2020

Pinellas County Multi-jurisdictional

LOCAL MITIGATION STRATEGY

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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), Pinellas County 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 County Hazard Mitigation Plan, more commonly called the Local Mitigation Strategy (LMS) in Florida communities, is to reduce death, injuries, and property losses caused by natural hazards in Pinellas County. The 2020 Plan identifies hazards based on the history of disasters within the county 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. This is a 5-year update of the countywide LMS that was last approved in May of 2015. While the document may refer to specific historical events for context, the plan update focuses on changes to the communities and their vulnerabilities over the last 5 years and provides an update to capabilities, programs, and actions that the participants intend to utilize to reduce exposure or consequences from the identified hazards. Hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs.

The LMS serves several purposes; including providing an explanation of how Pinellas County and its 24 municipalities identify strategies to implement an effective, comprehensive countywide Local Mitigation Strategy. The communities participating in this plan include the Unincorporated County and all its municipalities:

- Pinellas, Unincorporated
- Belleair, Town of
- Belleair Beach, City of
- Belleair Bluffs, City of
- Belleair Shore, Town of
- Clearwater, City of
- Dunedin, City of
- Gulfport, City of
- Indian Rocks Beach, City of
- Indian Shores, Town of
- Kenneth City, City of
- Largo, City of
- Madeira Beach, City of
- North Redington Beach, Town of
- Oldsmar, City of
- Pinellas Park, City of
- Redington Beach, Town of
- Redington Shores, Town of
- Safety Harbor, City of
- St. Pete Beach, City of
- St. Petersburg, City of
- Seminole, City of
- South Pasadena, City of
- Tarpon Springs, City of
- Treasure Island, City of

The 2020 Plan is coordinated through appropriate state, local, and regional agencies, as well as non-governmental interest groups. This plan, and its future revisions, will provide guidance in merging the planning efforts of all local governments, the private sector, and non-profit organizations within Pinellas County into one viable, comprehensive, mitigation program.

The scope of the LMS is broad. The plan explains the way in which the communities implement mitigation activities within the county in coordination with local agencies. Additionally, as required by statute, the Risk Assessment portion of the LMS identifies natural hazards, as well as technological and human-caused hazards. The Risk Assessment portion analyzes vulnerability of the County in countywide terms as well as results and capabilities at the municipal level.

The purpose of the 2020 LMS is to:

- Reduce risk to people, property, and the critical infrastructure.
- Increase public awareness and education about the plan and planning process.
- Maintain grant eligibility for participating jurisdictions.
- Update the plan in accordance with Community Rating System (CRS) requirements.
- Maintain compliance with state and federal legislative requirements for local hazard mitigation plans.
- Complete an update of information in the plan to demonstrate progress and reflect current conditions.

Pinellas County 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.

Planning Process and Maintenance Section

There are 10 primary steps that comprise the LMS planning process. The process defines not only who should be involved, but how the process is going to work, and an understanding of how the process facilitates the production of the final product.

- Step 1: The Planning Organization – The development of a mitigation strategy requires the involvement of representatives from the public, private, and governmental sectors.
- Step 2: Involving the Public – An important component of the mitigation planning process involves public participation.
- Step 3: Coordination – Coordinate activities within the County and to bring back perspectives of their constituency.
- Step 4: Assessing the Hazard – Conduct and maintain a hazard identification and vulnerability assessment.
- Step 5: Assessing the Problem – Quantify the impact of the hazards identified in the previous step on the community.
- Step 6: Goals and Objectives – Revisit goals and objectives and make adjustments as appropriate.
- Step 7: Possible Activities: Mitigation Opportunities and Initiatives – Identification of potential mitigation opportunities and initiatives.
- Step 8: An Action Plan – Objectives were identified for each goal to specifically identity action items and are reflected in six categories of mitigation activities.
- Step 9: Adoption of the Strategy – Officially adopt the LMS.
- Step 10: Implementation, Evaluation, and Revision – The LMS is intended to be a dynamic document that will be updated regularly.

There are two main working groups responsible for the LMS planning process. The LMS Working Group (WG) consists of representatives of the jurisdictions, private sector, and non-profits as well as any members of the public as all meetings are advertised on the County's website and calendar. The Flood Risk and Mitigation Public Information Working Group (FRMPIWG) is a group of public and private stakeholders formed to supplement input into the planning process.

The County's first LMS began its planning process in March of 1998 and took approximately 15 months to complete. The plan was then updated again in 2004, 2009, and 2015. This is the fourth update of the plan and the focus of the update was on adding new risk assessments, refining objectives, and refreshing the project list.

The 2020 LMS update began in the fall of 2018 when the County assessed its current plan and assessed it for improvement opportunities. When the plan update began, the LMS WG was presented with results of the assessment for concurrence on a path forward.

During the timeline of the plan update, the County and its jurisdictions also combined several other groups to supplement input into the planning process. Pinellas is a strong advocate of the National Flood Insurance Program's Community Rating System and had a few outreach groups in place to support those activities. A countywide Program for Public Information was installed over the past 12 months to facilitate consistent messaging across communities and provide tools for jurisdictions with limited resources. As the mitigation planning process was happening concurrently, this group of public and private stakeholders met three times over the year and became known as the Flood Risk and Mitigation Public Information Working Group (FRMPIWG). The FRMPIWG developed the following mission statement:

- Increase disaster resiliency across the county through the development and dissemination of public information and educational outreach about identified flood risks, minimization of those risks through mitigation and the efficacy of obtaining appropriate flood insurance coverage.
- Ensure attainment of flood insurance savings for residents and businesses within the incorporated and unincorporated areas of the county through effective participation in the Community Rating System.
- Engage and educate community stakeholders to enhance planning efforts by ensuring diverse representation and to provide stakeholders the opportunity to become more knowledgeable in the subject of mitigation and to expand reach while improving their ability to provide improved customer service.
- Develop strategies, concepts and projects for reducing flooding impacts that can become part of the county Local Mitigation Strategy plan.

The FRMPIWG meetings (typically over 70 participants with representatives from all municipalities) had a briefing from the LMS Working Group at every meeting to update them on recent activities. Likewise, the feedback from the FRMPIWG was provided to the LMS WG to be evaluated and included in the LMS update process.

After the 2020 LMS Plan Update underwent final revisions, and the plan was completed to the satisfaction of the State Hazard Mitigation Office (SHMO), which reviews the Plan for compliance on behalf of the Federal Emergency Management Agency, the plan was officially adopted by Pinellas County Board of County Commissioners by adoption of a resolution. The 2020 LMS update was submitted to the Board of

County Commissioners on 99/99/2020 and approved on 99/99/2020. The plan will be in effect from May 6, 2020 until May 5, 2025. Each jurisdiction also approved the Plan within their community as identified in Appendix F.

Risk Assessment Section

The risk assessment for Pinellas County was intentionally structured to align with the State of Florida Enhanced Hazard Mitigation Plan (SHMP) and provides the factual basis for developing a mitigation strategy for the county. This section profiles the natural, human-caused, and technological hazards that could possibly affect Pinellas communities. This risk assessment is used not only for the LMS, but also supports the County's Comprehensive Emergency Management Plan (CEMP). Each natural hazard profile includes a discussion of the geographic areas affected, the historical occurrences in the county, an impact analysis, the probability, and the vulnerability and loss estimation by county critical 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 22 hazards based on an examination of past disasters, probability of occurrence, possible impacts, and vulnerability. The hazards include:

Natural Hazards

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

Technological Hazards

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

Mitigation Strategy Section

The LMS details goals and objectives for achieving loss reduction in Pinellas County. The six goals are listed below.

1. Become a More Disaster Resilient Community.
2. Minimize Coastal Flooding Losses in the CHHA, Coastal Storm Area and Hurricane Vulnerability Zone.
3. Minimize Riverine or Inland Flooding Losses in the 25, 50, and 100-year Flood Zone.
4. Minimize Storm Wind Losses in the County.

5. Minimize Losses from Hazardous Material Incidents.
6. Minimize Vulnerability to Technological Hazards.

Additional information on the LMS goals and objectives can be found in this section.

Pinellas County has policies, programs, and capabilities designed to help mitigate the impacts of hazard events. 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.

Potential Funding Sources Section

The county 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.

Appendices

Many documents are included with the LMS as appendices. These appendices are referenced throughout the plan and support the plan.

- Appendix A: Planning Process Documentation
- Appendix B: Risk Assessment Tables
- Appendix C: CRS 610
- Appendix D: Mitigation Initiatives
- Appendix E: FL Review Tool
- Appendix F: Plan Adoption
- Appendix G: Plan Maintenance
- Appendix H: Program for Public Information
- Appendix I: Repetitive Loss Area Analysis

INTRODUCTION

Local Hazard Mitigation Plan Requirements
D1. Was the plan revised to reflect changes in development? [44 CFR 201.6(d)(3)]

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 County (and its municipalities) is required to have a Federal Emergency Management Agency (FEMA)-approved hazard mitigation plan in order to be eligible for federal hazard mitigation funding. In Florida, the hazard mitigation plan is known as a Local Mitigation Strategy, or LMS. The purpose of the Local Mitigation Strategy is to establish an ongoing process that will make hazard mitigation part of the daily functioning of the entire community, including both public and private sectors and our residents themselves. The Local Mitigation Strategy serves as a bridge between local governments' comprehensive growth management plans, the county comprehensive emergency management plan, land development regulations, and relevant ordinances and codes such as those for floodplain management. It may also fulfill some of the requirements of Florida Statutes Chapter 163, "Comprehensive Growth Management Plan." This strategy integrates mitigation initiatives established through various policies, programs, and regulations into a single stand-alone working document. The 2020 Plan identifies hazards based on the history of disasters within the community 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 County's first LMS began its planning process in March of 1998 and took approximately 15 months to complete. The plan was then updated again in 2004, 2009, and 2015. This is the fourth update of the plan and the focus of the update was on adding new risk assessments, refining objectives, and refreshing the project list.

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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. In January 2019, the Institute issued the Natural Hazard Mitigation Saves: 2018 Interim Report. The 2018 Interim Report highlights the significant savings that result from implementing mitigation strategies in terms of safety, and the prevention of property loss and disruption of day-to-day life. The report is a compilation of the project team's results to this point and includes the findings from the 2017 Interim Report, released in January 2018, and a second report, Natural Hazard Mitigation Saves: Utilities and Transportation Infrastructure, released in October 2018.

For this part of the ongoing study, the Institute's project team looked at the benefits of designing buildings to meet the 2018 International Residential Code (IRC) and 2018 International Building Code (IBC)—the model building codes developed by the International Code Council (ICC)—versus the prior generation of codes represented by 1990-era design and National Flood Insurance Program (NFIP) requirements. **The project team found a national benefit of $11 for every $1 invested.**[1]

Regulations

The Disaster Mitigation Act of 2000 (DMA2K) became law on 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 and Local 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
  - §201.6 Local 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
    - §13.10 Forms for Applying for Grants

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

[1] https://www.nibs.org/page/mitigationsaves

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

Other applicable standards include the Emergency Management Accreditation Program (EMAP) Standards. Pinellas County is not EMAP Accredited yet but is considering the process. This LMS update is designed for compliance with the EMAP Standards. The applicable Standards include:

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

Assurances

Pinellas County 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.

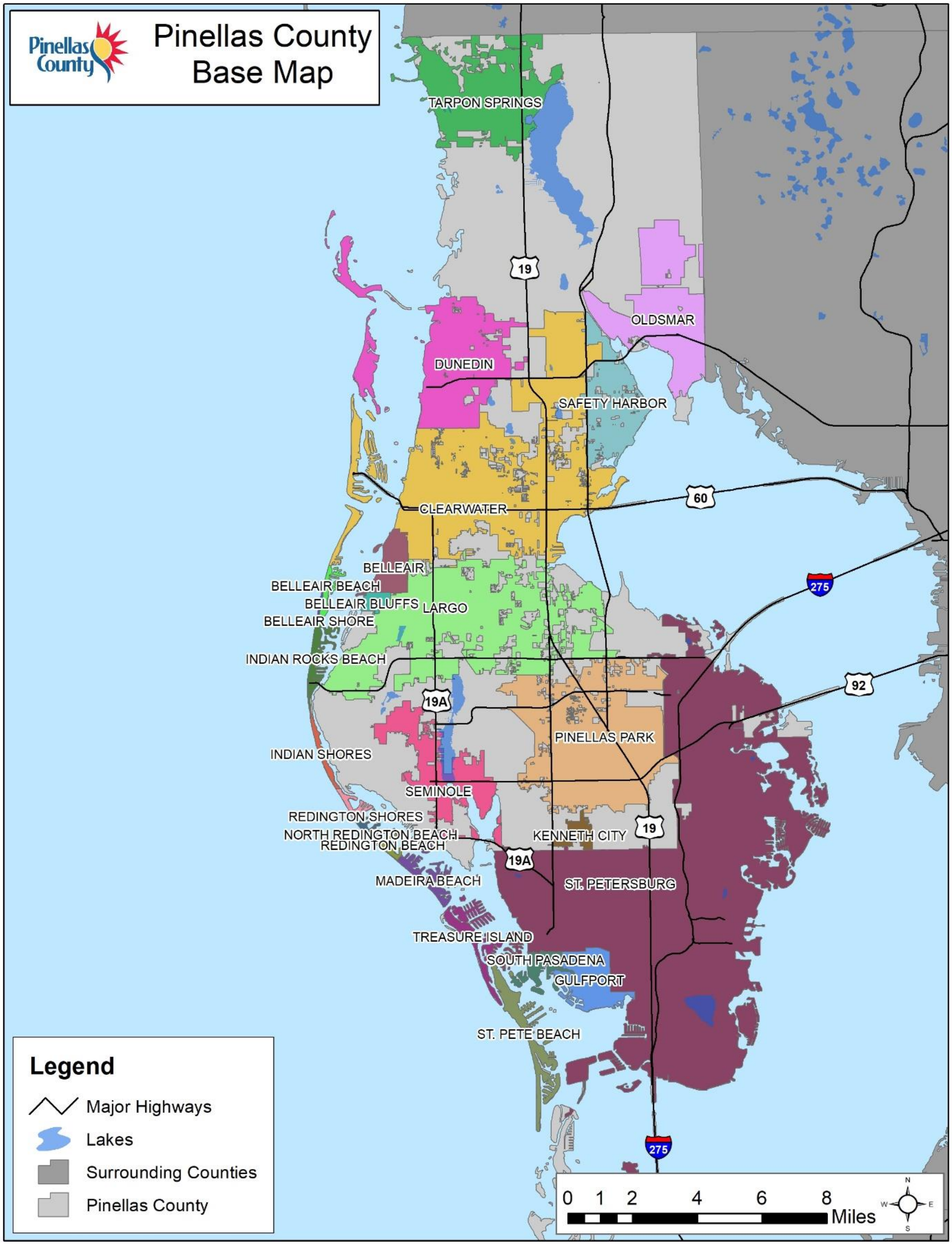
The County also assures it will amend the Local Mitigation Strategy in accordance to 44 CFR 13.11 (d). This includes amending the plan whenever necessary to reflect changes in state or Federal laws and statutes.

Pinellas County Profile

Attracted by the mild, sub-tropical climate and miles of white sand beaches, 975,280 (U.S. Census ACS 2018 Estimate) people have made Pinellas County their home. With an average 360 days of sunshine each year and beaches ranked among the best in the U.S., the county is also the most popular tourist destination on the Gulf of Mexico, drawing nearly six million tourists annually. Pinellas' diverse communities range in population from more than 252,000 in St. Petersburg to slightly more than 100 in Belleair Shore, and nearly all capitalize on living in a waterfront paradise. As an established county, the significant infrastructure – including schools, utilities, and roadways – is already in place. Pinellas is also well connected with regional access provided via Interstate-275, two international airports, and the largest port in Florida.[2]

[2] https://www.pced.org/page/PinellasOverview

Figure 1.1: Base Map of Pinellas County



Growth

Pinellas County is a major urban county with close to a million permanent residents. In addition, we have an influx of approximately 15.5 million visitors and tourists every year. This massive population is accommodated all within just 273 square miles of land, located on a peninsula. In terms of land area, the county represents only 11 percent of the total land in Tampa-St. Petersburg-Clearwater Metropolitan area. However, despite its small geographical size, Pinellas County is the sixth most populous as well as the densest county within the State of Florida.

Pinellas County saw most of its growth in the decades that followed Word War II. After seeing a period of phenomenal growth and urban expansion, today the county is mostly built out. Comprising of 24 municipalities, several old and newly-established neighborhoods, and characterized by a diversity of urban and suburban environments, the county has limited vacant land for new growth. Majority of the vacant land that is currently available for development are smaller, irregular tracts of land under separate ownership, that are distributed throughout its urban environment. This has created considerable challenges for accommodating new growth or for providing new housing and employment opportunities within the county. This has also inevitably, resulted in a shift in focus towards redevelopment and infill-development in recent years. While some areas such as the Gateway Area and Lealman, continue to show great potential for new growth or redevelopment, as highlighted ahead in the Risk Assessment Section (Development Trends and Changes in Vulnerability), overall there has been a low rate of residential development in the county since 2015.

Despite this slow down, the County's population has been slowly yet steadily increasing. According to the American Community Survey (ACS) estimates, since 2015, we have added approximately 60,790 residents, reaching a population of 975,280 by 2018. In another 30 years, we are expected to grow over a million. Today more than 400,000 households call Pinellas county their home. It is evident that Pinellas County continues to attract new residents and remains a desirable location to live and work in. However, what does this mean for us in terms of our vulnerability?

Studies indicate that population growth or increase in density and urbanization, can impact the vulnerability of a place. In addition, the geographic distribution of this population growth and the demographic characteristics, can help determine the different level of risks and vulnerability experienced by different population groups.

Increase in population no doubt increases the demand on services. Considering the small size of the county; its location on a peninsula with limited room to expand; older housing stock and infrastructure; and already a high susceptibility to flooding and a number of other hazards; an increase in population, creates considerable challenge for addressing not just emergency operations (such as evacuation and sheltering) but also for long-term mitigation and resiliency.

As discussed in the Risk Assessment Section (Development Trends and Changes in Vulnerability), since 2014, Pinellas County has experienced a relatively smaller increase in population. However, this population growth and increase in structures has resulted in a moderate increase in vulnerability for the whole county and a relatively higher increase in vulnerability for certain areas within the county. For increase in building counts or population specific to each jurisdiction, please refer Table 4.6 and Table 4.7 (Risk Assessment Section/Development Trends and Changes in Vulnerability).

While the increase in number (both structures and population) has increased our vulnerability, the age and condition of our built environment is another factor that adds to it. The coastal environment and the high susceptibility to both inland and coastal flooding further exacerbates this. Approximately 88,000 structures in Pinellas County and its municipalities are within the Special Flood Hazard Area. Approximately 55,000 of these structures were built prior to 1975, when federal floodplain regulations had not yet been adopted in most jurisdictions. Some of the older buildings that were built prior to the adoption of the new stricter construction codes, could be at a greater risk to flood or wind events. While these factors increase our risks and vulnerability, Pinellas County's numerous parks and ecological preserves act as a natural buffer and play a critical role in reducing our vulnerability. As stated within Pinellas County's Comprehensive Plan, these environmental areas form approximately one fifth of the land area within the county.

Change in Demographic Characteristics

In addition to population growth since 2015, we have also seen a change in our demographic profile, which could have significant impacts on our vulnerability. Some of these are trends described below, were visible since 2010 but have become more pronounced in recent years.

Pinellas County's population is aging, and we also continue to attract more retirees. Therefore, in the past decade, we have seen an overall increase in median age. In 2015, 39 percent of our population was 55 years of age or above and 23 percent was 65 years of age or above. This is a trend with significant implications in terms of our vulnerability and is expected to continue. By 2045 it is projected that, almost half of Pinellas County's population will be 55 years of age or above with 35 percent of the age 65 years or above. Today in Pinellas County, more than 140,000 households (approximately 35 percent of the total households) have a householder of the age 65 years or above. Elderly population are more likely to have a disability, chronic illnesses or mobility issues which could impede their ability to evacuate. Physical conditions, and limited income and access to resources, can limit their ability to recover following a major disaster.

Approximately 45,815 households in Pinellas County comprise of people who are Foreign Born Non-Citizens. This forms 11 percent of the total households within the county. Additionally, close to 3 percent of Pinellas County's households have limited English-speaking proficiency. People with limited English-speaking abilities find it difficult to understand emergency warnings which could severely limit their ability to quickly respond to them, in an effective and timely manner. These groups also most likely have limited knowledge of the available programs that they could be eligible for. In addition, people with language-limitations are also, most likely to have inadequate access to health care and other resources as compared to regular citizens, which can drastically impair their recovery following a major disaster.

Poverty and income levels are other factors that determine one's vulnerability and capacity to recover from a major catastrophic event. More than 120,000 households in Pinellas County are at or below the poverty level. According to the U.S. Department of Housing and Urban Development, cost-burdened families are defined as those "who pay more than 30 percent of their income for housing" and "may have difficulty affording necessities such as food, clothing, transportation, and medical care." Severe rent burden is defined as paying more than 50 percent of one's income on rent. According to the 2017 ACS estimates, more than a quarter of Pinellas County's households earn less than $50,000 and are cost-burdened or severely cost-burdened. Studies indicate that areas that are economically distressed prior to a disaster, take longer to recover from the aftermath of a disaster. Economically disadvantaged groups most likely occupy lower quality housing, have limited means to pay for flood insurance, and have limited access to warning information, which severely impairs their ability to recover.

According to the Centers for Disease Control and Prevention, certain factors such as sex, age, or income can influence one's health and risk to diseases and also the risk to get seriously affected by public health emergencies. This is a critical concern knowing that Pinellas County is highly susceptible to floods and everyone is located in some (high, moderate or low risk) flood zone. Flooding is one of the most common natural hazards in Pinellas County. Flooding poses a serious threat not just in terms of loss of life, personal property, businesses, transportation and utilities, but also to public health. If flooding causes conditions where floodwaters inundate drinking water facilities, wastewater treatment plants, and waste storage facilities or waste disposal sites, it could eventually lead to severe public health emergencies. A good proportion of our population is either old, has limited income or both, which disproportionately increases their risks to such impacts of flooding. Additionally, due to limited means and inadequate access to resources, such population groups also would have limited capacity to deal with the effects of a disaster. This highlights how critical it is to identify these at-risk groups well in advance, devise targeted mitigation efforts that cater to the needs of these specific groups and help plan for potential impacts of a disaster. Some of this research and identification of relevant mitigation actions, will be accomplished as a part of the Post-Disaster Redevelopment Planning process.

Maps given below indicate, specific areas that might have high vulnerability within the county owing to different socio-economic factors.

Figure 1.2: Distribution of Population Living Below the Poverty Line

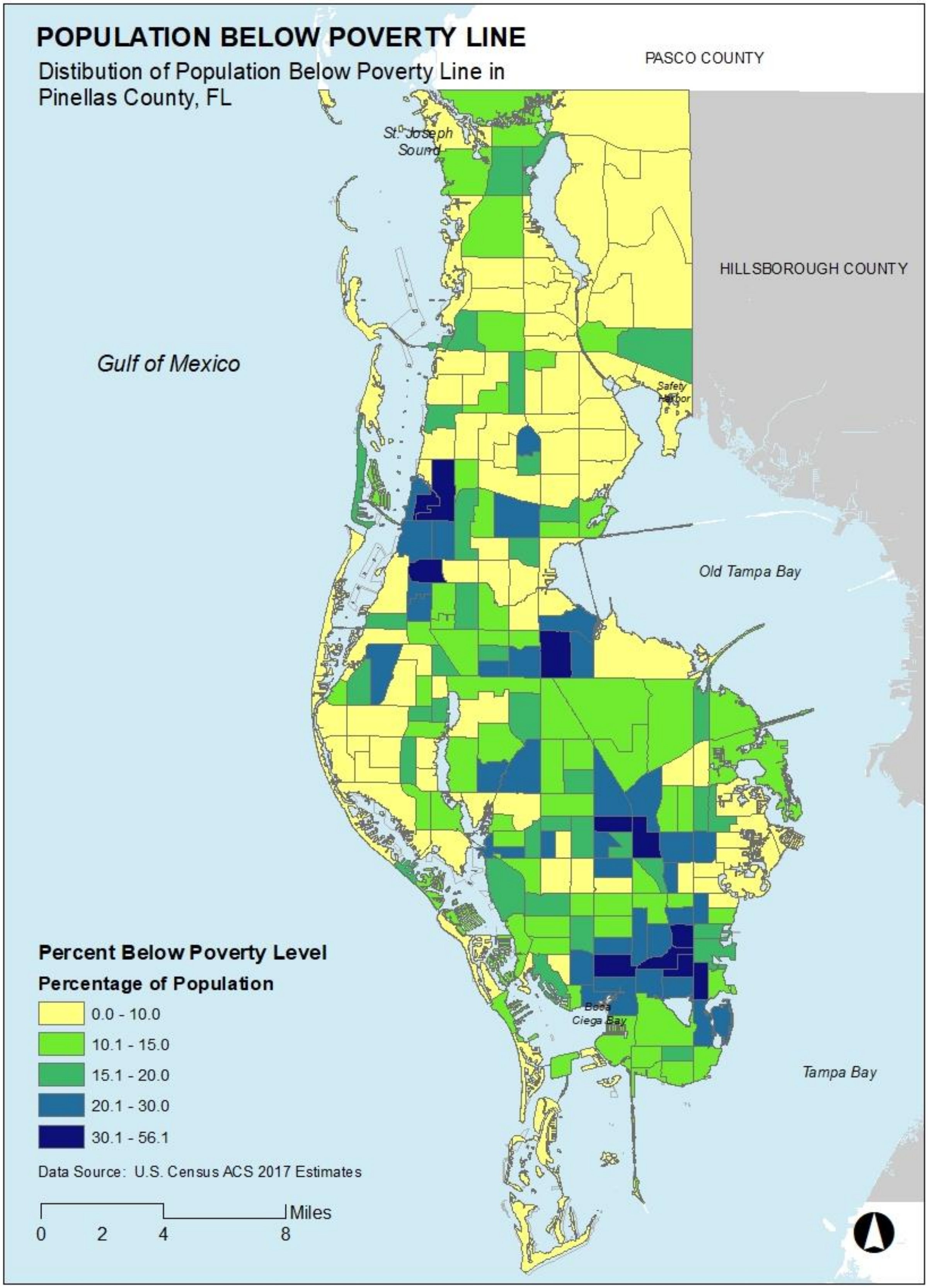
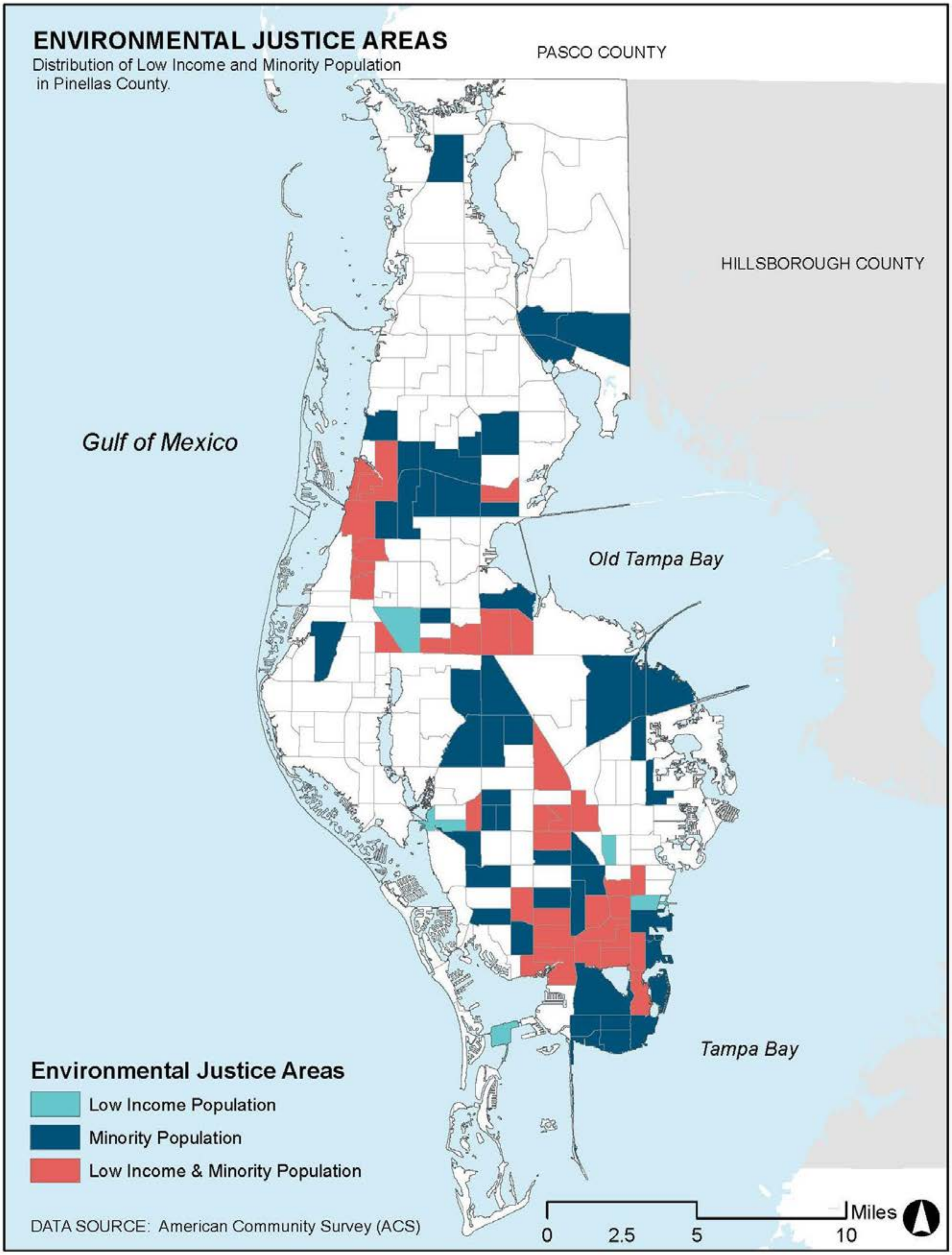


Figure 1.3: Concentration of Low Income and Minority Population in Pinellas County



Geography

Pinellas County is a peninsula located on the west central coast of Florida, bordered on the north by Pasco County, on the south by Tampa Bay, on the east by Tampa Bay and Hillsborough County, and on the west by the Gulf of Mexico. Pinellas County has the second-smallest land area of Florida's 67 counties, with 280 square miles in addition to another 334 square miles of water surface area. The county has a total of 588 miles of coastline.

Topographic features

The elevation of Pinellas County ranges from mean sea level (msl) to 110 feet. The county is divided into five subsections based on topography: the ridge, which generally runs in a north-south orientation through the county with elevations between 40 and 110 feet; a sloping transition area, with elevations between 10 and 40 feet; the flood plain, with elevations between zero and ten feet; the barrier beach islands, with elevations between zero and ten feet; and the coastal filled areas, that have elevations between zero and five feet.

Most of Pinellas County may be characterized as relatively flat, with five small areas that are identified as having short, steep slopes. These areas are generally along creek banks (parts of Possum, Bishop, and Curlew creeks in the northern part of the county and part of Booker Creek in St. Petersburg), in addition to the western mainland shore from Clearwater Harbor to Belleair.[3]

Surface hydrology: rivers, streams, and lakes

The Anclote River is the only river that flows through Pinellas County. With headwaters in adjacent Pasco County, the Anclote River crosses into Pinellas County along its northern border and runs only a few miles before emptying into the Gulf of Mexico at Tarpon Springs. Along with its importance as a natural resource, the Anclote River is also significant for tourism, as it runs through the famed Tarpon Springs sponge docks.

There are numerous streams, creeks and drainage channels that run through Pinellas County. Of these, the County has identified 25 creeks and canals that serve as major drainage features. The National Inventory of Dams, a congressionally authorized database maintained by USACE, documents dams in the United States. In the National Inventory of Dams, Taylor Lake Dam is the only privately-owned dam along the McKay Creek. The Sawgrass Lake structure and Structure 551 on Lake Tarpon Canal, which are owned by the SWFWMD, and Lake Seminole Dam, owned by the local government (Pinellas County), are identified in Pinellas County. There is an Emergency Action Plan for Structure 551 on Lake Tarpon Canal (USACE, 2012).

Prior to the urbanization, there were hundreds of lakes in Pinellas County, many that were indistinguishable from marshes and swamps. To accommodate development, many of the lakes in the urbanized areas of the county were landscaped, deepened, dredged, drained, or filled. Today, there are still numerous lakes and ponds located throughout Pinellas County. Some of the larger lakes include:

[3] Source: Conservation and Coastal Zone Management Element, Countywide Comprehensive Plan for Pinellas County, PPC

- Lake Tarpon: Covering 2,534 acres in the northern part of the county, Lake Tarpon is the county's largest lake. Lake Tarpon is fed by groundwater and at the surface by Brooker Creek. Until 1967, the lake had a hydrological connection to Spring Bayou (eventually flowing into the Anclote River) but was subsequently damned off by the US Army Corps of Engineers in order to control saltwater intrusion into the lake. A controlled height canal is an outfall for the lake into Tampa Bay near the City of Safety Harbor, which is used to periodically lower the water level of the lake.
- Lake Seminole: Formerly an estuary at the north end of Long Bayou in west-central Pinellas County, Lake Seminole has a surface area of 980 acres. The lake level is typically between 4 to 5 feet above mean sea level.
- Lake Maggiore: Located in the southern part of the City of St. Petersburg, Lake Maggiore covers 380 acres in size. Runoff from surrounding developed areas adds silt and organics to the lake, making the lake bottom a loose murky layer of mud and decomposing organics up to six feet thick.
- Other large lakes in the County include: Salt Lake, 220 acres; Lake Del Oro, 75 acres; Alligator Lake, 77 acres; Lake St. George and Lake Chautaugua, each about 50 acres.

Pinellas County proactively develops Watershed Management Plans (WMP) through funding from the County's Surface Water Assessment Fee, cooperative funding from SWFWMD and in some cases other municipalities within the County. These plans, in most cases, develop an existing conditions stormwater model the delineate drainage patterns in the watershed under certain storm events. These analyses also develop boundaries of floodplains at a more detailed level than currently available floodplain boundaries and are more representative of current conditions. The drainage patterns are then further analyzed, with the help of historical information, to develop conceptual projects that could reduce the flooding conditions within the watershed.

In addition to analyzing drainage patterns, these plans also evaluate the potential sources of pollutants in the watershed and develop recommended projects and strategies to help reduce or treat some of the pollutants. These WMPs are also utilized during the development of other projects since the preliminary drainage analysis has already been completed in the particular watershed.

Pinellas County currently has WMPs for the following watersheds:

- Allen's Creek
- Brooker Creek
- Clearwater Harbor / St. Joseph Sound Watershed
- Cross Bayou
- Lake Seminole
- Lake Tarpon
- Long Branch
- McKay Creek
- Starkey Basin

The County is also working on a WMP for Joes Creek and is updating the Lake Tarpon WMP.

Islands and significant habitats

There are a series of barrier islands in close proximity to the mainland coast. These islands extend about 34 miles along the western coastline of the County. With a few exceptions (notably, Caladesi Island and Anclote Key), all barrier islands are connected to the mainland by a series of 14 causeways and bridges. A few of the islands are publicly-owned and managed, such as Honeymoon and Caladesi Islands, Mullet Key/Fort DeSoto Park, Anclote Key, and others. However, most of the barrier islands are densely populated and completely built out. The barrier islands contain miles of light sandy beaches, which are a key element in Pinellas County's thriving tourist industry, and a major contributor to the overall economy of the county. In addition to the barrier islands, Pinellas County has invested in the mitigation and acquisition of large portions of environmentally sensitive lands to protect these valuable resources.

The wetland resources of Pinellas County provide a number of benefits. Freshwater and tidal wetlands provide habitats for wildlife such as birds, mammals and reptiles, including some endangered species. Because of their important function as a source of organic matter which functions as the base of the detrital food chain, tidal wetlands provide habitat, breeding areas and nurseries for commercial and recreational marine fisheries. Freshwater wetlands attenuate the damaging effects of storm and flood waters during peak runoff by slowing and storing those waters, then releasing them gradually. Coastal shorelines and uplands are buffered from the severity of tidal surge during a storm by the adjacent coastal wetlands. (Natural Resource Conservation and Management Element of the Pinellas County Comprehensive Plan, Pinellas County Planning Department as staff to the Local Planning Agency for the Board of County Commissioners of Pinellas County, Florida, Adopted March 2008)

Wetlands also function as a natural filtration system, cleansing storm water runoff before it enters Tampa Bay, the Gulf of Mexico or other surface water bodies. Sedimentation of the downstream waters is reduced by slowing the water velocity, allowing sediments to drop out of the water column while in the wetland. Subsequently, pollutants that are attached to the sediments are buried in the wetland soil. Excess nutrients and other chemicals may be filtered out of the water and soil by the wetland vegetation, stored in their biomass (leaves, stems and roots), and buried in the organic soil when the plants die. The associated birdlife and open vistas of wetlands provide aesthetic beauty and visual relief from the urbanized landscape of Pinellas County. (Natural Resource Conservation and Management Element of the Pinellas County Comprehensive Plan, Pinellas County Planning Department as staff to the Local Planning Agency for the Board of County Commissioners of Pinellas County, Florida, Adopted March 2008).

Climate

The climate in Pinellas County is humid subtropical (Köeppen climate classification: Cfa), characterized by warm, humid summers and mild winters. There is a definite rainy season which generally lasts from June through September. During these four months, the county receives, on average, about 60% of its average annual rainfall. "Dry" season, is a relative term, since the county average rainfall for the October-May period is about 20 inches. However, rain events are much less frequent in the dry season and rainfall intensity generally lower than in the rainy season. Snow events are very rare in Pinellas County, though a dusting of snow was recorded on January 19, 1977, and small amounts of sleet and snow fell on December 23, 1989.

The 30-year (1891-2010) mean annual temperature for the weather station at Albert Whitted Airport, located on the waterfront near downtown St. Petersburg, is 74.2 degrees Fahrenheit (°F). The normal daily maximum temperature ranges from 65.9°F in January to 90.9°F in July. The normal daily minimum temperature ranges from 53.7°F in January to 77.0°F in August. The highest daily maximum temperature recorded at St. Petersburg is 100°F (most recently on July 15, 2011). The lowest daily minimum temperature recorded at St. Petersburg is 22°F on December 13, 1962.

Located nearly entirely on a peninsula, Pinellas County has the relatively warmer waters of Tampa Bay and the Gulf of Mexico help to moderate cold temperatures in winter. Therefore, freezes are rare, especially hard freezes or freezes of duration greater than a couple of hours. The daily minimum temperature falls to 32°F or below an average of about once every three years at the weather station in St. Petersburg. The longest streak of consecutive days where the minimum temperature fell to 32°F or below is four days, On December 23-26, 1989. Another station near Tarpon Springs, near the northern boundary records a daily minimum temperature of 32°F or below an average of about 3 days per year.

Thunderstorms affect Pinellas County on a frequent basis, especially in the rainy summer months (June through September). Pinellas lies at the western edge of an area that runs along Interstate 4 through Tampa, Lakeland, and Orlando where thunderstorms occur an average of 85 to 100 days per year. These thunderstorms are significant because they often produce frequent lightning and intense rainfall. On occasion, Pinellas County experiences damaging thunderstorm winds in excess of 60 miles per hour and/or small hail, though these more intense events are not frequent.

Population

Pinellas County is the sixth most populous county in Florida, with an estimated 975,280 (U.S. Census ACS 2018 Estimate) permanent residents. Pinellas County hosts an annual total of 15.5 million annual tourists throughout the year. The county's population is projected to grow to around 1,063,500 by 2040.[4] There are 24 incorporated municipalities within Pinellas County including the largest city, St. Petersburg (pop. 265,098) and the smallest, the Town of Belleair Shore (pop. 114).[5]

[4] https://www.bebr.ufl.edu/population (BRBR, 2019)
[5] https://www.census.gov/quickfacts/pinellascountyflorida

Figure 1.4: Population Density

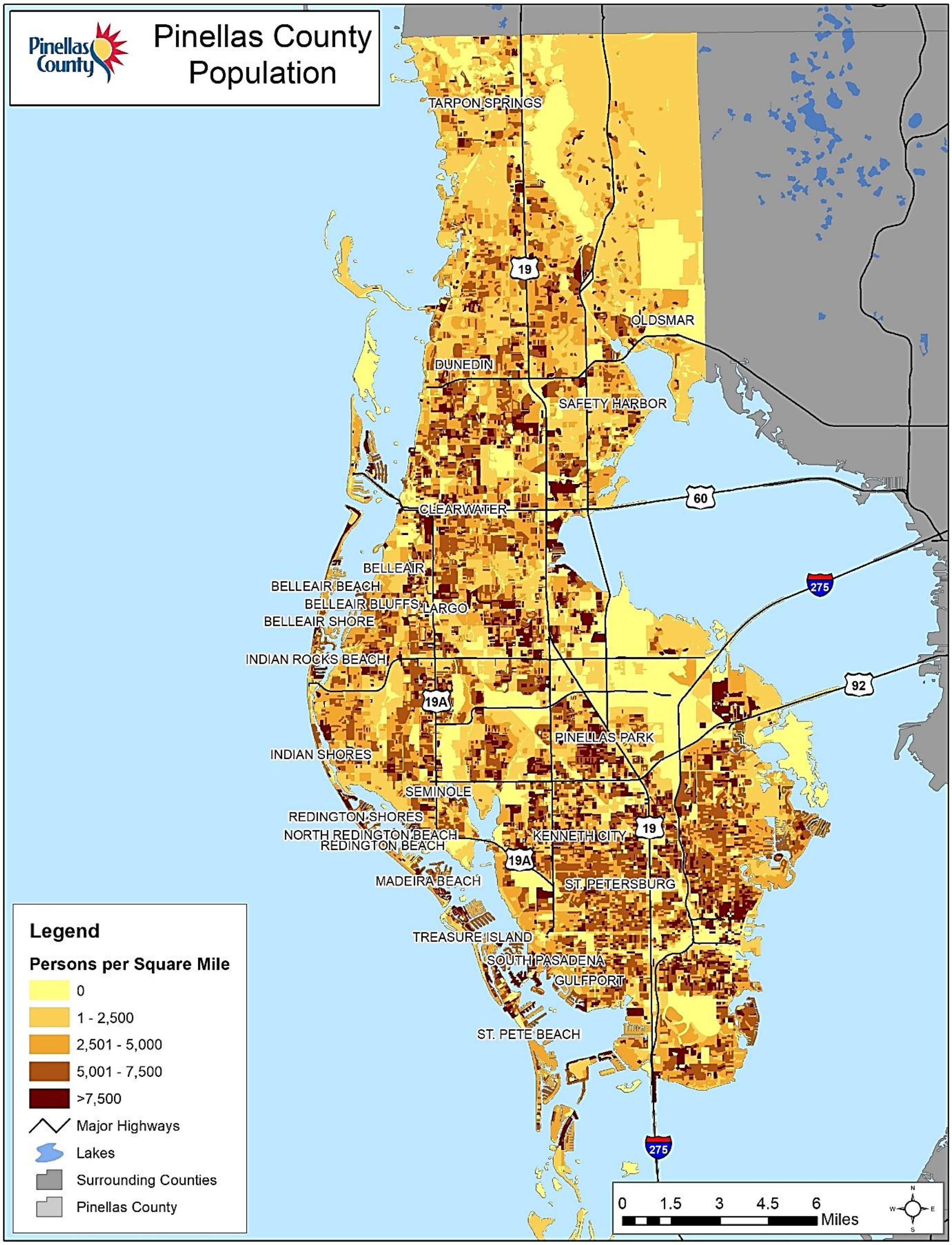
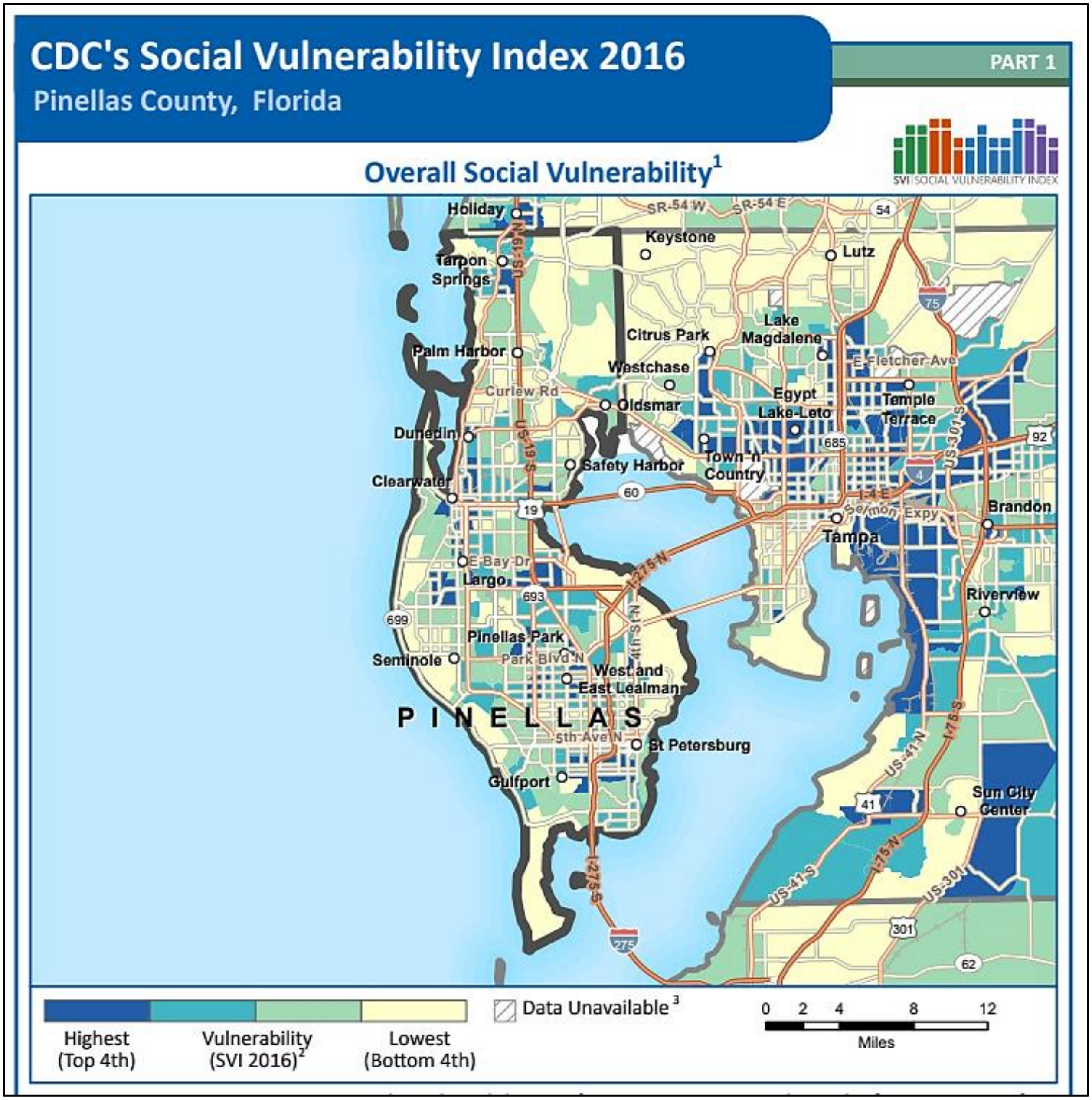


Figure 1.5: Social Vulnerability Map of Pinellas County[6]



One vulnerability for Pinellas is the concentration of its population. Pinellas County is the most densely populated County with 3,562 people per square mile. This is more than double the value of the next closest county which is Broward with 1,445 people per square mile.

Pinellas lies at the center of the robust Tampa Bay market, which is expected to grow from its current population of 4 million to 6 million by 2030. The market's significant economic clout is also evidenced by

[6] https://svi.cdc.gov/Documents/CountyMaps/2016/Florida/Florida2016_Pinellas.pdf

more than $70 billion in consumer spending and a labor force 2 million strong. The region is ranked number 20 in the U.S. for job growth and carries the country's 13th largest media market.[7]

Below are basic Florida demographics from the US Census Bureau.

Table 1.1: Pinellas Demographics[8]

Category	Data
2010 US Census population	916,804
2018 US Census population estimates	975,280 (6.4% increase over 2010 base)
Age	**Percentage**
2018 Persons under 5 years	4.3%
2018 Persons under 18 years	16.2%
2018 Persons 65 years and over	24.8%
Gender	**Percentage**
2016 Female persons	52.0%
2016 Male persons	48.0%
Race	**Percentage**
2018 White, alone	82.6.6%
2018 Black or African American, alone	11.1%
2018 American Indian and Alaska Native, alone	0.4%
2018 Asian, alone	3.6%
2018 Native Hawaiian and Other Pacific Islander	0.1%
2018 Two or More Races	2.2%
Hispanic Origin	**Percentage**
2018 Hispanic or Latino	10.0%
2018 White alone, Not Hispanic or Latino	73.8%
Characteristics	**Data**
2018 Veterans	86,959
2018 Foreign born persons	11.8%
Families and Living Arrangements	**Data**
2018 Households	406,871
2018 Persons per household	2.29
2018 Language other than English spoken at	14.0%
Education	**Percentage**
2018 High school graduate or higher	90.7%
2018 Bachelor's degree or higher	30.1%
Health	**Percentage**
2018 Persons with a disability, under age 65 years	9.8%

Pinellas' population is particularly vulnerable because 41% of the population is composed of children (18 years or younger) and seniors (65 years or older).

[7] https://www.pced.org/page/PinellasOverview
[8] https://www.census.gov/quickfacts/fact/table/FL/AFN120212#viewtop

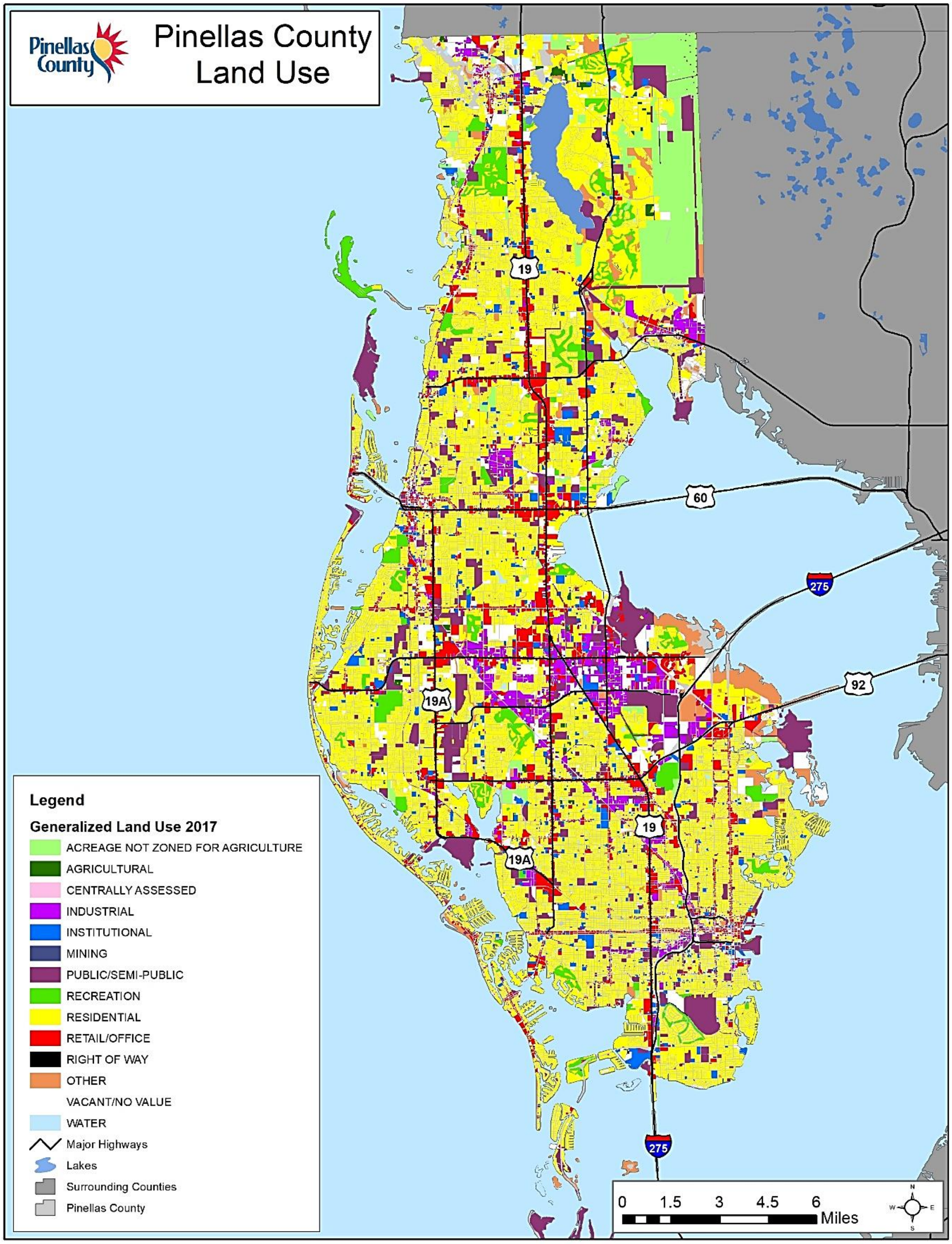
Land Use

Land use for the unincorporated areas within Pinellas County is defined by the County's Comprehensive Plan. Land use for the rest of Pinellas County is dictated by the Comprehensive Plan policies of the individual cities and towns. Additionally, Forward Pinellas serves as the County's overarching transportation and land use planning agency. It ensures countywide consistency in land use planning by establishing policies to which each of the municipalities and the unincorporated area must align their individual comprehensive plans.

Land use policies within a Comprehensive Plan cater to a variety of needs including employment, housing, conservation, recreation, as well as safety and protection from hazards. Pinellas County maintains over 20,000 acres of parks and preserves that are not only incredibly rich in biodiversity but also provide recreational opportunities to its residents. The County has approximately 588 miles of coastline along the Gulf of Mexico. It also includes a total of 4 preserves totaling approximately 13,900 acres. These preserves play a critical role in conserving land area, protecting the floodplain, safeguarding natural resources, and helping maintain the potable water supply. Currently, Pinellas County is updating its Comprehensive Plan. The current Comprehensive Plan has over 1,100 policies which are governed by over 40 principles. As a part of this update process, the County has consolidated its Comprehensive Plan policies and established eight guiding principles. The intent is to create multi-objective policies that are more focused and, therefore, easily implementable to help meet the County's regular needs as well as help achieve resiliency.

For more information on policies and programs please refer to the Local Capability Assessment in Section 3. The figure below shows the current land use in the County.

Figure 1.6: Pinellas County Land Use



Economy

Below are basic demographics of the Pinellas economy from the US Census Bureau. It is important to note that nearly 15% of Florida's population is in poverty. In Pinellas County, this is slightly lower at 12.2%. Consequently, another vulnerability for the county.

Table 1.2: Pinellas County Economic Demographics[9]

Category	Data
2018 Median household income	$48,968
2018 Persons in poverty	12.2%
2018 In civilian labor force, total, of population age 16 years and over	58.0%
2018 In civilian labor force, female, of population age 16 years and over	54.4%
2012 Total accommodation and food service sales ($1000)	$2,193,073
2012 Total retail sales ($1000)	$14,578,176
2016 Total employer establishments	28,117
2016 Total employment	374,390

Anchored by the urban markets of Clearwater and St. Petersburg, Pinellas has the second largest base of manufacturing employment in Florida. Fortune 500 technology manufacturers Jabil Circuit and Tech Data are headquartered here. Pinellas has diverse, yet symbiotic, industry clusters, including aviation/aerospace; defense/national security; medical technologies; business and financial services; and information technology. An extensive network of suppliers, service-providers and business associations support operations in these sectors. Relocating businesses can move to Pinellas and expect to begin growing immediately. Pinellas encourages innovation, and with industry giants such as Home Shopping Network (HSNi), Nielsen, ValPak and Catalina Marketing, it is rapidly becoming Florida's hub for big data. Through relationships with major universities and high-tech institutes, Pinellas has become a center for research and development in marine science, electronic instruments, medical devices, sensors, nanotechnology and health care. The county is home to numerous business accelerators, like the Tampa Bay Innovation Center, TEC Garage, the Gazelle Lab and Clearwater's SPARK, which are committed to nurturing and building new ventures. Notable Employers: Home Shopping Network (HSNi), Nielsen Media Research, Jabil Circuit, Raymond James Financial, Tech Data, Honeywell, Raytheon, Lockheed-Martin, ConMed Linvatec, TransAmerica and Bausch & Lomb.[10]

Infrastructure

Pinellas has an extensive infrastructure system. There are 4,521 miles of paved roads in the county, which cross 142 bridges. The first bridge to span Tampa Bay was the Gandy Causeway in 1924 and shortened the traveling distance between St. Petersburg and Tampa from 43 to 19 miles. Pinellas connected with Manatee County when the Sunshine Skyway bridge opened in 1954. Pinellas County is serviced by five major highways: I-275, US Highway 19, US 19A, US 92, and State Road 60. Other major transportation routes are Tarpon Avenue/SR582, Tampa Road/752-SR584, Curlew Road/SR586, East Bay/SR686,

[9] https://www.census.gov/quickfacts/pinellascountyflorida
[10] https://www.pced.org/page/PinellasOverview

Ulmerton Road/SR688, Park Boulevard/Gandy Boulevard, CR611, SR580, SR 693 and Gulf Boulevard/SR699.

Airports

There are three airports located in Pinellas County. St. Pete-Clearwater International Airport (PIE) is a full-service airport with commercial passenger service, cargo, military, and general aviation operations. PIE accommodates virtually any size aircraft, from jumbo jets to charter planes to private aircraft. FAA-operated Air Traffic Control and an Automated Flight Service Station are located on site. Also, the largest Coast Guard Air Station in the U.S. is located at PIE. Albert Whitted Airport (KSPG) in downtown St. Petersburg is classified as a Regional General Aviation Airport by the FAA. Albert Whitted Airport is owned and operated by the City of St. Petersburg. Clearwater Airpark (KCLW), a general aviation facility owned by the City of Clearwater in central Pinellas County, has a 4108-foot runway at a ground elevation of 71 feet. Additionally, Tampa International Airport, the region's largest commercial/passenger air facility, is located nearby in neighboring Hillsborough County.

Bus

The Pinellas Suncoast Transit Authority (PSTA) provides countywide public bus transit service, along with several routes to/from Hillsborough County. PSTA has a fleet of 203 vehicles, including 188 full-sized buses. Greyhound Lines, Inc. provides regularly scheduled bus service to out-of-county and out-of state locations from the Greyhound Bus Station in Downtown St. Petersburg. Additionally, the Pinellas County School Board operates a fleet of approximately 750 buses for the transport of students.

Railroad

CSX operates a single line freight rail service through Pinellas County. Most of the railway in Pinellas County has been converted into the Pinellas Trail, a recreational thoroughfare that traverses the county

Waterways

Pinellas County is a peninsula bounded by Tampa Bay on the east and south, and the Gulf of Mexico on the west. The Intracoastal Waterway runs the length of the county on its western side, between the mainland and the barrier islands. There is one port located in Pinellas County. The Port of St. Petersburg is located on Bayboro Harbor in Downtown St. Petersburg and can accommodate shallow draft ships. Deep draft ships must use Port Tampa Bay in Hillsborough County or Port Manatee in Manatee County. Port Tampa Bay is the largest port in Florida in terms of physical area and annual cargo tonnage.

Critical infrastructure is essential to the County's ability to provide assistance to its people and infrastructure. Transportation routes, utilities, government facilities, schools, and hospitals provide the local communities with the capacity to respond to disasters.

Outline of LMS

The 2020 LMS update included re-organization to better align with the 2018 Florida State Hazard Mitigation Plan. The outline of the plan is shown in the table below.

Table 1.3: Outline of 2020 LMS

<table>
<tr><th>Section</th><th>Description</th></tr>
<tr><td>Executive Summary and Introduction</td><td>The Executive Summary is a quick overview of the entire LMS.

The Introduction includes the purpose of the LMS as well as elements that are required by statute, such as Regulations and Assurances. The section also includes the definition of hazard mitigation and the Pinellas County profile.</td></tr>
<tr><td>Planning Process and Plan Maintenance Section</td><td>The Planning Process and Plan Maintenance Section includes a brief history of the Pinellas County LMS as well as a narrative regarding the 2020 LMS Update. 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.</td></tr>
<tr><td>Risk Assessment Section</td><td>The Risk Assessment Section includes the hazard profiles as well as the vulnerability and loss estimations for each of the twelve natural hazards:
Flood
Tropical Cyclone
Severe Storm
Extreme Heat
Drought
Wildfire
Erosion
Geological
Seismic
Tsunami
Winter Storm
Red Tide
The LMS Risk Assessment also includes ten technological and human-caused hazard profiles because the LMS Risk Assessment serves as the primary risk assessment for Pinellas County. The technological and human-caused hazards profiled include:
Agricultural Disruption
Biological Incident
Civil Disturbance
Cyber Incident
Mass Migration
Hazardous Materials Incident
Radiological Incident</td></tr>
</table>

Section	Description
	• Space Weather Incident • Terrorism • Transportation Disruption
Mitigation Strategy Section	The Mitigation Strategy Section discusses the goals, objectives, and mitigation capabilities of the County.
Potential Funding Sources Section	The Potential Funding Sources Section discusses federal, state, and local funding sources available for mitigation.
Appendices	The Appendices are documents that are referenced throughout the LMS and include: • Appendix A: Planning Process Documentation • Appendix B: Risk Assessment Tables • Appendix C: CRS 610 • Appendix D: Mitigation Initiatives • Appendix E: FL Review Tool • Appendix F: Plan Adoption • Appendix G: Plan Maintenance • Appendix H: Program for Public Information • Appendix I: Repetitive Loss Area Analysis

PLANNING PROCESS AND PLAN MAINTENANCE SECTION

Local Hazard Mitigation Plan Requirements
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? [44 CFR 201.6(c)(1)]
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? [44 CFR 201.6(b)(2)]
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? [44 CFR 201.6(b)(1) and 201.6(c)(1)]
A4. Does the Plan document the review and incorporation of existing plans, studies, reports, and technical information? [44 CFR 201.6(b)(3)]
A5. Is there a discussion on how the community(ies) will continue public participation in the plan maintenance process? [44 CFR 201.6(c)(4)(iii)]
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? [44 CFR 201.6(c)(4)(i)]

History of the HMP

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 County's first LMS began its planning process in March of 1998 and took approximately 15 months to complete. The plan was then updated again in 2004, 2009, and 2015. This is the fourth update of the plan and the focus of the update was on adding new risk assessments, refining objectives, and refreshing the project list.

In 2019, Pinellas County, its municipalities and stakeholders once again embarked on a comprehensive update of the Local Mitigation Strategy. The County and its partners recognize that the planning process is as important as the plan itself. Therefore, it documents the planning process including how the plan was prepared and updated, who was involved in the process and how the public was involved. Using the 10-step planning process identified in the FEMA Floodplain Management Planning (CRS Coordinator's Manual, 2017), members worked together to enhance the planning process and strengthen the overall multi-jurisdictional mitigation strategy. The local mitigation strategy planning process is critical in the creation of the LMS. The process defines not only who should be involved, but how the process is going to work, and an understanding of how the process facilitates the production of the final product.

STEP 1: THE PLANNING ORGANIZATION

The development of a mitigation strategy requires the involvement of representatives from the public, private, and governmental sectors. Therefore, every attempt has been made to include the following entities in the Working Group membership:

- Representatives from Pinellas County and its 24 Municipal planning and/or code enforcement or building departments, emergency management services, environmental protection and public information departments;

- State Agencies (Cooperative Extension Service, Department of Health, Florida Division of Emergency Management Regional Coordinator);
- Private utilities (Duke Energy, Clearwater Gas, etc.);
- Businesses, (Health Care, Business Contingency Planners, and the Hotel/Motel Industry, etc.);
- Educational (Eckerd College, St. Pete College, and Pinellas School Board);
- Civic Organizations;
- Southwest Water Management District;
- Tampa Bay Regional Planning Council;
- Volunteer organizations, (Recover Pinellas, Regional COAD, Red Cross, Salvation Army, Hospice, Habitat for Humanity);
- Private non-profit organizations (PARC, etc.)
- Surrounding county mitigation representatives (Hillsborough, Manatee, Pasco counties) and CRS Coordinators, and
- Public including Pinellas County Neighborhood Association, CAC members, County and
- municipal leadership programs.

Through the involvement of the members of the LMS Working Group, the LMS was developed in coordination with neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have development review authority, businesses, academia and other private and non-private interests. Pasco County, Hillsborough County, and the TBRPC were part of the Working Group. Representatives are brought together to enhance the Pinellas County LMS Working Group. These additional stakeholders, as well as the public are welcome to attend any meeting encouraging both a dynamic membership and participation of the Working Group. Meetings are noticed on County and municipal websites and online event calendars.

Although the existing email distribution list is large from the 20+ years of local mitigation strategy activities, additional activities were performed at the start of the 5-year update process. These activities included an email invitation to approximately 200 public and private stakeholders from the Tampa Bay region (Copy of email in Appendix A); starting off the new LMS Working Group meetings with a request for existing working group members to bring in new entities that they may work with in other capacities (shown in agendas and presentations within Appendix A); and introducing the Local Mitigation Strategy to the public and private participants of the Community Rating System's flood outreach group to include the involvement of lenders, real estate agents, and community entities, such as the St. Pete-Clearwater International Airport. As noted in other parts of this document, this existing flood outreach group merged with the local mitigation strategy outreach group to become the Flood Risk and Mitigation Public Information Working Group (FRMPIWG). **Please refer APPENDIX A for a copy of the email notifications that were sent out to the municipalities and other stakeholders, and the announcement of Working Group meetings on the Pinellas County LMS webpage.**

The LMS Working Group elects a Chairperson and Vice-Chairperson at its regular annual meeting in January of each year. The Working Group voted to meet at least every quarter in a central location with additional meetings to be scheduled as the workload dictates. In order to complete the 5-year update of the LMS in 2019-20, the LMS Working Group met most months from January 2019 to November 2019. The quarterly meeting schedule will resume in January 2020 augmented with conference calls to address comments and recommendations from the State Division of Emergency Management and FEMA. The meeting calendar is provided in Appendix A – Planning Process Documentation and reflects the Working Group work through the development and the revision of the LMS.

The Pinellas LMS website (www.pinellaslms.org) provides all meeting notices for the Working Group meetings. In addition, in the past, it has served as a valuable tool in updating and, in some cases, creating new sections of the Plan. Through the SharePoint section of the website, members have updated their projects and accomplishments, the departmental responsibilities, and local goals, policies, LDRs3, and mitigation programs. During the 2020 LMS Plan Five-Year update process, a Google drive was created, and its link shared with the Working Group and the stakeholders. This allowed the Working Group members to review, update, and help create new sections of the Plan. It also enabled them to weigh-in on the development of the strategy and provide recommendations and comments on the risk assessment, goals and objectives, mitigation initiatives, and public awareness programs.

Pinellas County has previously contracted with the Tampa Bay Regional Planning Council (TBRPC) when assistance is required to update the study. TBRPC provided additional staff support for the 2004 and 2009 5-year comprehensive updates, as well as the 2015 update. For the 2020 update, Pinellas County contracted with Atkins, an engineering and design firm headquartered in the Tampa Bay Area.

The representatives commit their time and available resources to develop a mitigation strategy that would protect life, property, and the environment as well as contribute to the economic well-being of the County. The implication of the Hazard Mitigation Planning and Hazard Mitigation Grant Program (HMGP) Interim Final Rule is that each of the jurisdictions and representatives on the Working Group must show participation in the planning process to qualify for HMGP, Pre-Disaster Mitigation Program (PDM) and Flood Mitigation Assistance Program (FMAP) funding. The definition of participation as determined by the Working Group is attendance at a minimum of 50% of the scheduled meetings during the year. The 2019 meeting schedule is abnormal in that there are more meetings to accommodate the development of the plan update. Each member signs in at each meeting for documentation purposes.

STEP 2: INVOLVING THE PUBLIC

Public participation was an important component of Pinellas County's mitigation planning process. Individual citizen and community-based input provides the entire planning team with a greater understanding of local concerns and increases the likelihood of successfully implementing mitigation actions by developing community "buy-in" from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of any community's overall mitigation strategy aimed at making a home, neighborhood, school, business or entire city safer from the potential effects of hazards.

Public involvement in the development of the Pinellas County LMS Update was sought using three methods: (1) public meetings were held and were advertised in local media; (2) public survey instruments were made available in hard copy and online; and (3) the draft Plan deliverables were made available on county LMS website along with contact information for providing input.

The general public was provided three opportunities to be involved in the development of the County plan: (1) twice during the drafting stage of the Plan; and (2) upon completion of a final draft Plan, but prior to official Plan approval and adoption.

- Public Information Meeting 1 (Introduction to Planning Process): March 21, 2019
- Public Information Meeting 2 (Input on Draft Plan): October 17, 2019

All meetings were advertised on the county website, the local newspaper, the electronic county calendar, additional websites, and through social media avenues. One citizen also attended the LMS Working Group meetings as well. After each of these meetings, members provided valuable input to the plan which was ultimately incorporated. Additional information on these meetings can be found in Appendix A. In addition, during the planning process, a public participation survey (see Appendix A) was made available at the meetings and online through the Pinellas County LMS website and the LMS Storymap; distributed through Pinellas County OpenGov; and advertised using LMS flyers, LMS information brochures, and a press release. **Please refer APPENDIX A for copies of newspaper notices for the two public workshops held for the 2020 LMS 5-Year update; workshop announcements on the County Calendar and LMS webpage; workshop flyers; social media posts; surveys; comment card; posters; and pictures from the public workshops.**

The public participation survey was designed to capture data and information from residents of Pinellas County that might not be able to attend public meetings or participate through other means in the mitigation planning process. A total of 64 survey responses were received, which provided valuable input for the Working Group to consider in the development of the plan update. Selected survey results are presented below:

- Approximately 73 percent of survey respondents understanding that their home, business or organization is vulnerable to natural and/or man-made hazards.
- Respondents ranked Hurricane/Tropical Storm as the highest threat to their neighborhood, followed by Flood and Transportation-related Incident.
- Approximately 60 percent of respondents have taken actions to make their homes more resistant to hazards to include roof retrofits and strengthen openings.
- Almost 97 percent of respondents understand that they would have to comply with current local/state codes, ordinances, and laws when rebuilding following a disaster.
- Infrastructure Projects; Preparedness, Coordination and Response Actions; and Education and Awareness Programs were ranked as the most important activities for communities to pursue in reducing risks.

In addition, as a part of the five-year plan update process, the Working Group members worked together with Pinellas County's Business Technology Services and Atkins to create an ESRI Storymap for Pinellas County's LMS. This Storymap is a concise online version of the LMS Plan developed in a graphically-oriented, user-friendly format. It functions as an invaluable tool that helps bring together all hazard related datasets and enables the County to combine them with maps, images, text, and multimedia to visually communicate ideas and processes in the form of a Storymap. Owing to this function, the LMS Storymap serves as an educational tool to generate awareness and interest in Pinellas County's mitigation efforts. It outlines the benefits of mitigation; identifies overall hazard risks faced by the county and its jurisdictions; highlights the county's mitigation accomplishments so far; and provides a range of local, state, and national level resources for understanding mitigation. The Storymap was launched at the second public workshop held for the 2020 plan update process. **Please refer APPENDIX A for a screenshot of the Pinellas County LMS Storymap requesting participation in the LMS Working Group and mitigation efforts.**

Input from the public occurs in many forms, such as: participating in working group meetings; taking surveys and providing comments at public forums; responding to messaging on social media channels; and engaging government staff and officials through direct communication. Throughout the plan update process, information from the public was integrated into the process in the appropriate method. For example, when the public participated in working group meetings, they were able to voice their concerns and engage the committee members in discussions to answer their questions. The working group would also deliberate to determine if the concerns were warranted and addressed in either an existing objective or actual project. If the concerns were valid and not already in the strategy document, the group suggested revised language of the appropriate objective to ensure that the issue could be further evaluated in future activities. As an example, during the update process, a very informed citizen presented concerns regarding the location and potential resilience of electric infrastructure within beach communities. The LMS WG and the FRMPIWG were both able to contribute to the discussion and then the objectives were evaluated to ensure they aligned with potential activities of the LMS WG for that concern. Following public meetings, the LMS WG was briefed on the event and informed of any concerns or suggestions raised by the public via direct conversation or through information provided in surveys or comment cards. This interaction helped to guide the LMS WG during their meetings to act upon any items raised by the public.

Apart from the efforts of the LMS Working Group, Pinellas County's Flood Risk and Mitigation Public Information Working Group (FRMPIWG) played a key role in public outreach and in advancing the county's mitigation efforts. The FRMPIWG provided input and feedback in support of the NFIP CRS program and LMS within the County. This Working Group consisted of representatives from all the jurisdictions in the County as well as citizens and members of the private sector. During the project timeline, this group met three times and developed their own mission statement and provided valuable input for the LMS and, in turn, a member of the LMS provided information on the LMS update progress. **Please refer Appendix A for email notifications indicating coordination between the LMS and FRMPIWG functions. For a copy of the FRMPIWG meeting minutes and sign-in sheets, please refer Appendix A of the Multi-Jurisdictional Program for Public Information (provided in APPENDIX H of the LMS Plan).**

During the plan maintenance process, the County will continue to use and refine the public engagement tools and methods described above to improve public awareness about mitigation, reach out to a wider audience, and increase participation in the County's mitigation efforts.

STEP 3: COORDINATION

The LMS Working Group representatives have responsibility to not only participate in the committee and its subcommittees, but to also reach out in their community to share significant information and messages, to coordinate activities within the County and to bring back perspectives of their constituency. The intent is for the representatives to contact agencies, organizations and their residents to collect information related to hazards and mitigation activities, provide information regarding the LMS and its update as well as offer these agencies and organizations an opportunity to be involved in the planning effort. The documents shared through Google drive for the 2020 LMS plan update and the discussions at the working group meetings helped to share information regarding existing plans, studies, and data belonging to different jurisdictions that are relevant to LMS. These discussions helped refine the Goals and Objectives within the LMS plan as a part of the five-year update. These discussions also emphasized the need to adopt language in related plans that encourage consistency in vulnerability metrics and mitigation measures throughout the County. (See Appendix A for more detailed information.) Local plans, such as comprehensive plans, capital improvement plans, economic development plans, etc., were also reviewed to inform the mitigation update process and may be updated in the future following the update of the risk assessment and strategy development. These plans are listed in Section 3 – Mitigation Strategy.

STEP 4: ASSESSING THE HAZARD

One of the most important tasks required of the LMS Working Group is to conduct and maintain a hazard identification and vulnerability assessment. The information provided by the assessment is the foundation on which decisions about future mitigation initiatives are based. An analysis of both natural and technological hazards is on-going as new information and technology evolves and events occur. The hazard identification and vulnerability assessment data is gathered from FEMA, National Oceanographic and Atmospheric Administration (NOAA) and the National Weather Service, the Tampa Bay Regional Planning Council (TBRPC); the National Hurricane Center SLOSH (Sea Lake Overland Surge in Hurricanes) model; the Laser Infrared Detection and Ranging system (LIDAR); the municipalities and their departments; and Pinellas County departments of Emergency Management, Planning, Building, Information Systems, Public Works, Utilities, and Developmental Review Services. The Hazards Analysis and Vulnerability Assessment relied heavily on GIS planning tools to identify vulnerable areas, populations and recognize geographic vulnerabilities of critical facilities and key infrastructure.

STEP 5: ASSESSING THE PROBLEM

This previous step assessed the hazards facing the community. This step quantifies the impact of those hazards on the community. The LMS Committee collected population and demographic data from the 2017 American Community Survey (ACS) data, critical infrastructure and facilities inventories, flood insurance data, building type/valuation from the property appraiser data, historical damage and an estimation of potential future events.

This section also described the areas within the floodplain that provide natural functions including wetlands, riparian areas, sensitive areas and habitat. This was tied to the community goals and policies reflected in the local government comprehensive plans which provide a description of the development, redevelopment and population trends.

STEP 6: GOALS AND OBJECTIVES

In 2009 a Goals and Objectives Subcommittee was tasked with the development of recommendations for new goals and objectives. The Subcommittee and Working Group decided to follow the Federal Guidance and develop hazard-specific goals addressing the major hazards facing the County: coastal flooding (storm surge, coastal erosion and wave action), inland and riverine flooding, severe winds (hurricanes and tornadoes), hazardous material incidents, and security hazards (terrorism, civil disruptions, etc.). In addition, an all-hazards goal was developed for those mitigation objectives or actions which addressed a broader safety goal or more than one hazard. In 2014 the Subcommittee revisited the Goals and

Objectives and made only minor adjustments to specifically address sea level rise, as appropriate. The LMS then focused on the identification and analysis of mitigation actions and addressed existing and new buildings and infrastructure. The County followed the FEMA suggestion that the mitigation actions be sorted into the following groups:

- Prevention
- Property Protection
- Public Education and Awareness
- Natural Resource Protection
- Structural Projects

In 2019, several changes were made to the goals and objectives to reflect updated information from the vulnerability assessment and revised focus areas to include six new objectives in Goal 1 – Disaster Resilience:

- Countywide consistency in approach to hazard planning and higher standards
- Addressing social vulnerability when assessing hazards
- Plan for future conditions of hazards
- Plan for impacts of Red Tide
- Better protection/resilience for energy infrastructure
- Chemical storage security and safety for private facilities.

Additionally, other objectives had language broadened to allow flexibility for multi-hazard approaches. As wildfire has been determined by the Working Group as a lesser concern, that goal has been removed, but its corresponding objectives were simply moved to the broader Goal 1 – Disaster Resilience.

STEP 7: POSSIBLE ACTIVITIES: MITIGATION OPPORTUNITIES AND INITIATIVES

The process of developing the local mitigation strategy culminated in the identification of potential mitigation opportunities and initiatives. Each Working Group member is required to review, evaluate, and analyze his or her current policies and ordinances regarding mitigation. The information is then shared and compared with the other members of the Working Group. This allows for the exchange of good ideas, accomplishments, and past experiences both successful and unsuccessful. The process also identifies any inconsistencies between communities. The most successful policies limit public expenditures in areas subject to repetitive damage from disasters; protect critical facilities and infrastructure; preserve, restore and enhance natural resources that can mitigate hazards; encourage economic diversification as protection from the loss of any one asset; encourage structural retrofitting, property acquisition and relocation; and identify procedures to expedite post-disaster recovery and permitting. Because of the education gained from this process, the Working Group is better prepared to determine the future mitigation initiatives that should be or need to be pursued. Some of the needed mitigation initiatives require unified intergovernmental coordination and participation. Other initiatives can be accomplished on an individual community basis.

STEP 8: AN ACTION PLAN

Objectives were identified for each Goal to specifically identify action items and are reflected in six categories of mitigation activities:

- **Preventive –** activities which keep vulnerability from getting worse. The use and development of vulnerable areas through planning, land acquisition or regulation. This includes hazard vulnerability mapping and data; open space preservation; floodplain regulations, coastal setbacks; planning and zoning; Stormwater management; drainage system maintenance and building codes.
- **Property protection –** activities which are usually undertaken by property owners or the community on a parcel by parcel basis, including relocation, acquisition, building elevation, retrofitting, sewer backup protection and insurance.
- **Natural resource protection –** activities which preserve or restore natural areas or the natural function of the floodplain and watershed areas. These activities include wetlands protection erosion and sediment control, natural area preservation or restoration, water quality improvement, coastal barrier protection, and environmental corridors.
- **Emergency services** - activities taken during any emergency to minimize its impact. This includes hazard threat recognition, warning, response operations, critical facilities protection, and post disaster mitigation actions.
- **Structural projects** – are those traditionally engineering/maintenance projects that protect vulnerable populations and structures including seawalls, levees, Stormwater/drainage improvements or maintenance, access restrictions, etc.
- **Public Information** – activities which advise property owners and visitors about hazards, ways to protect people and property from the hazards. These include maps, outreach projects, real estate disclosure, technical assistance and education.

Pinellas County and each of the twenty-four (24) participating municipalities submit a list of their prioritized mitigation initiatives. The initiatives are then placed on a consolidated county-wide list, which is divided into the six categories relevant to specific goals and objectives.

These mitigation actions were then evaluated using the STAPLEE method. This technique identifies the following local conditions: Social, Technical, Administrative, Political, Legal, Economic and Environmental. Actions are also evaluated using other criteria:

- Compatibility with the Local Government Comprehensive Plans
- Compatibility with the Comprehensive Emergency Management Plan
- Compatibility with other related programs, such as the Community Rating System

A spreadsheet was placed online for editing by working group participants. All stakeholders were asked to update the status of existing projects to either still viable, new, completed, or removed. Completed or removed projects were updated with an explanation as to what had changed. New projects were self-scored by the applicant, then reviewed by the LMS WG's scoring committee, and then presented to the LMS WG to provide any clarification on details before being accepted by the group.

2020 Update

The preparation for the 2020 LMS update began in mid-2016 at an LMS meeting, and, in 2018, the contractor, Atkins, was procured to update the plan. Throughout 2019, the LMS WG met numerous times and went through the entire process of assessing the hazards, analyzing the risks, and updating the appropriate mitigation actions. The plan was reviewed and updated to reflect progress in county mitigation efforts and changes in priorities. The schedule of the LMS meetings is included below along with the agencies and departments that participated on the LMS WG.

Table 2.1: List of LMS WG Meetings

Date	LMS Working Group Meetings
January 23, 2019	• Hazard Evaluation
February 18, 2019	• Risk Assessment Process
April 17, 2019	• Risk Assessment Analysis
June 21, 2019	• Stakeholder Involvement and Priority Risk Index
August 7, 2019	• Goals and Objectives
September 18, 2019	• Strategy Session
October 16, 2019	• Input and Update on Public Involvement Strategy
December 11, 2019	• Discussion and Approval of the LMS 5-Year Update and Annual Update Documents

List of Agencies that Participated in LMS Working Group Meetings during the planning process update.

Table 2.2: LMS Working Group Meeting Participating Agencies

LOCAL	OTHER	FEDERAL
American Red Cross	Area Agency on Aging of Pinellas and Pasco Counties	Federal Emergency Management Agency IV
Town of Belleair	Bayfront Health St. Petersburg	
City of Belleair Beach	Bay Area DKI	**STATE**
City of Belleair Bluffs	East Lake Tarpon Fire Control District	Florida Department of Transportation
City of Clearwater	Eckerd College	Florida Division of Emergency Management
City of Dunedin	FL Restaurant & Lodging Association	Southwest Florida WMD
City of Gulfport	HCA Health Care	
Hillsborough County	Advent Health North Pinellas	
City of Indian Rocks Beach	PARC	
Town of Indian Shores	St. Anthony's Hospital	
Town of Kenneth City	Sunstar	
City of Largo	University of South Florida	
City of Maderia Beach	Wright National Flood Insurance Company	
Town of North Redington Beach	UF/IFAS Extension	
City of Oldsmar		
Pasco County		
Pinellas County		
Pinellas County Juvenile Welfare Board		
Pinellas County Schools		
City of Pinellas Park		

Town of Redington Beach	[redacted]	[redacted]
Town of Redington Shores	[redacted]	[redacted]
City of Safety Harbor	[redacted]	[redacted]
City of Seminole	[redacted]	[redacted]
City of South Pasadena	[redacted]	[redacted]
City of St. Pete Beach	[redacted]	[redacted]
City of St. Petersburg	[redacted]	[redacted]
Tampa Bay Regional Planning Council	[redacted]	[redacted]
City of Tarpon Springs	[redacted]	[redacted]
Tarpon Springs Housing Authority	[redacted]	[redacted]
City of Treasure Island	[redacted]	[redacted]

STEP 9: ADOPTION OF THE STRATEGY

After the 2020 LMS underwent final revisions, and the plan was completed to the Florida Division of Emergency Management's satisfaction (and thus the Federal Emergency Management Agency per agreement with FDEM), the plan was officially adopted by Pinellas County via a memorandum signed by the Chief Executive Officer as the County's Authorized Representative, on XX/XX/2020. Each municipality adopted the updated plan and the exact dates are provided in Appendix F – Plan Adoption. The 2020 Plan will be effective from Month, Day, Year until Month, Day, Year.

The following documentation can be found in *Appendix F: Plan Adoption*.

- Adoption
- Approval

STEP 10: IMPLEMENTATION, EVALUATION, AND REVISION

The Pinellas County Local Mitigation Strategy serves as a guide for hazard mitigation activities on a county-wide basis. The strategy is intended to be a dynamic document that will be updated regularly. The current steward of the multijurisdictional plan and planning process is as follows:

Pinellas County Planning Department
310 Court St., Clearwater, FL.
http://www.pinellascounty.org/plan/
727.464.8200

The Planning Department Director and/or their designee is also currently assisted by staff from the County's Emergency Management Department to coordinate activities and ensure compliance with local, state, and federal requirements. Consistent with federal and state requirements, the LMS Working Group will meet to update and review the effectiveness of the local mitigation strategy quarterly. The Working Group meeting schedule for each calendar year, shall be officially approved by the Working Group. The LMS Chair (elected annually by the LMS Working Group) with help from the Working Group will submit the annual LMS updates to the Florida Division of Emergency Management no later than the last working weekday of each January. This update will follow an annual review of the plan by the LMS Working Group. The LMS Chair will also be responsible for calling and coordinating the Working Group meetings, and for monitoring and evaluating the plan for the update and on an ongoing basis.

To facilitate the evaluation of the LMS, a portion of each regularly occurring Working Group meeting (quarterly meetings) will address the following criteria:

- April: Evaluate any changes to risk assessment prior to the start of hurricane season. Assess opportunities for outreach with community.
- July: Evaluate objectives to determine if any activity needs to be revised based on any updated policies or risk assessment factors.
- October: Review the status of projects/actions and update the annual list. Finalize the yearly roster of working group members. Prepare for the annual update to FDEM (due Jan 31). Annual update also includes submission of materials to local, jurisdictional administration for signature prior to submitting to FDEM.
- Jan: Verify annual update items and submit to FDEM. Elect Chairperson for the year. Determine LMS WG priorities for the year.

If by email or other communication, the LMS Chair receives information to warrant a meeting, then a special meeting will be called to discuss the changes. Any Working Group member also may request a special meeting. Pinellas County Planning Department and the LMS Chair will coordinate scheduling and notification of Working Group meetings. A minimum of thirty (30) days advance notice will be given for annual meetings. As much advance notice as possible will be given for regular and special meetings including conference calls or online webinars.

On an ongoing basis, new initiatives will be considered by the Working Group for inclusion into the strategy. Completed initiatives, termed Accomplishments, will be removed from the Initiatives List and detailed in the Accomplishments Listing. The new initiatives will be added as they are identified, ranked and approved by the Working Group. Every five years, or after any major change, the strategy will be resubmitted to municipal councils/commissions and to the Board of County Commissioners for re-adoption.

Five-Year Update

In addition to these annual progress reports and reviews, the LMS will be updated every five years, in accordance with 44 CFR 201.4. The five-year updates are labor intensive and can take over a year to complete. Each section of the 2020 LMS will be reviewed and updated accordingly.

Below is a timeline starting when the 2020 Update began and ending at the end of 2025 and includes annual and five-year update cycle actions.

Table 2.3: Pinellas 2020 Plan Update Timeline

Year	Task(s)
2018	• Quarterly LMS Working Group Meetings • Program for Public Information Meetings (3) • Annual Progress Report to FDEM • Prepare for 2020 Update • Agreement with Consultant for 2020 Update
2019	• LMS Working Group Meetings (8 between January and November) • Program for Public Information Meetings (3)

Year	Task(s)
	• Work on the Five-Year 2020 Update • Provide Five-Year 2020 Plan Updates to FDEM • Annual Progress Report to FDEM
2020	• Provide any necessary revisions to FDEM for 2020 Update • Local Adoption of 2020 Plan • Quarterly LMS Working Group Meetings • Program for Public Information Meetings (3) • Prepare Annual Progress Report to FDEM
2021	• Quarterly LMS Working Group Meetings • Program for Public Information Meetings (3) • Annual Progress Report to FDEM
2022	• Quarterly LMS Working Group Meetings • Program for Public Information Meetings (3) • Annual Progress Report to FDEM
2023	• Quarterly LMS Working Group Meetings • Program for Public Information Meetings (3) • Annual Progress Report to FDEM • Prepare for 2025 Update
2024	• Quarterly LMS Working Group Meetings • Program for Public Information Meetings (3) • Annual Progress Report to FDEM • Provide updates for 2025 Plan to FDEM

MITIGATION STRATEGY SECTION

Local Hazard Mitigation Plan Requirements
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs? [44 CFR §201.6(c)(3)]
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? [44 CFR §201.6(c)(3)(ii)]
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? [44 CFR §201.6(c)(3)(i)]
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? [44 CFR §201.6(c)(4)(ii)]

Mitigation Strategy

The purpose of the local mitigation strategy is to develop a "blueprint" or guide intended to:

Provide a unified and consistent course of action needed to eliminate or reduce the impact of disasters that threaten Pinellas County and its municipalities.

This strategy was originally developed in 1998 in accordance with the Florida Department of Community Affairs publication, *The Local Mitigation Strategy: A Guidebook for Florida Cities and Counties*, and other applicable guidance promoted by the Department of Community Affairs (DCA), the Florida Division of Emergency Management (DEM) and the Federal Emergency Management Agency (FEMA).

The content of this section discusses how the county and its municipalities develop and prioritize actions in coordination with countywide goals and objectives.

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 county hazard mitigation strategy.

The following list represents the newly revised goals and objectives by the LMS Working Group. Additionally, the proposed revisions were provided to the Flood Risk and Mitigation Public Information Working Group (FRMPIWG) as well as provided to the public at an evening workshop for comment and recommendations.

Overview

Based on the hazards and vulnerability analyses, the next step in the LMS planning process was the development of definitive, realistic goals and objectives.

With the update of the 2020 Local Mitigation Strategy, the Workgroup found the existing goals and objectives provided a clear strategy on where to expend additional funds; as well as addressed mitigation as a comprehensive, multi-jurisdictional program. However, the LMS WG decided to modify the language of a few of the goals to be more generalized so that they could be more easily implemented through specific objectives and actions. While the jurisdictions want to be "ready" if mitigation funds are available, the shared goal of resiliency requires a local commitment even in difficult economic times.

In addition to non-structural approaches (growth management) to mitigation, public education campaigns as well as the hardening of critical facilities and shelters; the concepts of community resiliency and intergovernmental and inter-agency coordination remain critical to the LMS. The Workgroup focused on the hazard-specific goals to maintain the "all-hazards" approach.

Another specific change to this section includes the removal of a goal specific to wildfire. The risk assessment showed that there is decreased exposure to this hazard as the community is built out and wildland urban interface is contained to a small geography in the northern portion of the county that is well maintained by park services. Even though this goal was removed, the objectives related to it have been retained and moved to the more general goal number 1, "Become a More Disaster Resilient Community".

Beyond the goals themselves, changes were also made to the objectives. While some of the changes were minor tweaks to generalize language for more inclusive terminology of a hazard type, the more substantive changes were intended to: encourage collaboration countywide for consistent approach to mitigation and higher standards, consider future conditions of the hazards, and to include social vulnerabilities.

Additionally, objectives were reviewed and modified to achieve these goals. The six goals adopted for the LMS Plan are:

1. Become a More Disaster Resilient Community.

2. Minimize Coastal Flooding Losses in the CHHA, Coastal Storm Area and Hurricane Vulnerability Zone.

3. Minimize Riverine or Inland Flooding Losses in the 25, 50, and 100-year Flood Zone.

4. Minimize Storm Wind Losses in the County.

5. Minimize Losses from Hazardous Material Incidents.

6. Minimize Vulnerability to Technological Hazards.

Specific Measures

Mitigation tools and techniques fall into three broad categories: (1) **structural techniques** including design and construction; (2) **environmental interventions** and (3) **non-structural interventions**. Structural mitigation projects include strengthening of vulnerable structures and public facilities to withstand wind, fire and other forces, elevation of structures to protect them from flood damage, construction of storm water control facilities and drainage improvements. Environmental intervention refers to actions that reduce the vulnerability of communities by armoring them against the elements. This term includes beach restoration and stabilization projects. Non-structural mitigation refers to policies for avoiding hazard impacts, applying zoning restrictions, land acquisition in the floodplain, promoting citizen awareness and public education initiatives.

Each goal identified objectives which fell into one of five (5) specific measures:

A. Prevention:

Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space, preservation and storm water management regulation.

B. Property Protection:

Actions that involve the modification of existing building or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and impact-resistant glass.

C. Public Education and Awareness:

Actions to inform and educate citizens, elected officials and property owners about potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

D. Natural Resource Protection:

Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management and wetland restoration and preservation.

E. Structural Projects:

These are actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls, floodwalls, seawalls, retaining walls and safe rooms. The implementation of a mitigation program is a key component in the achievement of a "sustainable community", one in which citizens, businesses and institutions are protected from the disruptions and impacts of disasters. In an urbanized metropolitan county such as Pinellas County, coordination among and between levels of government is critical to the success of the program.

The LMS established the goals and objectives listed in the table on the following pages as a foundation of the countywide mitigation strategy in earlier plans. These were reviewed by the LMS Working Group during the August 2019 meeting. The proposed revisions were placed onto an online website for the group to further review and comment. In September, the revised objectives were provided to the broader, public stakeholder group known as Flood Risk and Mitigation Public Information Working Group (FRMPIWG). These revisions were reviewed and finalized during the September 2019 meeting.

Table 3.1: Pinellas County Goals and Objectives

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
1	Become a more disaster resilient community	Preventive Measures	1.1	Adopt comprehensive and consistent sets of goals, objectives, and policies in local government comprehensive plans which minimize risk and potential property damage through density restrictions, zoning, and land use regulations.	Local governments have adopted their Evaluation & Appraisal Report-based amendments of their respective comprehensive plans, according to Ch. 163, F.S. In addition, currently annual amendments update the Capital Improvement Elements of the Comprehensive Plans.	Local government comprehensive plans	Planning, Building/Dev. Review Services
1	Become a more disaster resilient community	Preventive Measures	1.2	Adopt and enforce land development regulations (LDRs) including building codes and floodplain management regulations which provide for enhanced public safety and structural integrity of buildings and infrastructure in order to achieve mitigation goals.	Local governments shall adopt and enforce LDRs to implement their respective comprehensive plans. Amendments to LDRs are made accordingly as comprehensive plan amendments are adopted.	Local government codes of ordinances	Building/Dev. Review Services, Public Works, Planning
1	Become a more disaster resilient community	Preventive Measures	1.3	Local governments, Non-governmental organizations (NGOs) and businesses should develop and maintain Continuity of Operations (COOP) Plans which minimize the impact of business interruption and protect vital records.	Local government departments prepare and update individual COOPs; promote Small Business Disaster Survival Kit Programs.	Department emergency response plans, COOPs	Emergency Management, Real Estate Mgt., all local government departments and constitutional departments

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
1	Become a more disaster resilient community	Preventive Measures	1.4	Continue to maintain and implement, as necessary, the Pinellas County Post-Disaster Redevelopment Plan annually.	In 2012, Pinellas County completed the most recent update to the Post-Disaster Redevelopment Plan. The County and the PDRP Working Group continue to coordinate with DEO regarding the implementation of the Post-Disaster Redevelopment Planning Program including emergency ordinances, Disaster Housing Strategy, Debris Management Plan, etc.	Local government comprehensive plans; CEMP, Local Government Disaster/Post-Disaster Redevelopment Guides; *Pinellas County Post-Disaster Redevelopment Guide* (2012)	Emergency Management and Planning are lead agencies, coordinating with other interested parties
1	Become a more disaster resilient community	Preventive Measures	1.5	Conduct research to determine impacts from climate change to the county and work regionally to identify adaptive strategies to meet future challenges including sea level rise.	Pinellas County will work with federal, state, and local entities to determine potential impacts to the county and its jurisdictions and will incorporate adaptive strategies in the next update of the LMS as appropriate.	Local government comprehensive plans; CEMP, Local Government Disaster/Post-Disaster Redevelopment Guides; *Pinellas County Post-Disaster Redevelopment Guide* (2012)	Planning agencies at local, regional, state and federal levels; the National Estuary Program, Tampa Bay Regional Planning Council; Pinellas County UF/Cooperative Extension Office and others.

