



## SECTION III

### HAZARDS ANALYSIS

#### A. BACKGROUND

In order to minimize loss of life, human suffering, damage to public and private property, and economic loss we must have complete knowledge of the types of hazards that affect Hillsborough County. This Hazard Identification and Vulnerability Assessment is a vital component in the development of a county-wide Local

Mitigation Strategy. Through the information gathered, we are better able to determine and prioritize mitigation initiatives.

The Hazards Analysis includes types of hazards, location, and population affected. The information was compiled by Hillsborough County Emergency Management, county and municipal planning departments, the Tampa Bay Regional Planning Council, Port Authority Tampa, National Weather Service, State of Florida DOT, U.S. Geological Survey, National Climatic Data Center, Local Mitigation Strategy Workgroup, and other sources.

Consistent with Federal and State Plans and the County Comprehensive Emergency Management Plan (CEMP), the Hillsborough County LMS reflects an "All-Hazards" approach to mitigation. Therefore, the LMS Working Group researched technological and societal hazards, as well as natural hazards, that may confront the county.

The following table III.A.1 was created to give an overview of the probability, potential impact, frequency and distribution of the hazards which could affect the county. The Plan addresses those natural hazards required by FEMA and the State of Florida. Three of those hazards do not pose any significant threat to Hillsborough County based on historical occurrences and meteorological, geological and topological research. However, due to the specific vulnerability of the County to certain technological and societal hazards, five additional hazards were addressed including hazardous material incidents (both transportation and fixed facility), dam or levee failure, power failure and terrorism.

Due to the topography, and geography of Hillsborough County it was determined that landslides and volcanoes pose no threat to the county. It was also found that earthquakes and tsunamis pose little threat to the county and therefore will not be fully profiled in the 2010 plan update." See table below with these comments incorporated

**Table III.A.1  
Hazards Probability Analysis Matrix**

| <b>Hazard - Natural</b>                     | <b>Probability</b>  | <b>Impact</b>   | <b>Average Occurrence</b> | <b>Distribution</b>  |
|---|---|---|---------------------------|--|
| Coastal/ Riverine Erosion                   | Moderate  | Possible structure collapse or relocation                       | Approx. every 5-10 years  | Primarily in coastal areas in Tampa and unincorporated county <b>(see Map 8)</b>   |
| CAT 1-2 Hurricanes (Minor)/ Tropical Storms | High  | Cosmetic damage to well-built houses; weak structures destroyed | Approx. every two years   | Storm surge in coastal areas in Tampa and unincorporated county. <b>(See Map 8 )</b> Winds - County-wide <b>(See Maps 14 &amp; 15)</b> |
| CAT 3-5 Hurricanes (Major)/ Tropical Storms | Moderate  | Many structures destroyed                                       | Approx. every 50 years    | County-wide and Regional wind damage, coastal and Riverine flooding <b>(See Map 8)</b>   |
| Drought                                     | Low   | Not structural damage; Agriculture losses                       | Approx every 5-10 years   | County-wide  |
| Extreme Heat                                | Low   | Not structural damage; agriculture and people affected          | Annually                  | Countywide   |
| Flooding (FEMA FIRM Zones)                  | Moderate  | Houses temporarily uninhabitable, some destroyed                | Approx. every 5-10 years  | Localized <b>(See Maps 9 &amp; 10 )</b>  |
| Sinkholes                                   | Moderate  | Possible structure collapse                                     | Annually                  | Localized <b>(See Map11 &amp; 12 )</b>   |
| Thunderstorm                                | High  | Mostly minor cosmetic damage                                    | Annually                  | Localized - specific to event  |
| Tornado                                     | High  | Cosmetic damage to complete devastation                         | 2-3 a year                | Localized – specific to event <b>(See Map 16)</b>  |
| Tsunami                                     | ***   | Coastal structures could be destroyed                           | ***                       | Primarily coastal areas depending on severity <b>(See Map 17)</b>  |
| Wildland Fires                              | High  | Complete loss of structures and crops                           | Several a year            | Localized on Urban Fringe <b>(See Map 13 )</b>   |
| Winter Storm                                | Low   | Loss of crops; structures not affected                          | Approx. every 3 - 4 years | County-wide  |
| Landslide***                                | Due to the topography and geography of Hillsborough County it was determined that landslides pose no threat to the county.  |   |                           |  |
| Volcano***                                  | Due to the topography and geography of Hillsborough County it was determined that volcanoes pose no threat to the county.   |   |                           |  |
| Earthquake***                               | Due to the topography and geography of Hillsborough County it was determined that earthquakes pose no threat to the county. |   |                           |  |

Table III.A.1 (cont.)  
Hazards Probability Analysis Matrix (cont.)

| Hazard-Technological                              | Vulnerability | Impact   | Average Occurrence | Distribution                                    |
|---|---------------|--|--------------------|---|
| Hazardous Materials Transportation                | High          | Moderate   | 50-100 each year   | Localized, greatest threat along Interstate     |
| Hazardous Materials Fixed Facility                | High          | Major  | 5-10 years         | Localized, greatest threat at the Port of Tampa |
| Dam/Levee Failure                                 | Low           | Minor  | Unknown            | Localized, along Hillsborough River             |
| Port Vessel Collision or On-Water Materials Spill | Low           | Moderate   | Unknown            | Localized, specific to event                    |
| Terrorism   | Moderate      | Major  | Unknown            | Localized, specific to event                    |
| Utility Failure/ Power Outages                    | High          | Moderate, greatest impact in downtowns and urban centers | Unknown            | Localized, specific to event                    |

\*\*\* Due to a lack of historical data, the probability, frequency, impact and location of these hazards cannot be quantified. While there is always a statistical probability of occurrence, based on the historical record, these events may not pose a hazard to Hillsborough County and will not be fully profiled..

**H** = High – Likely to experience threat, effect, or reoccurrence of event  
**M** =Moderate – Average to better than average likelihood of experiencing threat, effect or reoccurrence of event  
**L** = Low – Below average likelihood of experiencing threat, effect or reoccurrence of event  
**N** = Very little of no likelihood threat will occur

Table III.A.2  
Hazards Vulnerability by Jurisdiction

| Hazard – Natural  | Hillsborough County | Tampa | Temple Terrace | Plant City |
|---|---------------------|-------|----------------|------------|
| Coastal /Riverine Erosion   | L                   | H     | L              | L          |
| Category 1-2 Hurricane (Minor) /Tropical Storm  | H                   | H     | H              | H          |
| Category 3-5 Hurricane (Major) /Tropical Storm  | M                   | M     | M              | M          |
| Drought   | M                   | M     | M              | M          |
| Extreme Heat  | L                   | L     | L              | L          |
| Flooding (FEMA FIRM Zones)  | H                   | H     | M              | M          |
| Sinkholes   | M                   | L     | L              | L          |
| Thunderstorms   | H                   | H     | H              | H          |
| Tornadoes   | H                   | H     | H              | H          |
| Tsunami   | ***                 | ***   | ***            | ***        |
| Wildland Fires  | M                   | L     | L              | L          |
| Winter Storm  | L                   | L     | L              | L          |
| Hazard - Technological  |                     |       |                |            |
| Hazardous Materials Transportation  | M                   | M     | M              | M          |
| Hazardous Materials Fixed Facility  | M                   | M     | L              | M          |
| Dam/Levee Failure   | M                   | L     | L              | N          |
| Port Vessel Collision or On-Water Hazardous Materials Spill   | L                   | L     | L              | N          |
| Utility Failure/Power Outages   | M                   | M     | H              | M          |
| Terrorism   | M                   | M     | L              | M          |
| <input type="checkbox"/> Jurisdictions with significant coastal areas<br><input type="checkbox"/> Inland communities with some chance of flooding   |                     |       |                |            |
| <p>*** Due to a lack of historical data, the probability, frequency, impact and location of these hazards cannot be quantified. While there is always a statistical probability of occurrence, based on the historical record, these events may not pose a hazard to Hillsborough County and will not be fully profiled..</p>   |                     |       |                |            |
| <p><b>H</b> = High – Most of the population affected, major damage to old, poorly maintained, and mobile home structures, some damage to newer structures built to code likely<br/> <b>M</b> =Moderate –Around 50% of the population affected, mobile homes and poorly built or maintained structures most at risk<br/> <b>L</b> = Low – Special portions of the population affected, day-to-day operations not affected, minor cosmetic damage expected to some structures<br/> <b>N</b> =Not a threat</p> |                     |       |                |            |

## B. NATURAL HAZARDS

Severe weather events will occur in the Bay area. The tropical climate that attracts people from all over the world to live, work and visit here also includes sporadic tropical storms, tornadoes and flooding events. While the County rarely deals with snow, sleet or ice, winter storms and freezes can significantly impact the agricultural industry and coastal communities.

The development within coastal and riverine areas has put both residents and property at risk. The purpose of the LMS planning process is to identify these hazards and cost-effective mitigation strategies to reduce the risk to our community.

Table III.B.1 quantifies historical losses from the major natural hazards in Hillsborough County and provides an estimated annual ratio of loss based on the historical frequency of the event. The data was obtained from the on-line National Climate Center Database. Although the database may not include all storm events, it is one of the most comprehensive and complete sources of hazard information available. It is also provides sufficient information to assess relative hazard impacts on Hillsborough County. **Not all hazards listed on Table III.B.1 below are hazards that affect Hillsborough County and/or hazards are identified by different names than they are in MEMPHIS. The table is included for informational purposes in its entirety.**

Table III.B.1  
Severe Weather Occurrences  
**1950-2008**

| <b>Severe Storm Events</b> |                                 |                    |               |                 |                        |                     |
|----------------------------|---------------------------------|--------------------|---------------|-----------------|------------------------|---------------------|
| <b>First Year *</b>        | <b>Hazard</b>                   | <b># of Events</b> | <b>Deaths</b> | <b>Injuries</b> | <b>Property Damage</b> | <b>Crop Damage</b>  |
| 1994                       | Funnel Cloud                    | 8                  | 0.00          | 0.00            | \$0                    | \$0                 |
| 1958                       | Hail                            | 248                | 0.00          | 0.00            | \$1,175,000            | \$15,300,000        |
| 1995                       | Hurricane                       | 18                 | 1.00          | 10.00           | \$470,323,000          | \$15,025,000        |
| 1994                       | Lightning                       | 75                 | 7.00          | 54.00           | \$3,330,000            | \$0                 |
| 1994                       | Open Surf                       | 9                  | 4.00          | 0.00            | \$5,900,000            | \$0                 |
| 1995                       | Precipitation<br>Thunderstorms/ | 23                 | 0.00          | 0.00            | \$11,000               | \$0                 |
| 1955                       | High Winds                      | 364                | 1.00          | 26.00           | \$16,302,000           | \$17,015,000        |
| 1951                       | Tornado                         | 126                | 1.00          | 129.00          | \$23,882,000           | \$0                 |
| 1993                       | Waterspout                      | 14                 | 0.00          | 0.00            | \$1,000,000            | \$0                 |
| 1999                       | Wild Fires                      | 3                  | 0.00          | 2.00            | 0                      | \$0                 |
| 1996                       | Fog                             | 51                 | 1.00          | 30.00           | \$850,000              | \$0                 |
| 1993                       | Flood                           | 72                 | 1.00          | 2.00            | \$20,865,000           | 4401,000            |
|                            | <b>Total Events</b>             | <b>1,011</b>       | <b>16</b>     | <b>253</b>      | <b>\$543,638,000</b>   | <b>\$47,741,000</b> |

## Severe Storm Events Frequency

| Total Events Reported | Hazard        | Events / Year | Death/ Event | Injury/ event | Property Damage/ Event | Crop Damage/ Event |
|-----------------------|---------------|---------------|--------------|---------------|------------------------|--------------------|
| 8                     | Funnel Cloud  | .53           | 0.00         | 0.00          | \$0                    | \$0                |
| 248                   | Hail          | 6.05          | 0.00         | 0.00          | \$4,738                | \$61,944           |
| 18                    | Hurricane     | 1.29          | 0.06         | 0.56          | \$26,129,056           | \$834,722          |
| 75                    | Lightning     | 5.00          | 0.09         | 0.72          | \$44,400               | \$0                |
| 9                     | Open Surf     | 0.60          | 0.44         | 0.00          | \$655,556              | \$0                |
| 23                    | Precipitation | 1.64          | 0.00         | 0.00          | \$478                  | \$0                |
| 364                   | Thunderstorms | 8.27          | 0.00         | 0.07          | \$44,786               | \$46,745           |
| 126                   | Tornado       | 2.63          | 0.01         | 1.02          | \$189,540              | \$0                |
| 14                    | Waterspout    | 0.88          | 0.00         | 0.00          | \$71,429               | \$0                |
| 3                     | Wild Fires    | 0.30          | 0.00         | 0.67          | \$0                    | \$0                |
| 51                    | Fog           | 3.92          | 0.02         | 0.59          | \$16,667               | \$0                |
| 72                    | Flood         | 4.50          | 0.01         | 0.03          | \$289,792              | \$5,569            |

\* Year in which data first appears in the National Climate Center Database

Source: National Climate Center Database

<http://www4.ncdc.noaa.gov/cgi-win/wwwcgi.dll?wwEvent%7EStorms>

The following natural hazards and mitigation techniques are applicable to all jurisdictions. However, not all mitigation techniques have been included as projects within Appendix G in categorized objectives. Because of varying degrees in which the risk affects businesses and residences in different areas of the county and because of available limited resources not all mitigation techniques have been incorporated into the project list for all jurisdictions.

