Chapter 3

Natural Hazards Risk Assessment

Federal Requirement

Section 201.6(c)(2) of the mitigation planning regulation requires local jurisdictions to provide sufficient hazard and risk information from which to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. This includes detailed descriptions of all the hazards that could affect the jurisdiction along with an analysis of the jurisdiction’s vulnerability to those hazards. Local risk assessments coupled with the local mitigation strategies are the basis of the State’s evaluation of its resources and facilitate the establishment of statewide goals.

As defined by the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. “It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.”

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction’s potential risk to natural hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

Methodology

This risk assessment followed the methodology described in the FEMA publication “Local Multi-Hazard Mitigation Planning Guidance”, July, 2008 which breaks the assessment down to a four-step process:

1) Identify Hazards
2) Profile Hazard Events
3) Inventory Assets
4) Estimate Losses

Data collected through this process has been incorporated into the following sections of this chapter:

**Hazard Identification** - Identifies the hazards which threaten the planning area and describe why some hazards have been omitted from further consideration. It also discusses the research methodology utilized to gather the data in this plan.
**Hazard Profiles** - Discusses each of the included hazards which threaten the planning area. Provides a brief definition and overview of the hazard and reviews significant previous occurrences of the hazard. This section includes the following sub-sections for each hazard: description, geographic extent, previous occurrences, probability of future occurrences, exposure assessment, impact assessment, estimating potential losses, and overall summary.

**Vulnerability Summary** - Provides a county-wide analysis of exposure to hazards. This is a general picture that assesses common exposures for all hazards and includes specific data such as demographics, property values, and critical facilities. It combines the estimation of a hazard’s occurrence probability with the associated vulnerabilities of critical infrastructure and populations. Includes a summary of the hazard risk ratings and prioritizes hazards for mitigation implementation purposes.

**Mitigation Capabilities Assessment** - An inventory of existing mitigation activities and existing policies, regulations, and plans that pertain to mitigation and affect the County’s net vulnerability.

**Hazard Identification**

The Chippewa County Hazard Mitigation Plan, 2005, served as the starting point for the initial risk assessment in which 15 hazards were identified that the County was determined to be most susceptible to.

Additionally, a survey was distributed to local units of governments, the Chippewa County Hazard Mitigation Planning committee (CCHMPC) and other stakeholders with various expertise to gather information and opinions on the hazards that had been identified in the 2005 plan. (See Appendix A for a complete listing.)

An on-line community survey was made available through the Eastern U.P. Regional Planning and Development Commission’s website. An on-line mapping tool was also made available for citizens to add input. Information on how to access and complete the survey and edit the map was announced to the public through a news release in the area’s local newspaper “The Evening News” as well as on the EUP Regional Planning’s Facebook page and quarterly newsletter. Local units of government that have websites were asked to create links to this information.

Additionally, research was conducted on hazard events that occurred over the past five years. The hazard analysis committee met in April, 2013 where they re-examined these hazards, as well as examined additional gathered information. County-wide participation from townships, DeTour Village and the City of Sault Ste. Marie provided localized knowledge and information to update the hazard identification. Some technological hazards are included that the CCHMPC determined to be the biggest threat to the County, although this Plan is concentrating on mainly the natural hazards as many of the technological hazards described are due to the natural hazards that affect the County.
Based on the recommendations by FEMA, the CCHMPC, and historical records for Chippewa County, the following hazards (listed alphabetically), were considered during the plan update:

- Civil Disturbances
- Drought
- Extreme Temperatures
- Fixed Site – Haz. Mat. Incident
- Flooding
- Infrastructure Failures
- Pipeline Accidents
- Subsidence/Ground Movement
- Thunderstorm/Hail/Lightning/High Wind
- Tornadoes
- Transportation Haz. Mat. Accident
- Public Health Emergencies
- Severe Winter Weather
- Structural Fires/Scrap Tire Fire
- Wildfires

In the 2005 Plan the following criteria was used to determine the level of importance to assess each hazard by. The criteria included:

1) Likelihood of Occurrence = Low (1-3), Medium (4-6), High (7-10)
2) Casualty potential = Low (1-3), Medium (4-6), High (7-10)
3) Local capability = Low (7-10) (not very capable), Med (4-6) (somewhat capable), High (1-3) (very capable)
4) Population affected = Low (1-3) (less than 5% of population), Medium (4-6) (5% - 25% of population), High (7-10) (more than 25% of population)
5) Economic impact = Low (1-3) (less than $5,000), Medium (4-6) ($5,000 – $25,000), High (greater than $25,000)

Each of these aspects was assigned a weight as determined by the hazard analysis committee to balance the total score. The following weight was assigned to each criteria: the likelihood of occurrence and casualty potential were weighted at 35%, local capability at 15%, population affected at 10% and economic impact at 5%. Based upon this criteria the hazards ranked as follows in 2005:

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Likelihood of Occurrence</th>
<th>Casualty Potential</th>
<th>Local Capability</th>
<th>Population Affected</th>
<th>Economic Impact</th>
<th>Total Score</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Health Emergencies</td>
<td>3.2</td>
<td>3.15</td>
<td>1.05</td>
<td>.9</td>
<td>.45</td>
<td>8.75</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure Failures</td>
<td>3.2</td>
<td>1.4</td>
<td>.75</td>
<td>.9</td>
<td>.45</td>
<td>6.65</td>
<td>2</td>
</tr>
<tr>
<td>Transportation/Haz. Materials Transport Accidents</td>
<td>2.1</td>
<td>2.1</td>
<td>1.05</td>
<td>.7</td>
<td>.35</td>
<td>6.30</td>
<td>3</td>
</tr>
<tr>
<td>Severe Winter Weather Hazards</td>
<td>2.8</td>
<td>1.05</td>
<td>1.05</td>
<td>.9</td>
<td>.3</td>
<td>6.10</td>
<td>4</td>
</tr>
<tr>
<td>Fixed Site – Hazardous Material Incident</td>
<td>2.5</td>
<td>2.45</td>
<td>.45</td>
<td>.3</td>
<td>.3</td>
<td>5.95</td>
<td>5</td>
</tr>
</tbody>
</table>
## Table 8 – 2005 Hazard Ranking

As part of the update process, all participating members of the CCHMPC, emergency responders and local units of government were distributed surveys with blank versions of this table again. Each person completed the survey using their own experiences and judgment to assign the numeric values. A total of 30 surveys were returned. The numbers were then averaged, providing the basis for the updated hazard ranking. The following table shows the updated hazard ranking using the same criteria as in previous section:

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Likelihood of Occurrence</th>
<th>Casualty Potential</th>
<th>Local Capability</th>
<th>Population Affected</th>
<th>Economic Impact</th>
<th>Total Score</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thunderstorms, Lightning, Hail</td>
<td>2.8</td>
<td>.7</td>
<td>.9</td>
<td>.6</td>
<td>.15</td>
<td>5.15</td>
<td>6</td>
</tr>
<tr>
<td>Wildfires</td>
<td>2.8</td>
<td>.7</td>
<td>.9</td>
<td>.4</td>
<td>.3</td>
<td>5.1</td>
<td>7</td>
</tr>
<tr>
<td>Extreme Temperatures</td>
<td>2.1</td>
<td>.7</td>
<td>.9</td>
<td>.9</td>
<td>.35</td>
<td>4.95</td>
<td>8</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>2.1</td>
<td>.7</td>
<td>.9</td>
<td>.7</td>
<td>.35</td>
<td>4.75</td>
<td>9</td>
</tr>
<tr>
<td>Flooding Riverine/Shoreline/Dam Failures</td>
<td>2.8</td>
<td>.35</td>
<td>.6</td>
<td>.6</td>
<td>.3</td>
<td>4.65</td>
<td>10</td>
</tr>
<tr>
<td>Pipeline Accidents</td>
<td>2.1</td>
<td>.7</td>
<td>.75</td>
<td>.5</td>
<td>.2</td>
<td>4.25</td>
<td>11</td>
</tr>
<tr>
<td>Civil Disturbances</td>
<td>1.1</td>
<td>1.75</td>
<td>.9</td>
<td>.1</td>
<td>.05</td>
<td>3.85</td>
<td>12</td>
</tr>
<tr>
<td>Structural Fires/Scrap Tire Fires</td>
<td>.7</td>
<td>1.4</td>
<td>1.05</td>
<td>.1</td>
<td>.3</td>
<td>3.55</td>
<td>13</td>
</tr>
<tr>
<td>Drought</td>
<td>1.1</td>
<td>.35</td>
<td>.75</td>
<td>.9</td>
<td>.25</td>
<td>3.3</td>
<td>14</td>
</tr>
<tr>
<td>Subsidence</td>
<td>.4</td>
<td>.35</td>
<td>.3</td>
<td>.1</td>
<td>.05</td>
<td>1.15</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Likelihood of Occurrence</th>
<th>Casualty Potential</th>
<th>Local Capability</th>
<th>Population Affected</th>
<th>Economic Impact</th>
<th>Total Score</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Winter Weather</td>
<td>2.6</td>
<td>1.28</td>
<td>1.04</td>
<td>.65</td>
<td>.29</td>
<td>5.86</td>
<td>1</td>
</tr>
<tr>
<td>Thunderstorm/Hail/Lightning</td>
<td>2.6</td>
<td>1.18</td>
<td>1.02</td>
<td>.44</td>
<td>.24</td>
<td>5.46</td>
<td>2</td>
</tr>
<tr>
<td>Wildfires</td>
<td>2</td>
<td>1.68</td>
<td>.7</td>
<td>.34</td>
<td>.25</td>
<td>4.94</td>
<td>3</td>
</tr>
<tr>
<td>Drought</td>
<td>2.1</td>
<td>.91</td>
<td>.92</td>
<td>.52</td>
<td>.19</td>
<td>4.62</td>
<td>4</td>
</tr>
<tr>
<td>Public Heath Emergencies</td>
<td>1.9</td>
<td>1.17</td>
<td>1</td>
<td>.31</td>
<td>.22</td>
<td>4.60</td>
<td>5</td>
</tr>
<tr>
<td>Infrastructure Failure</td>
<td>1.9</td>
<td>.99</td>
<td>.78</td>
<td>.54</td>
<td>.20</td>
<td>4.39</td>
<td>6</td>
</tr>
<tr>
<td>Flooding</td>
<td>1.5</td>
<td>1.06</td>
<td>.85</td>
<td>.38</td>
<td>.19</td>
<td>3.94</td>
<td>7</td>
</tr>
<tr>
<td>Civil Disturbances</td>
<td>1.3</td>
<td>1.24</td>
<td>.72</td>
<td>.33</td>
<td>.22</td>
<td>3.85</td>
<td>8</td>
</tr>
<tr>
<td>Transportation/HM Accidents</td>
<td>1.3</td>
<td>.91</td>
<td>.72</td>
<td>.39</td>
<td>.24</td>
<td>3.59</td>
<td>9</td>
</tr>
<tr>
<td>Structural Fires/Scrap Tire Fires</td>
<td>.9</td>
<td>1.05</td>
<td>.68</td>
<td>.28</td>
<td>.15</td>
<td>3.33</td>
<td>10</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>1.3</td>
<td>.53</td>
<td>.7</td>
<td>.46</td>
<td>.19</td>
<td>3.23</td>
<td>11</td>
</tr>
<tr>
<td>Fixed Site/HM Incident</td>
<td>1.2</td>
<td>.63</td>
<td>.63</td>
<td>.27</td>
<td>.16</td>
<td>2.88</td>
<td>12</td>
</tr>
<tr>
<td>Pipeline Accidents</td>
<td>.9</td>
<td>.63</td>
<td>.66</td>
<td>.24</td>
<td>.12</td>
<td>2.55</td>
<td>13</td>
</tr>
</tbody>
</table>
According to this table, the CCHMPC ranked Severe Winter Weather as the most dangerous and costly hazard.

After conducting a cursory review of Chippewa County’s geographic location and climate, several of the natural hazards included in the initial composite list were discarded because they are not relevant to Chippewa County. These include: Avalanche, Earthquake, Expansive Soils, Hurricane, Tsunami, and Volcano. High Wind, Hail and Lightning were combined with Thunderstorms as those hazards typically occur during a passing storm system. Blizzards, Ice Storm and Sleet were combined in Severe Winter Weather category. Scrap Tire Fire category was combined with Structural Fires.

### Hazard History

As part of the hazard identification process, the EUPRP&DC staff researched past events which triggered federal and/or state emergency or disaster declarations in the planning area. Federal and/or state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government’s capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments’ capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

According to FEMA there have been 33 Presidential Disaster Declarations for the State of Michigan over the period of time from 1953-2010. Of those 33, 25 were Major Disaster Declarations, 7 Emergency Declarations, and 1 Fire Suppression Declaration. This data does not include separate Secretary of Agriculture or Small Business Administration (SBA) disaster declarations, which are issued under other authorities. Declarations after 1974 were issued under PL 93-288 (Disaster Relief Act), as amended by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (1988) and the Disaster Mitigation Act (2000).

Chippewa County was affected by 4 Presidential Disaster Declarations:
## Table 10 - Presidential Disasters affecting Chippewa County

<table>
<thead>
<tr>
<th>Date of Incident</th>
<th>Type of Incident</th>
<th>Area Affected</th>
<th>Type of Declaration</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/7/05</td>
<td>Hurricane Evacuation</td>
<td>Statewide</td>
<td></td>
</tr>
<tr>
<td>12/93-5/94</td>
<td>Underground Freeze</td>
<td>10 counties: Charlevoix, Cheboygan, Chippewa, Delta, Gogebic, Houghton, Mackinac, Marquette, Ontonagon, &amp; Schoolcraft Co.</td>
<td>Major Disaster</td>
</tr>
<tr>
<td>1/26-27/78</td>
<td>Blizzard &amp; Snowstorm</td>
<td>Statewide</td>
<td>Emergency</td>
</tr>
<tr>
<td>1/26-31/77</td>
<td>Blizzard &amp; Snowstorm</td>
<td>15 Counties: including Chippewa</td>
<td>Emergency</td>
</tr>
</tbody>
</table>

Over the 30-year period 1977-2007 there has been a total of 56 Governor Disaster Declarations for the State of Michigan. Of those 56, 38 were Disaster Declarations and 18 were Emergency Declarations.

Chippewa County was affected by the following 5 Governor Disaster Declarations:

<table>
<thead>
<tr>
<th>Date of Incident</th>
<th>Type of Incident</th>
<th>Area Affected</th>
<th>Type of Declaration</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/4/2005</td>
<td>Hurricane Evacuation</td>
<td>Statewide</td>
<td></td>
</tr>
<tr>
<td>12/13/95</td>
<td>Snowstorm</td>
<td>City of Sault Ste. Marie, Chippewa County</td>
<td>Emergency</td>
</tr>
<tr>
<td>1/26/78</td>
<td>Blizzard &amp; Snowstorm</td>
<td>Statewide</td>
<td>Disaster</td>
</tr>
<tr>
<td>1/28/77</td>
<td>Blizzard &amp; Snowstorm</td>
<td>15 Counties: Allegan, Barry, Berrien, Cass, Chippewa, Eaton, Hillsdale, Ionia, Muskegon, Newaygo, Oceana, Ottawa, Sanilac, Shiawassee, &amp; Van Buren Co.</td>
<td>Disaster</td>
</tr>
</tbody>
</table>

## Table 11 - Governor Disasters affecting Chippewa County

Although none from Chippewa County, the following table represents Michigan Weather Related Fatalities from the period 2005-2009 according to the National Weather Service.
Table 12 - Michigan Weather Related Deaths

Note: All the injuries listed above are “direct” injuries, in which the weather hazard is the major cause of injury. Heat Wave injuries are considered “illnesses.” And are not are not tabulated above. Likewise, nearly all injuries attributed to vehicle injuries on highways in Winter Storms are “indirect” injuries, since the driver was driving too fast for the conditions, etc. In other words, the snow or ice did not injure the individual; the injury was the result of a vehicle accident. Source: National Weather Service.

According to the National Climatic Data Center, Chippewa County listed 210 storm events during the period January 1, 1950 to February 28, 2010 listed in the following table:

Table 13 - Chippewa County Storm Events 1950-2010

In addition to property losses, there is potential for death or injury from many of the natural hazards that threaten the County. The past and potential impacts for each of the identified hazards are described in greater detail in each specific hazard profile.

2014 Hazard Profile

The hazards identified to have significant impact on Chippewa County are profiled individually in this section. Much of the profile information came from the same sources used to identify the hazards during the initial planning effort in 2005. These sources include records and information from the State of Michigan Emergency Management Division, FEMA, National Weather Service, Chippewa County Office of Emergency Services, as well as local research of news articles and inquiries to the many public and private stakeholders relevant to the project.
The information was reviewed for accuracy and applicability and updated where required. Significant occurrences of hazards that have occurred since the original plan’s adoption in 2005 are also included in the updated hazard profiles.

