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CITY OF MARATHON, FLORIDA
RESOLUTION 2015-139

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF MARATHON, FLORIDA, ADOPTING THE 2015 UPDATE OF THE LOCAL MITIGATION STRATEGY AS REQUIRED BY STATE AND FEDERAL REGULATIONS TO QUALIFY FOR CERTAIN MITIGATION GRANT FUNDING; PROVIDING FOR AN EFFECTIVE DATE.

WHEREAS, the City of Marathon Council adopted a Local Mitigation Strategy (LMS) update in 2005, and an update in 2011; and

WHEREAS, Monroe County and the cities of Key West, Key Colony Beach, Layton, Islamorada, and Marathon have experienced hurricanes and other natural hazard events that pose risks to public health and safety and which may cause serious property damage; and

WHEREAS, the Robert T. Stafford Disaster Relief and Emergency Management Act, as amended by the Disaster Mitigation Act of 2000, requires local jurisdictions to adopt mitigation plans in order to be eligible for post-disaster and pre-disaster grants to implement certain mitigation projects; and

WHEREAS, pursuant to Florida Administrative Code Section 27P-22, the County and municipalities must have a formal LMS Working Group and the LMS Working Group must review and update the LMS every five years in order to maintain eligibility for mitigation grant programs; and

WHEREAS, the National Flood Insurance Reform Act of 1994, the Flood Insurance Reform Act of 2004, as amended, require local jurisdictions to adopt a mitigation to be eligible for grants to implement certain flood mitigation projects; and

WHEREAS, the planning process required by the State of Florida and the Federal Emergency Management Agency offers the opportunity to consider natural hazards and risks and to identify mitigation actions to reduce future impacts of such hazards; and

WHEREAS, the State of Florida has provided federal mitigation funds to support the development of the Local Mitigation Strategy; and

WHEREAS, the 2015 Update of the Monroe County Local Mitigation Strategy was revised by the LMS Working Group composed of representatives of Monroe County, the cities of Key West, Key Colony Beach, Layton, Islamorada, and Marathon, and a number of nonprofit organizations have reviewed and updated the LMS; and

WHEREAS, the 2015 LMS Update identifies mitigation initiatives that will improve the process used to identify and manage mitigation initiatives intended to minimize and reduce safety threats and damage to private and public property; and

WHEREAS, the 2015 LMS Update was made available to the public and a public meeting was held on May 27, 2015, to solicit questions and comments and to present the LMS; and

WHEREAS, the 2015 LMS Update was submitted to the Florida Division of Emergency Management and FEMA for review and minor revisions were made in response to comments; final approval by the State and FEMA will be issued after the LMS is adopted.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF MARATHON, FLORIDA, that:

Section 1: The 2015 LMS Update is adopted as shown in "Exhibit A" as an official plan of The City of Marathon, Florida, contingent upon approval by the State and FEMA.

Section 2: Any initiative identified in the 2015 LMS Update shall be subject to, and contingent upon, budget approval, if required, which shall be at the discretion of the City Council of the City of Marathon, and this resolution shall not be interpreted so as to mandate any such appropriations.

Section 3: The Monroe County Emergency Management Department is directed to coordinate with appropriate County departments and to perform the annual report requirements set forth in the Florida Administrative Code Chapter 27P-22.004.

Section 4: That this Resolution shall go into effect immediately upon its passage and adoption and authentication by the signature of the presiding officer and Clerk of the Council.

Section 5: The Clerk is directed to mail copies of this resolution to the Florida Division of Emergency Management and the Federal Emergency Management Agency's Region IV Office.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF MARATHON, FLORIDA, THIS 8TH DAY OF DECEMBER, 2015.

THE CITY OF MARATHON, FLORIDA

Mark Senmartin, Mayor

AYES:	Bartus, Coldiron, Kelly, Zieg, Senmartin
NOES:	None
ABSENT:	None
ABSTAIN:	None

ATTEST:

Diane Clavier

Diane Clavier, City Clerk

(City Seal)

APPROVED AS TO FORM AND LEGALITY FOR THE USE AND RELIANCE OF THE CITY OF MARATHON, FLORIDA ONLY:

David Migut, City Attorney

Exhibit A
Local Mitigation Strategy

Monroe County and Incorporated Municipalities

Key West, Marathon, Key Colony Beach, Layton, and Islamorada Village of Islands

Local Mitigation Strategy 2015 Update

Florida Keys 1935 Hurricane Memorial

November 2015

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Chapter 1. Introduction

Monroe County, Florida, and its incorporated municipalities of the Village of Islamorada, City of Layton, City of Key Colony Beach, City of Marathon, and the City of Key West, undertook development of this 2015 Update of the *Local Mitigation Strategy* (LMS) because of its awareness that natural hazards, especially hurricane and flooding hazards, may affect many people and property. The 2015 Update replaces the 2010 and 2005 Updates of the 1999 LMS. The LMS is a requirement associated with receipt of certain federal mitigation grant program funds administered by the Florida Division of Emergency Management (FDEM) and the Federal Emergency Management Agency (FEMA).

1.1 Authority

The Board of County Commissioners directed the Monroe County Emergency Management Department (Monroe EMD) to coordinate with other appropriate departments and agencies, and the cities of Key West, Marathon, Key Colony Beach, Layton, and Islamorada, to facilitate the development of the LMS, and subsequent 5-year updates, in conformance with state and federal guidelines.

The 2015 LMS Update was prepared to comply with the FDEM requirements (Florida Administrative Code Chapter 27P-22) and the provisions of the federal Hazard Mitigation and Pre-Disaster Mitigation Programs (44 CFR Parts 201 and 206), and the Flood Mitigation Assistance Program (44 CFR 78.6). The 2015 Update continues to meet the requirements of National Flood Insurance Program Community Rating System (CRS) Activity 510 Floodplain Management Plan so that participating communities can receive CRS credit points. Communities and the non-profit organizations located in them must participate in a mitigation planning process that results in an adopted strategy that is approved by the FDEM and FEMA in order to qualify for certain federal mitigation funds.

Florida Administrative Code Chapter 27P-22 sets forth the composition and responsibilities of LMS Working Groups. In particular, Working Groups are to develop and revise the LMS, set the order of priority of projects submitted for funding, and submit an annual report. The minimum contents of the LMS are specified and include a number of provisions that are not explicitly set forth in federal requirements.

1.2 Working Group Membership

The LMS Working Group was established in 1998 pursuant to authorization by the Monroe County Board of County Commissioners (BOCC). It has met periodically since then. The Working Group meets at several times a year (see Section 3.2.1 and Appendix A1), convening on January 22, 2015 for the specific purpose of initiating the 2015 Update of the Local Mitigation Strategy (LMS).

The Working Group includes representatives from the Monroe County and all incorporated municipalities in the county. Prior to the 1999 LMS, Working Group Agreements were established between Monroe County and the municipalities. The City of Marathon joined upon its incorporation in late 1999. All jurisdictions have continued participation in the LMS Working Group meetings and the process to update the LMS every five years.

Representatives from following are designated members of the Working Group who were notified of each meeting, invited to participate in all meetings (see meeting notes in Appendix A2) and to provide comments on various drafts, and invited to review and comment on the 2015 Update before it was finalized for adoption:

- Monroe County, Emergency Management (Chair)
- Monroe County, Growth Management Director
- Monroe County, Senior Director Planning and Environmental Resources
- Monroe County, Senior Floodplain Coordinator
- Monroe County, Director of Engineering Services
- Monroe County, Public Works and Engineering Director
- Monroe County, Director Emergency Communications
- Monroe County Sheriff's Office, Risk Manager and Grants Administrator
- Monroe County School District
- Monroe County, Grants Administrator
- Monroe County, Risk Administrator
- Monroe County, Deputy Fire Rescue Chief
- Monroe County Extension Service
- City of Layton, City Administrator (Vice-Chair)
- City of Layton, Floodplain Administrator
- Village of Islamorada, Senior Planner
- Village of Islamorada, Fire Rescue Chief
- Village of Islamorada, Procurement/Grants Administration
- City of Key Colony Beach, Police Chief
- City of Key Colony Beach, Building Official
- City of Key West, KWFD Training Chief / Emergency Management Coordinator
- City of Key West, FEMA Coordinator/Floodplain Administrator
- City of Key West, Sustainability Coordinator
- City of Key West, Engineering Grants Manager

- City of Marathon, Marathon Fire Chief / Emergency Management Coordinator
- City of Marathon, Planning Director
- City of Marathon, Public Works Manager
- Florida Department of Health in Monroe County
- South Florida Water Management District
- The South Florida Regional Conservation and Development Council (SFRC&D)
- Monroe County, Historic Florida Keys Foundation
- Habitat for Humanity of Key West and Lower Florida Keys
- Keys Energy Services
- Florida Keys Electric Cooperative
- Florida Keys Aqueduct Authority, Director of Operations and Benefits & Risk Manager
- Mariners Hospital, Director Facilities Management
- The Nature Conservancy
- Florida Keys Outreach Coalition for the Homeless
- National Key Deer Refuge, Fire Management Specialist
- Southernmost Homeless Assistance League (SHAL)
- Florida National High Adventure Sea Base, Director
- Matecumbe Historical Trust
- Monroe Association for Remarkable Citizens
- U.S. Coast Guard Assistant District Staff Officer-Public Affairs (ADSO-PA)
- Island Christian School, Islamorada
- Habitat for Humanity, Lower Keys
- Baptist Health Hospital
- Key West Art and Historical Society
- Historical Florida Keys Foundation
- Residents of Monroe County and its municipalities

The following stakeholders were notified and invited to review and comment on the 2015 Update:

- Florida Division of Emergency Management (FDEM)
- Florida Keys Community College
- The Salvation Army
- Monroe County Association for Retarded Citizen's

- American Red Cross
- St. Justin The Martyr Catholic Church, Key Largo
- Big Pine Moose Lodge, Big Pine Key
- St. Mary Star of the Sea School, Key West
- Monroe County Mosquito Board
- Miami-Dade County LMS Chair
- Office of Congressional Representative Carlos Curbelo, 26th District
- Office of State Representative Holly Merrill Raschein, District #120
- Members of the public

1.3 Acknowledgments

The 2015 LMS Update was supported by a planning grant administered by the City of Miami and the Florida Division of Emergency Management EMPA Base Grant funding. The U.S. Department of Homeland Security provided financial assistance to the Miami urban area through the Urban Area Security Initiative (UASI) Grant program (2013).

The 2015 LMS Update was facilitated by RCQuinn Consulting, Inc., a mitigation planning and building code consultant, and AECOM, a global architecture and engineering company that now includes URS Corporation. The consultants helped to guide the Working Group through the update process, helped to research and update each chapter, documented decisions of the group, and collected comments, data, and incorporated the material into the 2015 LMS Update.

The 2010 LMS Update (and the 2005 revision) was prepared with the support of RCQuinn Consulting, Inc., Charlottesville, VA. The 1999 LMS was prepared with the support of Janice Drewing Consulting, Inc. of Plantation Key, Florida.

1.4 Key Terms

For the most part, terms used in the Plan have the meanings that are commonly associated with them:

- **Disaster** means the occurrence of widespread or severe damage, injury, loss of life or property, or such severe economic or social disruption that supplemental disaster relief assistance is necessary for the affected political jurisdiction(s) to recover and to alleviate the damage, loss, hardship, or suffering caused thereby.
- **Floodplain:** See "Flood Hazard Area."
- **Hazard** is defined as the natural or technological phenomenon, event, or physical condition that has the potential to cause property damage, infrastructure damage, other physical losses, and injuries and fatalities.

- **Mitigation** is defined as actions taken to reduce or eliminate the long-term risk to life and property from hazards. Mitigation actions are intended to reduce the need for emergency response – as opposed to improving the ability to respond.
- **National Flood Insurance Program (NFIP),** located within the U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA), is charged with preparing Flood Insurance Rate Maps, developing regulations to guide development, and providing insurance for flood damage.
- **Risk** is defined as the potential losses associated with a hazard. Ideally, risk is defined in terms of expected probability and frequency of the hazard occurring, people and property exposed, and potential consequences.
- **Flood Hazard Area** or **Floodplain** is the area adjoining a river, stream, shoreline, or other body of water that is subject to partial or complete inundation. The area predicted to flood during the 1% annual chance flood is commonly called the "100-year" flood.

1.5 Acronyms

The following acronyms are used in the document:

- **BOCC** – Board of County Commissioners
- **CRS** – Community Rating System (NFIP)
- **FBC** - Florida Building Code
- **FDEM** – Florida Division of Emergency Management
- **FEMA** – U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA)
- **FIRM** – Flood Insurance Rate Map
- **FMA** – Flood Mitigation Assistance (FEMA)
- **GIS** – Geographic Information System
- **HMGP** – Hazard Mitigation Grant Program (FEMA)
- **LMS** – Local Mitigation Strategy
- **NFIP** – National Flood Insurance Program (FEMA)
- **NROGO** - Non-Residential Rate of Growth Ordinance Allocation System
- **PDM** – Pre-Disaster Mitigation grant program
- **ROGO** – Rate of Growth Ordinance
- **RLAA** - Repetitive Loss Area Analysis
- **SRL** – Severe Repetitive Loss

1.6 References

American Society of Civil Engineers. 2010. *Minimum Design Loads for Buildings and Other Structures* (SEI/ASCE 7-10). Reston, VA.

Federal Emergency Management Agency. Various Panel Dates. *Flood Insurance Study and Flood Insurance Rate Maps* for Monroe County, Key West, Key Colony Beach, Layton, Islamorada, and Marathon, Washington, DC. [Available for public review at planning and/or permit offices of each jurisdiction.]

Florida Division of Emergency Management. Florida's 2010 Severe Weather Awareness Guide: Are You Ready? Online at http://www.floridadisaster.org/DEMpublic.asp.

Florida Division of Emergency Management. State of Florida Enhanced Hazard Mitigation Plan. August 2013.

Florida Sea Grant Program, University of Florida. July 1994. The Effect of Hurricane Andrew on Monroe County Businesses: Negative Economic Effects and Assistance Sought.

Kasper, Kennard. "Hurricane Wilma in the Florida Keys." National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS) Weather Forecast

Key West, Florida. 2010 Conformed Version of the Key West Comprehensive Plan.

Office (WFO) Key West, Florida (undated; (http://www.srh.noaa.gov/media/key/Research/wilma.pdf).

Monroe County, Florida. Year 2010 Comprehensive Plan: Policy Document.

Monroe County, Florida. Year 2010 Comprehensive Plan: Technical Document.

Monroe County, Florida. Comprehensive Emergency Management Plan (2007).

Monroe County Climate Action Plan. November 2013.

Monroe County Cooperative Extension Service. August 1994. The Effect of Hurricane Andrew on Monroe County's Natural Resources and Its Dependent Industries.

Chapter 2. The Planning Area

The planning area includes Monroe County and the incorporated municipalities of the Village of Islamorada, City of Layton, City of Key Colony Beach, the City of Marathon, and the City of Key West. The Monroe County *Year 2010 Comprehensive Plan* contains extensive narrative to describe the County and its policies. The following brief summaries are, in large part, taken from that document. As of March 2015, the Comprehensive Plan is undergoing an update; therefore, the 2010 plan is used for this LMS Update except where a significant change has occurred. For the 2015 Update, the Growth Management Division updated information for Section 2.3. Florida Building Code information was included as a new Section 2.4. For information on the Comprehensive Plan update, see http://keyscompplan.com/ for the updated information.

2.1 Geography and Planning Area

Monroe County is located at the southernmost tip of the State of Florida. The Florida Keys are situated in a precarious physical location between the Gulf of Mexico and the Atlantic Ocean. The Keys consist of an archipelago that sweeps for almost 150 miles in a southwesterly direction from southeastern Miami-Dade County. The mainland portion of the County is bordered by Collier County to the north and Miami-Dade County to the east (See Figure 2-1).

Figure 2-1. Location Map

The total area of Monroe County is approximately 1.2 million acres (about 1,875 square miles). Large portions are submerged lands associated with parks and preserves that are under the jurisdiction of the federal and state governments. The total land area is approximately 885 square miles, of which about 102 square miles are in the Keys (including unincorporated and incorporated municipalities). The entire mainland portion is within the Everglades National Park or the Big Cypress National Preserve and is virtually uninhabited (only 14 residential buildings).

The County's *Year 2010 Comprehensive Plan* focuses primarily on the Florida Keys – which is the same planning area for the Local Mitigation Strategy. The Florida Keys are typically long, narrow, and low-lying islands. The average elevations of the various larger islands range from four to seven feet above mean sea level. Only one small area in the City of Key West referred to as Solares Hill rises to 16 feet above mean sea level. Other relatively high areas are several coral ridges in Key Largo are near Mile-Marker 106.

2.2 Population

The 2014 estimated population of Monroe County and the incorporated municipalities was 74,044 (see Table 2-1). This figure represents a 1.3% increase from the estimated population in the 2010 Census (73,090). The area's population varies considerably due to seasonal residents; at peak season, the seasonal population is estimated at nearly 74,000. All told, the Florida Keys receives more than 3 million visitors each year.

Table 2-1. 2014 Estimated Permanent Population*

	Permanent Residents
Monroe County (unincorp)	33,793**
Islamorada	6,212
Layton	186
Key Colony Beach	808
Key West	24,620
Marathon	8,425
Total	74,044

* Southeast Florida Regional Planning Council based U.S. Census Bureau population estimates

**Mainland Monroe County has only 14 residential buildings; virtually all population is in the Keys.

As of 2015, the Special Needs Registry includes 614 people enrolled in the Special Needs Hurricane Evacuation Program due to age, medical condition, or other factors that require assistance from the County to evacuate during an emergency (Table 2-2). The County has

a small non-English speaking population spread throughout the Keys and a small transient worker population.

Table 2-2. Special Needs Registry (2015)

Mile Marker	Registered Special Needs
0-12	295
13-40	93
41-72	85
73-92	57
93-113	84
Total	614

2.3 Land Use and Growth Trends

Growth trends in Monroe County are regulated through the number of residential permits issued.

The number of dwelling units (permanent and seasonal) which can be permitted in unincorporated Monroe County and incorporated municipalities has been controlled by the Rate of Growth Ordinance (ROGO) adopted by Monroe County in 1992 to implement portions of its Comprehensive Plan. ROGO was developed as a response to the inability of the road network to accommodate a large-scale hurricane evacuation in a timely fashion. A series of complex models developed during the area's first evacuation study identified an approximate number of additional dwelling units which could be permitted and which would not have a detrimental effect on the time needed to evacuate the Keys. The number of allocations for each area was based upon the supply of vacant buildable lots. The ROGO system was developed as a tool to equitably distribute the remaining number of permits available both geographically and over time. Since ROGO has been implemented, the system has been revised from time to time such as with the adoption of the Tier System which is described below.

The ROGO system distributes a pre-determined number of allocations for new residential permits on a yearly basis beginning on or about July 13th each year. Each service area of unincorporated Monroe County and several of the incorporated areas receive allocations. The Ocean Reef area of north Key Largo currently excluded from ROGO based upon the December 2010 Ocean Reef Club Vested Development Rights Letter recognized and issued by the Department of Economic Opportunity.

Initially, the ROGO system in unincorporated Monroe County allowed 255 allocations for new residential units. However, the number of allocations in the unincorporated area has

been subsequently reduced due to incorporations and the lack of progress on the implementation of the *Year 2010 Comprehensive Plan.*

The County, in an effort to further address concerns of carrying capacity, implemented Monroe County 2010 Comprehensive Plan Goal 105 by adopting the Tier System. The system designates all lands outside of mainland Monroe County, except for the Ocean Reef planned development into three general categories for purposes of its Land Acquisition Program and smart growth. The three categories are: Natural Area (Tier 1); Transition and Sprawl Reduction Area (Tier II on Big Pine Key and No Name Key only; and Infill Area (Tier III), including a Special Protection Area (Tier III-A) which is a subset of Tier III. The permit allocation and tier system recognizes the finite limits of the carrying capacity of the natural and man-made systems in the Florida Keys, which includes the recognition that Monroe County must ensure public safety through the ability to maintain a hurricane evacuation clearance time.

The current allocation of 197 is divided into 126 "market rate" and 71 "affordable" units and are distributed in unincorporated Monroe County as follows:

- 61 market rate units in the Upper Keys service area,
- 57 market rate units in the Lower Keys service area,
- 8 market rate units in the Big Pine and No Name Keys service area,
- 36 affordable units for Very Low, Low, and Median Incomes*, and
- 35 affordable units for Moderate Income (includes one each for Big Pine Key and No Name Key).

Nonresidential permitting also plays a role in land use and growth trends. Nonresidential permits include everything that is not residential, including industrial, commercial, non-profit and public building.

With very little industrial and agricultural activity in the Keys, the predominant form of nonresidential development is commercial. There are two primary types of commercial development: retail trade and services (which includes tourism-related development such as marinas and restaurants). Therefore, the impact of nonresidential development on public facilities varies significantly based on the type of commercial use.

Nonresidential and residential developments tend to fuel one another. Residential populations provide markets for nonresidential activities. Nonresidential development, in turn, helps to drive permanent and seasonal population growth by providing services and employment. Certain types of nonresidential development also concentrate the demand for public facilities within certain locations and during peak seasons.

Since residential development is constrained through the ROGO Permit Allocation System, it was thought that nonresidential (commercial) development should also be constrained in the interest of maintaining a balance of land uses.

At the time the Comprehensive Plan was prepared in 1991, 17.6% of the land was under residential use, while 4.6% was used for commercial development). It was determined that this balance was appropriate at the time. To assure that balance was maintained, the Comprehensive Plan proposed Policy 101.3.1. In effect, the square footage of new commercial development that may be permitted is limited to 239 square feet for each new residential permit issued. The Non-Residential Allocation System (NROGO) in unincorporated Monroe County, excluding areas with the county mainland and with the Ocean Reef planned development has a maximum of 47,083 of square feet (sf) of floor area per NROGO year. Beginning NROGO Year 22 (July 13, 2013), the floor area to be distributed to three areas is shown in Table 2-3.

Table 2-3: Floor Area to Be Distributed by NROGO

County Subarea	Annual NROGO allocation
Upper	22,944 SF
Lower	21,749 SF
Big Pine/No Name	2,390 SF
Total	47,083 SF

The growth in Monroe County that occurred from 2010 to 2015 is described in terms of permits issued for each jurisdiction in Chapters 7 to 12. Although the reported permit data cover only three years and do not each report the same metrics, based on those data fewer than 1,000 single family homes and approximately 2,000 nonresidential buildings (new and renovated/additions) were constructed since 2010. Compared to the total number of buildings in the planning area,

Growth rates are regulated through ROGO and NRGOGO. In more well-developed areas like Key West, there is minimal undeveloped land. All new development, including redeveloped sites, are subject to the Florida Building Code (see Section 2.4) and other codes and regulations enforced by each jurisdiction. Vulnerability of new construction to base flood events (100-year) and design high winds (130-140 mph) is minimized because new construction must comply with those requirements and thus does not represent a substantive change in the area's risk profile.

2.4 The Florida Building Code (5th Edition, 2014)

All communities in Florida are required to enforce the Florida Building Code (FBC). The 5th Edition of the FBC was developed in 2014 by the Florida Building Commission, starting with the 2012 International Codes® and amended to incorporate Florida-specific provisions. This edition of the FBC is effective June 30, 2015. Building and structures authorized by building permits issued after that date shall comply with the design and construction requirements of the 5th Edition FBC. FEMA deemed the flood provisions of the 2012 I-Codes, on which the 5th Edition FBC is based, to meet or exceed the requirements of the NFIP for buildings and structures.

For flood provisions, the FBC, Building, references ASCE 24, *Flood Resistant Design and Construction.* ASCE 24 requires Risk Category II, III and IV buildings to be elevated or protected to a higher level than the NFIP, to a minimum of Base Flood Elevation plus one foot.

Flood Provisions of the FBC. The 2010 FBC, in effect since March 15, 2012, was the first state building code to include flood provisions (the Commission removed flood provisions from previous editions). FEMA deemed the flood provisions of the 2009 I-Codes, on which the 2010 FBC is based, to meet or exceed the requirements of the NFIP for buildings and structures. FDEM posts excerpts of the flood provisions online: www.floridadisaster.org/Mitigation/SFMP/lobc_resources.htm. Descriptions of how the flood provisions in the I-Codes (and thus the FBC) are more specific and, in some ways, exceed the requirements of the NFIP are contained in Chapter 3 of *Reducing Flood Losses Through the International Codes: Coordinating Building Codes and Floodplain Management Regulations*: www.fema.gov/media-library/assets/documents/96634.

The following are the more significant Florida amendments and differences between the flood provisions in the 2010 FBC and the 5th Edition:

- *Building*: Clarifies that relying on affidavits for issuance of permits does not extend to the flood load and flood resistant requirements of the FBC; Building: Adds a section for variances in flood hazard areas; modifies ASCE 24 to permit dry floodproofing in Coastal A Zones provided designs account for wave loads, erosion, and scour (does not apply to residential structures or residential areas of mixed-use structures).
- *Residential*: Refers to local floodplain management ordinances for requirements for installation of manufactured homes; states the more restrictive requirements of the flood provisions in Section R322 or FBC, B Section 3109 (coastal construction control line) govern; adds provisions for pools in flood hazard areas.
- *Existing Building*: Clarifies that when SI/SD is triggered, compliance with the FBC, B or FBC, R is required, as applicable.

Wind Provisions of the FBC. The following are the more significant Florida amendments to the International Codes that pertain to the design of buildings with respect to wind loads:

- *Building*: Requires siding, soffit and fascia products shall be capable of resisting design pressures specified for walls for components and cladding loads; specifies metal roofing thicknesses and aggregate size and embedment; requires a margin of safety of 2:1 be applied to all wind uplift resistance test results except when a margin of safety is specified in a test standard; requires wood screws and clips to be corrosion resistant; replaces the table for classification of asphalt shingle classification based on maximum basic wind speed; replaces underlayment application specifications for various roof covering types; specifies Florida-specific installation manual for concrete and clay roof tile in high wind areas; specifies impact resistant coverings to be tested at 1.5 times the design pressure determined by the FBC or ASCE 7; provides garage door and rolling door wind loads based on mean roof height; adds requirements for wind loads for screened enclosures and sunrooms; requires gable endwalls to be structurally continuous between points of lateral support; specifies wind load on glass is associated with the ultimate design wind speed.
- *Residential*: Defines the wind-borne debris region as areas within hurricane-prone regions located within 1 mile of the coastal mean high water line where the ultimate design wind speed is 130 mph or greater, or areas where the ultimate design wind speed is 140 mph or greater
- *Residential*: Specifies component and cladding loads, and garage door loads, for certain dwellings; requires sunrooms to comply with a standard and specific wind loads, has requirements for screened enclosures, specifies additional detail for protection of glazed openings; modifies definitions of wind zones in ASTM E 1996; modifies wind direction and sector specifications and surface roughnesses; requires exterior wall coverings and soffits to resist design pressures specified for walls for components and cladding loads; clarifies foundations required to resist all loads from roof uplift and building overturn; adds and expands prescriptive tables for loads for various building components based on material type; requires exterior doors, windows, and garage doors to be labeled with permanent label, marking, or etching; specified testing of garage doors; adds new section on impact-resistant coverings; specifies wind resistance, underlayment, and attachment of asphalt shingles, clay and concrete tile, metal roof coverings, wood shingles, and built-up roofs; modifies requirements for reroofing; specifies roof-to-wall connections; details retrofitting connections and gable end and hip roofs.
- *Existing Building*: Requires replacement garage doors, exterior doors, skylights, and operative and inoperative windows to be designed to comply with wind load requirements; adds a new section with reroofing requirements; and adds a new chapter with prescriptive methods for partial structural retrofitting to increase the resistance of gable end walls to out-of-plane wind loads applicable to buildings that meet specific eligibility requirements.

2.5 Number and Value of Buildings and Structures

The data for the number and value of structures for the two years shown in Table 2-4 is from the Monroe County Property Appraiser. It shows a comparison between the number of structures and associated value, by occupancy type, between 2009 and 2014. This information summarizes the general exposure of the built environment.

Figure 2-2 shows how the average and medial sale prices of single family homes have changed between 1965 and 2014. When the 1999 LMS was prepared, the average property value was $120,000; as of mid-2005 when the 2005 LMS Updated was prepared, the average value had climbed to $281,000. In 2009, the average property value was $570,500 and in 2014, the average value was $696,700. Similar variations have been experienced in the value of other types of properties.

Table 2-4. Number and Value of Buildings and Structures (2009* and 2014*).

Occupancy	# in 2009	$ in 2009	# in 2014	$ in 2014
Single-Family Homes	26,132	$14.83 B	26,925	$14.31 B
Manufactured Homes	5,619	$1.10 B	5,506	$846 M
Multi-Family (<10)	2,477	$1.30 B	2,127	$911 M
Other Residential	7,510	$3.56 B	7,513	$3.13 B
Commercial	4,286	$2.46 B	3,885	$2.03 B
Institutional	503	$565 M	442	$408 M
Hotels	452	$1.00 B	430	$1.46 B
TOTALS	46,979	$24.815 B	46,827	$23.095 B

* From the Monroe County Property Appraiser (2009 and 2014)

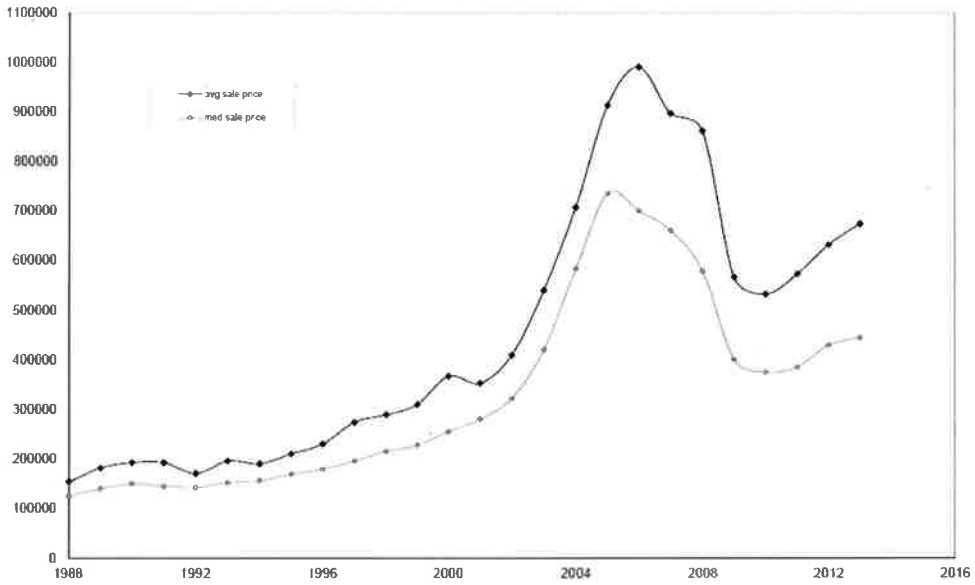


Figure 2-2. Average and Median Sale Prices of Single Family Homes in Monroe County
(Monroe County Property Appraiser, 2015)

2.6 Economic Characteristics

Monroe County's economy is unique in a number of respects due to its location and geography. The area attracts both seasonal residents and short-term visitors, drawn by the amenable climate and recreational opportunities. The economy is dominated by tourism and the commercial fishing industry. The following text is based on the *2010 Comprehensive Plan.*

The service sector, dominated by hospitality (food and lodging), is the largest segment of the private sector, followed by retail trade. These industries account for nearly 52% of total employment, and 67% of private sector employment.

Commercial fishing represents 7% of total employment and 9% of private sector employment. A combination of economic and natural resources factors have led to a decline in the number of commercial fishing vessels and a long-term downward trend in the total poundage of the harvest.

Two other private sector categories together account for about 15% of total employment: construction and finance/insurance/real estate.

Public sector employment accounts for just over 20% of total employment. This category includes the federal government (and military), State and local government agencies, and utilities.

Because the tax base in Monroe County is supplemented by tourism, declines in the number of visitors after major hurricanes lead to reduced revenue associated with the Bed Tax, Sales Tax, and Infrastructure Tax. Historically, damaging storms result in significant loss of revenues.

2.7 Transportation

The transportation network in the Florida Keys is unique in that a single road forms its backbone and the sole link to the Florida mainland. U.S. Route 1, referred to as the Overseas Highway, runs for 126 miles from Florida City in Dade County to Key West in Monroe County. Maintained by the Florida Department of Transportation, for most of its length U.S. 1 is a two-lane highway with 42 bridges (combined total length of 19 miles of bridge structure).

U.S. 1 is a lifeline for the Keys, functioning as both highway and "Main Street." Each day it brings food, materials, and tourists from the mainland, driving the local economy.

Approximately 450 miles of roads, including 37 bridges, are maintained by the County. Card Sound Road, operated as a toll road, is an alternate to U.S. 1 in some locations. Mainland Monroe County consists primarily of government-owned parks and preserves, and consequently has few roads. The only County-maintained road is Loop Road, a 16-mile excursion off of U.S. 41 crossing the Dade and Collier County lines.

The cities of Key West, Marathon, Key Colony Beach, Layton, and Islamorada are responsible for the streets within their boundaries.

Air transportation is a viable alternative to highway travel. Monroe County's by two airports: Key West Airport and Marathon Airport, serve major commercial airlines. Four privately-owned community airports are also located in the Keys.

2.8 Environmental and Historic Resources

2.8.1 Environmental Resources

The Florida Keys contains many valuable environmental resources. It has unique habitats, with many rare and/or endangered plant and animal species. Because of these special environmental considerations, in 1980, through legislative act, the State of Florida

designated the Keys portion of unincorporated Monroe County and the incorporated municipalities as "Areas of Critical State Concern." The purpose of the program is to protect the unique environment, vegetation, and natural resources of the designated area by regulating land development and other activities regarded as detrimental to the environment. In conjunction with the designation, the legislature enacted the "Principles for Guiding Development," which are set forth in Chapter 380.0552(7), Florida Statutes. The law provides for State oversight of development and changes to land use regulations, a function carried out by the Department of Economic Opportunity. The Department established Field Offices in Monroe County to assist in review of development permits and related issues for compliance with the "Principles."

The Florida Department of Environmental Protection's Office in Marathon submitted the following list of specific environmentally sensitive areas referred to as "Special Management Areas" (state and federal):

- Florida Keys Marine Sanctuary (comprehensive designation)
- Bahia Honda State Park
- Fort Zachary Taylor State Historic Site
- Indian Key State Historic Site
- John Pennekamp Coral Reef State Park
- Lignum Vitae Key State Botanical Site
- Long Key State Park
- Windley Key Fossil Reef State Geological Site
- Curry Hammocks State Park
- San Pedro Underwater Archaeological Preserve
- Key Deer National Wildlife Refuge
- Great White Heron National Wildlife Refuge
- Looe Key National Marine Sanctuary
- Key Largo National Marine Sanctuary
- Everglades National Park (primarily mainland Monroe)

2.8.2 Historic Resources

A significant percentage of tourism in the Keys is associated with its unique archeological, historical, and cultural heritage and many landmarks. Many sites are listed on the National Register of Historic Places and designated for protection (available at http://www.nps.gov/history/). Many identified historic resources could experience irreversible damage from hurricanes. The Historic Florida Keys Foundation, Inc. has an agreement with County to provide professional staffing for historic preservation. The

County has about 330 locally-designated sites identified under Article 8 of the Monroe County Code as Archaeological, Historical, and/or Cultural Landmarks (available on the County's webpage). Key West's Historic Architect Review Commission has locally-designated about 2,300 sites (available on the City's webpage).

Despite recent hurricanes, historic resources have, for the most part, escaped significant damage. A number of significant properties have been mitigated:

- The Old Monroe County Courthouse, a state-owned building, has suffered wind damage in the past; it was retrofit with window protection using FEMA's Hazard Mitigation Grant Program funds.
- Retrofit the steeple of the Old Key West City Hall with motorized hurricane shutters was funded by FEMA.
- The Key West Armory had roof strapping added, funded by the State Division of Historic Resources.
- The Gato Building rehabilitation project included impact-resistant windows.
- The Oldest House was retrofit with hurricane shutters, funded by Tourist Development Council.

2.9 Critical Facilities

The Monroe County *Comprehensive Emergency Management Plan* includes content related to essential services, critical facilities, and important infrastructure. The LMS Work Group determined that the following distinctions are appropriate for "critical facilities," where that term includes buildings and facilities that are identified by the public entities, utilities, and non-profit organizations that own them:

- **Critical Facilities** are buildings and infrastructure that are vital to the operations and continuity of government operations necessary to perform essential security missions and services to ensure the general public health and safety in order to make daily living and working possible. Critical facilities generally should be functional within 24 to 72 hours after a declared disaster depending on the severity of the event.
- **Primary/Important Facilities** are those that should be functional within seven days after a declared disaster.
- **Secondary/Standard Facilities** are those that need not be fully functional until six months after a declared disaster.

Monroe County Emergency Management Department maintains a secured database of public and critical facilities and certain private non-profit facilities. Figure 2-3 (series at end of chapter) show locations of the critical facilities identified by each jurisdiction that can be

plotted (figures prepared mid-2005; only one significant addition in 2015). Table 2-5 contains notes on selected critical facilities and Table 2-6 contains notes on selected infrastructure. Chapters 8 through 12, the chapters for the municipalities, also include lists of selected facilities identified by the municipalities.

Table 2-5. Notes on Selected Critical Facilities

Hospitals/Nursing Homes	**Hospitals** • Florida Keys Health Systems (DePoo Hospital and Lower Florida Keys Health Center) • Marathon (Middle Keys) – Fishermen's Hospital • Tavernier (Upper Keys) – Mariner's Hospital • All hospitals must evacuate Monroe County in a storm of Category 3 or greater. **Nursing Home** • Bayshore Manor, Key West (Monroe County owned and operated) must evacuate Monroe County when a storm of Category 3 or greater is predicated
Schools/Shelters	**Public Schools/Hurricane Shelters** Only selected schools have been identified as suitable shelters for use in tropical storms, Category 1-2 hurricanes, and other emergency purposes. In most cases, for hurricanes of Category 3 and higher all persons must evacuate Monroe County and shelters will not be used: • Key West High School, 2100 Flagler Ave., KW • Sugarloaf Elementary School, Mile-Marker 19, Sugarloaf Key • Marathon High School, 350 Sombrero Blvd, Marathon • Coral Shores High School, Mile-Marker 90 Plantation Key • Key Largo School Cafetorium, Mile-Marker 105, Key Largo **Other facilities that may be used as hurricane shelters:** • Saint Justin Martyr Catholic Church, Key Largo • Poinciana Elementary School, 1212 14th St, KW (open in 2008)
Other	**Other facilities critical/important for recovery:** • Habitat for Humanity of Key West and Lower Florida Keys, 30320 Overseas Highway (storage for water, temporary roof coverings and supplies, client intake for emergency home repair needs and staging area for volunteer coordination) • Monroe County Medical Examiner's Office (added 2009) • The Murray Nelson Government and Cultural Arts Center (added 2010)

Table 2-6. Notes on Selected Infrastructure

Bridges • 42 bridges connect primary roadway US 1. • Bascule-type drawbridge on Snake Creek Bridge at Mile-Marker 86, open periodically for marine traffic; drawbridge operations and possible breakdowns can interrupt traffic flow. • "Lifelines" (Linear components of critical infrastructure)
Water Lines • Primary supply pipeline on mainland in Florida City (managed by Florida Keys Aqueduct Authority) • Some distribution pipeline connected to roads and bridges.

Table 2-6. Notes on Selected Infrastructure

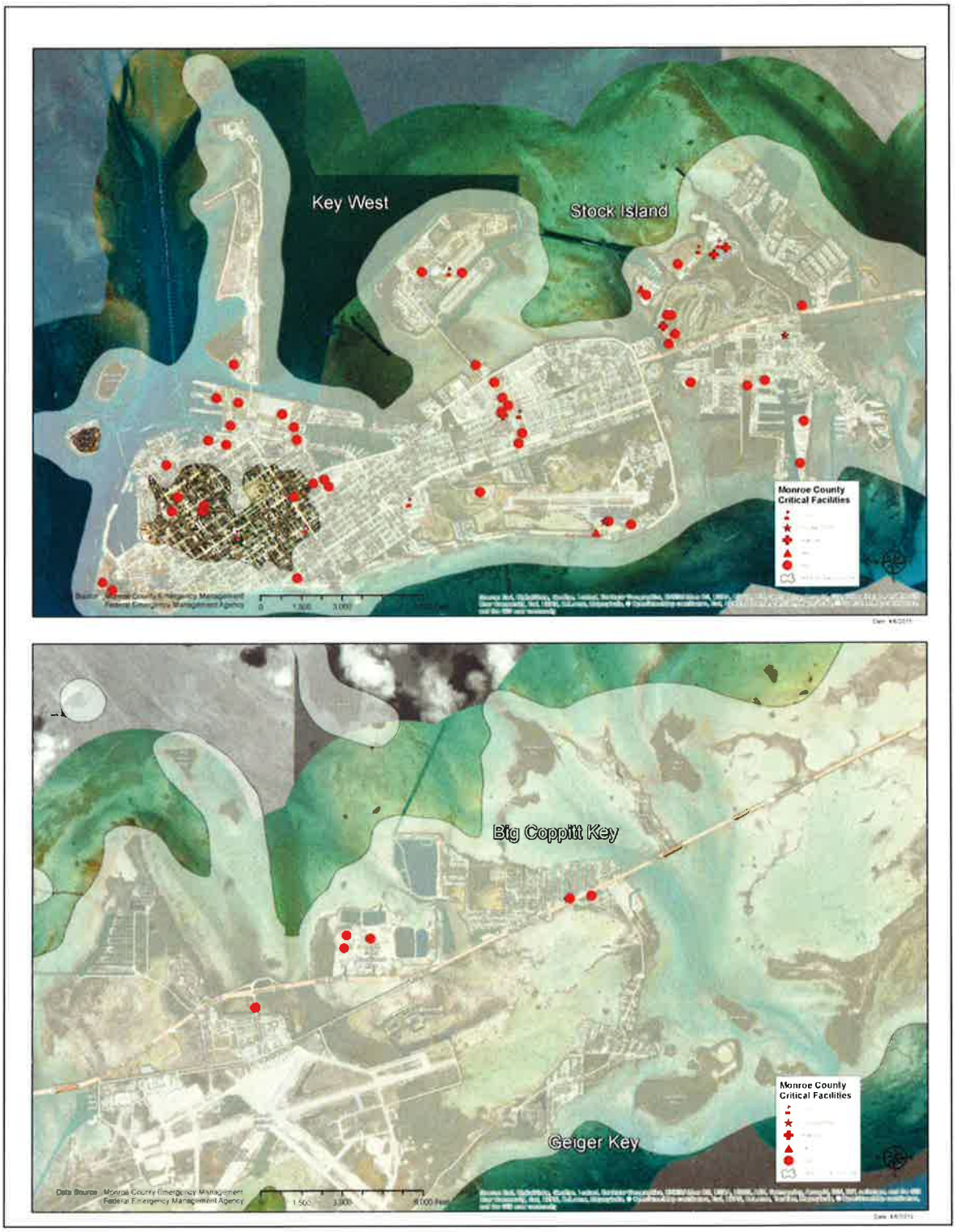
• Contingency and redundancy: • Primary pipeline serving Upper Keys is subaqueous and does not depend on roads and bridges. • Reverse Osmosis Plant located in Marathon to serve Middle Keys. • Reverse Osmosis Plant located in Stock Island (Key West) to serve Lower Keys. • Reverse Osmosis Plan located in Florida City (Upper Keys)
Power Lines • Electric Power supplied by Florida Keys Electric Cooperative (FKEC) Upper Keys to Marathon • Electric Power supplied by Keys Energy Service (KES) Marathon to Key West. • Majority of electric lines above ground. • No power poles located on bridges. • To prevent loss if bridges are damaged, transmission line power poles are pile-driven into the water along roads and bridges. • Subsequent to Hurricane Andrew poles re-designed to withstand serious storm conditions were installed in certain areas such as along the 18-mile stretch. Old equipment is being replaced with newer, more resilient materials.
Telephone Service • To provide redundancy, two major trunk fibers are provided from Homestead on the mainland to Key West. One is buried and the other is aerial. • Most cable lines located along underside of fixed bridges, therefore vulnerable if bridges fail. • Digging not feasible because of rock substructure. • Environmental considerations inhibit underwater installations.