### 1. Coastal or Riverine Erosion

Description / Background: Coastal or riverine erosion is defined as the gradual wearing away of the earth's surface by the natural forces of wind and water. In Hillsborough County, erosion along Tampa Bay and river shorelines is most noticeable after a significant rain and/or tidal surge event. Although this is a natural effect, shoreline development is at risk when erosion occurs at a rate greater than the natural rate of soil replenishment.

Location / Risk Assessment: Areas of greatest risks of erosion were identified within the applicable Local Government Comprehensive Plans as Coastal High Hazard Areas. These areas are found along the Hillsborough, Alafia, Little Manatee Rivers, associated tributaries, and areas illustrated as being within the velocity zones on the Federal Insurance Rate Maps. Erosion principally affects structures through deteriorating the structural integrity of buildings by undermining the foundation or associated pilings/piers.

History of Events: In 2001, a slow moving and persistent low pressure system, west of the mouth of Tampa Bay, produced coastal flooding, very heavy rain, sustained winds of 20 to 30 mph with occasional higher gusts of up to 50 mph, from Tampa south to Ft. Myers, along the West coast of Florida. Storm tide values ranged to 4.4 feet above MSL in along the Hillsborough county side of Tampa Bay. Near downtown Tampa, Bayshore Boulevard had water covering both the north and south lanes during the early to mid afternoon hours of July 23rd.

In June 2003, the Alafia River at Lithia crested four and a half feet above flood stage at 17.56 feet on June 23rd. Several homes in the River Drive area of Valrico had to evacuate.

In September 2004, widespread heavy rain associated with Hurricane Frances across west central Florida led to record flooding on many of the rivers. In Hillsborough County, the Hillsborough River at the Morris Bridge (flood stage 32 feet) reached it's all time high of 34.38 feet on the 8th, the Alafia River at Lithia (flood stage 13 feet) reached the 5th highest stage at 22.33 feet on the 7th, and the Little Manatee River at Wimauma (flood stage 11 feet) reach 17.09 feet on the 7th.

Probability: Erosion rates and occurrences vary by area and with time. Based on historical trends, coastal erosion occurs every 5-10 years.

Severity of Event / Consequences: While erosion itself is not an imminent threat to public safety it does impact the quality of life through damage to buildings, roads/bridges, and infrastructure (lifeline systems). Because of the relationship of flooding to erosion, the same structures affected by one are affected by the other. A worst-case scenario would be a pounding of the coastline from a category 3, 4, or 5 hurricanes that was motionless or moving at a very slow forward speed on a parallel line to the west coast of Florida. Past events, i.e. Hurricane Elena, have caused significant erosion at certain locations outside of Hillsborough County. Although damages to the Gulf Coast are estimated at \$1.25 billion (1982 USD) in damage, mainly in the form of property damage and beach erosion, Hillsborough County damages were principally from flooding associated with coastal storm surge, which was equivalent to a tropical storm or minor hurricane. Impacts resulted in property damage and economic impacts at the Port of Tampa (Wikipedia). Hillsborough County has 158.27 miles of shoreline that could potentially experience erosion in a storm. In areas where mangrove stands front the bay, waves with heights of 3 feet or greater are dissipated within approximately 200 feet of the shoreline (*Flood Insurance Study, Hillsborough County, Florida and Incorporated Areas, Vol. 1 of 5*). After the 2004 tropical cyclone events, the Hillsborough County Parks, Recreation and Conservation Department did request funding to assist with minor repairs (1,700 cubic yards of sand) associated with shore restoration of a park.. Such minor losses could be expected in the future.

Pursuant to the Flood Insurance Study for Hillsborough County published by the Federal Emergency Management Agency, the County has 17 major watershed basins with no less than 14 riverine systems that account for more than 700 linear miles of floodway that are potentially susceptible to erosion. No severe erosion has occurred within riverine systems due to any one storm event See Severity of Event/Consequences for flooding for more information.

Mitigation: While the County has miles of coastline, a large majority of the developed coastal shoreline has been hardened by seawalls. The seawalls, while not an environmentally preferred mitigation option, do minimize erosion from minor to moderate flooding events.

Strategies to protect the more pristine coastal areas of the community against erosion include: acquisition of sensitive coastal areas through either the county-wide

Environmental Lands Acquisition Preservation Program or various state programs such as Florida Forever; adherence to current engineering standards, vegetation and setbacks.

## 2. Hurricanes and Tropical Storms

Description / Background: Hurricanes and tropical storms are characterized by torrential rainfalls, tidal flooding, and damaging winds and can spawn severe thunderstorms, lightning and tornadoes. Tropical storms and hurricanes are differentiated by the intensity of the storm, typically measured by wind speed and wave height based on the Saffir-Simpson Hurricane Scale.

Table III.B.2

| Category                   | Wind speed (mph) | Storm surge (ft.) |
|----------------------------|------------------|-------------------|
| 5                          | ≥156             | >18               |
| 4                          | 131–155          | 13–18             |
| 3                          | 111–130          | 9–12              |
| 2                          | 96–110           | 6–8               |
| 1                          | 74–95            | 4–5               |
| <b>Tropical Storm</b>      | 39–73            | 0–3               |
| <b>Tropical Depression</b> | 0–38             | 0                 |

The three major hazards produced by a hurricanes and tropical storms are the storm surge, high winds and rainfall.

- Storm surge is the rise in water level in coastal areas caused by the wind and pressure forces of a hurricane. The more intense the hurricane, the higher the surge will be. The output of the National Oceanic and Atmospheric Administration (NOAA) storm surge prediction model (SLOSH) shows that storm surge height of 28 feet or more above sea level could impact certain coastal and river areas under a “worst case” Category 5 hurricane.
- The high winds of a hurricane also present significant dangers to the populace. This hazard especially applies to structures unable to withstand the stress and uplift forces from hurricane force winds (ranging from 74 to more than 155 miles per hour). Structures most vulnerable to hurricane force winds are manufactured homes and substandard housing. In addition, hurricane winds can create hazardous conditions from flying glass from high-rise buildings as well as homes unprotected by shutters or plywood boarding.
- Rainfall varies with hurricane size, forward speed, and other meteorological factors. Residents must be aware of flooding that may result from a hurricane, especially along rivers that are major drainage systems and low-lying areas. Heavy rainfall may continue after a storm loses hurricane status. The rainfall

associated with a hurricane is from 6 to 12 inches on average, with higher amounts common.

Historically, hurricanes and tropical storms are the natural disasters that pose the greatest threat to Florida and Hillsborough County. They have caused the greatest amount of property damage and as more people move to Hillsborough County, and more development takes place, the potential for hurricane-related deaths and damages, increases each year.

Location / Risk Assessment: The principle tool for analyzing the expected hazards from potential hurricanes that may affect the Tampa Bay Region is the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) numerical storm surge model. The SLOSH model predicts the tidal surge heights that result from test data about hypothetical hurricanes and tropical storms with various combinations of pressure, size, forward speed, track and winds. Coastal areas are most vulnerable to the greatest storm surge, high winds and rainfall impacts; however, the entire county is vulnerable to at least high rains and winds.

The vulnerability of Hillsborough County to potential hazards from hurricanes and tropical storms is analyzed prior to each storm. The population at risk and potential for property/economic damages is based on the specific characteristics of the threatening hurricane.

History of Events: Because of its unique geographical location and configuration, Florida is the most hurricane-prone state in the country. Hurricanes and tropical storms are the greatest natural disaster threat to Hillsborough County. The hurricane of record for the 20th century in Tampa Bay was in October 1921 when a Category 3 hurricane passed within 30 miles of Tampa and Hillsborough County, causing six deaths and \$1 million dollars in damage. Two other hurricanes of note hit Tampa Bay within two and a half weeks of each other in September-October 1948 causing 10 and 15 feet of storm surge.

In September 1985, Elena threatened the area and caused the Tampa Bay region to conduct a major evacuation of over 500,000 people. The county sustained substantial flooding from Tropical Storm Josephine in October 1993. Hurricane Georges caused a mandatory evacuation of coastal areas and manufactured homes in September 1998, however caused minimal damage. A total of six hurricanes/tropical storms threatened the City from 1995- 2001 resulting in voluntary evacuation advisories. None of these storms made direct hits, so minimal, or no, damage resulted. The storms were as follows: Tropical Storm Erin (August 1995), Hurricane Floyd (September 1999), Tropical Storm Harvey (September 1999), Hurricane Irene (October 1999), Hurricane Gordon (September 2000) and Hurricane Gabrielle (2001).

The 2004 hurricane season was unprecedented in modern times in Florida. Hurricanes Charley, Frances, Ivan and Jeanne, as well as Tropical Storm Bonnie, all hit Florida within a 48 day span, the most tropical activity in one state in 120 years. All four hurricanes either threatened or came close to striking the City of Tampa. Two of the storms Frances and Jeanne traversed through the County after making landfall on the East Coast. Both West Coast storms, Charley and Ivan, were projected to directly impact Tampa as they approached Florida. However, Charley struck south of the County and Ivan passed to the west and impacted the northern Gulf Coast. Both of these storms

made landfall as Category 4 hurricanes. Frances and Jeanne caused substantial damage with flooding, extensive amount of debris and significant power outages, though no winds were recorded in the hurricane force category.

More recently, on October 24, 2006, Hurricane Wilma produced tropical force winds for much of southwest and west central Florida. However, much of the damage was limited to downed tree limbs and localized flooding. In Hillsborough County, a Florida mesonet station in Balm recorded a peak wind of 51 MPH at 745 AM EDT. Other peak wind gusts included 44 MPH at the Tampa International Airport and 43 MPH at the MacDill Air Force Base. As of November 18th there were 381 insurance claims that totaled \$127,000.

On June 13, 2006, Tropical Storm Alberto became a storm north of the Yucatan Peninsula on June 11 and made landfall in the Big Bend area of Florida on June 13. The center of Tropical Storm Alberto moved from about 350 miles west of Fort Myers on the morning of August 12 to about 80 miles west of Cedar Key on the morning of August 13. Alberto brought widespread rains of 2 to 5 inches with isolated 7 inches to west central and southwest Florida. In Hillsborough County, a peak wind gust from the southwest of 49 knots (56 MPH) at 2:37 AM EDT was recorded at the MacDill Air Force Base (KMCF). The storm surge was 3.28 feet at McKay Bay and 2.75 feet at the Old Port Tampa COMPS station. The overspray from the surge combined with fresh water flooding closed parts of Bay Shore Blvd.

Probability: More than 37 hurricanes and tropical storms have passed within 60 nautical miles of Tampa Bay since 1871, which equates to an occurrence every 3.62 years.

It is considered that the occurrence of a hurricane in the Tampa Bay area on an annual basis is high.

The coastal regions of the United States are associated with intense winds from tropical storms and thunderstorms. It is not uncommon to have winds exceed 100 mph within these areas. Florida, including Tampa Bay, is susceptible to winds of greater than 100 mph on a regular basis. According to data from the American National Standards Institute -- 1982, the Tampa Bay area is identified as having winds in excess of 100 mph return at an annual probability of 0.2% (a 50 year storm event). The probability is greater for an occurrence of a storm with 70 mph winds.

