential, Type I & II), 36 groundwater samples, and no surface water samples were above PFOA criteria. Residential well sampling for the Camp Grayling-Maneuver Area Training Equipment Site (MATES) at Range 30 focused on the residences in closest proximity to the MATES facility (23 residential drinking water wells were tested). The groundwater was also sampled at the MATES facility. At the MATES facility, 12 monitoring wells were sampled, and one sample was greater or equal to standards, and 22 residential drinking wells were sampled with no samples greater or equal to standards.

Vulnerability Assessment

The existing and future drinking water system, the surface water and groundwater systems, and the population is at-risk. PFOA/PFAS has accumulated over time and contaminated the drinking and natural water systems. Residents may have been exposed to PFOA/PFAS from drinking

contaminated water. EGLE has been monitoring PFOA/PFAS in Crawford County and will continue to provide information on its website and conduct and monitor sampling requests. AECOM will prepare a Phase II Remedial Investigation Report. Residential areas are being resampled. District Health Department #10 has provided point of use filters and replacement cartridges to households with detections of PFAS. Residences with drinking water exceeding 70 ppt PFOA+PFOS criteria will be contacted by the military with remedies that include whole-house filters and connections to city water. For Lake Margarethe (south side), the Cantonment area soil and groundwater Supplemental Site Investigation will be completed in 2020 with portions of the Cantonment moving to the Remedial Investigation Phase in 2021. Other PFAS analytes have been detected in samples, but there are no federal or state standards for those analytes.

Scrap Tire Fires

Description
Scrap tires end up in either dumps or recycling facilities, some of which have more than several hundred thousand tires. The tires provide fuel for fires since the shape of a tire allows air to flow into the interior of a pile of tires, which renders standard firefighting practices nearly useless. Scrap tire fires impact the air, soil and water quality since the burning tires release hazardous compounds into the air, and the tires' oily residue can seep into the ground and water system. The Rubber Manufacturers Association reports a fire can convert a standard passenger vehicle tire into about two gallons of oily residue. Sometimes, the burning oil can spread the fire to adjacent areas and burn for months. These fires can cause an area to become a Superfund site.

Although infrequent, scrap tire fires can become a major hazard affecting entire communities due to the difficulty in extinguishing them and the expensive cleanup. Scrap tire fires differ from conventional fires since small scrap tire fires can require significant resources to control and extinguish, the costs of fire management are beyond what local governments can absorb, and the environmental consequences are significant.

According to the EPA and the Rubber Manufacturers Association, approximately 290 million tires are discarded in the United States each year, with approximately 80% of the tires being reused or recycled. As of 2017, Michigan generates approximately 10 million scrap tires annually according to EGLE. At the time of the 2014 update, Michigan had more than 24 million scrap tires at disposal sites throughout the state.

Location
The collection of scrap tires can occur throughout Crawford County.

Previous Occurrences and Probability of Future Occurrences
There have been no recorded occurrences of scrap tire fires in Crawford County. Based on this data, Crawford County will not have scrap tire fires in the future. However, there may be scrap tire collection sites in the county that few people know about and cause there to be a potential for a scrap tire fire in the county.

Extent
Extent can be measured by the number of acres burned and the cost of property damages. Since Crawford County has not had a reported scrap tire fire, data is unavailable to determine the number

of acres burned, property damage costs, and costs to fight the fire. However, there is a potential for an event to occur in an area of the county that few people know has a stockpile of tires.

Vulnerability Assessment
If a scrap tire fire were to occur in the county, all of the county's infrastructure, existing and future buildings and populations would be at-risk. Additionally, neighboring counties would also be at-risk since the fires are difficult to control and can spread across political and geographical boundaries. Depending on the location of a scrap tire fire, it has the potential to cause a wildfire since pre-settlement data shows Crawford County has a history of wildfires. Similar to wildfires, scrap tire fires burn property and structures, and have the potential to cause death and injuries for people who become trapped in the fire or are fighting the fire. Scrap tire fires also have high costs due to property damage and firefighting needs. Scrap tire fires can cause a loss in timber production and agricultural revenue from the fire damaging timber supplies and agricultural products and killing livestock. Communication and power infrastructure can be damaged by the fires resulting in power outages, reduced/loss of warning notifications to the public, and the inability to call for emergency services. Also, residents and businesses may have to evacuate and find shelter.

Structure Fires

Description
Structure fires occur when a fire ignites one or more structures of residential, commercial, industrial, institutional, or other type. These fires are considered to be the most common hazard with most incidents limited in scale and not having the ability to threaten or harm an entire community. However, fires in facilities, such as hotels, entertainment venues, schools, and hospitals, pose a great risk due to the large number of persons involved.

According to the National Fire Protection Association and the U.S. Fire Administration, the U.S. had 499,000 structure fires and 3,400 civilian fire deaths in 2017 with a national average of 2.3 deaths and 9.3 injuries per 1,000 fires. Michigan generally matches the national trend for structure fires.

From 1975 to 2009, the number of reported fires in Michigan has trended downwards, with annual numbers fluctuating. In 2003, the Fire Marshal Division of the Michigan Department of Licensing and Regulatory Affairs reported nearly 19,000 structure fires occurred in Michigan resulting in 161 deaths, 624 injuries, and $230 million in estimated damages. In 2006, Michigan's fire death rate was 15.4 persons per million, which ranked it in the middle of all states. According to the U.S. Fire Administration, Michigan reported 3.7 deaths and 15.6 injuries per 1,000 fires through the National Fire Incident Reporting System in 2017.

Location
All of the existing and future structures in Crawford County are at-risk for a structural fire.

Previous Occurrences and Probability of Future Occurrences
In 2003, there were 70 fires in Crawford County with a total property loss of $318,650. In 2018, Crawford County received 101 fire calls with 24 structure fire calls, 25 vehicle fire calls, and 52 other fire calls according to the National Fire Incident Reporting System. There were no fire related injuries or deaths, and the total fire loss amount was $422,450. Dependent on age of housing stock, infrastructure, and distance between structures, all of the existing and future structures are at-risk to a structural fire. The data shows that the cost of a structural fire has increased over time.

Extent
All existing and future structures are at-risk of a structural fire with the total fire loss amounting to $422,450 in 2018.

Vulnerability Assessment
All of the existing and future buildings, populations, and infrastructure in Crawford County are at-risk to a structural fire. The county has aging housing stock and infrastructure that was built under building codes and rules for fire prevention that are no longer in effect today. Aged electrical lines increase a buildings risk for structural fires. Also, buildings without smoke and carbon monoxide detectors increase the risk for deaths. If not contained, the structural fires can turn into wildfires.

Crawford County relies on a network of township paid and non-paid volunteer fire departments, which means there is a lack of full-time professional firefighters in outlying rural townships who are available to conduct fire inspections and take other preventive measures to lessen the threat of structure fires. Therefore, efforts in Crawford County are directed at fire suppression and make it challenging to maintain sustainable fire prevention and inspection programs. Additionally, some communities may not have fire prevention codes and rely on the State Rules for Fire Prevention, while other communities have developed local ordinances. However, the costs of compliance for existing buildings may be prohibitive for business owners, yet it would be beneficial for new construction to comply with both State building code and State Rules for Fire Prevention.

Fixed Site Hazardous Material Accident

Description
Fixed site hazardous material incidents occur when there is an uncontrolled release of hazardous materials from a fixed site that poses risks to health, safety, property, and the environment. Due to technological advances, hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities. These materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. Federal and state agencies regulate hazardous materials and many communities have plans and procedures to immediately respond to an incident. However, releases can occur despite the precautions taken to ensure careful handling during the manufacture, transport, storage, and use and disposal.

Location
According to the TIER II Manager, there are ten SARA Title III sites in Crawford County:

- Arctic Glacier, Inc. at 427 S I-75 Business Loop in Grayling
- Camp Grayling South Camp at Building 117in Camp Grayling
- CES, Inc. of Waters at 11375 Sherman Road in Frederic
- Frontier Communications at 412 Cedar Street in Grayling
- Frontier Communications at 4279 Skyline in Roscommon
- Georgia-Pacific Chemicals, LLC at 4113 W. Four Mile Road in Grayling
- Grayling Generating Station at 4400 W. Four Mile Road in Grayling
- Grayling Particle Board at 5851 Arauco Road in Grayling
- Spring Wood Products at 2669 Industrial Drive in Grayling
- Weyerhaeuser NR Company at 4111 West Four Mile Road in Grayling

Previous Occurrences and Probability of Future Occurrences
Crawford County does not have any recorded fixed site hazardous material accidents. However, there is the potential for an accident. Emergency Plans are on file with the Crawford County Emergency Management Office.

Extent
The extent can be measured by the amount of damage incurred from a fixed site hazardous material accident. However, the county has not had an accident in the past fifteen years and the emergency plans are annually reviewed.

Vulnerability Assessment
The infrastructure, existing and future buildings, and populations near the fixed sites are at-risk for a fixed site hazardous material accident. An accident could impact air quality. Individuals affected by the hazardous material may experience chemical burns, nausea, vomiting, disorders of the lungs, kidneys, or liver, and poisoning. An accident could also cause the area to be evacuated and require a need for emergency shelters. It would cause businesses to close and owners may have to pay for repairs caused by the accident. The hazardous material also has the potential to leak into the county's drinking and natural water systems as well as causing communication and utility infrastructure to fail.

Transportation Hazardous Material Accident

Description
A transportation hazardous material incident is an uncontrolled release of hazardous materials during transport that pose risks to health, safety, property, and the environment. All modes of transportation (e.g., highway, railroad, seaway, airway, and pipeline) carry thousands of hazardous material shipments on a daily basis through local communities. A transportation accident involving any of the hazardous material shipments could cause a local emergency that would affect the immediate vicinity of the accident site or a small portion of the surrounding community. The Pipeline and Hazardous Materials Safety Administration of the U.S. Department of Transportation regulates over 1 million daily shipments of hazardous materials in the United States.

All areas in Michigan are vulnerable to a hazardous material transportation incident with Southern Michigan being more vulnerable due to its highly concentrated populations. The State has experienced numerous small-scale incidents that are responded to by local fire departments and hazardous material teams. Fortunately, Michigan has not experienced large scale incidents.

Location
The City of Grayling, and Maple Forest, Grayling, Beaver Creek, Frederic, and South Branch Townships are vulnerable to transportation hazardous material accidents. Crawford County has a complex transportation system that runs through it (Figure 5-4). M-72 runs through a small portion of Frederic Township (southwest corner), the City of Grayling, Grayling Township, and South Branch Township. M-18 runs through South Branch Township. U.S. 127 runs through Beaver Creek Township. I-75 runs through the City of Grayling, and Beaver Creek, Grayling, and Maple Forest Townships.

Previous Occurrences and Probability of Future Occurrences
Crawford County has not had any significant accidents reported but may have had minor accidents that were not reported. Since the transportation network is complex, there is the potential for an

accident to occur on M-72, M-18, U.S. 127, and I-75. The City of Grayling has a high risk of an accident since the majority of hazardous material shipments travel through the city.

Extent
The extent of a transportation hazardous material accident can be measured by the amount of damage that is incurred. However, data is not available to quantify the cost of past accidents. Another way extent can be measured is based on location of an accident. I-75, U.S. 127, and M-72 are the most vulnerable to a transportation hazardous material accident since these are the major thoroughfares through the county.

Vulnerability Assessment
Existing and future buildings, infrastructure, and populations located near I-75, M-72, M-18, and U.S. 127 are at-risk for a transportation hazardous material accident. An accident has the potential to leak material into the county's surface water and groundwater systems, which would impact wells. Additionally, an accident could cause damage to buildings near the road, and damage communication and utility infrastructure that could cause power outages and a loss of communication lines. Dependent on the severity of the incident, individuals may experience chemical burns, nausea, vomiting, poisoning, and disorders of the body's organ systems. Businesses may close and a spill could cause the soil around businesses and residences to become contaminated.

Transportation Accidents (air/land/water)

Description
Transportation crashes or accidents involve air, land or water-based commercial passenger carriers. These accidents can result in mass casualties and tremendous injuries due to large numbers of passengers, unpredictable weather, mechanical failures, and human error. These accidents have the potential to strain local response and medical services. Airplane accidents tend to occur either during take-off or landing according to the NTSB and airline industry. When responding to these accidents, it may be difficult to suppress the fires, rescue and provide first aid to survivors, establish a mortuary facility, detect the presence of explosive, radioactive, or other hazardous materials, and provide crash site security and crowd control. Water transportation accidents may require underwater rescue and recovery efforts. Vulnerable populations to these hazards include communities near airports, communities with railroad tracks running through them, communities with commercial intercity passenger bus or local transit bus service, communities with school bus service, and communities with commercial marine passenger service or along water bodies.

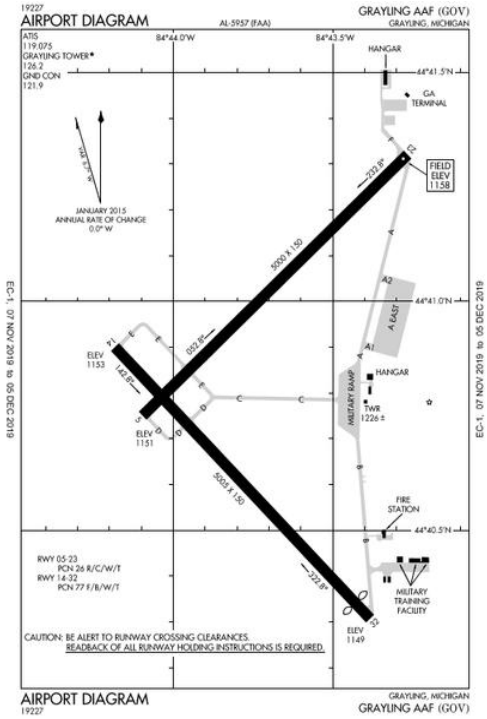


Figure 6-14 Grayling AAF Airport

Michigan has approximately 19 commercial passenger airports, more than 130 certified intercity carriers that provide passenger, charter, commuter, and special bus service to 220 Michigan communities with six offering regular route service, an intercity rail passenger system that consists of 568 route miles, along three corridors, serving 22 Michigan communities, 72 local bus transit systems serving 85 million passengers and 20 commercial marine passenger ferries.

Location
The entire county is susceptible to air, land, and water transportation accidents with the water accidents strictly occurring on all waterways (rivers, streams, lakes, etc.). The air transportation accidents have a greater chance of occurring at the Grayling AAF Airport at the Grayling Army Airfield (Frederic and Grayling Townships, and the City of Grayling) (Figure 6-14).

Previous Occurrences and Probability of Future Occurrences
Crawford County does not have any major accidents reported. However, there is the potential for accidents on all of the county's roadways, trails, waterways, and at the airport.

Extent
All of Crawford County is at-risk for an air, land, or water transportation accident. Air accidents would primarily occur around the airport. Land transportation accidents would primarily occur along the roadways and trails. Water transportation accidents would primarily occur on the county's major lakes, and on the Au Sable and Manistee Rivers. Even though Crawford County does not have any reported major air, land or water transportation accidents, the county does have the potential for accidents. The extent can be measured by the amount of property damages, deaths, and injuries. According to the University of Michigan Transportation Research Institute's *Societal Costs of Traffic Crashes and Crime in Michigan: 2017 Update*, Crawford County has had one fatal traffic crash, 22 with serious injuries, and property damage for 603 out of 717 traffic crashes. The average cost of a traffic crash casualty was $42,164 with the total traffic crash cost for all 717 accidents equaling $30,231,506. However, data is unavailable to quantify the cost of past air and water accidents. Another way extent can be measured is based on location of an accident. I-75, U.S. 127, and M-72 are the most vulnerable to a transportation hazardous material accident since these are the major thoroughfares through the county.

Vulnerability Assessment
Crawford County does not have a commercial airport, passenger rail service, intercity bus service, or commercial marine passenger service. However, it does have school bus and specialized public transit services that could result in loss of life and injuries if an accident occurred. An air transportation accident has the potential to cause deaths, injuries, and large amount of property damage if a plane hits the county's buildings, infrastructure, or year-round and/or seasonal populations. Land transportation accidents have the potential to cause damage to other vehicles, injuries, death, and a transportation hazardous material accident. Dependent on the severity of the accident, it can cause road closures that would impact the county's traffic flow patterns. Additionally, it could reduce emergency service response times. Water transportation accidents can cause death, injuries, and high property damage costs. Dependent on the location and severity of the accident, water resources have the potential to become contaminated.

Infrastructure Failures

Description

Infrastructure provides essential services, such as power, heating, air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. Infrastructure failures occur when public or private utility infrastructure becomes temporarily disabled. These failures can occur at any time and last from a few seconds to weeks. Infrastructure failures also cause widespread economic losses to businesses and industries, limit security, and alter lifestyles. Generally, the elderly, children, impoverished individuals, and people in poor health are most impacted by infrastructure failures. For example, people unable to afford generators or have access to fireplaces will have more difficulty getting through a failure.

Since infrastructure is becoming more complex and interdependent, these failures can be large in scope and magnitude. For example, a power outage during extreme heat and cold events has the potential to cause a person to die in their home, which creates a public safety emergency, and it may cause water or wastewater treatment systems to become inoperable, which may result in a public health emergency. Northern Michigan has fewer infrastructure networks than urban areas; however, a failure affects a larger geographic area since residences and businesses are spread out.

Michigan's infrastructure is aging, which is affecting maintenance funding and user demand. Additionally, Michigan's codes and standards for the design, construction, and operation of public and private utility infrastructure require a minimum level of structure integrity and operational performance, which is not adequate to protect infrastructure during a disaster. In 2018, the State of Michigan established the Michigan Infrastructure Council to develop a 30 year statewide strategic framework to address the need for infrastructure improvements in Michigan. For more information, see the following website: https://www.michigan.gov/mic.

Location

The entire county is susceptible to infrastructure failures including forested areas that infrastructure traverses.

Previous Occurrences and Probability of Future Occurrences

Crawford County has had an infrastructure failure regarding its stormwater management system that caused flooding. The county has not had other recorded events of infrastructure failure. However, there is the potential for an incident to occur based on the location and severity of other hazards, such as wildfires, severe winds, etc., the age of the county's infrastructure, and the availability of maintenance funding.

Extent

Since Crawford County is classified as rural, its infrastructure is spread over a large geographic area. If there is an infrastructure failure, a large area would be impacted. Additionally, if a failure occurred in the City of Grayling and Grayling Township, about 55% of the population would be affected.

Vulnerability Assessment

In Crawford County, the electrical system consists of above ground power transmission lines that traverse forested areas. Damage to these lines would cause a power outage over a large area since the county is rural in nature. A power outage would impact the population based on the time of year (winter would require heating stations to be set up and summer would require cooling stations to be set up), and if the population has any medical issues that require machines or

refrigerated medicine. Also, areas in the county are not covered by cell phone service due to topography and lack of infrastructure. Businesses, residents, and visitors would not be able to reach out to family and friends or call for emergency services if the existing communication infrastructure fails. Damage to the roads would cause them to be closed until fixed. These road closures would increase drive times and emergency response times.

Oil and Gas Accidents (well and pipeline)

Description

An oil and gas accident occurs when there is an uncontrolled release of oil, gas, or the poisonous by-product hydrogen sulfide from production wells or from a pipeline that causes property damage, environmental contamination, injuries, and loss of life. Michigan is a major consumer and producer of oil and natural gas products that are transported and stored throughout the state. The State has the greatest underground natural gas storage capacity in the nation and supplies natural gas to its residents and neighboring states. However, these underground pipelines have the potential to leak, rupture, and explode, which puts many communities at risk. In Michigan, oil and natural gas wells are located in 63 counties in the Lower Peninsula. Between 1927 and 2009, there have been 56,525 oil and natural gas wells drilled in Michigan with about half of them producing oil and gas. As of 2012, Michigan wells have produced approximately 1.4 billion barrels of crude oil and 6 trillion cubic feet of gas. Despite being highly regulated and having a fine safety record, the threat of oil and gas well accidental releases, fires, and explosions still exists. Additionally, unplugged abandoned wells impact the health and safety of surrounding communities since they have the potential to allow natural gas to flow underground and accumulate in nearby buildings, contaminate nearby water wells, and leak into soils and the water system.

