Chapter 2

Natural Hazard Analysis

In this chapter the hazards that Chippewa County is most susceptible to are discussed. Descriptions of some of the major hazards are included. Information on hazard history is included where that information was available. A short description of the technological hazards is included although this Plan is concentrating mainly on the natural hazards as many of the technological hazards described are due to the natural hazards that affect the County.

Public Health Emergencies

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.

Historical Events: 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:

►More than 100 children ill at a local elementary school from a Norwalk virus probably primarily spread through the air. Infection stopped by closing school.

►More than 100 visitors to a camp ill from a virus, probably a small round structured virus, probably introduced by an ill child and spread by contamination of food. Illness stopped by increased education of food service workers, changes in food handling techniques and increased sanitation.

►Salmonella, staphylococcus, clostridium, Norwalk virus, E. coli, campylobacter, are other microorganisms are suspected to cause small-scale illness outbreaks, that result in one or two cases being reported to the Health Department. Nation-wide, only 10% of food-borne illnesses are thought to be reported. These cases are reported at a rate of approximately two per month and are investigated and tracked.

►Several (approximately one per year) cases of Hepatitis A in restaurant workers have resulted in Health Department intervention to preclude possible spread to patrons.

►A bus-load of senior citizens traveling from lower Michigan became ill with an undetermined food borne illness while in Chippewa County. Investigation traced source of illness to a meal eaten in a Lower Michigan county. The investigation was continued by that county.

►More than 30 children ill from Shigella at a day care center and school. Investigation in cooperation with Inter-Tribal Council of Michigan revealed day care center as probably source of infection.

►Health Department assisted with a Plan of Action formulated by the Department of Immigration and Naturalization at the International Bridge to prevent spread of possible SARS across International Bridge from Sault, Ontario into Sault Ste. Marie, Michigan.

►Health Department frequently cooperates on food-borne and water-borne illness investigations with Algoma Health Unit to investigate illnesses incurred in either country by residents of the other country.

►Health Department assisted in control of scabies outbreak at nursing home.

►Health Department notified medical community regarding a multi-drug resistant strep pneumonia at area nursing homes.

►Cooper poisoning of several students at local university was investigated by Health Department and found to be caused by malfunctioning pop machine.

►Widespread occurrence of tuberculosis in county several years ago has resulted in routine tuberculosis screening to spot and prevent recurrence of similar outbreak.

►Health Department conducts frequent persistent head lice interventions in schools.

►Several cases of Blastomycosis in Sault Ste. Marie and on Drummond Island in two separate outbreaks resulted in one death. Cases were investigated by Health Department and resulted in education campaign to ensure citizens and medical community were aware of signs and symptoms of illness thus ensuring prompt treatment.

►On-going counseling and report of sexually transmitted diseases results in alerts to medical community and increased education regarding increased rates of Chlamydia in recent years.

►Annual routine speech, hearing and vision screenings catch numerous problems resulting in referrals for treatment.

►Health Department responds to high rates of influenza in community by increasing influenza vaccinations and increasing infection control procedures at health department

Environmental Contamination

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. Some of the cases in which CCHD have been involved in investigating and remediating follow.

►Regular sewage overflows in Sault Ste. Marie, Ontario result in raw sewage contaminating Chippewa County waterfront properties, including bathing beaches and private water intakes from the river. Health Department works on notification of property owners and posting of bathing beaches.

►Multiple and frequent investigations into cases of public and private water supplies being contaminated with bacteria, has resulted in a variety of methods of remediation including replacing wells and drain fields. Some of these bacteria have caused water-borne illness including Yersinia, cryptosporidia and very frequently, giardia.

►Widespread and long-term aquifer contamination, both bacterial and by hydrocarbons, in many areas of Chippewa County has resulted in need for stringently regulated well construction and careful oversight by Health Department.

►Regular contamination of commercial hot tubs and spas with rash-causing microorganisms results in need for regulation and oversight by Health Department.

►Death by child drowning in commercial swimming pool emphasizes need for routine Health Department inspections to ensure adherence to required safety precautions.

►Health Department assisted with investigation of contamination of wells with hazardous chemicals possibly from farm fertilizer applied on crops.

►Health Department has investigated several incidents of mercury contamination at schools and local museum and assisted with remediation.

►Water-borne illness outbreak at rental home and neighboring resort resulted in more than 20 illnesses as a result of contaminated aquifer providing water to both facilities. Health Department investigation resulted in stopping further spread of illness and ultimate replacement of poorly constructed well and drain field.

►Lead screening in children has caught high blood lead levels and prompted investigation into causes at private housing, sometimes resulting in remediation of problems.

►The Health Department has been involved in investigation into contamination of approximately two methamphetamine labs in the private homes in Chippewa County.

►Rat infestations are handled occasionally, perhaps once annually most often at private homes and at a local food warehouse.

►Cases of Schistosomosiasis (swimmers' itch) at local bathing beaches are handled occasionally.

►West Nile Virus is detected in birds each year since introduction into United States.

►Occasional infestations of cockroaches at food service facilities result in investigation and remediation requirements.

►Cases of food contamination by agents including copper, excessive MSG, and a homegrown folk medicine known to cause severe illness due to acidosis have been investigated.

Frequency: Infectious illness outbreaks: Small-scale outbreaks of infectious disease occur nearly weekly. Many are single cases that may signal the beginning of a larger outbreak and therefore, are usually investigated. Larger outbreaks involving 5 to 10 people occur several times each year and widespread illness outbreaks occur once every year or two.

Safety: The greatest emerging public health threat would be the intentional release of a radiological, chemical or biological agent with the potential to adversely impact a large number of people. Such a release would most likely be an act of sabotage aimed at the government or a specific organization or segment of the population. The spread of communicable disease or epidemics is also an area for concern. With Chippewa County home to the only landfill and a border community, importation of un-inspected solid waste is becoming a major concern.

Health: 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. In addition, the more vulnerable members of society – the elderly, children, impoverished individuals, and people in poor health – are also more at risk than the general population.

Critical Facilities: 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.

Economic Impact: The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be statewide, regional, or localized in scope and magnitude. Hospitals and medical facilities are often stretched to the limit of their resources. Depending upon the emergency, the economic impact can be devastating for area residents. When one or more of these independent, yet interrelated systems fail due to disaster or other cause – even for a short period of time – it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can literally die in their homes if immediate mitigation action is not taken.

Potential Losses: Depending on the extent of an emergency the potential loss could include a school having to close due to illness, disinfecting costs, extending operations to make-up time, loss of employment. Contamination of a critical facility such as the only hospital that serves the entire county as well as neighboring communities could be devastating for the area and would cause severe economic losses as well as loss of a major health care facility. Contamination of water supplies could result in communities having to boil their water or having to buy clean water as well as the cost of cleaning up and fixing the source of contamination.

Vulnerable Areas: 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, Brimley.

Infrastructure Failures

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.

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.

Frequency: Chippewa County can expect power/communication outages possibly numerous times a year usually due to severe weather conditions. Freezing ground is also expected annually.

Safety: 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. 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.

Health: When the water or wastewater treatment systems in a community are inoperable, serious public health problems arise that must be addressed immediately to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur.

Buildings: During cold weather months, homes that rely on electric for heat are more vulnerable.

Critical Facilities: Hospitals, emergency response facilities, shelters should all have back-up power capabilities.

Economic Impact: Loss of infrastructure has a great economic impact on all area businesses and people within the County.

Potential Losses: Depending on the situation loss of infrastructure such as electric power can affect area businesses due to having to close. Citizens may experience loss of heat which may lead to frozen pipes and damage if power outage occurs during the cold months for an extended period of time. In warmer months an extended power outage could result in loss of food and business. Damage caused by heaving to the road system can be very costly to repair, in some cases whole sections of the road must be re-built.

Vulnerable Areas: City of Sault Ste. Marie and surrounding area, Drummond Island, Sugar Island, Neebish Island, the communities of DeTour Village, Rudyard, Kincheloe, Pickford, Trout Lake, Brimley, Paradise, Hulbert, Strongs, Eckerman, Goetzville, Raber, Barbeau and the outlying areas of the County.

Transportation Accidents/Hazardous Materials Transportation Accidents

Transportation

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 Michigan could involve a commercial intercity passenger bus, a local public transit bus, a school bus, or an intercity passenger train. 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. Intercity passenger train accidents usually involve a collision with a vehicle attempting to cross the railroad tracks before the train arrives at the crossing. Unless the train accident results in a major derailment, serious injuries are usually kept to a minimum. Bus accidents, on the other hand, can be quite serious – especially if the bus has tipped over. 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 19 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.