Severity of Event / Consequences: Using the 2003 Hurricane Evacuation Zones, some of the major commercial, industrial, and residential areas impacted would include:

- Category 1 storm: Rocky Point; the western, southern, and eastern edges of the Interbay Peninsula including portions of MacDill Air Force Base; Davis Island; Harbour Island; Hookers Point; Port Sutton; Riverview; Gibsonton; Big Bend; Apollo Beach; Ruskin; and portions of the Hillsborough, Alafia, and Little Manatee Rivers floodplain.
- Category 3 storm: Same as a Category 1 storm; portions of Town N' Country; the Westshore business district including a portion of the western-most runway of Tampa International Airport; two-thirds of the Interbay Peninsula including all of MacDill Air Force Base; the eastern and western sides of the Hillsborough River to the Dam including Downtown Tampa and the University of Tampa; Ybor City south of 7<sup>th</sup> Avenue; portions of the Alafia

River floodplain eastward to Lithia-Pinecrest Road; and areas to the west of U.S. 41 south of Palm River.

- Category 5 storm: Same as a Category 3 storm; expanded portions of Town N' Country; the three runways and portion of the terminal, Tampa International Airport; all of the Interbay Peninsula south of Henderson Avenue; area between Hillsborough Avenue and the U.S. 301/I-75 interchange; area east of the By-pass Canal, south of 7<sup>th</sup> Avenue, and north of the Crosstown Expressway; areas between U.S. 41 and I-75; and expanded areas of the Hillsborough, Alafia, and Little Manatee River floodplains.

Table III.B.3  
Developed Parcels by Hurricane Evacuation Zone  
Potential Damage to the Number of Structures

| Type of Development | Evacuation Zone A | Evacuation Zone B | Evacuation Zone C | Evacuation Zone D | Evacuation Zone E |
|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Residential         | 17,200            | 20,554            | 18,765            | 16,871            | 12,677            |
| Commercial          | 821               | 1,029             | 1,090             | 1,703             | 1,048             |
| Industrial          | 452               | 456               | 448               | 449               | 292               |
| Agricultural        | 212               | 105               | 234               | 168               | 113               |
| Institutional       | 148               | 236               | 208               | 285               | 205               |
| Governmental        | 454               | 236               | 330               | 521               | 316               |
| Assessed Value      | \$3.8 billion     | \$3.2 billion     | \$2.4 billion     | \$2.5 billion     | \$1.5 billion     |

Source: Hillsborough County Hazard Mitigation Section and the City of Tampa, GIS CD 99-2 entered from the Hillsborough County Property Appraisers Database. 1999.

**Storm Surge:** The storm surge is by far the most dangerous of the three hazards, historically causing nine out of ten hurricane related deaths. This surge, when coupled with the breaking waves, will cause great destruction. The more intense the hurricane, and the closer to perpendicular its track is, in relation to the coastline, the higher the storm surge and resulting destruction will be. Also impacting on the height of storm surge is the depth of the water along a threatened coastline. Because of the configuration of Tampa Bay and the high shoaling factor (shallow water and gradual slope of the Gulf bottom) off the central west coast of Florida, Hillsborough County will receive higher surges than those indicated in the generalized Saffir/Simpson Hurricane Scale.

Around 81% of the 4,213 vacant acres in the Coastal High Hazard Area and 81% of the 71,081 vacant acres in the Hurricane Vulnerability Zone are to be developed for residential, commercial, industrial uses or public facilities, indicating that these risk reductions strategies should be considered prior to development of this vacant land. [Source: Hillsborough County Profile /Integration of the Local Mitigation Strategy Into The Local Comprehensive Plan/Florida Department of Community Affairs/2009 update].

**High Winds:** High winds will also render segments of the population vulnerable to the passing hurricane. Throughout Hillsborough County, the approximately 56,000 mobile and manufactured homes will be unable to withstand hurricane force winds. High winds will also have an impact on the timing of the evacuation order, since they arrive at the coastline several hours before the eye of the storm makes landfall. All evacuation activities must be completed prior to the arrival of sustained gale force winds (40 mph with significantly higher gusts).

Rainfall: Since the structure of every hurricane is unique, there is no way to determine the rate and distribution of the expected six to twelve inches of rainfall generally accompanying the storm. However, it is known that the rainfall has only a minor influence on the storm surge water levels. Rainfall, in itself, will not normally require the emergency evacuation of large numbers of residents during the passage of a hurricane as does the storm surge. However, rain may cause the slowing of traffic and may sever evacuation routes which could severely reduce the number of hours available for the overall evacuation.

The worst case scenario for Hillsborough County is a Category 5 Hurricane heading northeast at less than 15 miles per hour that makes landfall at high tide near Madeira Beach in Pinellas County. A potential 28 foot storm surge in the Back Bay areas would inundate the County several miles inland while the winds would destroy thousands of homes and cause damage to thousands more.

Mitigation Approaches: There is a multitude of approaches to mitigate effects from hurricanes. The following illustrates mitigation initiatives that have been the most effective within the region and throughout the U.S.

- *Public awareness and evacuation plans* -- The loss of life due to hurricanes has been reduced due to warning and forecast advances, public awareness programs and the development of evacuation plans. Evacuation efforts and the knowledge of the evacuation process assist in moving residents from areas vulnerable to storm surge, historically the major hurricane "killer". However, local officials recognize that public education is key to the success of any response plan especially in the densely population metropolitan communities such as Tampa Bay.
- *Building construction* -- Mitigation of property damage has been most successful in areas specifically designated special flood hazard areas through the implementation of construction codes, land-development regulations and growth management policies
- *Special flood hazard area setbacks* -- Land-development regulations developed in response to the county and cities participation in the National Flood Insurance Program have ensured structures constructed within the previous 20 years are elevated above base flood elevations and can withstand potential wave action. In addition, the implementation of Comprehensive Plan policies and the creation of a local Environmental Protection Commission have further minimized flooding impacts.
- Development prior to the adoption of various mitigation policies and regulations remains more susceptible to damage. Public education programs have been initiated to assist businesses and residents learn about retrofitting techniques. Mitigation strategies have also included repetitive loss acquisitions, structural elevations, wind retrofit projects, critical facility retrofits and acquisition of designated conservation areas.

### 3. Thunderstorms

Description / Background: It has been estimated by FEMA that the nation receives approximately 100,000 thunderstorms annually with approximately 10 identified as being classified as severe. Florida leads the country with the number of thunderstorms; however, Florida's thunderstorms are shorter in duration than thunderstorms that develop over western states (Arizona, Utah, and Nevada). Thunderstorms in Florida routinely last approximately 30 minutes and rarely affect an area greater than 15 miles. However, multiple storms can develop together and act as an integrated system.

Hazardous conditions associated with thunderstorms include tornadoes, lightning, hailstorms, downburst and microburst winds, and flooding. Strong "downbursts" (winds) exist within thunderstorms. These winds are concentrated, straight-line, winds created by falling rain and sinking air that exceed 125 mph. A separate wind phenomenon is the "microburst, which are narrowly-concentrated downdrafts can exceed speeds of 150 mph. Lightning occurs in all thunderstorms and can strike anywhere (air and ground). In addition to lighting and as noted previously, thunderstorms contain a variety of hazards including downburst, microburst, tornadoes, and localized flooding and flashfloods. An additional component of a severe thunderstorm is hail. Thunderstorms are classified with respect to the potential damage that can occur. A table describing thunderstorm classifications follows.

Table III.B.4  
Thunderstorm Classifications

| Types Characteristics       | Single Cell Storm   | Multi-Cell Cluster   | Multi-Cell Line (Squall Line)  | Super-Cell   |
|-----------------------------|---|--|--|--|
| Severe Weather Occurs As:   | Brief, isolated downburst; small hail; heavy rain; weak tornadoes | Downbursts, moderate size hail; flash floods; weak tornadoes | Downbursts; small-moderate sized hail; occasional flash floods; weak tornadoes | Strong downbursts; large hail; occasional flash floods; weak-violent tornadoes |
| Severe Event Predictability | Low   | Moderate   | Moderate   | High (Once identified as Super-Cell)   |
| Danger to Public            | Low   | Moderate   | Moderate   | Extreme  |
| Danger to Aviation          | Low   | Moderate to High   | Moderate to High   | Extreme  |

Source: National Oceanic and Atmospheric Agency; Compiled by Hillsborough County.

Location / Risk Assessment: Severe storms can (and have) occurred anywhere in the County.

History of Events: During the period from 1955 to 2009, this area experienced 364 thunderstorms. Thirty-two were classified as severe. (Note: A thunderstorm is classified "severe" when one or more of the following hazardous conditions occur: winds greater than 57 miles per hour, hail 3/4" in diameter or greater, or a tornado develops.)

Florida leads the nation in lightning deaths and injuries. Lightning killed 362 people and injured 1,241 people in Florida during the period 1959- 1995. During the same period, lightning caused 25 deaths and 69 injuries in Hillsborough County. Lightning is often

called the underrated killer. In an average year, more people die from lightning nationwide than from all hurricanes and tornadoes combined. Lightning may strike people directly or it can cause death and injury from fires it initiates.

In the past five years (2004-2009), there have been 16 major storm events recorded in Hillsborough County (National Climate Data Center). Most of the storms caused little or no damage. But on May 29, 2009, an upper low pressure system moved into the Lower Mississippi River Valley from the northern Gulf of Mexico and put deep southwest flow across the central west Florida. Numerous thunderstorms developed across the area producing hail and causing a few lightning injuries. Nine power poles were downed and six more were damaged along a half-mile stretch on Dale Mabry Highway near Geraci Road. There was no damage to trees or buildings along the area, however. The area had been wet from rain over the previous ten days and this may have led to the poles being pushed over in the estimated 50mph winds. Total damages were estimated at \$52,500.

Probability: The probability of a thunderstorm occurring depends on atmospheric and climatic conditions. Information collected by the National Weather Service found that the Tampa Bay has between 100 and 130 storms per year. The principal season for thunderstorms is similar to that associated with hurricanes – warmer tropical climate resulting in unstable air, which is conducive to the development of thunderstorms. Severe thunderstorms can occur at any time (within the Tampa Bay area), but mostly between the period from early summer through late fall.

The greater the number of thunderstorms and/or their duration, the higher the number of lightning and hail occurrences. According to the NOAA National Climatic Data Center, central Florida (including portions of Hillsborough County) has the greatest probability of lightning strikes within the continental United States.

Severity of Events / Consequences: Thunderstorms produce deadly and damaging tornadoes, hailstorms, intense downburst, and microburst winds. Additionally, lightning causes wildfires and damage to property. Damages associated with thunderstorms range from aircraft disasters to millions of dollars of damage from strong winds (including tornadoes), wildfires created by lightning, flash or localized flooding, and hail. They can also result in deaths, primarily as a result of lightning strikes.

A review of the National Climate Center Storm Database for thunderstorms reveals that most storm events in Hillsborough County produced less than \$50,000 in damage. However, in 2000, it was reported that thunderstorm winds produced widespread damage from near Plant City west to Thonotosassa. Thunderstorm winds destroyed two hangers and damaged eight small planes five miles north northwest of Plant City, resulting in \$500,000 in damage. Also, several large trees and power lines were downed by thunderstorm winds along U.S. Highway 301 near Hillsborough State Park. In Thonotosassa, thunderstorm winds overturned a trailer on Five Acre Road.

In 2007, lightning started a fire in a home near Tampa International Airport. The 2,600 square foot home was destroyed. The family of four inside the home when the fire started escaped without injury. Thirty-six firefighters battled the blaze to keep it from spreading to nearby homes. The damage amount includes \$300,000 rebuild the home and \$75, 000 to replace the contents.

In regard to hail, in 2000, it was reported that quarter to dime sized hail fell from downtown Tampa north to Carrollwood, mainly east of the I-275 corridor. The quarter sized hail caused several vehicles to incur glass and body damage from Tampa north to Carrollwood in the amount of \$250,000.