In addition, well accidents have the potential to release hydrogen sulfide, which is a poisonous gas that explodes when mixed with air temperatures of 500 degrees or above. Hydrogen sulfide gases can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil have a high sulfur content. Hydrogen sulfide has a "rotten egg" odor in concentrations from .03 parts per million (ppm) to 150 ppm, while in larger concentrations it paralyzes the olfactory nerves, so the odor is no longer an indicator of the hazard. Over 1,300 wells in Michigan have been identified as having hydrogen sulfide levels exceeding 300 ppm. At concentrations of 700 ppm, one breath of hydrogen sulfide can kill. Hydrogen sulfide can cause the failure of high-strength steels and other metals, which requires all company and government responders to be familiar with the emergency procedures and the kind of materials safe for use when responding to sour gas wells.

Location

Crawford County's oil and gas wells and pipelines are located throughout the entire county since the bedrock contains economic deposits of gas and oil. Oil and gas wells are concentrated on the west side of Beaver Creek Township, in the northern portion of Frederic Township, in the northwest portion of Maple Forest Township, and in the northwest portion and along the eastern boundary of Lovells Township (Figure 6-15). The county's pipelines deliver natural gas to homes and businesses and from wells to processing/compressor facilities. These facilities remove the brine and moisture from the natural gas and transmit the gas to major processing and storage facilities.

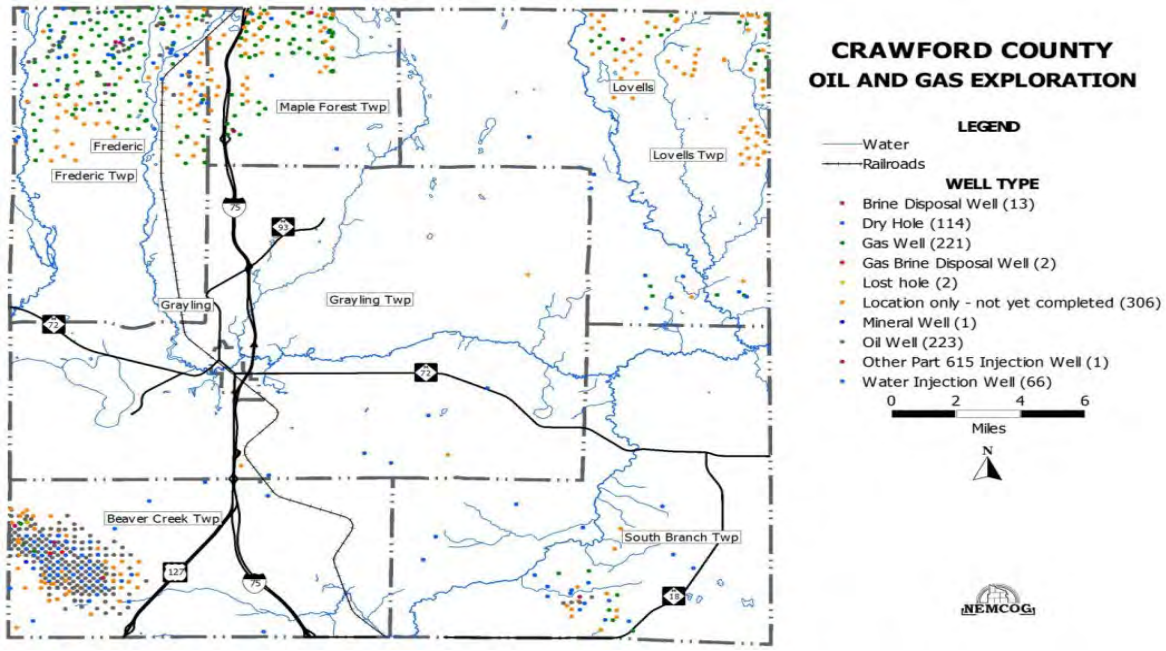


Figure 6-15 Crawford County Oil and Gas Well Types

Previous Occurrences and Probability of Future Occurrences

Crawford County has not had any reported major incidents; however, the potential for the occurrence of an incident does exist.

Extent

The majority of the oil and gas wells and pipelines are located in the northwestern, southwestern, and northeastern portions of the county with a small cluster in the southeastern portion of the township. In 2017, Crawford County had 652 oil and gas wells with 58 active, 197 plugging approved, 363 producing and 34 temporarily abandoned according to EGLE. There are 159 oil and gas wells that have a hydrogen sulfide concentration with 65 wells having a concentration of 700 ppm and greater. Even though Crawford County has not had any major reported incidents, the possibility of an oil and gas well and pipeline accident does exist.

Vulnerability Assessment

The existing and future buildings and populations near the oil and gas wells and pipelines are at-risk if there is an oil and gas well and/or pipeline accident. These accidents consist of accidental releases, fires, and explosions that would cause damage and/or destruction to the buildings, infrastructure, and natural areas around the event. Oil and gas well and pipeline accidents have the potential to contaminate water wells and spread into the surface water and groundwater systems. These accidents can also negatively impact air quality through the release of hydrogen sulfide that can accumulate in oil and gas wells, pipeline terminals, storage facilities, transportation facilities, and nearby buildings. Hydrogen sulfide can cause paralysis of the olfactory nerves, burns, death, and the failure of high strength metals. Additionally, oil and gas wells and pipelines located in high-risk wildfire areas are at greater risk for an accident.

Dam Failure

Description

A dam is either man-made or constructed by wildlife, and controls the flow of water for agriculture, flood-control, artificial lakes, municipal water supplies, and energy generation. A dam failure occurs when an impoundment either collapses or fails, which results in flash flooding downstream or water pouring over the top of the dam during a flood event. This failure may be due to poor operation, lack of maintenance, or vandalism of the dam. Dam failures can result in loss of life and extensive damage to property and natural resources since they occur unexpectedly.

According to EGLE, there are 2,500 dams in Michigan with 813 regulated by Part 307, Inland Lake Levels, and 235 regulated by Part 315, Dam Safety of The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The dams regulated by Part 307 have a court issued order that establishes the level at which the lake is to be maintained; while the dams regulated by Part 315 are over 6 feet in height and over 5 acres are impounded during the design flood. Additionally, the Federal Energy Regulatory Commission (FERC) regulates 99 hydroelectric dams under the Federal Power Act. Since 1888, EGLE has documented approximately 302 dam failures in Michigan with an estimated average annual property and crop damage of $0.3 million.

Part 315 requires EGLE staff to determine the hazard potential classification for each dam according to the potential downstream impact the dam would have if it failed and to establish an inspection schedule. Dam inspections are required every three to five years for state regulated dams based on their hazard potential rating. For dams classified with a high or significant hazard potential, dam owners are required to prepare and maintain emergency action plans. Additionally, owners are required to have the local emergency management coordinators review the plans for consistency with local emergency operations plans before the owners submit the emergency action plan to EGLE.

The FERC licenses and inspects private, municipal, and state hydropower projects. The FERC requires every applicant to develop and file an emergency action plan with the Regional Engineer unless granted a written exemption. The plan describes the actions that will be taken to moderate or alleviate a problem at the dam and the actions that will occur to respond to dam incidents or emergencies. It also includes inundation maps that identify critical infrastructure and at-risk populations. A yearly comprehensive review of the emergency action plan is conducted, which may include a functional exercise with local emergency management officials.

Location

Dams are located in t Maple Forest, Lovells, South Branch, and Grayling Townships. All of the dams have a low hazard potential. The National Inventory of Dams database also lists a dam in the City of Grayling. However, that dam was removed in 2007.

Previous Occurrences and Probability of Future Occurrences

Crawford County has not had any previous reported dam failures. According to the National Inventory of Dams, Crawford County has six dams with an average age of 46 years (Table 6-7, Figure 6-16). However, as noted above, the Grayling Dam was removed in 2007. Based on the aging infrastructure, there is a potential for a dam failure. Proper dam maintenance may predict and prevent the possibility of a future event. Since none of the dams have a high hazard potential, they are not required to have an emergency action plan. Therefore, dam failure will not be further analyzed at this time.

Extent and Vulnerability Assessment

The extent of a dam failure can be measured by the amount of damage that occurs and the number of deaths and injuries. Crawford County has not had a previous dam failure therefore, data is not available to quantify the extent. If a dam failure occurred, there could be environmental impacts from the release of sediments behind the dam. However, due to the few dams within the county and their low hazard potential it is unlikely any damage from a failure would be significant so no further assessment will be conducted at this time.

Table 6-7 Crawford County Dams									
	Name	**Height (ft)**	**Storage (acre-feet)**	**Location**	**Regulatory Agency**	**Dam Type**	**Year Completed**	**Dam Purpose**	**Hazard Potential**
1	Big Bradford Lake Level Control Structure	6.6	644	Bradford Creek	-	Private	1979	Recreation	Low
2	Grayling Dam/Stump Pond Dam	9	306	Au Sable River	-	Local Government	1933	Other	Undetermined
3	Forest Dunes Lake Dam	25.3	370	Tributary to Thayer Creek	State	Private	1999	Recreation	Low
4	Wakeley Lake Dam	9	693	Wakeley Creek	Federal-USDA FS	Federal	1991	Fish and Wildlife Pond	Low
5	Conners Marsh Dam	8	950	Connors Marsh Creek	State	State	1964	Recreation	Low
6	Big Creek Dam	25	728	Big Creek River	State	State	1964	Recreation	Low

Source: National Inventory of Dams, Retrieved July 2019

Note: The Grayling Dam was removed in 2007

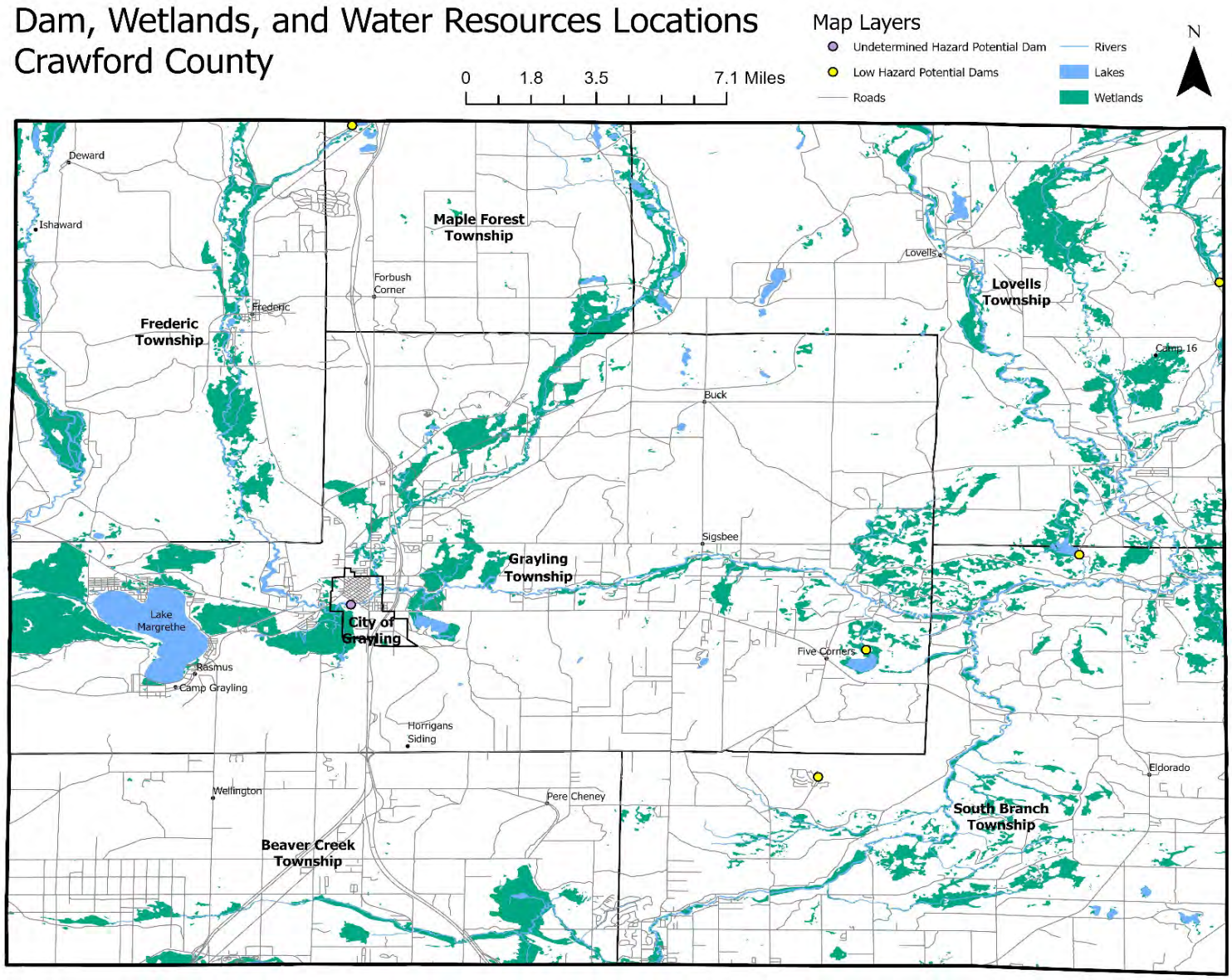


Figure 6-16 Dam, Wetlands, and Water Resources

Human-Related Hazards

Public Health Emergency

Description
Public health emergencies occur when there is a widespread and/or severe epidemic, contamination incident, bioterrorist attack, or other situation that negatively impacts the health and welfare of the public. These emergencies include disease epidemics, large-scale food or water contamination incidents, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents. A common characteristic of public health emergencies is that they impact or have the potential to impact a large number of people either statewide, regionally, or locally in scope and magnitude. These health emergencies can occur as primary events or as secondary events from another hazard or emergency (e.g., flood, tornado or hazardous material incident).

Throughout the years, there have been many pandemics. For example, there was an outbreak of severe acute respiratory syndrome (SARS) in 2003. This virus was a new coronavirus that resulted in over 8,000 infections and a 10% mortality rate around the world. Additionally, a new strain of H1N1 was detected in 2009, which had approximately 300,000 deaths. Older people were less likely to get sick from this disease since they had derived immunity from a flu strain that had circulated in the mid-20th century. Since 2012, Middle East respiratory syndrome (MERS), a coronavirus, has been reported in 27 countries where there have been approximately 2,494 people infected and 858 deaths. In 2017, the World Health Organization (WHO) put SARS and MERS on its priority pathogen list to spur further research into coronaviruses.

On March 11, 2020, the WHO declared the SARS-CoV-2 (COVID-19) outbreak a pandemic. The new coronavirus had not been previously identified in humans and does not have a vaccine or treatment. It was first reported in China on December 31, 2019. In early 2020, COVID-19 began impacting numerous countries around the globe. In response, countries and some states in the U.S. instituted bans and restrictions on travel, instituted nationwide lockdowns, closed schools and businesses, requested study abroad students return to their countries, transitioned from in-person to online classrooms, cancelled/postponed events (e.g. conferences, concerts, sporting events, commencement ceremonies, etc.), requested people call before arriving at hospitals, instituted bans on the number of people that can gather in one area, instituted social distancing of six feet between individuals, and some churches temporarily suspended services. Some citizens responded by purchasing supplies en masse, which caused some supply shortages. On March 13, 2020, the U.S. declared COVID-19 a national emergency and began developing a sweeping relief package, which was signed by President Trump on March 27, 2020. On March 23, 2020, Michigan announced an order for all Michigan businesses and operations to temporarily suspend in-person operations that are not necessary to sustain or protect life, and to stay home unless they are part of the critical infrastructure workforce, engaging in outdoor activities, or performing necessary tasks (e.g., going to the grocery store). On March 28, 2020, President Trump approved Governor Whitmer's request for a Major Disaster declaration in Michigan, which allows Michigan to participate in FEMA programming.

Location
Public health emergencies do not have geographic boundaries and affect all of Crawford County.

Previous Occurrences and Probability of Future Occurrences
As of December 7, 2020, there have been 404,386 confirmed COVID-19 cases and 9,947 deaths in Michigan, and 374 confirmed cases and 5 deaths in Crawford County. It is impossible to predict when a major event will occur or how severe it will be. However, a pandemic has a higher probability of occurring in areas where there is a high population concentration and during cold weather.

Extent
The extent of a public health emergency can be determined by the number of cases and deaths, and the amount of money spent to prepare for and respond to public health threats. In Crawford County, District Health Department #10 works with local, regional, state, and federal agencies to prepare for and respond to public health threats, including terrorist acts using biologic, chemical, and radiological agents. Additionally, the Region 7 Healthcare Coalition coordinates regional efforts to develop a comprehensive all-hazards medical preparedness plan. Between March 10, 2020 and December 7, 2020, Crawford County administered 5,608 tests for COVID-19 with 386 positive tests.

Vulnerability Assessment
A public health emergency will have a severe impact over a large geographic area or in densely populated areas. Additionally, the hazard will have a serious financial impact on residents and businesses. In extreme cases, travel may be prevented, and businesses and schools will be closed. If businesses close for extended periods of time, employees will lose wages and the ability to pay their bills, and the businesses will lose revenue, which may cause them to go out of business and employees to lose their jobs. At risk-populations include individuals who are at higher risk of severe complications from infectious diseases (older adults, pregnant women, children, people with pre-existing medical conditions), individuals with limitations that impact their ability to receive and respond to information, individuals who rely on personal care assistance, individuals with transportation needs, and individuals who have difficulty coping in new environments.

Sabotage/Terrorism/Nuclear Attack

Description
Sabotage and terrorism involve an intentional, unlawful use of force or violence against persons or property to intimidate or coerce a government or the civilian population to further political, social, or religious objectives. Since sabotage/terrorism objectives are widely varied, the potential targets are also varied. Any public facility, infrastructure, controversial business, assembly place, computer systems operated by government agencies, financial institutions, healthcare facilities and colleges/universities can be considered a potential target. Regardless, terrorists seek the greatest possible media exposure to frighten as many people as possible. Sabotage/terrorism techniques include bombings, assassinations, organized extortion, use of nuclear, chemical and/or biological weapons, information warfare, ethnic/religious/gender intimidation (hate crimes), state and local militia groups that advocate to overthrow the U.S. Government, eco-fanaticism (destruction or disruption of research or resource-related activities), and narcotics smuggling and distribution organizations.

A nuclear attack is any hostile action taken against the United States that involves nuclear weapons and results in property destruction and/or loss of life. Nuclear weapons are powerful explosive devices that can devastate an area. The entire United States is subject to the threat of a nuclear attack; however, the strategic importance of military bases, population centers and certain types of industries place these areas at a greater risk. With the end of the Cold War, the threat of a nuclear

attack against the U.S. diminished slightly with the dismantling of nuclear warheads aimed at U.S. targets. However, the number of countries capable of developing nuclear weapons continues to grow despite the ratification of an international nuclear non-proliferation treaty. Additionally, nuclear weapons have the potential to be acquired and/or developed by terrorist organizations.

Even though a nuclear attack is unlikely in Michigan, the extent of destruction and casualties from a nuclear weapon still make this hazard a possibility. Unfortunately, there is no way to assess the probability of a nuclear attack and most mitigation strategies would originate from and be prompted by federal initiatives and defense priorities. However, some things should be considered, such as the ability to shelter or evacuate people, maintain government functions and social services, protect critical computer and communication systems, and create redundancies in infrastructure and critical services.

Location
Camp Grayling and the airbase have the greatest risk for a terrorism, sabotage, and nuclear attack in Crawford County.

Previous Occurrences and the Probability of Future Occurrences
In the last 15 years, Crawford County has not had any recorded incidents of sabotage/terrorism/nuclear attack. Based on this data, the county would not have a sabotage/terrorism/nuclear attack in the future. However, it is impossible to predict when an event will occur and how severe it will be. Therefore, there is a possibility the county will experience a sabotage/terrorism/nuclear attack in the future.

Extent
The extent of a sabotage/terrorism/nuclear attack can be measured by the amount of damage that occurs. Since an event has not occurred in the county, no injuries, deaths, or damages have been incurred.

