Hazards Assessment

4.1 Introduction

This section of the Santa Rosa County Local LMS Plan summarizes the results of a vulnerability assessment process undertaken by the Task Force members. The intent of this section is to provide a compilation of the information regarding the hazards threatening Santa Rosa County. In this section, information relevant to the entire planning area is compiled. An overview of the analyses is provided as required by DMA2K requirements.

The hazards that will be analyzed in this section are both natural and human in origin. However, DMA2K does not require an assessment of technological and/or societal hazards. Analysis of hazardous materials (fixed facility and transportation), terrorism, and computer viruses are considered technological. Exceptions may be taken to what is defined as "technological." For example, dams are human caused. Likewise, some flooding is caused by development. These situations, however, are akin to natural disasters and are covered in this plan. Otherwise, technological mitigation is not covered under this plan or in the analysis of this section.

Primary attention is given to natural hazards (with sub-sections) considered reasonably possible to occur in the County. These hazards include:

- Hurricane
- Tropical Storm
- Storm Surge
- Flooding
- General Flooding
- Dam Safety
- Land Erosion
- Sinkholes
- Expansive Soils
- Severe Storms
- Tornado & Waterspout
- Thunderstorms and Lightning
- Winter Storms
- Heat Wave and Drought
- Wildfire

The hazards that are considered unlikely or impossible in the County will be briefly analyzed and commented on will be included. These hazards include:

- Earthquake
- Avalanche

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- Land Subsidence
- Landslide
- Tsunami
- Volcano

4.2 Hazard Identification

(See Appendix 4.2 series for maps and statistical information)

The technical DMA2K planning process begins with hazard identification. In this process, all of the natural hazards that threaten the communities are identified. This has been conducted through thorough research by planning staff to the LMS Committee, input from members and citizens, and data provided by FEMA and other sources.

The Federal Emergency Management Agency's Hazards U.S. Multi-Hazard (HAZUS-MH) software application and Santa Rosa County Staff ~~Kinetic Analysis Corporation and the University of Central Florida~~ have established a Natural Hazards Assessment of Santa Rosa County (provided as Appendix 4.2 of this plan). Appendices that follow this section are custom developed by LMS Committee planning staff and provide an often more detailed assessment of the hazards. The more detailed assessment is particularly pertinent to each municipality and in some cases to Navarre Beach.

4.2A Hurricane

Note to readers: Storm surge is evaluated in Section 4.2.A.1 of this chapter.

According to the National Oceanic and Atmospheric Administration (NOAA), Santa Rosa County has an approximate 33% chance of being impacted by a tropical storm or hurricane from the Atlantic / Caribbean / Gulf of Mexico basin in any given year (based on data from 1944-1999).

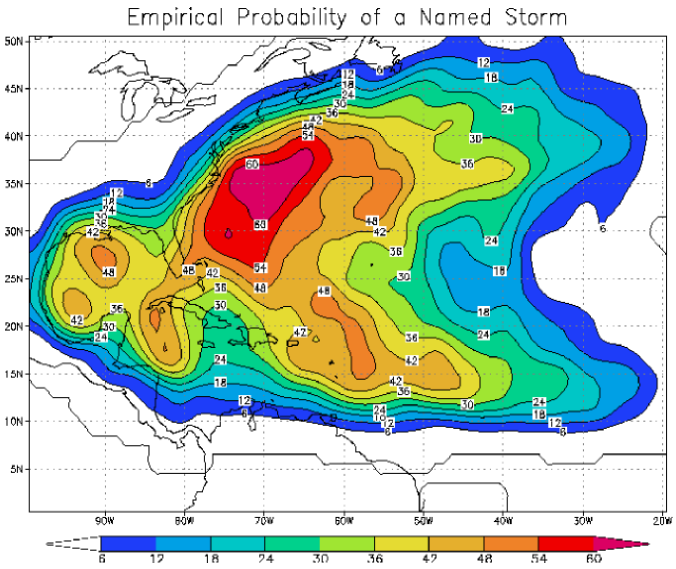

Figure 1: Percentage probability of a hurricane striking in any given year in the Atlantic/Gulf/Caribbean Basin. Santa Rosa County rests on the 33% contour. (Source: http://www.aoml.noaa.gov/hrd/tcfaq/G12.html).

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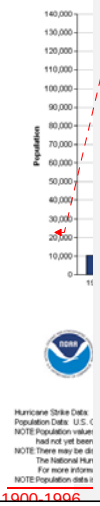
Historically, Santa Rosa County has experienced a peak 5% chance of hurricane landfall as indicated in Table 1 below. This peak percentage occurs during the month of September; a typical expectation being that the month of September falls right in the center of peak hurricane season -- between mid-August to late October. However, the official, nationally recognized hurricane season starts June 1st and spans to November 30th.

Month	Named Storm	Hurricane	Major Hurricane
June	4%	<2%	<1%
July	4%	<2%	<1%
August	7%	2%	<1%
September	15%	5%	1%
October	4%	<2%	<1%
November	1%	<1%	<1%

Table 1: Historical Trends of Tropical Storm/Hurricane Impacts by Percentage Odds. Source: Atlantic Oceanographic and Meteorological Laboratory, NOAA, Miami (Source: http://www.aoml.noaa.gov/hrd/tcfaq/G13.html)

However, the public should not be lulled into thinking that a 5% chance of a hurricane impacting the county in September is low. This represents a four in one hundred chance that Santa Rosa County could receive a hurricane in that month compared across the entire North Atlantic basin (hundreds of thousands of square miles stretching from Texas to the west coast of Africa). These odds are actually statistically high.



~~**Figure 2**: Annual Hurricane Landfalls in Santa Rosa County, Florida 1900-1996 (Source: http://www.aoml.noaa.gov/hrd/tcfaqG/ht).~~

Figure 2: Ann da, 1900-2005
Source: HTTP

Nine hurricanes struck Santa Rosa County between 1900 and 1996. Three of these storms were major (1917, 1926, and Opal in 1995). Figure 2 for Santa Rosa County shows the number of hurricanes making landfall in the county (source: Atlantic Oceanographic and Meteorological Laboratory, NOAA, Miami). Additionally, Hurricane Ivan (a major hurricane) struck the County in 2004.

High winds from hurricanes are a substantial threat to all homes, especially manufactured housing. Category 3 or higher force winds would likely cause substantial

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damage throughout the County. Winds in excess of 155 MPH could be experienced in a major Category 5 hurricane in some locations. In no instance should a resident of a manufactured home stay in the home in hurricane conditions. This creates an immediate need for sheltering and adds to traffic loading on area roadways (where evacuating residents of nearby coastal counties are already fleeing north). Traditional stud and brick veneer or siding homes and businesses are vulnerable, as well, especially when hurricane shutters are not used. Relatively few businesses and homes have hurricane shutters in the County, although shelters and some critical facilities are shuttered. There is an increased awareness of the need for shutters due to local emergency management, commercial, state, and federal government awareness campaigns.

In recent history, hurricane approaches towards West Florida have caused major traffic backups on Interstate 10 (Hurricanes Opal – 1995 and Floyd – 1999 are perfect examples). Hurricane Opal evacuees from Escambia, Santa Rosa, Okaloosa and Walton Counties caused traffic speeds to decrease to near standstill on I-10. Additionally, substantial evacuee numbers would be anticipated from residents of south Santa Rosa County, as well as neighboring Okaloosa and Escambia County on Pensacola Beach as citizens left coastal areas for inland locations. This could impact roadways such as U.S. 98 (Navarre Parkway and Gulf Breeze Parkway), SR 87, SR 281 (Garcon Point Road, the Garcon Point Bridge, and Avalon Boulevard), CR 197 (Chumuckla Highway), and SR 89. The number of evacuees traveling in or through the county, attempting to find shelters or motels, or being stuck in highway traffic is a real threat to emergency operations, coordination, resources, and management. Roadways built below flood levels create a risk of trapping people on roadways in vehicles (even if they are not victims of floodwaters) if hurricane force winds reach the area before all persons are evacuated or sheltered.

In September 2004, the eye wall of Hurricane Ivan impacted and devastated all areas of Santa Rosa County. The eye made landfall just west of Gulf Shores, Alabama. The right quadrant of the storm (the strong side) came across the County with Category 3 force winds. Hurricane force winds extended from coastal communities at Navarre Beach, Gulf Breeze, and Navarre, and extended inland through Milton and Pace north to Jay and the Alabama state line. The hurricane served as a reminder of the power of a major hurricane and its impacts across the entire area.

In July 2005, Hurricane Dennis impacted Santa Rosa County making landfall near Navarre Beach with Category 3 force winds. Hurricane force winds extended approximately 40 miles from the center, therefore all the coastal areas of the county were impacted. Dennis was a compact, fast moving storm which traversed the county from Navarre Beach, through the Milton and Jay areas to the Alabama state line. While not as severe as Hurricane Ivan a year earlier, Hurricane Dennis demonstrated the power and destruction a major hurricane can inflict.

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VULNERABILITY CHART: HURRICANES/TROPICAL STORMS

Geographic Locations	All geographic locations within Santa Rosa County are vulnerable; however, damaging winds and storm surge effects can be expected to be most intense along the Southern coastal border including Gulf Breeze, Midway, and Navarre Beach. Such coastal settings are the most sought after properties, with the potential for increased populations, and thus are at higher risk of property and personal damage. Coastal surge can also be expected to push up the bays and river systems flooding homes and businesses along water features. Locations further inland may experience lesser wind fields, but may still see significant damage.
Damage Estimates	Damage and loss are in direct relation to the population density of the impacted area. Please refer to the 2005 Local Mitigation Strategy Appendix A (Pgs 14-75 for Storm Surge and Pg 64 for Wind Events) for damage estimates.
Populations: 0-18yr/ 18-24/ 25-64/ 65+ / Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	All populations in Santa Rosa County are vulnerable to injury and increased hardship due to community interruption, however certain populations are more vulnerable: The elderly, handicapped and medically needy are more vulnerable due to mobility issues, medical conditions exacerbated by the storm, and potential reliance on medicines and electricity-dependant machinery. Hearing and sight-impaired populations are vulnerable as urgent public information or situational awareness may be impeded due to the nature of their disability. Homeless populations are also more vulnerable as situational awareness and ability to get to public shelters may be a factor. Impoverished populations are more vulnerable to the damage caused by hurricanes/tropical storms, as monies necessary to relocate or repair may not be available. Additionally, tourists are more vulnerable due to lack of familiarity with local roads, evacuation routes, alternate routes, locations of hospitals, and sources of relief. They are also unlikely to have necessary disaster supplies on hand. In addition, situational awareness may arrive more slowly for those focused on recreational activities. Many tourists stay in hotels, motels, RV parks or campgrounds and frequent tourist destinations near the same locations prone to higher hurricane impacts.
Personal Injury	Typical injuries may result from: Wind- blown debris, falling limbs, downed power lines, structural collapse, rising flood waters, vehicle accidents, heat stress, lack of food/water/ medical treatment/medicines, loss of access to emergency services Additional injuries may occur during the post event cleanup: Chainsaw Injuries, Falls from heights, Animal Bites (wasps, spiders, snakes, dogs etc), Heat Stress, Overexertion, Mold-induced respiratory conditions, hepatitis A and B, tetanus, mosquito-borne illnesses, heart attacks/stroke, increased stress, mental anxiety etc.
Group Homes	Assisted Living Facilities, Nursing Homes, Schools, Jails/Prisons are vulnerable due to the special needs of such facilities, the length of time necessary to evacuate, the transportation requirements of such a facility, and the staffing required to support group facilities. Additionally, most in group settings must rely on the emergency plans, decisions, and care of others.
Structural	All structures are vulnerable to hurricane damage. In general, sheds, pool coverings, lanais, carports, billboards/outdoor signage, Mobile Homes, already compromised structures and homes built to less stringent building codes (Pre 2001 Florida Building Code) are the most vulnerable to structural damage from collapse, tree damage, wind damage, lift-off, and other nature-forced movement. Roof and window systems are another source of structural vulnerability. Accessories attached to roof systems, can lead to roof failure, as can excessive winds, falling trees and wind-blown debris.
Infrastructure	Community infrastructure is vulnerable to considerable disruption/failure. Examples include: Road and bridge failure/blockage or compromise, gas leaks, compromised electric delivery systems, jammed cell and land line phones / downed towers / flooded switches/ broken lines, sewerage lift station failure, flooded/overwhelmed/powerless water treatment facilities

