Resolution FY24-03

A RESOLUTION OF THE BOARD OF COMMISSIONERS OF THE NORTH BROWARD HOSPITAL DISTRICT ADOPTING THE BROWARD COUNTY ENHANCED LOCAL MITIGATION STRATEGY PLAN, WHICH CREATES A COMPREHENSIVE MITIGATION PROGRAM MINIMIZING THE IMPACT OF NATURAL AND TECHNOLOGICAL DISASTERS THROUGH THE DISTRIBUTION OF GRANT FUNDS FOR IMPLEMENTATION OF REQUESTED, NEEDED, AND DISTRICT-APPROVED MITIGATION PROJECTS WITHIN THE NORTH BROWARD HOSPITAL DISTRICT

WHEREAS, North Broward Hospital District (the "District") is a special taxing district of the State of Florida, and is authorized and empowered to maintain hospitals and supportive facilities for the care and treatment of the people of said District;

WHEREAS, the District is governed by the Board of Commissioners of the North Broward Hospital District (the "Board");

WHEREAS, the District participates in Broward County's Local Mitigation Strategy Task Force;

WHEREAS, the Broward County Enhanced Local Mitigation Strategy Plan 2022 update was approved by the Florida Department of Emergency Management;

WHEREAS, the Federal Emergency Management Agency ("FEMA") requires all governmental entities to adopt the Enhanced Local Mitigation Strategy Plan by resolution;

WHEREAS, the Enhanced Local Mitigation Strategy Plan creates a comprehensive mitigation program to minimize the impact of natural and technological disasters through the distribution of grant funds for implementation of requested, needed, and approved mitigation projects;

WHEREAS, adoption of the Enhanced Local Mitigation Strategy Plan will permit the District's implementation of local mitigation initiatives that can utilize FEMA's financial support and other funding sources;

WHEREAS, the Board wishes to adopt the Enhanced Local Mitigation Strategy Plan dated September 2022 as its mitigation strategy action plan for continued enforcement of management standards and for emergency management needs; and

WHEREAS, unless context otherwise requires, capitalized terms used but not defined herein have the meanings ascribed to such terms in the Amended and Restated Bylaws of the North Broward Hospital District and its accompanying Codified Resolutions of the Board of Commissioners of the North Broward Hospital District.

NOW, THEREFORE, BE IT RESOLVED, by the Board of Commissioners of the North Broward Hospital District, that:

1. The above-stated recitals are true and correct in every respect are hereby incorporated herein by reference.

2. The Board hereby officially adopts the Broward County Enhanced Local Mitigation Strategy Plan, attached hereto and incorporated herein by reference as Exhibit A, and as may be amended from time to time, as its mitigation strategy action plan for continued enforcement of management standards and for emergency management needs.

3. The Board hereby authorizes and empowers the District's President and Chief Executive Officer ("CEO") to seek up to $100 million in funding from FEMA and other financial support, and to provide up to twenty-five percent (25%) of the funds to secure such funding.

4. The Board hereby authorizes and empowers the District's CEO, as well as any authorized delegees of the CEO ("Authorized Delegees"), to take, or cause to be taken, any and all acts, deeds, and matters, in any form approved by the CEO and/or the CEO's Authorized Delegees, and to make any filings or certifications, and to execute and deliver, or cause to be delivered all such agreements, notices, instruments and documents for, in the name of, and on the behalf of the District and in the best interests of the District, in each case, as the CEO and/or the CEO's Authorized Delegees deem necessary or appropriate in order to carry out and effectuate the purposes and intent of this Resolution.

5. This Resolution shall become effective immediately upon adoption.

6. This Resolution hereby supersedes, amends, replaces and repeals any conflicting resolution or conflicting policy previously adopted by the Board.

DULY ADOPTED this ___ day of September, 2023.

Time Adopted _____ PM

EXHIBIT A

BROWARD COUNTY ENHANCED LOCAL MITIGATION STRATEGY PLAN

Broward County
Emergency Management

ENHANCED LOCAL MITIGATION STRATEGY (ELMS)

for
Broward County
and its
Municipalities

September 2022

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Preface

The Broward County Local Mitigation Strategy (LMS) was developed in 1997, 1998, 1999, and 2004, 2009, 2012 and 2017. This 2022 update supersedes the prior versions. It was first adopted in March 2000, a follow-up revision was then adopted by the Broward County Board of County Commissioners (BOCC) in April 2005 (Resolution #2005-344), and finally, the most recent official submission to FEMA was adopted by Resolution by the BOCC on January 5, 2010 (Resolution 2010-015). This document was reviewed by the Florida Division of Emergency Management for compliance and consistency with the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended by Section 322 of the Disaster Mitigation Act of 2000 (P.L. 106-390); the National Flood Insurance Act of 1968, as amended by the National Flood Insurance Reform Act of 2004 (P.L. 108-264); and 44 Code of Federal Regulations (CFR) Part 201 – Mitigation Planning, inclusive of all amendments through September 16, 2009.

In some chapters of the updated Broward County LMS for the year 2009, the data originally submitted in 2004 remained in the LMS as they identify the background and development of the LMS. In 2011-2012, at the County's initiative, the LMS was again updated. The County included enhanced components beyond FEMA's and the State of Florida's planning requirements to produce an "Enhanced LMS" (ELMS). The 2022 update of the plan further expands the hazard identification and vulnerability assessment components to examine new emerging threats and hazards for possible inclusion, particularly urban heat impact. The ELMS conforms to the scope of work items in the FEMA mitigation grant, while also closely mirroring the FEMA Enhanced State Mitigation Plan regulations (where appropriate for locals) and the State's preliminary draft Enhanced Plan Guidance.

Overall, the ELMS has been the County's strategy for positive change for the County's mitigation program in multiple ways. For the ELMS, a beneficial cost-effectiveness screening tool and a framework for a more robust integration of hazard mitigation into the county's core civic business processes (e.g., comprehensive planning, capital improvement funding) was created. The ELMS has also been the drive of more involved mitigation partnering opportunities for the Emergency Management Division, Risk Management Division, the County's property insurer, and the Broward County Government Operations Climate Change group. (For more information on the Climate Change, see the "Sea Level Rise/Climate Change" subsection in Chapter 4; for more information on the County's Climate Change group, see the Capability Assessment Subsection of Chapter 6). These partnerships are broadening the reach of mitigation beyond emergency management to other vital county decision-making and investment processes. For example, the County is seeking to better integrate mitigation into yearly, on-going decisions about county growth, investment, and redevelopment, as well as partnering with other successful efforts, like climate change adaptation that share similar goals.

The ELMS process has helped and will continue to explore short term and long-term strategies and mitigation opportunities on a longer time horizon (i.e., 10 to 20 years) than the required 5-year update, for which the initial steps should be started immediately. For example, climate change action efforts may take longer to plan and implement as well as measures included for funding under the Capital Improvement Plan (CIP), which is typically a 10-year horizon. The following list includes the primary ELMS components that will lead to more robust integrated mitigation efforts in the County:

INCREASED MITIGATION EFFECTIVENESS	HOW ACCOMPLISHED
A more detailed look at the County's risk to natural hazards	➢ Sea level rise subsection ➢ New urban heat impact subsection ➢ Detailed economic hot spot analysis describing risk in key economic areas. ➢ Updated Hazus runs for wind and flood hazards. ➢ Updated hazard profile information
Emphasis on collaboration and coordination with other agencies and organizations, especially municipalities, the private sector and other similar groups(Climate Change Government Action Group)	➢ Reinforce the Climate Change Task Force's Adaptation Action Areas for long term planning. ➢ Coordination with Risk Management and county insurer to collaborate on additional mitigation. ➢ Reinvigorated Private Sector Committee ➢ Encourage municipalities to increase CRS class rating and provide training/awareness opportunities. ➢ Multiple opportunities and forums for discussing risk, actions, and priorities
Integration into other pre- and post- disaster recovery processes	➢ Better integration with recovery planning (all documents under the Broward County Recovery Plan. These include the Recovery Support Functions (RSF), the Recovery Framework, Damage Assessment, and Infrastructure. ➢ Quickly identify opportunities to do Public Assistance 406 Mitigation by providing training on eligible projects, pre-identification of potential projects, when to identify and implement projects, and how to potentially comingle with other funding sources to maximize disaster resiliency. ➢ Prepare post-disaster SOP for vulnerable facilities. ➢ Disaster Housing (integration of Housing Vulnerability into ELMS) ➢ Identify in Continuity of Operations (COOP) plans facilities that need additional mitigation to preserve function in post-disaster environment
Integration into community planning processes	➢ County seeks to find ways to better integrate mitigation into comprehensive planning and capital improvement planning. ➢ County encourages municipalities to follow this process and provides tools to do so
Development of innovative tools to increase local mitigation funding	➢ Support future reorganization of the Mitigation Assessment Team (MAT) tool, which provides a mechanism for considering

INCREASED MITIGATION EFFECTIVENESS	HOW ACCOMPLISHED
	mitigation for each community investment (not just post-disaster and mitigation grants); helps instill a mindset to always consider mitigation)
Continued use of the Loss Estimation Tool to better evaluate mitigation project ideas for FEMA funding	➢ Loss Estimation Tool (LET), which helps screening of potential mitigation projects to measure cost-effectiveness for FEMA mitigation programs. ➢ Revise project prioritization criteria to better identify high quality, eligible-type, and effective hazard mitigation grant projects
Review past mitigation actions to better define and validate their effectiveness	
Exercise of recovery and mitigation actions, strategies, and objectives to increase likelihood of success in post-disaster environment	➢ Reinforce important mitigation funding opportunities such as the Public Assistance 406 program in immediate recovery. ➢ Include hazard mitigation in emergency management training classes to heighten awareness for increasing the likelihood of project identification during response and recovery. ➢ Identify key officials and issues. ➢ Establish support networks. ➢ Increase the effectiveness of working relationships

The following are the most prevalent benefits of the ELMS for Broward County:

- Better educated and aware agencies and municipalities
- More channels for hazard mitigation integration and intra-county coordination (e.g., project identification, outreach and education, county funded mitigation, recovery, community planning processes, federal grants)
- Establishment of working relationships pre-disaster with multiple key stakeholders
- Increased community funding to mitigation: 1) piggyback on the county insurer's requirements; 2) look for mitigation opportunities in CIP process; 3) partner with County Government Operations Climate Change and LEED group.
- Initial screening of mitigation project candidates focuses County and municipal efforts on project ideas more likely to be eligible under FEMA programs.
- Increased discussion of best practices and lessons learned including input from jurisdictions and organizations outside of Broward.
- Increased participation in CRS

- Using the EMAP Hazard Mitigation standards as a benchmark and best practices. Ensuring the ELMS continues to meet the EMAP Hazard Mitigation standards augments the existing mitigation program and develops a greater ability to recover more quickly from disasters.

- Continuation of the robust and comprehensive hazard mitigation program in Broward County that will make the County and its municipalities more disaster resistant and resilient.

This 2022 ELMS update includes the following information and data:

Chapter 1 - Introduction
Description of additions to the LMS document because of the ELMS planning process.

Chapter 2 - Broward County Profile
The Broward County Profile was revised with updated demographic and economic data to reflect current conditions in Broward County.

Chapter 3 - Planning Process
The original Planning Process and the 2002 update remains part of the LMS documentation, as it gives a history of the development of the LMS. In 2009, the chapter was revised to further define the LMS Working Group and the new Executive Committee. This chapter has been revised in this 2022 update to incorporate findings from meetings that occurred during the ELMS planning process, which includes an emphasis on the CRS program and engagement with the Planning Subcommittee to oversee the plan update cycle. It also includes Plan Maintenance. The plan maintenance and updating procedures were updated to ensure continued compliance with the Emergency Management Accreditation Program (EMAP) standards. This section was revised during the ELMS process to include additional ways to integrate mitigation into other planning mechanisms.

Chapter 4 - Risk Assessment
This chapter underwent major revisions and updates in 2009, 2011-2012, 2017, and again in 2022 to depict risk more accurately for Broward County and its municipalities to all hazards. The risk data in the tables and figures were evaluated for current validity. If key risk data was insufficient, the information was updated. This chapter also includes a subsection on climate change and sea level rise, and urban heat impact.

Chapter 5 - Mitigation Initiatives
The Mitigation Initiatives chapter been revised to reflect current goals, objectives, and community actions. It also provides information on the project review and prioritization process as well as the incorporation and/or description of tools developed under the ELMS project (Loss Estimation Tool, Mitigation Assessment Team tool). In addition, the chapter has a section detailing compliance with Element 15 (Identification and Analysis of Mitigation Actions: NFIP Compliance) of the FEMA Planning Guidance.

Appendix A – Project Prioritization Matrix

A new Project Prioritization matrix was developed for the County in 2012 and revised as part of the EMAP self-assessment phase for Broward County in 2016. All current and future projects in Appendix C will be scored and ranked accordingly.

Appendix B – Proposed Mitigation Project Form

The Plan includes the LMS Proposed Project Form used to submit projects that reflects criteria in the Project Prioritization Matrix, key information needed to understand FEMA grant program eligibility, and information needed for CRS Activity 510.

Appendix C – Mitigation Project List

This list was updated on September 29, 2022, and it was recommended to the county to revise it again later in 2012 with sub applicants resubmitting their projects through the new Proposed Mitigation Project Form which was updated in 2016 to include consideration of hazards of most significant concern. The status for each project is included. Projects that have been completed or no longer viable are listed separately at the bottom of the list. This list has been evaluated and the projects that are not eligible for FEMA mitigation grants have been moved to a separate tab in the spreadsheet. The WebEOC LMS Dashboard is used by the LMS Working Group as a way of submitting proposed projects for review and consideration for funding by the Florida Department of Emergency Management Mitigation Branch.

Appendix D – LMSWG Membership List

This list is updated with the current membership as of September 29, 2022.

Appendix E – Planning Process Support Documents

Changes that were made in 2022 to reflect the ELMS meetings in 2021 to 2022.

Appendix F - Resolutions

Includes most current resolutions.

Appendix G – Discontinued ELMS Hazard Profiles (Formerly the CRS/NFIP Supporting Documentation)

This appendix contains previous ELMS version Hazard Profiles that are no longer considered Hazards of Most Significant Concern because of the 2017 Risk and Vulnerability Assessment Workshop. Copies of CRS Form AW-214- or 3/5-year Cycle approval documentation for participating CRS communities are now being maintained by CRS Coordinators at the municipal level and are accessible through the LMS CRS Subcommittee/User Group.

Appendix H – Local Enhanced Plan and Mitigation Integration Summary

The Repetitive Loss Property information for the County is tracked by Broward County Emergency Management in accordance with FEMA guidelines. It is protected from release by the Privacy Act of 1974, 5 U.S.C. Section 552(2) and not available to the public. Therefore, a decision was made to open this appendix to a document available to the public, the Mitigation Integration Summary. This appendix includes recommendations on how to meet the proposed draft Local Enhanced Plan requirements from Florida. This appendix also includes a summary of plan integration efforts.

Appendix I – Critical Facilities

This appendix shows Table 4.28, At-Risk Critical Facilities (Coastal Flood Events)

Appendix J – Hazards Summary Profile (Changed from EMAP Crosswalk to Hazards Summary Profile in 2016 and updated in 2017)

Describe the consequence analysis on the impacts of the following: public, responders, continuity of operations, property, facilities and infrastructure, the environment, economic condition, and public confidence in the Broward County's ability to govern.

Appendix K – Loss Avoidance Studies (LAS)/Loss Estimation Tool (LET)

Includes LAS study conducted in 2011-2012 and LET for flood and wind projects.

Appendix L – Grant Funding Sources

Appendix M – All Hazards Survey

Includes the results of the All-Hazards Survey from responding jurisdictions.

Chapter 1: Introduction

Prior to the creation of the LMS, there was no existing comprehensive, cohesive, or coordinated hazard mitigation program established for Broward County and its 31 municipalities to deal with emergency response and recovery issues, long and short-term planning issues, and economic issues relating to mitigation. The development and implementation of a local mitigation strategy provides a mechanism to address issues that will reduce or eliminate exposure to hazard impacts.

The Disaster Mitigation Act of 2000 (DMA 2000) requires all local governments to have a hazard mitigation plan in place to receive mitigation funding from the Federal Emergency Management Agency (FEMA). The DMA 2000 (Public Law 106-390) indicates that as of November 1, 2004, any local government that does not have a FEMA approved hazard mitigation plan in place is not eligible to receive federal pre- or post-disaster hazard mitigation funding. This Plan represents all jurisdictions in Broward County.

FEMA defines hazard mitigation as any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event. Mitigation planning is defined as a process for systematically identifying policies, activities, and tools that can be used to implement those actions.

The LMS has the on-going support of all Broward County municipalities, private sector, and nonprofit organizations. This document will be utilized as a viable working tool to mitigate losses. Mitigation will be institutionalized at the local level through the local mitigation strategy review process. Entities are encouraged to continue to identify and prioritize projects on a frequent basis and not just part of the annual review process.

Broward County's 1.9 plus million residents are the ultimate benefactors of this hazard mitigation project. An immediate short-term benefit of this project is to provide a forum for discussion and implementation of mitigation for Broward County. Minimizing and breaking the repetitive cycle of destruction and rebuilding after a disaster is a long-term goal that may be achieved by the implementation of this strategy.

The Enhanced LMS plan document and planning process continues to evolve to meet and/or exceed federal and state requirements with a goal of increasing its effectiveness including:

- More coordination with the private sector through the Private Sector Committee
- More emphasis on the county and municipalities obtaining more CRS credit points to improve their CRS Class Rating through a more robust CRS Subcommittee and CRS User Group
- Development of tools that will help determine better candidates for FEMA mitigation grants by looking at the degree of risk as determine by potential future losses.
- Development of a process/tool that can help identify year-round mitigation opportunities which include new construction, retrofits, upgrades, and enhancements.
- Methodology for integrating with other county and municipal planning mechanisms including comprehensive plans and capital improvements plans.

LMS Working Group

The LMS Working Group (LMSWG) consists of designated representatives from each

municipality, county government representatives that address the issues of unincorporated portions of the county and county owned facilities, Hospitals, School District, Universities, Housing Authorities, and Private Sector companies. State and federal agencies are also represented. The makeup of the Working Group is not limited to these entities. On the contrary, anyone who desires to participate in the LMSWG is welcome to do so.

LMS Sub Committees

To better structure the Working Groups' activities, several subcommittees work at addressing a specific area of concern. The Executive Committee serves as the overall governing body of LMS, represented by the chairperson and alternate of each subcommittee, the LMS Working Group Chair, and the LMS Coordinator. It also acts as the review committee for the ELMS Plan adoption and the prioritization of LMS projects. Membership on any subcommittee shall be voluntary and subject to the review of the Working Group. A subcommittee member who fails to attend a reasonable number of subcommittee meetings may be dropped from participation in the subcommittee by a majority vote of the other members of that subcommittee. As of September 2022, the LMSWG subcommittees are:

- Planning
- Education and Outreach
- Resilience
- Private Sector
- Community Rating System (SRS)

Chapter 2: Broward County Profile

Geography

Broward County comprises 1,225 square miles, located on the South Florida Peninsula, between the Atlantic Ocean and the Everglades. It is bordered by Miami-Dade County to the south, Palm Beach County to the north, Collier County to the west, and Hendry County to the northwest. The County is characterized by flat low-lying topography, mostly less than ten feet (averaging 6 feet) above mean sea level, which must be drained and reclaimed to be developed. Additionally, 4.9 square miles adjacent to U.S. 27, have been designated and acquired for conservation in the East Coast Buffer/Water Preservation Area. The County has 24 miles of coastline and 300 miles of inland waterways. There are 2 state parks in Broward County. Attractive sand beaches and a subtropical climate have led to development of the County's tourism industry. Most beachfront land is built up with high-rise hotels and condominiums. Westward expansion of development continued through the first decade of the 2000's. Though the County is rapidly approaching a build-out state population growth continues with redevelopment of areas within a broad swath of Central Broward extending north and south from county-line to county-line.

Broward County is accessible by road, rail, air, and sea. There are 3 interstate highways and Florida's Turnpike. Interstate 95 and the Turnpike provide the primary north-south connections. There are 2 north-south rail corridors that extend into Miami-Dade and Palm Beach counties: the Florida East Coast Railroad Company railway and the South Florida Rail Corridor (formerly CSX). Port Everglades seaport is the world's third largest cruise-port. About 2.5 million passengers were accommodated at the Port in 2020. This is a reduction due to the COVID 19 pandemic. On average between 2011 to 2019 Port Everglades accommodated 3.8 million passengers. In FY 21, The dollar value breakdown of all cargo types of Port-wide trade was nearly equal with exports representing 49.9% and import representing 50.1%. Port Everglades kicked off Fiscal Year 2022, which began October 1, 2021, with a record-setting first month reaching 94,588 TEUs (20-foot equivalent units. Container volumes were up 5.5 percent in October 2021 over the previous October record set in 2018. Fort Lauderdale-Hollywood International Airport passenger counts increased by 63.9% between 2010 and 2019. In 2020 during the COVID-19 pandemic passenger counts reduced from 36,747,622 in 2019 to 16,484,132. In 2021, Fort Lauderdale-Hollywood International Airport (FLL) is one of the fastest-recovering airports in the U.S. in 2021. Despite the impact of the COVID-19 pandemic on the aviation industry in 2020, FLL ranked 6th in total passenger traffic recovery and 4th in international traffic recovery amongst U.S. airports.

South Florida's Water Conservation Areas (WCA) 2 and 3 are two sections of northern Everglades. Water Conservation Area 2 (WCA-2) is a sawgrass wetland that encompasses an area of 210 square miles and represents the smallest of the three Everglades Water Conservation Areas. According to the 2021 South Florida Environmental Report 79.9% of the inflow water entering WCA-2 originates from the Everglades Agricultural Area (EAA). Water Conservation Area 3 (WCA-3), the largest of the three Everglades WCA's, is in western Dade and Broward counties. WCA-3 covers an area of 915 square miles. The area is predominately a vast sawgrass marsh dotted with tree islands, wet prairies, and aquatic sloughs. The underdeveloped WCA

makes up two-thirds of Broward County square mileage **(see Map 4.1)** and serve multiple water resource and environmental purposes, including flood control, water supply and habitat for South Florida's plant and animal communities. Ownership of the WCA's is mixed, with State, South Florida Water Management District, and private ownership. The State leases portions of its land to the Miccosukee Indian Tribe. The Florida Fish and Wildlife Conservation Commission is responsible for managing the area.

There are 31 municipalities in Broward County. According to the 2020 Census, these communities ranged in population size from 33 (Lazy Lake) to 182,760 (Fort Lauderdale). Seven cities each have more than 100,000 residents: Fort Lauderdale, Pembroke Pines, Hollywood, Miramar, Coral Springs, Pompano Beach, and Davie. Nine municipalities share the Broward County coastline.

Demographics

Much of the demographic information from this section was primarily taken from the United States Census Bureau decennial censuses (2000, 2010, & 2020) and the 2019 American Community Survey (ACS) 5-Year Estimates. According to 2020 Census, Broward County was the second most populous county in the State of Florida, with 1,944,375 people. At the 2010 Census conducted on April 1, 2010, the population of Broward County stood at 1,748,066. The percentage population gain from 2010 to 2020 was 11.2% (an increase of 196,309 people).

Broward County is composed of 31 Municipalities as well as Broward Municipal Services District, also referred to as unincorporated areas. Data from Census 2000 was not available for 2 of the 31 municipalities, West Park and Southwest Ranches incorporated after April 2000. The most significant population increases between 2000 and 2010 were seen in Parkland (73%), Miramar (68%), and Weston (33%). The most significant percent change between 2010 and 2020 were seen in Parkland (45%), Lazy Lake (38%), Cooper City (21%), and Tamarac (19%). In 2020, Fort Lauderdale (182,760) and Pembroke Pines (171,178) continued as the 2 largest Municipalities in Broward County, making up 18% of the total Broward County population (see **Table 2.2**).

According to the 2019 ACS 5-Year Estimates, 314,061 people (16.3%) were 65 years of age or older, including 139,141 (7.2%) that were age 75 or older; there were also some 112,234 (5.8%) children under the age of 5 years. The percentages of people over 75 and under 5 years old have remained relatively stable between Census 2010 (7.1% and 5.9%) and the 2019 ACS 5-Year Estimates (7.2% and 5.8%). Broward County's ethnic and racial diversity continues to increase between Census 2010 and Census 2020 with the Hispanic population increasing from 25.1% to 31.3%, the Non-Hispanic Black increasing from 25.7% to 26.6%, all Non-Hispanic Other race population increased from 3.9% to 5.1%, and all non-Hispanic people of Multiple races increased 1.7% to 3.8%. Meanwhile, during the same timeframe between 2010 and 2020, the percentage of the Non-Hispanic White population decreased from 43.5% to 33.1%.

Median age in Broward has increased from 39.7 in 2010 to 40.4 in 2019. This is in part because the population 65 years and over has increased by 25.9%, 249,424 people to 314,061.

Another special population within Broward County is the Homeless population. The Homeless population (sheltered and unsheltered) in Broward County consists of about 2,561 people according to the Broward County 2021 Point-In-Time (PIT) Homeless Count. This number represents a 33% decrease of Homeless people in Broward County from 2011. The survey that was conducted occurred during a challenging economy and pandemic, and thus it is possible that

this number does not accurately reflect the actual number of Homeless people within Broward County.

A third special population is Broward's prison population. This population can be looked at two ways. The number of individuals whose county of commitment is Broward County is 6,536 per the Florida Department of Corrections 2018 Comprehensive Correctional Master Plan. The number of individuals incarcerated within Broward County is an average of 3,574 (October 2021) in County Facilities and 114 in the Florida Department of Corrections facility (Census 2020).

The largest unique population to Broward County is the seasonal population. According to 2019 ACS 5-Year Estimates over 200,000 people take residence in Broward County seasonal units.

Due to continued urbanization Broward County has minimal farmland remaining. As such, Broward County's farm worker population is not significant enough to officially include in the demographic profile.

The median household income in Broward County in 2019 was $59,547, 7% greater than the median household income for Florida. In 2019, 44,163 (6.4%) households in Broward County reported income of less than $10,000. 13.1% of all people are currently living below the poverty level in Broward County. Poorer households are least likely to be able to withstand a major disaster since they have limited resources to invest in mitigation measures and insurance.

As of 2020, Broward County had 860,329 total housing units, of which 756,657 were reported as occupied and 103,672 as vacant. In 2019, owner-occupied units (428,682) represent 62.1% of housing units, while rentals (261,368) represent 37.9% of housing units.

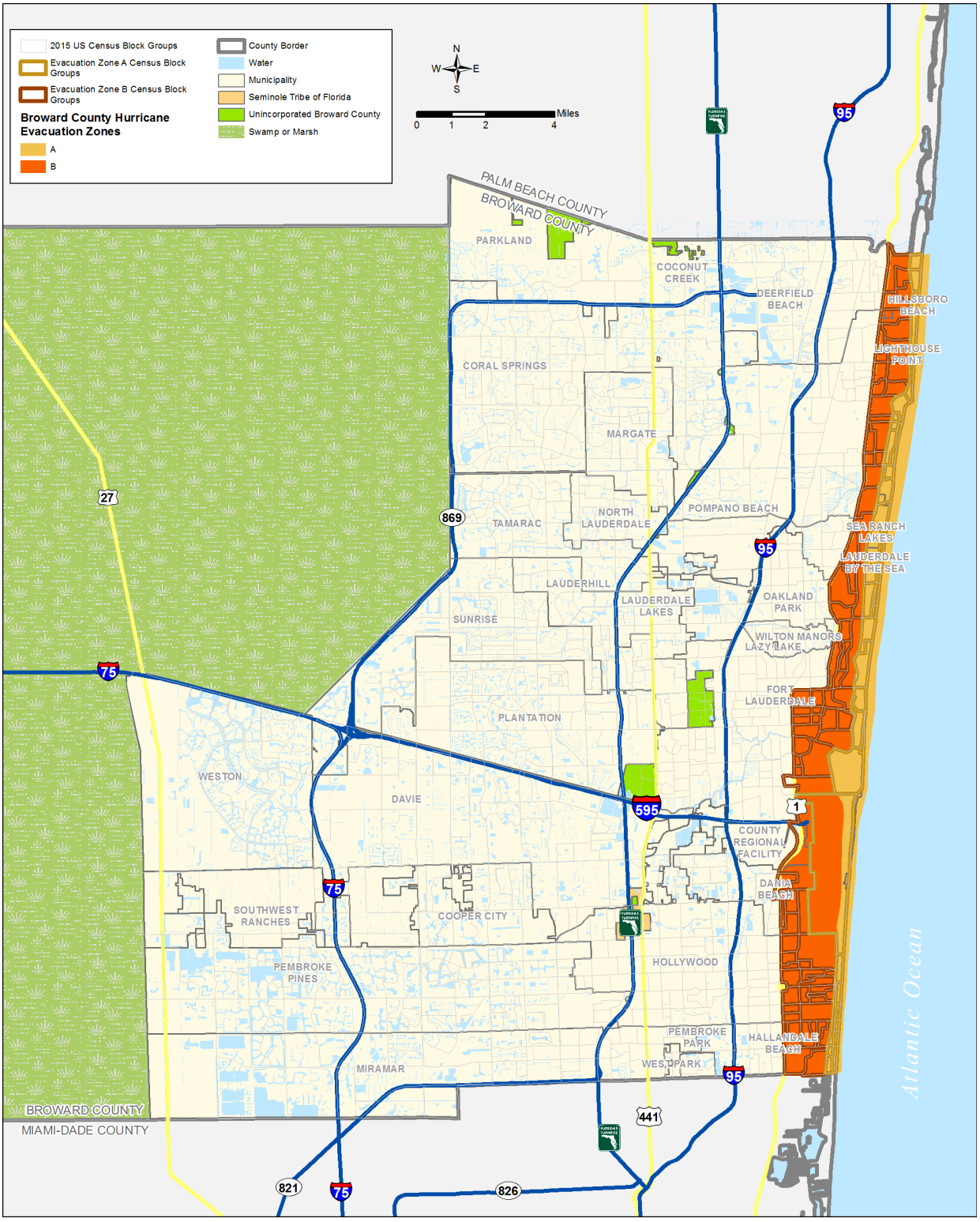
As the result of an elevation study conducted in the year 2000, there has been a significant reduction in the mandatory hurricane evacuation zones in Broward County. For a Category 1 & 2 hurricane, all areas east of the Intracoastal Waterway must be evacuated. For a Category 3 or higher storm, all areas east of Federal Highway (U.S. 1) must be evacuated. In addition, all mobile homes in Broward County must be evacuated for any level of hurricane regardless as to where they are in the County. The following table gives the pertinent data for the mandatory evacuation areas from the 2020 Census:

Table 2.1: Mandatory Evacuation Areas

Hurricane Evacuation Zone	Resident Population	Percentage of Total Population	Total Housing Units	Percentage of Total Housing Units
Categories 1 and 2 (Zone A)	51,447	2.65%	56,306	6.54%
Categories 3, 4 and 5 (Zone B)	107,048	5.51%	69,620	8.09%
Categories 1 – 5 (Zones A and B)	158,495	8.15%	125,926	14.64%

Source: 2020 Census

Map 2.1: Broward County Hurricane Evacuation Zones



Source: Broward County GIS

In 2000, because of the reduction of the mandatory hurricane evacuation zones, there had been a reduction of nearly 112,800 in the resident population that has to be evacuated for a Category 5 storm from around 261,600 based on evacuation zones prior to the year 2000 to around 148,800 for the evacuation zones established immediately following the 2000 Light Detection and Ranging (LiDAR) elevation study. There are currently 146,787 in the evacuation zones.

Senior citizens (retirees) make up a significant portion of those living in hurricane evacuation zones. The 2019 ACS 5-Year Estimates shows that some 44,838 residents living in hurricane evacuation zones were age 65 and older, or 31.4% of all persons living in evacuation zones. County-wide, some 16.3% of the population was over 65 according 2019 ACS 5-Year Estimates. In the Category 1 and 2 evacuation zones, the areas that are most likely to be evacuated, the population age 65 and over accounts for 45.5% of population in the area. In Categories 3, 4, the population age 65 and over accounts for 25.1% of population in the area.

According to the 2019 ACS 5-Year Estimates, there were 24,166 mobile homes in Broward County. This is a continuing reduction from the 2000 Census when mobile homes totaled 26,834. The number of mobile homes should continue to decline as there are virtually no new mobile home parks being established and several existing parks are being redeveloped for other uses including either permanent resident units or some other use.

Broward County has a diverse population with residents migrating here from all over the globe. Associated with this diversity is a multiplicity of languages. According to 2019 ACS 5-Year Estimates, 58.7% of Broward's population speaks only English and approximately 748,671 residents speak a language other than English. An estimated 265,498 of the residents that speak a language other than English, do not speak English very well. Most of the residents that speak a language other than English are Spanish speakers (483,401). Approximately, 211,255 people speak other Indo-European languages and 30,585 people speak Asian and Pacific Islander languages. The ability to effectively communicate to residents is obviously a key element of successful emergency management, thus it is important to be aware of the languages spoken within Broward County to best tailor hazard mitigation planning in an understandable manner.

Tables 2.2 and 2.3 are the latest demographic figures for Broward County and its municipalities from the 2000 Census, 2010 Census, 2020 Census, and the 2019 ACS 5-Year Estimates. The largest change was in Parkland with a population growth of 44.69%. This was due to the great amount of construction activity of new housing in the past decade.

Table 2.2: Current Municipal Populations and Percent Changes: 2000, 2010, 2020

Jurisdiction	Population Census 2000	Population Census 2010	Population Census 2020	Percent Change 2000 - 2010	Percent Change 2010 -2020
Coconut Creek	43,566	52,909	57,833	21.45%	9.31%
Cooper City	27,939	28,548	34,401	2.18%	20.50%
Coral Springs	117,549	121,096	134,394	3.02%	10.98%
Dania Beach	20,061	29,639	31,723	47.74%	7.03%
Davie	75,720	91,992	105,691	21.49%	14.89%
Deerfield Beach	64,583	75,018	86,859	16.16%	15.78%
Fort Lauderdale	152,397	165,521	182,760	8.61%	10.41%
Hallandale Beach	34,282	37,113	41,217	8.26%	11.06%
Hillsboro Beach	2,163	1,875	1,987	-13.31%	5.97%
Hollywood	139,357	140,768	153,067	1.01%	8.74%
Lauderdale by the Sea	5,582	6,056	6,198	8.49%	2.34%
Lauderdale Lakes	31,705	32,593	35,954	2.80%	10.31%
Lauderhill	57,585	66,887	74,482	16.15%	11.35%
Lazy Lake	38	24	33	-36.84%	37.50%
Lighthouse Point	10,767	10,344	10,486	-3.93%	1.37%
Margate	53,909	52,284	58,712	-3.01%	12.29%
Miramar	72,739	122,041	134,721	67.78%	10.39%
North Lauderdale	32,264	41,023	44,794	27.15%	9.19%
Oakland Park	30,966	41,363	44,229	33.58%	6.93%
Parkland	13,835	23,962	34,670	73.20%	44.69%
Pembroke Park	6,299	6,102	6,260	-3.13%	2.59%
Pembroke Pines	137,427	154,750	171,178	12.61%	10.62%
Plantation	82,934	84,955	91,750	2.44%	8.00%
Pompano Beach	78,191	99,845	112,046	27.69%	12.22%
Sea Ranch Lakes	734	670	540	-8.72%	-19.40%
Southwest Ranches	not available*	7,345	7,607		3.57%
Sunrise	85,779	84,438	97,335	-1.56%	15.27%
Tamarac	55,588	60,427	71,897	8.71%	18.98%
Broward Municipal Services District	129,437	17,357	16,888	-86.59%	-2.70%
West Park	not available*	14,156	15,130		6.88%
Weston	49,286	65,333	68,107	32.56%	4.25%
Wilton Manors	12,697	11,632	11,426	-8.39%	-1.77%
TOTAL	**1,625,379**	**1,748,066**	**1,944,375**	**9.25%**	**11.23%**

Source: 2000, 2010, and 2020 Census

Table 2.3: Other Key Demographic Data per Municipality

Jurisdiction	Percent of Total Population (2020)	Land Area (sq. miles)	Households 2020	Median Age 2019	Median Household Income 2019
Coconut Creek	2.97%	11.8	24,262	40.2	$ 62,973.00
Cooper City	1.77%	8.4	11,410	39.8	$ 106,795.00
Coral Springs	6.91%	23.9	45,892	37.4	$ 77,360.00
Dania Beach	1.63%	8.3	13,422	40.1	$ 47,135.00
Davie	5.44%	35.6	39,025	36.8	$ 71,780.00
Deerfield Beach	4.47%	16.2	37,858	42.9	$ 48,124.00
Fort Lauderdale	9.40%	36.3	84,409	42.1	$ 59,450.00
Hallandale Beach	2.12%	4.4	19,512	44.8	$ 39,184.00
Hillsboro Beach	0.10%	0.5	1,169	66.6	$ 73,558.00
Hollywood	7.87%	29.3	61,941	41.6	$ 54,251.00
Lauderdale by the Sea	0.32%	0.9	3,626	63.6	$ 72,537.00
Lauderdale Lakes	1.85%	3.7	12,910	37.6	$ 35,532.00
Lauderhill	3.83%	8.6	27,117	35.7	$ 41,723.00
Lazy Lake	0.00%	0	14	44.5	$ 250,000.00 +
Lighthouse Point	0.54%	2.4	5,048	52.9	$ 81,445.00
Margate	3.02%	9	23,163	46.4	$ 45,594.00
Miramar	6.93%	31.2	42,272	37	$ 70,669.00
North Lauderdale	2.30%	4.7	14,306	33.6	$ 43,759.00
Oakland Park	2.27%	8.2	19,091	41	$ 51,377.00
Parkland	1.78%	14.4	10,848	41.1	$ 154,844.00
Pembroke Park	0.32%	1.7	2,467	32.4	$ 38,119.00
Pembroke Pines	8.80%	34.8	63,080	40.9	$ 68,745.00
Plantation	4.72%	21.8	36,653	40.2	$ 74,903.00
Pompano Beach	5.76%	24.6	47,751	42.8	$ 49,518.00
Sea Ranch Lakes	0.03%	0.2	192	51.3	$ 206,667.00
Southwest Ranches	0.39%	13	2,364	46.7	$ 124,591.00
Sunrise	5.01%	18.1	37,348	39.5	$ 54,744.00
Tamarac	3.70%	12	31,461	47.1	$ 48,930.00
Broward Municipal Services District*	0.87%	808.1	5,353	35.1	$ 46,321.00
West Park	0.78%	2.2	4,613	34.7	$ 46,765.00
Weston	3.50%	26.1	21,845	40.4	$ 107,908.00
Wilton Manors	0.59%	2	6,235	52.8	$ 70,465.00

Source: 2020 Census and 2019 American Community Survey 5-Year Estimates

*Note: * Land area for BMSD includes Water Conservation, County Regional Facilities, Tribal Land, and unincorporated residential areas.*

Economy

According to Census 2020, Broward County is in the 8th largest Metropolitan Statistical Area (the Miami-Ft. Lauderdale-Pompano Beach MSA) in the country. Broward County is a Service and Retail-driven economy. A Service and Retail economy is concentrated in the industry sectors of the financial services, hospitality, retail, health, human services, information technology, and education. According to the Bureau of Economic Analysis in 2020 these industries represented 52% of the gross domestic product of Broward County. There is no surprise that population growth brings along employment growth. While the population grew by 11.23% from

2010 to 2020, Broward's labor force for this same period had an average labor force of 991,079. The labor force continues to grow with the current a current labor force of 1,062,260 in October 2021. The average unemployment rate between 2010 to 2020 was 6.4%. The unemployment rate for 2018 was 3.4% (35,454); 2019 was 3.2% (33,239); and for 2020 was at 8.9% (90,289). According to the U.S. Department of Labor, the unemployment rate for 2021 has trended favorably with an unemployment rate of 4.2% (44,786) in October 2021. In comparison, the rate was 9.8% in October 2010.

According to the U.S. Bureau of Economic Analysis (BEA), Broward had a per capita personal income (PCPI) of $55,908 in 2020. This PCPI ranked 12th in the state and was 100.4 percent of the state PCPI, $55,675, and 105.9% of the national PCPI, $48,112. The 2020 PCPI reflected an increase of 5.8% from 2019. The 2019-2020 state change was 5.0% and the national change was 6.9%. In 2010, the PCPI of Broward was $41,156 and ranked 10th in the state. The 2010-2020 annual growth rate of PCPI was 3.1%. The annual growth rate for the state was 3.7% and for the nation was 1.0%.

In 2020, Broward had a personal income of $109,473,926. This personal income ranked 3rd in the state and accounted for 9.0% of the state total. In 2010, the personal income of Broward was $72,139,286 and ranked 3rd in the state.

As mentioned above, Broward's economy is dominated by service and retail industries. According to the Quarterly Census of Employment and Wages in 2020, the service and retail industries make up 51.2% of all employment in Broward County. The industries with the largest increases in employment between 2010 and 2020 in Broward County were Management of Companies and Enterprises (56.4%), Construction (53.6%), and Transportation and Warehousing (44.9%). The top 5 employment sectors during 2020 in Broward County are currently Health Care and Social Assistance (14.1%), Retail Trade (13.2%), Administrative and Waste Services (9.1%), Accommodation and Food Services (9.0%), and Professional and Technical Services (7.0%). Between 2010 and 2020 Broward County saw an increase of 89,564 jobs. Broward's increase of jobs during this time ranked 5th amongst all counties. The top 3 sectors that saw the largest increase from 2010 to 2020 were Health Care and Social Assistance (16,891), Construction (16,830), and Administrative and Waste Services (16,111). The increase in these 3 sectors represent 55.6% of all jobs created in Broward County between 2010 and 2020.

The economy of 2020 was a period where there have been more employment reductions. All sectors in Broward County saw reductions between 2019 and 2020. The largest percentage change was in Arts, Entertainment, and Recreation (-22.2%) and Accommodation and Food Services (-21.6%). Broward County's economy remains a Service and Retail dominated economy. In 2021 currently, most of all sectors saw a positive change in employment. During this period, the industries with the largest positive change were the same Arts, Entertainment, and Recreation (11.1%) and Accommodation and Food Services (10.8%). This change is also reflected in the unemployment rate which averaged at 8.9% in 2020 and has reduced to an average year to date unemployment rate of 5.1% in 2021.

Currently, the estimated market value of all property in Broward County (according to the Broward County Property Appraiser) is $309.8 billion.

The following tables provide a breakdown of key economic areas by municipality. In most municipalities, the labor force size, median household income, and household expenditures have increased.

Table 2.4: Key Economic Factors by Community

Jurisdiction	2021 Total Establish-ments*	2021 Total Employees*	2019 Labor Force Size**	Labor Force Growth Rate (2011-2019)	2019 Unemployment Rate**	2019 Median Household income**	2021 Average Household Expenditures*
Coconut Creek	2,060	22,209	32,609	2.0%	4.8%	$62,973.00	$70,956.74
Cooper City	1,371	8,929	19,067	1.9%	3.2%	$106,795.00	$110,701.51
Coral Springs	6,700	51,286	72,979	0.6%	6.7%	$77,360.00	$89,798.80
Dania Beach	2,666	25,603	16,677	0.2%	7.6%	$47,135.00	$61,166.03
Davie	6,649	49,763	58,672	1.7%	4.3%	$71,780.00	$86,868.69
Deerfield Beach	5,625	56,385	42,307	0.6%	7.1%	$48,124.00	$57,727.18
Fort Lauderdale	20,452	190,822	98,499	0.8%	7.0%	$59,450.00	$88,621.89
Hallandale Beach	2,989	18,111	20,678	1.5%	7.3%	$39,184.00	$54,166.67
Hillsboro Beach	71	396	585	0.5%	4.8%	$73,558.00	$109,174.86
Hollywood	10,603	84,628	82,933	0.8%	6.5%	$54,251.00	$68,054.41
Lauderdale by the Sea	499	2,522	2,943	-0.1%	1.4%	$72,537.00	$106,452.77
Lauderdale Lakes	1,167	8,309	17,649	-0.3%	9.7%	$35,532.00	$41,489.43
Lauderhill	2,454	15,453	35,585	0.1%	8.1%	$41,723.00	$48,148.07
Lazy Lake	-	-	25	13.5%	0.0%	$250,000.00+	$77,042.91
Lighthouse Point	673	3,949	5,808	0.7%	3.1%	$81,445.00	$120,381.63
Margate	2,600	20,790	31,962	0.9%	5.4%	$45,594.00	$57,350.91
Miramar	4,353	35,642	77,284	1.9%	5.0%	$70,669.00	$79,457.19
North Lauderdale	1,002	7,201	25,140	1.3%	8.1%	$43,759.00	$51,592.20
Oakland Park	4,244	25,707	26,796	0.3%	7.6%	$51,377.00	$61,664.25
Parkland	730	4,224	14,250	2.4%	3.6%	$154,844.00	$167,174.98
Pembroke Park	726	5,539	3,195	1.9%	5.3%	$38,119.00	$37,079.58
Pembroke Pines	7,153	53,932	89,496	1.1%	5.4%	$68,745.00	$79,093.87
Plantation	5,686	52,688	51,910	0.7%	4.3%	$74,903.00	$85,426.65
Pompano Beach	9,591	74,129	54,467	1.0%	7.7%	$49,518.00	$63,589.35
Sea Ranch Lakes	86	404	232	-2.7%	1.3%	$206,667.00	$128,838.05
Southwest Ranches	361	2,411	4,484	1.2%	5.7%	$124,591.00	$128,643.04
Sunrise	5,621	48,374	50,118	0.5%	5.8%	$54,744.00	$65,178.23
Tamarac	2,517	19,810	34,182	1.0%	4.9%	$48,930.00	$56,771.80
Broward Municipal Services District	482	3,506	8,455	1.9%	9.7%	$46,321.17	$51,505.41
West Park	660	3,051	7,846	0.8%	6.6%	$46,765.00	$53,406.14
Weston	3,355	22,911	34,111	0.6%	4.5%	$107,908.00	$120,938.98
Wilton Manors	1,089	6,405	7,559	0.0%	4.4%	$70,465.00	$87,433.45
TOTAL	**114,235**	**925,089**	**1,028,503**	**1.0%**	**6.1%**	**$70,186.00**	**$80,184.24**

*Source: * 2021 Esri Demographics and **2019 American Community Survey 5-Year Estimates*

Chapter 3: Planning Process

Historical Review

After Hurricane Andrew in 1992, Broward County first applied for Hazard Mitigation Grant Program (HMGP) projects through FEMA. At that time, there was not a countywide hazard mitigation plan in existence for Broward County. In the mid- 1990's as part of trying to implement the 404 (mitigation)/406 Public Assistance programs and the HMGP program for Hurricane Andrew, Broward County recognized a void and began the process to formulate the County's first hazard mitigation plan. The Plan has seen many updates and versions since to address current hazard mitigation practices and planning. Over those first years, Broward became selected to be a FEMA Project Impact community as well as the Institute for Business and Home Safety Showcase mitigation community to highlight best practices for mitigation and be a catalyst for others. Broward County's Hazard Mitigation Plan was created in October 1997 incorporating those mitigation incubators. Broward's Hazard Mitigation Plan was first developed prior to the State's Local Mitigation Strategy guidelines/crosswalk and the Disaster Mitigation Act 2000. Initial membership in the first workgroup known as the Mitigation Task Force included county agencies, a coastal community representative, a non-coastal community representative, nonprofit groups, and the private sector.

The next version of the hazard mitigation plan turned into Broward County's Local Mitigation Strategy to capture updates needed since the enactment of DMA 2000 with FEMA review stipulations and State review with guidelines /crosswalk. The Mitigation Task Force was expanded in March 2005 to include 31 municipalities, additional county agencies, and private and nonprofit groups to reach a total membership of 49 members. Monthly meetings were typically held.

Broward County's Enhanced Local Mitigation Strategy has evolved during each review and update. As Broward County began the next revision for 2012 it was determined that Broward County Local Mitigation Strategy shall be viewed as a component with Broward County's Comprehensive Emergency Management Plan and thus the plan review process should complement each other. Further, the review and update should be like the planning process the County undertakes with the County's Comprehensive Plan and similar planning initiatives. The Mitigation Task Force was changed to be an actual local mitigation strategy work group (LMSWG) with Broward County government as the lead and membership representing stakeholders and partners with roles as part of the internal review structure and not part of separately reporting through boards. There is now better alignment with the established Broward County governmental planning practices and then ultimately meeting the needs of the criteria as identified though the Florida Division of Emergency Management (FDEM) and FEMA. Timelines have been modified to address moving from a three-year review to a five-year review unless an event warrants further updates off cycle. In the 2017 update of the Local Mitigation Strategy, it was modified to reflect an "Enhanced" Local Mitigation Strategy plan (ELMS) and certain components were updated as part of a Pre-Disaster Mitigation grant. The ELMS 2022 version today still has those components in place. As of September 2022, there are 112 members representing a cross-body of partners participating in the Local Mitigation Strategy Work Group for Broward County.

Planning Process

The Broward County Enhanced Local Mitigation Strategy plan development is coordinated through the Local Mitigation Strategy Executive and Planning subcommittees who participate in

the Local Mitigation Strategy meetings and review drafts of the plan at key stages. These subcommittees are comprised of Broward County department staff, staff from municipalities, and other constituent organizations. As with any LMSWG meeting, the public is always welcome to attend, and all meeting are advertised in compliance with the Florida Sunshine law.

The planning process for this updated version of the Enhanced Local Mitigation Strategy was significantly challenged due to timing issues associated with the Pandemic. Almost two- and one-half years of time that was pre-scheduled for the revision during this review cycle, was with Broward County being under a Local State of Emergency (from March 10, 2020, until May 10, 2022) for Covid and with many of the key staff and agencies providing vital support for COVID response operations. During the COVID pandemic, there were no in-person LMSWG quarterly meetings held. Thus, up until the second half of 2022, the LMSWG quarterly meetings were conducted virtually. Beginning with the second quarterly meeting that was conducted on June 22, 2022, the meetings for the rest of the year were conducted in a "hybrid" format with both in-person and virtual attendees participating.

This 2022 ELMS update was developed utilizing the following resources and information:

- Broward Emergency Management Division Comprehensive Emergency Management Plan (CEMP)
- Broward Emergency Management Division Recovery Plan
- Federal Emergency Management Agency (FEMA) National Risk Index
- FEMA National Flood Hazard Layer
- FEMA Repetitive Loss and Severe Repetitive Loss Properties Report for Broward County, 2022
- FEMA Hazard Mitigation Assistance Unified Guidance
- US Census Bureau
- National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center
- NOAA National Climatic Center Storm Event Database
- NOAA Storm Prediction Center, 2022
- NOAA National Centers for Environmental Information
- NOAA Slosh Model
- Broward County Property Appraiser 2022 Tax Roll Data
- Broward County Population Forecasting Model
- Broward County GIS
- Broward County HAZUS-MH
- Broward County Resilient Environment Department
- *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days*, Union of Concerned Scientists (2019), and the Southeast Florida Regional Compact (2022)
- PRISM Climate Group, Oregon State University
- Earthstar Geographics
- Earth Economics (2020) Urban Heat Island Analysis of Broward County
- Köppen Climate Classification
- US Geological Survey (USGS) Earth Explorer: Landsat Analysis Ready Data (ARD) Surface Temperature

- Fort Lauderdale Daily Climatological Records
- Centers for Disease Control and Prevention
- Florida Department of Health
- Southern Wildfire Risk Assessment
- US Environmental Protection Agency (EPA) Toxic Release Inventory Basic Data Files, 2022

General Body

The general body of the Local Mitigation Strategy Work Group (LMSWG) is composed of representatives from all 31 municipalities, the Seminole Tribe of Florida, essential governmental and non-governmental stakeholders, Hospitals, School Board of Broward County, Universities, Housing Authorities, and other public and interested parties who provide information on existing and/or potential projects that mitigate the effects of hazards within Broward County.

Pertinent county agencies have been identified and are actively engaged in the whole life cycle of the planning process to achieve a united effort for Broward County government. The County and supporting agencies have the primary mission to keep mitigation initiatives moving forward through the planning processes and supporting other public and private sector partners that have interests and/or membership on the Broward County LMS Working Group. Members of the Working Group shall review the strategy and assist in the identification of potential mitigation projects as assigned. All LMS Working Group meetings are open to the public and are advertised in accordance with Florida Sunshine laws. Public participation is encouraged in the planning process and any comments shall be taken into consideration. In the future, a new, dedicated interactive mitigation website may be developed and utilized in the planning process.

The LMSWG general body membership meets quarterly, and members are required to participate in at least 2 meetings per year. The general body plays an integral role identifying existing and potential mitigation activities and actions that will make Broward County more resilient to natural and human caused disasters. In the 2021-2022 LMS meetings, the general body was presented with the various components of the ELMS, as well as hearing guest speakers on mitigation in disaster recovery, FEMA, and the Florida Division of Emergency Management mitigation grant programs.

Committees

Committees from the Local Mitigation Strategy Work group have been established to assist in the planning process. These committees have assigned roles and responsibilities to ensure plan maintenance is achieved through monitoring, evaluation, implementation, and revision.

Executive Committee

The Executive Committee was formed in 2009 and has continued to serve in this same capacity today. The Executive Committee acts as the leading overall governing body of the Local Mitigation Strategy Work Group. Its responsibilities are as follows:

- Support plan development, monitoring, evaluation, implementation, and revision
- Attend all scheduled meetings.
- Approve overall LMS Goals and Objectives
- Provide subject matter expertise.

- Assist in evaluating and prioritizing mitigation actions.

Planning Subcommittee

The Planning Subcommittee was originally formed in March 1998 to serve as the working group for the Broward County Mitigation Task Force. The Planning subcommittee as it stands today is part of Broward County's Local Mitigation Strategy Workgroup and is charged with the review and revisions to Local Mitigation Strategy. The Planning group shall be chaired by a member of the Resilience Environment Dept. to ensure county wide planning and reliance initiatives are incorporated and addressed throughout the County's Local Mitigation Strategy and in other County plans and programs.

The Planning Committee remains responsible for research and on-going development for the Local Mitigation Strategy, evaluation and enhancement procedures, a conflict resolution mechanism, planning analysis, and mitigation initiative identification and prioritization procedures. Although Planning subcommittee overall membership can fluctuate over time at a minimum Broward County Emergency Management staff and Resilience Dept. agency staff shall be part of the subcommittee to facilitate and formulate the plan components moving forward to achieve a viable plan for Broward County government and its partners. As of September 2022, the Planning Subcommittee includes members representing the Broward Emergency Management Division, the Broward County Resilience Environment Dept. agencies, the City of Fort Lauderdale, the City of Pembroke Pines, the City of Miramar, the Broward Housing Council, and the City of Pembroke Park.

Education & Outreach Subcommittee

The original Education and Outreach Subcommittee (formerly Education and Training Committee) was created in March 1998 to address mitigation education and training issues for the Mitigation Task Force and has morphed over time to address current community needs as a subcommittee for Local Mitigation Strategy Workgroup.

A mission was developed by the Committee to promote mitigation education and outreach to strengthen Broward County's readiness for disasters and its capacity to minimize disaster-induced loss of life and property. Public education and awareness activities include articles, radio spots, flyers, fairs, conferences, workshops, and notices of public meetings to solicit public involvement. The primary goal of the subcommittee is to promote an awareness and understanding of disaster mitigation theory and practice, particularly of structural retrofitting and to advocate preparedness, through education, outreach and training. Objectives determined to meet this goal included:

- To identify which segments of the community are most at risk and therefore, most in need of education and outreach about disaster mitigation.
- To develop strategies for teaching the community about disaster mitigation in a timely and effective manner
- To coordinate with existing entities teaching about disaster preparedness and to encourage the dissemination of correct and up to date information about mitigation and preparedness.
- To serve as a clearinghouse for the delivery of disaster mitigation information

The original Education and Training Committee's goals and objectives were provided to the Planning committee for incorporation into the overall local mitigation goals and objectives. The

renamed Education and Outreach Committee now meets as needed to address the tasks associated with accomplishing the objectives.

Accomplishments beyond the development of goals and objectives include identification of potential mitigation projects and the creation of a mitigation speaker's bureau. Available Mitigation training includes existing courses offered by FEMA and the Florida Division of Emergency Management. Local requests for outreach and training courses are being processed on a case-by-case basis through the EOC training and outreach section staff. The Local Mitigation Strategy Coordinator routinely distributes related training notices as received from federal, state, regional agencies, and professional associations to the entire LMSWG membership so they can further promote within their entities and to the public as needed.

The LMS Coordinator, in coordination with the Subcommittee, works with the Office of Public Communications year-round to disseminate hazard mitigation information to the public. For post-disaster operations, Emergency Support Function (ESF) #14 Public Information will continue to assume this role with the EOC Mitigation Unit.

As of September 2022, the Education and Outreach Subcommittee includes representatives from Broward County Emergency Management, the Broward Sheriff's Office, the City of Lauderhill, Memorial Healthcare System, the City of Southwest Ranches, the American Red Cross Broward Chapter, Florida International University, the Florida Division of Emergency Management, the Broward County Office of Public Communications, the City of Lauderdale Lakes, and the Food for The Poor nonprofit.

Private Sector Subcommittee

The Private Sector Committee was created to strengthen the ties between the public and private sector as it relates to mitigation activities and business continuity of operations and recovery. The Committee is a valuable resource of information to the business community. In turn, the input from the private sector is utilized in the planning process for enhancement in the ELMS Plan. Members of the committee include Broward County Office of Economic and Small Business Development, the Broward Alliance (600 major corporations, 17 chambers of commerce, and 31 municipalities), and Broward County Emergency Management Division.

The ESF#18 - Business and Industry, for the County's Comprehensive Emergency Management Plan, was developed to address business and tourism needs during an emergency activation and recovery and will interface with ESF 14 – Public Information and the EOC Mitigation Unit if the EOC is activated for any business-related mitigation matters.

As of September 2022, the Private Sector Subcommittee includes representatives from Broward County Emergency Management, the City of Miramar, the City of Pompano Beach, the City of Coral Springs, Tidal Basin Consultants, and the Broward County Office of Economic and Small Business Development.

CRS Subcommittee

The CRS (Community Rating System) Subcommittee is a resource to the County for exploring ways to expand the CRS programs for all jurisdictions. The subcommittee also interacts with other important county flood mitigation groups including the Broward Surface Water Coordinating Council comprised of the SFWMD (South Florida Water Management District) and the various local drainage districts. All of Broward County's CRS communities have membership access and

participate in this committee throughout the year. As of September 2022, the CRS Subcommittee included some main representatives from Broward County Emergency Management, the City of Fort Lauderdale, the City of Hollywood, the City of Hallandale Beach, and the Broward County Resilient Environment Department.

Resilience Subcommittee

The Resilience Subcommittee was created in 2019 to support the ongoing emphasis of addressing resiliency throughout programs areas at the various levels of government and with partners. The Resiliency subcommittee shall be chaired by the Chief Resiliency Officer, Deputy Chief Resiliency Officer, or their designee. Membership includes Broward County agency members such as Emergency Management, and Natural Resources. Representatives from the Resilience subcommittee are also part of Broward County Government Operations Climate Change workgroup, led by the Resilience Environment Dept. This allows synergy and opportunity for Broward County governmental divisions/departments to assist in implementing various elements of the Climate Change Action Plan along with mitigation activities with the Local Mitigation Strategy. The City of Fort Lauderdale, City of Pompano Beach, City of Hollywood, City of Hallandale Beach, City of Plantation, and Town of Pembroke Park are some of the participating municipal partners.

Plan Maintenance

This section describes the process that will ensure the Plan remains an effective and relevant document over time. It establishes the method and schedule for monitoring, evaluating, and updating the Local Mitigation Strategy during a 5-year plan update cycle. This section includes discussion of some of the ways there is continual integration with other community planning processes and input into county financial investment decisions while recognizing the on-going importance of obtaining state and federal grants to assist with financing mitigation actions. In addition, the section describes how the public will continue to be involved in the mitigation planning process.

For this 2022 update, the Plan was not revised due to a change in priorities within jurisdictions. While the revisions reflect updates in such areas as the identification of Significant Hazards, demographics, etc., the priorities among all jurisdictions remain unchanged.

Method and Schedule for Monitoring, Evaluation, & Revision

The Local Mitigation Strategy Working Group has identified procedures for the periodic review of the local mitigation strategy. This process provides a coordinated approach for municipal, county regional, and state review at the various level of government. The LMS Working Group, which includes municipal, county and other organizational representatives meets quarterly unless otherwise noted to discuss mitigation strategies and projects.

Plan Maintenance Method and Approach

The LMS Working Group Planning Subcommittee created the plan method and maintenance approach consistent with the process and steps presented in FEMA's How-To-Guide: "Bringing the Plan to Life" (FEMA 386-4). The following FEMA requirements are addressed in this section:

Requirement §201.6(c)(4)(i): [The plan maintenance process ***shall*** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan with a 5-year cycle.

Requirement §201.6(c)(4)(ii): [The plan ***shall*** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, where appropriate.

Requirement §201.6(c)(4)(iii): [The plan maintenance process ***shall*** include a] discussion on how the community will continue public participation in the plan.

Municipal

All participating municipalities shall have membership in the LMS Working Group. Each municipality should form a municipal working group to review the local mitigation strategy and identify potential mitigation programs/projects in their communities. Residents and adjacent or impacted communities need to be included in the review process at the local level. This mechanism will serve to expand and improve upon the capabilities that are described in this plan. Since the 2017 update, all municipalities that adopted this Plan have incorporated the information into their respective mitigation strategy planning.

The following participating municipalities will be seeking approval of the Plan:

Coconut Creek	City
Cooper City	City
Coral Springs	City
Dania Beach	City
Davie	Town
Deerfield Beach	City
Fort Lauderdale	City
Hallandale Beach	City
Hillsboro Beach	Town
Hollywood	City
Lauderdale-by-the-Sea	Town
Lauderdale Lakes	City
Lauderhill	City
Lazy Lake	Village
Lighthouse Point	City
Margate	City
Miramar	City
North Lauderdale	City
Oakland Park	City
Parkland	City
Pembroke Park	Town
Pembroke Pines	City
Pompano Beach	City
Plantation	City
Sea Ranch Lakes	Village
Southwest Ranches	Town
Sunrise	City
Tamarac	City
West Park	City
Weston	City
Wilton Manors	City

In addition, the following Special Districts will be seeking approval of the Plan:

Coral Springs Improvement District
South Broward Drainage District
Memorial Hospital System

The LMS should be reviewed at the municipal level on an annual basis. An updated project list from each municipality shall be composed and submitted to Broward County Emergency Management Division by mid-January of each year as part of the revisions to the Local Mitigation Strategy. Possible viable projects should be sought throughout the year and placed in the WebEOC Mitigation project portal or removed/altered during the open enrollment cycle.

County

Components of the LMS shall be reviewed and updated annually including a revised countywide mitigation project list and membership roster. The review, revision and evaluation will be done through completion of the annually required Florida Administrative Code (FAC) 27P annual report to the state and discussed at quarterly Working Group meetings. Consolidation of municipal proposed revisions to the project list should be completed by January 15th of each year. A WebEOC mitigation project board was created to annually track and update possible mitigation projects by the County. An internal review shall be conducted by the Broward County Emergency Management Division as part of the annual self-assessment process. All county/municipal revisions shall be reviewed by staff and the LMS Working Group as needed, and the changes will be submitted to the Emergency Management Director or designee for approval, if deemed necessary.

All applicable components of the ELMS may be incorporated into the Broward County Comprehensive Emergency Management Plan as part of the annual review process. The Broward County Comprehensive Emergency Management Plan is reviewed and approved by the State every 4 years. Any proposed revisions from the State review of the CEMP will be part of the revisions submitted to the Board of County Commissioners. All necessary changes to Broward County and municipal comprehensive plans should be added into the established review schedule for the applicable elements and amendments.

Exercises shall be occurring that are based upon the hazard identification and vulnerability assessment of Broward County's Local Mitigation Strategy and existing roles as assigned per the Comprehensive Emergency Management Plan and supporting SOPs. The Integrated Preparedness Plan for Broward shall also focus on those hazards for exercises and training opportunities to address the need and be focused on the identified hazards and risks as outlined in the Local Mitigation Strategy. Mitigation initiatives shall be incorporated into county and state exercises as applicable.

This mechanism will serve to expand and improve upon the capabilities that are described in this plan.

Regional

A revised Enhanced Local Mitigation Strategy may be submitted to the South Florida Regional Planning Council (SFRPC) for review as a member of the LMS Working Group. Copies of the Local Mitigation Strategy may be available for adjacent counties and other applicable jurisdictions for comments.

The LMS Working Group has identified a regional conflict resolution procedure. Any disputes arising from the local mitigation strategy shall be mediated utilizing the South Florida Regional Planning Council Dispute Resolution Process. The SFRPC has established a Regional Dispute

Resolution Process (RDRP), as specified by Florida Statutes, 186.509.

*Participation in the RDRP does not waive any party's right to judicial or administrative action, nor does it convey or limit intervener status or standing in any judicial or administrative proceeding.

State

The revised ELMS shall be submitted to the State of Florida, Division of Emergency Management for review and comment as required by the 5-year FEMA review cycle or as directed by the division. This 2022 ELMS is being submitted as a full update to the State and FEMA and will be adopted by the Broward County Board of County Commissioners and the municipalities. The next update will be due to the State in early 2027.

Procedures have been identified to ensure that a broad group of local government representatives, citizens, adjacent community representatives, and county liaisons participate in the review and revision of the local mitigation strategy.

Implementation

Each municipality and Broward County is responsible for implementing mitigation actions as prescribed in this plan. Under the direction of the LMS Executive Committee and the coordination of the Broward County Emergency Management Division, funding will be sought from a variety of sources to implement mitigation projects in both pre-disaster and post-disaster environments. In addition, each municipality will be responsible for the integration of mitigation actions into the planning processes of their respective communities and providing mitigation input into their respective municipal capital improvement/risk management process. Broward County will act as a catalyst and facilitator to encourage this level of mitigation integration in the municipalities.

Mitigation actions will be integrated into other planning documents of the Broward County Emergency Management Division. Opportunities to integrate the requirements of this Plan into other planning mechanisms shall continue to be identified through future meetings of the Executive Committee and the 5-year review process described herein.

The Director of the Broward County Emergency Management Division or designee, acting as the Local Mitigation Strategy Chairperson, has overall leadership and guidance for implementing the LMS Plan. The Local Mitigation Strategy Coordinator is the key primary staff for review and ensuring participation in the planning process as well as submitting for approval of plan updates and changes prior to State/Federal mandated 5-year update.