Vulnerability Assessment
A Sabotage/Terrorism/Nuclear Attack event will impact the operations of Camp Grayling and the airfield along with nearby residential and commercial areas. Dependent on the type and severity of attack, the event may cause financial burdens based on the amount of damage needing to be repaired, medical costs associated with the event, and lost wages/revenue for employees and employers. Additionally, an event may cause an evacuation from the area and a shutdown of the hospital (if not causing the hospital to reach capacity and have to send patients to other medical facilities).

Civil Disturbance

Description
Civil disturbances occur from collective behavior that results in lawbreaking, a perceived threat to public order, or the disruption of essential functions. Large portions of a community may be encompassed by civil disturbances and require the involvement of multiple community agencies to respond to the disturbance. Some facilities that may be adversely impacted by civil disturbances include government buildings, military bases, colleges/universities, businesses, hospitals, and police and fire facilities. There are four types of civil disturbance:

- **Protests:** Formal organization of demonstrations to achieve collective goals that are threatening, disruptive, and malicious (e.g., political protests, labor disputes, etc.).

Sometimes these events result in property destruction, service interruptions, and interference with law-abiding citizens and emergency responders.

- **Hooliganism:** Unorganized, unlawful acts by either an individual or a collective that are inspired by crowds (e.g., disorder following sporting events and college parties, "block parties," etc.). These acts cause property destruction, assaults, disorderly conduct, and criminal victimization. Sometimes, hooliganism can include elements of protest.
- **Riots:** A disorganized, violent gathering of people that involves assaults, intimidation, and property destruction. Sometimes, individuals attempt to exploit the disorder (e.g., looting, arson, etc.).
- **Insurrection:** A deliberate effort to disrupt or replace the established government or its representatives (e.g., prison uprisings, political conflicts, ethnic conflicts, etc.).

Large-scale civil disturbances rarely occur; however, they are usually an offshoot of labor disputes with a high degree of animosity between two dissenting parties, high profile/controversial judicial proceedings, the implementation of controversial laws or other governmental actions, resource shortages caused by a catastrophic event, disagreements between special interest groups over a particular issue or cause, or a perceived unjust death or injury to a person held in high esteem by a particular segment of society. Crawford County has not had any recorded incidents of civil disturbances.

Location
The City of Grayling and Grayling Township is at risk for civil disturbances since 55% of the population is located in these jurisdictions.

Previous Occurrences and Probability of Future Occurrences
Crawford County has not had any recorded incidents of civil disturbances. Based on this information, the county would not have any civil disturbances in the future. However, an event does have the potential to occur dependent on political, social, and religious interests. Unfortunately, it is impossible to predict when an event will occur and how severe it will be.

Extent
The extent of a civil disturbance can be measured by the amount of damage that occurs. Since an event has not occurred in the county, no injuries, deaths, or damages have been incurred.

Vulnerability Assessment
Civil disturbance events will have minimal impacts and financial burdens on residents and businesses since the county is not an area that provides high profile media coverage. However, during community events, such as the AuSable River Marathon and Northern Strike, large crowds are attracted to the county. Dependent on the severity of the civil disturbance event, businesses may be damaged or looted, and injuries and deaths could occur.

Crawford County and its Local Jurisdictions

The Crawford County Hazard Map shows the location of oil and gas wells, high wildfire risk forest areas, flood prone soils (wetland inventory items), and main transportation routes (Figure 6-17). The local jurisdictions have base and hazard maps (Figures 6-18 to 6-31). The base maps show the community's infrastructure, facilities, and public lands. The hazard maps show the hazards in each jurisdiction. The hazard map displays high wildfire risk areas as pine, oak, and aspen-birch forest types, and flood prone areas as wetland types.

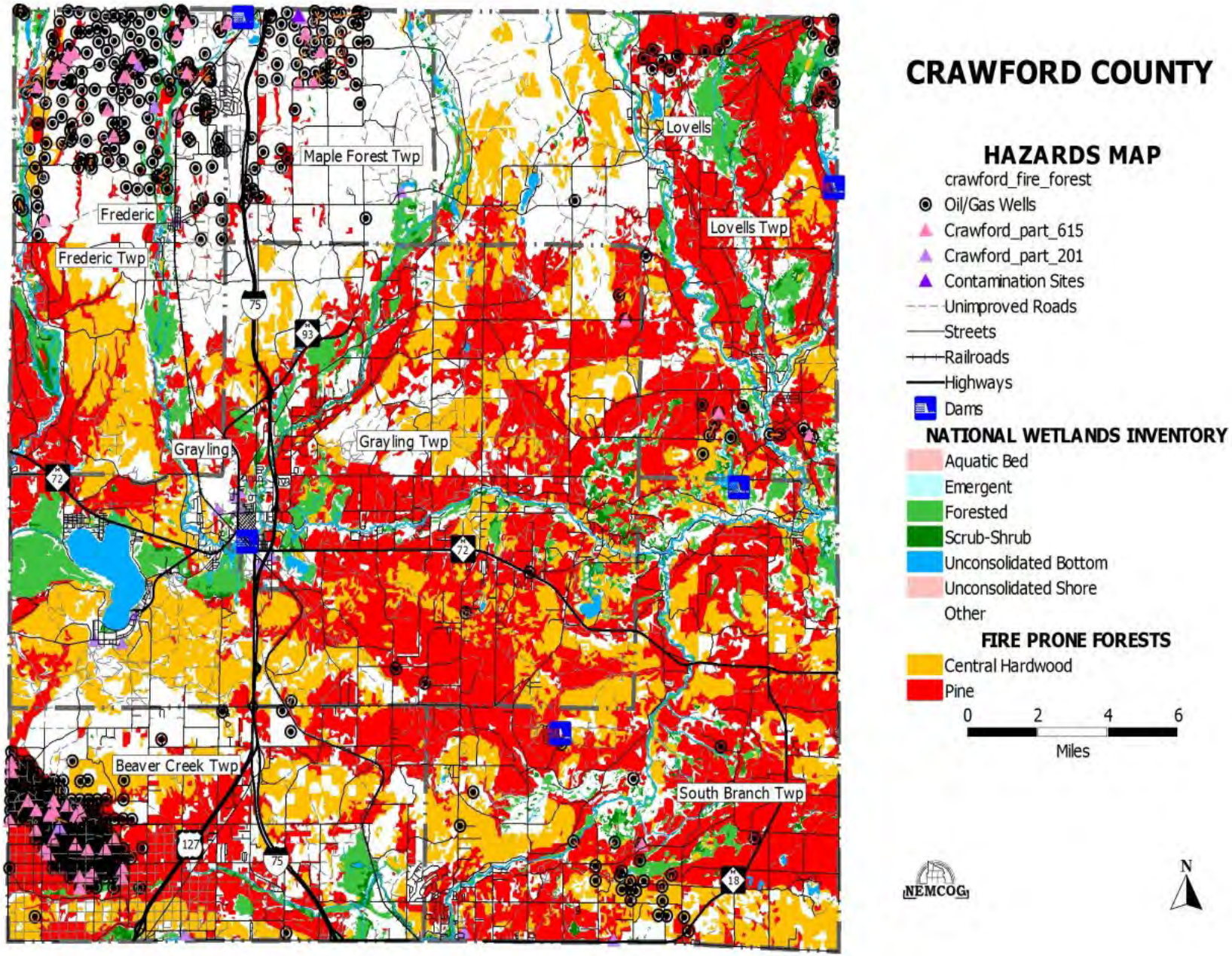
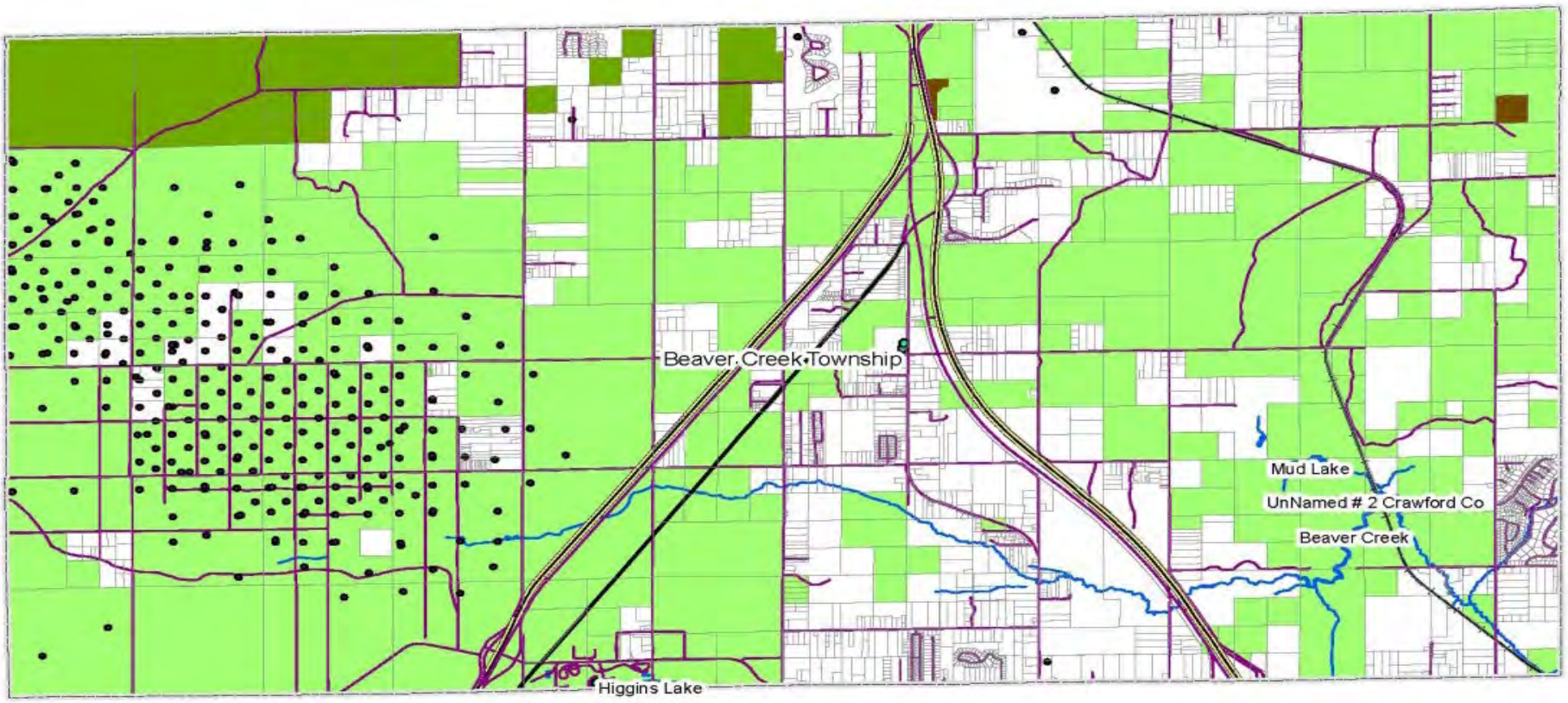