**Profile Methodology**

Each hazard is profiled in a similar format that is described below. This approach helps create a uniform planning basis and enables comparisons between the hazards. The basic outline is:

**Description:** This subsection gives a generic description of the hazard and associated problems, followed by details on the hazard specific to Chippewa County.

**Geographic Extent:** Here we discuss which areas of the County are most likely to be affected by a hazard event at any given time:
- **Isolated:** Single site occurrences for each incident (Points = 1)
- **Limited:** Less than 10 percent of the planning area (Points = 2)
- **Significant:** 10 to 50 percent of the planning area (Points = 3)
- **Extensive:** 50 to 100 percent of the planning area (Points = 4)

**Historical Events:** This subsection contains information on historic incidents, including impacts where known. The extent or location of the hazard within or near the Chippewa County Planning area is also included here.

**Likelihood of Future Occurrences:** The frequency of past events is used here to gauge the likelihood of future occurrences. Based on historical data, the likelihood of future occurrences is categorized into one of the following classifications:
- **Low** – less than a 1% chance of occurring annually (Points = 1)
- **Medium** – 1% - 50% chance of occurring annually (Points = 2)
- **High** – 51%-100% chance of occurring annually (Points = 3)

The frequency, or chance of occurrence, was calculated where possible based on existing data. Frequency was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of event happening in any given year. Where this data results in a percent above 100 percent, the hazard is assumed to have a yearly frequency rating. Example: Three droughts over a 30-year period equates to 10 percent chance that the hazard will occur in a given year, and is then rated as “medium”.

**Impact Assessment**

This examines the potential impacts of the hazard on Chippewa County using qualitative assessment methods. Based on past experiences in Chippewa County, in the State of Michigan, and nationwide, this is a qualitative discussion of the consequences that could be expected in the aftermath of each of the hazard events. Impacts are divided into two categories:
Direct Impacts
This describes the short-term consequences to people and property which occur directly as a result from the hazard.

Indirect Impacts
This describes the short-term and long-term consequences, including social and economic impacts. Secondary hazards are also examined here. Because indirect impacts are much broader and difficult to quantify than direct impacts, the section is abbreviated where appropriate to maintain mitigation focus.

Impact Magnitude and Severity Summary
This subsection summarizes the qualitative magnitude and severity of a hazard based on previous occurrences and the potential direct and indirect impacts. For most hazards the impacts are based on the event of record, or estimated worst case if history of events is limited. Impact magnitude and severity are classified in the following manner:

- Population affected: Low (less than 5% of population) (Points = 1); Medium (5% - 25% of population) (Points = 2); High (more than 25% of the population affected) (Points = 3)
- Casualty Potential: Low (no fatalities, treatable injuries) (Points = 1); Medium (fatalities possible, injuries probable) (Points = 2); High (fatalities, and/or life changing injuries probable) (Points = 3)
- Economic Impact: Low (less than $5,000) (Points = 1); Medium ($5,000-$25,000) (Points = 2); High (greater than $25,000) (Points = 3)
- Local Capability – Low (not very capable) (Points = 3); Medium (somewhat capable) (Points = 2); High (very capable) (Points = 1)

Vulnerability Assessment
This section provides an analysis of the exposed properties, people and resources in the county specific to the hazard. For clarification and ease of mitigation planning, exposures are broken into four major categories:

- Population
- General Property
- Essential Infrastructure, Facilities, and Other Important Community Assets
- Natural, Historic and Cultural Resources

Estimating Potential Losses
Potential losses are determined based on available data, so the methodology varies by hazard. For some hazards this may be based on average annualized losses, or using the documented event of record for the hazard and identifying the corresponding damage in dollars, adjusting them for inflation to reflect 2014 costs. Where the hazard occurs in a specific
area, such as flood, GIS methods were used estimate losses to structures and critical facilities, as available data permitted.

**Mitigation Capabilities Assessment**

A review of the existing mitigation activities and existing policies, regulations, and plans that pertain to mitigation and strategies that have been proven to be effective in reducing the risks and impact of a hazard.

**Overall Risk Summary**

Overall vulnerability for the hazard is measured in terms of geographic extent, impacts, magnitude and severity, probability of occurrence, and exposure. These findings are summarized in this section and analyzed to reveal an overall risk rating for the hazard. This rating is calculated by averaging the numeric ratings for each measurement and then assigning a corresponding interpretation to the average. This determines the vulnerability of the County to the hazard, relative to the other hazards profiled.

- Low: Minor risk (0 to 1.9 average)
- Medium: Moderate risk (2.0 to 2.5 average)
- High: High risk. (2.5 or higher average)

**Severe Winter Weather**

**Description:** There are many ways for winter storms to form, but certain key ingredients are needed. First temperatures must be below freezing in the clouds and near the ground. There must be a source of moisture in the form of evaporating water. Then lift in the atmosphere causes the moisture to rise and form clouds of precipitation.

Winter storms in the Midwest are caused by Canadian and Arctic cold fronts that push snow and ice deep into the interior region of the United States. Our area is also subject to lake effect snowstorms that develop from the passage of cold air over the relatively warm surface of Lake Superior and Lake Huron that can cause heavy snowfall and blizzard conditions.

Winter storms can occur as heavy snowfalls, ice storms or extreme cold temperatures. Winter storms can occur as a single event or they can occur in combination which can make an event more severe. For example, a moderate snowfall could create severe conditions if freezing rain and subsequent extremely cold temperatures followed it. The aftermath of a winter storm can impact a community or region for weeks, and even months.

Heavy snowfalls can range from large accumulations of snow over many hours to blizzard conditions with blowing snow that could last several days. The National Weather Service’s snow classification is in the table below:
### Snow Classifications

<table>
<thead>
<tr>
<th>Snow Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blizzard</td>
<td>Winds of 35 miles per hour or more with snow and blowing snow reducing visibility to less than ¼ mile for at least 3 hours.</td>
</tr>
<tr>
<td>Blowing Snow</td>
<td>Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.</td>
</tr>
<tr>
<td>Snow Squalls</td>
<td>Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.</td>
</tr>
<tr>
<td>Snow Showers</td>
<td>Snow falling at varying intensities for brief periods of time. Some accumulation possible.</td>
</tr>
<tr>
<td>Snow Flurries</td>
<td>Light snow falling for short duration with little or no accumulation.</td>
</tr>
</tbody>
</table>

*Source: National Weather Service*

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Winters and summers are later than those in other northern inland areas due to the temperatures of the surrounding large bodies of water. The climate is not as harsh as those inland areas of the Midwest.

Weather changes are frequent because many pressure systems pass eastward through this section of the United States and Canada. Winter snows are most often associated with northwest winds.

In Chippewa County **Snow** usually covers the ground from late November until mid-April. The average seasonal snowfall is 134.5 inches at Whitefish Point, 132.4 inches at Sault Ste. Marie, and 69.8 inches at DeTour Village. The greatest snow depth at any one time during the period of record was 71.7 inches at Whitefish Point, 98.7 inches at Sault Ste. Marie, and 57.7 inches at DeTour. On the average 145 days at Whitefish Point, 135 days at Sault Ste. Marie, and 133 days at DeTour have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year. In December, 1995 Sault Ste. Marie recorded 46 inches within a 2-day snowfall and 72.3 inches within a 7-day snowfall, in which it snowed for all seven days. The greatest daily snow depth at DeTour Village was 70.0 inches in 1962. The snowfall is an economic advantage to the area, especially for snowmobiling. However, the potential for transportation accidents increases as more snowmobilers hit the trails.
An **ice storm** occurs when freezing rain falls from clouds and freezes immediately upon impact. Freezing rain is found in between sleet and rain. It occurs when the precipitation falls into a large layer of warm air and then does not have time to refreeze in a cold layer (near or below 32°F) before it comes in contact with the surface which is also near or below 32°F.

**Geographic Extent:** Winter weather is a regional event that occurs across the entire county or sometimes the entire state. Snowfall can occur anytime between October and May. More substantial winter storms occur during the winter months, most frequently between December
and February. February has the most documented occurrences of severe winter weather. In the 2005 Chippewa Co. Natural Hazard Mitigation Plan the National Weather Service recorded 63 snow and ice events during the period January 1, 1950 and April 30, 2004. Of those 63 events, 49 were categorized as heavy snow, 10 as winter storms, 2 as freezing rain (one of which accompanied heavy snow), 2 as an ice storm and 1 lake effect snow. Between May, 2004 and February, 2010, 25 snow and ice events were listed for Chippewa County. Of those 25, 64% were categorized as winter storms, 32% as heavy snow and 4% as an ice storm. Rating for the geographic extent is Extensive.

Historical Events: The history of past winter storm events was gathered from NCDC data, newspaper reports and other data sources as cited. Winter storms have been a common occurrence for Chippewa County residents for as long as the area has been settled. Every winter provides some challenges to the population. Some of the most recent outstanding events are listed below.

- **December 9-11, 2009:** A powerful low pressure system moved across Lower Michigan on the 9th. Snow surged northward ahead of the low, with intense snowfall rates on the morning of the 9th. By evening, snowfall totals of 6 to 12 inches were common across all of Northern Michigan. The snow transitioned to lake effect snow that night, and lasted into the 11th in some of the snowbelt areas. Localized 4 to 8 inch accumulations were common in a given 12 hour period. There was a considerable amount of wind, and thus blowing and drifting snow, especially on the 9th. Almost all school districts were closed on the 9th, and some schools called off classes for three consecutive days.

- **November 30-December 1, 2008:** A strong low pressure system moved from the Central Plains into the Great Lakes region. Snow developed out of this system late in the day on November 30th, and continued through a good part of December 1st. Snowfall totals of around a foot were common in a band arcing from just west of Traverse City, northeastward into Eastern Upper Michigan. Trout Lake picked up 17 inches of snow.

- **October 12-13, 2006:** A large and cold low pressure system settled southward from the Canadian Arctic. Unseasonably cold air allowed precipitation to turn to snow, particularly away from the Lake Michigan shoreline (where warm water temperatures resulted in more rain and less snow). The heaviest snow was lake enhanced, and thus somewhat isolated. DeTour Village picked up nearly a foot of snow, as did Cheboygan. A brief period of thunder and lightning occurred with the heavy snow in this region. The heavy, wet snow caused a tree to fall on a major transmission line, knocking out power to almost all of Eastern Upper Michigan, east of M-129, for several hours. Local power outages, caused by fallen tree limbs, were also reported in isolated areas across Northern Lower Michigan. There was $5,000 in property damage reported with this storm.

- **December 9, 1995:** A snowstorm moved across the Upper Peninsula and stalled near Sault Ste. Marie for nearly 24 hours, dumping a record 28 inches of snow on the city.
That eclipsed the city’s previous 24-hour snowfall record (15.2 inches, in 1988) by more than one foot. By the time the storm system passed on December 12, Sault Ste. Marie had received a total of 61.7 inches of snow. The excessive snowfall presented a great threat to public safety. Most city streets were impassable to emergency vehicles, and snowdrifts and piles restricted visibility at intersections and buried hundreds of fire hydrants. Schools and most businesses were closed due to the difficult conditions.

A Governor’s Emergency Declaration was granted on December 13 to provide assistance with snow clearance and removal activities. The Michigan National Guard was activated, along with work crews from the Michigan Department of Transportation and the Michigan Department of Corrections, to clear and remove snow. (The Guard alone removed more than 150,000 cubic yards of snow in five days.) The Michigan Family Independence Agency and Michigan Office of Services to the Aging provided assistance to senior citizens and other homebound individuals. The Michigan Department of Environmental Quality waived regulations to allow the disposal of clean snow into the St. Mary’s River. This storm alone cost the city an additional $50,000 - $60,000 in snow removal.

**Probability of Future Occurrences:** Severe winter weather incidents are documented more than once yearly. Using the formula established in Profile Methodology, the assessment reflects (25 events over [divide by] 6 years) x 100 = over 100 percent chance of occurrence, which corresponds to a high likely to occur rating.

**Impact Assessment:** The occurrence of major snowstorms, ice storms, and blizzards can have a considerable impact on communities, utilities and transportation systems. Ice storms often produce extensive damage over large regions. The impacts of an ice storm are amplified when frigid temperatures follow the storm. Snow and ice accumulates on roads, highways, railroads, and airport runways and halts transportation efforts. Ice can cause telephone and power lines and tree branches to break and fall, which may damage property, cause injury, and create hazardous conditions. Power outages may last for days, and in some cases, it may be weeks before power is restored to more remote rural areas. As people have become increasingly dependent on electricity for heating and cooking, the possibility of experiencing a loss of electricity for an extended period has become more critical. While some of the direct impacts of ice or heavy snowstorms are easily identified, these can produce a wide range of indirect impacts. Many of these are summarized below.

**Direct Impacts:** Ice or heavy accumulations of snow, particularly with blowing and drifting, temporarily impact the roadway system. Roads can become impassable with heavy icing or as snow accumulates faster than it can be cleared. Snow and ice resulting in icy road conditions lead to major traffic accidents and numerous minor accidents. Similarly, if roads and streets are icy or snow covered, it is also difficult for emergency service personnel to travel and may pose a secondary threat to life safety if police, fire, and EMS crews cannot respond to calls. Schools typically have to close. Ice or heavy accumulations of snow also require vast amounts of overtime for County and local highway and streets departments to remove snow and melt ice.
Additionally, a hypothermia situation may arise due to prolonged exposure to the cold when a person attempts to walk during the height of a major winter storm. Heavy accumulations of snow on rooftops can cause roofs to collapse, resulting in possible injury or death to those inside the building as well as damaging the contents of the building. Ice storms or high winds in winter storms can cause extensive loss of overhead utility lines due to buildup either on the lines or on adjacent trees that either collapse due to the weight or blow down onto the utility lines. Services such as telephone, electricity, and cable TV are frequently affected by winter storms.

**Indirect Impacts:** The indirect impacts are what separate an ordinary winter snowstorm, even a heavy snow, from a disaster. Heavy accumulations of snow or ice can bring down trees, utility lines, and communications towers. This can disrupt communications and electrical power for days while utility companies repair the damage. Loss of power, in conjunction with impassible roads can isolate people in rural areas and essentially shut down urban areas, effectively paralyzing the entire region. Also, many of the deaths that occur are indirectly related to the storm itself. Many of these results are from traffic accidents or heart attacks while shoveling snow. The indirect impacts of severe winter storms ripple past the actual hazard event. Economic costs incurred by loss of business as a result of the storm, property damages, overtime costs, loss of income due to closed business, and missed school days all have long-reaching effects. Increased amounts of snow may increase the risk of flooding in the spring. Other examples of indirect impacts include:

- **Agricultural losses.** Livestock, particularly dairy cattle can be highly vulnerable to the impacts of an ice storm, especially if freezing conditions exist for a long time and are accompanied by an extensive power outage. Daily operations are dependent on electricity for milking and watering the animals. Loss of revenue or even disease and death of the animals can result.
- **Home Health Care Services.** Recipients of home health care services, particularly in rural areas face disruption of services in the aftermath of an ice or heavy snowstorm. Providers may have difficulty in reaching patients due to debris or downed power lines blocking roadways. Electrically powered life support equipment will fail to operate in a power outage. This can have dire consequences to the patient if the outage is prolonged.
- **Communications.** Telecommunications can be disrupted due to a variety of factors. Most telephone and cellular carriers have emergency back-up power supplies for primary equipment. In many cases, the back-up power supply is designed to provide power for 48-hours or less. In the prolonged power outages possible with a major ice storm, this equipment will fail when the fuel for the generator runs out or the back-up batteries become discharged. Overhead telephone lines are also susceptible to the same problems as overhead electrical lines. The consequences of communications failure can be far reaching. Coordination of the public safety response to the event relies heavily on the ability to communicate. The response is invariably hampered when these systems fail.
- **Public water supply and wastewater treatment.** Water supply pumps and wastewater lift stations are vulnerable to prolonged loss of power. Many of these have back-up
power supply for short-term power outages. An ice storm, however, has the potential to cause power outages that may last for days. Underground water lines can freeze and break leading to loss of fresh water.

• **Severely damaged trees.** Ice or exceedingly heavy snow can cause substantial damage to trees in urban and rural areas. Damaged or fallen trees in urban areas block roads and sidewalks and can take down power lines. Downed or fallen trees in rural areas can lead to fire hazards in subsequent years as dead trees add to the fuel load. In either case, removal of downed trees and branches can be a significant problem and cost.

• **Residential impacts.** Loss of power for residential use can lead to a loss of household heating, freezing and bursting water pipes leading to loss of fresh water supply and flooded basements, sewage back-up, and the loss of the ability to cook food.

• **Provisions.** As is common in many disasters, supplies of flashlights, batteries, shovels, bottled water, fuel, and food supplies may be short in areas immediately affected by the storm. This creates a particular stress on low-income individuals and families that are not able to stock-up on these supplies, and may cause a panic on certain supplies as stock levels drop.

• **Economic loss.** Chippewa County residents rely heavily on roadways and automobiles to commute to and from work. When employees cannot get to their jobs, commerce can be affected, especially if the situation lasts for days. In addition, all of the primary and indirect impacts of a major snow or ice storm can have cascading economic consequences.

