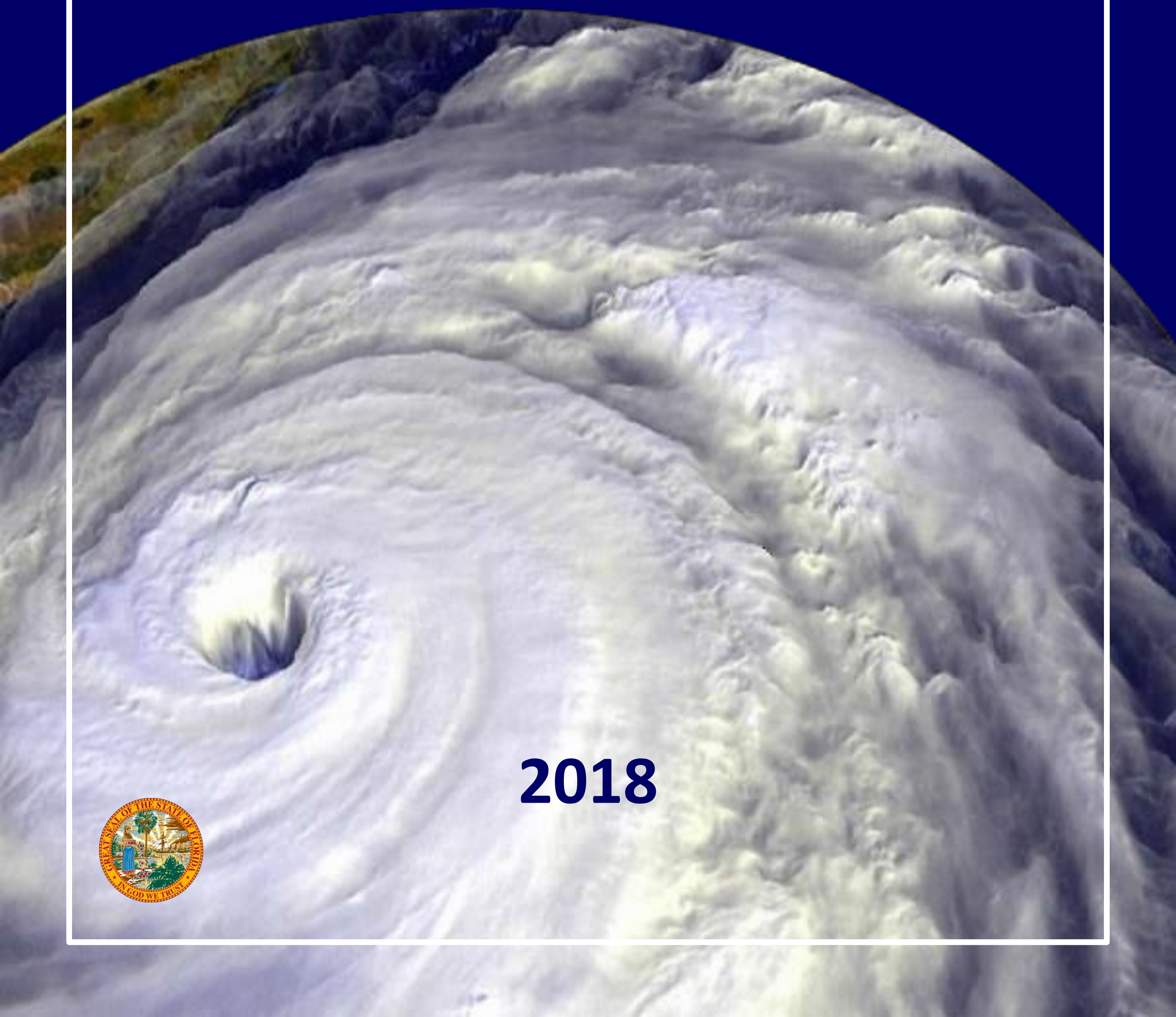
ENHANCED

STATE HAZARD MITIGATION PLAN

STATE OF FLORIDA



2018

EXECUTIVE SUMMARY

Introduction

Under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) enacted under the Disaster Mitigation Act of 2000 (DMA2K), the State of Florida is required to have a Federal Emergency Management Agency (FEMA)-approved hazard mitigation plan in order to be eligible for federal hazard mitigation funding. The purpose of the State Hazard Mitigation Plan (SHMP) is to reduce death, injuries, and property losses caused by natural hazards in Florida. The 2018 Plan identifies hazards based on the history of disasters within the state and lists goals, objectives, strategies, and actions for reducing future losses. Implementation of planned, pre-identified, and cost-effective mitigation measures not only helps to reduce losses to lives, property, and the environment but it also streamlines the disaster recovery process. Hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs.

The SHMP serves several purposes; including providing an explanation of the Florida Division of Emergency Management (FDEM) Mitigation Bureau and the strategies the State uses to implement an effective comprehensive statewide hazard mitigation plan. Plans are coordinated through appropriate state, local, and regional agencies, as well as non-governmental interest groups. This 2018 Plan, and its future revisions, will provide guidance in merging the planning efforts of all state agencies, local governments, the private sector, and non-profit organizations into one viable, comprehensive, and statewide mitigation program.

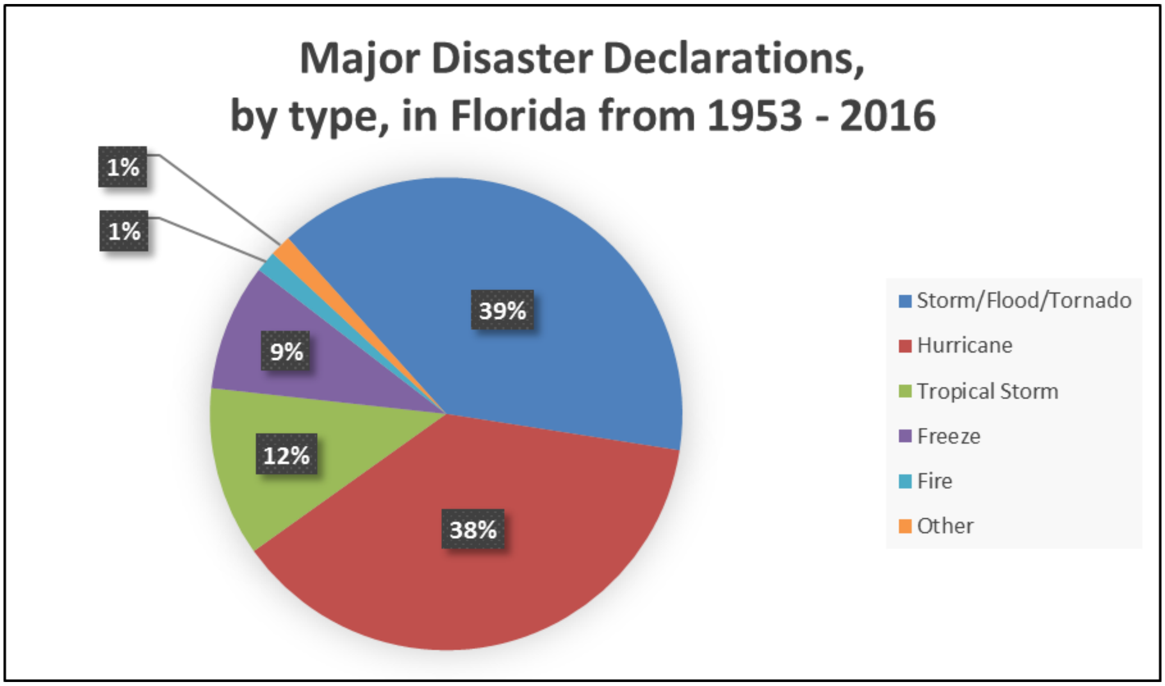
The scope of the SHMP is broad. The plan explains the way in which the Mitigation Bureau administers the Mitigation programs within the state, both within the Mitigation Bureau, and externally with other state and local agencies. Additionally, as required by statute, the Risk Assessment portion of the SHMP identifies natural hazards, as well as technological and human-caused hazards. The Risk Assessment portion analyzes vulnerability of the State in terms of jurisdictions (counties), and in terms of state agency facilities across Florida.

The 2018 SHMP demonstrates that:

- The State has developed a comprehensive mitigation program.
- The State effectively uses available mitigation funding.
- The State is capable of managing all funding, including that which results from achieving enhanced status.

Florida is vulnerable to both natural hazards and technological and human-caused hazards. The most common hazards to Florida are wildfires and floods; however, hurricanes have historically inflicted catastrophic destruction. Florida has had 69 Major Disaster Declarations from 1953 when these federal declarations began, through 2016. Below is a chart demonstrating the types of disasters that have received a Major Disaster Declaration, by type, from 1953 until 2016.

Figure 1 – Major Disaster Declarations, by type, in Florida from 1953 – 2016



Florida first received Hazard Mitigation Grant Program (HMGP) funding in 1993. Florida has received a total of $867,038,534 in HMGP funding from 1998 to 2016.[1] From 1998 until 2005, Florida received 15% of the 90-day Recovery cost estimates after federally declared disasters. In 2007, Florida began to receive 20% of the 90-day Recovery cost estimates because of the Enhanced status of the SHMP. Florida strives to maintain the Enhanced status to continue receiving the extra 5% in HMGP funding because the state recognizes the significant value to mitigation within the state. The additional 5% for HMGP funding from 2007 to 2016 has resulted in an extra $52,863,689 in HMGP funding.

Planning Process and Maintenance

In accordance with 44 CFR 201.4, Florida originally developed the SHMP and it was approved by FEMA in 2004. The plan was continually updated in 2007, 2010, and 2013. In 2014, FEMA extended the update cycle from three years to five years so the 2013 plan that was valid until 2016 was extended until 2018. The updates for 2018 began in mid-2016.

The Mitigation Planning Unit has been responsible for updating the SHMP in the past. Additionally, the Mitigation Planning Unit coordinated the SHMPAT group, which assisted with updating and approving the plan. The SHMPAT group was formed several years ago and included state partners. Each update cycle, new members have been engaged and added, including federal, local, non-profit, and private sector partners.

The 2018 SHMP update began in mid-2016 when the Mitigation Planning Unit conducted an in-depth review of the 2013 SHMP and the 2016 FEMA State Mitigation Plan Review Guide. When the plan update

[1] Records of HMGP funding from 1993 – 1997 were unavailable.

began, the SHMPAT was used as it had been in the past, as a resource for the Mitigation Planning Unit to assist with and approve updates and changes.

In 2017, Chapter 252.3655 went into effect, which mandates an interagency workgroup to share information on the current and potential impacts of natural hazards throughout the state, coordinating the ongoing efforts of state agencies in addressing the impacts of natural hazards, and collaborating on statewide initiatives to address the impacts of natural hazards. More information about this workgroup can be found in the *Planning Process and Plan Maintenance Section*.

After the creation of the group discussed above, the Mitigation Bureau decided to combine it with two other similar statewide mitigation groups: the SHMPAT and the Florida Silver Jackets team. The new group was named Mitigate FL. Therefore, one purpose of the Mitigate FL group is to bring together a cross-section of representatives from various sectors to assist the Mitigation Planning Unit with evaluating, revising, and otherwise maintaining the State's Enhanced Hazard Mitigation Plan. This group includes members from state agencies, local governments, regional planning councils, universities, non-profit organizations, FEMA, and other federal agencies. As these members work together, they gain and share valuable insight into how the plan may be integrated into their respective hazard mitigation planning processes. As they return to their communities or organizations, they bring with them plan knowledge and tools to update their own plans.

After the 2018 Enhanced SHMP underwent final revisions, and the plan was completed to the satisfaction of the State Hazard Mitigation Office (SHMO), the FDEM Mitigation Bureau, and the Mitigate FL group, the plan was officially adopted by the State of Florida via a memorandum signed by the Director of FDEM as the Governor's Authorized Representative. After adoption, the plan was submitted to FEMA for approval. The 2018 Enhanced SHMP update was submitted on 02/23/2018 and approved on XX/XX/XX. The plan will be in effect from August 24, 2018 until August 23, 2023.

Risk Assessment

The risk assessment for the State of Florida Enhanced Hazard Mitigation Plan (SHMP) provides the factual basis for developing a mitigation strategy for the state. This section profiles the natural, human-caused, and technological hazards that could possibly affect the state. This risk assessment is used not only for the SHMP, but also is the basis for the Florida Comprehensive Emergency Management Plan (CEMP). Each natural hazard profile includes a discussion of the geographic areas affected, the historical occurrences in the state, an impact analysis, the probability, and the vulnerability and loss estimation by county and of state facilities, and a discussion of overall vulnerability. Alternatively, the human-caused and technological hazards include similar topics of discussion, but not all aspects are able to be quantified. This is because of the limited data available and the imprecise nature of the human-caused and technological hazards.

The risk assessment identifies 21 hazards based on an analysis of federal risk assessment guidance, analysis of the 67 Florida county LMS plans, examination of past disasters, and other research. The 21 hazards include:

- Flood
- Tropical Cyclones

- Severe Storms
- Wildfire
- Erosion
- Drought
- Extreme Heat
- Geological
- Winter Storm
- Seismic
- Tsunami
- Transportation Incident
- Cyber Incident
- Hazardous Materials Incident
- Space Weather Incident
- Radiological Incident
- Terrorism
- Agricultural Disruption
- Biological Incident
- Mass Migration Incident
- Civil Disturbance Incident

State Mitigation Strategy

The State of Florida Enhanced SHMP Mitigation Strategy is to:

> *Reduce the impacts of all hazards within the State of Florida through effective administration of all mitigation grant programs and a coordinated approach to mitigation planning and floodplain management through federal, state, regional, and local initiatives.*

This mission also serves as the FDEM Mitigation Bureau mission and is the mission of the Mitigate FL interagency group.

Additionally, the Mitigation Bureau has a vision to:

> *Make Florida a hazard resilient and resistant state.*

The SHMP State Mitigation Strategy details goals and objectives for achieving loss reduction in Florida. The goals and objectives are listed below.

Goal 1: Implement an effective comprehensive statewide hazard mitigation plan.

- Objective 1.1: Provide training opportunities and encourage staff to pursue professional development.
- Objective 1.2: Pursue methodologies that will enhance mitigation successes.
- Objective 1.3: Integrate mitigation practices throughout all state plans, programs, and policies.

Goal 2: Support local and regional mitigation strategies.

- Objective 2.1: Maintain up-to-date risk assessment information in coordination with local communities.
- Objective 2.2: Assist in integrating hazard mitigation concepts into other local and regional planning efforts such as comprehensive plans, local mitigation strategies, and comprehensive emergency management plans.
- Objective 2.3: Ensure that all communities are aware of available mitigation funding sources and cycles.
- Objective 2.4: Assist in the integration of climate change and sea level rise research into state, local and regional planning efforts.
- Objective 2.5: Conduct all possible actions to mitigate severe repetitive loss properties.

Goal 3: Increase public and private sector awareness and support for hazard mitigation in Florida.

- Objective 3.1: Work with other state and regional entities to incorporate mitigation concepts and information into their outreach efforts.
- Objective 3.2: Educate Florida's private sector about mitigation concepts and opportunities.
- Objective 3.3: Develop and integrate hazard mitigation curriculum into higher education.
- Objective 3.4: Educate state risk management entities on mitigation incentives.
- Objective 3.5: Support hazard mitigation research and development.

Goal 4: Support mitigation initiatives and policies that protect the state’s cultural, economic, and natural resources.

- Objective 4.1: Support land acquisition programs that reduce or eliminate potential future losses due to natural hazards and that are compatible with the protection of natural or cultural resources.
- Objective 4.2: Support restoration and conservation of natural resources wherever possible.
- Objective 4.3 Seek mitigation opportunities that reduce economic losses and promote responsible economic growth.
- Objective 4.4: Retrofit existing state-owned facilities.
- Objective 4.5: Participate in climate change and sea level rise research that will further the state and local government’s ability to plan for and mitigate the impacts of future vulnerability.
- Objective 4.6: Coordinate effective partnerships between state agencies for floodplain management.

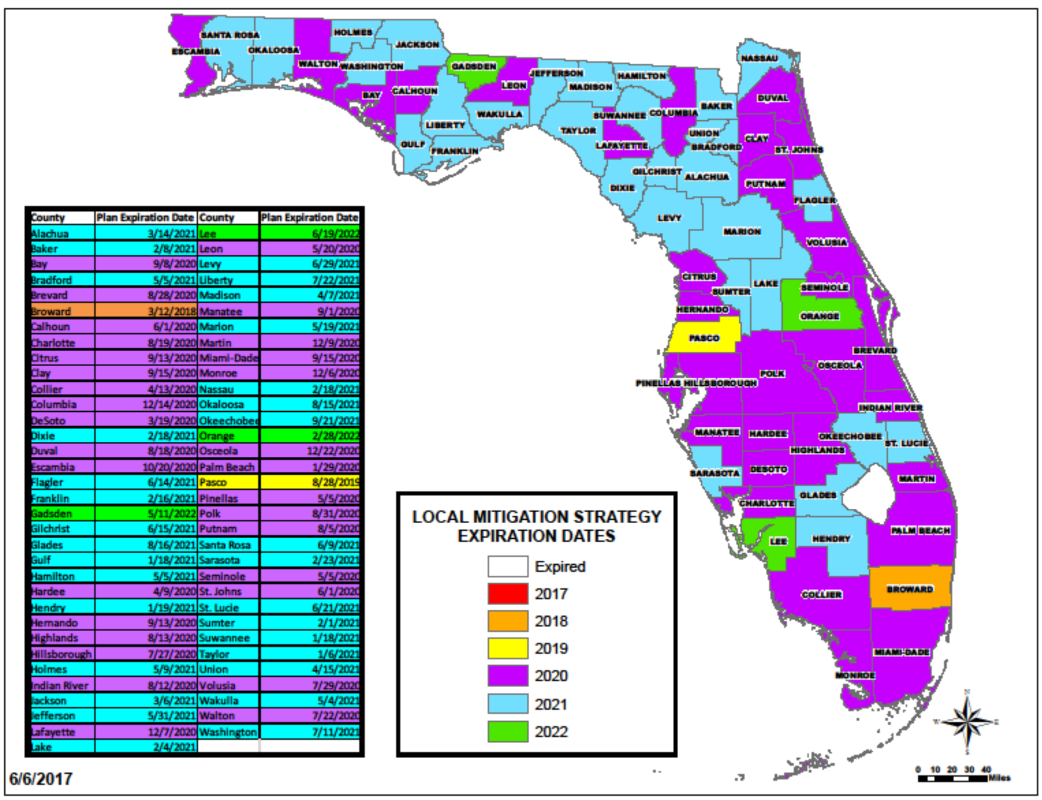
Many departments, agencies, and private organizations perform roles valuable to state government disaster mitigation and resistance efforts. Some seemingly unrelated programs are often complimentary to reducing the human and economic cost of disasters. It is a goal of the Mitigate FL Team and the State of Florida to educate its citizens (both public and private sectors) on the importance of mitigation. The state continually reaches out to residents and business groups concerning mitigation best practices, tips and how-to’s. Training and education are essential to Florida’s ability to respond to hazards and must remain a priority within the constraints of lower budgets. Public education reduces the burden on the state by increasing citizen capacity. The agency capability assessments included in this plan demonstrate Florida's comprehensive ability to mitigate hazards and guide development in hazard prone areas in accordance with policies and goals.

Local governments have policies, programs and capabilities designed to help mitigate the impacts of hazard events to their jurisdictions. Each community has its own policies, programs, and capabilities. These depend on factors such as the size of the geographic area, its population, or the amount of funding available through local resources. Regardless of size or wealth, each community has a unique core set of policies, programs and capabilities at its disposal related to hazard reduction and mitigation including building codes, land use plans, and regulations, which are discussed in this section.

FDEM has completed a general analysis of existing Local Mitigation Strategies (LMS) to evaluate locally identified policies, programs, and capabilities to maintain and support hazard mitigation planning activities. This analysis is based upon local evaluations of the effectiveness of the identified programs and their accompanying policies within their communities.

There are 67 counties in Florida, all of which have a multi-jurisdictional, multi-hazard LMS. FDEM's Mitigation Planning Unit thoroughly reviews these plans and works closely with the counties to assure that all criteria, including regulations and recommended best practices are met in their LMS. Florida is one of only two states in the nation given authority to review and approve LMS plans. Below is a figure showing the expiration date of all currently approved LMS plans in Florida.

Figure 2 – Local Mitigation Strategy Expiration Dates



County	Plan Expiration Date	County	Plan Expiration Date
Alachua	3/14/2021	Lee	6/19/2022
Baker	2/8/2021	Leon	5/20/2020
Bay	9/8/2020	Levy	6/29/2021
Bradford	5/5/2021	Liberty	7/22/2021
Brevard	8/28/2020	Madison	4/7/2021
Broward	3/12/2018	Manatee	9/1/2020
Calhoun	6/1/2020	Marion	5/19/2021
Charlotte	8/19/2020	Martin	12/9/2020
Citrus	9/13/2020	Miami-Dade	9/15/2020
Clay	9/15/2020	Monroe	12/6/2020
Collier	4/13/2020	Nassau	2/18/2021
Columbia	12/14/2020	Okaloosa	8/15/2021
DeSoto	3/19/2020	Okeechobee	9/21/2021
Dixie	2/18/2021	Orange	2/28/2022
Duval	8/18/2020	Osceola	12/22/2020
Escambia	10/20/2020	Palm Beach	1/29/2020
Flagler	6/14/2021	Pasco	8/28/2019
Franklin	2/16/2021	Pinellas	5/5/2020
Gadsden	5/11/2022	Polk	8/31/2020
Gilchrist	6/15/2021	Putnam	8/5/2020
Glades	8/16/2021	Santa Rosa	6/9/2021
Gulf	1/18/2021	Sarasota	2/23/2021
Hamilton	5/5/2021	Seminole	5/5/2020
Hardee	4/9/2020	St. Johns	6/1/2020
Hendry	1/19/2021	St. Lucie	6/21/2021
Hernando	9/13/2020	Sumter	2/1/2021
Highlands	8/13/2020	Suwannee	1/18/2021
Hillsborough	7/27/2020	Taylor	1/6/2021
Holmes	5/9/2021	Union	4/15/2021
Indian River	8/12/2020	Volusia	7/29/2020
Jackson	3/6/2021	Wakulla	5/4/2021
Jefferson	5/31/2021	Walton	7/22/2020
Lafayette	12/7/2020	Washington	7/11/2021
Lake	2/4/2021		

Funding and Projects

The state uses a variety of programs and funds to achieve its mitigation goals, including federal grant programs such as HMGP, Pre Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and the state grant Hurricane Loss Mitigation Program (HLMP). Various grants and programs are discussed throughout this section.

FDEM's Mitigation Bureau has a strong grant management and project implementation program, which is described in this section. Steps in the grant management and project implementation process include Application, Engineering, and Environmental Reviews; Benefit-Cost Analyses; Financial Reporting; Closeout Processes; and Recording Performance.

Appendices

Many documents are included with the SHMP as appendices. These appendices are referenced throughout the plan and support the plan and the FDEM Mitigation Bureau program.

- Appendix A: 2018 Revisions Log
- Appendix B: Governing Policies
- Appendix C: Planning Process Documentation
- Appendix D: Hazard Summary Matrices
- Appendix E: Risk Assessment Tables
- Appendix F: NFIP Policy Statistics
- Appendix G: Wildfire Mitigation Plan Annex
- Appendix H: Sinkhole Report
- Appendix I: Critically Eroded Beaches in Florida
- Appendix J: HMGP Administration Plan
- Appendix K: LMS Update Cycle AAR
- Appendix L: Outreach Record
- Appendix M: State Managed Projects
- Appendix N: Loss Avoidance Reports Tropical Storm Debby
- Appendix O: Loss Avoidance Reports Florida Severe Storms, Tornadoes, Straight-line Winds, and Flooding
- Appendix P: Home Hardening Matters
- Appendix Q: Loss Avoidance Report Hurricane Hermine
- Appendix R: Loss Avoidance Report Hurricane Matthew
- Appendix S: Adoption Documentation
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* Appendices are included as separate documents from the SHMP.

Appendices

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INTRODUCTION

State Hazard Mitigation Plan Requirements
S20. Did the state provide assurances? [44 CFR §201.4(c)(7)]

Purpose

Under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) enacted under the Disaster Mitigation Act of 2000 (DMA2K), the State of Florida is required to have a Federal Emergency Management Agency (FEMA)-approved hazard mitigation plan in order to be eligible for federal hazard mitigation funding. The purpose of the State Hazard Mitigation Plan (SHMP) is to reduce death, injuries, and property losses caused by natural hazards in Florida. The 2018 Plan identifies hazards based on the history of disasters within the state and lists goals, objectives, strategies, and actions for reducing future losses. Implementation of planned, pre-identified, and cost-effective mitigation measures not only helps to reduce losses to lives, property, and the environment but it also streamlines the disaster recovery process. Hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs.

Section 322, along with other sections of DMA2K, provides an opportunity to reduce the nation's disaster losses through hazard mitigation. The Stafford Act authorizes funding to be made available to states through the Hazard Mitigation Grant Program (HMGP) after presidentially declared disasters. In addition, the Stafford Act sets the requirements for state hazard mitigation plans and requires local jurisdictions to develop and adopt a local mitigation plan in order to receive federal funding for hazard mitigation too. The DMA2K is implemented by the FEMA and requires that all mitigation plans, both at the state and local level, be maintained and updated periodically.

According to the federal regulations outlined in DMA2K, state and local hazard mitigation plans are required to be updated and re-approved by FEMA every five years. The Florida SHMP was originally developed and officially approved by FEMA on August 24, 2004. Since 2004, the SHMP has been updated and re-approved in 2007, 2010, and 2013. In 2014, FEMA extended the update requirement from every three years to every five years. FEMA notified the State of Florida of this rule change and granted an extension for the 2013 Florida Enhanced SHMP so that instead of expiring in 2016, it expires in 2018.

The SHMP serves several purposes; including providing an explanation of the Florida Mitigation Program and the strategies the State uses to implement an effective comprehensive statewide hazard mitigation plan. Plans are coordinated through appropriate state, local, and regional agencies, as well as non-governmental interest groups. This 2018 Plan, and its future revisions, will provide guidance in merging the planning efforts of all state agencies, local governments, the private sector, and non-profit organizations into one viable, comprehensive, and statewide mitigation program.

The 2018 SHMP provides a framework that links pre- and post-disaster mitigation planning with both public and private interests. The intent is to ensure an integrated and comprehensive approach to disaster loss reduction. This approach supports state administration of HMGP and the non-disaster programs such as the Pre-Disaster Mitigation grant program (PDM) and the Flood Mitigation Assistance program (FMA). The SHMP represents a clear State commitment to mitigation activities, comprehensive state mitigation planning, and improved state program management.

The mission of the SHMP is to:

> *Reduce the impacts of all hazards within the State of Florida through effective administration of all mitigation grant programs and a coordinated approach to mitigation planning and floodplain management through federal, state, regional, and local initiatives.*

This mission also serves as the SHMP Mitigation Strategy and is the mission of the Mitigate FL interagency group.

Additionally, the Mitigation Bureau has a vision to:

> *Make Florida a hazard resilient and resistant state.*

The scope of the SHMP is broad. The plan explains the way in which the Mitigation Bureau administers the Mitigation programs within the state, both within the Mitigation Bureau, and externally with other state agencies and with local agencies. Additionally, as required by statute, the Risk Assessment portion of the SHMP identifies natural hazards, as well as technological and human-caused hazards. Furthermore, the Risk Assessment portion analyzes vulnerability of the State in terms of jurisdictions, (counties), and in terms of state agency facilities across Florida.

The 2018 SHMP demonstrates that:

- The State has developed a comprehensive mitigation program.
- The State effectively uses available mitigation funding.
- The State is capable of managing all funding, including that which results from achieving enhanced status.

What is hazard mitigation?

Hazard mitigation is defined as any action taken to reduce or eliminate the long-term risk to human life and property from manmade or natural hazards. A hazard is any event or condition with the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, environmental damage, business interruption, or other structural or financial loss.

Hazard mitigation aims to make human development and the natural environment safer and more resilient. Hazard mitigation generally involves enhancing the built environment to significantly reduce risks and vulnerability to hazards. Mitigation can also include removing the built environment from disaster prone areas and maintaining natural mitigating features, such as wetlands or floodplains. Hazard mitigation makes it easier and less expensive to respond to and recover from disasters by breaking the damage and repair cycle.

Examples of hazard mitigation measures include, but are not limited to, the following:

- Development of mitigation standards, regulations, policies, and programs;
- Land use/zoning policies;
- Strong statewide building code and floodplain management regulations;
- Dam safety program, seawalls, and levee systems;
- Acquisition of flood prone and environmentally sensitive lands;
- Retrofitting/hardening/elevating structures and critical facilities;
- Relocation of structures, infrastructure, and facilities out of vulnerable areas;
- Public awareness/education campaigns; and
- Improvement of warning and evacuation systems.

Benefits of hazard mitigation include, but are not limited to the following:

- Saving lives and protecting public health;
- Preventing or minimizing property damage;
- Minimizing social dislocation and stress;
- Reducing economic losses;
- Protecting and preserving infrastructure;
- Reducing legal liability of government and public officials; and
- Less expenditures on response and recovery efforts.

In 2005, a study by the National Institute of Building Sciences reported to Congress that, on average, every dollar spent on mitigation yields four dollars in future benefits.

Regulations

The Disaster Mitigation Act of 2000 (DMA2K) became law October 30, 2000. The act amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Public Law 93-288, as amended).

Federal statutes and regulations applicable to State Mitigation Planning include the following:

- Disaster Mitigation Act of 2000 (42 U.S. Code 5121)
- Stafford Act
  - Title III – Major Disaster and Emergency Assistance Administration
    - Section 322 – Mitigation Planning (42 U.S. Code 5165)
      - (a) Requirement of Mitigation Plan
      - (c) State Plans
      - (e) Increased Federal Share for Hazard Mitigation Measures
- Stafford Act
  - Title IV – Major Disaster Assistance Programs
    - Section 404 – Hazard Mitigation (42 U.S. Code 5170(c))
      - (c) Program Administration by States
- 44 Code of Federal Regulations 201 – Mitigation Planning
  - §201.4 Standard State Mitigation Plans
  - §201.5 Enhanced State Mitigation Plans

- 44 Code of Federal Regulations 13 – Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments
    - Subpart B – Pre-Award Requirements
        - §13.11 State Plans
            - (c) Assurances
            - (d) Amendments

Florida statutes and regulations applicable to State Mitigation Planning include the following:

- Florida Statute 252
    - Florida Administrative Code 27P-22
- Florida Statute 252.3655

Other applicable standards include the Emergency Management Accreditation Program (EMAP) Standards. The State of Florida is EMAP Accredited and the Florida Enhanced SHMP is compliant with the EMAP Standards. The applicable Standards include:

- 4.1: Hazard Identification, Risk Assessment and Consequence Analysis
- 4.2: Hazard Mitigation

Assurances

The State of Florida does comply, and assures it will continue to comply, with all applicable federal statutes and regulations in effect with respect to the periods for which it receives grant funding in compliance with 44 CFR 13.11(c). This includes managing and administering FEMA funding in accordance with applicable Federal statutes and regulations.

The state also assures it will amend the Florida Enhanced State Hazard Mitigation Plan in accordance to 44 CFR 13.11 (d). This includes amending the plan whenever necessary to reflect changes in state or Federal laws and statutes.

State Profile

Florida is one of the top tourist destinations in the world, famous for its pristine beaches, palm trees, historic heritage, beautiful nature preserves, and unrivaled entertainment parks. The state is culturally, ethnically, economically, ecologically, and politically diverse, with natural, human, and economic assets worthy of protection from all hazards. A main attraction of the state is the temperate climate, which boasts an average annual high temperature of 81 degrees Fahrenheit (27 degrees Celsius), while the average annual low temperature remains a comfortable 60 degrees Fahrenheit (16 degrees Celsius).

Figure 3 – County Boundary Map of Florida

Geography

The state of Florida has a total area of 34,366,945 acres, ranking it 22nd in the nation in total area. Florida has over 11,000 miles of rivers, streams and waterways with 1,197 statute miles of coastline and 663 miles of beaches, making Florida the third wettest state behind Alaska and Michigan. The state is also home to Lake Okeechobee, at 700 square miles, making it the second largest freshwater lake in the United States. Florida is a relatively flat state with the highest point being 345 feet above sea level with the state average being 100 feet above sea level.

Three geographic land areas make up the Florida landscape; the Atlantic Coastal Plain, the East Gulf Coastal Plain, and the Florida Uplands.

The Atlantic Coastal Plain completely covers the eastern part of Florida. The landscape is low and level and varies from about 30 to 90 miles wide. This includes most of southern Florida, 2,746 square miles, which is covered by the Big Cypress Swamp and the Florida Everglades. To the south of the mainland, lie the Florida Keys curving out to sea about 150 miles in a southwesterly direction.

The East Gulf Coastal Plain presents itself in two sections of Florida. In southwestern Florida, the East Gulf Coastal Plain extends inland to cover parts of the Big Cypress Swamp and the Everglades. The East Gulf Coastal Plain is similar to the Atlantic Coastal Plain on the other side of the Florida peninsula. Barrier islands run along the west coast of Florida and coastal swampland extends inland. The northern section of the East Gulf Coastal Plain curves around the upper edge of the northeastern Gulf of Mexico at Apalachee Bay and extends west across the Florida panhandle to Florida's western border.

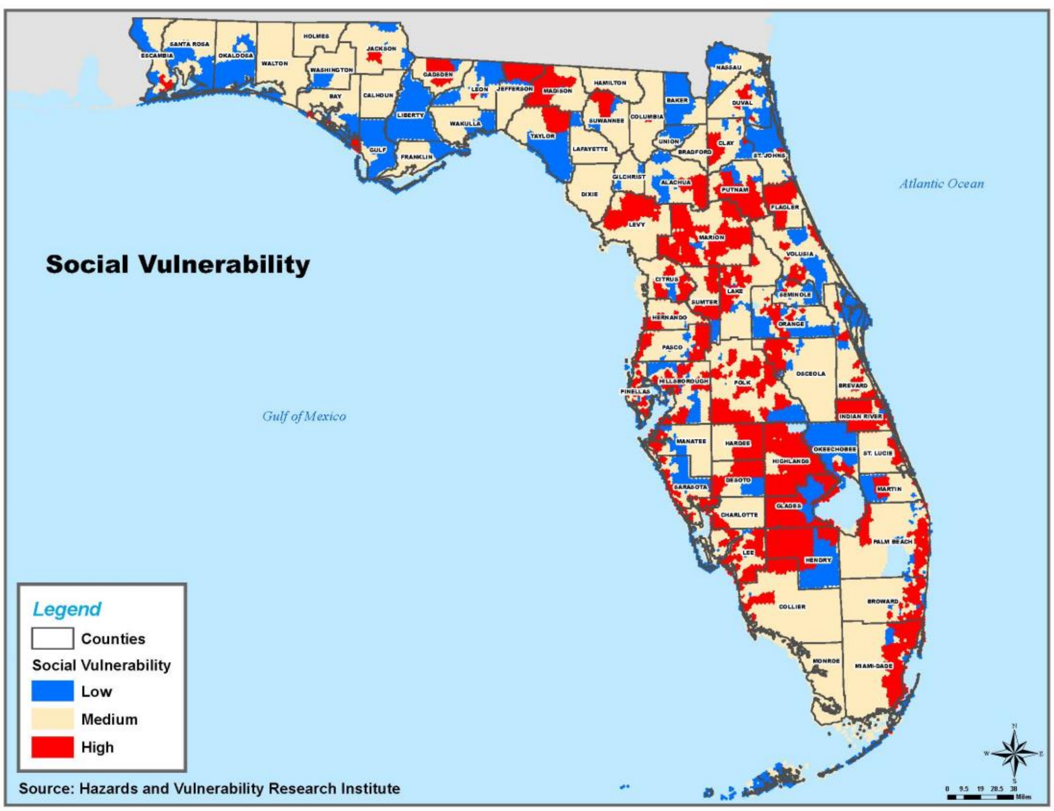
The Florida Uplands run about 275 miles west to east, along the northern edge of the Florida Panhandle and then extend south into the central area of the Florida peninsula. The width of the northern Florida Uplands varies from around 30 to 50 miles and is characterized by low rolling hills of red clay. The section of the Florida Uplands that extends south into the peninsula, covers an area with a length of approximately 160 miles and a width of 100 miles. This area extends from the north, south and to the east, to separate the two sections of the East Gulf Coastal Plain and to separate the East Gulf Coastal Plain from the Atlantic Coastal Plain.

Population Demographics

As of the 2010 US Census, Florida was the fourth largest state by population with over 18 million residents. The US Census 2016 estimates show that Florida has grown significantly in recent years and is now the third largest state by population, with well over 20 million residents.

The state has 67 counties with varying size and population; the largest, by land area, being Palm Beach County at 2,578 square miles with 1.44 million residents, and Union County being the smallest, by land area, at 245 square miles with a population of 15,142 residents.

Figure 4 – Social Vulnerability Map of Florida



One vulnerability for Florida is the concentration of its population. The state is home to four metropolitan areas with over one million residents, three of which are coastal cities, making them more vulnerable to certain hazards. These four metropolitan areas and their populations are as follows:

- Miami: 6.1 million residents, (2016 estimates, Miami Dade, Broward, Palm Beach counties)
- Tampa: 3 million residents, (2016 estimates, Hillsborough, Pinellas, Hernando, Pasco counties)
- Orlando: 2.4 million residents, (2016 estimates, Lake, Orange, Osceola, Seminole counties)
- Jacksonville: 1.5 million residents, (2016 estimates, Duval, Clay, St. Johns, Nassau, Baker counties)

According to the University of Florida's Office of Economic and Demographic Research (2011), the population of Florida is expected to grow at a rate of 1.4% between 2010 and 2030 resulting in a projected population of approximately 24 million people by the year 2030. As the population of Florida expands, the vulnerability of the state increases.

Below are basic Florida demographics from the US Census Bureau.

Table 1 – Florida Demographics[2][3]

Category	Data
2010 US Census population	18,801,310
2016 US Census population estimates	20,612,439
Age	**Percentage**
2016 Persons under 5 years	5.5%
2016 Persons under 18 years	20.1%
2016 Persons 65 years and over	19.9%
Gender	**Percentage**
2016 Female persons	51.1%
2016 Male persons	48.9%
Race	**Percentage**
2016 White, alone	77.6%
2016 Black or African American, alone	16.8%
2016 American Indian and Alaska Native, alone	0.5%
2016 Asian, alone	2.9%
2016 Native Hawaiian and Other Pacific Islander,	0.1%
2016 Two or More Races	2.1%
Hispanic Origin	**Percentage**
2016 Hispanic or Latino	24.9%
2016 Not Hispanic or Latino	54.9%
Characteristics	**Data**
2016 Veterans	1,480,133
2016 Foreign born persons	19.9%
Families and Living Arrangements	**Data**

[2] https://www.census.gov/quickfacts/fact/table/FL/AFN120212#viewtop
[3] http://edr.state.fl.us/Content/population-demographics/data/index-floridaproducts.cfm

2016 Households	7,393,262
2016 Persons per household	2.64
2016 Language other than English spoken at	28.3%
Education	**Percentage**
2016 High school graduate or higher	87.2%
2016 Bachelor's degree or higher	27.9%
Health	**Percentage**
2016 Persons with a disability, under age 65 years	8.6%

Florida's population is particularly vulnerable because 40% of the population is composed of children (18 years or younger) and seniors (65 years or older).

Florida also has two federally recognized Native American tribes, the Seminole Tribe and the Miccosukee Tribe. Both are located in the southern part of the state and are home to thousands of residents.

Land Use

Land in Florida is used for multiple purposes including urban, conservation, agricultural, wetlands, and forests. With a booming agricultural business, the state, as of 2015, had over 47,000 commercial farms that utilized roughly 9.45 million acres. The state has numerous large urban centers and south Florida includes over 1.5 million acres that is the Everglades National Park.

Florida has a long history of conserving the natural lands that the state needs in order to preserve the ecosystems that create clean air, clean and sufficient water, and recreational opportunities for residents, visitors and future generations. The Florida Department of Environmental Protection (DEP), through the Division of State Lands, manages one of the largest and most successful land conservation programs in the nation.[4]

With approximately 10.1 million acres in conservation land, the Division of State Lands assists landowners who want to sell land to the state, purchase land from the state or gain access to public lands. As of February 2017, Florida has 4,043,348 acres of federal conservation lands, 4,882,099 in state conservation lands and 496,494 acres of local (county and municipal) conservation lands. The majority of federal lands are managed by the USDA Forest Service and the National Park Service and the majority of state lands managed by the Florida Forest Service and the Florida Fish and Wildlife Conservation Commission.[5] The five Water Management Districts collectively manage 1,908,969 acres as well. Below is a map of land use in the state.

[4] https://floridadep.gov/lands
[5] http://fnai.org/PDF/Maacres_201702_FCL_plus_LTF.pdf

Figure 5 – State of Florida Land Use

Economy

Below are basic demographics of the Florida economy from the US Census Bureau. It is important to note that nearly 15% of Florida's population is in poverty. Consequently, another vulnerability for the state.

Table 2 – Florida Economic Demographics[6]

Category	Data
2016 Median household income	$48,900
2016 Persons in poverty	14.7%
2016 In civilian labor force, total, of population age 16 years and over	58.5%
2016 In civilian labor force, female, of population age 16 years and over	54.3%
2012 Total accommodation and food service sales ($1000)	$49,817,924
2012 Total retail sales ($1000)	$273,867,145
2015 Total employer establishments	532,830
2015 Total employment	7,777,990

[6] https://www.census.gov/quickfacts/fact/table/FL/AFN120212#viewtop

Florida's top economic driver is tourism. In 2015, the state attracted 106.6 million visitors who spent more than $108.8 billion and generated $11.3 billion in tax revenue in 2015.[7] Florida's reliance upon the tourism industry and the susceptibility of the tourism industry to hazards increases the vulnerability of the state to those hazards.

Florida is a major agricultural hub, with the industry playing a vital role in the state's economy. Florida's tropical/subtropical climate provides a conducive environment for near year-round production of a variety of plant and animal agricultural commodities. Florida farmers and ranchers produce hundreds of distinct commodities, all contributing to an agricultural industry which produced over $8.4 billion in 2014.

Infrastructure

Florida has an extensive infrastructure system. Within the state there are over 122,659 miles of highway, 273,000 miles of public roadways, 30 public transit systems, 3,000 miles of railroad track, 140 airports, 15 seaports, and 34,019 miles of pipelines to maintain and protect. Florida also has a comprehensive education system with 158 colleges and universities and 4,200 public schools for K-12. With over 300 hospitals, government buildings and leases, and dozens of utility companies and services, Florida has a wide ranging list of critical infrastructure.

Critical infrastructure is essential to the state's ability to provide assistance to its people and infrastructure such as transportation routes, utilities, government facilities, schools, and hospitals provide the state with the capacity to respond to disasters.

Government (FDEM and Mitigation Bureau)

The State of Florida government is organized as shown below.

- Florida Executive Office of the Governor
- Florida Senate and Florida House of Representatives
- Florida Judicial Branch, including Circuit Courts and District Courts of Appeal
- 34 State Agencies, including Florida Division of Emergency Management
- 11 Regional Planning Councils and 5 Water Management Districts
- County Government, including Health Department Offices, Elections Supervisors, Property Appraisers, Tax Collectors, Sheriffs, Clerks of Court, and Veterans' Service Offices

The Florida Division of Emergency Management, particularly the Mitigation Bureau is the foundation of the Florida Mitigation Strategy. In 2017, Florida statute 252.3655 went into effect requiring the creation of a natural hazards interagency workgroup.

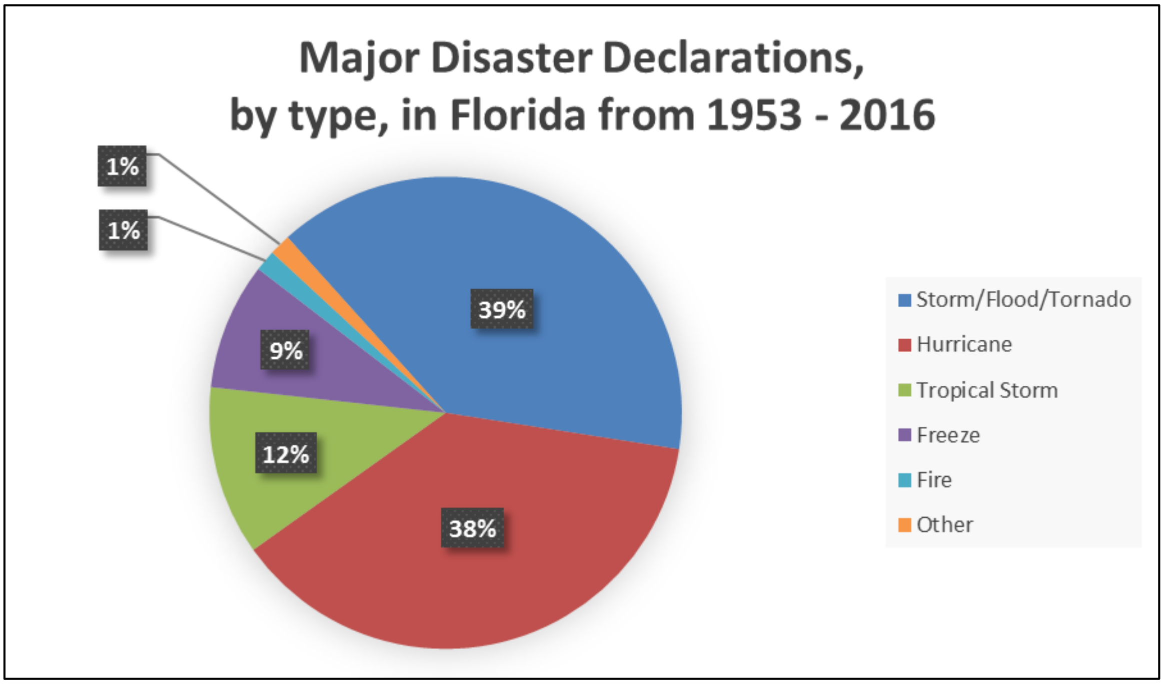
Past Disasters

Florida is vulnerable to both natural hazards and technological and human-caused hazards. In the state of Florida, the most common hazards are wildfires and floods; however, hurricanes have historically inflicted catastrophic destruction. Florida has had 69 Major Disaster Declarations from 1953 when these federal

[7] http://www.visitfloridamediablog.com/home/florida-facts/research/ and https://www.visitflorida.org/media/30679/florida-visitor-economic-impact-study.pdf

declarations began through 2016. Below is a chart demonstrating the types of disasters that have received a Major Disaster Declaration, by type, from 1953 until 2016.

Figure 6 – Major Disaster Declarations, by type, in Florida, 1953 – 2016



Wildfires are not commonly declared as a major disaster declaration, but rather a Fire Management Assistance Declaration. From 1953 through 2016, there have been 56 wildfires that have received the FM declaration. Only one wildfire has received a major disaster declaration in Florida.

Agricultural disruptions are also not commonly declared as a major disaster declaration, but as a Secretarial Disaster Declaration by the USDA. The following data is the number of primary counties that were declared and the contiguous, or surrounding, counties that also declared from 2012 through 2017.

- 2012: 63 primary counties and 4 contiguous counties
- 2013: 33 primary counties and 18 contiguous counties
- 2014: 12 primary counties and 22 contiguous counties
- 2015: 4 primary counties and 12 contiguous counties
- 2016: 18 primary counties and 31 contiguous counties
- 2017: 57 primary counties and 8 contiguous counties

Results of Enhanced SHMP & Florida's Mitigation Program

In support of the Stafford Act and DMA2K, the 2018 SHMP update addresses all required elements in order to achieve Enhanced status. Achieving Enhanced status means that states are able to successfully implement federal grant programs and have built successful mitigation programs. Receiving Enhanced status provides states an additional 5% of recovery costs in HMGP funds when a major disaster is declared.

Florida first received HMGP funding in 1998. Florida has received a total of $867,038,534 in HMGP funding from 1998 to 2016. From 1998 until 2005, Florida received 15% of the 90-day Recovery cost estimates after federally declared disasters. In 2007, Florida began to receive 20% of the 90-day Recovery cost estimates because of the Enhanced status of the SHMP. Florida strives to maintain the Enhanced status to continue receiving the extra 5% in HMGP funding because the state recognizes the significant value to mitigation within the state. The additional 5% for HMGP funding from 2007 to 2016 has resulted in an extra $52,863,689 in HMGP funding.

Additionally, FDEM conducts loss avoidance reports after each Major Disaster Declaration in the state. This consists of evaluating the damages from a disaster, with and without a mitigation project, to determine if the mitigation project was successful in reducing losses. FDEM believes this substantiates the need for mitigation, as well as prove that mitigation is successful in reducing losses. Furthermore, loss avoidance reports prove that FDEM is capable of effectively managing federal mitigation grants. More information can be found in the *State Mitigation Strategy Section* and the *Funding and Projects Section*.

Outline of SHMP

The 2018 SHMP update included re-organization. The outline of the plan is shown in the table below.

Table 3 – Outline of State Hazard Mitigation Plan

Section	Description
Executive Summary Section	The Executive Summary is a quick overview of the entire SHMP.
Introduction Section	The Introduction includes the purpose of the SHMP, as well as elements that are required by statute, such as Regulations and Assurances. The section also includes the definition of hazard mitigation, the Florida state profile, and the results of the Enhanced Florida Mitigation program.
Planning Process and Plan Maintenance Section	The Planning Process and Plan Maintenance Section includes a brief history of the Florida Enhanced SHMP, as well as a narrative regarding the 2018 SHMP Update. The section includes an explanation of the Mitigate FL interagency group and Local and State Plan Integration. Adoption and Approval process descriptions and documentation are also in this section. Finally, there is a section regarding annual reviews and updates, as well as the five-year cycle plan updates.
Risk Assessment Section	The Risk Assessment Section includes the hazard profiles, as well as the vulnerability and loss estimations for each of the eleven natural hazards: • Flood, • Tropical Cyclone, • Severe Storm, • Extreme Heat, • Drought,

	• Wildfire, • Erosion, • Geological, • Seismic, • Tsunami, and • Winter Storm. The SHMP Risk Assessment also includes ten technological and human-caused hazard profiles, because the SHMP Risk Assessment serves as the primary risk assessment for the State of Florida. The technological and human-caused hazards profiled include: • Agricultural Disruption, • Biological Incident, • Civil Disturbance, • Cyber Incident, • Mass Migration, • Hazardous Materials Incident, • Radiological Incident, • Space Weather Incident, • Terrorism, and • Transportation Disruption.
State Mitigation Strategy Section	The State Mitigation Strategy Section discusses the goals and capabilities the Mitigation Bureau has for the next several years. Additionally, there is a description of the state and regional agency mitigation capabilities.
Funding and Projects Section	The Funding and Projects Section discusses how the Mitigation Bureau conducts project management, including financial aspects, of federal grant projects. There is also a discussion of exemplary mitigation projects in Florida in this section.
Appendices	The Appendices are documents that are referenced throughout the SHMP and include: • Appendix A: 2018 Revisions Log • Appendix B: Governing Policies • Appendix C: Planning Process Documentation • Appendix D: Hazard Summary Matrices • Appendix E: Risk Assessment Tables • Appendix F: NFIP Policy Statistics • Appendix G: Wildfire Hazard Mitigation Plan Annex • Appendix H: Sinkhole Report • Appendix I: Critically Eroded Beaches in Florida • Appendix J: HMGP Administration Plan • Appendix K: LMS Update Cycle After Action Report • Appendix L: Outreach Record

	• Appendix M: State Managed Projects • Appendix N: Loss Avoidance Report Tropical Storm Debby • Appendix O: Loss Avoidance Report Severe Storms, Tornadoes, Straight-line Winds, and Flooding • Appendix P: Home Hardening Matters • Appendix Q: Loss Avoidance Report Hurricane Hermine • Appendix R: Loss Avoidance Report Hurricane Matthew • Appendix S: Adoption Documentation • Appendix T: Annual Updates

PLANNING PROCESS AND PLAN MAINTENANCE SECTION

State Hazard Mitigation Plan Requirements
S1. Does the plan describe the planning process used to develop the plan? [44 CFR §§201.4(b) and (c)(1)]
S2. Does the plan describe how the state coordinated with other agencies and stakeholders? [44 CFR §§201.4(b) and (c)(1)]
S11. Was the plan updated to reflect progress in statewide mitigation efforts and changes in priorities? [44 CFR §201.4(d)]
S17. Is there a description of the method and schedule for keeping the plan current? [44 CFR §§201.4(c)(5)(i) and 201.4(d)]
S18. Does the plan describe the systems for monitoring implementation and reviewing progress? [44 CFR §§201.4(c)(5)(ii) and 201.4(c)(5)(iii)]
S19. Did the state provide documentation that the plan has been formally adopted? [44 CFR §201.4(c)(6)]
E2. Does the plan demonstrate integration to the extent practicable with other state and/or regional planning initiatives and FEMA mitigation programs and initiatives? [44 CFR §201.5(b)(1)]
E3. Does the state demonstrate commitment to a comprehensive mitigation program? [44 CFR §201.5(b)(1)]

History of the Florida SHMP

In accordance with 44 CFR 201.4, Florida originally developed the SHMP which was approved by FEMA in 2004. The plan was continually updated in 2007, 2010, and 2013. In 2014, FEMA extended the update cycle from three years to five years, extending the 2013 plan from 2016 to 2018. The updates for 2018 began in mid-2016.

According to 44 CFR statute 201.5(a), states with an approved Enhanced SHMP receive 20% of recovery funds in HMGP funds, rather than the 15% that states with a Standard SHMP receive. In 2006, Florida added the Enhanced plan requirements to the Standard SHMP and Florida first received the extra funding in 2007. Since then, the plan has been Enhanced, earning the state an extra $52 million in HMGP funds.

Table 4 – History of Florida State Hazard Mitigation Plan

Date	Description
August 24, 2004	Florida SHMP approved by FEMA
August 24, 2007	Florida Enhanced SHMP approved by FEMA until August 24, 2010
August 24, 2010	Florida Enhanced SHMP update approved by FEMA until August 24, 2013
August 24, 2013	Florida Enhanced SHMP update approved by FEMA until August 23, 2018 (*originally approved until 2016 but extended due to new rule from FEMA)
August 24, 2018	Florida Enhanced SHMP update approved by FEMA until August 23, 2023 (not official yet)

The Mitigation Planning Unit has been responsible for updating the SHMP in the past. Additionally, the Mitigation Planning Unit coordinated the SHMPAT group, which assisted with updating and approving the plan. The SHMPAT group was formed several years ago and included state partners. Each update cycle, new members were engaged and added, including federal, local, non-profit, and private sector partners.

2018 Update

The 2018 SHMP update began in mid-2016 when the Mitigation Planning Unit conducted an in-depth review of the 2013 SHMP and the 2016 FEMA State Mitigation Plan Review Guide. When the plan update began, the SHMPAT was used as it had been in the past, as a resource for the Mitigation Planning Unit to assist with and approve updates and changes. The plan was reviewed and updated to reflect progress in statewide mitigation efforts and changes in priorities.

In July 2017, Florida statute 252.3655[8] went into effect. The statute mandates an interagency workgroup to share information on the current and potential impacts of natural hazards throughout the state, to coordinate the ongoing efforts of state agencies in addressing the impacts of natural hazards, and to collaborate on statewide initiatives to address the impacts of natural hazards. Each agency within the executive branch of state government, each water management district, and the Florida Public Service Commission is required to designate an agency liaison to the workgroup, while the director of DEM or designee will serve as the liaison and coordinator of the workgroup. Each liaison is required to provide information from his or her respective agency regarding the current and potential impacts of natural hazards to his or her agency, agency resources available to mitigate against natural hazards, and efforts made by the agency to address the impacts of natural hazards. FDEM is also required to submit an annual progress report regarding the implementation of the SHMP, beginning on January 1, 2019.

Since the membership and purpose of this new Natural Hazards Interagency Workgroup was similar to two other statewide mitigation groups – the SHMPAT and the Silver Jackets team – the Mitigation Bureau decided to combine the three groups into one, and title it Mitigate FL. This was done to avoid duplication of efforts and to use resources more effectively.

Since the last SHMP update in 2013, the Mitigation Planning Unit held biannual SHMPAT Meetings. When the 2018 SHMP update began in 2016, the Mitigation Planning Unit began to hold the SHMPAT Meetings quarterly. As explained, the Mitigation Planning Unit continued to hold these meetings, under the title of Mitigate FL Meetings beginning in October 2017. The Meetings from September 2016 through December 2017 were specifically focused on presenting and requesting approval of SHMP updates and changes and soliciting input and feedback. All meeting documentation can be found in *Appendix C: Planning Process Documentation*, but important points are shown below. Below is a list of the meetings from 2013 through the end of 2017.

Table 5 - List of Mitigate FL Meetings from 2013 – 2017

Year	Mitigate FL (SHMPAT) Meetings
2013	• July 2013

8 http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=0200-0299/0252/0252.html

	• December 2013
2014	• June 2014 • December 2014
2015	• June 2015 • December 2015
2016	• March 2016 • June 2016 • September 2016 • December 2016
2017	• March 2017 • June 2017 • October 2017 • December 2017

Various sections of the plan were discussed at the Mitigate FL (SHMPAT) Meetings in 2016 and 2017. The table below provides a detailed breakdown of what sections were discussed at which meetings.

Table 6 – Plan Section Discussions

Plan Section	Meeting(s)
Planning Process	• September 2016 • December 2017
Risk Assessment	• September 2016 • December 2016 • March 2017 • June 2017 • October 2017 • December 2017
Goals & Capabilities	• December 2016 • March 2017 • October 2017 • December 2017
Projects & Funding	• March 2017 • December 2017
Severe Repetitive Loss	• October 2017
Plan Maintenance	• March 2017 • December 2017

Several agencies were invited to attend each SHMPAT meeting, including Local, State, Federal, Non-Profit, and Private Sector partners. Below is a list of agencies that participated in SHMPAT and Mitigate FL Meetings from September 2016 until December 2017.

List of Agencies that Participated in Mitigate FL (formerly SHMPAT) Meetings from 2016 to 2018 for the 2018 SHMP update

Table 7 – Mitigate FL (SHMPAT) Meeting Participating Agencies

LOCAL	STATE	FEDERAL
Bay County	Apalachee Regional Planning Council	Federal Emergency Management Agency
Brevard County	Florida Agency for Healthcare Administration	Federal Alliance for Safe Homes
Broward County	Florida Agency Persons with Disabilities	United State Army Corps of Engineers
City of Brooksville	Florida Agency for State Technology	United States Department of Transportation
City of Fernandina Beach	Florida Courts	
City of St. Cloud	Florida Department of Agriculture and Consumer Services	**OTHER**
City of Tallahassee	Florida Department of Business and Professional Regulation	Dewberry
Columbia County	Florida Department of Citrus	Florida Gateway College
Desoto County	Florida Department of Corrections	Integrated Solutions Consulting
Flagler County	Florida Department of Economic Opportunity	Lakeland Regional Health
Hardee County	Florida Department of Education	Langton Consulting
Hendry County	Florida Department of Environmental Protection	Nova Southeastern University
Hernando County	Florida Department of Health	Pegasus Engineering
Holmes County	Florida Department of Juvenile Justice	St. Petersburg College
Jefferson County	Florida Department of Law Enforcement	University of Central Florida
Lee County	Florida Department of Management Services	University of Florida
Miami-Dade County	Florida Department of Revenue	Florida Emergency Preparedness Association
Manatee County	Florida Department of State	Florida Floodplain Managers Association
Martin County	Florida Department of Transportation	
Monroe County	Florida Division of Emergency Management	
Nassau County	Florida Fire Service	
Okaloosa County	Florida Fish and Wildlife Conservation Service	
Orange County	Florida Highway Patrol	
Osceola County	Florida Highway Safety and Motor Vehicles	
Palm Beach County	Florida Lottery	
Pasco County	Florida Office of Early Learning	
Pinellas County	Florida Public Service Commission	
Santa Rosa County	Northeast Florida Regional Council	
Sarasota County	Northwest Florida WMD	
Seminole County	Southwest Florida WMD	
St. Johns County	St. Johns River WMD	
St. Lucie County	Suwannee River WMD	
Taylor County	Volunteer Florida	
Volusia County	West Florida Regional Planning Council	
Wakulla County		

Mitigate FL Meetings

As explained, the Mitigate FL group was created in 2017 by combining three statewide mitigation groups, the Natural Hazards Interagency Workgroup, the SHMPAT, and the Silver Jackets team.

Membership of Mitigate FL is wide ranging. Florida statute 252.3655 requires liaisons from each state agency, water management district, and the Public Service Commission, which is about 40 people. The SHMPAT group included state agencies, non-governmental and non-profit agencies, and local emergency management professionals. The Silver Jackets group includes federal agency representatives and additional state agency members. The membership of all three groups was combined and the contact list includes about 300 people, with about 70 consistent attendees.

Mitigate FL Meetings, are held at least once each quarter, per Florida Statute 252.3655 and are held on the second Tuesday of the quarter (March, June, September, and December) from 1:00 PM to 2:00 PM. If something prevents a Mitigate FL Meeting from occurring, a makeup meeting is scheduled either in person or via conference call and webinar. The Mitigate FL Coordinator, within the Mitigation Planning Unit is responsible for coordinating the Mitigate FL interagency group, including scheduling and facilitating meetings.

Plan Integration

One purpose of the Mitigate FL group is to bring together a cross-section of representatives from various sectors to assist the Mitigation Planning Unit with evaluating, revising, and otherwise maintaining the State's Enhanced Hazard Mitigation Plan. This group includes members from state agencies, local governments, regional planning councils, universities, non-profit organizations, FEMA, and other federal agencies. As these members work together, they gain and share valuable insight into how the plan may be integrated into their respective hazard mitigation planning processes. As they return to their communities or organizations, they bring with them plan knowledge and tools to update their own plans.

Local Integration

FDEM staff works throughout the five-year update cycle with local jurisdictions to ensure the SHMP is incorporated into local plans such as Comprehensive Emergency Management Plans (CEMP) and Local Mitigation Strategies (LMS). In 2010, the SHMPAT began inviting members of the LMS working groups to participate in state level mitigation planning activities, including quarterly SHMPAT (now known as Mitigate FL) meetings. Participation in Mitigate FL meetings from local partners is always valued, as their participation greatly enhances the SHMP update. As a result, it has helped intertwine the two levels of mitigation planning and strengthened the ability of the state plan to support local plans.

Further integration efforts are noted throughout the 2018 SHMP. For example, the Risk Assessment Section discusses how updated risk assessment information was incorporated from each county LMS. It also discusses the various plans that were reviewed in order to complete the update. This integration process helps to further strengthen the tie between the local and state plans.

State Integration

The SHMP is closely aligned with the State of Florida CEMP. Chapter 252, Florida Statutes, (State Emergency Management Act) mandates the development of the Florida CEMP (see *Appendix G: Governing Policies*). The plan is operations-oriented and establishes a framework through which the State of Florida prepares for, responds to, recovers from, and mitigates the impacts of all hazards that could adversely affect people and property. The CEMP was developed using an all-hazards planning approach to standardize the functional framework under which strategies and resources are used to minimize the consequences of an event.

The SHMP's Risk Assessment Section serves as Florida's single point document on hazards and risks. As a result, the SHMP serves as one of the key documents for the CEMP plan and is integrated into the Florida's CEMP by reference and is listed as a supporting document. It is also a reference for state agencies, special districts, local governments, and voluntary agencies seeking guidance and information on statewide hazard mitigation goals and objectives.

The SHMP is also assimilated into a variety of other state and local plans and planning mechanisms. The plan continues to serve as a reference tool for the development and update of LMS plans and other planning mechanisms. Additional planning mechanisms and programs that are integrated into the SHMP include, but are not limited to, the following:

- Local Comprehensive Plans (see DEO's capability piece in the *State Mitigation Strategy Section*)
- The Florida Building Code (see *Funding and Projects Section*)
- Local Comprehensive Emergency Management Plans (see *Appendix B: Governing Policies* and *State Mitigation Strategy Section*)
- Post Disaster Redevelopment Plans (see *State Mitigation Strategy Section*)
- THIRA (see *Risk Assessment Section*)
- FEMA Hazard Mitigation Assistance Programs (see *Funding and Projects Section*)
- Florida's Silver Jackets Team (see *State Mitigation Strategy Section*)

The above examples demonstrate how the plan is integrated to the extent practicable with other state and regional planning initiatives. The state intends to continue this dialogue with state agencies, regional planning councils, water management districts, local jurisdictions, and others for amplified integration of mitigation measures into comprehensive planning, growth management activity, economic development, capital improvement opportunities, as well as emergency management plans.

Federal Integration

An example of Florida's integration of national standards to improve mitigation planning is the state's participation and accreditation in the Emergency Management Accreditation Program (EMAP). EMAP is a voluntary review process for state, territorial, and local emergency management programs. It provides emergency management programs with the opportunity to be recognized for compliance with national standards, to demonstrate accountability, and to focus attention on areas and issues where resources are needed. The EMAP process evaluates emergency management program compliance with 64 standards.

Florida achieved Emergency Management Accreditation Program (EMAP) accreditation in 2003 and again in 2009. The Mitigation Planning Unit integrated applicable standards into the Enhanced SHMP so that it is EMAP compliant. The applicable standards include the hazard vulnerability and risk assessment, state and local mitigation plans, mitigation grant administration, and public education and outreach. Preparations have begun for the next EMAP re-accreditation and the Mitigation Planning Unit takes an active role in supporting this process.

The SHMP was updated with considerations for all applicable regulations and planning guidance including FEMA's State Mitigation Planning Guide and the Key Topics Bulletins.

More information about tools and strategies used by the state to integrate mitigation planning into local and regional planning processes can be found in the *State Mitigation Strategy Section*, which discusses details of the state's work with local jurisdictions to initiate and complete LMS plans.

Adoption and Approval

After the 2018 Enhanced SHMP underwent final revisions, and the plan was completed to the Mitigate FL and Mitigation Planning Unit's satisfaction, the plan was officially adopted by the State of Florida via a memorandum signed by the Director of FDEM as the Governor's Authorized Representative, on 02/20/2018. After adoption, the plan was submitted to FEMA for approval. The 2018 Enhanced SHMP update was submitted on 02/23/2018 and approved by FEMA on XX/XX/XX. The 2018 Florida Enhanced SHMP will be effective from August 24, 2018 until August 23, 2023.

The following documentation can be found in *Appendix S: Adoption Documentation*.

- Adoption
- Submission
- Approval

Plan Maintenance

Annual Reviews and Reports

As previously stated, Florida §252.3655 requires that the FDEM workgroup coordinator prepare an annual progress report that be submitted to the Governor, the President of the Senate, and the Speaker of the House of Representatives. According to the statute, the annual progress report shall:

- Assess the relevance, level, and significance of current agency efforts to address the impacts of natural hazards; and
- Strategize and prioritize ongoing efforts to address the impacts of natural hazards.

In addition to these requirements, the workgroup coordinator, who also serves as FDEM's SHMP Planner, will include annual reviews and updates of the SHMP in the annual progress reports. The SHMP Planner will complete the annual reviews and updates, with assistance from the Mitigation Planning Unit and the Mitigate FL group. The annual reviews and updates will focus on the following topics:

- Hazard profiles and historical occurrences;
- Goals and objectives;

- Project closeouts;
- Program Administration by States audits;
- Various other audits;
- Loss Avoidance Reports after any federally declared disaster in the state; and
- Any mitigation success stories from the state that year.

These annual progress reports will be added as an Appendix to the SHMP and each agency required to participate in the Mitigate FL group, including FDEM, will post the annual progress reports to their respective agency's website.

FEMA Annual Consultation

Additionally FEMA conducts Annual Mitigation Program Consultations with the State of Florida. During this annual consultation, FEMA and the State review the Enhanced Mitigation Program and validate the capabilities of the state. This consultation helps the state to be sure its mitigation program is "On Target" and complies with Enhanced requirements.

According to FEMA's State Mitigation Plan Review Guide, effective in 2016, FEMA will conduct annual reviews and consultations regarding the state's mitigation program. FEMA is responsible for providing technical assistance and reviewing state activities, plans, and programs to ensure mitigation commitments are fulfilled. The benefits of an annual mitigation program consultation to the state include but are not limited to:

- Promoting dialogue between FEMA and the state on the means to achieve, support, and maintain effective state mitigation programs;
- Identifying the status of the state's mitigation program, including strengths and challenges, as well as specific needs and opportunities;
- Ensuring feedback to the state on maintaining continuous HMA grants management performance, particularly for states interested in developing an enhanced plan; and
- For states that currently have an approved enhanced plan, demonstrating continued mitigation capabilities, including HMA grants management performance, in advance of a plan update and not at the review of a five-year mitigation plan update.

During the consultation, topics of discussion will include, but are not limited to, status and specific needs for:

- Advancing implementation of the state mitigation strategy;
- Ensuring the state mitigation plan remains relevant over the approval period;
- Facilitating the plan update and approval process;
- Building mitigation capabilities through training, technical assistance, and partnerships with FEMA and other Federal agencies;
- Advancing local and tribal, as applicable, mitigation planning, including submitting approvable mitigation plans to FEMA; and

- Maintaining and/or improving mitigation capabilities, with particular attention to human resources and funding; and Maintaining and/or improving HMA grants management performance, including effectively using all available funding from FEMA mitigation programs.

After each consultation, FEMA will provide the state with a summary of the discussion. Appendix D of the State Mitigation Plan Review Guide is the Consultation Summary Template and is used for the FEMA Mitigation staff to prepare a summary of the discussion. FEMA will also document recommendations for improvements to the State Mitigation Program and any items that should be corrected or modified before the next state mitigation plan update. FEMA will not require a state mitigation plan update as a result of the consultation.

Florida values these annual consultations and appreciates the opportunity to provide proof of compliance and the opportunity to discuss issues and challenges between the State and FEMA.

The annual review documentation will also be included in annual reviews, reports, and updates completed by the State and will be considered during the five-year SHMP updates.

<u>Five-Year Update</u>

In addition to these annual progress reports and reviews, the SHMP will be updated every five years, in accordance with 44 CFR 201.4. The five-year updates are labor intensive and take several years to complete. As explained before, the 2018 SHMP update began in mid-2016. The Mitigation Planning Unit will follow the timeline below and will begin the 2023 SHMP update in mid-2021 to ensure adequate time to complete the update. Each section of the 2018 SHMP will be reviewed and updated accordingly.

Below is a timeline starting when the 2018 Update began and ending at the end of 2023 and includes annual and five-year update cycle actions.

Table 8 – State Hazard Mitigation Plan Update Timeline

Year	Task(s)
2016	• Quarterly Mitigate FL Meetings • Begin 2018 SHMP Update • FEMA Annual Consultation
2017	• Quarterly Mitigate FL Meetings • Continue 2018 SHMP Update • FEMA Annual Consultation
2018	• Quarterly Mitigate FL Meetings • Submit and receive SHMP approval • FEMA Annual Consultation • Prepare 2019 Mitigate FL 252.3655 Annual Report
2019	• Quarterly Mitigate FL Meetings • Conduct annual SHMP review • FEMA Annual Consultation • Prepare 2020 Mitigate FL 252.3655 Annual Report
2020	• Quarterly Mitigate FL Meetings

	• Conduct annual SHMP review • FEMA Annual Consultation • Prepare 2021 Mitigate FL 252.3655 Annual Report
2021	• Quarterly Mitigate FL Meetings • Conduct annual SHMP review • FEMA Annual Consultation • Prepare 2022 Mitigate FL 252.3655 Annual Report • Begin 2023 SHMP Update
2022	• Quarterly Mitigate FL Meetings • Continue 2023 SHMP Update • FEMA Annual Consultation • Prepare 2023 Mitigate FL 252.3655 Annual Report
2023	• Quarterly Mitigate FL Meetings • Submit and receive SHMP approval • FEMA Annual Consultation • Prepare 2024 Mitigate FL 252.3655 Annual Report

STATE MITIGATION STRATEGY SECTION

State Hazard Mitigation Plan Requirements
S8. Does the mitigation strategy include goals to reduce/avoid long-term vulnerabilities from the identified hazards [44 CFR §201.4(c)(3)(i)]
S12. Does the plan discuss the evaluation of the state's hazard management policies, programs, capabilities, and funding sources to mitigate the hazards identified in the risk assessment? [44 CFR §201.4(c)(3)(ii)]
S13. Does the plan generally describe and analyze the effectiveness of local and tribal, as applicable, mitigation policies, programs, and capabilities? [44 CFR §201.4(c)(3)(ii)]
S14. Does the plan describe the process to support the development of approvable local and tribal, as applicable, mitigation plans? [44 CFR §201.3(c)(5) and §201.4(c)(4)(i)
S16. Does the plan describe the process and timeframe to review, coordinate, and link local and tribal, as applicable, mitigation plans with the state mitigation plan? [44 CFR §201.3(c)(6), §201.4(c)(2)(ii), §201.4(c)(3)(iii), and §201.4(c)(4)(ii)]
E2. Does the plan demonstrate integration to the extent practicable with other state and/or regional planning initiatives and FEMA mitigation programs and initiatives? [44 CFR §201.5(b)(1)]
E3. Does the state demonstrate commitment to a comprehensive mitigation program? [44 CFR §201.5(b)(4)]
E5. Is the state effectively using existing mitigation programs to achieve mitigation goals? [44 CFR §201.5(b)(3)
E6. With regard to HMA, is the state maintaining the capability to meet application timeframes and submitting complete project applications? [44 CFR §201.5(b)(2)(iii)(A)]
E7. With regard to HMA, is the state maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [44 CFR §201.5(b)(2)(iii)(B)]
E8. With regard to HMA, is the state maintaining the capability to submit complete and accurate quarterly progress and financial reports on time? [44 CFR §201.5(b)(2)(iii)(C)]
E9. With regard to HMA, is the state maintaining the capability to complete HMA projects within established performance periods, including financial reconciliation? [44 CFR §201.5(b)(2)(iii)(D)]
RL.2 Did Element S8 (mitigation goals) address RL and SRL properties? [44 CFR §201.4(c)(3)(i) and §201.1(c)(3)(v)]
RL3. Did Element S9 (mitigation actions) address RL and SRL properties? [44 CFR §201.4(c)(3)(iii) and §201.4(c)(3)(v)]
RL4. Did Element S10 (funding sources) address RL and SRL properties? [44 CFR §201.4(c)(3)(iv) and §201.4(c)(3)(v)]
RL5. Did Element S13 (local and tribal, as applicable, capabilities) address RL and SRL properties? [44 CFR §201.4(c)(3)(ii) and §201.4(c)(3)(v)]

Mitigation Strategy

The State of Florida Enhanced SHMP Mitigation Strategy is to:

> *Reduce the impacts of all hazards within the State of Florida through effective administration of all mitigation grant programs and a coordinated approach to mitigation planning and floodplain management through federal, state, regional, and local initiatives.*

This mission also serves as the FDEM Mitigation Bureau mission and is the mission of the Mitigate FL interagency group.

Additionally, the Mitigation Bureau has a vision to:

> *Make Florida a hazard resilient and resistant state.*

The content of this section discusses how the State of Florida accomplishes the Mitigation Program, including Florida's Mitigation Goals and Objectives and the mitigation capabilities of State, Non-Governmental, and Local agencies.

Goals and Objectives

Goals and objectives help capture the overall purpose of the plan and assist with determining possible new directions for hazard mitigation efforts. Setting goals and objectives ensures that the state is headed in the right direction when it comes to hazard mitigation planning by providing ways in which success can be measured. The goals and objectives below are intended to reduce long-term vulnerabilities. It is important that both the goals and objectives are reviewed regularly for continuing relevance to the state hazard mitigation strategy.

For the 2018 update, the Mitigate FL team felt it was important to develop working definitions of goals and objectives. This was done to explain the differences between the two and to provide a consistent measure when establishing the new goals and objectives. The following definitions were used:

- Goal: A broad, long-term vision that the state is working toward accomplishing with regard to hazard mitigation.
- Objective: The approach the state will take in order to achieve the goals.

The following list represents the newly revised goals and objectives by the Mitigate FL team for the 2018 Enhanced State Hazard Mitigation Plan and beyond. Further clarification of changes made from the 2013 Enhanced State Hazard Mitigation Plan can be found in *Appendix A: 2018 Revisions Log*.

Goal 1: Implement an effective comprehensive statewide hazard mitigation plan.

- Objective 1.1: Provide training opportunities and encourage staff to pursue professional development.
- Objective 1.2: Pursue methodologies that will enhance mitigation successes.

- Objective 1.3: Integrate mitigation practices throughout all state plans, programs, and policies.

Goal 2: Support local and regional mitigation strategies.

- Objective 2.1: Maintain up-to-date risk assessment information in coordination with local communities.
- Objective 2.2: Assist in integrating hazard mitigation concepts into other local and regional planning efforts such as comprehensive plans, local mitigation strategies, and comprehensive emergency management plans.
- Objective 2.3: Ensure that all communities are aware of available mitigation funding sources and cycles.
- Objective 2.4: Assist in the integration of climate change and sea level rise research into state, local and regional planning efforts.
- Objective 2.5: Conduct all possible actions to mitigate severe repetitive loss properties.

Goal 3: Increase public and private sector awareness and support for hazard mitigation in Florida.

- Objective 3.1: Work with other state and regional entities to incorporate mitigation concepts and information into their outreach efforts.
- Objective 3.2: Educate Florida's private sector about mitigation concepts and opportunities.
- Objective 3.3: Develop and integrate hazard mitigation curriculum into higher education.
- Objective 3.4: Educate state risk management entities on mitigation incentives.
- Objective 3.5: Support hazard mitigation research and development.

Goal 4: Support mitigation initiatives and policies that protect the state’s cultural, economic, and natural resources.

- Objective 4.1: Support land acquisition programs that reduce or eliminate potential future losses due to natural hazards and that are compatible with the protection of natural or cultural resources.
- Objective 4.2: Support restoration and conservation of natural resources wherever possible.
- Objective 4.3 Seek mitigation opportunities that reduce economic losses and promote responsible economic growth.
- Objective 4.4: Retrofit existing state-owned facilities.
- Objective 4.5: Participate in climate change and sea level rise research that will further the state and local government’s ability to plan for and mitigate the impacts of future vulnerability.
- Objective 4.6: Coordinate effective partnerships between state agencies for floodplain management.

State Agency Capability Assessment

Many departments, agencies, and private organizations perform roles valuable to state government disaster resistance efforts. Some seemingly unrelated programs are often complimentary to reducing the human and economic cost of disasters. It is a goal of the Mitigate FL team and the State of Florida to educate its citizens (both public and private sectors) on the importance of mitigation. The state continually reaches out to residents and business groups concerning mitigation best practices, tips and how-to's. Training and education are essential to Florida's ability to respond to hazards and must remain a priority within the constraints of lower budgets. Public education reduces the burden on the state by increasing citizen capacity. The agency capability assessments included in this plan demonstrate Florida's comprehensive ability to mitigate hazards and guide development in hazard prone areas in accordance with policies and goals.

This section includes a review of pre- and post-disaster hazard management capabilities and development guidance offered through agencies' roles and programs.

As the main focus of this section is to discuss capabilities of state agencies specific to the State of Florida, during this 2018 plan update, the Mitigate FL team invited participating state agencies to identify and update their mitigation related capabilities. State agencies and their corresponding capabilities are outlined below.

The following agencies are discussed throughout (acronyms included to facilitate reading):

- Florida Division of Emergency Management (DEM)
- Florida Department of Agriculture and Consumer Services (DACS)
- Florida Department of Economic Opportunity (DEO)
- Florida Department of Education (DOE)
- Florida Department of Environmental Protection (DEP)
- Florida Department of Financial Services (DFS)
- Florida Department of Transportation (DOT)
- Florida Department of Veterans' Affairs (DVA)
- Florida Fish and Wildlife Conservation Commission (FWC)
- Regional Planning Councils (RPCs)
- State Board of Administration (SBA)
- Board of Governor's State University System (BOG SUS)
- Volunteer Florida (VF)
- Water Management Districts (WMDs)

Florida Division of Emergency Management

The State Emergency Management Act, outlined in *Appendix B: Governing Policies*, gives the Florida Division of Emergency Management (FDEM) responsibility to create and maintain a comprehensive statewide program of emergency management. Interagency cooperation is a key component of this responsibility. The statewide emergency management program must ensure that the state can adequately prepare for, respond to, recover from, and mitigate all hazards to which the state is vulnerable. FDEM prepares and implements a State of Florida Enhanced Hazard Mitigation Plan (SHMP), a Comprehensive Emergency Management Plan (CEMP), and Continuity of Operations Plan (COOP), just to name a few, and routinely conducts extensive exercises to test state and county emergency response capabilities.

The Division functions with five bureaus:

- Preparedness
- Response
- Recovery
- Mitigation
- Finance and Administration

While the other four bureaus are interlaced with mitigation holistically, the Bureau of Mitigation directly administers the mitigation planning and assistance programs. As such, the activities within the Bureau of Mitigation are the focus of this section. The Mitigation Bureau consists of five units described below:

- Hazard Mitigation Grant Program
- Non-Disaster Grants Programs
- Mitigation Finance Unit
- State Floodplain Management Office
- Mitigation Planning Unit

Additional information and detail of recent fund allocation for these programs can be found in the *Funding and Projects Section*. Recent projects funded by these programs are listed in *Appendix M: State Managed Projects*.

Hazard Mitigation Grant Program Unit

This unit administers the Hazard Mitigation Grant Program (HMGP). This program makes federal funds available post-disaster for mitigation projects in communities participating in the National Flood Insurance Program (NFIP) and that have an approved Local Mitigation Strategy (LMS). The overall goal of HMGP is to fund cost effective measures that reduce or eliminate the long-term risk of damage from natural hazards. Information about how HMGP money is distributed in Florida can be found in Appendix F: HMGP Administrative Plan.

Florida has an approved Enhanced State Hazard Mitigation Plan; therefore, FEMA provides 20 percent of total disaster costs from a presidentially-declared disaster specifically for mitigation projects, as opposed to the normal 15 percent under a non-enhanced plan. These funds have a 25 percent non-federal match requirement and are distributed as grants to affected communities. They are used to execute those mitigation projects identified in each county's respective LMS.

As a part of the Division's post disaster mitigation coordination efforts, the HMGP unit offers application development workshops to the affected areas. At these workshops, general information about the program and technical assistance is provided along with an opportunity to receive specific answers relating to potential applications. Since 2010, 23 in-person workshops and five state-wide webinar workshops have been held across six disasters.

- After Tropical Storm Debby, FEMA DR-4068, four in-person workshops for affected communities were held October-November 2012.

- After Hurricane Isaac, FEMA DR-4084, FDEM, one statewide webinar and two in-person workshops for affected communities were held April-May, 2013.
- After the Florida Severe Storms and Flooding event, FEMA DR-4183, one statewide webinar and four in-person workshops for affected communities were held January-February 2014.
- After the Florida Severe Storms, Tornadoes, Straight-line Winds, and Flooding event, FEMA DR-4177, one statewide webinar and four in-person workshops for affected communities were held November-December 2014.
- After Hurricane Hermine, FEMA DR-4280, one statewide webinar and four in-person workshops for affected communities were held February-March 2017.
- After Hurricane Matthew, FEMA DR-4283, one statewide webinar and five in-person workshops for affected communities were held March 2017.

Program Administration by States

The Program Administration by States (PAS) allows for FEMA to delegate its grant management responsibilities to States that have demonstrated a commitment to hazard mitigation and that have experience in the requested responsibilities. Within the HMGP Unit, these PAS responsibilities include reviewing project applications, completing benefit-cost analyses, approving scope-of-work modifications, and moving funds between applicable projects. This program gives Florida increased control and oversight over their projects and shortens the standard 24-month grant obligation timeline.

Allocations 27P-22

The Florida Administrative Code 27P-22 delineates how HMGP funding will be allocated after a major disaster declaration. The Rule explains that funding is to be allocated to counties, according to the amount of Public Assistance, Individual Assistance, and Small Business Administration loans allocated during a disaster response and recovery. The Rule is listed in *Appendix B: Governing Policies* for reference.

FEMA allocates 20% of Public Assistance, Individual Assistance, and Small Business Administration response and recovery funds for the HMGP. The available HMGP funds are allocated to the counties according to the Florida Administrative Code 27P-22.006. The Rule states that each county receives HMGP funds in the same proportion of the response and recovery costs. There are three tiers of HMGP funding in Florida. The first tier includes those counties which were impacted by a major disaster that was federally declared and the funding is allocated using the same proportion of response and recovery funds. If there is funding remaining after all eligible projects are funded, then the remaining funding is reallocated to those same counties that received the major disaster declaration whose allocation was not sufficient to fund all submitted eligible projects. Funding reaches the third tier if any remains and all counties, not only declared counties, are eligible to receive the funding.

Non-Disaster Grant Programs Unit

This unit administers the remaining grant programs outlined below.

Pre-Disaster Mitigation Program (PDM)

The PDM program is authorized is authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Act, as amended (Public Law 93-288) (42 U.S.C. 5133) and appropriated annually by the Consolidated Appropriations Act. It is a competitive federal grant program developed to assist state, local, and tribal governments to plan and implement cost-effective hazard mitigation activities. The intent of the program is to reduce overall risk to people and property while also minimizing the cost of disaster recovery. Only the state emergency management agency or a similar office assigned the primary responsibility of emergency management may apply to FEMA for funding under this program. FDEM reviews submitted planning and project applications to verify appropriateness, consistency with state and LMS plans, cost effectiveness, eligibility, technical feasibility and completeness before submitting them to FEMA.

Sub-applicants generally submit applications consisting of wind retrofit, drainage and generator projects. The program provides a maximum of $4 million per project in federal funding and a maximum of $400,000 for new mitigation plans; $300,000 for state/territory plan updates and $150,000 for single jurisdiction local/tribal mitigation plan updates. The program has a non-federal cost share requirement of 25 percent, all of which is assumed by the sub-applicant. All PDM projects are vital to meeting the state's primary goal of reducing the loss of life and property.

Funding availability, priorities and restrictions have varied since 2013; however, Florida will continue to utilize the maximum amount of PDM funding available and hopes that the program will remain in place in the future.

Flood Mitigation Assistance (FMA)

The FMA program is authorized Section 1366 of The National Flood Insurance Act of 1968, as amended (Pub. L. No. 90-448) (42 U.S.C. § 4104c) and appropriated annually by the Consolidated Appropriations Act. Since the last plan update, consistent with the legislative changes made in the Biggert-Waters Flood Insurance Reform Act of 2012, the three NFIP funded mitigation programs (Repetitive Flood Claims, Flood Mitigation Assistance and Severe Repetitive Loss) were consolidated into one single program; Flood Mitigation Assistance Program. The combined "National Flood Mitigation Fund" was to be funded at $90 million per year and has exceeded this amount in in FY 2015, FY 2016, and FY 2017. The new program simplifies and combines the three previous programs and includes the following elements:

- Encourages flood mitigation planning to be integrated into a community's multi-hazard mitigation plan.
- Adds demolition/rebuild (mitigation reconstruction) as an allowable mitigation activity under all programs.
- Caps the use of mitigation grant funds for mitigation planning activities at $50,000 to states and $25,000 for communities.
- Provides for denial of grant funds if not fully obligated in 5 years.
- Restructures the federal share requirement:
    - Up to 100 percent for severe repetitive loss structures (4 or more claims of over $5000 or 2 or more claims exceeding value of structure).

- Up to 90 percent for repetitive loss structures (2 claims over 10 years averaging at least 25 percent of the value of structure).
- Up to 75 percent for other approved mitigation activities.

It is this last piece that most interests Florida, as this change demonstrates an encouraging federal focus on mitigating properties that most frequently and severely experience flood damages. Florida has utilized the Flood Mitigation Assistance Program aggressively throughout the state, particularly in areas where severe repetitive loss properties are found. Obviously, the goal of the program is to reduce the risk of flood damage through building modifications, drainage projects, and floodplain management planning activities. FEMA's continued attempt to unify program elements such as eligibility, application requirements, and grant process guidance is admirable, and Florida looks forward to reducing vulnerability and strengthening resilience within communities through continued participation in this program.

Hurricane Loss Mitigation Program (HLMP)

The Hurricane Loss Mitigation Program (HLMP) is a state administered grant and receives $10 million annually from the Florida Hurricane Catastrophe Trust Fund (Ch. §215.559, Florida Statutes).

Three million dollars is allocated towards the purpose of retrofitting existing facilities that are used as public hurricane shelters. Each year the Division shall prioritize the use of these funds for projects included in the annual report of the Shelter Retrofit Report prepared in accordance with § 252.385(3). The Division is required to give funding priority to projects in regional planning council regions that have shelter deficits and to projects that maximize the use of state funds.

Up to $3.5 million is to be used to improve the wind resistance of residences through loans, subsidies, grants, demonstration projects, direct assistance, and cooperative programs with local and federal governments. The program is developed in coordination with the Advisory Council whose members consist of representatives from the Florida Association of Counties, the Florida Department of Insurance, the Federation of Manufactured Home Owners, the Florida Manufactured Housing Association, the Florida Insurance Council, and the Florida Home Builders Association.

$2.8 million is designated for the Mobile Home Tie-Down Program. Based on legislative directive the Florida Division of Emergency Management provides funding for mobile home tie-downs across the state, a program administered by Tallahassee Community College (TCC). By statute, TCC prepares a separate report for the Governor and the Legislature on these directives.

$700,000 is designated for Hurricane Research to be conducted by Florida International University (FIU) to continue the development of an innovative research of a full-scale structural testing to determine inherent weakness of structures when subjected to categories 1 to 5 hurricane-force winds and rain, leading to new technologies, designs and products.

Through partnering with local housing authorities and non-profit organizations, the Division has been able to promote wind mitigation and provide hazard mitigation upgrades to residents. Funded activities include retrofits, inspections, and construction or modification of building components designed to increase a structure's ability to withstand hurricane-force winds. The Retrofit Program utilizes the Florida Building Code as its standard for all retrofitting.

Grant funds awarded under the HLMP qualify as state financial assistance under the Florida Single Audit Act. See Section 215.971, Florida Statutes. The Catalog of State Financial Assistance number (CSFA#) for HLMP is 31.066. Because the Legislature provides the Division with HLMP funds through the grants and aid appropriation category, eligible proposers under this request for proposal (RPF) include governmental entities, nonprofit organizations, and qualified for-profit organizations; individual homeowners are ineligible to apply.

Mitigation Finance Unit

The fiscal unit manages all financial aspects of pre and post-disaster mitigation grant programs. This unit has been strengthened in recent years to provide a more comprehensive tracking system for mitigation efforts statewide. Since the last plan update, the unit has implemented Floridamitigation.org, which tracks all project and financial information for the Bureau of Mitigation. For more information on project tracking and financial procedures, please see the *Funding and Projects Section*.

State Floodplain Management Office (SFMO)

The State Floodplain Management Office (SFMO) administers Florida's coordinated statewide floodplain management program through its direct contacts with other State agencies, regional entities such as the ten Regional Planning Councils and five Water Management Districts, and local government cities and counties. FEMA depends on each state's NFIP Coordinator to deliver the NFIP program to communities through conducting compliance reviews of local floodplain management regulatory programs, providing educational programs to enhance communities' knowledge of floodplain management best management practices and to address questions about NFIP flood insurance. The State NFIP Coordinator is the state's Floodplain Manager who represents state-level administration of flood disaster response along with the federal FEMA partner during federally-declared disasters when FEMA staff are deployed. The SFMO also serves an active role in assisting the FEMA's mapping contractors in Flood Insurance Rate Maps (FIRMs) update process, and state staff must review revisions or updates of all local government flood ordinances prior to the effective date of new flood maps. The Office encourages communities to adopt higher regulatory standards in flood ordinances to help them advance in the Community Rating System (CRS) which helps lower the cost of NFIP flood insurance premiums.

Through funding from FEMA's Community Assistance Program - State Support Services Element (CAP-SSSE), the Floodplain Office conducts Community Assistance Visits and Community Assistance Contact Interviews, and offers general technical assistance to Florida communities. Beginning in 2015 and running through 2017, Florida's State Floodplain Management Office implemented an innovative pilot program, approved by the Federal Insurance Management Administration (FIMA) Headquarters administrators, to offer all communities in Florida with NFIP policies the opportunity to participate in CRS to reduce and offset increases in premiums resulting from Congress passing the Biggert Waters Act of 2012. While only partially funded by the CAP-SSSE, the State forged ahead with accomplishing Community Assistance Visits (CAVs) with 208 communities not participating in CRS. It is unlikely that any state has conducted as many CAVs in so little time throughout the 50-year history of the NFIP. The pilot program has, as its primary goal, substantially improved flood resiliency in communities that have not had the benefit of a CAV in many years if not decades. Many communities were able to correct NFIP floodplain management procedural problems and in exchange, are able to engage in a streamlined process to participate in CRS. The visits culminated in a far greater understanding of community floodplain management quid pro quo responsibilities which the communities agreed to assume when they originally joined the NFIP. The CRS/CAV Pilot Program achieved numerous unanticipated returns on investment, such as stimulating over 150 communities to adopt the state model flood ordinance which is coordinated with the Florida Building Code which uses the International Code Council's base code for buildings. Some 25 communities have already joined the CRS program and about 20 or more communities are working to participate in CRS once they resolve compliance matters and the State is able to close the CAVs. As a follow up to the pilot program, the State has funded the development of an evaluation report, which documents the value added gains achieved by the CRS/CAV Pilot Program. When the report is completed, it may serve as a model for use by FEMA and other States to improve flood resiliency and reduce the cost of NFIP flood insurance premiums through participation in CRS.

The SFMO supports FEMA's Map Modernization and Risk MAP processes throughout the state, and provides training for local officials. The training is conducted primarily through an agreement with the Florida Floodplain Managers Association (FFMA). For more information about work conducted under the most recent CAP-SSSE grants, please see *Appendix L: Outreach Record*.

NFIP Flood Insurance Policy Status

As of January 2018, Florida has 1,738,149 National Flood Insurance Program (NFIP) policies, equaling approximately 35 percent of all policies in the nation. Total premiums equal an annual amount of $950,483,682. These policies cover more than $423 billion in property. Florida has contributed to the NFIP fund an average over the past 40 years nearly 10 times the amount of premiums paid than the State has received in closed paid NFIP claims. As with much of the nation, flooding represents the most damaging natural hazard in the State. As of January 2018, Florida has 3,925 repetitive loss (RL) properties that have been mitigated and 14,887 RL properties that have not been mitigated. Moreover, there are 657 mitigated and non-mitigated properties that are considered severe repetitive loss (SRL). This demonstrates that a strong mitigation program is still necessary in Florida.

Florida currently has now 468 communities (local governments) that participate in the NFIP. There are an additional 10 listed on FEMA's Community Status Book (October 18, 2012) as non-participating with special flood hazard areas. The SFMO continues to enroll new communities with the expectation of increasing the 98 percent participation rate. In the five years since the last plan update (December 31, 2017), the state has enrolled 11 new communities in the NFIP. The newly enrolled communities are:

- Town of Altha, Calhoun County March 26, 2014
- City of Avon Park, Highlands County, November 18, 2015
- Town of Bristol, Liberty County, April 30, 2014
- City of Chiefland, Levy County, January 14, 2014
- Town of Estero, Lee County, March 30, 2015

- Town of Fort White, Columbia County, September 30, 2013
- Town of Greensboro, Gadsden County, December 23, 2013
- Town of Penny Farms, Clay County, March 17, 2014
- City of Sebring, Highlands County, November 18, 2015, and
- City of Williston, Levy County, January 2018
- Town of Loxahatchee Grove, Palm Beach County, January 2018.

The SFMO also promotes the enrollment of communities in the Community Rating System (CRS). CRS is a federal program that incentivizes improved floodplain management practices and public outreach in exchange for NFIP insurance premium rate reductions to policy holders in flood zones. The CRS organizes three broad category goals for which communities may earn credit points for advancing these goals. The main goals of the CRS program are to reduce flood risk/damage, encourage the purchase of NFIP flood insurance, and pursue a broad approach to enhancing floodplain management. As of January 2018, Florida has 240 communities enrolled in CRS, which is a 51 percent participation rate. More information can be found in Appendix F: NFIP Policy Statistics.

Repetitive Loss Strategy

The State of Florida Division of Emergency Management has a comprehensive mitigation program that includes addressing repetitive loss properties in the state. Several of the SHMP goals refer to actions taken to reduce RL properties and four units work with communities on different aspects of RL properties. The Mitigation Planning Unit works with communities from a planning and strategy perspective. The CRS Initiative works with communities to identify Repetitive Loss Areas, and assists CRS communities in gathering repetitive loss information from FEMA. The SFMO unit works with communities to identify projects and assist with planning and strategy. The Grants unit works with communities that apply for PDM and FMA grants. Particularly the FMA program focuses on mitigating RL properties to reduce or eliminate claims to the NFIP.

Repetitive Loss (RL) Properties are defined by FEMA in the National Flood Insurance Program (NFIP) as an NFIP-insured structure that has had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978. Similarly, Severe Repetitive Loss (SRL) Properties are NFIP-insured residential properties that meet either of the following criteria since 1978:

- At least four NFIP claims payments over $5,000 each and the cumulative amount of such claims payments exceeds $20,000; or
- At least two separate claims payments with the cumulative amount of such claims payments exceeding the market value of the buildings.

For either scenario, at least two of the referenced claims must have occurred within any 10-year period and must be separated by a period of greater than 10 days[9].

Goals and Objectives

[9] https://www.fema.gov/national-flood-insurance-program/definitions

The State of Florida considers mitigating RL and SRL properties to be of importance and value. One of the objectives of the SHMP is directly related to SRL properties. Goal 2 states that Florida will support local and regional mitigation strategies and Objective 2.5 states that Florida will conduct all possible actions to mitigate severe repetitive loss properties. The Bureau supports this objective by encouraging and supporting local communities with outreach, education, and planning assistance to mitigate their RL and SRL properties.

Other goals and objectives refer indirectly to the mitigation actions that lead to the reduction of claims to the NFIP. Goal 3 is to increase the public and private sector awareness and support for hazard mitigation in Florida and Objective 3.1 states that Florida will work with other state and regional entities to incorporate mitigation concepts and information into their outreach efforts. Again, FDEM supports this with planning assistance and encouraging local communities to conduct outreach to their RL and SRL properties.

Goal 4 states that Florida will support mitigation initiatives and policies that protect the state's cultural, economic, and natural resources. Objectives 4.1, 4.2, and 4.3 refer to mitigation actions that would reduce or eliminate claims to the NFIP, thereby reducing RL and SRL properties. The objectives support land acquisition programs, restoring and conserving natural resources, and seeking mitigation opportunities that reduced economic losses and promotes responsible economic growth.

FDEM Support and Actions

The Mitigation Planning Unit is responsible for reviewing and approving county Local Mitigation Strategy (LMS) plans. There are two elements required by FEMA and Florida to be in county LMS plans regarding RL properties. FEMA requires that the LMS plan addresses NFIP insured structures within the jurisdiction that have been repetitively damaged by floods. The State of Florida further requires that the LMS plan describe the type and number of FEMA repetitive loss properties within each jurisdiction.

Additionally, if a community participates in the CRS program and they have one or more repetitive loss properties in their community, there are extra steps the community must take and there is a particular emphasis on communities with 50 or more RL properties. For example, these communities must review and update their repetitive loss properties list each year and map repetitive loss areas. The review of the RL properties list must include a review of all historical damage to buildings, including all repetitive loss properties and all properties that have received flood insurance claims payments or have had an estimate of potential damage and dollar losses to vulnerable structures. The communities must also determine and describe the cause of the losses in the RL areas. Furthermore, communities must conduct annual outreach to the property owners or residents in the RL areas regarding that they are in an RL area or an area that has historical flood losses, the availability of flood insurance in their community, various retrofitting and property protection techniques, and the available funding sources to help pay for the mitigation actions.

The Florida CRS Initiative is managed by the State at FDEM, formerly within the Special Project's Team, and now within the Mitigation Bureau and State Floodplain Management Office. CRS staff assist communities with new applications to join CRS, modifications for improved floodplain management programs, recertification to remain in the program, and conduct training throughout the state. In addition to the elements listed above that must be included in the county LMS plan to satisfy the Repetitive Loss prerequisites of the CRS program, communities can earn additional credit points for their CRS rating through acquisition and relocation projects and other flood protection projects like elevation.

The SFMO, within the Mitigation Bureau also supports the RL and SRL property by assisting and encouraging communities to address their RL properties during their routine CAV's.

Funding Options

Communities and their residents can pursue many options for funding assistance for mitigation projects. States, Tribes, and Local governments can apply for all three of the FEMA mitigation grants. The FMA program is aimed at mitigating flood damaged properties to reduce or eliminate claims under the NFIP.

The PDM program can assist communities with implementing a sustained pre-disaster natural hazard mitigation programs to reduce overall risk to the populations and structures from future hazard events, while also reducing the reliance on Federal funding from future disasters. While the FMA program provides funding for flood mitigation, the PDM program can fund projects targeting other hazards, such as high winds and wildfires.

HMGP is only available to a community after it has experienced a federally declared disaster. The program is intended to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process after a disaster in a community.

After a federally declared disaster, Congress may appropriate funds to be used in HUD's CDBG – Disaster Recovery Program to provide flexible grants to help communities recover after federally declared disasters, particularly in low-income communities[10].

Common mitigation actions and projects include:

- Acquisition and Demolition
- Relocation
- Mitigation reconstructions
- Structure elevation
- Dry flood-proofing of non-residential and historical residential structures
- Minor localized flood reduction projects (drainage projects)
- Structural retrofitting

Mitigation Planning Unit

The Mitigation Planning Unit is primarily responsible for reviewing and approving Local Mitigation Strategy (LMS) plans and for updating the State Hazard Mitigation Plan (SHMP).

Since 2008, the Mitigation Planning Unit has grown to four full-time planning positions, and planners have been able to fully assist local communities in their LMS efforts. This includes 5-year updates to Florida's

[10] https://www.hudexchange.info/programs/cdbg-dr/

67 LMS plans as well as annual updates required by Florida Administrative Code 27P-22 (more information about 27P-22 can be found in *Appendix B: Governing Policies*).

The Mitigation Planning Unit is also responsible for reviewing:

- Disaster Resistant University (DRU) Plans (LMS plans developed for colleges or universities).
- Mitigation components of other plans such as local Comprehensive Emergency Management Plans (CEMP) and various state strategies.
- Floodplain Management Plans.
- Planning criteria of submitted mitigation grant projects.

The Mitigation Planning Unit also:

- Works with FDEM Mitigation Bureau Grant Units on outreach activities and local partnerships.
- Works with SFMO on the integration of floodplain management concepts, plans and practices into other planning mechanisms.
- Coordinates and teaches mitigation trainings across the state.

FEMA has delegated LMS plan review and approval responsibilities to Florida through PAS. As stated before, this designation is given to states that have demonstrated a commitment to hazard mitigation and that have experience in requested responsibilities. The Mitigation Planning Unit is authorized to review, require revisions, and approve the required LMS plans on FEMA's behalf. FEMA conducts an audit review for every ten plans that FDEM submits to FEMA.

In 2017, Florida Statute 252.3655 went into effect requiring the natural hazard interagency workgroup. The statute also required that a position within FDEM be created to be the coordinator of the workgroup. As explained before, the Natural Hazards Interagency Workgroup was combined with the SHMPAT and the Silver Jackets team to form the Mitigate FL group. A new SHMP Coordinator position at FDEM was placed within the Mitigation Planning Unit and is responsible for the Mitigate FL group and for updating the SHMP.

The three aspects of the Mitigate FL group are valuable and important. The natural hazards interagency workgroup will allow for stronger relationships between state agencies, which will lead to a stronger mitigation program. The Mitigate FL team assists the Mitigation Planning Unit with updates to the plan and helps to ensure stakeholder involvement and input in the plan. The Silver Jackets team offers opportunities for partnerships between state and federal agencies regarding mitigation projects across the state.

Enhanced Mitigation Program Capabilities and Validation

Florida is currently managing six disasters under Program Administration by States (PAS). According to the most recent FEMA Annual Consultation, all applications sent from Florida are quickly determined complete.

According to the 2016 and 2017 FEMA Annual Consultations, all Non-Disaster applications are quickly determined to be complete. All Non-Disaster progress and financial reports are complete and submitted on time. Florida successfully closed two grants in the review period.

Additionally, the 2016 FEMA Annual Consultation Summary states that environmental requirements are almost always complete and when there is an incomplete package, Florida has been very responsive and request for information (RFI's) have not gone beyond the informal first request. Additionally, all HMGP progress and financial reports have been completed upon submittal and only one extension was required. Florida successfully closed one grant in the review period and four more have been closed since then.

All HMA projects have been completed within the performance periods. Additionally, most Periods of Performance (POPs) have been extended in accordance with requirements. FEMA has not had an audit finding regarding POPs since 2012.

Florida Department of Agriculture and Consumer Services

Florida Forest Service

Through Chapter 590 of the Florida Statutes, the Florida Forest Service (FFS) is given the primary responsibility for "prevention, detection, and suppression of wildfires (any vegetative fire that threatens to destroy life, property, or natural resources) wherever they may occur." This includes the state's entire 34 million acres of both private and public land. The FFS is also responsible for authorizing all outdoor burning within the State of Florida (Florida Statutes, 590.125).

FFS uses many tools to communicate information to residents and visitors. Information is constantly supplied to various media sources locally and from the state level to inform the public of current wildfire conditions, wildfire suppression progress, actions homeowners can take to lower risk, and FFS activities.

In 2011, FFS completed a state-wide wildfire hazard mitigation plan to serve as an annex to the SHMP. The wildfire annex has been appended to the 2018 SHMP as *Appendix G: Wildfire Hazard Mitigation Plan Annex*, and contains valuable information for communities across the state. In addition to creating the annex, FFS recently updated its publication titled Wildfire Risk Reduction in Florida: Home, Neighborhood, and Community Best Practices, which explains many wildfire mitigation strategies homeowners can implement to keep their homes safe. More wildfire risk reduction information is also posted on the FFS website at www.floridaforestservice.com.

The FFS wildfire mitigation program has two major components designed to reduce risk throughout the state, Fuel Reduction and Information and Education. Programs are coordinated locally through the mitigation specialists located in FFS field offices.

Fuel Reduction

FFS uses prescribed fire and mechanical methods to reduce fuel loading on public and privately owned lands. This reduces wildfire size and intensity. The FFS also provides technical assistance to communities contracting for fuel reduction and is often able to provide fuel reduction activities at little or no cost to homeowners. The FFS has four regional Fire Management Teams equipped to provide fuel reduction services. Local FFS field units also have this capability.

In many areas, pre-suppression fire lines can reduce residential wildfire risk. Well-maintained fire lines significantly reduce chances wildfire will reach populated areas as well as reduce time needed to contain a wildfire. This helps ensure the most effective and efficient use of resources. FFS provides this service to landowners at specified rates.

Information and Education

The FFS information and education component has several facets:

- The Florida Firewise Communities Program: This program is a part of the National Fire Protection Association Firewise Communities USA Recognition Program. It is intended to educate residents on their responsibility to help prevent community wildfires. Homeowner workshops and field visits teach homeowners how to increase their home's chances of surviving a wildfire disaster, even if fire services cannot get to them. Communities that adopt and implement Firewise principles are encouraged to pursue recognition as part of Firewise Communities USA.
- Community Wildfire Protection Plan (CWPP): Communities, defined as a "group of residents," are brought together to develop and initiate a CWPP. These groups need representation from the local governing body (e.g., county officials), the local fire service, and FFS. To ensure that the plan is representative of local needs, other stakeholders are invited to participate in the development of the CWPP. These planning groups often involve Local Mitigation Strategy (LMS) members.
- Wildfire Risk Assessments: Local FFS field units help communities develop a wildfire risk assessment, which incorporates information generated by the Fire Risk Assessment System. This informs the community of actions they can take to lower their overall risk.
- Wildfire Prevention Program: Since over 75 percent of wildfires in Florida are human caused, FFS has an active wildfire prevention program. Television, newspapers, radio, billboards, movie theaters, and local flyer distribution are used.
- Policy Changes: FFS field units work with local governing bodies and LMS groups to change or institute local comprehensive plans, ordinances, and codes that encourage actions and strategies lowering wildfire risk.

Additional information about the programs and services provided by FFS can be found on the web at www.floridaforestservice.com.

Florida Wildland Fire Risk Assessment System (FRAS)

The purpose of the Florida Wildland Risk Assessment is to identify the potential for serious wildfires and prioritize areas for mitigation options. As of December 2012, the FRAS has been updated to include a new canopy layer and to have the ability to reflect current conditions. There have been no updates as of 2016 to this data.

The State of Florida is currently in the process of working with 12 other states to implement an online program that will allow fire managers and the general public to not only access these data, but produce reports based on the data for any size area within the state. This will be very helpful for Florida's counties when working on their fire prevention plans. Results can be used to:

- Locate opportunities for interagency planning.
- Identify opportunities for wildfire mitigation measures.
- Facilitate communication among agencies to better define priorities and improve emergency response to wildfires.
- Develop a refined analysis of a complex landscape using GIS.
- Facilitate communication with local residents to address community priorities and needs.

Florida Department of Economic Opportunity

The Department of Economic Opportunity (DEO) serves as the designated lead coordinating agency for state planning, housing and community development and workforce services related issues. Many of its programs and activities directly and indirectly reduce exposure to disasters. Coordination between divisions and programs of DEO are integral to development and implementation of a statewide mitigation plan. DEO also serves in a supporting role for ESF 6-Mass Care and ESF 14-Public Information and is the lead agency for ESF 18-Business Industry and Economic Stabilization.

A primary goal of the DEO is to ensure that its associates and partners are prepared to respond to emergencies, recover from them, and to mitigate their impact. Threat assessments of various emergency situations that could possibly impact DEOs staff and programs have been conducted. These assessments are useful in determining possible risks, severity of damage, and occurrence probability. Consequently, DEO developed procedures and established standards for enhancing safe, secure, and healthy workplace practices for its associates and visitors.

The Business Continuity Management Program under DEO provides a resilient framework that will allow business operations to continue under adverse conditions. It will also allow for rapid return to normal operations in the event of a minor interruption or major disaster.

DEO reviews most comprehensive plans and Florida Statute 163.3178(2)(d) requires that the Coastal Management Element of the local comprehensive plan contain a component which outlines policies for hazard mitigation and protection of human life against the effects of natural disasters, including population evacuation, which take into consideration the capability to safely evacuate the density of the coastal population proposed in the Future Land Use Element in the event of an impending natural disaster. In 2015, the Legislature amended section 163.3178(2)(f), Florida Statutes, related to the redevelopment component of the Coastal Management Element to require that it include development and redevelopment principles, strategies, and engineering solutions that reduce the flood risk in coastal areas which results from high-tide events, storm surge, flash floods, storm water runoff, and the related impacts of sea-level rise.

For the last several years, the Division of Community Development has been working with planning and emergency management officials to understand how Florida's communities are implementing hazard mitigation principles and whether these principles in each Local Mitigation Strategy (LMS), Comprehensive Emergency Management Plan (CEMP), Post-Disaster Redevelopment Plan (PDRP), and Long-Term Recovery Plan have been incorporated into local comprehensive plans.

DEO works closely with FDEM, contributing extensively to ongoing mitigation initiatives both directly and indirectly. The Bureau of Community Planning and Growth supports the State Hazard Mitigation Plan's goals and objectives through many programs and initiatives including:

- Adaptation Planning
- Coastal Zone Management consistency reviews under the Federal Coastal Management Program
- Assistance with Coastal Management Planning, including coastal redevelopment planning to reduce the risks of coastal flooding and the related impacts of sea level rise
- Hazard Mitigation Planning
- Military Base Encroachment Planning
- Post-Disaster Redevelopment Planning
- Waterfronts Florida Partnerships

The Division of Community Development (DCD) at DEO has been very successful in promoting mitigation throughout Florida. Several successful products and initiatives that DCD has prepared, or partnered on, in recent years are listed below.

- Post-Disaster Redevelopment Planning: A Guide for Florida Communities
- Post-Disaster Redevelopment Planning: Addressing Adaptation during Long-term Recovery
- Protecting Florida Communities: Land Use Planning Strategies and Best Development Practices for Minimizing Vulnerability to Flooding and Coastal Storms
- Wildfire Mitigation in Florida: Land Use Planning Strategies and Best Development Practices
- Wildfire Risk Reduction in Florida: Home, Neighborhood, and Community Best Practices
- Guiding the Way to Waterfronts Revitalization: Best Management Practices
- Disaster Planning for Florida's Historic Resources
- Disaster Mitigation for Historic Structures: Protection Strategies

Community Resiliency

In 2012, the Department kicked-off a five-year project to integrate adaptation to potential sea level rise into current planning mechanisms including the local comprehensive plan, local hazard mitigation plan and post-disaster redevelopment plan. This effort is steered by a focus group of statewide experts on planning for sea level rise adaptation and stakeholders in the coastal area. DEO researched similar efforts in other states as well as how the "Adaptation Action Area" may be implemented at the local level. DEO subcontracted with the South Florida Regional Planning Council to train staff in the other nine regional planning councils in Florida to assist local governments in developing data to be used to plan for adaptation and planning to address coastal flood risks. DEO then piloted adaptation planning projects in the state and is compiling all lessons learned from the projects to be used for statewide outreach.

Waterfronts Florida Partnership Program

The Florida Coastal Management Program created the Waterfronts Florida Partnership Program in 1997 to address the physical and economic decline of traditional working waterfront areas. Waterfronts Florida continues as a coastal technical assistance program of DCD.

Waterfronts Florida provides technical assistance and training to designated communities as well as other coastal communities involved in the revitalization of working waterfronts. To be designated by DEO as a Waterfronts Florida Community, a community must create a vision and action plan for waterfront revitalization targeting environmental and cultural resource protection, public access, economic health, and hazard mitigation. They must also demonstrate formal support from local governments and form a local committee of stakeholders in the community, including property and business owners, to serve as the steering committee for the effort.

Technical assistance is delivered to communities through special projects, visioning assistance, webinars, one-on-one meetings and Program Meetings that occur twice a year in a designated community, featuring guest speakers on topics important to working waterfronts and coastal communities.

DEO recognizes that resiliency and hazard mitigation are important components of this program, as they collectively comprise one of the four identified priorities. Several resources have been prepared for Waterfronts Florida Communities focused on how to become more resilient to coastal flooding and storm surge. Furthermore, DEO has begun to integrate aspects of adaptation planning for sea level rise into the technical assistance offered to communities.

Areas of Critical State Concern

The Area of Critical State Concern program in DCD provides oversight and assistance to local governments that have been recognized by the Florida Legislature as having resources of statewide significance through a designation as an Area of Critical State. The following areas have been designated: Big Cypress Swamp (located in portions of Collier, Dade, and Monroe County); the Green Swamp (portions of Lake and Polk County); Apalachicola Bay (currently the City of Apalachicola in Franklin County); the Florida Keys Area (unincorporated Monroe County, Marathon, Layton, Key Colony Beach, and Islamorada); and the City of Key West Area.

Within these areas (other than the Big Cypress Area), staff reviews comprehensive plans, land development regulations, environmental resource permits, and development orders for consistency with applicable statutes and rules. Staff provides technical assistance regarding planning matters including hurricane evacuation and mechanisms to implement and improve hazard mitigation and address coastal flood risks.

GIS Resources

DCD maintains and updates DEO's geographic information system (GIS) database. Planners use it to evaluate flood and hurricane hazards in land use plan amendments and local government approved Developments of Regional Impact (DRIs). The GIS unit maps are also used during regulatory reviews of comprehensive plan amendments and DRIs. The system also provides planners with storm surge zone and floodplain information and can be used to evaluate the Statewide Hurricane Evacuation Studies.

Division of Community Development, Bureau of Community Planning and Growth

The Bureau of Community Planning and Growth has three regional planning teams responsible for conducting reviews of comprehensive plans and plan amendments, DRIs, Florida Quality Developments, sector plans, rural land stewardship areas, and university campus master plans. The Bureau staff also reviews development agreements and assists with challenges to local comprehensive plan amendments and land development regulations to ensure consistency with existing comprehensive plans, including inherent hazard mitigation policies. This service supports local governments and ensures compliance with state law.

In 2015, the Legislature used the Community Planning Act to highlight the significance in reducing the flood risk in coastal areas resulting from high-tide events, storm surge, flash floods, storm water runoff, and the related impacts of sea-level rise.

The Coastal Management Element of the comprehensive plan sets forth policies to fulfill these legislative directives. Requirements for the Coastal Management Element state that the future land use map series recognize hurricane evacuation routes and identify Coastal High Hazard Areas (CHHA). The CHHA is the Category 1 storm surge zone as defined by the Sea, Lake and Overland Surges from Hurricanes (SLOSH) Model. Section 163.3177(6)6., Florida Statutes, requires local governments to limit public expenditures that subsidize development in coastal high hazard areas. Many local comprehensive plans have objectives and policies, which limit or restrict residential density, the type of development allowed, establish special building requirements, and that limit the use of public funds within the CHHA.

To implement the 2015 statutory requirements related to the risks of coastal flooding, DEO is providing technical assistance to local governments that are developing comprehensive plan goals, objectives, and policies to address the new statutory requirements. In addition, through its Community Planning Technical Assistance Grant program, and following up on the adaptation planning data gathered under the Coastal Resiliency Program, DEO has provided technical assistance grants to two municipalities and one regional planning council to prepare comprehensive plan goals, objectives and policies consistent with the requirements of section 163.3178(2)(f), Florida Statutes, to use as models for other local governments in the state.

Future land uses and amendments are based in part on land use suitability, which is in turn affected by environmental constraints, transportation, housing, water and sewer, park and open space impacts, and hazard suitability (vulnerability to natural disaster). Pursuant to Section 380.06(30), Florida Statutes, adopted in 2015, DRI review is no longer required for proposed large-scale developments that would otherwise be subject to the DRI review requirements in Section 380.06, Florida Statutes. Instead, they are reviewed through the comprehensive plan amendment process if a comprehensive plan amendment for the proposed development is required. For existing DRIs, staff in the Bureau of Community Planning and Growth identifies the state impacts of large-scale developments (DRIs) and makes recommendations to local governments to approve, suggest mitigating measures, or not approve modifications to such developments. For existing DRIs, the process provides for the incorporation of hazards data and may result in recommendations that hazard mitigation conditions be attached to the development order. For proposed new DRI-sized projects for which a comprehensive plan amendment is required, Bureau staff may also recommend hazard mitigation conditions for the proposed development.

Competitive Florida Partnership

The Competitive Florida Partnership in the Bureau of Community Planning and Growth consists of grants and technical assistance provided to local governments toward the creation and implementation of an economic development strategic plan. In promoting a comprehensive approach to economic development, the Partnership supports the inclusion of disaster resilience strategies within community plans.

Florida Department of Education

Office of Educational Facilities

The mission of the Office of Educational Facilities within the Florida Department of Education (DOE) is to provide technical support and information for issues related to education facility planning, funding, construction, and operations throughout Florida's K-20 Education System. The Office of Educational Facilities distributes authorized state funds for construction. The Office is also responsible for maintaining State Requirements for Educational Facilities. These include planning, funding, contracting, maintenance, and facility operations. Construction building code requirements are through the Florida Building Code (DEO) and the Florida Fire Prevention Code (State Fire Marshal).

The activities of DOE apply pre- and post- disaster by mitigating damage to education facilities. These facilities often double as shelters in times of disaster.

Florida Department of Environmental Protection

The Florida Department of Environmental Protection (DEP) is the lead state agency for environmental protection, resource management, and stewardship. The department administers regulatory programs and issues permits for air, water, and waste management. It also oversees the state's land acquisition and water management programs. DEP additionally manages the Florida Park Service. The key agency activities discussed below are applicable in both pre- and post-disaster situations.

Division of Water Resource Management

The Division of Water Resource Management is responsible for protecting the quality of Florida's drinking water, rivers, lakes, wetlands, and beaches. It is also responsible for reclaiming lands once mined for minerals. The Division establishes the technical basis for setting surface and groundwater quality standards. It additionally implements a variety of programs to monitor the water resource quality. The following programs under the Division of Water Resource Management have hazard mitigation implications.

Florida Dam Safety Program

The Florida Dam Safety Program (FDSP) receives a grant administered by FEMA to conduct some of the National Dam Safety Program (NDSP) activities. The purpose of the NDSP is to reduce the risks to life and property from dam failure in the U.S.

Dam safety in Florida is a shared responsibility among DEP, the regional water management districts, United States Army Corps of Engineers (USACE), local and regional governments, consultants, and private dam owners to assure the safety of dams and related structures. This effort is overseen by the State of Florida Dam Safety Officer, DEP, Division of Water Resource Management, Engineering, Hydrology, and

Geology Support Section. The State Dam Safety Officer implements the FDSP activities and serves as the State representative to the Association of State Dam Safety Officials (ASDSO).

Florida State regulations on dam safety include the Florida Statutes (Part IV Chapter 373, which is further discussed in *Appendix B: Governing Policies*) and can be found in the Florida Administrative Code for the management and storage of surface water. Under the above statute, Environmental Resources Permits (ERP) are required for all new dam construction and for modification or removal of any existing dams. Additional guidance on Minimum Requirements for Earthen Dams used in Phosphate Mining and Beneficiation Operations and for dikes used in Phosphogypsum stack system impoundments are available under Florida Administrative Code (FAC) Ch. 62-672.

The NDSP provides assistance to the states to establish, maintain, and improve an effective state dam safety program for activities such as the development of regulatory authority for the design, construction, and maintenance of dams; the undertaking of dam inspections; and the development of Emergency Action Plans (EAPs) for dams.

In December of 2010, the FDSP published a guide for dam owners and operators entitled "Emergency Action Plan (EAP) Template for Dams in Florida and Instructions for Developing Emergency Action Plans." A key responsibility of the FDSP is to update the state dam inventory (which is the source of the USACE's National Dam Inventory of Florida dams), review draft EAPs, and implement activities to meet the NDSP goals. The current goals include:

- Reducing the likelihood of dam failures.
- Reducing the potential consequences resulting from dam failure.
- Promoting research and training for state dam safety personnel and other professionals.

Florida's State Floodplain Manager has developed a working relationship with the State Dam Safety Officer to investigate a more coordinated understanding of Florida's dams, and their potential risk to surrounding communities. The DEP is an active member of the Mitigate FL group.

Submerged Lands and Environmental Resource Coordination Program

The Submerged Lands and Environmental Resource Coordination Program (ERP) regulates the construction, alteration, maintenance, operation, removal, and abandonment of storm water management systems, dams, impoundments, reservoirs, works (including dredging, filling, and construction in wetlands and other surface waters), and appurtenant works under Part IV of Chapter 373, F.S. It also processes related authorizations for requests to use sovereignty submerged lands under Chapter 253, F.S., and, if within an aquatic preserve, Chapter 258, F.S.

The program has flood mitigation implications because it addresses both storm water runoff quality and quantity (i.e. storm water attenuation and flooding of other properties).

The ERP program, which is implemented by DEP and the five water management districts, regulates the above activities for the protection of water quality, to prevent flooding, and draining of lands and water resources, and to ensure system structural integrity of constructed systems. The program also provides for post-storm emergency permitting to repair or restore damaged systems.

Bureau of Beaches and Coastal Systems

The Division of Water Resource Management also oversees activities affecting Florida's beaches, coastal systems, and sovereign submerged lands along the Atlantic Ocean, Gulf of Mexico, and Straits of Florida. These activities include the restoration and management of critically eroded beaches, safeguarding of the beach and dune systems, and determining shoreline conditions and trends.

The Beaches Programs consist of four interrelated programs: Coastal Construction Control Line Permitting (CCCL), Beaches Inlets & Ports Permitting, Beaches Field Services, and Coastal Engineering. The CCCL program regulates construction seaward of the coastal construction control line to protect the beach and dune system and to ensure that upland construction will withstand storm events to the maximum extent possible. CCCL also reviews temporary post-storm coastal armoring for its long-term impact on the beach and dune system. The Beaches, Inlets & Ports Program regulates erosion control activities that may affect the sandy beaches. The program also regulates activities associated with dredging at the state's 14 seaports.

The Beaches Field Services and Coastal Engineering Programs work in support of the other programs' regulatory functions, providing data, analysis, and compliance coordination. All of the Beaches programs collectively respond to emergency beach stabilization requests, resource evaluations, and storm response.

The Beach Management Funding Assistance Program is administered through DEP's Division of Water Restoration Assistance and administers grant funding provided by the Legislature for beach restoration, erosion control and inlet management activities.

Division of State Lands

The purpose of the Division of State Lands is to:

- Acquire, administer, and dispose of state lands owned by the State Board of Trustees of the Internal Improvement Trust Fund.
- Administer, manage, and maintain the records of all such lands.
- Administer and maintain the state geodetic survey requirements.
- Identify and set ordinary and mean high water boundaries for purposes of sovereignty and land title.

Florida Forever Program

In 1999, the Florida Legislature enacted the Florida Forever Program for the acquisition of lands, water areas, and related resources for outdoor recreation and natural resource conservation purposes. Florida Forever succeeded the Preservation 2000 program, and both programs have acquired and preserved more than 2.5 million acres of land.

The public acquisition of land and conservation easements avoids future developments in timberlands, wetlands, and coastal areas, which in turn reduces or eliminates potential impacts of wildfire, flooding, and coastal storms. Florida Forever also funds acquisition of in-holdings and additions to already existing conservation lands, the Florida Recreation Development Assistance Program (FRDAP) grant program, the Florida Communities Trust (FCT) grant program, the administration of the Stan Mayfield Working Waterfronts (SMWW) grant program within FCT, and the Rural and Family Lands Protection program (within the FFS).

Florida Geological Survey

The Florida Geological Survey (FGS) has a mission and work plan that shares the common vision and mission of DEP. FGS has additional directives mandated by the Florida Legislature (Section 377.075, Florida Statutes), which include periodically reporting survey progress, findings, and analyses. It also provides technical assistance to the general public, industry, and other local, state, and federal agencies. An FGS project that has hazard mitigation implications is the mapping of depressions, which may be used to support or update the existing map of sinkhole type, development, and distribution in Florida (see FGS Map Series No. 110).

FGS and FDEM partnered in 2013 on a grant from FEMA to map the favorability of sinkholes in the state. The study began with three test sites in the state and was expanded to several counties. The resulting map shows general favorability of an area for sinkhole development. The report and data are included as *Appendix H: Sinkhole Report*.

Additional FGS geologic information that has natural hazard mitigation implications includes reports on spring sheds, aquifer vulnerability and subsurface mapping, earthquakes, and flood control.

Florida Coastal Management Program (FCMP)

The Florida Coastal Management Program (FCMP) is the unit of DEP responsible for maintaining and updating a program based on existing Florida statutes and rules and submitting applications to the National Oceanic and Atmospheric Administration (NOAA) to receive funds under the Coastal Zone Management Act. FCMP allows for federal consistency reviews by state agencies; participation in a program to secure competitive federal funds for acquisition of coastal properties to reduce adverse land use and environmental impacts in the state coastal zone; and sub-grant funding of planning initiatives. For more on FCMP’s funding efforts, please see the Coastal Partnership Initiative (CPI) Grant Program information in the *Funding and Projects Section*.

Florida Department of Financial Services

The Florida Department of Financial Services (DFS) is responsible for overseeing the state's finances, collecting revenue, paying state bills, Insurance fraud investigations, auditing state agencies, regulating cemeteries and funerals, and handling fires and arsons. DFS has 15 divisions, two of which apply to mitigation: Division of Consumer Services and Division of State Fire Marshal. The Bureaus and programs listed below are within one of the two previously mentioned divisions.

Consumer Outreach

The Division of Consumer Services offers programs on a variety of topics that inform Florida consumers about insurance and financial issues in an effort to help them make informed decisions; and to serve as a resource for information before and after disasters. Principle among them for mitigation purposes are Hurricane Preparedness Materials that appear on their webpage.

Disaster Response

The Division has a Disaster Preparedness webpage[11] that contains up to date information about storm recovery and mitigation. The page provides up to the minute alerts concerning insurance information. It additionally provides links to useful resources, information concerning hurricane mitigation, and consumer tips. Citizens can access additional information by calling the hotline at 1-877-MY-FL-CFO.

Division of State Fire Marshal

The Division of State Fire Marshal is dedicated to protecting life, property and the environment from the devastation of fire. Our focus and efforts foster a fire safe environment through engineering, education and enforcement.

The different mitigation related activities of the State Fire Marshal include:

Fire Fighter Certifications

The Division's office issues over 3,000 basic fire fighter certifications a year. Students attend one of 35 certified training centers located across the state or the Florida State Fire College. The State Fire College trains over six thousand students per year in a wide variety of certification and professional development programs to include Pump Operator, Fire Officer, Fire Investigator, HAZMAT, and more.

State Building Inspection

The Division inspects over 14,000 state and over 16,000 public and private buildings a year for safety. The Division also reviews construction plans and documents for new construction, alterations, and renovations on all state-owned and state-leased buildings for Florida Fire Prevention Code compliance.

Florida Fire Incident Reporting Section

This section collects over 1,800,000 fire and emergency reports per year. These reports are combined with the other states reports in the National Fire Incident Reporting System for use by the fire services in analysis and trends. The Florida reports are also used to form the basis for the State Fire Marshal's Annual Report "Florida Fires".

Florida Department of Transportation (FDOT)

The FDOT's primary statutory mandate is to coordinate the planning and development of a safe transportation system that ensures the mobility of people and goods, enhances economic prosperity and preserves the quality of our environment and communities. In developing the state transportation system, FDOT works with local, regional and federal transportation partners. While the highest priorities are safety and system preservation, the agency places great emphasis on developing the transportation system to enhance economic prosperity and preserve the quality of our environment and communities.

[11] http://www.myfloridacfo.com/Division/Consumers/Storm/default.htm

FDOT has a major role in emergency management. To that end, FDOT has designated the following positions for assisting in emergency management efforts:

- Emergency Coordination Officer (ECO): The ECO, or designee, is a member of the Mitigate FL group. The ECO contributes to developing and implementing of Local Mitigation Strategy (LMS) and associated mitigation efforts.
- District Maintenance Engineer (DME): Each DME functions as the coordinator for emergencies in his or her respective district. The person serves as a point of contact for the Emergency Management Finance Chief in public assistance and mitigation efforts.

The agency is committed to maintaining the essential flow of traffic, and to ensuring the safety of Floridians and visitors that use Florida transportation systems. Hazard mitigation efforts related to transportation activities occurs in the planning and project development of transportation improvement projects, and they are part of the design, maintenance and construction areas of the Department.

The following summaries provide an overview of the plans, policies and practices used by the FDOT in its efforts to promote and improve safety, security, and resilience of Florida's transportation systems.

2060 Florida Transportation Plan (FTP)

The 2060 FTP is a statewide plan that defines Florida's future transportation vision and identifies goals, objectives, and strategies to guide transportation decisions over the next 50 years. The FTP contains several goals. The safety and security goal of the FTP is to "Provide a safe and secure transportation system for all users." Another goal is to "Maintain and operate Florida's transportation system proactively." An objective of this proactive maintenance is to reduce the vulnerability and increase the resilience of critical infrastructure to the impacts of extreme weather events and trends related to natural hazards.

Strategic Intermodal System (SIS) Policy Plan

The SIS is a statewide network of high priority transportation facilities including the state's largest and most significant airports, spaceports, deep-water ports, freight rail terminals, passenger rail and intercity bus terminals, rail corridors, waterways, and highways. These facilities represent the state's primary means for moving people and freight between Florida's diverse regions, including between Florida and other states and nations. A major objective of the SIS Strategic Plan is to ensure Florida's transportation system can meet national defense, emergency response and evacuation needs while providing a safe facility for the public.

Project Delivery

FDOT has restructured its mitigation program to promote efficiency, cost effectiveness, and timeliness in project delivery. Decisions are based on interagency coordination and the comparison of options to ensure that the chosen mitigation actions fully compensate for project impacts and that they are cost-effective and successful.

Compliance with environmental laws helps avoid development, including that of transportation infrastructure, in high-risk areas such as designated undeveloped coastal barriers. It helps improve the resilience of transportation facilities to flooding and other associated impacts, including those risks associated with coastal storms and storm surge.

In project delivery, the FDOT must comply with all applicable federal and state laws and environmental rules, including the following:

- National Environmental Policy Act (NEPA)
- National Flood Insurance Program (NFIP)
- Coastal Barrier Resources Act (CBRA)
- Coastal Zone Management Act (CZMA) including the enforceable policies of the Florida Coastal Zone Management Act (FCMA).

In complying with federal and state requirements, FDOT is committed to the following:

- Mitigating environmental impacts for encroachments into wetlands and floodplains.
- Managing storm water and drainage impacts through design, construction, and maintenance of transportation infrastructure.
- Avoiding or minimizing highway encroachments within the 100-year (base) floodplains, where practicable.
- Minimizing impacts where floodplain encroachments are unavoidable.
- Ensuring the wise use and protection of the state's water, cultural, historic and biological resources.
- Minimizing the state's vulnerability to coastal hazards.
- Ensuring compliance with the state's growth management laws.
- Protecting the state's transportation system.
- Protecting the state-owned right-of-way.