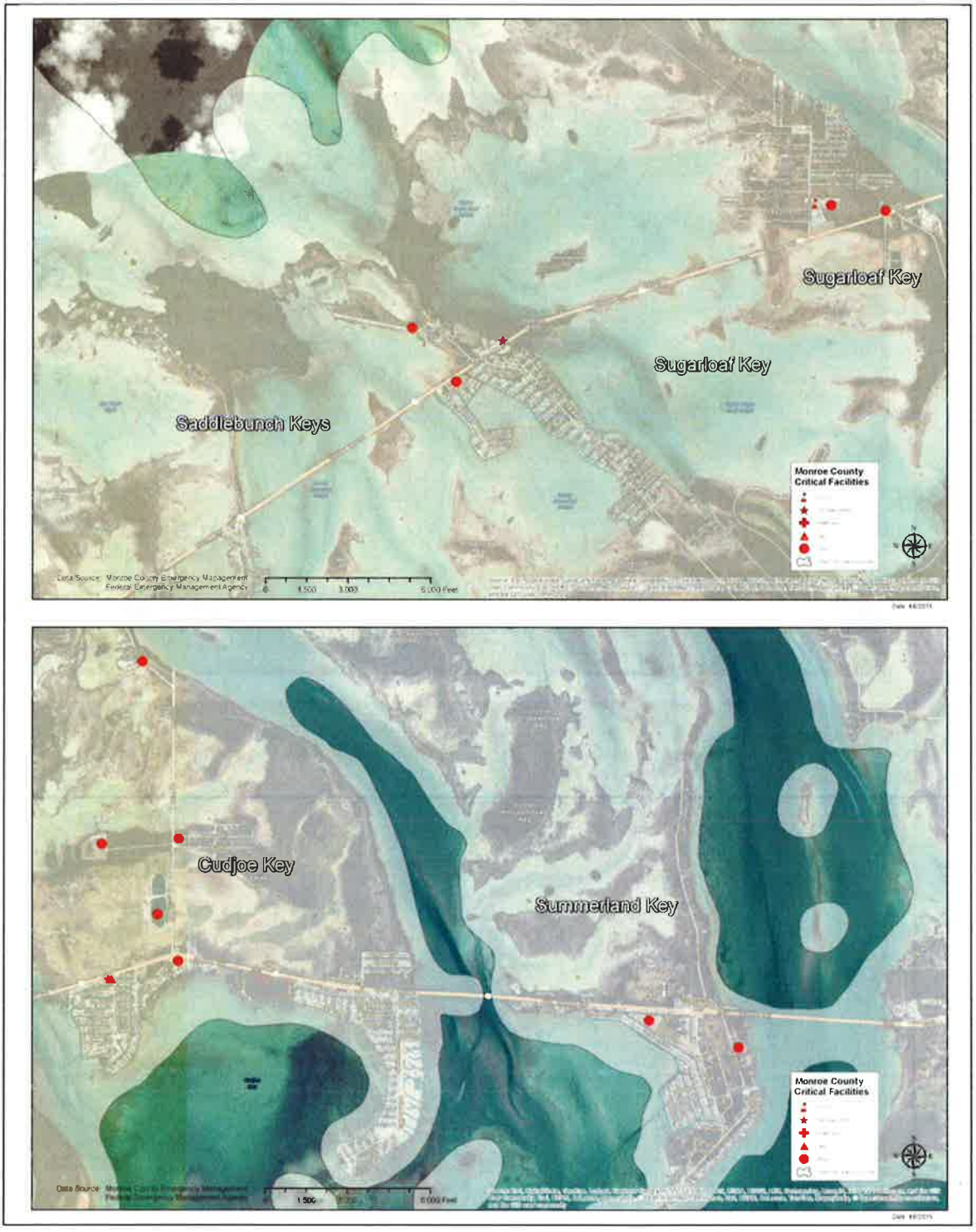
2.10 2015 Updates

The LMS Working Group reviewed and updated the pertinent sections. Some of the more significant changes include:

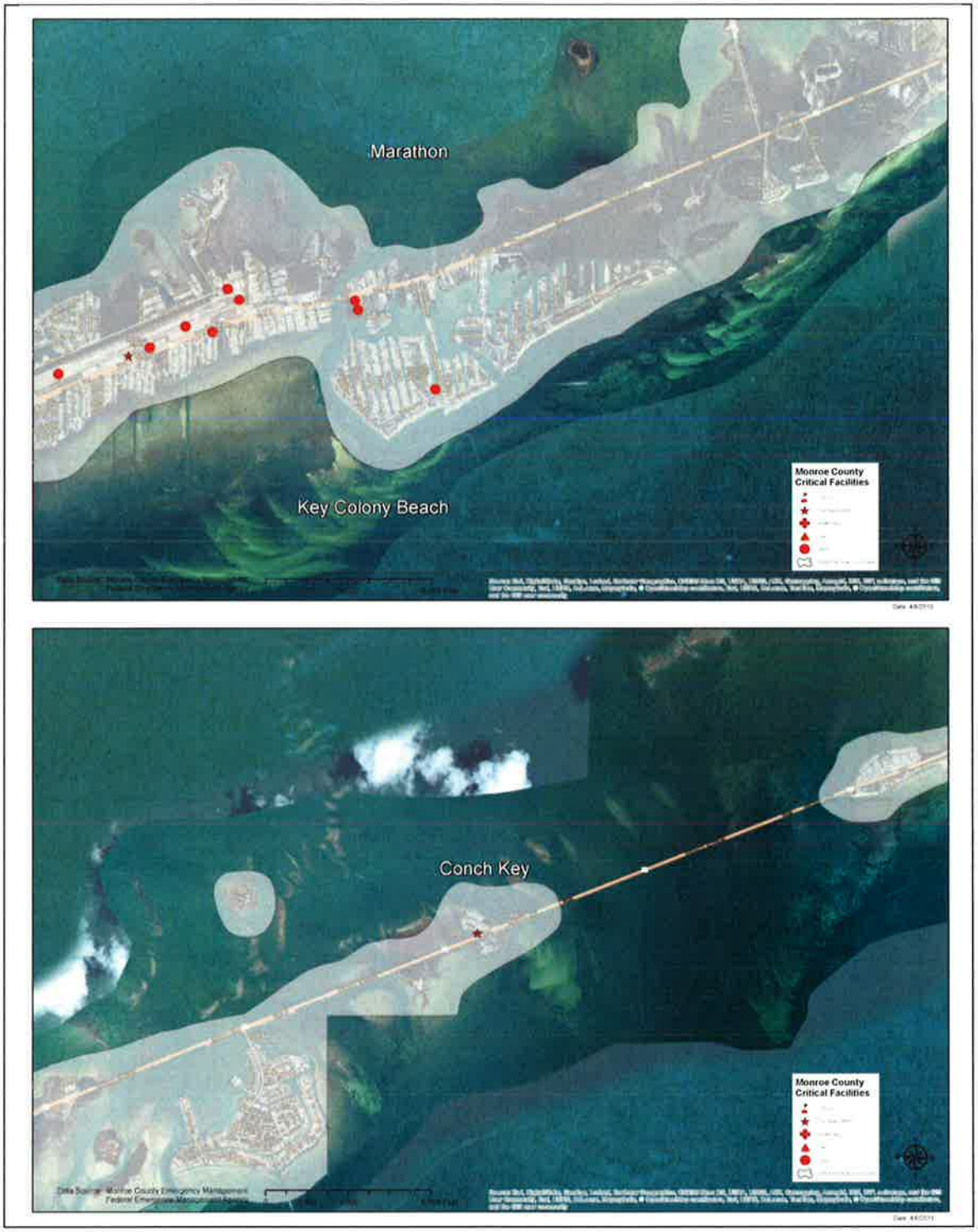
- Section 2.2: Updated population and Special Needs Registry data.
- Section 2.3: Revised the ROGO text.
- Section 2.4: Added new section on Florida Building Codes
- Section 2.5: Updated the value and number of buildings and structures.
- Section 2.8: Updated list of mitigated historic properties
- Section 2.9: Updated the table of critical facilities and maps showing locations

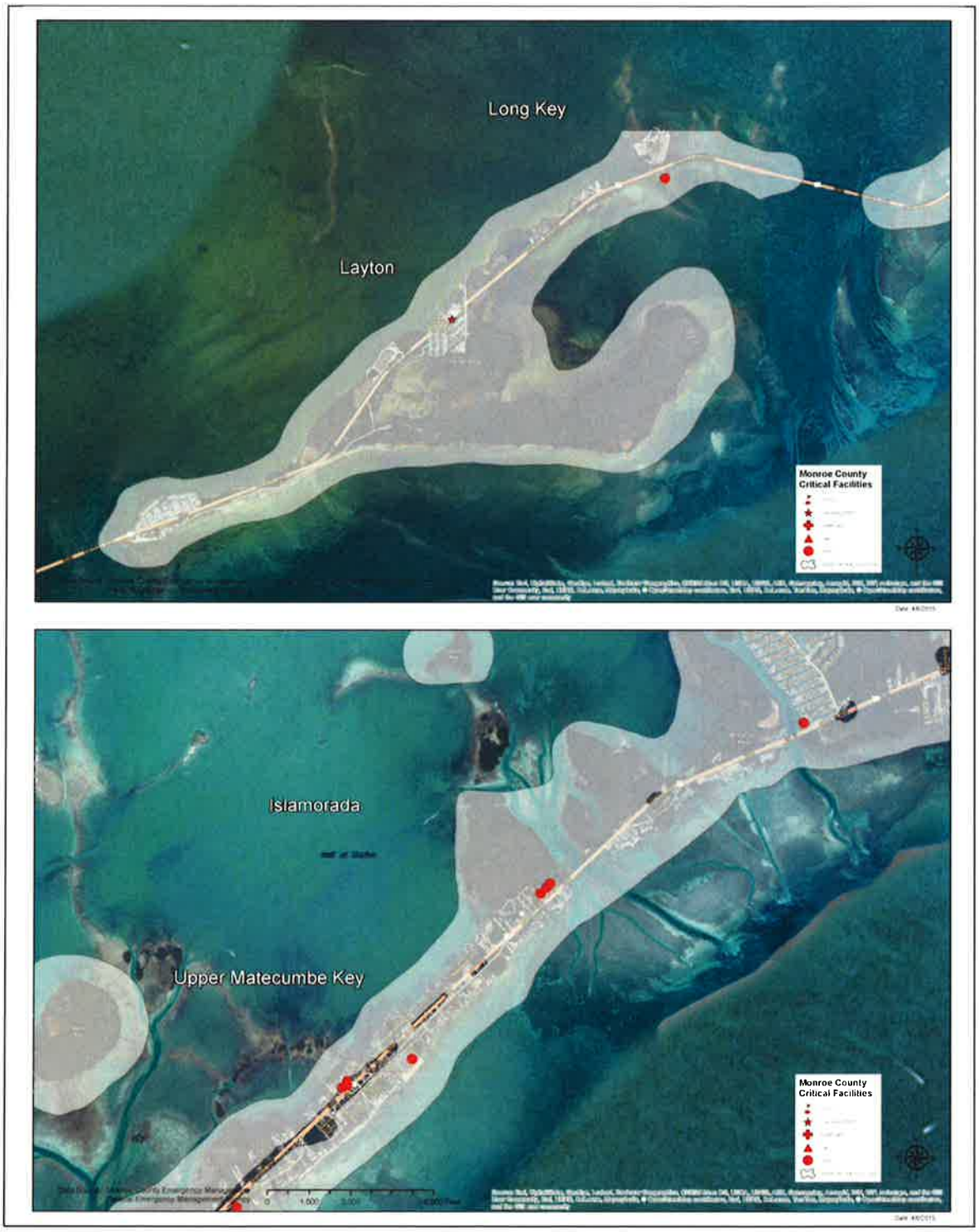
FIGURE 2-3 Locations of Critical & Important Facilities (series from south to north)




Sugarloaf Key
Sugarloaf Key
Saddlebunch Keys
Monroe County
Critical Facilities
Cudjoe Key
Summerland Key
Monroe County
Critical Facilities


Torch Keys
Big Pine Key
Ramrod Key
Monroe County
Critical Facilities
Marathon
Monroe County
Critical Facilities


Marathon
Key Colony Beach
Monroe County
Critical Facilities
Conch Key
Monroe County
Critical Facilities


Long Key
Layton
Monroe County
Critical Facilities
Islamorada
Upper Matecumbe Key
Monroe County
Critical Facilities


Islamorada
Plantation Key
Monroe County
Critical Facilities
Key Largo
Tavernier
Monroe County
Critical Facilities


Key Largo
Monroe County
Critical Facilities
Key Largo
Monroe County
Critical Facilities


Key Largo
Monroe County
Critical Facilities
Ocean Reef
Monroe County
Critical Facilities

Chapter 3. Mitigation Planning

3.1 Introduction

An important step in the lengthy process of improving resistance to natural hazards is the development of a Local Mitigation Strategy. The Monroe County LMS was prepared in accordance with the guidelines provided by the Federal Emergency Management Agency and the Florida Division of Emergency Management, and steps outlined in National Flood Insurance Program's (NFIP) 2013 Community Rating System Coordinator's Manual (FIA-15/2013).

The LMS serves several purposes. It sets the stage for long-term resistance to natural hazards through identification of actions that will, over time, reduce the exposure of people and property. Further, the LMS is required to be eligible for certain state and federal mitigation grant funds.

Chapter 5 (Hurricanes & Tropical Storms) and Chapter 6 (Other Hazards & Risks) provide overviews of hazards that threaten the County, estimates of the people and property exposed to hazards, the planning process, how hazards are recognized in the local government processes and functions, and priority mitigation action items. The hazard summary and disaster history help to characterize future hazards. When the magnitude of past events, the number of people and properties affected, and the severity of damage, hurricanes and tropical storm flooding hazards clearly are the most significant natural hazard to threaten Monroe County.

The LMS Working Group acknowledges that many buildings were built before the adoption of regulations for development in floodplains in the County and the incorporated municipalities. Current regulations require new development to be designed and built to resist anticipated wind and flood hazards. Older buildings, then, may reasonably be expected to sustain more property damage than new buildings.

3.2 2015 Update: The Mitigation Planning Process

The LMS Working Group followed a well-established planning process to revise the LMS. A mitigation planning consultant was retained to guide the Working Group through the update process, to help research and update each chapter, to document decisions of the group, and to collect comments and incorporate them into the LMS Update.

Monroe EMD publicizes in-person Working Group meetings through the County's normal channels. Several meetings were held during which the 2015 LMS Update was discussed (see Appendix A1 for meeting notices, agendas and notes):

- **January 22, 2015.** Review the LMS update process and State and federal requirements that require the Working Group to update the LMS every five years. Described the LMS components and the State crosswalk that includes CRS Activity 510 Floodplain Management Plan criteria. The Working Group must examine each section, and a summary of the update process must be included. The entire updated plan must be adopted by every jurisdiction, not just a summary of the updates. Before the meeting, revised community profile sections (Chapters 7-12) were distributed to community representatives and comments were sought. The importance of Working Group participation and contribution was stressed. Each local government member will be responsible for ensuring that their chapters are reviewed. A representative of the Key West National Weather Service office was available to review and comment on Chapter 5 (Hurricanes & Tropical Storms), Chapter 6 (Other Hazards & Risks).
- **March 5, 2015.** The consultants prepared revisions to Chapter 5 (Hurricanes & Tropical Storms) and Chapter 6 (Other Hazards & Risks), which were distributed to the Working Group two weeks before the meeting. Those chapters were reviewed including a presentation of Hazus results and introduction of climate change/sea level rise as a new hazard. Hazus is a regional multi-hazard loss estimation model developed by FEMA and the National Institute of Building Sciences. The Hazus results are acceptable for the purpose of identifying and prioritizing mitigation actions. The municipalities were asked to review their overall vulnerability and changes were included in the revised document. New Working Group Initiatives and new community-specific initiatives were discussed. Following the meeting, the County hosted a Repetitive Loss Area Analysis workshop.
- **May 27, 2015.** Notices of the public meeting were published and the meeting was held at the Marathon Fire Department, Station #14. Only one resident attended the public meeting and no comments were submitted.
- **June 23, 2015.** The local government members of the LMS Working Group met by conference call to review the outcome of the public meeting, to concur with the addition of two Working Group initiatives and an initiative for each local government.
- **October 2015.** The Working Group Chair determined the nature of revisions prompted by the DEM review did not warrant review. The LMS Update was prepared and provided for adoption by individual jurisdictions.

The overall mitigation planning process, summarized below, was facilitated by mitigation planning consultants:

- **Get Organized.** The Monroe County LMS Working Group was charged with coordinating a committee comprised of its members to review and update the LMS.

- **Coordinate.** Prior to the January 22, 2015, meeting, other agencies and other interested organizations were notified of the planning activity and invited to participate.
- **Review Identified Hazards.** The LMS Working Group reviewed the hazard identification content in the 2010 LMS and hazard events that had occurred in the intervening years, and confirmed the priority ranking of natural hazards. Several of the overall community vulnerability ratings were modified for the 2015 Update and Climate Change/Sea Level Rise was added as a hazard. The results from "The Arbiter of Storms" (TAOS) included in the 2010 LMS were replaced with FEMA's Hazus loss estimation for hurricane wind and a combined hurricane wind/storm surge (prepared by FDEM). The Hazus information provided an order of magnitude estimate of impacts and confirmed the Working Group's higher prioritization of hurricane (wind and storm surge) over other hazards.
- **Review how Natural Hazards are Addressed.** Working Group members reviewed brief descriptions of their agencies and on-going actions related to hazards and provided updates. The results are summarized in Chapter 7 (Monroe County) and Chapters 8 through 12 for the cities of Key West, Key Colony Beach, Layton, Islamorada and Marathon. To comply with changes in the FEMA Local Mitigation Plan Review Tool that requires a capability assessment for each participating jurisdiction, these chapters were slightly modified to reflect each community's capability to mitigate hazards.
- **Review Assessment of Risks.** The Working Group reviewed the risk assessment content (Chapters 5-6) in the 2010 LMS both in the revised draft and in a meeting. The Hazus results confirmed the WG's focus on hurricane impacts.
- **Research Existing Plans.** The Working Group reviewed existing comprehensive plans, climate change action plans and flood damage reduction regulations and referenced pertinent provisions in the LMS. The primary wind and flood requirements in the Florida Building Code were summarized.
- **Confirm the Mitigation Goals.** The mitigation goals were discussed and confirmed by the Working Group.
- **Identification of Mitigation Actions.** The list of potential mitigation actions is not static, it changes as new projects are identified, as projects are completed, and as the priorities of proponents change or better information about the feasibility and cost-effectiveness of an activity comes to light. Mitigation actions include projects (typically involving specific buildings or drainage problems) and other actions that have broader impact (such as public information and regulatory requirements). A high priority action identified in the 2005 LMS called for the Working Group to improve the method by which the list of projects is maintained and updated (this action was completed). Progress on the Working Group Initiatives from the 2010 LMS was recorded and new Working Group and Community –specific Initiatives for the 2015 LMS were prepared.
- **Draft the LMS Update.** The draft LMS Update was prepared and circulated to LMS Working Group members, regional organizations identified and

described in the text, and others on the email distribution list. Comments were collected and incorporated into the "public review" draft.

- **Make Available to the Public and Hold Public Meeting.** A press release was issued and posted on the County's webpage, facebook page, and Twitter. A notice of the public meeting and the availability of the Public Review Draft of the 2015 LMS Update was published in the *Florida Keys Keynoter* and *The Reporter* (see Appendix B). The County distributed notice to its <civicplus.com> listserve. The draft was posted on the County's webpage and hardcopies placed in the five city offices and the County's Growth Management office in Marathon. Notices were sent to adjacent counties, state and regional governmental and non-profit organizations, neighborhood associations, the utility companies that serve the area, and the e-mail listserve maintained by the LMS coordinator. The LMS Update was presented at a public meeting held on May 27, 2015 at Marathon Fire Department, Station #14 and comment period was open until June 12, 2015.

- **Provide to DEM for Technical Review.** No comments were received during the public comment period. In preparing the final draft for DEM review, additional edits and updated information were included and the Working Group convened by conference call to approve submission to the Division of Emergency Management for review.
- **Adopt LMS.** The LMS Update was presented to the Monroe County Board of County Commissioners and the governing bodies of the Village of Islamorada, the City of Layton, the City of Key Colony Beach, the City of Marathon, and the City of Key West. Copies of the resolutions of adoption are found in Appendix C.

3.2.1 LMS Working Group Annual Meetings

The LMS Working Group meets at least annually as required by State regulations (27P-22, F.A.C.) to discuss changes to the LMS, new actions and status of actions. Since the 2010 LMS Update, the dates for the Working Group meeting are recorded below (minutes included in Appendix A2):

- June 15, 2011 at the Marathon Fire Station
- May 30, 2012 at the Marathon Fire Station
- March 25, 2013 at the Monroe County Government Center
- September 30, 2014 at the Marathon Government Annex

During 2010, the Working Group met several times to work on the 2010 LMS Update (documentation of that process and those meetings is included in the LMS 2010 Update).

3.3 Public Involvement in Mitigation Planning

Consistent with the standard practices to inform and provide citizens the opportunity to comment, and to fulfill the public involvement requirements of the mitigation planning programs, the input was solicited and residents were notified and invited to review the LMS and attend a public meeting. In January 2015, Monroe County Emergency Management posted on its public website that the LMS Update was underway and that the general public is invited and welcome to attend meetings. Five residents of the County and/or municipalities receive information and regularly attend Working Group meetings. The results of Working Group meetings, including meeting notes and presentation materials, are also posted on the Monroe County Emergency Management website.

The Monroe County LMS 2015 Update (Public Review Draft) was presented to the public at a meeting on May 27, 2015 at the Marathon Fire Department, Station #14. Prior to the meeting, copies of the Public Review Draft were made available to the public in the offices of the cities, in the County Growth Management office in Marathon, and posted on the County's webpage. A press release was issued, notice issued on the County's webpage, facebook page, Twitter feed, and listserve (Appendix B). Notice of the meeting was published in the *Florida Keys Keynoter* and *The Reporter*. The Monroe-County LMS Working Group, federal, state and regional agencies, neighborhood associations, and the stakeholders on the LMS email notification listserve (see Section 1.2) were notified of the opportunity to review and provide comments. Comments were requested by June 12, 2015. One citizen attended the public meeting and no comments were submitted. Had comments been received they would have been evaluated to determine whether and how to amend the text, and whether those changes rise to the level that requires formal approval by the Working Group.

3.4 The 2015 Update: Hazard Identification and Risk Assessment

Chapter 5 (Hurricanes & Tropical Storms) and Chapter 6 (Other Hazards & Risks) include descriptions of hazards and characterizations of the assessments of risk. Chapter 5 includes a series of tables that summarize the 2014/2015 damage projections from data analysis run by the State using "FEMA's Hazus program. Hazus provides a probabilistic risk assessment based on current scientific and engineering knowledge, and U.S. Census data for population. As noted in Section 5.5, in 2015 the Working Group decided that like the previously used TAOS ("The Arbiter of Storms") software, the value of Hazus results are not in the precise numbers, but in the order of magnitude of projected damage (see Tables 5-9 through 5-15).

At the March 5, 2015 meeting, the Working Group confirmed this general risk assessment. With regard to buildings, while many new buildings have been constructed, compliance with the Florida Building Code and each jurisdictions flood damage prevention regulations limits vulnerabilities. To account for some of the changes in the preceding 5 years, the Working Group obtained the total number of each structure category and the current total value of those structures from the Monroe County Property Assessment Office (see Table 2-4).

3.5 2015 Updates

The LMS Working Group reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 3.2: Described the LMS meetings related to the 2015 Update; updated the description of the planning process to reflect recent actions
- Section 3.3: Updated public involvement activities
- Section 3.4: Updated to describe use of Hazus analyses to replace TAOS

Chapter 4. Mitigation Goals

4.1 Introduction

State and federal guidance and regulations pertaining to mitigation planning require the development of mitigation goals to reduce or avoid long-term vulnerabilities to identified hazards. Mitigation goals have been established by the Federal Emergency Management Agency, the State of Florida, and Monroe County's LMS Working Group.

4.2 LMS Mitigation Goals

State and federal guidance and regulations pertaining to mitigation planning require the identification of mitigation goals that are consistent with other goals, mission statements and vision statements. The Monroe County Comprehensive Plan (Year 2010) includes **Goal 217:** "Monroe County shall develop and implement a program of hazard mitigation and post-disaster redevelopment to increase public safety and reduce damages and public expenditures." As of early 2015, the Comprehensive Plan is being updated.

The LMS Working Group first developed a set of goals as part of the 1999 LMS. These goals were reviewed and confirmed for the LMS revision in 2005, with one minor addition. The goals were discussed and reconfirmed for both the 2010 and 2015 Updates. It was agreed for the 2015 Update that these goals focus on the key hazard mitigation issues for Monroe County and remain viable. To move towards meeting these goals, the members of the LMS Working Group consider the range of mitigation initiatives outlined in Section 13.2 when identifying initiatives within their jurisdictions.

Monroe County Local Mitigation Strategy Goals

1. *Preservation of sustainability of life, health, safety and welfare.*
2. *Preservation of infrastructure, including power, water, sewer and communications.*
3. *Maintenance and protection of roads and bridges, including traffic signals and street signs.*
4. *Protection of critical facilities, including public schools and public buildings.*
5. *Preservation of property and assets.*
6. *Preservation of economy during and after disaster, including business viability.*
7. *Preservation and protection of the environment, including natural and historic resources.*

4.3 Florida's Mitigation Vision & Mission Statement

The Florida *State Hazard Mitigation Plan* was revised and approved by FEMA in 2013. The Plan outlines the State's primary goals, detailed risk assessment, and a wide variety of actions.

The primary goals set forth in the State plan include:

- Goal 1: Implement an effective comprehensive statewide hazard mitigation plan
- Goal 2: Support local and regional mitigation strategies
- Goal 3: Increase public and private sector awareness and support for hazard mitigation in Florida
- Goal 4: Support mitigation initiatives and policies that protect the state's cultural, economic, and natural resources

4.4 2015 Updates

The LMS Working Group reviewed and updated the pertinent sections:

- Section 4.2: Noted the mitigation goals were discussed and confirmed
- Section 4.3: Updated primary goals from the State's mitigation plan (removing the vision and mission statements that are no longer in the State's 2013 Plan)
- Section 4.4: Former Section 4.4 contained FEMA's National Mitigation Goal; this section was removed because the agency produced the National Mitigation Framework which contains FEMA's mitigation strategy and goal statement

Chapter 5. Hurricanes & Tropical Storms

5.1 Introduction

Chapters 5 and 6 describe the natural hazards that affect Monroe County and the County's vulnerability as well as potential impacts of future hazard events. Chapter 5 focuses solely on the vulnerability and potential impacts from hurricanes and other tropical storms because these pose the greatest risk to the area in terms of both frequency and magnitude. Hurricanes and tropical storms are equally likely to occur through the entire extent of Monroe County.

Chapter 6 focuses on additional natural hazards that pose a higher degree of risk to Monroe County including:

- Strong Storms that include Tornadoes and Water Spouts
- Rainfall/Fresh Water Flooding
- Climate Change and Sea Level Rise
- Drought
- Wildland Fire
- Coastal Erosion

The descriptions of hazards, hazard histories, and impacts that are detailed in this chapter and Chapter 6 are summarized as "relative" vulnerabilities in Table 6-15. The overall vulnerability by each jurisdiction to these hazards is summarized in Table 6-16. Climate Change and Sea Level Rise is a new hazard for this 2015 Update and describes how it impacts other hazards including hurricane storm surge, hurricane wind, tropical storm precipitation (freshwater flooding), wildfire and drought.

Table 5-1 describes some natural hazards addressed in the 2013 State of Florida Mitigation Plan. These hazards were briefly considered for the LMS and 2015 Update and excluded because they do not pose significant risks to the area.

Table 5-1. Hazards Excluded from Further Examination

Hazard	Reasons for Exclusion
Extreme Heat	The State of Florida's 2013 Hazard Mitigation Plan rates Monroe County as having a "Low" Extreme Heat ranking.
Freeze	The 2013 State Plan rates Monroe County as having a "Low" Freeze Hazard ranking.
Winter Storm	Winter storms do not pose risks to agricultural interests and property because of the climatological and meteorological characteristics of the Keys. The winter of 1981 was especially cold, with temperatures in the low 40°s (record low was 35°F at Coral Key Village). In mid-January 2010, the Florida Keys experienced one of the longest and most

	intense periods of cold weather recorded, with temperatures remaining more than 10 degrees below normal for nearly two weeks. The greatest effect of an unusually low temperature would be a resulting low wind chill factor and the National Weather Service Weather Forecast Office in Key West issues wind chill advisories from time to time. Overall, the Florida Key are not at risk to winter storms (including snow, ice, sleet, and blizzard conditions).
Earthquake	Earthquakes are extremely rare in Florida and Monroe County is in the lowest risk are of the state according to the 2013 State Plan. The peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years for Monroe 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	South Florida and the Florida Keys are not at risk to expansive soils.
Sinkholes	The 2013 State Plan reports only one sinkhole occurrence in Monroe County (Key West).
Tsunami	While there is some tsunami hazard for the Atlantic and Gulf coasts for elevations less than 15 feet above mean high tide and within 300 feet horizontal distance from mean high tide line, they are an extremely rare hazard in the Florida Keys. The 2013 State of Florida Hazard Mitigation Plan concludes that the probability of future tsunamis is low.
Dam / Levee Failure	The 2013 State Plan does not report any high or significant hazard dams in Monroe County.

The hurricane loss estimate information in this chapter is based on the Hazus analysis conducted by FDEM in 2014 and 2015. The wind hazard analysis is acceptable for the purpose of identifying and prioritizing potential mitigation actions. It is supplemented with coastal flood hazard impacts estimated by the hurricane storm surge modeling (SLOSH) found in the 2013 update of the State of Florida Enhanced Hazard Mitigation Plan (SHMP). The SLOSH information is included by community in Chapters 7-12.

FEMA's Hazus is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods and hurricanes. Hazus uses Geographic Information Systems (GIS) technology to estimate physical, economic and social impacts of disasters.

Since 1965, 16 of the 18 events that prompted Presidential disaster declarations were associated with tropical cyclones (Table 5-2). One declaration was for fire hazard and one was for a severe cold spell that affected South Florida.

Table 5-2. Presidential Disaster Declarations (1965-2014)

DR#	Date of Declaration	Event	Assistance Provided*
209	09/14/1965	Hurricane Betsy	IA,PA
337	06/24/1972	Tropical Storm Agnes	IA,PA
955	08/24/1992	Hurricane Andrew	IA,PA
982	03/22/1993	Tornadoes, Flooding, High Winds & Tides, Freezing	IA,PA
1204	02/20/1998	Severe Storms, High Winds,	IA,PA

		Tornadoes & Flooding	
1223	06/19/1998	Extreme Fire Hazard	PA
1249	09/28/1998	Hurricane Georges	IA,PA
1259	11/06/1998	Tropical Storm Mitch	IA,PA
1306	10/22/1999	Hurricane Irene	IA,PA
1345	10/04/2000	Severe Storms & Flooding	IA
1359	02/06/2002	Severe Winter Storm	Disaster unemployment
1539	08/11-30/2004	Tropical Storm Bonnie & Hurricane Charlie	IA
1551	09/13/2004	Hurricane Ivan	PA-B
1595	07/10/2005	Hurricane Dennis	PA
1602	08/28/2005	Hurricane Katrina	PA
1609	10/24/2005	Hurricane Wilma	IA, PA
1785	08/24/2008	Tropical Storm Fay	PA
4084	10/18/2012	Hurricane Isaac	PA

* IA = Individual Assistance; PA = Public Assistance

5.2 Defining the Hazard

The most significant hazards that could affect Monroe County are winds and flooding associated with tropical cyclones (hurricanes, tropical storms, and tropical depressions) and non-tropical storms (see Chapter 6). Non-tropical coastal storms are less common, although such storms can produce high winds and flooding rains.

The Monroe County *Comprehensive Emergency Management Plan* states that "the Florida Keys has one of the highest probabilities of being affected by tropical cyclones in the Continental United States," a characterization that is echoed by the National Hurricane Center.

Most of Monroe County has natural elevations of about 4 to 7 feet above mean sea level. This makes the area vulnerable to coastal flooding. A few areas have poor drainage and accumulate water during heavy rainfalls.

Hurricanes and tropical storms, as well as tropical depressions, are all tropical cyclones defined by the National Weather Service, National Hurricane Center, as warm-core non-frontal synoptic-scale cyclones, originating over tropical or subtropical waters, with organized deep convection and closed surface wind circulation about a well-defined center. Once they have formed, tropical cyclones maintain themselves by extracting heat energy from the ocean at high temperatures and releasing heat at the low temperatures of the upper troposphere. Hurricanes and tropical storms bring heavy rainfalls, storm surge, and high winds, all of which can cause significant damage. These storms can last for several days, and therefore have the potential to cause sustained flooding, high wind, and erosion conditions.

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 categorization based on the hurricane's intensity at the indicated time. The scale provides examples of the type of damage and impacts in the United States associated with winds of the indicated intensity. In general, the damage rises by about a factor of four for every category increase. The scale does not address the potential for such other hurricane-related impacts, as storm surge, rainfall-induced floods, and tornadoes. For more information, see to the National Hurricane Center's website at: http://www.nhc.noaa.gov/aboutsshws.php

Tropical cyclones are classified using the Saffir-Simpson Hurricane Wind Scale, which replaces the Saffir-Simpson Hurricane Scale (Table 5-3). As described on the NOAA National Hurricane Center's webpage (below), the scale has been modified to indicate only wind intensity and anticipated types of damage and impacts. The description notes that the scale no longer indicates anticipated storm surge depths.

Storm surge is a large dome of water which may be 50- to 100-miles wide and rising from less than 4-feet to over 18-feet high. Generally, surges begin to arrive before a storm's landfall, although the timing is influenced by the path, forward speed, and timing of each storm with respect to the tide cycle. Wind-driven waves are a significant component of tropical cyclones. The height of waves is influenced by storm characteristics and whether shorelines are buffered by barrier islands.

Table 5-3. Saffir-Sampson Scale and Typical Damage

Tropical Storm: Sustained winds 39-73 mph.	
Category One Hurricane: Sustained winds 74-95 mph.	*Damaging winds are expected.* Some damage to building structures could occur, primarily to unanchored mobile homes (mainly pre-1994 construction). Some damage is likely to poorly constructed signs. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possible death. Numerous large branches of healthy trees will snap. Some trees will be uprooted, especially where the ground is saturated. Many areas will experience power outages with some downed power poles.
Category Two Hurricane: Sustained winds 96-110 mph *Very strong winds will produce widespread damage.*	Some roofing material, door, and window damage of buildings will occur. Considerable damage to mobile homes (mainly pre-1994 construction) and poorly constructed signs is likely. A number of glass windows in high rise buildings will be dislodged and become airborne. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possible death. Numerous large branches will break. Many trees will be uprooted or snapped. Extensive damage to power lines and poles will likely result in widespread power outages that could last a few to several days.
Category Three Hurricane: Sustained winds 111-130. *Dangerous winds will cause extensive damage.*	Some structural damage to houses and buildings will occur with a minor amount of wall failures. Mobile homes (mainly pre-1994 construction) and poorly constructed signs are destroyed. Many windows in high rise buildings will be dislodged and become airborne. Persons struck by windborne debris risk injury and possible death. Many trees will be snapped or uprooted and block numerous roads. Near total power loss is expected with outages that could last from several days to weeks.
Category Four Hurricane: Sustained winds 131-155 mph. *Extremely dangerous*	Some wall failures with some complete roof structure failures on houses will occur. All signs are blown down. Complete destruction of mobile homes (primarily pre-1994 construction). Extensive damage to doors and windows is

winds causing devastating damage are expected.	likely. Numerous windows in high rise buildings will be dislodged and become airborne. Windborne debris will cause extensive damage and persons struck by the wind-blown debris will be injured or killed. Most trees will be snapped or uprooted. Fallen trees could cut off residential areas for days to weeks. Electricity will be unavailable for weeks after the hurricane passes.
Category Five Hurricane: Sustained winds greater than 155 mph. *Catastrophic damage is expected.*	Complete roof failure on many residences and industrial buildings will occur. Some complete building failures with small buildings blown over or away are likely. All signs blown down. Complete destruction of mobile homes (built in any year). Severe and extensive window and door damage will occur. Nearly all windows in high rise buildings will be dislodged and become airborne. Severe injury or death is likely for persons struck by wind-blown debris. Nearly all trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months.

Storm surge can be modeled by various techniques; one such technique is the use of the National Weather Services' Sea, Lake and Overland Surges from Hurricanes (SLOSH) model. The model is used to predict storm surge heights based on hurricane category. Surge inundation areas are classified based on the category of hurricane that would cause flooding. As the category of the storm increases, more land area will become inundated. Storm surge is a major component of Nor'easter storms along the East Coast of the U.S. Because winds are moving from a north and/or eastward position, winds move across the ocean towards shore and form large waves.

5.2.1 Future Flooding Conditions

Due to the impacts of climate change and sea level rise, which are covered more extensively in Section 6.7, the frequency and severity of flooding conditions are expected to increase in the future. Surge heights are predicted to be greater due to sea level rise and climate change is expected to periodically cause more intense rainfall which will exacerbate freshwater flooding.

5.2.2 Flood Insurance Rate Maps

The National Flood Insurance Program (NFIP) prepares maps to depict areas that are predicted to flood during events up to and including the 1-percent annual chance flood (commonly called the 100-year flood). In Monroe County and the cities, virtually all areas shown on the Flood Insurance Rate Maps (FIRMs) are impacted by coastal flooding, whether due to hurricanes or other tropical storms. Monroe County and the cities all maintain copies of their current effective FIRMs and the maps are available for inspection by the public. The FIRM consists of many map panels. Some indication of the extent of the SFHA is shown on repetitive loss maps found in Chapter 7 (Monroe County) and chapters 8 through 12 (municipalities).

In order to make federal flood insurance available to citizens, communities adopt FIRMs and administer floodplain management ordinances. Table 5-4 indicates when the County and cities first joined the NFIP and the date of the current map.

Table 5-4. Flood Insurance Rate Maps

	Joined the NFIP	Date of Current Map
Monroe County	June 15, 1973	February 18, 2005
Islamorada	October 1, 1998	February 18, 2005
Key Colony Beach	July 16, 1971	February 18, 2005
Key West	September 3, 1971	February 18, 2005
Layton	July 13, 1971	February 18, 2005
Marathon	October 16, 2000	February 18, 2005

In Fiscal Year 2013, the Federal Emergency Management Agency (FEMA) initiated a coastal flood risk study for the South Florida Study Area that affects Monroe, Broward, Miami-Dade, and Palm Beach Counties. The results of that study will be incorporated into updated digital Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) reports for these counties. New surge and wave modeling is underway; completion is expected in 2017 and revised flood hazard mapping is anticipated to be completed in 3-4 years. Discovery meetings were held in Monroe County in July 2014. More information about the study is available at http://www.southeastcoastalmaps.com/Pages/Projects/South-Florida.aspx.

5.2.3 NFIP Flood Insurance Policies & Repetitive Loss Properties

National Flood Insurance Program data identifies properties in Monroe County and the cities that are, or have been, insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. These properties are called "repetitive loss properties." Table 5-5 shows that as of March 2015, there are a total of 916 such properties, an increase of four properties since February 2010. Data provided in February 2010 noted a total of 2,048 claims for a total of $60.3 million in claim payments. The 2010 data also indicated 78% of the repetitive loss properties were single-family homes, nearly 13% were multi-family buildings, and the remaining were nonresidential structures. In 2015, there was a total of 2,073 claims countywide for a total of $62.1 million in claims payments. Of the 916 repetitive loss properties, 833 are residential and 83 are non-residential.

Table 5-5. NFIP Repetitive Loss Properties – comparison between February 2010 and March 2015

	February 2010	March 2015		
	# of Properties	# of Properties	# Claims	Total Claim Payments (rounded to nearest 1/10 million)
Monroe County	636	631	1,350	$29.3 million
Islamorada	14	16	47	$1.2 million
Key Colony Beach	15	14	39	$1.8 million
Key West	216	221	563	$25.7 million
Layton	0	0	0	0
Marathon	31	34	74	$4.1 million
Total	912	916	2,073	$62.1 million

5.3 Hurricane Effects in Monroe County

The 2013 State Hazard Mitigation Plan contains results of an analysis that provides an overview of the County's vulnerability to coastal flooding. Table 5-6 shows the results of overlaying 2010 census block population with coastal flood depth grids. The flood depth grids came from the FEMA Coastal Flood Atlas. Reflecting the generally low-lying character of the Keys, the difference in population affected by the two categories is not large. The overall spatial extent of hurricane effects in Monroe County is medium to large, depending on the size and strength of a hurricane, with all of the County being susceptible to hurricane high winds and most areas, especially in the populated areas of the Florida Keys, vulnerable to storm surge (see Table 5-6 and Figure 5-1). Based on previous occurrences, Monroe County and municipalities are susceptible to hurricanes of all magnitudes, from Category 1 to Category 5. Probabilities of occurrence of hurricanes are described below Figure 5-1.

Table 5-6 Population Affected by Coastal Flooding from Category 2 and 5 Hurricanes

Depth →	1-3 ft	4-6 ft	7-10 ft	11-13 ft	14-16 ft	17-20 ft	over 20 ft
Population affected by Category 2	34,492	50,502	29,123	1	-	-	-
Additional Population affected by Category 5	290	733	1,834	1,376	145	216	202

Source: State of Florida Enhanced Hazard Mitigation Plan, August 2013

Figure 5-1 depicts surge zones for Categories 1 to 5. A large portion of the Florida Keys is susceptible to flooding from a Category 1 storm. A larger map of surge zones can be accessed at http://floridadisaster.org/publicmapping/SURGE/SURGE_MONROE.pdf.

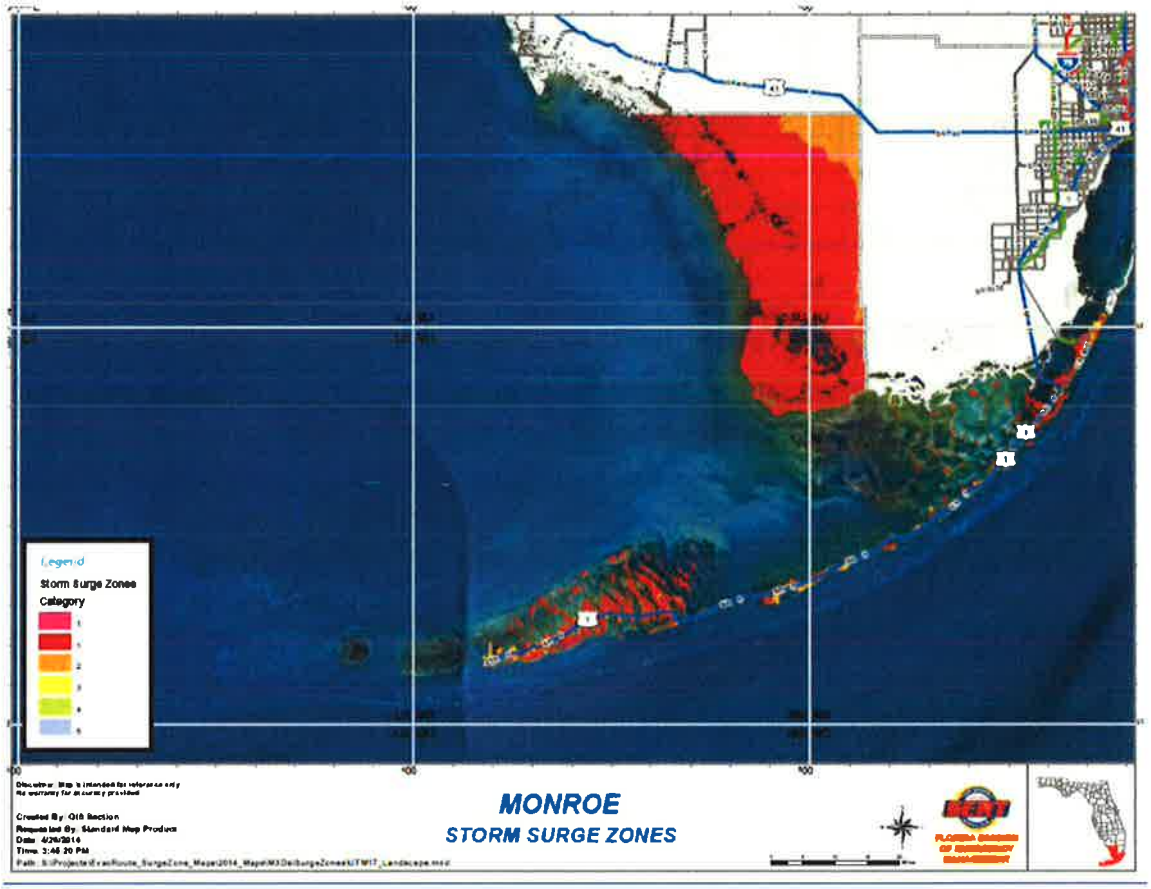


Figure 5-1. Storm surge zones for Monroe County.

Assigning frequencies to hurricanes is difficult, in large part because of the relatively short record. Based on past storms, it appears that the frequency for a Category 5 storm in Key West is one every 36 years (or about 3-percent chance in any given year – by comparison, the "100-year" storm has a 1-percent chance of occurring in any given year). A Category 4 storm is likely to occur about once every 22 years (or about 5-percent in any given year). Category 3, 2, and 1 hurricanes and tropical storms have increasing probabilities of occurrence in any given year. Overall, Monroe County has been advised that in any given

year, there is a one in four chance (25-percent) that the area will be affected by a tropical cyclone of some intensity.

One of the greatest threats posed by hurricanes is their erratic and irregular tracks, making prediction of landfall difficult. Figure 5-2 illustrates the tracks of past hurricanes and tropical storms. More hurricanes make landfall during September and October, although they have occurred in all months of hurricane season.

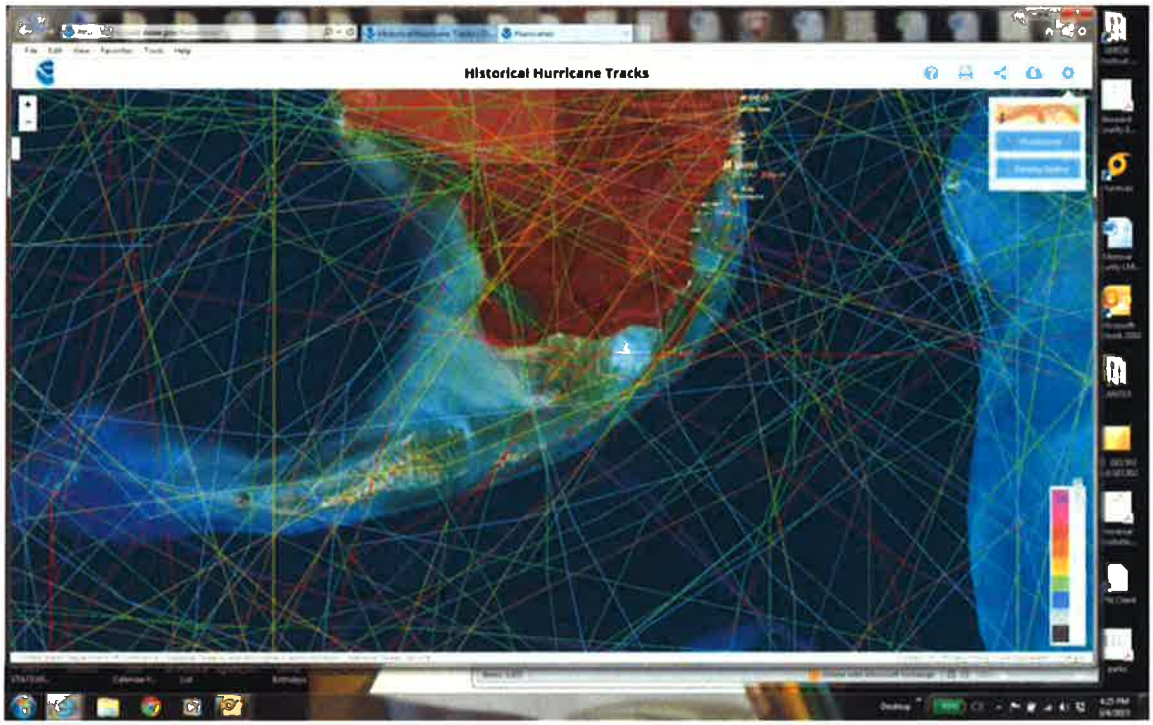


Figure 5-2. Historical hurricane and tropical storm tracks, South Florida (online http://coast.noaa.gov/digitalcoast/tools/hurricanes).

5.4 Some Major Hurricanes

The Florida Keys have experienced many hurricanes and tropical storms. Brief descriptions of some or the more significant storms (Table 5-7) are sufficient to characterize the hurricane history of the area. As of mid-2015, Hurricane Isaac, described below, is the most recent hurricane or tropical storm to have an impact in Monroe County.

Table 5-7. Some Major Hurricanes that Affected Monroe County

1919 Hurricane (September 2-15). The hurricane passed Key West and the Dry Tortugas on a westward course. Key West recorded winds of 95 mph, with a barometric pressure of 28.81 inches. Water levels were 5-7 feet above Mean Sea Level (MSL)
1929 Hurricane (September 22 to October 4). The hurricane crossed over Key Largo on a northerly course. Key Largo reported winds estimated at over 100 mph, a central barometric pressure of 28 inches, and tide levels of 8-9 feet above MSL. Key West experienced tide levels of 5-6 feet above MSL and winds of 66 mph.

Table 5-7. Some Major Hurricanes that Affected Monroe County

1935 Hurricane (August 29-September 10). The small, extremely violent, Category 5 hurricane crossed the Florida Keys on a northwesterly track. The Tavernier-Islamorada area reported winds estimated at 120 mph with gusts from 190-210 mph. Tide levels ranged from 14 feet above MSL in Key Largo to 18 feet above MSL in Lower Matecumbe Key. The storm was so intense and tightly wrapped that Key West had tide levels of only 2 feet above MSL and average sustained winds of less than 40 mph. Tragically, the storm caused the death of many WWI veterans who were working on construction of Henry Flagler's Overseas Railroad. The 1935 Keys Hurricane remains the strongest storm ever to hit the Continental U.S.
Hurricane Donna, 1960 (August 29-September 19). Hurricane Donna curved northwestward over the Middle Keys near Long Key/Layton and then traveled northward toward the Gulf Coast towns of Naples and Fort Myers. Areas in the vicinity of the storm experienced winds speed of 128 mph and a central pressure of 28.44 inches. The storm affected the Everglades with estimated winds of 150 mph. Tide levels were reported at Upper Matecumbe Key of 13.5 feet above MSL, at Plantation Key 10+ feet above MSL, and 8.9 feet above MSL in Key Largo. As of 1992 Hurricane Donna, a Category 4 storm, was listed as the 6th most intense hurricane in the U.S.
Hurricane Betsy, 1965 (August 26-September 12). Hurricane Betsy passed over Marathon while moving westward into the Gulf of Mexico. The lowest central pressure was measured in Tavernier at 28.12 inches and wind speeds were estimated to be 120 mph. Tide levels in Tavernier were 7.7 feet above MSL and Key Largo had tide levels of around 9 feet above MSL.
Hurricane Andrew, 1992. This storm made landfall in southern Dade and northern Monroe Counties in the early morning hours of Monday, August 24, 1992. A strong Category 4, the storm severely affected Monroe County in the Key Largo area, particularly North Key Largo and the community of Ocean Reef. According to National Hurricane Center, maximum sustained winds for this storm were 145 miles per hour, with gusts to 175 miles per hour. At landfall, its central barometric pressure was, 926 Mb, is the third lowest in the 20th Century. At the time, Hurricane Andrew was the third strongest storm this Century. Storm tides at Ocean Reef have been estimated at about 4.5 feet on the bay side and 3.9 to 5.0 feet on the ocean side. Because of the storm's intensity and tight configuration, it quickly moved inland. Hurricane Andrew was costly for Monroe County, including extensive roof and other structural damage to residences; public safety and administrative buildings; the Card Sound Road toll facility; and resort buildings; loss of emergency equipment; severe damage to roadways and signs; loss or emergency and security vehicles; and damage to marinas and craft. Other expenses accrued from large-scale landscape loss and damage; loss of and damage to private vehicles; damage to recreational facilities; and great loss of personal property. Many businesses in Upper Key Largo experienced some damage (especially roofs) and loss of signs and landscaping. County roadways were blocked by debris and street and road signs were lost. The Florida Keys Electric Coop reported $130,000 in losses of utility poles and related infrastructure. Total damage in Monroe County exceeded $131,000,000.
Hurricane Georges, 1998. On September 25, 1998, this hurricane made landfall in the Lower Keys and affected the entire county to some extent. Hurricane Georges devastated the Caribbean, including Haiti and the Dominican Republic, Puerto Rico, and Cuba before taking aim at Monroe County. When it hit Santo Domingo in the Dominican Republic on September 22nd, it was a strong Category 3 with sustained winds of120 mph. It weakened to a Category 2 by the time it arrived in the Florida Keys, with maximum sustained winds of 92 mph measured at the Naval Air Station (Boca Chica) near Key West. Gusts of 110 mph were reported in Marathon. According to the Key West Weather Service, precipitation levels in the Lower Keys were identified as 8.65 inches on the south side of Sugarloaf Key, 8.38 inches at Key West International Airport, 8.20 inches on Cudjoe Key, and 8.4 inches at Tavernier in the Upper Keys. The most severe damage was sustained between Sugarloaf Key and Big Pine Key in the Lower Keys. Damage estimates, including insurable, uninsurable, and infrastructure loss, was nearly $300 million. Substantial damage occurred to mobile homes and landscaping throughout the keys. Roof and flood damage occurred in several areas including Big Coppitt, Sugarloaf, Summerland, Ramrod, and Big Pine in the Lower Keys. Similar damage affected the Middle Keys including Marathon, Key Colony Beach, Grassy Key, Long Key/Layton, and Duck Key. In the Upper Keys, several hotels and motels, such as the Cheeca Lodge received damage as did portions of roadway, e.g. Lower Matecumbe where overwash occurred. A school under construction in Sugarloaf Key sustained damage to the unfinished roof, heavy damage to the Big Pine Community Center, and damage to the air conditioning unit on the roof of Marathon High School, which resulted in interior water damage. The City of Key West sustained damage to private buildings and public property, especially along low-lying areas along South Roosevelt Boulevard.

Table 5-7. Some Major Hurricanes that Affected Monroe County

Tropical Storm Mitch, 1998. Arriving on November 4 and 5, Mitch initially was forecast to bring minimal tropical storm conditions to the Keys. Unfortunately, feeder bands from Mitch containing super cells spawned several damaging tornadoes in the Upper Keys. Sections with mobile homes were especially hard hit. Islamorada experienced an F-1 tornado. Rock Harbor and Key Largo were hit by F-2 tornadoes. The State reported Monroe County's damage were estimated at nearly $11 million.
Hurricane Wilma, October 2005. During the night of October 23 to 24, 2005. Hurricane Wilma visited Monroe County, resulting in at least 2 injuries and at least $33 million in damage. Over the Upper Keys from Craig Key to Ocean Reef, maximum winds were measured at 65 knots with gusts to 79 knots. At Molasses Reef C-MAN station. Overall, average winds across the inhabited Lower Keys were estimated at 70 to 80 mph with gusts up to 90 mph with general Category 1 Saffir Simpson Damage noted. Rainfall across the Lower Keys was fairly light but typical for a fast-moving hurricane, 1.50 inches measured at Pennekamp State Park in Key Largo. Wilma's storm surge primarily affected the bayside of the Upper Keys, ranging from 4 to 5 feet above sea level with the worst in Lower Matecumbe Key. U.S. Route 1 north of Key Largo was temporarily flooded at least 3 inches at maximum surge during the afternoon hours on October 24. For a more complete description of the impacts, see Appendix D of this 2015 LMS Update, "Hurricane Wilma in the Florida Keys" by Kennard Kasper, National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS) Weather Forecast Office (WFO) Key West, Florida (http://www.srh.noaa.gov/media/key/Research/wilma.pdf).
Tropical Storm Isaac, August 2012. The storm that ultimately became Hurricane Isaac was a tropical storm as it moved west-northwest at 18 mph through the Straits of Florida, with the center passing across the lower Keys on Sunday, August 26th. The heaviest of the rain bands concentrated over Palm Beach and Broward counties, producing between 10 and 13 inches of rain. NWS Miami reports record a maximum of 4.66 inches of rain for mainland Monroe. In preparation for storm surge, strong winds and the possibility of tornadoes, the Keys' two airports closed Saturday night, and volunteers and some residents began filing into shelters, but eventually the island chain only experienced power outages and flooding in low-lying areas. Newspaper reports mentioned Duval Street in Key West being mostly closed. Mobile homes and residences in low-lying areas were evacuated between August 23rd and 25th in anticipation of the storm. Some parts of Monroe County shoreline experienced severe coastal erosion. Source: http://www.srh.noaa.gov/mfl/?n=isaac, and Monroe County Emergency Management

5.5 Losses Due to Major Disasters

No definitive record exists of all losses – public and private – due to disasters for Monroe County. For the United States as a whole, estimates of the total public and private costs of natural hazards range from $2 billion to over $6 billion per year. Most of those costs can only be estimated. In most declared major disasters, the Federal government reimburses 75% of the costs of cleanup and recovery, with the remaining 25% covered by states and affected local jurisdictions. FEMA administers two programs that help with recovery:

- Public Assistance program, that provides cost-shared grants for certain categories of damage/expenditures sustained by State and local governments and certain types of nonprofit organizations. FEMA provides supplemental assistance for debris removal, emergency protective measures, and the repair, replacement or restoration of damaged public facilities and facilities of certain nonprofit organizations, including damaged roads and bridges, flood control facilities, public buildings and equipment, public utilities, and parks and recreational facilities; and
- Individual Assistance program, which provides direct assistance to individuals, families, and businesses for certain losses that are not covered by insurance.

