
SECTION 4

RISK ASSESSMENT – HAZARD IDENTIFICATION

4.1 INTRODUCTION

According to the Federal Emergency Management Agency (FEMA) Guidance 386-2, “risk assessment is the process of measuring the potential loss of life, personal injury, economic injury and property damage resulting from natural hazards by assessing the vulnerability of people, buildings and infrastructure to natural and manmade hazards.

The risk assessment process used for this Plan is consistent with the process and steps presented in the Federal Emergency Management Agency (FEMA) 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA, 2001). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in the community. A risk assessment provides a foundation for the community’s decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs.

The first step of the risk assessment process is to identify the hazards of concern. FEMA’s current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and many other assets.

The second step of risk assessment is the profiling of hazards that have or may in the future impact Scott County and its jurisdictions. Included in the profile section is:

- Sources of information used or consulted for assembling a history of past occurrences
- Date and Duration of occurrence
- Location of event
- Description and severity (i.e., flood depth, wind speeds, earthquake intensity, etc.)
- Damages that occurred (e.g., costs of recovery, property damage, and lives lost) to the extent available
- The location or geographical areas
- The extent (magnitude/severity)
- The probability of the likelihood
- A discussion of past occurrences of hazard events

The third step of risk assessment is vulnerability analysis. Vulnerability analysis identifies the hazards of most concern to Scott County and its jurisdictions, identifies critical facilities, provides and in depth analysis of life, property and economic loss that may occur as a result of a severe hazard event.

The risk assessment process encourages the reciprocity of information and support between states and local governments states provide leadership and support to local communities. The primary source for identifying natural hazards was the historic hazard occurrence in Scott County and the State of Minnesota Hazard Mitigation Plan.



4.2 HAZARD IDENTIFICATION METHODOLOGY

FEMA’s current regulations only require identification, profiling and evaluation of natural hazards that threaten lives, property, and other assets. However, FEMA strongly suggests including manmade hazards in jurisdiction hazard mitigation plans.

Scott County is vulnerable to a wide array of hazards that threaten life and property. The Hazard Identification section provides background information for these hazards. It is important that all natural hazards be initially considered for relevance in advancing through the hazard mitigation planning process. Subsequent sections of the Plan—the Hazard Profiles and the Vulnerability Assessment—address the hazards of specific concern to the County. Scott County Hazard Mitigation Committee considered and evaluated all natural hazards in terms of their potential risk to Scott County and its citizens.

Multi-hazard Requirement §201.6(c)(2)(i): The risk assessment shall include a description of the type of all natural hazards that can affect the jurisdiction.
A. Does the new or updated plan include a description of the types of all natural hazards that affect the jurisdiction?

CRS Step 4: Assess the Hazard: CRS requires at the minimum that the flood hazard be identified including addressing the repetitive loss areas. However, additional credit can be earned for including discussion of all other natural hazards.

4.3 SCOTT COUNTY HAZARD DISASTER DECLARATIONS

Scott County has been included in federal disaster declarations. All of these events did not necessarily occur within the boundaries of Scott County. When major damage from a natural disaster occurs, FEMA, as a matter of practice, includes a "buffer" area of adjoining counties in the event it later determines the damage was more widespread. These declarations are listed in the table below.

Disaster Number	Disaster Type	Date
FEMA-1419-DR-MN		2002
FEMA-1370-DR-MN	Winter Storms, Flooding, Tornadoes	March 23, 2001 to July 3, 2001
FEMA-1225-DR-MN	Flooding	June 23, 1998
FEMA-1187-DR-MN	Tornadoes, Flooding	August 5, 1997
FEMA-1175-DR-MN	Winter Storms, High Winds, flooding, Ice	April 8, 1997
FEMA-1158-DR-MN	Snow	January 16, 1997
FEMA-993-DR-MN	Severe Storms, Tornadoes, Flooding	June 11, 1993



4.4 STATE OF MINNESOTA 2008 MITIGATION PLAN HAZARD DISPOSITION

The hazards table below identifies the Natural hazards and their disposition in the State plan and in the Scott County Plan.

Table 4.2 Natural Hazard Disposition In The State of Minnesota 2008 Plan Update					
Hazard	Data Sources	Probability	Mitigation Potential Rating	Disposition in the 2008 State Plan	Disposition in the 2009 Scott County Plan
Floods	NOAA, Minnesota Coastal Hazards Assessment, NWS, NFIP, FIRM	H	H	Identified, General profile, Risk Assessment	Identified, Profiled, Risk Assessment
Tornadoes	NOAA, NWS, SHELDUS, NWS, Minnesota Disaster Center	H	H	Identified, General profile, Risk Assessment	Identified, Profiled, Risk Assessment under High Winds
Hail	NOAA, NWS, Minnesota Disaster Center	H	M	Identified, General profile	Identified, Profiled
Coastal Erosion	Geological Survey of Minnesota, USGS, Coastal Hazards Assessment	H	M	Identified, General profile	Identified, Profiled
Severe Winter Storms	NOAA, NWS, SHELDUS	H	L	Identified, General profile	Identified, Profiled under Ice/Snow Storms
Blizzards	NOAA, NWS, SHELDUS	H	L		Identified, Profiled under Ice/Snow Storms
Ice and Ice Storms	NOAA, NWS, SHELDUS	H	L		Identified, Profiled under Ice/Snow Storms
Landslide	NOAA, USGS, MN Geological Survey,	M	L	Identified, General profile	Identified, Profiled
Sinkholes & Land Subsidence	Geological Survey of Minnesota, USGS	M	L	Identified, General profile	Identified, Profiled
Earthquake	Geological Survey of Minnesota, USGS, SHELDUS	L	L	Identified, General profile	Identified, Profiled
Drought	Minnesota Forestry Commission, Dept of Agriculture	H	L	Identified, General profile	Identified, Profiled
Wildfire	NOAA, Local Fire Service	H	H	Identified, General profile, Risk Assessment	Identified, Profiled
Extreme Temperatures	NOAA, National Weather Service, SHELDUS	H	L	Identified, General profile	Identified, Profiled
Lightning	NOAA, NWS, SHELDUS	H	L	Identified, General profile	Identified, Profiled



Table 4.2 Natural Hazard Disposition In The State of Minnesota 2008 Plan Update

Hazard	Data Sources	Probability	Mitigation Potential Rating	Disposition in the 2008 State Plan	Disposition in the 2009 Scott County Plan
Windstorms	NOAA, NWS, SHELDUS	H	H	Identified, General profile Risk Assessment	Identified, Profiled Risk Assessment under High Winds
Tropical Storms	NOAA, NWS, SHELDUS	L	L	Not Identified or Profiled	Not Identified or Profiled
Tsunami	NOAA, NWS, SHELDUS	L	L	Not Identified or Profiled	Not Identified or Profiled
Snow Avalanches	Local Response Departments	L	L	Not Identified or Profiled	Not Identified or Profiled
Expansive Soils	USGS	L	L	Not Identified or Profiled	Not Identified or Profiled
Volcanoes	USGS	L	L	Not Identified or Profiled	Not Identified or Profiled

As described in the planning process section Scott County is also evaluating manmade hazards and a Pandemic event as part of this plan.

Manmade Hazards are technological hazards and terrorism. These are distinct from natural hazards primarily in that they originate from human activity. In contrast, while the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human induced. The term “technological hazards” refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials.

The term “terrorism” refers to intentional, criminal, malicious acts. There is no single, universally accepted definition of terrorism. Officially, terrorism is defined in the Code of Federal Regulations as “the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.” (28 CFR, Section 0.85). The Federal Bureau of Investigation (FBI) further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization; however, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and its consequences. For the purposes of this plan, “terrorism” refers to the use of Weapons of Mass Destruction (WMD), including biological, chemical, nuclear, and radiological weapons, arson, incendiary, explosive, and armed attacks, industrial sabotage and intentional hazardous materials releases, and “cyber-terrorism.” The table below identifies the manmade hazards and their disposition in the State Plan and The Scott County Plan.