**Vulnerability Assessment:**

**Population**

While virtually all aspects of the population are vulnerable to severe winter weather, there are segments of the population that are more vulnerable to the potential indirect impacts of a severe winter storm than others, particularly the loss of electrical power. As a group, the elderly or disabled, especially those with home health care services that rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, Community Based Residential Facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. If they do not have a back-up power source, rural residents and agricultural operations reliant on electricity for heating and water supplies are also especially vulnerable to power outages.

Severe winter weather also increases the vulnerability of the commuting population. Traffic accidents occurring in winter conditions (snow or blowing snow) accounted for 1,091 accidents. Where road conditions were snowy, icy or slushy it is reported that there were 2,697 crashes over a 5 year period in Chippewa County. There were a total of 62 snowmobile accidents, 15 of which were due to snowy weather conditions over the same period, January, 2004 – December, 2009. While there is no way to quantify which of these accidents occur during severe winter storms versus regular winter storms, the numbers indicate that winter driving conditions raise the vulnerability of the commuting population. Overall, the population affected by severe winter weather is **high**.
General Property

Property vulnerabilities to severe weather include damage caused by high winds, ice, or snow pack and subsequently melting snow. Vehicles may be damaged by the same factors, or temporarily un-useable due to the driving conditions created by severe winter weather. Contents of homes, storage units, warehouses and storefronts may be damaged if the structures are compromised or fail due to the weather, or during potential flooding caused by melting snow. Very wet snow packs down densely and is very heavy. This may create strains on structures, causing partial or entire collapses of walls, roofs, or windows. This is impacted both by architecture and construction material, and should be assessed on a building-by-building basis. These records are probably tracked via insurance or other private vendors.

Essential Infrastructure, Facilities, and Other Important Community Assets

The physical structures which comprise essential infrastructure are as vulnerable as those outlined in the General Property subsection of this profile. Severe winter weather may also disrupt the availability of services from essential infrastructure, including utility delivery (gas, electric and water), telephone service, emergency response personnel capabilities, road plowing, and childcare availability. Severe winter storms may even halt the operation of the county for periods of time, making the vulnerability of the entire County even higher. As mentioned previously, ice or heavy accumulations of snow, particularly with blowing and drifting, can temporarily impact the roadway system. Snowbanks can become so high it makes it difficult to see at intersections resulting in a greater risk of traffic accidents. These accumulations also require vast amounts of overtime for County and local highway and streets departments to remove snow and melt ice. Ice storms or high winds in winter storms can cause extensive loss of overhead utility lines due to buildup either on the lines or on adjacent trees that either collapse due to the weight or blow down onto the utility lines. Services such as telephone, electricity, and cable TV are frequently affected by winter storms.

Natural, Historic and Cultural Resources

Natural resources may be damaged by the severe winter weather, including broken trees and death of unsheltered wildlife. Unseasonable storms may damage or kill plant and wildlife, which may impact natural food chains until the next growing season. Historical areas may be more vulnerable to severe winter storms due to construction and age of structures. Historical assets destroyed may never be able to be replaced resulting in a devastating loss for the public. Cultural resources generally experience the same vulnerabilities outlined in General Property, in addition to lost revenue impacts due to transportation impacts.

Estimating Potential Losses: The economic impact can be rated as High as the potential for property damage from snow accumulation, loss of life and injury resulting from transportation accidents or loss of power, and cost of response and clean-up would most likely total above the threshold of $25,000.
Mitigation Capabilities:  Chippewa County participates in national and state programs to mitigate or reduce the effects of severe winter weather including:

- **National Weather Service Doppler Radar** - The National Weather Service (NWS) has Doppler Weather Surveillance Radar, which can more easily detect severe weather events that threaten life and property – including storms that are likely to produce damaging hail. Most important, the lead time and specificity of warnings for severe weather have improved significantly.

  Doppler technology calculates both the speed and the direction of wind motion inside of severe storms. By providing data on the wind patterns within developing storms, the system allows forecasters to better identify the conditions leading to severe weather such as tornadoes, severe straight-line winds, lightning and damaging hail. This means early detection of the precursors to severe storms, as well as information on the direction and speed of storms once they form.

- **National Weather Service Watches/Warnings** - The National Weather Service issues winter storm watches and winter weather warnings to notify the public of severe winter weather conditions. A winter storm watch indicates that severe winter weather conditions (freezing rain, sleet, or heavy snow) may affect an area, while a winter weather warning indicates that severe winter weather conditions are imminent.

  Winter storm warnings can be issued for snow alone, but they also can take on different varieties. For example, a blizzard warning signifies that blizzard conditions are imminent or occurring. Blizzard conditions mean that the visibility will frequently be one-quarter mile or less in falling or blowing snow, with wind speeds at least 35 miles per hour. A wind chill warning is issued when wind chills drop below -30 degrees Fahrenheit, with winds equal to or greater than 10 miles per hour. Finally, an ice storm warning is issued for a significant accumulation of ice, normally a coating of at least one-quarter inch.

  The National Weather Service also issues a number of different advisories for winter weather. These advisories can be issued for snow, freezing rain, blowing snow, and wind chill, among other things. Advisories mean that conditions are expected to cause significant inconveniences and may be hazardous. However, if caution is exercised, the situation should not become life threatening.

  The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), National Oceanic and Atmospheric Administration (NOAA) weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The National Weather Service stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The National Weather Service
also provides detailed warning information on the Internet, through the Interactive Weather Information Network (IWIN).

- **Urban Forestry/Tree Maintenance Programs** - Urban forestry programs can be very effective in minimizing snowstorm damage caused by falling trees or tree branches. In almost every severe snowstorm, falling trees and branches cause power outages and clog public roadways with debris. However, a properly designed, managed and implemented urban forestry program can help keep tree-related damage and impact to a minimum. To be most effective, an urban forestry program should address tree maintenance in a comprehensive manner, from proper tree selection, to proper placement, to proper tree trimming and long-term care.

  When proper pruning methods are employed, and when the work is done on a regular basis with the aim of reducing potential storm-related damage, these programs can be quite effective. Often, however, tree trimming work is deferred when budgets get tight or other work is deemed a higher priority. When that occurs, the problem usually manifests itself in greater storm-related tree debris management problems down the line.

  Chippewa County also participates in tree planting along road right of ways to reduce the blowing snow and accumulating snow drifts along the highways.

**Mitigation Alternatives for Snowstorms**

- Increased coverage and use of NOAA Weather Radio.
- Producing and distributing family emergency preparedness information relating to severe winter weather hazards.
- Including safety strategies for severe weather events in driver education classes and materials.
- Tree trimming and maintenance to prevent limb breakage and safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)
- Buried/protected power and utility lines. (NOTE: May cause additional problems and costs in case of breakage, due to the increased difficulty in locating and repairing the problem.)
- Establishing heating centers/shelters for vulnerable populations.
- Organizing outreach to isolated, vulnerable, or special-needs populations.
- Encouraging residents to develop a Family Disaster Plan which includes the preparation of a Disaster Supplies Kit.
- Proper building/site design and code enforcement relating to snow loads, roof slope, snow removal and storage, etc.
- Farmer preparedness to address livestock needs/problems.
- Pre-arranging for shelters for stranded motorists/travelers, and others.
- Maintaining adequate road and debris clearing capabilities.
- Using snow fences or "living snow fences" (rows of trees or vegetation) to limit blowing and drifting of snow over critical roadway segments.
- Pre-planning for debris management staging and storage areas. (Debris is usually the sleet and ice itself being cleared from roads and roofs, or vegetation such as tree branches that have fallen under the impact of winds or the weight of ice. Broken power or phone lines that had frozen or been weighted down by ice or fallen branches could be part of the problem. In some cases, roofs may collapse under the weight of ice and snow. Some storage areas will definitely be needed for snow removal during blizzards.)

Summary

Overall, severe winter storms present a high risk for Chippewa County. The events occur frequently and over significant portions of the county, maximizing the potential to impact exposed population and structures, and have far reaching indirect impacts. Reports of damage to property and the impacts on essential infrastructure are high. The following table provides the methodology for how all aspects of the hazard profile were evaluated to establish an overall hazard rating.

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Thunderstorm/High Wind/Hail/Lightning

Description: A thunderstorm is a form of weather characterized by the presence of lightning and its acoustic effect on the earth's atmosphere known as thunder. The meteorologically-assigned cloud type associated with the thunderstorm is the cumulonimbus. Thunderstorms are usually accompanied by strong winds, heavy rain and sometimes snow, hail, or no precipitation at all and therefore those hazards have been combined into this one profile. Those thunderstorms which cause hail to fall are known as hailstorms. Thunderstorms may line up in a series or rainband, known as a squall line. Strong or severe thunderstorms may rotate, known as supercells. While most thunderstorms move with the mean wind flow through the layer of the troposphere that they occupy, vertical wind shear causes a deviation in their course at a right angle to the wind shear direction. Thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth's surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of air that spreads
out at earth's surface and causes strong winds associated with thunderstorms. Thunderstorms are most likely to happen in the spring and summer months and during the afternoon and evening hours but can occur year-round and at all hours. The biggest threats from thunderstorms are flash flooding and lightning. In most cases, flash flooding occurs in small drainage areas where water quickly accumulates before it drains to the flood plains. When taken together, these local drainage problems can be as great a problem as over bank flooding.

**Lightning**, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000°F. The rapid heating and cooling of the air near the channel causes a shock wave which produces thunder.

Other threats from thunderstorms include downburst winds, **high winds, hail** and tornadoes. Downburst winds are strong, concentrated, straight-line winds created by falling rain and sinking air that can reach speeds of 125 mph (200 km/h).

Hailstones are ice crystals that form within a low-pressure front due to warm air rising rapidly into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation. The size of hailstones is a direct function of the severity and size of the storm. Significant damage does not result until the stones reach 1.5 inches in diameter, which occurs in less than half of all hailstorms.

The National Weather Service classifies a thunderstorm as severe if its winds reach or exceed 58 mph, produces a tornado, or drops surface hail at least 0.75 inch in diameter. Compared with other atmospheric hazards such as tropical cyclones and winter low pressure systems, individual thunderstorms affect relatively small geographic areas. The average thunderstorm system is approximately 15 miles in diameter (75 square miles) and typically lasts less than 30 minutes at a single location. However, weather monitoring reports indicate that coherent thunder-storm systems can travel intact for distances in excess of 600 miles.

**Geographic Extent:** Thunderstorms can occur anywhere in Chippewa County and typically travel across the whole County. Given these facts, the geographic extent rating is **extensive**.

**Historical Events:** The National Weather Service and the National Climatic Data Center (NCDC) maintains a listing of reported thunderstorms from January 1, 1950 to February 28, 2010 including: strong winds, high winds, thunderstorm winds, lightning and hail events. In Chippewa County there were 3 strong wind events, 7 high wind events, 35 thunderstorm wind events, 1 lightning event, 32 hail events.

**June 6, 2008:** Warm and humid air surged northward into Northern Michigan on the 6th. A strong low pressure system moved into the region late in the day, helping to spawn numerous thunderstorms, several of which became severe. Hail was reported in Kelden area.
May 13, 2008: Thunderstorms marched across Eastern Upper Michigan early in the morning of the 13th. Lightning struck a large pine tree just outside the administration building of Tahquamenon Falls State Park. The tree was blasted into pieces, and most of the electronic equipment in the administration building was destroyed. Some electrical damage also occurred in a staff building, not quite an eighth of a mile away.

August 28, 2007: A small line of thunderstorms produced wind damage in central Chippewa County. A shed was damaged, and several large tree limbs were downed, causing $7,500 in property damages.

July 5, 2007: Thunderstorms ignited off of lake breezes as they pushed inland. A number of storms produced large hail in Pickford area.

June 7, 2007: Winds gusted up to 50 mph behind a cold front. With trees fully leafed out, some tree damage occurred. A power pole was knocked over 12 miles south of Paradise, starting a fire.

March 26, 2007: An upper level disturbance ignited a band of showers and embedded thunderstorms, which moved into Northern Michigan from the southwest. A few storms in the band produced marginally large hail.

July 16/17, 2006: Numerous trees and power lines downed in western Chippewa County on the 16th. A line of severe thunderstorms marched across Eastern Upper Michigan soon after dawn, bringing sporadic wind damage. A strong cold front ran headlong into warm and humid air in place over Michigan. Thunderstorms ignited by midday on 17th in Eastern Upper Michigan, and became widespread by late afternoon in Northern Lower Michigan. A large number of storms became severe, as this became the largest severe weather outbreak in Northern Michigan in several years. Trees were downed near Lower Tahquamenon Falls.

August 9, 2005: A line of thunderstorms, which formed on the 8th in the Dakotas, held together as it moved across the northern tier of states. The squall line reached eastern Upper Michigan early in the afternoon of the 9th, producing pockets of wind damage. Large tree limbs were downed onto a road. The storm system travelled east across the County with damages reported in Eckerman, Raber and DeTour Village.

Probability of Future Occurrences: Thunderstorms are infrequent in the area and tornadoes rarely occur. Thunderstorms occur on about 27 to 29 days each year. The frequencies of past thunderstorm/high wind/lightning/hail events provide a base line to predict the risk of future occurrences. Thunderstorm winds and Hail events are documented multiple times each year, and there are no climactic indications that these occurrences will change in the measurable future. Based on the past history of events, severe thunderstorms including high wind, lightning and hail has a 100 percent chance of occurrence in a given year, which correlates to a highly likely occurrence rating.
**Impact Assessment:** Many hazardous weather events are associated with thunderstorms. Lightning is responsible for starting forest fires, as well as causing deaths when people are struck. Under the right conditions, rainfall from thunderstorms causes flash flooding, which can change small creeks into raging torrents in a matter of minutes. Hail up to the size of softballs damages cars and windows, and kills wildlife caught out in the open. Strong (up to more than 120 mph) straight-line winds associated with thunderstorms can knock down trees and power lines. Tornadoes (with winds up to about 300 mph) can destroy all but the best-built man-made structures.

**Direct Impacts:** High winds, heavy rains, and hail can damage vegetation and stir up sediment in waterways disrupting the ecosystems. The impact that severe summer storms have on the environment is through the spawning tornados, flooding, and increased chance of wildfires from lightning strikes. Strong winds associated with severe thunderstorms or other phenomena can cause extensive damage and can result in deaths or injuries. Damage depends on both the wind speed and the nature of the objects in the path of the storm. Strong winds can turn debris and un-tethered objects into missiles. Even heavy vehicles can be rolled over. Homes and large buildings can sustain damage from the direct force of the wind. Broken windows and damaged roofs are common. Falling limbs and trees are also common and can contribute to property damages and downed power lines. Manufactured homes and metal sheds can be destroyed, particularly if they are not fastened to a foundation. Power and communications outages are also common, and storm debris in roads can disrupt transportation and delay emergency response vehicles. Farm operations can also be heavily impacted by windstorms. Winds can flatten farm crops such as corn and tobacco, and destroy orchard crops such as apples.

**Indirect Impacts:** The indirect social and economic impacts of wind damage are typically associated with the loss of electrical power. Given our society’s heavy reliance on electric power, any disruption in the supply, even for a short time period, can have significant consequences.

**Vulnerability Assessment:**

Essentially all Chippewa County buildings, critical facilities, and populations are vulnerable to damage during a thunderstorm.

**Population**

Some segments of the population are especially vulnerable to the indirect impacts of damaging wind, particularly the loss of electrical power. As a group, the elderly or disabled, especially those with home health care services relying on rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, Community Based Residential Facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. Without a back-up power source, rural residents and agricultural operations reliant
on electricity for heating, cooling, and water supplies are also especially vulnerable to power outages.

**General Property**

In terms of property losses, the actual damages will depend on the building density in the impacted area. This is highly variable across the County. A severe thunderstorm with high winds in an older residential area with older homes, large trees, and overhead utility lines will have a significantly greater impact with the same storm in a new development with lower building density, modern constructed buildings, small or newly planted trees, and underground power lines.

In terms of crop losses, the actual damages that occur will depend on the type of crop and the growth stage of the plants. A wind storm in a rural area in the early spring when the plants are just emerging will have much less of an impact than a storm of the same intensity occurring later in the growing season when the plants are more susceptible to damage and when there is no time to replant if the crop is a total loss.

**Essential Infrastructure, Facilities, and Other Important Community Assets**

Critical facilities are susceptible to the same damage and disruption from thunderstorms as other buildings. Power lines, communications networks, and other above-ground infrastructure are vulnerable to the effects of windstorms both directly and indirectly. The wind itself may damage the infrastructure, or the wind may damage tree branches and throw other debris into the air, which may cause secondary damage to buildings and critical facilities or capabilities. Emergency response vehicles with high profiles may be more exposed to high winds, which may hinder response times. Emergency operations can be disrupted as thunderstorms and lightning affect radio communications and antennas are a prime target for lightning. In addition, wind may exacerbate dangerous conditions, such as fires, making response more difficult and dangerous. These are unlikely events but they are severe in occurrence.

