

# **Appendix A: DANE COUNTY HAZARD AND VULNERABILITY ANALYSIS**

## **CONTENTS**

### **PREFACE**

### **SPECIAL POPULATIONS**

### **HAZARDS**

- **Civil Disorder**
- **Drought**
- **Earthquake**
- **Energy Emergency**
- **Fire**
- **Flood**
- **Hazardous Materials**
- **Heat Wave**
- **Major Transportation Incidents**
- **Nuclear Attack**
- **Severe Thunderstorm/Tornado**
- **Winter Storms**

## PREFACE

### DANE COUNTY HAZARD AND VULNERABILITY ANALYSIS

A community's ability to manage hazards and the effects of disaster is based in large part on knowledge of the community and of the hazards it faces.

The *Madison and Dane County, Wisconsin PROFILE* and supplementary documents compiled by the Greater Madison Chamber of Commerce and provided by the Dane County Regional Planning Commission are appended. Similar profiles have been produced for several county municipalities, including the city of Madison.

Dane County Emergency Management develops and maintains Off-Site Plans for facilities subject to the emergency planning provisions of PL 99-499, the Emergency Planning and Community Right-to-Know Act of 1986, Title III of the "Superfund and Amendments and Reauthorization Act of 1986" (SARA). These plans describe areas around each facility that may be vulnerable to accidental releases of hazardous substances ("vulnerability zones"), and include information about childcare centers, schools, long-term care facilities and hospitals.

Hazards confronting Dane County are analyzed along five dimensions:

- Predictability
- Frequency
- Controllability
- Time Factors, including speed of onset, length of forewarning and duration of impact
- Impact Factors, including scope and intensity.

The maximum threat posed by each hazard is contemplated, as are secondary events that the hazard may precipitate.

## **SPECIAL POPULATIONS**

Special populations are people whose physical, mental, socio-economic or other condition, or combination of conditions, limits their ability to manage hazards and the effects of disaster. This list is not all-inclusive and is subject to constant change. Many people fall into more than one group.

- a. More than 40,000 students in attendance at the University of Wisconsin at Madison. Most of these students live either on campus or within the downtown area. Of these, several thousand are international students.
- b. The residents of licensed long-term care facilities throughout Dane County. There are more than 30 long-term care facilities in Dane County.
- c. People living in mobile homes. There are 14 mobile home parks in Dane County.
- d. Seven hospitals, and the Central Wisconsin Center for the Developmentally Disabled.
- e. The unknown number of residents in temporary shelters. There are several community shelters in Dane County.
- f. Hispanic, Asian and Pacific Islander residents, many of whom have difficulty with language and customs.
- g. People with developmental disabilities and people with physical and/or sensory disabilities living in Dane County.
- h. People, especially the growing elderly (over 65) population, with extremely limited incomes.

## **HAZARDS**

Civil Disorder is a breach of civil order or peace, or a public disturbance. Examples include terrorist attack, riot, violent protest or demonstration, tumult and illegal assembly. Civil disorder can be caused by social, political or economic factors. The principal aim of intentional civil disorder is disruption of the targeted system, though death, injury, and extensive property damage may result.