In the past year January through December, 2004 the Coast Guard was involved in 140 cases of Search and Rescue (group wide) (58 cases handled by Station SSM), 181 Waterway Restrictions which is any incident (fog, snow, ice) which forces a commercial vessel to stop and that action delays the movement of any other vessel(s), 5 Groundings, 2 Collisions, and 13 Vessel Casualties (loss of engine, steering, gyro).

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 the Great Lakes, one of the most dangerous hazardous material transportation accident scenarios that could occur in Michigan 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.

Fixed Site – Hazardous Material Incidents

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

Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general public and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use, and disposal of these materials, accidental releases do occur. Often, these releases can cause severe harm to people or the environment if proper mitigative action is not immediately taken.

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. In addition, industrial accidents can cause severe economic disruption to the facility and surrounding community, as well as significant, long-term impacts on the families of the workers injured or killed.

Pipeline Accidents

Petroleum and natural gas pipelines pose a real threat in the Eastern Upper Peninsula. Petroleum and natural gas pipelines can leak or fracture and cause property damage, environmental contamination, injuries, and even loss of life. The vast majority of pipeline accidents that occur are caused by third party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations. However, some natural events such as subsidence can also cause damage to a pipeline. Petroleum and natural gas industries have historically had a fine safety record, and that pipelines are by far the safest form of transportation for these products, the threat of fires, explosions, ruptures, and spills nevertheless exists.

Chippewa County did experience some ground movement in April, 1997 along the Pine River in which the pipeline stability was threatened and is explained more under the Subsidence section.

Potential Losses: With any accident there is there is the cost of emergency response, the potential loss of life, most probably property damage and loss of function. An accident on the Lakes may cause loss of shipping. Transportation accidents may cause a re-routing of traffic and hazardous material/pipeline accidents would also cause loss of function.

Vulnerable Areas: Areas with pipeline, major transportation routes, railroad corridor, industrial areas, shipping channels, airports, hazardous material sites.

Civil Disturbances

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.

Potential Losses: With any civil disturbance there will be a cost for emergency response. The potential for casualties exist. There may be a loss of function and/or property damage.

Vulnerable Areas: City of Sault Ste. Marie, Kinross Charter Township

Severe Winter Weather

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.

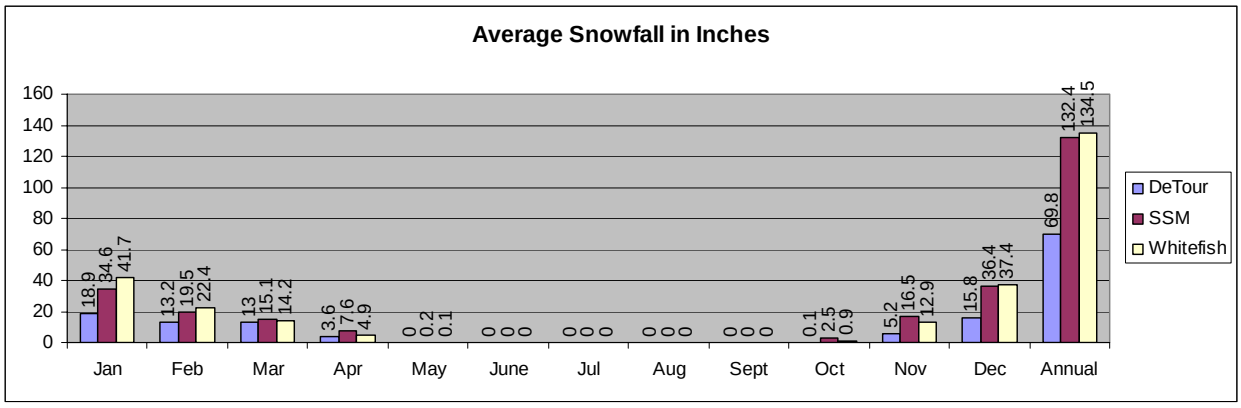
Snow: Heavy snowfalls can range from large accumulations of snow over many hours to blizzard conditions with blowing snow that could last several days. The National Weather Service's snow classification is in the table below.

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

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.

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.



Snowfall Extremes Period of Record: 1900-2001								
Month	High (in)			Year	1-Day Max (in)			Date
	SSM	Whitefish	DeTour		SSM	Whitefish	DeTour	
JAN	71	68	38	1982 1977 1982	12.2	11.2	12	1/25/1972 1/3/1995 1/26/1990
FEB	41.3	50.5	45.4	1972 1968 1962	12.4	14	14	2/2/1968 2/14/1918 2/26/1962
MAR	34.7	52	57.7	1964 1923 1951	11.8	13	21	3/5/1964 3/4/1920 3/23/1951

Snowfall Extremes Period of Record: 1900-2001								
Month	High (in)			Year	1-Day Max (in)			Date
	SSM	Whitefish	DeTour		SSM	Whitefish	DeTour	
APR	25.8	24	20	1982 1928 1950	9	16	10	4/6/1979 4/5/1977 4/2/1987
MAY	4.6	11	0.3	1947 1921 1990	4.6	7	0.3	5/29/1947 5/14/1921 5/11/1990
SEP	2.7	3	0	1956 1908 -	2.7	3	-	9/20/1956 9/29/1908 -
OCT	11.6	20.7	2.5	1969 1925 1962	7	14	2.5	10/27/1969 10/18/1930 10/28/1965
NOV	46.8	52	27.3	1989 1926 1950	14.3	22	13.5	11/16/1943 11/8/1900 11/15/1974
DEC	98.7	71.7	37.6	1995 1978 1983	26.6	15.4	13	12/10/1995 12/9/1988 12/12/1983
Season Jul-Jun	222	241	152.4	1995-1996 1976-1977 1950-1951	26.6	22	21	12/10/1995 11/8/1900 3/23/1951

Snowfall Threshold Climatology Derived from 1971-2000 Averages *Annual/seasonal totals may differ from the sum of the monthly totals due to rounding.												
Month	# Days Total ≥ 0.1"			# Days Total ≥ 1.0"			# Days Total ≥ 2. 0"			# Days Total ≥ 5.0"		
	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour
JAN	20.4	19.8	9	10.7	14.1	7.2	6.2	8.7	4.6	1.3	1.5	0.7
FEB	14.7	12.7	6.4	6.2	7.2	4.8	3.4	4.6	3.3	0.6	0.7	0.5
MAR	10.9	8	5.7	4.6	4.5	4.7	2.6	2.6	3.3	0.6	0.7	0.6
APR	5.1	2.7	1.5	2.3	1.4	1.1	1.3	0.7	0.8	0.3	0.2	0.2
MAY	0.5	0.2	0	0	0	0	0	0	0	0	0	0
SEP	0.2	0	0	0	0	0	0	0	0	0	0	0
OCT	2.8	0.6	0.1	0.8	0.4	0	0.3	0.2	0	0	0	0
NOV	11.3	7.3	2.9	5.6	4.5	2.1	3.1	2.6	1.2	0.5	0.3	0.1
DEC	18.8	16.5	7.7	10.5	11.8	5.7	6.2	7.8	3.8	1.6	1.4	0.7
Annual	86.2	66.7	33.1	41.6	43	25.4	23.7	26.7	16.8	5	4.7	2.8

Ice Storms: 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.

Historical Events: The National Weather Service recorded 63 Snow and Ice Events during the period between January 1, 1950 and April 30, 2004. Of the 63 events, 49 were categorized as heavy snow, 10 as winter storms, two as freezing rain (one of which accompanied heavy snow), two as an ice storm and one lake effect snow.

On 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.

A strong low pressure system developed over the southern Plains during the day on the 24th of February, 2001. During the evening of the 24th and through the early morning hours of the 25th, the low moved northeast into central Wisconsin. Warm, moist air surged northward into the northern Great Lakes Region ahead of this storm system. This allowed for widespread rainfall to develop across the Great Lakes. Surface temperatures across northern Lower and eastern Upper Michigan, however, remained below freezing throughout much of the period. This set the stage for freezing rain. Across northern Lower Michigan, the freezing rain began during the evening of the 24th. By late in the evening, a quarter of an inch of ice had accumulated on exposed surfaces. Across eastern Upper Michigan, the freezing rain began late in the evening on the 24th, and continued through the early morning hours of the 25th. By the morning of the 25th, ice had accumulated to between and a quarter and a half inch on exposed surfaces. As the storm system moved northeast across Wisconsin during the morning of the 25th, a surface warm front moved north across Northern Michigan. This quickly allowed surface temperatures to rise well above freezing, thereby rapidly melting the ice on the trees. Widespread tree damage and power outages did not occur with this event, as most trees and power lines were able to sustain the weight of the ice until it melted. Many area roads, however, were extremely icy.