This assistance is intended to help with critical expenses that are not covered in other ways – it is not intended to restore damaged property to pre-disaster condition.

The Florida Division of Emergency Management coordinates and administers aspects of FEMA's Public Assistance Program. FDEM provided the data shown in Table 5-8 which summarizes some costs associated with disaster recovery from declared disasters in the past decade (including estimates of some costs that were covered by insurance).

Table 5-8. Some Past Disaster Recovery Costs

Hurricane Georges Damage As Of September 1, 1999*	
Public Assistance (Infrastructure & Emergency Activities)	$ 54,257,290
Temporary Housing	$ 6,584,782
Individual Assistance	$ 3,966,572
Small Business Administration	$ 61,366,100
National Flood Insurance Program	$ 38,044,669
Wind Insurance (est.)	$131,000,000
TOTAL	$ 295,219,413
Tropical Storm Mitch Damage As Of September 1, 1999*	
Public Assistance (Infrastructure & Emergency Activities)	$ 4,021,718
Temporary Housing	$ 754,845
Individual Assistance	$ 395,663
Small Business Administration	$ 5,678,700
National Flood Insurance Program	$ 51,527
TOTAL	$ 10,902,183
Hurricane Ivan (DR# 1551)**	
Public Assistance (Infrastructure & Emergency Activities)	$362,648
Temporary Housing	Not declared
Individual Assistance	Not declared
Small Business Administration	Not declared
TOTAL	$362,648
Hurricane Dennis (DR# 1595)**	
Public Assistance (Infrastructure & Emergency Activities)	$6,260,342
Temporary Housing	Not declared
Individual Assistance	Not declared
Small Business Administration	Not declared
TOTAL	$6,260,342
Hurricane Katrina (DR# 1602)**	
Public Assistance (Infrastructure & Emergency Activities)	$5,522,803
Temporary Housing	Not declared

Individual Assistance	Not declared
Small Business Administration	$3,480,700
TOTAL	$9,003,503
Hurricane Wilma (DR# 1609)**	
Public Assistance (Infrastructure & Emergency Activities)	$69,875,249
Temporary Housing	$1,980,852
Individual Assistance	$24,596,806
Small Business Administration	$97,349,200
TOTAL	$193,802,107
Tropical Storm Fay (DR# 1785)**	
Public Assistance (Infrastructure & Emergency Activities)	$4,403,549
Temporary Housing	Not declared
Individual Assistance	Not declared
Small Business Administration	Not declared
TOTAL	$4,403,549
Hurricane Isaac (DR# 4084)***	
Public Assistance (Infrastructure & Emergency Activities)	$1,309,537
Temporary Housing	Not declared
Individual Assistance	Not declared
Small Business Administration	Not declared
TOTAL	$1,309,537

* Florida DCA, Recovery & Mitigation Section (2005)

** Florida DEM, Recovery Bureau (as of November 6, 2009)

*** Monroe County only, as of February 6, 2015

5.6 Impacts of Hurricanes

To estimate potential damage from hurricanes to Monroe County, the Florida Department of Emergency Management performed an analysis using Hazus, a regional multi-hazard loss estimation model developed by FEMA and the National Institute of Building Sciences. Hazus provides a probabilistic risk assessment based on current scientific and engineering knowledge, and U.S. Census data for population. The Hazus methodology models distinct hazard and inventory parameters (wind speed and building types) to determine the impact (damage and losses) on the built environment. One limiting factor is scale – some Hazus information is available at the county level.

Hazus reports building losses from hazard events in two categories: direct building losses and business interruption losses. Direct building losses are the estimated costs to repair or replace damage caused to a building and its contents. Business interruption losses are losses associated with inability to operate a business because of damage sustained during the event. Business interruption losses also include the temporary living expenses for people displaced

from their homes because of the event. All of the Hazus estimates are approximate only and intended to provide a sense of scale of potential damage. The figures have been rounded up to the nearest billion, million or hundred thousand for readability and to provide a snapshot of the potential damage.

FDEM conducted two Hazus analyses to model the impacts of hurricanes. The first analysis, conducted in September 2014, modeled the impacts of hurricane winds for different frequency events (10-, 20-, 50-, 100-, 200-, 500- , and 1000-year) at the county level. This first analysis uses 2010 Census and 2012 dollars. The second analysis, conducted in January 2015, modeled the impact of both hurricane wind and storm surge for a storm scenario similar to Hurricane Betsy in 1965, a Category 3 storm, also uses the 2010 Census for population while updating the dollar value (2012 dollars). A Category 3 storm is expected to have significant impacts and has a higher probability of occurrence than Category 4 and 5 storms. The full Hazus reports are available on request from Monroe County Emergency Management.

Hurricane Wind Analysis by Hazus

Results from Hazus show the impacts from natural hazards in a variety of ways. For this LMS update, the impacts of more frequent storms are reported. Severity of damage to different occupancy types of buildings from 10-year, 50-year and 100-year Hurricane wind storms are shown in Table 5-9. It is important to note that in a 50-year wind event, 8,784 buildings would receive moderate to severe damage while 1,360 buildings would be totally destroyed. In a 100-year event, 15,200 buildings would receive moderate to severe damage while 2,330 buildings would be totally destroyed. The damage shown in Table 5-9 are primarily to residential structures which make up the largest building type in Monroe County (94% of all buildings).

Table 5-9. Expected Building Damage from Hurricane Wind, by Building Occupancy Type: 10-year, 50-year, 100-year events (2012 dollars/2010 Census)

Level of Damage	Storm Frequency	Agriculture	Commercial	Education	Government	Industrial	Religion	Residential	Total
Minor (Count)	10-year	0	139	6	28	17	14	2,589	2,793
	50-year	0	111	5	22	15	13	4,774	4,940
	100-year	0	228	9	48	26	23	10,193	10,527
Moderate (Count)	10-year	0	75	2	13	8	5	522	622

	50-year	0	213	9	40	25	22	4,876	5,184
	100-year	0	373	16	78	45	33	8,766	9,310
Severe (Count)	**10-year**	0	17	0	3	2	1	34	57
	50-year	0	347	16	80	51	31	3,075	3,600
	100-year	0	551	26	132	79	45	5,057	5,890
Destruction (Count)	**10-year**	0	1	0	0	0	0	9	10
	50-year	0	36	0	0	1	1	1,322	1,360
	100-year	0	57	0	1	1	1	2,270	2,330

In addition to structural damage, Hazus categorizes projected economic losses under direct property damage (building, contents, inventory) and business interruption losses (income, relocation, rental, wage). In each of the 50-year and the 100-year wind events, Hazus estimates that there could be over $1 billion dollars in damage to the building themselves ($1.1 billion for the 50-year and $1.8 billion for the 100-year) and the content losses could be approximately $383 million from the 50-year event and $631 million from the 100-year event. Business interruption costs are also expected to be high in a 50-year event (approximately $265 million) and a 100-year event (approximately $439 M). There is a significant difference between the impacts of a 10-year storm and then the 50-year and 100-year storms which justifies the strong building codes already required in Monroe County. Table 5-10 shows the predicted damage from 10-year, 50-year and 100-year wind events with the expected results rounded up to the nearest million or tenth of a million where the figure is less than $1 million. In a couple cases, the figure is over $1 billion and is rounded up to the nearest tenth of a billion.

The Hazus model also estimates losses to essential facilities, debris generation and sheltering needs. For essential facilities, there are 4 hospitals in the region with a total bed capacity of 148 beds. In addition, there are 14 schools, 21 fire stations, 15 police stations and 5 emergency operation facilities. Table 5-11 shows expected impacts to essential facilities from the 10-year, 50-year and 100-year storm events. None of the essential facilities are expected to have complete damage after the 10-, 50-, or 100-year events. For the 50-year event, 9 out of the 14 schools, 9 of the 21 fire stations and 9 of the 15 police stations are expected to have moderate damage. One-half of the hospitals (2 of 4) could receive moderate damage in a 50-year and 20% of the emergency operation facilities. These numbers dramatically increase for the 100-year event with all four hospitals, 80% of the emergency operations facilities, 13 out of 15 police stations, and all 14 schools receiving moderate damage.

Table 5-10. Expected Economic Losses from Hurricane Wind by Building Occupancy Type: 10-year, 50-year, 100-year Event (2012 dollars / 2010 Census) (M= Million; B=Billion)

Type of Economic Loss		Storm Frequency	Residential	Commercial	Industrial	Others	Total
Property Damage Loss	Building	10-year	$54 M	$9 M	$0.5 M	$6 M	$70M
		50-year	$747 M	$147 M	$16 M	$153 M	$1.1 B
		100-year	$1.3 B	$232 M	$21 M	$221 M	$1.8 B
	Content	10-year	$6 m	$2 M	$0.1 M	$1 M	$9 M
		50-year	$276 M	$51 M	$6 M	$50 M	$383 M
		100-year	$468 M	$82 M	$7 M	$74 M	$631 M
	Inventory	10-year	$0	$0.2 M	less than $0.1 M	$0	$0.3 M
		50-year	$0	$4 M	$2 M	$0	$6 M
		100-year	$0	$7 M	$2 M	$0	$9 M
Business Interruption Loss	Income	10-year	$0.4 M	$0.2 M	less than $0.1 M	$0.3 M	$0.9 M
		50-year	$12 M	$5 M	$0.2 M	$0.8 M	$18 M
		100-year	$21 M	$8 M	$0.3 M	$1 M	$30 M
	Relocation	10-year	$3 M	$2 M	$0.1 M	$1 M	$6 M
		50-year	$73 M	$22 M	$2 M	$25 M	$122 M
		100-year	$130 M	$35 M	$3 M	$36 M	$204 M
	Rental	10-year	$6 M	$0.9 M	$less than $0.1 M	$0.3 M	$7 M
		50-year	$55 M	$14 M	$0.4 M	$7 M	$76 M
		100-year	$91 M	$23 M	$0.5 M	$10 M	$124 M
	Wage	10-year	$1 M	$0.4 M	less than $0.1 M	$3 M	$5 M
		50-year	$29 M	$12 M	$0.4 M	$8 M	$49 M
		100-year	$49 M	$19 M	$0.5 M	$12 M	$81 M

Table 5-11. Number of Essential Facilities Estimated to be Damaged: 10-year, 50-year, 100-year Event

	Level of Storm	Emergency Ops Facilities	Fire Stations	Hospitals	Police Stations	Schools
Probability of at least Moderate Damage > 50%	10-year	0	0	0	0	0
	50-year	1	9	2	9	9
	100-year	4	10	4	13	14
Probability of Complete Damage > 50%	10-year	0	0	0	0	0
	50-year	0	0	0	0	0
	100-year	0	0	0	0	0
Expected Loss of Use < 1 day	10-year	5	21	4	15	5
	50-year	4	19	2	6	4
	100-year	4	18	0	6	0

Predicted Building Debris Generation

Hazus estimates that a total of 167,474 tons of building debris could be generated by a 10-year wind event, 211,065 tons from a 50-year wind event and 571,058 tons from a 100-year wind event. If the building debris tonnage is converted to an estimated number of truckloads (at 25 tons per truck), clean up would require 421 truckloads, 6718 truckloads, and 11201 truckloads from a 10-year, 50-year and 100-year event respectively. A 25-ton dump truck can cost between $3,700 to $4,200 a week to rent so the costs of disposing just building debris could easily total several million dollars for the 50 and 100 year storms.

Predicted Shelter Needs

Hazus estimates the number of households that are expected to be displaced after hurricanes and the number of displaced people who would require accommodations in temporary public shelters. The model estimates 138 households could be displaced due to a 10-year wind event, 5,586 households after a 50-year wind event and 8,266 households after a 100-year wind event. Based on a total County-wide residential population of 73,090 (from the 2000 Census), an estimated 26 people would likely seek temporary shelter in public shelters

in a 10-year storm, and 1,145 people in a 50-year storm and 1,702 people in a 100-year storm.

Wind/Surge Analysis by Hazus – A Storm with Surge Similar to Hurricane Betsy Scenario

In the Florida Keys, Hurricane Betsy was a Category 3 hurricane when it made landfall in southern Florida on September 8, 1965, bringing storm tides of up to 6 to 10 feet above normal between Fort Lauderdale and Key Largo. High winds, tidal flooding, and beach erosion caused widespread damage along the lower Florida east coast (from http://www.stormsurge.noaa.gov/event_history_1960s.html . This analysis is for the combined impacts of wind and storm surge from an event that is similar to Hurricane Betsy in its track, wind speed, and surge levels. This scenario then runs this similar storm over Monroe County using the 2010 building and essential facility inventory as well as population levels and dollar values.

Table 5-12 summarizes Hurricane Betsy losses with the expected results rounded up to the nearest million or tenth of a million where the figure is less than $1 million. In a couple cases, the figure is over $1 billion and is rounded up to the nearest tenth of a billion. Hazus estimates total building-related losses caused by an event similar to Hurricane Betsy could be $2.9 billion. Another $17 million in business interruptions could be attributed to a storm similar to Betsy. The model estimated residential occupancies made up nearly 73% of the total loss.

Table 5-12. Hurricane Betsy Scenario: Building-Related Economic Loss Estimates: (2012 dollars / 2010 Census) (M= Million; B=Billion)

Type of Economic Loss		Residential	Commercial	Industrial	Others	Total
Building Loss (millions of dollars)	Building	$1.3 B	$146 M	$33 M	$17 M	$1.5 B
	Content	$813 M	$399 M	$61 M	$100 M	$1.4 B
	Inventory	$0	$6 M	$8 M	$1 M	$15 M
Business Interruption Loss (millions of	Income	$0.2 M	$3 M	$0 M	$0.2 M	$3 M
	Relocation	$3 M	$0.6 M	$0	$0.2 M	$4 M

	Rental Income	$1 M	$0.4 M	$0	$0	$1 M
	Wage	$0.6 M	$3 M	$0	$5 M	$9 M

Table 5-13 summarizes building damage by occupancy and Table 5-14 summarizes building damage by building type. Both tables analyze damage by 1-30%, 31-50%, and substantial damage (over 50%). Residential structures make up most of the structure types (approximately 97%). It is important to note that in this Category 3 event, of the approximately 42, 460 residential buildings in Monroe County, approximately 13% of these buildings would receive up to 30% damage; approximately 10% would receive 31-50% damage; and approximately 7% would receive over 50% damage. Approximately 70% of the residential buildings would not be damaged in this type of event. Table 5-14 shows that of the building types that received over 50% damage, the vast majority were manufactured housing (98%).

Table 5-13. Hurricane Betsy Scenario: Expected Building Damage by Occupancy and Level of Damage: (2012 dollars / 2010 Census)

Level of Damage	Agriculture	Commercial	Education	Government	Industrial	Religion	Residential	Total
1-30% Damage (Count)	0	42	0	7	0	2	5,418	5,469
31-50% Damage (Count)	0	4	0	0	0	0	4,099	4,103
Substantial - Over 50% Damage (Count)	0	0	0	0	0	0	2,785	2,785

Table 5-14. Hurricane Betsy Scenario: Expected Building Damage by Building Type (2012 dollars / 2010 Census)

Level of Damage	Concrete	Manufactured Housing	Masonry	Steel	Wood	Total
1-30% Damage (Count)	149	11	3,878	32	1,404	5,474
31-50% Damage (Count)	154	25	2,867	4	1,064	4,114
Substantial - Over 50% Damage (Count)	3	2,717	48	0	18	2,786

For the essential facilities in this 2010 Hazus scenario, there are 3 hospitals in the county with a total bed capacity of 257 beds. In addition, there are 28 schools, 10 fire stations, 8 police stations and 0 emergency operation facilities. Table 5-15 shows expected impacts to essential facilities from the Category 3 Betsy-type storm scenario. Of significance, 50% of both the fire and police stations would suffer a complete loss of use, and 1 hospital would be inoperable. On the day of the scenario event, the model estimates that 88 hospital beds would still available with one additional hospital receiving moderate damage and the other not damage.

Table 5-15 Hurricane Betsy Scenario: Expected Damage to Essential Facilities

Classification	Number of facilities			
	Total	At Least Moderate Damage	At Least Substantial Damage	Complete Damage – Loss of Use
Fire Stations	10*	5	0	5
Hospitals	3	1	0	1

Police Stations	8	4	0	4
Schools	28**	14	0	12

* - One fire station received no damage

** - Two schools received no damage

Predicted Building Debris Generation

Hazus estimates that a total of 381,321 tons of building debris could be generated by an event similar to Hurricane Betsy. If the building debris tonnage is converted to an estimated number of truckloads (at 25 tons per truck), it would require 15,253 truckloads to remove.

Predicted Shelter Needs

Hazus estimates the number of households expected to be displaced due to a storm similar to Hurricane Betsy and the number of displaced people that would require accommodations in temporary public shelters. The model estimates displaced 17,483 households and 46,896 people (out of a total population of 73,090), 64% of the population, would seek temporary shelter in public shelters.

The 2013 State of Florida Enhanced Hazard Mitigation Plan (Table C.7 to C.10 in Appendix C: Risk Assessment Tables) provides information on the Count and Value of residential and commercial structures vulnerable to flooding associated with Category 2 and Category 5 hurricanes. Similarly, Tables C.15 to C.18 in the State Plan provide the count and value of structures vulnerable to hurricane winds from Category 2 and Category 5 storms. The results for Monroe County are summarized in Table 5-16. It is interesting to note that while the impacts of Category 5 storm surge increase over those of Category 2 storm surge, the effects of hurricane force winds do not increase.

Table 5-16. SHMP Summary: Impacts of Hurricanes in Monroe County (2013).

		Number of Vulnerable Residential Structures	Number of Vulnerable Commercial Structures	Value of Residential Structures	Value of Commercial Structures
Coastal Flooding	**Category 2**	27,521	934	$13,310 million	$1,022 million
	Category 5	31,392	1,365	$5,469 million	$882 million
Hurricane Wind	**Category 2**	34,065	1,463	$5,975 million	$937 million
	Category 5	34,065	1,463	$5,975 million	$937 million

5.6.1 Buildings

County appraisal data indicate there approximately 70 mobile home/recreational vehicle parks (land owned by park operator). Between the units installed in those parks and those installed on individual parcels of land, there are more than 5,600 manufactured homes units. New manufactured home parks have not been approved since 1987. Installation of new or replacement units must comply with current codes.

Four hundred fifty-two parcels of land are recorded as "hotel/motel" and it is estimated that there are 7,100 available rooms (including guest houses but not including "condotels," which are privately-held condominiums that can function as hotels). Most were built before current strict standards related to wind and flood hazards. Additions or substantial renovation will trigger the need to comply with current codes.

A need for affordable housing has been identified in the County and Municipal Comprehensive Plans and was underscored by the experiences in Hurricane Georges and Tropical Storm Mitch. The preliminary damage assessments after those storms identified the number of housing units were determined to have been destroyed or to have sustained major or minimal damage (see Table 5-17). Hurricane Isaac, the only declaration from 2010 to 2014, did not cause significant damage to homes throughout the area and was declared for Public Assistance only.

Table 5-17. Monroe Housing Units Affected by Hurricanes Georges and Mitch

	Total Affected	Degree of Damage		
		Minimal	Major	Destroyed
Hurricane Georges	1,854	893	470	173
Tropical Storm Mitch	664	165	40	43

5.6.2 Transportation Infrastructure and Considerations for Evacuation and Warning

Historically, some areas and streets are more vulnerable than others to coastal flooding and/or pooling of rainfall runoff flooding from heavy rains. In the past decade, the following areas have been identified as likely to flood repetitively:

- MM 109 in the Upper Keys, which can hamper evacuation.
- MM 106, Lake Surprise area, vulnerable to the effects of wind driven wave run-up from E/NE and W/SW directions; heavy rainfall results in ponding.
- MM 111, the exposed beach area along the 18-mile stretch bordering Barnes Sound, experiences wave runup or "piling" with strong E and NE winds.

- MM 113, the Point Laura Marina Area, borders Barnes Sound is similarly susceptible to strong E and NE winds.
- MM 73.5 to approximately MM 74.5, the Lower Matecumbe area known as "Sea Oats Beach", vulnerable to NE / E / SE wind driven wave run-up.
- MM 30 -31, Big Pine Key. The area north of the Big Pine Plaza Shopping Center encompassing Wilder Road and Key Deer Boulevard, while not normally vulnerable to storm surge effects, experience rainfall ponding.
- MM 9-10, Big Coppitt Key, Bayside, experiences wind-generated wave run-up.

Hurricane Andrew, Hurricane Georges, Tropical Storm Mitch. Transportation disruptions in the Keys occurred during evacuations for Hurricane Andrew and Hurricane Georges. Following Tropical Storm Mitch and Hurricane Georges, debris on U.S. 1 somewhat impeded traffic flow. Both of the areas airports, Key West Airport and Marathon Airport, were closed before Hurricane Georges moved through the area. Damage to the airfield lighting at the Key West Airport closed the facility for five days. The Marathon Airport did not suffer any notable physical damage, but was closed for four days for debris removal and assessment and repair.

Hurricane Wilma. The Monroe County Public Works Division reported the following:

- Twenty-five separate work orders were issued for sign repairs in the upper Keys ($12,799) and Lower Keys ($29,732).
- Repair of revetment at the Long Key transfer station ($47,199).
- Road repairs on Lobster Lane, Key Largo ($4,869).
- Repairs to asphalt and limerock base on Seaview Avenue, Conch Key ($8,900).
- Repairs to various roads in the Lower Keys ($299,375).
- Repair of asphalt and limerock base, 450 linear feet of riprap barrier wall, and 750 linear feet of new riprap barrier wall (considered as "mitigation") at the end of Boca Chica Road (estimated $382,000).
- Repaired several street lights ($12,000).
- Storms were cleaning in the Lower Keys ($15,000).
- Repair of traffic signal equipment that was deteriorated by corrosion likely caused by salt water/moisture intrusion at several locations; it is likely the damage is attributable to Hurricane Wilma, even though the work was done nearly a year after the storm.

Warning and Evacuation Procedures

The Florida Keys are one of the most vulnerable areas in the nation to hurricanes. Monroe County has shelters set up at four schools for Category 1 and 2 storms. Shelters are not planned for Category 3 and stronger hurricanes because evacuation is mandatory. Due to the fact that U.S. Highway 1 is the only egress in the Florida Keys, evacuation procedures must begin early and are staged. The following are the basic procedures outlined in a memorandum of understanding between the Florida Department of Economic Opportunity and the County, municipalities, and FDEM:

- Approximately 48 hours in advance of tropical storm winds, mandatory evacuation is initiated for non-residents, visitors, recreational vehicles, travel trailers, live-aboards, and military personnel.
- Approximately 36 hours in advance of tropical storm winds, mandatory evacuation is initiated for mobile home residents, special needs residents, and hospital and nursing home patients.
- Approximately 30 hours in advance of tropical storm winds, mandatory phased evacuation of permanent residents is initiated by the following evacuation zones:
    - Zone 1 – Key West, Stock Island and Key Haven to Boca Chica Bridge (Mile Markers (MM) 1-6)
    - Zone 2 – Boca Chica Bridge to West end of 7-mile Bridge (MM 6-40)
    - Zone 3 – West end of 7-Mile Bridge to West end of Long Key Bridge (MM 40-63)
    - Zone 4 – West end of Long Boat Key Bridge to County Road (CR) 905 and CR 905A intersection (MM 63-106.5)
    - Zone 5 – CR 905A to ,and including Ocean Reef (MM 106.5-126.5)

The sequence of evacuation by zones will vary depending on the characteristics of actual storms. After storms have left the area, the County implements Hurricane Re-entry Procedures to allow law enforcement the option of separating residents who are traveling to areas with less damage from those returning to more badly damaged areas.

5.6.3 Communications

Most telephone service in the Keys is directed through facilities in Miami, although some local capability provides services within single exchanges. To ensure redundancy, two major trunk fibers are furnished from Homestead on the mainland to Key West (one buried and one aerial). However, most cable lines are located along the underside of fixed bridges, making them vulnerable if bridges fail. Installing sub-surface cable is not feasible because of rock substructure; environmental considerations inhibit underwater installations.

Communications infrastructure suffered in Hurricanes Andrew and Georges, downing towers and antennas in Dade County (cell towers, radio and TV towers, and repeaters) and damaging poles and switching equipment. The NOAA weather radio transmitter in Key Largo was damaged in Hurricane Andrew. Winds associated with Hurricane Georges destroyed the Key West Police Department's communication's tower. Major communication problems result from loss of electrical power.

The Monroe County Sheriff's Office Florida Keys reported installing a special door to protect the 911 equipment room from flooding.

5.6.4 Water Supply

Although Monroe County receives approximately 42 inches of rainfall per year, there are virtually no fresh water sources in the Upper Keys due to characteristics of the underlying limestone base rock. Some small fresh water lenses exist in the Lower Keys, primarily in Big Pine Key and Key West. Consequently, virtually all-potable water comes from the Biscayne Aquifer in Florida City via pipeline owned and operated by the Florida Keys Aqueduct Authority. The main pipeline that connects to the Upper Keys is laid underwater; some distribution pipelines are connected to roads and bridges and thus vulnerable to washout.

The Florida Keys Aqueduct Authority is an independent Special District created by the State of Florida Legislature, with the primary purpose and function to obtain, treat and distribute an adequate water supply to the residents and businesses of the Florida Keys. In 1998, the Florida Legislature modified the Authority's enabling Act to include providing wastewater collection, treatment and disposal throughout the unincorporated areas of Monroe County, with the exception of Key Largo. The Authority manages the infrastructure used to supply water and wastewater services to its customers in the Florida Keys, sets rates and provides customer service.

The Florida Key's Aqueduct Authority's mitigation and response activities include:

- The Authority's pipeline originates in Florida City in south Miami-Dade County. It ensures that the supply is protected from hazards and complies with South Florida Water Management Districts permit requirements, including identification and use of alternative sources. The Authority also operates and maintains two Reverse Osmosis emergency water treatment plants in the Florida Keys, to provide an alternate source when water cannot be supplied through the pipeline.
- The Authority participates in developing policies and procedures for responding to and recovering from shortages or disruptions in the supply and delivery of electricity, potable water, waste water collection and treatment and other fuels which affect or threaten to affect significant numbers of citizens and visitors.

The Authority, an agency of the State, has contingency plans and works diligently to provide water in the event of a hurricane in the Keys. Although not required to obtain local building permits, FKAA is required to meet or exceed the latest edition of the Florida Building Code when building or renovating its facilities. In addition, FKAA complies with the minimum design standards for flood protection of water and wastewater infrastructure and the standards set by the Florida Department of Environmental Protection. Some redundancy for the regular supply line was provided by restoring two reverse osmosis plants: the Marathon facility would serve the Middle Keys and the Stock Island (Key West) facility would serve the Lower Keys. All primary pumping and water treatment facilities have backup power generation capability.

Hurricane Andrew: The water treatment plant in Florida City was damaged (lost roof on control room; roof on high service pump building; loss of Quonset hut; other minor building damage; partial loss of communication system). The only impact to customers was discontinuation of lime softening at the plant.

Hurricane Georges: The Florida Keys Aqueduct Authority reported that little, if any, disruption occurred in the transmission system during Hurricane Georges. Distribution system disruptions occurred in isolated areas due to broken water mains caused by uprooted trees. Wave action on the ocean side of the Spanish Harbor Bridge washed out a portion of the approach road and exposed about 250 feet of 24-inch transmission main (subsequently relocated to the roadway). As a private non-profit entity, FKAA was eligible to receive $1.69 million in federal disaster assistance. The assistance was used to rehabilitate damaged facilities.

All new or replaced pump stations are built above the estimate storm surge level of 14 feet above mean seal level. Other new structures are hardened to help withstand storm damage and protection operational capacity. An existing transmission station was retrofit with floodproofed doors.

Private water wells that draw from shallow freshwater sources can be contaminated by flooding, whether from storm surge or ponded runoff. A number were contaminated by floodwaters in Hurricane Georges, especially on Big Pine Key, where it appears that flooded septic tanks, cesspools and drain fields overflowed. After that event the South Florida Water Management District provided funding to the FKAA to install distribution mains to homes on Big Pine Key that had wells contaminated by the tidal surge. The project also supported environmental objectives related to the Key Deer, and endangered species, by reducing withdrawals from the fresh water lens.

***Hurricane Wilma*:** In its 2007 Comprehensive Annual Financial Report, the FKAA reported having sustained no significant infrastructure damage and there were no interruptions of service.

5.6.5 Electric Power

Electric power is supplied by Florida Keys Electric Cooperative (FKEC) from the Upper Keys to Marathon, and by Keys Energy Service (KEYS) from Sunshine Key to Key West. The two agencies cooperate to provide the best service for the area. Both utilities purchase power from larger suppliers.

Keys Energy Service has the capability to generate electricity at its plant in Key West. The FKEC has limited generating capability at its Marathon Plant. With the exception of the private community of Ocean Reef in North Key Largo, the majority of electric lines in the county are above-ground. Due to vulnerability, power poles are not located on bridges but are submerged. Subsequent to Hurricane Andrew, some poles were re-designed to withstand higher wind forces. Both electric utilities have replaced older equipment with newer, more resilient designs and materials.

Hurricane Andrew: Due to the loss of the Florida Power and Light Company's electrical tie line in Dade County, Monroe County's approximately 78,000 residents were without power or on limited power for approximately two weeks. The Florida Keys Electric Cooperative reported a $130,000 loss of utility poles and related infrastructure. A report by the Florida Sea Grant Program identified lack of power as one the most significant factors affecting businesses and, while such damage was difficult to quantify in a monetary sense, they "left an indelible economic footprint on many businesses in the Keys."

Hurricane Georges: The Lower Keys experienced significant disruption of electric power. Damage to transformers, power poles, and transmission lines was responsible for widespread power outages, especially in areas serviced by Keys Energy Service. Power was restored on a priority basis with efforts directed at hospitals and critical services. Most electricity was reestablished within two weeks; however, as with most disasters, restoration in the hardest hit areas progressed more slowly. Power outages created major economic loss to Key businesses that are heavily dependent on the tourist trade. Disaster related unemployment, primarily due to the lack of electricity was significant because of loss of jobs in the service industry.

Hurricane Wilma:

- **Florida Keys Electric Cooperative (FKEC)** reported that its power transmission system sustained no damage and was able to transmit power immediately after Hurricane Wilma. The power distribution system sustained moderate damage, with repair costs totaling $712,500. Damage was sustained

by the land-based portion of the distribution system (downed primary taps, broken poles, transformer failures) and by the Channel Five water crossing, where severe winds caused disconnection of the wires. Overall, FKEC assessed that its power distribution and power transmission systems held up well, with limited outage.

- **Keys Energy Services (KEYS)**, in the Lower Florida Keys, experienced only moderate damage to its system. The utility had very minor damage to the main transmission 138kV line from the mainland power grid. In the distribution system, 68 utility poles failed (less than 0.5% of all poles). Seventy eight (78%) of customers had service restored within 24 hours. Within 72 hours, 93% of KEYS' customers had electrical service reestablished. Power was restored in accordance with a "Restoration Priority Plan" (i.e. hospital, EOC, critical customers) approved by local governmental agencies. KEYS activated its Mutual Aid Agreement with Florida's utilities and contractors. Approximately 112 outside crews and supporting staff assisted KEYS in the restoration efforts. Total damage was approximate $3.6 million, with impacts to transmission, distribution, generation, and other support building locations. Even though Hurricane Wilma was a major flood event, KEYS experienced minimal damage to its underground lines.

Hurricane Isaac:

- **Florida Keys Electric Cooperative:** FKEC reported no damage to its transmission system and minimal damage to the distribution system. Total incurred costs of $30,000 were for labor to respond and correct small outages resulting from blown fuses on transformers and lateral taps when trees and debris affected distribution lines. All outages were corrected within a few hours.
- **Keys Energy Services**. KEYS) reported no significant issues on the primary system, with several service drops caused by trees and vegetation. Only one pole required replacement.

5.6.6 Wastewater Facilities

Hurricane Georges: The State's Hurricane Georges assessment report noted that domestic wastewater facilities were surveyed in the two weeks following the storm. All regional facilities remained functional throughout the event, including facilities in Key West and Key Colony Beach. Approximately 250 package treatment plants are located throughout the County to serve such uses as motel, mobile home and RV parks, restaurants, and others. The loss of power to these small package plants did not result in overflows. While power was being restored, to prevent health and safety problems sewage was hauled away from these small collection systems.

5.6.7 The Economy, Tax Base and Major Employers

Disruption of the local economy is an anticipated consequence of hurricanes that directly affect the Florida Keys. Although major storms may generate debris and cause building and infrastructure damage, the most detrimental short-term impact of large and small storms is caused by the loss of electric power. The most significant long-term impact would be caused by major damage to U.S. 1. Lengthy repairs and limited easy access to the Florida Keys would directly affect tourism and the flow of goods.

The Florida Keys are susceptible to economic disruption because the primary industries are related to retail sales, service, tourism, and fishing. Events that cause visitors to stay away would result in economic loss to local businesses and loss of tax income to local governments. Visitors lodging the Florida Keys are charged 12.5% in tax which raises an approximate $4.5 million annually for the county. The 2013 Monroe County Tourist Development Council's annual report states that funds raised from the lodging tax support a variety of events and festivals that attract visitors. A major hurricane event would have a significant impact on lodging and the County would lose an important source of revenue for a period of time. The fishing industry would suffer economically with loss of power (affects ice production) and transportation disruption (affects transport to the mainland). If a major hurricane event does strike the Florida Keys, the perception of damage to the area may keep potential visitors away longer than the time needed to repair lodging and visitor attractions.

With a relatively high percentage of retirees in the area, interruption in government services that provide social security, disability, unemployment, and welfare payments would result in some economic impacts.

Major disasters can create a "domino effect" that can hurt the economy. For example, major damage and loss to residential properties can lead to displacement of people. Decrease in population means loss of clientele for local businesses. Businesses themselves may be destroyed or damaged to the degree that they cannot operate (whether short- or long-term). Even without initial major population relocation, business closings can contribute to reduced services, leading some to relocate in the short-term. Business closings and destruction or severe damage of facilities like schools, libraries, and other public buildings may eliminate jobs (even in the short-term) may lead some people to leave the area.

Since 1998, the Florida Keys Employment and Training Council has noted the significance of disasters on employee dislocation, unemployment, and underemployment. Because of the nature of the economy and the severe shortage of affordable housing, many employees do not have a stable economic base. Even a minor interruption in business may have serious effects on the work force. Given the already short supply of housing, another complicating factor is the likely reduction in the housing supply due to damage.

***Hurricane Andrew and Hurricane Georges*:** Both Hurricane Andrew and Hurricane Georges caused economic disruption in Monroe County, primarily due to the interruption of tourism. In addition, the fishing industry was hard hit due to the loss of many seafood traps, lack of ice for storage, and transportation disruption. Loss of power disrupted not only hospitality and retail businesses, but affected gas stations that could not pump and were slow to receive fuel because of transportation disruptions. The loss of more than 80 channel markers throughout the Keys curtailed boating and caused the suspension of cruise ship visits. In addition, the County and municipal governments were affected by a reduction in sales, infrastructure, and bed tax revenues immediately after the storm, resulting from business slow-downs.

***Hurricane Wilma*:** It has been reported that a number of permanent residents moved out of the area after flooding rendered at-grade dwelling units uninhabitable. Because affordable housing is limited throughout the Keys, the damage to those living units has an adverse impact on an already difficult housing market which makes it more difficult for low income residents and, in turn, affects the available work force.

5.6.8 Public Health Considerations

Extended exposure of buildings to floodwaters can cause mold growth which thrives in moist conditions. If mold growth is not treated properly it can cause serious health conditions, especially in people with breathing difficulty. The most common type of flooding in Monroe County is saltwater flooding from storm surge. Saturation of building materials and contents can cause mold growth just like freshwater. All flooded materials must be dried thoroughly after a storm to reduce the chance of mold growth and protect the health of occupants.

5.6.9 Environmental Resources and Natural Functions of the Floodplain

After Hurricane Andrew in 1992, the Monroe County Cooperative Extension Service received a grant to study environmental consequences. The study, "The Effect of Hurricane Andrew on Monroe County's Natural Resources and Its Dependent Industries," identified natural resources affected by the hurricane. It states that impacted resources include "pine rocklands, hard wood hammocks, mangrove forests, cypress domes, the freshwater regimes of the sawgrass community, and the coral reefs offshore of Key Largo."

The study notes that although South Florida ecosystems have evolved to adapt to natural episodic massive disturbances, including hurricanes, droughts, wildfires, and freezes, the growth of urban environments has significantly altered the ecology and ability of the ecosystems to respond and recover from catastrophic events. The floodplains in the Florida Keys are different from the typical floodplain in the United States as they are all related to

coastal flooding on smaller islands. Much of the land mass in the Keys is mapped flood hazard area.

Mangroves are very important to the environment of the Keys and serve as protective buffers in storms. Hurricane Andrew damaged the mangroves in Everglades National Park as severely as 80-95% in places, although areas south of the hurricanes' eye experienced more limited defoliation and branch damage. The study demonstrated that trees continue to suffer after the passage of a storm; initial estimates of mortality eventually were increased by up to 50%. Delayed mortality has been observed following past hurricanes, sometimes up to 2 years after the initial event.

Marsh Communities appeared to have survived Hurricane Andrew with little apparent damage, although the loss of periphyton, (which fish feed on) could affect "fish abundances." Pineland damage had a positive influence because of increased sapling growth. Hardwood hammocks are more susceptible to wind damage than pines. In North Key Largo, Hurricane Andrew damaged about two-thirds of the upland hardwood hammock trees.

Because Hurricane Andrew came ashore north of Monroe County, the Florida Keys reefs, including those in the Key Largo National Marine Sanctuary, were spared the affects of hurricane force conditions. Hurricanes can cause major damage to coral reefs; in past surveys in Puerto Rico, it was found that major hurricanes leave behind considerable breaks in coral formations.

Hurricanes can have a variety of impacts on fishery resources, including short-term and long-term impacts that are detected only after extended monitoring. After Hurricane Andrew, three species appeared to experience harvest declines in 1992 and 1993: Spanish Mackerel, Dolphin, and Spiny Lobster. In addition, there was a consistent decline in shrimp following the storm, but catches increased in the following year.

A survey of the commercial fishing industry after Hurricane Andrew, found that 53% of 43 survey respondents reported adverse impacts, primarily in the lobster industry because the storm occurred during the lobster season. The industry experienced inventory loss (virtually all 1 million traps were in the water), disruption of utilities (electric power to make ice), communications (for sales transactions), and transportation.

Overall, hurricanes are necessary and natural occurrences for the historical maintenance of the natural environment of the Florida Keys. Although Hurricane Andrew caused a relatively minor disruption of the portion of Monroe County's economy that is based on natural resources, the event pointed out opportunities to mitigate the impacts on the industry. In particular, restoration of power is a high priority.

***Hurricane Wilma*:** Hurricane Wilma, particularly its storm surge, severely damaged pine rocklands throughout the Florida Keys National Wildlife Refuges. Virtually all pines on Cudjoe Key were killed, with high mortality of both young and mature trees on Big Pine, Sugarloaf, and Little Pine Keys. Within a month of the storm's passage, boring insects attacked and killed significant numbers of the surviving pines on Big Pine Key. Recovery of the pinelands will be protracted and on Cudjoe Key especially, recovery is far from assured.

All backcountry islands in Great White Heron and Key West National Wildlife Refuges were severely damaged by Hurricane Wilma, with both wind and storm surge exacting a toll. Virtually all vegetation was either defoliated or killed. Little Crane Key was nearly obliterated, with only a few isolated trees left standing. As of late 2009, most backcountry islands are on the way to recovery.

A noteworthy large sand island near Boca Grande Key was created by Hurricane Wilma. In the 2006 and 2007 seasons the site harbored nesting roseate terns, the first known nesting by this species in Key West National Wildlife Refuge. Fifty-four bird species, including 4 federally listed species, have been observed at the site. The island has progressively shrunk due to erosion and is now less than 10% of its original size.

5.6.10 Historic Resources

Monroe County has many historic structures that are listed on the State and National Registers of Historic Places. These structures are owned by the State, the County, and private owners. Many historic properties, especially in Key West, attract many visitors.

In recent years, properties and sites that are listed on the National Register of Historic Places have not sustained major damage because the Keys have not had any landfalling major hurricanes. The Old Monroe County Courthouse, a state-owned building, has suffered wind damage in the past. It was retrofit with window protection using FEMA's Hazard Mitigation Grant Program funds. FEMA's funds also were used to retrofit the steeple of the Old Key West City Hall with motorized hurricane shutters. In 2005, flooding associated with Hurricane Wilma was approximately 14" deep, flooding the entire ground floor of the Old Key West City Hall, destroying all of the doors. The tenant abandoned the space because the saturated interior led to mold growth. Repair work was completed in January 2009: all old finishes were removed, mold was remediated, and retaining walls and impact windows were used to infill the large arched openings. The total cost of repairs was approximately $350,000. The Key West Arts & Historical Society operates three historic sites. During the 2004 and 2005 hurricane seasons, each site suffered significant damage:

- The Custom House Museum (State owned). During Hurricane Wilma, the basement was flooded, damaging all of the fire protection and electrical

equipment. The roof and winds were damaged by wind and water intrusion contributed to interior damage.

- The Lighthouse and Keeper's Quarters Museum is located on high ground. During Hurricane Wilma, windows and shutters were damaged by wind. The fence has deteriorated because of inundation.
- Fort East Martello, located near the airport, is flooded during most hurricanes, affecting the interior courtyard and the citadel. In Hurricane Wilma, floodwaters destroyed the massive front doors and damaged the gift shop.

5.6.11 Hazard Profile Summary

Table 5-18 summarizes each jurisdiction's risk from hurricanes and tropical storms.

Table 5-18. Hazard Profile Summary – Hurricane/Tropical Storm

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution / Location
Monroe County	High	Moderate to Severe	Medium to Large	1-2 every 3 years	Countywide
Key West	High	Moderate to Severe	Medium to Large	1-2 every 5 years	Citywide
Islamorada	High	Moderate to Severe	Medium to Large	1-2 every 5 years	Village-wide
Marathon	High	Moderate to Severe	Medium to Large	1-2 every 5 years	Citywide
Key Colony Beach	High	Moderate to Severe	Medium to Large	1-2 every 5 years	Citywide
Layton	High	Moderate to Severe	Medium to Large	1-2 every 5 years	Citywide

5.7 Climate Change and Sea Level Rise

Sea level rise, associated with climate change is a phenomenon resulting from a consistent change in the earth's temperature that leads to changes in climatic patterns. Those changes ultimately alter weather patterns with subsequent atmospheric and hydrologic impacts. The melting of ice at the polar ice caps is predicted to cause a worldwide increase in sea level. 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, as acknowledged by the Monroe County Climate Action Plan.

The NOAA Center for Operational Oceanographic Products and Services (CO-OPS) in Key West maintains the longest running tidal gauge in the western hemisphere (established on January 18, 1913). Data from a tidal gauge used by CO-OPS (Figure 5-3) shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend, including its 95% confidence interval, shows a steady increase in sea level rise.

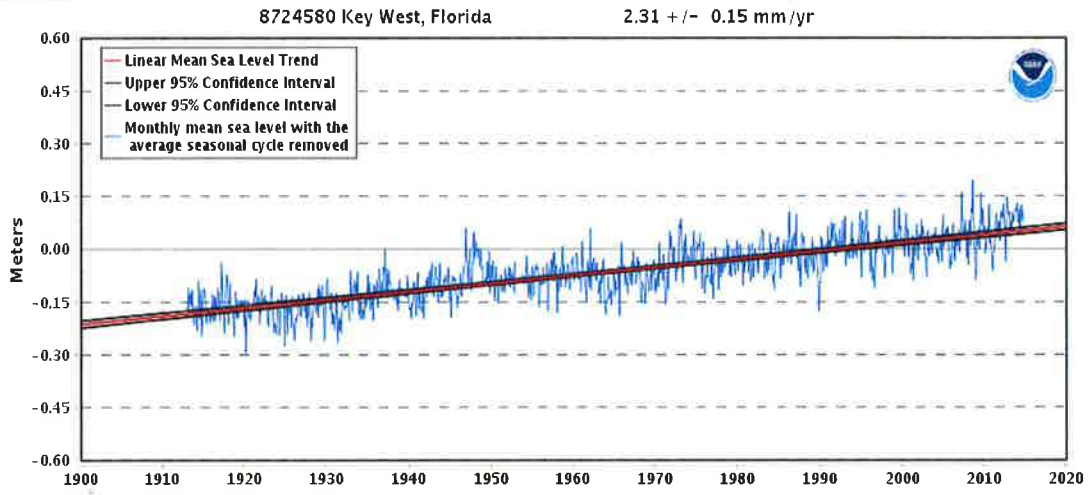


Figure 5-3. CO-OPS Mean Sea Level Trend from http://co-ops.nos.noaa.gov/sltrends/sltrends_station.shtml?stnid=8724580.

Sea level rise and 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 greater burn risk in drier periods).

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

- Decrease in the number of tropical storms and hurricanes from 6 to 34% (due to increased wind shear over the Atlantic basin)
- Increase in the wind intensity of the hurricanes from 2 to 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
- At this time, there is no indication of large alterations of historical storm origin and tracks so South Florida, including Monroe County continues to be a target of high probability
- More extreme drought cycles which also increase the risk of wildfire

The Monroe County Working Group recognizes there is no need for this LMS Update to go into the details of what is causing climate change; rather it is necessary to focus on the impacts of sea level rise on storm surge and coastal flooding and consider mitigation strategies accordingly. The 2011 SFWMD report states that, according to measurable changes in its coastal water control structures, sea level rise has already occurred. For example, in mainland South Florida, a majority of the coastal water control infrastructure managed by the SFWMD was constructed between 1950 and 1960. The Standard Flood design criteria used by the District for many of these structures assumes a headwater - tailwater differential of 6 inches. Due to the fact that several of these structures now have their discharge controlled by the tide (a rise in mean tailwater elevation), and what has been measured by tide gauges, then from the period 1950 to 2010, approximately 5.5 inches of sea level rise has occurred. Overall the report states that the sea level in Florida has risen about 9 inches over the past century.

As a coastal county, the impact of sea level rise on Monroe County has the potential to be high to severe in the long term. The Southeast Florida Climate Change Regional Compact[1] has outlined three potential scenarios in its April 2011 "A Unified Sea Level Rise Projection for Southeast Florida": a 1 foot rise in sea level (estimated time occurrence between 2040-2070); a 2 foot rise (estimated between 2060-2115); and a 3 foot rise (estimated between 2078-2115 (see Figures 5-4a through 4f at the end of this section). The overlaps in time periods between the 3 scenarios are due to the uncertainty in making these types of projections. These scenarios have been adopted by the Monroe County Board of County Commissioners as guidance for the Climate Change Advisory Committee in their determinations of potential sea level rise impacts.

The SFWMD report states that the main concerns with sea level rise for Monroe County are the following:

- Saltwater intrusion into coastal aquifers and a diminishing of fresh groundwater which negatively impacts the public water supply including Monroe County, which gets its drinking water from Miami-Dade County
- Increased tropical storm and hurricane surge levels
- More frequent coastal flooding and some inundation of coastal real estate by marine water

[1] The Southeast Florida Regional Climate Change Compact was signed by Broward, Miami-Dade, Monroe, and Palm Beach Counties in January 2010 to coordinate climate mitigation and adaptation activities across county lines. (http://southeastfloridaclimatecompact.org/).

The Southeast Florida Regional Climate Change Compact's "Analysis of the Vulnerability of Southeast Florida to Sea Level Rise" draft document from April 2011 (in the process of being updated) reported the following impacts to Monroe County:

- 68% (44,885 acres) of unincorporated Monroe County's land mass is vulnerable at the one foot scenario
- Military and residential conservation land uses were impacted in the early scenarios (1 to 2 ft rise)
- The two airports in the Keys (Key West and Marathon) are at risk in the one foot scenario with Key West being most prominent
- 6% of evacuation routes are impacted at the one foot scenario with a doubling of the percentage at each additional scenario
- Hospitals, schools and emergency shelters will all be impacted

In the November 2013 Monroe County Climate Action Plan, additional impacts to the County were described. With a warmer atmosphere and ocean, hurricane frequency in the Atlantic Ocean is expected to decrease but the intensity of hurricanes is expected to increase[2] as heat is the main driving force for hurricane intensity. A "business as usual" scenario was developed by Monroe County GIS staff and provided the following analysis of vulnerability of households, businesses and county infrastructure in three sea level rise scenarios:

- There is a greater than 75% certainty the 6.82% of developed land would be impacted by a one foot rise in sea level.
- With a two foot rise, the impact increases to 14.19% of the developed land would be vulnerable.
- The three foot rise scenario shows impacts to 28.58% of infrastructure and developed land.