- Predictability - Civil disorder is predictable to the extent that both causative factors and targeted systems exist. Dane County is home to the State Capitol, the University of Wisconsin at Madison, municipal, county, state and federal facilities and other potential targets including mass gatherings such as the annual 4th of July celebration "Rhythm and Booms", which draws upwards of 300,000 people to Warner Park in Madison, and 200,000 to nearby parks. Madison is one of 120 cities identified in federal legislation as deserving federal support to prepare for terrorism.
- Frequency - Dane County has experienced numerous instances of civil disorder, including the violent protests against the war in Vietnam, which included the bombing of Sterling Hall on the University of Wisconsin campus in 1970. Fan reaction to a U.W. football victory in 1993 resulted both in mass casualties and in damage to Camp Randall Stadium. Civil disorder at the 1996 Mifflin Street block party resulted in arrests, injury and considerable public and private damage. Anthrax hoaxes following the events of September 11, 2001 disrupted public and private activities in Madison and Dane County.
- Controllability - The controllability of civil disorder depends upon factors which include the preparedness of targeted systems, the amount of forewarning and the response capabilities of community agencies.
- Time Factors
  1. Speed of onset may be sudden as in the case of a terrorist attack (the 1993 World Trade Center bombing in New York City, the 1995 bombing of the Alfred Murrah Federal Building in Oklahoma City, the September 11, 2001 attacks) or gradual as can be the case with violent protest.
  2. Length of forewarning ranges from none to a considerable period.
  3. Duration of impact ranges from brief to prolonged.
- Impact Factors - Factors that determine the scope and intensity of civil disorder impact include the extent of system disruption and the extent of system influence. Disruption of county facilities may affect the County and its municipalities and citizens, whereas disruption of state or federal facilities in Dane County will affect agencies, municipalities, counties and citizens throughout the state and around the country.
- Maximum Threat - The most profound effect resulting from a single event within Dane County would likely involve terrorism in downtown Madison during a business day, targeting citizens and several vulnerable federal, state, county and local institutions simultaneously. An event like this or a violent protest, like that which occurred in Los Angeles in 1992 following the Rodney King jury verdict, can also cause numerous deaths, injuries and tremendous property damage.
- Secondary Events - Civil disorder may trigger fires, power failure (see Energy Emergency) and other events.

Drought is a period of abnormally dry weather sufficiently prolonged for the lack of water to cause a serious hydrologic imbalance. It is related by the total amount of moisture available in an area at a given time. This is affected by rainfall amounts and seasonal variations, temperature, humidity, cloud cover, wind, water storage capacity in the soil and other factors. The Palmer Drought Severity Index combines these factors to estimate total available moisture. Types of drought include agricultural drought, characterized by a very dry growing season which affects crop yields, and hydrologic drought, characterized by a very dry year which reduces lake, stream and ground water levels. Both types can occur together; each can occur independently of the other.

- Predictability - Droughts cannot be predicted, they can only be declared. However, major recurring climatological phenomena such as "El Niño" (a warming of the surface waters of the tropical eastern Pacific Ocean that changes the trade winds) can create conditions that may result in drought.
- Frequency - Wisconsin experiences a period of drought every 10 to 12 years, the most recent period ending in 1988.
- Controllability - Drought can be controlled to some degree through water conservation measures and agricultural planning to assure the most efficient use of scarce water supplies.
- Time Factors
  1. The speed of onset of drought is gradual.
  2. The length of forewarning is indeterminate.
  3. The duration of impact depends on the amount of time needed to produce agricultural and/or hydrologic drought and the persistence of drought conditions.
- Impact Factors - Drought has a very broad geographic scope. Intensity depends upon duration.
- Maximum Threat - Severe or extreme drought occurring over a long period can lead to climatic change, as has occurred in central Africa. Serious droughts like that experienced in 1988, if extended, could cause the County's considerable farm sector to suffer irretrievable loss. The County would lose farm income, with thousands of farmers and farm-related businesses bearing the brunt. This in turn would have tremendous social impact, creating needs in basic human service, financial assistance, job retraining and in finding and/or creating employment opportunities.
- Secondary Events - Droughts create increased risk from wildfire, urban fire and failure of the water supply. Droughts may be associated with heat emergencies (heat wave).

Earthquake is a shaking or trembling, sometimes violent movement of the earth's surface. It is observed by two principal methods: seismograph and human judgement. Earthquakes in Wisconsin probably result from still-occurring rebound of crust caused by the retreat of glacial ice that pressed down the crust. "Ice Quakes" such as that which occurred in Lake Mendota on January 15, 1948, can also cause the surface of the earth to tremble. The most recent earthquakes felt in Wisconsin actually originated in other states. Wisconsin has low seismic risk and Dane County has never experienced a major earthquake.