Table 4.3 Manmade Hazards Disposition in the 2008 State Mitigation Plan Update

Hazard	Information Source(s)	Probability	Mitigation Potential Rating	Disposition in the 2008 State Plan	Disposition in the 2009 County Plan
Infrastructure Dam Failure	USACE, Corps of Engineers, Dam Safety	M	M	Identified, General profile	Identified, Profiled under flooding
Hazardous Materials	Environmental Protection Agency (EPA), NRC	M	L	Identified, General profile	Identified, Profiled
Infectious Disease	U.S. Center for Disease Control, Minnesota Dept. of Public Health,	L	L	Identified, General profile	Identified, Profiled
Nuclear Accident	NRC, Nuclear Energy Institute	L	L	Identified, General profile	Identified, Profiled under Hazardous Material
Terrorism Conventional bomb Improvised explosive device Biological agent Chemical agent Nuclear bomb Radiological agent Arson/incendiary attack Armed attack Cyber-terrorism Agri-terrorism Intentional Hazardous material release	DHS, Law Enforcement	NR	NR	Identified, General profile	Identified, Profiled
Transportation Accidents	National Transportation Safety Board, State DOT	L	L	Identified, General profile	Identified, Profiled
Urban Fire	Local Fire Departments, State Fire Marshal	M	L	Identified, General profile	Identified, Profiled
Utility Power Failure	Power Companies			Identified, General profile	Identified, Profiled
Water Contamination	Local Water Districts, Minnesota Dept. of Public Health	M	M	Identified, General profile	Identified, Profiled

The primary source for identifying manmade hazards was local sources, historic occurrences, the Department of Homeland Security (DHS) website and the FEMA guide “Integrating Manmade Hazards into Mitigation Planning”.

4.5 NATURAL HAZARDS IDENTIFICATION

The specific hazards that were identified by Scott County Hazard Mitigation Planning Committee are identified below.

4.5.1 Drought Identification

The National Weather Service (NWS) Climate Prediction Center (CPC) defines drought as a deficiency of moisture that results in adverse impact on people, animals, or vegetation over a sizeable area. Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. In general, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector.

Other climatic factors, such as high temperatures, prolonged high winds and low relative humidity, can aggravate the severity of a drought. These conditions are caused by anomalous weather patterns when shifts

in the jet stream block storm systems from reaching an area. As a result, large high-pressure cells may dominate a region for a prolonged period, thus reducing precipitation. According to Institute for Catastrophic Loss Reduction (ICLR), this natural hazard differs from others in several ways. First, there is no universally accepted definition of drought. Second, drought onset and recovery are usually slow. Third, droughts also can cover a much larger area and last many times longer than most other natural hazards. Fourth, they are part of the natural climate variability. Due to these differences many communities have neglected to include this hazard in their disaster management plans (ICLR, 2005). According to the Federal Emergency Management Agency (FEMA), the National Drought Mitigation Center (NDMC) and the NWS, there are four ways that drought can be defined:

Meteorological drought is a measure of departure of precipitation from normal. It is defined solely on the degree of dryness. Due to climatic differences, what might be considered as a drought in one location of the country may not be considered as a drought in another location.

Agricultural drought links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, etc. It occurs when there is not enough water available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply and occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake and groundwater levels.

Figure 4.1: Depiction of Drought



Source: NWS

Socioeconomic drought is associated with the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods depends on weather (e.g., water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

4.5.2 Earthquake Identification

An earthquake is sudden motion or trembling caused by an abrupt release of accumulated strain in the tectonic plates that comprise the earth's crust." These rigid plates, known as tectonic plates, are some 50 to 60 miles in thickness and move slowly and continuously over the earth's interior. The plates meet along their edges, where they move away, past or under each other at rates varying from less than a fraction of an inch up to five inches per year. While this sounds small, at a rate of two inches per year, a distance of 30 miles would be covered in approximately one million years. The tectonic plates continually bump, slide, catch, and hold as they move past each other which causes stress to accumulate along faults. When this stress exceeds the elastic limit of the rock, an earthquake occurs, immediately causing sudden ground motion and seismic activity.

The vibration or shaking of the ground during an earthquake is described by ground motion. The severity of ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. The following are the two kinds of seismic waves:

P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back-and-forth oscillation along the direction of travel (vertical motion), with particle motion in the same direction as wave travel. They move through the earth at approximately 15,000 mph.

S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side-to-side (horizontal motion) due to particle motion at right angles to the direction of wave travel. Un-reinforced buildings are more easily damaged by S waves.

There are also two kinds of surface waves, Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

Secondary hazards may also occur, such as surface faulting, sinkholes, and landslides. While the majority of earthquakes occur near the edges of the tectonic plates, earthquakes may also occur at the interior of plates.

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the Earth's surface to

Figure 4.2: Earthquake Example



Source: University of Colorado

the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth's surface directly above the hypocenter (Shedlock and Pakiser, 1997). Earthquakes usually occur without warning and their effects can impact areas a great distance from the epicenter (FEMA, 2001).

4.5.3 Extreme Temperatures Identification

Extreme temperatures include both cold and hot events, which can have a significant impact to human health, commercial/agricultural businesses and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). Based on what the population is accustomed to, what constitutes "extreme cold" or "extreme heat" varies across different areas of the country.

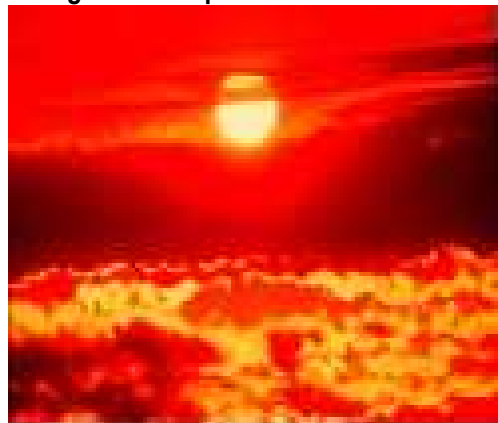
4.5.3.1 Extreme Cold Identification

What constitutes extreme cold and its effects can vary across different areas of the country. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered extreme cold. Extreme cold events are when temperatures drop well below normal in an area. Extremely cold temperatures often accompany a winter storm, so individuals may have to cope with power failures and icy roads. Although staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, individuals may also face indoor hazards. Many homes will be too cold—either due to a power failure or because the heating system is not adequate for the weather. As people use space heaters and fireplaces to stay warm, the risk of household fires and carbon monoxide poisoning increases. Exposure to cold temperatures can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes.

4.5.3.2 Extreme Heat Identification

The CDC defines temperatures that hover 10 degrees or more above the average high temperature for a region and last for several weeks as extreme heat. A heat wave is a prolonged period of excessively hot weather, which may be accompanied by high humidity. There is no universal definition of a heat wave because the term is relative to the usual weather in the area. Temperatures that people from a hotter climate consider normal can be termed a heat wave in a cooler area if they are outside the normal climate pattern for that area. Also, the term is applied both to routine weather variations and to extraordinary spells of heat, which may occur only once a century.

Figure 4.3: Depiction of Extreme Heat



Source: State of Minnesota Mitigation Plan

4.5.4 Flooding Identification

Flooding is an overflowing of water onto normally dry land and is one of the most significant and costly of natural disasters. The principle types of floods are dam or levee failure, flash floods, riverine floods and storm surge flooding.

Dam/Levee Failure floods usually result from intense rainfall or snow melt that produces water quantities that breach dams or levees because of faulty design, construction, or operational inadequacies. Levee failures also are a result of storm surge in coastal areas. Dam or levee failures are categorized as manmade hazards in this plan and are further discussed in section 5.

Flash floods resulting from quickly rising streams after heavy rain or rapid snowmelt, ice jams (ice that accumulates at a natural or human-made obstruction and slows the flow of water) or the absence or overflow of storm sewers in a relatively small drainage area and produce localized floods of great volume and short duration. Flash floods usually result from tropical storm/hurricane or thunderstorm weather events.

Riverine floods result from precipitation, snowmelt or ice jams that cover large areas and occur in river systems and tributaries that may drain large geographic areas. The precipitation usually results from tropical storm/hurricane or thunderstorm weather events.

Slowly rising lake levels cause Lake level floods. This type of flood is caused by a long-term, above-average precipitation trend in landlocked basins with poor water outlets. This flooding can cause significant localized damages. Water rises slowly over months or years, so the flooding is not caused by a single event.

Storm Surge Flooding resulting from tropical storm/ hurricane weather events.

Other flood related Definitions:

Floodplain - Any land area susceptible to inundation by floodwaters from any source.

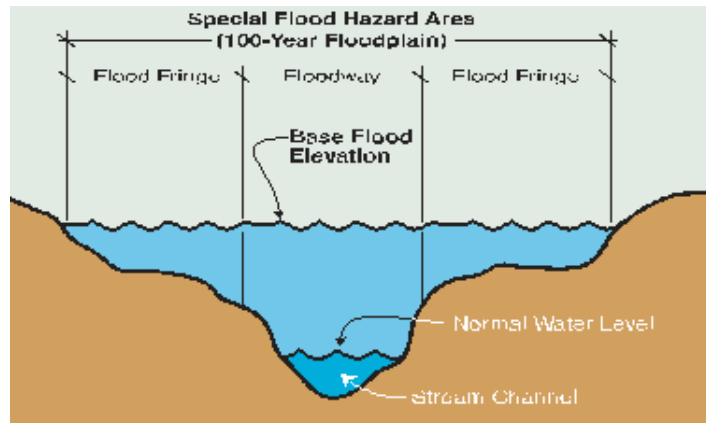
100/500 -Year Floodplain is defined as the area adjoining a river, stream, or watercourse covered by water in the event of a 100/500-year flood.