Table III.B.5:  
TORRO Hailstorm Intensity Scale

|            | Intensity Category   | Typical Hail Diameter (mm)* | Probable Kinetic Energy, J-m <sup>2</sup> | Typical Damage Impacts   |
|------------|----------------------|-----------------------------|---|--|
| <b>H0</b>  | Hard Hail            | 5                           | 0-20                                      | No damage  |
| <b>H1</b>  | Potentially Damaging | 5- <b>15</b>                | >20                                       | Slight general damage to plants, crops   |
| <b>H2</b>  | Significant          | 10- <b>20</b>               | >100                                      | Significant damage to fruit, crops, vegetation   |
| <b>H3</b>  | Severe               | 20- <b>30</b>               | >300                                      | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored  |
| <b>H4</b>  | Severe               | 25- <b>40</b>               | >500                                      | Widespread glass damage, vehicle bodywork damage   |
| <b>H5</b>  | Destructive          | 30- <b>50</b>               | >800                                      | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries              |
| <b>H6</b>  | Destructive          | 40- <b>60</b>               |   | Bodywork of grounded aircraft dented, brick walls pitted   |
| <b>H7</b>  | Destructive          | 50- <b>75</b>               |   | Severe roof damage, risk of serious injuries   |
| <b>H8</b>  | Destructive          | 60- <b>90</b>               |   | (Severest recorded in the British Isles) Severe damage to aircraft bodywork                      |
| <b>H9</b>  | Super Hailstorms     | 75- <b>100</b>              |   | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| <b>H10</b> | Super Hailstorms     | >100                        |   | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Approximate range (typical maximum size in bold), since other factors (e.g. number and density of hailstones, hail fall speed and surface wind speeds) affect severity The TORRO Hailstorm Intensity Scale (H0 to H10) in relation to typical damage and hail size codes. Size codes are presented in following table.

Table III.B.6:  
Hail Size and Diameter in Relation to TORRO Hailstorm Intensity Scale

| Size code | Maximum Diameter mm | Description                |
|-----------|---------------------|----------------------------|
| 0         | 5-9                 | Pea                        |
| 1         | 10-15               | Mothball                   |
| 2         | 16-20               | Marble, grape              |
| 3         | 21-30               | Walnut                     |
| 4         | 31-40               | Pigeon's egg > squash ball |

| Size code | Maximum Diameter mm | Description                |
|-----------|---------------------|----------------------------|
| 5         | 41-50               | Golf ball > Pullet's egg   |
| 6         | 51-60               | Hen's egg                  |
| 7         | 61-75               | Tennis ball > cricket ball |
| 8         | 76-90               | Large orange > Soft ball   |
| 9         | 91-100              | Grapefruit                 |
| 10        | >100                | Melon                      |

- **Mitigation:** *Warning systems.* There has been modernization of weather observation equipment, which has been linked to early severe-storm warning systems. Within Hillsborough County, more than 800 such connections have been made (Emergency Operations Center, 1999). Additionally, this access has been made available to all residents and businesses through a purchase of a weather radio (available at retail electronic stores).

Severe weather forecasting/detection is employed at the Tampa International Airport to detect conditions favorable for micro-wind bursts or wind downburst and reduce the chance of aircraft accidents due to “wind sheer”.

Techniques for reducing damage by lightening exist and have been incorporated into building standards. Some of these techniques include grounding various electrical components to lead the lightening away from a structure. Power surge protectors including “whole house protection” are also promoted by utilities to minimize damage.

#### 4. Tornadoes

Description / Background: Severe winds are a major cause of fatalities and property loss in the United States. The two principal sources of wind-related loss of life and property damage are tornadoes and hurricanes. Tornadoes, which affect almost every state, are more frequent and result in greater property damage in the central United States. Winds associated with hurricanes affect most coastal states and territories.

NOAA identifies damaging winds as occurring in two categories: rotational (tornadic) or straight-line (downburst). Both forms of wind are bi-products of a thunderstorm and can cause a similar degree of damage. Tornado wind damage is often highly concentrated over narrow width in relation to their damage length. Downburst wind damage is normally spread out over a broader width but shorter damage length. In either case, both can cause substantial damage to structures.

Tornadoes materialize at the trailing edge of large frontal cyclones that result from the clash of high pressure and low pressure weather systems moving at continental scales across North America. Because of climatic differences, southern states like Florida experience their most violent tornadoes in winter. A tornado event is not limited to winter. They can also be generated during the summer in association with afternoon thunderstorms. Most tornadoes are of short duration and do not touch down as the Category 4 or 5 that make national headlines.

Location / Risk Assessment: In terms of where tornadoes are most likely to occur, the northern portion of the state's Gulf Coast, between Tampa and Tallahassee, along with the Panhandle region have generally experienced more tornadoes. This is primarily due to the high frequency of thunderstorms making their way east through the Gulf of Mexico. But like thunderstorms, a tornado can occur most anywhere in the County.

History of Events: The National Weather Service ranks the Tampa Bay area as one of the highest areas in Florida for the occurrence of tornadoes. One of the most deadly tornado events in central Florida history occurred on October 3, 1992 when four people died and more than \$100 million in property damage occurred.

The U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) estimated approximately \$14 million dollars in damage from severe wind events between 1987 and 1996 within Hillsborough County. The damage was the result of 22 tornadoes and 112 downbursts. These occurrences resulted in one death and 16 injuries.

Since 1950, the National Climate Data Center has recorded 126 tornadoes in Hillsborough County. These tornadoes resulted in three deaths, 129 injuries, and \$24 million dollars in property damage. Research conducted by the City of Tampa staff found that the majority of tornadoes (51%) that have struck Hillsborough County between 1950-1988 had wind speeds of 73 miles per hour or less. A few of these tornadoes had wind speeds of more than 113 miles per hour, the equivalent of a Category 3 hurricane. Four tornadoes have been recorded since 2004.

Probability: Florida has averaged approximately 75 tornadoes per year since 1950, with an average of three deaths and 60 injured per year. According to the National Climatic Data Center, Florida experienced 3,983 tornado events from 1950 through February of 2003.

It should be noted that during severe storms, multiple tornadoes can form. Thus, using probabilities of tornadoes based on the total number of tornadoes reported may be somewhat higher than by using the number of storms in which a tornado(s) formed. Thunderstorms spawn more than 1,000 tornadoes annually. Over the last two decades, there have been more than 106 federally declared disasters due to tornado damage. Severe thunderstorm/wind events occur on the average of 2 every year in the Tampa-Hillsborough County area with sufficient force as to cause damage.

Severity of Events / Consequences: As storm events with wind speeds ranging from 40 mph to greater than 318 mph, tornadoes can be expected to inflict a considerable amount of damage over a wide area. Consequently, tornadoes generate a tremendous amount of debris, which becomes airborne creating additional damage to other structures. Because of extreme winds and the amount of airborne material generated, people living in manufactured or mobile homes are most exposed to damage from a tornado. Additionally, pillared and/or unanchored businesses and residential units are at greater risk of damage from a tornado as well.

The following observation from the LMS profile for Florida is particularly relevant to Hillsborough County, especially considering the county's anticipated continued growth, particularly in the easternmost unincorporated areas:

*There have been many tornadoes in Florida that could have killed scores of people and caused millions of dollars in property damage, but most of these tornadoes did not hit heavily populated areas. The most deadly tornado event in the state's history occurred on February 22 and 23, 1998 in which 45 people were killed. As the state's population continues to increase, particularly in the interior part of the state, the threat of a devastating tornado event grows.*

**The Fujita Scale** (also known as the Fujita-Pearson Scale) may not be a perfect system for linking damage to wind speed, but it had distinct advantages over what had gone on before its inception. And it was simple enough to use in daily practice without involving much additional expenditure of time or money. From a practical point of view, it is doubtful that any other system would have found its way into widespread accepted use, even to this day. The entire premise of estimating wind speeds from damage to non-engineered structures is very subjective and is difficult to defend from various meteorological perspectives. Nothing less than the combined influence and prestige of the late Professor Fujita and Allen Pearson, director of NSSFC (National Severe Storm Forecast Center) in 1971 could have brought this much needed system into widespread use. The FPP scale rates the intensity of the tornado, and measured both the path length and the path width. The Fujita part of the scale is as follows: (Source: <http://www.tornadoproject.com/fscale/fscale.htm>)

Table III.B.8  
The Fujita Scale

| <b>F-Scale Number</b> | <b>Intensity Phrase</b>    | <b>Wind Speed</b>  | <b>Type of Damage Done</b>   |
|-----------------------|----------------------------|--------------------|--|
| <b>F0</b>             | <b>Gale tornado</b>        | <b>40-72 mph</b>   | <b>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</b>  |
| <b>F1</b>             | <b>Moderate tornado</b>    | <b>73-112 mph</b>  | <b>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</b> |
| <b>F2</b>             | <b>Significant tornado</b> | <b>113-157 mph</b> | <b>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</b>   |
| <b>F3</b>             | <b>Severe tornado</b>      | <b>158-206 mph</b> | <b>Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted</b>  |
| <b>F4</b>             | <b>Devastating tornado</b> | <b>207-260 mph</b> | <b>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</b>  |

|           |                                  |                             |   |
|-----------|----------------------------------|-----------------------------|---|
| <b>F5</b> | <b>Incredible<br/>tornado</b>    | <b>261-<br/>318<br/>mph</b> | <b>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-inforced concrete structures badly damaged.</b>   |
| <b>F6</b> | <b>Inconceivable<br/>tornado</b> | <b>319-<br/>379<br/>mph</b> | <b>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies</b> |

Mitigation: The techniques used to mitigate the destruction caused by tornadoes are similar to those used for other wind hazards. The potential of extreme damage from a severe tornado will, however, make it difficult to mitigate in a cost-effective manner. The best protection from a tornado is provided by the type of construction and the reinforcement of walls, floors, and ceilings. Proper anchoring of walls to foundations and roofs to walls is essential for a building to withstand certain wind speeds (Residential Retrofitting, FEMA, 1997).

Additionally, there has been modernization of weather observation equipment and its linkage to early severe-storm warning systems.

The National Oceanic and Atmospheric Agency has produced standards to assist in reducing the risks associated with tornadoes. These include:

- Improve radio and wire communications with the media,
- Educate the public regarding the “safe room”,
- Equip gathering places with weather radios with an audible alert of warning,
- Continue awareness and preparation efforts in schools, and
- Make special efforts to inform mobile home residents.

The Hillsborough County Emergency Operations Center has implemented the aforementioned programs.

## **5. Flooding**

Description / Background: Flooding can occur in most communities in the United States. Flooding can result from the overflow of major rivers and their smaller tributaries, storm surge from hurricanes and other coastal storms, or inadequate local drainage.

Historically, floods have been a factor in over 80 percent of all Presidential-declared disasters. The Nation's strategy for reducing flood damages has evolved from a reliance almost solely on structural flood control projects to a more comprehensive approach that emphasizes non-structural measures such as local land-use planning and zoning, building codes, and acquisition or relocation of flood prone buildings.

The importance of a sound flood management policy is evident when it is considered that flooding and water related damage account for 80 percent of Federal disaster declarations.

The National Flood Insurance Program (NFIP) has played a critical role in fostering and accelerating this change. NFIP was established by the National Flood Insurance Act of 1968, which makes federally backed flood insurance available in those states and communities that agree to adopt and enforce floodplain management measures that meet or exceed minimum Federal criteria. NFIP was broadened and modified by the Flood Disaster Protection Act of 1973, which requires the purchase of flood insurance as a condition of receiving any form of Federal or federally related financial assistance. The National Flood Insurance Reform Act of 1994, strengthened NFIP by providing for mitigation insurance and establishing a grant program for State and community flood mitigation planning and projects.

Forty percent (40%) of the total flood insurance policies are within Florida, with 60% of flood claims being made through the State (Regional Office, FEMA, 1999). In Hillsborough County there are nearly 40,000 structures with coverage in excess of \$4.9 billion. More information on NFIP is located in Section V. Of the 700,000 structures in the County, FEMA has identified more than 400 as having received repetitive flooding. The National Flood Insurance Act of 1968 also requires that the President develop a Unified National Program for Floodplain Management. In 1994, a report on this program was provided by the Federal Interagency Floodplain Management Task Force. The update includes a set of national goals for floodplain management to focus the efforts of all levels of government as well as the private sector. In addition, Executive Order 11988, Floodplain Management, issued in 1977, requires that Federal agencies undertake a planning process prior to taking actions in, or that impact on, floodplains. The Midwest Floods of 1993 resulted in a further evolution in Federal flood policy. There is now a new emphasis on the acquisition or relocation of flood-damaged properties using funding from a number of Federal programs and from state and local governments and the private sector.

Location / Risk Assessment: The types of flooding events that have occurred within Hillsborough County include: inland, riverine, local drainage and high groundwater, fluctuating lake levels, and tidal surge.