Below are some of the activities that have been predefined to support implementation:

- Incorporate hazard mitigation actions into existing community planning mechanisms (e.g., attend comprehensive planning meetings, communicate frequently with community planners on land use issues, on-going meetings with community planners on issues of overlapping interest)
- Provide input and feedback into annual county budget process (e.g., capital improvement spending) for consideration of hazard mitigation measures beyond code.
- Partner with the Risk Management Division and the County's property and casualty insurer to coordinate efforts to lower risk and augment mitigation measures at each facility when opportunities present themselves (i.e., through the CIP or other spending)
- Encourage communities to find new ways to accrue CRS credit points or join CRS if not

currently in the program.

- Coordinate with and engage the County's Climate Change Government Operations group on mutual interests to increase effectiveness of both groups.
- Revisit indicators of project/action effectiveness or success and monitor/evaluate projects/actions that have been implemented.
- Collect important damage data after storm events when feasible.
- Implement the evaluation/revision schedule established to ensure plan is up to date at the end of 5-year cycle.
- Continue refining the process for public input and community involvement during the entire 5-year cycle.

Monitoring

Periodic revisions of the LMS Plan will be monitored by the LMS Executive Committee. The LMS Coordinator of the Broward Emergency Management Division will monitor and document hazard events, note changes in the risk environment, capture damage and loss data, and maintain and update hazard and vulnerability data on an ongoing basis.

The LMS Coordinator will organize, schedule, and conduct meetings of the Local Mitigation Strategy Work Group and respective subcommittees to address issues of interest, provide LMS members with meeting summaries and action items, and retain meeting results in LMS files. The LMS Coordinator will monitor grant opportunities and advise LMS member organizations of deadlines and application requirements.

The above activities outline general plan maintenance during the four years leading up to the fifth year of the planning cycle. Beginning in July before the revision year (the 4th year of the planning cycle), the Planning Subcommittee will lead a more intensive planning effort to update the Plan, obtain approvals, make necessary revisions, and work with the LMS Coordinator on completing items for the FEMA crosswalk for review and approval by the State and FEMA.

Evaluation

The LMS Plan, in parts or whole, will be evaluated annually to coincide with the Florida Administrative Code 27 P update and after significant disasters to review the effectiveness of its projects, programs, and policies. Areas needed for update will be noted for changes at the end of the year. As part of the annual review process, certain chapters will be identified by the LMS Chair and/or LMS Coordinator for review based on need. The LMS Working Group reviews the hazard mitigation goals to ensure that they continue to comply with County and municipal goals. The goals will also be reviewed to determine if changes are necessary.

As part of the annual evaluation, each entity shall review and revise their mitigation project lists such as for relevancy, costs, status, etc.as part of the overall master county- wide mitigation projects list. Projects are reviewed annually and are placed into the WebEOC mitigation project board for the respective year.

The LMS Working Group will determine if any significant events have occurred in the County to warrant any considerable changes in the ELMS Plan. In the event of a disaster or when deemed necessary by its members, the LMS Working Group and its subcommittees may meet more frequently.

Revision and Update

5 Year Plan Review

The Planning Committee will thoroughly review and analyze each Chapter of the LMS Plan during the 4th and 5th years of the 5 year Plan cycle to determine whether there have been any significant changes county-wide that would necessitate revisions in the types of mitigation actions proposed: 1) new development in identified hazard areas; 2) an increased exposure to hazards; 3) the increased or decreased capability to address hazards; 4) changes to county comprehensive planning and capital improvement funding policies; and 5) changes to federal or state legislation are examples of factors that may affect the necessary content of the Plan. The committee will also assess and consider recommended changes provided by the State and FEMA in the previous 5-year plan revision cycle. Input from each Committee will also be incorporated into the Plan.

During the 5-year Plan update cycle, the following process will occur to allow sufficient time for updating a plan of this size, for submitting for review by the State and FEMA, addressing State and FEMA comments, and adoption by all jurisdictions:

- At 2 years prior to Plan expiration, the LMS Planning Committee will identify areas that have been modified and need to be updated per the identified responsibilities of this group. During this time, the Broward County LMS Coordinator while working with the Planning Committee will review Federal, State, and local regulations and guidance to see if any appropriate changes need to be made The LMS Coordinator is tasked with making note of proposed changes and start the revision of the plan and update.
- At 8 months prior to Plan expiration is the desired time frame for the updated Broward County ELMS should be submitted to the State of Florida for review. It shall be noted that this man not always be achievable due to existing circumstances.

The plan review provides the LMS Working Group an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented. The LMS Coordinator will be responsible for convening the Planning and Executive Committees and conducting the 5-year review.

During the 5-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals address current and expected conditions?
- Has the nature or magnitude of risks changed?
- Are current human and capital resources appropriate for implementing the Plan?
- Are there additional partnering opportunities for evaluating risk and implementing mitigation?
- Are there new opportunities to implement, fund or integrate mitigation?
- Are there implementation obstacles, such as social, technical, administrative, political, legal, economic environmental issues, or coordination issues?
- Have the outcomes occurred as expected?
- Did the identical departments, individuals, and/or other partners participate in the plan implementation process as volunteered or assigned?
- Are there potential mitigation actions that would require a longer time horizon to realize (10 to 20 years out) for which it is important to start laying the groundwork?

Upon completion of the review and update process, the LMS Coordinator will send to LMS Chairperson and the Executive Committee to do a final review of the revised Plan as needed and approve the Plan to be submitted to the State Hazard Mitigation Officer at FDEM for final review and approval in coordination with FEMA.

After FEMA has approved the County Plan, the LMS Coordinator will submit it to the Board of County Commissioners for formal adoption. Once the Plan is formally adopted by the County, each of the 31 municipalities will follow suit.

Local Adoption

Once the LMS Plan is adopted by the County, all participating municipalities must also adopt the plan. Copies of resolutions must be submitted to the County LMS Coordinator for filing with the State and FEMA, to ensure eligibility of mitigation grant programs administered by FEMA. Appendix F contains local adoptions.

Post-Disaster Review and Update

In the event of a disaster, findings from the damage assessments and damage data collection, success story reporting will be reported to the LMS Planning Subcommittee. These findings will in turn be reviewed and the plan will be updated to reflect lessons learned, or to address specific issues and circumstances arising from the event, regardless of the 5-year interval. Data collection worksheets, when collected, will be kept by the County. Any future revisions of the plan will be posted on the County's website.

Recommendations to Continually Enhance the 5-Year Plan Review Process

- Invite State and FEMA mitigation counterparts to periodic meetings to keep them informed on the County's actions, policies, coordination efforts and successes.
- Track and share mitigation successes and challenges by utilizing the LMS meetings and other communication mechanisms to share best practices to increase the mitigation knowledge of municipalities and other stakeholders.
- Sharpen focus on what mitigation works well in the County (e.g., working with insurer, applying for FEMA grants, working with Climate Change groups)
- Communicate periodically with elected officials to inform them on policy changes and/or funding decisions that would better support mitigation.
- Continually search for better sources of risk data to assist with demonstrating cost-effectiveness with proposed projects.

Incorporation into Existing Planning Mechanisms

As part of the planning process, the Planning Subcommittee identifies current plans, programs, policies/ordinances, and studies/reports that will augment or help support mitigation planning efforts. The LMS Working Group will be the mechanism for ensuring that entities integrate hazard mitigation into its future planning activities. The subsection below entitled "Plan Integration Efforts" describes some of the examples from the ELMS process in identifying additional opportunities to incorporate mitigation into existing planning mechanisms.

To ensure the continued consistency, Broward County's Enhanced Local Mitigation Strategy (ELMS) Hazard Identification and Risk Assessment serves as the primary hazard identification and risk assessment for Broward County. Broward County ELMS shall be utilized for a detailed

hazard identification and risk assessment for all Broward County plans. An updated version of the hazard identification and risk assessment will be conducted in conjunction with each review and iteration of the County's Enhanced Local Mitigation Strategy.

Plan Integration Efforts

A major objective of the ELMS process is to integrate mitigation into other essential community planning processes. This strategy will allow achievement for more consistency, integration, and more effectiveness of mitigation practices into several existing county-wide, regional, state, and federal planning mechanisms. Below is a summary of some the integration efforts to demonstrate where other plans and programs are consistent with the Broward County's Local Mitigation Strategy and developed in concert with the Local Mitigation Strategy.

Jurisdiction Plan Integration Process

The LMS Coordinator works closely with all jurisdictions in a uniform effort to include ELMS planning strategies within local hazard mitigation planning. It is primarily accomplished via quarterly meetings with the Local Mitigation Strategy Working Group, meetings of the LMSWG Subcommittees, and in collaboration with the Emergency Management Division's Municipal Services Branch.

Broward County Comprehensive Emergency Management Plan

Broward County's Comprehensive Emergency Management Plan (CEMP), as adopted Nov. 17, 2020, was developed on the premise to provide an "all hazards" approach to emergency management. The Broward CEMP consists of three major components -the Basic Plan including supporting Standard Operating Procedures and annexes: the Broward Recovery Plan and the Broward Enhanced Local Mitigation Strategy (ELMS). The ELMS outlines the County's mitigation program to address a myriad of possible mitigation measures that will reduce or eliminate exposure to hazard impacts. The ELMS provides a comprehensive and coordinated hazard mitigation program for Broward County and its 31 municipalities aligned with Broward's CEMP. The Broward CEMP is consistent with the ELMS as having the same defined significant hazards of concern. Presently, the ELMS is integrated into the Broward County Comprehensive Emergency Management Plan (CEMP) through both plans' review cycles. Throughout the CEMP update process, the LMS Coordinator works closely with the Planning Section staff to ensure that elements of the ELMS are incorporated within the sections of the CEMP that address Broward County's mitigation strategies and initiatives. Additionally, the LMS Coordinator will continue to ensure that policies, programs, and mitigation actions are consistent between the ELMS and the Broward County CEMP. Further, all jurisdictions within Broward County having CEMPs are required to be consistent with the County CEMP. It should be noted that most municipalities have indicated that the vulnerability assessment section of the ELMS has been incorporated into their CEMP and is also utilized in the same manner to help develop Continuity of Operations (COOP) Plans like the County.

The Broward CEMP sets up an incident management system based upon National Incident Management protocols. This framework has identified roles and responsibilities for the Broward Emergency Response Team in the Broward Emergency Operations Center (EOC) environment. Recognizing the significance of prepositioning mitigation in the EOC response for the identification of mitigation opportunities, there is a Mitigation Unit under the Planning Section to ensure mitigation is part of the EOC response and short-term recovery planning. Mitigation is then further incorporated into the long-term recovery phase as part of the Recovery Coordination Center if activated.

County Comprehensive Plan

Broward County's Comprehensive Plan serves as a growth management planning document that guides development based upon projected growth and anticipated associated impacts on the County. The Broward NEXT 2.0 version of Broward County's Comprehensive Plan was adopted on March 28, 2019 (Ordinance No. 2019-11) with some elements being revised in 2020 and 2021 and amendments in 2022 as noted in support documents. Broward County's Land Use and comprehensive plans were updated including involvement from the 31 municipalities. The Broward County Land Use Plan of the Broward County Comprehensive Plan addresses climate resiliency, adaptation action areas and priority planning areas to address taking on a county-wide approach to land use planning. This last update of Broward Next sought to comprehensively update the County's land use planning program to meet the challenges of future growth by setting priorities and parameters for housing, transit, climate reliance and adaption, regional economic development, environmental protection, and disaster preparedness through mitigation.

The Coastal Management Element of the Comprehensive Plan was amended in 2022. The purpose of the Coastal Management Element (CME) is to plan for, and where appropriate, limit development activities where such activities would damage or destroy coastal resources, protect human life, and limit public expenditures in areas that are subject to destruction by natural disaster. The Florida Administrative Code (FAC) requires the CME to address coastal management, natural disaster, and deep-water port issues. Consistent with Florida Statutes Section 163.3177(g)7, the purpose of the Natural Disaster Component (NDC), as part of the Coastal Management Element (CME), is to plan to "protect human life against the effects of natural disasters." Natural disaster planning issues have been singled out as a separate component to stress their importance in Broward County. The NDC Support Document provides the data and analysis used as the basis for the goal, objectives and policies included in the NDC and was developed to provide for initiatives to support local mitigation strategy efforts.

SE Florida Regional Climate Change Compact: Regional Climate Action Plan

The Southeast Florida Regional Climate Change Compact was created in 2010 by Broward, Miami-Dade, Monroe, and Palm Beach counties to coordinate and collaborate on climate change action across county lines and is a leading example of regional-scale climate action and mitigation implementation. In 2012, the Compact codified its vision in its first Regional Climate Action Plan (RCAP). The Southeast Florida Regional Climate Change Compact is now on the third iteration (November 2022) of its Regional Climate Action Plan (RCAP). Developed with the guidance of more than 150 subject matter experts, including community members and stakeholders, the RCAP 3.0 provides updated guidance to support the implementation and acceleration of local and regional climate action in Southeast Florida.

The RCAP outlines goals, recommendations and supporting strategies across 11 focal areas to advance the objectives, of strengthening the adaptive capacity and climate resilience of the region's communities, institutions, and economy. The RCAP serves Broward, Miami-Dade, Monroe, and Palm Beach counties, inclusive of 109 municipal governments, the Seminole Tribe of Florida, and the Miccosukee Tribe of Indians of Florida, encompassing a total regional population of more than 6.2 million people.

Risk Reduction and Emergency Management is a highlighted focus area of the RCAP with the following Goal: Prepare SE Florida for climate shocks and stressors by coordinating interdisciplinary risk-reduction planning and with emergency management planning. There are currently 15 recommendations under this Goal with identified strategies for implementation that were developed to enhance regionally and then locally through Broward County's Local Mitigation Strategy programs and projects. The 15 recommendations are: Identify climate risks to communities, built/physical environment and infrastructure; Integrate climate risks into hazard mitigation and emergency planning; Advance infrastructure investments to reduce risks; Advocate for solvency and affordability of insurance; Prioritize investments in transportation infrastructure; Strengthen regulations to reduce risk; Promote existing risk mitigation policies and programs; Utilize distributed renewable energy for disaster recovery; Communicate climate risks and emergency information; Develop post-disaster redevelopment plans; Provide small business recovery resources; Train local government staff on disaster preparedness; Engage with frontline communities to inform planning; Identify low-income populations in "communities at risk" and strengthen inter-and intra- governmental coordination.

There are ongoing coordination efforts throughout Broward County government to ensure continued integration of mitigation measures as it relates to strengthen the adaptive capacity of Broward. Broward County has a Chief Resilience Officer along with a Resilience Environment Department to recommend, and develop programs, implement projects and policies to support sustainability and resilience. The Broward County Government Operations Climate Change workgroup, led by the Resilience Environment Dept. allows for the opportunity for Broward County governmental divisions/departments to assist in implementing various elements of the Climate Change Action Plan including the Emergency Management Division to promote countywide measurable efforts.

State's Resilient Florida Program

The Resilient Florida program was created in 2021 by Senate Bill 1954/House Bill 7019 to provide a coordinated approach for Statewide Flooding and Sea Level Rise Resilience Planning with an accompanying grant program administered by the Florida Department of Environmental Protection to help communities prepare for the impacts of flooding and storm surge. The legislation ensures a coordinated approach to Florida for coastal and inland resilience. The targeted funding and new directives have enhanced efforts to protect inland riparian areas, coastlines, shores, and coral reefs all which serve as invaluable natural defenses against sea level rise. These initiatives have been incorporated locally into Broward County's local mitigation strategy and supporting projects, programs, and plans.

Broward County and local municipalities will receive a combined $92 million in grant funds in 2023 for resilient infrastructure improvement projects. The funding was made available through the competitive grant program by the Florida Department of Environmental Protection to fund projects to help prepare coastal and inland communities to the adverse impacts of flooding and storm surge. Broward County received nearly $66 million to advance mitigation, infrastructure, and other water management improvements. 16 Broward County projects have been awarded funds, including replacement and improvement of bridges, septic to sewer conversions, wastewater

pumps, bulkheads, and several stormwater infrastructure projects. The cities of Dania Beach and Ft Lauderdale were also funded for critical stormwater and infrastructure upgrades in the amount of $25 million including the neighborhoods of Progresso and Dorsey Bend.

The Florida Dept. of Environmental Protection has also funded round of planning grants to assist in completing up to date comprehensive vulnerability assessments by 2026. Of the 122 communities awarded, Broward County and 11 Broward County cities received funding to update and/or develop vulnerability assessments.

State's Enhanced Hazard Mitigation Plan

The Florida Division of Emergency Management works closely with Broward County to ensure that the State Hazard Mitigation Plan and initiatives are incorporated locally into Broward's Local Mitigation Strategy and vice versus on a recurring basis and not just part of the 5-year updates. Starting in 2010, the State FDEM Mitigation Unit has invited members of the Local Mitigation Strategy working groups to participate in mitigation planning including the quarterly Mitigate Fl meetings. Broward County Emergency Management has been actively participating in Mitigate FL activities over these years. The State provides a variety of forums so that there is cross-jurisdiction interface as it relates to mitigation planning activities. The State FDEM Mitigation Unit along with other State agencies with mitigation programs such as FL DEP are invited and are part of programming for Broward County's Local Mitigation Strategy Workgroup.

The Floodplain Management Program; Flood Mitigation Assistance Program; Hazard Mitigation Grant Program, Hurricane Loss Mitigation Program; Pre-Disaster Mitigation Grant Program; Building Resilient Infrastructure and Communities Grant Program and Watershed Planning Initiatives are all programs that Broward takes every opportunity to partake in with the Florida Division of Emergency Management (FDEM). FDEM acts as the coordinating agency and provides support to Broward and its municipalities on these program areas, and all are part of the State's overall Mitigation Strategy. As new programs are developed and briefed through forums such as Mitigate FL, Broward County will incorporate into local planning initiatives as applicable.

South Florida Water Management District Planning

The South Florida Water Management District is a regional governmental agency that manages water resources in the southern half of the state covering 16 counties including Broward County for entire area of 9 million residents. The South Florida Water Management District operates and maintains the regional water management system known as the Central and South Florida Project, which was authorized by Congress more than 75 years ago to protect residents and businesses from floods and droughts. The primary system includes approximately 2,200 miles of canals, 2,100 miles of levees/berms, 84 pump stations, and 778 water control structures. This primary system of canals and waterways connects to community drainage districts and hundreds of smaller neighborhood systems to effectively manage floodwaters during heavy rains. As a result of this interconnected drainage system, flood control is a shared responsibility between the District, Broward County and other County and city governments served by the District, local drainage districts homeowner associations and residents.

On Sept. 8, 2022, the Governing Board for the South Florida Water Management District approved a cost share agreement with the U.S. Army Corps of Engineers to advance a new flood resiliency study for SE Florida Component of the Central & South Florida Project, the backbone of the region's flood management system. Broward County is an actively engaged participant in the process including participating in the planning charettes in January 2023 and holding Broward

County workshops in February 2023. The Flood Resiliency Study will address flood damage reduction, water supply and related water resource concerns that may occur over next 50 years through solutions that are structural, non-structural, natural and nature based.

National Flood insurance Program and Community Rating System

The National Flood Insurance Program is a federally subsidized flood damage insurance program administered by Federal Emergency Management Agency. Residents and businesses are eligible to purchase NFIP flood insurance policies in communities that regulate development in special flood hazard areas. Broward County has a robust participation in the National Flood Insurance Program with active engagement in the Community Rating System (CRS) self-voluntary incentive program to recognize and encourage community floodplain management practices that exceed the minimum requirements of the National Flood Insurance Program. Broward County and the participating CRS municipal communities shall continue to participate in the Local Mitigation Strategy process and support Community Rating System programs to minimize hazard risks and gain flood protection benefits for their residents. The Local Mitigation Strategy CRS Subcommittee/User Group evaluates changes to the CRS program and identifies areas where the County, and municipalities, can get more credit points based on existing activities and potential new ones. The CRS communities are constantly striving to reduce risk and by enacting flood mitigation measures and are at the forefront of the Local Mitigation Strategy. Activities such as outreach and infrastructure protection projects are emphasized The LMS supports the three overarching goals of the CRS:

1. Reduce flood losses and damage to insurable properties.
2. Support the insurance aspects of the National Insurance Program.
3. Encourage a comprehensive approach to local flood plain management and risk mitigation.

Out of 31 municipalities in Broward County, 23 are CRS Communities. The Broward Municipal Services District (unincorporated areas) is also a CRS Community, bringing the total number to 24. However, the seven communities that are not CRS Communities are enrolled in the National Flood Insurance Program.

Capital Improvement Planning: Linking LMS to County and Municipal CIPs

Broward County government and municipal partners have been actively engaging any opportunity to further enhance mitigation into projects funded under general and enterprise revenue funding streams through capital improvement and supplements as necessary. Some accomplishments focusing on populations at risk since the last Local Mitigation Strategy update including funding permanent fixed generators at schools utilized as Special Medical Needs shelters; retrofit of the two Homeless Assistance Centers ended up funded through HMGP; redundant generators and chillers for EOC and elevating proposed building design in new builds for example Property Appraiser and Supervisor of Elections as Broward County is a High Velocity Hurricane Zone (HVHZ) projects to meet “essential” and “enhanced standards’’ specs beyond the 2020 Florida Building Code.

Since the CIPs are local project funding processes in multiple sectors of local government service, it is both important to first determine where mitigation is occurring in current CIP projects. Second, and more importantly, it is critical to facilitate a process to integrate the potential more fully for mitigation in the full life cycle of the CIP selection and funding process.

The Mitigation Assessment Team (MAT) tool process is one of the tools that can identify opportunities for proactive mitigation measures to be identified year-round. This process is for considering the maximum practicable hazard mitigation protection for any county investment in retrofitting, repairing, upgrading, enhancing, or new construction for facilities or infrastructure. The County's insurer typically requires additional protection above and beyond code under its authority. This additional protection usually pertains to high wind protection to a Category 3 hurricane or greater but does not necessarily pertain to all other likely hazards, namely flood, which is the purview of the federal government.

The MAT tool process should identify additional mitigation opportunities above and beyond what is required under code and the County's insurer's authority. Parameters for investment include practical, cost-effective county investments during a construction process where a facility or infrastructure is being modified or built. Examples include protecting a county critical facility to a Category 5 wind speed and/or 1 foot of freeboard above the 500-year flood level. This process will consider future risk conditions, like climate change and sea level rise impacts, and an optimal time financially when the modification or new construction is being planned and constructed.

The MAT tool process will consider all potential funding sources but typically it is geared toward finance through County Capital Improvement funds. Therefore, it is essential that the identification process begin when capital improvement projects are first being considered in the CIP budgeting process. This typically occurs ten years in advance of when they are expected to be funded. The process will work roughly like this:

- When a new project is first considered in the CIP budget process at the Division Level (5-8 years in advance for a general project and 2-5 years in advance for a specific project), the MAT will review it for mitigation potential. If the team agrees that some form of mitigation is appropriate and cost-effective, it will provide a description of the mitigation idea with the scope of the CIP project and factor in the mitigation cost into the overall project cost. The MAT may use a worksheet with pre-identified actions to guide the process. The mitigation funding will likely be from the Alternative Financing process.
- As the date of actual funding and design gets close (1 to 2 years out), the MAT will help justify the need for the project to the County commission. The Finance team will help organize the alternative finance application. The MAT will also help draft the Request for Proposals (RFP) to make sure that the scope of services has a clear description of the mitigation measure.

The MAT tool process discussed above links the LMS's goals, principles, and strategies through to the County Capital Improvement Plan when feasible. To provide a link between the LMS and the local CIPs, each municipality should consider replicating this process as applicable at the community level.

Continued Public Involvement

Broward County and the LMS Working Group are dedicated to continued public involvement in the hazard mitigation planning and review process. Public participation has been woven into Broward County activities throughout the year to keep all stakeholders informed of the local mitigation strategy plan and updates, provide support and input for programs and projects with the hazards Broward faces, the possible impacts from those hazards and ways to mitigate.

Broward County participation in National Preparedness Month, Severe Weather Awareness

Week, Cyber Awareness Month, Eye of the Storm event, Hurricane Preparedness Open House, Business Resiliency Summit, Water Matters Day, municipal hurricane season preparedness briefings, awareness fairs, etc. are just a handful of preparedness and mitigation public participation activities that the County does to heighten awareness and discuss possibilities for mitigation and the overall mitigation strategy.

As described earlier in this chapter, significant changes or amendments to this Plan are discussed in the public, as deemed appropriate, to participate in the planning process prior to formal adoption procedures. Efforts to involve the public in the Plan maintenance, evaluation, and revision process were initiated as described per the Florida Sunshine Law with all LMS meetings being open to the public. To obtain the most recent input from the public and the LMS Working Group, an All-Hazards Survey was launched to solicit feedback from these two audiences. Broward's underserved and vulnerable communities were provided the opportunity to be involved in this initiative, as the Survey was disseminated to all population groups within the county.

The 2023 All-Hazards Survey and its description are included in Appendix M of this plan.

Chapter 4: Risk Assessment

Introduction

This chapter of the LMS includes the assessment of hazard risks facing Broward County and its participating municipal jurisdictions. The purpose of the risk assessment is to use best available data and technology to identify and evaluate potential hazard risks facing Broward County, as well as provide the factual basis for mitigation activities proposed in Broward County's LMS that aim to reduce those risks. The chapter has been broken down into the following key sections:

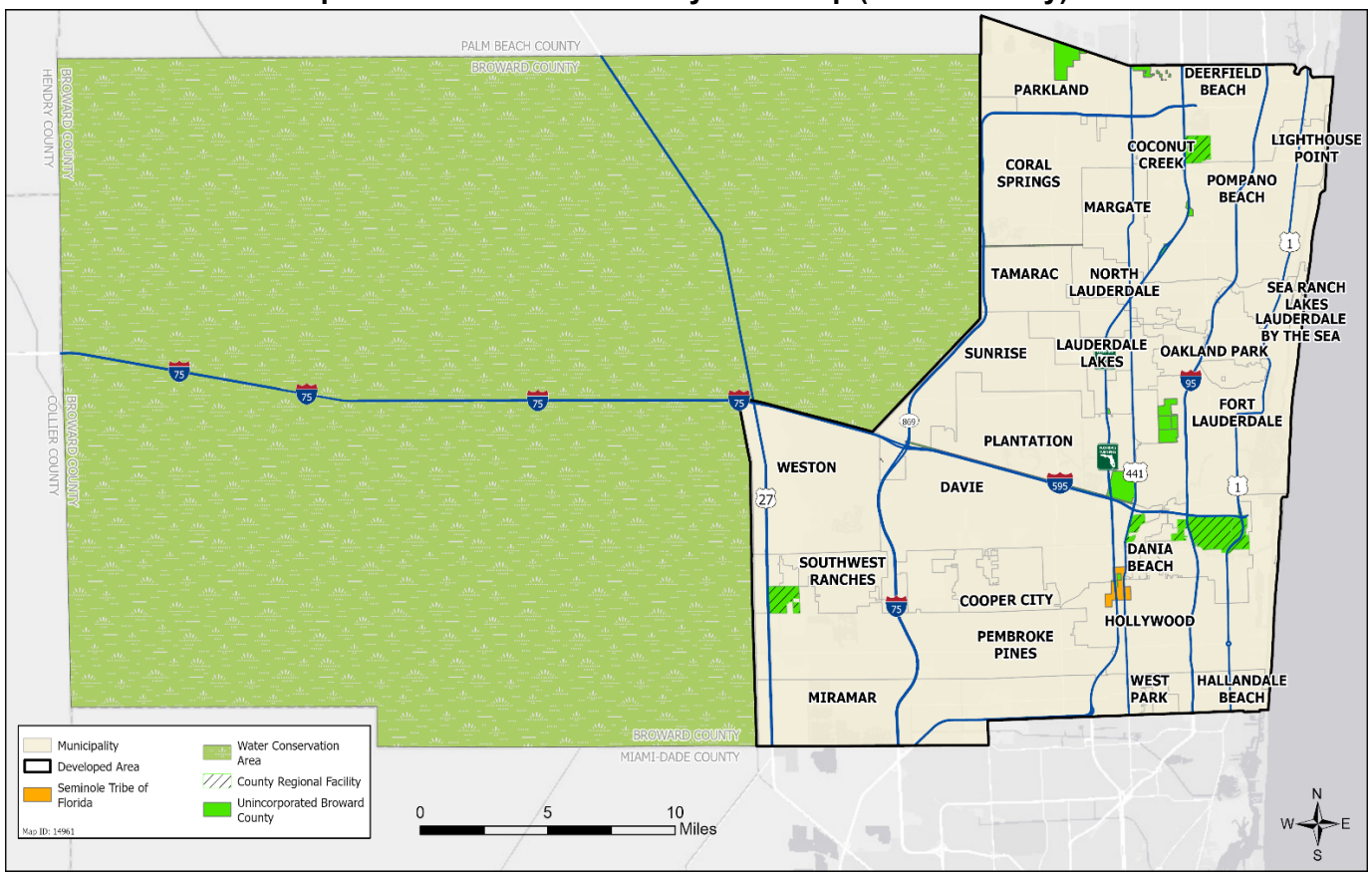
- Introduction
- Risk Assessment Methods
- Asset Inventory
- Initial Hazard Identification
- Natural Hazards
- Human Caused Hazards
- Conclusions on Hazard Risk

The risk assessment completed for Broward County provides for the identification and analysis of known hazards that may threaten life and property across the entire planning area. It also includes the results of a multi-jurisdictional vulnerability assessment conducted for each of Broward County's municipal jurisdictions[1] (shown in **Maps 4.1 and 4.2**) to determine where locally specific risks vary from those facing the rest of the county. The vulnerability assessment helps to describe each jurisdiction's vulnerability to identified hazards in terms of the types and numbers of buildings, infrastructure, and critical facilities located in hazard areas as well as potential loss estimates for vulnerable structures.

The Threat Hazard Identification and Risk Assessment (THIRA), Economic Vulnerability, and Mitigation Initiatives for Broward County have been prepared in compliance with the Federal Emergency Management Agency's Local Multi-Hazard Mitigation Planning Guidance, dated March 2013.and meets the requirements of 44 CFR § 201.

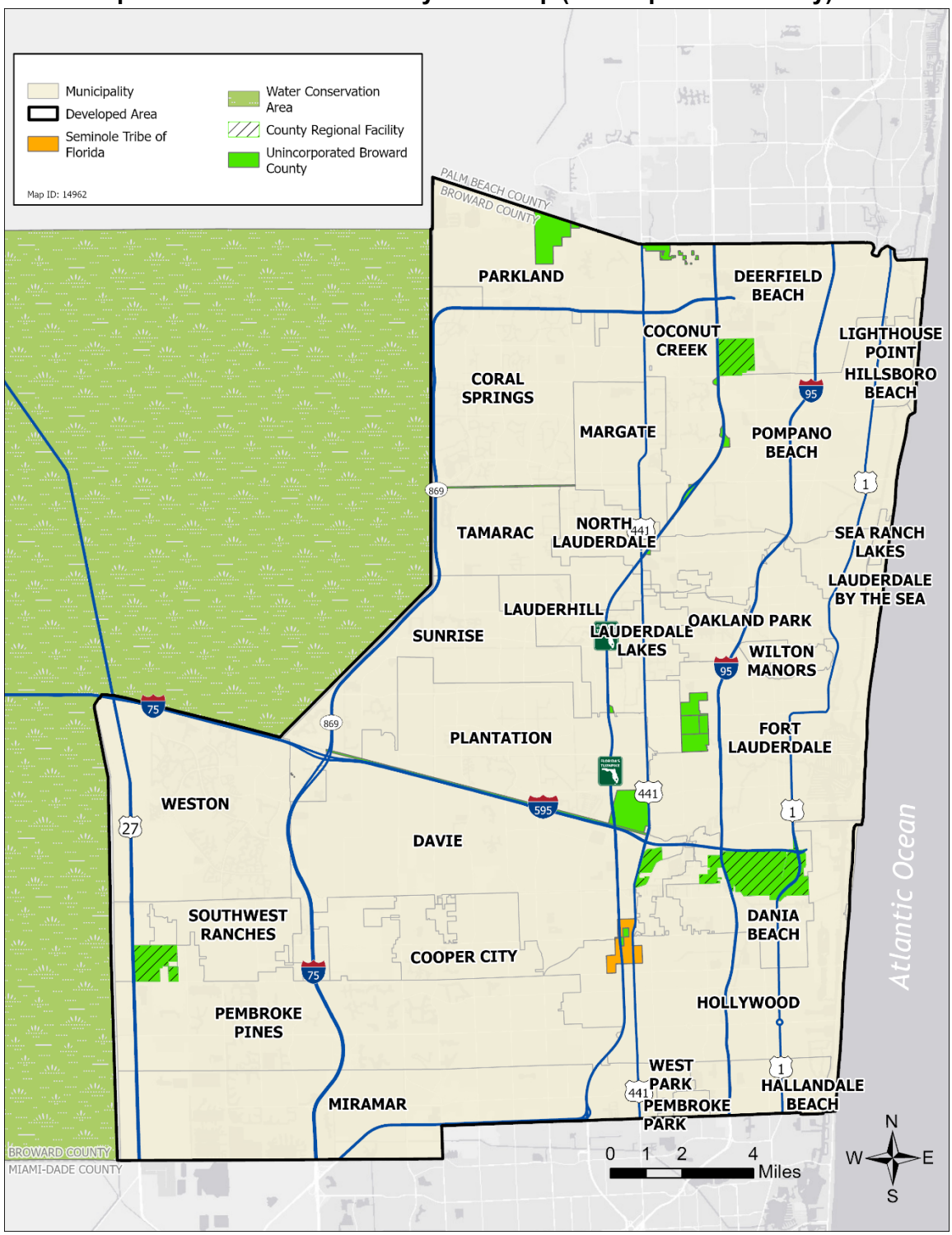
1 Although this risk assessment does not officially or comprehensively analyze risks faced by the Seminole Tribe of Florida, it is of significance to note that the Seminole Reservation Headquarters is located in Hollywood and there are 2 Seminole run Casinos located in Hollywood and Coconut Creek. The Hollywood Reservation is a 497 acre urban reservation that is home to more than 500 Seminoles.

Map 4.1: 2022 Broward County Base Map (Entire County)



Source: Broward County GIS 2022

Map 4.2: 2022 Broward County Base Map (Developed Areas Only)



Source: Broward County GIS 2022

Risk Assessment Methods

As described above, the risk assessment completed for Broward County includes two primary studies including: (1) the hazard identification and analysis; and (2) a multi-jurisdictional vulnerability assessment.

Data and modeling from FEMA's National Risk Index (effective 2022) was utilized for the updates to this section.

The hazard identification and analysis provide the following information for each hazard:

- A general background description of each potential natural, technological, and/or human caused hazard that could impact Broward County
- The known locations and/or spatial extent of each hazard (if applicable)
- A locally specific history of past hazard occurrences based on best available data.
- A statement addressing the probability of future hazard occurrences that could affect Broward County

All the information presented as part of the hazard identification and analysis is based on existing local, state, and federal sources as cited throughout. Sources include historical records on hazard events (such as the storm events database maintained by the National Climatic Data Center) as well as input from the Broward County Mitigation Task Force and other relevant information provided through existing local plans, studies, and reports.[2]

The multi-jurisdictional vulnerability assessment was conducted with two distinct methodologies: first, utilizing Hazards United States-Multi-Hazards (Hazus-MH), FEMA's loss estimation software, and second, a statistical risk assessment methodology. Each approach provides estimates for the potential impact by using a common, systematic framework for evaluation. The results of the multi-jurisdictional vulnerability assessment are provided for each hazard immediately following the summary of information provided through the hazard identification and analysis, as listed above.

The Hazus-MH risk assessment methodology is parametric, in that distinct hazard and inventory parameters (wind speed and building types) were modeled using the Hazus-MH software to determine the impact (damages and losses) on the built environment.

The statistical risk assessment methodology was applied to analyze hazards of concern that were outside the scope of the Hazus-MH software. The Hazus-MH driven methodology uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information. Below is a brief description of both approaches.

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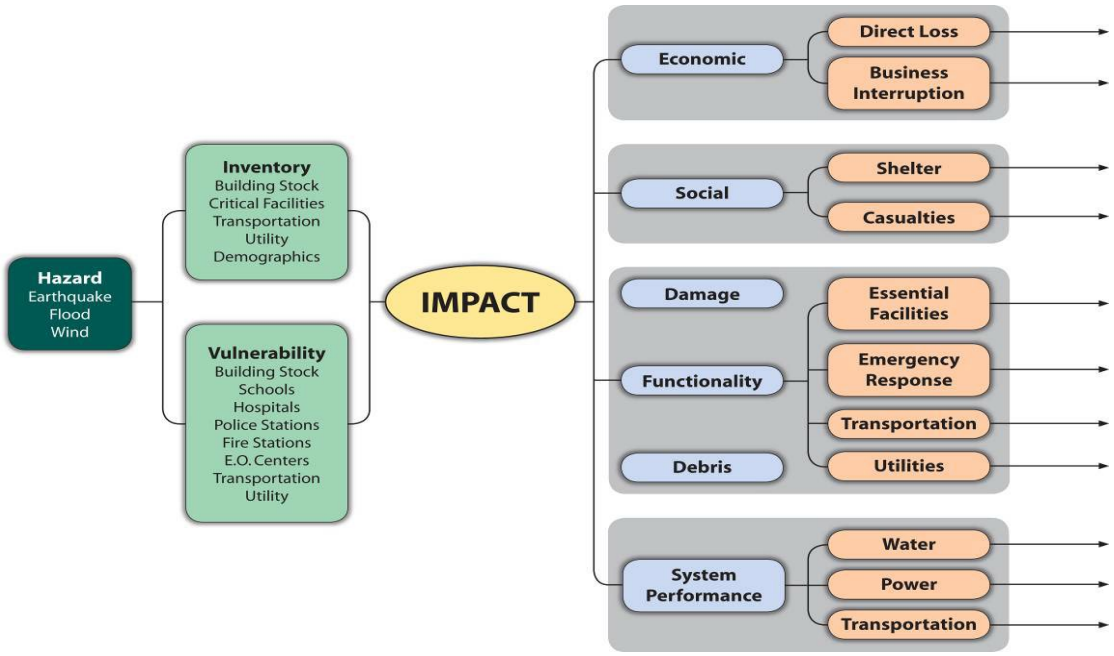
2 Other existing plans, studies and reports include the 2000 version of the Broward County Local Mitigation Strategy, the Broward County Economic & Socioeconomic Vulnerability Study, Port Everglades Vulnerability & Economic Study, the Broward County profile from Florida Department of Community Affairs report entitled *Integrating Hazard Mitigation Planning into Comprehensive Planning,* the State of Florida Hazard Mitigation Plan and the CSX Transportation Hazardous Materials Density Study for Broward County, Florida (2006).

Hazus-MH

Hazus-MH is FEMA's standardized loss estimation software program built upon an integrated geographic information system (GIS) platform (Figure 4.1) in March 2011. After the initial release of the program, FEMA released Hazus 2.0 in May/June 2011. The main update to Hazus in the 2.0 version was to enhance the capability of integrating storm surge results into the flood module. Subsequent versions of Hazus, including versions 3.0 (released November 2015) and 4.0 (March 2017) were released following Hazus 2.0. These updates provided optimizations to the Hazus program.

Figure 4.1: Conceptual Model of Hazus-MH Methodology



Statistical Risk Assessment Methodology

Risks associated with other natural and anthropogenic hazards (beyond wind and flood) were analyzed using a statistical assessment methodology developed and used specifically for this effort. Historical data for each hazard were used and statistical evaluations are performed using manual calculations. The general steps used in the statistical risk assessment methodology are summarized below:

Compile data from the following sources:

Local

National

Literature

Clean up data.

Remove duplicates.

Update losses (For inflation).

Modify losses (For population growth and distribution).

Identify patterns in:

Frequency

Intensity

Vulnerability

Loss

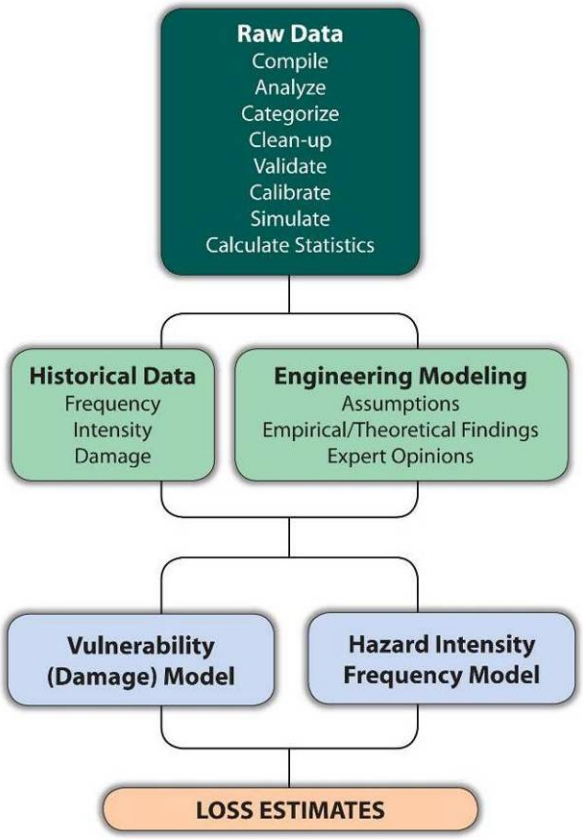
Statistically and probabilistically extrapolate the patterns.

Produce meaningful results.

Development of annualized loss estimates.

Figure 4.2 illustrates a conceptual model of the statistical risk assessment methodology as applied to Broward County.

Figure 4.2: Conceptual Model of the Statistical Risk Assessment Methodology



The economic loss results are presented here using two interrelated risk indicators:

1. The Annualized Loss (AL), which is the estimated long-term weighted average value of losses to property in any single year in a specified geographic area (i.e., county).

2. The Annualized Loss Ratio (ALR), which expresses estimated annualized loss normalized by property replacement value.

The estimated Annualized Loss (AL) addresses the key idea of risk: the probability of the loss occurring in the study area (largely a function of building construction type and quality). By annualizing estimated losses, the AL factors in historic patterns of frequent smaller events with infrequent but larger events to provide a balanced presentation of the risk. The Annualized Loss Ratio (ALR) represents the AL as a fraction of the replacement value of the local inventory. This ratio is calculated using the following formula:

ALR = Annualized Losses / Total Exposure

The annualized loss ratio gauges the relationship between average annualized loss and replacement value. This ratio can be used as a measure of vulnerability in the areas and, since it is normalized by replacement value, it can be directly compared across different geographic units such as metropolitan areas or counties. Loss estimates provided herein used best available data, and the methodologies applied resulted in an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

National Climatic Data Center Storm Event Database

Much of the historical event data presented in the tables in this section were taken directly from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database. NCDC receives storm data from the National Weather Service (NWS) which, in turn, receives their information from a variety of sources, including, but not limited to county, state and federal emergency management officials, local law enforcement officials, SKYWARN spotters, NWS damage surveys, newspaper clipping services, the insurance industry, and the public. For many hazards, NCDC data is most accurate beginning from the early to mid-1990's which limits its usefulness for conducting a detailed risk assessment. However, as it is the source of the best available data that can be easily obtained (and is recommended for use by FEMA), it has been heavily relied on to profile and analyze the hazards further discussed in this section.

Asset Inventory

A variety of data exists on buildings, infrastructure, and critical facilities for Broward County. For purposes of the multi-jurisdictional vulnerability assessment, much of this data was based on the inventory databases made readily available through Hazus-MH, FEMA's loss estimation software as described earlier in this section under "Risk Assessment Methods." This includes the number, type, and value of buildings located in each municipality in Broward County. **Table 4.1** summarizes the total building value for each jurisdiction as extracted from the Broward County Property Appraiser (and as utilized for estimating losses to hurricane wind, flood, and storm surge). **Table 4.2** shows the average just/market value of parcels in Broward County by their property type.

Table 4.1: Total Building Values for Broward County, By Type (As of September 2022)

Jurisdiction	Residential	Commercial	Industrial	Other*	Total
Coconut Creek	$5,308,909,990	$805,513,680	$240,721,850	$887,360,030	$7,242,505,550
Cooper City	$4,591,234,610	$318,873,860	$68,517,700	$409,271,000	$4,978,626,170
Coral Springs	$13,067,431,720	$1,998,948,900	$491,146,440	$1,106,486,350	$16,664,013,410
Dania Beach	$2,990,734,460	$1,339,458,760	$697,771,010	$317,585,910	$5,345,550,140
Davie	$11,853,653,860	$1,759,800,890	$990,297,550	$1,997,775,730	$16,601,528,030
Deerfield Beach	$7,665,862,030	$1,294,968,150	$1,370,437,260	$743,783,810	$11,075,051,250
Fort Lauderdale	$40,280,953,900	$10,752,834,340	$2,272,989,410	$3,627,783,620	$56,934,561,270
Hallandale Beach	$5,977,437,030	$906,218,460	$139,187,800	$293,143,460	$7,315,986,750
Hillsboro Beach	$1,752,642,150	$61,813,44	n/a	$11,425,720	$1,764,067,870
Hollywood	$18,164,519,180	$3,834,129,350	$1,186,380,450	$2,215,839,670	$2,215,839,670
Lauderdale-By-The-Sea	$3,037,585,970	$255,812,280	n/a	$19,396,310	$3,312,794,560
Lauderdale Lakes	$1,864,453,620	$275,274,920	$68,113,330	$249,755,110	$2,457,596,980
Lauderhill	$4,201,226,650	$499,780,820	$152,189,350	$430,646,050	$5,283,842,870
Lazy Lake	$11,490,720	n/a	n/a	$174,100	$11,664,820
Lighthouse Point	$3,463,656,570	$199,891,700	n/a	$34,792,700	$3,698,340,970
Margate	$4,669,009,960	$671,966,370	$200,018,900	$346,971,590	$5,887,966,820
Miramar	$12,938,283,030	$1,516,968,730	$983,373,570	$1,205,410,780	$16,644,036,110
North Lauderdale	$2,535,258,620	$317,307,420	$75,602,810	$231,044,240	$3,159,213,090
Oakland Park	$4,067,559,470	$901,865,930	$637,647,060	$313,595,980	$5,920,668,440
Parkland	$7,098,143,900	$116,627,160	$3,280,100	$479,324,610	$7,697,375,770

Jurisdiction	Residential	Commercial	Industrial	Other*	Total
Pembroke Park	$246,977,110	$157,079,450	$437,630,750	$68,216,460	$909,903,770
Pembroke Pines	$17,822,903,010	$2,532,946,030	$413,564,750	$1,673,757,640	$22,443,171,430
Plantation	$11,335,157,280	$2,258,055,930	$176,185,550	$982,216,780	$14,751,615,540
Pompano Beach	$13,222,377,380	$2,093,551,700	$3,111,607,580	$1,544,596,220	$19,972,132,880
Sea Ranch Lakes	$368,738,330	$18,434,880	n/a	$5,970	$387,179,180
Southwest Ranches	$1,972,755,640	$51,181,950	$9,715,730	$579,093,920	$2,612,747,240
Sunrise	$7,978,446,620	$2,679,191,270	$730,009,370	$1,164,328,160	$12,117,656,630
Tamarac	$6,122,085,300	$673,518,680	$307,692,710	$362,381,480	$7,465,678,170
Broward Municipal Services District	$897,304,560	$103,732,400	$76,004,350	$2,814,337,220	$3,891,378,530
West Park	$1,036,657,630	$95,148,410	$112,844,610	$58,338,670	$1,302,989,320
Weston	$10,534,843,600	$938,458,330	$416,465,720	$754,904,360	$12,644,672,010
Wilton Manors	$2,055,372,370	$239,614,090	$17,674,550	$116,382,180	$2,429,043,190
TOTAL	$229,133,666,270	$39,607,154,840	$15,387,070,260	$25,040,125,83	$285,139,398,430

* “Other” building occupancy category includes agriculture, religious/nonprofit, government, and education occupancies.

Source: Broward County Property Appraiser September 2022 Tax Roll Data.

Table 4.2: Average Just Value for Broward County, By Type

Property Type	Average Just/Market Value
Vacant Residential	$187,198
Single Family	$391,453
Townhouse	$247,441
Mobile Home	$88,950
Condominium	$178,272
Cooperative	$149,591
Multi-Family	$1,126,151
Vacant Commercial	$592,312

Commercial	$1,706,120
Vacant Industrial	$854,391
Industrial	$1,537,279
Agricultural	$359,147
Institutional	$2,849,088
Governmental	$4,032,498
Other	$65,108

Source: Broward County Property Appraiser 2019 Tax Roll Data

In addition to the data made readily available through Hazus-MH, some local inventory data has been integrated into the multi-jurisdictional vulnerability assessment. This also includes local tax assessor records for developed parcels in each of the municipal jurisdictions, which were utilized to estimate potential losses due to flooding events as further described under the vulnerability assessment section of the "Flood" hazard.

Critical Facilities

Critical Facilities are defined as those structures from which essential services and functions for survival, continuation of public safety actions, and disaster recovery are performed or provided. For the purposes of this document, Broward County has identified those critical facilities that have the potential for being affected by natural and human caused disasters. The identification and location of critical facilities throughout Broward County are shown in **Map 4.3**.

Population and Development Trends

According to the 2020 Census, Broward County was the second most populous county in the State of Florida, with 1,944,375 people. At the 2010 Census conducted on April 1, 2010, the population of Broward County stood at 1,748,066. The percentage population gain from 2010 to 2020 was 11.2% (an increase of 196,309 people). Population projections for Broward County were established in 2009 by a Broward County Population Forecasting Model (see **Figure 4.3)**.

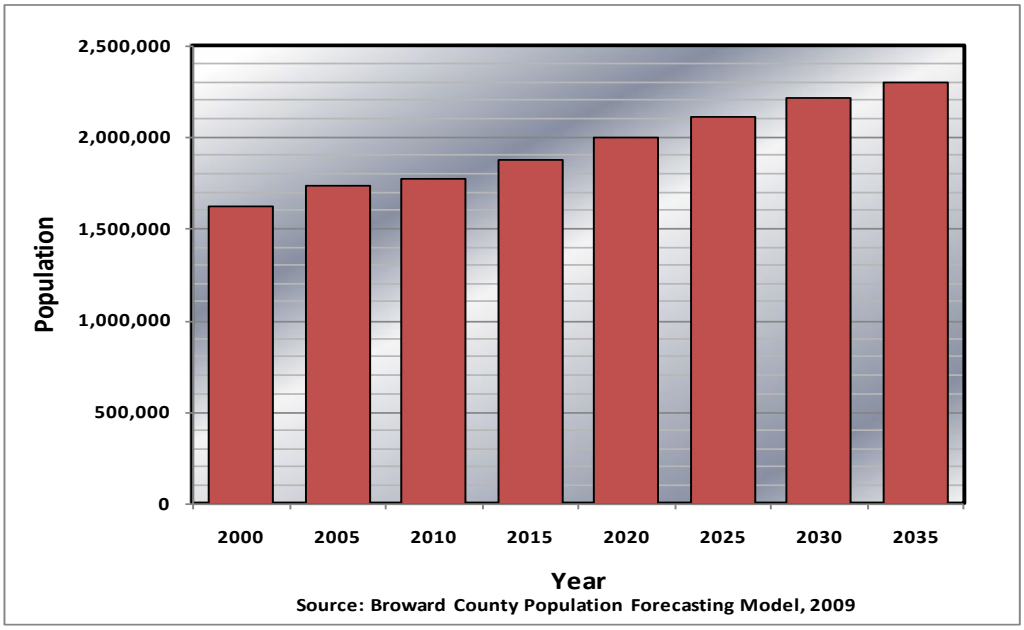
Broward County is composed of 31 Municipalities as well as the Broward Municipal Services District, also referred to as unincorporated areas. The most significant population increases between 2000 and 2010 were seen in Parkland (73%), Miramar (68%), and Weston (33%). The most significant percent change between 2010 and 2020 were seen in Parkland (45%), Lazy Lake (38%), Cooper City (21%), and Tamarac (19%). In 2020, Fort Lauderdale (182,760) and Pembroke Pines (171,178) continued as the 2 largest Municipalities in Broward County, making up 18% of the total Broward County population (see **Table 2.2**).

Potential Impact to Jurisdictions

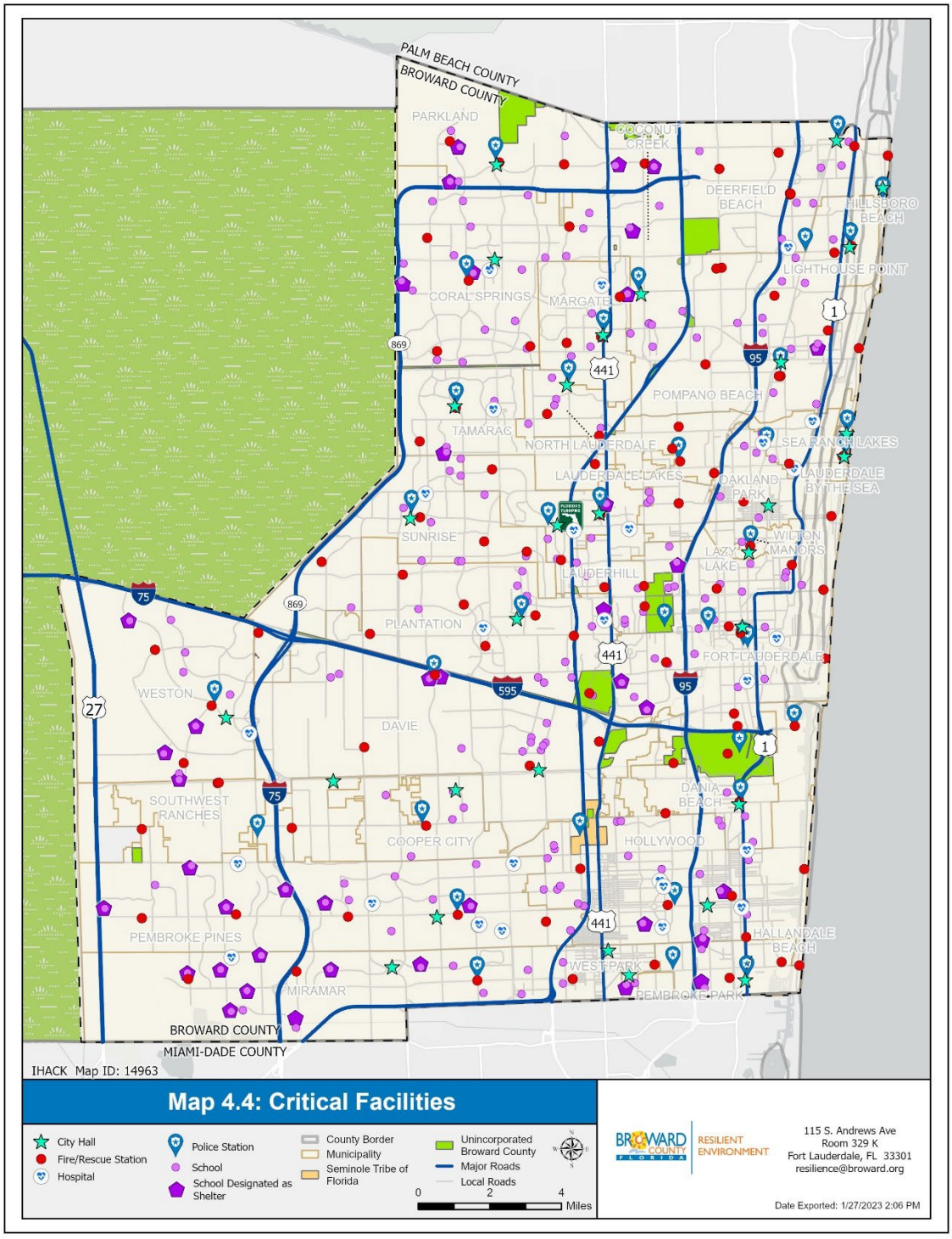
Broward County comprises 1,225 square miles. Thus, its 31 municipalities and unincorporated areas are vulnerable in varying degrees to several hazards that are identified in this update. For example, the County has 24 miles of coastline and 300 miles of inland waterways, making the coastal communities more vulnerable to the effects of Coastal Erosion and Sea Level Rise than the central and western communities. The central and western communities are potentially more

vulnerable to Wildfire, with a continuing westward expansion of development. All Broward communities are vulnerable to the hazards of Extreme Heat, Severe Storms, Tornados, Tropical Cyclones, Drought, Flood, Pandemic/Infectious Disease, Mass Migration, Terrorism, Active Shooter, HazMat Incident, and Cyber.

Figure 4.3: Population Projections for Broward County 2000-2035



Map 4.3: Critical Facilities



Source: Broward County GIS 2022

Hazard Vulnerability Profile for Existing and Future Land Use

This section provides information on Broward County's existing and future land use vulnerabilities to three spatially defined hazards to be addressed further in this risk assessment including storm surge from tropical cyclones, flood, and wildfire. It borrows heavily from a study performed by the Florida Department of Community Affairs (FDCA), an agency that is now defunct. Beginning in 2004, land use tabulations in relation to known hazard areas were developed by FDCA's Division of Community Planning as part of an analysis entitled, *Integrating Hazard Mitigation Planning into Comprehensive Planning: Broward County Profile.* The following data were used for the tabulations: online Mapping for Emergency Management, Parallel Hazard Information System (MEMPHIS)[3], 2017 Broward County Property Appraiser / Florida Department of Revenue data, and the current Florida Department of Environmental Protection and South Florida Water Management District GIS databases and shapefiles.

This section will be revised for the next update to reflect the most recent changes based upon data from the Broward County Property Appraiser.

For the purposes of this profile, the identified hazard areas include the coastal hazards zone in relation to storm surge, hurricane vulnerability zones in relation to evacuation clearance times, flood zones in relation to the 100-year flood, and wildfire susceptible areas. More details about the hazard zones used for the tabulation are as follows:

- The Coastal Hazards Zone (CHZ) illustrates areas at risk to surge, which is comprised of the category 1 storm surge zone from NOAA Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model and the category 1 evacuation zone.

- The Hurricane Vulnerability Zone (HVZ) shows hurricane risk, which includes Category 1 to 3 Hurricane Evacuation Zones.

- FEMAs designated 100-year flood zones (i.e., A, AE, V, VE, AO, 100 IC, IN, AH) are used for flood.

- All medium-to-high risk zones from MEMPHIS for wildfire (Level 5 through Level 9).

Existing land use data was acquired from County Property Appraisers and the Florida Department of Revenue for tabulation of the total amount of acres and percentage of land in identified hazard areas, sorted by existing land use category for the Broward Municipal Services District areas. The total amount of acres and percentage of land in the identified hazards areas was tabulated and sorted by future land use category according to the local future land use map, as well as the amount of these lands listed as vacant according to existing land use. Broward County future land use data was acquired from Broward County and might not reflect changes per recent future land use amendments.

3 MEMPHIS was designed to provide a variety of hazard related data in support of the Florida Local Mitigation Strategy DMA2K revision project. It was created by Kinetic Analysis Corporation under contract with the FDCA. For more details on a particular hazard or an explanation of the MEMPHIS methodology, consult the MEMPHIS Web site (http://lmsmaps.methaz.org/lmsmaps/index.html).

County acreage was tabulated by existing (**Table 4.3**) and future (**Table 4.4**) land uses within the hazard areas.[4] The results of these land use tabulations are summarized below along with some recommendations included with the FDCA study. This information was confirmed for accuracy and relevance with the Division of Forestry in July 2017.

Storm Surge from Tropical Cyclones

Table 4.3 presents the existing land uses within the surge zone. There are 14,665 acres of land within the coastal hazard zone (CHZ) and an additional 237 acres in the hurricane vulnerability zone (HVZ). These zones are primarily located on the barrier islands and inland up to a couple miles. Incorporated coastal communities occupy most of the land in these zones. Currently, 43.1% of the CHZ and 42.6% of the HVZ have single-family homes. Another major existing land use of these zones is commendably parks and conservation, with 13.0% of the CHZ and 13.9% of the HVZ used for these purposes. In addition, approximately 19% of both zones are still undeveloped. **Table 4.4** shows that of the currently vacant land in the CHZ and HVZ, 33.4% and 28.7%, respectively, are designated for future transportation uses. While future investment in transportation in these zones may increase evacuation capacities, it also will increase the taxpayer's investment in a hazardous area and subsidize future growth where the intention is to limit densities. **Table 4.4** also shows that currently vacant land is allocated for future residential use. According to the tabulations, 10.8% of the vacant property in both zones is designated for 5 dwelling units per acre and another 8.6% of the CHZ and 10.1% of the HVZ vacant acres are designated for 25 dwelling units per acre. If development occurs accordingly, it will further increase the population in the Category 1 evacuation zone and likely put more people at risk from storm surge.

Flood

Table 4.3 presents the existing land uses within the 100-year floodplain. Much of Broward County is within a flood zone. Currently, 193,965 acres are at risk from flooding, but this does not include the Everglades Conservation Area which naturally floods. Of the 193,965 acres, 64.8%, or 125,750 acres are in residential use. Also, 33,981 flood-prone acres, or 17.5%, of the floodplain, is currently undeveloped. An additional 9,934 acres besides those in the Everglades Conservation Area are designated as parks, conservation areas, and golf courses. Using flood-prone areas for parks and conservation purposes is a strong flood mitigation strategy since development can be limited in these areas and the natural hydrology left in place. Existing vacant land allows the County and municipalities an opportunity to regulate or limit development before it occurs. Of the 33,981 acres currently undeveloped in the zone, 50.2% are designated for future residential uses, as shown in Table 4.4. Another 3,177 acres are designated for commercial use while an additional 1,260 vacant acres are designated for community facilities. Transportation and right-of-way future land uses are designated towards 14.2% of existing undeveloped land. This is a lot of development that is currently allowable within the 100-year floodplain. With proper mitigation designed into these structures and roads, much of the development can occur without increasing the vulnerability of the County to flood losses. However, alterations to the natural hydrology often have unforeseen impacts if mitigation occurs in a piece-meal fashion rather than looking at system-wide drainage impacts.

4 Note: The Everglades Conservation Area is not included in the following land use tabulations.

Wildfire

Because of climate change, Wildfire poses an increased risk to Broward County, particularly in the less developed areas to the west. The data included in Table 4.3 represents the still current Wildfire vulnerability profile for the county. Revised data will be included in the next ELMS update.

Table 4.3 presents the land uses associated with high-risk wildfire zones. Small wildfire-prone areas are found throughout the County, although there is a concentration along Route 27. Single-family homes are found in 46.9% of the wildfire susceptible acres, generally scattered in isolated areas south of Highway 75 and east of Route 27. These homes are most likely very vulnerable to a wildfire since single-family residential neighborhoods on the outskirts of urban areas typically have a lot of vegetation that can allow a fire to spread between homes. Another 24% of the wildfire risk areas, or 1,628 acres, are currently conserved and special attention should be paid to maintaining wildfire fuel levels through prescribed burning or mechanical means in these areas. Another 875 acres are currently undeveloped. Vacant lands often can add to wildfire risk since wildfire fuel levels are not typically maintained. Of the undeveloped land, Table 4.4 shows that 19.1% is designated for future residential estates and 12.6% is designated for rural ranches. When development does occur on these lands, wildfire mitigation techniques for neighborhood design should be encouraged as well as education of homeowners about maintaining defensible space.