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
1	Become a more disaster resilient community	Property Protection	1.6	Develop a local program in concert with federal and state programs to encourage and provide incentives to residents to make their homes more resistant to natural, technological, and human- caused disasters.	The Pinellas County and St. Petersburg Home Repair Loan Programs are examples of local programs which provide low interest loans for improvements such as roof bracing/replacement, impact resistant windows and doors, shutters, etc. In addition, local governments may sponsor flood mitigation programs for repetitive and severe repetitive loss properties via the Flood Mitigation Assistance Program; Support State Hurricane Preparedness Tax Holidays and Wind Retrofit Program.	Housing programs, CIEs and budgets, HUD Programs, FMAP and Floodplain Management Programs; State action to allow for Hurricane Preparedness Tax Holidays; continuation of State Wind Retrofit Program	County Community Development Depts., City Housing Departments, DEO, FDEM
1	Become a more disaster resilient community	Property Protection	1.7	Identify, assess, prioritize and harden critical facilities and key critical infrastructure.	Each government through the updating of the CEMP and LMS assesses the status of critical facilities and infrastructure.	CEMP (2013); Local Mitigation Strategy (2015)	Emergency Management, Fire Administration, Real Estate Mgt.
1	Become a more disaster resilient community	Property Protection	1.8	Support environmental land acquisition programs which limit existing or future development potential from a hazard while protecting environmental lands	Continue programs that acquire environmentally-sensitive lands and flood-prone properties in conjunction with stormwater management projects.	Pinellas County and local comprehensive plans, Pinellas County Capital Improvements Program	Environmental Management, Real Estate Management, Public Works, Planning

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
				and/or providing recreational opportunities.			
1	Become a more disaster resilient community	Public Education and Awareness	1.9	Develop a public awareness and education campaign that informs citizens, officials, and businesses about potential risks, mitigation alternatives, their costs and benefits, incentives and funding assistance programs.	Continue CRS outreach efforts and education campaigns via flyers, newspaper articles, direct mailing to repetitive loss properties/areas, email subscriptions, local events, and speaker bureaus. Promote Family and Small Business Disaster Survival Kit Programs.	Local Floodplain Management Plan (CRS), Hurricane Guides, website, LMS Storymap	Emergency Management, Planning, Communications, Economic Development
1	Become a more disaster resilient community	Public Education and Awareness	1.10	Incorporate mitigation and preparedness activities into Neighborhood Crime Watch and CERT programs.	Coordinate information activities with local CERT and law enforcement agencies during local neighborhood meetings.	CEMP, Floodplain Management Plan	Fire Administration, Emergency Management, Law Enforcement
1	Become a more disaster resilient community	Public Education and Awareness	1.11	Provide hazard-specific training, such as awareness, ICS, hazardous material handling, floodproofing, code-plus construction techniques (“Blueprint for Safety”), etc., to governmental employees, contractors and citizens to reduce our vulnerabilities.	Coordinate information activities with local CERT and law enforcement agencies during local neighborhood meetings. Identify and expand training opportunities for governmental employees.	CEMP, Floodplain Management Plan, LEPC, RDSTF 5-year Training Program	Fire Administration, Emergency Management, Law Enforcement, Public Information Office

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
1	Become a more disaster resilient community	Natural Resource Protection	1.12	Adopt and enforce land development regulations (LDRs) which provide for the protection of environmentally-sensitive lands, i.e., wetlands, coastal areas and upland habitats in order to achieve mitigation goals.	Continue environmental protection through methods such as upland buffers, density restrictions within the CHHA, PCCCL and Coastal Storm Area, minimization of impervious surfaces consistent with local plans and codes.	Comprehensive Plan; Land development regulations, Gulf Beaches Coastal Construction Code	Building/Dev. Review Services, Planning, Pinellas County Construction Licensing Board
1	Become a more disaster resilient community	Structural Projects	1.13	Support the construction of structures that reduce the impact of hazards including storm water controls, floodwalls, seawalls, security and monitoring capabilities, and safe rooms.	Enforce land development codes regarding hardening shorelines (where appropriate) and developing more disaster resistant housing. Design improvements utilizing climate change and sea level rise for the life expectancy of the structure.	Land development regulations; Florida Building code; Gulf Beaches Coastal Construction Code	Public Works, Environmental Management, Pinellas County Construction Licensing
1	Become a more disaster resilient community	Preventive Measures	1.14[1]	When assessing hazards (exposure and impacts), consider future conditions.	Local planning documents should include maps and tables that illustrate expected future conditions from hazards.	Local government comprehensive plans; CEMP, Local Government Disaster/Post-Disaster Redevelopment Guides; Pinellas County Post-	Emergency Management and Planning are lead agencies, coordinating with other interested parties

[1] This is a new objective that was added during the 2020 Plan Update process.

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
						Disaster Redevelopment Guide (2012)	
1	Become a more disaster resilient community	Preventive Measures	1.15[1]	Establish countywide consistency in hazard planning policies and higher standards.	Identify benchmarks for hazard planning policies and higher standards that all communities could adopt.	Local government comprehensive plans, land development ordinances, stormwater manuals	Building/Dev. Review Services, Public Works, Planning
1	Become a more disaster resilient community	Preventive Measures	1.16[1]	Include social vulnerability when assessing hazards in community planning processes and identify related factors that could impair or slow down post-disaster recovery or redevelopment in the aftermath of a big disaster event.	Local planning documents should include maps and tables that illustrate expected social vulnerability impacts from hazards in coordination with public health agencies.	Local government comprehensive plans; CEMP, Local Government Disaster/Post-Disaster Redevelopment Guides; Pinellas County Post-Disaster Redevelopment Guide (2012); Local Mitigation Strategy	Emergency Management, Public Health, and Planning in coordination with other interested parties
1	Become a more disaster resilient community	Natural Resource Protection	1.17[1]	Develop plans and procedures that minimize impacts from red tide.	Continue environmental protection through methods such as upland buffers, density restrictions within the CHHA, PCCCL and Coastal	Local government comprehensive plans, land development ordinances,	Public Works and supporting water quality/environmental agencies

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
					Storm Area, minimization of pollutant runoff into waterways.	stormwater manuals	
1	Become a more disaster resilient community	Preventive Measures	1.18[2]	Enforce adopted building codes and "Firewise" policies (buffers, etc.) to minimize risk.	Assess existing codes in meeting updated "Firewise" guidelines.	Land development regulations, building codes	Building/Dev. Review Services
1	Become a more disaster resilient community	Preventive Measures	1.19[2]	Conduct prescriptive burning programs in passive recreational areas and parks.	Carry out controlled burning, mechanical vegetative thinning and timber thinning policies of local preserve management plans.	Brooker Creek Preserve Management Plan	Environmental Management, Fire Administration
1	Become a more disaster resilient community	Public Education and Awareness	1.20[2]	Provide residents with up-to-date information regarding their fire risk and Firewise strategies, as well as water conservation.	Carry out annual public outreach through websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV, and radio.	CEMP	Emergency Management, Environmental Management, Communications
1	Become a more disaster resilient community	Natural Resource Protection	1.21[2]	Protect wildland areas through prescribed burning, acquisition, provision of recreational opportunities (where appropriate), outdoor camping/fire restrictions, and habitat restoration.	Carry out controlled burning, mechanical vegetative thinning, timber thinning policies of local preserve management plans, and established park policies and regulations.	Park policies and regulations, Environmental lands management plans	Environmental Management, Culture, Education & Leisure (CEL) Depts.

[2] This objective was previously part of the Wildfire goal that has since been deleted. This is now part of Goal 1.

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
1	Become a more disaster resilient community	Preventive Measures	1.22[1]	Develop plans and procedures that minimize impacts from power outages.	Evaluate higher standards for critical infrastructure.	Land development regulations, CEMP	Planning, Utilities, and Emergency Management
1	Become a more disaster resilient community	Structural Projects	1.23[1]	Consider burying power lines when retrofitting existing utilities or in areas of new development.	Development review procedures should evaluate opportunities to bury power lines.	Land development regulations	Planning and Utilities
2	Minimize Coastal Flooding Losses[3]	Preventive Measures	2.1	Restrict permanent residential density increases, expenditure of public funds, and the location of critical facilities within areas of coastal vulnerability.	Develop appropriate land development regulations to implement coastal protection policies. Implement goals, objections, and policies in local comprehensive plans.	Comprehensive Plan; Land development regulations	Planning, Building/Dev. Review Services
2	Minimize Coastal Flooding Losses[3]	Preventive Measures	2.2	Enforce adopted building codes and floodplain management regulations.	Carry out obligations to participate in the National Flood Insurance Program and its associated CRS program.	Building code; land development regulations, comprehensive plan	Building/Dev. Review Services, Planning
2	Minimize Coastal Flooding Losses[3]	Preventive Measures	2.3	Develop a program which provides incentives to encourage code-plus flood mitigation construction and design.	Investigate the feasibility of initiating freeboard requirements greater than 1 foot.	Land development regulations	Building/Dev. Review Services
2	Minimize Coastal Flooding Losses[3]	Property Protection	2.4	Develop local programs in concert with federal and state programs that encourage and provide	Participate in Flood Mitigation Assistance Program through sponsorships of	Floodplain Management Plan	Floodplain Management sections; Building/Dev. Review

[3] Language of the goal's name or description was modified for clarity, but the intent is the same as the previous version.

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
				incentives to residents to elevate their homes or businesses within areas of coastal vulnerability.[3]	applications for grant funds.		
2	Minimize Coastal Flooding Losses[3]	Public Education and Awareness	2.5	Provide residents with up-to-date information regarding their Hurricane evacuation zone, flood zone, and opportunities to participate in programs which can assist them with their mitigation efforts.	Carry out public outreach regarding disaster preparations throughout the year through websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV, and radio, and CRS outreach activities.	CEMP, Floodplain Management Plan, Hurricane guides	Emergency Management, Planning, Communications, Building/Dev. Review Services, Public Information Office
2	Minimize Coastal Flooding Losses[3]	Public Education and Awareness	2.6	Provide vulnerable residents with up-to-date information to adequately plan for potential evacuation and disasters.	Carry out annual public outreach disaster preparations through websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV and radio, and CRS outreach activities.	CEMP, Floodplain Management Plan, Hurricane guides	Emergency Management, Planning, Communications, Public Information Office

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
2	Minimize Coastal Flooding Losses[3]	Natural Resource Protection	2.7	Protect coastal resources through acquisition, density restrictions, and the provision of beach access, natural vegetation, and dune protection.	Carry out environmental lands acquisition program, coastal management programs, and applicable land development regulations; i.e., community sea oat and dune planning activities, and community beach clean-up efforts.	Local capital improvements programs and departmental budgets	Public Works, Environmental Management, Parks and Recreation Departments, Public Information Office
2	Minimize Coastal Flooding Losses[3]	Natural Resource Protection	2.8	Identify structural projects where appropriate that minimize coastal flooding loss but protect environmental resources.	Update Comprehensive Plan Capital Improvements Element; local capital improvements program, and LMS project lists. Design the structural improvement utilizing the information pertaining to climate change and sea level rise for the life expectancy of the structure.	Capital Improvements Element, Capital Improvements Program, Local Mitigation Strategy	Public Works, Environmental Management, Planning
3	Minimize Inland or Riverine Flooding Losses[3]	Preventive Measures	3.1	Regulate residential density increases, expenditure of public funds and the location of critical facilities in areas of inland/riverine flood risk.[3]	Carry out local policies in comprehensive plans that deal with densities, critical facilities, and public expenditures within floodplains.	Local comprehensive plans, land development regulations	Building/Dev. Review Services, Planning
3	Minimize Inland or Riverine Flooding Losses[3]	Preventive Measures	3.2	Enforce adopted building codes and floodplain management regulations.	Carry out obligations to participate in the National Flood Insurance Program and its associated CRS program.	Building code, Land development regulations	Building/Dev. Review Services

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
3	Minimize Inland or Riverine Flooding Losses[3]	Preventive Measures	3.3	Develop a program which provides incentives to encourage code-plus flood mitigation construction and design.	Investigate the feasibility of initiating freeboard requirements.	Land development regulations	Building/Dev. Review Services
3	Minimize Inland or Riverine Flooding Losses[3]	Property Protection	3.4	Develop local programs in concert with federal and state programs to encourage and provide incentives to residents to floodproof or elevate their homes or businesses.[3]	Participate in Flood Mitigation Assistance Program through sponsorships of resident applications for grant funds.	Floodplain Management Programs, CRS	Planning Depts., Building/Dev. Review Services
3	Minimize Inland or Riverine Flooding Losses[3]	Public Education and Awareness	3.5	Provide residents with up-to-date information regarding their flood zone, the need and availability of flood insurance, opportunities to participate in programs which can assist them with their mitigation efforts.	Carry out annual public outreach disaster preparations through websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV, and radio, and CRS outreach activities.	Floodplain Management Plans, CEMP, Hurricane guides	Emergency Management, Planning, Communications, Building/Dev. Review Services
3	Minimize Inland or Riverine Flooding Losses[3]	Public Education and Awareness	3.6	Provide vulnerable residents with up-to-date information to adequately plan for potential evacuation and disasters.	Carry out annual public outreach disaster preparations through websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and	Floodplain Management Plans, CEMP, Hurricane guides	Emergency Management, Planning, Communications

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
					Governmental Channels (PEGs), local and commercial TV, and radio, individual mailings, and CRS outreach activities.		
3	Minimize Inland or Riverine Flooding Losses[3]	Public Education and Awareness	3.7	Educate the development community on Low Impact Development (LID) opportunities and transfer of density to avoid excessive development in the riverine areas.	Utilize websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV, and radio, and individual mailings.	Brochures on Low Impact Development, LMS Storymap	Building/Dev. Review Services
3	Minimize Inland or Riverine Flooding Losses[3]	Natural Resource Protection	3.8	Protect wetlands and watershed areas through acquisition, density restrictions, provision of recreational opportunities (where appropriate), and habitat restoration.	Continue programs that acquire environmentally-sensitive lands and flood-prone properties in conjunction with stormwater management projects.	Comprehensive Plans, Capital Improvements Programs	Building/Dev. Review Services, Environmental Management, Public Works, Real Estate Management
3	Minimize Inland or Riverine Flooding Losses[3]	Structural Projects	3.9	Identify structural projects where appropriate that minimize flood loss including stormwater projects, drainage projects, and retention areas.	Update Comprehensive Plan Capital Improvements Element, local capital improvements programs, CRS Floodplain Management Plan, and LMS project list.	Capital Improvements Programs, Comprehensive Plans, LMS, Floodplain Management Plan	Public Works, Environmental Management, Planning

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
4	Minimize Storm Wind Losses in the County	Preventive Measures	4.1	Regulate the placement of manufactured housing/ mobile homes and strive to replace stock with other affordable housing alternatives, including hurricane resistant modular construction.	Coordinate with the building industry, Florida Manufactured Housing Association (FMHA) on policy directions and programs.	Land development regulations, Comprehensive Plans	Building/Dev. Review Services, Planning
4	Minimize Storm Wind Losses in the County	Preventive Measures	4.2	Enforce adopted building codes, particularly with regards to window protection, garage doors, and roofs.	Carry out Florida Building Code. Work with local builders, builder associations, building official organizations and contractors.	Building codes, Florida Product Approvals	Building/Dev. Review Services
4	Minimize Storm Wind Losses in the County	Preventive Measures	4.3	Develop a program which provides incentives to encourage code-plus wind mitigation construction (FORTIFIED by IBHS) and design (e.g., hip roofs).[3]	Identify existing programs and non-profit partners to expand current efforts and assist homeowners in retrofitting their homes for wind; particularly window protection, bracing garage doors and anchoring roofs.	Housing Programs, Cooperative Extension Service, Florida Product Approvals	Habitat for Humanity; County Housing Dept. City of St. Petersburg, City of Clearwater, PC Community Development Dept
4	Minimize Storm Wind Losses in the County	Property Protection	4.4	Develop local programs in concert with federal and state programs to encourage and provide incentives/ assistance to residents to harden their homes or businesses.	Distribute information through public outreach outlets discussing how-to's in hardening structures. Provide testimonials; Support State Hurricane Preparedness Tax Holidays and Wind Retrofit Program.	CEMP, Hurricane guides, County All-Hazards Guides, Code enforcement; State action to allow for Hurricane Preparedness Tax Holidays;	Emergency Management, Communications, DEO, FDEM, Public Information Office, Red Cross

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
						continuation of State Wind Retrofit Program	
4	Minimize Storm Wind Losses in the County	Public Education and Awareness	4.5	Provide residents with up-to-date information regarding their hurricane wind risks, retrofit options, their costs and benefits (rebates, insurance discounts, etc.), new construction, and opportunities to participate in programs which can assist them with their mitigation efforts.	Carry out public outreach for disaster preparations through websites, speaker bureaus, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV and radio, and CRS outreach activities. Support State Hurricane Preparedness Tax Holidays and Wind Retrofit Program.	CEMP, Hurricane guides; State action to allow for Hurricane Preparedness Tax Holidays; continuation of State Wind Retrofit Program	Emergency Management, Communications, Planning
4	Minimize Storm Wind Losses in the County	Structural Projects	4.6	Identify structural construction techniques that minimize wind loss damage to critical facilities (city halls, courthouse, and fire stations) and infrastructure (utilities, etc.).	Each government, through the updating of the CEMP and LMS, assess the status of critical facilities.	CEMP, LMS, Florida Building Code, Florida Product Approvals	Emergency Management, Fire Administration, Building/Dev. Review Services
5	Minimize Losses from Hazardous Materials Incidents	Preventive Measures	5.1	Restrict noxious industrial land uses and the storage of potentially hazardous materials to specific areas.	Coordinate oversight through the Local Emergency Planning Committee (LEPC) and fire safety inspections.	Land development regulations, comprehensive plans, fire safety codes, Tampa	Fire Administration; LEPC, Code Enforcement agencies; Planning Dept

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
						Bay Region Hazardous Materials Plan, CEMP	
5	Minimize Losses from Hazardous Materials Incidents	Preventive Measures	5.2	Enforce adopted fire and safety regulations, EPCRA reporting requirements, and adequate oversight.	Coordinate oversight through the Local Emergency Planning Committee (LEPC).	Land development regulations, comprehensive plans, fire safety codes, Tampa Bay Region Hazardous Materials Plan, CEMP	Fire Administration; LEPC, Code Enforcement agencies; Planning Dept.
5	Minimize Losses from Hazardous Materials Incidents	Preventive Measures	5.3	Maintain the highest level of Hazardous Material Team response capabilities.	Continue to staff and train HazMat teams.	Tampa Bay Region Hazardous Materials Plan, CEMP	Fire Administration, LEPC
5	Minimize Losses from Hazardous Materials Incidents	Preventive Measures	5.4	Coordinate traffic routes and roadway system with MPO.	Coordinate with MPO to provide safe and effective/efficient routes in transporting hazardous materials.	MPO Long Range Transportation Plan; Traffic Management Plans; Transportation Element of Comprehensive Plans	Pinellas County MPO; Planning Departments
5	Minimize Losses from Hazardous Materials Incidents	Property Protection	5.5	Implement local programs in concert with federal and state programs to encourage businesses and industries, including	Coordinate oversight through the Local Emergency Planning Committee (LEPC) and Regional Domestic	Tampa Bay Region Hazardous Materials Plan, CEMP	Emergency Management, Fire Administration, LEPC, RDSTF

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
				transporters, to address and mitigate any potential for release or spills.	Security Task Force (RDSTF).		
5	Minimize Losses from Hazardous Materials Incidents	Public Education and Awareness	5.6	Provide residents with up-to-date information regarding emergency response; i.e., warnings, shelter in place, and evacuation.	Carry out annual public outreach disaster preparations through websites, speakers' bureau, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV, and radio.	Tampa Bay Region Hazardous Materials Plan, CEMP, website	Emergency Management, Communications, Fire Administration, LEPC
5	Minimize Losses from Hazardous Materials Incidents	Public Education and Awareness	5.7	Provide training to public works, parks/recreation and utility employees with Hazardous Materials Handling training as well as responders.	This training to be based at the first responder level, identification and proactive action to prevent/ mitigate damages from hazardous material incidents.	CEMP, 5-Year Training and Implementation Program	Emergency Management, Fire Administration, RDSTF, LEPC
5	Minimize Losses from Hazardous Materials Incidents	Natural Resource Protection	5.8	Protect environmental resources from the impacts of potential spills or releases through prevention activities, preparedness planning and enhanced response capabilities and provision of adequate resources.	Continue to Implement and coordinate with industry programs that minimize the use of hazardous materials in industrial processing (such a Pollution Preventions & Resource Recovery (P2R2) program).	Tampa Bay Region Hazardous Materials Plan, CEMP	Fire Administration, Emergency Management, Environmental Management, LEPC

Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
5	Minimize Losses from Hazardous Materials Incidents	Property Protection	5.9[1]	Work to ensure businesses that house, store or transport hazardous chemicals employ security measures and/or barriers to minimize unauthorized access to chemicals that may threaten community safety.	Coordinate oversight through the Local Emergency Planning Committee (LEPC) and Regional Domestic Security Task Force (RDSTF).	Tampa Bay Region Hazardous Materials Plan, CEMP	Emergency Management, Fire Administration, LEPC, RDSTF
6	Minimize Vulnerability to Technological Hazards[3]	Preventive Measures	6.1	Adopt key recommendations for Crime Prevention Through Environmental Design (CPTED), Buffer Zone Protection, etc. including territorial protection, access management, surveillance, etc.	Incorporate design principles in livable communities initiatives and LDRs.	Land development codes	Building/Dev. Review Services, law enforcement, fire depts.
6	Minimize Vulnerability to Technological Hazards[3]	Preventive Measures	6.2	Integrate emerging technologies into the threat and vulnerability analysis of critical infrastructure and key assets.[3]	Coordinate oversight through the Local Emergency Planning Committee (LEPC) and RDSTF.	Tampa Bay Region Hazardous Materials Plan, CEMP	Emergency Management, Fire Administration, Law Enforcement, LEPC, RDSTF
6	Minimize Vulnerability to Technological Hazards[3]	Preventive Measures	6.3	Local governments and businesses should develop and maintain Continuity of Operations (COOP) Plans which minimize the impact of business interruption and protect vital records.	Local government departments prepare and update individual COOPs; promote Small Business Disaster Survival Kit Programs.	Department emergency response plans, COOPS	Emergency Management, Real Estate Mgt., all local government departments and constitutional departments

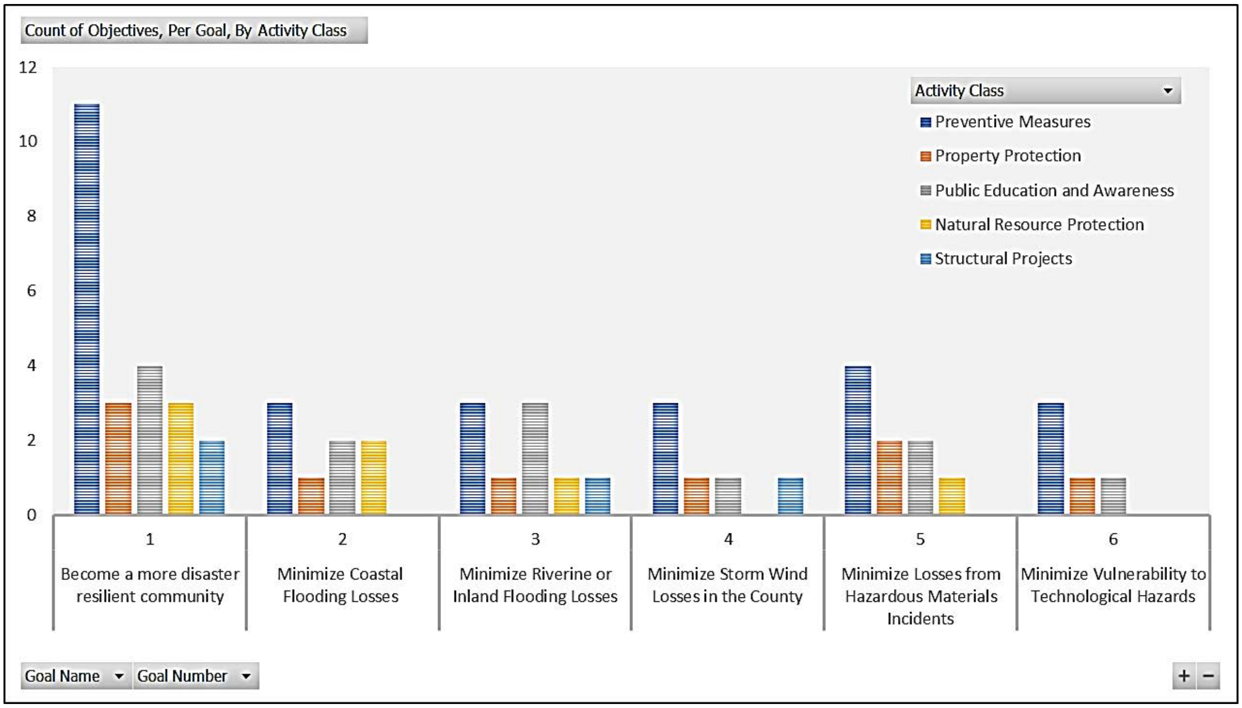
Goal Number	Goal Name	Type of Measure	Objective Number	Objective Description	Actions	Implementation Documents	Agency/Dept
6	Minimize Vulnerability to Technological Hazards[3]	Property Protection	6.4	Develop local programs in concert with federal and state programs to harden critical facilities and critical infrastructure and key assets and minimize vulnerabilities to attack.	Local governments and emergency management staff shall continue to participate in RDSTF regional critical infrastructure protection subcommittee.	Critical Infrastructure Protection Committee (CIPC) / RDSTF Government Documents	Emergency Management, Law Enforcement
6	Minimize Vulnerability to Technological Hazards[3]	Public Education and Awareness	6.5	Provide residents with up-to-date information to adequately plan for potential evacuation or shelter in place.	Carry out annual public outreach disaster preparations through websites, speakers' bureau, email subscriptions, events, PCC-TV and other Public, Educational and Governmental Channels (PEGs), local and commercial TV, and radio.	CEMP, County and City Communications Departments, Civic Associations, Economic Development Agencies	Emergency Management, Communications Dept., law enforcement

1 – Yellow Row: This is a new objective that was added during the 2020 Plan Update process.

2 – Orange Row: This objective was previously part of the Wildfire goal that has since been deleted. This is now part of Goal 1.

3 – Green Cell: Language of the goal's name or description was modified for clarity, but the intent is the same as the previous version.

The different objectives for each goal, by activity type, can be shown as follows:



Local Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of a local jurisdiction to implement a comprehensive mitigation strategy and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, or projects. As in any planning process, it is important to try to establish which goals, objectives, and/or actions are feasible based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practice and likely to be implement over time given a local government's planning and regulatory framework, level of administrative and technical support, amount of fiscal resources, and current political climate.

A capability assessment has two primary components: 1) an inventory of a local jurisdiction's relevant plans, ordinances, or programs already in place and 2) an analysis of its capacity to carry them out. Careful examination of local capabilities will detect any existing gaps, shortfalls, or weaknesses with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. A capability assessment also highlights the positive mitigation measures already in place or being implemented at the local government level, which should continue to be supported and enhanced through future mitigation efforts.

The capability assessment completed for Pinellas County serves as a critical planning step and an integral part of the foundation for designing an effective hazard mitigation strategy. Coupled with the Risk Assessment, the Capability Assessment helps identify and target meaningful mitigation actions for incorporation in the Mitigation Strategy portion of the LMS. It not only helps establish the goals and objectives for the County to pursue under this Plan but also ensures that those goals and objectives are realistically achievable under given local conditions.

Conducting the Capability Assessment

In order to facilitate the inventory and analysis of local government capabilities within participating jurisdictions of Pinellas County, a detailed Capability Assessment Survey was distributed. The survey questionnaire requested information on a variety of “capability indicators” such as existing local plans, policies, programs, or ordinances that contribute to and/or hinder the jurisdictions’ ability to implement hazard mitigation actions. Other indicators included information related to the jurisdictions’ fiscal, administrative, and technical capabilities, such as access to local budgetary and personnel resources for mitigation purposes. Survey respondents were also asked to comment on the current political climate with respect to hazard mitigation, an important consideration for any local planning or decision-making process.

At a minimum, survey results provide an extensive inventory of existing local plans, ordinances, programs, and resources in place or under development in addition to their overall effect on hazard loss reduction. However, the survey instrument can also serve to identify gaps, weaknesses, or conflicts that the local jurisdictions can recast as opportunities for specific actions to be proposed as part of the hazard mitigation strategy.

Planning and Regulatory Capability

Planning and regulatory capability is based on the implementation of plans, ordinances, and programs that demonstrate a local jurisdiction’s commitment to guiding and managing growth, development, and redevelopment in a responsible manner while maintaining the general welfare of the community. It includes emergency response and mitigation planning, comprehensive land use planning, and transportation planning; the enforcement of zoning or subdivision ordinances and building codes that regulate how land is developed and structures are built; as well as protecting environmental, historic, and cultural resources in the community. Although some conflicts can arise, these planning initiatives generally present significant opportunities to integrate hazard mitigation principles and practices into the local decision-making process.

This assessment is designed to provide a general overview of the key planning and regulatory tools and programs that are in place or under development for Pinellas County along with their potential effect on loss reduction. This information will help identify opportunities to address existing gaps, weaknesses, or conflicts with other initiatives in addition to integrating the implementation of this Plan with existing planning mechanisms where appropriate. There is a circular relationship between many of these plans as they occur at different points in time and are nuanced within each jurisdiction. The plans both inform and are informed by the LMS document as well as the planning process in which the government stakeholders participate. The data that informs these local plans (and the LMS) often lives in geospatial tools outside of the plan documents themselves and are refreshed more currently than the policy documents. The most direct links between the actual LMS document and local codes occur through the Comprehensive Emergency Management Plan (CEMP) and each jurisdiction’s Comprehensive Land Use Plan. The CEMP utilizes the risk assessment portion of the LMS to support it, and all jurisdictions coordinate emergency management activities with the County. The Comprehensive Plans have individual elements, some of which are provided guidance by the LMS (or more broadly stated in some local plans as “hazard mitigation activities”). For example, many communities have a Conservation and Coastal Management Element in which ecologic and coastal hazard mitigation concerns within the jurisdiction are addressed.

The table below provides a summary of the relevant local plans, ordinances, and programs already in place or under development for Pinellas County. An "X" indicates that the given item is currently in place and being implemented. An "*" indicates that the given item is currently being developed for future implementation. A green-filled box indicates that the item strongly supports loss reduction and a blue-filled box indicates that the item supports loss reduction but is not a primary tool. Each of these local plans, ordinances, and programs should be considered available mechanisms for incorporating the requirements of the Pinellas County LMS.

Table 3.2: Relevant Plans, Ordinances, and Programs

Planning/Regulatory Tool	Unincorporated County	Belleair	Belleair Beach	Belleair Bluffs	Belleair Shore	Clearwater	Dunedin	Gulfport	Indian Rocks Beach	Indian Shores	Kenneth City	Largo	Madeira Beach	North Redington Beach	Oldsmar	Pinellas Park	Redington Beach	Redington Shores	Safety Harbor	St. Petersburg	St. Pete Beach	Seminole	South Pasadena	Tarpon Springs	Treasure Island
Hazard Mitigation Plan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Threat and Hazard Identification and Risk Assessment (THIRA)	X	X												X		X				X		X	X		X
Comprehensive Land Use Plan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Floodplain Management Plan/Flood Mitigation Plan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Open Space Management Plan (Parks & Rec/Greenway Plan)	X	X	X										X	X		X	X	X		X	X	X	X		
Stormwater Management Plan/Ordinance	X	X	X	*		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Natural Resource Protection Plan		X				X		X		X	X	X	X		X	X	X				X	X			
Flood Response Plan		X	X	X												X		X		X			X	X	X
Emergency Operations Plan	X	X	X	X		X			X			X	X	X	X	X	X	X	X	X		X	X	X	X
Emergency Management Accreditation Program (EMAP Accreditation)		*																		X					
Continuity of Operations Plan		*	X													X		*	X	X		X		X	X
Evacuation Plan	X	*	X											X		X	X	X	X	X	X	X	X	X	X
Disaster Recovery Plan	X	*	X	X				X	X	X		X	X			X	X	X	X	X		X			X
Capital Improvements Plan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Economic Development Plan																X				X				X	
Historic Preservation Plan	X	*					X					X				X				X				X	
Flood Damage Prevention Ordinance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Planning/Regulatory Tool	Unincorporated County	Belleair	Belleair Beach	Belleair Bluffs	Belleair Shore	Clearwater	Dunedin	Gulfport	Indian Rocks Beach	Indian Shores	Kenneth City	Largo	Madeira Beach	North Redington Beach	Oldsmar	Pinellas Park	Redington Beach	Redington Shores	Safety Harbor	St. Petersburg	St. Pete Beach	Seminole	South Pasadena	Tarpon Springs	Treasure Island
Zoning Ordinance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Subdivision Ordinance	X	X					X			X	X				X	X	X	X	X	X	X	X		X	X
Post-Disaster Redevelopment/ Reconstruction Plan/Ordinance	X	X			X			X	X	X		X	X			X	X	X		*	X	X			
Building Code	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fire Code		X		X		X	X									X		X	X	X		X	X	X	X
National Flood Insurance Program (NFIP)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NFIP Community Rating System (CRS Program)	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X

Emergency Management

Hazard mitigation is widely recognized as one of the four primary phases of emergency management. The three other phases include preparedness, response, and recovery. In reality, each phase is interconnected with hazard mitigation. Opportunities to reduce potential losses through mitigation practices are most often implemented before disaster strikes, such as elevation of flood prone structures or through the continuous enforcement of policies that prevent and regulate development that is vulnerable to hazards due to its location, design, or other characteristics. Mitigation opportunities will also be presented during immediate preparedness or response activities, such as installing storm shutters in advance of a hurricane, and certainly during the long-term recovery and redevelopment process following a hazard event.

Planning for each phase is a critical part of a comprehensive emergency management program and a key to the successful implementation of hazard mitigation actions. As a result, the Capability Assessment Survey asked several questions across a range of emergency management plans in order to assess the participating jurisdictions' willingness to plan and their level of technical planning proficiency.

The following describes the various types of emergency management plans surveyed.

Hazard Mitigation Plan: A hazard mitigation plan represents a community's blueprint for how it intends to reduce the impact of natural and human-caused hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment, and mitigation strategy.

Threat and Hazard Identification and Risk Assessment (THIRA): A THIRA is a comprehensive risk assessment process that helps a community understand its risks and estimate capability requirements. Outputs of the THIRA process can inform a variety of disaster preparedness and emergency management efforts, including emergency operations planning, mutual aid agreements, and hazard mitigation planning.

Disaster Recovery Plan: A disaster recovery plan serves to guide the physical, social, environmental, and economic recovery and reconstruction process following a disaster. In many instances, hazard mitigation principles and practices are incorporated into local disaster recovery plans with the intent of capitalizing on opportunities to break the cycle of repetitive disaster losses. Disaster recovery plans can also lead to the preparation of disaster redevelopment policies and ordinances to be enacted following a hazard event.

Emergency Operations Plan: An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster. 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.

Continuity of Operations Plan: A continuity of operations plan establishes a chain of command, line of succession, and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster event.

Flood Response Plan: A flood response plan establishes procedures for responding to a flood emergency including coordinating and facilitating resources to minimize the impacts of flood.

Emergency Management Accreditation Program (EMAP): EMAP is the voluntary standards, assessment, and accreditation program for disaster preparedness programs. It provides emergency management programs the opportunity to be recognized for compliance with industry standards, to demonstrate accountability, and to focus attention on areas and issues where resources are needed.

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 requirements.

General Planning

The implementation of hazard mitigation activities often involves agencies and individuals beyond the emergency management profession. Stakeholders may include local planners, public works officials, economic development specialists, and others. In many instances, concurrent local planning efforts will help to achieve or complement hazard mitigation goals, even though they are not designed as such. Therefore, the Capability Assessment Survey also asked questions regarding general planning capabilities and the degree to which hazard mitigation is integrated into other ongoing planning efforts in Pinellas County.

The following describes the various types of general planning tools surveyed.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide for future governmental decision making. Typically, a comprehensive plan contains sections on demographic conditions, land use, transportation elements, and community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can enhance the likelihood of achieving risk reduction goals, objectives, and actions.

Capital Improvements Plan: A capital improvements plan guides the scheduling of spending on public improvements. A capital improvements plan can serve as an important mechanism for guiding future development away from identified hazard areas. Limiting public spending in hazardous areas is one of the most effective long-term mitigation actions available to local governments.

Historic Preservation Plan: A historic preservation plan is intended to preserve historic structures or districts within a community. An often-overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards and the identification of ways to reduce future damages. This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet current building standards or are within a historic district that cannot easily be relocated out of harm's way.

Zoning Ordinance: Zoning represents the primary means by which land use is controlled by local governments. As part of a community's police power, zoning is used to protect the public health, safety, and welfare of those in a given jurisdiction that maintains zoning authority. A zoning ordinance is the mechanism through which zoning is typically implemented. Since zoning regulations enable municipal governments to limit the type and density of development, a zoning ordinance can serve as a powerful tool when applied in identified hazard areas.

Subdivision Ordinance: A subdivision ordinance is intended to regulate the development of residential, commercial, industrial, or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development.

Building Codes, Permitting, and Inspections: Building codes regulate construction standards. In many communities, permits and inspections are required for new construction. Decisions regarding the adoption of building codes (that account for hazard risk), the type of permitting process required both before and after a disaster, and the enforcement of inspection protocols all affect the level of hazard risk faced by a community. 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.

Floodplain Management

Flooding represents the greatest natural hazard facing the nation. At the same time, the tools available to reduce the impacts associated with flooding are among the most developed when compared to other hazard-specific mitigation techniques. In addition to approaches that cut across hazards such as education, outreach, and the training of local officials, the National Flood Insurance Program (NFIP) contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary for local governments; however, program participation is strongly encouraged by FEMA as a first step for implementing and sustaining an effective hazard mitigation program. It is therefore used as part of this assessment as a key indicator for measuring local capability.

In order for a county or municipality to participate in the NFIP, they must adopt a local flood damage prevention ordinance that requires jurisdictions to follow established minimum building standards in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings will be protected from damage by a 100-year flood event and that new development in the floodplain will not exacerbate existing flood problems or increase damage to other properties.

A key service provided by the NFIP is the mapping of identified flood hazard areas. Once completed, the Flood Insurance Rate Maps (FIRMs) are used to assess flood hazard risk, regulate construction practices, and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials, and the private sector about the likelihood of flooding in their community.

NFIP policy and claim information for each participating jurisdiction in Pinellas County can be found in the Risk Assessment Section. Each of the jurisdictions that is participating in the development of this plan that also participates in the NFIP is committed to maintaining and enforcing its floodplain management ordinance and regulating new development in floodplains.

All of jurisdictions in Pinellas County are participants in the NFIP and will continue to comply with all required provisions of the program and will work to adequately comply in the future utilizing a number of strategies. For example, the jurisdictions will coordinate with FDEM and FEMA to develop maps and regulations related to special flood hazard areas within their jurisdictional boundaries and, through a consistent monitoring process, will design and improve their floodplain management program in a way that reduces the risk of flooding to people and property.

Community Rating System: An additional indicator of floodplain management capability is the active participation of local jurisdictions in the Community Rating System (CRS). The CRS is an incentive-based program that encourages counties and municipalities to undertake defined flood mitigation activities that go beyond the minimum requirements of the NFIP by adding extra local measures to provide protection from flooding. All of the 18 creditable CRS mitigation activities are assigned a range of point values. As points are accumulated and reach identified thresholds, communities can apply for an improved CRS class rating. Class ratings, which range from 10 to 1, are tied to flood insurance premium reductions as shown in the table below. As class ratings improve (the lower the number the better), the percent reduction in flood insurance premiums for NFIP policyholders in that community increases.

Table 3.3: CRS Premium Discounts by Class

CRS Class	Premium Reduction SFHA*	Premium Reduction Non-SFHA†
1	45%	10%
2	40%	10%
3	35%	10%
4	30%	10%

CRS Class	Premium Reduction SFHA*	Premium Reduction Non-SFHA†
5	25%	10%
6	20%	10%
7	15%	5%
8	10%	5%
9	5%	%5
10	0	0

*Special Flood Hazard Areas (SFHAs) – all A and V Zones (except AR and A99 Zones)

†Non-Special Flood Hazard Areas (non-SFHAs) – Zones B, C, X, D; all AR and A99 Zones are treated as non-SFHAs

Note: Premium reductions are subject to change.

Source: FEMA

Community participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10. The CRS application process has been greatly simplified over the past several years based on community comments. Changes were made with the intent to make the CRS more user-friendly and make extensive technical assistance available for communities who request it.

Table 3.4: Pinellas County CRS Communities and Classes

Location	CRS Class
Belleair	8
Belleair Beach	6
Belleair Bluffs	7
Belleair Shore	Not participating
Clearwater	6
Dunedin	5
Gulfport	6
Indian Rocks Beach	6
Indian Shores	6
Kenneth City	8
Largo	7
Madeira Beach	6
North Redington Beach	7
Oldsmar	6
Pinellas Park	6
Redington Beach	7
Redington Shores	6
Safety Harbor	7
St. Petersburg	5
St. Pete Beach	6
Seminole	Not participating
South Pasadena	7
Tarpon Springs	6
Treasure Island	6
Unincorporated	5

Both the NFIP and the CRS program allow county-level mitigation programs to address RL properties.

The following describes the other types of floodplain management tools surveyed.

Flood Damage Prevention Ordinance: A flood damage prevention ordinance establishes minimum building standards in the floodplain with the intent to minimize public and private losses due to flood conditions.

Floodplain Management Plan: A floodplain management plan (or a flood mitigation plan) provides a framework for action regarding corrective and preventative measures to reduce flood-related impacts.

Open Space Management Plan: An open space management plan is designed to preserve, protect, and restore largely undeveloped lands in their natural state and to expand or connect areas in the public domain such as parks, greenways, and other outdoor recreation areas. In many instances, open space management practices are consistent with the goals of reducing hazard losses, such as the preservation of wetlands or other flood-prone areas in their natural state in perpetuity.

Stormwater Management Plan: A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding.

Administrative and Technical Capability

The ability of a local government to develop and implement mitigation projects, policies, and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability can be evaluated by determining how mitigation-related activities are assigned to local departments and if there are adequate personnel resources to complete these activities. The degree of intergovernmental coordination among departments will also affect administrative capability for the implementation and success of proposed mitigation activities.

Technical capability can generally be evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in using Geographic Information Systems (GIS) to analyze and assess community hazard vulnerability. The Capability Assessment Survey was used to capture information on administrative and technical capability through the identification of available staff and personnel resources.

The table below provides a summary of the Capability Assessment Survey results for Pinellas County with regard to relevant staff and personnel resources. An “X” indicates the presence of a staff member(s) in that jurisdiction with the specified knowledge or skill.

Table 3.5: Relevant Staff/Personnel Resources

Staff/Personnel Resources	Unincorporated County	Belleair	Belleair Beach	Belleair Bluffs	Belleair Shore	Clearwater	Dunedin	Gulfport	Indian Rocks Beach	Indian Shores	Kenneth City	Largo	Madeira Beach	North Redington Beach	Oldsmar	Pinellas Park	Redington Beach	Redington Shores	Safety Harbor	St. Petersburg	St. Pete Beach	Seminole	South Pasadena	Tarpon Springs	Treasure Island
Planners with knowledge of land development/land management practices	X	X		X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X
Engineers or professionals trained in construction practices related to buildings and/or infrastructure	X	X	X			X	X			X	X	X		X	X	X			X	X			X	X	X
Planners or engineers with an understanding of natural and/or human-caused hazards	X	X		X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X
Emergency Manager	X	X	X	X		X	X			X				X		X		X	X	X	X	X	X	X	X
Floodplain Manager	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Land Surveyors	X	X				X										X				X			X		X
Scientists familiar with the hazards of the community		X																		X		X			
Staff with education or expertise to assess the community's vulnerability to hazards	X	X		X		X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X		X
Personnel skilled in GIS and/or Hazus	X	X		X		X	X	X							X	X			X	X			X	X	
Resource development staff or grant writers	X	X	X	X										X		X				X		X	X	X	X

Fiscal Capability

The ability of a local government to take action is often closely associated with the amount of money available to implement policies and projects. This may take the form of outside grant funding awards or locally-based revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied primarily to staff time or administrative costs associated with the creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project, such as the acquisition of flood-prone homes, which can require a substantial commitment from local, state, and federal funding sources.

The Capability Assessment Survey was used to capture information on the County's fiscal capability through the identification of locally-available financial resources.

The table below provides a summary of the Capability Assessment Survey results for Pinellas County with regard to relevant staff and personnel resources. An "X" indicates that the given fiscal resource has previously been used or is available to use to implement hazard mitigation actions. An “*” indicates that the given item is currently being developed as financial resources for hazard mitigation purposes.

Table 3.6: Relevant Fiscal Resources

Fiscal Tool/Resource	Unincorporated County	Belleair	Belleair Beach	Belleair Bluffs	Belleair Shore	Clearwater	Dunedin	Gulfport	Indian Rocks Beach	Indian Shores	Kenneth City	Largo	Madeira Beach	North Redington Beach	Oldsmar	Pinellas Park	Redington Beach	Redington Shores	Safety Harbor	St. Petersburg	St. Pete Beach	Seminole	South Pasadena	Tarpon Springs	Treasure Island
Capital Improvement Programming	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Community Development Block Grants (CDBG)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Special Purpose Taxes (or taxing districts)							X																	X	
Gas/Electric Utility Fees			X	X												X		X				X		X	
Water/Sewer Fees		X		X			X							X		X		X						X	
Stormwater Utility Fees		X		*										X		X		X						X	
Development Impact Fees		X		*			X							X		X						X	X	X	
General Obligation, Revenue, and/or Special Tax Bonds		X		X																		X	*	X	X
Partnering Arrangements or Intergovernmental	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to reduce the impact of future hazard events. Hazard mitigation may not be a local priority or may conflict with or be seen as an impediment to other goals of the community, such as growth and economic development. Therefore, the local political climate must be considered in designing mitigation strategies as it could be the most difficult hurdle to overcome in accomplishing their adoption and implementation.

The Capability Assessment Survey was used to capture information on political capability of Pinellas County and its municipalities. Survey respondents were asked to identify some general examples of local political capability, such as guiding development away from identified hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (e.g., building codes, floodplain management, etc.).

Some survey responses provided examples of development regulations that go beyond minimum state or federal requirements. The responses included information on the enforcement of ordinances and building standards as well.

The table below provides a summary of the results for Pinellas County with regard to political capability. An "X" indicates the expected degree of political support by local elected officials in terms of adopting/funding information.

Table 3.7: Local Political Support

Level of Support	Unincorporated County	Belleair	Belleair Beach	Belleair Bluffs	Belleair Shore	Clearwater	Dunedin	Gulfport	Indian Rocks Beach	Indian Shores	Kenneth City	Largo	Madeira Beach	North Redington Beach	Oldsmar	Pinellas Park	Redington Beach	Redington Shores	Safety Harbor	St. Petersburg	St. Pete Beach	Seminole	South Pasadena	Tarpon Springs	Treasure Island
Limited				X																					
Moderate		X														X		X		X		X	X		X
High	X		X																						
Unknown					X	X	X	X	X	X	X	X	X	X	X		X				X			X	

Local Implementation

It is important to note, LMS goals and objectives are already implemented through some of these programs or documents listed earlier in Table 3.2, which guide policy approaches, regulatory processes, and day-to-day operations within Pinellas County. Mitigation is incorporated into these existing mechanisms as described below.

The Pinellas County Program for Public Information (PPI) is an ongoing effort to identify, implement and continuously improve, a range of public information activities to improve flood safety and protection of floodplains' natural functions. Since Pinellas County's LMS serves as the Floodplain Management Plan for the county and most of its municipalities, the Flood Risk and Mitigation Public Information Working Group (FRMPIWG), which is the multi-jurisdictional action team for the PPI, works closely with the LMS working Group. These two groups work in coordination to ensure that we consistently address flood risks and mitigation in a comprehensive manner. There is an overlap of membership between the two groups. In addition, ideas and strategies generated from each group informs the functions of the other. Members of the FRMPIWG are specifically tasked with evaluating flood risks and insurance coverage, floodplain management activities, and flood warning and response planning to identify flood information needs, target audiences, and associated messages; coordinate projects (countywide and jurisdictional) to relay flood information; identify flood risks and related potential mitigation opportunities; and to provide support to the LMS Working Group.

The LMS goals and objectives also form a critical part of the Coastal Management Element within Pinellas County's Comprehensive Plan. The county's Comprehensive Plan lists policies, objectives and strategies that address mitigation from a variety of different approaches such as, encouraging non-structural or nature-based mitigation approaches; guiding density and development location; and requiring the maintenance of critical planning and operational documents that support mitigation and risk-reduction. Some of these mitigation-focused policies that are implemented through Pinellas County's Comprehensive plan include - protecting and preserving coastal habitats; limiting density within the Coastal Storm Area; restricting development within the Coastal Storm Area; restricting public infrastructure expenditures that subsidize (re)development in the Coastal Storm Area; and developing maintaining the LMS, Comprehensive Emergency Management Plan (CEMP) and the Post-Disaster Redevelopment Plan (PDRP).

The Comprehensive Plan policies define the scope of the post-disaster activities that need to be addressed in the PDRP. The associated strategies focus on incorporating mitigation and vulnerability-reduction into habitat restoration, rebuilding and other post-disaster activities. As a part of the county's ongoing Comprehensive Plan update, some of these policies were recently re-evaluated in conjunction with the 2020 LMS 5-Year update.

The Comprehensive Plans for other municipalities within Pinellas County such as the City of Clearwater and the City of St. Petersburg among many others, have similar policies that reflect the County's overall mitigation goals. For example, City of Clearwater's Comprehensive Plan's Coastal Management Element specifically identifies, objectives that implement hazard mitigation efforts; and emphasizes public education on flood risks, mitigation strategies, and all available programs to improve the City's Community Rating System (CRS) score.

In addition to the Comprehensive Plan, the LMS goals are closely tied with Pinellas County's CEMP. The principles and procedures defined within the county's CEMP were developed with input and expertise from various county departments, municipal emergency management coordinators as well as the LMS Working Group. The CEMP is the operations plan for Pinellas County that guides the response to a disaster. It establishes a framework through which Pinellas County and its municipalities prepare for, respond to, recover from, and mitigate the impacts of a wide variety of disasters. While Pinellas County's CEMP is an operations-based plan that addresses emergency protective actions such as evacuation, sheltering and recovery procedures, the LMS serves as the guiding document for all the mitigation priorities. The county's CEMP integrates the response and recovery activities with the LMS functions. For instance, as defined within Pinellas County's CEMP, in case of a disaster that results in damage impacts, the LMS Committee is provided with a detailed damage report by the Pinellas County Emergency Management Recovery Coordinator, to help determine if a local Mitigation Assessment Team should be mobilized, for the purpose of assessing property and infrastructure damage. The intent is to pro-actively identify mitigation-related needs and develop strategies for risk-reduction in future.

Pinellas County's PDRP is another such document that supports and implements mitigation goals. Developed in 2012, Pinellas County's PDRP identifies mitigation as one of its core post-disaster functions that is critical to how we approach land use changes in damaged areas, and rebuild, and restore the environment and infrastructure following a disaster. As we update the PDRP following the LMS update, the 2020 LMS Goals and Objectives will be used to revise and expand on the actions defined within the PDRP.

The PPI, Comprehensive Plan, PDRP and CEMP discussed above, are some of the overarching policy, procedure or operational documents that help implement the LMS goals and objectives. While the risk assessment and LMS Goals inform the policies, metrics and operational strategies within these plans, the analysis, policies and procedures developed as a part of these planning documents also inform the LMS goals. This is accomplished through the involvement of stakeholders from various municipalities representing multiple disciplines within the LMS and FRMPI working group. In addition to these plans and programs, there are other ongoing or upcoming initiatives that are equally comprehensive in scope and hold a lot of potential in implementing mitigation. These include, Pinellas County's Vulnerability

Assessment project, Sustainability and Resiliency Action Plan and the Health in All Policies Initiative. These initiatives can help - advance our understanding of vulnerability from a new perspective; address risk-reduction using new approaches; develop co-beneficial strategies and performance measures; strategically attain targeted goals; and reach out to new interested groups and mitigation partners. As a next step, we are looking for opportunities to integrate mitigation goals in these initiatives and vice versa.

Conclusions on Local Capability

The overall capability to implement hazard mitigation actions varies among the participating jurisdictions. Larger jurisdictions typically have higher planning and regulatory capability, more staff and technical resources, as well as greater fiscal capability compared to smaller jurisdictions.

One of the reasons for conducting a Capability Assessment is to examine local capabilities to detect any existing gaps or weaknesses within ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. These gaps or weaknesses have been identified for each jurisdiction in the tables found throughout this section. The participating jurisdictions used the Capability Assessment as part of the basis for the Mitigation Measures that are identified in this LMS; therefore, each jurisdiction addresses their ability to expand on and improve their existing capabilities through the identification of their Mitigation Measures.

<u>Linking the Capability Assessment with the Risk Assessment and the Mitigation Strategy</u>

The conclusions of the Risk Assessment and Capability Assessment serve as the foundation for the development of a meaningful hazard mitigation strategy. During the process of identifying specific mitigation actions to pursue, the LMS Working Group considered not only each jurisdiction's level of hazard risk but also their existing capability to minimize or eliminate that risk.

RISK ASSESSMENT SECTION

Local Hazard Mitigation Plan Requirements in this section are:
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))

Introduction

The risk assessment for the Pinellas County LMS 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.

2020 Update

Significant research was required to update the 12 natural hazard profiles and the 10 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
- NOAA
- Hazus-MH
- FEMA
- CDC
- U.S. Census Bureau

Current Status and Future Maintenance

As of 2020, this risk assessment is the most current and detailed hazard analysis for Pinellas County. 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
- Red Tide

Because this risk assessment serves as the single risk assessment for the Pinellas County, other hazards have been included to meet requirements. To avoid duplication of effort, the LMS risk assessment serves as the CEMP risk assessment as well as the risk assessment for any other emergency management plans. This identification of the same hazards for all plans will align with EMAP requirements should the County attain that certification. 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 22 hazards were identified based on examination of past disasters, probability of occurrence, possible impacts, and vulnerability.

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 4.1: 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 county 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 overall. There is also a list of every Major Disaster Declaration in the county for the hazard, if there are any.
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. 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.
Hazard Impact Analysis	This section lists impacts that are possible due to the hazard occurring in the county. 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.
Vulnerability Analysis and Loss Estimation by Jurisdiction	<u>Natural Hazards:</u> This section includes a discussion of the overall vulnerability, exposure, and an estimation of potential losses. This information is gathered from various sources as 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.

Hazard Profile Section	Description
Vulnerability Analysis and Loss Estimation of Critical Facilities	Natural Hazards: This section includes a discussion of the vulnerability of critical facilities and identifies the number of facilities located in high risk areas. Where possible, information regarding potential loss estimations are provided. Technological and Human-Caused Hazards: This section includes a discussion of overall vulnerability of the county.
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. Overview: A few sentences from the hazard description. Probability: Ranking of how often the hazard occurs. Impact: Rankings of the hazard's general impact on people, property, and critical facilities. Spatial Extent: Ranking of the area of the county that will be affected by the hazard. Warning Time: Amount of time generally available before an impending hazard event. Duration: Length of time a typical hazard event will last. PRI Score: Numerical value that indicates degree of risk for the hazard. *More details on how this is calculated can be found below. Overall Vulnerability: Overall risk ranking based on PRI scores.

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.

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. The NHC is located on the Florida International University in Miami, Florida.

National Centers for Environmental Information (NCEI)

The NCEI Storm Events 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 1950 through December 2018. 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.

National Climate Assessment

The National Climate Assessment is a summary document of the overall impact of climate change on the United States currently and futuristically. It is a culmination of work from a large pool of experts along with the Federal Advisory Committee. This document explores the effects of climate changes on the various sectors such as water, ecosystems, human health, energy, transportation, agriculture, and forests throughout the regions of the country.

United States Drought Monitor

Since 1999, the U.S. Drought Monitor is a map that is released weekly showing the parts of the country that are experiencing drought. The map depicts the drought through five different classifications and is hosted by the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln, NOAA, and the U.S. Department of Agriculture.

Southern Wildfire Risk Assessment

The Southern Wildfire Risk Assessment (SWRA) works with various other agencies to provide wildfire information for southern U.S. 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 United States 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*.

CDC

Centers for Disease Control and Prevention's (CDC) Social Vulnerability Index (SVI) uses 15 U.S. census variables at tract level to help local officials identify communities that may need support in preparing for hazards or recovering from disaster. Social vulnerability refers to the resilience of communities when confronted by external stresses on human health, stresses such as natural or human-caused disasters, or disease outbreaks. Reducing social vulnerability can decrease both human suffering and economic loss.

Florida State Agencies

Information from State of Florida agencies, such as Division of Emergency Management (FDEM), Florida Department of Transportation (FDOT) 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.

Priority Risk Index

In order to draw some meaningful planning conclusions on hazard risk for Pinellas County, the results of the hazard profiling process were used to generate county-wide hazard classifications according to a "Priority Risk Index" (PRI). The purpose of the PRI is to categorize and prioritize all potential hazards for Pinellas County as high, moderate, or low risk. Combined with the asset inventory and quantitative vulnerability assessment provided, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes and, more specifically, the identification of hazard mitigation opportunities for Pinellas County to consider as part of their proposed mitigation strategy.

The prioritization and categorization of identified hazards for Pinellas County is based principally on the PRI, a tool used to measure the degree of risk for identified hazards in a particular planning area. The PRI is used to assist the Pinellas County LMS Working Group in gaining consensus on the determination of those hazards that pose the most significant threat to the county based on a variety of factors. The PRI is not scientifically based but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in Pinellas County based on standardized criteria.

The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a valued (1 to 4) and an agreed upon weighting factor as summarized in the table below.[1] To calculate the PRI value for a given hazard, the assigned risk value

[1] The Pinellas County LMS Working Group, based upon any unique concerns or factors for the planning area, may adjust the PRI weighting scheme during future plan updates.

for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value as demonstrated in the example equation below:

PRI VALUE = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

According to the weighting scheme and point system applied, the highest possible value for any hazard is 4.0. When the scheme is applied for Pinellas County, the highest PRI value is 3.3 (flood and tropical cyclone). Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the Pinellas County LMS Working Group.

Table 4.2: Priority Risk Index for Pinellas County

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected are damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	> 24 hours	Self explanatory	1	10%
	12 to 24 hours	Self explanatory	2	
	6 to 12 hours	Self explanatory	3	
	< 6 hours	Self explanatory	4	
Duration	< 6 hours	Self explanatory	1	10%
	< 24 hours	Self explanatory	2	
	< 1 week	Self explanatory	3	
	> 1 week	Self explanatory	4	

Pinellas County Asset Inventory

An inventory of geo-referenced assets within Pinellas County and its jurisdictions was compiled in order to identify and characterize those properties potentially at risk to the identified hazards[1]. By understanding the type and number of assets that exist and where they are located in relation to known hazard areas, the relative risk and vulnerability for such assets can be assessed. Under this assessment, two categories of physical assets were created and then further assessed through GIS analysis. These are presented below.

Physical and Improved Assets

The two categories of physical assets consist of:

1. Improved Property: Includes all improved properties in Pinellas County according to local parcel data provided by the county. The information has been expressed in terms of the number of parcels and total assessed value of improvements (buildings) that may be exposed to the identified hazards. In addition, building footprint data was available for all jurisdictions and it was used to improve the overall assessment by providing an accurate assessment of how many buildings are located in hazard areas.

2. Critical Facilities: Critical facilities vary by jurisdiction and the critical facilities provided by the county are used in this section. It should be noted that this listing is not all-inclusive for assets located in the county, and it is anticipated that it may be expanded or adjusted during future plan updates as more geo-referenced data becomes available for use in GIS analysis. Critical facilities for each jurisdiction were determined based on jurisdictional boundaries and not necessarily by jurisdictional ownership.

The following tables provide a detailed listing of the geo-referenced assets that have been identified for inclusion in the vulnerability assessment by Pinellas County.

Table 4.3: Improved Property in Pinellas County

Location	Number of Parcels	Number of Buildings	Improved Value
Belleair	2,466	6,723	$333,521,233
Belleair Beach	1,217	3,632	$161,111,361
Belleair Bluffs	1,321	2,822	$105,229,223
Belleair Shore	122	401	$93,914,658
Clearwater	47,593	117,869	$5,773,587,238
Dunedin	17,734	48,173	$1,648,557,111
Gulfport	6,813	22,022	$550,701,205
Indian Rocks Beach	3,320	7,212	$233,620,768
Indian Shores	2,799	939	$37,200,089
Kenneth City	2,055	5,081	$143,192,911
Largo	30,824	86,092	$3,193,892,581
Madeira Beach	3,833	7,778	$262,668,665
North Redington Beach	1,203	1,588	$93,043,908
Oldsmar	6,292	18,738	$885,642,787

Location	Number of Parcels	Number of Buildings	Improved Value
Pinellas Park	21,267	69,533	$2,593,820,761
Redington Beach	1,081	3,597	$130,708,924
Redington Shores	2,135	3,269	$115,281,820
Safety Harbor	7,804	26,403	$1,103,109,033
St. Petersburg	106,831	338,806	$12,501,922,991
St. Pete Beach	7,671	16,105	$727,197,602
Seminole	9,225	21,841	$982,641,318
South Pasadena	4,239	5,522	$241,196,453
Tarpon Springs	12,805	36,638	$1,387,899,341
Treasure Island	5,965	10,435	$398,996,096
Unincorporated	129,703	368,333	$13,579,150,230
PINELLAS COUNTY TOTAL	**436,318**	**1,229,552**	**$47,277,808,307**

Table 4.4: Age of Building Stock in Pinellas County

Year Built Range	Number of Buildings
Before 1950	122,487
1950–1979	721,528
1980–1989	161,839
1990–1999	81,840
2000–2009	52,124
After 2009	7,980
Unknown	81,754

The maps below illustrate the age of the county's building stock as well as the location of mobile home parks.

Figure 4.1: Improved Property in Pinellas County

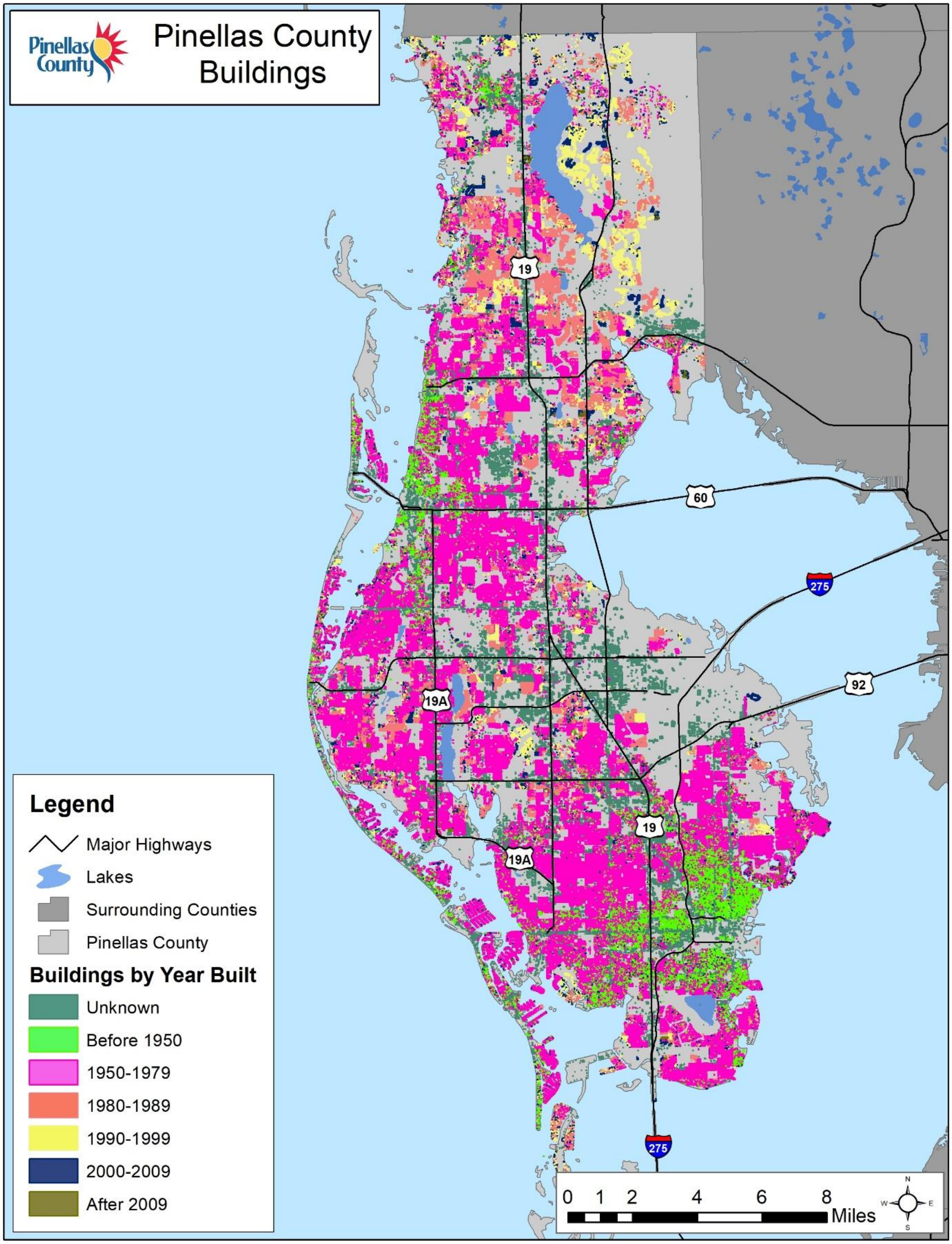
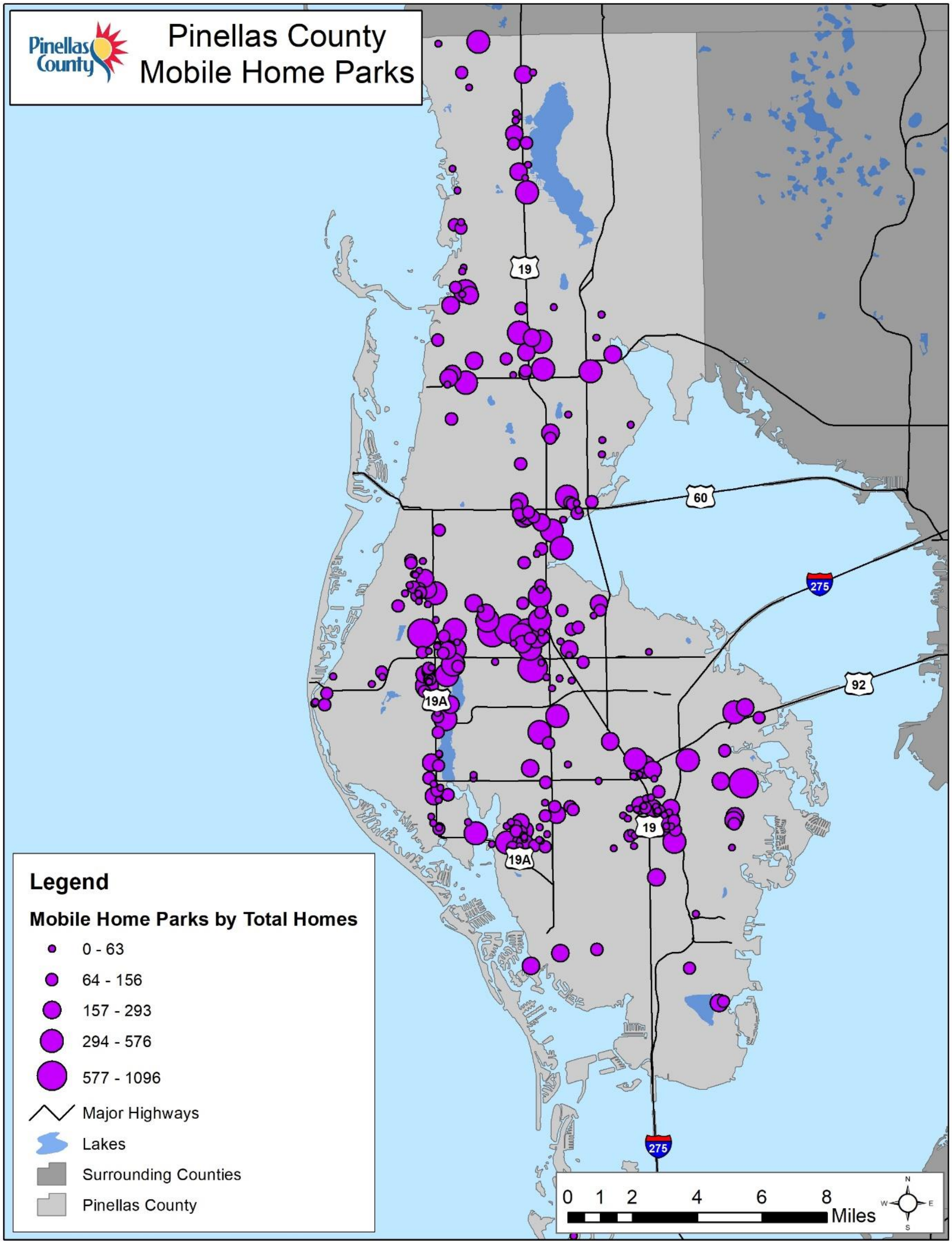


Figure 4.2: Mobile Home Parks in Pinellas County



The table below summarizes the emergency service, hazardous material, health, tower, and other critical facilities located in Pinellas County. These facilities were identified as primary critical facilities in that they are necessary to maintain government functions and protect the life, health, safety, and welfare of citizens.

Table 4.5: Critical Facility Inventory in Pinellas County

Location	Number of Critical Facilities
Belleair	5
Belleair Beach	3
Belleair Bluffs	9
Belleair Shore	0
Clearwater	173
Dunedin	60
Gulfport	15
Indian Rocks Beach	3
Indian Shores	8
Kenneth City	9
Largo	120
Madeira Beach	5
North Redington Beach	2
Oldsmar	29
Pinellas Park	122
Redington Beach	4
Redington Shores	4
Safety Harbor	34
St. Petersburg	302
St. Pete Beach	9
Seminole	34
South Pasadena	18
Tarpon Springs	41
Treasure Island	14
Unincorporated	349
PINELLAS COUNTY TOTAL	**1,372**

These facilities were geospatially mapped and used as the basis for further geographic analysis of the hazards that could potentially affect critical facilities. The maps below illustrate the location of critical facilities in the county by type.

Figure 4.3: Critical Facilities in Pinellas County – Emergency Services

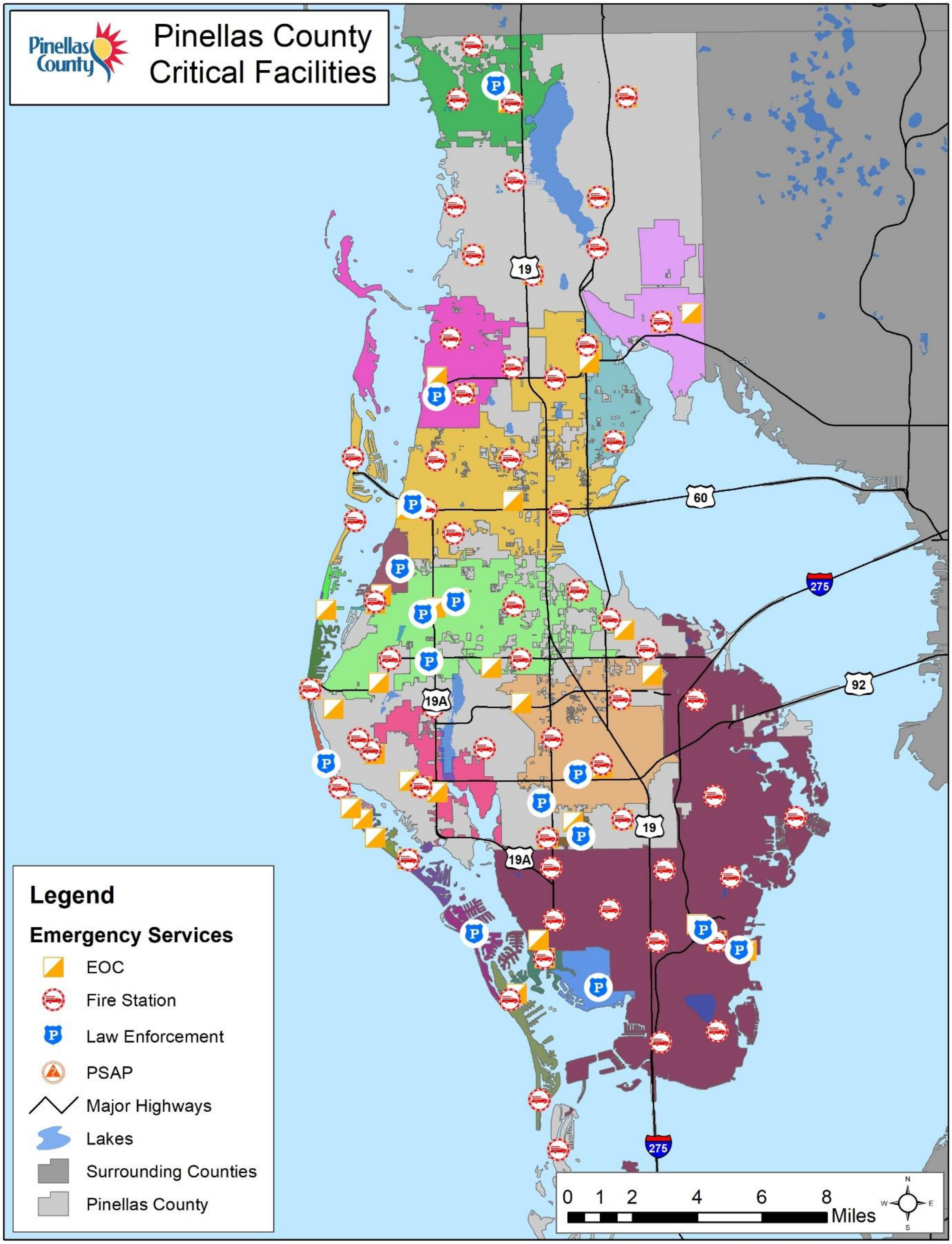


Figure 4.4: Critical Facilities in Pinellas County – Hazardous Materials

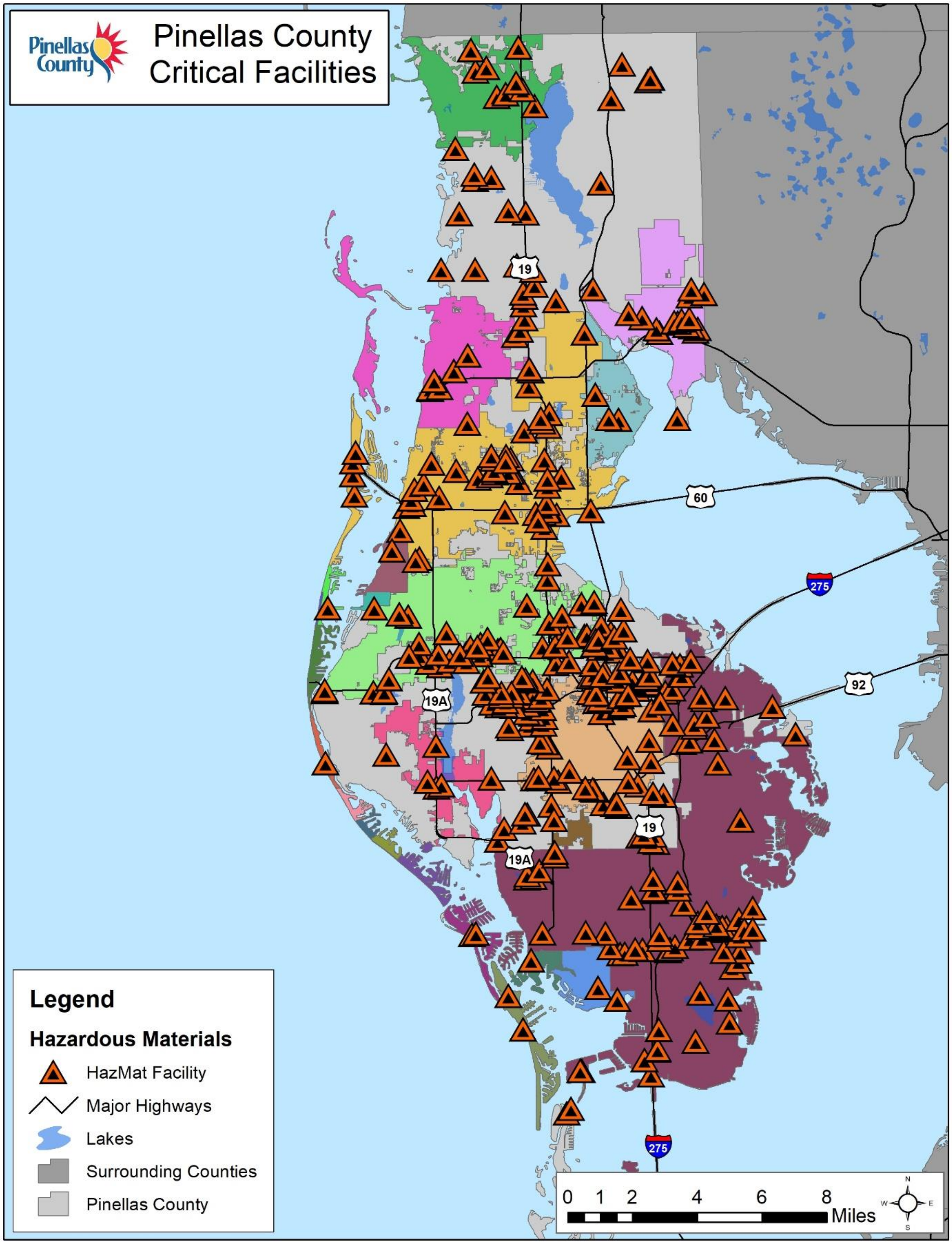


Figure 4.5: Critical Facilities in Pinellas County – Health

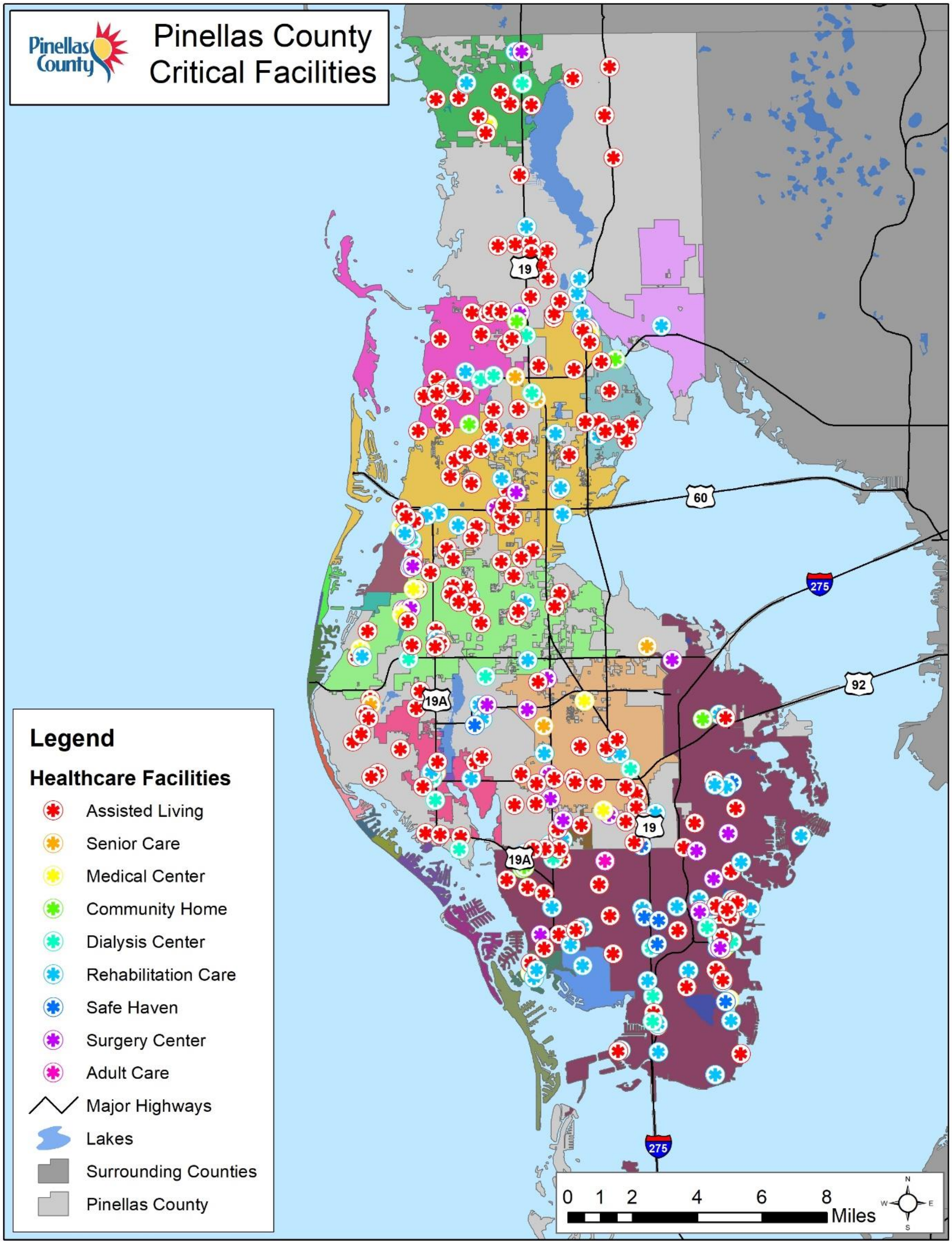


Figure 4.6: Critical Facilities in Pinellas County – Towers

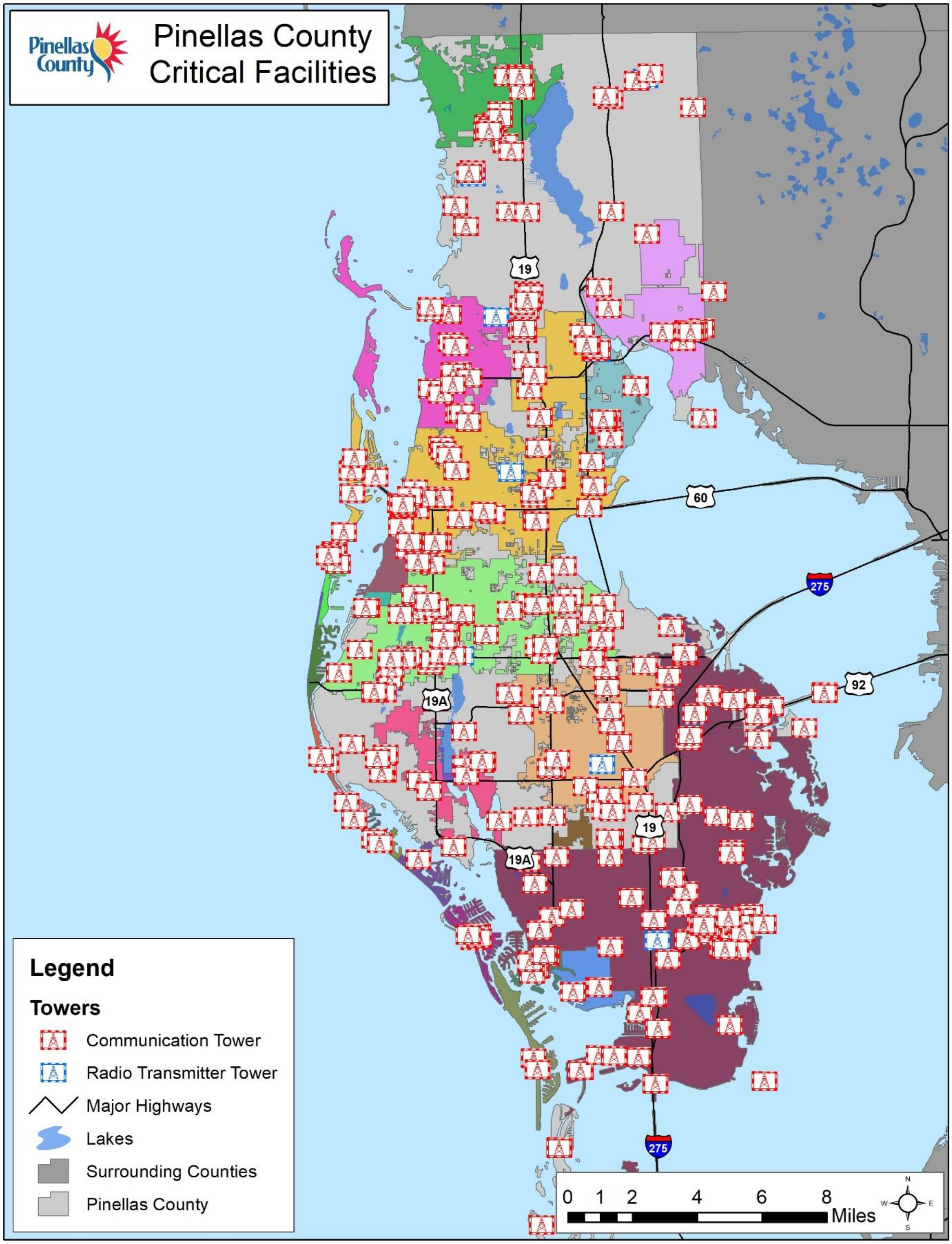
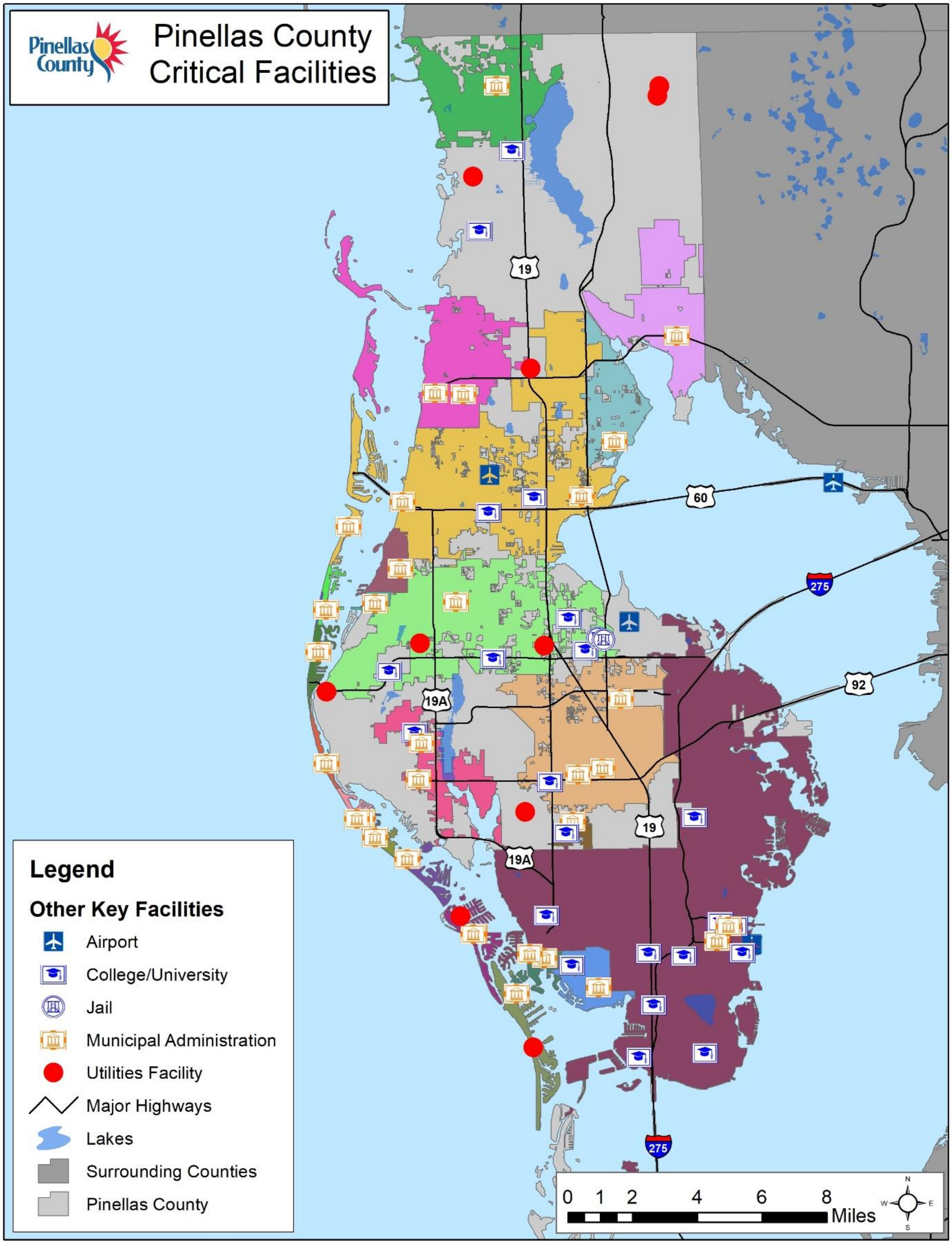


Figure 4.7: Critical Facilities in Pinellas County – Other



Social Vulnerability

In addition to identifying those assets potentially at risk to identified hazards, it is important to identify and assess those particular segments of the resident population in Pinellas County that are potentially at risk to these hazards.

The following maps illustrate population density by census block as it was reported by the U.S. Census in 2010 as well as other indicators of social vulnerability.