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VULNERABILITY CHART: HURRICANES/TROPICAL STORMS (continued)

Business/Economic Vulnerability	Businesses are vulnerable to loss of product/ facilities, displaced or loss of workers and customer base, supply disruption, loss of important paperwork, shifting of consumer spending to emergency/ replacement needs. All affect the economy of Santa Rosa County. This economic disruption may be offset somewhat by the significant boost in business for reconstruction occupations as residents rebuild, replace, and repair. All employment sectors are vulnerable, however, specific vulnerabilities exist for Farm Workers whose livelihood is vulnerable due to wind-damaged/flooded crops, eroded nutrient layers, loss of farm equipment/storage, increased pests/disease, disruption in supply and distribution.
Associated Hazards	Associated hazards include: damaging winds, dangerous lightning, storm produced tornadoes, inland and coastal flooding, contamination, storm surge, HAZMAT Releases, gas explosions, structural fires, electrocution from downed wires, drowning, sinkholes, civil disturbance, political unrest

4.2A1 Storm Surge

(See Appendix 4.2A1 for Storm Surge Maps)

Santa Rosa County is a coastal county. However, storm surge from East, Escambia and Pensacola Bays being pushed from the south up the Escambia, Yellow, and Blackwater river valleys of the Pensacola Bay Area basin could combine with river flooding. By far, the largest area of the county susceptible to storm surge are those areas lying up-river from the Pensacola Bay Area Basin. This is assumed due to the storm surge zones in Southern Santa Rosa and neighboring Escambia Bay "Hurricane Storm Tide Atlas 1999" showing lands surrounding the floodplain of the Escambia and East Bays as being in a storm surge zone; primarily land area south of I-10. A number of residents are vulnerable to storm surge in these areas up to 13.1 feet above mean sea level in a Category 5 hurricane. Since this corresponds with flooding in the East/Blackwater and Escambia Basin, and is well documented as being vulnerable to flooding on Flood Insurance Rate Maps of the area, a more complete analysis and mitigation discussion will be deferred to LMS sections on "flooding."

In a hurricane, the county is vulnerable to substantial flooding from tropical rains since the County serves as the central drainage area for three major river systems in the region; the Yellow, Escambia, and Blackwater Rivers. Although the majority of urban areas are not in floodplains, impact to roadways, some businesses, and homes stresses already limited emergency management resources. Additionally, many persons who live in flood-prone areas are low or very low income. This creates substantial need for public assistance in the form of cash, loans, sheltering, food, and resources for recovery. This can create a long-term response and recovery hardship for the County's emergency management staff.

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Hurricane Ivan (2004) demonstrated the power of storm surge and the overall risk to the County. Storm surge heights of fifteen feet and higher were recorded along the Gulf of Mexico, Santa Rosa Sound, Escambia, East, and Blackwater Bays. This kind of

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coastal surge on Navarre Beach causes erosion and damage to infrastructure as noted as recently as tropical storm Fay and hurricane Ike in 2008.

The measurement of storm surge heights from research conducted by FEMA after the hurricane does not include wave height. The impact of storm surge in Gulf Breeze, the Fair Point Peninsula, Navarre, Navarre Beach, Milton, Pace, and surrounding coastal and bay front communities was massive.

Being that Santa Rosa is a coastal county, much of the flooding (and flood damage) is a result of storm surge inundation along the Gulf Breeze Peninsula in the southern portion of the county (See Appendix4.2A1i). Storm surge creates upland riparian flooding conditions as river systems experience a stall in downriver flow and water essentially begins flowing upriver. Many of the communities located along these river systems are subsequently impacted the hardest.

Flood prone areas of the county include portions of the City of Milton near various drainage system ditches and former wetlands now dredged and filled, some residents and locations along the Escambia River, especially near the Pace community, some businesses and residents along I-10 leading across the Escambia Bay, and other locations where localized flooding may occur along numerous wetlands, streams, or sinkhole lakes. The real hazard lies in those areas affected by both strong storm surge activity and high flood areas. These areas include virtually the entire area of Garcon Point, the City of Gulf Breeze, and the swamp areas located along the eastern bank of the Escambia River toward the southern outlet into the Escambia Bay. Substantial mitigation efforts including buyouts of property have been ongoing since 1995. However, some residential dwellings remain vulnerable in the county to flooding since they were either not eligible for buyouts or chose not to participate in voluntary FEMA buyout programs.

4.2B Flooding

The Southeast's humid subtropical climate lends itself to very rainy periods (including rains from tropical systems, air mass thunderstorms, and frontal systems). Flooding is a real and a routinely expected event in Santa Rosa County. Erosion along banks and gullying in upland areas is present in the county and can present unique situations in prevention of topsoil loss and property damage. Flooding is considered the more dangerous of these two hazards as it relates to local government efforts to ensure public safety and to reduce the hazards to the community. These two issues, related to rainfall and the humid climate, are analyzed separately below.

4.2B1 General Flooding

(See Appendix 4.2.B. 1. series for maps)

More than any other natural or human-caused catastrophe, flooding has plagued Santa Rosa County's citizens, emergency operations, and mitigation efforts throughout the history of the community. Flooding is the primary emergency concern along the

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Escambia River, Yellow River, Blackwater River and associated tributaries, sloughs, river oxbow lakes, sinkhole/sand hill lakes and isolated swamps (locally called “bays.”).

Serious flooding has occurred in 1915, 1917, 1924, 1929, 1936, 1950, 1953, 1956, 1972, 1975, 1979, 1985, 1994, 1995, and 1998. In 1970, the flood level of the Blackwater River reached 86.11 feet in relation to the National Geodetic Vertical Datum (NGVD); the largest recorded flood elevation in the county. In 1995, Hurricane Opal caused the most recorded devastation to homes, public buildings, and residences near the major rivers in Santa Rosa County; causing nearly $3 billion in property damages. Interstate 10 was closed for a period of time because of damage to the bridges over the Escambia River and Escambia Bay. Hundreds of residents were displaced from homes, only to return to total devastation. Even homes built to the 100-year base flood elevation standards received water.

The Escambia River in western Santa Rosa County is not a major flooding concern for the county since 20.240 acres of the river’s adjacent lands in the County are owned by the Northwest Florida Water Management District (NWFWMD) and serve as a potable watershed protection area for Santa Rosa and neighboring Escambia County. These lands are vacant in perpetuity. In addition, flooding is not a major concern for the immediate area adjacent to the Yellow River in the eastern portion of the county. Similar to the Escambia River, the NWFWMD owns roughly 6,738 acres of adjacent property.

Also impacting Santa Rosa County is flooding in adjacent counties. For example, flooding in neighboring Escambia and Okaloosa Counties causes people to seek temporary shelter in Santa Rosa County. Sometimes, a search and rescue operation for people in these counties requires Santa Rosa County fire departments or other members of support agencies to participate.

Another cause of flooding in the County is urban runoff. The city of Milton experiences the majority of this problem. Development in now filled wetlands in combination with storm water runoff from homes, streets and commercial districts has caused devastation to homes and a few businesses in Milton. Mitigation purchases of properties as well as ditch cleaning efforts have solved some of these problems, but some homes continue to be victims of flooding.

Flooding can also severely impact Santa Rosa County’s road network. Many rural roads are not paved and are therefore highly subject to washout. Culverts and small bridges can sometimes be undermined, causing people to be stranded and isolated until the repairs can be made. Some major roadways used for evacuation are subject to flooding. This can create a scenario of stopping road traffic evacuating from other locations and trapping people in their vehicles in traffic jams. This is a critical issue if this is in combination with an approaching hurricane. Response and recovery resources in the County are usually overwhelmed in times of serious flooding. Out of the 2,207 total miles of State and County roads in Santa Rosa County, 331 miles (15%) are located in the 100-year flood zones and 14 miles (7%) are located in the 500-year flood zone. These

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figures do not count the possible hundreds of informal, undocumented roads located in the more rural areas of the county.

Flooding impacts the agricultural community by ruining crops, hay supplies, and meat production operations. From 2002 to 2008, natural hazards (of which, flooding being a leading culprit) caused over 1.4 billion dollars damage to Florida's crops (http://www.nws.noaa.gov/om/hazstats.shtml). According to the Santa Rosa County Soil Survey, approximately 90,000 acres (14%) of land area in the county is used for agriculture or pasture. Based on this knowledge, there is potential need for mitigation in the agricultural sectors in this county.

Public health is an immediate threat during and following flooding. Raw sewage from septic tanks and overflowing sewage treatment systems creates a high risk for the public and emergency responders. Dead animals can be present. And with the advent of West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE), mosquito infestations are now even more of a concern.

It should be noted that whereas the causes of many of the wastewater system failures were not caused by natural disasters *directly,* they could inevitably be an unfortunate casualty as a result of other system failures. For example, the chart above details that many of the floods and spills of the treatment plants were caused by power outages and failure of the electric grid (See Table 2). The grid failures could be the result of the occurrence of a natural disaster. It should be noted that these figures are *estimates* based upon available data.

Action	Santa Rosa County	Municipalities	Private	Total
Anthropogenic	0	8	1	**9**
Due to power complications	3	8	1	**12**
Other/Unknown cause	12	82	32	**126**
Total by Area	**15**	**98**	**34**	

Table 2: Wastewater Plant Overflow, Santa Rosa Co, 1996-2003. Source Florida Dept of Environmental Protection, 2003

Most importantly, flooding inside or outside of Santa Rosa County impacts the local economy by causing dollars to be spent on relief and reconstruction needs, rather than contributing to savings or long-term financial planning by families and businesses. The public tax base of the county is also harmed during each flood event.

Mitigation efforts in the late 1990's and early 2000's are reducing the numbers of individual homes and businesses subject to flooding. Millions of dollars have been invested by the federal and state governments, not to mention local-government matching funds and in-kind donations, to promote buy-outs and property purchases. As of October 2001, Santa Rosa County experienced $7,375,300 worth of property buyouts under the NFIP program. This figure includes the unincorporated areas of Santa Rosa County, the City of Gulf Breeze, and the City of Milton.

Many homes once in the county's floodplains have been purchased by FEMA dollars and demolished. Properties have become public property owned by the local governments. Building permits are issued strictly in accordance with the requirements of

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the National Flood Insurance Program (NFIP). Purchases of 26,978 acres of land in the County by the Northwest Florida Water Management District and Preservation 2000/Forever Florida programs in the Escambia River/Yellow River drainage basin is also mitigating future damage by having floodplains designated as natural conservation areas in the county's Comprehensive Land Use Plan. The only uses allowed on such lands are recreational in nature. Although the severity of flooding may now be reduced in the county, the potential for disaster continues.

NFIP Flood Insurance Rate Maps will only be available in an online form. The Building Inspections Office is the source of information regarding the Flood Insurance Program They can also be found in the Local Mitigation Strategy Plan latest edition, shows floodplains and flood-prone areas of the county and municipal jurisdictions.

Vulnerability Chart: Flooding/ Storm Surge

Vulnerable Geographic Locations	All geographic locations within Santa Rosa County are vulnerable due to relatively flat topography and a humid subtropical climate. Of the 2,207 miles of State and County roads, 331 miles are within the 100-year flood zone and 14 miles are within the 500-year flood zone not including the hundreds of undocumented rural roads. Floodwaters associated with severe storms, can affect those in low-lying areas, areas of poor-drainage or along bodies of water. See "Flooding" in the Basic CEMP Pg 23 for references to specific Santa Rosa County Flood Insurance Rate Maps. Areas of particular vulnerability and increased risk include, but are not limited to structures along: Escambia River, Yellow River, Blackwater River, local streams, creeks, bays, wetlands, or sinkhole lakes. Others include the City of Milton, near drainage ditches and former wetlands now dredged and filled; the Town of Pace along Escambia River, the lands bordering the Escambia Bay Bridge on I-10, Escambia Bay Bridge along Hwy 90; Garcon Point, the City of Gulf Breeze
Damage Estimates	Damage and loss are in direct relation to the population density and elevation of the impacted area. Please refer to the 2005 Local Mitigation Strategy for structural damage estimates Appendix A, P106-159.
Populations: 0-18yr/ 18-24/ 25-64/ 65+	All populations within the floodplain in Santa Rosa County are vulnerable to injury or structural damage. Certain populations are more vulnerable:

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/	The elderly, handicapped and medically needy are more vulnerable due to mobility issues, medical conditions exacerbated by the storm, and potential reliance on medicines and electricity-dependant machinery. Young children are more vulnerable to the illnesses contaminated floodwaters can bring.
Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists, Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	Non-English Speaking and Hearing-impaired populations are slightly more vulnerable as information such as status of closed/impassible roadways may be delayed. Similarly, Sight-impaired populations may not be able to visually gauge from a distance the status of rising floodwaters and may have difficulty in accessing or breaching rooftop egress etc. Homeless populations are also more vulnerable as situational awareness and ability to take appropriate shelter may be a factor. In addition, they are more likely to encounter floodwaters and less likely to be aware of "isolated" or localized flooding and not have access to appropriate medical care. Tourists are more vulnerable to the impacts of flooding due to their unfamiliarity with roadways and locations of drainage ditches, creeks, and other water features now obscured. Impoverished populations are more vulnerable as they are less likely to have adequate mitigation measures, ability to quickly restore functioning, and mitigative types of insurances (such as for flood damage, lost income, structural repairs, etc).
Group Homes	For flooding, Assisted Living Facilities, Nursing Homes, Schools, Jails/Prisons are vulnerable due to the special needs of the occupants of such facilities, the length of time necessary to take evacuate, the mobility of the occupants, and the potential for electrically-dependant populations within. Additionally, most in group settings must rely on the emergency plans, decisions, and care of others.