Policy and Design Changes

The FTE adopted a related policy for their facilities that are relied on for hurricane evacuation, which requires the mainline travel lanes to be above the 100-year floodplain elevation. This policy was integrated in the design criteria of the Plans Preparation Manual, Volume 1, Section 2.6.

Hazard mitigation related changes in design criteria include:

- Revising the design standards for making single and multi-post sign components.
- Making signals and equipment more wind resistant.
- Revising the wind speed criteria for structures so that the criteria used is consistent with requirements of the Florida Building Code.
- Changing the height of the superstructure of coastal bridges to be at least one foot above the 100-year wave crest.
- Developing new criteria for areas transitioning from normal crown to super elevations to reduce ponding and hydroplaning.

- Selecting coatings and using weathering steel for steel girders and box girder bridges to maximize bridge service life.
- Improved concrete materials in marine environments to maximize bridge service life.

Bridge Security

In designing significant, high profile structures, antiterrorist measures are considered to minimize vulnerability. Some examples of countermeasures include designing structures for blast effects, selective protection of the structural integrity of key members, and incorporating structural redundancy. Also, for security reasons, certain structural designs, such as those for bridges and certain storm water conveyance facilities are exempt from public records disclosure.

Asset Management

Reducing risk to hazards is also addressed within the broader context of asset management, which includes monitoring the transportation system and maintaining, upgrading, and operating physical assets cost effectively. Annual surveys of the state highway system are conducted to assess the condition and performance of the state's roadways as well as to predict future rehabilitation needs.

In the area of bridge maintenance, FDOT conducted a statewide assessment of bridges potentially vulnerable to wave loading on the superstructure. Emergency response plans were developed to speed response due to bridge loss or damage. Also, the effects of wave loading on the structure are considered during the design of new bridges that may be potentially vulnerable and critical – important to safety, the economy and are of significant value.

Research Efforts

The FDOT Research Center manages a vibrant and diverse transportation research program. Working with Florida's state universities, other agencies, research institutions, other states, and private contractors, the Center performs research in all areas of FDOT.

The Center emphasizes applied research, implementation, performance monitoring, and technology transfer. In addition, it works closely with functional areas within FDOT, peer agencies, and other stakeholders to conduct and implement research.

Current mitigation related research includes:

- Completed an evaluation of state bridges which identified potentially vulnerable transportation infrastructure to predict flooding from sea level and tidal changes.
- Development of wind resistant structures such as signs and signals has been completed and is now being implemented.
- Improving visibility and warning systems.
- Improving roadway design criteria for scour and wave loading.

The FDOT State Materials Office (SMO), located in Gainesville, provides testing, research, inspection, evaluation, recommendations, and training in materials composition, use, and performance for Florida's transportation system. The SMO develops the criteria for acceptable material quality; provides technical assistance and support to the districts in solving materials-related problems; and monitors field activities for compliance with federal and state policies and procedures.

Florida Department of Veterans' Affairs

The Florida Department of Veterans' Affairs (DVA) is a state agency responsible for assisting, without charge, Florida's veterans, their families and survivors in improving their health and economic well-being through high quality benefit information, advocacy, education, and long-term health care. DVA has Veterans' Claims Examiners co-located with the U.S. Department of Veterans Affairs (VA) Regional Office in Bay Pines, each VA Medical Center, and most VA Outpatient Clinics in Florida.

The department operates seven state veterans' homes. Six are 120-bed skilled nursing facilities and one is a 150-bed assisted living facility. All facilities are inspected annually by the VA and Florida Agency for Health Care Administration. All state veterans' homes have active COOP plans and are tested annually during the State of Florida Hurricane Response Exercise for hurricane preparedness. All DVA facilities are built to the Florida Building Code to ensure they are mitigated.

Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission (FWC) is committed to mitigating losses for the public safety of Floridians and visitors as well as Florida's state lands, state parks, and Florida's population of fish and wildlife. The mission of the FWC is to manage fish and wildlife resources for their long-term well-being and the benefit of people.

The FWC is the lead component in the Florida Division of Emergency Management's reconnaissance mission to document early impacts of manmade and natural disasters. FWC is also a first responder during and after disasters performing search and rescue, boating safety, and ensuring public safety. FWC enforces waterway security zones to ensure safety and to lessen impacts to Florida's property, natural resources, and environment and assists with derelict vessel recoveries after disasters as well as environmental impacts such as oil spills or other interferences to navigation. FWC also researches and documents impacts to Florida's fisheries, wildlife, and habitat as a result of the disaster and takes the necessary actions to alleviate those impacts. Those actions include open communications with partners and stakeholders for determining the best means of recovery.

Regional Planning Councils

Florida's 10 Regional Planning Councils (RPCs) are public organizations, owned by their member counties, which bring together the state's local governments to share responsibility for the future of Florida. The RPCs are recognized as Florida's only multi-purpose regional entity that is in a position to plan for and coordinate intergovernmental solutions to problems on greater-than-local issues. Each RPC, as indicated in Figure 7, serves as a bridge between state and local governments representing an area in which mutual resources, characteristics, and issues exist.

Each RPC has a Board of Directors that sets its work program and budget. These governing boards are made up of local elected officials, gubernatorial appointees, and ex-officio members, which include nonvoting members from the Florida DEO, DOT, DEP and the appropriate water management district(s). Funding for RPCs generally comes from local government membership dues and contracts, and federal and state funding.

Figure 7 – Florida Regional Planning Councils

Mitigation Programs and Functions

Because the state is increasingly vulnerable to natural, technological, and human-caused disasters, emergency management planning is a critical element of the 21st century planning paradigm. The role of RPCs in emergency management has increased over the past 30 years as governments recognize the benefits and necessity of working together as well as integrating the "whole of community" in emergency management planning. The planning effort has expanded to address all five mission areas: Prevention, Protection, Response, Recovery and Mitigation.

Statewide Regional Evacuation Study

Working together in a coordinated manner, RPCs in Florida completed a multi-year Statewide Regional Evacuation Study (SRES), which represents an unprecedented undertaking to concurrently update regional evacuation studies for each region. The studies included all-hazards and vulnerability assessments, behavioral analyses, shelter planning, and evacuation transportation modeling. The SRES provides planning tools that promote fully integrated, seamless planning across counties and regions to manage the movement of large numbers of citizens safely out of areas in danger. Emergency management offices across the state continue to use parts of the SRES in implementing their operational plans and procedures. Transportation and community development planners rely on the tools developed as part of the SRES in their mitigation and planning efforts.

Local Emergency Planning Committees (LEPC)

As with natural disasters, RPCs play a significant role in the hazards analyses planning process in Florida for hazardous materials. The Emergency Planning and Community Right-to-Know Act (EPCRA) requires that all facilities possessing extremely hazardous substances with an amount equal to or greater than certain thresholds, submit a report to the State Emergency Response Commission. The Regional Report identifies these chemicals, their quantities, the potential threat of a release, and critical facilities and special locations (i.e., schools, hospitals, and nursing homes) and threat zones. This information can be used for response planning and mitigation of these hazards in the community. RPC staff serve as the coordinators for Local Emergency Planning Committees (LEPCs). The goal of the LEPCs is twofold: First, to establish working relationships among agencies and industries that manage and respond to incidents by training alongside other responders; and second, to educate the public and facilities managers with regard to preparedness, contingency planning, and mitigation.

Local Mitigation Strategies (LMS)

RPCs provide planning and technical services to assist their local governments in developing Local Mitigation Strategies. The purpose of the LMS is to reduce or eliminate the impact of hazards within a community and diminish the loss of life and property damage. The LMS serves as a bridge between a local government's comprehensive growth and emergency management plans, land development regulations, building codes, ordinances, and related policies. With these plans in place, communities are able to prioritize and coordinate efforts to reduce or eliminate hazards in the future.

Post Disaster Redevelopment Plans (PDRP)

In addition to the LMS, the RPCs have been involved with and provided technical assistance in post-disaster redevelopment planning, working with the myriad of federal, state, and local stakeholders to develop plans for long-term recovery and community restoration. These plans address issues associated with short-and long-term recovery including, but not limited to Land Use and Mitigation, Disaster Housing, Permitting and Rebuilding Issues, Infrastructure Restoration, Environmental Restoration, Economic Redevelopment, and Health and Human Services. The PDRPs have continued to evolve and many are addressing additional issues such as adaptive strategies pertaining to the possibility of climate change and sea level rise impacts.

Other Regional Programs and Projects

RPC staff members can also serve on review teams for County Comprehensive Emergency Management Plans (CEMPs). As the Economic Development Districts in the State of Florida, many RPCs are modeling disaster scenarios to determine impacts and vulnerabilities associated with hazards. They are identifying industry clusters, supply lines, etc., as well as including an Emergency Management section in the regional Comprehensive Economic Development Strategies (CEDS) which addresses mitigation and resiliency.

When appropriate, RPCs have assisted local governments in preparing Public Assistance (PA) and Hazard Mitigation Grant Program (HMGP) applications following disasters. In addition, RPCs have served as the local entity for private non-profits and universities in pre-disaster mitigation projects. As part of its state-mandated mediation obligations, regional planning councils are required to have a dispute resolution process to address intergovernmental disputes. The intent of this Regional Dispute Resolution Process is to provide a flexible process to reconcile differences on planning and growth management issues. This capacity may be helpful in long-term redevelopment.

State Board of Administration

The State Board of Administration is created in Article IV, Section 4(e) of the State Constitution. Its members are the Governor, the Chief Financial Officer, and the Attorney General, serving as Trustees. The Board derives its powers to oversee state funds from Article XII, Section 9 of the Constitution. The State Board of Administration (SBA) provides a variety of investment services to various governmental entities. These include managing the assets of the Florida Retirement System, the Lawton Chiles Endowment Fund, the Local Government Surplus Funds Trust Fund, the Florida Hurricane Catastrophe Fund (FHCF), and a variety of other mandates. The FHCF was created in November 1993 during a special legislative session after Hurricane Andrew. The purpose of the FHCF is to protect and advance the state's interest in maintaining insurance capacity in Florida by providing reimbursements to insurers for a portion of their catastrophic hurricane losses.

Board of Governors State University System of Florida

The Board of Governors (BOG) manages the State University System (SUS) and ensures its coordination and operation. The state university system enrolls over 300,000 students and 60,000 faculty and staff. The BOG establishes policy and guidance to continue execution of mission-essential functions of the SUS of Florida and the State Emergency Management Act. Each university must develop and adopt policies, regulations, and procedures as required to ensure the continued health, safety, and well-being of the campus community. Such activities include the designation of an emergency manager and alternate, and the development and management of a Comprehensive Emergency Management Plan (CEMP) and Continuity of Operations Plan (COOP). Furthermore, universities are authorized to enter into mutual aid and other cooperative agreements to enhance campus safety and security. Universities within the SUS are prepared to:

- Maintain health, safety, and security of university students, staff, visitors, and property.
- Initiate and provide for the coordination of activities relating to emergency preparedness response, recovery, and mitigation among agencies and officials.
- Maintain essential functions in a setting that is endangered and/or debilitated.
- Execute viable operational plans to return the university to normal operating conditions, within a reasonable time frame, based on existing circumstances.
- Report on campus health and safety efforts.

- Comply with casualty, sanitation, and fire safety standards, including Florida Building Codes.

Volunteer Florida

Since 1997, the Governor's Commission on Volunteerism and Community Service (Volunteer Florida) has served as the lead agency for Emergency Support Function (ESF) 15 - Volunteers and Donations. Volunteer Florida is a 25-member governor appointed commission. Its mission is to strengthen Florida's communities through volunteerism and service. To fulfill this mission, the Commission facilitates the development, promotion, and implementation of volunteer and community service programs and practices. Volunteer Florida has entered into memoranda of understanding with over 35 support organizations to provide resources, services, and capabilities for disaster response, recovery, and mitigation.

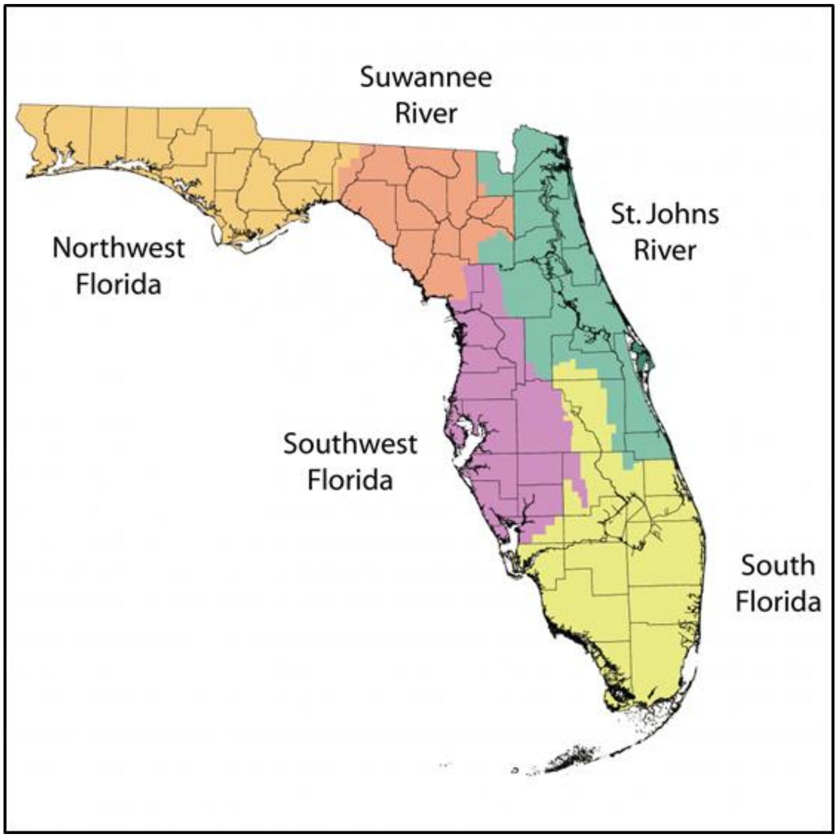
As the ESF 15 lead agency, Volunteer Florida provides the following disaster related services:

- Manages the activities and staffing of ESF 15 at the State Emergency Operations Center (SEOC) in Tallahassee.
- Operates the State Volunteers and Donations Hotline in times of disaster.
- Routes disaster donations to local agencies that need them.
- Trains Florida AmeriCorps members to assist communities impacted by disaster.
- Helps potential disaster volunteers connect with local disaster volunteer managers.
- Develops the response capabilities of Florida's voluntary agencies through networking, training and exercises.
- Provides training, presentations and support to County ESF 15 organizations, Volunteer Reception Centers, ESF 15 support organizations, and other partners.
- Participates in mitigation planning activities to consider possible mitigation projects, rule and ordinance changes that would reduce disaster-related costs and promote and engage volunteer organizations.

Water Management Districts

DEP has "general supervisory authority" over Water Management Districts (WMD) which are regional government entities (Chapter 373, Florida Statutes). There are five districts in the state, as shown in Figure 8, with boundaries determined by watersheds and other natural, hydrologic, and geographic features. Each works with the state to manage and protect water resources in times of crisis or emergency, as well as to manage and protect those same resources for the short and long term. In 1972, with the Florida Water Resources Act (Chapter 373), the state expanded the responsibilities of water management districts to include regional water resource management and environmental protection as well as flood control and water supply.

Figure 8 – Florida Water Management Districts



The water management districts administer flood protection programs and perform technical investigations into water resources. The districts partner with FEMA as Cooperating Technical Partners (CTPs) in the national Map Modernization process of updating the NFIP Flood Insurance Rate Maps for Florida communities. The districts also develop water management plans for water shortages in times of drought and to acquire and manage lands for water management purposes under the Save Our Rivers program. Regulatory programs delegated to the districts include programs to manage the consumptive use of water, aquifer recharge, well construction, and surface water management.

As part of their surface water management programs, the districts administer the department's storm water management program. This increases the districts' contacts with local governments by directing the districts to help with the development of the water elements in local government comprehensive plans. County LMS planners also request data and information from the WMDs during their plan update process. WMDs ensure present and future water provision for the state and exist as a direct mitigation measure.

Northwest Florida Water Management District (NWFWMD)

The Northwest Florida Water Management District (NWFWMD) has worked for decades to protect and manage water resources in a sustainable manner. It does this for the continued welfare of people and natural systems across a 16-county region. Within the district's 11,305 square-mile area, there are several major hydrologic (or drainage) basins. They include the Perdido River and Bay watershed, the Pensacola Bay System (Escambia, Blackwater and Yellow Rivers), the Choctawhatchee River and Bay watershed, the St. Andrew Bay watershed, the Apalachicola River and Bay system, the Ochlockonee River and Bay watershed, and the St. Marks River and Apalachee Bay watershed (including the Wakulla River).

The NWFWMD's strategic priorities include:

- *Springs Protection and Restoration:* Protect and restore water quality and flows within the major spring systems of northwest Florida. The NWFWMD conducts an array of activities to restore and protect its springs. Among these are septic-to-sewer retrofit projects, enhanced agricultural best management practices in partnership with agricultural producers, water quality and flow monitoring, and spring bank and streambank restoration and protection.
- *Minimum Flows and Minimum Water Levels (MFLs):* Develop and implement science-based MFLs that protect water resources and associated natural systems. Implementation of an effective MFL program is an important part of the District's overall effort to ensure the long-term protection and sustainability of regionally significant water resources, including the St. Marks River Rise; Wakulla Spring; Sally Ward Spring; Jackson Blue Spring; and the coastal Floridian aquifer in Walton, Okaloosa, and Santa Rosa counties.
- *Apalachicola-Chattahoochee-Flint River Basin:* Protect Apalachicola River and Bay water quality and freshwater inflow. The district continues to work with state agencies and local governments to protect the economic and ecological viability of the Apalachicola River and Bay watershed system.
- *Water Supply:* Plan and facilitate sustainable water supplies for future reasonable and beneficial uses. The district accomplishes this in many ways through water use permitting, well regulation, water supply planning and assessment, water resource development, and water supply development assistance.
- *Watershed Protection and Restoration:* Protect and restore watershed resources and functions. The district conducts watershed-based planning and restoration efforts and supports cooperative projects in partnership with local governments, state resource agencies, and other regional stakeholders.
- *Flood Protection and Floodplain Management:* Maintain natural floodplain functions and minimize harm from flooding. The district works in cooperation with the Federal Emergency Management Agency (FEMA) on the flood map modernization and Risk Mapping, Assessment, and Planning (Risk MAP) program. As a cooperating technical partner (CTP), the district collaborates with state and local agencies to deliver quality data to increase public awareness and support for actions that reduce flood risks.

Suwannee River Water Management District (SRWMD)

The Suwannee River Water Management District (SRWMD) covers 7,640 square miles with a population of approximately 320,000. Suwannee is the smallest of the state's water management districts in terms of geographic area, population served, tax base, and agency staff. The district has the highest concentration of freshwater springs in the state and ground and surface waters are intimately related. This makes the area very important for water quality and quantity.

The district is highly rural in character. Accordingly, most of the region's residential growth is in unincorporated rural areas. The Interstate 75 corridor from Lake City to Gainesville is experiencing rapid development and is projected to contain much of the district's future population. Total population is projected to increase to about 750,000 by 2050.

The district faces challenges in managing the water and related resources as the region continues to grow and develop. The district's water resources are affected by groundwater withdrawals and pollution outside of its boundaries, including Georgia and cities located along the northeastern coast of Florida.

The district's strategic priorities are as follows:

- *Sustainable Water Supply:* Ensure an adequate and sustainable water supply for all reasonable beneficial uses while protecting springs and other natural systems.
- *Water Conservation:* Maximize water conservation for all water uses. Conservation measures are encouraged with management incentives and regulatory mechanisms.
- *Minimum Flows and Levels:* Ensure district priority water bodies are protected for current and future generations. The district's efforts to develop minimum flows and levels (MFLs) for its major rivers and springs have revealed that water supplies are limited. Thus, management efforts must focus on protecting springs and natural systems, developing alternative water supplies that offset groundwater withdrawals, and encouraging regional water supply development. This must be accomplished by balancing the water needs of our communities and natural systems. Through the use of MFLs, the district works to protect and conserve water resources, which helps plan for adequate water supplies while protecting resources from significant harm.
- *Heartland Springs Initiative:* Ensure springs have adequate flow, maintain good water quality, and sustain healthy biological communities. Setting and achieving a high standard for protecting and managing springs demands a historic level of cooperation, coordination, and investment of public and private funds. Vital signs of the district's natural systems are monitored through an extensive system of water quality and quantity data networks. The information collected is used in the development of MFLs, regulatory programs, land management, and flood protection.
- *Water Management Lands:* Manage land and real estate interests to provide non-structural flood control, protect surface and ground water quality, and to enhance water resource related natural systems. SRWMD owns 160,000 acres of land and has conservation easements over an additional 125,000 acres. These lands provide benefits such as floodwater storage and conveyance, wildlife habitat, and recreation. Over 324 river front miles are protected.
- *Non-Structural Flood Protection:* Enhance flood risk information to protect life and property against flood hazards. District administered FEMA funds have made flood insurance rate map modernization possible for many jurisdictions. Such maps help guide local development regulations to avoid new development flood hazards.

St. John's River Water Management District (SJRWMD)

The St. Johns River Water Management District (SJRWMD) is responsible for balancing citizens' needs for water with nature's needs. The SJRWMD manages groundwater and surface water supplies in all or part of 18 counties in northeast and east-central Florida. The core missions of the SJRWMD are:

- *Water Supply:* To implement a regional strategy to provide sufficient waters for users and the environment.
- *Water Quality and Natural Systems Protection and Improvement:* To protect water quality and natural systems of the district and improve those resources within Surface Water Improvement and Management basins.
- *Flood Protection:* To prevent increases in flooding and operate and maintain the district's regional flood control projects. This is accomplished through a focus on implementing the environmental resource permitting program and maintaining the Upper St. Johns River Basin and the Ocklawaha River Basin regional flood control projects.
- *Organizational Effectiveness:* To provide for organizational structure and tools that result in and reward continuous improvement and enhanced service delivery.

Southwest Florida Water Management District (SWFWMD)

The Southwest Florida Water Management District (SWFWMD) encompasses roughly 10,000 square miles in all or part of 16 counties and serves a population of approximately 5.5 million people. The goal of the SWFWMD is to protect water resources, minimize flood risks, and ensure the public's water needs are met.

Responsibilities include, but are not limited to:

- Flood protection
- Water use
- Well construction and environmental resource permitting
- Water conservation
- Education
- Land acquisition
- Water resource and supply development
- Supportive data collection and analysis efforts

South Florida Water Management District (SFWMD)

The South Florida Water Management District (SFWMD) oversees the water resources in the southern half of the state. It covers 16 counties from Orlando to the Florida Keys and serves 8.1 million residents. SFWMD is the oldest and largest of the state's five water management districts. Created in 1949, the agency is responsible for managing and protecting water resources by balancing and improving water quality, flood control, natural systems and water supply.

The district owns a variety of land assets that are a reflection of its many programs, functions, and responsibilities. Over the course of several decades, the district has acquired land needed to support flood control infrastructure, protect South Florida's water resources and restore the region's impaired ecosystems.

Because of the region's vulnerability to sudden hazards, SFWMD is especially concerned with emergency management and mitigation. It has adopted a wide variety of measures to mitigate against potential damage. A few are listed below:

- The district has a full time emergency manager charged with seeing that the district is prepared for any emergency - not just those related to weather.
- Throughout the year, the district conducts an active inspection and maintenance program on its flood control system. This includes:
    - Approximately 2,100 miles of canals and 2,000 miles of levees/berms
    - More than 600 water control structures and 625 project culverts
    - 70 pump stations
    - Approximately 3,500 hydrological monitoring stations at more than 650 flow sites, including 200 rain gauges and 26 weather stations
- In advance of a storm's arrival, SFWMD may begin a gradual drawdown of its canals. This enhances the ability of local drainage facilities to route excess runoff into the district's primary canal system, which routes floodwaters to storage areas or to the coast.
- Perform aquatic weed control and tree removal programs to ensure maximum conveyance of the flood control system.
- The district schedules regular canal clearing maintenance in preparation for hurricanes or other storm events. This mitigates against flooding that could be caused by canal debris inhibiting water flow.
- The district has fortified a "safe room" within its critical pumping stations to allow District personnel to remain within these facilities before, during, and after hurricane events to ensure continuous operation of the Central and South Florida Flood Control Project.
- Following a storm event, the district deploys Rapid Impact Assessment Teams to immediately assess the integrity of its water control canals, storage areas, and structures. Areal inspection is also conducted.
- The district offers an informative brochure entitled "Managing Flood Waters - Before and After the Storm" that explains how the flood control system in South Florida works and the proper maintenance of on-site water management systems. "Managing Every Drop" is another publication that captures both the flood control and drought management aspects of water management.
- The SFWMD's Comprehensive Water Conservation Program, including a year-round landscape irrigation conservation measures rule, is designed to measurably reduce water use while promoting a lasting water conservation ethic throughout South Florida. Local governments may adopt alternative landscape irrigation ordinances based on local water demands, system limitations, or resource availability. These long-term actions help mitigate against water shortage.

- The district evaluates each of its properties and plans the timing and frequency of prescribed fire according to several parameters, including vegetative community type, fuel loads, size, and surrounding land use.
- The district is an active participant in the Governor's Regional Domestic Security Task Force and works closely with local, state, and federal partners regarding homeland security prevention, preparedness, and response issues.
- The District provides a representative on the counties' LMS working groups to assist in pre-identifying and ranking various mitigation projects.

Non-Governmental Agency Capability Assessment

Certain non-governmental agencies are also part of the Florida Mitigation Strategy and Program. Summaries have been included of several non-governmental organizations mitigation activities. While many non-governmental agency activities align well with state policies, we have chosen not to include them in our evaluation. To do so may give the impression that non-governmental agencies further a state-driven agenda and this is inappropriate. Summaries may use acronyms from time to time. For your convenience, all acronyms for participating agencies are listed below:

- American Red Cross (ARC)
- Federal Alliance for Safe Homes (FLASH)
- Florida Association of Counties (FAC)
- Florida Floodplain Managers Association (FFMA)
- Florida Home Builders Association (FHBA)
- Florida International University International Hurricane Research Center (FIU IHRC)
- Florida League of Cities (FLC)

American Red Cross

The 1905 American Red Cross (ARC) Congressional Charter designates its purpose to "continue and carry on a system of national and international relief in time of peace and apply the same in mitigating the sufferings caused by pestilence, famine, fire, floods and other great national calamities and to devise and carry on measures for preventing the same."

As America's premier humanitarian disaster relief organization, the ARC seeks to prevent needless suffering. Therefore, ARC works closely with its local, state, and national partners to help people turn preparedness and mitigation into a personal priority. In keeping with the National Preparedness System (National Preparedness Goal, PPD-8, and the National Mitigation Framework), the ARC will work toward:

- Ensuring the Florida population is aware of and understands the effects of threats and hazards and the vulnerabilities and risks associated with them.
- Engaging the "whole community" in meaningful ways. Whole community means individuals, the private sector, communities, nongovernment organizations, faith-based organizations, all levels of government, etc.

The goal of the ARC is to foster a "culture of prevention & preparedness" that helps families and communities become safer and more prepared when disasters strike. ARC programs are applicable in both pre- and post-disaster situations.

- Goal 1: Develop local community networks to address community-wide preparedness issues: Convene, connect and collaborate across sectors (emergency management, faith-based organizations, individuals and families, public health, schools, non-profits, business, and grass-root organizations) to assess and raise awareness of community risks, build trust, and foster relationships.
- Goal 2: Motivate people and organizations to take preparedness actions. Deliver community preparedness activities to enable the public to reduce risk resulting from disasters.
- Goal 3: Utilize Red Cross geospatial technology platform such as Red Cross Visual Interactive Event Wizard (RCView) to identify vulnerable communities to incidents of fires and develop strategies to smoke detector installation campaigns. Mobilize support for mitigation through partnerships to support the National Home Fire Campaign goal to reduce home fire deaths and injuries by 25%.

Current mitigation activities in which the ARC is engaged are listed below.

Awareness and Education

Raise awareness statewide of specific actions citizens or the community can take to prevent and reduce disaster losses. Preparedness Education includes a solid platform through activities such as: Home Fire Campaign (HFC), The Pillowcase Project, Citizen CPR, and Health and Safety Classes as requested. In addition, there are various Emergency, Children’s Preparedness (Monster Guard), Health & Safety, and Pet First Aid Apps available to the public for free. A self-guided Ready Rating tool is available to government, non-government, and community partners for free 24/7 online. Red Cross Information about all Red Cross preparedness resources may be accessed via www.RedCross.org

Mitigation on a Disaster Relief Operation

The immediate period following a disaster presents an opportune time to educate and motivate citizens about the steps they can and should take to prevent or reduce future losses. Red Cross chapters and disaster relief operations are uniquely positioned to encourage the public to rebuild stronger and safer. Therefore, ARC seeks to integrate mitigation into disaster response and relief efforts.

Some ways that mitigation may be integrated into American Red Cross disaster relief operations include:

- Identify and seize opportunities to help disaster victims reduce or prevent future disaster losses.
- Ensure the dissemination and appropriate use of Red Cross disaster safety and mitigation materials and messages.
- Collaborate with the in-kind donations stakeholders and partners to identify sources of donated resources (goods, materials, and services) that can be used by disaster victims for mitigation purposes.

For more information about Red Cross disaster initiatives and success stories go to http://www.redcross.org

Federal Alliance for Safe Homes

Federal Alliance for Safe Homes (FLASH®) is a nonprofit, 501(c)3, organization committed to promoting life safety and property protection. The organization includes an unprecedented alliance of private, public, and nonprofit partners dedicated to protecting families and homes from natural and manmade disasters. These include earthquake, flooding, hail, hurricane, lightning, severe storms, tornadoes, wildfires, winter freeze, and more. FLASH programs are applicable in both pre- and post-disaster situations.

FLASH began in 1998 as an advertising campaign designed to raise awareness about safety and mitigation options in Florida post-Hurricane Andrew. The campaign borrowed its consumer driven strategy from the highway safety movement to create widespread demand for safer, better-built homes. Founded as the Florida Alliance for Safe Homes, FLASH grew and expanded to become the Federal Alliance for Safe Homes in 2002. Today, its award-winning programs target a diverse and growing audience of consumers, code officials, design professionals, elected leaders, homeowners, and homebuilders.

The FLASH mission is to help reduce deaths, injuries, suffering, property damage, and economic losses caused by natural and manmade disasters. FLASH uses a social marketing philosophy to deliver disaster safety information. By creating awareness and fostering understanding, FLASH works to bring about acceptance and behavior change to both lay and technical audiences. Initiatives combine current, reliable information about the latest tools and techniques to create safer, better-built homes while offering free consumer resources and referrals to keep audiences progressing toward the goal. Some FLASH initiatives include those listed below.

#HurricaneStrong

Launched during the 2016 hurricane season, #HurricaneStrong is a national resilience initiative to save lives and homes through collaboration with leading organizations in the disaster safety movement. The collaboration offers empowering hurricane safety and mitigation information through business workshops, digital channels, events, home improvement store workshops, media outreach, school lesson plans, and a social media campaign featuring a #HurricaneStrong “pose." In 2016, #HurricaneStrong garnered success with White House recognition, national television programming, Public Service Announcements, more than 200 traditional news stories, 695 Home Depot workshops, 15,000 Tweets, 4,400 contributors on Twitter, and an audience reach exceeding 24 million. For more information, visit www.hurricanestrong.org.

Building Code Commentaries

FLASH developed a series of building code focused commentaries that have been the basis of keynote addresses, congressional briefings, and legislative testimonies. The commentaries have been credited as inspiration for several federal policies and studies regarding building codes and resilience.

DisasterSmart

The multi-faceted program provides resources and assets to elected officials to promote understanding of resilience policy fundamentals that include building codes, beyond-code mitigation, incentive-aligned relief programs, public-private initiatives, and smart disaster finance. The program includes toolkits, in-person forums, and a publication for media professionals.

FLASH Cards

This popular and colorful print campaign offers 26 easy-to-understand cards featuring weather perils, safety tools, and special topics like homeland security. The cards contain valuable information in an easy-to-understand format while offering resource lists for more detailed and technical data. Now available in Spanish, the campaign provides consumers with a handy reference tool to de-mystify mitigation techniques and is easily co-branded for widespread distribution.

FLASH Insurance Guide

The popular "If Disaster Strikes Will You Be Covered? A Homeowners' Insurance Guide to Natural Disasters?" addresses how to stay safe, save money, and protect homes. Topics include earthquake, flood, hail, hurricane, lightning, power outage, tornado, wildfire, and winter freeze. The Guide, available in English and Spanish, was developed in partnership with The Actuarial Foundation.

www.FLASH.org

The FLASH website provides one-stop shopping for those interested in the most accurate and up-to-date disaster safety information and provides new interactive DIY tools for homeowners to learn how to protect their homes.

Multi-media Public Service Campaigns

FLASH produces, distributes and launches an annual public service campaign to raise awareness and keep disaster safety top-of-mind. Using 30-second television and radio spots in English and Spanish, the campaign promotes FLASH websites and free resources. The campaign can be customized and used by partners in any media market.

Ready Business

One of the pillars of a community is its business segments. In partnership with FEMA and Ready.gov, FLASH created a business continuity program to move organizational leaders through a step-by-step process to, 1) Identify Risk, 2) Develop a Plan and 3) Take Action. The two components of the Ready Business Program are a series of hazard-specific Ready Business Toolkits and in-person Ready Business Workshops. Since its 2016 launch, more than 160 business have been through the program.

High Wind Safe Room Resources

Highwindsaferooms.org provides homeowners seeking information about building a safe room in their homes. Homeowners can "Give an Ordinary Room an Extraordinary Purpose" with instructions for building or retrofitting bathrooms, closets, wine cellars or other rooms with a tornado safe room. They'll also find a cost calculator, animation, and links to important safety and structural details.

Volunteer Construction Guides

Assets are currently used by local volunteer organizations that rebuild or renovate hundreds of properties in at-risk communities annually. FLASH developed high wind, flood, and wildfire guides and accompanying volunteer cards to assist volunteers that are doing the actual work. Through public-private partnerships, the use of the guides could be expanded.

Florida Association of Counties

The Florida Association of Counties (FAC) is a not-for-profit organization that has represented Florida's 67 counties since 1929. While its primary mission is to provide legislative advocacy for its members, FAC also has an extensive training and education program. The Certified County Commission (CCC) program has elective courses titled "Emergency Management: The Role of the County Commissioner" and "A County Commissioners Guide to Wind Mitigation Programs and Applications."

Emergency Management and Mitigation Training

In 2012, FAC was awarded an RCMP (now known as HLMP) grant from FDEM to develop, schedule, and conduct a Wind Mitigation Resources "pilot course" for county governments and their staff. In all, eight courses were delivered around the state with more than 120 attendees. In 2013, FAC was awarded a second grant and scoped to provide six county courses, two courses before Regional Planning Councils, and one course through a statewide video conference system. In addition, FAC has proposed to FDEM to develop and deliver a comprehensive flood mitigation training course for county commissioners through its CCC program in the future.

Florida Floodplain Managers Association

The Florida Floodplain Managers Association (FFMA) is the Florida chapter of the National Association of State Flood Plain Managers (ASFPM). FFMA was formed to improve floodplain management in Florida by supporting comprehensive management of floodplains and related water resources. FFMA believes that through coordination and education, the public and private sectors can reduce loss of life and properties resulting from floods, preserve the natural and cultural values of floodplains, and avoid actions that increase flood hazards.

To help reach these goals, FFMA and ASFPM fosters communication among those responsible for flood hazard activities, provides technical assistance and advice to governments and others about actions or policies that will affect flooding, and encourages flood hazard research, education, and training. Since its inception in June 2003, the Florida Floodplain Managers Association (FFMA) has improved the success of floodplain management programs in Florida. FFMA uses the activities listed below to contribute to mitigation efforts in Florida.

- *Information Exchange:* Through guidance, training programs, workshops and conferences, FFMA works closely with the state of Florida to improve the state emergency management program, including involving local, state and federal stakeholders in the process.
- *Publications and Newsletters:* "Plain Talk" is produced semi-annually as Fall/Winter and Spring/Summer and is currently e-mailed to our members. This newsletter highlights issues confronting Florida floodplain managers and keeps them up to date. FFMA coordinates with the SFMO to provide technical floodplain management articles on a regular basis.

- *Membership:* Membership composition includes state and local floodplain managers and a broad representation of federal agency staff, private industry, academia, research and related organization representatives. The FFMA now has over 700 members and continues to grow. FFMA works to continually increase membership by demonstrating that all local floodplain management programs have value to their communities.
- *Certified Floodplain Manager Program (CFM):* ASFPM has established a national program for professional certification of floodplain managers. The program has coordinated the certification of numerous floodplain managers in the State of Florida. It recognizes continuing education and professional development that enhance the knowledge and performance of local, state, federal, and private-sector floodplain managers. Through local floodplain managers, FFMA helps develop advanced training that will be field deployed in Florida for Continuing Education Credit (CEC) for the CFM. FFMA strongly advocates increased opportunities for CEC's for the CFM.
- *Annual Conferences:* FFMA has hosted annual conferences in Florida since 2004. Hundreds of professionals have attended from Florida, state agencies, and FEMA Region IV.
- *Statewide Training Events:* FFMA coordinates annually with the SFMO to conduct training for local officials across the state. This training includes numerous topics such as coastal construction issues, elevation certificates, substantial improvement/damage determination, Community Rating System application and implementation, floodplain management basics, implications of map updates, and other topics of interest and value to Florida floodplain managers.

Florida Home Builders Association

The Florida Home Builders Association (FHBA) is a trade association representing the residential construction industry in Florida. It is actively engaged in governmental affairs, political action, and legal defense programs designed to promote and protect homeownership opportunities in Florida. FHBA provides numerous services to its members including continuing education, insurance, leadership training, research, and networking opportunities. The FHBA trains licensed individuals throughout the State on the proper implementation of the Florida Building Code, a standard that helps Florida's buildings stand the test of time. According to statutes, Florida's licensed individuals are required to complete continuing education credits, of which, at least one hour must be spent on mitigation. One example of FHBA's education programs is a series of courses that were developed to teach the building/structural component of the Unified Florida Building Code. These classes specifically support the implementations of structural mitigation in Florida. FHBA's programs are applicable in both pre- and post-disaster situations.

Disaster Contractor's Network

Jointly supported by the FHBA; the Associated Builders and Contractors of Florida (ABC); Florida Roofing, Sheet Metal and Air Conditioning Contractors Association (FRSA), Association of General Contractors (AGC), the Center for Disaster Risk Policy at Florida State University, FDEM, Florida Department of Business and Professional Regulation, and FEMA Region IV (FEMA), the Disaster Contractors Network (DCN) provides services and training to building professionals. This includes online training offered through the Center for Disaster Risk Policy at Florida State University. Year-round mitigation activities and incentives are among the topics covered in DCN's online training. The DCN also provides resources for the general public about repairing their home or business after a disaster and provides a resource for homeowners to use when seeking trained professionals after a disaster.

Florida International University International Hurricane Research Center

The Florida International University (FIU) International Hurricane Research Center (IHRC) was created in 1996 through a public-private partnership between the post-Hurricane Andrew We Will Rebuild Foundation and the State of Florida through FIU in Miami. The We Will Rebuild Foundation was a private sector organization created by local business leaders in Miami-Dade County at the request of the President of the United States and the Governor of Florida. The FIU/IHRC programs focus on both pre- and post-disaster situations.

The IHRC promotes a multi-disciplinary research mission to mitigate hurricane damage to people, the economy, and the built and natural environments. The Center's overall objective is to help the State of Florida, vulnerable U.S. East Coast and Gulf States, and the nations of the Caribbean and Central America to reduce human and property losses regularly inflicted by hurricanes. Individual laboratories under the IHRC umbrella are dedicated to hurricane impact forecasting and mitigation. Their activities are discussed below.

Public Hurricane Loss Model

The Laboratory for Insurance, Financial, and Economic Research has developed a publicly funded model to predict long-term wind damage and associated insured losses for residential properties. A storm surge and flood damage component is currently being added to the model. The Public Hurricane Loss Model is the first certified public model to project hurricane losses for the State of Florida and is used by state regulators to help evaluate rate filings and by insurance companies to assess hurricane risk and generate loss estimates that can then be used as input in the rate making process. The model is certified by the Florida Commission on Hurricane Loss Projection Methodology.

Coastal and Estuarine Storm Tide (CEST) Model

The Laboratory for Coastal Research quantitatively assesses coastal area vulnerability and hurricane storm surges. The CEST Model is used to estimate storm surge as low-pressure weather systems, such as hurricanes, approach coastal areas. The model takes into account not only the expected tide at landfall and the atmospheric pressure and wind of the weather system, but also major coastal topographic features such as coastal ridges and barrier islands. The IHRC research team works closely with the storm surge research team at the federal government's National Hurricane Center (NHC) co-located on the FIU campus.

Wall of Wind (WoW) Program

The Laboratory for Wind Engineering Research is dedicated to making buildings more resilient during high wind events either through new products or improved mitigation techniques. The "Wall of Wind" (WoW) facility is capable of performing controlled and repeatable testing inflows that adequately and economically replicate hurricane winds up to a Category 5, and accompanied by wind-driven rain. In 2014, under the federal government's Natural Hazards Engineering Research Infrastructure program, the facility was designated a National Science Foundation (NSF) Experimental Facility – one of only seven throughout the United States. Together with a different type of wind engineering facility at the University of Florida, the NSF designation for FIU's Wall of Wind makes Florida a national, and even international, leader in hurricane research designed to enhance public safety.

The combination of these IHRC laboratories promotes an interdisciplinary, wide-ranging disaster research agenda that addresses Florida's principal hazards, exposures, and vulnerabilities.

Florida League of Cities

The Florida League of Cities (FLC) was created in 1922 by city officials who wished to unite the municipal governments in the state. The Florida League of Cities has become one of the largest state municipal leagues in the nation, which represents 412 of Florida's municipalities. The League's mitigation programs are applicable in both pre- and post-disaster situations.

The aim of the Florida League of Cities is to promote local self-government and serve the needs of the municipal governments in Florida. This includes:

- Advocacy at both the state and federal levels.
- Increasing public knowledge of municipal services and issues.
- Providing municipal officials with training and technical assistance.
- Providing cost-effective programs and products to local governments.

Through its participation in the state hazard mitigation planning process, the Florida League of Cities recognizes a need for informing the elected municipal officials. Officials need to know the importance of community-based hazard mitigation planning and implementation of mitigation initiatives.

Through Florida League outreach, officials learn to reduce community risk and vulnerability to hazards. A potential program to educate elected officials about hazard mitigation may be integrated with the Institute for Elected Municipal Officials. This Institute offers a comprehensive overview of Florida municipal government presented by a faculty of top professionals in the field.

Local Policies and Programs Capability Assessment

Local governments have policies, programs and capabilities designed to help mitigate the impacts of hazard events to their jurisdictions. Each community has its own policies, programs, and capabilities. These depend on factors such as the size of the geographic area, its population, or the amount of funding available through local resources. Regardless of size or wealth, each community has a unique core set of policies, programs, and capabilities at its disposal related to hazard reduction and mitigation including building codes, land use plans, and regulations.

There are always challenges to implementing an effective program. Common challenges among Florida's 67 counties include: lack of consistent participation in county Local Mitigation Strategy workgroups; lack of awareness of the benefits of mitigation, particularly among city and county elected officials; and the inability to dedicate adequate time to mitigation efforts due to other emergency management responsibilities such as response activations.

FDEM has completed a general analysis of existing Local Mitigation Strategies (LMS) to evaluate locally identified policies, programs, and capabilities to maintain and support hazard mitigation planning activities. This analysis is based upon local evaluations of the effectiveness of the identified programs and their accompanying policies within their communities.

Florida Building Code

The Florida Building Code (FBC) is a statewide building construction regulatory system that places emphasis on uniformity and accountability in order to ensure building strength in the events of natural disasters. The building code is implemented and enforced locally by individual counties. This delegation allows for greater state coverage, but also presents challenges as some smaller counties do not have the staff and resources that other counties might have.

All construction in the state must adhere to the FBC. This allows local jurisdictions to ensure structures are more resistant to certain types of natural disasters, especially to wind and flood events.

Zoning, Land Use Regulations, and Comprehensive Plans

Land development is governed by local comprehensive planning. Zones are designated for certain uses (commercial, industrial, residential, etc.) by the county and amendments are made at the local level. These development regulations assist in mitigation by restricting construction in hazard prone areas such as floodplains or coastal high hazard zones.

Overseeing these changes allows counties to direct development for the safety, health, and welfare of its residents. Comprehensive plans play a major role in local growth management. Florida's comprehensive plans include provisions for emergency situations and natural disasters.

These growth management plans allow jurisdictions to direct development away from disaster prone areas such as floodplains. Zoning changes must be approved through the appropriate channels of government, which allow jurisdictions to monitor the safety and welfare of residents. Every county and most jurisdictions have a state-approved comprehensive plan.

Floodplain Management

Communities in Florida are strongly encouraged to participate in the National Flood Insurance Program (NFIP). Participation in the NFIP is a pre-requisite for receiving FEMA mitigation grants and allows homeowners in the community the ability to purchase flood insurance. To remain in good standing with the NFIP, communities must conform to certain standards and have an approved and adopted flood prevention ordinance.

As of January 2018, Florida has 468 communities participating in the NFIP, which is 98 percent of communities in the state. Many of Florida's communities also participate in the Community Rating System (CRS). Furthermore, as of January 2018, there were 240 communities enrolled in the CRS program, which is 51%, indicating that the communities actively maintain and encourage initiatives on flood prevention. Both the NFIP and the CRS program allow county level mitigation programs to address RL and SRL properties. More information regarding this topic can be found above in the State Agency Capability Assessment Section and in *Appendix F: NFIP Policy Statistics*.

Local Mitigation Strategy

Each county submits a Local Mitigation Strategy (LMS) for FEMA approval in order to be eligible for federal mitigation program funding. The LMS analyzes risk, establishes goals, and prioritizes community mitigation projects for funding. Plans are typically multi-jurisdiction, multi-hazard plans that are maintained throughout the year and fully updated every five years. Local mitigation working groups are composed of many different community partners. Participation jurisdictions must adopt the LMS in order to be eligible for mitigation grants.

All 67 Florida counties have an approved LMS. In addition, several universities and colleges maintain their own mitigation plans or participate in the development and update of county-wide plans. As of October 1, 2017, 435 of the 454 jurisdictions have adopted their LMS plans, resulting in 95.8 percent of Florida's population being covered by an adopted LMS.

Comprehensive Emergency Management Plan

The State of Florida requires that every county develop and maintain a compliant Comprehensive Emergency Management Plan (CEMP). This plan addresses the threats to which a county or a region are exposed and how the local governing agency plans to respond to them.

The CEMP covers mitigation, response, recovery, and preparedness and is intended to provide a comprehensive understanding of emergency management for the jurisdiction. Florida Administrative Code establishes basic requirements for county CEMPs, including the requirement for county CEMPs to have a mitigation annex. In this annex, the CEMP must show the county's ability to coordinate project implementation and identify new projects. In 2012, the criteria for county CEMPs was revised. As part of these revisions, counties that have a FEMA approved and adopted LMS were required to address only three mitigation-specific criteria in their CEMP as opposed to 29 criteria for those counties without an approved LMS.

CEMPs require a risk assessment to be completed. FDEM encourages counties to integrate the LMS risk assessment into the CEMP in order to strengthen the tie between the two plans and reduce duplicated efforts. CEMPs are due to the state for review every four years.

Post Disaster Redevelopment Plan

The Post Disaster Redevelopment Plan (PDRP) identifies policies, operational strategies, and roles and responsibilities for implementation that will guide decisions affecting long-term recovery and redevelopment of a community after a disaster. The PDRP emphasizes seizing opportunities for hazard mitigation and community improvements consistent with the goals of the local comprehensive plan and with full participation of its citizens.

Amendments to Chapter 163, F.S. in 2015 (commonly known as Perils of Flood requirements) further clarified that the redevelopment component will:

- Include development and redevelopment principles, strategies, and engineering solutions that reduce the flood risk in coastal areas which results from high-tide events, storm surge, flash floods, storm water runoff, and the related impacts of sea-level rise.

- Encourage the use of best practices development and redevelopment principles, strategies, and engineering solutions that will result in the removal of coastal rea property from flood zone designations established by the Federal Emergency Management Agency.
- Identify site development techniques and best practices that may reduce losses due to flooding and claims made under flood insurance policies issued in this state.
- Be consistent with, or more stringent than, the food-resistant construction requirements in the Florida Building Code and applicable food plain management regulations set forth in 44 C.F.R. part 60.
- Require that any construction activities seaward of the coastal construction control lines established pursuant to Section 161.053, F.S., be consistent with Chapter 161, F.S.
- Encourage local governments to participate in the National Flood Insurance Program Community Rating System administered by the Federal Emergency Management Agency to achieve flood insurance premium discounts for their residents.

To date, 27 Counties and municipalities have amended their comprehensive plans to address these requirements.

Coordination of the Local Mitigation Program and Local Plan Reviews

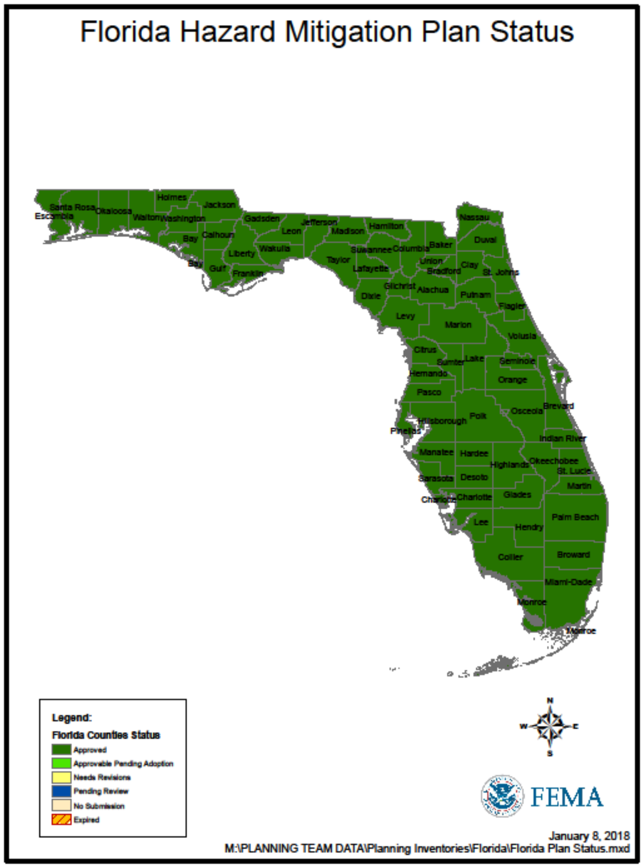
As stated before, the Disaster Mitigation Act of 2000 (DMA2K) requires every Florida County to have a FEMA-approved Local Mitigation Strategy (LMS). The hazard identification, risk analyses, and vulnerability assessments provide estimates of potential property losses throughout the state. Building upon these assessments, each county identifies a prioritized list of hazard mitigation measures, with an action plan for their implementation. The LMS has become the foundation of Florida's pre- and post-disaster mitigation planning activities.

Every LMS is reviewed on a regular basis and must be updated, approved, and adopted every five years. For this reason, the state's efforts are now directed toward maintaining a high standard and improving the effectiveness of these plans. LMS plans are often at different stages in the update and renewal process depending upon when it was approved. Additionally, each year every county is required to keep their LMS in compliance by meeting the standard outlined within the Florida Administrative Code (FAC) 27P-22. By the last business day each January, each county is required to adhere by the rule and provide:

- Current list of the members of the LMS working group, identifying current chairperson, vice-chairperson, and/or coordinator (and contact information);
- Current list of mitigation measures and their estimated costs;
- Major changes (when applicable) to the risk assessment, critical facilities list, repetitive loss properties list or plan maps occurring in the past year.

There are 67 counties in Florida, all of which have a multi-jurisdictional, multi-hazard LMS. FDEM's Mitigation Planning Unit thoroughly reviews these plans and works closely with the counties to assure that all criteria, including regulations and recommended best practices are met in their LMS.

Figure 9 – Florida Local Hazard Mitigation Plan Status



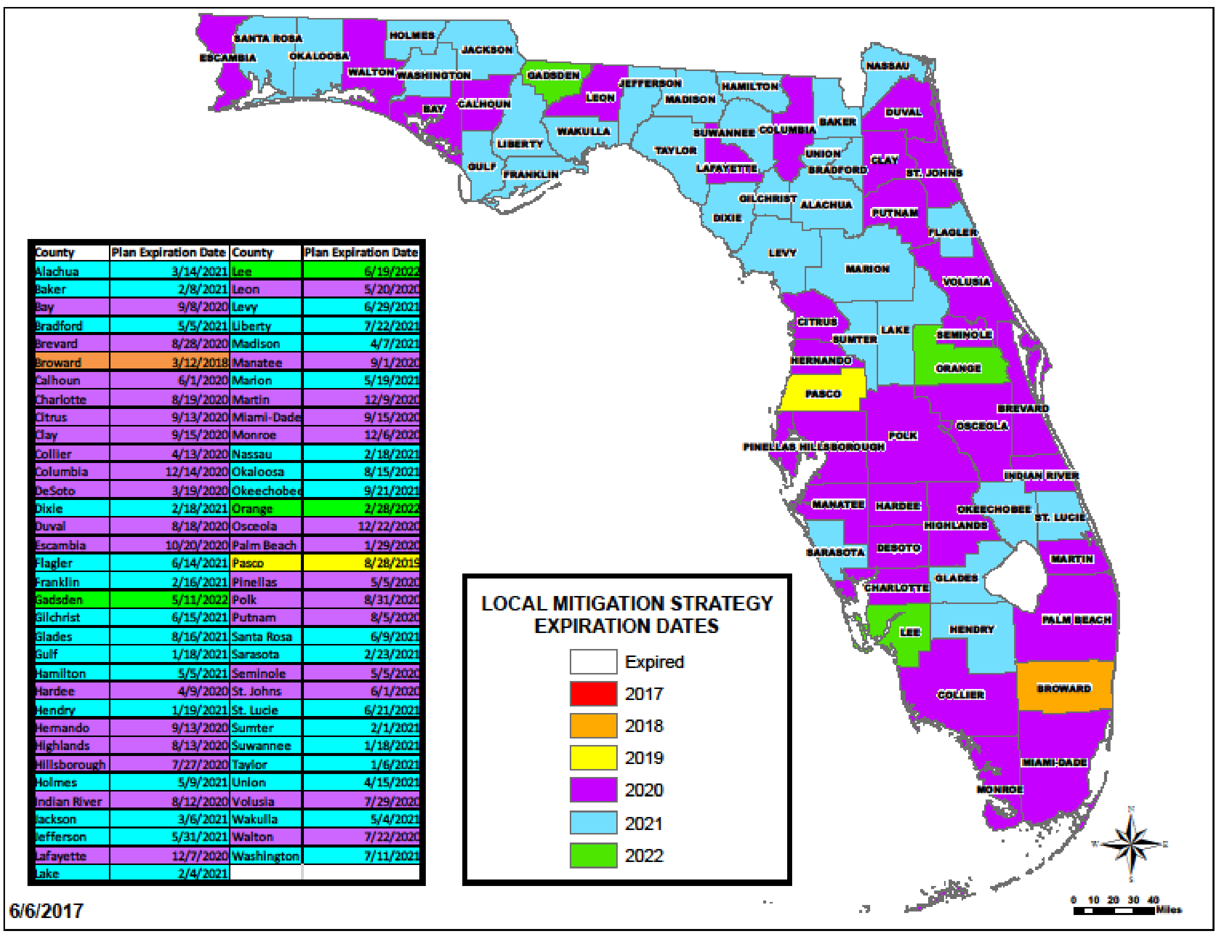
In order to provide technical assistance to local planners, the state provides principal contacts for local government representatives, municipalities, and members of the private sector regarding hazard mitigation planning and programming. This helps to ensure effective understanding of local conditions and characteristics important to successful implementation of mitigation and redevelopment measures by communities. They work with counties from early in the review process and provide feedback on drafts, answer questions, conduct workshops, and provide examples of good plans.

The responsibilities of the Mitigation Planning Unit staff are to support mitigation strategy maintenance and improvement by local governments; to understand conditions relevant to mitigation and redevelopment planning for these communities; to represent the interests of the communities to FDEM in program development and implementation; and to provide technical assistance to the LMS working groups on updating and implementing the LMS.

The state also offers FEMA G-318 and G-393 trainings to interested entities upon their request. This training provides guidance and instruction on preparing and reviewing local plans in an effort to assure that Florida counties have the appropriate tools and resources to update their local plans. The state offers G-393, Mitigation for Emergency Managers, which helps teach communities how to overcome roadblocks and successfully implement mitigation.

Since the last approved State Hazard Mitigation Plan (SHMP), the planning unit has successfully assisted all of Florida's counties through the update and re-approval process of their LMS plans. With only a handful of resolutions adopting the plan left to be submitted to FEMA, as of October 1, 2017, 95.8 percent of Florida's population is covered by an approved and adopted LMS. Broward County is the next plan set to expire in March 2018 and has already been reviewed and approved by the state, FEMA, and adopted by three-quarters of their jurisdictions, followed by Pasco County in August 2019. Below is a map depicting the LMS expiration dates.

Figure 10 – Local Mitigation Strategy Expiration Dates



County	Plan Expiration Date	County	Plan Expiration Date
Alachua	3/14/2021	Lee	6/19/2022
Baker	2/8/2021	Leon	5/20/2020
Bay	9/8/2020	Levy	6/29/2021
Bradford	5/5/2021	Liberty	7/22/2021
Brevard	8/28/2020	Madison	4/7/2021
Broward	3/12/2018	Manatee	9/1/2020
Calhoun	6/1/2020	Marion	5/19/2021
Charlotte	8/19/2020	Martin	12/9/2020
Citrus	9/13/2020	Miami-Dade	9/15/2020
Clay	9/15/2020	Monroe	12/6/2020
Collier	4/13/2020	Nassau	2/18/2021
Columbia	12/14/2020	Okaloosa	8/15/2021
DeSoto	3/19/2020	Okeechobee	9/21/2021
Dixie	2/18/2021	Orange	2/28/2022
Duval	8/18/2020	Osceola	12/22/2020
Escambia	10/20/2020	Palm Beach	1/29/2020
Flagler	6/14/2021	Pasco	8/28/2019
Franklin	2/16/2021	Pinellas	5/5/2020
Gadsden	5/11/2022	Polk	8/31/2020
Gilchrist	6/15/2021	Putnam	8/5/2020
Glades	8/16/2021	Santa Rosa	6/9/2021
Gulf	1/18/2021	Sarasota	2/23/2021
Hamilton	5/5/2021	Seminole	5/5/2020
Hardee	4/9/2020	St. Johns	6/1/2020
Hendry	1/19/2021	St. Lucie	6/21/2021
Hernando	9/13/2020	Sumter	2/1/2021
Highlands	8/13/2020	Suwannee	1/18/2021
Hillsborough	7/27/2020	Taylor	1/6/2021
Holmes	5/9/2021	Union	4/15/2021
Indian River	8/12/2020	Volusia	7/29/2020
Jackson	3/6/2021	Wakulla	5/4/2021
Jefferson	5/31/2021	Walton	7/22/2020
Lafayette	12/7/2020	Washington	7/11/2021
Lake	2/4/2021		

In an effort to identify best practices, the Mitigation Planning Unit created a survey to gather feedback on the last cycle of LMS plan updates. The survey was distributed to each LMS chairperson that oversaw their county's LMS update process. After analyzing the results, a report detailing the process that was used and recommend improvements for future LMS update cycles was developed. The report can be found in *Appendix K: LMS Update Cycle After Action Report*.

The Mitigation Planning Unit has been delegated the authority to review and approve LMS plans on FEMA's behalf, under the PAS program. Florida created a LMS review tool that is based on FEMA's review tool but also includes helpful tools for reviewers.

Plan Review Procedure

To begin the LMS approval process, updated LMS plans must be submitted to FDEM no later than six months before the plan's expiration date. Plans that are submitted later than this timeframe will be reviewed in the order they were received. FDEM will attempt to complete reviews within 30 days. This official submittal should consist of:

- SharePoint submission of the LMS Plan in its entirety including all Appendices;
- Electronic Microsoft Word version of the Plan Review Tool;
- Electronic (CD) of the plan document(s) to be reviewed.

The submitted plan document is considered a DRAFT until it is approved by FEMA. Plan submittals should be addressed to:

Miles E. Anderson
State Hazard Mitigation Officer
Florida Division of Emergency Management
2555 Shumard Oak Boulevard
Tallahassee, FL 32399
Attn: Mitigation Planning Unit

The assigned mitigation planner will provide a confirmation of receipt to the LMS chairperson as soon as it is received.

Two state mitigation planners conduct a detailed and thorough review of the LMS using the Florida Review Tool document to ensure compliance with all federal and state requirements, as well as ensuring alignment with the SHMP. Once the reviews are complete, both planners discuss their findings and reconcile any differences. Upon completion of the review (within 30 days, if possible), the assigned mitigation planner will inform the LMS chairperson that the plan is:

a. The plan is Approved Pending Adoption (APA) and is ready to be sent to FEMA.
OR
b. In need of revision. In this case, the revised plan must be corrected and resubmitted to FDEM within 30 days of notification.

After review of the final draft, FDEM will submit the document to FEMA no later than 90 days before the plan expiration date. Along with the plan, FDEM submits the Florida Review Tool document for FEMA's records, which includes page numbers of where elements are met in the plan, as well as the certification that the Mitigation Planning Unit has approved the plan.

If the plan is not approved by FEMA, FDEM will notify the LMS chairperson that the plan must be revised. If the plan reaches FEMA's "approval pending adoption" phase, at least one participating jurisdiction must resolve to adopt the plan within one year. Ideally all jurisdictions will adopt the plan within one year. A copy of all resolutions to adopt must be submitted to DEM for transmittal to FEMA.

Because of the PAS program, FEMA conducts an audit review of one plan for every ten that FDEM approves and submits.

RISK ASSESSMENT SECTION

State Hazard Mitigation Plan Requirements in this section are:
S3. Does the risk assessment include an overview of the type and location of all natural hazards that can affect the state? [44 CFR §201.4(c)(2)(i)]
S4. Does the risk assessment provide an overview of the probabilities of future hazard events? [44 CFR §201.4(c)(2)(i)]
S5. Does the risk assessment address the vulnerability of state assets located in hazard areas and estimate the potential dollar losses to these assets? [44 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)]
S6. Does the risk assessment include an overview and analysis of the vulnerability of jurisdictions to the identified hazards and the potential losses to vulnerable structures? [44 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)]
S7. Was the risk assessment revised to reflect changes in development? [44 CFR §201.4(d)]
S16. Does the plan describe the process and timeframe to review, coordinate and link local and tribal, as applicable, mitigation plans with the state mitigation plan? [44 CFR §§201.3(c)(6), 201.4(c)(2)(ii), 201.4(c)(3)(iii), and 201.4(c)(4)(ii)]
RL1. Did Element S6 (risk assessment) address RL and SRL properties? [44 CFR §§201.4(c)(2)(ii), 201.4(c)(2)(iii), and 201.4(c)(3)(v)]

Introduction

The risk assessment for the State of Florida Enhanced Hazard Mitigation Plan (SHMP) provides the factual basis for developing a mitigation strategy for the state. This section profiles the natural, human-caused, and technological hazards that could possibly affect the state. Each natural hazard profile includes a discussion of the geographic areas affected, the historical occurrences in the state, an impact analysis, the probability, and the vulnerability and loss estimation by county and of state facilities. Alternatively, the human-caused and technological hazards include similar topics of discussion, but not all aspects are able to be quantified. This is because of the limited data available and the imprecise nature of the human-caused and technological hazards.

Because of the extensive data available to determine vulnerability to natural hazards, the natural hazard profiles contain complete analyses. However, there is less data available to determine vulnerability to human-caused and technological hazards. Because of this, the human-caused and technological hazard profiles differ from the natural hazard profiles and may not contain complete vulnerability analyses.

2018 Update

FDEM used a contractor to write the Risk Assessment section in the previous updates of the SHMP. However, FDEM purchased a data analysis tool and was able to produce the data in-house for the 2018 SHMP update. The GIS Unit within FDEM was responsible for producing the data needed for the Risk Assessment and the Mitigation Planning Unit was responsible for analyzing the data and writing the hazard profiles.

Significant research was required to update the eleven natural hazard profiles and the ten technological and human-caused hazards. References and sources are included as footnotes in the hazard profiles, but the main sources of data included:

- Declared Events
- NCDC
- HAZUS-MH
- HelpFL Tool
- Internet Research

LMS Integration

Each of the 67 counties in the state of Florida has an approved Local Mitigation Strategy (LMS) plan. Those plans were reviewed in preparation for the 2018 SHMP update to determine which hazards the counties identified and how they ranked each hazard. This information is included in each hazard profile in the SHMP and helps to provide a picture of the hazards and vulnerabilities the state experiences. Over the next five years, each LMS plan will be reviewed for this information as it is reviewed for compliance and approval. This will allow the information to be readily available for the next SHMP update.

Since each county ranks their identified hazards differently, the Mitigation Planning Unit developed a key to organize how each county ranked each hazard. The method chosen to align all county plans into one ranking system was frequency of occurrence. The chart below describes the method for this determination.

Table 9 – County Hazard Ranking Matrix Key

Ranking Level	Code	Description
High Hazard Ranking	H	One or more occurrences each year
Medium/High Hazard Ranking	MH	One occurrence every 3 years
Medium Hazard Ranking	M	One occurrence every 5 – 7 years
Low Hazard Ranking	L	One occurrence every 10 years
Not Identified	-	-

Since the table is large, codes were used for each hazard. These codes are listed below.

- FL: Flood
- DF: Dam Failure
- HU/TS: Hurricane/Tropical Storm
- TO: Tornado
- SS: Severe Storm
- WF: Wildfire
- DR: Drought
- EH: Extreme Heat
- WS: Winter Storm
- FR: Freeze
- ER: Erosion
- SH: Sinkholes
- LS: Landslides
- SM: Seismic Events
- TR: Terrorism
- TC: Technological Incidents
- MM: Mass Migration

Table 10 – County Hazard Ranking Matrix

County	FL	DF	HU/TS	TO	SS	WF	DR	EH	WS	FR	ER	SH	LS	SM	TR	TC	MM
Alachua	MH		M	M	M	H											
Baker	H		H	M	H	H	H	H	L	L		L					
Bay	H		H	H		M						L					
Bradford	H		H	H	H	MH	H	M	L	L	L	L					
Brevard	H	L	H	H	H	MH	M	L	L		MH			L	L	M	
Broward	H		MH	H	H	MH	M	MH		L	MH	L			M	H	L
Calhoun	H		H	MH	H	H	MH	MH	L	L	L	L					
Charlotte	H		M	M	H	M	MH	L		M	M	L		L	L	M	
Citrus	H	L	H	H	H	H	H	M				H				H	
Clay	H		M	M	H	H	M	M	M	M		M		L	L	M	
Collier	MH	L	MH		H	H					H						
Columbia	M		M	H	H	M	M	M	L	M	M	M					
DeSoto	H		MH	M	H	M	H			M		L			L	L	
Dixie	H		H	M	M	M	M	M	M	M	L	L			L	L	L
Duval	H		H	L	H	H	L	L		L					L	M	
Escambia	H	L	H	MH	H	M	M			L	L	L	L	L	L	L	L
Flagler	H		H	H	H	H	L	H			MH				L	L	
Franklin	H		H	H	H	MH	H	M	L	L	MH						
Gadsden	H	L	H	H	H	H	MH	H	M	H		L	L				
Gilchrist	H		M	M	H	H	M	M	M	M		M					
Glades	H	L	H	M	H	H	M	M	M	M		L	L	L		H	
Gulf	H	L	H	M	M	H	M	M		M	M	L			L	M	
Hamilton	H	L	H	MH	MH	H	H	H	MH	MH	M	H					
Hardee	H		MH	MH	H	H	MH	MH	MH	MH							
Hendry	M	L	H	M	H	H	H	H	M	M		L	L	L	L		
Hernando	H		H	H	H	H	H	L	H	H	M	H				L	
Highlands	H	L	H		H	H	H	H	M	M		L	L		L	H	
Hillsborough	H	M	MH	H	H	H	L	L	L	L	L	M			L	M	L
Holmes	H	L	M	L	H	H	L	L	L		H	L					
Indian River	H	L	H	M	H	M	H	M	M	M	H	L		L	L	M	
Jackson	H		H	H	H	H	M	M			L	M			L	L	
Jefferson	H	L	H	M	H	H	H	H	M	H	L	M					
Lafayette	M		MH	M	H	H	M	M	L	M	M	M					
Lake	M	L	M	M	H	M	M	M	M	M	L	M					
Lee	M		M	M	H	H	M	M		H	H						
Leon	M		L	M	H	M	M					H			L	M	
Levy	H		M	H		H	H	H		H	M	H					
Liberty	H		H	MH	H	H	MH	H	MH	H	H	L					
Madison	H		MH	M	H	M	H		MH							H	
Manatee	H	M	H	H	H	H	H	M	L	L	M	L		L	H	H	
Marion	H		L	M		M	L	L	L		L	M					
Martin	H	L	M	M	H	M	L	L			M	L		L	L	M	L
Miami-Dade	H		H	H	H	L	M		M		M						
Monroe	H		MH	H	H	MH	L	L		L	H						
Nassau			L	L	M	L	L	L		L	L					L	
Okaloosa	MH	M	M	MH	MH	H	H	M		L		L					
Okeechobee	M		H	M	M	H	H		H	H	L	L	L				
Orange	H		H	H	H	H	H	H	M	M		H			M	H	
Osceola	H		H	H	H	H						L			H	L	
Palm Beach	H		H	L	H	L	M	L		L	L				L	M	L
Pasco	MH		M	H	H	H	H	L	L	L	M	H				M	
Pinellas	M	L	H	H	H	M	M	H	L	L	H	M			M	H	
Polk	H	L	MH	H	H	H	MH	M		H		H				M	
Putnam	MH	L	M	M	H	MH	MH	MH		M		M		L	L	L	
Santa Rosa	H		H	H	H	H	M	M	MH	MH	H						
Sarasota	H	L	H	H	H	H	H				H	M		L			
Seminole	H		H	H	MH	MH	H	MH	L	L		M		L	M	H	L

County	*FL*	*DF*	*HU/TS*	*TO*	*SS*	*WF*	*DR*	*EH*	*WS*	*FR*	*ER*	*SH*	*LS*	*SM*	*TR*	*TC*	*MM*
St. Johns	H		H	M	H	H	L	L	M	H	M				L	M	
St. Lucie	H		H	M	H	M	H	M		M	H	L				L	L
Sumter	H		M	M	H	H	M	M		M						M	
Suwannee	H		H	H	H	H	MH	H	L	MH	H	H					
Taylor	M	L	H	H	H	H	M		L	L	M	M		L	L	L	
Union	H		H	MH	H	H	H	MH	L	L	L	L					
Volusia	H		H	H	H	H	M		L	L	H	L					
Wakulla	H	L	H	L	H	H					M	M			L	M	
Walton	H	L	H	H	H	M	L	L	L	L	H	L					
Washington	M		M	M	H	L			L		M	L			L	M	

Please note that these rankings are subjective, as the Mitigation Planning Unit wanted to display how each county identified and ranked hazards for their county and had to fit each county ranking method into one for the whole state. These rankings are based on each county LMS and how they ranked and described their own hazards.

Current Status and Future Maintenance

As of 2018, this risk assessment is the most current and detailed hazard analysis for the State of Florida. The information has been analyzed using the most current data sets available at the time of revision and update. As this risk assessment is continually updated, this information will be used to further refine the current state mitigation strategies.

Identified Hazards

The list below shows the natural hazards that are profiled in this risk assessment.

- Flood
- Tropical Cyclones
- Severe Storms
- Wildfire
- Erosion
- Drought
- Extreme Heat
- Geological
- Winter Storm
- Seismic
- Tsunami

Because this risk assessment serves as the single risk assessment for the State of Florida, other hazards have been included to meet requirements. EMAP and other planning mechanisms require that the CEMP and SHMP identify the same hazards. To avoid duplication of effort, the SHMP risk assessment serves as the CEMP risk assessment, as well as the risk assessment for any other emergency management plans. The technological and human-caused hazards included in this risk assessment are listed below.

- Transportation Incident
- Cyber Incident

- Hazardous Materials Incident
- Space Weather Incident
- Radiological Incident
- Terrorism
- Agricultural Disruption
- Biological Incident
- Mass Migration Incident
- Civil Disturbance Incident

These 21 hazards were identified based on examination of past disasters, frequency of occurrence, probability of occurrence, possible impacts, analysis of individual LMS hazard rankings, and jurisdiction and state vulnerability. Severity? Magnitude?

Hazard Profiles

The hazard profiles all follow the same outline, the sections and a short description of the intent of the section is listed in the table below.

Table 11 – Hazard Profile Description

Hazard Profile Section	Description
Hazard Description	This section includes a basic overview of the hazard, such as causes, various types of the hazard, the measurements of the hazard, advisories for the hazard and any other pertinent information. There are also statements about the overall frequency and magnitude determinations that were made regarding the hazard. Each hazard description includes a section titled "Potential Impacts of Climate Change," where the potential impacts of climate change on that hazard are discussed. If there are no known potential impacts of climate change for a given hazard, there is a statement in place of the discussion.
Geographic Areas Affected by Hazard	This section discusses the areas of the state that are likely to be impacted by the hazard. There may also be references to where the hazard has occurred in the past.
Historical Occurrences of Hazard	This section lists significant occurrences of the hazard between 2006 and 2016. If there are significant occurrences before 2006, they are listed separately. There is also a list of every Major Disaster Declaration in the state for the hazard, if there are any.
Hazard Impact Analysis	This section lists impacts that are possible due to the hazard occurring in the state. They are categorized into impacts affecting: • Public; • First Responders; • Continuity of Operations (including continued delivery of services); • Property, Facilities, Infrastructure; • Environment; • Economic condition of the jurisdiction; and

	• Public Confidence in the Jurisdiction's Governance. The impacts were categorized this way to align more easily with EMAP Standard requirements.
Probability of Future Occurrences of Hazard	This section includes a description of the likelihood of the hazard occurring in the future. There is probabilistic data from HAZUS-MH and HelpFL for some hazards. Annual probability is also determined by averaging the number of occurrences within a specified timeframe. There is also a statement about the determined overall probability of the hazard.
LMS Integration	<u>Natural Hazards:</u> This section shows which counties included the hazard in their LMS plan and how they ranked it. <u>Technological and Human-Caused Hazards:</u> This section lists the counties that profiled the hazards in their LMS plan. <u>Note:</u> See explanation above for how each county LMS was reviewed and combined into one cohesive table.
Vulnerability Analysis and Loss Estimation, by Jurisdiction	<u>Natural Hazards:</u> This section includes a discussion of the overall vulnerability and an estimation of losses possible. This information is gathered from various sources, discussed below. <u>Technological and Human-Caused Hazards:</u> This section includes a discussion of overall vulnerability. Where possible, loss estimation information is provided. There are also examples of the cost of incidents in the past to provide a baseline of losses possible.
Vulnerability Analysis and Loss Estimation, of State Facilities	<u>Natural Hazards:</u> This section includes a discussion of the vulnerability of state facilities. Where possible, the value of state facilities is included to provide information regarding possible loss estimations. <u>Technological and Human-Caused Hazards:</u> This section includes a discussion of overall vulnerability of the state.
Hazard Summary Matrix	There is a statement about the ranking system below, as well as a statement about the overall vulnerability of the respective hazard in each profile. These statements are followed by the Hazard Summary Matrix. <u>Overview:</u> A few sentences from the hazard description. <u>Frequency:</u> Ranking of how often the hazard occurs. • Not Likely: every 50-100 years • Likely: every 5-10 years • Very Likely: annual <u>Probability:</u> Rankings of the likelihood of the hazard occurring. • Not Likely: every 50-100 years • Likely: every 5-10 years • Very Likely: annual <u>Magnitude:</u> • <u>Injuries/Deaths:</u> Ranking of how many injuries and deaths are likely due to the hazard occurrence. o Low: no injuries or deaths recorded o Medium: any injuries recorded, but no deaths o High: any deaths recorded

	• <u>Infrastructure:</u> Ranking of the general impact on infrastructure due to the hazard occurrence.
	  ○ Low: little to no damage to property
	  ○ Medium: significant damage to property
	  ○ High: destruction of property
	• <u>Environment:</u> Ranking of general impact on the environment due to the hazard occurrence.
	  ○ Low: little to no damage to environment
	  ○ Medium: some damage to environment
	  ○ High: significant damage to environment
	<u>Overall Vulnerability:</u> Ranking based on summary of Frequency, Probability, and Magnitude.
	Each category is given a number:
	• Not Likely and Low = 1
	• Likely and Medium = 2
	• Very Likely and High = 3
	When all 5 categories are added together, the overall vulnerability is a number between 5 and 15. Hazards are given an Overall Vulnerability ranking based on the rubric below.
	• 5: Low overall vulnerability
	• 6-10: Medium overall vulnerability
	• 11-15: High overall vulnerability

Data Sources

HAZUS-MH

HAZUS-MH is a nationally applicable standardized methodology that contains models for estimating potential losses from floods and hurricanes. HAZUS-MH uses Geographic Information Systems (GIS) technology to estimate physical, economic, and social impacts of disasters. This helps users to visualize the spatial relationship between populations and other more permanently fixed geographic assets or resources for the specific hazard being modeled. HAZUS-MH is used for preparedness, response, recovery, and mitigation and is useful in the risk assessment step in the mitigation planning process.

HAZUS-MH 4.0 uses 2010 Census data for population and general building stock information, which is aggregated to the Census Track and Block (wind and flood, respectively). Furthermore, the Flood model incorporates a dasymetric model which more accurately represents where the population is located based on land use and land cover.

HelpFL

The Hazards and Vulnerability Research Institute (HVRI) at the University of South Carolina developed a new and innovative scientific analysis, modeling, metrics, and visualization technique for the Florida Division of Emergency Management's Mitigation Bureau. These new methods are intended to create a baseline for Floridians to begin more comprehensively planning for and mitigating against threats to lives and property. The project had two main goals, to update and advance the science of spatially enabled hazard models and to develop and deploy a hazards analysis web mapping application for visualization and printing of hazard event data, zone areas of impact and threat, and a composite of hazard, social, and place vulnerability.

The Hazards of Place (HOP) model developed by the HVRI is an established conceptual model for identifying and assessing hazard risk. From this conceptual model, HVRI created a set of geospatial models for assessing risks and hazards in Florida. Outputs include geospatial models, geospatial data pertaining to hazard event locations, hazard zones, and hazard zone/probability combinations creating a Hazard Vulnerability Index (HazVI) for Florida. Hazards included in the HelpFL tool are geophysical, meteorological, and hydrological casual agents and include: earthquakes, sinkholes, tsunami, hurricane wind (tracks), hurricane storm surge (SLOSH), winter weather, wind, severe storm, lightning, heat, hail, fog, drought, tornadoes, extra-tropical coastal storms, 500-year flood, 100-year flood, flash flooding, coastal erosion, and wildfire.

The completed tool is called the Hazards Events and Locations Prognosticator – Florida, or “HelpFL” for short. This project was funded through an HMGP planning grant. For this 2018 Risk Assessment update, HelpFL calculated population using ArcGIS Online enrichment analysis, which utilized the 2017 American Community Survey population tables.

SOLARIS-FITS

Florida State Owned Lands and Records Information System – Facility Inventory Tracking System (SOLARIS-FITS) is a Florida Legislative required self-reporting database to record and maintain the inventory of real estate properties that are owned, leased, rented, or otherwise occupied by any state government entity. This database was developed in collaboration by both the Florida Department of Environmental Protection and the Florida Department of Management Services. Those occupying a state facility are instructed to input data to the SOLARIS-FITS database. The data used for the 2018 Risk Assessment update was based on the 2016 tax year. According to the data, there are 20,231 state owned, leased, rented, or occupied facilities in the state of Florida.

FEMA

The FEMA website provides information about each federal declaration that has been made for Florida, including emergency declarations, major disaster declarations, and fire management assistance declarations.

The Risk Mapping, Assessment and Planning (RiskMAP) program aims to identify flood risk and promote informed planning and development practices to help reduce risk. The GIS portion of the RiskMAP program was used to develop the flood hazard profile and analyses.

NOAA/NWS/NHC

The National Oceanic and Atmospheric Administration (NOAA) is a large agency with many purposes. The National Weather Service (NWS) is part of NOAA and both agencies provided information via their websites that is included in the natural hazard profiles.

The National Hurricane Center (NHC) is within NOAA/NWS and works to issue the best watches, warnings, forecasts, and analyses, as well as increase the understanding of tropical weather. Much of the tropical cyclone hazard profile stems from information on this website. NHC is located on the Florida International University in Miami, Florida.

National Climatic Data Center (NCDC)/ National Centers for Environmental Information (NCEI)

The NCDC Storm Event Database contains records which document three things: the occurrence of storms and other significant weather phenomena with sufficient intensity to cause loss of life, injuries, significant property damage, and disruption to commerce; rare or unusual weather phenomena that generates media attention; and other significant meteorological events, such as record maximum or minimum temperatures. The database was used to search for data from January 2006 until December 2016. Event types recorded include coastal flood, cold/wind chill, drought, excessive heat, extreme cold/wind chill, flash flood, flood, frost/freeze, hail, heat, heavy rain, high wind, lightning, sleet, storm surge/tide, strong wind, thunderstorm wind, tornado, tropical depression, tropical storm, wildfire, winter storm, and winter weather.

The Florida State University (FSU) Climate Center is affiliated with the NCDC and works to provide data, information and services for Florida and the US regarding climate data, extreme events, and special analysis.

Drought.gov

NOAAs National Integrated Drought Information System (NIDIS) program is intended to coordinate and integrate drought research and create a drought early warning information system. The programs website is called Drought.gov and contains a wealth of information that is included in the drought hazard profile.

Southern Wildfire Risk Assessment

The Southern Wildfire Risk Assessment (SWRA) works with various other agencies to provide wildfire information for southern US states, including identifying areas that are prone to wildfires. The SWRA Portal (SWRAP) also works to create awareness and to support mitigation planning. This information was used to develop GIS information for the wildfire hazard profile.

USGS

United States Geological Survey (USGS) provides the US with reliable scientific information to describe and understand the Earth and to minimize the loss of life and property from natural disasters. Information from USGS is included in several hazard profiles, including the geological hazard profile.

Florida State Agencies

Information from State of Florida agencies, such as Division of Emergency Management (FDEM), Department of Environmental Protection (FDEP), and Department of Agriculture and Consumer Services (FDACS) was used to develop the hazard profiles and the GIS data shown.

Flood Hazard Profile

1. Flood Description

A flood or flooding refers to the general or temporary conditions of partial or complete inundation of normally dry land areas from the overflow of inland or tidal water and of surface water runoff from any source. Floodplains are defined as any land areas susceptible to being inundated by water from any flooding source. While many people underestimate the severity of floods, loss of life and property from flooding are real threats in Florida. According to NOAA, in Florida, 2 died from a flood in 2009, 1 died in 2012, and 3 died in 2014.[12] Flood stages are the water elevations at which varying levels of damage to personal property occurs. Locally heavy precipitation may produce flooding in areas other than delineated floodplains or along recognized drainage channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding.

Types of Flooding

In Florida, several variations of flooding occur due to the effects of severe thunderstorms, tropical cyclones, seasonal rain, and other weather-related conditions. This hazard profile will focus on two broad categories of flooding, inland flooding and coastal flooding.

- Inland Flooding
    - Riverine Reach
    - Flash Floods
    - Dam or Dike Failure
- Coastal Flooding
    - Tidal Flooding

Inland or Riverine Flooding

Florida's low-lying topography combined with its subtropical climate makes it highly vulnerable to inland or riverine flooding. Riverine flooding occurs when the flow of runoff is greater than the carrying capacities of the natural drainage systems. Flood damage is proportional to the volume and the velocity of the water. High volumes of water can move heavy objects and undermine roads and bridges. Flooding can occur as a result of precipitation upstream without any precipitation occurring near the flooded areas. For example, portions of major drainage basins in Alabama and Georgia drain into the rivers in north Florida, and excessive rainfall in these southern states often causes flood conditions in Florida.

Flash floods present more significant safety risks than other riverine floods because of the rapid onset, the high water velocity, the debris load, and the potential for channel scour. In addition, more than one flood crest may result from a series of fast moving storms. Sudden destruction of structures and the washout of access routes may result in the loss of life.

[12] http://www.nws.noaa.gov/om/hazstats.shtml#

Although rural flooding is dangerous to fewer people and may be less costly than urban flooding, it can cause great damage to agricultural operations.

The U.S. Geological Survey has established a system of monitoring stations to retrieve data about stream flow conditions. This system works in real time for flood warnings and for short-term trends. The system is accessible at the following website: http://waterdata.usgs.gov/fl/nwis/rt.

Riverine Reach

The influence of river flooding on river stage gradually decreases with proximity to the Gulf, and the influence of tides and storm surges on river stage gradually increases the flood levels in bodies of water. Tides affect river stages at low and medium flows in the upper tidal reach and at all flows in the lower tidal reach. In the lower part of the lower tidal reach, stages during storm surges are higher than river flood stages. Soils are present in all riverine wetland forests, but the most nutrient-rich swamps are dry during low-flow periods. Most surface soils in the deepest riverine swamps, upper and lower tidal swamps and lower tidal mixed forests are continuously saturated mucks.

Upper Tidal Reach

Upper tidal mixed forests are found on low levees or in transitional areas between swamps and higher forest types. Upper tidal swamps are present at elevations below median monthly high stage and usually have surface soils that are permanently saturated mucks. The lower Suwannee River is the best example of an upper tidal reach in Florida.

Lower Tidal Reach

The lower tidal reach in a floodplain is found on elevations that do not receive regular tidal inundation or frequent river flooding, but have a high water table and are briefly inundated by storm surges several times a decade. The lower Suwannee River is an example of this. Lower tidal mixed forests include swamps with numerous small reaches and are found on deep muck soils that are below the elevation of the median daily or monthly high stage.

Flash Flooding

As Florida's population has rapidly increased since 1960, so has the profile of the state's landscape. Rapid urbanization has manifested itself in the form of increased impervious surface areas such as asphalt roads, concrete areas, sidewalks, and structures. This increase has led to a much higher level of flash flooding during heavy rainstorms and flooding events. The design of urban drainage systems in the past has concentrated on disposing of storm water as rapidly and efficiently as possible in a concentrated area; however, stormwater is often collected and transported elsewhere without a comprehensive strategy for dealing with it as a system. As a result, drainage in many of Florida's urbanized areas is often "piecemeal" and lacking comprehensive design.

Dam/Dike Failure Flooding

The failure of a dam or dike may also result in a flood event. The amount of water impounded by a dam is measured in acre-feet; an acre-foot of water is the volume that covers an acre of land to a depth of one foot. Dam failures are not routine. Two factors influence the potential severity of full or partial dam failure: (1) The amount of water impounded, and (2) the density, type, and value of development downstream.

In 2007, the U.S. Army Corps of Engineers declared that the Herbert Hoover Dike was on the top of the list of nationwide dams in need of repair. Since 2001, USACE had provided over $870 million in rehabilitation funds for the dike.[13] The Herbert Hoover Dike is one of many dams in Florida, each of which are listed in the National Inventory of Dams and are assigned a high, significant, or low hazard classification based on potential for loss of life and damage to property if the dam fails. Classifications are updated based on development and changing demographics upstream and downstream.

Dam hazard is a term indicating the potential hazard to the downstream area resulting from failure or operational errors of the dam or facilities. The level of risk associated with dams is classified into three categories based on definitions from USACE:

- Low: A dam where failure or operational error results in no probable loss of human life and low economic and/or environmental loss. Losses are principally limited to the owner's property.
- Significant: A dam where failure or operational error results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or affect other concerns. These dams are often located in predominantly rural or agricultural areas but could be located in areas with more dense populations and significant infrastructure.
- High: A dam where failure or operational error will probably cause loss of human life.

A number of outside forces can cause dam failure, including prolonged periods of rain or flooding, landslides into reservoirs, failure of dams upstream, high winds, and earthquakes. Failure due to natural events such as earthquakes or tornadoes is significant because there is little to no advance warning. Improper design and maintenance, inadequate spillway capacity, internal erosion or "piping" within a dam, or a deliberate attack may also cause dam failure.[14]

National statistics show that overtopping of dams due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34 percent of all dam failures. Foundation defects, including settlement and slope instability, account for 30 percent of all failures. Piping and seepage cause 20 percent of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16 percent of failures are caused by other means, including the failure of conduits and valves.[15]

Coastal Flooding

Coastal flooding is usually the result of a severe weather system such as a severe thunderstorm, hurricane, or tropical storm with high winds. Water driven ashore by the wind, known as a storm surge, is the main cause of coastal flooding.

The damaging effects to structures in beach areas are caused by a combination of higher levels of storm surge, winds, waves, rains, erosion, and battering by debris. Sea walls, jetties, and the beach areas are affected by coastal flooding, and the loss over a period of time becomes costly. Loss of life and property

[13] http://www.saj.usace.army.mil/Missions/Civil-Works/Lake-Okeechobee/Herbert-Hoover-Dike/
[14] http://www.damsafety.org/news/?p=412f29c8-3fd8-4529-b5c9-8d47364c1f3e
[15] http://www.ecy.wa.gov/PROGRAMS/wr/dams/failure.html

damage are often more severe because a storm surge involves velocity wave action and accompanying winds. Storm surge is discussed in depth in the Tropical Cyclone Profile.

Tidal Flooding

A tide is the periodic rise and fall of a body of water resulting from gravitational interactions between the Sun, Moon, and Earth.[16] Tides are very predictable and most coastal areas experience two high tides and two low tides every day. High tides occur about every 12 hours and 25 minutes and it takes about half that time (6 hours and 12.5 minutes) for the tide to go from high to low or low to high.[17]

King tides are higher than normal tides and usually occur in the autumn months from September to November. These tides tend to be 6 inches or more above the average high tide of that area. Similar to regular high and low tides, king tides are predictable and usually last for 5-7 days.[18] King tides can cause flooding of streets and even structures. It is also important to note that weather conditions and concurrent rainfall can exacerbate the effects of king tides.

Advisories

Below are the advisories that the NWS issues regarding flooding hazards:[19]

- Flood Advisory: normally issued as an Urban and Small Stream Flood Advisory, this is issued when the flooding is not expected to be severe enough to warrant a flood warning, but it may cause inconvenience and could threaten life or property if caution is not exercised. Examples include nuisance flooding of low-lying areas and areas of poor drainage and minor flooding of roadways.
- Flood or Flash Flood Watch: issued when conditions are favorable for a specific hazardous weather event, including flooding, to occur, meaning flooding is possible.
- Flood Warning: issued when a hazardous weather event, including flooding, is imminent or already happening.
- Areal Flood Warning: issued for flooding that occurs more gradually, normally from prolonged and persistent moderate to heavy rainfall.
- Flash Flood Warning: issued when a flash flood is imminent or occurring, referring to a sudden violent flood that can take minutes to hours to develop. It is even possible to experience a flash flood in areas not receiving rain.
- River Flood Warning: issued when a river is forecast to go above its designated flood stage at the forecast point.
- Coastal Flood Advisory/Watch/Warning: issued when flooding along the coast of the Atlantic Ocean, Pacific Ocean, or the Gulf of Mexico is possible. The flooding must be due to water being forced from the nearby body of water onto land, and not from rainfall.

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16 http://tidesandcurrents.noaa.gov/glossary.html
17 http://oceanservice.noaa.gov/education/kits/tides/tides05_lunarday.html
18 http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2016/06/KingTideToolkit.pdf
19 http://www.floodsafety.noaa.gov/watch_warning.shtml

Floodplains

According to FEMA, a floodplain is any land area susceptible to being inundated by floodwaters, from any source. The USGS further defines a floodplain as the relatively flat lowland that borders a river, and is usually dry but is subject to flooding.[20]

To establish floodplains, FEMA adopted the base flood elevation, which is the level of a flood that has a one percent probability of occurring in any given year. This level of flood is referred to as the base flood, the one percent flood, or the 100-year flood. The area that would be inundated by a base flood is called the 100-year floodplain. This is often misunderstood because many assume such a flood would only occur once every 100 years; however, as explained, the "100" number is referring to the one percent chance of the flood reaching that specified floodplain. The same theory is applied to understand the 500-year floodplain; it has a 0.2 percent chance of occurring each year.

FEMA has identified and mapped areas of flood risk on Flood Insurance Rate Maps and the zones are called Special Flood Hazard Areas (SFHA). The 100-year floodplain is considered a high-risk area and is denoted as Zone A. The 500-year floodplain is shown by the notation Zone C or Zone X. The areas between the 100 and 500-year floodplains are shown using Zone B and Zone X. Additionally, high risk coastal areas are denoted as Zone V. This information is shown in the table below.

TABLE 12 – FEMA Flood Zone Designations[21]

Zone	Description
Low to Moderate Risk Areas	
C and X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as a base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
High Risk Areas	
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1 – 30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

[20] https://pubs.usgs.gov/fs/FS-229-96/
[21] https://www.fema.gov/flood-zones

AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
High Risk Coastal Areas	
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1 – 30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
Undetermined Risk Areas	
D	Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

Mitigation measures are taken to reduce the flood risk in the floodplain; however, development is not prohibited. Management of floodplains is accomplished through building codes, local ordinances, and zoning regulations to mitigate the damage from floodwaters. The floodway is the channel of a watercourse and those portions of the adjoining floodplain that needs to be kept open to provide for the passage of a base flood. The floodway fringe is the portion of the floodplain which when fully developed should not result in more than a one-foot rise in flood levels.

Floodplains cover a very large area in Florida. Pressure from developers to build, and the potential tax revenues from developments, make it difficult to keep floodplains undeveloped and makes floodplain management challenging. This lack of control coupled with inadequate information available regarding the extent of floodplains and flood prone areas typically leads to unsound development on floodplain land.

Floodplains offer many benefits to communities by providing natural flood and erosion control, natural water filtration processes, habitats for plant and animal communities, as well as recreational areas and scientific field-study. Acting as natural flood storage areas, floodplains decrease the destructive force of floodwaters downstream by reducing the velocity of floodwaters. Though floodplain vegetation is partly responsible for slowing the rush of floodwaters, it also serves other valuable functions such as reducing soil erosion, trapping floodwater sediment that increases soil fertility by providing nutrients to environments, and reducing sediment load downstream.

The chemical filtration processes and biological activity that occur within a floodplain can also help reduce flood-generated pollution from agricultural and urban runoff and sewage overflow. Floodplains preserve and recharge groundwater supplies and provide opportunities for recreation, education, and scientific study. Urban expansion may encourage development in floodplains that would otherwise be reserved for these benefits.

The 100-year floodplain of the lower Suwannee River is a good example of the overall topography of the floodplain areas within the state. The lower Suwannee River runs across the entire north-central area of the state and starts from its confluence with the Santa Fe River to the tree line near the Gulf of Mexico. The Suwannee's floodplain is divided into three reaches based on changes in hydrology, vegetation, and soils with proximity to the coast: riverine (non-tidal), upper tidal, and lower tidal.

National Flood Insurance Program and Repetitive Loss Properties

One of the consequences of flooding is repetitive loss. A repetitive loss property is one for which two or more losses of at least $1,000 each have been paid by the National Flood Insurance Program (NFIP) over a rolling 10-year period.

As of January 2018, 468 communities participate in the NFIP, with only 10 communities not participating. Furthermore, there are 1.7 million NFIP policies in the state of Florida, with flood insurance coverage totaling over $423 trillion. According to the Florida NFIP Insurance Report and the NFIP Policy and Claims Report, there have been 255,725 NFIP claims in Florida since the beginning of the program in 1978, with the total paid equaling over $4.2 trillion. With a 98% participation rate it is clear that the NFIP is extremely important to the state of Florida. Furthermore, Florida pays $950 million in insurance premiums each year to the NFIP, proving that Florida is also important to the NFIP program. For more information about the NFIP, please see Section 4: Goals and Capabilities.

Table 13 – Florida NFIP Policies

Description	Total
Number of NFIP policies in Florida	1,738,149
Total coverage	$423,756,701,200
Total paid in premiums	$950,483,682
Total number of claims since 1978	255,725
Total paid in claims since 1978	$4,169,105,407

Repetitive Loss (RL) properties are the focus of strong mitigation programs. Mitigating RL and Severe Repetitive Loss (SRL) properties is strategic, because if there are properties that are known to flood, targeting them to mitigate will prevent flooding and losses in likely properties and give a high return on investment.

This table shows RL properties that have been mitigated, by county. Refer to *Appendix F: NFIP Policy Statistics* for the full table, Repetitive Loss County Summary.

Table 14 – Repetitive Loss Properties (Mitigated)

Description	Total
Total payments (building and contents)	$366,342,649.89
Average payment per claim	$36,361.55
Losses	10,075
Properties	3,925

This table shows RL properties that have not been mitigated. As of January 2018, there are 14,887 non-mitigated RL properties.

Table 15 – Repetitive Loss Properties (Non-Mitigated)

Description	Total
Number of RL buildings	14,887
Number of RL buildings Insured	8,019
Number of RL Losses	38,819
Number of RL Losses Insured	21,685
Total of RL Losses	$1,287,010,406.95
Total of RL Losses Insured	$860,098,672.03

This table provides a summary of all Severe Repetitive Loss (SRL) properties in Florida. This information is not available separated by mitigated and non-mitigated properties.

Table 16 – Severe Repetitive Loss Properties (Mitigated and Non-Mitigated)

Description	Total
Total payments (building and contents)	$146,305,534.07
Average payment per claim	$43,856.57
Losses	3,336
Properties	657

Furthermore, the NFIP's Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result of CRS, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS:

- Reduce flood losses
- Facilitate accurate insurance rating
- Promote the awareness of flood insurance

As of January 2018, there are 240 communities enrolled in the CRS program.

Sea Level Rise

Florida is vulnerable to sea level rise given its extensive shoreline and low elevation. If sea levels do rise, a number of consequences including the salination of fresh water sources, land loss, and increases in storms and flooding could be observed.

Rising sea level affects the salinity of both surface water and ground water through salt-water intrusion. Shallow coastal aquifers such as those in Florida are at risk to this salt-water intrusion process. The freshwater Everglades currently recharges Florida's Biscayne aquifer, the primary water supply to the Florida Keys. As rising water levels submerge low-lying portions of the Everglades, portions of the aquifer would become saline.

Communities that withdraw water from aquifers in various parts of Florida, including the Biscayne Aquifer in southeastern Florida, the Floridian Aquifer along the northeastern coast and in the Florida panhandle, and the Tamiami Aquifer in southwestern Florida, have already experienced problems with saltwater intrusion.

As sea levels rise, water inundates and erodes coastal wetland ecosystems such as mangroves and salt marshes. Higher water levels wash away wetlands and flood previously dry land. These coastal wetland ecosystems are crucial to absorbing the impact of tropical storms and provide a breeding ground for a significant proportion of sea life.

Sea level rise would increase the vulnerability of coastal areas to flooding during storms. During a tropical storm or hurricane, storm surge would build up on top of a higher base of water resulting in damages that are more significant.

Additionally, shore erosion increases storm vulnerability by removing the dunes and beaches that otherwise provide a buffer between coastal property and storm waves and surge.

Lastly, sea level rise would result in an increase in coastal flooding from rainstorms because low areas drain more slowly as sea levels rise.

Potential Effects of Climate Change on Flooding

Inland and Riverine Flooding

A warmer atmosphere holds more water vapor and, therefore, can result in heavier and more long-lasting rainfall events.[22] A possible global pattern is for arid areas to become drier and moist areas to become wetter. Where precipitation is enhanced, strong storms are expected to become stronger with the result that rainfall events with a given recurrence frequency, e.g. the 25-year storm, will happen more often.[23]

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[22] Peterson, T.C. et al. (2012). Explaining extreme events of 2011 from a climate perspective. Bulletin of the American Meteorological Society, July, 1044; http://journals.ametsoc.org/doi/full/10.1175/BAMS-D-12-00021.1; Williams et al. (2012). Physical climate forces. In, Burkett and Davidson (Eds.), Coastal impacts, adaptation and vulnerability: A technical input to the 2012 National Climate Assessment. http://www.coastalstates.org/wp-content/uploads/2011/03/Coastal-Impacts-Adaptation-Vulnerabilities-Oct-2012.pdf., p. 41.; http://www.ssec.wisc.edu/~kossin/articles/NCA_Coasts.pdf

[23] Knutson et al. (2010). Simulated reduction in Atlantic hurricane frequency under twenty-first-century warming conditions. Nature Geoscience, 1(6), 161.

Coastal Flooding

A warmer atmosphere may influence three drivers of coastal flooding: rainfall intensity and frequency, storm surge intensity, and sea level. Rising sea levels would raise the base for coastal floods and storm surge resulting in greater flood depths within existing flood hazard zones; as well as landward expansion of coastal and tidal rivers and stream floodplains and storm surge zones in areas with relatively flat topography. The relationship between a given increase in sea level and the resulting expansion of a coastal flood hazard or storm surge zone depends on the slope of local coastal topography as well as the type of geologic substrate (sand, clay, gravel, rock, etc.), and the presence and type of vegetation.[24] The boundaries of coastal flood zones will expand more rapidly as the rate of sea level rise increases.[25]

If frequency of higher intensity tropical cyclones increases (see *Tropical Cyclones Profile*) coastal communities will experience the storm surge flooding associated with those stronger storms more often (Category 4 and 5 hurricanes).[26] However, storm surge height is not solely determined by hurricane intensity. It also is a function of the size and speed of the storm, the geometry and bathymetry of the coast, and the process by which the storm develops prior to landfall.[27] The effects of climate change on tropical storm size (radius of maximum wind and outer radius) have not yet been studied thoroughly.

Sea Level Rise

Florida is vulnerable to sea level rise given its extensive shoreline and low elevation. The "relative sea level" that is measured by a tide gauge at a particular location, is a function of both changes in the elevation of the sea's surface due to changes in the volume of water in the ocean (eustatic sea level) and vertical movement of the land upon which the tide gauge sits due to subsidence or tectonic movement of the earth's crust. Eustatic sea level rise experienced at any particular location results primarily from expansion of sea water volume as heat is transferred from the atmosphere to the oceans, and the melting of glaciers and polar ice sheets. Both of these drivers are expected to cause an increase in the rate at which sea level is rising.[28] Regional eustatic sea level rise may differ from global average eustatic sea level rise due to distance from melting glaciers, different rates of sea level volume expansion because of the salinity and temperature of regional surface waters, and the effects of wind and currents on heat transfer between the atmosphere and the oceans.[29]

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[24] Williams et al.(2012), p. 30.

[25] AECOM (2013); Handmer et al. (2012). Changes in impacts of climate extremes: human systems and ecosystems. In, Field et al. (Eds.), Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. http://ipccwg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf, p. 260.; https://ipcc.ch/pdf/special-reports/srex/SREX-Chap4_FINAL.pdf

[26] Williams et al. (2012), pp. 29-30.

[27] Lin et al. (2012). Physically based assessment of hurricane surge threat under climate change. Nature Climate Change, 2, 462; Williams et al.(2012), p. 29.

[28] Parris et al. (2012). Global sea level rise scenarios for the US National Climate Assessment. NOAA Tech Memo OAR CPO-1. http://cpo.noaa.gov/sites/cpo/Reports/2012/NOAA_SLR_r3.pdf.

[29] Note: Water with higher salinity or that already is warm will expand less for a given amount of added heat than water that is less salty or colder. Areas closer to the tropics, such as Florida, tend to have warmer, saltier ocean water than areas closer to the poles, so the amount of sea water expansion from atmospheric warming may be less than the global average. See Bindhoff et al. (2007). Observations: Oceanic climate change and sea level. In S. Solomon

Rising sea levels would result in gradual coastal inundation, the most immediate impact of which is increased height of high tides. Similarly to regular tides, as sea levels rise, king tides will reach further inland and result in more severe damages to coastal communities[30]. In addition, rising sea levels may cause landward expansion of coastal flood zones. Through a combination of direct inundation and erosion, rising sea levels also cause recession of both beaches and coastal wetlands *(see Coastal Erosion Profile)*. The increased weight that results from a greater volume of sea water pushes saltwater into coastal aquifers and can worsen saltwater intrusion caused by excessive ground water withdrawal. Rising sea levels also push salt water further upstream in tidal rivers and streams, raise coastal ground water tables, and push saltwater further inland in soils at the margins of coastal wetlands causing wetland boundaries to expand where they are unimpeded.

2. Geographic Areas Affected by Flood

The entire State of Florida is particularly susceptible to flooding due to the large amounts of coastline, significant drainage systems, and the relatively low elevations. Many other factors contribute to flooding in Florida and therefore help to define the geographic area impacted by flooding. Areas along waterways, including lakes, rivers, streams and wetlands, are particularly susceptible to flooding due to heavy storms and rain or storm surge.

Inland Flooding

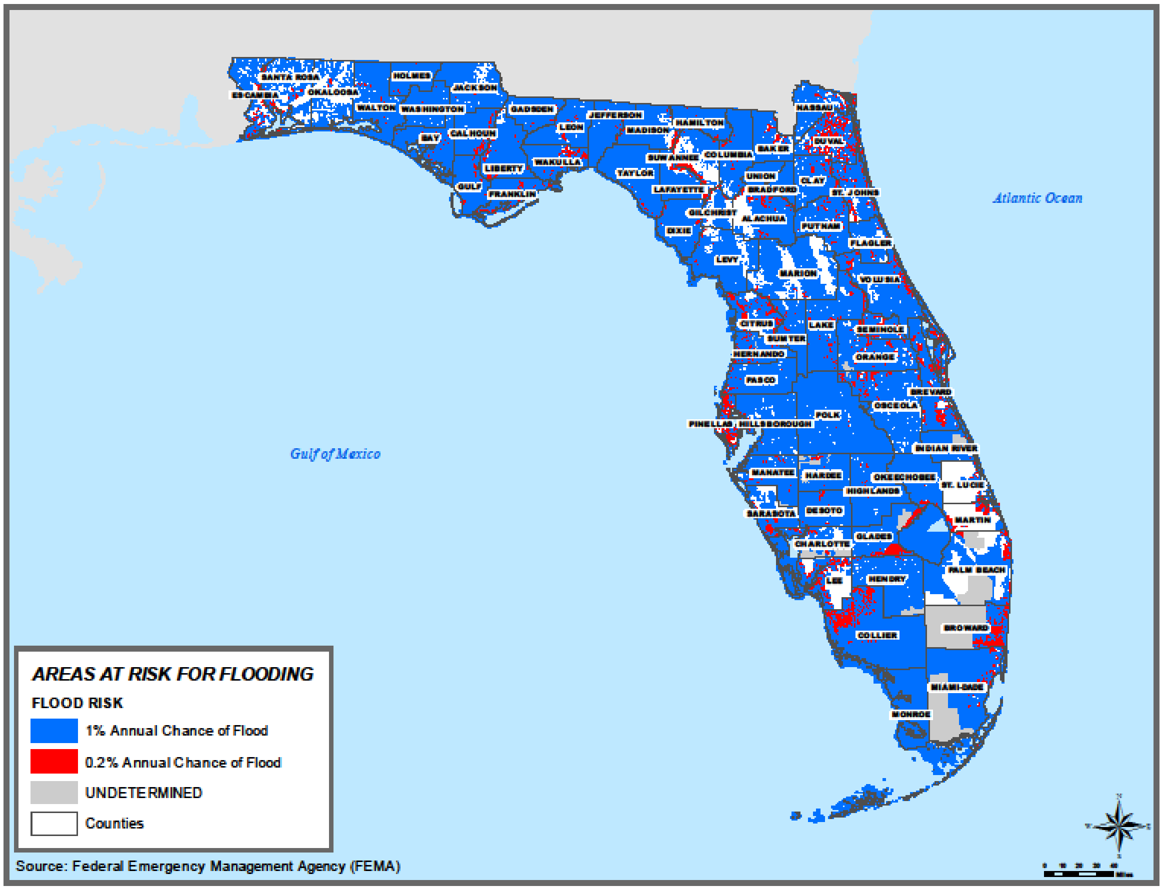
A geographic assessment of the inland flooding hazard was obtained using FEMA DFIRM floodplain data. This data is available for vulnerable counties in the state and it outlines the areas in the 100- year and the 500- year floodplains, with 1 percent annual probability and 0.2 percent probability of floods, respectively.

Below is a map showing the 100-year floodplain and the 500-year floodplain. The 500-year floodplain includes the areas in the 100-year floodplain, plus additional areas, which are shown in red.

et al. (Eds.), Climate change 2007: The physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change, (pp. 385-432). https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch5.html).

[30] https://www.epa.gov/cre/king-tides-and-climate-change

Figure 11: Areas at Risk for Flooding, 100- and 500-year Floodplains



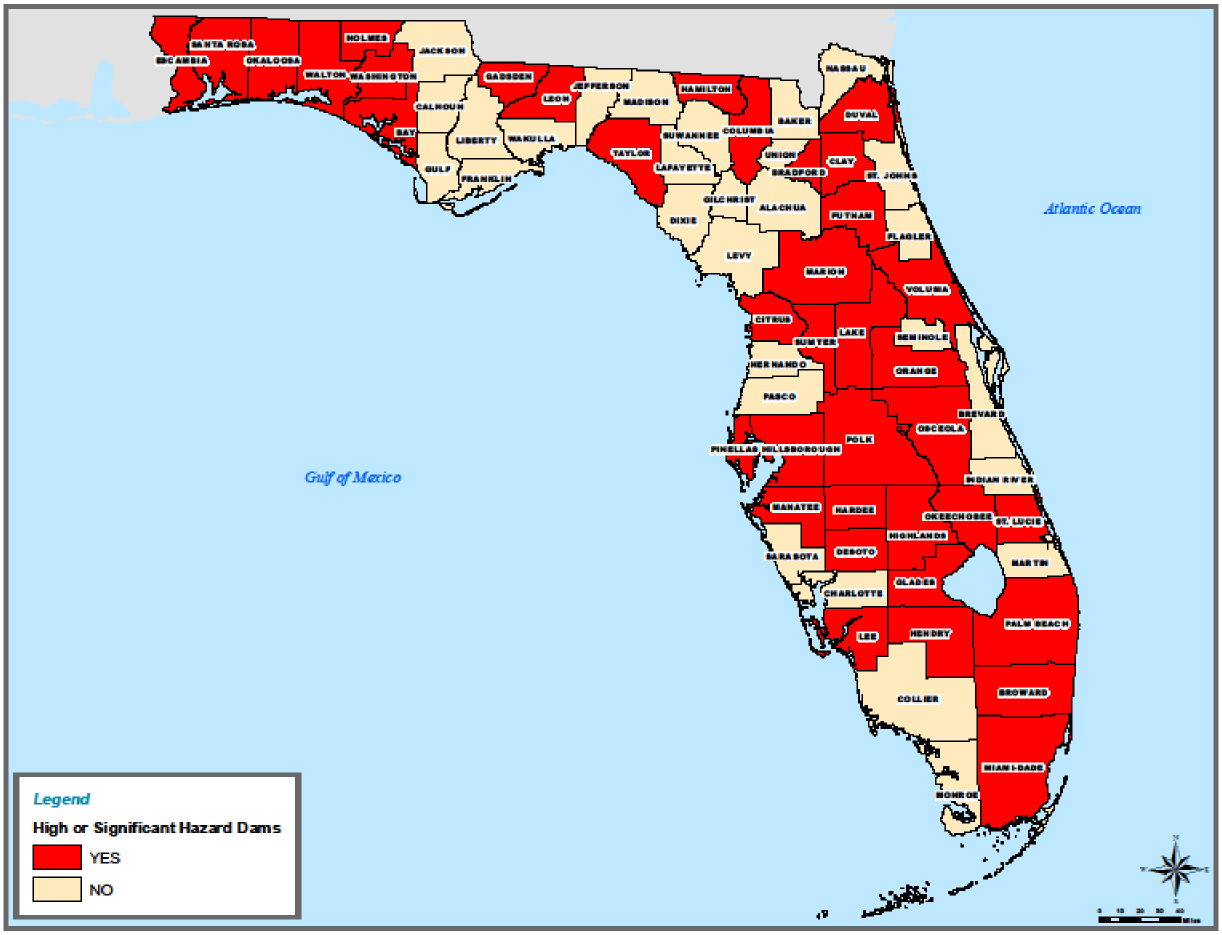
According to the USACE National Inventory of Dams, there are 1202 dams in the state of Florida as of March 2017. Of those, 80 are high hazard dams and 330 were significant hazard dams.[31] The Florida DEP coordinates the Florida Dam Safety Program and maintains a database of the 850 non-federal dams.[32] It has been determined that the counties, river systems, and the immediate areas around these dams are the zones with the highest vulnerability to flooding resulting from dam failure. Overall dam failure is a low priority with respect to flooding since the risks of coastal and inland flooding are much higher.

Figure 12 indicates which counties have high or significant hazard dams. The specific locations of the dams are not provided in the plan due to security concerns.

[31] http://nid.usace.army.mil/cm_apex/f?p=838:3:0::NO::P3_STATES:FL; Florida Department of Environmental Protection, Dam Safety Unit.

[32] http://dep.state.fl.us/water/mines/damsafe.htm

Figure 12: Counties with High or Significant Hazard Dams



Coastal Flooding

For information regarding the geographical areas of the state at risk for coastal flooding and storm surge, please refer to the Tropical Cyclone Profile.

3. Historical Occurrences of Flood

Inland and Coastal Flooding

Florida has experienced several flooding events. Below is a table highlighting significant flooding events from 2006 to 2016.

Table 17 – Significant Flooding Occurrences in Florida, 2006-2016[33]

Date	Description
2008	Tropical Storm Fay

[33] http://www.nws.noaa.gov/om/hazstats.shtml#

	• August 2008 • Over $117 million in Public and Individual assistance
2009	Heavy Rainfall • Substantial flooding from two incidents across the state • Over $46 million in Public and Individual assistance from both storms • 2 fatalities
2012	Heavy spring rains and Tropical Storms Beryl and Debby • Heavy rainfall in spring and summer in the Florida panhandle, caused flooding in Escambia County • Tropical Storm Beryl led to extensive street flooding in Miami-metro area • Tropical Storm Debby caused flooding in the Florida panhandle with an estimated over $75 million for Public and Individual assistance for this storm alone • 1 fatality
2014	Severe Storms, Tornadoes, Straight line winds, and Flooding • Significant impacts in western Florida panhandle • Over $163 million in Public and Individual assistance • 3 fatalities
2016	Hurricanes Hermine and Matthew • Over $76 million in Public and Individual assistance for both storms • Hermine impacted the big bend region of Florida and Matthew impacted the East coast, specifically the northeastern coast

Additionally, there have been several FEMA major disaster declarations in Florida that specifically are related to flooding events. Please note that some of these events are also listed under Severe Storms and Tornadoes or Tropical Cyclones. Also, there are some events that are categorized by FEMA as tropical storms or hurricanes and not flooding, even though the event may have caused significant flooding.

Table 18 – FEMA Major Disaster Declarations in Florida, 1953 – 2016[34]

Date	Name
October 22, 1953	DR-12: Flood
July 3, 1970	DR-289: Heavy Rains, Flooding
May 26, 1973	DR-387: Severe Storms, Flooding
August 22, 1975	DR-479: Flooding
September 26, 1975	DR-484: High Winds, Heavy Rains, Flooding
May 15, 1979	DR-586: Severe Storms, Tornadoes, Flooding
September 29, 1979	DR-607: Severe Storms, Flooding
July 7, 1982	DR-664: Severe Storms, Flooding
March 16 – April 9, 1990	DR-862: Flooding, Severe Storm
June 23 – 30, 1992	DR-952: Flooding, Severe Storm
October 3 – 4, 1992	DR-966: Flooding, Severe Storm, Tornadoes

[34] https://www.fema.gov/disasters?field_state_tid_selective=47&field_disaster_type_term_tid=6837&field_disaster_declaration_type_value=DR&items_per_page=20

March 12 – 16, 1993	DR-982: Tornadoes, Flooding, High Winds, Tides, Freezing
July 2 – 29, 1994	DR-1035: Severe Storm, Flooding, Tropical Storm Alberto
October 13 – November 20, 1995	DR-1074: Severe Storm, Flooding
October 7 – 21, 1996	DR-1141: Severe Storms, Flooding
February 2 – 4, 1998	DR-1204: Severe Thunderstorms, Tornadoes, and Flooding
October 3 – 11, 2000	DR:1345: Heavy Rains and Flooding
June 13 – August 22, 2003	DR-1481: Severe Storms and Flooding
December 25, 2006	DR-1680: Severe Storms, Tornadoes, and Flooding
March 26 – May 9, 2009	DR-1831: Severe Storms, Flooding, Tornadoes, and Straight-line Winds
May 17 – 28, 2009	DR-1840: Severe Storms, Flooding, Tornadoes, and Straight-line Winds
July 2 – 7, 2013	DR-4138: Severe Storms and Flooding
April 28 – May 6, 2014	DR-4177: Severe Storms, Tornadoes, Straight-line Winds, and Flooding

4. Flood Impact Analysis

Public

- Injury/Death
  - Drowning
  - Vehicle accidents
  - Extended wait for emergency response
  - Become stranded on rooftop, or trapped inside building or car
  - Exposure to hazardous materials or wastewater
- Traffic
  - Panic to evacuation
  - Accidents from driving through flooded roads – car washed away, water deeper than expected
- Damage to property
  - Mold infestation
  - Need to replace property damaged, furniture, clothes, etc.
  - Repairing damaged property
  - Issues with damage to uninsured property

Responders

- Injury/Death
  - Responding to calls during flooding, traversing flooded roads
  - Drowning
  - Dangerous rescue missions, from roofs, unstable buildings, stranded cars
  - Exposure to hazardous materials or wastewater
  - Power outage dangers, such as being electrocuted by live downed wires

Continuity of Operations (including continued delivery of services)

- Floodwaters may damage buildings, electrical systems, paperwork, etc. making continued operations difficult or impossible

- Floodwaters may hinder access to buildings (roads or sidewalks) preventing employees and the public from entering a building

Property, Facilities, Infrastructure

- Property damage
    - Floodwaters can damage property or carry heavy debris that could cause damage
- Infrastructure damage
    - If water overwhelms the drainage systems it can backup and cause damage to drains or even result in wastewater release

Environment

- Release of wastewater could damage environment
- Damage to habitat for plants and animals
- Inundation of agricultural areas could destroy crops
- Event generated debris impacting waterway navigation and submerged wetland habitats

Economic Condition

- Closure or delay of businesses because of flooded roads or water damage, leads to loss in revenue
- Crop damage or loss leads to decline in agricultural revenues

Public Confidence in Jurisdiction’s Governance

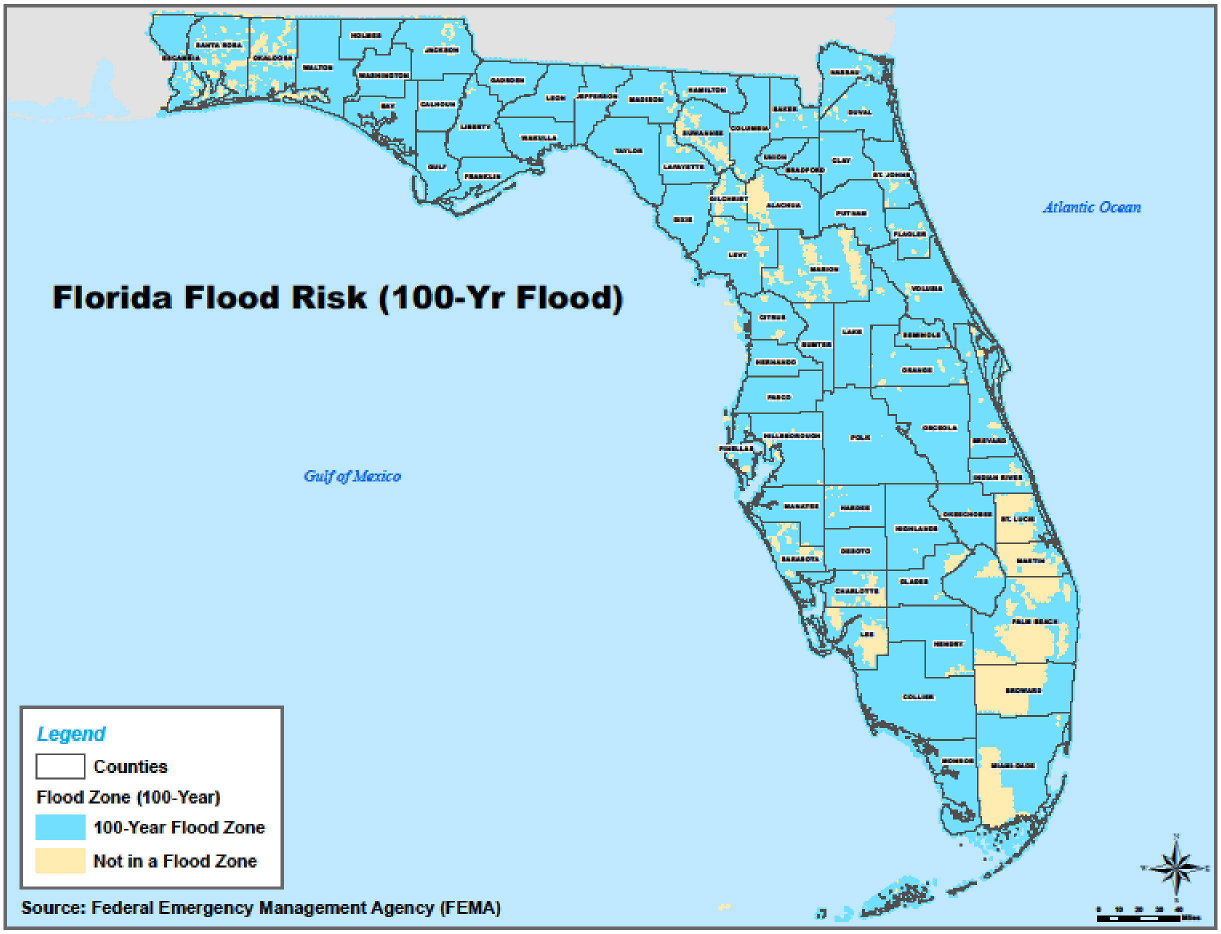
- If floodwaters do not recede quickly, it appears as though the water utilities and government aren’t able to manage water properly, which calls into question the capability of the government
- If public or government offices have to close because of restricted access due to floodwaters, people may think the government isn’t able to handle emergency events and lose confidence in their capabilities

5. Probability of Future Flood Events

Based on historical knowledge and an understanding of floodplains, it is believed that Florida will continue to experience flooding events on an annual basis. Specific probability is difficult to determine, however, 100-year and 500-year estimates help provide a baseline understanding. It is likely that Florida will continue to be impacted by flooding due to any number of causes annually.

The figure below shows the areas with a one percent annual probability of a flood, or the 100-year flood.

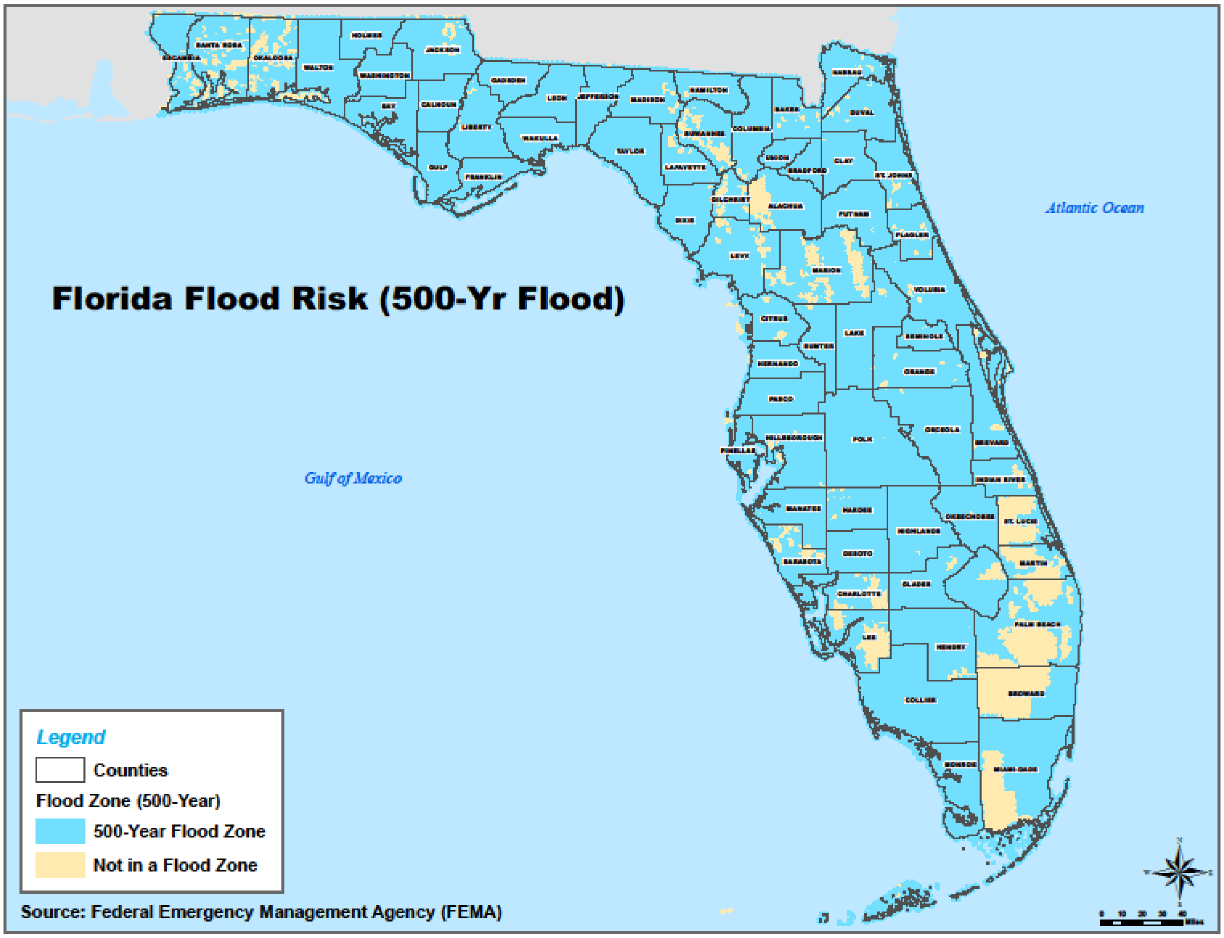
Figure 13: Florida 100-Year Flood Risk



This map demonstrates that nearly the entire state is within the 100-year flood zone.

Below is a figure showing the areas with a 0.2 percent chance annual probability of a flood, or the 500-year flood.

Figure 14: Florida 500-Year Flood Risk



This map shows that similarly to the 100-year flood zone, the 500-year flood zone covers nearly the entire state.

Below is a figure depicting the Flash Flood Risk in Florida. The potential of flash floods are difficult to predict. In 2003, subject matter experts developed the Flash Flood Potential Index (FFPI), which used the following equation where M represents Slope, L refers to Land Cover or Use, S represents Soil Type or Texture, and V equals the Vegetation Cover or Forest Density:

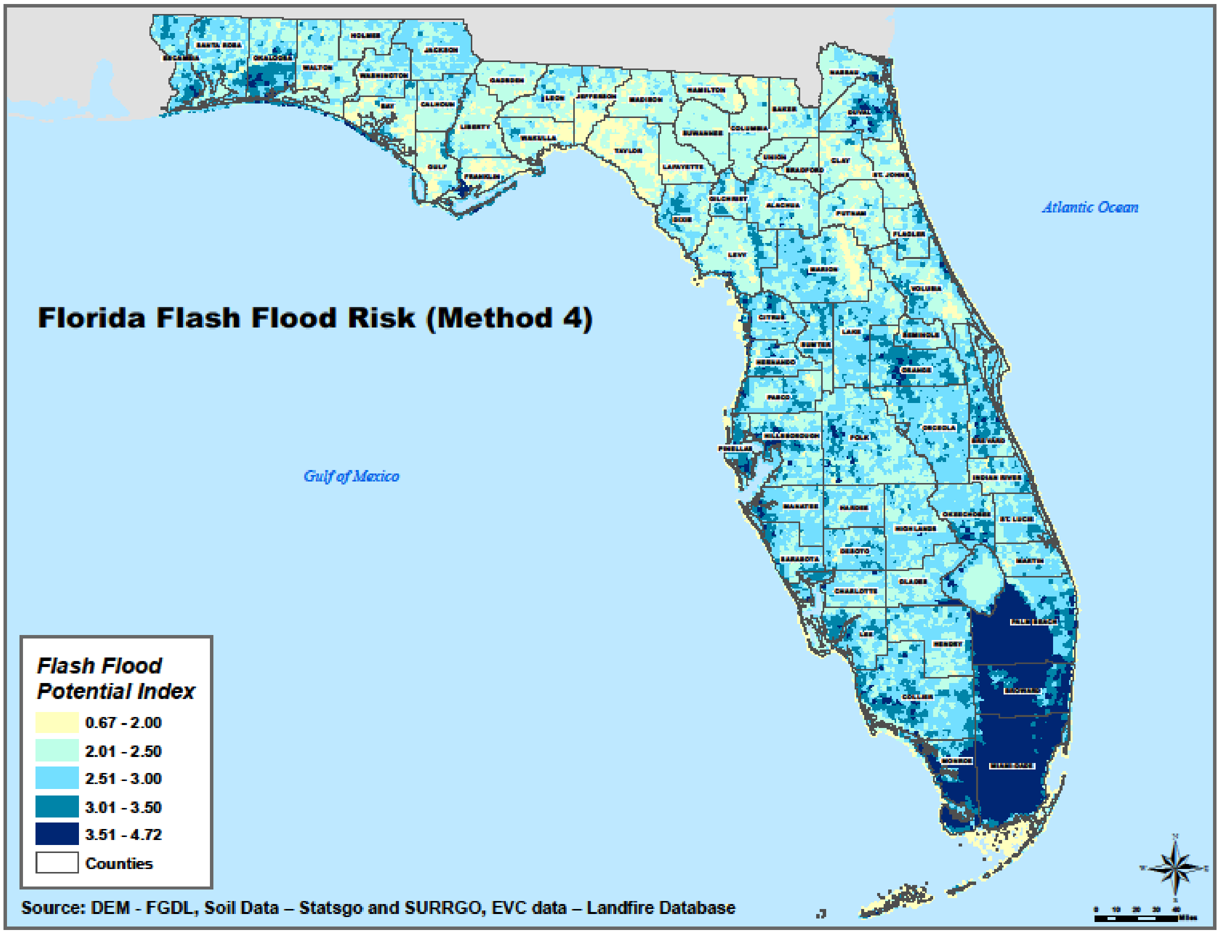
$$FFPI = (M + L + S + V) / N$$

Since 2003, this equation has been refined into four scenarios to more accurately represent specific areas and conditions. For Figure 15, the equation used is referred to as Model 4:

$$FFPI = (2*M+S+2*LV)/5$$

More information about the FFPI can be found here:
http://www.crh.noaa.gov/Image/dmx/hydro/FFPI/FFPI_WriteUp.pdf.

Figure 15: Florida Flash Flood Risk



This map shows the areas of the state that are at risk for Flash Flooding, based on various ground measures such as land use, soil type, vegetation cover, and the slope of the area. This shows that most area have a Flash Flood Potential of between 2.01 and 3.50.

Probability Based on Historical Occurrences

An analysis of flood reports from 2012 to 2016 in Florida, from the NCDC Storm Events Database indicates that there will be nine to ten coastal floods, sixteen flash floods, and nineteen to twenty floods each year in Florida.[35]

[35] http://www.ncdc.noaa.gov/stormevents/listevents.jsp?beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2008&endDate_mm=12&endDate_dd=31&endDate_yyyy=2011&county=ALL&eventType=Coastal+Flood&statefips=12%2CFLORIDA

Table 19: NCDC Flood Reports 2012 – 2016[36]

Type of Flood	NCDC Reports	Average per Year
Coastal Flood	48	9.6
Flash Flood	81	16.2
Flood	98	19.6
Total	227	45.4

6. 2018 LMS Flood Integration

An analysis of all 67 Florida County LMS Plans and their individual flood hazard rankings is shown below. Only two counties did not identify Flooding as a Hazard, while 42 counties did not identify Dam Failure as a Hazard.