Figure 4.8: Population Density in Pinellas County

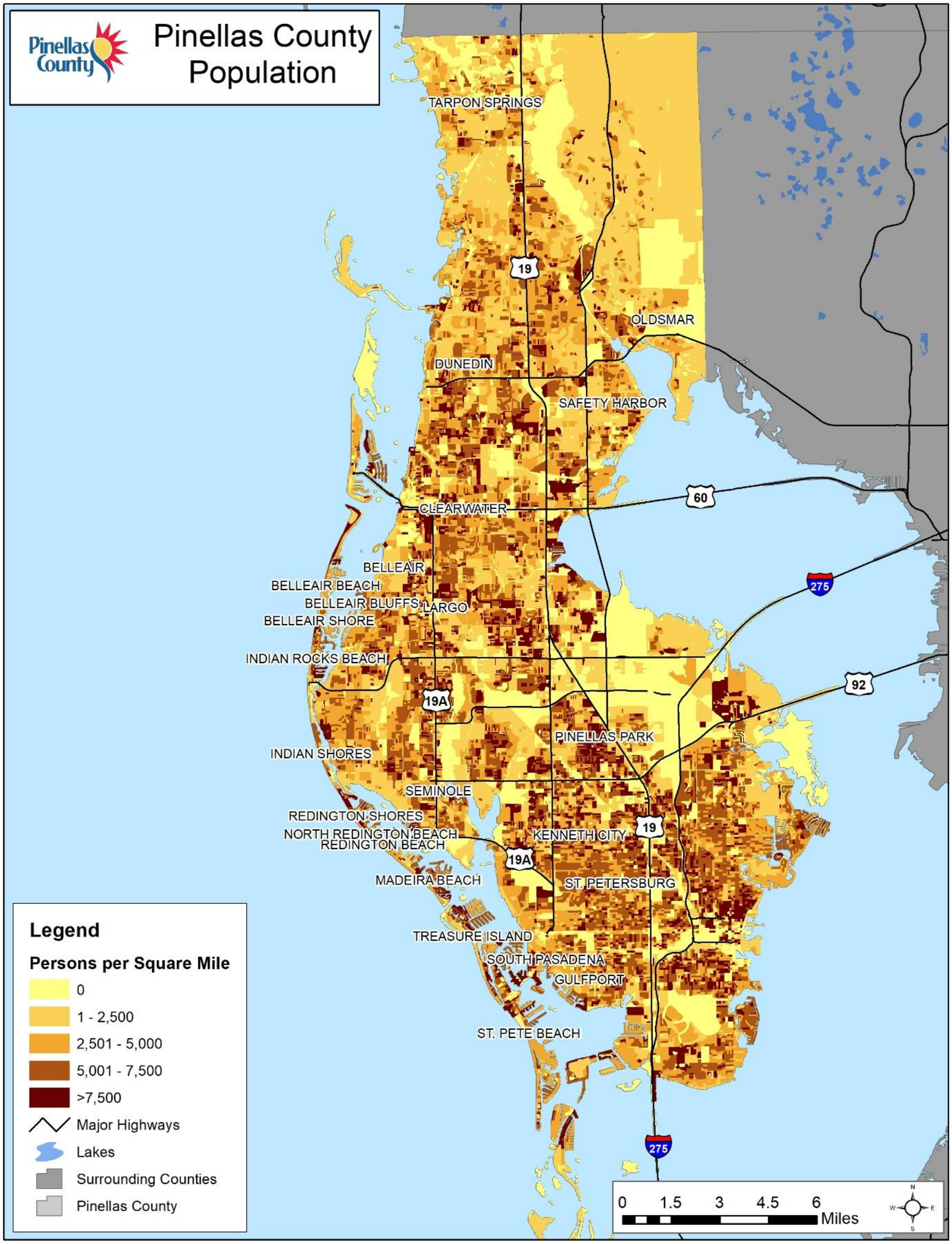


Figure 4.9: Population Aged 18 and Under in Pinellas County

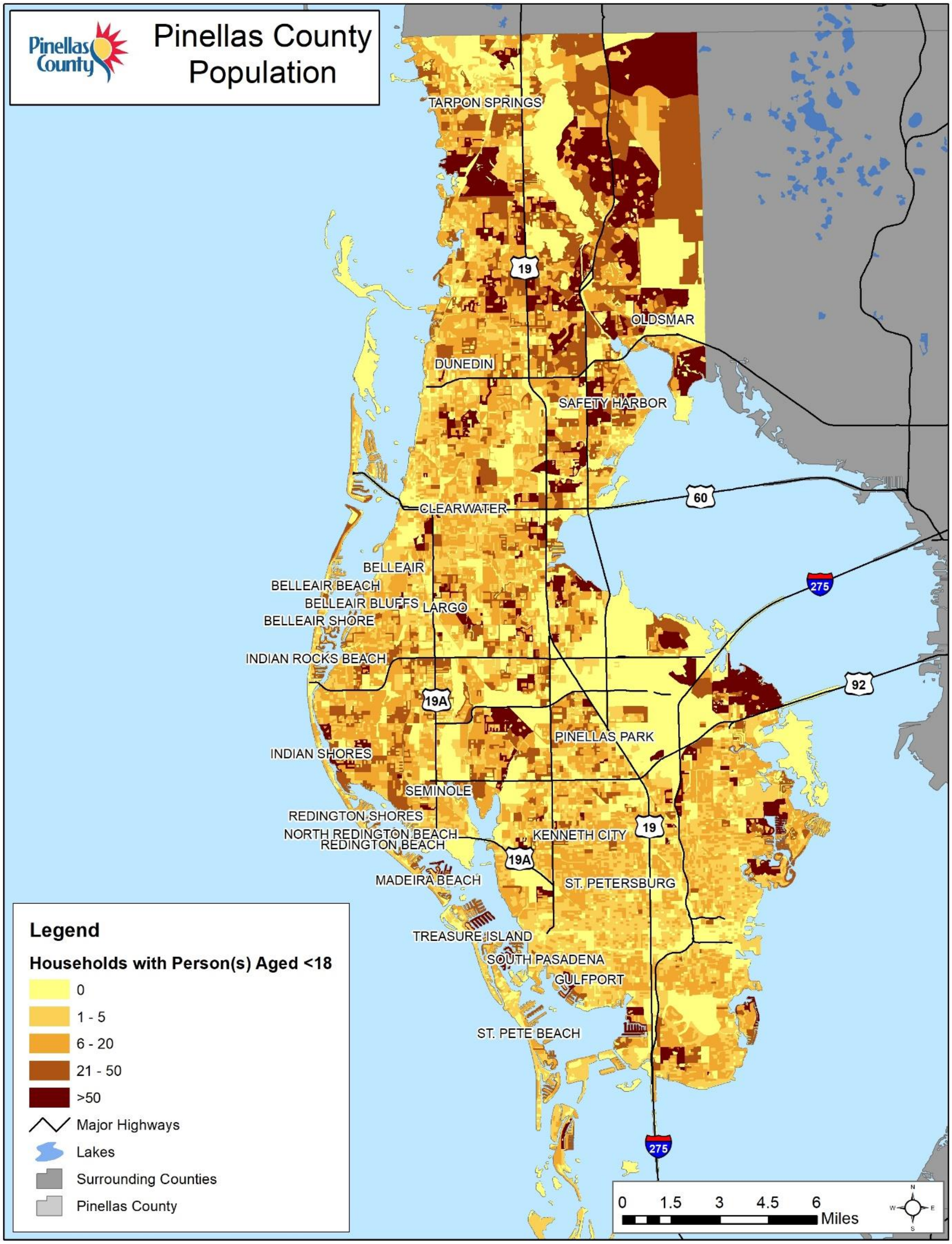


Figure 4.10: Population Aged 65 and Over in Pinellas County

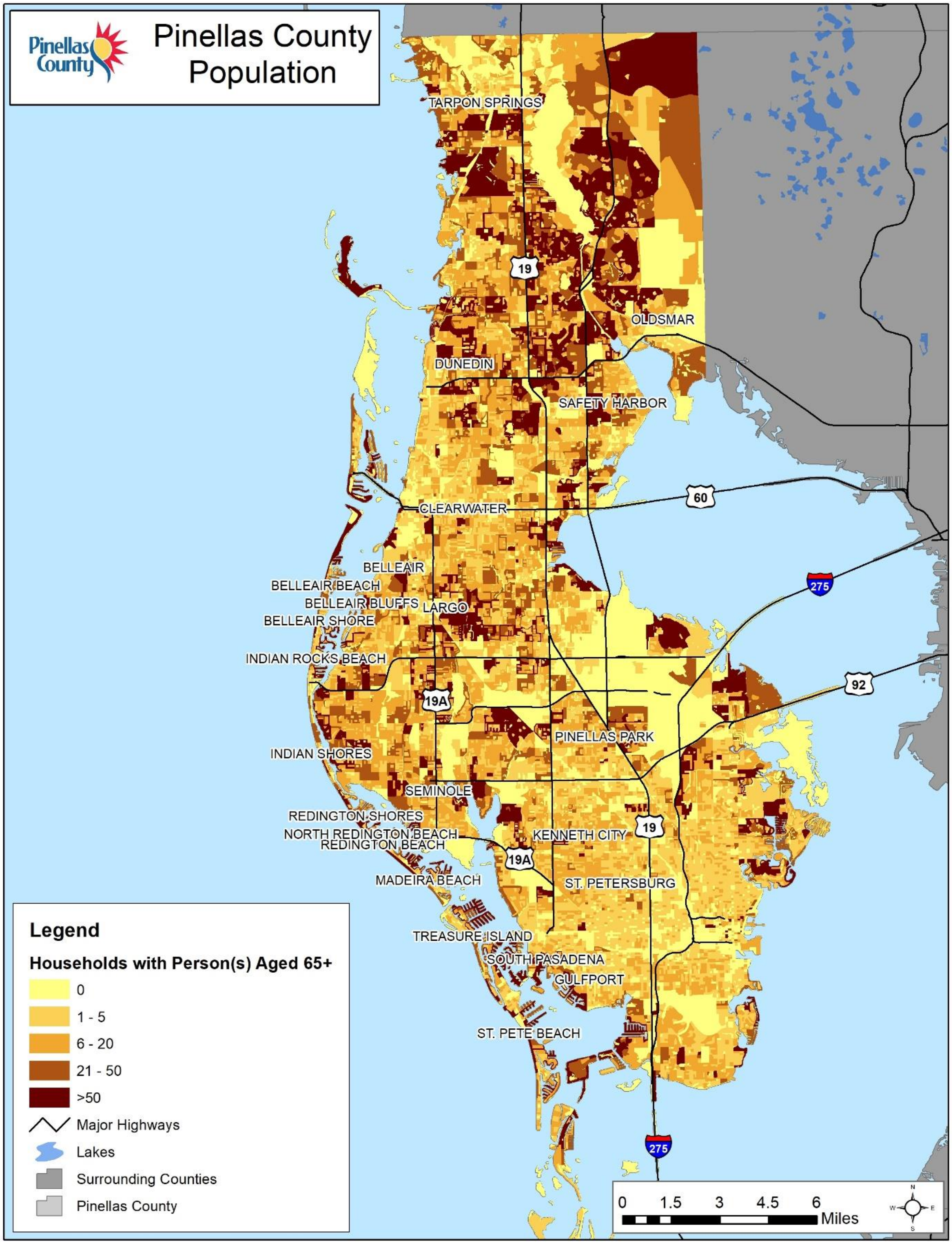


Figure 4.11: Social Vulnerability in Pinellas County – Total

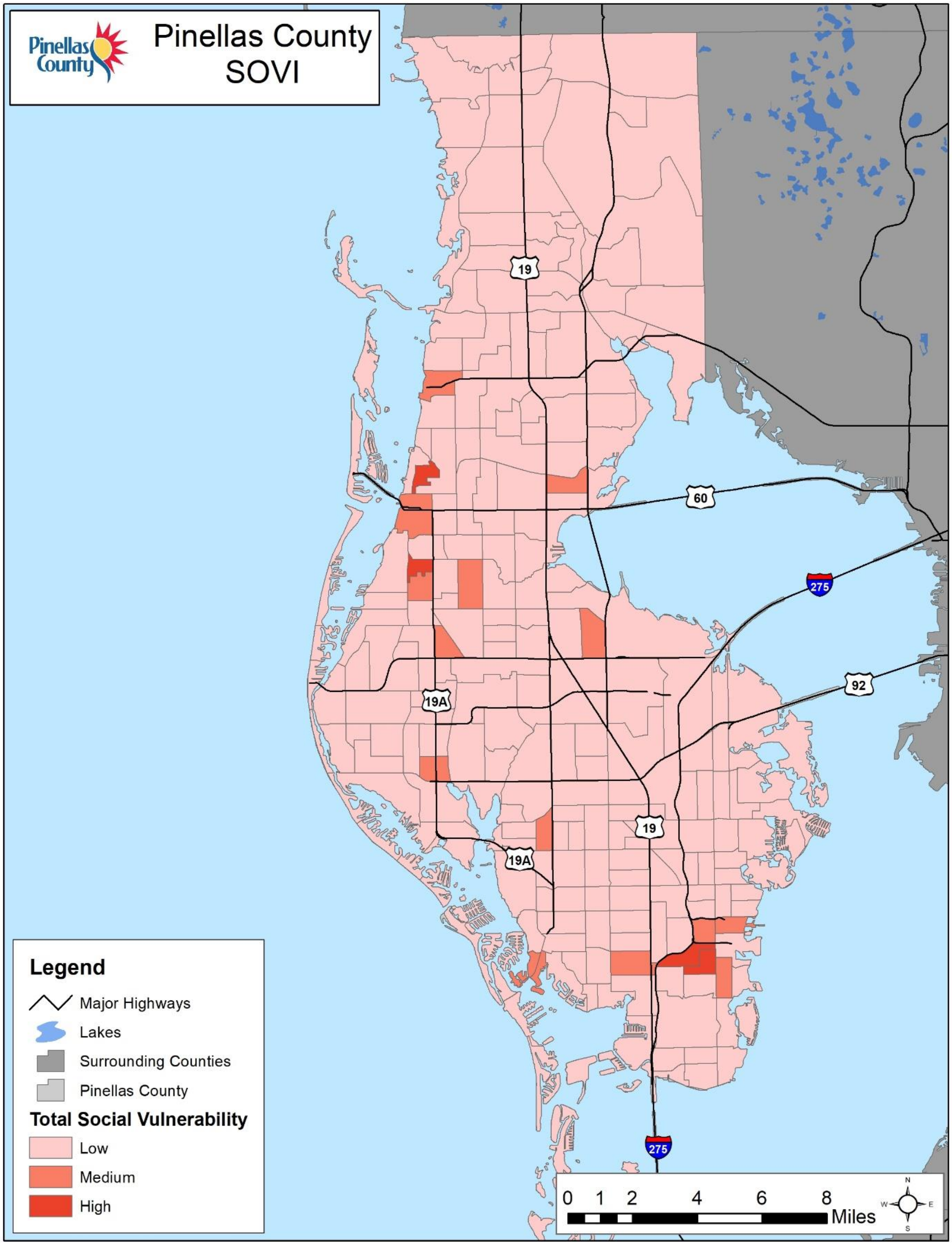


Figure 4.12: Social Vulnerability in Pinellas County – Disabled

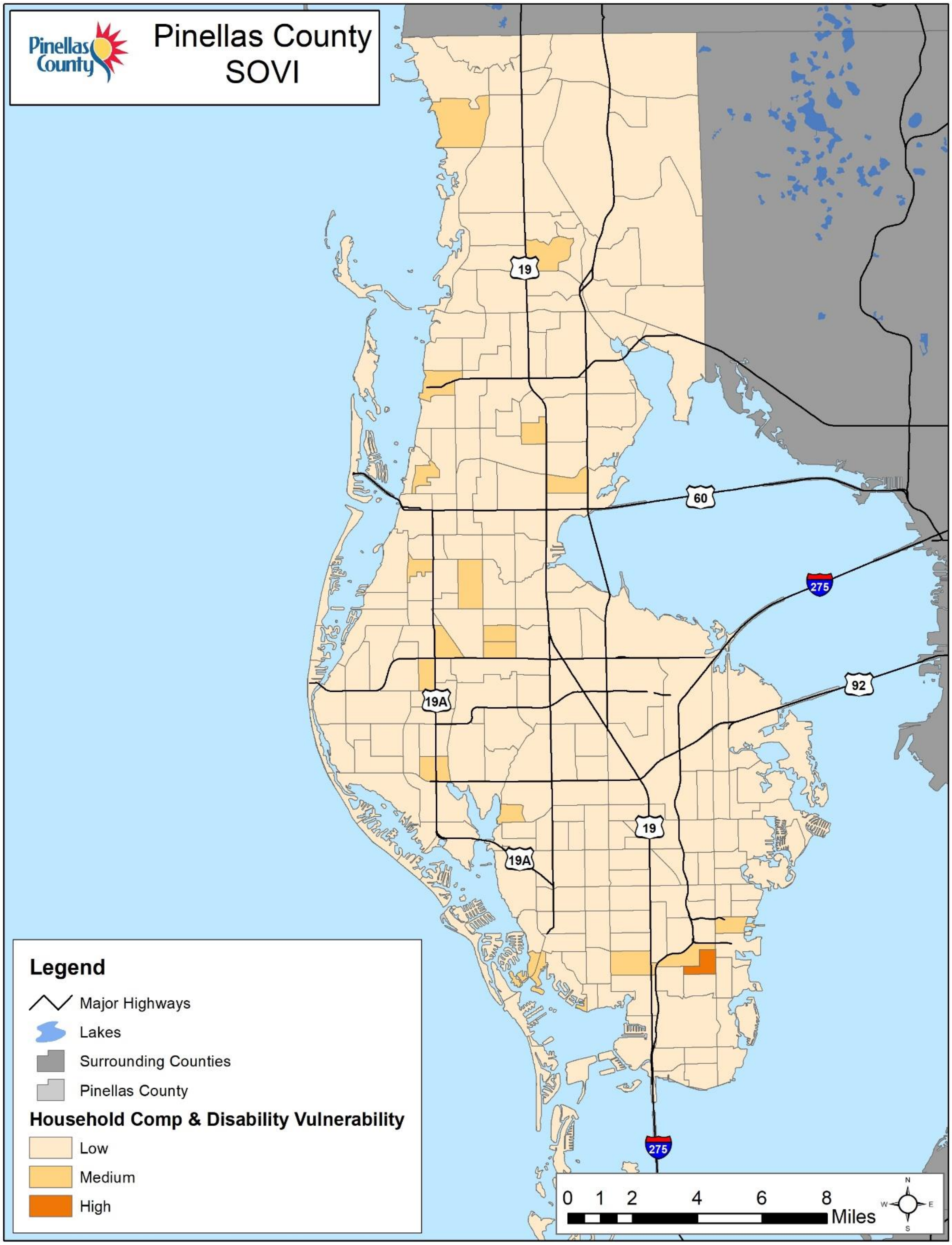


Figure 4.13: Social Vulnerability in Pinellas County – Low Income/Poverty Level

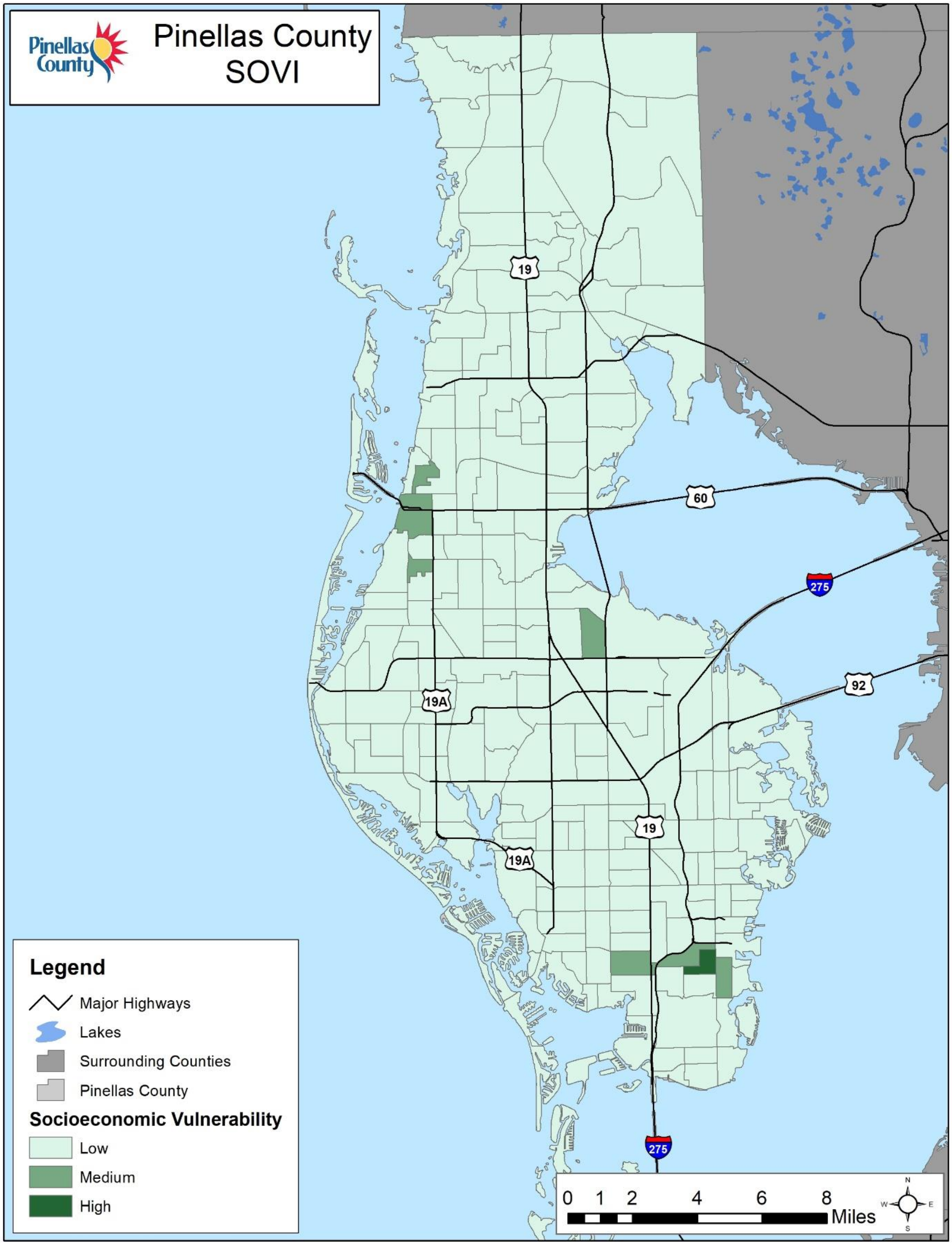


Figure 4.14: Social Vulnerability in Pinellas County – Minority Language

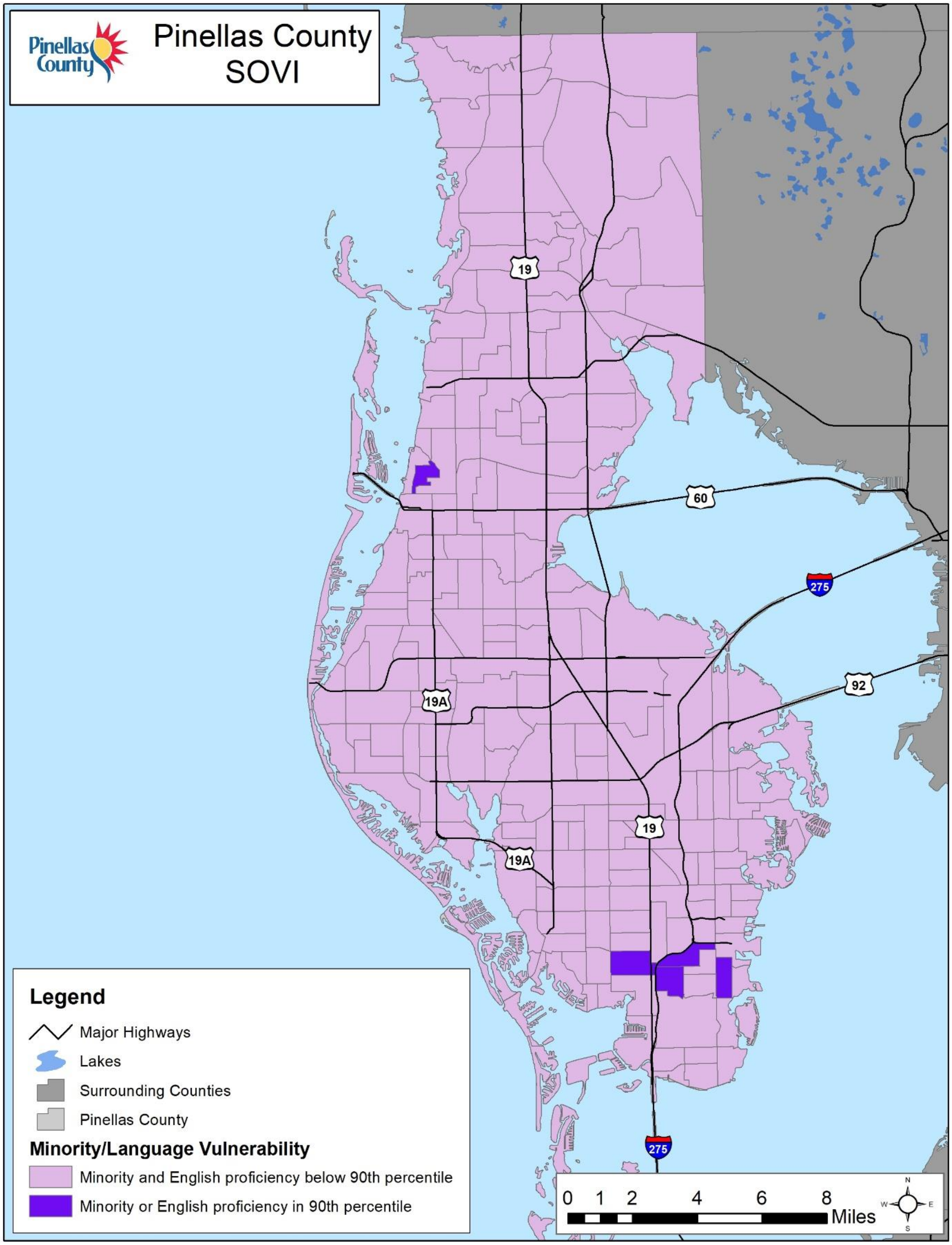
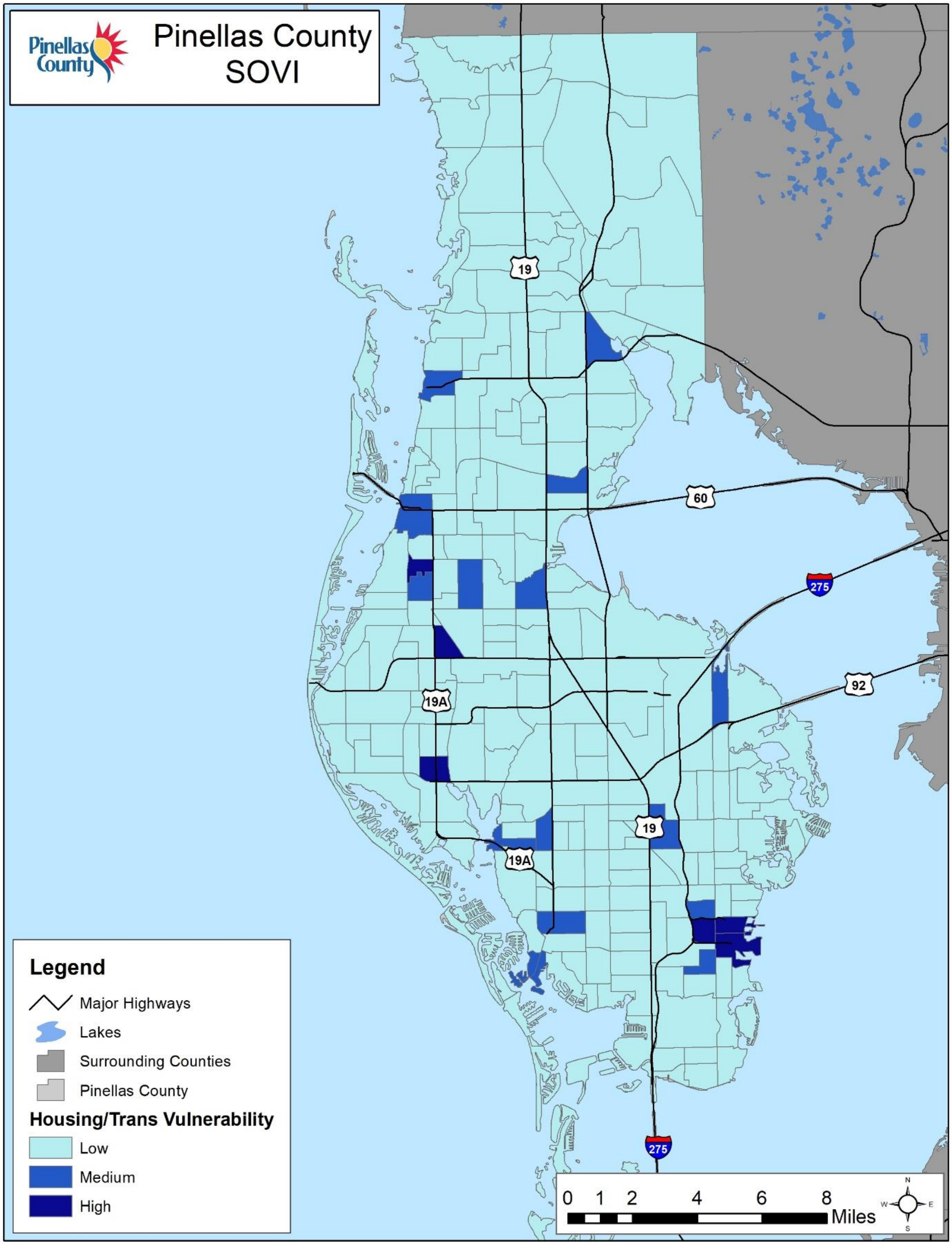


Figure 4.15: Social Vulnerability in Pinellas County – Transient/Homeless



Development Trends and Changes in Vulnerability

Since the previous LMS was approved, Pinellas County has experience limited growth and development. The table below shows the number of building units constructed since 2014 according to the U.S. Census American Community Survey.

Table 4.6: Building Counts for Pinellas County

Location	Total Housing Units (2017)	Units Built 2014 or Later	% of Building Stock Built Post-2014
Belleair	2,246	0	0.0%
Belleair Beach	1,120	6	0.5%
Belleair Bluffs	1,493	0	0.0%
Belleair Shore	44	0	0.0%
Clearwater	58,897	135	0.2%
Dunedin	20,585	39	0.2%
Gulfport	7,611	30	0.4%
Indian Rocks Beach	3,406	7	0.2%
Indian Shores	2,523	4	0.2%
Kenneth City	2,130	7	0.3%
Largo	46,421	121	0.3%
Madeira Beach	4,450	24	0.5%
North Redington Beach	1,362	6	0.4%
Oldsmar	6,001	57	0.9%
Pinellas Park	24,162	170	0.7%
Redington Beach	1,095	4	0.4%
Redington Shores	2,164	8	0.4%
Safety Harbor	8,229	89	1.1%
St. Petersburg	131,356	1,049	0.8%
St. Pete Beach	8,198	0	0.0%
Seminole	10,879	65	0.6%
South Pasadena	4,571	0	0.0%
Tarpon Springs	12,547	108	0.9%
Treasure Island	5,870	8	0.1%
Unincorporated	139,108	393	0.3%
PINELLAS COUNTY TOTAL	**506,468**	**2,330**	**0.5%**

The table below shows population estimates for the county from 2014 to 2017 based on the U.S. Census Bureau American Community Survey 5-Year Estimates.

Table 4.7: Population Growth for Pinellas County

Location	Population Estimates				% change 2014-2017
	2014	2015	2016	2017	
Belleair	3,903	3,941	3,958	3,982	2.0%
Belleair Beach	1,705	1,685	1,590	1,562	-8.4%
Belleair Bluffs	2,098	2,236	2,255	2,296	9.4%

Location	Population Estimates				% change 2014-2017
	2014	2015	2016	2017	
Belleair Shore	61	62	81	86	41.0%
Clearwater	109,210	110,381	111,747	112,794	3.3%
Dunedin	35,538	35,712	35,882	36,099	1.6%
Gulfport	12,102	12,167	12,222	12,222	1.0%
Indian Rocks Beach	4,153	4,172	4,213	4,192	0.9%
Indian Shores	1,392	1,469	1,498	1,354	-2.7%
Kenneth City	4,986	5,013	5,048	5,052	1.3%
Largo	78,391	79,737	80,678	82,433	5.2%
Madeira Beach	4,297	4,320	4,343	4,352	1.3%
North Redington Beach	1,472	1,484	1,533	1,417	-3.7%
Oldsmar	13,730	13,860	14,023	14,211	3.5%
Pinellas Park	49,874	50,433	50,946	51,788	3.8%
Redington Beach	1,475	1,565	1,489	1,518	2.9%
Redington Shores	2,093	2,046	2,136	2,222	6.2%
Safety Harbor	17,017	17,142	17,268	17,484	2.7%
St. Petersburg	248,429	250,713	253,585	256,031	3.1%
St. Pete Beach	9,408	9,466	9,528	9,529	1.3%
Seminole	17,477	17,637	17,906	18,206	4.2%
South Pasadena	4,993	5,009	5,040	5,061	1.4%
Tarpon Springs	23,789	24,003	24,244	24,686	3.8%
Treasure Island	6,749	6,783	6,827	6,844	1.4%
Unincorporated	270,688	270,441	271,508	274,421	1.4%
PINELLAS COUNTY TOTAL	**925,030**	**931,477**	**939,548**	**949,842**	**2.7%**

Based on the data above, there has been a low rate of residential development in the county since 2014. However, Oldsmar, Pinellas Park, Safety Harbor, St. Petersburg, and Tarpon Springs have experienced slightly higher rates of development compared to the rest of the county, resulting in an increased number of structures that are vulnerable to the potential impacts of the identified hazards. Additionally, there has been limited population growth in Pinellas County. However, Belleair Bluffs, Belleair Shore, Largo, and Redington Shores experienced higher rates of growth compared to the rest of the county. Since the population has increased across the county, there is now a greater number of people exposed to the identified hazards. Therefore, population growth has impacted the county's vulnerability since the previous hazard mitigation plan was approved, and there has been a moderate increase in the overall vulnerability as well as a more significant increase in certain areas and communities.

It is also important to note that as development increases in the future, greater populations and more structures and infrastructure will be exposed to potential hazards if development occurs in the floodplains or other high-risk areas.

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. 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.

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.

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 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.

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. 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.[2] 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

[2] http://www.saj.usace.army.mil/Missions/Civil-Works/Lake-Okeechobee/Herbert-Hoover-Dike/

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.[3]

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% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% 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% of failures are caused by other means, including the failure of conduits and valves.[4]

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 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 Hazard Profile*.

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[3] http://www.damsafety.org/news/?p=412f29c8-3fd8-4529-b5c9-8d47364c1f3e
[4] http://www.ecy.wa.gov/PROGRAMS/wr/dams/failure.html

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.[5] 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.[6]

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.[7] 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.

<u>Advisories</u>

Below are the advisories that the NWS issues regarding flooding hazards:[8]

- 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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[5] http://tidesandcurrents.noaa.gov/glossary.html
[6] http://oceanservice.noaa.gov/education/kits/tides/tides05_lunarday.html
[7] http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2016/06/KingTideToolkit.pdf
[8] 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.[9]

To establish floodplains, FEMA adopted the base flood elevation, which is the level of a flood that has a 1% probability of occurring in any given year. This level of flood is referred to as the base flood, the 1% 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 1% chance of the flood reaching that specified floodplain. The same theory is applied to understand the 500-year floodplain; it has a 0.2% 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 4.8: FEMA Flood Zone Designations[10]

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.

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

Zone	Description
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.

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 September 2018, all 24 jurisdictions and the unincorporated area of the county participate in the NFIP. Furthermore, there are 128,315 NFIP policies in Pinellas County, with flood insurance coverage totaling nearly $29.4 billion. According to the Florida NFIP Insurance Report and the NFIP Policy and Claims Report, there have been 5,609 NFIP claims in Pinellas County since the beginning of the program in 1978 in the county, with the total paid equaling almost $184.3 million. With a 100% participation rate it is clear that the NFIP is extremely important to Pinellas County. Furthermore, the county pays $103.3 million in insurance premiums each year to the NFIP, proving that Pinellas County is also important to the NFIP program. For more information about the NFIP, please see the Mitigation Strategy Section.

Table 4.9: Pinellas County NFIP Policies by Jurisdiction, as of September 30, 2018

Jurisdiction	Number of Policies	Insurance In-Force	Premium In-Force
Belleair	822	$216,971,900	$457,933
Belleair Beach	978	$236,460,900	$1,521,284
Belleair Bluffs	165	$42,532,400	$66,341
Belleair Shore	33	$10,919,300	$101,378
Clearwater	11,615	$2,781,049,000	$8,333,218
Dunedin	4,096	$872,711,600	$3,598,422
Gulfport	2,752	$555,436,100	$1,616,071
Indian Rocks Beach	2,743	$620,871,300	$2,400,439
Indian Shores	2,890	$597,151,700	$1,671,749
Kenneth City	250	$52,79,200	$143,748
Largo	2,089	$500,105,500	$1,397,134
Madeira Beach	3,136	$671,209,900	$3,073,092
North Redington Beach	1,277	$252,688,700	$972,106
Oldsmar	2,189	$601,431,600	$1,765,300
Pinellas Park	3,028	$777,112,900	$1,835,375
Redington Beach	650	$159,978,000	$1,248,045
Redington Shores	1,486	$343,693,500	$996,868
Safety Harbor	1,171	$329,121,300	$579,668
St. Petersburg	35,175	$7,863,678,900	$32,611,156
St. Pete Beach	6,656	$1,411,896,000	$7,569,604
Seminole	747	$178,011,100	$331,477
South Pasadena	2,948	$573,260,000	$1,740,483

Jurisdiction	Number of Policies	Insurance In-Force	Premium In-Force
Tarpon Springs	3,449	$836,273,000	$3,223,078
Treasure Island	4,899	$1,025,624,800	$4,792,871
Unincorporated	33,071	$7,929,709,200	$21,269,013
PINELLAS COUNTY TOTAL	**128,315**	**$29,387,898,600**	**$103,315,853**

Table 10: Pinellas County NFIP Claims by jurisdiction, 1978–2018

Jurisdiction	Total Number of Claims	Total Paid in Claims
Belleair	27	$1,942,493.70
Belleair Beach	151	$11,404,748.25
Belleair Bluffs	1	$303,300.86
Belleair Shore	20	$607,810.20
Clearwater	432	$11,759,715.43
Dunedin	144	$9,147,532.28
Gulfport	83	$1,143,626.25
Indian Rocks Beach	245	$6,362,598.79
Indian Shores	106	$2,191,102.94
Kenneth City	6	$17,062.59
Largo	89	$1,670,095.20
Madeira Beach	331	$16,204,858.42
North Redington Beach	54	$1,295,941.01
Oldsmar	102	$2,476,197.89
Pinellas Park	172	$2,870,607.89
Redington Beach	188	$8,807,015.16
Redington Shores	119	$2,072,199.73
Safety Harbor	35	$660,854.23
St. Petersburg	1,299	$55,856,369.69
St. Pete Beach	405	$8,984,714.73
Seminole	17	$68,368.56
South Pasadena	35	$337,094.62
Tarpon Springs	142	$6,882,281.01
Treasure Island	350	$8,189,922.48
Unincorporated	1,056	$22,997,779.75
PINELLAS COUNTY TOTAL	**5,609**	**$184,254,291.66**

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 summarizes the losses incurred by RL properties in Pinellas County. In total, there are 1,532 RL properties in the county that have experienced 4,683 losses resulting in over $80.7 million in claims payments.

Table 4.11: Pinellas County Repetitive Loss Properties Summary

Jurisdiction	Number of RL Properties	Number of Losses	Building Payments	Contents Payments	Total Payments
Belleair	6	17	$348,112.68	$90,727.76	$438,840.44
Belleair Beach	59	184	$7,356,758.43	$1,808,344.64	$9,165,103.07
Belleair Bluffs	0	0	$0.00	$0.00	$0.00
Belleair Shore	6	13	$429,495.25	$49,524.93	$479,020.18
Clearwater	89	254	$3,797,911.04	$1,173,021.18	$4,970,932.22
Dunedin	100	251	$3,754,425.40	$1,394,925.06	$5,149,350.46
Gulfport	13	53	$393,275.95	$80,822.91	$474,098.86
Indian Rocks Beach	40	106	$873,294.09	$256,849.80	$1,130,143.89
Indian Shores	19	46	$741,460.94	$174,815.30	$916,276.24
Kenneth City	0	0	$0.00	$0.00	$0.00
Largo	19	48	$458,959.75	$154,081.99	$613,041.74
Madeira Beach	172	714	$7,268,695.50	$3,339,446.56	$10,608,142.06
North Redington Beach	6	20	$429,780.08	$42,760.30	$472,540.38
Oldsmar	8	23	$345,333.58	$116,758.26	$462,091.84
Pinellas Park	25	64	$444,524.36	$124,745.04	$569,269.40
Redington Beach	93	328	$3,042,718.11	$1,495,238.15	$4,537,956.26
Redington Shores	22	57	$300,393.88	$170,769.88	$471,163.76
Safety Harbor	5	11	$404,163.01	$318,674.70	$722,837.71
St. Petersburg	410	1,191	$12,365,572.25	$7,123,709.34	$19,489,281.59
St. Pete Beach	77	249	$3,342,017.33	$1,208,749.72	$4,550,767.05
Seminole	0	0	$0.00	$0.00	$0.00
South Pasadena	4	10	$33,756.38	$30,824.39	$64,580.77
Tarpon Springs	79	214	$3,057,588.64	$1,269,442.88	$4,327,031.52
Treasure Island	138	437	$3,287,225.71	$1,594,922.20	$4,882,147.91
Unincorporated	142	393	$3,939,278.41	$2,308,981.66	$6,248,260.07
PINELLAS COUNTY TOTAL	**1,532**	**4,683**	**$56,414,740.77**	**$24,328,136.65**	**$80,742,877.42**

This table shows the type of RL properties located in Pinellas County. In total, there are 1,430 residential RL properties, 8 commercial RL properties, and 94 other types of RL properties in the county.

Table 4.12: Pinellas County Repetitive Loss Properties by Type

Jurisdiction	Residential	Commercial	Other	Total
Belleair	6	0	0	6
Belleair Beach	55	0	4	59
Belleair Bluffs	0	0	0	0
Belleair Shore	6	0	0	6
Clearwater	79	0	10	89
Dunedin	100	0	0	100
Gulfport	11	1	1	13

Jurisdiction	Residential	Commercial	Other	Total
Indian Rocks Beach	39	0	1	40
Indian Shores	18	0	1	19
Kenneth City	0	0	0	0
Largo	17	0	2	19
Madeira Beach	162	0	10	172
North Redington Beach	5	0	1	6
Oldsmar	8	0	0	8
Pinellas Park	21	2	2	25
Redington Beach	93	0	0	93
Redington Shores	21	0	1	22
Safety Harbor	2	0	3	5
St. Petersburg	395	0	15	410
St. Pete Beach	58	2	17	77
Seminole	0	0	0	0
South Pasadena	4	0	0	4
Tarpon Springs	70	2	7	79
Treasure Island	125	0	13	138
Unincorporated	135	1	6	142
PINELLAS COUNTY TOTAL	**1,430**	**8**	**94**	**1,532**

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

The county as well as 22 of the municipalities are part of the Community Rating System.

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.[11] 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.[12]

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

[11] 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

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

geologic substrate (sand, clay, gravel, rock, etc.), and the presence and type of vegetation.[13] The boundaries of coastal flood zones will expand more rapidly as the rate of sea level rise increases.[14]

If frequency of higher intensity tropical cyclones increases (see *Tropical Cyclone Hazard Profile*) coastal communities will experience the storm surge flooding associated with those stronger storms more often (Category 4 and 5 hurricanes).[15] 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.[16] 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.[17] 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.[18]

Rising sea levels would result in gradual coastal inundation, the most immediate impact of which is increased height of high tides. Similar to regular tides, as sea levels rise, king tides will reach further inland and result in more severe damages to coastal communities[19]. In addition, rising sea levels may cause

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[13] Williams et al.(2012), p. 30.
[14] 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
[15] Williams et al. (2012), pp. 29–30.
[16] 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.
[17] Parris et al. (2012). Global sea level rise scenarios for the U.S. National Climate Assessment. NOAA Tech Memo OAR CPO-1. http://cpo.noaa.gov/sites/cpo/Reports/2012/NOAA_SLR_r3.pdf.
[18] 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 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).
[19] https://www.epa.gov/cre/king-tides-and-climate-change

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 Hazard 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.

A geographic assessment of the flooding hazard in Pinellas County 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% annual probability and 0.2% probability of floods, respectively.

Below are maps showing the 100-year floodplain (including VE zones which are subject to additional hazards due to storm-induced velocity wave action) and the 500-year floodplain. The 500-year floodplain includes the areas in the 100-year floodplain, plus additional areas, which are shown in darker blue. The first map delineates the effective FIRM and the second map delineates the preliminary FIRM which provides an early look at project risk to flood hazards.

All communities in Pinellas are exposed to flood hazards and likely to be impacted frequently in the future. All communities have had flood insurance claims filed for damages in the past. All but two jurisdictions (Kenneth City and Seminole) have multiple repetitive loss properties. Variable climate impacts are likely to worsen exposure for coastal communities, but inland communities could also be impacted by more frequent, and higher volume precipitation events.

Figure 4.16: Areas at Risk for Flooding, 100- and 500-year Floodplains, Effective

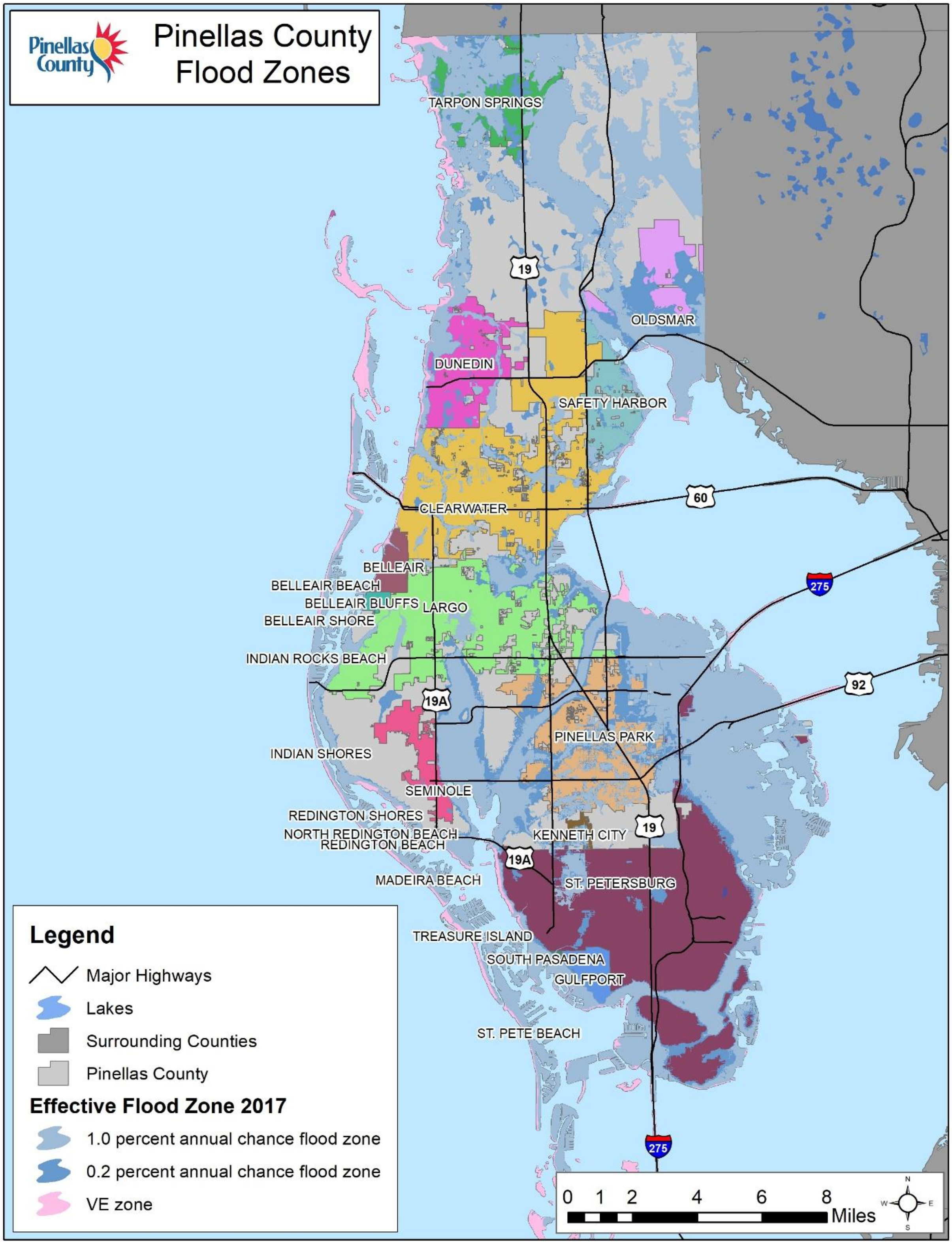
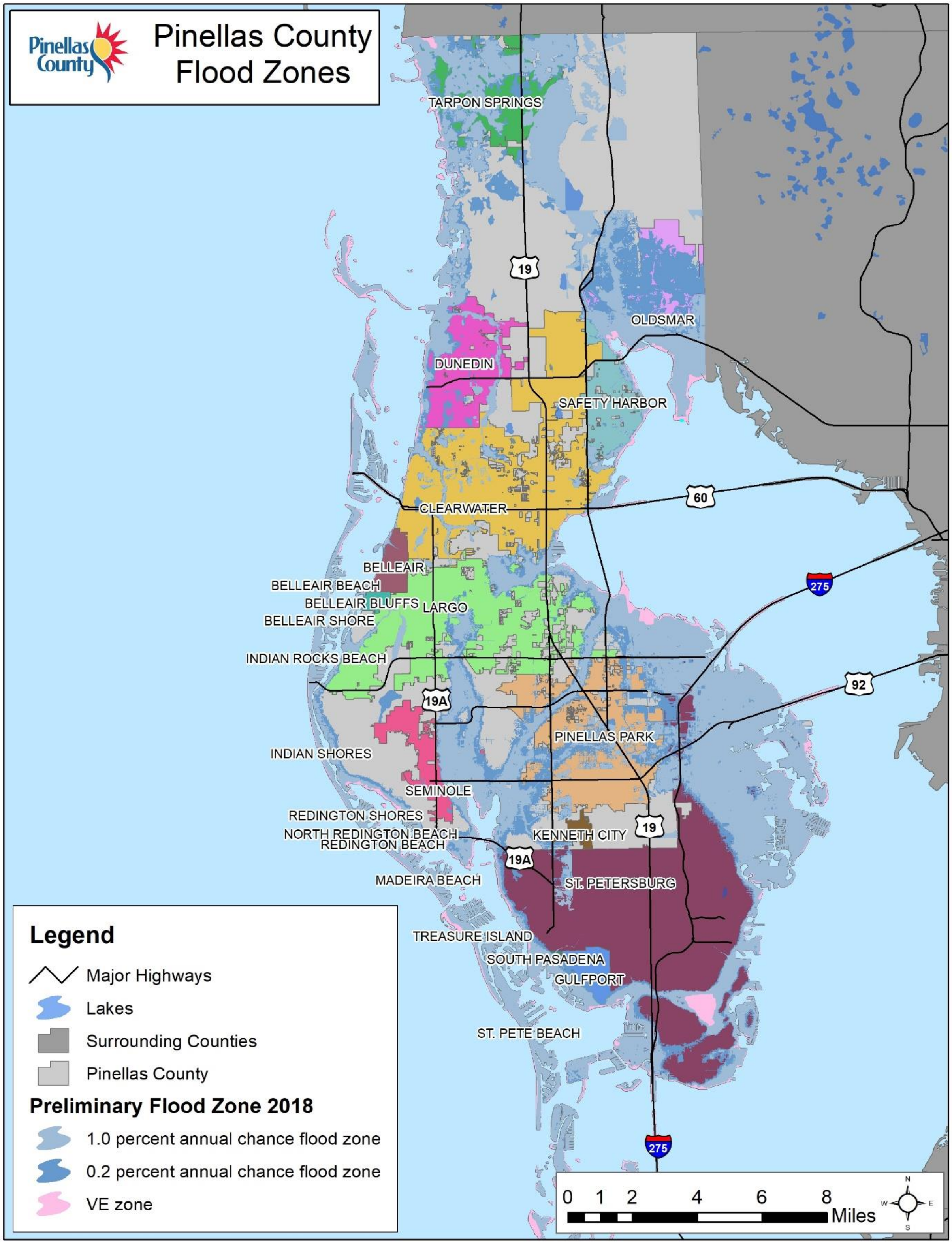


Figure 4.17: Areas at Risk for Flooding, 100- and 500-year Floodplains, Preliminary



The following maps show the location of repetitive loss (RL) properties in Pinellas County. The first map delineates the location of RL properties, and the second map indicates RL property density. These maps are based on data provided by the county; however, all of the data could not be geocoded successfully, so the maps are incomplete. These maps highlight areas that are susceptible to repetitive flooding and are at risk to flood hazards.

Figure 4.18: Repetitive Loss Properties

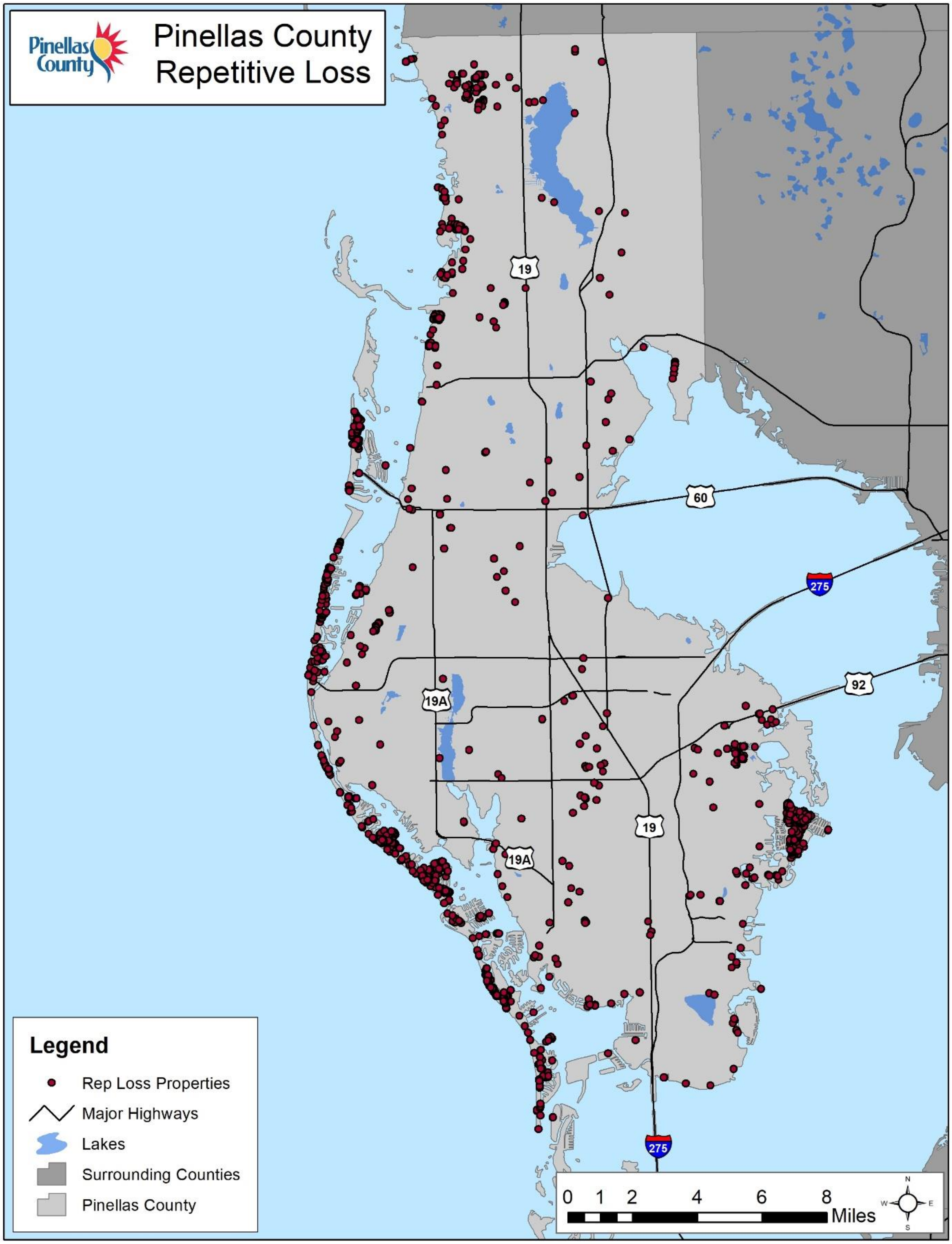
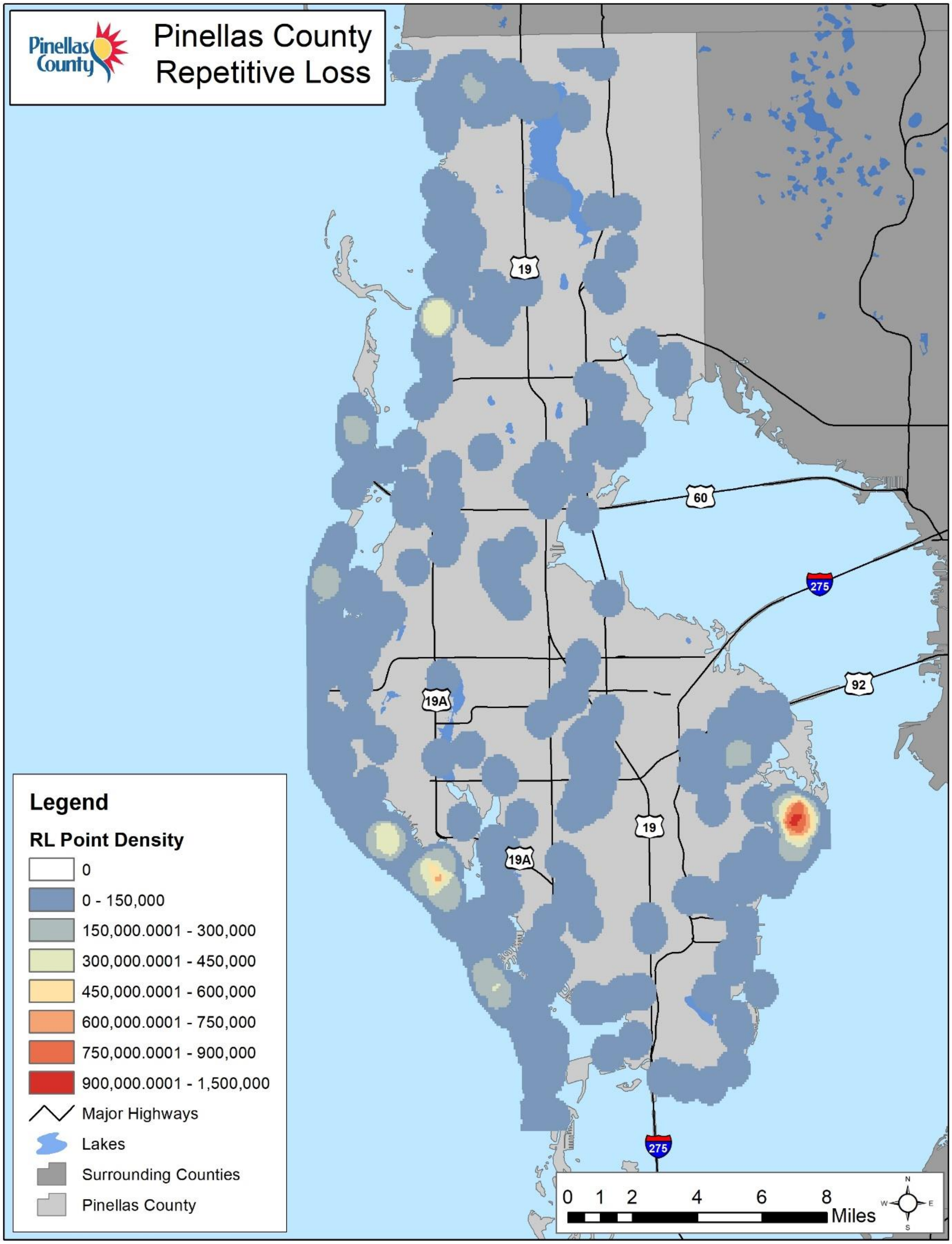


Figure 4.19: Repetitive Loss Property Density



Dam/Dike Failure Flooding

The National Inventory of Dams, a congressionally authorized database maintained by USACE, documents dams in the United States. In the National Inventory of Dams, Taylor Lake Dam is the only privately owned dam along the McKay Creek. The Sawgrass Lake structure and Structure 551 on Lake Tarpon Canal, which are owned by the SWFWMD, and Lake Seminole Dam, owned by the local government (Pinellas County), are identified in Pinellas County. There is an Emergency Action Plan for Structure 551 on Lake Tarpon Canal.[20]

The Florida DEP coordinates the Florida Dam Safety Program and maintains information for over 1,200 federal and non-federal dams in the state.[21] It has been determined that the 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.

The specific locations of the dams are not provided in the plan due to security concerns.

Sea Level Rise

The maps below delineate areas that are vulnerable to potential sea level rise. They illustrate projected 1-foot, 4-foot, 7-foot, and 10-foot sea level rise as well as the depth of flooding associated with 3-foot, 4-foot, and 7-foot sea level rise.

[20] https://www.southeastcoastalmaps.com/Pages/Projects/West-Florida.aspx
[21] https://floridadep.gov/water/engineering-hydrology-geology/content/florida-dam-safety-program

Figure 4.20: Projected Sea Level Rise

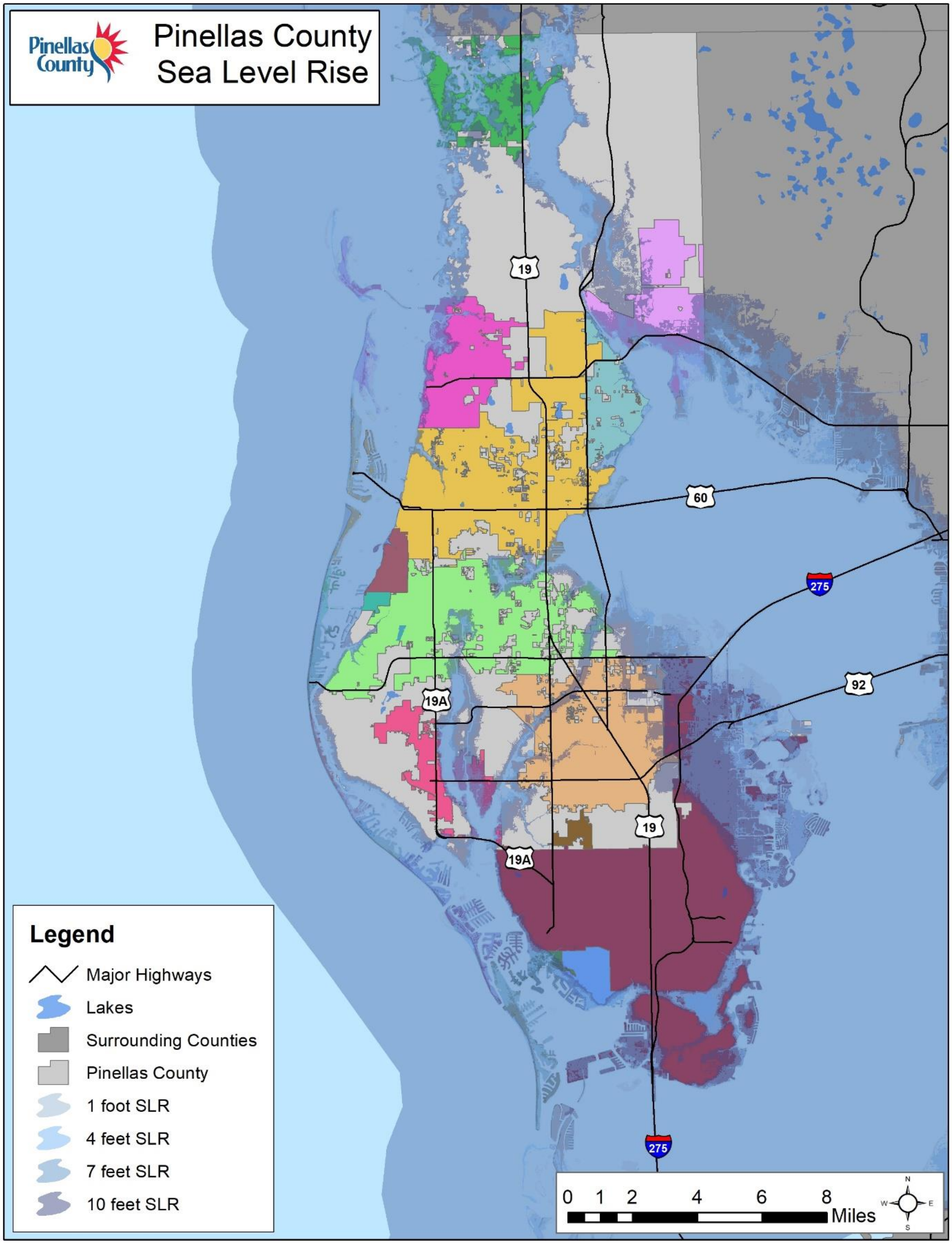


Figure 4.21: Projected Flooding with 3-foot Sea Level Rise

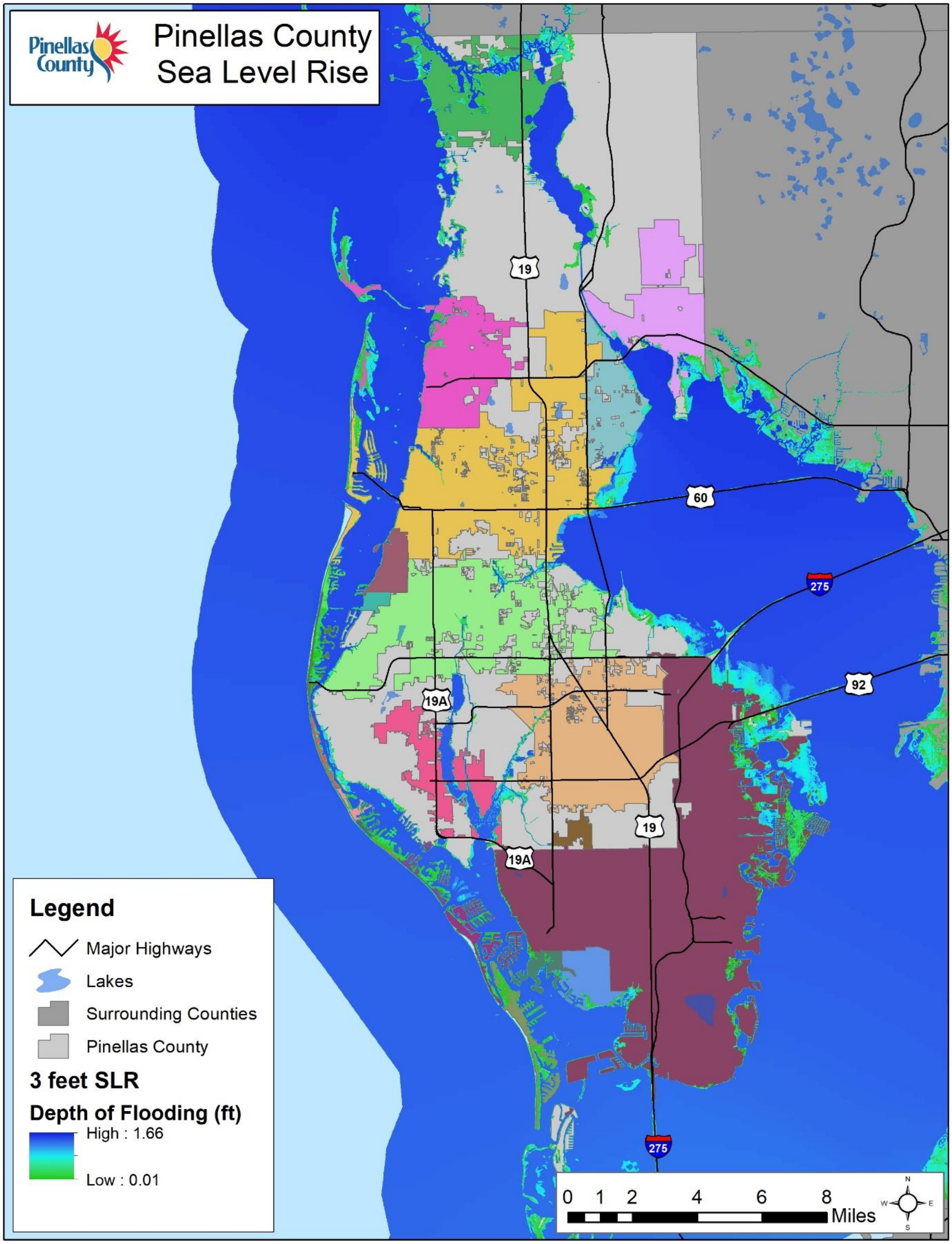


Figure 4.22: Projected Flooding with 4-foot Sea Level Rise

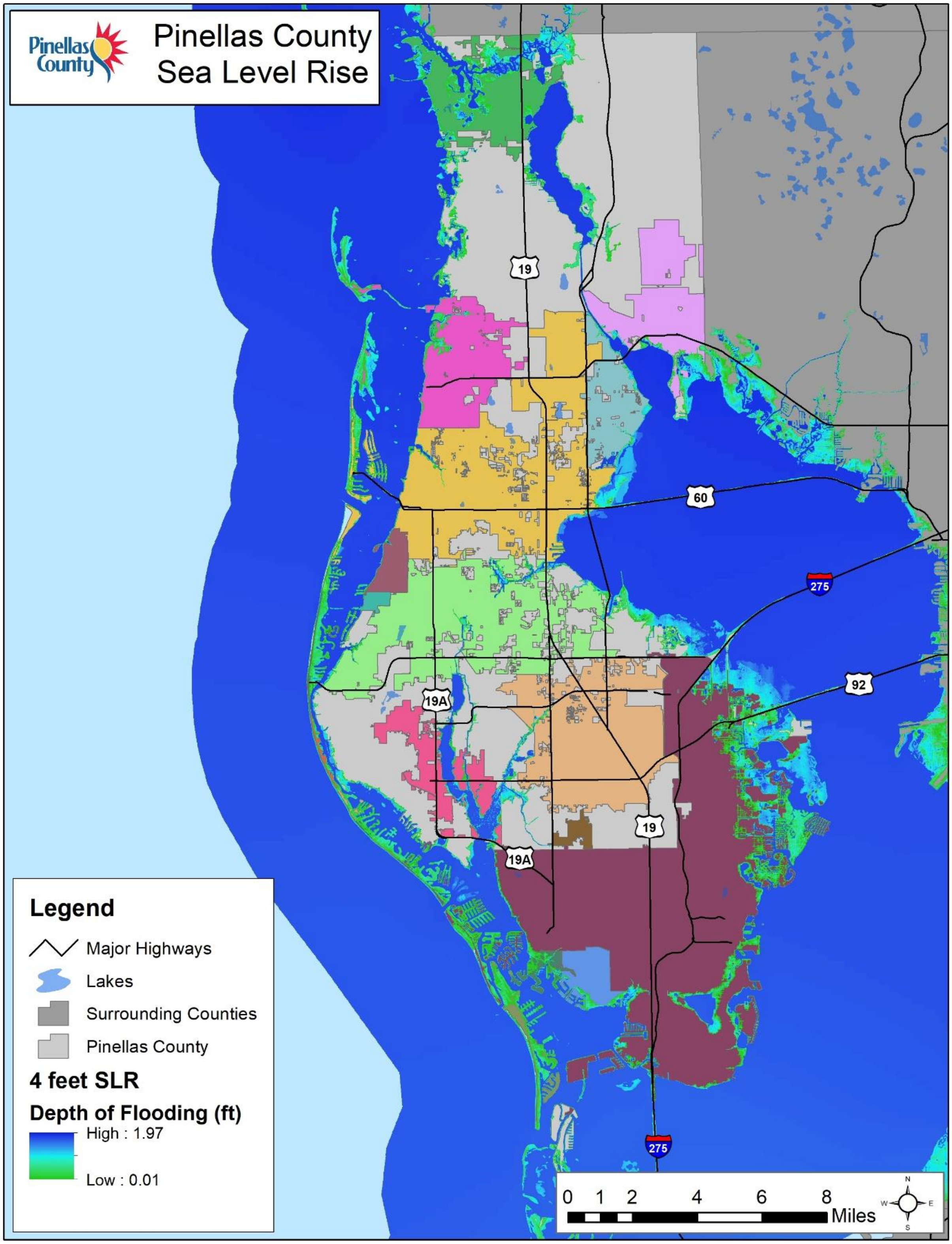
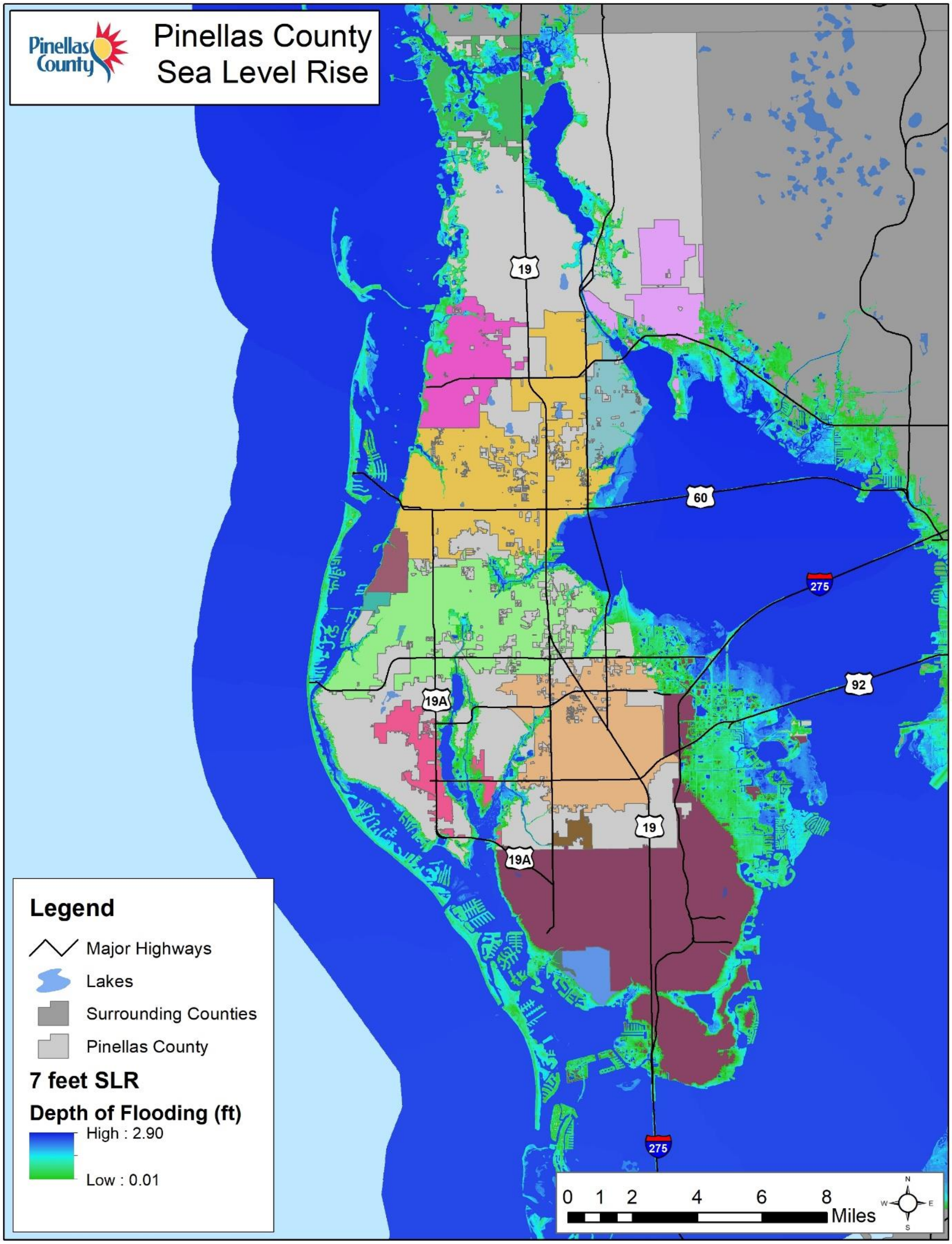


Figure 4.23: Projected Flooding with 7-foot Sea Level Rise



3. Historical Occurrences of Flood

Inland and Coastal Flooding

Pinellas County has experienced a number of damaging flood events in recent history. Below is a table highlighting the most significant events.

Table 4.13: Significant Flood Occurrences in Pinellas County

Date	Description
June 22–30, 1974	During the period of June 22 through June 30, 1974, Pinellas County received between 20 and 30 inches of rain. Damage to public and private property totaled more than $20 million.
May 8, 1979	Flooding occurred when 10–18 inches of rain fell in Pinellas County on May 8, 1979. The massive rain event led to three deaths in St. Petersburg. One woman drowned when her truck was swept down a flooded street. Another woman and her 12-year-old daughter were sucked into a drainage ditch. About 200 people were evacuated from their homes in Tyrone and St. Petersburg. 17.6 inches of rain fell in St. Petersburg during a 14-hour period. Shore Acres received 12.4 inches, while Seminole received 10.78 inches, and Tyrone received 8.7 inches. Several roads and bridges were washed out.[22]
September 1979	During the months of August and September 1979, central Florida, including Pinellas County, experienced the most significant period of rainfall in over three decades. In some areas, the two-month rainfall total was more than 40 inches.
September 1988	After a week of light to moderate rains, flooding began to occur countywide. Areas of Pinellas Park, Clearwater, and Dunedin were hardest hit. 13.25 inches of rain were recorded.
September 1997	Thirty-hour rainfall totals of 8 to 14 inches caused flooding of roads, highways, homes, commercial buildings, low-lying areas, and rivers over much of Pinellas and Hillsborough Counties. In St. Petersburg, a 13-year-old female was sept into a storm drain while playing in floodwaters at a city park on 36th Avenue N. and Eighth Street at 7 pm EST. She was dragged into raging waters underground for 2 blocks before she emerged and was rescued by firefighters. In St. Petersburg, floodwaters carried a 23-year-old woman twelve blocks underground in a drain before she was dumped into a retention pond with only minor injuries. Another woman was playing at Booker Creek under a wooden bridge with two children when she lost her footing and was carried off by the fast-moving flood waters. The heaviest rainfall and subsequent flooding occurred over the cities of Gulfport, Pinellas Park, and St. Petersburg in southern Pinellas County.[23]
February 3, 2006	The combination of tropical moisture flowing into a line of thunderstorms and an approaching upper-level disturbance allowed a train of intense thunderstorms to repeatedly cross over parts of the Tampa Bay area on

[22] *The Evening Independent*, 8/9/1979, and the National Weather Service.
[23] National Centers for Environmental Information Storm Events and the National Weather Service.

Date	Description
	February 3, 2006. Between 8 and 11 inches of rain fell in roughly a five-hour period in a five-mile wide strip extending from Madeira Beach northeast through Pinellas Park, then across Old Tampa Bay to west Tampa, including Tampa International Airport. The area of heaviest rain was so concentrated that downtown St. Petersburg, less than 10 miles away, recorded less than an inch of rain during the same period. The torrential rains caused flash flooding in the areas where more than eight inches fell. The flash flooding prompted the mayor of St. Petersburg to term the event a "hundred-year flood." In Lealman, an entire mobile home community was evacuated, and at least 69 of the homes were flooded. A partial roof collapse was reported at a big box store in St. Petersburg. Water pouring into the store washed out several cash register stands and injured on employee as he was washed into the parking lot. Another roof collapsed at Treasure Island. Hundreds of vehicles were stranded by the flood waters. Total property damage was estimated at $2.0 million. Rainfall amounts measured in Pinellas County include: Pinellas Park (Upper Highlands Canal): 11.7 inches; St. Petersburg/Clearwater International Airport: 8.20 inches; Seminole: 7.01 inches; Largo: 6.44 inches; and Clearwater: 5.81 inches.
July 2009	In July of 2009, a trough of low pressure was dissipating across the area with high pressure ridging across southern Florida. This kept west to southwest winds in place across the local area and allowed for numerous thunderstorms with heavy rains and a tornado. Heavy rains flooded roads in Tarpon Springs. One home on the 600 block of South Grosse Avenue was damaged as debris piled up in a nearby storm drain and caused flooding of three inches of water into the home and $20,000 in damage.
June 2012	In Pinellas County, widespread frequent wind gusts of 39 mph or stronger were reported on the 24th, the highest of which was a 56-mph wind gust at St. Petersburg Albert Whitted Airport on the morning of the 24th. Rainfall of at least 9 inches was reported across the entire county, with the highest storm total rain total of 15.26 inches near the Palm Harbor CoCoRaHS site. A total of 1,671 applications for individual assistance were filed, totaling $900,000. This value is a gross underestimate of the total damage but was the best number available at the time. The tide gauge at Clearwater Beach measured a peak tide of 5.43 feet MLLW on the afternoon of the 24th. Subtracting the predicted astronomical tide, the calculated highest storm surge was 3.10 feet on the evening of the 24th. The tide gauge at St. Petersburg measured a peak tide of 4.87 feet MLLW on the evening of the 25th. Subtracting the predicted astronomical tide, the highest storm surge was calculated as 3.56 feet late on the evening of the 25th. Significant street flooding was reported in Tarpon Springs and St. Petersburg. Along Dodecanese Boulevard in Tarpon Springs, street flooding was up to the foundations of several businesses. In Treasure Island, Gulf Boulevard between 107 Street South and St. John's Pass was flooded with cars stranded. In Clearwater, waves were splashing over the seawalls. In Gulfport, water rose up to the bumpers of cars and flooded streets. Damage to public beaches from erosion was estimated at $3 million. Heavy rain caused minor flooding in Indian Rocks Beach. A 71-year-old man died after suffering a heart attack while standing in less than a foot of water in

Date	Description
	his front yard and could not remove himself from the water. The medical examiner determined that the cause of death was drowning, with heart disease as a contributing factor.
July 3, 2013	On July 3, 2013, easterly winds and deep moisture allowed for a sea breeze collision just along the west coast of Florida, producing scattered to numerous thunderstorms. Some of the storms produced damaging thunderstorm wind gusts, lightning strikes, and heavy rain. Largo Police Department reported Belcher Road was closed from Ulmerton Road to 142nd Avenue with an estimated 2 feet of water on the road. Additionally, an estimated 3 feet of water covered Floral Drive and 36th Street Southeast. No damage, death, or injury reported.
September 1, 2013	On September 1, 2013, deep moisture allowed for sea breeze thunderstorms to develop in the afternoon. Some of these storms produced heavy rain and damaging lightning. Broadcast media relayed a report of street flooding up to the bumpers of cars in Clearwater near East Bay Drive and U.S. 19. No damage, death, or injury reported.
July 25, 2015	Pinellas County received heavy rain on the 24th and 25th, with a few sites in the northern parts of the county reporting nearly 9 inches of rain over the course of a few days. Water was reported on the roadways up to the bumpers of cars along portions of McMullen Booth Road.
August 3, 2015	A weak area of low pressure developed along a stationary frontal boundary across north Florida. This allowed for waves of showers and thunderstorms to move across the area for a few days causing flooding throughout much of the Tampa Bay area. The heaviest rainfall on the morning of the 3rd with some portions of Hillsborough, Pinellas and Pasco Counties receiving 6 to 8 of rain. This event was exacerbated from the flooding and saturated soils from multiple heavy rain events that occurred on August 1 and again during the last week of July. The Tarpon Woods subdivision near Palm Harbor was the hardest hit area in Pinellas County. 453 residences were impacted from the flooding as well as 224 condo units.
August 31, 2016	Excessive rainfall from a deeply moist environment ahead of Hurricane Hermine led to numerous reports of street flooding in southern and central Pinellas County. Cars were reported to be stalled in high water at 54th Avenue and Interstate 275, and additional flooding was reported in Saint Petersburg, Gulfport, and Indian Rocks Beach.
September 1, 2016	Heavy rain from Hurricane Hermine fell across Pinellas County, with the three-day total rainfall ranging from 6 to 20 inches. The highest rain accumulation recorded during the event was 22.11 inches at the CWOP station 1 mile SSE Baskin. The rain caused widespread street flooding and was reported to have inundated numerous homes and businesses. Damage from the flooding was roughly estimated to total $2.3 million.
January 22, 2017	A line of strong and fast-moving thunderstorms developed ahead of a cold front moving southeast through the Florida Peninsula. Breezy gradient winds were compounded by stronger thunderstorm wind gusts, some of which caused minor damage. Additionally, the persistent gradient winds caused minor coastal flooding. Water was observed to have risen 2.1 feet above the

Date	Description
	predicted high tide at Clearwater Beach. The city of Indian Rocks Beach also reported that beach erosion caused the loss of sand and damage to public signs and trash cans, totaling around $20,000 in damage.

Additionally, there have been several FEMA major disaster declarations in Pinellas County that are specifically related to flooding events. Please note that some of these events are also listed under Severe Storms and Tornadoes. 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 4.14: FEMA Major Disaster Declarations in Pinellas County, Flood, 1953–2018[24]

Disaster Number	Date	Name/Description
DR-586	May 15, 1979	SEVERE STORMS, TORNADOES & FLOODING
DR-966	October 3–4, 1992	SEVERE STORMS, TORNADOES & FLOODING
DR-982	March 12–16, 1993	TORNADOES, FLOODING, HIGH WINDS & TIDES, FREEZING
DR-1195	December 25, 1997–April 24, 1998	SEVERE STORMS, HIGH WINDS, TORNADOES, AND FLOODING

According to the NCEI Storm Events Database, there were 45 reports of flood in Pinellas County from 1996 to 2018.[25] These flood events are only inclusive of those reported by NCEI from 1996 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.15: Summary of Flood Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	0	0	0	$0	$0
Belleair Beach	0	0	0	$0	$0
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	0	0	0	$0	$0
Clearwater	6	0	0	$226,187	$10,281
Dunedin	1	0	0	$31,569	$1,578
Gulfport	0	0	0	$0	$0
Indian Rocks Beach	1	0	0	$0	$0
Indian Shores	0	0	0	$0	$0

[24] https://www.fema.gov/media-library/assets/documents/28318

[25] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Coastal+Flood&eventType=%28C%29+Flash+Flood&eventType=%28Z%29+Flood&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Kenneth City	0	0	0	$0	$0
Largo	2	0	0	$709,822	$33,801
Madeira Beach	1	0	0	$2,572,199	$214,350
North Redington Beach	0	0	0	$0	$0
Oldsmar	0	0	0	$0	$0
Pinellas Park	7	0	0	$297,330	$13,515
Redington Beach	0	0	0	$0	$0
Redington Shores	0	0	0	$0	$0
Safety Harbor	1	0	0	$313,172	$15,659
St. Petersburg	6	0	0	$104,461	$4,748
St. Pete Beach	1	0	0	$41,711	$2,781
Seminole	1	0	0	$15,639	$782
South Pasadena	0	0	0	$0	$0
Tarpon Springs	5	0	0	$161,776	$7,353
Treasure Island	2	0	1	$4,786	$228
Unincorporated	11	0	0	$7,772,445	$370,116
PINELLAS COUNTY TOTAL	**45**	**0**	**1**	**$12,251,097**	**$675,193**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.16: Historical Flood Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair						
NONE REPORTED	--	--	--	--	--	--
Belleair Beach						
NONE REPORTED	--	--	--	--	--	--
Belleair Bluffs						
NONE REPORTED	--	--	--	--	--	--
Belleair Shore						
NONE REPORTED	--	--	--	--	--	--
Clearwater						
CLEARWATER	8/6/1996	Flood	0	0	$32,492	$0
CLEARWATER	8/12/1996	Flood	0	0	$0	$0
CLEARWATER	10/31/1997	Flood	0	0	$15,814	$0
CLEARWATER	7/10/1998	Flood	0	0	$78,293	$0
CLEARWATER	7/20/1998	Flood	0	0	$23,488	$0
CLEARWATER	9/6/1999	Flood	0	0	$76,101	$0
Dunedin						
DUNEDIN	2/28/1998	Flood	0	0	$31,569	$0

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Gulfport						
NONE REPORTED	--	--	--	--	--	--
Indian Rocks Beach						
INDIAN ROCKS BEACH	8/31/2016	Flood	0	0	$0	$0
Indian Shores						
NONE REPORTED	--	--	--	--	--	--
Kenneth City						
NONE REPORTED	--	--	--	--	--	--
Largo						
LARGO	12/27/1997	Flood	0	0	$633,721	$0
LARGO	9/7/1999	Flood	0	0	$76,101	$0
Madeira Beach						
MADEIRA BEACH	2/3/2006	Flash Flood	0	0	$2,572,199	$0
North Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Oldsmar						
NONE REPORTED	--	--	--	--	--	--
Pinellas Park						
PINELLAS PARK	6/24/1996	Flood	0	0	$0	$0
PINELLAS PARK	9/26/1997	Flash Flood	0	0	$0	$0
PINELLAS PARK	7/1/1999	Flood	0	0	$76,649	$0
PINELLAS PARK	9/17/2000	Flash Flood	0	0	$220,680	$0
PINELLAS PARK	9/6/2002	Flood	0	0	$0	$0
PINELLAS PARK	12/13/2002	Flood	0	0	$0	$0
PINELLAS PARK	6/19/2003	Flash Flood	0	0	$0	$0
Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Redington Shores						
NONE REPORTED	--	--	--	--	--	--
Safety Harbor						
SAFETY HARBOR	7/10/1998	Flash Flood	0	0	$313,172	$0
St. Petersburg						
ST. PETERSBURG	1/1/1996	Flood	0	0	$0	$0
ST. PETERSBURG	2/2/1996	Flood	0	0	$0	$0
ST PETERSBURG	8/13/1997	Flood	0	0	$79,461	$0
ST PETERSBURG	9/26/1997	Flood	0	0	$0	$0
ST PETERSBURG	12/24/2002	Flood	0	0	$25,000	$0
ST PETERSBURG	12/31/2002	Flood	0	0	$0	$0
St. Pete Beach						
ST PETERSBURG BEACH	4/26/2003	Flash Flood	0	0	$41,711	$0
Seminole						
SEMINOLE	8/22/1998	Flood	0	0	$15,639	$0
South Pasadena						
NONE REPORTED	--	--	--	--	--	--

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Tarpon Springs						
TARPON SPRINGS	4/30/1996	Flood	0	0	$0	$0
TARPON SPRINGS	8/5/1996	Flood	0	0	$8,123	$0
TARPON SPGS	6/24/1997	Flood	0	0	$79,709	$0
TARPON SPGS	6/26/2000	Flood	0	0	$0	$0
TARPON SPGS	8/12/2000	Flood	0	0	$73,943	$0
Treasure Island						
TREASURE IS	4/26/1997	Flood	0	0	$4,786	$0
TREASURE IS	6/8/2002	Flood	0	1	$0	$0
Unincorporated						
COUNTYWIDE	12/13/1997	Flash Flood	0	0	$792,151	$0
COUNTYWIDE	2/2/1998	Flood	0	0	$7,892	$0
COUNTYWIDE	2/16/1998	Flood	0	0	$15,784	$0
COUNTYWIDE	2/19/1998	Flood	0	0	$47,353	$0
PASS A GRILLE BEACH	7/15/2000	Flash Flood	0	0	$1,479	$0
PINELLAS (ZONE)	7/23/2001	Flood	0	0	$143,971	$0
PASS A GRILLE BEACH	9/14/2001	Flash Flood	0	0	$501,637	$0
ANCLOTE	7/25/2015	Flood	0	0	$53,539	$0
ANCLOTE	8/3/2015	Flood	0	0	$3,753,076	$0
ANCLOTE	9/1/2016	Flood	0	0	$2,434,516	$0
PINELLAS (ZONE)	1/22/2017	Coastal Flood	0	0	$21,047	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

4. Probability of Future Flood Events

Based on historical knowledge and an understanding of floodplains, it is believed that Pinellas County 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 Pinellas County will continue to be impacted by flooding due to any number of causes annually.

The maps included in the Geographic Areas Affected by Flood section shows the areas with a 1% annual probability of a flood, or the 100-year flood, as well as the areas with a 0.2% chance annual probability of a flood, or the 500-year flood.

Below is a figure depicting the flash flood risk in Florida. The potential of flash floods is 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:

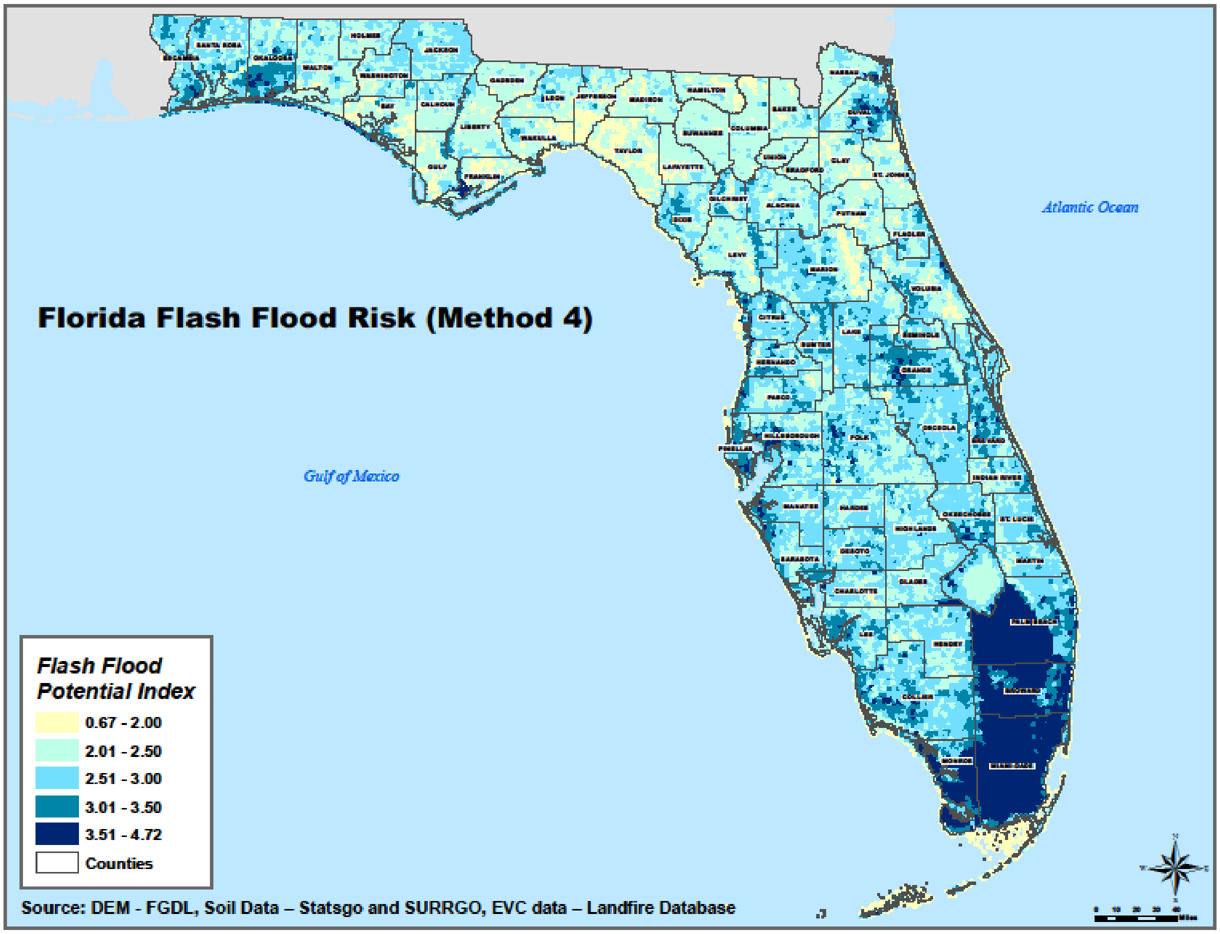
FFPI = (M+L+S+V)/N

Since 2003, this equation has been refined into four scenarios to more accurately represent specific areas and conditions. For the figure below, 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: https://www.cbrfc.noaa.gov/papers/ffp_wpap.pdf.

Figure 4.24: 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. It indicates that most areas in Pinellas County have a flash flood potential that ranges between 2.01 and 4.72.

<u>Probability Based on Historical Occurrences</u>

An analysis of flood reports from 1996 to 2018 in Pinellas County from the NCEI Storm Events Database indicates that there will be less than one coastal floods, less than one flash flood, and one to two floods each year in Pinellas County. The probability of future flood impacts is high for all jurisdictions.

Table 4.17: NCEI Flood Reports 1996–2018[26]

Type of Flood	NCEI Reports	Average per Year
Coastal Flood	1	< 1
Flash Flood	9	< 1
Flood	35	1.6
TOTAL	**45**	**2.0**

Based on historical information, this hazard was determined to have a probability level of highly likely (100% annual probability). All communities in Pinellas are exposed to flood hazards and likely to be impacted frequently in the future. All communities have filed flood insurance claims for damages in the past. All but two jurisdictions (Kenneth City and Seminole) have multiple repetitive loss properties. Variable climate impacts are likely to worsen exposure for coastal communities, but inland communities could also be impacted by more frequent, and higher volume precipitation events.

The probability of future flood impacts is high for all jurisdictions.

5. Flood Impact Analysis

All communities in Pinellas could receive the following impacts due to flooding. Variable climate impacts are likely to worsen exposure for coastal communities, but inland communities could also be impacted by more frequent, and higher volume precipitation events.

- 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

[26] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Coastal+Flood&eventType=%28C%29+Flash+Flood&eventType=%28Z%29+Flood&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

- <u>Responders</u>
  - 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
- <u>Continuity of Operations (including continued delivery of services)</u>
  - 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
- <u>Property, Facilities, Infrastructure</u>
  - 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
- <u>Environment</u>
  - 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
- <u>Economic Condition</u>
  - 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
- <u>Public Confidence in Jurisdiction's Governance</u>
  - If floodwaters do not recede quickly, it appears as though the water utilities and government are not 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 is not able to handle emergency events and lose confidence in their capabilities

6. Vulnerability Analysis and Loss Estimation by Jurisdiction

<u>Historical Losses</u>

The NCEI Storm Events Database information, presented in the Historical Occurrences 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 4.18: Flood Events in Pinellas County, by Type, (1996–2018)[27]

Type of Event	Number of Events	Deaths	Injuries	Property Damage (2019 dollars)	Crop Damage (2019 dollars)
Coastal Flood	1	0	0	$21,047	$0
Flash Flood	9	0	0	$4,443,029	$0
Flood	35	0	1	$7,787,021	$0
TOTAL	**45**	**0**	**1**	**$12,251,097**	**$0**

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 4.19: NCEI Floods, 1996–2018[28]

NCEI Storm Event (hazard)	Average Floods per Year	Annualized Property Loss (2019 dollars)	Annualized Crop Loss (2019 dollars)
All Types of Floods	2.0	$675,193	$0

According to the analysis, Pinellas County is historically vulnerable to over $675,000 in property damages and $0 in crop damages from roughly 2 flood events each year.

Exposure

To estimate exposure of improved property to flood, the approximate number of parcels and their associated improved valued located in the effective and preliminary floodplains was determined using GIS analysis.

Table 4.20: Estimated Exposure of Improved Property to Flood, Effective Floodplain

Location	Buildings and Parcels in Flood Risk Area								
	100-year floodplain (effective)			500-year floodplain (effective)			VE-Zone (effective)		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Belleair	547	685	$59,084,361	381	112	$22,427,283	409	371	$37,091,968
Belleair Beach	731	3,495	$147,686,402	0	0	$0	548	153	$24,284,283
Belleair Bluffs	141	41	$9,198,265	143	14	$9,378,874	230	0	$8,071,218
Belleair Shore	11	15,843	$9,680,489	0	0	$0	122	379	$93,914,658
Clearwater	12,126	7,987	$1,303,806,582	3,475	2,956	$647,016,894	4,839	1,228	$499,048,156
Dunedin	3,116	6,288	$397,108,040	3,017	3,947	$285,837,520	1,977	907	$81,821,337
Gulfport	3,057	7,053	$233,480,481	328	810	$29,907,049	619	305	$47,435,433

[27] 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
[28] 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

Location	Buildings and Parcels in Flood Risk Area								
	100-year floodplain (effective)			500-year floodplain (effective)			VE-Zone (effective)		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Indian Rocks Beach	3,163	448	$230,773,826	0	0	$0	1,040	287	$27,892,694
Indian Shores	1,527	832	$20,627,617	0	0	$0	1,653	520	$22,425,229
Kenneth City	712	6,535	$45,978,821	1,050	1,599	$48,360,194	0	0	$0
Largo	4,127	7,322	$495,444,615	2,049	3,437	$420,131,617	377	98	$39,241,518
Madeira Beach	2,687	1,439	$226,969,423	0	0	$0	1,302	480	$43,911,396
North Redington Beach	777	9,952	$71,632,166	0	0	$0	522	158	$23,783,558
Oldsmar	3,140	9,543	$449,196,513	2,675	7,282	$377,873,009	107	15	$13,784,461
Pinellas Park	7,695	2,859	$1,025,512,302	10,445	18,972	$1,354,038,093	0	0	$0
Redington Beach	716	2,997	$89,046,362	0	0	$0	408	766	$45,534,603
Redington Shores	1,800	2,165	$105,230,147	0	0	$0	1,059	285	$11,519,213
Safety Harbor	815	685	$104,159,657	706	1,604	$149,244,542	67	11	$21,611,748
St. Petersburg	43,083	103,784	$5,311,802,121	10,438	23,255	$1,167,877,553	2,910	1,413	$264,677,388
St. Pete Beach	6,444	15,617	$674,478,240	0	0	$0	1,710	599	$225,769,973
Seminole	3,600	4,012	$270,858,996	462	533	$78,294,925	34	33	$49,927,764
South Pasadena	3,630	3,891	$192,197,270	257	279	$5,415,473	547	186	$56,313,039
Tarpon Springs	6,494	14,509	$695,407,745	3,571	5,664	$434,154,312	892	1,836	$87,765,710
Treasure Island	4,952	8,663	$332,866,064	0	0	$0	1,703	1,891	$96,776,079
Unincorp.	40,635	64,586	$4,228,064,504	17,647	30,082	$1,941,519,622	3,746	4,222	$554,478,099
PINELLAS COUNTY TOTAL	**155,726**	**300,546**	**$16,730,291,009**	**56,644**	**100,546**	**$6,971,476,960**	**26,821**	**16,143**	**$2,377,079,525**

Table 4.21: Estimated Exposure of Improved Property to Flood, Preliminary Floodplain

Location	Buildings and Parcels in Flood Risk Area								
	100-year floodplain (preliminary)			500-year floodplain (preliminary)			VE-Zone (preliminary)		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Belleair	577	908	$67,118,507	426	132	$32,461,349	450		$29,648,564
Belleair Beach	1,217	3,627	$161,111,361	27	6	$337,351	96		$30,068,446
Belleair Bluffs	221	0	$2,992,639	131	5	$3,872,645	19		$9,257,438
Belleair Shore	122	388	$93,914,658	6	26	$9,300,896	122		$93,914,658
Clearwater	13,998	15,039	$1,328,818,523	3,504	3,317	$540,632,026	1,934	56	$485,280,561
Dunedin	4,304	6,792	$395,704,010	3,568	5,724	$335,751,758	708	162	$57,494,477
Gulfport	2,938	5,697	$235,225,684	639	1,892	$61,248,841	715	111	$39,411,749
Indian Rocks Beach	3,318	7,162	$233,620,768	42	60	$2,675,726	422	35	$18,248,458
Indian Shores	2,788	922	$36,860,293	22	18	$817,520	1,551	3	$14,749,461
Kenneth City	68	65	$8,452,408	258	743	$20,786,703	0		$0

Location	Buildings and Parcels in Flood Risk Area								
	100-year floodplain (preliminary)			500-year floodplain (preliminary)			VE-Zone (preliminary)		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Largo	4,190	5,848	$575,565,669	3,938	3,079	$460,169,265	369		$35,730,166
Madeira Beach	3,638	7,318	$245,757,893	0	0	$0	1,579	556	$61,465,698
North Redington Beach	1,148	1,356	$81,166,114	0	0	$0	390	246	$42,605,680
Oldsmar	4,303	13,439	$617,026,945	2,002	3,118	$370,738,560	222	197	$22,184,183
Pinellas Park	5,775	5,828	$797,624,097	8,550	16,379	$1,091,051,399	0		$0
Redington Beach	1,018	3,363	$115,714,811	0	0	$0	364	285	$48,363,302
Redington Shores	2,093	3,059	$108,607,116	0	0	$0	558	234	$13,122,045
Safety Harbor	957	2,564	$116,271,347	678	1,231	$134,663,577	139	89	$34,279,487
St. Petersburg	42,085	101,149	$5,198,454,381	10,229	18,135	$1,240,162,684	5,011	435	$520,030,731
St. Pete Beach	7,538	15,813	$711,645,100	11	56	$2,081,918	1,634	319	$255,907,688
Seminole	3,473	3,627	$254,780,382	1,057	846	$158,086,168	49	79	$17,764,145
South Pasadena	3,483	3,877	$229,918,622	304	426	$7,198,999	821	81	$95,647,023
Tarpon Springs	6,221	10,585	$670,455,107	4,630	9,672	$604,040,757	589	200	$43,725,080
Treasure Island	5,692	10,016	$338,161,235	1	0	$0	1,417	572	$86,147,231
Unincorporated	33,182	55,184	$3,614,531,166	20,373	39,398	$2,490,683,619	4,135	1,134	$609,660,330
PINELLAS COUNTY TOTAL	**154,347**	**283,626**	**$16,239,498,836**	**60,396**	**104,263**	**$7,566,761,761**	**23,294**	**4,794**	**$2,664,706,601**

To estimate the county population's exposure to flood, the effective and preliminary floodplains were intersected with census block data. As a result, these population estimates are going to be an overestimate of risk since the entire census block's population count will be included even if only a portion of the census block's area is located in a floodplain. However, these estimates still give an idea of the county population's risk to flood.