Structural	Homes built at-grade within flood-prone areas are more vulnerable than sufficiently raised houses. Structural vulnerability depends on elevation, proximity to bodies of water, capacity of community drainage systems, impediments to water flow, soil saturation, and other factors. Drywall, carpet, wood, and other materials are particularly vulnerable to flood damage. Structural, electrical, plumbing, and flooring systems may be compromised and contribute to the risk of other hazards. Additionally, flooding can cause mold growth on structural components or personal belongings.
Infrastructure	Community infrastructure is vulnerable to disruption/failure. The primary disruption is associated with flooded or undermined roads, clogged drainage systems, power outages, communications failure, flooded/overwhelmed/compromised water treatment facilities, and disruption of services.
Business/Economic Vulnerability	All economic sectors are vulnerable to loss from flooding. Business vulnerability is dependent on the degree of preparedness for continuity of operations, protection of key electrical components, ability to quickly restore functioning, and mitigative types of insurances (such as for flood damage, lost income, structural repairs, etc). Businesses may also be vulnerable to loss of product/facilities, supply disruption, loss of important paperwork, shifting in consumer spending to emergency/replacement needs.
Personal Injury	Typical injuries may result from falling trees/limbs, downed power lines, structural collapses, rising flood waters, vehicle accidents/submersion, drowning, contaminated water-borne illnesses, mosquito-borne illnesses, Mold-induced illnesses, sewerage contamination, animal bites
	Specific vulnerabilities exist for Farm Workers. Floods can destroy crops, equipment, farmhouses, storage bins, and result in personal or economic loss. While most farming operations are dependant on rainfall, flooding rains can damage fragile crops and erode nutrient layers in soil.
Associated Hazards	Associated hazards include: Damaging winds, dangerous lightning, storm produced tornadoes, contamination, storm surge, HAZMAT Releases, gas explosions, structural fires, electrocution from downed wires, drowning, sinkholes, vehicle accidents/submersion, flash-flooding, illness

Vulnerabilty Chart: Flooding/Storm Surge (continued)

4.2B2 Dam Safety

(See Appendix 4.2.B.2. for map)

Although dam safety might be considered a technological hazard, the primary concern is the potential for flooding downstream and down the valley from a dam where flooding might not naturally occur. Thousands of people have lost their lives in dam mishaps in the history of the nation. Although there are no situations where thousands of people could be potentially impacted by the failure of a dam in the county, the potential does exist where one or more homes or businesses (and therefore the people occupying such structures) could be impacted. Therefore, the issue deserves the attention of this plan. This section is considered separate from Section B.1 of this chapter (dealing strictly with natural flood) because of the technological relation to a human-made structure and the regulatory framework in place for dam safety. Dam safety is also considered in the LMS plan in support of the County's, Gulf Breeze's and Milton's Community Rating System programs already in place.

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The Northwest Florida Water Management District is responsible for the permitting, inspection, and revocation of permits for dams in Santa Rosa County that meet certain criteria, per the guidance of Chapters 373.3 14 and 373.3 16 Florida Statutes and Chapters 40A-4 and 40A-44 Florida Administrative Code (FAC). Dams are regulated only as applications are received for new facilities or repairs are made to existing structures. FAC 40A-4 regulates facilities that are used for other than farm purposes, while FAC 40A-44 regulates farm-related facilities.

There are generally two types of dams found in Santa Rosa County. These types include impoundments where water is normally kept behind the structure and structures positioned in gullies to prevent or reduce further erosion during wet periods.

The numbers of dams, their types, and regulating authority under FAC are shown in the table below.

Dam Type	Active Permits	Expired Permits	Permits Exempt	Permits Withdrawn/Void	Permits Denied
Agricultural	56	8	1	3	1
Non-Agricultural	11	0	0	3	0
Total	**67**	**8**	**1**	**6**	**1**

Table 3: Registered Dam Activity in Santa Rosa County as of 2003. Source: Northwest Florida Water Management District, 2003

4.2C Land Erosion

(See Appendix 4.2C for map)

The Gulf Coastal Plain consists of gravels, sands, clays and silts that form the soils of the County. Rock outcrops of ironstone (hardpan) can be found in a few locations, mainly along road cuts in the northeastern portions of the county. Otherwise, soft sediments that prevail can be vulnerable to erosion when topography, vegetation, and the inability to absorb water combine to form energy that weathers away soils.

Sheet erosion, rills, gullies, and alluvial fans are the most commonly observed features of erosion in the County. Most of these features are associated with disturbances in natural vegetation, poor management of agricultural lands, silviculture operations, building construction, and road construction/ maintenance projects. The slightest degree of slope can cause water to flow. As it begins to move, small areas of erosion develop in the unconsolidated soft soils. Such erosion, left unchecked, can damage drainage ditches, fill stormwater retention ponds with sediment, harm sensitive ecosystems, and cause erosion into property, including structures. Most erosion of this nature occurs in the northern two thirds of the County and along unpaved roadways in hilly areas. There is considerable potential for erosion in the cities of Gulf Breeze and Milton, as well.

The Blackwater Soil and Water Conservation District of the Natural Resources Conservation Service (NRCS) has analyzed the potential for erosion in the county for years as a part of its normal duties, in support of the Federal Farm Bill, and the

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Conservation Reserve Program (CRP). Lands susceptible to erosion are identified as a part of these efforts. Table 3 and Figure 3 show the potential for erosion in the county.

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Highly Erodible Soil Types of Santa Rosa County
Shown by soil name and corresponding number of soils depicted in the *Soil Survey of Santa Rosa County Florida* (USDA, May 1980)

Dothan Fine Sandy Loam (10) with slopes of 5 to 8 percent
Esto Loam (12 & 13) with slopes 2 to 8 percent
Fuquay Loamy Sand (15) with slopes 5 to 8 percent
Gullied Land (17)
Lake land Sand (23) with slopes 12 to 30 percent
Lucy Loamy Sand (26) with slopes 5 to 8 percent
Orangeburg Sandy Loan (32) with slopes 5 to 8 percent
Pits (36)
Tifton Sandy Loam (43) with slopes 5 to 8 percent
Troup Loamy Sand (45 & 46) with slopes 5 to 12 percent
Total Acres of Highly Erodible Land: 40,178
Source: Blackwater Soil and Water Conservation District, Sept 2003
Table 3: Erodible Lands in Santa Rosa County. Source: Santa Rosa County Soil Survey, Natural Resource Conservation Service, 1980

Santa Rosa County has a total area of 655,360 acres. As indicated above, out of the total acreage in the county, 6.1% of the area contains soils of a highly erodible nature and 28% of a potentially highly erodible nature. In total, over a third of the county's land area (34.1%) is susceptible to erosive conditions (See Appendix 2).

Professional and consultation services available in the community generally lead to quick elimination or control of erosion in these areas. Most erosion incidents are minor in nature and are corrected with terraces, hay bales, mulch, tilling practices, silt screens, water turnouts, or other features. The NRCS provides professional advice and design services to private property owners on erosion issues. Emphasis is on agriculture, but all property owners in the county and municipalities are eligible for assistance. It should be noted that neither NRCS nor any other professional or consultation service can address erosion issues on private lands unless permission is granted to enter and work on the property.

Potential Highly Erodible Soil Types
Shown by soil name and corresponding number of soils depicted in the *Soil Survey of Santa Rosa County Florida* (USDA, May 1980)

Angie Variant (2)
Dothan Fine Sandy Loam (9) with slopes 2 to 5 percent
Kureb Sand (20) with slopes 0 to 8 percent
Lakeland Sand (22) with slopes 5 to 12 percent
Orangeburg Sandy Loam (31) with slopes 2 to 5 percent
Red Bay Sandy Loam (3(0 with slopes 2 to 5 percent
Tifton Sandy Loan (42) with slopes 2 to 5 percent
Troup Loamy Sand (44) with slopes 0 to 5 percent
Total Acres of Potential Highly Erodible Land: 183,192
Source: Blackwater Soil and Water Conservation District, Sept 2003
Table 4: Erodible Lands in Santa Rosa County. Source: Santa Rosa County Soil Survey, Natural Resource Conservation Service, 1980

NRCS also sponsors the CRP. This program provides federal funding to farmers who remove highly erodible or potentially highly erodible lands from agricultural use and placing it in silviculture uses (which provides natural soil cover through leaf litter)

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reducing erosion potential. One hundred sixteen (116) contracts were active with NRCS under the CRP program as of November 2003.

The Florida Division of Forestry can also assist property owners when dealing with issues of erosion on silviculture lands. Professional engineering services are often used to examine and eliminate erosion issues on public lands.

Control of erosion on municipal or county property is the responsibility of the local government. Oftentimes, stormwater flow from private property is the source of water flow responsible for these erosion problems. Water also begins as runoff from roadways and as seepage where water tables are high and roads cut into these small elevated aquifers. The County and municipalities either employ or retain professional engineers to evaluate, design, and provide solutions and mitigation to such problems. The public works departments are responsible for following guidance of the engineers, as well as best management practices issued to generally reduce environmental consequences of runoff, to eliminate or reduce erosion on public properties, particularly roads and roadside swales and ditches. Santa Rosa County and Gulf Breeze get credits for their engineered mitigation efforts relating to erosion and stormwater control as participants in the Community Rating System of the NFIP.

Stormwater control through planning and design, engineering and management can also eliminate or reduce erosion. This is particularly true within development.

River bank erosion is a natural process that cannot be easily controlled by engineering or design. There are few problems identified in the county or municipalities where eroding riverbanks are causing loss of real property and structures in developed areas. Rivers where bluffs occur include Blackwater, Big Coldwater, Big Juniper, and their tributaries. The lower Blackwater (from near the entrance of Clear Creek westward), the Yellow, Escambia and East Bay River are slower rivers with wide floodplains and little, if any, erosion. Steephead valleys surrounding these rivers, however, may be subject to erosion. All rivers in the county, however, naturally meander. On each river curve, river current energy is primarily found on the outside of the meander, causing a cut in outside banks (thus causing bluffs as the bank erodes). The inside of the meander is a depositional area where sands, gravel and clays are found. There is a potential risk in the county on some rivers where homes could be built in locations where meanders could eventually erode to near or at the foundation.

The most structural solution to riverine erosion is installation of seawalls (which require permits from the Department of Environmental Protection). Site selection for building (away from the outside of cutting banks on rivers) is a way to avoid being in an erosive area. An understanding of river dynamics, proper site planning and construction should eliminate such problems. Many miles of riverfront properties are owned by the State of Florida's Division of Forestry as Blackwater River State Forest or as properties of the Northwest Florida Water Management District. Thus, mitigation through public land acquisition and conservation has occurred along many stream courses and rivers.

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Coastal erosion is caused by marine or estuarine wave action and, to some extent, wind action. Santa Rosa Island at Navarre Beach is subject to the greatest potential for coastal erosion on its Gulf of Mexico beaches. Hurricanes and coastal storms can remove or replace sand from offshore sand bars. Dunes are built by wind action combined with natural vegetation's ability to stop wind blown sand on its leaves and have individual grains drop to the ground. Over time, dunes on the island can reach elevations of twenty feet. When vegetation is removed (by construction, trampling by visitors walking between roads and parking areas to beaches, etc.), cuts in the vegetation lines can lead to blowouts and over wash of the island, causing massive shifts in sand structure and dunes.