“The term “100-year flood” is misleading. It is not a flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1 percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. A structure located within a special flood hazard area shown on a map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage. One hundred year floodplains have been identified, mapped and used for further analysis using the county’s Geographic Information System (GIS).

The 500-year standard (0.2-percent-annual-chance) follows the same logic as the 100- year flood definition.”

Floodway - The channel of a river or watercourse and the adjacent areas that must be reserved in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot.

Figure 4.4: Special Flood Hazard Area



Source: NOAA

Flood Fringe - That portion of the floodplain outside the floodway that is inundated by floodwaters in which encroachment is permissible.

Encroachment - Any man-made obstruction in the floodplain that displaces the natural passage of floodwaters.

Surcharge - An increase in flood elevation due to destruction of the floodplain that reduces conveyance capacity.

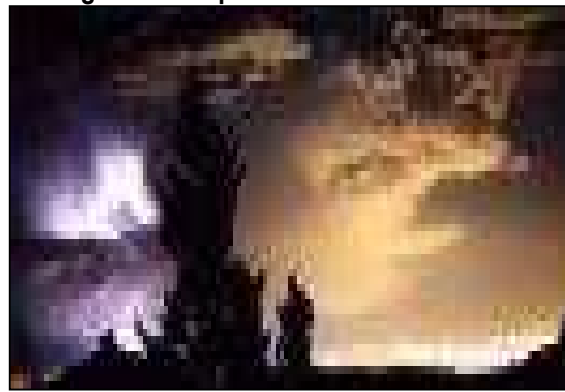
Described below are the major causes of natural hazard flooding: tropical storms/hurricanes, thunderstorms and storm surge.

4.5.4.1 Flooding Thunderstorm Identification

Thunderstorms are formed from a combination of moisture, rapidly rising warm air, and a force capable of lifting air (such as a sea breeze, a warm and cold front, or a mountain). Thunderstorms may occur singly, in clusters, or in lines. The most severe weather occurs when a single thunderstorm affects one location for an extended time.

Thunderstorms are associated with heavy rains that can lead to riverine, dam/levee failure and flash flooding. Thunderstorms affect relatively small-localized areas. Thunderstorms can strike in all regions of the U.S.; however, they are most common in the central and southern states. The atmospheric conditions in these regions of the country are most ideal for generating these powerful storms (NVRC, 2006). More than 100,000 thunderstorms occur each year in the U.S., however, only about 10% are classified as severe.

Figure 4.5: Depiction of a Thunderstorm



Source NOAA

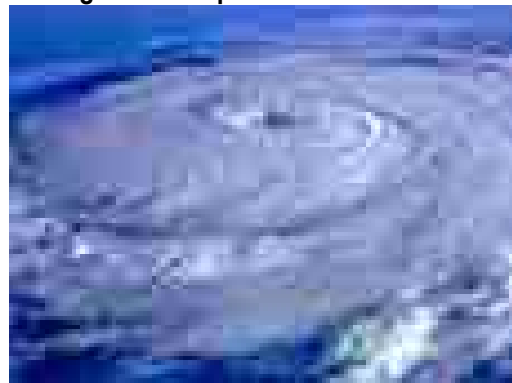
4.5.4.2 Flooding Tropical Storm/Hurricane Identification

As a tropical storm/hurricane nears land, it usually brings torrential rains that can last for days. These torrential rains cause dam/levee failure, riverine and flash flooding.

A Tropical Storm is an organized system of strong thunderstorms with maximum sustained winds between 34 to 63 knots (39 to 73 mph) (FEMA, 2007). In time, the storm becomes more organized and begins to become more circular in shape, resembling a hurricane.

A Hurricane is an intense tropical cyclone with wind speeds reaching a minimum constant speed of 74 mph (FEMA, 2004). It is a category of tropical cyclone

Figure 4.6: Depiction of a Hurricane



Source: NOAA

characterized by thunderstorms and defined surface wind circulation. They are caused by the atmospheric instability created by the collision of warm air with cooler air. They form in the warm waters of tropical and sub-tropical oceans, seas, or Gulf of Mexico (NWS, 2000). Hurricanes begin when areas of low atmospheric pressure move off the western coast of Africa

and into the Atlantic, where they grow and intensify in the moisture-laden air above the warm tropical ocean. Air moves toward these atmospheric lows from all directions and circulates clock-wise under the influence of the Coriolis effect, thereby initiating rotation in the converging wind fields. When these hot, moist air masses meet, they rise up into the atmosphere above the low-pressure area, potentially establishing a self-reinforcing feedback system.

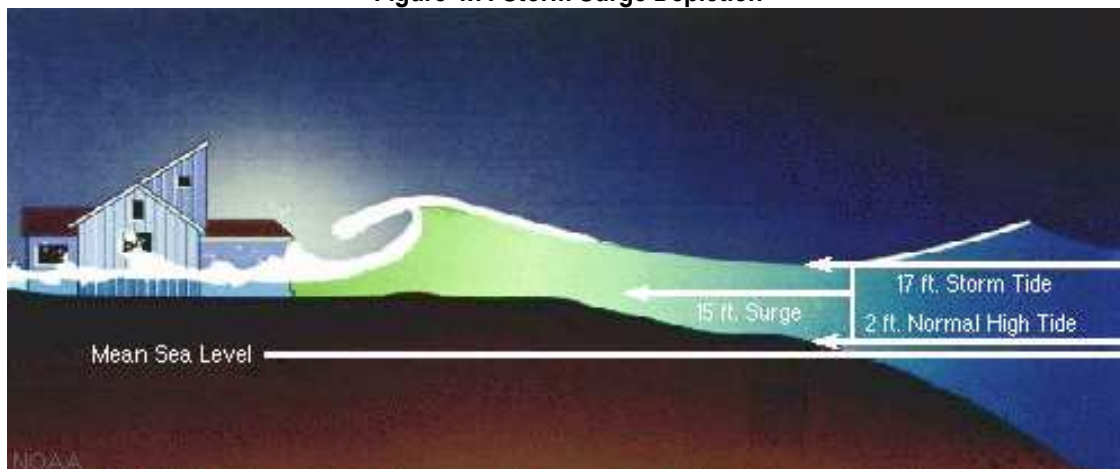
4.5.4.3 Flooding Storm Surge Identification

Storm Surge is water that is pushed toward the shore by the force of the winds swirling around a tropical storm or hurricane. This advancing surge combines with the normal tides to raise the water level. Wind driven waves are superimposed on the storm surge. A rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides. The storm surge creates a large dome of water, often 50 to 100 miles wide that sweeps across the coastline near where the hurricane makes landfall.

The stronger the hurricane and the shallower the offshore water, the higher the storm surge will be (NWS, 2000). Storm surges are particularly damaging when they occur during a high tide, combining the effects of the surge and the tide. As the water slams into shoreline structures, even well built structures quickly can be demolished. As the waters move inland, carrying debris, it can cause further damage.

Because storm surge is produced by the high winds circulating a tropical/storm or hurricane the resulting storm surge can occur from any direction where the hurricane is over the ocean or large bodies of waters such as bays.

Figure 4.7: Storm Surge Depiction



Source: NOAA

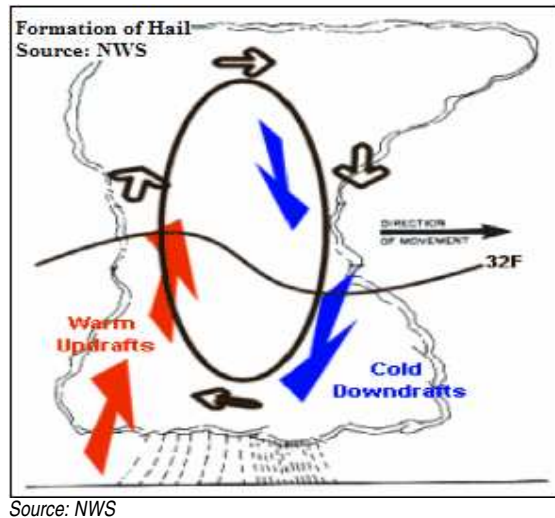
4.5.5 Hail Identification

Hailstones are products of thunderstorms and are developed by downdrafts and updrafts that develop inside cumulonimbus clouds of a thunderstorm, where super cooled water droplets exist. The transformation of droplets to ice requires a temperature below 32 degrees and a catalyst in the form of tiny particles of solid matter, or freezing nuclei. Continued deposits of super cooled water cause the ice crystals to grow into hailstones.