Table 4.22: Estimated Exposure of Population to Flood, Effective Floodplain

Location	Population in Flood Risk Area								
	100-year floodplain (effective)			500-year floodplain (effective)			VE-Zone (effective)		
	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65
Belleair	86	9	19	0	0	0	1,122	79	346
Belleair Beach	596	44	116	0	0	0	964	66	220
Belleair Bluffs	0	0	0	19	2	3	0	0	0
Belleair Shore	0	0	0	0	0	0	109	8	25
Clearwater	34,361	3,971	3,818	4,508	470	891	6,964	262	1,889
Dunedin	9,714	934	1,630	7,997	664	2,008	2,880	163	785
Gulfport	3,174	220	653	693	55	99	2,273	117	805
Indian Rocks Beach	2,484	193	309	0	0	0	1,037	56	244
Indian Shores	656	23	164	0	0	0	764	31	231

Location	Population in Flood Risk Area								
	100-year floodplain (effective)			500-year floodplain (effective)			VE-Zone (effective)		
	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65
Kenneth City	3,636	350	486	334	5	179	0	0	0
Largo	13,156	1,079	2,731	4,947	462	812	1,058	111	163
Madeira Beach	3,204	218	516	0	0	0	728	25	208
North Redington Beach	698	31	211	0	0	0	245	8	91
Oldsmar	9,618	1,336	806	2,625	356	241	614	76	50
Pinellas Park	30,002	3,393	3,946	10,953	1,193	1,712	0	0	0
Redington Beach	692	66	102	0	0	0	399	16	99
Redington Shores	1,215	100	170	0	0	0	757	22	259
Safety Harbor	3,344	301	655	3,232	348	505	368	30	42
St. Petersburg	96,938	10,482	12,019	17,922	2,046	2,035	13,930	1,013	2,363
St. Pete Beach	7,257	443	1,556	0	0	0	1,615	64	496
Seminole	6,219	459	1,765	695	59	81	363	21	120
South Pasadena	5,035	224	1,701	0	0	0	1,802	72	751
Tarpon Springs	13,485	1,483	1,986	4,989	458	1,087	2,186	163	554
Treasure Island	3,830	251	797	0	0	0	1,391	59	270
Unincorporated	105,927	10,538	16,840	27,304	2,632	5,348	14,494	893	3,146
PINELLAS COUNTY TOTAL	**355,327**	**36,148**	**52,996**	**86,218**	**8,750**	**15,001**	**56,063**	**3,355**	**13,157**

Table 4.23: Estimated Exposure of Population to Flood, Preliminary Floodplain

Location	Population in Flood Risk Area								
	100-year floodplain (preliminary)			500-year floodplain (preliminary)			VE-Zone (preliminary)		
	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65
Belleair	78	11	9	45	4	12	1,085	73	344
Belleair Beach	781	43	199	0	0	0	779	67	137
Belleair Bluffs	0	0	0	0	0	0	0	0	0
Belleair Shore	0	0	0	0	0	0	109	8	25
Clearwater	29,030	3,279	3,552	4,678	517	796	6,645	240	1,822
Dunedin	9,826	927	1,744	9,345	785	2,197	2,318	135	606
Gulfport	2,597	180	546	1,438	117	220	2,282	113	815
Indian Rocks Beach	2,663	208	335	0	0	0	858	41	218
Indian Shores	732	28	183	0	0	0	688	26	212
Kenneth City	1,497	116	149	256	31	31			
Largo	14,152	1,119	3,118	6,698	589	1,431	945	98	146

Location	Population in Flood Risk Area								
	100-year floodplain (preliminary)			500-year floodplain (preliminary)			VE-Zone (preliminary)		
	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65
Madeira Beach	1,643	115	180	0	0	0	2,289	128	544
North Redington Beach	545	15	189	0	0	0	398	24	113
Oldsmar	7,946	1,024	752	3,082	530	139	2,143	258	220
Pinellas Park	23,467	2,479	3,449	9,816	1,159	1,563			
Redington Beach	633	46	99	0	0	0	458	36	102
Redington Shores	756	56	104	0	0	0	1,216	66	325
Safety Harbor	2,786	288	522	2,014	213	313	1,863	117	433
St. Petersburg	90,802	9,669	11,263	13,384	1,663	1,335	17,019	1,361	2,801
St. Pete Beach	5,731	359	1,105	0	0	0	3,141	148	947
Seminole	4,641	340	1,390	932	77	138	1,664	118	429
South Pasadena	3,327	196	1,014	0	0	0	3,510	100	1,438
Tarpon Springs	12,330	1,366	1,811	5,279	491	1,092	2,062	159	506
Treasure Island	3,104	170	594	0	0	0	2,117	140	473
Unincorporated	86,138	8,444	13,650	26,468	2,782	4,234	16,385	1,052	3,590
PINELLAS COUNTY TOTAL	**305,205**	**30,478**	**45,957**	**83,435**	**8,958**	**13,501**	**69,974**	**4,508**	**16,246**

Sea Level Rise

To estimate exposure of improved property to sea level rise, the approximate number of parcels and their associated improved valued located in the areas vulnerable to 1-foot, 4-foot, 7-foot, and 10-foot increments of sea level rise was determined using GIS analysis.

Table 4.24: Estimated Exposure of Improved Property to Sea Level Rise Risk Areas – 1-foot and 4-foot – Pinellas County Total

Sea Level Rise Depth	Buildings and Parcels in Sea Level Rise Risk Areas					
	1-foot			4-foot		
	No. of Parcels	No. of Buildings	Improved Value	No. of Parcels	No. of Buildings	Improved Value
0 to 1 ft	1,829	346	$113,621,248	21,062	73,109	$2,331,948,549
1 to 2 ft	0	0	$0	2,081	328	$175,589,661
2 to 3 ft	0	0	$0	0	0	$0
3 to 4 ft	0	0	$0	0	0	$0
4 to 5 ft	0	0	$0	0	0	$0

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

Table 4.25: Estimated Exposure of Improved Property to Sea Level Rise Risk Areas – 7-foot and 10-foot – Pinellas County Total

Sea Level Rise Depth	Buildings and Parcels in Sea Level Rise Risk Areas					
	7-foot			10-foot		
	No. of Parcels	No. of Buildings	Improved Value	No. of Parcels	No. of Buildings	Improved Value
0 to 1 ft	71,587	161,528	$6,764,087,108	41,755	95,693	$4,084,685,994
1 to 2 ft	17,467	58,219	$1,951,360,557	71,503	164,379	$6,920,514,116
2 to 3 ft	3,168	333	$231,582,457	14,040	46,873	$1,541,029,581
3 to 4 ft	0	0	$0	3,180	317	$275,427,761
4 to 5 ft	0	0	$0	0	0	$0

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

To estimate the county population's exposure to potential sea level rise, the areas vulnerable to 1-foot, 4-foot, 7-foot, and 10-foot increments of sea level rise were intersected with census block data. As a result, these population estimates are going to be an overestimate of risk since the entire census block's population count will be included even if only a portion of the census block's area is located in an inundation area. However, these estimates still give an idea of the county population's risk to sea level rise.

Table 4.26: Estimated Exposure of Population to Sea Level Rise Risk Areas – Pinellas County Total

Sea Level Rise Depth	Population in Sea Level Rise Risk Areas											
	1-foot			4-foot			7-foot			10-foot		
	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65
0 to 1 ft	8,700	786	1,105	51,293	4,565	7,092	119,020	9,846	23,083	67,191	6,375	11,833
1 to 2 ft	0	0	0	9,821	824	1,428	54,937	4,933	7,415	124,012	10,409	23,543
2 to 3 ft	0	0	0	0	0	0	12,375	1,097	2,002	50,987	4,659	6,496
3 to 4 ft	0	0	0	0	0	0	0	0	0	16,409	1,545	3,128
4 to 5 ft	0	0	0	0	0	0	0	0	0	0	0	0

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

Hazus-MH

Hazus-MH was used to estimate the direct economic loss for the county from a 100-year and 500-year flood as shown below. This analysis includes losses to buildings, contents, inventory, relocation, income, rental, and wage.

Table 4.27: Direct Economic Loss from 100-year and 500-year Flood

	100-year Flood Event	500-year Flood Event
Building Loss	$231,213,000	$298,862,000
Contents Loss	$204,776,000	$264,758,000
Inventory Loss	$1,174,000	$1,722,000
Relocation Loss	$237,644,000	$271,397,000
Income Loss	$170,475,000	$195,096,000

	100-year Flood Event	500-year Flood Event
Rental Income Loss	$132,897,000	$153,148,000
Wage Loss	$183,559,000	$211,843,000
TOTAL LOSS	**$1,161,738,000**	**$1,396,826,000**

Figure 4.25: Direct Economic Loss 100-year Return Period

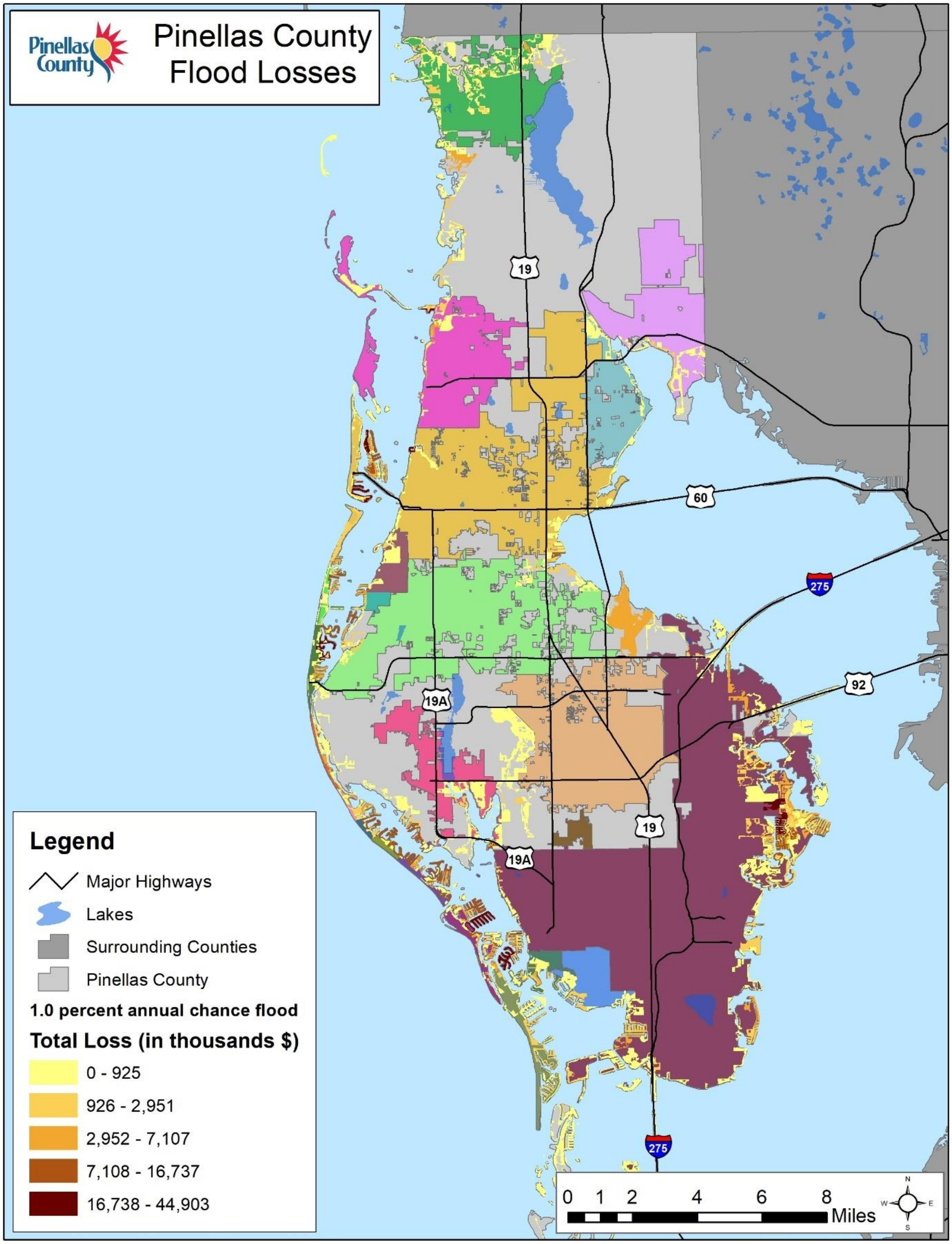
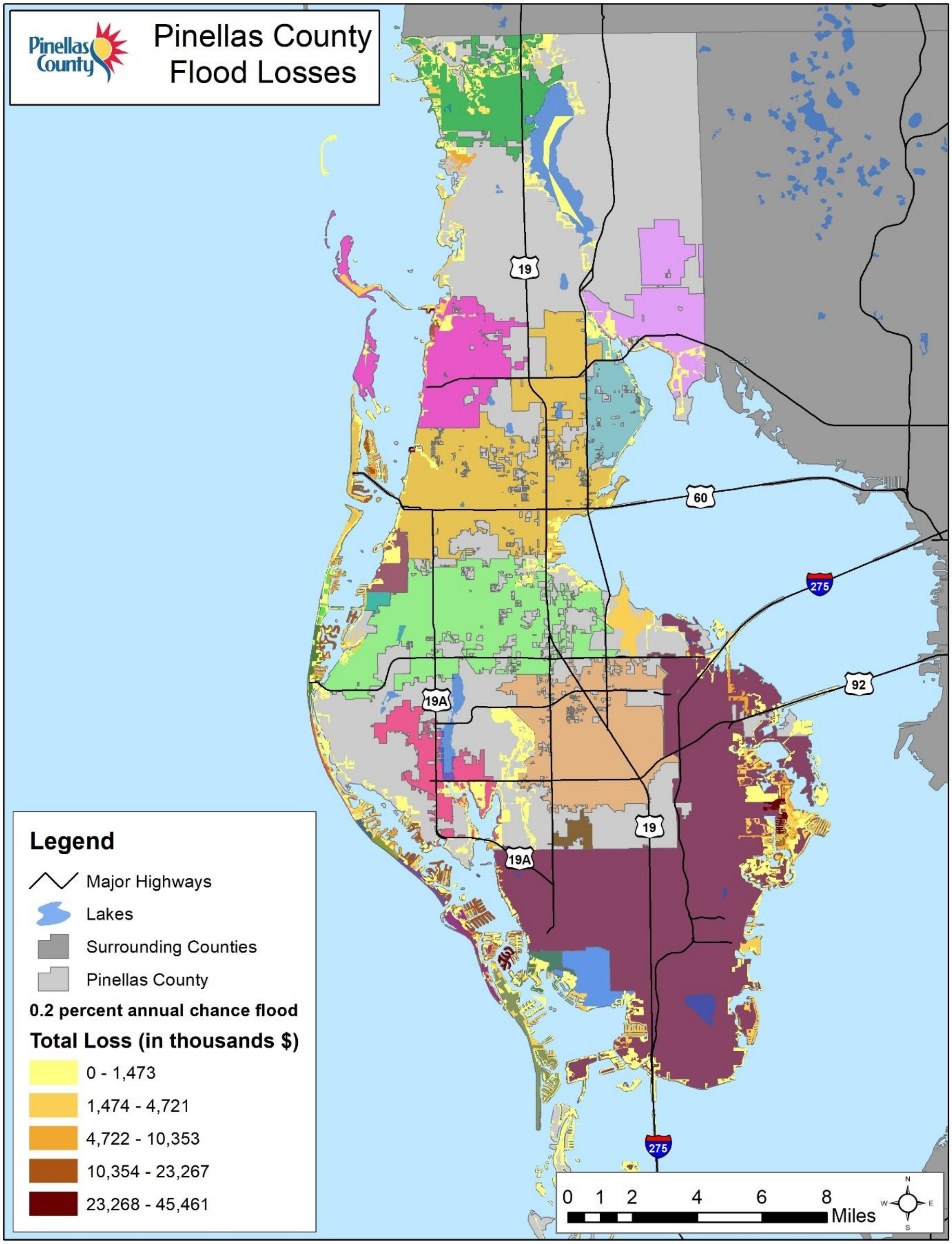


Figure 4.26: Direct Economic Loss 500-year Return Period



Coastal Flooding

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

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

To estimate exposure to flood for the critical facility analysis, floodplains were intersected with critical facility locations. Digital Flood Insurance Rate Map (DFIRM) date was used to delineate the effective and preliminary floodplains. The table below summarizes the critical facilities in the county that are located within an identified floodplain.

Table 4.28: Exposure of Critical Facilities to Flood Risk Areas

Location	Number of Critical Facilities in Flood Risk Area					
	Effective FIRM			Preliminary FIRM		
	100-year	500-year	VE-Zone	100-year	500-year	VE-Zone
Belleair	0	0	0	0	0	0
Belleair Beach	3	0	0	2	1	0
Belleair Bluffs	0	0	0	0	0	0
Belleair Shore	0	0	0	0	0	0
Clearwater	24	3	6	26	5	0
Dunedin	6	9	2	3	14	0
Gulfport	2	0	0	1	0	1
Indian Rocks Beach	3	0	0	3	0	0
Indian Shores	7	0	1	8	0	0
Kenneth City	3	0	0	0	1	0
Largo	13	7	0	11	10	0
Madeira Beach	5	0	0	5	0	0
North Redington Beach	2	0	0	2	0	0
Oldsmar	5	22	0	15	13	0
Pinellas Park	20	32	0	7	21	0
Redington Beach	3	0	1	4	0	0
Redington Shores	3	0	1	4	0	0
Safety Harbor	1	2	0	1	1	0
St. Petersburg	87	23	0	78	26	1
St. Pete Beach	7	0	2	9	0	0
Seminole	10	4	0	4	9	0
South Pasadena	14	0	4	16	0	2
Tarpon Springs	7	11	0	2	13	0
Treasure Island	13	0	1	13	1	0
Unincorporated	60	31	5	35	36	8
PINELLAS COUNTY TOTAL	**298**	**144**	**23**	**249**	**151**	**12**

Sea Level Rise

Additional analysis was done to estimate the exposure of critical facilities to sea level rise. Areas vulnerable to potential 1-foot, 4-foot, 7-foot, and 10-foot increments of sea level rise were interested with the critical facility locations. The table below summarizes the critical facilities in the county that are located within a potential sea level rise inundation area.

Table 4.29: Exposure of Critical Facilities to Sea Level Rise Risk Areas

Location	Number of Critical Facilities in Sea Level Rise Risk Area			
	1-foot	4-foot	7-foot	10-foot
Belleair	0	0	0	0
Belleair Beach	0	2	2	3
Belleair Bluffs	0	0	0	0
Belleair Shore	0	0	0	0
Clearwater	0	3	23	25
Dunedin	0	0	3	7
Gulfport	0	1	2	2
Indian Rocks Beach	0	3	3	3
Indian Shores	0	1	8	8
Kenneth City	0	0	0	0
Largo	0	1	5	20
Madeira Beach	0	4	5	5
North Redington Beach	0	2	2	2
Oldsmar	0	0	1	17
Pinellas Park	0	0	0	8
Redington Beach	0	4	4	4
Redington Shores	0	1	2	4
Safety Harbor	0	0	0	0
St. Petersburg	3	14	62	98
St. Pete Beach	0	4	9	9
Seminole	1	3	4	10
South Pasadena	0	4	18	18
Tarpon Springs	0	0	2	9
Treasure Island	0	4	13	13
Unincorporated	11	20	34	62
PINELLAS COUNTY TOTAL	**15**	**71**	**202**	**327**

All of the critical facilities and their associated risk can be found in Appendix B.

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

As seen throughout this profile, flood impacts are pervasive with potentially devastating impacts to people, built infrastructure, and the environment. When comparing vulnerabilities between communities, the relative vulnerability (low, medium, high) changes based on the metric (people, buildings, critical facilities, economic losses) and the flood hazard assessed (coastal, riverine, effective flood map risk areas, sea level rise, etc). To simplify the comparison between communities, the quantifiable metric of structures within the special flood hazard area (SFHA) is being utilized. More specifically, the percentage of the buildings within the community that are identified as being in the SFHA compared to all buildings in the community.

Table 4.30: Each Jurisdictions Relative Vulnerability to Flood (Using SFHA)

		All SFHA (A and V Zones)				
NAME	Buildings in Jurisdiction	Count of Buildings Exposed	% of Jurisdiction	Relative Jurisdictional Impacts	% of the at-risk exposure	% of County
UNINC	368,333	68,808	19%	Low	22%	6%
BELLEAIR	6,723	1,056	16%	Low	0%	0%
BELLEAIR BEACH	3,632	3,648	100%	Very High	1%	0%
BELLEAIR BLUFFS	2,822	-	0%	None	0%	0%
BELLEAIR SHORE	401	420	100%	Very High	0%	0%
CLEARWATER	117,869	17,071	14%	Low	5%	1%
DUNEDIN	48,173	8,894	18%	Low	3%	1%
GULFPORT	22,022	6,593	30%	Low	2%	1%
INDIAN ROCKS BEACH	7,212	7,340	100%	Very High	2%	1%
INDIAN SHORES	939	968	100%	Very High	0%	0%
KENNETH CITY	5,081	832	16%	Low	0%	0%
LARGO	86,092	6,633	8%	Low	2%	1%
MADEIRA BEACH	7,778	7,802	100%	Very High	2%	1%
NORTH REDINGTON BEACH	1,588	1,597	100%	Very High	1%	0%
OLDSMAR	18,738	9,967	53%	Medium	3%	1%
PINELLAS PARK	69,533	9,543	14%	Low	3%	1%
REDINGTON BEACH	3,597	3,625	100%	Very High	1%	0%
REDINGTON SHORES	3,269	3,282	100%	Very High	1%	0%
SAFETY HARBOR	26,403	2,176	8%	Low	1%	0%
SEMINOLE	21,841	4,045	19%	Low	1%	0%
SOUTH PASADENA	5,522	4,077	74%	High	1%	0%
ST. PETE BEACH	16,105	16,216	100%	Very High	5%	1%
ST. PETERSBURG	338,806	105,197	31%	Medium	33%	9%
TARPON SPRINGS	36,638	16,345	45%	Medium	5%	1%
TREASURE ISLAND	10,435	10,554	100%	Very High	3%	1%
Buildings in Risk Area		316,689				
All Buildings Countywide	1,229,552					
% of Risk Countywide		25.76%				

Jurisdictional Impact	% of Jurisdiction Impacted
No Exposure	0
Low	>0-30
Medium	30-60
High	60-85
Very High	85-100
	Highest Value of the Category

Furthermore, as flooding is the most prevalent hazard impacting the communities, there are additional, comprehensive sources of information within the appendices to supplement this section. These include the following: Appendix C - CRS 610; Appendix H – Program for Public Information; and Appendix I – Repetitive Loss Area Analysis. Appendix C covers the Flood Warning and Response Plan with detailed discussions on risk impacts to the community as well as language and demographic considerations for the flood vulnerable areas. Appendix H discusses all the mechanisms for communicating flood risk information to the community in both pre- and post-event situations. That documents also contains an assessment of the impacts to the jurisdictions to support the strategic development of risk communication initiatives for different audiences. Lastly, Appendix I provides a thorough assessment of watershed by watershed flood risks to identify the most at-risk (historically) geographies.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 3.3.

FLOOD					Overall Vulnerability
Overview					
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 Pinellas. Pinellas County communities experience several different kinds of floods due to the effects of severe thunderstorms, hurricanes, seasonal rains and other weather-related events.					HIGH
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Highly Likely	Critical	Moderate	6 to 12 hrs	< 1 week	3.3

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 poleward 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 to 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 the table below.

Table 4.30: Saffir-Simpson Hurricane Wind Scale[29]

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.

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

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
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 can issue during Tropical Cyclone events.[30]

- 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

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

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 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.

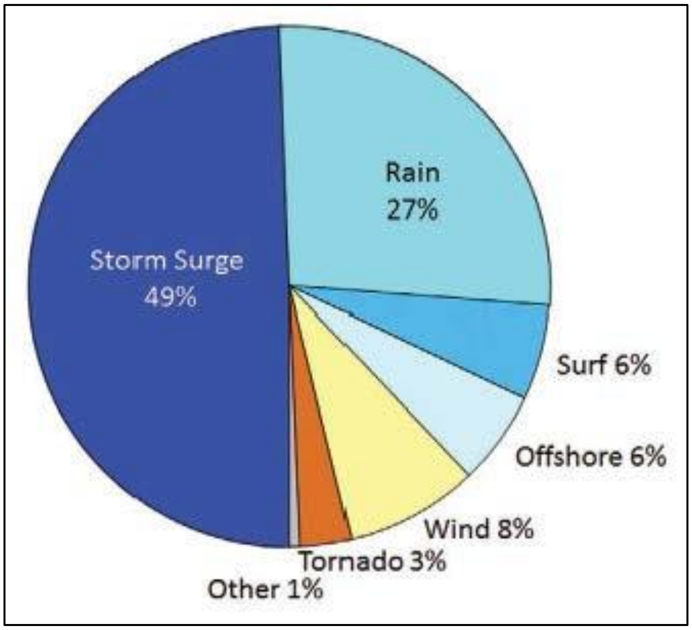
Causes of Fatalities in Tropical Cyclone Storms

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 causes death in the United States, two thirds of direct deaths from tropical cyclones were from just six specific storms.[31]

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

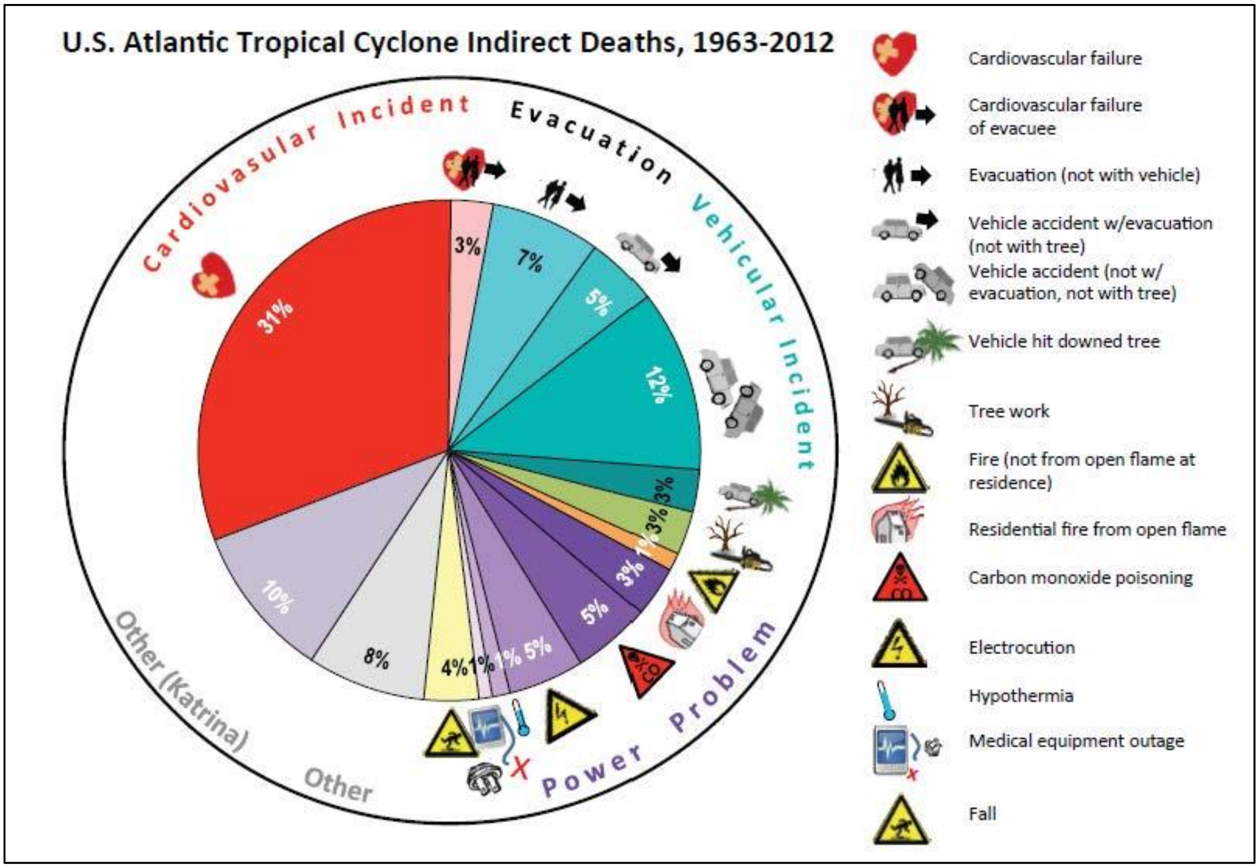
Figure 4.27: Deaths in the United States Directly Attributable to Atlantic Tropical Cyclones, 1963–2012[32]



The study also examined indirect deaths and found that there is 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.[33]

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

Figure 4.28: United States Atlantic Tropical Cyclone Indirect Deaths, 1963–2012[34]

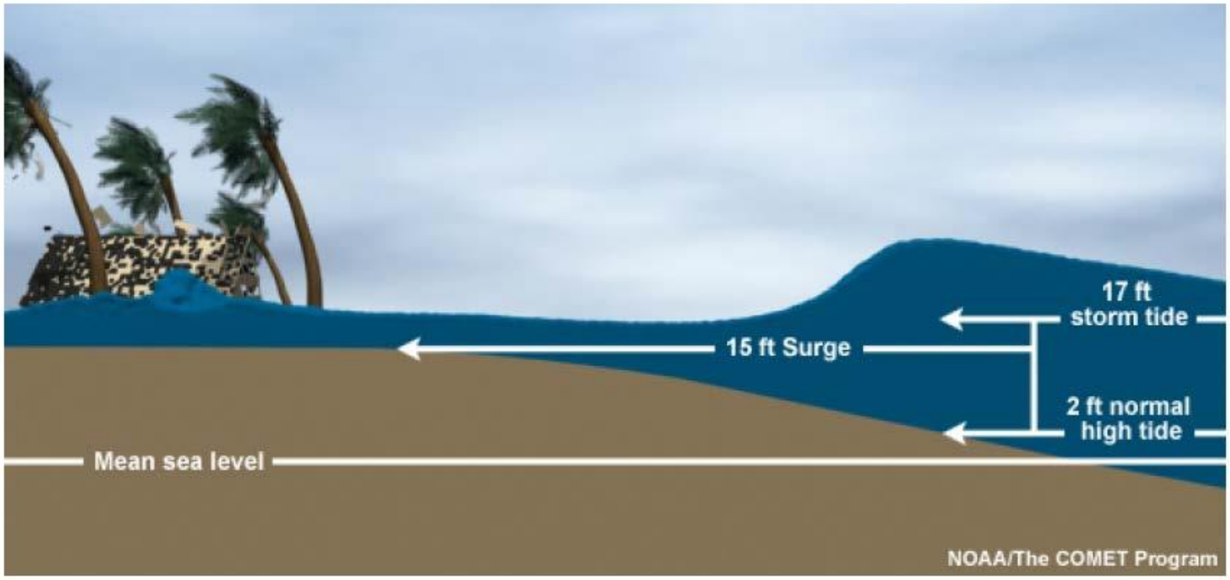


Storm Surge

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.[35]

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

Figure 4.29: 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%. 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 United States.

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.[36]

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 Storm 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 beachgoers. 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 beachgoers to the risk of rip currents at a particular beach. There are three levels of outlooks:[37]

- 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.

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

- High Risk: Life threatening rip currents are likely in the surf zone.

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.[38] 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,[39] 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.[40] Vertical wind shear disturbs the structure of a tropical cyclone and, therefore, increased shear can lead to system weakening.[41] 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.[42] As stated in the *Flood Hazard Profile*, higher rainfall intensity is likely as atmospheric moisture increases.[43]

2. Geographic Areas Affected by Tropical Cyclones

The entirety of Pinellas County is subject to the effects of tropical cyclones, but some areas are more vulnerable than others. This is due to its large areas of coastal shorelines on the Gulf Coast. The average diameter of hurricane force winds averages 100 miles, and tropical storm force winds extend out 300–400 miles;[44] while at the same time, no point within Pinellas County is more than 20 miles from the Gulf of Mexico. Tropical cyclones are random in distribution, so there is no specific region of Pinellas County

[38] 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.
[39] 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
[40] 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
[41] 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, 547.
[42] Kossin et al. (2010). *A globally consistent reanalysis of hurricane variability and trends.* Geophysical Research Letters, 34, 4. doi: 10.1029/2006GL028836.
[43] Knutson et al. (2010). *Simulated reduction in Atlantic hurricane frequency under twenty-first-century warming conditions.* Nature Geoscience,1(6), 161.
[44] http://www.hurricanescience.org/science/science/hurricanestructure/

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.

As seen in the map below, tropical cyclones are random and affect all of Pinellas County. The image below depicts all the tropical cyclones to affect Pinellas County from 1852 to 2017. This graphic shows that all areas of the county can be affected by tropical cyclones.[45]

The additional maps that follow delineate areas that are vulnerable to the storm surge that can be produced by tropical cyclones and are not located in the effective or preliminary floodplains.

[45] https://coast.noaa.gov/hurricanes/

Figure 4.30: Historical Tropical Cyclone Tracks, Pinellas County, 1852 to 2017

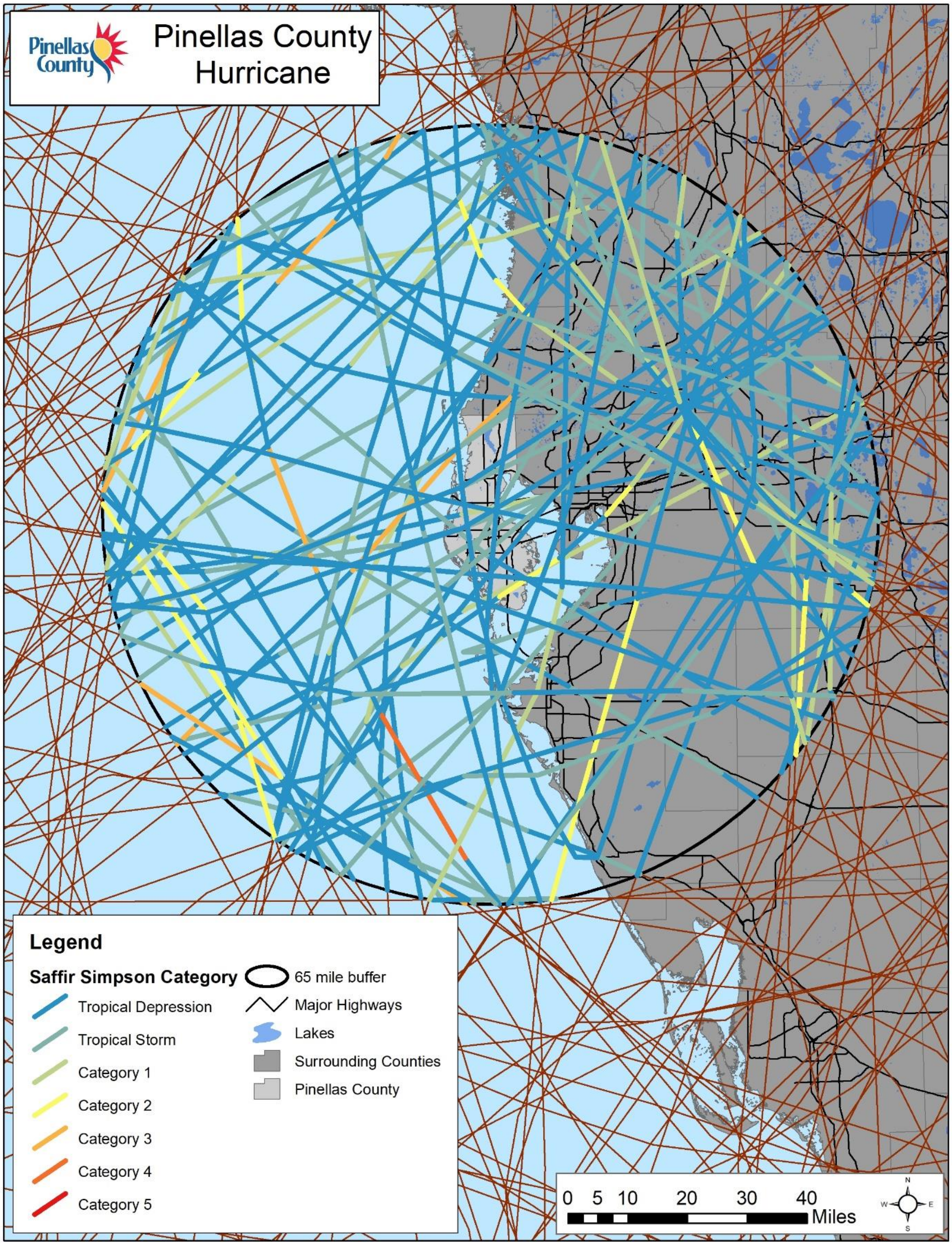


Figure 4.31: Storm Surge Zones – Not in Effective Flood Area

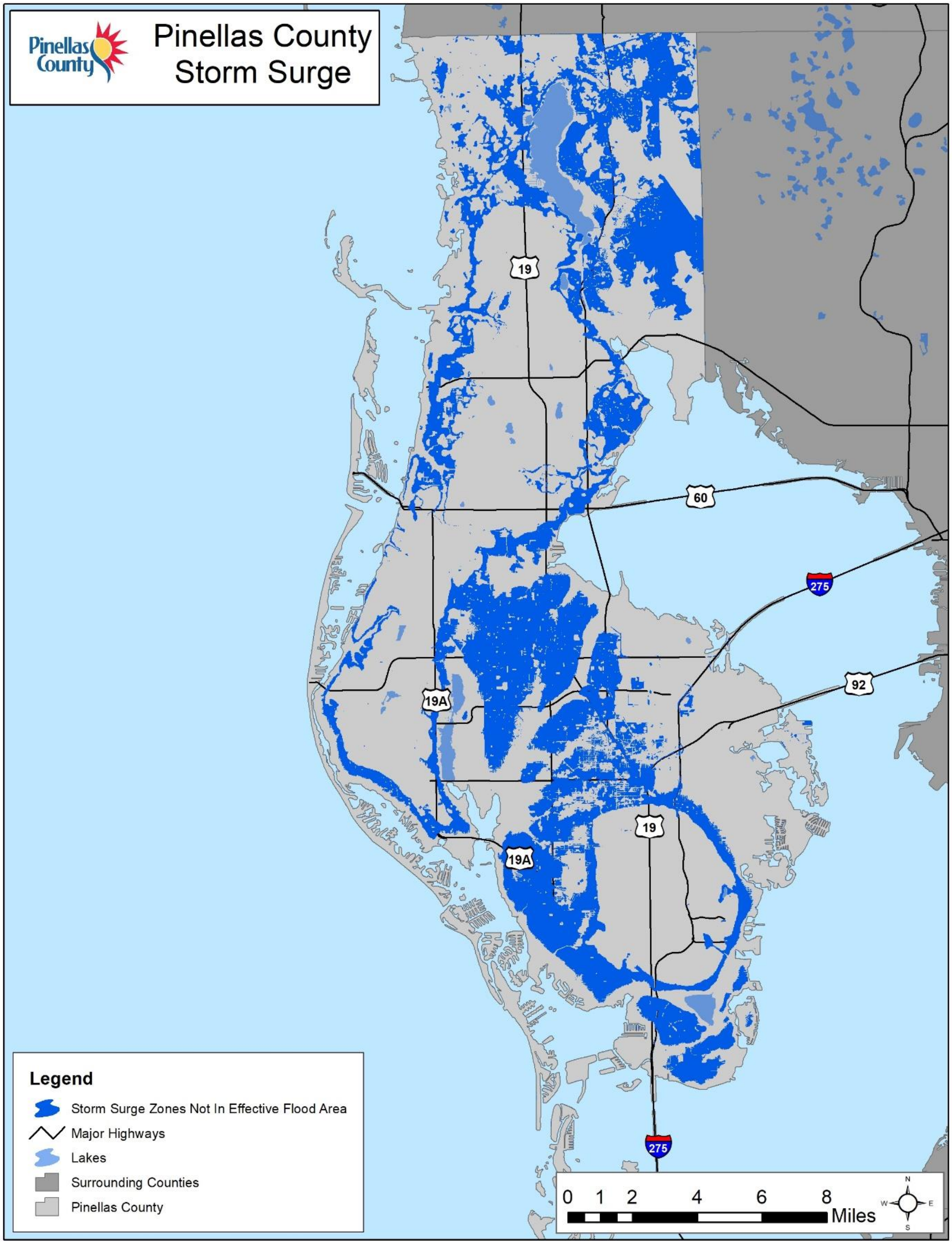


Figure 4.32: Storm Surge Zones – Not in Preliminary Flood Area

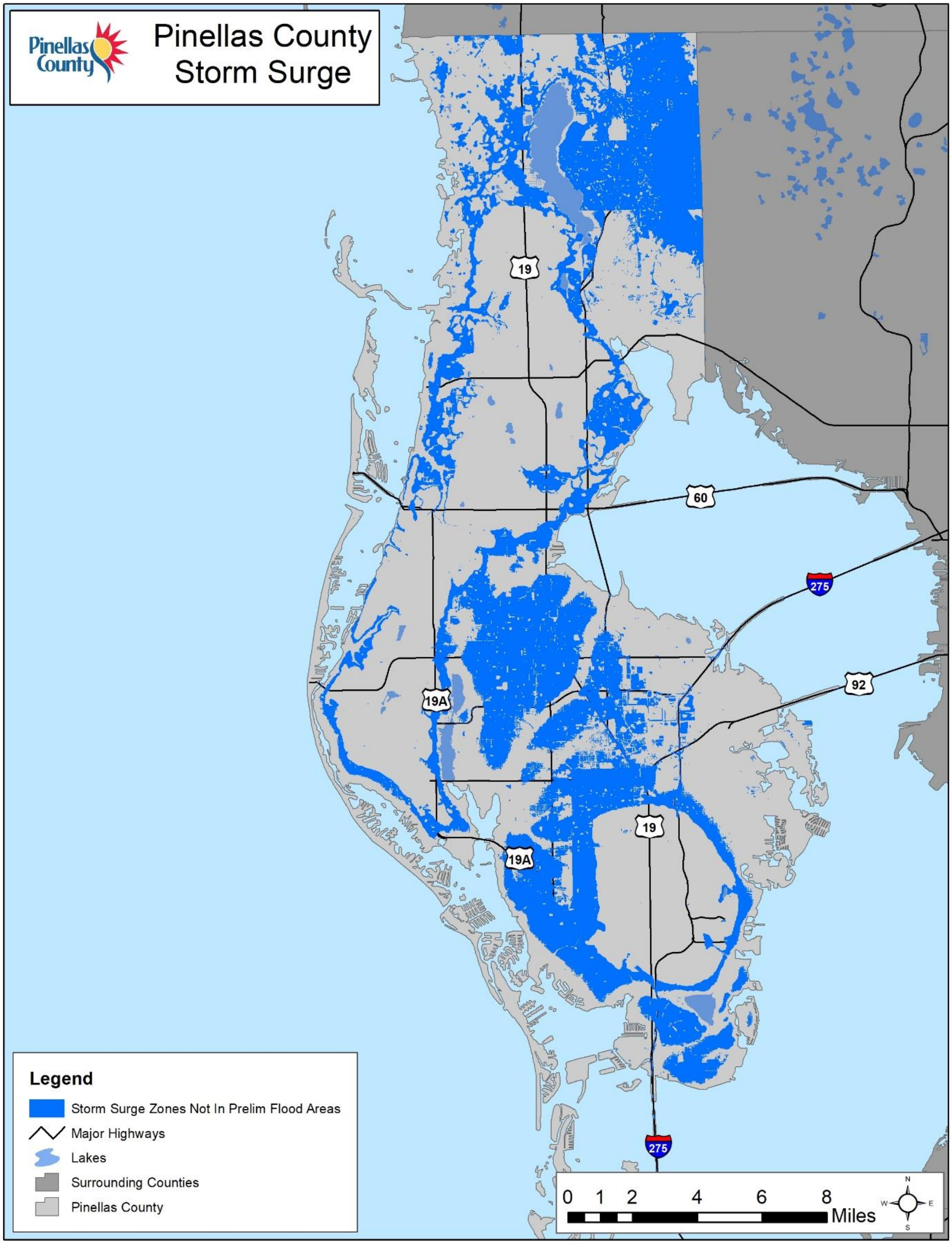


Figure 4.33: Storm Surge Zones – Category 1 Depth

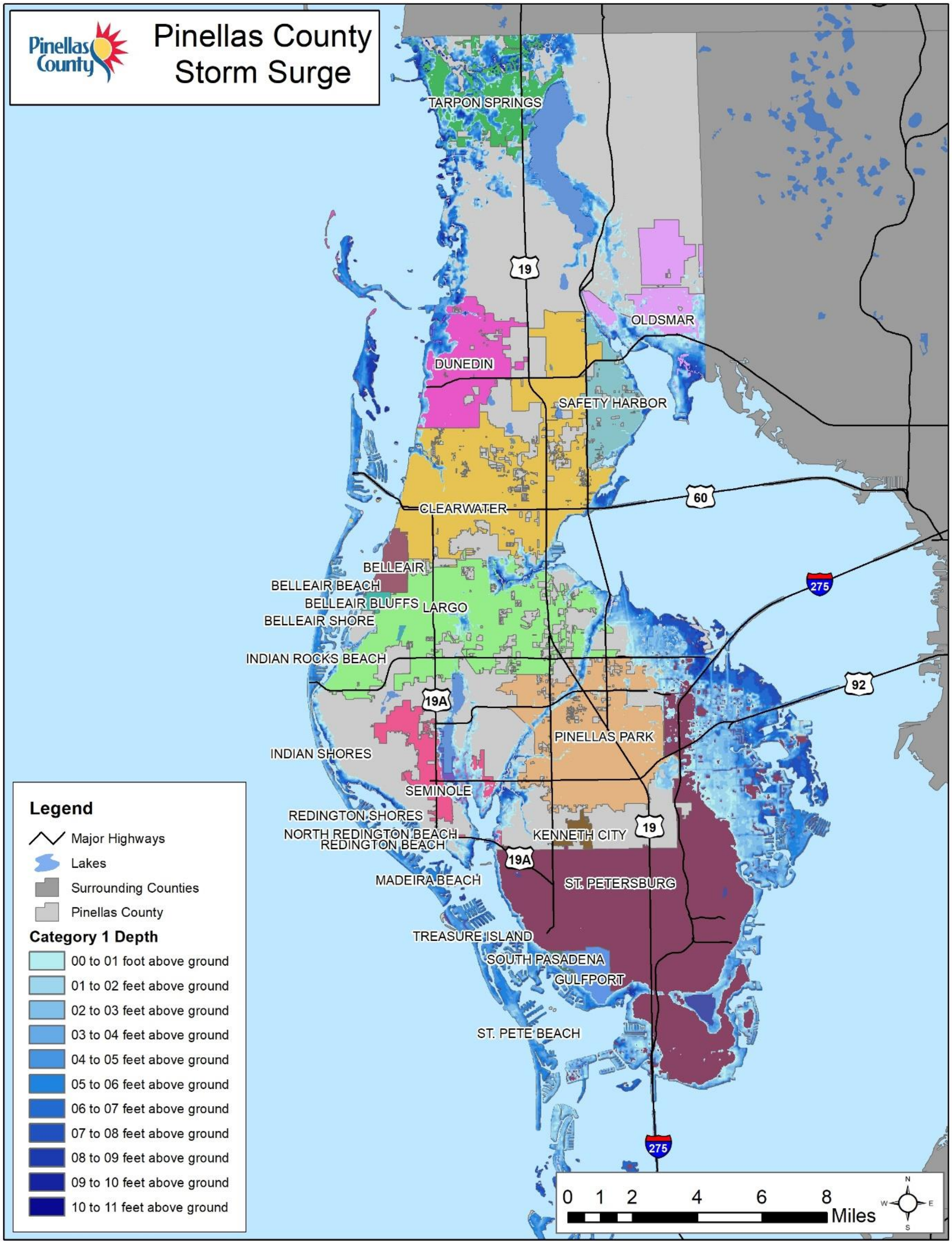


Figure 4.34: Storm Surge Zones – Category 3 Depth

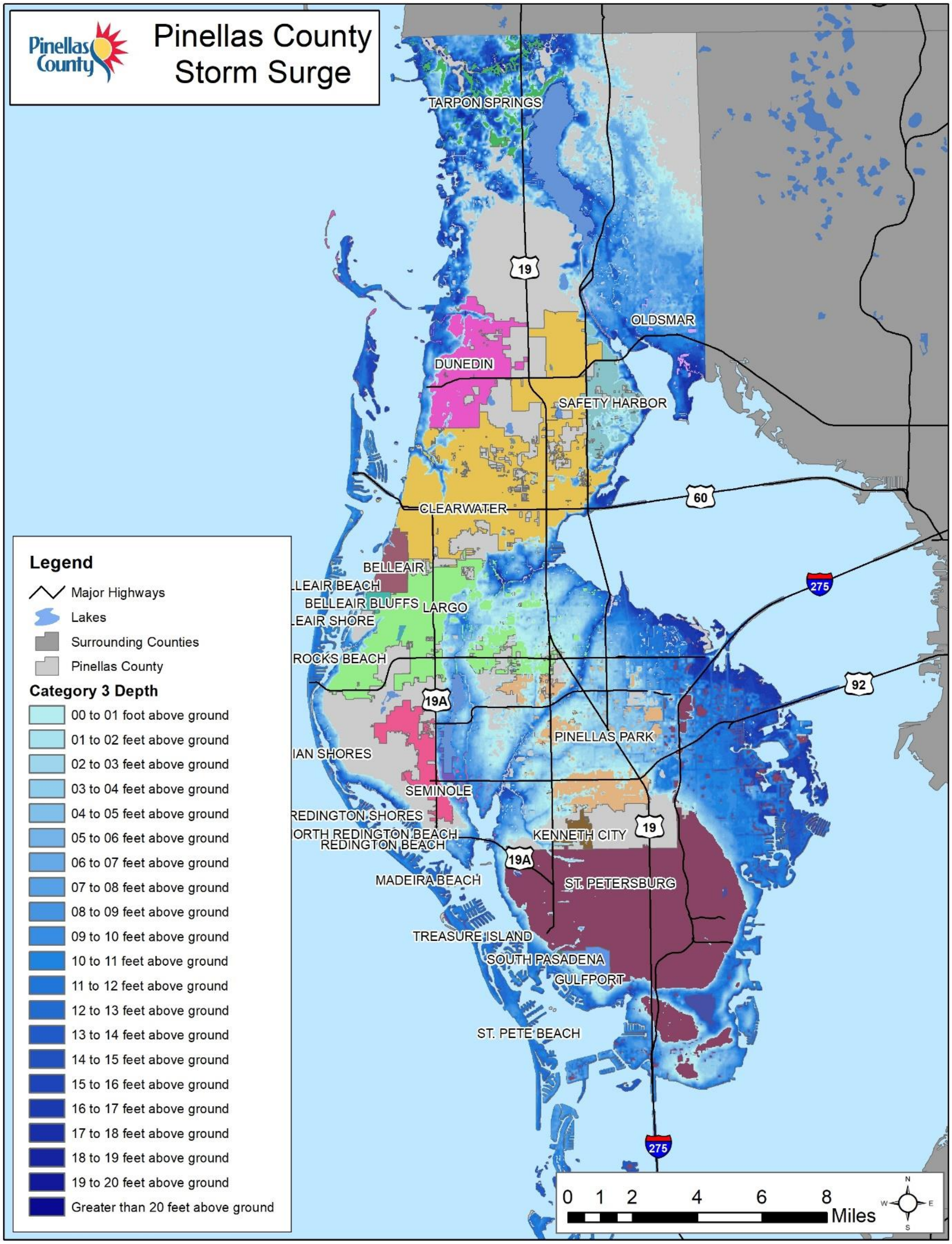
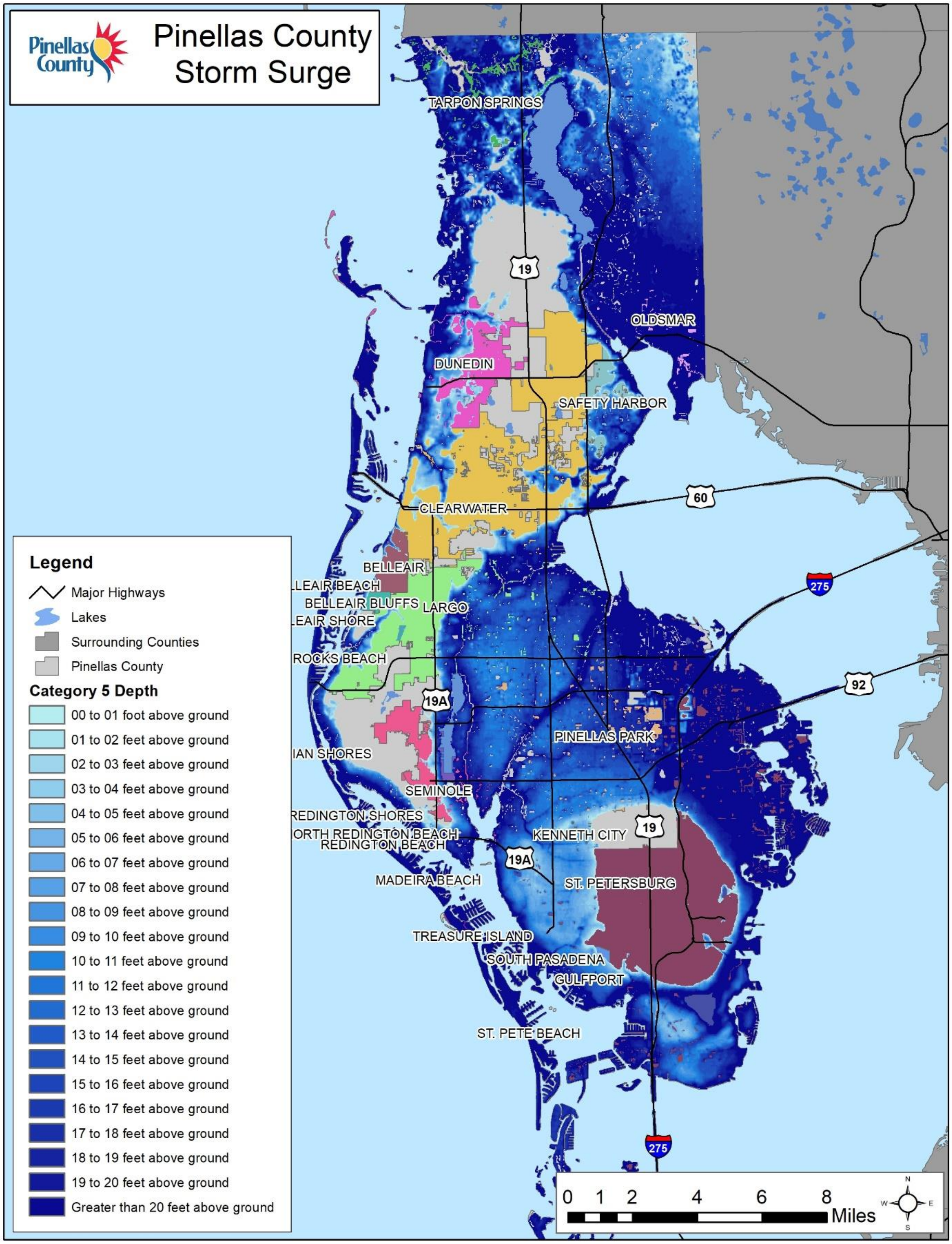


Figure 4.35: Storm Surge Zones – Category 5 Depth



3. Historical Occurrences of Tropical Cyclones

The table below lists the significant hurricanes and tropical storms that affected Pinellas County.

Table 4.31: Significant Tropical Cyclone Occurrences in Pinellas County[46]

Date	Description
1921	The hurricane of 1921 produced a storm surge of 10.5 feet which was the highest recorded since the hurricanes of 1848. Locally, it created both Longboat Pass (which now separates the City of Bradenton Beach and Longboat Key) and Hurricane Pass in Dunedin. Before the storm, Passage Key, located between Egmont Key and Anna Maria Island, was the home to a fishing village and fresh water lake. Following the storm and continuing today, Passage Key is a sandbar with little vegetation and a Natural Bird Sanctuary. This was the last major hurricane (a Category 3 when it hit he coast) to actually make landfall in Pinellas County.
September 1985	On Labor Day weekend 1985, Hurricane Elena threatened Pinellas County and approached within 80 miles of the coast. Evacuations in Louisiana, Mississippi, Alabama and Florida were of unprecedented proportions. Almost 1 million residents and visitors were affected in the initial evacuation orders in the Florida panhandle and coastal region of Alabama, Mississippi and Louisiana. Then, as the storm turned and the warnings shifted, 10 additional Florida counties including those in Tampa Bay were ordered to evacuate. The threat of Elena initiated an evacuation which forced over 500,000 to leave vulnerable areas in the Tampa Bay region and seek shelter. Many sought shelter in the homes of friends and relatives in inland areas of Florida and Georgia. Others went to hotels and motels – filling every room (and lobby) in the state particularly along the I-75 and I-4 corridors. More than 300,000 sought public shelter in the Tampa Bay Region alone – one of the largest evacuations and shelter operations in U.S. history. After stalling off the coast for two days, Hurricane Elena turned toward the Florida Panhandle again, forcing the evacuation of thousands of coastal residents just returning after the earlier round of evacuations, ultimately making landfall near Biloxi, Mississippi. Although it never made landfall, Pinellas County received approximately $118 million in damages.
August 1992	While Hurricane Andrew did not directly strike the Tampa Bay region, it did affect the entire state in many ways. Only two other hurricanes in history, both Category 5 storms – the Labor Day storm of 1935, Camille in 1969 – were stronger than Hurricane Andrew when they made landfall in the United States. It struck South Florida with a storm surge of over 16 feet and winds which gusted over 175 mph. The scale of the disaster was enormous and the massive recovery that ultimately ensued was of epic proportions. The damages were staggering – surpassing $50 billion – affecting emergency management policies and procedures, insurance industry and land development regulations (including the statewide building code).

[46] https://www.nhc.noaa.gov/

Date	Description
September 1998	Hurricane Georges threatened Central and Southwest Florida in the end of September 1998. From September 21st through the 30th, Hurricane Georges left a trail of destruction in the Caribbean region and across the southern U.S. Gulf coast. As the Hurricane threatened the Keys and Southwest Florida the potential threat to Pinellas County continued to develop. On Wednesday September 23rd the county activated the Citizens Information Center to answer the flood of calls from concerned citizens. On September 24th, preparedness and response actions and planning accelerated. A final meeting of the Disaster Advisory Committee was held at 9:30 AM. The County EOC was partially activated at 11:00 AM. The Board of County Commissioners met in Emergency Session at 11:30 AM and declared a State of Local Emergency and issued a Mandatory A Level Evacuation, to be effective at 6 AM on September 25th. At 6 PM the National Weather Service issued a Flood Watch and at 11PM the National Hurricane Center issued A Tropical Storm Warning. On September 25th the State of Local Emergency became effective at 6 AM. County Offices and schools were closed, and 55 Public Shelters were opened with a total capacity of 83,560 spaces. As the threat of Georges began to appear to lessen shelter operations were consolidated to relieve the load on first responders and management staff. By noon on the 25th of September the President of the United States declared a State of Emergency for Florida. On September 26th, the threat to West Central Florida continued to lessen. Tropical Storm Warnings and Tornado Watches for Pinellas County were canceled. The Mandatory A Level Evacuation Order was lifted and by noon the Shelters were closed and the EOC deactivated.
September 17, 2000	On September 17, 2000 Hurricane Gordon moved northeast across the eastern Gulf of Mexico and brought 30 to 40 mph sustained winds and 50 to nearly 70 mph tropical storm force wind gusts to mainly coastal areas of Southwest and West Central Florida throughout the daylight hours of the 17th. Hurricane Gordon produced maximum storm tides above mean sea level of 4 to 5.5 feet along the Pinellas and Hillsborough county coastlines. In Pinellas County, nearly a foot of water covered coastal roads from St. Pete Beach to Clearwater. The Courtney Campbell Parkway, separating Pinellas and Hillsborough counties, was closed for approximately 4 hours due to storm surge flooding. Beach erosion was minor to moderate over Pinellas County. In Pinellas County, 51 single-family homes, 32 mobile homes, 27 multi-family homes and 24 businesses sustained minor wind or water damage. Estimated cost of the damage in Pinellas County was $500,000 dollars.
September 14, 2001	Tropical Storm Gabrielle began to affect the Southwest Florida coast during the pre-dawn hours of September 14, 2001, with sustained winds of 40 to 50 mph along the coasts of Sarasota, Manatee, Charlotte and Lee counties. By sunrise, high end tropical storm force wind gusts of 60 to 70 mph were common from the mouth of Tampa Bay south to Charlotte Harbor. Gabrielle continued to move northeast and made landfall, south of Venice, in Sarasota County, between 6:45 and 7:00 a.m. EST. In Pinellas and Hillsborough counties, northeast wind gusts of 50 to 65 mph were common across most of Tampa Bay and the southern portions of the counties. Storm tide values of up to three feet were common on the Pinellas county side (west) of Tampa Bay, from the Gandy

Date	Description
	Bridge south to Pinellas Point. Most wind damage and flooding were minor across Pinellas and Hillsborough counties. The most significant impact for Pinellas County was overhead power distribution lines brought down by falling tree limbs particularly in the City of St. Petersburg.
August 9–14, 2004	Hurricane Charley strengthened rapidly just before striking the southwestern coast of Florida as a Category 4 hurricane on the Saffir-Simpson Hurricane Scale. Charley was the strongest hurricane to hit the United States since Andrew in 1992 and, although small in size, it caused catastrophic wind damage in Charlotte County, Florida. Serious damage occurred well inland over the Florida peninsula. In the Tampa Bay Region, dead center for the 24-hour forecast track, evacuations were ordered in all four counties. Charley was directly responsible for 10 deaths – primarily from flying debris and fallen trees. There were an additional 20 indirect deaths.
August 25–September 8, 2004	Hurricane Frances was a Cape Verde-type hurricane that reached a peak intensity of Category 4 on the Saffir-Simpson Hurricane Scale. It affected the Bahamas as a Category 3 hurricane and the Florida east coast as a Category 2 hurricane. The Tampa Bay Region experienced tropical storm and minimal hurricane force winds with some coastal and more extensive inland flooding caused by more than 10 inches of rainfall. Frances was directly responsible for seven deaths – five in Florida, one in the Bahamas, and one in Ohio. Three deaths were caused by wind, two by storm surge, one by freshwater flooding, and one by lightning. The hurricane was indirectly responsible for 42 deaths – 32 in Florida, 8 in Georgia, 1 in the Bahamas, and 1 in Ohio.
September 2–24, 2004	Hurricane Ivan was a classical, long-lived Cape Verde hurricane that reached Category 5 strength on the Saffir-Simpson Hurricane Scale (SSHS) three times. It was also the strongest hurricane on record that far south east of the Lesser Antilles. Ivan caused considerable damage and loss of life as it passed through the Caribbean Sea. Despite the unfavorable environmental conditions, the presence of cooler shelf water just offshore and eyewall replacement cycles, Ivan weakened only slowly and made landfall as a 105 kt hurricane (Category 3 on the SSHS) on September 16th, just west of Gulf Shores, Alabama. Ivan caused extensive damage to coastal and inland areas of the United States. Portions of the Interstate 10 bridge system across Pensacola Bay, Florida, were severely damaged in several locations as a result of severe wave action on top of the 10–15 ft storm surge. At one point, more than 1.8 million people were without power in nine states.
September 13–28, 2004	Hurricane Jeanne produced heavy rain over Guadeloupe, Puerto Rico and the Dominican Republic and caused an estimated 3000 or more deaths in Haiti, from torrential rainfall flooding. Finally, Jeanne hit the northern Bahamas and then the central Florida east coast as a Category 3 hurricane. Jeanne moved across central Florida while weakening and began to curve around the western periphery of the migratory ridge. The hurricane weakened to a tropical storm while centered about 30 mi north of Tampa September 26th and then weakened to a tropical depression about 24 hours later while moving northward across central Georgia accompanied by heavy rain. Winds were somewhat higher in the Tampa Bay Region for Hurricane Jeanne than

Date	Description
	Hurricane Frances resulting in wind damage and minimal coastal flooding. Areas still flooded from Frances (three weeks before) received additional flood waters.
August 2008	In 2008, Tropical Storm Fay resulted in resulted in approximately $20,000 in property damage in Pinellas County primarily from heavy rainfall. As it zigzagged from water to land, it became the first storm in recorded history to make landfall in Florida four times. Thirty-six deaths were blamed on Fay. The storm also resulted in one of the most prolific tropical cyclone related tornado outbreaks on record. A total of 81 tornadoes touched down across five states, three of which were rated as EF2. Damage from Fay was heavy in Florida, estimated at $560 million.
June 2012	In June 2012, Tropical Storm Debby, a minor tropical storm flooded many parts of the state including Pinellas County. In St. Petersburg, a gust of 45 mph (72 km/h) was observed, while 1.88 inches (48 mm) of rain fell in a one-hour period. With the substantial loss of beaches, tourism in the region is expected to suffer significantly. Portions of Upham Beach in Pinellas County were completely eroded up to the seawall and other areas in that county had lost 20 to 30 ft (6.1 to 9.1 m) of sand. On Treasure Island, coastal dunes were eroded by 10 to 15 ft (3.0 to 4.6 m). In Pass-a-Grille, Debby's storm surge flooded coastal hotels with ankle-deep water as the dunes were washed away. Throughout St. Pete Beach, 30–40 homes were damaged by a tornado spawned by Debby.
August–September 2016	Hermine formed in the Florida Straits south of Key West on August 28th. It remained a very disorganized tropical depression for a few days before the environment around it gradually became more favorable and it became a tropical storm late in the day on the 30th. Hurricane Hermine made landfall just east of St. Marks, Florida, around 0130EDT on September 2 as a Category 1 Hurricane with a minimum central pressure of 982 mb, and maximum sustained winds estimated at 70 knots (80 MPH). Heavy rainfall over West-Central and Southwest Florida began on August 31 and continued through September 2, with as much as 20 inches of rain falling in some locations. River flooding from this heavy rain impacted some areas through September 6th. Storm surge generally ranged from 2 to 7 feet above normal high tide, with the highest storm surge value recorded of 7.5 feet at Cedar Key. The collective effects of Hurricane Hermine during the period of September 1–6 resulted in just over $219M in property damage, and no fatalities or injuries across West-Central and Southwest Florida. In Pinellas County, the highest sustained wind speed recorded was 51 knots, with a peak gust of 68 knots in the afternoon of the 1st at a home weather station at Indian Shores Beach. Storm total rainfall ranged from 6 to 20 inches between the 31st and the 2nd, with the highest value recorded of 22.11 inches at the CWOP station 1 mile SSE Baskin. Storm surge generally ranged from 2 to 4 feet above normal high tide. At Clearwater Beach, the peak surge was 4.41 feet on the evening of the first, and when added to the normal astronomical tide cycle, the highest storm tide was 3.99 feet NAVD88 of total water. The total damage from Hermine in Pinellas County was estimated to be $7.3 million, which includes $4 million from coastal flooding, $2.3 million from inland flooding, and $1 million from wind damage.

Date	Description
	Combining all damage sources, a total of 867 residential properties had minor or affected damage, 3 had major damage, and 5 were reported destroyed in Pinellas county.
September 2017	In Pinellas County, the highest winds reported from Hurricane Irma was a gust to 77 knots at Pier 60 Park. Rainfall was generally around 4 inches or greater, with the highest rain total 5.98 inches at the GOES station BTRF1 in Tarpon Springs. The wind resulted in damage to numerous homes, as well as knocking over trees and power lines. Pinellas County Emergency Management reported that 77 homes or businesses were destroyed, 533 sustained major damage, 5761 had minor damage, and an additional 11,935 were affected by hurricane Irma throughout Pinellas County. The track of Irma resulted in a much stronger negative surge north of the eye, causing extremely low water levels in the Tampa Bay. No significant damage was reported from either the negative surge or the weak positive surge. The total damage from Irma in Pinellas County was estimated at $594.45 million, including $588.08 million in individual assistance claims and $6.37 million in public assistance claims, most of which was caused by wind damage. One indirect fatality was reported in Pinellas County from Hurricane Irma. A 53-year-old man was repairing cable lines in Feather Sound on the 16th when he fell 20 feet from a ladder. The medical examiner ruled that heart disease was a contributing factor.

Additionally, there have been 10 FEMA major disaster declarations in Pinellas County that are related to tropical cyclone events.

Table 4.32: FEMA Major Disaster Declarations in Pinellas County, Tropical Cyclone, 1953–2018[47]

Disaster Number	Date	Name/Description
DR-252	November 7, 1968	HURRICANE GLADYS
DR-337	June 23, 1972	TROPICAL STORM AGNES
DR-743	August 29–September 2, 1985	HURRICANE ELENA
DR-1141	October 7–21, 1996	TROPICAL STORM JOSEPHINE
DR-1539	August 11–30, 2004	TROPICAL STORM BONNIE AND HURRICANE CHARLEY
DR-1545	September 3–October 8, 2004	HURRICANE FRANCES
DR-1561	September 24–November 17, 2004	HURRICANE JEANNE
DR-4068	June 23–26, 2012	TROPICAL STORM DEBBY
DR-4280	August 31–September 11, 2016	HURRICANE HERMINE
DR-4337	September 4–October 18, 2017	HURRICANE IRMA

[47] https://www.fema.gov/media-library/assets/documents/28318

According to the NCEI Storm Events Database, there were 23 reports of tropical cyclone in Pinellas County from 1996 to 2018.[48] These tropical cyclone events are only inclusive of those reported by NCEI from 1996 through 2018, and events are only reported at the county level. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.33: Summary of Tropical Cyclone Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
PINELLAS COUNTY TOTAL	**23**	**0**	**1**	**$741,649,846**	**$33,711,357**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.34: Historical Tropical Cyclone Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Pinellas County						
PINELLAS (ZONE)	10/7/1996	Tropical Storm	0	1	$40,390,467	$0
PINELLAS (ZONE)	9/2/1998	Hurricane (Typhoon)	0	0	$0	$0
PINELLAS (ZONE)	9/25/1998	Hurricane (Typhoon)	0	0	$0	$0
PINELLAS (ZONE)	11/4/1998	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	9/20/1999	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	9/17/2000	Hurricane (Typhoon)	0	0	$14,712	$0
PINELLAS (ZONE)	9/17/2000	Hurricane (Typhoon)	0	0	$735,602	$0
PINELLAS (ZONE)	9/14/2001	Tropical Storm	0	0	$1,074,936	$0
PINELLAS (ZONE)	9/5/2004	Tropical Storm	0	0	$43,600,607	$0
PINELLAS (ZONE)	9/26/2004	Tropical Storm	0	0	$39,025,234	$0
PINELLAS (ZONE)	7/9/2005	Tropical Storm	0	0	$26,156	$0
PINELLAS (ZONE)	10/24/2005	Tropical Storm	0	0	$245,028	$0
PINELLAS (ZONE)	6/13/2006	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	6/2/2007	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	6/6/2013	Tropical Storm	0	0	$0	$0

[48] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Hurricane+%28Typhoon%29&eventType=%28Z%29+Tropical+Depression&eventType=%28Z%29+Tropical+Storm&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS (ZONE)	6/6/2016	Tropical Storm	0	0	$5,301	$0
PINELLAS (ZONE)	9/1/2016	Tropical Storm	0	0	$1,058,485	$0
PINELLAS (ZONE)	10/7/2016	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	10/7/2016	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	10/7/2016	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	7/31/2017	Tropical Storm	0	0	$0	$0
PINELLAS (ZONE)	9/10/2017	Hurricane	0	0	$615,473,317	$0
PINELLAS (ZONE)	5/27/2018	Tropical Storm	0	0	$0	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

Storm Surge

According to the NCEI Storm Events Database, there were 12 reports of storm surge in Pinellas County from 1998 to 2018.[49] These storm surge events are only inclusive of those reported by NCEI from 1996 through 2018, and events are only reported at the county level. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.35: Summary of Storm Surge Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
PINELLAS COUNTY TOTAL	**12**	**0**	**0**	**$11,490,594**	**$574,530**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.36: Historical Storm Surge Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Pinellas County						
ANCLOTE	1/2/1998	Storm Surge/Tide	0	0	$316,272	$0
ANCLOTE	1/2/1999	Storm Surge/Tide	0	0	$311,075	$0
PINELLAS (ZONE)	9/6/2004	Storm Surge/Tide	0	0	$672,849	$0
PINELLAS (ZONE)	9/15/2004	Storm Surge/Tide	0	0	$0	$0
PINELLAS (ZONE)	9/26/2004	Storm Surge/Tide	0	0	$0	$0
PINELLAS (ZONE)	7/10/2005	Storm Surge/Tide	0	0	$2,615,640	$0
PINELLAS (ZONE)	8/28/2005	Storm Surge/Tide	0	0	$0	$0

[49] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Storm+Surge%2FTide&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS (ZONE)	6/2/2007	Storm Surge/Tide	0	0	$0	$0
PINELLAS (ZONE)	9/10/2008	Storm Surge/Tide	0	0	$0	$0
PINELLAS (ZONE)	6/24/2012	Storm Surge/Tide	0	0	$3,340,817	$0
PINELLAS (ZONE)	6/6/2013	Storm Surge/Tide	0	0	$0	$0
PINELLAS (ZONE)	9/1/2016	Storm Surge/Tide	0	0	$4,233,941	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

4. Probability of Future Tropical Cyclones

Since tropical cyclones are random in distribution, it is impossible to forecast whether Pinellas County 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.

Probability Based on Historical Occurrences

An analysis of tropical cyclone reports from 1996 to 2018 in Pinellas County from the NCEI Storm Events Database indicates that there will be less than one tropical storm, less than one hurricane, and less than one storm surge event each year in Pinellas County.

Table 4.37: NCEI Tropical Cyclone Reports 1996–2018[50]

Type of Tropical Cyclone	NCEI Reports	Average per Year
Tropical Storm	18	< 1
Hurricane	5	< 1
Storm Surge	12	< 1
TOTAL	**35**	**1.6**

Based on historical information, this hazard was determined to have a probability level of likely (10 to 100% annual probability). The probability is high that all jurisdictions could be impacted by tropical cyclones. While communities along the Gulf of Mexico, Tampa Bay, and intercoastal waterways face potential storm surge conditions in addition to winds, even inland communities of Kenneth City and Pinellas Park can be devastated by wind impacts.

[50]https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Hurricane+%28Typhoon%29&eventType=%28Z%29+Storm+Surge%2FTide&eventType=%28Z%29+Tropical+Depression&eventType=%28Z%29+Tropical+Storm&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

5. Tropical Cyclones Impact Analysis

All jurisdictions could receive the following impacts due to tropical cyclones. While communities along the Gulf of Mexico, Tampa Bay, and intercoastal waterways face potential storm surge conditions in addition to winds, even inland communities of Kenneth City and Pinellas Park can be devastated by wind impacts.

- 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
    - Possibly forced to evacuate
      - Cost to travel
      - Cost to stay at hotel
      - Loss of wages if out of town
      - Loss of food if you cannot 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 does not have expected impacts

6. Vulnerability Analysis and Loss Estimation by Jurisdiction

Due to Pinellas County’s geographic location, the entire county is vulnerable to damage from tropical cyclones. As the population of the county increases, so does the number of those who have not experienced the impact of a tropical cyclone or major hurricane.

The vulnerability of the county 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.

Historic Losses

The NCEI Storm Events Database information, presented in the Historical Occurrences 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 4.38: Tropical Cyclone Events in Pinellas County, by Type, (1996–2018)[51]

Type of Event	Number of Events	Deaths	Injuries	Property Damage (2019 dollars)	Crop Damage (2019 dollars)
Tropical Storm	18	0	1	$125,426,215	$0
Hurricane	5	0	0	$616,223,631	$0
Storm Surge	12	0	0	$11,490,594	$0
TOTAL	**35**	**0**	**1**	**$753,140,440**	**$0**

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 4.39: NCEI Tropical Cyclones, 1996–2018[52]

NCEI Storm Event (hazard)	Average Tropical Cyclones per Year	Annualized Property Loss (2019 dollars)	Annualized Crop Loss (2019 dollars)
All Types of Tropical Cyclones	1.6	$34,233,656	$0

According to the analysis, Pinellas County is historically vulnerable to over $34 million in property damages and $0 in crop damages from approximately 1.6 tropical cyclone events each year.

Exposure

Storm Surge

To estimate exposure of improved property to storm surge, the approximate number of parcels and their associated improved valued located in hurricane risk areas was determined using GIS analysis. The storm surge zones utilized are those areas not located in the effective or preliminary floodplains and the hurricane storm surge areas associated with various category hurricanes.

[51] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Hurricane+%28Typhoon%29&eventType=%28Z%29+Storm+Surge%2FTide&eventType=%28Z%29+Tropical+Depression&eventType=%28Z%29+Tropical+Storm&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

[52] 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 4.40: Estimated Exposure of Improved Property to Hurricane Risk Areas – Storm Surge Zones

Location	Buildings and Parcels in Hurricane Risk Area					
	Storm Surge Zones Not in Effective Floodplain			Storm Surge Zones Not in Preliminary Floodplain		
	No. of Parcels	No. of Buildings	Improved Value	No. of Parcels	No. of Buildings	Improved Value
Belleair	702	536	$71,667,163	598	555	$54,675,861
Belleair Beach	154	36	$11,708,849	0	0	$0
Belleair Bluffs	203	143	$13,019,580	202	149	$13,019,580
Belleair Shore	38	0	$25,743,328	0	0	$0
Clearwater	11,602	21,199	$1,706,977,855	9,588	21,482	$1,520,792,993
Dunedin	7,072	17,711	$682,118,986	6,449	17,669	$658,271,462
Gulfport	4,284	13,758	$329,943,140	3,379	13,252	$278,339,549
Indian Rocks Beach	496	105	$22,524,525	0	0	$0
Indian Shores	985	0	$10,081,989	1	0	$15,456
Kenneth City	1,316	2,883	$103,955,465	1,900	4,338	$128,909,714
Largo	16,785	35,141	$1,734,533,907	16,582	35,894	$1,739,899,445
Madeira Beach	654	100	$60,853,773	0	0	$0
North Redington Beach	153	33	$13,833,920	0	0	$0
Oldsmar	944	1,784	$193,521,280	858	2,529	$216,065,356
Pinellas Park	15,939	46,996	$1,973,944,629	17,569	52,185	$2,172,774,346
Redington Beach	119	29	$10,906,950	0	0	$0
Redington Shores	460	77	$14,899,290	0	0	$0
Safety Harbor	5,350	15,555	$739,004,092	5,220	15,376	$730,005,746
St. Petersburg	32,676	92,307	$4,332,654,410	30,014	99,276	$4,294,592,897
St. Pete Beach	2,385	194	$273,238,957	0	0	$0
Seminole	2,123	3,709	$261,924,842	2,143	3,822	$251,480,099
South Pasadena	1,628	1,321	$102,245,399	495	1,242	$7,543,540
Tarpon Springs	6,143	15,201	$682,881,122	6,546	16,836	$732,308,604
Treasure Island	1,128	157	$80,080,348	0	0	$0
Unincorporated	49,183	125,709	$6,143,996,265	45,890	127,461	$5,643,548,296
PINELLAS COUNTY TOTAL	**162,522**	**394,684**	**$19,596,260,064**	**147,434**	**412,066**	**$18,442,242,944**

Table 4.41: Estimated Exposure of Improved Property to Hurricane Risk Areas – Hurricane Storm Surge (Category 1, 2, and 3) – Pinellas County Total

Storm Surge Depth	Buildings and Parcels in Hurricane Risk Areas								
	Category 1			Category 2			Category 3		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
0 to 1 ft	13,249	28,494	$1,176,059,505	11,618	33,752	$1,207,715,414	12,080	40,915	$1,410,147,294
1 to 2 ft	17,551	37,668	$1,726,350,607	9,499	27,876	$1,266,033,441	11,839	38,597	$1,431,741,735
2 to 3 ft	22,971	44,833	$2,296,143,570	9,749	24,657	$1,159,138,146	12,289	39,700	$1,329,061,033

Storm Surge Depth	Buildings and Parcels in Hurricane Risk Areas								
	Category 1			Category 2			Category 3		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
3 to 4 ft	24,238	40,365	$1,923,358,129	11,275	26,083	$1,064,463,623	11,743	37,420	$1,228,656,030
4 to 5 ft	20,582	44,750	$1,940,769,395	14,651	30,388	$1,319,876,957	12,182	34,046	$1,181,861,669
5 to 8 ft	23,693	68,549	$2,718,946,763	70,215	135,362	$6,591,699,765	32,931	80,616	$3,714,815,958
8 to 11 ft	785	2,494	$102,384,770	36,851	99,544	$3,913,639,187	65,488	119,740	$5,889,824,501
> 11 ft	0	0	$0	3,176	8,926	$383,225,123	58,552	154,134	$6,387,248,658

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

Table 4.42: Estimated Exposure of Improved Property to Hurricane Risk Areas – Hurricane Storm Surge Total (Category 4 and 5) – Pinellas County

Storm Surge Depth	Buildings and Parcels in Hurricane Risk Areas					
	Category 4			Category 5		
	No. of Parcels	No. of Buildings	Improved Value	No. of Parcels	No. of Buildings	Improved Value
0 to 1 ft	6,089	20,593	$756,542,004	2,889	9,217	$325,986,263
1 to 2 ft	6,273	21,482	$674,790,677	3,188	10,231	$416,246,316
2 to 3 ft	6,102	22,794	$710,895,223	2,990	10,307	$403,707,284
3 to 4 ft	6,564	23,903	$855,514,293	3,958	12,343	$636,715,226
4 to 5 ft	7,966	27,564	$1,086,825,843	4,459	14,119	$474,912,637
5 to 8 ft	36,341	114,523	$3,875,256,965	17,037	57,913	$2,072,703,999
8 to 11 ft	34,281	104,550	$3,661,082,759	20,744	73,710	$2,667,886,377
> 11 ft	163,067	374,692	$16,733,483,053	231,130	585,518	$24,068,516,666

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

To estimate the county population’s exposure to storm surge, areas of risk were intersected with census block data. As a result, these population estimates are going to be an overestimate of risk since the entire census block’s population count will be included even if only a portion of the census block’s area is located in a storm surge zone or hurricane storm surge area. However, these estimates still give an idea of the county population’s risk to storm surge.

Table 4.43: Estimated Exposure of Population to Hurricane Risk Areas – Storm Surge Zones

Location	Population in Storm Surge Zones					
	Storm Surge Zones Not in Effective Floodplain			Storm Surge Zones Not in Preliminary Floodplain		
	Total	< 18	> 65	Total	< 18	> 65
Belleair	1,754	146	445	1,516	116	411
Belleair Beach	962	71	208	0	0	0
Belleair Bluffs	469	31	150	469	31	150
Belleair Shore	109	8	25	0	0	0
Clearwater	41,164	4,202	6,072	39,126	4,207	5,381
Dunedin	21,089	1,933	4,062	19,851	1,847	3,769
Gulfport	9,424	798	1,726	7,595	738	963
Indian Rocks Beach	1,532	94	301	71	9	7

Location	Population in Storm Surge Zones					
	Storm Surge Zones Not in Effective Floodplain			Storm Surge Zones Not in Preliminary Floodplain		
	Total	< 18	> 65	Total	< 18	> 65
Indian Shores	1,107	41	310	0	0	0
Kenneth City	4,177	437	578	4,472	489	693
Largo	52,522	4,851	9,526	51,241	4,771	9,158
Madeira Beach	2,329	129	551	0	0	0
North Redington Beach	398	24	113	0	0	0
Oldsmar	6,294	934	477	5,519	854	367
Pinellas Park	43,916	5,008	5,858	45,200	5,131	6,007
Redington Beach	493	38	107	0	0	0
Redington Shores	1,242	68	331	0	0	0
Safety Harbor	15,035	1,652	2,083	14,764	1,631	2,012
St. Petersburg	101,794	10,824	12,945	93,098	10,093	11,540
St. Pete Beach	4,620	202	1,372	0	0	0
Seminole	7,862	629	2,014	6,413	497	1,708
South Pasadena	4,752	162	1,783	881	55	168
Tarpon Springs	18,582	1,901	3,322	19,277	1,968	3,440
Treasure Island	3,222	190	728	0	0	0
Unincorporated	159,211	16,048	25,021	148,293	15,670	22,207
PINELLAS COUNTY TOTAL	**504,059**	**50,421**	**80,108**	**457,786**	**48,107**	**67,981**

Table 4.44: Estimated Exposure of Population to Hurricane Risk Areas – Hurricane Storm Surge (Category 1, 2, and 3) – Pinellas County Total

Storm Surge Depth	Population in Hurricane Risk Areas								
	Category 1			Category 2			Category 3		
	Total	< 18	> 65	Total	< 18	> 65	Total	< 18	> 65
0 to 1 ft	18,934	1,812	3,272	22,867	2,050	3,058	31,913	3,391	4,940
1 to 2 ft	28,095	2,998	3,685	19,926	2,167	2,850	33,425	3,803	4,548
2 to 3 ft	39,680	3,437	7,302	18,452	2,055	2,613	26,906	2,947	3,746
3 to 4 ft	35,974	2,832	7,237	21,007	1,929	4,350	23,646	2,392	4,111
4 to 5 ft	33,472	2,356	6,929	22,102	2,229	3,532	23,584	2,300	4,010
5 to 8 ft	45,792	4,114	6,989	112,561	9,535	21,704	61,578	6,071	9,655
8 to 11 ft	1,786	155	289	63,230	5,392	9,916	96,393	8,314	18,260
11 to 14 ft	0	0	0	11,407	1,177	1,336	93,601	8,088	15,930
> 14 ft	0	0	0	0	0	0	22,028	2,265	2,647

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

Table 4.45: Estimated Exposure of Population to Hurricane Risk Areas – Hurricane Storm Surge (Category 4 and 5) – Pinellas County Total

Storm Surge Depth	Population in Hurricane Risk Areas					
	Category 4			Category 5		
	Total	< 18	> 65	Total	< 18	> 65
0 to 1 ft	14,505	1,687	1,867	6,715	641	1,141
1 to 2 ft	12,257	1,364	1,553	7,279	781	1,263
2 to 3 ft	16,382	1,813	2,196	5,905	602	903
3 to 4 ft	13,855	1,505	1,947	7,573	826	1,231
4 to 5 ft	19,849	2,304	2,459	10,998	1,254	1,265
5 to 8 ft	86,733	9,811	11,160	37,658	4,402	4,507
8 to 11 ft	78,016	8,243	12,351	49,155	5,425	6,613
11 to 14 ft	61,738	5,456	10,682	83,619	9,391	11,184
> 14 ft	222,883	20,108	38,127	359,719	33,529	60,385

*Additional municipal-level data for the participating jurisdictions can be found in Appendix B.

Hazus-MH

Wind

Hazus-MH was used to estimate the number of damaged buildings from a 100-year and 500-year hurricane event for the county as shown below. This analysis includes the number of buildings that sustain no, minor, moderate, severe, and complete damage from hurricane winds.

Table 4.46: Estimated Number of Buildings Damaged from 100-year and 500-year Hurricane Event Wind

	100-year Hurricane Event		500-year Hurricane Event	
	Number of Damaged Buildings	Percent of Total Building Stock	Number of Damaged Buildings	Percent of Total Building Stock
No Damage	186,988	49%	68,737	18%
Minor Damage	115,353	30%	117,396	31%
Moderate Damage	60,424	16%	118,583	31%
Severe Damage	12,063	3%	52,116	14%
Complete Damage	4,325	1%	22,322	6%
Total Building Count	379,153	--	379,153	--

Figure 4.36: At Least Moderate Loss, 100-year Return Period

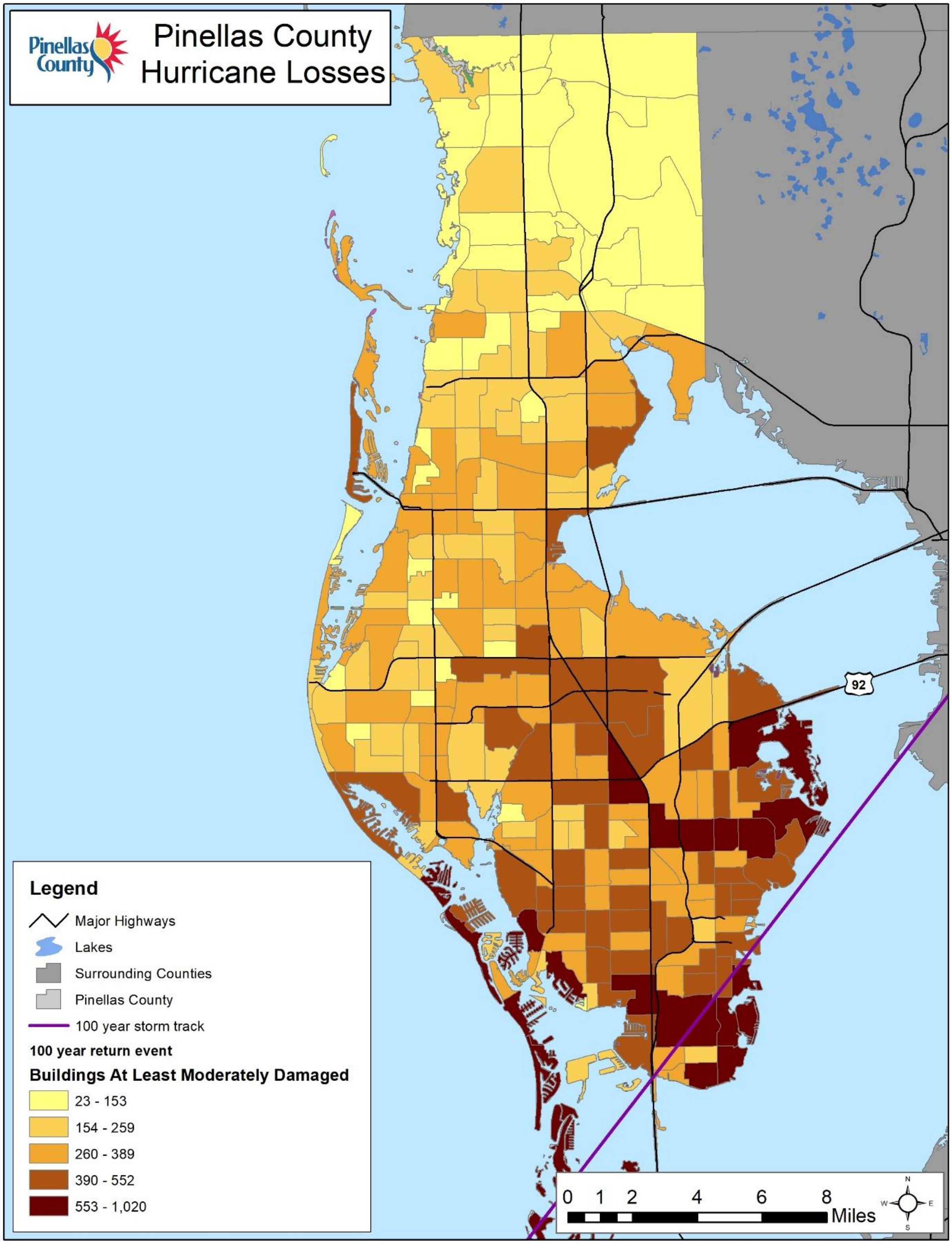


Figure 4.37: At Least Moderate Loss, 500-year Return Period

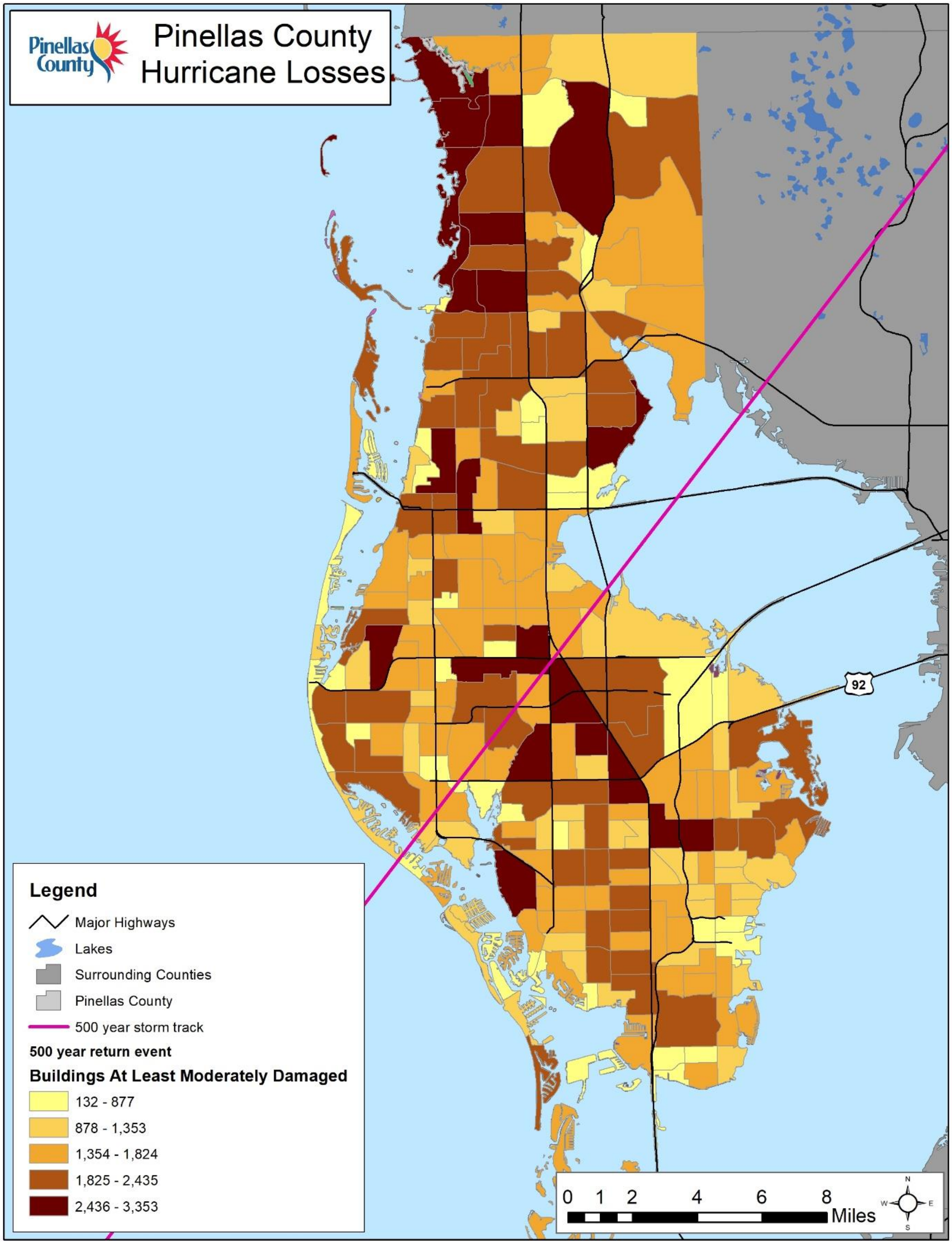


Figure 4.38: Total Loss, 100-year Return Period

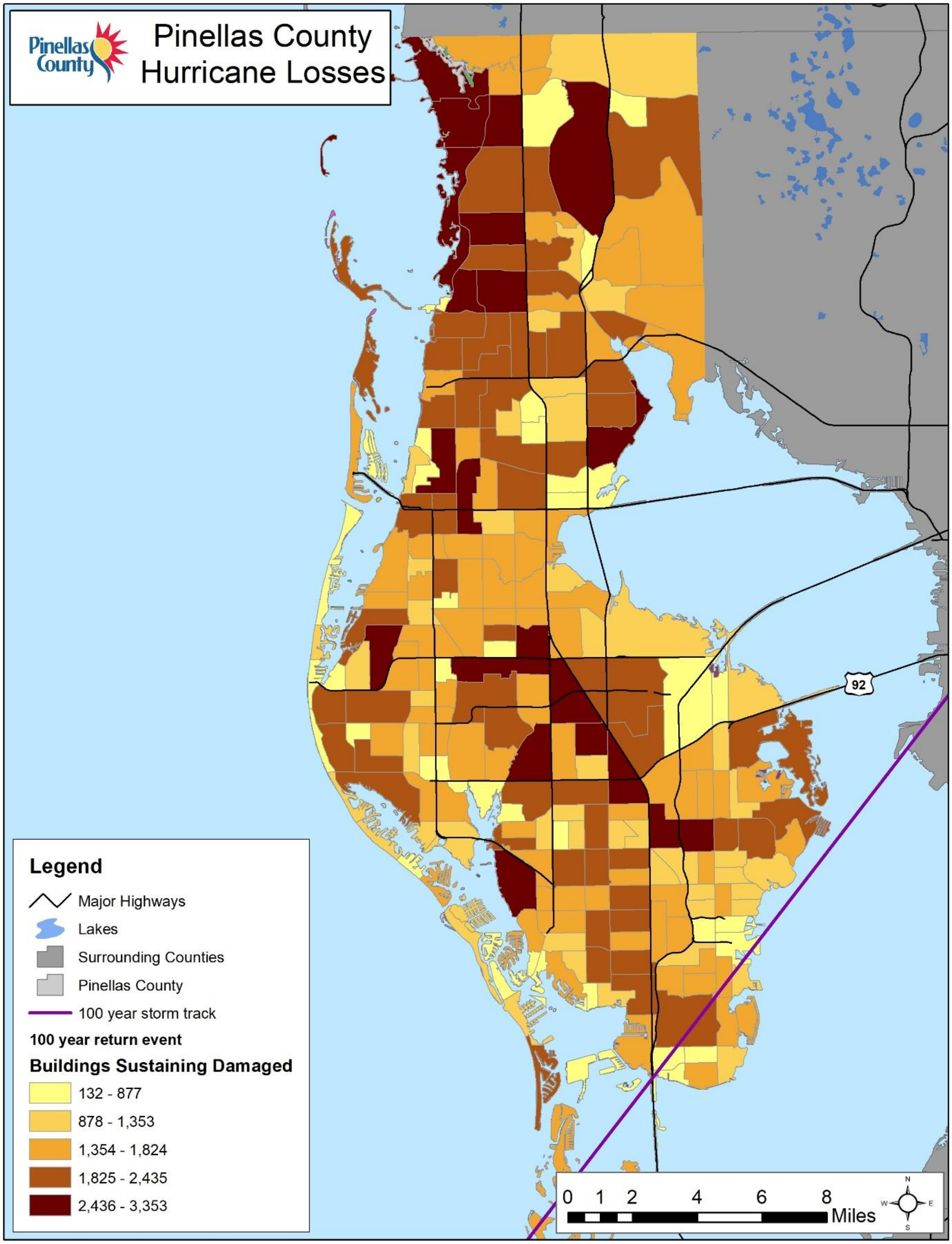
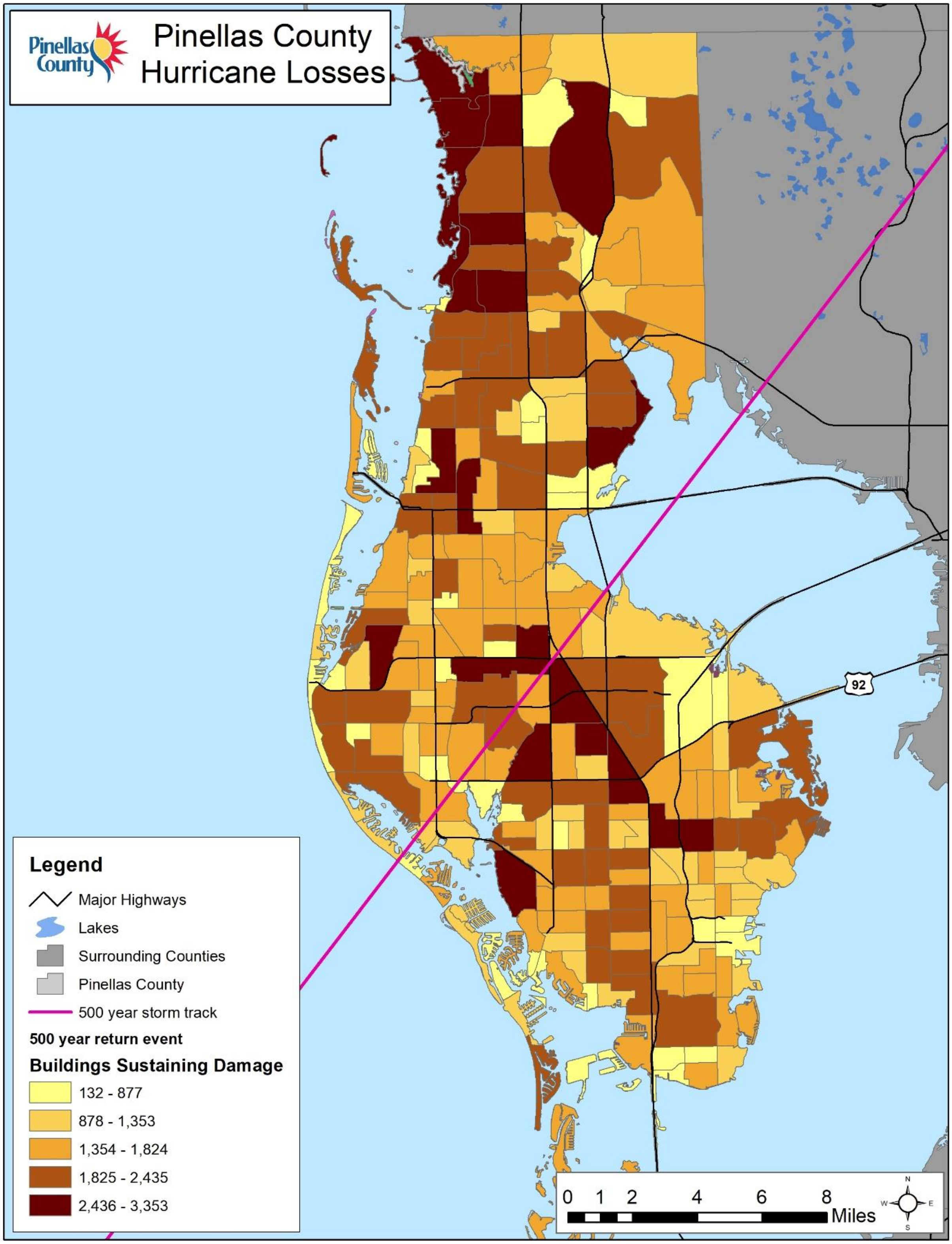


Figure 4.39: Total Loss, 500-year Return Period



Evacuation

Should a hurricane threaten the county, an evacuation order may be issued to get people away from the storm surge, the deadliest part of a hurricane. Evacuation zones are based on hurricane storm surge zones determined by the National Hurricane Center using ground elevation and the area's vulnerability to storm surge from a hurricane. However, all mobile homes, regardless of elevation, must be evacuated if an order is issued since they are vulnerable to the high winds of a hurricane and flying debris. The evacuation zones are marked from A through E, plus non-evacuation zones, and are shown in the map below.