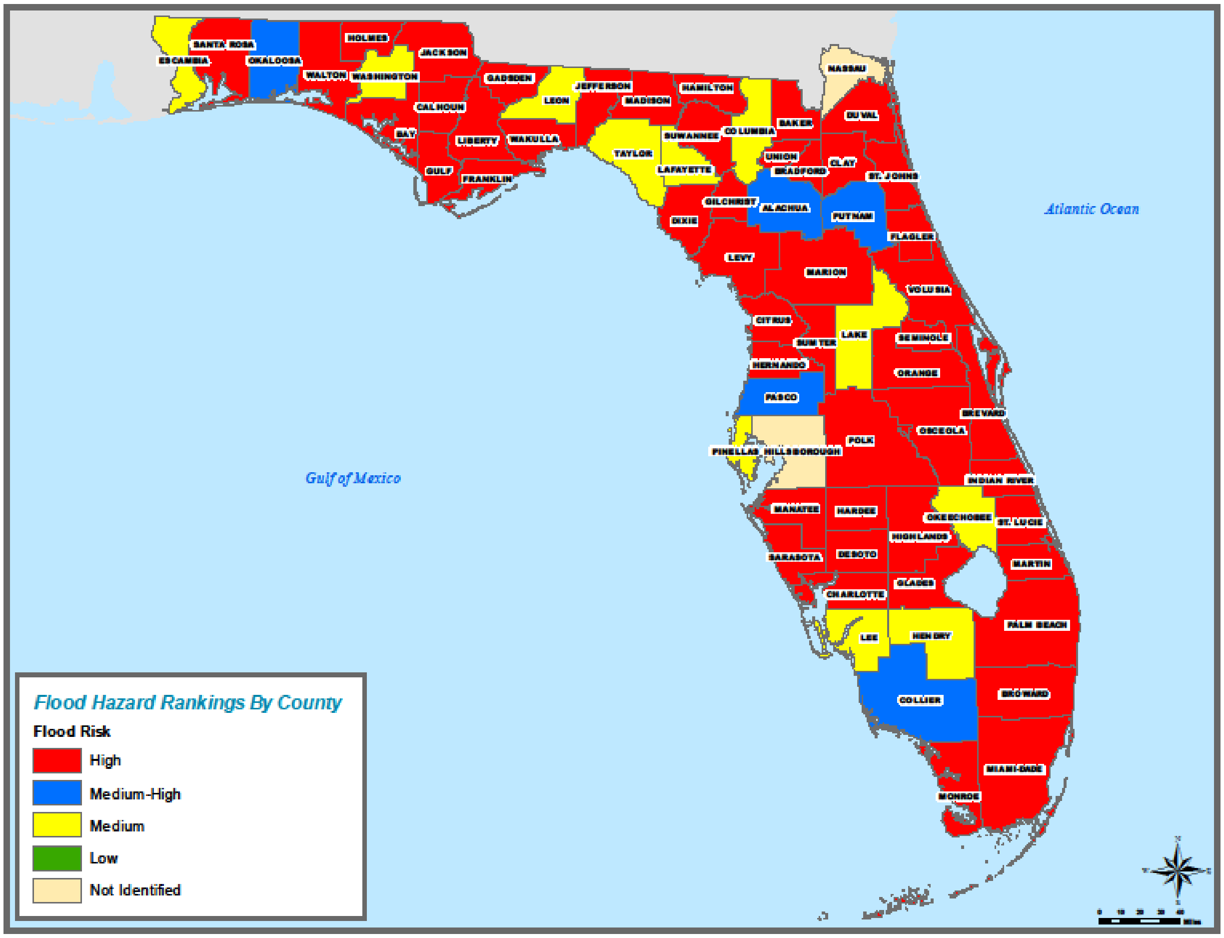
Flood

Based on the LMS plans, Figure 16 displays the jurisdictional rankings for the flood hazard. Not all counties have identified floods as one of their hazards.

- High-risk Jurisdictions: 49
- Medium-High-risk Jurisdictions: 5
- Medium-risk Jurisdictions: 11
- Low-risk Jurisdictions: 0
- Not identified Jurisdictions: 2

[36] Note: multiple reports that occurred on the same day were counted as one event.

Figure 16: Flood Hazard Rankings by County

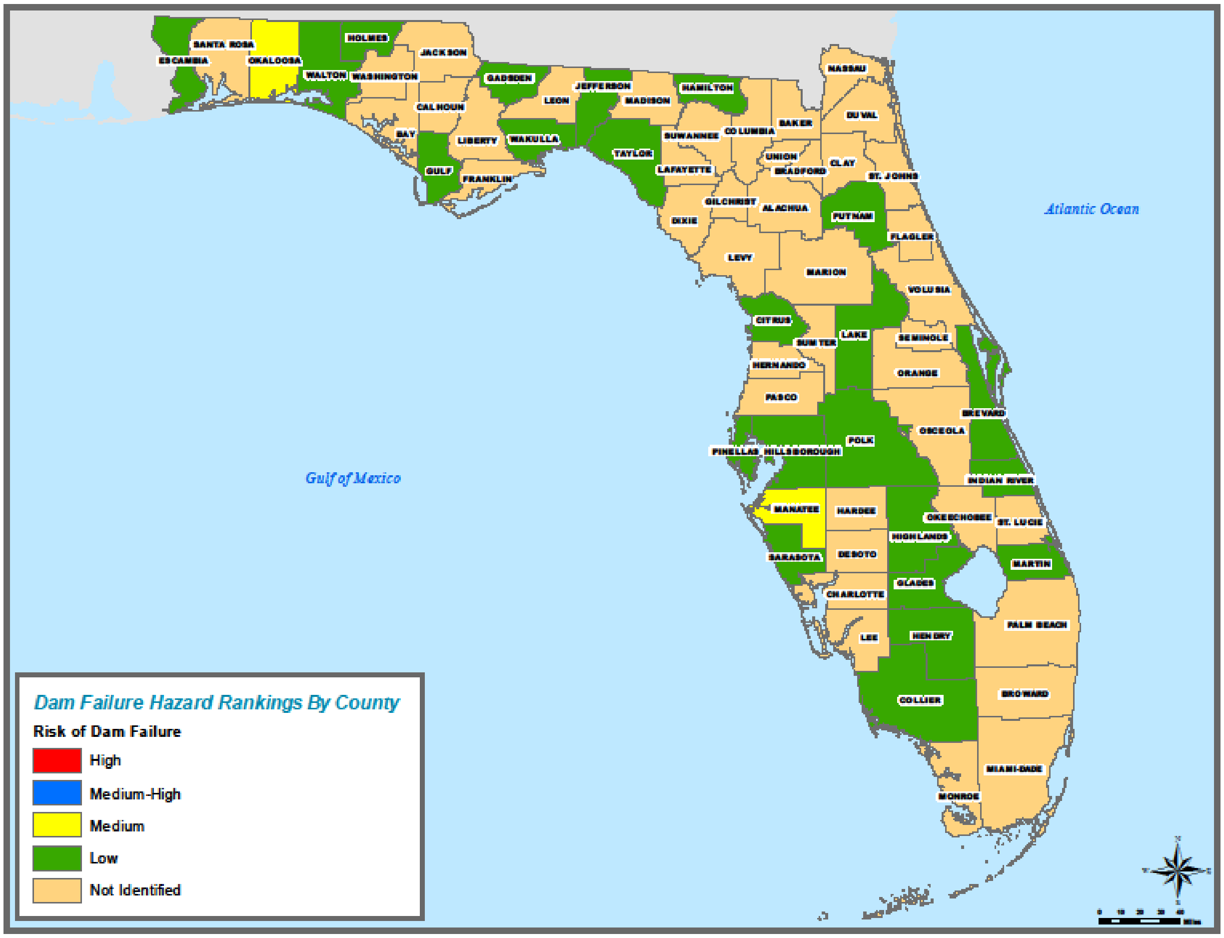


Dam Failure

Based on the LMS plans, Figure 17 displays the jurisdictional rankings for the dam failure hazard. Not all counties have identified dam failure as one of their hazards.

- High-risk Jurisdictions: 0
- Medium-High-risk Jurisdictions: 0
- Medium-risk Jurisdictions: 2
- Low-risk Jurisdictions: 23
- Not identified Jurisdictions: 42

Figure 17: Dam Failure Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation by Jurisdiction

Below is a table showing the population totals within the 100-year and 500-year floodplains, based on the HelpFL analysis. The population totals are based on a weighted average analysis of 2010 Census Blocks population that intersect the 100-year and 500-year floodplains, respectively. In addition, this weighted average analysis incorporates residential generalized use codes from the Florida Department of Revenue statewide 2016 parcels dataset, which more accurately considers where the population resides within 2010 Census Blocks. This analysis was then aggregated for each County. Please note that the data in the 500-year column is the number of people at risk, in addition to the 100-year population at risk, because the 500-year floodplain is the 100-year floodplain plus additional area.

Table 20: Inland Flood Hazard, Population[37]

Inland Flood Hazard Population		
County	**100-year**	**500-year**
Alachua	3,537	157
Baker	412	21
Bay	5,062	343
Bradford	672	21
Brevard	3,149	1,833
Broward	32,036	74,225
Calhoun	490	19
Charlotte	7,500	86
Citrus	2,395	580
Clay	1,382	380
Collier	12,783	4,375
Columbia	986	46
Desoto	482	70
Dixie	596	79
Duval	8,898	4,354
Escambia	1,904	131
Flagler	879	305
Franklin	1,001	261
Gadsden	327	3
Gilchrist	214	48
Glades	246	1,621
Gulf	680	69
Hamilton	251	29
Hardee	493	72
Hendry	1,606	212
Hernando	1,053	291
Highlands	791	5
Hillsborough	86,854	1,786
Holmes	953	23
Indian River	1,820	1,125
Jackson	711	11
Jefferson	318	11
Lafayette	295	63
Lake	2,555	69
Lee	17,277	5,660
Leon	2,514	288
Levy	752	29

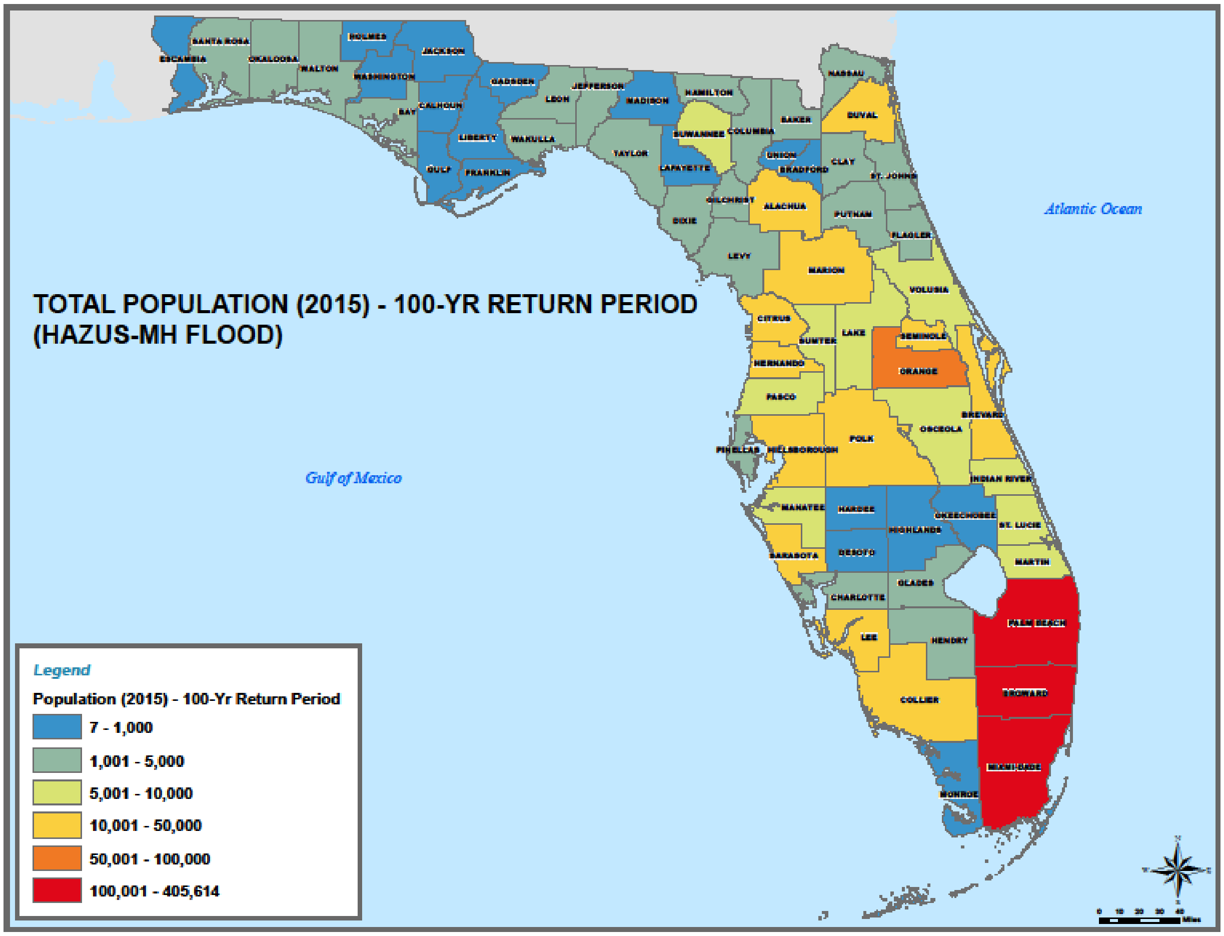
[37] Note: the data in the 500-year column is the number of people at risk, in addition to the 100-year population at risk, because the 500-year floodplain is the 100-year floodplain plus additional area.

Liberty	193	12
Madison	537	16
Manatee	8,994	1,081
Marion	2,246	471
Martin	801	863
Miami-Dade	184,272	15,422
Monroe	4,937	390
Nassau	960	307
Okaloosa	1,214	180
Okeechobee	1,022	500
Orange	10,616	2,119
Osceola	3,421	816
Palm Beach	12,334	6,513
Pasco	8,349	2,447
Pinellas	24,294	8,850
Polk	5,726	422
Putnam	1,440	46
Santa Rosa	717	265
Sarasota	7,691	4,109
Seminole	3,947	1,051
St. Johns	2,739	990
St. Lucie	1,507	442
Sumter	682	57
Suwannee	1,348	276
Taylor	1,290	446
Union	161	0
Volusia	7,966	3,769
Wakulla	796	173
Walton	1,087	16
Washington	756	10

According to this data, there are eight counties with over 10,000 people at risk for a 100-year flood event. For a 500-year flood event, there are eight counties with over 100,000 people at risk and five counties with over 10,000 people at risk.

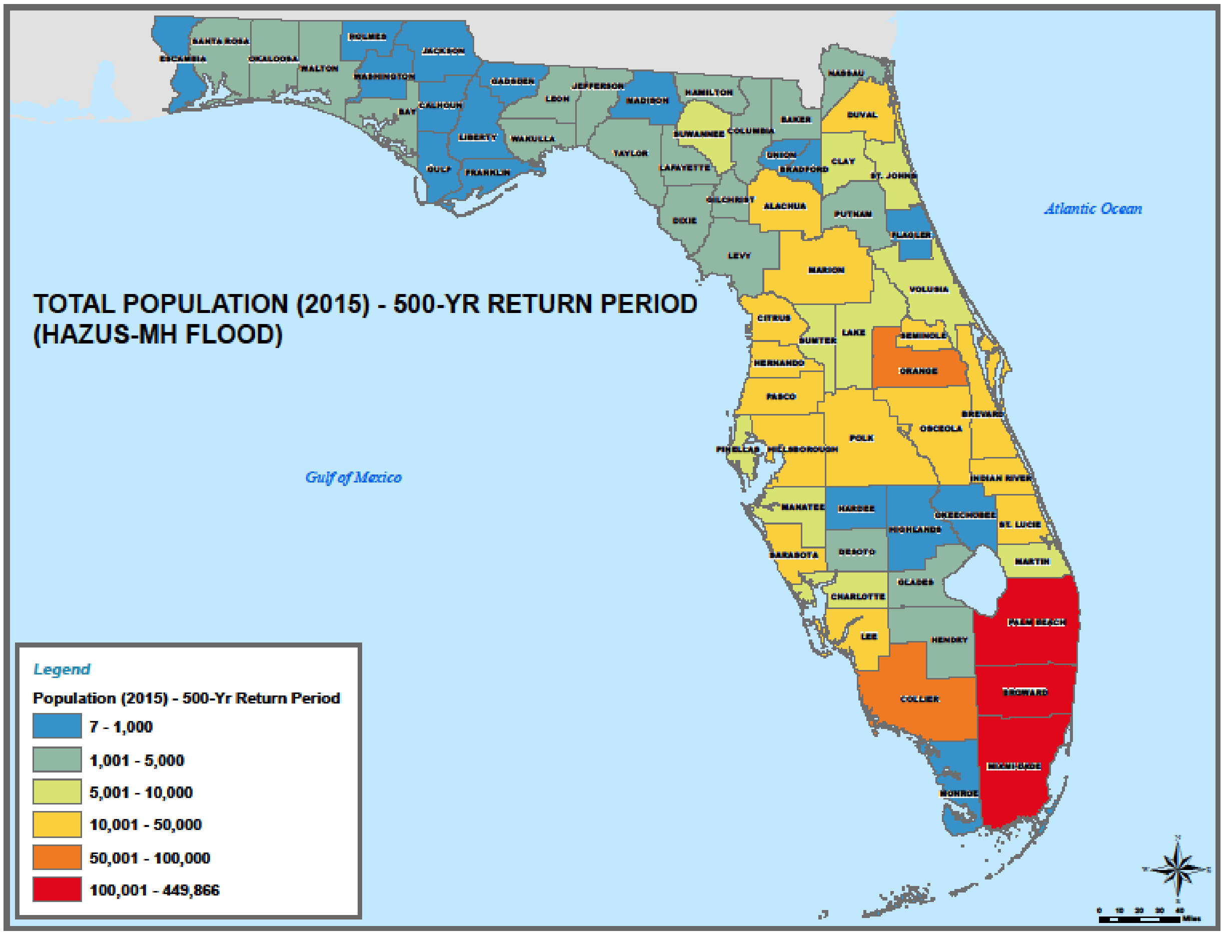
Below are two figures depicting the population living within the 100-year and 500-year probabilistic return period, as modeled using the HAZUS-MH Flood model riverine analysis and the 2015 American Community Survey. The information below, combined with population values above can provide a more complete analysis than using only one data source.

Figure 18: Population in the 100-year Probabilistic Return Period



This map shows that there three counties with over 100,000 people that live within the 100-year probabilistic return period floodplain, Miami-Dade, Broward, and Palm Beach counties. Orange County has between 50,000 and 100,000 people living within the 100-year return period area. Tables with this data can be found in *Appendix E: Risk Assessment Tables.*

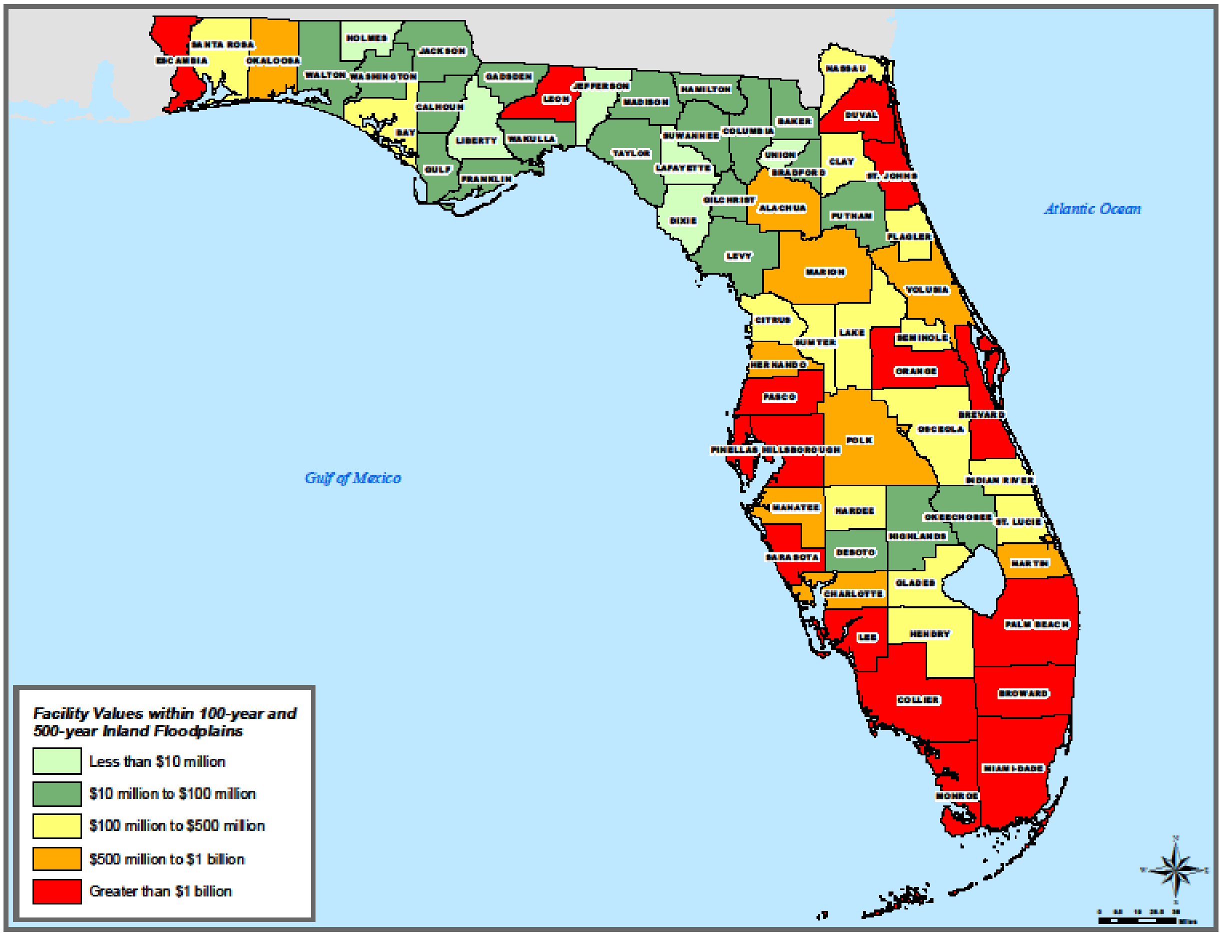
Figure 19: Population in the 500-year Probabilistic Return Period



This map shows that there three counties with over 100,000 additional people that live within the 500-year probabilistic return period floodplain, Miami-Dade, Broward, and Palm Beach counties. Collier and Orange counties have an additional 50,000 to 100,000 people living within the 500-year return period area. Tables with this data can be found in *Appendix E: Risk Assessment Tables*.

Below is a figure showing the value of facilities that are located within the 100-year and 500-year floodplains. This data is based on an analysis of the state facility database and the HelpFL inland flooding data.

Figure 20: Facility Values within 100 and 500-year Floodplains

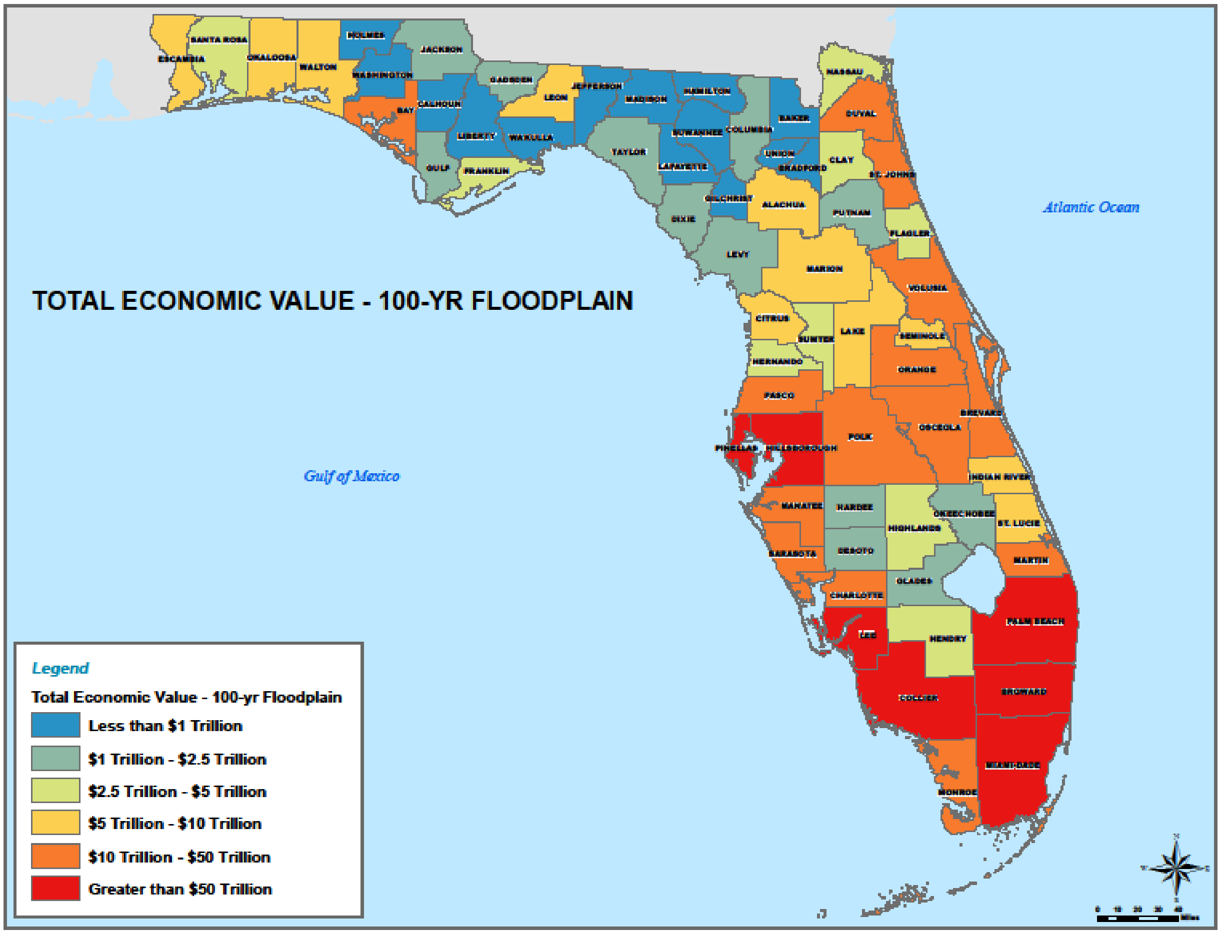


The analysis included public facilities, such as hospitals, fire stations, police stations, and schools. According to this data, there are 16 counties with over $1 billion worth of public facilities within the 100-year and 500-year floodplains, including Escambia, Leon, Duval, St. Johns, Orange, Brevard, Hillsborough, Pinellas, Pasco, Sarasota, Lee, Collier, Monroe, Miami-Dade, Broward, and Palm Beach. A table with this detailed information is available in *Appendix E: Risk Assessment Tables*.

The figures below shows the value of all real property within the 100-year and 500-year floodplains (Figures 21 and 22). Tables with detailed information can be found in *Appendix E: Risk Assessment Tables*.

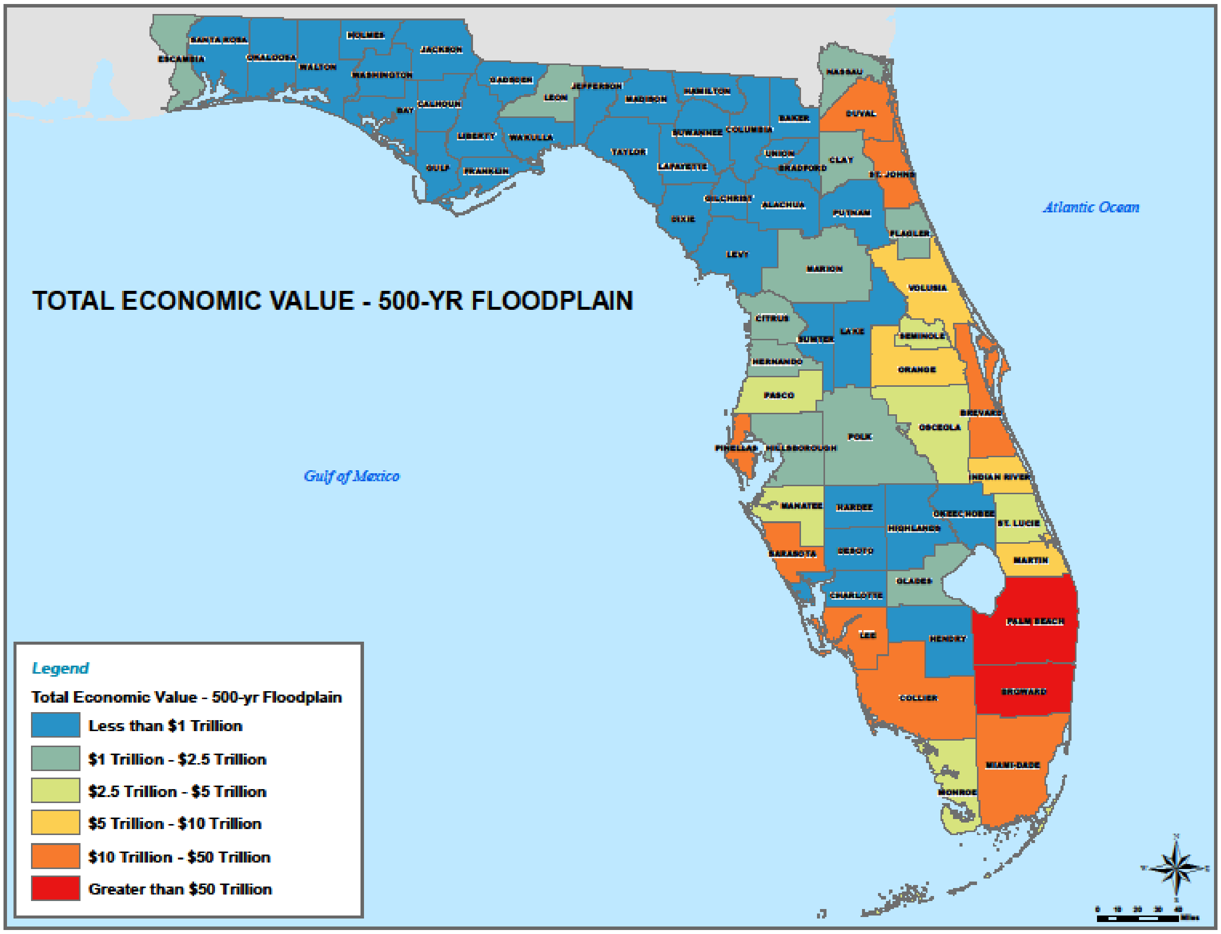
Structures included in a separate analysis include residential buildings, commercial buildings, medical buildings, educational buildings, and governmental buildings per parcel data from coastal and riverine flooding (Figure 23).

Figure 21: Total Economic Value 100-year Floodplain



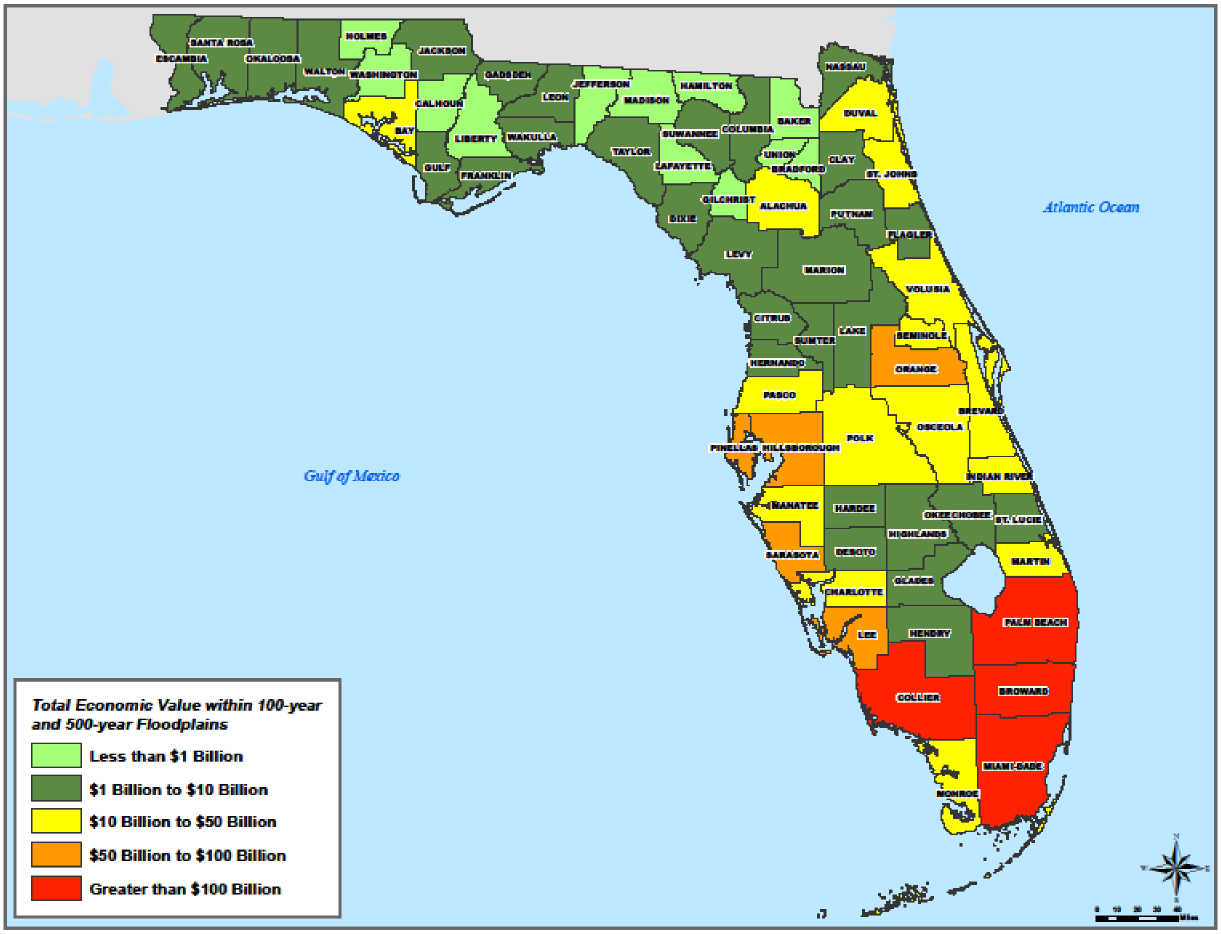
From this map, it is clear that there are many structures, worth trillions of dollars, located within the 100-year floodplain. Counties with over $50 trillion include Miami-Dade, Broward, Palm Beach, Collier, Lee, Hillsborough, and Pinellas.

Figure 22: Total Economic value 500-year Floodplain



The additional areas that comprise the 500-year floodplain contain structures worth trillions more dollars. Palm Beach and Broward counties both have an additional $50 trillion in structures at risk.

Figure 23: Total Economic Value within 100-year and 500-year Floodplains

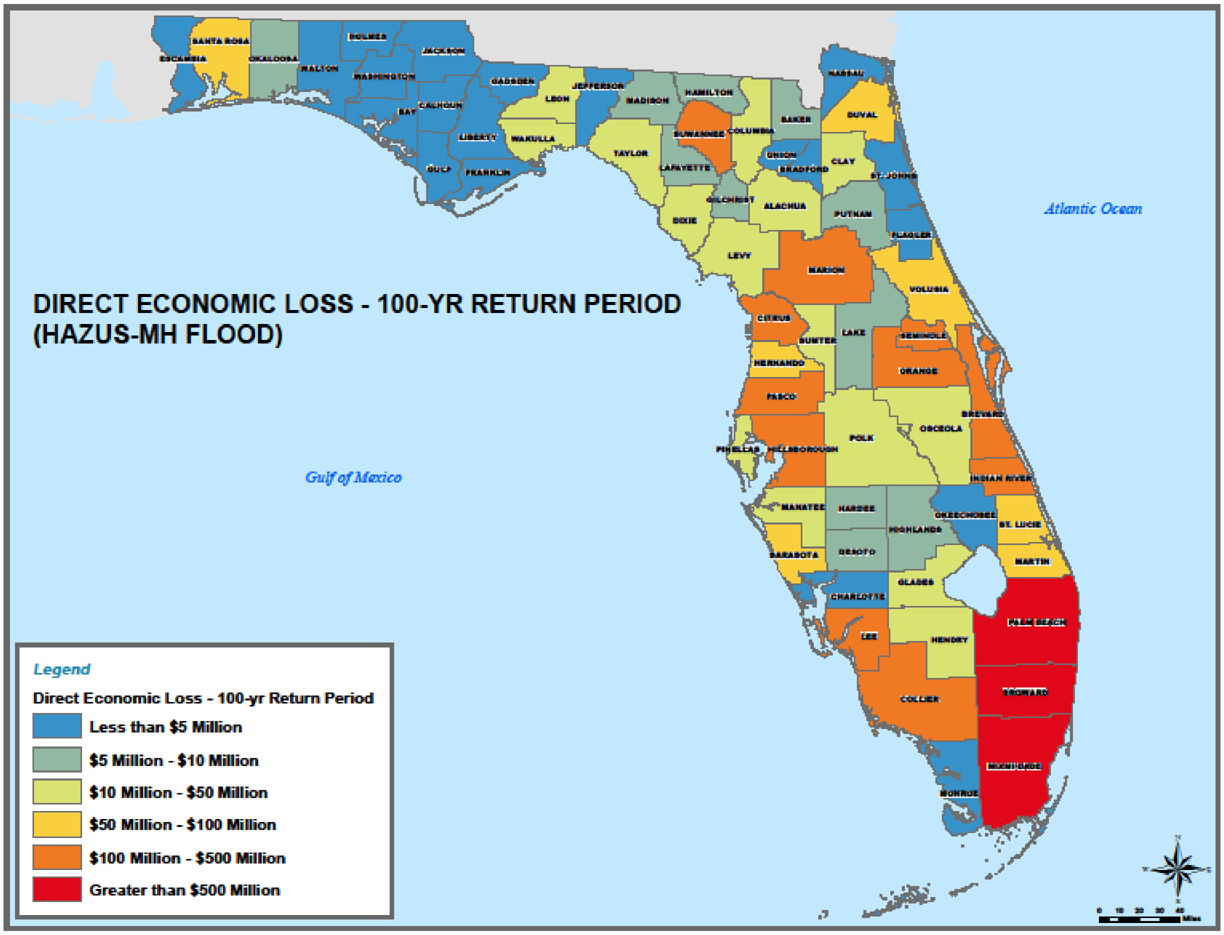


According to the data, there are four counties, Broward, Collier, Miami-Dade, and Palm Beach, which have over $100 billion worth of structures within 100-year floodplains. Data from the tables in *Appendix E: Risk Assessment Tables* show that there are six counties with over 100,000 structures within the 100-year floodplain, Broward, Hillsborough, Lee, Miami-Dade, Palm Beach, and Pinellas. When the 100-year and 500-year floodplains are added together, two more counties, Collier and Sarasota, have over 100,000 structures within the 500-year floodplain.

From this data it is clear that south Florida is highly vulnerable. Additionally, several urban coastal counties are also highly vulnerable.

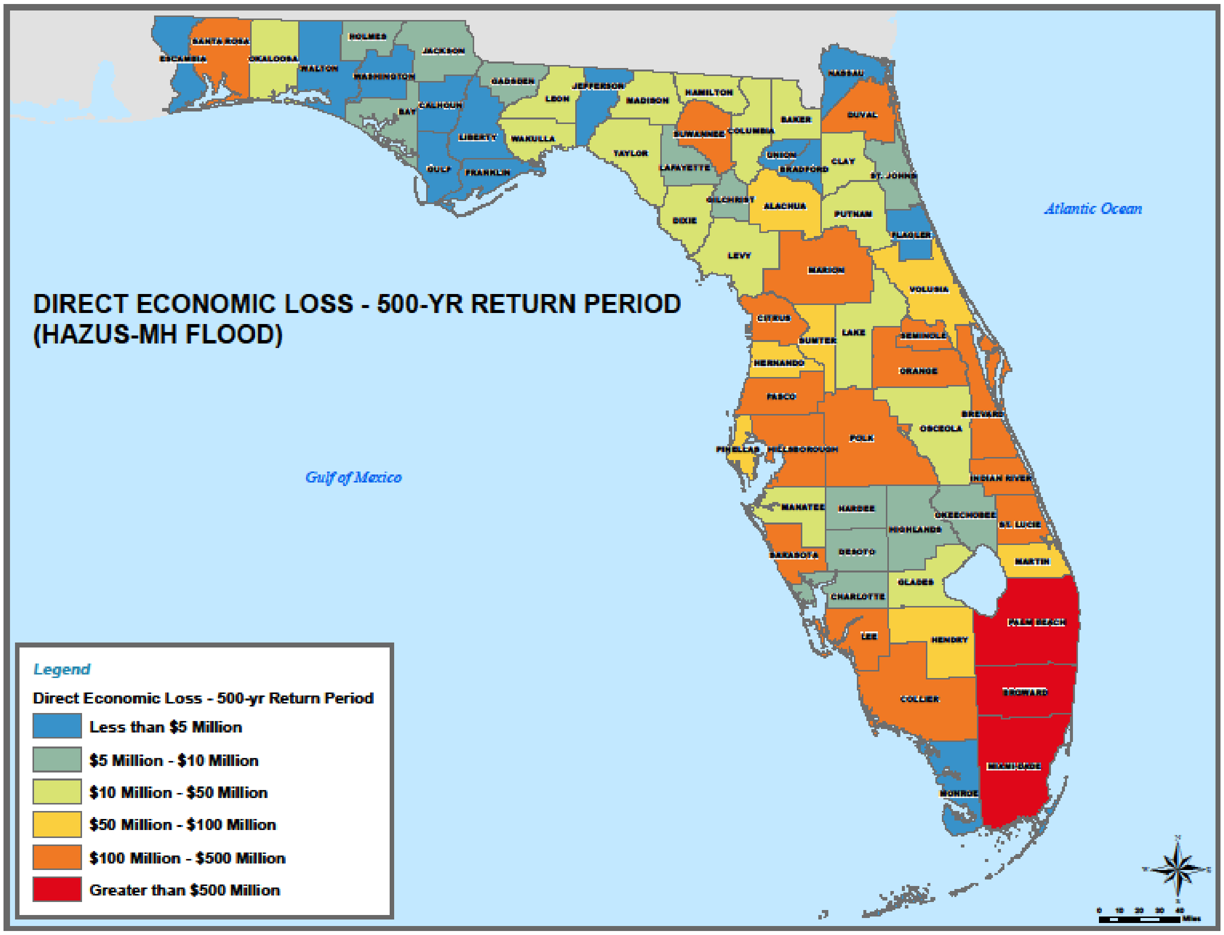
Below are figures showing the direct economic losses expected due to a 100-year and 500-year flood event. Direct economic losses were calculated in HAZUS-MH by taking the general building stock (Residential, Commercial, Industrial, etc.) that intersected a given Census Block and applied damage curves within the model based on the depth of flood inundation from the model's derived 100-year and 500-year return periods that were generated based on a Digital Elevation Model and calculated reaches within a County. The data for these figures can be found in *Appendix E: Risk Assessment Tables*.

Figure 24: Direct Economic Loss 100-year Return Period



According to data from HAZUS, three counties would experience more than $500 million in direct economic losses due to a 100-year flood. Eleven counties would experience between $100 million and $500 million in direct economic losses, including Suwannee, Marion, Citrus, Pasco, Hillsborough, Seminole, Orange, Brevard, Indian River, Lee, and Collier counties. Tables detailing this information are available in *Appendix E: Risk Assessment Tables*.

Figure 25: Direct Economic Loss 500-year Return Period



Similarly to the HAZUS data for a 100-year flood, a 500-year flood would result in over $500 million in direct economic losses in Palm Beach, Broward, and Miami-Dade counties. Fifteen counties would experience between $100 million and $500 million in direct economic losses due to a 500-year flood, including Santa Rosa, Suwannee, Duval, Marion, Citrus, Pasco, Hillsborough, Polk, Seminole, Orange, Brevard, Indian River, St. Lucie, Sarasota, Lee, and Collier counties. Tables detailing this information are available in *Appendix E: Risk Assessment Tables*.

Coastal Flooding

Please refer to the Tropical Cyclone Profile for vulnerability and loss estimates by jurisdiction due to coastal flooding and storm surge.

Historical Losses

The NCDC Storm Event Database information, presented in the Probability section above, also contained property and crop damage dollar amounts, which is shown in the table below. This information, combined with values of structures in hazard areas and with projected losses from HAZUS-MH can provide a more complete analysis than using only one data source.

Table 21: Flood Events in Florida, by Type, (2012-2016)[38 39]

Type of Event	Number of Events	Deaths	Injuries	Property Damage	Crop Damage
Coastal Flood	48	0	0	$46,072,000	$0
Flash Flood	81	3	0	$198,702,000	$0
Flood	98	1	0	$186,731,000	$39,265,000
Total	227	4	0	$431,505,000	$39,265,000

The information can be analyzed to provide the average amount of property and crop damage that is likely each year. This information is shown in the chart below.

Table 22: Flood Event Losses (2012-2016)[40 41]

Type of Flood	Average per Year	Annualized Property Loss	Annualized Crop Loss
Coastal Flood	9.6	$9,214,400	$0
Flash Flood	16.2	$39,740,400	$0
Flood	19.6	$37,346,200	$7,853,000
Total	45.4	$86,301,000	$7,853,000

According to the analysis, Florida is historically vulnerable to over $86 million in property damages and nearly $8 million in crop damages from roughly 45 flood events each year.

8. Vulnerability Analysis and Loss Estimation of State Facilities

The table below shows the number of state facilities that are located within the 100-year and 500-year floodplains, based on the state facility database and the HelpFL inland flood data.

Table 23: Inland Flood Count of State Facilities

Inland Flood Count of State Facilities		
County	**100-Year**	**500-Year**

[38] http://www.ncdc.noaa.gov/stormevents/listevents.jsp?beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2008&endDate_mm=12&endDate_dd=31&endDate_yyyy=2011&county=ALL&eventType=Coastal+Flood&statefips=12%2CFLORIDA

[39] Note: multiple reports that occurred on the same day were considered one event.

[40] http://www.ncdc.noaa.gov/stormevents/listevents.jsp?beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2008&endDate_mm=12&endDate_dd=31&endDate_yyyy=2011&county=ALL&eventType=Coastal+Flood&statefips=12%2CFLORIDA

[41] Note: multiple reports that occurred on the same day were counted as one event.

Alachua	66	0
Baker	0	0
Bay	54	8
Bradford	3	0
Brevard	24	12
Broward	161	168
Calhoun	0	0
Charlotte	66	0
Citrus	93	19
Clay	5	0
Collier	151	9
Columbia	14	9
Desoto	17	4
Dixie	1	0
Duval	48	11
Escambia	63	13
Flagler	31	21
Franklin	186	8
Gadsden	6	0
Gilchrist	9	0
Glades	15	26
Gulf	150	0
Hamilton	29	7
Hardee	8	1
Hendry	11	2
Hernando	4	23
Highlands	23	0
Hillsborough	59	0
Holmes	6	4
Indian River	72	14
Jackson	14	0
Jefferson	9	0
Lafayette	27	3
Lake	14	1
Lee	177	45
Leon	42	8
Levy	36	2
Liberty	0	0
Madison	9	0
Manatee	20	1
Marion	57	2
Martin	17	0
Miami-Dade	685	13

Monroe	223	14
Nassau	26	18
Okaloosa	1	0
Okeechobee	61	45
Orange	12	0
Osceola	30	2
Palm Beach	203	42
Pasco	42	1
Pinellas	147	16
Polk	179	0
Putnam	21	0
Santa Rosa	36	3
Sarasota	72	71
Seminole	0	0
St. Johns	161	31
St. Lucie	60	20
Sumter	13	1
Suwannee	59	19
Taylor	8	0
Union	0	0
Volusia	36	8
Wakulla	36	2
Walton	24	0
Washington	11	0

According to data there are nearly 4,000 state facilities in the 100-year floodplain and over 700 additional state facilities in further 500-year floodplain.

There are eleven counties with over 100 state facilities in the 100-year floodplain. They include Broward, Collier, Franklin, Gulf, Lee, Miami-Dade, Monroe, Palm Beach, Pinellas, Polk, and St. Johns. Miami-Dade County has the most, with almost 700 state facilities in the 100-year floodplain. Broward County is the only county with an additional 100 or more state facilities in the 500-year floodplain.

Please refer to the Tropical Cyclone Profile for vulnerability and loss estimations of state facilities due to coastal flooding and storm surge.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 15.

<table>
<tr><th colspan="5">FLOOD</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">A flood or flooding refers to the general or temporary conditions of partial or complete inundation of normally dry land areas from the overflow of inland or tidal water and of surface water runoff from any source. While many people underestimate the severity of floods, loss of life and property from flooding are real threats in Florida. Florida experiences several different kinds of floods due to the effects of severe thunderstorms, hurricanes, seasonal rains and other weather-related events.</td><td rowspan="5">HIGH</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Very Likely</td><td>Very Likely</td><td>High</td><td>High</td><td>High</td></tr>
</table>

Tropical Cyclone Hazard Profile

1. Tropical Cyclone Description

A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has a closed low-level circulation. Tropical cyclones rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere and have an average diameter of 200 to 400 miles across. These storms form when a developing center of low pressure moves over warm water and the pressure drops (measured in millibars or inches of Mercury) in the center of the storm. As the pressure drops, the system becomes better organized and the winds begin to rotate around the low pressure, pulling in the warm and moist ocean air. This is what causes the wind and rain associated with a tropical cyclone. If all of the conditions are favorable (warm ocean water and favorable high altitude winds), the system could build to a point where it has winds in excess of 155 miles per hour and could become catastrophic if it makes landfall in populated areas. Tropical cyclones act as a safety valve that limits the build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole ward latitudes. As the storm system rotates faster, an eye forms in the center. Higher pressure air from above flows down into the eye.

Tropical cyclones occasionally strengthen to become tropical storms or hurricanes. The following are descriptions of the four general levels of development for tropical cyclones:

- Tropical depression: The formative stages of a tropical cyclone in which the maximum sustained (1-min mean) surface wind is < 38 mph.
- Tropical storm: A warm core tropical cyclone in which the maximum sustained surface wind (1-min mean) ranges from 39–73 mph.
- Hurricane: A warm core tropical cyclone in which the maximum sustained surface wind (1-min mean) is at least 74 mph.
- Major Hurricane: A warm core tropical cyclone in which the maximum sustained surface wind (1-min mean) is at least 111 mph.

Hurricanes are further ranked by wind speed from Category 1 to 5, with 5 being catastrophic. The Saffir-Simpson Hurricane Wind Scale is shown in Table 24 below.

Table 24: Saffir-Simpson Hurricane Wind Scale[42]

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

[42] http://www.nhc.noaa.gov/aboutsshws.php

2	96-110 mph	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes
4 (major)	130-156 mph	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Advisories

Below are the advisories and thresholds that the National Hurricane Center (NHC) can issue during Tropical Cyclone events.[43]

- Tropical Storm
  - Tropical Storm Watch: issued when sustained winds of 39 to 73 mph are possible in the specified area within 48 hours in association with a tropical cyclone. These watches are issued 48 hours in advance of the anticipated onset of tropical storm force winds because preparedness activities become difficult and unsafe once winds reach tropical storm force.
  - Tropical Storm Warning: issued when sustained winds of 39 to 73 mph are expected in the specified area within 36 hours in association with a tropical cyclone. These warnings are issued 36 hours in advance of the anticipated onset of tropical storm force winds because preparedness activities become difficult and unsafe once winds reach tropical storm force.
  - Potential Tropical Storm: until 2017, the National Hurricane Center was only able to issue warnings when a storm was already formed. This is a problem because sometimes forecasting is certain enough to know that a disturbance will turn into a storm closer to landfall, but by the time a warning is sent out when a storm is close to land, it will be too late for protective actions. To remedy this issue, the NHC will now have the option to issue Potential Tropical

[43] http://www.nhc.noaa.gov/aboutgloss.shtml

Cyclone Warnings for areas of disturbance that are expected to develop into a tropical storm or hurricane and impact land within 48 hours.

- Hurricane
    - Hurricane Watch: issued when 74 mph winds or higher are possible in the specified area within 48 hours in association with a tropical cyclone. Because preparedness activities become difficult once winds reach tropical storm force, the hurricane watch is issued 48 hours in advance of the anticipated onset of tropical storm force winds
    - Hurricane Warning: issued when 74 mph winds or higher are expected in the specified area within 36 hours in association with a tropical cyclone. Because preparedness activities become difficult once winds reach tropical storm force, the hurricane warning is issued 36 hours in advance of the anticipated onset of tropical storm force winds
- Storm Surge
    - Storm Surge Watch: issued when there is the possibility of life-threatening inundation from rising water moving inland from the shoreline in the specified area, generally within 48 hours, in association with an ongoing or potential tropical cyclone.
    - Storm Surge Warning: issued when the danger of life-threatening inundation from rising water moving inland from the shoreline in the specified area, generally within 36 hours, in association with an ongoing or potential tropical cyclone.
    - Storm Surge Watches and Warnings may be issued earlier based on timing forecasts and may be issued for locations adjacent to expected life-threatening inundation areas.

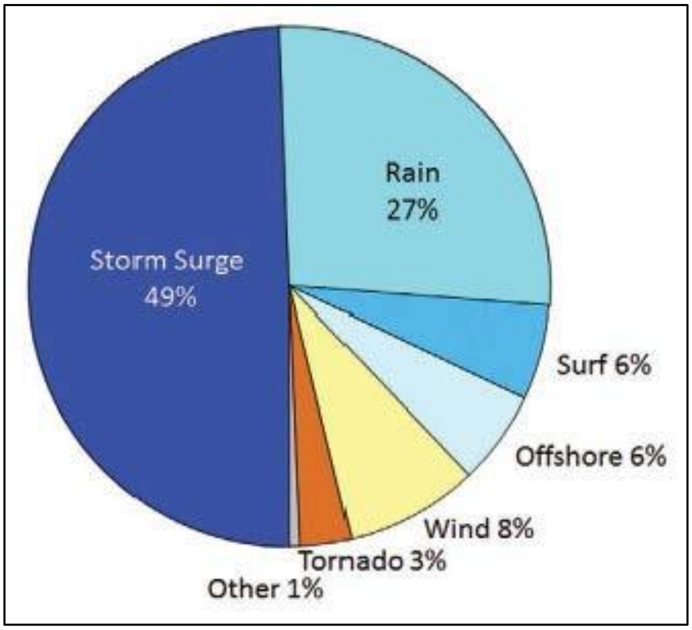
<u>Causes of Fatalities in Tropical Cyclone Storms</u>

There are two categories of causes of fatalities in tropical storms or hurricanes, direct and indirect. A direct death means that the fatality is attributable to forces of the storm, such as water or wind. An indirect death means that the fatality resulted from actions before, during, and after the storm.

In a study from the National Hurricane Center, from 1963 to 2012, there are an average of 40 to 50 direct deaths from tropical storms or hurricanes each year. According to the study, 90% of the deaths are due to water, either storm surge, freshwater flooding, or rainfall. Of course, there is a large storm-to-storm and year-to-year variability associated with that average. It was also determined that while 1 in every 5 tropical cyclones cause death in the US, two thirds of direct deaths from tropical cyclones were from just six specific storms.[44]

[44] http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-12-00074.1

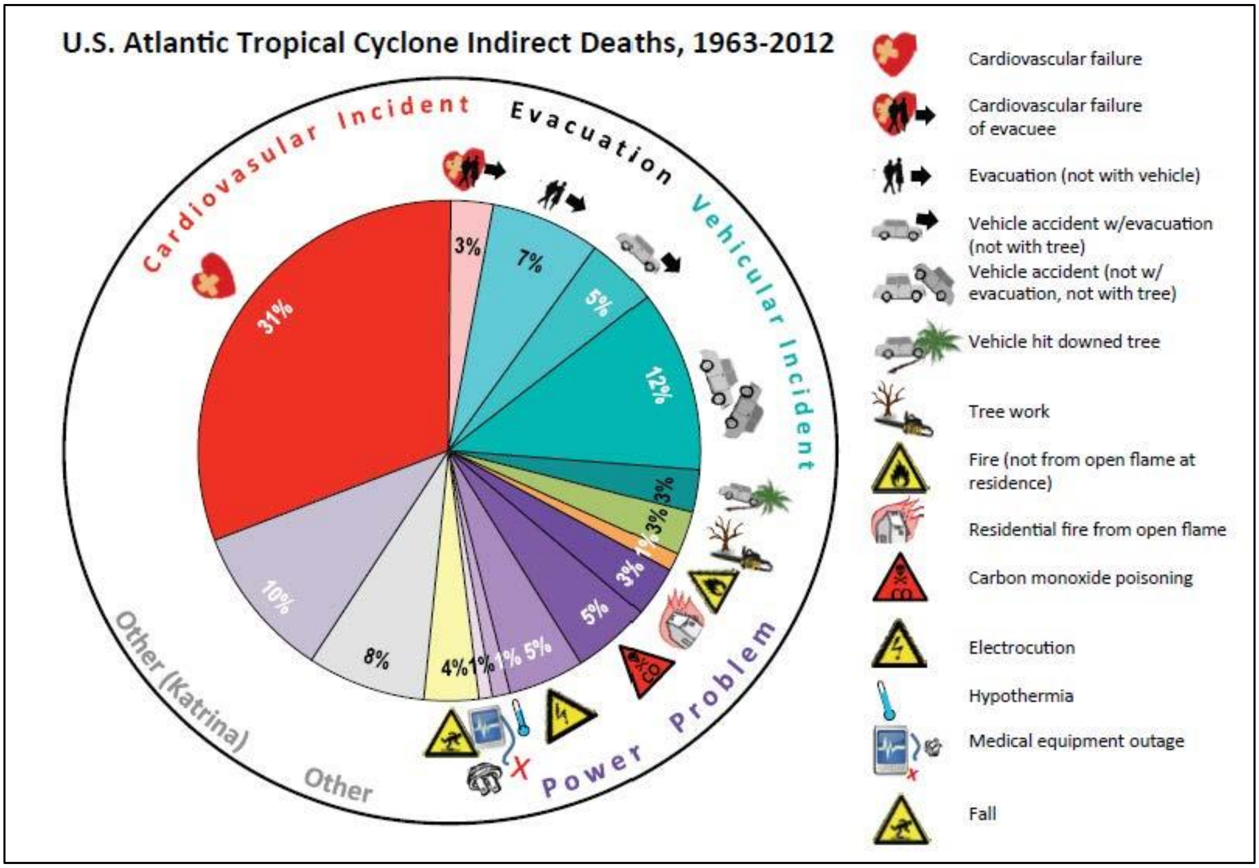
Figure 26: Deaths in the United States Directly Attributable to Atlantic Tropical Cyclones, 1963-2012.[45]



The study also examined indirect deaths and found that there are an average of 30 to 40 indirect fatalities from tropical storms or hurricanes each year. Additionally, those over age 70 were found to be 8 times as likely to be victims, than those under age 21. The study found four primary contributing factors to indirect deaths, some of which occur in combination. The leading cause of indirect deaths is cardiovascular complications; in fact, one third of all indirect deaths are attributed to cardiovascular complications. The next factor is complications during evacuations, either during the evacuation or when the victim reaches the destination. Vehicle accidents are also a contributing factor to indirect deaths. Examples of vehicle accidents include hydroplaning, traffic lights out, and downed trees. Finally, indirect deaths are sometimes caused by power related complications, such as the improper use of generators leading to carbon monoxide poisoning or structure fires; electrocutions; and losing power to life sustaining medical equipment.[46]

[45] http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-15-00042.1
[46] http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-15-00042.1

Figure 27: United States Atlantic Tropical Cyclone Indirect Deaths, 1963-2012[47]

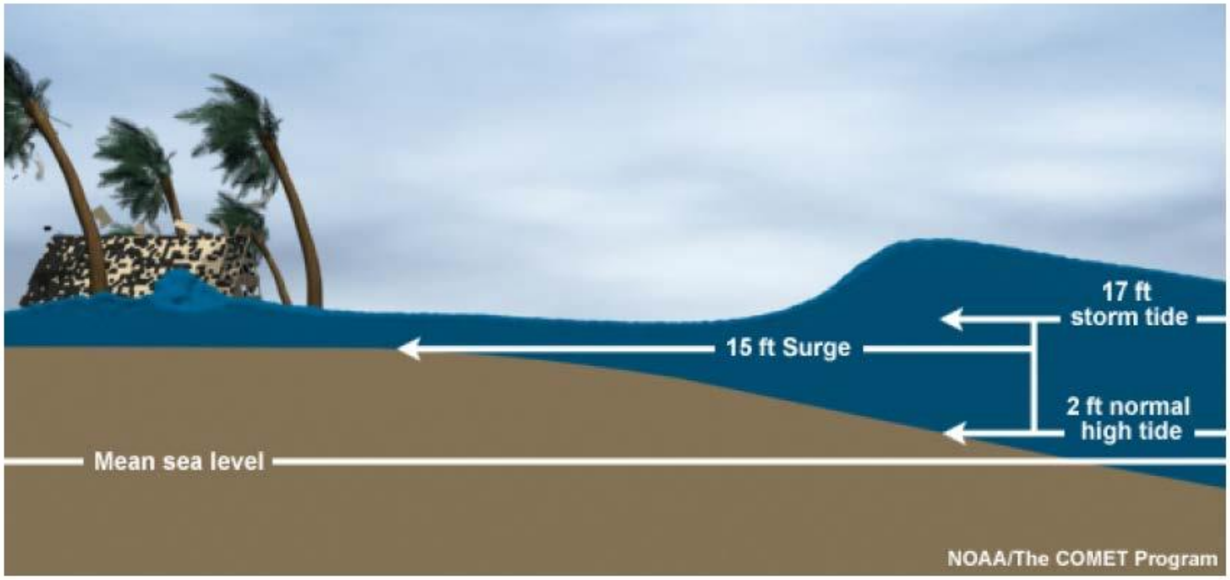


Storm Surge

Storm surge is perhaps the most dangerous aspect of a hurricane. It is a phenomenon that occurs when the winds and forward motion associated with a tropical cyclone pile water up in front, as it moves toward shore. Below is a diagram to demonstrate storm surge.[48]

[47] http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-15-00042.1
[48] http://www.nws.noaa.gov/om/hurricane/resources/surge_intro.pdf

Figure 28: Storm Surge Explanation



Storm surge heights are dependent upon the configuration of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). In 2010, the National Hurricane Center separated storm surge from the Saffir-Simpson Hurricane Wind Scale because it did not accurately describe storm surge. For example, a Category 1 hurricane could have devastating storm surge, while a Category 5 hurricane could have minimal storm surge. Along most of the Atlantic coast of Florida, a narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water in close proximity to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. The Gulf Coast of Florida has a long, gently sloping shelf and shallow water depths, leading to higher surge but smaller waves. South Miami-Dade County is somewhat of an exception to these general rules due to Biscayne Bay, which has a wide shelf and shallow depth. In this instance, a hurricane has a larger area to “pile up” water in advance of its landfall. Nowhere is the threat of storm surge more prevalent than in the Apalachee Bay Region, where storm surge can reach several feet above ground.

The National Hurricane Center forecasts storm surge using the SLOSH model, which stands for Sea, Lake, and Overland Surges from Hurricanes. The model is accurate to within 20 percent. The inputs include the central pressure of a tropical cyclone, storm size, the forward motion, its track, and maximum sustained winds. Local topography, bay and river orientation, depth of the sea bottom, astronomical tides, as well as other physical features are taken into account in a predefined grid referred to as a “SLOSH basin.” Overlapping basins are defined for the southern and eastern coastlines of the continental U.S.

The final output from the SLOSH model run will display the Maximum Envelope of Water, or MEOW, that occurred at each location. To allow for track or forecast uncertainties, usually several model runs with varying input parameters are generated to create a map of MOMs, or Maximum of Maximums. For hurricane evacuation studies, a family of storms with representative tracks for the region with varying intensity, eye diameter, and speed are modeled to produce worst-case water heights for any tropical cyclone occurrence. The results of these studies are typically generated from several thousand SLOSH runs.[49]

Tornadoes

Tornadoes are a significant threat during tropical cyclones and have been associated with the majority that have affected Florida. Tornadoes tend to develop on the leading northwest edge relative to the forward motion (or on the right-front quadrant) of hurricanes, within thunderstorms and rain bands away from the center. The majority of tornadoes that occur with hurricanes are relatively weak and short-lived. In recent years, much of the wind damage in hurricanes attributed to tornadoes has, in reality been the result of down bursts, which are strong downdrafts causing damaging winds on or near the ground. For more information regarding tornadoes, please see the Severe Storms Hazard Profile.

High Winds

Tropical Cyclones can produce very strong and destructive winds that can persist for great distance in area and duration even after landfall. Hurricane force winds are extremely dangerous and can cause severe damage and debris. This debris, including signs, pieces of structures not properly secured, and shallow rooted trees, is often then carried by the high winds and can cause further damage.

Rainfall

Tropical Cyclones are capable of producing widespread and heavy rains, which can result in life-threatening and damaging floods. This flooding is actually the biggest threat from tropical cyclones for people who live inland. The rainfall can cause flash flooding and flooding on rivers and streams that can persist for several days after the storm. Rainfall amounts are related to the speed and size of tropical cyclones, not the intensity. This is because a slower moving and larger tropical cyclone has a longer and larger capacity to produce more rainfall.

Rip Currents

The strong winds associated with tropical cyclones can cause rip currents, which are a significant drowning threat to coastal residents and beach goers. Rip currents are channeled currents of water flowing away from shore and can easily pull strong swimmers into the open water. These rip currents can occur at large distances from the storm.

The National Weather Service produces Rip Current Outlooks to alert beach goers to the risk of rip currents at a particular beach. There are three levels of outlooks:[50]

- Low Risk: The risk for rip currents is low; however, life-threatening rip currents often occur in the vicinity of jetties, reefs, and piers.
- Moderate Risk: Life threatening rip currents are possible in the surf zone.
- High Risk: Life threatening rip currents are likely in the surf zone.

[49] http://www.nhc.noaa.gov/surge/slosh.php
[50] http://www.nws.noaa.gov/os/hurricane/resources/TropicalCyclones11.pdf

Potential Effects of Climate Change on Tropical Cyclones

A warmer atmosphere could influence two of the factors that affect the generation and strength of tropical cyclones: (1) increased thermal energy resulting from higher sea surface temperatures (SST), and (2) increased vertical wind shear.[51] These effects are likely to counteract each other to some degree. The exact role of increasing SST remains to be determined: tropical cyclone intensity, as measured by power dissipation indices[52] may increase directly as a function of SST, or intensity may be a function of the difference between SST in the cyclone development region and mean global tropical SST.[53] Vertical wind shear disturbs the structure of a tropical cyclone and, therefore, increased shear can lead to system weakening *(Grossman and Morgan (2011), p. 547.)*. Tropical cyclone intensity is one of the principal determinants of storm surge height; thus, the net effects of climate change on tropical cyclone intensity will also affect the magnitude of coastal flooding associated with these storms. Tropical cyclone tracks and consequently, the number of systems that make landfall in Florida, could be influenced by atmospheric steering currents and climate phenomena such as the El Niño-Southern Oscillation, North Atlantic Oscillation, Atlantic Meridional Mode, and Madden-Julian Oscillation.[54] As stated in the flood hazard profile, higher rainfall intensity is likely as atmospheric moisture increases.[55]

2. Geographic Areas Affected by Tropical Cyclones

The entire State of Florida is subject to the effects of tropical cyclones, but some areas are much more vulnerable than others. This is due to its large areas of coastal shorelines on the Atlantic and Gulf Coast. The average diameter of hurricane force winds averages 100 miles, and tropical storm force winds extend out 300–400 miles;[56] while at the same time no point within Florida is more than 70 miles from the Atlantic Ocean/Gulf of Mexico. Maps throughout this section illustrate that all parts of Florida are and can be impacted by hurricanes at different levels over time. Tropical cyclones are random in distribution, so there is no specific region of Florida that is more at risk than another. However, the coastal areas are more vulnerable to the effects that a tropical cyclone can produce due to their urban development, location, and the storm surge that can occur.

[51] Grinsted et al. (2013). *Projected Atlantic hurricane surge threat from rising temperatures. Proceedings of the National Academy of Sciences,* 110(14), 5369, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3619316/; (Grossman and Morgan (2011). *Tropical cyclones, climate change, and scientific uncertainty: What do we know, what does it mean, and what should be done?* Climatic Change, 108, 547.

[52] Power dissipation indices are "an aggregate compound of tropical cyclone frequency, duration, and intensity that measures total energy consumption by tropical cyclones," Seneviratne et al., 2012, p. 159. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap3_FINAL.pdf

[53] Seneviratne et al. (2012). *Changes in climate extremes and their impacts on the natural physical environment.* In Field et al. (Eds.), *Managing the risks of extreme events and disasters to advance climate change adaptation,* p. 159. https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

[54] Kossin et al. (2010). *A globally consistent reanalysis of hurricane variability and trends.* Geophysical Research Letters, 34, 4. doi: 10.1029/2006GL028836.

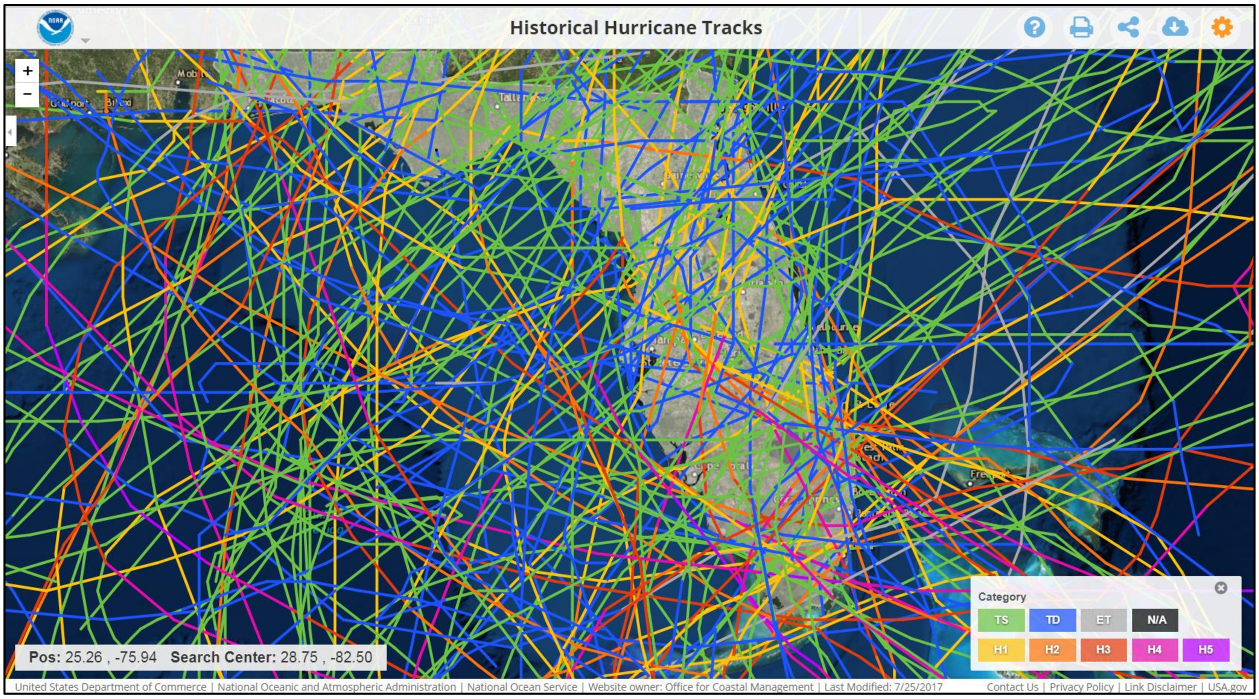
[55] Knutson et al. (2010). *Simulated reduction in Atlantic hurricane frequency under twenty-first-century warming conditions.* Nature Geoscience,1(6), 161.

[56] http://www.hurricanescience.org/science/science/hurricanestructure/

As seen in the image below, tropical cyclones are random and affect all of Florida.

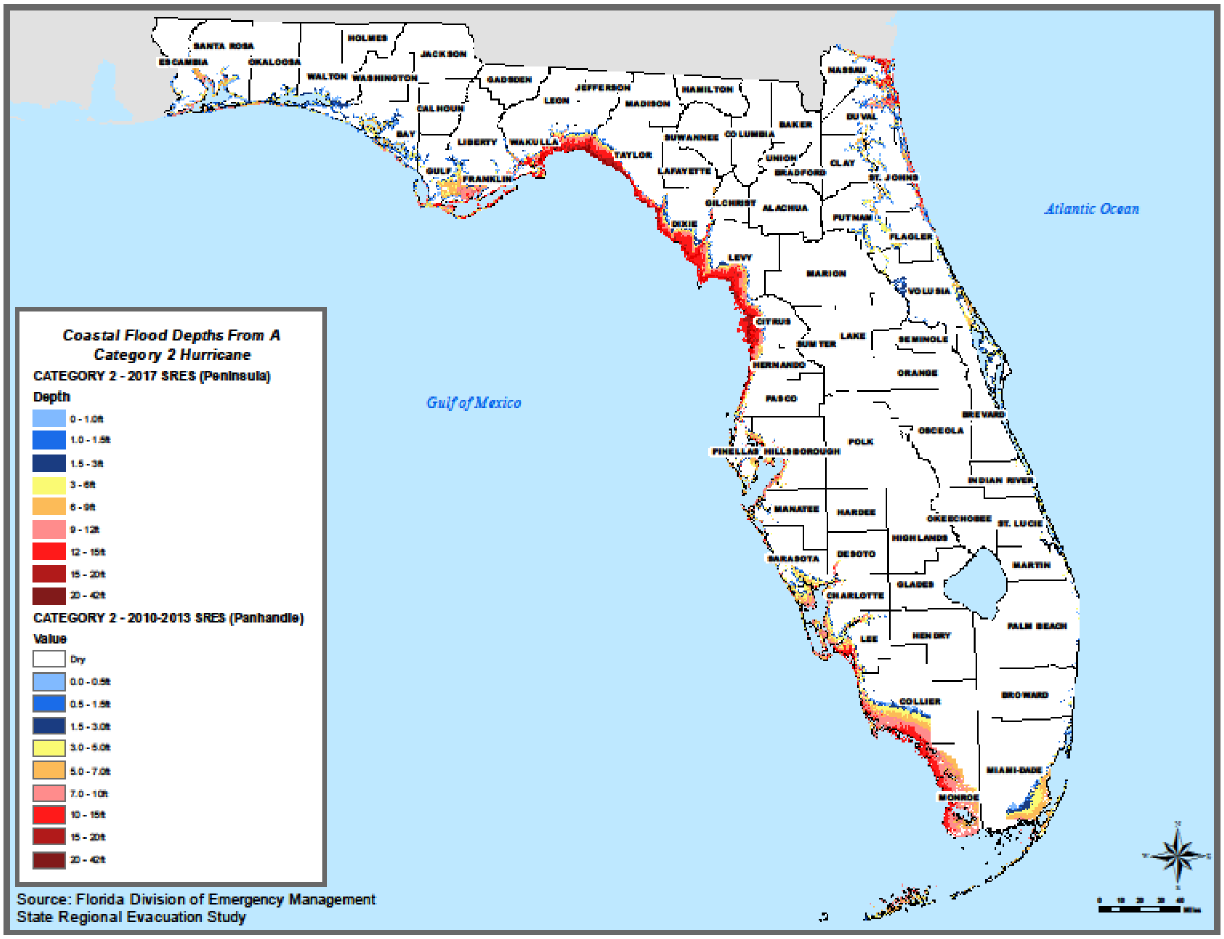
The image below depicts all the tropical cyclones to affect Florida from 1916 to 2016. This graphic shows that all areas of Florida can be affected by tropical cyclones.[57]

Figure 29: Historical Tropical Cyclone Tracks, Florida, 1916 to 2016



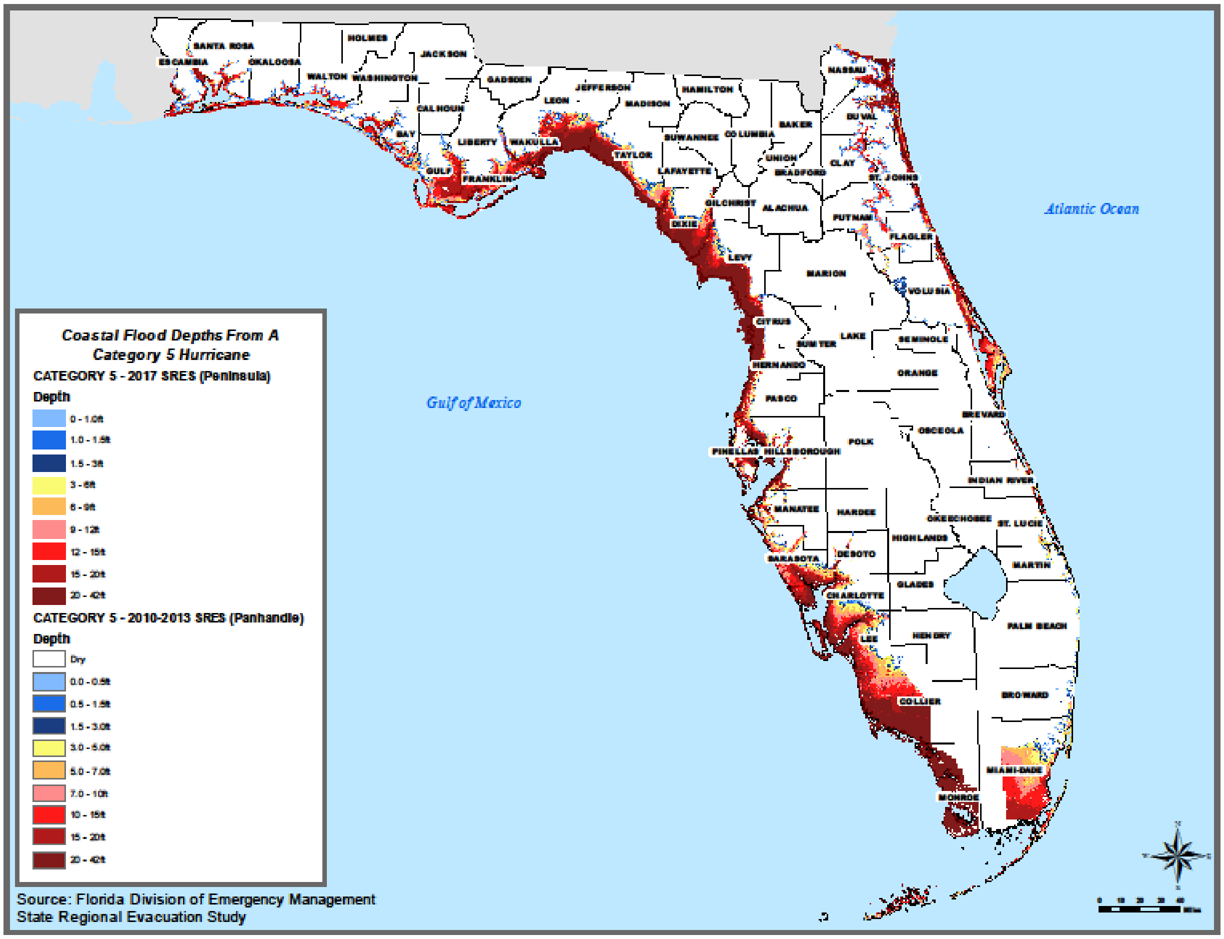
57 https://coast.noaa.gov/hurricanes/

Figure 30: Coastal Flood Depth, Category 2 Hurricane



This map shows that the Big Bend coastal region, the southwest coast and a small portion of the northeast coast of Florida are susceptible to coastal flooding due to a Category 2 Hurricane.

Figure 31: Coastal Flood Depth, Category 5 Hurricane



This map shows that the entire west coast of Florida, along with the upper half of the eastern coast and the Florida Keys are susceptible to coastal flooding due to a Category 5 Hurricane.

3. Historical Occurrences of Tropical Cyclones

The table below lists the hurricanes and tropical storms that affected the state from 2006 to 2016.

Table 25: Significant Tropical Cyclone Occurrences, 2006-2016

Name	Date
Tropical Storm Fay	August 18–23, 2008
Hurricane Ike	September 7, 2008
Hurricane Gustav	October 27, 2008
Tropical Storm Beryl	May 28–30, 2012
Tropical Storm Debby	June 24–25, 2012
Hurricane Isaac	August 25-27, 2012

Tropical Storm Erika	August 28, 2012
Tropical Storm Colin	June 6-7, 2016
Hurricane Hermine	August 31-September 2, 2016
Hurricane Matthew	October 3-6, 2016

Table 26: Significant Tropical Cyclones before 2006[58]

Date	Information
1921	Storm surge and abnormally high tides caused damage along much of the Florida west coast, from Pasco County southward. Several areas in Tampa were inundated with water. Strong winds damaged trees and structures. The agricultural industry suffered a significant loss. There were 4 deaths in Florida attributed to the storm.
1926	The eye of the Category 4 hurricane passed directly over Miami, there was 10 feet of storm surge in Miami Beach and the barrier islands. There were several deaths, many of which are attributed to the misunderstanding of hurricanes and that the calm was the eye of the storm, not the end of the storm. Damages were estimated to be over $1.2 billion in current US dollars.[59]
Okeechobee Hurricane, September 16–17, 1928	A Category 4 Hurricane made landfall near Palm Beach and the center of the hurricane passed near Lake Okeechobee causing lake waters to flood the surrounding areas. There were hundreds of deaths, perhaps as many as 2,500. Damage throughout the region was estimated to be between $25 million and $150 million in Florida.
Labor Day Hurricane, August 31–September 8, 1935	The Labor Day Hurricane hit Florida, mostly in the Florida Keys, and is considered to be one of the most severe hurricanes ever recorded in Florida. There were hundreds of deaths and the Keys Islands were cut off from the mainland for three days. Damage was estimated to be nearly $6 million.
1945 Miami	A Category 4 Hurricane hit Key Largo, Miami, and Homestead. Most of Homestead was destroyed.
Palm Beach 1949	A strong Category 4 Hurricane made landfall in West Palm Beach and moved inland over the northern part of Lake Okeechobee. This hurricane caused extensive damage across most of the east coast of Florida.
1950 – Easy; King	Hurricane Easy impacted northwest Florida and produced severe rainfall and high waves. Hurricane King hit Miami as a Category 4 hurricane, causing millions of dollars (1950 US dollars) of damage.

58 https://www.fema.gov/disasters?field_state_tid_selective=47&field_disaster_type_term_tid=6840&field_disaster_declaration_type_value=All&items_per_page=20&=GO

59 http://www.nhc.noaa.gov/outreach/history/#miami26

Hurricane Andrew, August 24, 1992	Hurricane Andrew hit south Florida as a Category 5 storm. While there were less than 100 deaths, hundreds of thousands of homes were destroyed or severely damaged. Additionally, Hurricane Andrew caused an estimated $26.5 billion in damages. The US military also deployed nearly 22,000 troops to aid in the recovery efforts.
Hurricane Earl, August 31–September 3, 1998	Hurricane Earl made landfall near Panama City, Florida as a Category 1 hurricane. There were very high storm surges in the Big Bend area of Florida, well away from the center of the hurricane. Hurricane Earl caused 2 deaths and an estimated $79 million in damages.
2004 Hurricane Season	There were several tropical cyclones to affect Florida in the 2004 hurricane season, including: • Tropical Storm Bonnie, which made landfall in panhandle of Florida; • Hurricane Charley, which made landfall as a Category 4 on the southwestern coast of Florida; • Hurricane Frances, which affected Florida east coast as a Category 2 hurricane; • Hurricane Jeanne, which made landfall in central Florida east coast as a Category 3 hurricane. The season led to over $3.6 billion in federal assistance
2005 Hurricane Season	The most active Atlantic Hurricane season in recorded history had several tropical cyclones that affected Florida, including: • Tropical Storm Arlene, which made landfall on the Florida panhandle; • Hurricane Dennis, which went through the western panhandle; • Hurricane Katrina, which caused significant effects in the Florida panhandle; • Hurricane Rita, which caused storm surge in the Florida keys; • Tropical Storm Tammy, which made landfall along the northeastern Florida coast; and • Hurricane Wilma, which affected southern Florida. These storms led to over $2.25 billion in federal assistance

Table 27: FEMA Major Disaster Declarations in Florida, 1960 – 2016[60]

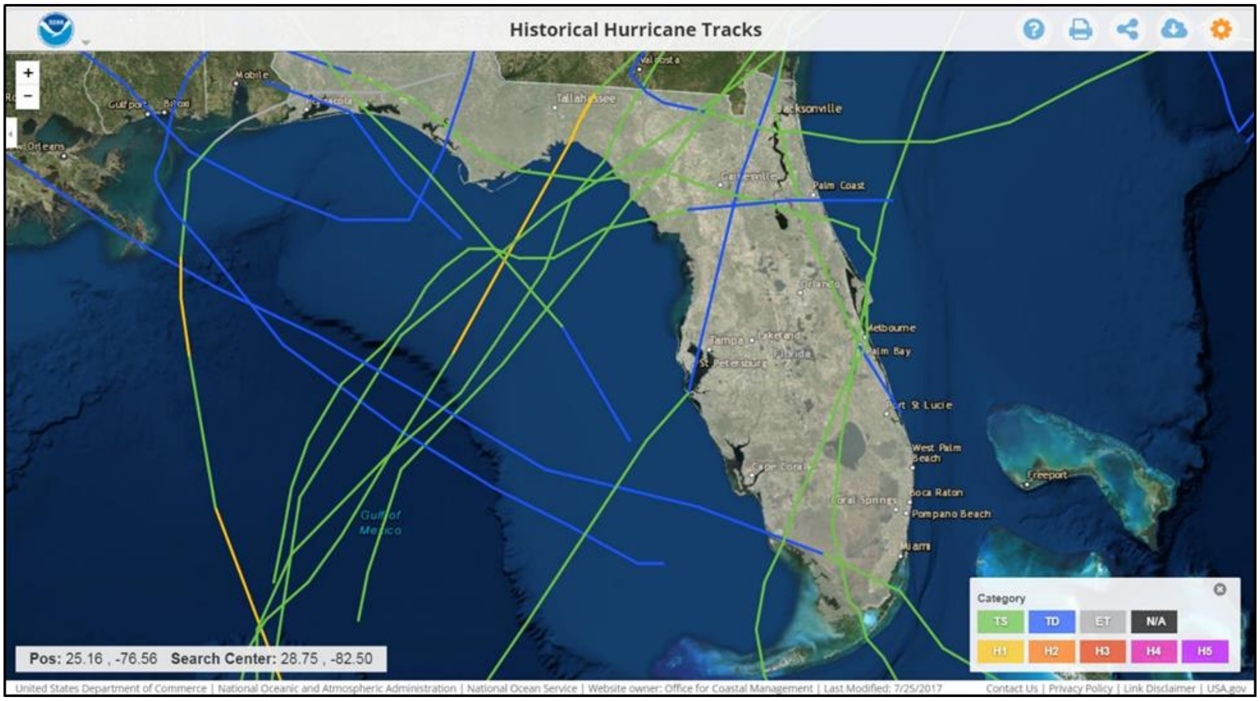
Date	Description
September 12, 1960	DR-106: Hurricane Donna
September 8, 1964	DR-175: Hurricane Cleo
September 10, 1964	DR-176: Hurricane Dora
September 14, 1965	DR-209: Hurricane Betsy
November 7, 1968	DR-252: Hurricane Gladys
June 23, 1972	DR-337: Tropical Storm Agnes
September 13, 1979	DR-600: Hurricane Frederic

60 https://www.fema.gov/disasters?field_state_tid_selective=47&field_disaster_type_term_tid=6840&field_disaster_declaration_type_value=DR&items_per_page=20

August 29 - September 2, 1985	DR-743: Hurricane Elena
November 21 – 22, 1985	DR-756: Hurricane Kate
August 24 – 25, 1992	DR-955: Hurricane Andrew
July 2 – 29, 1994	DR-1035: Tropical Storm Alberto
August 2 – 3, 1995	DR-1062: Hurricane Erin
October 4 – 11, 1995	DR-1069: Hurricane Opal
September 3, 1998	DR-1241: Hurricane Earl
September 25 – October 2, 1998	DR-1249: Hurricane Georges
November 4 – 5, 1998	DR-1259: Tropical Storm Mitch
September 13 -25, 1999	DR-1300: Hurricane Floyd
October 14 – 24, 1999	DR-1306: Hurricane Irene
September 21 – October 4, 2000	DR-1344: Tropical Storm Helene
June 11 – 15, 2001	DR-1381: Tropical Storm Allison
September 13 – 21, 2001	DR-1393: Tropical Storm Gabrielle
August 11 – 30, 2004	DR-1539: Hurricane Charley and Tropical Storm Bonnie
September 3 – October 8, 2004	DR-1545: Hurricane Frances
September 13 – November 17, 2004	DR-1551: Hurricane Ivan
September 24 – November 17, 2004	DR-1531: Hurricane Jeanne
July 7 – 20, 2005	DR-1595: Hurricane Dennis
August 24 – September 6, 2005	DR-1602: Hurricane Katrina
October 23 – November 18, 2005	DR-1609: Hurricane Wilma
August 18 – September 12, 2008	DR-1785: Tropical Storm Fay
August 31 – September 7, 2008	DR-1806: Hurricane Gustav
June 23 – July 26, 2012	DR-4068: Tropical Storm Debby
August 27 – 29, 2012	DR-4084: Hurricane Isaac
August 31 – September 11, 2016	DR-4280: Hurricane Hermine
October 3 – 19, 2016	DR-4283: Hurricane Matthew

The figure below shows all the tracks of tropical cyclones that affected Florida from 2006 to 2016.

Figure 32: Tropical Cyclone Tracks, Florida, 2006 to 2016[61]



NOAA tracks all weather related fatalities in the US. According to their data, there were nine deaths in Florida from 2006 to 2016 due to tropical cyclones:[62]

- 2008: 3 deaths
- 2009: 1 death
- 2012: 3 deaths
- 2016: 2 deaths

There were also 13 deaths attributed to wind from 2006 to 2016 in Florida:[63]

- 2009: 4 deaths
- 2011: 1 death
- 2012: 2 deaths
- 2013: 1 death
- 2014: 1 death
- 2015: 3 deaths
- 2016: 1 death

[61] https://coast.noaa.gov/hurricanes/
[62] http://www.nws.noaa.gov/om/hazstats.shtml#
[63] http://www.nws.noaa.gov/om/hazstats.shtml#

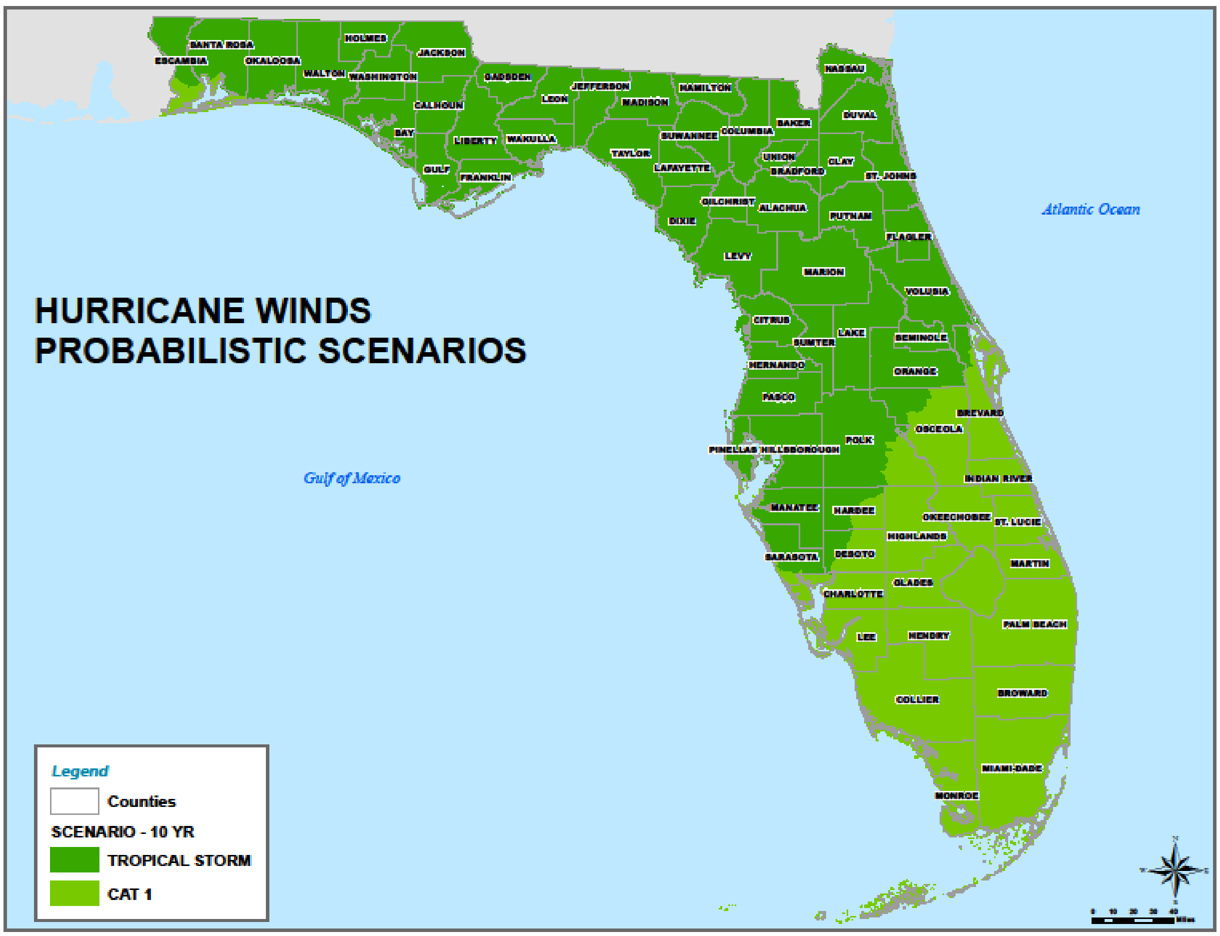
Furthermore, six deaths were attributed to floods in Florida from 2006 to 2016.

4. Probability of Future Tropical Cyclones

Since tropical cyclones are random in distribution, it is impossible to forecast whether Florida will experience a tropical cyclone. However, because of the high frequency of tropical cyclones that have affected Florida in the past, it is reasonable to assume that Florida will experience tropical cyclones again in the future.

The following maps show the probability that areas in Florida will receive Tropical Storm through Hurricane force winds within the specified return period.

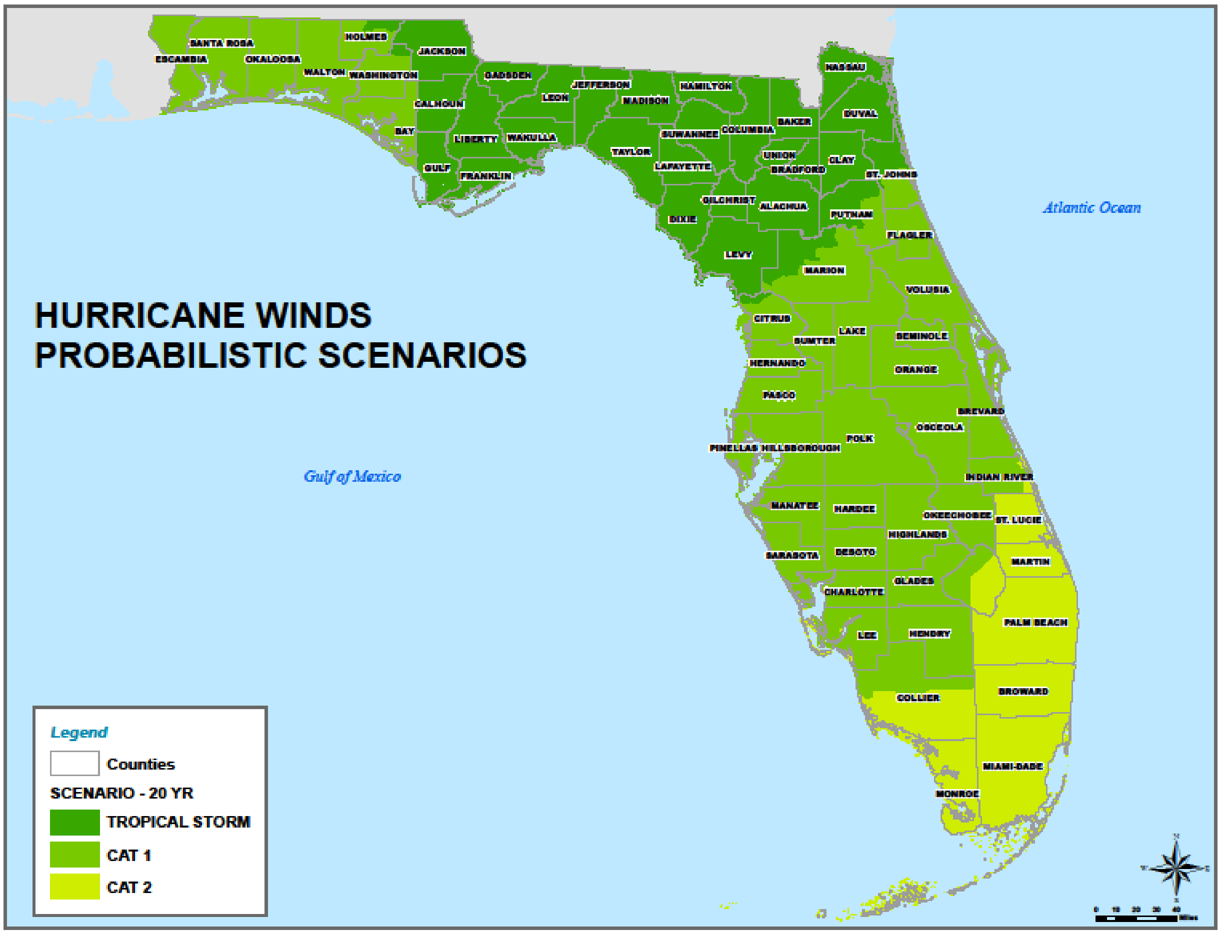
Figure 33: Hurricane Winds Probabilistic Scenario, 10-Year Return Period



This map is showing that it is likely that every 10 years, the areas shaded in darker green will experience at least one Tropical Storm and the areas shaded in lighter green will experience at least one Category 1 Hurricane.

Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* For this 10-year return period scenario, there are fifty-two counties with less than 1,000 structures likely to be damaged and fifteen counties with 1,000 to 100,000 structures likely to be damaged. There are twenty-four counties with zero to one million dollars of structural damage likely. Another thirty counties have between one million and 100 million dollars of structural damage likely. There are nine counties with between 100 million and 1 billion dollars of structural damage likely and four counties with over 1 billion dollars of structural damage likely.

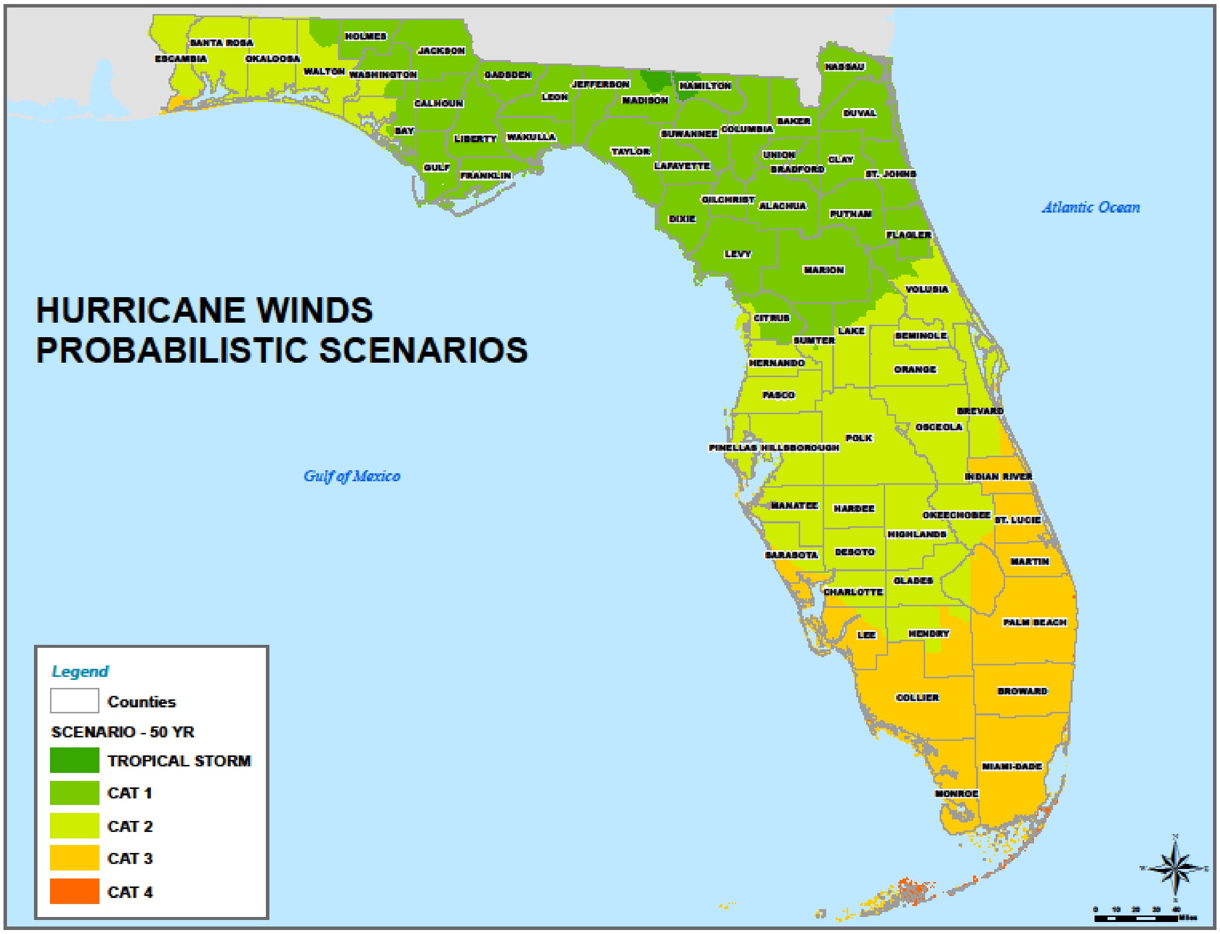
Figure 34: Hurricane Winds Probabilistic Scenario, 20-Year Return Period



This map is showing that it is likely that every 20 years, the areas shaded in darker green will experience at least one Tropical Storm; the areas shaded in lighter green will experience at least one Category 1 Hurricane; and the areas shaded in yellow-green will experience at least one Category 2 Hurricane.

Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* For this 20-year return period scenario, there are thirty six counties with less than 1,000 structures likely to be damaged, twenty-nine counties with between 1,000 and 100,000 structures likely to be damaged, and two counties with over 100,000 structures likely to be damaged. Only nine counties have between 100,000 and one million dollars of structural damage likely. There are thirty-one counties with between one million and 100 million dollars of structural damage likely and twenty-three counties with between 100 million and one billion dollars of structural damage likely. There are four counties with over one billion dollars of structural damage likely.

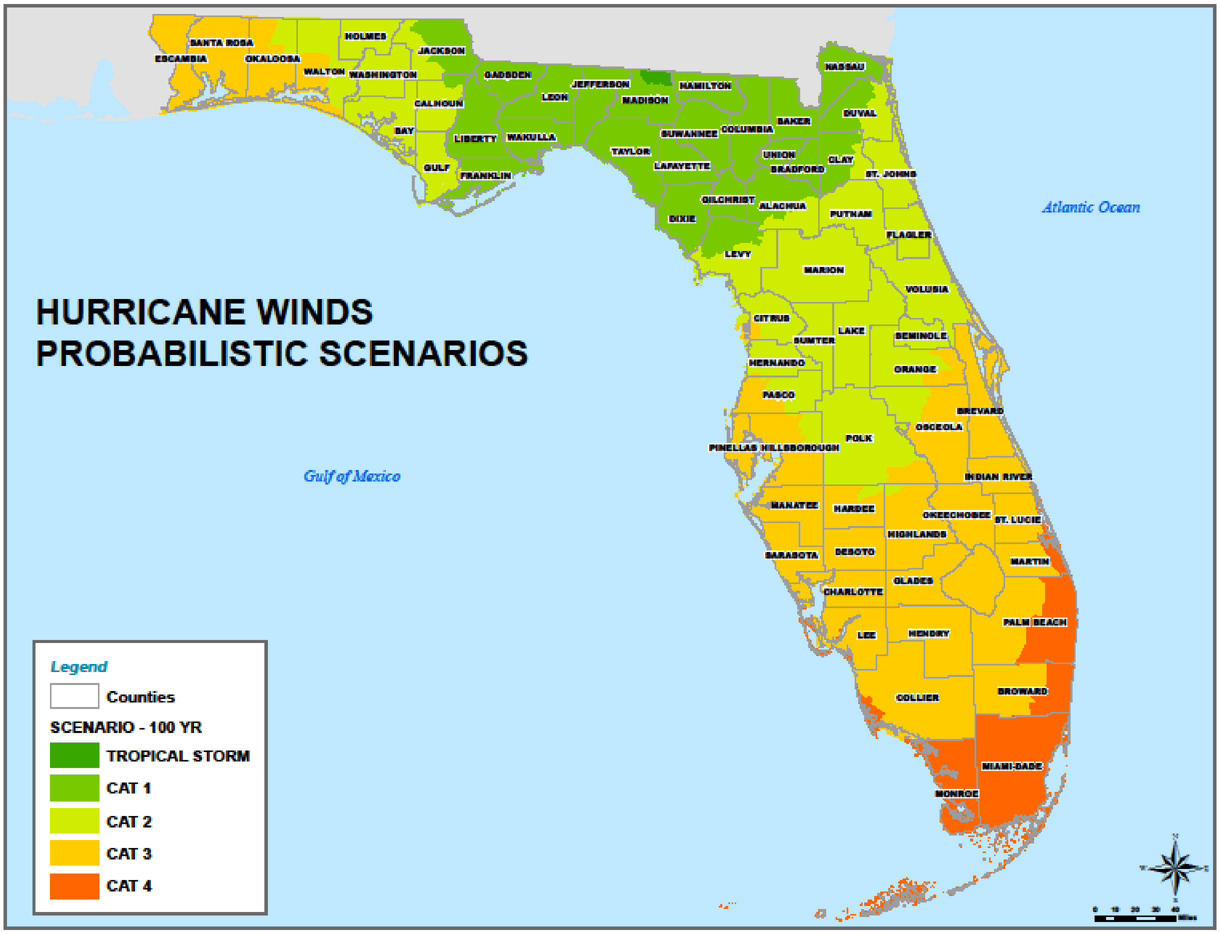
Figure 35: Hurricane Winds Probabilistic Scenario, 50-Year Return Period



This map is showing that it is likely that every 50 years, the areas shaded in green will experience at least one Tropical Storm; the areas shaded in lighter green will experience at least one Category 1 Hurricane; the areas shaded in yellow-green will experience at least one Category 2 Hurricane; the areas in yellow-orange will experience at least one Category 3 Hurricane; and areas shaded in orange will experience at least one Category 4 Hurricane.

Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* There are twenty-four counties with less than 1,000 structures likely to be damaged and thirty-nine counties with between 1,000 and 100,000 structures likely to be damaged. Only four counties have over 100,000 structures likely to be damaged. There are twenty-eight counties with between one million and 100 million dollars of structural damage likely; twenty-two counties with between 100 million and one billion dollars of structural damage likely; and seventeen counties with between one billion and 100 billion dollars of structural damage likely.

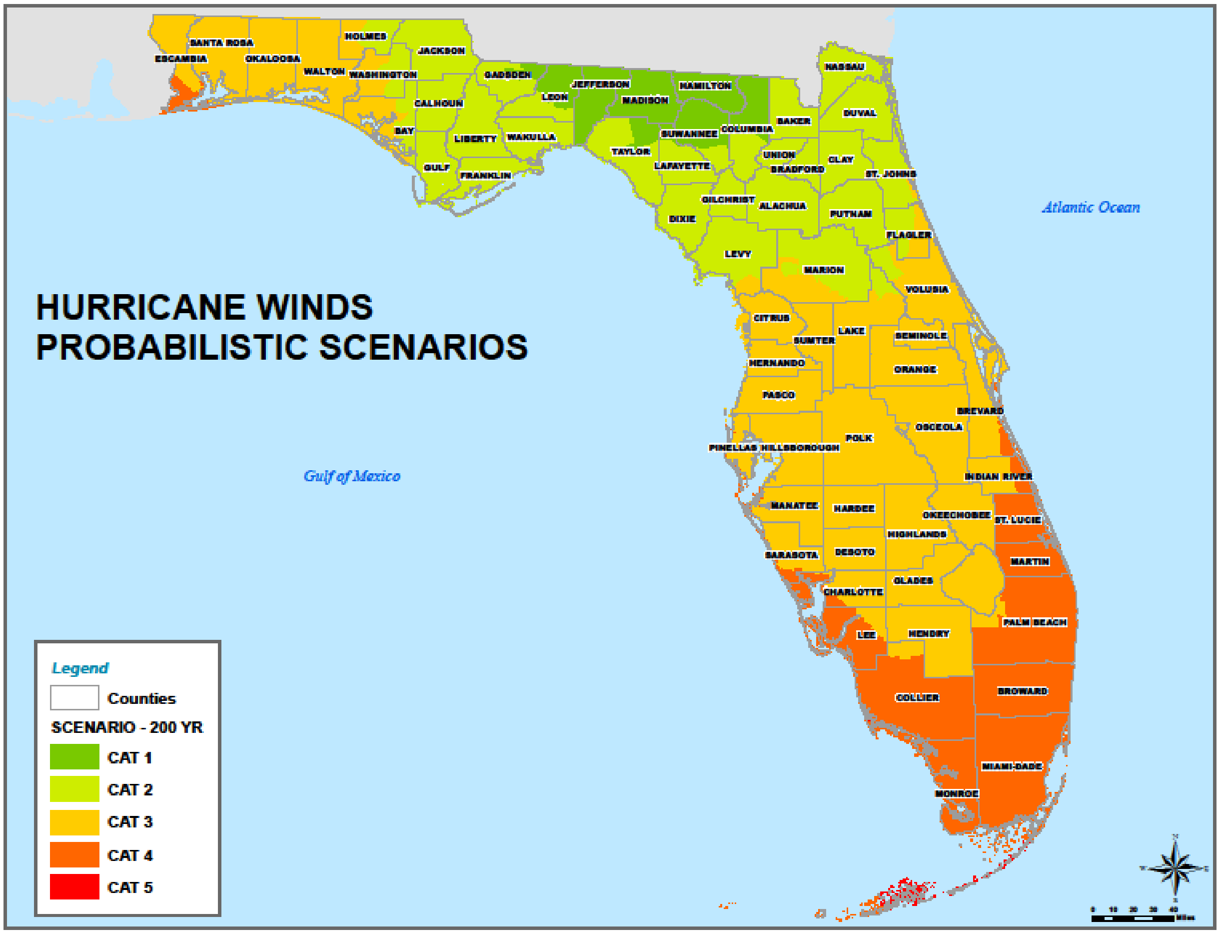
Figure 36: Hurricane Winds Probabilistic Scenario, 100-Year Return Period



This map is showing that it is likely that every 100 years, the area shaded in green will experience at least one Tropical Storm; the areas shaded lighter green will experience at least one Category 1 Hurricane; the areas shaded yellow-green will experience at least one Category 2 Hurricane; the areas shaded yellow-orange will experience at least one Category 3 Hurricane; and the area shaded orange will experience at least one Category 4 Hurricane.

Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* For this 100-year return period scenario, there are seventeen counties with less than 1,000 structures likely to be damaged, forty one counties with between 1,000 and 100,000 structures likely to be damaged, and nine counties with over 100,000 structures likely to be damaged. There are twenty-five counties with between one million and 100 million dollars of structural damage likely; eighteen counties with between 100 million and 1 billion dollars of structural damage likely, and twenty-four counties with between one billion and 100 billion dollars of structural damage likely.

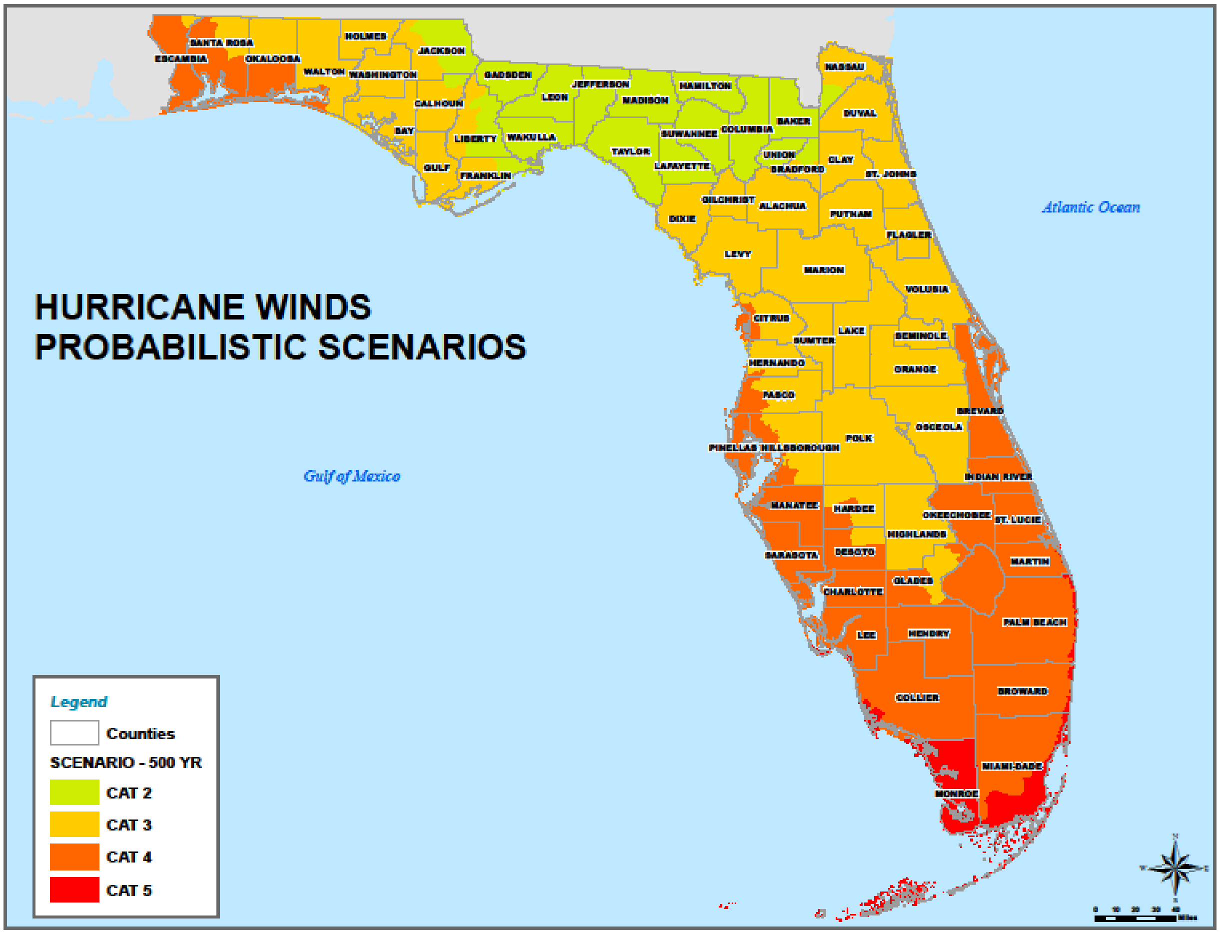
Figure 37: Hurricane Winds Probabilistic Scenario, 200-Year Return Period



This map is showing that it is likely that every 200 years, the area shaded in green will experience at least one Category 1 Hurricane; the areas shaded in yellow-green will experience at least one Category 2 Hurricane; the areas shaded in yellow-orange will experience at least one Category 3 Hurricane; the areas shaded in orange will experience at least one Category 4 Hurricane; and the areas shaded in red (in the Florida Keys) will experience at least one Category 5 Hurricane.

Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* For this 200-year return period scenario, there are eight counties with less than 1,000 structures likely to be damaged, 45 counties with between 1,000 and 100,000 structures likely to be damaged, and fourteen counties with more than 100,000 structures likely to be damaged. There are twenty-one counties with between one million and 100 million dollars of structural damage likely, fifteen counties with between 100 million and one billion dollars of structural damage likely, thirty counties with between one billion and 100 billion dollars of structural damage likely, and one county with over 100 billion dollars of structural damage likely.

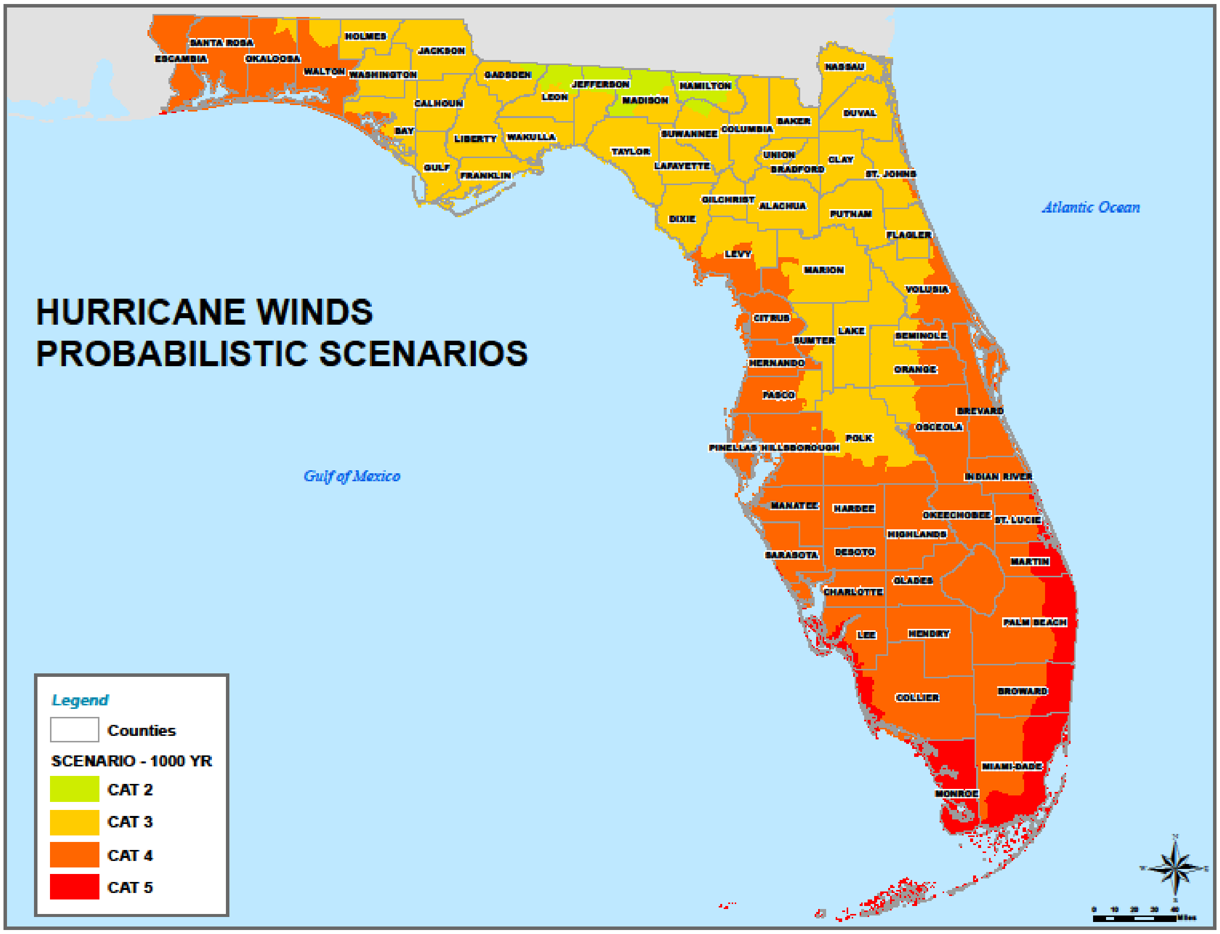
Figure 38: Hurricane Winds Probabilistic Scenario, 500-Year Return Period



This map is showing that it is likely that every 500 years, the areas shaded in yellow-green will experience at least one Category 2 Hurricane; the areas shaded in yellow-orange will experience at least one Category 3 Hurricane; the areas shaded in orange will experience at least one Category 4 Hurricane; and the areas shaded in red will experience at least one Category 5 Hurricane.

Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* For this 500-year return period scenario, there are four counties with less than 1,000 structures likely to be damaged, forty six counties with between 1,000 and 100,000 structures likely to be damaged, and seventeen counties with more than 100,000 structures likely to be damaged. Sixteen counties would have between one million and 100 million dollars of structural damage likely and another sixteen counties have between 100 million and 1 billion dollars of structural damage likely. Thirty-three counties would have between one billion and 100 billion dollars of structural damage likely and two counties would have over 100 billion dollars of structural damage likely.

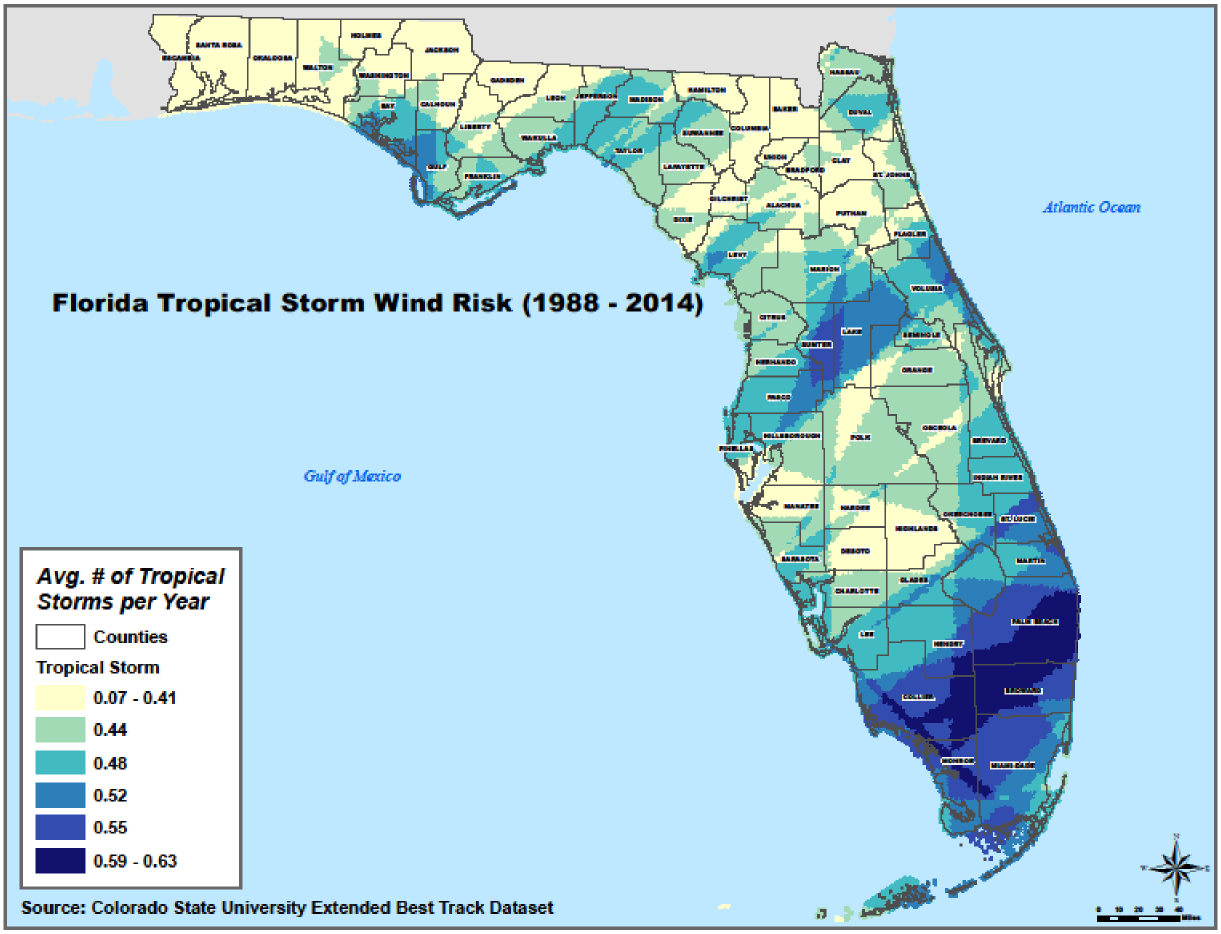
Figure 39: Hurricane Winds Probabilistic Scenario, 1000-Year Return Period



This map is showing that it is likely that every 1,000 years, the areas shaded yellow-green will experience at least one Category 2 Hurricane; the areas shaded in yellow-orange will experience at least one Category 3 Hurricane; the areas shaded orange will experience at least one Category 4 Hurricane; and the areas shaded in red will experience at least one Category 5 Hurricane.

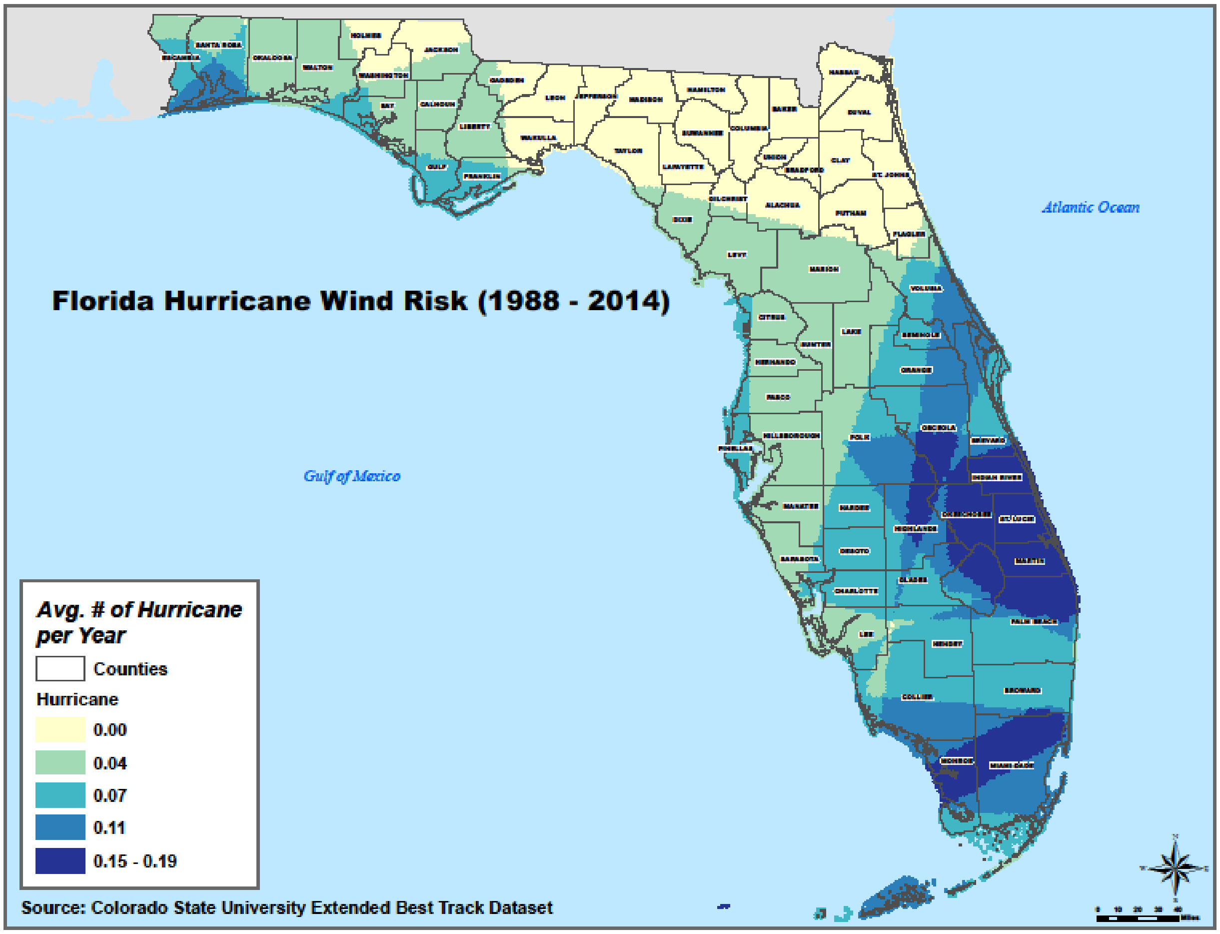
Tables with the Count and Value of structures within the shaded areas can be found in *Appendix E: Risk Assessment Tables.* For this 1,000-year return period scenario, there are forty-eight counties with less than 100,000 structures likely to be damaged and nineteen counties with over 100,000 structures likely to be damaged. There are nine counties with between one million and 100 million dollars of structural damage likely; eighteen counties with between 100 million and one billion dollars of structural damage likely; thirty-seven counties with between one billion and 100 billion dollars of structural damage likely; and three counties with over 100 billion dollars of structural damage likely.

Figure 40: Tropical Storm Wind Risk, Florida, 1988 – 2014



According to this data, south Florida is likely to experience between .48 and .63 tropical storms each year.

Figure 41: Hurricane Wind Risk, Florida, 1988 – 2014



According to this data, the western Panhandle and the peninsula of Florida are likely to experience between .04 and .19 hurricanes each year.

NCDC Average Number of Events

According to data from the NCDC Storm Event Database, and data from 2006 to 2016, Florida experiences an average of 1.27 tropical storms and .64 hurricanes each year. The data also included injury and death information and shows that it is likely that there will be .36 injuries and .73 deaths each year due to tropical storms and hurricanes.