On March 10, 2002, blizzard conditions covered the entire Eastern U.P. including Chippewa County. Snowfall was heavy and coupled by a northwest wind of 25-35 mph with gusts of winds up to 50 mph.

Frequency: According to the National Weather Service areas around the City of Sault Ste. Marie can expect 5 days of the year where snowfall is greater than 5 inches based on averages from 1971 to 2000. The area around Whitefish Point can expect 4.7 days and around DeTour Village it is expected that 2.8 days a year the area will receive greater than 5 inches of snow.

Safety: Loss of power is a major concern during the winter months for those who rely on electric for heat. Driving conditions are also a concern during winter storms. Other health issues include heart attacks from shoveling snow.

Health: People and animals are vulnerable when winter shows its fury. Extreme temperatures may accompany blizzards. Power outages may cause loss of heat. The effect of cold on people is made more severe by the impact of wind chill factors.

Buildings: Snow and ice accumulation upon roofs make all buildings vulnerable to damage. Older buildings or buildings with large expanses such as barns or airplane hangers if not properly constructed could collapse if snow and ice accumulations get too heavy.

Critical Facilities: Critical facilities are susceptible to the same damage from winter storms as other buildings. Emergency operations can be disrupted as travel may become extremely difficult or impossible. The major impacts of snow and ice storms on property are to utilities and roads. Power lines and tree limbs are coated with heavy ice resulting in disrupted power and telephone service, possibly for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces.

Economic Impact: Winter storms can shut down entire communities which would result in the economic loss of many businesses. Snow removal costs are increased which increases the burden on the County Road Commission. Shipping and air travel may be halted.

Potential Losses: Potential losses from severe winter weather could include structure collapses, increased cost in snow removal, increased potential for transportation accidents, increased potential for infrastructure failures, and possibly severely limiting emergency response time and ability.

Vulnerable Areas: The whole County would be vulnerable during severe winter weather. Areas along the northern shoreline typically get hit the hardest with a northwest wind. Areas along the southern shoreline typically get hit hard with a south wind.

Thunderstorms/High Wind/Lightning/Hail

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.

Historical Events: During the period January, 1993 through April, 2004 the National Weather Service recorded 19 Thunderstorms/High Wind events and 12 Hail events that affected Chippewa County. (See Map 15 Thunderstorm/High Wind Map, and Map 16 Historic Hail Storm Map.)

On October 21, 1993 a thunderstorm passed through the region spanning several counties including all of the Eastern Upper Peninsula as well as some Northern Lower Michigan Counties. This storm produced sustained winds of 25-40 mph with gusts up to 75 mph around the county, and as a result many trees and power lines went down.

One of the strongest storms ever recorded in the Great Lakes crossed the region on the November 10th and 11th, 1998. The storm originated over the Central Plains and lifted across western portions of Lake Superior. South to southeast winds increased steadily during the morning of the 10th and by late morning winds gusts of 40 to 50 mph were common over areas away from Lake Huron. Along the Lake Huron shoreline...winds were gusting to 60 to 70 mph with a peak gust of 95 mph reported on Mackinac Island. The wind shifted to the southwest during the afternoon...with the strongest winds generally developing along the Lake Michigan shoreline. During the afternoon and evening of the 10th wind gusts of 70 to 80 mph were common along the Lake Michigan shoreline...with 50 to 60 mph gusts across the rest of the

region. Similar winds persisted into the morning of the 11th and then began to diminish during the afternoon. A large number of trees were uprooted or snapped off with many branches also torn off. Many of the trees and branches fell on power lines resulting in widespread power outages region wide. Many roads were also blocked by falling trees and several accidents were reported as cars collided with debris on the roadways. Several homes and cars received damage from falling trees and branches. The strong winds generated 15 to 20 foot waves on Lake Michigan. Most ships took shelter with the approach of the storm and rode out the storm in protected waters. The strong winds on Mackinac Island toppled several trees onto a condominium.

In July, 2000 a weak cold front moved across the Great Lakes region during the afternoon and evening of the 13th. This front caused scattered thunderstorms to develop across the northern Great Lakes region. A couple of these storms produced large hail. No damage was reported.

A line of thunderstorms moved across eastern Upper and far northern Lower Michigan during the early afternoon hours on the 8th of August, 2001. These storms produced numerous reports of severe hail. Winds from these storms also downed numerous trees. One tree fell on a car, injuring the occupant.

Trees were downed at Tahquamenon State Park Four when waves of severe thunderstorms impacted northern Michigan during the morning, afternoon, and evening hours on the 1st of August, 2002. The first wave of severe thunderstorms struck the area during the early morning hours, initially knocking trees down in Tahquamenon Falls State Park. The last of the storms exited northern Michigan into Lake Huron during the evening hours. Three tornadoes were associated with the severe thunderstorms, but none of these crossed county boundaries.

Frequency: Thunderstorms are infrequent in the area and tornadoes rarely occur. Thunderstorms occur on about 27 to 29 days each year.

Safety: The threat to life varies by the cause of death. Toppling trees, debris in roadways can cause potential accidents. Downed power lines and lightning are potential killers.

Health: No special health problems are attributable to thunderstorms, other than the potential for tetanus and other diseases that arise from injuries and damaged property.

When lightning strikes a human being, serious burns or death are the common outcomes. For every person killed by lightning, three people are injured. For those who survive their injuries can lead to permanent disabilities. Seventy percent of the survivors suffer serious long-term effects, such as memory loss, sleep disorders, depression, and fatigue.

Buildings: As with tornadoes, mobile homes are at a high risk to damage from thunderstorms. Wind and water damage can result when windows are broken by flying debris or hail. Lightning can cause direct damage to structures (especially those without lightning protection systems) and can cause fires that damage forests and structures.

Hail can inflict severe damage to roofs, windows and siding, depending on hailstone size and winds.

Map 15 Thunderstorms/High Winds

Map 16 Historic Hail Storms

Critical Facilities: Critical facilities are susceptible to the same damage and disruption from thunderstorms as other buildings. Emergency operations can be disrupted as thunderstorms and lightning affect radio communications and antennas are a prime target for lightning.

Economic Impact: Thunderstorms, flash flooding, wind and hail can all (or separately) destroy crops in the field. Long stemmed vegetation, such as corn and wheat, is particularly vulnerable to hail. Winds greater than 39 miles per hour can damage crops during the growing season. Lightning is one of the major causes of forest fires. Fortunately, these impacts are relatively localized.

Thunderstorms can impact transportation and utilities. Airplanes have crashed when hit by downbursts or lightning. Automobiles and their windshields are subject to damage by hail.

Power lines can be knocked out by lightning or knocked down by wind and debris. Lightning can also cause power surges that damage appliances, electronic equipment and computers.

Potential Losses: Power outages, power surges, damages from wind and hail could create potential loss of function and property damage. Emergency response may be required and there is a potential for casualties.

Vulnerable Areas: The whole county can be affected by the weather. Heavily treed areas, communication towers, power facilities are more vulnerable to damage.

Wildfires

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.

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. (See Map 17 - Wildfire Fuel Map)

The 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 MNDR 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

Map 17 Wildfire Fuel Types

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.

Historical Events: Information for the Department of Natural Resources show that in 2003 there were a total of 18 fires in the Sault area which covers most of Chippewa County and parts of Mackinac County. This number was up significantly from 2001 in which only 7 fires were recorded and 8.1 acres burned. Overall, debris burning remains the leading cause of wildfires whose causes were determined.

In 1983, a significant fire was suppressed in the Kincheloe area.

Frequency: Records from the Department of Natural Resources indicate that State land in Chippewa County experienced 260 wildfires over a twenty year period for an average of 13 wildfires per year. The amount of land that burned was 2,731 acres or 137 acres per year. Many township volunteer fire departments may respond to calls that are not recorded by MDNR. The Hiawatha National Forest records show that one major fire occurs every ten years.

Safety: Evacuation from an area may be needed.

Health: Potential loss of life, burns and/or smoke inhalation can result from fire.

Buildings: Rural cabins, hunting shacks, seasonal homes, etc. would be most vulnerable, especially those which have fuels that feed a fire or which may not have the necessary access for responding vehicles.

Critical Facilities: Places of assembly such as campgrounds are vulnerable as many are located in rural areas. Power lines can be destroyed by heat or falling trees.