Figure 4.40: Evacuation Zones

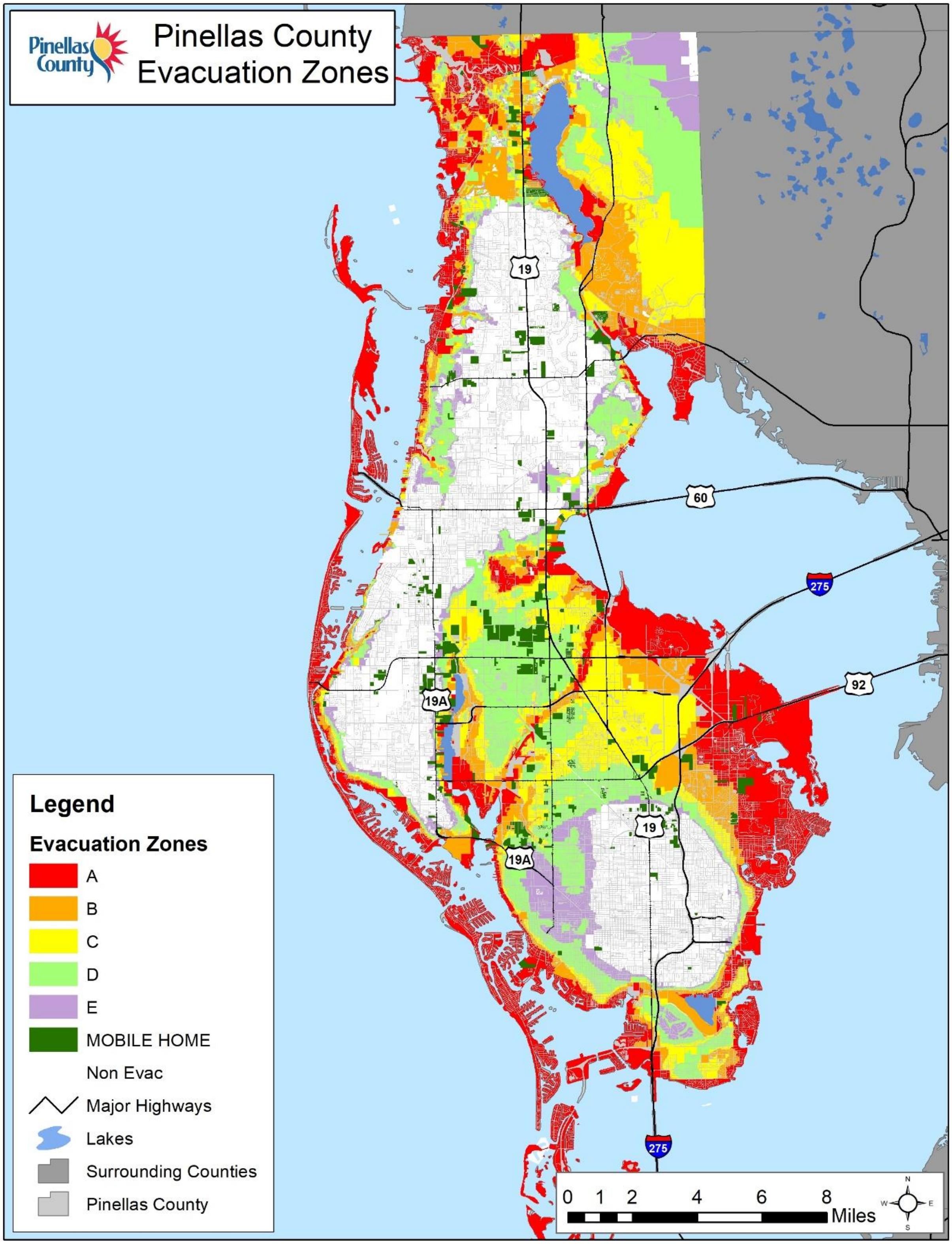


Table 4.47: Evacuation Analysis (Zones A, B, and C)

Location	Parcels and Buildings in Evacuation Zones								
	Zone A			Zone B			Zone C		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Belleair	377	907	$1,817,436,052	304	153	$10,553,858	75	66	$4,664,995
Belleair Beach	1,215	3,632	$46,420,963	0	0	$0	0	0	$0
Belleair Bluffs	91	401	$161,111,361	3	14	$789,753	100	54	$6,456,652
Belleair Shore	122	10,528	$0	0	0	$0	0	0	$0
Clearwater	10,013	5,221	$93,914,658	1,106	1,335	$89,861,023	1,080	3,524	$178,291,770
Dunedin	3,064	4,843	$776,976,656	830	2,901	$96,644,143	723	2,441	$60,233,406
Gulfport	2,654	7,196	$180,579,256	461	1,571	$43,751,848	615	2,731	$56,079,734
Indian Rocks Beach	3,301	939	$200,415,219	0	0	$0	0	0	$0
Indian Shores	2,797	907	$233,620,768	0	0	$0	18	1	$0
Kenneth City	0	0	$0	0	0	$0	0	0	$0
Largo	754	2,580	$180,256,597	1,207	2,352	$164,856,106	4,977	11,111	$553,777,828
Madeira Beach	3,818	7,759	$260,802,962	0	0	$0	0		$0
North Redington Beach	1,153	1,578	$92,924,353	0	0	$0	0	0	$0
Oldsmar	1,998	6,264	$211,708,355	2,490	7,167	$402,967,874	1,225	2,701	$253,323,162
Pinellas Park	28	21	$3,670,137	918	2,499	$219,641,243	9,926	37,143	$1,218,262,635
Redington Beach	1,079	3,588	$130,528,074	0	0	$0	0	0	$0
Redington Shores	2,135	3,261	$115,281,820	0	0	$0	0	0	$0
Safety Harbor	196	750	$42,182,455	403	1,253	$41,189,637	586	1,960	$81,940,020
St. Petersburg	32,115	77,443	$727,088,074	9,817	31,413	$1,332,877,312	7,829	23,212	$807,162,472
St. Pete Beach	7,666	16,079	$727,088,074	0	0	$0	0	0	$0
Seminole	1,455	1,511	$87,193,817	1,846	2,238	$129,127,581	504	368	$37,650,853
South Pasadena	3,423	3,255	$216,527,081	342	878	$15,685,396	215	251	$3,664,282
Tarpon Springs	4,386	10,392	$433,392,916	3,229	9,442	$404,665,863	2,414	6,914	$255,307,720
Treasure Island	5,960	10,417	$398,996,096	0	0	$0	0	0	$0
Unincorporated	17,473	37,045	$1,817,436,052	19,095	38,795	$1,982,211,445	15,705	43,578	$1,871,049,774
PINELLAS COUNTY TOTAL	**107,273**	**215,610**	**$7,175,315,833**	**42,051**	**102,011**	**$4,934,823,082**	**45,992**	**136,055**	**$5,387,865,303**

Table 4.48: Evacuation Analysis (Zones D, E, and Mobile Homes)

Location	Parcels and Buildings in Evacuation Zones								
	Zone D			Zone E			Mobile Homes		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Belleair	50	272	$17,132,694	82	111	$5,645,637	0	0	$0
Belleair Beach	0	0	$0	0	0	$0	0	0	$0
Belleair Bluffs	78	46	$2,670,722	11	41	$1,611,371	0	0	$0
Belleair Shore	0	0	$0	0	0	$0	0	0	$0
Clearwater	2,647	7,884	$309,530,656	2,383	6,113	$317,604,208	498	3,855	$8,829,204
Dunedin	2,039	7,133	$233,316,345	2,607	7,877	$175,627,537	653	3,678	$8,389,377

Location	Parcels and Buildings in Evacuation Zones								
	Zone D			Zone E			Mobile Homes		
	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value	No. of Parcels	No. of Bldgs	Improved Value
Gulfport	1,944	8,177	$170,434,878	680	2,548	$51,502,217	159	851	$1,691,537
Indian Rocks Beach	0	0	$0	0	0	$0	0	0	$0
Indian Shores	0	0	$0	0	0	$0	0	0	$0
Kenneth City	493	2,007	$45,904,271	1,520	2,898	$92,509,016	0	0	$0
Largo	6,395	16,373	$753,773,136	1,281	2,479	$114,556,368	5,999	22,179	$97,316,879
Madeira Beach	0	0	$0	0	0	$0	0	0	$0
North Redington Beach	0	0	$0	0	0	$0	0	0	$0
Oldsmar	0	0	$0	0	0	$0	528	2,590	$16,239,722
Pinellas Park	8,691	25,825	$1,075,239,747	202	346	$27,989,106	1,948	7,634	$41,992,088
Redington Beach	0	0	$0	0	0	$0	0	0	$0
Redington Shores	0	0	$0	0	0	$0	0	0	$0
Safety Harbor	3,045	7,950	$399,020,753	815	3,260	$150,557,747	589	3,076	$11,616,566
St. Petersburg	10,700	41,782	$1,381,076,488	9,588	33,402	$1,399,198,549	1,445	5,142	$28,674,964
St. Pete Beach	0	0	$0	0	0	$0	0	0	$0
Seminole	306	960	$22,590,649	369	1,420	$69,832,646	488	1,952	$8,326,540
South Pasadena	284	1,117	$5,054,910	0	0	$0	198	789	$887,589
Tarpon Springs	1,384	4,776	$191,080,136	541	1,674	$55,944,261	876	3,741	$13,802,864
Treasure Island	0	0	$0	0	0	$0	0	0	$0
Unincorporated	17,533	56,403	$2,277,155,086	4,953	17,827	$618,131,150	6,844	29,551	$113,226,435
PINELLAS COUNTY TOTAL	**55,589**	**180,705**	**$6,883,980,471**	**25,032**	**79,996**	**$3,080,709,813**	**20,225**	**85,038**	**$350,993,765**

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Since all counties within Florida are vulnerable to the effects of tropical cyclones, all of the Pinellas County critical facilities are vulnerable to potentially damaging storm surge and hurricane force winds.

To estimate exposure to storm surge for the critical facility analysis, storm surge zones were intersected with critical facility locations. The tables below summarize the critical facilities in the county that are located within a hurricane risk area.

Table 4.49: Exposure of Critical Facilities to Hurricane Risk Areas – Storm Surge Zones

Location	Number of Critical Facilities in Hurricane Risk Area	
	Storm Surge Zone Not in Effective Floodplain	Storm Surge Zone not in Preliminary Floodplain
Belleair	0	0
Belleair Beach	0	0
Belleair Bluffs	0	0
Belleair Shore	0	0
Clearwater	24	26
Dunedin	22	22
Gulfport	13	13

Location	Number of Critical Facilities in Hurricane Risk Area	
	Storm Surge Zone Not in Effective Floodplain	Storm Surge Zone not in Preliminary Floodplain
Indian Rocks Beach	0	0
Indian Shores	0	0
Kenneth City	6	8
Largo	57	56
Madeira Beach	0	0
North Redington Beach	0	0
Oldsmar	2	1
Pinellas Park	70	94
Redington Beach	0	0
Redington Shores	0	0
Safety Harbor	22	23
St. Petersburg	77	78
St. Pete Beach	0	0
Seminole	4	5
South Pasadena	0	0
Tarpon Springs	20	23
Treasure Island	0	0
Unincorporated	112	124
PINELLAS COUNTY TOTAL	**429**	**473**

Table 4.50: Exposure of Critical Facilities to Hurricane Risk Areas – Hurricane Storm Surge

Location	Number of Critical Facilities in Hurricane Risk Area				
	Category 1 Storm Surge	Category 2 Storm Surge	Category 3 Storm Surge	Category 4 Storm Surge	Category 5 Storm Surge
Belleair	0	0	0	0	0
Belleair Beach	3	3	3	3	3
Belleair Bluffs	0	0	0	0	0
Belleair Shore	0	0	0	0	0
Clearwater	21	24	28	34	51
Dunedin	6	11	15	25	33
Gulfport	2	2	9	15	15
Indian Rocks Beach	3	3	3	3	3
Indian Shores	8	8	8	8	8
Kenneth City	1	1	1	8	9
Largo	10	20	49	74	78
Madeira Beach	5	5	5	5	5
North Redington Beach	2	2	2	2	2
Oldsmar	5	23	23	23	23
Pinellas Park	1	28	77	117	121
Redington Beach	4	4	4	4	4
Redington Shores	4	4	4	4	4
Safety Harbor	0	0	16	20	24

Location	Number of Critical Facilities in Hurricane Risk Area				
	Category 1 Storm Surge	Category 2 Storm Surge	Category 3 Storm Surge	Category 4 Storm Surge	Category 5 Storm Surge
St. Petersburg	79	109	125	161	182
St. Pete Beach	9	9	9	9	9
Seminole	3	13	15	15	17
South Pasadena	18	18	18	18	18
Tarpon Springs	6	22	29	35	37
Treasure Island	14	14	14	14	14
Unincorporated	38	90	136	179	196
PINELLAS COUNTY TOTAL	**242**	**413**	**593**	**776**	**856**

All of the critical facilities and their associated risk can be found in Appendix B.

While all county facilities are vulnerable to tropical cyclones, it is clear that there are coastal areas with significant numbers of critical facilities within storm surge zones.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 3.3.

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
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Likely	Catastrophic	Large	> 24 hrs	< 1 week	3.3

Severe Storm Hazard Profile

1. Severe Storms Description

In this profile, Severe Storms refers to thunderstorms having one or more of these effects: lightning, flash floods, hail, straight-line winds, and tornadoes.

Thunderstorms are very prevalent in the state of Florida and Pinellas County. 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% 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:[53]

- 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.

[53] http://climatecenter.fsu.edu/topics/thunderstorms

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 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.[54]

Heavy Rain

Heavy rains are defined as 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 resulting from heavy rains. 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 with heavy rainfall. 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 resulting from heavy rains.

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.[55]

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 United States. Straight-line winds form as a result of outflow from a thunderstorm downdraft.[56]

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.

[54] http://www.nssl.noaa.gov/education/svrwx101/lightning/
[55] http://www.nssl.noaa.gov/education/svrwx101/hail/
[56] http://www.nssl.noaa.gov/education/svrwx101/wind/

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.

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 4.51: Enhanced Fujita Scale[57]

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

[57] http://climatecenter.fsu.edu/topics/tornadoes

EF Number	Estimated 3-second gust (mph)	Typical Damage
		debarked; steel reinforced concrete structures badly damaged.

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.[58]

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.[59] However, decreases in vertical wind shear are

[58] http://www.nws.noaa.gov/om/hazstats.shtml#
[59] 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., 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*

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.[60]

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 in the county. 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 United States.

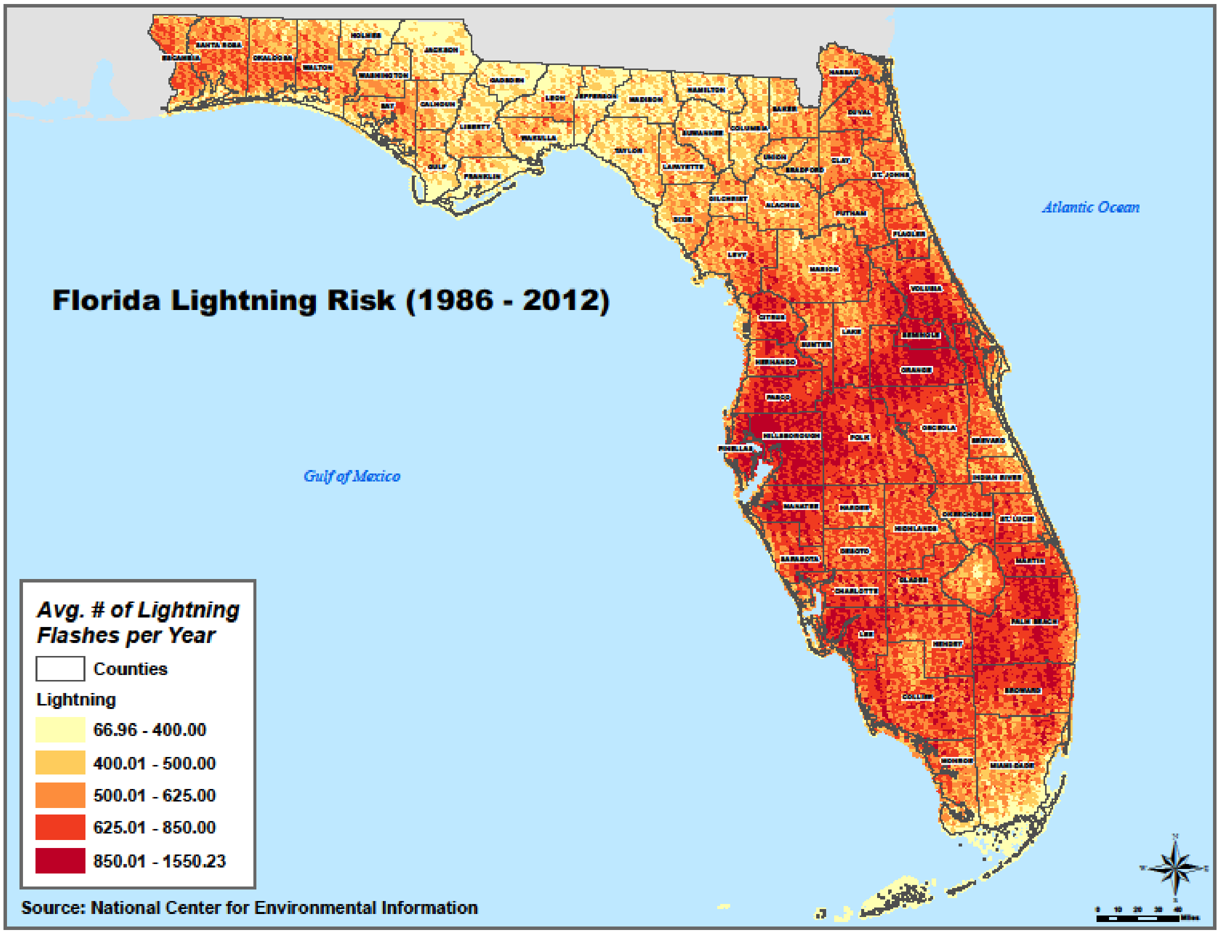
Lightning

Below is a map depicting the average number of lightning flashes per year based on historical data from 1986 to 2012.

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.

[60] Diffenbaugh et al. (2013), http://www.pnas.org/content/110/41/16361.full., p. 1.

Figure 4.41: Florida Lightning Risk, 1986–2012



According to the data, Pinellas County is expected to have between 850 and 1550 lightning flashes per year. However, lighting occurs randomly, therefore it is impossible to predict where and with what frequency it will strike. It is assumed that all of Pinellas County is uniformly exposed to lightning.

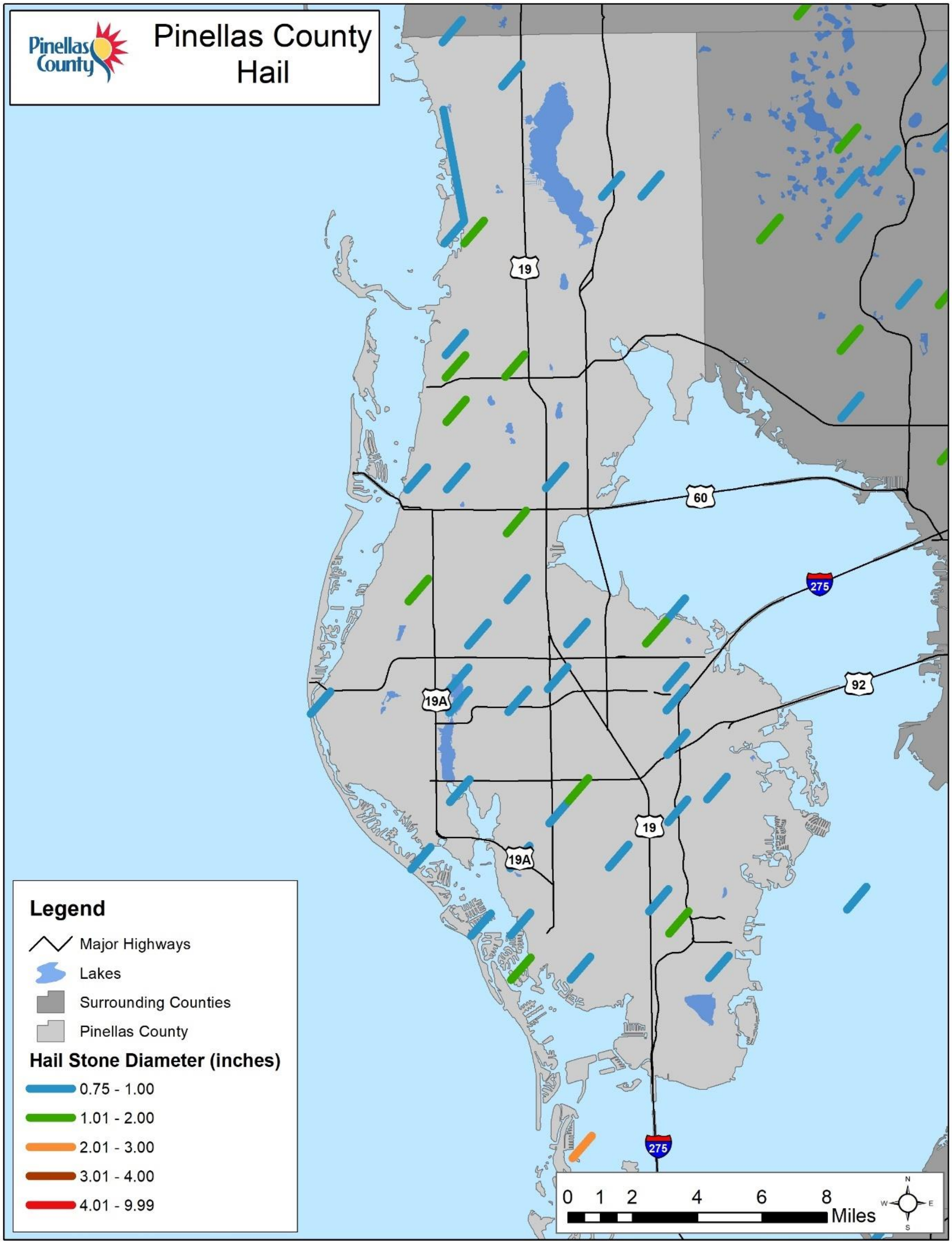
Heavy Rain

Heavy rain is produced by severe storms, so their locations and spatial extents coincide. It is assumed that Pinellas County is uniformly exposed to severe thunderstorms; therefore, all areas of the county are equally exposed to heavy rain which may be produced by such storms.

Hail

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. It is assumed that Pinellas County is uniformly exposed to severe thunderstorms; therefore, all areas of the county are equally exposed to hail which may be produced by such storms. With that in mind, the map below shows the location of hail events that have impacted Pinellas County based on historical data from 1955 to 2017.

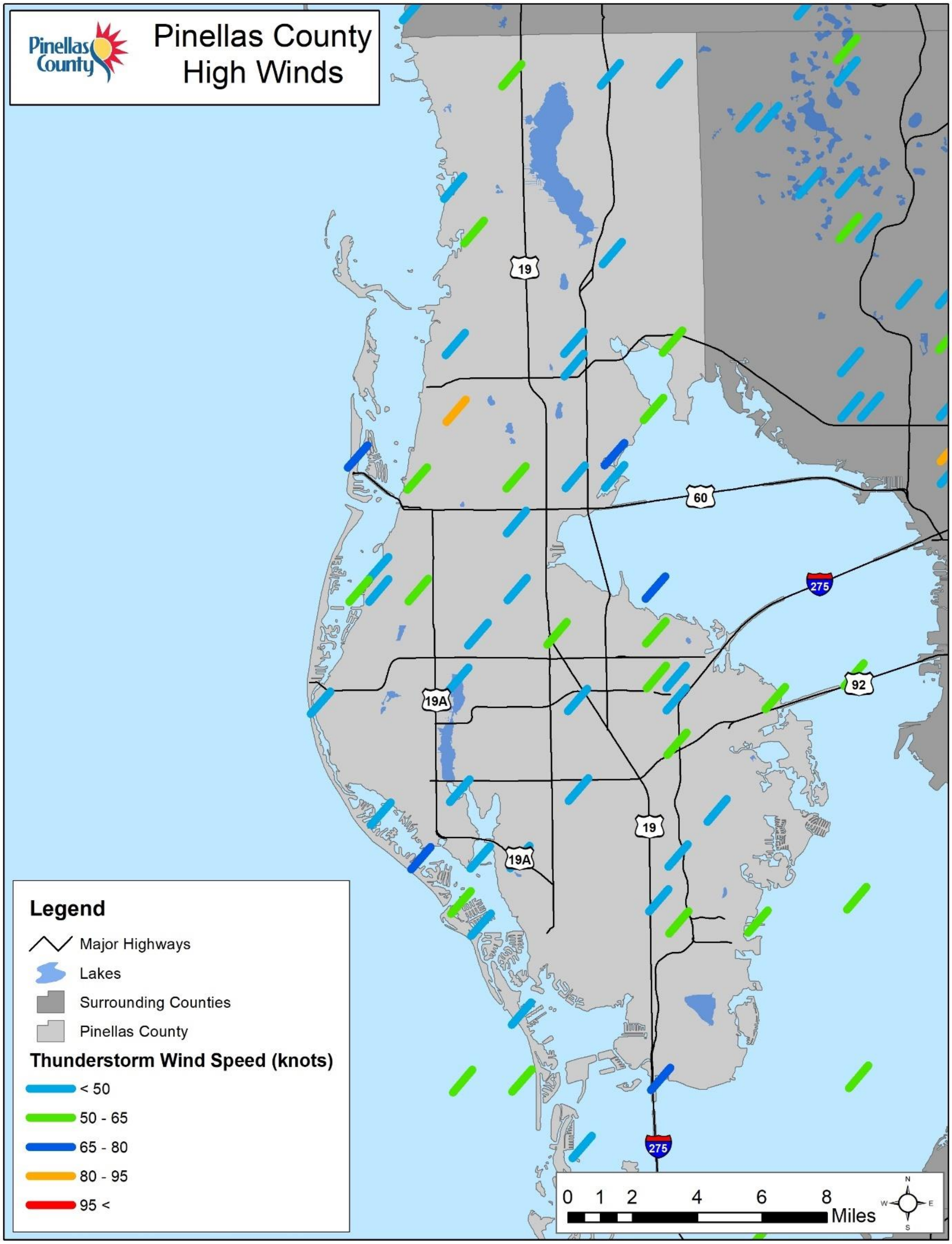
Figure 4.42: Pinellas County Hail Events, 1955–2017



Wind

A thunderstorm and its accompanying hazards, including wind, are atmospheric hazards and thus have no geographic boundaries. It is typically a widespread event that can occur in all regions of the United States, However, thunderstorms are most common in central and southern states, such as Florida, because atmospheric conditions in those regions are favorable for generating these powerful storms. It is assumed that all of Pinellas County is equally susceptible to the wind hazard. With that in mind, the map below shows the location of wind events that have impacted Pinellas County based on historical data from 1955 to 2017.

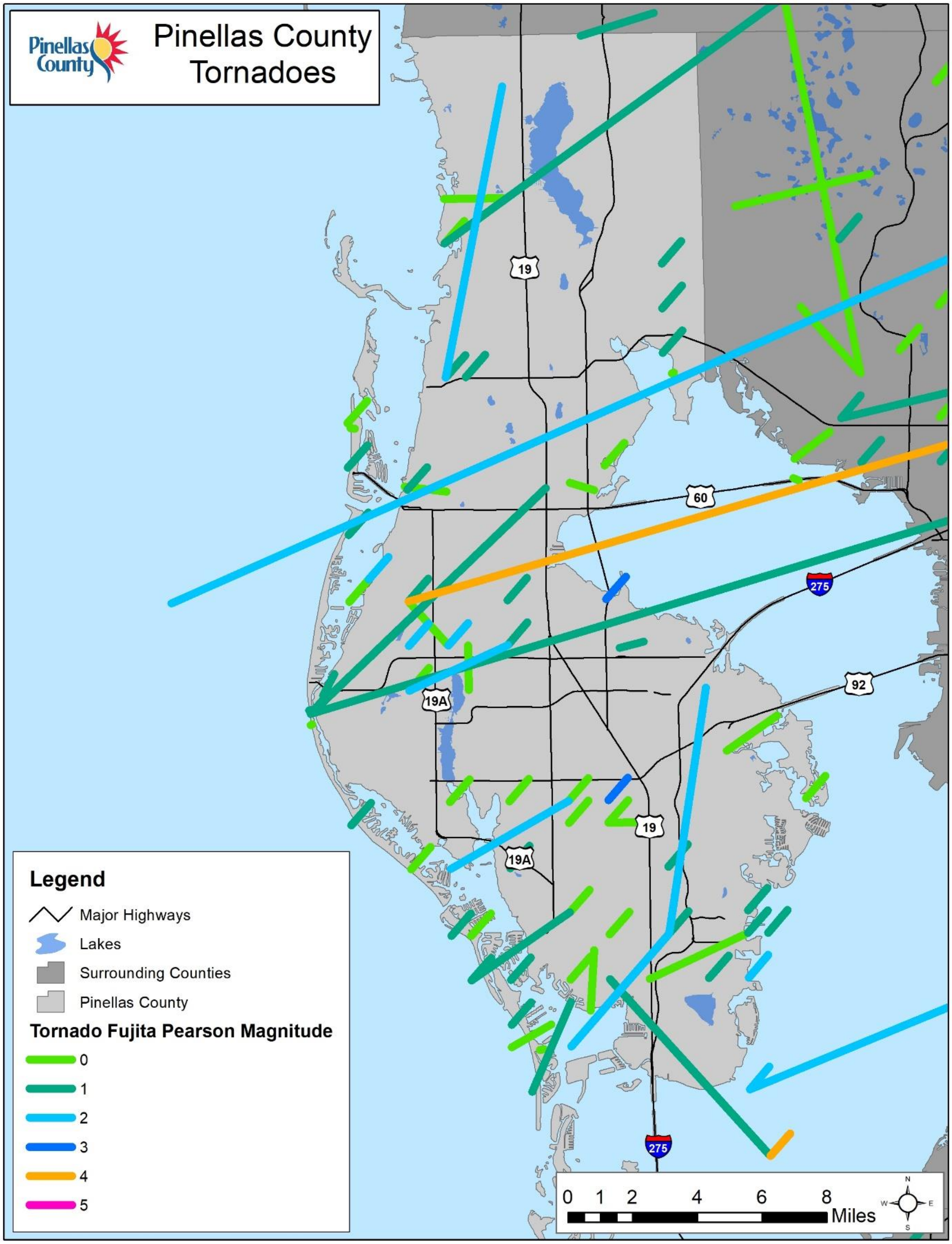
Figure 4.43: Pinellas County Wind Events, 1955–2017



Tornado

Tornadoes occur throughout the state of Florida and thus are possible in Pinellas County. Tornadoes typically impact a relatively small area, but damage may be extensive. Event locations are completely random, and it is not possible to predict specific areas that are more susceptible to tornado strives over time. Therefore, it is assumed that the county is uniformly exposed to this hazard. With that in mind, the map below shows tornado track data for many of the major tornado events that have impacted Pinellas County based on historical occurrences of tornadoes from 1950 to 2017. While no definitive pattern emerges from this data, some areas that have been impacted in the past may be potentially more susceptible in the future.

Figure 4.44: Pinellas County Tornado Events, 1950–2017



From this map, it is possible to understand that lower strength tornadoes, EF-0 through EF-2, are common across the county, 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 Pinellas from 1950 to 2017.

3. Historical Occurrences of Severe Storms

The table below lists significant severe storms and tornadoes that affected Pinellas County.

Table 4.52: Significant Severe Storm Occurrences in Pinellas County[61]

Date	Description
May 28, 1993	Thunderstorm Wind – Strong downburst winds moved a four-ton air conditioner unit on the roof of a store about one foot. Several nearby mobile homes suffered roof and carport damage.
June 23, 1998	Heavy Rain – Heavy rain caused significant water damage to property of three businesses that were undergoing renovation in the Northeast Shopping Center near U.S. Highway 92 (4th Street N.) and County Road 184 (38th Avenue N.). Water damage from the heavy rain caused rug, floor tile and ceiling tile damage to the buildings.
May 3, 2001	Hail – Tea cup (three inch) to dime sized hail was reported by Skywarn Spotters from Tierra Verde northwest to St. Pete Beach in southern Pinellas county. The three-inch hail busted windows and damaged the paint of several vehicles at the Don Cesar Hotel near the intersection of Gulf Boulevard (State Road 699) and 35th Avenue in St. Pete Beach.
June 8, 2002	Tornado – Damage survey showed path from Boca Ciega Isle to McPherson Bayou with damage to 40 homes, 10 of which were uninhabitable due to water damage. The tornado ripped off parts of roofs, crumbled pool cages, and toppled trees.
April 25, 2003	Thunderstorm Wind – The canopy over the gas pumps at a local station overturned and a roof collapsed at a nearby restaurant.
June 28, 2005	Heavy Rain – Heavy rains of 4.46 inches in Seminole and 3.58 inches in Tarpon Springs caused widespread minor flooding in Pinellas county. About 20 people were displaced in an apartment complex in Saint Petersburg as water trapped on the roof began to drain through the walls. A clogged drain caused the Bayfront Hospital Emergency Room to close for a short time due to flooding.
July 20, 2005	Tornado – The tornado, which touched down along Ulmerton Road just east of Seminole Boulevard, moved northwest for about 1/2 mile and caused damage at five mobile home parks. Much of the damage occurred at the Palm Hill Country Club mobile home park. In all, 51 mobile homes were damaged, 25 with heavy damage. No injuries or fatalities were reported. About 25,000 residents of the area lost power after the event.

[61] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28C%29+Heavy+Rain&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Date	Description
June 23, 2009	Thunderstorm Wind – A microburst with winds of about 60mph occurred in a mobile home park along 62nd Avenue North in Lealman. Fifteen mobile homes incurred damage, with four homes sustaining major damage, mainly to carports and portions of the roof where the carport was attached. One tree and numerous limbs were also downed just to the northwest of the mobile home park along 27th Street North from 59th Avenue North to 62nd Avenue North
June 25, 2010	Lightning – Lightning struck a tree and caused it to fall on a house on Flora Road. There was significant damage to the house.
January 25, 2011	Thunderstorm Wind – Straight-line winds estimated at 90mph caused damage across a few blocks of St. Petersburg. A parked car and gas station canopy were blown on their side at a gas station on the corner of 28th Street North and 30th Avenue North. The canopy fell on top of the toppled car, trapping a female inside the car. She was rescued and transported to the hospital with minor injuries. The bases of the canopy supports were rusted. A nearby commercial building on Morris Street North had a portion of the wood roof ripped off, and across the street from this building, there was an uprooted tree, a power pole blown down, portions of a wooden fence destroyed, and large garbage bins blown several feet down the street. Finally, on Xenia Street North between 31st and 32nd Avenues North, a large tree split near the base and fell in the front yard of a home onto a vehicle.
March 31, 2011	Thunderstorm Wind – Thunderstorm winds gusts snapped small tree trunks, pushed over shallow rooted trees, and caused damage to around 150 homes and mobile homes over a one-mile square area near Ulmerton Road. A 200-foot communication tower collapsed midway up the tower. Wind damage to trees at the surface suggested wind gusts at 60 MPH, while winds at the top of the tower were estimated at over 110 MPH. Downburst and tornadic wind damage occurred along an 11-mile path from Indian Rocks Beach to the Saint Petersburg/Clearwater International Airport. A small hanger was destroyed with debris damaging vehicles and small airplanes. The observation station on the north side of the airport recorded a wind gust of 55 MPH. Tornado – A waterspout moved onshore as a tornado and destroyed the second floor of a 3,600 square foot multiple occupancy home. Power lines and poles were snapped adjacent to the home. The tornado lifted before reaching the intercostal. Power poles and lines were snapped, with at least 10 trees down in the area. Roof debris from industrial buildings was spread along the path. Monetary damage is a conservative estimate.
May 19, 2012	Thunderstorm Wind – The Lealman Fire Department reported damage to an older hotel on the 4800 block of 34th Street North. The corner of the roof was taken off and damaged five cars in the parking lot. Damage in the area was isolated to this building.
June 24, 2012	Tornado – A tornado damaged 21 structures including mobile homes, car ports, billboards and trees. One block home lost part of the roof and debris blocked Walsingham Road near Hamlin Boulevard. A waterspout moved onshore and destroyed the top floor of a tourist rental building. No one was in the top units

Date	Description
	and no injuries were reported in the bottom units. The tornado caused moderate damage to the Pass-A-Grille Marina. Heavy Rain – Heavy rain caused roadway flooding with several cars stranded. Heavy rain caused minor flooding in Indian Rocks Beach. A 71-year-old man died after suffering a heart attack while standing in less than a foot of water in his front yard and could not remove himself from the water. The medical examiner determined that the cause of death was drowning, with heart disease as a contributing factor. A 51-year-old male was found in a creek under a bridge on 150th Avenue in Largo. The creek was swollen due to heavy rains from Tropical Storm Debby. The date and time of the death was estimated to be on the 24th. The body was found on the 27th.
July 9, 2012	Lightning – A lighting strike sparked a fire at a 5,700 square foot home in Tarpon Springs. Over 30 fire crews were called to the scene and the fire took several hours to put out.
July 21, 2012	Thunderstorm Wind – Six homes were damaged at a mobile home park on Alt Keene Road in Largo, mostly with roof damage. Two of the homes had major damage and the other 4 sustained minor damage. There were also downed power lines in the area.
September 5, 2013	Thunderstorm Wind – Broadcast media relayed a report of wind damage to homes and an apartment building around Bay Street SE and 20th Avenue in Indian Rocks Beach. A section of roof was blown off the apartment building on Bay Street SE and onto a road, and several trees and telephone poles were knocked down. Additionally, property damage reported on 20th Avenue included a porch, a lanai, a roof, and a stop sign. Time was estimated based off radar.
September 27, 2014	Heavy Rain – A CoCoRaHS observer south of Clearwater measured 5.9 inches of rain during the 4-day period. A CoCoRaHS observer three miles southwest of St. Petersburg measured 6.30 inches of rain during the 4-day period. A CoCoRaHS observer south of Pasadena measured 7.82 inches of rain during the 4-day period. A CoCoRaHS observer near Gulfport measured 8.28 inches of rain during the 4-day period.
April 20, 2015	Thunderstorm Wind – Daytime heating combined with a potent upper level system allowed for strong to severe storms to develop throughout the area. Many were sub-severe however a few reached severe limits causing damage to homes, trees, and power lines. A tree was reported down in the Palm Harbor area. Pinellas County Emergency Management relayed a report of widespread damage along 78th Avenue near Pinellas Park. Numerous trees were down along the street. A few homes sustained roof damage including a tree falling through a roof of one home. One home also had a porch collapse. Local broadcast media reported several downed trees around Starkey Rd. in Seminole. Parking lot lights were knocked down at a Target shopping center near U.S. Highway 19 and Park Boulevard in Pinellas Park.
June 19, 2015	Lightning – Florida Emergency Management reported that an 81-year-old man was struck and killed while walking near his home in Largo.

Date	Description
August 17, 2016	Lightning – Lightning struck a house and started a fire in the attic. The fire smoldered for an hour or so before flames ensued and ultimately the house was destroyed. The structure never collapsed but the inside of the house has been gutted.
December 8, 2017	Thunderstorm Wind – A cold front moved southeast through the Florida Peninsula on the evening of the 8th through early morning on the 9th. Thunderstorms developed along and ahead of the front, one of which produced a damaging wind gust. A large oak tree fell on a house in Safety Harbor, causing significant damage to the house.
July 26, 2018	Lightning – A lightning strike hit a home in Palm Harbor, leaving a burn mark in a bathroom ceiling. Sparks from the strike also caused minor burns to a resident laying in a bed in the home. No fire was caused by the lightning strike. A fire reported at a bank in Dunedin was suspected to be caused by a lightning strike. A fire reported at a house in Palm Harbor that was suspected to be caused by a lightning strike.
November 2, 2018	Tornado – A strong cold front pushed through the Florida peninsula during the afternoon hours on the 2nd. A squall-line associated with the front produced widespread damaging wind gusts along with multiple tornadoes embedded within the fast-moving line. Widespread damage was observed in two mobile home parks, and a condominium roof was torn off in addition to numerous downed trees and branches. One minor injury was reported in the area.

There have been 4 major disaster declarations from FEMA for severe storms and tornadoes in Pinellas County.

Table 4.53: FEMA Major Disaster Declarations in Pinellas County, Severe Storm, 1953–2018[62]

Disaster Number	Date	Name/Description
DR-586	May 15, 1979	SEVERE STORMS, TORNADOES & FLOODING
DR-966	October 3–4, 1992	SEVERE STORMS, TORNADOES & FLOODING
DR-982	March 12–16, 1993	TORNADOES, FLOODING, HIGH WINDS & TIDES, FREEZING
DR-1195	December 25, 1997–April 24, 1998	SEVERE STORMS, HIGH WINDS, TORNADOES, AND FLOODING

While severe storms may seem to be lesser threat to life safety than a hurricane, severe storms can be fatal. From 1996 to 2018, severe storms killed 9 people, 5 people died from lightning strikes, 1 person died from wind, and 3 people died from heavy rain, and from 1950 to 2018, 12 people died from a

[62] https://www.fema.gov/media-library/assets/documents/28318

tornado.[63] (It is important to note that the flooding and wind related fatalities could have been from other storms, not only thunderstorms.)

Lightning

According to the NCEI Storm Events Database, there were 151 reports of lightning in Pinellas County from 1996 to 2018.[64] These lightning events are only inclusive of those reported by NCEI from 1996 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.54: Summary of Lightning Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	2	0	2	$53,100	$26,550
Belleair Beach	3	0	0	$38,778	$7,756
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	2	1	1	$5,231,279	$402,406
Clearwater	24	1	13	$1,196,752	$54,398
Dunedin	3	0	4	$31,317	$1,566
Gulfport	6	0	3	$65,198	$3,260
Indian Rocks Beach	1	0	0	$10,141	$10,141
Indian Shores	0	0	0	$0	$0
Kenneth City	3	0	0	$50,895	$5,655
Largo	10	0	6	$146,659	$6,984
Madeira Beach	0	0	0	$0	$0
North Redington Beach	0	0	0	$0	$0
Oldsmar	3	0	0	$167,181	$7,961
Pinellas Park	9	0	7	$142,358	$7,118
Redington Beach	0	0	0	$0	$0
Redington Shores	2	0	1	$5,463	$1,093
Safety Harbor	1	0	0	$584	$58
St. Petersburg	18	0	22	$3,046,939	$138,497
St. Pete Beach	4	0	6	$21,240	$1,416
Seminole	8	0	2	$637,140	$30,340
South Pasadena	1	0	0	$11,840	$1,316
Tarpon Springs	7	0	1	$247,264	$11,239
Treasure Island	2	1	2	$0	$0
Unincorporated	42	2	9	$3,516,951	$167,474

[63] Note that the flooding and wind related fatalities could have been the result of other types of severe weather, such as hurricanes.
[64] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
PINELLAS COUNTY TOTAL	**151**	**5**	**78**	**$14,621,079**	**$885,227**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.55: Historical Lightning Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair						
BELLEAIR	7/12/2016	Lightning	0	0	$53,100	$0
BELLEAIR	7/19/2016	Lightning	0	2	$0	$0
Belleair Beach						
BELLEAIR BEACH	8/21/2013	Lightning	0	0	$1,093	$0
BELLEAIR BEACH	9/5/2013	Lightning	0	0	$10,914	$0
BELLEAIR BEACH	6/22/2015	Lightning	0	0	$26,772	$0
Belleair Bluffs						
NONE REPORTED	--	--	--	--	--	--
Belleair Shore						
BELLEAIR SHRS	7/4/2005	Lightning	0	0	$5,231,279	$0
BELLEAIR SHORES	5/28/2013	Lightning	1	0	$0	$0
Clearwater						
CLEARWATER	6/7/1996	Lightning	1	0	$0	$0
CLEARWATER	6/24/1996	Lightning	0	0	$122,311	$0
CLEARWATER	7/31/1996	Lightning	0	1	$0	$0
CLEARWATER	8/6/1996	Lightning	0	0	$48,738	$0
CLEARWATER	4/23/1997	Lightning	0	0	$7,976	$0
CLEARWATER	7/20/1997	Lightning	0	1	$0	$0
CLEARWATER	7/1/1999	Lightning	0	0	$229,947	$0
CLEARWATER	7/17/1999	Lightning	0	0	$76,649	$0
CLEARWATER	7/24/2002	Lightning	0	0	$0	$0
CLEARWATER	8/16/2002	Lightning	0	0	$4,243	$0
CLEARWATER	9/20/2002	Lightning	0	1	$0	$0
CLEARWATER	7/14/2003	Lightning	0	0	$347,401	$0
CLEARWATER	7/14/2003	Lightning	0	0	$41,688	$0
CLEARWATER	7/22/2003	Lightning	0	0	$248,739	$0
CLEARWATER	7/28/2003	Lightning	0	3	$0	$0
CLEARWATER BEACH	7/23/2005	Lightning	0	5	$0	$0
CLEARWATER	6/25/2010	Lightning	0	0	$35,173	$0
CLEARWATER	6/24/2013	Lightning	0	0	$5,472	$0
CLEARWATER EXEC ARPT	7/17/2013	Lightning	0	0	$21,879	$0

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
CLEARWATER EXEC ARPT	8/21/2013	Lightning	0	0	$5,463	$0
CLEARWATER BEACH	7/24/2014	Lightning	0	1	$0	$0
CLEARWATER EXEC ARPT	9/28/2014	Lightning	0	0	$1,074	$0
CLEARWATER	7/3/2015	Lightning	0	0	$0	$535
CLEARWATER EXEC ARPT	8/18/2017	Lightning	0	1	$0	$0
Dunedin						
DUNEDIN	7/20/1998	Lightning	0	1	$31,317	$0
DUNEDIN	6/16/2000	Lightning	0	3	$0	$0
DUNEDIN	7/3/2017	Lightning	0	0	$0	$0
Gulfport						
GULFPORT	7/21/1998	Lightning	0	2	$7,829	$0
GULFPORT	8/7/2002	Lightning	0	0	$14,142	$0
GULFPORT	3/28/2011	Lightning	0	0	$11,436	$0
GULFPORT	8/3/2014	Lightning	0	1	$0	$0
GULFPORT	7/5/2015	Lightning	0	0	$1,071	$0
GULFPORT	3/20/2018	Lightning	0	0	$30,721	$0
Indian Rocks Beach						
INDIAN ROCKS BEACH	7/24/2018	Lightning	0	0	$10,141	$0
Indian Shores						
NONE REPORTED	--	--	--	--	--	--
Kenneth City						
KENNETH CITY	8/7/2009	Lightning	0	0	$11,840	$0
KENNETH CITY	7/29/2010	Lightning	0	0	$17,583	$0
KENNETH CITY	9/3/2014	Lightning	0	0	$21,472	$0
Largo						
LARGO	6/28/1997	Lightning	0	1	$0	$0
LARGO	6/28/1997	Lightning	0	1	$0	$0
LARGO	10/31/1997	Lightning	0	1	$0	$0
LARGO	6/23/1998	Lightning	0	1	$0	$0
LARGO	7/1/1999	Lightning	0	1	$0	$0
LARGO	7/4/2001	Lightning	0	0	$71,985	$0
LARGO	9/6/2001	Lightning	0	1	$0	$0
LARGO	8/20/2003	Lightning	0	0	$69,217	$0
LARGO	7/19/2005	Lightning	0	0	$0	$0
LARGO	9/15/2013	Lightning	0	0	$5,457	$0
Madeira Beach						
NONE REPORTED	--	--	--	--	--	--
North Redington Beach						
NONE REPORTED	--	--	--	--	--	--

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Oldsmar						
OLDSMAR	7/16/1997	Lightning	0	0	$7,961	$0
OLDSMAR	7/17/1997	Lightning	0	0	$159,220	$0
OLDSMAR	6/17/2010	Lightning	0	0	$0	$586
Pinellas Park						
PINELLAS PARK	6/23/1998	Lightning	0	1	$0	$0
PINELLAS PARK	5/21/1999	Lightning	0	1	$0	$0
PINELLAS PARK	6/21/2001	Lightning	0	1	$0	$0
PINELLAS PARK	8/19/2002	Lightning	0	0	$35,355	$0
PINELLAS PARK	7/22/2003	Lightning	0	2	$0	$0
PINELLAS PARK	7/26/2003	Lightning	0	1	$34,740	$0
PINELLAS PARK	6/28/2005	Lightning	0	0	$32,847	$0
PINELLAS PARK	6/28/2005	Lightning	0	0	$39,416	$0
PINELLAS PARK	7/22/2007	Lightning	0	1	$0	$0
Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Redington Shores						
REDINGTON SHORES	8/9/2013	Lightning	0	0	$5,463	$0
REDINGTON SHORES	7/21/2016	Lightning	0	1	$0	$0
Safety Harbor						
SAFETY HARBOR	6/9/2008	Lightning	0	0	$584	$0
St. Petersburg						
ST. PETERSBURG	7/4/1996	Lightning	0	1	$0	$0
ST. PETERSBURG	7/13/1996	Lightning	0	4	$0	$0
ST. PETERSBURG	7/30/1996	Lightning	0	2	$0	$0
ST PETERSBURG	7/12/1997	Lightning	0	1	$0	$0
ST PETERSBURG	9/17/1997	Lightning	0	1	$0	$0
ST PETERSBURG	6/23/1998	Lightning	0	6	$0	$0
ST PETERSBURG	6/24/1998	Lightning	0	1	$0	$0
ST PETERSBURG	8/14/1999	Lightning	0	0	$15,293	$0
ST PETERSBURG	6/25/2000	Lightning	0	0	$2,964,594	$0
ST PETERSBURG	8/21/2001	Lightning	0	1	$0	$0
ST PETERSBURG	8/21/2001	Lightning	0	1	$0	$0
ST PETERSBURG	9/4/2001	Lightning	0	2	$0	$0
ST PETERSBURG	6/13/2003	Lightning	0	0	$0	$0
ST PETERSBURG	8/15/2003	Lightning	0	1	$0	$0
SAINT PETERSBURG	8/14/2007	Lightning	0	1	$0	$0
SAINT PETERSBURG	8/7/2013	Lightning	0	0	$5,463	$0
SAINT PETERSBURG PORTS SITE	9/5/2013	Lightning	0	0	$10,914	$0
SPG-ALBERT WHITTED AIRPORT	8/5/2018	Lightning	0	0	$50,675	$0

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
St. Pete Beach						
ST PETERSBURG BEACH	8/29/2003	Lightning	0	1 0	$0	$0
ST PETERSBURG BEACH	8/14/2004	Lightning	0	4 1	$0	$0
SAINT PETERSBURG BEACH	7/21/2016	Lightning	0	0 1	$21,240	$0
SAINT PETERSBURG BEACH	9/1/2017	Lightning	0	1 4	$0	$0
Seminole						
SEMINOLE	6/23/1997	Lightning	0	0	$47,826	$0
SEMINOLE	9/7/1999	Lightning	0	1	$0	$0
SEMINOLE	7/25/2003	Lightning	0	0	$55,584	$0
SEMINOLE	7/7/2005	Lightning	0	0	$3,923	$0
SEMINOLE	8/22/2005	Lightning	0	1	$0	$0
SEMINOLE	9/4/2006	Lightning	0	0	$478,601	$0
SEMINOLE	7/30/2016	Lightning	0	0	$531	$0
SEMINOLE	8/25/2018	Lightning	0	0	$50,675	$0
South Pasadena						
SOUTH PASADENA	8/7/2009	Lightning	0	0	$11,840	$0
Tarpon Springs						
TARPON SPRINGS	8/6/1996	Lightning	0	0	$4,061	$0
TARPON SPGS	8/21/2000	Lightning	0	0	$44,366	$0
TARPON SPGS	6/22/2001	Lightning	0	0	$93,318	$0
TARPON SPGS	7/10/2003	Lightning	0	0	$4,169	$0
TARPON SPRINGS	8/7/2013	Lightning	0	1	$0	$0
TARPON SPRINGS	8/25/2018	Lightning	0	0	$25,337	$0
TARPON SPRINGS	8/30/2018	Lightning	0	0	$76,012	$0
Treasure Island						
TREASURE ISLAND	7/20/2007	Lightning	1	1	$0	$0
TREASURE ISLAND	7/31/2011	Lightning	0	1	$0	$0
Unincorporated						
PALM HARBOR	6/24/1997	Lightning	0	0	$119,564	$0
PALM HARBOR	8/17/1998	Lightning	0	0	$1,564	$0
PALM HARBOR	6/18/1999	Lightning	0	0	$1,538	$0
PALM HARBOR	7/24/2002	Lightning	0	0	$0	$0
(PIE)ST PETE/CLRWATE	9/5/2002	Lightning	0	1	$0	$0
PALM HARBOR	10/13/2002	Lightning	0	0	$1,410	$0
ST PETE CLEARWATER I	7/21/2006	Lightning	0	1	$0	$0
TIERRA VERDE	2/13/2007	Lightning	0	1	$0	$0
TIERRA VERDE	6/8/2007	Lightning	0	0	$1,471,825	$0

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
(PIE)ST PETE/CLRWATE	8/1/2007	Lightning	0	0	$12,291	$0
(PIE)ST PETE/CLRWATE	8/27/2007	Lightning	0	0	$1,229	$0
TIERRA VERDE	6/14/2008	Lightning	0	0	$5,839	$0
(PIE)ST PETE/CLRWATE	5/21/2009	Lightning	0	0	$1,195	$0
BASKIN	7/1/2009	Lightning	0	1	$0	$0
COACHMAN	8/7/2009	Lightning	0	0	$11,840	$0
(PIE)ST PETE/CLRWATE	7/13/2010	Lightning	0	1	$0	$0
ANCLOTE	7/24/2010	Lightning	0	1	$0	$0
COACHMAN	4/25/2011	Lightning	0	1	$0	$0
LEALMAN	9/22/2011	Lightning	0	1	$0	$0
ANCLOTE	7/9/2012	Lightning	0	0	$836,568	$0
HIGHPOINT	6/24/2013	Lightning	0	0	$1,094	$0
FEATHER SOUND	7/17/2013	Lightning	0	0	$32,819	$0
PALM HARBOR	8/17/2013	Lightning	0	0	$10,927	$0
HARBOR BLUFFS	9/4/2013	Lightning	0	0	$5,457	$0
OAKHURST	5/14/2014	Lightning	1	0	$0	$0
BRIDGEPORT	7/4/2014	Lightning	0	0	$214,521	$0
BELMONT	7/15/2014	Lightning	0	0	$26,815	$0
PALM HARBOR	9/6/2014	Lightning	0	0	$53,680	$0
OZONA	10/14/2014	Lightning	0	0	$2,153	$0
BELMONT	6/19/2015	Lightning	1	0	$0	$0
(PIE)ST PETE/CLRWATE	6/24/2015	Lightning	0	0	$5,354	$0
BASKIN	7/17/2015	Lightning	0	0	$5,354	$0
ULMERTON	7/29/2015	Lightning	0	0	$26,770	$0
ULMERTON	7/8/2016	Lightning	0	0	$53,100	$0
PALM HARBOR	7/27/2016	Lightning	0	0	$15,930	$0
HIGHPOINT	8/17/2016	Lightning	0	0	$424,412	$0
LEALMAN	8/2/2017	Lightning	0	0	$52,042	$0
CRYSTAL BEACH	7/26/2018	Lightning	0	1	$0	$0
OZONA	7/26/2018	Lightning	0	0	$50,703	$0
CRYSTAL BEACH	7/26/2018	Lightning	0	0	$25,351	$0
OZONA	8/25/2018	Lightning	0	0	$20,270	$0
CRYSTAL BEACH	8/25/2018	Lightning	0	0	$25,337	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

Heavy Rain

According to the NCEI Storm Events Database, there were 29 reports of heavy rain in Pinellas County from 1996 to 2018.[65] These heavy rain events are only inclusive of those reported by NCEI from 1996 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.56: Summary of Heavy Rain Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	1	0	0	$0	$0
Belleair Beach	1	0	0	$0	$0
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	0	0	0	$0	$0
Clearwater	2	0	0	$0	$0
Dunedin	1	0	0	$0	$0
Gulfport	2	0	0	$0	$0
Indian Rocks Beach	2	1	0	$0	$0
Indian Shores	0	0	0	$0	$0
Kenneth City	0	0	0	$0	$0
Largo	2	0	0	$0	$0
Madeira Beach	0	0	0	$0	$0
North Redington Beach	0	0	0	$0	$0
Oldsmar	0	0	0	$0	$0
Pinellas Park	1	1	0	$0	$0
Redington Beach	0	0	0	$0	$0
Redington Shores	0	0	0	$0	$0
Safety Harbor	0	0	0	$0	$0
St. Petersburg	6	0	0	$287,722	$13,078
St. Pete Beach	0	0	0	$0	$0
Seminole	1	0	0	$0	$0
South Pasadena	1	0	0	$0	$0
Tarpon Springs	3	0	0	$23,733	$1,695
Treasure Island	0	0	0	$0	$0
Unincorporated	6	1	0	$5,472	$391
PINELLAS COUNTY TOTAL	**29**	**3**	**0**	**$316,927**	**$15,164**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

[65] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Heavy+Rain&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Table 4.57: Historical Heavy Rain Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair						
BELLEAIR	6/24/2012	Heavy Rain	0	0	$0	$0
Belleair Beach						
BELLEAIR BEACH	7/12/2008	Heavy Rain	0	0	$0	$0
Belleair Bluffs						
NONE REPORTED	--	--	--	--	--	--
Belleair Shore						
NONE REPORTED	--	--	--	--	--	--
Clearwater						
CLEARWATER	7/12/2008	Heavy Rain	0	0	$0	$0
CLEARWATER	7/3/2013	Heavy Rain	0	0	$0	$0
Dunedin						
DUNEDIN	5/12/2015	Heavy Rain	0	0	$0	$0
Gulfport						
GULFPORT	8/8/2010	Heavy Rain	0	0	$0	$0
GULFPORT	9/27/2014	Heavy Rain	0	0	$0	$0
Indian Rocks Beach						
INDIAN ROCKS BEACH	9/1/2011	Heavy Rain	0	0	$0	$0
INDIAN ROCKS BEACH	6/24/2012	Heavy Rain	1	0	$0	$0
Indian Shores						
NONE REPORTED	--	--	--	--	--	--
Kenneth City						
NONE REPORTED	--	--	--	--	--	--
Largo						
LARGO	6/1/2007	Heavy Rain	0	0	$0	$0
LARGO	7/12/2008	Heavy Rain	0	0	$0	$0
Madeira Beach						
NONE REPORTED	--	--	--	--	--	--
North Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Oldsmar						
NONE REPORTED	--	--	--	--	--	--
Pinellas Park						
PINELLAS PARK	7/29/2015	Heavy Rain	1	0	$0	$0
Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Redington Shores						
NONE REPORTED	--	--	--	--	--	--
Safety Harbor						
NONE REPORTED	--	--	--	--	--	--

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
St. Petersburg						
ST. PETERSBURG	4/30/1996	Heavy Rain	0	0	$0	$0
ST PETERSBURG	6/23/1998	Heavy Rain	0	0	$235,167	$0
ST PETERSBURG	6/28/2005	Heavy Rain	0	0	$52,555	$0
ST PETE A WHITTED AR	7/6/2008	Heavy Rain	0	0	$0	$0
SAINT PETERSBURG	8/5/2008	Heavy Rain	0	0	$0	$0
SAINT PETERSBURG PORTS SITE	9/27/2014	Heavy Rain	0	0	$0	$0
St. Pete Beach						
NONE REPORTED	--	--	--	--	--	--
Seminole						
SEMINOLE	4/26/1997	Heavy Rain	0	0	$0	$0
South Pasadena						
SOUTH PASADENA	9/27/2014	Heavy Rain	0	0	$0	$0
Tarpon Springs						
TARPON SPGS	9/4/2004	Heavy Rain	0	0	$0	$0
TARPON SPGS	6/10/2006	Heavy Rain	0	0	$0	$0
TARPON SPRINGS	7/1/2009	Heavy Rain	0	0	$23,733	$0
Treasure Island						
NONE REPORTED	--	--	--	--	--	--
Unincorporated						
ST PETE CLEARWATER I	2/25/2004	Heavy Rain	0	0	$0	$0
ULMERTON	9/1/2011	Heavy Rain	0	0	$0	$0
SAINT PETERSBURG-CLEARWATER INTL AIRPORT	6/24/2012	Heavy Rain	1	0	$0	$0
COACHMAN	6/6/2013	Heavy Rain	0	0	$5,472	$0
HIGHPOINT	9/1/2013	Heavy Rain	0	0	$0	$0
BELMONT	9/27/2014	Heavy Rain	0	0	$0	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

Hail

According to the NCEI Storm Events Database, there were 108 reports of hail in Pinellas County from 1956 to 2018.[66] These hail events are only inclusive of those reported by NCEI from 1955 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

[66] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Table 4.58: Summary of Hail Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	0	0	0	$0	$0
Belleair Beach	0	0	0	$0	$0
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	0	0	0	$0	$0
Clearwater	7	0	0	$0	$0
Dunedin	2	0	0	$0	$0
Gulfport	2	0	0	$0	$0
Indian Rocks Beach	1	0	0	$0	$0
Indian Shores	0	0	0	$0	$0
Kenneth City	1	0	0	$0	$0
Largo	8	0	0	$0	$0
Madeira Beach	0	0	0	$0	$0
North Redington Beach	0	0	0	$0	$0
Oldsmar	1	0	0	$0	$0
Pinellas Park	8	0	0	$0	$0
Redington Beach	0	0	0	$0	$0
Redington Shores	0	0	0	$0	$0
Safety Harbor	0	0	0	$0	$0
St. Petersburg	26	0	0	$584	$25
St. Pete Beach	0	0	0	$0	$0
Seminole	1	0	0	$0	$0
South Pasadena	1	0	0	$153,298	$8,068
Tarpon Springs	7	0	0	$290	$15
Treasure Island	1	0	0	$0	$0
Unincorporated	42	0	0	$359,522	$5,799
PINELLAS COUNTY TOTAL	**108**	**0**	**0**	**$513,694**	**$13,908**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.59: Historical Hail Occurrences in Pinellas County

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair							
NONE REPORTED	--	--	--	--	--	--	--
Belleair Beach							
NONE REPORTED	--	--	--	--	--	--	--
Belleair Bluffs							
NONE REPORTED	--	--	--	--	--	--	--

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair Shore							
NONE REPORTED	--	--	--	--	--	--	--
Clearwater							
CLEARWATER	7/20/1998	Hail	0.75 in.	0	0	$0	$0
CLEARWATER	8/30/1998	Hail	0.75 in.	0	0	$0	$0
CLEARWATER	5/21/1999	Hail	0.75 in.	0	0	$0	$0
CLEARWATER	5/21/1999	Hail	0.75 in.	0	0	$0	$0
CLEARWATER	7/17/1999	Hail	1.75 in.	0	0	$0	$0
CLEARWATER	8/30/2001	Hail	0.75 in.	0	0	$0	$0
CLEARWATER	5/19/2003	Hail	0.88 in.	0	0	$0	$0
Dunedin							
DUNEDIN TO	3/31/1993	Hail	1.00 in.	0	0	$0	$0
DUNEDIN	7/9/1999	Hail	1.00 in.	0	0	$0	$0
Gulfport							
GULFPORT	8/9/1993	Hail	0.75 in.	0	0	$0	$0
GULFPORT	8/10/1993	Hail	0.88 in.	0	0	$0	$0
Indian Rocks Beach							
INDIAN ROCKS BEACH	9/13/1993	Hail	1.00 in.	0	0	$0	$0
Indian Shores							
NONE REPORTED	--	--	--	--	--	--	--
Kenneth City							
KENNETH CITY	5/15/2015	Hail	0.88 in.	0	0	$0	$0
Largo							
LARGO	8/9/1993	Hail	0.88 in.	0	0	$0	$0
LARGO	8/22/1998	Hail	0.75 in.	0	0	$0	$0
LARGO	6/5/1999	Hail	0.75 in.	0	0	$0	$0
LARGO	6/26/1999	Hail	0.75 in.	0	0	$0	$0
LARGO	8/17/1999	Hail	1.75 in.	0	0	$0	$0
LARGO	3/31/2001	Hail	1.75 in.	0	0	$0	$0
LARGO	9/6/2002	Hail	0.75 in.	0	0	$0	$0
LARGO	10/13/2002	Hail	0.75 in.	0	0	$0	$0
Madeira Beach							
NONE REPORTED	--	--	--	--	--	--	--
North Redington Beach							
NONE REPORTED	--	--	--	--	--	--	--
Oldsmar							
OLDSMAR	8/16/1998	Hail	0.75 in.	0	0	$0	$0
Pinellas Park							
PINELLAS PARK	9/13/1993	Hail	0.88 in.	0	0	$0	$0
PINELLAS PARK	4/23/1997	Hail	1.75 in.	0	0	$0	$0
PINELLAS PARK	6/23/1998	Hail	0.75 in.	0	0	$0	$0
PINELLAS PARK	7/31/2000	Hail	0.75 in.	0	0	$0	$0
PINELLAS PARK	6/21/2001	Hail	1.75 in.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS PARK	8/19/2002	Hail	1.75 in.	0	0	$0	$0
PINELLAS PARK	7/4/2003	Hail	0.88 in.	0	0	$0	$0
PINELLAS PARK	6/28/2005	Hail	0.75 in.	0	0	$0	$0
Redington Beach							
NONE REPORTED	--	--	--	--	--	--	--
Redington Shores							
NONE REPORTED	--	--	--	--	--	--	--
Safety Harbor							
NONE REPORTED	--	--	--	--	--	--	--
St. Petersburg							
ST. PETERSBURG	6/11/1995	Hail	1.00 in.	0	0	$0	$0
ST PETERSBURG	7/16/1996	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	4/23/1997	Hail	1.75 in.	0	0	$0	$0
ST PETERSBURG	6/22/1997	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	8/16/1997	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	8/16/1997	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	5/5/1998	Hail	0.88 in.	0	0	$0	$0
ST PETERSBURG	6/29/1998	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	6/29/1998	Hail	1.75 in.	0	0	$0	$0
ST PETERSBURG	7/5/1998	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	4/28/1999	Hail	0.88 in.	0	0	$0	$0
ST PETERSBURG	4/28/1999	Hail	0.80 in.	0	0	$0	$0
ST PETERSBURG	7/9/1999	Hail	0.88 in.	0	0	$0	$0
ST PETERSBURG	7/9/1999	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	7/21/1999	Hail	1.00 in.	0	0	$0	$0
ST PETERSBURG	8/16/1999	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	6/25/2000	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	6/15/2001	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	6/19/2001	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	8/20/2001	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	4/25/2003	Hail	1.00 in.	0	0	$0	$0
ST PETERSBURG	4/25/2003	Hail	0.75 in.	0	0	$0	$0
ST PETERSBURG	8/14/2005	Hail	1.00 in.	0	0	$0	$0
ST PETE A WHITTED AR	6/9/2008	Hail	1.00 in.	0	0	$584	$0
ST PETE A WHITTED AR	6/25/2008	Hail	0.75 in.	0	0	$0	$0
SAINT PETERSBURG	3/20/2018	Hail	0.75 in.	0	0	$0	$0
St. Pete Beach							
NONE REPORTED	--	--	--	--	--	--	--
Seminole							
SEMINOLE	3/13/1993	Hail	0.75 in.	0	0	$0	$0
South Pasadena							
SOUTH PASADENA	7/15/1999	Hail	1.75 in.	0	0	$153,298	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
Tarpon Springs							
TARPON SPGS	5/30/1999	Hail	0.75 in.	0	0	$0	$0
TARPON SPGS	3/29/2001	Hail	0.75 in.	0	0	$0	$0
TARPON SPGS	6/5/2001	Hail	0.88 in.	0	0	$0	$0
TARPON SPGS	5/4/2005	Hail	1.00 in.	0	0	$0	$0
TARPON SPRINGS	7/7/2008	Hail	0.88 in.	0	0	$0	$0
TARPON SPRINGS	4/25/2010	Hail	1.00 in.	0	0	$0	$0
TARPON SPRINGS	1/10/2011	Hail	1.00 in.	0	0	$290	$0
Treasure Island							
TREASURE ISLAND	6/6/2008	Hail	0.88 in.	0	0	$0	$0
Unincorporated							
PINELLAS CO.	5/20/1956	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	3/16/1960	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	6/6/1963	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	6/23/1964	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	9/2/1967	Hail	1.50 in.	0	0	$0	$0
PINELLAS CO.	9/21/1973	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	5/17/1974	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	6/8/1974	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	8/25/1974	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	7/22/1976	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	8/8/1978	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	8/9/1979	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	3/24/1983	Hail	1.00 in.	0	0	$0	$0
PINELLAS CO.	3/24/1983	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	9/10/1983	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	7/11/1984	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	3/16/1986	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	3/16/1986	Hail	1.75 in.	0	0	$0	$0
PINELLAS CO.	6/7/1990	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	7/9/1990	Hail	1.25 in.	0	0	$0	$0
PINELLAS CO.	7/11/1990	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	9/1/1990	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	5/16/1991	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	5/31/1991	Hail	1.00 in.	0	0	$0	$0
PINELLAS CO.	8/6/1991	Hail	1.00 in.	0	0	$0	$0
PINELLAS CO.	2/5/1992	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	2/5/1992	Hail	0.88 in.	0	0	$0	$0
PINELLAS CO.	7/22/1992	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	8/7/1992	Hail	0.75 in.	0	0	$0	$0
PINELLAS CO.	8/7/1992	Hail	1.00 in.	0	0	$0	$0
PINELLAS CO.	9/2/1992	Hail	1.00 in.	0	0	$0	$0
TIERRA VERDE	7/6/1999	Hail	0.75 in.	0	0	$0	$0
PALM HARBOR	7/18/1999	Hail	0.88 in.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
TIERRA VERDE	5/3/2001	Hail	3.00 in.	0	0	$359,522	$0
PALM HARBOR	5/4/2005	Hail	1.00 in.	0	0	$0	$0
PALM HARBOR	7/27/2006	Hail	1.00 in.	0	0	$0	$0
SAINT PETERSBURG-CLEARWATER INTL AIRPORT	6/8/2007	Hail	0.75 in.	0	0	$0	$0
LEALMAN	7/21/2007	Hail	0.75 in.	0	0	$0	$0
BAY PINES	6/6/2008	Hail	0.88 in.	0	0	$0	$0
(PIE)ST PETE/CLRWATE	6/12/2008	Hail	0.75 in.	0	0	$0	$0
(PIE)ST PETE/CLRWATE	6/12/2008	Hail	0.88 in.	0	0	$0	$0
CRYSTAL BEACH	5/25/2014	Hail	0.88 in.	0	0	$0	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

Wind

According to the NCEI Storm Events Database, there were 254 reports of thunderstorm/high wind in Pinellas County from 1959 to 2018.[67] These wind events are only inclusive of those reported by NCEI from 1955 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.60: Summary of Wind Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	3	0	0	$5,463	$1,093
Belleair Beach	1	0	0	$171,534	$24,505
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	1	0	0	$76,649	$4,034
Clearwater	17	0	3	$671,966	$29,216
Dunedin	1	0	0	$3,066	$161
Gulfport	5	0	0	$32,971	$4,710
Indian Rocks Beach	6	0	0	$326,913	$13,077
Indian Shores	0	0	0	$0	$0
Kenneth City	1	0	0	$5,372	$1,343
Largo	11	0	0	$1,087,721	$43,509
Madeira Beach	3	0	0	$68,959	$6,896

[67] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
North Redington Beach	0	0	0	$0	$0
Oldsmar	2	0	0	$85,862	$4,293
Pinellas Park	9	0	0	$313,112	$15,656
Redington Beach	0	0	0	$0	$0
Redington Shores	1	0	0	$28,589	$4,084
Safety Harbor	2	0	0	$51,830	$2,728
St. Petersburg	44	0	2	$908,009	$36,320
St. Pete Beach	7	0	0	$75,382	$3,015
Seminole	3	0	0	$39,930	$4,437
South Pasadena	1	0	0	$8,880	$987
Tarpon Springs	11	0	0	$272,702	$10,908
Treasure Island	2	0	0	$0	$0
Unincorporated	123	1	1	$1,067,727	$18,097
PINELLAS COUNTY TOTAL	**254**	**1**	**6**	**$5,302,637**	**$229,068**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.61: Historical Wind Occurrences in Pinellas County

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair							
BELLEAIR	8/21/2013	T-storm Wind	50 kts.	0	0	$5,463	$0
BELLEAIR	8/21/2013	T-storm Wind	60 kts.	0	0	$0	$0
BELLEAIR	1/23/2017	T-storm Wind	50 kts.	0	0	$0	$0
Belleair Beach							
BELLEAIR BEACH	3/31/2011	T-storm Wind	52 kts.	0	0	$171,534	$0
Belleair Bluffs							
NONE REPORTED	--	--	--	--	--	--	--
Belleair Shore							
BELLEAIR SHRS	7/17/1999	T-storm Wind	--	0	0	$76,649	$0
Clearwater							
CLEARWATER	7/13/1995	T-storm Wind	0 kts.	0	0	$1,676	$0
CLEARWATER	7/14/1995	T-storm Wind	50 kts.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
CLEARWATER	7/27/1995	T-storm Wind	45 kts.	0	0	$1,676	$0
CLEARWATER	4/30/1996	T-storm Wind	--	0	0	$8,175	$0
CLEARWATER BEACH	4/30/1996	T-storm Wind	--	0	0	$408,746	$0
CLEARWATER	4/30/1996	T-storm Wind	--	0	0	$3,270	$0
CLEARWATER	1/9/1997	T-storm Wind	--	0	0	$16,062	$0
CLEARWATER	4/23/1997	T-storm Wind	--	0	0	$47,855	$0
CLEARWATER	8/20/1998	T-storm Wind	--	0	0	$31,279	$0
CLEARWATER	7/1/1999	T-storm Wind	--	0	0	$38,325	$0
CLEARWATER BEACH	8/12/2000	T-storm Wind	45 kts.	0	3	$1,479	$0
CLEARWATER	6/28/2002	T-storm Wind	55 kts.	0	0	$0	$0
CLEARWATER	4/25/2003	T-storm Wind	50 kts.	0	0	$55,614	$0
CLEARWATER	5/19/2003	T-storm Wind	50 kts.	0	0	$55,705	$0
CLEARWATER BEACH	12/16/2007	T-storm Wind	68 kts.	0	0	$0	$0
CLEARWATER EXEC ARPT	5/14/2011	T-storm Wind	62 kts.	0	0	$0	$0
CLEARWATER	1/22/2017	T-storm Wind	50 kts.	0	0	$2,105	$0
Dunedin							
DUNEDIN	7/9/1999	T-storm Wind	--	0	0	$3,066	$0
Gulfport							
GULFPORT	9/5/2011	T-storm Wind	52 kts.	0	0	$1,126	$0
GULFPORT	9/6/2011	T-storm Wind	52 kts.	0	0	$1,126	$0
GULFPORT	9/6/2011	T-storm Wind	52 kts.	0	0	$3,379	$0
GULFPORT	6/24/2012	T-storm Wind	52 kts.	0	0	$22,272	$0
GULFPORT	8/25/2018	T-storm Wind	50 kts.	0	0	$5,067	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
Indian Rocks Beach							
INDIAN ROCKS	1/16/1993	T-storm Wind	0 kts.	0	0	$89,603	$0
INDIAN ROCKS BEACH	2/2/1998	T-storm Wind	--	0	0	$78,922	$0
INDIAN ROCKS BEACH	2/19/1998	T-storm Wind	--	0	0	$15,784	$0
INDIAN ROCKS BEACH	6/5/1999	T-storm Wind	--	0	0	$115,319	$0
INDIAN ROCKS BEACH	5/14/2011	T-storm Wind	63 kts.	0	0	$0	$0
INDIAN ROCKS BEACH	9/5/2013	T-storm Wind	55 kts.	0	0	$27,285	$0
Indian Shores							
NONE REPORTED	--	--	--	--	--	--	--
Kenneth City							
KENNETH CITY	8/30/2014	T-storm Wind	40 kts.	0	0	$5,372	$0
Largo							
LARGO	5/28/1993	T-storm Wind	0 kts.	0	0	$886,089	$0
SOUTH LARGO	12/23/1993	T-storm Wind	0 kts.	0	0	$8,764	$0
LARGO	2/17/1998	T-storm Wind	52 kts.	0	0	$15,784	$0
LARGO	1/2/1999	T-storm Wind	52 kts.	0	0	$31,107	$0
LARGO	6/5/1999	T-storm Wind	--	0	0	$15,376	$0
LARGO	6/5/1999	T-storm Wind	--	0	0	$76,880	$0
LARGO	6/22/2001	T-storm Wind	--	0	0	$43,070	$0
LARGO	6/28/2003	T-storm Wind	55 kts.	0	0	$4,173	$0
LARGO	3/31/2011	T-storm Wind	60 kts.	0	0	$0	$0
LARGO	3/6/2014	T-storm Wind	39 kts.	0	0	$5,407	$0
LARGO	6/12/2015	T-storm Wind	45 kts.	0	0	$1,071	$0
Madeira Beach							
MADEIRA BEACH	4/5/2008	T-storm Wind	50 kts.	0	0	$17,844	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
MADEIRA BEACH	3/31/2011	T-storm Wind	56 kts.	0	0	$28,589	$0
MADEIRA BEACH	9/7/2011	T-storm Wind	30 kts.	0	0	$22,526	$0
North Redington Beach							
NONE REPORTED	--	--	--	--	--	--	--
Oldsmar							
OLDSMAR	8/16/1998	T-storm Wind	--	0	0	$78,197	$0
OLDSMAR	7/9/1999	T-storm Wind	--	0	0	$7,665	$0
Pinellas Park							
PINELLAS PARK	6/22/1998	T-storm Wind	--	0	0	$195,972	$0
PINELLAS PARK	6/23/1998	T-storm Wind	57 kts.	0	0	$7,839	$0
PINELLAS PARK	7/14/2000	T-storm Wind	--	0	0	$2,958	$0
PINELLAS PARK	8/6/2000	T-storm Wind	--	0	0	$73,943	$0
PINELLAS PARK	6/21/2001	T-storm Wind	--	0	0	$7,178	$0
PINELLAS PARK	7/4/2003	T-storm Wind	50 kts.	0	0	$20,844	$0
PINELLAS PARK	6/6/2008	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS PARK	6/21/2013	T-storm Wind	39 kts.	0	0	$3,283	$0
PINELLAS PARK	7/17/2013	T-storm Wind	40 kts.	0	0	$1,094	$0
Redington Beach							
NONE REPORTED	--	--	--	--	--	--	--
Redington Shores							
REDINGTON SHORES	3/31/2011	T-storm Wind	61 kts.	0	0	$28,589	$0
Safety Harbor							
SAFETY HARBOR	7/17/1999	T-storm Wind	52 kts.	0	0	$0	$0
SAFETY HARBOR	12/8/2017	T-storm Wind	40 kts.	0	0	$51,830	$0
St. Petersburg							
ST. PETERSBURG	3/13/1993	T-storm Wind	0 kts.	0	0	$8,898	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
ST. PETERSBURG	8/10/1993	T-storm Wind	0 kts.	0	0	$882	$0
ST PETERSBURG	7/17/1994	T-storm Wind	0 kts.	0	0	$86,101	$0
ST PETERSBURG	7/20/1994	T-storm Wind	52 kts.	0	0	$0	$0
ST. PETERSBURG	1/14/1995	T-storm Wind	0 kts.	0	0	$3,401	$0
ST. PETERSBURG	6/2/1995	T-storm Wind	0 kts.	0	1	$0	$0
ST. PETERSBURG	6/10/1995	T-storm Wind	0 kts.	0	0	$16,757	$0
ST PETERSBURG	8/15/1995	T-storm Wind	0 kts.	0	0	$16,713	$0
ST PETERSBURG	6/26/1996	T-storm Wind	--	0	0	$1,631	$0
ST PETERSBURG	6/26/1996	T-storm Wind	--	0	0	$0	$0
ST PETERSBURG	6/26/1996	T-storm Wind	53 kts.	0	0	$0	$0
ST PETERSBURG	6/26/1996	T-storm Wind	--	0	0	$8,154	$0
ST PETERSBURG	8/5/1996	T-storm Wind	52 kts.	0	0	$8,123	$0
ST PETERSBURG	4/23/1997	T-storm Wind	55 kts.	0	0	$0	$0
ST PETERSBURG	4/23/1997	T-storm Wind	--	0	0	$19,142	$0
ST PETERSBURG	4/23/1997	T-storm Wind	--	0	0	$7,976	$0
ST PETERSBURG	8/16/1997	T-storm Wind	--	0	0	$3,178	$0
ST PETERSBURG	8/16/1997	T-storm Wind	--	0	0	$1,589	$0
ST PETERSBURG	10/27/1997	T-storm Wind	55 kts.	0	0	$0	$0
ST PETERSBURG	2/2/1998	T-storm Wind	--	0	0	$118,382	$0
ST PETERSBURG	2/19/1998	T-storm Wind	--	0	0	$78,922	$0
ST PETERSBURG	3/9/1998	T-storm Wind	--	0	0	$3,151	$0
ST PETERSBURG	7/5/1998	T-storm Wind	--	0	0	$78,293	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
ST PETERSBURG	8/16/1999	T-storm Wind	--	0	0	$3,059	$0
ST PETERSBURG	6/7/2000	T-storm Wind	52 kts.	0	0	$14,823	$0
ST PETERSBURG	5/3/2001	T-storm Wind	--	0	0	$215,713	$0
ST PETERSBURG	6/18/2001	T-storm Wind	51 kts.	0	0	$0	$0
ST PETERSBURG	6/27/2001	T-storm Wind	--	0	0	$71,783	$0
ST PETERSBURG	8/25/2001	T-storm Wind	--	0	0	$1,440	$0
ST PETERSBURG	4/25/2003	T-storm Wind	60 kts.	0	1	$90,373	$0
ST PETERSBURG	7/26/2003	T-storm Wind	45 kts.	0	0	$6,948	$0
ST PETE A WHITTED AR	7/2/2004	T-storm Wind	51 kts.	0	0	$0	$0
ST PETERSBURG	6/1/2006	T-storm Wind	52 kts.	0	0	$18,892	$0
ST PETE A WHITTED AR	7/6/2008	T-storm Wind	56 kts.	0	0	$0	$0
ST PETE A WHITTED AR	7/6/2008	T-storm Wind	52 kts.	0	0	$0	$0
SAINT PETERSBURG PORTS SITE	6/23/2009	T-storm Wind	39 kts.	0	0	$11,848	$0
SPG-ALBERT WHITTED AIRPORT	2/5/2010	T-storm Wind	52 kts.	0	0	$7,664	$0
SPG-ALBERT WHITTED AIRPORT	3/31/2011	T-storm Wind	51 kts.	0	0	$0	$0
SPG-ALBERT WHITTED AIRPORT	7/22/2012	T-storm Wind	67 kts.	0	0	$0	$0
SAINT PETERSBURG PORTS SITE	4/2/2016	T-storm Wind	51 kts.	0	0	$0	$0
SPG-ALBERT WHITTED AIRPORT	7/19/2016	T-storm Wind	40 kts.	0	0	$2,124	$0
SPG-ALBERT WHITTED AIRPORT	7/4/2017	T-storm Wind	50 kts.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
SPG-ALBERT WHITTED AIRPORT	7/6/2017	T-storm Wind	50 kts.	0	0	$0	$0
SPG-ALBERT WHITTED AIRPORT	3/20/2018	T-storm Wind	40 kts.	0	0	$2,048	$0
St. Pete Beach							
ST. PETERSBURG BEACH	1/16/1993	T-storm Wind	0 kts.	0	0	$8,960	$0
ST PETERSBURG BCH	7/26/1994	T-storm Wind	0 kts.	0	0	$861	$0
ST PETERSBURG BEACH	4/23/1997	T-storm Wind	--	0	0	$39,880	$0
ST PETERSBURG BEACH	8/19/1998	T-storm Wind	--	0	0	$1,564	$0
ST PETERSBURG BEACH	11/19/2003	T-storm Wind	40 kts.	0	0	$20,776	$0
ST PETERSBURG BEACH	6/8/2004	T-storm Wind	55 kts.	0	0	$0	$0
SAINT PETERSBURG BEACH	6/24/2012	T-storm Wind	50 kts.	0	0	$3,341	$0
Seminole							
SEMINOLE	6/23/2009	T-storm Wind	43 kts.	0	0	$11,848	$0
SEMINOLE	4/20/2015	T-storm Wind	55 kts.	0	0	$27,002	$0
SEMINOLE	4/20/2015	T-storm Wind	55 kts.	0	0	$1,080	$0
South Pasadena							
SOUTH PASADENA	8/7/2009	T-storm Wind	43 kts.	0	0	$8,880	$0
Tarpon Springs							
TARPON SPRINGS	3/13/1993	T-storm Wind	0 kts.	0	0	$88,979	$0
TARPON SPRINGS	4/15/1993	T-storm Wind	60 kts.	0	0	$0	$0
TARPON SPGS	4/23/1997	T-storm Wind	--	0	0	$23,928	$0
TARPON SPGS	6/25/1997	T-storm Wind	--	0	0	$3,188	$0
TARPON SPGS	10/31/1997	T-storm Wind	--	0	0	$6,325	$0
TARPON SPGS	5/30/1999	T-storm Wind	--	0	0	$115,319	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
TARPON SPGS	3/4/2001	T-storm Wind	--	0	0	$14,503	$0
TARPON SPGS	6/5/2001	T-storm Wind	--	0	0	$14,357	$0
TARPON SPRINGS	4/14/2009	T-storm Wind	52 kts.	0	0	$0	$0
TARPON SPRINGS	3/4/2012	T-storm Wind	45 kts.	0	0	$5,570	$0
TARPON SPRINGS	5/4/2016	T-storm Wind	50 kts.	0	0	$532	$0
Treasure Island							
TREASURE ISLAND	6/6/2008	T-storm Wind	55 kts.	0	0	$0	$0
TREASURE ISLAND	6/6/2008	T-storm Wind	56 kts.	0	0	$0	$0
Unincorporated							
PINELLAS CO.	4/21/1959	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	2/19/1963	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	1/30/1965	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	6/5/1965	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/30/1965	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	8/4/1965	T-storm Wind	65 kts.	0	0	$0	$0
PINELLAS CO.	8/7/1966	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	11/11/1968	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	2/15/1969	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/18/1969	T-storm Wind	61 kts.	0	0	$0	$0
PINELLAS CO.	2/7/1971	T-storm Wind	83 kts.	0	0	$0	$0
PINELLAS CO.	3/3/1971	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	3/23/1974	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	3/29/1974	T-storm Wind	0 kts.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS CO.	5/17/1974	T-storm Wind	56 kts.	0	0	$0	$0
PINELLAS CO.	6/8/1974	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	1/25/1975	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	5/27/1975	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/18/1977	T-storm Wind	54 kts.	0	0	$0	$0
PINELLAS CO.	7/20/1977	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS CO.	8/9/1977	T-storm Wind	61 kts.	0	0	$0	$0
PINELLAS CO.	8/10/1977	T-storm Wind	57 kts.	0	0	$0	$0
PINELLAS CO.	1/19/1978	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	3/3/1978	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS CO.	6/29/1978	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS CO.	9/2/1978	T-storm Wind	80 kts.	0	0	$0	$0
PINELLAS CO.	5/8/1979	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	5/8/1979	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	8/24/1980	T-storm Wind	53 kts.	0	0	$0	$0
PINELLAS CO.	3/22/1981	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	6/18/1981	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	1/14/1982	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	4/10/1982	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS CO.	2/27/1984	T-storm Wind	54 kts.	0	0	$0	$0
PINELLAS CO.	4/8/1984	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	4/9/1984	T-storm Wind	0 kts.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS CO.	7/22/1984	T-storm Wind	54 kts.	0	0	$0	$0
PINELLAS CO.	7/23/1984	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	8/3/1984	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS CO.	7/30/1985	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	2/8/1986	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	6/18/1986	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	8/10/1986	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	1/22/1987	T-storm Wind	60 kts.	0	0	$0	$0
PINELLAS CO.	7/15/1987	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	8/21/1987	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	5/24/1988	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	7/15/1988	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	5/1/1989	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	6/6/1989	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	6/18/1989	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	8/19/1989	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	9/5/1989	T-storm Wind	60 kts.	0	0	$0	$0
PINELLAS CO.	9/17/1989	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	4/7/1990	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	6/30/1990	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/7/1990	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/7/1990	T-storm Wind	70 kts.	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS CO.	7/9/1990	T-storm Wind	60 kts.	0	0	$0	$0
PINELLAS CO.	7/18/1990	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	9/1/1990	T-storm Wind	52 kts.	0	0	$0	$0
PINELLAS CO.	10/5/1990	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	11/9/1990	T-storm Wind	61 kts.	0	0	$0	$0
PINELLAS CO.	1/19/1991	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	4/10/1991	T-storm Wind	0 kts.	1	0	$0	$0
PINELLAS CO.	4/25/1991	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	5/17/1991	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/31/1991	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	2/5/1992	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	3/30/1992	T-storm Wind	55 kts.	0	0	$0	$0
PINELLAS CO.	7/24/1992	T-storm Wind	56 kts.	0	0	$0	$0
PINELLAS CO.	10/3/1992	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	11/5/1992	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/20/1994	T-storm Wind	0 kts.	0	0	$0	$0
PINELLAS CO.	7/29/1994	T-storm Wind	0 kts.	0	0	$861	$0
NORTH AND CENTRAL PAR	3/8/1995	T-storm Wind	0 kts.	0	0	$0	$0
PIE	7/14/1995	T-storm Wind	50 kts.	0	0	$0	$0
PINELLAS CO.	10/4/1995	T-storm Wind	50 kts.	0	0	$4,157	$0
PINELLAS (ZONE)	11/15/1996	High Wind	43 kts.	0	0	$16,113	$0
PALM HARBOR	3/9/1998	T-storm Wind	--	0	0	$23,633	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PALM HARBOR	9/19/2000	T-storm Wind	--	0	0	$36,780	$0
PINELLAS (ZONE)	11/25/2000	High Wind	45 kts.	0	0	$36,696	$0
PINELLAS (ZONE)	3/2/2002	High Wind	--	0	0	$0	$0
SEMINOLE PARK	9/6/2002	T-storm Wind	--	0	0	$70,593	$0
PINELLAS (ZONE)	4/12/2004	Strong Wind	49 kts.	0	0	$27,186	$0
PINELLAS (ZONE)	12/26/2004	High Wind	53 kts.	0	0	$26,857	$0
(PIE)ST PETE/CLRWATE	11/15/2006	T-storm Wind	53 kts.	0	0	$0	$0
BELMONT	12/11/2008	T-storm Wind	43 kts.	0	0	$6,078	$0
LEALMAN	6/23/2009	T-storm Wind	52 kts.	0	0	$94,782	$0
SAINT PETERSBURG-CLEARWATER INTL AIRPORT	8/21/2009	T-storm Wind	54 kts.	0	0	$11,840	$0
PASS-A-GRILL BEACH	2/5/2010	T-storm Wind	52 kts.	0	0	$590	$0
LEALMAN	1/25/2011	T-storm Wind	78 kts.	0	1	$37,133	$0
CAMPBELL PARK COMPS SITE	1/25/2011	T-storm Wind	61 kts.	0	0	$0	$0
BASKIN	3/31/2011	T-storm Wind	56 kts.	0	0	$285,890	$0
SAINT PETERSBURG-CLEARWATER INTL AIRPORT	3/31/2011	T-storm Wind	56 kts.	0	0	$91,485	$0
FEATHER SOUND	3/31/2011	T-storm Wind	56 kts.	0	0	$5,718	$0
LEALMAN	5/14/2011	T-storm Wind	61 kts.	0	0	$0	$0
PASADENA	9/6/2011	T-storm Wind	52 kts.	0	0	$2,253	$0
LEALMAN	5/19/2012	T-storm Wind	50 kts.	0	0	$55,599	$0
BELMONT	7/21/2012	T-storm Wind	52 kts.	0	0	$55,771	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
COACHMAN	7/21/2012	T-storm Wind	50 kts.	0	0	$1,000	$0
BELMONT	8/20/2012	T-storm Wind	40 kts.	0	0	$1,109	$0
COACHMAN	7/17/2013	T-storm Wind	40 kts.	0	0	$5,470	$0
FEATHER SOUND	7/30/2013	T-storm Wind	50 kts.	0	0	$5,470	$0
BELMONT	8/21/2013	T-storm Wind	50 kts.	0	0	$0	$0
ULMERTON	9/15/2013	T-storm Wind	40 kts.	0	0	$2,183	$0
PINELLAS (ZONE)	1/3/2014	Strong Wind	40 kts.	0	0	$10,925	$0
PALM HARBOR	3/29/2014	T-storm Wind	50 kts.	0	0	$1,081	$0
BAY PINES	8/30/2014	T-storm Wind	45 kts.	0	0	$21,488	$0
CRYSTAL BEACH	4/20/2015	T-storm Wind	45 kts.	0	0	$540	$0
LEALMAN	4/20/2015	T-storm Wind	55 kts.	0	0	$2,160	$0
BELMONT	8/15/2015	T-storm Wind	35 kts.	0	0	$0	$0
PALM HARBOR	5/4/2016	T-storm Wind	50 kts.	0	0	$1,596	$0
CRYSTAL BEACH	7/21/2016	T-storm Wind	50 kts.	0	0	$21,240	$0
PINELLAS (ZONE)	5/5/2017	Strong Wind	26 kts.	0	0	$15,663	$0
HIGHPOINT	7/3/2017	T-storm Wind	40 kts.	0	0	$20,879	$0
CRYSTAL BEACH	7/23/2018	T-storm Wind	53 kts.	0	0	$0	$0
TIERRA VERDE	8/5/2018	T-storm Wind	43 kts.	0	0	$20,270	$0
BAY PINES	8/28/2018	T-storm Wind	50 kts.	0	0	$1,013	$0
(PIE)ST PETE/CLRWATE	11/2/2018	T-storm Wind	55 kts.	0	0	$10,139	$0
OAKHURST	11/2/2018	T-storm Wind	55 kts.	0	0	$20,279	$0
OAKHURST	11/2/2018	T-storm Wind	60 kts.	0	0	$15,209	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS (ZONE)	12/21/2018	High Wind	62 kts.	0	0	$0	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