Erosion on Santa Rosa Island occurs at a slow, unobservable pace, or rapidly during storms and hurricanes. Such erosion is a natural, daily process of barrier island dynamics.

Problems with beach erosion arise when construction of infrastructure and buildings do not take into consideration these dynamics. Mitigation techniques have been developed by the federal, state and local governments to reduce or eliminate the potential for unnatural erosion. Re-vegetation and fencing to form dunes, lines that prohibit construction seaward of the primary dunes (Coastal Construction Control Line), dune crossovers to eliminate dune trampling, and in some cases dredging and beach renourishment have been used.

Figure 3 - Hurricane Opal's 1995 storm surge and wave height of fourteen to twenty feet washed away roadways and buried them in sand. Notice road washout and sand coverage caused by storm surge and wave action erosion. Photo is of U.S. Highway 98 looking westbound towards Fort Walton Beach in Okaloosa County

Navarre Beach was greatly impacted with erosion by Hurricane Opal in 1995. Gulf water moved thousands of tons of sand over roadways, sidewalks and yards. Additional evaluation will be made in Chapter B.3 below on Storm Surge.

Coastal erosion also affects mainland portions of the county and City of Gulf Breeze. The Fairpoint Peninsula, on which Navarre, Holley-By-The-Sea, Midway, and Gulf Breeze are located, is an ancient coastal structure that once served as the primary beach before the formation of Santa Rosa Island at the conclusion of the Wisconsin Ice Age some 18,000 years ago. Fairpoint Peninsula is surrounded by Santa Rosa Sound on the south, and Pensacola and East Bays on the north.

The peninsula is made up of ancient dunes where soil formation has occurred. Marine erosion processes from daily wave and wind action to major storms and hurricanes have eroded back some of the land. Additionally,

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wave action from boats, personal watercraft, and barges along the Gulf Intracoastal Waterway can add energy to waves through wakes, accelerating erosion.

Exposed light orange/brown bluffs of 10 to 25 feet elevation are visible on the peninsula in some areas. Some of these sandy bluffs can be seen in the Naval Live Oaks Area of Gulf Islands National Seashore in Gulf Breeze. Construction on top of such bluffs is a risk. In some places in Gulf Breeze, construction has occurred and efforts must be made by property owners or through coordinated efforts with the state to shore up eroding locations (Deadman's Island is an example).

Along the Fairpoint Peninsula, portions of Garcon Point and along the east bay of Blackwater Bay near Ward Basin Road, seawalls are often used to elevate property and to eliminate erosion along the shorelines. Seawalls require a state permit to be constructed and must meet standards that protect the environment while serving a structural purpose. Seawalls can be used to fill wetlands in some instances. On the other hand, they can be used to shore up otherwise eroding properties in hazard areas along coastal locations and are recognized as a mitigation technique when used properly with considerations made for natural environments.

VULNERABILITY CHART: LAND EROSION/EXPANSIVE SOILS

Vulnerable Geographic Locations	34.1 % of soils in Santa Rosa are considered highly (39,977 acres) or potentially (18,350 acres) Erodable soils. 1.6% of the soils in the County are considered vulnerable to expansion. Land Erosion such as Sheet erosion, rills, gullies, and alluvial fans occurs in the northern two thirds of the County and along unpaved roadways in hilly areas. Potential also exists for erosion in the cities of Gulf Breeze and Milton. River erosion is found where bluffs occur. Areas can include rivers such as Blackwater, Big Coldwater, Big Juniper, and their tributaries. The lower Blackwater (from near the entrance of Clear Creek westward), the Yellow, Escambia, and East Bay River are slower rivers with wide floodplains and little, if any, erosion. Steephead valleys surrounding these rivers, however, may be subject to erosion. Santa Rosa Island is vulnerable to Coastal erosion, particularly at Gulf Breeze and Navarre Beach.
Damage Estimates	Varies depending on magnitude off erosion, mitigation efforts in place, and type and number of structures involved; Sudden erosive forces such as with hurricanes and storm surge can cost greater that 5 million dollars.
Populations: 0-18yr/ 18-24/ 25-64/ 65+ / Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists, Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	All populations are vulnerable to effects of erosion; Special populations may be more vulnerable to the associated hazards that may occur as a result of erosion. Such may include medically needy, handicapped, visually impaired due to physical mobility or impediments to situational awareness, particularly with collapse, ruptured gas lines, or flooding.
Personal Injury	Structural or earthen collapse, subsequent explosions/fires

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VULNERABILITY CHART: LAND EROSION/EXPANSIVE SOILS (Continued)

Group Homes	Same as general population
Structural	Structures along waterfront including bulkheads and seawalls are vulnerable to erosion associated with hurricanes and storm surge. Structures with storm water-induced erosion can trace the problem to development design problems related to construction of the structure itself, or to overall storm water management in a neighborhood or area. Structures built along the Gulf of Mexico are most vulnerable.
Infrastructure	Erosion can undermine structures or roadways and fill drainage systems, natural creeks, and water bodies with sediment. It can also undermine drainage pipes and water mains.
Business/Economic Vulnerability	Vulnerability of businesses exists to the extent that the facilities of such establishments may be located in erosion/expansion vulnerable areas.
Associated Hazards	Associated hazards include: broken gas lines, or water mains, road/ bridge collapse, vehicle accidents, structural collapse or undermining, sedimentation, increased flooding

4.2C1 Sinkholes

The Florida Geological Survey of the Department of Environmental Protection (DEP) indicates in its "Sinkhole Type, Development and Distribution in Florida" map and description indicates Santa Rosa County in its entirety is located in an area where sinkholes seldom, if ever occur. DEP's statewide sinkhole database indicates no sinkholes in the county. Since there is no history of this hazard in the county, no further analysis or risk assessment will be conducted for this plan.

4.2C2 Expansive Soils

According to the *Soil Survey of Santa Rosa County Florida* (USDA May 1980), two types of soils in the county are considered vulnerable to expansion. One is an upland soil type found near rivers, while the other is a tidal/salt marsh soil type that is seldom, if ever, built upon. These soils are known as shrinking and swelling or "expansive soils." Another way of describing expansive soils is the change of volume of a soil with a change of moisture content.

The following table lists soils having moderate to high shrink swell potential in Santa Rosa County. Only those soils with an associated risk of "High" are listed:

Soil Series	Shrink-Swell Potential	Total Acreage in County	Percentage of total soils in County
Angie Variant Loam	High	1,775	0.3%
Bohicket	High	8,500	1.3%

Table 5: Expansive Soils in Santa Rosa County. Source: Soil Survey of Santa Rosa County, Florida; May 1980; Table #14.

Angie Variant Loams are well-drained, nearly level soils primarily on broad flats between streams and along drainage ways. They are generally found in natural vegetative state in the northern sections of the county. Problems are generally

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encountered when constructing roads on these soils (additional fill and compacting overcome these limitations).

Bohicket soils are poorly drained soils in tidal marshes at the mouths of major streams and rivers. They are flooded daily by tidal water. There is little potential in these soils for urban development or infrastructure due to the frequent flooding. Most acreage of this soil type is owned by public agencies as preserves or is restricted from development due to wetland regulations.

The hazards listed below have been analyzed to determine that impact would be minimal or non-existent.

4.2D Severe Storms

The Severe Storms segment of the LMS Hazards Assessment will include thunderstorms, (including hail, lightning, and high winds) (exclusive of tornado and hurricane which are covered in other sections of this chapter), winter weather, and heat and drought collectively.

4.2D1 Tornado & Waterspout

Tornadoes and waterspouts are small-scale weather phenomena as a vortex of rising air. Tornadoes occur over land, and waterspouts occur over water.

The Fujita Scale is the basis of measurement of the strength of tornadoes. Nationwide, 76% of all tornadoes are F0 or F1 weak intensity and account for 4% of total deaths. Twenty five percent are F2 or F3 strong tornadoes, accounting for 29% of total nationwide tornado deaths. Finally, 1% are F 5 violent tornadoes and account for 67% of all tornado deaths nationwide.

From 1980 to 1999, the National Severe Storms Center has calculated Santa Rosa County as having about 0.8 to 1.0 tornado days each year. This is the average number of days that tornadoes occur on over the course of one year. By comparison, portions of the Great Plains have 1.6 to 2.0 tornado days each year.

The following table provides a reference to the number of documented tornadoes in Santa Rosa County (1955 – 1995):

Date	Time	Dead	Injured	Fujita Scale
April 30, 1963	0630	0	0	F2
Dec 1967	0700	0	0	F2
Jan 15, 1971	1105	0	0	F0
Jan 12, 1975	1015	0	12	F1
Sept 23, 1975	0830	0	0	F1
Mar 21, 1976	0620	0	0	F0
Oct 31, 1985	1030	0	0	F0
Nov 17, 1987	0402	0	0	F1
Nov 08, 1989	0430	0	0	F0

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Dec 12, 1989	1015	0	0	F1
Jan 23, 1992	0110	0	0	F0
Apr 26, 1993	0530	0	0	F1
Jun 25, 1994	0730	0	0	F0
Nov 11, 1995	0932	0	0	F1
Mar 16, 2001	0345	1	11	F2
Oct 13, 2001	1540	0	0	F1
Nov 5, 2002	1510	0	0	F0
Dec 24, 2002	1725	0	0	F0
Sep 15, 2004	1400	0	0	F0
Nov 24, 2004	0855	0	0	F1
Jun 11, 2005	1310	0	0	F0
Aug 29, 2005	0605	0	0	F0
Aug 29, 2005	0747	0	0	F0
Sep26, 2005	1230	0	0	F0
Sep 26, 2005	1421	0	0	F0
Sep 26, 2005	1505	0	0	F0
Jan 13, 2006	1056	0	0	F1
Mar 1, 2007	Unk	0	0	F0
Feb 17, 2008	1214	0	0	F1
Sep 1, 2008	0755	0	0	F0
Sep 1, 2008	0900	0	0	F0

Table 7: Tornado touchdowns in Santa Rosa County. Source: Tornado Project Online http://www.tornadoproject.com/index.html

The greatest likelihood of tornado occurrence is during April and May. The greatest likelihood of an F2 or greater is in April (See Figure 4). (Source: National Severe Storms Laboratory).

Figure 4 - Probability of a tornado in North America. Santa Rosa County's greatest probability for any tornado is in April and May of each year. The color depicted for the Santa Rosa County area on this maps shows Julian days 121-136 and the most vulnerable (May). Source: National Severe Storms Laboratory.

Because of the unpredictable patterns of tornadoes, and because the entire state, including Santa Rosa County, has a relatively high reoccurrence frequency, the entire County is vulnerable to tornado damage.

The damage potential for a tornado increases as a function of population density. As the number of structures and people increase, the potential damage/injury rate increases. Manufactured housing, poorly constructed or substandard housing or apartment

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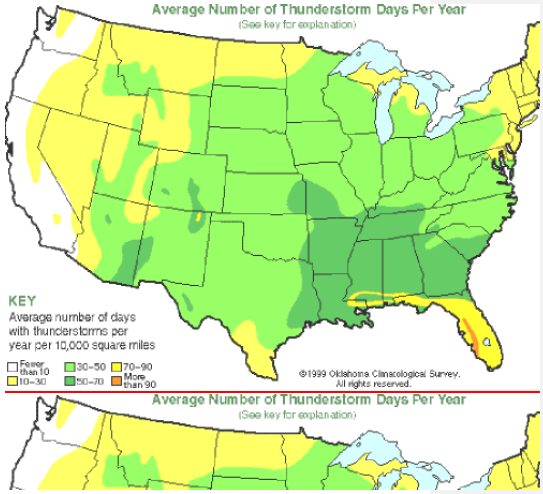
complexes are especially susceptible to damage from a tornado. Manufactured housing and substandard housing are exceptionally susceptible because of their lack of resistance to high winds, and apartment complexes and low rent projects because of their size and densities.