Economic Impact: Destruction of potential forestry products could mean a serious loss of income to the forestry industry. Loss of recreational property and scenic vistas could possibly bring fewer tourists to the area which would have a great economic impact on this area. Potential crop loss for area agriculture industry especially hay producers.

Potential Losses: Wildfires can cause potential loss of property and lives. Destruction of vegetation and contamination of soils can occur. Emergency response is necessary. There is a good probability that there will be some form of function loss such as power if lines are destroyed or transportation re-routing.

Vulnerable Areas: Remote areas of the county not easily accessible by emergency vehicles. Forested, cropland and grassland areas as well as wetland habitation can be destroyed if the area is dry enough.

Extreme Temperatures

Prolonged periods of extreme temperatures, whether extreme summer heat or extreme winter cold, can pose severe and often life-threatening problems for Michigan's citizens. Although they are radically different in terms of initiating conditions, the two hazards share a

commonality in that they both primarily affect the most vulnerable segments of the population – the elderly, children, impoverished individuals, and people in poor health. Due to their unique characteristics, extreme summer heat and extreme winter cold hazards will be discussed individually.

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 called a heat wave.

Because the combined effects of high temperatures and high humidity are more intense in urban centers, heatstroke and heat exhaustion are a greater problem in cities than in suburban or rural areas. Nationwide, approximately 200 deaths a year are directly attributable to extreme heat. 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, periods of prolonged, unusually cold weather can result in a significant number of temperature-related deaths. Each year in the United States, approximately 700 people die as a result of severe cold temperature-related causes. This is substantially higher than the average of 200 heat-related deaths each year. It should be noted that a significant number of cold-related deaths are not the direct result of "freezing" conditions. Rather, many deaths are the result of illnesses and diseases that are negatively impacted by severe cold weather, such as stroke, heart disease and pneumonia. It could convincingly be argued that, were it not for the extreme cold temperatures, death in many cases would not have occurred at the time it did from the illness or disease alone.

Historical Events: Excessive Heat was a problem the first two weeks in August, 2001 across all of northern Michigan. Temperatures reach the mid to upper 90s, on average, a few days each year; however, for a 5 day (8/5 - 8/9) stretch overnight low temperatures failed to fall below the lower 70s in most areas. This very humid air mass was unusual for northern Michigan, an area which typically sees cool nighttime temperatures and for this reason has very few homes with air conditioners. No heat related deaths or injuries were reported; however, most outdoor events were modified due to the forecasts of hot and humid conditions. County fairs sent animals home, yet still there were livestock losses at fairs in some counties. Attendance at county fairs was well below normal and this was attributed to the heat.

Frequency: The annual average temperature ranges from 38 degrees F to 40 degrees F. The average winter temperature range is 14 to16 degrees F. During the period 1931-2001, Chippewa

County had four times when the 1-Day Max temperature went over 90 degrees F. In the same period the County recorded three times when the 1-Day Min temperature dropped below -30 degrees F.

Temperature Extremes Period of Record: 1931-2001								
Month	1-Day Max Degrees F			Date	1-Day Min Degrees F			Date
	SSM	Whitefish	DeTour		SSM	Whitefish	DeTour	
JAN	54	45	53	1/7/1932 1/27/1931 1/1/1966	-36	-23	-27	1/10/1982 1/30/1994 1/15/1994
FEB	49	50	52	2/11/1999 2/18/1997 2/24/1984	-37	-27	-39	2/8/1934 2/18/1979 2/17/1979
MAR	75	61	60	3/28/1946 3/15/1990 3/30/1977	-28	-23	-32	3/11/1948 3/3/1972 3/3/1972
APR	85	78	83	4/25/1990 4/26/1990 4/26/1990	-2	-1	1	4/5/1982 4/8/1977 4/6/1972
MAY	89	85	88	5/30/1937 5/16/1962 5/31/1988	18	20	22	5/7/1966
JUN	93	90	96	6/26/1983 6/9/1959 6/29/1964	26	27	32	6/3/1982 6/2/1964
JUL	97	96	102	7/1/1931 7/29/1988 7/3/1966	36	33	38	7/14/1950 7/15/1987 7/11/1968
AUG	98	95	95	8/5/1947 8/21/1955 8/1/1975	29	6	36	8/29/1982 8/11/1961 8/29/1982
SEP	95	90	91	9/8/1976 9/5/1998 9/4/1983	25	26	27	9/25/1947 9/30/1993 9/16/1986
OCT	81	82	80	10/12/1938 10/1/1971 10/2/1971	3	19	19	10/18/1935 10/24/1981 10/23/1969
NOV	74	68	70	11/3/1938 11/2/1990 11/4/1964	-10	-5	-5	11/30/1936 11/29/1976 11/22/1964
DEC	62	57	58	12/5/2001 12/6/2001 12/4/1982	-31	-14	-24	12/26/1993 12/30/1989
Annual	98	96	102	8/5/1947 7/29/1988 7/3/1966	-37	-27	-39	2/8/1934 2/18/1979 2/17/1979

In winter, the average temperature is 18.5 degrees F at Whitefish Point, 15.7 degrees at Sault Ste. Marie, and 16.4 degrees at DeTour Village and the average daily minimum temperature is 11.5 degrees at Whitefish Point, 7.8 degrees at Sault Ste. Marie, and 7.2 degrees at DeTour. The lowest temperature on record is –30 at Whitefish Point, -37 at Sault Ste. Marie, and –39 at DeTour Village. In summer, the average temperature is 59.4 degrees at Whitefish Point, 61.6 degrees at Sault Ste. Marie and 62.5 degrees at DeTour and the average daily maximum temperature is 69.4 degrees at Whitefish Point, 72.9 degrees at Sault Ste. Marie, and 73.7 degrees at DeTour.

Temperature Threshold Climatology
Derived from 1971-2000 Averages
*Annual/seasonal totals may differ from the sum of the monthly totals due to rounding.

Month	# Days Total ≥ 90 F			# Days Max ≤ 32 F			# Days Min ≤ 32 F			# Days Min ≤ 0 F		
	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour
JAN	0	0	0	25.9	25.5	23.3	30.7	30.9	30.8	11.8	5.2	9.8
FEB	0	0	0	21.1	20.1	19.6	27.7	27.6	27.7	9.9	7.4	9
MAR	0	0	0	13.4	11.3	10.8	28.5	29.2	28.4	4	2.9	2.5
APR	0	0	0	2.1	1.4	1.6	20.4	20.7	18.3	0	0.1	0
MAY	0	0	0	0	0	0	6.7	6.8	3.5	0	0	0
JUN	0.2	0	0.2	0	0	0	0.9	0.7	0	0	0	0
JUL	0.8	0.2	0.5	0	0	0	0	0	0	0	0	0
AUG	0.3	0.1	0.4	0	0	0	0	0	0	0	0	0
SEP	0	0	0	0	0	0	1.9	0.5	0.2	0	0	0
OCT	0	0	0	0.1	0	0	10.7	6.5	5.4	0	0	0
NOV	0	0	0	7.3	5.7	4.1	22.3	20.3	19	0.2	0	0
DEC	0	0	0	20.3	18.8	16.1	29.6	29.3	28.9	5.7	1.7	3.4
Annual	1.3	0.3	1.2	90.2	81.2	75.6	179	170.1	162.5	31.7	17	24.8
Winter	0	0	0	67.4	64.1	59	88.1	87.7	87.4	27.4	14.2	22.2
Spring	0	0	0	15.3	12.6	12.3	55.3	56.4	50.2	4	3	2.5
Summer	1.3	0.3	1.1	0	0	0	0.9	0.7	0	0	0	0
Fall	0	0	0	7.3	5.7	4.1	34.9	27.2	24.8	0.2	0	0

Health: The major threats of extreme summer heat are heatstroke (a major medical emergency), and heat exhaustion. **Heatstroke** often results in high body temperatures, and the victim may be delirious, stuporous, or comatose. Rapid cooling is essential to preventing permanent neurological damage or death. **Heat exhaustion** is a less severe condition than heatstroke, although it can still cause severe problems such as dizziness, weakness and fatigue. Heat exhaustion is often the result of fluid imbalance due to increased perspiration in response to the intense heat. Treatment generally consists of restoring fluids and staying indoors in a cooler environment until the body returns to normal. Other, less serious risks associated with extreme summer heat are often exercise-related and include heat syncope (a loss of consciousness by

persons not acclimated to hot weather), and heat cramps (an imbalance of fluids that occurs when people unaccustomed to heat exercise outdoors).