**Natural, Historic and Cultural Resources**

Age and construction may impact the vulnerability of cultural or historic resources. Natural resources are vulnerable to damage such as broken or uprooted trees, flattened plant life, or, when wind is combined with extreme heat, severe drying and heightened fire risks. In addition, there is limited means of protecting these resources from wind damage.

**Estimating Potential Losses:** The economic impact has the potential to be high depending upon the damage a storm inflicts on the community. Damage to property and power lines and the resulting repairs and clean up could see costs rising above the $25,000 limit set for the high criteria, therefore, the Economic Impact is rated at high for this hazard.

**Mitigation Capabilities:** Chippewa County has been designated as a StormReady Community. The StormReady program is intended to encourage severe weather preparedness activities in communities that have achieved a notable level of preparedness. The public recognition comes...
in the form of "accreditation" when the community has net criteria collaboratively established by Emergency Managers and the National Weather Service.

The primary beneficiaries of the StormReady program will be the people who live in the accredited communities. They can take comfort in the fact that their community leaders have achieved some standard level in protecting them from hazardous weather. Although StormReady does not mean storm proof, it can provide people with a greater sense of safety.

**Mitigation Alternatives**

- Increased coverage and use of NOAA Weather Radio.
- Producing and distributing family emergency preparedness information relating to thunderstorm hazards.
- Public education and awareness of thunderstorm dangers.
- Training and increased use of weather spotters.
- Public early warning systems and networks.
- Tree trimming and maintenance to prevent limb breakage and to safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)
- Buried/protected power and utility lines. (NOTE: May cause additional problems and costs in case of breakage, due to the increased difficulty in locating and repairing the problem.)
- Inclusion of safety strategies for severe weather events in driver education classes and materials.
- Encourage residents to develop a Family Disaster Plan which includes the preparation of a Disaster Supplies Kit.
- Pre-planning for debris management staging and storage areas. (Debris could be rubble, vehicles, objects from destroyed/damaged structures, vegetation or other items knocked down or blown by winds.)
- Using structural bracing, window shutters, laminated glass in window panes, and hail-resistant roof shingles to minimize damage to public and private structures.
- Pre-planning for debris management staging and storage areas. (Debris is usually vegetation such as tree branches that have fallen under the impact of hail, or broken power or phone lines that had frozen or been weighted down by ice or fallen branches.)
Summary

Based on the previous assessments, the overall risk rating for Thunderstorms including high wind, hail and lightning is moderate.

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Wildfires

Description: A wildfire is an uncontrolled fire in forested areas, grass or brushlands. The most immediate dangers from wildfires are the destruction of homes and timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using the recreational facilities in the area. Long-term effects can be numerous and include scorched and barren land, soil erosion, landslide/mudflows, water sedimentation, and loss of recreational opportunities.

The Michigan Department of Natural Resources (MDNR) Forest Management Division directs and coordinates wildfire prevention, containment and suppression activities on all non-federal lands in the state, as well as Indian Reservations (under contract with the U.S. Bureau of Indian Affairs). The MDNR places great emphasis on wildfire prevention and public education, since the vast majority of wildfires in Michigan are caused by human activity. The MDNR Forest Management Division’s philosophy is that preventing fires from starting in the first place, and taking precautionary measures around rural homes to stop the spread of wildfires, are the best means of avoiding or minimizing wildfire losses. When conditions of extreme fire hazard exist, the MDNR can request the Governor to issue an outdoor burning ban to mitigate the potential for wildfire in all or part of the state. Such a ban restricts smoking, fireworks, and outdoor burning activities to approved locations.

Geographic Extent: Forests cover the largest area in Chippewa County covering almost three quarters of the County. The forest cover is good for both industry and recreation. However, it also makes many areas of the county potentially vulnerable to wildfires. Most Michigan wildfires occur close to where people live and recreate, which puts people, property and the environment at risk. Development in and around rural forested areas often increases the potential for loss of life and property from wildfires. The rating for geographic extent is Extensive.
Historical Events: The Governor has invoked an emergency proclamation ban on open fires four times. Most recently in August of 2007 Governor Jennifer M. Granholm addressed Extreme Fire Danger across the state by forbidding open fires and smoking in forested areas. Previous to that, Governor George Romney in 1963, Governor James Blanchard in 1988 and ten years later, Governor John Engler invoked a limited proclamation in 39 counties of Northern Lower Michigan and the Upper Peninsula. Overall, debris burning remains the leading cause of wildfires whose causes were determined.

Probability of Future Occurrences: Records from the DNR report that there were 270 wildfires that occurred from 1983-2007 with an average of 11 per year in Chippewa County. Approximately, 3,259 acres were destroyed which averages out to 136 acres per year. The probability of wildfires occurring increases during times of drought conditions. Based on this information the rating is highly likely for future occurrences.

Impact Assessment: Wildfires in the state of Michigan are generally underestimated in regard to number and losses. The Michigan Department of Natural Resources estimates that 8,000 to 10,000 wildfires occur each year in this state. While most of these are small wildfires - burning between 5 and 50 acres -- many wildfires exceed 100 acres and some have consumed thousands of acres. In addition, each year 100 to 200 homes and buildings are either lost or damaged due to wildfires. Because most wildfires are caused by human activities, the number of wildfires and losses can be reduced if residents would take more precautions. Wildfires encompass environment, properties, economic loss, and most unfortunately many lives. Public lands use, private lands, animals, tourism, merchants, schools and health institutions are just a few that experience losses. To assess an exact dollar amount may never be touchable. After the wildfires, there are years of recovery in all of these areas.

Direct Impacts: When a wildfire burns in an uncontrolled or unexpected manner it can have major direct impacts on life and property. It is particularly dangerous when it encroaches into urban areas, or when it moves faster than the local capability of fire suppression technology can handle. Sometimes, wildfires can exceed the warning time and evacuation capabilities of the population which greatly increases the direct impact on human life. Power lines can be destroyed if in the path of a wildfire. Wildfires also exhibit a number of positive direct impacts, mostly connected to the continued renewal of a healthy ecological balance in natural areas. However, according to the Michigan Department of Natural Resources, the majority of fires in Michigan are started by humans and are not, therefore, part of the natural ecologic process.

Indirect Impacts: Indirectly, wildfires create a significant drain on resources and manpower, as large fires are extremely complicated, require large commitments of resources and personnel, and may cause extensive personal and property damage. Soils can become contaminated and agriculture crops damaged or destroyed.

Vulnerability Assessment: The large number of permanent and seasonal homes in the County, coupled with the increase in tourists during the most dry (and therefore most vulnerable) times of the year, greatly increases the vulnerability risk from wildfires.
**Population**

The most vulnerable population are those living in the wildland-urban interface (WUI) zones, where residential properties are directly intruding into traditional wildland areas. The exposure of the population in these zones increases with the exposure of the corresponding general property, examined in the section below. Other exposed groups include children, the elderly, or those with breathing conditions who may be exposed to high levels of smoke. Populations living in long term care facilities or other skilled care facilities face additional exposures because of increased evacuation times and the potential that the population may be required to shelter in place. Overall, the vulnerability of the population to wildfires is medium.

**General Property**

Any material that is flammable is vulnerable during a wildfire, including structures and personal property. The vulnerability of general property increases as the distance of the property to wildfire-prone areas decreases, and is particularly high for structures located in the WUI. These structures receive an even higher level of vulnerability if the properties surrounding them are not properly mitigated for fire. Appropriate mitigation techniques include using non-flammable materials such as concrete for construction, leaving appropriate spaces between buildings and vegetation areas filled with non-flammable materials (such as decorative rock or stone), and clearing of underbrush and trees. However, the majority of general property is not located in these WUI zones and therefore experiences a minimal exposure to the hazard. If a wildland fire were to cross completely into an urban zone, the damage would be extensive and there would likely be a higher exposure of property. Overall, the exposure of general property in the County is medium.

**Essential Infrastructure, Facilities, and Other Important Community Assets**

These aspects of the County may be exposed directly or indirectly to wildfire. Direct exposures are similar to those of General Property and increase as the infrastructure or facilities and capabilities moves into the WUI zone. Communications lines passing through susceptible areas such as forests are more exposed than those located in cities and other more urban areas. The indirect exposure of response capability increases seasonally and with the number of occurrences. Though the populations making up the response capability are not directly exposed to all fire events, the response of some of the personnel to an event lessens the capabilities overall for response to other emergency situations. If there is a large increase in the number of simultaneous wildland fires, even small ones, the response capability of the County could easily be compromised. This is not considered likely, however, and the overall vulnerability rating is low.

**Natural, Historic and Cultural Resources**

Some natural resources and natural areas may benefit from wildland fire, as at some level they must also be exposed to wildfire for a healthy ecological development of the area. Historic and cultural resources exhibit a vulnerability rating similar to those in general property, where vulnerability ratings increase the further into the WUI the property is, and the less
mitigated the landscaping surrounding the property is. In addition, older buildings may be exempt from internal fire mitigation such as sprinklers and fire suppression technology, which may increase the vulnerability of the resource as a total loss once already on fire. Overall, the vulnerability rating is **low**.

**Estimating Potential Losses:** The cost of suppression resources as well as potential life and property damage allow for the economic impact for the wildfire hazard to be rated **High**.

**Mitigation Capabilities:** In 2010, Chippewa County started a Firewise Program in Whitefish Township. Planning efforts have begun to determine and map the wildland-urban interface, educate the public, assess property and develop a Community Wildfire Protection Plan.

**Mitigation Alternatives:**
- Proper maintenance of property in or near wildland areas (including short grass; thinned trees and removal of low-hanging branches; selection of fire-resistant vegetation; use of fire resistant roofing and building materials; use of functional shutters on windows; keeping flammables such as curtains securely away from windows or using heavy fire-resistant drapes; creating and maintaining a buffer zone (defensible space) between structures and adjacent wild lands; use of the fire department's home safety inspections; sweeping/cleaning dead or dry leaves, needles, twigs, and combustibles from roofs, decks, eaves, porches, and yards; keeping woodpiles and other combustibles away from structures; use of boxed or enclosed eaves on houses; thorough cleaning-up of spilled flammable fluids; and keeping garage areas protected from blowing embers).
- Safe disposal of yard and house waste rather than through open burning.
- Keep handy household items that can be used as fire tools; a rake, axe, hand/chainsaw, bucket and shovel.  (Installation and maintenance of smoke detectors and fire extinguishers, smoke alarms on each floor of buildings and homes, with monthly tests and batteries changed twice per year and family members instructed in fire extinguisher use—these are all relevant for preventing structural fires that might spread to adjacent lands, but are of limited value in the reverse case in which an existing wildfire threatens structures, escape routes, etc.)
- Post fire emergency telephone numbers.
- Use of structural fire mitigation systems such as interior and exterior sprinklers, smoke detectors, and fire extinguishers.
- Arson prevention activities, including reduction of blight (cleaning up areas of abandoned or collapsed structures, accumulated junk or debris, and lands with a history of flammable substances stored, spilled, or dumped on them).
- Public education on smoking hazards and recreational fires.
- Proper maintenance and separation of power lines. Ask the power company to clear branches from power lines.
- Efficient response to fallen power lines.
- Training and exercises for response personnel.
- GIS mapping of vegetative coverage, for use in planning decisions and analyses through comparison with topography, zoning, developments, infrastructure, etc.
- Create and enforce local ordinances that require burn permits and restrict campfires and outdoor burning.
- Mutual aid pacts with neighboring communities.
- Prescribed burns and fuel management (thinning of flammable vegetation, possibly including selective logging to thin out some areas. Fuels cleared can be given away as firewood or made into wood chips for distribution.)
- The creation of fuel breaks (areas where the spread of wildfires will be slowed or stopped due to removal of fuels, or the use of fire-retardant materials/vegetation) in high-risk forest or other areas.
- Keeping roads and driveways accessible to vehicles and fire equipment—driveways should be relatively straight and flat, with at least some open spaces to turn, bridges that can support emergency vehicles, and clearance wide and high enough for two-way traffic and emergency vehicle access (spare keys to gates for properties should be provided to the local fire department, and an address should be visible from the road so homes can be located quickly).
- Enclosing the foundations of homes and buildings rather than leaving them open with their underside exposed to blown embers or materials.
- Have adequate water supplies for emergency firefighting (in accordance with NFPA standards). For residents, identify and maintain an adequate outside water source such as a small pond, cistern, well, swimming pool or hydrant; have a garden hose that is long enough to reach any area of the home and other structures on the property; install freeze-proof exterior water outlets on at least two sides of the home and near other structures on the property. Install additional outlets at least 50 feet from the home; consider obtaining a portable gasoline powered pump in case electrical power is cut off.
- Obtaining insurance.
- Including wildfire safety information in materials provided by insurance companies to area residents.

**Summary:** The following table shows the overall risk for wildfires rating to be **High.**

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Drought

**Description:** Common to all types of drought is the fact that they originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (say, a few weeks or a couple months), the drought is considered short-term. But if the weather or atmospheric circulation pattern becomes entrenched and the precipitation deficits last for several months to several years, the drought is considered to be a long-term drought. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

Many quantitative measures of drought have been developed in the United States, depending on the discipline affected, the region being considered, and the particular application. Several indices developed by Wayne Palmer, as well as the Standardized Precipitation Index, are useful for describing the many scales of drought.

The **Palmer Z Index** measures short-term drought on a monthly scale. The Palmer **Crop Moisture Index (CMI)** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.

The **Palmer Drought Severity Index (PDSI)** (known operationally as the Palmer Drought Index (PDI)) attempts to measure the duration and intensity of the long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during the current month is dependent on the current weather patterns plus the cumulative patterns of previous months. Since weather patterns can change almost literally overnight from a long-term drought pattern to a long-term wet pattern, the PDSI (PDI) can respond fairly rapidly.

The Palmer Drought Index uses temperature and rainfall information to determine dryness or wetness over a period of time. The index is based on the supply-and-demand concept of the water balance equation, which takes into account not only the precipitation deficit at a specific location, but the water content of the soil as well. The values generated for the Palmer Index generally range from −6.0 to +6.0, with negative values indicating drier conditions and positive values indicating wetter conditions. A value range of −/+/0.5 indicates “normal” conditions, while values greater than +4.0 or −4.0 indicate periods of extreme wetness or extreme drought, respectively.

The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The **Palmer Hydrological Drought Index (PHDI)**, another long-term drought index, was developed to quantify these hydrological effects. The PHDI responds more slowly to changing conditions than the PDSI (PDI).

While Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff), the **Standardized Precipitation Index (SPI)** is a probability index that considers only precipitation. The SPI is an index based on
the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive. The SPI is computed by NCDC for several time scales, ranging from one month to 24 months, to capture the various scales of both short-term and long-term drought.

**Geographic Extent:** Drought is a regional phenomenon and affects the entirety of Chippewa County relatively simultaneously. The geographic extent rating is considered extensive.

**Historical Events:** The history of past drought events was gathered from NCDC data, newspaper reports and other data sources as cited.

**8/7/2007** - Drought conditions (severe, D2) expanded eastward into Eastern Upper Michigan during August. It was a dry summer in the region, especially in the Upper Peninsula. Dryness started in late May, with just 0.30 inches of rain at Sault Ste. Marie after May 16th through the end of the month. June rainfall of 1.74 inches was 1.26 inches below normal. Similarly, July rainfall at the Sault was 1.50 inches, 1.64 inches below normal. August rainfall totaled 1.03 inches, a full 2.44 inches below normal. The hay crop in Eastern Upper Michigan was 50 to 70 percent of normal. The resulting lack of feed led some farmers to cut their cattle herds. A burning ban was issued for the majority of the state in mid-August, the first such ban since 1998. Significant rains in September would eventually alleviate the drought.

**9/1/2007** - Drought conditions (severe, or D2) carried over from August in Eastern Upper Michigan and far Northern Lower Michigan. Several rain events eased the drought by mid-month. The area received half an inch to an inch of rain on September 3-4, again on the 7th, and again on the 11th.

**July-September, 2005** - According to the Midwestern Regional Climatic Center both Lake Superior and Lake Michigan-Huron levels started declining in August, 2005, a full month ahead of the normal lake level seasonal cycle. The U.S. Army Corp of Engineers reduced the flow of Lake Superior water into Lakes Michigan and Huron by 14% to slow the rate of fall of Lake Superior levels. Lake Michigan-Huron levels are a couple inches lower than last year at this time, erasing recent improvements in lake level. The Michigan-Huron level is now creeping once again towards low lake stand records. While a few wet weeks can greatly help the soil moisture situation, as happened in August, the long term hydrological dryness will require months of copious moisture during the cold season to recover fully.

**From 1998-2001,** Michigan experienced a series of droughts. These droughts caused considerable damages to the industries in these areas. In Michigan, during the summer of 2001, a severe drought caused damage to, or destroyed, 1/3 of the state's crops, such as fruits and vegetables. This resulted in a U.S. Department of Agriculture Disaster Declaration that included 82 of Michigan’s counties.
**Probability of Future Occurrences:** Figure 1 shows the average Palmer Index values from 1895 to 2010. Chippewa County has experienced Palmer Index values that would indicate extreme drought three times: 1896, 1911, and 1931. The graph also indicates a period of moderate drought over a four year period from 1998-2001. More recent years show drought levels in 2006 and 2007. This graph takes into consideration all months of the year.