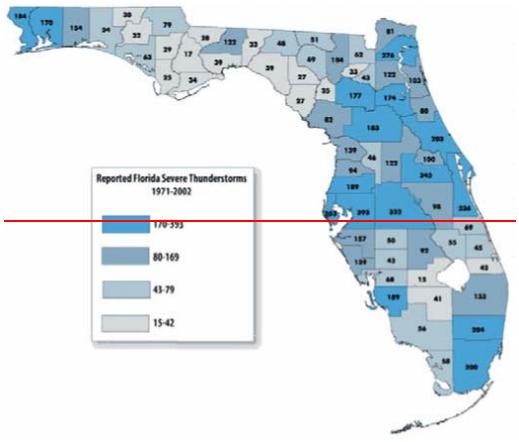
The most common and active weather threat in Santa Rosa County for the formation of tornadoes is severe thunderstorms associated with frontal boundaries. Frontal boundaries and summertime afternoon air mass thunderstorms can reach severe limits because of atmospheric uplift. Lightning is the most severe threat to the public. High winds relating to gust fronts and microbursts can create high wind speeds up to 100 MPH. Both buildings and highway traffic are vulnerable to these storms.

4.2D2 Thunderstorms and Lightning

The National Severe Storms Laboratory of the National Weather Service classifies a thunderstorm as severe when it contains one or more of the following phenomena:

- Hail 3/4" or greater
- Winds gusting in excess of 50 knots (57.5 mph)
- A tornado





~~**Figure 6** – One hundred and seventy severe thunderstorms were reported in Santa Rosa County from 1959 to 2002. This number is probably low due to the low number of persons per square mile in the county that could report such severe weather before the advent of NEXRAD systems up until the 1990's, consistent with the figures of other small population/rural counties in the state. Source: National Weather Service.~~

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Santa Rosa County has 70 to 90 thunderstorm days each year. Consistent with averages from around the State of Florida, this is some of the highest frequency in the nation. The vast majority of these days are from May to September. However, thunderstorms may occur during any month of the year.

Aside from being able to produce tornadoes, thunderstorms can cause damage with high winds (see Figure 5). These winds are usually caused by cold upper level air descending from the top of a thunderstorm to the ground. If the speed of decent is rapid, these cold "microbursts" can fan out as they come in contact with the ground at a high rate of speed. This is sometimes referred to as "straight line winds." These winds can cause significant property damage, injuries, and deaths similar to a F0 to F2 tornado or Category 1 or 2 hurricanes.

Florida leads the nation in lightning strikes per year (closely correlating with the number of thunderstorm days per year). In addition, Florida also leads the nation in lightning

fatalities with 9 recorded deaths in 2002. Santa Rosa County is estimated to have 4 to 8 flashes per square kilometer per year throughout the county, based upon data from 1996 to 2000 (source: U.S. Lightning Detection Network). This ranks as typical for Florida and the Southeast, but well above the average for the nation as a whole. Most thunderstorms in the County occur due to air mass heating during hot summer days. Additionally passage of cold fronts in the autumn, winter and spring can trigger lines of thunderstorms.

The primary risk to the county and its residents in thunderstorms is traffic accidents on wet roads and some flash flooding of prone areas, followed by lightning damage to electronics and structures, strikes on people, and wind and hail damage. Mitigation against thunderstorms is best accomplished by staying indoors in a well build structure or inside of a motor vehicle with a metal frame and body. Most people injured or killed by thunderstorms or lightning are outdoors, not inside. Electronic equipment and data loss prevention is best accomplished with surge protection devices, proper grounding, unplugging, or other electrical safety systems. Animal and crop losses due to thunderstorms, lightning and hail are more difficult to mitigate against. Cattle and horses are

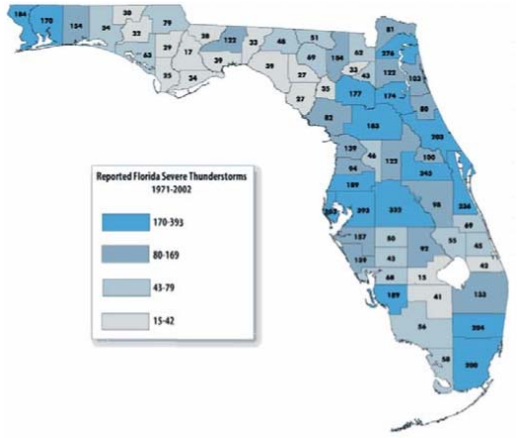

Figure 6 – One hundred and seventy severe thunderstorms were reported in Santa Rosa County from 1959 to 2002. This number is probably low due to the low number of persons per square mile in the county that could report such severe weather before the advent of NEXRAD systems up until the 1990s, consistent with the figures of other small population/rural counties in the state. Source: National Weather Service.

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sometimes killed while seeking shelter under trees (the very place lightning may strike in fields). Hail can devastate crops, although most hail in the area is fortunately pea sized and falls for a short duration. Mitigation for livestock and crops is generally handled through financial reimbursement with farm or commodity insurance.

VULNERABILITY CHART: THUNDERSTORMS/LIGHTNING/TORNADOES

Geographic Locations	All geographic locations within Santa Rosa County are vulnerable, including the coastline where tornadoes over water or "waterspouts" are possible. Rising floodwaters associated with severe storms, can affect those in low-lying areas, areas of poor-drainage or along bodies of water.
Damage Estimates	Damage and loss are in direct relation to the population density of the impacted area. Please refer to the 2005 Local Mitigation Strategy for structural damage estimates. See LMS Plan Appendix A-P78.

~~Populations: 0-18yr/ 18-24/ 25-64/ 65+ / Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished~~	~~All populations in Santa Rosa County are vulnerable to injury or structural damage, however certain populations are more vulnerable:~~
	~~The elderly, handicapped and medically needy are more vulnerable due to mobility issues, medical conditions exacerbated by the storm, and potential reliance on medicines and electricity-dependant machinery.~~ ~~Hearing and sight-impaired populations are more vulnerable as urgent public information or situational awareness may be impeded due to the nature of their disability. Hearing-impairments may also create vulnerability due to the inability to recognize the typical sounds associated with an approaching tornado. Homeless populations are also more vulnerable as situational awareness and ability to take/find appropriate shelter may be a factor.~~ ~~Impoverished populations are more vulnerable to the damage caused by severe thunderstorms and tornadoes, as monies necessary to relocate or repair may not be available.~~
~~Personal Injury~~	~~Typical injuries may result from: Vehicle accidents, wind-blown debris, falling limbs, lightning strikes, downed power lines, structural collapse, rising flood waters, mold-induced illnesses, contaminated waters~~

VULNERABILITY CHART: THUNDERSTORMS/LIGHTNING/TORNADOES (continued)

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Populations: 0-18yr/ 18-24/ 25-64/ 65+ / Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	All populations in Santa Rosa County are vulnerable to injury or structural damage, however certain populations are more vulnerable: The elderly, handicapped and medically needy are more vulnerable due to mobility issues, medical conditions exacerbated by the storm, and potential reliance on medicines and electricity-dependant machinery. Hearing and sight-impaired populations are more vulnerable as urgent public information or situational awareness may be impeded due to the nature of their disability. Hearing-impairments may also create vulnerability due to the inability to recognize the typical sounds associated with an approaching tornado. Homeless populations are also more vulnerable as situational awareness and ability to take/find appropriate shelter may be a factor. Impoverished populations are more vulnerable to the damage caused by severe thunderstorms and tornadoes, as monies necessary to relocate or repair may not be available.

Personal Injury	Typical injuries may result from: Vehicle accidents, wind-blown debris, falling limbs, lightning strikes, downed power lines, structural collapse, rising flood waters, mold-induced illnesses, contaminated waters
Group Homes	For tornadoes, Assisted Living Facilities, Nursing Homes, Schools, Jails/Prisons are vulnerable due to the special needs of the occupants of such facilities, the length of time necessary to take immediate shelter (for approaching tornadoes), and the potential for electrically-dependant populations within. Additionally, most in group settings must rely on the emergency plans, decisions, and care of others.
Structural	All structures are vulnerable to severe thunderstorms/lightning/tornado damage. Thunderstorms can result in water damage via localized flooding or through wind-driven water entering older or compromised roof systems. Structural vulnerability lies in the inability to withstand the cyclonic action of the winds. Manufactured housing, poorly constructed or substandard housing are particularly vulnerable due to their lack of resistance to even smaller intensity tornadoes. Substandard housing can create projectiles, which can compromise well-built structures.
Infrastructure	Community infrastructure is vulnerable to disruption/failure. The primary disruption is associated with power outages. Other possibilities include: Flooded, undermined or impassable roads, clogged drainage systems, communications failure, flooded/overwhelmed/powerless water treatment facilities
Business/Economic Vulnerability	For severe thunderstorms/tornadoes, economic sectors dependant on computers, power, or fair weather are vulnerable to disruption and loss. Business vulnerability is dependant on the degree of preparedness for continuity of operations, protection of key electrical components, ability to quickly restore functioning, and mitigative types of insurances (such as for flood damage, lost income, structural repairs etc). Businesses may also be vulnerable to loss of product/facilities, supply disruption, loss of important paperwork, shifting of consumer spending to emergency/replacement needs. Storms with widespread damage have the potential to disrupt the local economy. Specific vulnerabilities exist for Farm Workers whose farmlands offer little resistance to tornadoes, which can destroy equipment, farmhouses, storage bins, and result in personal or economic loss. While most farming operations are dependent on rainfall, thunderstorms with high winds, forceful downpours, and flooding rains can damage fragile crops.
Associated Hazards	Associated hazards include: Damaging winds, dangerous lightning, storm produced tornadoes, flooding, contamination, storm surge, HAZMAT Releases, gas explosions, structural fires, electrocution from downed wires, drowning, sinkholes, vehicle accidents

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4.2D3 Winter Storms

Winter weather in Santa Rosa County can include snow, ice, sleet (freezing rain), hard freeze temperatures, and frost. The most common winter event is frost, followed by hard freeze.

Freezes occur most every winter, with the average winter minimum low occurring near January 20 with a temperature of 20° F. (-6.6° C.). Generally, the second night following the passage of a strong cold front is the coldest night when skies are clear and humidity is lowest. Most low temperatures involving freezes occur at night and in the hours near dawn. In most instances, temperatures even on the coldest winter days rise above freezing during daylight hours. Such freezes are climatologically expected in this region of Florida.

A freeze's greatest risk is generally unprotected or under-protected water pipes in homes, businesses and infrastructure. Outdoor irrigation systems and plumbing in homes where insulation is inadequate in walls or in off-grade homes are most vulnerable. Unmitigated older structures are probably the most vulnerable structures, with manufactured housing (due to its off-grade construction and placement technique) is also vulnerable. Mitigation occurs when individuals take actions during construction or for a freeze to protect pipes with wrapping forming a layer of insulation, and/or keeping water moving through pipes by leaving a faucet on.

Home and business heating is accomplished locally with electricity, natural gas, or propane appliances. A few individuals may use other methods, such as kerosene heaters or wood fireplaces or stoves. Temperatures lower than 15° F. (-9.4° C.) for an extended period would likely cause County Emergency Management to open a shelter for those who had inadequate heating of their homes.

Since tropical or subtropical crops are generally not grown in northern and western Florida in the winter freeze season, agricultural damage so often associated with winter freezes in the state are all but absent in Santa Rosa County. Ill or old animals, or unprotected animals exposed to a night of freezing wind, are most vulnerable. During a very severe freeze, some ornamental plants may receive damage, and some poultry operations may experience difficulties keeping fowl warm in brooder houses in the county. Mitigation is generally accomplished through farm heating units and allowing animals to enter barns or shelters.

Icing, glaze, and sleet are rare but real possibilities in the county. A large ice storm affected portions of North Florida in the 1980's in the Lake City to Wildwood corridor of I-75 about 300 miles east of Santa Rosa County with devastating results on traffic flow. Some five inches of ice accumulated on I-75. The State of Florida had no means of ice removal in such a situation, and mutual aid resources from neighboring states were needed. A similar incident in Santa Rosa County would likely cause total paralysis of the community and its roadways, including I-10. With no means of salting roadways or

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removing ice, emergency response would be severely slowed in iced areas. Electrical service would likely be interrupted or totally absent in many areas due to power line glazing and tree branch falls. The possibility of need for shelter would be great in order to keep people warm and safe. Mitigation efforts would more likely focus on sheltering and ability to receive outside mutual aid assistance, rather than on equipment and ice buildup prevention due to the infrequency and inconsistency of such events.