In summary, the inundation models show that the cost of inaction would be tremendous. A series of Sea Level Inundation Maps from Monroe County Climate Action Plan covers the Keys. Pink color shows the areas that have 75-100% cumulative probability of "more likely to be inundated" by a 1 ft. rise in sea level between 2040 and 2070. Maps for 2 ft. and 3 ft. increase are part of the plan and available. All maps are available at http://fl-monroecounty.civicplus.com/index.aspx?NID=543

Local impacts related to climate change, especially sea level rise, are already occurring. Critical public infrastructure including beaches, roadways and especially storm water drainage treatment and conveyance systems have already begun to show vulnerabilities to the current rate of rise of sea level, extreme rainfall and seasonal high tides. Coastal

[2] Knutson, T. R., and others. 2010. Tropical cyclones and climate change. Nature Geoscience 3:157-163.

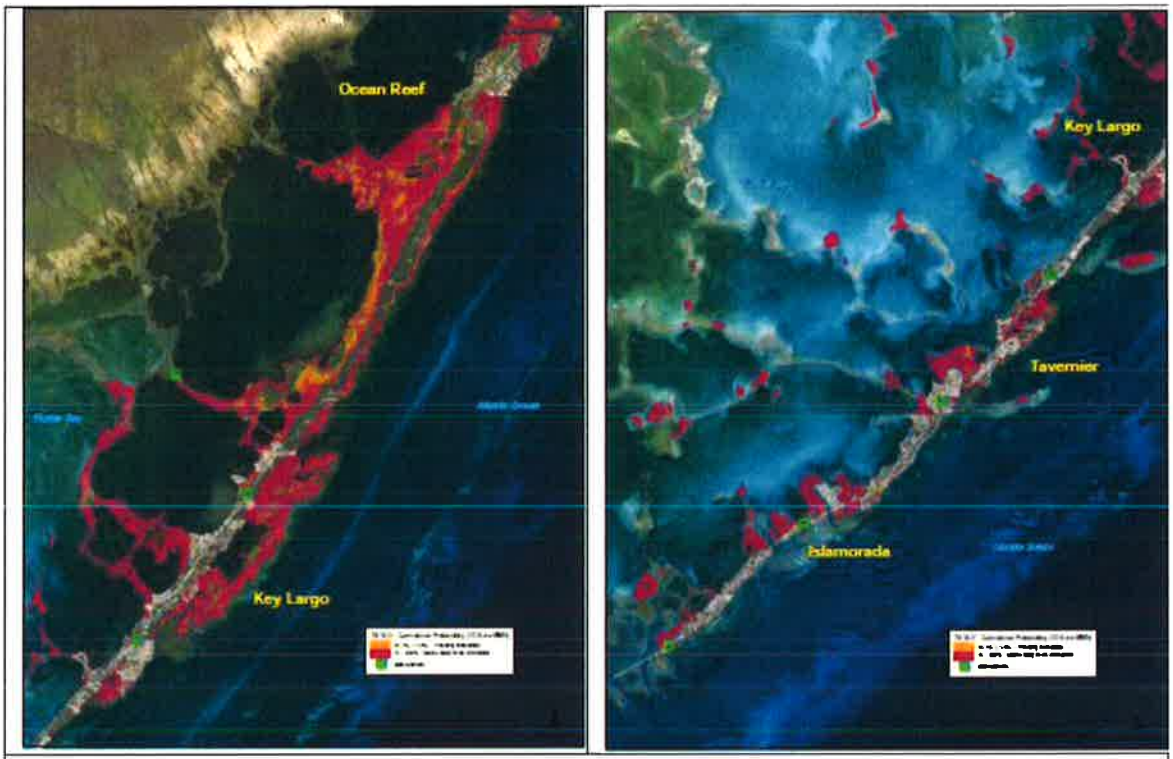
communities throughout Florida, including Monroe County, have begun to seek infrastructure improvements to address mounting drainage concerns. The predicted accelerated rate of sea level rise will further exacerbate the impact of saltwater intrusion on drinking water sources and on coastal habitats. Climate-related challenges currently exist suggesting action to address these issues is needed immediately. The LMS WG will seek ways to support the County's efforts to adapt to climate change as it shares many common goals as hazard mitigation.

5.7.1 Hazard Profile Summary

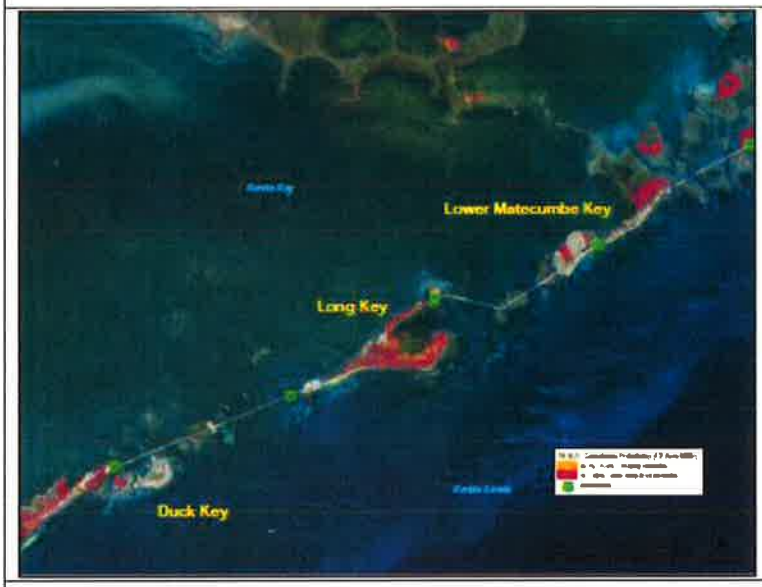
Table 5-19 summarizes each jurisdiction's risk from sea level rise.

Table 5-19. Hazard Profile Summary – Sea Level Rise

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution/ Location
Monroe County	Medium	Moderate to Severe over long-term	Small	Continuously increasing	Coastal and low-lying areas
Key West	Medium	Moderate to Severe over long-term	Small	Continuously increasing	Coastal and low-lying areas
Islamorada	Medium	Moderate to Severe over long-term	Small	Continuously increasing	Coastal and low-lying areas
Marathon	Medium	Moderate to Severe over long-term	Small	Continuously increasing	Coastal and low-lying areas
Key Colony Beach	Medium	Moderate to Severe over long-term	Small	Continuously increasing	Coastal and low-lying areas
Layton	Medium	Moderate to Severe over long-term	Small	Continuously increasing	Coastal and low-lying areas

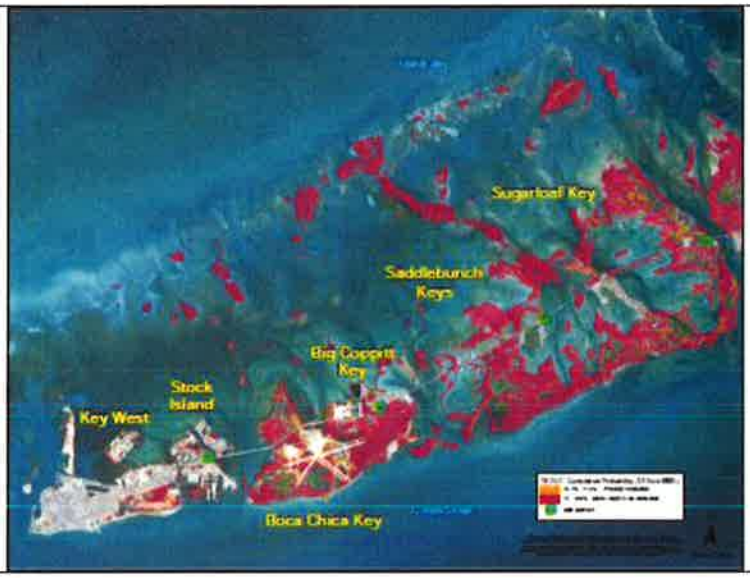


Figures 5-4a – 4b. Estimated Sea Level Rise Impacts.



Figures 5-4c. Estimated Sea Level Rise Impacts.

Figures 5-4d – 4e. Estimated Sea Level Rise Impacts.



Figures 5-4f. Estimated Sea Level Rise Impacts.

5.8 2015 Updates

The LMS Working Group reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 5-1: Added Table 5-1 which describes hazards that are excluded from further examination; updated Presidential disaster declarations.
- Section 5.2.1: Added new section to describe future flooding conditions.
- Section 5.2.2: Added overall SFHA map and when new FIRMs will be prepared.
- Section 5.2.3: Updated Repetitive Loss Property information.
- Section 5.3: Added population affected by coastal flooding and deleted probable storm tide ranges; updated historical storm tracks map; added description of Tropical Storm Isaac.
- Section 5.5: Added data on recovery costs for Hurricanes Isaac.
- Section 5.6: Added Hazus loss estimation for hurricane wind and hurricane surge/wind combination; deleted TAOS information; updated summary of impacts of hurricanes in Monroe County; in several subsections, added description of impacts of Hurricane Isaac.
- Section 5.6.2: Added warning and evacuation procedures.
- Section 5.6.7: Added information on impacts of hurricanes to tourism.
- Section 5.6.8: Added new section on public health considerations.
- Section 5.6.9: Added information on impacts of hurricanes to natural functions of the floodplain.
- Section 5.7: New section on climate change and sea level rise.

Chapter 6: Other Hazards & Risks

6.1 Introduction

Hurricanes and tropical storms pose major risks to Monroe County due to high winds and flooding (the effects of those storms are addressed in Chapter 5). Other natural hazards addressed in this chapter that affect the area to a lesser degree are high winds other than hurricane (severe storms/tornadoes), rainfall flooding, drought, wildland fires, and coastal erosion. These hazards are not profiled with the same degree of detail as hurricanes/tropical storms because they do not represent the same level of risk and do not threaten large areas nor affect many people. This is reflected in the summary table at the end of the chapter that identifies the relative vulnerability. As described in the following sections:

- Strong storms, including tornadoes and water spouts can equally affect the entire county. As with hurricanes and tropical storms, all types buildings are exposed to the effects of winds, with those that pre-date building code requirements somewhat more vulnerable than more recent buildings (Section 6.2);
- Rainfall pooling and occasional flooding of depressed areas occurs locally in Marathon and Key West, without severe property damage (Section 6.3);
- Drought affects the entire county, is managed by the water providers, and does not result in property damage (Section 6.4);
- Wildland fire risk is very localized, has affected only small areas in the past, the impacts are limited because of effective response capabilities (Section 6.5); and
- Coastal erosion areas have been identified only in a state study; there is insufficient reported evidence that many private properties with buildings are experiencing significant erosion (Section 6.6).

Numerous federal agencies maintain a variety of records regarding losses associated with natural hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency maintains records on federal expenditures associated with declared major disasters. The National Climatic Data Center (NCDC) of the National Oceanographic & Atmospheric Administration collects and maintains certain data in summary format, indicating injuries, deaths, and costs, although the basis of the cost estimates is not identified and the reports are not independently verified (http://www.ncdc.noaa.gov/oa/climate/severeweather/extremes.html).

6.2 Strong Storms, Including Tornadoes & Water Spouts[1]

The term "strong storms" is used to cover weather events that exhibit all or some of these characteristics: high winds (including tornadoes), heavy rainfall, lightning, and hail. Generally, thunderstorms form on warm-season afternoons and are local in effect. Storms that form in association with a cold front or other regional-scaled atmospheric disturbance can become severe, thereby producing strong winds, frequent lightning, hail, downbursts and even tornadoes. Strong storms are equally likely to occur through the entire extent of Monroe County.

Of the estimated 100,000 thunderstorms that occur each year in the U.S., only about 10% are classified as severe (produces hail at least 1 inch in diameter, winds of at least 58 miles per hour, or tornadoes). In Monroe County, most strong storms generally do not cause property damage unless the storm spawns a tornado.

Strong storms generally produce lightning, which kills more people in Florida, on average, than any other weather related phenomenon. Lightning is defined as a sudden and violent discharge of electricity from within a thunderstorm due to a difference in electrical charges and represents a flow of electrical current from cloud-to-cloud or cloud-to-ground. Nationally, lightning causes extensive damage to buildings and structures, kills or injures people and livestock, starts many forest fires and wildfires, and disrupts electromagnetic transmissions.

High winds associated with strong storms other than tornadoes, can cause significant property and crop damage, threaten public safety and disrupt utilities and communications. Straight-line winds are generally any wind not associated with rotation and in rare cases can exceed 100 miles per hour (mph). The National Weather Service defines high winds as sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration. High winds are often produced by super-cell thunderstorms or a line of thunderstorms that typically develop on hot and humid days.

Figure 6-1a and Figure 6-1b shows Figure 1609A and Figure 1609B from the 5th Edition Florida Building Code. These figures delineate the "ultimate design wind speeds" for Risk Category II buildings and Risk Category III and IV buildings, respectively. These wind speeds are used to design buildings to withstand reasonably anticipated winds in order to minimize property damage. In Monroe County, the ultimate design wind speed for most buildings (Risk Category II) ranges from 170 to more than 180 miles per hour (3-second gust measured at 33 feet above the ground). A probability or recurrence interval is not assigned to the ultimate design wind speeds. The structures that are most vulnerable to high

[1] The Monroe County LMS Working Group gratefully acknowledges the contributions to this section in 2010 by Andrew Devanas, Science and Operations Officer, National Weather Service Office in Key West, FL.

winds are mobile/manufactured homes and recreational vehicles. See Section 2.4 for a description of the more significant Florida amendments to the International Codes that pertain to the design of buildings with respect to wind loads. Data from the Monroe County Property Appraiser (see Section 5.5.1) indicates there are approximately 5,600 mobile/manufactured home units.

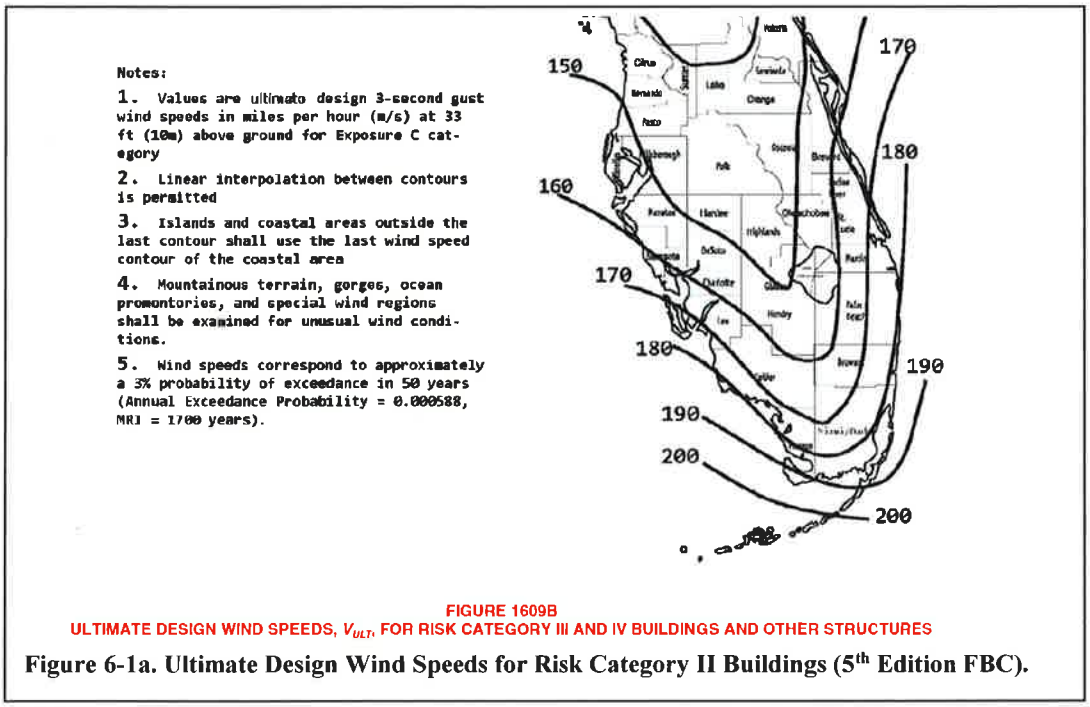


FIGURE 1609B
ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY III AND IV BUILDINGS AND OTHER STRUCTURES

Figure 6-1a. Ultimate Design Wind Speeds for Risk Category II Buildings (5th Edition FBC).

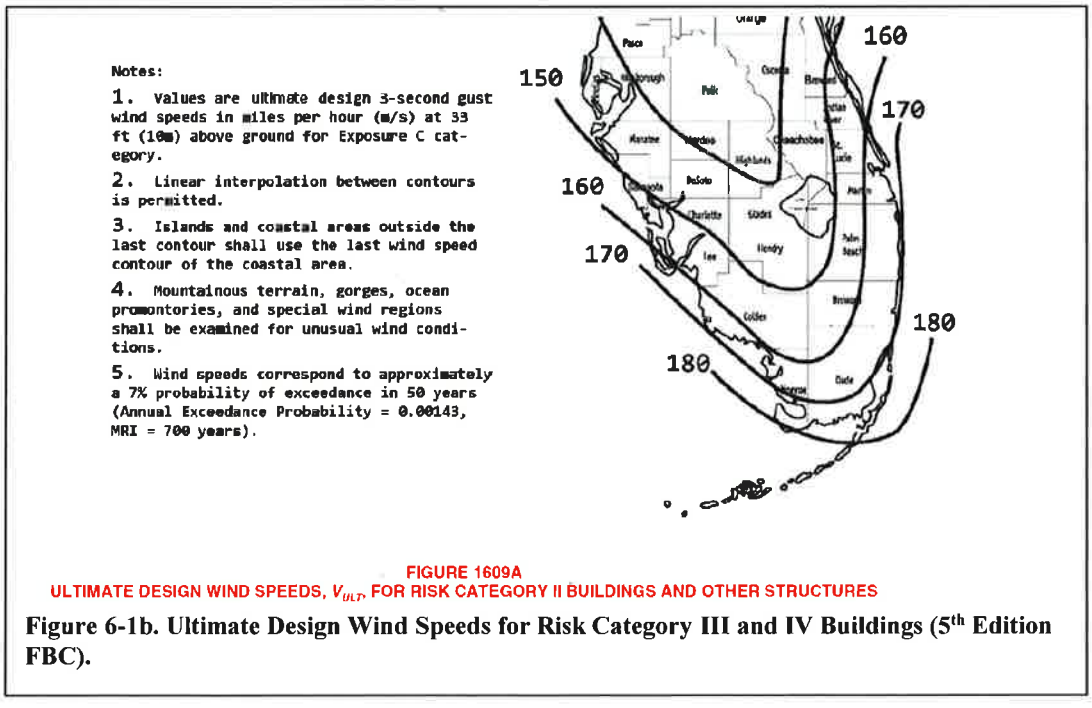


FIGURE 1609A
ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES

Figure 6-1b. Ultimate Design Wind Speeds for Risk Category III and IV Buildings (5th Edition FBC).

A tornado is a relatively short-lived storm composed of an intense rotating column of air, extending from a thunderstorm cloud system. Tornadoes may be spawned from storm systems associated with hurricanes and tropical storms. Average winds in a tornado, although never accurately measured, are thought to range between 100 and 200 miles per hour; extreme tornadoes may have winds exceeding 300 miles per hour. The Enhanced Fujita Scale, Table 6-1, classifies tornadoes by wind speed and is accompanied by a series of 28 damage indicators (http://www.spc.noaa.gov/efscale/ef-scale.html).

A water spout is a violently rotating column of air over water, often spawned from a strong or severe thunderstorm. Water spouts that come ashore are classified as tornadoes. Fortunately, most water spouts dissipate over water and do not result in many deaths or serious injuries. However, over water they are a threat to marine interests. According to the Storm Events Database of the National Climatic Data Center (NCDC), there have been 183 water spouts reported for Monroe County from 1950-2014.

Table 6-1. Enhanced Fujita Scale

Scale	3-Second Gust (miles per hour)
EF-0	65 to 85
EF-1	86 to 110
EF-2	111 to 135
EF-3	136 to 165
EF-4	166 to 200
EF-5	Over 200

On the U.S. mainland, tornado paths range from a few feet long to as long as 300 miles. Path widths average 300-400 yards, but severe tornadoes have cut swaths a mile or more in width, or have formed groups of two or three funnels traveling together. On the average, tornadoes move over land at speeds between 25 and 45 miles per hour, but speeds of up to 70 miles per hour have been reported. Tornadoes rarely linger more than a few minutes over a single spot or more than 15-20 minutes in a 10-mile area, but their short periods of existence do not limit the devastation. The destructive power of the tornado results primarily from its high wind velocities, sudden changes in pressure, and windborne debris. Since tornadoes are generally associated with severe storm systems, they are often accompanied by hail, torrential rain and intense lightning. Depending on intensity, tornadoes can uproot trees, bring down power lines and destroy buildings.

Hail is also associated with thunderstorms and other such strong storms. It forms when updrafts carry raindrops into extremely cold areas of the atmosphere where they freeze into ice. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is

pulled by gravity towards the earth. Hailstorms cause damage to cars, structures and other types of property, as well as crops and livestock, and in rare cases to humans.

Strong Storm, Water Spouts &Tornado/Lightning Experience and Probability

Tornadoes and Water Spouts

Most tornado deaths in Florida occur during the fall, winter, and spring seasons when stronger dynamics are present in the atmosphere capable of producing 'supercell'/mesocyclone thunderstorms. According to the National Weather Service Weather Forecast Office in Key West, there is an equal likelihood of any one area in the Florida Keys being impacted by a tornado. This demonstrates that the low-lying terrain and narrow islands do not appreciably slow onshore winds, nor does the topography and configuration of the islands favor tornado development in any specific area.

Half of tornadoes in Florida occur in the summer months from May through August, but only less than 10% of tornado-related deaths happen during this period of time. Most tornado deaths occur during seasons when stronger atmospheric dynamics may produce supercell/mesocyclone thunderstorms. Figure 6-2 shows the previous tornado occurrences in the State by F-scale (count). Monroe County is slightly above the state average, having experienced between 44 to 70 tornadoes during the 50 year period between 1960 and 2010.

The State Hazard Mitigation Plan (2013) identifies Monroe County as likely to experience 2 to 3.5 severe storms per year, including hail, thunderstorms and tornadoes. The northern part of mainland Monroe County is expected to have a higher frequency of severe storms, about 3.5 to 9.5 storms every year.

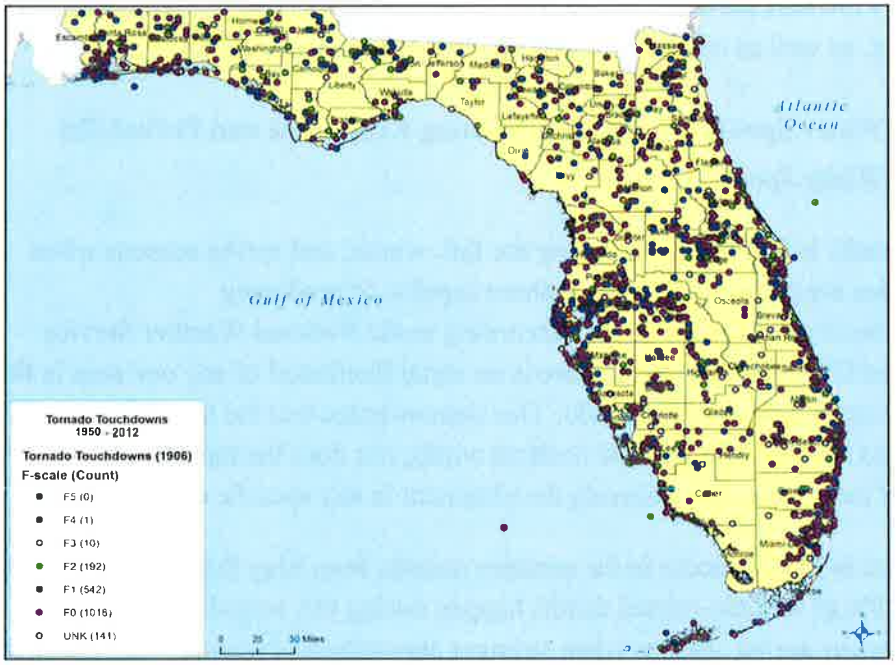


Figure 6-2. Tornado Previous Occurrences (Figure 3.19 from 2013 State Plan)

Table 6-2 summarizes tornadoes (by scale) that affected Monroe County from 1959 to 2014 and Table 6-3 lists detail on tornadoes that hit the area between 1998 and mid-2014 using National Climatic Data Center (NCDC) data. Based on these previous occurrences, at least one tornado of magnitude EF-0 and EF-1 is expected to occur somewhere in Monroe County in any given year. The largest expected extent (magnitude) tornado is expected to be EF-2, likely to occur on average every 9 to 10 years. During the 60 year span reflected in the two tables:

- A tornado of intensity EF-0 or EF-1 occurs, on average, about once each year; and
- EF-2 tornadoes, much rarer with only 6 reported associated with two hurricanes, caused most injuries and considerably more property damage.
- More intense tornadoes appear unlikely.

Table 6-2. Tornadoes (by scale): 1959 - 2014

Fujita Scale	# Tornadoes Reported	Deaths	Injuries	Cumulative Damage (not adjusted)
F-0	35	0	5	More than $5 million
F-1	15	0	0	More than $30 million
F-2	6	0	71	More than $55 million

Table 6-3 (by community). Tornadoes: 1998 – 2014

Location Affected	Date	Fujita Scale	Deaths	Injuries	Damage
Marathon	February 1998	F-1	0	0	$20,000
Islamorada	February 1998	F-0	0	0	
Key West	June 1998	F-0	0	0	$15,000
Islamorada	November 1998	F-1	0	0	$100,000
Rock Harbor	November 1998	F-2	0	0	$50,000
Key Largo	November 1998	F-2	0	20	$25 mil
Key West	May 1999	F-0	0	0	
Rick Harbor	September 1999	F-0	0	0	
Craig Key	October 1999	F-1	0	0	
Key West	October 2000	F-0	0	0	
Big Pine Key	July 2000	F-0	0	0	$15,000
Big Pine Key	August 2000	F-0	0	0	
Key West	October 2003	F-0	0	0	
Marathon	June 2005	F-0	0	0	$5,000
Marathon	August 2005	F-2	0	0	$5 mil
Sugarloaf Key	June 2007	F-0	0	0	$20,000
Marathon	June 2007	F-0	0	0	$3,000
Marathon	February 2008	F-0	0	0	$2,000
Big Coppit Is	August 2008	F-0	0	0	$1,000
Summerland Key	August 2008	F-0	0	0	$1,000
Upper Key Largo	September 2008	F-0	0	0	$25,000
Craig Key	September 2008	F-1	0	0	$120,000
Sugar Loaf Key	September 2008	F-0	0	0	0
Stock Island	September 2008	F-0	0	0	0
Key Largo	August 2010	EF-0	0	0	$500
Big Pine Key	April 2013	EF-0	0	0	$30,000

Source: NCDC online

NCDC provides a listing of reported water spouts from the years 1996 to 2001. As there are 183 reported sightings and none of them caused injuries, death or property damage, the ones from 1996 to 1998 are displayed in Table 6-4 to show the general frequency of these events. Sightings on the same day were combined into one row for space considerations.

Table 6-4. Water Spouts (by community): 1996 – 1998

Location Affected	Date(s)	Injuries/ Deaths	Damage
Key West International Airport	05/01/1996	0	$0
East Cape	06/21/1996	0	$0
Long Key	08/04/1996	0	$0
Key West International Airport	08/17/1996	0	$0
Key Largo	08/24/1996	0	$0
Key West International Airport	08/28/1996	0	$0
Big Pine Key	08/30/1996	0	$0

Table 6-4. Water Spouts (by community): 1996 – 1998

Location Affected	Date(s)	Injuries/ Deaths	Damage
Key West International Airport	09/07/1996	0	$0
Key Largo & Key West International Airport	09/15/1996	0	$0
Key West International Airport	09/19/1996	0	$0
6NM SE of Key West Airport	03/05/1997	0	$0
S of 7 Mile Bridge	03/14/1997	0	$0
5 NM N of Key West Airport	04/10/1997	0	$0
5N of Duck Key	05/17/1997	0	$0
Just South of Summerland Key	05/22/1997	0	$0
3 NM S MM 84.5, 4 NM SW Cape Sable, 10NM SW Everglades City, Just NW of Key West Airport	05/23/1997	0	$0
Marathon	06/11/1997	0	$0
East Cape	06/22/1997	0	$0
Craig Key	07/06/1997	0	$0
Key West International Airport	07/11/1997	0	$0
Key West International Airport	07/12/1997	0	$0
Marathon	07/13/1997	0	$0
Key West International Airport	07/15/1997, 07/18/1997, 07/19/1997	0	$0
Duck Key	07/20/1997	0	$0
Key West International Airport	08/01/1997, 08/04/1997	0	$0
Duck Key, Key West International Airport	08/09/1997	0	$0
Flamingo	08/10/1997	0	$0
Tavernier	08/14/1997	0	$0
Key West International Airport	08/16/1997	0	$0
Big Pine Key	08/17/1997	0	$0
Marathon	08/19/1997	0	$0
Marathon, Key West International Airport	08/23/1997	0	$0
Marathon	08/24/1997	0	$0
Long Key	08/30/1997	0	$0
Duck Key	08/31/1997	0	$0
Key West International Airport	09/06/1997	0	$0
Key West International Airport	09/10/1997	0	$0
Key West NAS, Big Pine Key	09/11/1997	0	$0
Key West	09/14/1997	0	$0
Duck Key, Key West Airport	09/15/1997	0	$0
Long Key, Key West Airport	09/16/1997	0	$0
Key West	09/19/1997	0	$0
Key West International Airport	10/02/1997	0	$0
Flamingo	10/18/1997	0	$0
Marathon	04/04/1998	0	$0
Big Coppit Key	05/29/1998	0	$0

Table 6-3 (by community). Tornadoes: 1998 – 2014

Location Affected	Date	Fujita Scale	Deaths	Injuries	Damage
Marathon	February 1998	F-1	0	0	$20,000
Islamorada	February 1998	F-0	0	0	
Key West	June 1998	F-0	0	0	$15,000
Islamorada	November 1998	F-1	0	0	$100,000
Rock Harbor	November 1998	F-2	0	0	$50,000
Key Largo	November 1998	F-2	0	20	$25 mil
Key West	May 1999	F-0	0	0	
Rick Harbor	September 1999	F-0	0	0	
Craig Key	October 1999	F-1	0	0	
Key West	October 2000	F-0	0	0	
Big Pine Key	July 2000	F-0	0	0	$15,000
Big Pine Key	August 2000	F-0	0	0	
Key West	October 2003	F-0	0	0	
Marathon	June 2005	F-0	0	0	$5,000
Marathon	August 2005	F-2	0	0	$5 mil
Sugarloaf Key	June 2007	F-0	0	0	$20,000
Marathon	June 2007	F-0	0	0	$3,000
Marathon	February 2008	F-0	0	0	$2,000
Big Coppit Is	August 2008	F-0	0	0	$1,000
Summerland Key	August 2008	F-0	0	0	$1,000
Upper Key Largo	September 2008	F-0	0	0	$25,000
Craig Key	September 2008	F-1	0	0	$120,000
Sugar Loaf Key	September 2008	F-0	0	0	0
Stock Island	September 2008	F-0	0	0	0
Key Largo	August 2010	EF-0	0	0	$500
Big Pine Key	April 2013	EF-0	0	0	$30,000

Source: NCDC online

NCDC provides a listing of reported water spouts from the years 1996 to 2001. As there are 183 reported sightings and none of them caused injuries, death or property damage, the ones from 1996 to 1998 are displayed in Table 6-4 to show the general frequency of these events. Sightings on the same day were combined into one row for space considerations.

Table 6-4. Water Spouts (by community): 1996 – 1998

Location Affected	Date(s)	Injuries/ Deaths	Damage
Key West International Airport	05/01/1996	0	$0
East Cape	06/21/1996	0	$0
Long Key	08/04/1996	0	$0
Key West International Airport	08/17/1996	0	$0
Key Largo	08/24/1996	0	$0
Key West International Airport	08/28/1996	0	$0
Big Pine Key	08/30/1996	0	$0

Table 6-4. Water Spouts (by community): 1996 – 1998			
Location Affected	**Date(s)**	**Injuries/ Deaths**	**Damage**
Key West International Airport	09/07/1996	0	$0
Key Largo & Key West International Airport	09/15/1996	0	$0
Key West International Airport	09/19/1996	0	$0
6NM SE of Key West Airport	03/05/1997	0	$0
S of 7 Mile Bridge	03/14/1997	0	$0
5 NM N of Key West Airport	04/10/1997	0	$0
5N of Duck Key	05/17/1997	0	$0
Just South of Summerland Key	05/22/1997	0	$0
3 NM S MM 84.5, 4 NM SW Cape Sable, 10NM SW Everglades City, Just NW of Key West Airport	05/23/1997	0	$0
Marathon	06/11/1997	0	$0
East Cape	06/22/1997	0	$0
Craig Key	07/06/1997	0	$0
Key West International Airport	07/11/1997	0	$0
Key West International Airport	07/12/1997	0	$0
Marathon	07/13/1997	0	$0
Key West International Airport	07/15/1997, 07/18/1997, 07/19/1997	0	$0
Duck Key	07/20/1997	0	$0
Key West International Airport	08/01/1997, 08/04/1997	0	$0
Duck Key, Key West International Airport	08/09/1997	0	$0
Flamingo	08/10/1997	0	$0
Tavernier	08/14/1997	0	$0
Key West International Airport	08/16/1997	0	$0
Big Pine Key	08/17/1997	0	$0
Marathon	08/19/1997	0	$0
Marathon, Key West International Airport	08/23/1997	0	$0
Marathon	08/24/1997	0	$0
Long Key	08/30/1997	0	$0
Duck Key	08/31/1997	0	$0
Key West International Airport	09/06/1997	0	$0
Key West International Airport	09/10/1997	0	$0
Key West NAS, Big Pine Key	09/11/1997	0	$0
Key West	09/14/1997	0	$0
Duck Key, Key West Airport	09/15/1997	0	$0
Long Key, Key West Airport	09/16/1997	0	$0
Key West	09/19/1997	0	$0
Key West International Airport	10/02/1997	0	$0
Flamingo	10/18/1997	0	$0
Marathon	04/04/1998	0	$0
Big Coppit Key	05/29/1998	0	$0

Table 6-4. Water Spouts (by community): 1996 – 1998

Location Affected	Date(s)	Injuries/ Deaths	Damage
Flamingo	05/31/1998	0	$0
Key West	06/08/1998, 06/18/1998, 07/10/1998, 07/14/1998	0	$0
Big Pine Key, Key West Airport	07/26/1998	0	$0
Key West	07/30/1998, 07/31/1998, 08/06/1998	0	$0
Duck Key	08/08/1998	0	$0
Key West	08/09/1998, 08/10/1998	0	$0
Key West International Airport	08/23/1998	0	$0
Key West International Airport	09/05/1998	0	$0
Ocean Reef	09/24/1998	0	$0
Duck Key	10/10/1998	0	$0
Key West International Airport	10/12/1998	0	$0
Duck Key and Key West Airport	10/13/1998	0	$0
Key West International Airport	10/14/1998	0	$0

For complete listing of NCDC water spout events in Monroe County, see https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Waterspout&beginDate_mm=04&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=04&endDate_dd=30&endDate_yyyy=2015&county=MONROE%3A87&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=12%2CFLORIDA

Source: NCDC online

Water spouts occur frequently in Monroe County but generally stay over water and typically not a threat to any development on land. Boaters and people involved in marine activities are advised to stay a considerable distance any observed water spout. The strength of water spouts are not measured on a scale comparable to the Fujita scale and are generally not expected to cause injury, death or damage in Monroe County.

Lightning

Florida leads the nation in lightning deaths and injuries, with most occurring from May to October (peaking in July). People near water appear to be at greater risk. Figure 6-3 shows ranges of lightning occurrences by county and shows that Monroe County is below the state average, having experienced between 11 to 20 lightning events during the 50 year period

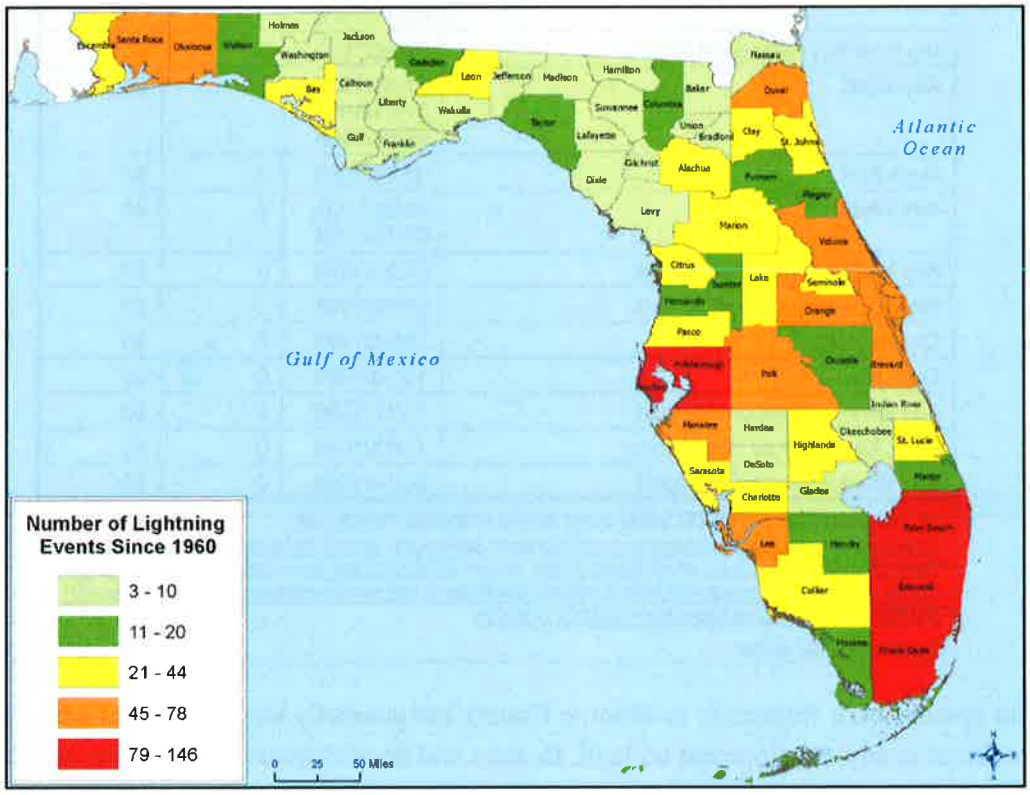


Figure 6-3. Lightning Previous Occurrences (Figure 3.22 from 2013 State Plan)

between 1960 and 2010. Monroe County can expect a lightning event to occur approximately once in every 3 years. Because the Florida Keys are surrounded by water and most tourism and recreation activities are water-based, lightning is a significant hazard (Table 6-5).

Table 6-5. Lightning Deaths/Injuries (1959-2014)

Date	Death	Injury	Remarks
September 1959	0	1	Bridge tender
October 1962	0	1	Unknown
June 1974	1	0	Trash collector in vehicle
July 1976	1	1	Fishing boat
August 1980	1	0	Fishing from bridge
September 1982	1	1	Snorkeling
June 1983	1	0	Fishing from bridge
August 1986	0	1	Standing under tree
August 1990	0	1	Fishing from boat
July 1995	0	1	Police officer next to car
July 1997	0	1	Unknown
July 2000	0	1	Fishing boat
August 2001	0	1	Restaurant employee
July 2009	0	1	White St pier
June 2010	0	0	Big Pine tiki hut damaged
July 2012	0	0	Key West residence affected
June 2013	0	0	Marathon - Bonefish Towers complex in Coco Plum experienced fire and electrical damage
June 2013	0	1	Stock Island – Police officer on motorcycle got injured
Total	5	12	
Average of 0.1 deaths and 0.2 injuries per year			

1959-2009 data from NWS Warning Meteorologists, Miami & Key West

2010-2014 data from Storm Events database of the National Climatic Data Center (NCDC)

Hail and High Winds

Reported hail and high wind events in Monroe County are reported in Table 6-6 and Table 6-7. These events generally are associated with thunderstorms and other strong storms. Monroe County can expect to have a hail event with the size of hail up to 1.75 inches (44.5 mm) every 10 years. This size hail corresponds approximately to a rating of H5 (which goes up to H10) on the Torro Hailstorm Intensity Scale with types of damage typically described as "Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries." Monroe County had nine reported high wind events from 1996 to 2015. The high wind events corresponded with the categories of Gale (8), Strong Gale (9), and Storm (10) on the Beaufort Scale. Monroe County can expect to experience a "Storm" event approximately every 5 years having experienced 3 such events in a 16 year period with property damage ranging from no damage to approximately $25,000.

Table 6-6. Reported Hail Damage (1950-2015)

Location	Date	Size of Hail	Property Damage
Monroe County	08/28/1983	1.75 inches	$0
Upper Key Largo	02/25/1994	0.75 inches	$0
Marathon	02/02/1998	1.75 inches	$0
Key West International Airport	04/27/2003	1.00 – 1.75 inches	$250
Key Largo	06/13/2007	0.75 inches	$0
Pinecrest	06/15/2012	0.88 inches	$0
Total Reported Property Damage			$250
*= Search for events started with 1950			

1950-2015 data from Storm Events database of the National Climatic Data Center (NCDC)

Table 6-7. Reported High Winds Damage (1950-2015)*

Location	Date	Wind Speed	Property Damage
Monroe/Middle Keys	01/07/1996	35 knots (40 mph)	$5,000
Monroe/Lower Keys	03/03/1996	N/R**	$25,000
Monroe/Lower Keys	02/02/1998	40 knots (46 mph)	$0
Monroe/Middle Keys	02/02/1998	40 knots	$0
Monroe/Upper Keys	02/02/1998	40 knots	$0
Mainland Monroe	02/02/1998	40 knots	$0
Monroe/Lower Keys	08/01/2001	44 knots (51 mph)	$0
Monroe/Middle Keys	08/30/2006	51 knots (59 mph)	$0
Monroe/Upper Keys	01/11/2012	52 knots (60 mph)	$2,000
Total Reported Property Damage			$32,000
*= Search for events started with 1950 **=Not Reported			

1950-2015 data from Storm Events database of the National Climatic Data Center (NCDC)

Notable Storms

A significant non-tropical weather event that affected Monroe County was the "Storm of the Century," a very strong winter storm that occurred from March 12-23, 1993. Moving from Florida's West Coast across the state and up the eastern seaboard, the storm eventually wreaked havoc from Florida to New England. It brought heavy rains, wind, and coastal

flooding to the Southeast and blizzard-like conditions in the Northeast. When it was finally over, the total damage estimates were over $800 million (over $200 million in Florida). The Florida Keys experienced high winds and tides and substantial amounts of rainfall and the County was among the 38 counties declared a Presidential disaster area.

A particularly active year was 1998. The first event of that year, referred to as the "Ground Hog's Day Storm," occurred on February 2, 1998 and involved multiple tornado touchdowns. Areas most affected were the Middle Keys including Grassy Key and Valhalla Beach in the vicinity of Duck Key. Several buildings were damaged. Also significant problems arose from the displacement of lobster traps which contributed to seaborne debris and navigational problems. The fishing industry suffered considerable loss of income.

Another notable weather event occurred on July 4, 1998, when severe thunderstorms with lightning and high winds came up quickly in the Middle Keys. The Key West Weather Service Office recorded sustained wind speeds up to 70 mph. Because it was July 4th, many boats were offshore celebrating and waiting for fireworks displays. One boat capsized, resulting in a fatality. This storm did not prompt a major disaster declaration.

The most damaging tornadoes in 1998 were spawned by Tropical Storm Mitch on November 4 and 5. Islamorada experienced an F-1 tornado, while Rock Harbor and Key Largo were hit by F-2 tornadoes. One tornado moved at 30 mph, tearing down utility lines, damaging boats, and damaging more than 600 structures, many of them were mobile homes.

Table 6-8 summarizes each jurisdiction's risk from strong storms.

Table 6-8. Hazard Profile Summary – Strong Storms/ Tornado/Lightning

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution/ Location
Monroe County	Medium	Moderate	Small	1-2 per year	Countywide
Key West	Medium	Moderate	Small	1-2 per year	Citywide
Islamorada	Medium	Moderate	Small	1-2 per year	Village-wide
Marathon	Medium	Moderate	Small	1-2 per year	Citywide
Key Colony Beach	Medium	Moderate	Small	1-2 per year	Citywide
Layton	Medium	Moderate	Small	1-2 per year	Citywide

6.3 Rainfall/Fresh Water Flooding

Rainfall/fresh water refers to water that collects on the ground surface due to flat topography and poor drainage or where stormwater drainage systems are not sufficient to safely drain runoff away. Some drainage system conveyance is disrupted by vegetation or other debris that blocks inlets or pipes. Rainfall runoff may pond in low-lying areas, often in street

intersections, and may carry debris, chemicals, dirt, and other pollutants from impervious surfaces.

Rainfall/fresh water flooding due to the accumulation of rainfall generally is not a problem in most of Monroe County and the municipalities. Most of the rainfall runs off into the surrounding seas. The rainfall which is caught in closed basins (depressed areas which collect rainfall and rainfall runoff) usually will drain relatively quickly because the underlying coral rock and limestone soils have high infiltration rates. The exceptions to this are:

- The City of Key West does experience some freshwater flooding when storm drains cannot handle the volume of runoff and the excess flows through the streets, often more than one-foot deep and more than two-feet deep depending on the tidal cycle; some low areas do not drain well, resulting in ponding. The city maintains records of the locations of these areas and actively pursues projects to improve drainage.
- The City of Marathon has identified several locations where ponded water that can range in depth from one to three feet deep causes access problems and can affect older, non-elevated, buildings. The city maintains records of the locations of these areas and actively pursues projects to improve drainage.

The most significant rainfall/fresh water flooding event occurred on November 11-12, 1980. The storm resulted in $1 million in property damage, primarily in the City of Key West. Known as the "Veteran's Day Storm," the event resulted from the influence of a stalled cold front and Tropical Storm Jeanne that was over Cuba. These combined systems produced 23 inches of rain in 24 hours, the heaviest 24-hour rainfall ever recorded for the area. Even though the water was pouring out into the surrounding seas, the intense rainfall resulted in widespread flooding especially in streets and low-lying areas. Weather Service reports indicated that 300 vehicles and 500 buildings were seriously damaged.

Monroe County Public Works reports that runoff from intense rainfalls generally does not result in road or drainage swale damage, although some unpaved roads exhibit washing and potholes.

The NCDC recorded one rainfall flood event since 2010. On August 20, 2013 thunderstorms produced heavy rainfall of 2 to 3 inches across Key West, resulting in street flooding in the low-lying sections of Old Town. Greene and Front Streets were closed in Old Town Key West, and Lower Duval Street and Caroline Street were also flooded. The City reports the same had occurred later that year during May.

The State Enhanced Hazard Mitigation Plan (2013) summarizes analyses of residential and commercial structures exposed to "inland" flooding (SHMP Table C.3 in Appendix C: Risk Assessment Tables). Table 6-9 summarizes estimated impacts for Monroe County.

Table 6-9. SHMP Summary: Inland Flooding Impacts (2013).

	Number of Residential Structures in 100 and 500-year Floodplain	Number of Commercial Structures in 100 and 500-year Floodplain	Value of Residential Structures in 100 and 500-year Floodplain	Value of Commercial Structures in 100 and 500-year Floodplain
Inland Flooding	32,449	1,155	$5,697,665 million ($5.7 Trillion)	$802,455 million ($802.5 Billion)

Table 6-10 summarizes each jurisdiction's risk from flooding (rainfall ponding).

Table 6-10. Hazard Profile Summary – Flooding (Rainfall Ponding)

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution/ Location
Monroe County	Medium (locally)	Low to Moderate	Small to Medium	1 time each year	More developed areas
Key West	High (locally)	Low to Moderate	Medium to Large	3-6 times each year	Multiple areas in the City
Islamorada	Medium (locally)	Low to Moderate	Small	Once every 3 years	More developed areas
Marathon	Medium (locally)	Low to Moderate	Small	Once every 3 years	More developed areas
Key Colony Beach	Medium (locally)	Low to Moderate	Small	Once every 3 years	More developed areas
Layton	Low	Low	Negligible	0 times each year	n/a

6.4 Drought

A drought is defined as a prolonged period of dry weather during which there is an inadequate supply of water to meet water demands that can have severe effects on people animals, and plants. Lack of rainfall and adequate water supply could result in health problems for humans, animals, and vegetation. Regulations and water restrictions may force residents to stop the waste of any potable water or water supply. Drought may be accompanied by prolonged periods of extreme heat.

Drought is a natural and expected part of the climate in most areas, but the severity of drought impacts differs based on duration, geographic extent, intensity, human demand for water, and agricultural practices. Drought can be defined as:

- Meteorological drought, an extended period of dry weather.
- Agricultural drought, a shortage of precipitation that affects crops.
- Hydrologic drought, a reduction in water content in lakes, rivers, streams, aquifers, and soils that may affect supplies available for all users.

6.4.1 Florida's Keetch-Byram Drought Index

The Keetch-Byram Drought Index (KBDI) is used by the Florida Division of Forestry to indicate the dryness of the soil and surface fuels. It is primarily used for fire potential assessment. The drought index is a continuous reference scale for estimating the dryness of the soil and duff layers. The index increases for each day without rain (the amount of increase depends on the daily high temperature) and decreases when it rains. The scale ranges from 0 (no moisture deficit) to 800. The range of the index is determined by assuming that there is 8 inches of moisture in a saturated soil that is readily available to the vegetation. Using 35 years of rainfall and temperature measurements from 9 locations throughout the state average KBDI values are determined for the state on a regional basis. Figure 6-4 is an example of how the KBDI is illustrated each day.

For different soil types, the depth of soil required to hold 8 inches of moisture varies (loam=30", clay=25" and sand=80"). A prolonged drought (high KBDI) influences fire intensity largely because more fuel is available for combustion (i.e. fuels have a lower moisture content). In addition, the drying of organic material in the soil can lead to increased difficulty in fire suppression.