Table 28: NCDC Tropical Storms and Hurricanes, Florida, 2006 – 2016

Type of Storm	NCDC Report	Average Events per year	Injuries	Average Injuries per year	Deaths	Average Deaths per year
Tropical Storm	14	1.27	4	0.36	6	0.55
Hurricane	7	0.64	0	0	2	0.18
Total	21	1.91	4	0.36	8	0.73

5. Tropical Cyclones Impact Analysis

- Public
    - Injury/death
        - Car accidents because of flood waters, high winds, panic, traffic jams because of evacuations, no power after storm
        - Not receiving emergency response during storm, like ambulance
        - Delayed emergency response because of blocked roads, etc.
        - Drowning in flood waters
        - Hit or crushed by debris
        - Stranded on roof because of flooding
        - Exposure to hazardous materials
        - Illness from contaminated water
        - Pet and other animal deaths from all of the above
    - Damage to home or property
        - Power loss or damage to power connections on home
        - Mold damage causing the need for expensive mold remediation actions
        - Cost to replace damaged and destroyed items, such as furniture, flooring, etc.
        - Cost and labor to repair damaged homes and other structures to make the house inhabitable
        - If the property was uninsured, the cost falls upon the property owner
        - Hotel room fees or having to live in a shelter until damage is repaired or home is replaced
        - Damaged or washed-away vehicles
        - Lost wages because no way to get to work if roads are blocked or if car was damaged in storm or if employer experienced damage
        - Possible forced to evacuate
            - Cost to travel
            - Cost to stay at hotel
            - Loss of wages if out of town
            - Loss of food if you can't go back to get it
    - Power outage

        - Cost of generators and gas to run the generators
            - Risk of accidental fire or carbon monoxide poisoning is high
        - Loss of food in refrigerator and freezer
        - Difficulties travelling anywhere because of outages at traffic lights
        - Cost of purchasing disaster supplies such as flashlights
        - Hotel room fees or having to live in a shelter until power is restored
        - Lost wages because employer is experiencing power outage
    - Emotional or psychological toll of surviving
        - If a friend or family member dies in storm individual may feel great sense of guilt or stress
        - If major damage occurs for an individual, they will likely experience stress and anxiety dealing with evacuating, staying in shelters, working to get insurance payments, working to get government assistance, etc.
        - Being forced to leave or forfeit a pet in an unsafe area during or after a tropical cyclone
- <u>Responders</u>
    - Injury/death
        - Responding during tropical storms is unsafe
        - Responding immediately after tropical storms is unsafe because of debris, unstable transportation infrastructure, unstable structures
        - Rescuing people from unstable buildings or by boat
        - Exposure to hazardous materials
    - Stress caused by severity of tasks such as rescuing people
    - Feelings of guilt for not being able to save people
    - Witnessing gruesome scenes of injured or dead
- <u>Continuity of Operations (including continued delivery of services)</u>
    - Loss of revenue if businesses cannot operate during or after event
    - Loss of wages if your employer's organization is damaged or destroyed and you cannot work
    - Utility failures such as electric or gas may prevent businesses from opening even if there is no damage
    - Utility failures may impede or prevent government offices from continuing daily services
    - Severe damage and interruption to transportation systems and infrastructure like roads and bridges; communication systems; power; water; wastewater; etc.
- <u>Property, Facilities, Infrastructure</u>
    - Damaged or destroyed property, such as homes and other buildings
        - Roofing is particularly susceptible to damage from high winds
        - The first floor of many buildings, plus all the items on that floor, are susceptible to severe damage from flooding
    - Cost of repairing damage to property such as buildings

  - Cost of replacing items damaged such as furniture on the first floor of a flooded home
  - Crop damage or loss
  - Damage to transportation infrastructure, like a road being washed out or a bridge collapsing and/or closure of major transportation networks
  - Inability to get clean water
  - Inability to control wastewater
  - Release of hazardous materials
- Environment
  - Beach and dune erosion
  - Downed trees
  - Eroded river banks
  - Release of hazardous materials can contaminate or damage the environment
  - Loss or damage to habitat for animals because of flooding or high winds
  - Crop damage or loss
  - Event generated marine debris impacting waterway navigation and submerged wetland habitats
- Economic Condition
  - Damaged and destroyed businesses leading to long-term closures and possibly permanent closures
  - Delayed re-opening of businesses because of utility issues, road blockages, etc.
  - Crop damage or loss from flooding and high winds
  - Absenteeism from work
  - Loss of tourism because of eroded beaches or damaged attractions
- Public Confidence in Jurisdiction's Governance
  - Evacuations not ordered in time lead to decrease in public confidence
  - Shelters not opened or having little information
  - Warnings not communicated effectively
  - Communicating too much
  - Over exaggeration of possible storm impacts, especially if the storm doesn't have expected impacts

6. 2018 LMS Integration of Tropical Cyclones

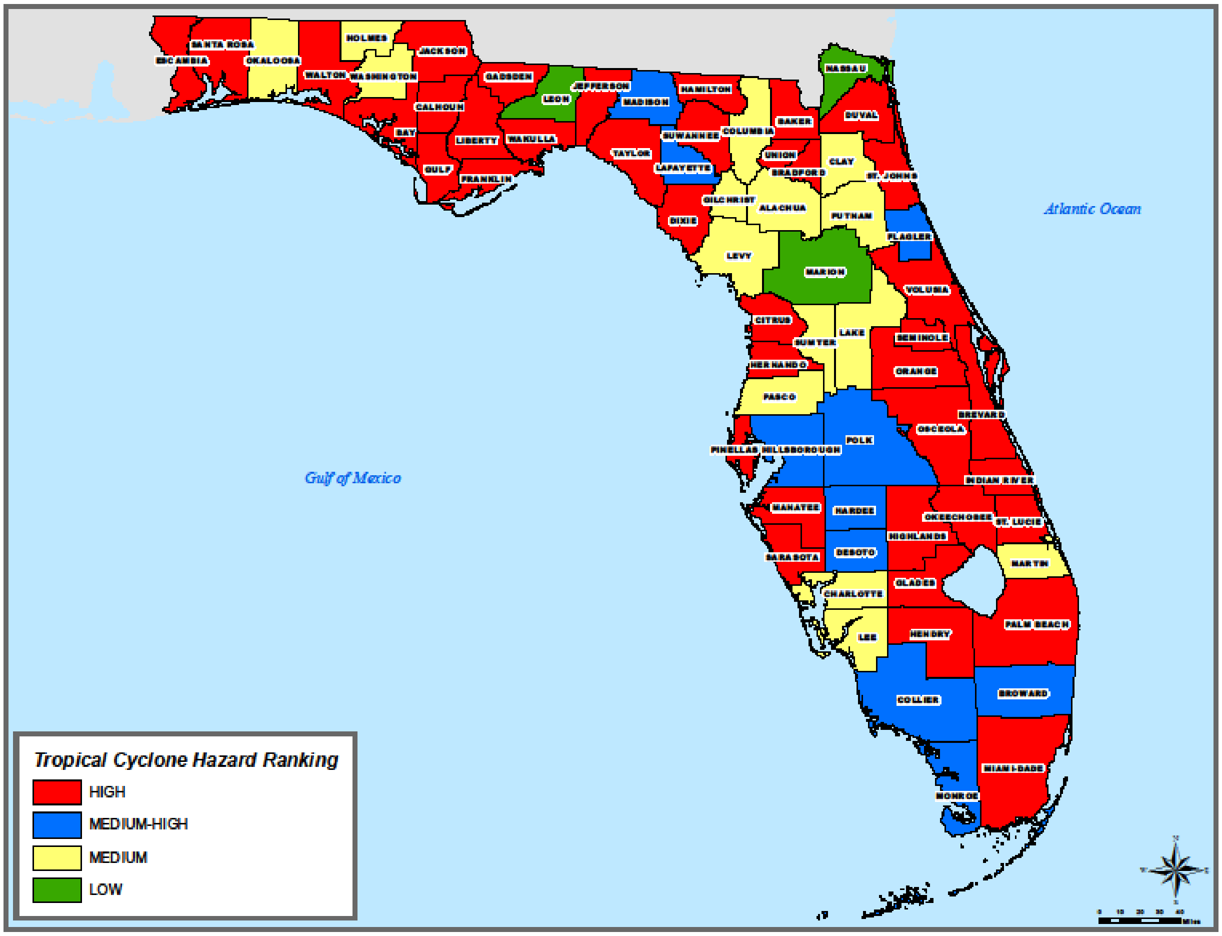
An analysis of all 67 Florida County LMS Plans and their individual tropical cyclone hazard rankings is shown below. All counties identified tropical cyclones (or something similar such as tropical storms or hurricanes) as a hazard.

Tropical Cyclones/ Hurricanes

Based on the LMS plans, Figure 3.38 displays the jurisdictional rankings for the tropical cyclone/hurricane hazard. All counties have identified tropical cyclones/hurricanes as one of their hazards.

- High-risk Jurisdictions: 39
- Medium-High-risk Jurisdictions: 10
- Medium-risk Jurisdictions: 15
- Low-risk Jurisdictions: 3
- Not identified Jurisdictions: 0

Figure 42: Tropical Cyclones Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

Due to Florida's geographic location, the entire state is vulnerable to damage from tropical cyclones. The southern tip of the peninsula and the Florida Keys are especially vulnerable due to exposure and the high population.

As the population of Florida increases, so too does the number of those who have not experienced the impact of a tropical cyclone or major hurricane. Approximately 33 percent of the total state population lives within 20 miles of the coast. The proximity of the Atlantic Ocean or the Gulf of Mexico, coupled with the generally low coastal elevations and the fact that 75 percent of the state's population resides in the 35 coastal counties, makes Florida very vulnerable to tropical cyclones.

Of the state's 67 counties, 35 have coastlines bordering either the Atlantic Ocean or the Gulf of Mexico. These counties comprise approximately 1,350 miles of general coastline. When considering the intricacies of the Florida coastline, with bays, inlets, and waterways, there is over 8000 miles of coastline.

Between 1906 and 2016, 28 major (Category 3 or higher) hurricanes affected the state. In that timeframe, 68 major hurricanes have made landfall within the state, with the majority being Category 1 hurricanes. Generally, the lower intensity hurricanes have made landfall in the northwest portion of the state.

The vulnerability of the state to hurricanes varies with the progression of the hurricane season. Early and late in the season (June and October), the region of maximum hurricane activity is in the Gulf of Mexico and the western Caribbean. Most of those systems that move into Florida approach the state from the south or southwest, entering the keys or along the west coast. Mid-season (August and most of September), tropical cyclones develop off the coast of Africa. These systems are known as Cape Verde Storms and approach the state from the east or southeast.

Storm Surge

Below is a table showing the population that resides in the areas that would be impacted by storm surge coastal flooding due to a Category 2 and Category 5 Hurricane. This analysis was based on the Sea, Lake and Overland Surge from Hurricanes (SLOSH) maps, flood depth grids from the State Regional Evacuation Studies, and census block data. Counties not at risk to storm surge have been omitted from the analysis.

Table 29: Coastal Flood Hazard in Category 2 Hurricane and Category 5 Hurricane Storm Surge, Population

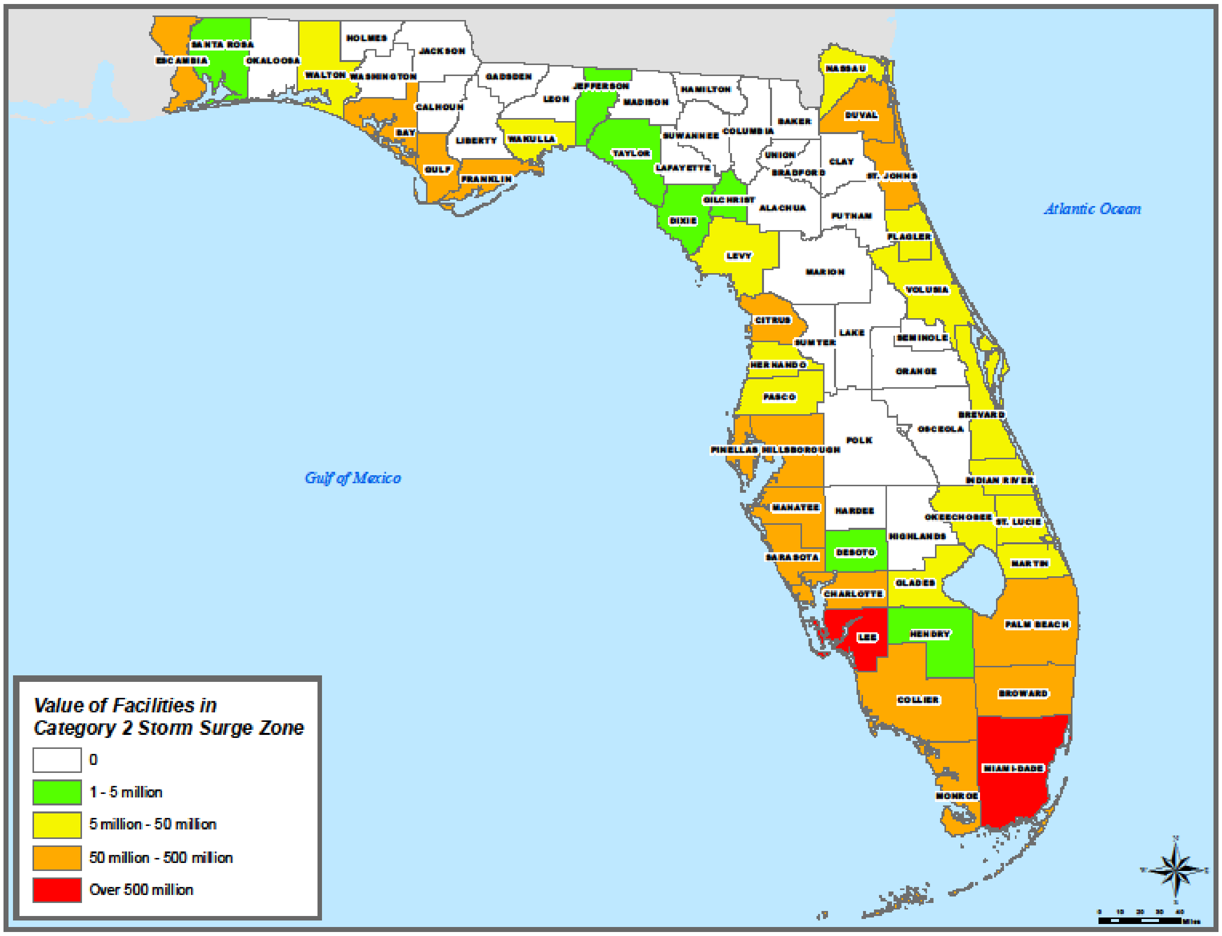
Population in Coastal Flood Hazard (storm surge)		
COUNTY	**CATEGORY 2**	**CATEGORY 5**
Bay	7,105	30,851
Brevard	17,178	144,575
Broward	29,157	204,988
Charlotte	99,047	154,345
Citrus	26,647	36,122
Clay	10,838	42,009
Collier	141,908	292,653
DeSoto	536	4,645
Dixie	1,679	7,267
Duval	55,063	295,720
Escambia	6,982	34,849
Flagler	16,095	30,936
Franklin	2,396	10,614
Gilchrist	132	1,246

Glades	1,236	6,435
Gulf	1,163	7,206
Hendry	2,009	4,312
Hernando	4,386	39,364
Highlands	14	60
Hillsborough	186,769	471,028
Indian River	12,841	33,620
Jefferson	1	241
Lafayette	0	27
Lee	297,359	547,803
Leon	0	5,855
Levy	3,452	6,791
Liberty	7	44
Manatee	57,253	234,414
Marion	0	75
Martin	9,355	50,238
Miami-Dade	272,382	1,454,072
Monroe	56,294	65,930
Nassau	12,929	41,801
Okaloosa	2,963	36,353
Okeechobee	2,456	3,305
Palm Beach	11,499	71,894
Pasco	66,804	192,971
Pinellas	280,349	569,882
Putnam	3,665	7,421
St. Johns	52,035	105,614
St. Lucie	6,564	27,085
Santa Rosa	5,364	26,038
Sarasota	58,315	257,964
Taylor	1,499	6,922
Volusia	59,082	198,437
Wakulla	3,950	26,840
Walton	1,318	12,060
Washington	3	39
TOTAL	1,888,079	5,802,961

According to this data, there are five counties with over 100,000 people living in the storm surge zone of a Category 2 Hurricane. These counties are Collier, Hillsborough, Lee, Miami-Dade, and Pinellas. Furthermore, there are fourteen counties with over 100,000 people living in the storm surge zone of a Category 5 hurricane. These counties are Brevard, Broward, Charlotte, Collier, Duval, Hillsborough, Lee, Manatee, Miami-Dade, Pasco, Pinellas, St. Johns, Sarasota, and Volusia. Notably, Miami-Dade County has the highest population in the Category 5 storm surge zone, with 1.4 million people.

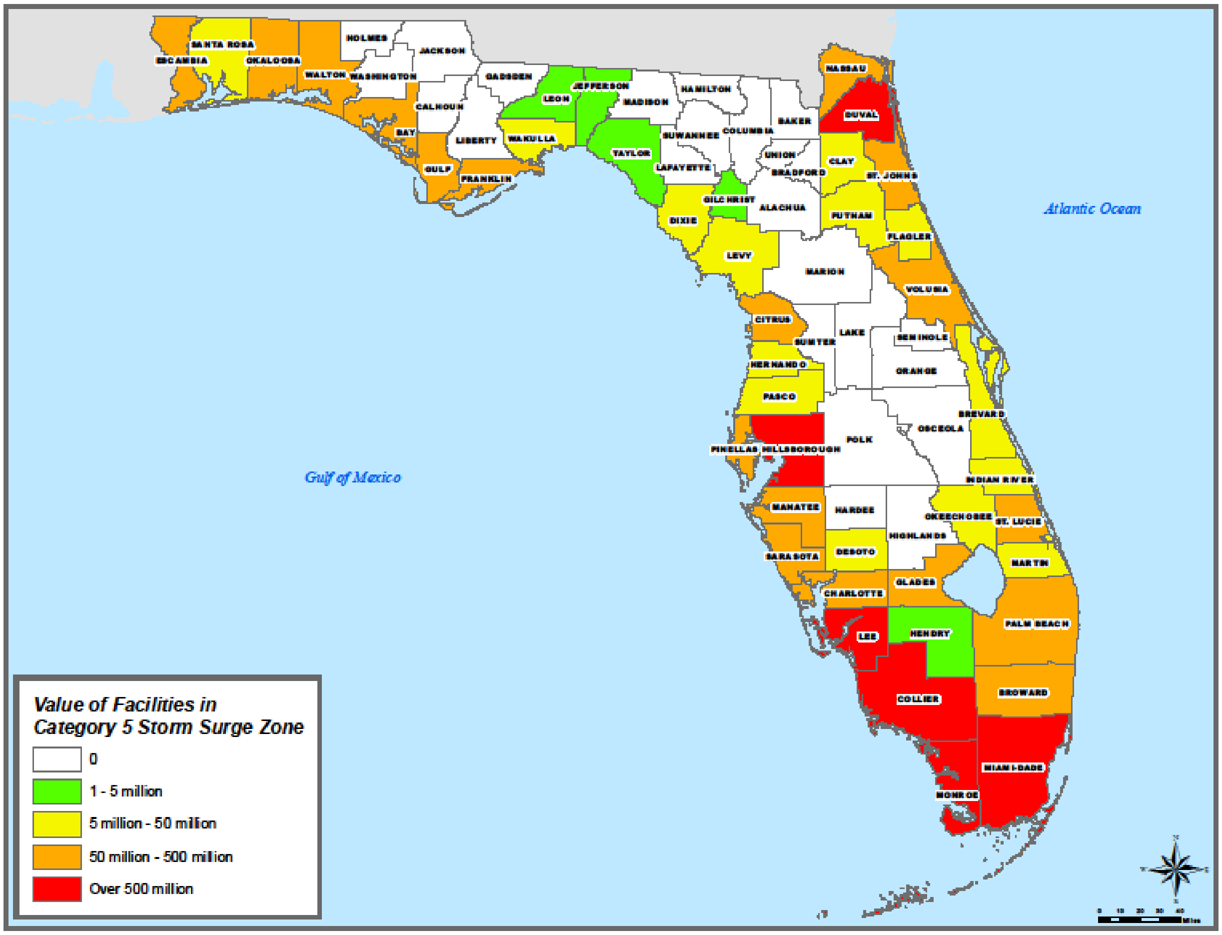
Below are maps showing the total number and total value of county facilities in the storm surge zones of a Category 2 and Category 5 hurricane. Tables detailing this data can also be found in *Appendix E: Risk Assessment Tables.*

Figure 43: Value of Facilities in Category 2 Storm Surge Zone



According to this data, Lee and Miami-Dade counties would have over $500 million of facilities in the storm surge zone for a Category 2 hurricane.

Figure 44: Value of Facilities in Category 5 Storm Surge Zone



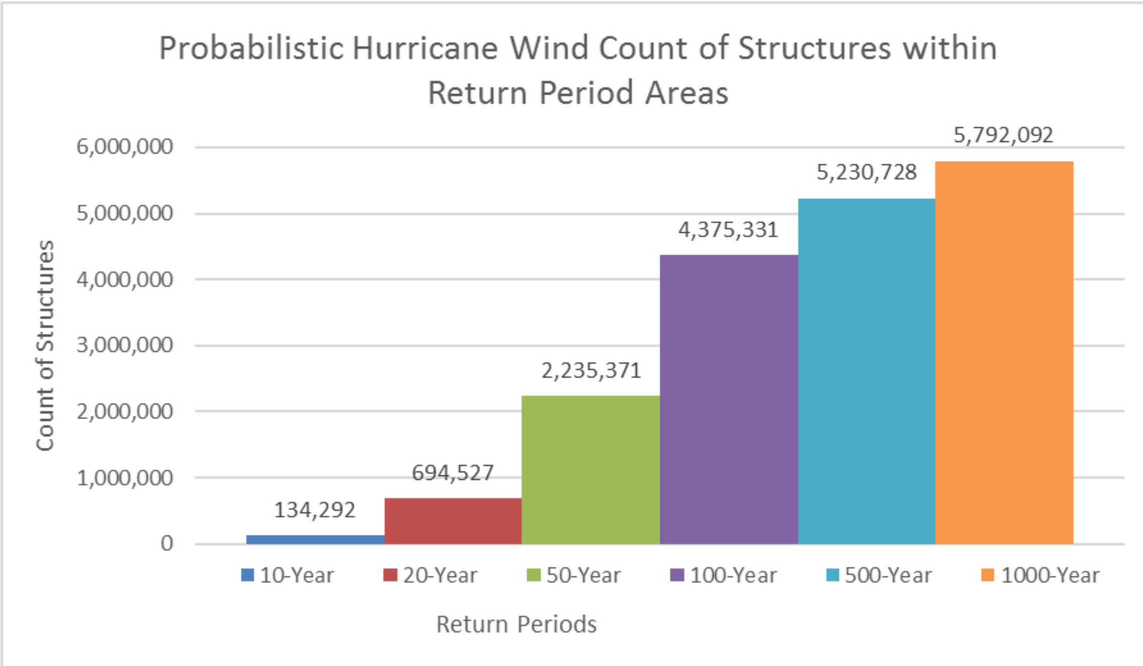
There are more counties with facilities in the Category 5 storm surge zone and the value of those facilities are much higher than the value of those in the Category 2 storm surge zone. There are six counties with over $500 million worth of facilities in the Category 5 storm surge zone. Notably, Lee and Miami-Dade counties each have over $1 billion worth of facilities within the Category 5 storm surge zone.

Wind

The vulnerability to Hurricane Winds is shown above in the Probability section. This analysis also depicts the areas that would be vulnerable to hurricane winds for various return periods. The Loss Estimation, by Jurisdiction, is shown in the bar chart below and is referencing those maps shown in the Probability section.

The loss estimation discussion below is based on tables that can be found in *Appendix E: Risk Assessment Tables.* Those tables include the information below, separated by county.

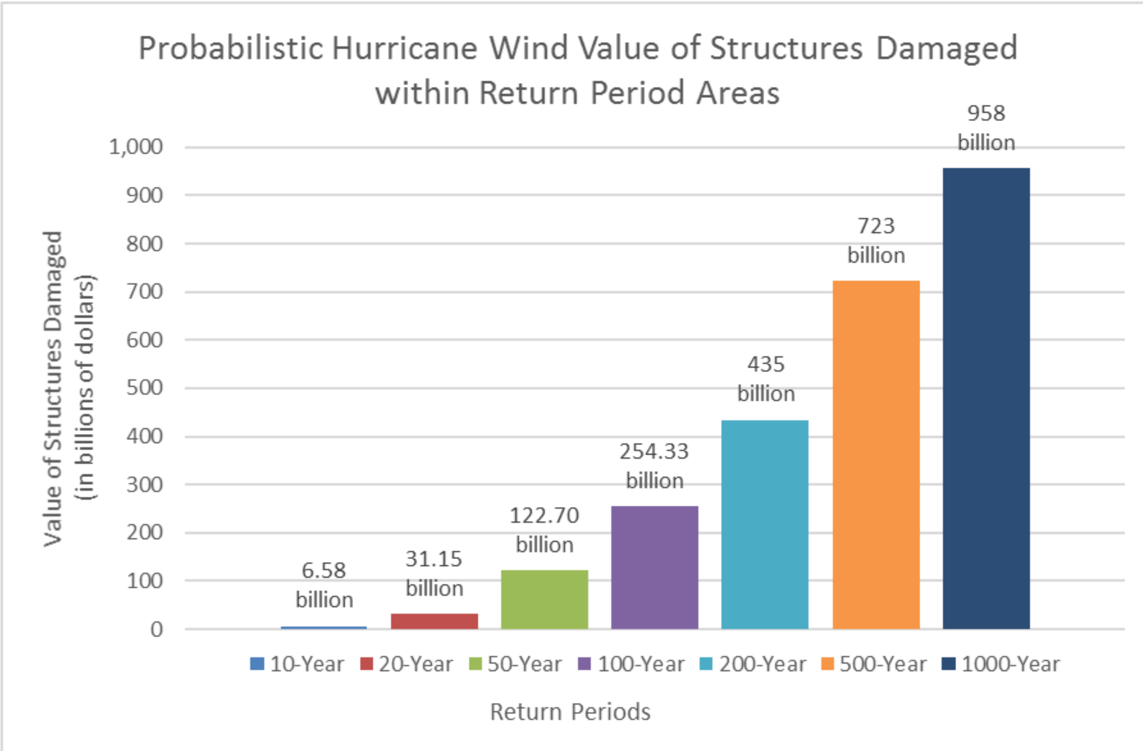
Figure 45: Probabilistic Hurricane Wind Count of Structures, Return Period Areas



According to the data, there are 134,292 structures within the 10-year return period for hurricane winds. The 50-year return period data shows that there are 2.2 million structures in that area, a significant increase from the structures vulnerable to the hurricane winds in the 10-year return period scenario.

Below is a bar chart showing the value of structures that would be damaged due to hurricane winds, in specific areas based on return periods.

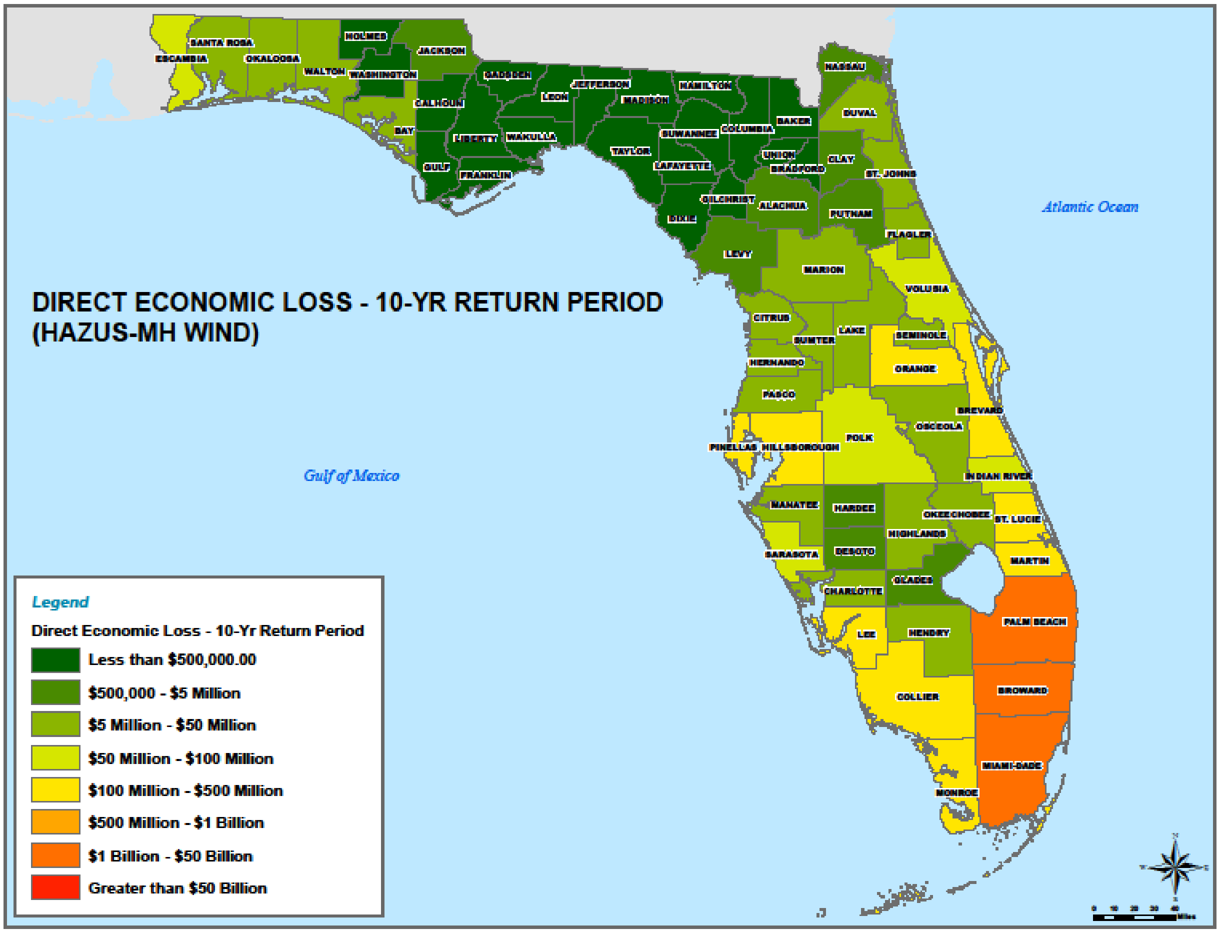
Figure 46: Probabilistic Hurricane Wind Value of Structures Damaged, Return Period Areas



This shows that while the value of structures that would be damaged from hurricane winds in the 10-year return period area is $6.58 billion that number increases exponentially to $958 billion in the 1000-year return period area.

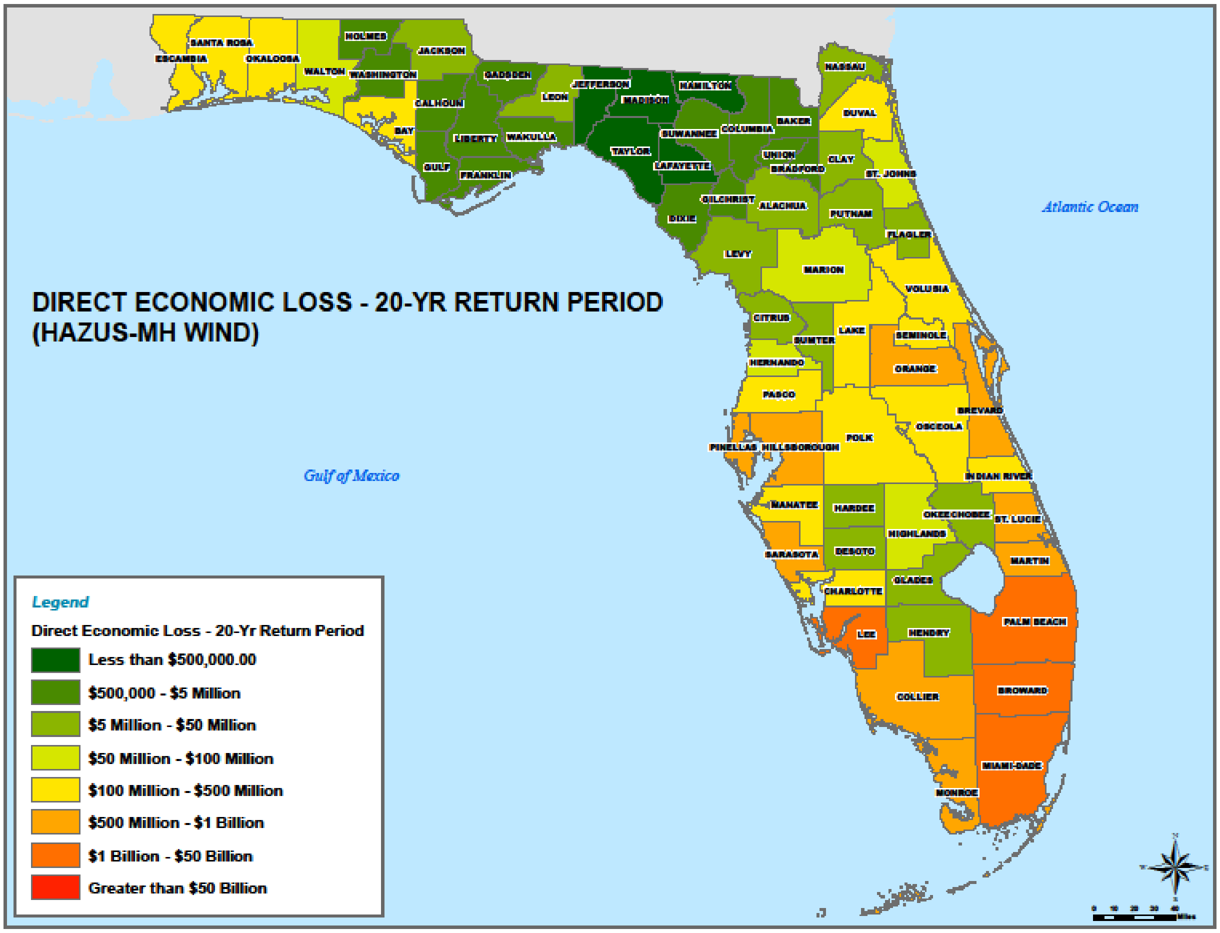
The maps below reflect the Economic Loss for Buildings by County and Return Period derived from the HAZUS-MH Wind model. Direct Economic Loss refers to a value from HAZUS-MH, which is the sum of the capital stock losses and the income losses. The capital stock losses include the cost building damage, the cost contents damage, and the inventory loss. The income losses include the cost of relocation, the capital related loss value, the wages lost, and the rental income lost. Tables detailing this data can be found in *Appendix E: Risk Assessment Tables*.

Figure 47: Direct Economic Loss, 10-Year Return Period



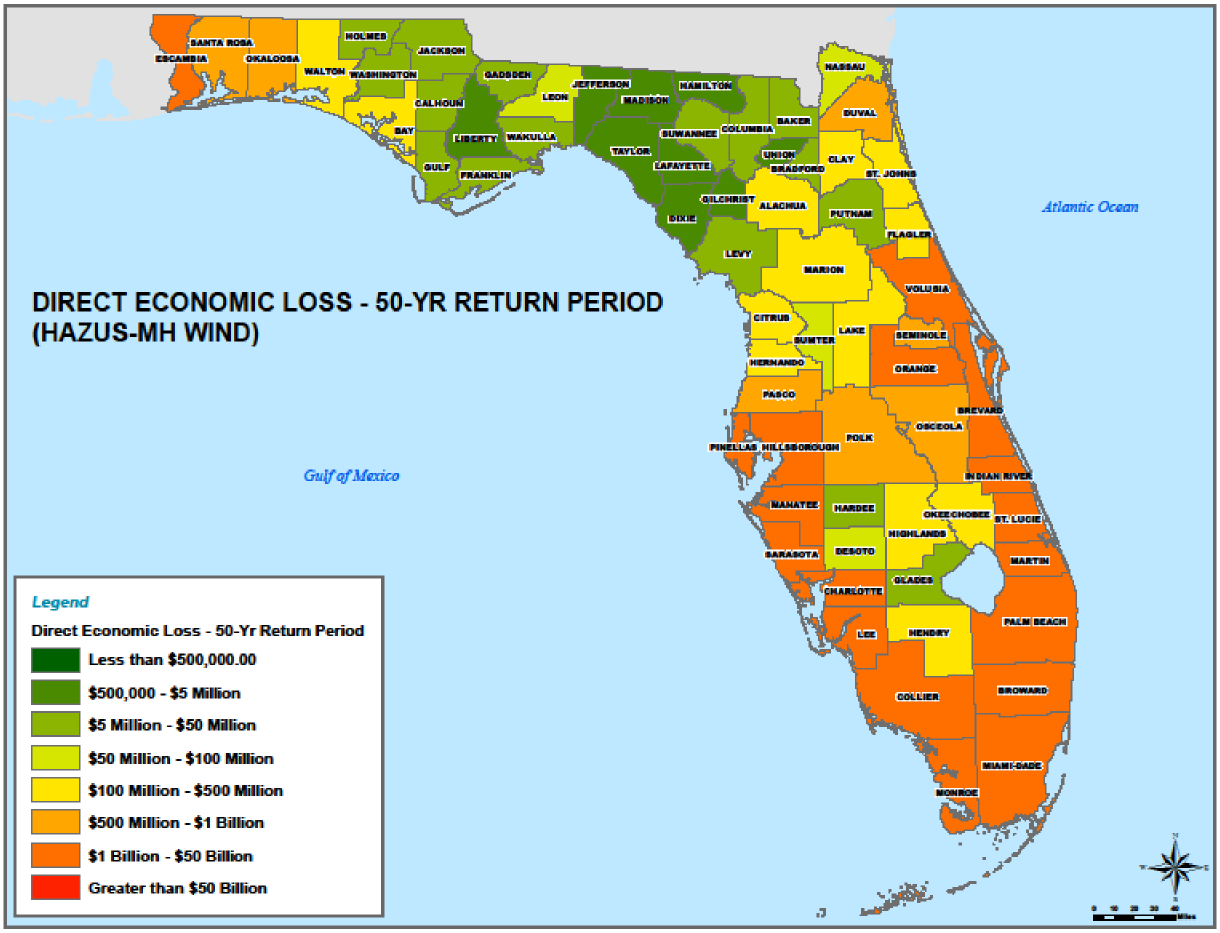
According to the HAZUS-MH data, there are three counties, Palm Beach, Broward, and Miami-Dade, which would sustain between $500 million and $1 billion worth of damage due to tropical storm and Category 1 winds in the 10-year return period (see map above). Most counties in the state would sustain less than $50 million in damages in this return period scenario.

Figure 48: Direct Economic Loss, 20-Year Return Period



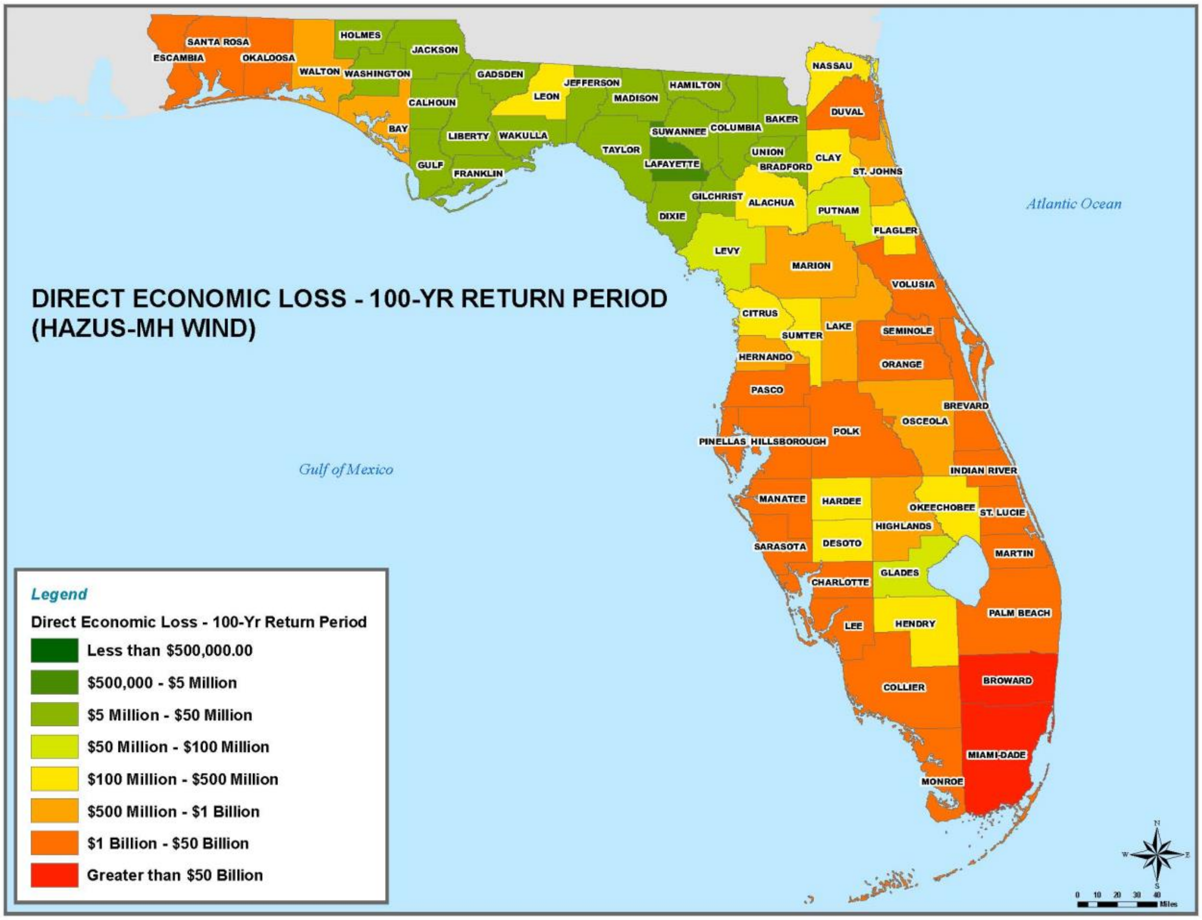
According to HAZUS-MH, there are four counties, Palm Beach, Broward, Miami-Dade, and Lee, which would sustain between $1 billion and $50 billion of damage due to tropical storm and Category 1 and 2 winds, as shown in the probabilistic wind 20-year return period map above. Several more counties would experience higher damage amounts, such as some of the western Florida and central Florida counties that would experience between $100 million and $500 million in damages.

Figure 49: Direct Economic Loss, 50-Year Return Period



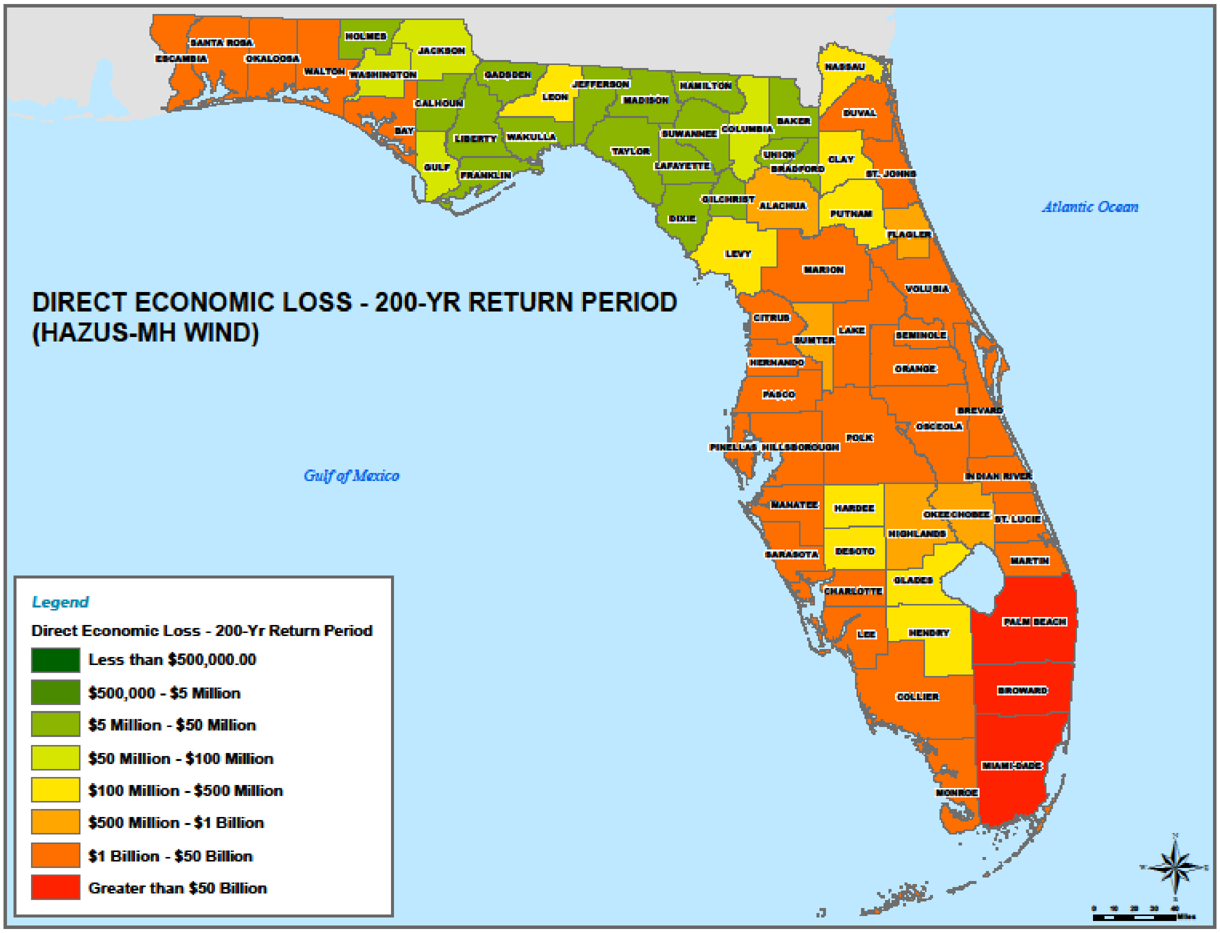
This map shows that in the 50-year return period, with between tropical storm winds and Category 4 winds likely, there would be significantly more damage likely. Most peninsula coastal counties would experience between $1 billion and $50 billion in damages.

Figure 50: Direct Economic Loss, 100-Year Return Period



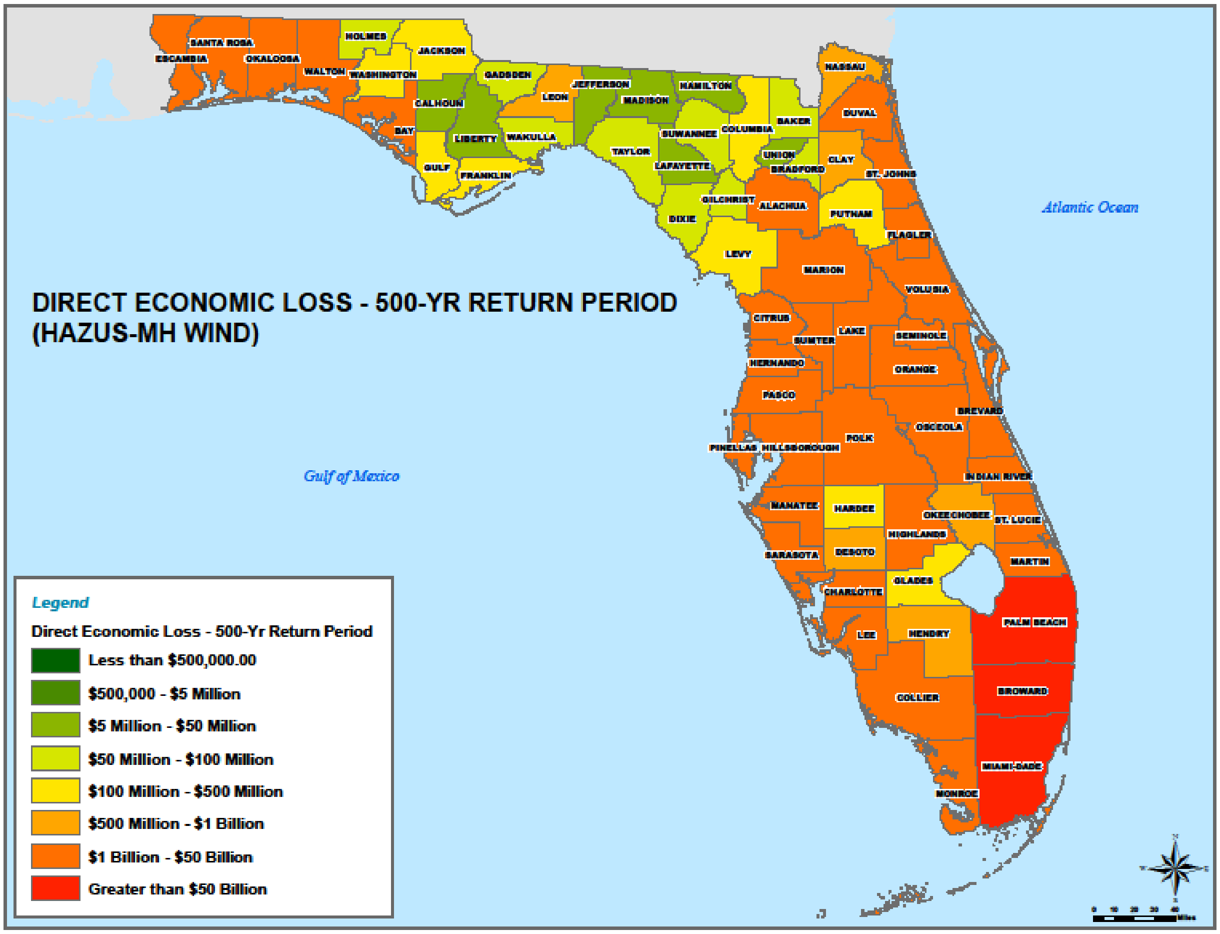
The 100-year return period for probabilistic wind shows that winds between tropical storm and Category 4 would be expected, but stronger winds would affect more areas of the state than in the 50-year return period. This map shows that a significant portion of the state would sustain between $1 billion and $50 billion of damages. Broward and Miami-Dade counties would experience the most damage, over $50 billion.

Figure 51: Direct Economic Loss, 200-Year Return Period



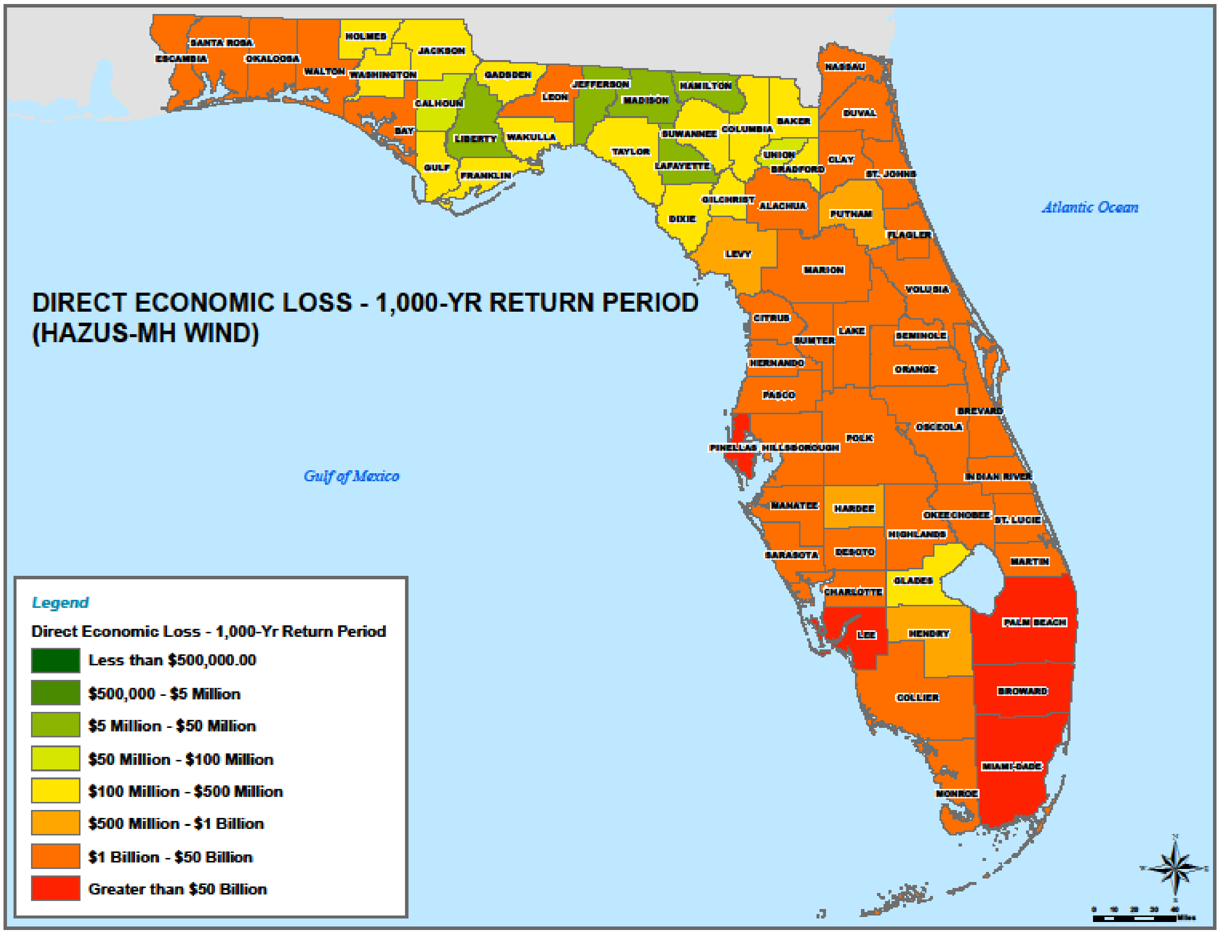
The 200-year return period winds would likely be between Category 1 and Category 5. Again, there is an increase in the number of counties that would sustain between $1 billion and $50 billion in damages and there are three counties, Palm Beach, Broward, and Miami-Dade, that would sustain over $50 billion in damages.

Figure 52: Direct Economic Loss, 500-Year Return Period



More counties would reach between $1 billion and $50 billion in damages due to most of the state experiencing Category 3 and 4 winds in the 500-year return period scenario. Again, Palm Beach, Broward, and Miami-Dade counties would sustain over $50 billion in damages.

Figure 53: Direct Economic Loss, 1000-Year Return Period



In the 1000-year return period, most of the state would experience Category 3 and 4 winds, with portions of coastal south Florida experiencing Category 5 winds. Therefore, most of the state would experience between $1 billion and $50 billion in damages, with Palm Beach, Broward, Miami-Dade, and Lee counties experiencing more than $50 billion in damages.

Data from the NCDC provides details about the historical hurricanes and tropical storms that have affected the state. The table below shows a breakdown of the types of tropical cyclones and associated annualized losses that have occurred in Florida from 2006 to 2016. There is also information in this table about the number of injuries and deaths from tropical cyclones in Florida.

Table 30: Tropical Cyclones Annualized Losses, 2006-2016[64]

Type of Storm	NCDC Reports	Annualized Property Loss
Tropical Storm	14	$6,482,920
Hurricane	7	$214,836,200
Total	21	$221,319,120

According to the NCDC Storm Events Database, the property losses due to hurricanes or tropical storms would be about $2.2 million each year.

Overall, all counties in Florida are vulnerable to at least some damage from tropical cyclones. Urban counties in south Florida are particularly vulnerable to damage from storm surge and hurricane force winds due to high populations, many structures and facilities, and the high probability that a tropical cyclone will impact that area.

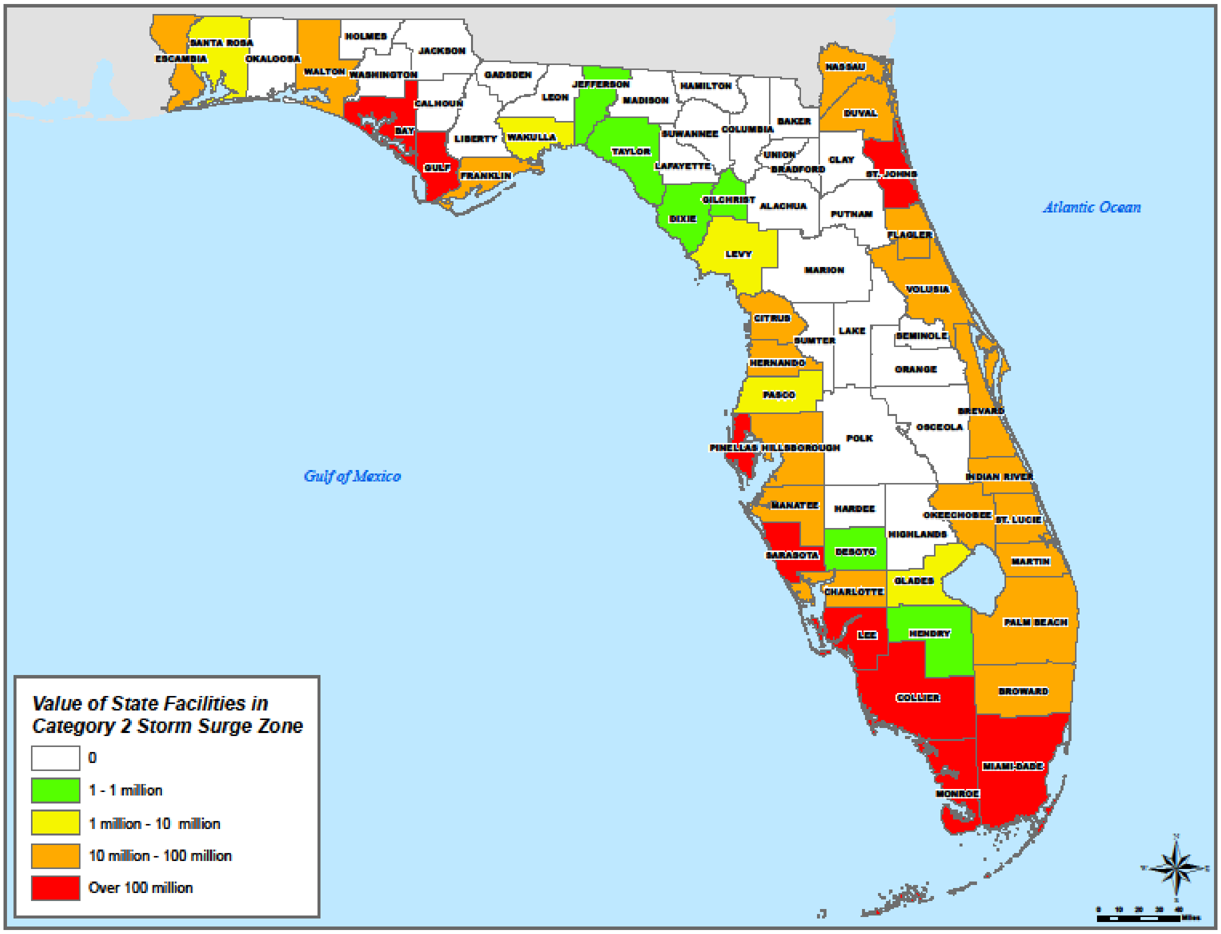
8. Vulnerability Analysis and Loss Estimation, of State Facilities

Since all counties within Florida are vulnerable to the effects of tropical cyclones, all of the 20,231 state-owned facilities and their insured values are vulnerable to potentially damaging storm surge and hurricane force winds.

Below are maps showing value of state-owned facilities at risk to damage from Category 2 and 5 Storm Surge.

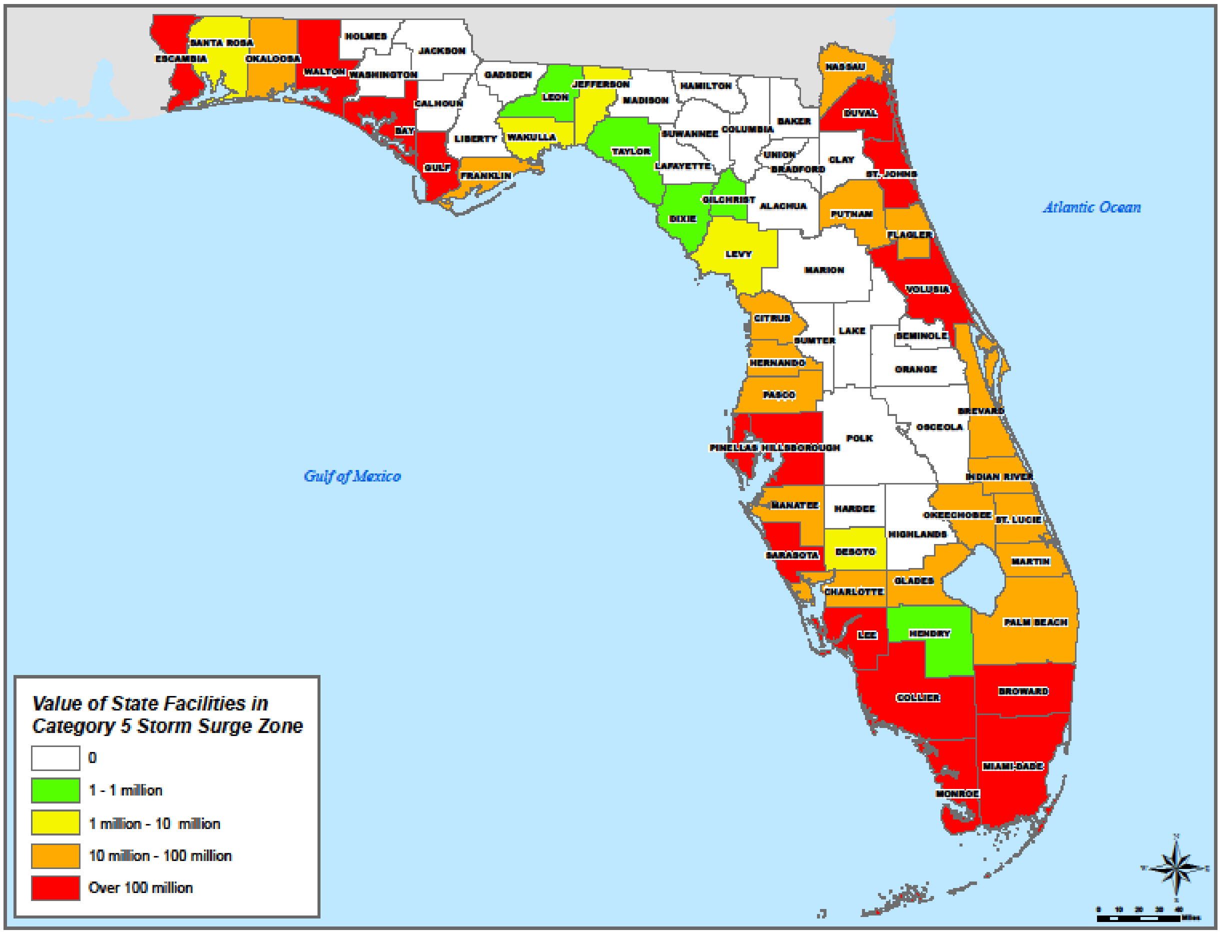
64 https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Hurricane+%28Typhoon%29&eventType=%28Z%29+Tropical+Storm&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2006&endDate_mm=12&endDate_dd=31&endDate_yyyy=2016&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Figure 54: Value of State Facilities in Category 2 Storm Surge Zone



From this map, it is clear to see that south Florida counties, such as Miami-Dade, Monroe, Collier, Lee, Sarasota, and Pinellas and various other counties, namely Bay, Gulf, and St. Johns are estimated to have losses over 100 million dollars due to Category 2 Storm Surge flooding.

Figure 55: Value of State Facilities in Category 5 Storm Surge Zone



This map shows that more counties would have estimated losses over 100 million dollars. These counties include Broward, Miami-Dade, Monroe, Collier, Lee, Sarasota, Pinellas, Hillsborough, Volusia, St. Johns, Duval, Gulf, Bay, Walton, and Escambia.

According to this analysis, $2.2 billion in state-owned facilities are at risk to damage due to Category 2 Storm Surge flooding and $4.9 billion in state-owned facilities are at risk to damage due to Category 5 Storm Surge flooding.

While all state facilities are vulnerable to tropical cyclones, it is clear that there are coastal counties with significant numbers and values of state facilities within category 2 and 5 storm surge zones.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 13.

TROPICAL CYCLONE					Overall Vulnerability
Overview					
A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has a closed low-level circulation. These storms have been known to transform into tropical storms and even hurricanes. Florida is at risk of experiencing a tropical cyclone due to its tropical climate and vicinity to large bodies of water. There are chances of the effects reaching all parts of the state but, due to high levels of development and concentrated numbers of civilians, the coastlines are vulnerable to greater impacts					HIGH
Frequency	Probability	Magnitude			
		Injuries/Deaths	Infrastructure	Environment	
Likely	Likely	High	High	High	

Severe Storm Hazard Profile

1. Severe Storms Description

In this profile, Severe Storms refers to thunderstorms.

Florida is considered the thunderstorm capital of the United States. A thunderstorm forms when moist, unstable air is lifted vertically into the atmosphere. The lifting of this air results in condensation and the release of latent heat. The process to initiate vertical lifting can be caused by:

- Unequal warming of the surface of the Earth;
- Orographic lifting due to topographic obstruction of airflow; or
- Dynamic lifting because of the presence of a frontal zone.

A typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Despite their small size, all thunderstorms are dangerous. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe.

The three key elements of a thunderstorm are wind, water, and lightning. The National Weather Service (NWS) considers a thunderstorm severe if it produces hail at least one inch in diameter, winds of 58 mph or stronger, or a tornado.

Thunderstorms also vary in type, depending on size and organization. Below are the different types of thunderstorms:[65]

- Ordinary cell thunderstorms only have one cell. These storms may also be referred to as single cell thunderstorms or pulse thunderstorms.
- Multi-cell cluster thunderstorms are organized in clusters of two to four short lived cells.
- Multi-cell line thunderstorms form in a line that extends, sometimes for hundreds of miles and can persist for hours. These are called squall lines and they can be continuous or include contiguous precipitation.
    - Long-lived squall lines are called derechos and can cause severe damage with fast straight line winds.
- Supercell thunderstorms are very dangerous storms with long-lived strong tornadoes and damaging wind, hail, and flash floods.

Lightning

Lightning is a rapid discharge of electricity in the atmosphere between clouds, the air, or the ground. Thunder is the sound of this rapid discharge and can be heard up to 25 miles away. Lightning tends to

[65] http://climatecenter.fsu.edu/topics/thunderstorms

strike tall objects such as trees, but can also strike in an open field. Thunderstorms always include lightning because lightning is what causes the sound of thunder.[66]

Flash Floods

Flash floods are caused by intense large amount of rainfall in a short period. Because of this, flash floods often occur during slow moving thunderstorms. Other factors, such as the topography of the area, the soil conditions, and the ground cover can also affect flash flooding. For example, if the ground is already waterlogged, new rainfall cannot filter into the ground and has no place to go, causing a flood.

As stated in the Flood Hazard Profile, flash flooding is a significant concern because of the rapid onset, the high water velocity, the debris load, and the potential for channel scour. In addition, more than one flood crest may result from a series of fast moving storms. Sudden destruction of structures and the washout of access routes may result in the loss of life. Furthermore, the rapid urbanization within the state of Florida has manifested itself in the form of increased impervious surface areas which leads to less natural drainage and more flash flooding.

Hail

Hail is frozen precipitation that can occur during a thunderstorm. Hail forms when raindrops freeze into balls of ice and usually range in size from 1/4 inch in diameter to 4 1/2 inches in diameter. Damage from hail increases with the size of the hail and can cause damage to vehicles, aircraft, and homes, and can be fatal to people and livestock. However, Florida thunderstorms do not often include hail because the hailstones usually melt before they reach the ground because of the generally warm temperatures in the state.[67]

Straight-line winds

Severe Storms often include strong winds that are called “straight-line” winds and are different than the winds in tornadoes. These damaging winds exceed 50-60 mph and can reach up to 100 mph. Damage from these winds is more common than damage form tornadoes in the continental US. Straight line winds form as a result of outflow from a thunderstorm downdraft.[68]

Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. Tornado wind speed normally ranges from 65 mph to over 200 mph. The maximum winds in tornadoes are often confined to extremely small areas and vary tremendously over very short distances, even within the funnel itself. Additionally, these storms typically travel around 10 to 20 mph, but can move at more than 60 mph. Tornadoes can occur at any time of the year and at any time of day.

[66] http://www.nssl.noaa.gov/education/svrwx101/lightning/
[67] http://www.nssl.noaa.gov/education/svrwx101/hail/
[68] http://www.nssl.noaa.gov/education/svrwx101/wind/

Tornadoes develop under three scenarios: (1) along or ahead of a squall line ahead of an advancing cold front moving from the north; (2) in connection with thunderstorm squall lines during hot, humid weather; and (3) within a tropical cyclone.

The most common, and often the most dangerous, tornadoes come from a supercell thunderstorm. Non-supercell tornadoes form because of spinning air already near the ground, caused by wind shear. These include a gustnado, a whirl of debris with no condensation funnel; a landspout, a narrow condensation funnel that develops while the thunderstorm is still growing; and a waterspout, a landspout that occurs over water.

Florida has two tornado seasons, the spring and summer. The deadly spring season is from February through April, and is characterized by powerful tornadoes associated with squall lines. The summer tornado season runs from June until September and has the highest frequencies of storm generation, with usual intensities of EF0 or EF1 on the Enhanced Fujita Scale. This includes those tornadoes associated with land-falling tropical cyclones.

Tornadoes are measured by their intensity or their wind speed, and their area, using the Enhanced Fujita (EF) Scale. The scale ranges from EF 0, with minor damages from winds ranging 65-85 mph, to EF 5 with severe damages from winds in excess of 200 mph.

Table 31: Enhanced Fujita Scale[69]

EF Number	Estimated 3-second gust (mph)	Typical Damage
0 (Gale)	65-85	Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; damaged sign boards.
1 (Weak)	86-110	Surfaces peeled off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
2 (Strong)	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
3 (Severe)	136-165	Roof and some walls torn off well constructed houses; trains overturned; most trees in forests uprooted Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
4 (Devastating)	166-200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
5 (Incredible)	200+	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

[69] http://climatecenter.fsu.edu/topics/tornadoes

Advisories

Below are the advisories that the NWS issues regarding flooding hazards:

- Severe Thunderstorm Watch: issued when conditions are favorable for severe thunderstorms to develop.
- Severe Thunderstorm Warning: issued when severe thunderstorms are occurring or are imminent.
- Tornado Watch: issued when conditions are favorable for severe thunderstorms and tornadoes to develop.
- Tornado Warning: issued when a tornado is sighted or imminent.
- Flash Flood Watch: issued when conditions are favorable for a specific hazardous weather event, including flooding, to occur, meaning flooding is possible.
- Flash Flood Warning: issued when a flash flood is imminent or occurring, referring to a sudden violent flood that can take minutes to hours to develop. It is even possible to experience a flash flood in areas not receiving rain.

Causes of Fatalities

All aspects of Severe Storms are life-threatening. NOAA tracks weather related fatalities and lighting itself contributes to the most deaths from thunderstorms in Florida. Other causes include flooding, tornadoes, and winds.[70]

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards *Environment* Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

Potential Effects of Climate Change on Severe Storms and Tornadoes

Higher temperatures and humidity may increase atmospheric instability associated with the generation of severe thunderstorms and tornadoes. However, vertical wind shear could also decrease, resulting in fewer or weaker severe thunderstorms and tornadoes.[71] However, decreases in vertical wind shear are

[70] http://www.nws.noaa.gov/om/hazstats.shtml#

[71] Seneviratne et al. (2012). *Changes in climate extremes and their impacts on the natural physical environment.* In Field et al. (Eds.), *Managing the risks of extreme events and disasters to advance climate change adaptation,* p.

most likely to occur when convective available potential energy (CAPE) is high in spring and summer months, which could result in more frequent severe storms. Furthermore, days with high CAPE are also likely to occur during times of the year with strong low-level wind shear, increasing the likelihood of the most severe storm events, including tornadoes.[72]

There has been an increase in the number of severe storm and tornado reports over the last 50 years. However, it is believed that this increase is attributed to the technology improvements that allow for better identification and reporting of such storms.

2. Geographic Areas Affected by Severe Storms

Severe Thunderstorms and Tornadoes can occur anywhere throughout the entire state. As the number of structures and the population increases, the probability that a severe storm or tornado will cause property damage or human casualties also increases. Florida experiences more thunderstorms each year than any other state in the US.

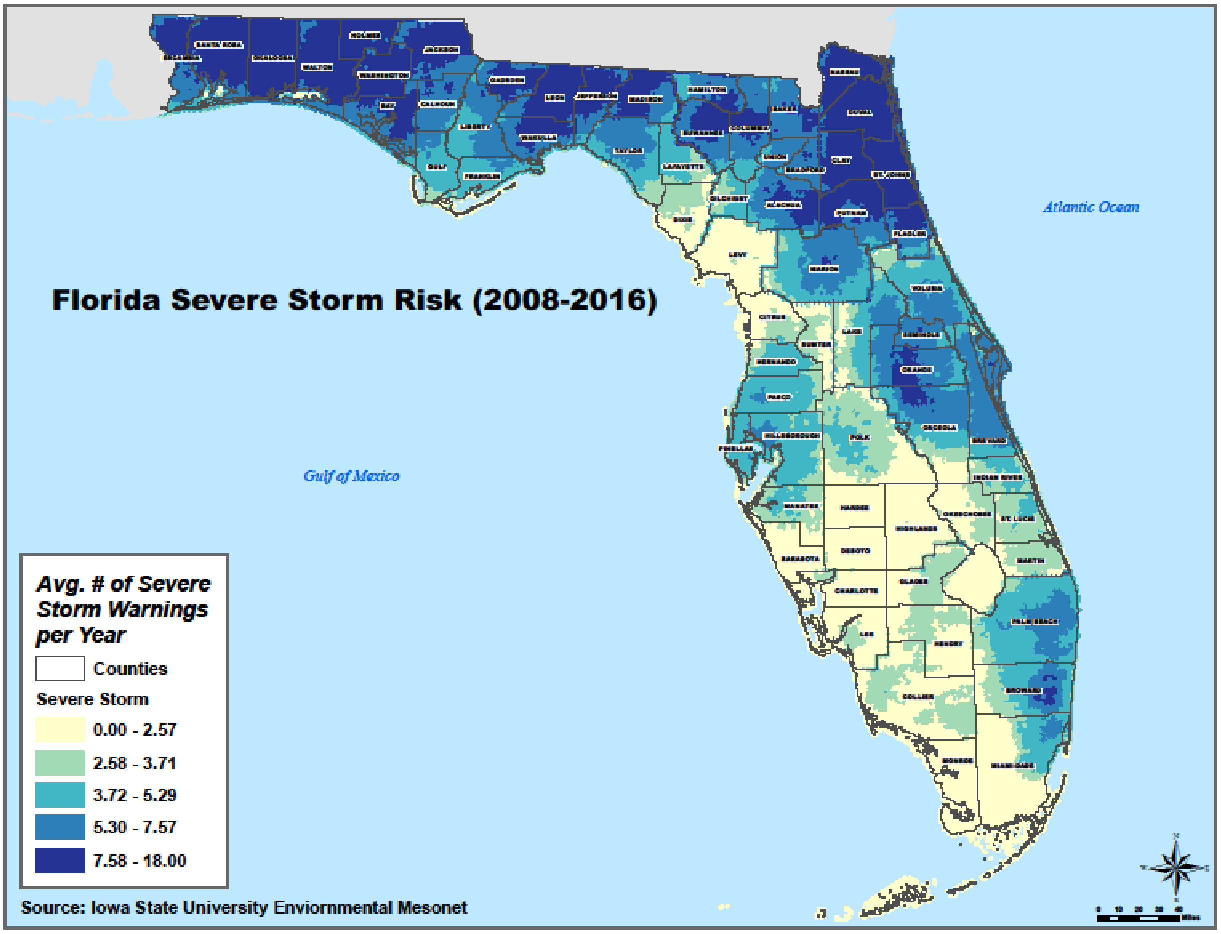
Severe Storm Risk

Below is a depiction of the Severe Storm Risk in Florida, based on the average number of severe storms from 2008 to 2016.

159. https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf., pp. 151-155; National Oceanic and Atmospheric Administration (NOAA) (2013). *Tornadoes, climate variability, and climate change. State of the science fact sheet.* http://nrc.noaa.gov/sites/nrc/Documents/SoS%20Fact%20Sheets/SoS_%20Fact_Sheet_Tornado%20and%20Climate_FINAL_Sept2017.pdf?ver=2017-12-05-115742-360., pp. 1-2. Diffenbaugh, et al. (2013). *Robust increases in severe thunderstorm environments in response to greenhouse forcing.* Proceedings of National Academy of Sciences. doi/10.1073/pnas. 1307758110., http://www.pnas.org/content/110/41/16361.full.

[72] Diffenbaugh et al. (2013), http://www.pnas.org/content/110/41/16361.full., p. 1.

Figure 56: Florida Severe Storm Risk, 2008 – 2016



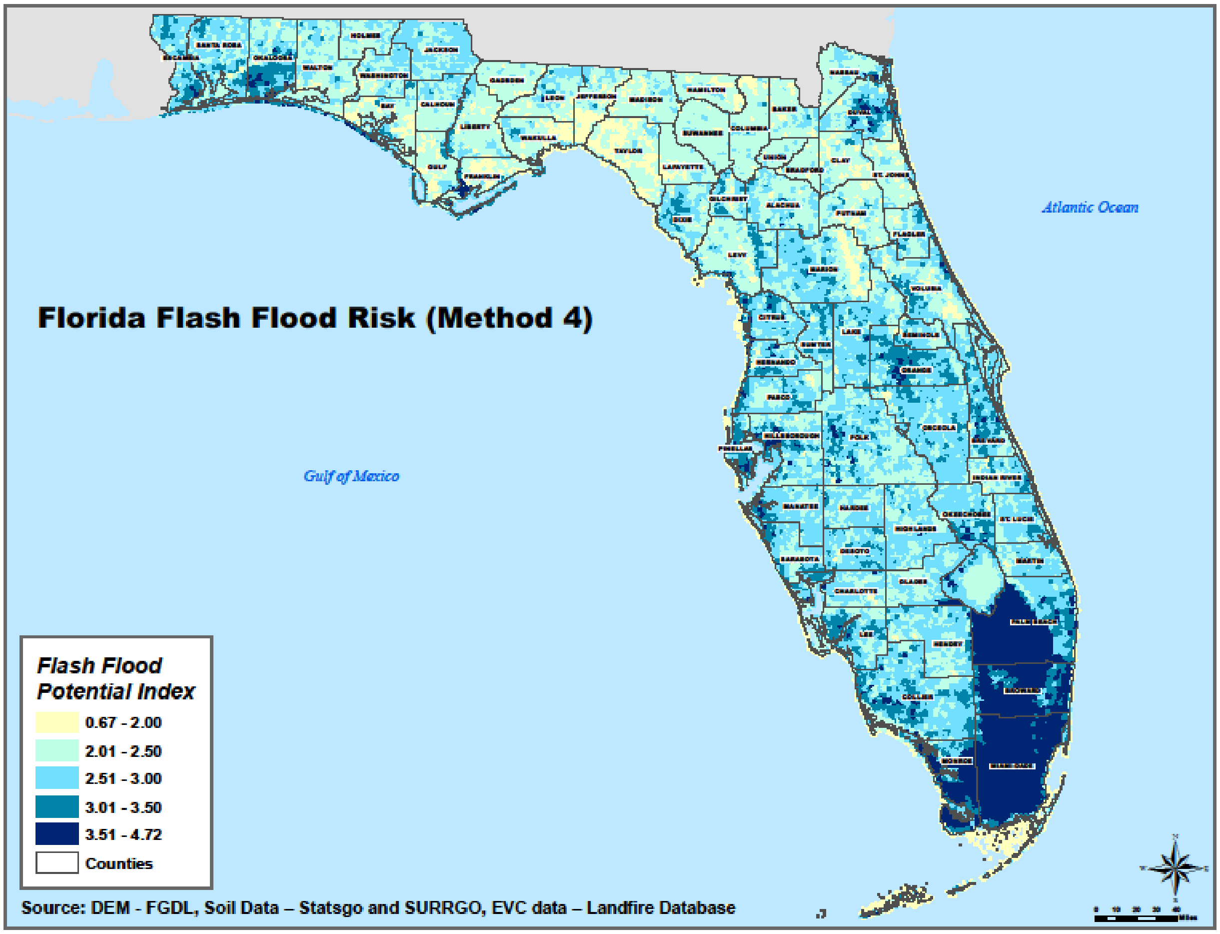
According to the data, north Florida, as well as portions of the state near Orlando and Fort Lauderdale are expected to have between 7.58 and 18 severe storm warnings per year.

Flash Flood

Below is a map depicting the potential for flash flooding to occur.

The map uses an equation called "Method 4" which is (2*M+S+2*LV)/5 where M=Slope, L=land cover/use, S=soil type/texture, and V=vegetation cover/forest density.

Figure 57: Florida Flash Flood Risk

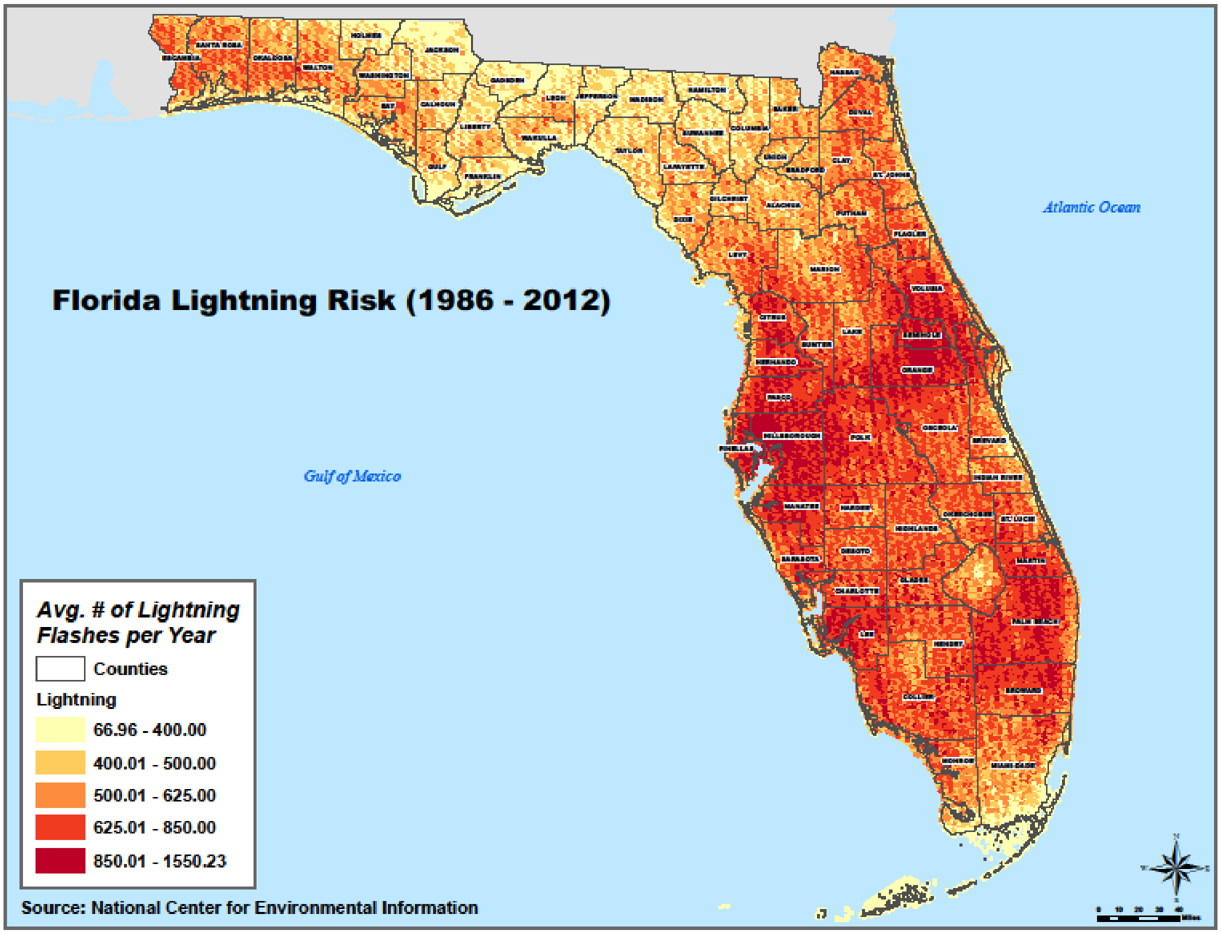


The map shows that most of the state has between 2.01 and 3.50 potential of occurring.

Lightning

Below is a map depicting the average number of lightning flashes per year, based on historical data from 1986 to 2012.

Figure 58: Florida Lightning Risk, 1986 – 2012

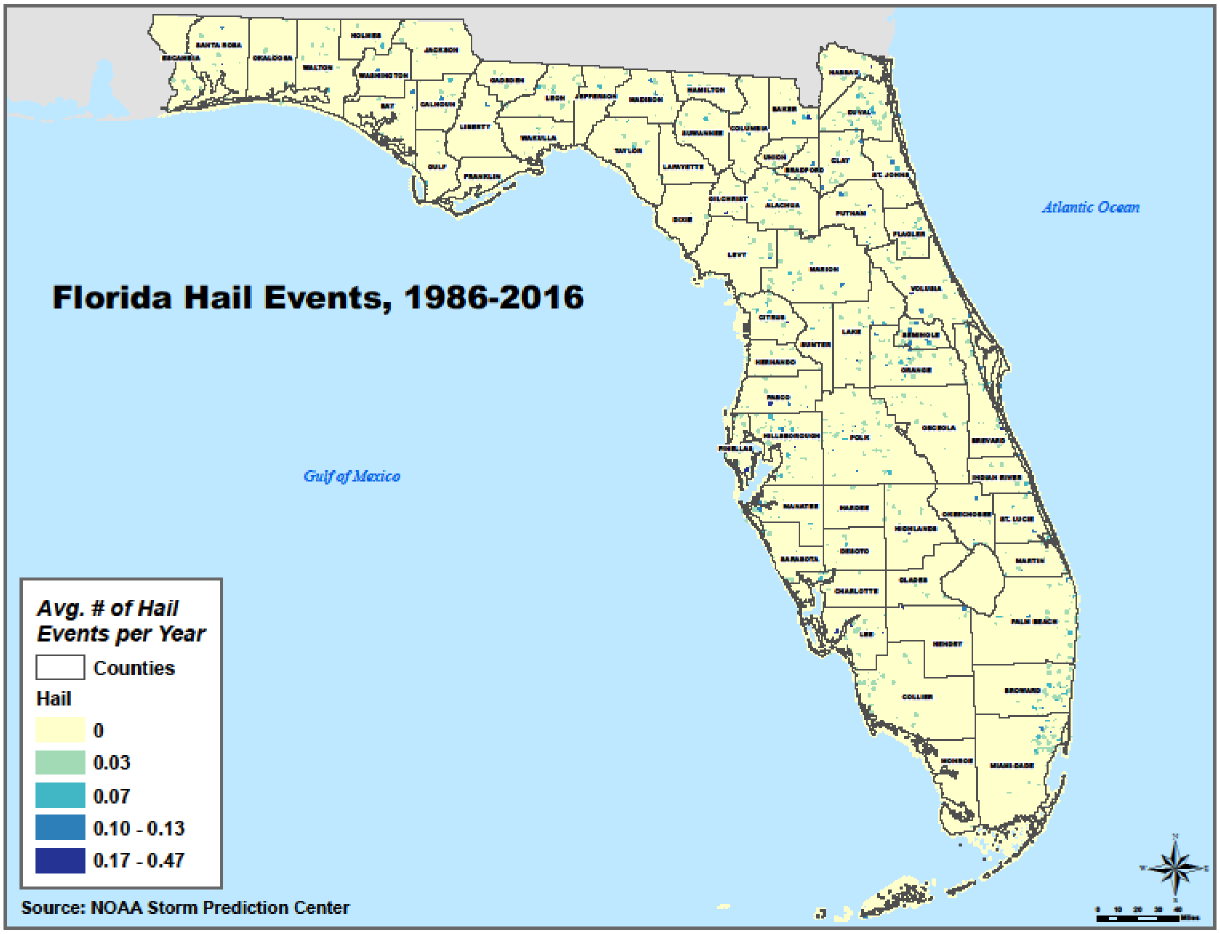


According to the data, central and southern Florida are expected to have between 850 and 1550 lightning flashes per year.

Hail

The map below shows the average number of hail events in Florida, based on historical data from 1986 to 2016.

Figure 59: Florida Hail Events, 1986 – 2016

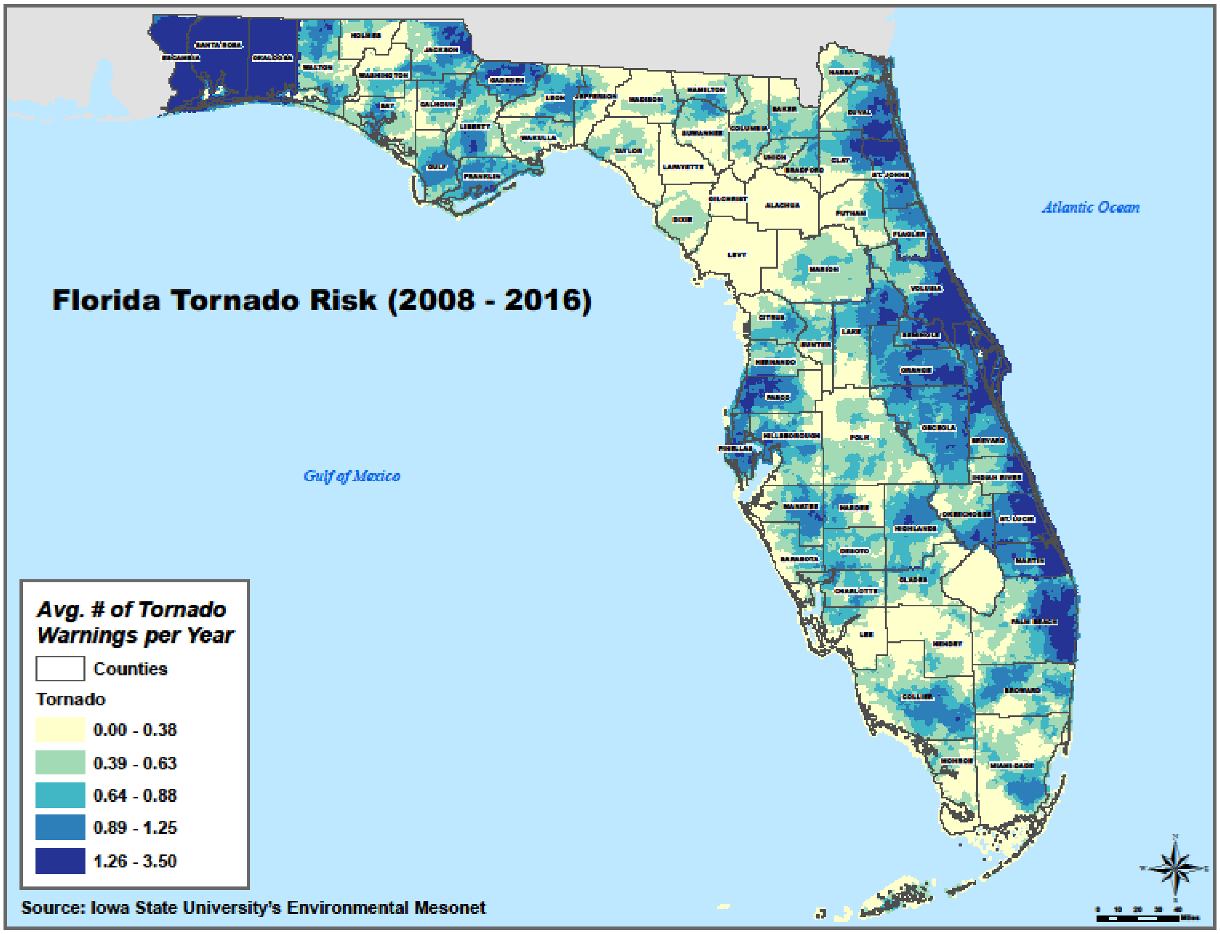


According to the data, hail events are not particularly common. In fact, the highest average number of hail events per year is less than 0.5.

Tornado

Below is a map depicting the average number of tornadoes per year based on historical occurrences of tornadoes from 2008 to 2016.

Figure 60: Florida Tornado Risk, 2008 – 2016



According to the data, the three counties furthest west, Escambia, Santa Rosa, and Okaloosa counties, have a risk of 1 to 3.5 tornado warnings each year. Additionally the east coast of the state is likely to have 1 to 3 tornado warnings each year.

Furthermore, when compared with other states, Florida ranks third in the US for average number of tornado events per year. These rankings are based upon data collected for all states and territories for tornado events between the years 1991 and 2010.[73]

3. Historical Occurrences of Severe Storms

The 2013 update used information from the NCDC storm event database. The database was not used for this update because the filters were for instances of hail, lightning, and high wind, it did not list events that were simply thunderstorms or tornadoes. NWS local data was used to compile a list of previous occurrences of severe storms and tornadoes in Florida.

[73] http://www.srh.noaa.gov/jetstream/tstorms/tornado.html).

Table 32: Florida Historical Occurrences, Severe Storms [74] [75] [76]

Date	Description
January 13, 2006	Several tornadoes developed from supercells that evolved from the remnants of a squall line across the southeastern states, with about a dozen students injured at a damaged school in Santa Rosa County.
October 27, 2006	A waterspout from a thunderstorm came ashore and became an EF 1 tornado in the Apalachicola area.
December 25, 2006	A squall line over the eastern Gulf of Mexico moved rapidly eastward into Florida, spawning severe thunderstorms and tornadoes across Central Florida during the late night and early morning hours Christmas Day.
February 2, 2007	Four tornadoes and severe winds across Central Florida results in twenty-one fatalities, 76 injuries, and significant property damage including over 2,000 damaged homes.
March 1-2, 2007	Several thunderstorms affected much of North Florida.
April 15, 2007	Severe thunderstorms caused widespread tree and property damage across Northeast Florida, including an EF-2 tornado in Baker.
February 13, 2008	Severe storms and tornadoes across South Florida damaged trees, boats, and aircrafts.
February 17-18, 2008	Supercells and tornadoes ahead of a cold front produced widespread damage and several injuries across the Florida Panhandle and Big Bend regions.
February 26, 2008	Severe storms produced widespread tree and power line damage across Northeast Florida.
March 7, 2008	A squall line tracked across the Gulf of Mexico and emerged in northern Florida, with supercells forming within it. Two people were killed and about 50 homes were damaged or destroyed.
August 19-22, 2008	At least 8 tornadoes affected Florida as a result of Tropical Storm Fay making landfall.
Late March to early April 2009	A series of severe thunderstorms, with hail, straight line winds, and record rainfall, affected the Panhandle and the Big Bend regions.
June 29, 2009	Severe storms across the Florida Big Bend region caused power outages and severe damage from falling trees.
January 21-22, 2010	Severe storms and a few weak tornadoes caused widespread tree and property damage in Northeast and East Central Florida.
January 25, 2011	Strong straight lines winds along a squall line produce numerous reports of trees and power lines down, along with minor roof damage across western Central Florida.
March 9, 2011	Over 20 structures were damaged in the western Panhandle associated with a tornado and straight lines winds.
March 31, 2011	Approximately 70 people were trapped in a collapsed building at the Sun 'n' Fun Aviation Fair in Lakeland due to severe winds.

[74] http://www.weather.gov/mob/events
[75] http://www.weather.gov/tae/events
[76] http://www.weather.gov/mfl/events_index

April 5, 2011	A squall line produced widespread tree damage and power outages across North Florida with over a dozen homes with minor damage.
June 23-24, 2012	Several tornadoes across south Florida, which stemmed from Tropical Storm Debby.
April 28 – May 6, 2014	Many severe storms, tornadoes, straight line winds, and flooding caused significant damage across the Panhandle.
October 14, 2014	Several tornadoes and thunderstorm winds along a squall line produced tree and roof damage in the Panhandle and Big Bend regions.
November 17, 2014	A severe weather outbreak took place during the morning hours mainly across the Florida Panhandle and Southwest Georgia. An EF-2 tornado damaged a correctional institute, flipped vehicles, and damaged buildings. Other weak tornadoes damaged mobile homes and sheds. Winds also caused damage across adjacent areas of Northern and Central Florida that afternoon.
April 19-20, 2015	A squall line produced tree damage across North Florida over a two day period. An EF-1 tornado in Marion County damaged 55 homes, 10 of which were uninhabitable. Two additional EF-1 tornadoes were also confirmed in Jackson and Leon counties with tree and home damage.
January 17, 2016	Tornado and straight line wind damage affected South Florida with structural damage.
January 22, 2016	Severe winds caused damage to trees and outdoor furniture, barns, and sheds in the western Panhandle.
February 2, 2016	Severe storms, including an EF 3 tornado, affected Escambia County.
February 16, 2016	Severe winds and tornadoes caused damage to mobile homes, roofs, sheds, pool screens, and outdoor furniture across South Florida.
February 24, 2016	Tornadoes in the western Panhandle caused significant structural damage.
May 17, 2016	Four tornadoes caused damage to warehouses, homes, trees, and mobile homes in St. Lucie and Indian River counties.

There have been 19 major disaster declarations from FEMA for severe storms and tornadoes in Florida.

Table 33: FEMA Major Disaster Declarations in Florida, Severe Storms and Tornadoes[77]

Date	Description
March 23, 1960	DR-97: Severe Weather
May 26, 1973	DR-387: Severe Storms, Flooding
September 26, 1975	DR-484: High Winds, Heavy Rains, Flooding
May 15, 1979	DR-586: Severe Storms, Tornadoes, Flooding
September 29, 1979	DR-607: Severe Storms, Flooding
July 7, 1982	DR-664: Severe Storms, Flooding
March 16 – April 9, 1990	DR-862: Flooding, Severe Storm
June 23 – 30, 1992	DR-952: Flooding, Severe Storm

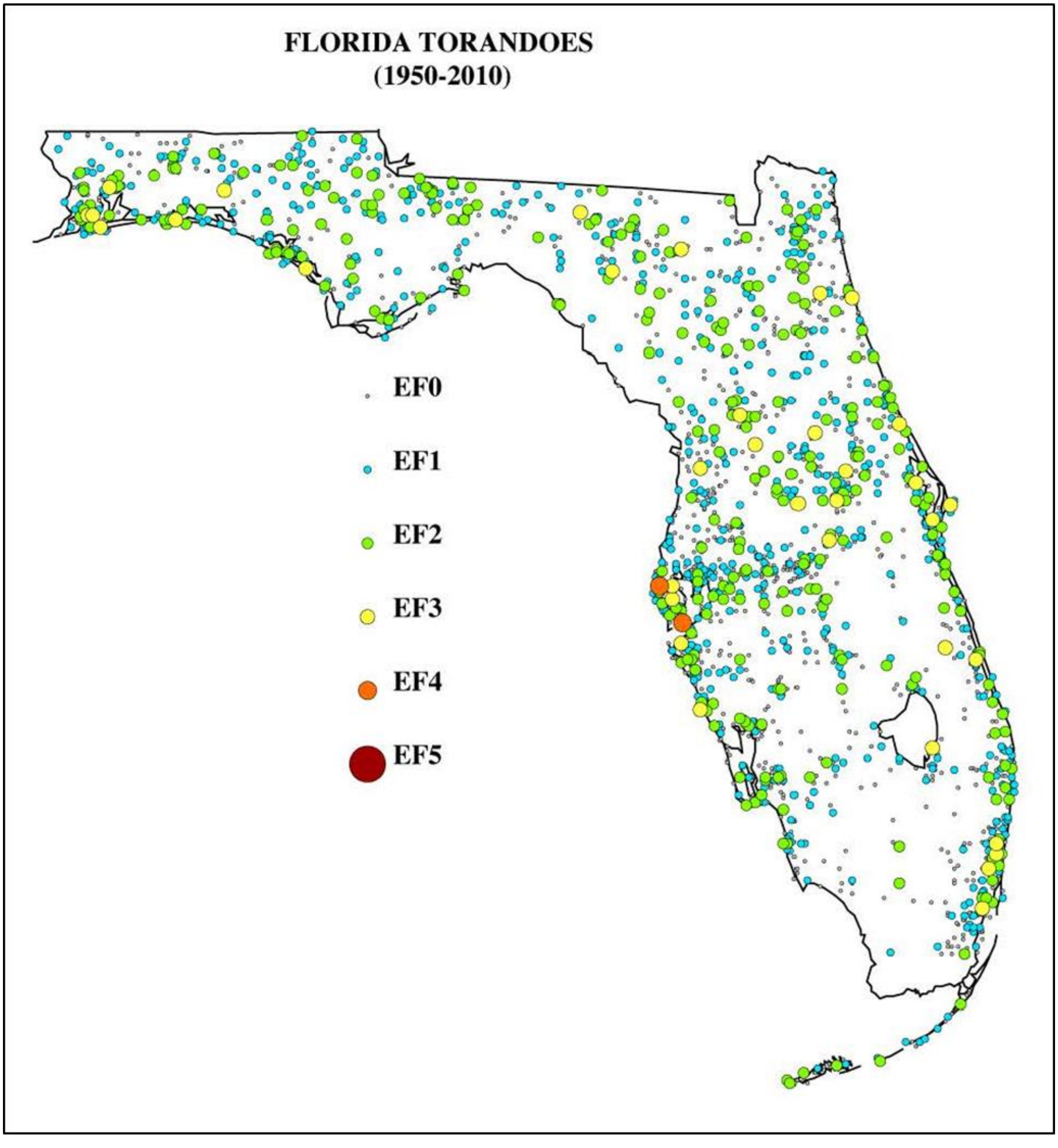
77 https://www.fema.gov/disasters?field_state_tid_selective=47&field_disaster_type_term_tid=7697&field_disaster_declaration_type_value=All&items_per_page=20

October 3 – 4, 1992	DR-1035: Flooding, Severe Storm, Tropical Storm Alberto
October 13 – November 20, 1995	DR-1074: Severe Storm, Flooding
October 7 – 21, 1996	DR-1141: Severe Storms/Flooding
February 2 – 4, 1998	DR-1204: Severe Thunderstorms, Tornadoes, and Flooding
October 3 – 11, 2000	DR-1345: Heavy Rains and Flooding
June 13 – August 22, 2003	DR-1481: Severe Storms and Flooding
February 1 – 2, 2007	DR-1680: Severe Storms and Tornadoes
March 26 – May 5, 2009	DR-1831: Severe Storms, Flooding, Tornadoes, and Straight-line Winds
May 17 – 28, 2009	DR-1840: Severe Storms, Flooding, Tornadoes, and Straight-line Winds
July 2 – 7, 2013	DR-4138: Severe Storms and Flooding
April 28 – May 6, 2014	DR-4177: Severe Storms, Tornadoes, Straight-line Winds, and Flooding

Below is a map showing the occurrences of tornadoes and their EF number in Florida from 1950 until 2010.[78]

[78] Information was available only through 2010.

Figure 61: Florida Tornadoes, 1950 – 2010



From this map, it is possible to understand that lower strength tornadoes, EF-0 through EF-2, are common across the state, while stronger tornadoes like EF-3 and EF-4 are uncommon, but have occurred. According to this data, there has not been an EF-5 tornado in Florida from 1950 to 2010.

While Severe Storms may seem to be lesser threat to life safety than a hurricane, Severe Storms can be fatal. From 2006 to 2016, Severe Storms killed 106 people; 56 people died from lightning strikes, 29 people died from a tornado, 13 people died from wind, and 6 people died from flooding.[79] (It is important to note that the flooding and wind related fatalities could have been from other storms, not only thunderstorms.)

Table 34: Severe Storm Fatalities, Florida, 2006 – 2016[80]

Year	Fatalities by Cause
2006	Lightning: 5
2007	Lightning: 11 Tornado: 21
2008	Lightning: 4 Tornado: 1
2009	Lightning: 5 Wind: 4 Flood: 2
2010	Lightning: 1
2011	Lightning: 1 Wind: 1
2012	Lightning: 5 Tornado: 1 Wind: 2 Flood: 1
2013	Lightning: 4 Tornado: 4 Wind: 1
2014	Lightning: 6 Wind: 1 Flood: 3
2015	Lightning: 5 Wind: 3
2016	Lightning: 9 Tornado: 2 Wind: 1

4. Probability of Future Occurrences of Severe Storms

Based on historical analysis, severe storms and tornadoes will continue to effect Florida. Most of Florida has an average of 80 thunderstorm days each year, with western Florida experiencing an average of 100 each year.[81]

[79] Note that the flooding and wind related fatalities could have been the result of other types of severe weather, such as hurricanes.
[80] http://www.nws.noaa.gov/om/hazstats.shtml#
[81] http://climatecenter.fsu.edu/topics/thunderstorms

The maps in the geographic areas affected section will be referenced here regarding probability of events across the state.

Severe Storms are highly likely in Florida, particularly in the Panhandle, northern, central, and southeast regions of the state. About half the state is likely to have approximately 3 to 18 severe storm warnings each year.

The entire state is likely to experience between approximately 67 and 1550 lightning flashes per year, with central and southern Florida likely to experience the most lightning flashes each year.

The state of Florida is not particularly likely to experience hail events, according to the average (probability) based on historical occurrences.

Tornado

Western Florida and the east coast of the state are likely to experience 1 to 3.5 tornado warnings each year. The central Panhandle region and the Tampa Bay region of Florida are likely to experience at least 1 tornado warning each year. The remaining areas of the state have an average, or probability, or less than 1 warning per year, which means that every few years, those areas are likely to experience a tornado warning.

Furthermore, as shown in the historical occurrences section, most tornadoes in Florida are likely to be of smaller strength, usually between an EF-0 and an EF-2. Additionally, tornadoes are most likely in Florida in the spring and between 4pm and 9pm.

Flash Flood

The map above explains that while most of the state has a Flash Flood Potential Index between 2.01 and 3.50, there are portions of south Florida, mostly near the Everglades, as well as a few other locations around urban coastal areas that have the highest potential index, between 3.51 and 4.72.

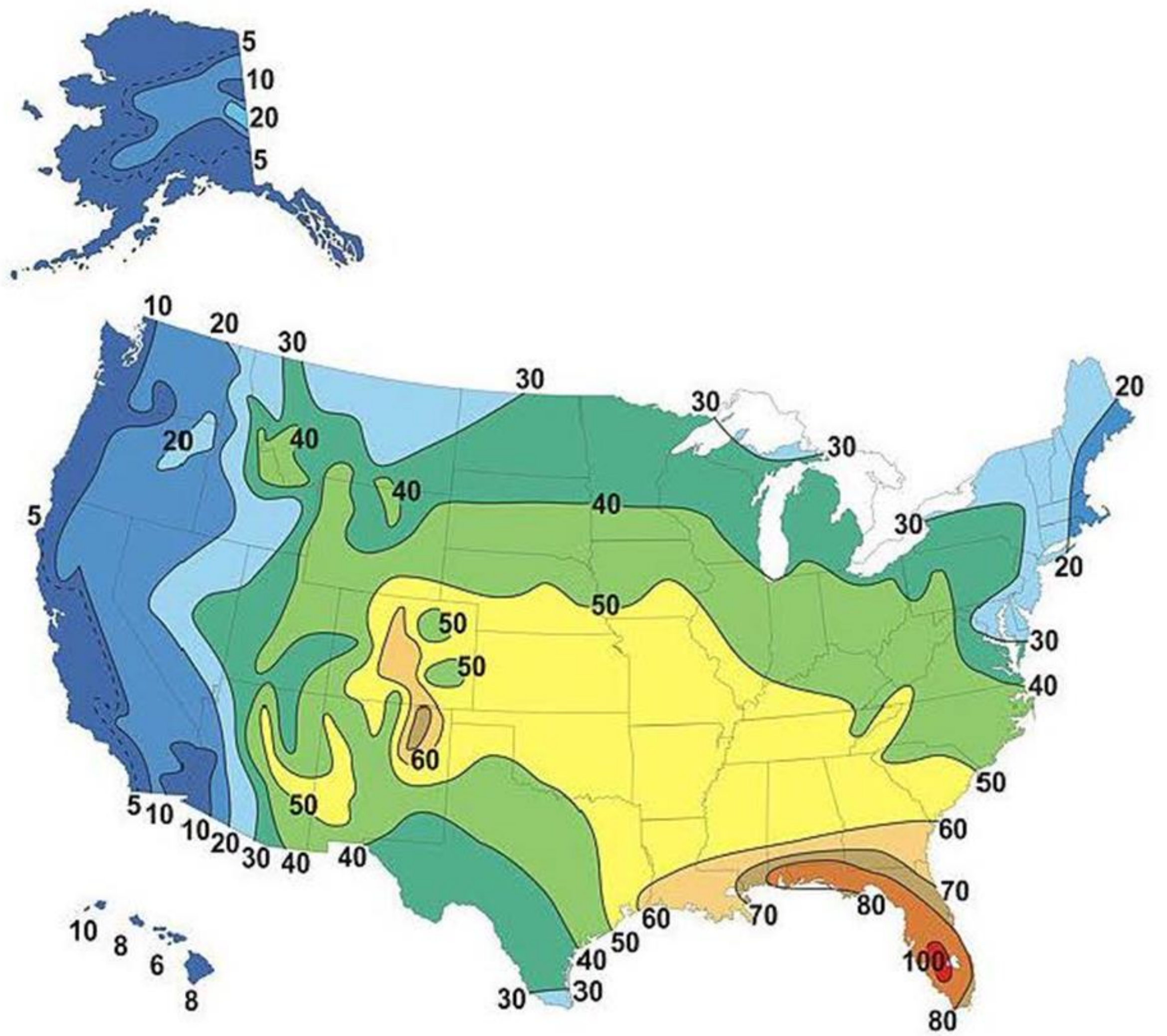
The map below shows the average number of thunderstorm days across the US. Not all storms are severe and any storm that contains thunder, regardless of frequency is classified as a thunderstorm. Given this, it can be impossible to count the number of actual thunderstorms, so the number of days with thunderstorms is counted instead.

Florida being first in the United States for lightning strikes per square mile.[82]

This hazard was determined to occur annually, giving it a Probability of Very Likely.

[82] http://www.nssl.noaa.gov/education/svrwx101/thunderstorms/

Figure 62: Average Number of Thunderstorm Days, United States[83]



5. Severe Storm Impact Analysis

- Public
    - Injury or death from being struck by lightning
    - Injury or death from hail
    - Injury or death from flying debris
    - Injury or death from tornadoes and not having adequate shelter
    - Car accident

[83] http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html

- Indirect death
- Survivors guilt if their house wasn't damaged from a severe storm or tornado and many neighbors died

- Responders
  - Responding during a severe storm can be very dangerous because of heavy rains, strong winds, hail, lightning, tornadoes
- Continuity of Operations (including continued delivery of services)
  - Thunderstorms often cause power outages from wind damage to power lines or lightning damage to power stations or other electrical infrastructure
- Property, Facilities, Infrastructure
  - Damage to property, including homes and businesses can occur from strong winds, flooding, or tornadoes. The damage can range from minor roof damage to total structure loss.
  - Damage to critical facilities, such as transformer stations, etc. from fallen trees and limbs, causing a power outage
- Environment
  - Damage to environment, from strong winds, flooding, and tornadoes
  - There may be severe damage to vegetation in localized areas from a tornado
- Economic Condition
  - Power outages cause lost revenue and lost wages for businesses and employees
- Public Confidence in the Jurisdiction's Governance
  - Power outages for extended periods give the appearance that the jurisdiction does not know how to restore power

6. 2018 LMS Integration

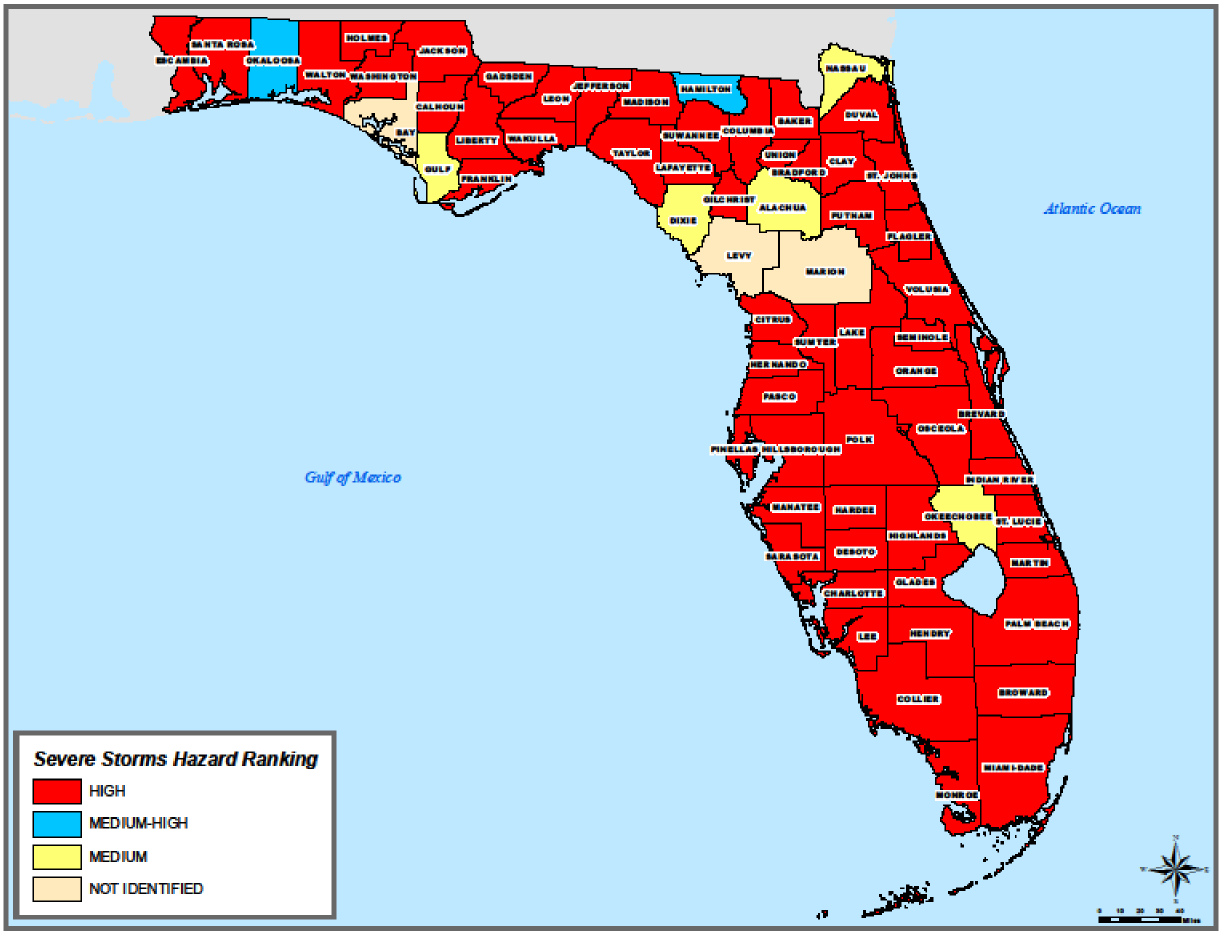
An analysis of all 67 Florida County LMS Plans and their individual severe storm and tornado hazard rankings is shown below. Only three counties did not identify Severe Storms as a Hazard and two counties did not identify Tornadoes as a Hazard.

Severe Storms

Based on the LMS plans, Figure 3.38 displays the jurisdictional rankings for the severe storms hazard. Not all counties have identified severe storms as one of their hazards.

- High-risk Jurisdictions: 57
- Medium-High-risk Jurisdictions: 2
- Medium-risk Jurisdictions: 5
- Low-risk Jurisdictions: 0
- Not identified Jurisdictions: 3

Figure 63: Severe Storm Hazard Rankings by County

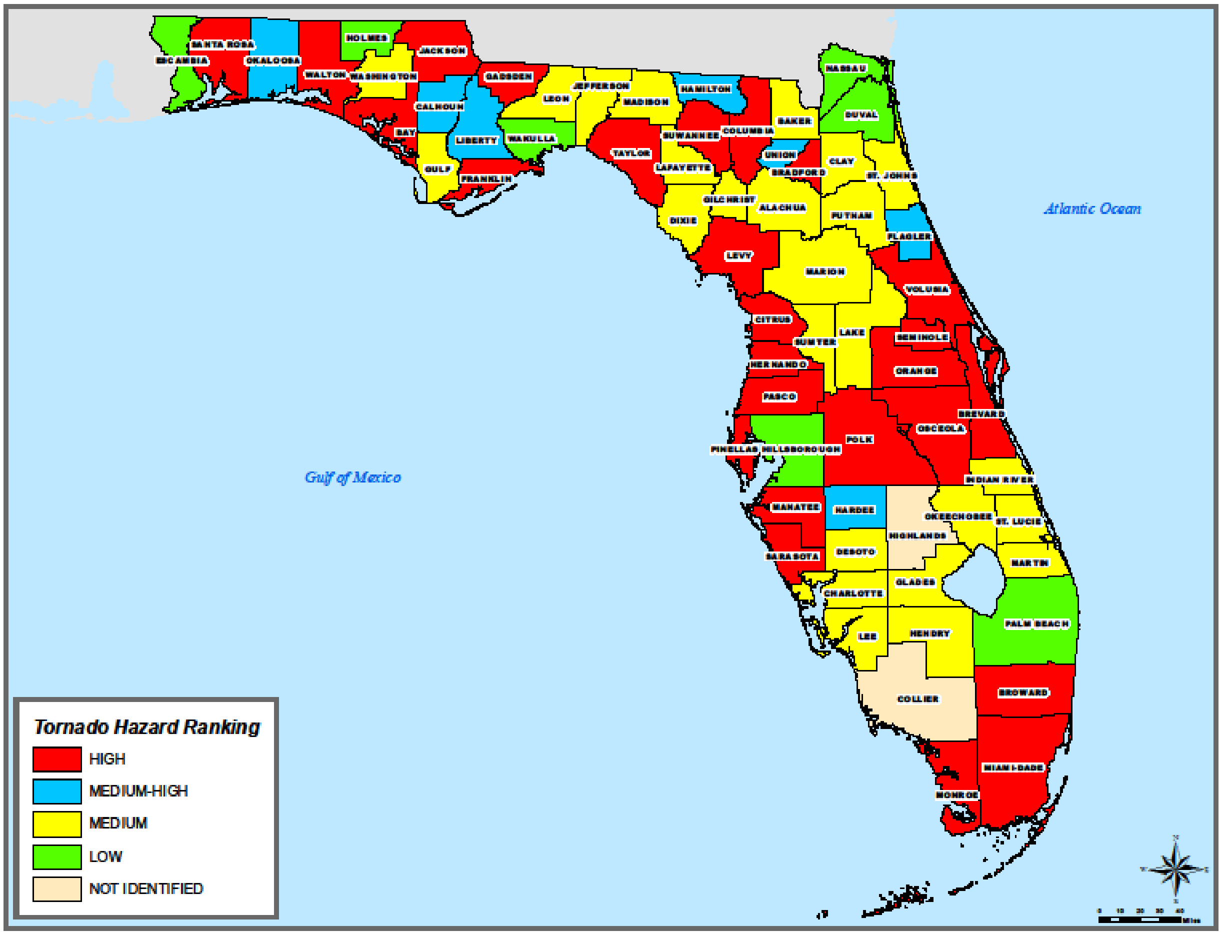


Tornados

Based on the LMS plans, Figure 3.38 displays the jurisdictional rankings for the tornados hazard. Not all counties have identified tornados as one of their hazards.

- High-risk Jurisdictions: 26
- Medium-High-risk Jurisdictions: 7
- Medium-risk Jurisdictions: 25
- Low-risk Jurisdictions: 7
- Not identified Jurisdictions: 2

Figure 64: Tornado Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

Vulnerability Analysis

According to the HelpFL data, which categorized the state by the average number of severe storm warnings per year, most structures in the state are within the Class 3 areas, meaning they have between 3.72 and 5.29 severe storm warnings per year. Additionally, there are eleven counties with over 300,000 structures in any of the classes, meaning they experience between 0 and 18 severe storm warnings per year. Those counties are Brevard, Broward, Collier, Duval, Hillsborough, Lee, Miami-Dade, Orange, Palm Beach, Pinellas, and Polk.

As explained in the Probability section, the Flash Flood Potential Index shows that there is a high chance of flash flooding in south Florida, as well as a few other locations around the urban coastal areas. Those areas, shaded in dark blue, would be the most vulnerable to flash flooding.

According to the data, counties that are most vulnerable to tornados include those on the east coast, as well as Escambia, Santa Rosa, and Okaloosa. Because hail events are not particularly common in Florida, no counties are particularly vulnerable to hail events. Central and southern Florida are the most vulnerable to lightning strikes, since those areas have the highest number of lightning strikes each year.

Loss Estimation

According to the HelpFL data, 57 counties have between $1 million and $99 billion worth of structures within the areas that are expected to experience any severe storm warnings. Six counties, Broward, Collier, Hillsborough, Miami-Dade, Orange, and Palm Beach, have over $100 billion worth of structures within the areas expected to experience any severe storm warnings. Similarly to the count of structures discussed above, there is over $1 trillion worth of structures in the Class 3 areas alone, meaning they experience between 3.72 and 5.29 severe storm warnings each year. This table can be found in *Appendix E: Risk Assessment Tables.*

8. Vulnerability Analysis and Loss Estimation, of State Facilities

Severe storms can strike anywhere in the state; therefore, all of the 20,231 state facilities and their insured values are equally vulnerable and at risk. However, severe storms do not always impact structures. Severe storm impacts to structures, including state facilities, could include flooding, wind, tornadoes, hail, and lighting. Please refer to the *Flood Hazard Profile* for the 100- and 500-year floodplain vulnerability and loss estimations. Because of the Florida Building Code, and the speed of most winds during severe storms, most structures do not sustain damage. This is because most buildings are built to withstand hurricane force winds and severe storms often do not have high wind speeds. Tornadoes however, may cause damage to structures, including state facilities. Hail is unlikely to cause damage because of the fact that oftentimes, hail does not impact the state. Lightning impacts on structures are minimal.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 12.

<table>
<tr><th colspan="5">SEVERE STORM</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">The three key elements of a thunderstorm are wind, water, and lightning. The National Weather Service (NWS) considers a thunderstorm severe if it produces hail at least one inch in diameter, winds of 58 mph or stronger, or a tornado. Lightning, Flash Floods, Hail, Straight Line winds, Tornadoes.</td><td rowspan="5">HIGH</td></tr>
<tr><th>Frequency</th><th>Probability</th><th colspan="3">Magnitude</th></tr>
<tr><td rowspan="2">Very Likely</td><td rowspan="2">Very Likely</td><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>High</td><td>Medium</td><td>Low</td></tr>
</table>

Wildfire Hazard Profile

1. Wildfire Description

Wildfire, or wildland fire, is a fire that was started by lightning or by humans in an area with vegetation. Wildfires occur in Florida every year and at all times of the year and are part of the natural cycle of Florida's fire-adapted ecosystems. Wildfires can cause major environmental, social, and economic damages because of the possible loss of life, property, wildlife habitats, and timber. Fortunately, many of these fires are quickly suppressed before they can damage or destroy property, homes, and lives.

Causes

Wildfires can be caused by humans or occur naturally. Based on analysis of statistics from 2006 to 2016 in Florida, about 70-80 percent of wildfires are caused by humans, including arson, burning debris, or accidents. Furthermore, 20-30 percent of wildfires are caused by lightning (Florida forest service report). These statistics are similar to nationwide statistics from the National Park Service data.

Wildfire prevention and public awareness campaigns such as Smokey Bear and Firewise Communities have helped to greatly reduce the number of human-caused wildfires in Florida. Other measures used to help reduce the number and severity of wildfires includes NWS advisories, prescribed burns, and county burn bans.

Although wildfires can cause severe damage, there can be benefits from this hazard. Sometimes, burns are "prescribed" by fire managers, meaning they are intentionally lit under carefully controlled conditions. The Florida Forest Service authorizes an average of 2 million acres to be burned each year in these prescribed burns. Benefits of prescribed burns include insect pest control, removal of exotic species, addition of nutrients to the soil for trees and other vegetation, removal of undergrowth to allow sunlight to reach the forest floor, and removal of extra fuel sources so when an un-prescribed burn occurs, there is less fuel for it to grow.[84] [85]

While there are many possible causes of wildfires, all spread in one of three patterns:

- Surface Fires: burn along the forest floor consuming the litter layer and small branches on or near the ground.
- Ground Fires: smolder or creep slowly underground. These fires usually occur during periods of prolonged drought and may burn for weeks or months until sufficient rainfall extinguishes the fire, or it runs out of fuel.
- Crown Fires: spread rapidly by the wind, moving through the tops of the trees.

The type and amount of fuel, as well as its burning qualities and level of moisture, affect wildfire potential and behavior. The continuity of fuels, expressed in both horizontal and vertical components, is also a factor because it expresses the pattern of vegetative growth and open areas. Topography is important

[84] http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Wildland-Fire
[85] https://www.nps.gov/fire/wildland-fire/learning-center/fire-in-depth/fire-spread.cfm

because it affects the movement of air (and thus the fire) over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. Temperature, humidity, and wind (both short- and long-term) affect the severity and duration of wildfires.

Environmental short-term loss caused by a wildland fire can include the destruction of wildlife habitat and watersheds. Long-term effects include reduced access to affected recreational areas, destruction of cultural and economic resources and community infrastructure, and vulnerability to flooding due to the destruction of watersheds.

Wildland/Urban Interface Fires

Population movement trends in the U.S. have resulted in rapid development in the outlying fringes of metropolitan areas and in the rural areas with attractive recreational and aesthetic amenities, such as forests. This demographic change is increasing the size of the WUI, defined as the area where structures and other human development meet or intermingle with undeveloped wildland. The WUI creates an environment for fire to move readily between vegetation fuels, such as brush or forests; and structural fuels, such as houses and buildings. Homes and other flammable structures can become fuel for WUI fires. There are three categories of WUI fires:

- Mixed Interface fires: contain structures that are scattered throughout rural areas. Usually, there are isolated homes surrounded by larger or smaller areas of land.
- Occluded Interface fires: are characterized by isolated (either large or small) areas within an urban area. An example may be a city park surrounded by urban homes trying to preserve some contact with a natural setting.
- Class Interface fires: are where homes, especially those crowded onto smaller lots in new subdivisions, press along the wildland vegetation along a broad front. Vast adjacent wildland areas can propagate a massive flame front during a wildfire, and numerous homes are put at risk by a single fire.

The WUI is largely the result of development in areas once considered wildlands where people desire to live in a more natural setting. Natural landscaping, which allows natural vegetation to grow and accumulate near homes, is a hazardous trend and does not mitigate the risk of fire reaching into a homeowner’s land. Many subdivision layouts are designed with numerous dead-end streets and cul-de-sacs, creating access issues for firefighting services and equipment. In addition, many of these areas do not have wet hydrants or other sources of water for firefighting.

Advisories

There are three advisories that the NWS can issue for wildfires:[86]

- Fire Weather Watch: indicates weather conditions could result in critical fire weather conditions in the next 72 hours.
- Red Flag Warning: indicates ongoing or imminent critical fire weather in the next 24 hours.

[86] http://www.nws.noaa.gov/om/fire/ww.shtml

- Extreme Fire Behavior: implies that a wildfire is either moving fast, has prolific crowning or spotting, has fire whirls, or has a strong convection column.

Measures

The Florida Forest Service has developed a web-based Geographic Information System (GIS) mapping application called Fire Risk Assessment System (FRAS).[87] FRAS uses wildfire fuel types and densities, environmental conditions, and fire history to produce a Level of Concern (LOC), which is a number on a scale that runs from 1 (low concern) to 9 (high concern), for a given geographic area. This data was compiled in 2011 and used in the Wildfire Annex to the SHMP. As of 2018, this data has not been updated because it would be too costly to update. For more information about this system, please refer to *Appendix G: Wildfire Hazard Mitigation Plan Annex*.

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Medium, meaning any injuries, but no deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be High, meaning significant damage to the environment occurs.

Potential Effects of Climate Change on Wildfire

The increased frequency or intensity of extreme heat or drought events, due to the augmenting of existing fuel flammability, could affect wildfire behavior.[88] Changes in vegetation types could also alter fuel mixtures. Reducing moisture of living vegetation, soils, and decomposing organic matter during drought or extreme heat events is associated with increased incidence of wildfires. Furthermore, changes over time in vegetation types could change the mixture and flammability of fuels. As these transitions occur, wildfire occurrences and severity could increase with the introduction of more flammable vegetation types or decrease with the introduction of more fire resistant species.[89] As the flood hazard profile

[87] http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Wildland-Fire/Resources/Fire-Tools-and-Downloads/Florida-s-Wildland-Fire-Risk-Assessment-System-FRAS

[88] Murray et al. (2012). *Case studies*, (https://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap9_FINAL.pdf). In Field et al. (Eds.), *Managing the risks of extreme events and disasters to advance climate change adaptation; A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*, pp. 487-542. https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf., p. 519; Walsh and Wuebbles (2013).; *Our changing climate*. In, *Draft national climate assessment* (pp. 25-103).
http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-fulldraft.pdf

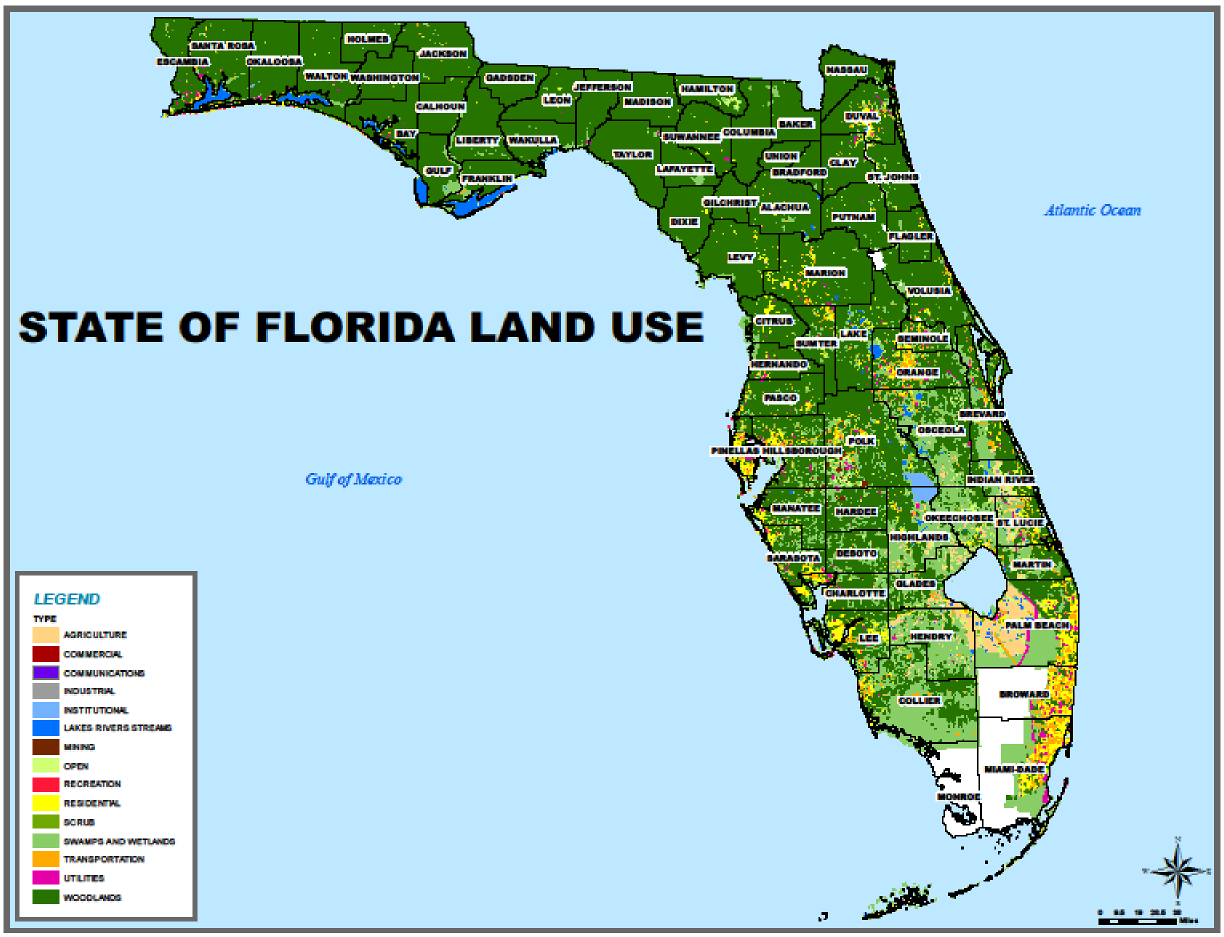
[89] Groffman and Kareiva (2013);
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.431.5893&rep=rep1&type=pdf; Walsh and Wuebbles

discussed that arid areas may become drier and moist areas to become wetter. Florida has weather patterns that lead to both dry and wet periods each year. Climate change may cause one or the other, or both to increase in occurrences and magnitude.

2. Geographic Areas Affected by Wildfire

The land use map below shows that much of Florida is prone to wildfire. Woodlands and timberlands are clearly vulnerable to wildfires. Additionally, droughts increase vulnerability in swamps, wetlands, and agricultural lands. These types of land are vulnerable because they contain materials that are easily combustible fuel.