Figure 6-17 Crawford County Hazard Map

Beaver Creek Township Base Map



Beaver Creek Township Hazards Map

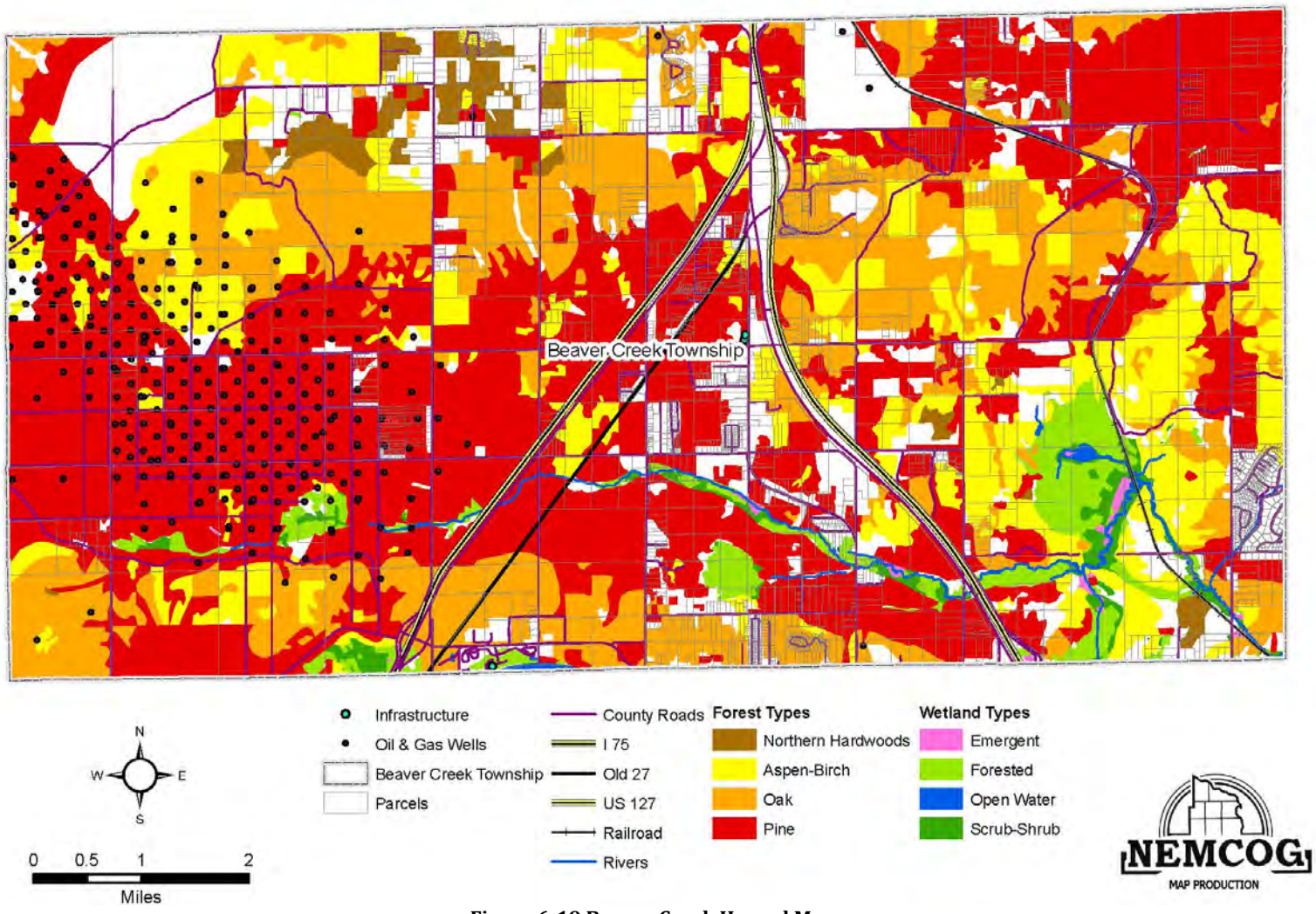


Figure 6-19 Beaver Creek Hazard Map

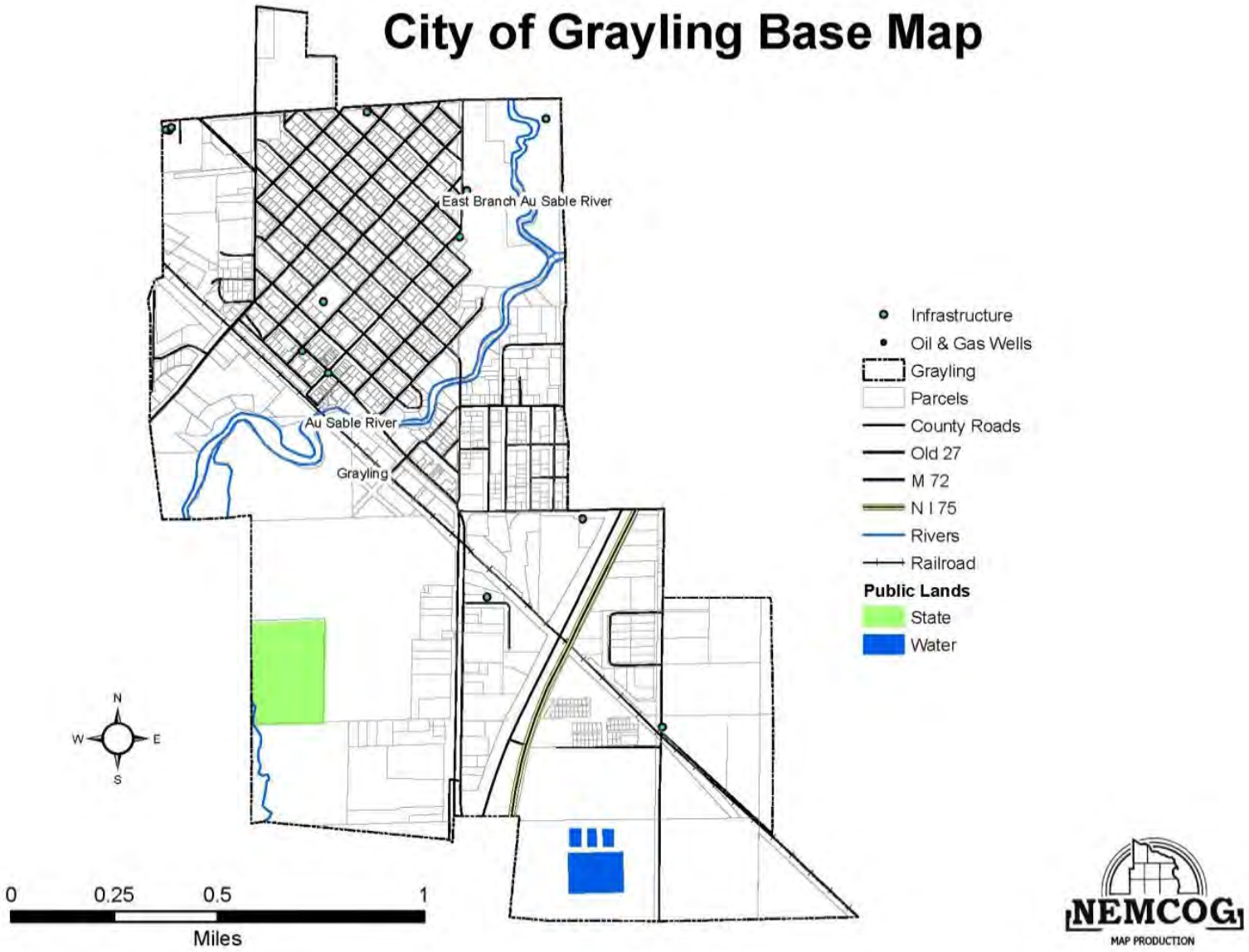


Figure 6-20 City of Grayling Base Map

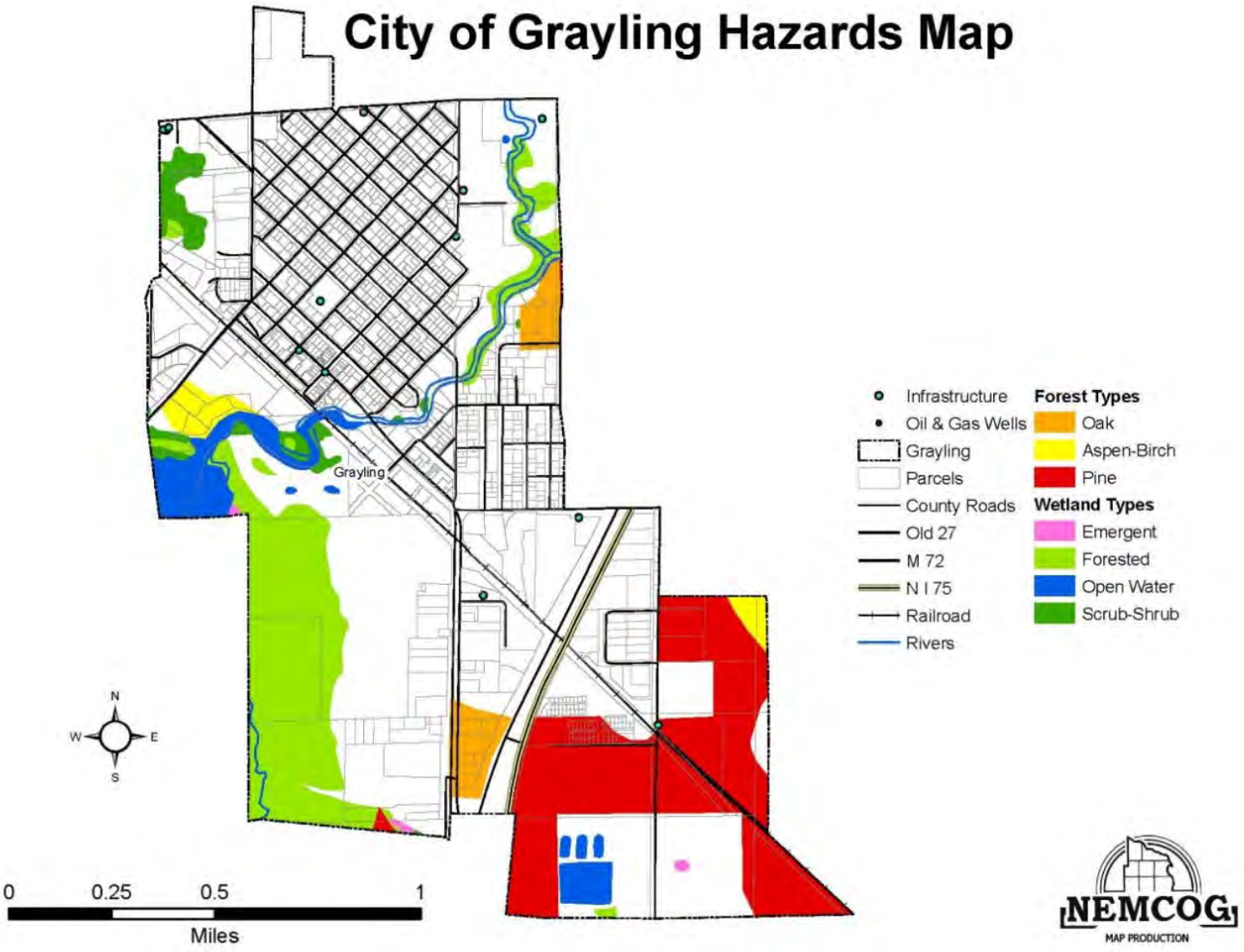


Figure 6-21 City of Grayling Hazard Map

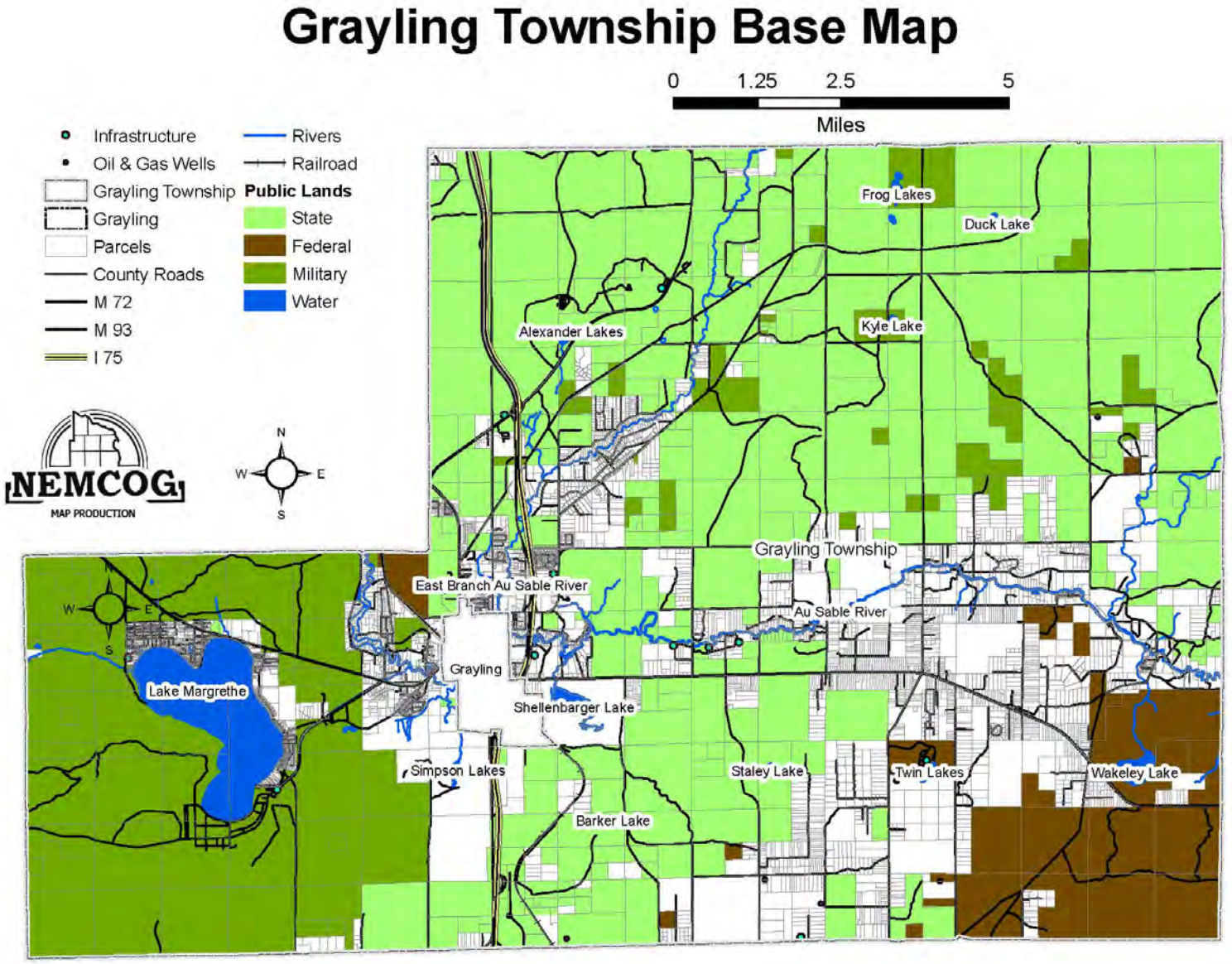


Figure 6-22 Grayling Township Base Map

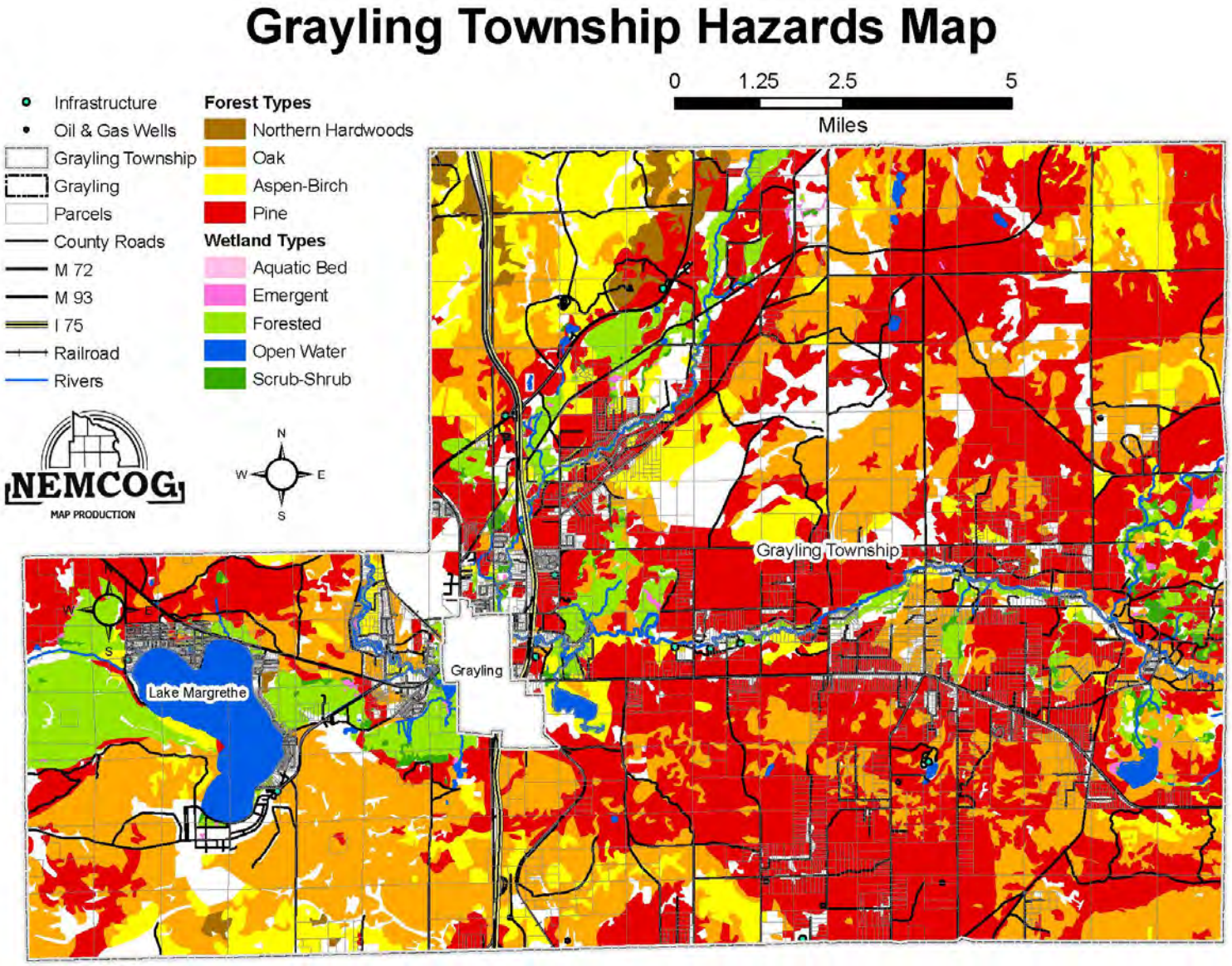


Figure 6-23 Grayling Township Hazard Map

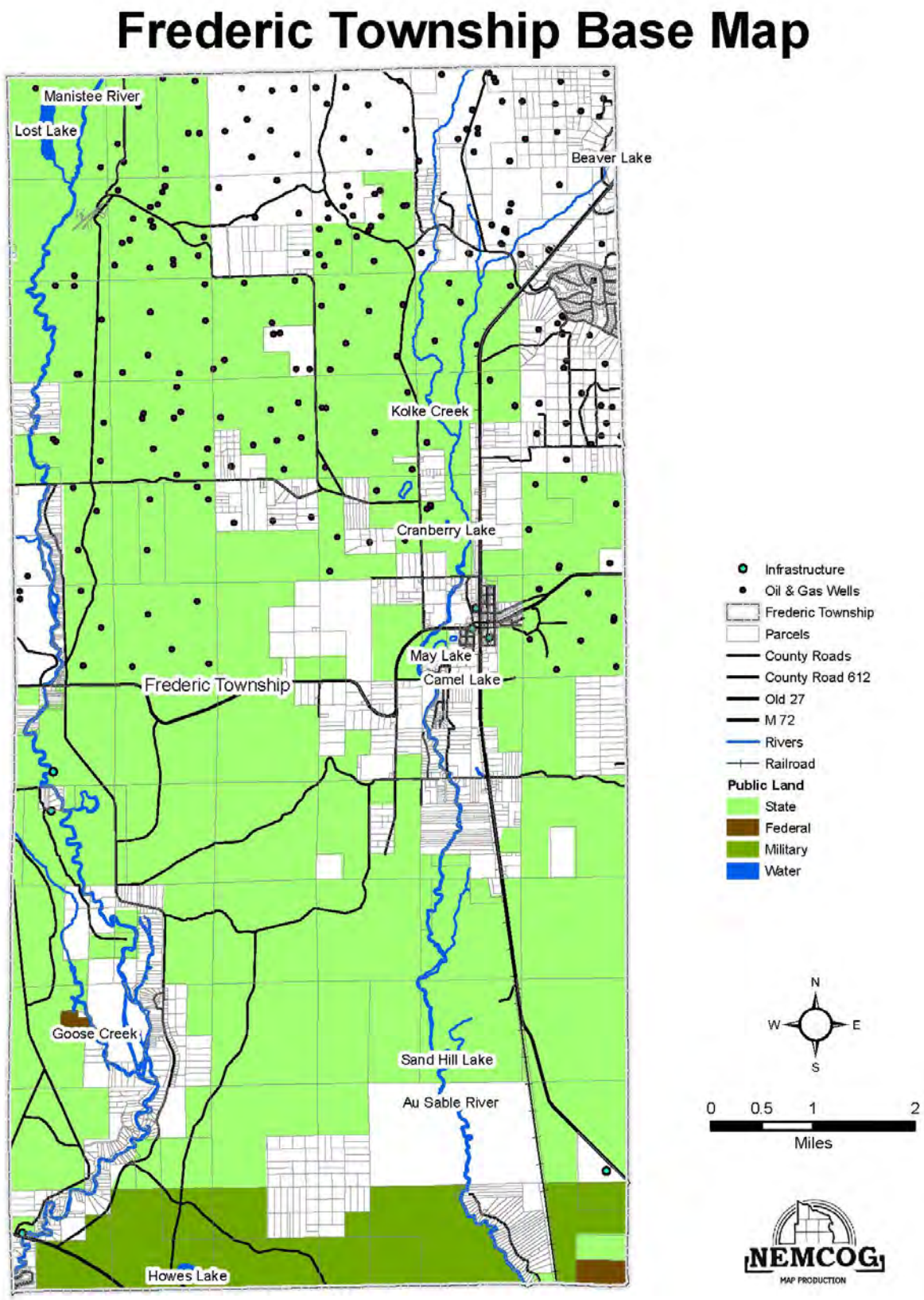


Figure 6-24 Frederic Township Base Map

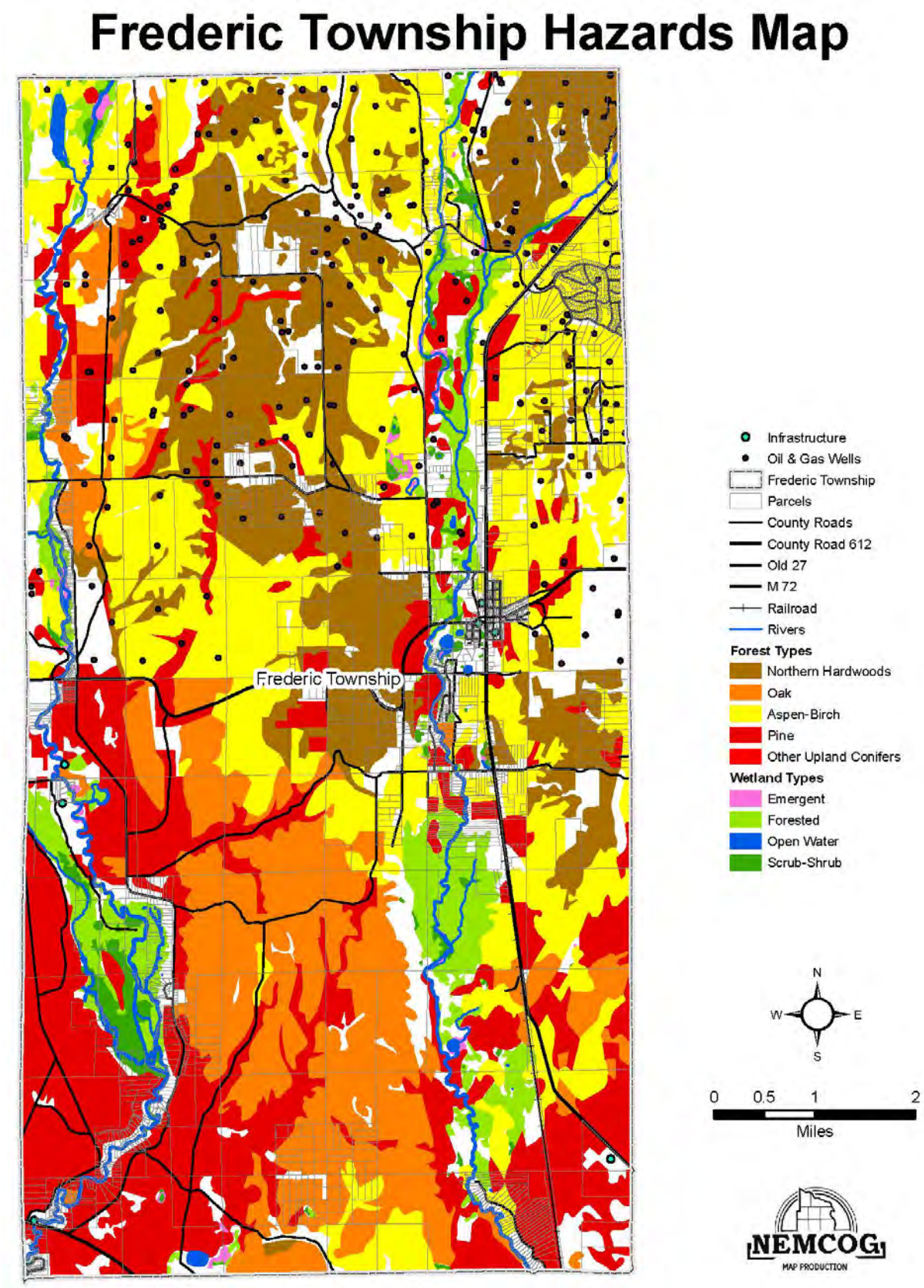


Figure 6-25 Frederic Township Hazard Map

Maple Forest Township Base Map

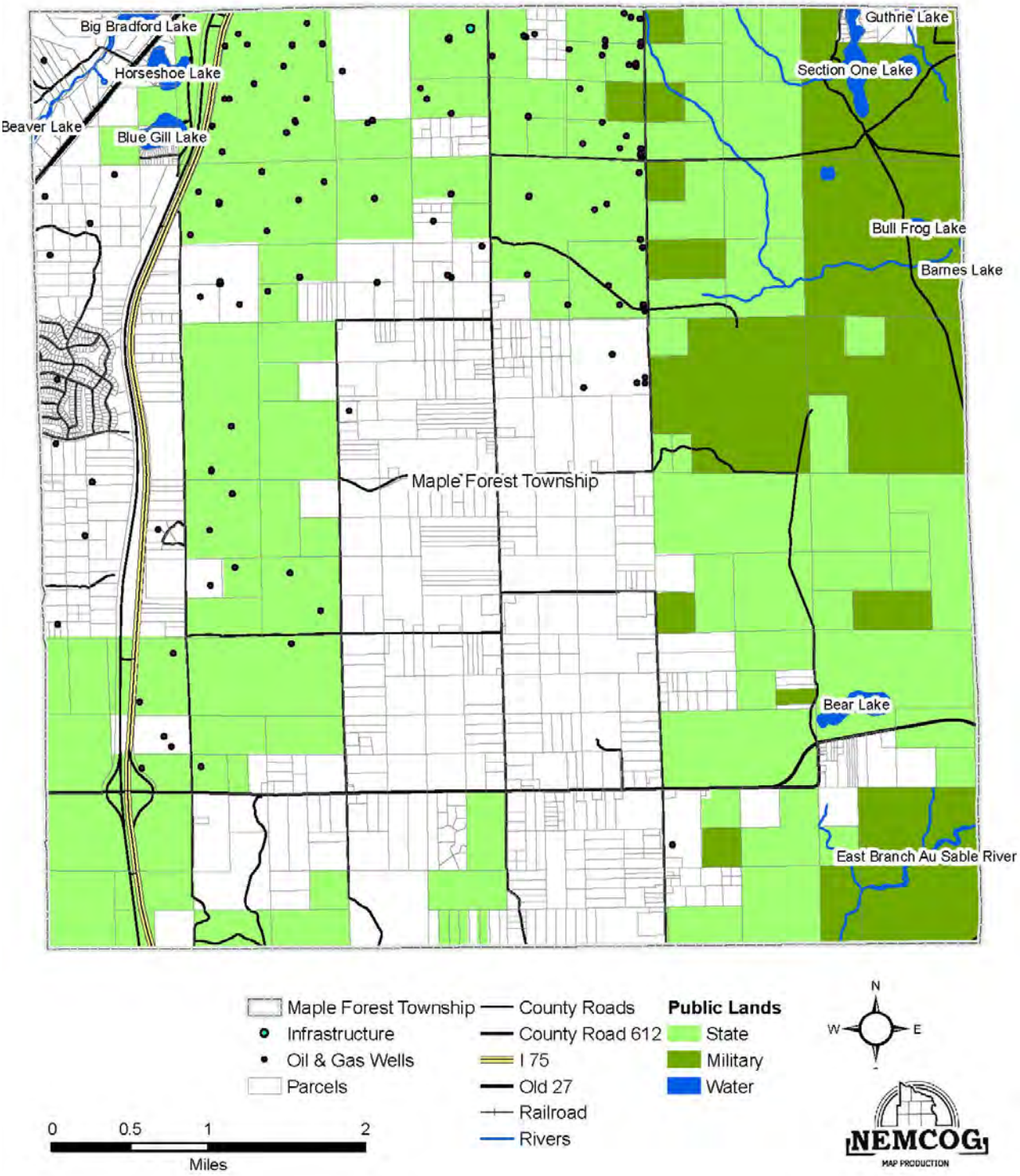


Figure 6-26 Maple Forest Township Base Map

Maple Forest Township Hazards Map

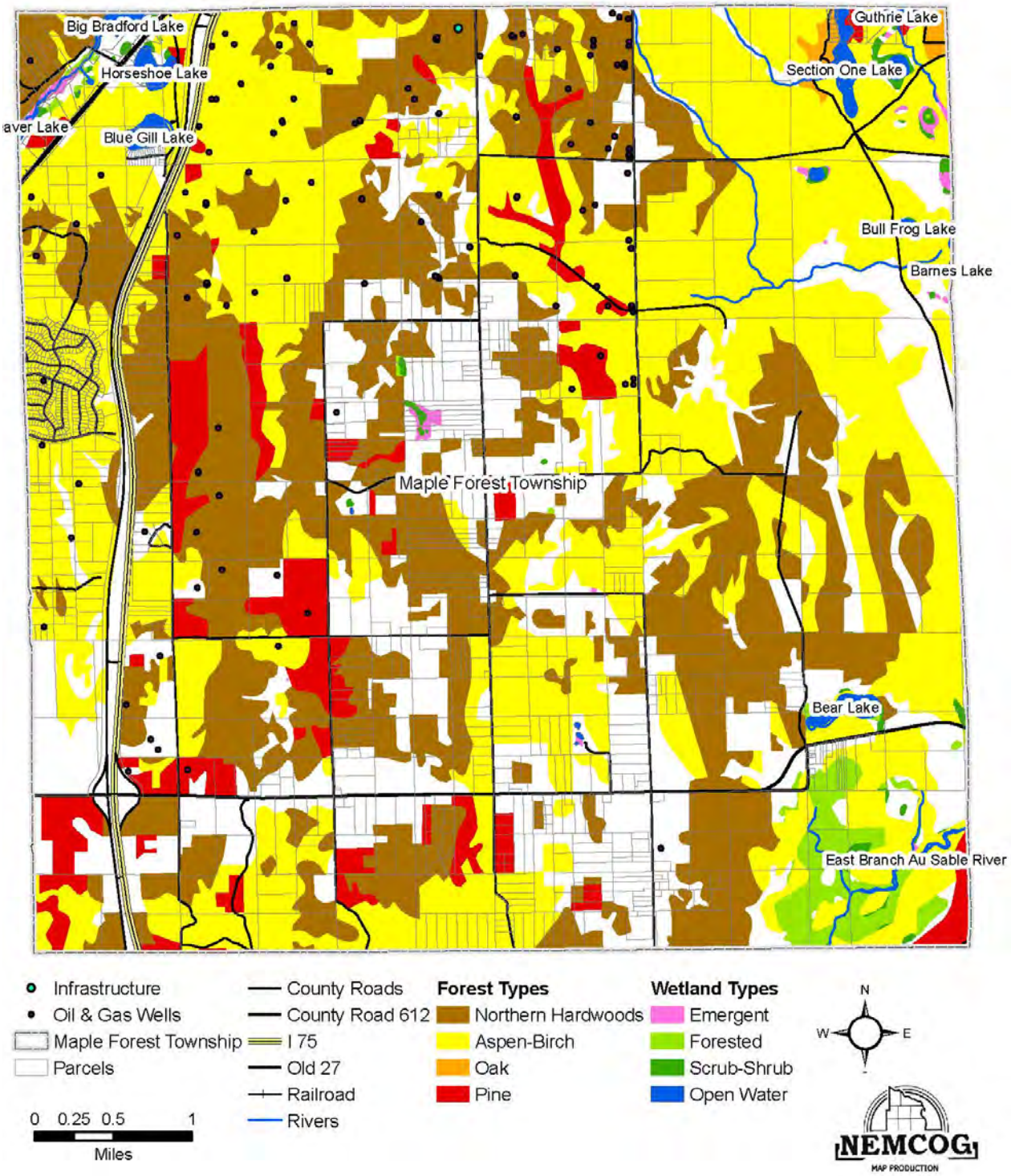


Figure 6-27 Maple Forest Township Hazard Map