Hypothermia (the unintentional lowering of core body temperature), and **frostbite** (damage from tissue being frozen) are probably the two conditions most closely associated with cold temperature-related injury and death. Hypothermia is usually the result of over-exposure to the cold, and is generally thought to be clinically significant when core body temperature reaches 95 degrees or less. As body temperature drops, the victim may slip in and out of consciousness, and appear confused or disoriented. Treatment normally involves re-warming the victim, although there is some controversy in the medical community as to exactly how that should be done. Frostbite rarely results in death, but in extreme cases it can result in amputation of the affected body tissue.

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

The special vulnerability of elderly persons to hypothermia has become readily apparent. Over half of the approximately 700 persons who die each year due to cold exposure are 60 years of age or older, even though this age group only represents about 20% of the country's population. This remarkable statistic may be due, in part, to the fact that elderly persons appear to perceive cold less well than younger persons and may voluntarily set thermostats to relatively low temperatures. In addition, high energy costs and the relative poverty among some elderly people may discourage their setting thermostats high enough to maintain adequate warmth. Because many elderly people live alone and do not have regular visitors, the cold conditions may persist for several days or weeks, thus allowing hypothermia to set in.

Babies and very young children are also very vulnerable to hypothermia. In addition, statistics indicate that death due to cold is more frequent among males than females in virtually all age groups. Part of that may be explained by differences in risk factors, and part may be due to different rates of cold exposure between the sexes.

Potential Losses: Loss of heat in extreme cold can lead to frozen pipes and loss of infrastructure. Prolonged periods of extreme heat can cause loss of crops and potential livestock loss. Function loss from heaving ground can also occur along the transportation network. The potential for casualties and emergency response will also factor into potential losses.

Vulnerable Areas: The entire county would be susceptible to extreme temperatures. Shoreline areas may experience a greater temperature difference than those inland areas.

Tornadoes

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 pat, 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.

The Fujita Scale of Tornado Intensity

F-Scale Number	Intensity Descriptor	Wind Speed (mph)	Type/Intensity of Damage
F0	Gale tornado	40-72	Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112	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.
F2	Significant tornado	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206	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.
F4	Devastating tornado	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318	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.
F6	Inconceivable tornado	319-379	These winds are very unlikely. The area of damage they might produce would be unrecognizable.

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)

Historical Events: According to the National Weather Service during the time frame of 1950-2004 Chippewa County has experienced six tornadoes. Of these six, one tornado was rated an F, three tornadoes rated F0 and two tornadoes reached the F1 category.

On August 5, 1977 an F1 tornado caused $25,000 in property damages. Another tornado on August 16, 1978 was reported to be 27 yards wide and 1 mile long. Along with this tornado $250,000 were reported in property damage, although it was only classified as an F. On April 1, 1987 an F0 tornado touched down for 10 yards and caused $2500.00 in property damage. During the other three tornados no damage was recorded one of which happened on July 12, 1972 and two of which happened in July of 1987.

Drummond Island reported that a Waterspout damaged a boat house and storage building on a marina dock on July 3, 1999.

Safety: Tornados can cause death and destruction and residents in mobile homes or recreational vehicles (campers) are at the greatest risk.

Health: The major health hazard from tornadoes is physical injury from flying debris or being in a collapsed building or mobile home. Based on national statistics for 1970-1980, for every person killed by a tornado, 25 people were injured and 1,000 people received some sort of emergency care.

Within a building, flying debris or missiles are generally stopped by interior walls. However, if a building has no partitions any glass, brick or other debris blown into the interior is life threatening. Following a tornado, damaged buildings are a potential health hazard due to instability, electrical system damage, and gas leaks. Sewage and water lines may also be damaged.

Building Damage: Although tornadoes strike at random, making all building vulnerable, three types of structures are more likely to suffer damages:

1. Mobile Homes
2. Homes on crawlspaces (more susceptible to lift), and
3. Buildings with large spans, such as airplane hangers, gymnasiums and factories.

Structures within the direct path of a tornado vortex are often reduced to rubble. However, structures adjacent to the tornadoes path are often severely damaged by high winds flowing into the tornado vortex, known as inflow winds.

Critical Facilities: Because a tornado can hit anywhere in the County, all critical facilities are susceptible to being hit. Schools are a particular concern, though for two reasons:

1. They have a large number of people present, either during school or as a storm shelter, and
2. They have large span areas, such as gyms and theaters.

Economic Impact: The major impact of a tornado on the local economy is damage to businesses and infrastructure. A heavily damaged business, especially one that was barely making a profit, often has to be closed.

Infrastructure damage is usually limited to above ground utilities, such as power lines. Damage to utility lines can usually be repaired or replaced relatively quickly.

Damage to roads and railroads is also localized. If it can't be repaired promptly, alternate transportation routes are usually available.

Public expenditures include search and rescue, shelters, and emergency protection measures. The large expenses are for repairs to public facilities and clean up and disposal of debris. Most public facilities are insured, so the economic impact on the local treasury may well be small.

Clean up and disposal can be a larger problem, especially with limited landfill capacity near the damage site.

Potential Losses: Property damage and loss of function are potential losses as well as emergency response and casualties.

Vulnerable Areas: Depending upon the area the tornado was to touch down the entire County would be vulnerable. The mobile home parks within the City of Sault Ste. Marie, campgrounds, and denser populated areas.

Flooding

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. Great Lakes water level information is shown in the following table:

Lake Superior
Period of Record: 1918-2003
English Units (feet)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	601.51	601.31	601.21	601.31	601.64	601.90	602.13	602.20	602.23	602.13	602.00	601.77
Max	602.69 **1986**	602.46 **1986**	602.40 **1986**	602.62 **1986**	602.82 **1986**	602.89 **1986**	603.08 **1950**	603.22 **1952**	603.22 **1985**	603.38 **1985**	603.31 **1985**	603.05 **1985**
Min	599.84 **1926**	599.61 **1926**	599.54 **1926**	599.48 **1926**	599.61 **1926**	599.90 **1926**	600.26 **1926**	600.46 **1926**	600.79 **1926**	600.72 **1925**	600.43 **1925**	600.13 **1925**
Chart Datum 601.1 feet												
Lakes Michigan-Huron												
Mean	578.54	578.48	578.54	578.81	579.13	579.33	579.43	579.36	579.20	579.00	578.81	578.64
Max	581.30 **1987**	581.07 **1986**	581.10 **1986**	581.46 **1986**	581.63 **1986**	581.79 **1986**	581.99 **1986**	581.99 **1986**	581.96 **1986**	582.35 **1986**	581.96 **1986**	581.56 **1986**
Min	576.12 **1965**	576.08 **1964**	576.05 **1964**	576.15 **1964**	576.57 **1964**	576.64 **1964**	576.71 **1964**	576.67 **1964**	576.64 **1964**	576.44 **1964**	576.28 **1964**	576.18 **1964**
Chart Datum 577.5 feet												International Great Lakes Datum of 1985

Chart Datum, also known as Low Water Datum, is a reference plane on each lake to which water depths on navigation charts are referred. The International Great Lakes Datum of 1985 has its zero base at Rimouski, Quebec near the mouth of the St. Lawrence River (approximate sea level).

Lake Superior at Point Iroquois, MI
Possible Storm Induced Rises (in feet)

	Probability of Exceedance				
	20%	10%	3%	2%	1%
January	1.20	1.40	1.70	1.90	2.00
February	0.90	1.00	1.20	1.30	1.30
March	0.90	1.00	1.20	1.30	1.40
April	0.90	1.10	1.40	1.50	1.70
May	0.90	1.10	1.30	1.50	1.60
June	0.80	0.90	1.10	1.20	1.30
July	0.70	0.90	1.20	1.40	1.60
August	0.80	0.80	0.90	1.00	1.10
September	1.00	1.10	1.30	1.50	1.60
October	1.20	1.40	1.70	1.90	2.20
November	1.40	1.60	1.80	2.00	2.10
December	1.20	1.40	1.60	1.70	1.80

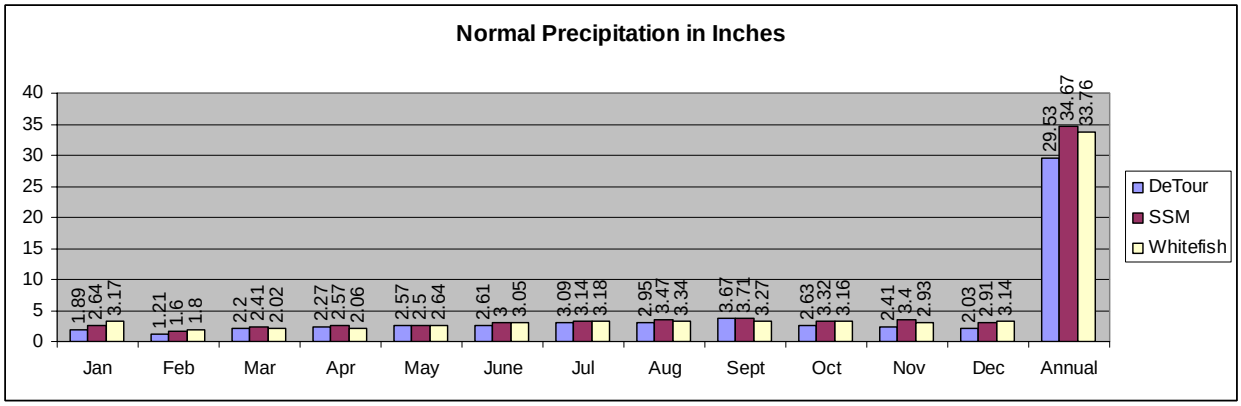
NOTE:
The rises shown here, should they occur, would be in addition to still water levels indicated on the Monthly Bulletin. Values of wave runup are not provided in this table.