Figure 65: Florida Land Use[90]



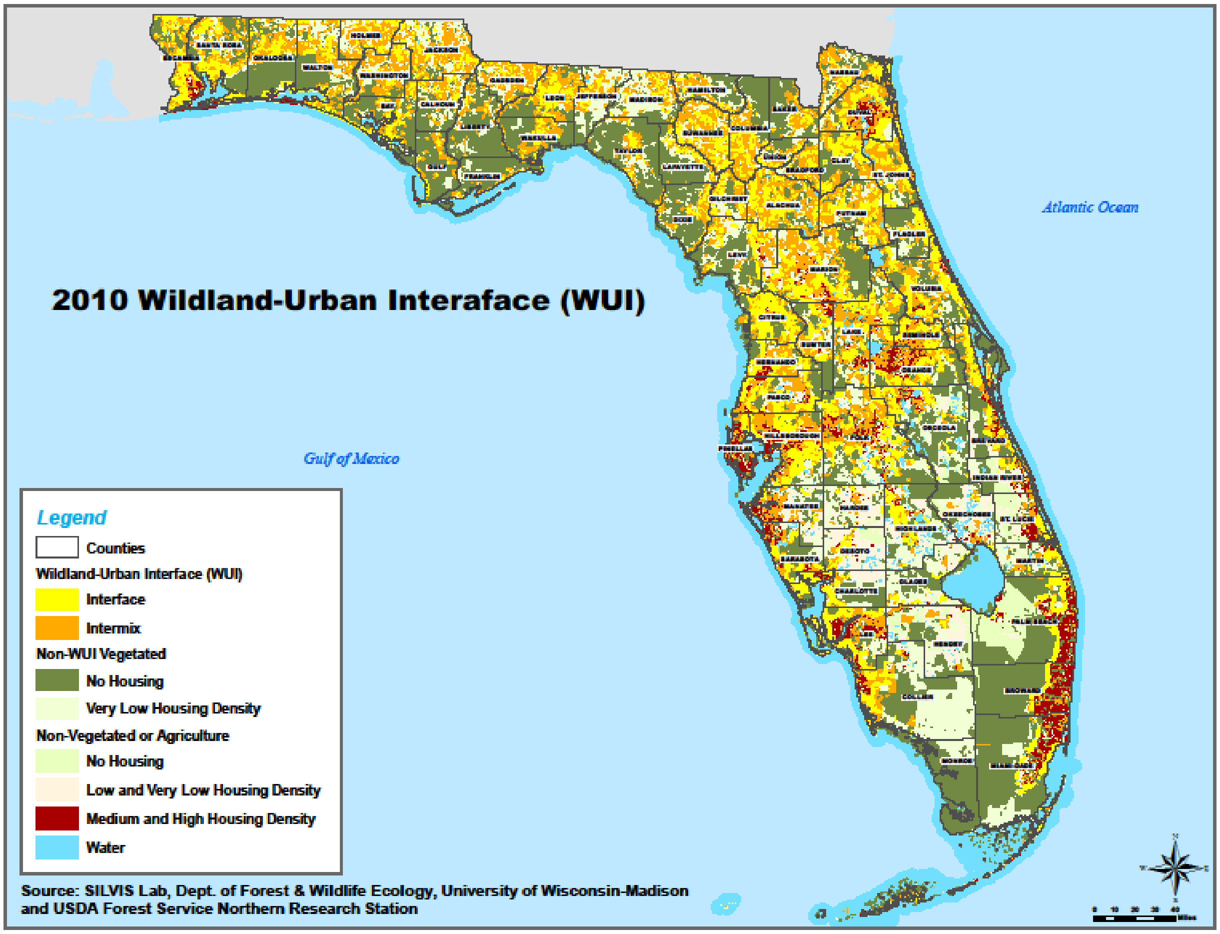
As explained before, the WUI areas of the state have increased. WUI areas are vulnerable to wildfires and can cause significant property damage. The WUI of the US was mapped in 2010, showing WU interface

(2013), https://www.globalchange.gov/sites/globalchange/files/NCAJan11-2013-publicreviewdraft-chap2-climate.pdf

90 Compiled from Florida Water Management District data.

areas and the intermix areas, as well as areas that were Non-WUI and vegetated, and areas that were Non-Vegetated or Agriculture. The 2010 data and analysis is the most recent of this kind.

Figure 66: Wildland-Urban Interface (WUI) 2010



This map allows visualization of the WU Interface and Intermix. It is clear that between very urban areas, such as the Tampa Bay region or the south east coast, shown in red, and vegetation areas, shown in green, there are areas that is known as WU Interface and Intermix, shown in yellow and orange.

3. Historical Occurrences of Wildfire

The most naturally caused wildland fires typically occur in July due to lightning strikes and coincide with the height of the thunderstorm season. Human-caused fires, such as arson, debris or trash burning, or sparking equipment, can occur any time of year but usually occur during the same season as wildfires. Table 3.37 includes a brief narrative for significant wildfires in the state from 2006 to 2016.

Table 34: Florida Significant Wildfires, 2006-2016

Date	Description
2007	Several wildfires burned across Florida for many weeks. Thick smoke from area wildfires forced officials to close stretches of I-75 and I-10 in northern Florida, among other main roads. The fires burned at least 101,000 acres in Florida. 5 wildfires were authorized to receive the FMAG grant.
2009	There were nearly 3,000 wildfires that burned 136,623 acres in Florida. Much of the activity occurred earlier than usual in the year.
2012	There was a heavy wildfire season with many road closures because of reduced visibility due to smoke. One multi-car accident on I-75 killed 11 people.

Since 1985, FEMA has authorized several Fire Management Assistance Grants (FMAG). The 1999 wildfire season was so severe that in addition to 11 FMAGs being authorized, an Emergency Declaration was made to assist with handling the fires. Below is a list of all the FMAG designations, plus the single major disaster declaration (DR) that Florida has received form FEMA.

Table 35: FEMA Fire Management Authorization Grant Declarations, Florida, 1985 – 2017

Date	Name/Description
May 17, 1985	Perry Fire, Aster Fire, Bonell Fire
May 20, 1985	Tomoka Fire
June 6, 1998	Pine Coast 98 Fire
June 16, 1998	Jacksonville Complex Fire
June 18, 1998	County Line Fire
June 19, 1998	Race Track – Waldo Fire, Waldo Southeast Fire, San Pedro Day Fire, Waccasassa Fire Complex
June 20, 1998	Bunnelle Fire Complex, Suwanee Fire Complex
June 21, 1998	Depot Creek Fire; Caloosahatchee Fire Complex
June 27, 1998	Withlacoochee Fire Complex
June 28, 1998	Orlando Fire Complex
April 13, 1999	Okeechobee Fire Complex, Wacasassa Fire Complex, Florida Fire Complex, Caloosahatchee Fire Complex, Chipola District Fire, Everglades District Fire, Tallahassee Fire District, Suwannee District Fire, Lakeland Fire, Myakka River District Fire
May 14, 1999	Jacksonville District Fire
April 11, 2000	Merritt Fire
May 15, 2000	Flowers – Myakka Fire Complex
May 19, 2000	Withlacoochee District Fire Complex
May 22, 2000	Lakeland District Fire Complex
May 28, 2000	Bunnell District Fire Complex
May 29, 2000	Waccasassa Fire Complex
June 2, 2000	Jacksonville Fire Complex
June 5, 2000	Suwannee Fire Complex
June 9, 2000	Perry Fire Complex

February 17, 2001	Lakeland Fire Complex
February 19, 2001	Okeechobee Fire Complex, Caloosahatchee Fire Complex
April 16, 2001	Orlando Fire Complex
April 17, 2001	Myakka Fire Complex, Everglades Fire Complex
May 14, 2001	Chipola River Fire Complex
May 15, 2001	Escambia Fire Complex
May 23, 2001	Perry Fire Complex
May 15 – June 26, 2006	Volusia Fire Complex
March 25 – 28, 2007	53 Big Pine Fire
May 1, 2007	Deland Fire Complex
May 7, 2007	Suwannee Fire Complex, Black Creek Fire, Caloosahatchee Fire Complex
May 29, 2007	Okeechobee Fire Complex
May 11, 2008	Brevard Fire Complex, Martin County Fire Complex
April 26 – May 31, 2011	Slope Fire
April 20, 2017	30th Avenue Fire
April 21, 2017	Lehigh Acres Fire, Indian Lakes Estate Fire

In addition to these FMAG designations, there has been one major disaster designation for a wildfire in Florida, named the Florida Extreme Fire Hazard, DR-1223, which occurred from May 25 until July 22, 1998.[91]

According to NCDC Storm Events Database, there were 118 reports of wildfires from 2006 until 2016. Some of these reports are regarding the same fire, but in different counties, so the true number is likely lower than 118.[92]

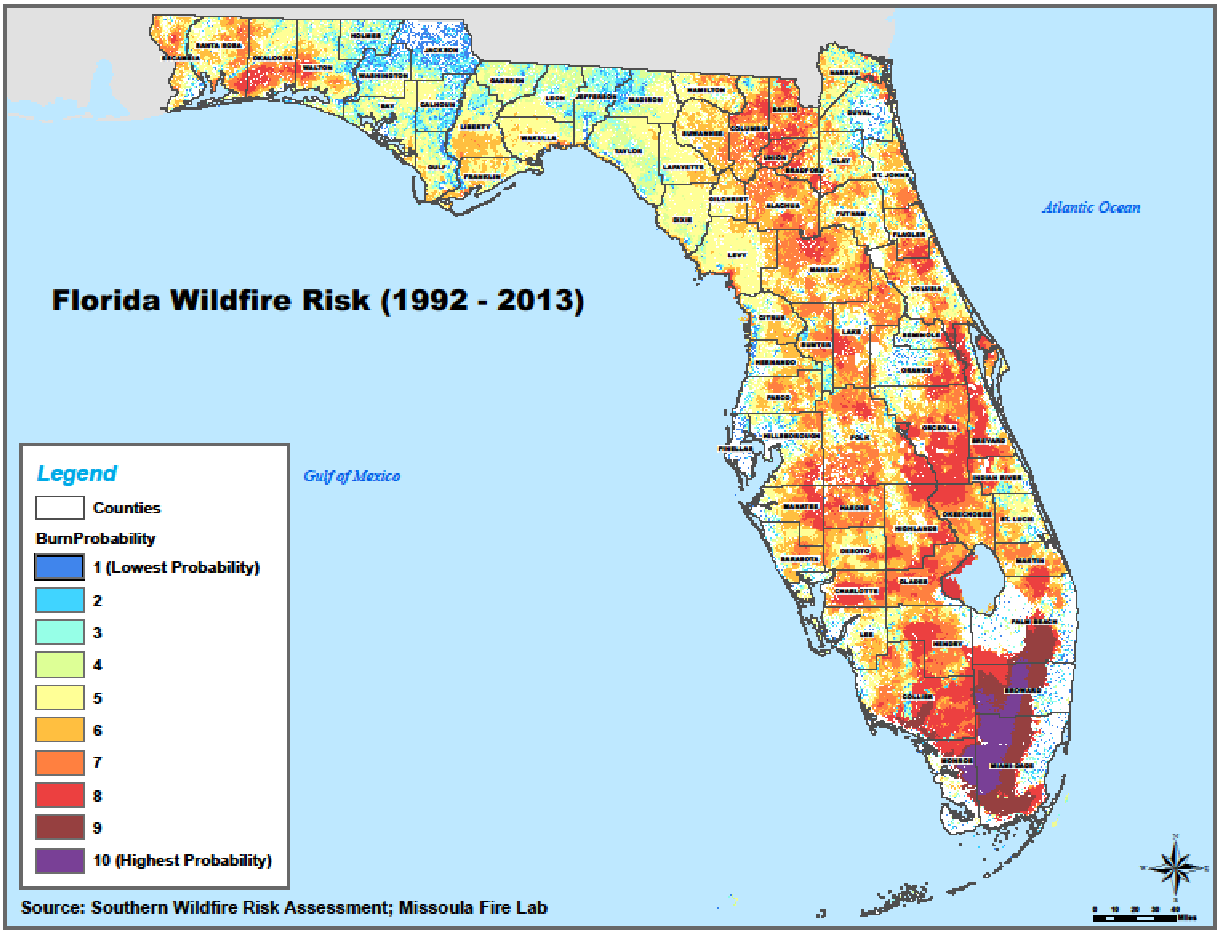
4. Probability of Future Occurrences of Wildfire

Below is a map showing the Burn Probability for Florida, based on historical data from 1992 to 2013.

[91] https://www.fema.gov/disasters?field_state_tid_selective=47&field_disaster_type_term_tid=6845&field_disaster_declaration_type_value=All&items_per_page=20&=GO

[92] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Wildfire&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2006&endDate_mm=12&endDate_dd=31&endDate_yyyy=2016&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Figure 67: Florida Wildfire Risk, 1992 – 2013[93]



According to this burn probability map, wildfires are likely to occur across most of the state, with a 5 through 10 probability, except for the central Panhandle region and other intermittent areas across the state. Areas in south Florida, in Monroe, Miami-Dade, Broward, and Palm Beach counties are likely to experience wildfires, with a 9 to 10 burn probability.

Florida has a year round fire season with the most active time being April to July, with the largest number of lightning-caused fires occurring in July. The dry months, combined with low humidity and high wind, tend to have the highest number of fires reported. Approximately 80 percent of all wildfires in Florida

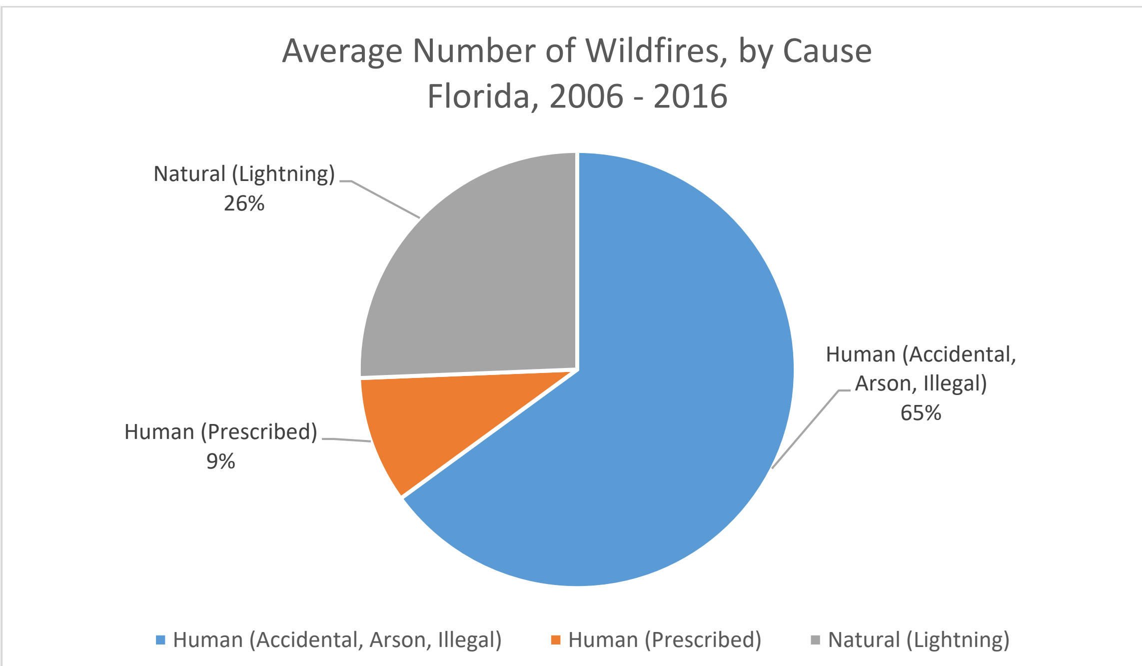
[93] *National burn probability (BP) and conditional fire intensity level (FIL) data were generated for the conterminous United States (US) using a geospatial Fire Simulation (FSim) system developed by the US Forest Service Missoula Fire Sciences Laboratory to estimate probabilistic components of wildfire risk (Finney et al. [2011]). The FSim system includes modules for weather generation, wildfire occurrence, fire growth, and fire suppression. FSim is designed to simulate the occurrence and growth of wildfires under tens of thousands of hypothetical contemporary fire seasons in order to estimate the probability of a given area (i.e., pixel) burning under current landscape conditions and fire management practices. The data presented here represent modeled BP and FIL for the conterminous US at a 270-meter grid spatial resolution.*

occur within one mile of the WUI. According to the map in the geographic section, most counties have a burn probability of at least 6 to 8 and south Florida has a burn probability of 9 to 10.

According to FFS and data about past wildfires, there is an average of 3,171 wildfires each year, burning an average of about 124,117 acres each year. Knowing this information, it is clear that wildfires are likely to occur in Florida each year. Specifically, there was an average of 2,357 human-caused wildfires each year, burning an average of about 70,059 acres per year, and an average of 813 lightning-caused wildfires each year, burning an average of about 54,058 acres per year.[94]

The chart below shows data from FFS and indicates there is an annual probability that approximately 65% of wildfires in Florida will be human caused, 9% of wildfires will be prescribed burns, and 26% of wildfires will occur from natural causes, such as from lightning strikes.

Figure 68: Average Wildfires by Cause, Florida, 2006 – 2016[95]



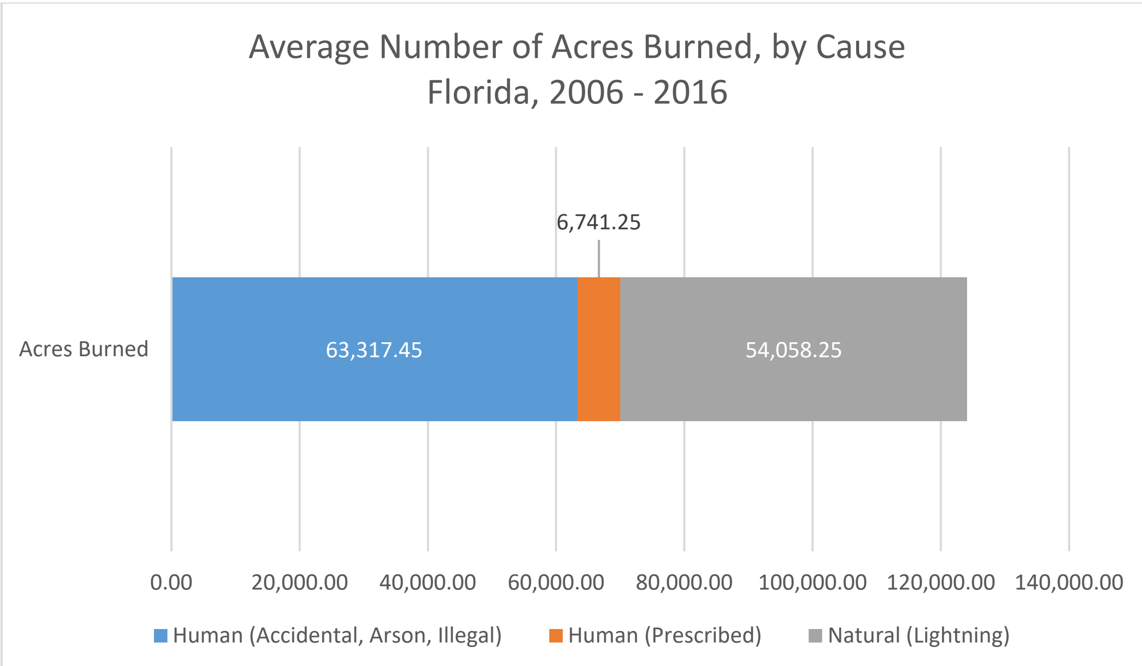
Furthermore, the chart below shows that there is an annual probability that approximately 124,000 acres will be burned by wildfire in Florida each year. Human caused (accidental, arson, illegal) accounts for about 51% of the wildfires, natural causes, such as lightning strikes, accounts for 43.6%, and Human caused (prescribed) burns cause 9.4% of wildfires each year.

---

[94] Florida Forest Service Report System, Fire by Causes, Statewide Summary 01/01/2006 through 12/31/2016. *Note: This data is an average of the wildfire occurrences from 2006 to 2016. It is important to note that this data does not include the fires that were managed by other agencies, such as the Department of Defense, US Fish and Wildlife Service, the National Parks Service, and the Bureau of Indian Affairs, all federal or tribal agencies that assist the State of Florida with managing wildfires on non-state owned land.*

[95] Florida Forest Service Report System, Fire by Causes, Statewide Summary 01/01/2006 through 12/31/2016

Figure 69: Average Acres Burned by Cause, Florida, 2006 – 2016[96]



According to the NCDC Storm Events Database, there are an average of 12 wildfires each year.[97]

The statewide wildfire hazard mitigation plan provides additional information on wildfires in Florida. Please see *Appendix G: Wildfire Hazard Mitigation Plan Annex* for a copy of the plan.

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

5. Wildfire Impact Analysis

- People
  - Injury or death from fire
  - Injury or death from smoke inhalation
  - Injury or death while evacuating
  - Vehicle accidents due to decreased visibility due to smoke
- Responders
  - Injury or death during wildfire suppression, especially during high wind conditions
  - Injury or death from vehicle accidents due to decreased visibility
  - Injury or death from evacuation and rescue missions
  - Injury or death from smoke inhalation
- Continuity of Operations (including continued delivery of services)

[96] Florida Forest Service Report System, Fire by Causes, Statewide Summary 01/01/2006 through 12/31/2016
[97] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Wildfire&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2006&endDate_mm=12&endDate_dd=31&endDate_yyyy=2016&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

- Inability to operate businesses if evacuations are ordered, leading to lost wages and revenue
- Employee absenteeism if employees are evacuated
- Blocked transportation routes because of decreased visibility

- Property, Facilities, Infrastructure
  - Damage or loss to personal structures and businesses
  - Damage or loss to critical infrastructure such as schools, hospitals, government buildings, utilities, etc.
  - Damage or loss to agricultural crops and timber, which leads to loss of income and loss of revenue
- Environment
  - Damage or loss to large forested areas
  - Damage or loss to habitats
- Economic Condition
  - Closure of businesses if in evacuee area leading to lost wages and revenue
  - Employee absenteeism leading to forced business closure which results in lost wages and lost revenue
  - Damage or loss to agricultural crops and timber, which leads to loss of income and loss of revenue
  - Loss of tourism if wildfires are in popular tourist areas
- Public Confidence in Jurisdiction's Governance
  - Lost confidence if evacuations not ordered, messaged, and coordinated effectively
  - Lost confidence if many deaths from wildfires from those that did not evacuate

6. 2018 LMS Integration

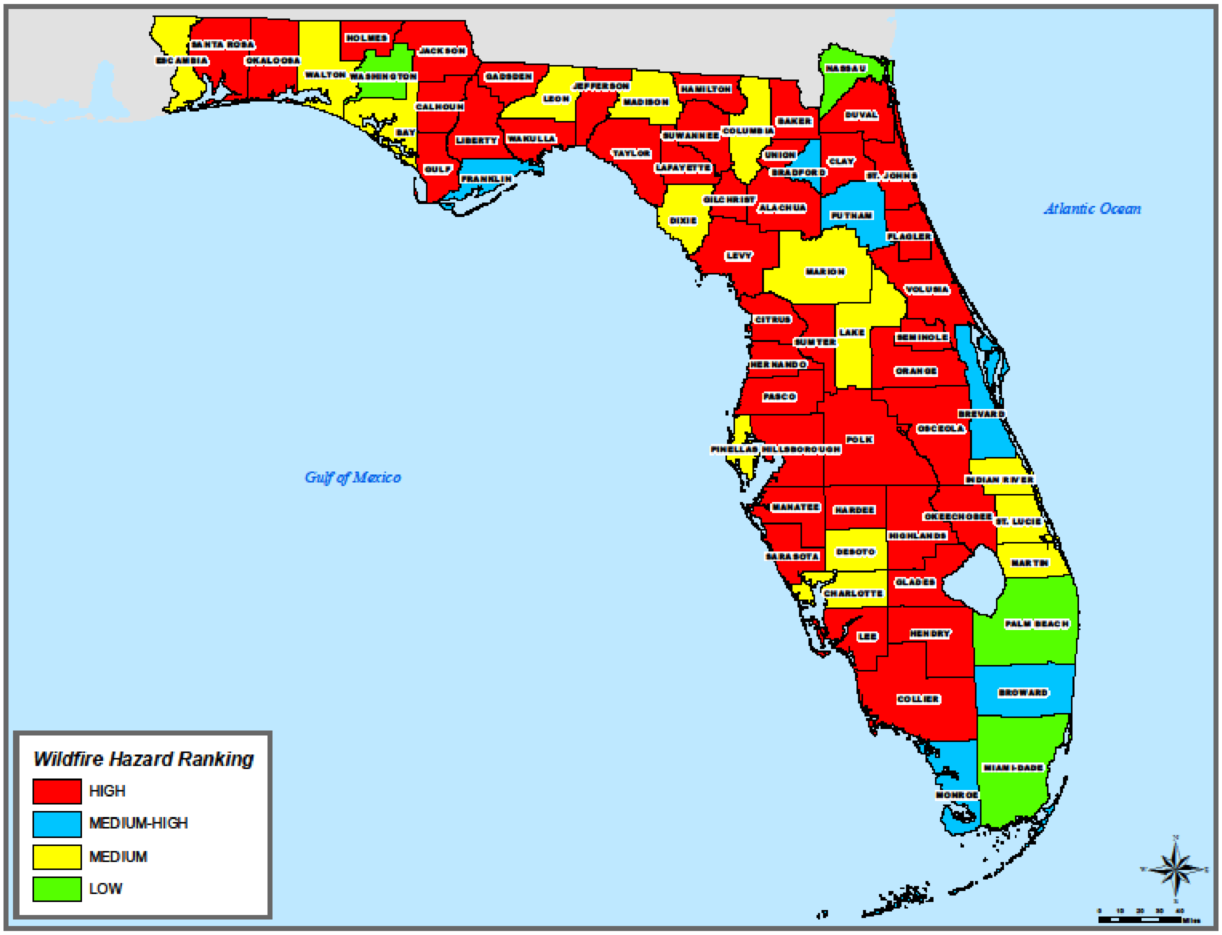
An analysis of all 67 Florida County LMS Plans and their individual wildfire hazard rankings is shown below. All counties identified wildfire as a hazard.

Wildfires

Based on the LMS plans, Figure 3.38 displays the jurisdictional rankings for the wildfire hazard. All counties have identified wildfires as one of their hazards.

- High-risk Jurisdictions: 42
- Medium-High-risk Jurisdictions: 6
- Medium-risk Jurisdictions: 15
- Low-risk Jurisdictions: 4
- Not identified Jurisdictions: 0

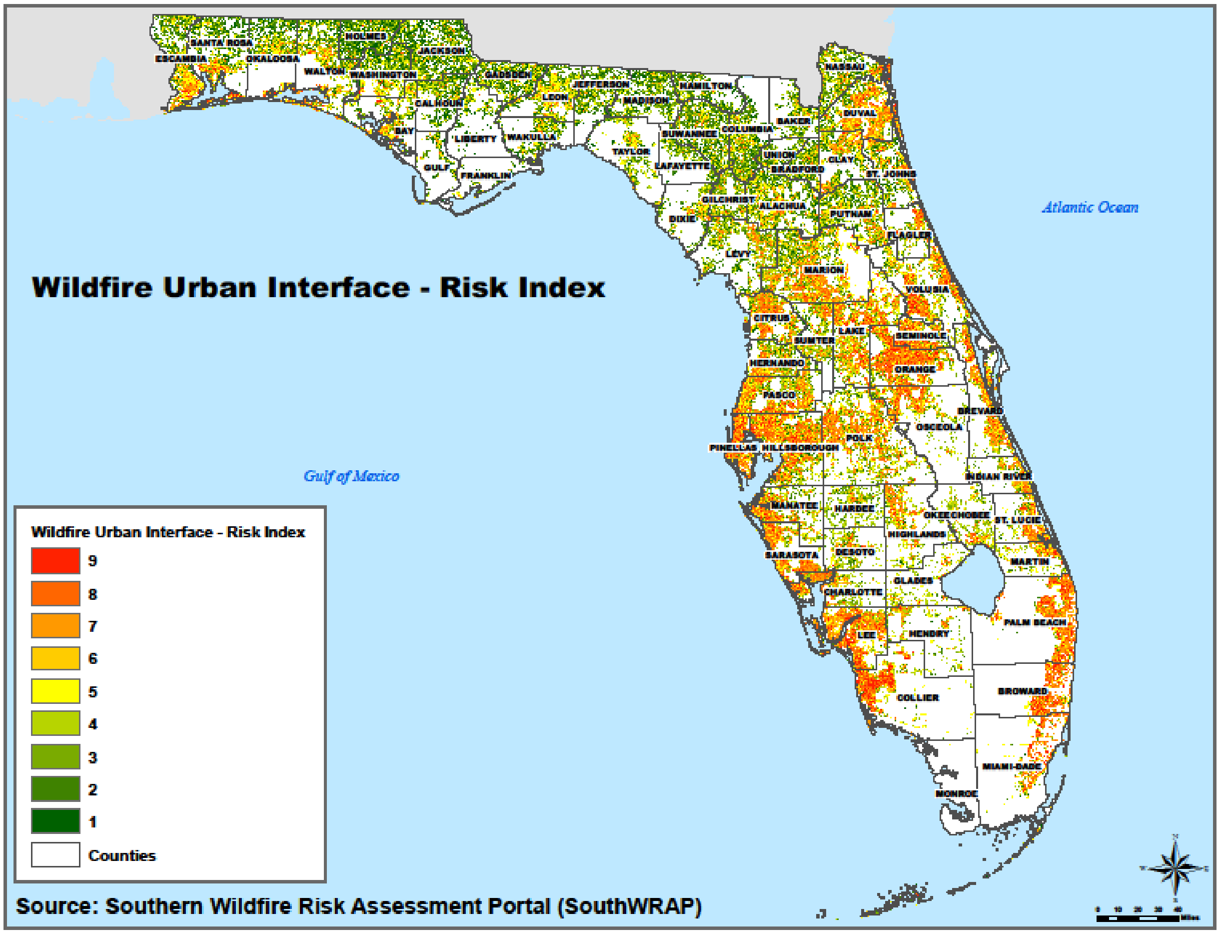
Figure 70: Wildfire Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Burn Probability map above shows that most of the state has a mid-range burn probability, but southern counties, such as Palm Beach, Broward, and Miami-Dade, have the highest burn probability, between 9 and 10.

Figure 71: Wildland Urban Interface Risk Index



This map is similar to the WUI area map above and shows the risk for WUI fires. These maps are similar because they both highlight the WUI areas in the state of Florida. The areas with a high WUI fire risk index are vulnerable because they are highly populated and near forested areas. Coastal areas and the central Florida region have a WUI risk index between 6 and 9.

According to NCDC Storm Events Database, the average (based on data from 2006 to 2016) annual property loss due to wildfires in Florida is $2.81 million.[98]

Table 36: NCDC Wildfires, 2006 – 2016

NCDC Storm Event (hazard)	Average Wildfires per Year	Annualized Property Loss ($Millions)	Annualized Crop Loss ($Millions)
Wildfires	12	2.81	0

[98] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Wildfire&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2006&endDate_mm=12&endDate_dd=31&endDate_yyyy=2016&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

While updated statewide loss estimation information was not possible to obtain, the data in the 2013 Wildfire Mitigation Plan Annex is still a good reference. Additionally, there are examples of how much wildfires can cost. After six weeks of wildfires across 18 counties in northeastern Florida in 1998, the following losses were calculated:[99] [100]

- Commercial timer (softwood) losses: $322 million to $509 million
- Property losses: $10 million to $12 million
- Tourism and trade losses: $140 million

Overall, urban coastal communities, particularly in south Florida, and some parts of central Florida, are vulnerable to wildfires.

8. Vulnerability Analysis and Loss Estimation, of State Facilities

An update of the state facility vulnerability analysis and loss estimation was not possible to obtain in 2017. It can be inferred however, that state facilities in the areas mentioned above, such as the urban coastal communities, are vulnerable to wildfires.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 11.

[99] Butry and others 2001
[100] https://www.fs.fed.us/openspace/fote/reports/GTR-299.pdf

<table>
<tr><th colspan="5">WILDFIRE</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Wildfire, or wildland fire, is a fire that was started by lightning or by humans in an area with vegetation. Wildfires occur in Florida every year and at all times of the year and are part of the natural cycle of Florida’s fire-adapted ecosystems. Wildfires can cause major environmental, social, and economic damages because of the possible loss of life, property, wildlife habitats, and timber.</td><td rowspan="5">HIGH</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>Medium</td><td>Medium</td><td>High</td></tr>
</table>

Coastal Erosion Hazard Profile

1. Coastal Erosion Description

Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. Waves generated by storms cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely in the temporary redistribution of coastal sediments. The study of erosion and sediment redistribution is called “coastal morphodynamics,” which can be described also as the dynamic interaction between the shoreline, seabed, and water.

The ability of waves to cause erosion depends on a number of factors, which include:

- Erodibility of the beach, cliff, or rocks;
- Power of the waves to cross the beach;
- Lowering of the beach or shore platform through wave action; and
- Near shore bathymetry.

For example, waves must be strong enough to remove material from the debris lobe for erosion to occur. Additionally, beaches can help dissipate wave energy on the foreshore and can provide a measure of protection to cliffs, rocks, and other harder formations, as well as any area upland.

Below is a table with the majority of the contribution factors to erosion. The factors are organized by first, second, and third orders depending on how the erosion occurs.

Table 37: Erosion Contribution Factors

First Order	Second Order	Third Order
Geological structure and lithology a) Hardness b) Height, etc. c) Fractures/faults d) Wave climate e) Prevailing wave direction f) Sub-aerial climate g) Weathering (frost, etc.) h) Stress relief swelling/ shrinkage i) Water-level change j) Groundwater fluctuations k) Tidal range l) Geomorphology	• Weathering and transport slope processes • Slope hydrology • Vegetation • Cliff foot erosion • Cliff foot sediment accumulation • Resistance of cliff foot sediment to attrition and transport	• Coastal land use • Resource extraction • Coastal management

As beaches are constantly moving, building up here and eroding there, in response to waves, winds, storms, and relative sea level rise, this issue requires long-term analysis and planning. The current beach-erosion problem has many causes, including the following items:

- The desire by many to live near the sea.
- A historically rapid rise in average ocean levels, now estimated to be rising at about 25–30 centimeters per century in much of the United States.
- The gradual sinking of coastal land (since the height of the land and the sea are both changing, the "relative sea level rise" is used to describe the rise of the ocean compared to the height of land in a particular location).
- Efforts to reduce erosion that have proved to be ineffective and instead increased it.

Some erosion changes are slow, inexorable, and usually gradual. However, the changes on a beach can happen overnight, especially during a storm. Even without storms, sediment may be lost to longshore drift (the currents that parallel coastlines), or sediment may be pulled to deeper water and lost to the coastal system. Coastal erosion may also be caused by the construction and maintenance of navigation inlets. There are over 60 inlets across Florida, many of which have been artificially deepened to accommodate commercial and recreational vessels. Jetties are also installed to prevent sediment from filling in these inlets. A consequence of this practice is that the jetties and inlets interrupt the natural flow of sediment along the beach, leading to an accumulation of sediment in the inlet and at jetty on one side of the inlet, and a loss of sediment to beaches on the other side of the inlet. There are many solutions to the major problem of beach erosion, including:

- <u>Beach re-nourishment</u>: Sand is purposefully deposited onto the beaches by humans; however, there is a very high cost associated with the solution.
- <u>Rebuild rivers</u>: Direct rivers back into places with a lack of sediment with the intention that the rivers will push the sediment back into place.
- <u>Breakwaters, sea walls, and groins</u>: While each location has different requirements that drive specific development and construction, these types of structural projects are intended to interfere with erosion. There are however some flaws and issues with these types of projects as they can trap as much sediment as they deposit with down-drift effects.
- <u>Limits on beach development</u>: Limit, restrict, or prohibit development on the impacted beaches.

Florida has 825 miles of sandy beach coastline fronting the Atlantic Ocean, the Gulf of Mexico, and the Straits of Florida. The beaches in Florida serve many critical purposes. For example, the beaches are home to several species of plants and animals that are dependent upon beaches, dunes, and near shore waters for all or part of their lives. In fact, there are over 30 rare species within the state that inhabit the beach and adjacent habitats. These species have adapted to living in the beach's harsh environment of salt spray, shifting and infertile sand, bright sunlight, and storms. Additionally, people visit Florida beaches at very high rates. Tourists and residents visit the beaches and coastal waters to relax, tan, swim, boat, fish, and dive.[101]

[101] http://www.dep.state.fl.us/beaches/

According to the Beach Management Funding Assistance Program (BMFA) within Florida Department of Environmental Protection (FDEP) (formerly the Beach Erosion Control Program), there are many stretches of shoreline that has been critically eroded. Critically eroded shoreline is defined as,

> *"a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects".*

Therefore, critically eroded beaches are those in which there is a threat or loss of one of four specific interests: upland development, recreation, wildlife habitat, or important cultural resources. Non-critically eroded beaches are those in which there may be significant erosion conditions, but there is currently no public or private interest threatened. In Florida, the 2016 Critical Erosion Report from FDEP states there are:

- 411.2 miles of critically eroded beach
- 8.7 miles of critically eroded inlet shoreline
- 93.5 miles of non-critically eroded beach
- 3.2 miles of non-critically eroded inlet shoreline

This is shown below in the map.

Figure 72: Critical Erosion Areas, Florida, 2106 [102]

Additionally, there are some areas where the erosion is not significant.

According to FDEP, roughly half of the designated critically eroded beaches are currently managed with restoration efforts such as placement of beach fill material. While these areas are improved from their eroded status, they are kept on the critically eroded list to ensure monitoring and continued eligibility for projects and funding.[103]

Beach Management Funding Assistance (BMFA) Program

The primary vehicle for implementing the beach management planning recommendations is the Florida Beach Erosion Control Program (BECP) within FDEP (formerly the Beach Erosion Control Program), a program established to work in concert with local, state, and federal governmental entities to achieve the protection, preservation, and restoration of the coastal sandy beach resources of the state. Under the program, financial assistance in an amount of up to 50 percent of project costs is available to Florida's

[102] http://www.dep.state.fl.us/beaches/publications/pdf/CriticalErosionReport.pdf
[103] http://www.dep.state.fl.us/beaches/publications/pdf/CriticalErosionReport.pdf

county and municipal governments, community development districts, or special taxing districts for shore protection and preservation activities. Eligible activities include beach restoration and nourishment activities, project design and engineering studies, environmental studies and monitoring, inlet management planning, inlet sediment transfer, dune restoration and protection activities, and other beach erosion prevention-related activities consistent with the adopted Strategic Beach Management Plan.

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Low, meaning no injuries or deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

Potential Effects of Climate Change on Erosion

Both increased rates of global eustatic sea level rise and increased frequency of higher intensity hurricanes may affect coastal erosion. As described in *Section 3.3.1 Flooding*, continued atmospheric warming could increase rates of global eustatic sea level rise. In the absence of offsetting changes in natural sediment supply, sand beaches will erode more rapidly as the rate of sea level rise increases. If the frequency of higher intensity hurricanes does increase (*see section 3.3.2 Tropical Cyclones*), events will occur more often when sand eroded from beaches is transported to depths from which it will not be moved back on shore by swell waves. More frequent category 4 and 5 hurricanes also would increase incidence of dune erosion and over wash where beach sediments are carried landward. These processes can damage structures, but where structures are not present, the over wash process can permit a beach and dune system to migrate landward.[104] Rising sea levels also threaten the survival of coastal wetlands when natural rates of sediment accretion and elevation increase are not fast enough to offset the rising sea.[105] However, wetlands also may be able to migrate landward with adequate sediment influx if there are no physical barriers to their movement.

[104] *(Gutierrez et al. (2009). Ocean coasts. http://papers.risingsea.net/coastal-sensitivity-to-sea-level-rise-3-ocean-coasts.html; In Titus et al. (Eds.), Coastal sensitivity to sea-level rise: A focus on the mid-Atlantic region. http://downloads.globalchange.gov/sap/sap4-1/sap4-1-final-report-all.pdf.).*

[105] *(Cahoon et al. (2009). Coastal wetland sustainability. http://papers.risingsea.net/coastal-sensitivity-to-sea-level-rise-4-wetland-accretion.html; In Titus et al. (eds.), Coastal sensitivity to sea-level rise: A focus on the mid-Atlantic region.).*

2. Geographic Areas Affected by Coastal Erosion

The Bureau of Beaches and Coastal Systems develops and publishes annually the Critically Eroded Beaches Report. The data from this report is gathered from a set of monitoring locations along the coast throughout the state. Data is collected from each of these stations, and then compiled into a GIS database for modeling and analysis. The continual reporting and analysis is combined with the historical data for detailed records about the status of the state's beaches. Erosion is a constantly changing issue as development continues on the beaches and in the inlets. It can also be instantly changed by a large storm or a hurricane.

The August 2016 Critically Eroded Beaches in Florida Report[106] (*Appendix I*)states that there are 411.2 miles of critically eroded beach and 93.5 miles of non-critically eroded beach. There are also 8.7 miles of critically eroded inlet shoreline and 3.2 miles of non-critically eroded inlet shoreline. The map shown before depicts this information.

3. Historical Occurrences of Coastal Erosion

DEP maintains a database of all the occurrences of erosion in the state with high quality reporting since the inception of the BMFA Program. There are constantly cases of beach erosion throughout the state, and the 2013 revision reflects agreement that each previous occurrence would not be listed in this section.

The disastrous hurricane seasons of 2004–2005 had a severe impact on the state in terms of erosion, and DEP has published a number of reports about the specific details of these events. A number of these events are listed below in Table 38.

Table 38: Florida Significant Erosion Contribution Events[107]

Year	Event
1972	Hurricane Agnes
1975	Hurricane Eloise
1979	Hurricanes David and Frederick
1984	Thanksgiving Day Nor'easter
1982	"no-name" storms
1985	Hurricanes Elena and Kate and Tropical Storms Bob and Juan
1992	Hurricane Andrew
1993	Winter storm
1995	Hurricanes Erin and Opal
1998	Hurricanes Earl and Georges
1999	Hurricanes Floyd and Irene
2004	Hurricanes Charley, Frances, Ivan, and Jeanne,
2005	Hurricanes Dennis, Katrina, Ophelia, Rita, and Wilma,
2008	Tropical Storm Fay and Hurricane Gustav
2012	Hurricane Isaac and Sandy and Tropical Storm Debby

106 http://www.dep.state.fl.us/beaches/publications/pdf/CriticalErosionReport.pdf
107 http://www.dep.state.fl.us/beaches/publications/pdf/SBMP/SBMP-Introduction.pdf

Table 39: Historical Beach Erosion Control Program, 2006-2016[108]

Date	Description
2006	Report stated: • 385.2 miles of critical beach erosion, • 96.8 miles of non-critical beach erosion, • 8.6 miles of critical inlet erosion, and • 3.2 miles of non-critical inlet erosion.
2008	Report stated: • 396.4 miles of critical beach erosion, • 95.5 miles of non-critical beach erosion, • 8.9 miles of critical inlet erosion, and • 3.2 miles of non-critical inlet erosion.
2010	Report stated: • 398.6 miles of critical beach erosion, • 95.9 miles of non-critical beach erosion, • 8.6 miles of critical inlet erosion, and • 3.2 miles of non-critical inlet erosion.
2012	Report stated: • 397.9 miles of critical beach erosion, • 96.2 miles of non-critical beach erosion, • 8.7 miles of critical inlet erosion, and • 3.2 miles of non-critical inlet erosion.
2016	Report stated: • 411.2 miles of critical beach erosion, • 93.5 miles of non-critical beach erosion, • 8.7 miles of critical inlet erosion, and • 3.2 miles of non-critical inlet erosion.

4. Probability of Future Occurrences of Coastal Erosion

The beaches of Florida will continue to shift and change over time, especially when faced with the current levels of development. During the 2013 plan revision process, it was agreed that this hazard will continue to affect the state, and there is considerable work being done regularly to mitigate potential damages. DEP maintains an active and on-going program to study this issue and mitigate damages as much as possible. The Mitigate FL Team considers this a high probability hazard, especially in conjunction with hurricanes, winter storms, and coastal flooding, and considering the likelihood of future development in coastal areas. There is a very high probability that this hazard will continue to affect the state in the future. Coastal erosion has occurred in Florida since the start of such record keeping. Additionally, coastal flooding will continue to occur, whether it is due to tropical storms or sea level rise, or both. While it

[108] http://www.dep.state.fl.us/beaches/publications/tech-rpt.htm

would be best to keep areas prone to coastal erosion undeveloped, the Mitigate FL Team recognizes this is unlikely and that future development in coastal areas will increase the probability of coastal erosion affecting developed areas.

This hazard was determined to occur annually, giving it a Probability of Very Likely.

5. Impact Analysis of Coastal Erosion

- Public
  - May lose property
  - May lose sandy beaches, dunes or mangroves, which could lead to storm surge flooding
  - Sandy beaches may have to close
- Responders
  - N/A
- Continuity of Operations (including continued delivery of services)
  - Businesses, critical infrastructure, government buildings, etc. may have operations hindered if erosion leads to damage to the structure
  - Operations may be hindered if roads to the structures are damaged from erosion
  - Continuity of transportation network may be interrupted because of erosion damage to roads
- Property, Facilities, Infrastructure
  - Structures may be damaged when coastal erosion damages the ground
- Environment
  - Coastal areas, marshes, mangroves, sandy beaches etc. may be severely damaged from coastal erosion which is a habitat for many species of plants and animals
  - If large portions of coastal areas and dunes are washed away from coastal erosion, storm surge from the next storm could reach homes, businesses, roads, etc.
- Economic Condition
  - N/A
- Public’s Confidence in Jurisdiction’s Governance
  - If damage from coastal erosion, such as damage to roads, is not quickly repaired, then the public may be frustrated with the jurisdiction’s governance

6. 2018 LMS Integration

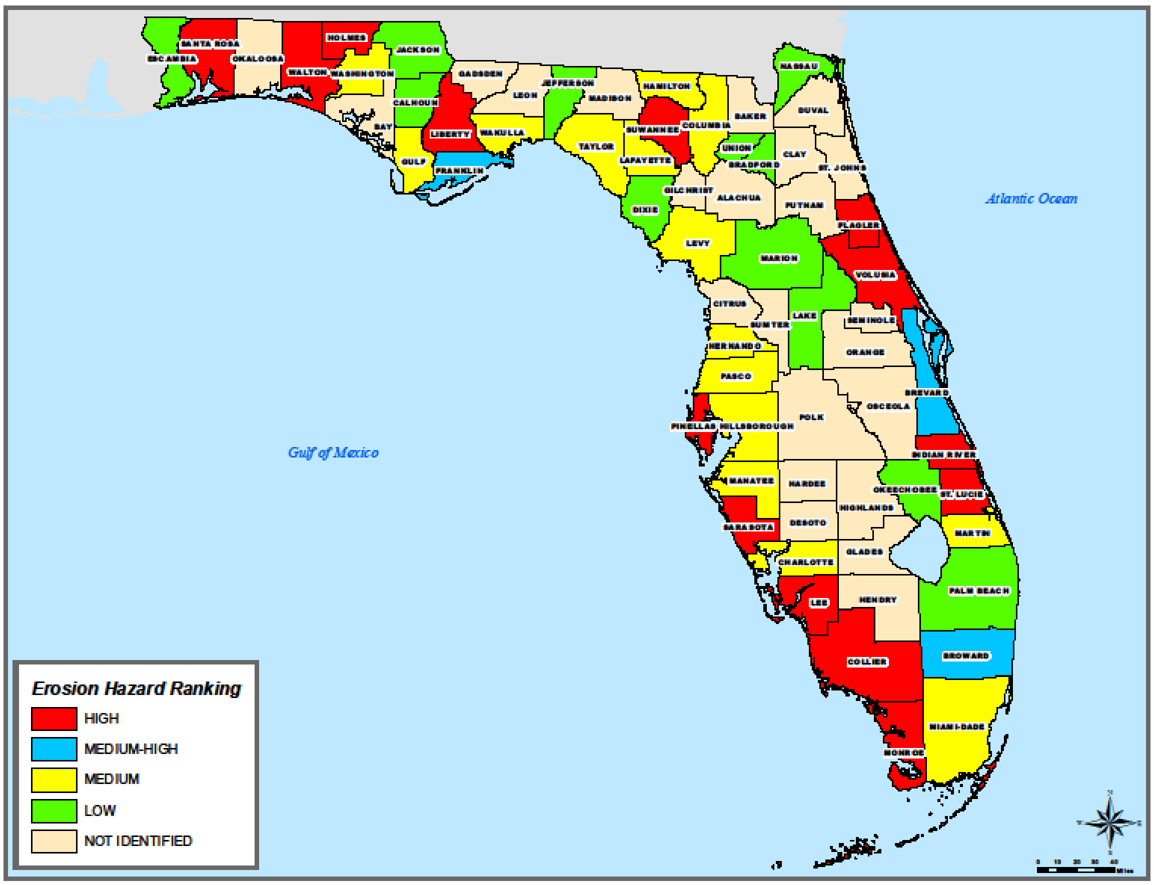
Mitigate FL focused on producing a statewide probability analysis based on estimates provided by all State of Florida LMS plans. The 67 multi-jurisdictional LMS plans provided a solid baseline for the overall state probability analysis. The following pages having the risk assessment information for erosion in the State of Florida.

Erosion

Based on the LMS plans, Figure 73 displays the jurisdictional rankings for the erosion hazard. Not all counties have identified erosion as one of their hazards.

- High-risk Jurisdictions: 14
- Medium-High-risk Jurisdictions: 3
- Medium-risk Jurisdictions: 15
- Low-risk Jurisdictions: 12
- Not identified Jurisdictions: 23

Figure 73: Erosion Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

In the June 2015 Strategic Beach Management Plan, the critically eroded shorelines were listed by region along with the levels of management. Table 40 lists those values.

Table 40: Florida Critically Eroded Managed Shoreline by Region[109]

Region	Critically Eroded Beaches (miles)	Critically eroded managed beaches (miles)	% of critically eroded beaches that are managed
Northeast Atlantic Coast	56.0	21.6	39
Central Atlantic Coast	82.7	45.3	55
Southeast Atlantic Coast	72.1	45.8	64
Florida Keys	10.2	1.5	15
Panhandle Gulf	84.3	51.9	62
Big Bend Gulf	2.3	0.2	9
Southwest Gulf	102.3	61.1	60
TOTAL	**409.9**	**227.4**	**56**

The table above summarizes the number of critical and non-critical erosion beaches, in miles, by region.

Additional information on the erosion areas for each coastal county fronting on the Atlantic Ocean, Gulf of Mexico, and Straits of Florida is available from FDEP, Bureau of Beaches and Coastal Systems. The listing of critical and non-critical erosion areas are identified by the Bureau's reference movement system (R numbers) or by virtual stations (V numbers). A few areas are not identified by either the R or V numbers because they are not included in the coastal construction control line program, nor have virtual stations been designated. These areas without R or V numbers are usually inlet shoreline areas, Florida Keys erosion areas, coastal bend erosion areas, and a few barrier islands in Pinellas, Hillsborough, and Collier counties.

It was recognized in previous plan updates to estimate losses related directly to erosion. This is because some erosion occurs long term, to be monitored over years, and some occurs quickly after just one storm. Additionally, damage from tropical storms and hurricanes is usually not directly because of erosion and the damages that are directly related to erosion are usually small, on private property and are not reported.

The FDEM, Mitigation FL, and DEP determined that a better way to estimate potential losses from erosion was to analyze the various projects and initiatives that DEP manages in order to protect and revitalize the state's beaches. The DEP program is authorized by Section 161.101, Florida Statutes. Since its inception in 1964, BMFA Program (formerly BECP) has been a primary source of funding to local governments for beach erosion control and preservation activities. Eligible activities include:

- Beach restoration and nourishment activities
- Project design and engineering studies
- Environmental studies and monitoring
- Inlet management planning
- Inlet sand transfer
- Dune restoration and protection activities

[109] http://www.dep.state.fl.us/beaches/publications/pdf/SBMP/SBMP-Introduction.pdf

- Other beach erosion prevention-related activities consistent with the adopted Strategic Beach Management Plan

Below are the appropriations through the program for the last 10 years. This shows that losses from coastal erosion are consistently in the tens of millions of dollars each year.

Table 41: Beach Management Funding Program, Appropriations [110]

Fiscal Year	Allocation
FY 07/08	$47,416,188
FY 08/09	$21,935,695
FY 09/10	$15,000,000
FY 10/11	$16,536,535
FY 11/12	$16,251,074
FY 12/13	$21,863,814
FY 13/14	$37,456,300
FY 14/15	$47,271,537
FY 15/16	$32,106,500
FY 16/17	$32,562,424

8. Vulnerability Analysis and Loss Estimation, of State Facilities

A vulnerability analysis of state facilities to the coastal erosion hazard would not be appropriate. Coastal erosion occurs only in specific locations along the coastline and few, if not none, of the state facilities are located in these coastline areas. Because of this, the vulnerability analysis has shown that state facilities are not vulnerable to coastal erosion. Because the state facilities are not vulnerable to coastal erosion, there will not be a loss estimation of state facilities to coastal erosion.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 11.

[110] FDEP BMFA grant program

EROSION					Overall Vulnerability
Overview					
Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. Waves generated by storms cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely in the temporary redistribution of coastal sediments.					HIGH
Frequency	Probability	Magnitude			
		Injuries/Deaths	Infrastructure	Environment	
Very Likely	Very Likely	Low	Medium	Medium	

Extreme Heat Hazard Profile

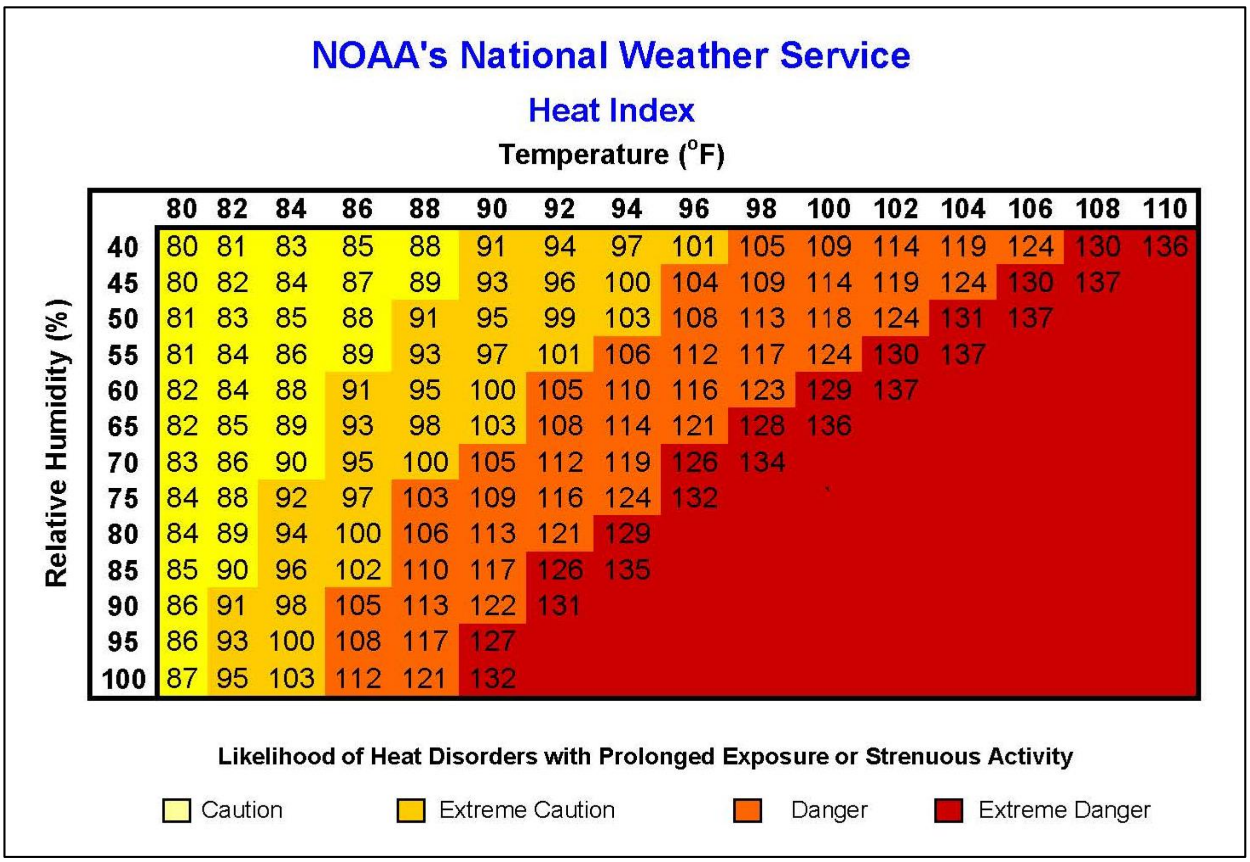
1. Extreme Heat Description

Extreme heat is defined as extended period where the temperature and relative humidity combine for a dangerous heat index.[111] Extreme heat events occur across the state each year. This hazard is focused on the effects to the human population, while drought focuses more on environmental interests.

Heat Index

The Heat Index is a measure of how hot the temperature feels when humidity is factored in with the actual temperature. The Heat Index chart is below. The red area indicates extreme danger. The NWS will begin to issue alerts when the heat index is expected to exceed 105-110 degrees Fahrenheit for at least two consecutive days.[112]

Figure 74: Heat Index



RH (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

111 http://www.nws.noaa.gov/os/heat/index.shtml
112 http://www.nws.noaa.gov/os/heat/heat_index.shtml

Advisories

The National Weather Service issues the following heat-related advisories:

- Excessive Heat Outlook: issued when the potential exists for an excessive heat event within the next 3-7 days.
- Heat Advisory: issued within 12 hours of extremely dangerous heat conditions.
- Excessive Heat Watch: issued when conditions are favorable for an excessive heat event within the next 24 to 72 hours; this is used when the risk of a heat wave has increased but the timing is still uncertain.
- Excessive Heat Warning: issued within 12 hours of extremely dangerous heat conditions.

Heat Related Illness

Extreme heat can cause death by making it difficult for a body to cool itself. Heat illnesses occur when the body temperature increases too quickly to cool itself or when too much fluid or salt is lost through dehydration or sweating. Older adults, young children, and those who are sick or overweight are more likely to succumb to extreme heat. Below are the different types of heat-related illnesses.[113]

Heat Cramps

Heat Cramps are the first sign of a heat illness and can lead to more serious illnesses. Symptoms of heat cramps include muscular pains and spasms, usually in the legs or abdomen.

Heat Exhaustion

Heat exhaustion follows heat cramps if the body is not able to cool itself. Symptoms include heavy sweating; weakness; cool, pale, clammy skin; a fast and weak pulse; dizziness; nausea or vomiting; and fainting.

Heat Stroke

Heat stroke usually occurs by ignoring the signs of heat exhaustion and is life-threatening. Signs of heat stroke include extremely high body temperature, red skin, changes in consciousness, rapid and weak pulse, rapid shallow breathing, confusion, vomiting, and seizures. This occurs because the body becomes overwhelmed by heat and begins to stop functioning. There are two types of heat stroke, classical and exertional. Classical heat stroke occurs when an individual is unable to maintain thermal equilibrium due to medication, injury, chronic illness, or age. Exertional heat stroke occurs when young and healthy individuals are engaged in strenuous activity in hot and humid weather.

Additionally, other chronic illnesses may become exacerbated by heat-related illnesses. For example, those with cardiovascular disease and other heart conditions may not be able to tolerate the increased cardiac output associated with heat illnesses. People with mental health disorders and certain behavioral disorders, such as substance abuse, are at higher risk for morbidity and mortality during extreme heat

[113] http://www.nws.noaa.gov/om/hazstats.shtml#

events. Those with respiratory diseases and Type I and II diabetes are also at higher risk for morbidity and mortality with increased heat exposure.[114]

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

Potential Effects of Climate Change on Extreme Heat

Average global temperatures are expected to increase anywhere from 4 to 12 degrees Fahrenheit by the end of the 21st century.[115] Average global temperatures move in tandem with extreme temperatures, suggesting that in the future extreme heat events will become more frequent and last longer with an overall warming trend.

According to analysis of 360 U.S. cities and the combination of several climate model projections, Florida will likely see an increase in days when the heat index is above 105 degrees Fahrenheit by 2050. Cities in Florida that are expected to experience these extreme temperatures in 2050, more often than they do now include Fort Meyers, Naples, Punta Gorda, Miami, Lakeland, Tampa, Sarasota, Port St. Lucie, Orlando, Vero Beach, Ocala, Palm Bay, and Gainesville.[116] While it is likely that cycles of cool periods and warm periods will continue in the future, it is believed that the overall long-term trend is projected to be an increase in the number of extreme heat events.

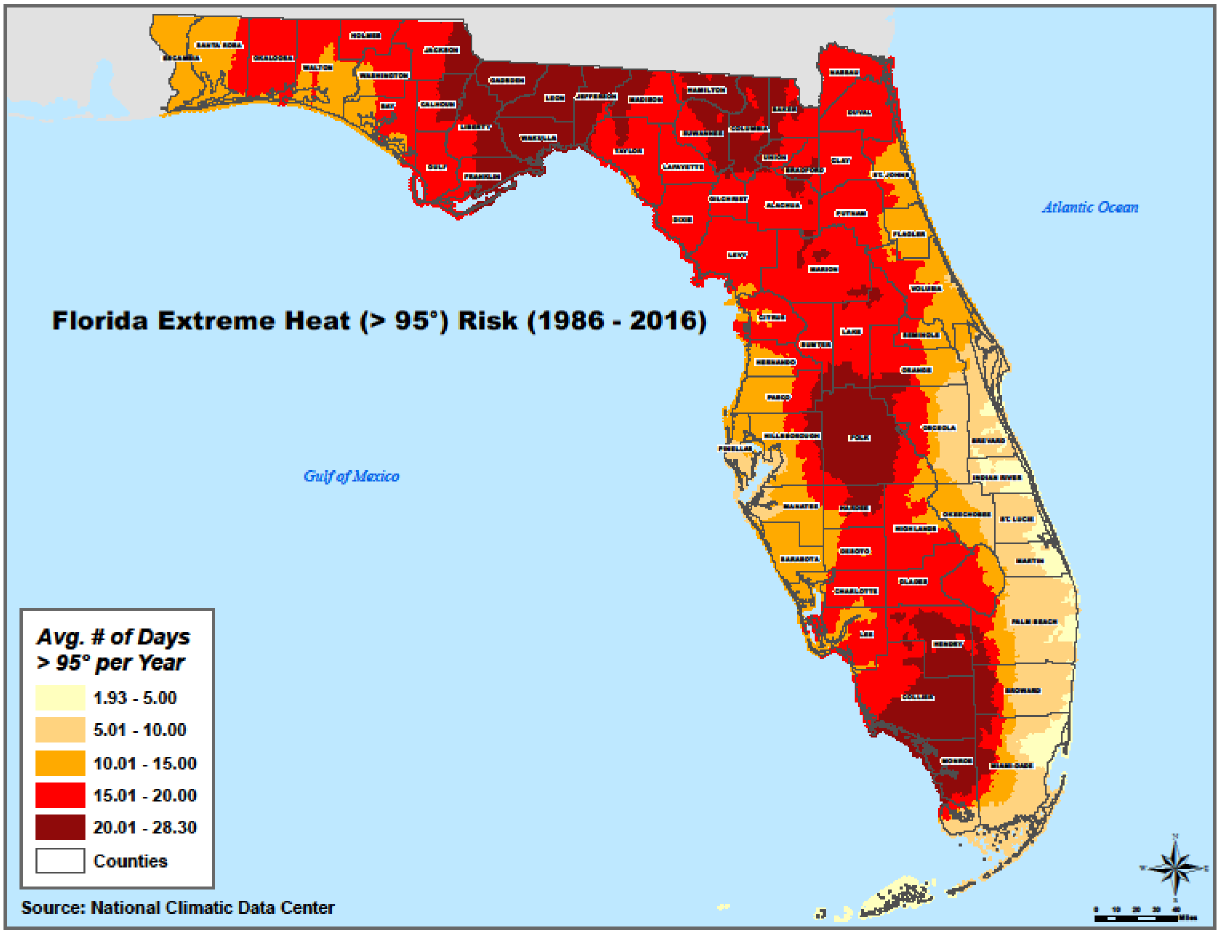
2. Geographic Areas Affected by Extreme Heat

Due to the subtropical climate of Florida, the entire state has historically been vulnerable to extreme heat events. Because of the close proximity of large bodies of water, Florida typically experiences fewer days when the temperature reaches 100 degrees Fahrenheit or greater than many other states. However, the proximity to large bodies of water also increases the humidity, which decreases the body's ability to dissipate the heat. The hottest daytime temperatures tend to occur in the northern and interior areas of the state, away from the moderating influence of the Gulf of Mexico and the Atlantic Ocean.

[114] http://flbrace.org/images/docs/heat-profile.pdf
[115] *(Karl et al. (Eds.). (2009). Global climate change impacts in the United States.* *https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf*
[116] *http://www.climatecentral.org/news/sizzling-summers-20515*

Additionally, the expansion of urban development in large cities around the state has increased the magnitude of the urban heat island effect. A heat island occurs when concrete, asphalt, and heat absorbing buildings replace the natural environment.[117]

Figure 75: Florida Extreme Heat (>95 degrees) Risk, 1986 – 2016



The map above shows the average number of days with temperatures above 95 degrees each year. From this map, it is clear that most of Florida experiencing between 10 and 28 days of above 95 degree weather each year.

[117] http://flbrace.org/images/docs/heat-profile.pdf

3. Historical Occurrences of Extreme Heat

Florida is known for its high humidity and heat, which combine to affect its population. According to NCEI, there have been 11 extreme heat occurrences since 2007. These extreme heat events sometimes lasted for more than one day and sometimes affected multiple counties.[118]

The table below shows various significant extreme heat incidents from 2006 to 2016.

Table 42: Florida Extreme Heat Occurrences, 2006-2016

Date	Description
August 2008	On August 8, heat advisories were issued in Santa Rosa, Escambia, and Okaloosa Counties for high temperatures and humidities. The heat index values were between 110 and 115 degrees.[119]
July 2010	On July 28, a heat wave began in Florida's panhandle. There were above normal temperatures and high humidity producing a heat index above 110 degrees Fahrenheit in Dixie, Franklin, Jackson, Taylor, Leon, and Bay Counties. Heat index values exceeded 115 degrees in a few locations on occasion.[120]
November 2011	In Mid-November in South Florida, there was unseasonably warm and humid weather, with heat index values in the mid to upper 80 degrees.[121]
July 2016	Seven cities from across Florida reported their hottest July on record.[122]

As stated above, NOAA tracks deaths related to weather events. According to their data, 1 person died from extreme heat in 2006, 2 people died in 2009, and 1 person died in 2010.[123]

Table 43: Significant Events before 2006

Date	Description
June 1998	Several long stretches of record-breaking high temperatures, including in Melbourne, Orlando, and Daytona Beach. Temperatures resulted in 1 death.
July 2000	July was the hottest month that had been recorded in northwest Florida. Several cities had multiple days of 100 degrees or higher, including Pensacola, Milton, and Niceville.[124]

118 https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Heat&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2007&endDate_mm=12&endDate_dd=31&endDate_yyyy=2016&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA
119 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=54001
120 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=253232
121 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=354723
122 https://weather.com/news/weather/news/record-warm-south-july-2016
123 http://www.nws.noaa.gov/om/hazstats.shtml#
124 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=348150

4. Probability of Future Occurrences of Extreme Heat

Based on historical analysis, incidents of extreme heat are expected to continue.

Extreme heat can occur throughout the state but typically occurs in the summer between the months of June and September.

As shown in the map above, most of Florida is likely to experience between 10 and 28 days of temperatures above 95 degrees. The panhandle, central Florida, and southwest Florida have the highest number of likely days per year with temperatures above 95 degrees, with between 20 and 28 days.

This hazard was determined to occur annually, giving it a Probability of Very Likely.

5. Extreme Heat Impact Analysis

- Public
  - Injury or death from overexposure, especially to infants, children, the elderly, those who are overweight, those with chronic illnesses, those who take certain medications
- Responders
  - Injury or death from over exertion in heat
- Continuity of Operations (including continued delivery of services)
  - Not likely to impact continuity of operations
- Property, Facilities, Infrastructure
  - Less efficient cooling systems or systems that must run constantly to effectively cool a building
- Environment
  - Faster evaporation
  - Damage to green spaces and agricultural lands
  - Death of plants and animals
- Economic Condition
  - Crop damage or loss
- Public Confidence in Jurisdiction's Governance
  - If people become ill or die from exposure to extreme heat, public may believe the government is not doing all that it can to help those in need, whether or not a cooling shelter was opened

6. 2018 LMS Integration

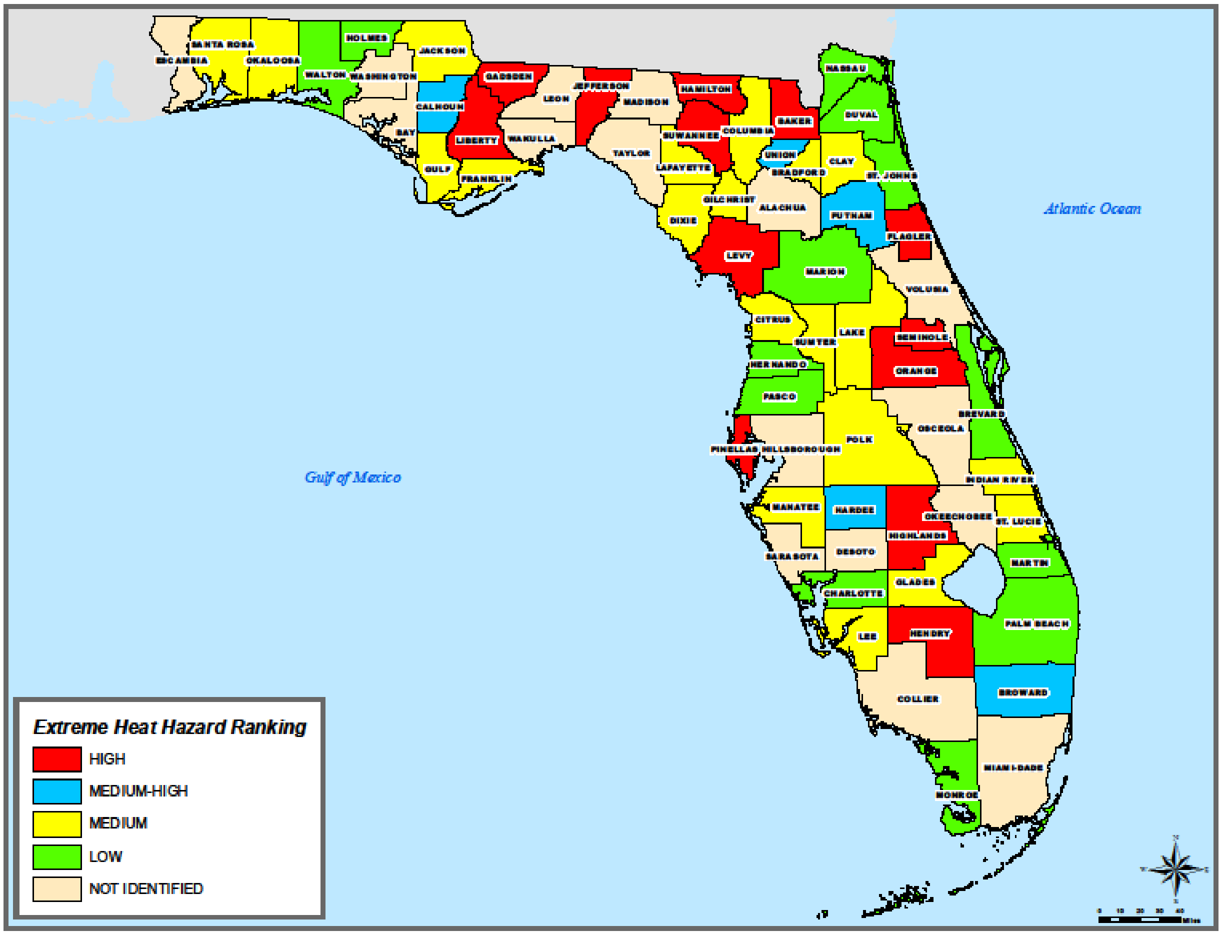
An analysis of all 67 Florida County LMS Plans and their individual Extrema Heat hazard rankings is shown below. Sixteen counties did not profile Extreme Heat as a hazard.

Extreme Heat

Based on the LMS plans, Figure 75 displays the jurisdictional rankings for the extreme heat hazard. Not all counties have identified extreme heat as one of their hazards.

- High-risk Jurisdictions: 13
- Medium-High-risk Jurisdictions: 5
- Medium-risk Jurisdictions: 20
- Low-risk Jurisdictions: 13
- Not identified Jurisdictions: 16

Figure 75: Extreme Heat Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Enhanced SHMP is required to evaluate the vulnerability of jurisdictions and estimate potential losses for each hazard. Below is the Vulnerability analysis and Loss Estimation of the state, by Jurisdiction, to Extreme Heat.

As shown in the map above and explained in the Geographic and Probability sections, most of Florida experiences between 10 and 28 days of temperatures above 95 degrees each year. Counties with the highest number of days with temperatures above 95 degrees, between 20 and 28, are Jackson, Calhoun, Liberty, Gadsden, Leon, Wakulla, Franklin, Jefferson, Madison, Taylor, Hamilton, Suwannee, Columbia, Baker, Union, Bradford, Alachua, Marion, lake, Orange, Polk, Pasco, Hillsborough, Osceola, Hardee, Hendry, Palm Beach, Broward, Collier, Miami-Dade, and Monroe.

The previous version of the plan grouped extreme heat and drought together. The SHMPAT did not conduct loss estimations by jurisdiction on extreme heat and drought in 2004 during the original plan development process. For extreme heat, the 2013 plan update does not include extreme heat-specific estimation by jurisdiction because structures are not vulnerable to extreme heat.

8. Vulnerability Analysis and Loss Estimation, of State Facilities

The Enhanced SHMP is required to evaluate the vulnerability and estimate potential losses regarding the State and its facilities across the state.

A vulnerability analysis on extreme heat was not conducted in 2004; however, in conjunction with drought, one was completed during the 2007 and 2010 plan update and revision process. In the 2013 update, extreme heat was separated from drought. Although facilities themselves are not vulnerable to extreme heat, the areas or regions that the facilities are located in may be susceptible to extreme heat. The efficiency at which a building operates may be affected (i.e. added load to building cooling systems) if the building is in an area vulnerable to extreme heat.

The SHMPAT did not conduct loss estimations on extreme heat for the 2013 plan because state facilities themselves are not vulnerable to extreme heat.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 11.

EXTREME HEAT					Overall Vulnerability
Overview					
Extreme heat is defined as extended period where the temperature and relative humidity combine for a dangerous heat index.					**HIGH**
Frequency	**Probability**	**Magnitude**			
		Injuries/Deaths	**Infrastructure**	**Environment**	
Very Likely	**Very Likely**	**High**	**Low**	**Low**	

Drought Hazard Profile

1. Drought Description

Drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage. While droughts are a normal and recurring feature of our climate, sometimes they can endanger vegetation, animals, and even people. There are several types of droughts, which will be discussed below[125].

- Meteorological droughts are based on the amount of dryness compared to normal for that region.
- Agricultural drought refers to agricultural concerns, such as precipitation shortages and reduced ground water.
- Hydrological drought refers to the hydrological effects from extended periods with precipitation deficits. These droughts take longer to occur than meteorological and agricultural droughts.
- Socioeconomic droughts occur when the demand for an economic good reliant upon water, such as fish, or hydroelectric power, exceeds supply as a result of a weather-related water shortfall.

Many factors of precipitation determine whether the rains will relieve a drought. For example, the timing and effectiveness of the rains. There is also a balance between precipitation and evapotranspiration that must be maintained to avoid a drought. Evapotranspiration is the sum of evaporation and transpiration, which is the release of water from plant leaves. High temperatures, high winds, and low relative humidity are also factors that can intensify a drought.

The agricultural industry is particularly vulnerable to the impacts of a drought because the crops depend on stored soil water and surface water.

Drought Indices and Measurements

One method to interpret drought is the Palmer Drought Severity Index (PDSI), which is based on the supply and demand concept of the water balance equation, taking into account more than just the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI), shown in Table 44, is to provide measurements of moisture conditions that are standardized so that comparisons using the index can be made between locations and between months.

The PDSI is most effective in determining long-term drought, over a matter of several months, and is not as reliable with short-term forecasts. 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 advantage of the PDSI is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions.

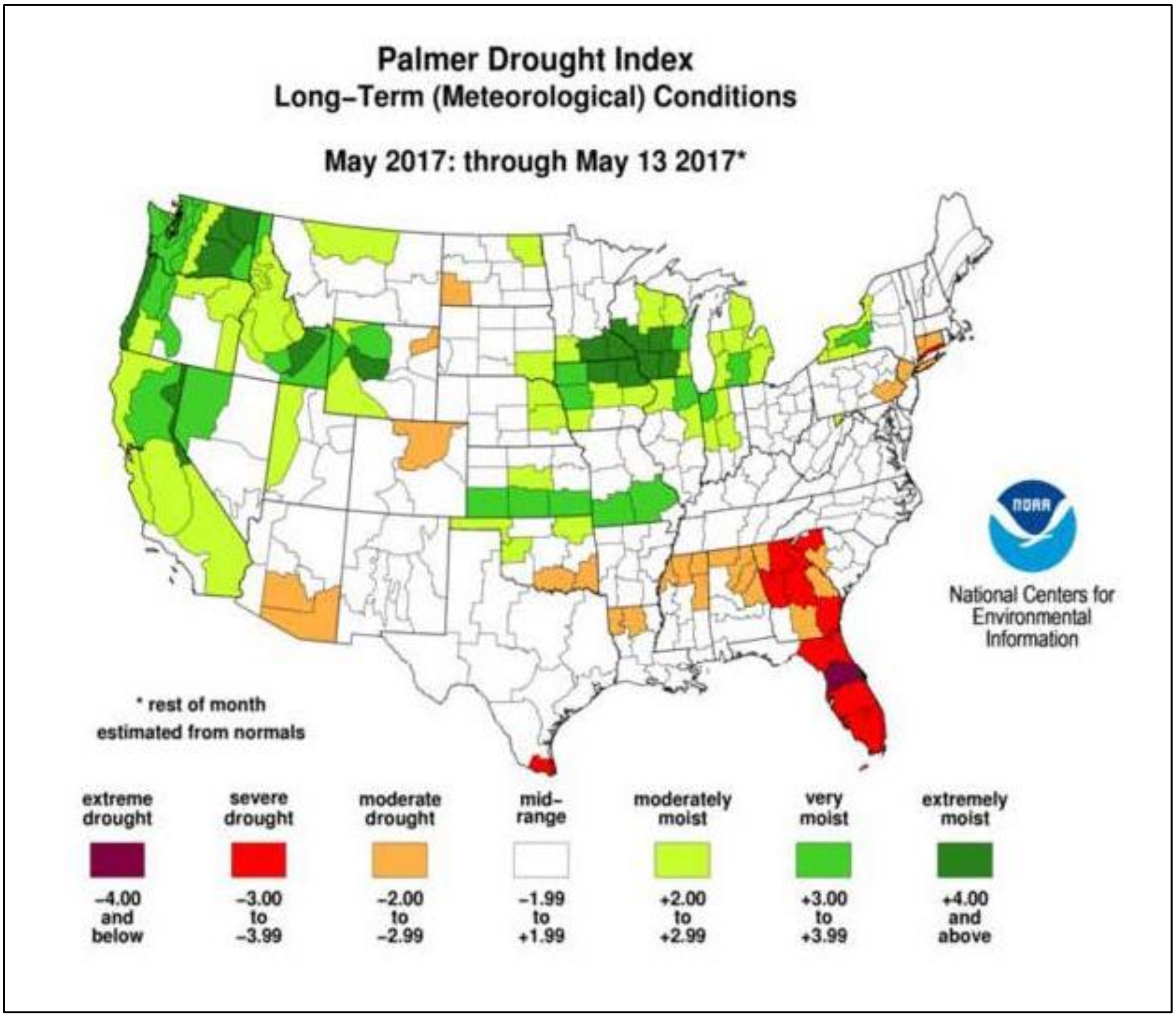
[125] http://www.nws.noaa.gov/os/brochures/climate/DroughtPublic2.pdf

Table 44: Palmer Drought Severity Index[126]

Term	Extreme drought	Severe drought	Moderate drought	Mid-range	Moderately moist	Very moist	Extremely moist
Numerical description	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above

Below is an example of the PDSI of the US from May 2017. [127]

Figure 76: Florida PDSI, May 2017



Another method to interpret drought is with the Keetch Byran Drought Index (KBDI). It is a reference scale for estimating the dryness of the soil and duff layers. The index increases for each day without rain and

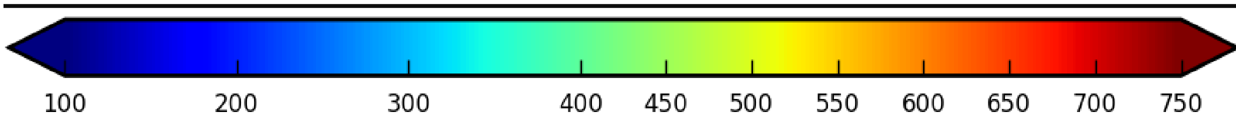
[126] https://www.drought.gov/drought/data-maps-tools/current-conditions
[127] https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/20170513

decreases when it rains and assumes there are 8 inches of saturated soil readily available to vegetation. The scale ranges from 0 (no moisture deficit) to 800.[128]

For different soil types, the depth of soil required to hold 8 inches of moisture varies (loam 30 inches, clay 25 inches, and sand 80 inches). A prolonged drought, meaning a high KBDI, can increase wildfire intensity because more fuel is available for combustion. In addition, the drying of organic material in the soil can lead to increased difficulty in fire suppression.

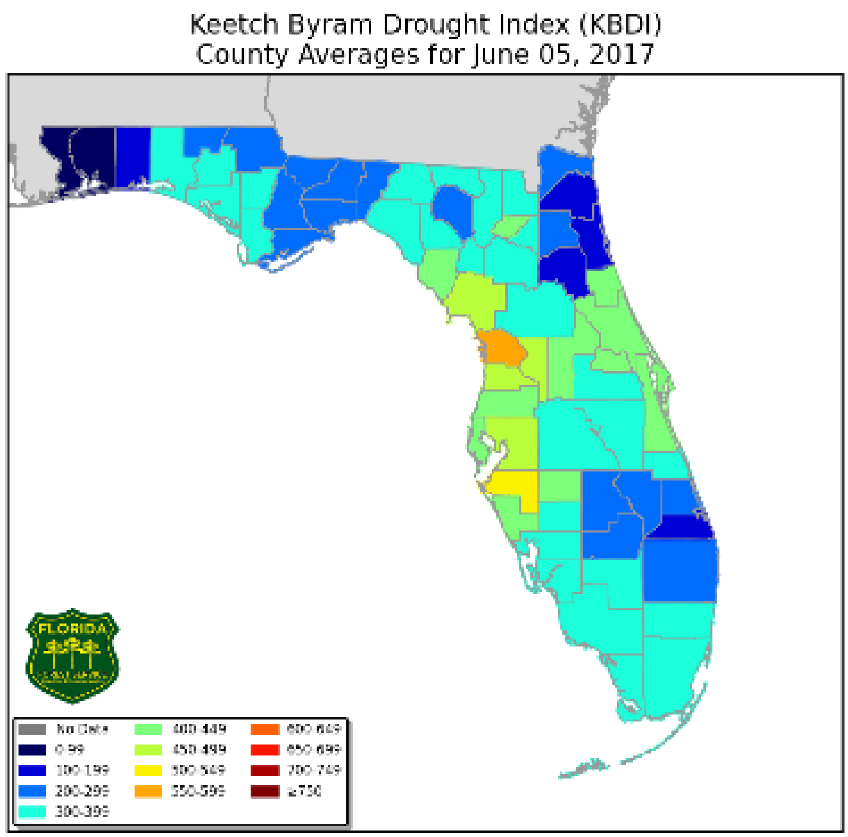
The index rating is displayed below[129].

Figure 77: Keetch Byran Drought Index



Below is an example of the KBDI for Florida from June 5, 2017.

Figure 78: Florida KBDI, June 2017[130]



128 https://climatecenter.fsu.edu/
129 http://currentweather.freshfromflorida.com/kbdi_4km.html
130 http://currentweather.freshfromflorida.com/images/KBDI-countymeans-d0.png

There is also a U.S. Drought Monitor, which focuses on broad drought conditions across the entire United States. In this measurement, drought intensity is classified from D0 Abnormally Dry to D4 Exceptional Drought.

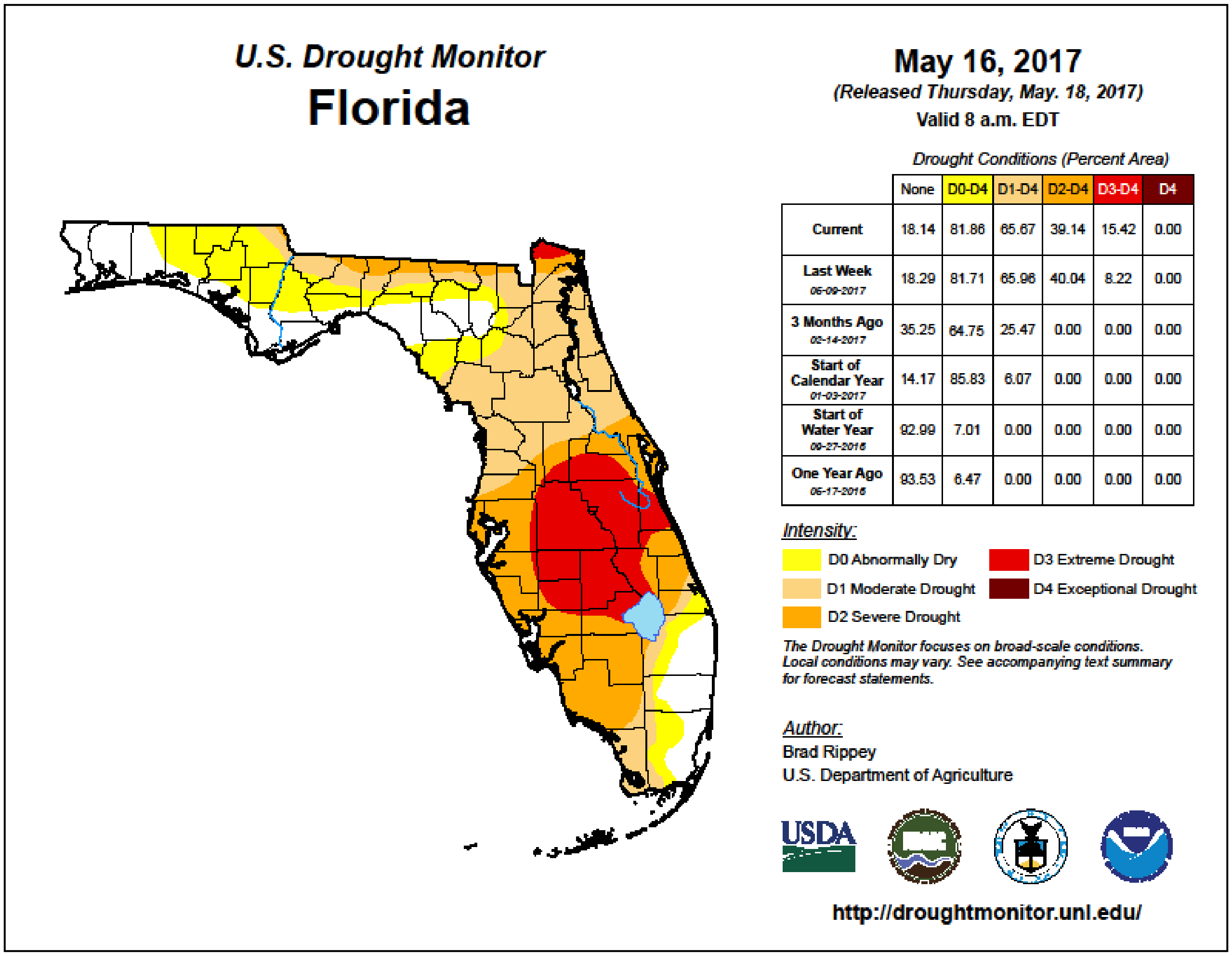
Table 45: United States Drought Monitor[131]

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: • Short-term dryness slows planting and growth of crops or pastures Coming out of drought • Some lingering water deficits • Pastures or crops are not fully recovered
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells are low; some water shortages are developing or imminent • Voluntary water-use restrictions requested
D2	Severe Drought	• Crop of pasture losses are likely • Water shortages are common • Water restrictions are imposed
D3	Extreme Drought	• Major crop or pasture losses • Widespread water shortages or restrictions
D4	Exceptional Drought	• Exceptional and widespread crop or pasture losses • Shortage of water in reservoirs, streams, and wells creating water emergencies

Below is an example of the drought monitor map for Florida from May 30, 2017.

[131] http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

Figure 79: Florida U.S. Drought Monitor, May 2017[132]



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	18.14	81.86	65.67	39.14	15.42	0.00
Last Week 05-09-2017	18.29	81.71	65.96	40.04	8.22	0.00
3 Months Ago 02-14-2017	35.25	64.75	25.47	0.00	0.00	0.00
Start of Calendar Year 01-03-2017	14.17	85.83	6.07	0.00	0.00	0.00
Start of Water Year 09-27-2016	92.99	7.01	0.00	0.00	0.00	0.00
One Year Ago 05-17-2016	93.53	6.47	0.00	0.00	0.00	0.00

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Low, meaning no injuries or deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

[132] http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?FL

Potential Effects of Climate Change on Drought

Changes in rates of precipitation, evaporation, and transpiration, may affect the duration and severity of drought events. A warmer climate would impact the hydrological cycle by increasing rates of evaporation leading to a decrease in runoff rates associated with rainfall events. Moreover, increased rates of evapotranspiration would exacerbate current droughts as existing soil moisture and plant moisture would likewise increase moisture in the atmosphere potentially leading to more frequent rainfall events. Regional effects are expected to range widely and are difficult to predict.[133] It is widely believed that an overall warming trend may intensify and prolong droughts as they occur due to increased rates of evapotranspiration associated with higher temperatures.[134]

The Intergovernmental Panel on Climate Change forecasts with medium confidence both an increase in heavy rainfall periods as well as an increase in the duration of relatively dry periods for North America, particularly in the subtropics, such as Florida.[135] South Florida, in particular, may see increased dry and hot periods between heavy rainfall events, exacerbating the risk for drought.[136] However, there is significant uncertainty associated with these projections given the numerous factors that contribute to climatic variability.[137]

As stated in the flood hazard profile, the expected global pattern is for arid areas to become drier, meaning that droughts may occur more frequently and be more severe.

2. Geographic Areas Affected by Drought

The State of Florida experiences cyclical drought on a regular basis. Analyzing past events as well as the current drought conditions has proven that the drought conditions and the severity of drought conditions has been variable over the years, affecting the east, north, south, and central regions randomly and somewhat equally.

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[133] *(Walsh and Wuebbles (2013). Our changing climate. In, Draft national climate assessment, pp. 25-103. https://www.globalchange.gov/sites/globalchange/files/NCAJan11-2013-publicreviewdraft-chap2-climate.pdf); p. 113.).*

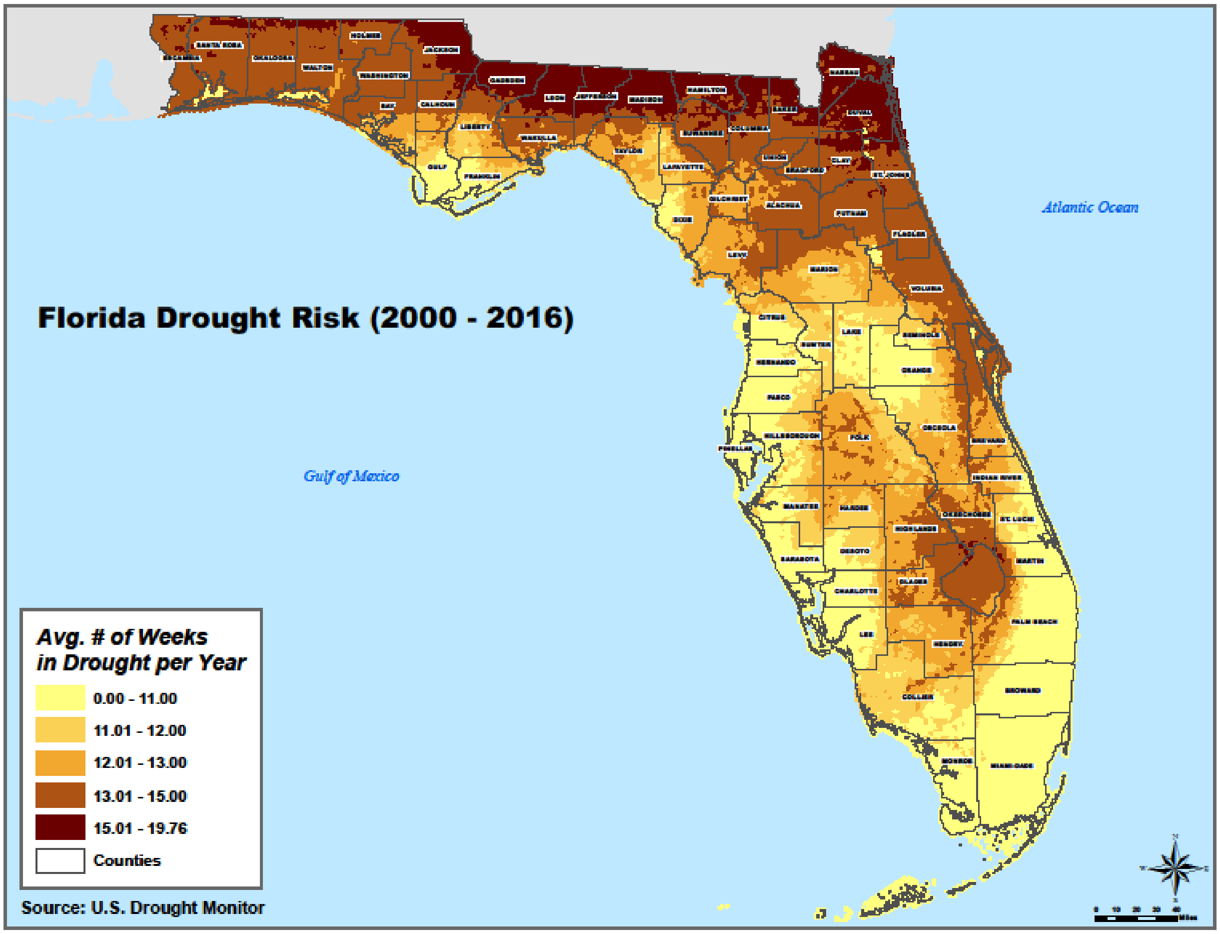
[134] *(Allen et al. (2012). Summary for policymakers. In Field et al. (Eds.), Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, pp. 3-21., https://www.ipcc.ch/pdf/special-reports/srex/SREX_FD_SPM_final.pdf, p. 13).*

[135] *(Seneviratne et al. (2012). Changes in climate extremes and their impacts on the natural physical environment. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap3_FINAL.pdf); In Field et al. (Eds.), Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, pp. 109-230. https://www.ipcc.ch/pdf/special-reports/srex/SREX_FD_SPM_final.pdf, pp. 174-175.).*

[136] *(Karl et al. (Eds.) (2009). https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf).*

[137] *(Seager et al. (2009). http://journals.ametsoc.org/doi/full/10.1175/2009JCLI2683.1).*

Figure 80: Florida Drought Risk, 2000 – 2016



The map shows that northern Florida is likely to be impacted by drought. In fact, several counties are likely to experience between 15 and 19 weeks of drought each year, including Jackson, Gadsden, Leon, Jefferson, Madison, Hamilton, Baker, Nassau, Duval, and Clay. Most remaining panhandle counties, as well as a few south central Florida counties are expected to experience between 13 and 15 weeks of drought per year.

3. Historical Occurrences of Drought

Florida experienced a destructive drought from 1998 to 2001 where farm crops were ruined, forest fires burned, and lake levels reached an all-time low. In 2006–2007, rainfall deficits were the largest observed since the mid-1950s, which led to severe wildfires in 2007.

While drought is a common occurrence in Florida, there has never been a Presidential Major Disaster Declaration for drought in the State of Florida. However, there have been disaster declarations for agriculture from the USDA. Agriculture-related disasters are quite common and most counties in the US have been designated as disaster areas at some time since 2012. The disaster designation makes emergency loans and other emergency assistance programs available to producers suffering losses in those counties. As of 2012, a county can be designated as a disaster area when there is a severe drought

(D2) in any area of the county, during the growing season, for 8 consecutive weeks, or a higher intensity (D3+) for any length of time.[138] Below are the drought disaster designations for the state of Florida from 2012 to 2016[139] (earlier data was not available on the USDA website).

- 2012: all counties
- 2013: 42 counties
- 2014: 4 counties
- 2015: 10 counties
- 2016: 11 counties

More specifically, the table below explains various drought events within the last 10 years, from 2006 to 2016.

Table 46: Florida Drought Occurrences, 2006-2016

Date	Description
2006 – 2007	Drought conditions began to develop in 2006 across Florida because of less than average rainfall. In 2007, the drought was so severe it was considered a one in 25-year drought. The drought affected most of the state. The 2007 wildfire season was very active because of the extreme drought classification.[140]
2010 – 2012	Drought conditions began in central Florida in late 2010 and continued into mid-2012. The drought affected most of the state, but the northern central and the Panhandle regions of the state were in "extreme drought" for several months.[141]
2016 – 2017	Drought conditions developed in late 2016 and persisted into mid 2017 leading to several wildfires across the state.[142]

This table shows drought events before 2006, including the worst drought in Florida's recorded history from 1954 to 1956. As well as the severe drought from 1998 to 2001.

Table 47: Drought Occurrences before 2006

Date	Description
1954-1956	The most extreme drought in Florida on record occurred during 1954–1956 when runoff was 8 inches below normal, causing extensive loss of crops and timber. The Panhandle and northern central regions of the state were in a drought for most of 1955 and the almost the entire state was in drought for most of 1956.[143]

[138](https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2017/emergency_disaster_designation_and_declaration_process_may2017.pdf

[139] https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index

[140] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/200601-200712

[141] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/201001-201212

[142] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/201601-201704

[143] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/195401-195612

1981-1982	Rainfall deficiencies caused the water levels in Lake Okeechobee reached the lowest levels ever recorded. In mid-1981, the entire state was in moderate or severe drought but most regions were out of drought by the end of the year.[144]
1998-2002	Lower than normal precipitation caused a severe long-term statewide drought in Florida lasting from 1998–2002. Within this timeframe, a severe drought affected southwest Florida from 2000 – 2001. This drought was particularly severe over the 5-year period in the northwest, northeast, and southwest regions of Florida. The drought became so severe that in 2001, the following actions were taken: • Three of Florida's five water management districts imposed mandatory cutbacks, strictly limiting water use. • Several municipalities hiked water-sewer rates, meaning even customers who cut back were paying more. • Restaurants in South Florida were ordered to stop serving water, except to diners who asked.[145]

4. Probability of Future Occurrences of Drought

Based on the previous occurrences of drought conditions in the state, the probability of future drought events occurring over the long term with some frequency remains high. As the state continues to develop with higher populations, higher water demands, and more demands related to agriculture and livestock, these drought conditions and drier trends may begin to have a profound impact on the state and its residents.

According to the Florida Drought Risk map above, most of north Florida is likely to experience between 13 and 20 weeks of drought each year. Central and South Florida, aside from the Lake Okeechobee area, is likely to receive between 0 and 13 weeks of drought each year.

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

5. Drought Impact Analysis

- Public
  - Lack of water or water restrictions for personal use
  - Damage to property, such as grass and other vegetation dying from lack of water
- Responders
  - Lack of water to extinguish fires
- Continuity of Operations (including continued delivery of services)
  - Lack of water or water restrictions may impact the public use of water and wastewater utilities; the public may have to restrict their showering time and other water use in the restroom, restrict their water usage for cooking and drinking, and restrict from watering their gardens or lawns
- Property, Facilities, and Infrastructure
  - Facilities and infrastructure should not be affected by drought

[144] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/198001-198212
[145] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/199801-200212

- Property, such as green spaces, gardens, crops, etc. may be damaged from lack of water
- Environment
  - Areas such as green spaces, gardens, and forests may be damaged from drought
- Economic Condition
  - Crop damage or loss from drought can severely impact farmers and the agricultural economy, which can in turn affect the economy of an area if it is dependent upon the sales of the crops, like how Florida relies upon the sales of citrus
  - Employment loss due to lower demand for services such as landscaping, lawn care, car wash, etc.
- Public Confidence in the Jurisdiction's Governance
  - The public may lose confidence in the jurisdiction's governance if there is not a plan in place to deal with lack of water or water restrictions

6. 2018 LMS Integration

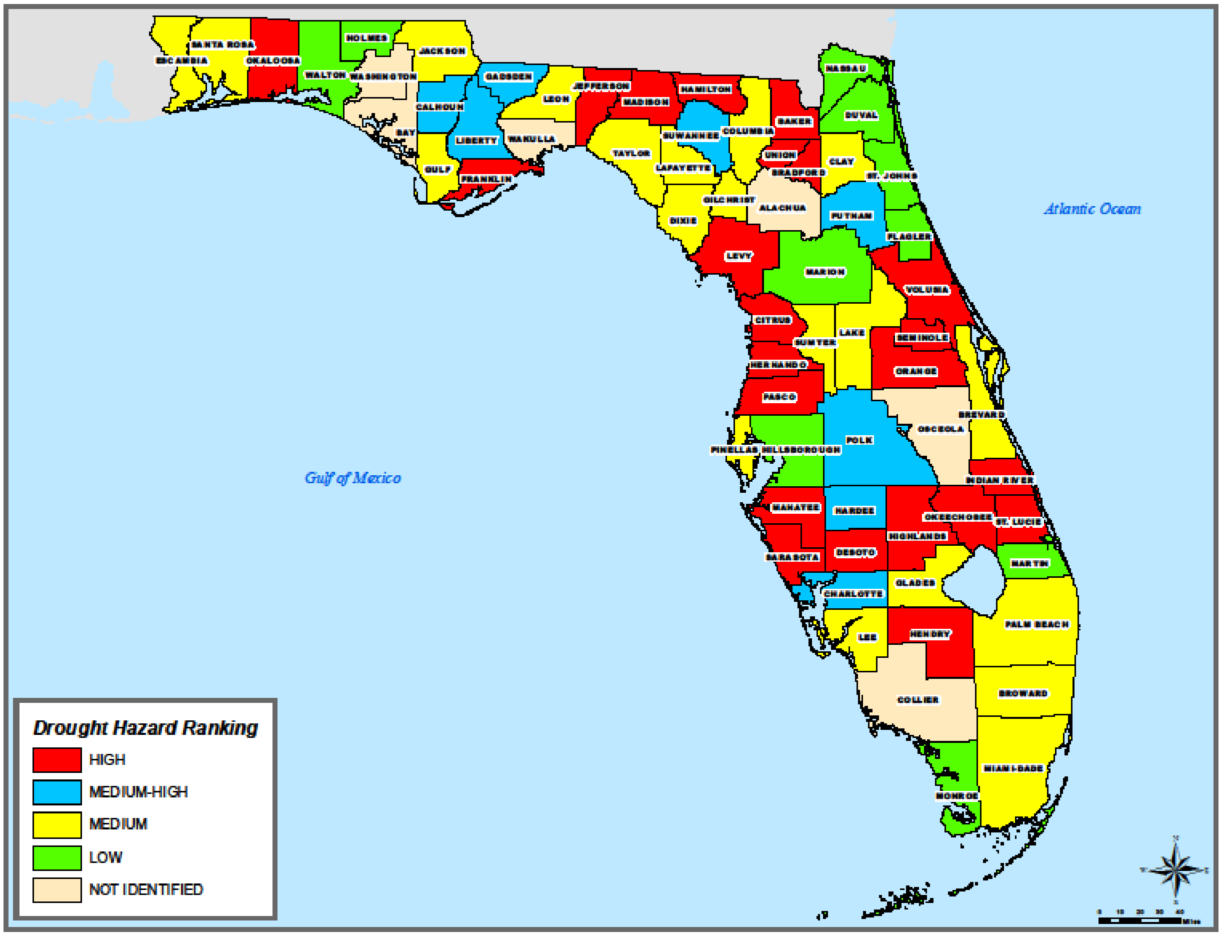
An analysis of all 67 Florida County LMS Plans and their individual drought hazard rankings is shown below. Six counties did not profile drought, while 23 included drought as a high risk hazard.

Drought

Based on the LMS plans, Figure 3.38 displays the jurisdictional rankings for the drought hazard.

- High-risk Jurisdictions: 23
- Medium-High-risk Jurisdictions: 8
- Medium-risk Jurisdictions: 20
- Low-risk Jurisdictions: 10
- Not identified Jurisdictions: 6

Figure 81: Drought Hazard Rankings



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Enhanced SHMP is required to evaluate the vulnerability of jurisdictions and estimate potential losses for each hazard. Below is the Vulnerability analysis and Loss Estimation of the state, by Jurisdiction, to Drought.

Vulnerability

According to the Drought Risk map shown above, as discussed in the Geographic and Probability section, most of north Florida is likely to experience at least 13 weeks of drought each year. Vulnerable counties include Escambia, Santa Rosa, Okaloosa, Walton, Holmes, Washington, Bay, Jackson, Calhoun, Liberty, Gadsden, Wakulla, Leon, Jefferson, Madison, Taylor, Hamilton, Suwannee, Lafayette, Columbia, Baker, Nassau, Duval, Union, Bradford, Clay, St. Johns, Alachua, Putnam, Flagler, Volusia, Marion, and Levy. Other vulnerable counties include Highlands, Okeechobee, Martin, Glades, Palm Beach, and Hendry.

Loss estimation information was unavailable for the 2018 risk assessment update. The 2013 SHMP concluded that several drought impacts would result in losses. For example, the agricultural sector could experience significant economic loss due to crop losses caused by lack of water. Additionally, the lack of water could affect pasturelands and in turn affect livestock. Drought can also increase the likelihood of wildfires and lower water levels in canals and other surface waters which could inhibit the ability to fight fires in rural areas.

During the last several SHMP updates, it was noted that there is a lack of sufficient data to fully estimate losses for drought. It recognized that some droughts are temporary and localized, with minimal or no subsequent losses, and that some have been statewide and prolonged, with extreme financial impact to the state. To collect better data for improved loss estimations during the next plan revision cycle, the team has agreed to work closely with these agencies involved in the state's Drought Action Plan:

- Department of Environmental Protection
- Division of Emergency Management
- Department of Agriculture and Consumer Services
- State Water Management Districts

The entire state continues to be vulnerable to cyclical drought, with the northern portion having a higher overall risk factor. The vulnerability to drought is different from the other vulnerabilities considered in this plan since the majority of the built environment is not vulnerable to this hazard.

The primary vulnerability to drought is the robust agricultural sector of the state. Both short-term drought during critical times in the growth cycle and long-term drought over many years affect the farmers.

Availability of water during drought conditions is controlled largely by the topography, geology, hydrogeology, and hydrology of an area. Because these factors vary considerably by physiographic regions in Florida, drought vulnerability can be generally assessed by physiographic region. Local conditions, such as the availability of a large impoundment for water storage, may affect drought vulnerability on a local scale.

National Climatic Data Center Drought Loss Estimation

Data from the NCDC was not complete. The drought events are listed in the database, however, not all the crop damage and loss information is included in the listings.

8. Vulnerability Analysis and Loss Estimation, of State Facilities

The Enhanced SHMP is required to evaluate the vulnerability and estimate potential losses regarding the State and its facilities across the state. The GIS team used the database of all state facilities and their values to provide the loss estimation data.

Vulnerability

Although facilities themselves are not vulnerable to drought, the areas or regions that the facilities are located in may be susceptible to drought. The efficiency at which a building operates may be affected (i.e., low water pressure) if the building is in a drought-stricken area.

Loss Estimation

The SHMPAT did not conduct loss estimations on drought because the facilities themselves are not vulnerable to drought.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 8.

DROUGHT

Overview

Drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage. While droughts are a normal and recurring feature of our climate, sometimes they can endanger vegetation, animals, and even people.

Frequency	Probability	Magnitude			Overall Vulnerability
		Injuries/Deaths	Infrastructure	Environment	
Likely	Likely	Low	Low	Medium	MEDIUM

Geological Event Hazard Profile

1. Geological Event Description

This profile will discuss landslides and sinkholes. In the 2013 update, the SHMP combined sinkholes, landslides and earthquakes. For the 2018 update, Mitigate FL decided to keep landslides and sinkholes together and re-name the profile Geological Events, and create a new hazard named Seismic.

Landslides

Landslides are rock, earth, or debris flows down slopes due to gravity. They can occur on any terrain given the right conditions of soil, moisture, and the angle of slope. Integral to the natural process of the Earth's surface geology, landslides serve to redistribute soil and sediments in a process that can be in abrupt collapses or in slow gradual slides. Also known as mud flows, debris flows, earth failures, and slope failures, landslides can be triggered by rains, floods, earthquakes, and other natural causes as well as human-made causes including grading, terrain cutting and filling, and excessive development.[146]

Because the factors affecting landslides can be geophysical or human-made, they can occur in developed areas, undeveloped areas, or any area where the terrain was altered for roads, houses, utilities, or buildings.

The State of Florida has very low topographic relief, meaning that the state is flat. Because of this, landslides are not a significant natural hazard in Florida.[147] Any risk or vulnerability to people, property, the environment, or operations would be low.

Sinkholes

Sinkholes are landforms created when overburden subsides or collapses into fissures or cavities in underlying carbonate rocks. Florida is underlain by several thousand feet of carbonate rock, limestone, and dolostone, with a variably thick mixture of sands, clays, shells, and other near surface carbonate rock units, called overburden. Those several thousand feet of carbonate rocks are host to one of the world's most productive aquifers, the Floridian aquifer system. Erosional processes, physical and chemical, have created fissures and cavities within the rock. This has created Florida's karst topography, characterized by the presence of sinkholes, swallets, caves, submerged conduits, springs, and disappearing and reappearing streams. Sinkholes are unpredictable, as they can form rapidly, within minutes to hours, or slowly, within months to years.[148]

This profile will focus on the two common types of sinkholes in Florida, cover collapse sinkholes and cover subsidence sinkholes, because of their rate of formation and the risk they pose to human life and property.

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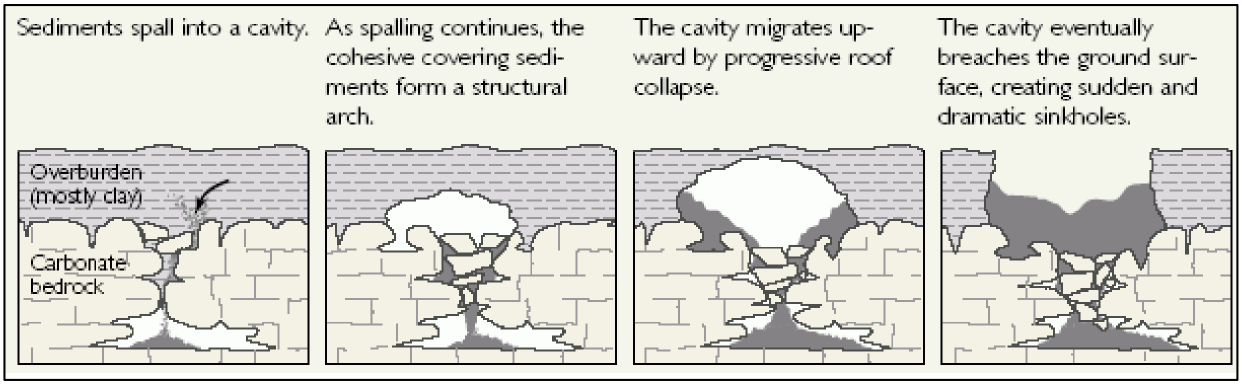
[146] https://landslides.usgs.gov/learn/ls101.php
[147] http://www.dep.state.fl.us/geology/geologictopics/hazards/landslides.htm
[148] Florida Department of Environmental Protection Florida Geological Survey. (2017). The favorability of Florida's geology to sinkhole formation. Page 4 – 7.

Cover Collapse Sinkholes

Cover-collapse sinkholes may develop quickly and cause significant damage. These sinkholes develop when the ceiling of an underground cavity can no longer support the overlying weight, resulting in an abrupt collapse of the overburden into the cavity, thereby forming a hole in the land surface.[149] This occurs because over time, surface drainage, erosion, and deposition of materials develop a shallow bowl-shaped depression beneath the surface of the ground.

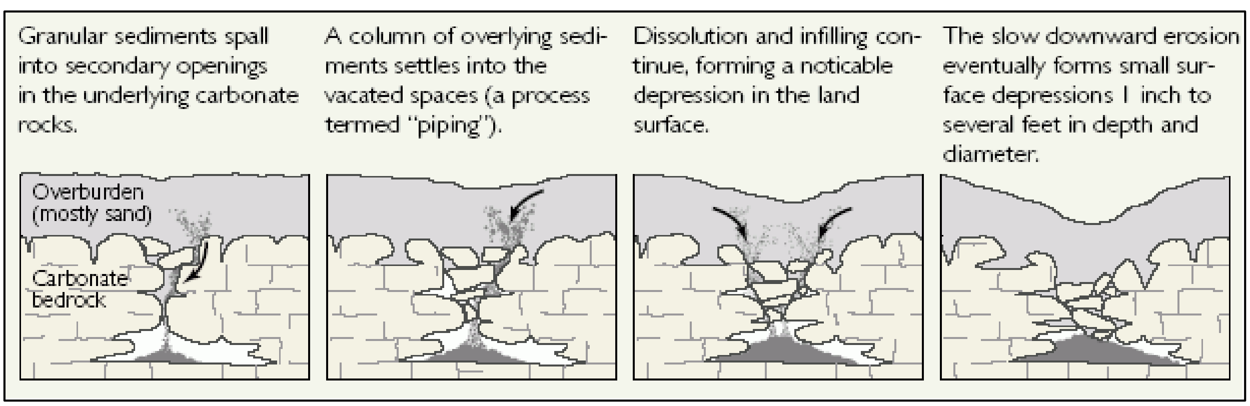
Figure 82: Cover Collapse Sinkholes[150]



Cover Subsidence Sinkholes

Cover-subsidence sinkholes develop more gradually, usually where the sediment is permeable and contains sand. The overburden slowly migrates down into the fissures and cavities in the underlying rock, which results in a depression in the land surface.[151]

Figure 83: Cover Subsidence Sinkholes[152]



[149] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 5.
[150] https://water.usgs.gov/edu/sinkholes.html
[151] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 4 – 7.
[152] https://water.usgs.gov/edu/sinkholes.html

Triggers

There are several triggers for sinkhole formation. For example, extended periods of drought can lead to sinkholes, especially if a heavy rain event occurs after an extended drought. Heavy rainfall can trigger sinkholes for several reasons. For example, heavy rainfall can add additional weight to overburden sediments above a cavity which could cause a failure of the cavity ceiling. Or heavy rainfall could collect in low lying areas adding to the weight and accelerating infiltration at that location, which could cause failure of a cavity ceilings. Additionally, heavy rainfall could saturate overburden sediments, making them soft, which could weaken the overburden sediments, causing failure of the cavity ceiling (sink report, 10). According to geologists, sinkholes can also be attributed to anthropogenic triggers, such as significant groundwater withdrawal; terraforming, which is the alteration of the earth's surface without realizing the area has thin overburden sediments; some stormwater management practices; heavy infrastructure over critical areas; and well drilling and development.[153]

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

Potential Effects of Climate Change on Sinkholes

Incidences of sinkholes increase either after severe storm events with associated flooding and soil saturation or during extended periods of drought.[154] With the potential for more prolonged and more intense periods of drought as well as greater intensity and frequency of rainfall and inland flooding *(see Sections 3.3.1, 3.3.3, and 3.3.5)*, it is likely that incidences of sinkholes will increase in the coming century in areas with karst geology or areas identified as favorable for sinkhole development.

Climate change is not expected to affect the occurrence of landslides in Florida.

2. Geographic Areas Affected by Geological Events

Landslides

Florida has low topographic relief and therefore is not affected by this hazard.

[153] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 11.

[154] Dragoni and Sukhija (2008) *Climate change and groundwater: A short review.* Geological Society, London, Special Publications, 288, 1-12; Hyatt and Jacobs (1996). *Distribution and morphology of sinkholes triggered by flooding following Tropical Storm Alberto at Albany, Georgia, USA.* Geomorphology, 17, 305-316.

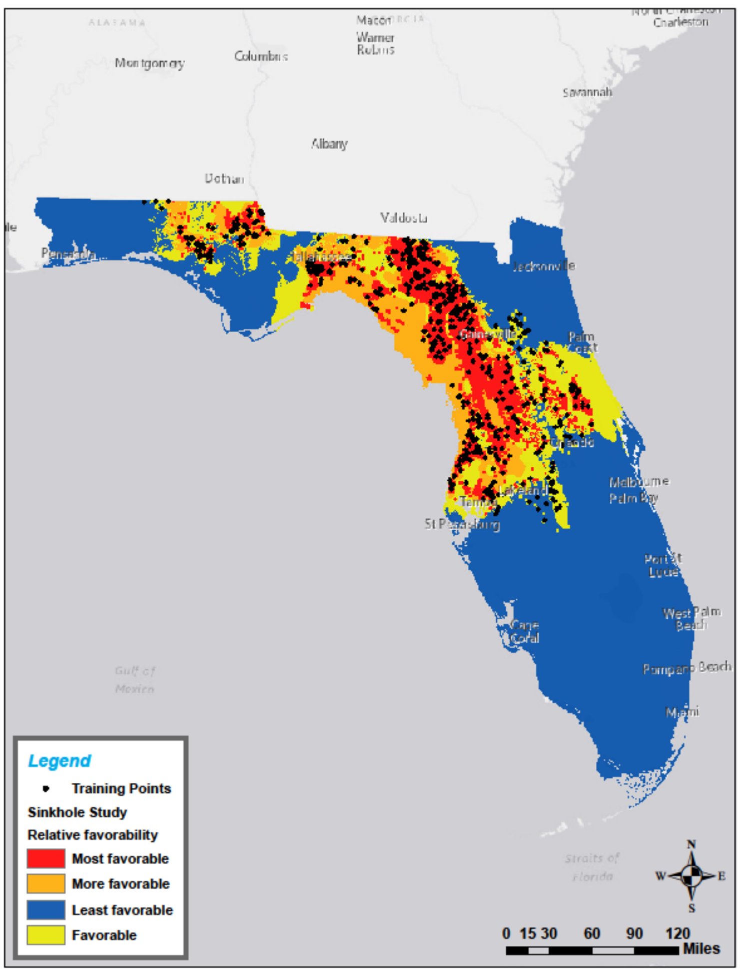
Sinkholes

Sinkholes are common wherever there is limestone terrain, but are rare in the southern part of the state. Central Florida and the Big Bend region have the largest incidence of sinkholes.

A report from FDEP aimed to determine the favorability of Florida's geography to sinkhole development. The results of the study show that 14% of the state is "favorable" to sinkholes, 10% is "more favorable" and 14% is "most favorable" to sinkholes. This was based on several factors, including already existing sinkholes, locations of thin overburden sediments, identification of closed circular topographic features, and locations with a small area between the top of soluble rock and the top of the water table.[155] The report does note however, that the analysis is not accurate or specific enough to determine whether a specific site will develop a sinkhole.

Below is the map from the report.

Figure 84: Favorability of Florida Geology to Sinkhole Formation



[155] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The Favorability of Florida's Geology to Sinkhole Formation.* Page 23 – 24.

The map shows that the Big Bend region of the state, as well as portions of the northern central Panhandle are most favorable to geology that favors sinkhole development.

3. Historical Occurrences of Geological Events

Landslides

There has only been one landslide in Florida in recorded history. In 1948, a landslide occurred on a farm in Gadsden County.[156] No one was injured and no structures were damaged.

Sinkholes

There are several significant historical occurrences of sinkholes, listed below in Table 48.

Table 48: Florida Historical Occurrences, Sinkholes

Date	Event Description
1959	A collapse sinkhole in Keystone Heights, induced by drilling, led to the fatality of a drill hand.
1960	The US-19 bridge over the Anclote River in Tarpon Springs collapsed due to a collapse sinkhole in the river under the bridge supports, leading to one fatality and five people injured.
1967	A young teenage boy died due to a sinkhole in Tampa. It was unknown if the sinkhole formed suddenly or if it previously existed.
May 1981	A roughly circular, but elongated sinkhole formed in Winter Park, Florida, approximately 300 feet by 300 feet in size. The sinkhole swallowed one house, a shed, half of a swimming pool, a vehicle, several large oak trees, and a section of the crossing street, and an estimated four million cubic feet of soil.
September 16, 1999	Lake Jackson in Tallahassee, a nationally known bass fishing lake, experienced a sinkhole that suddenly drained more than half the lake, including water, fish, and alligators.
July 12, 2001	Emergency officials for Hernando County investigated 18 confirmed sinkholes that developed in one day across the area, affecting a 15-16 block residential area and causing extensive damage to one house. One of the largest holes measured between 50 and 100 feet deep.
June 2002	A 150-foot wide sinkhole forced the evacuation of part of a 450-unit apartment building in Orlando, and a Spring Hill woman saw a 40-foot wide hole open in a retention area behind her uninsured home.
June 8, 2009	A sinkhole developed at about 8:45 AM and forced the FDOT to close the northbound outside land of Route 29 near Hollywood, backing up traffic most of the day.
September 15, 2009	Less than 10 feet in width but more than 50 feet deep, this sinkhole was the first of many discovered in High Spring after a torrential downpour. The largest sinkhole measured 75 feet deep and more than a hundred feet across. About a half dozen more are clustered in the same area, with some

[156] http://dep.state.fl.us/geology/geologictopics/hazards/landslides.htm

	ranging from just a few feet across and a few feet deep to others that are much larger and deeper.
2010	A collapse sinkhole was induced by blasting in the Mazak Mine in Mabel, Florida, leading to the fatality of one blasting expert.
2011	A collapse sinkhole in Trenton, Florida was induced by drilling, causing the fatality of one driller.
June 2012	Tropical Storm Debby brought heavy rainfall after an extended period of drought in Florida. The event led to the formation of hundreds of collapse sinkholes across the state, resulting in highway and residential road closures, evacuations of homes, and building closures.
March 2013	A Hillsborough County man was swallowed by a 50-foot deep sinkhole. Jeffrey Bush, 37, had been sleeping inside the Seffner home when the earth below his bedroom collapsed.[157]
July 2017	A large sinkhole developed in a Land-o-Lakes residential neighborhood leading to evacuations. Two homes were swallowed within 24 hours but the hole continued to slowly grow over the next month, leading to 6 more condemned homes.

4. Probability of Future Occurrences of Geological Events

Landslides

Because of Florida's relatively flat topography, landslides are not likely in Florida.

Sinkholes

It is highly likely that there will continue to be incidences of sinkholes in Florida because as explained above, Florida has terrain that is favorable to sinkholes.

Sinkholes can be triggered by natural and anthropogenic factors, such as heavy rain after an extended drought and groundwater withdrawal or well drilling. This means that heavy rainfall or high levels of groundwater withdrawal can increase the probability of sinkholes in an area.

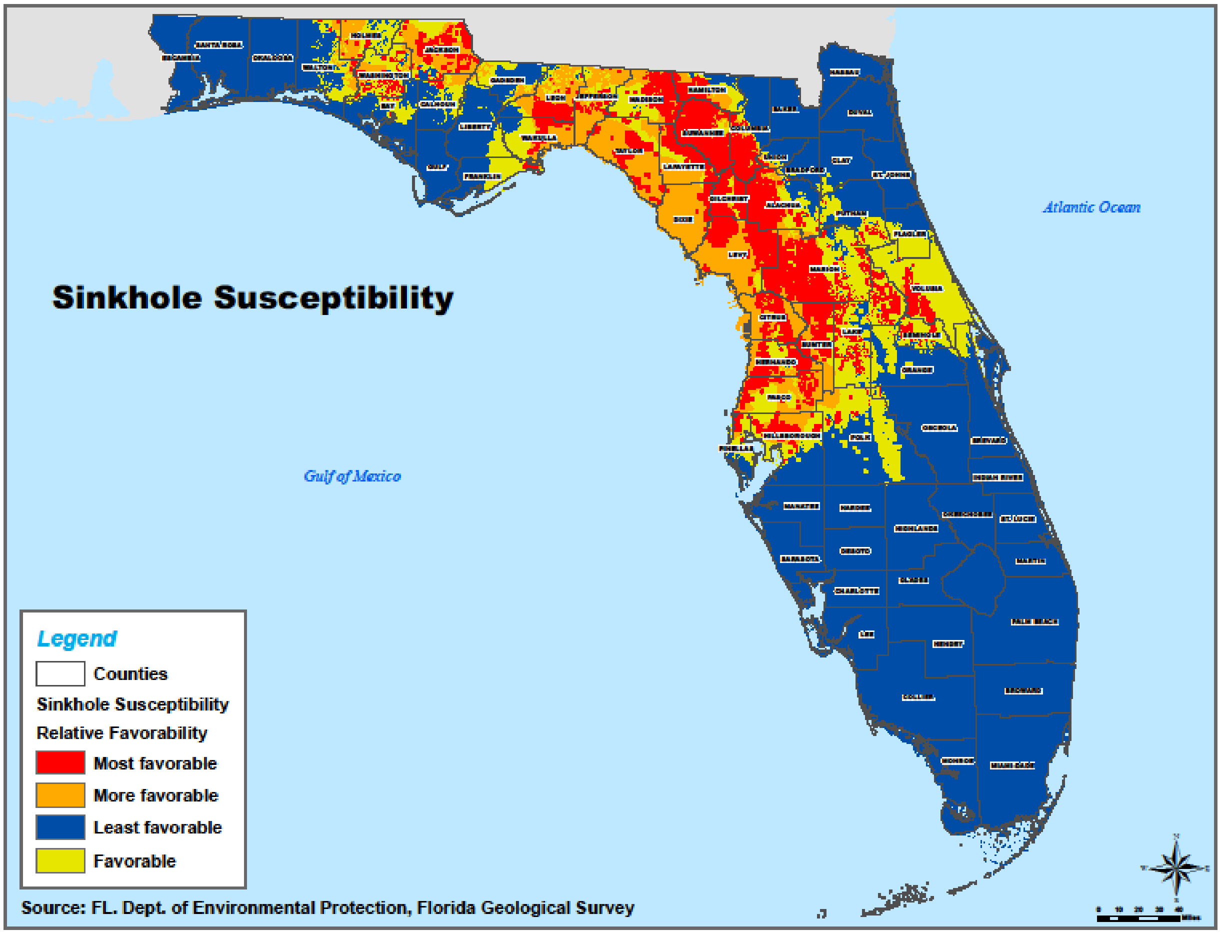
This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

Additionally, as Florida's population increases, the potential for individuals to be negatively impacted by a sinkhole increases because more people will live in locations that are favorable for sinkhole development.[158]

[157] http://articles.orlandosentinel.com/2013-08-12/news/os-sinkhole-damage-qa-20130812_1_largest-sinkhole-florida-geological-survey-limestone

[158] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 4.

Figure 85: Florida Sinkhole Susceptibility



According to the map from the report, the area most favorable to sinkhole development reach from the Big Bend region to west central Florida.

5. <u>Impact Analysis of Geological Events</u>

<u>Landslides</u>

N/A

<u>Sinkholes</u>

- <u>Public</u>
  - May fall in or drive in to a sinkhole
  - May be injured or killed from structure collapse because of sinkhole
- <u>Responders</u>
  - May be injured or killed when attempting rescue missions
- <u>Continuity of Operations (including continued delivery of services)</u>

    - If sinkhole affects structures or critical infrastructure, operations may be interrupted
- Property, Facilities, Infrastructure
    - Critical infrastructure, including structures and roads, may be affected or damaged causing disruption
- Environment
    - Sinkholes are part of the natural environment, but there may be damage to some natural spaces from a sinkhole; for example, a public park may be damaged and result in closure
- Economic Condition
    - Sinkhole damage repair can be very expensive, so a sinkhole may have a significant negative impact for the property owner; a sinkhole would likely not affect the economy of a community
- Public Confidence in Jurisdiction's Governance
    - If there is an increase in sinkhole occurrences and the government does not address the issue, the public may become concerned about what would happen if a sinkhole were to affect their property.

6. 2018 LMS Integration

An analysis of all 67 Florida County LMS Plans and their individual geological hazard rankings is shown below. Only 6 counties profiled Landslides as a hazard and ranked it as a low-risk. 11 counties considered sinkholes to be a high risk hazard to their jurisdiction.

Landslides

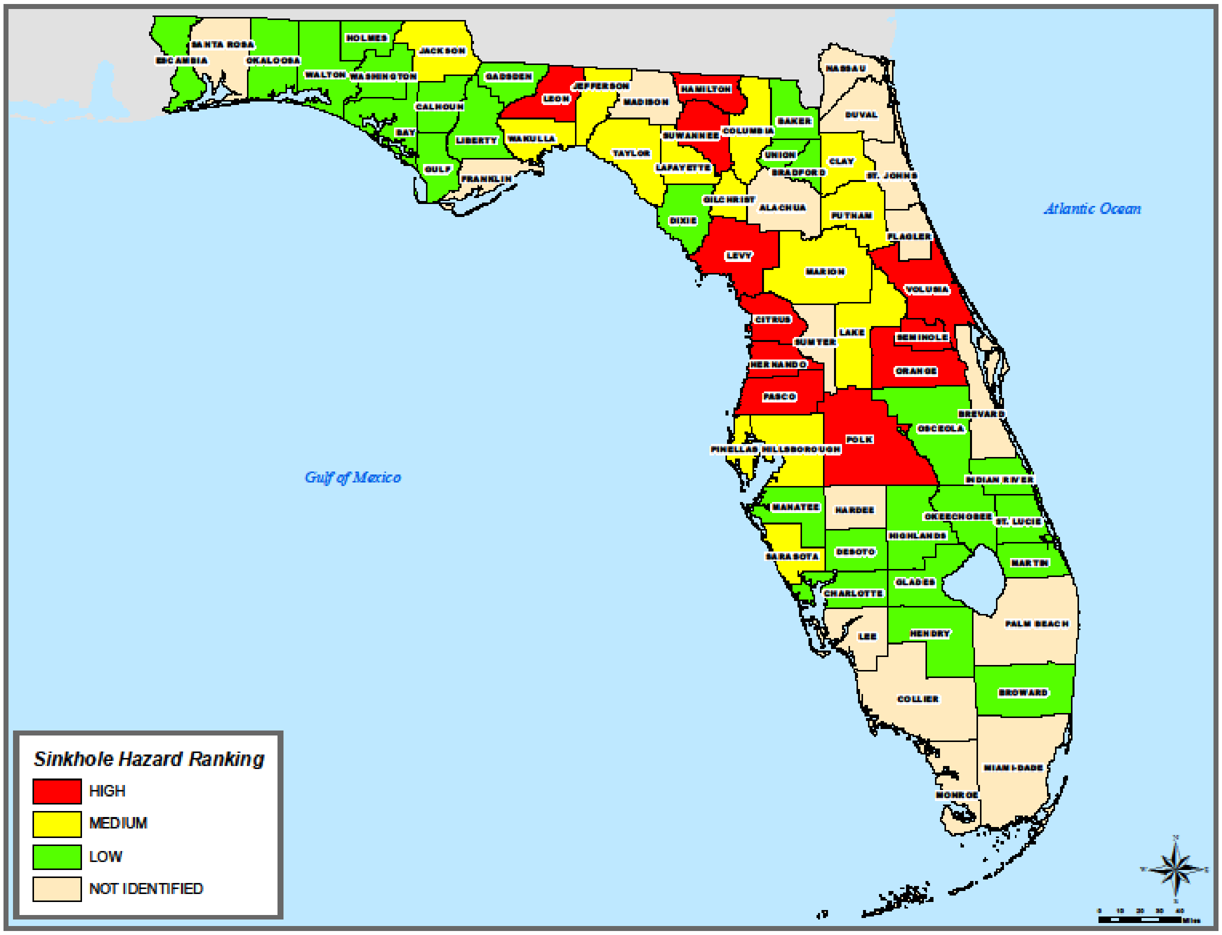
Only six jurisdictions identified landslides as a hazard in their LMS and they were ranked as low-risk. The other 61 LMS plans did not identify landslides as a hazard. Therefore, a map was not created to demonstrate this information.

Sinkholes

Based on the LMS plans, Figure 86 displays the jurisdictional rankings for the sinkhole hazard. Not all counties have identified sinkholes as one of their hazards.

- High-risk Jurisdictions: 11
- Medium-High-risk Jurisdictions: 0
- Medium-risk Jurisdictions: 14
- Low-risk Jurisdictions: 26
- Not identified Jurisdictions: 16

Figure 86: Sinkhole Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Enhanced SHMP is required to evaluate the vulnerability of jurisdictions and estimate potential losses for each hazard. Below is the Vulnerability Analysis and Loss Estimation of the state, by Jurisdiction, to Geological Events, broken down by Landslides and Sinkholes.

Landslides

Florida is not vulnerable to landslides so no vulnerability analysis or loss estimation will be conducted.

Sinkholes

Sinkhole events are prevalent across all parts of the State of Florida and there is no way of knowing where future sinkholes might appear. Because of this, the entire state is vulnerable to sinkholes. The counties with the most sinkholes in the past will likely continue to be vulnerable to sinkholes in the future. The map shown above in the Probability section shows which counties are more favorable and most favorable to sinkhole occurrences. Listed below are the counties that have areas designated in the FDEP report as either Favorable, More Favorable, or Most Favorable. Some counties are listed in all three of the sections. Please note that the counties are listed alphabetically, not by level of risk.

- Counties with areas that are “Favorable”
  - Alachua, Bay, Bradford, Brevard, Calhoun, Citrus, Columbia, Dixie, Flagler, Franklin, Gadsden, Gilchrist, Hamilton, Hernando, Hillsborough, Holmes, Jackson, Jefferson, Lafayette, Lake, Leon, Levy, Liberty, Madison, Marion, Orange, Osceola, Pasco, Pinellas, Polk, Putnam, Seminole, Sumter, Suwannee, Taylor, Union, Volusia, Wakulla, Walton, Washington
- Counties with areas that are “More Favorable”
  - Alachua, Calhoun, Citrus, Columbia, Dixie, Gadsden, Gilchrist, Hamilton, Hernando, Hillsborough, Holmes, Jackson, Jefferson, Lafayette, Leon, Levy, Madison, Marion, Pasco, Pinellas, Polk, Sumter, Suwannee, Taylor, Union, Wakulla, Walton, Washington
- Counties with areas that are “Most Favorable”
  - Alachua, Bay, Calhoun, Citrus, Columbia, Dixie, Franklin, Gilchrist, Hamilton, Hernando, Hillsborough, Holmes, Jackson, Jefferson, Lafayette, Lake, Leon, Levy, Madison, Marion, Orange, Pasco, Pinellas, Polk, Putnam, Seminole, Sumter, Suwannee, Taylor, Union, Volusia, Wakulla, Walton, Washington

No loss estimation was conducted. The map shows the geologic favorability for the development of sinkholes. Since this is such an imprecise method of identification, a loss estimation would not have been useful for these purposes.