- Inland flooding is a localized event associated with heavy rainfall and is usually occurring in areas identified as being within the 100-year floodplain or along recognizable drainage channels. Principal areas most susceptible to flooding in a 100-year event include: the western and southern portions of the Interbay Peninsula, Davis Island, Harbour Island, Hookers' Point and port areas of Tampa, unincorporated areas of Odessa and Ruskin, and the floodplains of the Hillsborough, Alafia, and the Little Manatee Rivers.

- Riverine flooding occurs following heavy rainfall events over an extended period of time. Areas in the county susceptible to this kind of flooding can be found along the Alafia and Little Manatee Rivers.
- Drainage/stormwater flooding usually occurs following a heavy rainfall event over a relatively short period of time. This type of flooding is usually localized to urban areas.
- Tidal flooding is the result of the effects of wind and low pressure in coastal areas. The effects are exacerbated when combined with high tide.
- Fluctuating lake levels is associated with either large weather systems and/or a continuous rainy season.

History of Events: Typically, monthly rainfalls in Hillsborough County range between 1.15 inches for April to as high as 7.61 inches for August. It is not unusual for individual, heavy rainfall events to occur. Between 1995 and 1998, there were five instances when the amount of rainfall exceeded 3.5 inches in a 24-hour period. Based on historical patterns, Hillsborough County can expect to receive 1-2 such downpours each year.

The occurrence of flooding in Hillsborough County between 1950 and 2008 has been documented and quantified. The data, however, does not provide an indication of the cause of the flooding. A table listing the flooding events from 1950 to 1998 follows.

Table III.B.9

| <b>Flooding Events in Tampa-Hillsborough County<br/>1950-1998</b> |           |          |          |                     |
|---|-----------|----------|----------|---------------------|
| Type  | #         | Deaths   | Injuries | Property Damage     |
| Coastal Flooding  | 1         | 0        | 0        | \$1,700,000         |
| Flash Flood   | 4         | 0        | 0        | \$200,000           |
| Flood   | 14        | 1        | 1        | \$7,620,000         |
| Riverine  | 21        | 0        | 0        | \$5,220,000         |
| Urban/Small Stream Flood  | 27        | 0        | 0        | \$975,000           |
| <b>Total</b>  | <b>67</b> | <b>1</b> | <b>1</b> | <b>\$15,715,000</b> |

Source: National Climate Data Center Severe Weather Events Database

Only one flood has been recorded since 2004. That was the February 3, 2006 flash flood. The combination of tropical moisture flowing into a line of thunderstorms and an approaching upper level disturbance allowed a train of intense thunderstorms to repeatedly cross over parts of the Tampa Bay area. Between 8 and more than 11 inches of rain fell in roughly a five hour period in a five mile wide stripe extending from Madeira Beach northeast through Pinellas Park, then across Old Tampa Bay to west Tampa, including Tampa International Airport. Most of the storm's effects were concentrated in Pinellas County. In Hillsborough County, 8.24 inches of rain were recorded at Tampa International Airport.

Probability: Flooding varies within the county. Base on the preceding table, the Tampa-Hillsborough area may have a major flood event on the average of once a year.

It has been determined that structures that are within the 100-year flood elevation have a 26% chance of being flooding in any given year. The actual risk of flooding varies on the height of the “finished floor” elevation. Because of the varied background associated with construction within the county, some structures flood at a two year interval (a severe flooding problem).

FEMA has quantified the probability of flooding through the preparation of Flood Insurance Rate Maps under NFIP. Made available to all jurisdictions, these maps delineate the 100-year floodplain. In using the maps, it is important to note that it is probable that no one storm will inundate all the areas within the flood zone and that areas outside the identified 100-year floodplain may be flooded.

Severity of Events / Consequences: For those residents of Hillsborough County who live along the coast, the Hillsborough, Alafia, and Little Manatee River, within the 100-year Special Flood Hazard Area, or urban neighborhoods, living with the flooding is a way of life. While the chances of flooding are not a common event, should it occur, the consequences can range from annoying to catastrophic.

In review of the National Climatic Center database and the National Weather Service Hydrologic Prediction Service websites widespread heavy rain associated with Hurricane Frances across west central Florida lead to record flooding on many of the rivers. All elevations are shown assuming vertical elevation used is NAVD 88. The Hillsborough River at the Morris Bridge (flood stage 32 feet) reached its all time high of 34.38 feet NAVD of elevation on September 8<sup>th</sup> (This event was not identified with meeting the 1% probability flood elevation). Road and ground flooding begins at a trailer park (no structures flooded) downstream from Morris Bridge and just upstream from the northern end of the Tampa Bypass Canal. At flood elevation 35 feet portions of Morris Bridge Road about  $\frac{3}{4}$  of a mile south of the bridge begin to flood. The Alafia River at Lithia Pinecrest Road reached the 5<sup>th</sup> highest stage at 22.33 feet of elevation on September 7<sup>th</sup> (not the 1% probability floodway). At 12 feet of elevation water begins to affect River Drive and Squirrel Run Way downstream of SR 640. At 13 feet of elevation River Drive and Squirrel Run Way Downstream of SR 640 are completely covered by water. At 15 of elevation feet additional residences downstream of the SR 640 Bridge begin flooding. At 27 feet water covers SR 640 in the Lithia Pinecrest Area. The Little Manatee River at Wimamau (flood stage 8 feet) reached its all time high of 17.21 feet of elevation on September 11<sup>th</sup> (not the 1% probability floodway). At 11 feet of elevation the river overflows its banks. The canoe rental area floods at 13 feet. At 14.5 feet of elevation flooding of several pre-firm houses begins near 32<sup>nd</sup> and 33<sup>rd</sup> Streets in Ruskin. At 22.5 feet of elevation water reaches the SR 301 Bridge roadbed. Widespread rain associated with hurricanes, tropical storms or El Nino events can be expected to produce similar flooding events. Flooding events reported within the aforementioned did not exceed the 1% probability storm event elevations associated with respective riverine system..

Although improvements have and will be made, floods will continue to occur. The amount of flooding should be reduced as drainage improvements are made and homes built prior to the County’s implementation of the National Flood Insurance Program are upgraded/ removed. As Hillsborough County continues to grow, the issue of flood

protection becomes evermore complicated. These factors include the affects on new development downstream, the increased amount of impervious surfaces and loss of natural water storage areas.

Table III.B.10  
Flood Zones

| Zone  | Description  |
|-------|--|
| A     | An area inundated by 1% annual chance flooding, for which no Base Flood Elevation (BFEs) have been determined. Depth for the 1% probability event is not provided on the Flood Insurance Rate Map (FIRM), which for Hillsborough County is provided by the Community. Flood depths range from 9 to 120 feet depending on the area being reported |
| AE    | An area inundated by 1% annual chance flooding, for which BFEs have been determined. Depth for 1% probability event elevation is provided on the FIRM. Flood depths range from 9 to 120 feet depending on the area being reported.   |
| AH    | An area inundated by 1% annual chance flooding (usually an area of ponding), for which BFEs have been determined; flood depths range from 1 to 3 feet. Such areas are not designated within Hillsborough County.   |
| AO    | An area inundated by 1% annual chance flooding, for which average depths and velocities have been determined; flood depths range from 1 to 3 feet. Such areas are not designated within Hillsborough County.   |
| UNDES | A body of water, such as pond, lake, ocean, etc., located within a community's jurisdictional limits, which has no defined hazard. Such areas are not designated within Hillsborough County.   |
| VE    | An area inundated by 1% annual chance flooding with velocity hazard (wave action), BFEs have been determined. Depths for 1% probability event are provided on the Flood Insurance Rate Map (FIRM).   |
| X     | An area that is determined to be outside the 1% and 0.2% annual chance flood plains.   |
| X500  | An area inundated by 0.2% annual chance flooding; an area inundated by 1% annual chance flooding with average depths of less than 1 foot or with drainage areas of less than 1 square mile; or an area protected by levees for 1% annual chance flooding. Areas are not designated within Hillsborough County.                                   |

Mitigation: Warnings of potential flooding, or an actual flood, is the responsibility of the National Weather Service (NWS) and the Florida Division of Emergency Management (DEM). Warning time for flood events may vary significantly. The least warning time would be with severe thunderstorms, which occur frequently in our area, but give little notice as to the extent of rainfall that can be produce in various parts of the County. With regard to riverine flooding as little as 4-6 hours of warning are possible. An average warning time for coastal flooding would be about 12 - 18 hours, however certain systems could produce more or less warning time.

In addition to warnings and public notification, there are other measures of protecting against floods.

All the jurisdictions in Hillsborough County participate in the National Flood Insurance Program (NFIP). Through this participation, standards exist for mitigation development in areas designated as flooding.

About 54% of the 181,486 vacant acres in the 100-year floodplain are to be developed for residential, commercial, industrial uses or public facilities, indicating risk reduction strategies should be considered prior to development of this vacant land. Source: Hillsborough County Profile /Integration of the Local Mitigation Strategy Into the Local Comprehensive Plan/Florida Department of Community Affairs/2009 update.

Through the NFIP, development regulations have been approved that assist in ensuring new development is designed and constructed in a fashion that is more flood-resistant and out of the 100-year floodplain.

## **6. Winter Storms**

Description / Background: Severe winter storms can affect the Tampa Bay area. Although Hillsborough County is not affected by snow, significant freezes have occurred with significant impact to the agriculture industry. Winter storms may be accompanied by other hazards, such as coastal flooding, strong winds (tornadoes), wind-chill, and power outages. These effects disrupt commerce, transportation, and may result in the loss of life; however, freeze events do not have a large scale effect on buildings.

Location / Risk Assessment: Typically, winters are mild with low temperatures ranging around 50 degrees. Freezing temperatures can occur on one to two mornings per year during December through February. In some years no freezing temperatures occur. Snowfall is very rare. Based on the 1951 – 1980 period, the average first occurrence of 32 degrees F in the fall is December 26 and the average last occurrence in the spring is February 3.

History of Events: Between 1999 and 2008, Hillsborough County experienced 22 temperature extremes; 17 freezes, 3 extreme wind chill and 2 wind-chill. The winter “No-Name” storm that affected Tampa Bay in March 1993 is considered one of the worst non-tropical storms in United States history. Equivalent to a Category 2 hurricane, it caused a significant amount of flooding and power outages within the Tampa Bay area and accounted for more than \$2 billion of damage across the eastern United States. From 2004-2009 there have been 3 extreme cold events. No damages to crops or deaths were recorded.

Probability: The probability of a damaging freeze in any given year is considered low to moderate. Based upon historical trends, it is expected that Hillsborough County will receive a damaging freeze, on an average, approximately once every three to four years.

Severity of Events / Consequences: Although the possibility of a major freeze in Hillsborough County is considered rare, they have occurred with devastating consequences. Since 1960, the County has experienced three such events: 1962, 1977, and 1983. The latter two resulted in over \$163 million in agricultural losses. In addition to the immediate economic impact of these freezes, a secondary impact was its contributing effect of the abandonment of many citrus groves and their conversion to urban uses. Hillsborough County could expect several nights below 30 degrees.

Mitigation: Techniques to mitigate the destruction caused by freezes are similar to measures used for other severe-storm hazards. Additionally, there has been

modernization of weather observation equipment, which has been linked to early severe-storm warning systems.

To assist with power that may accompany a severe freeze, utility companies and the Hillsborough County Emergency Operation Center have developed a “Response Plan for Power Shortage Emergencies Caused by Extreme Weather Conditions.” The Plan identifies strategies to minimize power outages due to severe weather (either through equipment failures or greater than peak usage of power) and to ensure “critical facilities” operations are maintained.

## **7. Droughts**

Description / Background: Drought is a normal phenomenon of all climates. The technical identification is a water shortage caused by a deficiency of rainfall. Additionally, a drought can be aggravated by other factors, such as high temperatures, high winds, and low humidity. The severity of drought depends on a multitude of factors, which include duration, intensity, geographic extent, water supply of the region, and demands by the local community on the existing water supply. The Federal Emergency Management Agency has identified four types of droughts: meteorological, hydrologic, agriculture, and socioeconomic; however, drought events do not have a large scale effect on buildings.

Location / Risk Assessment: The risks associated with droughts are both social and economic. On the social side, there is the impact on available potable water resources and the subsequent need to take corrective measures. On the economic side, there is the impact on agriculture and those businesses which depend on water such as landscaping and recreation. Representing a combination of both social and economic risk is the short and long-term environmental impacts of a drought. Droughts can occur countywide.