Table 4.3: Total County Acres in Hazard Areas by Existing Land Use Category

Existing Land Use Category		Coastal Hazard Zone	Hurricane Vulnerability Zone	Flood Zones	Wildfire Susceptible Areas
Agriculture	Acres	85.8	150.1	5,446.3	832.0
	%	0.49%	0.68%	2.88%	3.54%
Attractions, Stadiums, Lodging	Acres	144.8	295.6	509.1	2.9
	%	0.82%	1.33%	0.27%	0.01%
Places of Worship	Acres	45.3	117.2	1,678.6	187.1
	%	0.26%	0.53%	0.89%	0.80%
Commercial	Acres	615.2	1,224.4	9,445.8	370.4
	%	3.49%	5.51%	5.00%	1.58%
Government, Institutional, Hospitals, Education	Acres	2,170.2	1,116.4	14,097.4	1,900.2
	%	12.32%	5.02%	7.47%	8.10%
Industrial	Acres	249.0	302.8	5,803.5	271.2
	%	1.41%	1.36%	3.07%	1.16%
Parks, Conservation Areas, Golf Courses	Acres	2,643.1	2,633.0	9,676.3	743.7
	%	15.00%	11.85%	5.12%	3.17%
Residential Group Quarters, Nursing Homes	Acres	5.9	7.1	337.0	0.2
	%	0.03%	0.03%	0.18%	0.00%
Residential Multi-Family	Acres	174.5	853.8	5,673.1	183.0
	%	0.99%	3.84%	3.00%	0.78%
	Acres	182.7	279.0	2,701.5	61.0

Existing Land Use Category		Coastal Hazard Zone	Hurricane Vulnerability Zone	Flood Zones	Wildfire Susceptible Areas
Residential Mobile Home, or Commercial Parking Lot	%	1.04%	1.25%	1.43%	0.26%
Residential Single-Family	Acres	1,577.1	5,264.2	32,778.4	2,635.8
	%	8.95%	23.68%	17.36%	11.23%
Submerged Lands (Water Bodies)	Acres	3,181.1	1,966.1	16,171.3	2,345.7
	%	18.05%	8.84%	8.56%	9.99%
Transportation, Communication, Rights-of-Way	Acres	2,157.8	1,972.1	24,255.1	1,997.5
	%	12.25%	8.87%	12.85%	8.51%
Utility Plants and Lines, Solid Waste Disposal	Acres	232.4	15.9	8,732.3	6,836.9
	%	1.32%	0.07%	4.62%	29.13%
Vacant	Acres	221.8	122.9	4,994.7	178.5
	%	1.26%	0.55%	2.65%	0.76%
All Others	Acres	701.2	907.5	18,827.5	2,795.3
	%	3.98%	4.08%	9.97%	11.91%
No Data	Acres	3,233.6	5,000.9	27,688.5	2,130.6
	%	18.35%	22.50%	14.66%	9.08%
TOTAL	**Acres**	**17,621.5**	**22,229.0**	**188,816.4**	**23,472.2**
	%	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Source: Broward County Property Appraiser GIS July 2017 Data, Broward County Property Appraiser GIS, Florida Regional Planning Councils and Florida Division of Emergency Management, Broward County GIS, FEMA National Flood Hazard Layer, Southern Wildfire Risk Assessment

Table 4.4: Total and Undeveloped Acres in Hazard Areas by Future Land Use Category

Future Land Use Category		Coastal Hazard Zone		Hurricane Vulnerability Zone		Flood Zones		Wildfire Susceptible Areas	
		Total	Undev.	Total	Undev.	Total	Undev.	Total	Undev.
Activity Center	Acres	949.2	340.0	1415.8	794.4	11498.5	6718.0	884.9	390.3
	% of Total	5.4%	4.9%	6.4%	7.1%	6.1%	7.3%	3.8%	5.3%
Agricultural	Acres	77.9	0.0	0.0	0.0	9686.1	959.8	7989.9	518.0
	% of Total	0.4%	0.0%	0.0%	0.0%	5.1%	1.0%	34.0%	7.0%
Commerce	Acres	1386.3	889.0	1681.4	1086.8	24230.8	16386.7	1338.6	862.2
	% of Total	7.9%	12.9%	7.6%	9.7%	12.8%	17.9%	5.7%	11.6%
Commercial Recreation	Acres	312.8	281.6	357.1	307.0	4169.6	2235.6	0.0	0.0
	% of Total	1.8%	4.1%	1.6%	2.7%	2.2%	2.4%	0.0%	0.0%
Community	Acres	314.0	190.3	499.3	385.1	7055.3	5911.2	937.5	890.8
	% of Total	1.8%	2.8%	2.2%	3.4%	3.7%	6.4%	4.0%	12.0%

Future Land Use Category		Coastal Hazard Zone		Hurricane Vulnerability Zone		Flood Zones		Wildfire Susceptible Areas	
		Total	Undev.	Total	Undev.	Total	Undev.	Total	Undev.
Conservation - Natural Reservations	Acres	1681.5	214.0	1518.8	223.2	4218.1	674.6	1172.5	156.6
	% of Total	9.5%	3.1%	6.8%	2.0%	2.2%	0.7%	5.0%	2.1%
Conservation - Reserve Water Supply Area	Acres	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	% of Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Electrical Generation Facility	Acres	501.5	255.3	59.4	53.7	561.7	313.5	0.0	0.0
	% of Total	2.8%	3.7%	0.3%	0.5%	0.3%	0.3%	0.0%	0.0%
Estate (1) Residential	Acres	30.6	2.8	0.0	0.0	13515.7	8919.2	554.0	255.1
	% of Total	0.2%	0.0%	0.0%	0.0%	7.2%	9.7%	2.4%	3.4%
High (50) Residential	Acres	184.0	61.4	794.0	199.4	1070.5	318.9	0.0	0.0
	% of Total	1.0%	0.9%	3.6%	1.8%	0.6%	0.3%	0.0%	0.0%
Irregular Residential	Acres	160.5	4.7	30.3	2.2	20689.9	6677.7	2731.2	711.3
	% of Total	0.9%	0.1%	0.1%	0.0%	11.0%	7.3%	11.6%	9.6%
Low (2) Residential	Acres	53.3	29.2	93.3	66.0	3366.3	1099.0	1053.3	218.2
	% of Total	0.3%	0.4%	0.4%	0.6%	1.8%	1.2%	4.5%	2.9%
Low (3) Residential	Acres	1778.1	413.7	2699.4	1282.6	12859.2	5083.9	1155.8	319.0
	% of Total	10.1%	6.0%	12.1%	11.5%	6.8%	5.5%	4.9%	4.3%
Low (5) Residential	Acres	3188.8	1214.9	5257.2	3326.6	26515.3	12498.9	182.7	38.7
	% of Total	18.1%	17.6%	23.6%	29.7%	14.0%	13.6%	0.8%	0.5%
Low-Medium (10) Residential	Acres	283.0	81.6	356.2	234.8	7476.2	3197.6	200.5	39.3
	% of Total	1.6%	1.2%	1.6%	2.1%	4.0%	3.5%	0.9%	0.5%
Medium (16) Residential	Acres	374.8	81.8	1068.9	519.8	6972.1	3015.5	6.4	0.0
	% of Total	2.1%	1.2%	4.8%	4.6%	3.7%	3.3%	0.0%	0.0%
Medium-High (25) Residential	Acres	806.0	110.7	2029.3	597.3	3742.8	1150.9	0.0	0.0
	% of Total	4.6%	1.6%	9.1%	5.3%	2.0%	1.3%	0.0%	0.0%
Mining	Acres	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	% of Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Palm Beach County Rural Residential-10	Acres	0.0	0.0	0.0	0.0	112.7	37.0	0.0	0.0
	% of Total	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Recreation and Open Space	Acres	1590.4	984.1	1409.6	852.5	10026.6	7235.7	1174.1	997.7
	% of Total	9.0%	14.3%	6.3%	7.6%	5.3%	7.9%	5.0%	13.4%
Rural Estates	Acres	0.0	0.0	0.0	0.0	1348.1	910.0	637.6	391.4
	% of Total	0.0%	0.0%	0.0%	0.0%	0.7%	1.0%	2.7%	5.3%
Rural Ranches	Acres	0.0	0.0	0.0	0.0	5318.6	3988.3	2296.1	1639.0

Future Land Use Category		Coastal Hazard Zone		Hurricane Vulnerability Zone		Flood Zones		Wildfire Susceptible Areas	
		Total	Undev.	Total	Undev.	Total	Undev.	Total	Undev.
	% of Total	0.0%	0.0%	0.0%	0.0%	2.8%	4.3%	9.8%	22.1%
Transportation	Acres	2122.8	1624.5	1702.8	1136.4	11334.4	4243.0	928.5	0.0
	% of Total	12.0%	23.6%	7.7%	10.2%	6.0%	4.6%	4.0%	0.0%
Water	Acres	1825.9	109.0	1256.1	114.7	3022.1	115.1	228.6	0.0
	% of Total	10.4%	1.6%	5.7%	1.0%	1.6%	0.1%	1.0%	0.0%
TOTAL	**Acres**	**17621.5**	**6888.5**	**22229.0**	**11182.7**	**188790.5**	**91690.1**	**23472.2**	**7427.4**
	% of Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Source: Broward County Property Appraiser GIS July 2017 Data, Broward County Property Appraiser GIS, Florida Regional Planning Councils and Florida Division of Emergency Management, Broward County GIS, FEMA National Flood Hazard Layer, Southern Wildfire Risk Assessment

Small wildfire-prone areas are found throughout the County, although there is a concentration along Route 27. Single-family homes are found in 46.9% of the wildfire susceptible acres, generally scattered in isolated areas south of Highway 75 and east of Route 27. These homes are most likely very vulnerable to a wildfire since single-family residential neighborhoods on the outskirts of urban areas typically have a lot of vegetation that can allow a fire to spread between homes. Another 24% of the wildfire risk areas, or 1,628 acres, are currently conserved and special attention should be paid to maintaining wildfire fuel levels through prescribed burning or mechanical means in these areas. Another 875 acres are currently undeveloped. Vacant lands often can add to wildfire risk since wildfire fuel levels are not typically maintained. Of the undeveloped land, 19.1% is designated for future residential estates and 12.6% is designated for rural ranches. When development does occur on these lands, wildfire mitigation techniques for neighborhood design should be encouraged as well as education of homeowners about maintaining defensible space.

Major Disaster Declarations

Prior to determining the potential hazards of most significant concern for Broward County, it is also helpful to review past major disaster declarations that have impacted the area. Major disasters are declared by the President of the United States when the magnitude of a disaster event is of such severity and magnitude that effective response is beyond the capabilities of the State and the local governments. In these cases, eligible applicants may apply for a wide range of federal disaster assistance that include funds for public assistance, individual assistance, and hazard mitigation assistance.

Since 1965, Broward County has received 21 presidential disaster declarations for hurricane, flood, wildfire, tornado, and freeze events as listed in **Table 4.5**. Please note that this listing does not include all federal, state, or local emergency declarations issued for smaller, less damaging disaster events that did not warrant a presidential declaration.

Table 4.5: Presidential Disaster Declarations for Broward County (1965–2022)

Event	Declaration Date	Declaration Number
Hurricane Betsy	09/14/1965	FEMA-209-DR
Freeze	03/15/1971	FEMA-304-DR
Hurricane Andrew	08/24/1992	FEMA-955-DR
Tornadoes, Flooding, High Winds & Tides, Freezing	03/22/1993	FEMA-982-DR
Severe Storms, High Winds, Tornadoes, and Flooding	02/20/1998	FEMA-1204-DR
Severe Storms, High Winds, Tornadoes, and Flooding	03/09/1998	FEMA-1195-DR
Extreme Fire Hazard	06/18/1998	FEMA-1223-DR
Hurricane Irene	10/20/1999	FEMA-1306-DR
Heavy Rains and Flooding	10/04/2000	FEMA-1345-DR
Severe Freeze	02/06/2001	FEMA-1359-DR
Hurricane Charley and Tropical Storm Bonnie	08/13/2004	FEMA-1539-DR
Hurricane Frances	09/04/2004	FEMA-1545-DR
Hurricane Jeanne	09/26/2004	FEMA-1561-DR
Hurricane Katrina	08/28/2005	FEMA-1602-DR
Hurricane Wilma	10/24/2005	FEMA-1609-DR
Tropical Storm Fay	8/21/2008	FEMA-3288-DR
Hurricane Matthew	11/04/2016	FEMA-4283-DR
Hurricane Dorian	10/21/2019	FEMA-4468-EM

Covid-19-Pandemic	03/25/2020	FEMA-4486-DR
Hurricane Isaias	08/01/2020	FEMA-3533-EM
Hurricane Ian	11/10/2022	FEMA-4673-DR
Hurricane Nicole	12/13/2022	FEMA-4680-DR

Hazards of Most Significant Concern for Broward County

Each of the initially identified hazards was studied for their potential impact on Broward County as well as in terms of the availability of hazard mitigation strategies to reduce that impact. Best available data on historical occurrences, the geographic location and extent as well as the probability of future occurrences were collected and reviewed as part of the hazard identification process.

Hazard Identification

Broward County is vulnerable to a wide range of natural and human caused hazards that threaten life and property. FEMA's current regulations and guidance under the Disaster Mitigation Act of 2000 (DMA 2000) require, at a minimum, an evaluation of a full range of natural hazards. An evaluation of human-caused hazards (i.e., technological hazards, terrorism) is encouraged, though not required for plan approval.

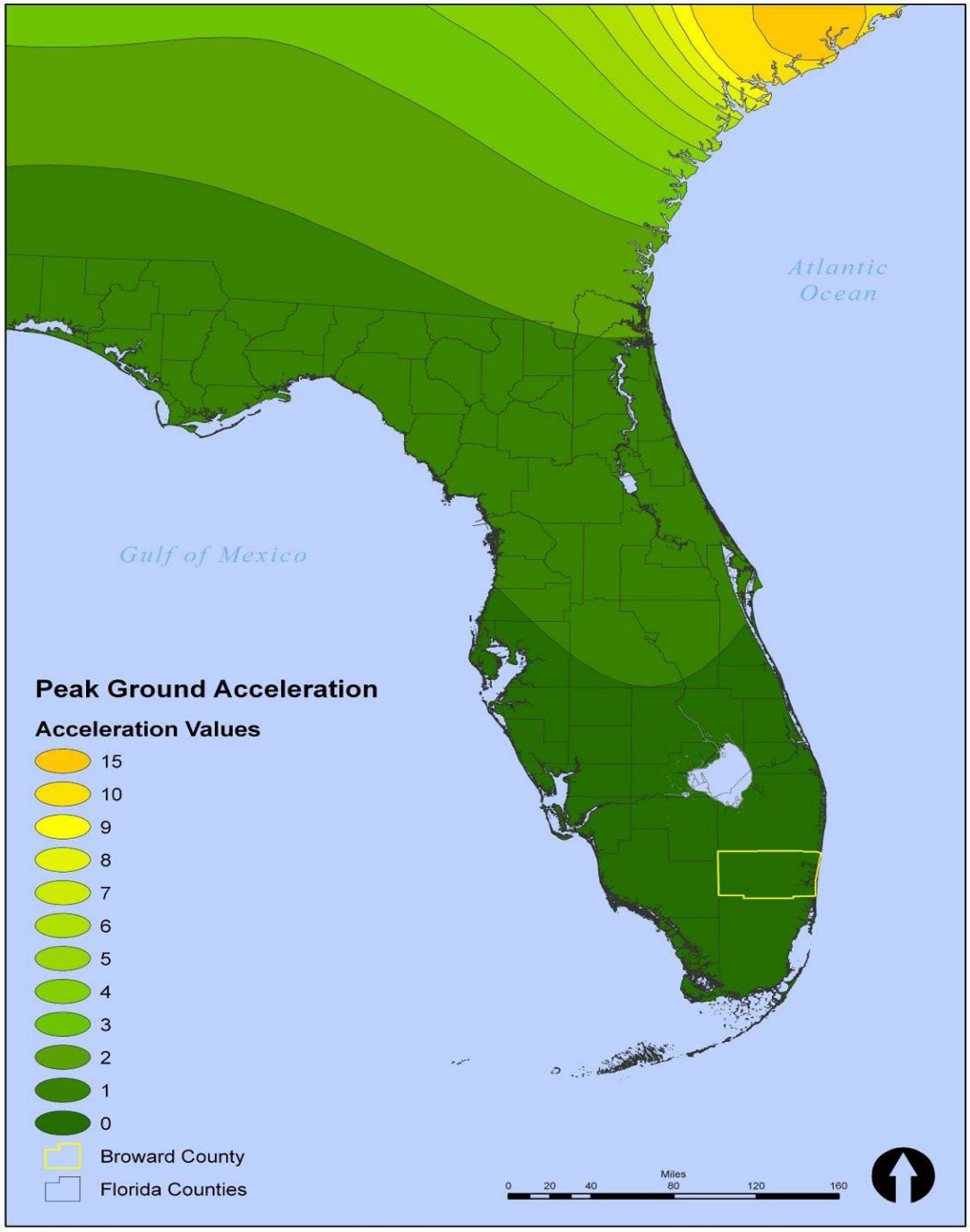
Table 4.6: Most Significant Hazards of Concern for Broward County

Natural Hazards	Human Caused Hazards
Atmospheric ☑ Extreme Heat ☐ Freeze ☐ Lightning ☑ Severe Thunderstorm ☑ Tornado ☑ Tropical Cyclone (Storms and Hurricanes) ☐ Winter Storm **Hydrologic** ☑ Coastal Erosion ☑ Drought ☑ Flood ☐ Rip Current ☑ Sea Level Rise/Climate Change **Geologic** ☐ Earthquake ☐ Expansive Soils ☐ Sinkhole / Land Subsidence ☐ Tsunami ☐ Volcano **Other** ☑ Wildfire	**Biological** ☐ Agricultural Disease ☑ Pandemic/Infectious Disease **Societal** ☐ Civil Disturbance ☑ Mass Migration ☑ Terrorism ☑ Active Shooter **Technological** ☑ Cyber ☐ Dam / Levee Failure ☑ Hazardous Material Incident ☐ Nuclear Power Plant Accident ☐ Structural Fire

Table 4.7: Hazards Excluded from Further Analysis

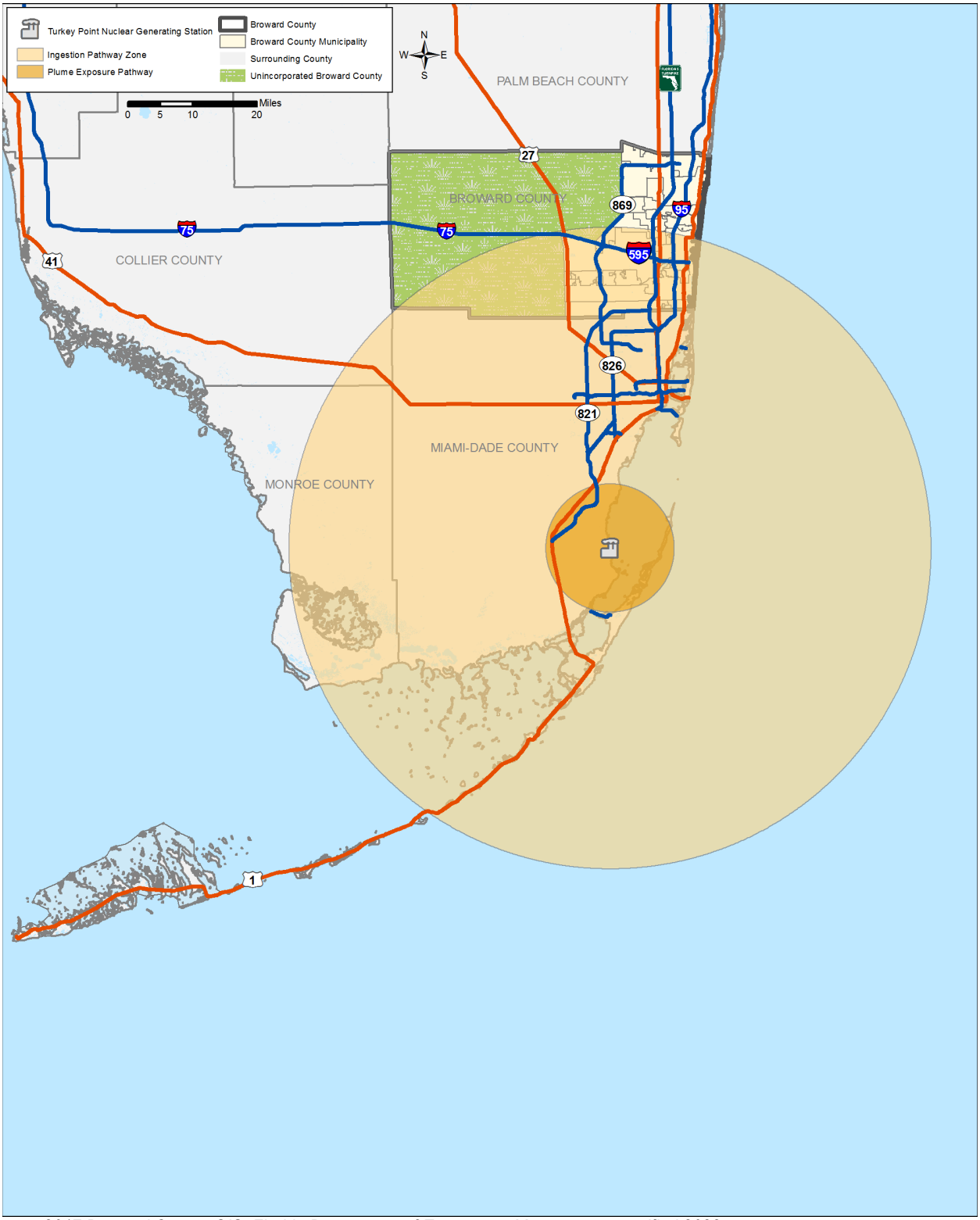
Hazard	Reasons for Exclusion
Freeze	Deep freezes do occasionally occur in South Florida; however, these events cause minimal impact outside of agricultural losses and related economic industries (including commercial nurseries). Due to widespread urban development and minimal agricultural land uses in Broward County, historical crop damages due to freezes are minimal in comparison to other areas in Florida.
Winter Storm	South Florida is not at risk to winter storms (including snow, ice, sleet, and blizzard conditions).
Earthquake	Broward County is located well outside of any areas identified by the United States Geological Survey as having seismic risk (see **Map 4.5**). The peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years for Broward County is 0% gravity (g) (lowest potential for seismic ground shaking events). FEMA recommends that earthquakes only be further evaluated for mitigation purposes in areas with a PGA of 3% g or more.
Expansive Soils/Land Subsidence	South Florida is not at risk to expansive soils. Based on its soil type, there is no potential for ground swelling and associated property damages in Broward County.
Tsunami	Extremely rare, small events are possible along the eastern shoreline of Broward County, but the impact would likely be minimal. Further, the vulnerability of coastal assets to tsunami inundation is lessened through ongoing hurricane storm surge mitigation practices.
Volcano	Volcanoes are not located anywhere near Broward County.
Agricultural Disease	Due to widespread urban development and minimal agricultural land uses in Broward County, agricultural disease is not a significant hazard of concern for Broward County. Although some residents do have citrus trees on their property that are susceptible to citrus canker, the Florida Department of Agriculture has an aggressive program in place for the cutting down and removal of infected trees.
Civil Disturbance	There have been no recorded instances of large, unlawful civil disturbances in Broward County that have exceeded the ability of existing law enforcement resources and partnering agencies to suppress and control. Aside from existing operations planning and ongoing security preparedness efforts, there is little that may be done in terms of hazard mitigation.
Dam / Levee Failure	According to the U.S. Army Corps of Engineers and the FEMA National Dam Safety Program, there are no identified dams or levees which pose a high or intermediate hazard to Broward County. The Broward County portion of the East Coast Protective Levee was accredited in September 2013. Although not included as a significant hazard of concern, future analysis should be done on the impact of dam / levee failure.
Nuclear Power Plant Accident	Broward County is located outside of the Plume Exposure Pathway (10-mile radius) of the Turkey Point Nuclear Power Generating Station (located in Miami-Dade County) in which shelter and/or evacuation would likely be the principal immediate protective actions against accidental releases of radiological plumes (see **Map 4.6**). Portions of Broward County are in the Ingestion Pathway Zone (50-mile radius) but in the event of an accident, impacts are likely to be limited to serving as a host to evacuees from Miami-Dade County.
Structural Fire	The structural fire hazard is more appropriately and adequately addressed through statewide and local fire safety standards and codes, in addition to the continuous planning, training, and routine operation of local firefighting services.
*** Lightning	Lightning is a weather hazard of importance and extensive cautionary messaging is produced from the National Weather Services and local television venues during storms and rain events. Although not included as significant hazard of concern, more in-depth analysis was done on lighting in hazards assessment.
*** Rip Currents	Rip currents are a risk of importance and cautionary messaging is produced from the National Weather Services and local television venues. Although not included as significant hazard of concern, more in-depth analysis was done on rip currents in hazards assessment.

Map 4.4: Peak Ground Acceleration for Earthquake Risk



Source: 2017 Broward County ELMS, verified 2022

Map 4.5: Turkey Point Nuclear Power Plant Emergency Planning Zones



Source: 2017 Broward County GIS, Florida Department of Emergency Management, verified 2022.

Natural Hazards and Human Caused Hazards

Natural hazards have the potential to threaten lives and cause costly damages to the built environment. Natural hazards are the largest single contributor to catastrophic or repetitive damage to communities in Broward County. This section includes the natural hazards that pose the greatest risk in Broward County. Natural hazards are categorized as atmospheric, hydrologic, geologic, and other (i.e., wildfire). Hazards are listed alphabetically by category. An addition to the enhanced LMS plan is the inclusion of sea level rise/climate change as a natural hazard. While this warrants its own subsection under "Hydrologic Hazards", it has far ranged impacts that are discussed in the "Probability of Future Events" sections of other hazards that will be impacted such as drought, hurricane wind, flood, and wildfire. Broward County's list of projects to mitigate hazards may be found in Appendix C. In the project list, tropical cyclones (hurricanes and tropical storms), thunderstorms, and tornadoes are all listed as "Wind" events.

Human caused hazards also have the potential to threaten life, health and safety for the residents and businesses of Broward County. These include biological, societal, and technological hazards. A listing of these hazards and the potential impact to Broward County is described in this section.

Hazards Locations

Broward County has experienced multiple natural hazards among its 31 municipalities and unincorporated areas. These hazards primarily include tropical cyclones and tornadoes and, more recently, extreme heat.

While a tropical cyclone is expected and thus provides the opportunity for advance preparedness and, if necessary, evacuation planning and execution, another natural hazard, tornado, does not. In September 2022, a tornado that was spawned by Hurricane Ian when it made landfall in the Fort Myers area on the West Coast, struck the suburb of Pembroke Pines and caused minor to moderate damage to businesses and the general aviation North Perry airport.

In recent years, the increased severity of extreme heat has impacted the urban areas of Broward County, specifically Fort Lauderdale.

Atmospheric Hazards

For the purposes of this vulnerability assessment atmospheric hazards are events or incidents that are associated with weather generated phenomenon. Atmospheric hazards included in this section are extreme heat, lightning, severe thunderstorm (hail and wind), tornado, and tropical cyclone.

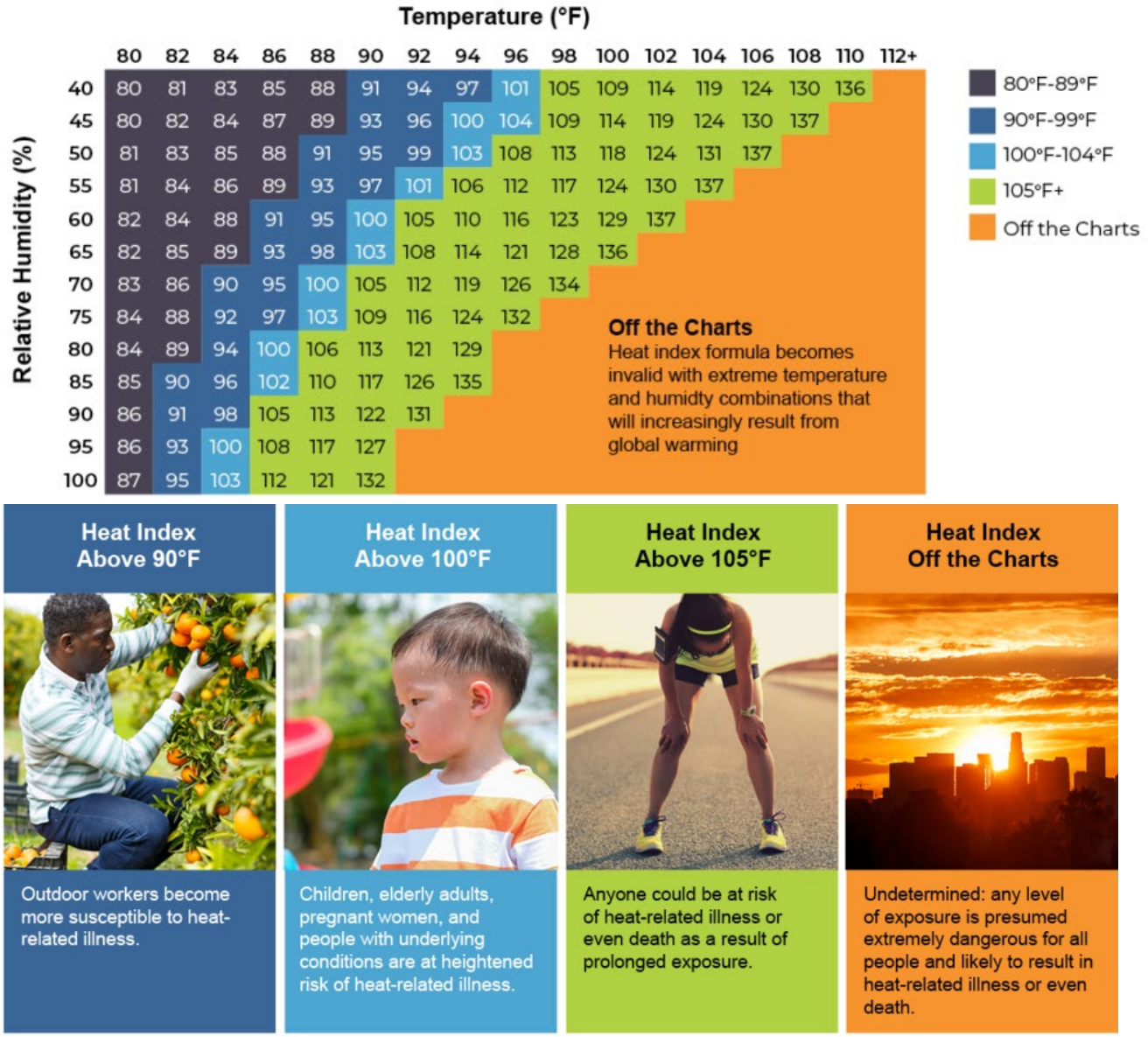
Extreme Heat

Background

Since the 2017 ELMS update, Broward County has experienced increased vulnerability of this hazard. Expanded development in terms of residential and commercial construction is a contributing factor, with the greatest concentration of Extreme Heat in the eastern section of the

county (*see Location and Spatial Extent*, *Vulnerability Assessment)*. Each year, heat is the leading cause of weather-related deaths in the United States (NOAA, 2022). Extreme heat is generally referred to as temperatures that are approximately 10 degrees or more above the average high temperature and is also defined by FEMA as high temperatures elevated above 90°F combined with high humidity lasting for a period of at least 24 to 72 hours. These conditions can limit the body's ability to regulate its temperature and can result in heat related illnesses such as heat rash, heat cramps, heat exhaustion and heat stroke. Young children, the elderly, and persons with preexisting conditions are most at risk along with outdoor workers, and persons with limited mobility or finances (See Figure X1 on heat index and health impacts below). Extreme heat can also impact our natural and built environment, threatening critical assets such as our railway systems and the power grid. As the earth warms and the climate changes in response to heightened atmospheric concentrations of greenhouse gases (GHG's), elevated temperatures, changing wind and heat circulation patterns, and increases in moisture and humidity all contribute to shifts in extreme heat observed. (The Centers for Disease Control and Prevention, and The American Public Health Association, "EXTREME HEAT CAN IMPACT OUR HEALTH IN MANY WAYS".)

Figure 4.4: Heat Index & Health Impacts at a Glance



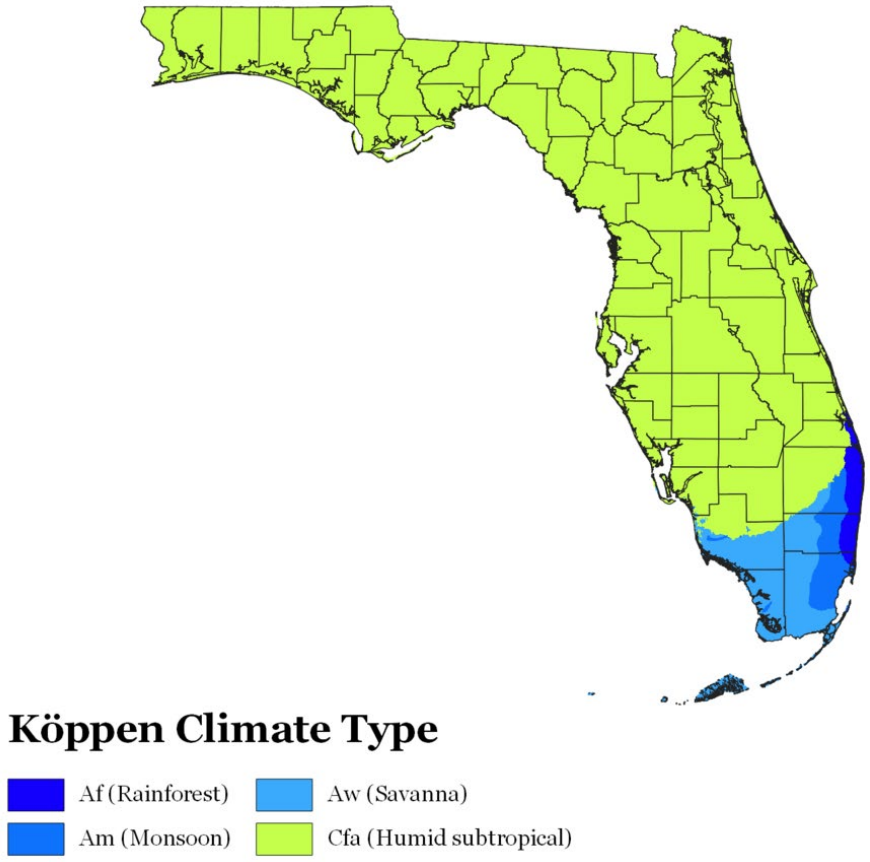
Sources: Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days. Union of Concerned Scientists (2019), and the Southeast Florida Regional Compact (2022)

The heat index is an accurate measure of how hot it really feels when relative humidity is combined with the air temperature and has important considerations for the human body's comfort (NWS, 2022). In very humid conditions, when the air temperature exceeds 90°F, the heat index can approach or reach 'off the charts levels' (when it feels hotter than approximately 135°F), which is presumed extremely dangerous for all people and likely to result in heat-related illness or even death.

Location and Spatial Extent

Broward County (1224.70 mi2) has a developed area bound by the Atlantic Ocean to the east and the Everglades to the west, where its conservation area is located. Broward County (≈ 26.1525° N, 80.4869° W) is located within the subtropical climate zone and experiences all four Köppen climate types found in Florida with most of the developed area identified as rainforest or monsoon types (AF or AM respectively), while the conservation area has mainly a savanna climate with a small northwestern area having a humid subtropical climate type (Aw and Cfa respectively; See Figure X2 and Table X1). Because of its climate, the entire County has been historically vulnerable to extreme heat events. Broward has an extensive network of waterbodies (see Figure X3) which can generate a localized cooling effect during extreme heat events due to water's high specific heat capacity which enables it to heat up and cool down much slower than land. When a waterbody is cooler than the adjacent land, several heat transfer mechanisms can facilitate a cooling effect on the land such as a surface-air temperature gradient over a waterbody generating a pull on the heat energy above the adjacent land. However, as waterbodies heat up in response to a warmer climate and more extended periods of extreme heat, waterbodies can drive increases in relative humidity via evaporation from its surface, which can increase the heat index or how hot it feels. Because of Broward County's subtropical latitude, the area is exposed to easterly trade winds that move west. While these winds can diminish the impacts of extreme heat, they can also drive warmer oceanic surface water west towards Broward's east coast. Broward's low-lying topography has few natural sources of shade: cloud cover and tree canopy cover (generally denser in western communities). Broward County is exposed to the urban heat island (UHI) effect where urbanized areas with more dense buildings, roads, infrastructure, and other impervious surfaces experience higher temperatures than outlying areas with more natural landscapes. This is largely due to the lower solar reflectance of impervious materials than that of vegetation. Generally, Broward County is more built up in the east, where UHIs can exacerbate extreme heat.

Figure 4.5: Köppen Climate Types of Florida



Source: 1991-2020 climate normal from PRISM Climate Group, Oregon State University, https://prisim.oregonstate.edu.edu; Outline map from US Census Bureau

Table 4.8: Classification of major climatic types according to the modified Koppen-Geiger scheme

Classification of major climatic types according to the modified Koppen-Geiger scheme			
Letter Symbol			Criterion
1st	2nd	3rd	
A			temperature of coolest month 64.4 °F (18 °C) or higher
	f		precipitation in driest month at least 2.36” (60 mm)

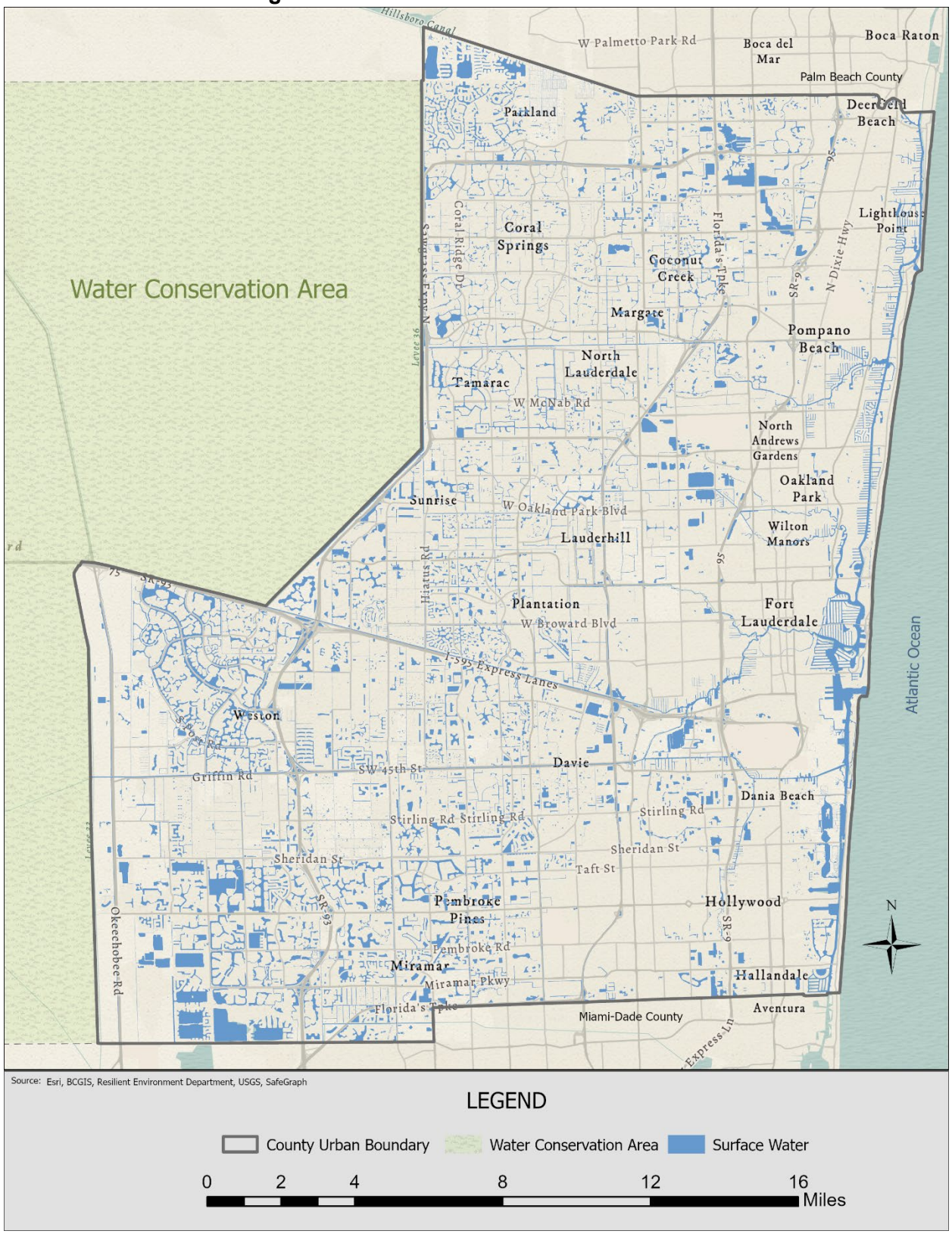
	m		precipitation in driest month < 2.36" (60mm) but ≥ 100 –(r/25)*
	w		precipitation in driest month < 2.36" (60mm) and < 100 –(r/25)
B2			70% or more of annual precipitation falls in the summer 1/2 of the year and r less than 20t + 280, or 70% or more of annual precipitation falls in the winter 1/2 of the year & r less than 20t, or neither 1/2 of the year has 70% or more of annual precipitation and r < 20t + 140 3
	W		r is < 1/2 of the upper limit for classification as a B type (see above)
	S		r is < 1/2 of the upper limit for classification as a B type but is > 1/2 of that amount
		h	t ≥ 64.4 °F (18°C)
		k	t < 64.4 °F (18°C)
C			temperature of the warmest month ≥ 50 F (10°C), & temperature of coldest month < 64.4 °F (18°C) but > 26.6F (-3°C)
	s		precipitation in the driest month of the winter 1/2 of the year < 1.2" (30 mm) & < 1/3 of the amount in the wettest month of the winter half
	w		precipitation in the driest month of the winter 1/2 of the year < 1/10 of the amount in the wettest month of the summer half
	f		precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied
		a	temperature of warmest month ≥ 71.6F (22°C)
		b	temperature of each of four warmest months 50°F (10°C) or above but warmest month < 71.6 F (22°C)
		c	temperature of one to three months 50°F (10°C) or above but warmest month < 71.6°F (22°C)
D			temperature of warmest month ≥ 10 C, & temperature of coldest month = 26.6°F (-3°C)
	s		same as for type C
	w		same as for type C

	f		same as for type C
		a	same as for type C
		b	same as for type C
		c	same as for type C
		d	temperature of coldest month < -36.4°F –(38°C), D designation then used instead of a, b, or C)
E			temperature of warmest month < 50°F (10°C)
		T	temperature of warmest month > 32°F (0°C) but < 50°F (10°C)
		F	temperature of warmest month 32°F (0°C) or below
H4			temperature & precipitation characteristics highly dependent on traits of adjacent zones & overall elevation – highland climates may occur at any latitude

Source: https://www.britannica.com/science/Koppen-climate-classification

In the formulas above, r is average annual precipitation total (mm), and t is average annual temperature °F (°C). All other temperatures are monthly means °F (°C), and all other precipitation amounts are mean monthly totals (mm).[2]Any climate that satisfies the criteria for designation as a B type is classified as such, irrespective of its other characteristics.[3]The summer half of the year is defined as the months April–September for the Northern Hemisphere and October–March for the Southern Hemisphere.[4]Most modern climate schemes consider the role of altitude. The highland zone has been taken from G.T. Trewartha, An Introduction to Climate, 4th ed. (1968).

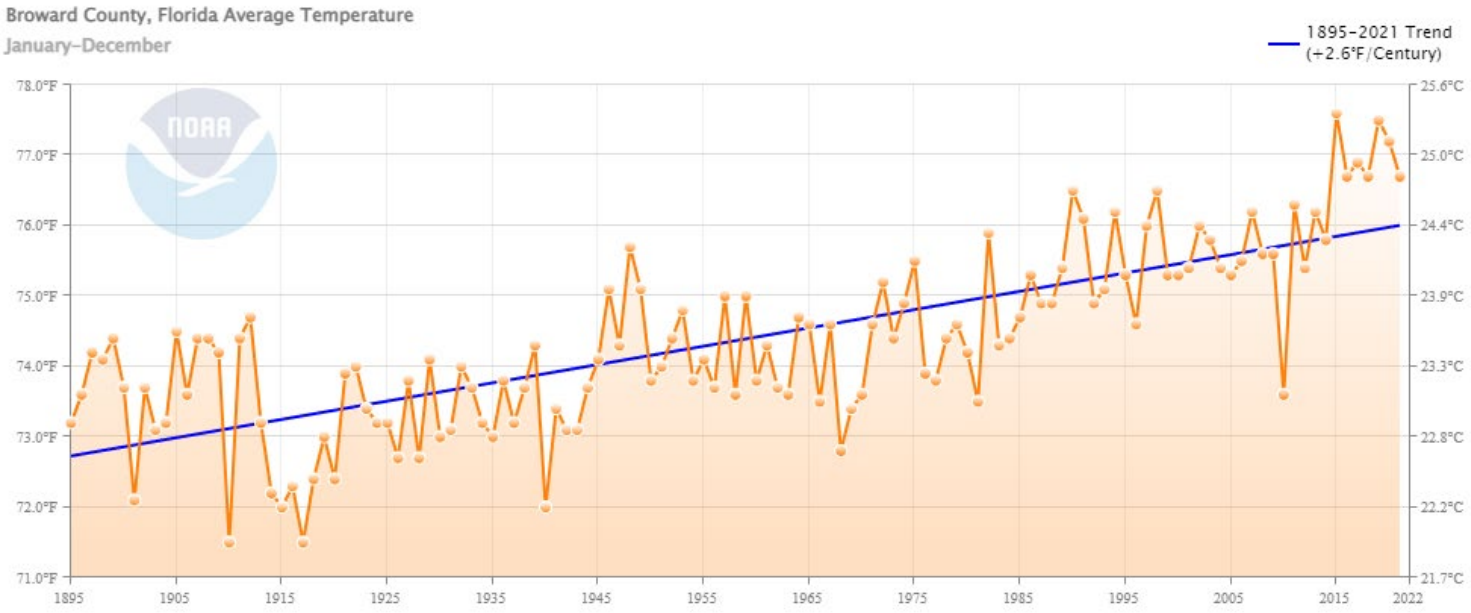
Figure 4.6: Waterbodies & Surface Water Features



Observed Temperature

Global and local temperatures fluctuate in response to seasonal changes, astrological and geological events, and recurring oceanic and atmospheric phenomena such as El Niño and La Niña. Over the past century, the average temperature, minimum temperature, and maximum temperature in Broward County have all increased. Minimum temperature has demonstrated the most accelerated increase at a rate of +3.1°F/ century, followed by average temperature (+2.6°F/ century), and maximum temperature (+2.1°F/ century) which increased at the slowest rate (NOAA, 2022; See Figures X4-X7). An analysis of ambient temperature in Broward County's developed area between 1980-2021 revealed that the average mean temperature was 76.51°F, the average minimum temperature was 68.92°F, and the average maximum temperature was 84.07 °F, with annual average mean, and minimum for the past 6 years (2015-2021), above the mean line for the timeseries (See **Figure 4.7**).

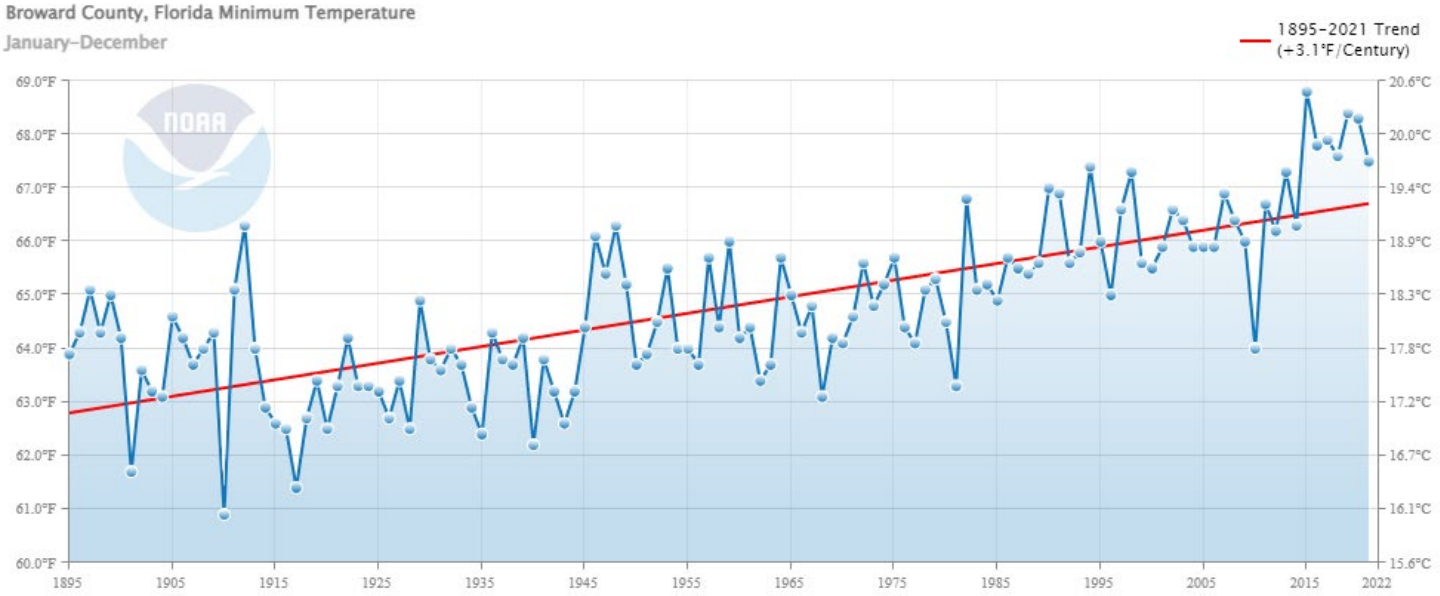
Figure 4.7: Annual Average Temperature in Broward County from 1895 to 2022



NOAA National Centers for Environmental information, Climate at a Glance: County Time Series, Average Temperature, published August 2022, retrieved on September 7, 2022, from https://www.ncdc.noaa.gov/cag/

The graph above shows an increase of 3.5 degrees since 1895 at a rate of +2.6°F per century. While temperature variability appears to be greater than the change in average temperature, the upward trend (shown by the blue line) indicates increasing temperatures over time.

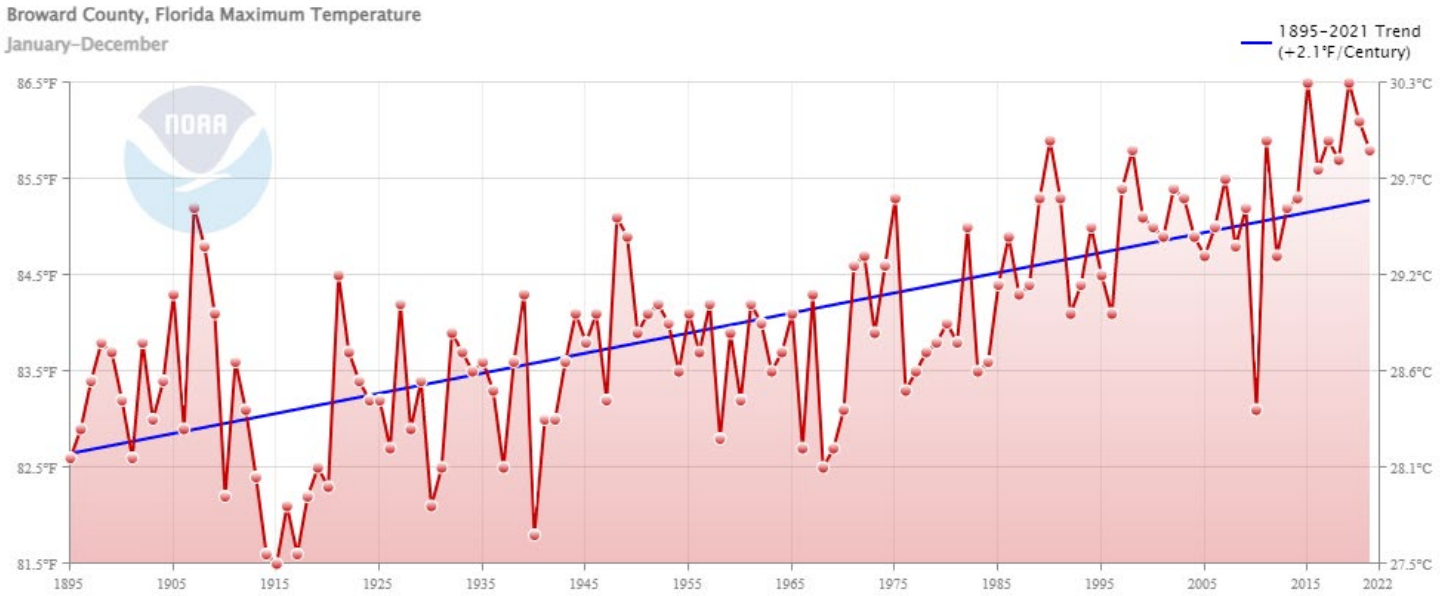
Figure 4.8: Annual Minimum Temperature in Broward County from 1895 to 2022



NOAA National Centers for Environmental information, Climate at a Glance: County Time Series, Minimum Temperature, published August 2022, retrieved on September 7, 2022, from https://www.ncdc.noaa.gov/cag/

The graph above shows an increase of 3.6 degrees since 1895 at a rate of +3.1°F per century. While temperature variability appears to be greater than the change in temperature, the upward trend (shown by the red line) indicates increase in minimum temperatures over time.

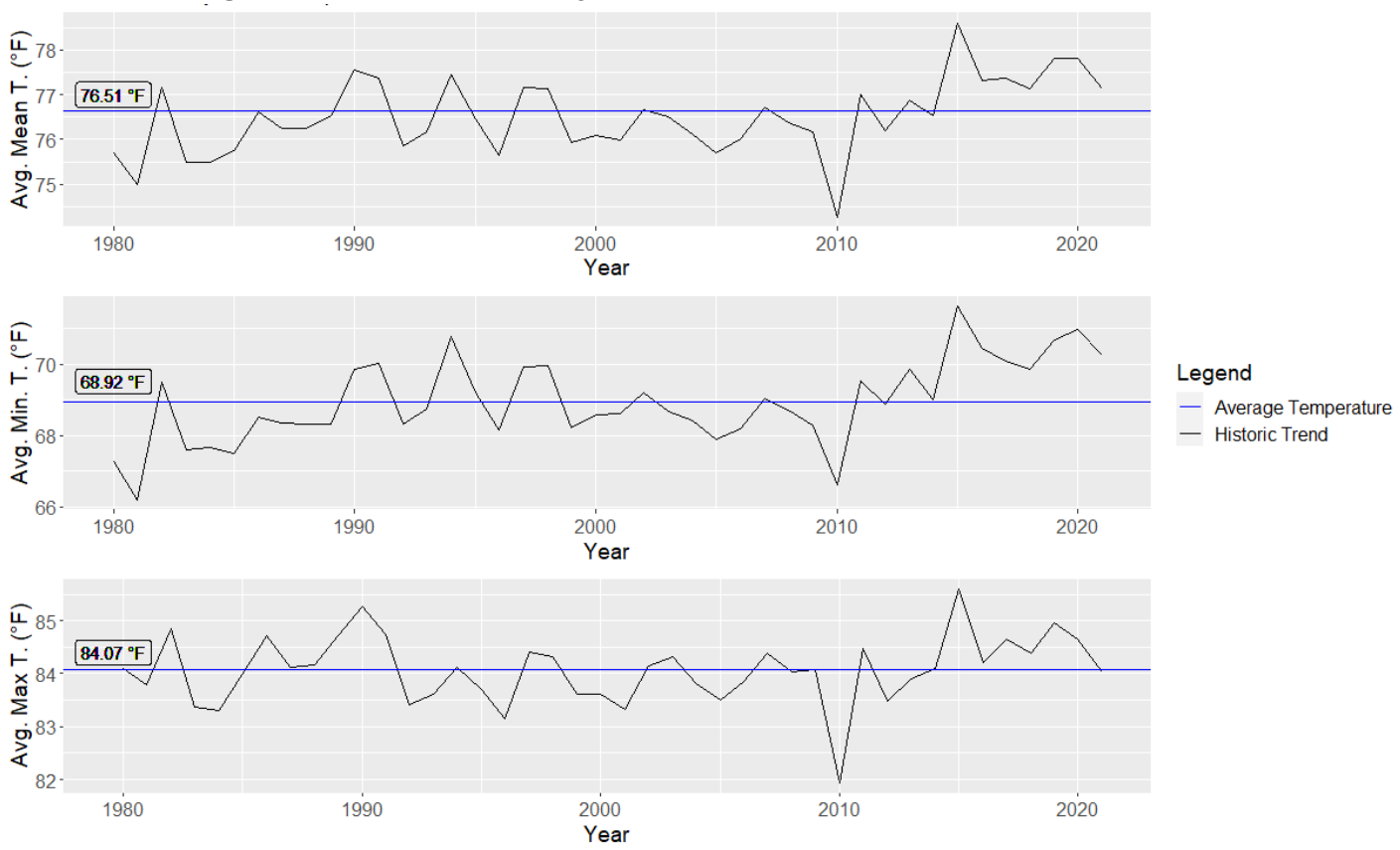
Figure 4.9: Maximum Temperature in Broward County from 1895 to 2022



NOAA National Centers for Environmental information, Climate at a Glance: County Time Series, Maximum Temperature, published August 2022, retrieved on September 7, 2022, from https://www.ncdc.noaa.gov/cag/

The graph above shows an increase of 3.2 degrees since 1895 at a rate of +2.1°F per century. While temperature variability appears to be greater than the change in temperature, the upward trend (shown by the blue line) indicates increase in maximum temperatures over time.

Figure 4.10: Broward County Urban Temperature from 1980 to 2021



Source: PRISM and Broward County Resilient Environment Department

The graph above shows the 42-year (1980 – 2021) air temperature trend for Broward County. Where Avg. Mean T., Avg. Min. T. and Avg. Max T. stand for Average Mean, Average Minimum and Average Maximum Temperature, respectively for the entire time period. The labeled values represent the average temperature (blue line) for each of the three variables. The timeseries indicates that in case of Avg. Mean T. and Avg. Min. T., the temperatures during last 5-6 years are higher than the long-term average, indicating an increasing trend.

Broward County's Water Conservation Area experiences cooler temperatures than the urban area, and between 1980 and 2021 the entire County including the conservation area had an average ambient temperature of 76.05 °F, which is roughly 0.5 degrees cooler than the mean temperature of the County's urban area (76.51°F).

Land surface temperature maps of the entire County between 1987 and 2022 also demonstrated the urban heat island effect at work with the conservation area maintaining lower surface temperatures than the developed area (See Figures X8 and X9). Generally, densely developed areas with more infrastructure (e.g., large highways, rail, bridges etc.) and a high impervious surface area absorb more heat energy than areas with more natural landscapes. Also, within the County's urban area, temperatures are generally cooler in the west and warmer towards the east, though within the east, waterfront communities along the intracoastal are generally cooler than other areas.

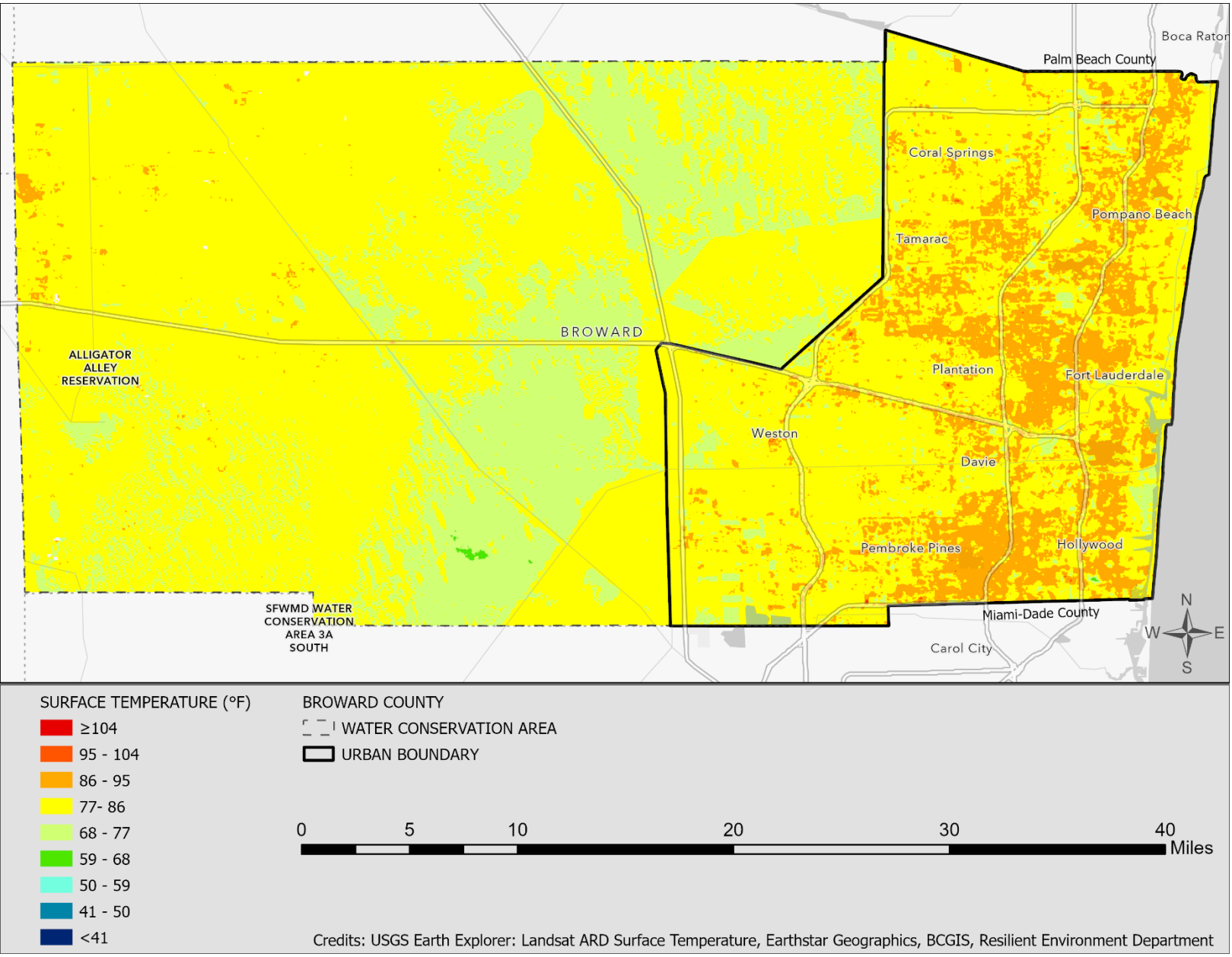
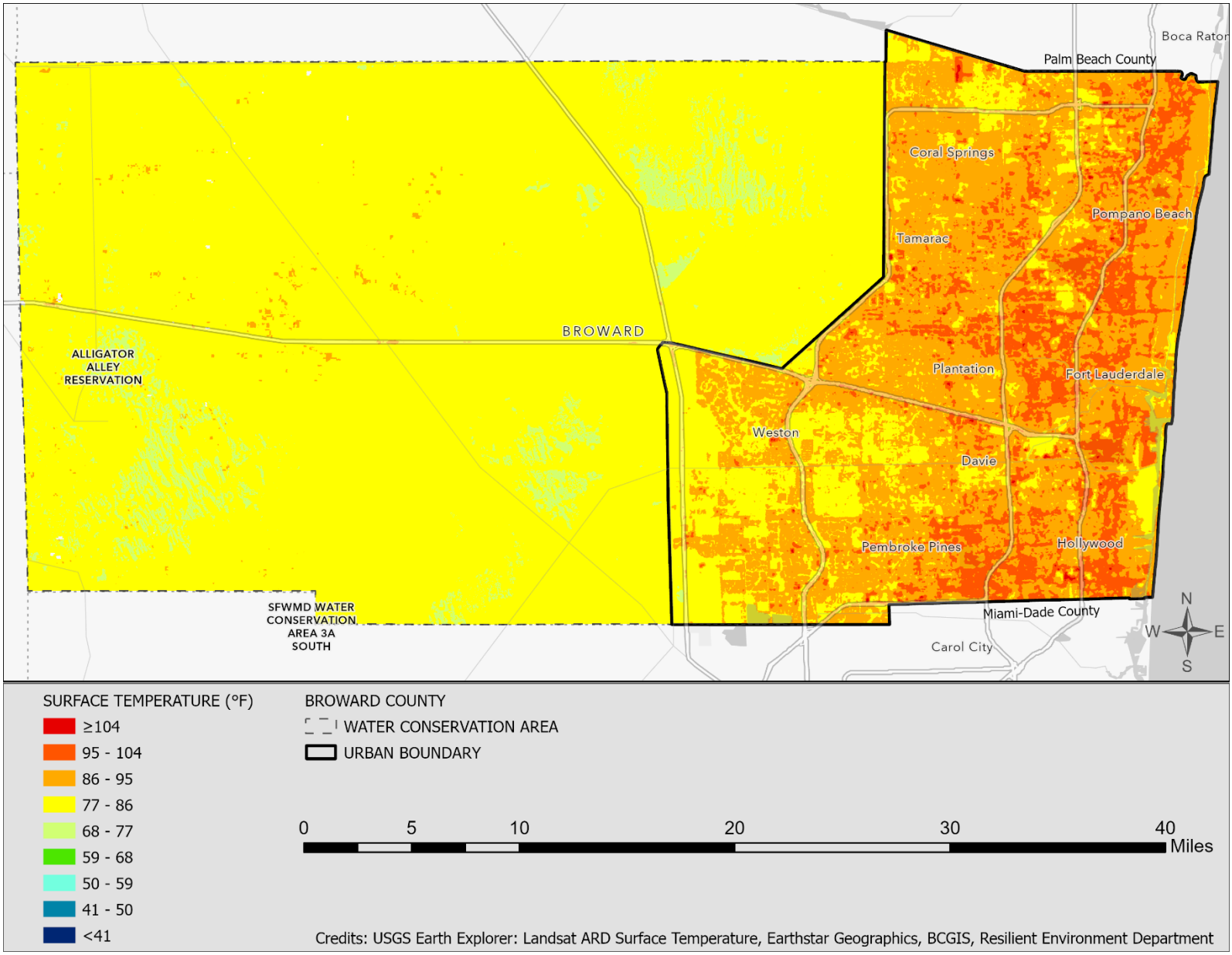


Figure 4.11: Land Surface Temperature January 2020

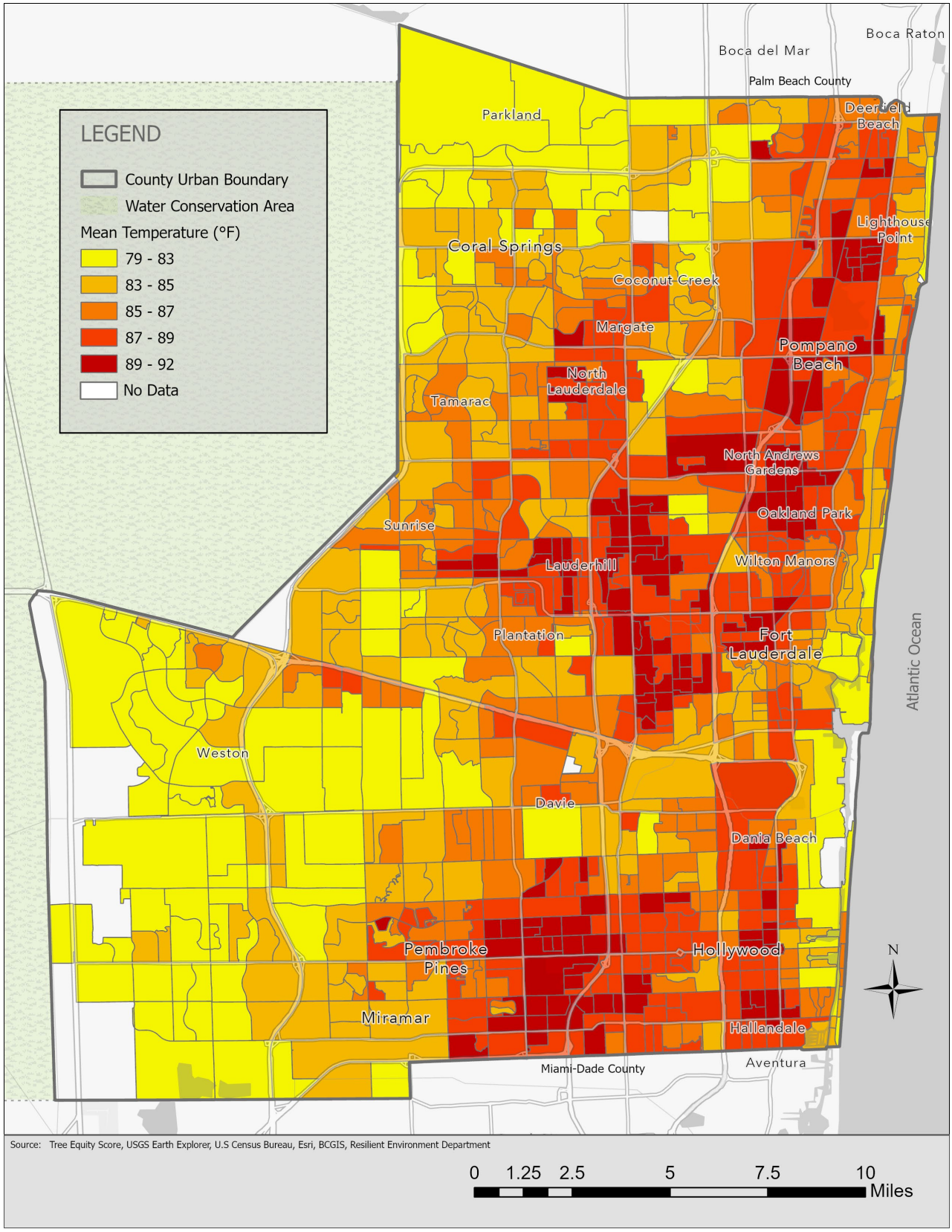
Above is a land surface temperature map of Broward County on January 19, 2020, that shows 45% of the developed area reaching a surface temperature of between 86 – 95°F with the highest temperatures generally following eastern highways (I-95, Dixie Hwy/ FEC right-of-way, I-595) and extending into the surrounding areas. Relatively lower temperatures in the conservation area were also observed.