Lovells Township Base Map

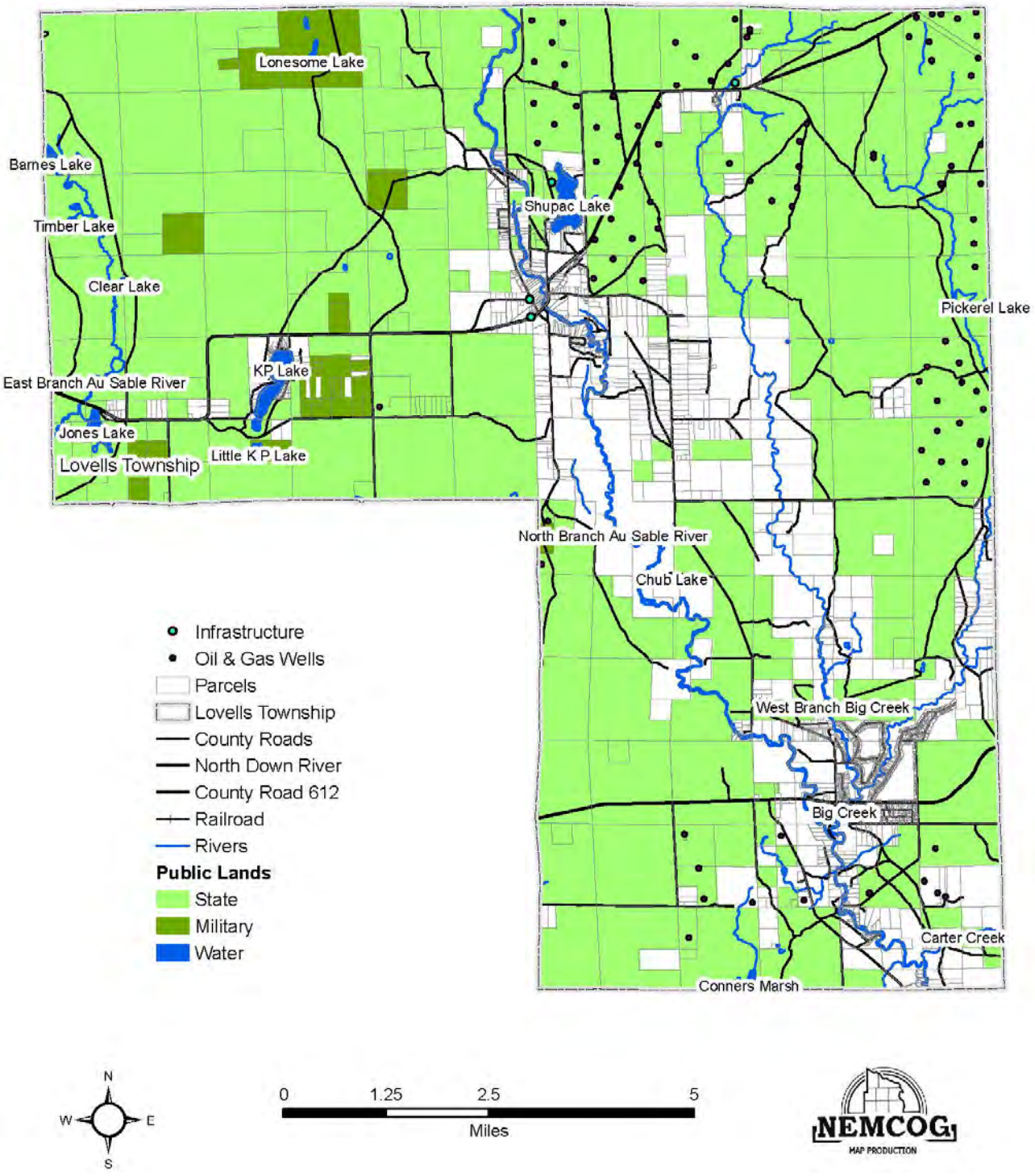


Figure 6-28 Lovells Township Base Map

Lovells Township Hazards Map

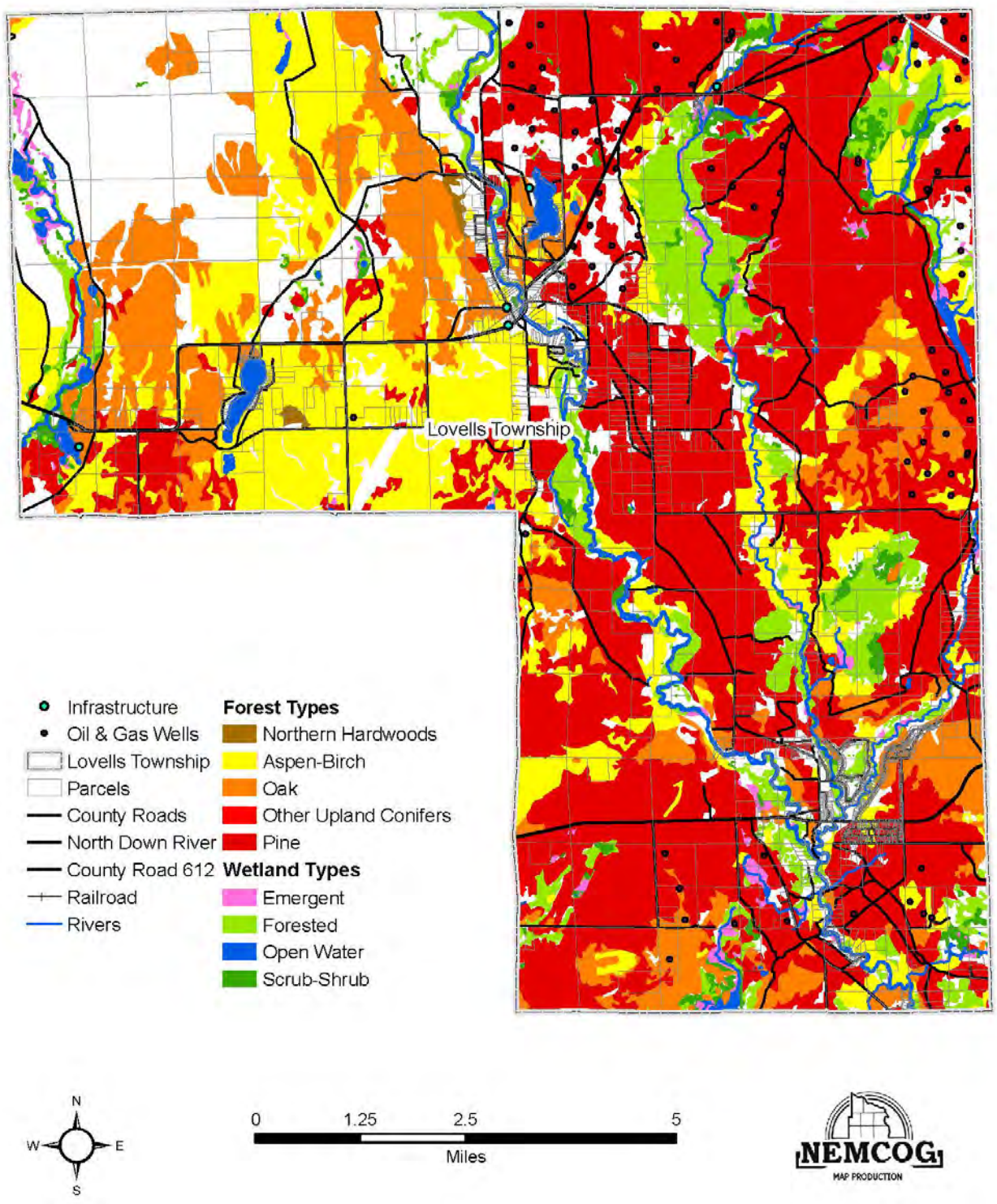


Figure 6-29 Lovells Township Hazard Map

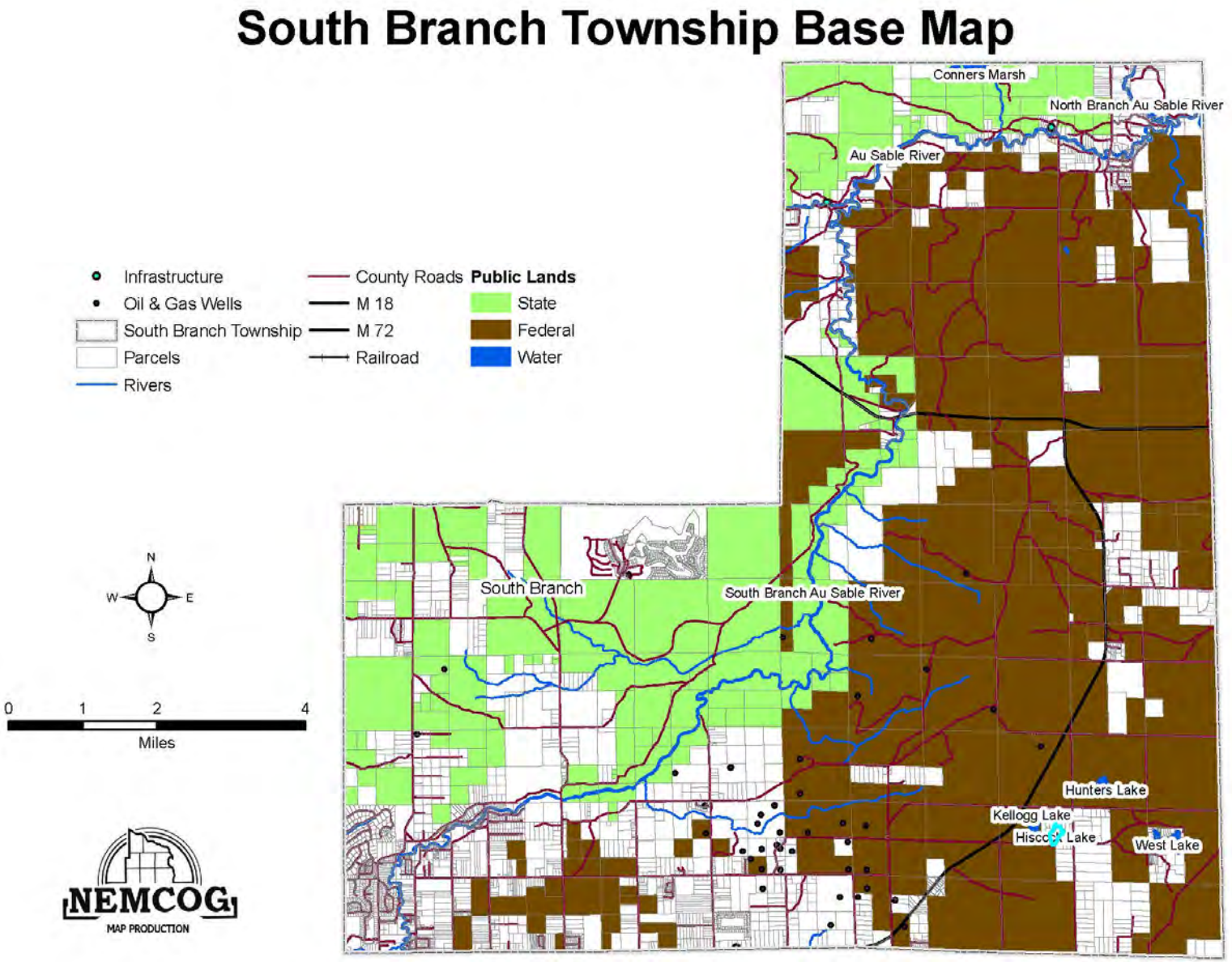


Figure 6-30 South Branch Township Base Map

South Branch Township Hazards Map

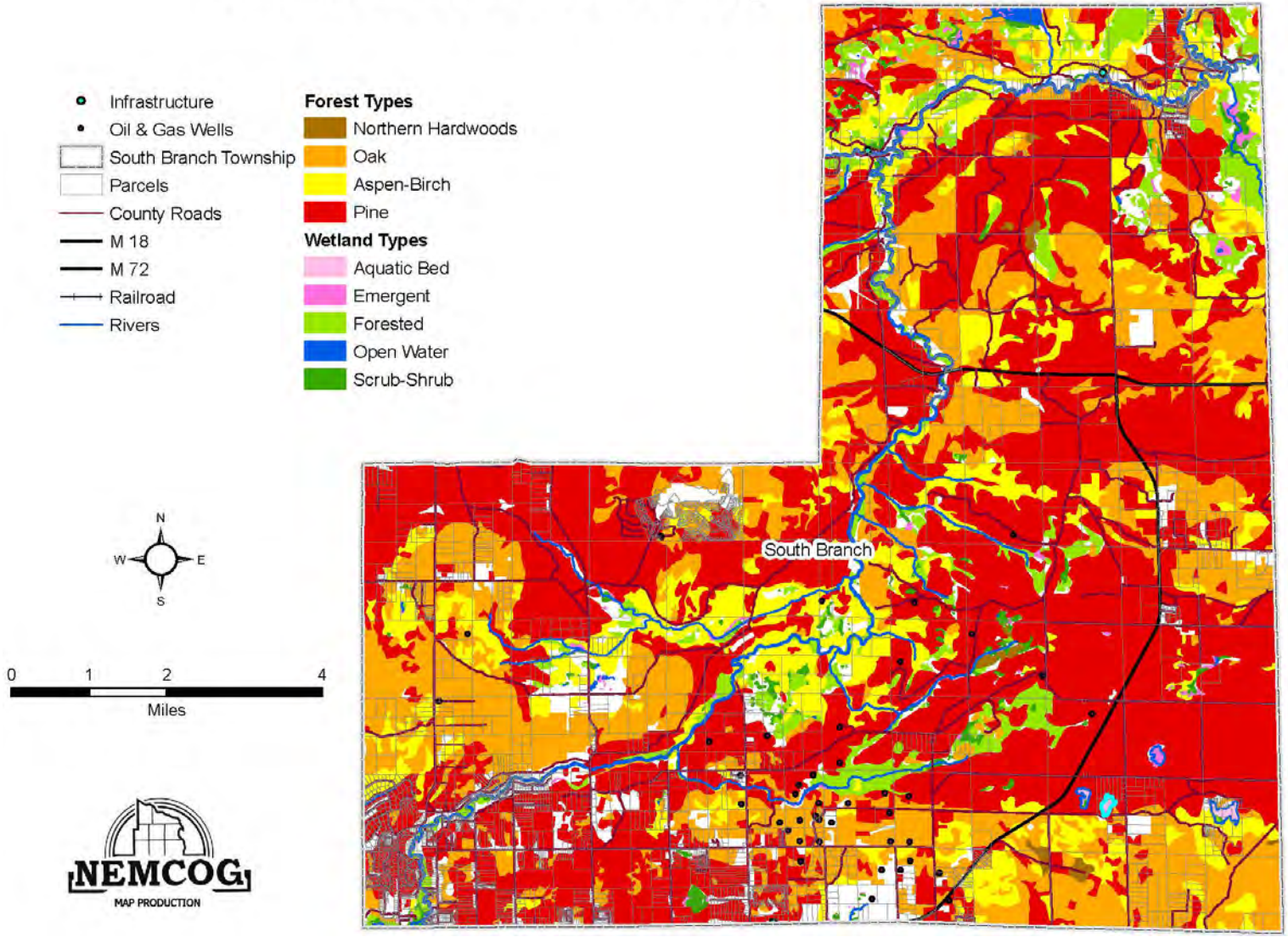


Figure 6-31 South Branch Township Hazard Map

Risk and Vulnerability Assessments

After identifying which hazards pose a risk in Crawford County, the LEPC ranked the hazards based on the Priority Risk Index to determine which hazards pose the greatest threat to the county (Table 6-8). Then, the LEPC evaluated the ranked hazards based on their risk and vulnerabilities. It should be noted the sleet and ice storm events, and snowstorm hazard events are displayed as winter weather hazards in the Priority Risk Index.