Lake Huron at Detour Village, MI
Possible Storm Induced Rises (in feet)

	Probability of Exceedance				
	20%	10%	3%	2%	1%
January	0.70	0.70	0.80	0.80	0.90
February	0.50	0.60	0.70	0.70	0.80
March	0.50	0.60	0.70	0.80	0.90
April	0.60	0.60	0.70	0.80	0.90
May	0.40	0.50	0.50	0.50	0.60
June	0.40	0.50	0.60	0.60	0.60
July	0.40	0.40	0.50	0.60	0.60
August	0.40	0.40	0.50	0.50	0.50
September	0.50	0.50	0.60	0.60	0.60
October	0.60	0.70	0.80	0.80	0.90
November	0.70	0.70	0.80	0.90	0.90
December	0.70	0.70	0.80	0.80	0.90

NOTE:
The rises shown here, should they occur, would be in addition to still water levels indicated on the Monthly Bulletin. Values of wave runup are not provided in this table.

Precipitation: Annual precipitation for Chippewa County ranges between 28" and 35". The total annual precipitation is 33.76 inches at Whitefish Point, 34.67 inches at Sault Ste. Marie, and 29.53 inches at DeTour Village. Of these totals, 17.54 inches at Whitefish Point, 18.39 inches at Sault Ste. Marie and 17.16 inches at DeTour usually fall in April through September.



Precipitation Threshold Climatology Derived from 1971-2000 Averages *Annual/seasonal totals may differ from the sum of the monthly totals due to rounding.												
Month	# Days Total ≥ 0.01"			# Days Total ≥ 0.10"			# Days Total ≥ 0.50"			# Days Total ≥ 1.00"		
	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour	SSM	Whitefish	DeTour
JAN	19.9	20.2	10.8	8.8	11	6.8	0.8	0.9	0.6	0.1	0	0.1
FEB	13.8	13.7	7.4	4.8	6.2	4.4	0.5	0.4	0.4	0	0	0
MAR	13.4	11.4	8.9	6.2	5.6	5.9	1.2	0.9	1.4	0.1	0.2	0.2
APR	10.9	9.5	7.8	6.2	5.3	5.9	1.5	1.2	1.4	0.4	0.2	0.3
MAY	11	9.6	8.8	6.1	5.7	6.1	1.6	1.9	1.6	0.3	0.5	0.4
JUN	11.2	10.4	8.5	6.6	6.9	6.3	1.8	2	1.7	0.5	0.6	0.3
JUL	10.8	10.8	8.8	6.4	6.7	6.4	2.3	2.3	2	0.6	0.6	0.7
AUG	11.4	10.9	8.8	7.1	6.9	6.6	1.9	2.4	2.2	0.7	0.8	0.5
SEP	13.1	12.8	10.3	8.3	7.4	7.9	2.4	2	2.4	0.7	0.4	0.9
OCT	14.5	14.1	10.2	8.3	8.6	6.8	1.8	1.8	1.5	0.4	0.3	0.4
NOV	17.3	16	9.6	9.8	8.8	6.7	1.5	1.2	1.4	0.4	0.2	0.4
DEC	19.6	19	10.7	9	11.1	6.8	1.1	1	0.7	0.1	0	0.1
Annual	167.2	158	110.5	87.7	90	76.7	18.3	18.2	17.2	4.5	3.8	4.4
Winter	53.3	52.9	28.9	22.6	28.2	18.1	2.4	2.4	1.7	0.3	0	0.2
Spring	35.3	30.5	25.5	18.5	16.6	18	4.3	4	4.4	0.9	0.9	1
Summer	33.5	32	26	20.1	20.4	19.3	6	6.6	5.9	1.8	2	1.5
Fall	44.9	42.9	30.2	26.4	24.9	21.3	5.7	5.1	5.2	1.5	0.9	1.7

Weather changes are frequent because many pressure systems pass eastward through this section of the United States and Canada. Precipitation is well distributed throughout each year. Summer rains usually accompany a southeast surface wind. The heaviest 1-day rainfall during the period of record was 6.92 inches at Whitefish Point, 5.92 inches at Sault Ste. Marie and 4.3 inches at DeTour Village.

Precipitation Extremes Period of Record: 1900-2001												
Month	High (in)			Year	Low (in)			Year	1-Day Max (in)			Date
	SSM	Whitefish	DeTour		SSM	Whitefish	DeTour		SSM	Whitefish	DeTour	
JAN	4.52	6.19	4.95	1982 1977 1950	0.51	0.69	0.26	1961 1956	1.21	1.15	1.68	1/5/1988 1/10/1932 1/5/1997
FEB	3.73	5.16	4.47	1971 1932 1949	0.21	0.45	0.2	1993 1956 1964	1	2.2	1.23	2/24/1977 2/24/1949
MAR	4.96	6.6	5.3	1976 1920 1979	0.24	0.2	0.25	1937 1919 1993	1.38	2.15	2.3	3/15/1971 3/28/1931 3/4/1979
APR	5.15	8.02	4.74	1954 1914	0.6	.55	0.61	1949 1901	2.34	3.75	1.78	4/26/1954 4/28/1914 4/27/1954
MAY	7.4	7.37	4.85	1970 1904 1973	0.62	0.08	0.3	1996 1967 1948	5.08	2.65	2.09	5/31/1970 5/18/1918 5/9/1964
JUN	7.35	6.97	7.35	1969 1915	0.52	0.51	0.41	1988 1921	2.39	2.32	3.2	6/26/1969 6/2/1900 6/24/1960
JUL	7.23	6.28	9.41	1996 1922 1986	0.57	0.26	0.03	1939 1954 1989	2.23	2.54	6.72	7/15/1955 7/1/1918 7/5/1986
AUG	9.47	6.61	6.08	1974 1988 2001	0.5	0.33	0.42	1947 1930 1991	5.92	3.95	2.73	8/3/1974 8/29/1969 8/13/1963
SEP	7.77	10.63	10.99	1970 1916	0.86	0.31	0.32	1943 1963 1948	2.2	4.3	2.71	9/12/1984 9/4/1916 9/14/1993
OCT	6.84	7.77	5.31	2001 1901	0.16	0.77	0.44	1963 1920 1956	1.86	2.7	1.9	10/24/1959 10/13/1901 10/4/1951
NOV	7.72	6.81	5.93	1988	0.87	0.49	.51	1962 1917 1999	2.33	1.52	2.5	11/5/1988 11/3/1977 11/28/1964
DEC	6.24	6.68	4.4	1995 1978 1971	0.58	0.19	0.42	1994	1.46	1.55	1.6	12/9/1995 12/14/1975 12/29/1968
Annual	45.84	43.18	41.04	1995 1960 1996	22.4	21.18	15.58	1900 1930 1948	5.92	4.3	6.72	8/3/1974 9/4/1916 7/5/1986

Watersheds:

A "watershed" is an area of land that drains into a lake, stream or other body of water. The runoff from rain or snowmelt is collected by smaller channels (tributaries), which send the water to larger channels and eventually to the lowest body of water in the watershed (main channel). When a channel receives too much water, the excess flows over its banks and into the adjacent area – causing a flood.

Chippewa County has eight watersheds basins, shown on Map 18 – Watershed Basins and 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.