![Palmer Drought Severity Index](image)

Figure 5 - National Oceanic and Atmospheric Administration, National Climatic Data Center

Using the formula established in **Profile Methodology**, the assessment reflects (9 drought incidents where the NDSI was -3.0 or lower over [divide by] 114 years) x 100 = 8 percent chance of occurrence and a **medium** likely occurrence rating.

**Impact Assessment:**

**Direct Impacts:** There are many ways a community can be affected if a drought were to occur. There can be a shortage of water in the area for drinking, agriculture, power generation, or other uses. This is often accompanied by a drop in both the quality and quantity of crops in the area, as well as a drop in the quality of natural bodies of water. Due to a lack of water, there can also be increased numbers of wildfires in the area. These are just a few of the many problems that can occur due to a drought.

Urban areas will suffer because they are more vulnerable to water shortages. This is because of the increased number of people competing for a limited water supply. This is
especially true for children and the elderly who may be more affected by the warmer weather. Restrictions may be imposed on watering lawns or washing vehicles.

The rural areas of Michigan can be affected as well. A drought is most influential on the crops and livestock that are found in these areas. The drought can greatly affect the quantity and quality of these crops. This effect on crops can hurt the financial well-being of the people who depend on them. The size of forest fires in the area can also be influenced.

**Indirect Impacts:** Major highway damage was noted in several states due to heaving of road surfaces. Crops were stunted in the southern and eastern parts of the Midwest due to the combination of heat and lack of rainfall. Milk production at dairy farms was also hard hit, and thousands of cattle, pigs, and chickens died due to the heat.

**Vulnerability Assessment:** Community water supply systems that obtain their water from surface water sources have the potential to be affected by severe drought conditions when stream flow amounts and the flow of shallow groundwater that feeds surface water bodies are reduced. For many communities in Chippewa County, the lack of any serious drought threat in recent memory and living in the Great Lakes basin has fostered a sense of security concerning the adequacy of their supply. In many cases a sense of security is warranted; in other cases, it is not. With record low water levels in the Great Lakes the communities of Chippewa County need to be aware of the potential vulnerability to drought.

**Population:** The general population of Chippewa County is vulnerable to severe drought situations with the elderly and very young at most risk. Entire communities in the County may be affected if water supplies dry up. During periods of drought there is a higher incident rate of certain infectious diseases.

**General Property:** Chippewa County’s watershed’s, wetlands, agriculture land and forest land is all vulnerable to drought. In the forest, dry conditions lead to lower overall production of fruits and nuts, something called “mast.” Although, in some cases, the current year response may be the opposite. Trees and other plants produce less palatable browse, in both quantity and quality. Some herbaceous species go into dormancy earlier. Reductions of these energy rich food sources result in less fat build-up among herbivores. Those wildlife species that remain resident throughout the winter may not have enough reserves to survive. Those that migrate will have a more difficult passage and will need good food supplies at their destinations, if they arrive.

Poorer habitat quality has ramifications beyond the summer. Trees and shrubs will produce fewer flower buds. That means that next year, there will, again, be a lower amount of fruits and nuts. Aspen will have fewer flower buds to feed wintering ruffed grouse. Increased mortality of perennial vegetation leaves cover gaps needed for over-wintering, breeding and shelter from predators and foul weather. Vegetation on sandy and shallow soils is particularly vulnerable.
Reduced lake levels are more than just a recreational inconvenience. Exposed structure reduces habitat for certain fish species. Wider shorelines increase the risk of predation by animals that utilize these riparian zones. Of course, this is good if you’re a hawk, owl or coyote. It also may be good to re-establish and invigorate some wetland plant species – if the lake reductions aren’t long term.

**Essential Infrastructure, Facilities, and Other Important Community Assets:** Production of electricity at the Edison Sault Power Plant will be less and more costly if the power company has to purchase the power from other sources. Without the normal water pressure holding them up, seawalls will buckle and collapse, requiring expensive repairs. Also threatened are freshly exposed wood pilings under many docks. Long-submerged sections are prone to rot when exposed to air. Low water levels are threatening to local marinas and recreational boaters. Canals are too shallow, launching ramps fall short of the water’s edge, and many boat slips are simply off-limits. High cost of dredging face many local resort owners who rely on water recreational tourism for their living.

**Natural, Historic and Cultural Resources:** A long term drought accompanied by higher seasonal temperatures will have a detrimental effect on older buildings making them more vulnerable to fire hazard. Natural and historic resources are a big tourism draw to the area, some of which are related to water levels in lake and rivers and low levels will have an economic effect as well as being detrimental to the plants and wildlife.

**Estimating Potential Losses:** Low water levels hurt shippers and manufacturers and create inflationary pressure. The impact is widespread. Giant cargo ships must lighten their loads to avoid running aground. And with their supply lines pinched, steel manufacturers and coal-burning power plants have to dip into their stocks of iron ore, coal, and other raw materials. The low water is lifting power prices, too. Less water means hydropower plants can’t generate as much electricity, and producers are increasing prices where possible. Many communities rely on lakes and rivers for recreational tourism as well as livelihoods for commercial fisherman. The economic impact is far reaching.

**Mitigation Capabilities:** Strategies for drought preparedness focus mainly on water conservation. Local communities should consider drought contingency planning in their emergency planning efforts because drought conditions will lead to higher risk for other hazards such as wildfires or public health emergencies.

Sustainable agriculture is good for the environment as well as for people. Sustainable agriculture refers to practices that optimally utilize resources to provide the best quality agricultural products. There are numerous ways in which agriculture can be considered sustainable. Taking advantage of the unique characteristics of local resources is one of the hallmarks of sustainable agriculture. Planting crops that are native to an area often means that they will be more resilient and grow with fewer complications. Additionally these local crops often require less fertilizer and pesticides and are believed to be healthier for us to eat. Consistently employing these practices helps to keep land viable for longer periods of time. This
allows more high quality food to be produced locally. If these practices are used, particularly in areas where food production is limited, there will be greater access to higher quality food in more places.

The following are established practices of soil and water conservation:

- Crop rotation
- Contoured row crops
- Terracing
- Tillage practices
- Erosion-control structures
- Water retention and detention structures
- Windbreaks and shelterbelts
- Litter management
- Reclamation of salt-affected soil.

Soil and water conservation can be approached through agronomic and engineering measures. Agronomic measures include contour farming, off-season tillage, deep tillage, mulching and providing vegetative barriers on the contour. These measures prevent soil erosion and increase soil moisture.

Engineering measures differ with location, slope of the land, soil type, and amount and intensity of rainfall. Measures commonly used are the following:

- **Contour bunds, trenches and stone walls**
  These features prevent soil erosion and obstruct the flow of runoff. The retained water increases soil moisture and recharges the groundwater.

- **Check dams and other gully-plugging structures**
  Check dams are temporary structures constructed with locally available materials. Types of check dams are the brush-wood dam (Fig. 2 a), the loose-rock dam (Fig. 2 b) and the woven-wire dam.

- **Percolation ponds**
  These features store water for livestock and recharge the groundwater. They are constructed by excavating a depression to form a small reservoir, or by constructing an embankment in a natural ravine or gully to form an impoundment.

  Water-supply projects can also be implemented for drought mitigation, with a view to strengthen drought preparedness. Activities such as water-use planning, rain-water harvesting, runoff collection using surface and underground structures, improved management of channels
and wells, exploration of additional water resources through drilling and dam construction, are implemented as a part of a drought-mitigation plan.

To increase moisture availability, the following in-situ moisture-conservation practices can be adopted:

- For agricultural crops, measures include ridges and furrows, basins, and water spreading.
- For tree crops, measures include saucer basins, semi-circular bunds, crescent-shaped bunds, catch pits and deep pitting.
- Rainwater harvesting collects rainfall or moisture for immediate or eventual use in irrigation or domestic supplies. Part of the rainwater collected from roofs can be stored in a cistern or tank for later use.
- Landscape contouring is used to direct runoff into areas planted with trees, shrubs, and turf.

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### Public Health Emergencies

**Description:** Public health emergencies can take many forms – disease epidemics, large-scale incidents of food or water contamination, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents – to name just a few. Public health emergencies can occur as primary events by themselves, or they may be secondary events to another disaster or emergency such as a flood, tornado, or hazardous material incident.

Chippewa County’s Health Department efforts are aimed at preventative measures such as vaccinations, public awareness programs, and inspections of food service facilities throughout the County.

The Health Department’s Division of Environmental Health investigates cases of contamination of drinking water, beaches, indoor air and other environments by sewage, surface water, hazardous chemicals and agents and animals and insects. Some of these have
been widespread such a long-term, perhaps permanent contamination of drinking water aquifers, and others are small-scale contaminations such as a localized mercury contamination of a building.

**Geographic Extent:** Although no area in Chippewa County is immune to public health emergencies, areas with high population concentrations will always be more vulnerable to the threat. Communities with schools, health facilities, water/sewer services including the City of Sault Ste. Marie, Kinross Charter Township, Drummond Island Township, DeTour Village, Pickford, Rudyard, Paradise, and Brimley. Rating for the geographic extent is Extensive.

**Historical Events:**

**2005-2013:** Following is a list of some of the health related problems in Chippewa County that the Chippewa County Health Department has worked on in recent years. Some of these include:

- Education and enforcement of the local ordinance- smoke free air law that was passed in 2004.
- Led response to pandemic influenza H1N1 in 2009 with multiple mass vaccination clinics
- Ongoing national and international surveillance of Novel Flu Virus’s H5N1, H7N9, H1N1, H5N3, and Influenza B.
- Ongoing Blastomycosis infection prevention training for both septic installers and physicians- 2013 death in Trout Lake.
- Continuous monitoring and specimen testing for West Nile Virus. Responded to several dead birds in the summer of 2012.
- Ongoing specimen testing for rabies virus infections for animal bites- one animal bite on a ship in 2012.
- In 2012 CCHD assisted in the successful recovery of a large amount of Sodium Cyanide from a Soo Township Residence.
- County Prosecutor and Health Officer responded to nationwide overdoses resulting from the K2/ Synthetic Marijuana fad by confiscating all products within Chippewa County.
- Prevention and awareness training in response to multiple Clostridium difficile infections and deaths throughout the elderly population in Chippewa County.
- The Michigan Department Surveillance System reports indicate that HEP C is on the rise. A five year report was run in MDSS that showed in 2009 no reported cases as compared to 2013 reporting ten cases of acute Hepatitis C.
- The Chippewa County Health Department first visits by the Karen Population began back in 2009. The challenges faced were that of a language barrier and cultural education. The Karen families needed PH assistance for WIC, Immunizations and Prenatal Care.
- In 2005 CCHD acquired a grant to construct the Sault Health Adolescent Care Center (SHACC).
- The SHACC conducts concussion screening, assessment, and follow-up for student athletes.
• Provides non emergent mental health care for SHACC eligible students and dental services for SHACC eligible and those who cannot find other services.
• Prevention and education ongoing for an area with abnormally high rates of suicide, alcoholism, and tobacco use.
• Prescription Drug and Heroin Abuse Task Force and Families against Narcotics (FAN) have been implemented to address the high number of overdoses seen in the community.
• CCHD has responded to multiple mercury spills at places including the Whitefish Shipwreck Museum, Rudyard Schools, and the Chippewa Recycling Center.
• CCHD has conducted years of follow-up sampling due to fuel tank spills and subsequent groundwater contamination in Whitefish and Drummond Townships.
• CCHD has dealt with Radon contamination at the County Courthouse and in the groundwater at a Soo Township Residence in 2011.
• Conducts continuous private well groundwater testing for bacteria, heavy metals, and Arsenic.
• Investigations of illicit connections and failing private septic systems are ongoing throughout the county, particularly on older and undersized waterfront properties.
• From 2006 to 2012 CCHD responded to multiple sewage bypasses on the North Shore of Sugar Island by issuing recreation advisories.
• Many beach closures at Sherman Park and Brimley State Park were issued by CCHD as a result of failing sanitary and storm water infrastructure.
• Grants obtained by CCHD through the Great Lakes Restoration Initiative (GLRI) have provided Chippewa County with research and restoration money for area beaches.
• CCHD environmental health has investigated several public nuisance homes and with home health, has removed dependent individuals from deplorable living conditions.
• The persistence of Lyme disease each year continues to move closer to the EUP. Ongoing tick and tick bite ID are provided by CCHD.

Probability of Future Occurrences: Each year the health department handles a wide-variety of health related incidents from disease to water contamination. Based on the history of the past 10 years it has been determined that there is a high likelihood of future occurrences.

Impact Assessment:
Direct Impacts: Disasters related to natural events may affect the transmission of pre-existing infectious disease, but the imminent risk of large outbreaks in the aftermath of natural disasters is often overstated. In the short-term, an increased number of hospital visits due to diarrheal diseases, acute respiratory infections, dermatitis, and other causes should be expected following most disasters. In the medium term, heavy rainfalls may affect the transmission of vector-borne diseases, for example, from residual water that may contribute to an explosive rise in mosquitoes. The risk of compromised water supplies depends on the condition of the community’s water supply before the disaster. Prolonged flooding endangers local agriculture and sometimes means large-scale food assistance will be needed. The primary
health concerns are overcrowded living conditions and poor water and sanitation in temporary settlements and other areas where services have deteriorated or are suspended.

**Indirect Impacts:** The health burden of disasters includes damage to housing, schools, channels of communication, and industry. Damage to hospitals, health facilities, and water and sewage systems have the biggest impact on health. The long-term health burden includes loss of medical care, interruptions in the control of communicable disease and other public health programs, and loss of laboratory support and diagnostic capabilities of hospitals. Indirect losses refer to the production of goods and services that are lost as an outcome of the disaster, and to the resulting reduced income.

**Vulnerability Assessment:**

**Population:** Medical facilities, nursing homes, schools would be areas that are most vulnerable as they house a number of the most vulnerable population – the elderly, children or those who are sick. Households that rely on water wells are vulnerable to groundwater contamination and water borne illness and/or death that may arise from the contamination. The population affected by public health emergencies is determined to be Medium.

**General Property**

**Essential Infrastructure, Facilities, and Other Important Community Assets**
Medical facilities, nursing homes, schools would be areas that are most vulnerable as they house a number of the most vulnerable population – the elderly, children or those who are sick. Communities and households that rely on well or use rivers or lakes as their water supply.

**Natural, Historic and Cultural Resources**
The Great Lakes and rivers that surround and run through Chippewa County are natural resources that the population rely on for its life sources. Clean water is essential. These resources are also used in recreation, tourism and for some as their way of making a living.

**Mitigation Capabilities:** The CCHD Office of Emergency Preparedness currently keeps and maintains several county-wide plans that are intended to increase preparedness and response that will greatly reduce the loss of life and property during a natural or man-made public health emergency. CCHD collaborates daily with other county, tribal, and hospital preparedness partners to identify the most probable hazards here in Chippewa County and the most efficient ways to respond to them. They develop partnerships at the local and regional level to help organize the people and resources that may be needed before, during, and after an emergency.
**Summary**

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**Infrastructure Failure**

**Description:** The increasing complexity and interconnectedness of energy, telecommunications, transportation and financial infrastructures pose new challenges for secure, reliable management and operation. No single entity has complete control of these multi-scale, distributed, highly interactive networks, or the ability to evaluate, monitor, and manage them in real time. Loss of one infrastructure could lead to failures in other areas.

Citizens are dependent on the public and private utility infrastructure to provide essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation.

These are just some examples of the types of infrastructure failures that can occur, and all of these situations can lead to disastrous public health and safety consequences if immediate mitigation actions are not taken.

**Geographic Extent:** Inhabited structures throughout the County. The geographic extent for infrastructure failure is rated at **significant**.

**Historical Events:** Chippewa County has had numerous widespread and severe electrical power outages and telephone/communications disruptions, caused mostly by severe weather such as windstorms or ice and sleet storms and are discussed more under those categories. However, damage has also been known to occur by man with construction equipment cutting underground lines. Other infrastructures such as water and sewer lines are damaged due to extreme temperatures or ground heaving. There are several areas in the City of Sault Ste. Marie where residents must let their water run during winter months to prevent frozen pipes. The transportation network is always affected by the heaving movement of frozen ground and must be attended to each spring.

**Probability of Future Occurrences:** Chippewa County can expect power/communication outages possibly numerous times a year usually due to severe weather conditions. Freezing
ground is also expected annually. Heavy snow or ice can bring down power lines or cause entire trees or tree limbs to fall on power lines taking out power. High winds during thunderstorms can also cause power outages due to falling trees or tree limbs coming down across power lines. The likelihood of future occurrences of an infrastructure failure is determined to be High.