Snow in Santa Rosa County is considered a very rare and exciting event. Neighborhoods come to life with children playing outdoors when it snows. A single snow "event" over five or ten years is probably the average. A few big wet flakes and a dusting on the ground on a Christmas Eve (as occurred in 1988) was an occasion worth celebrating and remembering for young and old across West Florida! During the past fifty years, there have been approximately twenty-five events of "trace amounts" of snow, and about four measurable snowfall events of up to four inches of accumulation. The March 10, 1993 "Super storm" provided one of the heaviest snowfalls on record for the area (4 inches). Snow generally will melt off in about six to eight hours; if indeed it takes that long (more often melting occurs in minutes). Such an event will cause schools to close. Snow generally accumulates on natural surfaces, while roadways remain open, albeit slippery on some bridges. Generally, the risk of snow and the chances or needs for mitigation of snow events are virtually zero in the county.

VULNERABILITY CHART: WINTER STORMS (ICE STORMS, SNOW, SLEET, HARD FREEZE)

Vulnerable Geographic Locations	ALL-particularly communities not located directly on the Gulf of Mexico
Damage Estimates	Varies depending on magnitude; Severe Ice storms can rival costs associated with hurricanes; See the 2010~~05~~-2015~~0~~ Local Mitigation Strategy. See Appendix A P78 for Hail and Pgs 3-64 for Hurricanes.
Populations: 0-18yr/ 18-24/ 25-64/ 65+ /	All populations are vulnerable to effects of winter storms, particularly compounded due to potential utility loss at a critical time when heating is needed. Those without access to portable heaters and generators are more vulnerable.
Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists, Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	Special populations may also be more vulnerable to winter storms. Vulnerability exists for those who are particularly susceptible to cold weather (children, elderly, homeless), unable to afford available heating (impoverished) or reliant on electricity for life-sustaining medical equipment (medically-needy). Additional populations are vulnerable such as those with hearing or visual impairments, as situational awareness of associated hazards may be impeded.
Personal Injury	Typical injuries may result from: slippery surfaces, falling limbs, downed power lines, structural collapse, vehicle accidents, freezing, frostbite, hypothermia, lack of food/water/medical treatment/medicines, limited access to emergency services.
Group Homes	Assisted Living Facilities, Nursing Homes, Schools, Jails/Prisons are vulnerable due to the special needs of such facilities, the transportation requirements of such a facility, large-scale heating needs and the staffing required to support group facilities. Additionally, most in group settings must rely on the emergency plans, decisions, and care of others.
Structural	All structures are vulnerable to winter storm damage. In general, structures are the most vulnerable to tree damage; hail, burst or uprooted water pipes and gas lines. Additionally elevated structures are more vulnerable to the bursting of water pipes associated with freezing temperatures.
Infrastructure	Power and communication systems using overhead lines are usually the hardest hit by ice storms. Additionally gas and water lines are vulnerable to tree damage and extreme temperatures. Roads and bridges may be impassible due to storm debris, or icing.

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Business/Economic Vulnerability	Economic sectors such as utilities, government, construction, agriculture, and other outdoor related sectors are vulnerable to the impact of winter storms; in the case of severe ice storm scenarios, all employment sectors could be affected. Businesses are vulnerable to loss of production, supply disruption, displaced workers, shifting of consumer spending to emergency/replacement needs. All affect the economy of Santa Rosa County. Specific vulnerabilities exist for Farm Workers whose crops may be devastated by extreme temperatures.
Associated Hazards	Associated hazards include: lack of heating, hail, falling trees, communication system and/or power outage, broken gas lines, or water mains, iced roads/bridges, vehicle accidents, structural collapse

4.2D4 Heat Waves and Drought

Heat waves usually occur over five to ten continuous days along the northern Gulf Coastal region and West Florida. The Gulf of Mexico's presence tends to moderate temperatures and form coastal thunderstorms, reducing heat levels and providing coastal sea breeze front rains.

Droughts are more frequent and cyclical in the area. Seasonal climatological droughts occur in April and October. Despite the assumption that the southern portion of Florida receives the highest temperatures due to sheer geography, the highest recorded heat waves have occurred in the Florida Panhandle. To date, the highest recorded temperature in Florida was set in the Town of Monticello at a searing 109 degrees Fahrenheit (See Figure 6). Whereas this record was not set in Santa Rosa County specifically, it should be noted that this temperature was recorded only 180 miles away.

When heat waves occur, large high-pressure systems generally become entrenched over the Southeastern states. Once stagnation occurs and weather systems do not move away, heat can build up in the summer months and cause temperatures to climb into the upper 90° F. range (35° C.) or above. The general threat to the community is to agricultural crops, livestock, poultry, and individuals without adequate cooling systems in their homes, with emphasis on low income and the elderly. Electrical system failures due to demand would only enhance problems for all of these industries and populations. Mitigation efforts might focus on evaluation of

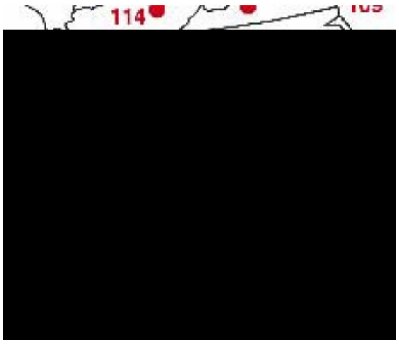

Figure 7: Highest Recorded Temperature in Florida. Source: NCDC, http://lwf.ncdc.noaa.gov/img/climate/severeweather/sa-thigh.gif

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vulnerability, providing adequate shelters for people, and maintaining mutual aid agreements to ensure a supply of generators for electrical purposes at critical facilities or agricultural facilities.

Drought has impacted the county in a number of ways. Bay swamps saw a decline in the levels of natural water levels to near 15 feet below normal water lines during the four-year drought from 1999 to 2002. Agricultural losses occurred, primarily with summer crops. Demand on local municipal and private water supply systems to the public caused some generators and pumps to fail at critical moments, creating low or no pressure for critical facilities such as fire hydrants and medical centers. Although mitigation cannot bring about rainfall, reliance on groundwater sources can create harsh conditions for water pumps and generators, especially older models. A need for upgrade of such facilities may exist.

Firefighting increases as drought deepens. Since the county is mostly rural and open and forested lands are a prominent part of the landscape, the ability to obtain water from fire hydrants or "dry hydrants" (essentially wells and piping connected to the underlying Floridian Aquifer or surface lakes or ponds to allow for rapid pumping of water by fire trucks) is an important means of combating fire during drought. (A more thorough analysis of fire hazards is provided in Section 4.2.F of this chapter.)

VULNERABILITY CHART: HEAT WAVE/DROUGHT

Vulnerable Geographic Locations	ALL
Damage Estimates	Varies depending on magnitude; could jeopardize Santa Rosa County's $20,000,000 + agricultural production in addition to electrical, municipal and water supply expenses.
Populations: 0-18yr/ 18-24/ 25-64/ 65+ / Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists, Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	All populations are vulnerable to effects of heat wave/drought. Special populations may also be more vulnerable to heat wave/drought. Outdoor workers, Elderly persons, small children, invalid, homeless, those on certain medications or drugs (especially tranquilizers and anticholinergics), and persons with weight and alcohol problems are particularly susceptible to heat reactions. Additionally, impoverished individuals are more vulnerable as they may reduce or eliminate the use of A/C systems due to rising cooling costs.
Personal Injury	Typical injuries: sunburn, heat cramps, heat exhaustion, heat stroke, dehydration, fatigue, death
Group Homes	Assisted Living Facilities, Nursing Homes, Schools, are more vulnerable due to the population they accommodate being more susceptible to the effects of heat.
Structural	Structures may be vulnerable to structural expansion, soil erosion, soil contraction, and fires.
Infrastructure	Power lines are vulnerable to heat wave, as they sag more than normal when heated and can contact nearby trees, taking the line out of service, and shifting load to other lines. Vulnerability also lies in the increased demand and reliability of the transmission.

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	Drought-induced water shortages may result as water sources declines and demands for personal consumption and firefighting increase.
Business/Economic Vulnerability	Drought/Heat wave can cause crop failure, wildfires, energy shortages, municipal water shortages, higher energy prices, and fish and wildlife mortality, and, therefore, affects many sectors of the economy—particularly agricultural, energy, and tourism, as well as municipalities, government.
Associated Hazards	Associated hazards include: heat wave trapped air pollutants, concentrated levels of chemicals and bacteria in water supply, wildfires, energy shortages, water shortages, flash flood, wind erosion

4.2E Wildfire

(See Appendix 4.2.E. series for maps)

With probably 85% to 90% of the land in the county vacant, and with a most locations outside of floodplains and swamplands consisting of natural vegetation historically related to the Longleaf Pine/scrub oak forests of the Southeast (a fire dependent ecology), Santa Rosa County is vulnerable to wildfire.

Natural fires can be caused primarily from lightning. More often, human-induced fires are the likely cause. This includes intentional fire (arson) or accidental causes (escaping trash fires, cigarettes, sparks from passing railcars, motor vehicle fires on roadsides that spread to woodlands, or house fires that expand to wildlands).

During droughts, wildfire is a significant concern to a number of residential areas and even whole communities. Soils and plant communities contribute greatly to the potential for a fire in the Garcon Point part of the county, but fires may occur at practically any location. Although not the only identifying characteristic to identify wildfire-vulnerable areas, those locations with a high density of pine trees.

Vacant fields, woodlands, lots and acreage connect communities to the rural/urban interface. This could allow fires to come into subdivisions and neighborhoods in urban and suburban areas… a potentially catastrophic situation. Land use in the county is often focused on timber plantations. There is substantial acreage of forest grown for pulpwood and timber production. Prescribed burning alleviates the potential for wildfire in much of the county. It is of agricultural importance to purposely burn (in a controlled manner) understory and fuel on the ground to reduce the potential of a fire going out of control.

Currently, the Florida Department of Forestry is currently supporting a large state-wide wildfire risk assessment using new spatial technologies. These technologies enable forest managers to observe and plan for reducing wildfire risk to consistent encroachment of urban areas to forestlands. Specifically, the Division of Forestry is developing FRAS (Fire Risk Assessment Application), a GIS-based interface software package that will used to assess wildfire hazard in proportion to a host of terrestrial, man-made phenomenon. The official goals of the program include:

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1. To identify and define individual elements which compose wildfire risk and hazard in the State of Florida.
2. Map statewide fuel sources.
3. To model and map "Levels of Concern" (LOC). Meaning: areas where significant areas of fuel reduction work must involve cooperative efforts between State, public, and private landowners.
4. Allow for location sensitivity analysis for the identified LOC's in order to make changes to input variables
5. Facilitate the updating of the model for changes in evolving land uses and change in fuel characteristics.

VULNERABILITY CHART: FIRE

Vulnerable Geographic Locations	All geographic locations are vulnerable to fires. At particular risk are those structures and agricultural operations along the rural/urban interface. Vacant fields, woodlands, lots, and acreage connect communities to the rural/urban interface. This could allow fires to come into subdivisions and neighborhoods in urban and suburban areas.
Damage Estimates	See Santa Rosa County LMS for damage estimates (Section 5 page 53)

VULNERABILITY CHART: FIRE (Continued)

Populations: 0-18yr/ 18-24/ 25-64/ 65+ / Medically-Needy, Handicapped, Homeless, Transient, Transportation Disadvantaged, Tourists, Non-English Speaking, Hearing-Impaired, Visually-Impaired, Impoverished	The entire population is vulnerable to the effects of fire. Vulnerability to structure fires may be increased for the elderly, young children, or those with physical handicaps. Additionally the impoverished, may be more apt to live in conditions favorable for fires, and are subsequently more vulnerable to fires. The elderly, young children, and those with existing respiratory ailments may be more vulnerable to respiratory distress caused by smoke from wildfires.
Personal Injury	Typical injuries include: smoke inhalation, toxic inhalation, burns, respiratory distress, structural collapse, trauma, death
Group Homes	Nursing home facilities near the rural-urban interface may be more vulnerable to fires. The vulnerability of elderly populations is stated above.
Structural	All structures are vulnerable to fire, however vulnerability is increased for those with older or faulty electrical systems, those that lack or have inadequate smoke detectors or alarms, those without interior sprinkler systems, wood structures, etc
Infrastructure	Infrastructure is vulnerable to fires, as transportation routes may be blocked during the response to wildfires, critical facilities along the urban rural interface may be more vulnerable to the direct effect of fire, or to associated hazards.
Business/Economic Vulnerability	Each employment sector is potentially vulnerable to fire. Such precautions as fire escape plans, smoke detectors/alarms, sprinkler systems, continuity of operations planning, insurance, and contingency planning for the protection of critical records, helps to reduce the vulnerability associated with a potential fire.
Associated Hazards	Associated hazards include: explosions, hazardous materials incidents, vehicle accidents, mass exodus, evacuations, illness.