- Predictability - Earthquakes cannot be predicted.
- Frequency - Seven earthquakes have been felt in Dane County since 1914.

- Controllability - Earthquakes are typically "controlled" through building codes and public education.
- Time Factors
  1. The speed of earthquake onset is sudden.
  2. The length of forewarning is indeterminate.
  3. The duration of impact may be prolonged as in the case of an earthquake followed by aftershocks.
- Impact Factors - Earthquakes generally have a broad geographic scope. Intensity can range from barely perceptible to totally destructive.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property likely to result from a single maximum event is based on a major earthquake occurring during a business day whose epicenter is in downtown Madison. Such an event would injure or kill hundreds or thousands and cause tremendous damage.
- Secondary Events - While the probability of a major earthquake occurring in Dane County is extremely low, such an earthquake along the New Madrid Fault would likely disrupt the oil and natural gas pipelines that supply the County. Disruption of fuel supplies is discussed under separate heading (Energy Emergency).

Energy Emergency is any major disruption, loss or shortage in electrical power, natural gas, fuel or heating oil.

- Predictability - Electrical outages are frequently caused by severe weather. Extreme heat can increase electrical demand and imperil production. In 1997, concern for possible electrical power outages due to the temporary simultaneous shut-down of several nuclear and coal-powered power plants in the Midwest region arose for the first time. Failure of natural gas, fuel oil and heating oil supplies cannot be predicted although the availability and price of oil is tied to global politics.
- Frequency - Dane County has experienced numerous short-term electrical outages, mostly brief and limited to several dozen or several hundred people. The ice storm of March 4, 1976, the windstorm of July 7, 1991 and severe weather in the spring and summer in 1993 caused thousands of County residents to lose electric power for days. The County has never experienced a major loss or shortage in natural gas, fuel or heating oil.
- Controllability - Energy emergencies can be controlled to the extent that suppliers can overcome the cause of the emergency, reinstate energy supplies and implement special measures (e.g. rolling blackouts), and also to the extent that customers can compensate through measures that may include conservation, rationing, the use of alternative systems and spending more money.
- Time Factors
  1. The speed of onset is sudden for uncontrolled electrical outages and indeterminate for other failures.
  2. The length of forewarning is indeterminate.

3. Duration of impact can range from momentary to extremely prolonged.

- Impact Factors - Energy emergencies may affect a single customer or an entire community. Intensity is dependent upon duration and user vulnerability.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss that can be considered from a single maximum event would occur during severe weather and would involve prolonged loss of fuel supplies and/or long-term blackout. Such an event would have a devastating effect on the County, especially among special populations, hospitals and nursing homes. Indeed, the effects of a widespread long-term blackout alone could be enormous.

#### Effects On Industry

- Spoiled raw materials, work-in-progress and finished goods. Loss of research data.
- Exposure of workers and surrounding communities to possible injury or health hazard due to loss of environmental or safety equipment.

#### Effects On Commerce

- Product damage.
- Loss of data and damage to computer equipment.
- Irretrievable loss of business to firms that service immediate demand (i.e. fast food outlets).

#### Effects On Agriculture

- Hazards to livestock and produce due to loss of sensitive processes including incubation, milking, pumping, heating, air conditioning and refrigeration.

#### Effects On Residents

- Loss of air conditioning/heat, hot water, lighting, elevators, refrigerators, freezers, home computers, microwaves, clocks, etc. Effects would range from spoiled food to illness (frostbite, hypothermia, etc. in winter, heat exhaustion and stroke in summer) and even death.
- Loss of traffic lights and street lighting.
- Gas pumps inoperative resulting in decline over time of public transportation (buses) and taxis.
- Disruption of air travel.