The size of hailstones varies and is related to the severity and size of the thunderstorm that produced it. The higher the temperatures at the Earth's surface, the greater the strength of the updrafts, and the greater the amount of time the hailstones are suspended, giving the hailstones more time to increase in size. Hailstones vary widely in size. Note that penny size or larger hail is considered severe.

Hailstorms occur most frequently during the late spring and early summer, when the jet stream moves northward across the Great Plains. During this period, extreme temperature changes occur from the surface up to the jet stream, resulting in the strong updrafts required for hail formation.

Figure 4.8: Formation of Hail



4.5.6 Coastal Erosion Identification

Coastal erosion is defined as the wearing away of land and the loss of beach, shoreline, or dune material over a period of time as a result of natural coastal processes or human influences. Characteristics such as supply of sand and processes such, as sea level change, currents, tides, waves, and wind are natural factors that contribute to the rate of erosion.

Human-caused contributors to erosion include dredging tidal entrances, jetty and groin construction, hardening shorelines with seawall, beach nourishment, and construction of harbors and sediment-trapping dams.

As high lake levels increase, bluff recession rates also increase. Increasing assaults by wave action against the base of the bluff cause erosion and beach-building sediments. Navigational improvements and dredge-material disposal practices deplete both tributary and shore land sources of sediment; removing these sediments from the shore system contributes to erosion. Ice ridges that form and break up each winter along the shoreline cause erosion by trapping sand in floating fragments of ice that are carried offshore into deep water. This continual natural process is one of the principal mechanisms by which sand is lost from the near shore system (USGS, 1992).

Coastal erosion is usually a gradual process, and sudden incidents prompting emergency action are rare. Such rare events include strong storms with high winds or heavy wave action that can cause sudden failure of bluffs.

Coastal property owners are acutely aware of hazards during periods of high water levels and especially right after a damaging storm or a bluff failure, but this awareness can fade over time if low lake levels slow the erosion rate.

4.5.7 High Winds Identification

Wind is defined as the motion of air relative to the earth's surface. In the mainland United States the mean annual wind speed is reported to be eight to 12 mph, with frequent speeds of 50 mph and occasional wind speeds greater than 70 mph. High Winds are generally the result of thunderstorms, tornadoes and tropical storms/hurricanes.

4.5.7.1 High Winds Tropical Storm/Hurricane Identification

Tropical Storm/Hurricane Wind Damage is the force of wind that can quickly decimate the tree population, down power lines and utility poles, knock over signs, and damage/destroy homes and buildings. Flying debris can also cause damage to both structures and the general population. When hurricanes first make landfall, it is common for tornadoes to form.

A Tropical Storm is an organized system of strong thunderstorms with maximum sustained winds between 34 to 63 knots (39 to 73 mph) (FEMA, 2007). In time, the storm becomes more organized and begins to become more circular in shape, resembling a hurricane.

A Hurricane is an intense tropical cyclone with wind speeds reaching a minimum constant speed of 74 mph (FEMA, 2004). It is a category of tropical cyclone characterized by thunderstorms and defined surface wind circulation. They are caused by the atmospheric instability created by the collision of warm air with cooler air. They form in the warm waters of tropical and sub-tropical oceans, seas, or Gulf of Mexico (NWS, 2000). Hurricanes begin when areas of low atmospheric pressure move off the western coast of Africa and into the Atlantic, where they grow and intensify in the moisture-laden air above the warm tropical ocean. Air moves toward these atmospheric lows from all directions and circulates clock-wise under the influence of the Coriolis effect, thereby initiating rotation in the converging wind fields. When these hot, moist air masses meet, they rise up into the atmosphere above the low-pressure area, potentially establishing a self-reinforcing feedback system.

4.5.7.2 High Winds Tornado Identification

Tornadoes are violent windstorms characterized by a twisting, funnel-shaped cloud. A tornado is spawned by a thunderstorm or hurricane and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. A funnel does not need to reach to the ground for a tornado to be present. Tornadoes occur at any time of the year; however, the season is generally March through August.

The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long. Even with advances

in meteorology, adequate warning time for tornadoes is short or sometimes not possible. A debris cloud beneath a thunderstorm is all that is needed to confirm the presence of a tornado. The damage from a tornado is a result of the high wind velocity and wind-blown debris.

Figure 4.9 Tornado



Source NOAA

4.5.7.3 High Winds Thunderstorm Identification

High winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems, or gradient winds from high or low-pressure systems. Thunderstorms produce downdraft winds, which are defined as a small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation as in a shower or thunderstorm. A downburst is the result of a strong downdraft. The downburst can

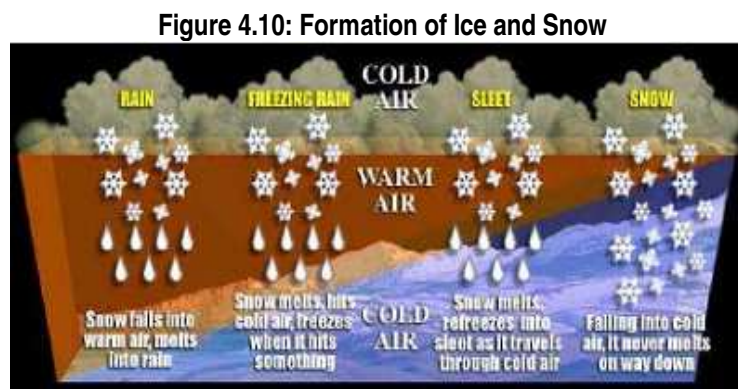
cause damage equivalent to a tornado. The outflow of cool or colder air can also create damaging winds at or near the surface. As these downburst winds spread out they are often referred to as straight-line winds, which exceed 130 miles per hour.

Thunderstorms are formed from a combination of moisture, rapidly rising warm air, and a force capable of lifting air (such as a sea breeze, a warm and cold front, or a mountain). Thunderstorms usually occur singly and affect relatively small-localized areas; however, they may in clusters, or in lines. The most severe thunderstorm is one affects one location for an extended time.

4.5.8 Ice/Snow Storm Identification

Winter storms produce an array of hazardous weather conditions including heavy snow, blizzards, freezing rain, ice pellets, and extreme cold. Severe winter storms are extra-tropical cyclones (storms that form outside of the warm tropics) fueled by strong temperature gradients and an active upper-level jet stream. The definitions of winter weather include:

Ice and Sleet Storms: A storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or property damage. Ice Storm (freezing rain), probably the most serious of the ice storms, occurs during a precipitation event when warm air aloft exceeds 32o while the surface remains below the freezing point. When precipitation originating as rain or drizzle contacts physical structures on the surface, ice



Source: University of Nebraska

forms on all surfaces creating issues for traffic, utility lines and tree limbs. Sleet forms when precipitation originating as rain falls through a large layer of the atmosphere that has below freezing temperatures allowing raindrops to freeze before reaching the ground. Sleet is also referred to as ice pellets. Sleet storms are usually of shorter duration than freezing rain and generally create fewer problems.

Blizzards: The occurrence of the following conditions lasting for three hours or longer: 1) wind speeds of 35 miles per hour (mph) or more; 2) considerable falling and/or blowing snow (reducing visibility frequently to less than ¼ mile); and 3) generally temperatures of 20 degrees Fahrenheit (F) or lower. A severe blizzard has: 1) wind speeds of 45 mph or more; 2) a great density of falling and/or blowing snow (reducing visibility to near zero); and 3) temperatures of 10 degrees F or lower.

4.5.9 Landslides/Mudslides Identification

Landslides (rockslides, mudslides, etc.) are among the most common natural hazards. Unlike most natural hazards, however, most damage is not caused by extreme events, but by uncounted (and often unreported) minor events.

Slumps usually damage utilities within or below the slide mass, but seldom cause a threat to life.

Flows, around well-built structures causing damage from water and mud.

Lateral spreads are large movements of rock, fine-grained soils (i.e., quick clays), or granular soils, distributed laterally. Liquefaction may occur in loose, granular soils, and can occur spontaneously due to changes in pore-water pressure or due to earthquake vibrations.

Falls and topples are masses of rocks or material that detach from a steep slope or cliff that free-fall, roll, or bounce. Movements typically are rapid to extremely rapid. Earthquakes commonly trigger rock falls. These Translational slides can be the most catastrophic. In addition to presenting a hazard to structures and utilities, they can cause damage and death both far from and slightly below the source.