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. (See Map 19 – Lakes & Rivers)

Flash Floods: Flash floods are generated by severe storms that drop much rainfall in a short time. All flash floods strike quickly and end swiftly. Areas with steep slopes and narrow stream valleys are particularly vulnerable to flash flooding, as are the banks of small tributary streams. In hilly areas, the high-velocity flows and short warning time make flash floods hazardous and very destructive.

Obstructions: Obstructions can be channel obstructions, such as small bridge openings or log jams, or floodplain obstructions, such as road embankments, fill and buildings. Channel obstructions will cause smaller more frequent floods, while floodplain obstructions impact the larger, less frequent floods where most of the flow is over bank, outside the channel.

Map 18 Watershed Basins

Map 19 Major Lakes and Rivers

Obstructions can be natural or man made. Natural obstructions, like log jams, can be cleared out or are washed away during larger floods. The great problem is man made obstructions, which tend to be more permanent.

Ice Jams: Ice jams occur when warm weather and rain break up frozen rivers or any time there is a rapid cycle of freezing and thawing. The broken ice floats downriver until it is blocked by an obstruction such as a bridge or shallow area. An ice dam forms, blocking the channel and causing flooding upstream. Ice jams present three hazards:

1. Sudden flooding of areas upstream from the jam, often on clear days with little or no warning,
2. Sudden flooding of areas downstream when an ice jam breaks. The impact is similar to a dam break, damaging or destroying buildings and structures.
3. Movement of ice chunks that can push over trees and crush buildings.

The Great Lakes Hydraulics and Hydrology Office monitors potential inland river flooding year round and potential flooding on the connecting channels of the Great Lakes (St. Marys River, St. Clair River, and Detroit River) due to ice jams. The general mission is to prevent and/or minimize loss of life and property damage caused by river/connecting channel flooding. The main focus of the mission is vigilant, on-going monitoring and advanced notification to emergency managers in regard to forecasted inclement weather and ice conditions potentially causing floods.

The main focus of ice jam monitoring is a series of water level gages strategically set up in the connecting channels to pinpoint the location of such a jam. Typically, when an ice jam begins to form, the water level upstream of the jam begins to rise and the water level downstream begins to fall, a classic divergence. The Detroit District office has near real-time access to gage data and, when such a 'divergence' occurs, can notify emergency managers who in turn notify the U.S. Coast Guard to break ice to alleviate potential flooding.

Dam Failures: Dams are made to hold back large amounts of water. If they fail or are overtopped, they can produce a dangerous flood situation because of the high velocities and large volumes of water released. A break in a dam can occur with little or no warning on clear days when people are not expecting rain, much less a flood. Breaching often occurs within hours after the first visible signs of dam failure, leaving little time for evacuation.

Dam failures are usually caused by either structural problems with the dam or by hydrologic problems. Structural problems include seepage, erosion, cracking, sliding and overturning that are a result of the age of the dam or lack of maintenance. Hydrologic problems typically occur when there is excessive runoff due to heavy precipitation. A dam failure can occur if the dam has to impound (hold back) more water than it is designed to, or if the spillway capacity is inadequate for the amount of water needing to pass downstream.

The series of tragic dam failures that occurred across the United States in the 1970s prompted government action to more stringently regulate dams and heightened public concern

about hazards created by unsafe dams. Both the Michigan Department of Environmental Quality (MDEQ) and the Federal Energy Regulatory Commission (FERC) classify and regulate dams in Michigan. This statute requires the MDEQ to rate each dam as either "high", "significant", or "low" hazard potential, according to the potential downstream impact if the dam were to fail (not according to the physical condition of the dam). The MDEQ has identified and rated over 2,400 dams in Michigan. Dams over 6 feet in height that create an impoundment with a surface area of more than 5 acres are regulated by this statute.

There are ten dams in Chippewa County included in MDEQ's inventory. Of these 10, one is rated as a high hazard. The other 9 dams are rated as low.

Historical Events: On June 2, 1999 rainfall began late in the morning across eastern upper Michigan. Spotter reports and WSR-88D rainfall estimates indicated 2 to 5 inches of rain over eastern portions of the county. The bulk of the rain fell within a fairly short time frame (3 to 6 hours). Some roadways flooded and a few dirt roads washed out from Rudyard and Kinross northward along I-75 and M-129 to Sault Ste. Marie. Roadway flooding was also reported on Sugar Island. The only report of flood damage to property came from Sugar Island, where a garage floor had some standing water on it. The home suffered no monetary damage, and no businesses were affected.

A combination of runoff from snowmelt and rainfall resulted in minor flooding primarily along the Pine River in the Upper Peninsula on April 12, 2001. No damage was reported though flood waters did rise onto some private property. Primarily, the water rose into yards and did not damage any structures.

The most recent event was this spring, March 30, 2004 when the Pine River near Rudyard flooded due to an ice jam between Mackinac Trail and I-75. A river stage of 19.3 feet was observed at Mackinac Trail, which established a new flood of record. The old flood of record was 18.4 feet on March 30 1986. The river submerged the Prairie Road bridge west of Rudyard, along with several other roads and yards in the vicinity. Flooding also occurred in the Pickford area, where the Munuscong River rose out of its banks.

Future Flood Risk: Past floods are indications of what can happen in the future, but flood studies and mitigation plans are based on the *risk* of future flooding. Flood studies extrapolate from historical records to determine the statistical potential that storms and floods of certain magnitude will recur. Such events are measured by their "recurrence interval," i.e., a 10-year storm or a 50-year flood.

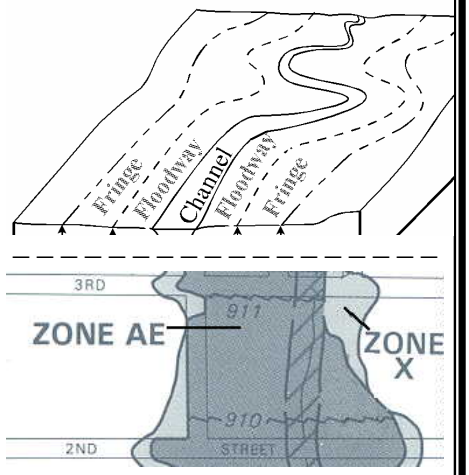
These terms are often misconstrued. Commonly, people interpret the 50-year flood definition to mean "once every 50 years." This is incorrect. Statistically speaking, a 50-year flood has a 1/50 (2%) chance of occurring in any given year. In reality, a 50-year flood could occur two times in the same year, two years in a row, or four times over the course of 50 years. It is possible to not have a 50-year flood over the course of 100 years.

The base flood is the one percent chance flood, i.e., the flood that has a one percent (one out of 100) chance of occurring in any given year. The one percent chance flood has also been

called the 100-year flood. This *Plan* uses the base flood as a basis for determining the flood risk in Chippewa County.

Another term used is the "500-year flood." This has a 0.2% chance of occurring in any given year. While the odds are more remote, it is the national standard used for protecting critical facilities, such as hospitals and power plants.

The base floodplain: The area inundated by the base flood is the "base floodplain." FEMA maps (called Flood Insurance Rate Maps, or FIRMs) also call this the Special Flood Hazard Area or A Zone. The base floodplains for Chippewa County are the ones shown on Map 20 FIRM. An example of a FIRM is shown to the right.



Floodplain/Floodway Delineation

The upper schematic identifies the channel, floodway and fringe portions of the base floodplain, which is shown in the lower map as a Zone AE on the Flood Insurance Rate Map (FIRM). The floodway is shown on the FIRM with diagonal lines. The Zone X is the area mapped as higher than the base floodplain, but it may still have local drainage and flooding problems.

The central part of the floodplain is called the "floodway." The floodway is the channel and that portion of the adjacent floodplain which must remain open to permit passage of the base flood. Floodwaters generally are deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. The remainder of the floodplain is called the "fringe," where water may be shallower and slower.

The depth and velocity of a river are also important considerations in mitigation efforts. The faster the water moves, the more pressure it puts on a structure and the more it will erode stream banks and scour the earth around a building's foundation.

While buildings may be easy to protect in areas of low velocities, people are not always safe. The total impact of moving water is related to the depth of the flooding. Studies have shown that deep water and low velocities can cause as much damage as shallow water and high velocities. Any summary data presented in this Plan should be augmented by site-specific data, such as depths and velocities, when looking at mitigation alternatives at any single location.

Impact: Impacts 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).

Safety: A car will float in less than 2 feet of moving water and can be swept downstream into deeper waters. This is one reason floods kill more people trapped in vehicles than anywhere else.