Figure 4.12: Land Surface Temperature October 2016



Above is a land surface temperature map of Broward County on October 22, 2016. Despite the seasonal differences, the footprint of the hottest areas is like that of the previous surface temperature map for January 19, 2020.

Figure 4.13: Average Temperature by Census Block Groups



Historical Occurrences

According to the CDC's National Environmental Tracing Network (Link), from 2017 through 2020 there were a total of 125 heat related illness fatalities in Florida with 41 deaths occurring in 2020, 27 deaths in 2019, 15 deaths in 2018, and 42 deaths in 2017. In the City of Fort Lauderdale, the record high for the maximum daily temperature was broken once in 2021, and 10 times in 2020. The record high for the minimum daily temperature was surpassed 19 times in 2021, and 44 times in 2020. In contrast, the record low for the minimum daily temperature was not exceeded in 2020 nor in 2021 (NOAA, 2022: Link).

Table 4.8: Daily Climatological Records in Fort Lauderdale between 2017 – 2021 where Maximum Temperature is ≥ 95°F

Date	Description
July 2020	On July 9, 2020, the maximum temperature in Fort. Lauderdale reached a high of 96°F
September 2019	On September 6, 2019, the temperature in Fort. Lauderdale reached a high of 95°F

Source: Daily Climatological Records for Fort Lauderdale
https://www.weather.gov/media/mfl/climate/Daily_Records_Fort_Lauderdale.pdf

Probability and Extent of Future Events

By 2050 the number of days that the heat index exceeds 90 °F is projected to increase to 184 days (32 days higher than the historical numbers), and at least 1 day of off the charts heat index is predicted. By 2070, these number are even more alarming (See **Table 4.10**). By late century, if global warming is limited to 2°C, modeling indicates there will still be significant increases in the number of days the heat index is above 90°F, 100°F, and 105°F, however there will not be any days that the heat index is off the charts (See **Table 4.10**). The probability of this hazard occurring is highly likely**.**

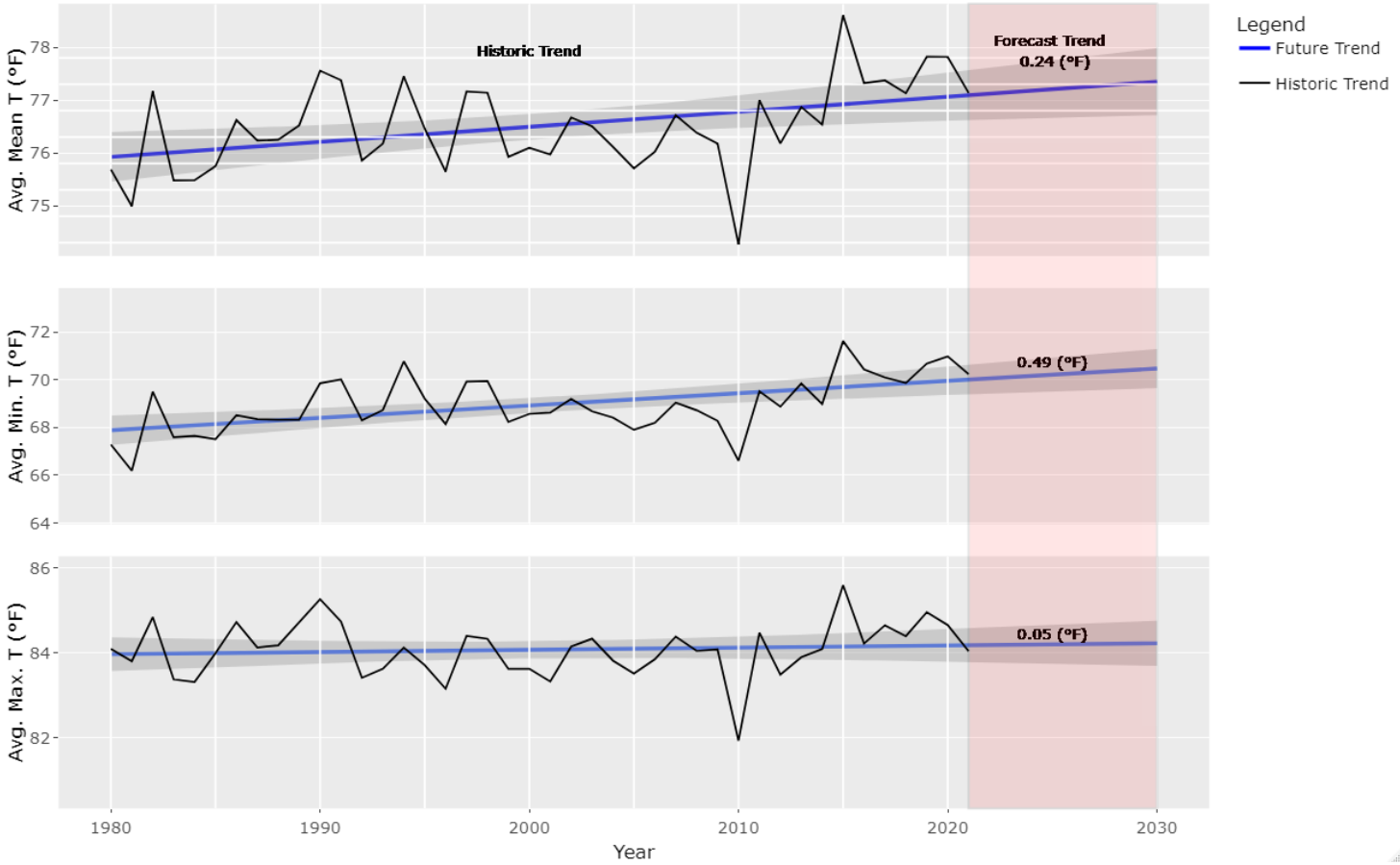
Table 4.9: Historical and Projected Heat Index

BROWARD COUNTY				
Heat Index above	Historical (1971-2000)	By midcentury (2036-2065)	By late century (2070-2099)	By late century, if we limit warming to 2℃ (2070-2099)
90℉ ------	152 days	184 days	198 days	180 days
100℉ ------	34 days	128 days	162 days	109 days
105℉ ------	5 days	80 days	132 days	52 days
Off the Charts	0 days	1 days	14 days	0 days

Source: Killer Heat in the United Stated: Climate Choices and the Future of Dangerously Hot Days

The average mean temperature, average minimum temperature, and the average maximum temperature in Broward County are all forecasted to continue trending upwards, with average minimum temperature showing the most accelerated increase, and average maximum temperature showing the slowest increase (See **Figure 4.15**).

Figure 4.14: Historical and Forecasted Temperature in Broward County



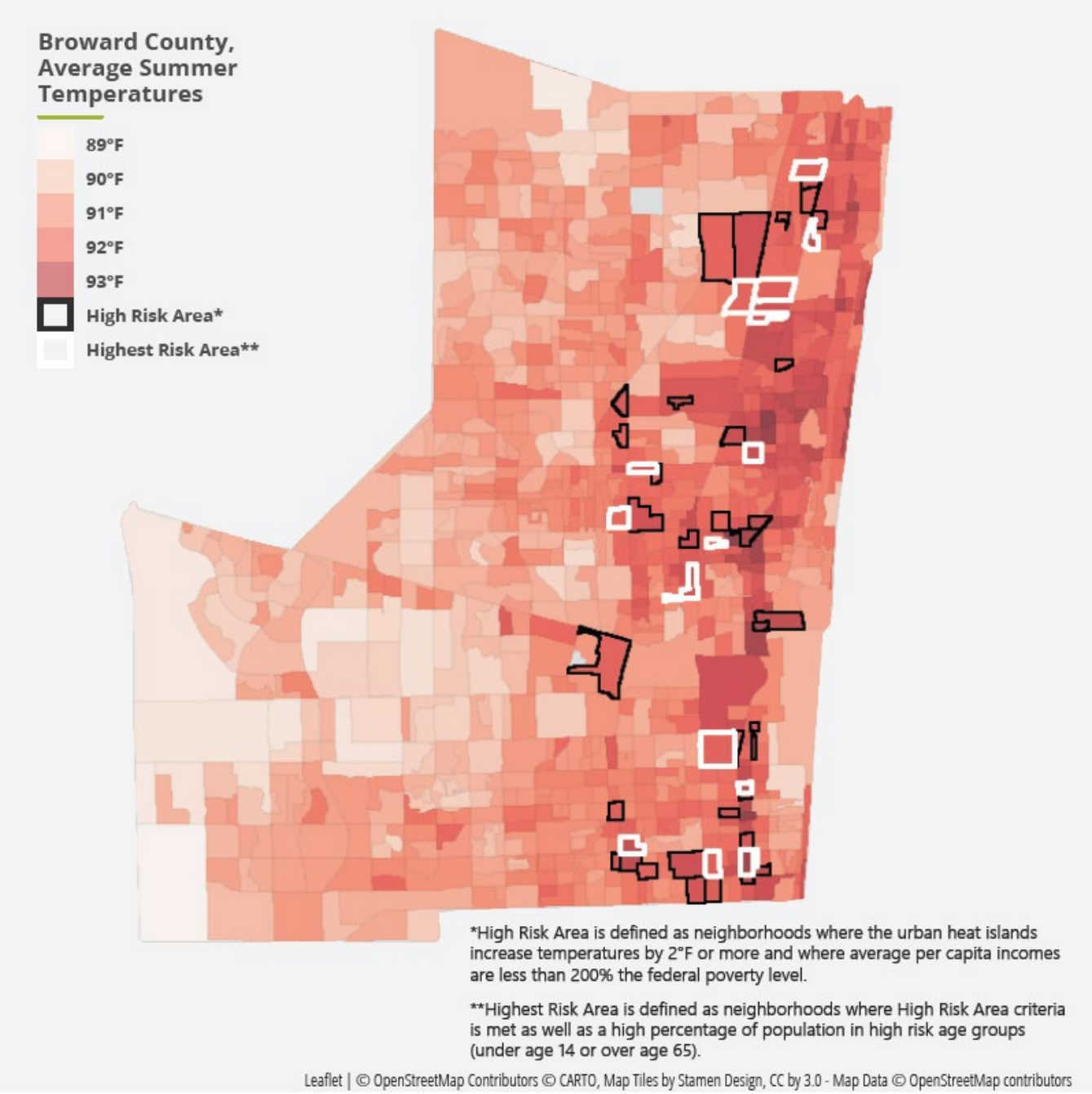
Source: PRISM and Broward County Resilient Environment Department

The graph above shows the forecast for the three air temperature variables analyzed. All these variables show an increase in air temperature in the future. The labeled values represent the rate of change over the next nine years, where Avg. Min. T shows the highest change as shown in the pink shaded region of the graph.

Vulnerability Assessment

The eastern half of Broward County is more exposed to extreme heat, with the highest temperatures generally concentrated in densely populated areas with more infrastructure and greater impervious surface area (e.g., surrounding I-95 and other large highways, rail, bridges etc.). An urban heat island analysis conducted by Earth Economics (2020) revealed that in Broward County, 90,000 people lived in neighborhoods where urban heat islands increase temperatures by 2 °F or more and where average per capita incomes are less than 200% the federal poverty level (See Figure X12 below, area outlined in black).These communities lie in the City of Pompano Beach, Oakland Park, North Lauderdale, Lauderhill, Lauderdale Lakes, Fort Lauderdale, Davie, Hollywood, Dania Beach, West Park, Pembroke Park, and Hallandale Beach. In evaluating areas with a high percentage of population in high-risk age groups (under age 14 or over age 65) in addition to the criteria previously described, it was found that 33,000 persons were at risk (See **Figure 4.15** below, area outlined in white). These communities termed 'highest risk area**' in the report lie in the City of Deerfield Beach, Pompano Beach, Oakland Park, Lauderdale Lakes, Lauderhill, Fort Lauderdale, Hollywood, Hallandale Beach.

Figure 4.15: Broward County Average Summer Temperatures & High-Risk Census Block Groups



Source: Earth Economics (2020) Urban Heat Island Analysis of Broward County. See full report here

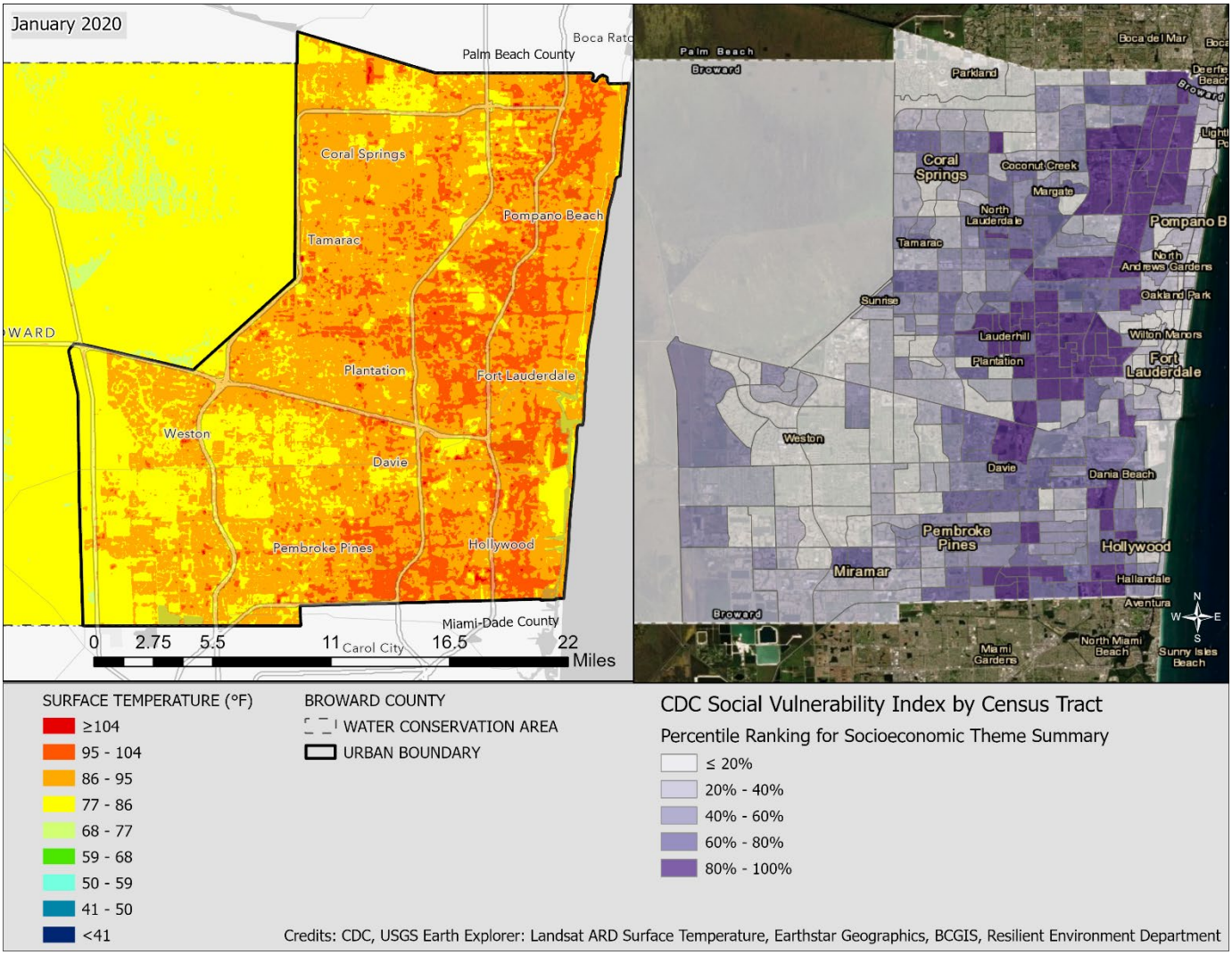
The Centers for Disease Control and Prevention (CDC) released a Social Vulnerability Index (SVI) in 2018 by census tract for the United States, to help public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event such as a heat wave or extreme heat.

The SVI indicates the relative vulnerability of each tract ranked on 15 social factors which are further grouped into 4 themes: Socioeconomic; Household Composition; Minority Status/Language; and Housing Type/ Transportation.

Socioeconomic Vulnerability

The socioeconomic vulnerability theme includes demographics such as per capita income, persons 25 and older with no high school diploma, persons below poverty, and unemployed persons 16 and older in its social vulnerability ranking tracts. A high percentile ranking for this theme indicates that individuals may lack the flexibility that funds provide for example to relocate to a cooler neighborhood, to opt out of working outdoors, or to purchase, utilize, and maintain air conditioning systems in their homes and vehicles. In comparing the socioeconomic vulnerability maps with the surface temperature maps, great overlap between the most vulnerable populations and communities with relatively higher temperatures was observed. These overlapping areas include parts of Pompano Beach, Oakland Park, Lauderhill and Lauderdale Lakes, Eastern Davie, Dania Beach, Hollywood, Hallandale Beach, West Park, and Eastern Miramar (See **Figure 4.16**).

Figure 4.16: Heat Exposure & Socioeconomic Vulnerability

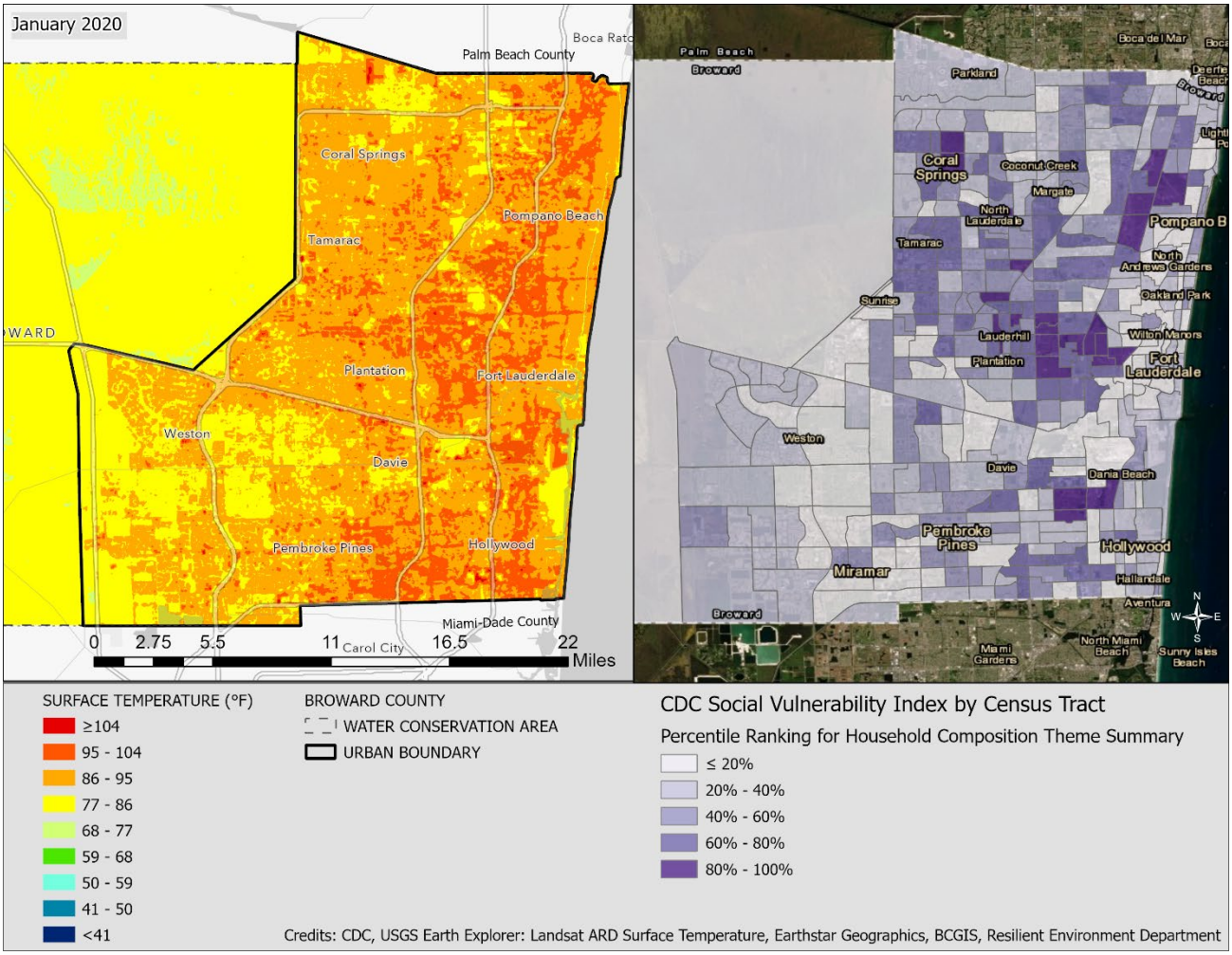


Vulnerability by Household Composition

Under this theme, the CDC has included demographics such as age (persons 18 and younger, and 65 and older), single parent households with children under 18, and noninstitutionalized persons with a disability in its social vulnerability ranking. Census tracts with a high percentile ranking for this theme are likely to show increased sensitivity to extreme heat because of elevated health risks, a reduced capacity to flee to cooler conditions, and a greater dependency on others.

In comparing the social vulnerability maps under this theme with surface temperature maps, it was found that while many of the vulnerable populations were also in communities with relatively higher temperatures, some were not. For portions of Pompano Beach, Central County between Fort Lauderdale and Plantation, and South Broward in parts of Dania Beach & Hollywood, the most vulnerable populations under this theme intersected the hottest communities. While in parts of Coral Springs and Tamarac, the vulnerable population does not overlap communities with relatively higher surface temperatures (See **Figure 4.18**).

Figure 4.17: Heat Exposure & Social Vulnerability by Household Composition

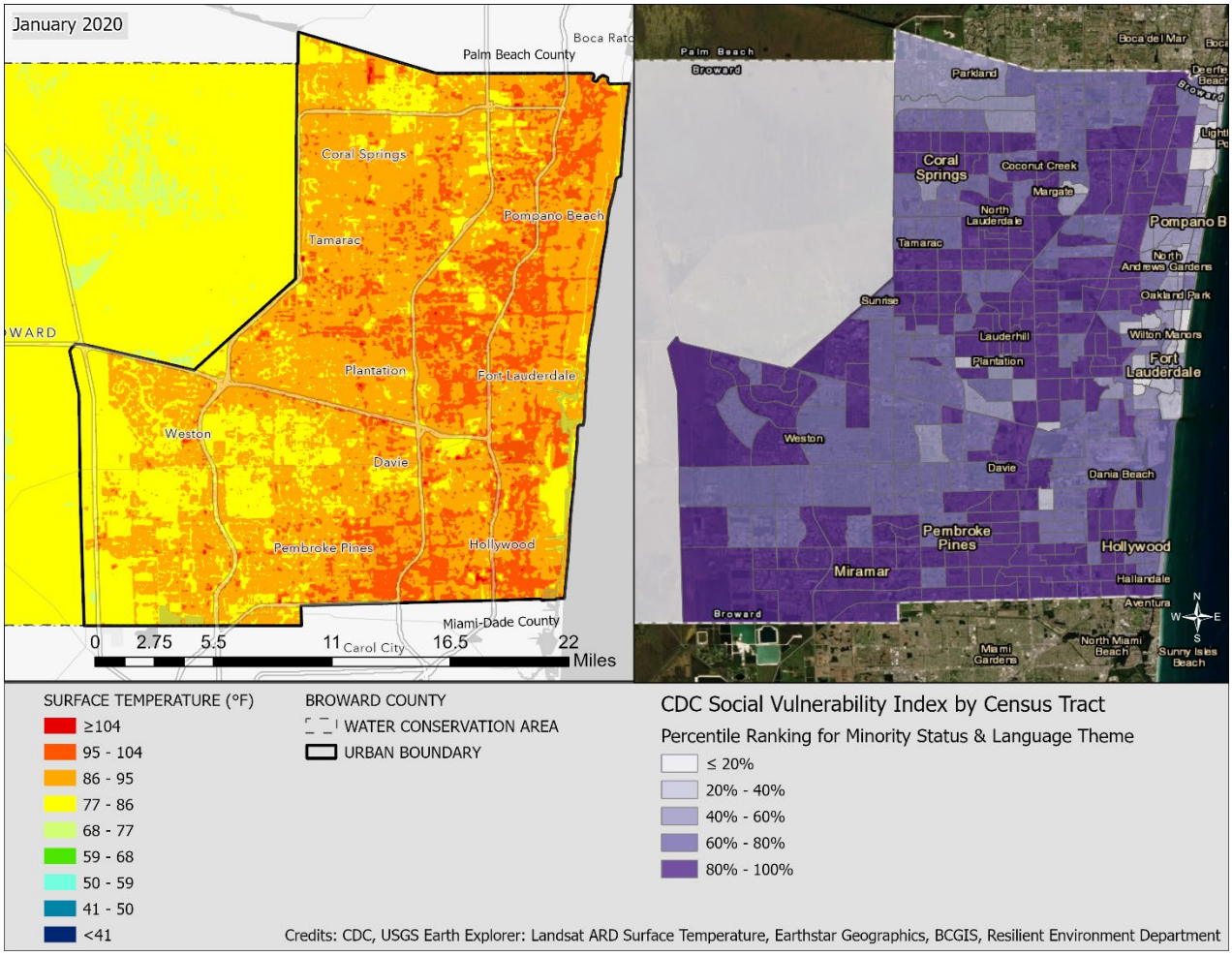


Vulnerability by Minority Status & Language

The CDC has included demographics such as percentage minority (all persons except white, non-Hispanic), and percentage of persons ages 5 and over who speak English less than well in its social vulnerability ranking under the minority status/language theme Census tracts with a high percentile ranking for this theme may have less access to heat advisories and warnings, and other resources that may allow for a quick response. Also, according to the US Census Bureau (2018), Black/ African Americans and Hispanic/ Latinos make up more than 40% of the outdoor workforce. Outdoor workers are more exposed to extreme weather and are more at risk for heat related illnesses.

In comparing the social vulnerability maps under this theme with surface temperature maps, a weak overlap was observed, particularly in western Broward. The social vulnerability map under this theme is essentially a diversity map, and with large bands in eastern, central, and western Broward falling into the highest percentile ranges due to the County's high diversity. Because of the County's large minority population overall, the minority status and language may not be as useful an indicator for vulnerability to heat as in other parts of the country (See Figure **4.18**)

Figure 4.18: Heat Exposure & Social Vulnerability by Minority Status & Language



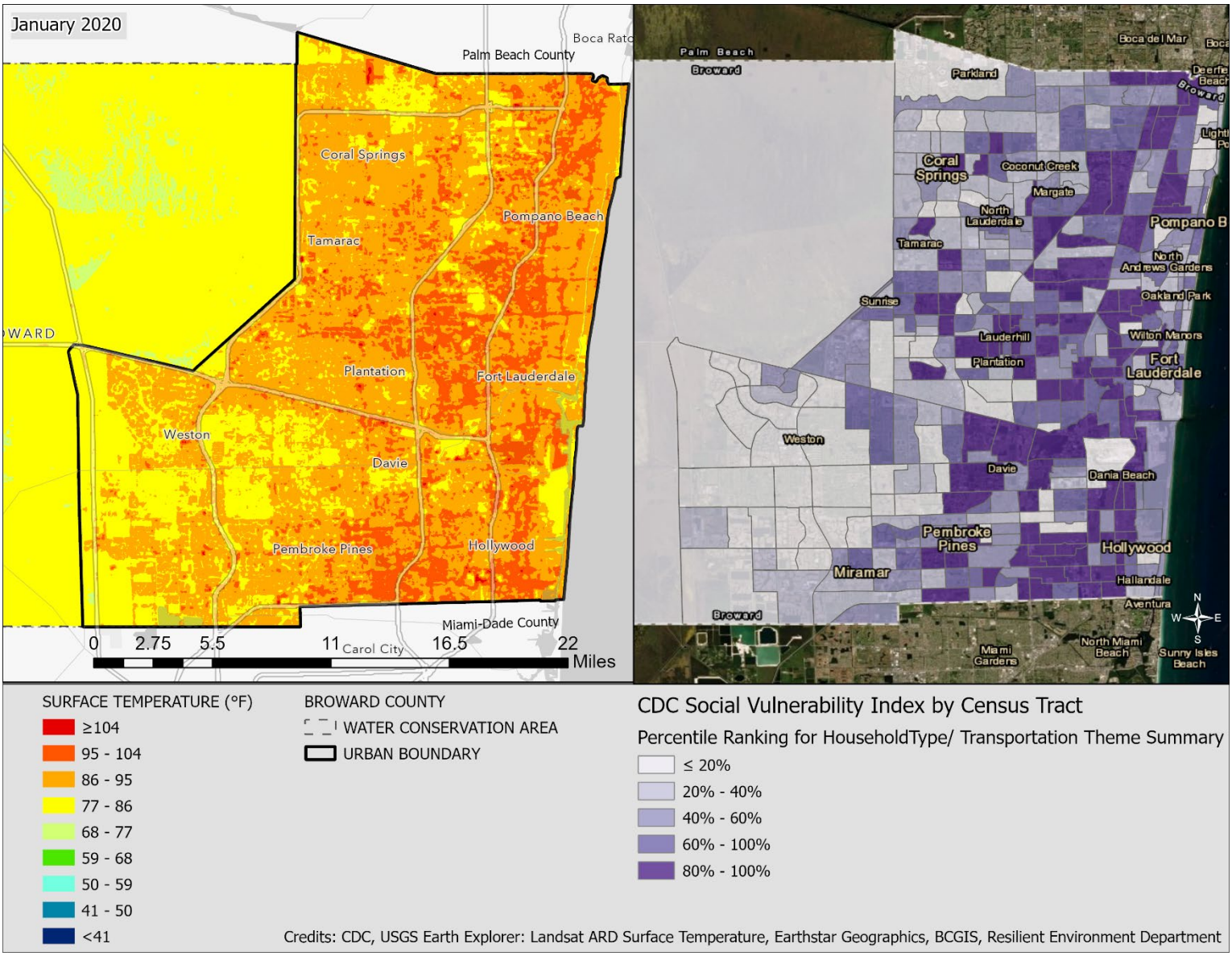
Vulnerability by Household Type/ Transportation

The CDC has included demographics such as households with no vehicle available, households with more people than rooms, percentage housing in structures with 10 or more units, percentage of mobile homes, and percentage of persons in institutionalized group quarters in its social vulnerability ranking under the housing type/transportation theme. Persons in census tracts with a high percentile ranking for this theme are likely to lack the resources needed to facilitate a quick response to elevated temperatures, for example, households with no vehicle available may face challenges in quickly moving to cooler areas during extreme heat events.

The social vulnerability map under this theme identifies several areas in central and eastern Broward as highly vulnerable, while areas west of Pembroke Pines depict lower vulnerability. This could be because there are more transit-oriented corridors in the central and eastern parts of the County which encourage multimodal transportation. In comparing the social vulnerability map with the surface temperature map, it was found that while there are serval areas where the most vulnerable populations intersect the hottest communities, such as portions of Pompano Beach, Oakland Park, Fort Lauderdale, Lauderhill, and Lauderdale Lakes, Hollywood, Dania Beach, Hallandale, West Park and Eastern Miramar, and others, there are also examples where the

most vulnerable are not in communities with the relatively higher surface temperatures, such as parts of Deerfield Beach, Coral Springs, Tamarac, Davie, and others (See **Figure 4.18**).

Figure 4.19: Heat Exposure & Social Vulnerability by Household Type/Transportation



Pandemic/Infectious disease

The Covid-19 pandemic that began in 2020 impacted the lives of residents as well as all commercial and governmental operations in Broward County. While, as of this 2022 update, many of the restrictions and precautions that were imposed to contain the spread of the virus have been relaxed or waived, it is recognized that this is a hazard that must be included in the planning and preparedness for the foreseeable future. Broward County Emergency Management Division works closely with the Florida Department of Health in monitoring disease trends and outbreaks and, when necessitated, to take appropriate action to safeguard the Broward County community.

Probability and Extent of Future Events

This hazard is considered likely to occur.

Mass Migration

While this is not a hazard that has the potential to impact Broward County in the same way as a natural hazard or a pandemic, each occurrence can disrupt the daily lives of residents and tourists and business and governmental operations as well. Most recently, there has been an increased level of occurrence as migrants seeking refuge in the United States are arriving on the shores of Broward County's ocean front communities such as Deerfield Beach, Pompano Beach, and Fort Lauderdale.

Probability and Extent of Future Events

This hazard is considered likely to occur.

Terrorism

Since the terrorist attacks of September 11, 2001, the public safety agencies of Broward County have instituted pro-active measures to identify and contain a potential terrorist incident. This vigilance, in coordination with state and federal law enforcement agencies, has largely prevented another terrorist attack from occurring and impacting Broward County and its 31 municipalities. Still, the possibility of another terrorist attack occurring that would impact Broward County is recognized. Through ongoing training and exercising, the county maintains and will maintain its vigilance of this hazard.

Probability and Extent of Future Events

This hazard is considered likely to occur.

Cyber

The threat of a cyber-attack has been added to the listing of Most Significant Hazards of Concern For Broward County. Over the past five years, the potential for a cyber-attack has greatly increased due to the latest methods and capabilities that enable cyber criminals to access government, business, and personal computers and even servers. Government owned and/or operated electronic systems that access the Internet, for example, are at the top of the list of targets for cyber criminals. Broward County government has implemented numerous safeguards to prevent cyber-attacks on its internal communications systems.

Probability and Extent of Future Events

This hazard is considered highly likely to occur.

Hazardous Material Incident

Hazardous material incidents occur routinely throughout Broward County's municipalities and unincorporated areas. Normally, these incidents are contained and resolved by county and local fire/rescue and law enforcement first responders. In an extensive hazmat release, the protocols

for response and, when necessary, evacuation, facilitate the actions that successfully mitigate the incident. However, continuous training for first responders and initiatives that promote public awareness of a hazmat incident are supported by Broward County government and by its 31 municipalities.

Probability and Extent of Future Events

This hazard is considered highly likely to occur.

Severe Storm

Since the 2017 ELMS update, Broward County has experienced an increased level of Severe Storm activity. While the number of severe storms generated each year is dependent upon a variety of climatological factors, Broward can expect to see more severe storms that include the following elements.

Background

According to the National Severe Storms Laboratory, more than 100,000 thunderstorms occur each year, though only about 10% of these storms are classified as "severe" (wind speeds greater than 58 miles per hour). Although thunderstorms generally affect a small area when they occur, they are very dangerous because of their ability to generate strong winds, tornadoes, hailstorms, flash flooding, and damaging lightning. While thunderstorms can occur in all regions of the United States, they are most common in the central and southern states because atmospheric conditions in those regions are most ideal for generating these powerful storms.

Thunderstorms are caused when air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for thunderstorms. These storms can occur singularly, in lines or in clusters. They can move through an area very quickly or linger for several hours.

The National Weather Service estimates that as many as 40,000 thunderstorm occurrences each day world-wide. On an annual basis, this means an incredible 14.6 million occurrences annually world-wide. Florida leads the nation with the highest incidence per year (80 to 100 plus annual thunderstorm days). Because of Florida's vulnerability to this hazard, specifically Broward County, the impacts to residents and businesses can be severe. Long term power outages, which can occur during a severe storm, impact the health and safety of segments of the vulnerable population. Similarly, straight-line wind and hail can cause injury and property damage.

Straight-line Wind and Hail, as described below, are components of severe storms.

Probability and Extent of Future Events

This hazard is considered highly likely to occur.

Straight-line Wind

Straight-line winds, which in extreme cases have the potential to cause wind gusts that exceed 100 miles per hour, are responsible for most thunderstorm wind damage. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation.

Hail

Hailstorms are another potential damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until having developed sufficient weight they fall as precipitation—as balls or irregularly shaped masses of ice greater than 0.75 inches in diameter. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft

winds keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size.

Location and Spatial Extent

Florida remains one of the most vulnerable states in the U.S. to thunderstorm events. According to the State of Florida Hazard Mitigation Plan, it is a rare occasion when thunderstorms are not observed somewhere in the state daily during the summer rainy season (generally the end of May through the beginning of October). Thunderstorms vary tremendously in terms of size, location, intensity, and duration but are considered extremely frequent occurrences throughout South Florida and Broward County. It is assumed that all of Broward County is uniformly exposed to severe thunderstorms.

Historical Occurrences

According to the National Centers for Environmental Information, there have been 427 recorded severe thunderstorm events (including hail and high wind) in Broward County since the early 1950's. These included:

- **282 high wind events** since 1955.
- **155 hail events** since 1955.
- The locations of historically recorded hail events are shown in **Map 4.7**. *Probability and Extent of Future Events*

The probability of future severe thunderstorm events in Broward County is considered "highly likely". In the future Broward County could be expected to receive severe thunderstorm events with straight-line winds that exceed 58 mph winds and hail size up to 3 inches in diameter.

Vulnerability Assessment

Historical evidence shows that all of Broward County is vulnerable to impacts from severe thunderstorms. Because it cannot be predicted where severe thunderstorms may strike, all buildings and facilities are uniformly exposed to this hazard and could potentially be impacted. It is important to note that only high wind and hail events attributed to severe thunderstorms that have been reported through NOAA data have been factored into this risk assessment. However, in the past 62 years it is likely that a higher number of thunderstorm occurrences have not been reported.

Tornado

With the expected increase in the number of severe storms (i.e., thunderstorms) each year due to climatological factors related to climate change, it is anticipated that Broward County will experience increased tornado activity. As an example, as is further described in this section, two unclassified tornados spawned by Hurricane Ian before it made landfall on Florida's west coast struck the neighborhood of Pasadena Lakes in east Pembroke Pines and in Davie, causing major damage.

Background

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes and other tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally range from 40 to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and can cause extreme destruction and turning normally harmless objects into deadly missiles.

Each year, an average of over 1,230 tornadoes are reported nationwide, resulting in an average of 71 deaths over the last thirty years (NOAA Storm Prediction Center (SPC). They are more likely to occur during the months of March through May and can occur at any time of day but are likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

The destruction caused by tornadoes ranges from light to inconceivable depending on the Intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction such as residential homes (particularly mobile homes). The Enhanced Fujita Scale for Tornadoes was developed to measure tornado strength and associated damages (**Table 4.11**).

Table 4.10: Enhanced Fujita Scale for Tornadoes

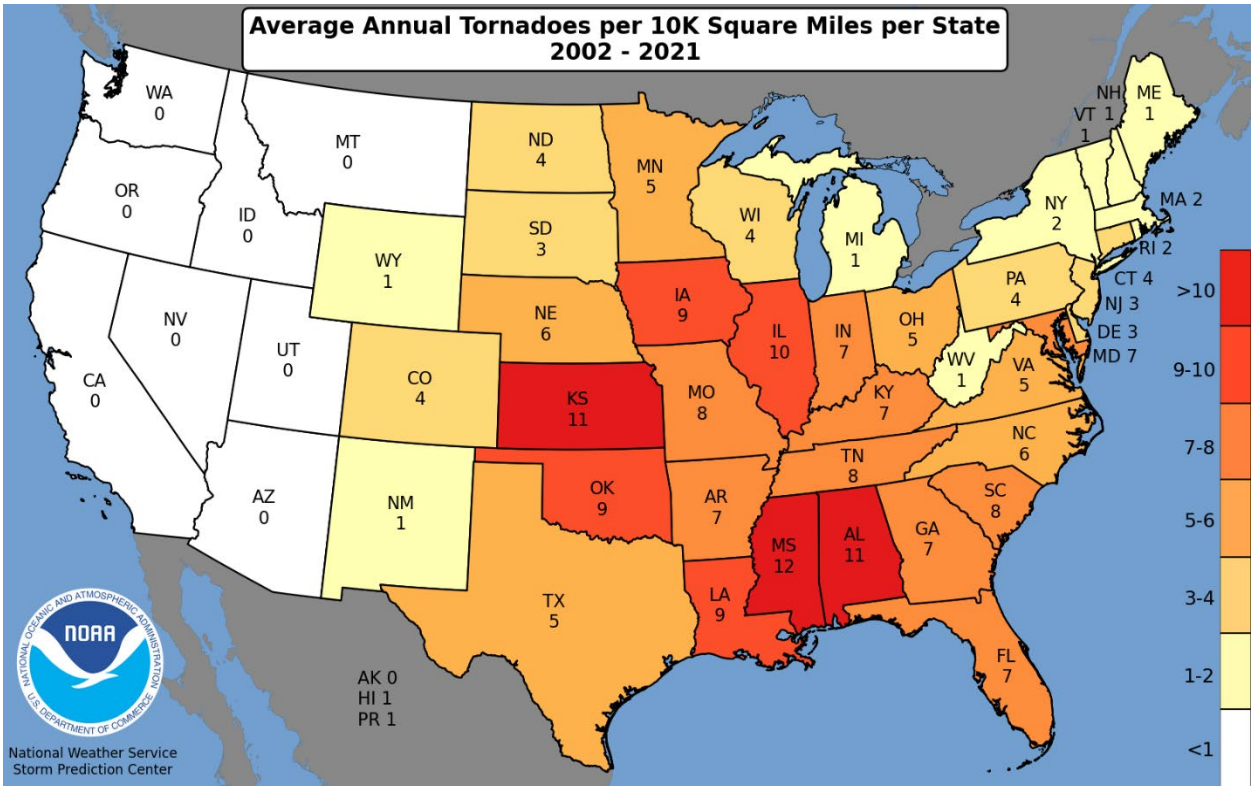
EF-Scale Number	Intensity Phrase	3 Second Gust (MPH)	Type of Damage Done
EF0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	SIGNIFICANT	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	SEVERE	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown, and large missiles generated.
EF5	INCREDIBLE	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

According to the SPC, the highest concentration of tornadoes in the United States has been in Oklahoma, Texas, Kansas, and Florida respectively. Although the Great Plains region of the

Central United States does favor the development of the largest and most dangerous tornadoes, Florida experiences some of the highest numbers of tornadoes per square mile of all U.S. states and are generally EF0 or EF1 in intensity (SPC, 2021). **Figure 4.20** shows tornado activity in the United States from 2002 to 2021 based on the number of recorded tornadoes per 10,000 square miles.

The tornadoes associated with tropical cyclones are most frequent in September and October when the incidence of tropical storm systems is greatest. This type of tornado usually occurs around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction.

Figure 4.20 Tornado activity in the United States based on the number of recorded tornadoes per 10,000 square miles.



Source: NOAA Storm Prediction Center, 2022

Location and Spatial Extent

Tornadoes occur throughout the State of Florida and based on historical data more confirmed tornado touchdowns have been confirmed in South Florida than other regions in the state. Florida tornadoes typically impact a relatively small area; however, events are completely random, and it is not possible to predict specific areas that are more susceptible to tornado strikes over time. Therefore, it is assumed that all of Broward County is uniformly exposed to this hazard. According to the Florida Division of Emergency Management, Florida has 2 distinct tornado seasons: (1) summer (most frequent, less intense events); and (2) late winter/early spring (less frequent, more intense events).

Historical Occurrences

From 2012 to 2021, Florida averaged 41 tornado events per year, though most are smaller, less intense, and shorter in duration than those in other states. According to the State of Florida Hazard Mitigation Plan, Broward County is designated as a "High Risk" jurisdiction when compared with other Florida counties.

According to the National Centers for Environmental Information, there have been 115 recorded tornado events in Broward County since 1950.[5] These events resulted in 1 death, 96 injuries, and an estimated $173.7 million in property damages. Most of these events (74) were determined to be of minimal tornado intensity (F0), as shown in **Table 4.12**. The strongest and most deadly tornado in Broward County history occurred on March 1, 1980, when an F3 tornado killed 1 person, injured 33, and caused approximately $25 million in property damages.

Table 4.11: Overall Historical Tornado Impact in Broward County by Jurisdiction

Jurisdiction	Number of Events (1950-2022)	Magnitude (Fujita Scale*)						Maximum F Scale
		F0	F1	F2	F3	F4	F5	
Coconut Creek	1	0	1	0	0	0	0	F1**
Cooper City	0	0	0	0	0	0	0	not applicable
Coral Springs	5	4	0	0	0	0	0	F0
Dania Beach	0	0	0	0	0	0	0	not applicable
Davie	3	3	0	1	0	0	0	F0 and F 2
Deerfield Beach	2	1	1	0	0	0	0	F1
Fort Lauderdale	5	3	2	0	0	0	0	F0 and F1
Fort Lauderdale International Airport	1	1	0	0	0	0	0	F0
Hallandale Beach	6	4	2	0	0	0	0	F1
Hillsboro Beach	1	1	0	0	0	0	0	F0
Hillsboro Lighthouse	0	0	0	0	0	0	0	not applicable
Hollywood	3	2	1	0	0	0	0	F0 and F1
Hollywood N. Perry Airport	1	0	1	0	0	0	0	F1
Lauderdale-By-The-Sea	0	0	0	0	0	0	0	not applicable

5 These events do not include reported funnel clouds or waterspouts.

Jurisdiction	Number of Events (1950-2022)	Magnitude (Fujita Scale*)						Maximum F Scale
		F0	F1	F2	F3	F4	F5	
Lauderdale Lakes	1	0	1	0	0	0	0	F1**
Lauderhill	1	1	0	0	0	0	0	F0
Lazy Lake	0	0	0	0	0	0	0	not applicable
Lighthouse Point	0	0	0	0	0	0	0	not applicable
Margate	1	1	0	0	0	0	0	F0
Miramar	3	1	2	0	0	0	0	F1
North Lauderdale	0	0	0	0	0	0	0	not applicable
Oakland Park	1	1	0	0	0	0	0	F0
Parkland	0	0	0	0	0	0	0	not applicable
Pembroke Park	0	0	0	0	0	0	0	not applicable
Pembroke Pines	3	2	1	0	0	0	0	F1
Plantation	3	3	0	0	0	0	0	F0**
Pompano Beach	4	4	0	0	0	0	0	F0
Sea Ranch Lakes	0	0	0	0	0	0	0	not applicable
Southwest Ranches	0	0	0	0	0	0	0	not applicable
Sunrise	2	0	1	1	0	0	0	F1 and F2
Tamarac	2	1	1	0	0	0	0	F1
Broward Municipal Services Districts	71	45	16	7	3	0	0	F3
West Park	0	0	0	0	0	0	0	not applicable
Weston	0	0	0	0	0	0	0	not applicable
Wilton Manors	0	0	0	0	0	0	0	not applicable
TOTAL	**120**	**78**	**30**	**9**	**3**	**0**	**0**	**F3**

Source: National Centers For Environmental Information – as of 12/31/2022

** - For historical purposes, the Fujita Scale was used in this table*

*** - The tornados occurred when the Enhanced Fujita scale had been adopted.*

To exemplify the potential impact of a major tornado event, the following notable recent events are described and considered as part of Broward County's risk assessment and mitigation planning purposes.

June 16, 1997
An F1 tornado touched down in Sunrise at the intersection of Commercial Boulevard and Nob Hill, flipping 1 car. The tornado moved southwest to near NW 103 Street/NW 45 Avenue. Several roofs were damaged, numerous windows were broken, small trees were uprooted, and power lines knocked down. Several cars were damaged by flying debris, and 1 injury was reported. Total damages exceeded $1 million.

February 2, 1998
In the evening, several F1 tornadoes crossed the Dade/Broward County line and damaged a strip shopping center in Miramar. The multiple tornadoes moved across North Perry airport, where 40 aircraft were destroyed, and 40 aircraft were damaged. The tornadoes weakened as they continued north-northeast damaging a shopping center in Davie near Orange Road/Hiatus Road. Total damages exceeded $30 million.

October 18, 2011
A strong tornado rated as an EF-2 with maximum estimated winds of 125 mph moved across western portions of Plantation and Sunrise on the evening of October 18th. A total of 136 structures suffered damage, with about 20-25 of these sustaining significant to severe damage. A few mobile homes in the Plantation section of the tornado were destroyed with roof and wall collapse. The tornado intensified as it moved into Sunrise, damaging homes in the New Orleans Homes subdivision. Two concrete block homes sustained significant to total roof loss, and several other homes had significant roof, garage, and window damage. Cars were damaged by winds and debris as well as uprooted and sheared trees. Most of the damage was in the EF-1 range, except for a two-block area of EF-2 damage in Sunrise at the New Orleans Homes subdivision where the highest winds were noted. Despite the magnitude and extent of the damage, no major injuries were reported with only a few scrapes and cuts. Federal assistance was approved for residents in the affected area due to the severity and magnitude of the damage.

January 27, 2016

A line of severe storms moved onto the Gulf coast at 5am that morning, prompting the issuance of several special weather statements, severe thunderstorm warnings, and tornado warnings as it crossed the south-Central peninsula. A strong cyclic mesocyclone that moved onshore during the early morning hours tracked across the peninsula, where it re-intensified over north Central Broward county and produced an EF-1 tornado that moved across Coconut Creek and Pompano Beach. The tornado touched down near the intersection of NW 2nd court and NW 43rd Ave and traveled northeast leading to several snapped and uprooted hardwood trees and damage to fences across NW 42nd, Palmetto Drive, and Coconut Creek Boulevard. The tornado damaged trees, power lines and tossed several cars across the impacted area.

September 27, 2022
An EF-1 tornado spawned by Hurricane Ian before it made landfall on Florida's west coast struck the neighborhood of Pasadena Lakes in east Pembroke Pines. The storm ripped through the neighborhood after destroying about 30 small planes at North Perry airport. Some were missing wings and tails; others were flipped upside down. In addition, there was a small amount of structural damage to the airport, which is operated by Broward County. At approximately the same time, another EF-1 tornado spawned by Ian struck a mobile home park in the nearby city of Davie, damaging at least 10 mobile homes. There were no reported injuries reported from either tornado.

Probability and Extent of Future Events

The probability of future tornado occurrences affecting Broward County is considered highly likely. According to historical records, Broward County experiences an average of nearly 2 confirmed tornado touchdowns per year. While most of these events are small in terms of size, intensity, and duration, they do pose a significant threat should Broward County experience a direct tornado strike. In the future, Broward County can expect to be hit by tornadoes reaching up to EF3 in strength. Tornadoes, even those at an EF-0 level, can impact residents and businesses, and can cause injuries and property damage.

Vulnerability Analysis

To estimate potential losses due to tornadoes, NOAA historical tornado loss data was used to develop a tornado stochastic model. In this model:

- Losses were scaled for inflation.
- Average historic tornado damageability was used to generate losses for historical tornadic events where losses were not reported.
- Expected annualized losses were calculated through a non-linear regression of historical data.
- Probabilistic losses were scaled to account for would-be losses where no exposure/instrument was present at the time of the event.

Table 4.13 shows potential annualized property losses for each jurisdiction in Broward County.

Table 4.12: Potential Annualized Losses by Jurisdiction (Tornado)

Jurisdiction	Total Exposure	Annualized Expected Property Losses ($)	Annualized Percent Loss Ratio
Coconut Creek	$3,061,603,270	*Negligible*	0.00%
Cooper City	$1,943,657,150	*Negligible*	0.00%
Coral Springs	$8,134,798,700	*Negligible*	0.00%
Dania Beach	$1,878,435,580	*Negligible*	0.00%
Davie	$6,711,031,880	*Negligible*	0.00%
Deerfield Beach	$5,161,599,440	$8,756	0.00%
Fort Lauderdale	$22,130,694,710	$40,834	0.00%
Hallandale Beach	$3,836,691,130	$21,247	0.00%
Hillsboro Beach	$810,574,300	*Negligible*	0.00%
Hollywood	$10,029,588,340	*Negligible*	0.00%
Lauderdale-By-The-Sea	$1,739,928,950	*Negligible*	0.00%
Lauderdale Lakes	$1,152,461,750	*Negligible*	0.00%
Lauderhill	$2,492,601,430	*Negligible*	0.00%
Lazy Lake	$4,107,550	*Negligible*	0.00%
Lighthouse Point	$1,261,700,120	*Negligible*	0.00%
Margate	$2,296,212,030	*Negligible*	0.00%
Miramar	$7,475,638,380	$1,046,334	0.01%
North Lauderdale	$1,260,435,790	*Negligible*	0.00%
Oakland Park	$2,473,754,560	*Negligible*	0.00%
Parkland	$2,682,321,260	*Negligible*	0.00%
Pembroke Park	$404,154,300	*Negligible*	0.00%
Pembroke Pines	$10,247,846,250	$7,872	0.00%
Plantation	$6,803,128,100	*Negligible*	0.00%
Pompano Beach	$8,981,181,420	*Negligible*	0.00%
Sea Ranch Lakes	$110,763,020	*Negligible*	0.00%

Jurisdiction	Total Exposure	Annualized Expected Property Losses ($)	Annualized Percent Loss Ratio
Southwest Ranches	$890,133,450	*Negligible*	0.00%
Sunrise	$5,308,400,300	$22,890	0.00%
Tamarac	$3,283,696,510	*Negligible*	0.00%
Broward Municipal Services Districts	$1,106,396,610	$553,674	0.05%
West Park	$331,537,990	*Negligible*	0.00%
Weston	$6,490,572,820	*Negligible*	0.00%
Wilton Manors	$941,493,080	*Negligible*	0.00%
TOTAL	**$131,437,140,170**	**$1,701,607**	**0.00%**

** Negligible is less than $5,000*
Source: 2017 Broward County LMS, FEMA's National Risk Index

According to FEMA's National Risk Index as of 2022, the Expected Annual Loss for tornadoes in Broward County is $8.8M, with a Total Exposure of $13T. While FEMA designates Broward's Historic Loss Ratio from tornadoes as Very Low, the county's Expected Annual Loss Score is Relatively High at 39.69. The Risk Index Score for tornadoes is 28.91.

Waterspout

Background

Waterspouts are weak tornadoes that form over warm water and are most common along the Gulf Coast and southeastern states. Waterspouts occasionally move inland, becoming tornadoes that can cause damage and injury. However, most waterspouts dissipate over the open water threatening only marine and boating interests. Typically, a waterspout is weak and short-lived, and because they are so common, most go unreported unless they cause damage.

Probability and Extent of Future Events

This hazard is considered highly likely to occur.

Tropical Cyclones (Storms and Hurricanes)

Background

Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counterclockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves, and tidal flooding which can be more destructive than cyclone wind.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. Most hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in this basin is about 6.

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Scale (**Table 4.14**), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense. Storm surge is no longer included in the scale due to fluctuations in wind speed in the span of a hurricane that may not alter the storm surge level.

Located immediately offshore and running parallel to Broward County's 24 miles of shoreline, Florida's coral reef consisting of a ridge complex, inner, middle, and outer reefs provide storm

protection and flood reduction benefits to the County. The physical relief features of coral reefs serve as a natural barrier to shorelines by reducing wave energy. According to Ferrario et al. (2014), on average, coral reefs reduce wave energy by 97%.

Due to its close the proximity to the highly urbanized shoreline of Broward County, the exposure of coral reefs to human-induced impacts coupled with the effects of climate change on ocean chemistry and temperature, and the recent widespread outbreak of stony coral tissue loss disease, resulted in both biological and physical degradation of the coral reef ecosystem. The degradation reduces the capability of coral reefs to act as natural infrastructure to provide shore protection.

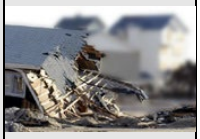
The value of US reefs as flood protection against damages to property in Florida is estimated to be $823 million annually (Storlazzi et al., 2019).

Table 4.13: Saffir-Simpson Hurricane Wind Scale

Category	Maximum Sustained Wind Speed (MPH)	Minimum Surface Pressure (Millibars)
1	74 – 95	Greater than 980
2	96 – 110	979-965
3	111 – 130	964-945
4	131 – 155	944-920
5	155 plus	Less than 920

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure and, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes, and while hurricanes within this range comprise only 20% of total tropical cyclone landfalls, they account for over 70% of the damage in the United States. **Table 4.15** describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

Table 4.14: Hurricane Damage Classifications

Storm Category	Damage Level	Description of Damages	Photo Example
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.	
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.	
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland.	
4	EXTREME	More extensive curtain wall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.	
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.	

Sources: National Hurricane Center; Federal Emergency Management Agency

Location and Spatial Extent

Florida remains one of the most vulnerable states in the U.S. to hurricanes and tropical storms.

By virtue of its geographic location in South Florida, all areas of Broward County are highly susceptible to hurricanes and tropical storm-force winds. Further, the immediate coastal zone and areas along the canals of Broward County are extremely susceptible to potential storm surge inundation resulting from hurricanes and tropical storms, as well as inundation from King Tide events, which will be exacerbated as sea levels rise. The South Florida Water Management District (SFWMD) manages water levels in the canals to reduce saltwater intrusion into the fresh ground water and nearby wellfields that are used for public water supply. SFWMD monitors water levels in the canals carefully and operates a series of water control structures in each canal that have gates which shut when the tailwater levels (ocean side) are higher than headwater levels (inland side), which would allow saltwater to move inland. Examples of the water control structures, which are part of the C&SF System, are the S33 on Canal C-12 (the North Fork of the

New River) and S36 on Canal C-13. These structures are generally west of I-95 about halfway between the I-95 and the Florida Turnpike (one exception is the G54 on the G-15 Canal (the North New River Canal) which is just west of the Florida Turnpike). As sea levels rise, the performance of these gravity based coastal water control structures are being reduced, because discharge rates are a result of the difference between inland water levels and tidal water levels, which are decreasing, in average. Along with sea level rise, other climate impacts, land development, population increase, and aging of the C&SF infrastructure, which was mostly designed and constructed in the 1950's, are significantly impacting the overall performance of the C&SF system.

SFWMD is making significant infrastructure adaptation investments that are needed to successfully continue to implement its mission of safeguarding and restoring South Florida's water resources and ecosystems, protecting communities from flooding, and ensuring an adequate water supply for all of South Florida's needs, today and in the future. As part of the District's commitment to resiliency, alongside local governments, stakeholders, and communities in the region, to address the impacts of these changing conditions on the District's critical assets, water management operations, water supplies, and water resources, the District is developing its Sea Level Rise and Flood Resiliency Plan. The plan compiles a comprehensive list of priority resiliency projects with the goal of reducing the risks of flooding, sea level rise, and other climate impacts on water resources and increasing community and ecosystem resiliency in South Florida.

In addition, the Jacksonville District and the South Florida Water Management District, non-federal partner, initiated the Central and Southern Florida (C&SF) Flood Resiliency Study to identify the need to provide continued flood risk management to reduce the most immediate risk to the C&SF Project due to changing conditions including climate change, sea level change, land development, and population growth in the lower east coast of Florida in Palm Beach, Broward, and Miami-Dade counties. FRM measures to be evaluated may include a combination of structural, non-structural, natural, and nature-based features.

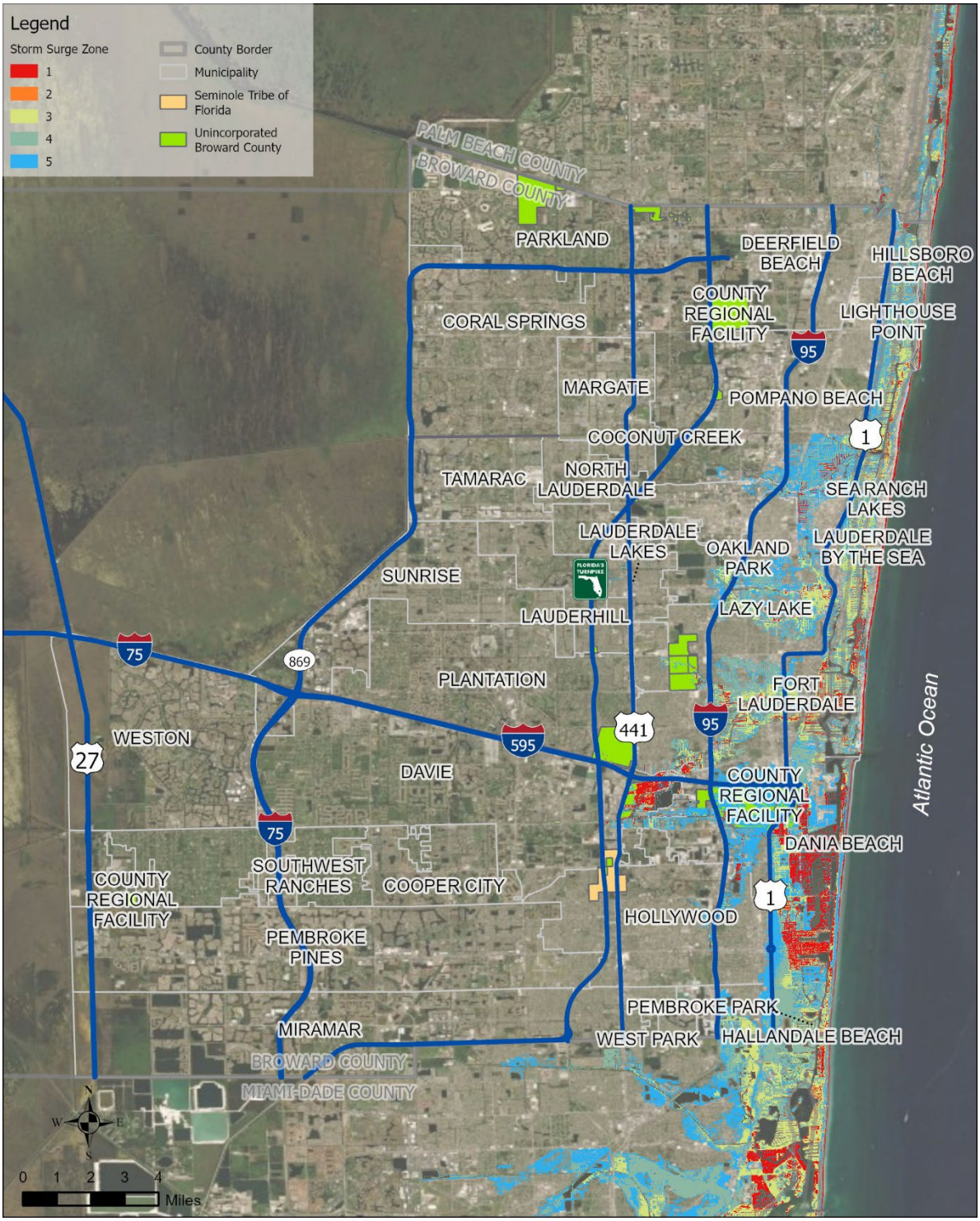
High tailwater generally occurs during high tide conditions and the effect is to block saltwater from travelling farther to the west of the water control structures. Just as these structures are operated in the closed position during high tide, they are also closed during storm surge events, such that the gates would serve to block storm surge from travelling west of the water control structures. While it is conceivable that an extreme event may damage the gates, rendering them inoperable as a defense to storm surge, this is not within the reasonable range of potential events, especially given resilience improvements and redundancies planned and underway to ensure backup energy sources and elevating/hardening of control structures and appurtenant infrastructure. While storm surges typically do not generate notable inundation west of the water control structures, high tides and moderate storm surge have been shown to affect water levels in canals west of the control structures, with the potential to hinder basin drainage. Further increases in sea level combined with intensifying high tides and storm surge will necessitate more significant resilience investments, including the replacement of gravity operated gates with pumps, to manage inland stormwater discharges. Without these investments, overtopping of water control structures is likely, along with severe constrains on stormwater management that will increase the flood risk of low-lying areas both coastal and inland in addition to increasing the risk of saltwater contamination of coastal wellfields.

Maps 4.8 and 4.9 illustrate storm surge inundation zones for Broward County derived from Florida Division of Emergency Management's effort to update Regional Evacuation Studies. As part of the statewide study, the DEM managed a separate contract to produce updated LIDAR elevation data, which was completed for about 28,000 square miles across the State of Florida. New Sea, Lake, and Overland Surge from Hurricanes (SLOSH) modeling was then completed for 2 SLOSH basins involved in the update for South Florida: Biscayne Bay for Miami-Dade and Broward Counties, and Florida Bay for Monroe County. Maps 4.9 and 4.10 were developed by BCRED based on the updated 2022 SLOSH modeling results taken from NOAA website. SLOSH is a modeling tool used to estimate storm surge for coastal areas resulting from historical, hypothetical, or predicted hurricanes considering maximum expected levels for pressure, size, forward speed, track, and winds. Therefore, the SLOSH data is best used for defining the potential maximum surge for any location.

Map 4.8: Storm Surge Inundation Zones

Data Source: National Hurricane Center, NOAA Broward County GIS

Map 4.9: Aerial of Storm Surge Inundation



Source: National Hurricane Center, NOAA, Broward County GIS.

Historical Occurrences

According to NOAA historical storm track records, 102 hurricane or tropical storm tracks have passed within 75 miles of Broward County since 1850.[6] This includes: three Category 5 hurricanes, 8 Category 4 hurricanes, 13 Category 3 hurricanes, 15 Category 2 hurricanes, 18 Category 1 hurricanes, and 51 tropical storms. Of the 106 recorded storm events, 22 had tracks that traversed directly through Broward County. **Table 4.16** provides for each event the date of occurrence, name (if applicable), maximum wind speed (as recorded within 75 miles of Broward County), and Category of the storm based on the Saffir-Simpson Scale.