8. Vulnerability Analysis and Loss Estimation, of State Facilities

The Enhanced SHMP is required to evaluate the vulnerability and estimate potential losses regarding the State and its facilities across the state. The GIS team used the database of all state facilities and their values to provide the loss estimation data.

Landslides

Florida is not vulnerable to landslides so no vulnerability analysis or loss estimation will be conducted.

Sinkholes

State facilities within the areas marked as “favorable,” “more favorable,” and “most favorable,” may be vulnerable to damage due to sinkhole development. The state facility GIS layer was not layered with the sinkhole favorability map above because of the imprecise nature of the favorability map. The data shows the geologic favorability for the development of sinkholes and therefore is not useful to determine whether or not a state facility is actually vulnerable. Furthermore, a loss estimation was not conducted because it would not have been useful for risk assessment purposes because of the imprecise method of identification of areas favorable for sinkhole development.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 10.

<table>
<tr><th colspan="5">GEOLOGICAL</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Sinkholes are landforms created when overburden subsides or collapses into fissures or cavities in underlying carbonate rocks. Florida is underlain by several thousand feet of carbonate rock, limestone, and dolostone, with a variably thick mixture of sands, clays, shells, and other near surface carbonate rock units, called overburden.</td><td rowspan="5">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>High</td><td>Medium</td><td>Low</td></tr>
</table>

Winter Storm and Freeze Hazard Profile

1. Winter Storm and Freeze Description

Severe winter weather includes extreme cold, snowfall, ice storms, winter storms, and/or strong winds, and affects every state in the continental United States. Areas where such weather is uncommon, such as Florida, may experience a greater impact on transportation, agriculture, and people from relatively small events compared to other states that experience winter weather more frequently.

Winter storm formation requires below-freezing temperatures, moisture, and lift to raise the moist air to form the clouds and cause precipitation. Lift is commonly provided by warm air colliding with cold air along a weather front. These storms move easterly or northeasterly and use both the southward plunge of cold air from Canada and the northward flow of moisture from the Gulf of Mexico to produce ice, snow, and sometimes blizzard conditions. These fronts may push deep into the interior regions, sometimes as far south as Florida. The National Weather Service will issue Frost Advisories, Wind Chill Advisories, Watches or Warnings, along with Freeze and Hard Freeze Watches and Warnings when cold weather threatens an area.

Frozen Precipitation: Snow, Sleet, and Freezing Rain

As a hazardous winter weather phenomena, the National Weather Service (NWS) defines a Winter Storm a weather event with accumulating frozen precipitation such as snow, sleet, and/or freezing rain.

- Snowfall: steady fall of snow for several hours or more. Heavy snow is defined as either a snowfall accumulating to 4 inches in depth in 12 hours or less, or snowfall accumulation to 6 inches or more in depth in 24 hours or less.
- Sleet: pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. Heavy sleet is a relatively rare event defined as the accumulation of ice pellets covering the ground to a depth of 0.5 inch or more.

In states such as Florida, where even the smallest accumulations can cause impacts, lower thresholds are typically used to define significant winter storms and the issuance of Winter Storm Warnings. This is because of a lower capacity to respond to winter storm events.

In North Florida, a Winter Storm Warning is issued when greater than 1" of snow and/or sleet is expected to fall. For Central Florida, any snow or sleet amount over a 1/2" is considered a Winter Storm. An Ice Storm is when ice accumulates on the ground, vegetation, and power lines. Freezing Rain falls as liquid rain, but then freezes on contact with surfaces when the air temperature is below freezing. A Winter Storm Warning is issued in North Florida for ice accumulations over 1/4". This amount is often when trees and power lines begin to feel the weight of the ice. Ice accumulations are usually accumulations of 0.25 inches or greater across the country; however, amounts as little as 0.1 inch in Florida have significant impact on transportation, special needs populations, and agriculture and livestock throughout the state.

These accumulations become heavy and can damage buildings, trees, and even disrupt power and communications systems. A small amount of ice can be dangerous to pedestrians and motorists, with bridges being particularly dangerous because they freeze before other surfaces. A thin layer of ice can cause travel issues on untreated roadways.

Frost, Freeze, and Hard Freeze

Frost is the accumulation of small ice crystals on surfaces, similar to the accumulation of dew in the mornings. If a frost persists for long enough, it can lead to crop damage or loss. Frost is not a threat to the public but is a concern to the agricultural industry particularly that of Florida's citrus growing season. Frost can occur when air temperatures fall below 36 degrees Fahrenheit, the wind is light, and there is sufficient moisture in the air. A Freeze occurs when overnight temperatures reach at least 32 degrees Fahrenheit. A Hard Freeze occurs when the temperature falls below 28 degrees Fahrenheit for four hours or more. While most vegetation can survive a frost, very little vegetation can survive a hard freeze and this is when the most damage to crops occurs. While cold fronts rarely bring snow or sleet to Florida, long lasting cold temperatures occur more often and can last for several days. Nighttime temperatures can drop below freezing for periods well in excess of 8 hours.

Nor'easter

A Nor'easter is a storm over the Atlantic coast, typically moving to the northeast, with northeasterly winds blowing from the ocean across the coast. According to the NWS, these storms can occur at any time of the year, but are more common and stronger between September and April. These storms bring heavy rain, frozen precipitation, high winds, and rough surf, all of which may impact Florida. While Nor'easters don't typically bring winter weather, they have contributed to high winds, coastal erosion, and frozen precipitation in Florida.

Cold Illnesses

Frostbite is damage to skin and tissue caused by exposure to freezing temperatures – typically any temperature below 31F, and can occur in a matter of minutes when bare skin is exposed to extreme cold. Hypothermia occurs when the body loses the ability to regulate temperature. Both of these illnesses are very dangerous and can be life threatening if not treated immediately. Infants and elderly people are most at risk. When strong winds combine with cold temperatures, the heat loss from a person's skin can be accelerated. This is called the wind chill. The wind chill can make it feel like it is much colder outside than what the actual temperature is. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." During unexpected or prolonged cold periods in Florida, there are often issues with propane gas supplies, and electrical and natural gas systems are pushed to their limits to meet the record demands. Also, many residents of Florida have inadequate heating systems and turn to alternatives such as space heaters and wood fires that increase the likelihood of accidental house fires and deaths from carbon monoxide poisoning.[159]

[159] http://www.nws.noaa.gov/om/winter/index/shtml

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Medium, meaning any injuries, but no deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

<u>Potential Effects of Climate Change on Winter Storms and Freezes</u>

Climate change is not expected to increase occurrences or magnitude of winter storms and freezes in Florida. However, climate change does not mean that winter storms and freezes would not continue to occur in Florida. Climate variability will continue to influence daily temperature variability so isolated and prolonged winter storms and freeze events are not unlikely.[160]

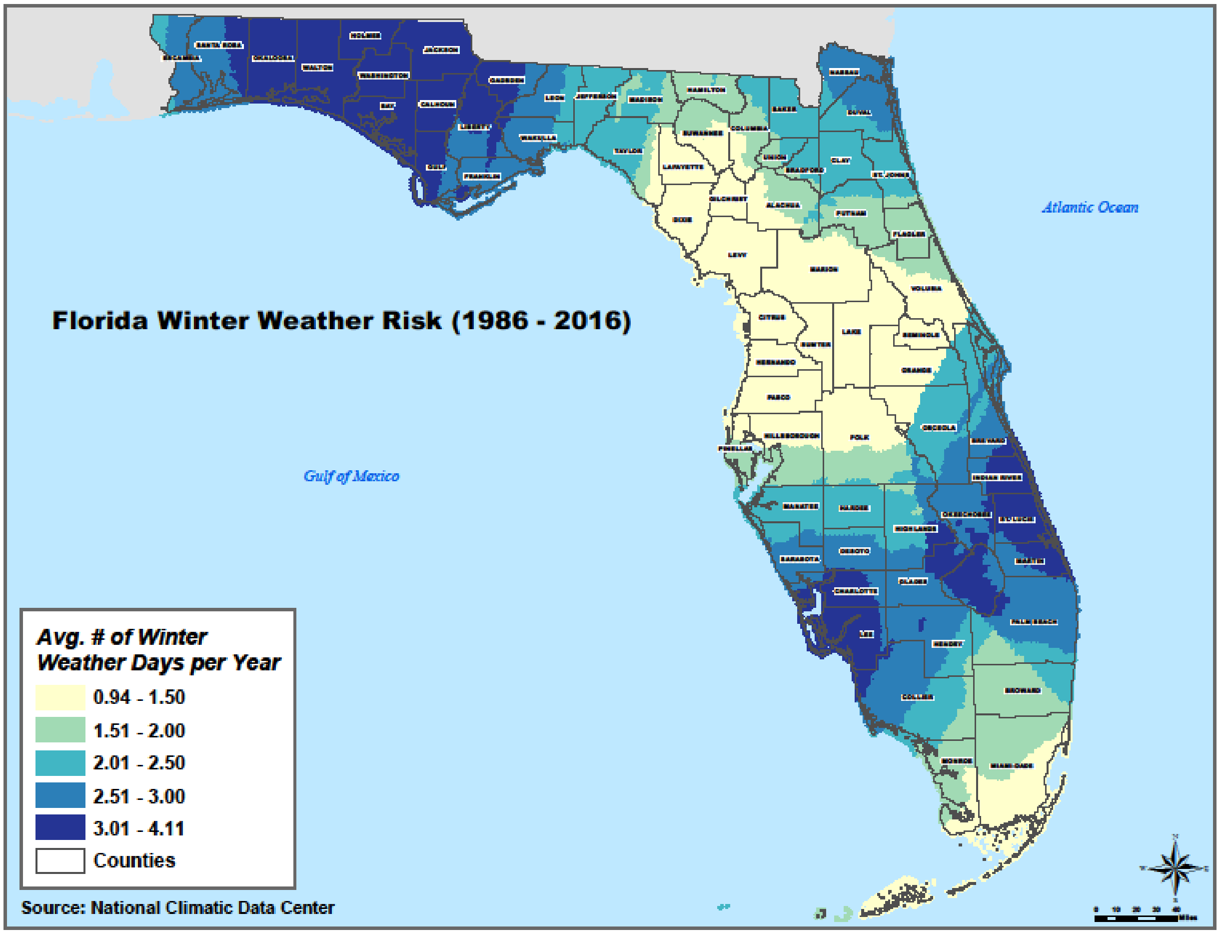
Severe winter storms will not disappear. Specifically, isolated or prolonged winter freeze events in Florida will still occur.

2. Geographic Areas Affected by Winter Storm and Freeze

The northern portion of the state is affected by winter storm and freeze events more frequently than southern Florida. That being said, south Florida can still experience freeze events, as shown in the historical section below.

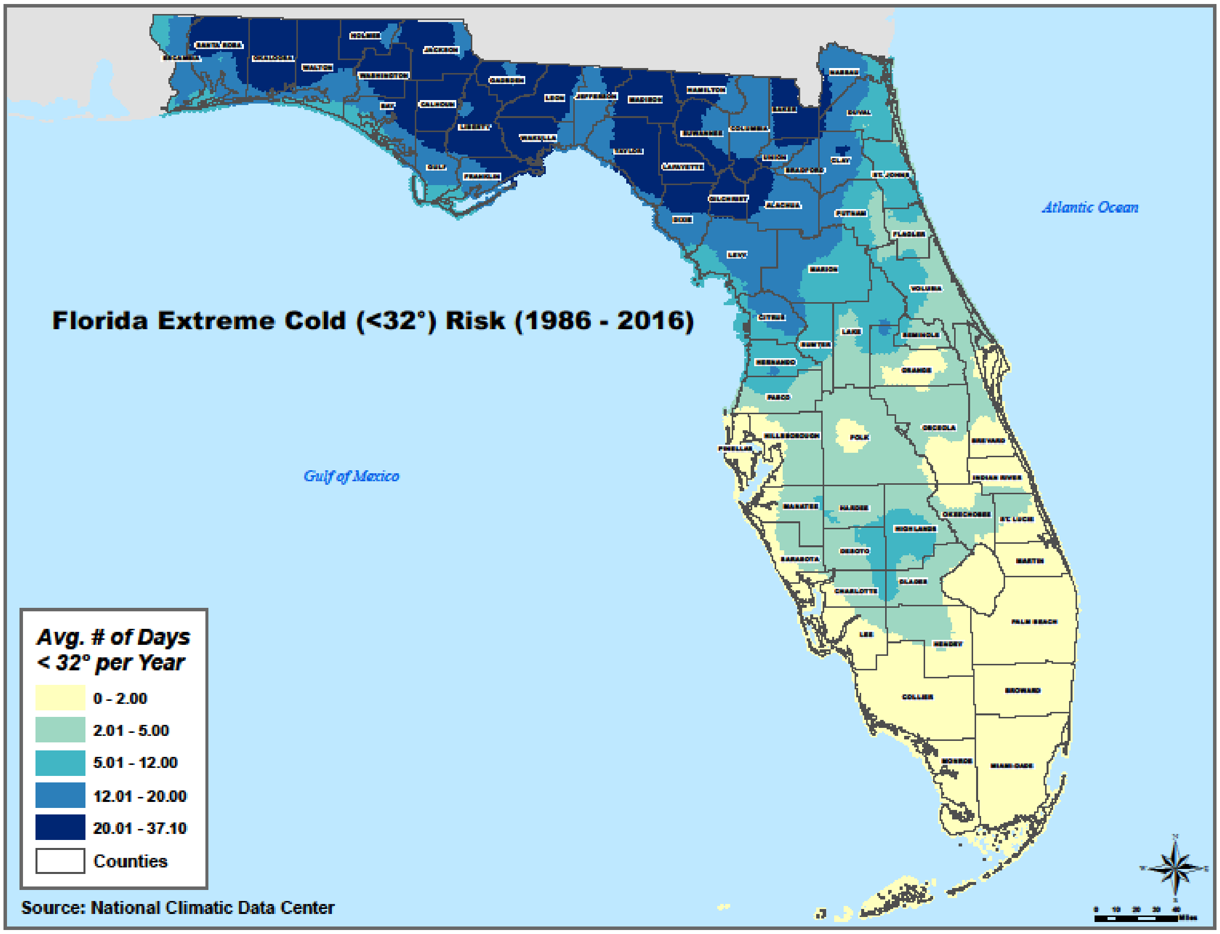
[160] *Ingram and Carter (2012). Southeast region technical report to the National Climate Assessment.* *http://gyr.fortlauderdale.gov/home/showdocument?id=3153*

Figure 87: Winter Weather Risk, 1986 – 2016



According to this data, most of north Florida, as well as portions of southwest and southeast Florida are likely to receive 2 to 4 days of winter weather. Central Florida and the very southern Florida are likely to experience only 1 to 1 ½ days of winter weather.

Figure 88: Florida Extreme Cold (<32 degrees) Risk, 1986-2016



According to this data, north Florida is likely to experience between 5 and 37 days of Extreme Cold, which is classified as less than 32 degrees. Specifically, the northern portions of the panhandle of Florida are likely to experience between 20 and 37 days with temperatures less than 32 degrees.

3. Historical Occurrences of Winter Storm and Freeze

Of the 69 FEMA-declared events in Florida from 1953 until 2016, there have been seven events that involved severe winter weather. These events all related to freezing and to a large degree focused on the overall impact to the Florida economy. Below is a table of the major disaster declarations related to severe winter weather, as designated by FEMA.

Table 49: FEMA Major Disaster Declarations in Florida, 1953 - 2016[161]

Date	Event	Declaration Number
March 15, 1971	Freeze	DR-304
January 31, 1977	Severe Winter Weather	DR-526
December 24 – 26, 1983	Freezing Temperatures	DR-698
March 18, 1985	Severe Freeze	DR-732
December 23 – 25, 1989	Severe Freeze	DR-851
March 12 – 16, 1993	Tornadoes, Flooding, High Winds, Tides, Freezing	DR-982
December 1, 2000 – January 25, 2001	Severe Freeze	DR-1359

According to the NCDC Storm Event Database, there were 58 winter storm and freeze events in Florida, including Extreme Cold, Frost/Freeze, and Winter Weather/Storm from 2006 to 2016. These events often lasted for longer than one day and affected multiple counties.

While there were no declared winter storm or freeze events in Florida from 2006 to 2016, there were several events that affected Florida.

Table 50: Florida Historical Occurrences, Winter Weather and Freeze, 2006-2016[162]

Date	Event Type	Location	Impacts
November 21, 2006	Snowstorm	Central Florida	Snow fell in parts of Central Florida; this was the first November snow event in the State since 1912.
February 17, 2007	Frost/Freeze	Palm Beach County	Estimated $50 million in crop damages; durations of freezing temperatures ranged from 7-11 hours north of I-4 and 3-5 hours south of I-4.
January 2-3, 2008	Frost/Freeze	Hillsborough, Collier, Hendry counties	Estimated $15 million in crop damages; brief snow flurries reported in St. Johns, Flagler, Volusia, and Brevard counties.

161 https://www.fema.gov/disasters?field_state_tid_selective=47&field_disaster_type_term_tid=9243&field_disaster_declaration_type_value=All&items_per_page=20&=GO

162 https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Blizzard&eventType=%28Z%29+Cold%2FWind+Chill&eventType=%28Z%29+Extreme+Cold%2FWind+Chill&eventType=%28Z%29+Freezing+Fog&eventType=%28Z%29+Frost%2FFreeze&eventType=%28Z%29+Heavy+Snow&eventType=%28Z%29+Ice+Storm&eventType=%28Z%29+Sleet&eventType=%28Z%29+Winter+Storm&eventType=%28Z%29+Winter+Weather&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2006&endDate_mm=12&endDate_dd=31&endDate_yyyy=2011&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

January 21-22, 2009	Frost/Freeze; Extreme Cold	Statewide	1 death; $61.55 million in crop damages.
February 5, 2009	Extreme Cold	Broward County	1 death; crops were damaged by the cold.
January 2, 2010	Frost/Freeze	Lake, Volusia, Orange, Okeechobee, Brevard, Indian River, St. Lucie, Seminole, Martin, and Osceola counties	Estimated $14.5 million in crop damages.
January 4, 2010	Extreme Cold	Broward County	1 death.
January 9, 2010	Extreme Cold	Brevard, Volusia, Orange, Putnam, Marion, Flagler, Seminole, Lake, and Miami-Dade counties	1 injury and 1 death; sleet and snow, freezing rain mixed with a band of light rain from Kissimmee to Palm Bay northward; a slight accumulation of mixed precipitation occurred on vehicles, pool screen enclosures, and plants.
January 10-11, 2010	Frost/Freeze	Collier, Miami-Dade, Hernando, Levy, Polk, Pasco, Citrus, Hillsborough, Hardee, Desoto, Charlotte, Sumter, Highlands, Manatee, Sarasota, and Lee counties	Over $648 million in crop damages and $3 million in property damage.
February 26, 2010	Frost/Freeze	Levy, Hernando, Citrus, Sumter, Highlands, Pasco, Manatee, Polk, Hillsborough, Hardee, Desoto, Charlotte, Sarasota, and Lee counties	Estimated $8.86 million in crop damages.
December 14-15, 2010	Frost/Freeze	Hernando, Hardee, Sarasota, Hillsborough, Levy, Sumter, Citrus, Pasco, Desoto, Manatee, Polk, Highlands, Charlotte, and Lee counties	Estimated $41.23 million in crop damages.
December 27-28, 2010	Frost/Freeze	Indian River, Osceola, Seminole, Lake, Brevard, Volusia, Okeechobee, Orange, Martin, St. Lucie, Palm Beach, Collier, Miami-Dade, and Broward counties	Estimated $300,000 in crop damages; temperatures stayed below freezing for up to 12 hours over the Nature Coast with hard freeze conditions for up to 10 hours; central Florida had around 8 hours of freezing temperatures with as many as 4 hours of hard freeze conditions; southwest

			Florida had up to 4 hours of sub-freezing temperatures.
January 3, 2012	Frost/Freeze	Miami-Dade and Hendry counties	$300,000 in crop damages.
March 4, 2013	Frost/Freeze	Palm Beach County	$3 million in crop damages.
January 7, 2014	Extreme Cold	Leon County	$1.1 million in property damages.
January 28, 2014	Winter Weather	Walton, Gulf, Calhoun, Jackson, Washington, Holmes, Bay, Franklin, Wakulla, Jefferson, Madison, Leon, Gadsden, and Liberty counties	Estimated $70.17 million in property damages; several roads were closed including a large stretch of I-10 in the panhandle; most bridges were closed at one point from Tallahassee westward; during the peak of the event, there was no road access to cross the Apalachicola River; this all led to transportation impacts with significant monetary losses for trucking companies.

The storm of 1993, considered to be among the worst non-tropical weather events in the United States, killed at least 79 people, injured more than 600, and caused more than $2 billion in property damage across parts of 20 states. Florida was affected by this winter storm, and it was a FEMA-declared event for tornadoes, flooding, high winds, tides, and freezing. According to NOAA, 2 people died from exposure to the cold in 2009 and 2 people died in 2010. This does not include additional deaths related to carbon monoxide poisoning from using improper heating sources.[163]

Prolonged freezing temperatures in January 2010 led to agricultural losses of more than $200 million. The USDA declared 59 of 67 Florida counties natural disaster areas for agricultural production as the temperature dropped below 28 degrees for more than 4 hours in a row across most of the state.[164]

4. Probability of Future Occurrences of Winter Storm and Freeze

Based on all the historical evidence, it is anticipated that a freeze may be expected in Florida every one to two years. Hard freezes, where the greatest numbers of winter crops are lost, may be expected on average once every five years based on historic FEMA-declared disasters.

According to the maps above, the panhandle of Florida, as well as portions of southeast and southwest Florida are likely to experience between 2 and 4 days of winter weather each year. Additionally, north Florida, particularly the northern panhandle, is likely to experience at least 5 days and up to 37 days of extreme cold, with temperatures less than 32 degrees.

[163] http://www.nws.noaa.gov/om/hazstats.shtml#
[164] http://www.tbo.com/news/usda-approves-disaster-declaration-for-florida-crops-87897

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

NCDC Database

According to the NCDC database, there were 42 winter storm and freeze events in Florida from 2006 to 2016. The database categorizes these events as cold or extreme cold; frost or freeze; and winter storm or weather. In the given timeframe, there were 5 to 6 times more frost or freeze events than extreme cold and winter storm or weather events. Based on this data, there will be an average of 2-3 frost and freeze events each year and an average 1 extreme cold or winter weather event each year in Florida.

Table 51: NCDC Winter Storm and Freeze, 2006-2016[165]

Type	NCDC Report	Average per year
Cold/Extreme Cold	6	.55
Frost/Freeze	31	2.82
Winter Storm/Weather	5	.45
Total	42	3.82

5. Winter Storm and Freeze Impact Analysis

- Public
  - Injury or death, as well as possible property damage from car accidents because of ice on roads and bridges.
  - Injury or death from exposure to cold weather, either because of being stranded outside, or inside without proper heating systems.
  - Deaths and injuries have resulted from accidents including automobile collisions due to poor driving conditions. Emergency medical response can be severely hindered from the effects of a winter storm event. This is because Floridians are not accustomed to driving in winter weather conditions.
- Responders
  - First responders are increasingly at risk as they respond to traffic incidents and calls for medical attention. They are vulnerable to the same transportation dangers as other citizens, but often have to go out in hazardous conditions when ordinary citizens would not.
- Continuity of Operations (including continued delivery of services)
  - During a winter storm and the days that follow, many people do not travel due to the road conditions. The absenteeism of workers affects the overall continuity of operations of the government.
- Property, Facilities, Infrastructure
  - Loss or damage of crops and agricultural revenue because of frost/freeze events.

[165] https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=12%2CFLORIDA

- Roads and highways are most vulnerable to the effects of winter storms. Roads frequently become iced over, resulting in accidents, injuries, deaths, and traffic congestion. Roads can be heavily damaged due to winter weather events. Potholes and cracks can be found on roadways after a winter weather event, resulting in the need for repairs, causing further economic losses to the local area.
- Electrical transmission lines are highly vulnerable to severe winter weather. Trees frequently fall due to the extra weight of ice accumulating on branches. Trees falling on nearby power lines cause disruption of power service, which results in additional costs for repairs and maintenance.
- Other impacts resulting from winter storms include damage to plumbing, sewers, and waterlines, as well as minor roof damage and house fires resulting from portable heaters.

- Environment
  - Loss or damage to environment, including green spaces, habitats, species because of cold weather, winter weather, and/or frost/freeze events.
- Economic Condition
  - Loss or damage to crops because of freezes result in the loss of tens and sometimes hundreds of millions of dollars. This affects individual farmers and industries, such as the citrus industry in Florida.
  - During a winter storm and the days that follow, many people do not travel due to the road conditions. The absenteeism of workers affects the economy.
- Public Confidence in the Jurisdiction's Governance
  - A high number of motor vehicle accidents, school closures, power outages, or injuries and deaths may cause the public to believe that the government did not adequately prepare for the incident.
  -

6. 2018 LMS Integration

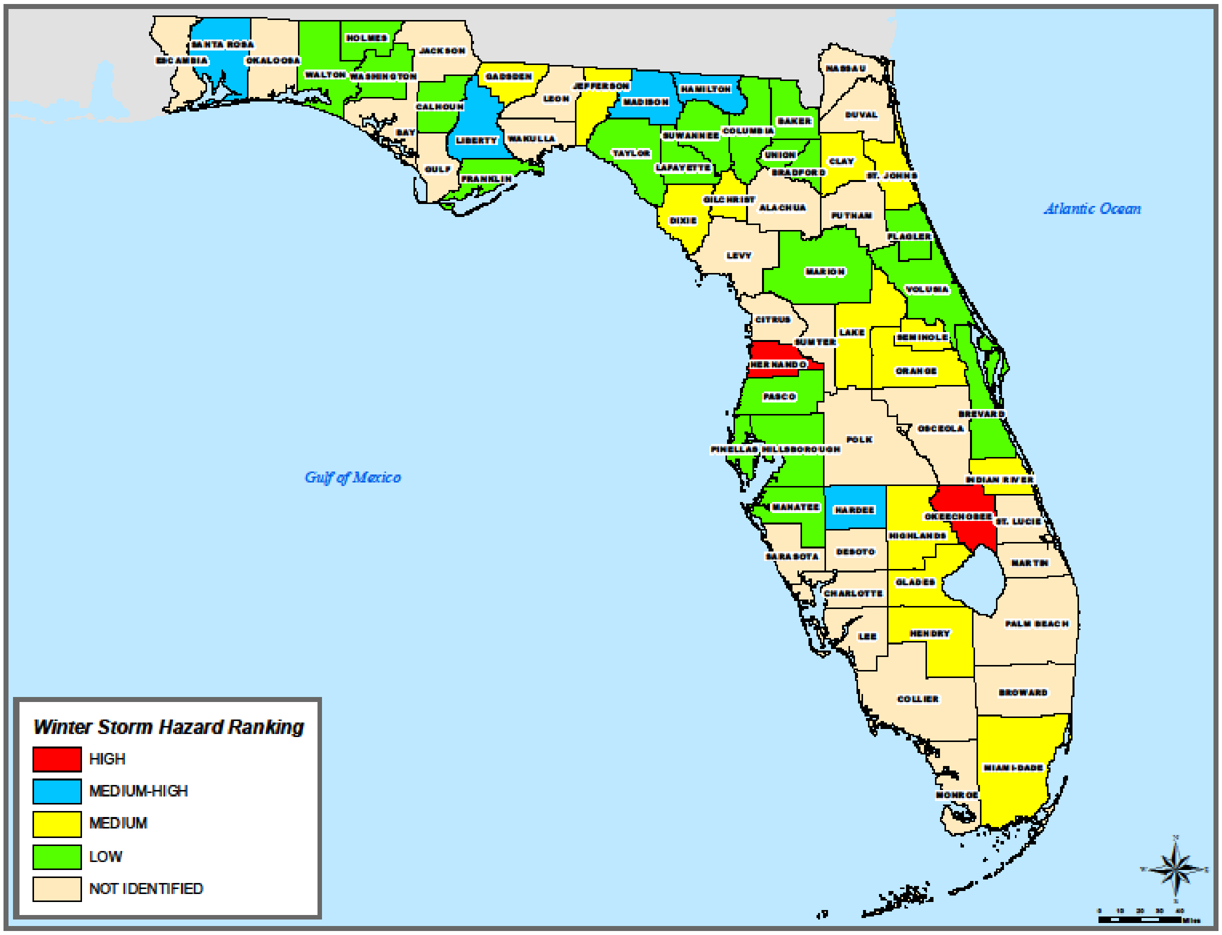
An analysis of all 67 Florida County LMS Plans and their individual winter storms or freeze hazard rankings is shown below. While 2 counties considered winter storms to a high risk in their county, 26 counties did not identify winter storms as a hazard. More counties identified Freezes as a hazard to their jurisdiction, with 8 considering freeze to be a high risk hazard and only 17 counties did not identify freeze as a hazard.

Winter Storms

Based on the LMS Plans, Figure 89 displays the jurisdictional rankings for the winter storms hazard. Not all counties have identified winter storms as one of their hazards.

- High-risk Jurisdictions: 2
- Medium-High-risk Jurisdictions: 5
- Medium-risk Jurisdictions: 14
- Low-risk Jurisdictions: 20
- Not identified: 26

Figure 89: Winter Storm Hazard Rankings by County

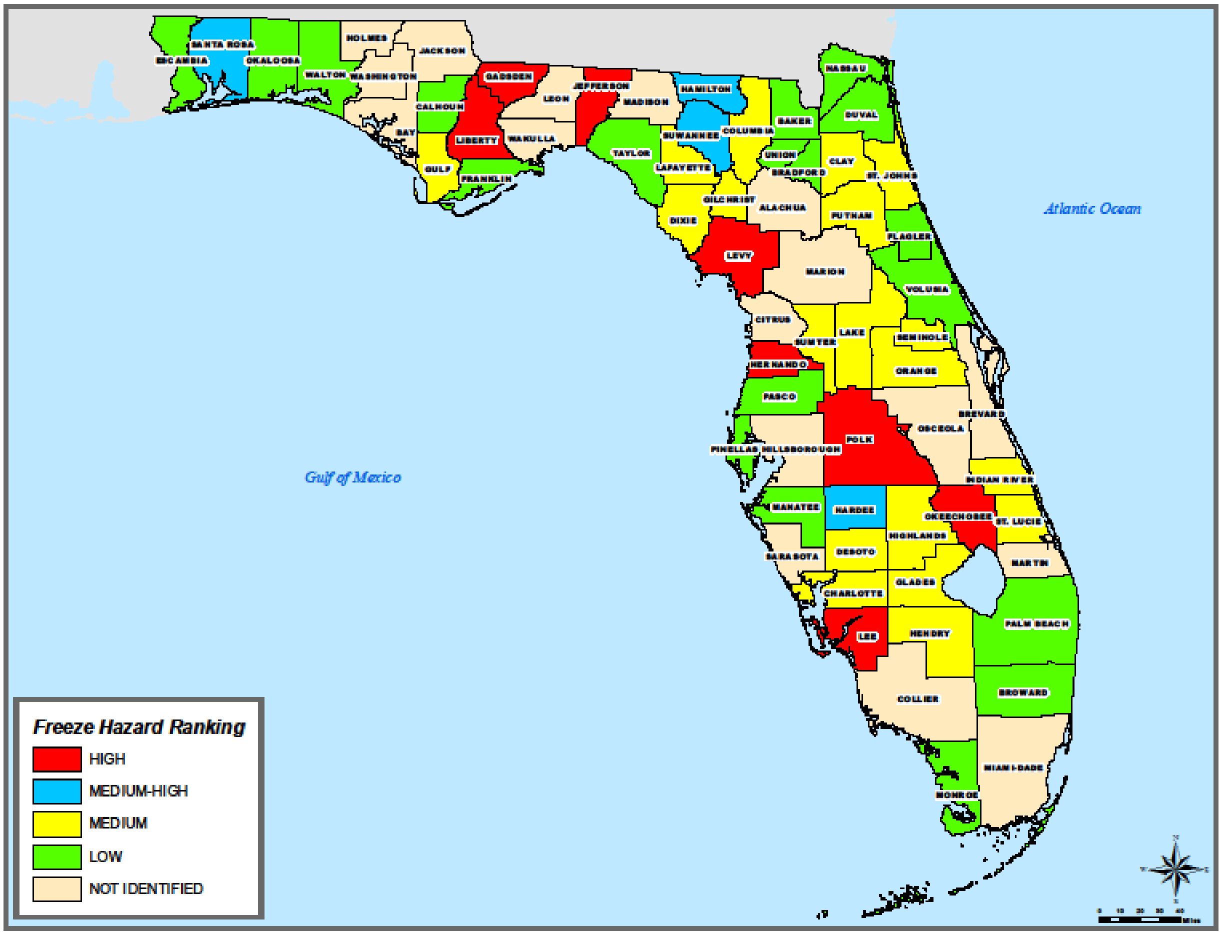


Freezes

Based on the LMS plans, Figure 90 displays the jurisdictional rankings for the freezes hazard. Not all counties have identified freezes as one of their hazards.

- High-Risk Jurisdictions: 8
- Medium-High-risk Jurisdictions: 4
- Medium-risk Jurisdictions: 19
- Low-risk Jurisdictions: 19
- Not identified Jurisdictions: 17

Figure 90: Freeze Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Enhanced SHMP is required to evaluate the vulnerability of jurisdictions and estimate potential losses for each hazard. Below is the Vulnerability Analysis and Loss Estimation of the state, by Jurisdiction, to Winter Storms and Freezes.

Severe winter weather events do not occur with the same frequency within all parts of Florida. Counties found in northern Florida have experienced more winter weather than central and southern counties.

As explained above, northern counties are likely to experience between 2 and 4 days of winter weather. There are also areas in southwest and southeast Florida that are likely to experience between 2 and 4 days of winter weather each year. Counties likely to experience between 3 and 4 days of winter weather include: Santa Rosa, Okaloosa, Walton, Holmes, Washington, Bay, Jackson, Calhoun, Gulf, Gadsden, Liberty, Charlotte, Lee, Indian River, St. Lucie, Martin, Highlands, and Glades.

Furthermore, as the map above shows, most northern counties are expected to receive between 2 and 37 days of extreme cold, with temperatures below 32 degrees. Specifically, the following northern panhandle counties are likely to receive between 20 and 37 days of extreme cold: Santa Rosa, Okaloosa, Walton, Holmes, Washington, Bay, Jackson, Calhoun, Liberty, Gulf, Gadsden, Leon, Liberty, Wakulla, Franklin, Jefferson, Madison, Taylor, Hamilton, Suwannee, Lafayette, Dixie, Gilchrist, Alachua, Columbia, and Baker.

National Climatic Data Center Winter Storm and Freeze Loss Estimation

As explained before, there will likely be an average of 3 to 4 winter storm and freeze events each year in Florida, with 2 to 3 of those events being a frost or freeze. According to the NCDC data, deaths and injuries are unlikely from these events. There were 4 direct deaths and 1 injury from these types of events in Florida from 2006 to 2016. This averages to about .09 deaths and .02 deaths resulting from each winter storm or freeze in Florida. These fatalities are a direct result of hypothermia and do not include indirect deaths due to carbon monoxide poisoning or other causes, which may increase the probability of cold weather deaths in a given year.

Property and crop damages are much more likely than deaths and injuries. According to the database, it is likely that there will be an average of $100,000 in property damage and over $74 million in crop damages. Because there is a significant agriculture and livestock industry, Florida is vulnerable to winter storms and freezes. The large citrus industry is particularly vulnerable because the primary citrus growing season is throughout the winter months when freeze events occur.

Table 52: Florida Winter Weather Impacts, 2006-2016[166]

	Total 2006 – 2016	**Annual Average**	**Average per Event**
Deaths	**4**	**0.36**	**0.9**
Injuries	**1**	**0.09**	**0.02**
Property Damage	$1,100,000	$100,00	$26,178
Crop Damage	$814,873,340	$74,079,394	$19,392,511
Total Damage	**$815,973,340**	**$74,179,394**	**$19,418,689**

8. Vulnerability Analysis and Loss Estimation, of State Facilities

The Enhanced SHMP is required to evaluate the vulnerability and estimate potential losses regarding the State and its facilities across the state. The GIS team used the database of all state facilities and their values to provide the loss estimation data.

The 2018 plan does not change the perspective that state facilities are not vulnerable to winter storms and freezes; the operating capacity of a building may be affected by this particular hazard but not to a significant degree. During the 2018 plan update and revision process, the winter weather-specific estimation of losses has not been calculated, as the impacts to state facilities from severe winter weather are negligible. The past and future vulnerabilities to winter storm events within Florida were reviewed in

[166] https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=12%2CFLORIDA

an effort to determine the state's overall vulnerability. However, winter storms—similar to droughts—usually do not cause direct structural damage to facilities.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 9.

<table>
<tr><th colspan="5">WINTER STORM & FREEZE</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Severe winter weather includes extreme cold, snowfall, ice storms, winter storms, and/or strong winds, and affects every state in the continental United States. Areas where such weather is uncommon, such as Florida, may experience a greater impact on transportation, agriculture, and people from relatively small events compared to other states that experience winter weather more frequently.</td><td rowspan="4">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>Medium</td><td>Low</td><td>Medium</td></tr>
</table>

Seismic Event Hazard Profile

1. Seismic Event Description

A seismic event, or an earthquake, is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface that creates seismic waves. This shaking can cause buildings and bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger landslides, and tsunamis or indirectly cause flash floods or fires.

Measures

Earthquakes are measured in two ways, by magnitude and by intensity. Magnitude is defined as one number, while intensity varies based on what is experience in a specific location.

The magnitude is measured on the moment magnitude (Mw) scale and measures how much energy is released from a seismic event, such as the amount of rock movement and the area of the fault or fracture surface. The moment magnitude scale ranges from 0 to 10 and each increase in number is about 32 times greater than the previous number.

Table 53: Moment Magnitude Scale

Moment Magnitude Scale (Mw)	
10	
9	
	Great earthquake; near total destruction, massive loss of life
8	
	Major earthquake; severe economic impact; large loss of life
7	
	Strong earthquake; damage in the $ billions; loss of life
6	
	Moderate earthquake; Property damage
5	
	Light earthquake; some property damage
4	
	Minor earthquake; felt by humans
3	
2	
1	

The intensity of earthquakes is measured using the Modified Mercalli (MM) Intensity Scale, which attributes a number to the level of effects that people experience and the damages that are likely. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally - total destruction. The scale is composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, and is designated by Roman numerals. It does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects.

The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude. Being far from the epicenter of an earthquake would mean people and structures experience a lower intensity, so the MM value would be lower. Whereas being close to the epicenter of an earthquake would have a higher MM value because people and structures would experience a higher intensity. Structural engineers usually contribute information for assigning intensity values of VIII or above. The Modified Mercalli Intensity Scale is shown below.

Table 54: Modified Mercalli Intensity Scale

Modified Mercalli Intensity Scale	
I.	Not felt except by a very few under especially favorable conditions.
II.	Felt only by a few persons at rest, especially on upper floors of buildings.
III.	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV.	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V.	Felt by nearly everyone, many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI.	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII.	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII.	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI.	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII.	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Frequency

This hazard was determined to occur about every 50-100 years, giving it a Frequency ranking of Not Likely.

Magnitude

This hazards *Injuries and Deaths* Magnitude was determined to be Low, meaning no injuries or deaths are recorded.

This hazards *Infrastructure* Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards *Environment* Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

<u>Potential Effect of Climate Change</u>

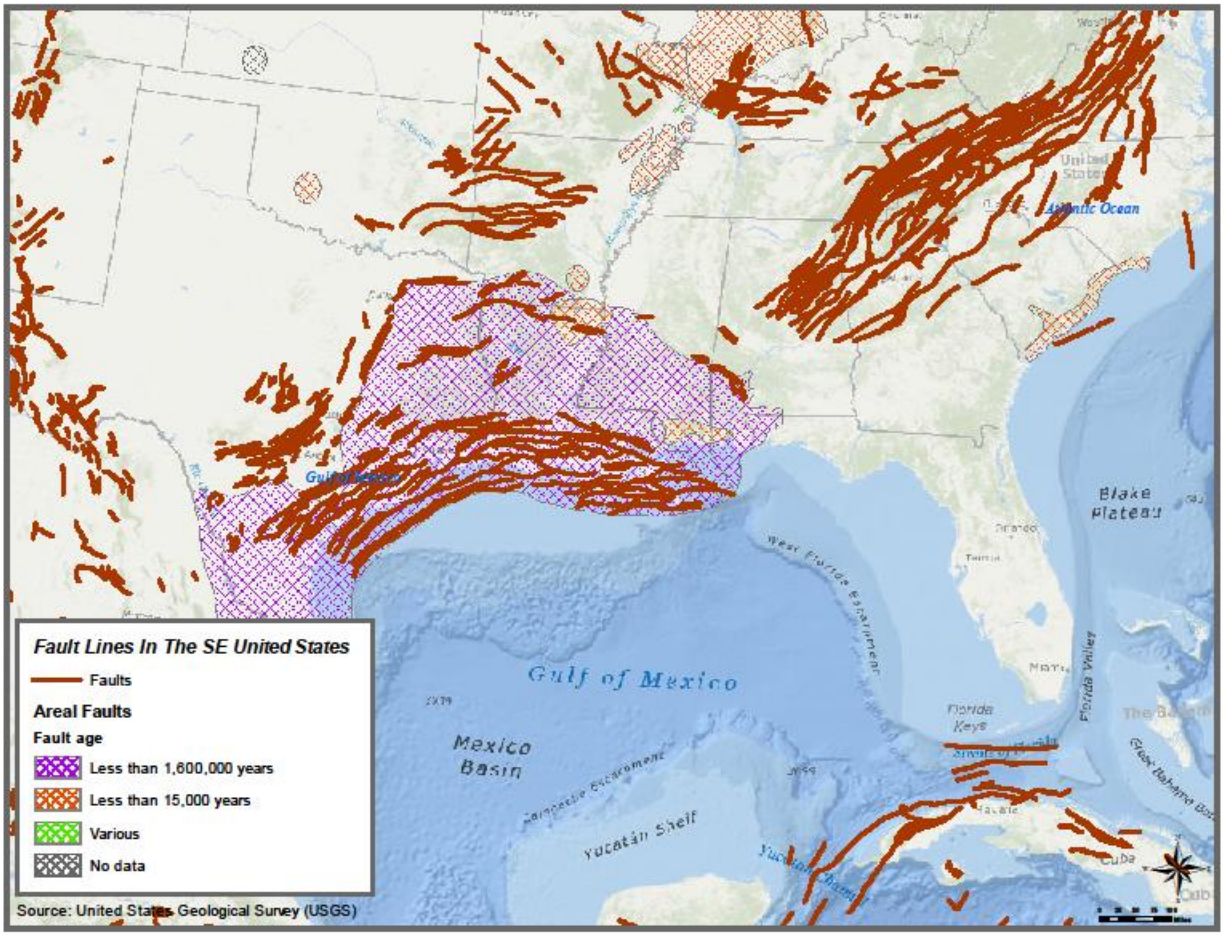
Climate change is not expected to affect the occurrence or magnitude of seismic events in Florida.

2. Geographic Areas Affected by Seismic Events

Seismic activity is rare in Florida and no earthquakes have had an epicenter in Florida. This is because there are no documented active faults in the State. Shaking felt in Florida comes from earthquakes either in the Gulf of Mexico, the Caribbean, or from the small fault line that is northeast of the State near Charleston, South Carolina.

Below is a map of fault lines in the southeast US. The map shows that there are not any known fault lines in Florida and that any seismic activity felt in Florida is likely from the faults to the north, west, or south.

Figure 91: Southeast United States Fault Lines



3. Historical Occurrences of Seismic Events

Earthquakes are very rare in Florida and there are no significant recorded incidents. Additionally, many of the reports of earthquakes from before technological advancements have no proof and the original reports are lost.

Table 55: Florida Historical Occurrences, Seismic

Date	Description
August 31, 1886	Known as the “great earthquake,” a severe earthquake hit Charleston, South Carolina. It was so powerful that shaking was felt in St. Augustine and Tampa. There were also several aftershocks in the months after the quake that were felt in Florida.
January 5, 1945	Shaking was felt in Volusia County. Windows in a De Land courthouse shook violently.
October 27, 1973	A shock was felt in Seminole, Volusia, Orange, and Brevard counties with a maximum intensity of MM V.

January 13, 1978	Two shocks were felt in Polk County, each lasting about 15 seconds and one minute apart. It rattled doors and windows, but there were no injuries or damages.
November 13, 1978	A shock was felt in northwest Florida. The seismic station estimated that it originated in the Atlantic Ocean.[167]
September 10, 2006	A strong quake was felt in Florida and other Gulf Coast states. USGS determined it was magnitude 6 quake originating in the Gulf of Mexico, 250 miles southwest of the Apalachicola area.[168]
July 16, 2016	Some felt small shakes in Florida and USGS rated it as a 3.7 magnitude. It was later discovered that the "quake" was actually an experimental explosion in the ocean by the US Navy.[169]

Many reports of Earthquakes felt in Florida are unsubstantiated and only known because of personal accounts of "tremblors." The 1886 Charleston, South Carolina earthquake was felt in Florida. There was a shock felt in 1978 and then no seismic activity in Florida until 2006 when a quake in the Gulf of Mexico was reportedly felt in Florida. Shaking in 2016 was thought to be a rare earthquake affecting Florida, but it was actually shaking felt from explosion tests by the US Navy.

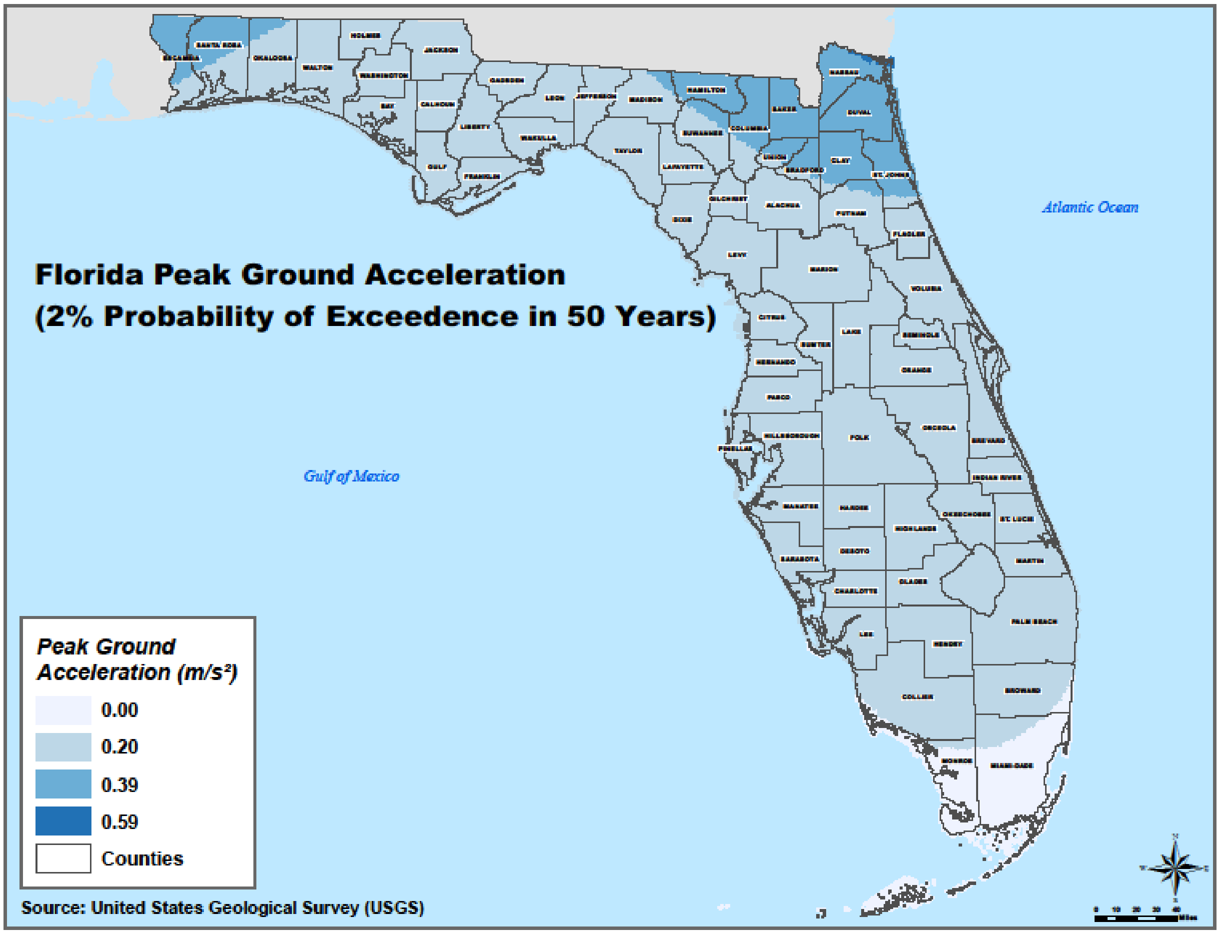
4. Probability of Future Occurrences of Seismic Events

The probability is extremely low that a major earthquake will affect the State of Florida and cause significant damage. According to USGS, Florida is classified as a stable geological area, which means that damage from any shaking or tremors felt from an earthquake, is expected to be minimal. The map below shows zones of peak ground acceleration as a percentage of gravitational acceleration. There is a two percent probability that the given acceleration range will be exceeded in a 50-year period. Peak ground acceleration refers to the maximum shaking that occurs at a specific location during an earthquake.

This hazard was determined to occur about every 50-100 years, giving it a Probability ranking of Not Likely.

[167] http://ufdc.ufl.edu/UF00001039/00001/13x
[168] http://publicfiles.dep.state.fl.us/FGS/FGS_Publications/Forum/forum_oct2006.pdf
[169] https://earthquake.usgs.gov/earthquakes/eventpage/us20006f8n#executive

Figure 92: Florida Peak Ground Acceleration



Generally, a peak ground acceleration of 0.01 m/s^2 is felt by humans and a peak ground acceleration of 0.2 m/s^2 can cause people to lose their balance. As shown in the map above from USGS, most of the state would experience 0.20 m/s^2 peak ground acceleration in the event of an earthquake affecting Florida. Portions of Escambia, Santa Rosa, Okaloosa, Madison, Hamilton, Suwannee, Columbia, Baker, Union, Bradford, Nassau, Duval, Clay, St. Johns, and Putnam counties would perhaps experience 0.39 m/s^2 peak ground acceleration. To be clear, this does not mean that an earthquake that centered near Florida would be felt by all of Florida, but that shaking may be possible to feel.

5. Impact Analysis of Seismic Events

- Public
    - May feel slight shaking, but no injuries will result in shaking from an earthquake
- Responders
    - Unlikely to experience impacts
- Continuity of Operations (including continued delivery of services)
    - Unlikely to cause interruptions to operations

- Property, Facilities, Infrastructure
  - Some windows may be shattered from a large earthquake that sends shocks and shaking to Florida, but this is very unlikely
- Environment
  - Unlikely to impact the environment
- Economic Condition
  - Unlikely to impact the economy
- Public Confidence in Jurisdiction's Governance
  - Unlikely to impact the public confidence in the jurisdiction's governance

6. 2018 LMS Integration

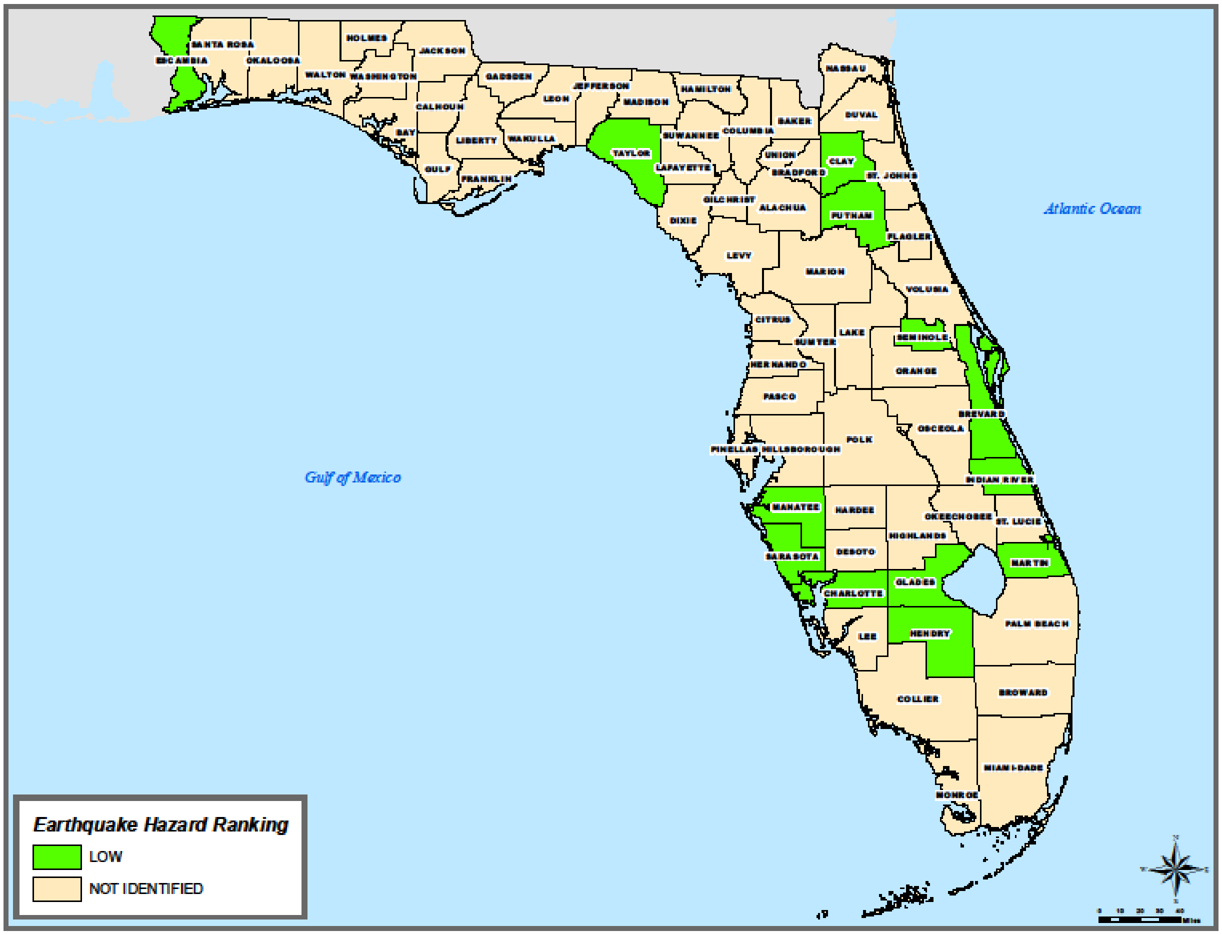
An analysis of all 67 Florida County LMS Plans and their individual seismic hazard rankings is shown below. Only 13 counties profiled Seismic Events as a hazard and all ranked it as a low-risk hazard.

Earthquakes

Based on the LMS plans, Figure 93 displays the jurisdictional rankings for the earthquakes hazard. Not all counties have identified earthquakes as one of their hazards.

- High-risk Jurisdictions: 0
- Medium-High-risk Jurisdictions: 0
- Medium-risk Jurisdictions: 0
- Low-risk Jurisdictions: 13
- Not identified Jurisdictions: 54

Figure 93: Seismic Hazard Rankings by County



7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Enhanced SHMP is required to evaluate the vulnerability of jurisdictions and estimate potential losses for each hazard. Below is the Vulnerability Analysis and Loss Estimation of the state, by Jurisdiction, to Seismic Events.

According to the peak ground acceleration map above, most of the state has equally low vulnerability. There are small portions of north Florida that may experience slightly more intense shaking.

There are no losses expected to be caused by a seismic event.

8. Vulnerability Analysis and Loss Estimation, of State Facilities

The Enhanced SHMP is required to evaluate the vulnerability and estimate potential losses regarding the State and its facilities across the state. The GIS team used the database of all state facilities and their values to provide the loss estimation data.

Similarly to the jurisdiction vulnerability and loss estimates, state facilities have a low vulnerability to seismic events and there are minimal to no losses expected.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Low, with a score of 5.

<table>
<tr><th colspan="5">SEISMIC EVENTS</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">A seismic event, or an earthquake, is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface that creates seismic waves. This shaking can cause buildings and bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger landslides, and tsunamis or indirectly cause flash floods or fires.</td><td rowspan="4">LOW</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Not Likely</td><td>Not Likely</td><td>Low</td><td>Low</td><td>Low</td></tr>
</table>

Tsunami Hazard Profile

1. Tsunami Description

Tsunamis are among the most devastating of geologic disasters. Tsunamis are powerful waves created as a consequence of another non-meteorological, geologic in nature, hazard such as earthquakes, underwater landslides, volcanic eruptions, or other displacements of large amounts of water under the sea. As the waves travel towards land, they build up to higher heights as the depth of the ocean decreases and appear as walls of water or turbulent waves that resemble hurricane storm surge. The speed at which a tsunami travels depends on the ocean depth rather than the distance from the source of the wave. Deeper water generates greater speed, and the waves slow down when reaching shallow waters. Where the ocean is deep, tsunamis can travel at speeds up to 500 miles an hour. Tsunamis arrive on land with enormous force and recede with nearly equal force.

A tsunami is not a single wave, but rather a series of waves often referred to as a "wave train". There can be as many as 60 miles between peaks of each wave series and be as far as one hour apart.[170] Tsunamis have a much smaller amplitude (wave height) offshore, and a very long wavelength (often hundreds of kilometers long), which is why they generally pass unnoticed at sea, forming only a passing "hump" in the ocean. The number of arrivals and the amplitudes of each wave will vary depending on the coastal properties, the exact travel direction, and other specifics of how the tsunami was generated. They will vary from place to place and event to event. In the largest tsunamis, surge can continue for many hours and more than a day.

Scientists cannot predict when and where the next tsunami will strike, but Tsunami Warning Centers know which earthquakes are likely to generate tsunamis and can issue messages when they think it is possible.

Tsunami Monitoring and Forecasting

There is often no advance warning of an approaching tsunami. However, since earthquakes are often a cause of tsunamis, an earthquake felt near a body of water may be considered an indication that a tsunami could shortly follow. The first part of a tsunami to reach land is a trough rather than a crest of the wave. The water along the shoreline may recede dramatically, exposing areas that are normally submerged. This can serve as an advance warning of the approaching crest of the tsunami, although, the warning only gives a very short time before the crest, which typically arrives seconds to minutes later.[171]

NOAA's Pacific Marine Environmental Laboratory developed Deep-Ocean Assessment and Reporting of Tsunamis (DART) buoys to monitor tsunami systems in real time. These buoys are positioned at strategic locations throughout the ocean globally and play a critical role in tsunami forecasting. NOAA has two tsunami warning centers:[172]

[170] http://news.nationalgeographic.com/news/2007/04/070402-tsunami.html
[171] http://www.tsunami.gov/?page=tsunamiFAQ
[172] http://www.tsunami.gov/?page=tsunamiFAQ

- The National Tsunami Warning Center in Palmer, Alaska, serves the continental United States, Alaska, Puerto Rico, and Virgin Islands and Canada
- The Pacific Tsunami Warning Center in Honolulu, Hawaii, directly serves the Hawaiian Islands and the U.S. Pacific territories and is the primary international forecast center for the warning systems of the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization in the Pacific and the Caribbean and Adjacent Regions

NOAA's National Geophysical Data Center (NGDC) is building high-resolution digital elevation models (DEMs) for select U.S. coastal regions. These combined bathymetric-topographic DEMs are used to support tsunami forecasting and modeling efforts at the NOAA Center for Tsunami Research, Pacific Marine Environmental Laboratory (PMEL). The DEMs are part of the Short-term Inundation Forecasting for Tsunamis (SIFT) system currently being developed by the PMEL for the NOAA tsunami warning centers, and are used in the Method of Splitting Tsunami (MOST) model developed by the PMEL to simulate tsunami generation, propagation, and inundation.

Misnomers

Tsunamis are often referred to as tidal waves; however, oceanographers discourage this name because tides have little to do with these giant waves.[173]

There is another phenomenon often confused with tsunamis called rogue waves. There remains debate as to whether these waves are related to tsunamis. They are included in this section as the mitigation plans address the threat in the same relative manner. Rogue waves are unpredictable, little is known about their formation, but may be caused by regularly-spaced ocean swells that are magnified by currents or the atmosphere.

Frequency

This hazard was determined to occur about every 50-100 years, giving it a Frequency ranking of Not Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Low, meaning no injuries or deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

Potential Effect of Climate Change

Climate change is not expected to affect the occurrence of tsunamis in Florida.

[173] http://oceanservice.noaa.gov/facts/tsunami.html

2. Geographic Areas Affected by Tsunami

Tsunami events occur most often in the Pacific Ocean, but they are a global phenomenon and all are potentially dangerous, though they may not damage every coastline they strike. Analyzing the past 150 years of tsunami records shows that the most frequent and destructive tsunamis to affect the U.S. have occurred along the coasts of California, Oregon, Washington, Alaska, and Hawaii.[174]

Overall, Florida has experienced few destructive tsunami or rogue wave events, but there were several small events.

Mitigate FL found that there are two ways of identifying geographic locations that could be affected by a tsunami event. The first way is to consider the fact that there is scientific evidence that shows that there is the potential for a geological event, such as a massive landslide, to take place with Cumbre Vieja in the Canary Islands. If this event were to occur, a large-scale tsunami could affect the United States' eastern coastline, and it is expected that the eastern coastline of the State of Florida would suffer extensive damage and loss of life.

Earthquakes are frequently the cause for tsunami events, and because there is no way of knowing exactly when and where future earthquake events might take place, Mitigate FL has concluded that all geographic areas of Florida that border the Atlantic Ocean or Gulf of Mexico are at risk. However, sediment deposits in the Gulf of Mexico and Great Bahama Bank may lead to underwater landslide activity. The following vulnerabilities are organized by threat to the Atlantic Coast, or Gulf Coast and Keys and list the potential causes of a tsunami that would put the state at risk:[175]

- Florida's Atlantic Coast
- Puerto Rico Trench
- Cumbre Vieja Volcano in Canary Islands
- Azores-Gibraltar Fracture Zone
- Florida's Gulf Coast and Keys
- Puerto Rico Trench (minor effect as wave wraps around islands)
- Large Meteorite into Gulf of Mexico

3. Historical Occurrences of Tsunami

There have been 4 reported tsunami events in the history of Florida. All 4 of these tsunamis occurred on the Atlantic Coast. Below are the causes of these tsunamis.[176]

- 1 was caused by an Atlantic Coast earthquake

[174] http://nws.weather.gov/nthmp/documents/GoM-Final01regionalAssessment.pdf
[175] http://www.rsmas.miami.edu/news-events/press-releases/2016/study-models-tsunami-risk-for-florida-and-cuba
[176] http://nws.weather.gov/nthmp/documents/Tsunami_Assessment_Final.pdf

- 1 was caused by a non-Atlantic earthquake
- 2 were caused by a Caribbean earthquake

While no known tsunamis have ever affected the Florida Gulf Coast, a tsunami in that location is not impossible. Additionally, while tsunamis have historically affected the Caribbean many times, it is unlikely that those tsunamis will also affect Florida.

While it wasn't officially a "tsunami," there was a tsunami-like event on July 7, 1992 when a large "rogue wave" suddenly appeared along the coast in the Daytona area. The wave was reportedly about 10 feet above normal waves and stretched 27 miles long, from Ormond Beach to New Smyrna Beach. There was one death, over 20 people injured, and damage to about 100 cars parked near the coastline. The best theory is that the wave was caused by winds from a storm front.[177]

4. Probability of Future Occurrences of Tsunami

Based on a historical analysis, and the frequency of prior tsunami events from around the world, it is Mitigate FL's conclusion that the probability of future tsunami events affecting the State of Florida is low.

Since earthquakes cause most tsunamis and Florida is in a seismically stable region, there is a low probability that a tsunami will affect Florida. However, underwater landslides can also trigger tsunamis. Such landslides are unlikely, but not impossible.[178]

This hazard was determined to occur about every 50-100 years, giving it a Probability ranking of Not Likely.

5. Impact Analysis of Tsunami

- Public
    - There may be injury or death
- Responders
    - Rescue missions may be life-threatening if buildings are not structurally stable or if rescuing from waters of unknown depth
- Continuity of Operations (including continued delivery of services)
    - If a structure were severely damaged or flooded, operations would be disrupted
- Property, Facilities, Infrastructure
    - If a major tsunami were to occur in Florida, many structures and critical infrastructure would be severely damaged from the force of the waters and from flooding effects
- Environment
    - The coast could be altered, including intra-coastal areas, beaches, mangroves, etc.
- Economic Condition
    - If a major tsunami were to occur in Florida, there would be many businesses damaged and forced to close and employee absenteeism would also be a challenge
- Public Confidence in Jurisdiction's Governance

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[177] https://www.deseretnews.com/article/235629/ROGUE-WAVE-CRASHES-ASHORE-IN-FLORIDA.html
[178] http://dep.state.fl.us/geology/geologictopics/hazards/tsunamis.htm

- If a major tsunami were to occur in Florida and response and recovery efforts were not fast enough, the public may lose confidence in the jurisdiction's governance

6. 2018 LMS Integration

Mitigate FL focused on producing a statewide vulnerability analysis based on estimates provided by the Local Mitigation Strategies (LMS). With 67 multi-jurisdictional Local Mitigation Strategy plans, the local risk assessment data provided a solid baseline for the overall state vulnerability analysis. For counties that analyzed tsunamis, all reported low vulnerability and many included the analysis within the "Storm Surge" or "Coastal Flooding" portion of their plan. Due to this fact, it was not possible to acquire a vulnerability score for each county. Only Santa Rosa and Indian River counties identified Tsunami as a hazard in their LMS.

7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

The Enhanced SHMP is required to evaluate the vulnerability of jurisdictions and estimate potential losses for each hazard. Below is the Vulnerability analysis and Loss Estimation of the state, by Jurisdiction, to Tsunamis.

Historically, large-scale tsunami events have not been a major threat to the State of Florida; however, that exposure has increased as more people move into the state in areas of close proximity to the coast.

Approximately 33 percent of the total state population lives within 20 miles of the coast, and that number is increasing. The majority of the state's residents are not educated on the warning signs or effects of a tsunami and would be put at a higher risk of exposure should a large-scale event occur.

The original plan did not perform a loss estimate on a statewide level for tsunamis. In the past, storm surge or coastal flood data was used in place of tsunami data because tsunami data was unavailable. The Florida 2018 Hurricane Exercise included an inject event that was an earthquake, which caused a landslide in the Gulf of Mexico, which caused a tsunami to affect the Gulf Coast of Florida. When the GIS and Meteorology team analyzed this hypothetical scenario, it was determined that the past assumption that storm surge or coastal flood data could be used as an equivalent of tsunami data was incorrect. As explained above, tsunami data for Florida is not available because NOAA has not yet completed the models.

8. Vulnerability Analysis and Loss Estimation, on State Facilities

The Enhanced SHMP is required to evaluate the vulnerability and estimate potential losses regarding the State and its facilities across the state. The GIS team used the database of all state facilities and their values to provide the loss estimation data.

In the past, storm surge or coastal flood data was used in place of tsunami data because tsunami data was unavailable. The Florida 2018 Hurricane Exercise included an inject event that was an earthquake, which caused a landslide in the Gulf of Mexico, which caused a tsunami to affect the Gulf Coast of Florida. When the GIS and Meteorology team analyzed this hypothetical scenario, it was determined that the past assumption that storm surge or coastal flood data could be used as an equivalent of tsunami data was incorrect. As explained above, tsunami data for Florida is not available because NOAA has not yet completed the models.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Low, with a score of 5.

<table>
<tr><th colspan="5">TSUNAMI</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Tsunamis are powerful waves created as a consequence of another non-meteorological, geologic in nature, hazard such as earthquakes, underwater landslides, volcanic eruptions, or other displacements of large amounts of water under the sea. As the waves travel towards land, they build up to higher heights as the depth of the ocean decreases and appear as walls of water or turbulent waves that resemble hurricane storm surge.</td><td rowspan="5">Low</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Not Likely</td><td>Not Likely</td><td>Low</td><td>Low</td><td>Low</td></tr>
</table>

Transportation Incident Hazard Profile

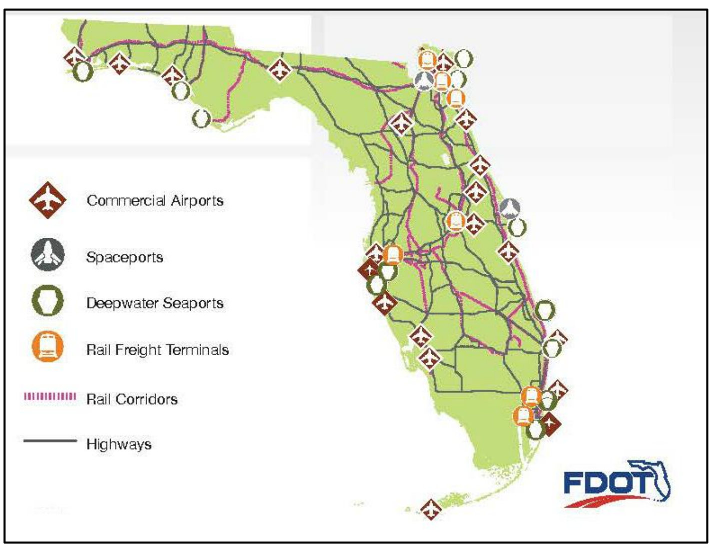
1. Transportation Incident Description

Transportation systems are designed to move people, goods, and services efficiently, economically, and safely from one point to another. As the movement of people, goods, and services increases due to population growth and technological innovation, the need to plan for events becomes increasingly important. As one of the critical infrastructure sectors, the Department of Homeland Security (DHS) categorizes the transportation sector into the following seven modes:[179]

- Aviation
- Highway and Motor Carrier
- Maritime
- Mass Transit and Passenger Rail
- Pipeline Systems
- Freight Rail
- Postal and Shipping

Florida has a large transportation network that consists of airports, major highways, passenger railroads, marine ports, and pipelines. These transportation systems provide lifeline services for communities and are vitally important for response and recovery operations. The vast network of public and private critical infrastructure owners and operators, the infrastructure and services they manage, and the extensive interdependencies among the transportation modes and other sectors indicate the need for coordinated planning to manage all hazards efficiently and effectively.

Figure 94: Florida Department of Transportation Network



[179] https://www.dhs.gov/sites/default/files/publications/nipp-ssp-transportation-systems-2015-508.pdf

The identification of critical transportation infrastructure requires consideration of Federal, State, regional, and local jurisdictions, their interests and a variety of hazards. At the national level, critical infrastructure in each of the four subsectors—aviation, maritime, surface, and postal and shipping—contribute to national security, economic stability, and public health and safety. At the regional, State, and local levels, the necessity of infrastructure is primarily determined by the business, lifestyle, and emergency needs of the community.

To secure transportation systems from risks such as natural disasters and man-made threats, states can conduct assessments of physical, human, and cyber elements of critical infrastructure. Risks to critical transportation infrastructure include natural disasters as well as manmade physical and cyber threats. Man-made threats include terrorism, vandalism, theft, technological failures, and accidents. Cyber threats to the Sector are of concern because of the growing reliance on cyber-based control, navigation, tracking, positioning, and communications systems, as well as the ease with which actors can exploit cyber systems serving transportation. While engineered hazards such as road curve geometry can be addressed through design, hazards such as terrorist attacks and extreme weather can be difficult to predict and mitigate.

Terrorism

Terrorist attacks, whether physical or cyber, can significantly disrupt vital transportation services and cause long-term sociological and economic consequences. The risk of a terrorist attack on transportation infrastructure is typically assessed using attack scenarios to evaluate the threats, vulnerabilities, and consequences. Transport vehicles are abundant, moving virtually unnoticed within industrial locations and major population centers; across borders; and in the case of mail and express package services, to nearly every household, business, and government office in the country. As seen on September 11th, 2001, modes of transportation, such as airplanes, can be used as the weapons themselves. The very nature of the transportation enterprise is to be open, efficient, and accessible which can make it a target for terrorist attacks. For more on terrorism please see the *Terrorism Incidents Profile* on page 367.

Natural Disasters and Extreme Weather

Global transportation infrastructure today is confronted with significant vulnerabilities, including the evolving threats of our changing climate. Natural disaster risks to Florida transportation systems include wildfires, flooding, severe storms, tropical cyclones, and drought, all of which have the potential for widespread disruption of transportation services. Risks from natural disasters have a varying regional or local relevance because of prevailing weather patterns, geological trends, topographical features, and population density.

In Florida, heavy rainfall events can disrupt transportation services and damage infrastructure and facilities. During or following periods of heavy rainfall, inundation and washouts can block transportation routes, damage facilities, and interrupt power supplies. Tropical cyclones can damage critical infrastructure such as roads and bridges causing delays in critical response, services, and the ability to move throughout the state. Tornados have similar effects while also creating dangerous situations with people on the roads.

Fog

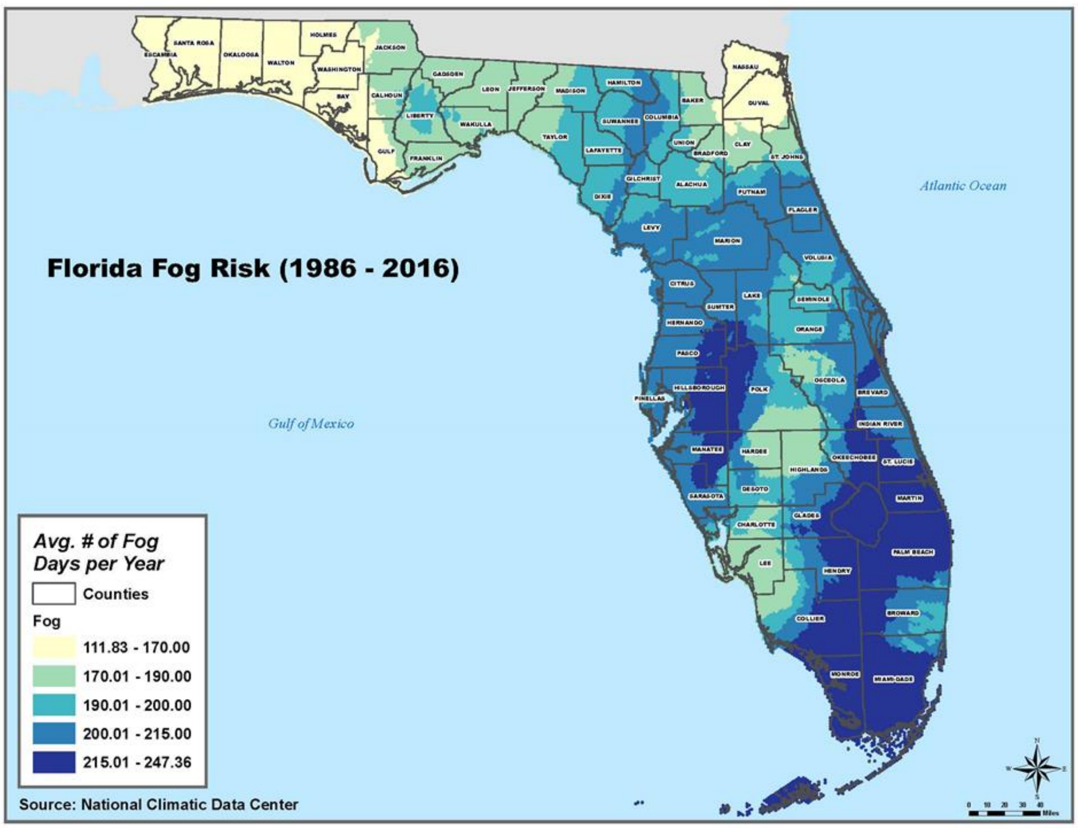
Fog is a cloud form at the surface of the earth made of tiny water droplets suspended in the air. The greatest problem with fog is visibility. Heavy fog is defined as visibility below one quarter of a mile. A

Dense Fog Advisory means that dense fog has reduced visibility to 1/4 mile or less within the advisory area. These conditions make travel difficult.[180]

A Freezing Fog Advisory is when fog develops and surface temperatures are at or below freezing. The tiny liquid droplets in the fog can freeze instantly to any surface, including vehicles and road surfaces. Freezing fog makes driving, boating, flying and other forms of transportation particularly hazardous. Visibilities are typically at or below 1 mile.

Fog, particularly when dense, can be hazardous to drivers, mariners and aviators, contributing to numerous travel accidents every year. Restrictions in visibility resulting from fog can also impact takeoff and landing procedures and requirements for pilots, and can be the cause of weather-related aviation delays.

Figure 95: Florida Fog Risk, 1986-2016



Aging Infrastructure

The condition of Florida's transportation infrastructure is also a concern because of the advanced age and deterioration of many structures throughout the state's transportation network. Aging infrastructure threatens the resilience of these systems and can multiply risks from other factors such as man-made or natural disasters. The impact of a loss of a key asset, such as a bridge, poses an immediate threat and can

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[180] http://www.nws.noaa.gov/om/fog/ww.shtml

have cascading impacts to passenger and freight movement, as well as potentially large-scale impacts such as supply chain disruption.[181]

Deterioration of the nation's infrastructure jeopardizes public safety, threatens quality of life, and drains the U.S. economy. Most experts agree that America's infrastructure needs to be upgraded. More than half of America's natural gas transmission pipelines were installed before 1970; the same holds true for pipelines that carry hazardous liquids such as gasoline, diesel, and jet fuel. Pipelines are just a fraction of the nation's vast network of transportation infrastructure — the roads, cables, wires, conduits, drains, satellites, and switches that enable the flow of everything from sewage to gas. The pipelines within Florida are owned by numerous companies and have differing levels of condition, making the system vulnerable to accidents and failure. Meanwhile, the government owned infrastructure — roads, bridges, rail, and mass transit — is under severe financial strain because maintenance costs have increased.

Cyber

Cyber-based technologies in transportation operations enable greater economies and efficiencies, improve customer service, enhance operational controls, and provide better security capabilities. Consequently, transportation companies are increasingly dependent on cyber systems for business, security, and operational functions. Cyber technologies upon which transportation services rely include positioning, navigation, tracking, shipment routing, industrial system controls, access controls, signaling, communications, and data and business management. These technologies are often interconnected through networks and remote access terminals, which may allow malicious actors easier access to key areas. For more information please see the *Cyber Incidents Profile* on page 314.

Types of Transportation

The Florida Department of Transportation (FDOT) is the lead agency in committing to a safe transportation system that ensures the mobility of people and goods, enhances economic prosperity, and preserves the quality of the environment and communities. FDOT has implemented the Strategic Intermodal System (SIS), the state's highest priority for transportation investments. SIS also has a focus for implementing the Florida Transportation Plan (FTP) which is the state's long-term transportation vision and policy. SIS is a transportation system that:[182]

- Is made up of facilities and services of statewide and interregional significance;
- Contains all forms of transportation for moving both people and goods, including linkages that provide for smooth and efficient transfers between modes and major facilities, and;
- Integrates individual facilities, services, modes of transportation and linkages into a single, integrated transportation network.

The system was established to efficiently serve the mobility needs of Florida citizens, businesses, and visitors and to help Florida become a worldwide economic leader, enhance economic prosperity and competitiveness, enrich quality of life, and reflect responsible environmental stewardship.

SIS is a network of high-priority transportation facilities including the state's largest and most significant commercial service airports, spaceports, deep-water seaports, freight rail terminals, passenger rail and

[181] http://knowledge.wharton.upenn.edu/article/americas-aging-infrastructure-what-to-fix-and-who-will-pay/
[182] http://www.fdot.gov/info/moredot/mvv.shtm

intercity bus terminals, rail corridors, waterways, and highways. These state facilities carry more than 99% of all commercial air passengers and cargo, virtually all waterborne freight and cruise passengers, almost all rail freight, 89% of all interregional rail and bus passengers, 55% of total traffic, and more than 70% of all truck traffic on the state highway system.[183]

Aviation

Florida has long been the world's premier gateway to space, the air traffic hub of the Americas, a major hub for flight training, and home to leading manufacturers of all types of aircraft and aircraft components. Florida is fortunate to be served by one of the most comprehensive and progressive airport systems in the country. Florida's aviation sector drives a large portion of the state's economy. In 2010, aviation made up more than 8.5% of Florida's Gross State Product (GSP). One of the largest drivers of the state's economy is international trade, with air cargo accounting for more than one third of Florida's international trade dollars. The second largest is tourism and over half of all visitors to the state arrive by air.

Florida has 21 commercial airports throughout the state, 107 general aviation airports and 12 military airfields. In 2015, 161 million airline passengers flew through Florida airports.[184] FDOT and the Federal Aviation Administration (FAA) coordinate efforts to ensure safe air travel and mitigate against potential hazards. In 2005, FDOT in cooperation with the FAA and Florida's Public Airports developed the Florida Aviation System Plan (FASP). They focused the plan on traditional aviation system planning elements, but also included an analysis of the intermodal aspects of the state transportation system. The FASP also includes a strategic planning element, identifying seven strategic goals considered essential.[185]

Air transportation hazards can include crashes and issues with the airplanes themselves but can also include potential hazards at the airport or within the surrounding areas. Causes and contributors to airplane accidents could include faulty parts and defects, operational or pilot error, system malfunctions, and outside forces such as extreme weather. Airports and the surrounding areas could also potentially cause additional hazards. One such hazard is bird strikes, and while unlikely to cause a crash, birds can cause flight delays and emergency landings.[186] Terrorist attacks could be targeted at major airports or involve the use of airplanes as a weapon. Degraded runways and equipment also pose a significant threat to the aviation infrastructure.[187]

Airplane crashes could lead to cascading hazards, as a crash could lead to wildfires, dam or levee damage leading to flooding, roadway blockage and damage, and utility damage from downed power lines leading to outages and potential accidents. Air transportation hazards could also lead to damage or destruction of goods and freight and loss of life.[188]

Florida is also a premier aerospace and space location, and is a top state for aerospace manufacturing. The industry companies excel in areas from aircraft parts and assembly, to intelligence, surveillance and

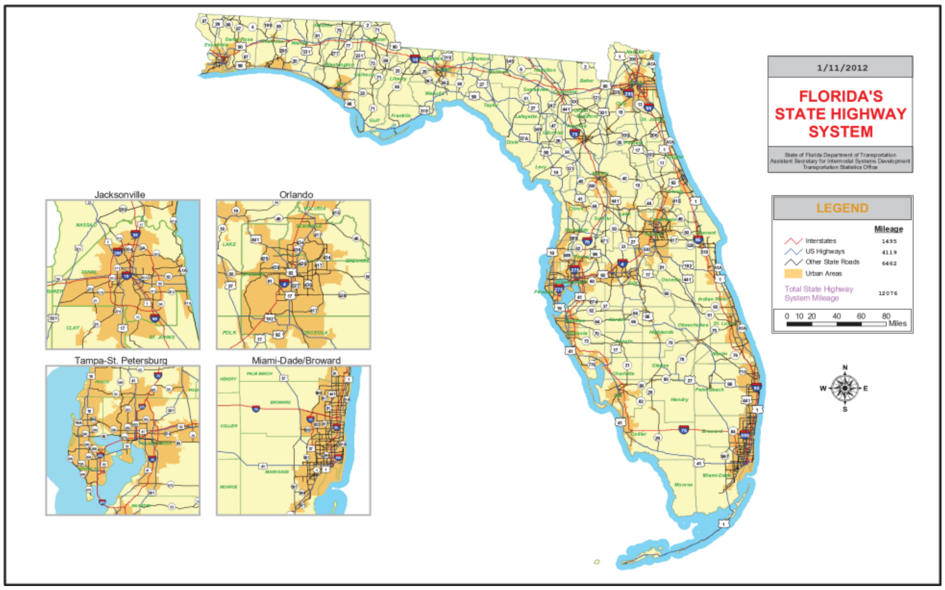
[183] http://www.fdot.gov/planning/sis/about.shtm
[184] https://www.faa.gov/
[185] http://www.fdot.gov/planning/fastfacts.pdf
[186] http://www.bne.com.au
[187] http://www.fdot.gov/aviation/planning.shtm
[188] http://www.fdot.gov/aviation/pdfs/Welcome%20to%20Fl%20Aviation112010.pdf

reconnaissance, and missiles. Florida also offers tremendous space launch assets. Florida has two spaceports and conducted 17 spaceport launches in 2015.[189]

Highway and Motor Carrier

This mode of transportation includes highways, roadways, bridges, trucks, commercial freight vehicles, motor coaches, and school buses.[190] Florida has 122,659 miles of highway, over 273,000 miles of total public roadways, 12,262 bridges, and over 30 public transit systems. In fiscal year 2015, 207 billion automobile miles were traveled within the state. This includes private vehicles, passenger transportation, freight, and hazardous materials transportation. The public transit system had 271 million passengers in 2014.[191] Consequently, today's roadways are dangerously overcrowded, turning the focus to identifying serious roadway hazards.

Figure 96: Florida State Highway System



Accidents are the highest risk on roadways and according to the Florida Department of Highway Safety and Motor Vehicles there were 374,342 accidents in 2015 with 2,939 fatalities.[192] Accidents involving freight could lead to loss of revenue for businesses and wages for drivers as well as affect the consumers waiting on the cargo being transported. Hazardous material is routinely transported along Florida's road system and can affect the environment and surrounding population in the event of a spill. For more information regarding the transportation of hazardous materials please see the *Hazardous Materials Incidents Profile* on page 328. Florida's 12,262 bridges within the state can malfunction or be degraded to the point of structural instability, causing not only roadway hazards but waterway hazards as well.[193]

189 https://www.nasa.gov/
190 http://www.floridatransportationindicators.org/index.php?chart=13d
191 http://www.fdot.gov/planning/fastfacts.pdf
192 https://flhsmv.gov/pdf/crashreports/crash_facts_2015.pdf
193 http://www.smartmotorist.com/traffic-and-safety-guideline/roadway-hazards.html

Florida's roads boost significant economic growth and social mobility.[194] By dramatically expediting and substantially reducing costs for the transportation of goods, the roadway and freeway system changed the way the state does business, enabling national supply chains to efficiently make and deliver products. Good, efficient roads make commuting feasible, however, aging roads can lead to hazards and accidents. The Federal Highway Administration's most recent survey points out that almost 20% of U.S. roads are in poor condition. This includes roads and bridges that need to be repaved, are crumbling, or have significant damage. [195]

Maritime

Florida has a total water area of 4,308 square miles with more than 11,000 miles of rivers, streams and waterways.[196] The state has 1,197 statute miles of coastline and 2,276 statute miles of tidal shorelines. This includes 825 miles of beaches. The map below shows Florida's waterways.[197]

Figure 97: Florida Waterways

There are 15 seaports within the state that accommodate cruise lines, military ships, passenger and private vessels, and freight vessels.[198] Florida's 15 public seaports play a critical role in the lives of citizens and continue to drive Florida's economy. From what we wear to what we eat, from building materials to automobiles, almost everything we use in our daily lives flows through Florida ports. In 2015, 15.2 million cruise passengers made port in Florida and many more made port on private vessels. Currently, Florida seaports generate nearly 900,000 direct and indirect jobs and contribute $117.6 billion in economic value

[194] https://www.nhtsa.gov/
[195] https://www.fhwa.dot.gov/
[196] http://geology.com/lakes-rivers-water/florida.shtml
[197] http://www.stateofflorida.com/facts.aspx
[198] http://flaports.org/about/the-florida-system-of-seaports/

to the state through cargo and cruise activities. Florida maritime activities account for approximately 13% of Florida's GDP while contributing $4.2 billion in state and local taxes.

The Maritime Administration (MARAD) is the agency within the U.S. Department of Transportation regarding waterborne transportation. Its programs promote the use of waterborne transportation and its seamless integration with other segments of the transportation system, and the viability of the U.S. merchant marine. MARAD works in many areas involving ships and shipping, shipbuilding, port operations, vessel operations, national security, environment, and safety. [199]

FDOT and MARAD, along with Customs and Border Patrol (CBP)[200] monitor the maritime transportation system in Florida, including waterborne transportation, landside infrastructure, the shipbuilding and repair industry, and labor. They integrate the economy with a vast network of systems that moves large quantities of consumer goods, people, agricultural products, energy, and raw materials.

The United States Coast Guard (USCG) and CBP work together to ensure secure borders. U.S. Customs and Border Protection as part of their comprehensive effort to improve security at the nation's borders while enhancing legitimate travel, including private boaters, established the Local Boater Option (LBO). This means boaters can register with CPB, and then phone-in entry into the U.S. from a foreign country, instead of reporting in person. This reduces the number of undocumented individuals coming to Florida shores and works to reduce drug smuggling operations into the state. On an average day the USCG conducts search and rescue operations, saves lives and property in peril, conducts waterborne patrols of critical maritime infrastructure, seizes drugs, conducts security boarding in and around Florida ports, and interdicts undocumented migrants.[201]

Florida Fish and Wildlife Conservation Commission (FWC) oversees and coordinates statewide regulatory waterway markers to ensure compliance with the uniform marking system and to improve compliance of state boating and resource protection zones for the long term well-being and benefit of all waterway users and the fish and wildlife resources. FWC regulates licenses and permits related to boating and fishing, and manages waterways within the state.[202]

Mass Transit and Passenger Rail

Mass Transit and Passenger Rail includes terminals, operational systems, and supporting infrastructure for passenger services by transit buses, trolleybuses, monorail, heavy rail—also known as subways or metros—light rail, passenger rail, and vanpool or rideshare.[203] Florida has a complex public transportation network with over 270 million public transit riders within the state annually.[204] Public transportation in Florida is a crucial part of the solution to the state's economic, energy, and environmental challenges – helping to bring a better quality of life and economic prosperity. In increasing numbers, people are using public transportation, and local communities are expanding public transit services. The Florida Public Transportation Association (FPTA) is one of the most active state transit associations in the nation. FPTA

[199] https://www.marad.dot.gov/
[200] https://www.cbp.gov/
[201] http://www.uscg.mil
[202] http://myfwc.com/
[203] https://www.dhs.gov/transportation-systems-sector
[204] http://www.fdot.gov/planning/fastfacts.pdf

is a nonprofit association whose members include every major public transit agency in Florida as well as interested citizens and businesses.[205]

Florida has 2,908 main rail corridor miles, owned by 15 operating railroads and terminal or switching companies, as well as 81 miles owned by the State of Florida. The largest operator in the State is CSX Transportation, which owns more than 53% of the statewide track mileage.[206]

On average there is a train collision or derailment every two hours and a hazardous materials transportation incident every two weeks throughout the country. The Federal Railroad Administration (FRA) was created by the Department of Transportation Act of 1966 and is one of ten agencies within the U.S. Department of Transportation concerned with intermodal transportation. The FRA's mission is to enable the safe, reliable, and efficient movement of people and goods, now and in the future.[207]

Railroad hazards could include train collisions, derailments, accidents involving cars or pedestrians, rail worker accidents, and hazardous materials spills. Natural hazards also cause issues for railways including freezing tracks and malfunction with train car operations such as brakes. Dense fog could cause visual obstructions, animals on the tracks could lead to derailments and all accidents can lead to the damage or destruction of freight, property, and loss of life. These accidents could also be caused by equipment failure, operator error, signal failure, and track damage or failure.[208]

Florida also has an extensive bus system with over 60,000 registered buses throughout the state.[209] Public transportation provides access to job opportunities for Floridian's as well as a transportation option to get to work, school, visit friends, or go to a doctor's office. Public Transportation saves America about 4.2 billion gallons of gasoline each year. According to FPTA, Florida currently ranks third among all states in total gasoline consumption. The 4.2 billion gallons of gasoline saved by the transit industry represents Florida's entire gasoline consumption for about seven months.

Pipeline Systems

Energy pipelines are a fundamentally safe and efficient means of transporting materials key to the U.S. energy supply but, given that they often carry toxic, volatile, or flammable material, energy pipelines have the potential to cause injury and environmental damage.[210] There are a total of 34,019 miles of pipeline within Florida:[211]

- 552 miles Intrastate Natural Gas Transmission
- 4,510 miles Interstate Natural Gas Transmission
- 203 miles Propane
- 80 miles Liquid Hazardous Materials
- 43 miles Oil
- 36 miles Refined Petroleum Products

[205] https://floridatransit.org/about-us
[206] https://www.fra.dot.gov/Page/P0002
[207] https://www.aar.org/data-center/railroads-states#state/FL
[208] http://www.fdot.gov/rail/PlanDevel/Documents/FinalInvestmentElement/G-Chapter2-FreightRail.pdf
[209] https://www.statista.com/statistics/196342/total-number-of-registered-buses-in-the-united-states-by-state/
[210] http://hazardmitigation.calema.ca.gov/plan/state_multi-hazard_mitigation_plan_shmp
[211] http://www.fdot.gov/planning/fastfacts.pdf

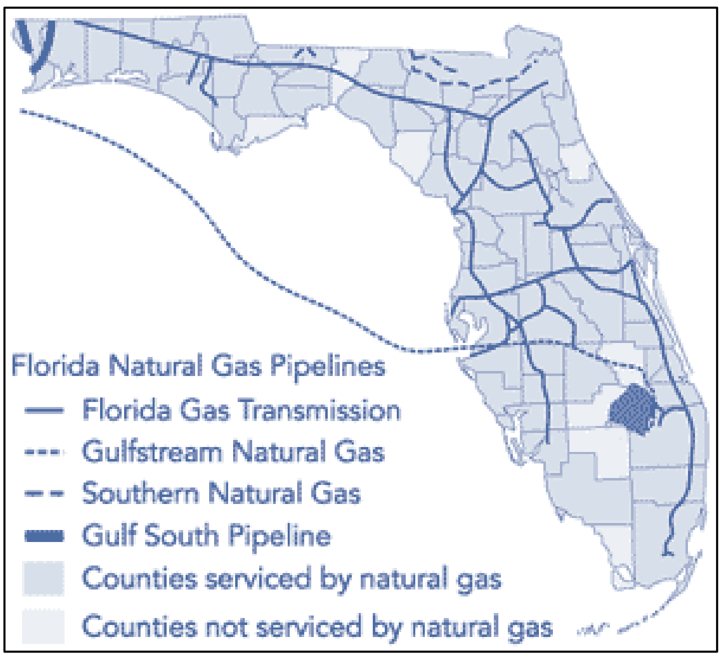
- 28,567 miles Natural Gas Distribution Systems

FDOT and the Pipeline and Hazardous Materials Safety Administration (PHMSA) work together to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to citizens' daily lives. To do this, PHMSA establishes national policy, sets and enforces standards, educates, and conducts research to prevent incidents. PHMSA also prepares the public and first responders to reduce consequences if an incident does occur.[212]

Increased urbanization is resulting in more people living and working closer to existing transmission pipelines. Growth in population, urbanization, and land development near transmission pipelines, together with the addition of new facilities to meet demands, may increase the likelihood of pipeline damage due to human activity and the exposure of people and property to pipeline failures. Compounding the potential risk is the age and gradual deterioration of the transmission pipeline system due to natural causes. [213]

Causes and contributors to pipeline failures include construction errors, material defects, internal and external corrosion, pressure buildups, operational errors, control system malfunctions, and outside force damage. Natural hazards such as sinkholes or land subsidence, earthquake or seismic activity, and flooding can all put pressure on existing pipelines resulting in bursts, spills, or leaks of natural gas, oil, and hazardous substances. For more information on pipelines also see the *Hazardous Materials Incidents Profile* on page 328. The map below shows the major pipelines and the companies that own them.

Figure 98: Florida Natural Gas Pipelines



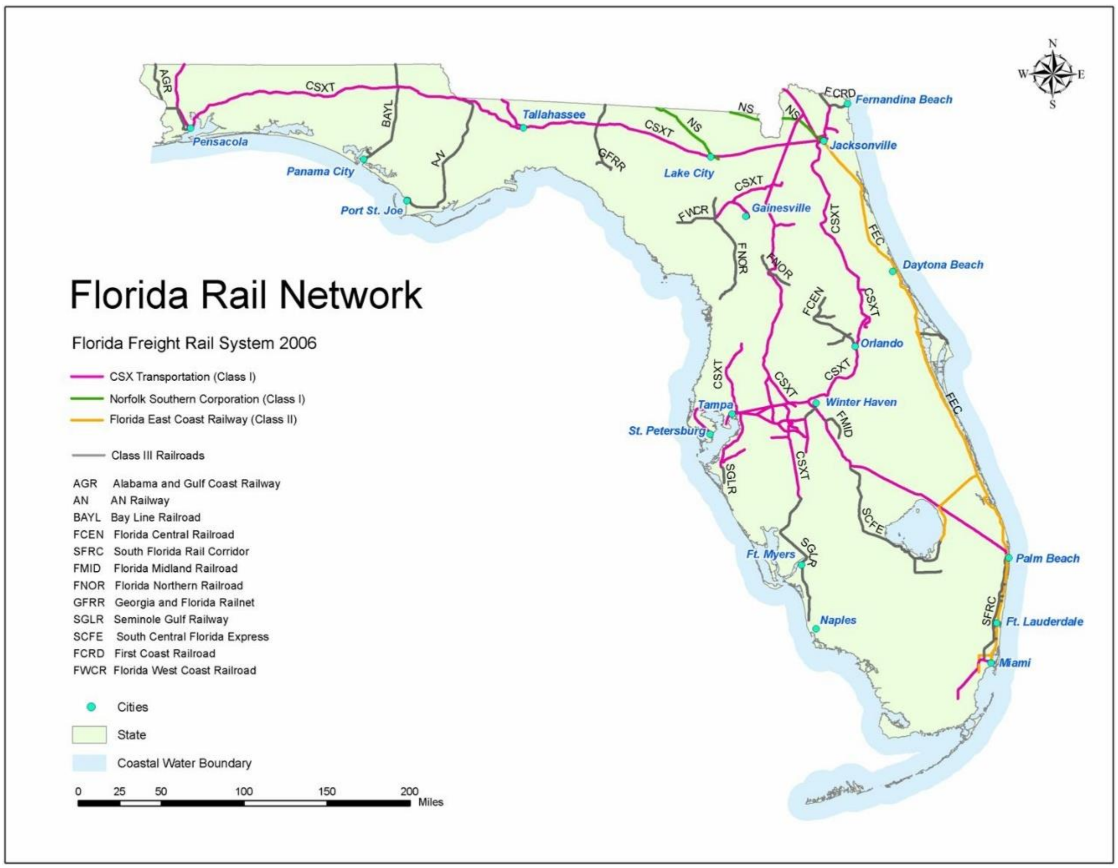
[212] https://www.phmsa.dot.gov/about/mission
[213] https://s3images.americangeosciences.org/agi/statefactsheets/FL_GeoscienceInYourState_AGI.pdf

Freight Rail

Recognizing the increasing demand for rail services and the importance of rail in the state's overall mobility, Florida has been one of the nationwide leaders in promoting public-private partnerships and supporting the rail system. Of the 2,908 miles of rail lines in Florida, all but 81 miles are owned by the State's 15 freight railroads and the entire track is controlled by the freight railroads. Freight rail companies are the shippers that depend on rail to transport their goods in the global marketplace, to stock their shelves with the latest products for Florida residents and visitors, and to haul construction materials to keep pace with the rapid population growth.

There are 15 freight railroads operating in Florida. These railroads carried about 1.2 million carloads and 805,260 intermodal units (trailers and containers) and 119 million tons of freight, effectively removing almost six million heavy trucks from the roadways. The map below shows the freight rail companies in the state.

Figure 99: Florida Freight Rail Network



Below are the seven Florida industries which depend on a strong freight rail system. These industries are:[214]

Phosphates and Fertilizers

Mineral deposits in West Central Florida make the state a world leader in the production of phosphate rock. With the exception of Hamilton County in northern Florida, the state's phosphates production is concentrated in Polk, Hillsborough, and Hardee counties. Florida accounts for just over half of the nation's production of phosphate fertilizers. The phosphates and fertilizers produced in Florida are shipped nationwide and to markets throughout the world, with China, India, Australia, and Brazil ranking among the leading foreign destinations.

Distribution and Retail

The distribution and retail trade industry is comprised of several key economic sectors – wholesale trade, retail trade, and transportation and warehousing. Florida's distribution and retail trade industry depends on the efficient movement of goods to keep costs down and to remain competitive. Rail is crucial for long hauls that bring goods into the state from distribution hubs such as Chicago, Atlanta, and Dallas-Fort Worth, as well as from more distant gateways, including the west coast ports which are the leading point of entry for consumer items entering the United States from Asia.

Food and Agriculture

Rail plays a crucial role in Florida's food and agriculture industries. Perhaps the most famous freight rail shipments are the Tropicana "Orange Juice Trains," originating in Bradenton and Fort Pierce. The railcars are specially designed refrigerated boxcars, each capable of carrying four truckloads worth of product. Rail also plays a critical role in allowing Florida sugar to compete against foreign imports. U.S. Sugar uses rail to haul sugar cane from the fields into the processing plants.

Paper and Fiber

Much of Florida's Panhandle is forested, lying within the yellow pine growing region that stretches from East Texas to Georgia, one of the country's most prodigious areas for forestry. As such, Florida has a substantial paper and fiber industry that has been one of the pillars of the North Florida economy for decades. Rail remains popular for long hauls following the processing of timber into paper and wood products and also as the best option for hauling lumber long distances.

Automotive Distribution

The expanding population stimulates demand for retail sales of automobiles while the millions of tourists visiting the state on an annual basis depend on rental cars for mobility. The combination of retail sales and rental cars makes Florida the second largest market for new vehicles in the country, only surpassed by the much more populous state of California. Whether new or used, meeting Floridians demand for vehicles requires thousands of truck and rail trips annually as part of a system to transport vehicles to dealers and wholesalers

[214] http://www.fdot.gov/rail/Publications/Plans/2006/flrail06.pdf

Energy

The transport of fuels (i.e., coal and petroleum) by rail is one of the leading inputs in the energy industry. Rail, joined by coal and petroleum commodity purchases, construction, and business services is a principal cost factor in electricity production that affects the overall price of energy. Rail is the primary mode of transportation to bring coal into Florida.

Construction

Rail is involved in the movement of many of the materials essential to the Florida construction industry, including metals, lumber, and cement. The largest tonnages though are for movement of aggregate rock such as crushed limestone from the Miami-Dade area to construction markets in Orlando, Jacksonville, and out-of-state markets.

Postal and Shipping

Postal and Shipping in the United States moves roughly 720 million letters and packages each day and includes large integrated carriers, regional and local courier services, mail services, mail management firms, and chartered and delivery services.

The United States Postal Service delivers more mail to more addresses in a larger geographical area than any other post in the world. The Postal Service delivers to more than 156 million addresses in every state, city and town in the country. Everyone living in the United States and its territories has access to postal products and services and pays the same for a First-Class postage stamp regardless of their location.

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

Climate Change and Transportation Infrastructure

A changing climate can modify the types and quantity of food we eat, where we live, the types of available jobs, and how people and goods move. The transportation infrastructure has potential vulnerabilities to rising sea levels, rising temperatures, more intense storms, and extreme drought. The table summarizes climate change factors and the effects they could have on transportation infrastructure.[215]

[215] https://ntl.bts.gov/lib/52000/52800/52855/Transportation_System_Resilience_Extreme_Weather_and_Climate_Change.pdf

Table 56: Transportation Infrastructure Climate Change Impacts

Climate Change Factor	Transportation Effect
Increased storm frequency and severity • Higher drought probability • More extreme precipitation	• Maintenance costs will rise • Costs for erosion and flood control prevention will rise
Change in ocean temperature • Loss of ocean protection from storm surge and damage • Coral reef damage and losses	• Coastal infrastructure will be more vulnerable to extreme and severe weather events • Reduction in commercial fishing
Rising temperatures • More days with temperatures above 95 degrees • Increased risk of wildfire	• Transportation infrastructure degrading • Increased maintenance costs • Increased energy costs for transportation facilities
Rising sea levels and storm surges • Reduced amount of protective barrier islands and coastal wetlands • Loss of coastal land	• Coastal infrastructure degrading • Impacts to supply chains • Rail and road infrastructure damage

2. Geographic Areas Affected by Transportation Incidents

Transportation incidents can occur anywhere within the State of Florida. Areas of high traffic are particularly vulnerable to transportation hazards. Large urban areas with large populations and different forms of transportation are considered high traffic areas, meaning the risk is elevated. Due to the large number of railways, roadways, airports, pipelines, and seaports, the entire State of Florida is at risk for transportation hazards. These hazards also involve the transportation of hazardous materials which carry their own risks and can be found in the *Hazardous Materials Incidents Profile* on page 338.

3. Historical Occurrences of Transportation Incident

Due to the vast number of transportation routes, transportation incidents are fairly common. Below are some of the major incidents that have occurred in Florida.

The ValuJet crash in the Everglades in May 1996 is an example of how a mass casualty incident can overtax the resources of even the largest and most urbanized local government within the state. Shortly after takeoff from the Miami airport, a fire broke out on the plane due to the unsafe handling procedures of hazardous canisters. After attempting to turn back, the plane crashed into the muck in the Everglades, killing all 110 people on board. The first responders had difficulties reaching the crash site due to the remote location and hazardous conditions and spent days working to retrieve evidence.[216]

In April 2002, an Amtrak train derailed carrying 468 passengers near Jacksonville, Florida. Of the many cars, 21 derailed and flipped, killing 6 people, critically injuring more than 100, and trapping dozens more.

[216] Gabino, H. (2016, May 11). The Day A Plane With 110 People Disappeared In The Everglades. The Miami Herald. Retrieved from http://www.miamiherald.com/news/local/community/miami-dade/article76767282.html

The State Emergency Response Team (SERT) worked with local rescue efforts to free passengers and clear the tracks.[217]

In January 2012, an automobile pileup on I-75 in Alachua County left 11 people dead and 21 injured. The cause of the early morning crash was attributed to dense fog and smoke from a nearby marsh fire. The decreased visibility led to a crash involving over a dozen cars and six tractor trailers and closed I-75 north and southbound for hours. First responders worked tirelessly to reach victims and survivors whose vehicles were spread over a mile down the highway.[218]

In May 2017, a 22 foot private vessel travelling off the coast of Dania Beach took on water and capsized. Two people on board were killed and one was rescued from the water. The local Coast Guard and rescue officials heard the call of a boat in distress and immediately were deployed. Private vessel accidents are common along the Florida coast for a multitude of reasons including inebriation, operator error, and system malfunction.

4. Probability of Future Transportation Incident

There is no sure way to predict future transportation incidents as most typically occur without warning. The probability of a major transportation event in the State of Florida is perceived to be high. The Florida Department of Transportation (FDOT) is part of an ongoing assessment of the state's vulnerability and coordinates efforts to prepare for, prevent, mitigate, respond to, and recover from transportation events that affect the state. In coordination with other transportation agencies such as the FAA, PHMSA, USCG, and CBP, FDOT ensures the safe travel and transportation of people and goods throughout the state.

This hazard was determined to occur annually, giving it a Probability of Very Likely.

5. Transportation Incident Impact Analysis

- Public
  - Mass casualties.
  - Injury or death.
  - Delays.
- Responders
  - Danger in reaching victims/survivors.
  - Injury or death during rescue efforts.
- Continuity of Operations (including continued delivery of services)
  - Normal transportation operations may not return to return to normal for a significant time due to repairs.
  - Goods cannot be delivered or accepted.
- Property, Facilities, Infrastructure

[217] Six Die As U.S. Train Derails. (n.d.). Retrieved from The Daily Mail website: http://www.dailymail.co.uk/news/article-110476/Six-die-US-train-derails.html

[218] Stutzman, R., & Jacobson, S. (2012, January 31). Florida's Deadley Pileup: Death Toll Raised to 11 As New Victim Found In Truck. The Orlando Sentinel. Retrieved from http://articles.orlandosentinel.com/2012-01-31/news/os-florida-highway-deaths-killed-i-75-20120130_1_deadly-pileup-smoke-and-fog-first-crash

- Potential damage to infrastructure and public transportation programs
- Shutting down affected highways, railways, airports, etc.

- Environment
  - Hazardous material spills
  - Pipeline burst/leak
- Economic Condition
  - Cost for repairs and down time.
  - Could cause loss in revenue or wages.
    - Loss in shipping revenues.
    - Loss of tourism.
- Public Confidence in Jurisdiction's Governance
  - Citizens may lose trust in particular public transportation services.
  - Tourists may reconsider visiting Florida.

6. 2018 LMS Integration

The following counties profile Transportation Incidents:

- Brevard
- Collier
- Glades
- Hendry
- Indian River
- Lee
- Leon
- Martin
- Osceola
- Palm Beach
- Pinellas
- Seminole

7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

Due to the nature and unpredictability of technological hazards, all property and infrastructure in the State of Florida is at risk to these events. Large counties and those with significant tourism are particularly at risk. Counties with large transportation hubs such as airports or ports are also at a higher risk.

8. Vulnerability Analysis and Loss Estimation of State Facilities

Due to the nature and unpredictability of technological hazards, all property and infrastructure in the State of Florida is at risk to these events. Large transportation hubs such as airports or ports are at a higher risk.

Though Florida recognizes that state facilities are vulnerable to transportation incidents, there is a lack of data to quantify the vulnerability of facilities to these hazards compared to natural hazards.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 13.

<table>
<tr><th colspan="5">TRANSPORTATION INCIDENTS</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Transportation systems are designed to move people, goods, and services efficiently, economically, and safely from one point to another. As the movement of people, goods, and services increases due to population growth and technological innovation, the need to plan for events becomes increasingly important. Florida has a large transportation network that consists of airports, major highways, passenger railroads, marine ports, and pipelines. These transportation systems provide lifeline services for communities and are vitally important for response and recovery operations. The vast network of public and private critical infrastructure owners and operators, the infrastructure and services they manage, and the extensive interdependencies among the transportation modes and other sectors indicate the need for coordinated planning to manage all hazards efficiently and effectively.</td><td rowspan="4">HIGH</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Very Likely</td><td>Very Likely</td><td>High</td><td>Medium</td><td>Medium</td></tr>
</table>

Cyber Incident Hazard Profile

1. Cyber Incident Description

Cyber incidents are becoming more common and more costly in our society. Because of this, Cyber Incidents will be profiled as a hazard to the state of Florida. The word Cyber refers to anything that contains, is connected to, or controlled by computers and computer networks. A computer is a machine that can take instructions and perform computations based on those instructions. Cyber technology refers to the computers and computer networks and the information and services we rely upon. For example, critical infrastructure relies on such computers and the Internet. Critical infrastructure includes sectors such as communications, energy, financial services, health care, transportation, and water and wastewater systems, among others. A Cyber Incident then, refers to an incident involving computers, networks, and information or services that affect daily operations of critical infrastructure.

A Cyber Incident differs from traditional hazards such as a flood, which makes it difficult to plan for, respond to, recover from, and mitigate against. For example, there is often a lack of physical presence or evidence of a cyber-incident, making it difficult to understand the scope of the incident. Furthermore, the scope will likely cross municipal jurisdictions because of the nature of cyber technology. There are also fewer resources for cyber incidents due to a lack of awareness and knowledge of the cyber threat.[219]

Cyber Threat refers to the possibility of a malicious attempt to damage or disrupt a computer network or system.[220] This is a global threat because of the nature of cyber technology and the wide scope of cyber incidents. In fact, in 2013 the United States intelligence community assessed cyber threats as the top global threat, followed by terrorism.[221]

This makes it clear that cybersecurity is directly linked to our national defense.[222] According to DHS's National Infrastructure Protection Plan (NIPP), cybersecurity is defined as the

> *"prevention of damage to, unauthorized use of, or exploitation of, and if needed, the restoration of electronic information and communication systems and the information contained therein to ensure confidentiality, integrity, and availability; includ(ing) protection, restoration, when needed, of information networks and wireline, wireless, satellite, public safety answering points, and 911 communications systems and control systems."* [223]

Put more simply, cybersecurity is protecting the machines connected to networks and the Internet and the information stored, accessed, or transmitted. A cybersecurity incident then, refers to a data breach. A data breach is when a name plus another record (i.e. financial, medical, credit card) is put at risk, either electronically or in a hard copy.

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219 FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.7 – 2.8
220 FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.4
221 FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.4
222 FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.12
223 https://www.dhs.gov/sites/default/files/publications/national-infrastructure-protection-plan-2013-508.pdf

There are many causes of a data breach or a cyber-incident. A cyber incident could be a malicious attack or it could stem from a system glitch or human error. In 2014, the average cost of a data breach to an organization in the United States was $6.53 million.[224] With so much at stake, it is important to be prepared for a cyber-incident. Cyber Preparedness is defined as the process of ensuring that an agency has developed, tested, and validated its capability to protect against, prevent, mitigate, respond to and recover from a significant cyber incident.[225]

Though a cyber-incident is different than traditional hazards, all phases of emergency management are still applicable. For instance, Mitigation, Prevention, and Preparedness occur before a cyber-incident happens, by implementing policies and increasing awareness. Response is attempting to stop the cyber incident or a data breach. Recovery, and sometimes Mitigation, are after the cyber incident and involve restoring networks, replacing damaged equipment, and eliminating vulnerabilities that allowed the breach.[226]

Cyber Attacks

Some cyber incidents are cyber-attacks, meaning they have a malicious intent. The most significant risk for exposure to attack stems from human error. Any computer system that is accessible from the Internet is a potential target. The goal of a cyber-attack is the theft of proprietary, personal, or financial information. Additionally, cyber warfare and cyber espionage, carried out by other nation states, are possible goals in today's society.[227]

There are three levels of cyber-attacks: unstructured, structured, and highly structured.

Unstructured attacks have little to no organization and no significant funding. These are usually carried out by amateurs who use pre-made tools to take advantage of well-known flaws. These pre-made tools are easily downloadable from the Internet. These attacks are the most common type of threat but they are also easily spotted by network security.[228]

Structured attacks involve more organization and planning and have decent financial backing. These attacks also have specific targets and are intended to disrupt operations to a specific organization or sector. Additionally, these attacks are conducted over long periods of time to avoid detection. The impacts from a structured attack can range from minimal to significant. Potential perpetrators include insider threats, like a disgruntled employee; industrial competitors, like rivals stealing company secrets; organized crime groups, like Columbian drug traffickers; hacktivists motivated by a specific cause, like Anonymous; or blackmail and ransom hackers, using extortion to receive money.[229]

Highly structured attacks involve extensive organization, planning and funding. Attackers conduct reconnaissance and then use multiple attacks to achieve their goal. Sometimes these attacks even include

[224] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 1.25
[225] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.4
[226] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.29 – 2.31
[227] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.12
[228] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.7 – 2.13
[229] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.14 – 2.23

physical attacks along with a cyber-attack. Possible attackers conducting highly structured attacks include ideological groups, cyber terrorists, and nation states.[230]

Malware

Cyber-attacks are conducted using different types of malware. Malware is *mal*icious soft*ware* that can infect a computer or network and cause harm. Malware can destroy all data, damage networks, or steal information. Malware must be introduced to a computer or network using methods such as removable media, phishing, and drive by downloads. This can be completed using tools such as a virus, worm, trojan, or adware.[231]

A Virus spreads malicious code by copying itself and infecting host computers through downloads, email attachments, or removable media. The virus then corrupts or deletes data on your computer or erases the hard drive.

A Worm is a malicious computer program that replicates itself to spread to other computers. It relies on security failures and utilizes the computer network to spread itself. Worms can cause harm to the network, consume bandwidth, install backdoors (for access later), and allow the creation of botnets.

A Trojan is a malicious program that is disguised as legitimate software. It looks useful to an unsuspecting user but is actually harmful when executed. After installed, the trojan waits silently on the infected machine and invisibly carries out its misdeeds with remote administration capabilities. Trojans can control the mouse and keyboard, format drives, log keystrokes, play sounds, record sound and video, and use the Internet connection to perform Denial of Service attacks. [232]

Methods

Attackers use several methods to complete their goals. The following will be discussed here: social engineering, botnets, Denial of Service (DoS), Zero day exploits, Web-based, malicious insider, and unintentional actions or errors.

Social engineering is a very common method to conduct attacks that involves manipulating legitimate users and convincing them to perform actions or give confidential information using email, phone, in person encounters, dumpster diving, or insider threats. People are often the weakest link in the cyber security chain and social engineering takes advantage of that. There are several types of social engineering but phishing is one of the most common. Phishing is when an attacker sends an email that appears to originate from a legitimate source, such as a bank, advising that verification of account information is needed immediately to prevent serious consequences. The email usually contains a link to a fraudulent website with a form for customers to enter their information. Similarly, spear phishing is when an attacker sends a phishing email to a specific organization or person. Whaling is when attackers attempt to spear phish a high priority target, such as a CEO.[233]

Botnets are another method to conduct an attack. A "bot" is malware that allows attackers to take control of the computer. A "botnet" then, is a ro*bot net*work of infected computers used to conduct malicious

[230] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.23
[231] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.10 – 2.12
[232] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.32 – 2.33
[233] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.38 – 2.40

activities. A botnet is created when one bot infects several computers and then networks them together. Botnets can be used for Denial of Service attacks, malware distribution, and covert intelligence gathering. Owners of computers that are part of a botnet often have no idea their computer has been compromised. A botnet can include thousands or millions of bots and may remain quietly operational for years. This method is successful because it distributes the activities to several computers, making it more difficult to track and block.[234]

Denial of Service attacks are simply what they sound like, the attackers attempt to prevent legitimate users from accessing information or services of a computer system or network by overwhelming the system with more traffic than it can handle. When you type an address into your web browser, you are sending a request to that site's computer server to view the page. The server can only process a certain number of requests at one time, so when it is overloaded, the website does not work. A Denial of Service (DoS) attack occurs when an attacker overwhelms the server with false requests so that the server cannot process the legitimate requests. A Distributed DoS or DDoS attack occurs when attackers use multiple computers and multiple Internet connections to conduct the attack. This greatly increases the magnitude of false requests that can be sent, meaning a larger DDoS attack. Attackers sometimes use botnets, as discussed above, to carry out DDoS attacks. These types of attacks can be used against a wide variety of targets, from retail websites to nation states.[235]

A Zero Day Exploit is an attack that takes advantage of a security risk on the same day that the risk becomes known to the public. Because there is no known solution to the risk yet, attackers are able to conduct attacks without being stopped. These exploits can be purchased from those who find these security risks and choose not to report to them to the company, but rather sell the information to would-be attackers. Attacks such as these have been used to target programs like Microsoft Word, PowerPoint, Excel, Adobe, and Flash Player.[236]

Web-based attacks involve websites redirecting the browser to a malicious website where malicious software downloads to the computer. These attacks are known as drive by downloads and involve malicious code downloading in the background of a computer just from visiting a certain site, without clicking on anything. These attacks require no action from the target and they often have no idea their computer has been infected.

Another method is to use a Malicious Insider to conduct an attack. A malicious insider is a person with special advantage, influence, or proprietary knowledge, and uses it for malicious intent. These could be current or former employees, or even contractors or vendors. Malicious insiders risk the theft of confidential information and the sabotage of systems.

As stated earlier, humans are the weakest link in cyber security. Unintentional actions or errors can provide an opportunity for attackers to steal information and gain unauthorized access. For example, unintentional acts or failures directly compromise the security of a computer network or a resource

[234] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.34 – 1.35
[235] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.20; FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.36 – 2.37
[236] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.22

dependent on the network. This includes not properly updating software or a network and the failure to remove or change system permissions after personnel changes.[237]

Vulnerabilities

Because our society is increasingly reliant upon cyber technology and the Internet, new vulnerabilities are presenting themselves. There are vulnerabilities at the personal, local and national scale. For example, an individual person may have their identity stolen. Additionally, hackers may take a local 911 system offline for an extended period of time. Finally, there could be a multi-state power outage or a hack of a large company that affects many across the nation, such as the Yahoo or Target breaches.

More specifically, critical infrastructure often relies upon cyber technology and the Internet, making critical infrastructure vulnerable to cyber incidents. Additionally, many critical infrastructure systems are interconnected, so even if a particular critical sector is not reliant upon cyber technology, it may be reliant upon a critical sector that is reliant upon cyber technology. These possible cascading impacts are very important to consider when planning for hazard mitigation. This can be complicated though, as not all critical infrastructure sectors are controlled by the government, some include privately owned companies, like a private energy company, financial institution, or hospital. Sometimes the priorities of privately owned organizations differ from those of the government. For example, while the government is concerned with protecting all critical infrastructure from cyber-attacks, these privately owned organizations may be more concerned with profits or public reputation. Furthermore, the interconnectivity of sectors expands the scope from one geographical area to large regional areas that likely cross political jurisdictions, making planning more complicated.[238]

Another vulnerability is that the Internet was designed with efficiency and access concerns, not specifically with security considerations. Now that cyber technology and Internet capabilities have expanded, vulnerabilities are appearing. For example, many critical infrastructure systems are controlled remotely using systems called Supervisory Control and Data Acquisition (SCADA) or Distributed Control Systems (DCS). These systems are used to manipulate functions and services of systems remotely so people do not have to deploy to sites in the field where equipment is located, but can instead alter systems, like adjusting pressure or flow, from their offices.[239] This is a concern because these systems can be hacked and controlled by enemies.

SHODAN is a search engine to find Internet connected devices. From 2012 to 2014, a research project to increase awareness of the vulnerabilities, Project SHINE, attempted to find SCADA and DCS systems. The project found hundreds of thousands of SCADA and DCS devices and systems. When the project ended in 2014, it wasn't because they had found all the devices, it was because they saw no end in sight with hundreds and sometimes thousands of devices being added every day.

Some of these devices and connections are not secure, meaning they can be hacked. Policies and procedures need to be adopted by all critical infrastructure sectors using Internet connected devices. Many times owners keep the default username and password, which are very easy to hack. The Project SHINE report concluded that critical infrastructure and cyber security professionals must not continue to

[237] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.40 – 2.43
[238] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.15 – 1.16
[239] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.12

use "compliance-based security," but focus on an "attitude of safety, vigilance, and performance awareness."[240]

Cybersecurity and Cyber Preparedness

Presidential Policy Directive (PPD) 8 aimed at strengthening the security and resilience of the US through systematic preparation for the threats that pose the greatest risk to the security of the Nation, including acts of terrorism, cyber-attacks, pandemics, and catastrophic natural disasters.[241]

PPD 41 gives principles for the Federal Government response to any cyber incident. It also recognizes that cyber incidents are occurring more frequently and that responding to cyber incidents that pose a significant threat requires deliberative planning, coordination and exercising of the response plan.[242]

The US also has a National Cyber Incident Response Plan that was published in December 2016 after PPD 41 was issued, detailing the response activities and responsibilities of federal agencies during a significant cyber incident.[243]

The State of Florida has several cyber security mechanisms. One is the Florida Computer Crime Center (FC3), which conducts cyber investigations, trainings, research, and prevention. The FC3 also developed the Florida Infrastructure Protection Center (FIPC) to anticipate, prevent, react to, and recover from acts of terrorism, sabotage, and cyber crime. There are three components to the FIPC: the "Secure Florida" Education and Awareness campaign, the Central Analysis and Warning Point to monitor and analyze information, and the Computer Incident Response Team (CIRT). The CIRT is always on-call to respond to critical cyber incidents in Florida.[244]

The Florida Infrastructure Protection Center (FIPC) has evolved into a group of services, which range from investigations, awareness training, intelligence, and domestic security. All FDLE regions have sworn agents that conduct high-tech investigations into computer crimes. Additionally, FDLE has strong cyber intelligence efforts within the Cyber Intelligence Unit and the Domestic Security Critical Infrastructure Unit is expanding as well. The Secure Florida group within the FIPC conducts business and consumer education awareness and efforts.

The Computer Incident Response Teams (CIRT) are used in two ways. For example, an individual criminal incident, such as the unauthorized access into a computer system and theft of data, are investigated as criminal cases by the Regional Network Intrusion Unit or the Cyber Crime Unit. Larger scale cyber incidents, such as those that affect several organizations and systems within Florida's critical infrastructure system, are investigated by the Domestic Security Working Group, which is composed of several agencies including AST, the FBI, the Florida National Guard, FDEM, and other stakeholders.

Additionally, the Agency for State Technology (AST)[245] developed a Statewide Strategic Information Technology Security Plan. This plan is designed to ensure state data is secure and outlines their roadmap

[240] https://scadahacker.com/library/Documents/ICS_Vulnerabilities/Infracritical%20-%20Project%20SHINE%20Findings%20Report%20-%20Oct%202014.pdf
[241] https://www.dhs.gov/presidential-policy-directive-8-national-preparedness
[242] https://fas.org/irp/offdocs/ppd/ppd-41.html
[243] https://www.us-cert.gov/sites/default/files/ncirp/National_Cyber_Incident_Response_Plan.pdf
[244] http://www.fdle.state.fl.us/cms/FCCC/About-Us.aspx)
[245] http://www.ast.myflorida.com/publications.asp

to continually enhance cybersecurity and operational effectiveness. The key to the AST information security strategy is the protection of the confidentiality, integrity, and availability of the state's IT resources. The plan lists three strategies:

1) Establish a strong cybersecurity framework, improve situational awareness to empower information security personnel, and cultivate partnerships for response efforts;

2) Establish objectives for assessing and enhancing the state's data center infrastructure; and

3) Establish objectives for project assurance and oversight and promote strategic business alignment by collaborating with state agencies to understand and support their mission-specific strategies.

AST has accomplished several goals since they were created in 2014, including creating the Florida Cybersecurity Standards Security Rule in the Florida Administrative Code (74-2, FAC).[246]

Finally, the Florida Division of Emergency Management has a Cyber Incident Plan that details policies and procedures in the event of a cyber-incident within the Division.

The National Institute of Standards and Technology (NIST) has developed the Cybersecurity Framework, which promotes the protection of critical infrastructure through standards, guidelines, and practices for organizations to adopt. The framework is designed to work with existing business processes and to improve existing cybersecurity efforts.

The core functions of the framework follow along with the phases of emergency management. For example, the first two core functions are Identify and Protect, which are similar to Mitigation and Preparedness. In the framework, Identify means naming the risk and then removing the behavior creating the risk. This is completed by implementing policies and procedures to reduce, remove, or transfer risk. Protect refers to protecting data from unauthorized disclosure by authenticating access, promoting information security, implementing business continuity plans, and insuring confidentiality of data.[247] More information about the NIST Cybersecurity Framework can be found at: link.com.

There are many resources for agencies and organizations to develop a cybersecurity program. Some are outlined below.

US Computer Emergency Response Team (US-CERT) was created in the early 2000's in response to cyber breaches in federal government. The team responds to incidents and analyzes data about emerging cyber threats. Additionally, the team provides cybersecurity protection to Federal civilian executive branch agencies through intrusion detection and prevention capabilities. They also collaborate with foreign governments and international entities to enhance the nation's cybersecurity posture. US-CERT also has a scoring system to determine risk and priority in a national context, which can be viewed online[248].

The FBI has a Cyber Crime division and is the lead federal agency for investigating cyber-attacks by criminals, overseas adversaries, and terrorists. According to the FBI, cyber intrusions are becoming more common and dangerous, especially considering that our nation's critical infrastructure is targeted. The FBI

[246] https://www.flrules.org/gateway/ChapterHome.asp?Chapter=74-2
[247] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 1.38 – 1.43
[248] https://www.us-cert.gov/sites/default/files/publications/NCCIC_Cyber_Incident_Scoring_System.pdf

also has the Internet Crime Complaint Center to report cyber crimes and the Cyber Action Team which provides rapid incident response for major computer intrusions and other cyber related emergencies.

Infraguard is a partnership between the FBI and the private sector to share information and intelligence to prevent hostile acts against the US. Florida has several chapters including Jacksonville, Orlando, South Florida, Tallahassee, and Tampa Bay.[249]

Individuals can report identify theft to the Federal Trade Commission here: https://www.ftc.gov/.

The National Cyber Security Alliance has created the StaySafeOnline.org website with resources for individuals and businesses.[250]

NetSmartz is a resource for children to learn about different types of cyber crime and cybersecurity.[251]

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

2. Geographic Areas Affected by Cyber Incidents

Because cyber incidents occur in "cyber space," there are not always geographic areas affected by cyber incidents. However, cyber incidents may cause physical disruptions in critical infrastructure, which could affect a jurisdiction or a power grid. It is important to note that power grids are vast, sometimes crossing state lines, meaning that a cyber incident at one facility at one location could cause disruptions at other locations hundreds of miles away.

3. Historical Occurrences of Cyber Incidents

Table 56: Florida Historical Occurrences, Cyber Incidents, 2007-2017

Date	Location	Description
2007	Estonia	Dispute regarding the movement of a Russian statute led to a cyber-attack that crippled websites for government services, banks, media outlets, etc. (FEMA AWR 136-22)
2010	Iran	US agents introduced Stuxnet, a worm, to Iranian industrial sites including a uranium enrichment facility. The worm caused subtle increases in pressure

[249] infraguard.org
[250] staysafeonline.org
[251] netsmartz.org

		on spinning centrifuges while displaying normal readings in the control room. This led to the destruction of one of the five Iranian nuclear centrifuges. (FEMA AWR 136, 2-25; FEMA MGT 384, 2-32-33)
2011	Cyberspace	Twitter accounts of several news stations were hacked. The hackers tweeted false news reports. (FEMA AWR 136, 2-8)
2011	United States and Russia	A water treatment facility worker was on vacation in Russia when he remotely accessed the facility system to check on operations. The IT staff at the facility thought they were under attack from Russian hackers. (FEMA AWR 136, 1-12)
2011	Orlando, Florida	City of Orlando was targeted by the hacktivist group Anonymous because non-profit workers were arrested for distributing food without permits. (FEMA MGT 384, 1-30)
2013	United States	Hackers obtained 40 million credit and debit card numbers, including expiration dates and CCV codes when the retail company Target was attacked. Additionally, 70 million personal records including names, addresses, emails, and phone numbers were stolen. The attack cost credit unions and banks $200 million to re-issue nearly 22 million cards. Target experienced earnings losses and drops in the stock market for several months. (FEMA MGT 384, 1-25, 1-31)
2014	United States	Two Chinese agents were charged with hacking Yahoo and stealing information from at least 500,000 user accounts.
2014	Phoenix, Arizona	The City of Phoenix Internet systems were attacked with a DDoS, disrupting the police department computers. During this time, dispatchers were unable to send information to police officers regarding names, license plates, and criminal records. (FEMA MGT 384, 2-36-37)
2015	Panama City, Florida; global	An anonymous source leaked 11.5 million documents from a law firm in Panama City. The documents detailed financial and attorney-client information for more than 200,000 offshore entities. When reporters searched through the information, it was discovered that the law firm had been involved in illegal actions, including fraud and tax evasion. [252]
2016	Sarasota, Florida	A ransomware virus on the Sarasota City Hall computer systems encrypted 160,000 files and demanded $33 million in Bitcoins to unlock them. The IT staff quickly shut down the system, which saved the city from catastrophic data loss and financial costs, and the attack was contained within a few hours.[253]
2017	Florida	A cyber-attack on a server used to administer Florida Standard Assessments prevented students from testing. It also made clear that the student and employee information may not be safe. [254]

[252] Bloomberg, J. (2016, April 21). Cybersecurity Lessons Learned From 'Panama Papers' Breach. Retrieved from Forbes website: https://www.forbes.com/sites/jasonbloomberg/2016/04/21/cybersecurity-lessons-learned-from-panama-papers-breach/#3a353ae2003f

[253] Murdock, Z. (2017, July 28). The City of Sarasota, A Ransomware Attack, ISIS and the FBI. Herald-Tribune. Retrieved from http://www.heraldtribune.com/news/20170728/city-of-sarasota-ransomware-attack-isis-and-fbi

[254] http://www.fldoe.org/newsroom/latest-news/2010319-fdle-investigating-cyber-attacks-against-fsa-testing-system-.stml

2017	Global	Several ransomware attacks, called WannaCry and Petya, affected companies and organizations globally. The malware spread very quickly and encrypted files and demanded the user pay $300 in Bitcoins to unlock the files.