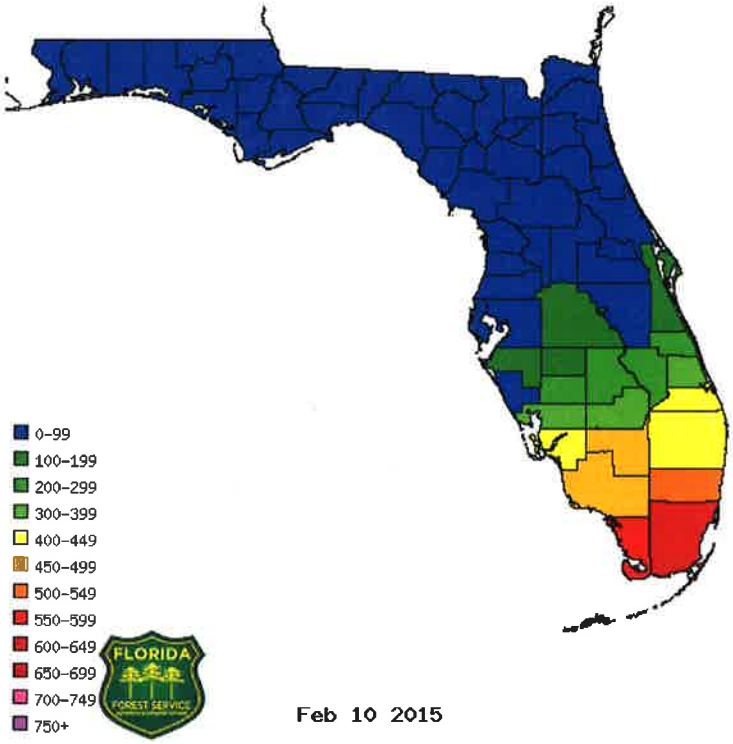


Figure 6-4. Example of the KBDI (February 10, 2015).

6.4.2 Drought in the Florida Keys

The Florida Keys are normally characterized by an arid climate and native vegetation is acclimated to such conditions. However, human usage of potable water continues to rise as development occurs. The water providers for the Keys, the Florida Keys Aqueduct Authority and the South Florida Water Management District, impose restrictions on water use depending on conditions which are continuously monitored. Situations requiring water usage restrictions have occurred over the last several years:

- The City of Key West imposed water restrictions in November 1990.
- The City of Layton operated under water restrictions in the mid-1990s.
- In 2001 the South Florida Water Management District imposed Phase 1 and Phase 2 water restriction rules throughout the Keys.
- Late 2009, the South Florida Water Management District imposed Landscape Irrigation Water Restrictions throughout the District's jurisdiction, including Monroe County.

Using a simplified approach of occurrence over a given period, for the ten-year period of the 1990s the frequency of drought was 20%. This statement of frequency does not imply severity. Indeed, the National Weather Service Weather Forecast Office indicated that drought periods in the Keys have not been prolonged or widespread and thus drought is not considered to be a significant hazard for Monroe County. However, the Department of Agriculture's online archived records of the KBDI show that the maximum index recorded for Monroe County is 764 (out of a maximum 800).

Based on this, Monroe County can expect to see severe drought conditions, even if not prolonged. Because there is relatively little agricultural activity in Monroe, a drought that impacts the mainland source of water is expected to equally affect the entire extent of Monroe County. Drought does not cause property damage to buildings. Drought is generally a broad geographic hazard that is not tied to site specific topographic and geologic features. Monroe County can expect to see droughts with magnitude/severity of up to 765 on the KBDI index but more typically in the 500 to 600 range.

The County is supplied with water from the mainland and all residents are very aware of the need for water conservation on a regular basis, not only during announced drought periods. Typical usage is 169 gallons per person per day during tourist season and 96 gallons per person per day off-season. Measures such as encouraging native vegetation and using native ground cover vegetation in place of lawns contribute to reducing water consumption. Compared to other counties in South Florida, Monroe County's per capita water use is at or below average in most areas.

In mid-2009, the South Florida Water Management District issued restrictions on water use throughout its service area, including Monroe County. During this period, the KBDI peaked at 692 in mid-May. Water restrictions are mandatory and are enforced by the District, local governments, and law enforcement agencies. Residents and businesses were placed on two-day-a-week alternating schedules, with watering not allowed between 10 a.m. and 4 p.m. The restrictions apply to all sources of water for irrigation, including wells, canals, ponds, and lakes. Use of 100% reclaimed or supplemented reclaimed water is allowed during specific periods of time, and low-volume systems that apply water direct to root plant zones may be used provided no runoff is produced. Car and boat washing is allowed (recommended over non-paved, grassy or porous surfaces), and pressure washing is allowed, with runoff water channeled to grassy or porous areas.

The 2013 SHMP reported that in 2011, there was continued dry weather in January 2011, coupled with long-term dryness going back to the previous summer and this led to the expansion of severe drought conditions over South Florida. Rainfall deficits in October 2011 were in the 3–6 inch range with the level of Lake Okeechobee remaining steady at about 12.5 feet, which is 2.2 feet below normal. NCDC reported severe drought conditions in the

mainland area of Monroe County from 2011 to 2012. As of mid-2015, the 2012 drought is the last reported event in Monroe County. Overall, the 2013 SHMP reported that the County has a "Low" Drought Hazard Ranking.

Table 6-11 summarizes each jurisdiction's risk from drought.

Table 6-11. Hazard Profile Summary: Drought

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution/ Location
Monroe County	Low	Low	Small	1-2 per decade	Countywide
Key West	Low	Low	Small	1-2 per decade	Citywide
Islamorada	Low	Low	Small	1-2 per decade	Village-wide
Marathon	Low	Low	Small	1-2 per decade	Citywide
Key Colony Beach	Low	Low	Small	1-2 per decade	Citywide
Layton	Low	Low	Small	1-2 per decade	Citywide

6.5 Wildland Fire

Wildland fires are defined as an uncontrolled fire spreading through vegetative fuels that exposes and possibly destroys buildings. Wildfires are classified as either wildland (in relatively undeveloped areas, perhaps with some basic infrastructure such as roads, power lines, and railroads) or an urban-wildland interface fire (areas with buildings and development).

Certain conditions must be present for a wildland fire hazard to exist: a large source of fuel; conductive weather (generally hot, dry, sunny, and windy) and lack of fire suppression capability due to remoteness or other limitations.

High values of the KBDI, described in Section 6.4.1, are an indication that conditions are favorable for the occurrence and spread of wildfires, but drought is not by itself a prerequisite for wildfires. Other weather factors, such as wind, temperature, relative humidity and atmospheric stability, play a major role in determining the actual fire danger.

High values of the drought index are associated with severe wildfire outbreaks such as occurred during 1998. However, no threshold point has previously been determined to indicate that conditions are far above normal and warrant concern. This work operates under the premise that wide spread drought is accompanied by severe wildfire outbreaks. The

average KBDI is compared to recent levels of fire activity (1981-present) to determine threshold levels that indicate above normal fire activity

The Monroe County *Comprehensive Emergency Management Plan* notes that the extent of the brush and wildland fire threat is minimal for the majority of Monroe County. The exceptions are the Everglades National Park in mainland Monroe, and on Big Pine, No Name, Cudjoe, and Sugarloaf Keys in the Lower Keys where there are remnant tracts of native pine rockland forest.

A primary cause of fires is arson, especially vandalism by school age children and escaped campfires started by the homeless. Other factors that contribute to fires are high winds and droughts, lightening, carelessness, and accidents. Problems can also occur, especially in storms when downed utility lines may spark fires. Accumulated debris after hurricanes contributes to overall fire potential, including wildland fire potential. After Hurricane Georges in 1998, brush debris caught fire in Big Pine.

Information provided by the Florida Department of Forestry indicates that while wildland and brush fires occur infrequently and with little significant consequence in Monroe County, they may occur more often than many think. However, most wildfires are small and contained quickly. On rare occasion, incidents are more serious. For the most part, fires in the Everglades do not threaten residential properties although heavy smoke can lead to road closures.

Since 1987, there have been 38 unintentional wildfires on U.S. Fish and Wildlife Service lands in the National Key Deer Refuge. The largest occurred in 1992 when three wildfires burned over 50 acres. Of the 38 wildfires, 6 were caused by lightning and 15 by arson. Fireworks have also played a role in wildland fire, indicated as the cause of 10 fires. Since 2000, an average of three wildland fires have occurred each year in the Lower Keys affecting an average of 1.27 acres. The largest potential wildfire in the Keys is approximately 500 acres, which is the largest contiguous block of vegetation on Big Pine Key. The extent of any given fire is limited by the size of vegetated areas and also effective response capabilities (described below in "Existing Mitigation Measures.")

In 2007, the Thunderstruck Fire burned 7 acres on Big Pine Key, affecting vacant property adjacent to residential and commercial structures. The Florida Division of Forestry brought in resources from Miami to assist in controlling the fire. The U.S. Fish and Wildlife Service provided helicopter water drops to help control the fire spread. During this event, firefighters from several stations worked in the yards of homes and several businesses to prevent damage. Flame lengths on this wildfire exceeded thirty feet, and nearly all the vegetation was killed as a result of the severity and intensity. NCDC did not report any wildfire events in Monroe County from 2010 to 2014.

The Florida Department of Forestry reports that areas prone to wildland and brush fires in Monroe County include Everglades National Park, No Name Key, Big Pine Key, Grassy Key, Sugarloaf Key, Cudjoe Key, and Big Coppitt Key (including Geiger and Boca Chica). Table 6-12 provides the wildfire risk assessment from the 2013 State Mitigation Plan that analyzes relative risk by population, number and value of structures and total acres at risk. Overall, the 2013 SHMP reported that the County has a "Low" Wildfire Hazard Ranking.

Table 6-12. Monroe County Wildfire Risk Assessment*

Area by Wildfire Risk Rating	Population	# of Structures	Value of Structures	Total Acres at Risk
Low Level of Concern Areas	89,930	39,923	$23,344,290,000	719,886
Medium Level of Concern Areas	118	77	$28,740,000	1,401
High Level of Concern Areas	0	1	$450,000	99

* 2013 Florida Enhanced State Hazard Mitigation Plan Appendix E

Figure 6-5, carried forward from the 2010 Plan, depicts these areas in terms of potential fire behavior:

- Areas of low fire behavior potential are shown in green (flame lengths of less than 4 feet; relatively easy to control). Fires of this intensity would be most likely to occur in hardwood hammock areas or in areas where brush has been removed.
- Areas of moderate fire behavior potential are shown in yellow (flame lengths of 4-8 feet; difficult to control). These areas are characterized as marshes and areas transitioning out of marshes into uplands.
- Areas of high wildland fire behavior potential are shown in red (flame lengths exceeding 8 ft; very difficult to control, especially during the afternoon when solar radiation peaks). These areas would be characterized as the pine rockland uplands that are found on the islands in the Lower Keys, which is also where the concentrations of structures occur.

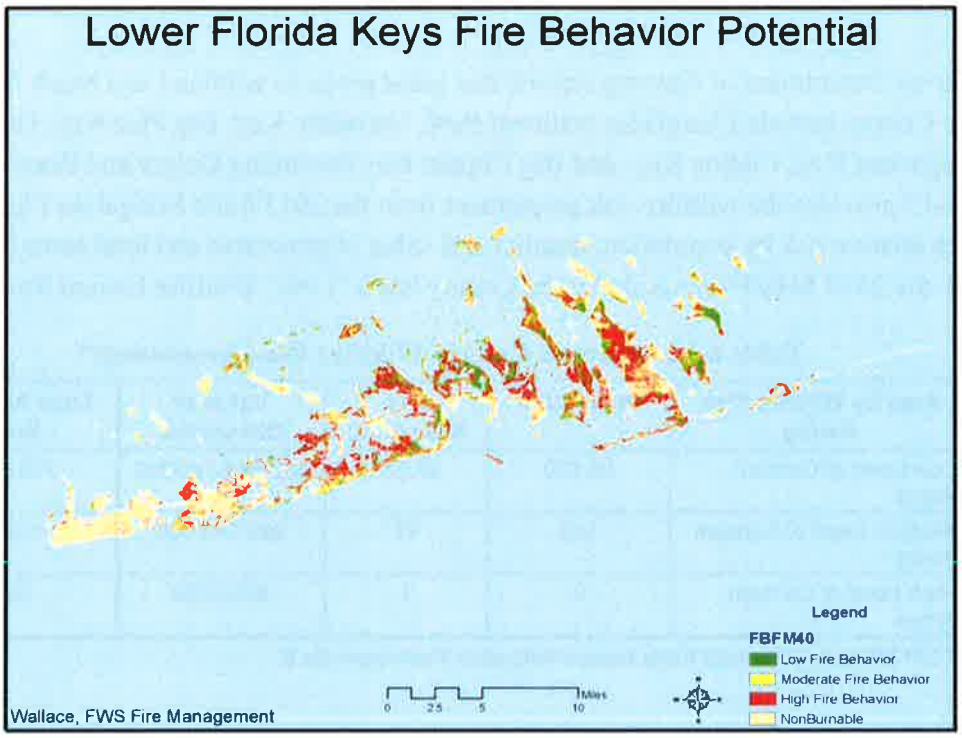


Figure 6-5. Lower Florida Keys Fire Behavior Potential.

Existing Mitigation Measures. Monroe County and Marathon have programs for training and certifying volunteer fire departments in wildland firefighting. Although, the Department of Forestry in the Keys received new equipment in the late 1990s, staff levels have been reduced to only two rangers for all of Monroe County. The U.S. Fish and Wildlife Service National Key Deer Refuge has also received grant money to help train fire department personnel in wildland fire control, fires in wildland urban interface areas, and the Incident Command System. The U.S. Fish and Wildlife Service has a full time prescribed fire specialist/firefighter on staff in Big Pine Key, along with a tracked wildland fire engine and a small wildland fire truck.

The following preventive measures are recommended by the Department of Forestry and the U.S. Fish and Wildlife Service:

- Educational programs, especially for children.
- Create defensible space around buildings by removing brush and burnable materials from around structure so that firefighters have easy access.
- Cleaning gutters to prevent build-up of burnable materials.
- Timely disposal of yard waste and household debris, particularly mattresses.
- Development of ordinances dealing with removal of brush and potentially dangerous vegetative materials, especially during dry spells and during hurricane season, and rapid removal of storm debris.

- When residential property is threatened by fire, the roof and yard should be wet down to provide protection.
- Selective prescribed burning by a state-certified burn manager, to reduce the quantities of fuel.

To deal with wildfire threats on Cudjoe Key, the Florida Division of Forestry added water supply wells and widened some roads to improve emergency vehicle access.

Table 6-13 summarizes each jurisdiction's risk from wildfire; for the municipalities, no reported events were found but some residual risk remains, especially in larger municipalities like Islamorada and Marathon where larger tracts of vegetation exist.

Table 6-13. Hazard Profile Summary: Wildfire

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution/ Location
Monroe County	Low	Moderate	Small to Medium	Less than 1 per year	Select areas – mostly the Lower Keys and mainland Monroe
Key West	Low	Low	Negligible	Once every 50 years	n/a
Islamorada	Low	Low	Negligible	Once every 25 years	n/a
Marathon	Low	Low	Negligible	Once every 25 years	Some risk in Grassy Key area but no reported events
Key Colony Beach	Low	Low	Negligible	Once every 50 years	n/a
Layton	Low	Low	Negligible	Once every 50 years	n/a

6.6 Coastal Erosion

Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. Waves generated by storms cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely in the temporary redistribution of coastal sediments. The concept of probability of occurrence is not applicable because coastal erosion is a long-term, on-going process. Erosion in one location may result in accretion nearby.

The following definition has been adopted by the Florida Department of Environmental Protection (DEP), Bureau of Beaches and Coastal Systems, to identify areas of critical erosion:

> "Critical erosion area is a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critical erosion areas may also include peripheral segments or gaps between identified critical erosion areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects."

Some erosion-related changes are slow, inexorable, and usually gradual. However the changes on a beach, in contrast, can happen literally overnight, at least during a storm. Even without storms, sand may be lost to longshore drift (the currents that parallel coastlines) or sand may be pulled to deeper water, essentially lost to the coastal system. DEP determines the geographic areas of the state that are at high risk of erosion. The Bureau develops and publishes an annual report on Critically Eroded Beaches Report. DEP's *Strategic Beach Management Plan: Florida Keys Region* (June 2015) illustrates identified critically beaches in Figure 6-6. Because of the level of detail in this report it is included in Appendix E.

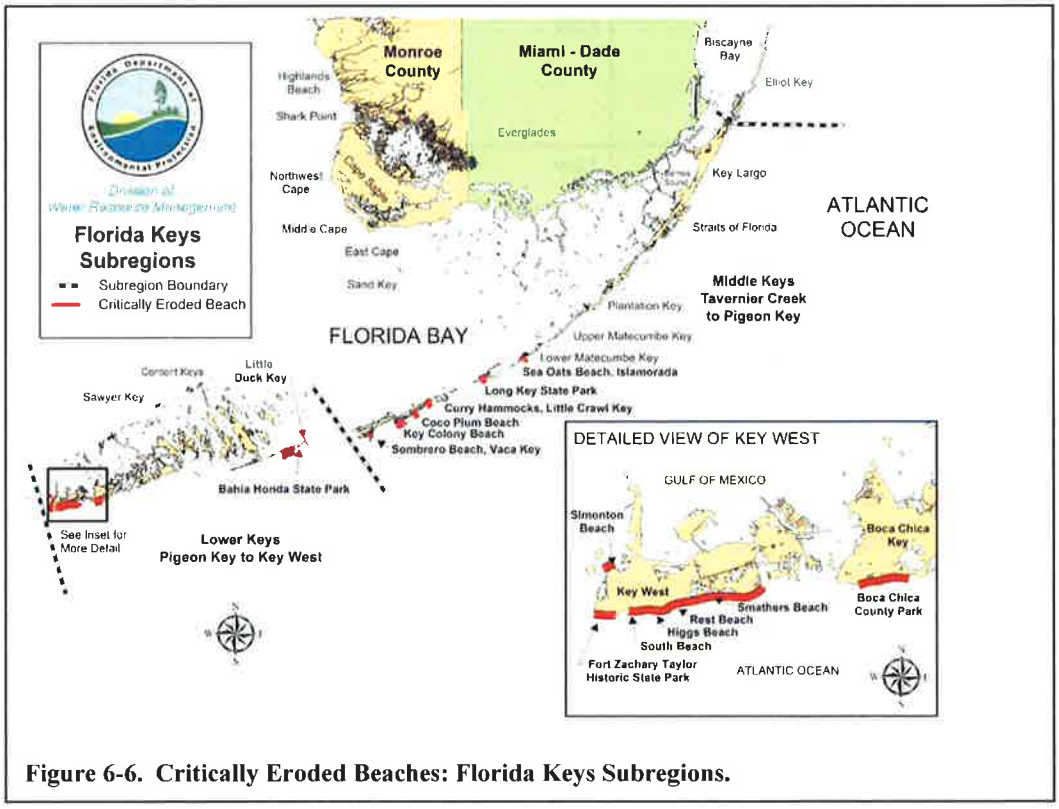


Figure 6-6. Critically Eroded Beaches: Florida Keys Subregions.

During the 2005 hurricane season, hurricanes Dennis, Katrina, Rita, and Wilma caused erosion and flooding along the coastal barrier beaches of Dade County and the Florida Keys and mainland beaches of Monroe County.

DEP's 2015 report, *Critically Eroded Beaches in Florida*, and the 2015 *Strategic Beach Management Plan – Florida Keys Region* report some erosion impacts from Hurricanes Rita and Wilma. Using this characterization to estimate the extent of erosion vulnerability, Monroe County has 10.2 miles of shoreline designated critical, and 1.6 miles of shoreline designated non-critical. DEP notes the "Gulf fronting beaches in Monroe County, including the cape Sable region and the distal sand keys west of Key West (e.g., Marquesas Keys, Tortugas Keys), have insufficient data to identify erosion problem areas at this time; however, the Department has documented substantial erosion in these areas due to hurricanes in 2005." Based on reported observations at one location, the rate of shoreline erosion may be as high as 3 feet per year in the most vulnerable locations. It is notable that most reported damage is to public facilities and park infrastructure:

- Hurricanes Rita and Wilma caused moderate beach and dune erosion and flooding to Sea Oats Beach on Lower Matecumbe Key, Key Colony Beach, and Little Duck Key, and destroyed park facilities on Little Duck Key.
- Hurricanes Rita and Wilma combined to severely impact the park and destroyed the waterfront campsites and infrastructure at Long Key State Park.
- Hurricane Wilma inflicted moderate beach and dune erosion and additional overwash, and also damaged major structures at West Coco Plum Beach.
- Hurricane Wilma caused major beach and dune erosion as well as greater structural damages at West Key Colony Beach.
- Hurricane Wilma damaged much of Sombrero Beach's infrastructure on Vaca Key and caused moderate erosion.
- Hurricane Wilma caused moderate to major beach and dune erosion at Calusa Beach and Loggerhead Beach, and minor dune erosion with beach accretion within the critically eroded portion of Sandspur Beach.
- Hurricane Wilma caused moderate to major beach erosion at Boca Chica Beach in the Lower Keys and destroyed much of the beach road (since abandoned).
- Hurricane Wilma critically eroded Simonton Beach, a part in Key West.
- Hurricanes Rita and Wilma caused minor to moderate beach and dune erosion at the Fort Zachary Taylor Historic State Park's beach, and Hurricane Wilma caused additional minor beach and dune erosion along the beach. Also during Wilma, one of the four detached breakwaters sustained major damage, and the west shore revetment sustained minor damage.
- Hurricane Wilma caused severe erosion on the mainland beaches of Cape Sable and Key McLaughlin.

NCDC reported the Tropical Storm Fay in August 2008 resulted in damage and preparedness costs to government facilities and infrastructure totaled $2.8 million, with about one million dollars due to damage to roads and $200,000 due to erosion. NCDC reported Hurricane Ike in September 2008 caused some erosion "county-wide" due to storm surge flooding.

In general, some islands and reaches of coastlines of Monroe County are susceptible to erosion due to the relatively frequent occurrences of hurricanes and tropical storms. Because of the geologic composition of the Lower Keys, with more calcium carbonate sand beaches, that area is significantly more vulnerable to erosion than the Upper and Middle Keys. Table 6-14 lists specific areas of reported impacts of critical erosion and what is vulnerable are documented from the State DEP's 2015 *Critically Eroded Beaches in Florida* and 2015 *Strategic Beach Management Plan – Florida Keys Region.*

Although DEP identifies specific lengths of shoreline as vulnerable to erosion, the reports do not include any projection of rates of shoreline recession. Without such rates, it is not possible to identify buildings and infrastructure at risk of future erosion. Park officials and Public Works monitor past erosion on County-owned land as an indicator of potential problems. The LMS Working Group asked Monroe County Growth Management to consider including DEM's information about coastal erosion in its recently initiated Sustainability study, which will examine vulnerability to sea level rise. In the future, as more analyses are done, it should be possible to improve identification of at-risk public property and infrastructure, along with private property.

Table 6-14. Identified Critically Eroded Beaches and Vulnerability

Location	Erosion Condition & Length (miles)	Vulnerability
Sea Oats Beach, Lower Matecumbe Key	Critical – 0.7	Recreational interests and U.S. Highway 1
Long Key	Critical – 1.0	Critically eroded threatening recreational interests at the Long Key State Park. Park officials estimated shoreline recession at 3 ft/year since 1970.
Curry Hammocks, Little Crawl Key	Critical – 0.1	Critically eroded threatening recreation interests at Curry Hammocks State Park (beach restoration occurring)
Coco Plum Beach, east	Non-critical – 0.6	City of Marathon public beach park
Coco Plum Beach, west	Critical – 0.3	Private Development
Key Colony Beach	Critical – 0.9	Private Development
Key Colony Beach, west shoreline	Critical – 0.2	Public recreational interests at Sunset Beach
Sombrero Beach, Vaca Key	Critical – 0.3	City of Marathon's public park

		(beach restoration occurring)
Little Duck Key	Critical - 0.2	Monroe County park
Bahia Honda Key	Critical – 2.0	Threatening recreational interests as well as the park road and park development (beach restoration occurring at Calusa Beach and revetment along park road)
Boca Chica Key	Critical – 1.3	Public beach and access road (these were lost during Hurricanes Rita and Wilma)
Key West (south coast)	Critical – 2.8	Recreational beach (beach restoration occurring at Smathers Beach; a seawall has been constructed along most of S. Roosevelt Boulevard)
Simonton Beach (south shoreline of Key West)	Critical – 0.1	City park (was critically eroded by Hurricane Wilma)
Ft. Zachary Taylor (west end of Key West)	Critical – 0.3 miles	Threatening recreational interests

Three post-disaster projects to address beach erosion and loss of sand have been funded under FEMA's public assistance program. On these beaches and similar sandy beaches in the area are expected to see similar erosion in the future under similar storm conditions. Storms that do not move through the region quickly could result in even greater loss of sand:

- Smathers Beach in Key West has been renourished several times since the late 1980s. After Tropical Storm Ike (2008), an engineering investigation confirmed erosion of the permanent beach face of 2,453 cubic yards of sand.
- Coco Plum Beach in Marathon sustained loss of approximately 4,444 cubic yards of sand associated with Tropical Storm Fay (2008).

Table 6-14 summarizes each jurisdiction's risk from coastal erosion.

Table 6-14. Hazard Profile Summary: Coastal Erosion

Jurisdiction	Vulnerability	Impact	Extent / Magnitude	Frequency	Distribution/ Location
Monroe County	Medium	Moderate	Small to Medium	1-2 per year (with coastal storms)	Limited selected areas ranging from Key Largo to Lower Keys
Key West	High	Moderate	Medium to Large	1-2 per year (with coastal storms)	2.9 miles of beaches and Fort Zachary Taylor
Islamorada	Low	Low	Negligible	Significant erosion generally not an issue	No reported areas of significant erosion
Marathon	Low	Low	Small	Significant	Sombrero

				erosion generally not an issue	Beach has some erosion areas
Key Colony Beach	Low	Low	Small	Significant erosion generally not an issue	Key Colony Beach and West Key Colony Beach have some erosion areas
Layton	Low	Low	Negligible	Significant erosion generally not an issue	No reported areas of significant erosion

6.7 Overview of Monroe's Hazards & Risks

The descriptions of hazards, hazard histories, and impacts that are detailed in Chapter 5 and this chapter are summarized as "relative" vulnerabilities in Table 6-15. A summary of overall vulnerability by jurisdiction to the identified hazards is in Table 6-16. At its March 5, 2015 meeting, the LMS Work Group agreed to the following:

- Flooding (rainfall/ponding): Changed from "High" to "Medium" in Marathon and from "Medium" to "Low" in Layton.
- Coastal Erosion: Still has a "low" ranking in most jurisdictions but warrants a "medium" in Monroe County and "high" in Key West.
- Confirmed that Climate Change and Sea Level Rise is a "medium" ranking hazard and will exacerbate the impacts of other hazards like surge flooding, rainfall flooding, and hurricane wind.

Table 6-15. Hazards: Relative Vulnerability

Hazard	Vulnerability	Impact	Frequency	Distribution
Hurricane/Tropical Storm	High	Moderate to Severe	1-2 per year	Countywide
Sea Level Rise	Moderate	Moderate to Severe	Continuously increasing	Coastal and low-lying areas
Flooding (rainfall ponding)	High (locally)	Moderate	6-12 times each year	Key West
Strong Storms/ Tornado/Lightning	Moderate	Moderate	1-2 per year	Countywide
Wildfire	Low	Low	Less than 1 per year	Selected areas
Drought	Low	Low	1-2 per decade	Countywide
Coastal Erosion	Low	Low	1-2 per year (with coastal	Limited selected

Table 6-15. Hazards: Relative Vulnerability

Hazard	Vulnerability	Impact	Frequency	Distribution
			storms)	areas

Table 6-16. Hazards: Overall Vulnerability Scores

Hazard	Jurisdictions and Overall Vulnerability Rating					
	Monroe County	Islamorada	Marathon	Key Colony Beach	Layton	Key West
Hurricane/ Tropical Storm	High	High	High	High	High	High
Flooding (rainfall ponding)	Medium	Medium	Medium	Medium	Low	High
Strong Storms/ Tornado/ Lightning	Medium	Medium	Medium	Medium	Medium	Medium
Wildfire	Low	Low	Low	Low	Low	Low
Drought	Low	Low	Low	Low	Low	Low
Coastal Erosion	Medium	Low	Low	Low	Low	High
Sea Level Rise	Medium (Continuous increase)	Medium (Continuous increase)	Medium (Continuous increase)	Medium (Continuous increase)	Medium (Continuous increase)	Medium (Continuous increase)

6.8 2015 Updates

The LMS Working Group reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 6.1: Moved text about hazards not further considered to Chapter 5.
- Section 6.2: Updated wind maps from the Florida Building Code; added number of water spouts, table summarizing hail damage and a table summarizing wind damage; updated map of tornado occurrences, added a lightning event map, and updated tornado and lightning events.
- Section 6.3: Updated rainfall/fresh water flooding events and inland flooding impacts table.
- Section 6.4.1: Added new Keetch-Byram Drought Index (KBDI) map; updated drought conditions.
- Section 6.4.2: Added historical record of KBDI.
- Section 6.5: Added Monroe County Wildfire Risk Assessment from State Plan.

- Section 6.6: Updated areas affected by coastal erosion based on two reports released by DEM in 2015; updated map showing critical erosion areas identified by DEP.
- Section 6.7: Updated table of relative vulnerabilities and new table of overall vulnerability by jurisdiction.

References:

- "Hurricane Wilma in the Florida Keys" by Kennard Kasper, National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS) Weather Forecast Office (WFO) Key West, Florida
- "Strategic Beach Management Plan: Florida Keys Region" by Florida Department of Environmental Protection, June 2015.
- State of Florida Enhanced Hazard Mitigation Plan, August 2013
- Monroe County Climate Action Plan, November 2013
- Strategic Beach Management Plan for the Florida Keys Region May 2008
- Analysis of the Vulnerability of Southeast Florida to Sea Level Rise August 2012
- Annual Report of the Monroe County Tourist Development Council September 2013

Chapter 7. Monroe County

This chapter contains an overview of Monroe County agencies and their functions as they relate to natural hazards and hazard mitigation. This plan summarizes the functions of Emergency Services Division, but does not characterize its functions that deal with emergency response and immediate post-event recovery. That information is found in the Monroe County *Comprehensive Emergency Management Plan.*

Chapters 8 through 12 describe the cities Key West, Layton, Key Colony Beach, Islamorada Village of Islands, and Marathon.

7.1 Capability Assessment: County Government Structure

Monroe County, created in 1823, is a political subdivision of the State of Florida. The powers and authority of the County emanate from the State Legislature.

The Board of County Commissioners (BOCC), which performs the legislative and executive functions, consists of five members elected at large. Each commissioner represents one of five districts and is elected for a term of four years. Pursuant to Florida Statute 252, the BOCC is responsible for safeguarding the life and property of the population of Monroe County, and to provide effective governmental control and coordination of emergency operations.

For administrative purposes and to conduct the work of the County, the Board of County Commissioners (BOCC) has organized County agencies into six functional divisions, each with several departments (Table 7-1). Selected departments that have direct or indirect roles in addressing natural hazards are described below.

Table 7-1. Monroe County's Functional Divisions

Division	Departments Supervised	Mitigation Role	
		Direct	Indirect or None
County Administrator	Airports	X	
	Budget and Finance	X	
	Social Services		X
	Library Services		X
	Extension Services	X	
	Information Technology	X	
	Veteran's Affairs		X
	Project Management	X	
	Wastewater		

Table 7-1. Monroe County's Functional Divisions

Division	Departments Supervised	Mitigation Role	
County Attorney	Represents officials and all departments employees		X
Emergency Services	Fire/Rescue	X	
	Emergency Medical Services	X	
	Emergency Management	X	
	Fire Marshall	X	
	Upper Keys Health Care Taxing District	X	
Public Works & Engineering	Fleet Management	X	
	Facilities Maintenance	X	
	Detention Facilities		X
	Unincorporated Parks & Beaches		X
	Higgs Beach & Martello Museums	X	
	Engineering Services	X	
	Roads & Bridges	X	
	Solid Waste Mgmt & Recycling	X	
	Animal Control		X
	Card Sound Toll Authority		X
Growth Management	Code Compliance	X	
	Building Department	X	
	Planning & Environmental Resources	X	
	Floodplain Management	X	
	Marine Resources	X	
	GIS Department	X	
Employee Services	Human Resources		X
	Employee Benefits		X
	Risk Management	X	
	Safety Office		

7.1.1 Emergency Services Division

The Emergency Services Division has administrative responsibility for Fire Rescue, Emergency Management, the Fire Marshall, and the Upper Keys Health Care Taxing District. These agencies are responsible for firefighting, emergency medical services, and urban search and rescue.

The Division of Emergency Services (and its functional units) is responsible for the following disaster-related activities:

- Manage the Emergency Operations Center
- Coordinate with local hospitals
- Coordinate Special Medical Needs
- Coordination with Monroe County School District

- Manage in-county and out-of-county shelters
- Provide and coordinate fire rescue resources to support emergency functions requiring firefighting and emergency response, recovery and assistance missions. Participating agencies include municipal fire rescue departments, the Florida Department of Forestry, U.S. Navy, Boca Chica, Florida Fish and Wildlife Conservation Commission, Provide and coordinate search and rescue operations and resources; provide support to local agencies, locate missing persons, lost vessels, persons trapped in confined areas (including damaged/destroyed structures); locate downed aircraft, extricate, if necessary, and treat victims upon rescue.
- Review and assess health and medical needs of the County in the event of an emergency event and obtain resources to meet needs.
- Provide, coordinate and direct efforts to complement local emergency response actions in the aftermath of a hazardous material accident/incident; secures affected areas and coordinates removal and disposal of materials from the disaster location.

7.1.2 Emergency Management Department

The Emergency Management Department is a unit of the Emergency Services Division. Chapter 252.38 of the Florida Statutes requires political subdivisions to develop emergency plans to provide for the safeguarding of life and property of its citizens.

The Monroe County Emergency Management Department has jurisdiction over the entire county and serves as liaison for, and coordinator of, municipalities' requests for State and Federal assistance during post-disaster emergency operations. By State rules, each municipal emergency management plan must be consistent with, and subject to, the county emergency management plan. Such consistency will be evidenced in the elements of their respective preparedness, response, recovery, and mitigation plans.

The 2012 Monroe County *Comprehensive Emergency Management Plan* (CEMP), establishes official emergency management policy for all agencies and municipalities for response to, recovery from, and mitigation of, emergencies and disasters within Monroe County. Examples of other planning and response plans are those pertaining to Hurricane Evacuation, Shelter, and Refuge of Last Resort Plan, Turkey Point Nuclear Power Plant Emergency Plan, Migration, and Terrorism, among other plans and procedures. The Plan is available on-line at: http://www.monroecountyem.com/DocumentCenter/Home/View/16

Included among the Department's many activities are the following:

- Emergency Management is the primary department responsible for training and public awareness as it relates to disaster preparedness; throughout the year, personnel conduct seminars and presentations, and meetings regarding emergency preparedness.

- Emergency Management conducts annual training programs for all county departments and other county entities participating in Emergency Operation Center and Shelter operations, and other emergency preparedness activities and needs.
- Emergency Management has established a number of public information and education programs regarding recovery efforts and available assistance.
- Hurricane preparedness information concerning mobile home, travel trailer and RV hurricane procedures and local shelter information is disseminated to the public via local television, radio, print media, and other media outlets, each year prior to Hurricane Season.
- Emergency Management personnel, as part of their professional development, are encouraged to attend State and FEMA courses.
- Local personnel are trained through programs of relief organizations (American Red Cross and HAM radio groups).
- Monroe County conducts annual drills and exercises in, but not limited to, hurricane response, nuclear power plant response, airport disaster response, mass migration, cruise ships emergencies, terrorism threats, and oil spill response. These exercises are scheduled in conjunction with the Florida Division of Emergency Management, and various County, State, and Federal agencies.
- All agencies with emergency response roles participate in annual exercises and drills.

The Monroe County Emergency Management Department is charged with facilitating, developing, managing, monitoring and evaluating the Monroe County Local Mitigation Strategy Plan, in cooperation with the municipalities of Key West, Marathon, Key Colony Beach, Layton, and the Village of Islamorada. The agency coordinates with the Florida Division of Emergency Management to process applications for mitigation grant funds. The Plan is available on line at: http://www.monroecountyem.com/index.aspx?NID=135

Projects funded with hazard mitigation funds, including funds that may be made available as part of FEMA reimbursements for damage to public facilities, must conform to established Monroe County codes and regulations.

7.1.3 Growth Management Division

The Growth Management Division recommends and implements policies provided in the County's Comprehensive Plan and the Land Development Regulations. The Building, Planning and Environmental Resources, Code Compliance, and Marine Resources Departments are under the Division's jurisdiction. Planning staff assists in the development of and updates to the County's Comprehensive Plan and Land Development Regulations.

The Planning and Environmental Resources, Building, and Code Compliance Departments are responsible for reviewing construction plans, issuing building permits, assuring compliance with the floodplain regulations, and inspecting projects during construction. Enforcement of zoning and building standards are intended to safeguard public safety and to minimize damage associated with high winds and flooding. Table 7-2 shows the number of permits issued in calendar years 2012, 2013, and 2014. The Division serves as the coordinator for the National Flood Insurance Program and assists the public in identifying and implementing flood damage prevention measures (see Section 7.3.2).

Monroe County, Florida

- *Seven Inspectors*
- *Two Inspectors hold minimal standard certifications and five Inspectors are cross certified in each trade; plumbing, mechanical electrical and structural*
- *Building Code Effectiveness Grading Schedule rating:*
  - *3 for 1-2 Family Dwellings*
  - *3 for Commercial*

Table 7-2. Permits Issued in 2012, 2013, and 2014

Activity	CY2012	CY2013	CY2014
New single-family, detached	50	100	197
Multi-family (2 or more)	12	0	0
Non-residential (all types)	707	771	709
Residential (additions, alterations, repairs)	3,329	2,989	3,210
Non-residential (additions, alterations, repairs)	225	183	177
Demolition	171	131	141
Mobile home (permanent/temporary)	5	15	19
Total	4,499	4,189	4,453

In the event of a disaster, post-damage inspections are conducted to determine requirements that are applicable during repair and reconstruction. After a hazard event that prompts recovery, the Growth Management Division carries out the following specific duties:

- Collection of information for preparation of Damage Survey Reports is a joint effort of MC Emergency Management and MC Growth Management. The MC Growth Management Division surveys neighborhoods for structural

damage. For the purpose of re-construction, damage to structures is categorized by "minor", "major", "uninhabitable" (major electrical, plumbing or roof damage), and "destroyed".

- For substantially damaged buildings that also are insured by the NFIP, the Growth Management Division issues letters for application of Increased Cost of Construction (ICC) claims and requires re-construction through the permitting process to comply with all current codes.
- Mitigation activities in post-disaster situations will be handled through the Growth Management Division and the Department of Emergency Management.
- Planning Department policies ensure that mitigation related items in the Comprehensive Plan, such as floodplain and natural resource management, are followed and reflected in the County's Codes and Standards.
- Planning personnel participate in post-disaster appraisals and may formulate additional mitigation measures for use in the Comprehensive Plan. Personnel work closely with building and zoning staff to ensure coordination.
- Mitigation recommendations, especially those based on direct disaster experience will be reflected in the Evaluation and Appraisal Reports (EAR) required for the Comprehensive Plan.
- Environmental Resources monitors environmental provisions in regulations, codes, and plans and coordinates with other agencies as needed.

7.1.4 Public Works & Engineering Division

The Public Works & Engineering Division is responsible for overseeing the maintenance and operation of County facilities, including roads and bridges. From three locations (Key West, Marathon, and Plantation Key), the Division operates and maintains the County's heavy equipment, vehicles, repair shop, and fueling stations.

The Public Works & Engineering Division is responsible for the following disaster and mitigation-related activities:

- Deploy protective measures at County's designated Shelter facilities (i.e., install shutters, position generators, etc.).
- Expedite debris clearance of Overseas Highway (US #1) and County-maintained roads.
- Assist with re-entry and respond to assistance requests from municipal agencies.
- Coordinate and manage debris collection and disposal contractors.
- Secure environmental waivers and legal clearances for debris removal and disposal.
- Identify and report damage to public facilities and infrastructure, participate in preparation of documentation for State and federal reimbursements, and consider possible mitigation measures as part of repairs and reconstruction.

- Establish priorities regarding the repair and/or reconstruction of damaged transportation routes (roads, bridges, airfields, etc.).
- Coordinate emergency contracting and emergency repair of drainage and solid waste facilities.

7.1.5 Florida Department of Health in Monroe County (DOH-Monroe)

The Florida Department of Health in Monroe County functions as the primary public health unit for the county and municipalities. DOH-Monroe operates from six locations in the upper, middle and lower Keys. Each office oversees issues such as environmental health, rabies and infectious disease control, and community clinical and preventive health services. DOH-Monroe's responsibilities include investigating and addressing public health threats including documenting reportable and non-reportable diseases and environmental issues, regulating and permitting biomedical waste, responding to radiological incidents, inspecting and permitting group care facilities sanitation inspection, septic tank permitting, regulation of toxic and hazardous materials, , and permitting of mobile home and RV parks.

The DOH-Monroe is responsible for the following disaster-related activities:

- Coordinate ESF 8 activities with representation at the Emergency Operations Center.
- Disaster Community Health Assessment Teams conduct post-disaster assessments of public health risks.
- Following a disaster, DOH-Monroe maintains surveillance of outbreaks of infectious diseases and takes necessary actions to address problems.
- May undertake event-specific activities; for example, after Hurricane Georges the department reviewed performance of various kinds of septic and waste systems.
- Provides personnel, coordination and planning related to Special Needs sheltering needs at designated locations and at Florida International University.

7.1.6 Monroe County Budget and Finance

Budget and Finance includes the Office of Management and Budget, the Purchasing Department, and the Grants Department.

Budget and Finance is responsible for the following disaster-related activities:

- Give guidance to all departments to ensure they collect and maintain thorough documentation of disaster-related expenditures, the key element in the reimbursement process which requires maintenance of logs, records and file copies of all expenditures in order to provide clear accountability for reimbursement requests.

- Establishes financial management procedures in conformance with State and federal requirements specific to funding sources.

7.1.7 Monroe County School District

The Monroe County School District operates and maintains the school system in the County and municipalities. In addition to serving the student population, schools are a vital component of the County's Emergency Management Program. Selected school buildings may function as shelters, school personnel often serve as shelter staff, school buses are used in evacuations, and school personnel provide shelter support services.

The Monroe County School District mitigation and response activities include:

- The District construction standards among the strictest in the State; new construction is required to meet 150 mile per hour wind-load standards.
- The District and school system is a participating member on the Local Mitigation Strategy Working Group.
- The District and Monroe County government cooperate in many emergency-related efforts, including applying for grant funds to install hurricane shutters on several schools used as shelters.
- Enhanced Hurricane Protection Area (EHPA) construction upgrades were made possible through funding provide by County, municipality (City of Marathon), and the District. The following schools will benefit from the EHPA upgrades: Key West High School, Poinciana School, Marathon High School, and Key Largo School.

7.2 Regional Agencies & Organizations

7.2.1 South Florida Regional Planning Council

The South Florida Regional Planning Council plans for and coordinates activities of the South Florida Region (Broward, Miami-Dade, and Monroe Counties). State legislation passed in 1993 recognized that the regional planning councils are Florida's only multi-purpose regional entities that are in a position to plan for and coordinate intergovernmental solutions to growth-related problems on greater-than-local issues.

Regional planning councils are required to develop Strategic Regional Policy Plans. Emergency Preparedness is one of the six strategic subject areas addressed and goals and policies contain provisions relating to hazard mitigation. In addition, the other strategic areas (land use and public facilities, natural resources, economic development, transportation, and emergency housing), may provide recommendations related to mitigation. The Plan recognizes the critical link between land use and emergency preparedness. For example, management of growth in the region relates directly to

emergency evacuation. Preservation of the environment reduces development or guides development in ways that maintain important natural areas that may buffer the effects of storms and other hazards.

The South Florida Regional Planning Council's mitigation and response activities include:

- During the development process for the Strategic Regional Policy Plan, the South Florida Regional Planning Council held workshops with regional agencies to acquire input. An Emergency Preparedness Workshop which included discussion of mitigation issues was held and provided an opportunity to interested agencies to identify their concerns and needs relating to mitigation.
- In its review of documents such as County Comprehensive Plans and Comprehensive Emergency Management Plans, the South Florida Regional Planning Council can recommend policies that enhance hazard mitigation.
- The South Florida Regional Planning Council conducts other projects that directly assist in effective emergency management and hazard mitigation, such as publication of the "Hurricane Survival Guide for Small Businesses, September 1995."
- After the unprecedented activity in the 2004 and 2005 hurricane seasons, the Florida Division of Emergency Management contracted with the Council to facilitate, in collaboration with local emergency management officials, consistent and integrated mapping and analysis of all-hazards evacuation across the Region. The Regional Evacuation Study for South Florida was completed in 2010. The Study includes regional hazards, behavioral, vulnerability, population, shelter and transportation analyses for evacuation. Storm surge map atlases are included. In 2012, the Depth Analysis Atlas for South Florida provided storm surge water depth for impacted areas. In 2015, a Directional Atlas will further refine storm surge affected areas through the analysis of paralleling, land falling and exiting storms.
- The South Florida Regional Planning Council is an ex officio member of the Steering Committee for the Southeast Florida Regional Climate Compact (Monroe, Miami-Dade, Broward and Palm Beach Counties). The Council conducted a project with the Compact, funded by the Florida Department of Economic Development, creating a publication entitled "Guidebook for Local Government Adaptation Action Areas."

7.2.2 South Florida Water Management District

The South Florida Water Management District, operating under the jurisdiction of the Florida Department of Environmental Protection, is responsible for overseeing the very complex system of waterways and canals that affect the water system throughout much of South Florida.

The Florida Keys of Monroe County does not contain a system of drainage canals under the supervision of the Water Management District, as do other counties. However, portions of

the County on the mainland that are located in Everglades National Park and Big Cypress Basin are under the District's control. The County and incorporated municipalities may coordinate with the District to develop Storm Water Management Master Plans and policies to improve storm water management techniques and participation in the Surface Water Improvement Management Program.

The South Florida Water Management District's mitigation and response activities include:

- Analyses and recommendations for water control measures to mitigate hazards such as floods and droughts.
- The District, with support of local governments and law enforcement agencies, enforces mandatory water shortage restrictions when such restrictions are activated.
- Implementation of storm water management measures advocated by the District, such as discouraging the use of impervious surfacing and filling and retention of natural drainage patterns and open space, could help decrease property damage from a major storm event.
- Through the planning and use of various water control techniques, the District's work can mitigate certain hazards such as those related to flooding and the mixing of fresh and salt water.

7.2.3 Florida Keys Aqueduct Authority

The Florida Keys Aqueduct Authority is an independent agency constituted by the State of Florida with the primary purpose and function to obtain, supply, and distribute an adequate water supply to the Florida Keys. The Authority manages the infrastructure used to supply water to the Florida Keys and provides service to the consumer, sets rates, and conducts billing.

The Florida Key's Aqueduct Authority's mitigation and response activities include:

- The Authority's pipeline originates in Florida City in south Miami-Dade County. It examines ways to protect the supply system from hazards and minimize the opportunities for disruption. The Authority works to find ways to deal with disruption, including identification of alternative sources when water cannot be supplied through the pipeline.
- The Authority participates in developing policies and procedures for responding to and recovering from shortages and disruptions in the supply and delivery of electricity, potable water, and other forms of energy and fuels which affect or threaten to affect significant numbers of citizens and visitors.
- The Authority has 100% redundancy with diesel-powered pumps to mitigate the loss of water flow to the Keys during electric service outages. The redundancy includes three desalinization plants: Stock Island (2 million gallons per day); Marathon (1 million gallons per day); and Florida City (6 million gallons per day).

7.2.4 Electric Utilities

The electric utilities that serve Monroe County are the Florida Keys Electric Cooperative (FKEC), the Keys Energy System (KEYS), and Florida Power and Light (FP&L). The mitigation and response activities of the utilities include:

- Establish policies and procedures for responding to and recovering from shortages and disruptions, including the supply and delivery of electricity, and other forms of energy and fuel, which affect or may affect significant numbers of citizens and visitors.
- Restoration of electric utility services which were interrupted due to major or catastrophic emergencies. Coordination of services and communications among utilities and local, state and federal agencies. Identification of emergency-related problems and development of remedial actions.
- FKEC completed its Operations Center in December 2009.

7.2.5 Habitat for Humanity of Key West and Lower Florida Keys

The mission of Habitat for Habitat for Humanity of Key West and Lower Florida Keys, Inc. is to eliminate substandard housing and provide post disaster recovery assistance to the community. The organization occupies a 13,000 square foot concrete facility located at 30320 Overseas Highway, Big Pine Key, behind Roger's Furniture. In the event of a disaster, Habitat is positioned to provide a staging area for post disaster operations including volunteer deployment, project coordination and supply distribution. Habitat works in partnership with federal, state, county and municipal disaster response teams as well as nonprofit organizations such as The American Red Cross, The Salvation Army, State, national and local ecumenical response groups, and the community at large.

7.3 Planning & Development Processes

7.3.1 Comprehensive Plan: Year 2010

The Monroe County Comprehensive Plan (Year 2010) consists of three parts: the Policy Document; the Technical Document; and the Map Atlas. The plan is available online at http://www.monroecounty-fl.gov/pages/MonroeCoFL_Growth/CompPlan2010/index.

The Year 2010 Comprehensive Plan Policy Document contains the goals, objectives and policies for each element, the capital improvements implementation program, and the monitoring and evaluation procedures. The Technical Document contains background information and support data and analyses for the elements of the plan. The Map Atlas contains maps depicting background information for the various elements (existing land use, natural features, existing, transportation, etc.). The County's commitment to implementing the Comprehensive Plan is "limited to its reasonable ability to fund only part of the cost of

implementation." It is acknowledged that external funding is required for full implementation.