#### Effects On Telecommunications

- The extent of disruption will depend on the availability and reliability of backup systems. Because of the growing reliance by business and government on telecommunications networks, extended power outages could lead to economic disruption and disruption of crucial municipal public services.

#### Effects On Emergency Services

- Disruption of communications for fire, police and emergency medical systems.

- Disruption of population warning systems.
- Potential loss of some hospital services, though most critical activities are supported by emergency power systems.
- Severe strain on emergency services due to increased number of emergency calls, potential for looting and arson.

#### Effects On Public Utilities and Services

- Disruption of sewage services and fresh water supplies.

The costs associated with blackouts would also be enormous. The July 13-14, 1977, New York City blackout had a total cost of nearly \$350,000,000. A four-day, 1988 Seattle blackout that covered part of the Labor Day weekend cost one department store an estimated \$500,000; restaurants estimated lost business at \$10,000 to \$45,000 for the four days.

- Secondary Events - The events that may be triggered by energy emergencies, particularly blackouts, are listed under Maximum Threat.

Fire Wildfire is any instance of uncontrolled burning on grasslands, brush or woodlands. Urban fire is uncontrolled burning in residential, commercial, industrial or other properties in developed areas.

- Predictability - The incidence of wildfire increases during extremely hot and dry conditions. Incidence of urban fire increases with cold weather.
- Frequency - Dane County experiences regular wildfire and urban fire, the latter primarily in the City of Madison.
- Controllability - Wildfire is controllable to the extent that communities can implement control procedures and resources and personnel are available. Urban fire is controllable to the extent that residents implement protective activities (smoke alarms, fire extinguishers, evacuation procedures) and to the extent that fire resources and personnel are available.
- Time Factors
  1. Speed of onset of fire is sudden.
  2. Length of forewarning is indeterminate.
  3. Duration of impact ranges from relatively brief to prolonged.
- Impact Factors - Wildfire generally has a broad geographic scope, affecting primarily nonresidential areas. Environmental and agricultural losses could be high. Urban fire can affect a single home, several homes, multiple dwelling units, commercial or industrial facilities. There is a great potential for destroyed homes, loss of jobs, injury and death.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss likely to result from a single maximum event assumes uncontrolled wildfire impinging on urban development (the wildland/urban interface). Thousands of County residents live in rural homes or areas surrounded by wildland vegetation (tall grasses, forests, etc.). These conditions, coupled with hot, dry and windy weather may cause a conflagration that would kill or injure dozens of people and cause tremendous damage.

- Secondary Events - Major fires may trigger power failure (see Energy Emergency) and hazardous materials incidents.

Flood is a general condition of partial or complete inundation of normally dry land area from the overflow of inland waters, or the unusual and rapid accumulation or runoff of surface waters from any source. Flooding may result from failure of any of Dane County's 33 dams. A dam in Mazomanie is classified by the Wisconsin DNR as high hazard, which means failure could cause loss of life and extreme flood damage. Five others pose a significant hazard - failure could cause extreme flood damage. They are on the Yahara River in Madison and Dunkirk, on Waterloo Creek in Marshall, on Lake Waubesa in the Village of McFarland, and on Koshkonong Creek in Rockdale.

- Predictability - Prolonged periods of heavy rain have caused floods in Dane County. Flood magnitude can be affected by a combination of snowmelt and rainfall runoff from frozen, impervious ground.
- Frequency - Minor localized flooding occurs regularly. Heavy rains in June-July 1978 caused more than \$3,000,000 worth of damage in Dane County. Dane County received federal disaster declarations in 1990, in 1993 when unprecedented agricultural and other losses exceeded \$10,000,000 and again in 2000. Heavy rains in June 1996 also caused many millions of dollars damage throughout the county.
- Controllability - Flooding is controllable to the extent that communities implement sound flood plain management as required for participation in the National Flood Insurance Program, and through emergency response activities (e.g. sandbagging, pumping, etc.).
- Time Factors
  1. Speed of onset ranges from sudden for flash floods to gradual.
  2. Length of forewarning can be several hours.
  3. Duration of impact can range from hours to months.
- Impact Factors - Floods generally have a broad geographic impact. Intensity can range from minor losses to tremendous property damage, injury and death.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss that can be considered from a single event would follow a prolonged period of heavy rain, would cause flash flooding and would flood the Yahara and Wisconsin Rivers, Lakes Mendota, Monona, Waubesa and Kegonsa and the remaining bodies of water in Dane County. Such an event may cause numerous injuries and deaths and tremendous widespread damage.
- Secondary Events - Floods may cause transportation accidents, power failure and failure of water supplies.