Tornado

According to the NCEI Storm Events Database, there were 132 reports of tornado in Pinellas County from 1951 to 2018.[68] These tornado events are only inclusive of those reported by NCEI from 1950 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.62: Summary of Tornado Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	0	0	0	$0	$0
Belleair Beach	0	0	0	$0	$0
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	0	0	0	$0	$0
Clearwater	5	0	0	$16,559	$753
Dunedin	0	0	0	$0	$0
Gulfport	2	0	0	$42,287	$8,457
Indian Rocks Beach	4	0	4	$8,118,565	$386,598
Indian Shores	0	0	0	$0	$0
Kenneth City	0	0	0	$0	$0
Largo	4	0	0	$726,234	$38,223
Madeira Beach	0	0	0	$0	$0
North Redington Beach	0	0	0	$0	$0
Oldsmar	0	0	0	$0	$0
Pinellas Park	1	1	0	$0	$0
Redington Beach	0	0	0	$0	$0
Redington Shores	0	0	0	$0	$0
Safety Harbor	1	0	0	$10,940	$2,188
St. Petersburg	5	0	1	$433,572	$17,343
St. Pete Beach	5	0	0	$934,806	$42,491
Seminole	1	0	1	$304,178	$304,178
South Pasadena	0	0	0	$0	$0
Tarpon Springs	2	0	0	$45,019	$2,369

[68] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Treasure Island	2	0	0	$117,358	$4,694
Unincorporated	100	11	305	$321,996,455	$4,805,917
PINELLAS COUNTY TOTAL	**132**	**12**	**311**	**$332,745,973**	**$5,613,212**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.63: Historical Tornado Occurrences in Pinellas County

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair							
NONE REPORTED	--	--	--	--	--	--	--
Belleair Beach							
NONE REPORTED	--	--	--	--	--	--	--
Belleair Bluffs							
NONE REPORTED	--	--	--	--	--	--	--
Belleair Shore							
NONE REPORTED	--	--	--	--	--	--	--
Clearwater							
CLEARWATER	11/8/1996	Tornado	F0	0	0	$8,056	$0
CLEARWATER	4/23/1997	Tornado	F0	0	0	$0	$0
CLEARWATER	10/27/1997	Tornado	F0	0	0	$3,163	$0
CLEARWATER	5/22/2009	Tornado	EF0	0	0	$0	$0
CLEARWATER BEACH	4/7/2016	Tornado	EF0	0	0	$5,340	$0
Dunedin							
NONE REPORTED	--	--	--	--	--	--	--
Gulfport							
GULFPORT	6/6/2013	Tornado	EF0	0	0	$21,888	$0
GULFPORT	4/15/2018	Tornado	EF0	0	0	$20,399	$0
Indian Rocks Beach							
INDIAN ROCKS BEACH	10/27/1997	Tornado	F1	0	4	$7,116,126	$0
INDIAN ROCKS BEACH	3/31/2011	Tornado	EF1	0	0	$857,670	$0
INDIAN ROCKS BEACH	6/24/2012	Tornado	EF1	0	0	$144,769	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
INDIAN ROCKS BEACH	3/6/2014	Tornado	EF0	0	0	$0	$0
Indian Shores							
NONE REPORTED	--	--	--	--	--	--	--
Kenneth City							
NONE REPORTED	--	--	--	--	--	--	--
Largo							
LARGO	7/15/1999	Tornado	F0	0	0	$153,298	$0
LARGO	7/12/2002	Tornado	F0	0	0	$1,419	$0
LARGO	6/23/2005	Tornado	F0	0	0	$0	$0
LARGO	7/20/2005	Tornado	F0	0	0	$571,517	$0
Madeira Beach							
NONE REPORTED	--	--	--	--	--	--	--
North Redington Beach							
NONE REPORTED	--	--	--	--	--	--	--
Oldsmar							
NONE REPORTED	--	--	--	--	--	--	--
Pinellas Park							
PINELLAS PARK	7/9/2005	Tornado	F0	1	0	$0	$0
Redington Beach							
NONE REPORTED	--	--	--	--	--	--	--
Redington Shores							
NONE REPORTED	--	--	--	--	--	--	--
Safety Harbor							
SAFETY HARBOR	7/1/2013	Tornado	EF0	0	0	$10,940	$0
St. Petersburg							
N ST PETERSBURG	1/16/1993	Tornado	F0	0	0	$89,603	$0
ST. PETERSBURG	8/9/1993	Tornado	F0	0	0	$0	$0
ST. PETERSBURG	8/9/1993	Tornado	F1	0	0	$8,824	$0
ST. PETE.	7/12/1995	Tornado	F1	0	1	$335,145	$0
ST PETERSBURG	7/10/1998	Tornado	F0	0	0	$0	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
St. Pete Beach							
ST PETERSBURG BEACH	9/20/1996	Tornado	F0	0	0	$48,583	$0
ST PETERSBURG BEACH	6/8/2002	Tornado	F0	0	0	$710,250	$0
ST PETERSBURG BEACH	8/24/2004	Tornado	F0	0	0	$6,743	$0
SAINT PETERSBURG BEACH	6/24/2012	Tornado	EF1	0	0	$167,041	$0
SAINT PETERSBURG BEACH	6/25/2013	Tornado	EF0	0	0	$2,189	$0
Seminole							
SEMINOLE	11/2/2018	Tornado	EF1	0	1	$304,178	$0
South Pasadena							
NONE REPORTED	--	--	--	--	--	--	--
Tarpon Springs							
TARPON SPGS	6/20/1999	Tornado	F0	0	0	$3,075	$0
TARPON SPRINGS COMPS SITE	4/14/2009	Tornado	EF0	0	0	$41,944	$0
Treasure Island							
Treasure Island	3/13/1993	Tornado	--	0	0	$88,979	$0
TREASURE IS	7/11/2002	Tornado	F0	0	0	$28,378	$0
Unincorporated							
PINELLAS CO.	12/18/1951	Tornado	F1	0	0	$24,108	$0
PINELLAS CO.	5/30/1952	Tornado	F2	0	0	$24,200	$0
PINELLAS CO.	6/13/1952	Tornado	F1	0	0	$24,108	$0
PINELLAS CO.	6/29/1952	Tornado	F1	0	0	$24,108	$0
PINELLAS CO.	6/5/1953	Tornado	F0	0	0	$286	$0
PINELLAS CO.	6/18/1953	Tornado	F1	0	0	$23,838	$0
PINELLAS CO.	8/20/1954	Tornado	F1	0	0	$237,498	$0
PINELLAS CO.	5/5/1961	Tornado	F2	0	0	$214,386	$0
PINELLAS CO.	5/30/1963	Tornado	F1	0	0	$20,947	$0
PINELLAS CO.	8/13/1963	Tornado	F2	0	0	$208,101	$0
PINELLAS CO.	8/21/1963	Tornado	F2	0	0	$20,810	$0
PINELLAS CO.	8/22/1963	Tornado	F1	0	0	$20,810	$0
PINELLAS CO.	3/20/1964	Tornado	F1	0	1	$2,067,540	$0
PINELLAS CO.	8/21/1964	Tornado	F1	0	2	$20,609	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS CO.	4/4/1966	Tornado	F4	3	80	$197,792,570	$0
PINELLAS CO.	4/4/1966	Tornado	F2	0	0	$1,977,926	$0
PINELLAS CO.	4/28/1966	Tornado	F1	0	0	$1,978	$0
PINELLAS CO.	6/6/1966	Tornado	F1	0	1	$1,971,821	$0
PINELLAS CO.	8/28/1966	Tornado	--	0	0	$0	$0
PINELLAS CO.	9/5/1966	Tornado	F0	0	0	$0	$0
PINELLAS CO.	12/28/1967	Tornado	F2	0	0	$188,457	$0
PINELLAS CO.	1/23/1968	Tornado	F1	0	0	$187,352	$0
PINELLAS CO.	5/19/1968	Tornado	--	0	0	$18,518	$0
PINELLAS CO.	7/14/1968	Tornado	F1	0	0	$18,306	$0
PINELLAS CO.	7/14/1968	Tornado	F1	0	0	$183,057	$0
PINELLAS CO.	11/9/1968	Tornado	F1	0	0	$18,047	$0
PINELLAS CO.	11/11/1968	Tornado	F1	0	0	$1,804,718	$0
PINELLAS CO.	12/10/1969	Tornado	F2	0	1	$1,694,615	$0
PINELLAS CO.	1/2/1972	Tornado	F0	0	0	$15,544	$0
PINELLAS CO.	3/17/1973	Tornado	F1	0	0	$147,545	$0
PINELLAS CO.	6/2/1973	Tornado	F0	0	0	$144,541	$0
PINELLAS CO.	10/31/1973	Tornado	F2	0	9	$14,010,307	$0
PINELLAS CO.	2/19/1974	Tornado	F1	0	2	$13,535,381	$0
PINELLAS CO.	7/25/1974	Tornado	F0	0	0	$129,326	$0
PINELLAS CO.	5/26/1975	Tornado	F1	0	0	$120,088	$0
PINELLAS CO.	8/17/1975	Tornado	F0	0	0	$11,766	$0
PINELLAS CO.	9/11/1975	Tornado	F0	0	0	$11,701	$0
PINELLAS CO.	1/8/1976	Tornado	F0	0	0	$11,490	$0
PINELLAS CO.	4/8/1976	Tornado	F0	0	2	$113,881	$0
PINELLAS CO.	7/7/1976	Tornado	F0	0	0	$11,189	$0
PINELLAS CO.	8/12/1976	Tornado	F1	1	21	$11,130,139	$0
PINELLAS CO.	5/4/1978	Tornado	F3	3	94	$9,904,961	$0
PINELLAS CO.	6/8/1978	Tornado	F0	0	0	$9,799	$0
PINELLAS CO.	6/29/1978	Tornado	F0	0	2	$97,986	$0
PINELLAS CO.	5/8/1979	Tornado	F0	0	0	$893,524	$0
PINELLAS CO.	5/8/1979	Tornado	F0	0	0	$893,524	$0
PINELLAS CO.	5/24/1979	Tornado	--	0	0	$89,352	$0
PINELLAS CO.	9/1/1979	Tornado	F1	0	0	$856,394	$0
PINELLAS CO.	9/25/1979	Tornado	F1	0	0	$85,639	$0
PINELLAS CO.	10/5/1979	Tornado	F0	0	0	$84,956	$0
PINELLAS CO.	6/19/1981	Tornado	F0	0	1	$70,515	$0
PINELLAS CO.	7/15/1981	Tornado	F0	0	0	$697,456	$0
PINELLAS CO.	12/15/1981	Tornado	F2	0	5	$679,649	$0
PINELLAS CO.	3/6/1982	Tornado	F0	0	0	$67,605	$0
PINELLAS CO.	9/21/1982	Tornado	F1	0	0	$652,574	$0
PINELLAS CO.	2/2/1983	Tornado	F1	0	1	$652,574	$0
PINELLAS CO.	12/11/1983	Tornado	F2	0	0	$630,671	$0
PINELLAS CO.	3/15/1985	Tornado	F1	0	2	$6,004	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS CO.	5/20/1986	Tornado	F0	0	0	$5,867	$0
PINELLAS CO.	6/3/1986	Tornado	F0	0	0	$583	$0
PINELLAS CO.	6/12/1986	Tornado	F0	0	0	$58,344	$0
PINELLAS CO.	6/18/1987	Tornado	F0	0	0	$56,288	$0
PINELLAS CO.	7/6/1987	Tornado	F0	0	0	$561,397	$0
PINELLAS CO.	7/15/1988	Tornado	F0	0	0	$5,391	$0
PINELLAS CO.	7/25/1988	Tornado	F0	0	0	$53,913	$0
PINELLAS CO.	8/14/1988	Tornado	F0	0	0	$53,687	$0
PINELLAS CO.	9/8/1988	Tornado	F0	0	0	$53,328	$0
PINELLAS CO.	11/22/1988	Tornado	F0	0	0	$5,311	$0
PINELLAS CO.	11/22/1988	Tornado	F0	0	0	$5,311	$0
PINELLAS CO.	12/11/1988	Tornado	F0	0	0	$530,183	$0
PINELLAS CO.	8/10/1989	Tornado	F0	0	0	$512,737	$0
PINELLAS CO.	6/7/1990	Tornado	F0	0	0	$4,918	$0
PINELLAS CO.	8/19/1990	Tornado	F0	0	0	$485	$0
PINELLAS CO.	1/19/1991	Tornado	F0	0	0	$0	$0
PINELLAS CO.	4/25/1991	Tornado	F0	0	0	$473	$0
PINELLAS CO.	4/25/1991	Tornado	F1	0	0	$472,537	$0
PINELLAS CO.	5/16/1991	Tornado	F0	0	0	$471	$0
PINELLAS CO.	5/16/1991	Tornado	F0	0	0	$4,711	$0
PINELLAS CO.	5/17/1991	Tornado	F0	0	0	$0	$0
PINELLAS CO.	7/20/1991	Tornado	F0	0	0	$0	$0
PINELLAS CO.	2/5/1992	Tornado	F0	0	0	$0	$0
PINELLAS CO.	2/5/1992	Tornado	F0	0	0	$461	$0
PINELLAS CO.	2/5/1992	Tornado	F0	0	0	$461	$0
PINELLAS CO.	6/17/1992	Tornado	F1	0	0	$4,557	$0
PINELLAS CO.	7/12/1992	Tornado	F2	0	6	$4,547,117	$0
PINELLAS CO.	7/19/1992	Tornado	F1	0	0	$45,471	$0
PINELLAS CO.	7/20/1992	Tornado	F0	0	0	$455	$0
PINELLAS CO.	7/20/1992	Tornado	F0	0	0	$455	$0
PINELLAS CO.	7/22/1992	Tornado	F0	0	0	$0	$0
PINELLAS CO.	9/1/1992	Tornado	F0	0	0	$0	$0
PINELLAS CO.	10/3/1992	Tornado	F2	1	0	$4,505,430	$0
PINELLAS CO.	10/3/1992	Tornado	F1	0	0	$45,054	$0
PINELLAS CO.	10/3/1992	Tornado	F3	3	75	$45,054,302	$0
CRYSTAL BEACH	7/11/1994	Tornado	F0	0	0	$0	$0
PALM HARBOR	8/12/2000	Tornado	F0	0	0	$739,433	$0
TIERRA VERDE	7/14/2001	Tornado	F0	0	0	$0	$0
CRYSTAL BEACH	6/5/2002	Tornado	F0	0	0	$0	$0
(PIE)ST PETE/CLRWATE	3/31/2011	Tornado	EF1	0	0	$5,718	$0

	Date	Type	Magnitude	Deaths	Injuries	Property Damage*	Crop Damage*
FEATHER SOUND	6/24/2013	Tornado	EF0	0	0	$0	$0
COACHMAN	4/7/2016	Tornado	EF0	0	0	$106,807	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

4. Probability of Future Occurrences of Severe Storms

Based on historical analysis, severe storms and tornadoes will continue to effect Pinellas County.

The map below shows the average number of thunderstorm days across the United States. 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.

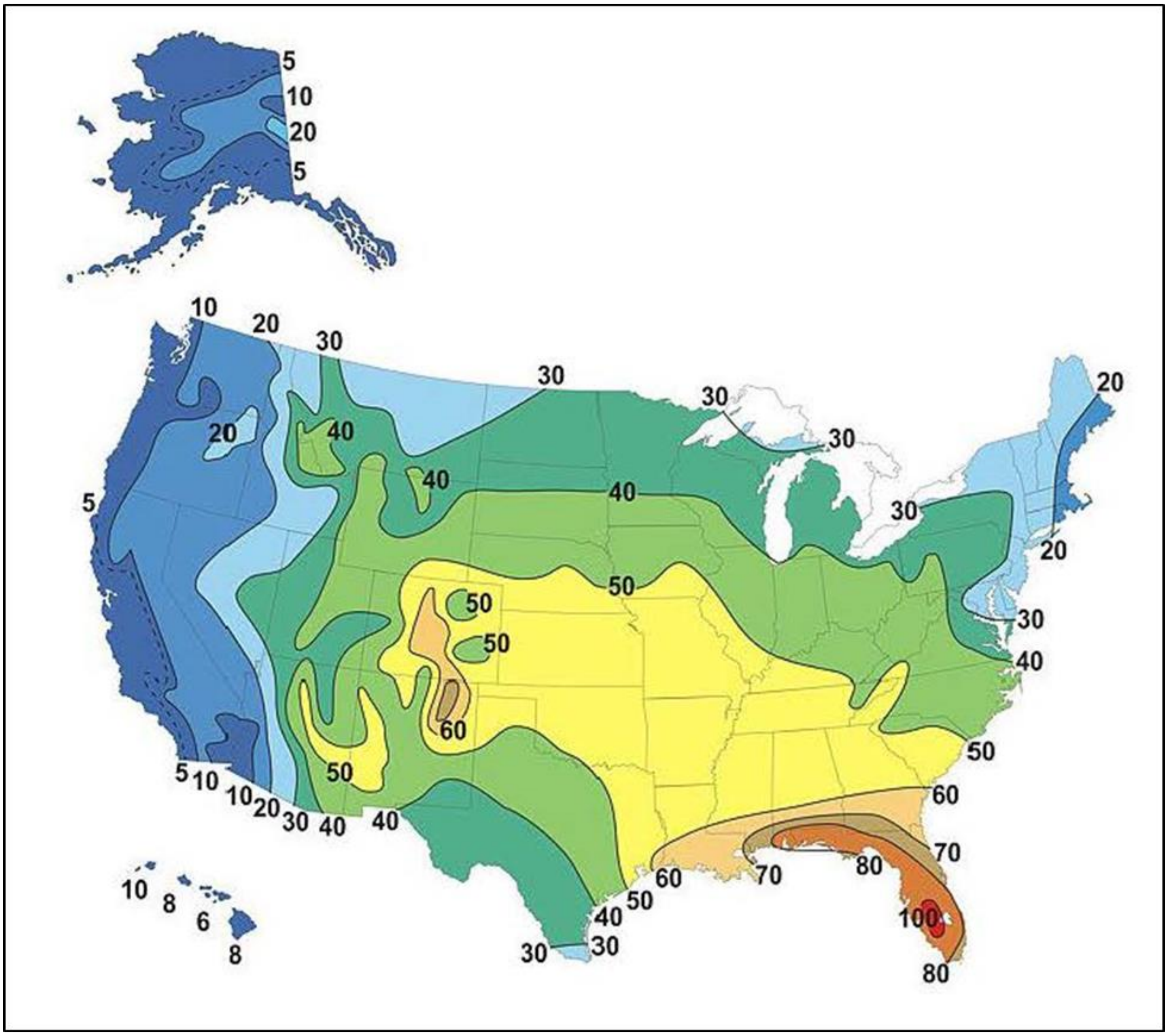
Pinellas County experiences 80 to 90 days of thunderstorms through the year and the state of Florida has about 1.4 million lightning strikes on an annual basis making Florida first in the United States for lightning strikes per square mile.[69] [70] Due to these annual occurrences, lightning is one of the prevalent hazards in the county.

Pinellas County is also likely to experience at least 1 tornado warning each year. 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.

The probability is high that all jurisdictions could be impacted by severe storms. Variances in how much damage these storms generate within each community would be dependent upon severity of storms, maintenance of vegetation and infrastructure, and strength of residential and commercial structures.

[69] http://www.nssl.noaa.gov/education/svrwx101/thunderstorms/
[70] https://www.floridadisaster.org/hazards/thunderstorms/

Figure 4.45: Average Number of Thunderstorm Days, United States[71]



Probability Based on Historical Occurrences

An analysis of severe storm reports from 1950 to 2018 in Pinellas County from the NCEI Storm Events Database indicates that there will be approximately 7 lightning events, 1 heavy rain event, 2 hail events, 4 wind events, and 2 tornado events each year in Pinellas County.

[71] http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html

Table 4.64: NCEI Severe Storm Reports 1950–2018[72]

Type of Severe Storm	NCEI Reports	Average per Year
Lightning	151	6.9
Heavy Rain	29	1.3
Hail	108	1.7
Wind	254	4.0
Tornado	132	1.9
TOTAL	**674**	**15.8**

Based on historical information, this hazard was determined to have a probability level of highly likely (100% annual probability).

5. Severe Storm Impact Analysis

All jurisdictions could receive the following impacts due to severe storms. Variances in how much damage these storms generate within each community would be dependent upon severity of storms, maintenance of vegetation and infrastructure, and strength of residential and commercial structures.

- 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
  - Indirect death
  - Survivors guilt if their house was not 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.

[72] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28C%29+Heavy+Rain&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

  - 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Historical Losses

The NCEI Storm Events Database information, presented in the Historical Occurrences section above, also contained property and crop damage dollar amounts, which is shown in the table below.

Table 4.65: Severe Storm Events in Pinellas County, by Type, (1950–2018)[73]

Type of Event	Number of Events	Deaths	Injuries	Property Damage (2019 dollars)	Crop Damage (2019 dollars)
Lightning	151	5	78	$14,621,079	$1,122
Heavy Rain	29	3	0	$316,927	$0
Hail	108	0	0	$513,694	$0
Wind	254	1	6	$5,302,637	$0
Tornado	132	12	311	$332,745,973	$0
TOTAL	**674**	**21**	**395**	**$353,500,310**	**$0**

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 4.66: NCEI Severe Storms, 1950–2018

NCEI Storm Event (hazard)	Average Severe Storms per Year	Annualized Property Loss (2019 dollars)	Annualized Crop Loss (2019 dollars)
All Types of Severe Storm	15.8	$6,756,579	$52

[73] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28C%29+Heavy+Rain&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

According to the analysis, Pinellas County is historically vulnerable to over $6,756,000 in property damages and approximately $50 in crop damages from roughly 16 severe storm events each year.

Exposure

Since severe storm is a hazard that does not have geographically definable boundaries, it was excluded from spatial analysis through GIS. However, because severe storms are considered atmospheric, they have the potential to affect all buildings and all populations in Pinellas County.

Severe storms do not always impact structures, but impacts could include flooding from heavy rain, wind, tornadoes, hail, and lighting. Please refer to the *Flood Hazard Profile* for the 100-year 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. Hail is unlikely to cause damage because of the fact that, oftentimes, hail does not impact the county. Lightning impacts on structures are minimal.

People could be impacted by severe storms in a number of ways. Lightning can result in death or severe injury if a person is struck, heavy rain can result in rising floodwaters that can lead to drowning or other serious injury, injuries from hail are rare but they can be severe, wind can cause trees to fall and potentially result in injuries or death, and a tornado can directly damage and destroy buildings and vehicles with occupants inside as well as create flying windborne debris that can cause serious injuries or loss of life.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Severe storms can strike anywhere in Pinellas County; therefore, all of the county critical facilities are equally vulnerable and at risk. However, severe storms do not always impact structures. The impacts of severe storms to structures, including critical facilities, are listed above under Exposure.

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 3.1.

SEVERE STORM Overview					Overall Vulnerability
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.					HIGH
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Highly Likely	Critical	Moderate	6 to 12 hrs	< 6 hrs	3.1

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% of wildfires are caused by humans, including arson, burning debris, or accidents. Furthermore, 20–30% 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.[74] [75]

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

[74] http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Wildland-Fire
[75] 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 (WUI) Fires

Population movement trends in the United States 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:[76]

- 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.

[76] 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 data used to determine vulnerability to wildfire in Pinellas County is based on GIS data called the Southern Wildfire Risk Assessment (SWRA). This data is available on the Southern Wildfire Risk Assessment website and can be downloaded and imported into ArcGIS. A specific layer, known as "Wildland Urban Interface Risk Index" (WUIRI) was used to determine vulnerability of people and property. The WUIRI is presented on a scale of 0 to -9. It combines data on housing density with the data on the impact and likelihood of a wildfire occurring in a specific area. The primary purpose of the data is to highlight areas of concern that may be conducive to mitigation actions. Due to the assumptions made, it is not a true probability. However, it does provide a comparison of risk throughout the region.

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.[77] 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.[78] As the *Flood Hazard Profile* 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 areas in Pinellas County that may be 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. As most of Pinellas County and its municipalities are urbanized, there are few areas with large fuels to support a catastrophic event. The only large exposure occurs in the northwestern portion of Unincorporated County in a managed open-space area.

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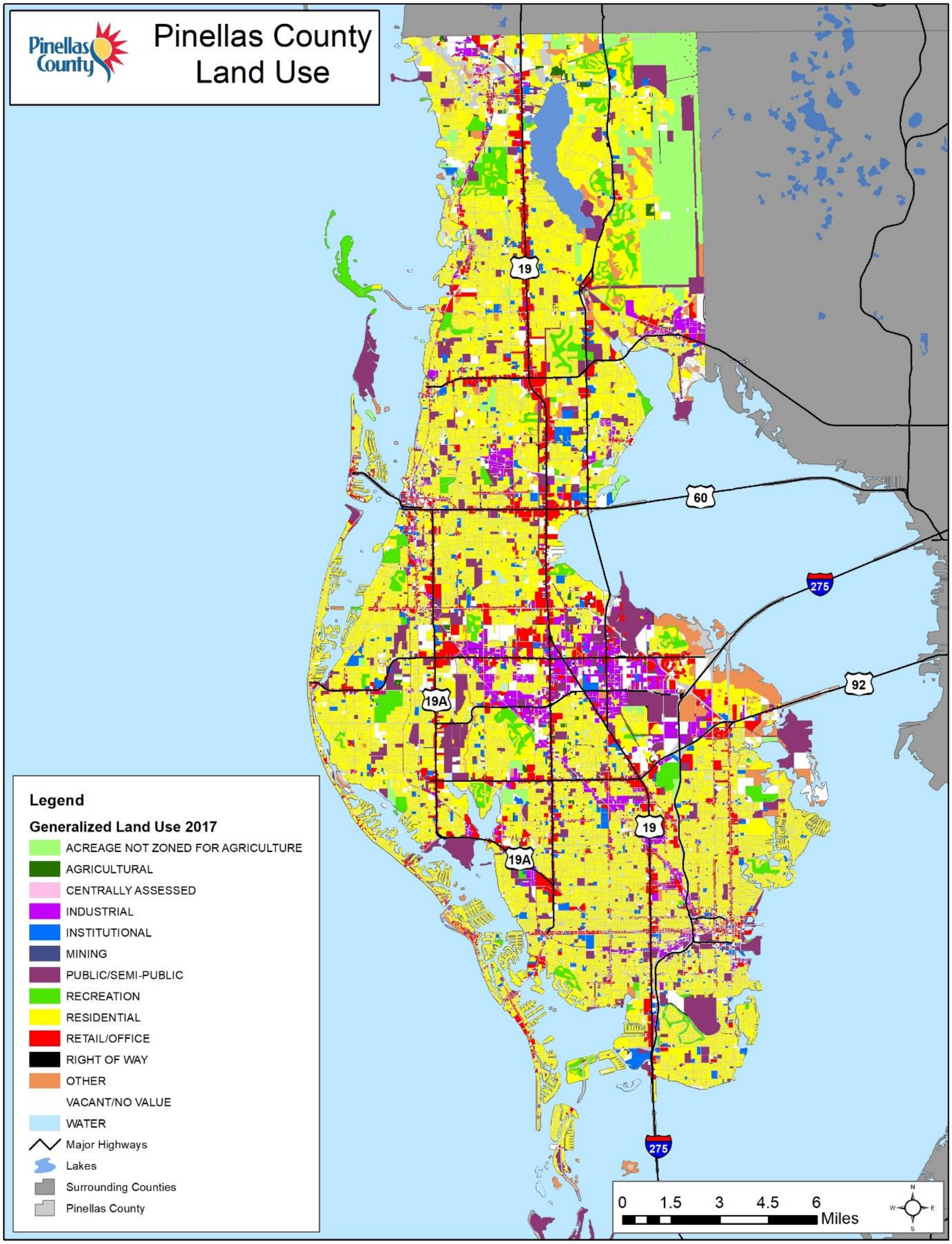
[77] Murray et al. (2012). *Case studies*, (https://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap9_FINAL.pdf). In Field et al. (Eds.), *Managing the risks of extreme events and disasters to advance climate change adaptation; A Special Report of Working Groups I and II of the Intergovernmental Panel 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*

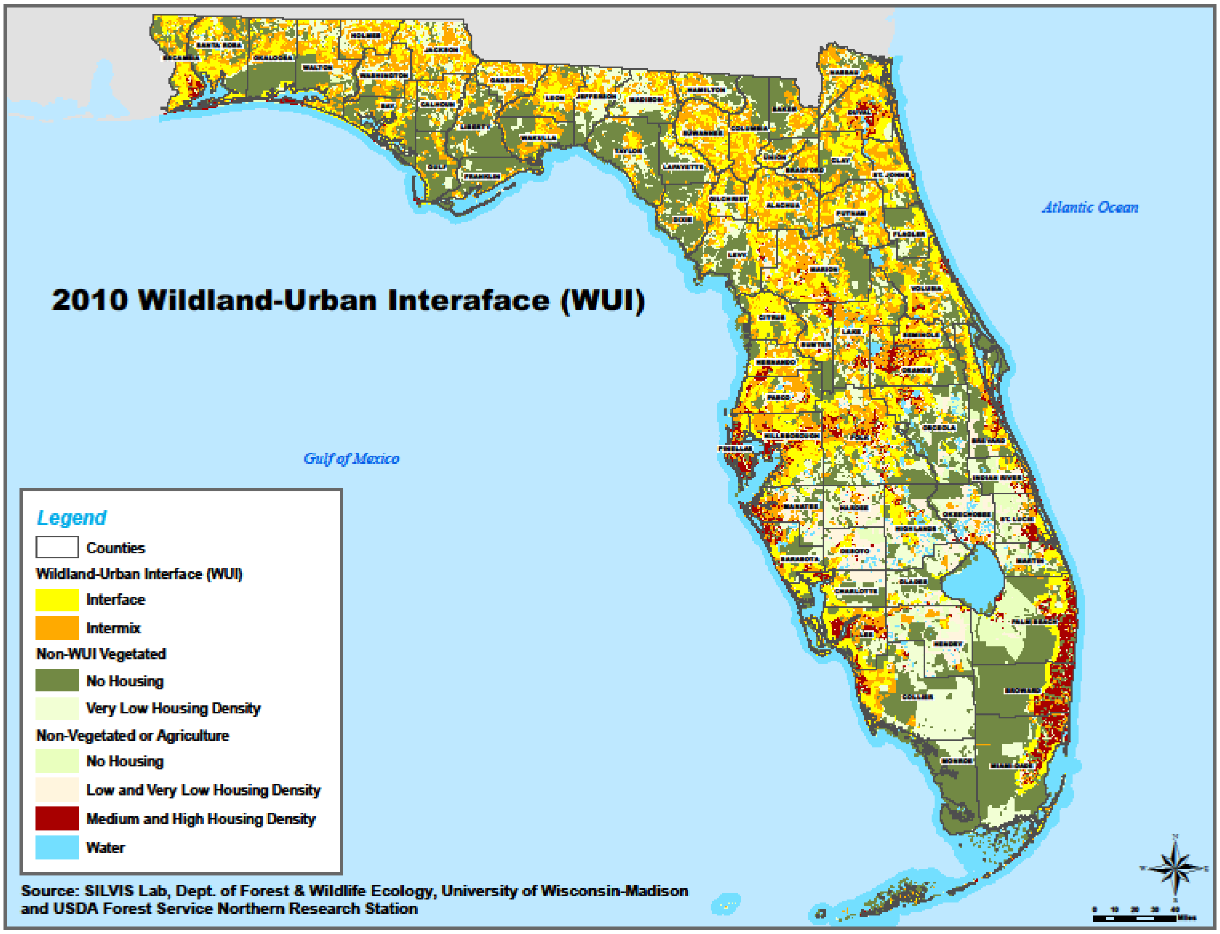
[78] Groffman and Kareiva (2013); http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.431.5893&rep=rep1&type=pdf; Walsh and Wuebbles (2013), https://www.globalchange.gov/sites/globalchange/files/NCAJan11-2013-publicreviewdraft-chap2-climate.pdf

Figure 4.46: Pinellas County Land Use



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 United States was mapped in 2010, showing WU interface 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 are the most recent of this kind.

Figure 4.47: 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 are 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. The table below includes a brief narrative for significant wildfires in the county.

Table 4.67: Significant Wildfire Occurrences in Pinellas County

Date	Description
March 23, 2000	The City of Clearwater experienced minor property damage ($5,000) from a small wildfire. A wildfire consumed 10 to 15 acres of brush and timber on the east side of McMullen Park near the intersection of U.S. Highway 19 and State Road 60 in Clearwater. One home incurred minor damage from the wildfire.
May 23–25, 2001	The county experienced smoke from fires in adjacent counties.
2006	There were 16 reported wildfires affecting 206.4 acres in Pinellas County.
Spring/ Summer 2007	Pinellas County residents experienced smoke from fires across the state and in Georgia. There were no damages and no injuries.

Since 1999, FEMA has authorized several Fire Management (FM) disaster declarations. The 1999 wildfire season was so severe that in addition to the Fire Management assistance being authorized, an Emergency Declaration (EM) was made to assist with handling the fires. Below is a list of all the FM and EM designations, plus the single major disaster declaration (DR) that Pinellas county has received from FEMA.

Table 4.68: FEMA Major Disaster Declarations in Pinellas County, Wildfire, 1953–2018[79]

Disaster Number	Date	Name/Description
DR-1223	May 25–July 22, 1998	EXTREME FIRE HAZARD
FS-2259	April 13, 1999	FL-FIRES 04/13/99
EM-3139	April 15–May 25, 1999	FL-FIRES 04/15/99
FS-2300	May 22, 2000	LAKELAND DISTRICT FIRE
FS-2353	February 17, 2001	FL - LAKELAND COMPLEX FIRE

In addition to these FM designations, there has been one major disaster designation for a wildfire in Pinellas County, named the Florida Extreme Fire Hazard, DR-1223, which occurred from May 25 until July 22, 1998.

According to the NCEI Storm Events Database, there were 4 reports of wildfire in Pinellas County from 2000 to 2018.[80] These wildfire events are only inclusive of those reported by NCEI from 1996 through 2018. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.69: Summary of Wildfire Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair	0	0	0	$0	$0

[79] https://www.fema.gov/media-library/assets/documents/28318

[80] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Wildfire&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2019)*	Annualized Property Loss
Belleair Beach	0	0	0	$0	$0
Belleair Bluffs	0	0	0	$0	$0
Belleair Shore	0	0	0	$0	$0
Clearwater	1	0	0	$7,463	$415
Dunedin	0	0	0	$0	$0
Gulfport	0	0	0	$0	$0
Indian Rocks Beach	0	0	0	$0	$0
Indian Shores	0	0	0	$0	$0
Kenneth City	0	0	0	$0	$0
Largo	0	0	0	$0	$0
Madeira Beach	0	0	0	$0	$0
North Redington Beach	0	0	0	$0	$0
Oldsmar	0	0	0	$0	$0
Pinellas Park	0	0	0	$0	$0
Redington Beach	0	0	0	$0	$0
Redington Shores	0	0	0	$0	$0
Safety Harbor	0	0	0	$0	$0
St. Petersburg	0	0	0	$0	$0
St. Pete Beach	0	0	0	$0	$0
Seminole	0	0	0	$0	$0
South Pasadena	0	0	0	$0	$0
Tarpon Springs	0	0	0	$0	$0
Treasure Island	0	0	0	$0	$0
Unincorporated	3	0	0	$0	$0
PINELLAS COUNTY TOTAL	**4**	**0**	**0**	**$7,463**	**$415**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.70: Historical Wildfire Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Belleair						
NONE REPORTED	--	--	--	--	--	--
Belleair Beach						
NONE REPORTED	--	--	--	--	--	--
Belleair Bluffs						
NONE REPORTED	--	--	--	--	--	--
Belleair Shore						
NONE REPORTED	--	--	--	--	--	--
Clearwater						
CLEARWATER	3/23/2000	Wildfire	0	0	$7,463	$0

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Dunedin						
NONE REPORTED	--	--	--	--	--	--
Gulfport						
NONE REPORTED	--	--	--	--	--	--
Indian Rocks Beach						
NONE REPORTED	--	--	--	--	--	--
Indian Shores						
NONE REPORTED	--	--	--	--	--	--
Kenneth City						
NONE REPORTED	--	--	--	--	--	--
Largo						
NONE REPORTED	--	--	--	--	--	--
Madeira Beach						
NONE REPORTED	--	--	--	--	--	--
North Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Oldsmar						
NONE REPORTED	--	--	--	--	--	--
Pinellas Park						
NONE REPORTED	--	--	--	--	--	--
Redington Beach						
NONE REPORTED	--	--	--	--	--	--
Redington Shores						
NONE REPORTED	--	--	--	--	--	--
Safety Harbor						
NONE REPORTED	--	--	--	--	--	--
St. Petersburg						
NONE REPORTED	--	--	--	--	--	--
St. Pete Beach						
NONE REPORTED	--	--	--	--	--	--
Seminole						
NONE REPORTED	--	--	--	--	--	--
South Pasadena						
NONE REPORTED	--	--	--	--	--	--
Tarpon Springs						
NONE REPORTED	--	--	--	--	--	--
Treasure Island						
NONE REPORTED	--	--	--	--	--	--
Unincorporated						
PINELLAS (ZONE)	5/23/2001	Wildfire	0	0	$0	$0
PINELLAS (ZONE)	5/24/2001	Wildfire	0	0	$0	$0
PINELLAS (ZONE)	5/26/2001	Wildfire	0	0	$0	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

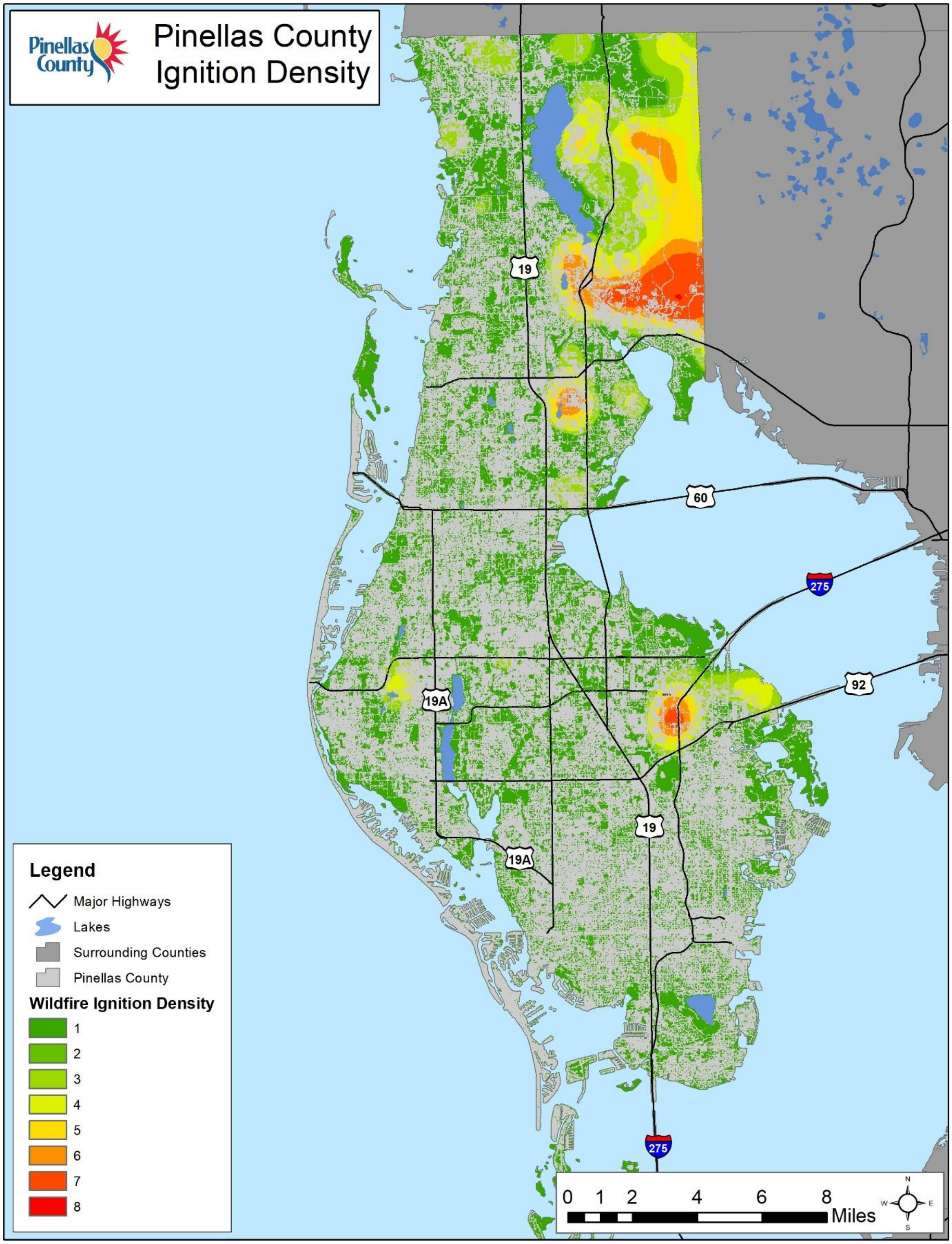
Data from the State Fire Marshal Annual Reports was also reviewed to obtain additional information on historical wildfire events in the county. The table below summarizes the wildfires reported from 2006 to 2016.

Table 4.71: Reported Wildfires in Pinellas County, 2006–2016

Year	Number of Reported Wildfires	Acres Affected
2006	16	306.8
2007	1	0.2
2008	1	3.0
2009	4	76.0
2010	3	53.0
2011	4	47.5
2012	4	53.0
2013	1	0.3
2014	3	61.5
2015	3	22.0
2016	7	23.0
TOTAL	**47**	**646.3**

The wildfire ignition density shown in the figure below gives an indication of historic location in Pinellas County. The wildfire ignition density is based on data from the Southern Wildfire Risk Assessment. This data is based on historical fire ignitions and the likelihood of a wildfire igniting in an area. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. This is measured in the number of fires per year per 1,000 acres.

Figure 4.48: Pinellas County Wildfire Ignition Density, 2014



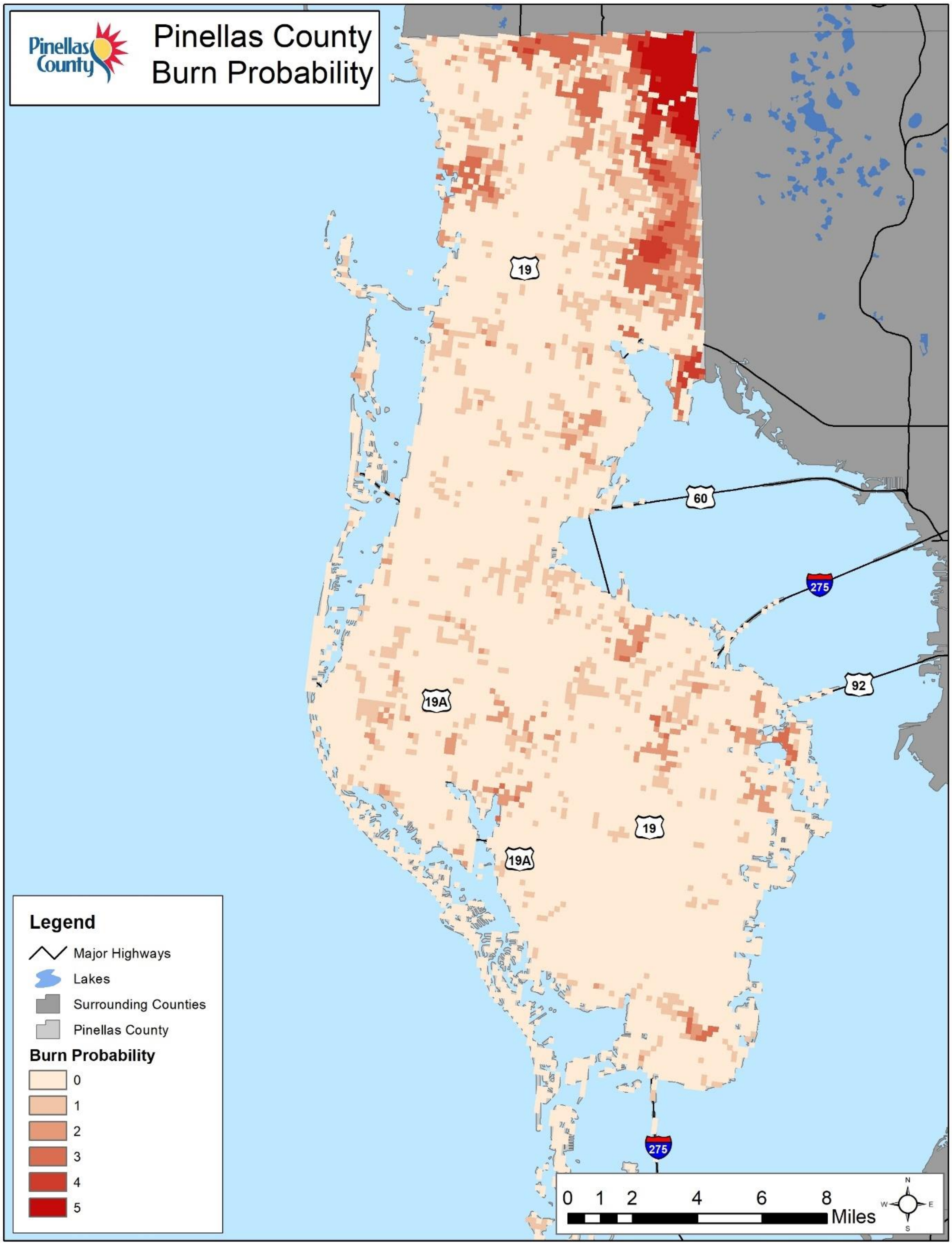
4. Probability of Future Occurrences of Wildfire

Below is a map showing the Burn Probability for Pinellas County, based on data from the Southern Wildfire Risk Assessment.

According to this burn probability map, there is some probability a wildfire will occur throughout the county, but they are most likely to occur in the northeast corner of Unincorporated County. When utilizing the WUI-9 (Major Impacts) metric, Unincorporated County shows 9% of buildings potentially at risk. The only municipalities with more than 1% of buildings within WUI-9 probable areas are Clearwater (3%), St. Petersburg (2%), and both Largo and Safety Harbor just over 1%. All other municipalities have less than 1% and most at 0% within the WUI-9 extents. The likelihood of wildfires increases during drought cycles and abnormally dry conditions. Fires are likely to stay small in size but could increase due local climate and ground conditions. Dry, windy conditions with an accumulation of forest floor fuel (potentially due to ice storms or lack of fire) could create conditions for a large fire that spreads quickly. It should also be noted that some areas do vary somewhat in risk. For example, highly developed areas are less susceptible unless they are located near the urban-wildland boundary. The risk will also vary due to assets. Areas in the WUI will have much more property at risk, resulting in increased vulnerability and need to mitigate compared to rural, mainly forested areas.

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% of all wildfires in Florida occur within one mile of the WUI.

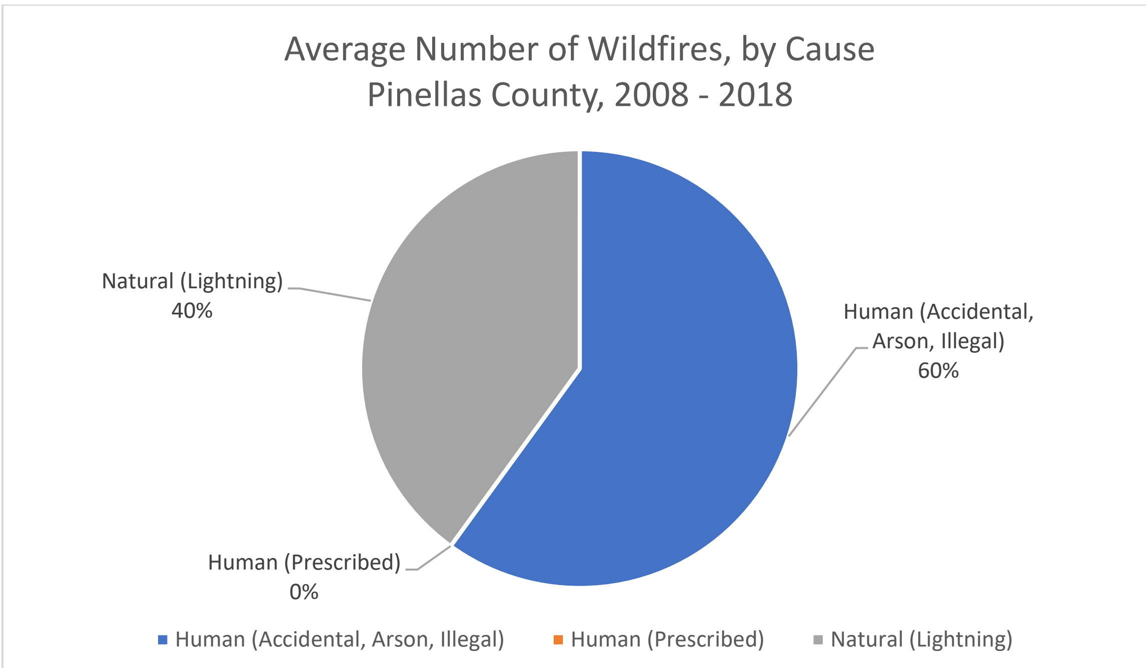
Figure 4.49: Pinellas County Burn Probability



According to FFS and data about past wildfires in Pinellas, there is an average of 4 wildfires each year, burning an average of 44 acres each year. Knowing this information, it is clear that it is possible wildfires occur in the county each year. Specifically, there was an average of 2 human-caused wildfires each year, burning an average of about 22 acres per year, and an average of 1.5 lightning-caused wildfires each year, also burning an average of about 22 acres per year.[81]

The chart below shows data from FFS and indicates there is an annual probability that approximately 60% of wildfires in Pinellas County will be human caused, 0% of wildfires will be prescribed burns, and 40% of wildfires will occur from natural causes, such as from lightning strikes.

Figure 4.50: Average Wildfires by Cause, Pinellas County, 2008–2018[82]



Furthermore, the chart below shows that there is an annual probability that approximately 44 acres will be burned by wildfire in Pinellas County each year. Human caused (accidental, arson, illegal) accounts for about 50% of the wildfires, natural causes, such as lightning strikes, accounts for 50%, and Human caused (prescribed) burns cause 0% of wildfires each year.

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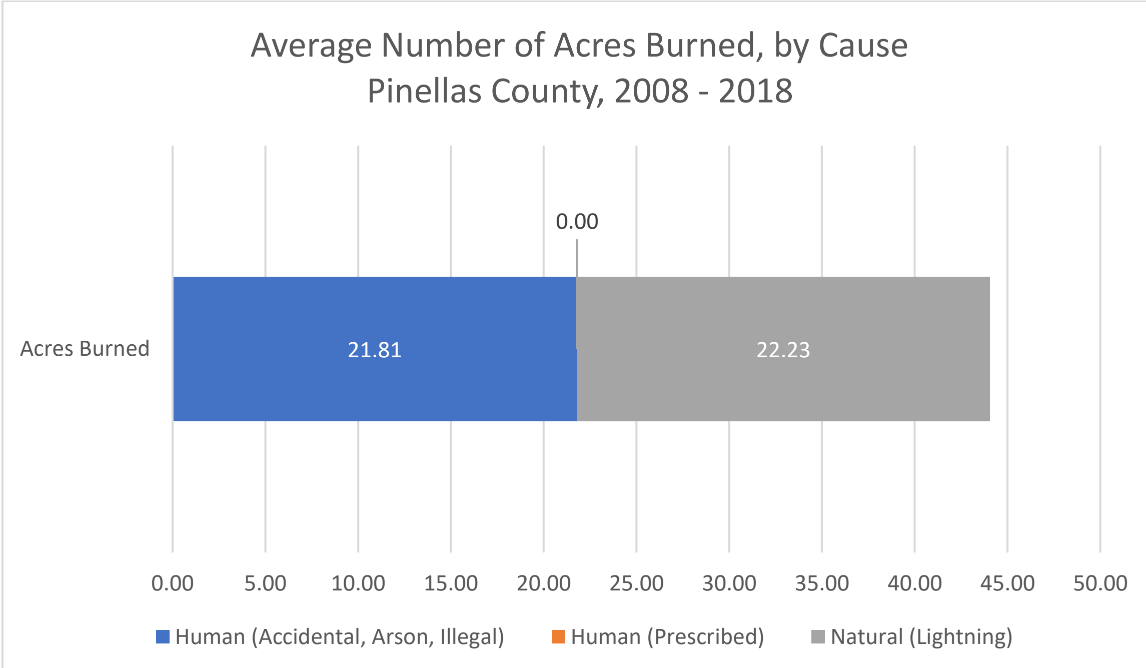
[81] Florida Forest Service Report System, Fire by Causes, Pinellas County 01/01/2008 through 12/31/2018.
Note: This data is an average of the wildfire occurrences from 2008 to 2018. It is important to note that this data does not include the fires that were managed by other agencies, such as the Department of Defense, U.S. 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.
[82] Florida Forest Service Report System, Fire by Causes, Pinellas County 01/01/2008 through 12/31/2018

Figure 4.51: Average Acres Burned by Cause, Pinellas County, 2008–2018[83]



Based on historical information, this hazard was determined to have a probability level of possible (1 to 10% annual probability). According to this burn probability map, there is some probability a wildfire will occur throughout the county, but they are most likely to occur in the northeast corner of Unincorporated County. When utilizing the WUI-9 (Major Impacts) metric, Unincorporated County shows 9% of buildings potentially at risk. The only municipalities with more than 1% of buildings within potential WUI-9 areas are Clearwater (3%), St. Petersburg (2%), and both Largo and Safety Harbor just over 1%. All other municipalities have less than 1% and most at 0% within the WUI-9 extents.

5. Wildfire Impact Analysis

All jurisdictions could receive the following impacts due to wildfire. However, the northeast corner of the Unincorporated County, Clearwater, St. Petersburg, Largo, and Safety Harbor have a greater percentage of buildings at risk.

- 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

[83] Florida Forest Service Report System, Fire by Causes, Pinellas County 01/01/2008 through 12/31/2018

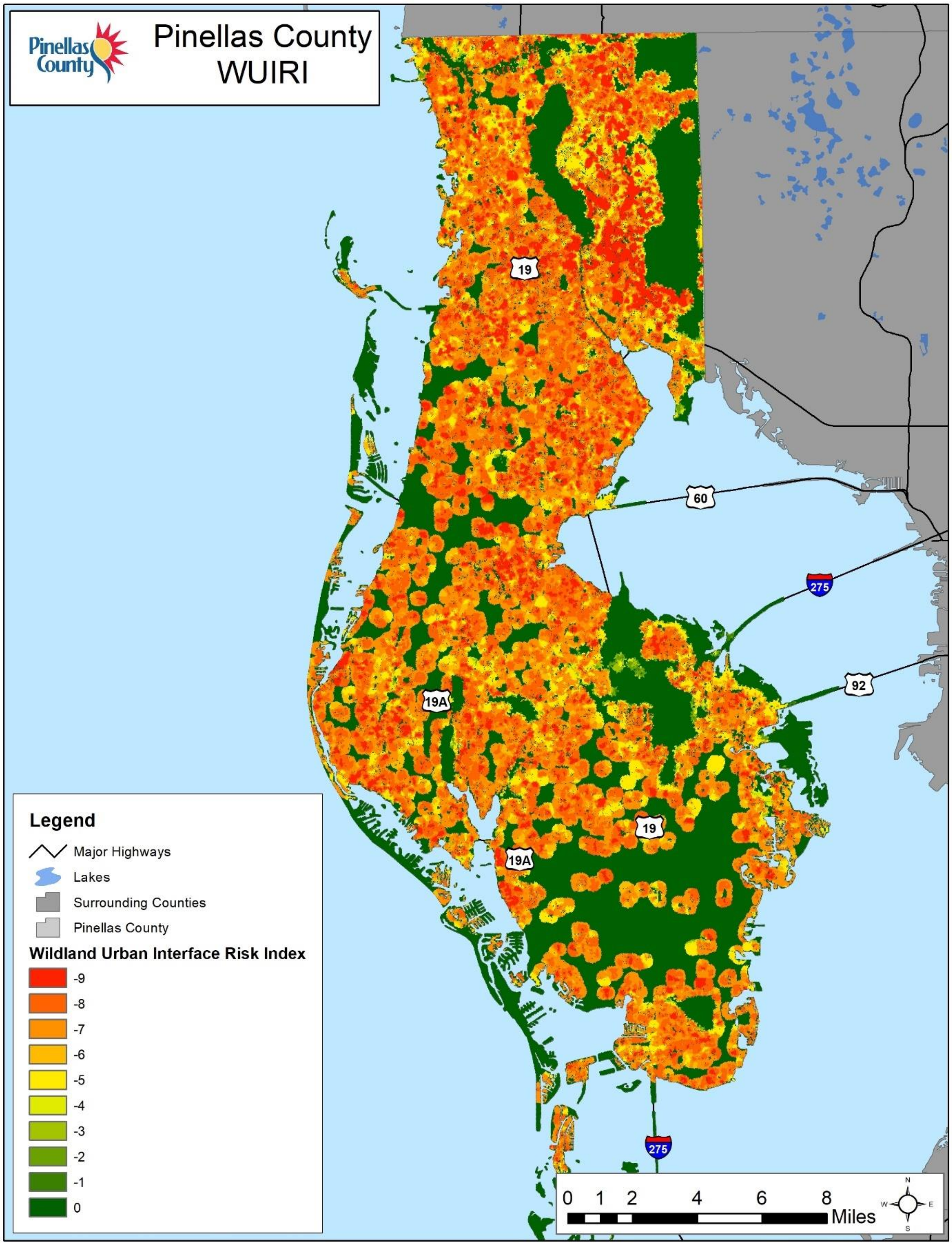
  - Injury or death from evacuation and rescue missions
  - Injury or death from smoke inhalation
- Continuity of Operations (including continued delivery of services)
  - Inability to operate businesses if evacuations are ordered, leading to lost wages and revenue
  - Employee absenteeism if employees 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 evacuation 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

The Burn Probability map above shows that there is some burn probability across the county, but areas in the northeast corner have the highest burn probability.

The map below is similar to the state of Florida WUI area map above and shows the risk for WUI fires. These maps are similar because they both highlight the WUI areas. The areas with a high WUI fire risk index are vulnerable because they are highly populated and near forested areas. Most areas throughout Pinellas County have a WUI risk index between -6 and -9.

Figure 4.52: Wildland Urban Interface Risk Index



Historical Losses

According to NCEI Storm Events Database, the average (based on data from 2000 to 2018) annual property loss due to wildfires in Pinellas County is $7,463.

Table 4.72: NCEI Wildfires, 2000–2018[84]

NCEI Storm Event (hazard)	Average Wildfires per Year	Annualized Property Loss (2019 dollars)	Annualized Crop Loss (2019 dollars)
Wildfires	< 1	$7,463	$0

Exposure

To estimate exposure of improved property to wildfire, the approximate number of parcels and their associated improved valued located in high wildfire risk areas was determined using GIS analysis. The WUI Risk Index data ranges from 0 to -9 with lower values being most severe. Areas with a WUI Risk Index of -6 and -9 were chosen to be displayed as areas of risk because this shows the upper echelon of the scale and the areas of highest risk. The maps below delineate the areas with WUI Risk Index values less than -6 and less than -9, and the table below summarizes the buildings and parcels in the county that are located in the high wildfire risk areas.

[84] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Wildfire&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Figure 4.53: Wildland Urban Interface Risk Index

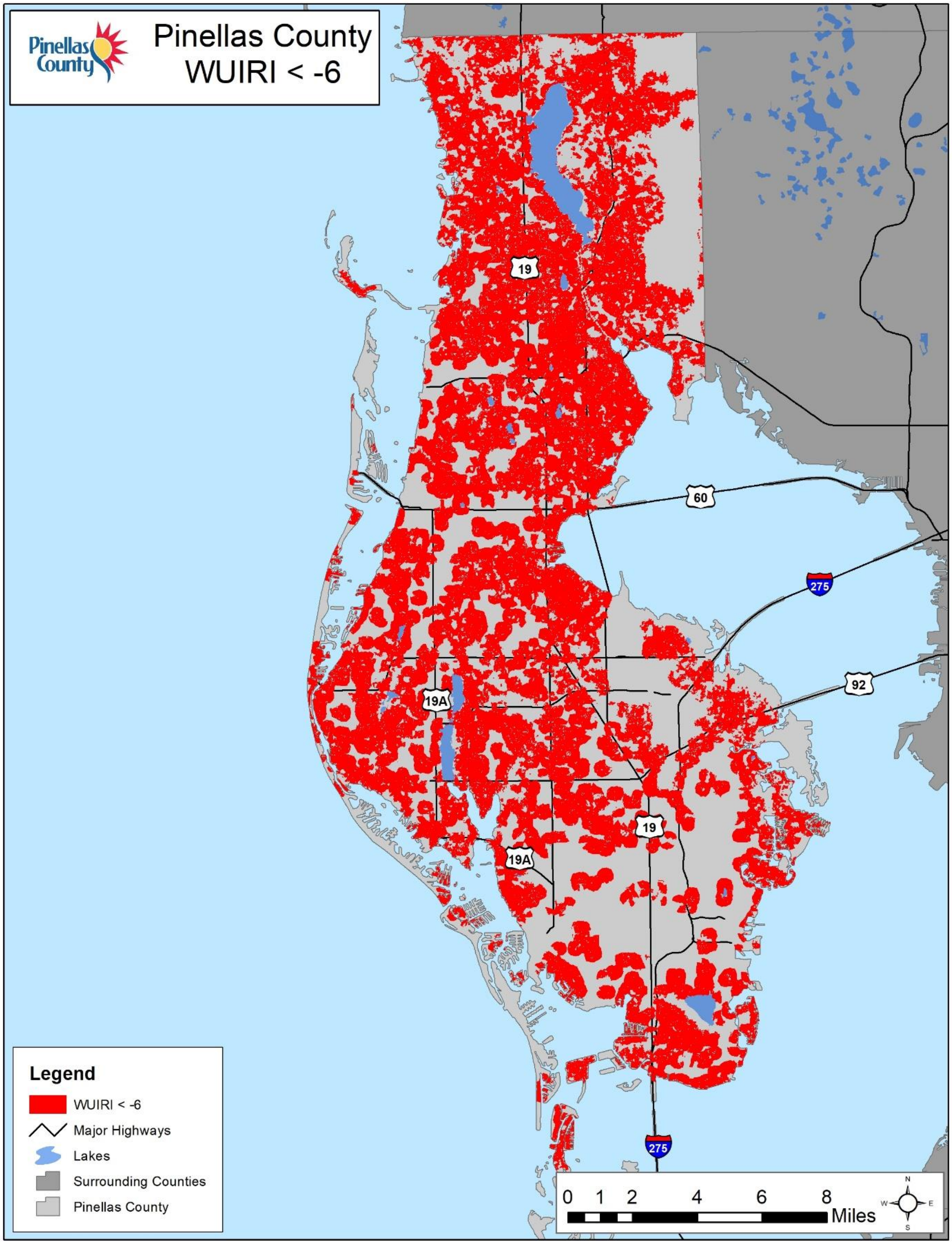


Figure 4.54: Wildland Urban Interface Risk Index

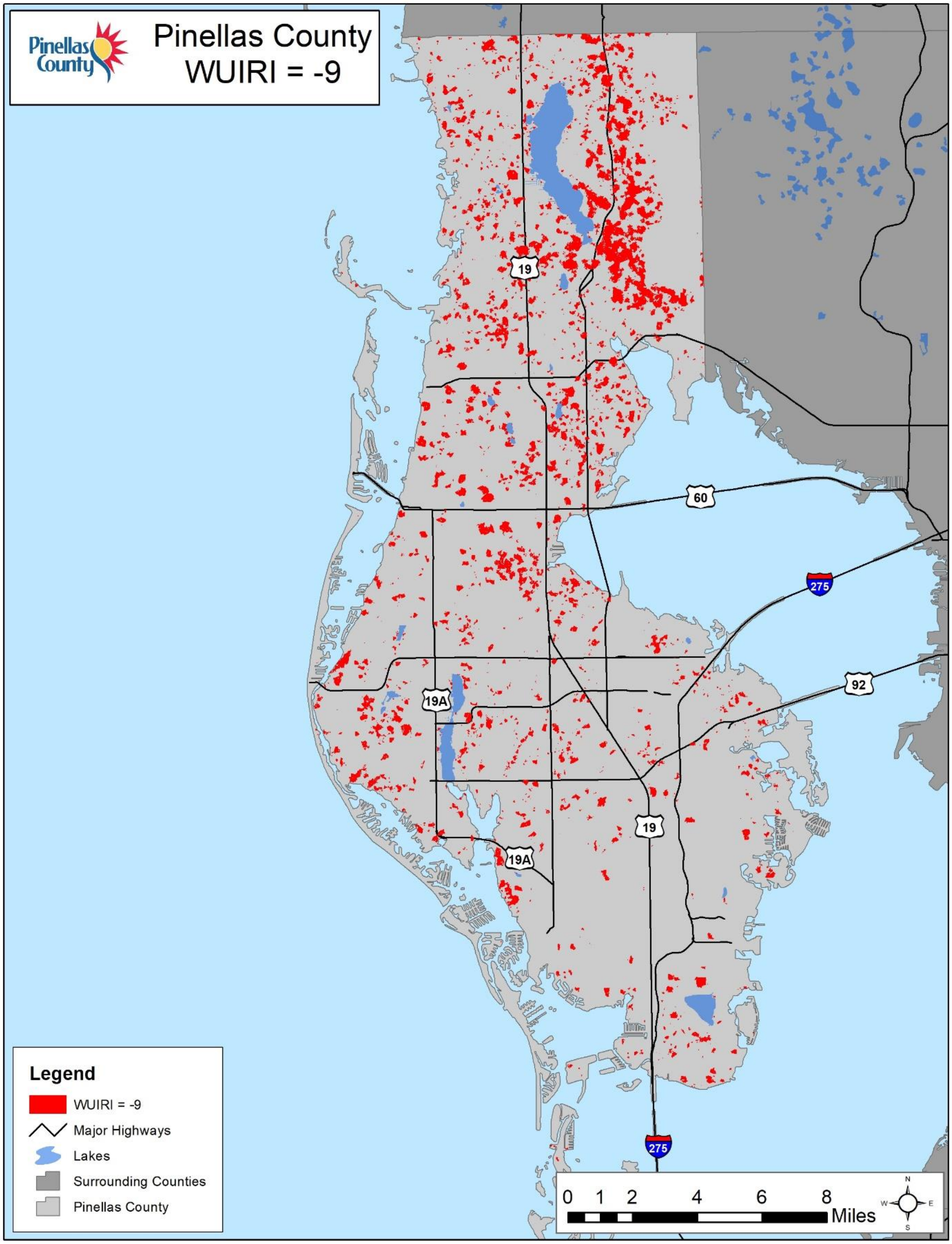


Table 4.73: Estimated Exposure of Improved Property to Wildfire

Location	Buildings and Parcels in High Wildfire Risk Area					
	WUI Risk Index < -6			WUI Risk Index < -9		
	No. of Parcels	No. of Buildings	Improved Value	No. of Parcels	No. of Buildings	Improved Value
Belleair	2,271	5,401	$296,320,245	249	495	$53,936,754
Belleair Beach	297	663	$45,431,954	0	0	0
Belleair Bluffs	980	1,445	$65,163,941	160	238	$14,641,595
Belleair Shore	30,067	0	$0	0	0	0
Clearwater	12,069	76,385	$3,989,895,362	7,352	11,006	$1,053,462,522
Dunedin	2,793	30,227	$1,216,707,030	2,614	3,450	$339,205,167
Gulfport	2,036	9,744	$304,136,014	187	607	$19,377,047
Indian Rocks Beach	2,209	3,613	$125,151,504	4	0	$285,383
Indian Shores	1,364	637	$18,788,531	101	3	$102,370
Kenneth City	25,262	2,050	$88,615,269	22	42	$3,342,237
Largo	1,065	54,245	$2,631,730,280	5,069	4,392	$657,962,161
Madeira Beach	30,067	2,634	$100,302,751	0	0	$0
North Redington Beach	0	0	$0	0	0	$0
Oldsmar	4,841	12,925	$674,570,237	899	1,861	$189,883,435
Pinellas Park	15,489	43,356	$1,788,808,825	2,825	2,475	$380,161,219
Redington Beach	0	0	$0	0	0	$0
Redington Shores	279	235	$8,222,953	0	0	$0
Safety Harbor	7,439	23,728	$1,053,346,423	1,915	3,930	$341,358,614
St. Petersburg	47,950	123,701	$5,876,415,397	7,413	8,190	$1,100,536,994
St. Pete Beach	594	2,053	$85,553,194	0	0	$0
Seminole	7,626	15,518	$830,602,426	1,183	2,016	$232,050,378
South Pasadena	2,396	3,421	$129,912,728	150	12	$885,105
Tarpon Springs	11,090	28,192	$1,185,877,316	1,853	3,490	$264,159,669
Treasure Island	2,142	1,838	$74,752,454	1	0	$120,748
Unincorporated	105,526	258,638	$11,154,943,876	24,753	34,428	$3,133,915,446
PINELLAS COUNTY TOTAL	**285,785**	**700,649**	**$31,745,248,710**	**56,750**	**76,635**	**$7,785,386,844**

To estimate the county population's exposure to wildfire, areas of risk were intersected with census block data. As a result, these population estimates are going to be an overestimate of risk since the entire census block's population count will be included even if only a portion of the census block's area is located in a risk area. However, these estimates still give an idea of the county population's risk to wildfire.

Table 4.74: Estimated Exposure of Population to Wildfire

Location	Population in High Wildfire Risk Area					
	WUI Risk Index < -6			WUI Risk Index < -9		
	Total	< 18	> 65	Total	< 18	> 65
Belleair	3,769	324	839	1,209	108	306

Location	Population in High Wildfire Risk Area					
	WUI Risk Index < -6			WUI Risk Index < -9		
	Total	< 18	> 65	Total	< 18	> 65
Belleair Beach	822	52	191	0	0	0
Belleair Bluffs	1,504	117	352	502	27	171
Belleair Shore	0	0	0	0	0	0
Clearwater	86,896	9,283	12,423	40,360	4,224	6,393
Dunedin	30,080	2,684	6,206	14,156	1,232	2,990
Gulfport	6,447	586	962	1,362	125	212
Indian Rocks Beach	2,401	172	360	185	11	33
Indian Shores	1,332	51	360	261	11	50
Kenneth City	4,044	404	589	198	18	21
Largo	70,791	6,610	12,774	20,773	1,892	3,836
Madeira Beach	1,935	141	282	0	0	0
North Redington Beach	0	0	0	0	0	0
Oldsmar	12,786	1,771	1,081	7,766	1,140	550
Pinellas Park	41,627	4,671	5,838	12,542	1,378	1,528
Redington Beach	0	0	0	0	0	0
Redington Shores	841	36	257	0	0	0
Safety Harbor	16,710	1,849	2,280	12,052	1,326	1,658
St. Petersburg	139,592	15,258	16,728	41,580	4,271	4,842
St. Pete Beach	1,152	71	274	0	0	0
Seminole	16,120	1,404	3,742	6,610	608	1,581
South Pasadena	5,785	221	2,199	363	21	62
Tarpon Springs	22,015	2,278	3,809	13,242	1,342	2,361
Treasure Island	3,480	228	738	0	0	0
Unincorporated	258,263	26,313	42,294	126,040	12,672	20,625
PINELLAS COUNTY TOTAL	**728,392**	**74,524**	**114,578**	**299,201**	**30,406**	**47,219**

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

To estimate exposure to wildfire for the critical facility analysis, areas of risk were intersected with critical facility locations. The table below summarizes the critical facilities in the county that are located in high wildfire risk areas. The WUI Risk Index data ranges from 0 to -9 with lower values being most severe. Areas with a WUI Risk Index of -6 and -9 were chosen to be displayed as areas of risk because this shows the upper echelon of the scale and the areas of highest risk.

Table 4.75: Exposure of Critical Facilities to Wildfire Risk Areas

Location	Number of Critical Facilities in High Wildfire Risk Area	
	WUI Risk Index < -6	WUI Risk Index < -9
Belleair	5	0
Belleair Beach	0	0
Belleair Bluffs	5	0
Belleair Shore	0	0
Clearwater	83	9

Location	Number of Critical Facilities in High Wildfire Risk Area	
	WUI Risk Index < -6	WUI Risk Index < -9
Dunedin	29	6
Gulfport	5	0
Indian Rocks Beach	3	0
Indian Shores	2	0
Kenneth City	4	0
Largo	86	10
Madeira Beach	0	0
North Redington Beach	0	0
Oldsmar	9	2
Pinellas Park	60	6
Redington Beach	0	0
Redington Shores	0	0
Safety Harbor	20	3
St. Petersburg	90	1
St. Pete Beach	1	0
Seminole	23	0
South Pasadena	5	0
Tarpon Springs	29	2
Treasure Island	1	0
Unincorporated	201	24
PINELLAS COUNTY TOTAL	**661**	**63**

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.5.

WILDFIRE					Overall Vulnerability
Overview					
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 can occur within the County at all times of the year as 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.					MODERATE
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Possible	Limited	Moderate	6 to 12 hrs	< 1 week	2.5

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 also be described 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 4.76: 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 the 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:

- Beach re-nourishment: Sand is purposefully deposited onto the beaches by humans; however, there is a very high cost associated with the solution.
- Rebuild rivers: Direct rivers back into places with a lack of sediment with the intention that the rivers will push the sediment back into place.
- Breakwaters, sea walls, and groins: 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.
- Limits on beach development: 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 nearshore 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.[85]

[85] 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.

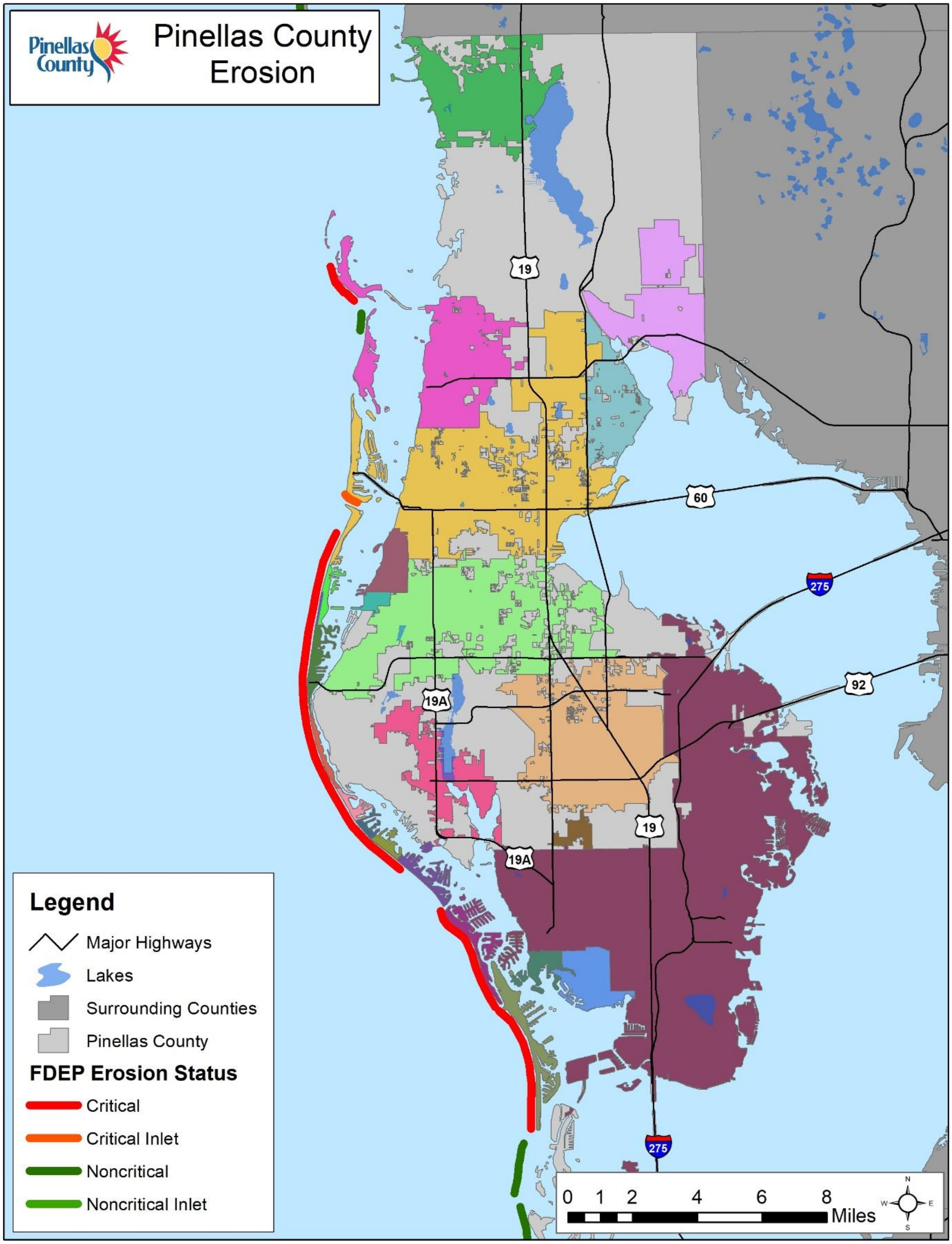
In Pinellas County, the 2018 Critical Erosion Report from FDEP states there are:[86]

- 21.4 miles of critically eroded beach
- 0.5 miles of critically eroded inlet shoreline
- 4.4 miles of non-critically eroded beach
- 0.0 miles of non-critically eroded inlet shoreline

This is shown below in the map.

[86] https://floridadep.gov/sites/default/files/CriticallyErodedBeaches.pdf

Figure 4.55: Critical Erosion Areas, Pinellas County, 2106[87]



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.[88]

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% of project costs is available to Florida's 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.

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 the *Flood Hazard Profile*, 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 *Tropical Cyclone Hazard Profile*), 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.[89] 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.[90] However, wetlands also may be able to migrate landward with adequate sediment influx if there are no physical barriers to their movement.

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[87] https://floridadep.gov/sites/default/files/CriticallyErodedBeaches.pdf
[88] https://floridadep.gov/sites/default/files/CriticallyErodedBeaches.pdf
[89] *(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.).*
[90] *(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

Almost the entire length of Pinellas County on the Gulf Coast is lined with fine, white sandy beaches. These beaches, a main tourism attraction, are highly vulnerable to erosion from coastal events as well as inland coastal exposures along the county coastline. These events typically have caused considerable loss of the beachfront and widespread damage to structures that line those beaches.

The Bureau of Beaches and Coastal Systems develops and publishes the Critically Eroded Beaches Report annually. 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 are 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 June 2018 Critically Eroded Beaches in Florida Report[91] states that there are 21.4 miles of critically eroded beach and 4.4 miles of non-critically eroded beach in Pinellas County. There are also 0.5 miles of critically eroded inlet shoreline but no areas of non-critically eroded inlet shoreline in the county. The map shown in the previous section depicts this information and indicates that the following communities have some exposure to critical erosion: Unincorporated County, Belleair Beach, Belleair Shore, Clearwater, Indian Rocks Beach, Indian Shores, Madeira Beach, North Redington Beach, Redington Beach, Redington Shores, St. Pete Beach, and Tarpon Springs. Other beach communities may have minimal exposure but are not identified as significant per the FDEP 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.

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.

Table 4.77: Florida Significant Erosion Contribution Events[92]

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

91 https://floridadep.gov/sites/default/files/CriticallyErodedBeaches.pdf
92 https://floridadep.gov/sites/default/files/SBMP-Introduction_0.pdf

Year	Event
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

Tropical Storm Debby was a recent significant erosion contribution event that resulted in severe beach and dune erosion to Pinellas County beaches at: Honeymoon Island State Park, sections of Sand Key, Sunshine and Sunset beaches on Treasure Island, and Upham and Pass-a-Grille beaches on Long Key.

The University of South Florida's (USF's) Coastal Research Lab staff documented sand volume and dry beach changes due to Tropical Storm Debby.[93] The table below provides volume changes to the dune and dry beach as well as the approximate loss of dry feet in terms of linear distance seaward from the mean high tide line. For example, Pass-a-Grille lost a total of 22,900 cubic yards of sand and 25.6 feet of dry beach width as a result of Tropical Storm Debby.

Table 4.78: Volume Changes to the Dune and Dry Beach in Pinellas County after Tropical Storm Debby

Location	Nourished/Not Nourished	Volume Change (cubic yards)				MHT Line Change (ft)
		Dune	Dry Beach	Overall Loss	Overall Gain	
Long Key Barrier Island						
Pass-a-Grille	Nourished in 2004	1,500	-22,100	-36,500	22,900	-25.6
Middle Long Key	Not nourished	6,400	-31,500	-64,000	82,600	-15.1
Upham Beach	Nourished in 2010; T-Groins	270	-5,100	-12,900	20,400	-10.8
LONG KEY TOTAL	**--**	**8,170**	**-58,700**	**-113,400**	**125,900**	**--**
Treasure Island Barrier						
Sunset Beach	Nourished in 2010	-7,700	-12,000	-43,400	22,600	-21.3
Middle Treasure Island	Not nourished	11,000	-13,000	-50,100	63,600	-10.2
Sunshine Beach	Nourished in 2010	--	-2,100	--	--	--
TREASURE ISLAND TOTAL	**--**	**3,300**	**-27,100**	**-93,500**	**86,200**	**--**
Sand Key Barrier Island						
Madeira Beach	Not nourished in 2006	700	-22,500	-29,600	35,000	-18.4

[93] Volume and Shoreline Changes along Pinellas County Beaches during Tropical Storm Debby, Ping Wang and Tiffany M. Roberts, Coastal Research Laboratory, University of South Florida July 24, 2012

Location	Nourished/Not Nourished	Volume Change (cubic yards)				MHT Line Change (ft)
		Dune	Dry Beach	Overall Loss	Overall Gain	
Redington Beach	Not nourished in 2006	-4,300	-19,200	-38,600	48,800	-18.4
North Redington Beach	Nourished in 2006	-500	-21,800	-59,400	41,000	-33.8
Indian Shores	Nourished in 2006	-6,300	-32,200	-98,400	100,000	-34.4
Headland	Nourished in 2006	-5,500	-15,800	-58,400	61,400	-28.2
Indian Rocks Beach	Nourished in 2006	-12,100	-15,300	-86,900	100,800	-10.2
Belleair Shore	Not nourished in 2006	-2,800	6,800	-29,900	38,600	10.5
North Sand Key	Nourished in 2006 and 2014/15	-5,600	2,500	-22,800	20,000	--
SAND KEY TOTAL	**--**	**-36,400**	**-117,500**	**-424,000**	**445,600**	

Sunshine Beach and Sunset Beach on Treasure Island received U.S. Army Corps of Engineers (USACE) Flood Control and Coastal Emergencies (FCCE) supplemental appropriations funding to cover the sand losses on those two beaches from Tropical Storm Debby. Those two beaches were repaired by a USACE nourishment project in 2014 with costs shared by the USACE, FDEP, and Pinellas County. The FCCE funding for the construction to replace sand loss from Tropical Storm Debby on those two beaches totaled approximately $1.55 million. The beach at Honeymoon Island State Park also lost sand due to Tropical Storm Debby. The sand volume loss was calculated to be 19,817 cubic yards at a construction cost of $239,480 as approved by FEMA to replace the lost sand.

Note that the beach segments in Pinellas County with the highest loss of volume and dry beach width from Tropical Storm Debby do not necessarily relate to the beaches subject to the highest annual mean erosion rates. Some of the wider beaches prior to Tropical Storm Debby passing through the area had much more sand volume and dry beach width to lose, and thus, resulted in some of the higher losses. Conversely, many beaches that chronically erode quickly had very little sand to lose since much sand had already eroded away prior to the arrival of Tropical Storm Debby. The estimated mean annual erosion rates of the hotspot beaches that need nourishment every 4–6 years are shown in the table below.

Table 4.79: Estimated Mean Annual Erosion Rates in Pinellas County

Location	Survey Lines	Timeframe	Erosion Rate (ft/yr)
Sunshine Beach on Treasure Island	R127 to R128	2006–2014	24.0
Sunset Beach on Treasure Island	R135 to R141	2006–2014	12.8
Upham Beach on Long Key	LK2A to LK5	2006–2014	58.1
Sand Key	R58 to R66	2006–2010	17.1
Sand Key	R72 to R79	2006–2010	5.9
Sand Key	R80 to R85A	2006–2010	8.5

Location	Survey Lines	Timeframe	Erosion Rate (ft/yr)
Honeymoon Island State Park	--	--	10.0

Over the past four years, the northern beach of Honeymoon Island State Park has lost 70–80 feet of the shore-parallel portion of the parking lot due to erosion resulting in 65 parking spaces being reallocated. The State Park also had to move more than one bathroom building away from the shoreline due to erosion.

Pinellas County has a very proactive Coastal Management Program with nourishments occurring periodically as part of the federal Pinellas County Shore Protection Project at Sand Key (since 1988), Treasure Island (since 1969), and Long Key (since 1980) as well as cooperative efforts between Pinellas County and FDEP's Division of Recreation and Parks to nourish the beach at Honeymoon Island State Park that began in 1989. The Costal Management Program overall has provided exceptional upland infrastructure and private property storm protection over a large fraction of the Pinellas County shoreline.

4. Probability of Future Occurrences of Coastal Erosion

The beaches of Pinellas County will continue to shift and change over time, especially when faced with the current levels of development. This hazard will continue to affect the county, 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. This hazard will continue to affect the county in the future, especially in conjunction with hurricanes, winter storms, and coastal flooding, and considering the likelihood of future development in coastal areas. Coastal erosion has occurred in Pinellas County 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 would be best to keep areas prone to coastal erosion undeveloped, this is unlikely and future development in coastal areas will increase the probability of coastal erosion affecting developed areas.

Based on historical information, this hazard was determined to have a probability level of likely (10 to 100% annual probability). All waterfront communities are likely to be impacted by erosion. However, some communities have much bigger proportions of their community with areas susceptible to erosion and thus their vulnerability differs (identified later in this profile). The only communities with a none-to-low probability of coastal erosion are the land locked and higher elevated communities of Kenneth City and Pinellas Park as they have small creeks and drainage systems running through them.

5. Coastal Erosion Impact Analysis

All waterfront communities could receive the following impacts due to coastal erosion. However, some communities have much bigger proportions of their community with areas susceptible to erosion and thus their vulnerability differs. The only communities with a none-to-low probability of coastal erosion are the land locked and higher elevated communities of Kenneth City and Pinellas Park as they have small creeks and drainage systems running through them.

- 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Exposure

To estimate exposure of improved property to erosion, the approximate number of parcels and their associated improved valued located in high erosion risk areas was determined using GIS analysis. A 400-meter buffer of the critical erosion areas was chosen as the area of risk used for the analysis.

Table 4.80: Estimated Exposure of Improved Property to Erosion

Location	Buildings and Parcels in High Erosion Risk Area		
	No. of Parcels	No. of Buildings	Improved Value
Belleair	0	0	$0
Belleair Beach	575	390	$29,722,247
Belleair Bluffs	0	0	$0
Belleair Shore	122	401	$93,914,658
Clearwater	2,451	115	$159,155,901
Dunedin	1	0	$542,536
Gulfport	0	0	$0
Indian Rocks Beach	1,463	1,504	$48,501,945
Indian Shores	2,520	882	$37,118,666
Kenneth City	0	0	$0

Location	Buildings and Parcels in High Erosion Risk Area		
	No. of Parcels	No. of Buildings	Improved Value
Largo	0	0	$0
Madeira Beach	552	50	$4,166,569
North Redington Beach	808	208	$32,588,699
Oldsmar	0	0	$0
Pinellas Park	0	0	$0
Redington Beach	464	792	$45,741,628
Redington Shores	1,198	594	$18,579,148
Safety Harbor	0	0	$0
St. Petersburg	0	0	$0
St. Pete Beach	2,420	2,403	$279,228,089
Seminole	0	0	$0
South Pasadena	0	0	$0
Tarpon Springs	0	0	$0
Treasure Island	2,224	2,819	$127,723,563
Unincorporated	391	30	$8,089,745
PINELLAS COUNTY TOTAL	**15,189**	**10,188**	**$885,073,394**

To estimate the county population's exposure to erosion, areas of risk were intersected with census block data. As a result, these population estimates are going to be an overestimate of risk since the entire census block's population count will be included even if only a portion of the census block's area is located in a risk area. However, these estimates still give an idea of the county population's risk to erosion.

Table 4.81: Estimated Exposure of Population to Erosion

Location	Population in High Erosion Risk Area		
	Total	< 18	> 65
Belleair	0	0	0
Belleair Beach	964	66	220
Belleair Bluffs	0	0	0
Belleair Shore	109	8	25
Clearwater	2,339	44	874
Dunedin	0	0	0
Gulfport	0	0	0
Indian Rocks Beach	1,570	94	283
Indian Shores	1,420	54	395
Kenneth City	0	0	0
Largo	0	0	0
Madeira Beach	463	15	142
North Redington Beach	705	20	264
Oldsmar	0	0	0
Pinellas Park	0	0	0
Redington Beach	376	14	96
Redington Shores	1,078	55	299
Safety Harbor	0	0	0

Location	Population in High Erosion Risk Area		
	Total	< 18	> 65
St. Petersburg	0	0	0
St. Pete Beach	2,629	133	676
Seminole	0	0	0
South Pasadena	0	0	0
Tarpon Springs	0	0	0
Treasure Island	1,816	79	350
Unincorporated	1,960	105	550
PINELLAS COUNTY TOTAL	**15,429**	**687**	**4,174**

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

To estimate exposure to erosion for the critical facility analysis, areas of risk were intersected with critical facility locations. The table below summarizes the critical facilities in the county that are located in high erosion risk areas. The erosion risk areas are based on data from FDEP.

Table 4.82: Exposure of Critical Facilities to Erosion Risk Areas

Location	Number of Critical Facilities in High Erosion Risk Area
Belleair	0
Belleair Beach	0
Belleair Bluffs	0
Belleair Shore	0
Clearwater	7
Dunedin	0
Gulfport	0
Indian Rocks Beach	2
Indian Shores	2
Kenneth City	0
Largo	0
Madeira Beach	0
North Redington Beach	0
Oldsmar	0
Pinellas Park	0
Redington Beach	2
Redington Shores	2
Safety Harbor	0
St. Petersburg	0
St. Pete Beach	3
Seminole	0
South Pasadena	0
Tarpon Springs	0
Treasure Island	4
Unincorporated	2

Location	Number of Critical Facilities in High Erosion Risk Area
PINELLAS COUNTY TOTAL	**24**

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.6.

EROSION Overview					Overall Vulnerability
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.					**MODERATE**
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Likely	**Limited**	**Moderate**	**> 24 hrs**	**> 1 week**	**2.6**

Extreme Heat Hazard Profile

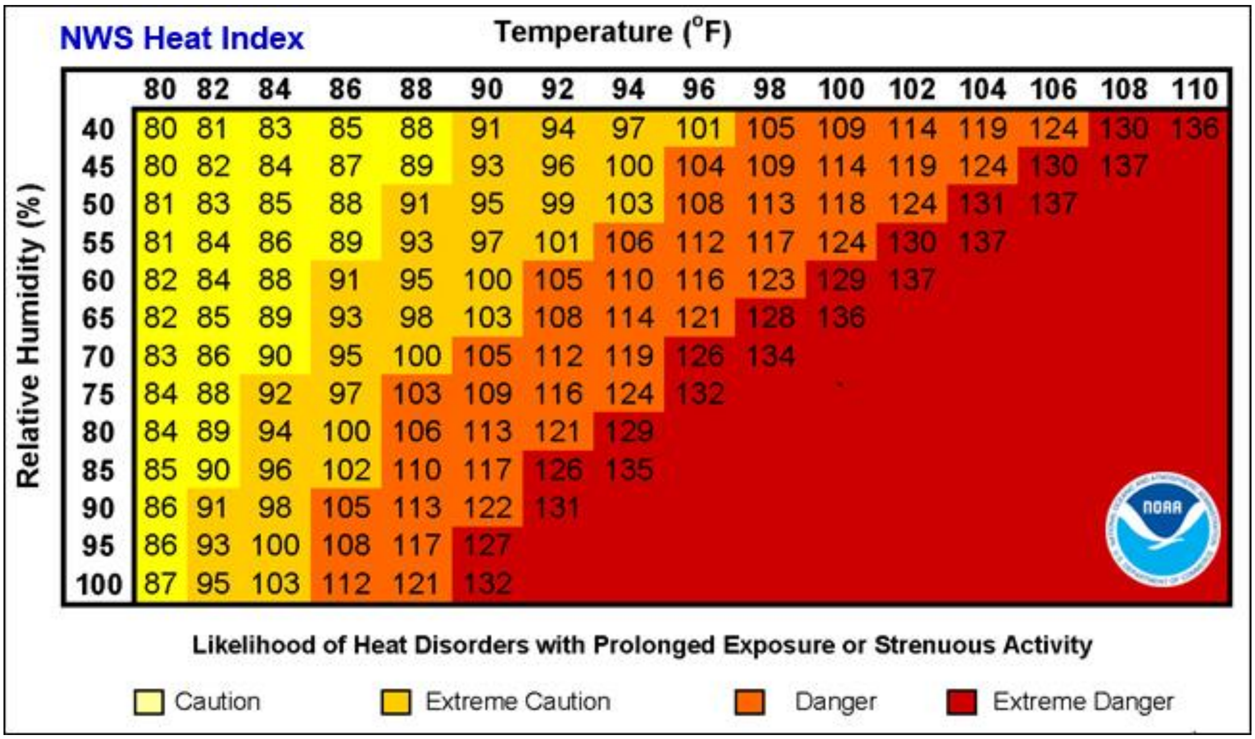
1. Extreme Heat Description

Extreme heat is defined as extended period where the temperature and relative humidity combine for a dangerous heat index.[94] 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.[95]

Figure 4.56: 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										

Advisories

The National Weather Service issues the following heat-related advisories:

[94] https://www.weather.gov/safety/heat-index
[95] https://www.weather.gov/safety/heat-index

- Excessive Heat Outlook: issued when the potential exists for an excessive heat event within the next 3 to 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.[96]

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

[96] https://www.weather.gov/safety/heat-illness

events. Those with respiratory diseases and Type I and II diabetes are also at higher risk for morbidity and mortality with increased heat exposure.[97]

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.[98] 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.[99] 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.

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.[100]

The map below shows the average number of days with temperatures above 95 degrees each year. From this map, it is evident that Pinellas County experiences between 5 and 15 days of above 95 degree weather each year.