Table 4.15: Historical Storm Tracks within 75 Miles of Broward County (1850–2022)

Date of Occurrence	Storm Name	Maximum Wind Speed (MPH)	Storm Category
10/17/1859	Unnamed	70	Tropical Storm
11/1/1861	Unnamed	70	Tropical Storm
9/17/1863	Unnamed	70	Tropical Storm
10/23/1865	Unnamed	105	Category 2 Hurricane *
10/11/1870	Unnamed	105	Category 2 Hurricane
10/20/1870	Unnamed	90	Category 1 Hurricane
8/17/1871	Unnamed	115	Category 3 Hurricane
8/25/1871	Unnamed	105	Category 2 Hurricane
10/7/1873	Unnamed	115	Category 3 Hurricane
9/16/1876	Unnamed	70	Tropical Storm
10/20/1876	Unnamed	105	Category 2 Hurricane
7/3/1878	Unnamed	45	Tropical Storm
9/8/1878	Unnamed	70	Tropical Storm
10/22/1878	Unnamed	80	Category 1 Hurricane
8/17/1881	Unnamed	45	Tropical Storm
8/24/1885	Unnamed	80	Category 1 Hurricane
8/24/1886	Unnamed	80	Category 1 Hurricane
8/16/1888	Unnamed	125	Category 3 Hurricane *
9/8/1888	Unnamed	50	Tropical Storm
9/24/1888	Unnamed	45	Tropical Storm
10/6/1889	Unnamed	45	Tropical Storm *
8/24/1891	Unnamed	85	Category 1 Hurricane
10/7/1891	Unnamed	50	Tropical Storm*
6/10/1892	Unnamed	45	Tropical Storm *
9/25/1894	Unnamed	105	Category 2 Hurricane
10/2/1895	Unnamed	60	Tropical Storm
10/16/1895	Unnamed	40	Tropical Storm*
10/9/1896	Unnamed	60	Tropical Storm
8/2/1898	Unnamed	40	Tropical Storm
9/27/1898	Unnamed	40	Tropical Storm
10/11/1898	Unnamed	70	Tropical Storm
7/30/1899	Unnamed	45	Tropical Storm

6 These storm track statistics do not include tropical depressions or extratropical storms. Though these related hazard events are less severe in intensity, they may indeed cause significant local impact in terms of rainfall and high winds.

Date of Occurrence	Storm Name	Maximum Wind Speed (MPH)	Storm Category
8/10/1901	Unnamed	45	Tropical Storm*
9/11/1903	Unnamed	85	Category 1 Hurricane*
10/17/1904	Unnamed	80	Category 1 Hurricane
6/17/1906	Unnamed	85	Category 1 Hurricane
10/18/1906	Unnamed	120	Category 3 Hurricane
6/28/1909	Unnamed	50	Tropical Storm*
8/29/1909	Unnamed	50	Tropical Storm
10/11/1909	Unnamed	115	Category 3 Hurricane
10/18/1910	Unnamed	120	Category 3 Hurricane
11/15/1916	Unnamed	80	Category 1 Hurricane
10/20/1924	Unnamed	105	Category 2 Hurricane*
7/27/1926	Unnamed	110	Category 2 Hurricane
9/16/1926	Unnamed	40	Tropical Storm
9/18/1926	Unnamed	140	Category 4 Hurricane
10/21/1926	Unnamed	110	Category 2 Hurricane
8/8/1928	Unnamed	100	Category 2 Hurricane
8/13/1928	Unnamed	60	Tropical Storm
9/16/1928	Unnamed	150	Category 4 Hurricane
9/28/1929	Unnamed	110	Category 2 Hurricane
8/30/1932	Unnamed	65	Tropical Storm
7/30/1933	Unnamed	85	Category 1 Hurricane
9/4/1933	Unnamed	130	Category 4 Hurricane
10/5/1933	Unnamed	130	Category 4 Hurricane
5/27/1934	Unnamed	45	Tropical Storm
9/3/1935	Unnamed	160	Category 5 Hurricane
9/29/1935	Unnamed	115	Category 3 Hurricane
11/4/1935	Unnamed	75	Category 1 Hurricane
6/15/1936	Unnamed	45	Tropical Storm
7/29/1936	Unnamed	65	Tropical Storm
8/11/1939	Unnamed	80	Category 1 Hurricane
10/6/1941	Unnamed	120	Category 3 Hurricane
9/15/1945	Unnamed	140	Category 4 Hurricane*
11/1/1946	Unnamed	45	Tropical Storm
9/17/1947	Unnamed	160	Category 5 Hurricane*
10/12/1947	Unnamed	85	Category 1 Hurricane*
9/22/1948	Unnamed	120	Category 3 Hurricane*
10/5/1948	Unnamed	125	Category 3 Hurricane
8/27/1949	Unnamed	150	Category 4 Hurricane
10/18/1950	King	110	Category 2 Hurricane*
10/2/1951	How	70	Tropical Storm
2/3/1952	Unnamed	50	Tropical Storm*
8/29/1953	Unnamed	50	Tropical Storm*
10/5/1953	Unnamed	40	Tropical Storm
10/9/1953	Hazel	70	Tropical Storm
10/18/1959	Judith	50	Tropical Storm
9/10/1960	Donna	140	Category 4 Hurricane
8/27/1964	Cleo	105	Category 2 Hurricane*
10/14/1964	Isbell	125	Category 3 Hurricane*
9/8/1965	Betsy	125	Category 3 Hurricane
10/4/1966	Inez	85	Category 1 Hurricane

Date of Occurrence	Storm Name	Maximum Wind Speed (MPH)	Storm Category
10/2/1969	Jenny	45	Tropical Storm
8/19/1976	Dottie	40	Tropical Storm*
9/3/1979	David	100	Category 2 Hurricane
8/18/1981	Dennis	40	Tropical Storm
9/27/1984	Isidore	60	Tropical Storm
7/24/1985	Bob	45	Tropical Storm
10/12/1987	Floyd	75	Category 1 Hurricane
10/16/1991	Fabian	45	Tropical Storm
8/24/1992	Andrew	160	Category 5 Hurricane
11/16/1994	Gordon	50	Tropical Storm
8/2/1995	Erin	85	Category 1 Hurricane
8/24/1995	Jerry	40	Tropical Storm
11/5/1998	Mitch	65	Tropical Storm
9/21/1999	Harvey	60	Tropical Storm*
10/15/1999	Irene	75	Category 1 Hurricane*
8/13/2004	Charley	145	Category 4 Hurricane
9/5/2004	Frances	110	Category 2 Hurricane
9/26/2004	Jeanne	120	Category 3 Hurricane
8/25/2005	Katrina	80	Category 1 Hurricane
10/24/2005	Wilma	105	Category 2 Hurricane
8/30/2006	Ernesto	70	Tropical Storm
8/20/2008	Fay	80	Tropical Storm
7/24/2008	Bonnie	45	Tropical Storm
8/2/2013	Dorian	39	Tropical Storm
09/09/2017	Irma	70	Tropical Storm
09/02/2018	Gordon	50	Tropical Storm
11/08/2020	Eta	56	Tropical Storm
09/27/2022	Ian	55	Tropical Storm

** Storm track traversed through Broward County.*
Source: NOAA National Centers for Environmental Information, 2022

Some of the more notable historical tropical cyclone events for Broward County are described below:

October 18, 1906, Hurricane
A hurricane moved across the Florida Keys and passed over Miami on October 18 as a Category 3 storm resulting in the loss of 134 lives.

September 18, 1926, Hurricane
The eye of the hurricane moved directly over Miami on the morning of September 18, leaving approximately 100 dead. The storm continued northwestward across South Florida and entered the Gulf of Mexico at Fort Myers. Northeast winds from the storm raised Lake Okeechobee water levels above the low dike on the south end of the lake near Moore Haven. Approximately 3 miles of dike failed, sending 10-to-12-foot floodwaters into Moore Haven and at least 5-foot-deep floodwaters into Clewiston, 16 miles to the southeast.

September 16, 1928, Hurricane [Okeechobee Hurricane]
A Category 4 hurricane made landfall near Palm Beach on September 16 with a central pressure of 929 millibars. The center passed near Lake Okeechobee, causing the lake to overflow its banks and inundate the surrounding area to a depth of 6 to 9 feet. An estimated 1,836 people died in Florida, primarily due to the lake surge. Damage to property was estimated at $25 million in Florida.

September 3, 1935 [Labor Day Hurricane]
This hurricane is one of the most severe hurricanes ever recorded in Florida. With winds more than 200 miles per hour, the storm passed over the Florida Keys on September 2 with a minimum barometric pressure of 26.35 inches. Three relief-work camps, inhabited by veterans of World War I, were destroyed. The American Red Cross estimates that 408 lives were lost.

September 3, 1979, Hurricane David
Hurricane David, a category 2 storm, made landfall north of Palm Beach and caused an estimated $476 million in damages.

August 24, 1992, Hurricane Andrew
Hurricane Andrew made a memorable landfall in South Miami-Dade County, causing estimated damages more than $26 billion in damages. Andrew produced approximately 7 inches of rain, sustained winds of 165 miles per hour, a maximum storm tide of 16 feet, and a total of 96 deaths (including Louisiana). In all, Andrew destroyed 25,000 homes and significantly damaged more than 100,000 others in South Florida. Two weeks after the hurricane, the U.S. military deployed nearly 22,000 troops to aid in the recovery efforts, the largest military rescue operation in U.S. history. When Hurricane Andrew hit southeast Miami-Dade County, flying debris in the storm's winds knocked out most ground-based wind measuring instruments, and widespread power outages caused electric-based measuring equipment to fail. The winds were so strong many wind-measuring tools were incapable of registering the maximum winds. Surviving wind observations and measurements from aircraft reconnaissance, surface pressure, satellite analysis, radar, and distribution of debris and structural failures were used to estimate the surface winds. Although originally classified as a Category 4 storm, extensive post-impact research led to the reclassification of Andrew as a Category 5 hurricane in 2002.

Augusts 2, 1995 Hurricane Erin
Erin, a tropical storm in the central Bahamas, strengthened to minimal hurricane intensity, before moving ashore near Vero Beach. Erin moved across central Florida as a tropical storm then moved into the northeast Gulf of Mexico where it intensified to hurricane strength before moving ashore a final time near Pensacola. In southeast Florida maximum winds gusts were 37 knots at Miami Beach with the lowest pressure of 1000.9 millibars at West Palm Beach International Airport. An unscientific study estimated that lost productivity in Dade, Broward, and Palm Beach counties, caused by the approach of Erin, amounted to $200 million.

November 5, 1998, Tropical Storm Mitch
Tropical Storm Mitch, once a powerful Category 5 storm, crossed South Florida at Monroe and Palm Beach counties at tropical storm strength. The storm caused gusty winds, severe thunderstorms, tornadoes, and beach erosion. Property damage was estimated at $30 million.

September 13–22, 1999 Hurricane Floyd
Hurricane Floyd was an enormous Category 4 storm that skirted the southeast Florida coast with minimal effects, mostly to marine interests. Most areas reported maximum sustained winds of 25 to 30 miles per hour, which caused very minor damage, mainly to trees and some utility lines. Rainfall amounts were unusually light with less than 1/2 inch reported at all official stations in South Florida. The storm surge ranged from 3.3 feet above normal in Palm Beach County to 1.5 feet above normal in Miami-Dade County, causing mostly minor beach erosion. Other marine damage occurred to sea walls and small boats. Floyd's unpredictable path led to the largest peacetime evacuation in U.S. history as over a million people sought refuge. Floyd did not make landfall in Florida, but created flooding, beach erosion, and resulted in nearly $68 million in property damages.

October 15, 1999, Hurricane Irene
Hurricane Irene was a Category 1 storm as it made landfall in Monroe and Miami-Dade counties, moving southwest to northeast. It moved northeast across central Miami-Dade and Broward counties before exiting into the Atlantic on October 16 near Jupiter in northeast Palm Beach County. The storm caused major flooding due to 9-18 inches of rainfall, beach erosion, and minor wind damages. Heavy rains and sustained winds of tropical storm force caused widespread flooding and power outages in the metropolitan areas of Broward County. 4 tornadoes touched down in Broward and Palm Beach counties, injuring 3 persons. Damage in southeast Florida, mainly from flooding is estimated near $600 million which includes $335 million in agricultural losses. An estimated 700,000 customers lost electricity. Flooding in a few residential areas lasted for a week displacing several hundred persons and isolating thousands more. Other long-term ecological repercussions may be experienced from the flooding rains such as the effects of high water on Everglade's hammocks, and the effects of excessive fresh-water runoff on estuaries.

September 5, 2004, Hurricane Frances
Hurricane Frances made landfall at Seawalls Point in Martin County as a Category 2 hurricane. Frances moved farther inland just north of Lake Okeechobee and weakened to a tropical storm before crossing the entire Florida Peninsula and exiting into the Gulf of Mexico just north of Tampa. The highest measured sustained wind at Fort Lauderdale-

Hollywood International Airport was 41 miles per hour with a peak gust of 55 miles per hour. The estimated storm surge ranged from 1-2 feet along the northeast Broward Coast. 2 vehicle-related deaths were reported in Broward County. Florida Power and Light (FPL) reported power outages occurred to 423,000 customers in Broward. An estimated 7,000 persons sought refuge in public shelters in Broward County. Wind damage to house roofs, mobile homes, trees, power lines, signs, screened enclosures, and outbuildings occurred over much of southeast Florida, but was greatest in Palm Beach County. Preliminary property damage in South Florida is estimated at $620 million, including $80 million in Broward County.

September 26, 2004, Hurricane Jeanne

Hurricane Jeanne made landfall as a Category 3 hurricane near the south end of Hutchinson Island, nearly coincident with the landfall point of Hurricane Frances only 3 weeks before. After landfall Jeanne initially moved along a track like Frances, just north of Lake Okeechobee as it weakened to a tropical storm then it turned to the northwest and moved over the northwest Florida. Although slightly smaller and stronger than Hurricane Frances, winds and pressures over southeast Florida were remarkably like Frances. The estimated storm surge ranged from 1-2 feet along the northeast Broward Coast. Property damage from storm surge and winds at the coast occurred to condos, marinas, piers, seawalls, bridges, and docks, as well as to boats and a few coastal roadways. Preliminary property damage in southeast Florida is estimated at $330 million, including $50 million in Broward. Florida Power and Light reported outages occurred to 165,900 customers in Broward County.

August 25, 2005, Hurricane Katrina

Hurricane Katrina made landfall as a Category 1 hurricane along the southeast Florida coast. The center of the 25-mile-wide eye of Katrina made landfall near the Broward/Miami-Dade County border then moved toward the southwest across central and southwest Miami-Dade County, passing directly over the National Weather Service (NWS) Office in Sweetwater. Katrina weakened to a tropical storm before exiting the Florida peninsula into the Gulf of Mexico then quickly regained hurricane strength (and would later strike the Mississippi and Louisiana coast). Maximum sustained winds measured at the NWS Automated Surface Observing System (ASOS) sites included 60 miles per hour at Fort Lauderdale-Hollywood International Airport. The maximum ASOS-measured peak wind gusts included 82 miles per hour at Fort Lauderdale-Hollywood International Airport, and other unofficial peak wind gust measurements included 92 miles per hour at Port Everglades. Mostly minor beach erosion and isolated incidence of coastal flooding were observed. Total damage in South Florida was estimated at around $100 million. Wind damage was mainly to vegetation, signs, and watercraft. Winds and flooding combined caused an estimated $423 million in losses to agriculture and nurseries.

Hurricane Wilma caused extensive damage throughout Broward County.

October 24, 2005, Hurricane Wilma

Hurricane Wilma made landfall as a Category 3 storm on the southwest Florida coast between Everglades City and Cape Romano in Collier County. Wilma exhibited a very large 55- to 65-mile-wide eye while crossing the state, and the eye

covered large portions of South Florida, including most of Broward County with maximum sustained winds of 125 miles per hour and an estimated minimum central pressure of 950 millibars. The highest recorded gusts were in the 100-120 miles per hour range.

An interesting and revealing aspect of Wilma was the wind field in the eye wall. The winds on the back (south/west) side of the eye wall were as strong, if not stronger, than those on the front (north/east) side. This goes against the common, but sometimes erroneous, belief that the strongest winds in a hurricane are always in the right-front quadrant of the storm. This occurred over much of South Florida, and likely contributed to the heavier damage across Broward and Palm Beach counties compared to slightly lesser damage across much of Miami-Dade and Collier counties.

Wilma moved rapidly northeast across the state, with an average forward speed of 25 miles per hour, exiting the east coast over northeastern Palm Beach County near Palm Beach Gardens on the morning of October 24th as a Category 2 hurricane with maximum sustained winds of around 105 miles per hour. Damage was widespread, with large trees and power lines down virtually everywhere. Structural damage was heaviest in Broward and Palm Beach counties where roof damage and downed or split power poles were noted. The hurricane particularly affected older structures in downtown Ft. Lauderdale like the Broward County Courthouse, School Board Building, and other tall office buildings constructed before the post-Hurricane Andrew-era of more stringent wind protection standards. The glass façades of several downtown buildings, including the Templeton Building, were sheared off. Hurricane Wilma caused $20.6 billion worth of damage in Florida.

October 5, 2016, Hurricane Matthew
Hurricane Matthew was a powerful and devastating tropical cyclone which became the first Category 5 Atlantic hurricane since 2007. The thirteenth named storm, fifth hurricane and second major hurricane of the 2016 Atlantic hurricane season, Matthew wrought widespread destruction and catastrophic loss of life during its journey across the Western Atlantic. A total of 47 deaths have been attributed to the storm in Florida. Although Broward County did not take a direct hit from Matthew, 8,980 Florida Power and Light customers lost power as the storm passed to the east, and while damage was primarily confined to the coast, Matthew caused widespread debris and flooding.

September 10, 2017, Hurricane Irma
Hurricane Irma was an extremely powerful Cape Verde hurricane that caused widespread destruction across its path. Irma was the first Category 5 hurricane to strike the Leeward Islands on record, followed by Maria two weeks later. It was the ninth named storm, fourth hurricane, second major hurricane, and first Category 5 hurricane of the 2017 season. Irma caused widespread and catastrophic damage, particularly in the Florida Keys, and was the first major hurricane to make landfall in Florida at since Wilma in 2005. Irma made landfall in Cudjoe Key at 1:00 PM on September 10 as a Category 4 with winds of 130 mph. After passing over land and reentering the Gulf of Mexico, it made another landfall in Marco Island as a weakened Category 3. Once Irma had moved inland, it began to accelerate to the north-northwest, while rapid weakening began to occur due to the increasing wind shear, land interaction, and dry air, with the storm falling below Category 3 intensity hours after landfall. Passing east of Tampa as a weakening Category 1 hurricane around 06:00 UTC on September 11, Irma continued to weaken as most of the deep convection became more spread out towards the northern semi-circle of the circulation –

though it retained a large wind field, with most of Florida experiencing gale-force winds. Broward County experienced Category 1-2 wind conditions and wave inundation of approximately 3 feet. Minor beach erosion occurred along the Broward County coastline. In addition, Broward County had 21 fatalities, the most of any county in Florida. Among those deaths were 12 people at a nursing home in Hollywood. The patients died from the heat worsened by a lack of air conditioning.

October 10, 2018, Hurricane Michael
Hurricane Michael was a very powerful and destructive cyclone that became the first Category 5 hurricane to make landfall in the contiguous United States since Andrew in 1992. It was the third most intense Atlantic hurricane to make landfall in the contiguous United States in terms of pressure, behind the 1935 Labor Day hurricane and Hurricane Camille in 1969. Michael was the thirteenth named storm, seventh hurricane, and second major hurricane of the 2018 Atlantic hurricane season. As it approached the Florida panhandle, it reached Category 5 status with peak winds of 161 mph and made landfall near Mexico Beach on October 10th.

August 28, 2019, Hurricane Dorian
Hurricane Dorian was an extremely powerful and catastrophic Category 5 Atlantic hurricane. It was also one of the most powerful hurricanes recorded in the Atlantic Ocean, with its winds peaking at 185 mph. Dorian was the fourth named storm, second hurricane, the first major hurricane, and the first Category 5 hurricane of the 2019 Atlantic hurricane season. In preparation for the storm, several states including Florida declared state of emergency. with many coastal counties issuing mandatory evacuation orders. After striking the Bahamas and weakening considerably, Dorian began moving northwestward on September 3, parallel to the east coast of Broward County. Dwindling in strength, the hurricane turned to the northeast the next day and made landfall on Cape Hatteras as a Category 2 on September 6.

September 14, 2020, Hurricane Sally
Hurricane Sally is remembered as a destructive and slow-moving Atlantic hurricane. It was the eighteenth named storm and the seventh hurricane of the 2020 Atlantic hurricane season. In South Florida including Broward County, heavy rain led to localized flash flooding. The area between Mobile, Alabama and Pensacola-Gulf Breeze, Florida were impacted the most severely with widespread wind damage, storm surge flooding, and over 30 inches of rainfall within a 48-hour period.

September 23, 2022, Hurricane Ian
Hurricane Ian was the third-costliest weather disaster on record, and the deadliest hurricane to strike Florida since the 1935 Labor Day hurricane. It was the ninth named storm, the fourth hurricane, and the second major hurricane of the 2022 Atlantic hurricane season. Ian was the strongest hurricane to strike Florida since Hurricane Michael in 2018. It became a high-end Category 4 hurricane with sustained winds up to 155 mph early on September 28, while progressing towards the west coast of Florida. Ian made landfall just below peak intensity in southwest Florida on Cayo Costa Island. It was the 5th-strongest hurricane on record to make landfall in the contiguous United States. Ian caused 149 deaths in Florida and caused catastrophic damage with losses estimated to be $113 billion. Much of the damage was from flooding brought about by a storm surge of 10–15 ft. The cities of Fort Myers, Cape Coral, and Naples were particularly hard hit, leaving millions without power and numerous inhabitants forced to climb to their roofs to escape the flood waters. Sanibel Island, Fort Myers Beach, and Pine Island were decimated by the storm surge, which destroyed nearly all standing structures and damaged both the Sanibel Causeway and the Matlacha Bride to Pine Island,

entrapping those left on the islands for several days. Across South Florida, peak winders were in the 45-70 mph range. A total of 13 reported tornadoes were spawned by Ian on Tuesday, September 27th and early on Wednesday, September 28th as it was approaching the Southwest Florida coast. The strongest was an EF-2 in the Delray Beach area of Palm Beach County. In Broward County, Ian spawned at least two tornadoes, one of which damaged several aircraft at North Perry Airport. Total rainfall amounts from 8 AM on September 26th to 8 AM on September 29th ranged from 4-10 inches across southern Florida. The highest rainfall amounts occurred in the day or two leading up to Ian's landfall. The highest amount was over western metro Broward County, ranging from 8-10 inches.

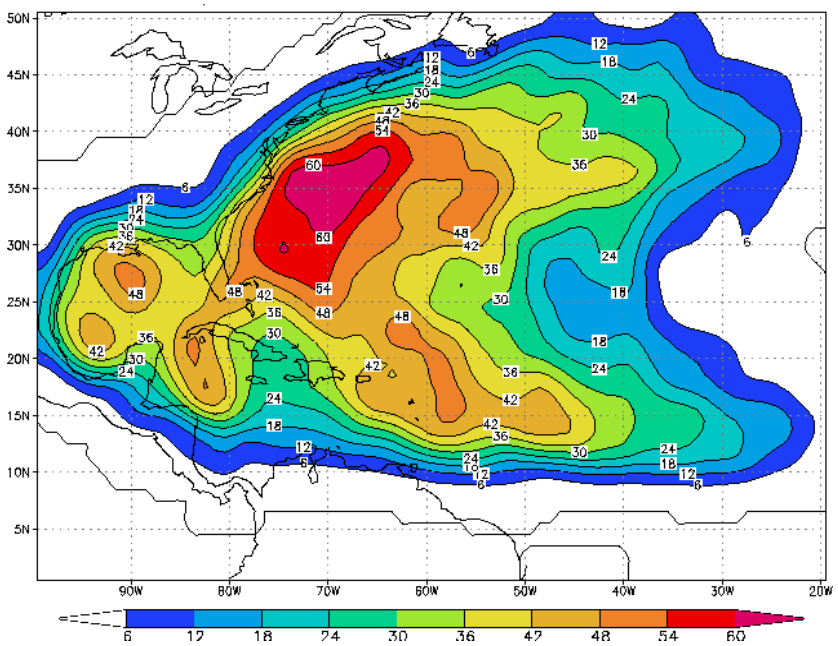
November 10, 2022, Hurricane Nicole
After moving over Great Abaco and Grand Bahama islands, Hurricane Nicole turned to the northwest as it approached Florida. It made landfall on at 3 AM on November 10th south of Vero Beach as a Category 1 hurricane. Nicole's large wind field produced tropical storm force winds along the Southeast Florida Coast including Broward County. The highest sustained winds ranged from 40-45 mph across the coastal sections of Broward County, with a peak measured sustained wind of 43 mph at Dania Pier at 3:50 AM on November 9th. The highest measured wind gust was 59 mph at Dania Pier at 10:15 PM on November 8th. Wind damage was minor, and a total of 13,790 customers lost power across all of Broward County. Tidal flooding and beach erosion occurred from Miami-Dade County north through the Palm Beaches. Across Southeast Florida, total rainfall ranged from 3-5 inches.

Probability and Extent of Future Events

The probability of future tropical storm/hurricane events in Broward County is considered highly likely. According to statistical data provided by the National Hurricane Center, the annual probability of a hurricane and tropical storm affecting the area is between 48 and 54% per year. This empirical probability is consistent with other scientific studies and observed historical data made available through a variety of federal, state, and local sources. Additional data made available through NOAA indicate that the return period for a Category 3 hurricane in Broward County is between 9 and 15% per year. In the future Broward County could be expected to be hit by tropical storms/hurricanes with wind speeds up to 160 mph and storm surge with storm tide heights up to 9.5 feet and inundation depths up to 6.5 feet at Moffett Street/NE 14th Avenue in Hallandale Beach [from the 2010 Florida Statewide Regional Evacuation Study Program Storm Tide Atlas for Broward].

Figure 4.10 shows for any location what the chance is that a tropical storm or hurricane will affect the area sometime during the Atlantic hurricane season. This illustration was created by the National Oceanic and Atmospheric Administration's Hurricane Research Division using data from 1944 to 1999 and counting hits when a storm or hurricane was within approximately 100 miles (165 km) of each location.

Figure 4.10: Empirical Probability of a Named Hurricane or Tropical Storm



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

Table 4.17 profiles the potential peak gust wind speeds in miles per hour (MPH) that could be expected in Broward County during a hurricane event for various return periods.

Table 4.16: Average Expected Hurricane Wind Speeds (Peak Gust) by Jurisdiction

Jurisdiction	Wind Speed [MPH] vs. Return Periods [Year]						
	10	20	50	100	200	500	1000
Coconut Creek	85	103	120	131	140	152	161
Cooper City	85	103	121	132	142	154	162
Coral Springs	85	102	120	131	140	152	161
County Regional Facility	85	103	121	132	142	154	163
Dania Beach	85	104	122	132	143	155	164
Davie	85	103	121	132	142	154	162
Deerfield Beach	86	103	120	131	141	154	162
Fort Lauderdale	81	104	121	132	142	154	163
Hallandale Beach	86	104	122	133	143	156	165
Hillsboro Beach	87	104	122	133	142	155	164
Hollywood	85	104	122	133	143	155	164
Lauderdale-By-The-Sea	86	104	121	133	142	155	163

Jurisdiction	Wind Speed [MPH] vs. Return Periods [Year]						
	10	20	50	100	200	500	1000
Lauderdale Lakes	85	103	121	131	141	154	162
Lauderhill	85	103	120	131	141	153	162
Lazy Lake	86	104	121	132	142	155	163
Lighthouse Point	86	104	121	132	142	155	164
Margate	85	103	120	131	140	153	161
Miramar	85	103	121	133	142	155	164
North Lauderdale	85	103	120	131	141	153	161
Oakland Park	85	103	121	132	142	154	162
Parkland	85	102	120	131	140	152	160
Pembroke Park	85	104	122	133	143	156	165
Pembroke Pines	85	103	121	132	142	155	163
Plantation	85	103	121	131	141	153	162
Pompano Beach	86	103	121	132	141	154	163
Sea Ranch Lakes	86	104	122	133	143	155	164
Seminole Tribe of Florida	85	103	121	132	142	154	163
Southwest Ranches	85	103	120	131	141	153	161
Sunrise	85	103	120	131	141	153	161
Tamarac	85	103	120	131	141	153	161
Broward Municipal Services Districts	85	103	120	131	141	153	161
West Park	85	104	122	133	143	156	165
Weston	85	102	120	131	140	152	160
Wilton Manors	85	103	121	132	142	154	163

Source: Hazus-MH MR5 Scenario Based on Hurricane Wilma

Vulnerability Assessment

Two methods were utilized to estimate potential losses caused by tropical cyclones. Hazus-MH was utilized to conduct a loss estimation analysis for hurricane wind, while a separate GIS-based analysis was completed for storm surge inundation using NOAA's SLOSH data in combination with Broward County's local tax assessor records. These analyses are more thoroughly described earlier in this section under "risk assessment methods," and the results are provided below. See Appendix J for information on housing vulnerability to hurricane wind.

Hurricane Wind

Hazus-MH wind speed data, inventory and damage functions, and methodology were used to determine the annual expected losses due to hurricane wind. **Table 4.18** shows annualized property losses and annualized percent loss ratios by jurisdiction.

Table 4.17: Potential Annualized Losses by Jurisdiction (Hurricane Wind)

Jurisdiction	Total Exposure	Annualized Losses For Residential Buildings at Risk	Annualized Losses For Commercial Buildings at Risk	Total Annualized Expected Property Losses	Annualized Percent Loss Ratio
Coconut Creek	$3,061,603,270	$20,077,953	$2,701,953	$22,779,906	0.85%
Cooper City	$1,943,657,150	$14,283,112	$945,406	$15,228,518	0.85%
Coral Springs	$8,134,798,700	$50,443,688	$58,811,868	$59,255,556	0.81%
Dania Beach	$1,878,435,580	$11,253,369	$4,220,747	$15,474,116	1.02%
Davie	$6,711,031,880	$53,307,442	$6,752,467	$60,059,909	1.05%
Deerfield Beach	$5,161,599,440	$29,645,076	$5,872,001	$35,517,077	0.85%
Fort Lauderdale	$22,130,694,710	$131,927,103	$37,961,493	$169,888,596	0.88%
Hallandale Beach	$3,836,691,130	$38,926,804	$3,890,859	$42,817,663	1.16%
Hillsboro Beach	$810,574,300	$9,378,275	$81,263	$9,459,538	1.17%
Hollywood	$10,029,588,340	$65,836,859	$13,482,769	$79,319,628	0.91%
Lauderdale-By-The-Sea	$1,739,928,950	$16,193,293	$806,623	$16,999,916	0.98%
Lauderdale Lakes	$1,152,461,750	$7,078,126	$1,087,491	$8,165,617	0.85%
Lauderhill	$2,492,601,430	$15,717,939	$1,905,096	$17,623,035	0.83%
Lazy Lake	$4,107,550	$32,860	$0	$32,860	0.80%
Lighthouse Point	$1,261,700,120	$10,140,074	$730,255	$10,870,329	0.87%
Margate	$2,296,212,030	$12,990,439	$2,155,018	$15,145,457	0.74%
Miramar	$7,475,638,380	$64,704,961	$6,742,450	$71,447,411	1.07%
North Lauderdale	$1,260,435,790	$8,191,643	$872,629	$9,064,272	0.83%
Oakland Park	$2,473,754,560	$12,110,730	$3,279,496	$15,390,226	0.79%
Parkland	$2,682,321,260	$21,170,976	$426,482	$21,597,458	0.86%
Pembroke Park	$404,154,300	$1,362,551	$513,828	$1,876,379	1.12%
Pembroke Pines	$10,247,846,250	$83,973,781	$11,133,727	$95,107,508	1.00%
Plantation	$6,803,128,100	$41,173,210	$9,405,538	$50,578,748	0.82%
Pompano Beach	$8,981,181,420	$53,315,183	$7,475,290	$60,790,473	0.88%
Sea Ranch Lakes	$110,763,020	$927,402	$113,770	$1,041,172	0.94%
Southwest Ranches	$890,133,450	$7,821,244	$324,963	$8,146,207	1.11%
Sunrise	$5,308,400,300	$24,191,394	$10,316,132	$34,507,526	0.80%
Tamarac	$3,283,696,510	$20,394,375	$2,363,439	$22,757,814	0.76%
Broward Municipal Services Districts	$1,106,396,610	$3,155,168	$1,911,498	$5,066,666	0.98%
West Park	$331,537,990	$1,848,026	$364,252	$2,212,278	0.84%
Weston	$6,490,572,820	$60,142,219	$5,392,299	$65,534,518	1.09%
Wilton Manors	$941,493,080	$6,845,365	$940,569	$7,785,934	0.82%
TOTAL	**$131,437,140,170**	**$898,560,640**	**$152,981,671**	**$1,051,542,311**	**0.92%**

Source: Broward County Property Appraiser and Hazus-MH MR2, FEMA's National Risk Index, 2022

According to FEMA's National Risk Index, the Expected Annual Loss from hurricanes in Broward County is $9.9M, with a total exposure of $13T. While the Historic Loss Ratio is Very Low, Broward

County's Expected Annual Risk Score for hurricanes is Relatively High at 26.68. The Risk Index Score for hurricanes is 28.91.

Future Risk Conditions Influencing Hurricane Wind Speeds

Climate change will have an impact on future hurricane wind speeds. While the impacts of sea level rise are discussed in greater detail in a subsection dedicated to this subject in Chapter 4, the following results of climate change and sea level rise, will impact storm surge levels in Broward County.

In conclusion, the impacts of climate change will likely exacerbate the severity of future hurricane events. One interesting factor from the 2011 SFWMD report is that, due to increased wind shear over the Atlantic basin, that the number of tropical storms and hurricanes may decrease 6-34%.

Storm Surge

The level of exposure and potential loss estimates for storm surge were generated based on inundation zones derived from the 2014 NOAA SLOSH data described earlier in this section (and shown in Map 4.9) in combination with Broward County's geo-referenced parcel data and tax assessor records. To complete the analysis, every individual land parcel that is located wholly or partially within a storm surge inundation zone for a Category 3 storm event was identified, by jurisdiction. This analysis is intended for use as a general planning tool to provide reasonable estimates of potential at-risk properties using best available geo-referenced data. It is important to note that while using best readily available data, this GIS-based assessment does not consider certain unknown site-specific factors that may mitigate future storm surge losses on a building-by-building basis (such as elevation, surrounding topography, flood-proofing measures, structural projects, etc.).

The objective of the GIS-based analysis is to calculate the total building value of all potentially at-risk properties in Broward County, by jurisdiction. Annualized loss estimates were then calculated based on the assumption of total building loss (worst case scenario) for those properties expected to be inundated during a Category 3 storm event based on the NOAA SLOSH data. In so doing, total exposed building value for each jurisdiction was multiplied by .09 (9% annual chance for Category 3 hurricane based on NOAA probability data[7]). The results of the GIS-based storm surge analysis for Broward County are provided in **Table 4.18**.

Future Risk Conditions Influencing Storm Surge Levels

The impacts of climate change and the associated sea level rise will have considerable impact on future storm surge levels. While the impacts of sea level rise are discussed in greater detail in a subsection dedicated to this subject later in Chapter 4, the following results of climate change and sea level rise, as documented by the 2011 SFWMD report, will impact storm surge levels in Broward County:

7 While NOAA probability data indicate the annual percent chance of a Category 3 event in Broward County is between 9 and 15%, the lower figure of 9% was utilized based on the lower likelihood of all conditions (storm direction and speed, tidal cycle, etc,) necessary for what would be considered a maximum "worst case" storm surge event.

- Inundation of coastal properties by higher sea level and reduced effectiveness of existing storm surge barriers in Broward County
- Higher storm surge levels

In conclusion, the impacts of climate change, global warming, and sea level rise will likely exacerbate the severity of future storm surge events. Thus, this hazard is considered highly likely to occur. Additional factors that could mitigate storm surge include the construction of additional structures on the canal system closer to the Atlantic Ocean that would block even more inland storm surge penetration via the canals. One interesting factor from the 2011 SFWMD report is that, due to increased wind shear over the Atlantic basin, that the number of tropical storms and hurricanes may decrease 6-34%. For more information about climate change, refer to the "Sea Level Rise/Climate Change" part in this section (starting p.138) and the Economic Hot Spot Profiles of Chapter 5.

Table 4.18: Total Building Value of At-Risk Properties by Jurisdiction (Based upon a Category 3 Storm Surge)

Jurisdiction	Number of At-Risk Properties	Total Building Value	Annualized Loss Estimate
Coconut Creek	0	$0.00	$0.00
Cooper City	0	$0.00	$0.00
Coral Springs	0	$0.00	$0.00
Dania Beach	984	$709,977,650.00	$63,897,988.50
Davie	246	$982,643,980.00	$88,437,958.20
Deerfield Beach	648	$251,459,500.00	$22,631,355.00
Fort Lauderdale	9900	$10,535,176,680.00	$948,165,901.20
Hallandale Beach	1080	$714,584,710.00	$64,312,623.90
Hillsboro Beach	75	$239,122,050.00	$21,520,984.50
Hollywood	3018	$2,262,823,000.00	$203,654,070.00
Lauderdale-By-The-Sea	620	$287,203,020.00	$25,848,271.80
Lauderdale Lakes	1	$13,711,430.00	$1,234,028.70
Lauderhill	9	$26,876,130.00	$2,418,851.70
Lazy Lake	0	$0.00	$0.00
Lighthouse Point	1870	$1,119,906,350.00	$100,791,571.50
Margate	0	$0.00	$0.00
Miramar	0	$0.00	$0.00
North Lauderdale	0	$0.00	$0.00
Oakland Park	996	$393,705,300.00	$35,433,477.00
Parkland	0	$0.00	$0.00
Pembroke Park	13	$41,521,890.00	$3,736,970.10
Pembroke Pines	0	$0.00	$0.00
Plantation	26	$49,479,510.00	$4,453,155.90

Jurisdiction	Number of At-Risk Properties	Total Building Value	Annualized Loss Estimate
Pompano Beach	4040	$1,511,731,930.00	$136,055,873.70
Sea Ranch Lakes	90	$88,171,610.00	$7,935,444.90
Southwest Ranches	0	$0.00	$0.00
Sunrise	0	$0.00	$0.00
Tamarac	6	$554,410.00	$49,896.90
Broward Municipal Services Districts	31	$1,286,029,070.00	$115,742,616.30
West Park	0	$0.00	$0.00
Weston	0	$0.00	$0.00
Wilton Manors	1300	$514,007,610.00	$46,260,684.90
TOTAL	**24953**	**$21,028,685,830.00**	**$1,892,581,724.70**

Sources: Broward County Property Appraiser GIS; July 2017 Download of NOAA SLOSH Model Data

Hydrologic Hazards

For the purposes of this vulnerability assessment hydrologic hazards are defined as events or incidents associated with water related damage. Hydrologic hazards account for over 75% of Federal disaster declarations in the United States, with annual costs averaging billions of dollars. Hydrologic hazards included in this section are coastal erosion, drought, flood, and rip current.

Coastal Erosion

Background

Coastal erosion is measured as the rate of change in the position of the shoreline or a reduction in the volume of sand along a shoreline over a period. The root cause of beach erosion is a deficit of sand in the littoral system (region between the limits of high and low tides), caused by development on or adjacent to beaches, removal of dunes, damming of rivers, and/or blockage of the alongshore movement of sand by groins, jetties, or stabilized inlets. Significant short-term fluctuations of shoreline position and sand volume can result from storms-driven waves, but chronic erosion is an effect of a shortage of sand combined with storms and disruption of sand movement. Natural recovery from erosion can take months or years, and in a sand-starved beach system, may never occur. If a beach and dune system does not recover naturally, coastal and upland property may be exposed to further damage in subsequent storm events. Death and injury are not often associated with coastal erosion; however, it can cause the destruction of buildings and infrastructure.

Most Broward County beaches are subject to periodic beach renourishment, which is the mechanical infusion of sand from sources relatively remote from the beach. Historically, the County's beach renourishment program is a partnership of local government, the State of Florida, and the Federal Government through the US Army Corps of Engineers. Since 1970, nearly 11 million cubic yards of sand has been placed on approximately 12 of the County's 24 miles of

beach in 10 partnered projects. Broward County's shoreline is fully developed, with little of the original dune systems intact. The County strives to maintain a berm (beach) width of approximately 50-100 feet, which provides the minimally adequate level of both recreational beach space and storm wave protection for upland development. The beach is subject to 2 types of weather hazards: northeasterly low-pressure systems (nor'easters) and tropical systems. The Florida Department of Environmental Protection has estimated that 21.3 of the 24 miles of Broward County's beaches are critically eroded.[8] Three critical erosion areas (21.3 miles) are specifically identified.

1. Segment I: The south end of Deerfield Beach and the entire Town of Hillsboro Beach along northern Broward County is a 3.2 mile long critically eroded area (R6-R23). Private development is vulnerable throughout this area. Some seawalls exist in Hillsboro Beach and a boulder mound groin field exists along the Deerfield Beach shoreline. In 2011, the cities of Hillsboro Beach and Deerfield Beach completed a beach renourishment project for the southern 500 feet of Deerfield Beach and the northern 5,750 feet for Hillsboro Beach. The "Hillsboro-Deerfield Beach Renourishment Project" placed 340,000 cubic yards of sand on these beaches.[9]

2. Segment II: South of Hillsboro Inlet and extending for 10 miles along Pompano Beach, Sea Ranch Lakes, Lauderdale-By-The-Sea, and Ft. Lauderdale is a continuous critically eroded area (R25-R77) that threatens development and recreational interests including State Road A1A. A beach restoration project has been constructed at Pompano Beach and Lauderdale-By-The-Sea, and inlet sand transfer is ongoing at Hillsboro Inlet. Numerous bulkheads and retaining walls also exist along this stretch of coast.

3. The Segment II Renourishment Project was completed in 2016. Approximately 750,000 cubic yards sand was delivered between Hillsboro Inlet and Broward County's Port Everglades with sand placement along 4.9 miles of shoreline. The renourishment focused on Lauderdale-by-the-Sea, Pompano Beach, and Fort Lauderdale beaches to restore the beaches and increase protection to shoreline, upland development from potential storms.

4. Segment III: Along the southern beaches of Broward County starting just south of the entrance to Port Everglades are critically eroded areas (R86-R128) that threaten recreational interests at John U. Lloyd State Park and development and recreational interests along the communities of Dania Beach, Hollywood, and Hallandale Beach. "Segment III of the Broward County Beach Erosion Control Project", which was completed in 2006 with sand placement along 6.2 miles of beaches from the Broward County line in Hallandale Beach to the John Lloyd State Park. The project also included the cities of

[9] www.townofhillsborobeach.com

Hollywood and Dania Beach and involved the placement of 1.7 million cubic yards of sand.[10]

5. Segment II and Segment III reaches were approved for restoration by the U.S. Army Corps of Engineers as Flood Control & Coastal Emergency FCCE projects following the impacts of Hurricane Irma in 2017. Restoration of Segment II was completed Spring 2022 with placement of approximately 394,400 cubic yards of sand material. Restoration of Segment III commenced in 2021 with completion anticipated in 2024. This project includes approximately 884,000 cubic yards of sand placement along Segment III coastline.

Historical Occurrences

According to the National Climatic Data Center, there were 11 major climatological incidents that resulted in beach erosion in eighteen years, between 1998 and 2016. Broward County's beaches are more susceptible to erosion during nor'easter storm season and hurricane season, which run from October 1 to March 31 and June 1 to November 30, respectively. Most of the historical occurrences of tropical systems have been in September or November, with nor'easters common during the period November through March.

Some of the more notable historical events are described below:

November 1998 Tropical Storm Mitch
Tropical Storm Mitch, once a powerful Category 5 storm, crossed South Florida at Monroe and Palm Beach counties at tropical storm strength. The storm caused gusty winds, severe thunderstorms, tornadoes, and beach erosion.

September 13–22, 1999 Hurricane Floyd
Hurricane Floyd was an enormous Category 4 storm that skirted the southeast Florida coast with minimal effects, mostly to marine interests. The storm surge ranged from 3.3 feet above normal in Palm Beach County to 1.5 feet above normal in Miami-Dade County, causing mostly coastal flooding and minor beach erosion.

November 2001 Coastal Flooding resulting from Hurricane Michelle

Nearly a week of moderate to strong onshore winds, culminating with the approach of Hurricane Michelle, produced coastal flooding from Hollywood Beach to Hallandale Beach. Beach erosion in Broward, Palm Beach, and Miami-Dade counties during the entire event was moderate to locally severe. Costs for remediation of beach erosion from the event were estimated at over $10 million, and property damage was estimated at $20,000.

September 5, 2004, Hurricane Frances
Hurricane Frances made landfall at Sewall's Point in Martin County as a Category 2 hurricane. Frances moved farther inland just north of Lake Okeechobee and weakened to a tropical storm before crossing the entire Florida Peninsula and exiting into the Gulf of Mexico just north of Tampa. The estimated storm surge ranged from 1-2 feet along the northeast Broward Coast, resulting in beach erosion.

[10] www.broward.org/beachrenourishment

September 26, 2004, Hurricane Jeanne
Hurricane Jeanne made landfall as a Category 3 hurricane near the south end of Hutchinson Island, nearly coincident with the landfall point of Hurricane Frances nearly three weeks before. The estimated storm surge ranged from 1-2 feet along the northeast Broward Coast, resulting in beach erosion.

2004 Nor'easter
Nor'easter caused beach erosion in Broward County.

August 25, 2005, Hurricane Katrina
Hurricane Katrina made landfall as a Category 1 hurricane along the southeast Florida coast. Mostly minor beach erosion and isolated incidence of coastal flooding were observed.

October 24, 2005, Hurricane Wilma
Hurricane Wilma made landfall as a Category 3 hurricane on the southwest Florida coast, traversing west to east and covering most of Broward County. Minor to moderate beach erosion occurred along the Broward County coastline.

October 28, 2012, Hurricane Sandy
Hurricane Sandy passed by South Florida as a Category 1 hurricane, through the Bahama islands. Although Sandy did not make landfall in Florida, the storm caused great tidal swells along the coastline of Broward County. These swells caused beach erosion and large-scale flooding along A1A highway, causing A1A's collapse and subsequent restoration project.

September 10, 2017, Hurricane Irma
Hurricane Irma made landfall made landfall as a Category 4 hurricane at the Florida Keys, moving north on the west coast of Florida. Broward County experienced Category 1/2 wind conditions and wave inundation of approximately 3 feet. Minor beach erosion occurred along the Broward County coastline.

Probability and Extent of Future Occurrences

The probability of future erosion along the Broward County coastline is considered "highly likely" due to a chronic scarcity of sand in the littoral system. Beaches in Hallandale Beach, Hollywood, Dania Beach, Lauderdale-By-The-Sea, and Pompano Beach have historically participated in federal, state, and locally cost-shared beach nourishment programs, and other beaches, such as Deerfield Beach and the Town of Hillsboro Beach, have conducted small-scale beach fill projects using municipal, state, and federal funds. In the future, Broward County could be expected to engage in more frequent, smaller scale beach re-nourishment projects approximately every 4-5 years, anticipating the need for more frequent beach supplement than provided by the typical design life of historic projects. Additionally, the potential in future construction of a sand bypass system at Port Everglades inlet will promote the natural transport of sand along the County's shoreline. Rates of erosion vary greatly amongst different parts of the Broward coastline and would be impossible to summarize.

Future Risk Conditions Influencing Coastal Erosion Rates

The impacts of climate change and the attendant sea level rise will have a significant impact on future coastal erosion rates due to the following likely factors of future sea levels and coastal storms:

- Inundation of coastal properties by higher sea level and likely overtopping and submersion of existing coastal erosion control structures
- Higher storm surge levels

Vulnerability Analysis

Most of Broward County's 24 miles of coastline are vulnerable to erosion. There are 3 specific areas in Broward County that are critically eroded: 1) the south end of Deerfield Beach and the entire Town of Hillsboro Beach, 2) the area south of Hillsboro Inlet and extending for 10 miles along Pompano Beach, Sea Ranch Lakes, Lauderdale-By-The-Sea, and Ft. Lauderdale, and 3) the area along the southern 8.1 miles of Broward County south of Port Everglades.

Many Broward County beaches are actively eroding, while others are relatively stable but of inadequate dimensions to provide storm protection and recreational beach space. Factors which contribute to the vulnerable condition of the County's beaches include the unmitigated erosive influence of stabilized inlets, encroaching development, storms, and removal of historic dunes. To address this vulnerability, Broward County has been engaged in shore protection and beach nourishment efforts since the early 1960's. These projects, mostly funded by a partnership of federal, state, and local government agencies, have performed as designed, in most cases exceeding their design life of 10 to 12 years. The current Broward County Beach Management Program is a comprehensive plan to replace beach sand where it is needed, to stabilize with structures the most erosive stretch of beach, and, by means of inlet sand bypassing, to "feed" those beaches which are sand starved because of the presence of stabilized inlets. Restoring the historical southward migration of sand, in combination with the other elements of the program, will reduce the extent and frequency of beach nourishment projects and provide a nearly sustainable beach many miles downstream, especially in the Broward communities of Dania Beach, Hollywood, and Hallandale Beach.

Prior studies conducted for predecessors of the County's Natural Resource Division have identified the economic rationale for engaging in shore protection and beach nourishment activities. There are also environmental benefits as the beaches are also a primary nesting ground for threatened and endangered sea turtles and are an important habitat for several plant and animal species. Economically, according to prior studies, beaches are critical to Broward County considering the following factors:

- Broward's beaches attract 7.2 million visitors a year, who spend $422 million annually in Broward County.
- Broward's beaches contribute $548 million annually to Broward County's economy, including the creation and sustenance of 17,700 full-time equivalent jobs in the County.
- Broward's beaches add $1.4 billion to County property values.
- As a result of the beaches, local government tax revenues are increased by $29 million annually, of which the largest beneficiary is the Broward School District, which collects about $10 million annually because of the beaches.

- Broward's beaches result in an $803 million annual input to southeast Florida regional economy and create 26,000 jobs in the region.
- Out-of-State visitors to Broward's beaches have a $598 million annual impact on the economy of the State of Florida, create 19,000 jobs in the state, and produce $19 million in annual state tax revenues.
- More than 60% of overnight tourists said that they would not have come to Broward County if there were no beaches, and a further 14.3% said they would come less frequently.
- Broward's beaches protect over $4 billion in upland property, structures, and infrastructure.
- In Florida, beaches protect $150 billion in shorefront structures and infrastructure.
- Florida's beaches alone result in an annual increase of about a half billion dollars annually in Federal income tax revenues.
- Florida's beaches attract 2 million international tourists, who spend about $1.1 billion annually in the state.

Drought

The likelihood that Broward County will experience a severe Drought is determined by the climatological conditions that are present. Due to the hazard of heat impact and an absence of rainfall, Broward could experience a severe Drought event. However, the four South Florida counties, in partnership with the South Florida Water Management District, have contingency plans to meet this challenge should it occur.

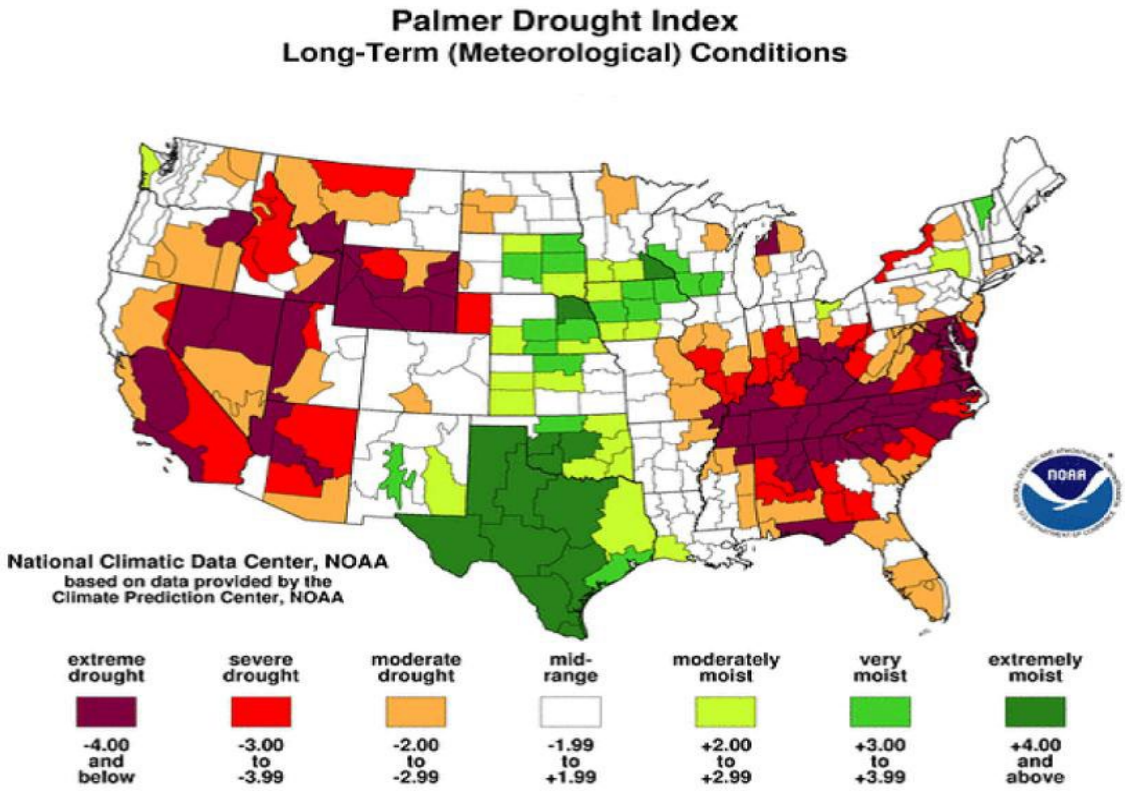
Background

Drought is a natural climatic condition caused by an extended period of limited rainfall beyond that which occurs naturally in a broad geographic area. High temperatures, high winds, and low humidity can worsen drought conditions, and can make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.

Droughts are frequently classified as one of following 4 types: meteorological, agricultural, hydrological, or socio-economic. Meteorological droughts are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

Figure 4.11 shows the Palmer Drought Severity Index (PDSI) Summary Map for the United States from 1895 to 1995. PDSI drought classifications are based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). As can be seen, the Eastern United States has historically not seen as many significant long-term droughts as the Central and Western regions of the country.

Figure 4.11: Palmer Drought Severity Index Summary Map for the United States



Source: National Climatic Data Center, NOAA

Drought typically impacts a large area that cannot be confined to any geographic boundaries; however, some regions of the United States are more susceptible to drought conditions than others. According to the 2017 Palmer Drought Severity Index (PDSI) Summary Map for the United States, South Florida is in a zone less than or equal to -2.9 (-2.9 indicating moderate drought conditions) meaning that moderate drought conditions are a relatively low to moderate risk for Broward County.

Drought conditions typically do not cause significant damage to the built environment, but rather drought effects are most directly felt by agricultural sectors. At times, drought may also cause community-wide impacts because of acute water shortages (regulatory use restrictions, drinking water supply, and saltwater intrusion).

There are a few agricultural areas in the county that have greater exposure to drought. According to the Broward County Property Appraiser data, the areas with the most agricultural land use were the municipalities of Parkland, Coconut Creek, and Southwest Ranches, as well as south of Weston and west of Cooper City. According to the Florida Department of Agriculture, there are

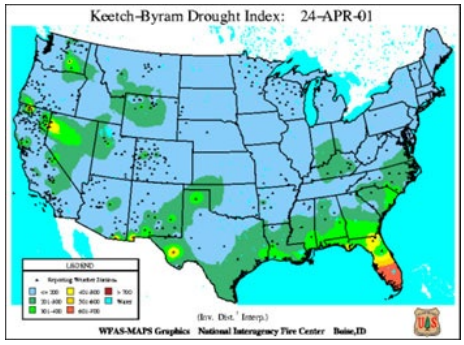
2,507 open acres and over 2.7 million greenhouse acres used for horticulture purposes. In urban Broward County, horticulture dominates the commercial agricultural production. Nursery production, landscape installation, landscape maintenance, and arboriculture account for over $200 million in annual sales. Hundreds of firms employ thousands of individuals.[11]

Water shortages during times of drought (and the degree of regulatory use restrictions) can have a potentially significant impact throughout Broward County and possibly higher economic costs for water supply. As a secondary effect, drought events increase the threat of wildfire in South Florida (and particularly the Everglades) which can also cause serious consequences, including the destruction of property.

Historical Occurrences

South Florida relies on its summer rains for its year-round water demands. According to the State of Florida Mitigation Plan, there have been 10 drought cycles in Florida (typically 2-year periods) since the year 1900. In Central and South Florida, severe droughts were reported in 1932, 1955–1957, 1961–1963, 1971–1972, 1973–1974, 1980–1982, 1985, 1988–1989, 1990, 2000–2001, 2006–2007, 2008-2009, and 2010-2011. According to the National Drought Mitigation Center, from January 1, 1850, to September 19, 2007, there were 134 reported drought impacts for Broward County. There were 17 agricultural, 34 fire, 32 water/energy, 18 social, and 21 other specific drought impacts. However, according to FEMA's National Risk Index, the Risk Index for Drought in Broward County as of 2022 is designated Relatively Low with a score of 7.99. Also, according to the Index, the Expected Annual Loss Score for drought is 7.04.

Throughout a drought cycle in South Florida in 2000-2001 rainfall amounts fell 30% below normal. During this time, Lake Okeechobee (Florida's largest source of fresh drinking water) set daily record-breaking lows. Similarly, groundwater levels declined and there were periods when below-average levels were reached across the region. In September 2000, the water shortage was becoming a threat to agricultural, environmental, and utilities' needs. In these times of drought, the use of well water for crop irrigation lowers the water table, which exposes the water table to saltwater intrusion and a serious compromise of drinking water supplies. Based on their concerns and on the precipitation forecast, the South Florida Water Management District (SFWMD) activated their Emergency Operations Center (EOC) to respond to the emergency situations more effectively. It operated approximately 12 hours a day and remained activated until July 2001.



The severity of the 2000-2001 drought in South Florida is highlighted in this static map of the Keetch-Byram Drought Index (April 24, 2001).

During 2006 to 2007 Broward County experienced extreme drought conditions. According to the Florida Department of Agriculture, drought caused $100 million in crop damage and economic losses to Florida during this period, and the figure could rise tenfold over the next 2 years. On August 1, 2007, the lake level of Lake Okeechobee was 9.20 feet above sea level. This was the

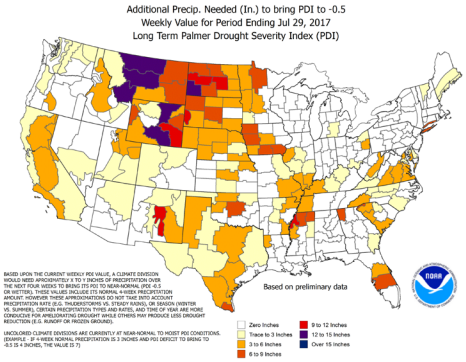
11 Broward County Extension.

lowest level ever recorded during most of the 41 years between 1965 and 2005. Water levels were so low that chloride levels have been a concern in sentinel monitoring wells near well-fields in Hallandale Beach and Dania Beach.

The five-month period from November 2008 to April 2009 was the second driest on record for most South Florida locations. The driest winter on record over many locations in southeast Florida led to the onset of severe drought (D2) conditions. The level of Lake Okeechobee fell from 12.2 feet at the beginning of the month to 11.1 feet by the end of the month, which was 2.5 feet below normal levels. Normal conditions began to resume with the onset of the rainy season by the end of May 2009.

Continued dry weather from January-April 2011, coupled with long-term dryness going back to the previous summer, led to the expansion of severe drought conditions over South Florida. The period of October 2010 to February 2011 was the driest on record in the 80-year history of the SFWMD's records. This led to the continuation of extreme drought conditions (D3) over the eastern half of the peninsula. Underground water levels were in the lowest 10% of normal levels along the east coast and 10 to 30% of normal over interior and west coast areas. The level of Lake Okeechobee fell from 12.15 at the beginning of the month to 11.66 by the end of the month. This was about 2.5 feet below normal for April.

Probability and Extent of Future Events



The probability of future drought events in Broward County and South Florida is considered likely although such occurrences are typically not classified as severe in comparison to other regions. The effects, if any, of drought events on Broward County will depend on the severity and duration of drought conditions, water shortages, and the degree of regulatory water use restrictions. For a drought forecast for a future year, check the National Climatic Data Center website. Based on historical records, Broward County, in the future could be expected to be impacted by a drought ranging from severe to extreme every 10 years. As noted in the Climate Change section, the pattern of drought may change in the future. Any new historical trends should be addressed in future updates.

Future Risk Conditions Influencing Drought

The impacts of climate change, specifically the warming of the planet, will likely exacerbate the length and intensity of drought periods. Fluctuations between periods of greater than average and lesser than average rainfall are expected. Therefore, drought will continue to be a factor in the future and climate change will likely exacerbate cyclical drought conditions. The main impact for the County will be minimizing impacts to the public water supply and natural resources.

Vulnerability Assessment

To analyze the risk of the Broward County area to drought and estimate potential losses, 100 years of statistical data from the University of Nebraska was used (this data was developed by

the University based on Palmer Drought and Crop Severity Indices) as well as 2002 USDA agriculture data. A drought event frequency-impact was then developed to determine a drought impact profile on non-irrigated agriculture products and estimate potential losses due to drought in the area. **Table 4.20** shows annualized expected exposure to drought for Broward County.

Table 4.19: Annualized Expected Agricultural Product Market Value Exposed to Drought

County	Total Agricultural Products Exposure (2007 Dollars)	Annualized Loss	% Loss Ratio
Broward	$85,288.00	*Negligible*	0.00%

**Negligible is less than $5,000*

Source: 2022 FEMA National Risk Index

Note: Total includes all incorporated jurisdictions within the County

Flood

Background

Flooding is the most frequent and costly natural hazard in the United States, a hazard that has caused more than 10,000 deaths since 1900. Nearly 90% of presidential disaster declarations result from natural events where flooding was a major component.

Floods are generally the result of excessive precipitation and can be classified under two categories: general floods, precipitation over a given river basin for a long period of time along with storm-induced wave or tidal action, and flash floods, the product of heavy localized precipitation in a short time over a given location. The severity of a flooding event is typically determined by a combination of several major factors including stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface.

Generally, inland floods in South Florida may last for several days due to a relative lack of topography to drain flood waters, heavy urbanization, and impacts of tides on outfall toward the Atlantic Ocean. The primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding[12] is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, and other large coastal storms. Urban flooding occurs where manmade development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.

Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms. However, flash flooding events may also occur

12 While briefly mentioned here, coastal flooding is more thoroughly addressed under the "Tropical Cyclone" hazard.

from a dam or levee failure within minutes or hours of heavy amounts of rainfall, or from a sudden release of water held by a retention basin or other stormwater control facility. Although flash flooding occurs most often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces.

The periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as floodplain) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence each year, which is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1% chance of occurring in any given year. The 500-year flood has a 0.2% chance of occurring in any given year.

Location and Spatial Extent

Much of Broward County is susceptible to localized flooding, particularly during the rainy season of June through October. The county is surrounded by and interspersed with man-made canals, storm water management lakes, freshwater ponds, rivers such as the Middle and the New Rivers, the Everglades, the Atlantic Ocean, and the Intracoastal Waterway. There are 7 primary canals and numerous secondary and tertiary canals that provide flood control and water supply protection for the area's enormous growth and development. Stormwater management ponds are also used for flood protection as well as stormwater treatment and are created by removing rock to build up the surrounding land for homes. The western portion of Broward County has undergone significant development over the last 25 to 30 years which has resulted in the filling of wetlands to accommodate new housing developments.

Broward County lies close to sea level (with elevation ranging from 5 to 25 feet) and is relatively flat, which often results in extensive “ponding” due to the lack of elevation gradients to facilitate adequate stormwater runoff. Further, its water supply lies just below the surface of the ground. Major rainfall events sometimes leave rainwater nowhere to drain, causing flooding near rivers and canals as well as in urban areas due to poor percolation rates and the low elevations (particularly in western parts of the county). Coastal flooding along the county’s immediate shoreline is typically associated with tidal surge caused by landfalling tropical storms and hurricane events (note: storm surge is addressed under “Tropical Cyclone”).

The severity of flooding is directly related to the amount and duration of the rainfall event. The areas affected by flooding in Broward County could increase. For the barrier island communities, should a significant rainfall event occur at the same time as high-tide, on-shore winds, or a combination of both, the severity could be devastating. Flooding of up to 4 feet could be expected in some areas. Broward County could easily be caught “off-guard” and people living in flood-prone areas would be at an increased risk to property damage and life safety.

Based upon a Category 5 hurricane event, Broward County could see storm surges of over 6 feet above normal tide levels, resulting in significant to severe flooding the barrier islands. This could inundate the barrier islands with 4 to 6 feet of water and sand. The storm tide would also penetrate inland for several miles, reaching Federal Highway with expected flooding of 1 to 2 feet, including downtown Fort Lauderdale.

Map 4.12 illustrates the location and extent of currently mapped special flood hazard areas for Broward County based on FEMA digital Q3 flood data which became effective in 2014. This includes Zones A/AE (100-year floodplain), Zone VE (100-year coastal flood zones, associated with wave action), Zone AH (areas subject to shallow flooding) and Zone X500 (500-year floodplain which is also known as the shaded X zone). It is important to note that flooding and flood-related losses do occur outside of delineated special flood hazard areas, and according to Broward County officials, there are known inaccuracies with the currently mapped, FEMA-identified flood hazard zones. Broward County is currently coordinating with FEMA on map modernization and undergoing limited re-studies for some flood zones which will assist in correcting some of these data accuracy deficiencies. FEMA recently completed additional modeling analyses in some parts of Broward County, including South and Southeast parts, to update the existing FIRM and Flood Hazard areas maps. These updated FEMA maps are expected to become official in late 2022 or early 2023.