To begin the hazard ranking process, the county's LEPC selected evaluation criteria by determining which aspects were of most concern to the community. The LEPC assigned a level of importance ranging from "Always Important to "Not Worth Considering" for each aspect. The following evaluation criteria were considered: likelihood of occurrence, size of affected area, speed of onset, population impact, economic impacts, duration of threat, seasonal risk pattern, predictability of a hazard, collateral damage, availability of warning system, ability to mitigate, percent of population affected, environmental impact, damage capacity, and public awareness. The LEPC rated likelihood of occurrence, size of affected area, population impact, economic impacts, ability to mitigate, percent of population affected, and damage capacity as "always very important." The LEPC rated availability of warning system as "usually important." The LEPC rated predictability of hazard, collateral damage, and environmental impact as "sometimes important," and speed of onset, duration of threat, and seasonal risk pattern as "rarely important."

After the rating process, the LEPC selected the following evaluation criteria:

- **Likelihood of Occurrence:** The frequency a particular hazard event occurs. The more frequent the event occurs, the greater potential there will be damage and a negative impact on the community.
- **Damage Capacity:** The destructive capacity of the hazard. While the destructive capacity of some hazard events (e.g., floods and tornadoes) is immediate and readily apparent, some hazards may have significant destructive capacity that is less obvious since it occurs over an extended period of time (e.g., extreme temperatures and drought).
- **Size of Affected Area:** The size of a geographic area that a hazard affects. The larger the area affected, the greater the impact a hazard has on a community; even though the size of an area does not indicate the destructive potential of a hazard. For example, a blizzard may affect an entire state, while a flood may affect a portion of a municipality.
- **Ability to Mitigate:** The relative ease a particular hazard event can be mitigated through the application of structural and/or non-structural mitigation strategies. The easier it is to mitigate a hazard, the less likely the hazard will pose a threat (e.g., loss of life and property damage) to the community in the future.
- **Population Impact:** The percent of the county's population that may be affected directly or indirectly by a hazard event.
- **Economic Impacts:** The monetary damages incurred from a hazard event that include public and private damages. Direct physical damage costs and indirect impact costs, such as lost business and tax revenue, are included in this criterion.

Then, the LEPC assigned relative weights to each evaluation criteria to express the criterion's level of important in analyzing the hazard. The relative weights were converted into percentages since the sum of the weights must equal 100%. After determining the impact each evaluation criterion

has on each hazard, the LEPC created evaluation scales for each evaluation criterion. The point values on the scales ranged between 1 and 10 and were assigned based on the criterion's relative severity and negative impacts. These scales can be found below. Finally, the LEPC used a spreadsheet to rank the county's hazards based on the evaluation scales for each criterion (Table 6-8). The LEPC elevated the county's risk for transportation accidents, added Per- and Polyfluoroaklyl Substances (PFAS) as a hazard, and reduced the county's risk for Sabotage/Terrorism/Nuclear Attack.

The following evaluation scales were used to evaluate each hazard:

Likelihood of Occurrence	
Excessive Occurrence (Occurs one or more times per year)	10 pts
High Occurrence (Occurs every 2-3 years)	7 pts
Medium Occurrence (Occurs every 5 years)	4 pts
Low Occurrence (Potential yearly occurrence)	1 pt
Unable to be Determined	0 pts

Affected Area	
Entire Area (Impacts all or most of the county)	10 pts
Large Area (Impacts ½ to ¾ of the county)	7 pts
Moderate Area (Impacts less than ½ of the county)	4 pts
Small Area (Impacts a small area in the county)	1 pt
Unable to be Determined	0 pts

Population Impact	
75% to 100% of the population impacted	10 pts
50% to 74% of the population impacted	7 pts
25% to 49% of the population impacted	4 pts
1% to 24% of the population impacted	1 pt
No Population Impact	0 pts

Ability to Mitigate	
Easy to Mitigate (Variety of structural/non-structural measures)	10 pts
Possible to Mitigate (Some structural/non-structural measures)	7 pts
Difficult to Mitigate (Limited structural/non-structural measures)	4 pts
Impossible to Mitigate (Impossible to mitigate future events)	1 pt

Damage Capacity	
High Capacity	10 pts
Medium Capacity	7 pts
Low Capacity	4 pts
No Capacity	1 pt
Unable to be Determined	0 pts

Economic Impacts	
Significant Impact (Over $500,000 in monetary damages incurred)	10 pts
Medium Impact ($300,001 to $500,000 in monetary damages incurred)	7 pts
Low Impact ($100,000 to $300,000 in monetary damages incurred)	4 pts
Minimal Impact (Less than $100,000 in monetary damages incurred)	1 pt
No Impact	0 pts

Table 6-8 Crawford County Priority Risk Index								
Rank	Hazard	Evaluation Criteria						Score
		Likelihood of Occurrence (20%)	Population Impact (30%)	Damage Capacity (15%)	Ability to Mitigate (15%)	Size of Affected Area (10%)	Economic Impact (10%)	
1	Wildfires	10	7	10	7	10	10	8.7
2	Fixed Site Hazardous Material Accident	8	8	10	7	9	8	8.3
3	Structure Fires	10	6	8	7	9	9	7.9
4	Infrastructure Failures	7	6	7	8	10	10	7.5
4	Transportation Hazardous Material Accident	7	7	10	7	7	7	7.5
6	Per-Polyfluoroaklyl Substances (PFOA/PFAS)	10	7	5	4	4	10	6.9
7	Public Health Emergency	4	7	1	7	10	10	6.1
8	Severe Winds (derecho)	10	6	7	1	10	1	6.1
9	Tornadoes	4	8	8	4	0	4	5.4
10	Transportation Accident (air/land/water)	10	5	4	7	1	1	5.4
11	Winter Weather Hazards	10	0	4	10	10	1	5.2
12	Sabotage/Terrorism/Nuclear Attack	0	7	10	1	4	10	5.2
13	Lightning	10	3	4	1	10	1	4.8
14	Extreme Temperatures (Extreme Heat and Extreme Cold)	6	4	4	4	10	1	4.7
15	Hailstorms	7	1	4	7	10	1	4.5
16	Oil and Gas Accidents (well and pipeline)	1	2	4	7	7	7	3.9
17	Drought	4	1	4	4	4	10	3.7
18	Riverine and Urban Flooding	4	1	4	7	4	4	3.6
19	Scrap Tire Fires	0	1	0	10	1	7	2.6
20	Civil Disturbance	0	1	0	7	1	1	1.6

Risk and Vulnerability Assessment Summaries

The county's risk and vulnerability assessments can be found in Table 6-9. The goal of the risk assessment is to determine where the hazards exist, their frequency, and their impact. The county's risk was determined by the hazard's likelihood of occurrence, the county's ability to mitigate the hazard, the hazard's capacity to cause physical damage, and the size of the affected area. The risk is classified as follows:

- **High Probability/High Impact:** The hazard will most likely happen and has a high potential to affect existing and future buildings and populations.
- **Low Probability/High Impact:** The hazard has a small chance of happening and has a high potential to affect existing and future buildings and populations.
- **High Probability/Low Impact:** The hazard will most likely happen and has a low potential to affect existing and future buildings and populations.
- **Low Probability/Low Impact:** The hazard has a small chance of happening and has a low potential to affect existing and future buildings and populations.

The vulnerability assessment determines where the population and critical facilities overlap with the hazards. The county's vulnerability assessment was evaluated based its population and economic impacts. The vulnerability is classified as follows:

- **Severe:** The hazard event will have severe impacts over a large geographic area or in densely populated areas and will have a serious financial impact on residents and businesses.
- **Noticeable:** The hazard event will have confined impacts and financial burdens on residents and businesses.
- **Minor:** The hazard event will have minimal impacts and financial burdens on residents and businesses.

Table 6-9 Crawford County Risk and Vulnerability Assessment Summary			
Rank	**Hazard**	**Risk Assessment**	**Vulnerability Assessment**
1	Wildfires	High Probability/High Impact	Severe
2	Fixed Site Hazardous Material Accident	High Probability/High Impact	Severe
3	Structure Fires	High Probability/High Impact	Noticeable
4	Infrastructure Failures	High Probability/High Impact	Severe
4	Transportation Hazardous Material Accident	High Probability/High Impact	Severe
6	Per-Polyfluoroaklyl Substances (PFOA/PFAS)	High Probability/High Impact	Severe
7	Public Health Emergency	Low Probability/High Impact	Severe
8	Severe Winds (derecho)	High Probability/High Impact	Noticeable
9	Tornadoes	Low Probability/High Impact	Noticeable
10	Transportation Accident (air/land/water)	High Probability/Low Impact	Noticeable
11	Winter Weather Hazards	High Probability/Low Impact	Noticeable
12	Sabotage/Terrorism/Nuclear Attack	Low Probability/High Impact	Severe
13	Lightning	High Probability/Low Impact	Noticeable
14	Extreme Temperatures (Extreme Heat and Extreme Cold)	High Probability/Low Impact	Noticeable
15	Hailstorms	High Probability/Low Impact	Noticeable
16	Oil and Gas Accidents (well and pipeline)	Low Probability/High Impact	Noticeable
17	Drought	Low Probability/High Impact	Noticeable
18	Riverine and Urban Flooding	Low Probability/High Impact	Noticeable
19	Scrap Tire Fires	Low Probability/Low Impact	Severe
20	Civil Disturbance	Low Probability/Low Impact	Minor

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Chapter 7 Goals and Objectives

Overview

The community goals and objectives for Crawford County were developed through the analysis of the county's existing social and economic conditions, critical services and facilities, environmental conditions, existing land use, hazard analysis, and vulnerability assessment. The local communities are encouraged to incorporate the hazard mitigation goals and objectives into their other planning activities, such as their master plans and capital improvement plans.

Goals and Objectives

The following goals and objectives will be used to guide the hazard mitigation efforts within Crawford County. The goals are broad in nature with slightly more specific objectives. Detailed action items can be found in Chapter 8: Mitigation Strategies and Priorities.

GOAL 1: Protect Public Health and Safety

Objectives

- Provide community-wide hazard warning systems (natural, health and terrorism).
- Provide information and resources to increase hazard awareness and education.
- Maintain existing resources and provide necessary training.
- Identify and obtain necessary resources and equipment to prevent or minimize the effects from hazard(s).

GOAL 2: Minimize Damage to Public and Private Property

Objectives

- Apply proactive mitigation measures to prevent hazard damage.
- Obtain necessary equipment, resources and training to protect property if a hazard occurs.
- Adopt policies to make property less vulnerable.
- Conduct training sessions and scenarios to prepare for possible hazards.

GOAL 3: Maintain Essential Services

Objectives

- Inspect, maintain, and upgrade all critical infrastructure and facilities.
- Repair or replace critical infrastructure and facilities that are damaged or degraded.
- Protect critical infrastructure and facilities from hazard damage.
- Obtain necessary resources and equipment to ensure essential services are maintained in the event of a hazard.

GOAL 4: Guide Growth/Development

Objectives

- Develop hazard resistant growth policies.
- Prevent development in high hazard areas.
- Integrate hazard mitigation planning into land use planning.
- Encourage sustainable development.
- Protect natural resources.

GOAL 5: Build partnerships to support emergency response services and hazard mitigation activities on a regional basis.

Objectives

- Continue to work cooperatively with agencies and communities in Crawford County.
- Continue to work cooperatively with agencies and communities in Northern Michigan.
- Develop regional grant applications for hazard mitigation implementation.
- Continue to participate in the Region 7 Homeland Security Board.

GOAL 6: Develop, update, and maintain geographic information system (GIS) data sets

Objectives

- Develop GIS data sets for usage by county officials, the emergency management office, and 911 staff.
- Evaluate data sets annually and update.

Chapter 8
Mitigation Strategies and Priorities

Overview

After determining Crawford County's goals and objectives, hazard mitigation actions were developed based on the following categories: prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects. These actions and strategies were prioritized and evaluated to determine the effect they will have on the goals and objectives. During the prioritization process, each action was evaluated based on its social impact, technical feasibility, administrative potential, political impact, legal ramification, environmental impact, overall benefit, and cost effectiveness. The Crawford County LEPC, county and local governments considered their budgets, available technical resources, and current visions to assess each action item's priority, and current and future progress.

Mitigation Actions and Implementation Strategies Tables

In the previous hazard mitigation plan, the mitigation actions and implementation strategies were categorized based on the hazard(s) they addressed (Appendix D). When the LEPC reviewed the strategies, they moved many action items to the all-hazard mitigation table, five action items were deemed no longer relevant in the county (and will be removed from future plans), two strategies were added regarding PFOA/PFAS, and many items were determined to be ongoing/long-term projects. The Fall 2020 FEMA review determined this categorization was not adequate since it did not provide a purpose for each mitigation action item. To rectify this issue, the mitigation actions and implementation strategies were re-categorized based on the categories used to develop the action items: prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects. Additionally, a line item was added under each action item to address which hazard(s) the action item mitigates.

Prevention Action and Implementation Strategies

The purpose of the prevention action and implementation strategies is to address the strategies related to government administrative or regulatory actions and processes that influence how land is developed and buildings are constructed. Also, public activities that reduce hazard losses are included in this category. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations. For each mitigation strategy in this category, the strategies are designed to reduce deaths and injuries, reduce structural damage and deterioration, prevent the interruption of businesses, prevent insurance losses, reduce capital costs for repairs, and reduce the degradation of cultural and natural resources.

1. Acquire test well location maps from the Michigan Department of Environment, Great Lakes, and Energy.

Priority Level: High
Hazards Addressed: Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency
Responsible Agencies: County Emergency Management Office, State, County, District Health Department, Grayling Township
Financial and Technical Resources: State

Progress/Status: Ongoing/Long term throughout the entire county. Early stages in acquiring test well locations.
Previous Plans: Not applicable. This item was added to the 2021 Plan.

2. Monitor the PFOA/PFAS plume.

Priority Level: High
Hazards Addressed: Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency
Responsible Agencies: County Emergency Management Office, County, District Health Department, Grayling Township
Financial and Technical Resources: State
Progress/Status: Ongoing/Long term throughout the entire county. Early monitoring stages.
Previous Plans: Not applicable. This item was added to the 2021 Plan.

3. Develop and/or review and update site emergency response plans for schools, factories, office buildings, shopping malls, hospitals, campgrounds, sports complex, animal shelter, community events, correctional facilities, etc.

Priority Level: High
Hazards Addressed: Wildfires, Structure Fires, Infrastructure Failures, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Winter Weather Hazards
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, Road Commission, Civic Groups and Churches, Insurance Companies, Local Businesses, Schools
Financial and Technical Resources: American Red Cross, Civic Groups and Churches, Federal Government, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Major progress in schools, factories, and the hospital. The Emergency Management Office is working with the City Manager and School Superintendent.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

4. Maintain emergency shelter locations.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Civic Groups and Churches, American Red Cross, Schools, Local Fire Departments

Financial and Technical Resources: District Health Department, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In place—American Red Cross is the primary responsible agency. Shelters identified, reviewed, and updated as needed.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

5. Develop plans to identify and inform persons of "safe areas" during festivals and events, including the acquisition of portable/changeable message signs to provide information and directions.

Priority Level: High
Hazards Addressed: Severe Winds (derecho), Tornadoes, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, Road Commission, Police, Civic Groups and Churches, State
Financial and Technical Resources: County, State, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In Progress—Message boards on I-75.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

6. Encourage the continuation of the house numbering program.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline)
Responsible Agencies: County Emergency Management Office, County, Beaver Creek Township, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, Road Commission, Police, State
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. System in place.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

7. Build the capabilities of the county GIS program to function as a tool to address multiple hazards through the creation/update of datasets, such as parcels/ownership, location of all structures, driveways with ingress/egress conditions, roads, forest types, ownership types, floodplains, utilities (e.g., power lines, gas lines and water lines), wetlands, water features, bridges and culverts, water supply location, gas and oil well locations, SARA III sites, etc.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, Road Commission, U.S. Forest Service, Michigan Department of Natural Resources, Utility Company
Financial and Technical Resources: Federal Government, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, State, County
Progress/Status: Ongoing/Long term throughout the entire county. Major Progress—GIS program in place and is continually reviewed and updated.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually reviewed and updated.

8. Individual communities should prepare future land use plans and capital improvement programs to plan for their future hazard mitigation needs, including but not limited to separating and implementing buffers between industrial areas and other land uses (e.g., schools, nursing homes, hospitals, etc.).

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, Civic Groups and Churches, Landowners, Local Businesses, Real Estate Companies, Federal Government, Schools
Financial and Technical Resources: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, NEMCOG
Progress/Status: Ongoing/Long term throughout the entire county. Progress made, updates when needed. Separation of uses is addressed in zoning ordinances.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually reviewed and updated.

9. Implement and promote solutions to keep roads and driveways accessible to vehicles and fire equipment.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Oil and Gas Accidents (well and pipeline), Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, Frederic Township, City of Grayling, Grayling Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Local Fire Departments, County Road Commission, Landowners, U.S. Forest Service, Michigan Department of Natural Resources
Financial and Technical Resources: County Emergency Management Office, County, Local Fire Department, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Progress made through Firewise program and fire code; Frederic Township has minimum widths for new private roads.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually promoted and implemented.

10. Enforce open burning regulations, including but not limited to inspecting campsites in public forest areas.

Priority Level: High
Hazards Addressed: Wildfires, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources, Police
Financial and Technical Resources: Federal Government, Local Fire Department, State, U.S. Forest Service, Michigan Department of Natural Resources
Progress/Status: Ongoing/Long term throughout the entire county. Procedures in place—DNR law enforcement issues tickets. Michigan Department of Natural Resources and the U.S. Forest Service are the primary responsible agencies.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

11. Maintain and implement the Crawford County Community Wildfire Protection Plan, including but not limited to the implementation of a countywide Firewise program and incorporating Firewise development strategies in master plans and zoning ordinances.

Priority Level: High
Hazards Addressed: Wildfires
Responsible Agencies: County, County Emergency Management Office, Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources, State, Landowners, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Financial and Technical Resources: Federal Government, State, County, Local Fire Departments, U.S. Forest Service, Michigan Department of Natural Resources, City of Grayling, Grayling Township,

Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. In Progress—Plan adopted in 2019. Pursuing grants. South Branch Township is taking the lead to include Firewise development strategies in its master plan and zoning ordinance.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a high priority. The priority has not changed since the plan will be continually reviewed, updated, and implemented.

12. Develop a wildfire evacuation plan for residential areas and high use recreational areas, such as the AuSable River Corridor, canoe liveries, ORV trails, campgrounds, etc. that includes procedures regarding public notification about wildfire events.

Priority Level: High
Hazards Addressed: Wildfires, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources, State, County
Financial and Technical Resources: Federal Government, Local Fire Department, State, County, U.S. Forest Service, Michigan Department of Natural Resources, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Progress made. Reverse 911 is in place; Emergency units are sent out to campgrounds and liveries.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually reviewed, updated, and implemented.

13. Review strategies to ensure redundancies in utility and communications systems.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Scrap Tire Fires, Civil Disturbance
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Emergency Management Office, County, Local Fire Departments, Police, National Weather Service, District Health Department, Civic groups and churches
Financial and Technical Resources: Utility Company
Progress/Status: Ongoing/Long term throughout the entire county. Progress made.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

14. Maintain a community public health system with sufficient disease monitoring and surveillance capabilities to protect the population from large-scale outbreaks.