**Impact Assessment:**

**Direct Impacts:** Direct impacts of infrastructure failures such as electricity or loss of heat during an extreme winter event for a prolonged period could potentially mean loss of life. Communication is essential in cases of emergency and would have a direct impact on emergency services if there were not a backup system in place. Fresh food supplies and storage would be directly impacted. Telecommunications, transportation, financial, medical, governmental, utilities would all be impacted and interrupted.

**Indirect Impacts:** Indirect impacts of loss of electricity for a prolonged period would induce economic losses to individuals and businesses in the affected area. Rioting and looting could also take place. Repair and/or clean-up costs of a major infrastructure failure would most likely have a high economic impact.

**Vulnerability Assessment:**

**Population**
Typically, it is the most vulnerable members of society (i.e., the elderly, children, impoverished individuals, and people in poor health) that are the most heavily impacted by an infrastructure failure. If the failure involves more than one system, or is large enough in scope and magnitude, whole communities and possibly even regions can be severely impacted. Individuals who rely on electricity for heat or medical reasons would be more vulnerable. The islands of Sugar, Neebish and Drummond would become vulnerable if ferry service were lost for an extended period of time. There would be no easy means to transport fuel or food supplies.

**General Property**
Depending upon the type of infrastructure failure households, businesses, and transportation networks could all be affected.

**Essential Infrastructure, Facilities, and Other Important Community Assets**
Hospitals, nursing homes and other medical facilities and emergency shelters or emergency command centers are critical assets that need to be protected from a prolonged infrastructure failure. Critical information centers such as financial institutions and public records would also be vulnerable.

**Natural, Historic and Cultural Resources**
The historical documents, artwork, or artifacts that are in a temperature controlled environment would be most vulnerable.
Mitigation Capabilities
Purchase and installation of back-up power sources or burying power lines to prevent loss of electrical power. System redundancies so if one system fails, there is a back-up that can take over. Installation of back-up heating sources such as wood burning fireplaces or woodstoves. Regular maintenance and equipment checks, replacement or renovation of aging infrastructure and equipment will help to reduce the chances of a failure. Protection from lightning on communication towers and other critical assets. Develop a community program/network to inform and aid the most vulnerable citizens in the event of a prolonged period of infrastructure failure.

Summary

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Flooding

Description: Floods are the most common and widespread of all natural disasters--except fire. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow thaws.

A flood, as defined by the National Flood Insurance Program is: "A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from:

- Overflow of inland or tidal waters,
- Unusual and rapid accumulation or runoff of surface waters from any source, or
- A mudflow.

[The] collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood."

The following terminology is used when describing floods:

The term **Minor Flooding** is used to indicate minimal or no property damage. However, some public inconvenience is possible.
The term **Moderate Flooding** is used to indicate the inundation of secondary roads. Transfer to higher elevation may be necessary to save property. Some evacuation may be required.

The term **Major Flooding** is used to indicate extensive inundation and property damage, usually characterized by the evacuation of people and livestock, and the closure of both primary and secondary roads.

**Riverine Flooding**

The most common and most damaging floods occur along rivers and streams and this is called over bank flooding. Over bank flooding of rivers and streams can be caused by one or more of three factors:

1. Too much precipitation in the watershed for the channels to convey.
2. Obstructions in a channel, such as an ice jam or beaver dam, and
3. Large release of water when a dam or other obstruction fails.

Flooding can also occur in streets when rainwater cannot flow into a storm sewer. Basements can flood when rainwater cannot flow away from the house or when the sewers back up. These problems are usually caused by heavy local rains and are often not related to over bank flooding or floodplain locations.

**Shoreline Flooding**

Flooding and erosion of shoreline areas caused by high Great Lakes water levels, storm surges, or winds is known as shoreline flooding. Chippewa County has approximately 421 miles of shoreline (including islands) on Lakes Superior and Huron and the St. Mary’s River.

The following communities participate in the National Flood Insurance Program:

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<th>Community Name</th>
<th>Total Premium</th>
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Responses acquired through the on-line community survey show that 50% of respondents experienced flooding on their property and 50% experienced River/Lake erosion. Of the total respondents in the community survey 37.5% experienced flooding in their basement and 50% of respondents experienced flooding on their street. The majority of respondents stated they are either somewhat concerned or very concerned about flooding.

Responses from the local units of government in Chippewa County reveal flooding occurs annually in DeTour Village in the Sims Street area causing problems for property owners in their basements and yards. Flooding also occurs in residential areas on N. Erie Street where underground springs flood neighborhood yards.

Kinross Charter Township reported that local streets typically flood during significant rainfall due to an aging storm water drain system that has also been damaged through severe freezing allowing sandy soils into the system.

Discussions with the Chippewa County Road Commission Manager reveal concerns each spring for county roads and bridges along the Pine River at Prairie Road and Mackinac Trail. The Charlotte River on Lower Hay Lake Road has also flooded during spring thaw.

Geographic Extent: Chippewa County has eight watersheds basins, described in the following paragraphs.

The Tahquamenon River Basin and Betsy River Basin originates in Luce County and covers part of western Chippewa County. These basins consist of Betsy or Shelldrake River, Tahquamenon River, plus numerous small tributaries, with discharge to Whitefish Bay on Lake Superior. The Hendrie River also branches off of the Tahquamenon into western Chippewa County.

The Carp River Basin, Waishkey River Basin and Pine River Basin are located in central Chippewa and the central part of Mackinac Counties.

The Charlotte River Basin, Little Munuscong River Basin and Munuscong River Basin are located on the eastern shore of Chippewa County with parts of the Munuscong reaching into Mackinac County.
St. Mary’s River runs along the east shore of Chippewa County from Sault Ste. Marie to DeTour Village. Lake Superior borders the northern shore and Lake Huron borders a portion of the southern shore of the County.

Trout Lake area consists of many lakes but the important ones are (by size) Carp Lake; Little Trout Lake; Frenchman Lake and Wegwaas Lake. Both Carp Lake and Frenchman Lake have public access for boating and fishing. Caribou Lake is the largest inland lake at the eastern end of the County with public access for boating and fishing. Other lakes in Chippewa County include: Hulbert Lake, Piatt Lake, Soldier’s Lake, Monocle Lake, Spectacle Lake, Pendills Lake, McNearney Lake, Kinross Lake, and Dukes Lake. The geographic extent for flooding is deemed to be Extensive.

Historical Events:

Heavy rains, in September, 2013, washed away several portions of roads on Sugar Island, cutting off the most direct route to the ferry and causing most Island residents longer routes to travel to detour around the damage (see picture on cover page). These roads may never be restored to what they were due to the extensive cost of the damage. During that same thunderstorm event, areas in the City of Sault Ste. Marie suffered damages with soil erosion, washed away sidewalk foundations, water/wastewater infrastructure and building foundation failures, sink holes, flooding of homes and basements, undersized culverts that could not handle the overflow, ditches that could not handle the water flow, and some road infrastructure damage. Specific information on damages from are listed in more detail in the Community Profiles in Appendix E.

In September, 2010, two days of heavy rain produced localized flooding in Eastern Upper Michigan. Rainfall amounts of 2 to 5 inches were common, most of which fell on the night of the 23rd. Raber picked up 4.75 inches of rain. The Pine River near Rudyard crested near 18 feet at midday on the 24th. Flood stage was 17 feet. The river reached the bottom of the Prairie Road Bridge deck.

The Pine River flooded in the spring of 2004 and again in 2008, both times threatening the Prairie Road Bridge and flooding roads in low lying areas. The Charlotte River has flooded periodically in past history, flooding the Lower Hay Lake Road and low lying land in that area.

March 29-31, 2003 the Pine River flooded due to an ice jam setting a new flood record high of 19.3 feet. The old record was 18.4 feet from March, 1986. The Prairie Road Bridge, other roads and yards in the vicinity were submerged. The Munuscong River in the Pickford area also flooded over its banks this year. In April, 2003 there was flooding reported on the Tahquamenon River.

Probability of Future Occurrences: Based on the historical data the likelihood of future flood occurrences is rated at High.
Impact Assessment:

Direct Impacts: Direct and indirect impacts of flooding can be classified in four categories: impact on people (e.g., safety and health), damage to buildings, damage to critical facilities, and economic disruption (damage to businesses and infrastructure). Direct impact can include loss of life, disease caused by contamination of water supplies, damage to crops, stress: physical and mental health problems, damage to infrastructure: roads and communications, rebuilding costs, loss in the value of properties, and increase in insurance premiums.

Indirect Impacts: Indirect impacts can be disruption to traffic which costs businesses money, and disrupts transport, effects of reduced spending power in the local area as people lose money, jobs etc. Loss in tourist spending in the area, survivors feel vulnerable, and also have difficulty getting insurance for their properties, there could potentially be less investment in the area

Vulnerability Assessment:

Population: People who live in the flood zone areas near lakes, rivers and streams. Developed areas where storm water can overflow or back-up. Shoreline communities and areas that have major rivers and a more clay soil base, towards the north, central and east areas of the county.

General Property: Households or structures and the contents, especially those with basements, agricultural land and livestock in low-lying areas, near water, behind a levee or downstream from a dam. Even very small streams, gullies, creeks, culverts, dry streambeds or low-lying ground that appear harmless in dry weather can flood.

Essential Infrastructure, Facilities, and Other Important Community Assets

Critical facilities are those community components that are most needed to withstand the impacts of disaster. Included in this classification are police and fire stations, hospitals, schools that serve as emergency shelters, and lifeline utilities; power, water and sewer system components as well as transportation infrastructure such as road ways and bridges.

Several bridges in Chippewa County have been identified as being vulnerable to flooding with the potential and high risk for road failure and are listed below:
Map 11 – Bridge Concern Area #1

Prairie Rd. Bridge in Rudyard Township is typically affected each spring due to ice jams. The structure is not big enough to allow for the flow of ice and water during this time and at times the road will be covered with water making it impassable to traffic as well as vulnerable to wash out.

Map 12 – Bridge Concern Area #2

The Mackinac Trail Bridge, in Rudyard Township, on the Pine River was built in 1929 with a timber under-structure. Ice jam pressure against this timber structure makes it very vulnerable in the spring thaw. With Mackinac Trail being a high volume traffic road, if this structure should fail it could lead to multiple injuries and/or fatalities making it a very high area of concern for the local road commission.

Map 13 – Bridge Concern Area #3

In Superior Township, on Bound Road, south of Highway M-28 a bridge structure over the West Branch of the Waishkey River is vulnerable to bank erosion causing concern for potential wash out. This road is a major connector to the community of Kinross.
Map 14 – Bridge Concern Area #4

In Bruce Township, an undersized structure on the South Branch of the Charlotte River along W. 12 Mile Road causes water flow issues making it a high area of concern for the road commission.

Map 15 – Bridge Concern Area #5

In Dafter Township, on 10 Mile Road, west of Dafter, is an undersized culvert with a steep ravine along a small branch of the Waishkey River with water flow issues. This route is an east-west road parallel to M-28 and is used as an emergency route.

Map 16 – Bridge Concern Area #6

Also in Dafter Township, on Maple Road, just north of 10 Mile, is a similar undersized culvert that has flow issues from a South Branch of the East Branch of the Waishkey River.
Map 17 – Bridge Concern Area #7

In Trout Lake Township, a bridge span on Huckleberry Road over the Carp River which is an outlet of the Lakes of Carp, Frenchman and Wegwaas is too small and has critical fractures. This route is a major timber route and would cause great loss of economic activity if it were washed out.

Map 18 – Bridge Concern Area #8

Other identified areas where there are undersized culverts include 18 Mile Road over School Creek on the border of Bruce and Pickford Township.

Map 19 – Bridge Concern Area #9

In Pickford Township on E. 20 Mile Road over Desormeaux Creek.
Map 20 – Bridge Concern Area #10

In Bruce Township on 12 Mile Road over the Charlotte River.

Larger versions of the maps above can be found in Appendix D.

**Natural, Historic and Cultural Resources**
Historical museums, historical societies, libraries or courthouses that house historical documents or artifacts. Wetland and low lying agricultural areas.

**Mitigation Capabilities**
Engaging in floodplain management activities, constructing barriers, such as levees, and purchasing flood insurance will help reduce the amount of structural damage to a home and financial loss from building and crop damage should a flood or flash flood occur. Monitoring of current weather conditions and weather forecasts gives advanced notification of potential flooding. Hazardous weather outlooks and forecasts give vital information on the amounts of precipitation, wind intensity and direction, time and extent, etc. thus, the severity of potential flooding can be assessed and prepared for effectively. Creating a household emergency communications plan and developing an emergency kit. Local units of government can provide informational handouts or create a website to disseminate general flood mitigation information to the public.

Mitigation strategies for the Road Commission include replacing the identified smaller culverts causing flooding issues with bigger structures. In some cases, land acquisition to create a drainage field would be appropriate to alleviate repetitive flooding issues. Reinforcement of the bridge with timber understructure with steel beams and a larger bridge structure where it has been identified as being too small for the flow of water.
### Summary

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### Civil Disturbances

**Description:** Large-scale civil disturbances rarely occur, but when they do they are usually an offshoot or result of one or more of the following events: 1) labor disputes where there is a high degree of animosity between the participating parties; 2) high profile/controversial judicial proceedings; 3) the implementation of controversial laws or other governmental actions; 4) resource shortages caused by a catastrophic event; 5) disagreements between special interest groups over a particular issue or cause; 6) a perceived unjust death or injury to a person held in high esteem or regard by a particular segment of society; or 7) a “celebration” of an important victory by a sports team.

Prison uprisings are normally the result of perceived injustice by inmates regarding facility rules, operating policies and/or living conditions, or insurrections started by rival groups or gangs within the facility.

Prison uprisings are handled first by Michigan Department of Corrections riot units composed of trained Corrections Officers. Additional units may be brought in from other nearby facilities, if necessary, to quell the disturbance. If those resources are not sufficient to manage and end the uprising, specially trained officers from the Michigan State Police can be activated to assist Department of Corrections personnel. The Michigan State Police may also be mobilized to provide perimeter security around the facility, and to augment resource needs. In extreme cases, Michigan National Guard military police personnel can be activated to assist with the restoration of order within the facility.

**Geographic Extent:** Larger communities of the County such as Sault Ste. Marie and the Kincheloe area. The geographic extent is rated to be **Limited**.

**Historical Events:**

There is no history of public riots or civil disturbances in Chippewa County.
In July, 2010 three prisoners at a Kincheloe Prison facility hijacked a semi-truck in an attempted escape. They were unsuccessful, however, did create some damage to the fence and prison guards were forced to take action that resulted in the death of one prisoner.

**Probability of Future Occurrences:**
Since the prison facilities were opened in the late 1970’s there have been no “riots”. Closure of facilities due to budget cuts have left remaining facilities overcrowded adding to the potential risk for such outbreaks.

Sporting events have the potential for large group disturbances when emotions run hot and tempers flare.

**Impact Assessment:** Civil disturbances can have far reaching impacts.

**Direct Impacts:** The direct impact of a civil disturbance can include serious injuries or fatalities to people directly involved and also cause emotional distress to those directly involved. Destruction of property and use of public utilities may be disrupted.

**Indirect Impacts:** Indirect impacts could affect the local population not directly involved in a civil disturbance by having their lives significantly disrupted. They may not be able to work or enjoy recreational activities and may even lose the ability to obtain necessities.

**Vulnerability Assessment:**

**Population:** The emergency responders and those in law enforcement would be most vulnerable, as well as the general population in the vicinity of a disturbance. Overall the population affected is rated to be low.

**General Property:** Depending upon the reason for a civil disturbance public utilities, local government facilities and critical facilities may be most vulnerable. Private and commercial property could also be vulnerable if located in the midst of the disturbance.

**Essential Infrastructure, Facilities, and Other Important Community Assets:** Public utility systems that provide water, electricity, gas/fuel for heating and communications as well as critical facilities including cyberspace are vulnerable to tampering or destruction.

**Natural, Historic and Cultural Resources:** Depending upon the nature of a civil disturbance the historical government Courthouse may be vulnerable if the civil unrest were related to governmental issues. Sports facilities and the local schools may be vulnerable in the event of a riot at a sporting event.

**Estimating Potential Losses:** The cost of responding to a civil disturbance and potential for property destruction is rated to be **medium**.
Mitigation Capabilities: Mitigation basically implies efforts to prevent or minimize the damage which can result from civil unrest. These efforts can be developed using lessons learned from previous civil disturbances in large, medium, and small cities.

Police presence at local events and demonstrations may be enough to prevent a disturbance, however, mutual aid agreements with fire departments and additional enforcement personnel such as a National Guard unit may be necessary in the event of a large civil disturbance. Planning and training can help prepare for such events. Good communication between departments and the community can reduce the risk. Installation of sprinkler systems in vulnerable facilities can reduce the damage to property in the event of arson or other fire-related incidents.