Historical Occurrences

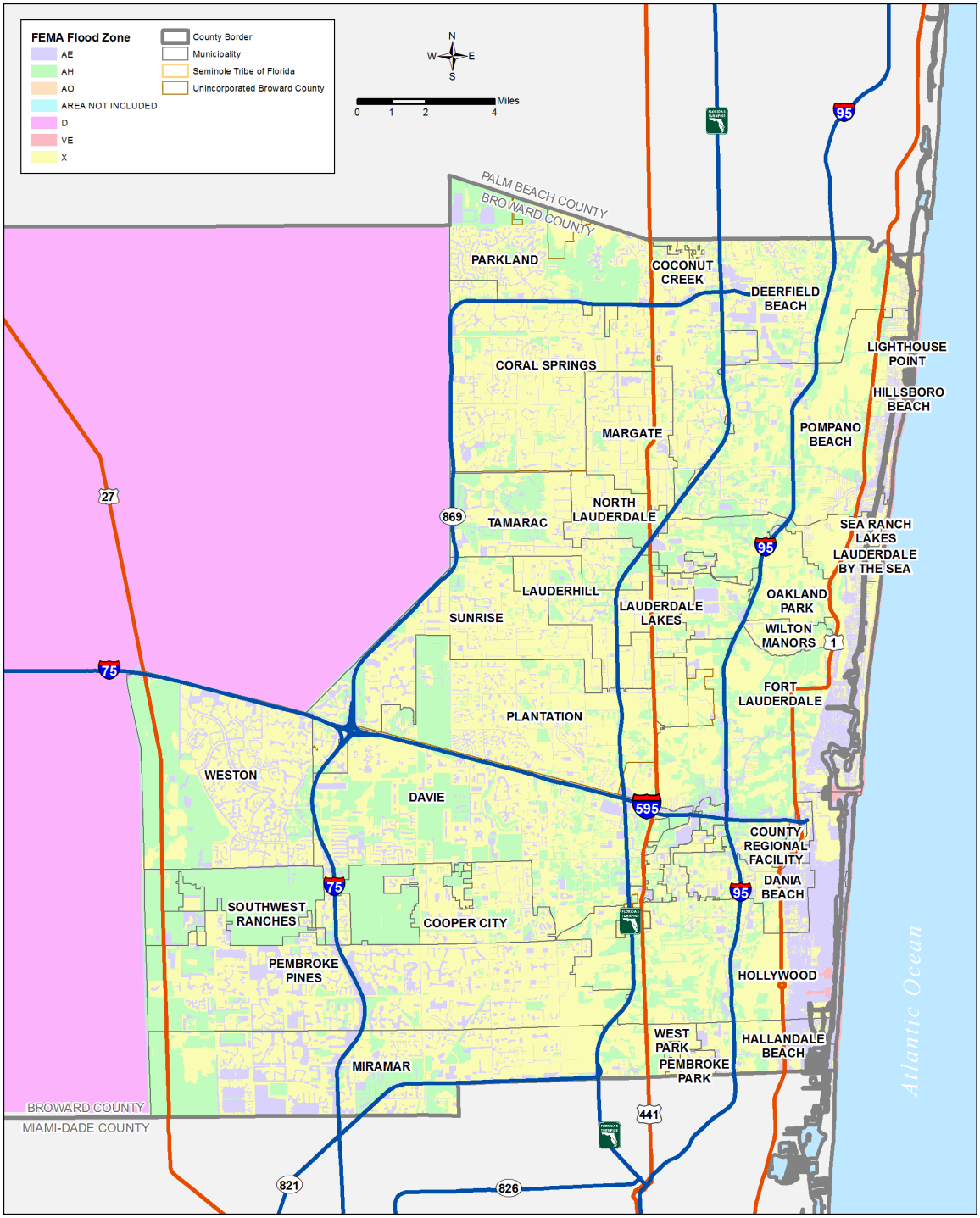
According to the National Climatic Data Center, there have been 114 reported flood events (three event types - Coastal flood, flash flood and flood) in Broward County from January 1, 1990, through August 30, 2022. According to the data, there were no deaths or injuries associated with these flooding events, but there was nearly $62 million in property damage and $25 million in crop damages in Broward County; this estimate does not include the reported losses under hurricanes, tropical storms and storm surge categories that is estimated to be at $221 million for Broward County. Some of the more notable events are described below:

June 1998 – Flash Flood
Excessive rains caused localized heavy flooding from Boca Raton to Miami Beach. The greatest official 24-hour rainfall was 13.75 inches at Pompano Beach with over 7 inches reported at Boca Raton and Miami Shores. Numerous streets were flooded, and several vehicles became submerged in parking lots with their occupants having to be rescued. 3 Broward mobile homes had to be evacuated, several roofs collapsed, and numerous dwellings had flood waters inside. Property damage was estimated at $1 million.

October 1999 – Flash Flood resulting from Hurricane Irene
After crossing Florida Bay, the center of Irene made landfall on the peninsula near Cape Sable on October 15 as a Category 1 hurricane. It moved northeast across central Miami-Dade and Broward counties before exiting into the Atlantic on October 16 near Jupiter in northeast Palm Beach County. Heavy rains and sustained winds of tropical storm force caused widespread flooding and power outages in the metropolitan areas of Miami-Dade, Broward, and Palm Beach counties. Within a 24-hour period, rainfall totals in southeast Florida ranged from 6 to 17 inches with many areas getting 10 to 15 inches. Cooper City had over 15 inches of water, West Pembroke Pines had over 14 inches, Ft. Lauderdale and Hollywood had over 13 inches, Plantation had nearly 12 inches, and Lauderdale Lakes and Pompano Beach had over 9 inches. Property damages in southeast Florida were estimated by the National Climatic Data Center to be approximately $600 million,

which includes $335 million in agricultural losses. An estimated 700,000 customers lost electricity. Flooding in a few residential areas lasted for a week, displacing several hundred persons and isolating thousands more. It was reported that 8,000 people suffered flood damages. Some roads were impassible for weeks, electricity was out in certain areas, and residents and businesses suffered heavy losses.

Map 4.12: FEMA Flood Zones



Source: FEMA NFHL May 25, 2022

October 2000 – "No Name" or "Pre-Leslie" Storm
On October 3, 2000, a low-pressure system, later to become Tropical Storm Leslie, developed off the west coast of Cuba, and headed toward South Florida. Water managers and weather officials closely tracked the storm, and preemptive measures were taken to start moving water out of the canals. However, weather forecasts called for 4-8 inches of rainfall from this storm, and unfortunately, once the storm passed over South Florida, it dumped 14-18 inches of rainfall over a linear area in the center of the county. An estimated 93,000 houses with about 214,000 persons were isolated by flood waters. Power was cut to 13,000 people. There were 3 indirect deaths including 2 males who drove vehicles into canals and 1 man who fell from a roof while repairing a leak.

October 2001 – Flash Flood
Up to 10 inches of rain fell in 2 hours at Lighthouse Point and up to a total of 12 inches fell across portions of northeast metropolitan Broward County. Severe street flooding caused many stalled vehicles and 25 houses, and 25 to 30 apartments suffered flood damage. Property damage was estimated at $100,000.

November 2001 – Coastal Flooding resulting from Hurricane Michelle
Nearly a week of moderate to strong onshore winds, culminating with the approach of hurricane Michelle, produced coastal flooding from Hollywood Beach to Hallandale Beach. The flooding was worst near the time of high tide and involved damage to sea walls and other coastal structures. Water flowed across the "boardwalk" and into some businesses. Beach erosion in Broward, Palm Beach, and Miami-Dade counties during the entire event was moderate to locally severe. Beach renourishment costs are estimated at over $10 million, and property damage was estimated at $20,000.

May 2003 – Flash Flood
A weak tropical wave extending north from the west Caribbean Sea in combination with a mid/upper-level trough of low pressure in the east Gulf of Mexico caused locally extreme rainfall over portions of the Broward-Miami-Dade metropolitan areas. The most rain occurred in a swath from Hollywood to Pompano Beach with an official maximum of 10.21" measured at Fort Lauderdale-Hollywood International Airport. Of that total, 7.36 inches fell from 6 to 8 PM which exceeds the 100-year maximum rate for that time. Radar estimates of 12 to 14 inches of rain were made near Oakland Park and Wilton Manors. According to Emergency Management estimates, 492 homes and businesses suffered some flood damage, and many roadways were impassable. Property damage was estimated at $1 million.

November 2005 – Flash Flood
Law enforcement reported flooding of homes, cars, and streets in northeastern Broward County from Deerfield Beach south to Pompano Beach and Oakland Park. Persistent showers developed over northeastern Broward County late in the evening of Friday, November 19 and reached its peak during the early morning hours of Saturday November 20. Doppler radar estimated up to 5 inches of rain in a 2-hour period between midnight and 2:00 AM fell over these areas.

December 2009 Flash Flood
Extensive and severe flooding occurred over southeastern Broward County. Hardest-hit communities were Dania Beach, Hollywood, Hallandale Beach, and Pembroke Park. As much as 14 inches of rain fell in about 6 hours with other reports and radar estimates showing an

area of 8 to 13 inches of rain primarily along and east of I-95 in the above-mentioned communities. Severe flooding began around 7:30 PM in Dania Beach, gradually progressing southward between 8 and 10 PM to cover the rest of the affected area. A total of 101 homes sustained major flood damage in Broward County, with an additional 88 homes having minor damage. Water was reported to be as high as 2 feet deep inside some homes, and a mobile home park in Pembroke Park had to be evacuated due to the rising water. Shelters were opened in Hallandale Beach and Hollywood to accommodate the evacuees. 6 businesses also sustained significant water damage. One building had a roof collapse in Hallandale Beach. Hundreds of cars were damaged or destroyed by the water. In addition to the water damage, about 2,000 customers lost power in Broward and Miami-Dade counties. Property damage in Broward County was estimated to be at $500,000.

October 2011 – Flash Flood

A weak frontal boundary across South Florida in combination with a flow of deep tropical moisture from the western Caribbean Sea associated with the remnant of Hurricane Rina led to periods of very heavy rain and significant flooding lasting the better part of 4 days. An estimated 2,000 customers lost power across South Florida due to the rain. Torrential rainfall affected eastern sections of metro Broward County during the overnight hours of October 31st. Rainfall totals of 8 to 12 inches occurred over an area bounded by I-595 to the south and Pompano Beach to the north, from NW 31 Ave to the west all the way to the Atlantic coast. A few spots in this area likely received amounts close to 15 inches in about a 9-hour time span. These rains fell over areas already saturated from the rains of the previous two days. A total of 402 homes were affected by water damage and streets were closed due to inundation in Fort Lauderdale, Oakland Park, Wilton Manors and Pompano Beach. The area hardest-hit was between Broward and Commercial Boulevards between I-95 and Federal Highway where water covered the ground up to a few feet. Property damages in tune of $2 million were reported for Broward County.

June 2017 – Heavy Rain Flood

A disturbance meandering across the Gulf of Mexico in combination with an upper-level system across the western Gulf of Mexico lead to nearly a week of heavy rainfall across South Florida. The heaviest rainfall fell in the corridor from Marco Island and southern Collier county northeast into Broward and southern Palm Beach counties. Many locations in this swath saw rainfall amounts in excess of 9 to 10 inches in a single day, and as high as almost 15 inches on the heaviest day, resulting in event totals of 15 to 20 inches in this area. The heaviest rainfall of the event across Broward County fell during June 7th and 8th. The worst impacts were generally reported across Sunrise, Weston, and Davie. There was a multiday closure of the Sawgrass Mills Mall located in Sunrise, the second largest attraction in the state of Florida, due to flooding of the parking lot and mall entrances. Sunrise Fire Station 59 sustained roof damage to the lobby and firefighter sleeping quarters and damage was sustained to the Sunrise Civic Center due to seeping water in the orchestra pit and the public assembly area of the facility. An off-duty NWS employee also reported 6 to 8 inches of water in most low-lying areas and roadways in the vicinity. Most swales and lakes were also out of there banks and flooding adjacent yards. The city of Davie reported several road closures, numerous flooded roadways, as well as several flooding homes due to both roof leaks and water encroachment from swales and lakes. Elsewhere across the county, widespread minor to moderate flooding was reported along with several unconfirmed reports of roof collapses.

November 2020 – Tropical Storm Eta Flooding
Extensive flooding occurred in several parts of Broward County after heavy rainfall from Storm Eta during November 8-9, 2020. Based on the radar data, some areas of the County including Central, South-West parts, received 11-13 inches of rainfall. Flooding was reported in almost all Cities of the County including Fort Lauderdale, Lauderhill, Sunrise, Miramar, Davie and Weston. Water was knee-deep in parts of Broward County. The power was out for more than 24,000 Florida Power & Light customers at 5:30 p.m. Monday (11/9/2020), mostly in Miami-Dade, Broward, and Palm Beach Counties.

Historical Summary of Insured Flood Losses

According to FEMA flood insurance policy records, there have been more than 22,000 flood losses reported in Broward County through the National Flood Insurance Program (NFIP), totaling more than $64 million in claims payments.

Probability and Extent of Future Events

The probability that Broward County will continue to experience flooding associated with large tropical storms, hurricanes, and heavy rainfall events is highly likely. Flooding is a very geographic-specific hazard and in Broward County, the source can either be inland flooding (heavy rainfall and high-water table) and/or storm surge. In the future Broward County could be expected to be hit by large floods, either from large rainstorms or tropical storms/hurricanes, with typical floodwater depths from to 6 inches to 2 feet and near maximum floodwater depths could ranging up to 8 feet (floodwaters of this depth were recorded in parts of Broward County from the Cape Sable hurricane of 1947).

Future Risk Conditions Influencing Flood

The impacts of climate change and associated sea level rise will have considerable impact on future flood conditions. While the impacts of sea level rise are discussed in greater detail in a subsection dedicated to this subject in Section 4, the following results of climate change and sea level rise, as documented in several SFWMD reports including “Sea Level Rise and Flood Resiliency Plan” and “Adoption of Future Extreme Rainfall Change Factors for Flood Resiliency Planning in South Florida” reports published in 2022, will impact flooding in Broward County:

- Inundation of coastal properties due to higher sea levels, astronomical tides, and storm surges.
- Projected changes in future rainfall ranging from a 2% decrease to 62% increase, depending on the rainfall duration and frequency.
- Higher sea levels and storm surges will limit the ability of coastal drainage systems to drain inland stormwater runoff into ocean thus exacerbating flooding and reducing the effectiveness of the primary/secondary drainage system.
- Flood protection level of service provided by existing drainage infrastructure will be reduced due to higher flows and levels in canals from increased rainfall and reduced drainage capacity due to higher tidal levels

In conclusion, the impacts of climate change, and sea level rise will likely exacerbate the severity and duration of floods, including those caused by tropical cyclones and those non-cyclone events.

Vulnerability Assessment

To assess flood risk, two distinct vulnerability assessment approaches were applied for Broward County to assess exposure and potential losses to flood hazard events. This includes (1) a Hazus-MH analysis for riverine (or "non-coastal") flood events; and (2) a GIS-based analysis for riverine and coastal flood events using FEMA's digital Q3 flood data (as shown in Map 4.11) in combination with Broward County's local tax assessor records.

First, riverine flood hazards were modeled using Hazus-MH for the 10-, 50-, 100-, and 500-year flood events. Flood depth was estimated at the pixel level for affected areas, along with proportion of the area affected within the census block. Hazus-MH was utilized to estimate floodplain boundaries, potential exposure for each event frequency, and loss estimates based on probabilistic scenarios using a Level 1 analysis.[13] **Table 4.21** shows potential building losses for 10- and 50-year riverine flood events by jurisdiction, and **Table 4.22** shows potential building losses for 100- and 500-year riverine flood events by jurisdiction.

Table 4.20: Potential Building Losses by Jurisdiction (10- and 50-year Riverine Flood Events)

Jurisdiction	Total Exposure	10-Year			50-Year		
		Residential	Commercial	Industrial	Residential	Commercial	Industrial
Coconut Creek	$3,061,603,270	$291,110	*Negligible*	*Negligible*	$552,120	*Negligible*	*Negligible*
Cooper City	$1,943,657,150	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Coral Springs	$8,134,798,700	$44,516,190	$443,730	$126,760	$52,586,240	$1,196,600	$1,672,740
Dania Beach	$1,878,435,580	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Davie	$6,711,031,880	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Deerfield Beach	$5,161,599,440	$229,320	$56,310	$150,520	$512,810	$124,510	$337,660
Fort Lauderdale	$22,130,694,710	$10,703,830	$184,520	$92,120	$16,108,420	$782,980	$829,050
Hallandale Beach	$3,836,691,130	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Hillsboro Beach	$810,574,300	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Hollywood	$10,029,588,340	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lauderdale-By-The-Sea	$1,739,928,950	$2,434280	$55,540	*Negligible*	$2,500,100	$155,870	*Negligible*
Lauderdale Lakes	$1,152,461,750	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lauderhill	$2,492,601,430	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lazy Lake	$4,107,550	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lighthouse Point	$1,261,700,120	*Negligible*	*Negligible*	*Negligible*	$136,000	*Negligible*	*Negligible*
Margate	$2,296,212,030	$10,548,780	$248,200	$39,920	$17,173,400	$718,770	$252,010
Miramar	$7,475,638,380	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
North Lauderdale	$1,260,435,790	$840,840	$90,980	*Negligible*	$6,246,740	$351,530	$59,580
Oakland Park	$2,473,754,560	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Parkland	$2,682,321,260	$29,746,130	$78,060	*Negligible*	$30,233,850	$78,060	*Negligible*

13 According to FEMA's Hazus Web site, "a Level 1 analysis yields a rough estimate based on the nationwide database and is a great way to begin the risk assessment process and prioritize high-risk communities."

Jurisdiction	Total Exposure	10-Year			50-Year		
		Residential	Commercial	Industrial	Residential	Commercial	Industrial
Pembroke Park	$404,154,300	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Pembroke Pines	$10,247,846,250	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Plantation	$6,803,128,100	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Pompano Beach	$8,981,181,420	$33,942,220	$2,477,240	$9,686,510	$67,084,270	$5,607,320	$18,322,110
Sea Ranch Lakes	$110,763,020	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Southwest Ranches	$890,133,450	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Sunrise	$5,308,400,300	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Tamarac	$3,283,696,510	$5,522,610	*Negligible*	*Negligible*	$23,560,490	$93,600	*Negligible*
Broward Municipal Services Districts	$1,106,396,610	$107,630	$17,350	$33,260	$171,000	$39,180	$75,050
West Park	$331,537,990	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Weston	$6,490,572,820	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Wilton Manors	$941,493,080	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
TOTAL	**$131,437,140,170**	**$138,882,940**	**$3,651,930**	**$10,129,090**	**$216,912,220**	**$9,148,420**	**$21,548,200**

** Negligible means less than $5,000*

Source: Broward County Property Appraiser and Hazus-MH MR2

Table 4.21: Potential Building Losses by Jurisdiction (100- and 500-year Riverine Flood Events)

Jurisdiction	Total Exposure	100-Year			500-Year		
		Residential	Commercial	Industrial	Residential	Commercial	Industrial
Coconut Creek	$3,061,603,270	$840,020	*Negligible*	*Negligible*	$706,560	*Negligible*	*Negligible*
Cooper City	$1,943,657,150	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Coral Springs	$8,134,798,700	$53,765,270	$1,435,120	$1,864,120	$61,010,430	$4,714,770	$7,227,810
Dania Beach	$1,878,435,580	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Davie	$6,711,031,880	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Deerfield Beach	$5,161,599,440	$660,040	$162,290	$443,430	$2,243,370	$300,690	$742,450
Fort Lauderdale	$22,130,694,710	$19,225,060	$919,290	$1,050,810	$23,874,870	$1,787,050	$2,285,860
Hallandale Beach	$3,836,691,130	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Hillsboro Beach	$810,574,300	*Negligible*	*Negligible*	*Negligible*	$909,900	$42,300	*Negligible*
Hollywood	$10,029,588,340	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lauderdale-By-The-Sea	$1,739,928,950	$5,487,730	$193,500	*Negligible*	$11,498,500	$481,050	*Negligible*
Lauderdale Lakes	$1,152,461,750	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lauderhill	$2,492,601,430	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lazy Lake	$4,107,550	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Lighthouse Point	$1,261,700,120	$196,220	*Negligible*	*Negligible*	$5,022,540	$37,250	*Negligible*
Margate	$2,296,212,030	$19,102,270	$1,599,370	$522,720	$24,953,830	$2,091,590	$1,319,960
Miramar	$7,475,638,380	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
North Lauderdale	$1,260,435,790	$6,688,620	$355,660	$61,500	$8,161,780	$2,706,750	$1,097,330
Oakland Park	$2,473,754,560	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Parkland	$2,682,321,260	$30,417,440	$78,060	*Negligible*	$32,291,920	$646,270	*Negligible*
Pembroke Park	$404,154,300	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*

Jurisdiction	Total Exposure	100-Year			500-Year		
		Residential	Commercial	Industrial	Residential	Commercial	Industrial
Pembroke Pines	$10,247,846,520	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Plantation	$6,803,128,100	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Pompano Beach	$8,981,181,420	$78,029,050	$6,935,920	$22,599,440	$151,152,010	$10,806,250	$36,645,670
Sea Ranch Lakes	$110,763,020	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Southwest Ranches	$890,133,450	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Sunrise	$5,308,400,300	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Tamarac	$3,283,696,510	$23,572,450	$94,490	$236,240	$27,554,200	$619,550	$333,520
Broward Municipal Services Districts	$1,106,396,610	$229,600	$50,970	$98,360	$321,570	$108,520	$176,390
West Park	$331,537,990	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Weston	$6,490,572,820	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Wilton Manors	$941,493,080	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
TOTAL	**$131,437,140,170**	**$238,213,770**	**$11,824,670**	**$26,876,620**	**$348,791,580**	**$24,299,740**	**$49,828,990**

** Negligible means less than $5,000*

Source: Broward County Property Appraiser and Hazus-MH MR2

The second approach to assessing each jurisdiction's exposure and potential losses to riverine and coastal flood hazard events included an independent GIS-based analysis using FEMA's digital Q3 flood data in combination with Broward County's local tax assessor records and critical facilities data. To complete the assessment, initially every individual land parcel and critical facility that is located wholly or partially within a FEMA Zone A, AE, or V special flood hazard area with a 1% annual chance of flooding (100-year floodplain) was identified, by jurisdiction. It should be noted in this revised Plan, critical facilities in FEMA AH Zone have been added to broaden the analysis. This analysis is intended for use as a general planning tool to provide reasonable estimates of potential at-risk properties or facilities using best available georeferenced data in comparison to the results of the Hazus-MH loss estimation results. It is important to note that while the GIS-based assessment does use specific attribute data tied to each individual at-risk property (i.e., year built and building value), it does not consider certain unknown site-specific factors that may mitigate future flood losses on a building-by-building basis (such as elevation, surrounding topography, flood-proofing measures, drainage, etc.).

The identification of at-risk properties (and subsequently buildings) was completed using local parcel data layers in combination with local tax assessor records. To further narrow down the list of initially identified floodplain properties to those with buildings potentially at-risk to flood events, GIS selection criteria was utilized to identify only those properties with buildings constructed prior to 1972 (pre-NFIP), under the assumption that those built after 1972 would be protected to the 100-year flood level due to the availability of flood hazard maps and the adoption of local flood damage prevention ordinances. The objective of the GIS-based analysis is to calculate the total building value of all potentially at-risk properties in Broward County, by jurisdiction.

Table 4.22: Total Building Value of At-Risk Properties by Jurisdiction (Riverine/Coastal Flood Events)

Jurisdiction	Number of Floodplain Properties	Total Building Value	Pre-NFIP Building Value (pre-1972)
Coconut Creek	1,869	$1,306,681,800	$71,100,070
Cooper City	1,624	$810,494,740	$23,743,350
Coral Springs	5,745	$3,180,227,640	$63,828,780
Dania Beach	4,445	$1,776,980,710	$414,616,870
Davie	8,759	$5,546,165,150	$255,383,400
Deerfield Beach	6,011	$3,005,807,940	$611,475,750
Fort Lauderdale	25,141	$19,222,038,200	$7,228,275,670
Hallandale Beach	3,239	$1,366,926,790	$509,567,500
Hillsboro Beach	138	$466,685,750	$48,759,060
Hollywood	17,362	$7,277,525,630	$3,681,864,720
Lauderdale-By-The-Sea	954	$478,142,800	$332,620,530
Lauderdale Lakes	1,130	$399,942,840	$150,473,660
Lauderhill	2,371	$1,331,798,790	$124,890,330
Lazy Lake	12	$3,772,250	$2,025,340
Lighthouse Point	2,772	$1,503,893,870	$685,591,480
Margate	2,682	$938,879,450	$139,698,440
Miramar	4,741	$2,981,240,320	$258,243,450
North Lauderdale	2,655	$799,415,090	$162,504,030
Oakland Park	4,182	$1,398,811,920	$864,880,250
Parkland	4,633	$2,586,319,670	$10,078,630
Pembroke Park	306	$205,287,170	$47,088,900
Pembroke Pines	7,913	$4,503,655,510	$509,111,850
Plantation	6,449	$4,550,651,810	$518,163,740
Pompano Beach	9,605	$4,927,487,700	$1,824,301,550
Sea Ranch Lakes	129	$122,818,790	$86,313,460
Southwest Ranches	2,573	$1,240,036,790	$78,789,600
Sunrise	3,430	$2,678,798,050	$90,502,690
Tamarac	7,227	$1,795,652,310	$342,940,630
Broward Municipal Services Districts	937	$2,221,672,880	$406,286,560
West Park	947	$132,576,650	$94,767,740
Weston	5,705	$3,613,148,570	$2,240,750
Wilton Manors	1,754	$658,071,090	$525,374,870
TOTAL	**147,440**	**$83,031,608,670**	**$20,165,503,650**

Sources: Broward County Property Appraiser; Federal Emergency Management Agency National Flood Hazard Layer

Table 4.23: Total Bldg. Value of At-Risk Properties by Jurisdiction and Type of Building (Riverine/Coastal Flood Events)

Jurisdiction	Residential	Commercial	Industrial	Other*	Total
Coconut Creek	$728,164,410	$211,142,210	$78,166,980	$289,208,200	$1,306,681,800
Cooper City	$571,558,220	$49,570,950	$7,459,790	$181,905,780	$810,494,740
Coral Springs	$1,974,038,740	$631,852,380	$130,130,650	$444,205,870	$3,180,227,640
Dania Beach	$823,322,850	$539,305,710	$316,741,530	$97,610,620	$1,776,980,710
Davie	$3,574,966,430	$549,964,800	$315,564,580	$1,105,669,340	$5,546,165,150
Deerfield Beach	$1,498,836,230	$647,854,540	$533,205,470	$325,911,700	$3,005,807,940
Fort Lauderdale	$10,126,050,210	$5,216,955,210	$918,930,240	$2,960,102,540	$19,222,038,200
Hallandale Beach	$748,735,250	$496,638,700	$32,711,410	$88,841,430	$1,366,926,790
Hillsboro Beach	$456,379,020	$8,929,340	$0	$1,377,390	$466,685,750
Hollywood	$4,174,819,290	$1,655,649,130	$389,317,270	$1,057,739,940	$7,277,525,630
Lauderdale-By-The-Sea	$412,321,620	$61,387,260	$0	$4,433,920	$478,142,800
Lauderdale Lakes	$204,539,760	$122,197,510	$20,303,030	$52,902,540	$399,942,840
Lauderhill	$1,057,774,750	$103,141,230	$28,491,620	$142,391,190	$1,331,798,790
Lazy Lake	$3,772,250	$0	$0	$0	$3,772,250
Lighthouse Point	$1,448,639,210	$48,288,070	$0	$6,966,590	$1,503,893,870
Margate	$577,324,620	$150,917,450	$44,494,870	$166,142,510	$938,879,450
Miramar	$1,525,809,110	$384,043,240	$297,006,560	$774,381,410	$2,981,240,320
North Lauderdale	$593,544,350	$99,589,610	$23,808,970	$82,472,160	$799,415,090
Oakland Park	$741,351,810	$281,076,400	$263,812,430	$112,571,280	$1,398,811,920
Parkland	$2,329,536,620	$49,941,490	$430,780	$206,410,780	$2,586,319,670
Pembroke Park	$39,356,530	$19,329,590	$110,532,470	$36,068,580	$205,287,170
Pembroke Pines	$2,905,267,930	$856,912,500	$37,165,520	$704,309,560	$4,503,655,510
Plantation	$2,970,844,770	$1,050,359,860	$58,774,790	$470,672,390	$4,550,651,810
Pompano Beach	$2,517,213,190	$668,923,610	$1,067,183,320	$674,167,580	$4,927,487,700
Sea Ranch Lakes	$122,818,790	$0	$0	$0	$122,818,790
Southwest Ranches	$1,010,094,120	$30,035,550	$430,490	$199,476,630	$1,240,036,790
Sunrise	$964,284,030	$854,728,170	$227,399,450	$632,386,400	$2,678,798,050
Tamarac	$1,295,904,110	$215,126,770	$143,901,740	$140,719,690	$1,795,652,310
Broward Municipal Services Districts	$96,547,460	$17,959,870	$27,697,580	$2,079,467,970	$2,221,672,880
West Park	$96,538,170	$18,134,350	$13,222,750	$4,681,380	$132,576,650
Weston	$2,818,908,810	$422,970,340	$204,144,270	$167,125,150	$3,613,148,570
Wilton Manors	$547,836,990	$57,693,870	$2,038,660	$50,501,570	$658,071,090
TOTAL	**$48,957,099,650**	**$15,520,619,710**	**$5,293,067,220**	**$13,260,822,090**	**$83,031,608,670**

** "Other" building occupancy category includes agriculture, religious/nonprofit, government, and education occupancies.*

Jurisdiction	Residential	Commercial	Industrial	Other*	Total

Source: Broward County Property Appraiser; Federal Emergency Management Agency National Flood Hazard Layer

Table 4.24: Total # of Buildings At-Risk Properties by Jurisdiction and Type of Building (Riverine/Coastal Flood Events)

Jurisdiction	Residential	Commercial	Industrial	Other*	Total
Coconut Creek	1768	33	15	53	1869
Cooper City	1550	18	1	55	1624
Coral Springs	5403	172	75	95	5745
Dania Beach	3773	246	328	98	4445
Davie	7927	284	193	355	8759
Deerfield Beach	5418	261	238	94	6011
Fort Lauderdale	21285	2192	1008	656	25141
Hallandale Beach	2954	191	50	44	3239
Hillsboro Beach	133	3	0	2	138
Hollywood	15873	945	222	322	17362
Lauderdale-By-The-Sea	879	66	0	9	954
Lauderdale Lakes	1036	59	13	22	1130
Lauderhill	2213	98	22	38	2371
Lazy Lake	12	0	0	0	12
Lighthouse Point	2706	52	0	14	2772
Margate	2542	68	33	39	2682
Miramar	4507	99	39	96	4741
North Lauderdale	2550	58	12	35	2655
Oakland Park	3223	339	537	83	4182
Parkland	4523	19	1	90	4633
Pembroke Park	222	25	47	12	306
Pembroke Pines	7685	131	10	87	7913
Plantation	6005	274	51	119	6449
Pompano Beach	8116	509	759	221	9605
Sea Ranch Lakes	129	0	0	0	129
Southwest Ranches	2214	14	2	343	2573
Sunrise	3090	179	85	76	3430
Tamarac	6982	144	56	45	7227
Broward Municipal Services Districts	716	54	23	144	937
West Park	903	24	10	10	947

Jurisdiction	Residential	Commercial	Industrial	Other*	Total
Weston	5501	134	37	33	5705
Wilton Manors	1624	96	2	32	1754
TOTAL	**133462**	**6787**	**3869**	**3322**	**147440**

** "Other" building occupancy category includes agriculture, religious/nonprofit, government, and education occupancies. Source: Broward County Property Appraiser*

The GIS-based analysis for critical facilities identified 78 critical facilities throughout Broward County as being potentially at-risk to flood events. These include 24 city halls, 80 fire stations, 28 police stations, 14 hospital, and 201 schools (26 of which are designated as either county or local shelters).

FEMA defines a repetitive loss property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Currently there are over 122,000 repetitive loss properties nationwide. FEMA defines a severe repetitive loss (SRL) property as with 1 of the following conditions in a 10-year period: 1) At least 4 claims payments (building and contents) over $5,000 each; 2) At least 2 building claims payments with the cumulative amount exceeding the market value of the building. The list of FEMA RL properties is shown in **Table 4.26.** All but 1 of Broward County's municipal jurisdictions (Sea Ranch Lakes) is identified as having one or more Repetitive Loss Properties.

Also included is the list of FEMA SRL properties in **Table 4.27.**

Although this information is tracked by the County in accordance with FEMA guidelines, it is protected from release by the Privacy Act of 1974, 5 U.S.C. Section 552(2).

Table 4.25: NFIP Repetitive Loss Properties by Jurisdiction (as of 2022)

Jurisdiction	Number of Repetitive Loss Properties	Number of Losses	Building Payments	Contents Payments	Total Payments
Coconut Creek	1	2	$2,920.00	$0.00	$2,920.00
Cooper City	4	8	$17,909.19	$2,339.00	$20,248.19
Coral Springs	19	39	$573,876.80	$886,97.03	$662,573.83
Dania Beach	28	103	$1,846,476.60	$310,116.72	$2,156,593.32
Davie	27	80	$834,843.60	$631,012.48	$1,465,856.08
Deerfield Beach	9	22	$376,595.07	$66,190.52	$442,785.59
Fort Lauderdale	172	577	$12,380,724.42	$4,935,948.86	$17,316,673.28
Hallandale Beach	153	560	$18,122,188.42	$4,954,850.27	$23,077,038.69
Hillsboro Beach	2	5	$215,350.20	$65,467.10	$280,817.30
Hollywood	246	669	$10,525,648.82	$3,187,055.84	$13,712,704.66
Lauderdale-By-The-Sea	2	56	$102,289.90	$2,800.00	$105,089.90
Lauderdale Lakes	22	50	$219,522.89	$86,555.07	$306,077.96
Lauderhill	41	75	$477,677.75	$142,004.52	$619,682.27

Jurisdiction	Number of Repetitive Loss Properties	Number of Losses	Building Payments	Contents Payments	Total Payments
Lighthouse Point	3	6	$50,270.83	$38,487.23	$88,758.06
Margate	61	38	$153,398.92	$21,537.02	$174,935.94
Miramar	43	91	$454,959.44	$152,771.14	$607,730.58
North Lauderdale	14	29	$127,025.28	$10,692.20	$137,717.48
Oakland Park	45	182	$3,274,055.88	$748,529.45	$4,022,585.33
Parkland	1	2	$9,320.09	$1,574.63	$10,894.72
Pembroke Park	7	45	$550,654.68	$755,426.52	$1,306,081.20
Pembroke Pines	14	36	$301,506.07	$33,438.63	$334,944.70
Plantation	16	33	$296,758.61	$30,578.33	$327,336.94
Pompano Beach	32	90	$1,919,531.97	$569,043.43	$2,488,575.40
Southwest Ranches	2	4	$33,904.13	$63,151.18	$97,055.31
Sunrise	11	33	$218,105.13	$137,578.64	$355,683.77
Tamarac	14	30	$179,649.85	$58,518.08	$238,167.93
Broward Municipal Services Districts	64	172	$1,935,238.56	$780,982.03	$2,716,220.59
West Park	3	33	$330,653.83	$176,190.54	$506,844.37
Weston	1	2	$18,056.57	$0.00	$18,056.57
Wilton Manors	22	58	$804,844.43	$324,359.67	$1,129,204.10
TOTAL	1,079	3,130	$56,353,957.93	$18,287,199.10	$74,641,157.03

Source: Federal Emergency Management Agency Repetitive Loss Properties Report for Broward County, August 17, 2022, Report

Greatest increase in number of Repetitive Loss Properties (from 2017 LMS to present):

- Fort Lauderdale -- 95 to 195 properties
- Biggest decrease in number of Repetitive Loss Properties (from 2017 LMS to present)
- West Park -- 18 to 6 properties

Table 4.26: NFIP SRL Properties by Jurisdiction (as of 2022)

Jurisdiction	Number of SRL Properties	Number of Losses	Building Payments	Contents Payments	Total Payments
Coconut Creek	0	0	$0.00	$0.00	$0.00
Cooper City	0	0	$0.00	$0.00	$0.00
Coral Springs	1	13	$0.00	$0.00	$0.00
Dania Beach	5	87	$156,949.14	$28,728.22	$185,677.36
Davie	2	11	$132,085.38	$226,528.00	$358,613.38
Deerfield Beach	0	5	$103,688.22	$12,327.08	$116,015.30
Fort Lauderdale	23	159	$1,258,570.94	$1,193,075.30	$2,451,646.24
Hallandale Beach	22	76	$4,691,415.25	$2,023,704.87	$6,715,120.12
Hillsboro Beach	0	0	$0.00	$0.00	$0.00
Hollywood	14	37	$597,251.22	$372,218.34	$969,469.56
Lauderdale-By-The-Sea	0	0	$0.00	$0.00	$0.00
Lauderdale Lakes	1	0	$0.00	$0.00	$0.00

Jurisdiction	Number of SRL Properties	Number of Losses	Building Payments	Contents Payments	Total Payments
Lauderhill	3	0	$0.00	$0.00	$0.00
Lazy Lake	0	0	$0.00	$0.00	$0.00
Lighthouse Point	0	0	$0.00	$0.00	$0.00
Margate	0	0	$0.00	$0.00	$0.00
Miramar	1	0	$0.00	$0.00	$0.00
North Lauderdale	0	0	$0.00	$0.00	$0.00
Oakland Park	10	30	$958,919.42	$309,370.31	$1,268,289.73
Parkland	0	0	$0.00	$0.00	$0.00
Pembroke Park	4	7	$106,987.88	$327,594.89	$434,582.77
Pembroke Pines	1	0	$0.00	$0.00	$0.00
Plantation	0	0	$0.00	$0.00	$0.00
Pompano Beach	1	10	$481,228.54	$0.00	$481,228.54
Sea Ranch Lakes	0	0	$0.00	$0.00	$0.00
Southwest Ranches	0	0	$0.00	$0.00	$0.00
Sunrise	1	0	$0.00	$0.00	$0.00
Tamarac	0	0	$0.00	$0.00	$0.00
Broward Municipal Services Districts	6	22	$321,939.07	$180,048.15	$501,987.22
West Park	3	11	$118,648.77	$47,225.57	$165,874.34
Weston	0	0	$0.00	$0.00	$0.00
Wilton Manors	1	0	$0.00	$0.00	$0.00
TOTAL	99	468	$8,927,683.83	$4,720,820.73	$13,648,504.56

Source: Federal Emergency Management Agency Repetitive Loss and Severe Repetitive Loss Properties Report for Broward County, August 17, 2022, Report

Table 4.27: RL/SRL Properties by Property Type (as of 2022)

Jurisdiction	Residential		Commercial		Other Non-Residential	
	RL	SRL	RL	SRL	RL	SRL
Coconut Creek	1	-	-	-	-	-
Cooper City	4	-	-	-	-	-
Coral Springs	18	1	-	-	1	-
Dania Beach	21	5	6	-	1	-
Davie	25	2	1	-	1	-
Deerfield Beach	8	-	-	-	1	-
Fort Lauderdale	145	19	9	1	18	3
Hallandale Beach	142	17	4	4	7	1
Hillsboro Beach	2	-	-	-	-	-
Hollywood	235	11	2	-	9	3
Lauderdale-By-The-Sea	1	-	-	-	1	-

Lauderdale Lakes	22	1	-	-	-	-
Lauderhill	41	3	-	-	-	-
Lighthouse Point	3	-	-	-	-	-
Margate	61	-	-	-	-	-
Miramar	43	1	-	-	-	-
North Lauderdale	14	-	-	-	-	-
Oakland Park	32	5	8	4	5	1
Parkland	1	-	-	-	-	-
Pembroke Park	4	-	1	3	2	1
Pembroke Pines	14	1	-	-	-	-
Plantation	16	-	-	-	-	-
Pompano Beach	22	-	5	1	5	-
Southwest Ranches	2	-	-	-	-	-
Sunrise	11	1	-	-	-	-
Tamarac	14	-	-	-	-	-
West Park	3	3	-	-	-	-
Weston	1	-	-	-	-	-
Wilton Manors	19	1	2	-	1	-
Broward Municipal Services Districts	53	4	-	1	5	1

Source: Federal Emergency Management Agency Repetitive Loss and Severe Repetitive Loss Properties Report for Broward County, August 17, 2022, Report

Sea Level Rise/Climate Change

As is stated in the following narrative, the probability of future increases in high tide flooding events in Broward County due to sea level rise is considered “highly likely”. More specifics about the scenarios that were developed for Broward County and how they are consistent with planning scenarios are included in the subsection below. In addition, the subsection describes the potential impact to residents and businesses.

Background

Sea level rise, caused by climate change, is a phenomenon resulting from a consistent change in the earth’s temperature that leads to changes in atmospheric and climatic patterns which ultimately impacts the complex hydrology of southeast Florida, including surface and subsurface flows. While the majority of sea level rise realized to date has been a function of thermal expansion

of oceanic waters the melting of ice at the polar ice caps is likely to substantially influence the total rate of rise in the coming decades both worldwide and regionally. While there is still debate on the degree of the impact, the evidence is clear that a trend is occurring, and sea levels have been rising for the better part of the 20th century and into the 21st century. The rate of rise is increasing, with an average of 1 inch of rise measured every 4 to 4 ¼ years during the last several decades. A total of 40 inches of sea level rise is anticipated by 2070, relative to 2000, for southeast Florida under the NOAA Intermediate-High scenario.

This chapter will not go into the details of what is causing climate change; it will focus on the impacts from climate change on sea level rise including storm surge and coastal flooding. The mitigation strategies section will follow up to propose potential adaptation and mitigation actions. Sea level rise and other impacts of climate change also affect atmospheric and hydrologic patterns which in turn impact other hazards like inland flood (increased rainfall periods), drought (decreased rainfall periods), and wildfire (exacerbated by vegetative fuel growth in periods of higher rainfall and then burn risk in drier periods). The impact of climate change on these hazards will be discussed in the appropriate hazard subsections of Chapter 4. For this subsection, the impacts of sea level rise will be discussed.

An article from Nature Geoscience by T.R. Knutson, et al. entitled “Tropical Cyclones and Climate Change” (2010) referenced in the SFWMD report entitled “Past and Projected Trends in Climate and Sea Level Rise for South Florida – External Review Draft” (2011) reveals that the potential impacts of climate change, particularly global warming, for the Atlantic Ocean basin are the following:

- Decrease in the number of tropical storms and hurricanes from 6-34% (due to increased wind shear over the Atlantic basin)
- Increase in the wind intensity of the hurricanes from 2-11%
- Increase in the height and strength of hurricane storm surge (due to higher sea level and wind intensity)
- Rainfall increases of up to 20% within 60 miles of tropical storms and hurricanes.
- Currently, there is no indication of large alterations of historical storm origin and tracks so south Florida continues to be a target of high probability.

The 2011 SFWMD report states that the main concerns with sea level rise for South Florida are the following:

- Saltwater intrusion into coastal aquifers and a diminishing of fresh groundwater which negatively impacts the public water supply.
- Less capacity to drain overland flooding and stormwater from inland areas to marine waters because the higher sea levels effectively block positive drainage from west to east (i.e., due to low South Florida surface elevations, most larger and local drainage systems depend on a differential between upstream and downstream water levels, headwater and tailwater respectively, where the downstream areas are generally in tidal/marine areas).
- Increased tropical storm and hurricane surge levels.
- More frequent coastal flooding and some inundation of coastal real estate by marine water

Location and Spatial Extent

As a coastal county, the impact of sea level rise on Broward County has the potential to be high to severe in the long term. The inundation maps (Maps 4.14-4.17) and at-risk property information (Tables 4.32- 4.35) provided in this section utilizes the Sea Level Rise projections for NOAA intermediate-Low and Intermediate-High Scenarios as outlined in NOAA 2017 report. Based on

the Southeast Florida Regional Climate Change Compact's (Compact) latest Unified Sea Level Rise Projection report (2019 update), Broward County uses the same NOAA 2017 Sea Level Rise projections for the future planning purposes. The Compact's Unified Sea Level Rise Projections for Key West gauge indicate 17 in and 40 in of rise in sea levels by 2040 and 2070, respectively under the 2017 NOAA Intermediate-High scenario. Sea level rise projections for 2040 and 2070 used in this assessment also align with the statutory requirement of the Resilient Florida Grant Program.

Historical Occurrences

Historical (1913-2020) data from NOAA Key West tidal gauge indicates that relative sea levels has been rising at a rate of 2.5 mm/yr (or 1 inch/10-yr). However, recent analyses of Key West tide gauge record indicate a more rapid acceleration in the rate of sea level rise since 2000; five-year average sea level trends showed a 5 inch of increase in relative mean sea levels between 2000-2021. A majority of the coastal water control infrastructure managed by the SFWMD was constructed between 1950 and 1960. The Standard Flood design criteria for many of these structures assumes a headwater-tailwater differential of 6 inches. Increasing tidal levels may have already started affecting the drainage capacity of these coastal drainage structures especially for the solely gravity driven structures. A recent (2022) "Flood Protection Level of Service" study by SFWMD indicates reduced level of flood protection in several basins (e.g., NNR, C-13, C-14 and Pompano) in the County due to rising tidal levels limiting the drainage capacity of the gravity-controlled structures.

Probability and Extent of Future Occurrences

The probability of future increase in high tide flooding events in Broward County due to sea level rise is considered "highly likely". Sea level rise projections for the year 2100 from 2017 NOAA report and 2019 Compact report indicate a potential range from 2.7 to 8.5 feet. The main variable affecting such large range of these estimates is the uncertainty in the rate of glacial and polar ice melting to be realized in the coming decades. More specifics about the scenarios developed for Broward County consistent with planning scenarios developed in conjunction with the Compact are provided in subsection below.

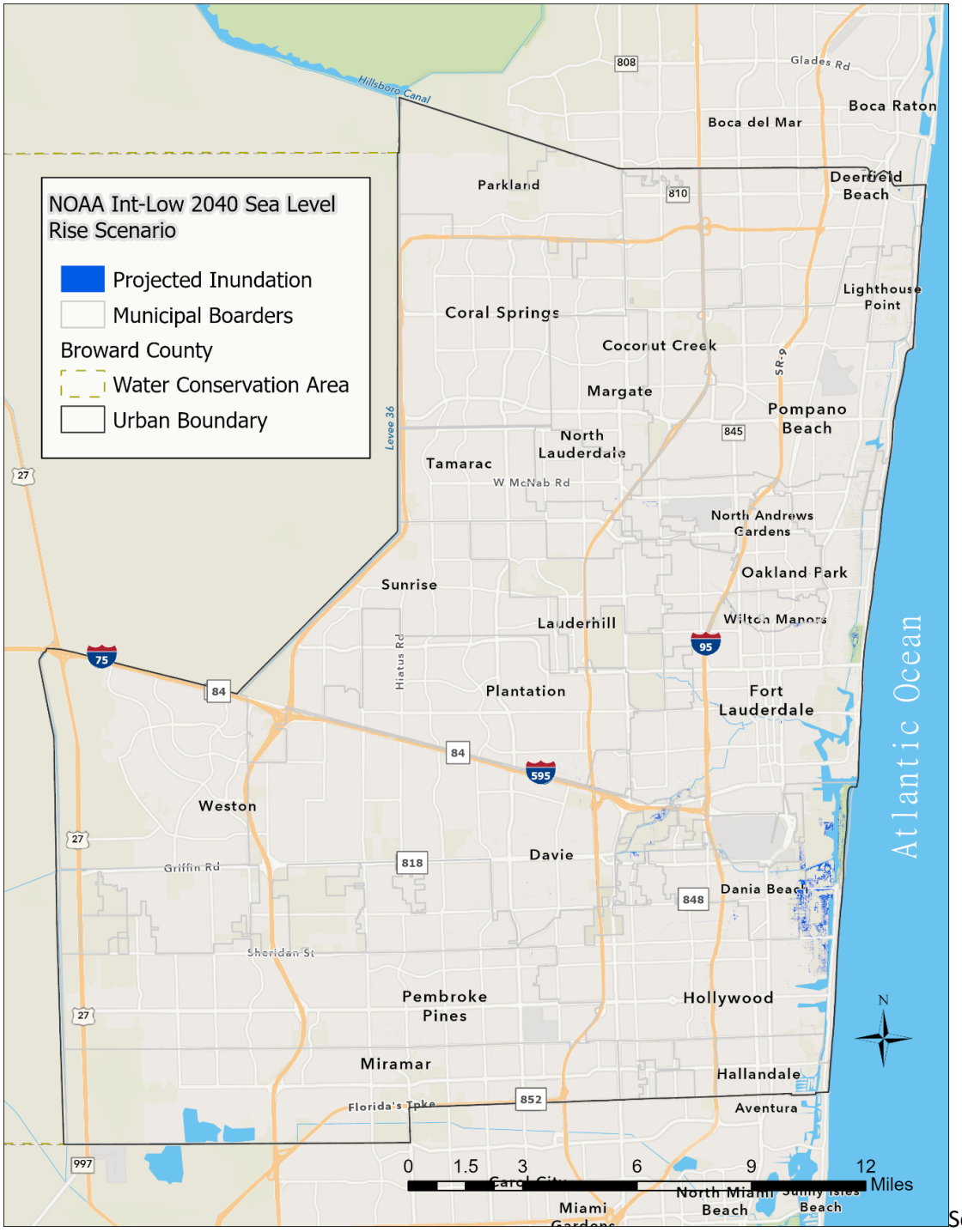
Vulnerability Assessment

While there is considerable non-scientific debate about the probability of sea level rise, and variation within the scientific community on the severity of sea level rise (but consensus on the probability), the County is likely to continue to be vulnerable to the impacts of sea level rise. The level of impact ranges from moderate to severe.

In 2021 a vulnerability assessment of Broward County was conducted using the NOAA Intermediate-High (Int-High), and Intermediate-Low (Int-Low) sea level rise scenarios for 2040 and 2070. See **Maps 4.13 -** below for a spatial depiction of the inundation risk from these four sea level rise scenarios, based solely on land elevation relative to predicted coastal water levels. The assessment revealed that under the NOAA Int-Low 2040 scenario, the total taxable value (as of 2021) of vulnerable property was $10B, while under the highest scenario evaluated (Int-High 2070) the taxable value of vulnerable properties increased to $42B (See Figure XE below). Under the highest scenario evaluated (Int-High 2070) 1.05% of the County is impacted with residential and other being the major land use types inundated. However, under the other scenarios evaluated (Int-High 2040, Int-Low 2070, and Int-Low 2040), conservation lands and open space

is the land use type with the highest projected impacts (**See Tables 4.31-35**). In terms of acres inundated, wetlands are among the major land use type impacted." **Tables 4.31-35**, after the maps, show the projected damage impacts and level of inundation by land use for the analyzed future climate scenarios. This analysis is currently being augmented with a more complete evaluation of the combined impacts of compound flood factors, sea level rise, groundwater table rise, rainfall (and intensification), high tides, and storm surge, on coastal and inland flooding with detailed accounting of water management systems and operations as part of a County-wide Resilience Plan. This project will be completed in 2024 and will present a more comprehensive and accurate assessment of future flood risk county-wide than what can be derived from the current elevation-based model and data set.

Map 4.13: Inundation Extent in Broward County under the NOAA Int-Low 2040 Sea Level Rise Scenario

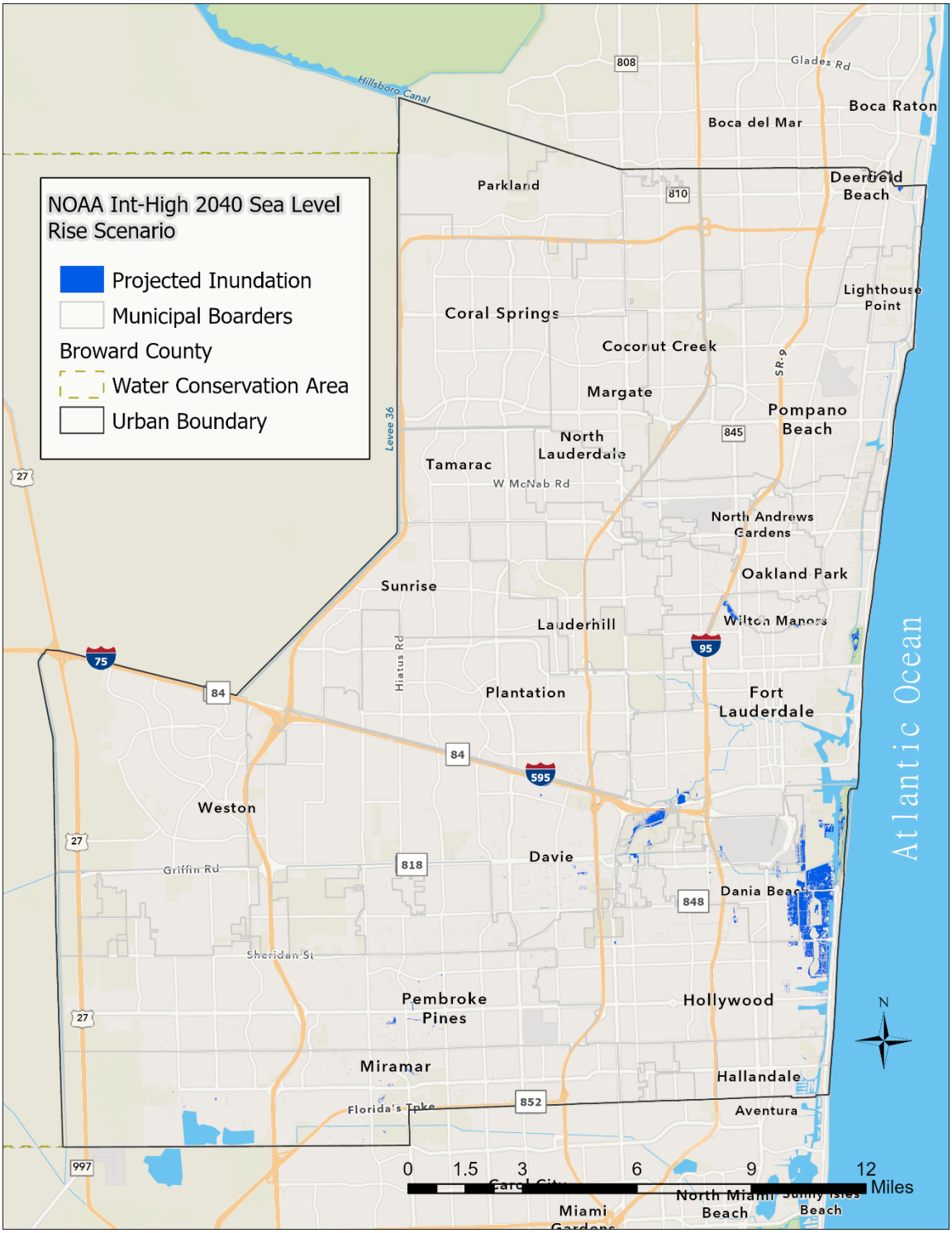


Source: *Broward County Resilience Unit, NOAA 2022*

Map 4.14: Inundation Extent in Broward County under the NOAA Int-Low 2070 Sea Level Rise Scenario

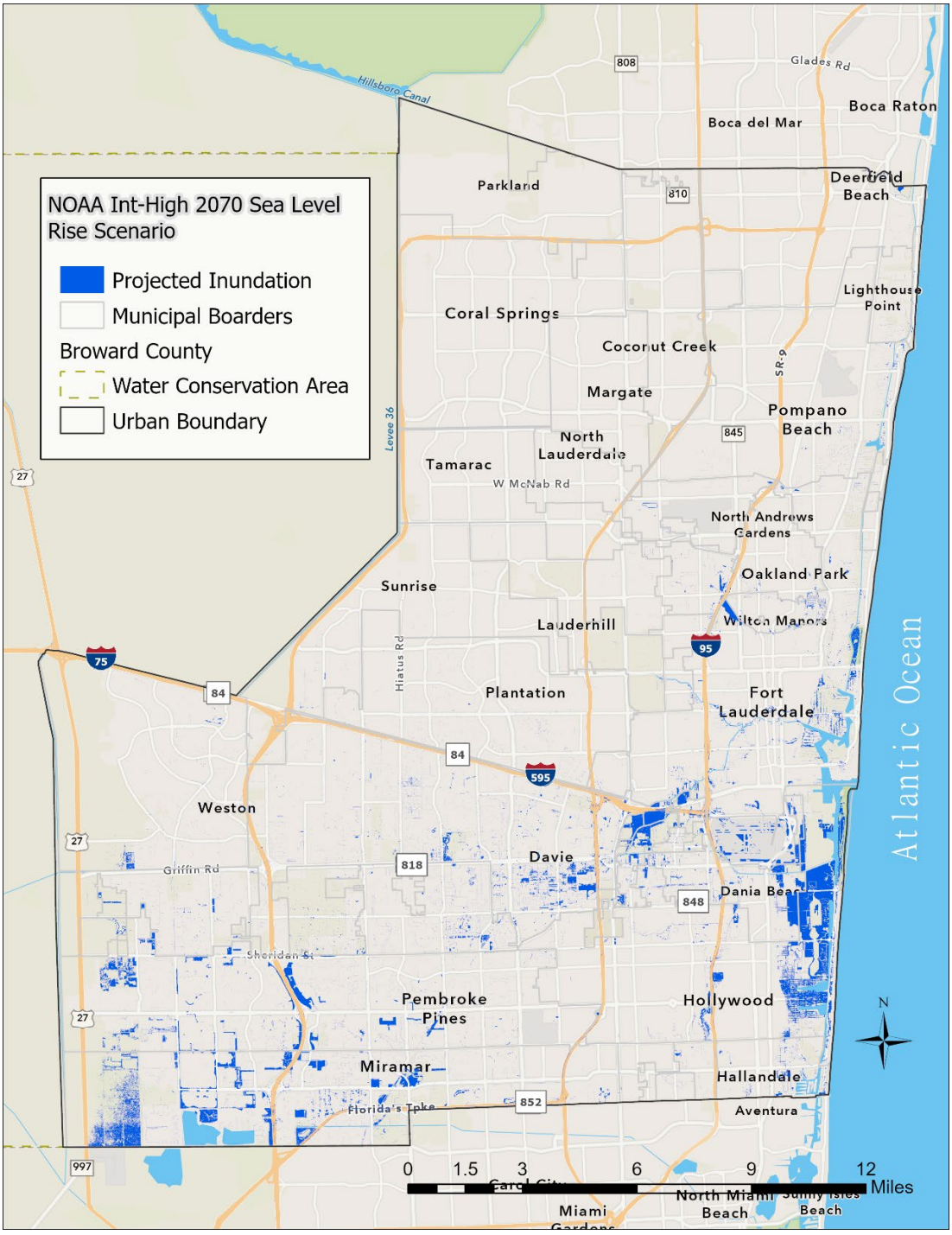
Source: Broward County Resilience Unit, NOAA 2022

Map 4.15: Inundation Extent in Broward County under the NOAA Int-High 2040 Sea Level Rise Scenario



Source: Broward County Resilience Unit, NOAA 2022

Map 4.16: Inundation Extent in Broward County under the NOAA Int-High 2070 Sea Level Rise Scenario



Source: Broward County Resilience Unit, NOAA 2022

Table 4.28: Taxable Property Value County-wide projected to be at risk due to sea level rise under NOAA 2017 Intermediate-High and Intermediate-Low scenarios for the 2040 and 2070 timeframes.

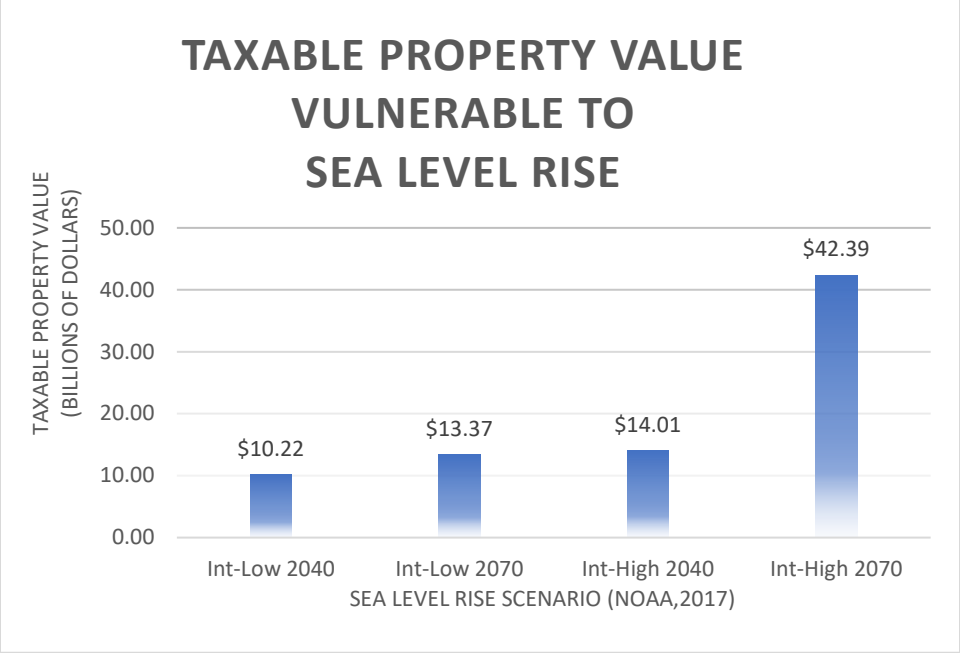


Table 4.29: Loss Estimation of Broward Commercial Properties for NOAA Int-High & Int-Low 2040 & 2070 Sea Level Rise Scenarios

Scenario	Value for Vulnerable Commercial Properties	Approximate Level of Damages*
Int-Low 2040	$1,745,630,160	$34,912,603,200
Int-Low 2070	$2,677,829,940	$53,556,598,800
Int-High 2040	$2,911,300,200	$58,226,004,000
Int-High 2070	$9,766,260,610	$195,325,212,200

Source: Broward County Resilience Unit, Broward County Appraiser GIS, NOAA 2017. Last Year Taxable Value field used from the Broward County Property Appraiser's Parcel Data

** Sum of commercial property building taxable values with projected inundation*

*** Multiply total building value in inundation zone by 20% to estimate building and content damage*

Table 4.30: Land Use Impacts Under the NOAA Int-Low 2040 Sea Level Rise Scenario

Land Use	Inundation (acres)	Total Land Use Coverage (acres)	Percent Inundation of that Land Use
Residential	43.38	112,129.16	0.04%
Commercial	11.48	27,573.68	0.04%
Industrial	1.96	10,727.40	0.02%
Agriculture and Timber Lands	3.30	4,966.36	0.07%
Conservation Land/ Open Space & Recreation	384.71	86,038.21	0.45%
Utilities / Transportation	23.05	35,670.19	0.06%
Other	153.02	506,689.28	0.03%

Land use codes sourced from the Broward County Property Appraiser's Office. Note, for Agricultural and Timber Lands codes = 50-69, for Conservation Land/ Open Space code = 82 or 97, for Utilities/ Transportation code = 91 or 94, for Other code = All Institutional codes, Miscellaneous codes excluding 91, 94, 97, and including all Government codes excluding 82, and including codes 98 and 99, and parcels with unlisted codes. See codes at: https://bcpa.net/use_code.asp

Table 4.31: Land Use Impacts Under the NOAA Int-Low 2070 Sea Level Rise Scenario

Land Use	Inundation (acres)	Total Land Use Coverage (acres)	Percent Inundation of that Land Use
Residential	105.79	112,129.16	0.09%
Commercial	38.79	27,573.68	0.14%
Industrial	8.09	10,727.40	0.08%
Agriculture and Timber Lands	12.35	4,966.36	0.25%
Conservation Land/ Open Space & Recreation	1004.39	86,038.21	1.17%
Utilities / Transportation	60.70	35,670.19	0.17%
Other	375.39	506,689.28	0.07%

Source: Broward County Resilience Unit, Broward County Property Appraiser GIS, NOAA 2022

Land use codes sourced from the Broward County Property Appraiser's Office. Note, for Agricultural and Timber Lands codes = 50-69, for Conservation Land/ Open Space code = 82 or 97, for Utilities/ Transportation code = 91 or 94, for Other code = All Institutional codes, Miscellaneous codes excluding 91, 94, 97, and including all Government codes excluding 82, and including codes 98 and 99, and parcels with unlisted codes. See codes at: https://bcpa.net/use_code.asp

Table 4.32: Land Use Impacts Under the NOAA Int-High 2040 Sea Level Rise Scenario

Land Use	Inundation (acres)	Total Land Use Coverage (acres)	Percent Inundation of Land Use
Residential	124.79	112,129.16	0.11%
Commercial	53.71	27,573.68	0.19%
Industrial	11.51	10,727.40	0.11%
Agriculture and Timber Lands	13.82	4,966.36	0.28%
Conservation Land/ Open Space & Recreation	1090.12	86,038.21	1.27%
Utilities / Transportation	73.75	35,670.19	0.21%
Other	427.41	506,689.28	0.08%

Source: Broward County Resilience Unit, Broward County Property Appraiser GIS, NOAA 2022

Land use codes sourced from the Broward County Property Appraiser's Office. Note, for Agricultural and Timber Lands codes = 50-69, for Conservation Land/ Open Space code = 82 or 97, for Utilities/ Transportation code = 91 or 94, for Other code = All Institutional codes, Miscellaneous codes excluding 91, 94, 97, and including all Government codes excluding 82, and including codes 98 and 99, and parcels with unlisted codes. See codes at: https://bcpa.net/use_code.asp

Table 4.33: Land Use Impacts Under the NOAA Int-High 2070 Sea Level Rise Scenario

Land Use	Inundation (acres)	Total Land Use Coverage (acres)	Percent Inundation of Land Use
Residential	2,151.31	112,129.16	1.92%
Commercial	508.11	27,573.68	1.84%
Industrial	143.67	10,727.40	1.34%
Agriculture and Timber Lands	265.50	4,966.36	5.35%
Conservation Land/ Open Space & Recreation	1,668.02	86,038.21	1.94%
Utilities / Transportation	841.76	35,670.19	2.36%
Other	2,654.56	506,689.28	0.52%

Source: Broward County Resilience Unit, Broward County Property Appraiser GIS, NOAA 2022

Land use codes sourced from the Broward County Property Appraiser's Office. Note, for Agricultural and Timber Lands codes = 50-69, for Conservation Land/ Open Space code = 82 or 97, for Utilities/ Transportation code = 91 or 94, for Other code = All Institutional codes, Miscellaneous codes excluding 91, 94, 97, and including all Government codes excluding 82, and including codes 98 and 99, and parcels with unlisted codes. See codes at: https://bcpa.net/use_code.asp

Geologic Hazards

For the purposes of this risk assessment geologic hazards are events or incidents that involve seismic or non-seismic ground failures such as earthquakes, landslides, sinkholes, land subsidence, and expansive soils as well as the hazards of tsunami and volcano. The occurrence of geologic hazards is often interrelated with other natural phenomena.

Other Natural Hazards

For the purposes of this vulnerability assessment, "other" natural hazards are limited to wildfire.

Wildfire

Background

A wildfire is any fire occurring in a wildland area (i.e., grassland, forest, brush land) except for fire under prescription.[14] Wildfires are part of the natural management of forest ecosystems but may also be caused by human factors. Nationally, over 80% of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

There are 3 classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these 3 classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildland fires are usually signaled by dense smoke that fills the area for miles around.

Wildfire probability depends on local weather conditions, outdoor activities such as camping, debris burning, and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural hazards (such as tornadoes, hurricanes, etc.) increase the probability of wildfires by producing fuel in both urban and rural settings. Forest damage from hurricanes and tornadoes may also block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities.

Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses, and industries are located within high wildfire hazard areas. Further, the increasing demand for outdoor recreation places more people in wildlands during holidays, weekends, and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for wildfire events that can sweep through the brush and timber and destroy property within minutes.

Wildfires can result in severe economic losses as well. Businesses that depend on timber, such as paper mills and lumber companies, experience losses that are often passed along to consumers through higher prices, and sometimes jobs are lost. The high cost of responding to and recovering from wildfires can deplete state resources and increase insurance rates. The

14 Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.

economic impact of wildfires can also be felt in the tourism industry if roads and tourist attractions are closed due to health and safety concerns.

State and local governments can impose fire safety regulations on home sites and developments to help curb wildfire. Land treatment measures such as fire access roads, water storage, helipads, safety zones, buffers, firebreaks, fuel breaks, and fuel management can be designed as part of an overall fire defense system to aid in fire control. Fuel management, prescribed burning, and cooperative land management planning can also be encouraged to reduce fire hazards.

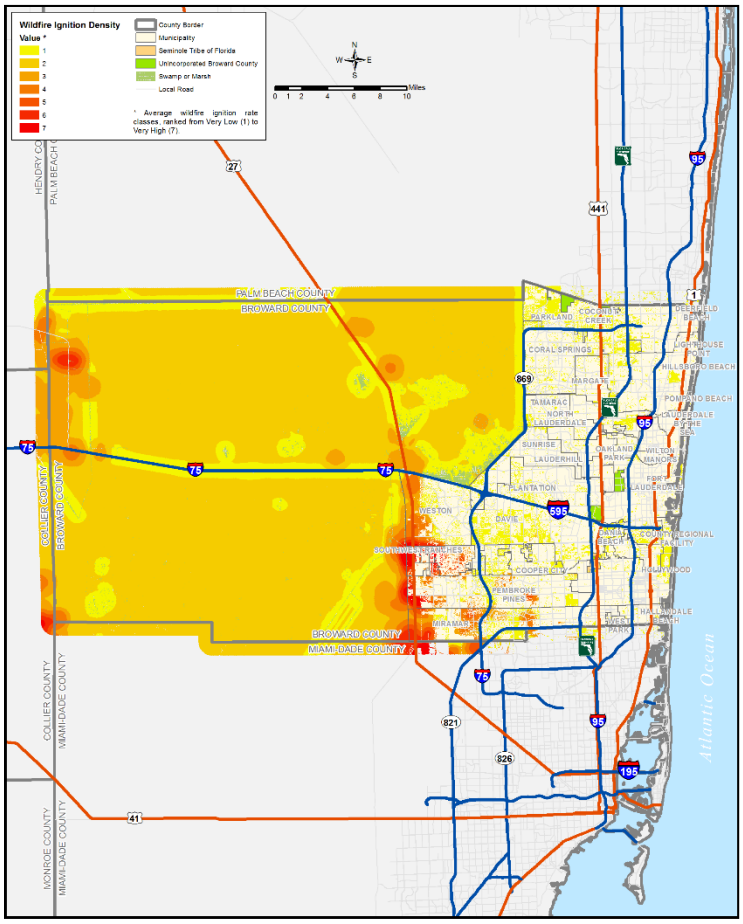
Location and Spatial Extent

Wildfires remain a major hazard of concern throughout the State of Florida. According to the Florida Division of Forestry, nearly 5 million acres have been burned across the state by wildfire since 1981. This includes nearly 125,000 distinct fires, equating to an average wildfire size of 40 acres though many of the larger uncontrolled wildfires may burn hundreds of thousands of acres before being suppressed. The leading causes have been wildfires in Florida have been identified as lightning (particularly in the summer months), incendiary (arson), and debris burning.

Broward County is comprised of 1,197 square miles of land, of which 787 square miles lie within the Everglades Conservation Area. Even though the Everglades are typically thought as of being boggy or wet, a substantial part of the everglades is comprised of sawgrass and melaleuca trees that can rapidly burn. Most fires in the Everglades are started by lightning, a very frequent phenomenon in the Everglades, due to large thunderstorms that form inland. Other fires are caused by improper burning at campfires, or arson.

The Florida Division of Forestry recently completed the development of the Florida Wildfire Risk Assessment System (FRAS). The primary purpose of FRAS is to provide an automated tool for Division staff, as well as other Florida fire specialists, to access and use a series of spatial map data that has been compiled and derived to support operational staff in the future assessment and management of wildland fire risk across the state. This data has been derived by a team of fire experts and reflects the latest and most accurate data describing the wildland fire risk situation based on burnable areas within Florida. **Figure 4.12** illustrates the default FRAS data for Broward County.

Figure 4.12: Wildfire Risk Areas in Broward County



Source: Southern Wildfire Risk Assessment

According to FRAS, the municipalities in western Broward County are at greatest risk to wildfire. They are Coral Springs, Miramar, Parkland, Pembroke Pines, Southwest Ranches, Sunrise, Tamarac, and Weston.

While most of the Broward County municipalities are not likely to be heavily impacted directly by wildfire, the secondary effects of smoke and ash pose significant threats to air quality throughout the area. Human respiratory health is a related concern regarding wildfires occurring not only in the county, but also elsewhere in south Florida.

Historical Occurrences

According to the Florida Division of Forestry, there have been over 21 significant fires in Broward County since 1981 (burning 10,000 acres or more).

Most of these large wildfire events occur in the undeveloped, western portions of Broward County, including the Everglades, and most have occurred during Broward County's dry season which extends from January through May. Common causes of wildfires within the county are drought,

lightning, arson; carelessness by smokers; debris burning; equipment operation; and children playing with matches.

Residential development within the past 10 years has encroached on environmentally sensitive land, including the Everglades Conservation Area. The impact of wildfires in Broward County is seen by reduced air quality, closure of roads, in particular Interstate 75 (Alligator Alley) which is a main link with the west coast of Florida, and in some cases, fires can be a threat to residential and business structure. Wildfires also potentially impact the Miccosukee and Seminole tribal activities in the Everglades.

During May 2007, at least 233 fires burned roughly 100,000 acres in 52 of the 67 Florida Counties, mostly in the northern, central, and southwest. Although most of the acreage burnt by these fires occurred outside of Broward County, the county was blanketed with smoke. This resulted in the closure of major roads and forced many people indoors. On May 9th, the Air Quality Index reached an "unhealthy" range of 154, meaning that the air was unhealthy for sensitive people who have asthma and heart disease. No significant wildfires have occurred in Broward County since 2007.

Probability and Extent of Future Events

The probability of future large wildfire events in western portions of Broward County is considered “likely”, particularly during drought cycles and abnormally dry conditions in the Everglades. Of more concern to Broward County emergency management officials are the smaller, more frequent brush fires that ignite in pockets of undeveloped natural areas during periods of dry conditions that are immediately adjacent to developed properties in the urban areas of the County. In the future Broward County is likely to be impacted by significant wildfires that could burn over 10,000 acres or more.

Future Risk Conditions Influencing Wildfire

As discussed earlier in the drought subsection, climate change will likely bring periods of extended drought and higher temperatures which would exacerbate the risk of wildfire in already vulnerable areas.

Vulnerability Assessment

According to the 2011 State of Florida Wildfire Hazard Mitigation Plan Annex, the Florida Fire Service (FFS) maintains a Fire Activity Report database that includes information on all wildfires that FFS responded to dating back to 1980. According to these records, there have been 141,230 fires that have burned over 5 million acres in the past 30 years in Florida. The 2009 parcel data remained the same for Broward County.

Table 4.34: Estimated Number of Structures at Risk from Wildfire

Structure Type	Number of At-Risk Structures
Single-Family Homes	30,840
Mobile Homes	3,980
Multi-Family Homes	21,105
Commercial	1,420
Agriculture	418
Gov./Institutional	372
Total	**58,135**

Human Caused Hazards

Human caused hazards can affect localized or regional areas are often unpredictable, can cause loss of life and property damage, and can significantly impact infrastructure in Broward County. This section includes human caused hazards that pose the greatest risk in Broward County. Human caused hazards are categorized as biological, societal, and technological. Hazards are listed alphabetically by category.

Biological Hazards

Pandemic/Infectious Disease

Background

Infectious diseases are a constant threat to humanity. Societal, environmental, and technological factors impact the occurrence and persistence of infectious diseases worldwide, as new diseases (e.g., SARS, West Nile Virus) continue to emerge each year and old diseases reappear or evolve into new drug-resistant strains (e.g., malaria, tuberculosis, bacterial pneumonias). Infectious diseases can be carried by infected people, animals, and insects, and can also be contained within commercial shipments of contaminated food.

Three terms are commonly used to classify disease impacts: endemic, epidemic, and pandemic. An endemic is always present at a low frequency (e.g., chicken pox in the U.S.). An epidemic is a sudden severe outbreak of disease (e.g., the bubonic plague during Medieval times), and a pandemic is an epidemic that becomes very widespread and affects a whole region, a continent, or the world (e.g., the 1957 flu pandemic caused at least 70,000 deaths in the U.S. and 1-2 million deaths worldwide.). Fears of pandemic have risen in recent years as our globalized economy and growing population fosters large scale international travel and trade. Also, growing populations increases the vulnerability of all areas to disease as it can travel more quickly and creates difficulty in preventing the spread of infection.

Location and Spatial Extent

Disease impacts all areas of the world, and all areas are vulnerable. Third world countries have fewer resources to fight disease and may be more vulnerable than more industrialized nations. In the United States, the public health system works at the federal, state, and local levels to monitor diseases, plan, and prepare for outbreaks, and prevent epidemics where possible. But, in the age of air travel and worldwide shipping, it is becoming increasingly difficult to contain localized outbreaks as infected or exposed people travel and work, sending the disease across the globe in a matter of hours. Therefore, in an increasing globalized world, public health threats that are not endemic to Florida can impact the region very quickly from halfway around the world.

Historical Occurrences

In early 2020, the Covid-19 pandemic in Broward County impacted businesses and governmental operations. As of this 2022 ELMS update, while the numbers of hospitalized Covid patients and deaths in the Broward County area have fallen, the test positivity rate remains high. Since the beginning of the pandemic, a total of 766,482 cases have been reported. At least 1 in 290 residents have died of Covid-19 for a total of 6,735 reported deaths.
(Source: Communicable Disease Frequency Report, Florida Department of Health)

The Florida Department of Health and the Broward County Health Department maintain disease surveillance for the County, reporting all known medical diagnoses of certain diseases. The current list of reportable communicable diseases for 2022 is listed in **Table 4.37** below.

Table 4.35: Broward County Communicable Disease Cases

Reportable Communicable Disease	Total Reported Cases	Percent of total county population impacted*
Anaplasmosis	2	0.04%
Brucellosis	1	0.02%
Campylobacteriosis	241	5.17%
Carbon monoxide poisoning	9	0.19%
Ciguatera fish poisoning	4	0.09%
Coronavirus/COVID-19	1.071	0.54%
Creutzfeldt-Jakob Disease (CJD)	6	0.13%
Cryptosporidiosis	49	0.05%
Cyclosporiasis	21	0.45%
Giardiasis, acute	93	2.00%
Haemophilus influenzae invasive disease	24	0.52%
Hemolytic Uremic Syndrome (HUS)	1	0.02%
Hepatitis A	8	0.17%
Hepatitis B (pregnant women)	84	1.80%
Hepatitis B, Acute	39	0.84%
Hepatitis B, Chronic	529	11.35%
Hepatitis C, Acute	92	1.97%
Hepatitis C, Chronic (including perinatal)	879	18.86%
Lead Poisoning	212	4.55%
Legionellosis	32	0.69%
Listeriosis	2	0.04%
Malaria	6	0.13%

Reportable Communicable Disease	Total Reported Cases	Percent of total county population impacted*
Meningitis, bacterial or mycotic	5	0.11%
Meningococcal Disease	6	0.13%
Mercury Poisoning	1	0.02%
Mpox	710	15.24%
Mumps	1	0.02%
Pertussis	1	0.02%
Pesticide-related illness and injury, acute	1	0.02%
Rabies, animal	3	0.06%
Rabies, possible exposure	346	7.42%
Rocky Mountain spotted fever and spotted fever rickettsiosis	1	0.02%
Salmonella Paratyphi infection	2	0.04%
Salmonella Typhi infection	1	0.02%
Salmonellosis	898	19.27%
Shiga toxin-producing Escherichia coli (STEC) infection	93	2.00%
Shigellosis	149	3.20%
Streptococcus pneumoniae invasive disease	53	1.14%
Varicella (chickenpox)	38	0.82%
Vibriosis (excluding cholera and Vibrio vulnificus)	15	0.32%
Vibriosis (Vibrio vulnificus)	2	0.04%
Total:	**4,661**	**100%**

Source: Data Source: Communicable Disease Frequency Report, Florida Department of Health, 2022

Probability of Future Occurrences

Historical evidence shows that the population of Broward County is vulnerable to disease outbreak, and it is probable that epidemics of infectious disease will impact Broward County in the future warranting a probability level of likely. State and local public health officials maintain surveillance in hopes of identifying disease prominence and containing potential threats before they become epidemics.

Vulnerability Assessment

Estimated potential losses are difficult to calculate because infectious disease causes little damage to the built environment and damages generally are experienced through public health response and medical costs as well as lost wages by patients. Therefore, it is assumed that all buildings and facilities are exposed to disease but would experience negligible damage in the occurrence of an outbreak, but the costs to the public health sector for responding to an outbreak as well as impact to humans may be great.

Hand washing is an effective means of preventing the spread of many diseases, including colds, influenza, norovirus, and shigellosis. Increasing participation in immunization programs will help decrease the vulnerability of some portions of the population to vaccine-preventable diseases. Additional prevention measures continue to be taken in Broward County to limit exposure to insect borne disease (Encephalitis, West Nile Virus, etc.), which primarily means limiting exposure to

mosquitoes. Additional spraying of ponds, standing water, and neighborhoods is occurring throughout Broward County to limit mosquito reproduction.

Societal Hazards

Active Shooter

Background

Active shooter describes the perpetrator of a type of mass murder marked by rapidity, scale, randomness, and often suicide. The Federal Bureau of Investigation defines an active shooter as "one or more individuals actively engaged in killing or attempting to kill people in a populated area.", excluding self-defense, gang or drug violence, crossfire, and domestic disputes. The United States Department of Homeland Security defines an active shooter as "an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearms and there is no pattern or method to this selection of victims." Most incidents occur at locations in which the killers find little impediment in pressing their attack. Locations are generally described as *soft targets* that carry limited security measures to protect members of the public. In most instances, the shooters die by suicide, are shot by police, or surrender when confrontation with responding law enforcement becomes unavoidable. In addition, active shooter events are often over in 10 to 15 minutes. In the past five years, Broward County law enforcement, government officials, school employees, and residents have been experiencing a heightened awareness of the possibility of an active shooter incident occurring in a school or even at public venues. The emergence of an active shooter as a significant hazard stem from the tragic event that occurred at Marjory Stoneman Douglas High School in Parkland in 2018.

On February 14, 19-year-old Nikolas Cruz opened fire on students and staff at Marjory Stoneman Douglas High School in Parkland, a suburb about 30 miles northwest of Fort Lauderdale, murdering 17 people and injuring 17 others. Cruz, a former student at the school, fled the scene on foot by blending in with other students, and was arrested without incident approximately one hour later in nearby Coral Springs. The killing spree is the deadliest high school shooting in United States history, surpassing the Columbine High School massacre that killed 15, including the shooters, in Colorado in April 1999. In the aftermath of the shooting, students at Parkland founded Never Again MSD, an advocacy group that lobbies for gun safety regulations. Governor Rick Scott subsequently signed a bill that implemented new restrictions to Florida’s gun laws, and which also allowed for the arming of teachers who are properly trained. The bill also provided funding for the hiring of additional school resource officers. On October 20, 2021, Cruz pleaded guilty to all charges, and on November 2, 2022, he was sentenced to life in prison without the possibility of parole.

Probability and Extent of Future Events

The probability of this hazard occurring is highly likely.

Mass Migration

Background

Mass migration is defined as large numbers of foreign refugees illegally entering into the United States whether by air, land, or sea. The control of migration into the United States is entirely the responsibility of the United States Department of Homeland Security (DHS). As necessary, DHS will deploy resources and direct multi-agency operations to address a potential and full-scale mass migration event in coordination with state and local agencies. Refugees will be processed by the United States Immigration and Naturalization Service, and anyone who is denied entry but remains in the United States will be classified as an illegal alien. Persons entering the United States illegally, or entering through legal manner, such as under Visas etc., but overstay the expiration of the Visa are also considered illegal aliens.

A large uncontrolled influx of immigrants has the potential of significantly disrupting the social and economic stability of local communities by overwhelming the delivery of essential services such as medical response and public safety. While the federal government has the primary responsibility for assuming control of mass migration emergencies, Broward County may have to provide basic care including shelter, food, water, medical, and other social services.

Mass migration events can have widespread and lasting social and economic impacts, including:

- Adverse impacts on the capacity of public schools, public hospitals, and other public facilities to serve the resident population.
- Negative impacts on the wages and working conditions for the resident population.
- Medical costs for illegal immigrants unduly burden hospitals by having to deal with the costs of unpaid medical bills.
- Increased numbers of children without health insurance.
- Contagious diseases that are generally considered to have been controlled in the United States are readily evident along the border and entry points for migration.

Another concern with mass migration events is that many countries today are not willing to take back deported citizens that have tried unsuccessfully to relocate to the United States.

Location and Spatial Extent

Generally, it is assumed that all of Broward County is uniformly exposed to mass migration, and that the spatial extent of impact is large. The areas with the highest vulnerability to immediate and direct mass migration impacts are the coastal municipalities as such an event would likely be executed by sea.

Historical Occurrences

South Florida does have some history with mass migrations from the Caribbean basin, particularly Cuba and Haiti.

April 15 – October 31, 1980 (Mariel boatlift)
The Mariel boatlift was a mass movement of Cubans who departed from Cuba's Mariel Harbor for South Florida between April 15 and October 31, 1980. The boatlift was precipitated by a sharp

downturn in the Cuban economy, leading to simmering internal tensions on the island and a bid by up to 10,000 Cubans to gain asylum in the Peruvian embassy. The Cuban government subsequently announced that anyone who wanted to leave could do so, and an impromptu exodus organized by Cuban Americans with the agreement of Cuban President Fidel Castro was underway. Soon after it was discovered that several the exiles had been released from Cuban jails and mental health facilities, and the exodus was ended by mutual agreement between the two governments in October 1980. By that time up to 125,000 Cubans had made the journey to Florida in an estimated 1,700 boats that overwhelmed the U.S. Coast Guard. Upon arrival, many Cubans were placed in refugee camps, while others were held in federal prisons to undergo deportation hearings.

August – September 1994 (Cuban Raft Crisis)
On August 13, 1994, President Fidel Castro, in view of the increase in illegal Cuban sea exits announced in a speech that from then on, he would retire the Cuban Frontier Guard from the Cuban coasts and would allow anyone who wanted to leave the country to do so. He thereby provoked the biggest raft crisis in the history of the continent, as tens of thousands of Cubans headed by sea toward South Florida. When Florida's Governor announced that the state could not cope with the surge of arriving Cuban immigrants, President Clinton declared an immigration emergency and ordered the interception of Cuban refugees and their transfer to "safe havens" such as the U.S. Naval Base at Guantánamo Bay, Cuba. During this period a total of more than 32,000 Cuban citizens were intercepted on the high seas and transferred to Guantánamo.

Probability of Future Occurrences

As political unrest in South America and the Caribbean continues, there will always be people wanting to immigrate to South Florida where there is an existing extensive network of people from these countries in place. However, as the Department of Homeland Security (DHS) continues to increase border patrols and tightens the security requirements for inbound vessels, the likelihood of a mass migration seems less likely. The probability of future mass migration events in Broward County is considered likely.

Vulnerability Assessment

South Florida is susceptible to mass migration events due to natural catastrophes and political unrest in foreign countries, particularly Haiti and Cuba. Mass migration events involving tens of thousands of immigrants have occurred several times within the last several decades. However, due to more stringent border patrol by DHS the vulnerability of Broward County to such events is limited to moderate.

Terrorism

Background

Information in this subsection borrows heavily from the FEMA, State, and Local Mitigation Planning How-to Guide: *Integrating Manmade Hazards into Mitigation Planning* (FEMA Publication 386-7). For the sake of brevity and consistency with other subsections of this risk assessment, each individual element of terrorism is introduced in relatively abbreviated format.

International and domestic terrorism remains a significant hazard of concern for most communities across the United States, and is even more so following the attacks of September 11, 2001, in the City of New York and Washington, DC. According to the U.S. Department of Justice, Federal Bureau of Investigation (FBI), "Terrorism is the unlawful use of force or violence, or threatened use of force or violence, against persons and places for the purpose of intimidation and/or coercing a government, its citizens, or any segment thereof for political or social goals." The FBI further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization; however, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and its consequences.

Terrorism can include computer-based (cyber) attacks and the use of weapons of mass destruction (WMD) to include chemical, biological, radiological, nuclear, or explosive (CBRNE) agents. However, within these general categories, there are many variations. Particularly in biological and chemical weapons, there are a wide variety of agents and ways for them to be disseminated.

The following types of terrorist attacks have been identified by FEMA as part of their guidance on integrating manmade hazards into mitigation planning:

Armed Attack
This element of terrorism refers primarily to tactical assault or sniping from a remote location.

Arson/Incendiary Attack
Arson/incendiary attack refers to the initiation of fire or explosion on or near a target either by direct contact or remotely via projectile.

Agriterrorism
Agriterrorism is the direct, typically covert contamination of food supplies or the introduction of pests and/or disease agents to crops and livestock.

Biological Agent
Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits, and moving sprayers.

Chemical Agent
Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; *liquids vaporizing from puddles or containers; or munitions.*

Conventional Bomb/Improvised Explosive Device
This refers to the intentional detonation of an explosive device on or near a target with the mode of delivery being via person, vehicle, or projectile.

Cyber-terrorism
Cyber-terrorism refers to electronic attack using one computer system against another. Cyberthreat vectors inclusive of hacking for political, ideological, and reputational status purposes, and for profit are constantly targeting private and governmental entities. The 2017

ELMS update classified cyberthreats as an area for additional analysis and Broward County seeks to collaborate with public and private partners such as Florida's Agency for State Technology (AST), the Florida Department of Law Enforcement (FDLE), the Multi-State Information Sharing & Analysis Center (MS-ISAC), and the Southeast Florida Fusion Center for ongoing strategic planning and training initiatives of cybersecurity policy and IT systems protection. Identified Cyberthreats Include:

Malware: Short for Malicious software, is an umbrella term used to refer to a variety of forms of hostile or intrusive software, including computer viruses, worms, trojan horses, ransomware, spyware, adware, scareware, and other malicious programs. It can take the form of executable code, scripts, active content, and other software. Malware is defined by its malicious intent, acting against the requirements of the computer user - and so does not include software that causes unintentional harm due to some deficiency. The majority of malware is propagated through user-initiated actions such as clicking on a malicious link in a spam e-mail or visiting a malicious or compromised website. In other instances, malware is disseminated through advertising and drive-by downloads, which do not require user engagement for the infection to be successful.

Ransomware: Ransomware is a type of malware that encrypts files on the infected system/network (crypto ransomware), although a few variants are known to erase files or block access to the system using other methods (locker ransomware). Once access to the system is blocked, the ransomware demands a ransom in order to unlock the files, frequently $200 - $3,000 in bitcoins, though other currencies and gift cards are occasionally reported. Ransomware variants almost always opportunistically target victims, infecting an array of devices from computers to smartphones.

Phishing / Spear Phishing: Phishing is the attempt to obtain sensitive information such as usernames, passwords, and credit card details (and, indirectly, money), often for malicious reasons, by disguising as a trustworthy entity in an electronic communication. Phishing is typically carried out by email spoofing or instant messaging, and it often directs users to enter personal information at a fake website, the look and feel of which are almost identical to the legitimate one. Communications purporting to be from social web sites, auction sites, banks, online payment processors or IT administrators are often used to lure victims. Phishing emails may contain links to websites that are infected with malware. Spear Phishing involves social engineering that targets a preidentified victim with details pertaining to the individual.

Denial-of-Service / Distributed Denial-of-Service: Is a cyber-attack where the perpetrator seeks to make a machine or network resource unavailable to its intended users by temporarily or indefinitely disrupting services of a host connected to the Internet. Denial of service is typically accomplished by flooding the targeted machine or resource with superfluous requests in an attempt to overload systems and prevent some or all legitimate requests from being fulfilled. In a distributed denial-of-service attack (DDoS attack), the incoming traffic flooding the victim originates from many different sources. This effectively makes it impossible to stop the attack simply by blocking a single source.

SQL Injection: Is a code injection technique, used to hack data-driven applications, in which nefarious SQL statements are inserted into an entry field for execution (e.g. to dump the database contents to the attacker). SQL injection must exploit a security vulnerability in an application's software. SQL injection is mostly known as an attack vector for websites but can

be used to attack any type of SQL database. SQL injection attacks also allows attackers to spoof identity, tamper with existing data, cause repudiation issues such as voiding transactions or changing balances, allow the complete disclosure of all data on the system, destroy the data or make it otherwise unavailable, and become administrators of the database server.

Intentional Hazardous Material Release

Solid, liquid, and/or gaseous contaminants may be intentionally released from either fixed or mobile containers.

Nuclear Bomb

A nuclear device may be detonated underground, at the surface, in the air or at high altitude.

Radiological Agent

Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point or line sources such as munitions, covert deposits, and moving sprayers.

Location and Spatial Extent

The location of terrorist attacks is unpredictable, though certain critical facilities and venues for large public gatherings are usually considered to have more inherent vulnerability. With miles of strip malls, about 7.5 million tourists visiting every year and a growing degree of diversity, many say Broward County, and all South Florida, is an ideal place to keep a low profile. Some observers say the county's growth and diversity have added a layer of anonymity for potential wrongdoers. Others point to the proximity of Port Everglades in Fort Lauderdale and the Port of Miami, 2 of the state's busiest ports, and the region's airports and flight schools.

Broward County, like most major metropolitan communities, has the potential to be a target of the terrorist. The county has several sites that would be attractive to a terrorist based on location, potential for publicity, and other targeting factors too numerous to mention here. The world is shrinking, and geographical boundaries and proximity are no longer major factors. Terrorism and drug-related crime have been linked in the past and the area has the potential to be a spawning ground for these illegal and criminal activities, factors that increase risk. Broward County has a population that is ethnically, racially, and economically diverse. While these factors, in and of themselves are of no immediate concern, they can provide individuals and groups commonly associated with terrorism, some degree of freedom to stage and conduct activities. Terrorists have and will take advantage of these conditions to blend in when conducting their illegal activities.

In the hours and days immediately following the terrorist events of September 11, 2001, attention was focused on Broward County in South Florida, where it was suspected at least one of the suicide hijackers, Mohammed Atta, had made his residence in the months prior to that fateful day. Subsequent investigations revealed that at least 7 of the 19 men who crashed hijacked planes on September 11 had spent time in the county.

The location and extent of the various types of terrorist attacks is briefly and generally described below in terms of their effect on the physical environment.

Probability of Future Events

The probability of a future terrorist attack is likely due to the number of potential targets and the current law enforcement efforts underway. The probability of future terrorist attacks is partially monitored by the Department of Homeland Security through the Homeland Security Advisory System. For more information on this system, visit http://www.whitehouse.gov/homeland/.

Vulnerability Assessment

The U.S. Department of Justice and the Federal Bureau of Investigation have identified Broward County as a highly volatile area for terrorism activity. There are areas in Broward that are more likely to be targets for terrorism such as critical facilities, communication systems, water and utilities, monuments, and areas where large groups congregate (e.g., stadiums, conventions, worship areas).

Technological Hazards

Hazardous Material Incident

Background

Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the Nation's highways, and on the water. Approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway incidents, 991 are railroad incidents, and 266 are due to other causes (FEMA, 1997). In essence, HAZMAT incidents consist of solid, liquid, and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and possibly wildlife as well.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Location and Spatial Extent

A hazardous material incident can occur in a variety of locations and spatial extents. Some incidents (such as a fuel spill) can occur in a small location and impact a small spatial extent. Others, such as the release of toxic chemicals may occur from a small location or source but can spread over large areas.

The Emergency Planning & Community Right-to-Know Act of 1986 (EPCRA) requires facilities storing hazardous materials to report those substances annually to the State Emergency Response Commission (SERC), the Local Emergency Planning Committee (LEPC), and local fire departments. There are hundreds of such facilities located throughout Broward County, though many do not store substances or quantities of such that are considered extremely hazardous. Of greater concern to the emergency management community are those facilities that use or produce toxic chemicals above specific thresholds that pose major threats to human life and safety. These include Toxics Release Inventory (TRI) facilities as discussed further under *Vulnerability Assessment*. In Broward County there are a total of 130 TRI facilities, most of which are shown on **Map 4.17**.

Broward County is not only vulnerable to hazardous materials at fixed hazardous material sites but also along key transportation corridors such as Interstate 95, the Florida Turnpike, and the 2 major rail lines that transverse the County. According to the CSX Transportation's report, *Hazardous Materials Density Study for Broward County*, 2006, the topmost transported products via rail system are Sodium Hydroxide Solution, Chorine, Liquefied Petroleum Gases, and

Petroleum Distillates. There are also 3 underground petroleum pipelines that service Miami International, Homestead, and Ft. Lauderdale International Airports.

One of the most vulnerable locations for hazardous materials incidents is Port Everglades. Port Everglades seaport is the world's third largest cruise-port. About 2.5 million passengers were accommodated at the Port in 2020. On average between 2011 to 2019 Port Everglades accommodated 3.8 million passengers. In FY 21, The dollar value breakdown of all cargo types of Port-wide trade was nearly equal with exports representing 49.9% and import representing 50.1%. Port Everglades kicked off Fiscal Year 2022, which began October 1, 2021, with a record-setting first month reaching 94,588 TEUs (20-foot equivalent units. Container volumes were up 5.5 percent in October 2021 over the previous October record set in 2018. Revenue from petroleum products accounts for nearly 25% of the Port's total revenue. Some 18 counties in Florida are directly reliant on this source of petroleum products.

Map 4.17: Toxic Release Inventory (TRI) Sites

Source: US Environmental Protection Agency 2022 TRI Basic Data Files

Historical Occurrences

Broward County averages about 1 reported hazardous material incident every 3 weeks. These incidents may be a tanker rollover or other accidental releases of substances during transport.

Slightly more than 70% of the hazardous material releases involve petroleum. The most frequently released non-petroleum-based chemicals are ammonia and chlorine.

Probability of Future Events

Due to the continuous presence of hazardous materials being transported or stored in and around Broward County, hazardous materials incidents of varying magnitudes are considered highly likely future events.

Vulnerability Analysis

The Toxics Release Inventory (TRI) is a publicly available database from the U.S. Environmental Protection Agency (EPA) that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to EPA and to their state or tribal entity. A facility must report if it meets the following three criteria:

- The facility falls within one of the following industrial categories: manufacturing; metal mining; coal mining; electric generating facilities that combust coal and/or oil; chemical wholesale distributors; petroleum terminals and bulk storage facilities; RCRA Subtitle C treatment, storage, and disposal (TSD) facilities; and solvent recovery services.
- Has 10 or more full-time employee equivalents
- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, bio accumulative and toxic (PBT) chemicals are subject to different thresholds of 10 pounds, 100 pounds, or 0.1 grams depending on the chemical.

For fixed site analysis, only toxic sites that have georeferenced data available were analyzed and the circle buffers are drawn around each hazardous material site. 2 sizes of buffers, 500 and 2,500 meters are assumed in respect to the different levels of effect-- immediate (primary) and secondary. For mobile analysis, the major roads (Interstate highway, US highway, State highway) and railroads are chosen to be the routes where hazardous material is allowed. The buffer along the roads is drawn with the same size as fixed site analysis. Census block data was used to estimate exposure.

Table 4.38 shows estimated toxic release exposure of people and buildings by jurisdiction for fixed sites using census block data, while **Table 4.39** shows the result for mobile site toxic release. Primary and secondary impact sites were selected based on guidance from FEMA Publication #426 (*Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*) and professional engineering judgment. Because many sites containing hazardous materials are in densely populated areas, there are population and structures that could be susceptible to a release from more than 1 site. In some jurisdictions, the number of people and property has been counted more than once to account for their susceptibility to multiple potential toxic releases. Therefore, the number of people and structures that could potentially be impacted may appear to exceed the total number or value of structural units and total population by jurisdiction.

Table 4.36: Estimated Exposure of People and Buildings by Jurisdiction (Fixed Site Toxic Release)

Jurisdiction	Immediate (Primary) Impact			Secondary Impact		
	Number People at Risk	Number of Buildings at Risk	Value of Buildings at Risk	Number People at Risk	Number of Buildings at Risk	Value of Buildings at Risk
Coconut Creek	0	0	$0	15,287	3,952	$1,093,314,447
Cooper City	0	0	$0	0	0	$0
Coral Springs	4,222	1,018	$301,346,504	35,606	11,649	$2,742,053,616
Dania Beach	1,113	668	$204,351,779	21,178	9,393	$2,134,792,947
Davie	0	0	$0	4,573	2,440	$701,481,325
Deerfield Beach	9,353	1,961	$1,120,009,400	51,911	15,824	$4,448,959,176
Fort Lauderdale	11,212	4,759	$2,652,504,621	123,450	45,566	$18,762,613,213
Hallandale Beach	0	0	$0	0	0	$0
Hillsboro Beach	0	0	$0	0	0	$0
Hollywood	4,615	2,177	$542,352,933	72,447	27,436	$6,384,248,787
Lauderdale-By-The-Sea	0	0	$0	0	0	$0
Lauderdale Lakes	154	63	$23,765,544	3,945	1,311	$213,447,602
Lauderhill	0	0	$0	382	214	$19,833,531
Lazy Lake	0	0	$0	75	31	$2,867,225
Lighthouse Point	0	0	$0	2,212	821	$270,046,908
Margate	0	0	$0	56	20	$2,695,446
Miramar	2,455	826	$450,554,441	38,698	13,289	$3,924,123,469
North Lauderdale	99	54	$23,126,107	511	176	$49,384,601
Oakland Park	3,719	1,252	$283,831,547	37,782	13,164	$2,474,434,020
Parkland	0	0	$0	422	332	$174,843,394
Pembroke Park	0	0	$0	318	140	$31,266,729
Pembroke Pines	1,797	670	$127,936,540	16,978	4,931	$1,231,619,120
Plantation	0	0	$0	247	110	$29,185,980
Pompano Beach	5,075	1,450	$1,371,996,575	52,807	13,734	$5,819,120,030
Sea Ranch Lakes	0	0	$0	0	0	$0
Southwest Ranches	0	0	$0	0	0	$0
Sunrise	0	0	$0	0	0	$0
Tamarac	710	290	$121,555,644	2,102	731	$307,341,280
Broward Municipal Services Districts	807	330	$43,529,894	10,052	3,789	$296,934,041
West Park	0	0	$0	1,316	643	$82,046,605
Weston	0	0	$0	0	0	$398,199
Wilton Manors	0	0	$0	10,437	3,832	$890,702,030
TOTAL	**45,330**	**15,520**	**$7,266,861,530**	**502,790**	**173,527**	**$52,087,753,720**

Source: Broward County Property Appraiser and Hazus-MH MR3

Table 4.37: Estimated Exposure of People and Buildings by Jurisdiction (Mobile Site TRI)

County	Immediate (Primary) Impact			Secondary Impact		
	Number People at Risk	Number of Buildings at Risk	Value of Buildings at Risk	Number People at Risk	Number of Buildings at Risk	Value of Buildings at Risk
Coconut Creek	33,417	10,859	$2,681,134,650	45,753	11,701	$3,061,603,270
Cooper City	11,944	4,759	$827,267,090	30,324	11,860	$1,943,657,150
Coral Springs	53,193	18,016	$4,829,695,700	118,703	31,655	$8,134,798,700
Dania Beach	21,041	9,157	$2,146,967,360	22,493	7,704	$1,878,435,580
Davie	43,128	17,434	$4,911,733,240	72,125	25,955	$6,711,031,880
Deerfield Beach	65,918	21,755	$5,746,695,970	71,708	18,500	$5,161,599,440
Fort Lauderdale	145,839	52,081	$24,307,175,720	174,407	46,963	$22,130,694,710
Hallandale Beach	27,471	6,629	$3,809,116,360	32,437	5,574	$3,836,691,130
Hillsboro Beach	1,947	337	$874,503,810	1,947	283	$810,574,300
Hollywood	106,966	38,547	$9,785,340,920	137,407	39,957	$10,029,588,340
Lauderdale-By-The-Sea	6,427	2,192	$2,102,941,510	6,427	1,575	$1,739,928,950
Lauderdale Lakes	22,813	3,868	$1,158,439,200	27,809	4,232	$1,152,461,750
Lauderhill	49,604	10,116	$2,197,719,300	66,051	11,554	$2,492,601,430
Lazy Lake	102	47	$4,145,050	118	38	$4,107,550
Lighthouse Point	9,733	4,647	$1,362,148,460	11,028	4,489	$1,261,700,120
Margate	22,943	7,520	$1,277,732,100	50,439	13,866	$2,296,212,030
Miramar	47,227	17,475	$5,235,872,030	76,220	26,478	$7,475,638,380
North Lauderdale	8,644	2,797	$403,375,520	36,656	9,432	$1,260,435,790
Oakland Park	34,108	12,609	$2,494,719,440	42,547	11,631	$2,473,754,560
Parkland	6,961	3,167	$1,695,072,100	13,254	5,261	$2,682,321,260
Pembroke Park	2,055	566	$118,884,600	6,527	2,906	$404,154,300
Pembroke Pines	80,205	27,794	$7,451,109,490	130,899	40,848	$10,247,846,250
Plantation	43,468	15,451	$4,271,908,620	83,575	26,821	$6,803,128,100
Pompano Beach	86,547	26,114	$9,808,804,590	96,834	22,747	$8,981,181,420
Sea Ranch Lakes	805	360	$142,788,670	805	258	$110,763,020
Southwest Ranches	934	325	$747,880,580	1,266	358	$890,133,450
Sunrise	25,072	7,805	$1,899,288,370	86,466	22,356	$5,308,400,300
Tamarac	25,873	8,432	$1,981,329,900	52,060	15,087	$3,283,696,510
Broward Municipal Services Districts	35,913	14,135	$759,483,820	57,590	20,754	$1,106,396,610
West Park	11,074	3,992	$351,459,380	14,328	4,196	$331,537,990
Weston	15,794	6,191	$3,059,188,670	39,508	14,589	$6,490,572,820
Wilton Manors	11,370	4,410	$1,017,041,510	12,617	3,475	$941,493,080
TOTAL	**1,058,644**	**359,603**	**$109,460,963,730**	**1,620,434**	**463,119**	**$131,437,140,170**

Source: Broward County Property Appraiser and Hazus-MH MR3

Conclusions on Hazard Risk

The findings presented in this section were developed using best available data, and the methods applied have resulted in an *approximation* of hazard risk. These approximations should be used to understand relative hazard risk and the potential losses that may be incurred. However, uncertainties are inherent in risk assessment methodology, arising in part from incomplete scientific knowledge concerning specific hazards and their effects on the built environment and from assumptions or generalities that are necessary in order to provide a comprehensive analysis and overview of hazard risk for large planning areas.

The hazard identification and risk assessment completed for Broward County is principally a qualitative assessment as recommended by FEMA in its "How-to" guidance document entitled *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA Publication 386-2). It relies heavily on historical and anecdotal data, stakeholder input, and professional and experienced judgment regarding expected hazard impacts. It also carefully considers the findings in other relevant plans, studies, and technical reports.

However, when possible, conclusions on hazard risk for Broward County are also driven by quantitative loss estimation using best available data and technology, including the use of Hazus-MH and the statistical risk assessment methodology (further described in the "risk assessment methods" section of this chapter). These quantitative risk assessment approaches are useful for estimating the potential future impact of hazard occurrences in Broward County and each of its municipalities. The results of the quantitative assessment are made even more meaningful when combined with other qualitative information made available through the qualitative assessment, as has been done throughout this chapter and in Chapter 5.

To draw some meaningful planning conclusions on hazard risk for Broward County, the results of the combined risk assessment process were used to generate hazard profiles according to a "Priority Risk Index" (PRI). The purpose of the PRI, described further below, is to categorize and prioritize all potential hazards for Broward County as high, moderate, or low risk.

Priority Risk Index

The prioritization and categorization of identified hazards for Broward County is based principally on the Priority Risk Index (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 Broward County Mitigation Task Force in gaining consensus on the determination of those hazards that pose the most significant threat to Broward County based on a variety of factors. The PRI is by no means scientific but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in Broward County based on standardized criteria. Combined with the inventory of local assets and critical facilities, the hazard profiles generated using 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 the Broward County Mitigation Task Force to consider as part of its proposed mitigation strategy.

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 5 categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor, as summarized in **Table 4.40**. To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor.

The sum of all 5 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)]

Table 4.38: 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 1 week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area 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	More than 24 hours	Self explanatory	1	10%
	12 to 24 hours	Self explanatory	2	
	6 to 12 hours	Self explanatory	3	
	Less than 6 hours	Self explanatory	4	
Duration	Less than 6 hours	Self explanatory	1	10%
	Less than 24 hours	Self explanatory	2	
	Less than 1 week	Self explanatory	3	
	More than 1 week	Self explanatory	4	

According to the weighting scheme applied for Broward County, the highest possible PRI value is 4.0. Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the Broward County LMS Working Group.

PRI Results

Table 4.41 summarizes the degree of risk assigned to each category for all initially identified hazards based on the application of the PRI. Assigned risk levels were based on the detailed

hazard profiles developed for this section. The results were then used in calculating PRI values and making final determinations for the risk assessment.

Table 4.39: Hazards

	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	*PRI Score*
Atmospheric Hazards						
Extreme Heat	Likely	Critical	Large	More than 24 hours	Less than 1week	2.3
Severe Storm	Highly Likely	Critical	Moderate	Less than 6 hours	Less than 6 hours	2.8
Tornado	Highly Likely	Critical	Moderate	Less than 6 hours	Less than 6 hours	2.3
Tropical Cyclone	Likely	Catastrophic	Large	More than 24 hours	Less than 1 week	3.2
Hydrologic Hazards						
Coastal Erosion	Likely	Minor	Small	More than 24 hours	More than 1 week	1.9
Drought	Possible	Minor	Large	More than 24 hours	More than 1 week	2.1
Flood	Highly Likely	Critical	Moderate	More than 24 hours	Less than 1 week	2.7
Sea Level Rise/Climate Change	Likely	Critical	Large	More than 24 hours	More than 1 week	2.2
Other Natural Hazards						
Wildfire	Likely	Limited	Moderate	6 to 12 hours	Less than 1 week	1.9
Biological Hazards						
Pandemic/Infectious Disease	Possible	Critical	Moderate	More than 24 hours	More than 1 week	2.7
Societal Hazards						
Mass Migration	Possible	Minor	Small	More than 24 hours	More than 1 week	2.0
Terrorism	Possible	Critical	Moderate	6-12 hours	Less than 24 hours	2.3
Active Shooter	Possible	Critical	Small	Less than 6 hours	Less than 24 hours	2.4
Technological Hazards						
Hazardous Material Incident	Highly Likely	Limited	Small	6-12 hours	Less than 24 hours	2.4
Cyber	Possible	Critical	Large	More than 24 hours	Less than 1 week	2.5

Final Determinations

The conclusions drawn from the risk assessment process for Broward County, including the PRI results and input from the Broward County Local Mitigation Strategy Working Group, the municipalities, and the public, resulted in the classification of risk for each identified hazard according to three categories: *High Risk*, *Moderate Risk, and Low Risk* **(Table 4.42).** It should be noted that although some hazards are classified as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases and will continue to be reevaluated

during future updates. This table was reviewed during this 2022 ELMS revision and the results were confirmed.

Table 4.40: Conclusions on Hazard Risk for Broward County

HIGH RISK	**Tropical Cyclone** **Flood** **Severe Storm** **Tornado**	**Hazardous Material Incident** **Sea Level Rise / Climate Change** **Extreme Heat**
MODERATE RISK	**Wildfire** **Pandemic/Infectious Disease** **Terrorism** **Cyber**	**Drought** **Coastal Erosion**
LOW RISK	**Mass Migration**	

Chapter 5 – Mitigation Initiatives

As an initial step in the development of the ELMS, it is necessary to determine what hazard mitigation initiatives are currently underway in the County or planned for the immediate future to establish a baseline of known governmental activities to improve the county's resistance to the impact of disasters. This activity assists the Working Group in establishing its goals and objectives.

Existing Mitigation Initiatives

To complete an inventory of existing and planned initiatives, Broward County's LMS Planning Subcommittee met and worked with stakeholders to gather information regarding initiatives being implemented or planned by local governments in the county. The Planning Subcommittee through a Survey Monkey soliciting information as well as communications internally within the municipalities yielded the information needed to determine existing and future initiatives. A LMS survey form was given to each municipal LMS Working Group member as well as being disseminated to the public for each municipality. Now being more familiar with the definition of mitigation and having ownership in the survey instrument, all the municipalities answered in more detail about mitigation practices. Review of mitigation initiatives throughout Broward County is an ongoing effort.

Broward County and its current 31 municipalities and the Seminole Tribe of Florida participate in a full range of federal, state, and local mitigation programs and initiatives. These programs and initiatives include the LMS, the Community Rating System (CRS), the National Flood Insurance Program (NFIP), Flood Mitigation Assistance Program (FMA), Pre-Disaster Mitigation Program (PDM), Hazard Mitigation Grant Program (HMGP), Emergency Management & Assistance Program (EMPA), Citizen Corp, Continuity of Operations Plan (COOP), Continuity of Government (COG) Plan, ESF#18 – Business and Industry, Broward Recovery Plan and the Broward Comprehensive Emergency Management Plan. The overarching purpose of these activities is the elimination or reduction of hazards presenting significant risk to the county and its residents. Pre-disaster activities will be coordinated through the LMS Working Group (LMSWG). The LMS Coordinator will be the Liaison between the Working Group and the State. For post-disaster activities, the Recovery Manager will liaise with the State mitigation staff and if applicable, the Joint Field Office (JFO), formerly called the Disaster Field Office (DFO).

Some municipalities have proposed no or reduced building permit fees for shuttering of residential structures and related upgrades that are considered mitigation actions, provided that the action meets the South Florida Building Code. All building activity in Broward County (both new construction and renovations) must meet the South Florida building code, which is more stringent than the building code in the rest of the state.

A major mitigation priority of the LMS is the tracking and reduction of repetitive flood loss properties. The county and its CRS participating municipalities track repetitive loss properties county-wide on an ongoing basis using data gathered annually from FEMA and the State (See Chapter 4, "Flood" subsection). For mitigation planning and strategy development purposes, the LMS maintains updated GIS maps and informational databases of repetitive loss property locations relative to historical flood areas and designated Special Flood Hazard Areas (SFHA). Repetitive loss properties are an ongoing discussion and planning priority for the LMS. In the future, a Flood/CRS technical subcommittee will be established to address these issues. The

subcommittee is envisioned to be comprised of public and private sector representatives and will be encouraged to develop and promote mitigation project ideas and strategies.

Building Permitting Activities

The Planning Committee of the LMS Working Group was given the task of determining where mitigation measures are being applied to residential and commercial properties to serve as a benchmark for the LMS. It was determined to be too time consuming for each community to gather information and write a report on behalf of the Working Group. A survey instrument was developed to be filled out by each individual applicant as they apply for a permit in each municipality as part of the permitting process. The completed permit survey forms are gathered by each municipality and submitted to Broward County Emergency Management on a semi-annual basis. An annual report of all mitigation activity will then be compiled.

Capability Assessment

The mitigation strategy serves as a vital link between the risk described in the Risk and Vulnerability Assessment and the ultimate action outcomes of the plan and planning process. A necessary intermediary step is a understanding of the presence of the resources, laws, and programs that help implement mitigation actions. This step is known as the capability assessment and it's basis in the current regulations is 44 CFR 201.6(c)(3):

> 3) *A mitigation strategy* that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

"Future Mitigation Initiatives", found later in Chapter 6, outlines actions to expand on and improve existing tools. Some of the information below is detailed in other parts of the plan. It is summarized (and referenced) below to provide an overview of the authorities, policies, programs and resources (which includes committees, tools, laws and funding sources) that make mitigation possible on an on-going, not just post-disaster, basis in Broward County:

Funding programs

See "Funding Sources" found later in this Chapter.

County programs

- Broward County Risk Management Division – This division for the Broward County Board of County Commissioners is responsible for administering the County's self-insurance program for workers' compensation, general liability, automobile liability, and property damage claims. Broward County's purchased insurance program includes the procurement of property insurance which in 2011-2012 was Factory Mutual (FM) Global. The Division's mission is to continuously develop, manage, and improve insurance and safety/occupational health services in order to provide quality, cost-effective support to its customers and to protect the County's financial well-being.
    - The County has a deductible of $100,000,000 for its property and FM Global generally requires protection up to a Category 3 windstorm for properties it insures.

Planning policies and Laws

- Land Use Plan - The Broward County Planning Council is charged with the responsibility of preparing a county-wide land use plan under the Charter of Broward County, Florida. The Charter requires all local land use plans within the County to conform to the Broward County Land Use Plan. The Land Use Plan establishes the framework for the future development and redevelopment of Broward County and for the provision of facilities and services within the County. All development must be consistent with the uses, the densities and the intensities of this policy plan.
    - Objective 1.05.00 – Coastal Densities and Hurricane Evacuation: Consider appropriate densities in coastal areas with regards to Broward County hurricane evacuation clearance standards
    - Objective 8.03.10 – Encourages municipalities to prepare flexible land development codes and regulations that address negative drainage pattern impacts caused by impervious surface area of redevelopment/infill activities.
    - Objective 8.08.00 – Post-Disaster Redevelopment and Hazard Mitigation: 1) Inventory hazard-prone properties and encourage building codes and development regulations that reduce future property damages and losses [*see Chapter 7 for suggestions for future changes*]. 3) Encourage acquisition or redevelopment of hazard prone property to avoid future damages.
    - Objective 9.07.00 – Protect Areas Subject to Seasonal or Periodic Flooding (identified floodplains): Includes requirements that redevelopment address existing flood problems.

- See “Plan Integration Efforts” in Appendix H for more information about how mitigation is integrated into other community plans including the County’s Comprehensive Plan (which is only pertinent to the Broward Municipal Services District unincorporated parts of the County).

Building codes

- State of Florida Building Code - Broward County and South Florida have probably the most restrictive wind protection building code standards in the nation. Broward County must comply with the State of Florida Building Code, revised in 2010, which has the following wind protection requirements (effective March 12, 2012):
    - Ultimate Design Wind Speed is 170 miles per hour but for residential structures, the design pressures that the wind protection products are required to meet virtually stays the same as the 2007 code which for Broward was 140 miles per hour for the 3-second gust. All of Broward County is in the Wind-Borne Debris Region of the state.
    - Exposure Category (used to describe area around building): C. This category is the most second stringent standard in Florida. Areas affected by wind over open water that extends 5000 feet or 20 times the height of the building in the upwind direction are in Exposure Category D, the most stringent standard.
    - Building Risk Categories requirements for Broward (Ultimate Design Wind Speed):
        - Risk Category I Buildings and Structures: 156 mph
        - Risk Category II Buildings and Structures: 170 mph
        - Risk Category III and IV Buildings & Structures: 180 mph
    - Building Risk Categories are the following:

- **I** - Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to agricultural, minor storage and certain types of temporary facilities.
- **II** – Buildings/structures not listed in I, III and IV which is most residential and commercial buildings.
- **III** - Buildings and other structures that represent a substantial hazard to human life in the event of failure. A few examples include:
    - Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300.
    - Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250.
    - Power-generating stations, water treatment facilities for potable water, wastewater treatment facilities and other public utility facilities not included in Occupancy Category IV
- **IV** - Buildings and other structures designated as essential facilities. A few examples include:
    - Fire, rescue, ambulance and police stations and emergency vehicle garages.
    - Designated earthquake, hurricane or other emergency shelters.
    - Designated emergency preparedness, communications and operations centers and other facilities required for emergency response.
    - Aviation control towers, air traffic control centers and emergency aircraft hangars.
    - Water storage facilities and pump structures required to maintain water pressure for fire suppression.

- The Building Code Effectiveness Grading Schedule (BCEGS®) - Assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. The concept is simple: municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The prospect of lessening catastrophe-related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously — especially as they relate to windstorm and earthquake damage. Several Broward municipalities participate in the BCEGS rating system. In 2011, Broward Municipal Services District unincorporated Broward County, Lazy Lake, Hillsboro Beach and Lauderdale-By-The-Sea retained a 10% insurance discount because the Broward County Permitting Section of the Permitting, Licensing and Consumer Protection Division maintained its BCEGS rating.

Floodplain management/Flood insurance/Drainage

NFIP participation – As of April 2020, 31 out of 31 of Broward County's municipalities participate in the NFIP as well as the County itself and the Seminole Tribe which is partially located in Broward County. https://www.fema.gov/cis/FL.pdf

CRS participation – As of October 1, 2022, 24 of 31 Broward County's municipalities participate in the CRS program. The Broward's Municipal Services District (BMSD) also participates.

Drainage responsibilities - Responsibility for canal and lake maintenance (storm water management systems) in most developments is that of the homeowners association. There are 24 independent and dependent districts that have jurisdiction over water related issues and several cities actively manage surface waters in their jurisdictions (e.g., South Broward Drainage District, Central Broward Water Control District). The Broward County Water Management Division has responsibility for seven dependent drainage districts and the Broward Municipal Services District unincorporated neighborhoods not within an independent drainage district. Permitting is done by the independent drainage districts in their districts and by Broward County Department of Planning and Environmental Protection (DPEP) for areas outside of the independent districts. SFWMD permits the larger developments throughout the County. (http://gis.broward.org/maps/webPDFs/EnvironmentalMaps/draindistrict.pdf)

Overarching and Collaborative partnerships

- Climate Change Task Force – On June 24, 2008, the Broward County Board of County Commissioners approved Resolution 2008-442, creating a Climate Change Task Force to develop recommendations for a coordinated county-wide strategy in mitigating the causes, and addressing the local implications, of global climate change. Members of the Task Force are appointed by the Board and other appointing authorities and are supported by County staff. The Task Force meets quarterly, receives reports and presentations on climate issues, and makes recommendations to the Board of County Commissioners.
    - Key responsibility related to hazard mitigation include "the development and implementation of adaptation strategies to alleviate the likely adverse consequences of climate change including rising sea levels, hurricanes and other violent weather events."
    - The Climate Change Task Force oversees the development and update of the County-wide Climate Change Action Plan (2010, 2015, and 2020).

- Climate Change Government Operations Work Group - The Broward County Climate Change Work Group, which includes representatives from many county agencies, works to identify potential emission reduction strategies and propose implementation of selected actions.

- Southeast Florida Regional Climate Change Compact - Represents a joint commitment of Broward, Miami-Dade, Palm Beach and Monroe Counties to partner in cutting greenhouse gas emissions and adapting to climate impacts. The Compact was formalized following the 2009 Southeast Florida Climate Leadership Summit, when elected officials came together to discuss challenges and strategies for responding to the impacts of climate change. The Compact outlines a collaborative effort to participate in a Regional Climate Team toward the development of a Southeast Florida Regional Climate Change Action Plan. Among the actions the Compact takes related to hazard mitigation are:

- Three iterations (2012, 2015, and 2020) of a Regional Unified Sea Level Rise Projection – partnered with many agencies and experts, including SFWMD.
- Completion of a regional vulnerability assessment.
- Three iterations (2012, 2017, and 2022) of a Regional Climate Action Plan, which includes a chapter on Risk Reduction and Emergency Management.
- Policy positions in the Compact's annual State and Federal Legislative Policies and Priorities documents pertaining to hazard mitigation.
- Successful advocacy that led the Florida Legislature to create Adaptation Action Areas, a planning designation that allows local governments to focus adaptation improvements in areas of increased risk of inundation due to sea level rise.

- Broward Surface Water Coordinating Council – This group is primarily composed of the SFWMD and local drainage districts. Broward County EMD officials have started attending these meetings to participate in discussions about drainage and public works needs.

- Enhanced Local Mitigation Strategy –Broward County has a currently approved ELMS and its efforts to enhance it were completed by September 2017. This effort for the 5-year required update is expected to be completed, approved and adopted by March 2018.

- South Florida Regional Planning Council – Oversees larger issues affecting the four counties in the South Florida area (Monroe, Miami-Dade, and Broward). As of May 2012, the SFRPC is investigating the possibility of conducting a regional economic analysis using modeling software from Regional Economics Modeling, Inc. Also acquires and maintains important economic and demographic data. The Council regularly reviews local government comprehensive plans and plan amendments for consistency with the Strategic Regional Policy Plan (SRPP). Local governments amend their plans regularly to adjust to changing conditions. Plan and plan amendments are reviewed to determine compatibility with the SRPP and for extra-jurisdictional impacts.
- LEED for Cities and Communities Rating System – In February 2014, Broward County became the first county government in the United States to achieve a Certified 4-STAR (Sustainability Tools for Assessing and Rating Communities) Community Rating. STAR certification provided a clear, data-driven approach to assessing our County's sustainability efforts. In 2018, all STAR Communities projects were fully integrated into the U.S. Green Building Council's LEED for Cities and Communities program. In early 2022, the County joined the first Florida cohort of the LEED for Cities Local Government Leadership Program and committed to recertifying under the new program criteria. The County will be featured in an upcoming issue of USGBC+ Magazine that highlights Florida communities participating in the Leadership Program. The assessment is projected to be a year-long effort, involving input from dozens of County staff, city liaisons and community partners, led by Broward County's Natural Resources Division and Resilience Unit. Broward County sees the LEED for Cities and Communities program as an opportunity to continue with our long-running commitment to national certification programs that hold our sustainability programs accountable. It also an opportunity for conversation and collaboration among our County agencies and departments that goes beyond data collection requests for greenhouse gas inventories.

Post-disaster initiatives for mitigation

- See Broward County Recovery Plan

Federal standards

Department of Homeland Security (DHS) core capabilities - One of the goals of the National Preparedness System (NPS), based on Presidential Policy Directive (PPD) – 8, is the "the unrelenting pursuit of risk informed decisions and actions that increase resiliency". One central focus of the ELMS is to update and advance an understanding of risk in Broward County to natural and manmade hazards (updating of Chapter 4 including new subsection of Climate Change/Sea Level Rise and addition of Chapter 5). A follow-up to this effort is to review existing mitigation actions and develop new ones based on this better understanding of risk. The following are a listing of DHS core capabilities relevant to hazard mitigation and how the ELMS meets these capabilities:

- Threats and Hazard Identification – "Identify the threats and hazards that occur in the geographic area; determine the frequency and magnitude; and incorporate this into analysis and planning processes so as to clearly understand the needs of a community or entity."
    - ELMS meets this capability by providing detailed analysis of how different natural and manmade hazards and threat may affect the County and determine potential magnitudes as well as frequencies (likelihood of future recurrence). This analysis in Chapters 4 and 5 is the basis for the rest of the plan.

- Risk and Disaster Resilience Assessment – "Assess risk and disaster resilience so that decision makers, responders, and community members can take informed action to reduce their entity's risk and increase their resilience."
    - ELMS meets this capability by involving a wide representation of the community in LMS meetings and presenting them the findings of the risk and vulnerability assessment. In at least 3 meetings during the ELMS development in 2011-2012, the findings of the Economic Vulnerability and update Risk Assessment (e.g., sea level rise subsection) have been presented to the LMS. The LMS has increased its overall membership including the private sector. Under the Recovery Framework development, leadership on the Technical Assistance Committees has emerged from multiple sources (e.g., County/municipal government, private sector).

- Community Resilience – "Lead the integrated effort to recognize, understand, communicate, plan, and address risks so that the community can develop a set of actions to accomplish Mitigation and improve resilience."
    - See response to "Risk and Disaster Resilience Assessment". The ELMS is available for review on the Broward County ftp site.

- Long-term Vulnerability Reduction – "Build and sustain resilient systems, communities, and critical infrastructure and key resources lifelines so as to reduce their vulnerability to natural, technological, and human-caused incidents by lessening the likelihood, severity, and duration of the adverse consequences related to these incidents."
    - ELMS meets this through the development of the MAT Tool process which sets up a system for reviewing county investments for mitigation opportunities. In addition, several projects on the current LMS list are for protecting key facilities and

resources. The LMS is in partnership with the Climate Change Government Operations Group which is developing comprehensive planning principles to steer future infrastructure and development away from areas at highest risk from the impacts of climate change and hurricanes. A future step in this process will be to analyze the potential impacts of technological and human-caused impacts on lifelines and taking action. See Appendix O for more information.

- DHS Threat and Hazard Identification and Risk Assessment (THIRA) guide – It provides a comprehensive approach for identifying and assessing risks and associated impacts. It expands on existing local, tribal, territorial, and state Hazard Identification and Risk Assessments (HIRAs) and other risk methodologies by broadening the factors considered in the process, incorporating the whole community throughout the entire process, and by accounting for important community-specific factors.
    - Step 1: Assess various threats and hazards facing a community of any size – Chapter 4 provides a comprehensive review of hazards and threats in Broward County
    - Step 2: Vulnerability of the community to these hazards in context with time, season, location, and community factors – Chapter 4 provides historical information indicating where and when these hazards have occurred. It also provides future likelihood and some maps of where the future project losses may occur. Chapter 5 looks specifically at how the major hazards may threaten key commercial core areas and key infrastructure in those area very specifically with maps and loss projections.
    - Step 3: Consequences of the threat and hazards impacting the community – In Chapter 5, under "Summary of Potential Impacts and Potential Areas for Redevelopment" and "Major Government Facilities/Infrastructure Analysis", consequences of some of the hazards impacting the community are described.
    - Step 4: Through the lens of DHS core capabilities, establish capability targets: This step is primarily geared toward preparedness but in this subsection, it is listed how the ELMS meets the four core capabilities related to hazard mitigation.
    - Step 5: Using the results of the THIRA process, set an informed foundation for mitigation planning activities – Chapter 6 lists County Initiatives, Appendix C lists LMS projects, and Chapter 7 provides how mitigation is incorporated into county planning processes which demonstrate how the County responds through actions and initiatives to the risk outlined in Chapters 4 and 5.

Future Mitigation Initiatives

During 2011-2012, the following additional components were included in the ELMS:

- Inclusion of climate change and sea level rise impacts including proposed changes from the Climate Change Government Operations Group (e.g., the Priority Planning areas as part of the Adaptation Action Areas revision to the Comprehensive Plan)
- More robust private sector involvement including ways to help businesses mitigate and recover quicker from hazard events.
- Coordination with the Recovery efforts including all documents in the Broward County Recovery Framework (formerly County-wide Recovery Process or CRP)
- Use of cost-effectiveness screening tools like the Loss Estimation Tool (LET), which was developed during the ELMS process (Appendix L)

- Integration with community planning and capital improvement funding processes
- Development of a secure website for applicants to submit LMS projects. It will include access to the Loss Estimation Tool and will allow for an automated process of prioritizing the projects based on the criteria in the current prioritization matrix (Appendix A).
- Development of public website to contain guidance materials for the community on mitigation projects for their homes.
- Suggested change to Broward County Land Use Plan.
- HSEEP-compliant workshop on April 12, 2012, to discuss how ELMS meets DHS core capabilities related to hazard mitigation.

During the 2017 Risk and Vulnerability Analysis Workshop the following current or planned Mitigation Capital Improvement Projects were identified:

Table 5.1: Mitigation Capital Improvement Projects

Jurisdiction	Project Description
Broward County	• Traffic Engineering Division has a mast arm conversion program underway to change concrete signals to a mast arms system. Approximately10 signals per year being completed and they are two-thirds transitioned at this point. Also upgraded traffic sign post program with sturdier square posts. • Construction Management Division – Testing Uplift System
BCAD – Aviation	• Planned Emergency Operations Center – Improved Physical Location
Town of Davie	• Davie is hiring a consultant and getting a Storm Water Master plan completed so that they can further understand their risk and invest dollars in the most effective place for mitigation. • New Field Operations Center Construction • Employee Cybersecurity Training
City of Deerfield Beach	• Storm Water Management Master Plan • Facility (Structural) renovations and rebuild
City of Fort Lauderdale	• The City of Fort Lauderdale has been leveeing residential areas to deal with flooding. City recognizes it needs to improve storm water handling. They have imposed a fee on the Greater Ft. Lauderdale Convention & Visitors Bureau (CVB) and will be imposing it on all residents as well to help pay for this.
City of Hallandale Beach	• Hallandale Beach is nearing the end of a loss mitigation plan that they instituted with the help of FEMA money. HSGP funding providing a Storm Water Pump System with injection wells. • Replacement Lift Station with improved generator built to account for sea-level rise.
City of Margate Engineering	• DEES (Engineering) – Flood Plan Managers, Planning Development Review • PW – Storm water maintenance and improvements • IT – Cybersecurity Threats
City of Margate Fire Department	• Acquisition of Drones for aerial surveillance
City of North Lauderdale	• Repaving and creating greener area • Programming more CIP funding for updated servers for computers and back-up systems. • Making sure pumping stations are up to date, used and tested.

Oakland Park	• New EOC with state-of-the-art technology for improved communications. • Drainage improvement program that was initiated in 1998 and is ongoing. • New pump station. • Upgrade of traffic signage (heavier gauge, sturdier)
City of Parkland	• Road Stabilization
City of Pembroke Pines	• Storm Water Improvements – Utility Infrastructure Hardening
City of Tamarac	• Undergone drainage improvements, specifically tree planting and repaving. • Pumps in business district – westside of flood plain • Government Cyber-security investment • Upgrades to canal system

Appendix C contains the latest update of Broward County's LMS Mitigation Project List. The list of projects is ever changing as projects completed through self-funding or with grant assistance are dropped and new proposed and planned projects are added. Jurisdictions and other potential project sponsors, particularly those not having projects on the current list, are encouraged to submit projects. The expectation is that all eligible applicants are represented on this list with projects that address identified local hazards, vulnerabilities, and mitigation strategies.

The status for each project is included.

Goals and Objectives and Strategies

The Executive Committee has been given the task of formulating the goals and objectives for the LMS. Mitigation goals and objectives must be consistent with the goals and objectives of the county and the individual municipalities' master plans, their codes and ordinances, as well as other endeavors that reflect the aspirations for the welfare, safety and quality of life of their citizens. The 2016-2017 update also included additional new goals and objectives and the identification of proposed strategies that would serve as guidance in achieving goals and objectives. The strategies, goals and objectives were reviewed again in 2016-2017. Most of the existing goals were affirmed and a few revisions/additions were made to the objectives.