The Comprehensive Plan is framed as a series of goals, objectives, and policies that are organized under fourteen elements. Natural hazards, especially flooding and high winds associated with hurricanes and coastal storms, stormwater and drainage, and drought are incorporated throughout. The following are some of the more notable citations:

- **Goal 101:** Monroe County shall manage future growth to enhance the quality of life, ensure the safety of County residents and visitor, and protect valuable natural resources.
  - **Objective 101.2:** Monroe County shall reduce hurricane evacuation clearance times to 24 hours by the year 2010. This policy is implemented through the Permit Allocation System and consideration of the new hurricane evacuation transportation model in consideration of capital improvements.
  - **Objective 101.5:** Monroe County shall implement a Point System which directs future growth to encourage redevelopment and renewal of blighted areas, to maintain and enhance the character of the community, to protect natural resources, to encourage a compact pattern of development, and to encourage affordable housing.
  - **Objective 101.9:** Monroe County shall provide for drainage and stormwater management so as to protect real and personal property and to protect and improve water quality.
  - **Objective 101.14:** By January 4, 1997, Monroe County shall adopt Land Development Regulations which direct future growth away from areas subject to periodic flooding (with particular focus on the Coastal High Hazard Areas, in which mobile homes shall be prohibited except in existing parks or subdivisions).
- **Goal 102:** Monroe County shall direct future growth to lands which are intrinsically most suitable for development and shall encourage conservation and protection of environmentally sensitive lands.
  - **Objective 102.8:** Monroe County shall take actions to discourage private development in areas designated as units of the Coastal Barrier Resources System, including discouraging extension of facilities and services by providers of electricity and telephone service.
- **Goal 206:** The health and integrity of Monroe County's beach/berm resources shall be protected and, where possible, enhanced (through development standards for siting structures, disturbances, setbacks, restoration of native vegetation).
- **Goal 211:** Monroe County shall conserve and protect potable water resources and cooperate with regional efforts to ensure the continued availability of quality potable water.
  - **Objective 212.2:** Monroe County shall adopt minimum performance standards designed to reduce the storm water runoff impacts, aesthetic impacts, and hydrologic impacts of shoreline development.
  - **Objective 212.3:** Permitted uses and performance standards within the shoreline setback are outlined.
- **Goal 216:** Monroe County shall provide for hurricane evacuation, shelters and refuges, and communication capabilities to promote safeguarding of the

public against the effects of hurricanes and tropical storms. Among policies outlined are consideration of impact fees to offset the public costs of hazard mitigation, evacuation, reconstruction of public facilities, emergency communications equipment, and similar needs (Policy 216.1.15) and inclusion in the Post-Disaster Recovery Plan a structured procedure aimed at debris removal preparedness during hurricane evacuation and re-entry (Policy 216.1.14).

- **Goal 217:** Monroe County shall develop and implement a program of hazard mitigation and post-disaster redevelopment to increase public safety and reduce damages and public expenditures.
  - **Objective 217.1:** Monroe County shall develop and implement a program of hazard mitigation in the Coastal High Hazard Area which reduces floodplain alteration and damage or loss due to natural disasters. Policies address new or replacement sanitary sewage systems, supply of potable water, review of the building code, participation in the NFIP's Community Rating System, enforcement of setback and elevation requirements, and public acquisition decisions.
  - **Objective 217.2:** Monroe County shall develop a Post-Disaster Redevelopment Plan which addresses priorities for immediate recovery and long-term redevelopment including reducing exposure of human life to natural hazards. Policies address coordination of post-disaster recovery operations, damage infrastructure, FEMA-designated V Zones and repetitive loss areas, and limits on certain redevelopment.
  - **Objective 217.3:** Monroe County shall adopt Land Development Regulations which direct future growth away from the Coastal High Hazard Area. Policies include assigning a negative point rating to developments proposed within this area and prohibition on placement of mobile homes except on an approved lot within an existing mobile home park or subdivision zoned for such use.

- **Goal 701:** Monroe County shall support the Florida Keys Aqueduct Authority in the fulfillment of their statutory obligation and authority to provide for a safe, high quality and adequate supply, treatment, distribution, and conservation of potable water to meet the needs of present and future residents. Objectives include water conservation efforts.
- **Goal 1001:** Monroe County shall provide a storm water management system which protects real and person properties, and which promotes and protects ground and near-shore water quality.
- **Goal 1301:** Monroe County shall promote and encourage intergovernmental coordination between the County, the municipalities, the counties of Dade and Collier, regional state and federal governments and private entities in order to anticipate and resolve present and future concerns and conflicts.
- **Goal 1401:** Monroe County shall provide and maintain, in a timely and efficient manner, adequate public facilities for both existing and future populations, consistent with available financial resources and the other elements of the Comprehensive Plan. Considerations include elimination of public hazards, with limitations on public expenditures within the Coastal High Hazard Area.

In early 2015 the County initiated a significant update and revision process to develop the 2030 Comprehensive Plan (Plan). The goal is to continue to provide an effective and efficient balance of future anticipated growth in order to enhance the quality of life, maintain community character, economic development, ensure the safety of County residents and visitors, and protect valuable natural resources. The proposed update to the Plan includes an adjustment to ROGO permit distribution to a 20-year period to address build-out challenges (1,970 permits vs. 8,168 privately owned vacant parcels) and land acquisition priorities.

The County, in an effort to balance community character, economic sustainability, ensure the safety of County residents and visitors, and protect valuable natural resources with future anticipated development expectations by property owners, recommended extending the timeframe for distribution of the 1,970 ROGO allocations through the year 2033. This extended timeframe can provide a safety net to Monroe County and provide additional time to implement land acquisition, coordinate with our State and Federal partners on additional land acquisition funding, and other strategies to reduce the demand for ROGO allocations and help transition land into public ownership.

Additionally, proposed updates to the Plan include a new Energy and Climate element to ensure the County is preparing for, exchanging data and developing coordinated strategies to address future, potential energy conservation and impacts from climate change (for example: considering climate change impacts such as increased temperatures, sea level rise, potentially shifting habitat and ecosystem types and the need to withstand increased storm surge in evaluating public infrastructure decisions).

7.3.2 Floodplain Management

Compliance with the NFIP

The County entered the National Flood Insurance Program in 1973 by adoption of an ordinance that complies with the requirements of the program. The County reviews all development proposals in special flood hazard areas and enforces the requirements of the ordinance. To ensure continued compliance with the NFIP, the County will continue to:

NFIP Flood Insurance Policies in Monroe County: 15,739

Claims paid since 1978: 8,019

https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13
(as of March 15, 2015)

- Enforce the adopted floodplain management ordinance, including inspection of permitted development and unpermitted activities;
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Notify the public when there are proposed changes to the ordinance or Flood

Insurance Rate Maps; and

- Promote the purchase of NFIP flood insurance policies as financial protection.

Monroe County administers the Floodplain Management Ordinance to regulate development within areas designated by National Flood Insurance Program (NFIP) as "areas as of special flood hazard." The purpose is to "protect the public health, safety and general welfare and to minimize public and private losses due to flood conditions". Areas of special flood hazard are identified as those expected to be inundated by the 1%-annual chance flood (commonly called the "100-year flood").

The NFIP prepared a Flood Insurance Rate Map for Monroe County (current effective map is dated February 18, 2005). Special flood hazard areas are specified as "A/AE Zones" where waves are expected to be less than 3-feet high and V Zones where high velocity wave energies are expected. Most of the County's land area is subject to flooding. The FIRMs show the anticipated flood elevations (referenced to mean sea level).

In Fiscal Year 2013, the Federal Emergency Management Agency (FEMA) initiated a coastal flood risk study for the South Florida Study Area that affects Monroe, Broward, Miami-Dade, and Palm Beach Counties. The results of that study will be incorporated into updated digital Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) reports for these counties. Under this study new surge and wave modeling is underway; anticipated to be completed in about 2 years, and flood hazard mapping is anticipated to be completed in 3-4 years. Discovery meetings were held in Monroe County in July 2014. More information about the study is available at http://www.southeastcoastalmaps.com/Pages/Projects/South-Florida.aspx

The County's Floodplain Management Ordinance specifies standards for residential and non-residential construction and water supply and sanitary sewer systems that are located in areas of special flood hazard. It prohibits the alteration of sand dunes, mangrove stands or wetlands if such alterations would increase the potential for flood damage. Placement of fill and obstructions is discouraged (structural fill is prohibited in V Zones).

Standards are set forth for residential, non-residential, and manufactured (mobile home) developments in special flood hazard areas. The dominant standard requires that the lowest floor of buildings (including manufactured homes) be elevated to or above base flood levels. Enclosures below the elevated lowest floor are allowed only if they meet requirements specific to the flood zone.

Enclosures Below Elevated Buildings

In 1995, FEMA notified Monroe County that the illegal conversion and occupancy of enclosures below elevated residential structures had resulted from a deficiency in the County's enforcement of its floodplain management regulations. The County was directed to correct the deficiency or face suspension from the National Flood Insurance Program.

The Board of County Commissioners responded by appointing a task force to address the problem, which is complicated by the fact that Florida law prevents on-site investigations. The task force, working with the State and FEMA, developed the concept that evolved into the "Flood Insurance Inspection Program." For the five-year period of 2002 to 2007, NFIP-insured homes with enclosures below the Base Flood Elevation must be inspected to identify deficiencies and deficiencies must be corrected in order for flood insurance policies to be written. As of December 31, 2009, over 2,000 properties had been inspected and approximately 1,600 had been brought into compliance. In mid-2013, FEMA notified Monroe County that the Pilot Program for new inspections would end, but that Monroe County must continue enforcement for all inspected structures and that Monroe County continue its enforcement of floodplain regulations regarding enclosed areas below the base flood elevation.

Section 122-6 of the County's Floodplain Management Ordinance requires the County to provide an "inspection upon Transfer of Property." A report is provided to the new owner regarding any non-conformities associated with enclosures.

NFIP Repetitive Loss Properties

Data provided by FEMA to the Florida Division of Emergency Management identifies properties that are, or have been, insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. In 2005, unincorporated Monroe County had only 161 properties that met this definition. As of March 2015, 631 individual properties have received 1,350 claims, totaling approximately $29.3 million (average payment of approximately $21,700). Of these 631 properties, 585 properties are residential and 38 are non-residential. Figures 7-1a to 7-1i (end of chapter) illustrate the areas subject to repetitive flooding based on NFIP repetitive claims data.

A subset of the NFIP's Repetitive Loss Properties includes those that meet the Federal definition for "severe repetitive loss." Seven properties in unincorporated Monroe County have received a total of 30 claims, totaling more than $760,000. The statutory definition is a residential property that is covered by an NFIP flood insurance policy and (a) that has at least four claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims exceeding $20,000; or (b) for which at least two separate claim payments (building only) have been made with the cumulative amount exceeding the

market value of the building. For both (a) and (b), at least two of the qualifying claims must have occurred within any 10-year period.

In the summer of 2008, the County mailed letters to six owners of properties that FEMA identified as Severe Repetitive Loss Properties. Two owners responded and applications were submitted for funding to elevate the buildings in compliance with the County's requirements. As of early 2015, one project is complete, and the other property sold and the property retained the right to the funds awarded. The County is continuing to update the Repetitive Loss Property list.

Coastal High Hazard Areas

Florida Statute (163.3178, F.S.) requires local governments to amend their Comprehensive Plan (future land use map and coastal management element) to include a definition of "coastal high-hazard area" and to depict the coastal high-hazard area on the future land use map. The coastal high-hazard area is the area below the elevation of the Category 1 storm surge line as established by a Sea, Lake, and Overland Surges from Hurricanes (SLOSH) computerized storm surge model. The intent is to limit public expenditures that subsidize development in these high-risk areas.

Coastal High Hazard Area
Areas which have historically experienced destruction or severe damage, or are scientifically predicated to experience destruction or severe damage from storm surge, waves, erosion, or other manifestations of rapidly moving or storm-driven water.
Note: This definition and how it is used is not the same as "Zone V" shown on FIRMs.

Due to its low-lying terrain, approximately 80% of the County is located in the CHHA. Areas outside the CHHA are chiefly confined to a linear zone along much of U.S. 1 and some areas of higher elevation on various keys.

Coastal Barrier Resource System

The federal Coastal Barriers Resource Act (CBRA) of 1982 established the Coastal Barriers Resources System (CBRS). The purpose of the program is to restrict federally subsidized development of undeveloped coastal barriers to minimize loss of human life, reduce wasteful expenditures of federal funds, and reduce damage to fish and wildlife habitat and other valuable natural resources of coastal barriers. The intent of the CBRA is to remove from undeveloped coastal barriers federal incentives for new development, such as National Flood Insurance, structural stabilization projects, and Federal assistance for construction of sewers, water supply systems, airports, highways, and bridges.

On November 1, 1990, the Coastal Barrier Improvement Act (CBIA) reauthorized the CBRA; expanded the CBRS to include undeveloped coastal barriers along the Florida Keys; and added a new category of coastal barriers to the CBRS called "otherwise protected areas"

(OPAs). The CBRS now contains two types of units, System Units and Otherwise Protected Areas (OPAs). The County's definition in its regulations applies only to the 15 System Units; the County does not have policies or regulations for OPAs.

These sites are located throughout the county and include areas such as the undeveloped portion of North Key Largo and sections of Sugarloaf Key. Most of the CBRS units are largely undeveloped. Protection of these areas is provided through land use policies in the Comprehensive Plan and related land development regulations. Among the policies advocated for these sites is public acquisition, especially portions of North Key Largo.

7.4 Communicating about Hazards

Monroe County and other organizations in the area recognize the importance of informing residents and visitors about hurricanes, evacuation, public safety, and minimizing damage. The following are some key ways that communications are undertaken:

- The County's floodplain management page has information about property inquiries and code requirements, and lists a phone number for the floodplain management office. The page also has links for flood maps, FEMA technical bulletins, the inspection program (enclosures), flood warning, and additional resources (which has a link to the floodplain management ordinance).
- The emergency services page offers information about hurricane preparedness, the Special Needs Registry, what to bring to shelters, the Local Mitigation Strategy (including meeting and project information), and several links related sites;
- Emergency bulletins are posted on the webpage, information is scrolled on the Monroe County Government Television Channel (Channel 76), and the Emergency Management Hotline is activated (1-800-955-5504) when storm activity or other hazard events threaten;
- People can request e-mail notification whenever emergency bulletins are issued or updated;
- Materials are provided in booths at local fairs;
- Presentations are offered to schools and other groups;
- Both electric companies provide information to property owners about tree trimming to reduce power outages;
- Public information and pre-recorded public service announcements are transmitted via local radio and television stations, including the County's cable channel;
- The Tourist Development Council is structured to transmit emergency information to the industry (e.g., blast FAX);
- The County's floodplain manager speaks before various professional organizations such as the Boards of Realtors and individual Real Estate companies;

- The County participates in the Home Depot annual hurricane event, sending personnel to the stores in Marathon and Key West; topics covered include supplies needed for family safety, tips on hardening homes to resist storm damage, alert notification types, and home generator sizing and safety tips;
- Sponsors and promotes Florida Hazardous Weather Awareness Week; and
- American Red Cross does some public service announcements related to hazardous weather.

Hurricane wind and flood hazards are well-recognized throughout the Keys, but the importance of awareness is emphasized in the Floodplain Management Ordinance (at Section 9.5-317)(a)(13)) which states that:

> "All agreements for deed, purchase, agreements, leases or other contracts for sale or exchange of lots within areas of special flood hazard shall carry the following flood hazard warning prominently displayed on the document: FLOOD HAZARD WARNING This property may be subject to flooding. You should contact the County Growth Management Division and obtain the latest information regarding flood elevations and restrictions on development before making use of this property".

7.5 Recent and Near-Term Mitigation Actions

Improving resistance to the impacts of hurricanes is routine in Monroe County. Many actions are not dependent on external funding but are part of the normal course of business and compliance with various regulations. As of mid-2015, the following characterize some of these activities:

- The Key West Airport Authority replaced a portion of the terminal. The replacement was designed and constructed to meet the wind resistance provisions of the Florida Building Code. [Included in 2005 update]
- The drawbridge at MM 107 on Jewfish Creek ("Goliath Bridge") was replaced with a fixed span bridge, helping to minimize traffic delays. [Included in 2005 update]
- One Federal mitigation grant for a repetitive loss property was approved in 2008, and one was approved in 2009. Both are single-family homes that were demolished and rebuilt elevated, in compliance with the building code and floodplain management regulations. [Included in 2005 update]
- Installed hurricane shutters on Marathon Airport passenger terminal. [Included in 2015 update]
- Elevated traffic and sallyport gate operators to protect against flooding at Monroe County Detention Center (MCDC) locations on Stock Island, Key Vaca Jail, Plantation Key Jail and MCSO Hangar in Marathon. [Included in 2015 update]
- Retrofit of overhead rolling doors at MCDC –Stock Island and at the County's Marathon Garage, to meet 155 mph wind load standards. [Included in 2015 update]

- Riprap boulders protecting three locations (Tidal basin and Wilkinson Point; H. Harris Park; and MM68 Landfill) have been repaired to provide coastal erosion protection. [Included in 2015 update]

Moving Mitigation Forward

The County continues to work with FEMA to meet the requirements to allow application to the Community Rating System. The Growth Management Division brought in external support to evaluate the steps necessary to meet FEMA compliance requirements before preparing a formal application.

7.6 2015 Updates

Several County offices and other entities reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 7.1: Updated text and table describing functional divisions; updated permits issued.
- Section 7.2: Minor edits to some descriptions of regional agencies
- Section 7.3.1: Described the ongoing process to update and revise the Comprehensive Plan and new elements. Updated ROGO description.
- Section 7.3.2: Noted FEMA initiated a coastal flood risk study in FY2013. Updated status of enclosure inspection program. Clarified description of the State requirements for "coastal high hazard areas" and for CBRS. Updated figures showing locations of repetitive loss properties.
- Section 7.4: Updated descriptions of ways the County communicates about hazards.
- Section 7.5: Updated and added recent mitigation actions.

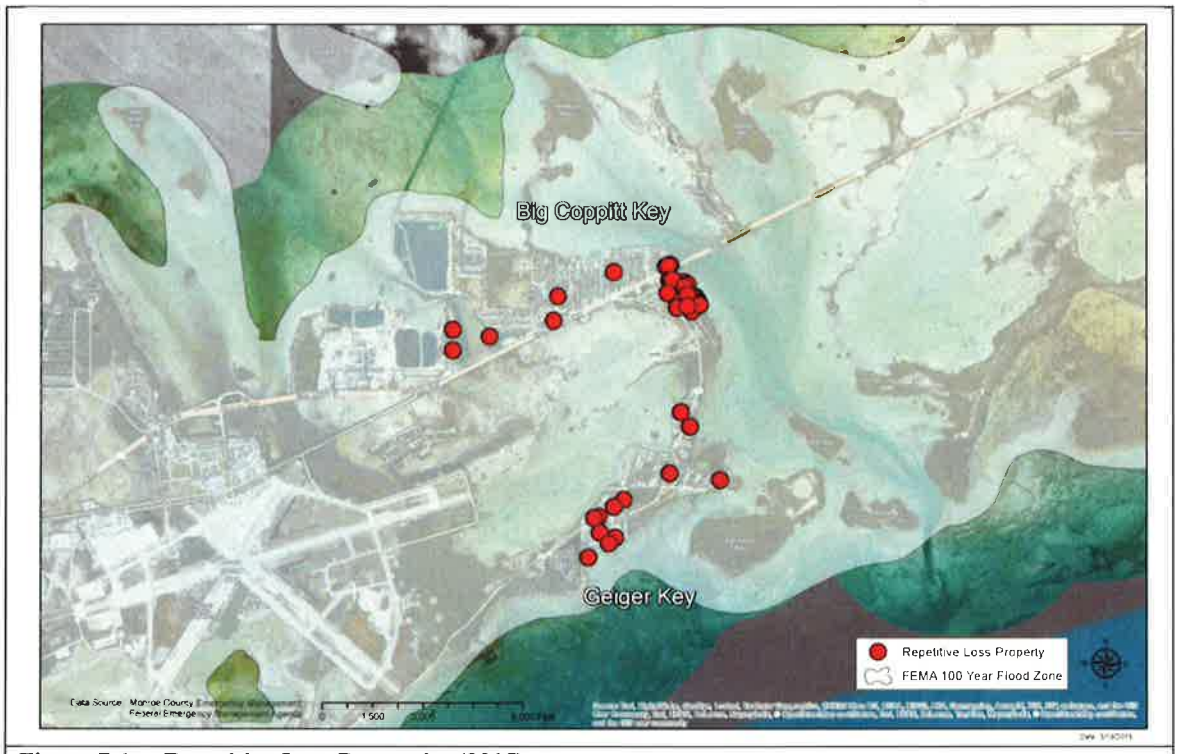


Figure 7-1a. Repetitive Loss Properties (2015).

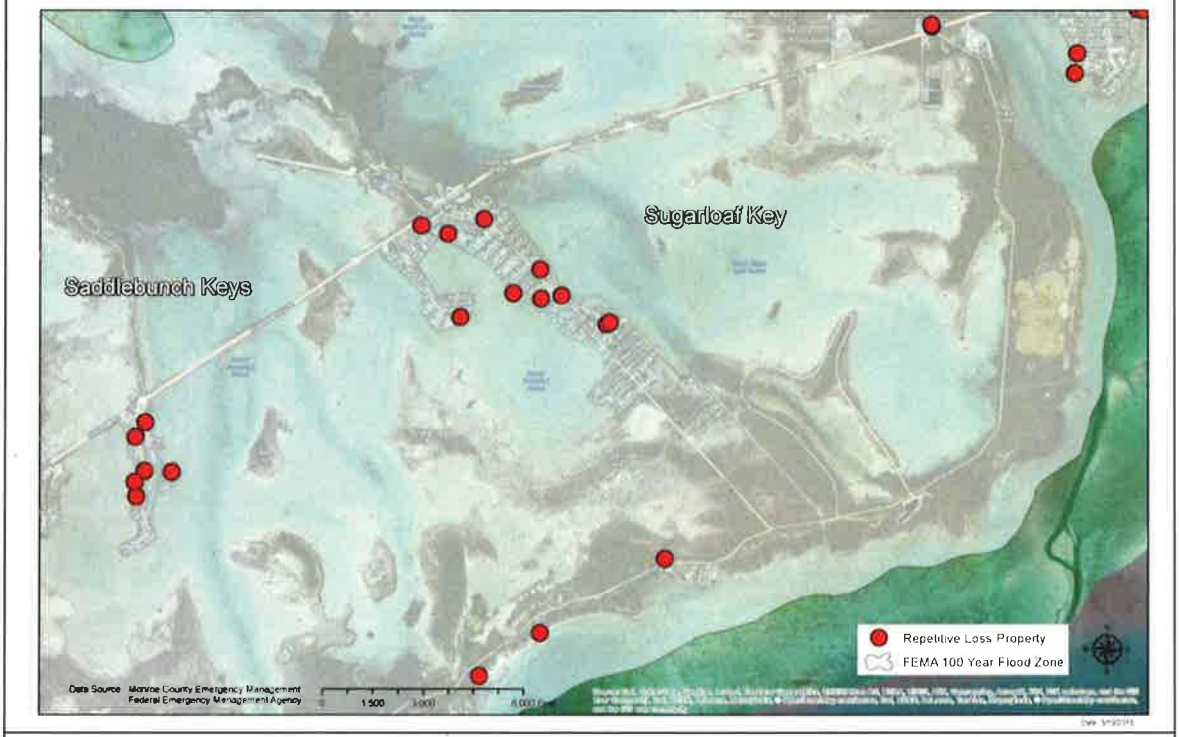


Figure 7-1b. Repetitive Loss Properties (2015).

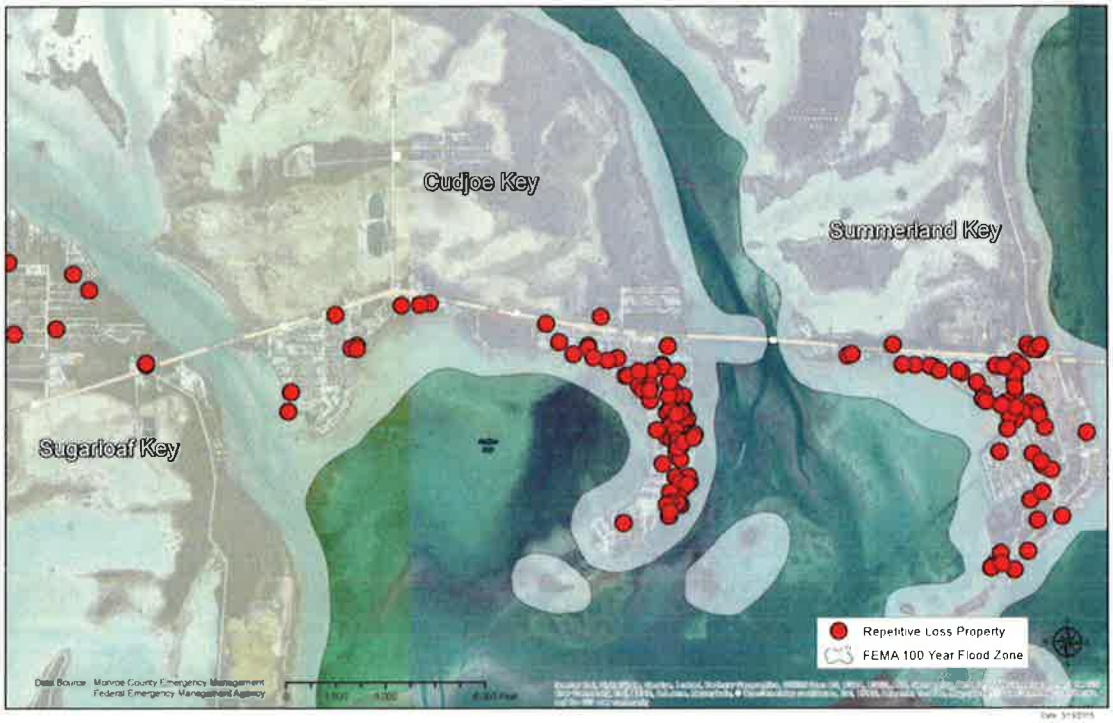


Figure 7-1c. Repetitive Loss Properties (2015).

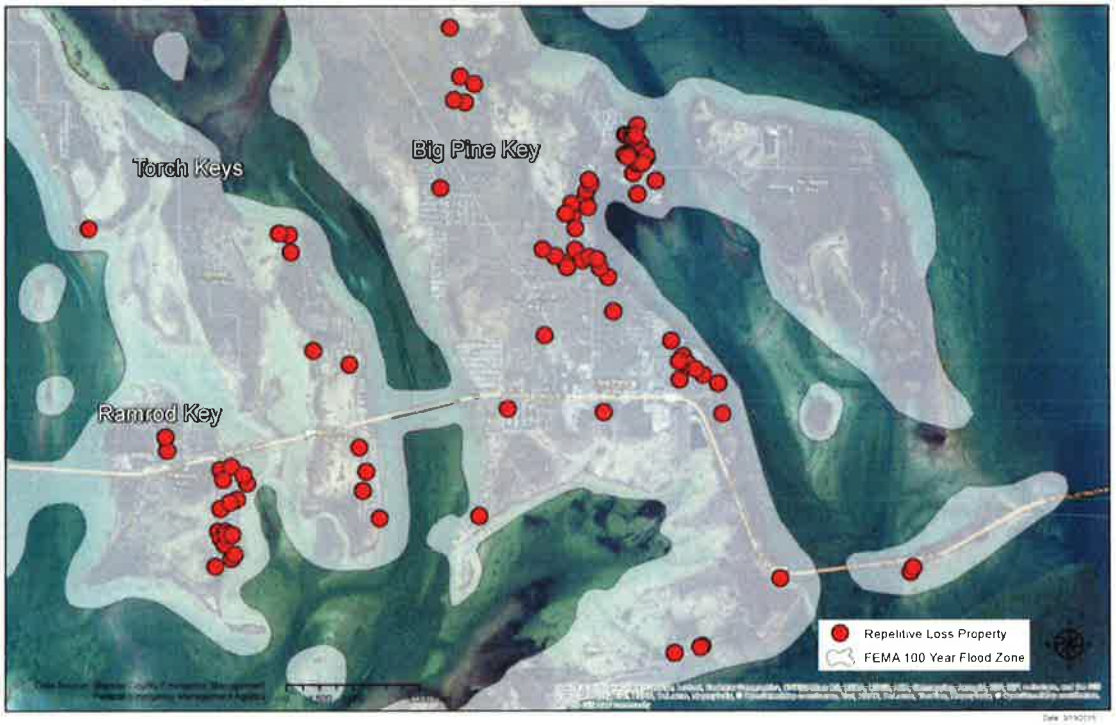


Figure 7-1d. Repetitive Loss Properties (2015).

Figure 7-1e. Repetitive Loss Properties (2015).

Figure 7-1f. Repetitive Loss Properties (2015).

Figure 7-1g. Repetitive Loss Properties (2015).

Figure 7-1h. Repetitive Loss Properties (2015).

Figure 7-1i. Repetitive Loss Properties (2015).

Chapter 8. City of Key West

The City of Key West, the County seat of Monroe County, is located in the southernmost portion of the Lower Keys. Incorporated in 1832 and nicknamed the "Island City", the City is surrounded by the turquoise waters of the Gulf of Mexico and Atlantic Oceans. Aside from its natural beauty, Key West is noted for historic and cultural resources with over 2500 historic buildings and sites. The National Register Historic District is often referred to as "Old Town" and is home to the largest and densest Historic District of vernacular wood framed homes in the nation, most over 100 years old.

8.1 Overview of Key West

Geography

The island of Key West comprises just 3,370 acres in area. It is low-lying, rising from 2 feet along the shoreline near Rest Beach to 16 feet above mean sea level at Solares Hill. Other higher elevations are man-made and are the waste management area (landfill) and bridges such as Garrison Bight Causeway. Most of the newer development is raised buildings built on fill material. While most of the "Old Town" section averages around 7-feet MSL, certain locations important for tourism, such as Front Street, Key West Bight, and Mallory Square are only at 3-feet MSL. Critical areas such as Key West Airport, Lower Keys Hospital, DePoo Hospital, Florida Keys Community College, South Roosevelt Boulevard, Key West Landfill, Florida Keys Community College, Poinciana Elementary, Gerald Adams Elementary, Horace O'Bryant Middle School (and Shelter), Key West High School, the Wastewater Treatment Plant on Fleming Key, as well as Florida Keys Aqueduct Authority's Main Office, Service Station, Storage Facility and Substation, are at very low elevations (approximately 3-feet MSL).

The City's few natural beaches have oolitic limestone outcrops or thin sand and shell over a rocky base; a low dune exists at Rest Beach. Although sandy beaches are present along the southern shore (e.g., Higgs Beach and Smathers Beach), some were artificially constructed. Mangroves are present along small sections of the island's northern shoreline. Beaches on the southern shoreline experience erosion due to coastal currents, tides, and wave impact. The rate of erosion accelerates during storm events. Shallow waters surrounding the island may contribute to increased storm surge height. Canals, cuts, and inlets experience flooding due to storm surges that may be higher than along flat shorelines.

Population

The Southeast Florida Regional Planning Council, using US Census data, estimates the City of Key West has a permanent resident population of approximately 24,620. According to the 2013 Key West Comprehensive Plan the total number of people on Key West on an average day, including permanent residents, seasonal residents, the maritime population,

overnight tourists, day-trippers, cruise ship visitors, commuters, and shoppers, is estimated to be 56,335. While the City's permanent population is projected to decrease slightly during the five-, ten-, 15-and 20-year planning periods due to growth limitations and the lack of significant amounts of vacant and developable land, the transient population is expected to continue to grow and make up the difference.

Land Use & Economy

Key West essentially is completely developed, with a mix of single family residences, multi-family dwellings, time-share and seasonal units, tourist lodgings (hotels, motels, inns, bed and breakfasts, etc.), tourist-oriented uses (museums, attractions), marine-related and recreational uses, commercial uses (restaurants, retail sales, banks, Realtors), medical facilities and offices, and government uses. Redevelopment and renovation are constant activities. The City is a world renowned tourist destination, drawing 3 million visitors a year. It also is a popular location for second homes.

2013 Key West Comprehensive Plan

The 2013 Key West Comprehensive Plan updates the 2008 Conformed Version that succeeded the 1993 Plan and six subsequent amendments. The plan incorporates the maximum amount of dwelling units per acre and floor area ratio established as of January 1, 2012. Climate adaptation and resiliency were added and featured more prominently. Key West recognizes the natural hazards described in the LMS (Chapter 5 and 6) throughout the 2013 Plan, summarized in Table 8-1. The hazards not addressed in the Plan are tornado and wildfire (as noted in Chapter 6, the city has insufficient areas of vegetation to represent a risk). There are plans to develop a separate Climate Change Element.

Table 8-1. Selected Objectives and Policies in the 2013 Key West Comprehensive Plan Relevant to Hazards

Objective 1-1.12: Consider Application of Innovative Land and Water Resource Management, Climate Adaptation, and Energy Conservation Concepts.
Policy 1.1.12.5: Increased Height:
Policy 1.1.4.6: Increase Resilience of General Landscaping.
Policy 2-1.3.4: Climate Change Preparedness.
Objective 1A-1.5: Historic Preservation in Coastal High Hazard Area
Policy 1A-1.5.1: Compliance with FEMA Standards.
Policy 1A-1.5.2: Hurricane Strategy Plan.
Policy 1A-1.5.3: Activities of Hurricane Recovery Task Force.
Objective 4-3.1 Protect Natural Drainage Features
Policy 4-3.1.1 Ensure that Urban Lands Provide Adequate Drainage and Protection from Flooding and Manage the Retention of Ground and Surface Water at levels that Enhance Natural Storage Capacity of Watersheds and Promote Aquifer Recharge
Policy 4-3.1.6 Managing Land Use in the Floodplain

Table 8-1. Selected Objectives and Policies in the 2013 Key West Comprehensive Plan Relevant to Hazards
Policy 4-3.1.7 Inspection and Maintenance of Drainage Systems
Objective 4-4.1 Coordinate Issues Surrounding Aquifer Recharge
Objective 5-1.1 Protect Coastal Resources, Wetlands, Estuarine Saltpond Environmental Quality, Living Marine Resources, and Wildlife Habitats
Policy 5-1.1.3 Protect Stabilize, and Enhance the Coastal and Wetland Shorelines
Objective 5-1.3 Land Use Controls and Construction Standards for Protecting the Natural Shoreline and the Very Limited Beach/Dune System
Policy 5-1.3.1 Shoreline Setback
Policy 5-1.3.2 Natural Shoreline and Beach/Dune Stabilization
Objective 5-1.4 Limiting Public Subsidy of Development in the Coastal High Hazard Area
Objective 5-1.5 Avoid Population Concentrations in Coastal High Hazard Areas
Policy 5-1.5.3: Adaptation Action Areas.
Objective 5-1.6 Hurricane Evacuation
Objective 5-1.7 Post-Disaster Redevelopment
Policy 5-1.7.2 Post-Hurricane Assessments Bullet #5 (Hazard Mitigation Options in Rebuilding)
Policy 5-1.7.4 Hazard Mitigation and Comprehensive Plan Amendments.
Objective 5-1.10 Public Facility Level of Service Standards in Coastal Area
Objective 5-1.13: Planning for Resiliency and Adaptation in Coastal Areas
Objective 6-1.3 Maintenance of Floodplains
Policy 6-1.3.1 Enforce Policies to Maintain Floodplain
Policy 6-1.3.2 Land Purchase through Save Our Rivers Program or Other Available State and Federal Programs
Objective 6-1.15: Planning for Resiliency and Adaptation in Natural Areas
Objective 9-1.2 Limitation on Public Investment in the Coastal High Hazard Area

8.2 Capability Assessment: City Organization and Agencies

The Key West City Commission is composed of 7 members, including the Mayor who is elected specifically to that office. The Commission sets government policy and adopts guidance documents, such as the Comprehensive Plan and ordinances establishing various codes and standards.

Key West is organized into several agencies, each with some authorized responsibilities that, as described below, have bearing on how natural hazards are recognized and addressed.

City Manager. The City Manager of Key West implements the policies of the Commission and administers the overall operations of the City. Related to mitigation of the impacts of natural hazards, the City Manager:

- Participates in post-disaster assessment and may develop mitigation initiatives to address reduction of future loss.

- Participates in the Key West Emergency Operations Center (EOC) and coordinates with the County and other local governments.
- Works with the City's Post-Disaster Recovery Task Force which serves as the City's designated Public Facilities Review Committee. This group is charged with the responsibility for reviewing available alternatives for damaged public facilities following a hurricane or other disaster.
- May perform an analysis and provide recommendations to the City Commission for hazard mitigation options, including relocation and reconstruction of damaged public facilities.
- Participates in intra- and inter-governmental disaster planning efforts, including multi-agency Site Plan Review Committee and Hazard Mitigation.

Key West Planning Department. The Key West Planning Department is responsible for the development and maintenance of the City's Comprehensive Plan, land development regulations, and zoning ordinance. Department personnel support the City Commission, Planning Board, Historic Architectural Review Commission, Development Review Committee, Bahama Village Redevelopment Advisory Board, Housing Committee, and the Truman Waterfront Committee. Related to hazard mitigation, the department:

- Ensures that mitigation related items in the Comprehensive Plan, such as floodplain management and natural resource management, are followed and reflected in the City's Codes and Standards.
- Participates in post-disaster appraisals and may formulate additional mitigation measures for use in the Comprehensive Plan.
- Works closely with Building Department staff to maintain an accounting system of permits issued pursuant to ROGO and coordinates actions related to disaster planning, recovery, and mitigation.
- Conducts surveys for hurricane evacuation modeling (and in 2009, hired an expert on hurricane evacuation).
- Incorporates mitigation recommendations, especially those based on direct disaster experience, in the Evaluation and Appraisal Reports (EAR) required for the Comprehensive Plan.
- Maintains the Water Supply Plan.

Key West Building Department. The Building Department reviews construction plans and impacts upon species focus areas of concern, issues permits, and inspects projects for compliance (see Table 8-2). The staff includes: one State Certified Building Code Administrator, who is also a Certified Floodplain Manager; a second Certified Floodplain Manager serving as the Floodplain Administrator and who is also a State Certified Code Enforcement Officer, three fulltime building inspectors; and 4 full-time Permit Technicians.

Specific to hazards, Department personnel:

- Enforce the City's floodplain management and building code requirements designed to minimize damage to structures from flooding and wind.
- Identify and pursue legislative proposals for the enhancement of flood damage prevention measures.
- Monitor ongoing Substantial Improvement/Damage thresholds.
- Review, approve, refer and inspect construction plans/sites for locations specifically designated as Species Focus Areas for potential impact to endangered species habitats.
- Enforce the Florida Building Code requirements for wind loads and anchoring foundations into bedrock.
- Participates in the Post-Disaster Recovery Task Force.
- Participates with the Lawful Unit Determination Team.
- Continue to improve public awareness of the Florida Building Code by conducting workshops and use public forums to educate the public about the need to obtain permits.
- Participates with the Development Review Committee performing multi-faceted pre-application reviews of significant development projects.
- Continues efforts to address and eliminate unsafe structures.

Table 8-2. Permits Issued in 2012, 2013, and 2014

Type of Development	CY 2012	CY 2013	CY 2014
New single family	32	18	17
New other (commercial, industrial, religious, etc.)	7	1	12
New multi-family (2 or more)	0	1	0
Commercial (additions, renovation, conversions)	539	599	569
Residential (additions, renovation, conversions)	796	996	932
Other	2	12	4
Demolition	40	45	37
Relocation	0	0	0
Manufactured home (permanent, temporary)	0	0	0
Totals	1,416	1,692	1,571

Key West Historic Architectural Review Commission (HARC). Key West includes numerous historic resources, including two historic districts listed in the National Register of Historic Places: Key West Historic District and the US Naval Station (known as Truman Annex). The Key West Historic District is significant due to its unique concentration of frame vernacular architecture; possible one of the largest districts of its kind in the Nation. The district is also recognized as the largest historic district in the State of Florida. HARC

was created by City Charter and is charged of preserving the character and appearance of the historic districts and historic structures. By doing so, HARC reviews proposed projects within the districts and determines their appropriateness based on adopted guidelines that incorporate the principles of the Secretary of the Interior's Standards for Rehabilitation, and including regulations that are unique to the historic fabric of Key West.

Because historic properties in Key West are significant locally and nationally, they require special attention and application of sensible reconstruction methodologies after damaging events. Doing so ensures adequate procedures that will preserve the historic quality and character found in Key West historic districts. In 2008, the Florida State Historic Preservation Office (*Florida SHPO*), Division of Historical Resources prepared a planning tool, *Disaster Mitigation for Historic Resources: Protection Strategies*, which will be adopted by HARC. Since 1991, the City of Key West has been recognized by the U.S. Secretary of the Interior and the Florida State Historic Preservation Office as a Certified Local Government; therefore, the City needs to comply with all State and Federal regulations regarding protection of historic structures in order to maintain the certification. In 2001, First Lady Laura Bush recognized the Key West Historic District as a Preserve America Community.

Key West Finance Department. The Finance Department is responsible for overseeing the day-to-day financial requirements of the City, including establishment of purchasing procedures for all agencies. To expedite preparation for, response to, and recovery from disasters, the Finance Department may implement special emergency procedures to expedite necessary purchase and payment before, during, and after a disaster.

Key West General Services Department. The General Services (Utilities) Department includes Wastewater, Stormwater, Engineering Services, and Solid Waste, including the management of the City's waste removal contract with Waste Management. The Department also includes the Richard A. Heyman Environmental Pollution Control Facility (Wastewater Treatment Plant) which is operated by a private contractor.

Key West Utilities Director. The Utilities Director is responsible for coordinating various utility resources in the city. These include the Richard A. Heyman Environmental Protection Facility (treatment Plant), Sewage Treatment System including pumping and lift stations, Garbage Collection Program, Waste Transfer Facility, and the Stormwater Utility. These facilities have specific written emergency plans and procedures designed for use in emergencies such as tropical cyclones, severe storms, flooding and tornadoes. A separate plan for hazardous materials is specific to the Sewage Treatment Plant

When reviewing the physical plant of the City's utility facilities, the Utilities Manager evaluates vulnerabilities such as flood height, roof construction, and window protection. The Utilities Manager provides input in the Post-Disaster Recovery Task Force.

Engineering Department. The Director of the Engineering Services Department is responsible for engineering and construction related services throughout the City. Engineering Services staff are professionally qualified to review Civil Engineering plans to determine compliance with the Florida Building Code and construction requirements. The Engineering Department performs other responsibilities relating to the construction and technical needs of the City, including overseeing the engineering requirements of public facilities such as roads, bridges, sewer treatment facility, and other City buildings. The Engineering Department monitors public beaches for shoreline erosion and participates in grant applications for renourishment and mitigation activities.

After a damaging event, Engineering staff conduct damage assessments of public infrastructure and works with federal and state agencies such as FEMA and Florida DEM to develop scopes of work and to facilitate funding assistance for recovery operations. Under the federal Public Assistance Program, mitigation measures to reduce future loss to public facilities may be included in requests for recovery assistance. The Director of Engineering provides input to the Post-Disaster Recovery Task Force.

Key West Community Services Department. The Community Services Department is responsible for overseeing the maintenance and operation of all city facilities, including buildings, roads and bridges. The Public Works unit is responsible for coordination and provision of emergency public works, evaluation of infrastructure damage, and preparation of documentation required for federal reimbursement (including identification of mitigation components to be incorporated during recovery), and coordination of emergency debris clearance. The Director of Community Services also directs the City's Facilities Maintenance section (FMT). FMT is responsible for maintenance and repairs on some government structures, and small new construction and additions.

In executing its disaster and recovery responsibilities, Public Works coordinates with the Florida Department of Transportation (FDOT), Monroe County Department of Public Works, Florida Keys Aqueduct Authority, and Keys Energy System. The Department plans, coordinates and initiates restoration of the serviceability of transportation routes, bridges, and assurance as to the safety and affected public and private dwellings and structures.

Key West owns approximately 100 buildings; many are leased to commercial concerns. Some buildings have hurricane shutters; the presence of rooftop equipment and whether it is anchored to resist hurricane winds is not known at this time. All work on buildings must

comply with the Florida Building Code and other pertinent requirements (such as floodplain management). The City maintains flood insurance policies on some buildings. For leased buildings, generally if one is damaged, the City provides some abatement of rent during the period of restoration. If one is destroyed, the lease would be terminated.

Key West Transportation Department. The Transportation Department provides for citywide and fixed route intra-county transportation services in the Lower Keys, operating a fleet of buses. It also assists in transportation and evacuation planning. The Department's Hurricane Plan and Procedures are designed to effectively implement its responsibility of moving civilians to shelters or, in the event of an out-of-county evacuation, to staging areas for school bus transport to the mainland shelter at Florida International University. The Department participates in the emergency after-action process and formulates measures to address future needs.

Key West Police Department. The Police Department is responsible for overall law enforcement and protection of residents and visitors in the City of Key West. The Department plays a key role in planning and response during emergencies. The permanent standing Hurricane Preparedness Committee reports to the Chief of Police and is responsible for preparation, review, and revisions of plans, procedures, operations and training materials relating to hurricane preparation, response, and recovery. The committee prepares after-action critiques of every implementation or exercise of any element of the disaster response and recovery plan and provides recommendations for addressing future problems.

The Police Department's preparedness and response activities include supervision of the Emergency Law Enforcement and Traffic Control plan, coordination with other City Departments, and outside agencies (Monroe County Sheriff's Office and the Florida Highway Patrol to promote speedy and safe evacuation), communications with base operations, field personnel, and emergency shelters.

Key West Fire Department. The Fire Department provides emergency management assistance and direction to the City of Key West in concert with other duties of fire control, fire prevention, and fire and hurricane public education. The Department plays a lead role in planning and response for emergencies. In 2015, the Insurance Services Office evaluated and awarded the department an ISO Public Protection Classification Rating of 2.

The Fire Department's preparedness and response mitigation activities include assisting Monroe County Emergency Management, directing the operations of the City's Emergency Operations Center, and contributing to pre-planning strategies and evacuation planning. The Department is responsible for planning for hazardous materials incidents, maintaining a

hazardous materials inventory and response plan, and responding to hazardous materials incidents.

Key West Port Department. The City hosts many cruise ships and ferry boats throughout the year, serving approximately 800,000 visitors a year. The Ports and Marine Services Director meets with the U.S. Coast Guard when impending weather conditions may prompt decisions regarding port operations and whether to close the Key West Harbor to cruise ships, passenger ships, and other large vessels. Prior to storm conditions, the department coordinates preparation of private vessels in both the City Marina at Garrison Bight and Key West Bight Marina and secures those facilities.

Key West Human Resources Department. The Human Resources Director is responsible for monitoring senior City staff participation in the Incident Command System/National Incident Management System (ICS/NIMS) training program. ICS training is required of City Management, Department Heads and designated staff. On-line training (IS-100, 200, 700 and 800) is supplemented by classroom training for advanced courses.

Moving Mitigation Forward

Overall, because of Key West's size and geography, its staff preparedness and familiarity with hazard readiness and after actions are strong. The City's GIS Manager (a new position) is working with other departments to document buildings and infrastructure. Based on the new changes to the Comprehensive Plan, forthcoming Land Development Regulations will also be stronger for hazard mitigation standards across residential, commercial and governmental buildings and infrastructure.

Key West's biggest hazard mitigation challenge is to qualify for the CRS and achieve as high a rating as possible. The City also intends to complete its Post Disaster Recovery Plan in FY16 and will examine lessons learned and model plans already in existence.

8.3 Hazards and Risk in Key West

Historic Storms

From the wreck of the treasure-laden ship, Nuestra Senora de Atocha, destroyed by a hurricane in 1622 to the present, hurricanes have played a major role in the life of Key West. Some of the more significant events include:

- October 11, 1846. As one survivor commented, it was '"the most destructive of any that had ever visited these latitudes within the memory of man". Most of the damage was located in the north and west sides of the island, along Whitehead and Duval Streets to the Gulf (Bahama Village and Truman Annex) and the Key West Bight. Damage included buildings that were pulled off their foundations and swept out to sea, uprooted trees, destruction of a

lighthouse, and the cemetery located along South Beach was washed away with the dead scattered in trees. Fort Zachary Taylor, which was under construction, was severely damaged.

- October 11 and 17, 1909. Listed by the National Hurricane Center as one of the most intense to affect the U.S., this storm was a Category 3 with a barometric pressure of 957 millibars. According to the Key West Historic Districts Hurricane Guide, "the arrival of this hurricane caught residents completely unprepared . . . Seven factories, several churches, and much of the waterfront was destroyed. Afterwards, debris clogged the streets." To make matters worse, another Category 3 hurricane struck on October 17, 1910, causing 30 deaths and $300,000 in damage (not adjusted).
- September 9-10, 1919. One of the most deadly and intense hurricanes listed in the records of the National Hurricane Center, this Category 4 storm (927 millibars), this storm caused approximately 600 deaths. Key West recorded winds of 95 mph and flood levels were 5-7 feet above Mean Sea Level.

Other Notable Hurricanes that Affected Key West

Hurricanes Donna (1960), Betsy (1965), and Inez (1966), Tropical Storm Alberto (1982), Hurricanes Kate (1982), Hurricane Floyd (1987), and Hurricane Andrew (1992).

- November 11-12, 1980. The most notable flooding not produced by storm surge resulted from the 24-hour event known as the "Veteran's Day Storm". Nearly 23 inches of rain – the area's record – resulted from the influence of Tropical Storm Jeanne over Cuba and a stalled cold front. Widespread flooding affected streets and low-lying areas that were unable to drain due to the flat topography and continual rainfall. Reports indicate that 300 vehicles and 500 buildings were seriously damaged.
- September 24-26, 1998. Hurricane Georges (Category 2) made landfall in the Lower Keys. The entire county was affected to some extent (1 death and $300 million total damage). Maximum sustained winds at the Naval Air Station (Boca Chica) were 92 mph and the Monroe EOC in Marathon reported gusts to 110 mph. According to the Key West Weather Service, precipitation levels in the Lower Keys were identified as 8.65 inches on the south side of Sugarloaf Key, 8.38 inches at Key West International Airport, and 8.20 inches on Cudjoe Key.
- October 22, 1999. With little warning, Hurricane Irene suddenly altered its course and crossed near Key West.
- August 26, 2012. Hurricane Isaac reached tropical storm status as it moved west-northwest at 18 mph through the Straits of Florida, with the center passing across the lower Keys. The heaviest of the rain bands concentrated

over Palm Beach and Broward counties, producing between 10 and 13 inches of rain. NWS Miami reports record a maximum of 4.66 inches of rain for mainland Monroe. Portions of the Key West shoreline experienced severe coastal erosion.