Summary

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Transportation/Hazardous Materials Accident

Description:

Air Transportation Accidents

There are four circumstances that can result in an air transportation accident: 1) an airliner colliding with another aircraft in the air; 2) an airliner crashing while in the cruise phase of a flight due to mechanical problems, sabotage, or other cause; 3) an airliner crashing while in the takeoff or landing phases of a flight; or 4) two or more airliners colliding with one another on the ground during staging or taxi operations. When responding to any of these types of air transportation accidents, emergency personnel may be confronted with a number of problems, including: 1) suppressing fires; 2) rescuing and providing emergency first aid for survivors; 3) establishing mortuary facilities for victims; 4) detecting the presence of explosive or radioactive materials; and 5) providing crash site security, crowd and traffic control, and protection of evidence.

Land Transportation Accidents

A land transportation accident in Chippewa County could involve a commercial intercity passenger bus, a local public transit bus, or a school bus. Although these modes of land transportation have a good safety record, accidents do occur. Typically, bus accidents are
caused by the bus slipping off a roadway in inclement weather, or colliding with another vehicle. Bus accidents can be quite serious – especially if the bus has tipped over. Numerous injuries are a very real possibility in those types of situations.

Chippewa County has hundreds of miles of recreational trails used by both non-motorized and motorized vehicles. Accidents in remote areas with lack of communication capability or location identification can make it difficult on the emergency response team.

**Water Transportation Accidents**

A water transportation accident involving one of the commercial marine passenger ferries operating from Michigan’s Great Lakes shoreline communities could have significant life safety consequences. Most of these marine ferry services operate on a seasonal basis (typically May through November). Vessel sizes vary, but it is not uncommon for 100-200 passengers or more to be on board many of the ferries at peak tourist season. In a typical year, these ferries make thousands of trips across Great Lakes waters. Although the vessels have an excellent safety record, and they must pass rigorous Coast Guard inspections, the potential for an accident is always present. Accidents in other states or countries involving similar vessels validate the need for rigorous emergency preparedness actions to prevent loss of life in an open water setting such as the Great Lakes.

The one commonality all transportation accidents share – whether air, land or water-based – is that they can result in mass casualties. Air transportation accidents, in particular, can result in tremendous numbers of deaths and injuries and major victim identification and crash scene management problems. Water transportation accidents, on the other hand, may require a significant underwater rescue and recovery effort that few local jurisdictions may be equipped or trained to handle.

**Hazardous Materials Transportation Accident**

As a result of the extensive use of chemicals in our society, all modes of transportation – highway, rail, air, marine, and pipeline – are carrying thousands of hazardous materials shipments on a daily basis through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people.

Local and state emergency responders and hazardous material response teams usually effectively deal with a small hazardous material transportation accident. Larger incidents, however, pose a whole new set of problems and concerns for the affected community. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material (or have the potential for such a release) can adversely impact the life safety and/or health and well-being of those in the immediate vicinity of the accident site, as well as those who come in contact with the spill or airborne plume. In addition, damage to property and the environment can be severe as well. Statistics show almost all hazardous
material transportation incidents are the result of an accident or other human error. Rarely are they caused simply by mechanical failure of the carrying vessel.

Being surrounded by two Great Lakes and large river system, one of the most dangerous hazardous material transportation accident scenarios that could occur in Chippewa County would be a spill or release of oil, petroleum or other harmful materials into one of the lakes from a marine cargo vessel. Such an incident, if it involved a large quantity of material, could cause environmental contamination of unprecedented proportions. Fortunately, the Great Lakes states, working in partnership with oil and petroleum companies and other private industry, have taken significant steps to ensure that a spill of significant magnitude is not likely to occur on the Great Lakes.

**Geographic Extent:** Chippewa County has an international airport as well as several smaller airports located throughout the county. There is an active rail line in which hazardous materials is transported over. Conditions of this rail line in some areas is reported to be bad enough that trains can only travel at 10 mph. Chippewa County is bounded by water on three sides in which freighter shipping occurs. Recent low water levels in these waters make for a higher risk of a hazardous materials incident. A pipeline also traverses the County carrying hazardous materials. The geographic extent is considered to be **Significant.**

**Historical Events:**
In August, 2012 the U.S. Coast Guard reported the Paul R. Tregurtha, carrying 62,000 tons of coal, ran hard aground near Light 33 in West Neebish Channel — in the vicinity of what is commonly known as "The Rock Cut" — shortly after 3 a.m. The initial grounding, reports indicate, occurred when the bow struck the shallower waters after straying from the shipping channel causing the ship to pivot upon impact. The stern then ran aground on the opposite side of the channel. Initial reports indicated there is no resultant pollution and no injuries were reported, but there is some damage to the ship.

December 20, 2003 Rudyard -- Several area emergency units responded to Thursday's gas leak in Rudyard although most mainly stood by through a cold December day. Among those units called to the scene were: the Chippewa County Sheriff's Department; Michigan State Police; Rudyard Township Volunteer Fire Department; Kinross Township Volunteer Fire Department; Rudyard Ambulance Service; Kinross District Police; Sault Tribe Police; and Chief Ken Eagle from the Sault Ste. Marie Fire Department.
December 19, 2003 Rudyard -- A day-long emergency that resulted in eventual evacuation of the downtown area of Rudyard Thursday ended without untoward incident late in the afternoon. Around 8:30 a.m. a leak was discovered in cargo transfer equipment as a semi truck loaded with liquid propane was pulled up at the Shute Oil Co. terminal on Railroad Street in Rudyard. Police, fire and other emergency officials alerted to the hazard ordered evacuation of the immediate downtown area, including the Rudyard Schools.

**Probability of Future Occurrences:** Based on historical incidents in Chippewa County there is a **Low** probability of future occurrences.

**Impact Assessment:** Accidents involving hazardous materials pose a significant impact to the environment, public health and safety and community well-being. They can also produce long lasting economic, social and psychological impacts on a community.

**Direct Impacts:** Direct impacts can include contamination of the air, land and ground water affecting humans, plants and animals. Depending on the situation evacuation of people may be necessary. If an accident happens in a remote area, responding to the scene may be difficult leading to a greater impact to the environment.

**Indirect Impacts:** Indirect impacts can include the social and psychological effects on the community that is long lasting after the event where concerns for health can create long-term anxiety and alarm. Loss of trust, social conflict and division and social stigma are common and reduces the quality of life in a community.

**Vulnerability Assessment:**

**Population:** The most vulnerable of the population would be those in the direct vicinity or down wind, or down water of the incident where exposure to the air, land and water has occurred. The population affected is rated as **Low**.

**General Property:** The immediate surrounding environment will be the most vulnerable and depends on the type and amount of hazardous material that is released.

**Essential Infrastructure, Facilities, and Other Important Community Assets:** Vulnerable infrastructure includes drinking water sources, transportation infrastructure and utilities.

**Natural, Historic and Cultural Resources:** Chippewa County relies heavily on tourism as an economic base and much of that is from the natural environment and recreational activities on land and water. The potential destruction from a hazardous materials incident on these natural resources would have a tremendous negative impact on the County.

**Estimating Potential Losses:** Every situation is different therefore making it difficult to estimate potential losses. For the purposes of this plan it is estimated that the economic impact would be rated **medium** at a minimum.
Mitigation Capabilities

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Structural Fires/Scrap Tire Fire

Description: Structural fires include a fire that ignites one or more structures, causing loss of life and/or property. A Scrap Tire Fire is typically a large fire that burns scrap tires being stored for recycling or re-use. The Department of Environmental Quality’s (DEQ) Scrap Tire Program is charged with the responsibility of ensuring the proper disposal of all scrap tires generated in the state, and with the cleanup of existing scrap tire piles in amounts of 500 or more. Program staff regularly inspects scrap tire collection sites, processors, end-users, and generators, which include tire dealers and auto scrap yards.

Geographic Extent: In Chippewa County approximately 44% of the structures were built in 1960 or prior and these structures are spread throughout the county. The majority of housing structures lie in the City of Sault Ste. Marie and the smaller communities of DeTour Village, Rudyard, Paradise, Hulbert, Pickford and Kincheloe as well as the rural area throughout the County.

Historical Events: July 19, 2013 reported in the local newspaper: The Sault Fire Department staff reported five runs last evening in response to lightning strikes. One run was at the Soo Locks Lodge on the I-75 Business Spur. Lightning struck the top of the building and blasted a hole in the roof with charring and some damage. However, no fire was caused by the lightning strike. After a thorough search firefighters left the scene. The first run was a call to a church on East Spruce Street where lightning set off a fire alarm. The church was unharmed.

On average the Sault Ste. Marie Fire Department has 231 calls per year, of which structural fires average 18 a year. There are no records of injuries or fatalities for any of these fires. There are no major auto salvage scrap yards within the city limits so there are no issues on scrap tire fires.

Probability of Future Occurrences: Whole scrap tires have been banned from Michigan landfills since 2004. The Michigan Department of Environmental Quality regulates scrap tire storage and disposal and requires an annual registration. In Chippewa County there was one
facility registered in 2009. The Dafter Sanitary Landfill is approved in license, but has no used tires. Structural fires occur frequently and have a high likelihood of occurring, scrap tire fires are at rated at low probability of future occurrence in Chippewa County.

Impact Assessment:

Direct Impacts: Scrap tires can threaten not only the environment, but the public health of Chippewa County as well. Run-off from scrap tire fires can contaminate groundwater and surface water, and scrap tire sites are an ideal habitat for the breeding of mosquitoes carrying disease such as West Nile Virus. Smoke and toxic gases kill more people than flames do. Fire uses up the oxygen you need and produces smoke and poisonous gases that kill. Breathing even small amounts of smoke and toxic gases can make you drowsy, disoriented and short of breath.

Vulnerability Assessment:

Population: Structural fires typically involve one structure, although larger fires may spread and ignite multiple structures. Explosions caused by leaking gas could affect a multitude of persons in the nearby vicinity. Scrap tires fires would be located at an isolated area, but air or water pollution from a large fire could affect the population in the near vicinity. Persons of any age can be vulnerable to fires, but especially the very young, elderly and special needs populations.

General Property: Approximately 11% of homes in Chippewa County use wood as the primary heating source placing them in high risk for a structural fire. Older structures may have deteriorating electrical wiring which would also place structures at high risk. Apartment buildings, college dorm housing, hotels, motels, nursing homes and other facilities with special need users are more vulnerable to multiple injuries or fatalities due to the potential high number of residents. Commercial buildings that are affected by a structural fire may have a major impact on the economy of a community. Automotive repair, places that store a lot of tires or dispose of scrap tires are higher risk for incidents.

Essential Infrastructure, Facilities, and Other Important Community Assets: Emergency facilities, War Memorial Hospital and area nursing homes are especially vulnerable as they house emergency equipment, may require a large evacuation of patients and stress the local capability. Utility power sources, utility lines, water sources and communication sources may all be vulnerable to structural fires.

Natural, Historic and Cultural Resources: Many of the communities in the County have a historical museum which house the valuable and irreplaceable information, photos, and artifacts of the community.

Mitigation Capabilities: The State of Michigan has many laws in effect with regards to fire and the Departments of Energy, Labor and Growth, Environmental Quality and Natural Resources
have broad authority, regulation and training programs and assist in the suppression of fire if necessary.

The County maintains a Building Department and follow the Michigan Building Codes Zoning regulations. Building permits are required for all new structures and are inspected by the County Building Inspector. Electrical, plumbing and mechanical inspections are made by the State.

The City of Sault Ste. Marie maintains a paid staff department 24/7 and covers approximately 14 miles south of the City. Most Townships within the county maintain a fire department with service equipment and a volunteer crew; Bay Mills, Bruce, Dafter, DeTour Village, Drummond, Hulbert, Kinross Charter, Pickford, Raber, Rudyard, Soo (including Neebish Island), Sugar Island, Superior, Trout Lake, and Whitefish.

Other mitigation efforts to protect the vulnerable structures of the County can include fire alarms, lightning protection, sprinkler systems and using fire retardant materials in building. Educational programs that teach fire safety and use of space heaters or other flammable materials should be made available to the public. Having evacuation routes and fire drills and training. Reducing blight in urban areas and creating defensible space around structures in the rural wildfire prone areas.

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Tornadoes

**Description:** A tornado is a swirling column of air extending from a thunderstorm to the ground. Tornadoes can have wind speeds from 40 mph to over 300 mph. A majority of tornadoes have wind speeds of 112 mph or less. Tornadoes in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the polar regions to generate severe thunderstorms.

Debris hurled by the wind can hit with enough force to penetrate walls. Tornadoes create localized low-pressure areas that can make a building explode. Window, chimneys and roofs are the most vulnerable parts of building to tornado damage.
Tornadoes can move forward at up to 70 mph, pause, slow down and change directions. Most have a narrow path, less than 100 yards wide and a couple of miles long. However, damage paths can be more than 1 mile wide and 50 miles long.

The northern Michigan tornado season runs from March into October with the most active period occurring during June and July. The most active time of the day for tornadoes is during the late afternoon and early evening.

In 1971, Dr. T. Theodore Fujita of the University of Chicago devised a six-category scale to classify U.S. tornadoes into six damage categories, called F0-F5. F0 described the weakest tornadoes and F5 described only the most destructive tornadoes. From 2000-2004, the Wind Science and Engineering Research Center at Texas Tech University, in cooperation with numerous expert meteorologists, civil engineers and the National Weather Service (NWS), developed an Enhanced Fujita scale, or EF-scale. In addition to improving the ranking process, it was essential to the development team that the new EF-scale support and be consistent with the original F-scale.

The Enhanced Fujita Scale of Tornado Intensity

<table>
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<tr>
<th>F-Scale Number</th>
<th>Intensity Descriptor</th>
<th>Wind Speed (mph)</th>
<th>Type/Intensity of Damage</th>
<th>EF-Scale Number</th>
<th>3-Second gust (mph)</th>
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<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72</td>
<td>Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
<td>0</td>
<td>65-85</td>
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<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112</td>
<td>Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
<td>1</td>
<td>86-110</td>
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<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
<td>2</td>
<td>111-135</td>
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<td>F3</td>
<td>Severe tornado</td>
<td>158-206</td>
<td>Severe damage. Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.</td>
<td>3</td>
<td>136-165</td>
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<td>F4</td>
<td>Devastating tornado</td>
<td>207-260</td>
<td>Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
<td>4</td>
<td>166-200</td>
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<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318</td>
<td>Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged; incredible phenomena will occur.</td>
<td>5</td>
<td>Over 200</td>
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NOTE: When describing tornadoes, meteorologists often classify the storms as follows: F and F1 - weak tornado; F2 and F3 - strong tornado; F4 and F5 - violent tornado
(Source: The Tornado Project; Storm Data, National Climatic Data Center)

**Geographic Extent:** The entire county is vulnerable to a tornado as one could occur anywhere, but tornado’s typically are funnel shaped with the narrow end touching the ground and encircled by a cloud of debris. They usually only travel a few miles before dissipating, although they could be bigger and travel further. The geographic extent is rated to be **limited**.

**Historical Events:** The most recent siting of a funnel cloud in Chippewa County was July 22, 2013. It did not touch the ground. The National Weather Service issued a tornado warning to the County which prompted many businesses to close the doors early allowing residents to get home and also prompted officials to stop traffic on the International Bridge for a short period of time.

The last tornado warning received from the National Weather Service was July 4, 1999.

According to the National Climatic Data Center there have been no reported tornados in Chippewa County during the period 1/1/1996 – 7/30/2013. There was one waterspout recorded during that time period on July 3, 1999 on Drummond Island which caused $200,000 in property damage to a local marina.

Overall there have been 6 recorded tornados in the period 1950-2009 according to the National Weather Service.

**Probability of Future Occurrences:** Based on historical events there is a **low** probability of future occurrences.

**Impact Assessment:**

**Direct Impacts:** The direct impact of a tornado and the swirling debris will cause damage or destruction to property and injury or fatalities to animals and people. Utility lines are often downed by high winds or falling debris. Explosions, electrocutions or fires could occur with the damage to the utility lines.

**Indirect Impacts:** Injuries could occur during the rescue attempt/clean-up aftermath. Power and other utilities may be out of service for a period of time. People may be displaced from their homes and commercial businesses may be affected. Communities that are struck by a damaging tornado will experience economic losses while recuperating from the aftermath.

**Vulnerability Assessment:**

**Population:** Those people in the direct path of a tornado would be at high risk. Vulnerable populations include the elderly and young, those in hospitals or nursing homes, trailer courts, and campgrounds. People who do not have a place to take shelter or who do not have a basement to go to for protection will be especially vulnerable if in the path of a tornado.
**General Property:** A tornado can cause minor damage or total destruction without any warning. Most tornados are relatively weak and therefore, primarily damage only damage roofs, windows and trees. A tornado that generates wind speed over 200 is going to destroy anything in its path as well as creating flying debris.

**Essential Infrastructure, Facilities, and Other Important Community Assets:** Critical facilities such as fire and ambulance stations need to protect the equipment housed for rescue efforts in the aftermath of a tornado. Buildings used as shelters need to be constructed to be able to withstand high winds and flying debris. Power utility substations, power lines, communication towers, gas pipelines are most likely to be damaged in the path of a tornado or flying debris.

**Natural, Historic and Cultural Resources:** Chippewa County has several communities with small museums that house the artifacts, photos, and history of the area. Sault Ste. Marie, Paradise are home to several tourist attractions such as the Tower of History and historical churches. Other cultural resources in and around the County include historic lighthouses.