Undated and Widespread:

- A virus called "Sobig" infected the computer system at CSX Corp's Jacksonville, Florida headquarters. It shut down signaling, dispatching, and other systems and affected 23 states east of the Mississippi River.[255]
- Facebook was used in a phishing hack where victims would respond to an email asking for them to click on a link to their Facebook account. When they clicked the link, they were taken to a fake webpage and prompted to enter their account information. Hackers then took over their accounts and sent messages to friends asking for money via Western Union stating they had been robbed.[256]
- A disgruntled employee of a contractor that supplied IT and control system technology for the sewage system in Maroochy Shire Queensland, Australia used his insider knowledge of the sewage system to issue commands. This led to 800,000 liters of raw sewage spilling into local parks, rivers, and the grounds of a hotel. The effects included marine life dying, water turning black, and a stench that was unbearable for the residents.[257]
- Melbourne, Australia's Metropolitan ambulance service conducted an upgrade that disabled the service's computer-aided dispatch system for 24 hours. This caused delayed response and duplicate responses.[258]
- The WannaCry ransomware infected computers in 99 countries. This malware encrypted files and demanded $300 in Bitcoins to unlock the files. Computers affected included banks, healthcare facilities, shipping companies, utility companies, etc.[259]

4. Cyber Incident Impact Analysis

- Public
  - Release of sensitive information including bank accounts and social security numbers.
  - Financial loss
    - Possible loss of wages if organization is forced to close.
- Responders
  - Long hours outside of regular work hours to stop and/or remediate attack.

[255] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.32 – 2.33
[256] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.38 – 2.40
[257] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.41 – 2.42
[258] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.42 – 2.43
[259] http://www.bbc.com/news/technology-39901382

    - First responders may not be able to respond properly if a cyber-attack targets emergency or public safety systems.
- Property, Infrastructure, Facilities
    - Incident could lead to damage of equipment for infrastructure.
    - Organization may lose revenue and may have significant costs for remediation, legal fees, and public relations.
    - Organization may lose customer confidence, or may sustain damage to their reputation or to their market share.
- Continuity of Operations (including continued delivery of services)
    - Incident could take operations offline for any amount of time and/or make information inaccessible or distribute false information.
    - Interrupt public safety, etc. services.
    - Loss of productivity.
    - Loss of critical systems or data.
    - May disable emergency or public safety systems.
- Environment
    - An incident could cause a release of some material, which could damage the environment.
- Economic Condition
    - Incidents cost millions of dollars to consumers and organizations, in the form of lost wages, lost revenue, and recovery and remediation costs.
- Public Confidence in Jurisdiction's Governance
    - Lost confidence in ability to keep services operational and safe.
    - Private organization: Loss of public or consumer confidence in an organization leading to loss of market share and possibly loss of future sales.

5. Probability of Future Cyber Incidents

The probability of cyber incidents occurring is increasing every day. Hospitals are highly likely, but so are local jurisdictions and federal and state agencies.

It is estimated that every 40 seconds, a business falls victim to a ransomware attack and it is predicted that attacks will rise to every 14 seconds by 2019.[260]

In 2015, government was among the top five most cyber-attacked industries and that is expected to remain accurate in the future.[261]

According to an Accenture Cyber Crime Cost Study in 2017, the average number of security breaches each year is 130, which is a 27.4% increase in average annual number of security breaches.[262]

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[260] https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/
[261] *X-Force Cyber Security Intelligence Index*. (2016). IBM
[262] https://www.accenture.com/t20170926T072837Z__w__/us-en/_acnmedia/PDF-61/Accenture-2017-CostCyberCrimeStudy.pdf

This hazard was determined to occur annually, giving it a Probability of Very Likely.

6. 2018 LMS Cyber Incident Integration

The following counties profile Cyber Incidents in their most recent LMS plan:

- Calhoun
- Duval
- Hillsborough
- Lee
- Miami-Dade
- Osceola
- Seminole
- Volusia

7. Vulnerability Analysis and Loss Estimation by Jurisdiction

Without having access to each county Cyber Incident Plan and the ability to analyze that plan, it is impossible to determine the vulnerability of a jurisdiction. However, it is reasonable to assume that counties and municipalities will continue to be vulnerable to cyber incidents. Any county that utilizes computers and the internet for major utilities, transportation routes, or data storage is vulnerable to a cyber-incident.

Cyber-attacks are very costly and it is expected that from 2017 until 2021, $6 trillion will be spent on cyber crime damages.[263]

Financial impacts on enterprises such as the electronic leakage of data cost an average of $1.9 million in 2017.[264]

The top five cyber attacked industries in 2015 were healthcare, manufacturing, financial services, government, and transportation, and it is believe this trend will continue.[265]

8. Vulnerability Analysis and Loss Estimation of State Facilities

Without having access to each state agency Cyber Incident Plan and the ability to analyze that plan, it is impossible to determine the vulnerability of each state facility. However, it is reasonable to assume that state agencies will continue to be vulnerable to cyber incidents. Any agency that utilizes computers and the internet is vulnerable to a cyber-incident. The State of Florida has a robust Cyber Incident Response plan and team and conducts regular trainings to maintain preparedness for cyber incidents.

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[263] Morgan, S. (2017, December 13). Cyber Attack Surface Facts, Figures and Statistics from 2017 to 2022. Retrieved from CSO website: https://www.csoonline.com/article/3241816/security/cyber-attack-surface-facts-figures-and-statistics-for-2017-to-2022.html

[264] Smith, M. (2017, September 20). Cyber Attacks Cost U.S. #1.3 Million On Average in 2017. Retrieved from CSO website: https://www.csoonline.com/article/3227065/security/cyber-attacks-cost-us-enterprises-13-million-on-average-in-2017.html

[265] *X-Force Cyber Security Intelligence Index*. (2016). IBM

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 12.

CYBER INCIDENT					Overall Vulnerability
Overview					
Cyber incidents are described as involving computers, networks, information, or services that affect daily operations of critical infrastructure. These hazards lack a physical presence as well as physical evidence, making them unlike traditional hazards, and therefore, difficult to plan for, respond to and recover from.					HIGH
Frequency	Probability	Magnitude			
		Injuries/Deaths	Infrastructure	Environment	
Very Likely	Very Likely	High	Medium	Low	

Hazardous Materials Incident Hazard Profile

1. Hazardous Materials Description

A hazardous material is any substance that poses a threat to humans, animals, or the environment. Hazardous Materials, commonly referred to as HazMat, refers generally to hazardous substances, petroleum, natural gas, synthetic gas, and acutely toxic chemicals. Hazardous materials are defined and regulated in the United States primarily by laws and regulations administered by the EPA, OSHA, DOT, and the Nuclear Regulatory Commission (NRC).

The Occupational Safety and Health Administration (OSHA) further explains that HazMat is any substance or chemical which is a health hazard or physical hazard, including:

- chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers;
- agents which act on the hematopoietic system;
- agents which damage the lungs, skin, eyes, or mucus membranes;
- chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and
- chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists, or smoke which may have any of the previously mentioned characteristics.

Hazardous materials typically fall into one of three categories: Biological Hazards, Chemical Hazards, or Radiological Hazards. All of these HazMats have both short-term and long-term effects based on the timing of detection and the response time to mitigate the effects of the hazard.[266]

Biological Hazards

Biological Hazards are materials or incidents that involve exposure to a biological or living agent that cause harm. These agents include microorganisms, viruses, and any toxins originating from biological sources. Examples of biological hazards include Anthrax, Bloodborne Pathogens, Molds, Ebola, Small Pox, and any medical waste that comes into contact with such microorganisms or viruses. Biological hazards are extremely contagious and pose a threat to any populations that are exposed. For more information on Biological Hazards, please refer to the *Biological Incident Profile* on page 399.

Chemical Hazards

Chemical Hazards are hazards or incidents that involve exposure to chemicals that cause harm. Chemical HazMats include neurotoxins, immune agents, dermatologic agents, carcinogens, and other toxins. Chemical hazards can be introduced to populations through ingestion, inhalation, or physical contact. Chemicals enter the body through the eyes, skin, lungs, and digestive tract. Once in the body, the effect depends on the dosage and toxicity. The type of chemical, how it entered the body and the susceptibility of the individual all effect the outcome of exposure. Once exposed to chemical substances there can be

[266] https://www.ihmm.org/about-ihmm/what-are-hazardous-materials

acute (immediate) or chronic (long-term) health issues for the community. The effects of chemical hazards on an exposed population are not limited to the development of lesions and burns on skin and respiratory issues.

Radiological Hazards

Radiological Hazards are hazards or incidents that involve exposure to materials that have encountered radioactive substances, thus making them contaminated. Exposure to radiological materials have both short-term and long-term effects; some short-term effects include radiation burns and radiation sickness, while long-term effects include radiation poisoning and radiation damage.[267] For more information on Radiological Hazards, please look at the *Radiological Incident Profile* on page 354.

With the passage of the Federal Emergency Planning and Community Right-To-Know Act (EPCRA) in 1986, FDEM began implementation of a statewide Hazardous Materials Emergency Planning Program. For the first time, passage of the EPCRA allowed emergency planners, responders, and the public access to facility-specific information regarding the identification, location, and quantity of particular hazardous materials at fixed sites.

The law requires facilities with certain threshold quantities of federally mandated substances to report annually to state and local emergency officials. In addition, facilities must immediately notify officials of any releases of harmful chemicals that have the potential to result in offsite consequences. This information is utilized to prepare emergency plans for HazMat incidents, to allow responders to receive training based on specific known threats, and to inform and educate the public regarding the chemicals present in their communities. The term Extremely Hazardous Substance (EHS) is used in Title III of the Superfund Amendments and Reauthorization Act of 1986 to refer to those chemicals that could cause serious health effects following short-term exposure from accidental releases. Florida has more than 4,500 fixed facility locations that report the presence of an EHS in federally mandated threshold amounts.

The State Emergency Response Commission (SERC) is responsible for implementing the federal Emergency Planning and Community Right-To-Know Act (EPCRA) provisions in Florida. The SERC, along with the Local Emergency Planning Committees (LEPCs), work to mitigate the effects of a release or spill of hazardous materials by collecting data on the storage of hazardous chemicals above planning quantities. The Technological Hazards Unit at the Florida Division of Emergency Management provides programmatic support for the SERC.[268]

Hazardous Waste

Hazardous waste is unwanted or discarded hazardous materials that may harm the health or wellbeing of people or the environment. As hazardous materials are produced, stored, and used, hazardous waste is created and must be disposed of. A hazardous waste site can be any place, whether a landfill or former industrial facility, where chemicals have made contact with the water, soil, or air. Ensuring that hazardous wastes (HW) are handled in accordance with federal and state rules and laws is the responsibility of the Compliance and Enforcement staff at DEP. This group interacts with the public and with the Resource Conservation and Recovery Act (RCRA) branch of the Federal EPA to develop policies and guidance, to

[267] http://www.floridahealth.gov/environmental-health/chemicals
[268] https://www.floridadisaster.org/hazmat/serc/

provide compliance assistance to the public and the regulated community, and to enforce the laws regulating the handling of hazardous waste.

Due to the unregulated process of dumping hazardous materials and waste, Congress signed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. This became known as the “Superfund” Act and gave the Environmental Protection Agency (EPA) authority to clean up hazardous waste sites and spills. The Superfund Program, through the EPA, is responsible for cleaning some of the most contaminated areas in the United States and responds to emergencies involving the environment such as oil spills, hazardous material spills, and hazardous waste sites. To assist with this task the National Priorities List (NPL) was created which tracks the known releases or threatened releases of hazardous substances, pollutants, or contaminants. The NPL has four distinct categories:

- *Proposed* – The site has been contaminated by hazardous waste and is a candidate for cleanup. The site isn’t on the list yet.
- *Withdrawn* – The site poses no real or potential threat to the environment or community and was removed from the NPL.
- *Final* – These sites are currently on the list and pose a real or potential threat to the environment or community. The EPA will be part of the cleanup process.
- *Deleted* – These sites have been removed from the NPL because the cleanup goals were accomplished and the area requires no further response.

As of July 2017 Florida has 53 final sites on the NPL and 2 proposed sites.[269]

Hazardous Waste Generators

A generator is any person, organization, or agency who produces a hazardous waste as listed or characterized in Part 261 of Title 40 of the Code of Federal Regulations (CFR). Recognizing that generators produce waste in different quantities, the EPA established 3 categories of generators in the regulations. The volume of hazardous waste each generator produces in a calendar month determines which regulations apply to that generator.[270]

Conditionally Exempt Small Quantity Generators (CESQG’s) generate less than 220 pounds per month of hazardous waste or less than 2.2 pounds per month of acutely hazardous waste, such as some pesticides, toxins, or arsenic and cyanide compounds.

Small Quantity Generators (SQG) generate 220 to 2,200 pounds per month and have additional regulations including emergency planning and storage time limits.

Large Quantity Generators (LQG) generate 2,200 pounds or more of hazardous waste per month or 2.2 pounds or more per month of acutely hazardous waste.[271]

[269] http://www.epa.gov/superfund
[270] https://www.epa.gov/hwgenerators/categories-hazardous-waste-generators
[271] https://floridadep.gov/waste/permitting-compliance-assistance/content/hazardous-waste-compliance-and-enforcement

Within the State of Florida there are 17,123 CESQG's, 3,547 SQG's, and 501 LQG's as well as 111 Hazardous Waste Transporters that are regulated and overseen by the Florida Department of Environmental Protection.[272]

Pipelines

There are a total of 34,019 miles of pipeline within Florida. The breakdown of pipeline types are as follows:

- 552 miles Intrastate Natural Gas Transmission
- 4,510 miles Interstate Natural Gas Transmission
- 203 miles Propane
- 80 miles Liquid Hazardous Materials
- 43 miles Oil
- 36 miles Refined Petroleum Products
- 28,567 miles Natural Gas Distribution Systems

Energy pipelines are a fundamentally safe and efficient means of transporting materials key to the U.S. energy supply but, given that they often carry toxic, volatile, or flammable material, energy pipelines have the potential to cause injury and environmental damage.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) identifies "serious" and "significant" pipeline incidents. Serious incidents are those involving a fatality or injury requiring hospitalization. Significant incidents have the following conditions:

a) Fatality or injury requiring hospitalization,
b) $50,000 or more in total costs,
c) Highly volatile liquid releases of five or more barrels or other liquid releases of fifty barrels or more, and
d) Liquid release that results in fire or explosion. PHMSA, as of 2004, does not include gas distribution incidents that are caused by nearby fire or explosion and impacts the pipelines.

According to PHMSA there was 1 natural gas interstate transmission pipeline incident in 2014 with no injuries and 6 significant intrastate distribution pipeline incidents resulting in 2 injuries from 2014 through 2016 in the State of Florida. These incidents resulted in a total of $5,059,988 in property damages involving natural gas distribution systems incidents and $1,494,000 involving an interstate natural gas transmission pipeline.[273]

Historically nationwide, the most common threats to energy pipelines have been accidents and seismic activity; however, more recently, DHS has warned that U.S. natural gas pipelines are targets of cyber-attacks. DHS has been working with critical infrastructure owners and operators in the oil and natural gas sector to address a series of cyber intrusions targeting natural gas pipeline companies. Publically available information does not indicate the extent to which systems have been infiltrated but cyber security officials warn that, with sufficient access, a hacker could potentially "manipulate pressure and other control

[272] https://fldeploc.dep.state.fl.us/www_rcra/reports/handler_sel.asp
[273] http://www.ncsl.org/research/energy/state-gas-pipelines-pipeline-accidents.aspx#Significant_Incidents

system settings, potentially reaping explosions or other dangerous conditions." Additionally, sufficient access could shut down energy transit, significantly disrupting U.S. energy supply.

Within the State of Florida, the Department of Environmental Protection is the lead agency for the Emergency Support Function (ESF) that deals with HazMat and environmental affecting incidents. Florida Fish and Wildlife Conservation Committee (FWC) is an additional supporting agency that assists with HazMat incidents in the event that the material or incident in question is an environmental crime. The Department of Health (DOH) is a supporting agency for radiological incidents as well. The PHMSA is responsible for safety of interstate natural gas transmission lines, propane, and liquid transporting pipelines in Florida. The Florida Public Service Commission is responsible for natural gas safety of intrastate and distribution systems.

811 Call Before You Dig

Pipelines exist almost everywhere throughout the country and Florida has an extensive pipeline and utility grid. One nationwide program that works to mitigate the risks associated with utility or pipeline damage is 811. According to data collected by the Common Ground Alliance (CGA), an underground utility line or pipeline is damaged once every six minutes nationwide. Before digging or excavating, residents or businesses can call 811 to ensure there are no buried utilities or pipelines on the property. Officials will be sent to locate these utilities and pipelines and mark the approximate location. This is a free service and used to ensure residents proceed without damaging any critical utilities or pipelines. [274]

Oil Spill

An oil spill is the release of crude oil, or liquid petroleum, into the environment. This is usually associated with marine spills but can also happen on land. Oil spills are caused by the release of oil from offshore platforms, drilling rigs, tankers, ships that have sunk, and any vehicle used to transport crude oil, over the water or land. These spills have far reaching effects including continued damage to the environment and a financial loss to communities affected.

As of 2017, there are 23 operating rigs in the Gulf of Mexico, 19 drilling for crude oil and 4 drilling for natural gas.[275] While there are currently no drilling rigs on the east coast of Florida, the US Chamber of Commerce predicts that rigs could be seen in the future as exploration estimates roughly 4.72 billion barrels of recoverable oil and 37.51 trillion cubic feet of recoverable natural gas from Maine to Florida.[276] As of 2015, Florida produced 2.2 million barrels of crude oil.[277]

Given Florida's dependence on tourism and the related sales tax revenue, an oil spill, which is classified as a type of HazMat event, could affect any of Florida's many natural resources, which could be catastrophic. In 2015, Florida had over 105 million tourists visit the state, with 14.5% coming from international communities. Tourism generates roughly 23% of the state's sales tax revenue and as of 2014 employs over 1.5 million people.[278] The Florida impacts of the 2010 Deepwater Horizon incident were

[274] http://call811.com/
[275] http://www.wtrg.com/rotaryrigs
[276] Hackbarth, S. (2014, August 13). Will We See Oil Rigs In The Atlantic? Retrieved from U.S. Chamber of Commerce website: https://www.uschamber.com/above-the-fold/will-we-see-oil-rigs-the-atlantic
[277] https://s3images.americangeosciences.org/agi/statefactsheets/FL_GeoscienceInYourState_AGI.pdf
[278] http://www.visitflorida.org

mostly limited and contained, but the predictions at the time of potential impacts were severe. Moody's Analytics released a report which stated, should a significant amount of oil wash onto Florida's shores, the economic impact from tourism-related tax revenue and job losses could rival that of the ongoing recession and simulate a double dip recession. Following the lawsuits, Florida received over 200 million dollars in a settlement for lost tourism income.

In addition to economic impacts, an oil spill in Florida or off its shores could have severe consequences for wildlife, ecosystems, and the ecology. The Deepwater Horizon spill affected the wildlife populations of numerous species of turtles, birds, bottlenose dolphins, whales, and fish. Gulf states saw a decrease in bottlenose reproduction and a rise in deaths, the Kemp's Ridley sea turtle, already endangered, saw a massive drop in numbers, and scientists estimate the habitats on the bottom of the Gulf could take anywhere from multiple decades to hundreds of years to fully recover.[279]

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Medium, meaning any injuries, but no deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

2. Geographic Areas Affected by Hazardous Materials

Hazardous material incidents can occur during the production, transportation, use, and storage of those hazardous materials and can happen anywhere within the State of Florida. As these materials are processed and stored, those in the immediate vicinity are at risk of toxic fumes, soil contamination, and water contamination. Even those communities removed from production or storage facilities are at risk given that hazardous materials are routinely and frequently transported via roadways, railways, pipelines, and waterways, concluding that all areas of the state are potentially at risk.

[279] http://www.nwf.org

3. Historical Occurrences of Hazardous Materials Incidents

Table 57: Florida Historical Occurrences, Hazardous Material Incidents, 2009-2017

Date	Description
December 15, 2009	Approximately 1,000 gallons of sodium hydroxide was released from a faulty gasket on a pipeline connected to an above ground storage tank at the liquid transfer facility in St. Marks, Florida. The product flowed to an adjacent tidal creek before ultimately releasing some of the product into the St. Marks River. A Unified Command was established between EPA, USCG, DEP, County EMA, DOI and the RP. Response efforts included stabilizing the leaking gasket, sampling the impacted water bodies, conducting water patrols to ensure endangered/threatened species did not enter the area (e.g., manatees, birds, and alligators), damming up the tidal creek and pumping out the majority of the contaminated water (ph12+) from the tidal creek. The contaminated water was transferred to a containment area and was properly treated and disposed of.
May 9, 2009	An east coast railway train consisting of 22 rail cars and 2 locomotives derailed in Palm Coast, Florida. One rail car containing hydrochloric acid (HCL) was breached, resulting in HCL being released into the environment. Response operations concentrated on providing air-monitoring support for worker safety, as well as ensuring the off-loading procedures were conducted in a safe manner.
May 31, 2011	The DEP's Bureau of Emergency Response reported a mercury spill in a residential house in Tampa, Florida. DEP personnel observed at least two ounces of visible mercury within the residence. Mercury vapor readings with windows open in two rooms were 43,000 ng/m3 and 47,000 ng/m3 respectively (Lumex readings). Based on the readings, DEP advised the owners and their children to relocate until the hazards could be mitigated. The source of mercury is unknown and was discovered during home renovation activities.
January 11, 2012	Exposure to an unknown substance on a forest service road overcame two nearby community members. The Lake County HazMat Team conducted field screening of material and identified formaldehyde as a constituent.
July 22, 2012	Kinder Morgan (Central Florida Pipeline) had an ongoing release of refined petroleum product from a 10 inch pipeline. Kinder Morgan shut off the pipeline and responded with state and local response agencies to locate the source and evaluate extent of impact. It was determined that the pipeline failed in a drainage ditch full of water. The ditch flows into a nearby creek which discharges into Tampa Bypass Canal and then into McKay Bay. Kinder Morgan estimated 750 barrels of refined product were released. About two miles of the creek, which includes ditches, creek, ponds, and wetlands were impacted.

January 28, 2014	A train derailment in McDavid, Florida resulted in railcars containing phosphoric acid submerging in Fletcher Creek. There were no reported injuries or fatalities. A total of four railcars with 96% concentration phosphoric acid were derailed, at least one was leaking into the creek. Each railcar contained 12,000 gallons.
September 23, 2016	A tanker truck containing 8,000 gallons of petroleum products overturned on Interstate 75 in North Port, Florida. Both shoulders of the interstate were affected as well as nearby wetlands. FDEP, Sarasota County HazMat, and Charlotte County Fire Rescue responded.
April 3, 2017	A collision between two trains resulted in the release of approximately 7,400 gallons of diesel fuel and 77 gallons of battery acid.

4. Probability of Future Hazardous Materials Incidents

Major disasters like that in Bhopal, India, in December 1984, which resulted in 2,000 deaths and over 200,000 injuries, are rare. Reports of hazardous material spills and releases, however, are increasingly commonplace. Thousands of new chemicals are developed each year and transported domestically and internationally creating the risk for accidents and spills.

Major chemicals spills can occur at any facility that produces, uses, or stores chemicals. These include chemical manifesting plants, laboratories, shipyards, railroad yards, warehouses, or chemical disposal areas. Illegal dumpsites can appear anywhere. Accidents involving the transportation of hazardous materials can occur at any time and severely impact the affected community. Recent evidence shows that hazardous materials incidents may be the most significant threat facing local jurisdictions.

This hazard was determined to occur annually, giving it a Probability of Very Likely.

5. Hazardous Materials Incident Impact Analysis

- Public
  - Loss of life or injury from contamination.
  - Diseases may be exacerbated.
- Responders
  - Loss of life or injury from contamination, explosions, cleanup and destruction.
  - Diseases.
  - Cleanup and destruction at waste sites and incident sites.
- Continuity of Operations (including continued delivery of services)
  - Lost material, such as gas, is unusable and could lead to shortages and price increases.
- Property, Facilities, Infrastructure
  - Damage due to excavation and removal of soil and water.
  - Inability to rebuild in affected areas.
  - Services could be closed or blocked due to the contaminant.
    - Roads
    - Trains

        - Airplanes
        - Bridges
        - Waterways
    - Long term contamination at hazardous waste sites.
- Environment
    - Death or illness to pets or wildlife near the spill.
    - Damage to plants and wildlife.
    - Airborne issues such as toxic fumes, gases or vapors caused by chemicals.
    - Water contamination.
    - Soil contamination.
    - Loss of critical or endangered species.
    - Pollution.
- Economic Condition
    - Business closures may lead to lost revenue and wages.
    - Loss of tourism and income.
    - Loss of product.
    - Cost of cleanup and restoration.
- Public Confidence in Jurisdiction's Governance
    - If the government doesn't communicate with the public, fear could ensue, leading to a fear of the government.
    - If cleanup is slow, the public could believe the government doesn't know how to properly clean it up or that the accident was malicious.

6. 2018 LMS Integration

The following counties profile hazardous materials:

- Brevard
- Broward
- Calhoun
- Charlotte
- Citrus
- Clay
- DeSoto
- Dixie
- Duval
- Escambia
- Flagler
- Glades
- Gulf

- Hamilton
- Hendry
- Hernando
- Highlands
- Hillsborough
- Indian River
- Jackson
- Lee
- Leon
- Levy
- Manatee
- Marion
- Martin
- Miami-Dade
- Nassau
- Orange
- Osceola
- Palm Beach
- Pasco
- Pinellas
- Polk
- Putnam
- Seminole
- St. Johns
- St. Lucie
- Sumter
- Taylor
- Volusia
- Wakulla
- Walton
- Washington

7. Vulnerability Analysis and Estimated Losses by Jurisdiction

Major HazMat incidents can occur at any facility that produces, uses, or stores hazardous materials. These include chemical manifesting plants, laboratories, shipyards, railroad yards, warehouses, or chemical disposal areas. Illegal dumpsites can appear anywhere. Accidents involving the transportation of hazardous materials can occur at any time and severely impact the affected community. The entire State of Florida is vulnerable to HazMat Incidents.

8. Vulnerability Analysis and Estimated Losses of State Facilities

Hazardous Materials Incidents can, and do, occur anywhere and at any time. In most cases, they do not result in serious impacts to state facilities. However, state facilities that store or handle hazardous chemicals listed in the SARA Title III Superfund Amendments and Reauthorization Act are most vulnerable.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 12.

HAZARDOUS MATERIALS INCIDENT					Overall Vulnerability
Overview					
A hazardous material is any substance that poses a threat to humans, animals, or the environment. Hazardous Materials, commonly referred to as HazMat, refers generally to hazardous substances, petroleum, natural gas, synthetic gas, and acutely toxic chemicals. Hazardous materials are defined and regulated in the United States primarily by laws and regulations administered by the EPA, OSHA, DOT, and the Nuclear Regulatory Commission (NRC). Hazardous materials typically fall into one of three categories: Biological Hazards, Chemical Hazards, or Radiological Hazards.					MEDIUM
Frequency	Probability	Magnitude			
		Injuries/Deaths	Infrastructure	Environment	
Very Likely	Very Likely	Medium	Medium	Medium	

Space Weather Hazard Profile

1. Space Weather Description and Background Information

Space Weather is a broad term used to describe atmospheric events that have the potential to adversely affect conditions on Earth. Space Weather events are caused by the interaction of Earth with emissions from the Sun. There are two causes of space weather events, coronal mass ejections (CMEs) and solar flares, which are different incidents that occur on the Sun. CMEs and solar flares can cause three different types of space weather events on Earth, Geomagnetic Storms, Solar Radiation Storms, and Radio Blackouts.

When Space Weather does interact with the Earth and its magnetic field, the technology on Earth can be disrupted, including that which operates critical infrastructure. For example, communications networks, satellite and airline operations, navigation systems, and the electric power grid could be disrupted, causing severe problems and damage.

According to the National Space Weather Strategy, published in October 2015, space weather poses a significant risk to the security of our country, including infrastructure and the economy. This is because our nation is becoming more and more dependent on technology and the failure of one critical infrastructure facility or system could lead to failures in many other systems.[280]

The Space Weather Operations, Research and Mitigation (SWORM) Task Force was created in 2014 with the goal of uniting the national and homeland security field with the science and technology industry to formulate a cohesive vision to enhance national preparedness for space weather. The SWORM Task Force created two documents, the Space Weather Strategy and the Space Weather Action Plan,[281] to guide federal level actions to achieve the goal. Both documents build on recent efforts to reduce risks associated with natural hazards and improve resilience of essential facilities and systems. The Strategy contains goals and objectives and the Action Plan contains measurable actions to take to improve preparedness and resilience.

Causes

As stated before, Space Weather events are caused by two types of incidents on the surface of the Sun. These will be discussed below.

Coronal Mass Ejections

Coronal Mass Ejections (CMEs) are large eruptions of plasma and magnetic field structures in the Sun's atmosphere, which then travel through space at millions of miles per hour, eventually reaching Earth and affecting Earth's own magnetic field. When CMEs erupt from active regions on the Sun, they are often accompanied by large solar flares.

[280] National Space Weather Strategy, National Science and Technology Council, October 2015
[281] National Space Weather Action Plan, National Science and Technology Council, October 2015

Solar Flares

Solar Flares are sudden bursts of electromagnetic radiation, including x rays and ultraviolet light. The Sun continually streams out solar wind, which consists of charged particles, or plasma, travelling at high speeds. Solar wind carries the solar magnetic field into space where it interacts with magnetic fields of planets. When solar wind is very fast or turbulent, it can cause changes in the magnetic fields of planets; this is the basis of a Geomagnetic Storm. X-rays from Solar Flares affect Earth's ionosphere by causing a prompt loss of its ability to reflect long-range radio waves, which results in a radio blackout event. The plasma from Solar Flares can damage satellites and cause high frequency radio blackouts in polar-regions and the sun-facing side of the Earth.

Space Weather Events

CMEs and solar flares can cause three different types of Space Weather events on Earth. These will be discussed below.

1) **Geomagnetic Storms**

Geomagnetic Storms occur when CMEs affect Earth's magnetic field. The Earth's magnetic field attempts to adjust to the large amounts of energy from the Sun, carried in solar wind. CMEs from the Sun can disturb Earth's geomagnetic field for days and several CMEs at once may cause prolonged disturbed periods. Geomagnetic storms usually last from a few hours to a few days, but stronger storms can last up to a week.

These storms induce currents that can have significant impacts on technological systems and critical infrastructure, including electrical transmission equipment. Electric power companies have procedures in place to mitigate the impact of Geomagnetic Storms. Strong Geomagnetic Storms are visible from Earth, in the form of aurora, which during a storm becomes brighter and moves closer to the equator.

Geomagnetic Storms are measured on a scale from G1: Minor to G5: Extreme. The chart below from the National Oceanic and Atmosphere Administration (NOAA) describes the effects and frequency in detail.

Table 58: Geomagnetic Storm Scale

Scale	Description	Effect	Physical measure	Average Frequency (1 cycle = 11 years)
G5	Extreme	**Power systems:** Widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. **Spacecraft operations:** May experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. **Other systems:** Pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).	Kp = 9	4 per cycle (4 days per cycle)
G4	Severe	**Power systems:** Possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. **Spacecraft operations:** May experience surface charging and tracking problems, corrections may be needed for orientation problems. **Other systems:** Induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-	Kp = 8	100 per cycle (60 days per cycle)

		frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).		
G3	Strong	**Power systems:** Voltage corrections may be required, false alarms triggered on some protection devices. **Spacecraft operations:** Surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. **Other systems:** Intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).	Kp = 7	200 per cycle (130 days per cycle)
G2	Moderate	**Power systems:** High-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. **Spacecraft operations:** Corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. **Other systems:** HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).	Kp = 6	600 per cycle (900 days per cycle)
G1	Minor	**Power systems:** Weak power grid fluctuations can occur. **Spacecraft operations:** Minor impact on satellite operations possible. **Other systems:** Migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).	Kp = 5	1700 per cycle (900 days per cycle)

2) Solar Radiation Storms

Solar Radiation Storms occur when there is a giant eruption from a sunspot region, causing large quantities of charged particles, or plasma, to accelerate through space and cover the near-Earth satellite environment with high-energy particles. These storms occur about 30 minutes to several hours after a solar flare and they can last from a few hours to a few days. Sometimes these storms can penetrate down to the Earth's surface.

Solar Radiation storms cause the loss of High Frequency (HF) radio communications in the polar region. Because of the increase in radiation, astronauts, as well as passengers and crew in aircraft at high altitudes and latitudes, are at risk of increased radiation exposure. Additionally, these storms can cause navigation position errors and damage to satellite systems.

Solar Radiation Storms are measured on a scale from S1: Minor to S5: Extreme. The chart below from NOAA describes the effects and frequency in detail.

Table 59: Solar Radiation Storm Scale

Scale	Description	Effect	Physical measure	Average Frequency
S5	Extreme	**Biological:** Unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity); passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. **Satellite operations:** Satellites may be rendered useless, memory impacts can cause loss of control, may cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. **Other systems:** Complete blackout of HF (high frequency) communications possible through the polar regions, and position errors make navigation operations extremely difficult.	10^5	Fewer than 1 per cycle

S4	Severe	**Biological:** Unavoidable radiation hazard to astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. **Satellite operations:** May experience memory device problems and noise on imaging systems; star-tracker problems may cause orientation problems, and solar panel efficiency can be degraded. **Other systems:** Blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10^4	3 per cycle
S3	Strong	**Biological:** Radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. **Satellite operations:** Single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely. **Other systems:** Degraded HF radio propagation through the polar regions and navigation position errors likely.	10^3	10 per cycle
S 2	Moderate	**Biological:** Passengers and crew in high-flying aircraft at high latitudes may be exposed to elevated radiation risk. **Satellite operations:** Infrequent single-event upsets possible. **Other systems:** Small effects on HF propagation through the polar regions and navigation at polar cap locations possibly affected.	10^2	25 per cycle
S1	Minor	**Biological:** None. **Satellite operations:** None. **Other systems:** Minor impacts on HF radio in the polar regions.	10	50 per cycle

3) Radio Blackouts

Radio Blackouts are caused by the bursts of x-rays and ultra-violet radiation from solar flares. These x-ray and ultra-violet ray emissions that come along with solar flares ionize (by increasing electron densities) the sunlit side of the Earth, which increases the amount of energy lost as radio waves pass through the region. These blackouts are the fastest and among the most common of Space Weather events to affect Earth. Earth is impacted after about 8 minutes because the x-rays travel at the speed of light and it takes about 8 minutes for the light from the Sun to reach the Earth. This makes advance warning for these events difficult. These blackouts usually last for several minutes, but can last up to a few hours.

High Frequency (HF) communications ranging from 3 to 30 MHz can be disrupted by solar flares. Very High Frequency (VHF) communications range from 30 to 300 MHz can be faded or have diminished reception because of solar flares. Similar to Solar Radiation Storms, Radio Blackouts affect HF and VHF communications, polar-regions, and the sunlit side of the Earth, with impacts ~~are~~ being primarily felt by aviation and marine industries.

Radio Blackouts are measured from R1: Minor to R5: Extreme. The chart below from NOAA describes the effects and frequency in detail.

Table 60: Radio Blackout Scale

Scale	Description	Effect	Physical measure	Average Frequency
R5	Extreme	**HF Radio:** Complete HF (high frequency) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with mariners and en route aviators in this sector. **Navigation:** Low-frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite	X20	Less than 1 per cycle

		navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.		
R4	Severe	**HF Radio:** HF radio communication blackout on most of the sunlit side of Earth for one to two hours. HF radio contact lost during this time. **Navigation:** Outages of low-frequency navigation signals cause increased error in positioning for one to two hours. Minor disruptions of satellite navigation possible on the sunlit side of Earth.	X10	8 per cycle (8 days per cycle)
R3	Strong	**HF Radio:** Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. **Navigation:** Low-frequency navigation signals degraded for about an hour.	X1	175 per cycle (140 days per cycle)
R2	Moderate	**HF Radio:** Limited blackout of HF radio communication on sunlit side, loss of radio contact for tens of minutes. **Navigation:** Degradation of low-frequency navigation signals for tens of minutes.	M5	350 per cycle (300 days per cycle)
R1	Minor	**HF Radio:** Weak or minor degradation of HF radio communication on sunlit side, occasional loss of radio contact. **Navigation:** Low-frequency navigation signals degraded for brief intervals.	M1	2000 per cycle (950 days per cycle)

Protection

Earth's magnetosphere, ionosphere, and atmosphere protect us from the most hazardous effects of Space Weather. However, the amount of protection from Space Weather events depends on the location of impact. The polar-regions are most affected because the magnetic field lines at the poles extend vertically downwards, allowing particles to spiral down the field lines and penetrate the atmosphere, increasing ionization. Extreme storms can produce disruptive and potentially damaging effects to medium and low Earth orbit satellites and lower mid-latitude terrestrial electric grids. Both satellite communications and ground-based utilities have mitigation measures that can be activated, such as temporarily ceasing non-essential maintenance operations, reducing the load on vulnerable equipment, increasing reactive reserve power and taking steps to maximize system reliability.

Forecasting

Space Weather can be predicted and forecasted. There are three levels of alerts that can be sent out for Space Weather: a Watch, a Warning, and an Alert.

A Watch is when the risk of a potentially hazardous Space Weather event has increased significantly, but its occurrence or timing is still uncertain. A Space Weather Watch is intended to provide enough advance notice, usually a few hours or days, for protection plans to be implemented.

Warnings are sent out when a significant space weather event is occurring, imminent, or likely. These alerts are short term and there is a high confidence of occurrence. The Warning is intended to give a lead time of a few minutes to a few hours.

An Alert is sent out to indicate observed conditions, usually after a Warning has been sent out, to inform that a Space Weather event has already started.

Solar Cycle

The solar cycle is a 9 to 14 year period, or an 11 year average, that the Sun goes through to release magnetic energy. The peak is the solar maximum, when there may be hundreds of sunspots visible at any time. The low is the solar minimum, when there can be many days in a row with no sunspots visible.

The first recorded solar cycle began in 1755. We are currently in cycle 24, which began in 2008, therefore 2018 will be year 10 of the current cycle.[282]

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Medium, meaning any injuries, but no deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

2. Geographic Areas Affected by Space Weather

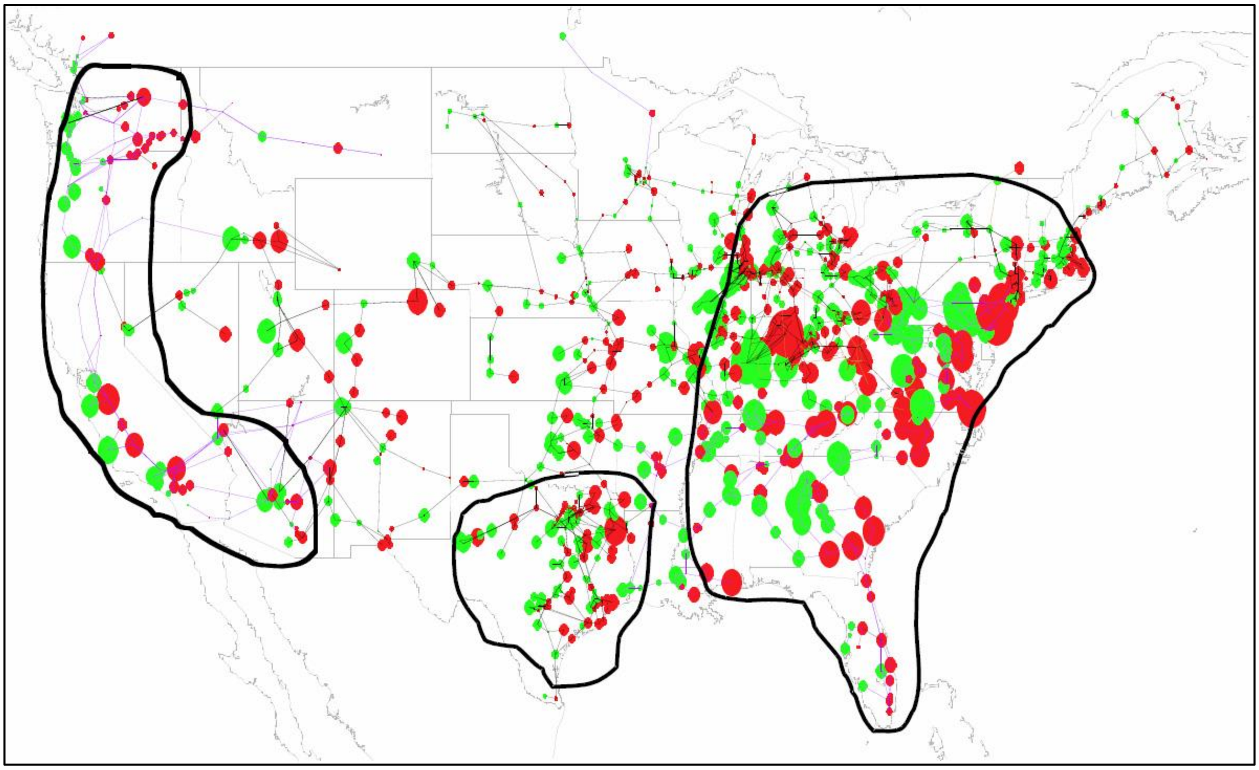
As mentioned in the section above, any region of the Earth is susceptible to the effects of Space Weather. The sunlit side of the Earth – whichever that happens to be at the time of impact – will have more effects than the unlit side of Earth. Additionally, there are stronger effects to communication systems and radiation exposure at higher altitudes and higher latitudes, such as at the polar-regions.

The effects of Space Weather can affect more than the physical location of the impact. In fact, space weather could affect the whole of North America at the same time, and potentially become a global incident. For example, there may be cascading impacts. Because our power grids and communication systems are interconnected, an outage in one location could have far-reaching effects.

Florida has not been significantly affected by space weather since modern infrastructure began to be built in the 1950's. However, due to the high uncertainty of geomagnetically induced current impact locations, extreme geomagnetic storms could produce electrical system disturbances and possibly widespread disruptions or blackouts. The follow figures demonstrate that Florida is potentially vulnerable due to both ground connectivity and proximity to the ocean coastline.

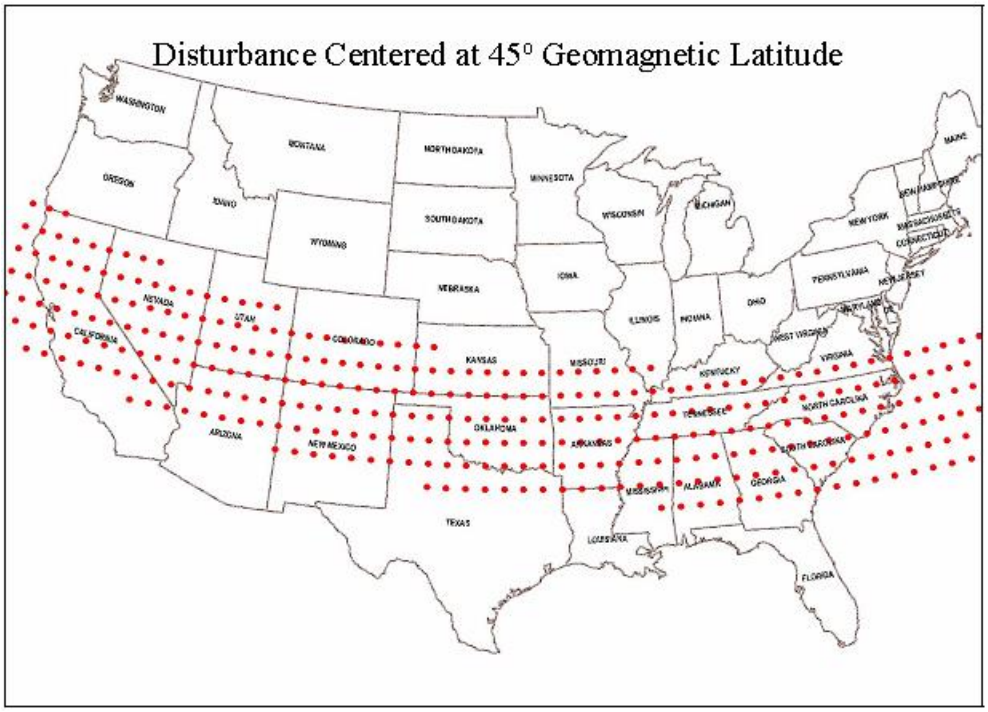
[282] http://www.nws.noaa.gov/om/space/index.shtml

Figure 100: United States Regions Susceptible to Electric System Collapse, 100-year Geomagnetic Storm 45 degree Latitude Scenario, [283]



[283] https://www.ferc.gov/industries/electric/indus-act/reliability/cybersecurity/ferc_meta-r-319.pdf

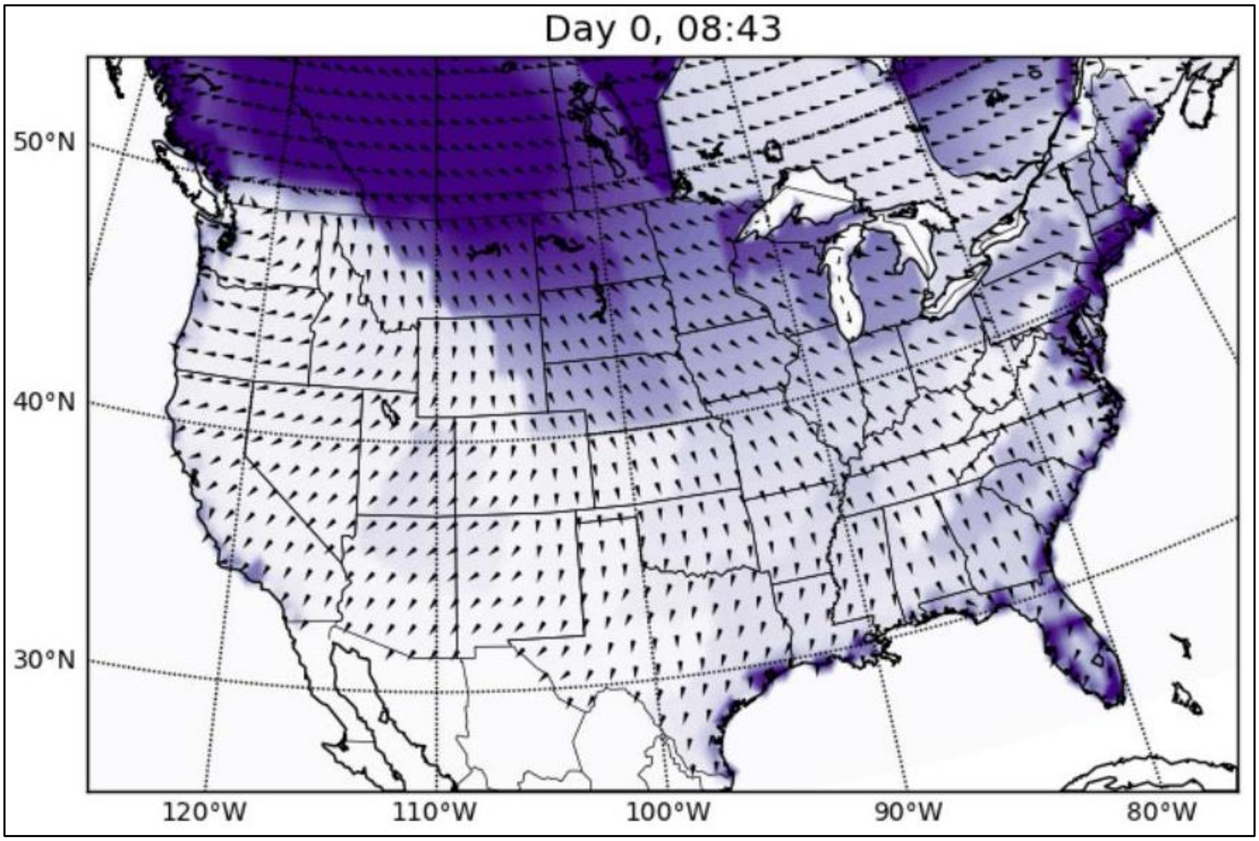
Figure 101: Disturbance Regions, Geomagnetic Storm, 45 degree Latitude[284]



Below is a figure depicting the electric field amplitudes (color-scale) and direction (barbs) during a simulated Carrington-level storm. Regions shaded in dark purple are experiencing the strongest surface electric fields at that time.

[284] https://www.ferc.gov/industries/electric/indus-act/reliability/cybersecurity/ferc_meta-r-319.pdf

Figure 102: Carrington Level Storm Electric Field Amplitudes Model[285]



3. Historical Occurrences of Space Weather

There has not been a Space Weather event to significantly affect Florida since our country began recording such incidents. However, Space Weather can affect any region at any time.

Table 61: Florida Historical Occurrences, Space Weather

Date	Description
September 1859	The strongest Geomagnetic Storm in recorded history, called the Carrington Event, occurred. Excess currents caused telegraph lines to fail. Technicians were shocked and some telegraph equipment even caught fire. The Aurorae from this event were seen as far south as Cuba and Hawaii.
May 1921	A powerful geomagnetic storm called the New York Railroad Storm caused similar effects as the Carrington Event. There was interference in telegraph equipment, trans-Atlantic cable communications (telephone and telegraph), and railroad switching systems. Fires were also ignited in telegraph switchgear.
August 1972	A large solar flare disrupted long distance telephone communications across Illinois.

[285] Lloyd's/Atmospheric and Environmental Research, Solar Storm Risk to the North American Electric Grid, 2013, Figure 5, p 11

March 1989	A very powerful Geomagnetic Storm led to a major blackout in Canada, which left 6 million people without electricity for 9 hours. The storm disrupted electric power transmission from a generating station in Quebec and damaged power transformers in New Jersey.
October and November 2003	The Halloween geomagnetic storms were the strongest since March 1989. Both terrestrial electric utilities, aviation and spacecraft operations were affected by storms, but most were recoverable without incident. Temporary blackouts were reported in northern Europe. The November 20th storm also caused blackouts in northern Europe and South Africa. Several high-voltage transformers were damaged or destroyed in South Africa.
December 2005	X-rays from a solar storm disrupted satellite to ground communications and global positioning systems (GPS) navigation systems for 10 minutes.

4. Probability of Future Space Weather

Power outages due to Space Weather are rare; however, significant effects could occur.

The entire State of Florida and its population and infrastructure is susceptible to solar storms; however, the effect that minor solar events could have on the public, property, environment, and operations would be minimal. If a rare, major solar storm were to occur, there could be a much larger impact on the population, property, and operations. However, the environment would still not be affected.

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Geomagnetic Storms

The frequency of Geomagnetic Storms depends on where Earth is in the average 11-year solar cycle, with most storms occurring around the solar maximum. The current solar cycle (cycle 24) maximum occurred from early 2012 to late 2014. These storms are also common in the declining phase, due to an increase in solar wind speeds. However, severe space weather can be observed at any time during the solar cycle.

Additionally, a CME may intensify a geomagnetic storm as it approaches the Earth. With sufficient time, a CME with a southward oriented magnetic field will cause geomagnetic storming by compressing and agitating the Earth's magnetic field. Weak sub-storm to strong storming is common with hundreds of occurrences per solar cycle, less than 10-year long-term occurrence rates.

Storm intensity can also be measured in Disturbance storm time (*Dst*) with greater intensity represented by a more negative *Dst* value. Geomagnetic storms that cause the most significant disruptions and damage have Dst values of more than -300 nT[286], which may occur on Earth about 4 days per solar cycle. This means the probability of a storm with a Dst intensity value of about -450 nT occurs about once per solar cycle. A storm with an intensity similar to the March 1989 Great Storm may occur about one every 60 years, or about once per five solar cycles. Larger geomagnetic storms with intensities similar to the Carrington Event are rare and may occur about once every 250 years or more.

[286] nanotesla, unit of measurement

Furthermore, periods with very active sunspot groups, features such as corotating interaction regions can create an interstellar environment where unexpectedly intense and prolonged geomagnetic storming can occur.

The table below describes long-term geomagnetic storm occurrence and intensity.

Table 62: Space Weather Geomagnetic Storm Occurrence and Intensity Indicators

Space Weather Geomagnetic Storm Occurrence and Intensity					
Long-term Occurrence, years	Storm Intensity Physical Measure Indicators				
	Kyoto Equatorial *Dst* Index, nT	Number of Storm Days per Cycle, days	Planetary K	NOAA Geomagnetic Storm Scale	Storm Intensity Description
< 10	> -100	900	< 7	< 3	weak - moderate
	-100	130	7	3	strong
	-200	60	8/9-	4	severe
	-350	4	9	5	extreme
10 [287]	-451	1			
20 [5]	-501	< 1			Great Storms
30 [5]	-534				
50 [5]	-578				
60 [288]	-589				
100 [5]	-645				
200 [5]	-721				
250 [289]	-800				Carrington Class
500 [6]	-850				
1000 [6]	-925				
nT – nanotesla; Dst – Disturbance Storm Time					

The long-term geomagnetic occurrence rates illustrated above do not necessarily reflect the sun's potential to produce extreme storms at any time when active sunspot groups are present, even during lower than normal sunspot cycles. As an example, the STEREO A spacecraft orbits the sun at a location that is 1 AU distant from the sun, but with a view of the farside. At least twice during solar cycle 24, the sun produced major farside CME that would have likely impacted Earth if it had been in the path. The STEREO A spacecraft was able to directly observe the extreme interstellar conditions of a major CME in

[287] Table 2. Probable Storm Intensity S_T, *Long-term occurrence probabilities of intense geomagnetic storm events*, K. Tsubouchi and Y. Omura, Space Weather, Vol 5, 2007

[288] March 13/14, 1989 Great Geomagnetic Storm (Quebec Blackout)

[289] Estimates based on Figure 6. Probable storm intensity S_T as a function of year, *Long-term occurrence probabilities of intense geomagnetic storm events*, K. Tsubouchi and Y. Omura, Space Weather, Vol 5, 2007

July 2012 and July 2017. Academic publications indicate that the July 2012 storm could have rivaled the Carrington Event.

Solar Radiation Storms

Solar Radiation Storms can occur at any time during the solar cycle, but are most common around solar maximum.

Radio Blackouts

Radio Blackouts are caused by Solar Flares, which are quite common. In fact, minor events or R1 events, occur about 2000 times each solar cycle.

5. Space Weather Impact Analysis

- Public
  - Traffic accidents caused by power outages.
  - Power outages.
    - Lost wages.
    - Perishable food and medications.
- Responders
  - N/A
- Continuity of Operations (including continued delivery of services)
  - Power outages may interrupt operations or delivery of services in government, private businesses, etc.
- Property, Facilities, Infrastructure
  - Damage to electrical lines, transformers, etc. may take several days or weeks to repair.
  - Damage to lines may cause fires.
  - Disruptions to computer systems, telephone systems, and other communications systems.
  - Water and wastewater distribution systems.
  - Public transportation systems.
  - All electrical systems that do not have back up power.
  - Heating/air conditioning and electrical lighting systems.
  - Fuel distribution systems and fuel pipelines.
- Environment
  - N/A
- Economic Condition
  - Extensive power outages would close businesses, causing them to lose revenue and employees to lose wages.
  - High cost of repairing damage to utilities may put a burden on utility companies and they may have to raise rates.
- Public Confidence in the Jurisdiction's Governance
  - May lose confidence in jurisdiction if communications or utilities are disrupted for an extended period of time.

6. 2018 LMS Integration

The following counties profile Space Weather Incidents:

- Miami-Dade
- Osceola

7. Vulnerability Analysis and Estimated Losses by Jurisdiction

In 2013, the SHMPAT identified Space Weather as an emerging threat. As of the 2018 update, there is no way to accurately assess risk and vulnerability of jurisdictions to Space Weather. This is because no one county or area in Florida is more vulnerable to Space Weather than another. Additionally, Space Weather impacts are not distributed geographically like natural hazard often are, but instead are based on the power grid. Because of this, there may be impacts in Florida from damage in another state caused by Space Weather.

8. Vulnerability Analysis and Estimated Losses of State Facilities

As explained above, the SHMPAT identified solar storms as a potential emerging threat in 2013. According to current data, there is no way to assess risk and vulnerability of State Facilities to Space Weather. This is because no one area in Florida is more vulnerable than another to this hazard. Additionally, no state facilities are particularly more vulnerable than others to be affected by Space Weather because the geographic distribution of impacts would be based on the power grid.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 9.

<table>
<tr><th colspan="5">SPACE WEATHER EVENTS</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Space Weather is a broad term used to describe atmospheric events that have the potential to adversely affect conditions on Earth. Space Weather events are caused by the interaction of Earth with emissions from the Sun. There are two causes of space weather events, coronal mass ejections (CMEs) and solar flares, which are different incidents that occur on the Sun. CMEs and solar flares can cause three different types of space weather events on Earth, Geomagnetic Storms, Solar Radiation Storms, and Radio Blackouts.</td><td rowspan="5">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>Medium</td><td>Medium</td><td>Low</td></tr>
</table>

Radiological Incidents Hazard Profile

1. Radiological Incidents Description

Radioactive material is a substance that gives off radiation. Radiation is a form of energy that is naturally present in our everyday lives. Humans along with all forms of animals are exposed to radiation every day from naturally occurring sources like ground soil or from manufactured sources such older television sets. Radiation is not bad and actually has many beneficial uses. However, radioactive material can be harmful if it is not used properly. There are two types of radiation, ionizing and non-ionizing. Non-ionizing radiation is used in lasers, microwaves, infrared lamps, and radio waves. This type of radiation is not strong enough to break molecular bonds and is therefore not damaging to living cells. Ionizing radiation has more energy than non-ionizing radiation. When ionizing radiation moves through a material, it leaves enough energy to break molecular bonds and remove electrons from atoms. Ionizing radiation, or particle radiation, is used to generate electric power, treat cancer and it's used in x-rays. Over time, radioactive particles lose their potency in a process called radioactive decay, also known as "half-life". This decay is measured in half-lives, which refers to the time it takes a half of an atom of a radioisotope to decay by emitting radiation. This time can range from fractions of a second, to millions of years.

Radiation is also used in certain industries, such as health care facilities, research institutions, and some manufacturing facilities. While these amounts are typically smaller than the levels found in a power plant, the materials must still be handled properly to avoid contamination or exposure.[290] The US Nuclear Regulatory Commission exists to regulate the use of radioactive materials.[291]

Types of Incidents

There are many types of emergencies that may involve radiation or radioactive materials. These incidents may be intentional or unintentional. According to the CDC, the incidents involving radiation that are most likely to occur are a release from a radiological dispersal device, a radiological exposure device, a nuclear power plant accident, a transportation accident, and an occupational accident.

A nuclear emergency would involve the detonation of a nuclear weapon, which includes an intense pulse of heat, light, air pressure, and radiation. A nuclear detonation would produce radioactive fallout, which when given the right conditions, could be carried long distances.

A Radiological Dispersal Device (RDD), also known as a dirty bomb, mixes explosives with radioactive materials. These bombs do not create an atomic blast, but they can spread the radioactive material to the surrounding area when detonated.

A Radiological Exposure Device (RED) contains radioactive material and is hidden so that people are exposed to the radiation without their knowledge. An explosion would be involved with this type of incident.

The transportation and disposal of radioactive materials and waste creates problems because of the long life of radioactive materials. The launch of spacecraft from the Kennedy Space Center also represents a

[290] https://emergency.cdc.gov/radiation/typesofemergencies.asp
[291] https://www.nrc.gov/about-nrc/radiation/health-effects/radiation-basics.html

significant threat to the state for launch vehicles carrying Radioisotope Thermoelectric Generators (RTG). The primary threat is an in-flight explosion within the first two minutes of vehicle lift-off. The Space Coast of Florida uses nuclear material as a fuel source for some launches. Because of this, the EPA and other agencies are involved with the launches.

A Nuclear Power Plant Incident could involve the release of a large amount of radiation from the plant. This type of release would likely be in the form of a plume, or a large cloud of radiation, which could move from plant facility grounds to the surrounding areas and possibly contaminate people, buildings, food, water, and livestock. In this plume form, radioactive material could enter the body via inhalation or by ingesting contaminated food or water.

Incidents at a nuclear power plant are classified using specific classification levels and criteria.

Table 63: Nuclear Power Plant Incident Classifications

Classification	Description
Unusual Event	An off-normal incident or condition at the plant for which no significant degradation of safety has occurred or is expected. Any releases of radioactive material which may have occurred or are expected to occur are minor and constitute no appreciable health hazard. An unusual event is a minor incident, often non-nuclear, such as a plant worker injury or severe weather. No public action is required.
Alert	An event that involves an actual or potential substantial degradation of safety, combined with a potential for limited uncontrolled releases of radioactivity from the plant. This is still a relatively minor incident, and no public action is required.
Site Area Emergency	An event that involves actual or likely major failures of plant functions needed for protection of the public, combined with a potential for significant uncontrolled releases of radioactivity. Sirens within the 10-mile emergency planning zone around the plant would sound, alerting the public to tune to local radio and television stations for official information. Non-essential plant personnel would evacuate. This category involves a serious incident, such as a reactor coolant leak or fire in a safety system.
General Emergency	An event involving actual or imminent substantial core degradation and potential loss of containment integrity combined with a likelihood of significant uncontrolled releases of radioactivity. This is the most severe emergency. Sirens within the 10-mile zone would sound, alerting people to tune to local radio and television stations for official information. Some public protection measures would be likely.

Effects of Radiation

There are three radiation exposure pathways; direct or external exposure, inhalation, and ingestion. After contamination, the contaminated person or property must be decontaminated properly. However, being exposed to radiation does not necessarily mean that contamination has occurred.

According to Radiation Ready, low frequency sources of non-ionizing radiation are not known to cause health risks. However, high frequency sources of non-ionizing, like ultraviolet radiation, can cause burns and tissue damage with overexposure.

Ionizing radiation can damage living tissue by changing the cell structure and damaging DNA. The level of damage depends on many things, including the type of radiation, the exposure pathway, and the amount of radiation absorbed. The greatest risk from ionizing radiation is developing cancer.[292]

Other risks of radiation contamination include Acute Radiation Syndrome, which involves nausea, vomiting, headache, and diarrhea. Additionally, radiation emergencies may also cause emotional and psychological distress or mass panic.

A developing fetus is very susceptible to negative health effects from radiation exposure and radioactive material can also be passed from mothers to babies via breast milk. Infants, children, the elderly, pregnant women, and those with compromised immune systems are more susceptible to health effects of radiation exposure.[293]

There are some medical treatments available after radiation exposure or contamination; however, the effectiveness of these treatments depends upon the type of radioactive material. For example, Potassium Iodide (KI) is safe and effective in blocking the uptake of radioactive iodide into the thyroid. Calcium-DTPA and Zinc-DTPA are effective treatments for contamination of plutonium, americium, or curium. Radiogardase, also known as Prussian Blue, is an effective treatment for contamination from cesium-137 or thallium. It is important to note that KI is only effective against radioactive iodine and only prevents thyroid cancer later in life by decreasing the amount of radioactive material that the thyroid absorbs.[294]

There is also a risk for radioactive materials contaminating crops or livestock. For example, an incident at a nuclear power plant could spread radioactive materials many miles from the plant. In this scenario, crops may need to be de-contaminated or left alone until the radiation dissipates. Additionally, livestock may need to be sheltered from the radioactive plume and fed uncontaminated stored feed, until the radiation dissipates from the grazing fields. This is of particular concern for dairy animals because of the quick turnaround from the time milk is gathered to the time the consumer buys it. Because of this, milk may need to be tested and quarantined until the radiation dissipates.

Security & Authority

The Nuclear Regulatory Commission (NRC) is responsible for licensing and regulating the civilian uses of certain radioactive materials, including uranium, thorium, enriched uranium and plutonium, and byproduct materials. The Code of Federal Regulations requires protections like dose limits for workers, monitoring of materials, and labeling and signage.

The NRC is also responsible for the nuclear security in the U.S. Because of security requirements, nuclear power plants are well protected. Additionally, the NRC is responsible for the security of radioactive materials. The NRC also works with the International Atomic Energy Agency (IAEA), which works to ensure peaceful use of nuclear materials and prevent the spread of nuclear explosive capabilities.[295]

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[292] http://www.radiationready.org/wp/wp-content/uploads/2017/04/Radiation-Exposure-Handout.pdf
[293] https://emergency.cdc.gov/radiation/healthandsafety.asp
[294] https://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm063807.htm
[295] https://www.nrc.gov/about-nrc/radiation/protects-you/reg-matls.html

The Environmental Protection Agency (EPA) has the ability and authority to respond to many types of radiological incidents in a coordinating role.[296]

Frequency

This hazard was determined to occur about every 50-100 years, giving it a Frequency ranking of Not Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

2. Geographic Areas Affected by Radiological Incidents

There are active two nuclear power plants in the State of Florida which each house two working reactors, one decommissioned plant, and another active plant on the Alabama-Florida border.

An incident at the St. Lucie Nuclear Power Plant, on Hutchinson Island in Jensen Beach, Florida, would affect residents within a 10-mile radius of the plant, which includes portions of St. Lucie County and Martin County. The ingestion pathway zone is about a 50-mile radius and could potentially affect Brevard, Glades, Highlands, Indian River, Martin, Okeechobee, Osceola, Palm Beach, and St. Lucie counties.

An incident at the Turkey Point Nuclear Power Plant in Homestead, Florida in southeast Miami-Dade County, would affect residents within a 10-mile radius of the plant, which includes portions of Miami-Dade County and Monroe County. The ingestion pathway zone is a 50-mile radius and potentially affected counties are Collier, Bay, Miami-Dade, and Monroe counties.

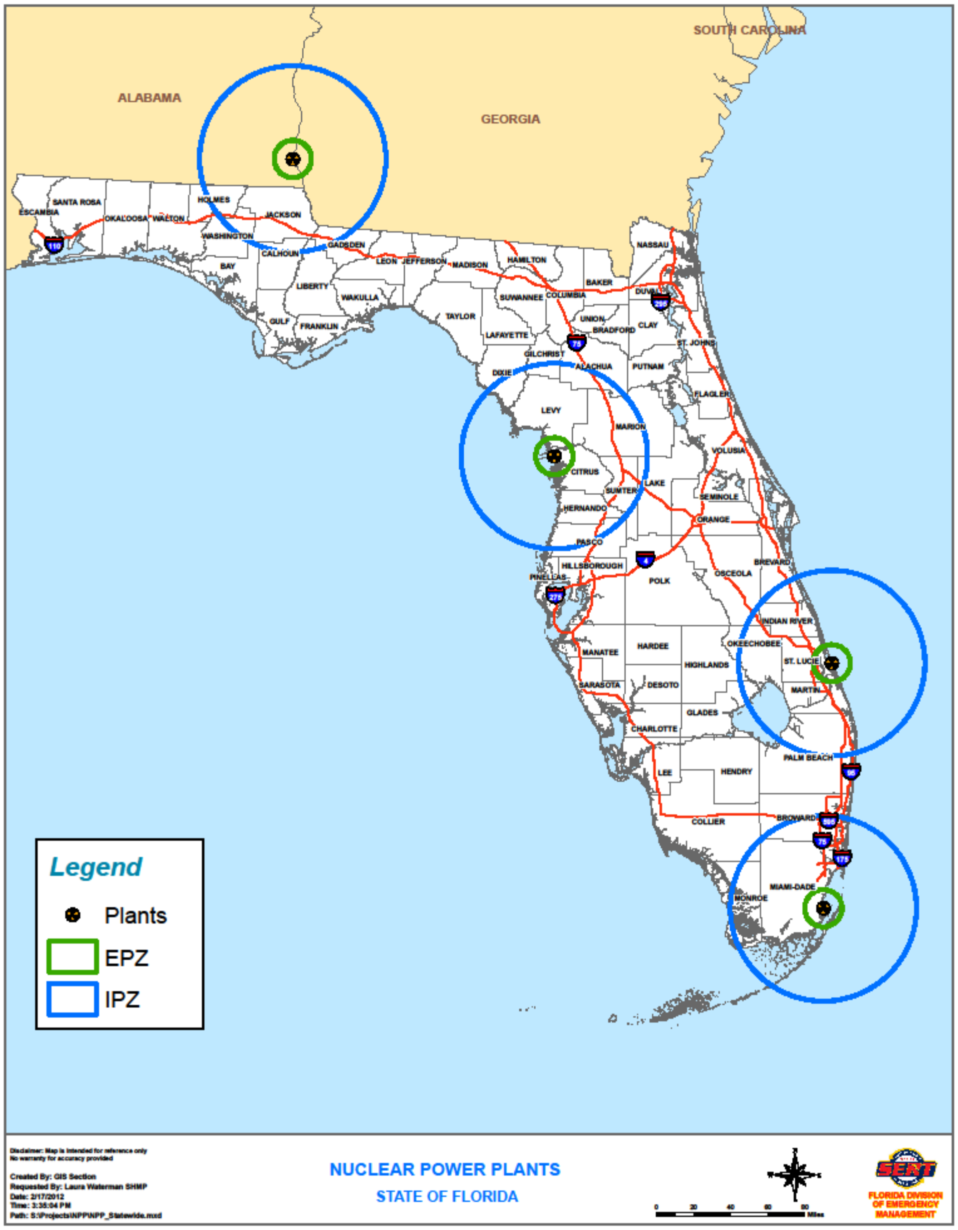
Plant Farley is near Dothan, Alabama. Farley Power Plant's Ingestion Pathway counties are Bay, Calhoun, Gadsden, Holmes, Jackson, Liberty, and Washington counties.

A Nuclear Power Plant at Crystal River in Citrus County was decommissioned in 2013. The plant will be monitored for 60 years for potential releases, but any release there would be nuclear waste and would not contaminate the surrounding area.

Below is a map showing the portions of the counties that are at risk for a radiological incident to impact the county.

[296] https://www.epa.gov/radiation/radiological-emergency-response-authorities

Figure 103: Florida Emergency Planning Zones and Ingestion Pathway Zones



The University of Florida has a nuclear reactor for scientific research. An incident with the nuclear reactor could affect Alachua County.

King's Bay Naval Base in southern Georgia is in close proximity to the Florida border. The base has some radioactive materials on site so Florida participates in the King's Bay exercises. An incident at the base could affect northeastern Florida counties.

All ports in Florida have radiation monitoring equipment to monitor incoming materials from cargo ships and other vessels that could be carrying radioactive materials.

3. Historical Occurrences of Radiological Incidents

Table 64: Florida Historical Occurrences, Radiological Incidents[297]

Date	Description
November 17, 1976	China tested two nuclear weapons in 1976. The two detonations resulted in radioactive material being injected into the atmosphere. The EPA noticed low, but measurable, quantities of radioactive material in the U.S.
March 28, 1979	Three Mile Island, Pennsylvania had a series of mechanical, electrical and human failures that led to the accidental release of a small amount of radioactive material to the environment. The area was monitored for 10 years to ensure public health and the environment were protected.
April 26, 1986	In Chernobyl, Ukraine a reactor at a nuclear power station exploded and caused a release of large quantities of radioactive material. It became one of the most disastrous nuclear power plant accidents in history, both in terms of cost and casualties.
1989, 1990, 2011	NASA Launch Support in Florida has many spacecraft that are launched carrying a radioactive source on board. Many agencies were involved in developing a plan for possible accidents and radiological releases.
September 30, 1999	In Tokaimura, Japan a release occurred from a nuclear material processing facility, however most of the release was contained to the building and did not cause any exposure or contamination to the U.S.
2000, 2011	The Los Alamos and Los Conchas Fires threatened communities with radiological release. Radioactive waste located on Los Alamos National Laboratory property was threatened by wildfires on numerous occasions. The fire never reached the contaminated areas and no radioactive material was released or spread.
March 11, 2011	The Fukushima, Japan earthquake led to a tsunami which struck and damaged the plant causing explosions which allowed radioactive elements to escape into the environment
February 14, 2014	A Waste Isolation Pilot Plant Radioactive Release in New Mexico did not pose a threat to public health or the environment.

4. Probability of Future Radiological Incidents

While it is unlikely that a radiological incident will occur, the consequences could be devastating. Radiological incidents can range from a minor emergency with no offsite effects to a major emergency that may result in an offsite release of radioactive materials. The probability of a radiological incident is impossible to predict with certainty, and even threats that can be anticipated, require a large and concentrated effort to mitigate the potential damage.

This hazard was determined to occur about every 50-100 years, giving it a Probability ranking of Not Likely.

[297] https://www.epa.gov/radiation/radiological-emergency-response-planning-and-past-responses#tab-3

5. Radiological Incident Impact Analysis

- Public
    - Contamination or radiation poisoning.
- Responders
    - Contamination or radiation poisoning.
    - Special equipment will be needed to handle radioactive materials.
- Continuity of Operations (including continued delivery of services)
    - Disruption of nuclear power plant.
    - Disruption of production of crops and milk.
- Property, Facilities, Infrastructure
    - Require de-contamination of facility.
    - Could damage surrounding properties.
- Environment
    - Require de-contamination or closing of areas until the radiation dissipates on its own.
    - Could affect animal species and habitats leading to decreased numbers.
- Economic Condition
    - Disruption of a nuclear power plant would be costly to owners and consumers. There would be lost wages, lost revenue, and cost of recovery and remediation.
    - Disruption of food and milk production or delivery would be costly to farmers, distributors, grocery stores, consumers. There would be lost wages, lost revenue, and cost of recovery, remediation, and replacement.
- Public Confidence in Jurisdiction's Governance
    - Incident at a nuclear power plant would cause significant loss of public confidence in the jurisdiction, as panic would likely ensue.
    - Public would take their own protective measures, such as evacuations, even if authorities told them they were safe.

6. 2018 LMS Integration

The following counties profile Radiological Incidents:

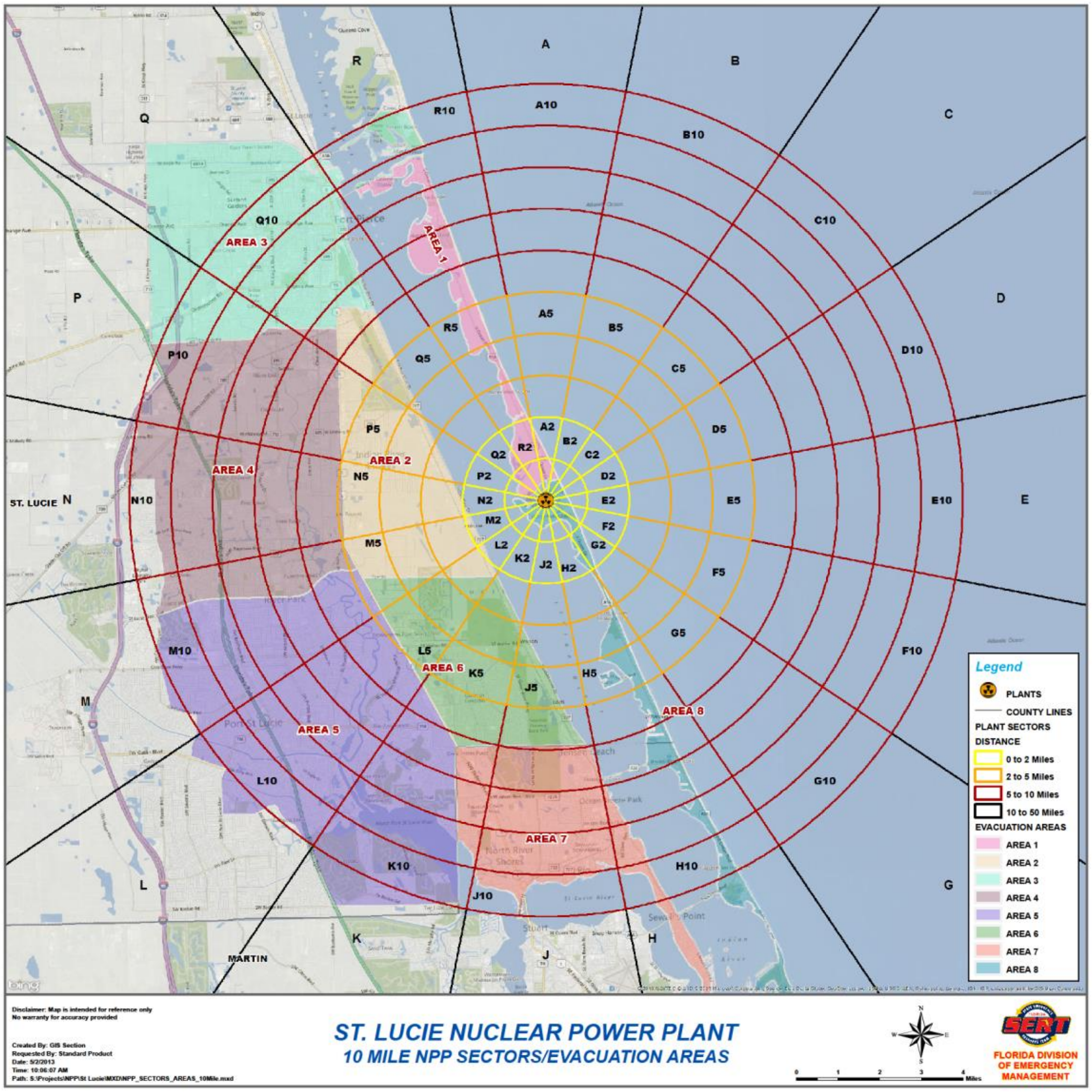
- Brevard
- Citrus
- Dixie
- Escambia
- Gulf
- Hillsborough
- Indian River
- Jackson
- Lee

- Levy
- Martin
- Miami-Dade
- Osceola
- Palm Beach
- Pinellas
- Seminole
- St. Lucie
- Walton

7. Vulnerability Analysis and Estimated Losses by Jurisdiction

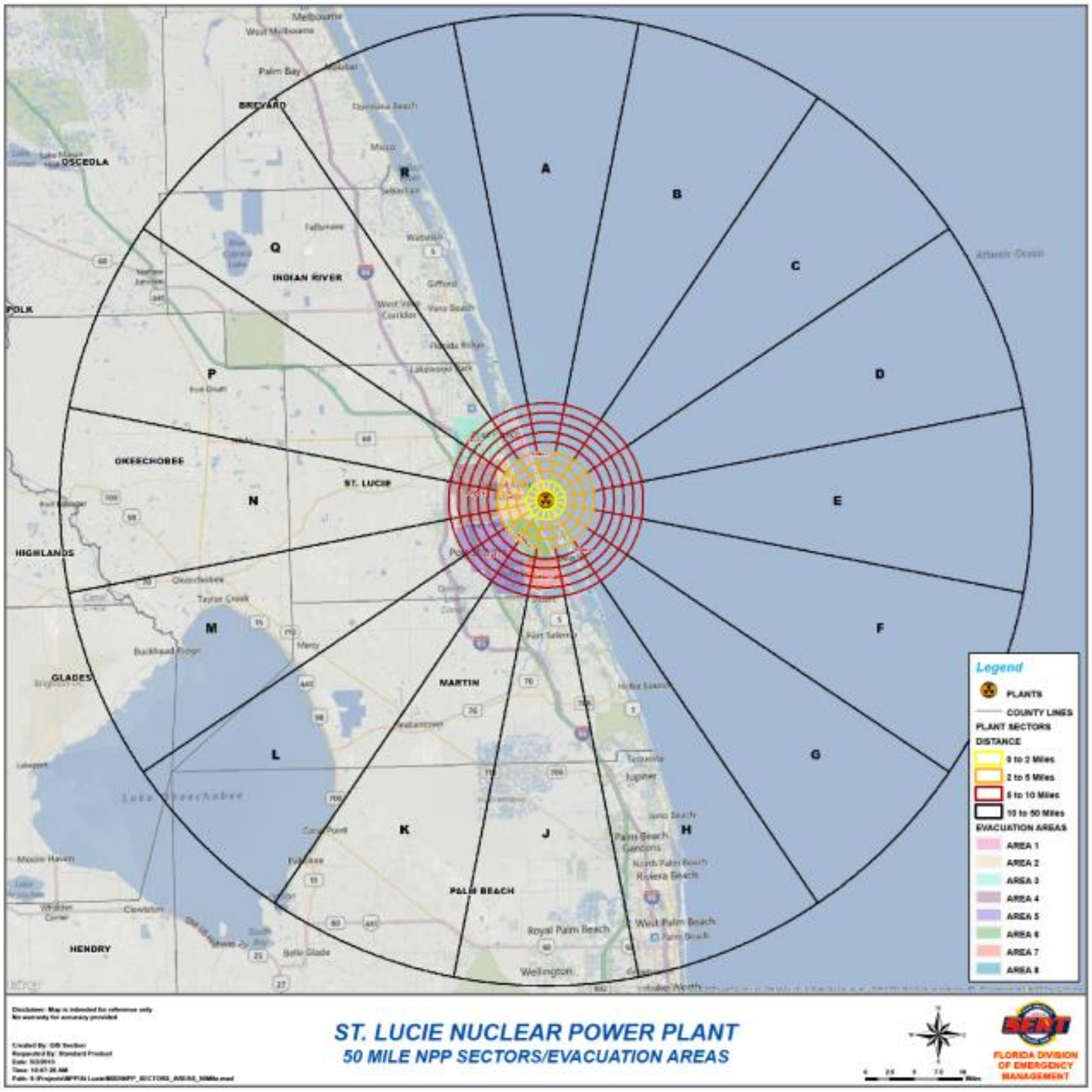
For nuclear power plant incidents, areas at risk are normally designated as (1) within the plume emergency planning zone (EPZ) of such facilities (i.e., jurisdiction located within a 10-mile radius of a nuclear power plant) or (2) within the ingestion emergency planning zone (IPZ) (i.e., jurisdictions within a 50-mile radius of a nuclear power plant).

Figure 104: St. Lucie Nuclear Power Plant 10 Mile Emergency Planning Zone



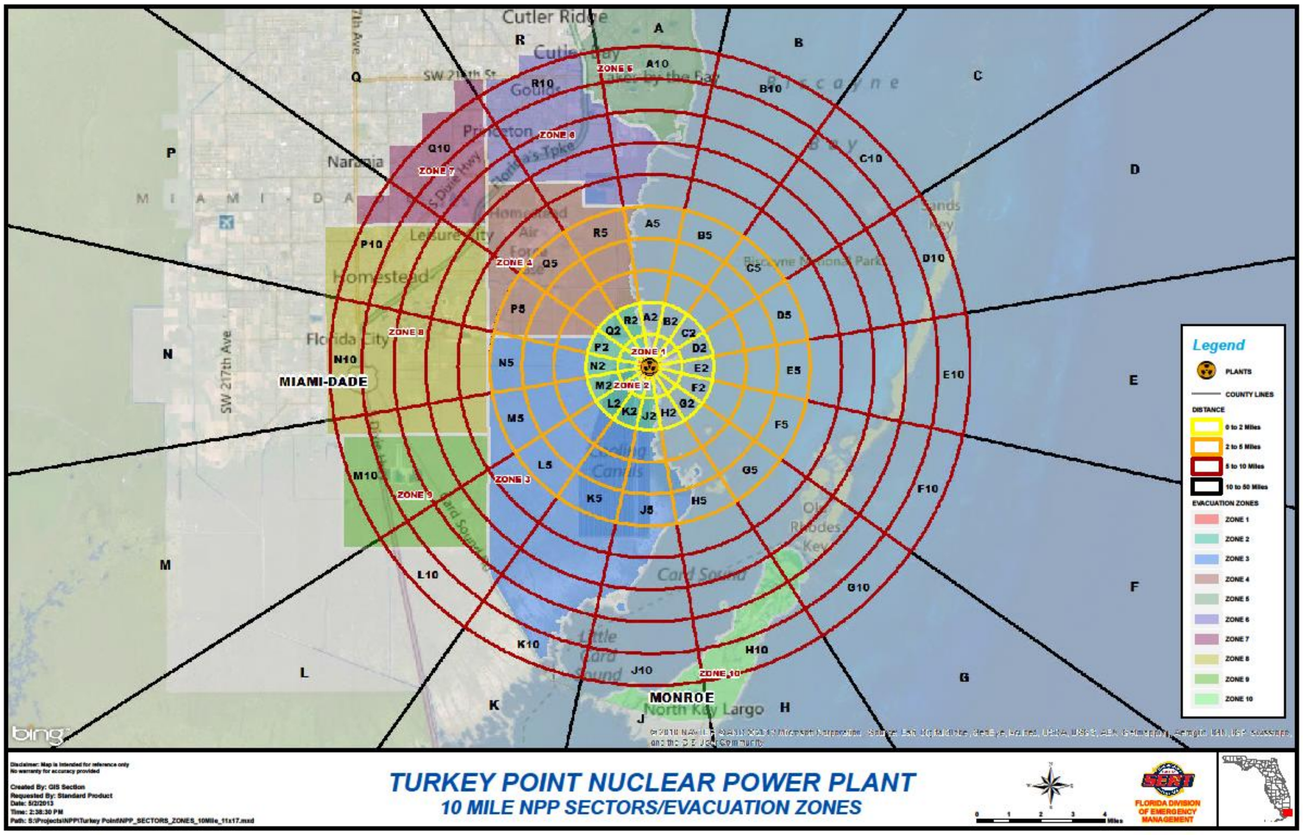
Vulnerable counties include St. Lucie and Martin.

Figure 105: St. Lucie Nuclear Power Plant 50 Mile Ingestion Pathway Zone



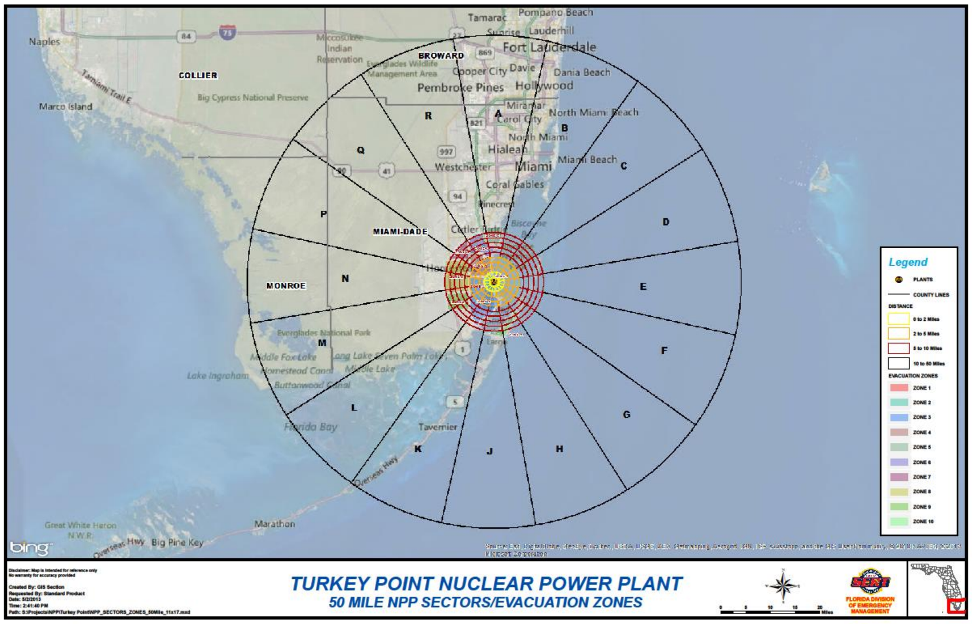
Vulnerable counties include St. Lucie, Okeechobee, Highlands, Glades, Hendry, Martin, and Palm Beach.

Figure 106: Turkey Point Nuclear Power Plant 10 Mile Emergency Planning Zone



Vulnerable counties include Miami-Dade and Monroe.

Figure 107: Turkey Point Nuclear Power Plant 50 Mile Ingestion Pathway Zone



Vulnerable counties include Miami-Dade, Monroe, Broward, and Collier.

8. Vulnerability Analysis and Estimated Losses of State Facilities

State facilities are not vulnerable to radiological incidents involving the nuclear power plants in the state. Any individuals within state facilities that are within the EPZ or IPZ areas may be required to take protective actions. If a facility were to become contaminated, it may need to be closed and decontaminated, which may interrupt normal state operations.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 9.

<table>
<tr><th colspan="5">RADIOLOGICAL INCIDENTS</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Radiation is a form of energy that is naturally present in our everyday lives, and radioactive material is a substance that gives off radiation. There are many types of emergencies that may involve radiation or radioactive materials and may be intentional or unintentional. According to the CDC, the incidents involving radiation that are most likely to occur are a nuclear emergency, a release from a radiological dispersal device, a radiological exposure device, a nuclear power plant accident, a transportation accident, and an occupational accident.</td><td rowspan="5">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Not Likely</td><td>Not Likely</td><td>High</td><td>Medium</td><td>Medium</td></tr>
</table>

Terrorism Hazard Profile

1. Terrorism Description

The population, property, and environmental resources of the State of Florida are vulnerable to a threatened or actual terrorist attack. While there are multiple definitions and political connotations that accompany the term terrorism, for the purpose of this document the following definition will be used;

> *"Terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. It is the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom".*

State and local governments have primary responsibility in planning for and managing the consequences of a terrorist incident using available resources in the critical hours before Federal assistance can arrive. If a terrorist incident occurs in a city or county, communities may receive assistance from federal agencies under the existing Integrated Emergency Management System. The Department of Homeland Security is the lead federal agency for supporting state and local response to the consequences of terrorist attacks.[298]

Terrorism is often categorized as either domestic, international, or lone wolf.

Domestic

The U.S. Patriot Act defines domestic terrorism as an attempt to "intimidate or coerce a civilian population; to influence the policy of a government by intimidation or coercion; or to affect the conduct of a government by mass destruction, assassination, or kidnapping".

Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of the U.S. government or population without foreign direction. It is the unlawful use, or threatened use, of violence by a group or individual based and operating entirely within the United States, or its territories, without foreign direction, committed against persons or property to intimidate or coerce a government, the civilian population, or any group, in furtherance of political or social objectives. This can also include single issue groups looking to further specific social ideas or practices.[299]

International

International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States or whose activities transcend national boundaries. This distinction refers not to where the terrorist act takes place but rather to the origin of the individuals or groups responsible for it.

For example, the 1995 bombing of the Murrah Federal Building in Oklahoma City was an act of domestic terrorism, but the attacks of September 11, 2001 were international in nature. For the purposes of

[298] https://www.fema.gov/pdf/plan/managingemerconseq.pdf
[299] https://archives.fbi.gov/archives/news/testimony/the-terrorist-threat-confronting-the-united-states

consequence management, the origin of the perpetrator(s) is of less importance than the impacts of the attack on life and property; thus, the distinction between domestic and international terrorism is less relevant for the purposes of mitigation, preparedness, response, and recovery than for understanding the capabilities of terrorist groups and how to respond to the impacts they can generate.

Lone Wolf

Lone wolf terrorism is used to describe violent acts committed by a single perpetrator. The person acts independently and without the help of outside organizations. A lone wolf terrorist may, however, follow the ideology of a particular organization or group and may commit acts of terror to show their support of said group. Many of these individuals exclude themselves, or feel excluded, from normal social interactions and day to day relationships. In their social exclusion, lone individuals feel deprived of what they perceive as values to which they are entitled, and form grievances against the government or people who they feel are responsible for their problems, such as unemployment, discrimination, and injustices. Their violence is a means to achieve their goals and to punish those responsible.[300]

Effects

The effects of terrorism can vary significantly—from loss of life and injuries to property damage and disruptions in services such as electricity, water supply, public transportation, and communications. One way that governments attempt to reduce vulnerability to terrorist incidents is by increasing security at airports and other public facilities that could be considered as targets.

While one can never predict what target a terrorist will choose, the following are some of the factors many use when selecting a target:

- Produce a large number of victims.
- Cause mass panic.
- Target locations that have symbolic or cultural value, and areas where large groups congregate.
- Garner the greatest possible media attention.

Terrorists are likely to target heavily populated, enclosed areas like stadiums, government buildings, sporting events, airport terminals, subways, shopping malls, and industrial manufacturing facilities.

A terrorist attack can take several forms, depending on the technological means available to the terrorist, the nature of the political issue motivating the attack, and the points of weakness of the terrorist's target. Other possibilities include an attack at transportation facilities, an attack against utilities or other public services, an incident involving chemical or biological agents, an active shooter, or a cyber-attack.

In 2011, the U.S. Department of Homeland Security (DHS) replaced the color-coded alerts of the Homeland Security Advisory System (HSAS) with the National Terrorism Advisory System (NTAS), designed to more effectively communicate information about terrorist threats by providing timely, detailed information to the public. The system uses the following three alerts:

[300] https://www.ncjrs.gov/pdffiles1/nij/grants/248691.pdf

- Bulletin: describes current developments or general trends regarding threats of terrorism.
- Elevated Alert: warns of a credible terrorism threat against the United States.
- Imminent Alert: warns of a credible, specific and impending terrorism threat against the United States.

In an effort to include and prepare the entire community, DHS created the “If You See Something, Say Something” campaign. It is a national campaign that raises public awareness of the indicators of terrorism and terrorism-related crime, as well as the importance of reporting suspicious activity to state and local law enforcement. Suspicious activity could include, but isn’t limited to, unusual items or situations, eliciting information, and observation or surveillance.

Terrorism in Florida

Florida is considered to be vulnerable because the chief objective of a terrorist is to spread fear and create economic damage. Florida is a major tourist attraction with large theme parks, beaches, cruise lines, and military bases.

The open availability of basic shelf-type chemicals and mail-order biological research materials, coupled with access to even the crudest laboratory facilities, could enable the individual extremist or an organized terrorist faction to manufacture highly lethal substances or to fashion less sophisticated weapons of mass destruction (WMD). The use of such weapons could result in mass casualties and long-term contamination, wreaking havoc on both the state and national economies.

Unlike natural disasters, there are relatively few methods to predict the time or place of a terrorist incident. This fact negates the “watch” and “warning” time phases. The action phases for a terrorist incident are Prevention, Protection, Mitigation, Response, and Recovery. Activities associated with each action are detailed below.

- ***Prevention Phase***
  - The actions during this phase are those taken by local, state, and federal agencies to monitor and coordinate intelligence and other potential indicators to prevent, defend against, prepare for, and mitigate the impacts of terrorist attacks against the nation.
  - Florida uses intelligence provided by Fusion Centers, Joint Terrorism Taskforces, and Regional Domestic Security Taskforces.
- ***Protection Phase***
  - The actions during this phase are those taken by local, state, and federal agencies to limit the impacts of a potential event on a specific area.
- ***Mitigation Phase***
  - The actions during this phase are those that require time to carry out. They include training, planning, public awareness, and any activities that require long-term programs to accomplish their objectives.

- ***Response Phase***
  - These actions are those taken immediately after an incident to 72 hours after the incident, with the major goal of saving lives, alleviating suffering, and preventing further disaster.
  - When responding to disaster events, the National Incident Management System (NIMS) is used by qualified staff to manage the response actions.
- ***Recovery Phase***
  - The actions during this phase are those taken during the first one to two months after the incident.
  - These actions, which begin immediately after the emergency response operations, have the goal of returning the state and citizens to normal conditions.
  - The emphasis will transition from saving lives to cleanup of the affected areas and returning people to normal activities.

Florida realizes that there is appropriate concern that a terrorist event is possible due to the state's highly visible and popular tourist destinations. The state also has nuclear power plant locations, numerous international shipping ports, cruise ship destinations, and large-capacity arenas.

Mitigation and preparedness planning grants are one way that Florida works to mitigate the risks of terrorist attacks. The Florida Division of Emergency Management (FDEM) is the State Administrative Agency (SAA) for the Department of Homeland Security Grant Program (HSGP). HSGP is comprised of three grant programs. The Domestic Security Unit is responsible for the administration of these programs for the State of Florida. The three programs include:

- State Homeland Security Grant Program (SHGP): The SHGP assists state, tribal, territorial, and local preparedness activities that address high-priority preparedness gaps across all core capabilities that support terrorism preparedness.
- Urban Area Security Initiative (UASI): The UASI program assists high-threat, high-density Urban Areas in efforts to build, sustain, and deliver the capabilities necessary to prevent, protect against, mitigate, respond to, and recover from acts of terrorism.
- Operation Stonegarden (OPSG): The OPSG Program supports enhanced cooperation and coordination between Customs and Border Protection, United States Border Patrol, and federal, state, local, tribal, and territorial law enforcement agencies. The OPSG Program provides funding to support joint efforts to secure the United States' borders along routes of ingress from international borders to include travel corridors in states bordering Mexico and Canada, as well as states and territories with international water borders.

With the vast majority of America's critical infrastructure owned and/or operated by state, local, and private sector partners, critical infrastructure and key resource (CI/KR) locations within the state that are determined to be credible targets of a terrorist event can be documented and monitored. Structures selected for inclusion in the CI/KR list are eligible for additional government grant funding to increase their security against a terrorist event.

One example of funding for which CI/KR sites qualify is the Buffer Zone Protection Program (BZPP). The purpose of the BZPP is to make it more difficult for terrorists to conduct planning activities or successfully launch attacks from the immediate vicinity of likely targets. The program is based on the premise that local law enforcement agencies and first responders are on the front lines preventing, defending against, preparing for, and mitigating the impacts of terrorist attacks against our nation. The funds provided by the BZPP are provided to increase the preparedness capabilities of jurisdictions responsible for the safety and security of communities surrounding high-priority critical infrastructure and key resource (CIKR) assets through allowable planning and equipment acquisition.

Florida utilizes the Domestic Security Strategic Plan for terrorist attacks. Florida's Domestic Security Strategic Plan remains a working document, reviewed and prioritized each year. Seven Regional Domestic Security Task Forces (RDSTF's) co-chaired by a local sheriff or police chief and the local FDLE Special Agent in Charge, are the foundation of Florida's Domestic Security Strategy. These multi-jurisdictional and multidisciplinary task forces work together to strengthen Florida's domestic security preparedness, prevention, protection, mitigation, and response. In addition to law enforcement, task force members include first responders such as fire rescue, emergency management, public health, and hospitals. The task force also works with schools, businesses, and private industries.[301]

Chemical

Chemical terrorism is the deliberate release of certain chemicals that could poison people, animals, plants, or the environment. Chemical agents can be delivered in various forms—vapors, aerosols, liquids and solids—and by a wide variety of methods, including sprays and explosives. Chemical warfare agents are substances specifically designed to kill, seriously injure, or disable people. In general, terrorists use chemical agents because they are relatively easy and cheap to make.

Most chemical agents, depending on their type, concentration, and length of exposure, can be deadly. These chemicals can be categorized by type or by their effect. The Center for Disease Control (CDC) categorizes the following types:

- Anticoagulants – cause uncontrolled bleeding
- Biotoxins – come from plants or animals
- Blister Agents – blister the eyes, skin, or throat and lungs
- Blood Agents – absorbed into the blood
- Caustics – burn on contact
- Choking, Lung and Pulmonary Agents
- Incapacitating Agents – alter consciousness or thinking
- Metallic Poisons
- Nerve Agents – prevent the nervous system from functioning properly
- Organic Solvents – damage living tissue by dissolving fats and oils
- Tear gas and riot control agents

[301] http://www.fdle.state.fl.us/Publications/Documents/Brochures/DomesticSecurity_Brochure_2017_02.aspx

- Toxic Alcohols
- Vomiting Agents

Chemical agents can produce effects quickly, sometimes within a few seconds, or slowly, sometimes as much as two days after exposure with some agents being odorless and tasteless.[302]

Biological

Bioterrorism refers to the intentional release of toxic biological agents to harm and terrorize civilians, in the name of a cause. Biological agents are living organisms, or the products of living organisms, that can be deadly. Biological agents can go undetected for hours to days. Signs and symptoms might initially look like a bad cold, flu, or other common illness. Some agents can be extremely lethal in very small quantities. Biological weapons fall into three categories: bacteria, viruses, and toxins with bacteria. All three types can potentially be deadly to people and animals. The CDC has classified the viruses, bacteria, and toxins that could be used in an attack. Category A Biological Diseases are those most likely to do the most damage. They include:

- Anthrax (Bacillus anthracis)
- Botulism (Clostridium botulinum toxin)
- The Plague (Yersinia pestis)
- Smallpox (Variola major)
- Tularemia (Francisella tularensis)
- Hemorrahagic Fever
- Ebola Virus

Bioweapons can also be spliced to create a super-virus that either has no cure or is resistant to already formulated antidotes. For more information on Biological Hazards please see the *Biological Incident Profile* on page 399.

Nuclear

Nuclear terrorism refers to a number of different ways nuclear materials might be exploited as a terrorist tactic. These include attacking nuclear facilities, purchasing nuclear weapons, building nuclear weapons or otherwise finding ways to disperse radioactive materials. There are low levels of radiation exposure present in the everyday environment, but the danger in a nuclear terrorist attack comes with the amount and type of radiation given off.

Given the number of capable groups with serious intent, the increasing accessibility of weapons or nuclear materials from which elementary weapons could be constructed, and the countless ways in which terrorists could smuggle a weapon across borders, nuclear terrorism has become a clear and present danger.

Nuclear terrorism can involve the use of Weapons of Mass Destruction (WMD's). Weapons of mass destruction are defined as (1) any destructive device as defined in 18 U.S.C., Section 2332a, which includes any explosive, incendiary, or poison gas, bomb, grenade, rocket having a propellant charge of more than

[302] http://www.acsim.army.mil/readyarmy/Chemical_Terrorism_Fact_Sheet.pdf

four ounces, missile having an explosive or incendiary charge of more than one quarter ounce, mine or device similar to the above; (2) poison gas; (3) any weapon involving a disease organism; or (4) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life.

The effects of a nuclear attack depend on how much radiation is received, how long someone is exposed to the radiation, and how the radiation entered the body.

Environmental

Ecoterrorism, a recently coined term, describes violence in the interests of environmentalism. In general, environmental extremists sabotage property to inflict economic damage on industries or actors they see as harming animals or the natural environment. These have included fur companies, logging companies, and animal research laboratories. This can also be known as special interest terrorism.

Special interest terrorism differs from traditional right-wing and left-wing terrorism in that extremist special interest groups seek to resolve specific issues, rather than effect widespread political change. These groups continue to conduct acts of politically motivated violence to force segments of society, including the general public, to change attitudes about issues considered important to their causes. These groups occupy the extreme fringes of animal rights, pro-life, environmental, anti-nuclear, and other movements. Some special interest extremists, most notably within the animal rights and environmental movements, have turned increasingly toward vandalism and terrorist activity in attempts to further their causes. The Animal Liberation Front (ALF) and the Earth Liberation Front (ELF) have also become well known for their use of arson to destroy facilities and spread their message.

Bombing

The easiest to obtain and use of all weapons is still a conventional explosive device, or improvised bomb, which may be used to cause massive local destruction or to disperse chemical, biological, or radiological agents.

Many of the devices used by terrorists today are IED's.[303] An improvised explosive device (IED) is a homemade bomb or destructive device used to destroy, incapacitate, harass, or distract. IED's are categorized as being explosive or incendiary, employing high or low filler explosive materials to explode or cause fires. IED's can come in many forms, ranging from small, easy to make pipe bombs to more sophisticated devices capable of mass damage and loss of life. These devices can be lightweight and easy to carry such as the backpacks of the Boston Marathon bombers; however, they can also be large enough that use of a vehicle to transport is necessary, such as the bombing of the Alfred P. Murrah Federal Building in Oklahoma City. IED's can also be made of numerous chemicals and hazardous materials and may include the use of shrapnel such as nails or ball bearings.

The components are readily available, as are detailed instructions to construct such a device. Large, powerful devices can be outfitted with timed or remotely triggered detonators and can be designed to be activated by light, pressure, movement, or radio transmission. The potential exists for single or multiple bombing incidents in single or multiple municipalities. Historically, less than five percent of actual or attempted bombings were preceded by a threat. Explosive materials can be employed covertly with little

[303] https://www.dhs.gov/xlibrary/assets/prep_ied_fact_sheet.pdf

signature and are not readily detectable. Secondary explosive devices may also be used as weapons against responders and the public in coincident acts.[304]

Cyber Attack

Cyber terrorism is the premeditated use of disruptive activities, or the threat thereof, against computers and/or networks, with the intention to cause harm or further social, ideological, religious, political or similar objectives, or to intimidate any person in furtherance of such objectives. Cyberterrorists use information technology to attack civilians and draw attention to their cause. This form of terrorism could severely disrupt the U.S. financial sector and banking, communications, transportation systems, business operations, and all major government infrastructure that relies on computers and the Internet.

This may mean that they use information technology, such as computer systems or telecommunications, as a tool to orchestrate a traditional attack. More often, cyberterrorism refers to an attack on information technology itself in a way that would radically disrupt networked services. For example, cyber terrorists could disable networked emergency systems or hack into networks housing critical financial information.[305] For more information on cyber-attacks please see the *Cyber Incident Profile* on page 314.

Active Shooter

An active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area. Multiple active shooters is a group that participates in a random or systematic shooting spree demonstrating their intent to continuously harm or kill others. In most cases, active shooters use numerous types of firearms and there is no pattern or method to their selection of victims. Active shooter situations are unpredictable and evolve quickly, with most active shooter situations over within 10 to 15 minutes. Warning signs that someone may be planning an attack are:[306]

- Increasingly erratic, unsafe, or aggressive behaviors.
- Hostile feelings of injustice or perceived wrongdoing.
- Drug and alcohol abuse.
- Marginalization or distancing from friends and colleagues.
- Changes in performance at work.
- Sudden and dramatic changes in home life or in personality.
- Financial difficulties.
- Pending civil or criminal litigation.
- Observable grievances with threats and plans of retribution.

The Department of Homeland Security defines certain characteristics of an active shooter as the following:[307]

- Active shooters are likely to engage more than one target. They may target particular individuals or they may be intent on killing as many randomly chosen people as possible.

[304] https://www.fema.gov/pdf/plan/managingemerconseq.pdf
[305] http://www.crime-research.org/library/Cyberterrorism.html
[306] https://www.dhs.gov/sites/default/files/publications/dhs-pathway-to-violence-09-15-16-508.pdf
[307] https://www.alicetraining.com/active-shooter/

- Active Shooters often go to locations with high concentrations of people, such as schools, theaters, shopping centers, or other places of business.
- Active shooters often, but not always, are suicidal and may attempt suicide by police. Escape from the police is usually not a priority of an active shooter. Most active shooters do not attempt to hide their identity.

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be High, meaning destruction of property occurs.

This hazards Environment Magnitude was determined to be Medium, meaning some damage to the environment occurs.

2. Geographic Areas Affected by Terrorism

It is almost impossible to predict where and when a terrorist attack could occur. Generally, terrorists target densely populated or high profile areas, making any of the state's major urban areas a potential target. High profile infrastructure such as government and state buildings, amphitheaters, amusement parks, ports, and airports are also at risk of a potential attack. The specific motivations of terrorists dictate target selection; therefore, any location within the State of Florida has the potential to become a target of terrorism.

3. Historical Occurrences of Terrorism

Table 65 summarizes the major terrorism events in Florida since the attacks in New York City on September 11, 2001.

Table 65: Florida Historical Occurrences, Terrorism Events, 2001-2017

Date	Information
December 2001	Richard Reid unsuccessfully attempted to blow up an American Airlines Paris-to-Miami flight by placing explosives in his shoes.
November 2006	In Sanibel, Florida, a small bomb was found in a parking lot located among three restaurants. Authorities said the eight inch-by two inch-by three inch bomb was connected to a cell phone. It was rigged so that if the phone was called, the device would explode. The Lee County bomb squad responded to the scene and dismantled the device. Two other restaurants and a nearby road were closed for about four hours.

Date	Information
May 2010	The Federal Bureau of Investigation (FBI) investigated a pipe bomb found at the scene of the May 10, 2010 attack at the Islamic Center of Northeast Florida (ICNEF) in Jacksonville, Florida. There were 60 people in the building at the time of the attack.[308]
May 2011	The FBI arrested three Pakistani-Americans, including father and son imams from South Florida mosques, charging them with providing financing and other material support to the Pakistani Taliban.[309]
January 2012	Sami Osmakac, an American citizen born in the former Yugoslavia who is a Florida resident, was charged with plotting a terrorist spree around Tampa, including bombing nightclubs, destroying bridges, and shooting police officers in the name of radical Islam.[310]
June 12, 2016	Omar Mateen, an American citizen born in New York, killed 49 people and injured 53 others when he entered an Orlando, Florida nightclub and fired using multiple weapons. He had been previously investigated by the FBI in 2013 and 2014. It was the deadliest attack since September 11, 2001, and the worst mass shooting in modern U.S. history.[311]
January 6, 2017	Estaban Santiago, an American citizen from Alaska, opened fire at the Ft. Lauderdale-Hollywood International Airport in Ft. Lauderdale, Florida. Santiago checked a bag with a gun inside on a flight from Alaska to Florida and after departing the flight took his bag to the bathroom and loaded the weapon. He opened fire in baggage claim, killing 5 people and wounding 6. Over 40 were injured in the chaos and shuffle to evacuate.[312]

4. Probability of Future Terrorism Incidents

There is no sure way to predict future terrorism events as most typically occur without warning. The probability of a major terrorist event in the State of Florida is perceived to be high, and planning must be done as part of the larger national DHS initiatives. The Florida Division of Law Enforcement (FDLE) plays a large part in providing the state with critical intelligence and serves as a prevention measure to the state.

[308] Imm, J. (2010, May 13). Florida: FBI Investigating Mosque Pipe-Bombing as Possible Domestic Terrorism. Retrieved from R.E.A.L. website: http://www.realcourage.org/2010/05/florida-fbi-investigation/

[309] Harris, G. (2011, May 14). Florida Men Accused of Aiding Pakistani Taliban. The New York Times. Retrieved from http://www.nytimes.com/2011/05/15/world/15taliban.html

[310] Brown, R. (2012, January 9). Florida Man Charged With Plotting Terror Campaign in Name of Islam. The New York Times. Retrieved from http://www.nytimes.com/2012/01/10/us/florida-man-charged-with-plotting-strikes-in-name-of-islam.html?_r=1

[311] Zambelich, A., & Hurt, A. (2016, June 26). 3 Hours In Orlando: Piecing Together an Attack and Its Aftermath. Retrieved from NPR website: https://www.npr.org/2016/06/16/482322488/orlando-shooting-what-happened-update

[312] Shoichet, C. E. (2017, January 7). Ft. Lauderdale Airport Suspect 'Came Here Specifically To Attack', FBI Says. Retrieved from CNN website: http://www.cnn.com/2017/01/06/us/fort-lauderdale-airport-incident/

FDLE is part of an ongoing assessment of the state's vulnerability and coordinates efforts to prepare for, prevent, mitigate, respond to, and recover from acts of terrorism that affect the state. [313]

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

5. Terrorism Impact Analysis

- Public
  - Witnesses are at risk of PTSD and survivor's guilt following a large scale attack.
  - Fear throughout the affected community, and the country, is high causing a hazardous environment.
  - Civilians are a target for attacks and are at risk.
  - Exposure to Hazardous Materials is a possibility and could affect the nearby population and first responders.
  - Lack of clean running water can cause unsanitary conditions and dehydration.
- Responders
  - First responders are at risk of PTSD and other health issues following a violent attack.
  - First Responders are a target for second wave attacks and are at risk during rescue operations.
  - Exposure to Hazardous Materials is a possibility and could affect the nearby population and first responders.
  - Lack of communications and disruption of critical services can delay emergency response times.
- Continuity of Operations (including continued delivery of services)
  - Tourism can decline following an attack and could cause lost revenue to a community and the economy.
  - Airports in surrounding areas may close causing delays, leaving travelers stranded.
  - Streets blocked with debris or closed due to proximity can cause street congestion and slow down response times and evacuation routes.
  - Bridges could be closed causing issues evacuating and responding.
  - Train disruptions can cause delays and stranded passengers.
  - Communication grid overload can cause the system to crash following a large attack.
  - Damage to phone lines can cause issues getting information and calling for emergency services.
  - Loss of Internet can affect numerous industries and emergency response.
- Property, Facilities, Infrastructure
  - Bridges could be destroyed or damaged causing issues evacuating a community.

[313] http://www.fdle.state.fl.us/cms/Domestic-Security/Domestic-Security-Home.aspx

  - Train tracks could be damaged or destroyed causing further delay in passengers and cargo being transported.
  - Cars in the vicinity could be damaged or destroyed.
  - Roads can be damaged or destroyed causing prolonged delays and reduced access for evacuation.
  - Damage to buildings can include:
    - Collapse (full/partial)
    - Windows blown out
    - Fire
  - Damage or destruction of government buildings could delay necessary services for the community.
  - Damage or destruction to critical infrastructure such as places of travel, banks, and utilities could cause stress and hardship within the community.
  - Outages can be widespread.
  - Damage to power grid can prolong outages.
- <u>Environment</u>
  - Exposure to Hazardous Materials is a possibility and could affect the environment and wildlife.
  - Could contaminate the food and water sources.
  - Damage to green spaces.
- <u>Economic Condition</u>
  - Prolonged loss of revenue could cause businesses to close and the economy to suffer.
  - Loss of wages could affect citizens' ability to buy necessities and could affect the economy.
  - The economy (business, personal, and government) could be affected if banks are closed or not able to access the Internet.
- <u>Public Confidence in Jurisdiction's Governance</u>
  - Lack of communication from leadership to the public.
  - Evacuation timeframe
  - Response timeframe
  - Recovery timeframe
  - Not stopping an attack could lead to a loss of respect or confidence.

6. 2018 LMS Integration

The following counties profile terrorism:

- Brevard
- Broward
- Calhoun

- Charlotte
- Collier
- Dixie
- Duval
- Escambia
- Flagler
- Glades
- Gulf
- Hendry
- Highlands
- Hillsborough
- Indian River
- Jackson
- Lee
- Leon
- Levy
- Madison
- Manatee
- Marion
- Martin
- Orange
- Osceola
- Palm Beach
- Pinellas
- Putnam
- Seminole
- St. Johns
- St. Lucie
- Sumter
- Wakulla
- Walton
- Washington

7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

Though Florida recognizes that state facilities are vulnerable to terrorism, the abstract way in which terrorism occurs creates a vacuum of high-level detailed vulnerability and risk assessment. Counties with large populations, major transportation hubs, theme parks or cruise ships, and those with a large influx of tourism are the most at risk for a terrorist attack.

8. Vulnerability Analysis and Loss Estimation of State Facilities

Though Florida recognizes that state facilities are vulnerable to terrorism, the abstract way in which terrorism occurs creates a vacuum of high-level detailed vulnerability and risk assessment. As such, while it is prudent to recognize the threat, there is not a viable manner in which to quantitatively communicate the vulnerability or loss of facilities compared to other hazards.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 12.

<table>
<tr><th colspan="5">TERRORISM</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">In the Code of Regulations, terrorism is defined as “the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.” This is something that is difficult to mitigate against due to sheer unpredictability. Florida faces a particular threat from events involving terrorism due to the booming tourist industry, international ports, etc.</td><td rowspan="4">HIGH</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>High</td><td>High</td><td>Medium</td></tr>
</table>

Agricultural Disruption Hazard Profile

1. Agricultural Disruption Description

Florida's subtropical climate provides a conducive environment for near year-round production of a variety of plant and animal agricultural commodities. Florida farmers and ranchers produce hundreds of distinct commodities, all contributing to an agricultural industry which produced over $8.4 billion in 2014. Its seaports, including deep draft ports, and its proximity to the markets of the Caribbean basin make an ideal trade center and regional hub. However, the tropical climate brings with it vulnerability to severe weather and increased disease and pest pressure. Its status as an international tourist and business destination increases the dangers that new plant and animal diseases or invasive species will be unintentionally introduced.

Figure 108: Florida Commodities

Florida's 48,000 farms and ranches cover 9.5 million acres across the state, and produce a variety of products. The largest categories by value include, among others: citrus, vegetables, nursery and greenhouse products, berries, and livestock. In 2014 Florida ranked:

- 1st nationally in value of production of tomatoes, watermelons, snap peas, squash, sugarcane, oranges, and cucumbers.

- 2nd in greenhouse/nursery products, strawberries, sweet corn, bell peppers, spring potatoes, peanuts, tangerines, and avocados.
- 3rd in honey and cabbage.
- 7th nationally for fresh seafood production with 99.2 million pounds harvested and a dockside value of $257.7 million.[314]
- 7th in the U.S. for agricultural exports, with over $4 billion of agricultural commodities shipped in 2015.
- 12th nationally in the number of egg layers on farms in 2014.

The livestock industry produced $1.97 billion in cash receipts in 2013. As of January 1, 2015 there were 1.7 million head of cattle on farms and ranches in Florida, including 916,000 head of beef cows and 124,000 head of milk cows. Florida's poultry farmers maintained an average of 8.6 million layers in 2014, producing 2.39 billion eggs and 66.7 million broilers. Nursery and greenhouse products totaled just over $1.62 billion in cash receipts in 2013.

With the risk of invasive pests, diseases, and severe weather, Florida's economy has a lot to lose when faced with hazards. As an example of how damaging an exotic pest can be, the detection of oriental fruit flies in Miami-Dade County in 2015 triggered a quarantine lasting several months, with economic losses that may have exceeded $1 billion. In addition, the fact that Florida produces the majority of its fruit and vegetable crops during the winter means product is in the field and close to harvest during the coldest months of the year, rendering it vulnerable to freezes which can destroy a significant portion of a crop at the height of its production window. [315]

The Florida Department of Agriculture and Consumer Services (FDACS), the Florida Department of Health (FDOH), and the Florida Department of Business and Professional Regulation (FDBPR) are the three primary state agencies that are tasked with preventing, preparing for, responding to, and ensuring recovery from food and feed emergencies and incidents in Florida. Currently, Florida has established the Food Emergency Response Plan, an annex to the Comprehensive Emergency Management Plan (CEMP)[316], to govern the operational concepts, policies, and plans required to achieve the broad objectives for a response of one or more agencies. [317]

Citrus

Florida is a main producer of citrus within the United States, which includes oranges, grapefruits, tangerines, lemons, and limes. In 2014, Florida produced 59% of total U.S. citrus production with 60% of the total U.S. value for oranges, 58% of the total value for grapefruit and 9% of the total value for tangerines. In 2014 Florida's share of U.S. citrus production was 124 million boxes. The top five citrus producing counties in Florida in 2014 were Polk (19.9 million boxes), Hendry (16.3 million boxes), Highlands (14.9 million boxes), DeSoto (13.7 million boxes), and Hardee (10.5 million boxes). Oranges

[314] http://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development/Education/For-Researchers/Florida-Seafood-and-Aquaculture-Overview-and-Statistics
[315] http://freshfromflorida.s3.amazonaws.com/Media%2FFiles%2FMarketing-Development-Files%2FFlorida_Agriculture_by_the_Numbers_Brochure_2014.pdf
[316] http://www.floridadisaster.org/documents/CEMP/2012/FERP%2011-8-2011.pdf
[317] Florida Agricultural Disaster Profile. Fresh from Florida, Florida Department of Consumer Services, Mar. 2017.

comprise the vast majority of citrus leaving the state and approximately 90% of the oranges produced in the state are squeezed for juice. Florida is second only to Brazil in global orange juice production and the state remains the world's leading producer of grapefruit. Florida produces a significant amount of the United States' supply of citrus, with major oversees export markets including Canada, Japan, France, and the United Kingdom. The citrus industry generates close to $1 billion in tax revenues helping support schools, highways, and healthcare services.

Citrus also has a positive impact on Florida's environment. The modern grove design allows for large areas of undeveloped land which provides an excellent wildlife habitat and natural buffer between farmlands and urban development. University of Florida researchers recently observed more than 159 native species of wildlife within grove ecosystems. Research shows that for every acre of mature trees, 16.7 tons of oxygen is produced per year.[318]

Pests and disease is a risk when dealing with citrus groves. The most common pests include mites, psyllids, scales, weevils, and leaf miners. Common diseases include citrus greening, canker, citrus black spot, and phytophthora. Severe weather such as tropical cyclone conditions, heavy rain, extreme heat or cold, and drought all pose risks to the Florida citrus industry. Below are the harvest months for some of Florida's citrus crops.

Table 66: Florida Citrus Crop Harvest Months

Crop	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Navel Orange	X	X	X	X	X							
Ambersweet	X	X	X	X	X							
Hamlin Orange	X	X	X	X	X	X	X					
Pineapple Orange				X	X	X	X					
Temple					X	X	X					
Valencia Orange					X	X	X	X	X	X		
White Grapefruit	X	X	X	X	X	X	X	X	X	X		
Colored Grapefruit	X	X	X	X	X	X	X	X	X	X		
Seedy Grapefruit				X	X	X	X					
Nova Tangelo		X	X									
Minneola Tangelo					X	X						
Robinson Tangerine	X	X	X									
Sunburst Tangerine		X	X	X	X							
Avocado	X	X	X	X	X	X				X	X	X

[318] http://www.visitflorida.com/en-us/eat-drink/facts-about-florida-citrus-oranges.html

Field Crops

Field crops are defined as crops that feed animals, such as corn, small grains, soybeans, and hay. The field crop definition could also include cover crops. On small farms, field crops can be a rotation crop with other high value crops, such as vegetables. For example, vegetable fields can be rotated with hay crops, such as orchard grass, to give the soil a rest from intensive cultivation.

Acreage harvested in 2014 for corn, cotton, hay, peanuts, soybeans, and wheat totaled 679 thousand acres, with harvested acres increasing for soybeans 37,000 acres, peanuts 167,000 acres, and hay 320,000 acres. Florida producers harvested 412,000 acres of sugarcane for sugar and seed in 2014, and production was up 10% from the previous year. The value of production for the 2013 crop was $505 million. The 2014 total value of production of corn, cotton, cottonseed, hay, peanuts, pecans, soybeans, and wheat totaled $385 million, an increase of 1% from the previous year's total of $380 million.[319]

Pests and disease is also a risk when dealing with field crops. Some common pests include the sugarcane borer, white grubs, wireworms, yellow aphid, and lesser cornstalk borer. Signs of infestation can include, but are not limited to, pinholes in leaves and holes in stalks. Water management issues throughout South Florida, as well as occasional drought and the erosion or depletion of the muck soils in which the crops grow, are ongoing problems. As with all areas, severe weather such as tropical cyclone conditions, heavy rain, extreme heat or cold, and drought all pose risks to field crops. Below are the harvest months for some of Florida's field crops.

Table 67: Florida Field Crop Harvest Months

Crop	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Corn for Grain	X											X
Corn for Silage											X	
Corn for Forage	X	X										
Cotton		X										
Peanuts	X	X										
Potatoes							X	X	X	X		
Soybeans		X	X									
Sugarcane			X	X	X	X						
Winter Wheat										X		
Hay	X	X	X							X	X	X

[319] http://freshfromflorida.s3.amazonaws.com/Media%2FFiles%2FMarketing-Development-Files%2FFlorida_Agriculture_by_the_Numbers_Brochure_2014.pdf

Vegetables, Melons and Berries

In 2014 Florida accounted for 39% of the total U.S. value for tomatoes, 39% of cucumbers, 35% of snap beans, 27% of bell peppers, 21% of squash, 19% of watermelons, and 18% of sweet corn. Florida is also known for being the largest producer of strawberries during the winter. The 2014 value of production for the published major berries, Irish potatoes, vegetable, and watermelon crops totaled $1.55 billion. The harvested acreage for 2014 for the published major berries, potatoes, vegetable crops, and watermelons totaled 200,600 acres, with acreage increasing 6% for cabbage and 3% for strawberries. Production in 2014 of the published major berries, potatoes, vegetable crops, and melons totaled 39.8 million hundredweight and production increased on sweet potatoes, cabbage, tomatoes, cucumbers, and bell peppers. Florida ranks second behind California in the total value of fresh market vegetable production. Below are the harvest months for vegetables, berries, and melons.[320]

The main pests that affect vegetables, berries, and melons are the twospotted spider mite, thrips, and butterfly and moth larvae. Other pests include birds, slugs, and snails. Bird predation used to be viewed as a sporadic threat, but has rapidly been growing to the point where losses are measured in millions of dollars. While irrigation can usually prevent drought damage to crops, excessive rain and flooding can increase pest and disease pressure. Freezes during any crops harvest window can likewise damage both plants and fruit.

Table 68: Florida Vegetable, Melon, and Berry Harvest Months

Crop	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Snap Beans					X	X	X	X	X	X		
Blueberries										X	X	
Cabbage							X	X	X	X		
Carrots						X	X	X	X	X		
Cantaloupes						X	X	X	X	X	X	
Celery							X	X	X	X		
Sweet Corn					X	X	X	X	X	X	X	
Cucumbers					X	X	X	X	X	X		
Eggplant					X	X	X	X	X	X	X	X
Romaine						X	X	X	X	X		
Peppers					X	X	X	X	X	X		
Potatoes								X				
Strawberries								X	X			
Tomatoes					X	X	X	X	X	X	X	

[320]https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Brochures/Florida_Agriculture_by_the_Numbers_Brochure_2014.pdf

Livestock

In January 2015 Florida ranches were home to 1.7 million head of cattle. Florida dairies produced 2.51 billion pounds of milk in 2014, up from 2.38 billion pounds in 2013. Florida ranks 19th in the nation in number of milk cows and cash receipts from Florida milk production in 2014 totaled $705 million, up from $560 million in 2013. Dairies aren't the only source of livestock production; beef cows in the state of Florida total over 900,000. Nationally, Florida ranked 10th in beef cows and 16th in total cattle. The primary cattle crop is calves which are shipped to other states to be finished and processed into beef. During 2014, 830,000 calves were born with an estimated value of $400 million. Cash receipts from cattle and calf production were $868 million in 2014 with Florida's beef cattle herd valued in excess of a billion dollars. Florida is home to five of the top ten largest cow/calf operations in the United States and nearly half of all Florida agricultural land is involved in cattle production. [321]

Florida has had several regional winners and one national winner of the National Cattlemen's Environmental Stewardship Award for their conservation efforts. Lands that are used for cattle production are also important green space for wildlife and native plant habitat, aquifer recharge, and carbon recovery. Grass and forages used for cattle production are renewable resources occurring in a great variety of landscapes typically found on cattle ranches, including improved pastures, wetlands, and marsh, woodlands, and prairies. Florida's cattle industry was also a leader in the formulation and adoption of agricultural industry Water Quality Best Management Practices and other standards.

Florida has a large poultry production operation as well, with 9 million hens and pullets of laying age on farms in 2014. Florida's egg production was 2.39 million eggs, up from 2.2 million in 2013. In 2014 the total value of Florida egg production was $219 million and the total value of broilers produced was $246 million. Florida broiler production in 2014 totaled 387 million pounds.[322]

Diseases are a risk within the livestock population and non-endemic animal diseases can threaten the industry if introduced. For example, in 2016, a livestock quarantine was in effect in Monroe County due to an outbreak of New World Screwworm. Infested animals can die of infection in as little as seven days. Excessive rain and flooding can create conditions even more favorable to the spread of disease and infestations in livestock. Drought, extreme heat or cold, and severe weather can also affect the livestock industry.

Forestry and Horticulture

Of Florida's 17.3 million acres of forestland, 15.4 million acres of timberlands support economic activities. The total economic output of all wood, forestry, and paper products in 2013 was $16.34 billion and it created 80,665 full and part-time jobs. The paper products industry supported 73% of income paid to the forestry labor force in 2013 and total forestry related jobs had an income impact of $4.15 billion.

[321] https://www.freshfromflorida.com/content/download/17161/272486/P-00044.pdf

[322] https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Brochures/Florida_Agriculture_by_the_Numbers_Brochure_2014.pdf

Florida ranked second in the United States for the production of floriculture crops and provided 22.2% of the U.S. supply in 2014. Total greenhouse and nursery values in 2014 were $1.62 billion and made up 19.2% of Florida's total cash receipts.[323]

Weather can severely impact both of these agricultural industries. Drought, flooding, extreme heat or cold, and wildfires are the highest natural threats to forestry and horticulture industries. Invasive species of plants and pests can also destroy various plants and trees.

Aquaculture and Seafood

Aquaculture is the process of farming or growing animals or plants in a controlled water environment. Florida's top farm-raised aquatic products are tropical fish, aquatic plants, fish, shellfish, and alligators. Aquaculture sales for human consumption in 2014 totaled $24.1 million and included freshwater or marine fish, clams, oysters, shrimp, prawns, alligators, and turtles. Florida aquaculturists also produce plants or animals for ornamental markets with sales totaling $35.5 million in 2014.[324]

Florida ranked seventh nationally in 2014 for fresh seafood production with 99.2 million pounds harvested and a dockside value of $257 million. Florida ranked 1st in the United States by value of grouper, pompano, mullet, stone crab, pink shrimp, spiny lobsters, and Spanish mackerel. Florida anglers caught 92% of the nation's supply of grouper, pompano, mullet, stone crab, pink shrimp, spiny lobsters, and Spanish mackerel and accounted for almost 100% of spiny lobster (99.9%) and stone crab (99.5%) harvested in the United States. Florida's total value for commercial seafood estimated in 2014 is $258 million, up 11.7% from $231.1 million in 2013. This is equivalent to 92.5 million pounds.[325]

The largest threats to aquaculture and seafood are diseases, non-native or invasive species, and severe weather.

Pests and Diseases

Agriculture is one of the state's largest industries and the introduction of pests or a disease outbreak can severely impact the economic prosperity of the industry. Crops are grown in Florida year round and animals are raised and slaughtered, which provides a large percentage of U.S. food resources. Due to our convenient trade location, products are imported and exported rapidly which can introduce unknown diseases and pests to the area. Disease can spread and create an outbreak, killing untold numbers of plants and animals. Pests ranging from birds, rodents and insects such as beetles, caterpillars, and grasshoppers, can ruin a crop harvest and severely impact the economic community.

University of Florida Entomology and Nematology Department personnel identified a number of arthropod pests that can severely damage agricultural crops, ornamental plants, turf, fruiting plants, and trees. The ability to rapidly identify the pests or damage can help prevent costly or aesthetic losses to crops and landscaping.

[323] https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Brochures/Florida_Agriculture_by_the_Numbers_Brochure_2014.pdf
[324] http://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development/Education/For-Researchers/Florida-Seafood-and-Aquaculture-Overview-and-Statistics
[325] http://freshfromflorida.s3.amazonaws.com/P-01587.pdf

The table below outlines some of the pests within the Florida agricultural industry.

Table 69: Florida Significant Pests[326]

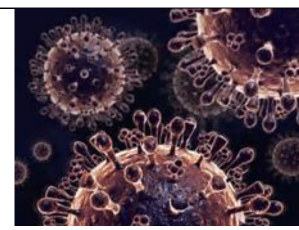
Name	Description	Picture
Drosophila melanogaster Also known as the Fruit Fly.	Fruit flies are one of the most potentially destructive pests in the world. Fruit flies have a wide host range of fruits, vegetables and nuts, and most of Florida's crops, including citrus, fall within the host range.	
Singhiella simplex Also known as the Fig Whitefly.	Generally, whitefly populations are kept in check by natural parasites and predators, but in agriculture crops or on ornamentals, where man has upset the natural balance, consistent high and often damaging populations may occur.	
Oxycarenus hyalinipennis Also known as the Cotton Seed Bug.	The Cotton Seed Bug is a serious pest of cotton and other plants in the cotton family. This pest can also feed on other fruits and seeds of unrelated plants, causing significant damage.	
Romalea microptera Also known as the Eastern Lubber Grasshopper.	Because of its size and coloration, even one individual in a garden is conspicuous, but occasionally local populations explode to such an extent that the grasshoppers can seriously damage ornamentals, row crops, and citrus groves.	

Disease is prevalent in livestock and crops within Florida and can easily spread under certain conditions. Multiple factors can influence disease development in plants and animals including age, environment, weather, and genetics of the pathogen populations. Human involvement can also speed up the spread of unknown diseases. The introduction of disease may severely limit the ability to move, harvest, slaughter, and export plant or animals products. Widespread disease can cause significant losses to farmers and economic hardship on the community.

326 http://ipm.ifas.ufl.edu/applying/Florida's_Major_Agricultural_Pests.shtml

The table below outlines some of the top plant and animal diseases within the Florida agricultural industry.

Table 70: Florida Significant Plant and Animal Diseases[327]

Name	Description	Picture
Citrus Black Spot	Citrus black spot is a fungal disease marked by dark necrotic spots or blotches on the rinds of fruit. It produces early fruit drop, reduces crop yields and, if not controlled, renders the highly blemished fruit unmarketable.	
Laurel Wilt Disease	The disease is caused by a fungus (Raffaelea lauricola) that is introduced into host trees by a nonnative insect, the redbay ambrosia beetle.	
Avian Influenza	Avian influenza is a serious disease concern for the poultry industry and animal health officials alike. While influenza virus strains in birds vary considerably in severity, some can be devastating to domestic poultry.	
New World Screwworm	New World screwworms are fly larvae (maggots) that can infest livestock and other warm-blooded animals, including people. They feed on the animal's living flesh and, if not treated, infestations can be fatal.	

One Method to Mitigate…

Currently, the United States Department of Agriculture (USDA) administers a biological control program[328] (biocontrol) that involves the reduction of pest populations through the use of natural enemies such as parasitoids, predators, pathogens, antagonists, or competitors to suppress pest populations. The goal of this program is to safeguard America's agricultural production and natural areas from significant economic losses and negative impacts caused by insects, other arthropods, nematodes, weeds and diseases of regulatory significance to the federal government, state departments of agriculture, tribal governments

[327] http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Pests-Diseases/Citrus-Diseases/Other-Pests-of-Citrus/Key-to-Whitefly-of-Citrus-in-Florida

[328] https://www.aphis.usda.gov/aphis/ourfocus/planthealth/sa_domestic_pests_and_diseases/sa_bio_control

and cooperators within the continental United States and on American territories through the use of biological control agents.