Hazardous Materials - Fixed facility incidents are those involving the accidental release of hazardous substances from facilities that produce, use or store hazardous substances located in Dane County. Transportation incidents are those involving the accidental release of hazardous substances from vehicles transporting hazardous substances through Dane County. This includes hazardous substances transported by rail, by truck, by aircraft or by pipeline. Another type of hazardous materials incident involves the deliberate dumping of hazardous substances by unknown individuals.

- Predictability - Hazardous materials incidents are predictable to the extent that certain hazardous materials facilities as defined in federal and state law are required to report to local agencies and to the extent that hazardous materials are known to be transported throughout Dane County.
- Frequency - Dane County has experienced hundreds of hazardous materials incidents of all three types.
- Controllability - Hazardous materials incidents are controllable to the extent that they are preventable by facilities and transporters, to the extent that incidents can be handled by facilities and transporters, to the extent that communities can implement protective activities (shelter-in-place, evacuation) and to the extent that special community resources, capabilities and personnel are available.
- Time Factors
  1. Speed of onset for hazardous materials incidents is generally sudden.
  2. Length of forewarning is indeterminate.
  3. Duration of impact ranges from brief to prolonged.
- Impact Factors - Hazardous materials incidents can range in size from localized spills or explosions to catastrophic releases that cover several square miles. Intensity can range from minor with very little effect, to major with tremendous property damage and/or injury and loss of life.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss that can be considered from a single hazardous materials event would involve a catastrophic release in downtown Madison during a business day. Such an event would likely kill or injure many dozens of people and may cause tremendous damage.
- Secondary Events - Hazardous materials incidents may trigger or be associated with fires.

Heat Wave – According to the National Weather Service office in Sulkivan, “heat waves usually consist of high temperatures and high relative humidity.” The Heat Index (HI), also known as the apparent temperature, is an accurate measure of how it really feels when the relative humidity (RH) is combined with the actual air temperature. HI values above 105° (see Chart next page) may cause increasingly severe heat disorders with continued exposure and/or activity. The NWS devised HI values for shady, light wind conditions. EXPOSURE TO FULL SUNSHINE CAN INCREASE HI VALUES BY UP TO 15°F. ALSO, STRONG WINDS, PARTICULARLY WITH VERY HOT, DRY AIR CAN ADD TO THE HAZARD.

- Predictability - The NWS can issue a "Special Weather Outlook Statement" up to 3 to 5 days before a heat wave, and a "Heat Watch" up to 2 days in advance. A "Heat Advisory" is issued when weather conditions for 2 days consist of daytime HI of 105° or above and nighttime minimum HI of 80° or more. It is possible that a Heat Advisory could be issued for only one day. An "Excessive Heat Warning" is issued when HIs are expected to equal or exceed 120° for 3 hours or more, and may be issued if the HI is expected to be 117 to 119 for several hours during the day.
- Frequency - Dane County experienced major heat waves in 1988, 1994 and 1995. The heat wave of 1988 was combined with a drought.