The hazards associated with landslides are as diverse as the types of failure. Falls may damage roads or buildings at the base of a steep slope, injure climbers, or remain on a road as a hazard to transportation. In addition to the direct hazards of a landslide moving out from under or onto structures or utilities, there is a major indirect hazard. Large slides generally do not stop moving until they reach the bottom of a valley where they block streams, usually resulting in flooding and damage to the ecology.

Figure 4.11 Landslide Depiction



Source: NOAA

4.5.10 Land Subsidence Identification

Subsidence is a phenomenon that combines soil compaction and geological/tectonic forces. Subsidence is the formation of depressions, cracks, and sinkholes in the earth's surface, which normally occurs over many days to a few years usually a result of Karst topography. Karst topography develops when beds of relatively soft limestone and dolomite are present. The diluted organic acids present in water percolates downward and dissolves these formations. In such places, rock is honeycombed with cracks, fissures and potentially large caverns that can collapse. Subsidence results from a number of factors including: compaction/consolidation of shallow strata caused by the weight of river delta deposits, soil oxidation, and aquifer draw-down (shallow component); consolidation of deeper strata (intermediate components); and tectonic effects (deep component). This last element was only recently quantified, and research indicates that it accounts for 50% or more of subsidence.

Figure 4.12: Depiction of Land Subsidence



Source: FEMA

In some areas natural drainage occurs below ground rather than surface streams. These underground passages are commonly connected to the surface by funnel-shaped depressions called sinkholes. The formation of these sinkholes often leads to ground subsidence or collapse. This results from the settlement or collapse of overlying materials into openings beneath the surface, such as caves or enlarged joints. Sinkhole development is usually a slow process;

however, they may occur suddenly. In addition to sinkholes Land Subsidence also occurs when abandoned mines, mine shafts, and tunnels give way.

4.5.11 Lightning Identification

Lightning is generally associated with thunderstorms and is an electrical discharge that results from the buildup of positive and negative charges. When the buildup becomes strong enough, lightning appears as a "bolt." This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning reaches a temperature approaching 50,000 degrees in a split second.

Lightning casualties can happen at the beginning of an approaching storm; however, more than half of lightning deaths occur after a thunderstorm has passed. The lightning threat diminishes after the last sound of thunder, but may persist for more than 30 minutes. When thunderstorms are in the area, but not overhead, the lightning threat can exist when skies are clear. Lightning has been known to strike more than 10 miles from the storm in an area with clear sky above.

According to the National Oceanic and Atmospheric Administration (NOAA), an average of 20 million cloud-to-ground flashes has been detected every year in the continental United States. About half of all flashes have more than one ground strike point, so at least 30 million points on the ground are struck on the average each year. In addition, there are roughly 5 to 10 times as many cloud-to-cloud flashes as there are to cloud-to-ground flashes (NOAA, July 7, 2003).

Figure 4.13: Depiction of Lightning



Source: NWS

4.5.12 Wildfires Identification

A wildfire is any instance of uncontrolled burning in grasslands, forests, and brush land. A Wildfire is further defined as an uncontrolled fire spreading through vegetative fuels, possibly consuming structures (FEMA, 2001). Wildfires often begin unnoticed and spread quickly. The Federal Emergency Management Agency's (FEMA) Fire Management Assistance Grant Program (FMAGP) indicates that a wildfire is also known as a forest fire, vegetation fire, grass fire, or brush fire, is an uncontrolled fire requiring suppression action.

Common causes of wildfires include lightning, negligent human behavior and arson. Many sources indicate that arson, defined as an intentional and willful "crime of setting a fire for an unlawful or improper purpose", is one of the leading causes of wild-land fires in most states.

FEMA indicates that there are four categories of wildfires that are experienced throughout the U.S. These categories are defined as follows:

Figure 4.14: Depiction of a Wildfire



Source: FEMA



Interface or intermix fires – Urban wild-land interface fires are wildfires in a geographical area where structures and other human development meet or intermingle with wild-land or vegetative fuels. Vegetation and the built-environment provide fuel to Urban/wild-land fires.

Firestorms – events of such extreme intensity that effective suppression is virtually impossible. Firestorms occur during extreme weather and generally burn until conditions change or the available fuel is exhausted.

Prescribed fires and prescribed natural burns – fires that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes (FEMA, 1997).

Wild-land fires are wildfires in an area where development is essentially nonexistent except for roads, railroads, power-lines, and similar facilities. Wild-land fires are fueled almost exclusively by natural vegetation. Wild-land fires can be classified as surface fires, ground fires, and/or crown fires. Surface fires are the most common type and burn along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires are spread rapidly by wind and move quickly by jumping along the tops of trees.

The potential for wildfire depends upon fuel characteristics, climate conditions, meteorological conditions, and fire behavior. Hot, dry summers and dry vegetation increase susceptibility to fire. The potential for wildfire, and its subsequent development and severity, is determined by the area's topography, the presence of fuel, and weather.

Topography can have a powerful influence on wildfire behavior. The movement of air over the terrain tends to direct a fire's course. Gulches and canyons can funnel air and act as a chimney, intensifying fire behavior and inducing faster spread rates. Saddles on ridge tops tend to offer lower resistance to the passage of air and will draw fires. Solar heating of drier, south-facing slopes produces upslope thermal winds that can complicate behavior.

Slope is an important factor. If the uphill slope doubles, the rate at which the wildfire spreads will most likely double. On steep slopes, fuels on the uphill side of the fire are closer physically to the source of heat. Radiation preheats and dries the fuel, thus intensifying fire behavior. Terrain can inhibit wildfires: fire travels down slope much more slowly than it does upslope, and ridge tops often mark the end of wildfire's rapid spread (FEMA, 1997).

Fuels are classified by weight or volume (fuel loading) and by type. Fuel loading can be used to describe the amount of vegetative material available. If this doubles, the energy released can also double. Each fuel type has a burn index, which is an estimate of the amount of potential energy that may be released. Different fuels have different burn qualities. Grass releases relatively little energy but can sustain very high rates of spread (FEMA, 1997). According to the U.S. Forest Service, a forest stand may consist of several layers of live and dead vegetation in the understory (surface fuels), midstory (ladder fuels), and overstory (crown fuels).

Surface fuels consist of grasses, shrubs, litter, and woody material lying on the ground. Surface fires burn low vegetation, woody debris, and litter. Under the right conditions, surface fires reduce the likelihood that future wildfires will grow into crown fires.

Ladder fuels consists of live and dead small trees and shrubs, live and dead lower branches from larger trees, needles, vines, lichens, mosses, and any other combustible biomass located between the top of the surface fuels and the bottom of the overstory tree crowns.

Crown fuels are suspended above the ground in treetops or other vegetation and consist mostly of live and dead fine material. When historically low-density forests become overcrowded, tree



crowns may merge and form a closed canopy. Tree canopies are the primary fuel layer in a forest crown fire (U.S. Forest Service, 2003).

4.6 MANMADE HAZARDS IDENTIFICATION

4.6.1 Flooding Dam/Levee Failure Identification

A dam is a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. A levee is a barrier constructed along the side of a watercourse or along a coastal or bay shoreline for the purpose of preventing water-flow to extend beyond the watercourse or an ocean or bay. Dams and levees generally fall into the following categories:

Earth Dams/Levees make up the vast majority of dams and levees and are safe if properly constructed and maintained.

Concrete Gravity Dams/Levees are designed to resist sliding and overturning.

Buttress Concrete Dams/Levees have a strong foundation and are resistant to sliding, overturning and overflowing.

Arch Concrete Dams are used to narrow sites and have strong abutments.

Gravity Arch Concrete Dams are a conservative design of the Arch.

Stone Masonry Dams are constructed of stone or block with masonry joints.

Dam/levee failure floods are usually associated with intense rainfall or rapid snowmelt. Coastal levees also fail as a result of storm surge. Dam/levee failure may be caused by faulty design, construction and operational inadequacies, or a flood event larger than the dam/levee design.

The degree and extent of damage from a dam failure depends on the size of the dam or levee. The greatest threat to people and property is in the area immediately below a dam since the volume of water decreases as the flood wave moves downstream.

The degree and extent of damage from a levee failure depends on the height and length of the levee preventing water from inundating the area protected by the levee and the elevation of the land or structures at risk. The greatest threat to people and property is in the area immediately adjacent to the waterway, ocean or bay. A levee failure resulting from storm surge would have a similar effect as a dam break were-as a levee failure along a watercourse generally affects an area over with a lower volume of water over a longer time.