History of Events: For Hillsborough County and the Tampa Bay region as a whole, droughts are becoming a common event. The area has experienced several drought events over the last ten years. The National Drought Mitigation Center indicates that the last began in March 2000 and did not end until 2003.

According to the Florida Drought Monitor, Florida has entered into a second year of drought conditions, as statewide average rainfall deficits during 2006-07 are the largest observed since the mid 1950s. Approximately 20% of Florida is experiencing severe to extreme drought conditions as of January 1st, 2008. The drought has been most pronounced in southwest Florida and the Kissimmee River watershed. Conditions in Tampa were extreme enough to warrant emergency watering restrictions.

Probability: There are no common techniques determining the return of a drought event, so people rely on drought indices to detect and measure droughts. The National and Florida Drought Monitor tracks several indices which can provide a picture of the conditions that can cause and support a drought.

Severity of Events / Consequences: The Palmer Drought Index is an often-used measurement of dryness based on recent precipitation and temperature. The index has proven most effective in determining long-term drought — a matter of several months. It

uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought. The index also is used to describe wet spells, using corresponding positive numbers. According to the September 2009 Palmer Drought Index maps, Hillsborough County remains in a moderate drought condition.

According to Florida's Department of Environmental Protection, records show 2006-2007 were the driest back-to-back calendar years Florida has experienced, based on data dating back to 1932. The Southwest Florida Water Management District has imposed restrictions on watering as a means to conserve drinking water during the drought.

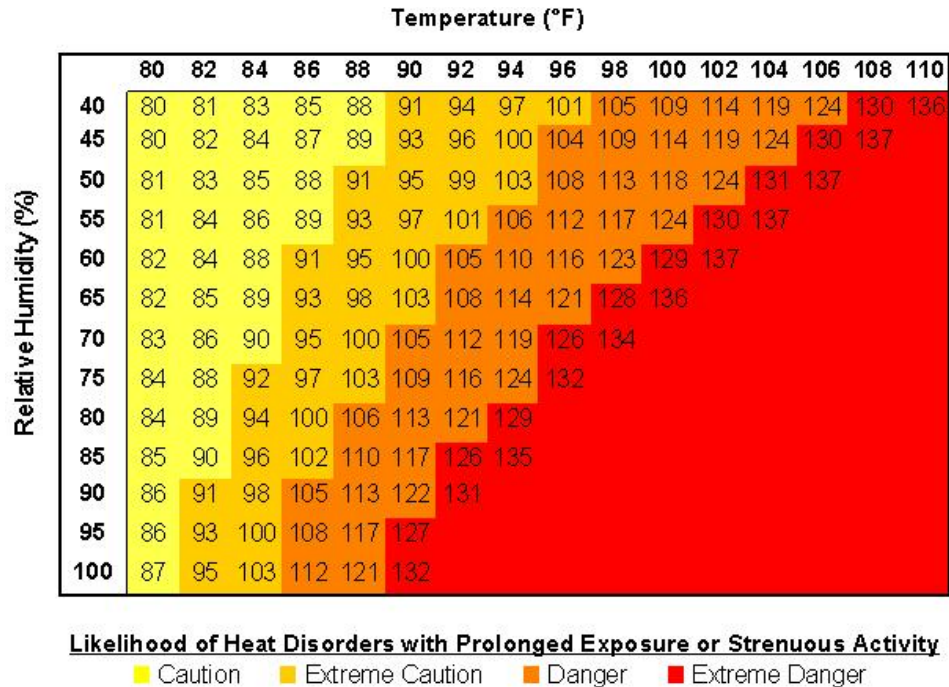
Mitigation: Preplanning is the key to drought mitigation. Measures must be considered to both increase available water supplies and improve the efficient use of those supplies.

The Tampa Bay area lies within the Southwest Florida Water Management District. The District has developed a water management plan that is implemented during time of droughts to minimize their adverse effects. Additionally, the majority of the area's potable water supply is provided by Tampa Bay Water. These two agencies work closely with local governments to ensure mitigation strategies are implemented during a time of drought.

## **8. Extreme Heat**

Description / Background: Extreme Heat conditions are defined by summertime weather that is substantially hotter and/or more humid than average for a location at that time of year. The National Weather Services measures extreme heat using the "Heat Index" (HI). The HI, given in degrees F, is a measure of how hot it really feels when relative humidity (RH) is added to the actual air temperature. The HI for any temperature can be found by cross-checking the temperature (found on the top of the table) and the relative humidity (RH) found on the left of the table. The point of intersection is the measure of how hot it really feels. However, extreme heat events do not have a large scale effect on buildings.

**Figure III.B.1**



**Location / Risk Assessment:** Extreme heat conditions generally occur throughout Hillsborough County during any single event. People in Tampa, Temple Terrace, Plant City and unincorporated Hillsborough County are vulnerable to the dangers present during these conditions.

**History of Events:** According to data compiled by the National Climate Data Center, there was one recorded excessive heat incident between 1995 - 2009. On July 21, 2006, an 11-year-old boy died of heat stroke during football practice. A 12-year-old boy died a few days earlier during football practice but the cause was undetermined.

**Probability:** In the 14 year period from January 1995 through February 2009, there was 1 extreme heat event recorded in Hillsborough County. This indicates a 7% probability that an extreme heat event will occur in Hillsborough County in any given year.

**Severity of Events / Consequences:** Unlike other natural hazard events extreme heat does not leave physical damage. There is little or no damage to buildings. The toll is on people and can lead to extreme medical conditions and death.

Heat related injuries are a major concern with heatstroke being a severe medical condition that requires emergency medical treatment. The most vulnerable are the elderly, infants, young children, and people with chronic health problems. In central Illinois most deaths have occurred when people have been in a closed home with no air conditioning. Because the concrete and asphalt in urban areas retains heat and releases it at night offsetting any relief that otherwise would have been felt, there is a greater concern in these areas. The loss of power can also exacerbate a serious situation

Extreme heat is a combination of high temperatures and high humidity. Conditions of extreme heat are dangerous and can cause injury and death. The body cools itself by sweating because the evaporation of moisture has a cooling effect. High humidity reduces this evaporation and hinders the body's effort to cool itself. Extreme heat can manifest itself in the following symptoms:

- Heat cramps: muscular pains and spasms due to heavy exertion. They usually involve the abdominal muscles or legs. It is generally thought that the loss of water from heavy sweating causes the cramps.
- Heat exhaustion: occurs when people exercise heavily or work in a warm, humid place where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to vital organs. This results in mild shock.
- Heatstroke/Sunstroke: LIFE THREATENING. The victim's temperature control system stops working as the body quits producing sweat. The body temperature can rise so high that brain damage and death may result.

The relationship of heat disorders to heat index (shown above) is summarized below:

- Heat Index of 130° OR Higher: Heatstroke/Sunstroke Highly Likely with continued exposure
- Heat Index of 105°- 130°: Sunstroke, Heat Cramps or Heat Exhausting Likely, and Heatstroke possible with prolonged exposure and/or physical activity.
- Heat Index of 90°- 105°: Sunstroke, Heat Cramps or Heat Exhausting Possible with prolonged exposure and/or physical activity.
- Heat Index of 80° - 90°: Fatigue possible with prolonged exposure and/or physical activity.

Mitigation: In general, elderly persons, small children, chronic invalids, those on certain medications or drugs (especially tranquilizers and anticholinergics), and persons with weight and alcohol problems are particularly susceptible to heat reactions, especially during heat waves. The National Weather Service (NWS) Weather Forecast Office (WFO) can issue the following heat-related alerts as conditions warrant so that individuals and institutions can plan for potential severe heat impacts.

- Excessive Heat Outlook: when the potential exists for an excessive heat event in the next 3 to 7 days. An outlook is used to indicate that a heat event may develop. It is intended to provide information to those who need considerable lead time to prepare for the event, such as public utilities, emergency management and public health officials.
- Excessive Heat Watch: when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A watch is used when the risk of a heat wave has increased, but its occurrence and timing is still uncertain. It is intended to provide enough lead time so those who need to set their plans in motion can do so, such as established individual city excessive heat event mitigation plans.

- Excessive Heat Warning/Advisory: when an excessive heat event is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurrence. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property.

## 10. Sinkholes

Description / Background: For the residents of Florida, the sudden appearance of sinkholes is not an unusual occurrence. Taken from an Issue Paper, the Southwest Florida Water Management District (SWFWMD) noted that sinkholes are as common in Florida as lakes, rivers and warm weather. In fact, many lakes in central Florida were formed by sinkholes. As the name suggests, sinkholes result from the ground sinking and creating a depression. The cause of the depression is underground in the porous limestone base. As rainfall is filtered through the ground to the limestone, it erodes and dissolves the soluble rock and creating cavities in the subsurface. Another cause of sinkholes is the lowering of underground water levels, either by lack of rainfall or over pumping for water supply. In this case, the water in the underground cavities helps support the layers holding up the land surface.

Location / Risk Assessment: Within the 17 counties which comprise SWFWMD, sinkholes develop more frequently north of Tampa Bay where the limestone base is closest to the land surface and the supporting sand and clay layers are thin. The following graphic identifies the increasing possibility of sinkhole activity with SWFWMD.

History of Events: As seen in the graphic, using the Alafia River as a reference point, Hillsborough County is roughly divided in half in terms of the possibility of sinkhole formation. North of the Alafia River, sinkhole formation increases in possibility whereas south of the river, sinkhole formation is rare. These are validated by the fact that SWFWMD has recorded 300 sinkholes in Hillsborough County since 1970. Of these, 290 occurred north of the Alafia River and 10 south of the river.

The Florida Center for Instructional Technology at the University of South Florida has produced a map of sinkhole activity in Hillsborough County. The map depicts the location of more 300 sinkholes and indicates that the central portion of the County is

most susceptible to sinkholes. From 2005-2009, seven sinkholes have been recorded by the Florida Department of Environmental Protection in Brandon, Lutz and Tampa.

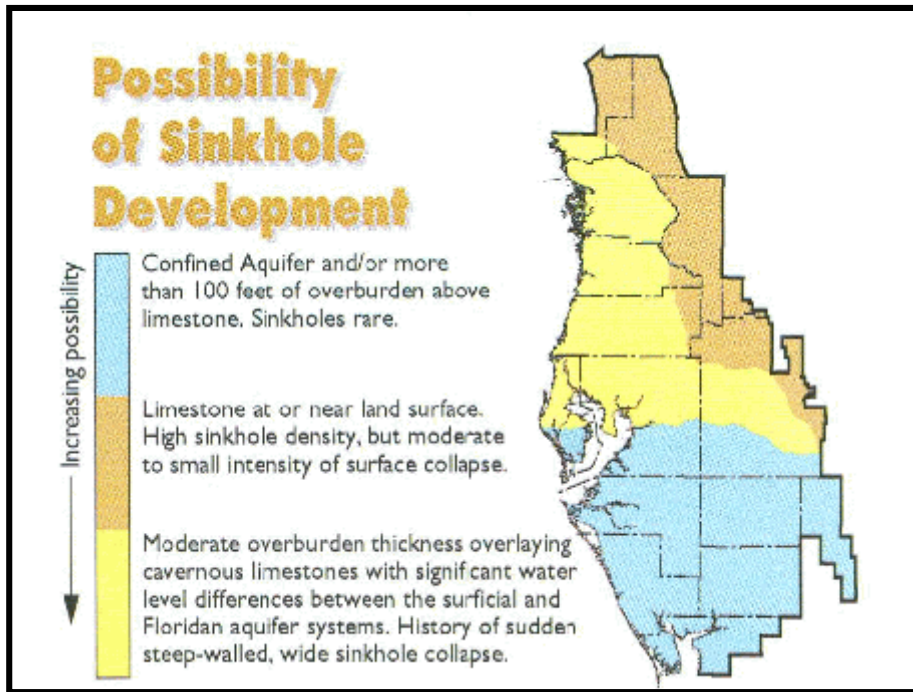
Probability: The difficulty in emergency planning for sinkholes is the fact of not knowing exactly where and when they will occur. Geologists have a good idea where sinkholes are likely to form geographically, but it's much more difficult to accurately predict specifically where sinkholes will occur. As a consequence, while the damage could range from low to high, it is almost impossible to predetermine in Hillsborough County which individual property could be affected by sinkhole activity. All that be ascertained with any certainty is that the likelihood of sinkholes will occur in that portion of the County located north of the Alafia River. See Figure III.B.2

Severity of Events / Consequences: Sinkholes generally do not cause tremendous damage since their average size is generally small, less than 10 feet in width. Structural cracks, sagging floors, or large potholes in yards or roadways will usually occur due to a sinkhole collapse.