Map 20 Flood Zones

Victims of floods have often put themselves in perilous situations by ignoring warnings about travel or mistakenly thinking that a washed-out bridge is still there. People die of heart attacks, especially from exertion during a flood fight. Electrocution is a cause of flood deaths, claiming lives in flooded areas that carry a live current created when electrical components short out. Floods also can damage gas lines, floors, and stairs, creating secondary hazards such as gas leaks, unsafe structures, and fires. Fires are particularly damaging in areas made inaccessible to fire-fighting equipment by high water or flood-related road or bridge damage.

Warning and evacuation: The threat to life posed by a flood can be avoided if people can evacuate before the waters reach their buildings or close their evacuation routes. This requires advance notice that a flood is coming and a system to disseminate flood warnings.

Transportation: Loss of road access is a major flood impact that affects all residents and businesses, not just those who own property in the floodplain. Sometimes the loss is temporary, such as during the flood. Bridges that can be expected to go under water are shown

Sometimes the loss of transportation lasts well after the disaster. When roads, bridges or railroads are washed out by a flood, it can be weeks or months before they are repaired and reusable.

Bridges: A key evacuation and safety concern is when roads and bridges go under water. Generally, the larger the road, the more likely it will not flood, but this is not always the case. A review of the Flood Insurance Rate Map and accompanying flood profiles identified 58 bridges and culverts that will be underwater during a base flood. These are shown in Map 14 in Chapter 1. They are listed in Appendix E.

In addition to the locations listed in Appendix F, there are bridges and culverts in areas that are not included in the Flood Insurance Rate Map study areas, such as those located along small tributary streams.

Health: While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry whatever was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where cattle and hogs are kept can contribute polluted waters to the receiving streams.

Flood waters saturate the ground which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment lead to overloaded sewer lines which back up into low lying areas and some homes. Even though diluted by flood waters, raw sewage can be a breeding ground for bacteria, such as e coli, and other disease causing agents.

The second type of health problem comes after the water is gone. Stagnant pools become breeding grounds for mosquitoes, and wet areas of a building that have not been cleaned breed mold and mildew. A building that is not thoroughly and properly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when heating ducts in a forced-air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants.

If the water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Building damage: In a few situations, deep or fast moving waters will push a building off its foundation, but this is rare. More often, structural damage is caused by the weight of standing water, known as "hydrostatic pressure."

Basement walls and floors are particularly susceptible to damage by hydrostatic pressure. Not only is the water acting on basement walls deeper, a basement is subjected to the combined weight of water and saturated earth. In addition, water in the ground underneath a flooded building will seek its own level, resulting in uplift forces that can break a concrete basement floor.

The most common type of damage inflicted by a flood is caused by soaking. When soaked, many materials change their composition or shape. Wet wood will swell and, if dried too quickly, will crack, split or warp. Plywood can come apart. Gypsum wallboard will fall apart if it is bumped before it dries out. The longer these materials are wet, the more moisture, sediment and pollutants they will absorb.

Soaking can cause extensive damage to household goods. Wooden furniture may become so badly warped that it cannot be used. Other furnishings such as upholstery, carpeting, mattresses, and books usually are not worth drying out and restoring. Electrical appliances and gasoline engines will not work safely until they are professionally dried and cleaned.

In short, while a building may look sound and unharmed after a flood, the waters can cause a lot of damage. To properly clean a flooded building, the walls and floors should be stripped, cleaned, and allowed to dry before being recovered. This can take weeks and is expensive.

Damage data: A source of damage data is past claims paid by the National Flood Insurance Program. These are shown in the following table:

NFIP INSURANCE REPORT BY COMMUNITY						
Community Name	**Total Premium**	**Current**	**A-Zone**	**Total Coverage**	**Claims since 78 Total**	**Doll since 78 Total**
BAY MILLS TOWNSHIP	7799	20	17	1433100	0	0
BRUCE TOWNSHIP	1977	6	4	310900	0	0
DETOUR TOWNSHIP	2977	5	4	625000	0	0
DRUMMOND ISLAND TOWNSHIP	5295	12	6	1835300	0	0
RABER TOWNSHIP	2332	7	4	472900	0	0
SAULT STE. MARIE, CITY	801	1	1	162900	1	0
SUPERIOR TOWNSHIP	1800	5	4	530500	0	0
WHITEFISH TOWNSHIP	5399	11	8	1308400	0	0
County Total	28380	67	48	6679000	1	0

Flood insurance claims figures do not include items not covered by a flood insurance policy, such as landscaping and automobiles, and the value of lost family heirlooms. They also do not include damage to uninsured or underinsured properties.

Floods can be slow, or fast rising but generally develop over a period of days. Investing in mitigation steps now, such as, 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.

Potential Losses: Property damage, loss of function, and emergency response costs.

Vulnerable Areas: Shoreline communities and areas that have major rivers and a more clay soil base, towards the north, central and east areas of the county.

Drought

Drought is a normal part of the climate of Michigan and of virtually all other climates around the world – including areas with high and low average rainfall. Drought differs from normal arid conditions found in low rainfall areas in that aridity is a permanent characteristic of

that type of climate. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. The severity of a drought depends not only on its location, duration, and geographical extent, but also on the water supply demands made by human activities and vegetation. This multi-faceted nature of the hazard makes it difficult to define a drought and assess when and where one is likely to occur.

Drought differs from other natural hazards in several ways. First, it is difficult to determine the exact beginning and end of a drought, since its effects may accumulate slowly and linger even after the event is generally thought of as being over. Second, the lack of a clear-cut definition of drought often makes it difficult to determine whether one actually exists, and if it does, its degree of severity. Third, drought impacts are often less obvious than other natural hazards, and they are typically spread over a much larger geographic area. Fourth, due primarily to the aforementioned reasons, most communities do not have in place any contingency plans for addressing drought. This lack of pre-planning can greatly hinder a community's response capability when a drought does occur.

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

Historical Events: In the September, 2001 Chippewa County was one of 73 counties in Michigan requesting federal assistance from devastating crop losses due to severe drought. The request was based on 30 percent or more loss estimates in at least one commodity. From the middle of June through the middle of August, less than ¾ inch rain fell in most areas and in addition temperatures exceeding 100 degrees F were common during the last two weeks of July, exacerbating the already dry conditions.

Frequency: In 2 years out of 10, the rainfall in April through September is less than 14 inches at Whitefish Point, 13.8 inches at Sault Ste. Marie, and 15.9 inches at Dunbar. The growing season for most crops falls within this period.

Potential Losses: With a severe drought the County can expect function loss of some sort and possible casualties and emergency response costs.

Vulnerable Areas: More inland areas but possibly the whole County would be affected.

Subsidence

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. (See Map 21 – Slopes)


Pine River - April, 1997 Landslide that compromised the gas pipeline.

Historical Events: 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.

Potential Losses: Function loss, environmental contamination, property damage, possible casualties and emergency response.

Vulnerable Areas: Areas with steep slopes such as those greater than 35%.

Conclusions

This chapter provides information on the hazards that can affect Chippewa County: public health emergencies, transportation accidents, hazardous materials incidents, severe winter weather, thunderstorms, wildfires, extreme temperatures, tornadoes, flooding, drought and subsidence. Data on the hazards are provided in terms of severity, frequency and historical occurrences. Technological hazards such as hazardous materials incidents will need more in-depth analysis than this plan provides, which is concentrating more on the natural hazards.

The impact of these hazards are reviewed under four categories: how they impact people, how they impact property, what critical facilities may be damaged and economic disruption (damage to businesses or infrastructure).

While it is hard to compare different natural phenomena, a general summary can show how they impact the County. This is done in Table 1, "Impact of the Hazards."

Frequency: The annual chance column in the table shows the likelihood of occurrence in any given year. These numbers are discussed in the "Frequency" section of each hazard.

Location: The location and area affected by a single occurrence is shown.

Safety: The safety hazard rating for thunderstorms and winter/ice storms is relatively high because of the dangerous conditions they may cause.

Property Damage: The property damage column is a factor of the estimated damage per structure times the number of structures likely to be damaged by the hazard.

Critical Facilities: The types of critical facilities and infrastructure that are affected are listed.

Economic disruption: Typical impacts on businesses and utilities are listed in this column.

Table 2 "Vulnerable Areas" shows the hazards and the municipalities which may be impacted.

Overall, there is adequate data on the hazards affecting the County as a whole. However, to measure the impact on individual communities and locations, such as critical facilities, requires addition effort beyond the scope of this county-wide plan. It is recommended that each critical facility be investigated further to determine its vulnerability to damage by the hazards reviewed in this chapter.

Map 21 Slope

Table 1 Impact of Hazards

Table 2 Areas of Vulnerability