Damage due to Hurricane Georges (1998)

Table 8-3 summarizes reimbursements received by the City from FEMA's disaster assistance program. These amounts underestimate the total cost of damage to public property and expenditures of manpower for recovery because they do not include the non-federal share nor do they include costs determined to be ineligible. Other than debris removal and emergency work on beaches, the two most costly projects were the seawall replacement ($6.9 million) and repairs at the incinerator plant ($535,000).

The damage left after Hurricane Georges moved through the Keys illustrates the vulnerability and the types and magnitudes of damage and costs. Among the reported damage were the following:

- The Hemingway House, a historic property, was damaged by a 146 year old Banyan tree weakened by the winds and rain.
- The Key West International Airport's runway was flooded and one private plane was overturned.
- A number of roads and sites were covered in sand and debris.
- Houseboats were damaged.
- Waterfront businesses suffered damage including lost piers and decks.

Table 8-3. FEMA Reimbursements for Hurricane Georges (DR 1249)

FEMA Category of Damage	Amount of Reimbursements
A Debris Removal	$3,390,800
B Emergency Protective Measures	$1,925,900
C Roads and Bridges	0
D Water Control Facilities	0
E Buildings and Equipment (Public)	$792,800
F Utilities	0
G Parks, Recreational Facilities and Other	$7,597,500
Totals	$13,707,000

Damage due to Hurricane Wilma (2005)

Based on the Preliminary Damage Assessment for the City, more than 5,200 structures experienced flood depths ranging from 36" to 60" (1,477 structures), 12" to 36" (2,213 structures), and less than 12" (1,512 structures). Eighty-five structures were destroyed and many vehicles were damaged. Flood damage claims paid by the National Flood Insurance Program (NFIP) totaled $164 million.

Table 8-4 summarizes reimbursements received by the City from FEMA's disaster assistance program. These amounts underestimate the total cost of damage to public property and expenditures of manpower for recovery because they do not include the non-federal share nor do they include costs determined to be ineligible, nor do they include damage to private property.

Table 8-4. FEMA Reimbursements City Expenditures for Hurricane Wilma (DR 1609)

FEMA Category of Damage	Amount of Reimbursements
A Debris Removal	$3,506,346.19
B Emergency Protective Measures	$1,858,886.27
C Roads and Bridges	$0.00
D Water Control Facilities	$99,739.00
E Buildings and Equipment (Public)	$2,040,886.20
F Utilities	$596,150.92
G Parks, Recreational Facilities and Other	$1,573,849.36
Totals	$9,675,857.94

Damage due to Hurricane Isaac (2012)

In preparation for storm surge, strong winds and the possibility of tornadoes, the Keys' two airports closed Saturday night, and volunteers and some residents began filing into shelters, but eventually the island chain only experienced power outages and flooding in low-lying areas. Newspaper reports mentioned Duval Street in Key West being mostly closed. In Key West, privately-owned property experienced minimal damage.

Total damage caused by beach erosion to city-owned shoreline was estimated at more than $1.2 million.

Table 8-5 summarizes reimbursements received by the City from FEMA's disaster assistance program. These amounts underestimate the total cost of damage to public property and expenditures of manpower for recovery because they do not include the non-federal share nor do they include costs determined to be ineligible.

Table 8-5. FEMA Reimbursements for City Expenditures for Hurricane Isaac (DR 4084)	
FEMA Category of Damage	**Amount of Reimbursements**
A Debris Removal	$93,685
B Emergency Protective Measures	$63,573
C Roads and Bridges	$0
D Water Control Facilities	$0
E Buildings and Equipment (Public)	$0
F Utilities	$0
G Parks, Recreational Facilities and Other	$722,000
Totals	$880,154

Hurricane Flooding as Predicted by SLOSH Modeling

The National Hurricane Center's surge model, called SLOSH (Sea, Lake, and Overland Surges from Hurricanes), estimates surges associated with different characteristics of tropical cyclones (track, forward speed, wind speed, etc.). Table 8-6 is carried forward from the 2010 Plan as it provide more site-specific potential surge impacts and is to be used in conjunction with the Hazus results from Chapter 5. The results can be combined with topographic mapping to delineate inland areas subject to flooding (with a margin of error of +/- 20).

Table 8-6. SLOSH Maximum Predicted Water Depths (ft above MSL)

Ocean Side						Bay Side					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
WSW	3	4	9	9	10	WSW	4	6	9	10	10
W	4	6	8	9	10	W	4	7	8	10	10
WNW	4	6	8	9	10	WNW	4	7	8	10	10
WN	4	6	7	9	9	NW	4	6	7	9	9
NNW	4	5	7	9	9	NNW	4	5	7	9	9
N	4	5	7	9	9	N	4	5	7	9	9
NNE	4	5	7	9	9	NNE	4	5	7	9	9
NE	4	5	6	8	9	NE	3	5	6	8	9
ENE	4	5	6	8	10	ENE	4	5	6	9	10
E	3	5	7	8	10	E	4	5	7	9	10

Rainfall/Fresh Water Flooding in Key West

In several locations the City's storm drain system is inadequate to handle as little as three to five inches of rainfall, which happens several times each year. The types of damage caused by flooding of this nature include traffic rerouting, business closures, and flooding above

finished floor height and above of homes and businesses. In just the Old Town area at North Duval, a typical storm can disrupt businesses causing losses of approximately $20,000 each day. Damage to private structures and contents and the costs of clean up are not estimated. The most susceptible locations are listed in Table 8-7.

According to the NCDC Storm Events Database there has been one significant flooding event in the last five years. On August 20, 2013 thunderstorms produced heavy rainfall of 2 to 3 inches across Key West, resulting in street flooding in the low-lying sections of Old Town. Greene and Front Streets had to be closed and Lower Duval Street and Caroline Street were also flooding.

Table 8-7. Locations Susceptible to Rainfall/Fresh Water Flooding.

Location	Status (mid-2015)
The north section of Old Town bounded by the Gulf of Mexico and Whitehead and Green Streets, some buildings experience flooding above finished floor elevation flooding approximately twice a year.	Work ongoing with the East Front Street Flood Mitigation Project. Work completed June 2015.
Palm Avenue and Eaton Street (at White Street) which can reroute 5,000 vehicles per day during heavy rains, affects businesses, and causes stranding of residents of the adjacent housing authority homes.	Not completed – Monroe County Right of Way.
Sirugo Avenue and Sunshine Drive, which has floods above finished floors in residences annually.	Plans are developed and in line for construction.
United Street and Thompson Street basin, which has causes flooding of residences finished floor.	Plans are developed and in line for construction.
North Roosevelt Boulevard (US Highway 1) which floods two outbound lanes completely during heavy rain storms 2 to 3 times each year, negatively impacting businesses and causing significant traffic rerouting.	Florida DOT project completed in September 2014, including flood mitigation and stormwater run-off controls.
Fourth Street at Patterson Avenue floods frequently, causing commercial business and residential traffic disruptions.	Plans are developed and in line for construction.
Blanch, Dennis and Duncombe Streets causing school bus disruptions and flooding above finish floors of residences.	Plans in development.
Duck Street Ave.and 20th Street, causing traffic disruptions and flooding above finish floors of residences.	Not completed.
Various very localized flooding spots causing water infiltration into homes and businesses can be found around town.	Areas are being prioritized for possible plan development.

Sea Level Rise

The 2009 Key West Climate Action Plan acknowledges that the topic of climate change has been discussed for over 30 years and the science of projecting impacts has been determined to be sound. The Action Plan states impacts are being observed and it is time to act on an adaptation strategy. NOAA data shows that the mean sea level rise trend is 2.24 millimeters/year with a 95% confidence interval of +/- 0.16 mm/yr based on monthly mean

sea level data from 1913 to 2006. This is equivalent to a change of 0.73 feet (8.76 inches) in 100 years. In other words, the City can expect a 9-inch rise in tide by 2100.

In the context of this Local Mitigation Strategy, the inevitable impact of sea level rise is increased flooding for homes, businesses, roads and public facilities (parks, beaches, airport) affecting everyday activities to which Key West residents and visitors are accustomed. The Action Plan describes the impact in terms of how many more roads and recreational facilities will be flooded and tables identify specific impacts on facilities (parks, beaches, airport, aquarium, etc.) and roadways expected to have portions inundated by saltwater with a 9-inch tide rise.

As a partner to the Southeast Florida Climate Change Compact (Compact), the City of Key West adopted the April 2011 "Unified Sea Level Rise Projection for Southeast Florida" document, joining the Counties of Monroe, Miami-Dade, Broward and West Palm Beach in recognizing the planning windows of 3-7 inches of sea level rise by 2030 and 9-24 inches of sea level rise by 2060. Source: http://www.southeastfloridaclimatecompact.org//wp-content/uploads/2014/09/sea-level-rise.pdf

Also in conjunction with the Compact, Key West was included in the August 2012 "Analysis of the Vulnerability of Southeast Florida to Sea Level Rise". From that analysis, Table 8-8 summarizes infrastructure and acreage located at very low elevations (approximately 3-feet MSL).

Table 8.8. Inundation Acreage with 3-foot Sea Level Rise

Facility	More Likely To Be Inundated	Possibly Inundated	Total Inundation	Total Acreage	Percent Inundation
Key West International Airport	150.3	9.3	159.5	170.6	94%
Keys Energy Services Main Office	0.7	0.1	0.8	0.8	100%
Keys Energy Services Substation Kennedy Drive – Key West	0.0	0.1	0.1	0.4	31.1%
FKAA Storage Facility – N. Stock Island	0.0	0.2	0.2	2.3	7.1%
Fleming Key WWTP	1.1	0.7	1.7	11.9	14.6%
Key West Landfill	22.2	1.1	23.4	73.5	31.8%
DePoo Hospital LFKHS	0.0	0.1	0.1	1.2	8.3%
Lower Keys Hospital – N. Stock Island	1.8	0.4	2.2	15.1	14.7%
Florida Keys Community College – N. Stock Island	1.4	1.1	2.5	21.4	11.8%
Gerald Adams Elementary – N. Stock Island	0.4	0.1	0.5	9.5	4.9%
Horace O'Bryant Middle School (Shelter)	4.4	2.8	7.2	9.2	78.7%

Key West High School	6.9	4.8	11.7	25.2	46.5%
Poinciana Elementary School	2.4	0.5	2.8	6.9	41%
Sigsbee Elementary School	5.3	0.2	5.5	11.2	48.8%

Floodplain Management & Compliance with the NFIP

The City entered the National Flood Insurance Program in 1971 by adoption of an ordinance that complies with the requirements of the program. The ordinance has been revised several times, most recently in 2013 when the City replaced the ordinance with a code-coordinated ordinance as part of a statewide effort to coordinate local ordinances with the flood provisions of the Florida Building Code.

NFIP Flood Insurance Policies in Key West: 7,657

Claims paid since 1978: 3,426

https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13 (as of March 31, 2015)

The City reviews all development proposals in special flood hazard areas and enforces the requirements of the ordinance. To ensure continued compliance with the NFIP, the City continues to:

- Enforce the adopted floodplain management ordinance, including inspection of permitted development and unpermitted activities;
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Maintain a special section of the city web site dedicated to flood damage prevention information, online flood maps, mitigation measures, elevation certificates and map changes.
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Notify the public when there are proposed changes to the ordinance or Flood Insurance Rate Maps; and
- Promote the purchase of NFIP flood insurance policies as financial protection.

NFIP Floodplain Mapping

Key West has participated in the National Flood Insurance Program (NFIP) since September 1971. The City's current Flood Insurance Rate Map, prepared by FEMA, is dated February 18, 2005. FEMA initiated a coastal study to revise the FIRM, expected to be completed in 3 to 4 years.

The FIRM delineates areas that have been determined to be subject to flooding by the "base flood," the flood that has a 1-percent-annual chance of flooding in any given year (commonly called the 100-year flood). Flooding of this frequency is not associated with a

specific hurricane category. Key West has the following flood zones and flood elevations (above MSL) shown on the FIRM:

- VE Zones (coastal flood with velocity hazard wave action) of 11-13 feet are near the shoreline and in sections adjacent to Cow Key Channel on the border with Stock Island.
- AE Zones (areas subject to flooding but waves are predicted to be less than 3-feet in height) of mostly 7-9 feet are indicated for the newer sections of Key West and in areas of "Old Town" close to the shoreline.
- X Zones are delineated in most of the inland areas of the older, historic portion of the City. X Zones include areas determined subject to flooding by the 0.2-percent annual-chance flood (500-year) and areas that are outside the 500-year floodplain.
- AO Zones, where flood depths of 1-3 feet are predicted in sloping areas for Sunset Island offshore of the west side of Key West.

NFIP Repetitive Loss Properties

Data provided by the Florida Division of Emergency Management identifies properties that are, or have been, insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. In 2005, 51 properties met the definition. As of March 2015, 221 individual properties are classified as repetitive loss and have received 563 claims, totaling approximately $25.7 million (average payment of approximately $45,600). Of these 221 properties, 183 are residential and 38 are non-residential. Figure 8-1 shows the locations of repetitive loss properties and Figure 8-2 illustrates the bigger picture of insured flood losses, by showing relative concentrations of NFIP insurance claim payments for period 2000 through 2014. Both figures are at the end of the chapter.

A subset of the NFIP's Repetitive Loss Properties includes those that meet the Federal definition for "severe repetitive loss." Eleven properties in Key West are designated as Severe Repetitive Loss properties, having received a total of 60 claims totaling more than $2.5 million. In one instance, the cumulative value of flood claims paid is believed to represent 120% of the building's value. A few other buildings have a similar history, with at least 90% of the building's value received in flood claims.

A Severe Repetitive Loss Property is defined as a residential property that is covered by an NFIP flood insurance policy and (a) that has at least four claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims exceeding $20,000; or (b) for which at least two separate claim payments (building only) have been made with the cumulative amount exceeding the market value of the building. For both (a) and (b), at least two of the qualifying claims must have occurred within any 10-year period.

Tornadoes in Key West

Table 8-9 includes information on tornadoes that have affected Key West since the late 1950s. Fortunately, no deaths or injuries have resulted.

Table 8-9. Tornadoes in Key West

Date	Fujita Scale*	Damage (not adjusted)
July 1, 1959	F-0	$3,000
June 2, 1966	F-0	$25,000
June 18, 1972 (Hurricane Agnes)	F-2	$400,000
August 20, 1978	F-0	$25,000
June 28, 1979	F-0	$3,000
May 16, 1988	F-0	$1,000
May 3, 1989	F-0	Not reported
May 1999	F-0	Not reported
October 2000	F-0	Not reported
October 2003	F-0	Not reported
December 2009	EF-0	$5,000

*Enhanced Fujita Scale (EF) operational February 1, 2007
Source: NWS Key West Warning Meteorologist and NCDC

Drought Hazards

Drought hazards for the planning area are described in Section 6.4. Key West's risk due to drought is comparable the drought risk throughout the area.

Wildland Fire Hazards

The Florida Forestry Department has not indicated that areas in Key West are likely to experience significant risk of wildland or brush fires.

Key West's Important and Critical Facilities

Table 8-10 lists facilities that the City deems important and critical. Figure 8-3 shows the locations of the City's bridges, water treatment and sewer facilities, city buildings and emergency facilities (end of chapter; also see Figure 2-3).

Table 8-10. Important and Critical Facilities in Key West

Critical/Essential Facilities: • bridges • 24 sewer lift stations and one Wastewater Treatment Plant • 4 stormwater lift stations • City buildings (New City Hall – complete February 2016), Old City Hall, City Hall Annex, , Old Town Garage • Fire Stations: Central #1, Angela St #2, Kennedy #3) • City Parks & Recreational Facilities: Martin Luther King Pool Building, Indigenous Park, Mallory Square, Douglas Gym, Clayton Sterling sports complex, Wickers Sports Complex, Bayview Park Recreational Center, Fire Station Museum • Emergency Operations Center (Public Safety Facility), Fire Station #3, • Key West DOT Building, Public Works Building, OMI Repair Building, Transit Facility • Southernmost Transfer Station	**Other Public Facilities:** • Dee Poo Hospital • Lower Florida Keys Health Center • U.S. Naval Hospital • Key West International Airport • Florida Highway Patrol Substation South Roosevelt Boulevard • US Coast Guard Base • Military Fuel Storage Facility • Keys Energy Services Main Office & Substation • Florida Keys Aqueduct (FKAA) Authority Main Office, Water Towers, Storage Facility, Pump Station • Sheriff's Office Main Switch Board • Monroe County Health Department – Gato Bldg • Coastal & Aquatic Managed Areas
Hazardous Materials Sites (302 Facilities): • Bell South, 530 Southard Street • KES 1001 James Street • Key West Wastewater Treatment Plant, Trumbo Point Annex, Fleming Key • Naval Air Station, Trumbo Point	**Mobile Home and Recreational Vehicle Parks:** • Key West Villas (Poinciana) LTD Mobile Home Park • Stadium Mobile Home Park • Key West Trailer Court • Mastic
Marinas: • A & B Marina • Galleon Marina • Garrison Bight Marina • Hilton Haven Marina • Key West Seaport • Key West Yacht Club Marina • Land's End Marina • Truman Annex Marina • City Marina • Ocean Key House	**Cruise Ship and Ferry Ports:** • Mallory Square • Outer Mole • Pier B • KW Ferry Terminal

8.4 Damage Reduction Activities

On-Going Activities

The City activates a Post-Disaster Recovery Task Force after a major damaging event has occurred. In addition to members from City departments, various neighborhood and interest-based groups are represented. A main focus of the task force is to encourage public participation in the post-storm redevelopment planning and review process, including historic preservation interests. The Task Force also analyzes the outcome of an event and makes recommendations for mitigation.

Between 1992 and 1999 the City of Key West participated in the NFIP's Community Rating System. In recent years, the City addressed identified compliance concerns and has been invited to reapply to the CRS. The City has also approved a new staff position, expected to be filled in FY15 to address Repetitive Loss properties and other CRS matters.

Through the efforts of the City's Sustainability Coordinator, the City is also convening a bi-monthly Planners Forum with the other 5 local governments in the Keys to proactively address climate change and hazard planning through policy changes. The Sustainability Coordinator sits on the staff steering committee for the Southeast Florida Regional Climate Change Compact and attends its regional workshops on stormwater, adaptation action areas, risk communication, and CRS.

The City was awarded a Climate Change Adaptation Grant through Sea Grant Gulf of Mexico to overhaul its Land Development Regulations in regards to Adaptation, which will be complete by the end of FY15.

Regulatory Change: Building Height

On Nov. 4th, 2014 Key West voters approved a Building Height Referendum to allow buildings with lowest floors below the BFE to exceed the height restriction when the buildings are raised on higher foundations. The final regulations, expected in May 2015, will allow buildings, by exception to the building height regulations, to be voluntarily raised up to 4 feet above the BFE, provided the maximum height is no more than 40 feet in height. Buildings outside of the mapped SFHA (i.e., located within the "X" and "Shaded X" flood zones) are not subject to flood hazard area requirements and thus are not affected by this change.

The exception allows the Building Department to approve applications to elevate buildings if the applications meet the guidelines for the height exception. Approval for structures located within the historic district is contingent on Historic Architectural Review Commission approval to elevate higher than the minimum flood level.

Floodplain Management Changes

The City revised its floodplain management regulations in 2013, in part to coordinate with the Florida Building Code. It includes a number of standards that exceed the NFIP minimum requirements:

- Eliminated 36" height above grade rule for mobile home parks, in favor of minimum elevation to Base Flood Elevation for new or substantially improved manufactured homes.
- Prohibited installment of manufactured homes in coastal high hazard areas (Zone V).
- Re-enacted five-year cumulative rule for Substantial Improvement calculations.
- Removed elevation exemption for utilities and servicing equipment for otherwise exempted historic buildings.

Mitigation Projects

The City has undertaken various projects to reduce exposure to future damage, such as drainage improvements and retrofits of public buildings and facilities (with or without FEMA funding). Table 8-11 lists projects completed between 1999 and 2004.

Table 8-11. Key West Mitigation Projects (1999–2014)

	Mitigation Project Location and Notes on Activity
Storm Shutters	Key West Transfer/SWTE. Notes: Pending grant approval to redevelop the site as the Key West Department of Transportation / Monroe County School District Transportation Hub and Fleet Services Center.
	DOT Building
	FDS Gym. Notes: Seeking grants to enhance the structure to be used as a general population shelter and point of distribution.
	Fire Station #1 HMGP
Stormwater Improvements	Grinnell Street (Backflow preventers)
	William Street
	Elizabeth Street
	Green Street
	Duval Street
	Ashby Street Pump Station. Notes: Control panel was raised above BFE and provided elevated platform for portable electric generation. Seeking grants to install permanent emergency power for all pumping stations.
	Simonton Street (Duval/Front Pump Station)
	East Front Street Flood Mitigation Project (new outfall, gravity wells, new inlets, tide valve)
	Major Pipe Cleaning Project. Notes: Ongoing.

Table 8-11. Key West Mitigation Projects (1999–2014)

	Mitigation Project Location and Notes on Activity
Injection Well Projects	White Street
	Kamien Subdivision. Notes: Ongoing.
	Fort Street. Notes: Ongoing.
	Reynolds Street
	Searstown / Donald Ave
	2005 Project: 26 Locations
	Margaret Street
	East Front Street Flood Mitigation Project: 6 Locations
	Olivia Street
Berms & Beaches	Rest Beach Berm – re-nourishment and associated seagrass mitigation delayed due to extended Army Corps of Engineers permit application review.
	Dog Beach Berm
	South Beach Berm
	Simonton Beach Berm
	Smathers Beach Berm - re-nourishment delayed due to extended Army Corps of Engineers permit application review.
	Seawall Additional Length
	South Beach Pier
Flood Proofing	Margaret Street building, Key West Bight

8.5 2015 Updates

- Section 8.1: Revised to update population estimates and objectives and policies based on the 2013 Comprehensive Plan.
- Section 8.2: Updated agency descriptions to reflect current organization and descriptions of functions related to hurricanes and hazard mitigation.
- Section 8.3: Added text on Hurricane Isaac; added new subsection on sea level rise; updated continued compliance with the NFIP; expanded text on repetitive loss properties, severe repetitive loss properties, and updated map of repetitive loss properties; updated list of critical facilities.
- Section 8.4: Added description of new Sustainability Coordinator; summarized regulatory change related to allowing elevated buildings to exceed building height restrictions; updated recent mitigation projects.
- Plans consulted during the 2015 update:
  - 2013 City of Key West Comprehensive Plan
  - 2011 Key West Strategic Plan
  - 2009 Key West Climate Action Plan

Figure 8-1. NFIP Repetitive Loss Properties (2015). Note: The south side of Stock Island not part of the City of Key West.

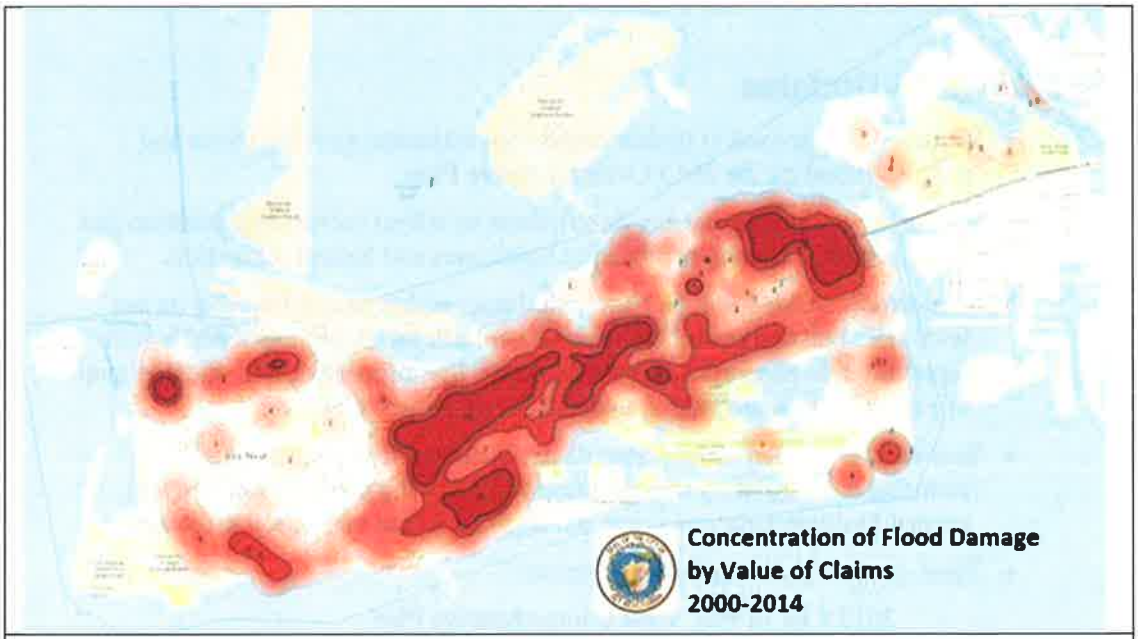


Figure 8-2. Concentrations of NFIP Paid Claims (2000 – 2014).

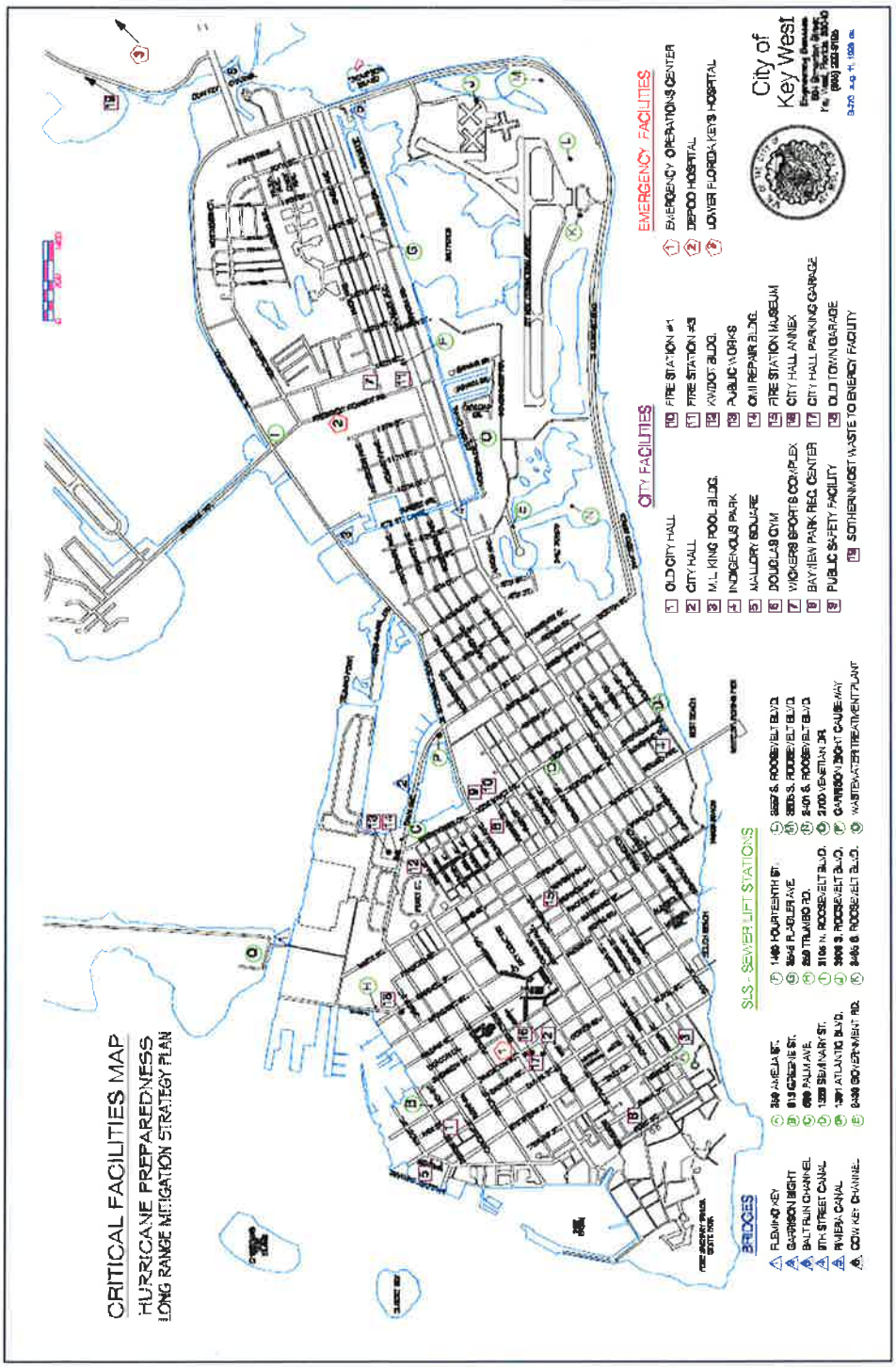


Figure 8-3. Key West's Critical Facilities Map.

Chapter 9. City of Layton

The City of Layton, incorporated in 1963, is located in the Middle Keys primarily on the east side of Overseas Highway, just north of Long Key State Park entrance.

9.1 Overview of Layton

Geography

Layton comprises just 85 acres in area. Layton is building almost entirely on waterfront property, mostly canals. It is low-lying, with all land below 6 feet above mean sea (MSL).

Population

The Southeast Florida Regional Planning Council, using US Census data, estimates the City of Layton has a permanent resident population of 186. The seasonal population increases to as much as 250. Current population projects indicate the permanent population may grow to 205 by 2020.

The City's small size and population allows it to quickly provide personal responses to disasters. In 2014, the Monroe County Social Services registered just one person in the Layton area as having special needs for hurricane assistance.

Land Use & Economy

Layton's development is primarily single family residences located along canals and small businesses (restaurants and convenience stores).

The City is "built out" with only 11 buildable lots available for residential development. In addition, growth is limited through the Rate of Growth Ordinance to implement portions of the City's Comprehensive Plan. ROGO, as the ordinance is called, establishes a building permit allocation system for residential construction. The purpose is to encourage in-fill of platted lots served by existing infrastructure and to limit growth to enable safe and timely hurricane evacuation. Pursuant to ROGO and an agreement between the City, County and the Department of Economic Opportunity, the annual allocation for Layton is three permits per year for residential dwelling units.

According to the current City of Layton Comprehensive Plan (amended in 2015), the pattern of development in the past has been largely limited to single family homes along with commercial development along the Overseas Highway is expected to continue in the future. The approximately 50 acre tract in the southeast quadrant of the City is now owned by the City of Layton and the comprehensive plan and ordinances are being amended to maintain that property without development in perpetuity. This parcel is the only unplatted vacant

land in the City. All new construction, reconstruction, and improvements to existing buildings must comply with the current Florida Building Code requirements.

Layton joined the National Flood Insurance Program in July 1971 and administers a floodplain management ordinance that meets or exceeds the minimum federal requirements. In 2001, the city qualified for the NFIP Community Rating System.

9.2 Capability Assessment: City Organization and Agencies

Layton's City Council is composed of 6 members, including the Mayor who is elected specifically to that office. The City Council sets government policy and adopts guidance documents, such as the Comprehensive Plan 1996 and ordinances establishing various codes and standards, and responsible for the adoption of the Local Mitigation Strategy.

Layton is organized into several agencies, each with authorized responsibilities that, as described below, have bearing on how natural hazards are recognized and addressed.

Mayor. The Mayor implements the policies of the Commission and administers the overall operations of the City, including hiring staff as funded by the Council and chairing the Council meetings. The Mayor also sits on the LMS Working Group.

City Clerk. The City Clerk is appointed by the City Council and is responsible for maintaining City records, publishing meeting notices, maintaining the financial records, Community Rating Systems Coordinator, Local Mitigation Strategy Working Group member, and other duties as directed by the City Council.

Administrative Assistant to the Mayor. The Administrative Assistant is responsible for the daily activities of the City and in the absence of the Mayor, represents the Mayor at official meetings and functions.

Layton Planning Department. The Planning Department is responsible for the development and maintenance of the City's Comprehensive Plan and the City Planner is the Vice-Chair for the LMS Working Group.

City Building Official. The Building Official reviews construction plans, issues permits, and inspects projects for compliance. He is also the Floodplain Manager and a member of the LMS Working Group. Layton enforces the Florida State Building Code. The Department is responsible for enforcing zoning and building standards and the Land Development Regulations.

Layton , Florida

- *Building Department has 2 staff members, including a Certified Floodplain Manager*
- *City Clerk has 1 staff member who is a Certified Municipal Clerk.*
- *Administrative Department has 1 staff member*
- *Planning Department has 1 staff member*
- *Code Enforcement Department has 1 staff member and an appointed Code Enforcement Board*

Table 9-1. Layton: Permits Issued (2012, 2013, 2014)

	CY 2012	CY 2013	CY 2014
New single-family, detached	0	0	0
New single-family, attached	0	0	0
Multi-family (2 or more)	0	0	0
Non-residential (all types)	0	0	0
Residential (additions, alterations, repairs)	16	19	20
Non-residential (additions, alterations, repairs)	14	11	15
Demolition	0	4	0
Relocation	0	0	0
Mobile home (permanent/temporary)	0	0	0
Total Permits Issued	30	31	36

Moving Mitigation Forward

The City is striving to maintain its rapid response on disasters and flood issues and is striving to improve its CRS rating from Class 8 to Class 7.

9.3 Hazards and Risk in Layton

Historic Storms

Hurricane Donna (August 29-September 19, 1960). A Category 4 hurricane, this storm is listed among the most intense in U.S. history. It curved northwestward over the Middle Keys before turning north towards the mainland at Naples and Fort Myers. Wind speeds of 128 mph and central pressure of 28.44 inches were measures. Tide levels ranged from 13.5 feet above MSL at Upper Matecumbe Key, +10 feet at Plantation Key, and 8.9 feet in Key Largo. The high water mark closest to Layton was nearly 8 feet (ocean side, Craig Key Mile Marker 72).

Hurricane Betsy (August 26-September 12, 1965). A Category 3 hurricane, Betsy passed over Marathon moving westward into the Gulf of Mexico. At Tavernier, central pressure was recorded at 18.12 inches and wind speeds were estimated at 120 mph. Flood levels were measures at 9 feet MSL in Key Largo.

Ground Hog's Day Storm (February 2, 1998). This severe weather system produced tornadic activity in the area.

Hurricane Georges (September 25, 1998). Near Layton at Mile-Marker 70, storm debris rendered U.S. 1 impassable to civilian vehicles. The high water marks closest to Layton were 4.6 feet at Mile-Marker 69.5 and 5.7 feet at Long Key State Park Mile-Marker 66.8.

Tropical Storm Mitch (November 4-5, 1998) affected the City of Layton.

Effect of Recent Hurricane Disasters

Damage from Hurricane Georges is representative of Layton's exposure:

- Damaged city property; a reimbursement of over $7,000 was received for damage to signs and streets, park cleanup, and EOC staffing.
- All private residences that were below the crown of the city's streets received flooding, and most roofs suffered wind damage (shingles). About 2% of homes sustained significant wind damage.
- Due to a 4-day power outage, all businesses were closed or experienced restricted operations.
- Lobster fishermen lost approximately 50% of their traps.

Damage from Hurricane Wilma

Although there was only minor damage to City property, there was severe water and wave action caused more than $1,000,000 in damage to the waterfront commercial and residential properties on the north side of the Overseas Highway as the surge from the storm exceeded 5.5 feet above Base Flood.

Damage from Hurricane Isaac

The City of Layton sustained no damage.

Hurricane Flooding as Predicted by SLOSH Modeling

The National Hurricane Center's surge model, called SLOSH (Sea, Lake, and Overland Surges from Hurricanes), estimates surges associated with different characteristics of tropical cyclones (track, forward speed, wind speed, etc.). This information is carried forward from the 2010 Plan as it provide more site-specific potential surge impacts and is to be used in conjunction with the Hazus results from Chapter 5. The results can be combined

with topographic mapping to delineate inland areas subject to flooding (with a margin of error of +/- 20%). The closest available predications are made for Conch Key Mile-Marker 63 and Islamorada Mile-Marker 82 (Table 9-2). Although storm surge flooding cannot be predicted simply at any given location, these charts can be used to approximate surge flooding in Layton.

Table 9-2. SLOSH Maximum Predicted Water Depths (ft above MSL)

Ocean Side Mile-Marker 63						Ocean Side Mile Marker 82					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
WSW	4	6	8	9	9	WSW	4	5	7	8	9
W	4	6	7	8	9	W	4	6	7	9	10
WNW	4	5	7	8	9	WNW	4	6	7	9	10
WN	4	5	7	7	8	NW	4	6	7	9	10
NNW	4	5	6	7	8	NNW	4	5	7	8	10
N	3	5	6	7	8	N	4	5	7	8	9
NNE	3	4	6	7	8	NNE	4	5	6	8	9
NE	3	5	6	8	9	NE	4	5	6	7	8
ENE	4	6	8	10	11	ENE	3	5	6	7	8
E	5	8	10	11	12	E	3	4	6	7	8

Floodplain Management & Compliance with the NFIP

The City entered the National Flood Insurance Program in 1971 by adoption of an ordinance that complies with the requirements of the program. The City reviews all development proposals in special flood hazard areas and enforces the requirements of the ordinance. To ensure continued compliance with the NFIP, the City will continue to:

- Enforce the adopted floodplain management ordinance, including inspection of permitted development and unpermitted activities;
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Notify the public when there are proposed changes to the ordinance or Flood Insurance Rate Maps;
- Implement activities recognized by the NFIP's Community Rating System; and
- Promote the purchase of NFIP flood insurance policies as financial protection.

NFIP Flood Insurance Policies in Layton: 89

Claims paid since 1978: 8

https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13
(as of March 31, 2015)

NFIP Floodplain Mapping

Layton has participated in the National Flood Insurance Program (NFIP) since July 23, 1971. The National Flood Insurance Program (NFIP) prepared a Flood Insurance Rate Map for Monroe County and incorporated municipalities (current effective map is dated February 18, 2005). The FIRM delineates areas that have been determined to be subject to flooding by the "base flood," the flood that has a 1-percent-annual chance of flooding in any given year (commonly called the 100-year flood). FEMA initiated a coastal study to revise the FIRM, expected to be completed in 3 to 4 years.

All land in Layton is subject to flooding; all buildings are subject to some degree of risk depending on type of construction and elevation above grade. Areas designated as VE Zones (coastal flood with velocity hazard wave action) are shown as exposed to flooding ranging from 11-13 feet above MSL. Areas delineated as AE Zones (areas subject to flooding but waves are predicted to be less than 3-feet in height) are exposed to flooding 8-9 feet above MSL.

NFIP Repetitive Loss Properties

Data provided by the Florida Division of Emergency Management identifies properties that are or have been insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. Based on data as of March 2015 there are no repetitive loss properties in Layton.

Severe Storms, Tornadoes, Water Spouts and High Winds (Other than Hurricane)

Layton, like the rest of the Keys, has low-lying terrain. Section 6.2 characterizes the entire area encompassed by Monroe County and the cities as having equal distribution of winds. The risk of severe storms, tornadoes, water spouts and high winds in Layton does not vary from the rest of the planning area. All new buildings, replacement buildings, and additions to existing buildings must comply with the Florida Building Code's wind load requirements.

Rainfall/Ponding Flooding

Layton does not have any identified areas where rainfall/ponding flooding is so severe or prolonged as to cause access problems or damage to buildings.

Drought Hazards

Drought hazards for the planning area are described in Section 6.4. Layton's risk due to drought is comparable the drought risk throughout the area.

Wildland Fire Hazards

The Florida Forestry Department has not indicated that areas in Layton are likely to experience significant risk of wildland or brush fires. The exception to this statement may be along the city's boundary with Long Key State Park where natural vegetation may increase fire hazards during some dry periods.

Risk: Layton's Critical and Important Facilities

The locations of the City's facilities that are listed in Table 9-3 are shown in Figure 2-3.

Table 9-3. Important and Critical Facilities in Layton

Critical/Essential Facilities: • City Hall/Fire Rescue Complex • Bell South Mobility Towner • Florida Keys Aqueduct Authority Pumping Station (Mile-Marker 70, Long Key)	**Other Facilities:** • Florida Keys Marine Laboratory • U.S. Post Office
Hazardous Materials Sites (302 Facilities): • None	**Mobile Home and Recreational Vehicle Parks (as of October 1995):** • None

9.4 Damage Reduction Activities

On-Going Activities

- The City's Comprehensive Plan policies include provisions for limiting densities in the Coastal High Hazard Area, improving hurricane evacuation timing, and protection of native vegetation and natural shorelines.
- Other measures dealing with hazard planning include the consideration of mobile home restrictions and the need to increase the availability of emergency generators for use in the City.
- The Building Department implements mitigation policies reflected in the Florida Building Code and Land Development Regulations, including standards to reduce vulnerability to high wind load and enforcement of the "substantial improvements" rule.
- The Planning Department implements mitigation measures reflected in the Comprehensive Plan and Land Development Regulations, including regulations designed to minimize damage to structures from wind and waves resulting from storms and floodplain management controls.
- New construction must include storm shutters or high impact windows and doors designed to resist design winds of 180 mph and debris impacts.
- The Comprehensive Plan calls for engineering and other analyses to be undertaken before post-disaster redevelopment is undertaken so that appropriate building regulations can be adopted and design guidelines established for replacement or repair of infrastructure.

Layton participates in the Community Rating System (CRS) of the National Flood Insurance Program. The CRS recognizes actions that exceed the minimum requirements. In return, the City's property owners enjoy a 10% reduction in the cost of NFIP flood insurance. Actions undertaken by the City include:

- Maintains elevation certificates
- Makes NFIP map determinations
- Requires new buildings and substantially improved or damaged buildings to be elevated 3 feet above the BFE.
- Limits enclosures below elevated buildings to 300 square feet
- Sends annual NFIP mailings to all local lenders, realtors, and insurance companies
- Keeps NFIP library in City Hall
- Warns citizens of impending flooding
- The City monitors building repairs or improvements in order to enforce the Substantial Damage/Improvement 50% rules.

Recent Projects

In 2002, with a Federal-State Hazard Mitigation Grant, the City of Layton installed hurricane retrofit measures to the City Hall/Fire Station to meet the 159 miles per hour standards. The total cost was $75,000 (50% Federal, 25% State, 25% City).

Replacement culverts were installed under South Layton Drive to assist in tidal water flow in the canals. Rip-rap storm water retention swales and native plants were included in the project. The $60,000 project was funded locally.

9.5 2015 Updates

The City reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 91: Updated population; described acquisition of large parcel of land.
- Section 9.2: Updated position descriptions to include LMS responsibilities.
- Section 9.3: Noted Hurricane Isaac did not affect the City.
- Reference: City of Layton Comprehensive Plan – amended 2015

Chapter 10. City of Key Colony Beach

10.1 Overview of Key Colony Beach

Geography

Key Colony Beach, a man-made island community built in 1957, comprises just 285 acres in area. It is low-lying, with all land below about 5.5 feet above mean sea (MSL). The entire south shore faces the Atlantic Ocean and the west shoreline faces Vaca Cut, which connects the Atlantic to the Gulf of Mexico. The island, located approximately between Mile Marker 53 and Mile Marker 54, contains numerous dead-end canals, channels and bays that experience flooding due to storm surges that may be higher than along flat shorelines.

Population

The Southeast Florida Regional Planning Council, using US Census data, estimates the City of Key Colony Beach has a permanent resident population of 808 in 2014. The seasonal population increases by as much as 3,600.

In 2014, the Monroe County Social Services registered 14 people in the area between Mile Marker 53 and Mile-Marker 60 as having special needs for hurricane assistance.

Land Use & Economy

Key Colony Beach is a well-planned community comprised of single family, duplex, and multifamily dwellings. These uses are served by limited commercial development, including light retail, restaurants, offices and marinas. Just over 10% of the land area is used for recreational purposes.

The City joined the National Flood Insurance Program in July 1971 and administers a floodplain management ordinance that meets or exceeds the minimum federal requirements. About 35% of the buildings were constructed prior to 1971.

Comprehensive Plan

The City of Key Colony Beach adopted its Comprehensive Plan in February 1992. The plan includes nine elements pertaining to the future growth and development of the City. Throughout the plan are numerous goals, objectives and policies that acknowledge hurricane risks, especially related to evacuation, growth, ensuring safety, providing adequate facilities, managing storm water, working with providers of water supply and wastewater services, and requirement compliance with codes. The Infrastructure Element and the Conservation and Coastal Element contain specific policies relevant to mitigation of future risk and damage.

The Infrastructure Element includes:

- Complete a detailed engineering study of drainage and implement priority storm water projects. As of 2015, the construction of identified projects is 75% construction complete with citywide storm water retention systems.
- On-site wastewater disposal facilities to minimize potential environmental impacts. The City's wastewater treatment plant was installed in 1970 and has been upgraded to 2016 standards.
- Establish and coordinate acquisition programs. The City has acquired several properties over the past ten years.

The Conservation and Coastal Element includes:

- New development encroaching into the 100-year floodplain shall incorporate elevation and flood protection measures sufficient to protect against the 100-year flood.
- The City shall maintain consistency with program policies of the National Flood Insurance Program.
- The City shall monitor new, cost-effective programs for minimizing flood damage.
- Such programs may include modifications to construction setback requirements or other site design techniques, as well as upgraded building and construction techniques.

10.2 Capability Assessment: City Organization and Agencies

The City of Key Colony Beach is a Commission Form of Government. The City Commission is composed of 5 members, including the Mayor who is selected by the Commission to that office. The City Commission sets government policy and adopts guidance documents, such as the Comprehensive Plan, the Land Development Regulation, and ordinances establishing various codes and standards.

Key Colony Beach is organized into several departments, each with authorized responsibilities that, as described below, have bearing on how natural hazards are recognized and addressed.

Mayor/City Administrator. The Mayor of Key Colony Beach implements the policies of the Commission and administers the overall operations of the City. With regard to floodplain management the Mayor (or designee) is appointed to administer and implement these provisions consistent with the requirements of the National Flood Insurance Program.

Key Colony Beach Planning and Zoning Committee. The Key Colony Beach Planning and Zoning Committee is responsible for the development and maintenance of the City's

Comprehensive Plan and the Land Development Regulations. City personnel serve as staff to the Committee and are involved in the following related to hazard mitigation:

- Ensures that mitigation related items in the Comprehensive Plan, such as floodplain management and natural resource management, are followed and reflected in the City's Codes and Standards.
- Participates in post-disaster appraisals and may formulate additional mitigation measures for use in the Comprehensive Plan.
- Works closely with the Building, Code Enforcement, and Fire Department to ensure coordination of actions related to disaster planning, recovery, and mitigation.
- Reviews construction plans for compliance to the NFIP regulations.
- Responsible for enforcing planning and zoning standards.

Key Colony Beach Building Department. The Building Department is responsible for regulations of building construction pertaining to life safety, health, and environmental land use zoning regulations. The department is staffed by the Building Official, a Building Inspector, a Permit Clerk and an on-call State of Florida Registered Engineer. Related to mitigation of hazards, the department is responsible for the following:

- Review of construction plans and issuing building permits
- Inspection and enforcement during construction
- Designated as coordinator for the National Flood Insurance Program.

Table 10-1. Key Colony Beach Permit Statistics for 2012, 2013, 2014

Permits Issued	CY 2012	CY 2013	CY 2014
New single-family, detached	2	9	1
Duplexes	0	1	2
Multi-family (3 or more)	0	0	0
Non-residential (all types)	0	0	0
Residential (additions, alterations, repairs)	357	343	355
Non-residential (additions, alterations, repairs)	9	15	21
Demolition	0	2	0
Relocation	0	0	0
Number of inspections	1,071	1,104	1,065

Key Colony Beach Public Works Department. The Public Works Department works under the Building Official and is responsible for overseeing the maintenance of most city facilities, including buildings, roads, and bridges. It operates and maintains City vehicles.

Public Works is responsible for coordination and provision of emergency public works, initial evaluation of infrastructure damage and preparation of documentation required for federal reimbursement (including identification of mitigation components to be incorporated), and coordination of emergency debris clearing.

In executing its disaster recovery responsibilities, Public Works coordinates with the Florida Department of Transportation, Monroe County Department of Public Works, Florida Keys Aqueduct Authority, and Florida Keys Electric Co-op. The department plans, coordinates and initiates restoration of the serviceability of transportation routes, bridges, and assurance as to the safety of affected public and private dwellings and structures.

Key Colony Beach Code Enforcement Board and Officer. The Code Enforcement Board and Officer oversee after-the-fact code compliance issues pertaining to safety, health, and environmental land use zoning regulations. The department is staffed by a Code Enforcement Officer and an Administrative Assistant. Related to mitigation of hazards, the department is responsible for: working closely with the Building, Planning, and Fire departments to ensure coordination of actions related to disaster planning, recovery, and mitigation; and participating in post-disaster appraisals.

City Clerk/Finance Administrator. The Finance Administrator is responsible for overseeing the day-to-day financial requirements of the City, including establishment of purchasing procedures for all agencies. To expedite preparation for, response to, and recovery from disasters, the Finance Administrator may implement special emergency procedures to expedite necessary purchase and payment before, during, and after a disaster.

Key Colony Beach Police Department. The Key Colony Beach Police Department is responsible for overall law enforcement and protection of residents and visitors in the City of Key Colony Beach. The department plays a key role in planning and response during emergencies to include but not limited to: coordination with Florida Highway Patrol to promote speedy and safe evacuation, communicates with base operations, field personnel, and emergency shelters.

Marathon Fire Department. The City contracts with the City of Marathon to provide emergency management assistance and direction to the City of Key Colony Beach for all life safety in connection with other duties of fire control, fire prevention, and fire and hurricane public education. The department plays a lead role in planning and response for all emergencies. As required under U.S. Homeland Security Presidential Directive 5, has adopted and uses the National Interagency Incident Management System (NIIMS) and will adopt the National Fire Service Incident Management System (IMS) Incident Command System (ICS) as the baseline incident management system. ICS is implemented for all fires,

haz-mat incidents, rescues, structural collapse and urban search and rescue operations, manmade and natural disasters, and EMS responses that require two or more rescue companies.