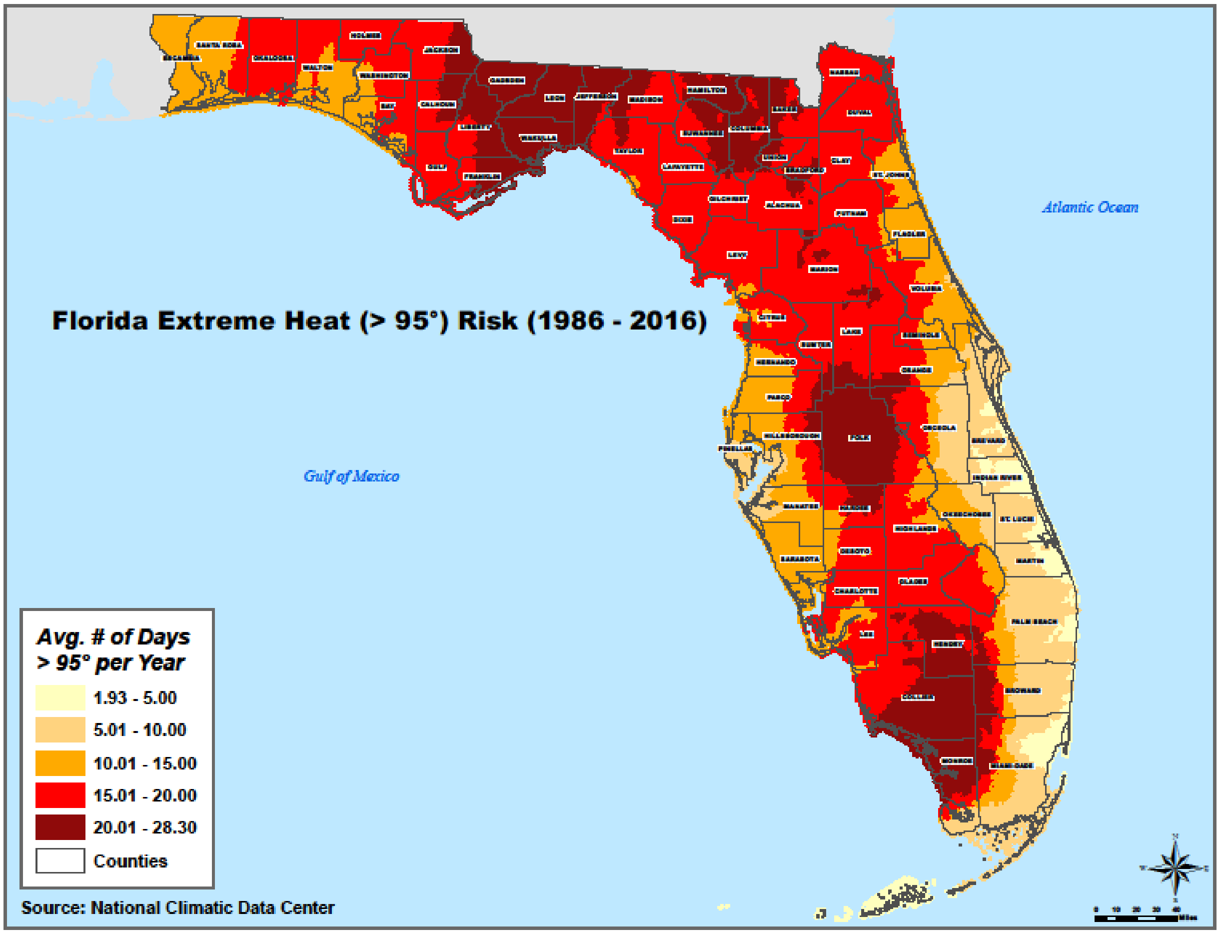
[97] http://flbrace.org/images/docs/heat-profile.pdf

[98] *(Karl et al. (Eds.). (2009). Global climate change impacts in the United States. https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf*

[99] *http://www.climatecentral.org/news/sizzling-summers-20515*

[100] http://flbrace.org/images/docs/heat-profile.pdf

Figure 4.57: Florida Extreme Heat (>95 degrees) Risk, 1986–2016



Extreme heat events typically impact a large area and cannot be defined to any geographic or political boundaries. All municipalities within the county are susceptible to extreme heat. While some communities may have more social vulnerability factors that would make them more challenged (for any hazards), all communities have a high chance of being impacted by extreme heat.

3. Historical Occurrences of Extreme Heat

Florida is known for its high humidity and heat, which combine to affect its population. However, the NCEI Storm Events Database has no record of extreme heat events reported in Pinellas County from 1996 to 2018.[101]

[101] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Excessive+Heat&eventType=%28Z%29+Heat&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

The table below describes various significant extreme heat incidents that have occurred in the state of Florida. Similar events are also likely in Pinellas County.

Table 4.83: Significant Extreme Heat Occurrences in Pinellas County

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.[102]
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.[103]
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.[104]
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.[105]
July 2016	Seven cities from across Florida reported their hottest July on record.[106]

As stated above, NOAA tracks deaths related to weather events by state. According to their data for Florida from 1995 to 2018, 1 person died from extreme heat in 1995, 1997, 2003, 2006, and 2010; 2 people died in 2009; and 4 people died in 1998.[107]

The tables below identify the history of maximum daily temperatures over 95 degrees in Pinellas County based on the NCEI Climate Data Online collection of Local Climatological Data from 2009 to 2018.[108] Data is available for three locations in the county, and they are identified on the map that follows.

Table 4.84: Extended Periods of Maximum Daily Temperatures over 95°F in Pinellas County, 2009–2018

Clearwater Air Park			St. Petersburg Clearwater International Airport			St. Petersburg Albert Whitted Airport		
Consecutive Days	Begin Date	End Date	Consecutive Days	Begin Date	End Date	Consecutive Days	Begin Date	End Date
Maximum Temperature >= 95°F								
--	--	--	7	6/17/2009	6/23/2009	3	6/11/2010	6/13/2010
--	--	--	5	6/26/2014	6/30/2014	3	7/29/2013	7/31/2013

102 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=348150
103 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=54001
104 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=253232
105 https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=354723
106 https://weather.com/news/weather/news/record-warm-south-july-2016
107 http://www.nws.noaa.gov/om/hazstats.shtml#
108 https://www.ncdc.noaa.gov/cdo-web/

Clearwater Air Park			St. Petersburg Clearwater International Airport			St. Petersburg Albert Whitted Airport		
--	--	--	4	5/16/2017	5/19/2017	3	7/4/2017	7/6/2017

Table 4.85: Total Number of Days with Maximum Temperatures over 95°F in Pinellas County, 2009–2018

Clearwater Air Park		St. Petersburg Clearwater International Airport		St. Petersburg Albert Whitted Airport	
TOTAL NUMBER OF DAYS >= 95	0	TOTAL NUMBER OF DAYS >= 95	60	TOTAL NUMBER OF DAYS >= 95	37

Figure 4.58: NCEI Climate Data Online Local Climatological Data Station Locations in Pinellas County

4. Probability of Future Occurrences of Extreme Heat

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 in the Geographic Areas section above, Pinellas County is likely to experience between 5 and 15 days of temperatures above 95 degrees each year, and incidents of extreme heat are expected to continue in the county.

Based on historical information, this hazard was determined to have a probability level of likely (10 to 100% annual probability). For all jurisdictions, the probability is likely (10 to 100% annual probability) that each could be impacted by extreme heat. The county is essentially built out and urbanized which further amplifies concerns for this hazard. Portions of these communities with high concentrations of senior residents and very young individuals could be the most at risk.

5. Extreme Heat Impact Analysis

All jurisdictions could receive the following impacts due to extreme heat. The county is essentially built out and urbanized which further amplifies concerns for this hazard. Portions of these communities with high concentrations of senior residents and very young individuals could be the most at risk.

- Public
  - Injury or death from overexposure, especially to infants, children, the elderly, those who are overweight, those with chronic illnesses, and those who take certain medications
- Responders
  - Injury or death from overexertion 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Historical Losses

Because there was no record of extreme heat events reported by the NCEI Storm Events Database in Pinellas County, it is not possible to analyze historical losses for this hazard.

Exposure

Since extreme heat is a hazard that does not have geographically definable boundaries, it was excluded from spatial analysis through GIS. However, because extreme heat is considered atmospheric, it has the potential to affect all buildings and all populations in Pinellas County.

Extreme heat usually does not cause significant damage to the built environment. Although structures themselves are not vulnerable to extreme heat, the areas or regions that the structures 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.

Extreme heat primarily affects the human population. Extreme heat can ultimately cause death, and most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Extreme heat can strike anywhere in Pinellas County; therefore, all of the county critical facilities are equally vulnerable and at risk. However, extreme heat usually does not cause direct structural damage to critical facilities. Extreme heat impacts to structures, including to critical facilities, are listed above under Exposure.

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.5.

EXTREME HEAT Overview					Overall Vulnerability
Extreme heat is defined as extended period where the temperature and relative humidity combine for a dangerous heat index.					MODERATE
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Likely	Minor	Large	> 24 hrs	> 1 week	2.5

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.[109]

- 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 the table below, 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.

[109] https://www.nws.noaa.gov/om/csd/graphics/content/outreach/brochures/FactSheet_Drought.pdf

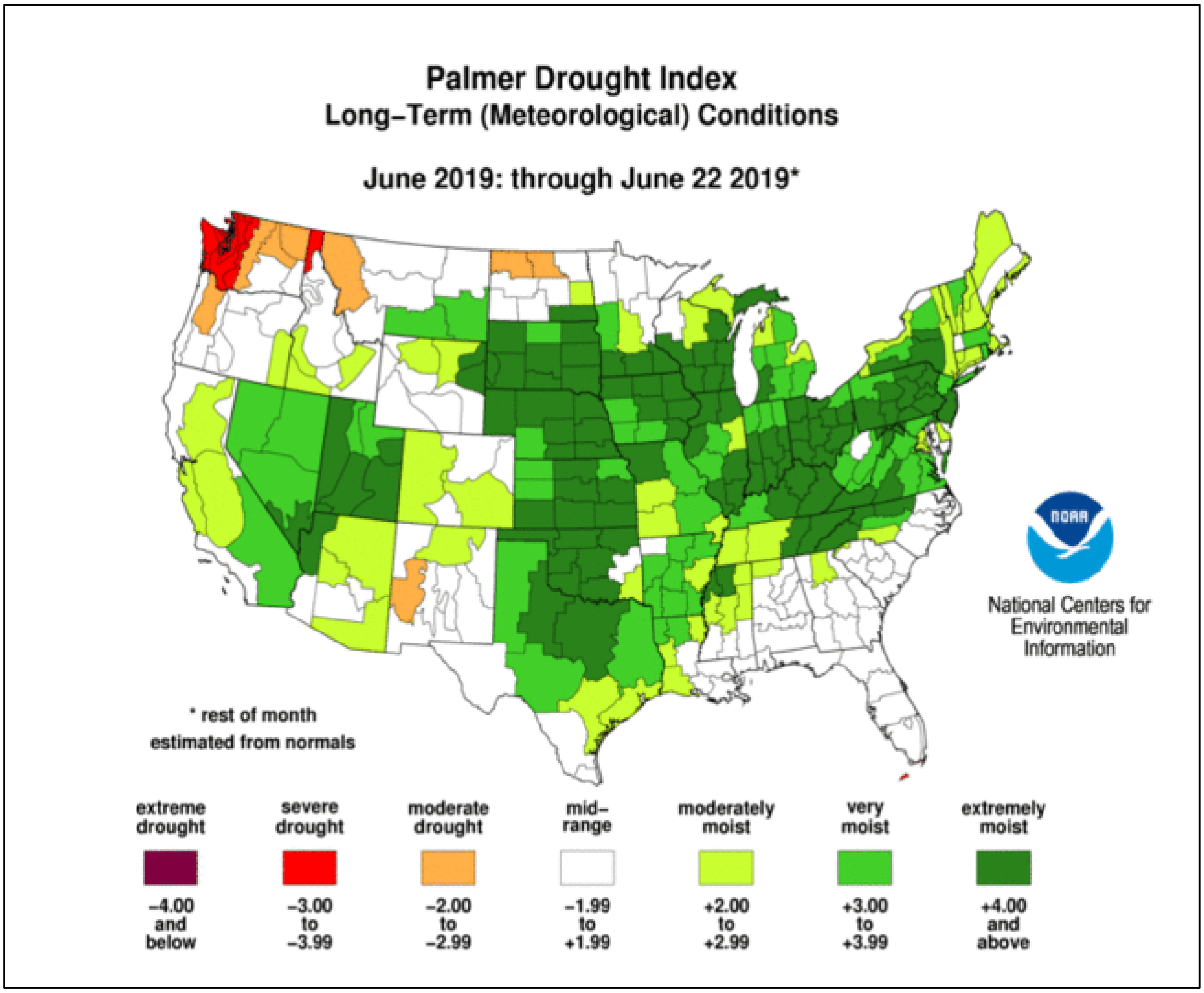
Table 4.86: Palmer Drought Severity Index[110]

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 United States from June 2019.[111]

110 https://www.drought.gov/drought/data-maps-tools/current-conditions
111 https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/20190622

Figure 4.59: Florida PDSI, June 2019



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 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.[112]

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.[113]

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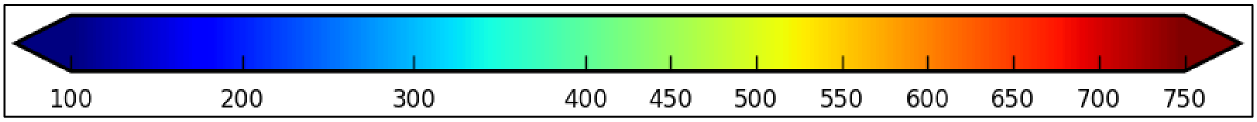
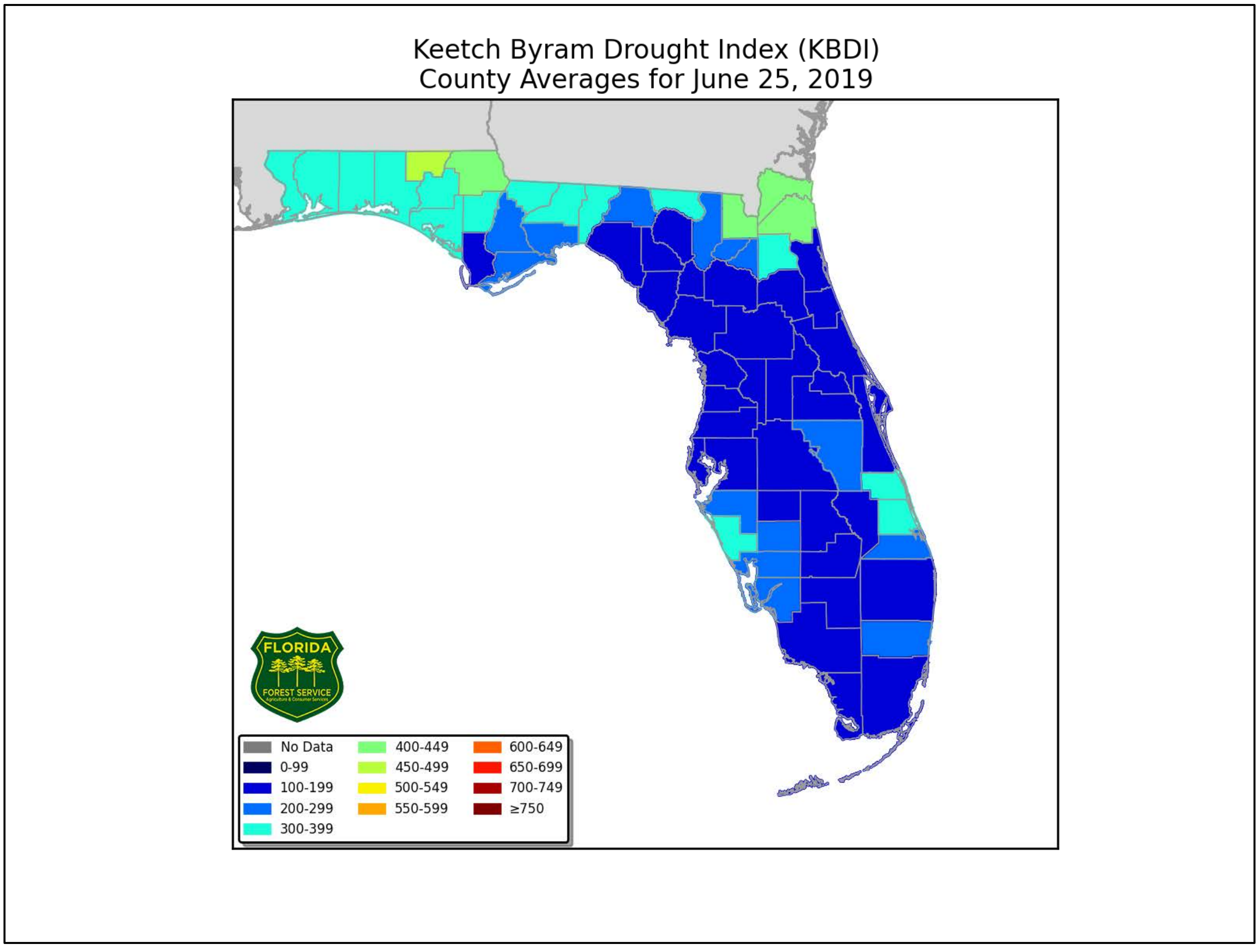
[112] https://climatecenter.fsu.edu/
[113] http://currentweather.freshfromflorida.com/kbdi_4km.html

Figure 4.60: Keetch Byran Drought Index



Below is an example of the KBDI for Florida from June 25, 2019.

Figure 4.61: Florida KBDI, June 2019[114]



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.

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[114] http://currentweather.freshfromflorida.com/kbdi_index.html

Table 4.87: United States Drought Monitor[115]

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

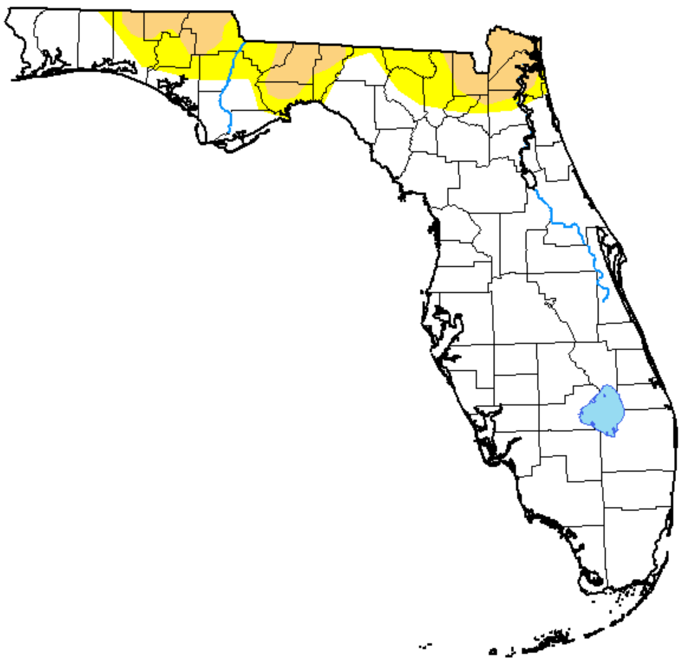
Below is an example of the drought monitor map for Florida from June 18, 2019.

115 https://droughtmonitor.unl.edu/AboutUSDM/AbouttheData/DroughtClassification.aspx

Figure 4.62: Florida U.S. Drought Monitor, June 2019[116]

U.S. Drought Monitor

Florida



June 18, 2019

(Released Thursday, Jun. 20, 2019)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	80.86	19.14	8.62	0.00	0.00	0.00
Last Week *06-11-2019*	69.78	30.22	16.94	0.00	0.00	0.00
3 Months Ago *03-19-2019*	92.75	7.25	0.00	0.00	0.00	0.00
Start of Calendar Year *01-01-2019*	68.86	31.14	22.51	0.00	0.00	0.00
Start of Water Year *09-25-2018*	100.00	0.00	0.00	0.00	0.00	0.00
One Year Ago *06-19-2018*	100.00	0.00	0.00	0.00	0.00	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

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droughtmonitor.unl.edu

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.[117] It is widely believed that an

[116] https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

[117] *(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.).*

overall warming trend may intensify and prolong droughts as they occur due to increased rates of evapotranspiration associated with higher temperatures.[118]

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.[119] South Florida, in particular, may see increased dry and hot periods between heavy rainfall events, exacerbating the risk for drought.[120] However, there is significant uncertainty associated with these projections given the numerous factors that contribute to climatic variability.[121]

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 conditions and severity of drought conditions has been variable over the years, affecting the east, north, south, and central regions randomly and somewhat equally.

The map below shows that Pinellas County is likely to be impacted by drought and experiences up to 11 weeks of drought each year. All municipalities within the county are susceptible to drought. While some communities may have more social vulnerability factors that would make them more challenged (for any hazards), all communities have an approximately equal chance of being impacted by drought.

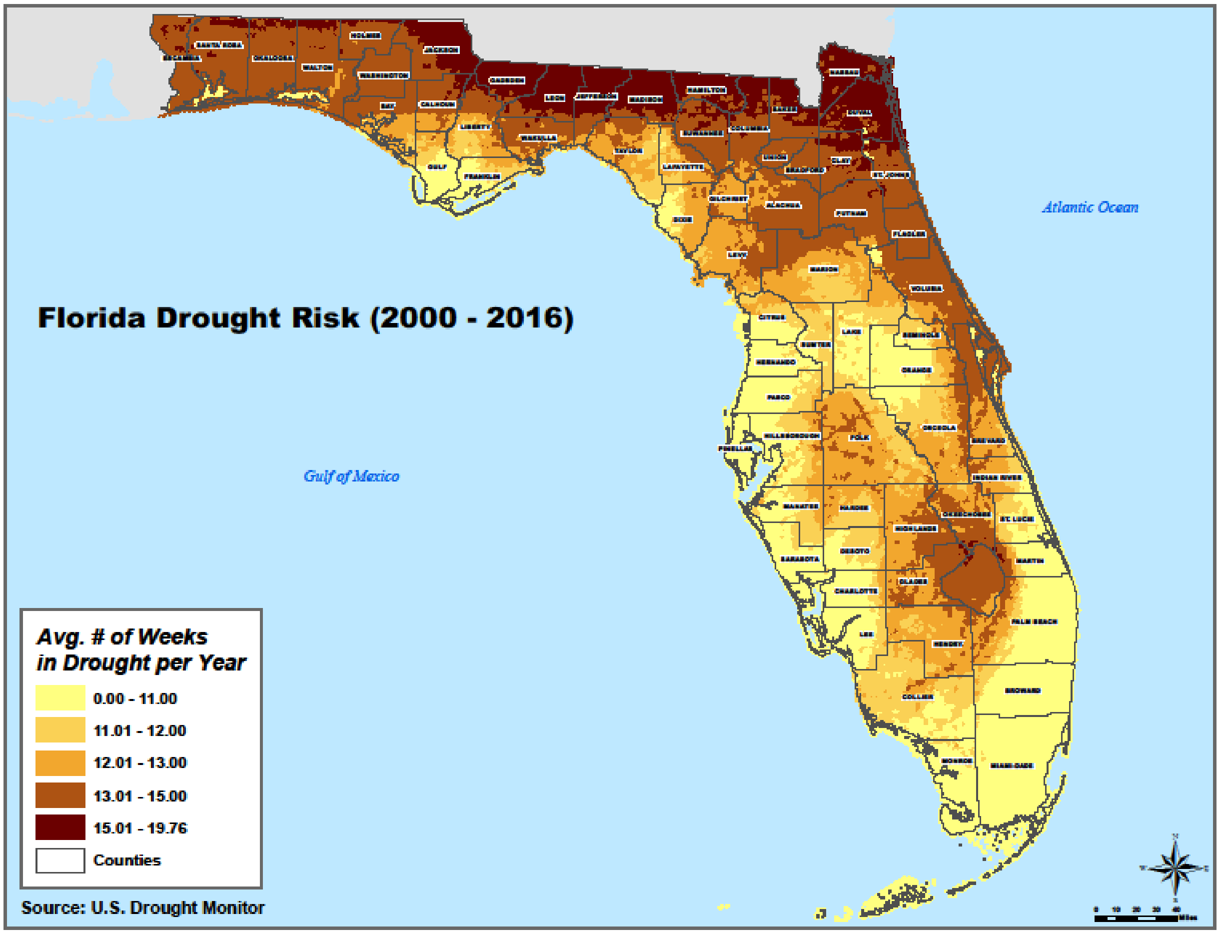
[118] *(Allen et al. (2012). Summary for policymakers. In Field et al. (Eds.), Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, pp. 3–21., https://www.ipcc.ch/pdf/special-reports/srex/SREX_FD_SPM_final.pdf, p. 13).*

[119] *(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.).*

[120] *(Karl et al. (Eds.) (2009). https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf).*

[121] *(Seager et al. (2009). http://journals.ametsoc.org/doi/full/10.1175/2009JCLI2683.1).*

Figure 4.63: Florida Drought Risk, 2000–2016



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 to 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. Additionally, Pinellas County has very little agriculture; therefore, no economic losses from drought have been reported. The NCEI Storm Events Database also has no record of drought events reported in Pinellas County from 1996 to 2018.[122]

[122] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Drought&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

The table below explains various significant drought events that have occurred in Florida.

Table 4.88: Significant Drought Occurrences in Florida

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.[123]
1981–1982	Rainfall deficiencies caused the water levels in Lake Okeechobee to reach 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.[124]
1998–2002	Lower than normal precipitation caused a severe long-term statewide drought in Florida lasting from 1998–2002. 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.[125]
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.[126]
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.[127]
2016–2017	Drought conditions developed in late 2016 and persisted into mid 2017 leading to several wildfires across the state.[128]

Data from the U.S. Drought Monitor was used to ascertain historical drought conditions for Pinellas County. (Data was only available at the county level, so each jurisdiction is not shown separately.) The

[123] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/195401-195612
[124] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/198001-198212
[125] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/199801-200212
[126] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/200601-200712
[127] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/201001-201212
[128] https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/201601-201704

U.S. Drought Monitor provides weekly updates on drought status by county. Drought conditions are classified on a scale of D0 to D4 as described previously in this section.

According to the U.S. Drought Monitor data from 2000 to 2018, the greatest magnitude of drought, D4 – exceptional drought, occurred in Pinellas County in 2000 and 2001, and the county has experienced at least abnormally dry conditions every year except 2015. The table below shows the most severe drought classification for each year and the associated number of weeks reported at that category. It should be noted that the U.S. Drought Monitor also estimates what percentage of the county is in each classification of drought severity. For example, the most severe classification reported may be exceptional, but a majority of the county may actually be in a less severe condition.

Table 4.89: Historical Drought Occurrences in Pinellas County[129]

Year	Most Severe Drought Condition		Number of Weeks
	Category	Description	
2000	D4	Exceptional Drought	3
2001	D4	Exceptional Drought	14
2002	D0	Abnormally Dry	16
2003	D0	Abnormally Dry	2
2004	D0	Abnormally Dry	2
2005	D0	Abnormally Dry	17
2006	D1	Moderate Drought	4
2007	D1	Moderate Drought	23
2008	D1	Moderate Drought	21
2009	D2	Severe Drought	8
2010	D1	Moderate Drought	5
2011	D2	Severe Drought	2
2012	D3	Extreme Drought	9
2013	D1	Moderate Drought	11
2014	D0	Abnormally Dry	4
2015	None	--	--
2016	D0	Abnormally Dry	2
2017	D2	Severe Drought	9
2018	D0	Abnormally Dry	4

4. Probability of Future Occurrences of Drought

Based on the previous occurrences of drought conditions in the county, future drought events occurring over the long term with some frequency are expected to continue. According to the Florida Drought Risk map shown above, Pinellas County is likely to experience up to 11 weeks of drought each year. As Pinellas County continues to develop with higher populations and higher water demands, these drought conditions and drier trends may begin to have a profound impact on the county and its residents.

[129] https://droughtmonitor.unl.edu/Data/DataDownload/ComprehensiveStatistics.aspx

Based on historical information, this hazard was determined to have a probability level of likely (10 to 100% annual probability) for all jurisdictions within the county.

5. Drought Impact Analysis

All jurisdictions could receive the following impacts due to drought. As Pinellas County continues to develop with higher populations and higher water demands, drought conditions and drier trends may begin to have a profound impact on the county and its residents.

- 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
  - 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Historical Losses

Because there was no record of drought events reported by the NCEI Storm Events Database in Pinellas County, it is not possible to analyze historical losses for this hazard.

Exposure

Since drought is a hazard that does not have geographically definable boundaries, it was excluded from spatial analysis through GIS. However, because drought is considered atmospheric, it has the potential to affect all buildings and all populations in Pinellas County.

Drought conditions typically do not cause significant damage to the built environment. Although structures themselves are not vulnerable to drought, the areas or regions that the structures 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. Furthermore, 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 potentially increasing impacts to structures.

The agriculture sector is most vulnerable to drought because crops, pasturelands, and livestock can be impacted by lack of water due to short-term drought during critical times in the growth cycle and long-term drought over many years. However, there is very little agriculture in Pinellas County as previously noted.

Drought conditions may also require water use restrictions and result in more water supply shortages. Availability of water during drought conditions is controlled largely by the topography, geology, hydrogeology, and hydrology of an area. Local conditions, such as the availability of a large impoundment for water storage, may affect drought vulnerability on a local scale.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Drought can strike anywhere in Pinellas County; therefore, all of the county critical facilities are equally vulnerable and at risk. However, drought usually does not cause direct structural damage to critical facilities. Drought impacts to structures, including to critical facilities, are listed above under Exposure.

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.5.

DROUGHT Overview					Overall Vulnerability
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.					MODERATE
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Likely	Minor	Large	> 24 hrs	> 1 week	2.5

Geological Event Hazard Profile

1. Geological Event Description

This profile will discuss landslides and sinkholes.

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.[130]

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.[131] 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.[132]

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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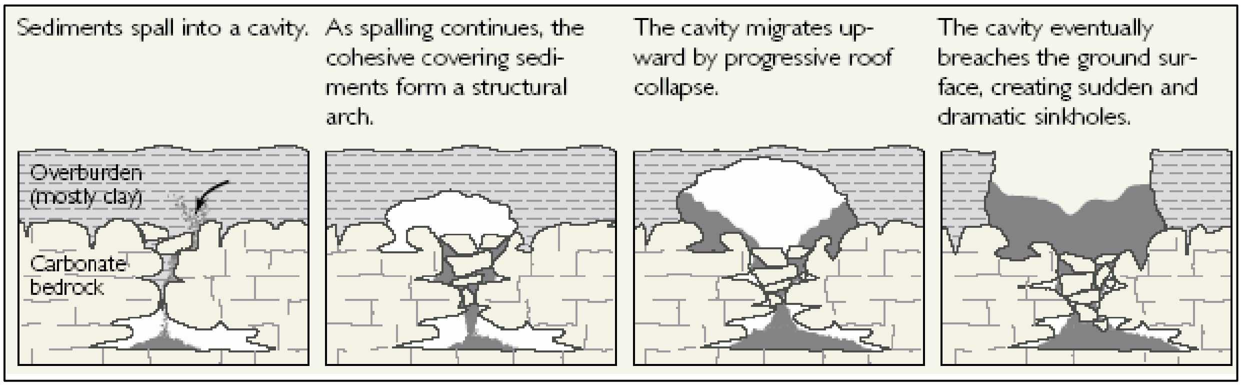
[130] https://landslides.usgs.gov/learn/ls101.php
[131] http://www.dep.state.fl.us/geology/geologictopics/hazards/landslides.htm
[132] Florida Department of Environmental Protection Florida Geological Survey. (2017). The favorability of Florida's geology to sinkhole formation. Page 4–7.

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.[133] This occurs because, over time, surface drainage, erosion, and deposition of materials develop a shallow bowl-shaped depression beneath the surface of the ground.

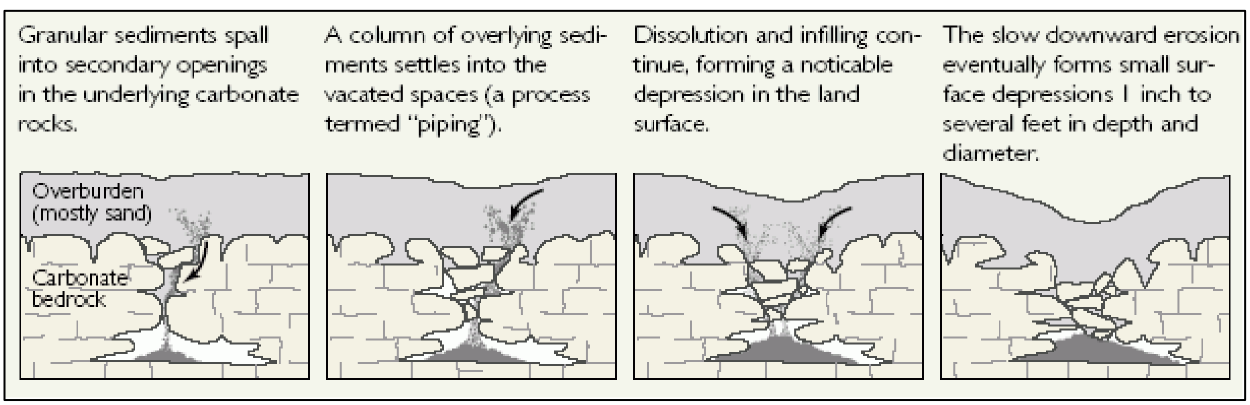
Figure 4.64: Cover Collapse Sinkholes[134]



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.[135]

Figure 4.65: Cover Subsidence Sinkholes[136]



[133] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 5.
[134] https://water.usgs.gov/edu/sinkholes.html
[135] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 4–7.
[136] 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 cavity ceilings. Additionally, heavy rainfall could saturate overburden sediments, making them soft, which could weaken the overburden sediments, causing failure of the cavity ceiling. 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.[137]

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.[138] 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 *Flood Hazard Profile)*, 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.

Sinkholes

A geological survey conducted for the Pinellas County General Plan (1979) indicates that the central and northern portions of the county are more prone to sinkhole development due to the heavy limestone composition of the substrate in the area. All municipalities within the county have some exposure to drought. All communities are low exposure, except for Clearwater which has a medium exposure as well as Unincorporated County (particularly central and northern areas) and Tarpon Springs which are highly likely to see sinkholes.

Sinkholes are common wherever there is limestone terrain. The following define areas of sinkhole occurrence in Florida:

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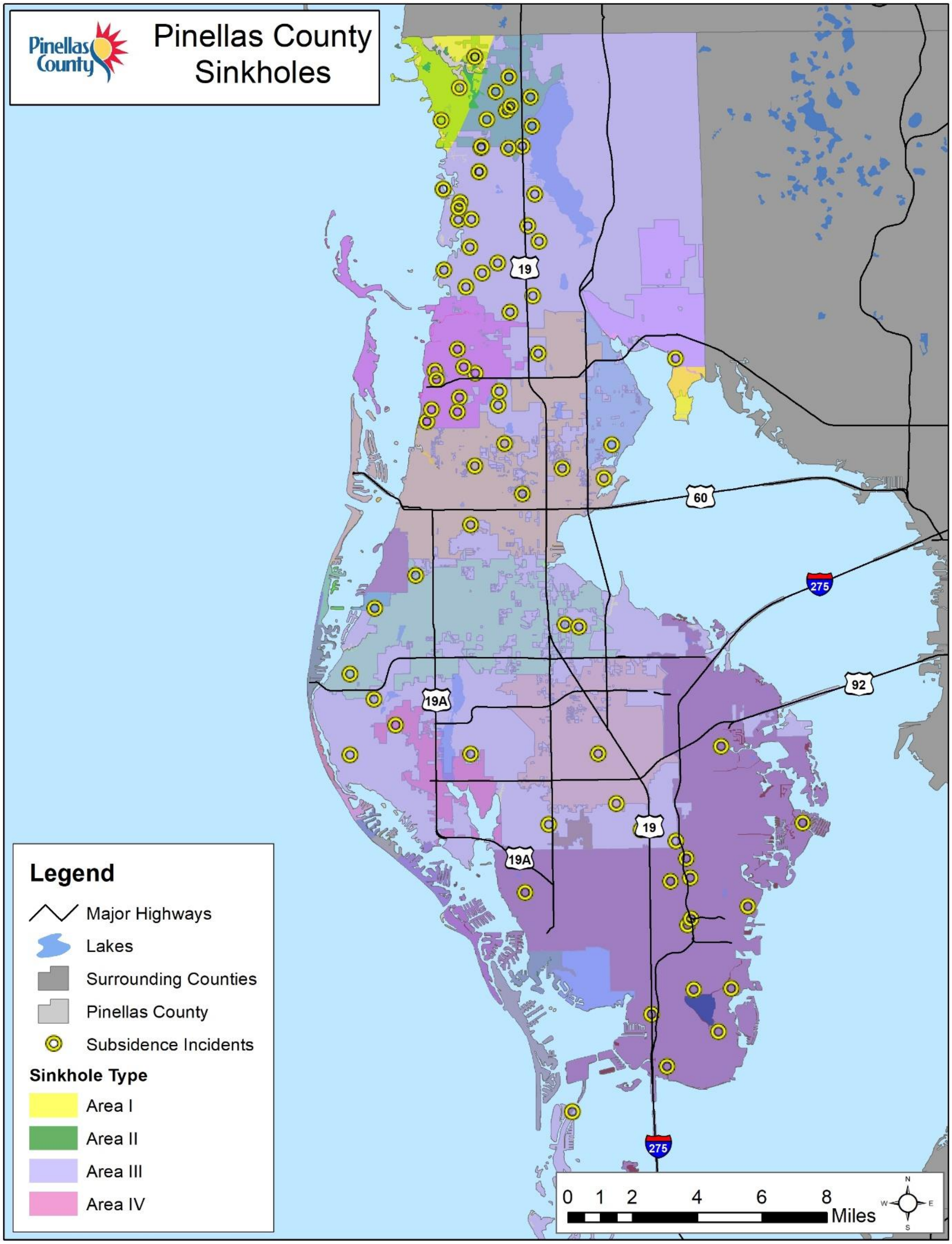
[137] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 11.

[138] 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.

- Area I – Few sinkholes, generally shallow and broad that develop gradually.
- Area II – Few sinkholes, shallow and of small diameter that develop gradually.
- Area III – Sinkholes are most numerous, of varying size and develop abruptly.
- Area IV – Very few sinkholes but a large diameter and deep.

Area I and Area III of sinkhole occurrence are both present in Pinellas County. All municipalities within the county have some exposure to sinkholes. All communities are low exposure, except for Clearwater which has a medium exposure as well as Unincorporated County (particularly central and northern areas) and Tarpon Springs which are both highly likely to see sinkholes. The map below delineates the location of these areas as well as the location of documented sinkhole and subsidence incidents.

Figure 4.66: Areas of Sinkhole Occurrence



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.[139] No one was injured, and no structures were damaged. There have been no occurrence in Pinellas County.

Sinkholes

Sinkholes, a common occurrence in many parts of Florida, have a history of occurring in Pinellas County. In Pinellas County, sinkholes have generally developed rather slowly and are fairly shallow and small in diameter. The 95th percentile for sinkhole lengths recorded in the county is approximately 30 feet, which means that 95% of all the sinkholes that have occurred are smaller than this. The geometric mean is 9.43-foot width, 10.09-foot length, and 6.22-foot depth.

Much of the property damage caused by sinkholes and subsidence events in Pinellas County has been relatively minor, including damage or destruction of a shed, a carport, part of a seawall, and several instances where small portions of roadways sustained minor damage. Of the sinkhole or other subsidence events that were reported to have caused property damage, the majority were between 12 and 20 feet long and wide and 5 to 10 feet deep. Future sinkholes of this size have the potential to cause similar types of property damage, though a similar sinkhole that occurs directly beneath a building or roadway could cause injury from falling debris or partial structure collapse.

There are several significant historical occurrences of sinkholes in Pinellas County listed below.

Table 4.90: Significant Sinkhole Incidents in Pinellas County[140]

Date	Event Description
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.
March 18, 1981	An 18-foot long, 18-foot wide, 6-foot deep sinkhole occurred in 2–3 hours in Palm Harbor. A carport was severely damaged and actually sank into the sinkhole.
October 24, 1983	A significant sinkhole occurred on October 24, 1983 in Palm Harbor that measured 20-feet long, 15-feet wide, 10-feet deep. According to the St. Petersburg Times, the sinkhole caused the partial collapse of a concrete block office building used by W.F. Madsen and Company, an insurance adjustment firm. No injuries were reported with this event, and no property damage value was reported.
November 2, 1983	A 60-foot long, 50-foot wide, 3-foot deep sinkhole occurred in Safety Harbor on November 2, 1983. The sinkhole resulted in heavy structural damage to a building, road, and asphalt parking lot.

[139] https://floridadep.gov/fgs/data-maps/media/florida-geological-surveydep-staffgadsden-landslide-terrain-model
[140] https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports

Date	Event Description
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.
November 14, 2013	The most significant sinkhole event in Pinellas County, according to the Florida Geological Survey database, occurred on November 14, 2013, when a 70-foot long, 70-foot wide, 55-foot deep sinkhole severely damaged two single family homes in Dunedin. According to the St. Petersburg Times report dated November 15, 2013, there were no injuries reported even though both homes were occupied at the time that the sinkhole occurred. No injuries were reported with this event, and no property damage value was reported.
April 17, 2014	A sinkhole with a diameter of about 20 feet and 12–15 feet deep and growing occurred in Floral City. The sinkhole damaged the road surface, but no buildings were threatened.
February 7, 2017	A 6-foot long, 6-foot wide, 1 foot-deep sinkhole occurred in St. Pete Beach. A vehicle was temporarily stuck in the hole, and the road was temporarily closed.

Only a small percentage of sinkhole reports are determined to be actual sinkholes. Most are subsidence events, resulting from clay shrinkage or fill deterioration. However, most occurrences of subsidence are incorrectly identified as sinkholes.

The Florida Geological Survey maintains a database of sinkholes and subsidence incidents reported throughout the state. As of June 2019, this database reported 91 incidents for Pinellas County.[141]

Table 4.91: Summary of Sinkhole Occurrences in Pinellas County

Location	Number of Occurrences
Belleair	0
Belleair Beach	0
Belleair Bluffs	0
Belleair Shore	0
Clearwater	8
Dunedin	10
Gulfport	0
Indian Rocks Beach	0
Indian Shores	0
Kenneth City	0
Largo	4
Madeira Beach	0
North Redington Beach	0
Oldsmar	1

[141] https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports

Location	Number of Occurrences
Pinellas Park	2
Redington Beach	0
Redington Shores	0
Safety Harbor	1
St. Petersburg	10
St. Pete Beach	1
Seminole	3
South Pasadena	0
Tarpon Springs	16
Treasure Island	0
Unincorporated	35
PINELLAS COUNTY TOTAL	**91**

Table 4.92: Historical Sinkhole Occurrences in Pinellas County

	Data	Length (ft)	Width (ft)	Depth (ft)
Belleair				
NONE REPORTED	--	--	--	--
Belleair Beach				
NONE REPORTED	--	--	--	--
Belleair Bluffs				
NONE REPORTED	--	--	--	--
Belleair Shore				
NONE REPORTED	--	--	--	--
Clearwater				
CLEARWATER	6/19/1981	2	2	3
CLEARWATER	6/19/1981	4	4	3
CLEARWATER	6/18/1985	20	15	30
CLEARWATER	3/3/1986	0	0	0
CLEARWATER	1/10/2003	15	15	8
CLEARWATER	7/14/2003	5	8	5
CLEARWATER	4/3/2016	4	4	0
CLEARWATER	9/2/2016	4	4	4
Dunedin				
DUNEDIN	5/15/1988	21	16	7
DUNEDIN	9/8/1988	8	8	0.5
DUNEDIN	9/19/1989	21	21	10
DUNEDIN	2/12/1990	5	2.5	1
DUNEDIN	2/17/1990	15	15	15
DUNEDIN	6/29/2000	20	8	0
DUNEDIN	12/9/2002	0	0	0
DUNEDIN	7/16/2003	0	0	0
DUNEDIN	4/29/2013	0.8	0.8	1
DUNEDIN	11/14/2013	70	70	55

	Data	Length (ft)	Width (ft)	Depth (ft)
Gulfport				
NONE REPORTED	--	--	--	--
Indian Rocks Beach				
NONE REPORTED	--	--	--	--
Indian Shores				
NONE REPORTED	--	--	--	--
Kenneth City				
NONE REPORTED	--	--	--	--
Largo				
LARGO	7/7/1988	12	12	5
LARGO	3/13/2003	4	4	2
LARGO	7/15/2013	1	1	6
LARGO	4/23/2014	4.5	4.5	0
Madeira Beach				
NONE REPORTED	--	--	--	--
North Redington Beach				
NONE REPORTED	--	--	--	--
Oldsmar				
OLDSMAR	9/5/2002	4	4	3
Pinellas Park				
PINELLAS PARK	11/15/1989	0.8	0.8	2
PINELLAS PARK	8/29/2013	0	0	0
Redington Beach				
NONE REPORTED	--	--	--	--
Redington Shores				
NONE REPORTED	--	--	--	--
Safety Harbor				
SAFETY HARBOR	11/2/1983	60	50	3
St. Petersburg				
ST. PETERSBURG	8/1/1981	20	20	10
ST. PETERSBURG	9/12/1988	4	4	2
ST. PETERSBURG	1/11/2001	10	30	0
ST. PETERSBURG	12/9/2002	3	3	2
ST. PETERSBURG	8/18/2003	1.5	1.5	2
ST. PETERSBURG	9/11/2003	4	4	8
ST. PETERSBURG	8/6/2004	4	4	6
ST. PETERSBURG	8/7/2013	2.5	2.5	0
ST. PETERSBURG	6/27/2014	5	5	4
ST. PETERSBURG	9/2/2016	8	5	0
St. Pete Beach				
St. PETE BEACH	2/7/2017	6	6	1
Seminole				
SEMINOLE	4/30/1987	0	0	0
SEMINOLE	4/21/1988	4	4	16
SEMINOLE	3/24/1989	10	10	1.5

	Data	Length (ft)	Width (ft)	Depth (ft)
South Pasadena				
NONE REPORTED	--	--	--	--
Tarpon Springs				
TARPON SPRINGS	4/14/1979	30	30	25
TARPON SPRINGS	6/2/1979	20	20	10
TARPON SPRINGS	4/13/1989	12	12	9
TARPON SPRINGS	4/13/1989	35	35	16
TARPON SPRINGS	4/13/1989	12	12	9
TARPON SPRINGS	7/20/1989	6.5	5.5	1
TARPON SPRINGS	11/6/1989	4.5	4.5	0.5
TARPON SPRINGS	2/9/1990	8	8	6
TARPON SPRINGS	2/9/1990	10	10	2
TARPON SPRINGS	3/1991	8	8	6
TARPON SPRINGS	11/21/2002	0	0	15
TARPON SPRINGS	2/8/2003	3	3	0
TARPON SPRINGS	7/6/2004	3	3	0
TARPON SPRINGS	6/16/2011	0	0	0
TARPON SPRINGS	6/16/2011	15	15	15
TARPON SPRINGS	3/30/2016	0	60	15
Treasure Island				
NONE REPORTED	--	--	--	--
Unincorporated				
PINELLAS CO.	6/30/1970	15	15	0.5
PINELLAS CO.	1975	15	9	0.3
PINELLAS CO.	4/16/1975	18	15	12
PINELLAS CO.	4/16/1975	15	15	8
PINELLAS CO.	4/16/1975	5	5	3
PINELLAS CO.	4/16/1975	18	15	8
PINELLAS CO.	4/16/1975	30	25	8
PALM HARBOR	3/18/1981	5	5	1.5
PALM HARBOR	3/18/1981	18	18	6
PALM HARBOR	10/24/1983	20	15	10
OZONA	4/16/1985	0	0	0
PINELLAS CO.	4/30/1987	8	8	1.5
PINELLAS CO.	11/9/1987	10	10	8
PALM HARBOR	1/29/1988	6	6	3
PINELLAS CO.	3/31/1989	0	0	0
PALM HARBOR	9/1/1989	20	20	14
PINELLAS CO.	4/30/1990	3	3	1
PALM HARBOR	1/23/1991	5	5	11
PALM HARBOR	1/25/1991	3	3	2.5
PINELLAS CO.	8/1/1991	8	8	20
PALM HARBOR	3/19/2001	10	10	2
PALM HARBOR	11/30/2002	6	6	6
PALM HARBOR	4/18/2003	8	8	4

	Data	Length (ft)	Width (ft)	Depth (ft)
PALM HARBOR	7/18/2003	3	4	0
PALM HARBOR	10/26/2003	3	3	5
PINELLAS CO.	3/19/2006	8	8	0.83
PINELLAS CO.	3/1/2007	1.5	1.5	3
PINELLAS CO.	4/29/2007	2	4	0
PINELLAS CO.	2/12/2010	4	3.5	2
FLORAL CITY	4/17/2014	20	20	15
PINELLAS CO.	10/1/2014	6	3	5
PINELLAS CO.	3/31/2015	6	4	2
PINELLAS CO.	5/29/2015	0	0	0
PINELLAS CO.	8/11/2015	0	0	0
PALM HARBOR	--	0.8	0.8	5

4. Probability of Future Occurrences of Geological Events

Landslides

Because of Florida's relatively flat topography, landslides are not likely in Florida.

Sinkholes

There will continue to be incidences of sinkholes in Pinellas County 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.

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.[142]

Based on historical information, this hazard was determined to have a probability level of likely (10 to 100% annual probability) for all jurisdictions.

5. Geological Events Impact Analysis

Landslides

N/A

[142] Florida Department of Environmental Protection Florida Geological Survey. (2017). *The favorability of Florida's geology to sinkhole formation.* Page 4.

Sinkholes

All jurisdictions could receive the following impacts due to sinkholes. As the county'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.

- Public
  - May fall in or drive in to a sinkhole
  - May be injured or killed from structure collapse because of sinkhole
- Responders
  - May be injured or killed when attempting rescue missions
- Continuity of Operations (including continued delivery of services)
  - 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Exposure

Landslides

Florida is not vulnerable to landslides, so no vulnerability analysis or loss estimation will be conducted.

Sinkholes

To estimate exposure of improved property to sinkholes, the approximate number of parcels and their associated improved valued located in high sinkhole risk areas was determined using GIS analysis. Areas classified as Area III of sinkhole occurrence were chosen to be displayed as areas of risk because these areas are susceptible to the most numerous sinkholes of varying size and develop abruptly.

Table 4.93: Estimated Exposure of Improved Property to Sinkholes

Location	Buildings and Parcels in High Sinkhole Risk Area		
	No. of Parcels	No. of Buildings	Improved Value
Belleair	2,466	6,672	$333,521,233
Belleair Beach	1,123	3,140	$136,367,294
Belleair Bluffs	1,320	2,822	$105,229,223
Belleair Shore	122	401	$93,914,658
Clearwater	47,581	117,769	$5,773,407,656
Dunedin	17,731	48,112	$1,648,437,009
Gulfport	6,810	21,974	$550,433,126
Indian Rocks Beach	3,318	6,951	$233,397,583
Indian Shores	2,781	938	$37,200,089
Kenneth City	2,055	5,081	$143,192,911
Largo	30,824	86,038	$3,193,892,581
Madeira Beach	3,812	7,431	$260,970,811
North Redington Beach	1,185	1,302	$92,550,082
Oldsmar	5,779	17,002	$821,222,979
Pinellas Park	21,267	69,533	$2,593,820,761
Redington Beach	1,081	3,438	$130,708,924
Redington Shores	2,121	3,002	$113,229,353
Safety Harbor	7,804	26,393	$1,103,109,033
St. Petersburg	106,613	336,601	$12,425,621,791
St. Pete Beach	7,671	16,071	$727,197,602
Seminole	9,225	21,840	$982,641,318
South Pasadena	4,237	5,441	$241,196,453
Tarpon Springs	7,703	21,070	$790,342,500
Treasure Island	5,961	10,352	$398,996,096
Unincorporated	128,535	360,986	$13,456,950,450
PINELLAS COUNTY TOTAL	**429,125**	**1,200,360**	**$46,387,551,516**

To estimate the county population's exposure to sinkhole, areas of risk were intersected with census block data. As a result, these population estimates are going to be an overestimate of risk since the entire census block's population count will be included even if only a portion of the census block's area is located in a risk area. However, these estimates still give an idea of the county population's risk to sinkhole.

Table 4.94: Estimated Exposure of Population to Erosion

Location	Population in High Sinkhole Risk Area		
	Total	< 18	> 65
Belleair	3,869	335	847
Belleair Beach	1,341	89	299
Belleair Bluffs	1,822	145	382
Belleair Shore	109	8	25
Clearwater	102,945	10,908	14,747
Dunedin	34,944	3,159	7,089

Location	Population in High Sinkhole Risk Area		
	Total	< 18	> 65
Gulfport	11,899	977	2,230
Indian Rocks Beach	3,521	249	553
Indian Shores	1,420	54	395
Kenneth City	4,997	517	717
Largo	78,793	7,361	14,470
Madeira Beach	3,932	243	724
North Redington Beach	943	39	302
Oldsmar	12,830	1,782	1,084
Pinellas Park	48,593	5,477	6,695
Redington Beach	1,091	82	201
Redington Shores	1,972	122	429
Safety Harbor	16,803	1,859	2,287
St. Petersburg	242,744	26,852	27,870
St. Pete Beach	8,872	507	2,052
Seminole	17,221	1,504	3,931
South Pasadena	6,912	296	2,492
Tarpon Springs	15,657	1,668	2,688
Treasure Island	5,221	310	1,067
Unincorporated	278,591	28,283	45,944
PINELLAS COUNTY TOTAL	**907,042**	**92,826**	**139,520**

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Landslides

Florida is not vulnerable to landslides, so no vulnerability analysis or loss estimation will be conducted.

Sinkholes

To estimate exposure to sinkholes for the critical facility analysis, areas of risk were intersected with critical facility locations. The table below summarizes the critical facilities in the county that are located in high sinkhole risk areas. Areas classified as Area III of sinkhole occurrence were chosen to be displayed as areas of risk because these areas are susceptible to the most numerous sinkholes of varying size and develop abruptly.

Table 4.95: Exposure of Critical Facilities to Sinkhole Risk Areas

Location	Number of Critical Facilities in High Sinkhole Risk Area
Belleair	5
Belleair Beach	3
Belleair Bluffs	9
Belleair Shore	0
Clearwater	173
Dunedin	60

Location	Number of Critical Facilities in High Sinkhole Risk Area
Gulfport	15
Indian Rocks Beach	3
Indian Shores	8
Kenneth City	9
Largo	120
Madeira Beach	5
North Redington Beach	2
Oldsmar	29
Pinellas Park	122
Redington Beach	4
Redington Shores	4
Safety Harbor	34
St. Petersburg	302
St. Pete Beach	9
Seminole	34
South Pasadena	18
Tarpon Springs	34
Treasure Island	14
Unincorporated	347
PINELLAS COUNTY TOTAL	**1,363**

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.5.

GEOLOGICAL					Overall Vulnerability
Overview					
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.					MODERATE
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Likely	Limited	Small	< 6 hrs	< 24 hrs	2.5

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 phenomenon, 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 inch of snow and/or sleet is expected to fall. For Central Florida, any snow or sleet amount over a 1/2 inch 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 inch. 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 and 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 do not 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 the actual temperature. 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.[143]

[143] http://www.nws.noaa.gov/om/winter/index/shtml

Potential Effects of Climate Change on Winter Storms and Freezes

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.[144]

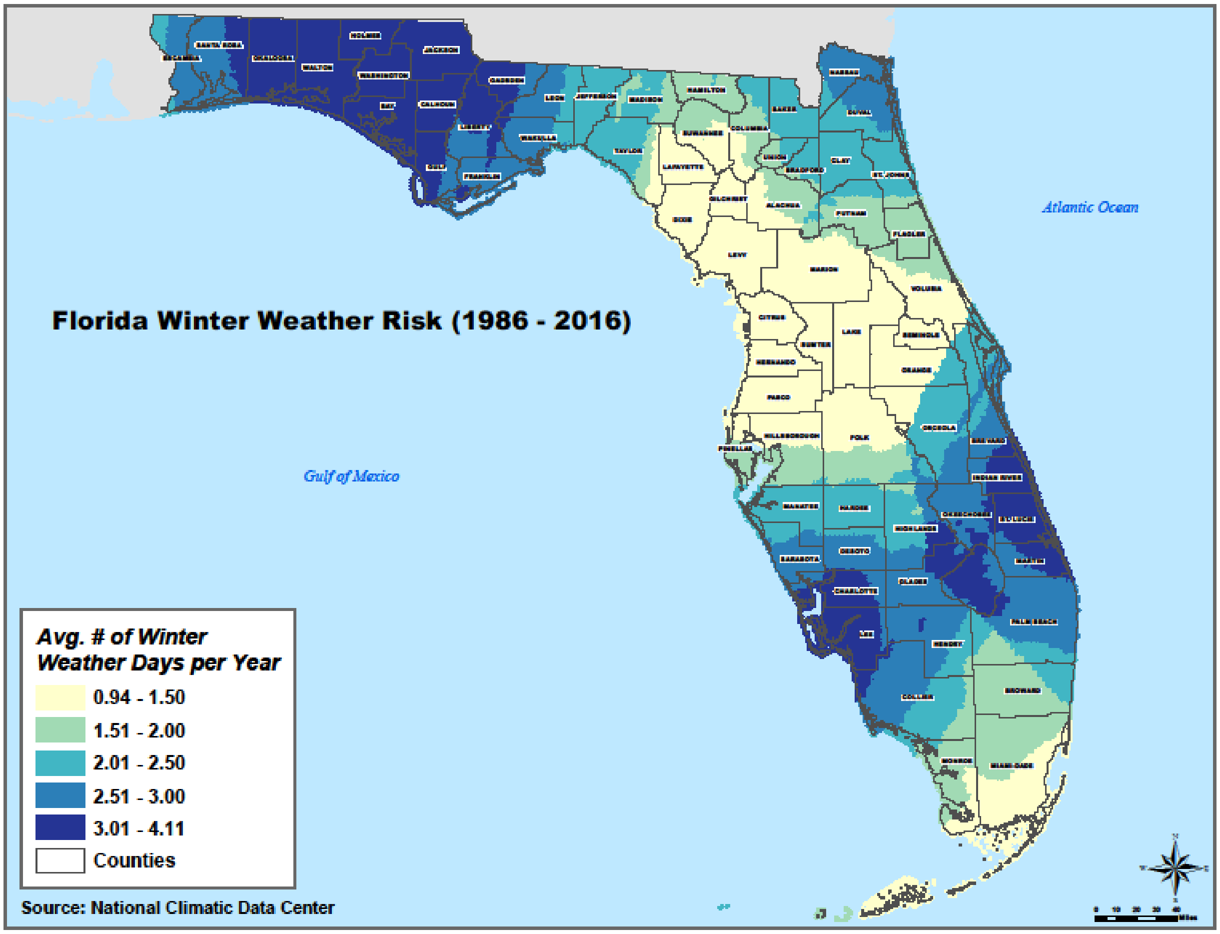
Severe winter storms will not disappear. Specifically, isolated or prolonged winter freeze events in Florida will still occur.

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 central and southern Florida. With that being said, central and southern Florida can still experience freeze events, and given the atmospheric nature of the hazard, the entirety of Pinellas County has uniform exposure to winter storm and freeze events.

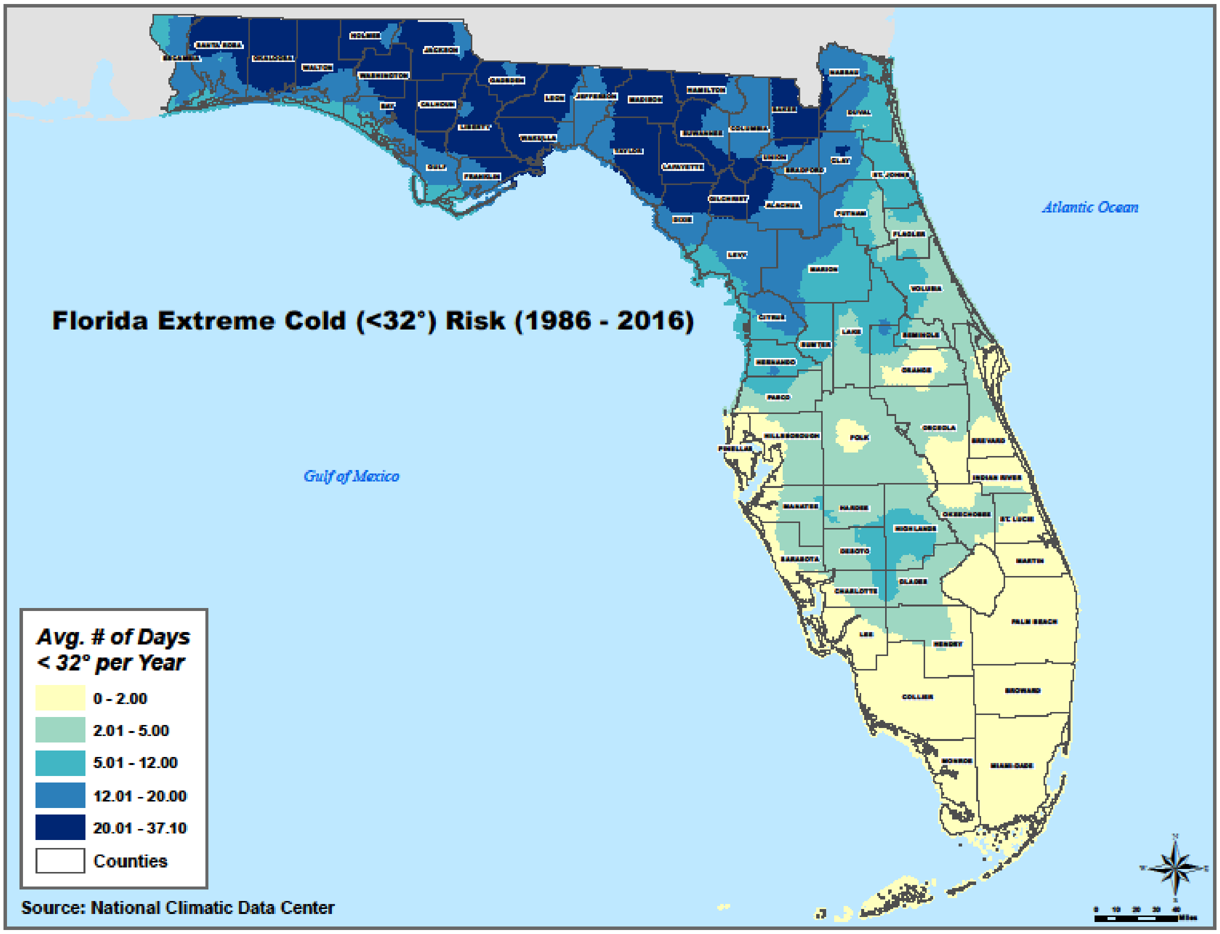
[144] *Ingram and Carter (2012). Southeast region technical report to the National Climate Assessment.* *http://gyr.fortlauderdale.gov/home/showdocument?id=3153*

Figure 4.67: Winter Weather Risk, 1986–2016



According to this data, Pinellas County is likely to receive less than 1 to 2 days of winter weather each year.

Figure 4.68: Florida Extreme Cold (<32 degrees) Risk, 1986–2016



According to this data, Pinellas County is likely to experience between 0 to 2 days of extreme cold, which is classified as less than 32 degrees, each year.

3. Historical Occurrences of Winter Storm and Freeze

The table below lists the significant winter storm and freeze events that affected Pinellas County.

Table 4.96: Significant Winter Weather and Freeze in Pinellas County[145]

Date	Description
January 24–25, 2003	A strong cold front ushered in cold temperatures and gusty northwest winds into the Florida peninsula, which created some of the coldest weather in

[145]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&eve

Date	Description
	several years. Wind chill temperatures ranged from 10 to 15 in Bronson, around 20 in Tampa and Lakeland, to 20 to 25 degrees in Fort Myers. Overnight low temperatures ranged from near 20 north to the upper 20s in the inland counties south, to the lower 30s along the coast near Fort Myers. A hard freeze (temperatures of 27 degrees or less for three or more hours) reached south into northeast Hillsborough and northern Polk counties. Citrus crops fared well because the freeze did not last long enough but strawberries took a $4.5 million loss and tropical fish a $4 million loss.
January 3, 2008	A strong cold front moved through the area with strong high pressure behind the front bringing an arctic airmass over the state on strong northerly flow. Freezing temperatures settled into Levy county Wednesday morning and then settled across the entire area for Thursday morning, with many locations seeing freezing temperatures for six or more hours. North winds of 10 to 15 mph Thursday morning also allowed wind chill values to fall to 15 to 20 degrees across the area. Temperatures moderated for Friday morning, but freezing temperatures were still felt across the Nature Coast for several hours. The ASOS at the St. Petersburg/Clearwater International Airport had a wind chill value of 19 degrees. Freezing conditions were felt across much of Pinellas county, with the ASOS at the St. Petersburg/Clearwater International Airport reaching a low of 31 degrees and the COOP station in Tarpon Springs reaching 29 degrees.
January 11, 2010	Pinellas County had below freezing temperatures for 2 to 3 hours. The ASOS station at the Albert Whitted Airport recorded a low of 33 degrees, breaking the previous low of 34 degrees set in 1977. The lowest temperature across the county of 26 degrees was recorded at a mesonet station in Palm Harbor. A 77-year-old man, his 72-year-old wife, and their 41-year-old daughter were hospitalized from being sickened by carbon monoxide after using a charcoal barbecue grill to heat their home for 12 hours due to the power going out from a blown transformer. The low temperature recorded at the Albert Whitted Airport was 35 degrees and the high temperature was 42 degrees, which set a new record low maximum temperature record. The previous record low maximum temperature was 48 degrees set in 1970.
January 4, 2012	In 2012, a strong cold front moved through the Florida Peninsula on January 2nd dropping temperatures to well below freezing. The coldest temperatures were felt on the morning of January 4th with slightly warmer but still subfreezing temperatures on January 5th. Pinellas County recorded sub-freezing temperatures for around 4 hours at the COOP site at Tarpon Springs in the northern part of the county where temperature fell to 28 degrees.

ntType=%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

Of the 18 FEMA-declared events in Pinellas County from 1953 until 2018, there have been 4 events that involved severe winter weather. These events all related to freezing and to a large degree focused on the overall impact to the local economy. Below is a table of the major disaster declarations related to severe winter weather as designated by FEMA.

Table 4.97: FEMA Major Disaster Declarations in Pinellas County, Winter Storm and Freeze, 1953–2018[146]

Disaster Number	Date	Name/Description
DR-526	January 31, 1977	SEVERE WINTER WEATHER – FREEZING
DR-851	December 23–25, 1989	SEVERE FREEZE
DR-982	March 12–16, 1993	TORNADOES, FLOODING, HIGH WINDS & TIDES, FREEZING
DR-1359	December 1, 2000–January 25, 2001	SEVERE FREEZE

According to the NCEI Storm Events Database, there were 9 reports of winter storm and freeze in Pinellas County from 2000 to 2018.[147] These winter storm and freeze events are only inclusive of those reported by NCEI from 1996 through 2018, and events are only reported at the county level. It is likely that additional events have affected Pinellas County. As additional local data becomes available, this hazard profile will be amended.

Table 4.98: Summary of Winter Storm and Freeze Occurrences in Pinellas County

Location	Number of Occurrences	Deaths	Injuries	Crop Damage (2019)*	Annualized Crop Loss
PINELLAS COUNTY TOTAL	**9**	**0**	**0**	**$1,406,428**	**$78,135**

*Adjusted dollar values were calculated based on the Consumer Price Index for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. This data represents changes in the prices of all goods and services purchased for consumption by urban households. This monthly index value has been calculated every year since 1913. The 2019 dollar values were calculated based on buying power in April 2019.

Table 4.99: Historical Winter Storm and Freeze Occurrences in Pinellas County

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
Pinellas County						
PINELLAS (ZONE)	12/31/2000	Frost/Freeze	0	0	$0	$0
PINELLAS (ZONE)	1/5/2001	Frost/Freeze	0	0	$0	$0

[146] https://www.fema.gov/media-library/assets/documents/28318
[147] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Cold%2FWind+Chill&eventType=%28Z%29+Extreme+Cold%2FWind+Chill&eventType=%28Z%29+Frost%2FFreeze&eventType=%28Z%29+Winter+Storm&eventType=%28Z%29+Winter+Weather&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

	Date	Type	Deaths	Injuries	Property Damage*	Crop Damage*
PINELLAS (ZONE)	1/24/2003	Extreme Cold/Wind Chill	0	0	$0	$1,406,428
PINELLAS (ZONE)	1/25/2003	Extreme Cold/Wind Chill	0	0	$0	$0
PINELLAS (ZONE)	1/3/2008	Cold/Wind Chill	0	0	$0	$0
PINELLAS (ZONE)	1/3/2008	Frost/Freeze	0	0	$0	$0
PINELLAS (ZONE)	10/28/2008	Cold/Wind Chill	0	0	$0	$0
PINELLAS (ZONE)	1/11/2010	Frost/Freeze	0	0	$0	$0
PINELLAS (ZONE)	1/4/2012	Frost/Freeze	0	0	$0	$0

*Damage is reported in 2019 dollars. All damage may not have been reported.

4. Probability of Future Occurrences of Winter Storm and Freeze

Based on the historical evidence, it is anticipated that a freeze is possible in Pinellas County. But there is no record of winter storm or winter weather events.

Probability Based on Historical Occurrences

An analysis of winter storm and freeze reports from 1996 to 2018 in Pinellas County from the NCEI Storm Events Database indicates that there will be approximately less than one cold/extreme cold/wind chill event and less than 1 frost/freeze event each year in Pinellas County.

Table 4.100: NCEI Winter Storm and Freeze Reports 1996–2018[148]

Type of Severe Storm	NCEI Reports	Average per Year
Cold/Extreme Cold/Wind Chill	4	< 1
Frost/Freeze	5	< 1
Winter Storm/Winter Weather	0	0
TOTAL	**9**	**< 1**

Based on historical information, this hazard was determined to have a probability level of possible (1 to 10% annual probability).

5. Winter Storm and Freeze Impact Analysis

All jurisdictions could receive the following impacts due to winter storm and freeze.

- Public

[148] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Cold%2FWind+Chill&eventType=%28Z%29+Extreme+Cold%2FWind+Chill&eventType=%28Z%29+Frost%2FFreeze&eventType=%28Z%29+Winter+Storm&eventType=%28Z%29+Winter+Weather&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

  - 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
  - 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, and 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Historical Losses

The NCEI Storm Events Database information, presented in the Historical Occurrences section above, also contained property and crop damage dollar amounts, which is shown in the table below.

Table 4.101: Winter Storm and Freeze Events in Pinellas County, by Type, (1996–2018)[149]

Type of Event	Number of Events	Deaths	Injuries	Property Damage (2019 dollars)	Crop Damage (2019 dollars)
Cold/Extreme Cold/Wind Chill	4	0	0	$0	$1,406,428
Frost/Freeze	5	0	0	$0	$0
Winter Storm/Winter Weather	0	0	0	$0	$0
TOTAL	**9**	**0**	**0**	**$0**	**$1,406,428**

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 4.102: NCEI Winter Storm and Freeze, 1996–2018

NCEI Storm Event (hazard)	Average Winter Storms and Freeze per Year	Annualized Property Loss (2019 dollars)	Annualized Crop Loss (2019 dollars)
All Types of Winter Storm and Freeze	< 1	$0	$78,135

According to the analysis, Pinellas County is historically vulnerable to $0 in property damages and approximately $78,135 in crop damages from less than one winter storm or freeze event each year.

[149] https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Cold%2FWind+Chill&eventType=%28Z%29+Extreme+Cold%2FWind+Chill&eventType=%28Z%29+Frost%2FFreeze&eventType=%28Z%29+Winter+Storm&eventType=%28Z%29+Winter+Weather&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=12&endDate_dd=31&endDate_yyyy=2018&county=PINELLAS%3A103&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Exposure

Since winter storm and freeze is a hazard that does not have geographically definable boundaries, it was excluded from spatial analysis through GIS. However, because winter storms and freeze are considered atmospheric, they have the potential to affect all buildings and all populations in Pinellas County.

Winter storms and freeze usually do not cause direct damage to structures in the county. And, although large-scale property damage is rare with these events, crop damage is much more likely and could significantly impact the local agriculture and livestock industry. However, Pinellas County is an urban county with almost no acreage devoted to agriculture.

Winter storm and freeze can also have several negative externalities including hypothermia, cost of snow and debris cleanup, business and government service interruption, traffic accidents, and power outages. Furthermore, citizens may resort to using inappropriate heating devices that could lead to fire or an accumulation of toxic fumes. The population most vulnerable to winter storm and freeze is the elderly population or those medically dependent upon power.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Winter storms and freeze can strike anywhere in Pinellas County; therefore, all of the county's critical facilities are equally vulnerable and at risk. However, winter storms and freeze usually do not cause direct structural damage to critical facilities. Winter storm and freeze impacts to structures, including to critical facilities, are listed above under Exposure.

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be low, with a PRI score of 2.1.

<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>Low</td></tr>
<tr><th>Probability</th><th>Impact</th><th>Spatial Extent</th><th>Warning Time</th><th>Duration</th><th>PRI Score</th></tr>
<tr><td>Possible</td><td>Minor</td><td>Large</td><td>> 24 hrs</td><td>< 1 week</td><td>2.1</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 experienced 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 4.103: 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 4.104: 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.

Potential Effect of Climate Change

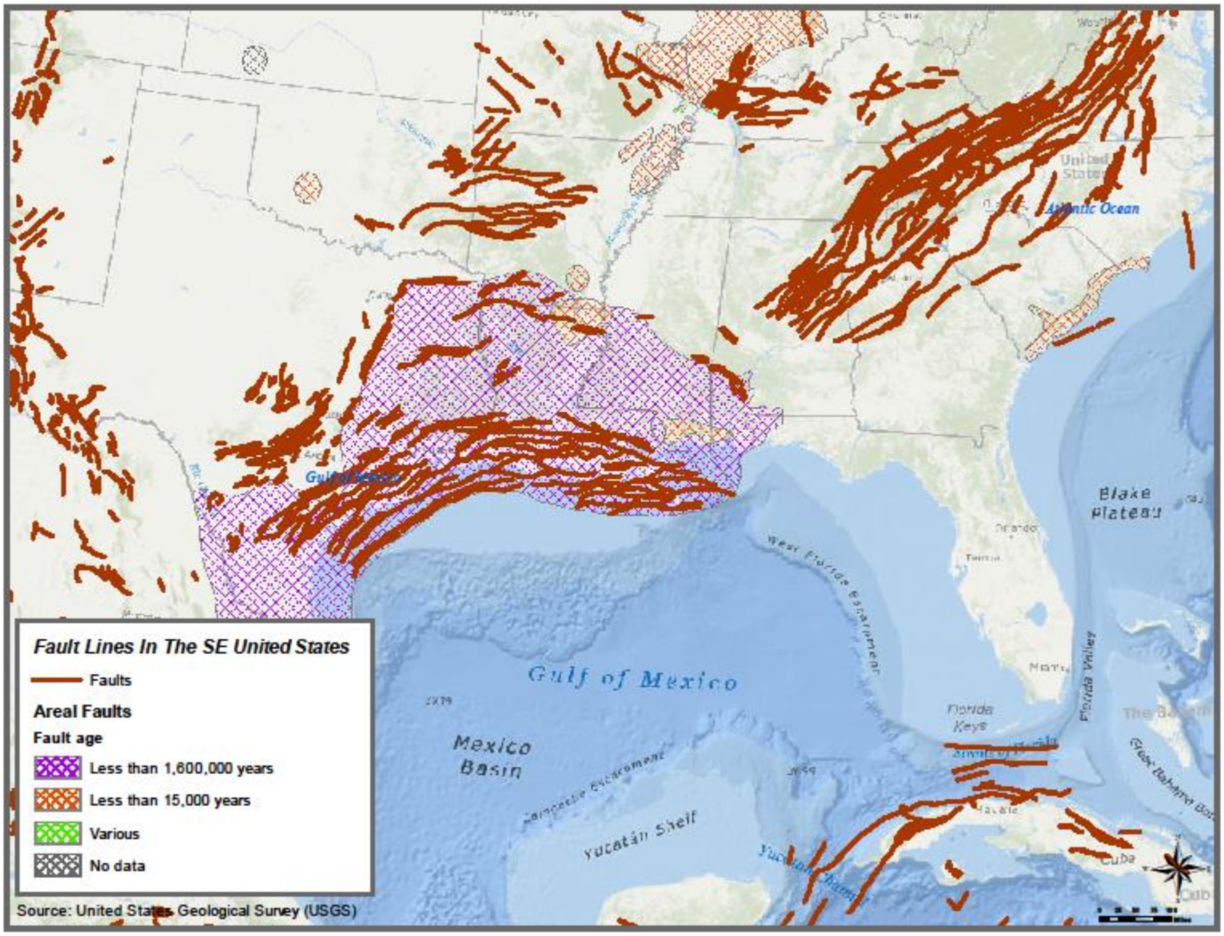
Climate change is not expected to affect the occurrence or magnitude of seismic events in Florida.

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 United States. The map shows that there are no known fault lines in Florida and that any seismic activity felt in Pinellas County is likely from the faults to the north, west, or south.

Figure 4.69: Southeast United States Fault Lines



3. Historical Occurrences of Seismic Events

Earthquakes are very rare in Florida and there are no significant recorded incidents in the state. Additionally, many of the reports of earthquakes from before technological advancements have no proof and the original reports are lost.

Table 4.105: 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.

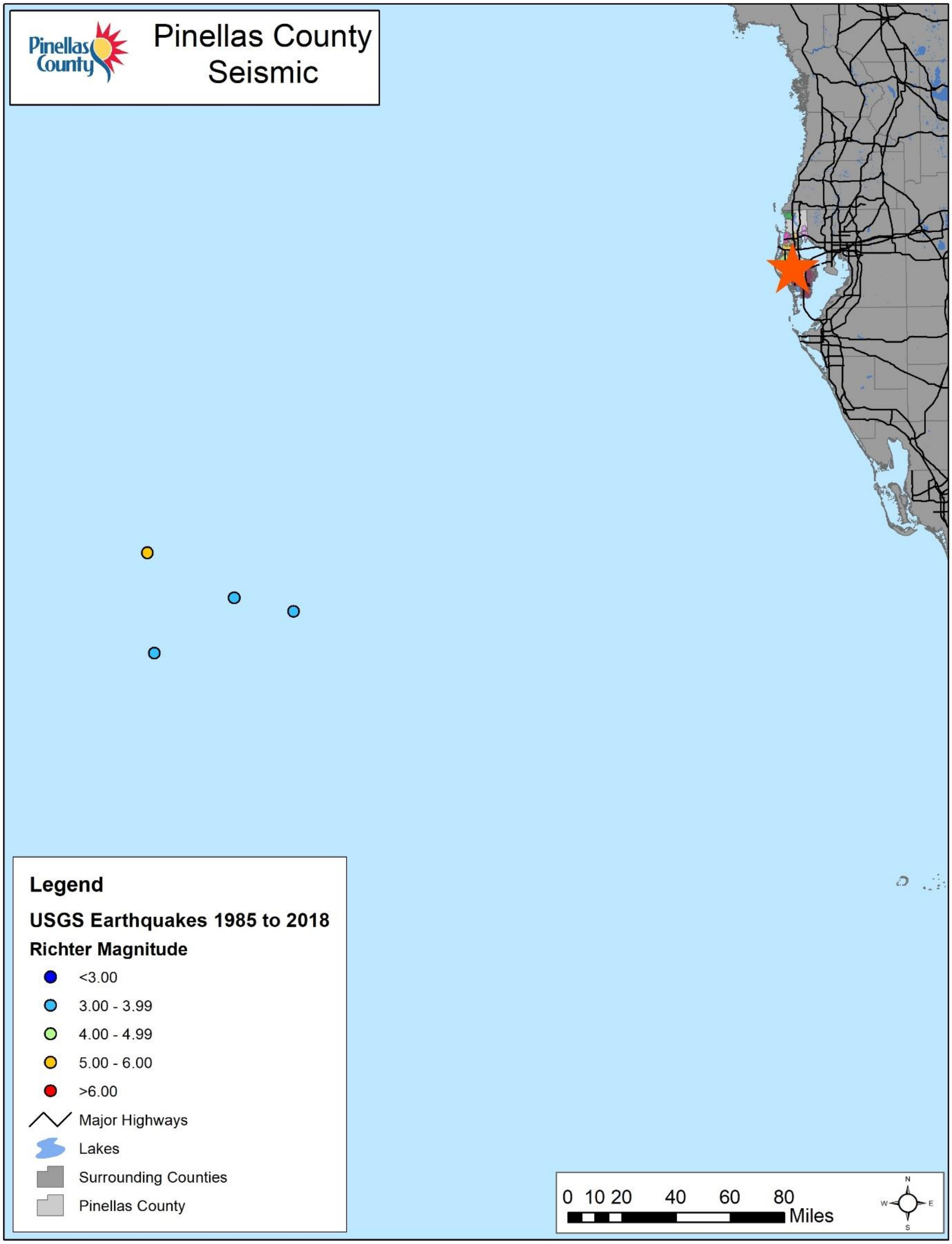
Date	Description
October 27, 1973	A shock was felt in Seminole, Volusia, Orange, and Brevard counties with a maximum intensity of MM V.
January 13, 1978	Two shocks were felt in Polk County, each lasting about 15 seconds and one minute apart. It rattled doors and windows, but there were no injuries or damages.
November 13, 1978	A shock was felt in northwest Florida. The seismic station estimated that it originated in the Atlantic Ocean.[150]
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.[151]
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 U.S. Navy.[152]

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 U.S. Navy.

The map below shows earthquakes with epicenters that occurred near Pinellas County between 1985 and 2018. No earthquakes occurred within the county boundaries during this period, but several did occur in the Gulf of Mexico.

[150] http://ufdc.ufl.edu/UF00001039/00001/13x
[151] http://publicfiles.dep.state.fl.us/FGS/FGS_Publications/Forum/forum_oct2006.pdf
[152] https://earthquake.usgs.gov/earthquakes/eventpage/us20006f8n#executive

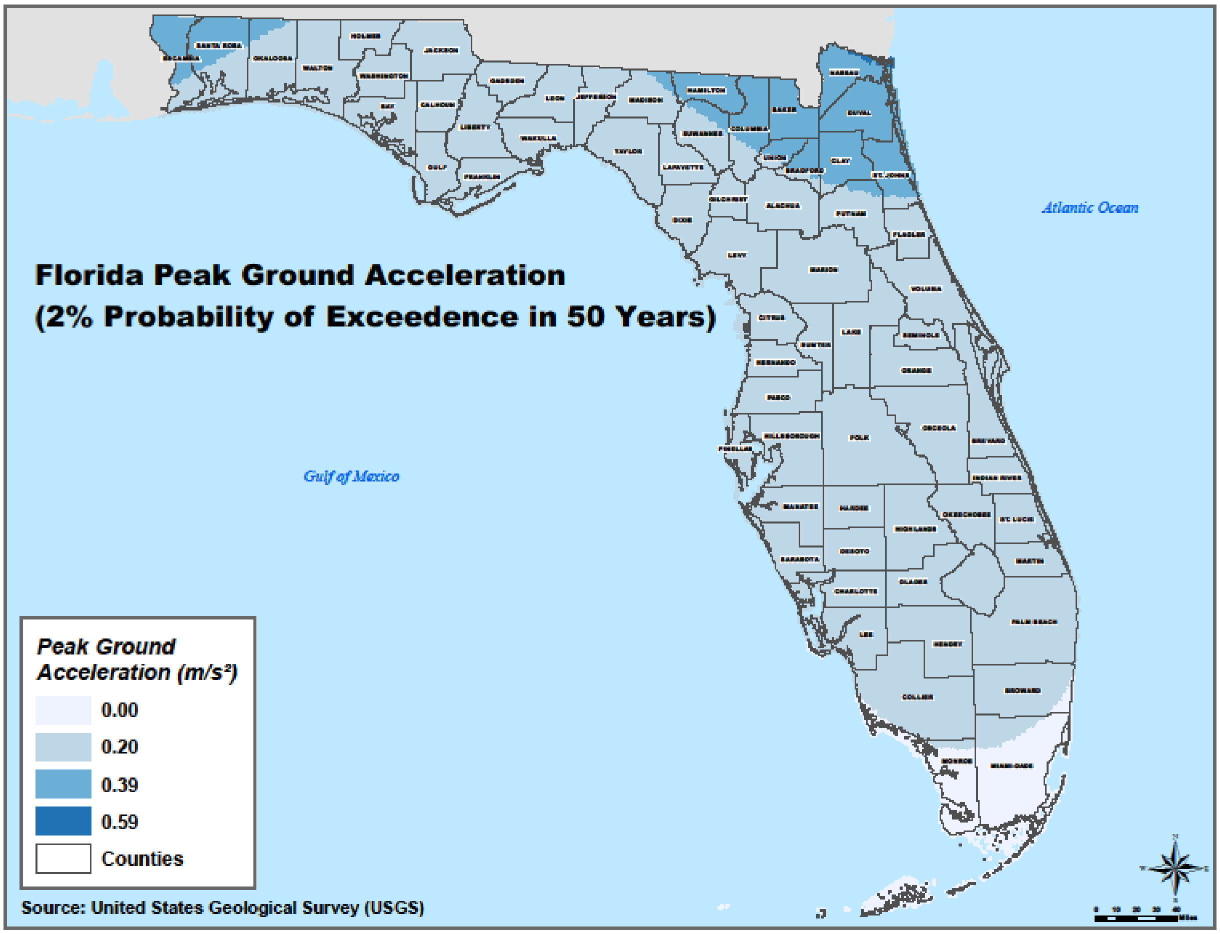
Figure 4.70: Historical Earthquake Epicenters, 1985–2018



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.

Figure 4.71: 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, including Pinellas County, would experience 0.20 m/s^2 peak ground acceleration in the event of an earthquake affecting Florida. 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.

Based on historical information, this hazard was determined to have a probability level of possible (1 to 10% annual probability).

5. Seismic Events Impact Analysis

All jurisdictions could receive the following impacts due to 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

According to the peak ground acceleration map above, Pinellas County has equally low vulnerability. But it is possible that the county may experience shaking during a future event centered near Florida.

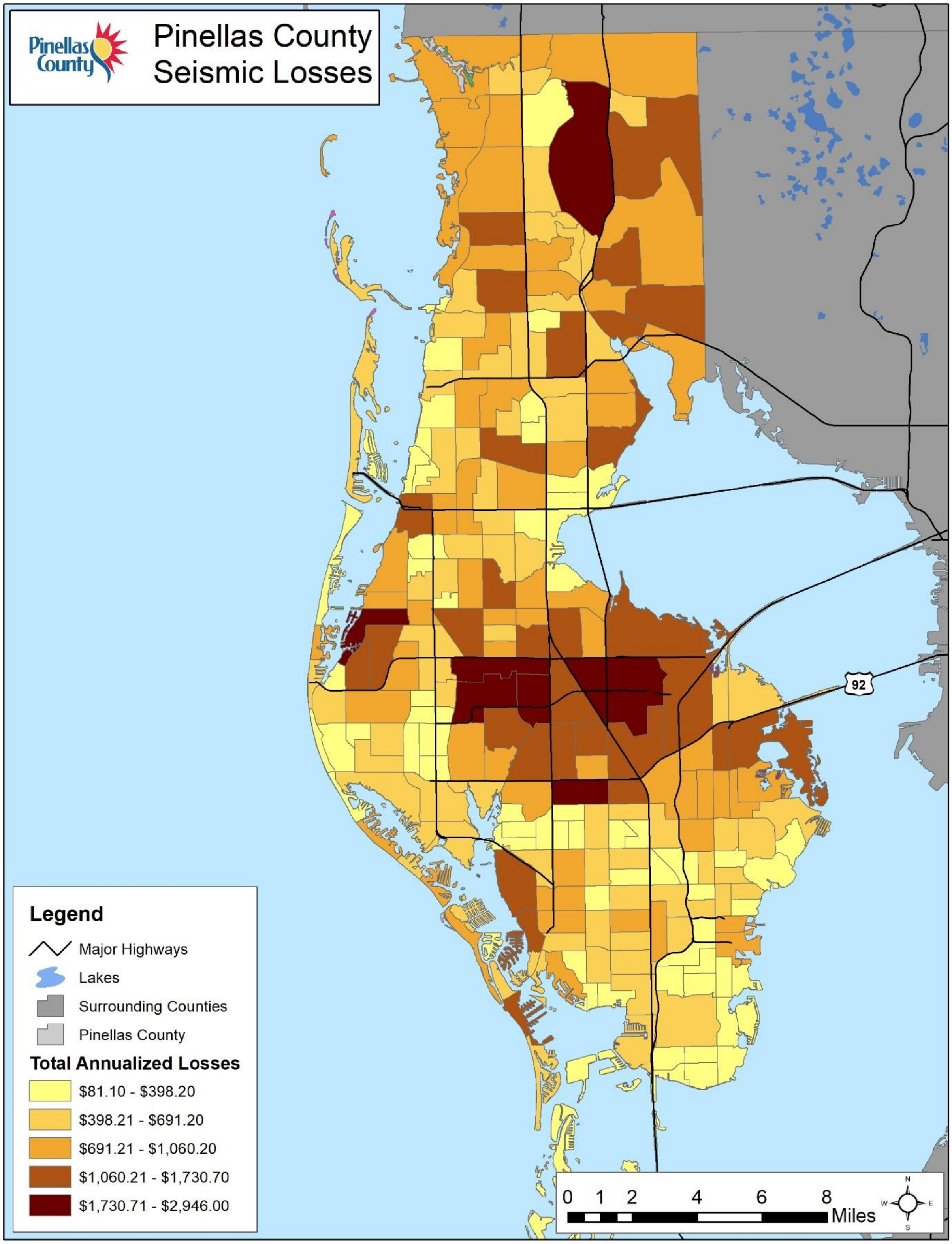
Hazus-MH

Hazus-MH was used to estimate the annualized loss for the county from a probabilistic earthquake scenario as shown below. Since the scenario is annualized, no building counts are provided. Losses reported include losses due to building damage (structural and non-structural), contents, inventory, relocation, capital, wages, and rental income.

Table 4.106: Estimated Annualized Loss for Probabilistic Earthquake Scenario

	Probabilistic Earthquake Scenario
Structural	$42,000
Non-Structural	$59,000
Contents	$8,000
Inventory	$0
Relocation	$31,000
Capital	$5,000
Wages	$7,000
Rental Income	$12,000
TOTAL LOSS	**$165,000**

Figure 4.72: Seismic Annualized Losses



7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Similar to the jurisdiction vulnerability and loss estimates, critical facilities have a low vulnerability to seismic events and there are minimal to no losses expected.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be low, with a PRI score of 2.0.

SEISMIC EVENTS					Overall Vulnerability
Overview					
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.					Low
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Possible	Minor	Moderate	< 6 hrs	< 6 hrs	2.0

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 hazard that is geologic in nature 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 waves can be as far as one hour apart.[153] 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.[154]

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:[155]

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[153] http://news.nationalgeographic.com/news/2007/04/070402-tsunami.html
[154] http://www.tsunami.gov/?page=tsunamiFAQ
[155] http://www.tsunami.gov/?page=tsunamiFAQ

- The National Tsunami Warning Center in Palmer, Alaska, serves the continental United States, Alaska, Puerto Rico, 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 Centers for Environmental Information (NCEI), formerly the 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.[156]

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, and little is known about their formation, but they may be caused by regularly spaced ocean swells that are magnified by currents or the atmosphere.

Potential Effect of Climate Change

Climate change is not expected to affect the occurrence of tsunamis in Florida.

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 United States have occurred along the coasts of California, Oregon, Washington, Alaska, and Hawaii.[157]

Overall, Florida has experienced few destructive tsunami or rogue wave events, but there were several small events.

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

[156] http://oceanservice.noaa.gov/facts/tsunami.html
[157] http://nws.weather.gov/nthmp/documents/GoM-Final01regionalAssessment.pdf

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, it has been concluded that all geographic areas of Florida that border the Atlantic Ocean or Gulf of Mexico, including Pinellas County, 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:[158]

- 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

A coastal event could impact any waterfront jurisdiction (23 of the 25 have some frontage). The cities of Kenneth City and Pinellas Park are inland and at higher elevations and thus would be less likely to see an impact.

3. Historical Occurrences of Tsunami

There have been four reported tsunami events in the history of Florida. However, all four of these tsunamis occurred on the Atlantic Coast. Below are the causes of these tsunamis.[159]

- 1 was caused by an Atlantic Coast earthquake
- 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, and Pinellas County, 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 was not 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

[158] http://www.rsmas.miami.edu/news-events/press-releases/2016/study-models-tsunami-risk-for-florida-and-cuba
[159] http://nws.weather.gov/nthmp/documents/Tsunami_Assessment_Final.pdf

1 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.[160]

4. Probability of Future Occurrences of Tsunami

Based on a historical analysis and the frequency of prior tsunami events from around the world, it can be concluded 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.[161]

Based on historical information, this hazard was determined to have a probability level of unlikely (less than 1% annual probability).

5. Tsunami Impact Analysis

All waterfront jurisdictions could receive the following impacts due to tsunami. The cities of Kenneth City and Pinellas Park are inland and at higher elevations and thus would be less likely to see an impact.

- 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
  - 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

[160] https://www.deseretnews.com/article/235629/ROGUE-WAVE-CRASHES-ASHORE-IN-FLORIDA.html
[161] http://dep.state.fl.us/geology/geologictopics/hazards/tsunamis.htm

6. Vulnerability Analysis and Loss Estimation by Jurisdiction

Exposure

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 areas of close proximity to the coast and more coastal development occurs.

Approximately 33% of the state's total 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.

Further analysis could not be conducted because, as explained above, tsunami data for Florida is not available because NOAA has not yet completed the models.

7. Vulnerability Analysis and Loss Estimation on Critical Facilities

As explained above, tsunami data for Florida is not available because NOAA has not yet completed the models. As such, the vulnerability of critical facilities could not be analyzed. However, it is possible that critical facilities located near the coast could potentially be impacted by a tsunami.

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be low, with a PRI score of 1.8.

TSUNAMI Overview					Overall Vulnerability
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.					**Low**
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Unlikely	**Limited**	**Small**	**< 6 hrs**	**< 6 hrs**	**1.8**

Red Tide Hazard Profile

1. Red Tide Description

The term red tide is commonly used to describe certain kinds of harmful algal blooms (HABs), a proliferation of a toxic or nuisance microalgal species. Not all red tides are red, and not all harmful algal blooms discolor the water. HABs can include both toxic and non-toxic species; however, all HABs have one important characteristic in common, they can negatively affect natural resources, local economies, and human health.[162]

Native to the Gulf of Mexico, *Karenia brevis* is a microscopic alga that blooms almost annually off the west coast of Florida and is the organism responsible for Florida red tide. Background concentrations of *K. brevis* are always present in the Gulf of Mexico ecosystem, and a Florida red tide is caused by an increase, or bloom, and higher-than-normal concentration. Nutrient enrichment of coastal waters can make blooms worse and longer lived.[163]

K. brevis does produce toxins, called brevetoxins, that can be mixed with airborne sea spray and have harmful effects on people, fish, marine mammals, and bids. People may experience varying degrees of eye, nose, and throat irritation. When a person leaves an area with a red tide, symptoms usually go away. People with severe or chronic respiratory conditions such as asthma or chronic lung disease are cautioned to avoid areas with active red tides. The blooms can also cause large fish kills, result in bird and marine animal deaths, and discolor water along the coast. Additionally, people who consume shellfish contaminated with toxins can suffer Neurotoxic Shellfish Poisoning (NSP); however, commercial shellfish beds are well monitored and there have been no NSP cases from consumption of regulated shellfish on the Florida coast.[164]

The table below describes the possible effects of *K. brevis* at various concentration levels.[165]

Table 4.107: Possible Effects of *K. brevis*

Description	*K. brevis* Abundance (cells/liter)	Possible Effects
NOT PRESENT-BACKGROUND	background levels of 1,000 cells/L or less	No effects anticipated
VERY LOW	> 1,000 - 10,000 cells/L	Possible respiratory irritation; shellfish harvesting closures when cell abundance equals or exceeds 5,000 cells/L

[162] https://myfwc.com/media/16370/2013-ecphab-brochure_red-tides-on-the-west-florida-shelf.pdf
[163] https://myfwc.com/media/16370/2013-ecphab-brochure_red-tides-on-the-west-florida-shelf.pdf
[164] http://www.pinellascounty.org/environment/watershed/red-tide.htm
[165] https://myfwc.com/research/redtide/statewide/

Description	*K. brevis* Abundance (cells/liter)	Possible Effects
LOW	> 10,000 - 100,000 cells/L	Respiratory irritation; shellfish harvesting closures; possible fish kills; probable detection of chlorophyll by satellites at upper range of cell abundance
MEDIUM	> 100,000 - 1,000,000 cells/L	Respiratory irritation; shellfish harvesting closures; probable fish kills; detection of surface chlorophyll by satellites
HIGH	> 1,000,000 cells/L	As above, plus water discoloration

Weekly red tide status updates are available from the Florida Fish and Wildfire Conservation Commission. These updates include current conditions, fish kills, and forecasts.[166] The map below is the status map for the week of June 20–27, 2019.