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4.2F Other Hazards

1. Earthquake

Although the U.S. Geological Survey National Seismic Hazard Mapping Project (1996) indicates there is a 1 .5%g peak acceleration rate for earthquake hazard (this is considered very minimal risk), there have been a series of small seismic events within 75 miles of northern Santa Rosa County that deserve analysis in this plan in order to justify it as a "non-impact" or "virtually no impact" risk. The table below shows a record of seismic activity in the area.

Date	Co/State	Epicenter	Lat	Long	Depth in km	Magnitude (Richter)	Felt at or located at
6/13/1929	Mobile, AL	Mobile	30.7	88			
12/10/1974	Escambia, AL	Huxford	32.35	87.47			
1/6/1984	Clarke, AL	Jackson	31.61	87.65		3.0	Jackson & Walker Springs
5/4/1997	Escambia, AL	Atmore	31	87.4	5	3.1	Brewton & Flomaton
	Co/State	Epicenter	Lat	Long	Depth in km	Magnitude (Richter)	Felt at or located at
10/24/1997	Escambia, AL	Little Rock	31.2	87.3	shallow	4.9	Within 10 miles of Jay
10/26/1997	Escambia, AL	Little Rock	31.1	87.3	10	3.7	Within 10 miles of Jay
10/28/1997	Escambia, AL	Little Rock	31.1	87.3	10	3.0	Within 10 miles of Jay
1/26/1998	Escambia, AL	Little Rock	31.18	87.61	4	2.8	21 km north of Atmore, felt south of Little Rock
9/5/2000	Monroe, AL	Monroeville	31.51	87.31	7	2.5	Monroeville
9/5/2000	Clarke, AL	Fulton	31.79	87.84	5	2.4	10 km west of Fulton
9/29/2003	Escambia, AL	Little Rock	31.12	87.52	5	3.3	10 km NNW of Atmore, within 10 miles of Jay

Table 8: History of Seismic Activity Within 75 Miles of Santa Rosa County, FL 1929-2003 Source: Modified from U.S. Geological Survey National Earthquake Informaton Center. Preliminary Determination of Epicenters: Vierginia Polytechnic Institute and State University, Southeastern U.S. Seismic Network Bulletin, 1981-1995; and Earthquakes in the Alabama Area (1994). Modified for LMS planning purposes by W. Fla. Regional Planning Council. Copied form http://www.gsa.state.al.us/gsa/EQ2/eqtable.html

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The October 24, 1997 earthquake at Little Rock, Alabama (located 31.114° N. and 87.3 89° W. or about ten miles northwest of Jay, FL in Escambia County, AL) registered 4.9 on the Richter scale and provided Mercalli Intensity Scale ranges of III, IV, V and VI (See Figure 7). These ranges cause the effects as listed on Table 9 below.

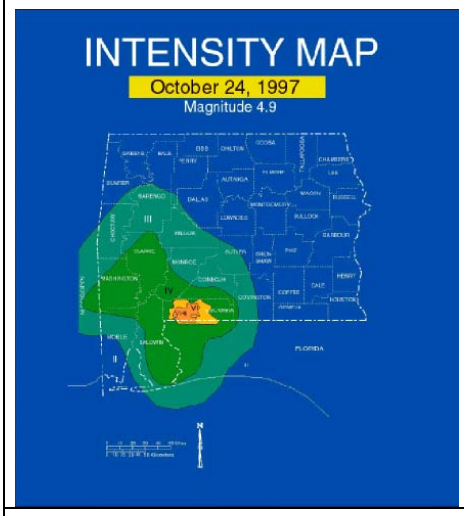

Figure 7 - Intensity map of the October 24, 1997 earthquake at Little Rock, Alabama. Note that Mercalli Intensity Scale ranges went from III to VI in Santa Rosa County. Source: Geological Survey of Alabama, 1999.

The Little Rock 4.9M earthquake was widely reported by area media and felt by hundreds if not thousands of people. 911 centers were deluged with surprised residents in both Escambia (FL) and Santa Rosa Counties with reports of experiencing shaking, hearing a loud rumble or small explosion, or noticing pictures or household items shaking or rattling on shelves and counters. Because the earthquake happened in the early morning hours, the number of telephone calls to 911 centers would indicate it woke hundreds of people from their sleep. There was some property and vegetation damage reported near the epicenter in Alabama, including a crane and trees that slid into a sand pit and an incident where goods shook onto the floor in a convenience store near Barnett Crossroads at Exit 67 on I-65. (See http://www.gsa.state.al.us/gsa/EQ2/EscambiaCo.html for photos and descriptions of damage.)

Mercalli Intensity Scale Rating	Effects Noticed
I	Not felt. Marginal and long period effects of large earthquakes
II	Felt by persons at rest, on upper floors, or

Richter Scale Reference

Magnitude (M)	Effects
1 to 3	Recorded on local seismographs, but generally not felt
3 to 4	Often felt, no damage
5	Felt widely, slight damage near epicenter
6	Damage to poorly constructed buildings and other structures within 10's km
7	"Major" earthquake, causes serious damage up to ~100km (recent Taiwan, Turkey, Kobe, Japan, and California earthquakes)
8	"Great" earthquake, great destruction, loss of life over several 100km (1906 San Francisco)
9	Rare great earthquake, major damage over a large region over 1000km (Chile 1960, Alaska 1964)

Table 9: Richter Scale Reference. Source: Canada Geological Survey 2003

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	favorably placed
III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated
IV	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing automobiles rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak
V	Felt outdoors; direction estimated. Sleepers waken. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate
VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware break. Knick-knacks, books, etc off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Church and school bells ring. Trees, bushes shaken (visibly or heard to rustle)

Table 10: Partial listing of the Mercalli Earthquake Intensity Scale Rating System, Source: Association of Bay Area Governments, California 2003

The cause of the number of small tremors in the vicinity of Santa Rosa County is not fully understood by seismologists and geologists. It is known that a series of faults known as the "Pickens-Gilbertown-Flomaton Fault System" exist from near Meridian, Mississippi to the Luann Salt Formation approximately 18,000 feet below the surface in the vicinity of Jay. Along this fault line are a number of petroleum producing areas, including the Little Escambia Creek oilfield in north Santa Rosa County near Jay. (Source: Cooey, Julian C., P.G., Geologist, Santa Rosa County Public Works.) Most of the tremors in the area are originating at a depth, or focus, of 3 miles (5 km). Some individuals have pointed to the possibility that oil extraction processes in the area may be causing the increasing number of earthquakes, but this has not been proven or acknowledged by the oil industry.

Seismologists do collectively agree the 1 .5%g peak acceleration rates for earthquake hazard is at a minimal risk level. This means there is roughly a 1.5% chance in fifty years of the ground experiencing a horizontal shaking.

Since there is no history of ***damaging*** earthquakes in the county, the peak acceleration rate is determined to be low by the U.S. Geological Survey, and recent events near Santa Rosa County provide a reference that building damage will not occur from the area's seismic activity, no further analysis or risk assessment will be conducted for this plan (See Figure 8). Mitigation activities will not be considered in this plan at this time. However, continued or more frequent seismic activity, or an increase in intensity in the area may warrant possible examination of mitigation activities that may need to occur, especially near Jay and in northern Santa Rosa County.

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2. Avalanche

Santa Rosa County does not have topography nor snowfall amounts that would create conditions for an avalanche. Since there is no history of this hazard in the county, no further analysis or risk assessment will be conducted for this plan.

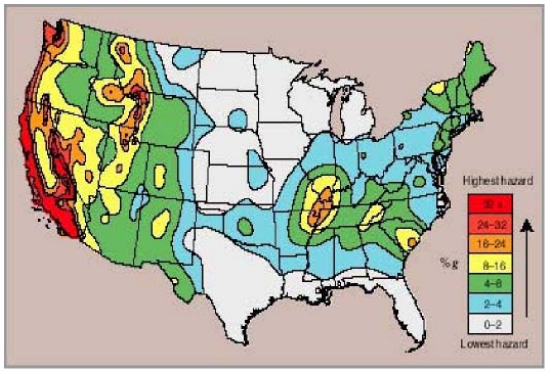

Figure 8: Earthquake frequency in Santa Rosa County is considered to be at less than 2%g, or very minimal. Source: U.S. Geological Survey national Seismic Hazard Mapping Project.

3. Land Subsidence

No land subsidence has been documented in Santa Rosa County. Since there is no history of this hazard in the county, no further analysis or risk assessment will be conducted for this plan.

4. Landslide

According to the U.S. Geological Survey Geologic Hazards (Open-File Report 97-289 by Godt) program, Santa Rosa County shares a large area of the Gulf Coastal Plain where less than 1.5% of area is susceptible to landslide. Although some portions of the county are “hilly” by coastal plain standards, there are no documented cases of a landslide occurring in the county (researched back to the 1940’s). Landslide is therefore considered to be a minimal risk to the county and no further analysis or risk assessment will be conducted for this plan.

5. Tsunami

Santa Rosa County is not considered to be in an area subject to tsunamis, according to the U.S. Geological Survey. Since there is no history of this hazard in the county, no further analysis or risk assessment will be conducted for this plan.

6. Volcano

There are no geological features in or near Santa Rosa County or the Southeast related to volcanism. Since there is no history of this hazard in the county, no further analysis or risk assessment will be conducted for this plan.

4.3 Disaster History

Whan a disaster strikes that overwhelms the ability of local communities to respond, the President of the United States can declare the affected communities a federal disaster area. This enables local communities to receive federal disaster assistance. Disaster assistance includes public assistance for disaster related losses to local governments,

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family and individual assistance, low interest loans to businesses to cope with lost revenues during the rebuilding process, and hazard mitigation grants to help fund projects to reduce local vulnerability to future disasters. The following table lists the major disasters that have occurred in Santa Rosa County since the year 2000. Previous occurrences (i.e. historical events) are documented for the following hazards: thunderstorms, hail, lightning, flooding, tornadoes, hurricanes, rip currents, high winds, excessive heat and wildfire. For the remaining hazards, there is no record of historical events.

DATE	TYPE OF EVENT	LOCATION/LOCAL GOVERNMENT	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
03/29/00	Hail	Gulf Breeze	0.88 in.	0	0	0	0
03/31/00	Rip Currents	Navarre	N/A	1	0	0	0
04/24/00	Thunderstorm-Wind	Milton	65 Kts	0	0	22K	0
05/13/00	Hail	Jay	1.00 in.	0	0	0	0
06/16/00	Waterspout	Gulf Breeze	N/A	0	0	0	0
07/01/00	Excessive Heat	Santa Rosa County	N/A	0	0	0	0
07/08/00	Waterspout	Navarre	N/A	0	0	0	0
07/10/00	Waterspout	Navarre	N/A	0	0	0	0
07/11/00	Hail	Jay	0.75 in.	0	0	0	0
07/11/00	Thunderstorm-Wind	Jay	60 Kts	0	0	8K	0
07/11/00	Lightning	Pace	N/A	0	0	5K	0
07/11/00	Thunderstorm-Wind	Pace	55 Kts	0	0	5K	0
07/12/00	Hail	Navarre	0.75 in.	0	0	0	0
07/13/00	Thunderstorm-Wind	Milton	60 Kts	0	0	15K	0
07/20/00	Thunderstorm-Wind	Navarre	60 Kts	0	0	15K	0
07/20/00	Thunderstorm-Wind	Jay	65 Kts	0	0	25K	0
07/22/00	Thunderstorm-Wind	Jay	60 Kts	0	0	7K	0
07/22/00	Thunderstorm-Wind	Jay	55 Kts	0	0	5K	0
07/30/00	Funnel Cloud	Navarre	N/A	0	0	0	0
08/20/00	Waterspout	Navarre	N/A	0	0	0	0
08/25/00	Thunderstorm-Wind	Jay	65 Kts	0	0	15K	0
08/27/00	Hail	Milton	1.00 in.	0	0	0	0
08/27/00	Thunderstorm-Wind	Munson	55 Kts	0	0	5K	0
09/21/00	Tropical Storm	Santa Rosa County	N/A	0	0	0	0
03/12/01	Hail	Harold	1.75 in.	0	0	0	0
03/12/01	Thunderstorm-Wind	Jay	60 Kts	0	0	15K	0
03/15/01	Thunderstorm-Wind	Milton	50 Kts	0	0	35K	0
04/08/01	Rip Currents	Navarre	N/A	1	0	0	0
04/13/01	Rip Currents	Navarre	N/A	1	0	0	0
04/29/01	Rip Currents	Navarre	N/A	1	0	0	0
06/07/01	Rip Currents	Navarre	N/A	1	0	0	0
06/11/01	High Wind	Santa Rosa County	45 Kts	0	0	30K	0
07/10/01	Thunderstorm-Wind	Gulf Breeze	52 Kts	0	0	0	0
08/04/01	Tropical Storm Barry	Santa Rosa County	N/A	0	0	700K	0
08/18/01	Thunderstorm-Wind	Chumuckla	50 Kts	0	0	5K	0
08/28/01	Waterspout	Gulf Breeze	N/A	0	0	0	0
10/13/01	Thunderstorm-Wind	Chumuckla	60 Kts	0	0	15K	0