Priority Level: High
Hazards Addressed: Public Health Emergency
Responsible Agencies: District Health Department, State, Medical, Federal Government
Financial and Technical Resources: District Health Department, Federal Government

Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

15. Review and update if necessary, airport maintenance, security, and safety programs.

Priority Level: Medium
Hazards Addressed: Infrastructure Failures, Transportation Hazardous Material Accident, Transportation Accident (air/land/water), Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, Grayling Township, Frederic Township
Financial and Technical Resources: Federal Government, State
Progress/Status: Ongoing/Long term on the National Guard Air Base. In place, military is responsible at airbase.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

16. Maintain site emergency plans and community response plans as required under SARA Title III. Provide training and maintain compliance for all safety procedures and systems related to the manufacture, storage, transport, use, and disposal of hazardous materials.

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, Local Businesses, State, Federal Government, District Health Department
Financial and Technical Resources: Federal Government, State, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. In Place. Plans for 302 sites.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

17. Develop and/or review and update landlord-tenant ordinances. Review and update housing/landlord building codes to address heating requirements.

Priority Level: Medium
Hazards Addressed: Structure Fires, Infrastructure Failures, Public Health Emergency, Winter Weather Hazards, Extreme Temperatures (Extreme Heat and Extreme Cold)

Responsible Agencies: County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Financial and Technical Resources: State, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Minor progress made.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

18. Review and update regulations to ensure manufactured homes and exterior structures are properly anchored.

Priority Level: Medium
Hazards Addressed: Severe Winds (derecho), Tornadoes, Winter Weather Hazards
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Emergency Management Office, County
Financial and Technical Resources: Federal Government, State, County
Progress/Status: Ongoing/Long term throughout the entire county. In place, building department is responsible.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

19. Enforce zoning ordinances.

Priority Level: Low
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding
Responsible Agencies: County, City of Grayling, Beaver Creek Township, Frederic Township, Grayling Township, Lovells Township, Maple Forest Township, South Branch Township, Police, State
Financial and Technical Resources: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Progress made. The city and every township are active. Some items covered under the county.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

20. Identify optimal staffing levels for County and community needs. Seek funding to meet optimal levels.

Priority Level: Low
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance

Responsible Agencies: County Emergency Management Office, County, City of Grayling, Beaver Creek Township, Frederic Township, Grayling Township, Lovells Township, Maple Forest Township, South Branch Township, Road Commission, Police, Local Fire Departments, Medical
Financial and Technical Resources: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County
Progress/Status: Ongoing/Long term throughout the entire county. Ongoing review, limited by funding.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

21. Identify and promote evacuation and detour routes.

Priority Level: Low
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Road Commission, State
Financial and Technical Resources: County Emergency Management Office, County Road Commission, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. In progress.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

Property Protection Action and Implementation Strategies

The purpose of the property protection action and implementation strategies is to address the strategies related to actions involved in the modification of existing buildings or structures to protect them from a hazard or remove them from a hazardous area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass. For each mitigation strategy in this category, the strategies are designed to reduce structural damage and deterioration, prevent the interruption of businesses, prevent insurance losses, and reduce capital costs for repairs.

1. Review wind engineering and construction techniques to propose improvements that strengthen public and private structures.

Priority Level: High
Hazards Addressed: Infrastructure Failures, Severe Winds (derecho), Tornadoes
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Emergency Management Office, County
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Minor progress made.

Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

2. Encourage securing loose items and moving yard and patio items to areas where the winds cannot blow them about.

Priority Level: High
Hazards Addressed: Severe Winds (derecho), Tornadoes
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Emergency Management Office, County
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Firewise Program Presentations.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

3. Encourage new mobile home parks to have tornado/wind shelters.

Priority Level: High
Hazards Addressed: Severe Winds (derecho), Tornadoes
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Emergency Management Office, County, National Weather Service
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Camp Grayling has a warning siren.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

4. Inventory problem sections of roadways. Place snow fences or rows of trees/vegetation to limit snow drift over critical roadways.

Priority Level: Medium
Hazards Addressed: Infrastructure Failures, Winter Weather Hazards, Extreme Temperatures (Extreme Heat and Extreme Cold), Riverine and Urban Flooding
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Road Commission
Financial and Technical Resources: Federal Government, State, County Road Commission
Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

5. Improve tree trimming and maintenance efforts to prevent limb breakage and safeguard utility lines.

Priority Level: Low
Hazards Addressed: Infrastructure Failures, Severe Winds (derecho), Tornadoes, Winter Weather Hazards, Hailstorms
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Road Commission, Utility Company
Financial and Technical Resources: Utility Company
Progress/Status: Ongoing/Long term throughout the entire county. Consumer's Power and Great Lakes have programs in place.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

6. Bury and protect power and utility lines, where feasible and cost effective (e.g., high population density areas).

Priority Level: Low
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Landowners, Utility Company
Financial and Technical Resources: Utility Company
Progress/Status: Ongoing/Long term throughout the entire county. Limited implementation. Cost prohibitive.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

7. Demolish and remove vacant, condemned structures.

Priority Level: Low
Hazards Addressed: Wildfires, Structure Fires, Public Health Emergency, Scrap Tire Fires
Responsible Agencies: District Health Department, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Financial and Technical Resources: County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. System in place.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

Public Education and Awareness Action and Implementation Strategies

The purpose of the public education and awareness action and implementation strategies is to address the strategies related to actions that inform and educate citizens, elected officials, and property owners about hazards and the potential ways to mitigate them. Examples include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs. For each mitigation strategy in this category, the strategies are designed to reduce deaths and injuries, reduce structural damage and deterioration, prevent the interruption of businesses, prevent insurance losses, reduce capital costs for repairs, and reduce the degradation of cultural and natural resources.

1. Compile a list of homes and facilities with vulnerable residents (elderly, infirmed, and disabled individuals). Establish an outreach assistance program.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Severe Winds (derecho), Tornadoes, Winter Weather Hazards, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, Road Commission, District Health Department, Federal Government, Civic Groups and Churches, U.S. Forest Service, Michigan Department of Natural Resources, American Red Cross, Utility Company
Financial and Technical Resources: District Health Department, County, American Red Cross, Local Governments, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Commission on Aging, Emergency Management Office, and American Red Cross maintain and update lists.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually reviewed and updated.

2. Implement, review, and update if necessary, public education programs about hazards. Produce and distribute family emergency preparedness information and conduct workshops to encourage residents to develop a Family Disaster Plan, including the preparation of a disaster supplies kit and determining a structure fire evacuation route and congregation spot. Implement education and outreach procedures to encourage the public to "shelter in place" during hazardous material accidents. Increase public awareness about radon dangers and prevention efforts to reduce radon concentrations in homes and buildings.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance

Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, Road Commission, District Health Department, U.S. Forest Service, Michigan Department of Natural Resources, State, American Red Cross, Medical, National Weather Service, Landowners
Financial and Technical Resources: District Health Department, County Emergency Management Office, Schools, County, American Red Cross, Civic Groups and Churches, Local Fire Departments, Local Governments, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Materials available and distributed; social media outreach; presentations by Fire Departments and county; Fire Department and Emergency Management Office programs (Firewise). Minor progress made to implement outreach procedures about hazardous material accidents. System in place to address radon dangers with monthly education programs.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high, medium, or low priority. The priority changed since the strategy combined multiple strategies with varying priorities from the previous plan into one that focuses on public education and outreach.

3. Review and updated if necessary, community awareness, public education, and school programs regarding the proper installation and maintenance of heating systems, and the safe and responsible use of stoves, fireworks, matches/lighters, electric and space heaters, etc., and provide information about household items that can be used as fire tools.

Priority Level: High
Hazards Addressed: Structure Fires
Responsible Agencies: County Emergency Management Office, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, Insurance Companies
Financial and Technical Resources: Federal Government, Local Fire Departments
Progress/Status: Ongoing/Long term throughout the entire county. In Place, fire department and Emergency management awareness programs.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

4. Encourage residents to receive immunizations against communicable diseases. Increase public awareness about the causes, symptoms, and protective actions for disease outbreaks and other public health emergencies.

Priority Level: High
Hazards Addressed: Public Health Emergency
Responsible Agencies: District Health Department, Civic groups and churches, State, Medical, American Red Cross, Schools
Financial and Technical Resources: District Health Department, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Marketing materials in place.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

5. Acquire portable signs to inform motorists about hazard conditions (e.g., high wind areas, accidents, whiteout conditions, road glazing, fire areas, etc.).

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Road Commission, Police, State, Medical, National Weather Service
Financial and Technical Resources: State
Progress/Status: Ongoing/Long term throughout the entire county. In progress, Message Boards on I-75.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

6. Review and update if necessary, procedures regarding the distribution of emergency telephone numbers to the public. Maintain an updated list of emergency telephone numbers.

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, Police
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In progress, 211 system in place.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually reviewed and implemented.

7. Expand community support for free or reduced-expense clinics and school health services.

Priority Level: Medium
Hazards Addressed: Public Health Emergency
Responsible Agencies: County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, District Health Department, Civic groups and churches, State, Medical
Financial and Technical Resources: District Health Department

Progress/Status: Ongoing/Long term throughout the entire county. System in place.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

8. Promote media broadcasts about fire weather and warnings.

Priority Level: Medium
Hazards Addressed: Wildfires, Structure Fires, Severe Winds (derecho), Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources
Financial and Technical Resources: County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Federal Government, U.S. Forest Service, Michigan Department of Natural Resources
Progress/Status: Ongoing/Long term throughout the entire county. Program is in place. U.S. Forest Service, Michigan Department of Natural Resources, and Local Fire Departments are the primary responsible agencies.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be maintained.

9. Promote designated sites in the county that accept woody debris to reduce burning of brush piles.

Priority Level: Medium
Hazards Addressed: Wildfires, Structure Fires, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, Landowners
Financial and Technical Resources: County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments
Progress/Status: Ongoing/Long term throughout the entire county. Co-Gen plant takes materials.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a medium priority. The priority has not changed since the strategy will be maintained.

10. Provide wildfire safety information to residents.

Priority Level: Medium
Hazards Addressed: Wildfires, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, Landowners, State, Real Estate Companies, Insurance Companies
Financial and Technical Resources: State, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Local governments and fire departments provide information to residents.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be maintained.

11. Expand community awareness about evacuation plans.

Priority Level: Low
Hazards Addressed: Wildfires, Infrastructure Failures, Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Financial and Technical Resources: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Progress made.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually reviewed and implemented.

Natural Resource Protection Action and Implementation Strategies

The purpose of the natural resource protection action and implementation strategies is to address the strategies related to actions that minimize hazard losses and preserve or restore the functions of natural systems. Examples include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation. For each mitigation strategy in this category, the strategies are designed to reduce deaths and injuries, reduce structural damage and deterioration, prevent the interruption of businesses, prevent insurance losses, reduce capital costs for repairs, and reduce the degradation of cultural and natural resources.

1. Promote and implement fuel management through thinning and selective thinning of vegetation, creation of fuel breaks, and use of fire-retardant materials and vegetation.

Priority Level: High
Hazards Addressed: Wildfires, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources, State
Financial and Technical Resources: Federal Government, County, State
Progress/Status: Ongoing/Long term throughout the entire county. In progress—U.S. Forest Service and Michigan Department of Natural Resources are the primary responsible agencies.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

2. Seek support and funding to clean up environmental contamination sites, including but not limited to brownfield sites.

Priority Level: High
Hazards Addressed: Fixed Site Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Oil and Gas Accidents (well and pipeline), Scrap Tire Fires
Responsible Agencies: County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Federal Government, State, Local Businesses
Financial and Technical Resources: Federal Government, State

Progress/Status: Ongoing/Long term throughout the entire county. In Progress.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

3. Educate the public about the proper disposal of chemicals and scrap materials to reduce pollution.

Priority Level: Medium
Hazards Addressed: Fixed Site Hazardous Material Accident, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, District Health Department, Federal Government, State, Local Businesses, Schools
Financial and Technical Resources: Federal Government, District Health Department
Progress/Status: Ongoing/Long term throughout the entire county. In place, household hazardous waste collection program available.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually promoted and implemented.

4. Communities will work with FEMA to refine floodplain mapping.

Priority Level: Medium
Hazards Addressed: Riverine and Urban Flooding
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Beaver Creek Township, Frederic Township, Grayling Township, Lovells Township, Maple Forest Township, South Branch Township, State, Medical
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Maps are in effect on rivers.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually reviewed and implemented.

Emergency Services Action and Implementation Strategies

The purpose of the emergency services action and implementation strategies is to address the strategies related to actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities. For each mitigation strategy in this category, the strategies are designed to reduce deaths and injuries and reduce the interruption of businesses.

1. Maintain trained, equipped, and prepared search and rescue teams.

Priority Level: High
Hazards Addressed: Wildfires, Infrastructure Failures, Severe Winds (derecho), Tornadoes, Winter Weather Hazards, Hailstorms, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, State, Utility Company

Financial and Technical Resources: County Emergency Management Office, District Health Department, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In Place—CERT is very active.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

2. Seek funding to maintain and improve the public early warning system and network.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, State, Medical, National Weather Service
Financial and Technical Resources: County, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Implemented Reverse 911 System and Hyper-Reach.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

3. Continue developing an Emergency Response Team program to assist in preparing for all hazard events.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, State
Financial and Technical Resources: County Emergency Management Office, District Health Department, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In Progress—Focus is at a regional level.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

4. Implement, review, and update if necessary, procedures to train, equip, and prepare hazardous material emergency response teams.

Priority Level: High
Hazards Addressed: Fixed Site Hazardous Material Accident, Transportation Hazardous Material Accident
Responsible Agencies: County Emergency Management Office, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, State, Local Businesses
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Annual reviews.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

5. Maintain partnerships with local fire departments, the Michigan Department of Natural Resources, U.S. Forest Service, and National Guard to address wildfire mitigation and suppression.

Priority Level: High
Hazards Addressed: Wildfires, Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources
Financial and Technical Resources: Federal Government, Local Fire Department, State, County, U.S. Forest Service, Michigan Department of Natural Resources, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Partnerships developed and maintained.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a high priority. The priority has not changed since the strategy will be maintained and developed, if needed.

6. Seek funding to provide training for firefighters, police, and first responders.

Priority Level: High
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, County Road Commission, Schools, Local Fire Department, Police, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Ongoing/Long term training for airfield emergencies on the National Guard Air Base and continual development of partnerships with Grayling and the National Guard, including equipment and staffing.

Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

7. Continue training and increase the use of weather spotters.

Priority Level: Medium
Hazards Addressed: Severe Winds (derecho), Tornadoes, Winter Weather Hazards, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms
Responsible Agencies: County Emergency Management Office, National Weather Service
Financial and Technical Resources: National Weather Service
Progress/Status: Ongoing/Long term throughout the entire county. Weather service summer and winter weather spotter annual training.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

8. Review and update if necessary, procedures to utilize National Guard Helicopters to supply water for fire suppression.

Priority Level: Medium
Hazards Addressed: Wildfires, Scrap Tire Fires
Responsible Agencies: Local Fire Department, U.S. Forest Service, Michigan Department of Natural Resources
Financial and Technical Resources: State, Federal Government, U.S. Forest Service, Michigan Department of Natural Resources
Progress/Status: Ongoing/Long term throughout the entire county. Program is in place and updated, when needed.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a medium priority. The priority has not changed since the strategy will be maintained.

9. Ensure the county, city, and townships have adequate equipment, staff, and training to respond to hazards specific to their needs.

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Drought, Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Road Commission, Federal Government, State, Medical
Financial and Technical Resources: County, Local Governments, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In progress, No HazMat Team, Road Commission has traffic control.

Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually reviewed and implemented.

10. Review the emergency generator inventory and acquire generators as needed to maintain community infrastructure at acceptable operating levels during extended power failures (supply drinking water, shelters, emergency healthcare services, emergency communications, wastewater processing, etc.). Maintain generators and provide back-up generators if needed.

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Infrastructure Failures, Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, Grayling Township, Beaver Creek Township, City of Grayling, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Local Fire Department, State, Medical, Utility Company
Financial and Technical Resources: County, Local Governments, Federal Government, State
Progress/Status: Ongoing/Long term throughout the entire county. In progress, City DPW, Arauco, Grayling Township and Beaver Creek Township have generators.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually reviewed and implemented.

11. Review and update if necessary, procedures regarding regular maintenance and equipment checks for all critical equipment.

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Public Health Emergency, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department, County Road Commission, Utility Company
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In place, each department is primarily responsible for equipment maintenance.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

12. Maintain an updated list for gasoline stations that have the capacity to pump gasoline during power outages.

Priority Level: Low
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, Police, Local Businesses
Financial and Technical Resources: Local Businesses
Progress/Status: Ongoing/Long term throughout the entire county. Fick & Sons is the only stations that can pump gasoline. Speedway has a hook-up, but no generator.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually reviewed and implemented.

13. Determine locations for post-disaster debris storage areas.

Priority Level: Low
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Severe Winds (derecho), Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Lightning, Extreme Temperatures (Extreme Heat and Extreme Cold), Hailstorms, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires, Civil Disturbance
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Departments, County Road Commission, State
Financial and Technical Resources: County Emergency Management Office, County Road Commission, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Progress/Status: Ongoing/Long term throughout the entire county. Sites have been identified for hazard debris. There are no debris areas for public use.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually reviewed and implemented.

14. Increase volunteer recruitment efforts for local fire departments.

Priority Level: Medium
Hazards Addressed: Wildfires, Fixed Site Hazardous Material Accident, Structure Fires, Infrastructure Failures, Transportation Hazardous Material Accident, Public Health Emergency, Tornadoes, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Scrap Tire Fires
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Local Fire Department
Financial and Technical Resources: Local Fire Departments

Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

Structural Projects Action and Implementation Strategies

The purpose of the structural projects action and implementation strategies is to address the strategies related to actions involving the construction of structures to reduce the impact from a hazard. Examples include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms. For each mitigation strategy in this category, the strategies are designed to reduce deaths and injuries, reduce structural damage and deterioration, prevent the interruption of businesses, prevent insurance losses, reduce capital costs for repairs, and reduce the degradation of cultural and natural resources.

1. Develop and implement improved design, routing, and traffic control at problem roadway areas. Encourage and enforce the use of designated truck routes, and weight and travel restrictions for truck traffic.

Priority Level: High
Hazards Addressed: Infrastructure Failures, Transportation Hazardous Material Accident, Transportation Accident (air/land/water)
Responsible Agencies: County Emergency Management Office, County, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Road Commission, State
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In Progress, Road Commission has designated routes in certain areas.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

2. Research and improve the location, design, and maintenance of water and sewer systems, including the insulation of critical components to prevent damage from ground freeze.

Priority Level: High
Hazards Addressed: Infrastructure Failures, Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Transportation Accident (air/land/water), Winter Weather Hazards, Sabotage/Terrorism/Nuclear Attack, Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, Utility Company
Financial and Technical Resources: State, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. Identified and continually implementing.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a high priority. The priority has not changed since the strategy will be continually implemented.

3. Identify and improve critical road and stream crossings.

Priority Level: Medium
Hazards Addressed: Wildfires, Infrastructure Failures, Transportation Hazardous Material Accident, Transportation Accident (air/land/water), Extreme Temperatures (Extreme Heat and Extreme Cold), Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding, Scrap Tire Fires
Responsible Agencies: City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township, County Emergency Management Office, County, County Road Commission, U.S. Forest Service, Michigan Department of Natural Resources
Financial and Technical Resources: State, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county. In place, funding permitting.
Previous Plans: This item has been retained from the 2014 plan, in which it was classified as a medium priority. The priority has not changed since the strategy will be continually implemented.

4. Coordinate with the health department and local governments to assure proper location, installation, cleaning, monitoring, and maintenance of septic tanks.

Priority Level: Low
Hazards Addressed: Per-Polyfluoroaklyl Substances (PFOA/PFAS), Public Health Emergency, Oil and Gas Accidents (well and pipeline), Riverine and Urban Flooding
Responsible Agencies: District Health Department, City of Grayling, Grayling Township, Frederic Township, Maple Forest Township, Lovells Township, South Branch Township, Beaver Creek Township
Financial and Technical Resources: District Health Department
Progress/Status: Ongoing/Long term throughout the entire county. System in place.
Previous Plans: This item has been retained from the 2005 and 2014 plans, in which it was classified as a low priority. The priority has not changed since the strategy will be continually implemented.