Figure 4.15: Depiction of a Dam



Source: TVA

Figure 4.16: Picture of a Slidell LA Levee



Source: St. Tammany

4.6.2 Hazardous Materials Incident Identification

Varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States--from major industrial plants to local dry cleaning establishments and gardening supply stores. Hazardous materials are transported by highway, railway, waterway, and pipeline daily, so any area is vulnerable to event.

Hazardous materials incidents typically take three forms: transportation, pipeline incidents and fixed facility chemical and radiological incidents. It is reasonably possible to identify and prepare for a fixed site incident, as laws require those facilities to notify state and local authorities as to what is being used or produced. Transportation and pipeline incidents are much harder to prepare for, as the material involved and the incident location are not known until the accident actually occurs.

Transportation Incident is any hazardous material release during transport that poses a risk to health, safety, and property, as defined by Department of Transportation materials transport regulations. Hazardous materials transportation incidents can occur at any time and place, although the majority occurs on interstate highways, major federal or state highways, or on the major rail lines.

Pipeline Incident is a release of HAZMAT materials that are transported by a pipeline. The potential risk of pipeline accidents is a significant national and county concern. United States are the principal mode for transporting oil and petroleum products such as gasoline, and virtually all natural gas in the U.S. is moved via pipeline as well. Much of this oil pipeline infrastructure is old, requiring regular safety and environmental reviews to ensure its safety and reliability. Virtually all natural gas in the United States is moved via pipeline. Energy pipelines are also extremely vulnerable to sabotage and disruption, and the resulting spills can generate large-scale environmental damage and require extensive clean-up and remediation. Recently, the U.S. Department of Homeland Security identified the energy sector as one of the 14 primary Critical Infrastructures and pipelines in particular must be evaluated to determine the impact of loss or damage. In 2004, the Hazardous Materials Pipeline Act required all pipeline owners to conduct an analysis of pipeline exposures.

Fixed Facility Incident is any occurrence of uncontrolled release of materials from a fixed site that poses a risk to health, safety, and property as determined in the EPA's Resource Conservation and Recovery Act. These materials are classed identically to those specified in the section on transportation accidents.

Figure 4.17: Hazmat Train Accident



Source: TVA

Figure 4.18: Hazmat Pipeline



Source: Petroleum Institute

Radiological Incident is defined as the unintentional exposure to materials that emit ionizing radiation. Nuclear power plants are a significant potential source of ionizing radiation. The health and environment impacts from the Three-Mile Island and Chernobyl, Russia disasters illustrate the potential hazards from nuclear power plants. Other sources of ionizing radiation include medical and diagnostic X-ray machines, certain surveying instruments, some imaging systems used to check pipelines, radioactive sources used to calibrate radiation detection instruments, and even some household fire detectors.

Nuclear power plants are a significant potential source of ionizing radiation. The health and environment impacts from the Three-Mile Island and Chernobyl, Russia disasters illustrate the potential hazards from nuclear power plants.

Figure 4.19: HAZMAT Nuclear Facility



Source: TVA

4.6.3 Illegal Methamphetamine Labs Identification

Typically “meth” is a white powder that easily dissolves in water. Another form of meth is clear, chunky crystals called crystal meth, or ice. Meth can also be in the form of small, brightly colored tablets. The pills are often called by their Thai name, yabba. Street terms for Methamphetamine are meth, poor man's cocaine, crystal meth, ice, glass, and speed.

Amphetamine, dextroamphetamine, Methamphetamine, and their various salts are collectively referred to as amphetamines. In fact, their chemical properties and actions are so similar that even experienced users have difficulty knowing which drug they have taken. Methamphetamine is the most commonly abused.

Illegal domestic labs that produce Methamphetamine (meth) are dependent on supplies of the precursor ephedrine or pseudoephedrine. Sometimes it is smuggled in quantity from Canada and Mexico, but may be readily purchased over-the-counter in the form of the decongestant Sudafed and other pseudoephedrine-containing cold tablets. Depending on the method used, meth is “cooked” using the cold medicine and other easily obtained items such as coffee filters, lye, battery acid, matchbook striker plates, iodine, lithium batteries, and Coleman fuel.

The process of cooking meth leaves behind a hazardous coating on walls, floors, and in ventilation systems. State law requires meth-contaminated property be quarantined until clean up operations have been completed and the property tested by a certified contractor as safe for habitation. Cost for cleaning and certifying a 1,200 square foot house is about \$9,000. In hotels, rooms adjacent, above, and below must also be certified as safe.

Drug Enforcement Agency officials estimate that for each pound of meth produced, a lab operator winds up with 6 pounds of toxic waste, including leftover chemicals such as anhydrous ammonia, lye and solid meth residue.

Figure 4.20 Methamphetamine



Source: DEA

Effects of usage include addiction, psychotic behavior, and brain damage. Chronic use can cause violent behavior, anxiety, confusion, insomnia, weight loss, auditory hallucinations, mood disturbances, delusions, and paranoia. Damage to the brain caused by meth usage is similar to Alzheimer's disease, stroke, and epilepsy.

4.6.4 Pandemics/Epidemics/Vectors Identification

Pandemics occur when disease affects large numbers of the population worldwide. Epidemics occur when large numbers are affected in a more localized area such as a city, region, state, or nation. Vector-based threats - bacteria, insects, and animals are threats that pose a direct or indirect hazard to humans, their food supply, or the economy.

Pandemics have occurred three times in the last 100 years in the world's human population.

The 1918-1919 Spanish Flu caused the highest number of deaths. India had 16 million deaths. The U.S. had 675,000 deaths. In England 230,000 died. In Germany 225,000 and in France 166,000 perished. World wide, the estimated fatalities were 20 million to 50 million. During the Spanish Flu pandemic, Spain closed its government. New York City closed its port and trains did not run. The British Navy did not sail for three weeks.

The 1957-58 Asian Flu was identified in February 1957 in China. By June, it had crossed the Pacific and entered the U.S. Globally, it caused a million deaths. In the U.S., 70,000 persons died. It was a Type A virus.

The 1968-69 Hong Kong Flu caused four million deaths worldwide and 34,000 deaths in the U.S. It was a Type A virus.

4.6.4.1 Human Pandemic/Epidemic Hazard Identification

Influenza occurs every year and nations attempt to prepare for the "flu season" which brings one to two weeks of symptoms, even pneumonia and death. The cost in the U.S. is \$71 to \$167 billion annually. Some 36,000 in the U.S. and 250,000 to 500,000 worldwide die annually.

Three types of influenza viruses exist: A, B, and C. Type A viruses are of most concern for humans, pigs, marine mammals and birds. Type B virus has been identified in the seal population and is fatal. Influenza C virus is associated with ticks.

Influenza viruses are constantly evolving. The viruses undergo minor and major modifications through antigenic drift and antigenic shift. Antigenic drift is the mechanism responsible for creating small changes in the genetic composition of the virus. Antigenic drift occurs in Type A and B influenza. Antigenic shift describes significant changes in the genetic structure of the virus. It occurs only in type "A" when two different virus strains are simultaneously present in a host or after transmission of viruses from different hosts. The two viruses swap genetic material creating a "new" virus. The ability to jump species, the constant changes in the generic makeup of the influenza virus, the potential for vaccine loss, and the rapid spread of Flu viruses are some of the reasons influenza is always a threat to the world's population.

Avian flu was first discovered in Canada. It is estimated that 50% of wild ducks in Canada carry forms of the flu. Highly infectious forms are destructive to domestic poultry. Three strains of avian influenza viruses are known to jump the species barrier from birds to non-human animals to humans: A(H9n2), A(H7N7) and A(H5N1). A(H5N1) is the most lethal, causing death in 68% of humans infected. Coughing or sneezing, victims spew infectious droplets at a rate of 150 feet

per second. Shaking hands or contact with contaminated public washrooms and doorknobs can spread the disease very quickly.

Scientists expect that an Avian H5 Flu virus, which has swept through chickens and other poultry in Asia, will transform into a flu that can be transmitted to humans. It has emerged as a highly pathogenic strain of influenza virus that is affecting the entire western component of Asia. The CDC is preparing for a possible pandemic. Humans have no immunity to this new avian flu.

Confirmed cases of human infection from several subtypes of avian influenza infection have been reported since 1997. Most cases of avian influenza infection in humans have resulted from contact with infected poultry (e.g., domesticated chicken, ducks, and turkeys) or surfaces contaminated with secretion/excretions from infected birds. The spread of avian influenza viruses from one ill person to another has been reported very rarely, and has been limited, inefficient and unsustainable.

Small Pox (variola major) was last seen in the US in 1949. The last naturally occurring case was in Somalia in 1977. Smallpox vaccination in the US ended in 1972 except for military personnel.