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DATE	TYPE OF EVENT	LOCATION/LOCAL GOVERNMENT	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
10/13/01	Thunderstorm-Wind	Chumuckla	60 Kts	0	0	10K	0
10/13/01	Waterspout	Gulf Breeze	N/A	0	0	0	0
10/13/01	Thunderstorm-Wind	Gulf Breeze	75 Kts	0	0	50K	0
10/13/01	Tornado	Milton	F1	0	0	625K	0
11/23/01	Rip Currents	Navarre	N/A	1	0	0	0
11/24/01	Rip Currents	Navarre	N/A	1	0	0	0
01/05/02	Thunderstorm-Wind	Navarre	70 Kts	0	0	720K	0
03/26/02	Thunderstorm-Wind	Milton	50 kts	0	0	10K	0
05/17/02	Lightning	Milton	N/A	0	0	20K	0
06/14/02	Thunderstorm-Wind	Jay	50 Kts	0	0	8K	0
06/14/02	Thunderstorm-Wind	Holley	50 Kts	0	0	20K	0
07/01/02	Thunderstorm-Wind	Berrydale	55Kts	0	0	5K	0
07/03/02	Hail	Milton	0.75 in.	0	0	0	0
07/08/02	Lightning	Allentown	N/A	0	1	0	0
07/19/02	Thunderstorm-Wind	Berrydale	50 Kts	0	0	8K	0
07/19/02	Lightning	Bagdad	N/A	0	1	0	0
07/21/02	Thunderstorm-Wind	Gulf Breeze	50 Kts	0	0	8K	0
07/26/02	Lightning	Pace	N/A	0	1	0	0
08/01/02	Lightning	Holley	N/A	0	1	0	0
08/22/02	Lightning	Chumuckla	N/A	0	1	0	0
09/12/02	Tropical Storm Hanna	Santa Rosa County	N/A	0	0	100K	0
09/24/02	Tropical Storm Isidore	Santa Rosa County	N/A	0	0	11.2M	0
09/25/02	Flash Flood	Pace	N/A	0	0	0	0
09/25/02	Flood	Santa Rosa County	N/A	0	0	0	0
09/26/02	Funnel Cloud	Pace	N/A	0	0	0	0
10/02/02	Coastal Flooding	Santa Rosa County	N/A	0	0	100K	0
11/05/02	Thunderstorm-Wind	Milton	55 Kts	0	0	5K	0
11/05/02	Tornado	Bagdad	F0	0	0	15K	0
12/24/02	Tornado	Munson	F0	0	0	142K	0
12/24/02	Thunderstorm-Wind	Santa Rosa County	55 Kts	0	0	20K	0
02/21/03	Lightning	Milton	N/A	0	0	5K	0
03/12/03	Hail	Gulf Breeze	1.00 In.	0	0	0	0
03/12/03	Hail	Navarre	0.75 In.	0	0	0	0
04/25/03	Thunderstorm-Wind	Munson	55 Kts	0	0	5K	0
05/02/03	Hail	Munson	0.75 in.	0	0	0	0
05/02/03	Hail	Jay	0.75 in.	0	0	0	0
05/09/03	Rip Currents	Navarre	N/A	1	0	0	0
06/30/03	Flash Flood	Santa Rosa County	N/A	0	0	0	0
06/30/03	Thunderstorm-Wind	Allentown	50 Kts	0	0	7K	0

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DATE	TYPE OF EVENT	LOCATION/LOCAL GOVERNMENT	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
07/01/03	Flash Flood	Santa Rosa County	N/A	0	0	0	0
07/17/03	Hail	Milton	0.75 in.	0	0	0	0
07/18/03	Hail	Pace	0.75 in.	0	0	0	0
08/16/03	Lightning	Milton	N/A	0	0	10K	0
05/18/04	Hail	Berrydale	1.00 in.	0	0	0	0
06/02/04	Thunderstorm-Wind	Milton	50 Kts	0	0	8K	0
06/27/04	Thunderstorm-Wind	Milton	50 Kts	0	0	8K	0
06/28/04	Thunderstorm-Wind	Milton	50 Kts	0	0	8K	0
07/16/04	Thunderstorm-Wind	Jay	50 Kts	0	0	8K	0
07/16/04	Thunderstorm-Wind	Berrydale	50 Kts	0	0	8K	0
08/10/04	Tropical Storm Bonnie	Santa Rosa County	N/A	0	0	0	0
09/13/04	Hurricane Ivan	Santa Rosa County	N/A	7	0	4.0B	25.0M
09/15/04	Tornado	Gulf Breeze	F0	0	0	3K	0
11/24/04	Tornado	Milton	F1	0	0	75K	0
03/26/05	Hail	Milton	1.00 in.	0	0	0	0
03/26/05	Hail	Milton	2.75 in.	0	0	2.5M	0
03/26/05	Hail	Navarre	1.00 in.	0	0	0	0
03/26/05	Thunderstorm-Wind	Navarre	60 Kts	0	0	10K	0
03/31/05	Lightning	Berrydale	N/A	0	1	0	0
03/31/05	Flash Flood	Santa Rosa County	N/A	0	0	3K	0
04/01/05	Flash Flood	Santa Rosa County	N/A	0	0	25K	0
04/01/05	Lightning	Berrydale	N/A	0	1	0	0
04/06/05	Hail	Chumuckla	0.75 in.	0	0	0	0
04/06/05	Flash Flood	Santa Rosa County	N/A	0	0	25K	0
04/26/05	Hail	Milton	1.75 in.	0	0	4K	0
04/30/05	Flash Flood	Santa Rosa County	N/A	0	0	0	0
05/05/05	Hail	Munson	1.00 in.	0	0	0	0
05/05/05	Hail	Munson	1,75 in.	0	0	10K	0
05/05/05	Hail	Harold	0.75 in.	0	0	0	0
05/05/05	Hail	Pace	0.75 in.	0	0	0	0
06/10/05	Tropical Storm Arlene	Santa Rosa County	N/A	0	0	3.5M	0
06/11/05	Tornado	Navarre	F0	0	0	3K	0
06/15/05	Lightning	Navarre	N/A	1	1	0	0
07/05/05	Tropical Storm Cindy	Santa Rosa County	N/A	0	0	150K	0
07/09/05	Hurricane Dennis	Santa Rosa County	N/A	0	0	1.5B	300K
07/10/05	Hurricane Dennis	Santa Rosa County	N/A	0	0	0	0
07/10/05	Flash Flood	Santa Rosa County	N/A	0	0	0	0
07/29/05	Lightning	Milton	N/A	0	0	50K	0
08/27/05	Tropical Storm Katrina	Santa Rosa County	N/A	0	0	100.0M	0
08/29/05	Tornado	Munson	F0	0	0	8K	0
08/29/05	Tornado	Munson	F0	0	0	5K	0
08/29/05	Flash Flood	Santa Rosa County	N/A	0	0	0	0
09/26/05	Flash Flood	Santa Rosa County	N/A	0	0	0	0
09/26/05	Tornado	Milton	F0	0	0	0	0

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DATE	TYPE OF EVENT	LOCATION/LOCAL GOVERNMENT	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
09/26/05	Tornado	Pace	F0	0	0	0	0
09/26/05	Tornado	Avalon Beach	F0	0	0	0	0
01/13/06	Tornado	Berrydale	F1	0	0	500K	0
08/03/06	Thunderstorm-Wind	Jay	50 Kts	0	0	20K	0
11/15/06	Thunderstorm-Wind	Milton	50 Kts	0	0	12K	0
02/13/07	Hail	Milton	0.75 in.	0	0	0	0
06/09/07	Thunderstorm-Wind	Harold	56 Kts	0	0	0	0
06/27/07	Lightning	Pace	N/A	0	0	80K	0
07/14/07	Lightning	Pace	N/A	0	0	15K	0
07/14/07	Thunderstorm-Wind	Harold	50 Kts	0	0	12K	0
07/20/07	Thunderstorm-Wind	Holley	50 Kts	0	0	10K	0
07/24/07	Lightning	Navarre	N/A	0	0	15K	0
08/26/07	Funnel Cloud	Jay	N/A	0	0	0	0
09/14/07	Lightning	Pace	N/A	0	0	100K	0
11/21/07	Thunderstorm-Wind	Milton	61 Kts	0	0	50K	0
12/15/07	Thunderstorm-Wind	Navarre	60 Kts	0	0	40K	0
02/12/08	Funnel Cloud	NAS Whiting Field	N/A	0	0	0	0
02/12/08	Hail	Berrydale	1.00 in.	0	0	0	0
02/12/08	Thunderstorm-Wind	Milton	50 Kts	0	0	50K	0
02/17/08	Tornado	Chumuckla	F1	0	0	200K	0
02/21/08	Hail	Berrydale	1.00 in.	0	0	0	0
05/15/08	Thunderstorm-Wind	Allentown	50 Kts	0	0	18K	0
06/10/08	Thunderstorm-Wind	Allentown	50 Kts	0	0	12K	0
06/10/08	Lightning	Allentown	N/A	0	0	0	0
06/29/08	Thunderstorm-Wind	NAS Whiting Field	50 Kts	0	0	25K	0
06/29/08	Lightning	Navarre	N/A	0	0	10K	0
07/13/08	Lightning	Bagdad	N/A	0	0	15K	0
08/07/08	Lightning	Munson	N/A	0	1	0	0
08/23/08	Tropical Storm Fay	Santa Rosa County	N/A	0	0	0	0
09/01/08	Tornado	Gulf Breeze	F0	0	0	12K	0
09/01/08	Tornado	Navarre	F0	0	0	0	0
09/01/08	Tropical Storm Gustav	Santa Rosa County	N/A	0	0	0	0
09/01/08	Storm Surge/tide	Santa Rosa County	N/A	0	0	250K	0
09/11/08	Hurricane Ike	Santa Rosa County	N/A	0	0	500K	0
12/10/08	Thunderstorm-Wind	Allentown	58 Kts	0	0	33K	0
02/18/09	Hail	Munson	1.00 in.	0	0	0	0
03/27/09	Hail	Allentown	0.88 in.	0	0	0	0
03/27/09	Thunderstorm-Wind	Chumuckla	61 Kts	0	0	0	0
03/28/09	Thunderstorm-	Milton	50 Kts	0	0	0	0

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	Wind						
03/28/09	Hail	Allentown	1.75 in.	0	0	0	0
03/28/09	Hail	Milton	0.75 In.	0	0	0	0
03/28/09	Thunderstorm-Wind	Berrydale	50 Kts	0	0	0	0
03/31/09	Thunderstorm-Wind	Munson	50 Kts	0	0	25K	0

As evidenced by the information in the preceding table, over the last 10 years, Santa Rosa County has been affected by an incredible array of disasters. Although most of these disaster declarations have been the result of severe tropical weather, the County is vulnerable to a wide variety of hazards that are described in the previous pages.

Summary

It must be emphasized that the fundamental reason for undertaking the hazard identification is to highlight vulnerabilities that need to be addressed by the development of mitigation initiatives for inclusion into the Santa Rosa County LMS Plan. Because of the numerous facilities, systems and neighborhoods in Santa Rosa County that need be assessed for their vulnerability to disasters, this planning process can be expected to continue in the future. Specific community vulnerabilities shall be assessed in the following Section 5.

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