Removed Hazard Mitigation Actions and Implementation Strategies from the 2021 Crawford County Hazard Mitigation Plan

1. Inventory and secure debris, yard items or stored objects (e.g., oil, gasoline and propane tanks, and paint and chemical barrels) in floodplains that may pose a hazard.

Priority Level: Medium
Responsible Agencies: County Emergency Management Office, County, Local Governments, Local Fire Department, Landowners, Local Businesses
Financial and Technical Resources: Local Governments
Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been removed from the 2021 hazard mitigation plan since it is no longer an issue in the county.

2. Review and develop a regional base for air-firefighting wildfire support at Camp Grayling Airport.

Priority Level: Medium
Responsible Agencies: County Emergency Management Office, State, U.S. Forest Service, Michigan Department of Natural Resources

Financial and Technical Resources: State, U.S. Forest Service, Michigan Department of Natural Resources, Federal Government
Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been removed from the 2021 hazard mitigation plan since the USFS base is located in Gaylord and it is not feasible to relocate it to Camp Grayling Airport.

3. Explore methods to provide NOAA radios at cost or as a reward for completing a "Family Disaster Plan."

Priority Level: Medium
Responsible Agencies: County Emergency Management Office, County, Local Governments, State, Medical, National Weather Service
Financial and Technical Resources: Federal Government
Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been removed from the 2021 hazard mitigation plan since NOAA radios do not have signal in the county.

4. Increase the usage of NOAA Weather Radios by subsidizing the purchase and distribution of radios to county residents, organizations and businesses. Use NOAA radios as a community emergency alert system.

Priority Level: Low
Responsible Agencies: County Emergency Management Office, County, Local Governments, Local Fire Departments, Landowners, Insurance Companies, National Weather Service, Schools
Financial and Technical Resources: Federal Government, State
Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been removed from the 2021 hazard mitigation plan since NOAA radios do not have signal in the county.

5. Research and implement plan to distribute NOAA radios throughout the county.

Priority Level: Low
Responsible Agencies: County Emergency Management Office, County, Local Governments, National Weather Service
Financial and Technical Resources: County, Local Governments, County Emergency Management Office
Progress/Status: Ongoing/Long term throughout the entire county.
Previous Plans: This item has been removed from the 2021 hazard mitigation plan since NOAA radios do not have signal in the county.

Crawford County Community Wildfire Protection Plan Objectives and Action Items

The Crawford County Community Wildfire Protection Plan (CWPP) is a supplemental plan to the Crawford County Hazard Mitigation Plan. The CWPP establishes local priorities to protect residents, property, and critical infrastructure from wildfires since the county is dominated by high-risk forests, high ignition sources (e.g., National Guard training exercises, recreational uses, etc.), and high value infrastructure in the wildland-urban interface. More information about the plan can be found at https://www.crawfordco.org/wp-content/uploads/2019/09/2019-Crawford-County-Community-Wildifre-Protection-Plan.pdf.

Objective 1: Suppress wildfires using an appropriate management response in a manner compatible with Management Area Objectives.		
Action Items	**Responsible**	**Year**
1. Adopt the National Incident Management System and incorporate NIMS principles into agency policies and procedures.	Local Gov., FD MDNR, USFS	Completed
2. Conduct National Incident Management System Incident Command Training for all emergency first responders and utilize Incident Command during disaster exercises.	Local Gov., FD MDNR, USFS	Ongoing
3. Utilize NIMS Incident Command principles in all emergency responses.	Local Gov., FD MDNR, USFS	Ongoing
4. Continue to use and update procedures to notify/evacuate campers and river users (canoes, kayakers, fishermen) from hazard areas. Current systems include Smart 911, Rave Mobile Safety System, and Integrated Public Alert & Warning System (IPAWS).	Local Gov., FD MDNR, USFS	Ongoing

Objective 2: Encourage adequate fire prevention, fire-safe construction, and pre-suppression activities on private lands in Wildland Urban Interface areas (WUI) using Firewise Landscaping and Construction standards. The foundation of this objective will be building partnerships with the county, local units of governments, MDNR, USFS, MSUE and other interested organizations.		
Action Items	**Responsible**	**Year**
1. Communities and agencies should develop a partnership agreement that defines roles and responsibilities for each entity.	Local Gov., FD MDNR, USFS	Ongoing
2. Communities and agencies should adopt/endorse recommendations and strategies of the "Firewise" program via resolutions or letters of support.	Local Gov., FD MDNR, USFS	Ongoing
3. Communities and agencies will implement programs to educate landowners in the wildland/urban interface area to become acquainted with Firewise mitigation strategies to protect their property from wildfire hazards and to use Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance and other techniques.	Local Gov., FD MDNR, USFS, MSUE	Ongoing
4. Representatives from local fire departments and agencies will be trained to conduct Firewise education programs and Firewise home assessments.	Local Gov. MDNR, FD USFS, MSUE	Ongoing
5. Local fire departments and agencies will pursue grants to purchase equipment and materials needed to conduct training and education programs.	Local Gov. MDNR, FD USFS, MSUE	Ongoing
6. Communities and local fire departments will encourage retrofitting of existing structures to install ignition resistant building materials including fire resistant or non-combustible roof coverings, roof sheathing, roof flashing, roof skylights, roof and attic vents, roof eaves, gutters, siding, windows and screens, and fences and decks.	Local Gov. FD	Ongoing
7. Communities, local fire departments and agencies will encourage retrofitting of ignition resistant building techniques including closed decks, balconies, and porches to prevent debris and embers from collecting.	Local Gov., FD MDNR, USFS	Ongoing

Objective 2: Encourage adequate fire prevention, fire-safe construction, and pre-suppression activities on private lands in Wildland Urban Interface areas (WUI) using Firewise Landscaping and Construction standards. The foundation of this objective will be building partnerships with the county, local units of governments, MDNR, USFS, MSUE and other interested organizations.		
8. Communities, local fire departments and agencies will encourage creating defendable spaces around structures through the removal or reduction of flammable vegetation including vertical clearance of tree branches.	Local Gov., FD MDNR, USFS	Ongoing
9. Communities and local fire departments will work to create better ingress and egress to homes including clearance of trees along access roads, widening access roads too narrow for equipment travel, and creating a turn-around at the home site.	Local Gov. FD	Ongoing
10. Communities and local fire departments will encourage improvement of private or public roads which could provide fuel breaks in areas of continuous fuels.	Local Gov. FD	Ongoing
11. The county will continue to incorporate Firewise Construction Standards, International Wildland Urban Interface Code and International Fire Code into existing building codes, zoning ordinances, and community land use plans.	County, Local Gov.	Ongoing
12. Local units of government will develop a program to assist those with special needs with applying Firewise Mitigation Strategies.	Local Gov. FD	Grant availability
13. Utilize available State and Federal Programs for Wildfire Mitigation including, but not limited to FEMA's Hazard Mitigation Assistance Grant, Michigan Department of Natural Resources and Environment Community Wildfire Protection Grant Program, and Secure Rural Schools and Community Self-Determination Act Title III Funding.	Local Gov. County, FD	Ongoing
14. Local fire departments will provide opportunities for homeowners to interact with wildfire experts through ongoing home evaluations.	MDNR, USFS, FD, MSUE	Ongoing
15. Provide Firewise education training to staff at all fire departments, who can in turn promote the program at community events.	FD. MDNR USFS, MSUE	Ongoing
16. Local fire departments will work together to develop a packet of Firewise information to be given to local real estate agents with contact information as well as recommendations on how to make your home and property more Firewise.	Local Gov. MSUE	Ongoing
17. Distribute Firewise construction handouts to homeowners.	County, Local Gov.	Ongoing

Objective 4: Continue to assist and encourage communities within the county to participate in the Community's Wildfire Protection Plan		
Action Items	**Responsible**	**Year**
1. The Local Emergency Planning Committee (LEPC) will review the CWPP on an annual basis to monitor and assess whether the plan continues to meet the community's needs.	LEPC, Local Gov., MDNR, USFS, FD	January of each year
2. Activities associated with implementing the CWPP will be discussed at each Crawford County Fire Chiefs meetings. This will enable each community to share their accomplishments.	FD	Ongoing
3. Foster public, interagency, and interdisciplinary cooperation when identifying, developing, and prioritizing hazardous fuels mitigation measures annually.	Local Gov. FD, MDNR USFS, MSUE	Ongoing
4. Work with communities on pilot projects such as brush disposal sites, Firewise mitigation projects, etc.	Local Gov. MDNR, FD, USFS	Ongoing
Objective 3: Support the members of the Michigan Interagency Wildfire Prevention Association (MIWFPA) as a way to further the message of fire prevention.		
Action Items	**Responsible**	**Year**
1. Local fire departments, MDNR and USFS will conduct Firewise public education campaigns and awareness programs to inform the public about the wildfire hazard in Crawford County, the measures necessary to minimize potential damage and injury, and what mitigation actions can be taken.	Local Gov. MDNR, FD, USFS, MSUE	Ongoing
2. Conduct *Assessing Wildfire Hazards in the Home Ignition Zone* training for local volunteer fire departments on a biennial basis. Last training was conducted in 2018.	FD, MDNR USFS, MSUE, Local Gov.	2020
3. Local fire departments will conduct home assessments in the Wildland Urban Interface communities and surrounding areas within their jurisdiction.	FD	Ongoing

Objective 5: Fuel Management - manage forests to maintain fuel loads within the range of natural specific ecosystem variability in order to minimize adverse effect to ecological and socioeconomic values.		
Action Items	**Responsible**	**Year**
1. Reduce excessive fuel loads outside of the natural range of variability for specific community types to reduce the hazard of catastrophic wildfires to forest resources and public and private facilities.	MDNR, USFS	*Ongoing
2. Maintain fuel breaks plan using GIS technology to identify needs, map potential fuel breaks and determine options to install fuel breaks and provide long term maintenance. The process identifies fuel breaks on public and private properties.	MDNR, USFS	*Ongoing
3. Implement fuel breaks plans to fund and develop various stretches of fuel breaks and to perform long term maintenance on them.	MDNR, USFS	*Ongoing
4. Work with other fire agencies and local units of government to encourage landowners and residents within the wildland-urban interface to reduce excessive fuel loads and to establish "defensible space" landscapes around	MDNR, USFS, FD, Local Gov.	*Ongoing

Objective 5: Fuel Management - manage forests to maintain fuel loads within the range of natural specific ecosystem variability in order to minimize adverse effect to ecological and socioeconomic values.		
Action Items	**Responsible**	**Year**
structures.		
5. Prescribe salvage cuts, where appropriate, to reduce fuel loads in areas with extensive mortality due to disease or insect infestations while also considering the biodiversity values associated with snags and large woody debris.	MDNR, USFS	*Ongoing
6. Reduce the potential for large crown fires in conifer species by reducing the occurrence of fuel ladders, increasing crown spacing, and decreasing density. The vegetation management program is the primary means by which this will be accomplished.	MDNR, USFS	*Ongoing
7. Regularly maintain existing and establish new fuel breaks to protect critical facilities, structures, and forests.	MDNR, USFS	*Ongoing
8. Use prescribed burning or clear cutting, where appropriate, to remove slash and regenerate forest stands.	MDNR, USFS	*Ongoing
9. Work toward establishing new fuel breaks on public lands that will strengthen existing and proposed mitigation strategies.	MDNR, USFS	*Ongoing
*Note: due to fluctuating funding amounts, these activities will be completed as time and budgets allow.		

Objective 6: Implement Firewise planning and zoning strategies at the local level. Implementation of action items under this objective are the responsibility of each community. Furthermore, it is understood that each local unit of government will need to determine which action items will be acceptable and enforceable under their current program administration.	
Community Master Plan Action Items	**Year**
1. Natural Resource section: identify general forest types, high risk wildfire areas, steep slopes and hydric soils, and droughty soils.	As plans are updated per Michigan Planning Enabling Act (MPEA)
2. Address Firewise Program in goals and objectives.	As plans are updated
3. Future land use section: consider overlay zone or special issue area.	As plans are updated
4. Zoning Plan section: identify zoning techniques for Firewise Community.	As plans are updated
Zoning Ordinance Action Items	**Year**
5. Consider use of a Wildfire Overlay Zone in the zoning ordinance, whereby properties within the overlay zone will subject to additional standards to mitigate impacts of wildfires.	As zoning ordinances are amended
6. Vegetative fuel clearance provision concerns the distance between heavy vegetation types and the proposed structures. a. The zone immediately adjacent to a dwelling is the area of maximum fuel modification and management and typically extends 30 feet from the structure. The second zone is a transition area to any adjacent woodland. This zone is	As zoning ordinances are amended

Objective 6: Implement Firewise planning and zoning strategies at the local level. Implementation of action items under this objective are the responsibility of each community. Furthermore, it is understood that each local unit of government will need to determine which action items will be acceptable and enforceable under their current program administration.	
managed for fuels between the woodland and a structure regardless of property ownership.	
7. Vegetative maintenance for managing dangerous fuel loads in high fire risk areas.	As zoning ordinances are amended
8. Roadway and driveway standards to ensure access for large emergency vehicles. a. minimum road/drive widths b. minimum vertical clearance c. an appropriate surface material d. maximum grade e. turnaround distances and radii f. street identification g. premise identification h. develop land subs with a minimum of two egress/ingress roads i. culverts	As zoning ordinances are amended
County Planning Commission	**Year**
9. The County Planning Commission will review annually all communities' master plan updates and zoning ordinance amendments completed over the previous year to monitor their implementation of the CWPP and incorporation of Firewise standards in local planning and zoning activities. Tables 3.2 and 3.3 of the CWPP should be reviewed and updated as communities implement the plan. The County Planning Commission will submit a brief report to be submitted to the LEPC, County Board of Commissioners and local units of governments.	March of each year

Objective 7: Provide fire prevention and fire suppression to Camp Grayling base and Michigan National Guard properties in Crawford County.		
Action Items	**Responsible**	**Year**
1. The Michigan National Guard and Michigan Department of Natural Resources will meet annually to review and update the Memorandum of Understanding concerning fire prevention and suppression.	MDNR Michigan National Guard	Annually
2. Due to budget constraints, the Michigan National Guard may be able to provide seasonal wildfire coverage (March to November) with their staff. The Michigan National Guard intends to contract with local fire departments for structural fires on the base and the MDNR for fire suppression outside impact areas.	MDNR Michigan National Guard	Annually
3. The MDNR and the Michigan National Guard co-manage National Guard lands. The MDNR and Michigan National Guard will continue to work in cooperation to develop and	MDNR Michigan National Guard	Annually

maintain fuel breaks around impact zones and conduct prescribed burns, as necessary.		

Objective 8: With homes and dispersed outdoor recreational facilities, such as campgrounds and canoeing, located within high-risk areas, it is extremely important to provide mechanisms for informing people of wildfire risks and, when necessary, provide for evacuation to safe areas.		
Action Items	**Responsible**	**Year**
1. Continue to support and Smart 911, RAVE Mobile Safety System, and Integrated Public Alert & Warning System (IPAWS) to selectively notify homeowners in areas threatened by a wildfire.	County	Ongoing
2. Establish procedures for notifying campground and canoe liveries.	Local Gov. MDNR USFS	2019

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Chapter 9 Plan Maintenance

Implementation, Monitoring, and Evaluation

The Crawford County Board of Commissioners (BOC) and the Crawford County Emergency Management Office (EM) are the primary entities responsible for implementing the Crawford County Hazard Mitigation Plan. The BOC will need to evaluate funding and staffing required to implement the plan since the current resources, both staff and financial, may not accommodate the expanded role of the EM and the Crawford County Local Emergency Planning Committee (LEPC). GIS data sets and maps will be updated and maintained by the local governments for future use in the implementation and monitoring of hazard mitigation activities.

The LEPC is organized under the Michigan SARA Title III Program and meets on a regular basis to carry out its duties. A Hazard Mitigation Committee (HMC) was formed from the members of the LEPC. The HMC and the Emergency Manager will be responsible for monitoring and overseeing the implementation of the hazard mitigation plan. Since the HMC is a sub-committee of the LEPC, it will function under the BOC. Staff support will be provided by the EM and will coordinate with the BOC. The Emergency Manager will provide program administration and project oversight on an ad-hoc basis.

The roles related to the HMC may be defined/re-defined by the committee. The HMC will develop a five-year project list from the mitigation strategies identified in the Crawford County Hazard Mitigation Plan and will perform an annual review of the hazard mitigation plan to determine what projects have been accomplished and to add new projects to the five-year action list. The HMC may also assist other agencies in accomplishing projects, such as determining overall costs and funding sources, identifying the staff and agencies required to complete the project, and determining timelines. The HMC may also support grant writing to seek funding to complete projects, address specific issues and circumstances arising from an event that caused a disaster declaration, evaluate the need for new projects and amend the hazard mitigation plan, review reports from agencies involved in implementing mitigation projects, prepare an annual mitigation activity report for the BOC, and function as a clearinghouse for mitigation grant applications. During the hazard mitigation plan update process, the HMC will advertise and facilitate two public meetings to obtain input from the general public, businesses, townships, and agencies. A notice will be posted to advertise any meeting of the HMC where the committee will be reviewing and/or updating the mitigation plan. Additional emergency management staff time will be required to assist the HMC in completing its duties.

Additionally, the HMC and EM will be responsible for evaluating the effectiveness of the plan during the five-year update or more often, if necessary. The evaluation will keep the plan current and will include an assessment about whether the goals and objectives address current and expected conditions, the risks have changed in nature, magnitude or type, there are implementation issues, the current resources are appropriate for plan implementation, there have been favorable outcomes, and other agencies and stakeholders have participated as expected.

Local governments, county departments, and local, state and federal agencies will have the ability to propose projects and sponsor projects identified in the plan. The HMC will coordinate and support plan implementation, and allow the committee to monitor the plan's progress, determine timelines, and evaluate the plan for revisions.

Partnerships with the following agencies and organizations will strengthen the county's hazard mitigation program to efficiently leverage available resources:

- Crawford County Departments
- City of Grayling
- Beaver Creek Township
- Frederic Township
- Grayling Township
- Lovells Township
- Maple Forest Township
- South Branch Township
- Township and City Fire Departments
- Crawford County Conservation District
- Crawford County Road Commission
- Northeast Michigan Council of Governments
- Michigan Department of Natural Resources
- Michigan Department of Environment, Great Lakes, and Energy
- U.S. Forest Service
- Michigan State University Extension
- Michigan Department of Agriculture and Rural Development
- Natural Resource Conservation Service
- Huron Pines
- Federal Emergency Management Administration
- Michigan State Police
- District Health Department
- American Red Cross
- Insurance Companies
- Real Estate Companies
- Local Businesses
- Civic Groups and Churches

Integration

Crawford County, the City of Grayling, all townships in Crawford County, and local and state agencies will consider integrating information from the hazard mitigation plan into their comprehensive and operations plans. When jurisdictions update their master plans and zoning ordinances, they will consider incorporating appropriate hazard mitigation information. All communities will be encouraged to adopt zoning regulations to minimize hazard effects.

Five Year Plan Review and Update

The Stafford Act, as amended by the Disaster Mitigation Act of 2000, requires the Crawford County Hazard Mitigation Plan to be updated, adopted, and re-submitted for Federal Emergency Management Agency (FEMA) approval every five years. The plan will be reviewed by the HMC every five years in alignment with federal regulations. The update will include determining changes in the county, such as changes in development, an increase in exposure to hazards, an increase or decrease in the communities' capability to address hazards, addition and/or removal of mitigation actions and strategies, reviewing goals, and a change in federal or state legislation. Upon plan review and update completion, the plan will be sent to the State Hazard Mitigation Officer at the Michigan State Police for final review and approval in coordination with FEMA. When the plan has received an "approved pending adoption" status from FEMA, the BOC can review, approve, and adopt the plan. Requests will be sent to the Grayling City Council and all Township Boards for their review, approval and adoption of the plan. In order to properly update the plan, Crawford County will need to seek funding from appropriate state and federal agencies.

Continued Public Involvement

Crawford County is committed to keeping the public involved in the implementation and update of the Hazard Mitigation Plan. Copies of the plan will be available at the county libraries, county clerk's office, and all township offices, and will be posted on the community websites and/or regional planning agency website. The EM will be responsible for keeping a record of public comments on the plan.