**Estimating Potential Losses:** Using historical data, and estimating the impact and potential destruction of property and environment, as well as the possible need for rescue operations and clean up the economic impact of a tornado incident is rated to be high.

**Mitigation Capabilities:** Mitigation strategies include having building codes that require structures that are capable of withstanding strong winds and that have protection for large windows. Construction of safe houses around campgrounds or trailer courts would give people a place of shelter in case of an emergency.

Advanced warning through the National Weather Service or County Emergency Services Office can prepare residents to take shelter. Warning sirens are located throughout the County. Public education programs, tv or radio spots to provide information to the public about the siren warning system and what to do.

Creating brochures or a website to distribute information on shelters and educating the public what to do or where to go in the event of a tornado warning would help prepare the County’s population to take measures to protect themselves and their property.

Minimizing debris potential by trimming dead trees and branches that could potentially fall on buildings or power lines. Establishing a community forestry program.

Ensuring tie-downs, fasteners, reinforcements are in place and maintained on building components. Requiring manufactured homes have proper anchoring. Retrofitting buildings with shutters for the windows and strengthening components such as doors, skylights, roofs, and walls.
Developing local severe weather emergency planning. Requiring large businesses and schools to have emergency plans in place and having weather radios or other equipment available to monitor conditions.

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**Fixed Site Hazardous Materials Incident**

**Description:** Hazardous materials can be present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities in our communities. Hazardous materials are materials or substances which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released. Corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gasses are some examples of the types of hazardous materials.

Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general public and the environment. Even with the best precautions taken, accidental releases can and do occur. The potential for serious harm to people can take place if mitigative action is not taken immediately.

**Geographic Extent:** Industrial parks are located in the City of Sault Ste. Marie and the community of Kincheloe. Sault Ste. Marie, Ontario, Canada lies just north of Sault Ste. Marie, Michigan with industries directly across the St. Mary’s River. Hazardous materials released from those sites in the air or water could possibly affect our region. The extent of a fixed site incident would be considered to be isolated.

**Historical Events:** April 10, 2013 Sault Ste. Marie - Meth Bust in a home on Andary Avenue.

September 15, 2004 Sault Ste. Marie -- A leaking chlorine tank at a Magazine Street industrial gas warehouse resulted in evacuation of the neighborhood and two apparently minor injuries Tuesday afternoon. A small army of police and fire department emergency units surrounded the area after fire officials received the first alert of leaking chlorine gas at 2:48 p.m.
**Probability of Future Occurrences:** As long as there are industries and other sites storing and using hazardous material, a threat of a potential incident will also be there. Homemade meth labs seem to be on the rise. Based on historical data and the minimal amount of industry in the County the likelihood of future occurrence is rated to be **low**.

**Impact Assessment:**

**Direct Impacts:** Industrial accidents differ from hazardous material incidents in the scope and magnitude of offsite impacts. Whereas hazardous material incidents typically involve an uncontrolled release of material into the surrounding community and environment that may necessitate evacuations or in-place sheltering of the affected population, the impacts from industrial accidents are often confined to the site or facility itself, with minimal physical outside impacts. Nonetheless, industrial accidents such as fires, explosions, and excessive exposure to hazardous materials, may cause injury or loss of life to the workers at the facility, and often significant property damage.

**Indirect Impacts:** Industrial accidents can cause severe economic disruption to the facility and surrounding community, as well as significant, long-term impacts on the families of the workers injured or killed.

**Vulnerability Assessment:**

**Population:** Those who would be most affected by a hazardous materials fixed site incident would be the ones in the immediate vicinity, possibly employees. If a chemical is released into the air the general population downwind of the incident will be vulnerable. First responders may be at higher risk and exposed to toxic chemicals.

**General Property:** The risk to the environment through air, water or ground contamination may be detrimental to the surrounding area of an incident and affect it for years.

**Essential Infrastructure, Facilities, and Other Important Community Assets:** Essential infrastructure such as water supply sources, ground wells or intakes would be vulnerable to nearby air, water or ground contamination.

**Natural, Historic and Cultural Resources:** Chippewa County relies heavily on its natural resources for economic and recreational activities. A significant hazardous materials release and contamination would be detrimental to the environment.

**Estimating Potential Losses:** Estimating potential losses for a fixed site hazardous materials incident would depend on the size of the incident and the site. For the purposes of this plan it is estimated that the potential economic impact at a minimum would be medium.

**Mitigation Capabilities:** Advanced planning, preparing and training, as well as a good communication system with various federal, State, and local officials and stakeholders can make the County better prepared to handle an incident. Traffic controls or road closures may
be needed. Having the correct equipment, trained personnel and participating in practice drills and exercises.

Adopting policies and establishing zoning regulations for industries. Ensuring that industries have a buffer zone and proper separation between other land uses such as residential or recreational. Requiring site plans and emergency plans be in place.

Educational awareness campaigns, brochures and information on a website for the general public to find out more information. Use of advance warning sirens or systems.

Ensuring compliance with federal, State, and local regulations. Purchasing and maintaining insurance policies. Brownfield cleanup activities on identified sites.

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Pipeline

Description: An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline. Chippewa County has many miles of petroleum and natural gas pipelines that can pose a real threat. Pipelines can leak or fracture and cause property damage, environmental contamination, injuries, and even loss of life. Typically, damages to a pipeline are caused by human error during construction or other digging activities.

Geographic Extent: Natural gas is provided to the residents in the City of Sault Ste. Marie through underground lines. A pipeline is located in the central portion of the County that travels through portions of the City of Sault Ste. Marie, Soo Township, Dafter Township, Superior Township, Kinross Township, and Rudyard Township. The geographic extent is deemed to be limited.

Historical Events: October 14, 2008 Sault Ste. Marie Gas leak - Sault police and Sault firefighters were forced to shut down a portion of the I-75 Business Spur for approximately eight hours Monday evening after construction equipment tangled with a 4-inch natural gas line. Police were quite busy following the incident as drivers apparently had difficulty interpreting what the orange cones and barricades meant.
September 1, 2004 Sault Ste. Marie Gas leak - City police, fire and streets units were summoned to the intersection of Osborn Blvd. and Water Street at 5:58 p.m. Tuesday, when another natural gas leak erupted in the area. According to police reports, the gas leak apparently occurred while construction equipment was excavating in the area. Police blocked intersections leading to the area and assisted in clearing people from the immediate leak site.

September 5, 2003 Sault Ste. Marie -- For the second time in several weeks, city firefighters and MichCon crews were called to a natural gas line break near War Memorial Hospital Thursday afternoon. No injuries or fires were reported from the scene, but firefighters and specialist repair crews from lower Michigan worked through the night to halt the leak and install a replacement gas main. An apparent result of a heavy equipment accident in street construction work at the W. Spruce-Osborn intersection.

April, 1997 officials discovered a problem with part of the gas pipeline that runs through Rudyard Township. This was due to landslide movement which threatened the stability of the pipeline.

**Probability of Future Occurrences:** Anytime there is excavation activities around an underground pipeline there will be some risk of an incident. Based on the historical data, the likelihood of future occurrences is deemed to be **low**.

**Impact Assessment:**

*Direct Impacts:* Leaking gas into the environment would contaminate air, ground and water. Evacuations may be necessary while repairs are made. Explosions or fire could destroy a structure and cause injuries or fatalities.

*Indirect Impacts:* Fuel costs may be increased. People may be displaced from their homes if a structure is destroyed. Water or ground contamination could destroy the natural environment and have long term effects for people and animals.

**Vulnerability Assessment:**

*Population:* First responders and emergency personnel are placed at risk when having to respond to a pipeline incident. The community of Sault Ste. Marie and those who live in the vicinity of the pipeline that runs through the County are most vulnerable.

*General Property:* Any structure that has piped in natural gas or near the pipeline will be more vulnerable to an incident.

*Essential Infrastructure, Facilities, and Other Important Community Assets:* Hospitals, nursing homes, apartment buildings and other facilities that have a large volume of residents such as motels or hotels would require evacuation or have the potential for a large amount of injuries or deaths if a major incident occurred and would stress the local capability.
Natural, Historic and Cultural Resources: The natural environment such as rivers, lakes, streams, wetland areas, forested area, and agricultural land would be vulnerable to long term contamination of a leaking or broken pipeline.

Estimating Potential Losses: With the potential destruction of the surrounding environment and high cost of repair, it is estimated that the economic impact of a gas/oil pipeline incident would be high.

Mitigation Capabilities: Pipeline should be regularly inspected and maintained and have warning systems in place. Owner and community should be compliant with industry and safety regulations and standards.

A buffer zone should be established around the pipeline or other hazardous materials facilities and incorporated into County, City, and Township land use planning.

Site emergency planning for schools, factories, hospital, correctional facilities, shopping centers and large recreation stadiums or venues.

Coordination and communication between owners, workers, and emergency responders. Contingency and evacuation planning for public and workers protection at construction sites.

Summary

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Extreme Temperatures

Description: Extended periods of extreme temperatures, either extreme summer heat or extreme winter cold, can pose severe and possibly life-threatening problems for residents of Chippewa County.

Extreme Summer Heat

Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. When persisting over a long period of time, this phenomenon is commonly known as a heat wave.
Extreme summer heat is also hazardous to livestock and agricultural crops, and it can cause water shortages, exacerbate fire hazards, and prompt excessive demands for energy. Roads, bridges, railroad tracks and other infrastructure are susceptible to damage from extreme heat.

Air conditioning is probably the most effective measure for mitigating the effects of extreme summer heat on people. Unfortunately, many of those most vulnerable to this hazard do not live or work in air-conditioned environments, especially in major urban centers where the vulnerability is highest. The use of fans to move air may help some, but recent research indicates that increased air movement may actually exacerbate heat stress in many individuals.

**Extreme Winter Cold**

Like heat waves, long periods of unusually cold weather can result in a significant number of temperature-related deaths. A significant number of cold-related deaths are not necessarily the direct result of “freezing” conditions. Rather, many deaths are the result of illnesses and diseases that are negatively impacted by severe cold weather, such as stroke, heart disease and pneumonia.

**Geographic Extent:** Shoreline areas are less susceptible to extreme temperatures, due to the effect of the water. The entire county can be affected by extreme temperature, therefore the geographic extent is deemed to be significant.

**Historical Events:**
Jan. 23, 2011 – No record breaking, but cold air and clear skies were the major contributors to some very low temperatures posted around the County: Raco -34, Pickford -33, Drummond Isl. -24, Trout Lake -23, Sault Ste. Marie -22, Rudyard -26.

Feb. 4-5, 2007 - Exceptionally cold air surged into Northern Michigan. High temperatures on the 4th (Super Bowl Sunday) were around zero, with low temperatures that night from five to ten below zero. Gusty northwest winds produced hazardous wind chills of 20 to 30 below zero, along with blowing and drifting snow. Many area schools closed on the 5th, due to the extreme cold and poor road conditions.

**Probability of Future Occurrences:** Based on the historical occurrences the likelihood of future occurrences is deemed to be low.

**Impact Assessment:**

**Direct Impacts:** Direct impacts of extreme temperatures can include dehydration, heat exhaustion or heatstroke in the case of heat or frostbite and hypothermia in the case of severe cold. Illness and death can occur from both heat and cold. Excessive demands on power supply can cause power outages and increased costs. Businesses and school closures are common as the road condition worsens.
**Indirect Impacts:** During times of extreme heat people tend to move less which would decrease economic activities of shopping and recreation. Extended power outages or restrictions on use could occur because of the excessive demand on the system. Increase demand on the medical field as illness or death increases.

**Vulnerability Assessment:**

**Population:** The most vulnerable population are the elderly who live alone on a fixed income, or individuals who have lower income or are impoverished, those who cannot afford air conditioning or the higher cost of heating, also the very young – babies and young children.

**General Property:** Extreme temperatures can affect livestock and pets.

**Essential Infrastructure, Facilities, and Other Important Community Assets:** Extreme heat and cold can affect the transportation infrastructure such as roads and railroads. Excessive demand on the supply of electricity may cause black outs.

**Natural, Historic and Cultural Resources:** Extended periods of heat can cause drought conditions, damaging the environment and increasing the risk of wildfire and other fire hazards.

**Estimating Potential Losses:** Estimating potential losses from extreme temperature events is difficult. Based on the historical data, it is determined that the economic impact would be low, however, that would change dependent upon the situation and length of time the event took place.

**Mitigation Capabilities:**

Establishing and opening shelters for relief from the extreme temperatures and getting that information out to the public.

Providing community assistance and networks to check on the elderly or other vulnerable population members during these times of extreme temperatures.

Ensuring the building codes and landlord regulations are in place for appropriate insulation or heating appliances.

Distribution of educational brochures or make information available on a web-site.
**Summary**

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**Subsidence/Ground Movement**

**Description:** Subsidence is the lowering or collapse of the land surface due to loss of subsurface support. It can be caused by a variety of natural or human-induced activities. Natural subsidence occurs when the ground collapses into underground cavities produced by the solution of limestone or other soluble materials by groundwater. Human-induced subsidence is caused principally by groundwater withdrawal, drainage of organic soils, and underground mining.

**Geographic Extent:** Subsidence is most likely in areas within the County where slopes are steep such as those greater than 35%. The steeper slopes usually occur along banks of rivers or creeks and high ridges. Subsidence can also occur where ground water aquifers are drained and sink holes occur. Water saturation in the soil can also cause ground movement.

**Historical Events:** On Sugar Island, September 9, 2013 during overnight thunderstorms, heavy rains washed out a portion of E. 1 ½ Mile Road from S. Westshore to S. Brasser. Other roads that were impassable and closed were N. Westshore from Seppie to Brasser; Hay Point from Townhall East; Bailey’s from Three Mile East; E. Shore from Brasser; and Three Mile between Townhall and Brasser.

In Chippewa County there was a recent incident (May, 2013) reported in the local newspaper of a portion of the Waishkey River bank that recently slid into the river and with such force it went up the other side. The, 2 story or so, massive landslide appears to have come from a private parcel of property upriver from the Waishkey’s confluence with Orr’s Creek in the vicinity of another recent landslide making it impassable by boat or even a canoe. The water is still flowing and officials have been contemplating on how to deal with the natural phenomena.

The last incident was recorded in April, 1997 officials discovered a problem with part of the gas pipeline that runs through Rudyard Township. This was due to landslide movement which threatened the stability of the pipeline.
From the public input survey, a resident of Sault Ste. Marie, identified a small sink hole that occurs each year in a residential area of Kimball Street.

Kinross Charter Township reported sink holes occurring due to the sandy soils entering into the storm and wastewater drain system causing pipes to be blocked and to crack in freezing weather.

In Michigan, broken water pipes or the improper discharge of rainwater are the most common causes of water-related incidents of subsidence

**Probability of Future Occurrences:** Based on the historical events there is a low probability of future occurrences. However, during seasons of heavy rainfall the risk of subsidence or ground movement would be significantly higher. Spontaneous ground openings can be dangerous if a sinkhole were to open below an occupied structure.

**Impact Assessment:**

**Direct Impacts:**
Direct impacts of subsidence could include infrastructure function loss, environmental contamination, property damage, possible casualties and emergency response. The consequences of improper utilization of land subject to ground subsidence will generally consist of excessive economic losses. This includes high repair and maintenance costs for buildings, irrigation works, highways, utilities and other structures. At times, structures are condemned because of the damage. This results in direct economic losses to citizens.

**Indirect Impacts:** Indirect losses may be realized through increased taxes and decreased property values. Lawsuits may also occur if property damage or loss of life occurs because of man induced activities.

**Vulnerability Assessment:**

**Population**
In general subsidence causes more of a risk to property than to humans. However, if infrastructure is damaged excessively it could potentially increase the risk to human life, such as a washed away roadway.

**General Property**
Some subsidence incidents may cause private property damage and casualties, others may affect roadways or other public infrastructure, and thus cause a more general impact on the population of an area.

**Essential Infrastructure, Facilities, and Other Important Community Assets**
Infrastructure such as roads, water lines, pipelines and utility lines would create a significant impact if affected by ground movement.
Natural, Historic and Cultural Resources

Water aquifers would be vulnerable if the densely populated areas of the County were to drain the reservoirs capacity leading to collapse and compaction. Changes in an area’s landscape, wildlife habitat and the natural ecosystem could also occur. Historical and aged structures would be more vulnerable.

Estimating Potential Losses: Although research indicates a certain amount of land subsidence hazard in Chippewa County, it also indicates very low risk to population and property. Additionally, the extremely localized and virtually unpredictable nature of land subsidence makes it nearly impossible to estimate potential loss.

Mitigation Capabilities
Community education and awareness is probably the most effective way to mitigate subsidence hazards. Local officials in subsidence-prone areas need to be aware of their community’s potential vulnerability to subsidence, and that awareness needs to be communicated to the public. Provisions in zoning ordinances that relate to new development need to be adopted to prevent developing in risk-prone areas.

Summary

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