- **Controllability** - Heat waves are controllable to the extent that individuals can implement protective measures, and to the extent that communities can provide facilities and/or services to assist individuals (especially special populations) whose abilities are limited.
- **Time Factors**
  1. Speed of onset for heat waves is gradual.
  2. Length of forewarning can be up to several days.
  3. Duration of impact can range from 3 days to several weeks.
- **Impact Factors** - Heat waves generally affect large geographical areas. Intensity depends largely upon duration. The urban "Heat Island" effect intensifies heat waves. Elderly persons, small children, people using certain medications or drugs and others are particularly susceptible to heat disorders. The heat wave of 1995 produced extremely elevated HI values. Several deaths in Dane County and at least 135 in Wisconsin and more than 500 in Chicago were attributed in part to the heat wave.
- **Maximum Threat** - The greatest destruction in terms of loss of life, injury and property loss likely to result from a maximum event would be the result of a prolonged heat wave. Such an event could kill hundreds of people, especially special populations. It would probably not cause tremendous property damage.
- **Secondary Events** - Prolonged heat waves may cause power outages (see Energy Emergency).

		Relative Humidity (%)															
		40	45	50	55	60	65	70	75	80	85	90	95	100			
Air Temperature	°F	40	45	50	55	60	65	70	75	80	85	90	95	100			
	110	136														<p style="color: red; font-weight: bold;">With Prolonged Exposure and/or Physical Activity</p> <div style="background-color: red; color: white; padding: 5px; font-weight: bold;">Extreme Danger</div> <div style="padding: 5px;">Heat stroke or sunstroke highly likely</div> <div style="background-color: orange; color: white; padding: 5px; font-weight: bold;">Danger</div> <div style="padding: 5px;">Sunstroke, muscle cramps, and/or heat exhaustion likely</div> <div style="background-color: yellow; color: black; padding: 5px; font-weight: bold;">Extreme Caution</div> <div style="padding: 5px;">Sunstroke, muscle cramps, and/or heat exhaustion possible</div> <div style="background-color: lightgreen; color: black; padding: 5px; font-weight: bold;">Caution</div> <div style="padding: 5px;">Fatigue possible</div>	
	108	130	137														
	106	124	130	137													
	104	119	124	131	137												
	102	114	119	124	130	137											
	100	109	114	118	124	129	136										
	98	105	109	113	117	123	128	134									
	96	101	104	108	112	116	121	126	132								
	94	97	100	103	106	110	114	119	124	129	135						
	92	94	96	99	101	105	108	112	116	121	125	131					
	90	91	93	95	97	100	103	106	109	113	117	122	127	132			
	88	88	89	91	93	95	98	100	103	106	110	113	117	121			
	86	85	87	88	89	91	93	95	97	100	102	105	108	112			
84	83	84	85	86	88	89	90	92	94	96	98	100	103				
82	81	82	83	84	84	85	86	88	89	90	91	93	95				
80	80	80	81	81	82	82	83	84	84	85	86	86	87				

Major Transportation Incidents Mass casualty transportation incidents are those which require mobilization of three or more mutual aid jurisdictions. Examples include multiple-vehicle accidents, bus accidents, passenger train accidents and aircraft crashes. Other incidents are those which may disrupt community functions for a prolonged period. Examples include train derailments without numerous casualties and motor vehicle accidents on major thoroughfares. Hazardous materials transportation incidents are discussed under Hazardous Materials above.

- Predictability - There exists a correlation between severe weather (heavy rains, fog, winter storms) and increased incidence of traffic problems.
- Frequency - Transportation incidents have occurred in Dane County, including train derailments and private and military aircraft crashes. Several have resulted in mass casualties; none has caused serious prolonged disruption of community functions.
- Controllability - Major transportation incidents are controllable to the extent that vehicles are safely and cautiously used, to the extent that traffic routes are, or can be, maintained and controlled, and to the extent that emergency response agencies can respond effectively.
- Time Factors
  1. Speed of onset of major transportation incidents is generally sudden.
  2. Length of forewarning can range from none to a matter of hours.
  3. Duration of impact is generally brief.
- Impact Factors - Major transportation incidents are generally localized. They may have tremendous impact in terms of injury and loss of life.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss that can be considered from a single event would likely involve the crash of a fully loaded passenger aircraft into a heavily populated residential or commercial area. Such an event would likely kill hundreds, injure many more and cause tremendous damage.
- Secondary Events - Major transportation incidents may cause fires or hazardous materials incidents.