When smallpox was considered eradicated worldwide, only two laboratories were designated to keep the virus. One lab was the CDC in Atlanta, Georgia, and the other lab was in Russia. When the USSR break-up occurred, the location of Russia's smallpox virus became unknown. It was widely thought that at least four other countries received part of the virus.

Variola is classified as a biological weapon, included on the "A" list by the CDC. The virus can be transmitted from person to person, may result in high mortality rate (30%), and cause panic and social disruption. Variola has a moderate to high potential for large-scale dissemination and requires special action for public health preparedness and response.

Hepatitis A Virus results from eating food or drinking water contaminated with human excrement. Outbreaks are associated with consumption of produce. Hepatitis A virus attacks the liver, is highly infectious, and can lead to varying degrees of illness, hospitalization and death.

Emerging Pathogens: Severe Acute Respiratory Syndrome (SARS) started in China in late 2002. The World Health Organization reported 29 countries were affected by the end of July 2003. There were 8,500 cumulative cases and 774 deaths. In the United States, 29 cases were confirmed. SARS is closely associated with influenza and is of major concern to all public health officials.

Emerging Pathogens: Monkey Pox Virus is an orthopoxvirus, which also includes cowpox and smallpox. It is a viral disease occurring in the rain forests of central and West Africa. Monkey pox is milder than smallpox. It was seen in the US June 14, 2003. It was introduced to this country by prairie dogs infected by Gambian rats imported by a distributor of exotic pets. By June 18, 2003, 87 persons in six states were confirmed with the virus.

4.6.4.2 Animal and Vector-Based Agriculture Hazard Identification

An "emerging" series of threats to communities is vector-based threats - bacteria, insects, and animals that pose a direct or indirect hazard to humans, their food supply, or the economy.

Foot and Mouth Disease (FMD) is a highly infectious and difficult to control disease of cloven-hoofed mammals including cattle, swine, wild sheep, goats, deer, and pigs. Although many people don't consider Foot and Mouth Disease to be a "threat," an outbreak of the disease in Europe caused widespread concern over the safety of the meat supply, as well as the possibility of resulting infection of humans. Federal, state and local officials, including the emergency

services community, have plans and procedures for handling incidents involving these threats. Should an outbreak occur anywhere in the United States, routine livestock movements could rapidly spread the disease making early detection, combined with immediate eradication of affected animals, crucial for controlling the disease. Left unchecked, the economic impact of FMD could reach billions of dollars in the first year. Deer and other wildlife would likely become infected and be a source for re-infection of livestock. FMD is not known to cause illness in humans.

In recent years, FMD has been found in Africa, South America, Asia, and parts of Europe. Currently, North America, Central America, Australia, New Zealand and some countries in Europe are considered free of FMD. The United States has eradicated nine outbreaks of FMD, most recently in 1929.

Avian influenza in birds (AI) is a viral disease characterized by respiratory signs, depression and reduced feed and water intake. In egg laying birds there is a decline in egg production and quality. There are two pathotypes of AI virus: the most common is low pathogenic AI (LPAI) and the other is highly pathogenic AI (HPAI).

The most virulent form (HPAI) was once called fowl plague. At the 1981 International Symposium on Avian Influenza, the term fowl plague was replaced with the term "highly virulent" influenza virus infection. The AI epidemic of 1983-1984 required yet new terms to describe relative pathogenicity of different isolates of the same stereotypes (nonpathogenic, low-pathogenic, highly pathogenic).

Infected birds shed influenza virus in their saliva, nasal secretions, and feces. Susceptible birds become infected when they have contact with contaminated secretions or excretions or with surfaces that are contaminated with secretions or excretions from infected birds. Domesticated birds may become infected with avian influenza virus through direct contact with infected waterfowl or other infected poultry, or through contact with surfaces (such as dirt or cages) or materials (such as water or feed) that have been contaminated with the virus.

Infection with avian influenza viruses in domestic poultry causes two main forms of disease that are distinguished by low and high extremes of virulence. The "low pathogenic" form may go undetected and usually causes only mild symptoms (such as ruffled feathers and a drop in egg production). However, the highly pathogenic form spreads more rapidly through flocks of poultry. This form may cause disease that affects multiple internal organs and has a mortality rate that can reach 90-100% often within 48 hours.

4.6.5 Terrorism Identification

The Federal Bureau of Investigation (FBI) defines terrorism as "the unlawful use of force against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in the furtherance of political or social objectives." Events typically would be expected in urban areas near public gatherings, government facilities, or highly visible areas. Terrorism is generally categorized as one of two types.

Figure 4.21 Foot and Mouth Disease Animals



Source: Dept. of Agriculture

Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction.

International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the U. S., or whose activities transcend national boundaries.

A terrorist attack can take several forms including involving the use of “Weapons of Mass Destruction” (WMD). The term “Weapons of Mass Destruction” has various definitions. Common to all of them is the assumption that WMD’s comprise incendiary, explosive, chemical, biological, radioactive, and/or nuclear agents. 50 U.S.C., § 2302 defines WMD as “any weapon or device that is intended, or has the capability, to cause death or serious bodily injury to a significant number of people through the release, dissemination, or impact of a toxic or poisonous chemicals or their precursors, a disease organism; or radiation or radioactivity.”

4.6.5.1 Bombings Identification

Bombings are the most frequently used method terrorist event in the U. S. This includes the 1993 bombing of the World Trade Center in New York, the U. S. Capitol, Mobil Oil's corporate headquarters in New York City, and the bombing of the Alfred P. Murrah federal building in Oklahoma City. More recently, the World Trade Center Buildings and the Pentagon were the targets of a well-planned terrorist attack involving the use of commercial aircraft as flying bombs.

Figure 4.22 9/11 Terrorist Attack



Source: Dept. of Agriculture

4.6.5.2 Chemical/Biological Agents Identification

Chemical/Biological agents have been developed by several nations for use in warfare. Such agents are selected or adapted from bacteria, fungi, viruses, or toxins that cause various diseases in humans, animals, or food crops. Currently, the development of biological agents as weapons has kept pace with our ever-evolving day-to-day technology. Despite the widespread ban, international diplomatic efforts have not been entirely effective in preventing the enhancement and proliferation of offensive biological warfare programs. There are four major categories under which the chemical agents may be classified:

Blister agents are intended to incapacitate, rather than kill. These agents were used extensively during World War I. Their use by a terrorist group largely depends on the group’s objectives and moral views. If the intent of an attack were to injure numerous people and overload the area’s medical facilities without causing many deaths, then a blister agent would be the best choice.

Choking agents were the agents most used during WW I. With the advent of nerve agents, they have lost much of their usefulness. These substances are intended to cause death and are convenient and readily available to terrorists.

Blood agents are cyanide-based compounds. Unsuitable for use on multitudes of people, the primary use would be the assassination of targeted individuals.

Nerve agents are the most recently developed chemical weapons. Originally developed by German scientists 1930's as insecticides, nerve agents were used as chemical weapons by the

Nazi military. Hundreds of times more lethal than blister, choking, or blood agents, nerve agents have been stockpiled as the primary chemical weapon. These chemicals are the most useful to terrorists due to the small quantity needed to inflict a substantial amount of damage.

4.6.5.3 Radiation Device Identification

Radiation Devices including a nuclear bomb produce five primary potential effects:

- **Overpressure:** is when a nuclear weapon explodes in the atmosphere, a blast or shock wave is created that initially moves at speeds higher than the speed of sound.
- **INR/EMP:** Initial nuclear radiation (INR) is radiation in the first minute after detonation and is hazardous to unprotected people within about 1.5 miles. Electromagnetic radiation pulse (EMP) is the conversion of nuclear energy into electromagnetic frequency and occurs when a nuclear weapon is detonated outside of earth's atmosphere. EMP disrupts electrical and electronic equipment across entire continents. The equipment is unusable until repaired.
- **Fire Risk:** The combined effects of blast overpressure damage and the thermal pulse or fireball can ignite combustible materials, causing sustained fires. Primary fires are those ignited directly by the thermal pulse. Secondary fires are generated by damage and destruction from blast overpressures and result from the disruption of furnaces and gas and electric lines.
- **Fallout risk:** A nuclear explosion near the ground makes a big crater. Earth from the crater is changed from solids into hot gas and fine dust. This hot gas and dust, together with vaporized materials, form a giant fireball that rises rapidly and becomes the top part of the nuclear mushroom cloud. The heavier particles of earth become the stem of the mushroom cloud. The earth in the stem and in the mushroom cloud becomes radioactive. The top of the mushroom is a cloud of fine particles. The heavier, larger particles settle close to the point of explosion, the small particles float several hundred miles in the wind. The first 24 hours is the most dangerous period as the initial fallout is highly radioactive. The delayed fallout particles lose much of their radioactivity and reaches earth in rain or snow over periods ranging from days to years. The three kinds of dangerous radiation in fallout are alpha, beta and gamma. Gamma radiation penetrates the body, causing damage to organs, blood and bones. Large doses of gamma radiation can cause sickness or death. Small doses incurred over a long period of time may not have an immediate effect, but may cause various forms of illness later in life. Genetic damage in subsequent generations may also result. Alpha radiation is stopped by the outer skin layers and does not usually present an external hazard. However, if contaminated air, food, or water enters the body in sufficient quantity, considerable internal damage can occur. Beta radiation is more penetrating and may cause burns where fallout particles have deposited on the skin.