The following are the goals and objectives of the ELMS:

Mission Statement

The mission of the Broward County Local Mitigation Strategy Working Group (LMS) is to promote a comprehensive mitigation program to strengthen Broward County and its communities and to minimize the impact of natural, technological, and societal hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction, and identifying activities that will guide the county towards building a safer community.

I. Proposed Strategies:

A. Encourage requiring damaged housing structures in the City (municipality) and the Broward Municipal Services District (BMSD) to be restored using hazard mitigation measures to reduce hazard vulnerability.
   1. There is a building official's roundtable that meets monthly, and Committee Members will engage and participate if allowable to ensure consistent communication and information.

B. Establish a Disaster Resistant Economic Action for Mitigation (DREAM) Team in the municipalities to assist businesses that will need to mitigate future disasters and increase the likelihood of their continuity. This will become and initiative for the Private Sector Subcommittee.

C. Incorporate disaster mitigation and resiliency type projects identified and funded in the Enhanced Local Mitigation Strategy (ELMS) into the municipalities Capital Improvement Plans (CIPs).

Goal #1 – Protect human health, safety, and welfare.

Objectives

1.1 Limit long-term public investment in areas identified as subject to repetitive damage from disasters.

1.2 Ensure the protection of critical facilities such as prohibitions on constructing critical facilities in high-hazard areas (which includes 100-year and 500-year floodplains prohibited by FEMA in 44 CFR Part 9 if federal funds are involved).

1.3 Reduce or eliminate development in hazard prone areas such as floodplains (e.g., short term focus on 100-year floodplain and long-term 500-year floodplain).

1.4 Implement additional development restrictions in high-hazard areas especially as related to post-disaster redevelopment.

1.5 Consider the use of land acquisition programs for properties subject to development that are in high-hazard areas.

1.6 Coordinate with SFWMD to discuss what measures need to be taken to prepare and retrofit water control structures for sea level rise to maintain salinity barrier and offer flood protection.

Goal #2 – To increase business, residential, and community awareness and implementation of hazard mitigation.

Objectives

2.1 Identify segments of the community most at risk and develop strategies that will ensure effective dissemination of mitigation information.

2.2 Implement a strategy to educate interest in obtaining disaster mitigation and preparedness training.

2.3 Develop a single clearinghouse to disseminate accurate and consistent information relating to disaster mitigation.

2.4 Maintain a profile of available funding sources for mitigation projects and make it available through the Broward County website.

2.5 Create and maintain a listing of successfully mitigated projects to showcase best practices county-wide.

2.6 Actively support the Private Sector Committee and help businesses identify mitigation opportunities for self-funding; particularly in areas identified as vulnerable in the 'hot spots' of Chapter 5.

2.7 Create and maintain a list of highly successful sea level rise adaptation projects to showcase best practices utilized in the South Florida region.

2.8 Hotels, especially those high-rises in coastal mandatory evacuation zones should consider mitigation measures that allow guests and staff to shelter-in-place to protect guests, protect property, and reduce the pressure on shelters.

2.9 With results from Housing Vulnerability Chapter of ELMS (soon to be added), work with municipalities to identify mitigation measures and state/federal funding available to residents in areas of highest vulnerability.

Goal #3 – To ensure adequate training opportunities to support hazard mitigation and enhance outreach efforts that educate the public on existing identified hazards as well as new and emerging threats and hazards.

Objectives

3.1 Develop ongoing education and exercise curricula for public and private officials in the areas of hazard mitigation and emergency management.

3.2 Support local training opportunities in hazard mitigation construction techniques for building officials, engineers, and other public officials.

3.3 Support existing hazard mitigation training efforts.

3.4 Maintain a profile of existing available resources for mitigation training projects.

3.5 Partner with businesses to offer hazard mitigation classes for residents, especially at hardware and home improvement stores (see also Miami-Dade's "*Mitigation for Misers"*).

Goal #4 – To facilitate preventive measures to mitigate hazards.

Objectives

4.1 Encourage local municipalities and eligible nonprofit entities to review site and building plans for hazard mitigation issues and to include storm hardening in the building plans, including retrofit and renovation, of all municipal structures. Link hazard mitigation considerations to each municipality's capital improvement funding process.

4.2 Encourage retrofitting of existing residential and business structures using disaster mitigation construction techniques.

4.3 Encourage the development of hazard mitigation related building codes and inspection procedures.

4.4 Encourage local governments to implement prioritized hazard mitigation projects.

4.5 Maintain a profile of existing available funding sources for structural mitigation projects and make it available through the Broward County website, press releases (as applicable), and any Broward County newsletters available to the general public.

4.6 Encourage County and municipal agencies to identify mitigation needs for key facilities identified for post-disaster use in COOP plans and research ways and means to mitigate vulnerabilities.

Goal #5 – To facilitate planning initiatives that ensure effective hazard mitigation programs and policies.

5.1 In the Adaptation Action Areas, all regulatory agencies should discourage expenditures of public funds for infrastructure improvements that attract new residential development. [see Appendix H and Chapter 7, "County Comprehensive Plan" under "Plan Integration Efforts for more information on Adaptation Action Areas"]

5.2 Develop strategies to reduce risk to healthcare patients and special needs medical populations within vulnerable areas, including land development code revisions to discourage the construction of new year-round residential facilities for treatment of special needs medical populations in Adaptation Action Areas.

5.4 Encourage all municipalities to develop and maintain an all-hazard Comprehensive Emergency Management Plan (CEMP) that is consistent with other county plans and procedures.

5.5 In areas identified by the vulnerability analysis as being a threat due to the presence of hazardous materials, local governments should encourage compatible land uses, and improve public safety.

Goal #6 – Develop and enhance regional mitigation efforts.

Objectives

6.1 Coordinate with other government agencies to develop regional mitigation efforts to include a variety of hazard related events and potential future sea level rise threats.

6.2 Work with SFWMD to upgrade and/or retrofit water control structures for flooding and changing sea level rise conditions.

6.3 County should continue to work in collaboration with municipalities, adjacent counties and continue to focus on efforts to mitigate against sea level rise, especially in the face of a probable decrease in funding from state and federal government.

Goal #7 – Promote mitigation partnerships and innovative methods of financing mitigation.

Objectives

7.1 Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future hazard mitigation efforts.

7.2 Identify Alternative Financing for mitigation measures for locally funded actions beyond code, beyond county insurer requirements.

7.3 Evaluate use of Global Match credit to be tracked for potential use with HMGP projects.

7.4 Utilize County personnel (EMD, OIAPS/Grants Management) to assist municipalities on obtaining grants or other funding for infrastructure repair/improvement projects especially those that improve drainage in areas historically prone to flooding or Repetitive Loss (RL) or Severe Repetitive Loss (SRL) properties.

Goal #8 – Lower flood insurance premiums through Community Rating System (CRS) Activities.

Objectives

8.1 Encourage 100% municipal participation in the CRS.

8.2 Because the LMS Working Group recognizes that flood insurance premiums will continue. to rise, pursue actions whenever possible which will result in CRS credit for the county. and all municipalities within it.

Goal #9 – Encourage resilient infrastructure county-wide.

Objectives

9.1 Utilize the LMS Project List to prioritize projects that encourage sustainable, resilient. infrastructure and include as part of annual project list update process with revision of

language on screening forms.

9.2 Utilize the LMS to promote the incorporation of green infrastructure where, and when possible, mitigate existing critical facilities and promote activities that address. climate change concerns.

9.3 Prioritize incorporation of natural solutions to hazard mitigation and climate adaptation efforts to address and enhance the recovery of coral reefs. Promote coral restoration-related projects, including coral propagation and deployment capacity, in efforts to restore and enhance the integrity of natural infrastructure.

Prioritization of Mitigation Projects

A mechanism for determining and prioritizing mitigation projects for Broward County was sought out as part of the early Local Mitigation Strategy. A consultant drafted the first version of prioritization procedures, but as the LMS Working Group evolved, members began the process and realized a more simplified version would be necessary for implementation. In 2015 as part of the EMAP self-assessment phase and in 2016-2017 as part of the ELMS process and with oversight by the Executive Committee the Matrix was slightly revised to include language changes that incorporated compliance with emergency management standards. The latest Project Prioritization Matrix version can be found in Appendix A and the revised Proposed Mitigation Project Form in Appendix B.

It is the responsibility of each jurisdiction/agency to identify mitigation projects. As projects are identified, the jurisdiction/agency should screen the project using the Loss Estimation Tool and must complete a submission form for the project to be considered (see Appendix B). This tool incorporates FEMA mitigation grant cost-effectiveness principles in a user-friendly format and is an excellent way to screen projects on their likelihood to be cost-effective. Once completed, the project proposal form is then submitted to the LMS Coordinator, who in turn presents them to the Executive Committee to be scored and ranked. In the future, a formal review schedule will be developed. See Appendix L for Loss Estimation Tool information.

A current listing of active projects can be found in Appendix C and will be reviewed by the Executive Committee on an annual basis, or as deemed necessary, to validate its ranking and applicability. In addition to these projects, which should undergo a resubmittal using the revised Appendix A and B forms, the ELMS process created additional overarching mitigation actions that are listed in “Future Mitigation Initiatives” and “County Initiatives” in this chapter. As part of the annual updates, all entities who have submitted projects are required to indicate if a project has remained viable. If not, that project will be removed from the active list and coded “Inactive”. Completed projects will also remain on the list to show progress in implementing the mitigation plan.

Presently, the top 10 priority projects are listed, along with scoring numbers. Soon, it is a priority for the LMS Working Group to completely review and update all projects to reflect current costs and applicant priorities.

In the event of a Presidentially Declared Disaster, Broward County Emergency Management Division will work with federal, state, and local officials to coordinate and manage FEMA Disaster Assistance funding programs. When the State opens the application period for HMGP and/or

PDM funds, the most current prioritized projects, which meet the HMGP and/or PDM requirements, will be gathered and reviewed by the Executive Committee. Consideration for projects for other FEMA funding sources, e.g., FMA, Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL), will occur as needed based on funding availability and meeting these programs' more restrictive eligibility criteria.

A tiered approach will be used to best utilize the available HMGP funding throughout Broward County. Projects will be categorized as Single Jurisdiction, Multi-jurisdictional, and County-wide. The applicable percentage applied for each category will be established by the Executive Committee for each disaster.

County Initiatives

These are larger overarching actions that require the leaderships of the County EMD and the LMS Executive Committee to consider for implementation. These are recommended actions resulting from the various components of the ELMS process. Overall, they will respond to the updated risk information from Chapter 4 and Chapter 5.

- Use the National Weather Service (NWS) Storm Data Report as recommended by the Florida Division of Emergency Management/Florida Planning and Development Lab's "Recommended Integration Practices: Strengthening the Floodplain Management Plan and Portions of the Local Mitigation Strategy"[15]. The County EMD should facilitate the adoption of this process with the municipalities. It provides a uniform, credible source of data collection that is stored in a centralized area on a more permanent basis that can endure changes in staff level at local level. It is accessible to anyone with an internet connection and has the following procedures:
    - Storm Data Report allow multiple avenues for the submission of storm data which includes phone reports, internet reports, collection from local media sources, and calls to local emergency dispatchers during or after a severe weather occurrence. This data will then be compiled and stored in the online NWS Storm Data Database to include critical detailed Information like a listing of structures impacted and flood depths with each report.
- Coordinate with the SFWMD and Surface Water Coordinating Council on larger-scale drainage projects.
- Consider the formal designation of cooling centers.
- Conduct a pilot project to evaluate the feasibility of developing a network of weather sensors across the county that support real time analysis and alert of local conditions.
- Support the following recommendations from the 2020 Broward County Climate Change Action Plan that pertain to hazard mitigation:
    - Contribute to local, regional, and state climate planning efforts.
    - Continue support for the Southeast Florida Regional Climate Change Compact (Compact)
    - Lead advocacy for climate change policies and legislation
    - Engage technical support of state and federal agencies.
    - Adopt adaptation standards that consider climate change and sea-level rise.

[15] Reference to the August 2011 draft version of this FDEM/FSU document

- Support adaptation of at-risk infrastructure and facilities
- Address mitigation and adaptation policies in the Land Use Plan
- Incorporate resilience criteria into the Broward County surtax project review process.
- Utilize resiliency checklists.
- Pursue amendments local and state codes to advance resilient design.
- Educate residents on climate risk.
- Educate and prepare for public health impacts.
- Encourage dialogue among elected officials, staff, and socially vulnerable populations.
- Address social vulnerabilities through local government programs.
- Engage and educate private sector stakeholders and community members about resilience strategies for the built, natural, and social environment.
- Support community hubs that enable economic mobility, health, mental health, and safety for all community members
- Ensure beneficial social equity and health outcomes by considering the impacts of land use policy, public infrastructure, public service, and post-disaster recovery decisions on vulnerable populations.
- Update and advance assessments of the vulnerability of transportation infrastructure
- Integrate dynamic adaptive approaches into processes leading to transportation and other investments.
- Coordinate to achieve resilience across transportation planning and investments.
- Pursue shared drainage and water management infrastructure.
- Use local and regional data and tools to inform resilience planning.
- Maintain, update, and share high-resolution elevation data.
- Expand the use of technology and data analytics.
- Pilot technologies and services
- Partner on data and performance measurement
- Sea level rise adaptation planning
- Improve inundation mapping capabilities.
- Encourage FEMA to consider sea-level rise in flood map updates.
- Adopt new 100-year storm maps.
- Update design storm criteria
- Incorporate combined sea-level rise/storm surge impacts in hazard mitigation and adaptation planning.
- Re-evaluate CCCL and CHHA for climate change impacts.
- Support research on the vulnerability of the built environment
- Collect LiDAR data.
- Analyze sea-level rise, rainfall, drainage and hurricane impacts.
- Analyze flood control level of service and compounded flooding.
- Develop dynamically adaptive management strategies.
- Apply models to develop resilient design standards.
- Enhance the resiliency of County-owned infrastructure and properties.
- Improve the resilience of buildings and structures.
- Maintain beaches.
- Retrofit flood control structures for sea-level rise.
- Coordinate local water management improvements.
- Advance sanitary sewer connections

  - Phase-out septic systems where necessary to protect public health and water quality.
  - Engage the private sector in resilience initiatives.
  - Convene a countywide forum for coordinated resilience planning.
  - Develop and implement a countywide resilience plan.
  - Emphasize adaptive pathways.
  - Develop a resilience dashboard.
  - Engage the private sector to develop strategies for adapting energy infrastructure.
  - Support ongoing coral reef restoration and resilience activities.
  - Prioritize areas for living shorelines.
  - Resilience planning for parks and open spaces
  - Promote green stormwater infrastructure.
  - Engage the community in flood mitigation programs.

- Support efforts to restore funding to SFWMD needed for long-term drainage assistance.
- Build on public involvement efforts in developing a website or webpage to provide the public guidance materials on mitigation projects for their homes. This effort and any follow-up technical assistance/outreach activities will help mitigate the vulnerability of residential housing in Broward County depicted in Appendix J.
- Encourage the participation and coordination of nature-based solution projects through design, implementation, monitoring, and maintenance, supporting shoreline protection through reef restoration.
- Coordinate with federal and state agencies, regional and local governments, and stakeholders to advance partnerships and identify priority projects that address coral reef restoration through nature-based solutions for the purposes of hazard mitigation.

Funding Sources

The following is a list of the primary funding sources for mitigation projects with key information:

Federal

- **FEMA HMGP** – Key purpose is to provide an opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters during the post-disaster reconstruction process. The State of Florida has additional parameters on how HMGP funds are made available in the state post-disaster. (See **Table 6.1** for a list of eligible project types for HMGP and the other 4 FEMA mitigation grant programs).

- **FEMA PDM** – Key purpose is to provide a sustained pre-disaster natural hazard mitigation program to reduce the risk to population and structures from future hazard events. The program is funded out of non-disaster programs with the intent to reduce reliance on Federal funding from future disasters. The PDM annual budget is subject to periodic fluctuations based on Congressional priorities.

- **FEMA FMA**– Key purpose is to reduce or eliminate claims under the NFIP by making available funds for flood mitigation projects for structures covered by flood insurance policies.

- **FEMA RFC** – Key purpose is to make grant funds available to reduce flood damages to individual properties for which one or more flood insurance claim payments for losses have been made and that will result in the greatest savings to the National Flood Insurance Fund (NFIF) in the shortest period.

- **FEMA SRL** – Key purpose is to make grant funds available to reduce flood damages to residential properties that have experienced severe repetitive losses under flood insurance coverage and will result in the greatest savings to the NFIF in the shortest period.

- **FEMA Public Assistance (PA) 406 Mitigation Grant Program** (this potential funding source is also detailed in the Broward County Recovery Framework (former CRP) – Is available for counties included in a FEMA presidential disaster declaration if they are otherwise eligible for the PA program, a valid and eligible PA project is included in the Project Worksheet in a timely manner, and the FEMA PA group administering the disaster is in agreement. Project types range from floodproofing, to wind protection to road elevation to drainage upgrades/improvements.

- **Department of Housing and Urban Development (HUD) Community Development Block Grant program (CDBG) Disaster Recovery Program** – This program is made available on a case-by-case basis by the U.S. Congress and is usually authorized after larger disaster events that already received a presidential disaster declaration. Project types are generally for residential properties (acquisition, elevation) but can also be available for small businesses including rental properties (elevation). Code enforcement support is also potentially eligible.

- **US Army Corps of Engineers Mitigation -** The USACE's Flood Control (Structural & Non-Structural), Section 205 of the 1948 Flood Control Act, as amended, authorizes the U.S. Army Corps of Engineers to develop and construct small flood control projects. Each project is limited to a Federal cost of $7,000,000.00 and must be economically justified, environmentally sound, and technically feasible. The USACE's Emergency Streambank and Shore Protection program, Section 14 of the 1946 Flood Control Act, as amended, authorizes the USACE to develop and construct streambank and shoreline protection projects. The goal of the program is to protect endangered highways, bridge approaches, public works facilities, churches, public and private nonprofit public facilities. Each project is limited to a Federal cost of $1,500,000.00 and must be economically justified, environmentally sound, and technically feasible. Section 103 of the 1962 River and Harbor Act authorizes the USACE to develop small projects for the purpose of shore protection and beach restoration. Each project is limited to a Federal cost of $3,000,000, and must be economically justified, environmentally sound, and engineering feasible. Eligible applicants include local municipalities and public agencies.

- **Department of Homeland Security (DHS), State Homeland Security Program (SHSP) –** Eligible activities include planning, training, exercise, and organization including mitigation and recovery activities from acts of terrorism and catastrophic events.

- **Coastal Management Program Grants –** Includes the Coastal Resource Improvement Program which funds on small-scale construction or land acquisition projects that enhance

public access to the coast, facilitate redevelopment of urban waterfronts, or preserve and restore coastal resources,

- **Department of Education Emergency Management for Higher Education (EMHE)** - A grant program for institutions of higher education to evaluate their risk and prepare for risks from natural and manmade hazards. In 2008-2009, Broward College received an EMHE grant. Eligible project activities include plans, vulnerability assessments, support building, organization, and training.

- **EPA grants for stormwater including Green Infrastructure, Clean Water grants, and Impaired Streams** (usually must include water quality element) – see http://water.epa.gov/grants_funding)

Table 5.2: Eligible Project Activities of the 5 FEMA Mitigation Grant Programs

ELIGIBLE ACTIVITIES	HMGP	PDM	FMA	RFC	SRL
1. Mitigation Projects	☒	☒	☒	☒	☒
Property Acquisition and Structure Demolition	☒	☒	☒	☒	☒
Property Acquisition and Structure Relocation	☒	☒	☒	☒	☒
Structure Elevation	☒	☒	☒	☒	☒
Mitigation Reconstruction					☒
Dry Floodproofing of Historic Residential Structures	☒	☒	☒	☒	☒
Dry Floodproofing of Non-residential Structures	☒	☒	☒	☒	
Minor Localized Flood Reduction Projects	☒	☒	☒	☒	☒
Structural Retrofitting of Existing Buildings	☒	☒			
Non-structural Retrofitting of Existing Building/Facilities	☒	☒			
Safe Room Construction	☒	☒			
Infrastructure Retrofit	☒	☒			
Soil Stabilization	☒	☒			
Wildfire Mitigation	☒	☒			
Post-Disaster Code Enforcement	☒				
5% Initiative Projects	☒				
2. Hazard Mitigation Planning	☒	☒	☒		
3. Management Costs	☒	☒	☒	☒	☒

Source: FEMA Hazard Mitigation Assistance Unified Guidance

State

- Resilient Florida Grant Program
- EMPA Competitive Grant Program
- Emergency Management Performance Grant
- County Base Grant Program
- The Florida Coastal Management Program
- Florida Coastal Partnership Initiative –http://www.dep.state.fl.us/cmp/grants/index.htm
- Hurricane Loss Program (formerly Residential Construction Mitigation Program)

Any required local match will be the responsibility of the applicant. For FEMA approved projects using HMGP funds, there can be instances where project costs increase and the federal share become less than the applicable cost share, typically 75%. If this occurs and additional funding becomes available, the LMS may choose to increase the federal cost share to the maximum allowable amount. Any locally funded hazard mitigation projects should be brought to the attention of the LMS Executive Committee for potential Global Match credit.

Pending Wind Mitigation Actions

The Broward County Division of Construction Management obtained FEMA hazard mitigation grants for four County hazard mitigation projects. The funding was used to fortify the Main Library, the Ron Cochran Building at the Public Safety Complex, the East Wing of the Broward County Judicial Center, and Fleet Service Center Number Three in Pompano Beach. This work will primarily involve the replacement of windows at each location with new impact-resistant glass and frames.[16]

Completed Flood Mitigation Actions and National Flood Insurance Program (NFIP) by Jurisdiction

As required by 44 CFR §201.6(3)(ii), each jurisdiction must address its "participation in the NFIP, and continued compliance with NFIP requirements as appropriate". The National Flood Insurance Program Community Book http://www.fema.gov/fema/csb.shtm verifies all Broward County communities are listed as participating in the National Flood Program. The following activities are broken down by community:

Broward County, Unincorporated Broward Municipal Services District – (CRS Community)

Unincorporated Broward County has been a CRS community since October 1, 1992, and is currently a Class 6. The County has designated the Environmental Permitting Division's Assistant Director as the CRS Coordinator and Floodplain Manager. CRS activities undertaken in the past 6 years include:

- Maintain Elevation Certificates for New/Substantially Improved Buildings
- Provide Flood Zone Information
- Inform Lenders, Insurance Agents, and Real Estate Offices of Our Services
- Keep Old and Current FIRMs
- Produce/Distribute Flood News Newsletter
- Maintain Flood Protection Materials at Library
- Provide Flood Protection Assistance
- Preserve Open Space in Floodplain
- Enforce Floodplain Management Regulations

[16] From Broward County eCounty website, accessed on 4/27/12, which delivers news at http://www.broward.org/ecountyline/Pages/vol_33_no_3/news.htm

- Use/Update Flood Data GIS Information
- Produce/Distribute Property Protection Information to Repetitive Loss Areas
- Prepare Floodplain Management Plan (LMS) Annual Progress Report
- Inspect/Repair/Maintain Drainage Systems
- Implement Drainage System Portions of CIP
- Provide Information on Stream Dumping Regulations
- Implement Flood Warning Program

Broward County's current Floodplain Management Ordinance reflects the latest FIRM maps. As of December 2022, the County had 3,239 NFIP policies in force (in 2016, this count was 14,988).

Coconut Creek, City of– (CRS Community)

CRS activities undertaken in the past 5 years include:

1. Constant monitoring of the drainage systems and drainage basins.
2. On-going Capital improvement projects to improve water quantity and quality of the drainage system, which consist of waterways dredging and maintenance. The design and permitting are performed in-house.
3. On-going preventive maintenance programs consisting of swale re-grading, and stormwater systems cleaning and repairs. Maintenance program performed mainly in-house.
4. Training by Floodplain Manager of Engineering Department staff, who reviews building permits. Training includes NFIP regulations and Elevation Certificates.
5. Maintenance of a clear map depicting various Flood Zone designations.
6. Brochures related to flooding and NFIP requirements were sent to every household in the City.
7. Answering various residents with questions about Flood Zones, Flood Hazards, and how to mitigate flooding. Courtesy site visits are also available.
8. GIS mapping of all utilities including drainage in the City as well as Flood Zones. The maps can also be accessed by the public since it is web-based.
9. Maintenance and scanning of all elevation certificates database.
10. Maintenance of all Letter of Map Revision (LOMR) database.
11. CRS 510 Floodplain Management update for year 2010 (see attachment).

The City of Coconut Creek's current Floodplain Management Ordinance reflects the latest FIRM maps.

Cooper City, City of– (CRS Community)

The City of City of Cooper City has been a CRS Community since 1992. CRS activities undertaken in the past 5 years include:

- Conduct and document drainage system maintenance throughout the community.
- Conduct drainage system maintenance by inspecting/repair/maintain drainage system.
- Continue to preserve and maintain our open space and parks system.
- Enforce Floodplain Development Permits
- Enforce Floodplain Management Regulations

- Enforce stormwater management ordinances.
- Enforce our stream dumping regulations.
- Inform lenders, insurance agents, and real estate offices of our services.
- Inform residents of the Broward County "Home Damage Assessment Program" which will benefit the City by providing critical information where major damage has occurred.
- Maintain and keep old and current FIRMs.
- Maintain Elevation Certificates for all new/substantially improved buildings.
- Maintain flood protection materials at the local library.
- On-going training for staff relative to floodplain management
- Prepare/distribute Floodplain Management Plan (LMS) Annual Progress Report
- Preserve open space in floodplain.
- Produce and maintain a log and history of drainage system maintenance provided to residents.
- Produce/distribute outreach projects to all residents/businesses within the floodplain and all of Cooper City
- Produce/distribute property protection information to Repetitive Loss Areas
- Produce/distribute property protection information to Repetitive Loss Properties
- Provide copies of Elevation Certificates to residents and/or businesses
- Provide flood protection assistance.
- Provide information on “no dumping” signage throughout the City.
- Provide letters of Flood Insurance Rate Map Determination
- Provide property protection assistance to homeowners and/or businesses.
- Update and maintain the Flood Information on the City's website.

The City of Cooper City’s current Floodplain Management Ordinance reflects the latest FIRM maps.

Coral Springs, City of– (CRS Community)

The City of Coral Springs has been a CRS community since 1992. Coral Springs is currently a Class 8 Community. The Development Services Department serves as the CRS Coordinator and Floodplain Manager. CRS activities undertaken in the past 5 years include:

- Elevation Certificates are required by the Building Department to be completed for all projects in areas considered in the special flood hazard areas.
- The City’s Engineering Department provides basic flood zone information as well as personal assistance and site visits to all inquirers.
- Maps showing the City’s flood zones are provided at the library and can also be accessed at http://www.coralsprings.org/floodinformation/floodmap.pdf
- Coral Springs provides information to every city resident through its “Under the Sun” magazine. Information in the magazine includes knowing about hazards, protecting people, protecting property, preparations and warning systems, and education.
- about wetlands

- Coral Springs also hosts “Slice of the Springs” meetings which provide more specific education and information to local areas of the City.
- The City’s Engineering Department also provides information available to residents who call or visit the office with questions regarding flood information.

The City also provides flood information online at: http://www.coralsprings.org/living/flood-zone-information. The City of Coral Springs' current Floodplain Management Ordinance reflects the latest FIRM maps.

Dania Beach, City of– (CRS Community)

The City of Dania Beach has been a CRS Community since December 1992. Dania beach is currently a Class 9 Community. The city has designated Eleanor Norena, City’s Community Development Operations Manager as CRS Coordinator and Floodplain Manager. CRS activities undertaken in the past 5years include:

- Maintenance of Elevation Certificates on all new and substantially improved building in our Special Flood Hazard Area.
- Availability of elevation certificates for newer properties as requested.
- The Building Division provides flood insurance rate map information to inquiries and keeps electronic record of the information provided.
- Flood insurance rate maps are updated as necessary.
- The Broward County Main Library maintains flood protection materials.
- Floodplain management provisions outlined in the City’s zoning and building codes are enforced.
- The Florida Building Code is enforced by the City of Dania Beach.

The City of Dania Beach’s current Floodplain Management Ordinance reflects the latest FIRM maps. As of May 31, 2017, Dania Beach has 3,161 flood policies (in 2011 this count was 2,084).

The last Community Assistance Contact (CAC) was October 20, 2010, by the State at which time FEMA found no violations or other programs deficiencies.

Davie, Town of– (CRS Community)

The Town of Davie has been a CRS Community since 1992. CRS activities undertaken in the past 5 years include:

- Elevation Certificates
- Map Information Service
- Outreach Projects
- Flood Protection Information
- Open Space Preservation
- Higher Regulatory Standards
- Flood Data Maintenance
- Stormwater Management
- Floodplain Management Planning
- Drainage System Maintenance
- Dam Safety

The Town of Davie enacted its initial floodplain management ordinance on June 16, 1976, through Ordinance 1976-23, and still reflects the latest FIRM maps. There have been 4 revisions, in 1977, 1988, 1995, and 2005. Based on this ordinance, the Town's Building and Engineering Departments enforce the floodplain management ordinance. As of January 2011, the Town had 17,752 NFIP flood policies in force (in 2009, this count was 19,294).

The State of Florida conducted its Community Assistance Contact (CAC) in February 2006. The Community Assistance Visit (CAV) identified that additional definitions were necessary in the Town's floodplain management ordinance. The Town Council revised the ordinance to reflect these new definitions in March 2005

Deerfield Beach, City of– (CRS Community)

The City of Deerfield Beach has been a CRS Community since 1992. CRS activities undertaken in the past 5 years include:

- Elevation Certificates
- Map Information Service
- Outreach Projects
- Flood Protection Information
- Open Space Preservation
- Higher Regulatory Standards
- Flood Data Maintenance
- Stormwater Management
- Drainage Systems Maintenance
- Flood Warning Program

The City of Deerfield Beach's current Floodplain Management Ordinance reflects the latest FIRM maps.

Fort Lauderdale, City of– (CRS Community)

The City of Fort Lauderdale has been a CRS Community since 1992 and is currently a Class 6. The city has a standalone Floodplain Manager, who is also designated as the CRS Coordinator. The Floodplain Manager has a staff of three Floodplain Development Review Specialists. CRS activities undertaken in the last 5 years include:

- Provide On-going Training for Staff and External Stakeholders Relative to Floodplain Management
- Maintain Elevation Certificates for New/Substantially Improved Buildings
- Provide Flood Zone Information · Inform Lenders, Insurance Agents, and Real Estate Offices of Our Services
- Keep Old and Current FIRMs
- Maintenance of all Elevation Certificates in an Electronic Database
- Develop and Distribute Floodplain Management Related Outreach
- Maintain Flood Protection Materials at Local Libraries
- Provide Flood Protection Assistance
- Preserve Open Space in Floodplain
- Enforce Floodplain Management Regulations
- Use/Update Flood Data GIS Information

- Produce/Distribute Property Protection Information to Repetitive Loss Areas
- Prepare Floodplain Management Plan (LMS) Annual Progress Report
- Inspect/Repair/Maintain Drainage Systems
- Conduct Drainage System Portions of CIP
- Provide Information on Stream Dumping Regulations

The City of Fort Lauderdale's current Floodplain Management Ordinance reflects the latest FIRM maps. As of June 26, 2017, the City had 39,239 flood policies. The Florida Division of Emergency Management, State Floodplain Management Office conducted a Community Assistance Visit in 2013 and found no violations or other program deficiencies. The last ISO CRS Cycle Visit was in 2016 and reviewed the City's documentation regarding current and past CRS activities. The last Community Assistance Visit was conducted by FEMA in the summer of 2017.

Hallandale Beach, City of– (CRS Community)

The City of Hallandale Beach has been a CRS Community since 1994. Hallandale Beach is currently a Class 6. The city has designated the Building Official as the CRS Coordinator and the Floodplain Manager. CRS activities undertaken in the past 5 years include:

- Maintain Elevation Certificates on all new and substantially improved buildings in our Special Flood Hazard Area
- Provide Flood Insurance Rate Map information; inform lenders, insurance agents, real estate offices of the above activity.
- Provide an annual outreach project to the community.
- Maintain flood protection materials in our public library.
- Provide flood protection assistance to inquirers and maintain records of the service.
- Preserve open space in the floodplain.
- Enforce storm water management provisions through our Zoning, Engineering, Building, and local Code of Ordinances
- Mandate a drainage system maintenance program.
- Develop a Program for Public Information (PPI)

The City of Hallandale Beach's current Floodplain Management Ordinance reflects the latest FIRM maps.

Hillsboro Beach, Town of– (CRS Community)

The Town of Hillsboro Beach has been a NFIP participating community since 1978 and a CRS Community since October 1994.

On September 10, 2008, the Town had a 5-year Cycle Visit, and no violations or deficiencies were noted. The Town expanded the Public Outreach and Map Information Services for this visit. GIS Based Flood Plain Maps were prepared relative to FEMA Flood Zones, Parcel Lines, Future Land Use and Zoning Districts. The Town's Website and Flood Prevention Brochure were updated and provided to all Town residents.

Hollywood, City of– (CRS Community)

The City of Hollywood, Florida has been a NFIP participating community since 1972 and a CRS Community since October 10, 1992. CRS activities undertaken in the past 5 years include:

- Elevation Certificates
- Map Information
- Outreach Projects
- Flood protection Information
- Flood Data
- Open Space preservation
- Higher regulatory Standards
- Flood Data Maintenance
- Storm Water Maintenance
- Stormwater management
- Floodplain Management
- Drain System Maintenance
- Dam Safety

The current Floodplain Management Code of Ordinance for the City of Hollywood titled Chapter 154: Flood Damage Prevention reflects the latest FIRM maps including: Map Numbers 12011C0304, 307,308,309,312,316,317,319 with Map Index 12011C000 Revised 10/2/97. The City's code specifically regulates new construction and substantial improvement to existing structures.

Lauderdale-By-The-Sea, Town of– (CRS Community)

The Town of Lauderdale- By-The-Sea has been a CRS Community since 2000. CRS activities undertaken in the past 5 years include:

- Outreach Programs
- Enforcement
- New Drainage and Maintenance
- Community Activities include:
    - Open Space preservation
    - Map Information
    - Maintaining Elevation Certificates on all new and substantially improved buildings in our Special Flood Hazard Area (SFHA)
    - Continue to make copies of elevation certificates on newer properties available on the community's present office location.
    - Provide Flood Insurance Rate Map information, advise information on the flood insurance purchase requirement to inquirers, and keep records of the service.
    - Continue to keep our FIRM updated and maintain old copies of the FIRM.
    - The public library continues to maintain flood protection materials.
    - Continue to provide flood protection assistance to inquirers.
    - Continue to enforce our current building code.
    - Continue to enforce the floodplain management provisions of our zoning, subdivision, and building' code ordinances.
    - Continue to enforce the stormwater management provisions of our zoning, subdivision, and building code ordinances for new developments in the watershed.
    - Continue to implement our drainage system maintenance program including record keeping of maintenance activities.
    - Continue to implement the sections of our Capital Improvements Program

which pertain to drainage system maintenance.
- Continue to enforce our stream dumping regulations.

The Town of Lauderdale-By-The-Sea's current Floodplain Management Ordinance reflects the latest FIRM maps.

Lauderdale Lakes, City of

The City of Lauderdale Lakes has been a participating NFIP community since 1979 and in good standing. In 2006, the City passed a Floodplain Management Ordinance that continues to reflect the current FIRM maps. The designated Floodplain Manager is the Operations Manager of the Public Works & Engineering Services Department. Permitting in Special Flood Hazard Areas (SFHAs) is issued through a consultant contracted by the Engineering Services Division.

Lauderhill, City of– (CRS Community)

The City of Lauderhill has been a CRS Community since October 2, 1992. The City of Lauderhill is currently a Class 7. The City has designated the City Engineer as Floodplain Manager and Mrs. Joan Fletcher as the CRS Coordinator. CRS activities undertaken in the past 5 years include:

- Maintaining two pump stations (A and B) which control 2/3 of the entire canal channel which reduces flooding and give the City of Lauderhill control of the canal elevation.
- Yearly cleaning of the catch basins throughout the communities to ensure entire drainage system is free of blockage.
- The installation of new drainage and the lowering of the swale area.
- Repaving the roads redirecting the rainwater toward the drainage or catch basins.
- Culvert rehabilitations (Canal 30 and NW 82 Avenue, NW 50 Avenue, and NW 19th Street)
- Canal/Lake embankment stabilizations
- Water Treatment Plant Drainage Reconfiguration
- A Northwest Quadrant Drainage Project to assist in the drainage improvements after storm events.

The City of Lauderhill current Floodplain Management Ordinance reflects the latest FIRM maps. As of January 2017, the City has 3,020 flood policies. Most of the City was removed from the Special Flood Hazard Area in the 2014 FEMA Flood Map update. The last CAC was conducted in January 11, 2012, at which time the State found no violations or other program deficiencies. The next CAC is scheduled for May 1, 2018.

Lazy Lake, Village of

The Village of Lazy Lake has been a participating NFIP community since 1992 and in good standing. Lazy Lake has an approved Flood Damage Prevention Ordinance that continues to reflect the current FIRM maps. The designated Floodplain Manager is the Mayor and manages development as required by a participating member of the NFIP.

Lighthouse Point, City of – (CRS Community)

The City of Lighthouse Point has been a CRS Community since 1993. CRS activities undertaken in the last 5 years include:

- Providing outreach to its property owners by way of the City website and newsletter regarding flood zone information. The information in the City newsletter is mailed to every property owner on an annual basis, and a brochure is mailed annually to all properties in

the community's Special Flood Hazard Area (SFHA). The information is also on display at the City's public buildings. The City Library has available a multitude of periodicals, such as books, pamphlets, brochures, and fact sheets regarding disaster preparedness and recovery, flood insurance program, and its supporting documentation. During hurricane season, the Library places on display hurricane/wind/flood disaster preparedness in a showcase which includes sources of information, damage, and disaster control.

- The City's Building Department maintains both on-site and off-site elevation certificates for new and substantially improved buildings and recordkeeping of floodplain inquiries. Upon request, elevation documentation, and the Flood Insurance Rate Map (FIRM) is provided to the public. Additionally, technical advice and assistance is provided to interested property owners. The available documentation and technical assistance is annually publicized and always displayed on the community's website.

- Overall, the City maintains its designated open space preservation sites. The City's Stormwater Management Plan enforces the stormwater management regulations, including freeboard in non-SFHA zones, soil and erosion control, and water quality. The City enforces a regulation prohibiting dumping in the drainage system. The drainage system inspection and maintenance is conducted on an on-going basis. A Capital Improvement Program is ongoing for the drainage system management.

The City of Lighthouse Point current Floodplain Management Ordinance reflects the latest FIRM maps.

Margate, City of– (CRS Community)

The City of Margate has been a CRS Community since the year 2000. Margate became a Class 7 Community in 2011. The City has designated Reddy Chitepu, Director, as both the Floodplain Manager and CRS Coordinator. CRS activities undertaken in the past 5 years include the following activities:

- Maintain Elevation Certificates on all new and substantially improved buildings in Special Flood Hazard Areas (SFHA).
- Maintain database for permits issued for new or substantially improved buildings in the SFHA.
- Provide Flood Insurance Rate Map (FIRM) information and information on the flood insurance purchase requirements to inquirers.
- Complete annual outreach project to the community.
- Keep our FIRM updated and maintain old copies of our FIRM.
- Maintain flood protection materials on the city website and the public library.
- Update flood information on the city website annually.
- Provide flood assistance/information to anyone requesting such assistance/information.
- Preserve or increase open space in the floodplain.
- Enforce the floodplain management provisions of our zoning, subdivision, and building code ordinances.
- Use and update our flood data maintenance system.
- Enforce the stormwater management provisions of our zoning, subdivision, and building code ordinances for new developments in the watershed.
- Track building improvements and repairs

- Enforce the requirement that all new buildings must be elevated above the street or base flood elevation.
- Inspect and maintain all city drainage facilities.
- Enforce the current building code.
- Use and update our flood data.
- Provide flood management data to our repetitive loss properties as well as our defined repetitive loss areas.
- Implement our drainage system maintenance program.
- Enforce our stream dumping regulations.
- Maintain our system of Benchmarks.
- Maintain our Flood System Threat Recognition

The City of Margate's current Floodplain Management Ordinance reflects the latest FIRM maps. As of January 2011, the City had 10,884 flood insurance policies.

Miramar, City of– (CRS Community)

The City of Miramar, Florida has been a CRS Community since 1994. Miramar is currently a Class 8. The City has designated the Assistant Public Works Director as the CRS Coordinator and Senior Zoning Specialist as Floodplain Manager. CRS activities undertaken in the past 5 years include:

- Elevation Certificates
- Map Information Service
- Outreach Projects
- Flood protection Information
- Flood protection Assistance
- Update flood information on the City's website
- Open Space preservation
- Higher Regulatory Standards
- Flood data maintenance
- Stormwater management
- Floodplain management Planning
- Drainage System maintenance
- Flood Warning program
- Dam Safety
- Canal embankment stabilizations

The City of Miramar's current Floodplain Management Ordinance reflects the latest FIRM maps. As of April 2017, the City had 7,193 flood policies. The last Community Assistance Visit was conducted on 2013 at which time no violations or other program deficiencies were found.

In 2011, the City of Miramar purchased a replacement street sweeper as part of its continuing efforts to reduce the amount of debris on the roads and contaminants entering the City's stormwater system, canal, and waterways. These actions are in accordance with the City's Best Management Practices and NPDES requirements for flood protection.
n and pollution control.

Flood Damage Reduction Projects Follow-up

Historic Miramar Redevelopment is a major City priority in preserving and upgrading the historical eastern areas of the City. During the Historic Miramar Infrastructure Improvements Phase 1 project, the City invested $10 million to enhance and improve the underground utilities infrastructure. These improvements were completed in 2007. In 2010, Phase 2 was started and completed in December 2013 for $700,000. Phase 3 was bid in September 2016 and awarded in May 2017 for $8.4 million with an expected completion date of late 2018. A goal of this project is to provide water and sewerage, and enhanced flood protection.

Canal/Lake Embankment Stabilization Project
The City of Miramar owns the canals and lakes east of University Drive in Historic Miramar. Many of these canal and lake banks are experiencing erosion and failing seawalls. In 2012, the City embarked on a canal/lake embankment stabilization program for the repair/reconstruction of eroded canal/lake banks. The City retained a consultant to perform an Engineering Feasibility and Needs Assessment Study of the canal/lake embankments. In February 2016, Phase 1 was started and completed in March 2017 for $260,000. The City has allocated $1.7 million to future phases of the project over the next five (5) years. Stabilization of the canal/lake embankments will prevent further loss of land on the affected properties; and help improve the water quality in the canals and lakes. In addition, the associated dredging of the canals/lakes bottoms will increase the storage capacity of water in the canals/lakes.

North Lauderdale, City of– (CRS Community)

The City of North Lauderdale has been a NFIP participating community since 1979 and a CRS Community since October 1993. CRS activities undertaken in the past 5 years include:

- Secure and store elevation certificates
- Firm Map Information to the public, lending institutions, and insurance agents
- Outreach Projects such as quarterly newsletters and special events
- Flood Protection Information through the Broward County Library System in the city
- Flood Protection Assistance by providing certified construction and stormwater inspectors to address public concerns.
- Open Space Preservation throughout the 153.7 AC of parks in the SFHA to control flooding potential.
- Stormwater Management and participation with Broward County in compliance with our NPDES permit
- Drainage System Maintenance is conducted by the North Lauderdale Water Control District personnel.

The City of North Lauderdale current Floodplain Management Ordinance reflects the latest FIRM maps.

Oakland Park, City of– (CRS Community)

The City Of Oakland Park (ID #120050) has fully participated in the NFIP Community Rating System (CRS) since June 9, 1994. The City's CRS activities undertaken in the past 5 years include:

- The maintenance of a Stormwater Management Ordinance as part of the City's Land Development Code, enforcing floodplain management requirements related to drainage which includes regulating all and substantially improved construction in special Flood Hazard Areas (SFHAs).

- The City's Engineering & Community Development Department along with the Public Works Department are committed to enforcement of regulations, procedures, and design criteria as it relates to the City's Stormwater/Floodplain Management Plan. New development/redevelopment is regulated by the City's Land Development Code, Chapter 24. Sections pertaining to Stormwater Management include Article IX, Environmental Regulations and Article X, Floodplain Management. The City's Building Official enforces all development/redevelopment in accordance with the latest edition of the Florida Building Code.

- The City's Public Works Director and the City Engineer jointly enforce all regulations as adopted in Chapter 12 of the City Code, Article II, Stormwater Management. The City's Building & Permitting Division of Engineering & Community Development Department maintains all elevation certificates for new and substantially improved buildings. Copies of those elevation certificates are made available to the public upon request. Oakland Park has also adopted the Broward County Local Mitigation Strategy (LMS).

In addition, the City participates in the following NFIP/CRS activities:

- Map Information Service
- Open Space Preservation
- Flood Data Maintenance
- Community Assistance
- Higher Regulator Standards
- Community Outreach
- Drainage System Maintenance Program
- Stormwater Management
- Repetitive Loss Properties

The City of Oakland Park's current Floodplain Management Ordinance reflects the latest FIRM maps. Oakland Park provides an annual Floodplain Management Plan update to the CRS as a requirement of our annual recertification. In addition, the City maintains a database in relation to the FEMA flood insurance rate map amendments and uses GIS floodplain identification and mapping techniques for data collection, research, and public information purposes.

Parkland, City of

The City of Parkland has been a participating NFIP community in good standing since 1979. In 1988, the City passed a Floodplain Management Ordinance that continues to reflect the current FIRM maps. The designated Floodplain Manager is the Building Official. Permits in Special Flood Hazard Areas (SFHAs) are issued by the Building Division, excluding development permits such as for infrastructure and roadways, which are permitted by the Engineering Department. The City of Parkland has not approved any variances to the Floodplain Management Ordinance.

Other Information

Most property in the City is zoned residential. All commercial and most residential construction in the City is post-FIRM.

Approximately half of all properties within the City are designated Zone 'X' since December 1992, with a very small area of Zone 'X' (shaded). At the time of the City's adoption of the Floodplain Management Ordinance, this area represented the approximate physical boundaries of the City.

The other, western 'half', which was farmland subsequently annexed into the City, is for the most part designated Special Flood Hazard Area 'AH'. The base flood elevations were determined to be 12, 13, and 14 at the time of the printing of the rate maps, August 18, 1992. The major developer, who added lakes, culverts, and a pumping station, received approval for 2 LOMRs, which essentially modified most of this property from AH 13 or 14 to AH 12.

In addition, the City received notification from FEMA approving LOMAs for 33 individual lots and one 35-lot residential subdivision development in this western area, re-designating each of these SFR structures from AH 12 to Zone 'X'.

Pembroke Park, Town of

The Town of Pembroke Park has been a participating NFIP community in good standing since May 1, 1979. In 1979, the Town passed a Floodplain Management Ordinance that continues to reflect the current FIRM maps. The designated Floodplain Manager is the Public Works Director. Permitting in Special Flood Hazard Areas (SFHAs) is issued by the Chief Building Official. The Town has not allowed variance to the flood plain ordinance.

Pembroke Pines, City of- (CRS Community)

The City of Pembroke Pines has been a CRS Community since October 1, 1994. Pembroke Pines is currently a Class 7. The City has designated the City Engineer as the CRS Coordinator and Floodplain Manager. CRS activities undertaken in the past 5 years include:

- Publishing a flood awareness flyer to all residential and commercial address twice per year
- A pro-active drainage system maintenance program
- Adding flood zone information to our public website as well as a trained staff member available by telephoning the department
- Acquisition of open space
- Modification of our flood protection ordinance

The City of Pembroke Pines' current Floodplain Management Ordinance reflects the latest FIRM maps. As of January 2017, the City had 10,022 flood policies (in 2011, this count was 35,622). The last CAV was on November 14, 2007, at which time the FEMA found no violations or other program deficiencies.

Plantation, City of– (CRS Community)

The City of Plantation has been a CRS Community since October 1, 1992. The City of Plantation is currently a Class 6. The City has designated Samira Shalan, City Engineer, as the CRS Coordinator and Floodplain Manager. CRS activities undertaken in the past 5 years include:

- Maintain Elevation Certificates on all new and substantially improved buildings in Special Flood Hazard Areas (SFHA).
- Maintain database for permits issued for new or substantially improved buildings in the SFHA.
- Provide Flood Insurance Rate Map (FIRM) information and information on the flood insurance purchase requirements to inquirers.

- Complete annual outreach project to the community.
- Continue to keep our FIRM updated and maintain old copies of our FIRM.
- Maintain flood protection materials on the city website and the public library.
- Continue to preserve or increase open space in the floodplain.
- Continue to enforce the floodplain management provisions of our zoning, subdivision, and building code ordinances for new developments in the watershed.
- Continue to enforce the requirement that all new buildings must be elevated above the street or base flood elevation.
- Continue to inspect and maintain all city drainage facilities.
- Provide property protection and flood management data to our repetitive loss properties as well as our defined repetitive loss areas.
- Continue to implement our drainage system maintenance program.
- Continue to enforce our stream dumping regulations.

The City of Plantation's current Floodplain Management Ordinance reflects the latest FIRM maps. As of January 2017, the City had 7,698 flood policies (in 2011, this count was 21,240). The Insurance Services office conducted a verification visit on October 12, 2017.

Pompano Beach, City of– (CRS Community)

The City of Pompano Beach has been a CRS Community since 1993. Pompano Beach is currently a Class 7 and has been since 2012. The city has designated Paola A. West, Principal Planner, as the CRS Coordinator and Michael P. Rada as the city's Floodplain Manager. The following is the summary of the city's current program for NFIP compliance:

- Prevention for new properties:
  - The City of Pompano Beach has land development regulations which mandate the height of all new residential buildings at 18" inches above the crown of the road and of all new nonresidential buildings at 6" inches above the crown of the road. Section 152.29 (C) (1) (a) & (b)
  - The City of Pompano Beach requires that the elevation of seawalls newly erected, or repaired in a manner which effects elevation, shall be consistent with the elevations of adjacent seawalls. Persons so desiring to construct or repair a seawall to an elevation above adjacent seawalls shall furnish a plan to the City Engineer for approval prepared by an engineer in the State of Florida, showing elevations of proposed and adjacent seawalls referenced to North American Vertical Datum of 1988 (NAVD 88) and justifying the desired seawall elevation. The design shall provide for a stepped transition from proposed to existing seawall elevations with a rise not to exceed seven inches and a run or tread not less than eleven inches. However, the desired seawall elevation shall not exceed an elevation of five feet ten inches NAVD 88. Section 151.05. By the end of July, a revision to this code section is anticipated to be adopted whereas the "stepped transition" for seawalls will be removed and will read as follows: The desired seawall elevation shall not exceed an elevation of five feet ten inches NAVD 88. Persons so desiring to construct or repair a seawall shall furnish a plan to the City Engineer for approval prepared by an engineer in the State of Florida, showing elevations of proposed and adjacent seawalls referenced to North American Vertical Datum of 1988 (NAVD 88).
  - The State of Florida established a coastal construction line pursuant to section 161.053, F.S. Floodplain development permits and building permits shall include a condition that all other applicable state or federal permits be obtained before

commencement of the permitted development, including but not limited to the Florida Department of Environmental Protection for construction , reconstruction, changes, or physical activities for shore protection or other activities seaward of the coastal construction control line ; section 161.141, F.S. Section 152.24.

- Drainage Facilities are required for all new development. The level of service is established in the Drainage Element of the Comprehensive Plan. Section 154.74
- The City of Pompano Beach has a stormwater utility which maintains the existing drainage facilities and constructs new drainage facilities. Section 53.16 (E)
- Property protection: To protect existing properties from flooding and maintain drainage, the city limits paving of the swales in the right-of-way (Section 100.38); encourage existing homeowners to maximize green space and regrade their properties to direct stormwater into swales and catch basins; the city regularly regrades swales, as needed, and maintains catch basins and routinely clean drains to ensure flooding due to clogged catch basins is minimized; the City has spent $14.7 million in the past 5-years on capital improvement projects that improve stormwater management and reduce flood potential on private property; the city has a 5-year capital improvement plan with $29.0 million worth of stormwater improvements to be implemented in the next 5-year time frame. The City also assists the private sector in issuing Letters of Map Amendments (LOMAs) and Letters of Map Revisions (LOMRs); maintains training in the NFIP; and in the review of Elevation Certificates. The City currently has six (6) Certified Floodplain Managers in the Building Division and one additional Floodplain Manager in the Planning and Zoning Division. The city also maintains a GIS system with elevation and flood plain data and keeps the city website updated with all flood related information that might be useful to the private sector.
- Natural resource protection: The city has a dune restoration program along the beach and maintains several pine scrubs preserves within the city limits.
- Emergency services: In coordination with the City of Pompano Beach and the National Weather Service, Broward County issues hurricane and tropical storm watches and warnings as well as storm surge watches and warnings (new in 2017). Broward County and the City of Pompano Beach operate Emergency Operations Centers and the city currently utilizes the CodeRed system for emergency notification messages. The water utility phone base is utilized for contact information and the public can also opt into the system through the city's Website.
- Structural projects: Beach renourishment is performed at irregular intervals and the city implements an annual list of stormwater improvement projects as mentioned above. The city has updated the Floodplain/Stormwater Management Master Plan which is a 2-year process that will culminate in an updated Capital Improvements Program to continue to improve the structural integrity of the drainage system.

Public Information:

- The City of Pompano Beach maintains digital flood zone maps on a GIS system with an aerial base map that shows an extremely high level of detail and can be searched for specific properties based on the property address for any property in the city.
- The City of Pompano Beach mails the Tradewinds magazine to residents twice a year. Tradewinds contains an article on flooding and flood protection.
- The City of Pompano Beach mails a letter to insurers, lenders, and real estate offices each year to inform them of the availability of flood zone information.
- Flood plain maps are available at the City’s libraries as well as City Hall.
- People can call the City for technical assistance. The telephone number is published in Tradewinds article.

- The city mails an 11-page, highly detailed "Flood Hazard" brochure to all property owners near the start of each hurricane season.
- The city has established a specialized email address floodzoneinfo@copbfl.com for people to request their flood zone information.

The City of Pompano is scheduled to be converted from the 2007 CRS Manual to the new 2013 CRS Manual at its verification visit sometime next year. To assess the current flood mitigation practices of the City, find new ways to reduce flood risk (and possibly obtain a lower classification and increase flood insurance discounts), and to convert practices to the “new” manual standards, the City has entered into a Service Agreement with CRS (Community Rating System) Max Consultants. CRS Max Consultants has recently identified a few areas where changes in regulations can help obtain additional CRS points, with the goal of improving the City’s rating from a 7 to either a 6 or 5. An analysis is being done to determine if/how adoption of the freeboard standard, which requires that new residential buildings or substantial improvements to existing residential buildings be constructed 1 foot or more above the Base Flood
Elevation could be implemented in Pompano Beach. The freeboard approach is different from the current regulation which mandates the height of all new residential buildings and substantial improvements to existing buildings be at base flood or 18” inches above the crown of the road--whichever is greater, and all new nonresidential buildings be base flood plus one foot or 6” inches above the crown of the road--whichever is greater (Section 152.29 (C). Adoption of the freeboard standard has been identified by CRS Max Consultants as one of these changes. Additionally, the City is currently working on creating a Program for Public Information (PPI) Committee to find additional ways to obtain credit through outreach.

The City of Pompano Beach current Floodplain Management Ordinance reflects the latest FIRM maps that were adopted on August 18th, 2014. As of May 2017, the city had 19,426 flood policies (in 2013, this count was 25,824).

Sea Ranch Lakes, Village of

The Village of Sea Ranch Lakes has been a participating NFIP community in good standing since 1977. Sea Ranch Lakes has an approved Flood Damage Prevention Ordinance that continues to reflect the current FIRM maps. The designated Floodplain Manager is the Chief of Police. Permitting in Special Flood Hazard Areas (SFHAs) is issued by the Village Clerk.

Southwest Ranches, Town of

The Town of Town of Southwest Ranches has been a participating NFIP community in good standing since November 2004. In 2004, the Town passed a Floodplain Management Ordinance that continues to reflect the current FIRM maps. The new designated Floodplain Manager will be the Town Engineer. Permitting in Broward County Emergency Management Special Flood Hazard Areas (SFHAs) will also be issued by the Town Engineer.

Sunrise, City of– (CRS Community)

The City of Sunrise has been a CRS Community since 1996. Sunrise is currently a Class 7. The City has designated the Deputy Utilities Director as the CRS Coordinator and City Engineer as the Floodplain Manager. CRS activities undertaken in the past 5 years include:

- Maintaining Elevation Certificates for New/Substantially Improved Buildings
- As requested, provide Flood Insurance Rate Map information and copies of available Elevation Certificates to residents, lenders, insurance agents, and real estate offices.
- Providing annual outreach to all property owners, including residents within the flood

plains, receiving a water bill.
- Our website and public library maintain flood protection materials.
- We use our regulatory flood data before a new development can proceed in our floodplain.
- We continue to enforce the floodplain management provisions of our zoning, subdivision and building code ordinances.
- Updating or flood data maintenance system on an annual basis as needed.
- Enforcing the stormwater management provisions of our zoning, subdivision and building code ordinances for new developments in the watershed.
- We continue to implement our drainage system maintenance program.
- We continue to enforce our stream dumping regulations.
- We continue to preserve our open space in the floodplain open space within the floodplain.

The City of Sunrise's current Floodplain Management Ordinance reflects the latest FIRM maps. As of October 2016, there were 5,750 flood insurance policies in force in the City of Sunrise. The City of Sunrise is currently preparing for the next CRS Cycle Visit, which will take place on September 7, 2017, and will be based on the 2017 CRS manual.

Tamarac, City of – (CRS Community)

The City of Tamarac has been a CRS Community since 1992. CRS activities undertaken in the past 5 years include:

- Print and mail out to all residents and business owners a Flood Protection Brochure twice a year were explaining to all property owners' things to know such as, the National Flood Insurance Program, the Benefits of having Flood Insurance in each property, Flood Plain Development Permit Requirements, Flood Warning Systems, and Flood Hazard Information.
- Provide copies of Elevation Certificates when available and Make Flood Zone Determinations with the FIRM map, and the Special Flood Hazard Area Map.
- The City continues to preserve approximately 1,352 acres in the Special Flood Hazard Areas as open space.
- The City continues to enforce the requirements that all new buildings must be elevated above the crown of the road as required in our City Ordinance.
- The Public Works Department has a Drainage System Maintenance Program for the entire City.
- The Public Works Department provides site visits regarding Flooding, Drainage, and Storm Water related problems to address any issues and correct them as required.
- The City also has an Outreach Program to the Community thru Neighborhood Meetings, Homeowners Association meetings, and information in The City's Website to help and alert the residents and the business community about The City's Flood Programs.
- On March 10, 2010, the Tamarac City Commission approved Resolution 2010-29 adopting the December 2009 Revision of the Broward County Multi-Jurisdictional Local Mitigation Strategy Plan.

The City of Tamarac current Floodplain Management Ordinance reflects the latest FIRM maps.

West Park, City of

The City of West Park has been participating in the NFIP community since 2006. In 2005, the City passed a Floodplain Management Ordinance. To this end, the City has already started by completing the following:

- Stormwater Management Program adoption
- Drainage System Maintenance Public Outreach & Education
- Storm Drainage Cleaning and Maintenance
- Twin Lakes Maintenance
- Retention Pond Maintenance
- Tree Planting
- Map Information Service
- Open Space Preservation
- Adherence to National Pollutant Discharge Elimination System (NPDES) Permit Requirements
- Adoption of Capital Improvement Plan
- Streamlined Illegal Dumping Ordinance
- Floodplain Management Plan is being Updated.

The City is constantly monitoring drainage system and catch basins.

The City of West Park will continue to be an active member of the Broward County Local Mitigation Strategy.

Weston, City of

The City of Weston has been a CRS community since May 1, 2009. Weston is currently a Class 8. The city has designated the Director of Public Works as the CRS Coordinator and consultant Calvin, Giordano & Associates as Floodplain Manager. CRS activities undertaken in the past year include:

- Review and Maintain Elevation Certificates on all new and substantially improved buildings in our Special Flood Hazard Area.
- Provide Flood Insurance Rate Map information to the public, lenders, insurance agents, and real estate offices.
- Provide Flood protection assistance to inquirers and maintain a “records of service”.
- Provide an annual outreach project to the community.
- Provide a copy of the community’s Flood Insurance Rate Map and an explanation of their use in our public library.
- Enforce storm water management provisions through our Zoning, Engineering, Building,
- and local Code Ordinances.
- Preserve open space in the Floodplain.
- Provide a copy of property protection for repetitive loss areas.
- Exercise an outreach program that informs the public of flood warnings and safety.
- measures.
- Administer a drainage system maintenance program.

The City of Weston’s current Floodplain Management Ordinance reflects the latest FIRM maps. The City adopted the ELMS March 18, 2013, via City of Weston Resolution No. 2013-23.

As of March 2017, The City had 4,422 NFIP policies in force (in 2011, this count was 3,637). The last CAV was in April 2012, and the City's ISO Community Rating Visit was on March 4, 2008, at which time the State and FEMA found no violations or other program deficiencies.

Wilton Manors, City of

The City of Wilton Manors has been a participating NFIP community in good standing since 1987. In 1987 (amended 2005), the City passed a Floodplain Management Ordinance that continues to reflect the current FIRM maps. The designated Floodplain Manager is the Director of Community Development Services. Permitting in Special Flood Hazard Areas (SFHAs) is issued by the Director of Community Development Services.

Continued Compliance

Broward County and all its jurisdictions are committed to continued participation and compliance with the National Flood Insurance program (NFIP). A major mitigation priority of the LMS is the reduction of repetitive flood loss properties. The County and its CRS participating municipalities track repetitive loss properties county-wide on an ongoing basis using data gathered annually from FEMA.

For mitigation, planning, and strategy development purposes, the LMS maintains updated GIS maps and informational databases of repetitive loss property locations relative to historical flood areas and designated Special Flood Hazard Areas. Repetitive loss properties are an ongoing discussion and planning priority for the LMS. All committees of the LMS are encouraged to develop and promote mitigation project ideas and strategies.

Specific prioritized actions for continued compliance with the NFIP for the next 5 years cycle include:

- Promote and continue to participate in the National Flood Insurance Program
- Identify and reduce the number of repetitive loss properties in each jurisdiction.
- Provide additional support to the Community Rating System (CRS) to increase Class Ratings
- Continue activities within the CRS Subcommittee/User Group to address reduction in CRS Class ratings.
- Identify and implement storm water projects that would eliminate in-urban and residential areas.

County-wide Flood Loss Reduction Strategy

Flood is consistently the most recurrent and costly hazard to the residents, businesses, and government operations. Therefore, an important part of the ELMS was to place special emphasis on addressing and mitigating the flood risk. A new chapter, Economic Vulnerability, described in detail the flood risk and potential loss scenarios for key economic areas in the County. Renewed emphasis has been placed on active participation in CRS and SFWMD has become an active partner in the LMS. By 2013, Broward County will have updated digital Flood Insurance Rate Maps (dFIRMs).

The items below, which may be repetitive of other sections of the plan, have been grouped here to show the overall recently invigorated effort to reduce the County's flood risk:

- Encourage all municipalities to participate in CRS and encourage currently participating communities to implement activities that will accrue more CRS credit points.
- Continued engagement of the LMS CRS Subcommittee/User Group and include sea level rise issues.
- Leverage public-private partnerships to mitigate flood vulnerabilities identified in the Economic Vulnerability Chapter of the ELMS
- Integrate flood mitigation measures and policies into other community planning processes like comprehensive plans.
- Consider adopting 500-year flood elevation standard.
- Continue the partnership with SE Florida Regional Climate Change Compact group to address sea level rise.
- Continue frequent communication with the SFWMD through the District's Broward Intergovernmental Representative (who in 2012 was also a member of the County LMS group) to find ways to strengthen partnership in addressing flood hazards.
    - Support the SFWMD Operations and Maintenance (O&M) Plan implementation.
    - Review the SFWMD's 50-year plan and find out what is relevant to Broward County flood mitigation.
    - Support the SFWMD's effort to modernize its older facilities in Broward County
        - Consider larger scale flood projects on canal system under FEMA programs like HMGP and PDM
        - Consider sea level rise impacts on water control structures and canals under SFWMD jurisdiction (SFWMD coordinates with the County and municipalities on sustainability actions)
    - County EMD mitigation and recovery officials should continue, along with other key LMS representatives, attend the quarterly meetings of the Broward County Water Resources Task Force and Broward Surface Water Coordinating Council (which includes the SFWMD, local water control districts like the South Broward Drainage District (some are also known as '298s' after Chapter 298 of Florida Statutes))
        - Consider use of WebEOC to tie in SFWMD and local drainage districts before and during likely flood events.
    - Work with SFWMD to scope and pursue project that include mitigation measures from funding sources for stormwater projects (e.g., the Environmental Protection Agency's grant programs). These grant pursuits would likely need to include multiple objectives like water quality.
        - The LMS should coordinate with local elected officials and Broward state legislators to seek state funds for combined stormwater/mitigation projects.
        - SFWMD should continue to work with local drainage districts to find solutions to more localized drainage issues (e.g., installation of gates and change in operating criteria in Southwest Ranches)

Appendices

Appendix A – Project Prioritization Matrix

Appendix B – Proposed Mitigation Project Form

Appendix C – Mitigation Project List

Appendix C contains the latest update of Broward County's LMS Mitigation Project List. The list of projects is ever changing as projects completed through self-funding or with grant assistance are dropped and new proposed and planned projects are added. Jurisdictions and other potential project sponsors, particularly those not having projects on the current list, are encouraged to submit projects. The expectation is that all eligible applicants are represented on this list with projects that address identified local hazards, vulnerabilities, and mitigation strategies. The status for each project is included.

Appendix D – LMSWG Membership List

Appendix E – Planning Process Support Documents

A binder containing this information is maintained at the Broward Emergency Management Division's office.

Appendix F – Resolutions

This appendix will contain the Resolution by the Broward County Board of County Commissioners adopting this Plan and all municipal resolutions supporting the ELMS Plan.

Appendix G – Discontinued ELMS Hazard Profiles

This appendix contains previous ELMS version Hazard *Profiles that are no longer considered Hazards of Most Concern because of the 2017 Risk and Vulnerability Assessment Workshop.*

Appendix H – Local Enhanced Plan and Mitigation Integration Summary

Appendix I – Critical Facilities

Appendix J – Hazards Summary Profile

Appendix K – Loss Estimation Tool

Appendix L – Grant Funding Sources Table

Appendix M – All Hazards Survey