Nuclear Attack is an attack upon the United States using nuclear weapons.

- Predictability - Predictability of nuclear attack is indeterminate. Scenarios have been developed which describe periods of heightened world tensions as prelude to nuclear exchange. Since the breakup of the Soviet Union, these may no longer be applicable. However, there exists the disturbing possibility of nuclear terrorism.
- Frequency - There has never been a nuclear attack upon the United States.
- Controllability - Nuclear attack has been deemed controllable by Federal authorities. State and county governments receive federal support in part for maintaining plans for nuclear attack response and recovery. The effectiveness of this program, and of related public education material, has never been tested.

■ Time Factors

1. Speed of onset of nuclear attack would be sudden.
2. Length of forewarning would range from none to days or weeks.
3. Duration of impact would range from prolonged, in the case of nuclear fallout only, to years in the case of a direct hit.

■ Impact Factors - Nuclear attack would likely have wide geographic impact. Intensity would be greatest in case of a direct hit.

■ Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss that can be considered from a single maximum event presumes a direct attack without warning. Such an event would likely kill thousands of people, injure thousands more and cause near total destruction.

■ Secondary Events - A nuclear attack would likely cause numerous secondary events.

Severe Thunderstorm/Tornado - A thunderstorm is an electrical storm accompanied by heavy rain. It may also be accompanied by heavy winds and hail, and can produce tornadoes. A tornado is a violently rotating column of air in contact with the ground and nearly always visible as a funnel shape. Average wind speeds range between 175 and 250 miles per hour, although winds exceeding 300 miles per hour can be produced. They are usually accompanied by hail, torrential rain and intense lightning. Typical tornadoes produce damage in an area 1/4-mile in width and 16 miles long, though track lengths greater than 150 miles and wider than one mile have been reported.

■ Predictability - Thunderstorm development in Dane County can be forecast with accuracy up to 48 hours in advance of the phenomenon. The potential for severe thunderstorms or tornadic outbreaks can be forecast with accuracy up to 24 hours in advance. Exact locations of storm development and storm tracks are unpredictable. However, once observed the likelihood of severe thunderstorms and tornadoes affecting a given community can be determined.

■ Frequency - Dane County averages between five and ten severe thunderstorms per year. Dane County has experienced 34 tornadoes since 1950, most recently in July 1997.

■ Controllability - Severe thunderstorms and tornadoes are controllable to the extent that communities maintain an awareness of threatening weather conditions and take protective actions when indicated, and to the extent that communities can effectively respond to the needs created by the severe weather.

■ Time Factors

1. Speed of onset of severe thunderstorms and tornadoes may be gradual or sudden.
2. Length of forewarning can be up to several hours.
3. Duration of impact is generally brief.

- Impact Factors - Thunderstorms can affect a large geographic area, and tornadoes may affect areas up to several hundred yards in width and up to several miles in length. Thunderstorms can do considerable damage. Tornadoes will devastate property and can cause considerable injury and death.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property loss likely to result from a single maximum event is based on a tornado with winds of 300 miles per hour passing through the center of the City of Madison. Such an event would likely injure or kill dozens of people and would cause tremendous damage.
- Secondary Events - Tornadoes may trigger transportation accidents, power failure (see Energy Emergency), fires and/or hazardous materials incidents.

Winter Storms - A blizzard occurs when sustained wind speeds in excess of 35 miles per hour accompany heavy snow or large amounts of blowing or drifting snow. An ice storm occurs when rain falling out of the warm and moist upper levels of the atmosphere meets a cold and dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces.