The effects of a nuclear/radiation attack have varying effects on populations. Those people located near the explosion would be killed or seriously injured by the blast, heat or initial nuclear radiation. People a few miles away would be subject to blast, heat, and fires. A high percentage of the population residing in the lighter damaged areas would probably survive, but might subsequently be endangered by radioactive fallout.

4.6.5.4 Cyber-Terrorism Identification

The U.S. interest in promoting cyber-security extends well beyond its borders. Critical domestic information infrastructures are directly linked with Canada, Mexico, Europe, Asia, and South America. The nation's economy and security depend on far-flung U.S. corporations, military forces and foreign trading partners that require secure and reliable global information networks to function. The vast majority of cyber attacks originates or passes through systems abroad, crosses several borders, and requires international cooperation to stop.

In 1998, the United States received a wake-up call to the national security dimensions of the threat. Eventually dubbed "Solar Sunrise," this incident found U.S. military systems under electronic assault, with computer systems in the United Arab Emirates the apparent source. Unclassified logistics, administrative, and accounting systems essential to the management and deployment of military forces were penetrated at a time that military action was being considered against Iraq. The timing of the attacks raised U.S. suspicion that this was the first wave of a major cyber attack by a hostile nation. It was eventually learned that two California teenagers under the guidance and direction of a sophisticated Israeli hacker orchestrated the attacks.

Another event in February 2000, computer servers hosting several of the largest commercial web sites on the Internet were flooded with connection requests, which clogged systems and consumed server capacity. Ultimately, these denial-of-service attacks paralyzed large parts of the Internet. Close cooperation between U.S. and Canadian law enforcement investigators discovered that a Canadian teenager had been breaking into legions of computers around the world for many months. By retaining control over these compromised servers, he created a "zombie army" which on command would flood the servers of his next corporate victim. The cost of slowdowns and outages that occurred was an estimated billion dollars in economic losses.

On May 4, 2000, the "I love you" virus began infecting computers around the globe. First detected in Asia, this virus quickly swept around the world in a wave of indiscriminate attacks on government and private sector networks. The destructive virus infected nearly 60 million computers and caused billions of dollars in damage. Cooperation among law enforcement authorities around the world led to the identification of the perpetrator, a computer science dropout in the Philippines. He was neither charged nor punished for his deeds because, at the time, the Philippine criminal code did not explicitly outlaw such actions.

The possibilities of a terrorist incident include attacks on critical facilities and soft targets involving explosives, chemical/biological, disease, radiation or cyber agents. It is clear that U.S. domestic efforts alone cannot deter or prevent attacks. Local, state and federal law enforcement officials monitor suspected terrorist groups and try to prevent potential attacks. Additionally, the U. S. Government works with other countries to limit support for terrorism.

Figure 4.23 Cyber Attack



Source: DHS

4.6.6 Transportation Accident Identification

A transportation accident is an incident related to a mode of transportation (highway, air, rail, waterway, port, harbor) where an emergency response is necessary to protect life and property.

Highways are the primary mode of transportation across the U. S, the State, and local jurisdictions and are directly responsible for the majority of fatalities and property loss

Bridge Failure can be a catastrophic cause of fatalities and property loss. There are several thousand bridges that are rated as structurally deficient across the United States

Train derailments can be a major cause of fatalities and property loss. There are several thousands of miles of railway across the United States whose use is divided between freight, passenger, and light rail commuter services. Plans for commuter trains and light rail are in various phases of implementation.

Commercial Waterways in many of the major rivers and along ocean coasts are critical to agricultural, mining and manufacturing economies. Shipments by barge, large vessel, or salt-water ship can result in significant property loss and water contamination.

Aeronautics Aircraft accidents, when they happen have significant impact on communities due to the loss of life. Aircraft, airports, and support systems such as radar stations and aircraft landing systems are vulnerable to natural hazards. Aircraft sustain damage from high winds if not tied down or in a shelter. Hail damage to an aircraft may render the aircraft not fit for airworthiness unless repaired

Transportation incidents require the routine response of local EMS units from across the county and are a significant cost burden to local fire districts. Incidents involving air or rail passenger travel can result in mass casualties or mass fatalities, and the release, or potential release, of hazardous materials.

Figure 4.24 Transportation Accident



Source: FEMA

4.6.7 Urban Fire Identification

Fire is a rapid, persistent chemical reaction that releases heat and light, especially the exothermic combination of a combustible substance with oxygen. A fire is categorized as both a natural hazard and a manmade hazard. The types of fires include:

Residential: single family dwellings, apartments, mobile homes, hotels, and motels.

Public and Mercantile: stores, restaurants, grocery stores, institutions, churches, public facilities, education.

Figure 4.25: Structure Fire



Source: NFPA

Industrial, Manufacturing: Other Buildings: basic industry, manufacturing, storage, residential garages and vacant buildings.

Vehicle Fires: aircraft, automobiles, trucks, trains, buses, boats.

There are many causes of fire as a technological hazard including careless smoking, cooking, or campfires, arson, improper building wiring, industrial mishaps, and instances such as train derailments or transportation collisions. Lightning is a natural hazard that can cause Urban Fires.

4.6.8 Utility Power Failure Identification

A major electrical power failure is defined as a failure of the electrical distribution system that exceeds twenty-four hours in duration and effect greater than 33% of a given geographical area.

The electric system in the U.S. is an interconnected, multi-modal distribution system that consists of three major parts: generation, transmission and distribution, along with control and communications. Generation assets include fossil fuel plants, hydroelectric dams, and nuclear power plants. Transmission systems link areas of the grid. Distribution systems manage and control the distribution of electricity into homes and businesses. Control and communications systems operate and monitor critical infrastructure components.

The nation's power and utility infrastructure has grown increasingly complex and interdependent; consequently, any disruption could have far-reaching effects. Large-scale power and utility failures may result from a variety of natural causes such as geomagnetic storms, High Winds, Lightning, Ice/Snow Storms and earthquakes. They may also result from a variety of manmade causes such as technological accidents, equipment failures or deliberate interference.

Almost every form of productive activity – whether in businesses, manufacturing plants, schools, hospitals, or homes – requires electricity. Utility Power systems are critical components to the overall health and safety of citizens. Our society uses utilities, including HVAC systems, daily and in some cases at certain times of the year these systems are for survival. A prolonged major electrical system failure during extreme temperatures, can have dramatic effects on a population.

4.6.9 Water Contamination Identification

The water sector consists of two basic and vital components: fresh water supply and wastewater collection and treatment. Water sector infrastructures are diverse, complex and distributed ranging from rural to urban systems. The primary focus of critical infrastructure protection efforts are the public water systems that depend on reservoirs, dams, wells and aquifers, as well as treatment facilities, pumping stations, aqueducts and transmission pipelines.

Drinking water comes from surface water and from ground water. Large-scale water supply systems tend to rely on surface water resources such as rivers, lakes, and reservoirs. Smaller water systems tend to use ground water pumped from wells.

The primary concern with regard to water infrastructure is adequate water supply and the damage or disruption of service that could be caused by natural or manmade hazards that could potentially include the following:

- The introduction of pollutants into public groundwater and/or surface water supplies;
- Chemicals from leaking underground storage tanks, feedlots and waste disposal sites;
- Human wastes and pesticides that may be carried to lakes and streams;



- Damage or destruction of water assets, including intentional releases of toxic chemicals;
- Actual or threatened contamination of the water supply;
- Cyber attack on water management systems or other electronic systems;
- Interruption of services from other infrastructure.

The Safe Drinking Water Act of 1974, sets uniform nationwide minimum standards for drinking water. State public health and environmental agencies have the primary responsibility for ensuring that federal and state drinking water standards are met by each public water supplier. The EPA requires an ongoing water quality-monitoring program to ensure water systems are working properly and require suppliers to inform the public if a supply becomes contaminated.