The primary risk associated with sinkholes is the collapse of a structure due to the ground giving way underneath. Such occurrences are normally not widespread, but they can totally engulf and destroy individual structures.

The greatest threat to the general population and overall public welfare would result when a sinkhole occurred at a site containing hazardous materials. If severely damaged by a sinkhole, chemicals could be released causing severe health risks to nearby residents. There is also a potential risk that a sinkhole, disrupting a facility's foundation, might cause hazardous materials to enter the underground water system.

Figure III.B.2



**Mitigation:** It is difficult to determine where and when a sinkhole will occur. It is possible to detect sinkholes in the early stages of development. Sites can be examined for the sinkhole activity through ground penetrating radar. Once found, preventative measures can be undertaken, such as filling the void, to prevent a collapse of land from occurring. In general, such measures can be costly and are limited to projects that would be significantly impacted financially as a result of a sinkhole.

For residential homes, sinkhole damages are covered by homeowner's insurance. In such cases, a residential homeowner may not be willing to invest in costly mitigation measures (which may not necessarily ensure a structure's survivability), when in reality the annual insurance premiums already cover the potential risk. Because sinkhole occurrences are few, this may be the most effective form of mitigation for homeowners.

## 11. Wildland Fires

**Description / Background:** As people search for a place to live, they often desire two conflicting conditions: Live in the country but have urban services readily available. This desire for urban/rural living has been given the name "wildland/urban interface." As described by the Florida Division of Forestry, the wildland/urban interface "refers to that geographical point where two diverse systems – wildland and urban – meet and affect each other and give rise to conflicts between societal values and expectations concerning the management of natural resources." The major problem resulting from the wildland/urban interface is wildfire.

**Location / Risk Assessment:** Much of the unincorporated area of Hillsborough County is located in the wildland/urban interface. As the population of unincorporated Hillsborough

County continues to grow, the number of residents residing within the wildland/urban interface also grows. The University of Florida's Institute of Food and Agricultural Science has identified the fire characteristics of nine ecosystems found in Florida's wildland/urban interface.

Table III.B.11  
Ecosystems in Florida's Wildland

| Ecosystem                          | Fire Frequency (years) | Wildfire Hazard |
|------------------------------------|------------------------|-----------------|
| Scrub Pine                         | 10 – 100               | Extreme         |
| Pine Rockland                      | 3 – 10                 | Extreme         |
| Pine Flatwood                      | 1 – 8                  | Extreme         |
| Dry Prairie                        | 1 – 4                  | High            |
| Marsh                              | 1 – 5                  | High            |
| High Pine/Sandhill                 | 1 – 8                  | Medium          |
| Swamp                              | 5 – 200                | Medium          |
| Hardwood Hammock                   | 30 – 50+               | Low             |
| Hardwood Rockland/Tropical Hammock | 59+                    | Low             |

Three of these ecosystems can be found in Hillsborough County: Pine Flatwood, High Pine/Sandhill, and Swamp.

History of Events: Nationally, since 1970, wildfires have destroyed 10,000 homes and 20,000 other structures, cost \$20 billion to suppress, and \$6 billion in restitution. Wildfires in Florida are not an unusual occurrence. From 1981 to 1996, there was an average of 6,080 wildfires each year, burning 219,725 acres. According to the State, since 1998, there have been more than 21,000 wildfires, devastating over 1.3 million acres, and destroying more than 1,000 structures. The largest and costliest wildfires in Florida history occurred in May 2001. The Mallory Swamp fire near Perry burned 57,000 acres and cost an estimated \$6.7 million to suppress.

In May, 2006 Interstate 75 was closed for six hours between Gibsonton Drive and Big Bend Road as 130 emergency workers fought the blaze with plows, helicopters, brush trucks and water tankers. Thousands of people were evacuated in developments east of the interstate when the fire jumped the road.

Probability: While the conditions which are favorable for wildfires are well known, where and when they will occur cannot be predicted. The three principal ingredients for wildfires are topography, fuel, and weather. According to the Florida Division of Forestry, Florida is unique in that weather and topography are different from other parts of the country. Here we have relatively flat terrain and abundant rainfall. These factors normally afford firefighters an opportunity to control interface fires in a timely and effective manner. When rainfall is below normal or a killing frost has decimated vegetation or vegetation is allowed to accumulate, the likelihood for a wildfire increases.

According to the State, Florida's typical fire season is from January through May. The potential for wildfires increases dramatically during the dry season as a result of low humidity and high winds. The largest number of lightning caused wildfires occurs in July coinciding with the peak of the thunderstorm season. The top three causes for wildfires

in Florida, as determined by the Florida Division of Forestry are arson/incendiary, escaped debris burning, and lightning.

Severity of Events / Consequences: The consequences of a wildland/urban interface wildfire were described by the Florida Division of Forestry as follows: Hillsborough County could expect a wildfire with greater than 500 acres burned with evacuations and multiple structures at risk.

“Today, most people’s dream home is a place tucked in among the trees with a view of a lake or stream; a place where they can get away from it all, a place that is secure; serene and most of all quiet. Unfortunately, these places...come at a cost; the very real danger of wildfires....Wildfire often begins with little or no warning, spreading quickly, igniting trees, brush and your home.”

In addition to homes, wildfires can also damage/destroy commercial structures, public infrastructure, and agricultural activities. In other words, their impact can be far ranging.

Mitigation: The logical method for mitigating the threat of wildland/urban interface wildfires would be to stop development from occurring in the interface. Of course, this will not occur.

About 78% of the 63, 782 vacant acres that are susceptible to wildfire are to be developed for residential, commercial, industrial uses or public facilities, indicating that these risk reduction strategies should be considered prior to development of this vacant land. [Source: Hillsborough County Profile /Integration of the Local Mitigation Strategy into the Local Comprehensive Plan/Florida Department Of Community Affairs/2009 update].

One method for mitigating for the dangers of wildfires would be through the application of the development principals outlined through the Firewise Communities program. The concepts of this program include: establishment of defensible space; fire-resistant additions, preparation of a disaster plan; lean, clean, and green landscaping, fire-resistant roof construction; fire-resistant roof construction; and emergency access.

For Hillsborough County, a second mitigation measure would be the continued implementation and enforcement of the Hillsborough County Emergency Management’s wildfire preparedness guidelines.

### **13. Tsunamis**

Description / Background: When a person hears the term “tsunamis” odds are that they’ll think of a large wall of water resulting from a major earthquake somewhere in the Pacific Ocean. The unfortunate truth is that such a belief is only partially correct. While tsunamis can be very large, they can also be only a few meters tall. Tsunamis may be generated by any event which results in the vertical displacement of the water column. Although generally associated with earthquakes, tsunamis may also be caused by underwater landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites.

Of equal concern should be danger posed by a rouge wave. Rouge waves are sudden, extreme waves with wave height well above the background waves. They generally occur in rough sea conditions

Location / Risk Assessment: Since tsunamis generally result from earthquakes, it is not surprising that they would most frequently occur along the boundaries of tectonic plates as found along the continental Pacific coast, Alaska, and Hawaii. This assumption may not be totally true, however. In an article entitled *Tsunamis and Tsunami-Like Waves of the Eastern United States* (Science of Tsunami Hazards, Volume 20, 2002) it was noted that since 1600, forty tsunamis and tsunami-like waves have occurred in the eastern United States? The Atlantic coast of Florida was included among those areas feeling the effects of a tsunami.

According to some scientists, certain marine conditions exist which increase the likelihood of the east coast of the United States experiencing a major tsunami. This belief is not shared by all. Tom Hilde of Texas A & M University notes in an article entitled *Tidal Waves, Not Likely In Atlantic* that most of the world's tsunamis are generated at convergent plate margins. The Atlantic margin of the United States is a passive margin, not a plate boundary, and so is not tectonically active. This area has few, and generally low magnitude, earthquakes. Even so, some scientists, such as George Maul, professor of oceanography at Florida Tech, has noted that it's not a matter of if; it's a matter of when the Atlantic will experience a tsunami. In a *"Florida Today"* article, it was noted that although tsunamis are rare in Florida and the Caribbean, geologists say the threat is real."

History of Events: A rogue wave, estimated to be 18 feet tall, hit Daytona Beach on July 3, 1992. It is believed that this particular wave was the result of a series of thunderstorms off the Georgia coast. No other occurrences have been recorded.

Probability: Since Florida is not located along the convergent margins of the tectonic plates, there is no likelihood of earthquake-generated tsunamis. While history has shown that Florida's east coast has experienced some tsunami activity, there is no such record for the Gulf coast. Consequently, it can be assumed that the Gulf coast has little to fear from this natural occurrence.

Severity of Events / Consequences: With their power and little warning, a tsunami has the potential to be destructive both in terms of property damage and loss of life. However, with little historical evidence of tsunami activity on Hillsborough County, the level of severity cannot be quantified.

Mitigation: As noted above, the likelihood of a tsunami affecting Florida is slight. Even so, the possibility of a tsunami affecting the eastern coast of Florida is real. Consequently, emergency management professionals should remain on alert to those events which may result in a tsunami.

## C. TECHNOLOGICAL HAZARDS

### 1. Hazardous Materials

Description / Background: The threat from hazardous materials exists in two forms. The first is from fixed facilities; the second is from materials transported within or through the city.

Location / Risk Assessment: There are a wide variety of facility sites within the county which use or store hazardous materials. Accurate data are not available to make a determination as to the magnitude of potential hazards. In addition, hazardous materials releases result from storage tank and container ruptures or leaks, releases through safety and relief valves, piping ruptures and leaks, fire induced releases, equipment failures, overfills and overflows of storage tanks and human error (FEMA, 1999). Most facilities have taken passive mitigation efforts (i.e., dikes, berms, etc.) to contain liquid spills that might occur. With most extremely hazardous material facilities, receptacles are protected from Florida's worst-case disasters such as hurricanes.

The Port of Tampa contains the largest concentration of hazardous materials in Hillsborough County. Included are such products as petroleum, chlorine, and ammonia. Although these products are stored within an industrial area, the port is located immediately adjacent to downtown Tampa and large residential concentrations on Harbour Island and Davis Island.

History of Events: There are approximately 6,774 hazardous materials events in the U.S. annually. Of these, the greatest risk of an event is associated with the transportation system (FEMA, 1997).

Table III.C.1  
**National Annual Hazardous Materials Events**

|                            |       |
|----------------------------|-------|
| Average Annual Occurrences | 6,774 |
| Percent Transportation     | 80%   |
| Percent Railroad           | 15%   |
| Percent Other              | 5%    |

Source: Federal Emergency Management Agency, 1997; Hillsborough County Emergency Management Operations and Hazard Mitigation Agencies, 1999.

The majority of the transportation hazardous materials events involve tanker trucks or trailers and certain types of bulk-cargo vehicles. Because of the number of miles traveled by these vehicles within the County daily, transportation is the greatest area of potential hazardous materials spills. Additionally, rain, high winds and fires can worsen conditions surrounding these hazardous materials events.

For the City of Tampa, approximately 25.3% of the recorded incidents are related to a hazardous condition other than residential gas and fuel spill emergencies. Damage estimates associated with the hazardous conditions are not available. All calls for hazardous incidents within the City are funneled through the Tampa Fire Rescue Department.

Table III.C.2

| Number of Hazardous Materials Calls - For the City of Tampa<br>1993-1998   |        |       |                |
|--|--------|-------|----------------|
| Hazardous Condition  | Number | %     | 1-year Average |
| Residential Gas Emergency  | 714    | 33.5  | 143            |
| Hazardous Condition  | 540    | 25.3  | 108            |
| Fuel Spills  | 879    | 41.2  | 176            |
| Total Calls (incidents)  | 2133   | 100.0 | 427            |
| Source: Tampa Fire Rescue Department from records of the number of calls placed to the Department between 1993 -1998 |        |       |                |

**Probability:** Presently, there is no analysis on the probability of a hazardous material release or accident in the port area (Tampa Bay Regional Planning Council, 1999). The Regional Planning Council reports that under the law SARA Title III/Emergency Planning and Community Right-to-Know Act (EPCRA) every Section 302 facility must have a hazard analysis performed and made available for public inspection. The analysis must identify a circle of vulnerability (identifying populations at risk) for the most-probable worst-case release and a most-probable release scenario from the facility. These analyses will not provide a probability of release - only what would happen if a release occurred. This information is used to identify those populations and significant facilities (schools, government buildings, hospitals, etc.) which may be at risk and the mitigation measures that may be used in event of failure. The hazard analyses use a "High, Medium, and Low" probability of risk of release and a "High, Medium, and Low" probability of danger.