- Predictability - Winter storms are predictable through observation of weather conditions.
- Frequency - Blizzards are rare in Wisconsin, but near blizzard conditions have occurred on several occasions, including January 1979 when record snowfall was accompanied by wind speeds of over 30 miles per hour, and the winter of 1981-82 when cold temperatures and high winds produced wind chill factors of 100° below zero. On December 3, 1990, a blizzard with sustained 40-mile per hour wind speeds deposited a record 17.3 inches of snow on southern Wisconsin including Dane County. Ice storms can occur anytime throughout the winter. The March 1976 storm prompted a Presidential Disaster Declaration. The most recent ice storm occurred during the winter of 1988-89. Record snowfalls and extreme cold in December 2000 prompted a Presidential Disaster Declaration in 14 Wisconsin counties including Dane.
- Controllability - Winter storms are controllable to the extent that communities maintain an awareness of threatening weather conditions and take protective actions when indicated, and to the extent that communities can effectively respond to the needs caused by the severe weather.
- Time Factors
  1. Speed of onset of winter storms is generally gradual.
  2. Length of forewarning can be up to several days.
  3. Duration of impact may be up to several weeks.
- Impact Factors - Winter storms generally affect a large geographical area. Intensity depends in large part on duration.
- Maximum Threat - The greatest destruction in terms of loss of life, injury and property likely to result from a single maximum event assumes a prolonged storm affecting the entire County. Such an event may cause several deaths but is unlikely to cause tremendous property damage.
- Secondary Events - Severe winter storms may trigger power failure (see Energy Emergency), fuel shortages and major transportation accidents.

Appendices  
Maps

1. Primary Highway Routes For Hazardous Materials.
2. Railroads.
3. Natural Gas Pipelines.
4. Gasoline and Oil Pipelines.
5. Dane County Regional Airport Area Airspace/Consolidated Flight Tracks

## References

### Drought

- *The Drought of 1989 - A Report Prepared by the Wisconsin Department of Administration*, July 1989.
- *Drought in the United States: A Short History*. Jane M. Porter, U.S. Department of Agriculture, December 1988.

### Earthquake

- *Survivor: The Newsletter of the Wisconsin Geological and Natural History Survey*. Vol. 10, No. 2, Fall/Winter 1990.
- *List of Earthquakes in Wisconsin*, M.G. Mudrey, Jr., Open-File Report 84-1, 1984.

### Energy Emergency

- U.S. Congress, Office of Technology Assessment, *Physical Vulnerability of Electric Systems To Natural Disasters And Sabotage*, OTA-E-453 (Washington, D.C., U.S. Printing Office, June 1990).
- *Estimating Transportation Energy Consumption of Residential Land Types*, Dane County Regional Planning Commission, February 1983.
- *Dane County Electrical Power Disruption Management Plan*, Dane County Emergency Management, 1997

### Flood

- Flood insurance studies (FEMA) were consulted for this section. Areas and dates of completion are as follows:

Dane County-Unincorporated areas (rev. 8/19/87).

City of Madison (9/18/86).

City of Middleton (11/79).

City of Stoughton (12/77).

City of Monona (12/77).

City of Verona (2/80).

Village of Black Earth (7/2/80).

Village of Cambridge (12/79).

Village of Cross Plains (8/16/82).

Village of DeForest (8/5/85).

Village of Marshall (6/80).

Village of Mazomanie (6/1/81).

Village of McFarland (12/77).

Village of Oregon (3/80).

Village of Rockdale (6/80).

Village of Waunakee (11/77).

## References (cont.)

### Hazardous Materials

- *Dane County Hazardous Materials Emergency Plan*, Dane County Local Emergency Planning Committee, revised 1994.

### Heat Wave

- *Heat Wave: A Major Summer Killer*, U. S. Department of Commerce (NOAA/PA 85001)

### Nuclear Attack

- *Wisconsin Allocation Summary*, Wisconsin Department of Military Affairs, Division of Emergency Government, March 1990.