Figure 4.73: Statewide Red Tide Status Map, June 28, 2019

[166] https://myfwc.com/research/redtide/statewide/

While blooms are not a new phenomenon in this region, they have resulted in increased economic costs for the west coast of Florida. Coastal regions of Florida have experienced some of the most rapid population growth and development in the United States. Beach cleanups, tourism-related losses, medical expenses, and lost work days during red tide events can average over a million dollars lost annually.[167]

Potential Effect of Climate Change

Scientists predict that climate change will have many effects on freshwater and marine environments. These effects, along with nutrient pollution, might cause HABs to occur more often, in more waterbodies, and to be more intense.[168]

Harmful algae usually bloom during the summer season or when water temperatures are warmer than usual. Warmer water due to climate change might favor harmful algae in a number of ways:

- Warmer temperatures prevent water from mixing, allowing algae to grow thicker and faster.
- Warmer water is easier for small organisms to move through and allows algae to float to the surface faster.
- Algal blooms absorb sunlight, making water even warmer and promoting more blooms.

Other impacts related to climate change including more droughts which make freshwater saltier, higher levels of carbon dioxide in the air and water, changes in rainfall patterns that lead to alternating periods of drought and intense storms that cause more nutrient runoff into waterbodies, sea level rise that creates more shallow and stable costal water, and altered timing and intensity of coastal upwelling that delivers an excess of nutrients to the coast could all be factors that contribute to more blooms.

2. Geographic Areas Affected by Red Tide

Red tides vary greatly in size, expanding as far as 10,000 square miles, and can be present from the surface of the water to the sea floor.[169] Blooms occur most commonly in the area off Clearwater south to Fort Meyers. The map below illustrates the red tide events on the west coast of Florida from 1957 to 2012. Each red dot indicates a year when a bloom was observed.[170] Historically, Red Tide has not been observed much further north than the city of Clearwater, meaning Tarpon Springs is the only beachfront community on the gulf coast with a slightly lower likelihood than the other jurisdictions. Also, the inland communities of Kenneth City and Pinellas Park are not likely to be impacted directly.

[167] https://myfwc.com/media/16370/2013-ecphab-brochure_red-tides-on-the-west-florida-shelf.pdf
[168] https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms
[169] https://myfwc.com/research/redtide/faq/
[170] https://myfwc.com/media/16370/2013-ecphab-brochure_red-tides-on-the-west-florida-shelf.pdf

Figure 4.74: Historical Red Tide Events on West Coast of Florida, 1957–2012

3. Historical Occurrences of Red Tide

K. *brevis* blooms are not a new phenomenon on the west Florida shelf as ships' logs suggest bloom-related events (fish kills) dating back to the 1500s.[171] Blooms have occurred in all months of the year but are most common in the late summer and fall. The following table highlights historical red tide events that occurred in Florida over the past several years.

Table 4.108: Florida Historical Occurrences, Red Tide[172]

Date	Description
Winter 2001–Spring 2002	A large and lengthy dark water event began offshore of Charlotte Harbor in late 2001 and spread south to the Florida Keys by March 2002. During this time period, the area covered by dark water ranged from more than 1,200 square miles to almost 3,700 square miles. Nontoxic mat-forming diatoms were most abundant in the dark water, but a waning toxic red tide from the West Florida Shelf was also present. The co-occurring blooms combined with water containing colored dissolved organic matter from rivers to cause the dark color. Clockwise water circulation retained the dark water in early 2002, likely contributing to its size and duration.

[171] https://myfwc.com/media/16369/2013-ecohab-newsletter_red-tides-of-the-west-florida-shelf_science-and-management.pdf
[172] https://myfwc.com/media/18871/bloom-historic-database.pdf

Date	Description
March–April 2004	A dolphin mortality event was initially reported from St. Joseph Bay in northwest Florida on March 11 and 12, 2004. A limited number of dead fish and horseshoe crabs were also reported. By the end of April, dolphin mortalities totaled 107. Dolphin tissues contained elevated brevetoxin levels and trace amounts of domoic acid (significance of low levels of domoic acid in bottlenose dolphins is unknown).
2005	The 2005 bloom of *Karenia brevis*, the Florida red tide organism, was extensive and persistent, spanning more than 500 square miles and lasting nearly 13 months. This bloom killed fish, manatees, dolphins, and sea turtles. Shellfish harvesting areas were closed for more than a year because brevetoxins, the neurotoxins produced by *K. brevis*, had accumulated in clams and oysters. Additionally, separation of the water column into distinct layers trapped *K. brevis* in the bottom water layers between New Port Richey south to Sarasota, leading to deaths of bottom-dwelling animals. The bloom was first detected approximately 20 miles west of St. Petersburg in January 2005. During the next two weeks, the bloom moved rapidly inshore. *K. brevis* concentrations remained high in the nearshore region between St. Petersburg and Lee County's Sanibel Island through late March. By June 2005, the main patch of *K. brevis* spread from the Tampa Bay area and adjacent coastal waters northwest to the Florida-Alabama border. The bloom eventually ended in February 2006. As with most *K. brevis* blooms, fish kills were common; however, the extent and duration of this bloom resulted in severe effects on fish populations. Commercial fishing boats reported severe declines in catches. When FWRI researchers compared fish abundance during this period to that of the previous 10 years, they found population declines of juvenile spotted seatrout, sand seatrout, and red drum. Researchers also noted changes in the sand seatrout spawning aggregations in the Tampa Bay area. Unique to the 2005–2006 bloom was the widespread deaths of bottom-dwelling animals caused by oxygen depletion in bottom waters from New Port Richey south to Sarasota approximately 3 to 23 miles offshore. Researchers estimated the bloom affected bottom communities within a 2,162-square-mile area. During the first week of August 2005, diving and fishing charter businesses reported mass die-offs of fish and other reef animals. Reports also mentioned a smell similar to rotten eggs and divers' silver jewelry and coins turning black, conditions that indicate low oxygen concentrations. Researchers confirmed low dissolved oxygen in the affected areas. Organisms affected included fish (ranging from baitfish to goliath grouper), sponges, corals, worms, molluscs, crabs, sea urchins, starfish, and sea turtles. Bottom visibility was also considerably reduced. Several factors contributed to the widespread animal die-offs. First, the 2005–2006 bloom extended across a large area and persisted for a long period. Such blooms have greater effects than localized and short blooms. It was suggested that the 2004 hurricane season triggered pulses of groundwater release in offshore springs that provided substantial nutrients to the 2005 red tide bloom. Then, in summer 2005,

Date	Description
	the sun heated up coastal surface waters leading to a layering of warmer, less dense water over a cooler, denser layer near the bottom. This layering trapped red tide cells in the cooler bottom layer, where bottom-dwelling animals were present. Through time, bacterial decomposition of dead animals and *K. brevis* cells decreased oxygen concentrations to the point that low oxygen (hypoxia) and no oxygen (anoxia) near the bottom caused mass die-offs. The considerable temperature difference between the two water layers further prevented dissolved oxygen in surface layers from reaching the bottom, worsening the oxygen depletion. Fish killed on the surface by the red tide toxin may have also sunk to the bottom during decay, further reducing oxygen.
January 2006	The FWC's Fish and Wildlife Research Institute (FWRI) Fish Kill Hotline received reports of dead and dying aquatic animals, mainly fish, in the Garnier Bayou Area of Choctawhatchee Bay in the Florida Panhandle. Mortalities included gulf sturgeon, bay anchovies, skipjack shad, hickory shad, longnose gar, juvenile spot, lion's mane jellyfish, and blue crabs. Although no *Karenia brevis* cells were observed and only background levels of neurotoxic brevetoxins were present in water samples, dying fish from the affected areas behaved as if they had been exposed to brevetoxins and high concentrations of brevetoxins were found in the internal organs or multiple samples of fish which indicated toxin exposure. Based on the results of further testing, brevetoxin is considered the primary cause of the fish kills. These findings also indicate that a reservoir of brevetoxin from a previous bloom along the Florida Panhandle may have been present in Choctawhatchee Bay. This event exemplifies how effects from red tide can continue long after (weeks to months) a bloom has ended.
September 2007–January 2008	In September of 2007 through January 2008, a *Karenia brevis* bloom occurred on the northeast coast of Florida, but it was not the first time red tide had occurred in the Jacksonville area. In 1980, a *K. brevis* bloom moved inshore at Jacksonville via a warm water meander and was transported south along the coastline via inshore currents. Respiratory irritation and fish kills were reported. The last time a red tide occurred in the Jacksonville area was 1999. East Coast red tides usually persist for a month or less. The Gulf Stream System, which included the Loop and Florida Currents and the Gulf Stream, plays a major role in the distribution of red tide. Prevailing winds and currents can move blooms from offshore to inshore. When blooms are held inshore by winds and currents impacts to beach goers and coastal communities are more acute.
Winter 2011–Spring 2012	A dark water event began as phytoplankton bloom in the Gulf of Mexico north of Charlotte Harbor in Fall 2011. The dark water expanded and moved south, extending from the coast to the waters north of the Florida Keys by January 2012 and dissipating by April. The size of the dark water event covered, on average, about 500 square miles. The patches of dark water off southwest Florida contained relatively low concentrations of colored dissolved organic matter but high phytoplankton biomass, with varying concentrations of *Karenia brevis* (Florida red tide organism) and nontoxic mat-forming diatoms, which are microscopic phytoplankton with cell walls made of silica.
2017–2018	An unusually persistent harmful algal bloom (red tide) affected portions of the coasts of Florida between 2017 and 2018, dissipating in the winter of 2018/2019. It

Date	Description
	persisted on the southwest coast beginning in October 2017 and spread to the Panhandle and the east coast of Florida. This red tide resulted in serious impacts to fish, marine mammals, marine birds, residents, and coastal businesses. Many beaches had dead fish, odor, and poor air quality.[173] The 2017–2018 red tide had severe economic impacts on businesses in Pinellas County. Economic costs are associated with four main sectors: recreation and tourism, commercial fisheries, public health, and monitoring and management costs. As of September 2018, 738 tons of red tide debris, such as dead marine life, had been collected in the county and 40 businesses had reported more than $128 million in losses.[174]

The table below provides a record of the red tides that have occurred off Florida's West Coast from 1878 to 2019 according to the Florida Fish and Wildfire Conservation Commission.

Table 4.109: Red Tides off Florida West Coast, 1878–2019[175]

Red Tide (MEDIUM levels or greater; >100,000 cells/L)
Suspected continuance of red tide not confirmed by water sample

Year	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1878												
1879	Reports of fish kills; no duration											
1880												
1882												
1883	Reports of fish kills; no duration											
1884	Reports of fish kills; no duration											
1885												
1908	Reports of fish kills; no duration											
1916												
1935	Reports of fish kills; no duration											
1946												
1947												
1948	Reports of fish kills; no duration											
1952												
1953												
1954												

[173] https://oceanservice.noaa.gov/news/redtide-florida/
[174] https://www.wtsp.com/article/news/red-tide/economic-impacts-of-red-tide-on-businesses-in-pinellas-county-worse-than-expected/67-598909555
[175] https://myfwc.com/media/18871/bloom-historic-database.pdf

Year	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1955												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1966												
1967												
1968												
1970												
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Year	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014												
2015												
2016												
2017												
2018												
2019												

4. Probability of Future Occurrences of Red Tide

Florida red tides are not uncommon and occur almost annually in the Gulf of Mexico.

Based on historical information, this hazard was determined to have a probability level of likely (between 10 and 100% annual probability) for the jurisdictions along the coast and Tampa Bay. The inland jurisdictions of Kenneth City and Pinellas Park have no probability of red tide but could potentially have residents impacted by air quality or indirect economic losses.

5. Red Tide Impact Analysis

The jurisdictions along the coast and Tampa Bay could receive the following impacts due to red tide. The inland jurisdictions of Kenneth City and Pinellas Park could potentially have residents impacted by air quality or indirect economic losses.

- Public
  - Human health impacts from exposure to brevetoxins
    - Eye, nose, throat, and respiratory irritation (coughing, sneezing, and tearing)
    - Asthma attacks or chronic pulmonary symptoms
    - Skin and eye irritation, including itching, burning, and rashes, from contact with water or sea foam
    - Nausea, vomiting, diarrhea, abdominal pain, and, in rare cases, acute liver failure from coming in contact with algae or swallowing water

        - Neurotoxin Shellfish Poisoning (NSP) if brevetoxin-laden shellfish (oysters, clams) are consumed – results in rapid onset of gastrointestinal symptoms and/or neurological symptoms but no fatalities have been attributed to NSP to date

- Responders
    - Human health impacts from exposure to brevetoxins
        - Eye, nose, throat, and respiratory irritation (coughing, sneezing, and tearing)
        - Asthma attacks or chronic pulmonary symptoms
        - Skin and eye irritation, including itching, burning, and rashes, from contact with water or sea foam
        - Nausea, vomiting, diarrhea, abdominal pain, and, in rare cases, acute liver failure from coming in contact with algae or swallowing water
- Continuity of Operations (including continued delivery of services)
    - Unlikely to cause interruptions to operations
- Property, Facilities, Infrastructure
    - Unlikely to impact property, facilities, and infrastructure
- Environment
    - Inhalation, direct contact, or ingestion of brevetoxins in high concentration can harm and kill fish, birds, turtles, and marine mammals
    - Toxic ocean waters
    - Depletion of oxygen in the ocean, can cause a dead zone
- Economic Condition
    - Negative impacts to recreation and tourism industries and local businesses
    - Sale losses for commercial fisheries and aquaculture industry
    - Health costs attributed to medical expenses
    - Lost work days associated with respiratory illness
    - Clean-up costs associated with disposal of dead fish and marine life
- Public Confidence in Jurisdiction's Governance
    - Lost confidence in ability to keep beaches open and safe as well as clean-up, monitoring, and management efforts
    - Tourists may reconsider visiting Florida

6. Vulnerability Analysis and Loss Estimation by Jurisdiction

Exposure

Since red tide is a hazard that does not have geographically definable boundaries, it was excluded from spatial analysis through GIS. Furthermore, red tide does not result in damage to the built environment and does not have the potential to affect any buildings in Pinellas County.

Although red tide does not cause damage to the built environment, it does have the potential to affect people, fish, marine mammals, and birds. Red tide can result in varying levels of eye and respiratory irritation for people, which may be more severe for those with preexisting respiratory conditions (such as asthma). The blooms can also cause large fish kills and discolored water along the coast.

Florida's tourism-related businesses are also particularly affected by red tide blooms as dead marine animals wash ashore and public health advisories are posted for beach activities and shellfish consumption during a bloom. The damage to the food chain and the respiratory pollution caused by the smell of large amounts of decomposing marine life discourages tourism and is harmful to the fishing industry. Shellfish borne illness, respiratory problems, and the decline in hotel stays and holiday rentals have significant cumulative direct and indirect impacts on the Florida economy.

7. Vulnerability Analysis and Loss Estimation on Critical Facilities

Because red tide does not result in damage to the built environment, it does not have the potential to affect any of the county critical facilities.

All of the critical facilities and their associated risk can be found in Appendix B.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.4.

RED TIDE					Overall Vulnerability
Overview					
The term red tide is commonly used to describe certain kinds of harmful algal blooms (HABs), a proliferation of a toxic or nuisance microalgal species. Not all algal blooms are red, and not all harmful algal blooms discolor the water. HABs can include both toxic and non-toxic species; however, all HABs have one important characteristic in common, they can negatively affect natural resources, local economies, and human health.					MODERATE
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Likely	Limited	Small	> 24 hrs	> 1 week	2.4

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:[176]

- 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.

[176] https://www.dhs.gov/sites/default/files/publications/nipp-ssp-transportation-systems-2015-508.pdf

Figure 4.75: Pinellas County Corridor Map

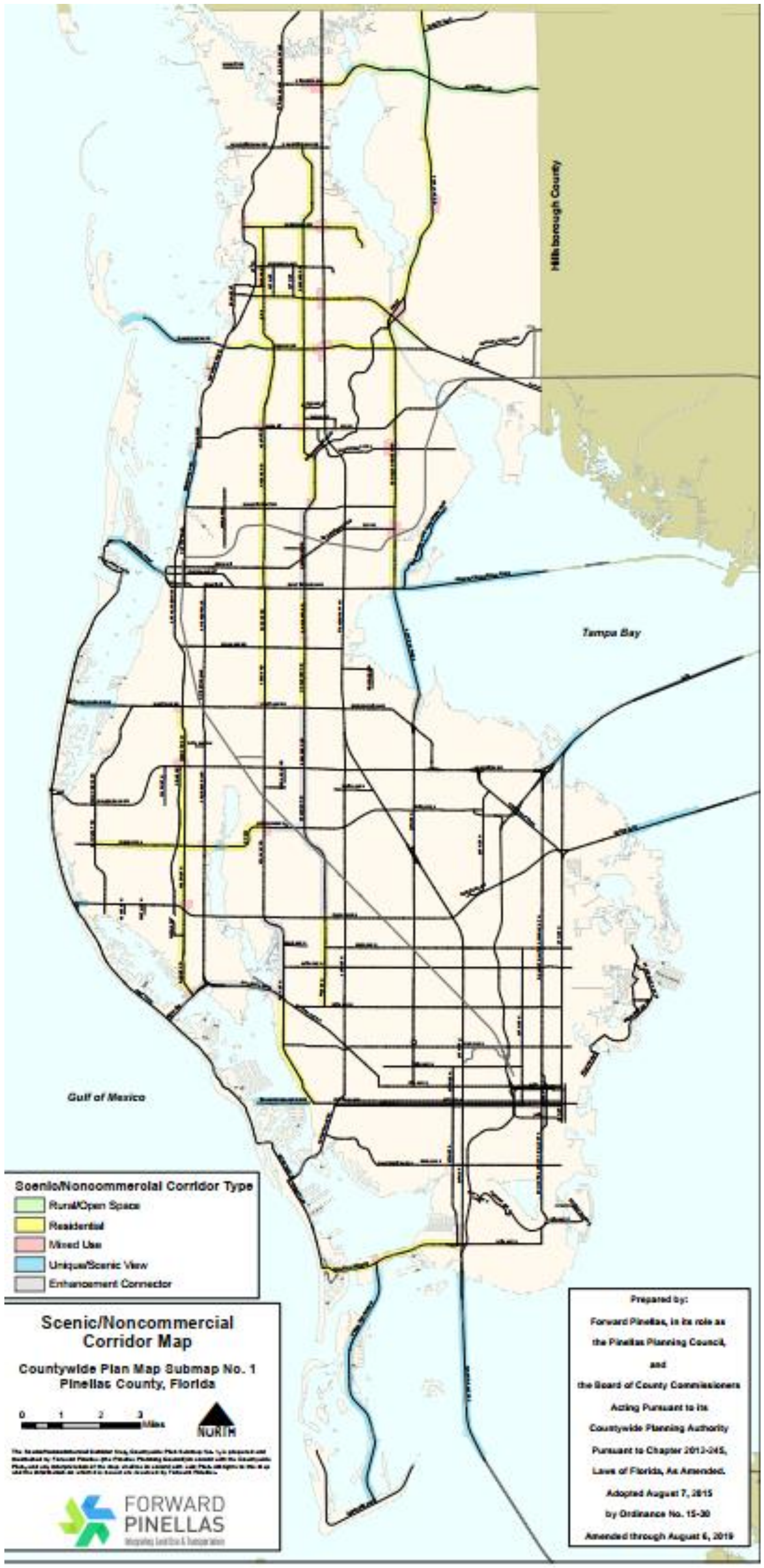
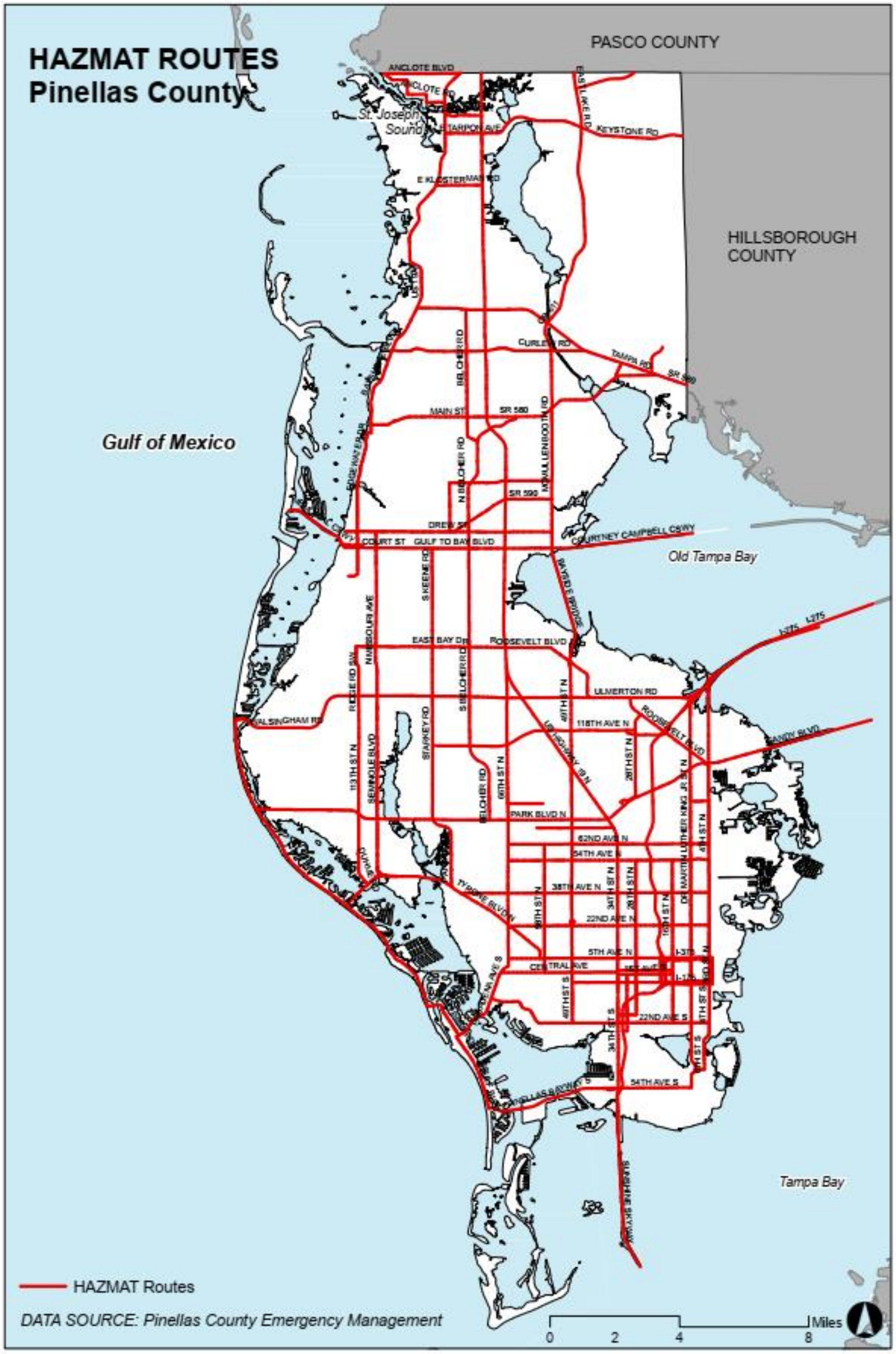


Figure 4.76: Pinellas County HAZMAT Route Map



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.

Risks to critical transportation infrastructure include natural disasters as well as man-made 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 11, 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 Hazard Profile*.

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 Pinellas County 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.

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

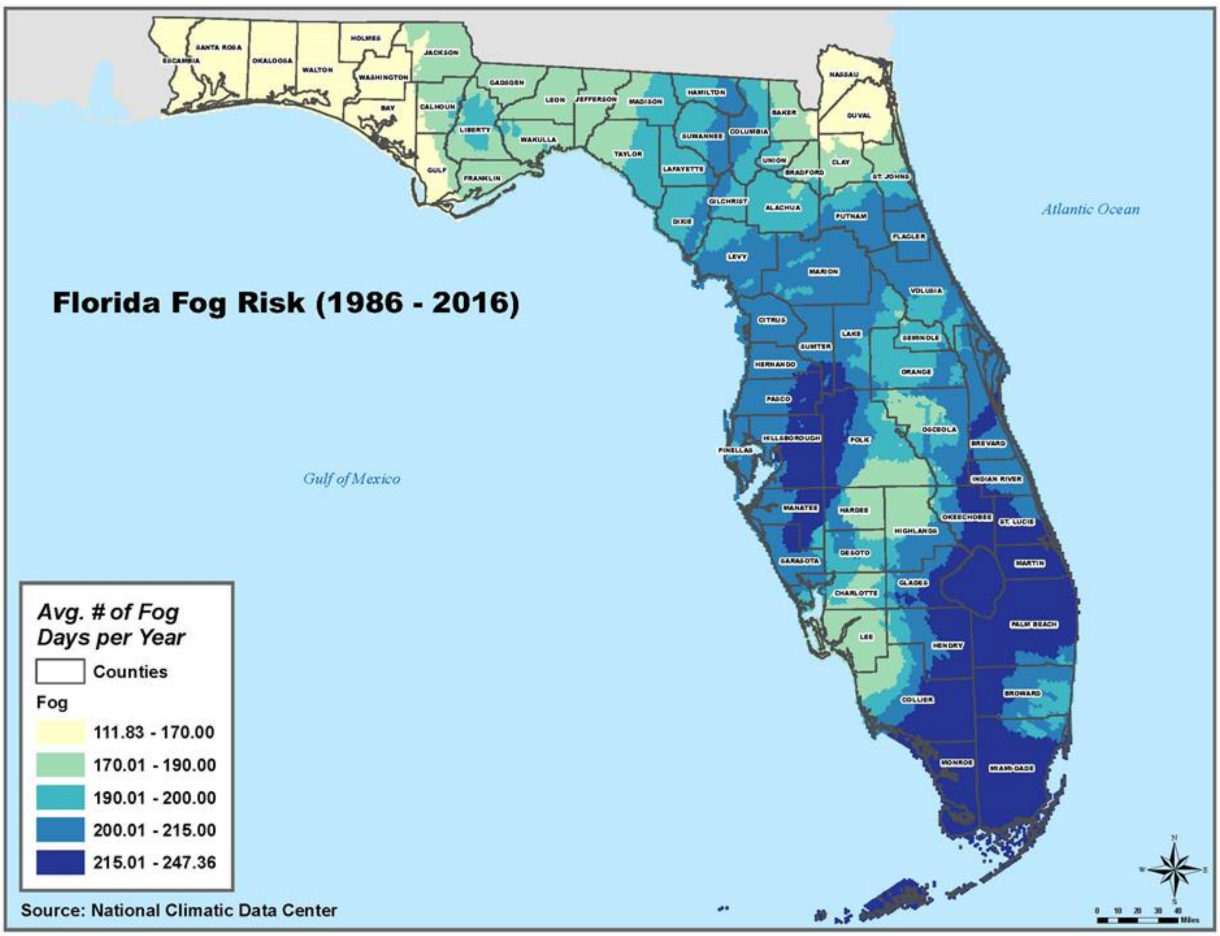
Fog is a cloud form at the surface of the earth made of tiny water droplets suspended in the air. The greatest problem with fog is visibility. Heavy fog is defined as visibility below one quarter of a mile. A

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.[177]

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 one 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 4.77: Florida Fog Risk, 1986–2016



177 http://www.nws.noaa.gov/om/fog/ww.shtml

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 have cascading impacts to passenger and freight movement as well as potentially large-scale impacts such as supply chain disruption.[178]

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 private 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 Incident Hazard Profile*.

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:[179]

- 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

[178] http://knowledge.wharton.upenn.edu/article/americas-aging-infrastructure-what-to-fix-and-who-will-pay/
[179] http://www.fdot.gov/info/moredot/mvv.shtm

- 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 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.[180]

Locally, Forward Pinellas serves to provide transportation plans that provide viable mobility options and sustainable development patterns. The transportation system internal to Pinellas County is part of a larger regional multimodal transportation system serving the Tampa Bay area. Regional connections in Pinellas serve a vital role for business, tourism, and the mobility of the county's residents and goods. The regional connections in Pinellas are critical for all modes of travel, including personal vehicles, freight, public transportation, multiuse trails, and waterborne transportation.[181]

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.

Pinellas County has one commercial airport, St. Petersburg-Clearwater International Airport, and two general aviation airports, Albert Whitted Municipal Airport and Clearwater Airpark. St. Petersburg-Clearwater International Airport and its tenants currently employ a total of 1369 people on site. As of the end of 2018, its annual economic impact was estimated to be $1.04 Billion. In 2018 a total of 2,237,446 domestic and international passengers and zero tons of air cargo traveled through the airport. An estimated 134,906 aircraft operations (take off and landings) occurred at the facility.

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

[180] http://www.fdot.gov/planning/sis/about.shtm
[181] http://forwardpinellas.org/the-way-you-move/regional-transportation/

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.[182] 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.[183]

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.[184]

Florida is also a premier aerospace and space flight location and is a top state for aerospace manufacturing. Pinellas aerospace companies excel in areas from aircraft parts and assembly to intelligence, and surveillance and reconnaissance. Florida also offers tremendous space launch assets. Florida has 2 spaceports and conducted 17 spaceport launches in 2015.[185]

Highway and Motor Carrier

This mode of transportation includes highways, roadways, bridges, trucks, commercial freight vehicles, motor coaches, and school buses.[186] 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.[187] Pinellas County has 4,521 miles of roadway and 142 bridges.[188] Consequently, today's roadways are dangerously overcrowded, turning the focus to identifying serious roadway hazards.

Accidents are the highest risk on roadways, and according to the Florida Department of Highway Safety and Motor Vehicles, there were 374,342 accidents with 2,939 fatalities in 2015.[189] 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 materials are routinely transported along Pinellas'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*

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182 http://www.bne.com.au
183 http://www.fdot.gov/aviation/planning.shtm
184 http://www.fdot.gov/aviation/pdfs/Welcome%20to%20Fl%20Aviation112010.pdf
185 https://www.nasa.gov/
186 http://www.floridatransportationindicators.org/index.php?chart=13d
187 http://www.fdot.gov/planning/fastfacts.pdf
188 http://www.pinellascounty.org/facts.htm
189 https://flhsmv.gov/pdf/crashreports/crash_facts_2015.pdf

Incident Hazard Profile. Pinellas's 142 bridges within the County can malfunction or be degraded to the point of structural instability, causing not only roadway hazards but waterway hazards as well.[190]

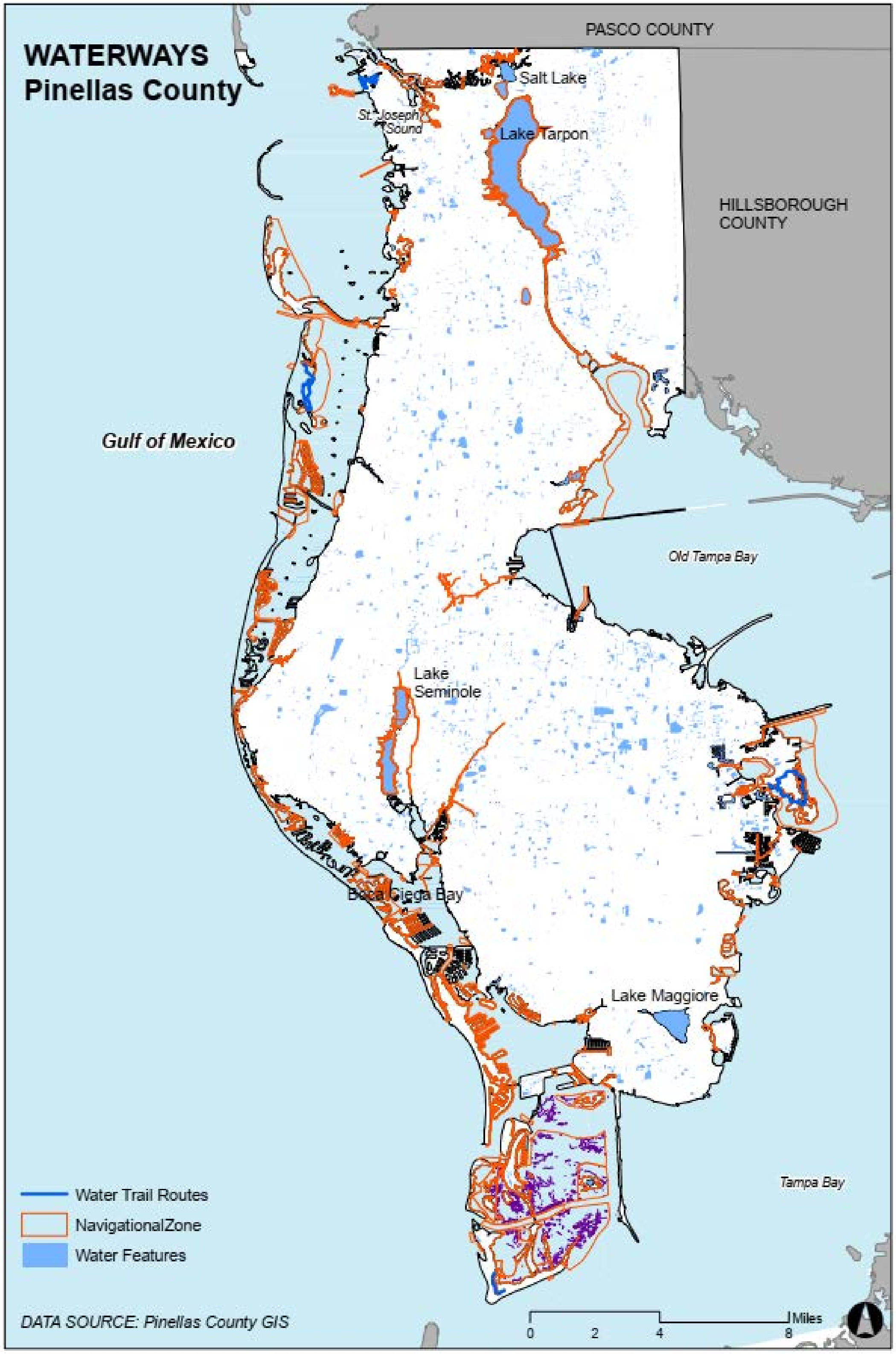
Good, efficient roads make commuting feasible; however, aging roads can lead to hazards and accidents. The Federal Highway Administration's most recent survey points out that almost 20% of U.S. roads are in poor condition. This includes roads and bridges that need to be repaved, are crumbling, or have significant damage.[191]

Maritime

Florida has a total water area of 4,308 square miles with more than 11,000 miles of rivers, streams, and waterways.[192] The state has 1,197 statute miles of coastline and 2,276 statute miles of tidal shorelines. This includes 825 miles of beaches. Pinellas County is a peninsula with nearly 588 miles of coastline. There are 35 miles of sandy beaches on 11 barrier islands. There is also one seaport, the Port of St. Petersburg. The map below shows Pinellas County's waterways.[193]

[190] http://www.smartmotorist.com/traffic-and-safety-guideline/roadway-hazards.html
[191] https://www.fhwa.dot.gov/
[192] http://geology.com/lakes-rivers-water/florida.shtml
[193] http://www.stateofflorida.com/facts.aspx

Figure 4.78: Pinellas County Waterways



FDOT and The Maritime Administration (MARAD), along with Customs and Border Patrol (CBP),[194] 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.

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.[195]

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.[196] Florida has a complex public transportation network with over 270 million public transit riders within the state annually.[197] 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 is a nonprofit association whose members include every major public transit agency in Florida as well as interested citizens and businesses.[198]

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.[199]

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.[200]

[194] https://www.cbp.gov/
[195] http://myfwc.com/
[196] https://www.dhs.gov/transportation-systems-sector
[197] http://www.fdot.gov/planning/fastfacts.pdf
[198] https://floridatransit.org/about-us
[199] https://www.fra.dot.gov/Page/P0002
[200] http://www.fdot.gov/rail/PlanDevel/Documents/FinalInvestmentElement/G-Chapter2-FreightRail.pdf

Florida also has an extensive bus system with over 60,000 registered buses throughout the state.[201] 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.

The Pinellas Suncoast Transit Authority (PSTA) is the county public transit provider with 210 Transit vehicles on 40 routes, including 2 express routes to Hillsborough County. Total ridership in fiscal year 2019 was 12.1 million annually; 38,711 daily.[202]

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.[203] There are a total of 34,019 miles of pipeline within Florida:[204]

- 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

Clearwater Gas and TECO Peoples Gas are the two providers for Pinellas County.

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.[205]

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

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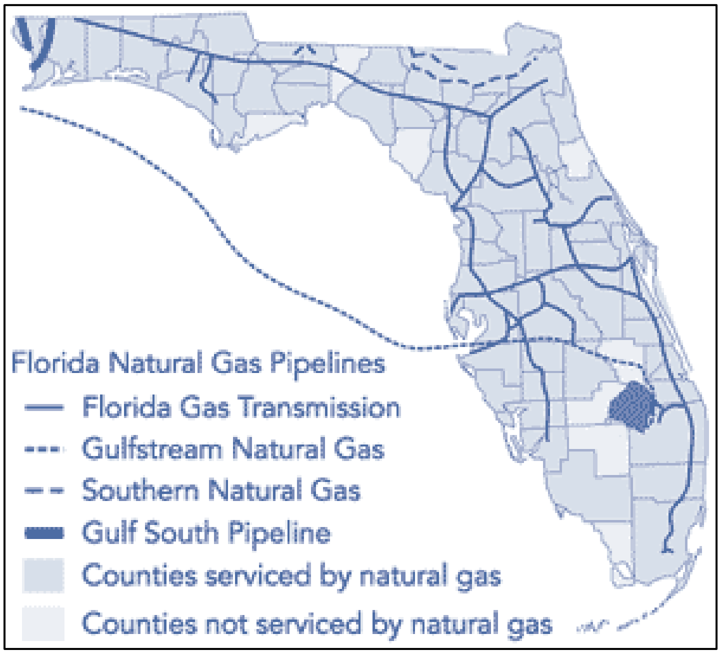
[201] https://www.statista.com/statistics/196342/total-number-of-registered-buses-in-the-united-states-by-state/
[202] https://www.psta.net/about-psta/history-and-facts/
[203] http://hazardmitigation.calema.ca.gov/plan/state_multi-hazard_mitigation_plan_shmp
[204] http://www.fdot.gov/planning/fastfacts.pdf
[205] https://s3images.americangeosciences.org/agi/statefactsheets/FL_GeoscienceInYourState_AGI.pdf

hazardous substances. For more information on pipelines, also see the *Hazardous Materials Incident Hazard Profile*. The map below shows the major pipelines and the companies that own them.

Figure 4.79: Florida Natural Gas Pipelines

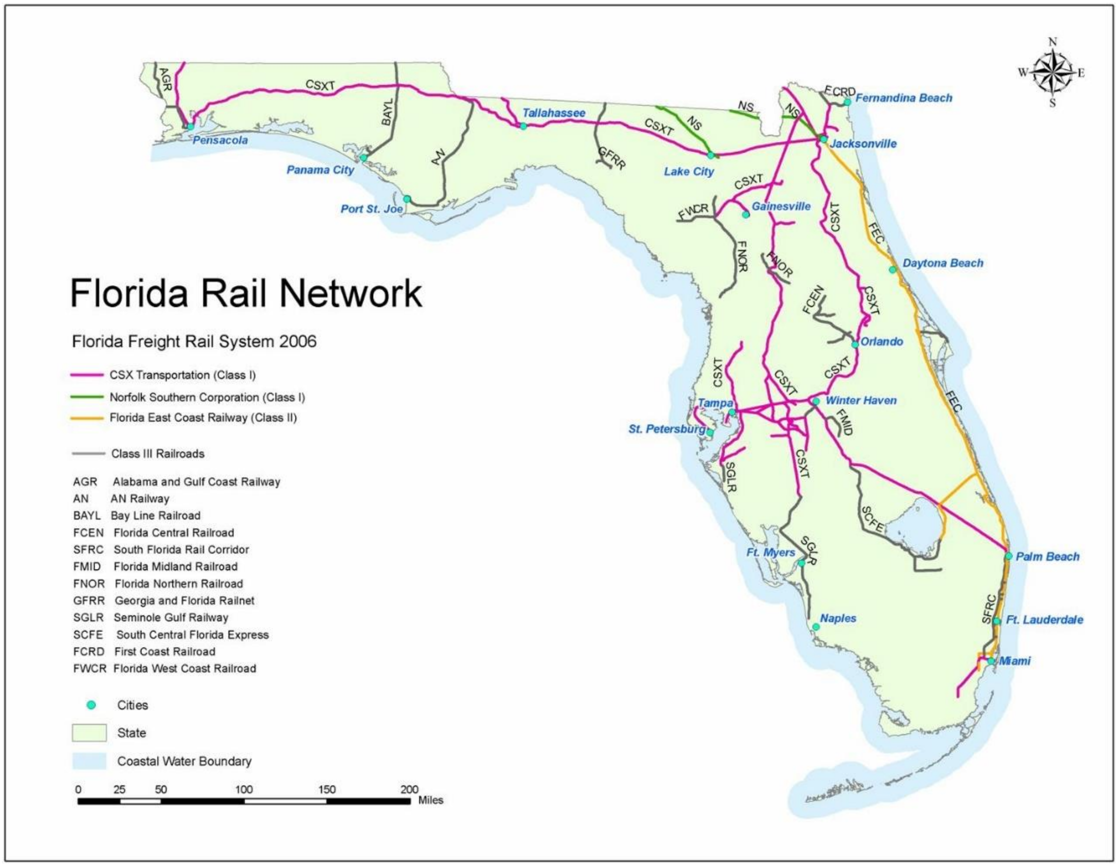


Freight Rail

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, 805,260 intermodal units (trailers and containers), and 119 million tons of freight, effectively removing almost 6 million heavy trucks from the roadways. The map below shows the freight rail companies in the state.

Figure 4.80: Florida Freight Rail Network



CSX Transportation (CSXT) is the only operator of a railroad system in Pinellas County, which is only freight. There is one set of tracks with 97 crossings, of which 63 have gates. The Federal Railroad Administration reports that there were four railroad incidents on CSXT facilities in the last 20 years. Two were minor accidents at railroad crossings and two were a track defect causing a minor derailment. The last incident occurred at the Tampa Port. There were no injuries or fatalities in any cases.

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. Pinellas County has not produced elemental phosphorous since 1981.[206]

[206] https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=5045&context=etd

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.[207]

Table 4.110: 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 County. 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 County is at risk for transportation hazards. Areas surrounding the airports and ports are even more susceptible. These hazards also involve the transportation of hazardous materials which carry their own risks and can be found in the *Hazardous Materials Incident Hazard Profile*. Five major roadway corridors service the County from the north, east, and south. Marine delivery routes border the county on the east, south, and west. One main railroad corridor services the county. Thus, the county is vulnerable to a transportation accident.

Aviation

The crash of a large passenger aircraft into a densely populated area in either St. Petersburg or Pinellas Park represents the maximum threat in the southern portion of the County. In the north,

[207] https://ntl.bts.gov/lib/52000/52800/52855/Transportation_System_Resilience_Extreme_Weather_and_Climate_Change.pdf

the same situation exists if a large aircraft would crash in Safety Harbor, or striking the Countryside High School, during a school day. In either case, the crash would threaten 50 to 100 homes and 200-400 people. The crash of a large aircraft into Countryside High School would place over 2,700 staff and students at risk. In this situation, it is expected that fatalities and injuries would be extremely high.

Railroad/Waterway Incidents

An incident such as the MV Summit Venture in 1980 which struck the Skyway Bridge represents a serious threat impacting the transportation infrastructure (highway and port) and economy as well as injuries and loss of life. A derailment of a rail car carrying hazardous materials could also pose a significant threat to local neighborhoods and major transportation facilities.

Hazardous Materials (Fixed Facilities)

The largest threat is from Brenntag Mid-South, a facility that stores approximately 1.25 million pounds of chlorine (maximum) on site. The chlorine is repackaged at the facility into containers of various sizes, contributing to the possibility for a leak or other release to occur. The facility is located in the center of the County. A release of the worst case would be the failure of one of the largest containers, on a day with high humidity, little to no wind, and during tourist season. This would be an 180,000 pound (one rail car) release at 1.0 miles per hour wind speed, atmospheric stability class D that would generate a vulnerability zone of at least a 10 mile radius from the site. The potential number of citizens affected by this incident could be well over 500,000 persons, depending on time of day and year.

Hazardous Materials (Transportation)

Rail deliveries of chlorine to Clearwater pose the largest threat.
The threat would exactly duplicate the **Hazardous Materials (fixed facility)** scenario above, except that the location would be unknown. This incident could occur at any point along the rail delivery corridor throughout the northern half of the county.

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 Pinellas County.

Between the years 2016 through 2018, there have been ninety-three aircraft emergencies at St. Petersburg-Clearwater International Airport, thirteen at Albert Whitted Airport, and six at Clearwater Executive Airport.

The following are significant historical waterway accidents in the waterways in/near Pinellas County:

- January 28, 1980: USCGC *Blackthorn*, a 180-foot seagoing buoy tender, and the tanker SS *Capricorn* collided near the Sunshine Skyway Bridge. The *Blackthorn* capsized and sank, killing 23 of her crew.

- May 9, 1980: The freighter MV *Summit Venture* collided with a support column of the Sunshine Skyway in a thunderstorm, causing a section of the bridge to collapse. Six cars, a truck, and a passenger bus fell into the water, killing 35 people.

- August 10, 1993: Two fuel barges and a phosphate freighter collided near the entrance to Tampa Bay, causing a spill of about 330,000 gallons of heavy fuel oil and 32,000 gallons of jet fuel, diesel, and gasoline

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 County 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 have a probability level of possible (1 to 10% annual probability).

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
  - 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

Due to the nature and unpredictability of technological hazards, all property and infrastructure in the County is at risk to these events. Due to the significant tourism in the County all of the municipalities are at risk. Pinellas is at a higher risk with large transportation hubs especially within the metropolitan area of Tampa such as the airports, port, and cruise terminal.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Due to the nature and unpredictability of technological hazards, all property and infrastructure in the County are at risk to these events. Large transportation hubs such as airports or ports are at a higher risk.

The County recognizes that critical 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.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 2.8.

TRANSPORTATION INCIDENTS					Overall Vulnerability
Overview					
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. Pinellas County 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.					**HIGH**
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Possible	**Critical**	**Moderate**	**<6 hours**	**< 1 week**	**2.8**

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 is 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.[208]

Cyber threat refers to the possibility of a malicious attempt to damage or disrupt a computer network or system.[209] 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.[210]

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.[211] 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.[212]

<u>Cyberattacks</u>

Some cyber incidents are cyberattacks, 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

[208] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.7–2.8
[209] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.4
[210] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.4
[211] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 1.25
[212] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.4

a potential target. The goal of a cyberattack 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.[213]

Malware

Cyberattacks 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.[214]

Methods

Attackers use several methods to complete their goals. The following will be discussed here: social engineering, botnets, denial-of-service (DoS) attacks, zero-day exploits, web-based attacks, malicious insider attacks, 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 cybersecurity 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.[215]

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 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.[216]

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

[213] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.12
[214] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.10–2.12
[215] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.38–2.40
[216] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.34–1.35

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.[217]

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.[218]

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 who 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 cybersecurity. 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 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.[219]

Vulnerabilities

Critical infrastructure often relies upon cybertechnology 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 cybertechnology, it may be reliant upon a critical sector that is reliant upon cybertechnology. These possible cascading impacts are very important to consider when planning for hazard mitigation. This can be complicated though as not all critical

[217] 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
[218] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 2.22
[219] FEMA. (2016). *Community Preparedness for Cyber Incidents MGT 384* (Version 1.1). Page 2.40–2.43

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 cyberattacks, 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.[220]

Another vulnerability is that the Internet was designed with efficiency and access concerns, not specifically with security considerations. Now that cybertechnology 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.[221] This is a concern because these systems can be hacked and controlled by enemies.

2. Geographic Areas Affected by Cyber Incidents

Because cyber incidents occur in "cyberspace," 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

A record of historical occurrences of cyber incidences in Pinellas County is not available at this time.

4. 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.[222]

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[220] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.15–1.16
[221] FEMA. (2016). *Essentials of Community Cybersecurity AWR 136.* Page 1.12
[222] https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/

In 2015, government was among the top five most cyber-attacked industries and that is expected to remain accurate in the future.[223]

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.[224]

This hazard was determined to have a probability level of possible (1 to 10% annual probability).

5. 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
  - First responders may not be able to respond properly if a cyberattack 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 or other critical 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

223 *X-Force Cyber Security Intelligence Index*. (2016). IBM
224 https://www.accenture.com/t20170926T072837Z__w__/us-en/_acnmedia/PDF-61/Accenture-2017-CostCyberCrimeStudy.pdf

- Private organization – loss of public or consumer confidence in an organization leading to loss of market share and possibly loss of future sales

6. Vulnerability Analysis and Loss Estimation by Jurisdiction

Without having access to each jurisdiction's 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 the County and municipalities will continue to be vulnerable to cyber incidents. Any jurisdiction that utilizes computers and the Internet for major utilities, transportation routes, or data storage is vulnerable to a cyber incident.

Cyberattacks are very costly and it is expected that from 2017 until 2021, $6 trillion will be spent on cybercrime damages.[225]

Financial impacts on enterprises such as the electronic leakage of data cost an average of $1.9 million in 2017.[226]

The top five cyber-attacked industries in 2015 were healthcare, manufacturing, financial services, government, and transportation, and it is believed this trend will continue.[227]

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

It is reasonable to assume that most jurisdictions will continue to be vulnerable to cyber incidents. Any department that utilizes computers and the Internet is vulnerable to a cyber incident.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be medium, with a PRI score of 2.5.

[225] 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

[226] 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

[227] *X-Force Cyber Security Intelligence Index*. (2016). IBM

CYBER INCIDENT Overview					Overall Vulnerability
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.					MEDIUM
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Possible	Limited	Moderate	< 6 hours	< 1 week	2.5

Hazardous Materials Incident Hazard Profile

1. Hazardous Materials Incident 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 that is a health hazard or physical hazard, including:

- chemicals which are carcinogens, toxic agents, irritants, corrosives, or 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 hazardous materials 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.[228]

Biological Hazards

Biological hazards are materials or incidents that involve exposure to a biological or living agent that causes harm. These agents include microorganisms, viruses, and any toxins originating from biological sources. Examples of biological hazards include anthrax, bloodborne pathogens, molds, Ebola, smallpox, 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 Hazard Profile*.

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

[228] https://www.ihmm.org/about-ihmm/what-are-hazardous-materials

of the individual all affect the outcome of exposure. Once exposed to chemical substances, there can be 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.[229] For more information on radiological hazards, please look at the *Radiological Incident Hazard Profile*.

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), works 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.[230]

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

[229] http://www.floridahealth.gov/environmental-health/chemicals
[230] https://www.floridadisaster.org/hazmat/serc/

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 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 is not 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 2019, Florida has 54 final sites on the NPL and 1 proposed site.[231]

<u>Pipelines</u>

There is 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.

[231] https://www.epa.gov/fl/list-superfund-sites-florida

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.

As of 2004, PHMSA does not include gas distribution incidents that are caused by nearby fire or explosion and impacts the pipelines.

According to PHMSA, in the state of Florida, there was one natural gas interstate transmission pipeline incident with no injuries in 2014 and six significant intrastate distribution pipeline incidents resulting in two injuries from 2014 through 2016. These incidents resulted in a total of $5,059,988 in property damages involving natural gas distribution systems incidents and $1,494,000 in property damages involving an interstate natural gas transmission pipeline.[232]

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 cyberattacks. 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. Publicly available information does not indicate the extent to which systems have been infiltrated, but cybersecurity officials warn that, with sufficient access, a hacker could potentially “manipulate pressure and other control 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

[232] http://www.ncsl.org/research/energy/state-gas-pipelines-pipeline-accidents.aspx#Significant_Incidents

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.[233]

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 June 2019, there are 26 operating rigs in the Gulf of Mexico, 24 drilling for crude oil and 2 drilling for natural gas.[234] While there are currently no drilling rigs on the east coast of Florida, the U.S. 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.[235] As of 2015, Florida produced 2.2 million barrels of crude oil.[236]

Given Pinellas County's coastal location on the Gulf of Mexico and 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 Pinellas County's many natural resources, which could be catastrophic.

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.[237]

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 county. 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.

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[233] http://call811.com/
[234] https://www.wtrg.com/rotaryrigs.html
[235] 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
[236] https://s3images.americangeosciences.org/agi/statefactsheets/FL_GeoscienceInYourState_AGI.pdf
[237] http://www.nwf.org

Five hundred and forty fixed facilities in the county produce, store, or use reportable hazardous substances, with approximately two hundred producing, storing, or using extremely hazardous substances. The Pinellas County Hazardous Materials Response Team responded to 563 from 2015 through 2018. The majority of these releases are small, affecting only the building of origin and, in a few instances, immediately adjacent buildings.

The largest threat is from Brenntag Mid-South, a facility that stores approximately 1.25 million pounds of chlorine (maximum) on site. The chlorine is repackaged at the facility into containers of various sizes, contributing to the possibility for a leak or other release to occur. The facility is located in the center of the County. A release of the worst case would be the failure of one of the largest containers, on a day with high humidity, little to no wind, and during tourist season. This would be an 180,000 pound (one rail car) release at 1.0 miles per hour wind speed, atmospheric stability class D that would generate a vulnerability zone of at least a 10 mile radius from the site. The potential number of citizens affected by this incident could be well over 500,000 persons, depending on time of day and year.

3. Historical Occurrences of Hazardous Materials Incidents

Pinellas County is surrounded by water with hundreds of commercial and private marine vessels traveling its waterways daily. The Port of Tampa resides to the east of the county and is one of the busiest in the Gulf of Mexico, making the probability of a major spill more likely to occur. The last major incident occurred in 1993 when three ships collided at the entrance to Tampa Bay causing a major fire and oil spill, which affected the southern third of the county significantly. More than 330,000 gallons of No. 6 oil were spilled following a three-vessel collision. In July 1993 the U.S. Coast Guard responded to the worst hazardous materials incident in recent history involving the motor vessel OCELOT. In September 1995, the USCG also responded to a 5000-gallon diesel spill in the east Tampa Bay requiring multiple clean-up contractors. The spill would later prove to be the nation's fifth most resource intensive oil spill that year at a cost of $500,000.

4. Probability of Future Hazardous Materials Incidents

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. Small fuel spills occur in the waters surrounding Pinellas on a daily basis. Most are due to overfilling boat fuel tanks and a few due to boat sinking. Law enforcement agencies routinely receive reports of illegal oil dumping from the public.

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 have a probability level of possible (1 to 10% annual probability).

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 does not communicate with the public, fear could ensue, leading to a fear of the government
  - If cleanup is slow, the public could believe the government does not know how to properly clean it up or that the accident was malicious

6. 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 northern half of the county could be largely affected if there was a chlorine release during transport based on the delivery corridor route.

7. Vulnerability Analysis and Estimated Losses of Critical Facilities

Hazardous Materials Incidents can, and do, occur anywhere and at any time. In most cases, they do not result in serious impacts to critical facilities. However, critical facilities that store or handle hazardous chemicals listed in the Environmental Protection Agency (EPA) Superfund Amendments and Reauthorization Act (SARA) Title III are most vulnerable.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 2.9.

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.					**HIGH**
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Possible	**Critical**	**Moderate**	**< 6 hours**	**> 1 week**	**2.9**

Space Weather Hazard Profile

1. Space Weather Description

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 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.[238]

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.

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 Earth.

[238] National Space Weather Strategy, National Science and Technology Council, October 2015

Space Weather Events

CMEs and solar flares can cause three different types of space weather events on Earth. These will be discussed below.

Geomagnetic Storms

Geomagnetic storms occur when CMEs affect Earth's magnetic field. 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 becomes brighter and moves closer to the equator during a storm.

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 4.111: 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-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).	Kp = 8	100 per cycle (60 days per cycle)

Scale	Description	Effect	Physical measure	Average Frequency (1 cycle = 11 years)
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)

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 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 4.112: 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

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 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 eight minutes because the x-rays travel at the speed of light and it takes about eight minutes for the light from the Sun to reach 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 Earth, with impacts 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 4.113: 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 navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.	X20	Less than 1 per cycle
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)

Scale	Description	Effect	Physical measure	Average Frequency
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, 2020 will be year 12 of the current cycle.[239]

[239] http://www.nws.noaa.gov/om/space/index.shtml

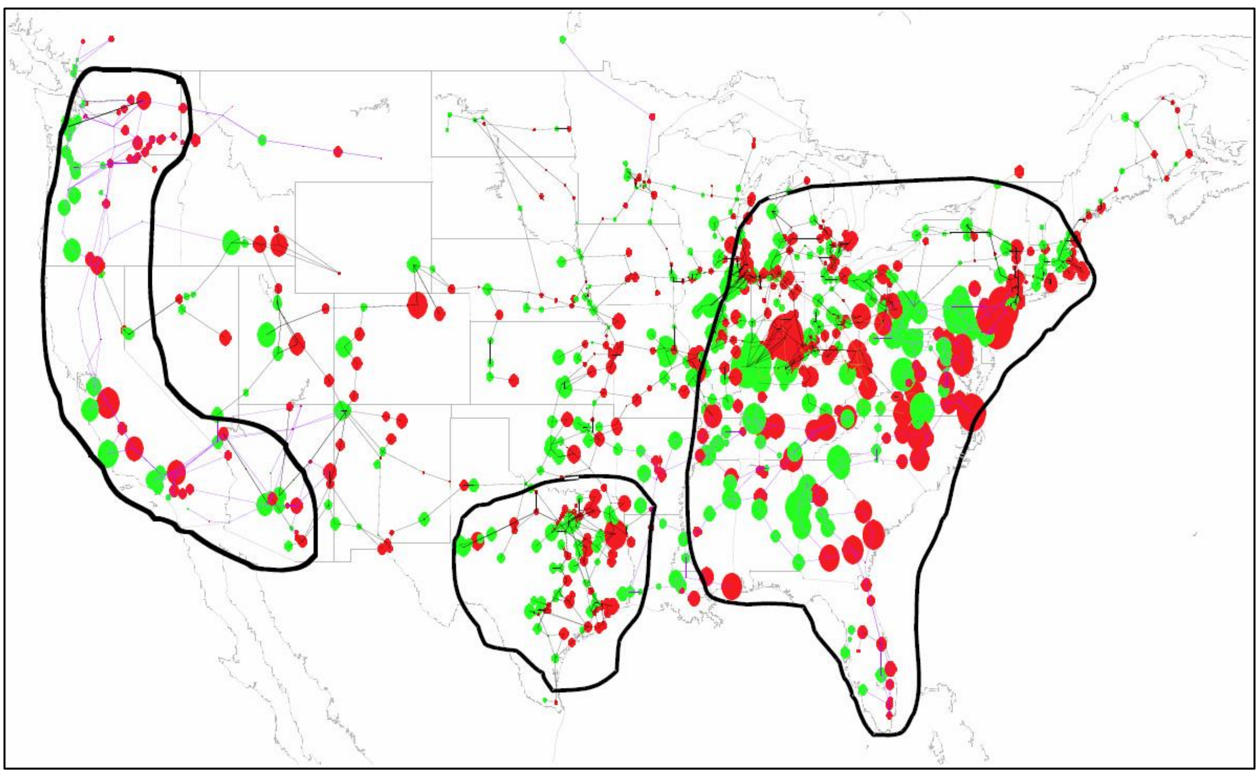
2. Geographic Areas Affected by Space Weather

As mentioned in the section above, any region of Earth is susceptible to the effects of space weather. The sunlit side of 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.

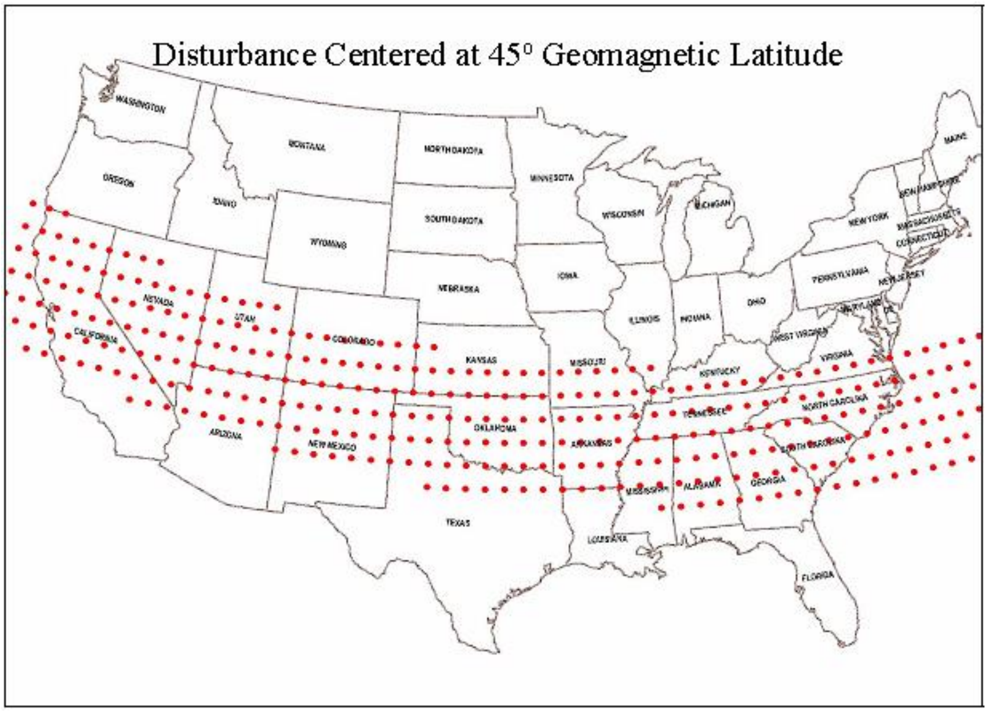
Florida has not been significantly affected by space weather since modern infrastructure began to be built in the 1950's. However, due to the high uncertainty of the location of geomagnetically induced impacts, extreme geomagnetic storms could produce electrical system disturbances and possibly widespread disruptions or blackouts. The following figures demonstrate that Florida is potentially vulnerable due to both ground connectivity and proximity to the ocean coastline.

Figure 4.81: United States Regions Susceptible to Electric System Collapse, 100-year Geomagnetic Storm 45 degree Latitude Scenario[240]



[240] https://www.ferc.gov/industries/electric/indus-act/reliability/cybersecurity/ferc_meta-r-319.pdf

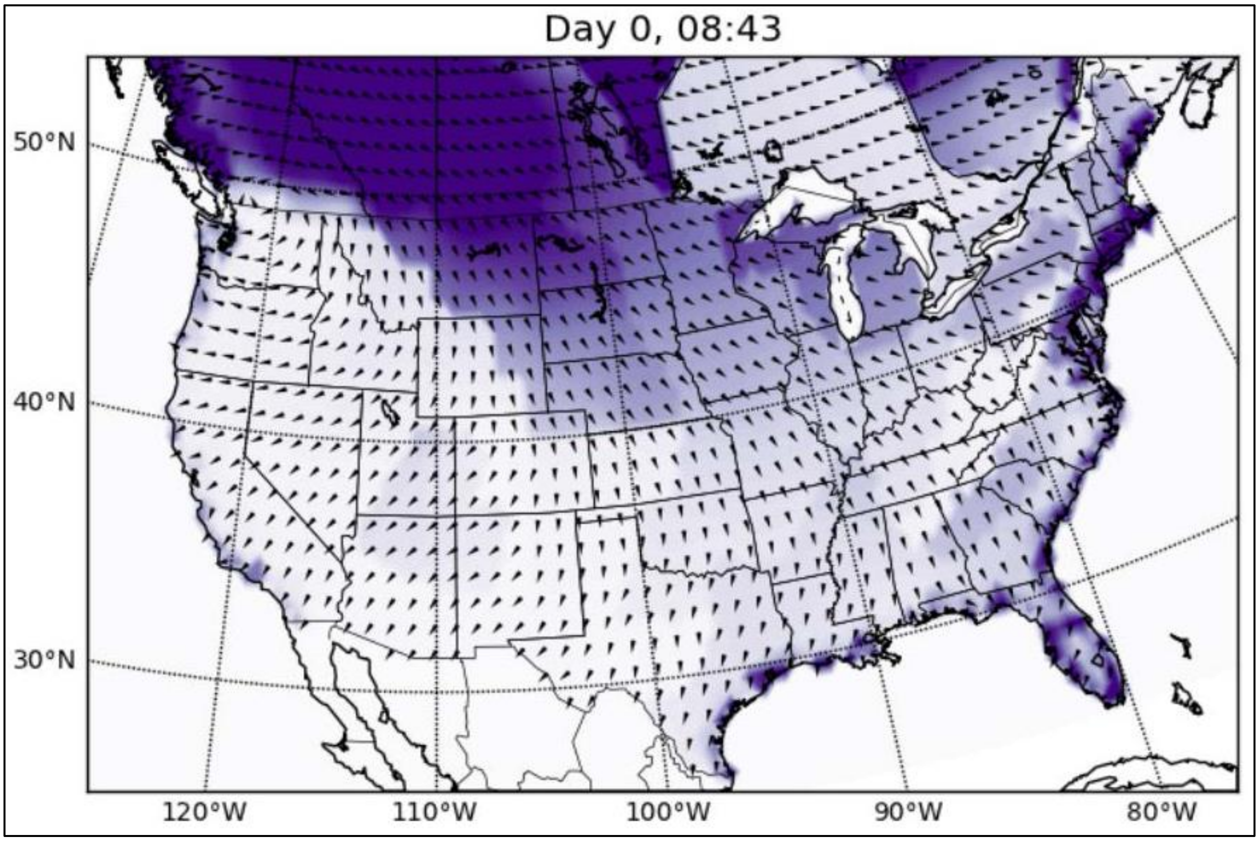
Figure 4.82: Disturbance Regions, Geomagnetic Storm, 45 degree Latitude[241]



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.

[241] https://www.ferc.gov/industries/electric/indus-act/reliability/cybersecurity/ferc_meta-r-319.pdf

Figure 4.83: Carrington Level Storm Electric Field Amplitudes Model[242]



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 4.114: 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.

[242] Lloyd's/Atmospheric and Environmental Research, Solar Storm Risk to the North American Electric Grid, 2013, Figure 5, p 11

Date	Description
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 have a probability level of unlikely (less than 1% annual probability).

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 Earth. With sufficient time, a CME with a southward oriented magnetic field will cause geomagnetic storming by compressing and agitating 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.

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 2,000 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. Vulnerability Analysis and Estimated Losses by Jurisdiction

In 2013, the state mitigation group, Mitigate Florida, 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.

7. Vulnerability Analysis and Estimated Losses of Critical Facilities

As explained above, Mitigate Florida 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.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 2.8.

SPACE WEATHER EVENTS					Overall Vulnerability
Overview					
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.					HIGH
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Unlikely	**Catastrophic**	**Large**	**< 6 hours**	**< 6 hours**	**2.8**

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 is 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.[243] The U.S. Nuclear Regulatory Commission exists to regulate the use of radioactive materials.[244]

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.

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[243] https://emergency.cdc.gov/radiation/typesofemergencies.asp
[244] https://www.nrc.gov/about-nrc/radiation/health-effects/radiation-basics.html

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 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 liftoff. 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 4.115: 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 radiation, 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.[245]

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.[246]

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.[247]

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 and 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.

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[245] http://www.radiationready.org/wp/wp-content/uploads/2017/04/Radiation-Exposure-Handout.pdf
[246] https://emergency.cdc.gov/radiation/healthandsafety.asp
[247] https://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm063807.htm

The NRC is also responsible for the nuclear security in the United States. 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.[248]

The Environmental Protection Agency (EPA) has the ability and authority to respond to many types of radiological incidents in a coordinating role.[249]

2. Geographic Areas Affected by Radiological Incidents

There are no nuclear power plants in Pinellas County. The nearest plant is the Crystal River Power Plant located in Crystal River (Citrus County). This plant has been closed; although there is some material stored at the site. This risk of a catastrophic release of radioactive material at the plant is extremely low. Even if one were to occur, the prevailing winds would tend to blow most of the radioactive isotopes towards the east. Pinellas County is located outside the plant's 50-mile ingestion pathway.

Below is a map showing the portions of the counties that are at risk for a radiological incident to impact the county.

Figure 4.84: Florida Emergency Planning Zones and Ingestion Pathway Zones

[248] https://www.nrc.gov/about-nrc/radiation/protects-you/reg-matls.html
[249] https://www.epa.gov/radiation/radiological-emergency-response-authorities

All ports in Florida including the Tampa port 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

A record of historical occurrences of radiological incidents in Pinellas County is not available at this time.

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 have a probability level of unlikely (less than 1% annual probability).

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, and 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. 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). However, Pinellas County is not within the 10-mile radius of a nuclear power plan so there is little to no vulnerability.

7. Vulnerability Analysis and Estimated Losses of Critical Facilities

Critical facilities are not vulnerable to radiological incidents involving the nuclear power plants within Pinellas County. If a facility were to become contaminated, it may need to be closed and decontaminated, which may interrupt normal state operations.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be unlikely, with a PRI score of 1.3.

RADIOLOGICAL INCIDENTS					Overall Vulnerability
Overview					
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.					LOW
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Unlikely	Minor	Negligible	< 6 hours	< 6 hours	1.3

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.[250]

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.[251]

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.

[250] https://www.fema.gov/pdf/plan/managingemerconseq.pdf
[251] https://archives.fbi.gov/archives/news/testimony/the-terrorist-threat-confronting-the-united-states

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 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.[252]

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 cyberattack.

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

[252] https://www.ncjrs.gov/pdffiles1/nij/grants/248691.pdf

to more effectively communicate information about terrorist threats by providing timely, detailed information to the public. The system uses the following three alerts:

- 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 is not limited to, unusual items or situations, eliciting information, and observation or surveillance.

<u>Terrorism in Florida</u>

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.[253]

<u>Chemical</u>

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, such as 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

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[253] 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 many as two days after exposure, with some agents being odorless and tasteless.[254]

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*)
- 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 Hazard Profile*.

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). Weapons of mass destruction are defined as (1) any destructive device as defined in 18 U.S.C., Section 2332a, which includes

[254] http://www.acsim.army.mil/readyarmy/Chemical_Terrorism_Fact_Sheet.pdf

any explosive, incendiary, poison gas, bomb, grenade, or rocket having a propellant charge of more than 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 IEDs.[255] An improvised explosive device (IED) is a homemade bomb or destructive device used to destroy, incapacitate, harass, or distract. IEDs are categorized as being explosive or incendiary, employing high- or low-filler explosive materials to explode or cause fires. IEDs 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. IEDs can also be made of numerous chemicals and hazardous materials and may include the use of shrapnel such as nails or ball bearings.

[255] https://www.dhs.gov/xlibrary/assets/prep_ied_fact_sheet.pdf

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 signature and are not readily detectable. Secondary explosive devices may also be used as weapons against responders and the public in coincident acts.[256]

Cyberattack

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, cyberterrorists could disable networked emergency systems or hack into networks housing critical financial information.[257] For more information on cyberattacks, please see the *Cyber Incident Hazard Profile*.

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 are 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:[258]

- 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.

[256] https://www.fema.gov/pdf/plan/managingemerconseq.pdf
[257] http://www.crime-research.org/library/Cyberterrorism.html
[258] https://www.dhs.gov/sites/default/files/publications/dhs-pathway-to-violence-09-15-16-508.pdf

- 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:[259]

- 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.
- 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.

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, is also at risk of a potential attack. The specific motivations of terrorists dictate target selection; therefore, any location within the county has the potential to become a target of terrorism, especially since it is one of the most populated counties in the state of Florida.

3. Historical Occurrences of Terrorism

There has never been a known terrorist incident in Pinellas County, although a young despondent individual did fly a plane from St. Pete Clearwater Airport into a large building in Tampa following the tragic events of September 11, 2001. Pinellas County does host large events and supports security initiatives for major events in the region such as the Super Bowl (2011) and Republican National Convention (2012).

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. 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.[260]

This hazard was determined to have a probability level of possible (1 to 10% annual probability).

[259] https://www.alicetraining.com/active-shooter/
[260] http://www.fdle.state.fl.us/cms/Domestic-Security/Domestic-Security-Home.aspx

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
  - 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

- Environment
  - 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
- Economic Condition
  - 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
- Public Confidence in Jurisdiction's Governance
  - 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. Vulnerability Analysis and Loss Estimation by Jurisdiction

The County recently has conducted and been involved in numerous large scale multi-jurisdictional terrorism exercises. Joint planning efforts with a number of response agencies are currently under way. It is expected that resultant changes in a number of procedures will ultimately minimize the potential effects of a terror incident, should one occur. According to the Regional Domestic Security Task Force, the sector most at risk is Commercial Facilities. The threat category contributing the most risk is IED (Incendiary Explosive Device).

Areas 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.

7. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 2.9.

TERRORISM					Overall Vulnerability
Overview					
In the Florida 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. Pinellas County faces a particular threat from events involving terrorism due to the booming tourist industry, international ports, etc.					HIGH
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Possible	Critical	Moderate	< 6 hours	> 1 week	2.9

Agricultural Disruption Hazard Profile

1. Agricultural Disruption Description

Florida to include Pinellas County'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 4.85: 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.[261]
- 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.[262]

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),[263] to govern the operational concepts, policies, and plans required to achieve the broad objectives for a response of one or more agencies.[264]

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),

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[261] http://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development/Education/For-Researchers/Florida-Seafood-and-Aquaculture-Overview-and-Statistics
[262] http://freshfromflorida.s3.amazonaws.com/Media%2FFiles%2FMarketing-Development-Files%2FFlorida_Agriculture_by_the_Numbers_Brochure_2014.pdf
[263] http://www.floridadisaster.org/documents/CEMP/2012/FERP%2011-8-2011.pdf
[264] Florida Agricultural Disaster Profile. Fresh from Florida, Florida Department of Consumer Services, Mar. 2017.

Highlands (14.9 million boxes), DeSoto (13.7 million boxes), and Hardee (10.5 million boxes). Oranges 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.[265]

Pests and disease are 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 4.116: 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

265 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 679,000 acres, with harvested acres increasing for soybeans by 37,000 acres, peanuts by 167,000 acres, and hay by 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.[266]

Pests and disease are 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 4.117: 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

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

266 http://freshfromflorida.s3.amazonaws.com/Media%2FFiles%2FMarketing-Development-Files%2FFlorida_Agriculture_by_the_Numbers_Brochure_2014.pdf

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.

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 it 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 crop's harvest window can likewise damage both plants and fruit. Below are the harvest months for vegetables, berries, and melons.[267]

Table 4.118: 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	

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 nineteenth 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 are not the only source of livestock production; beef cows in the state of Florida total over 900,000. Nationally, Florida ranked tenth in beef cows and sixteenth 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

[267] https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Brochures/Florida_Agriculture_by_the_Numbers_Brochure_2014.pdf

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 5 of the top 10 largest cow/calf operations in the United States and nearly half of all Florida agricultural land is involved in cattle production.[268]

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, 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 totaled 387 million pounds in 2014.[269]

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.

<u>Forestry and Horticulture</u>

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.

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.[270]

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.

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[268] https://www.freshfromflorida.com/content/download/17161/272486/P-00044.pdf
[269] https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Brochures/Florida_Agriculture_by_the_Numbers_Brochure_2014.pdf
[270] https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Brochures/Florida_Agriculture_by_the_Numbers_Brochure_2014.pdf

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.[271]

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 first 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.[272]

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.

The table below outlines some of the pests within the Florida agricultural industry.

271 http://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development/Education/For-Researchers/Florida-Seafood-and-Aquaculture-Overview-and-Statistics

272 http://freshfromflorida.s3.amazonaws.com/P-01587.pdf

Table 4.119: Florida Significant Pests[273]

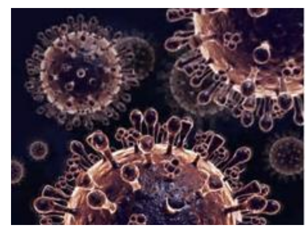
Name	Description	Picture
Drosophila melanogaster Also known as the Fruit Fly	Fruit flies are one of the most potentially destructive pests in the world. Fruit flies have a wide host range of fruits, vegetables, and nuts, and most of Florida's crops, including citrus, fall within the host range.	
Singhiella 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 animal products. Widespread disease can cause significant losses to farmers and economic hardship on the community.

The table below outlines some of the top plant and animal diseases within the Florida agricultural industry.

273 http://ipm.ifas.ufl.edu/applying/Florida's_Major_Agricultural_Pests.shtml

Table 4.120: Florida Significant Plant and Animal Diseases[274]

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[275] (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, and cooperators within the continental United States and on American territories through the use of biological control agents.

[274] http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Pests-Diseases/Citrus-Diseases/Other-Pests-of-Citrus/Key-to-Whitefly-of-Citrus-in-Florida
[275] https://www.aphis.usda.gov/aphis/ourfocus/planthealth/sa_domestic_pests_and_diseases/sa_bio_control

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.[276]

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.

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.[277]

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

[276] http://www.nwf.org/Wildlife/Threats-to-Wildlife/Invasive-Species.aspx

[277] http://floridadisaster.org/documents/CEMP/2014/2014%20Hazard%20Annexes/2014%20Tropical%20and%20Non-Tropical%20Severe%20Weather%20Annex%20%20to%20the%20CEMP.pdf

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.[278]

Potential Effects of Climate Change[279]

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; however, Pinellas County is mostly built out and has little agricultural business and industry. Invasive species are another source of agricultural disruption with introducing a new insect, intentionally or unintentionally, being incredibly detrimental.

3. Historical Occurrences of Agricultural Disruption

A record of historical occurrences of agricultural disruption in Pinellas County is not available at this time.

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.

This hazard was determined to have a probability level of unlikely (less than 1% annual probability).

5. Agricultural Disruption Impact Analysis

- Public
    - Human health from diseased crops or livestock
    - Invasive species that are poisonous or dangerous

[278] https://s3images.americangeosciences.org/agi/statefactsheets/FL_GeoscienceInYourState_AGI.pdf
[279] https://www.usda.gov/oce/climate_change/effects_2012/CC%20and%20Agriculture%20Report%20(02-04-2013)b.pdf

- 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
  - 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. 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 as compared to Pinellas County.

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.

7. Vulnerability Analysis and Loss Estimation of Critical 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 as compared to Pinellas County.

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. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 2.8.

AGRICULTURAL DISRUPTION Overview					Overall Vulnerability
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.					HIGH
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Unlikely	**Critical**	**Large**	**< 6 hours**	**> 1 week**	**2.8**

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.[280]

Terminology

Some of the most virulent and prevalent biological agents include the following:[281]

- Anthrax
- Avian flu
- Botulism
- Ebola
- Hantavirus
- Legionnaires disease
- Mold
- Plague
- Ricin
- Severe acute respiratory syndrome (SARS)
- Smallpox
- Tularemia
- Viral hemorrhagic fevers (VHFs)

[280] https://www.osha.gov/SLTC/biologicalagents/index.html
[281] https://www.cdc.gov/phpr/publications/2008/appendix6.pdf

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 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.[282]

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.[283]

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.[284]

[282] https://www.cdc.gov/ncezid/who-we-are/index.html
[283] https://emergency.cdc.gov/chemical/index.asp
[284] http://www.cdc.gov/healthypets/diseases/index.html

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
- Listeria
- Shigella
- 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.[285]

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.[286]

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.[287]

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* genus 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

[285] https://www.osha.gov/SLTC/biologicalagents/index.html
[286] http://www.cdc.gov/foodsafety/foodborne-germs.html
[287] http://www.cdc.gov/ncezid/dpei/index.html

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 U.S. territories.

The Florida Department of Health (FDOH) identified one square mile in Miami-Dade County as having locally transmitted, mosquito-borne Zika; travel guidance was issued for these areas. The specific location 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.[288]

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 June 2019, Florida was reporting decreased influenza-like illness activity at levels similar to those observed in past years. Influenza viruses continued to circulate at low levels and the most common subtype detected at the Bureau of Public Health Laboratories statewide over the last four weeks has been the strain B Victoria lineage.

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.[289]

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 three counties, including large populations of immigrants. Additionally, Florida has

[288] https://www.cdc.gov/zika/index.html
[289] http://www.floridahealth.gov/diseases-and-conditions/influenza/florida-influenza-surveillance-reports/index.html

a large tourism industry, 2 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.[290]

The DEP Influenza Pandemic Response Plan can be found online.[291]

Vibrio Vulnificus

Vibrio vulnificus is a natural bacterium that normally lives in warm, brackish seawater. These infections are rare but serious.[292]

Table 4.121: *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
2017	50	11
2018	42	9

Transmission

There are several methods of disease transmission.

290 http://www.floridahealth.gov/diseases-and-conditions/influenza/pandemic-influenza.html
291 http://www.dep.state.fl.us/secretary/events/annex_k_pandemic.pdf
292 http://www.floridahealth.gov/diseases-and-conditions/vibrio-infections/vibrio-vulnificus/index.html?utm_source=flhealthIndex

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.[293] Diseases can also be waterborne or foodborne, meaning indirect transmission occurs by consuming contaminated water or food.[294] [295]

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.[296]

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.[297]

Terrorists could release biological agents in many different forms, including, aerosol, food, water, infected humans, infected animals, insects, physically (mail), or agriculturally.[298]

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.

[293] http://www.who.int/csr/disease/WHO_PED_flyer_2014.PDF?ua=1
[294] https://www.cdc.gov/ncezid/who-we-are/index.html
[295] https://www.fema.gov/pdf/emergency/nrf/nrf_BiologicalIncidentAnnex.pdf
[296] https://emergency.cdc.gov/bioterrorism/index.asp
[297] https://emergency.cdc.gov/bioterrorism/index.asp
[298] https://www.dhs.gov/xlibrary/assets/prep_biological_fact_sheet.pdf

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 contamination, deliberate or not, of livestock or produce, it may be necessary to halt the movement and recall possibly contaminated products to limit exposure.[299]

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.[300]

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

[299] https://www.dhs.gov/xlibrary/assets/prep_biological_fact_sheet.pdf
[300] http://www.cdc.gov/phpr/stockpile/history.htm

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.[301] 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.[302]

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 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.[303]

2. Geographic Areas Affected by Biological Incidents

The entire state of Florida could be affected by biological incidents including Pinellas County. Overall, Pinellas' vulnerability to disease outbreak is low to moderate depending on the type of disease. The most vulnerable populations are the elderly and very young. Pinellas County has one of the largest concentrations of people over the age of 55 in the state. They tend to live in close proximity with each other in mobile home, deed restricted, and condominium communities. However, the county is also becoming younger as more families with younger children are moving into the area. The county is seeing more schools and daycare centers opening each year. 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

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.[304]

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301 http://www.cdc.gov/ncezid/dpei/index.html
302 http://www.cdc.gov/foodsafety/foodborne-germs.html
303 https://www.fema.gov/pdf/emergency/nrf/nrf_BiologicalIncidentAnnex.pdf
304 https://www.dhs.gov/xlibrary/assets/prep_biological_fact_sheet.pdf

4. Probability of Future Biological Incidents

The probability of any disease outbreak that affects the large Pinellas population still remains low. However, each specific disease has its own set of risk factors and probabilities that influence the overall risks. These factors include world traffic patterns of people and animals, virulence, surveillance systems, and early detection systems. The Zika outbreak occurred and it is likely that other diseases will affect the state.

This hazard was determined to have a probability level of possible (1 to 10% annual probability).

5. 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

6. 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.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

A critical facility is not itself vulnerable to a biological incident. However, a critical facility may notice impacts from a biological incident, such as employee absenteeism, leading to disrupted operations and therefore lost wages and productivity.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be moderate, with a PRI score of 2.1.

BIOLOGICAL INCIDENTS					Overall Vulnerability
Overview					
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 intentionally placing these biological agents into a society in order to harm people or animals is referred to as bioterrorism. Pinellas County has encountered issues involving influenza and the Zika virus in the past.					Moderate
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Possible	Limited	Small	> 24 hours	< 1 week	2.1

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.[305] 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 of the undocumented population at the national average of 250%.[306]

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.[307] 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

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305 http://www.floridadisaster.org/documents/CEMP/2012/MASS%20MIGRATION%20ANNEX.pdf
306 http://www.pewhispanic.org/interactives/unauthorized-trends/
307 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

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 seek employment or educational opportunities in the United States. The age of these individuals, their 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).[308] 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 4.122: Unaccompanied Minors Released to Sponsors, FY 2019[309]

County	Total number of children
Broward	414
Collier	236
Duval	206
Hillsborough	212
Lee	479
Manatee	103
Martin	142
Miami-Dade	1,189
Orange	336
Palm Beach	1,099
Polk	62
St. Lucie	71

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[310] 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

[308] https://www.acf.hhs.gov/orr/programs/ucs
[309] https://www.acf.hhs.gov/orr/resource/unaccompanied-alien-children-released-to-sponsors-by-county
[310] https://www.ecfr.gov/cgi-bin/text-idx?SID=29f9238515a0b92dcfa5f8f11f2d5abb&mc=true&node=se8.1.1_12&rgn=div8

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.

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 United States 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.[311] 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.

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 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.[312]

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

[311] http://www.floridadisaster.org/documents/CEMP/2012/Repatriation%20Annex%20to%20the%20CEMP.pdf
[312] https://fas.org/sgp/crs/row/R40566.pdf

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.[313]

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.[314]

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 United States. 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.[315]

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.[316]

Pinellas County does not have history of mass migration, but due to the already dense population of the County, and mass migration to the area would be difficult to absorb.

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.

This hazard was determined to have a probability level of unlikely (less than 1% annual probability).

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[313] http://www.crf-usa.org/bill-of-rights-in-action/bria-10-2-b-haiti-and-the-boat-people
[314] https://www.hrw.org/legacy/reports/pdfs/c/cuba/cuba94o.pdf
[315] http://www.migrationpolicy.org/article/haitian-immigrants-united-states/
[316] https://www.local10.com/news/tent-village-near-homestead-air-reserve-base-prepared-to-shelter-refugee-children

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. 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, unlike Pinellas County.

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.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Due to the nature and unpredictability of human-caused hazards, all critical facilities could potentially be at risk. The facilities could become overwhelmed, have a lack of space, and programs could become drained.

Though the county recognizes that critical 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.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be low, with a PRI score of 1.7.

MASS MIGRATION					Overall Vulnerability
Overview					
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.					LOW
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Unlikely	Minor	Moderate	> 24 hours	> 1 week	1.7

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.[317]

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 U.S. 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.

[317] 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.

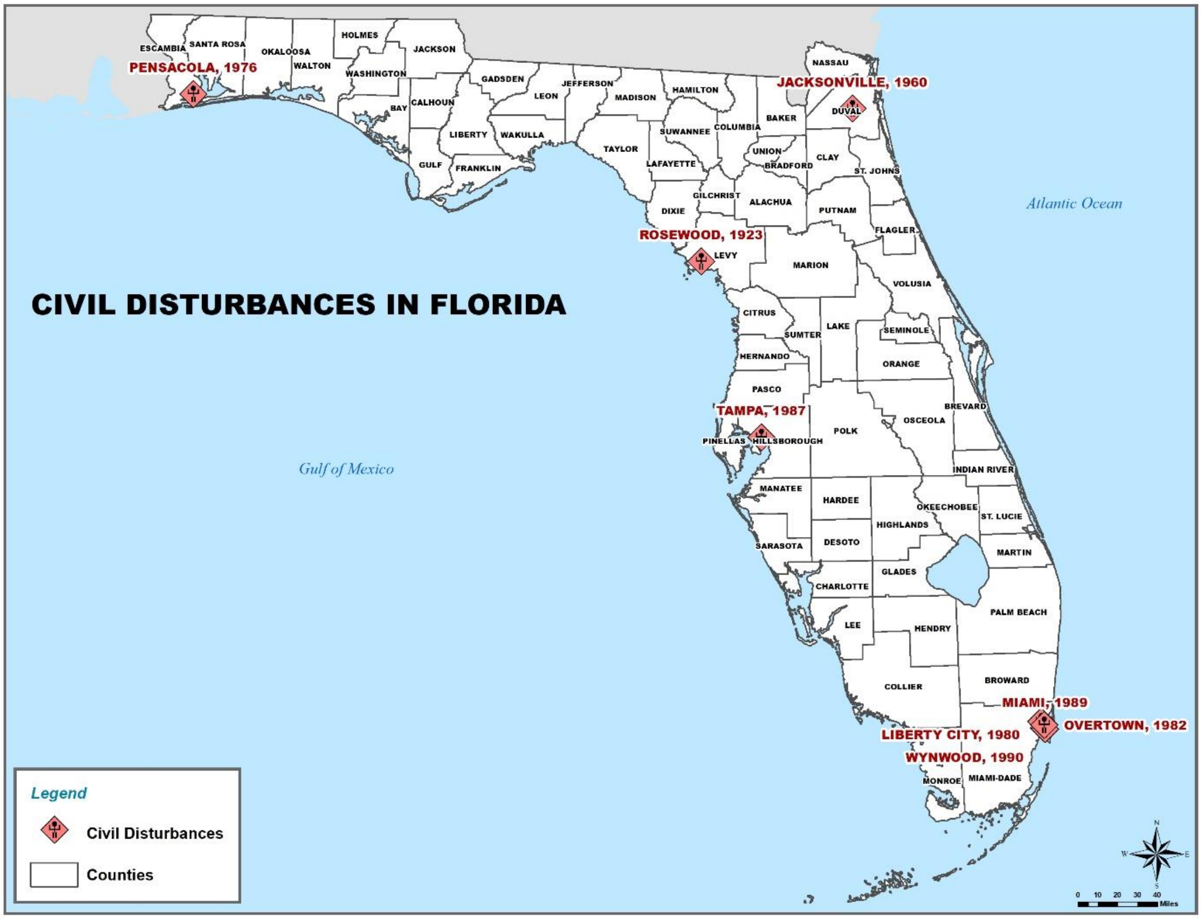
Each local jurisdiction should have a civil disturbance response plan; however, it is important to remember that each incident is unique and intelligence about a specific group, such as their demonstrators, capabilities, and possible courses of action, is key to developing a successful response plan. Additionally, the response plans should emphasize prevention and de-escalation, not confrontation.[318]

[318] http://documents.theblackvault.com/documents/gardenplot/fm3-19CivilDisturbanceOPs.pdf

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 4.86: Florida Historical Occurrences, Civil Disturbance



3. Historical Occurrences of Civil Disturbance

Civil disturbances occur infrequently but have been quite large in the past. The City of St. Petersburg had two related civil disturbances in late 1996. Several hundred people in southern St. Petersburg took to the streets to protest a controversial police shooting that killed a young man, damaging property and threatening first responders for seven hours on Oct 25, 1996. Tensions remained high into November 1996 when the police officer involved in the shooting was exonerated. Hundreds of people again rioted for three days setting businesses on fire and shooting at fire department personnel responding to those fires. St. Petersburg sustained more than $3.1 million in property damage and expended $1.2 million in response costs. The police arrested 78 adults and 2 juveniles. Twenty-three first responders received minor injuries.

4. Probability of Future Occurrences of Civil Disturbance

It is likely that occurrences of civil disturbance will continue in the future. The potential for civil disturbance is always present especially in the urbanized areas of the county. Since 1996, however, Pinellas law enforcement and community agencies have instituted several successful programs that have opened communication lines preventing conflicts to escalate between conflicting parties. Social, political, and economic factors are very dynamic and must be monitored to gauge the threat of civil unrest.

This hazard was determined to have a probability level of likely (1 to 10% annual probability).

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. 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.

7. Vulnerability Analysis and Loss Estimation of Critical Facilities

Critical facilities are not particularly vulnerable to civil disturbances. There is a chance the group would protest in a critical facility and that the protest might turn violent or destructive. There is also the chance that since sometimes critical 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 critical facilities for civil disturbances is not possible to conduct.

8. Overall Vulnerability

Each of the five PRI categories was assigned a value from 1 to 4 and the pre-determined weighting factor was applied to calculate a PRI score. PRI scores can range from 1.0 to 4.0 and the overall vulnerability ranking or high, moderate, or low was assigned based on the PRI scores.

Based on the probability, impact, spatial extent, warning time, and duration, the overall vulnerability of this hazard was determined to be high, with a PRI score of 2.8.

CIVIL DISTURBANCE INCIDENTS					Overall Vulnerability
Overview					
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.					HIGH
Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Possible	Critical	Moderate	< 6 hours	< 1 week	2.8

POTENTIAL FUNDING SOURCES SECTION

Introduction

One of the requirements for the LMS is the identification of potential funding for mitigation projects. Federal, state and local governments have programs which provide funding for various types of mitigation. Some funding is available prior to a disaster while other programs are initiated in a post- disaster scenario. Typically, many more resources specifically earmarked for mitigation activities are available following a federal disaster declaration.

Local and state agencies have dedicated financial resources toward the funding of mitigation projects. The majority of the state funds that indirectly support mitigation related activities are provided for land acquisition, water quality and quantity-related issues as well as meeting non-federal match requirements for various federally-funded mitigation assistance programs. Similarly, local governments fund various projects including implementation of growth management initiatives; planning, permitting and code enforcement; acquisition and maintenance of parks and conservation areas; stormwater projects; housing mitigation assistance programs for low- and moderate-income citizens; and construction and structural hardening of critical facilities, such as public safety and emergency operations centers, fire and police stations, city halls, etc.

Both the State of Florida and local governments leverage funds available from federal and state sources to provide financial assistance to implement the hazard mitigation projects that have been identified, prioritized and documented by the Local Mitigation Strategy (LMS) Working Group as well as the projects submitted under the Flood Mitigation Assistance Program (FMAP), Repetitive Flood Claims and Severe Repetitive Loss Programs.

Funding Source Identification and Usage

The county uses a variety of programs and funds to achieve its mitigation goals. Various programs and sources of project funding are described throughout this section.

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 county'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 the county has utilized in the past.

Table 5.1: LMS Funding Source Identification

Funding and Projects Section: LMS Projects Funding Matrix																			
	Federal Grants									State/Community Funds						Tax			
	Available Post-Disaster			Available Pre-Disaster/Annually															
	HMPG	406	Public Assistance	PDM/ FMA	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	Stormwater	Sales
Pinellas	X			X	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-22.005, in which, Florida requires the prioritized project list outlines 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.

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, 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.

<u>Eligibility for Hazard Mitigation Grant Program Grants</u>

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, 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 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.

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 5.2: 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.

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 5.3: 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.

<u>“406 Mitigation”</u>

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.

Flood Mitigation Assistance Program

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

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.

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.

<u>Eligibility for Pre-Disaster Mitigation Program Grants</u>

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.

Emergency Management Performance Grant

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.

U.S. Army Corps of Engineers Grant Sources

Beach Erosion Control Projects

The U.S. Army Corps of Engineers provides a funding program to control beach and shore erosion occurring on public shores through programs not specifically authorized by Congress.

Flood Control Projects

The U.S. Army Corps of Engineers provides a funding program to reduce flood damages through projects not specifically authorized by Congress.

Floodplain Management Services

The U.S. Army Corps of Engineers provides a full range of technical services and planning guidance to communities to support effective, local floodplain management. Services may include site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Studies can also be conducted for floodplain delineation/hazard, dam failure analyses, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, flood proofing, and inventories of flood prone structures.

Additional U.S. Army Corps Funding Sources:

Protection, Clearing and Straightening Channels

Protection of Essential Highways, Highway Bridge Approaches, and Public Works

Snagging and Clearing for Flood Control

Watershed Protection and Flood Prevention

The U.S. Department of Agriculture's Watersheds and Wetlands Division provide resources to support technical and financial assistance in carrying out works of improvement to protect, develop, and utilize the land and water resources in small watersheds.

Community Assistance Program State Support Services Element (CAP-SSSE)

To ensure that communities participating in the National Flood Insurance Program (NFIP) are achieving flood loss reduction measures consistent with program direction. The CAP-SSEE is intended to identify, prevent and resolve floodplain management issues in participating communities before they develop into problems requiring enforcement action. Fundable activities include: strategic planning, entering floodplain management data into the Community Information System (CIS), ordinance assistance, CAP gap analysis, Community Assistance Visits (CAV), outreach, workshops, training, mapping coordination, technical assistance, and coordination with other state programs and agencies. State agencies designated by statute or the Governor's declaration as a NFIP state coordinating agency are eligible for funding support.

Emergency Advance Measures for Flood Prevention

This source of funding is from the U.S. Army Corps of Engineers to perform activities prior to flooding or flood fight that would assist in protecting against loss of life and damages to property due to flooding. The governor of the state must request the assistance.

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.

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.

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.

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.

<u>Eligibility for Coastal Partnership Initiative Grant Program</u>

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, coastal resource stewardship, access to coastal resources, and working waterfronts.

<u>Prioritization for Coastal Partnership Initiative Grant Program</u>

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

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.

<u>Eligibility for Florida Small Cities Community Development Block Grant Program</u>

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.

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.

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.

Beach Management Funding Assistance (BMFA) Program

This program is intended to provide and manage grants for local governments for the planning and implementation of beach and inlet management projects to protect upland structures and infrastructure, to provide critical habitat for threatened and endangered species, to provide recreational opportunities and to support local economies through tourism. This program is managed by the Florida Department of Environmental Protection’s Division of Water Resource Management.

Eligibility for Beach Management Funding Assistance Program

Financial assistance in an amount up to 50 percent of project costs is available to local governments, including county and municipal governments, community development districts and special taxing districts. Potential activities can include beach restoration and nourishment activities; project design and engineering studies; environmental studies and monitoring; inlet management planning; inlet sand transfer; dune restoration; beach and inlet protection activities; and other beach erosion prevention related activities consistent with the adopted Strategic Beach Management Plan.

Projects must be accessible to the public, located on the Gulf of Mexico, Atlantic Ocean or Straits of Florida as well as within an area listed as critically eroded.

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.