**Severity of Event / Consequences:** Hazardous materials releases pose short and long-term toxicological threats to humans and to terrestrial and aquatic plants and wildlife. Toxic materials affect people through inhalation, ingestion, and/or direct contact. As noted previously, should a hazardous material spill or accident occur in the Port of Tampa under favorable weather conditions, a significant number of people working, visiting, or living near the port could be adversely affected

**Mitigation:** There are two basic types of applications used to avoid hazardous materials events. These are physical and social adjustments. Physical adjustments include:

- Planning and designing facilities to withstand various natural hazards;
- Identifying and avoiding sites where risks are high;
- Predicting occurrence; and
- Preventing or altering the characteristics of the potential hazard.

Social adjustments for avoiding impacts associated with hazards include:

- Restricting use of land and establishing minimum standards and conditions;
- Implementing public awareness programs;
- Initiating emergency preparedness and evacuation programs;
- Establishing systems of notification;
- Spreading economic loss among a larger population through insurance, taxation and monetary grants; and

- Reconstructing communities to be less vulnerable to future hazard events and releases.

Mitigation also involves the continued dialogue between industry and emergency responders.

## 2. Dam/Levee Failures

Description / Background: When the term “dam” is used, it is normal to think only of structures associated with the impounding of rivers for use as drinking water reservoirs, the production of electricity, or flood control. In Florida, the term can take on an additional meaning, that of impounding clay settling ponds or phosphogypsum stacks associated with the mining and processing of phosphate. Both types of structures can be found within Hillsborough County. Dam/Levee failure is a collapse or breach in a dam or levee. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage amounts can cause significant downstream flooding.

Location / Risk Assessment: Located east of 28<sup>th</sup> Street, just downstream from the City of Temple Terrace, is the City of Tampa’s Hillsborough River Reservoir. The Reservoir is approximately 1,300 acres in size and contains up to 1.6 billion gallons of water. The Reservoir has served as the City of Tampa’s water source since the mid-1920s.

In southeastern Hillsborough County, near CR 672 and SR 39, south of the Alafia River, is the Tampa Bay Regional Reservoir. The Reservoir is being built by Tampa Bay Water to provide an additional source of potable water for the residents of the Tampa Bay area. The 1,100-acre Reservoir has a total volume of 15 billion gallons.

During the 1950s and 1960s, residents along the Hillsborough River experienced several serious flood events. As a consequence, in the 1960s and 1970s, the Tampa Bypass Canal was constructed. Following the course of Palm River, the 14 mile waterway, with its flood-control structures, is intended to redirect rising waters from the Hillsborough River to McKay Bay. In addition to the Tampa Bypass Canal, flood control structures can be found along several of the creeks in the western portions of Hillsborough County. These creeks flow into the northern reaches of Tampa Bay.

Phosphate mining activities can be found in the eastern portions of the County. As noted above, phosphate mining and processing requires the need for water impoundments associated with clay settling ponds at the mining site and phosphogypsum stacks associated with the phosphate processing plant. Generally, phosphate processing plants are located in proximity to the mine sites. The exception to this is the Cargill Plant located at the mouth of the Alafia River on Hillsborough Bay.

History of Events: The construction and safety of dams and levees in Florida is governed by Chapters 62 and 373, FS. Through design and permitting, there is little danger of failure from the Hillsborough River Reservoir, Tampa Bypass Canal, or Tampa Bay Regional Reservoir.

Unfortunately, the same cannot be said for clay settling ponds and phosphogypsum stacks. Since 1988, there have been four failures of such facilities either in or directly impacting Hillsborough County. The following is a summary of these events:

- 1988 and 1993, Riverview, unincorporated Hillsborough County. Acidic water spill at the Cargill (aka Gardinier) phosphate processing plant located at the mouth of the Alafia River.
- November 1994, Hopewell, unincorporated Hillsborough County. Failure of a clay settling pond at the Hopewell Mine spilled approximately 1.9 million gallons of water into the Alafia River. In addition, some flooding occurred in the Keystone area.
- December 1997, unincorporated Polk County. Failure of a phosphogypsum stack at Mulberry Phosphates resulted in 2.0 million gallons of phosphogypsum process water entering the Alafia River.
- September 5, 2004 in Riverview, Florida, a dike at the top of a 100-foot-high gypsum stack holding 150-million gallons of polluted water broke after waves driven by Hurricane Frances bashed the dike's southwest corner. Nearly 60 million gallons (227,000 m<sup>3</sup>) of acidic liquid spilled into Archie Creek that leads to Hillsborough Bay

Probability: There is no method of determining the probability of a dam failure or a historical frequency that can be used to calculate a return interval of an earthen dam failure. Working together, the phosphate industry and the State have proven that a dam monitoring program can be successful in minimizing the risk associated with dam failures through periodic inspections and repair programs. Additionally, a failure due to a single rainstorm or tropical storm event is minimal due to the design of a respective dam and the periodic monitoring such areas receive.

Severity of Events / Consequences: Residents of Tampa living downstream of the Hillsborough River Reservoir are the most vulnerable should there be a dam failure. The exact number of residents which would be affected by such an event would be dependent upon the degree of the failure.

Concern with flooding was a major issue of residents and elected officials during the permitting of the Tampa Bay Regional Reservoir. The potential for such an event was deemed to be slight during the review of the Reservoir's Environmental Impact Statement by the U.S. Environmental Protection Agency and construction permit by the Florida Department of Environmental Protection.

Although it is possible, is not probable that the failure of clay settling pond or phosphogypsum stack would adversely impact county residents. This determination can be made based on the general isolated nature of these operations. Still, as noted in the 1994 event, flooding of residences can occur. As a result of their general isolation, it is not possible to determine the potential number of residents in the unincorporated county who could be affected. The major consequence of a failure event would be the resulting environmental damage should contaminated water reached a creek or river or infiltrate into the groundwater supply.

Mitigation: The State and industry have in-place federally approved dam inspection processes (Federal Insurance Agency, 1998). Areas associated with mining have been identified on growth management maps and within the Hillsborough County Comprehensive Plan. Use of these programs and continued cooperation between the County, State, and industry will serve to minimize the risks of dam failures within Hillsborough County.

### **3. Port Vessel Collision or On-Water Hazardous Materials Spill**

Description / Background: In any mishap within the port, there is a need for one focus point to ensure efficient efforts are taken to minimize risk and to ensure an effective response is given. The U.S. Coast Guard is the principal authority at the Port of Tampa with respect to oil spills or vehicle collisions.

Location / Risk Assessment: Port Vessel collisions and on-water hazardous material spills are most likely to occur in the shipping lanes serving the Tampa Port Authority.

History of Events: Port of Tampa and Port Manatee are major terminuses for petroleum products for west Florida. Accordingly, Tampa Bay is vulnerable to oil spills from shipping accidents. The last major oil spill in August 1993 was caused by a collision of a freighter and two tugs, one pushing a barge carrying 255,000 barrels of Jet A gasoline and one pushing a barge containing 88,000 barrels of diesel fuel. This spill caused significant ecological and economic damage to shoreline and beaches of Pinellas County.

Probability: As a major port, the probability of an accident involving hazardous materials does exist. However, mitigation measures for in-route transportation are in place to minimize exposure to the general populace and to the environment. Thus, the probability of a serious event is considered to be low.

Severity of Events / Consequences: As an active port, two factors are present which contribute to the need for vigilance. First, as a port, hazardous materials will always be present, either in transit or storage. Second, as a port, the potential for accidents is always present, either in the transfer of hazardous materials from ship-to-shore to storage, or transfer from storage to overland transport. Given the amount of hazardous materials found at the port and its location, should a spill or fire/explosion occur the impact on the surrounding community could be catastrophic!

Mitigation: Maintaining safety of port operations is the responsibility of the U.S. Coast Guard's Marine Safety Office. To improve overall safety, this office coordinates its activities with the various governmental agencies of the county, city, and region and industry. This coordination has resulted in several programs being put into place which will improve the overall safety of the port's operation.

In response to the growth of the Port facility, multiple avenues of communications have been obtained and ongoing cross-agency training of personnel has been instituted. In addition, fire-fighting contingency plans have been developed and vessel-response plans have been incorporated to ensure resources are available for operations in the event a major catastrophe should occur.

### **4. Terrorism / Homeland Security**

Description / Background: As the tragic events of September 11<sup>th</sup> demonstrated, the United States is not exempt from the threat of terrorist attack on its home shore. While the kinds of weapons a terrorist may use are varied, the most fearful are those classified as weapons of mass destruction (WMD). Of these, the greatest threat comes from those classified as CBERN or chemical, biological, explosives, radiological and nuclear. In

addition, terrorist attacks may be as common as explosives and as sophisticated as global cyber-attacks.

Location / Risk Assessment: Tampa contains numerous targets of opportunity for potential terrorist groups. Being one of the top 15 media markets in the country, containing a major seaport and international airport, hosting major NFL, MLB and NHL sports teams are all among the factors which could attract terrorist activity to the area. Tampa houses MacDill Air Force Base, a major military base with a worldwide orientation. MacDill is the headquarters for two major commands; special U.S. Operations Command and U.S. Central Command. And it's also where Coalition Village is located, comprised of representatives from 65 nations who are working together to combat terrorism. An incident involving weapons of mass destruction (WMD) by a terrorist organization using chemical, biological, or nuclear substances is a distinct possibility in light of the contemporary worldwide terrorist threat.

Probability: The probably of an event cannot be quantified.

Severity of Events / Consequences: The impact of a single terrorist attack would of course vary depending on the attack. A terrorist attack which is successful could kill or injure a large number of people. There are also potential long-term environmental and/or economic impacts of an attack.

Mitigation: Post 9/11 has placed a greater urgency on the need for vigilance and preparation. Federal, state, and local law enforcement, public safety, and emergency management officials and agencies are working in greater cooperation to coordinate pre-event preparation and potential post-event response.

A renewed interest in Community Emergency Response Teams (CERT) as part of the Citizen Corps has been identified by the LMS Working Group and the community as an invaluable asset in homeland security. (See Resolution supporting the Citizen Corps Council and CERT training)

## **5. Utility Failure/Power Outages**

Description / Background: As growth continues in Hillsborough County, there is an increasing demand for electrical power. Through the 10-year Site Plan process, Tampa Electric Company (TECO) addresses growth in their expansion plans. There may be situations where power generating capability may not meet total demand during extreme weather conditions or after a severe storm.

Location / Risk Assessment: Power outages can occur anywhere in the County.

History of Events: During the Christmas weekend of 1989, the extremely cold weather caused extended power outages throughout the county.

Probability: It is difficult to predict when a power outage may occur, as the northeast power failure showed in 2003.

Severity of Events / Consequences: A power failure is most likely to occur during an extreme weather event. Local governments must be prepared to respond in order to maintain the public safety and health and welfare of its citizens.

Mitigation: TECO actively manages power distribution during shortages. During these periods, one of TECO's power management techniques is to rotate outages among users. There are various facilities in the County that are highlighted as critical users of TECO power during power shortages.

A committee of representatives from the County, the three municipalities and TECO have developed and categorized a critical facility list for the County. All critical facilities have been placed in priority categories. From this critical facility list TECO has developed a restoration priority that will be used during any power shortage emergency.

TECO's goal during any future power shortage emergency is to limit power outages to any circuit in the county to 15 minute power restoration.

## **ATTACHMENT B**

### **Hazard Vulnerability Maps**

8. Hurricane Storm Surge Areas & Evacuation Zones
9. NFIP Flood Zones
10. Repetitive Flood Loss Structures by Section
11. Sinkholes by Section
12. Sinkhole Risk
13. Wildland Fire Risk
14. Wind Speeds – Category 3 Storm
15. Wind Speeds – Category 5 Storm
16. Tornado Risk
17. Tsunami Risk