Invasive Species

An invasive species can be any kind of living organism such as an amphibian, plant, insect, fish, fungus, or bacteria that is not native to an ecosystem and which causes harm. Invasive species can harm the environment, the economy or even, human health. Species that grow and reproduce quickly, and spread aggressively, with potential to cause harm, are given the label of “invasive”.

Invasive species are primarily spread through human activities, often unintentionally. People, and the goods we use, travel around the world very quickly, and they often carry uninvited species with them. Ships can carry aquatic organisms in their ballast water, insects can get into wood shipping crates that are sent around the world, ornamental plants can escape into the wild and become invasive, or invasive species can be intentionally or accidentally released, such as pets or smuggled exotic species.[329]

Invasive species cause harm to wildlife and agricultural production in many ways. When a new and aggressive species is introduced into an ecosystem, it might not have any natural predators or controls. It can breed and spread quickly, taking over an area. Native wildlife may not have evolved defenses against the invader or they cannot compete with a species that has no predators.

Sporobolus jacquemontii or West Indian Dropseed is a weedy grass native to the West Indies and was introduced into Florida in the early 1900’s. It became prevalent in cattle grazing pastures where it crowds out forage grasses and isn’t palatable for cattle. It is very difficult to control and in recent years it has begun to spread into natural areas such as palmetto prairies and open flatwoods.[330]

Eichhornia crassipes, or the water hyacinth, is a floating plant. This invasive nuisance often jams rivers and lakes with thousands of tons of floating plant matter. A healthy acre of water hyacinths can weigh up to 200 tons. In Florida, where for 100 years this weed had the upper-hand in water management, the water hyacinth in most places is under “maintenance control”, meaning field crews constantly work to keep the plant numbers at their lowest possible levels, so that the rivers and lakes remaining usable.

Aquatic invasive species are a problem within the state of Florida as it is surrounded by water and has numerous lakes and rivers throughout. A variety of aquatic nonnative species have caused damage to Florida’s ecology and economy and continues to cost Floridians considerable sums of money to prevent, control, or eradicate. Throughout Florida invasive nonnative species clog waterways (hydrilla) and power plant cooling intakes (green and Charru mussels) or affect native aquatic plants, shellfish, or fish populations through: competition for space (green mussel, water lettuce), diet overlap, herbivory (island apple snail), predation (lionfish), or by interbreeding with native species (red-eared slider turtle).[331]

The lionfish, introduced into Atlantic waters around the 1980’s, is a devastating invasive species. This fish can breed rapidly, kills out other predators for food and has the ability to thrive in almost any environment. The introduction of this fish has harmed commercial and sport fishing industries and has caused a decrease in certain types of fish Florida’s economy relies on.

[329] http://www.nwf.org/Wildlife/Threats-to-Wildlife/Invasive-Species.aspx
[330] http://plants.ifas.ufl.edu/plant-directory/eichhornia-crassipes/
[331] http://www.freshfromflorida.com/content/download/5697/97665/Aquatic-Invasive-Species.pdf

Severe Weather

Florida may be considered the most vulnerable state in the nation to the impacts from hurricanes, tropical storms, and tropical depressions – collectively known as tropical cyclones. In addition to tropical cyclones, the State of Florida is vulnerable to numerous other types of severe weather such as severe storms, tornadoes, hail, drought, various types of flooding, and extreme temperatures, including freezes. The vulnerable geography and environment of the state combined with the subtropical climate creates continuous threats from these severe weather events.[332]

Freezes in Florida create a threat to the agricultural industry as the state's winter-season vegetable growers historically face a high risk of freeze damage from cold temperatures. Vulnerable crops include citrus and sugarcane crops and commercial foliage (tropical plants, trees, and shrubs). Florida accounts for about one-third of fresh-market supplies of warm-season vegetables during the late fall to early spring period. Therefore, a freeze in Florida can cause substantial disruption in the nation's supply of vegetables as well as economic problems. Additionally, prolonged freezes can have a detrimental effect on the state's aquaculture industry, specifically fish farming.

Within the State of Florida, the Department of Environmental Protection and the regional Water Management Districts monitor water supply and flood potential within their regions. A drought or flood can severely impact the industry causing loss of crops, the inability to replant, loss of livestock, and increased chance of disease or pest infestation. The Florida agricultural industry relies on water distribution to ensure healthy livestock and crops. In 2010 Florida withdrew 2.9 billion gallons of water a day for irrigation purposes and 213 million gallons a day for industrial fresh water supplies. This water is used for irrigation on farms, watering livestock, and aquaculture and fisheries within the state.[333]

Frequency

This hazard was determined to occur annually, giving it a Frequency ranking of Very Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Low, meaning no injuries or deaths are recorded.

This hazards Infrastructure Magnitude was determined to be High, meaning destruction of property occurs.

This hazards Environment Magnitude was determined to be High, meaning significant damage to the environment occurs.

[332] http://floridadisaster.org/documents/CEMP/2014/2014%20Hazard%20Annexes/2014%20Tropical%20and%20Non-Tropical%20Severe%20Weather%20Annex%20%20to%20the%20CEMP.pdf
[333] https://s3images.americangeosciences.org/agi/statefactsheets/FL_GeoscienceInYourState_AGI.pdf

Potential Effects of Climate Change[334]

The potential impact of climate change on Florida's agriculture, commercial forests, and natural ecosystems is hard to predict; however, scientists agree that the warmer climate means more intense weather – heavier rains, higher probability of large storms, and longer periods of drought.

Commercial crops such as sugar cane, tomatoes, and even citrus may see a decline in yields over the long term with higher temperatures. Commercial forestry could see an increase in wildfire risk and the altered temperatures could change attributes of tree species. Climate change may also have an effect on the threat of invasive pests and species. The warmer conditions would likely affect livestock health and productivity as well as increase the risk of disease and outbreaks.

The aquaculture and commercial fishing industry could potentially see a decline in fish quantity and a move to deeper waters. Aquaculture farms may see a decline in health and productivity of fish and plant farms.

2. Geographic Areas Affected by Agricultural Disruption

All of Florida is vulnerable to Agricultural Disruption. Because of the sub-tropical environment, it is easy to grow crops and flowers, as well as keep livestock and aquatic animals. This climate also brings hazards that can disrupt production. If the weather is too hot or too cold, crops may not thrive. Most of Florida's fruits and vegetables are harvested in the winter months making them vulnerable to freezing and cold temperatures. Invasive species are another source of agricultural disruption with introducing a new insect, intentionally or unintentionally, being incredibly detrimental.

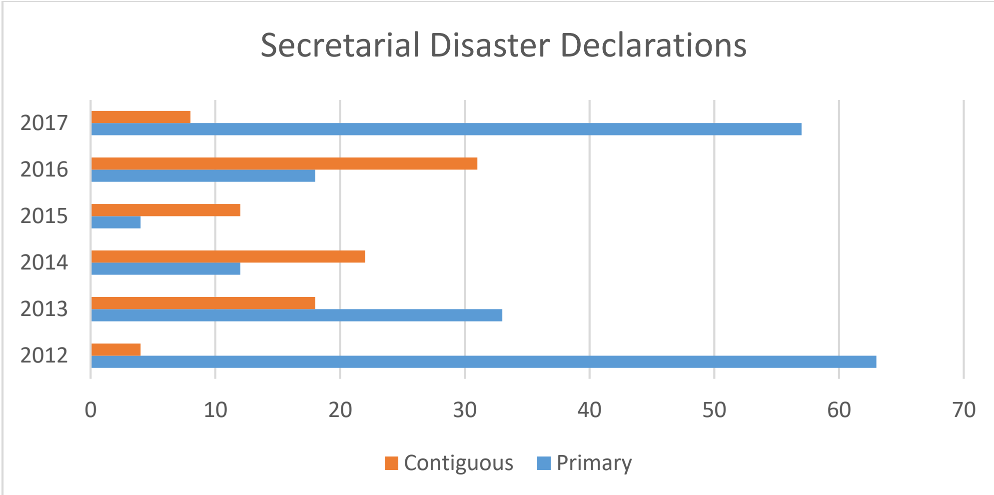
All counties in the state are potentially at risk, with the southern central counties at a slightly elevated risk due to the number of large farmlands. While there are human health implications from infected food supply, it is likely that the economic consequences of an agricultural disruption will be the most significant.

3. Historical Occurrences of Agricultural Disruption

Agricultural related disasters can be common within the state and the Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans available to those suffering losses in affected counties and in counties that are adjacent to a designated county. In addition, other emergency assistance programs, such as Farm Service Agency (FSA) disaster assistance programs use disaster designations as an eligibility trigger. The chart below displays the Secretarial Disaster Declarations from 2012 through 2017.

[334] https://www.usda.gov/oce/climate_change/effects_2012/CC%20and%20Agriculture%20Report%20(02-04-2013)b.pdf

Figure 109: Florida Secretarial Disaster Declarations, 2012-2017



Florida's lionfish threat began off the Atlantic coast in the late 1980s. Experts suspect the invasion started when someone released aquarium lionfish into the wild. Lionfish don't throw marine ecosystems out of balance in their native Indo-Pacific region, but in the Atlantic, research shows the rapid increase in lionfish coincided with a 65-percent native fish decline. The introduction of this fish has harmed commercial and sport fishing industries and has caused a decrease in certain types of fish Florida's economy relies on.

In 2015, Miami-Dade County declared a state of emergency for an Oriental Fruit Fly outbreak.[335] The Florida Department of Agriculture and Consumer Services Division of Plant Industry (FDACS-DPI) confirmed it to be the largest outbreak on record and a quarantine of 85 square miles was instituted. Florida destroyed more than eight tons of infected fruit and sales from the quarantine area were on hold until the pest was eradicated. As of February 2016, the Oriental Fruit Fly has been eradicated from Miami-Dade County.

In 2015, Broward, Collier, Hendry, Miami-Dade, Monroe and Palm Beach counties were affected by a severe drought.[336] According to the South Florida Water Management District, rainfall levels were well below average. Mobile irrigation labs were deployed to assist with agricultural irrigation schedules and water usage. Drought can have direct impacts on the agricultural industry such as reduced crop production, increased fire risk, increased livestock mortality rates, and increased risk of pest and disease infestation.

In 2015, Escambia, Holmes, Jackson, Okaloosa, Santa Rosa, and Walton counties experienced excessive rain, wind, and flooding. This type of inclement weather can result in loss of crops, damage or the prevention of planting crops. It can also lead to loss of livestock and feed. Damage to facilities and needed

[335] http://www.freshfromflorida.com/News-Events/Press-Releases/2016-Press-Releases/Commissioner-Putnam-Announces-Successful-Oriental-Fruit-Fly-Eradication-in-Miami-Dade-County
[336] https://www.wcc.nrcs.usda.gov/ftpref/support/drought/dmrpt-20160908.pdf

equipment can be seen following excessive winds and the areas are at a higher risk of disease and pest infestation.

In 2016, the USDA Animal and Plant Health Inspection Service (APHIS) confirmed the presence of New World screwworm in Key deer from National Key Deer Refuge in Big Pine Key, Florida. USDA's National Veterinary Services Laboratories in Ames, Iowa, confirmed it was a local infestation of New World screwworm (Cochliomyia hominivorax). It was the first local infestation in the United States in more than 30 years. In response to this infestation, the state declared an agricultural state of emergency in Monroe County, Florida.[337]

4. Probability of Future Agricultural Disruption

While the probability of a specific disease, pest, or weather threat is impossible to predict with certainty, tropical cyclones are a seasonal threat which cause damage through excessive rain, flooding, and wind. The introduction of pests and diseases which have been previously unknown in Florida or which have been long absent from the state will remain a threat as long as Florida remains open to the international trade and tourism it needs for its economic health. Even threats that can be anticipated, such as hurricanes and freezes, require a large and concentrated effort to mitigate the potential damage to crops and livestock, and sometimes damage or loss is unavoidable.

This hazard was determined to occur annually, giving it a Probability of Very Likely.

5. Agricultural Disruption Impact Analysis

- Public
    - Human health from diseased crops or livestock
    - Invasive species that are poisonous or dangerous
- Responders
    - N/A
- Continuity of Operations (including continued delivery of services)
    - Reduced supply of crop or livestock product.
    - Invasive species and plants can cause water flow disruptions and clogged transportation.
    - Livestock and plant health due to disease or pest infestation.
- Property, Facilities, Infrastructure
    - N/A
- Environment
    - Decline in natural species.
    - Loss of habitats and grazing land for livestock and marine animals and plants.
    - Invasive species and plants can cause water flow disruptions and clogged transportation.
- Economic Condition
    - Cost of quarantines for disease or pest infestation.
    - Cost to eradicate invasive species.

[337] Staletovich, J. (2015, September 15). Florida declares farming emergency to deal with Asian fruit flies in Miami-Dade. The Miami Herald. Retrieved from http://www.miamiherald.com/news/local/environment/article35324667.html

- Economic losses for the state.
- Lost wages for farm workers
- Lost revenue for farmers.

- Public Confidence in Jurisdiction's Governance
    - The government could appear to not be in control.

6. 2018 LMS Integration

The following counties currently profile Agricultural Disruption or Pests and Diseases:

- Brevard
- Broward
- Charlotte
- Glades
- Hendry
- Hillsborough
- Indian River
- Jackson
- Lee
- Leon
- Palm Beach
- Martin
- Orange
- Osceola
- Pinellas
- Polk
- Seminole
- St. Lucie

7. Vulnerability Analysis and Loss Estimation, by Jurisdiction

Due to the nature and unpredictability of agricultural disruptions, all property and infrastructure within the agricultural industry in the State of Florida is at risk to these events. The majority of the agricultural industry is in the southern part of the state and so these counties would have an elevated risk for agricultural disruptions.

Florida recognizes that jurisdictions are vulnerable to agricultural disruptions, but there is a lack of data to quantify the economic vulnerability from these hazards compared to others.

8. Vulnerability Analysis and Loss Estimation of State Facilities

Due to the nature and unpredictability of agricultural disruptions, all property and infrastructure within the agricultural industry in the State of Florida is at risk to these events. The majority of the agricultural industry is in the southern part of the state and so these counties would have an elevated risk for agricultural disruptions.

Florida recognizes that jurisdictions are vulnerable to agricultural disruptions, but there is a lack of data to quantify the economic vulnerability from these hazards compared to others.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be High, with a score of 13.

<table>
<tr><th colspan="5">AGRICULTURAL DISRUPTION</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Hazards in the agricultural industry come in the form of pests, disease, and severe weather conditions. The industry brings in $8 billion in cash receipts to the state of Florida. Weather poses a threat to Florida due to the subtropical nature of the state and the time of year that many of the harvests take place. As a popular destination for tourism and international business, the state faces an increased threat of foreign disease and pest infestations, as well.</td><td rowspan="5">HIGH</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Very Likely</td><td>Very Likely</td><td>Low</td><td>High</td><td>High</td></tr>
</table>

Biological Incident Hazard Profile

1. Biological Incident Description

A Biological Incident can refer to many different types of incidents, involving bacteria, viruses, or toxins, all of which can be harmful or deadly to humans and animals. These various bacteria, viruses and toxins are referred to as biological agents.

It is important to understand the terminology of diseases. Many people use the words pandemic and epidemic interchangeably although they have very distinct definitions. An epidemic is a widespread occurrence of an infectious disease in a community at a particular time. A pandemic refers to an epidemic that has spread beyond a region to infect large numbers of people worldwide. Another often confused word is endemic, which refers to a disease or condition that is regularly found among a specific group of people or geographic area.

Below are several examples of common agents that cause illness and disease in humans. Some are commonly known and naturally occurring, others are emerging diseases or zoonotic diseases that have recently spread in humans. These diseases are waterborne, foodborne, and airborne. Additionally, outbreaks can be naturally occurring or they can be the result of a terrorist act.[338]

Terminology

Some of the most virulent and prevalent biological agents include the following:[339]

- Anthrax
- Avian Flu
- Botulism
- Ebola
- Hantavirus
- Legionnaires disease
- Mold
- Plague
- Ricin
- Severe Acute Respiratory Syndrome (SARS)
- Smallpox
- Tularemia
- Viral Hemorrhagic Fevers (VHFs)

Emerging Diseases

The terms emerging disease or emerging biological agent refers to infections that have increased recently or are threatening to increase in the near future. According to the National Center for Emerging and

[338] https://www.osha.gov/SLTC/biologicalagents/index.html
[339] https://www.cdc.gov/phpr/publications/2008/appendix6.pdf

Zoonotic Infectious Diseases, these infections could be completely new or previously unknown; completely new to a specific area; reappearing in an area; or could be caused by bacteria that have become antibiotic resistant. Examples of each of these types are discussed below.

- The Bourbon Virus was discovered in Kansas in 2015 and is considered a completely new emerging disease. The Middle East Respiratory Syndrome (MERS) was also considered a completely new disease when it appeared in the Middle East in 2012.
- Until 2013, Chikungunya, which causes severe and disabling symptoms, was reported in Africa, Asia, Europe and the Indian and Pacific Ocean nations, but never in the Americas. Travelers likely brought the virus to the Americas and it has now spread to Florida.
- Dengue Fever is not endemic to the United States, but it has appeared a few times, due to traveler transmission, such as in Texas.
- Some infections have changed and become resistant to antibiotics, such as Methicillin-resistant Staphylococcus aureus (MRSA) as well as a strain of Tuberculosis. These cases are very difficult to cure, more expensive to treat, and often result in patient death.[340]

Chemicals

Biotoxin chemicals could also be released, intentionally or unintentionally, causing mass illness. These agents include, blister agents, blood agents, acids, choking agents, incapacitating agents, anticoagulants, metals, nerve agents, organic solvents, tear gas, toxic alcohols, or vomiting agents.[341]

Zoonotic Diseases

Zoonotic Diseases are those that are spread between animals and people. Commonly known examples are:

- Lyme disease, which is spread by ticks;
- Salmonella, which is spread by poultry; and
- Rabies, which is spread by mammals.

Additionally, there are several diseases that are spread by household pets, such as Cat Scratch Disease, E.coli, and Ringworm.[342]

Foodborne Illnesses

There are also several types of Foodborne Illnesses. The most common are those caused by Norovirus, Salmonella, Clostridium perringens, and Campylobacter. Other commonly known foodborne illnesses and diseases are:

- Botulism,
- Cholera,
- E.coli,

340 https://www.cdc.gov/ncezid/who-we-are/index.html
341 https://emergency.cdc.gov/chemical/index.asp
342 http://www.cdc.gov/healthypets/diseases/index.html

- Listeria,
- Shigella, and
- Travelers Diarrhea.

The CDC estimates that 48 million people get sick every year from foodborne illnesses and that 128,000 are hospitalized and 3,000 die. The CDC Food Safety division describes over 250 foodborne diseases, most of which are infections caused by bacteria, viruses, parasites, toxins, or poisonous chemicals. Each disease causes different symptoms, but nausea, vomiting, abdominal cramps, and diarrhea are very common. More severe symptoms include life threatening neurologic, hepatic, and renal syndromes.[343]

Foods most associated with foodborne illness include raw meat, poultry, shellfish, eggs, and unpasteurized milk. Unwashed fruits and vegetables processed in unsanitary conditions can also cause illness.

A foodborne illness is considered a foodborne disease outbreak when two or more people get the same illness from the same source.[344]

The CDC works with state and local health departments and hospitals to monitor possible disease outbreaks. The Emerging Infections Program has several programs, including the Active Bacterial Core Surveillance, FoodNet, Healthcare Associated Infections-Community Interface, and Influenza monitoring programs.[345]

Because there are hundreds of possible agents that could cause a deliberate or non-deliberate outbreak or epidemic, this profile will not go into great detail for all agents. Of particular concern to the United States and the State of Florida is the Zika Fever Virus and Influenza, so these will be profiled in greater depth below.

Zika Virus

Zika is a virus that is spread by the bite of an infected mosquito. There are many types of mosquitos but only the Aedes species spreads Zika. These mosquitos bite during both the day and night. Other types of transmission include sexual intercourse with an infected person and blood transfusions from an infected person. Zika can also be passed from a pregnant woman to her fetus and cause certain birth defects, such as microcephaly and Guillain-Barre syndrome. While Zika is not deadly, there is no vaccine or medicine to cure Zika. Symptoms of Zika include fever, rash, joint pain, red eyes, muscle pain, and headache and these symptoms last for several days to a week. A blood or urine test can confirm a Zika infection.

Zika was discovered in 1947, with the first human cases confirmed in 1952. Outbreaks of the disease have been reported in Africa, Southeast Asia, and the Pacific Islands. Outbreaks occurred in 2015 in Central and South America, Mexico, and the Caribbean. In 2016, Zika was introduced to Miami, Florida and began to be transmitted locally in southern Florida and Brownsville, Texas, as well as three US territories.

The Florida Department of Health (FDOH) identified a 1 square-mile in Miami-Dade County as having locally transmitted, mosquito-borne Zika; travel guidance was issued for these areas. The specific location

[343] https://www.osha.gov/SLTC/biologicalagents/index.html
[344] http://www.cdc.gov/foodsafety/foodborne-germs.html
[345] http://www.cdc.gov/ncezid/dpei/index.html

changed over the next few months, but in December 2016, it was determined that there were not any new locally transmitted cases of Zika and travel guidance was removed. There are currently no areas of ongoing, active transmission of Zika by mosquitoes in Florida. All previously identified zones have been cleared.[346]

Influenza

Influenza is a contagious respiratory illness caused by a flu virus. It can cause mild to severe illness and can lead to death. According to the Florida Department of Health, the best way to prevent the flu is to get a flu vaccine each fall, but individuals will need to be re-vaccinated each year because the flu viruses change. People aged 65 years and older; children, especially those from the ages of 6 months to 23 months; and those with chronic medical conditions are more likely to have complications with influenza. However, it is important to remember that anyone can get the flu and that serious complications can occur at any age.

While about 114,000 people are admitted to the hospital each year for an influenza infection, about 36,000 people in the United States die from influenza each year.

As of March 2017, Florida was reporting widespread activity for the eighth week in a row. The most common subtype detected at the Bureau of Public Health Laboratories statewide has been the strain Influenza A (H3).

A weekly Florida Influenza Surveillance report is available on the Florida Department of Health website. There are historical reports dating back to the 2001-2002 influenza season.[347]

Pandemic Influenza, or PanFlu, refers to an influenza pandemic where a novel and highly contagious strain of the influenza virus emerges, affecting populations around the world. According to FDOH, these influenza pandemics have occurred every 11-39 years; however, it has been more than 30 years since the last pandemic. Florida's geographic and demographic characteristics make it particularly vulnerable to the importation and spread of influenza. This is because nearly one third of Floridians reside in urban and suburban areas of just 3 counties, including large populations of immigrants. Additionally, Florida has a large tourism industry, two Interstate road systems, and 13 international airports, the largest being Orlando and Miami.

FDOH has estimated that an influenza pandemic could result in up to 10 million infected Floridians, with 5 million chronically ill and up to 18,000 deaths. The demands on the healthcare industry in Florida would overwhelm the state's capabilities. Additionally, because a pandemic influenza would likely affect the entire United States, mutual aid from other states would likely be unavailable. Because of this serious risk that pandemic influenza poses to Florida, an Influenza Pandemic Preparedness Plan has been developed, with cooperation from surrounding states and the CDC. The plan describes disease surveillance, emergency management, vaccine delivery, laboratory and communications activities, and agency coordination.[348]

[346] https://www.cdc.gov/zika/index.html
[347] http://www.floridahealth.gov/diseases-and-conditions/influenza/florida-influenza-surveillance-reports/index.html
[348] http://www.floridahealth.gov/diseases-and-conditions/influenza/pandemic-influenza.html

The DEP influenza pandemic response plan can be found online. [349]

Vibrio Vulnificus

Vibrio vulnificus is a natural bacterium that normally lives in warm, brackish seawater. These infections are rare but serious.[350]

Table 71: Vibrio Vulnificus, Florida Cases

Year	Cases	Deaths
2008	16	6
2009	24	7
2010	32	10
2011	35	13
2012	26	9
2013	41	12
2014	32	7
2015	45	14
2016	46	10

Transmission

There are several methods of disease transmission.

The diseases and illnesses that could cause an outbreak or biological incident are communicable. This means the disease is spread through direct or indirect contact with the disease.

Direct contact refers to an infected person or animal actually touching an uninfected person.

Indirect contact refers to an environmental reservoir, such as a contaminated surface or atmospheric dispersion. Another example of indirect transmission is the spread of disease via vectors, such as mosquitoes and other insects.[351] Diseases can also be waterborne or foodborne, meaning indirect transmission occurs by consuming contaminated water or food.[352] [353]

Bioterrorism

Bioterrorism is a concern in today’s society. Bioterrorism is the deliberate release of viruses, bacteria, or other germs (agents) used to cause illness or death in people, animals, or plants. These agents are typically found in nature, but can be altered by terrorists to increase their ability to cause disease or to increase their transmission capabilities. These agents are usually either airborne, waterborne or foodborne.[354]

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[349] http://www.dep.state.fl.us/secretary/events/annex_k_pandemic.pdf
[350] http://www.floridahealth.gov/diseases-and-conditions/vibrio-infections/vibrio-vulnificus/index.html?utm_source=flhealthIndex
[351] http://www.who.int/csr/disease/WHO_PED_flyer_2014.PDF?ua=1
[352] https://www.cdc.gov/ncezid/who-we-are/index.html
[353] https://www.fema.gov/pdf/emergency/nrf/nrf_BiologicalIncidentAnnex.pdf
[354] https://emergency.cdc.gov/bioterrorism/index.asp

A Biological Attack refers to an intentional release of a disease-causing agent against humans, animals, or plants. The purpose of this type of attack is to cause illness, death, fear, social disruption, and economic damage.[355]

Terrorists could release biological agents in many different forms, including, aerosol, food, water, infected humans, infected animals, insects, physically (mail), or agriculturally.[356]

Biological agents are readily available because they are found in nature. Agents could also be stolen from laboratories. Additionally, agents could be manipulated in a laboratory to make them more destructive. For example, an agent could be manipulated into an aerosol form for easier dispersion, or an agent could be altered to shorten an incubation period to make containment nearly impossible.

Biological agents are organized into three categories, based on their capabilities for damage and their availability.

- Category A agents are high priority and pose the highest risk to the public and national security. These agents are easily spread, result in a high death rate, can cause public panic and social disruption, and require special response.
- Category B agents are moderately easy to spread, result in moderate illness rates and low death rates, but still require special response.
- Category C agents are emerging pathogens that can be manipulated for mass dispersion, are easily available, easily produced, and have high morbidity and mortality rates.

The United States plans for specific agents that are possible bioweapons, mostly Category A and B. These agents include:

- Anthrax
- Botulism
- Brucellosis
- Plague
- Smallpox
- Tularemia
- Viral Hemorrhagic Fever

Symptoms

Aside from the health impacts, there are psychological impacts after a biological attack, including anger, fear and social isolation. There is also the risk of mass hysteria and mass psychogenic illness, which means that people display similar symptoms as others who were infected, but are not actually infected. This is a real condition, noted by the DSM-IV-TR as epidemic hysteria, where people develop symptoms similar to those who were infected. Decontamination is required after a biological agent exposure. If there is a

[355] https://emergency.cdc.gov/bioterrorism/index.asp
[356] https://www.dhs.gov/xlibrary/assets/prep_biological_fact_sheet.pdf

contamination, deliberate or not, of livestock or produce, it may be necessary to halt the movement and recall possibly contaminated products to limit exposure.[357]

SNS Stockpile

The National Pharmaceutical Stockpile was created in 1999 to ensure the nation was prepared for a bioterrorism event. The idea was to have large quantities of medical supplies that could be delivered to a community in need within a short timeframe. This program became the Strategic National Stockpile (SNS) and has been used several times in recent years, including during the 9/11 attacks, natural disasters, H1N1 PanFlu, Ebola outbreak, and the Zika virus. The packs include antibiotics, chemical antidotes, antitoxins, vaccines, antivirus drugs, Personal Protective Equipment, and ventilators, among other things. There is also a 12 hour Push Package available for when a biological incident is occurring but the specific agent is unknown. This includes 50 tons of emergency medical resources and is the first line of federal support. Another resource is a CHEMPACK which contains nerve agent antidotes and can be used even when the agent is unknown because the medicine treats the symptoms of exposure. This is a useful tool because more than 90% of the population lives within 1 hour of a location. The SNS locations are placed strategically across the United States to be available to all areas in a short amount of time.[358]

Surveillance

Public Health agencies monitor the occurrence of certain diseases in an attempt to stop an outbreak from continuing or from becoming more severe. The CDC Emerging Infections Program has several programs to monitor the health of the nation, including Active Bacterial Core Surveillance (ABCs), FoodNet, Healthcare Associated Infections – Community Interface (HAIC), as well as monitoring reports of influenza. These programs translate surveillance and research into informed policy and public health practices.[359] Additionally, there is a tool called the National Bio Surveillance Integration System to help determine the difference between a normal or common illness and a biological incident. Medical centers are often the first place that the introduction of biological agents is detected, whether it is natural or a biological attack. The CDC also has an Outbreak Response Team that coordinates multistate foodborne outbreak investigations for agents such as Salmonella and E.coli. This team coordinates with the USDA to remove contaminated food from commerce. In addition to this team, the CDC has a program called Foodborne Diseases Centers for Outbreak Response Enhancement which responds to bacteria outbreaks in food.[360]

Control

To prevent a disease outbreak, mass isolation or quarantine of affected or potentially affected people may be necessary. International and interstate travel may also need to be restricted to prevent further outbreak. Decontamination of exposed individuals may be necessary. Food, animals and agricultural products may need to be quarantined as well. Livestock and poultry may need to be either vaccinated or depopulated and the movement of animals and equipment may be restricted. All of these actions would

[357] https://www.dhs.gov/xlibrary/assets/prep_biological_fact_sheet.pdf
[358] http://www.cdc.gov/phpr/stockpile/history.htm
[359] http://www.cdc.gov/ncezid/dpei/index.html
[360] http://www.cdc.gov/foodsafety/foodborne-germs.html

be intended to prevent the spread of disease. It is important to note that the restriction of travel and movement of animals could severely impact the economy.[361]

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

2. Geographic Areas Affected by Biological Incidents

The entire State of Florida could be affected by Biological Incidents. Transportation hubs, like Orlando and Miami, could be more likely to experience these incidents and would likely be the first to experience these incidents because of the large population and high numbers of travelers.

3. Historical Occurrences of Biological Incidents

Table 72: Florida Historical Occurrences, Biological Incidents

Date/Time Period	Description
1340s	Europeans threw plague-infected cadavers over city walls to infect those within.
World War I	Germans infected Allied livestock with anthrax and glanders.
World War II	Unit 731 in Manchuria dropped plague infected fleas in Japanese controlled area in China, which led to more than 50,000 deaths.
1984	Cult followers of Baghwan Shree Rajneesh sickened 751 people in Oregon with salmonella bacteria in salad bars in 10 restaurants, intended to keep people from voting in the election.
1990s	The cult Aum Shinrikyo attempted and failed to release anthrax and botulinum toxin in Tokyo. The cult did succeed in carrying out a chemical attack with Sarin nerve agent.
2001	Anthrax attacks through the US mail infected 11 people, 5 of which died, with inhalational anthrax. An additional 11 people were infected with skin anthrax.
2014	In September of 2014, the first confirmed case of Ebola within the United States was documented. The man had traveled to Dallas, Texas from Liberia with no apparent symptoms. The patient passed away in October. In October 2014, two

[361] https://www.fema.gov/pdf/emergency/nrf/nrf_BiologicalIncidentAnnex.pdf

	health care workers from Texas Presbyterian Hospital contracted the disease and have since recovered. A New York City health care worker returned home after contracting the disease in Guinea and has since recovered.

Florida has only experienced one biological incident in recent history. In 2016, there were 1,122 cases of Zika virus and 118 cases in 2017. There were cases of local transmission of the Zika virus in four Miami communities in 2016, but all were designated as clear by the end of that year.[362]

4. Biological Incident Impact Analysis

- Public
  - Injury or death from exposure
  - Fear
- Responders
  - Injury or death from exposure
- Continuity of Operations (including continued delivery of services)
  - Services may be interrupted because of employee absenteeism
- Property, Facilities, Infrastructure
  - N/A
- Environment
  - Could affect animal species and cause drop in numbers.
- Economic Condition
  - If employee or consumer absenteeism is a major issue, businesses may be forced to close
- Public Confidence in Jurisdiction's Governance
  - Public will begin to doubt in capabilities and take precautions themselves, perhaps dangerously

5. Probability of Future Biological Incidents

It is somewhat likely that a biological incident will occur in Florida. The Zika outbreak occurred and it is likely that other diseases will affect the state.

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

6. 2018 LMS Biological Incident Integration

The following counties profile Biological Incidents (or a similar hazard) in their most recent LMS plan:

- Brevard
- Broward

[362] https://www.dhs.gov/xlibrary/assets/prep_biological_fact_sheet.pdf

- Clay
- Collier
- Dixie
- Duval
- Escambia
- Flagler
- Glades
- Gulf
- Hendry
- Hillsborough
- Indian River
- Leon
- Madison
- Martin
- Miami-Dade
- Nassau
- Orange
- Osceola
- Palm Beach
- Pinellas
- Polk
- Seminole
- St. Lucie
- Sumter
- Volusia

7. Vulnerability Analysis and Loss Estimation by Jurisdiction

It is impossible to determine a jurisdiction's vulnerability, however it is reasonable to claim that every county is somewhat vulnerable to a biological incident occurring. Additionally, a loss estimation is difficult to determine because of several unknown variables, but it is reasonable to claim that losses could range from minimal, to extreme, depending on the disease and the magnitude.

8. Vulnerability Analysis and Loss Estimation of State Facilities

A state facility is not itself vulnerable to a biological incident. However, a state facility may notice impacts from a biological incident, such as employee absenteeism, leading to disrupted operations and therefore lost wages and productivity.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 9.

<table>
<tr><th colspan="5">BIOLOGICAL INCIDENTS</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Biological Incidents are incidents involving bacteria, viruses, or toxins that can all be harmful or deadly to humans and animals. These various actors are called biological agents. It is important to note that these can be naturally occurring or intentionally placed into a society. The act of intentional placing these biological agents into a society in order to harm people or animals is referred to as bioterrorism. Florida has encountered issues involving Influenza and the Zika virus in the past.</td><td rowspan="4">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>High</td><td>Low</td><td>Low</td></tr>
</table>

Mass Migration Hazard Profile

1. Mass Migration Description

Florida's proximity to the Caribbean basin makes it a vulnerable point of entry for a massive influx of immigrants and refugees entering the United States. While the majority come from the Caribbean, they can come from other locations such as Mexico and South America. Even though all of Florida's counties are subject to receiving such arrivals, the most vulnerable counties are Monroe, Miami-Dade, Broward, Palm Beach, Martin, St. Lucie, Indian River, Lee, and Collier. The consequences of a mass arrival of undocumented entrants include the threat of health, safety, and welfare of citizens and that of entrants that may be detained for an extended length of time. Florida has participated with the federal government in the development of a federal Mass Immigration Annex that bridges components of the federal Mass Immigration Plan with the National Response Framework.

Mass Migration

According to United States Code Title 8, Chapter 12, the definition of mass migration is a migration of undocumented aliens that is of such magnitude and duration that it poses a threat to the national security of the United States, as determined by the President. This usually refers to an event, or series of events, that may take place over the course of several years or even decades. The event could be economic, social, or political in nature but it is something that causes a mass exodus from the country of origin. While some counties and state agencies use a specific number that determines when an emergency exists for operational purposes, the State of Florida understands that a continuous and high volume flow of migrants over a period of time, could exceed the normal capabilities of the local offices of the United States Coast Guard and Customs and Border Protection.[363] The main problem posed by undocumented individuals is the inability of the system to assimilate them without affecting already strained local economies and infrastructure such as health, medical, and social services. The Pew Research Center estimates that in fiscal year 2014, Florida had an influx of 850,000 (+/- 40,000) undocumented migrants and that the state experienced growth in undocumented population at the national average of 250%.[364]

Unaccompanied Minors

Children who arrive in the United States alone or who are required to appear in immigration court on their own often are referred to as unaccompanied children or unaccompanied minors.[365] Unaccompanied alien child (UAC) is a technical term defined by law as a child who has no lawful immigration status in the United States; has not attained 18 years of age; and with respect to whom—there is no parent or legal guardian in the United States; or no parent or legal guardian in the United States is available to provide care and physical custody. Unaccompanied children generally leave their home countries to join family already in the United States; escape abuse, persecution or exploitation in their home country; or to seek employment or educational opportunities in the United States. The age of these individuals, their

[363] http://www.floridadisaster.org/documents/CEMP/2012/MASS%20MIGRATION%20ANNEX.pdf
[364] http://www.pewhispanic.org/interactives/unauthorized-trends/
[365] https://www.americanimmigrationcouncil.org/sites/default/files/research/a_guide_to_children_arriving_at_the_border_and_the_laws_and_policies_governing_our_response.pdf

separation from parents and relatives, and the hazardous journey they take make unaccompanied children especially vulnerable to human trafficking, exploitation, and abuse. When a child who is not accompanied by a parent or legal guardian is apprehended by immigration authorities, the child is transferred to the care and custody of the Office of Refugee Resettlement (ORR).[366] Federal law requires that ORR feed, shelter, and provide medical care for unaccompanied children until it is able to release them to safe settings with sponsors (usually family members), while they await immigration proceedings.

The following table shows the total number of unaccompanied children released to sponsors in fiscal year 2017.

Table 73: Unaccompanied Minors Released to Sponsors, FY 2017[367]

County	Total number of children
Broward	282
Collier	186
Duval	122
Hillsborough	148
Lee	333
Manatee	53
Martin	91
Miami-Dade	930
Orange	185
Palm Beach	818

Mass Immigration

Immigration is the movement of people to another country, of which they are not natives, and where they do not possess citizenship, in order to settle or reside there. The definition of an immigrant or alien from the United States Code Title 8[368] means an applicant for admission coming or attempting to come into the United States at a port-of-entry, or an alien seeking transit through the United States at a port-of-entry, or an alien interdicted in international or United States waters and brought into the United States by any means, whether or not to a designated port-of-entry, and regardless of the means of transport. The Bureau of Economic and Business Research shows that migration or immigration is the primary source of Florida's population growth and the U.S. Census Bureau estimates that in fiscal year 2015, 86% of the total population growth since 2010 was due to net migration and immigration. Palm Beach, Broward, Miami-Dade, Orange, and Hillsborough counties see the highest influx of immigration and Miami-Dade alone accounted for a quarter of Florida's total foreign immigrants between 2005 and 2009. As with mass migration, an influx of immigrants to any particular county could overwhelm the local economy and infrastructure.

[366] https://www.acf.hhs.gov/orr/programs/ucs
[367] https://www.acf.hhs.gov/orr/resource/unaccompanied-alien-children-released-to-sponsors-by-county
[368] https://www.ecfr.gov/cgi-bin/text-idx?SID=29f9238515a0b92dcfa5f8f11f2d5abb&mc=true&node=se8.1.1_12&rgn=div8

Repatriation

Repatriation is the procedure where United States citizens and their dependents, who have been identified by the U.S. Department of State, are returned from a foreign country to the U.S. because of destitution, illness, war, threat of war, or a similar crisis. This could also include Third Country Nationals (TCN) who are individuals approved by the Department of State that are neither a U.S. Department of Defense dependent nor a U.S. citizen. Emergency Repatriation is the influx of 500 or more U.S. citizens or dependents from foreign countries. Through ORR agreements, states that are designated as ports of entry will be asked to activate their state emergency repatriation plan during an emergency repatriation.[369] Florida has three designated Ports of Debarkation and the bases and installations designated with primary responsibilities will be the lead agent. The American Red Cross is the lead agency on providing shelters, mass feeding, first aid, emergency communications, and access to financial assistance to those in need. Florida currently has a Repatriation plan that can be activated should the need arise.

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be High, meaning any deaths are recorded.

This hazards Infrastructure Magnitude was determined to be Low, meaning little to no damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

2. Geographic Areas Affected by Mass Migration

Although it is possible that any Florida county could receive a migrant landing, either maritime or aviation, counties in the southern half of the state are most vulnerable due to geography. South Florida is in proximity to islands such as Cuba, Puerto Rico, Dominican Republic and Haiti, and the Gulf Coast is within proximity of Mexico. Mass migration can also occur domestically due to an impending hazard causing large groups of people to head north or inland to other counties in an effort to evacuate.

3. Historical Occurrences of Mass Migration

The 1980 Mariel Boatlift was one of the largest incidents of mass migration to affect Florida. Beginning in April 1980 and ending in October 1980, over 125,000 Cubans and between 40,000 and 80,000 Haitians made their way to South Florida. The Cuban President at the time, Fidel Castro, granted permission to all Cubans who wanted to leave access to the Port of Mariel. The United States Coast Guard was tasked with

[369] http://www.floridadisaster.org/documents/CEMP/2012/Repatriation%20Annex%20to%20the%20CEMP.pdf

assisting the boats and rafts making their way to Florida and it would become one of the largest operations they had ever undertaken during peacetime.[370]

In the autumn of 1991 a military coup overthrowing Haitian President Aristide led to a mass exodus of roughly 38,000 people towards South Florida. Many perished at sea on failing vessels or homemade rafts and those that survived were detained and interviewed at Guantanamo Bay before being forcibly sent back to Haiti. Of the thousands that left, roughly 200 were granted asylum in the United States with many of them settling in Florida’s metropolitan areas.[371]

The Cuban Exodus in August 1994 saw over 35,000 refugees on often handmade boats and rafts, fleeing to South Florida. Many died at sea but those that survived were apprehended by the United States Coast Guard and detained at Guantanamo Bay. In May 1995, almost all those detained, roughly 30,000 people, were released and allowed entry into the United States. Many of them settled in South Florida and this exodus would lead to a change in public policy and the creation of the “Wet foot, Dry foot” policy.[372]

While not an incident of mass migration, the 2010 Haiti Earthquake resulted in a number of unique immigration situations and challenges. Florida supported the repatriation of U.S. citizens, as well as helping Haitian and other foreign nationals with passports or visas into the U.S. 50,000 Haitians were brought into the United States under Temporary Protected Status (TPS) with many resettling in Miami and Orlando. Some Haitians visiting or residing in Florida at the time of the earthquake were unable or unwilling to return to their newly devastated homeland and were given TPS in order to remain in the United States.[373]

In 2016, 800 unaccompanied minors were transported to Homestead, Florida and placed within a temporary tent city. They came from multiple countries including Honduras, Guatemala, and El Salvador to escape violence, poverty, or abuse. The American Red Cross and the Office for Refugee Resettlement worked together to care for these children and ultimately place them with sponsors throughout the state.[374]

4. Probability of Future Mass Migration Events

There is no sure way to predict future mass migration events as most typically occur without warning. The probability of a migration influx in the State of Florida is perceived to be high, and planning must be done as part of the larger national DHS initiatives. As political unrest and large scale natural disasters continue to increase within the Caribbean and South American regions, there will be people wanting to leave. South Florida is in close proximity and has an extensive network of people from these countries in place. The Mass Migration Annex of the Florida State Comprehensive Emergency Management Plan provides augmentation information that connects with the U.S. Department of Homeland Security Plan entitled “Operation Vigilant Sentry” and subsequent revisions.

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370 https://fas.org/sgp/crs/row/R40566.pdf
371 http://www.crf-usa.org/bill-of-rights-in-action/bria-10-2-b-haiti-and-the-boat-people
372 https://www.hrw.org/legacy/reports/pdfs/c/cuba/cuba94o.pdf
373 http://www.migrationpolicy.org/article/haitian-immigrants-united-states/
374 https://www.local10.com/news/tent-village-near-homestead-air-reserve-base-prepared-to-shelter-refugee-children

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

5. Mass Migration Impact Analysis

- Public
  - Loss of life.
  - Injury.
  - Fear of going to law enforcement can lead to undocumented individuals not seeking help or evacuating in the event of a hazard.
  - Few resources available:
    - Food
    - School
    - Water
    - Work
    - Translators
    - Housing
- Responders
  - Public safety resources could be strained or depleted causing community wide problems.
  - Local law enforcement is affected with added population and confrontation with undocumented individuals.
  - Customs and Border Protection is responsible for ensuring all incoming immigrants have proper documentation and intervening with unauthorized entry into the state. This can lead to a strain on the agency.
  - Coast Guard is responsible for protecting the shores and intervening with any unauthorized entry into the state. This can lead to a strain on the agency.
- Continuity of Operations (including continued delivery of services)
  - Evacuations in the event of a hazard can get congested with additional population numbers.
  - Overwhelmed public service of too many people go to the same places, such as schools or jobs.
- Property, Facilities, Infrastructure
  - Strain on detention facilities following mass undocumented intervention could lead to economic strain and lack of space.
  - Education is used by undocumented families and can place a strain on local schools and facilities within a community.
  - Social services can be strained to accommodate incoming immigrants/migrants and unaccompanied children
- Environment
  - Additional pressure on the environment and natural resources.
  - Could bring invasive species.
- Economic Condition
  - A financial strain on communities is present when the population grows quickly and local communities, or the state, cannot account for them all in terms of services and emergency needs.
  - Growth of population can cause impacts to urban planning and resources such as local economies and social services.

- Public Confidence in Jurisdiction's Governance
    - Lack of ability to integrate these people reflects poorly on government.
    - Reports of mistreated detained immigrants reflects poorly on government.

6. 2018 LMS Integration

The following counties profile Mass Migration:

- Broward
- Dixie
- Escambia
- Indian River
- Levy
- Madison
- Martin
- Osceola
- Palm Beach
- Seminole
- St. Lucie
- Sumter

7. Vulnerability Analysis and Loss Estimation by Jurisdiction

Due to the nature and unpredictability of human-caused hazards, all property and infrastructure in the State of Florida is at risk to these events. Even though all of Florida's counties are subject to receiving such arrivals, the most vulnerable counties are Monroe, Miami-Dade, Broward, Palm Beach, Martin, St. Lucie, Indian River, Lee, and Collier.

Florida recognizes that jurisdictions are vulnerable to human caused hazards, but there is a lack of data to quantify the economic vulnerability from these hazards compared to others.

8. Vulnerability Analysis and Loss Estimation of State Facilities

Due to the nature and unpredictability of human-caused hazards, all state facilities could potentially be at risk. The facilities could become overwhelmed, have a lack of space, and programs could become drained.

Though Florida recognizes that state facilities are vulnerable to human caused hazards, there is a lack of data to quantify the vulnerability of facilities to these hazards compared to natural hazards.

9. Overall Vulnerability

Each category was given a number and when all 5 categories are added together, the overall vulnerability is a number between 5 and 15.

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 9.

<table>
<tr><th colspan="5">MASS MIGRATION</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Florida’s proximity to the Caribbean basin makes it a vulnerable point of entry for a massive influx of immigrants and refugees entering the United States. While the majority come from the Caribbean, they can come from other locations such as Mexico and South America. The consequences of a mass arrival of undocumented entrants include the threat of health, safety, and welfare of citizens and that of entrants that may be detained for an extended length of time.</td><td rowspan="5">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>High</td><td>Low</td><td>Low</td></tr>
</table>

Civil Disturbance Hazard Profile

1. Civil Disturbance Description

According to FEMA, civil disturbance, sometimes referred to as civil unrest, is an activity such as a demonstration, riot, or strike that disrupts a community and requires intervention to maintain public safety.[375]

Most protestors are law abiding citizens who intend their protest to be nonviolent; however, sometimes these situations become highly emotional and tense which can turn a peaceful crowd into a violent riot.

According to the US Army Civil Disturbance Operations Manual, civil disturbances and riots can arise from crowds. Crowds are gatherings of a multitude of individuals and small groups that have temporarily assembled in the same place, usually representing a group belief or cause.

There are two types of gatherings, impromptu and organized. Impromptu gatherings develop informally and by word of mouth, while organized gatherings involve well-established groups that plan and organize the gathering.

There are three phases of gatherings: the assembly process, the building of the crowd, and the dispersal process. The assembly process refers to the movement of people to a common location within a given period, usually coinciding with activities of individual or groups with a specific agenda, like yelling a slogan.

During the building of the crowd phase, it is important to note that not all participants are the same and that the majority of crowds are comprised of several small groups and only some individuals. Additionally, not all participants have the same motivations.

The dispersal phase is the movement of people from the assembly location to one or more alternate locations. Dispersal can be routine, emergency, or coerced. Routine dispersal is often specified in advance by organizers, while emergency dispersal occurs when people evacuate an area in response to an unexpected crisis. A coerced dispersal involves the use of force from law enforcement at some level; however, this is not necessarily the best or safest way to force crowd dispersal.

Most gathered crowds are orderly, nonviolent and do not cause problems for authorities, but there are three types of crowds that can create a civil disturbance. A Public Disorder is the basic breach of civic order, meaning the crowd has a tendency to disrupt the normal flow of things around them, such as traffic. A Disorder is escalated to a Public Disturbance, or a demonstration that is designed to cause turmoil and disruption. These crowds chant, yell, and sing to voice collective opinions. Finally, a Disturbance escalates to a Riot when it turns violent. The crowd suddenly becomes a mob that violently expresses itself by destroying property, assaulting others, and creating an extremely volatile environment.

Riots can be further categorized into communal, protest, commodity, and celebration riots. Communal riots are those involving a group of people with deep-seated ethnic, religious, or language differences. Protest riots are those involving people aggressively and sometimes violently opposing something.

[375] https://training.fema.gov/programs/emischool/el361toolkit/glossary.htm#C

Commodity riots involve an attack on property with vandalism, looting, or arson. Celebration riots are those involving a group of people celebrating some event, usually a sports team victory.

There are several types of crowds, including casual, sighting, agitated, and mob-like. Casual crowds are those that consist of people gathered in the same place but have nothing in common, such as a crowd at a mall. Sighting crowds are those where people have gathered in the same location for a specific event, such as a concert. Agitated crowds are similar to sighting crowds, but strong emotions are also present, which can spread, developing a sense of unity and changing the demeanor of the crowd from pleasant to yelling, screaming, crying, and name-calling. Finally, mob-like crowds are agitated crowds that are also aggressive, physical, and sometimes violent. While all types of crowds can turn violent, agitated and mob-like crowds have the greatest tendency to do so.

Crowd dynamics and how people act when they are part of a crowd are complex topics. Crowds provide a sense of anonymity and therefore a sense of invulnerability and anyone in a crowd is susceptible to behaving contrary to their normal behavior. Emotional contagion is a serious psychological factor of crowd dynamics, which provides a temporary bond of unity and can push a simple organized crowd into a mob.

Crowds, especially angry and organized crowds, use certain tactics to provoke law enforcement and defeat authorities. One common tactic is verbal abuse, such as obscene language, racial remarks, taunts, and ridicules to anger, demoralize, and provoke a physical response from law enforcement. Another common tactic is throwing rocks, bottles, smoke grenades, or Molotov cocktails to disrupt and confuse the control force. Other tactics include creating barricades to protect themselves and even feinting and flanking actions to attempt to engage, surround, or overpower the control force.

Crowds can become a riot or a violent mob very quickly. These are the types of civil disturbances that are of primary concern to the state of Florida. Violent crowds strike out physically at bystanders and others in the crowd, destroy private and government property, and often set fires and smash glass. Riots or mobs also often create barricades or physical barriers, using any available materials such as vehicles, trees, furniture, and fencing, to impede movement of authorities and to provide a source of protection against law enforcement.

Although violent riots or mobs are a serious concern, nonviolent crowds can be considered a civil disturbance too. Nonviolent actions can be disruptive if they are in direct conflict with instructions from authorities. Examples of disruptive nonviolent actions are refusing to leave when instructed, locking arms, and sitting in areas that authorities are attempting to clear.

Each local jurisdiction should have a civil disturbance response plan; however, it is important to remember that each incident is unique and intelligence about a specific group, such as their demonstrators, capabilities, and possible courses of action are key to developing a successful response plan. Additionally, the response plans should emphasize prevention and de-escalation, not confrontation.[376]

Frequency

This hazard was determined to occur about every 5-10 years, giving it a Frequency ranking of Likely.

[376] http://documents.theblackvault.com/documents/gardenplot/fm3-19CivilDisturbanceOPs.pdf

Magnitude

This hazards Injuries and Deaths Magnitude was determined to be Medium, meaning any injuries, but no deaths are recorded.

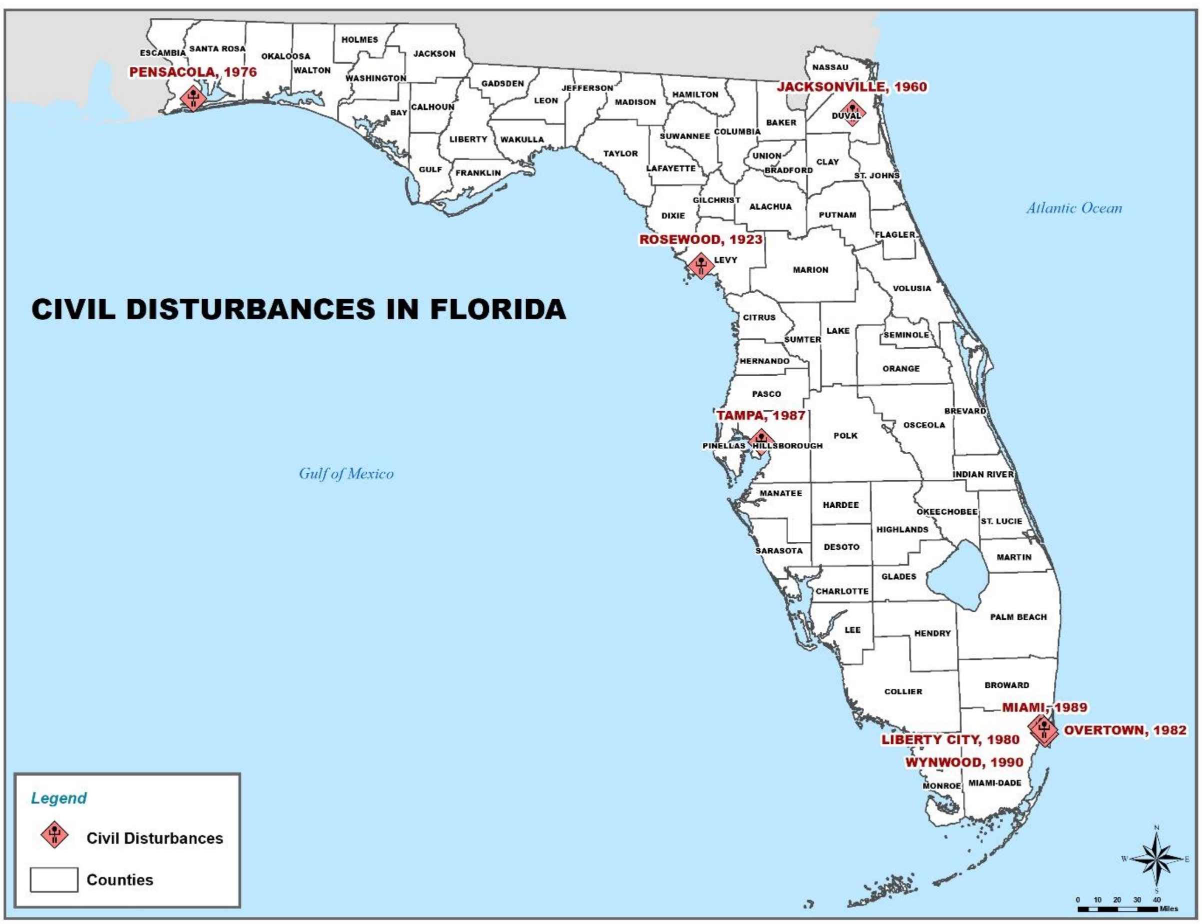
This hazards Infrastructure Magnitude was determined to be Medium, meaning significant damage to property occurs.

This hazards Environment Magnitude was determined to be Low, meaning little to no damage to the environment occurs.

2. Geographic Areas Affected by Civil Disturbance

Civil Disturbances tend to occur in urban areas, but can occur anywhere. Below is a map depicting major incidents of civil disturbance in Florida, which are discussed below in Historical Occurrences.

Figure 110: Florida Historical Occurrences, Civil Disturbance



3. Historical Occurrences of Civil Disturbance

Civil Disturbances have been occurring since the beginning of time. There are several examples of civil disturbances in Florida. Many of the examples below include some type of racial motivation, such as anger in response to police brutality against African Americans.

Table 74: Florida Historical Occurrences, Civil Disturbance

Date	Location	Description
1923	Rosewood	A mob of several hundred white men searched the area for Black men and burned almost every structure in Rosewood. Several Black men died. Survivors hid in swamps for days until they were rescued.
1960	Jacksonville	An angry white mob attacked Black youths for attempting to eat at a white only lunch counter, using ax handles (without the blades) and baseball bats. The attacks quickly turned into a riot in the downtown area involving whites and Blacks. Dozens were injured.
1976	Pensacola	A white school was desegregated leading to the ban of the racially insensitive mascot and use of the confederate flag. Hundreds of white students gathered and attempted to raise the confederate flag on the school flagpole and Black students responded with violence. The riot between the white students outside the school and Black students inside the school lasted for 4 hours, left 30 students injured, and caused extensive damage to the school.
May 17, 1980	Liberty City, Miami	A riot erupted after four white Miami Dade police officers were acquitted in the beating death of Black insurance agent Arthur McDuffie. This came after four other police brutality cases in Miami in 1979 and 1980. The riot lasted three days, 18 people died, 400 were injured, 116 businesses were looted and burned, and property damage totaled $100 million.
1982	Overtown, Miami	After police shot and killed a 21-year-old Black man, hundreds gathered at the scene. When homicide detectives arrived, a riot began. Seven people were injured and there was property damage, including police cars set on fire.
1987	Tampa	A police officer used a controversial chokehold to subdue a Black man in custody, who later died of suffocation. Later that evening, the media reported the arrest of a famous Black athlete from Tampa. That night a riot broke out with angry citizens throwing rocks and bottles. The violence lasted for several nights.
1989	Miami	There were three days of riots after Miami police shot and killed two unarmed Black men. When one of the police officers, who was Hispanic, was found guilty for this shooting, people celebrated in another riot.
1990	Wynwood, Miami	Riots occurred when a Miami police officer was acquitted after he beat a Puerto Rican drug dealer to death. Hundreds from the Puerto Rican community in Miami, who felt a sense of alienation and powerlessness, rioted, looting stores and setting fires.
October 24, 1996	St. Petersburg	A St. Petersburg police officer shot an 18-year-old Black man during a traffic stop. This came after St. Petersburg police had shot 5 other Black men already that year. Within 30 minutes of the shooting, over 100 protestors gathered at the scene. The rioters scuffled with police, threw rocks, bottles, stones, and Molotov cocktails, set vehicles on fire, including a news van, and broke windows of a responding fire engine. Police shot tear gas into the crowd but the situation became increasingly volatile. The Mayor declared a State of Emergency and brought in the Florida National Guard to help

		police regain control. Eventually, the Mayor met with community leaders to diffuse the situation. By the end there were 20 people arrested, 11 people injured, at least 28 cases of arson, and several stores looted. Riots broke out again a few weeks later when a grand jury did not indict the officers that were involved with the shooting on October 24.
November 19, 2000	Miami	During a recount of presidential election votes, hundreds of paid Republican operatives traveled to south Florida to protest the State's recount. Protestors were described as 50-year-old white lawyers with cell phones, Hermès ties, and Brooks Brothers suits. The demonstration turned violent when protestors tried to rush the doors of the Office of the Supervisor of Elections. People were trampled, punched, and kicked and sheriff deputies had to restore order.
2000	Miami	Riots broke out when US Immigration Officers stormed a home and took 6-year-old Elian Gonzalez and flew him to be with his father near Washington DC. After he was taken, his relatives that had been taking care of him in Miami and the rest of the community gathered in the streets, crying; soon they began to burn tires and disrupt traffic. They also kicked and spat at police, threw bus benches into streets, and blocked the road to the Miami International Airport. The situation was highly emotional and tense because of Cuban-American relations. The Cuban refugees living in Miami didn't want the boy to be forced to return to Cuba.
2003	Miami	More than 10,000 peaceful demonstrators protested Bush's free trade zone agenda at the trade ministers' meeting. Several dozen demonstrators grew violent and clashed with police, throwing bottles, rocks, and smoke bombs, and setting fires. Police responded with pepper spray, rubber bullets, and stun guns.

4. Probability of Future Occurrences of Civil Disturbance

It is likely that occurrences of Civil Disturbance will continue in the future. There have been several in Florida in the past and protesting is a fundamental right protected by the US Constitution.

This hazard was determined to occur about every 5-10 years, giving it a Probability ranking of Likely.

5. Civil Disturbance Impact Analysis

- Public
  - Injury
  - Death
  - Arrested
- Responders
  - Injury
  - Death
- Continuity of Operations (including continued delivery of services)
  - Disrupt transportation systems
  - Disrupt operations of the facility that is being blocked
- Property, Facilities, Infrastructure
  - May damage roads, fencing, benches, etc.
  - Businesses and adjacent buildings may be vandalized or damaged.

- Environment
  - The use of Molotov cocktails or other forms of fire could create environmental issues and cascade into other hazards such as fires.
- Economic Condition
  - Blocked roads could lead to an inability for businesses to open or employees to get to work, causing economic impacts.
- Public Confidence in the Jurisdiction's Governance
  - If the law enforcement cannot control civil disturbances, then it is likely that the public will view the jurisdiction as weak and that they are able to be taken advantage of

6. 2018 LMS Integration

The following counties profile Civil Disturbance (or some similar hazard) in their most recent LMS plan:

- Brevard
- Clay
- Dixie
- Escambia
- Flagler
- Glades
- Hendry
- Indian River
- Levy
- Madison
- Martin
- Miami-Dade
- Osceola
- Palm Beach
- Pinellas
- Seminole
- St. Lucie
- Volusia

7. Vulnerability Analysis and Loss Estimation by Jurisdiction

It is impossible to conduct a vulnerability analysis and loss estimation by jurisdiction for Civil Disturbances. While peaceful protests or demonstrations occur frequently, it is difficult to determine when a protest will become a civil disturbance or riot, by disrupting daily operations or by becoming violent. Based on the historical occurrences, the large, urban areas of the state are more likely to be affected by Civil Disturbances than the small rural areas.

8. Vulnerability Analysis and Loss Estimation of State Facilities

State facilities are not particularly vulnerable to civil disturbances. There is a chance the group would protest in a state facility and that the protest might turn violent or destructive. There is also the chance that since sometimes state facilities are in downtown areas, that a facility may be damaged during civil disturbances or riots in the general downtown area. A Loss Estimation of State Facilities for Civil Disturbances is not possible to conduct.

9. Overall Vulnerability

Based on the Frequency, Probability, and Magnitude summary, the Overall Vulnerability of this hazard was determined to be Medium, with a score of 9.

<table>
<tr><th colspan="5">CIVIL DISTURBANCE INCIDENTS</th><th rowspan="2">Overall Vulnerability</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><td colspan="5">Civil disturbance is an activity such as a demonstration, riot, or strike that disrupts a community and requires intervention to maintain safety in the community. The different types of gatherings include impromptu and organized. Civil disturbance incidents tend to occur in urban locations but can realistically happen anywhere.</td><td rowspan="5">MEDIUM</td></tr>
<tr><th rowspan="2">Frequency</th><th rowspan="2">Probability</th><th colspan="3">Magnitude</th></tr>
<tr><th>Injuries/Deaths</th><th>Infrastructure</th><th>Environment</th></tr>
<tr><td>Likely</td><td>Likely</td><td>Medium</td><td>Medium</td><td>Low</td></tr>
</table>

FUNDING AND PROJECTS

State Hazard Mitigation Plan Requirements
S9. Does the plan prioritize mitigation actions to reduce vulnerabilities identified in the risk assessment? [44 CFR §201.4(c)(3)(iii) and §201.4(c)(3)(iv)]
S10. Does the plan identify current and potential sources of funding to implement mitigation actions and activities? [44 CFR §201.4(c)(3)(iv)
S12. Does the plan discuss the evaluation of the state's hazard management policies, programs, capabilities, and funding sources to mitigate the hazards identified in the risk assessment? [44 CFR §201.4(c)(3)(ii)]
S15. Does the plan describe the criteria for prioritizing funding? [44 CFR §201.4 (c)(4)(iii)]
E2. Does the plan demonstrate integration to the extent practicable with other state and/or regional planning initiatives and FEMA mitigation programs and initiatives? [44 CFR §201.5(b)(1)]
E4. Does the enhanced plan document capability to implement mitigation actions? [44 CFR §201.5(b)(2)(i), §201.5(b)(2)(ii), and §201.5(b)(2)(iv)]
E5. Is the state effectively using existing mitigation programs to achieve mitigation goals? [44 CFR §201.5(b)(3)
E6. With regard to HMA, is the state maintaining the capability to meet application timeframes and submitting complete project applications? [44 CFR §201.5(b)(2)(iii)(A)]
E7. With regard to HMA, is the state maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [44 CFR §201.5(b)(2)(iii)(B)]
E8. With regard to HMA, is the state maintaining the capability to submit complete and accurate quarterly progress and financial reports on time? [44 CFR §201.5(b)(2)(iii)(C)]
E9. With regard to HMA, is the state maintaining the capability to complete HMA projects within established performance periods, including financial reconciliation? [44 CFR §201.5(b)(2)(iii)(D)]
RL4. Did Element S10 (funding sources) address RL and SRL properties? [44 CFR §201.4(c)(3)(iv) and §201.4(c)(3)(v)]
RL6. Did Element S15 (prioritizing funding) address RL and SRL properties? [44 CFR §201.4(c)(4)(iii) and §201.4(c)(3)(v)]

Introduction

The Florida Division of Emergency Management (FDEM) assists communities and other potential applicants with finding disaster mitigation and recovery funds. Once funding opportunities are made known to the Mitigation Planning Unit, communities and potential applicants are provided with information on various funding opportunities via phone and email. In addition, all applicable state and local mitigation counterparts are provided opportunity to attend various workshops delivered by state mitigation staff on these opportunities once they are available.

The state makes full use of the Federal Emergency Management Agency (FEMA) mitigation grant program funding and encourages local communities to do the same. FEMA mitigation grants are used to leverage state, local, and other funds for maximum mitigation activity. For recent funding use, please see individual grant descriptions later in this section as well as in the *State Mitigation Strategy Section*.

The 2018 SHMP attempts to streamline information about each of the available funding programs by combining the majority of program information under one heading. For the 2018 update, all available funding sources were reviewed and updated as necessary. Enhanced and standard plan elements have been integrated throughout this section.

Funding Source Identification and Usage

The state uses a variety of programs and funds to achieve its mitigation goals. This includes special appropriations from Congress and State Legislature, as well as funds from federal sources. Various programs and sources of project funding are described throughout this section.

All projects funded by FEMA and managed by the state must align with the goals and objectives in the SHMP. As stated in the *State Mitigation Strategy Section*, the four goals for the 2018 Enhanced State Hazard Mitigation Plan (SHMP) are as follows:

- Goal 1: Implement an effective comprehensive statewide hazard mitigation plan.
- Goal 2: Support local and regional mitigation strategies.
- Goal 3: Increase public and private sector awareness and support for hazard mitigation in Florida.
- Goal 4: Support mitigation initiatives and policies that protect the state's cultural, economic, and natural resources.

In addition to making sure that projects align with the SHMP goals, projects submitted under many of the federal grant programs must also be prioritized. Project prioritization varies by funding source and applicant. In general, limited special prioritization considerations are given to communities that have the highest risk or are under strong development pressures; however, proactive approaches are encouraged whenever possible.

Federal Funding

Mitigation opportunities are pursued on a year-round basis in Florida. While many opportunities exist to fund projects at the local level, both the state and local applicants rely heavily on the use of federal funds to implement mitigation projects. The following federal funding sources are some of the most popular programs used to help achieve the state's mitigation goals. More information regarding federal funding sources can be found on FEMA's website.

Below is a snapshot of both Federal and State funding sources that each county has utilized in the past.

Table 75: LMS Funding Source Identification

Funding & Projects Section : LMS Projects Funding Matrix																		
	Federal Grants									State/Community Funds						Tax		
	HMGP	PDM / FMA	406	Public Assistance	HLMP	CDBG	EMPA	EMPG	State Homeland Security Program	Revenue Bonds	Jurisdiction Funds	General County Fund	State / County Agencies	Florida Communities Trust	In-Kind	Ad Valorem	Storm-water	Sales
Alachua	X	X																
Baker	X									X	x	x	x					
Bay	x	x										x						
Bradford	x											x						
Brevard	x			x		x			x			x						
Broward	x	x					X					X						
Calhoun	X	X	X		X	X						X	X					
Charlotte	X										X	X	X					X
Citrus	X	X						X			X	X						
Clay	x																	
Collier	x	x			x								x			x		
Columbia	x	x			x		x				x	x	x					
Desoto	x											x						
Dixie	x	x				x	x						x					
Duval	x	x			x						x	x	x					
Escambia	x										x							
Flagler	x	x			x		x				x	x						
Franklin	x				x													
Gadsden	x	x				x	x						x					
Gilchrist	x					x									x			
Glades	x				x							x						
Gulf	x	x			x	x					x	x						
Hamilton	x					x												
Hardee	x										x	x	x					
Hendry	x	x			x	x						x						
Hernando	x	x					x				x	x						
Highlands	x	x	x		x	x	x					x	x		x			
Hillsborough	x	x											x					x
Holmes	x	x				x	x					x	x					
Indian River	x	x				x	x						x					
Jackson	x	x				x						x	x					
Jefferson	x						x				x	x	x					
Lafayette	x											x						
Lake	x											x						
Lee	x																	
Leon	x	x				x	x				x	x	x					
Levy	x	x				x	x						x					
Liberty	x	x			x							x	x					
Madison	x	x				x												
Manatee	x										x	x	x				x	
Marion	x	x										x	x			x		
Martin				x		x					x	x						
Miami-Dade											x	x	x				x	
Monroe	x			x									x					
Nassau	x	x									x	x	x					
Okaloosa	x											x						
Okeechobee	x	x		x									x					
Orange	x	x																
Osceola	x	x				x							x					
Palm Beach	x	x		x		x												
Pasco	x	x				x	x					x	x			x	x	
Pinellas	x	x			x	x	x				x	x	x			x		
Polk	x	x					x				x	x	x					
Putnam	x	x					x				x	x	x					
Santa Rosa	x											x						
Sarasota	x											x	x					
Seminole	x	x																
St. Johns	x					x					x	x						
St. Lucie	x								x		x	x	x					
Sumter	x	x				x						x						
Suwannee	x					x					x	x	x				x	
Taylor	x	x				x	x	x					x	x				
Union	x				x			x			x		x					
Volusia	x																	
Wakulla	x	x			x	x		x					x	x				
Walton	x	x		x		x	x						x					
Washington	x	x				x	x				x		x	x				

All mitigation measures submitted to the state for funding under FEMA's Hazard Mitigation Assistance (HMA) programs which include the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) grant program, the Flood Mitigation Assistance (FMA) program, the Severe Repetitive Loss (SRL), and the Hazard Loss Mitigation Program (HLMP) program must:

- Be consistent with the SHMP.
- Solve or at the very least address a problem.
- Be technically feasible.
- Be cost effective.
- Comply with environmental regulations.
- Identify a non-federal match (if required).

In addition, to the standard federal requirements, the State of Florida has developed additional eligibility criteria for all proposed multi-hazard mitigation measures submitted to FDEM. These criteria are reflected in Florida Administrative Code 27P-22 (see *Appendix B: Governing Policies*).

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 93-288 as amended). This program, administered by DEM's HMGP Unit (See DEM's Agency Summary in the *State Mitigation Strategy Section*), is designed to help states, local governments, private non-profit organizations, and tribes implement long-term hazard mitigation measures following a major disaster declaration. Funds may be used to protect public or private property. They may also be used to purchase property that has been subjected to, or is in danger of, repetitive damage. Projects include acquisition and relocation, multi-hazard retrofits, minor flood control projects, and construction of safe rooms.

The standard federal mitigation funding allocation for this program is 15 percent of allocated disaster relief (the sum of public assistance, individual assistance and Small Business Administration (SBA). States with an approved Enhanced SHMP are eligible to receive an additional five percent of the disaster relief funds. Up to seven percent of HMGP money can be used for mitigation planning activities.

In Florida, it is up to the state as to how those planning funds will be allocated. Often times the seven percent planning funds are used for state level planning initiatives. Under this program, the state requests the additional seven percent set aside, which requires approval from FEMA. Other set-asides can include a five percent initiative for special state initiatives and potentially another five percent for activities that address promoting disaster-resistant codes for all hazards.

The state's five percent initiative funds are used to implement special mitigation priorities set by the Governor and the Governor's Authorized Representative (GAR). These statewide projects include those mitigation activities that are proposed by state and regional agencies. This includes activities proposed by DEM that are regional or statewide in scope. If there are no priorities set for these initiative funds, the five percent can be applied to local initiatives, at the discretion of the state.

Key objectives of the HMGP are to:

- Prevent future losses of lives and damage to property due to disasters.
- Implement state or local hazard mitigation plans.

- Enable mitigation measures to be implemented during immediate recovery from a disaster.
- Provide funding for mitigation measures that benefit the disaster area.

While the HMGP is a federally funded program, it is administered by the HMGP Unit in accordance with federal and state regulations. In this capacity, the key responsibilities of the state are to:

- Solicit and review HMGP proposals from applicants.
- Prepare and submit proposals to FEMA in accordance with the HMGP Administrative Plan.
- Manage HMGP and funds allocated under the program.

The state is the grantee of the GAR funds. The GAR serves as the grant administrator for all funds provided under HMGP, as well as funds authorized under other disaster programs. In Florida, the GAR has signatory authority for all disaster assistance programs, but the State Coordinating Officer (SCO) manages HMGP through the State Hazard Mitigation Officer (SHMO).

Eligibility for Hazard Mitigation Grant Program Grants

To be eligible for mitigation funding, a project must be listed in the community's Local Mitigation Strategy (LMS) and satisfy the requirements listed below.

These criteria are also listed in the HMGP Administrative Plan (see *Appendix J: HMGP Administrative Plan*), which is used for all federal hazard mitigation programs:

- Be in conformance with the SHMP.
- Have a beneficial impact upon the declared disaster area. A project located outside the declared disaster area cannot be eligible unless it has a direct and beneficial impact to the disaster area or until all projects within the declared disaster area have been funded.
- Conform to 44 CFR, Part 9, Floodplain Management and Protection of Wetlands, and 44 CFR, Part 10, Environmental Considerations.
- Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project will be completed as a whole. Projects that merely identify or analyze hazards or problems are not eligible.
- Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster. The grantee must demonstrate this by documenting that the project:
- Addresses a problem that has been repetitive, or a problem that poses a significant risk to public health and safety if left unsolved.
- Will not cost more than the anticipated value of the reduction in direct damages and subsequent negative impacts to the area if future disasters were to occur.
- After consideration of a range of options, has been determined the most practical, effective and environmentally sound alternative.
- Contributes to a long-term solution to what it is intended to address.
- Considers long-term changes to the areas and entities it protects, and has manageable future maintenance and modification requirements.

FEMA defines hazard mitigation as an action intended to reduce repetitive losses from future natural disasters. In this context, "repetitive" refers to similar types of losses caused by a recurring natural hazard. The term "losses" refers to expenditures for the repair or replacement of public and private property, and for the relief of personal loss or other hardship. Post-disaster projects that simply repair and reconstruct damaged property to pre-disaster conditions are not eligible. Rather than mitigating loss, these types of projects serve to perpetuate the cycle of damage, reconstruction, and repeated damage.

Acquisition or construction of a site in the designated Special Flood Hazard Area (SFHA) of a community not participating in NFIP is not eligible for HMGP funding. This includes communities suspended from participation. Non-participating communities may submit projects to the HMGP only if the projects are located in unmapped areas or outside of the SFHA.

Any HMGP construction project located within a SFHA must be comply with the minimum NFIP standards for such projects. The activities of the HMGP Unit within DEM’s Bureau of Mitigation are reviewed in DEM’s agency summary within the *State Mitigation Strategy Section*. You can find projects currently funded through HMGP by referencing *Appendix M: State Managed Projects*.

The Disaster Mitigation Act of 2000 (DMA2K) requires, as a condition for receipt of federal mitigation assistance funds, local governments develop a FEMA approved local mitigation plan. The plan must contain locally prioritized projects that are technically feasible, cost effective, and environmentally sound. In Florida, the prioritized project lists serve a very important purpose. In addition to the federal criteria, Florida requires, through 27P-22.005 of the Florida Administrative Code (FAC), the prioritized project list to list the estimated costs and associated funding source for each project listed. Florida is the only known state to have a legislatively approved process for distributing HMGP funds. The law serves to strengthen local planning processes while providing autonomy in how funds are distributed.

In the instances where a cost effective, eligible, and technically feasible project submitted under a specific grant program fails to receive a grant due to lack of funds, DEM will provide information on the next available qualifying funding source. For example, if an acquisition is submitted under HMGP and meets all program eligibility requirements but is not funded due to limited HMGP funds, this project will be provided to the FMA staff for consideration under the next open cycle.

Prioritization for HMGP Funds

Upon notice from FEMA of the availability of HMGP funds, the mitigation staff determines the amount of funds that have been dispersed in each of the declared counties from the Individual Assistance (IA) Program, the Public Assistance (PA) Program, and the SBA Disaster Loan Program. Each county receives a proportional HMGP allocation based on these figures.

DEM will use the 90-day estimate in order to determine the percentage of funds allocated to each county. This process repeats after each successive estimate and the allocations adjust accordingly. When county allocations have been determined, a Notice of Funding Availability (NOFA) is published in Florida Administrative Weekly and distributed to mitigation partners throughout the state.

Local mitigation projects are prioritized by each LMS Working Group. Prioritized lists are submitted to the state each year as a part of the FAC 27P-22 rule update process and again with five- year plan updates. DEM has delegated its authority to set priorities and select projects to the LMS Working Groups in order to validate the local mitigation planning process embodied in the LMS. Under the rule, only prioritized projects from the LMS are eligible for HMGP project funding. LMS Working Groups are encouraged to gather estimates of costs and conduct a simple benefit-cost review as part of the priority setting process, not only to help meet federal planning requirements but also because it is critical to early implementation of projects in a disaster's aftermath.

A letter from the LMS Chairperson must accompany each application submitted endorsing the project and assigning a funding priority. To meet the requirements of DMA2K, the letter must indicate the LMS goal (and objective where appropriate) addressed by the project. The state mitigation staff verifies that the community is listed as an approved participant in the LMS.

To ensure that all of the HMGP project funds are used, DEM uses a three-tiered distribution system as described below.

Table 76: Hazard Mitigation Grant Program Distribution System

Tier 1	HMGP funds are allocated to counties included in the relevant Presidential disaster declaration. Funds are allocated in proportion to each county's share of federal disaster funding from the PA, IA, and SBA Disaster Loan Program as of the date of receipt of the FEMA NOFA. Eligible projects are funded in order of LMS priority until allocations (through the 12-month lock-in) are exhausted or all eligible projects are funded.
Tier 2	Any funds remaining after all eligible projects are funded are re-allocated to declared counties with insufficient allocations to fund all submitted eligible projects. Priority for re-allocating funds begins with the declared county with the lowest initial allocation.
Tier 3	If funds remain, they shall be applied to fund eligible projects submitted first-come-first-served from counties that did not receive a Tier 1 allocation because they were not included for IA, PA or SBA loans.

Prioritization for Hazard Mitigation Grant Program Set-Asides

Prioritization for special set-asides under the HMGP are handled a different way. If the state chooses to use the five percent initiative funding under HMGP, the Governor and the GAR in consultation with the state legislature set priorities for the funding based upon the hazard, type of damages, and identified need resulting from a hazard event. If the Governor and legislature do not set statewide priorities for funds, projects will be deferred to a Project Review Committee of subject matter experts. In all cases, the projects recommended for funding must be in compliance with all other applicable federal requirements.

In Florida, prioritization for statewide and regional agency projects typically falls under the responsibility of the Mitigate FL Team and the SHMO. The SHMO also coordinates with many other entities on these decisions. All projects are endorsed by the SHMO as being consistent with the SHMP.

Prioritization for Hazard Mitigation Grant Program Planning (Seven Percent) Funds

When these funds are available, the review of projects submitted for funding will consist of a Project Review Team comprised of subject matter experts. A standardized process has been developed to rank planning grants for when the amount of available funding is not enough to cover all projects submitted, or when similar projects are received from different jurisdictions or agencies.

The scoring system below, as established by DEM, determines how HMGP planning projects will be prioritized for funding.

Table 77: Hazard Mitigation Grant Program Prioritization Scoring System

The clarity of the defined mitigation need and the degree to which the projected outcome of the planning project addresses the need.	75 points
The consistency of the planning project with risk analysis and the goals and objectives of the relevant LMS, other local plans, and the SHMP.	75 points
The degree to which the planning project integrates with other local plans.	100 points
The suitability of the proposed planning process to address the need including proposed actions to involve the public and, where appropriate, participants from surrounding neighborhoods as well as appropriate state and local agency or other personnel.	100 points
Creativity of approach to meeting the required match.	50 points
The capability of the applicant to complete the project based on experience, resources and demonstrated ability.	25 points
TOTAL Scoring	**425 points**

Tiebreaker: The degree to which the planning project builds on earlier planning projects.

Allocations of Hazard Mitigation Grant Program

The FAC 27P-22 defines how the HMGP Unit will allocate the funds. As previously mentioned, the HMGP Unit maintains an Administrative Plan (see *Appendix J: HMGP Administrative Plan*), approved by FEMA after each disaster, which further explains how the program funds will be distributed. Projects submitted to the state for potential funding have all been prioritized at the local level.

As of August 2016, Florida had completed more than 2,800 projects under HMGP worth over $853 million. Florida has disbursed $553.8 million in HMGP funds since 2004. As of August 2017, we are managing 99 HMGP open projects totaling $155 million. Since September 2008, the state has received $45, 306,741 in additional mitigation funding due to our enhanced status. Since the last plan update, Florida has closed a total of 6 disasters. Florida is one of the nation's most active mitigation states. Examples of projects that have been funded or are in the process of being funded through HMGP can be found in *Appendix M: State Managed Projects*.

"406 Mitigation"

HMGP is similar to the PA Program authorized by Section 406 of the Stafford Act. PA funds allow an eligible applicant to incorporate mitigation measures into the repair of an existing damaged structure and infrastructure if the measures are cost-effective or required by code. HMGP can fund mitigation measures to protect public or private property in compliance with the program's guidelines. It is appropriate to fund mitigation measures for public property damage in a disaster under Section 406 before applying for assistance under HMGP.

<u>Flood Mitigation Assistance Program</u>

The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of The National Flood Insurance Act of 1968, as amended (Pub. L. No. 90-448) (42 U.S.C. § 4104c) and appropriated annually by the Consolidated Appropriations Act. Since the last plan update, consistent with the legislative changes made in the Biggert-Waters Flood Insurance Reform Act of 2012, the established partnership was designed to help states, local, and tribal governments reduce or eliminate long-term risks of flood damage to repetitively flooded structures insured under NFIP. The goals of the FMA are to:

- Fund cost-effective and technically feasible measures that reduce or eliminate long-term risk of flood damage to structures insured through NFIP.
- Encourage long-term, comprehensive mitigation planning against repetitive flooding.
- Reduce repetitively or substantially damaged structures and associated claims on the National Flood Insurance Fund (NFIF) by giving priority to Severe Repetitive Loss (SRL) structures.
- Complement other federal and state mitigation programs with similar goals.

As of FY 2017, the types of grants available through FMA are: Community Flood Mitigation Advance Assistance, Community Flood Mitigation Projects, Mitigation Planning and Residential Mitigation Projects. Projects include the following eligible activities:

- Development of Mitigation Strategies and/or Data to Prioritize, Select and Develop Viable Community Flood Mitigation Projects
- Projects that Integrate Cost Effective Natural Floodplain Restoration Solutions and Improvements to NFIP-Insured Properties
- Development of State or Local Flood Plans and Flood Plan Updates
- Acquisition and demolition
- Acquisition and relocation
- Standard elevation
- Mitigation reconstruction
- Dry flood-proofing
- Minor flood control projects

Although the FMA Program is federally funded, the program is administered through a partnership with DEM. In this capacity, the key responsibilities of the state are to:

- Solicit and review FMA proposals from applicants
- Prepare and submit fundable proposals to FEMA
- Manage the FMA Program
- Fully utilize the funds available under the program

Eligibility for Flood Mitigation Assistance Grants

State mitigation staff evaluate all applications to ensure that the applicant and proposed projects are eligible according to 44 C.F.R. Part 79 and the HMA Guidance. Projects must conform to regulations found in 44 C.F.R. Part 79 and the HMA Guidance. Projects must be:

- Eligible, cost-effective and technically feasible.
- In conformance with applicable environmental laws and regulations.
- Included in, and in conformance with, the Floodplain Management Plan.

- Physically located in a participating NFIP community not on probation, or the project must benefit such a community directly by reducing future flood damage.
- NFIP insured at the time of the opening of an application period and maintained through at least the completion of the project. For projects where a structure remains in the special flood hazard area (SFHA), properties must maintain a flood insurance policy for the life of the structure.

State agencies, federally recognized tribes, and local governments/communities are eligible to apply.

Prioritization for Flood Mitigation Assistance

The State of Florida supports and encourages multi-hazard planning and each LMS must include a flood component. Specialized flood planning is an eligible activity through FMA to augment multi-hazard plans. As the FMA applicant, FDEM has the authority to rank or prioritize project and planning grants applications. FDEM also has the authority to decide whether or not to submit sub-applications to FEMA for FMA related activities.

FDEM utilizes FEMA’s priorities to assist communities with determining if they may benefit from FMA project and/or planning opportunities. In conjunction with communities, staff considers various circumstances to make this determination. These include the impact of flooding on the community and the desire to initiate new and improved flood hazard initiatives or implement strategies to improve their usage of FMA project funds.

There was never a case in which the number of projects exceeded the FMA allocation, but in the event there was, the following method would have been used to review and rank local government applications:

- Priority #1: Local governments that have experienced a significant flood event and did not receive a presidential disaster declaration.
- Priority #2: Local governments that have severe repetitive loss structures, but have never submitted or infrequently submitted applications to FMA for flood mitigation projects.
- Priority #3: Local governments that have a high number of FEMA repetitive loss structures.
- Priority #4: Local governments that have targeted repetitive loss structures.
- Priority #5: Those who participate in CRS with ten or more FEMA repetitive loss properties.

Should multiple applicants rank equally, the highest number of severe repetitive loss structures will have priority. FDEM elects not to provide FEMA with sub-applications that exceed its annual allocation of FMA funds.

Allocations of Flood Mitigation Assistance

The State of Florida has aggressively implemented and administered the FMA program. The State Hazard Mitigation Office, the office responsible for managing the FMA program, has managed funding and the implementation and completion of acquisition, elevation, mitigation reconstruction and flood retrofitting of repetitively flooded structures since 1997.

Evidence of the state’s proactive mitigation effort is seen in the fact that it would often request a waiver to increase the five-year, $20 million limit. As last known, the program works with local and federal partners to mitigate both residential and non-residential properties.

Florida received $43,465,434.71 in federal funds for FMA projects between fiscal years (FY) 2013 and 2016. Yearly awards include:

- FY 2013: $6,291,844.71
- FY 2014: $7,718,267.57
- FY 2015: $7,468,074.09
- FY 2016: $21,987,248.34

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation Grant Program (PDM) is authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Act, as amended (Public Law 93-288) (42 U.S.C. 5133) and appropriated annually by the Consolidated Appropriations Act. It exists to assist communities in reducing overall risk to the population and structures from natural disasters. Eligible applicants are state agencies, federally recognized Indian tribal governments, and local governments. Private non-profit organizations are not eligible to apply; however, they may request a local government submit an application for proposed activities on their behalf.

Potential project types include:

- Acquisition/Demolition; Acquisition/Relocation
- Elevation
- Mitigation Reconstruction
- Dry Flood proofing
- Generators
- Engineering studies
- Hydrologic/hydraulic studies/analyses
- Localized and Non-localized flood reduction projects
- Protective measures for utilities
- Retrofitting
- Safe rooms
- Storm water management projects
- Soil Stabilization
- Wildfire Mitigation

Through PDM, Florida has provided protection to local government structures and critical facilities, as well as reduced flooding in neighborhoods. Although the PDM program is federally funded, the program is administered through a partnership arrangement with DEM. In this capacity, the key responsibilities of the state are to:

- Solicit and review PDM proposals from applicants.
- Prepare and submit eligible proposals to FEMA.
- Manage the FMA Program.
- Fully utilize the funds available under the program.

Eligibility for Pre-Disaster Mitigation Program Grants

State mitigation staff evaluates the projects to be sure that the applicant and project are eligible according to FEMA's most recent HMA Guidance. The project must conform to regulations found in this Guidance, including:

- Be in conformance with the LMS, local ordinances, planning requirements, and floodplain management plans as applicable.
- Be complete and cost-effective.
- Be long-term and technically feasible.
- Conform to all applicable environmental, historic, or cultural preservation reviews.
- Benefits must not duplicate those available through another primary source or program.

Prioritization for Pre-Disaster Mitigation Program

Florida will only consider PDM applications from communities that have a FEMA-approved LMS. Typically, PDM funds are available to all eligible applicants statewide for projects that are designed to reduce future risk to individuals and property from natural hazards. While not required to be prioritized by the local LMS working groups, projects submitted for funding under the PDM must be consistent with the LMS and documented as such.

Since funding for PDM is competitive nationwide and the federal guidance material may or may not limit the total number of sub-applications a state may submit, FDEM provides technical assistance to all eligible applicants with a FEMA approved LMS. When these funds are available, the review of projects submitted for funding will consist of a Project Review Team composed of subject matter experts.

In those instances where federal guidance limits the number of sub-applications a state may submit, FDEM will limit its submittals to eligible cost-effective sub-applications as provided in the guidance. In any case, FDEM will prioritize and rank eligible cost-effective project applications by FEMA’s priorities, benefit cost ratio and technical feasibility.

In situations where there is a tie, FDEM will prioritize those project applications from communities that have not received any HMGP funds over a 12-month period.

This process is the state’s system to rank mitigation grant applications when the amount of available funding is not enough to cover all projects submitted or when similar projects are received from different jurisdictions or agencies.

Allocations of Pre-Disaster Mitigation Program

The PDM program is highly competitive on a national level. Considering the recent funding limitations and restrictions under the PDM program, the State of Florida has continued to aggressively implement and administer the PDM program. The State Hazard Mitigation Office, the office responsible for managing the PDM program has successfully managed funding and the implementation and completion of many dry flood proofing, generator, retrofit and drainage projects.

Florida received $8,436,862.03 in federal funds for PDM projects between fiscal years (FY) 2013 and 2016. Yearly awards include:

- FY 2013: $272,199.85
- FY 2014: $929,074.06
- FY 2015: $624,987.65
- FY 2016: $6,610,600.47

<u>Emergency Management Performance Grant</u>

FEMA is responsible for leading and supporting the nation in a comprehensive, risk-based, all hazards emergency management program. The primary means of ensuring the development and maintenance of such a program is FEMA funding to states through the Emergency Management Performance Grant (EMPG). The purpose of the Emergency Management Performance Grant (EMPG) Program is to provide federal funds to states to assist state, local, territorial, and tribal governments in preparing for all hazards. DHS/FEMA make grants available for the purpose of providing a system of emergency preparedness for the protection of life and property in the United States from hazards and to vest responsibility for emergency preparedness jointly in the Federal Government, states, and their political subdivisions. The Federal Government, through the EMPG Program, provides necessary direction, coordination, and guidance, as well as assistance, to support a comprehensive all hazards emergency preparedness system.

FDEM uses EMPG funding for programs in all four phases of emergency management: preparedness, response, recovery and mitigation. Examples of EMPG funded mitigation activities include initiating or achieving whole community approach to security and emergency management; updating emergency plans; completing the State Preparedness Reports (SPR), including the Threat and Hazard Identification and Risk Assessment (THIRA) process; designing and conducting exercises that engage a whole community of stakeholders and validate core capabilities; and conducting training.

Allocations of Emergency Management Performance Grant

Florida receives EMPG funding each year for state and county emergency management, as well as for special projects. Generally, these funds are used to implement state priorities, maintain or expand capacity in planning, exercise, and training, and to implement NIMS.

Between fiscal years 2011 and 2016, the State of Florida received over $44 million in EMPG funding for:

- Local Emergency management programs
- Public education and outreach
- Private sector outreach
- Training and exercise activities on required capabilities
- Upgrades to state emergency management resources
- Catastrophic analysis and planning for state and local plans

Recent mitigation-related projects between fiscal years 2010/2011 and 2015/2016 under the EMPG program include:

- FY2010/2011
  - Television and Radio Airtime ($250,000)
  - "Get A Plan" Outreach ($200,000)
  - FloridaDisaster.org redevelopment ($150,000)

- Community Outreach Materials, Events, Documentation, and Development of Public Service Announcements ($425,000)
- County Emergency Management Programs ($5,404,070)

- FY2011/2012
  - Television and Radio Airtime ($250,000)
  - Public Information Website Maintenance and Upgrades ($75,000)
  - Florida Severe Weather Awareness Week ($100,000)
  - Production Services for Website and Television Outreach ($125,000)
  - Community Outreach Materials, Events, Documentation, and Development of Public Service Announcements ($125,000)
  - "Get A Plan" Events, TV/ Radio Spot ($100,000)
  - Depth Analysis for state ($25,000)
  - Training and Maintenance on the Regional Evacuation Studies ($100,000)
  - County Emergency Management Programs ($5,602,085)
- FY2012/2013
  - Television and Radio Airtime ($250,000)
  - Florida Severe Weather Awareness Week ($75,000)
  - Production Services for Website and Television Outreach ($300,000)
  - Community Outreach Materials, and Public Service Announcements ($125,000)
  - Kids Get A Plan Education Campaign ($175,000)
  - Training and Maintenance of the Regional Evacuation Studies ($80,000)
  - Citizen Corp Program Funding for County Base Grants ($290,000)
  - County Emergency Management Programs ($5,709,319)
- FY2013/2014
  - Television and Radio Airtime ($600,000)
  - Kids Get A Plan Education ($841,897)
  - Florida Severe Weather Awareness Week ($27,500)
  - Production Services for Website and Television Outreach ($150,000)
  - Florida's Get A Plan Education Materials and Outreach ($220,000)
  - Training and Maintenance of the Regional Evacuation Studies ($490,000)
  - Citizen Corp Program ($279,240)
  - Statewide Emergency & Alert Notification System ($1,501,398)
  - County Emergency Management Programs ($6,229,836)
- FY2014/2015
  - Kids Get A Plan ($113,114)
  - Private Sector Outreach Campaign ($15,928)
  - Florida's Get A Plan Outreach and Production Services ($218,445)
  - Special Needs Public Education ($229,896)
  - Citizen Corp Program ($282,896)
  - County Emergency Management Programs ($6,102,312)
- FY2015/2016
  - Public Education Campaign ($485,698)

- Planning, Training, Exercise ($500,000)
- Citizen Corp Program ($360,000)
- Special Needs Registry ($125,000)
- All Hazards Incident Management Team ($30,000)
- County Emergency Management Programs ($6,285,075)

State Funding

The following is an overview of available state funding sources that have been used as the non-federal share for federal grant programs as well as to fund non-federally funded local projects. This list is not all-inclusive and will be updated as additional state funding sources are identified.

Florida Hurricane Catastrophe Fund

The Florida Hurricane Catastrophe Fund (FHCF) is a tax-exempt trust fund created by the Florida Legislature in November 1993. Following Hurricane Andrew in August of 1992, numerous problems developed in the residential property insurance market and the availability of reinsurance for hurricanes became scarce and extremely expensive. Many insurers were forced to re-evaluate their exposure in Florida. State action was deemed necessary to maintain a stable property insurance market.

Section 215.555, Florida Statutes, created the FHCF with the purpose of providing a stable and ongoing source of reimbursement to insurers for a portion of their catastrophic hurricane losses in order to provide additional insurance capacity for the state. The FHCF operates as a public-private partnership, supporting the private sector's role as the primary risk bearer.

The FHCF plays a significant role in the provision of property insurance coverage for Florida residents. Eleven consecutive seasons with limited claims payment activity have given the FHCF an opportunity to accumulate sufficient reserves to prepare for future storms. The FHCF has significant financial resources as of the end of 2016, with an estimated fund balance of approximately $13.8 billion. In addition to these resources, the FHCF also has $2.7 billion available in pre-event bond proceeds from outstanding Series 2013A pre-event debt ($1.5 billion outstanding) and Series 2016A pre-event debt ($1.2 billion outstanding) providing additional liquidity for 2017 and subsequent seasons. Nonetheless, the FHCF might still need to rely on emergency assessments and/or post-event bonding to pay claims if a storm or storms of sufficient magnitude impacted Florida.

Hurricane Loss Mitigation Program

The Florida Division of Emergency Management created the Hurricane Loss Mitigation Program (HLMP) with a purpose aimed towards minimizing damages caused by hurricanes. The program began as an active response to the devastation brought by Hurricane Andrew, specifically to the insurance market in the State of Florida. With an annual budget of 10 million, provided by the Florida Hurricane Catastrophe Trust Fund, the program is funding activities that promote property resiliency through retrofits made to residential, commercial, and mobile home properties, the promotion of public education and public information, and through hurricane research activities.

The specific areas funded by the $10 million appropriation include retrofits for existing public facilities, the Mobile Home Tie Down program administered by Tallahassee Community College, a hurricane research program conducted by Florida International University, wind mitigation retrofit projects, and public outreach programs.

Up to $3.4 million is to be used on improving community resiliency through the Hurricane Loss Mitigation Program Grant. Through partnering with local housing authorities and non-profit organizations, the Division has been able to promote wind and flood mitigation and provide hazard mitigation retrofitting to residential and commercial properties. Funded activities include retrofits, inspections, and construction or modification of building components designed to increase a structure's ability to withstand hurricane-force winds and flooding. The Retrofit Program utilizes the Florida Building Code as its standard for all retrofitting.

The shelter retrofit program receives $3 million of the annual $10 million appropriation. Funding permits shelter surveying and the mitigation of hurricane shelters in the state of Florida.

Of moneys provided to the Division, $700,000 is allocated to Florida International University to be applied to research and outreach conducted by the International Hurricane Research Center. The IHRC is a multi-disciplinary research and education organization focused on a single mission: to reduce hurricane damage and loss of life through more effective mitigation. As a University entity, the IHRC conducts both basic and applied research. The IHRC research tries to answer fundamental questions in order to reduce the hurricane threat. The Center's current studies involve such areas as: household mitigation and evacuation, storm hazard and vulnerability mapping, long-term community recovery, and economic loss modeling.

$2.8 million of the appropriation by the Legislature is used to inspect and improve tie-downs for mobile homes. Section 215.559, Florida Statutes, authorizes the Department to contract with Tallahassee Community College to administer the mobile home tie-down program.

The Mobile Home Tie-Down Program is a pilot project designed to demonstrate, test and raise awareness of new techniques to enhance manufactured home wind resistance. The goal is to reduce property damage from high wind events. A tie-down system is designed to secure the manufactured homes to the ground. Traditional tie-down systems use the longitudinal ground anchors and straps, which sometimes corrode and disintegrate. The new tie-down system include lateral foundation systems with longitudinal stabilizer devices or ground stabilizer plates wherever possible. Tie-down retrofit services provided through this program must comply with the Rules of the Department of Highway Safety and Motor Vehicles, Division of Motor Vehicles, Chapter 15C-1, General.

Competitive Evaluation

An evaluation committee consisting of subject-matter experts is established each fiscal year that funding becomes available. The evaluation committee uses a competitive scoring system that considers the project team, references, work plan/approach, needs, and project justification. Submitted proposals are evaluated and points are awarded by each reviewer independently. Projects are prioritized in descending order and funds are awarded until all funds have been expended.

Florida International University (FIU) continues to conduct hurricane research at their International Hurricane Research Center (IHRC) and investigation into better building materials, the effects of high wind speeds on construction, and research into other wind damage concepts.

Florida Communities Trust Fund

Florida Communities Trust Fund (FCT) is a state land acquisition grant program housed within the Department of Environmental Protection. Funding for FCT grants comes from the Florida Forever program. When Florida Forever funding is available, FCT's Parks and Open Space program receives 21 percent of the funds and FCT's Stan Mayfield Working Waterfronts program receives 2.5 percent of the funds.

The FCT was created to help implement the goals, objectives, and policies outlined in the conservation, recreation and open space, and coastal management elements of local comprehensive plans. It also helps local governments bring their comprehensive plans into compliance as well as conserve natural resources and resolve land use conflicts. The FCT has acquired over 85,000 acres of private lands to be placed in public trust free from future development. Many of these lands are in floodplains along the state's vast rivers and coastal lands.

The FCT makes grants available to local governments and non-profit environmental organizations through a competitive application cycle to help purchase parks, greenways, and open spaces identified in local comprehensive plans. Under this program, all local governments are required to provide a minimum 25 percent match, except small local governments (counties with a population fewer than 75,000 and cities with a population fewer than 10,000) who would qualify for a 100 percent grant.

Allocations of Florida Communities Trust Fund

Recent mitigation-related funds under the FCT Fund include:

- FY 10/11
    - Total projects acquired: All 10 projects acquired during FY 10/11contained 100-year floodplains and/or coastal high hazard areas.
    - Florida Forever funds provided by FCT: $17,137,643 for projects that contain 100-year floodplains and/or coastal high hazard areas.
    - Local matching funds provided: $5,220,963 for projects that contain 100-year floodplains and/or coastal high hazard areas.
    - Total acres: 2,333 acres acquired for projects that contain 100-year floodplains and/or coastal high hazard areas.
- FY 11/12
    - Total projects acquired: six out of the seven projects acquired during FY 11/12 contained 100-year floodplains and/or coastal high hazard areas.
    - Florida Forever funds provided by FCT: $4,901,150 for projects that contain 100-year floodplains and/or coastal high hazard areas.
    - Local matching funds provided: $3,213,012 for projects that contain 100-year floodplains and/or coastal high hazard areas.
    - Total acres: 1,712 acres acquired for projects that contain 100-year floodplains and/or coastal high hazard areas.

Coastal Partnership Initiative Grant Program

The Coastal Partnership Initiative (CPI) grant program promotes the protection and effective management of Florida's coastal resources at the local level. The Florida Coastal Management Program (FCMP) makes National Oceanic and Atmospheric Administration (NOAA) funds available, on a competitive basis, to eligible local governments. Project must be feasible and completed within one year. The project is governed by Rule 62S-4 of the Florida Administrative Code.

Eligibility for Coastal Partnership Initiative Grant Program

Eligible local governments are defined as Florida's 35 coastal counties and all municipalities within their boundaries that are required to include a coastal element in their local comprehensive plan. Florida's public colleges and universities, regional planning councils, national estuary programs, and non-profit groups may also apply if an eligible local government agrees to participate as a partner. Each year in the fall FCMP publishes a notice of availability of funds in the Florida Administrative Register to solicit CPI applications from eligible entities. CPI grants provide support for innovative local coastal management projects in four program areas:

- Resilient Communities: The goal of this priority area is to help coastal communities prepare for and respond to the effects of climate change, natural hazards, and disasters. Project examples include conducting vulnerability analyses and risk assessments, developing post-disaster redevelopment plans and strategies, restoring coastal wetlands, developing energy strategies, and improving communities' resiliency to coastal hazards.
- Coastal Resource Stewardship: To promote stewardship and appreciation of fragile coastal resources, applicants may request funds for community-based projects that involve citizens, volunteers, and the local government. Project examples include dune and wetland restoration, exotic plant control, coastal clean-ups, and environmental awareness initiatives, events, and field trips.
- Access to Coastal Resources: Communities are encouraged to accommodate public access to coastal and marine resources while protecting fragile and overused environments. Access projects could include developing plans for land acquisition and management, developing site plans for nature trails, developing recreational surface water use policies, exotic species removal and restoration of native species, and small-scale capital improvements such as dune walkovers, boardwalks, and canoe/kayak launches.
- Working Waterfronts: Waterfront communities may wish to revitalize, renew, and promote interest in their waterfront districts. Some examples of projects include developing and implementing a vision plan for a waterfront district, developing architectural standards for waterfront areas, small construction projects such as a boardwalk, observation platform, welcome center, or information kiosk, restoring shorelines and wetlands, or implementing other measures that mitigate the effects of natural hazards.

Prioritization for Coastal Partnership Initiative Grant Program

CPI applications are reviewed by a technical evaluation committee with knowledge of coastal resource management. The highest rated projects will be considered for funding, subject to the availability of funds from NOAA. All applications are evaluated using the following criteria:

- Project Location
- Project Description
- Demonstrated need and benefit to coastal resource management
- Objectives, tasks, deliverables, and timelines that clearly relate to project
- Cost-effectiveness
- Technical feasibility

Allocations of Coastal Partnership Initiative Grant Program

Allocations for the past three fiscal years under the CPI program are the following:

- FY2014/2015 - $229,610
- FY2015/2016 - $ 89,817
- FY2016/2017 - $ 39,760

Florida Small Cities Community Development Block Grant Program

The Florida Small Cities Community Development Block Grant Program provides federal funding for low income housing rehabilitation and community development. The program, regulated by the U. S. Department of Housing and Urban Development (HUD), assists smaller local governments to provide water and sewer infrastructure, housing rehabilitation opportunities for low income homeowners, commercial revitalization, and economic development projects.

Eligibility for Florida Small Cities Community Development Block Grant Program

The following communities are eligible to apply for funds:

- Non-entitlement cities with fewer than 50,000 residents
- Counties with fewer than 200,000 residents
- Cities that opt out of the urban entitlement program

Prioritization for Florida Small Cities Community Development Block Grant Program

To be eligible for funding, an activity must meet at least one of the following national objectives:

- Low-Moderate National Objective: at least 51 percent of the beneficiaries must be low and moderate income persons (total family income is at or below 80 percent of the area's median income).
- Slum and Blight National Objective: the area must be a slum or blighted area as defined by state or local law.
- Urgent Needs National Objective: the activity must alleviate existing conditions which pose a serious and immediate threat to those living in the area and are 18 months or less in origin. The

local government must demonstrate that it is unable to finance the activity on its own and that other funding is not available.

Allocations of Florida Small Cities Community Development Block Grant Program

Since 1983, the state has received $18-35 million each year to assist eligible local governments with housing rehabilitation, neighborhood and commercial revitalization, and economic development activities.

Community Development Block Grant Disaster Recovery Initiative

Congress began allocating Community Development Block Grant (CDBG) Disaster Recovery funds to Florida following the 2004 Hurricane Season in response to unusual hurricane activity. Subsequent allocations for 2005 and 2008 storms assist with disaster relief, long-term recovery, restoration of infrastructure, and mitigation efforts in the most impacted and distressed areas.

Eligibility for Community Development Block Grant Disaster Recovery Initiative

CDBG Disaster Recovery funds are made available to states, units of local governments, and insular areas designated by the President of the United States as disaster areas. Communities must have significant unmet recovery needs and the capacity to carry out a disaster recovery. Disaster Recovery funds are most appropriate for long-term recovery needs. Grantees may use funds for recovery efforts that involve housing, economic development, infrastructure and prevention of further damage to affected areas.

Examples of eligible activities include restoration of affordable housing, rehabilitation, demolition, replacement, acquisition, new construction, transitional housing, emergency shelter facilities, and complementary housing activities.

Prioritization for Community Development Block Grant Disaster Recovery Initiative

Activities must meet at least one of three program national objectives:

- Benefit persons of low and moderate income.
- Aid in the prevention or elimination of slums or blight.
- Meet other urgent community development needs.

Allocations of Community Development Block Grant Disaster Recovery Initiative

The following are the allocation of funds from the CDBG Disaster Recovery for the 2004, 2005, and 2008 hurricane seasons:

- 2004 Hurricane Season- $100,915,626 in grant funds was issued following Tropical Storm Bonnie and Hurricanes Frances, Ivan, and Jeanne.
- 2005 Hurricane Season- $82,904,000 in grant funds was released following Hurricanes Katrina and Wilma. Disaster recovery funds were distributed to 20 Florida counties.
- 2008 Hurricane Season- $107,680,530 in grant funds was released following Tropical Storm Fay and Hurricanes Gustav and Ike. Funds were directed to areas facing the greatest need.

The Weatherization Assistance Program

The Weatherization Assistance Program (WAP) provides grants to community action agencies, local governments, Indian tribes, and non-profit agencies to fund energy-saving repairs to low-income homes throughout the state. The grants may be used for insulation, weather stripping, water heater wraps, and the reduction of air infiltration. The program may also fund the repair or replacement of inefficient heaters and air conditioners.

Eligibility for the Weatherization Assistance Program

The total household income may not be more than 200 percent above the national poverty level. Preference is given to elderly (60 years-plus) or physically disabled residents, families with children under 12, and households with a high energy burden (repeated high utility bills).

Prioritization for Weatherization Assistance Program

The revised WAP allocation formula is based on three factors for each state:

- Low-income population: This number represents how many low-income households live in each state and is expressed as a percentage of the total for the country.
- Climatic conditions: These data are obtained from the heating and cooling degree-days for each state and deal proportionally with the energy needed for heating and cooling.
- Residential energy expenditures by low-income households: This number is an approximation of the financial burden that energy use places on low-income households in each state.

Allocations of Weatherization Assistance Program

WAP is funded each year by the United States Department of Energy and receives supplemental funding from the United States Department of Health and Human Services. The extent of services to be provided depends on available funding.

Local Funding

Local Mitigation Strategy (LMS) projects funded by grants usually require a local match for implementation. LMS projects span a wide range of mitigation issues including coordination/ integration of public and private sector mitigation projects, post-disaster planning, long-term redevelopment, and public education.

The following provides a synopsis of data obtained from reviewing each of the existing 67 LMS's to identify local funding sources that have been used in the past to fund local mitigation related projects. This list contains funding sources that have been used as a match for federal grant programs as well as to fund non-federally funded local projects.

Ad Valorem Tax

The ad valorem tax is levied based on the value of real and tangible personal property as of January 1 of each year and is intended to increase total revenue of local governments.

Stormwater Tax Assessment

The fee is based on the total amount of a property's impervious surface and has been used to prepare a stormwater program and fund a wide range of drainage improvements.

In-Kind Services

Services or equipment for projects provided by those in the community.

Impact Fees/ Development Exaction

Impact fees on new development such as 1) Water and Sewer Connection Fee; 2) Fire Impact Fee; 3) Law Enforcement Impact Fee; 4) Transportation Impact Fee; and 5) School Impact Fee are used for the purchase and construction of capital assets. (School impact fees may be remitted periodically to the County School Board).

Tourist Tax Local Option

A local tax is levied on most rents, leases or lets, and living accommodations in hotels, motels, apartments, houses, and mobile homes (contracted for periods of less than six months or less) in promotion of tourism and tourist-type activities.

Revenue Bonds

This is revenue derived from the issuance of long-term debt, such as bonds or commercial paper. Proceeds are deposited into capital projects funds and/or debt service funds.

Permit Fees

This is revenue derived from the issuance of local licenses and permits. Exceptions include occupational licenses and building permits.

State Revenue Sharing

Two tax sources are earmarked for sharing with counties: 2.9 percent of net cigarette tax collections; 41.3 percent of net intangible tax collections. Intangible tax collections provide 95 percent of total revenue shared with counties in this category.

Project Implementation

Project Management and Tracking

Prioritization

The first step to determining how mitigation funds are to be distributed is to follow the prioritization method for each program. As described earlier in this section, different grant programs have different prioritization methods. In review, Florida uses the summarized information below to prioritize projects:

- Statewide mitigation and state agency projects are prioritized by the agency, the Mitigate FL, and the State Hazard Mitigation Officer (SHMO).

- FMA: levels of participation are low enough that all eligible projects are submitted to FEMA. Nevertheless, should popularity for the program increase, priorities are in place to guide project selection.
- HMGP Seven Percent and PDM Planning Grants: Should more projects than funding allows prove eligible, those scoring highest in the eligibility process will be submitted for funding.
- HMGP Project Grants: Funds are prioritized at the local level and confirmed by FDEM. Funds are distributed through a tiered prioritization process (described in FAC 27P-22) should local governments not use their entire allocation.
- HLMP: Projects are prioritized based on the project's RFP and benefit-cost ratio.
- PDM Project Grants: Projects are prioritized based on benefit-cost ratio and technical feasibility.

Application Review

All mitigation measures submitted to the state for funding consideration must be cost-effective, environmentally sound, and technically feasible. As such, the state completes a technical feasibility analysis for each eligible mitigation measure. This process is used by grant management staff at FDEM for all proposed project applications regardless of type of measure or funding source. Upon request, the state will provide technical assistance to the LMS Working Group or applicant to help complete the technical feasibility analysis.

All proposed projects are subject to a three-part screening process: Engineering Review, Benefit Cost Analysis to determine financial viability, and Environmental Review. The evaluations are performed simultaneously.

Engineering Review

This review establishes whether the project is feasible from an engineering standpoint and whether it will reduce damages as claimed. In other words, it is conducted to determine whether or not the proposed project's scope of work will actually resolve the identified problem. Additionally, this review involves whether the application contains sufficient information and data for input into the benefit-cost model.

The engineer performs a preliminary benefit cost analysis using the information provided in the application worksheet. He or she may suggest changes to the scope of work, to ensure a clear explanation of the problem and the solution and may request changes in an effort to make the project more efficient in reducing damage and loss. A site visit could take place to review and document existing conditions and/or to collect damage information for benefit cost analysis purpose to demonstrate the benefits of the project. Once the review is completed, the engineer prepares a report and forwards it to the project manager with a recommendation to fund or not the project.

For projects that are approved, scope of work and project cost changes will be review to ensure that the project remains feasible and cost effective. Interim and final inspections are performed and upon completion, a final report is written with a recommendation regarding scope of work completeness and requirement compliance for final payment.

Benefit-Cost Analysis

State staff conducts benefit cost analysis (BCA) for each mitigation project application. Staff members use FEMA approved benefit cost modules, which are based upon OMB Circular A-94, Guidelines and Discount Rates for Benefit Cost Analysis of Federal Programs.

BCA assesses whether the cost of investing in a mitigation project today (the cost) will likely result in sufficiently savings by reducing damages in the future (the benefits) to fund the project.

Benefits are mathematically divided by costs to produce the benefit-cost ratio. The benefit-cost ratio states whether and by how much benefits exceed project costs. If the cost of the project exceeds the benefits, the project will not be deemed cost-effective. A benefit-cost ratio of at least one is necessary for a project to be cost-effective.

Benefit-cost analysis will yield one of three outcomes:

- The project is cost-effective (BCR>1.0)
- The project is not cost-effective (BCR<1.0)
- Additional data is required

Benefit-Cost Analysis Exemptions

The following categories of mitigation measures are exempt from the FEMA policy on BCA:

- Five percent or Tornado Initiative projects: states that receive a presidential declaration are eligible to use up to five percent of available HMGP funding at their discretion. An additional five percent may be used to fund tornado projects at the state's request.
- Substantial Damage Waivers for acquisition of substantially damaged structures in the 100-year floodplain.
- Mitigation planning related grants.
- Alternative methodology for determining cost-effectiveness.
- Pre-calculated benefits for Acquisition and Elevation projects locate in a Special Flood Hazard Area.
- Pre-calculated benefits for residential wind retrofits.

Environmental Review

All projects that receive federal funding must comply with federal and state laws as well as executive orders. This is required by the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA). State staff coordinates with FEMA Region IV environmental staff to review each project proposed for funding. Review reveals any adverse environmental, historical, or cultural impacts based upon the project's scope of work. Once the environmental review is completed, the recommended NEPA document and compliance documentation is submitted to FEMA.

State environmental specialists provide technical assistance to applicants before submission to avoid delays in the review process. Once the application is submitted to the state, an environmental specialist reviews each environmental section of the application for completeness to ensure all the necessary documents and information is included for review. The environmental unit must sign off on all projects before they can be input into NEMIS or submitted to FEMA for final approval.

Environmental Categorical Exclusions

Projects that have been determined not to have significant impact on the environment are excluded from having a detailed environmental analysis in an Environmental Assessment or Environmental Impact Statement. A partial list of categorical exclusions (CATEX) is included below:

- Administrative Actions Associated with Grants Management.
- Federal Assistance for Property Acquisition and Demolition.
- Federal Assistance for Structure and Facility Upgrades.
- Federal Assistance for Relocation/Realignment of Structures and Facilities.
- Federal Assistance for Flood Hazard Reduction Actions.
- Federal Assistance for Construction or Installation of Structures, Facilities, or Equipment to Ensure Continuity of Operations.

Management

Effective program management is evidenced through efforts to continually improve efficiency, capability, and process. The state works diligently on its grants and program management to continually refine the application process and management tasks. The state continues to meet all mitigation grant application timeframes and submits complete, technically feasible, and eligible project applications with appropriate supporting documentation evidenced through passing Program Administration by States (PAS) program reviews that are evaluated by FEMA. The current application submission process allows extra time for state review of applications to ensure completeness, eligibility, and cost-effectiveness before forwarding to FEMA. Employees are cross-trained so that numerous staff members are familiar with the process and projects. FDEM mitigation staff also receives regular benefit-cost analysis training from FEMA.

The State of Florida has implemented an on-going technical assistance process to assist potential applicants with developing technically feasible and cost-effective projects. The state conducts application workshops in order to bring application materials, tools, and techniques to potential applicants. In addition to conducting training sessions and workshops, state staff provides ongoing individual training and assistance to potential applicants upon request. The state strongly urges applicants to work with the technical staff year round to develop the application and its technical elements. Such support includes demonstrations on appropriate benefit cost modules to ensure development of the best possible benefit cost ratio.

Tracking

The Bureau of Mitigation used planning grants to develop a grants management database called www.FloridaMitigation.org. The goal of this project was to design and develop an application that effectively manages the mitigation programs of the Bureau of Mitigation.

The system has been operational since January 1, 2009 and use of the old FERS tracking system was discontinued in June 2010. The comprehensive, completed product supports both programmatic and fiscal applications for entry, support queries, programmatic and fiscal reporting, and overall project management. FloridaMitigation.org is designed to address the following stated objectives:

- Provide a web-based system that provides the ability to effectively track project management objectives and maintain mitigation program budget and expenditures.
- Provide a direct data exchange to the State of Florida statewide accounting system (FLAIR). This data exchange downloads financial code data that reduces or prevents accounting entry errors.
- Provide detailed coordination between FEMA sub grant award projects and state contracting projects. There are many times that state contracting rules and procedures require that a single FEMA sub grant award be implemented utilizing multiple state contract awards. This provides data correlation between these different processes.
- Provide enhanced financial audit capabilities that included the ability to utilize direct data from FLAIR provided on a daily basis to reduce the time and effort of coordination between mitigation staff and Division of Accounting and Auditing staff.
- Provide a single database system that coordinates data between state staff located in Tallahassee and state staff located at the State Logistic Response Center (SLRC) in Orlando.
- Provide additional business process improvement analysis as well as effective exceptions and error reporting in order to improve quarterly reporting.
- Identify and rectify existing tracking and reporting errors as well as implement effective exception and error reporting on a systematic basis to ensure improved data accuracy.

This database allows Florida Mitigation Bureau staff to achieve maximum efficiency and accountability for every project that passes through its mitigation programs, as well as effectively utilize federal and state funds. This system also allows the State of Florida to provide more accurate data related to older programs that are being closed out, and allows timely response to findings and reconciliations that are required as we improve the reporting of current project activity.

The system currently manages HMGP projects from 2016 as well as non- disaster projects under the FMA, PDM, HLMP and unmet needs programs. There has also been a tremendous amount of work associated with data clean up and reconciliation. In addition, coordination of state contracting projects to sub-grant award projects and the project and financial reconciliation is an ongoing process.

Financial Reports

The Division's Finance Unit routinely submits Standard Form 425 to report the status of FEMA obligated funds. The mitigation section submits quarterly progress reports within 30 days of the fiscal quarter end to FEMA's Regional Office. The state submits two separate quarterly reports:

- Financial Report
- Project Progress Report

If an extension is needed, the section will follow proper procedures to file requests. These reports indicate the updated status and projected completion date for each funded project and pertinent notes on the project. The following is an overview of the process used by the state to compile and submit the quarterly progress reports:

- Quarterly reports must be submitted by sub-grantees at the end of each fiscal quarter. The report should document the activities, accomplishments, and failures to date for the project. The state's standard Quarterly Report form is included as an attachment in DEM's Sub-grantee Agreement and also made available via the state's website at http://www.floridadisaster.org/index.asp.

- The sub-grantee quarterly reports are reviewed by state mitigation staff and used to update the appropriate fields in the state Quarterly Progress Report document that is submitted to FEMA.

The state monitors performance using identified project milestones and the project completion date. Interim revisions to existing quarterly reports will be made as needed or requested by the Regional Office.

Closeout Process

Florida has a history of closing out mitigation grant applications, including financial reconciliation, within the period of performance. If needed, DEM follows proper procedures for filing extensions. The state completes all post-award activities within 90 days from project completion, even if the project comes in before the performance period ends. The following process is used to close-out all federal hazard mitigation projects:

1. State mitigation staff use quarterly reports, on-site visits, and interim inspections to monitor mitigation project progress.
2. The sub-grantee submits a formal request for a final inspection upon work completion.
3. State mitigation staff inspects the project site and provides a report indicating whether the sub-grantee has met all scope of work requirements.
4. If any outstanding documentation is needed, state mitigation staff informs the sub-grantee. Documentation should be received at the state office in a timely manner.
5. The Project Closeout Checklist is accessed and project completion data is entered with:
    - FEMA Project Number
    - Project Name
    - Sub-grantee Name
    - Sub-grantee FIPS Code
    - DEM Agreement Number
    - Obligated Budget Amounts
    - Final Project Cost Amounts
    - Project Completion Date
    - Final Inspection Date
    - Project Cost Overrun/Underrun Amount
6. The Project Closeout Checklist is signed and dated by the project manager and attached to the closeout documentation as required:
    - Final project photographs with date
    - Final inspection report
    - Environmental report
    - Completion letter from Sub-grantee
    - Certificate of Acceptance
    - Signed design plans
7. Any other project specific closeout documentation for the final inspection report is attached to the Project Close-out Checklist.

8. The final Request for Payment is forwarded to the mitigation finance section along with the closeout documents.
9. Upon final payment, the state mitigation finance manager drafts a letter to FEMA requesting that the project be closed.
10. The state mitigation finance manager prepares a closeout spreadsheet based upon the FEMA obligated award amount and the final total project cost.
11. The closeout letter and closeout spreadsheet are attached to the closeout documentation package and are forwarded to the State Hazard Mitigation Officer for signature along with the final payment request.
12. A closeout spreadsheet is maintained by the mitigation finance staff. This spreadsheet is updated with the project number, project name, date of the closeout letter sent to FEMA and date that the closeout/de-obligation letter is received back from FEMA.

Records of Performance

Federal Mitigation Grants

FDEM strives to ensure that projects are successfully implemented and closed within the approved period of performance. The federal HMA programs include:

- Flood Mitigation Assistance Program (FMA)
- Severe Repetitive Loss Program (SRL)*
- Repetitive Flood Claims Program (RFC)*
- Pre-Disaster Mitigation (PDM)
- Hazard Mitigation Grant Program (HMGP)

*Note – as of 2013 the SRL and RFC grant programs were combined into FMA.

Since 1992, the state has managed the HMGP for 46 presidentially declared disasters. Of the 46 presidentially declared disasters, 13 occurred between the years of 2004 and 2009 and six occurred between the years of 2012 and 2016. As of 2017, the state has closed out 32 of the 46 HMGP grants awarded since 1992. Management of the sub-grantee applications for each of the 12 open events is ongoing. The state, in partnership with FEMA, conducted joint reviews of projects submitted for funding consideration under 2004 events: DR-1539, DR-1545, DR-1551 and DR-1561 and independently for all other disasters.

Federal non-disaster grant programs listed above follow the same procedures as the HMGP. In cases where extenuating circumstances prevent project completion in the approved time period, the state follows proper procedures to request a time extension. Time extensions on projects may or may not affect the overall period of performance of the grant.

As of August 31, 2017, the following annual grant packages are currently open:

- 5 PDM
- 6 FMA
- 2 RFC
- 2 SRL

Target closeout dates as well as the total number of projects funded for these programs are available in *Appendix M: State Managed Projects*.

Project Evaluation

The state assesses the effectiveness of completed mitigation actions. It documents the estimated losses avoided for each action in two ways:

- Final inspection/ Benefit Cost Analysis (BCA)
- Post-disaster mitigation assessments of project performance

Final Inspection/ Benefit-Cost Analysis

As each project concludes, the state engineering staff performs a final inspection to ensure it was completed in accordance with the approved scope of work and associated design specifications. The state records estimated benefits from completed projects as submitted in the BCA described above. If a cost overrun occurs, an additional BCA will be conducted prior to final inspection to ensure the project was cost effective.

Post-Disaster Mitigation Assessments

In accordance with 44 CFR 201.5(b)(2)(iv), the State of Florida has developed a system and strategy by which it will conduct an assessment of completed mitigation actions and includes a record of the effectiveness (actual cost avoidance) of each mitigation action. This system and strategy, called Loss Avoidance Assessment, is intended to contribute part of the requirements to maintain a FEMA approved Enhanced SHMP.

The state studied loss avoidance assessment methodologies, past FEMA loss avoidance studies, and other sources to determine methods for streamlining existing processes. This was done to identify ways to complete comprehensive analyses using existing staff and without adding significantly to the cost of mitigation.

Losses avoided can be calculated for one event or multiple events and over the life of the project. Thus, in addition to calculating losses avoided by a single project for a single event, Florida may be able to provide the net present value of a mitigation project or the net present value, in investment terms, of all mitigation projects in the State of Florida available for analysis. Such analyses may help guide decision-making and identify best practices.

Florida Severe Storms, Tornados, Straight-line Winds and Flooding event from 2014 and Hurricanes Hermine and Matthew from 2016 are the most recent events for which the State of Florida conducted loss avoidance assessments.

Once projects are completed and grants are closed out, FDEM accounts for them and analyzes them if they are impacted by a disaster event that receives a major disaster declaration by conducting loss avoidance reports.

Loss avoidance reports are conducted by using knowledge of completed mitigation projects and GIS software. A real disaster event is modeled using HAZUS and GIS software and the nature, extent, and severity of damages are recorded. Then the known mitigation projects in the areas impacted by the disaster are analyzed to determine the mitigation present versus mitigation absent scenarios. The difference between the damages with and without the mitigation projects represents the "losses avoided." Then the cost of the mitigation projects are adjusted to normalize the losses avoided. The difference between those two values is the return on investment (ROI). The paragraphs below summarize the loss avoidance reports that FDEM completed between 2012 and 2017. The actual loss avoidance reports are also included as *Appendix N: Loss Avoidance Report Tropical Storm Debby; Appendix O: Loss Avoidance Report Florida Severe Storms, Tornadoes, Straight-line Winds, and Flooding; Appendix Q: Loss Avoidance Report Hurricane Hermine; Appendix R: Loss Avoidance Report Hurricane Matthew*.

Tropical Storm Debby, June 2012

In 2012, Tropical Storm Debby impacted 50 projects, which cost $18.9 million (in 2012 dollars) to implement. Without the mitigation projects, the damages would have cost $21.9 million, which means the total losses avoided was over $3 million which is 116% ROI. This a remarkably high ROI, especially considering that most of the projects were completed just one year earlier.

Florida Severe Storms, Tornadoes, Straight-line Winds, and Flooding, April – May 2014

In 2014, Severe Storms, Tornadoes, Straight-line Winds, and Flooding impacted 33 projects, which cost $18.4 million (in 2015 dollars) to implement. Without the mitigation projects, the damages would have cost over $24 million, which means the total losses avoided was $5.6 million, which is a 132% ROI.

When these results are combined with previous loss avoidance results of some of the same projects, the 33 projects analyzed have avoided losses of $33.2 million from Major Disaster Declaration events since 2008.

Hurricane Hermine, September 2016

Hurricane Hermine impacted 31 projects, which cost $9.8 million (in 2016 dollars) to implement, in 2016. Without the mitigation projects, damages would have cost $20.7 million, which means the mitigation projects led to $10.9 million losses avoided, which is an 82% ROI. One drainage project alone cost only $1 million and avoided $18 million in damages from Hurricane Hermine.

Hurricane Matthew, October 2016

Hurricane Matthew hit Florida in 2016 and impacted 40 projects, which cost $19.2 million (in 2016 dollars) to implement. Without the mitigation projects, the damages would have cost $81.1 million, which means the mitigation projects led to $61.9 million in losses avoided, which is a 97% ROI. In Volusia County alone, $3.3 million in damages and relocation costs were avoided due to 22 building modification and wind mitigation projects. Another major mitigation success was that the drainage projects that were impacted by storm surge or riverine flooding during Hurricane Matthew were able to convey water more swiftly than it would have receded on its own.

Complete Timeline

The timeline found in Figure 111 is illustrative and empirically based. It begins after a Presidential Declaration has been issued. Its primary purpose is to illustrate the general progression, timing, and interaction of various participating entities. The timeline should not be viewed as definitive in stage length nor with regard to agencies involved in the process. In practice, the selection and implementation of mitigation measures are contingent on a number of variables. These variables may include the nature and severity of the event, quality and sophistication of the sub-grantee's personnel, availability and requisite parts, material, and environmental issues.

Figure 111: Mitigation Project Lifespan

	1 – 6 Months	*7 – 12 Months*	*12 – 42 Months*		*Within 90 Days of Project Completion*
	Step 1: Funding Availability	***Step 2: Application***	***Step 3: Contract Development***	***Step 4: Progress Monitoring***	***Step 5: Completion and Evaluation***
Deadlines	• Administrative Plan • Request State Management Costs • Receive 3 Month Estimate • Receive 6 Month Lock-In • Applicant Briefing • Open Funding Cycle	12 Month Deadline for: -Review -Submission to FEMA	FEMA Review ***Contract length is typically two years***		Post-Project evaluation should be finished within 90 days of project completion, even if this is prior to project performance period end.
Planners/Project Managers	Mitigation programs are promoted year round. As funding becomes available, the state: • Publishes a Notice of Funding Availability (NOFA) • Promotes the program and/or holds grant application workshops in impacted communities • Where applicable, the state conducts applicant briefings and/or offers technical assistance to applicants • Coordination with LMS working groups • Oversee county allocations/budgets	• Applications are developed by sub-grantee. {This includes concurrence with Local Mitigation Strategy priorities} • eGrant/Hard copy applications are submitted to the state for eligibility and completeness review • Enters project information into NEMIS • Submits hard copy to FEMA along with BCA and environmental report • Initiates Administrative Rights procedures for denied projects • Provides quarterly reports to FEMA	• FEMA obligation and contract generation. • The project manager forwards the obligation report, budget, and scope of work for contract development • Contract is sent to sub-grantee for signature • Signed contract is routed for internal signature • Project manager distributes executed contract to appropriate stakeholders • Provide technical assistance	• Planners review, evaluate, recommend supplemental funding, scope changes, time extension requests • Project manager monitors progress • Request, review and file quarterly reports • Conduct field monitoring • Obtain reports and updates • Engage applicant and offer technical assistance as needed • Maintain awareness of project deadlines and period of performance • Conduct interim inspection/ site visit with Technical Support Unit	• Applicant requests final inspection • Technical Support Unit conducts final inspection and reports to project manager • If project is completed, final payment request, closeout documentation, final payments is submitted and file is closed • Quality control officer reviews all payments made to applicant throughout the project implementation period

	1 – 6 Months	7 – 12 Months	12 – 42 Months		Within 90 Days of Project Completion
	Step 1: Funding Availability	*Step 2: Application*	*Step 3: Contract Development*	*Step 4: Progress Monitoring*	*Step 5: Completion and Evaluation*
Engineers	Participates in applicant briefings to provide engineering technical assistance as requested	• Review the application scope of work for feasibility, cost effectiveness, the degree to which the proposed solution solves the existing problem • Performs preliminary site visits • Renders requested technical assistance that may be needed		• Technical Support Unit and project manager conduct joint interim inspection/ site visit • Monitors during construction phase	Conducts final inspection
Environmental Specialists	Participates in applicant briefings to provide environmental technical assistance as requested	• Review for compliance under the National Environmental Policy Act • Identify applicable cultural, historic or economic significance • State Clearing House facilitated review • Provides technical assistance and consults with agencies regarding permitting process • Environmental site visits • Information entered into NEMIS		Monitors for environmental compliance	Conducts final review of project
Grants Specialists	• Assists Program Manager with disaster budgets for the Hazard Mitigation Grant Program funds allocated to regular, five percent projects, and planning • Technical assistance • Generates contracts			• Assists Project Manager with processing payments, advances, contract modifications, supplemental funding requests, time extension requests • Request closeout documentation, and requests for final payment • Monitors compliance with OMB Circulars and relevant CFRs	

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