10.3 Hazards and Risk in Key Colony Beach

Historic Storms that have affected the Key Colony Beach Area:

- 1929 Hurricane (September 22 to October 4) – The hurricane crossed over Key Largo on a northerly course. Key Largo reported winds estimated at over 100 mph, a central barometric pressure of 28 inches, and tide levels of 8-9 feet above MSL. Key West experienced tide levels of 5-6 feet above MSL and winds of 66 mph.
- 1935, Hurricane (August 29-September 10) - The small, extremely violent, Category 5 hurricane crossed the Florida Keys on a northwesterly track. The Tavernier-Islamorada area reported winds estimated at 120 mph with gusts from 190-210 mph. Tide levels in the Florida Keys ranged from 14 feet above MSL in Key Largo to 18 feet above MSL in Lower Matecumbe Key. The storm was so intense and tightly wrapped that Key West had tide levels of only 2 feet above MSL and average sustained winds of less than 40 mph. One of the most tragic aspects of the 1935 storm was the unfortunate death of many WWI veterans who were working on construction of the first Overseas Highway.
- Hurricane Donna, 1960 (August 29-September 19) – Hurricane Donna curved northwestward over the Middle Keys near Long Key/Layton and then traveled northward toward the Gulf Coast towns of Naples and Fort Myers. Areas in the vicinity of the storm experienced winds speed of 128 mph and a central pressure of 28.44 inches. The storm affected the Everglades with estimated winds of 150 mph. Tide levels were reported at Upper Matecumbe Key of 13.5 feet above MSL, at Plantation Key 10+ feet above MSL, and 8.9 feet above MSL in Key Largo. As of 1992 Hurricane Donna, a Category 4 storm is listed as the 6th most intense hurricane in the US.
- Hurricane Betsy, 1965 (August 26-Septmber 12) – Hurricane Betsy passed over Marathon while moving westward into the Gulf of Mexico. The lowest central pressure was measured in Tavernier at 28.12 inches and wind speeds were estimated to be 120 mph. Tide levels in Tavernier were 7.7 feet above MSL and Key Largo had tide levels of around 9 feet above MSL. Betsy was a Category 3 storm and is ranked 25th in intensity.
- Ground Hog's Day Storm (February 2, 1998) involved multiple F-2 tornado touchdowns resulting from severe thunderstorms characterized by dangerous cells with high, cold cloud tops affecting the Florida Keys. Areas most affected were primarily in the Middle Keys including Grassy Key and Valhalla Beach in the vicinity of Duck Key. Several buildings were damaged. Also significant problems occurred from the displacement of lobster traps that contributed to seaborne debris and navigational problems; the fishing industry suffered considerable loss of income.

- Severe thunderstorms (July 4, 1998). Severe thunderstorms with lightning and high winds came up quickly in the Middle Keys. The Weather Service Office in Key West recorded wind speeds up to 70 mph sustained. Because it was July 4th, many boats were offshore celebrating and waiting for the fireworks. Although, this event did not warrant a presidential disaster declaration, it did result in loss of life.
- Hurricane Georges, 1998 (September 25, 1998), a Category 2 when made landfall in the Lower Keys, affecting the entire county to some extent. Damage estimates approached $300 million, including insured and uninsured damage and infrastructure loss. Maximum sustained winds at the Naval Air Station (Boca Chica) near Key West were 92 mph; gusts up to 110 mph were reported by the Emergency Operations Center in Marathon. According to the Key West Weather Service, precipitation levels in the Lower Keys were as 8.65 inches on the south side of Sugarloaf Key, 8.38 inches at Key West International Airport, and 8.20 inches on Cudjoe Key. Tavernier in the Upper Keys recorded 8.41 inches. In Key Colony Beach storm surge flooding exceeded six feet over normal high tide. All city streets and many buildings were flooded, with approximately 125 damaged ground level dwelling units.
- Tropical Storm Mitch, 1998 (November 4 and 5). Feeder bands from Mitch containing dangerous super cells spawned several damaging tornadoes in the Upper Keys. Sections with mobile homes were especially hard hit. Islamorada experienced an F-1 tornado; Rock Harbor and Key Largo were hit by F-2 tornadoes. According to the Department of Community Affairs, damages were estimated at $11 million.
- Hurricane Irene, October 1999. Hurricane Irene hit the Florida Keys and Southeastern Florida. This Category 1 Hurricane dumped 10 to 20 inches of rain resulting in severe flooding in the Florida Keys and Southeastern Florida causing total damage estimated at $800 million
- Tropical Storm Gabrielle, September 2001. Although it did not reach hurricane strength, this storm hit the southwest coast of Florida and caused flooding problems; Marathon did see some effects from the storm.
- In 2005, the city was affected by Tropical Storm Dennis, Hurricane Katrina, and Hurricane Rita, each caused minor property damage, flooding, coastal erosion, and generated debris (largely landscaping materials).
- Hurricane Isaac, August 2012. The City of Key Colony Beach suffered minor property damage from coastal flooding and beach erosion.

Some Costs of Recent Hurricane Disasters

Damage from Hurricane Georges is representative of Key Colony Beach's exposure to tropical cyclones:

- Debris removal costs exceeded $300,000
- Repair of city street signage and parks cost $7,900
- Waterway cleanup, including buoy replacement, cost $8,300

- Manning the EOC, search and rescue, and emergency labor and supplies cost $8,600
- Contract for structural engineering support was $16,300
- Repairs to the wastewater treatment system cost $31,400
- Repairs to the storm water system cost $36,000

Damage sustained on private property included:

- Wind and flood damage was estimated at $4.4 million
- Approximately 10% of all residences were damaged, notably those that predated the City's floodplain management requirements
- Approximately 5% of fiberglass roof singles and concrete tile roofs were damaged
- 4% of all structures sustained significant flood, wave and wind damage
- All businesses were closed or severely restricted due to structural damage and power outages
- Tourist-based businesses were most affected

Damage from Hurricane Isaac

The City of Key Colony Beach suffered minor property damage from coastal flooding and beach erosion.

Hurricane Flooding as Predicted by SLOSH Modeling

The National Hurricane Center's surge model, called SLOSH (Sea, Lake, and Overland Surges from Hurricanes), estimates surges associated with different characteristics of tropical cyclones (track, forward speed, wind speed, etc.). Table 10-2 is carried forward from the 2010 Plan as it provide more site-specific potential surge impacts and is to be used in conjunction with the Hazus results from Chapter 5. The results can be combined with topographic mapping to delineate inland areas subject to flooding (with a margin of error of +/- 20%). The closest available predications are made for Marathon Mile-Marker 50 and Duck Key Mile-Marker 61 (Table 10-2). Although storm surge flooding cannot be predicted simply at any given location, these charts can be used to approximate surge flooding in Key Colony Beach.

Table 10-2. SLOSH Maximum Predicted Water Depths (ft. above MSL)

Ocean Side Mile-Marker 50						Ocean Side Mile Marker 61					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
WSW	4	5	6	7	8	WSW	4	5	6	7	8
W	4	5	7	8	9	W	4	5	7	8	9
WNW	4	6	7	8	9	WNW	4	6	7	9	10
WN	4	6	7	8	9	NW	4	5	7	8	10
NNW	4	5	7	8	9	NNW	4	5	7	8	9
N	4	5	7	8	9	N	4	5	6	8	9
NNE	4	5	6	7	9	NNE	4	5	6	8	9
NE	4	5	6	7	8	NE	4	5	6	7	9
ENE	3	5	6	7	8	ENE	3	5	6	7	8
E	3	4	5	6	7	E	3	4	5	6	8

Floodplain Management & Compliance with the NFIP

The City entered the National Flood Insurance Program in 1971 by adoption of an ordinance that complies with the requirements of the program. The City reviews all development proposals in special flood hazard areas and enforces the requirements of the ordinance. To ensure continued compliance with the NFIP, the City will continue to:

- Enforce the adopted floodplain management ordinance, including inspection of permitted development and unpermitted activities;
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Notify the public when there are proposed changes to the ordinance or Flood Insurance Rate Maps;
- Implement activities recognized by the NFIP's Community Rating System; and
- Promote the purchase of NFIP flood insurance policies as financial protection.

NFIP Flood Insurance Policies in Key Colony Beach: 1,150

Claims paid since 1978: 166

https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13 (as of March 31, 2015)

NFIP Floodplain Mapping

The National Flood Insurance Program (NFIP) prepared a Flood Insurance Rate Map for Monroe County and incorporated municipalities (current effective map is dated February 18, 2005). The FIRM delineates areas that have been determined to be subject to flooding by

the "base flood," the flood that has a 1-percent-annual chance of flooding in any given year (commonly called the 100-year flood).

The entire City is located in areas designated as VE Zones (coastal flood with velocity hazard wave action) and AE Zones. With land elevations averaging 4-7 feet, water depths associated with the 1%-annual chance flood can be expected to range from 4 to 9 feet. As indicated by the predicted storm surge flood depths, even deeper flooding will occur during more severe hurricanes. As such, all new development in the City is subject to the floodplain management standards established in the City's Land Development Regulations. FEMA initiated a coastal study to revise the FIRM, expected to be completed in 3 to 4 years.

NFIP Repetitive Loss Properties

Data provided by the Florida Division of Emergency Management identifies properties that are or have been insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. In 2005, 9 properties met the definition. As of March 2015, 14 individual properties have received 39 claims, totaling $1.8 million (average payment of $46,150). Of these 14 properties, 10 are residential and 4 are non-residential. Figure 10-1 shows property locations of those records that were able to be plotted.

Figure 10-1. Key Colony Beach Repetitive Loss Properties (2015).

Stormwater Management & Rainfall/Ponding Flooding

Key Colony Beach's Stormwater Management Master Plan, prepared in 1995, identifies areas of localized flooding and specific engineered construction plans to minimize local flooding that includes closed drainage systems, open swales, retention ponds, covered trenches, and injection wells. Projects to address the problems are approximately 75% completed construction as of early 2015.

Severe Storms, Tornadoes, Water Spouts and High Winds (Other than Hurricane)

Key Colony Beach, like the rest of the Keys, has low-lying terrain. Section 6.2 characterizes the entire area encompassed by Monroe County and the cities as having equal distribution of winds. The risk of severe storms, tornadoes, water spouts and high winds in Key Colony Beach does not vary from the rest of the planning area. All new buildings, replacement buildings, and additions to existing buildings must comply with the Florida Building Code's wind load requirements.

Drought Hazards

Drought hazards for the planning area are described in Section 6.4. Key Colony Beach's risk due to drought is comparable to the drought risk throughout the area.

Wildland Fire Hazards

The Florida Forestry Department indicates that in the Key Colony Beach area, Grassy Key (including Geiger and Boca Chica) is the area most prone to wildland/brush fires. Based on data provided by Monroe County Property Appraiser, Grassy Key includes a total of 9,391 parcels of land of which 6,498 are improved. The total assessed value of improvements is $1,562,786,704. It is important to note that this summary is not to imply that all properties would be vulnerable in any given wildfire outbreak. Future development on Grassy Key is influenced by property owner choices; all new construction must comply with environmental restrictions.

Key Colony Beach's Important and Critical Facilities

The City's facilities that are listed in Table 10-3 are shown in Figure 2-3.

Table 10-3. Important and Critical Facilities in Key Colony Beach

Critical/Essential Facilities: • City Hall-Police/Auditorium/Post Office Complex • Wastewater Treatment Plant and System • Stormwater System • Public Works Building	**Other Public Facilities :** • Public Golf Courses • Public Tennis Courts • City Parks and Playground
Hazardous Materials Sites (302 Facilities): • Wastewater Treatment Plant (chlorine and	**Marinas:** • The Boat House (MM 53.5, Ocean side)

Table 10-3. Important and Critical Facilities in Key Colony Beach

sulfuric acid)	• Key Colony Beach Marina (MM53.7, Ocean side)

10.4 Damage Reduction Activities

On-Going Activities

- Comprehensive Plan objectives and policies address the need to hold down densities so as not to increase hurricane evacuation times. A stated objective of the Plan is to: "Grant no land use amendments that would increase the land use density and intensity, in order to assure that the projected 'build-out' hurricane evacuation traffic entering on U.S. 1 will not increase. Concurrent policies address restrictions on population density "in order to avoid further burdens on the hurricane evacuation plan".
- Plan policies advocate no City expenditures for infrastructure in the V zone that would encourage increased private development.
- The City of Key Colony Beach Disaster Preparedness Committee, composed of residents and City representatives, coordinates with the County on emergency management activities such as planning, response, recovery, and mitigation. It provides its own public information program, disaster command center, and emergency supplies.
- Post-disaster redevelopment is addressed in the Coastal Management Element of the Comprehensive Plan, recognizing that redevelopment may require greater building setbacks and elevations, and installation of dunes rather than seawalls.
- The Building Code requires buildings to be designed to withstand the forces of 180 mph winds (assumed in any direction and without regard to the effects of shielding of other structures).
- Post-disaster assessments are required by the Building Department to determine whether demolition versus repairs are appropriate given the level of damage; buildings damaged more than 50% must be rebuilt to current codes, including elevation requirements for construction in the floodplain.
- The Land Development Code requires that all existing mangroves be maintained to state requirements; use of seawalls is restricted; new oceanfront development shall include dune planting plans.

Key Colony Beach participates in the Community Rating System (CRS) of the National Flood Insurance Program. The CRS recognizes actions that exceed the minimum requirements. In return, the City's property owners enjoy a 10% reduction in the cost of NFIP flood insurance. Actions undertaken by the City include:

- Maintains elevation certificates
- Makes NFIP map determinations
- Sends annual NFIP mailings to all local lenders, realtors, and insurance companies

- Keeps library of NFIP materials in City Hall
- Constructs stormwater facilities
- Warns citizens of impending flooding

Recent Projects

- Since Hurricane Georges, the City has replaced its causeway bridge to improve its ability to withstand storm surge.
- The City has its own sewage collection and treatment system, which is operated by the Wastewater Treatment Plant Operator. The sewage treatment plant is subject to storm surge flooding but has been recently retrofitted and operating at 2016 requirements. A generating system has been added for emergency operation and all of our effluent is converted to potable irrigation through our reverse osmosis and storage system. All lift stations and lines are continually being retrofitted and monitored for infiltration.
- The entire City Hall/Post Office complex has been retrofitted and floodproofed to current requirements.
- Several properties were purchased by the City and converted to open space.
- The City's master storm water control project includes swales, retention ponds, and deep injection wells which were designed, installed, and monitored by the South Florida Water Management District, FL Department of Environmental Protection, and the U.S. Environmental Protection Agency. As of early 2015, the citywide project is approximately 75% complete.
- All utilities along the 0.8 mile-long entry causeway have been installed underground.
- A new 1.1 million gallon reverse osmosis building and plant were built in 2014.
- Initiated a Repetitive Loss Area Analysis, as part of the 2015 LMS Update; the document must be completed, property owner outreach conducted, and adopted by Council, at which time it can be submitted for CRS recognition.

10.5 2015 Updates

The City reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 10.1 and 10.4: Updated the status of construction of storm water projects.
- Section 10.2: Added permit data.
- Section 10.3: Noted minor damage from Hurricane Isaac; added text related to compliance with the NFIP; updated information on repetitive loss properties and added figure to show location of those properties.
- Section 10.4: Added to list of recent projects.

Chapter 11 Islamorada, Village of Islands

11.1 Overview of Islamorada

Early settlers came to the islands from the Bahamas and New England. These people raised and shipped thousands of pineapples to northern markets. One of these ships was named the "Island Home" which was built on Plantation Key by Johnny Brush Pinder. It was from this schooner that the Village took its name: "Isla Morada," which means Island Home in the Spanish language.

Islamorada, Village of Islands (the "Village"), located in the Upper Florida Keys of Monroe County, was incorporated as a municipality on December 31, 1997. House Bill No. 1265 created the Village and also gave the Mayor authority to sign and execute documents. Islamorada is known as the "Sport Fishing Capitol of the World."

Geography

The Village is located in the 822-island archipelago known as the Florida Keys, surrounded by the Atlantic Ocean and the estuarine waters of Florida Bay. The adjacent marine environments support rich biological communities possessing extensive conservation, recreational, commercial, ecological, historical, research, educational, and aesthetic values that give this area special national significance.

As a part of the Florida Keys chain of islands, the Village's municipal boundaries extend from Mile Marker 90.939 to Mile Marker 72.658 (along U.S. Highway 1), and consists of four islands: Plantation Key, Windley Key, Upper Matecumbe Key and Lower Matecumbe Key. The Village is approximately 18 linear miles long and no more approximately one half of a mile (1/2) wide, encompassing 11,748 acres.

Population

The Southeast Florida Regional Planning Council, using US Census data, estimates Islamorada has a permanent resident population of approximately 6,212 in 2014. Tourism sometimes doubles the population in the area.

The Village's Comprehensive Plan mandates that its government manage the rate of development and population growth to promote small-town ambiance, improve quality of life for residents, enhance and protect natural resources and environmental quality unique to the Florida Keys, comply with adopted level of service standards for public facilities, effectively time public infrastructure and services according to the availability of public funds and support safe and timely evacuation prior to a hurricane.

Land Use & Economy

A significant portion of the waters adjacent to the islands have been designated as Outstanding Florida Waters, and includes the 2,800-nautical square mile Florida Keys National Marine Sanctuary, the second largest in the United States. The extraordinary natural resources support the two primary industries of the Village—tourism and commercial fishing. Many residents earn their living through the fishing and diving industries and the tropical island atmosphere generates tourism from around the world. As a result, the health and welfare of the community are largely dependent upon the health of the surrounding environment. Therefore, the Village has a responsibility to protect and preserve its unique natural resources, which will in turn protect and foster its community character, maintaining the health safety and welfare of its citizenry.

Much of the Village is developed with a mix of single family residences, multi-family dwellings, tourist lodging (hotels, motels, inns), commercial retail, professional offices, marine uses including commercial fishing, tourist-oriented recreational uses, and government uses.

Three sites are listed by the Historic Florida Keys Foundation, Inc., or are listed on the National Register of Historic Places: Windley Key Fossil Reef State Geological Site; Hurricane Monument (MM 81.5); and LeBranch Fishing Camp (Upper Matecumbe) Indian Key.

11.2 Capability Assessment: Village Organization and Agencies

Islamorada, Village of Islands is a "city manager" form of municipal government. Appointed by the Village Council, the Village Manager (also Village Attorney) is responsible for the management of the Village, and reports directly to the Village Council. The governing body of the Village is the Village Council of Islamorada, Village of Islands. The Village Council is composed of five members, including the Mayor who is appointed by the Village Council body annually. Immediately after the initial election, the first Village Council went to work quickly and composed the following Vision:

To Protect the residents' right to quiet enjoyment of life
To Plan for enhancing the Village character
To Preserve our community resources . . . people, natural resources, pride and
To Provide basic service to support our quality of life.

The Village is a rural municipality, with 94 employees delivering basic services of government including:

- Fire protection, emergency management and emergency medical services;

- Planning and zoning;
- Building and Code Compliance (permitting, inspection and code enforcement);
- Public works;
- Waste collection;
- Parks and conservation lands; and
- Recreation services

Police enforcement services are provided contractually by the Monroe County Sheriff's Office. Solid waste services are also delivered contractually resulting from competitive bids and contract negotiations.

The departments with primary responsibility for identifying natural and manmade hazards are fire/rescue, planning, building and public works. These departments also take an active role in addressing mitigation of identified hazards and the protection of public facilities and infrastructure.

Table 11-1. Islamorada: Permits Issued (2012, 2013, 2014).

	CY 2012	CY 2013	CY 2014
New single-family, detached	26	21	27
New single-family, attached	0	0	0
Multi-family (2 or more)	1	18	0
Non-residential buildings (all types)	209	241	215
Residential (additions, alterations, repairs)	246	273	278
Non-residential (additions, substantial)	25	37	46
Demolition	18	16	18
Relocation	0	0	0
Mobile home (permanent/temporary)	1	1	0
Total Permits Issued	526	607	584
Total Inspections Conducted	3,796	4,909	4,695

The Village Comprehensive Plan was updated in 2014. Several objectives and policies address hazards and support hazard mitigation:

OBJECTIVE 5-1.6: MINIMIZE COASTAL HAZARDS
Policy 5-1.6.1: Coastal High Hazard Areas Defined
Policy 5-1.6.2: Manage Coastal Hazards and Coordinate Update of the Hazard Mitigation Plan
Policy 5-1.6.3: Maintain a Local Hazard Mitigation and Post Disaster Redevelopment Program
Policy 5-1.6.5: Identify Areas Particularly Susceptible to Damage within the CHHA
Policy 5-1.6.6: Limit Redevelopment in CHHA
Policy 5-1.6.7: Restore or Enhance Disturbed or Degraded Natural Resources
Policy 5-1.6.8: Implement General Hazard Mitigation by Restricting the Density/Intensity of Development
Policy 5-1.6.9: Identify the Erosion and Sedimentation Problem Areas
Policy 5-1.6.10: Identify Shorelines with Serious Erosion Problems

OBJECTIVE 5-1.8: LIMIT PUBLIC SUBSIDY OF DEVELOPMENT IN THE COASTAL HIGH-HAZARD AREA
Policy 5-1.8.1: Inventory Existing Infrastructure in the Coastal High-Hazard Area
Policy 5-1.8.2: Restrict Future Infrastructure in the Coastal High-Hazard Area
Policy 5-1.8.3: Limit Public Expenditures in the CHHA

OBJECTIVE 5-1.9: AVOID POPULATION CONCENTRATIONS IN THE COASTAL HIGH-HAZARD AREA
Policy 5-1.9.1: Restrict Development in Coastal High-Hazard Areas
Policy 5-1.9.2: The CHHA shall include FEMA Velocity Zones

OBJECTIVE 5-1.10: COORDINATE HURRICANE EVACUATION
Policy 5-1.10.1: Provide Hurricane Evacuation Logistical Support
Policy 5-1.10.2: Coordinate With the County in Emergency Preparedness
Policy 5-1.10.3: Ensure Village Hurricane Preparedness
Policy 5-1.10.4: Designate U.S. 1 the Primary Evacuation Route
Policy 5-1.10.5: Ensure a Quick Re-Entry Into the Village Following an Evacuation

OBJECTIVE 5-1.11: FACILITATE POST-DISASTER REDEVELOPMENT
Policy 5-1.11.1: Recovery Operations
Policy 5-1.11.2 Conduct Post-Hurricane Assessments
Policy 5-1.11.3: Coordinate Repair and Clean Up
Policy 5-1.11.4: Propose Hazard Mitigation and Comprehensive Plan Amendments
Policy 5-1.11.5: Manage Redevelopment Activities
Policy 5-1.11.6: Review Post Disaster Management Alternatives
Policy 5-1.11.7: Maintain a Contingency Fund for Disaster Assistance
Policy 5-1.11.8: Regulate Redevelopment of Non-Conforming Structures

OBJECTIVE 5-1.14: IDENTIFY PUBLIC FACILITY LEVEL OF SERVICE STANDARDS IN THE COASTAL AREA
Policy 5-1.14.1: Ensure Available Infrastructure and Coordinate Timing and Staging of Public Facilities with Private Development

The Village regularly approves ordinances that amend the Comprehensive Plan or the Building Permit Allocation System (BPAS). A list of Village ordinances by year is available at http://www.islamorada.fl.us/Ordinances.asp. The most recent ordinance relevant to hazard mitigation amended the coastal management element of the comprehensive plan by amending policy 5-1.1.5 "prohibit construction of new bulkheads, seawalls or other hardened vertical shoreline structures on open water" ; policy 5-1.1.6 "enact measures to stabilize canals and shorelines"; and policy 5-1.1.7 "limit hardened shorelines" to ensure consistency with state law, administrative code and adopted regional policies and providing for internal consistency and clarification.

Moving Mitigation Forward

The Village Council of Islamorada adopted a resolution on December 18, 2014 declaring that it is considering amending the Comprehensive Plan and Land Development Regulations pertaining to the development and redevelopment of nonresidential structures greater than 10,000 square feet.

The Village has existing contracts to clear debris throughout the Village, these are updated on an annual basis to ensure service in the case of a catastrophic event. Many of Islamorada's Staff have obtained certifications through the National Incident Management System (NIMS) and participates in an annual drill to practice the implementation of the skills should a catastrophic event occur. The Village staff has been trained with NIMS and new staff is being trained currently in preparation for the 2015 Hurricane season.

11.3 Hazards and Risk in Islamorada

In the recent past, the Florida Keys has suffered from natural disasters of varying degrees. In September 25, 1998, Hurricane Georges inundated the Keys. Following this, on November 4-5, 1998, the Florida Keys suffered another blow from Tropical Storm Mitch. The tropical storm was more severe than originally anticipated and spawned several tornadoes. The Upper Keys, including the Village sustained serious amounts of damage. The two-year period of 2004-2005 included eight hurricanes that had varying degrees of impacts on the Village. Hurricane Wilma, (October 2005) had the most significant impact on the Village.

The Indian Key Fills located between Upper and Lower Matecumbe are particularly vulnerable to storm surge and flood events. In the event of overtopping there is a high likelihood of the road being washed out. This is of special concern because it is the only route south to the rest of the Florida Keys during a storm; if the passage is compromised, recovery supplies would not be able to reach past the Indian Keys Fills.

Historic Storms

The landfall location for the strongest hurricane recorded, the "Labor Day Storm" of 1935, made landfall at Islamorada. It is remains one of the most intense category 5 and deadliest hurricanes. Winds were estimated at 160 mph with gusts from 190-210 mph. Tide levels ranged from 14 feet above MSL in Key Largo to 18 feet above MSL in Lower Matecumbe Key. Despite its ferocity, it was a small storm causing water levels at Key West to rise only two feet above MSL and sustained winds of less than 40 mph.

Florida has been devastated by several flood-related events over the years, caused by heavy rainfall, tropical depressions and hurricanes. Between 1992 and 1994, the State of Florida received six Presidential Disaster Declarations for natural disaster events, four of which were flood related. Each year, there is a potential that Florida will suffer from tropical storms, severe rain events or hurricanes.

Other significant storms:

- Hurricane Donna (August 29-September 19, 1960). A Category 4 hurricane, this storm is listed among the most intense in U.S. history. It curved northwestward over the Middle Keys before turning north towards the mainland at Naples and Fort Myers. Wind speeds of 128 mph and central pressure of 28.44 inches were measures. Tide levels ranged from 13.5 feet above MSL ocean side at Islamorada (MM 80-83), +10 feet MSL ocean side Upper Matecumbe Key (MM 83-84) and 9-10 feet MSL Bay side.

- Hurricane Betsy (August 26-September 12, 1965). A Category 3 hurricane, Betsy passed over Marathon moving westward into the Gulf of Mexico. At Tavernier, central pressure was recorded at 18.12 inches and wind speeds were estimated at 120 mph. Flood levels were measures at 9 feet MSL in Key Largo.

- Hurricane Georges (September 25, 1998). Near Islamorada at Mile-Marker 76.8, water rose to 4.5 feet above MSL and 6.1 feet at Mile-Marker 77.8. Near Mile-Marker 84, the highway was affected by flooding, downed trees and damage to road signs. Some beach erosion occurred.

Effect of Past Hurricane Disasters

Damage from Hurricane Georges is representative of Islamorada's exposure:

- Debris Removal: $2.5 million

- Emergency Labor and Supplies: $12,000

- Manning of EOC and Search and Rescue: $8,000
- Waste Water Treatment System Repairs: $10,000
- Storm Water Systems Repair: $10,000

Private property damage totaled approximately $5 million due to the effects of high winds, driven rain, and flooding. The following is an account of damage in Islamorada as reported in a special edition of the Miami Herald, September 27, 1998:

- Lower Matecumbe Key – Storm surge cut across U.S. 1 highway covering it with sand, chunks of concrete, seaweed, and wood pilings. Bulldozers have cleared a pathway for emergency vehicles. Water rose more than a foot high in some homes.
- Windley Key – Holiday Isle Marina undamaged, but oceanside docks and tiki huts were mostly destroyed. Rooftop air conditioning unit at the Dive and Swim Center was damaged.
- Islamorada – Shoreline Motel lost 50-foot section of aluminum facing from the roof. An oceanside cottage at Cheeca Lodge (MM 82) lost some roofing. At Island Christian School, a large ficus toppled and crushed a chain link fence.
- Plantation Key – Many mobile homes flooded at Ocean San Pedro Trailer Park.

Despite Hurricane Georges only being a Category 2 hurricane, all businesses were closed or severely restricted from operating due to structural damage and power outages. Businesses related to tourism and fishing and marine activities were most affected by Georges.

Damage from Hurricane Wilma

Hurricane Wilma produced bayside flooding that had significant impacts on several marinas and notably the Village's administrative and planning departments that were located at Founders Park. The flooding forced Village Hall into temporary accommodations for a period of four years. Flooding was the primary impact although there was minimal wind-damage to structures and vegetation. The secondary impact was associated with the entire season of hurricanes (the most named storms in history) that destroyed or damaged hundreds of docks in the Village.

Damage from Hurricane Isaac

Hurricane Isaac caused no significant damage in the Village.

Hurricane Flooding as Predicted by SLOSH Modeling

The National Hurricane Center's surge model, called SLOSH (Sea, Lake, and Overland Surges from Hurricanes), estimates surges associated with different characteristics of tropical cyclones (track, forward speed, wind speed, etc.). This information is carried forward from the 2010 Plan as it provide more site-specific potential surge impacts and is to be used in conjunction with the Hazus results from Chapter 5. The results can be combined with topographic mapping to delineate inland areas subject to flooding (with a margin of error of +/- 20%). Table 11-2 shows the storm surge predications for four locations in Islamorada (Islamorada MM82, Islamorada MM 83.5, Plantation Key MM 88.5, and Plantation Key MM 90).

Table 11-2. SLOSH Maximum Predicted Water Depths (ft above MSL)

Islamorada Mile-Marker 82 Ocean Side						Islamorada Mile-Marker 82 Bay Side					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
WSW	4	5	7	8	9	WSW	4	5	7	8	9
W	4	6	7	9	10	W	4	5	7	8	9
WNW	4	6	7	9	10	WNW	4	5	6	7	8
WN	4	6	7	9	10	NW	3	4	6	7	7
NNW	4	5	7	8	9	NNW	3	4	6	7	8
N	4	5	7	8	9	N	3	4	6	7	8
NNE	4	5	6	8	9	NNE	3	5	6	7	8
NE	4	5	6	7	8	NE	4	5	7	8	9
ENE	3	5	6	7	8	ENE	4	7	9	10	11
E	3	4	6	7	8	E	5	8	10	10	11

Plantation Key Mile-Marker 88.5 Bay Side						Plantation Key Mile-Marker 90 Ocean Side					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
WSW	4	6	8	9	10	WSW	4	5	7	8	10
W	4	5	7	8	9	W	4	6	8	9	11
WNW	3	5	7	7	8	WNW	4	6	8	9	11
WN	3	5	6	7	8	NW	3	4	6	7	7
NNW	3	5	6	7	9	NNW	4	6	7	9	10
N	3	5	7	8	9	N	4	5	7	8	9
NNE	3	5	7	8	9	NNE	4	5	7	8	10
NE	4	6	8	9	10	NE	4	5	6	8	9
ENE	5	8	10	12	13	ENE	4	5	6	8	9
E	6	10	11	12	13	E	3	5	6	7	8

Floodplain Management & Compliance with the NFIP

The Village entered the National Flood Insurance Program when it incorporated in 1997 by adoption of an ordinance that complies with the requirements of the program. The Village reviews all development proposals in special flood hazard areas and enforces the requirements of the ordinance. To ensure continued compliance with the NFIP, the Village will continue to:

- Enforce the adopted floodplain management ordinance, including inspection of permitted development and unpermitted activities;
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Notify the public when there are proposed changes to the ordinance or Flood Insurance Rate Maps; and
- Promote the purchase of NFIP flood insurance policies as financial protection.

NFIP Flood Insurance Policies in Islamorada 3,114

Claims paid since 1978: 168*

https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13 (as of March 31, 2015)

*records prior to incorporation included in claims for Monroe County

NFIP Floodplain Mapping

The National Flood Insurance Program (NFIP) prepared a Flood Insurance Rate Map for the Monroe County and incorporated municipalities (current effective map is Monroe County's Flood Insurance Rate Map dated February 18, 2005). The FIRM delineates areas that have been determined to be subject to flooding by the "base flood," the flood that has a 1-percent-annual chance of flooding in any given year (commonly called the 100-year flood). The majority of land in Islamorada is subject to flooding. Areas noted as VE Zone, subject to high velocity wave action, are shown with flood levels ranging from 10 to 14 feet above MSL. Areas noted as AE Zone, where waves are expected to be less than 3-feet in height, flood levels are predicted to range from 6 to 10 feet above MSL.

The area along U.S. Route 1 and commercial properties that front on the highway, plus Plantation Key, Windley Key, and Upper Matecumbe Key, have some areas with ground elevations higher than the predicted 100-year flood elevation. Sections around Coral Shores High School are also shown as outside of the mapped floodplain. FEMA initiated a coastal study to revise the FIRM, expected to be completed in 3 to 4 years.

NFIP Repetitive Loss Properties

Data provided by the Florida Division of Emergency Management identifies properties that are or have been insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. In 2005, only three properties met the definition. As of March 2015, 16 individual properties have received 47 claims totaling approximately $1.2 million (average payment of approximately $25,500). Of these 16 properties, 14 are residential and 2 are non-residential. Figures 11-1a, 1b, and 1c show property locations of those records that were able to be plotted (end of chapter).

A subset of the NFIP's Repetitive Loss Properties includes those that meet the Federal definition for "severe repetitive loss." One property in Islamorada is designated as a Severe Repetitive Loss Property, having received 6 claims totaling $64,600. A Severe Repetitive Loss Property is defined as a residential property that is covered by an NFIP flood insurance policy and (a) that has at least four claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims exceeding $20,000; or (b) for which at least two separate claim payments (building only) have been made with the cumulative amount exceeding the market value of the building. For both (a) and (b), at least two of the qualifying claims must have occurred within any 10-year period.

Severe Storms, Tornadoes, Water Spouts and High Winds (Other than Hurricane)

Islamorada, like the rest of the Keys, has low-lying terrain. Section 6.2 characterizes the entire area encompassed by Monroe County and the cities as having equal distribution of winds. The risk of severe storms, tornadoes, water spouts and high winds in Layton does not vary from the rest of the planning area. All new buildings, replacement buildings, and additions to existing buildings must comply with the Florida Building Code's wind load requirements.

Rainfall/Ponding Flooding

Islamorada does not have any identified areas where rainfall/ponding flooding is so severe or prolonged as to cause access problems or damage to buildings.

Drought Hazards

Drought hazards for the planning area are described in Section 6.4. Islamorada's risk due to drought is comparable to the drought risk throughout the area.

Wildland Fire Hazards

The Florida Forestry Department has not indicated that areas in Islamorada are likely to experience significant risk of wildland or brush fires.

Islamorada's Important and Critical Facilities

Table 11-3 lists the City's important facilities, some of which are shown in Figure 2-3.

Table 11-3. Important and Critical Facilities in Islamorada

Critical/Essential Facilities:	**Other Facilities:**
• Village of Islands Administration Center & Public Safety Headquarters • Monroe Sheriff's Sub-Station (Roth Building) • Founders Park • Islamorada Fire- Rescue HQ Station #20/EOC • Islamorada Fire Station #19 • Islamorada Fire Station #21 • Coral Shores High School (County) • Plantation Key Elementary School (County) • Plantation Key Jail • Monroe County Gov./Courthouse • Monroe County Health Department • Plantation Key Government Center (County)	• U.S. Coast Guard Station • Florida Keys Electric Cooperative Sub-Station • Island Christian School • Treasure Village Montessori SchoolFlorida Keys Children's Shelter • Comcast Cable • Bell South • Cingular Cell • Theater of the Sea • Wastewater Treatment Plants at various nonresidential properties • Amerigas Liquid Propane Yard • Monroe County Public Works Yard
Marinas:	**Mobile Home and Recreational Vehicle Parks:**
• Abels Marina • Bud N Mary's Marina • MM 80.8 • Caribee Boat Sales and Marina • Caloosa Cove Marina • Coconut Cove Resort and Marina • Coral Bay Marina • FWC Marina • Postcard Inn Resorts and Marina • Islamorada Boat Center • Islamorada Yacht Basin/Lorelei • La Siesta Marina • Mr. Lobster (Lower Matecumbe) • Watermark Marina (Matecumbe Yacht Club) • Plantation Yacht Harbor Marina • Robbies Marina • Smuggler's Cove Marina • Smugglers, Snake Creek • Snake Creek Marina • Tavernier Creek Marina • Treasure Harbor Marina • Whale Harbor Marina • World Wide Sportsmen Marina	• Coral Bay Trailer Court • Harris Ocean Park Estates, 1st Addition • Key Lantern Travel MH Park • Peaceful Palms Mobile Homes (Windley Key) • Windley Key Trailer Park • Sea Breeze Trailer/RV Park (Plantation Key) • San Pedro Trailer Park (Plantation Key) • Plantation Tropical Park (Plantation Key) • Village Mobile Park

Table 11-3. Important and Critical Facilities in Islamorada

Hazardous Materials Sites (302 Facilities):
• Bell South Telecommunications Facility
• Monroe County Plantation Key Public Works
• Plantation Key Colony Water Treatment Plant
• Islamorada Founder's Park Water Treatment Plant
• North Plantation Key Master Pump Station
• Mid-Plantation Key Wastewater Pump Station
• South Plantation Key Wastewater Pump Station
• Upper Matecumbe Key Wastewater Pump Station
• Lower Matecumbe Key Wastewater Pump Station

11.4 Damage Reduction Activities

On-Going Activities

- Continue the inspection of enclosures below elevated lowest floors, as required by FEMA.
- Continue to identify and implement hazard mitigation projects for critical infrastructure.

Projects Completed Before 2005

- Completed renovations to Islamorada Fire Station #20 which included an emergency operations center.
- Completed the Lower Matecumbe Stormwater Improvement Project which provided drainage infrastructure for flood mitigation and protection of a section of the island that experiences heavy flooding during mild storm events.
- Completed the Upper Matecumbe Stormwater Improvement Project which provided drainage infrastructure for flood mitigation and protection of a section of the island that experiences heavy flooding during mild storm events.

Projects Completed 2005-2014

- Completed the new Village Hall and the new Fire Station #21 and Islamorada Sheriff's Substation (one building).
- Completed North Plantation Key Wastewater Treatment Plant.

- Lower Matecumbe Key Fire Station #19.

- The Tollgate Shores Stormwater Improvement Project provides drainage infrastructure for flood mitigation and protection for households in a section of the Lower Matecumbe Key Island that experiences heavy flooding during mild storm events.

- Completed a study to mitigate the exposure and vulnerability of U.S. 1 located at Sea Oats Beach from the effects of a hurricane. This area will always be inundated by storm surge from any category hurricane and suffer significant damage resulting in segmentation of the Keys. This study resulted in some remedial action including the placement of artificial substrate and vegetation along the entire length of Sea Oats Beach to mitigate erosion.

- Permanently installed emergency generators in Coral Shores High School.

- The Village adopted a staged evacuation plan and coordinates implementation with Monroe County and other municipalities. The staged evacuation plan contains several strategies for facilitating evacuation, including two northbound lanes where possible, traffic control markers and revised timing for signals along U.S. 1.

- Completed acquisition of computer weather equipment to provide access for weather-related product such as hurricane tracking.

Projects Planned or Under Way

- Provide a new LIDAR Mapping of the Village to update the flood base and storm surge vulnerability information. This should be a countywide project in conjunction with FEMA's Map Modernization effort. This is an on-going project with the goal of establishing a more accurate SLOSH model for the Village and Monroe County.

- Provide permanently installed emergency generators in Island Christian School (a primary shelter).

- The Village of Islamorada will conclude an effort in 2015 to identify vulnerable infrastructure, assets and habitat based on four sea level rise scenarios of 3" and 7" by 2030 and 9" and 24" by 2060. In particular, water, wastewater, Village facilities and roads will be mapped indicating varying degrees of vulnerability from these scenarios for future

inundation. The overall Islamorada Matters Plan will make recommendation on near and mid-term strategies and mechanisms for implementation to address these vulnerabilities. These recommendations and mechanisms for implementation could include policy, program and/or comprehensive plan or code revisions. Data from the effort can also be used for future design and planning purposes or land management and acquisition priorities.

11.5 2015 Updates

The Village reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 11.2: Added list of objectives and policies from the Comprehensive Plan; expanded text about Emergency Management Plan; added notes on moving mitigation forward
- Section 11.3: Updated critical facilities list.
- Section 11.4: Updated projects completed 2005-2014 and added description of an ongoing activity related to sea level rise.
- Reference: Islamorada: The Village That Reclaimed the Keys, Comprehensive Plan, February 3, 2014

Figure 11-1a. Islamorada Repetitive Loss Properties (2015).

Figure 11-b. Islamorada Repetitive Loss Properties (2015).

Figure 11-1c. Islamorada Repetitive Loss Properties (2015).

Chapter 12. City of Marathon

The City of Marathon, incorporated in November 1999, is located in the Middle Keys and consists generally of previously unincorporated areas of Monroe County known as Marathon, Marathon Shores, and Grassy Key. The corporate boundaries of the city are as follows:

"from the East end of the Seven Mile Bridge (approximately Mile Marker 47) to the West end of the Tom's Harbor Bridge (approximately Mile Marker 60), including, but not limited to, the entire islands of Knight Key; Hog Key; Vaca Key; Stirrup Key; Boot Key; Crawl Key; East Sister's Island; West Sister's Island; Fat Deer Key; Long Point Key; Deer Key; Little Deer Key; Little Crawl Key; Grassy Key; the unincorporated areas of Monroe County commonly known as Marathon and Coco Plum; all land filled in between the islands, including all islands connected by U.S. 1, Overseas Highway and roadways connecting thereto; and all adjacent islands not connected by roadways within the boundaries of Monroe County between Mile Marker 47 and Mile Marker 60, specifically excluding all areas within the boundaries of the City of Key Colony Beach, all of the above being within the boundaries of Monroe County, Florida."

12.1 Overview of Marathon

Geography

Marathon is located between the Gulf of Mexico and the Atlantic Ocean. Marathon is approximately 8,320 acres consisting of a number of islands. Elevations in Marathon range from approximately 2 feet above mean sea level to approximately 7 feet above mean sea level.

Several keys make up the City and they vary greatly in size. Marathon is essentially a string of low coral islands with flat terrain. The long and narrow configuration creates a risk for storm surge from both sides of the island chain.

Marathon has no inland areas; all locations are equally vulnerable to high wind effects. The "friction factor", which causes winds from storms to decrease over land, does not apply in the Keys.

Population

The Southeast Florida Regional Planning Council, using US Census data, estimates the City of Marathon has a permanent resident population of approximately 8,425 in 2014. The seasonal population increases by as much as 50%..

In 2009, the Monroe County Social Services registered 2 people as having special needs for hurricane evacuation assistance within the City of Marathon.

Land Use & Economy

Marathon's development is a mix of single family residences, multifamily dwellings, tourist lodgings (hotels, motels, and destination resorts), tourist-oriented uses (museums, research center, attractions), marine-related and recreational uses, commercial uses (restaurants, retail sales, banks, Realtors), medical facilities and offices, and government uses.

Future growth is limited through the Rate of Growth Ordinance (ROGO) adopted by Monroe County in 1992 to implement portions of its Comprehensive Plan. Within the City of Marathon, this is now known as the Building Permit Allocation System (BPAS). BPAS establishes a building permit allocation system for residential construction. The purpose is to encourage in-fill of platted lots served by existing infrastructure and to limit growth to enable safe and timely hurricane evacuation. Pursuant to the BPAS Ordinance and an agreement between the City, County and the department of Community Affairs, the annual allocation for Marathon is thirty (30) permits per year for residential dwelling units.

All new construction, reconstruction, and improvements to existing buildings must comply with the current building code requirements.

The City joined the National Flood Insurance Program in October 2000 and administers a floodplain management ordinance that meets or exceeds the minimum federal requirements.

Comprehensive Plan

The City of Marathon adopted its Comprehensive Plan in March 2005. The plan includes nine elements pertaining to the future growth and development the City. Throughout the plan are numerous goals, objectives and policies that acknowledge hurricane risks, especially related to evacuation, growth, ensuring safety, providing adequate facilities, managing stormwater, working with providers of water supply and wastewater services, and requirement compliance with codes. The Infrastructure Element and the Conservation and Coastal Element contain specific policies relevant to mitigation of future risk and damage:

- The Infrastructure Element includes such mitigation policies as:
- Completing a detailed engineering study of drainage and implement priority storm water projects.
- On-site wastewater disposal facilities to minimize potential environmental impacts.
- Establish and coordinate acquisition programs.

The Conservation and Coastal Element of the Comprehensive Plan includes such mitigation policies as:

- New development encroaching into the 100-year floodplain shall incorporate elevation and flood protection measures sufficient to protect against the 100-year flood.
- The City shall maintain consistency with program policies of the National Flood Insurance Program.
- The City shall monitor new cost effective programs for minimizing flood damage.
- Such programs may include modifications to construction setback requirements or other site design techniques, as well as upgraded building and construction techniques. The City discourages development in the High Velocity Area and regulates redevelopment of structures non-conforming to the required base flood elevation.

12.2 Capability Assessment - City Organization and Agencies

City of Marathon is a Council Form of Government. The City Council is composed of 5 members, including the Mayor who is selected by the Council to that office. The City Council sets government policy and adopts guidance documents, such as the Comprehensive Plan, the Land Development Regulation and ordinances establishing various codes and standards.

Marathon is organized into several departments, each with authorized responsibilities that, as described below, have bearing on how natural hazards are recognized and addressed.

City Manager. The City Manager of Marathon implements the policies of the Council and administers the overall operations of the City. With regards to the floodplain management, the City Manager has a FEMA Coordinator appointed to administer and implement the provisions consistent with the requirements of the National Flood Insurance Program.

Marathon Planning Department. The Marathon Planning Department is responsible for the development and maintenance of the City's Comprehensive Plan and the Land Development Regulations. Department personnel (Director, Planners, Planning Technician, Biologist) serve as staff to the City's Planning Commission and are involved in the following activities related to hazard mitigation:

- Ensures that mitigation related items in the Comprehensive Plan, such as floodplain management and natural resource management, are followed and reflected in the City's Codes and Standards.

- Participates in post-disaster appraisals and may formulate additional mitigation measures for use in the Comprehensive Plan.
- Works closely with the Building, Code Compliance, and Fire Department to ensure coordination of actions related to disaster planning, recovery, and mitigation.
- Reviews construction plans for compliance to the NFIP regulations.
- Responsible for enforcing planning and zoning standards.

Marathon Building Department. The Building Department is responsible for regulations of building construction pertaining to life safety, health, and environmental land use zoning regulations. The department is staff by the Building Official, a Building Inspector, and Permit Clerks. Related to mitigation of hazards, the department is responsible for the following:

- Review of construction plans and issuing building permits.
- Inspection and enforcement during construction.
- Designated as coordinator for the National Flood Insurance Program.
- Assist the public in identifying and implementing flood damage prevention measures.
- Participate in post-disaster appraisals.
- Work closely with the Planning, Fire, and Code Compliance Department to ensure coordination of actions related to disaster planning, recovery, and mitigation.

Table 12-1. Permits Issued in 2012, 2013, 2014

	Fiscal Year 2012	Fiscal Year 2013	Fiscal Year 2014
New single-family (Market Rate & Affordable)	4	23	23
Transient Residential Use	0	65	35
Building Permits	276	312	270
Electric Permits	349	368	298
Plumbing Permits	185	202	139
Mechanical Permits	208	343	274

Marathon Code Compliance Department. The Code Compliance Department oversees after-the-fact code compliance issues pertaining to safety, health, and environmental land use and zoning regulations. The department is staffed by a Code Compliance Supervisor, Code Officers, and an Administrative Assistant. Related to mitigation of hazards, the department is responsible for: working closely with the Building, Planning, and Fire departments to ensure coordination of actions related to disaster planning, recovery, and mitigation; and participating in post-disaster appraisals.

Marathon Finance Department. The Finance Department (contracted) is responsible for overseeing the day-to-day financial requirements of the City, including establishment of purchasing procedures for all agencies. To expedite preparation for, response to, and recovery from disasters, the Finance Department may implement special emergency procedures to expedite necessary purchase and payment before, during, and after a disaster.

Marathon Community Services. The Community Services Department has a Director, a Community Services Coordinator, Grants Coordinator and houses the Parks and recreation Department. It provides technical assistance for City projects which require design, construction, and operation of economical and efficient structures, equipment, and systems.

Marathon Public Works Department. The Public Works Department works under the direction of the Public Works Director and is responsible for overseeing the maintenance of all city facilities, including buildings, roads, and bridges. The Department also operates and maintains City vehicles, with the exception of Fire Department vehicles.

Public Works is responsible for coordination and provision of emergency public works, initial evaluation of infrastructure damage and preparation of documentation required for federal reimbursement (including identification of mitigation components to be incorporated during recovery), and coordination of emergency debris clearing.

In executing its disaster recovery responsibilities, Public Works coordinates with the Florida Department of Transportation, Monroe County Department of Public Works, Florida Keys Aqueduct Authority, and Florida Keys Electric Co-op. The department plans, coordinates and initiates restoration of the serviceability of transportation routes, bridges, and assurance as to the safety of affected public and private dwellings and structures.

Marathon Utilities Department, Stormwater Utility. In 2002 the City adopted the Master Service Assessment Ordinance allowing the City to collect assessments as necessary for infrastructure purposes. In 2004 the Florida Department of Environmental Protection (FDEP) designated the City Of Marathon as a regulated municipality under Phase II of the National Pollutant Discharge Elimination System (NPDES). One requirement of the MS4 designation is establishment of a stormwater utility and commencement of a five year program to prohibit stormwater from running into Florida Outstanding Waters, as well as other requirements. On May 10, 2005, the City adopted Ordinance 2005-10 creating a stormwater utility and adopted an initial rate of $60 per Equivalent Residential Unit (ERU) for a single family home and 1 ERU for every 4,769 sf of impervious area for commercial properties (includes vacant properties) These funds are collected through non-ad valorem taxes annually. The first year of collection was 2005.

The creation of a Stormwater Utility and the imposition of a Stormwater Service Assessment to pay for the design, construction, operation and maintenance of the Stormwater Utility's facilities, programs, and collection and treatment services is an equitable and efficient method of allocating and apportioning costs to address stormwater requirements among all parcels of assessable property located in the City.

Monroe County Sheriff's Office: Marathon Division. The Sheriff's Office (contracted) is responsible for overall law enforcement and protection of residents and visitors in the City of Marathon. The department plays a key role in planning and response during emergencies to include but not limited to: coordination with Florida Highway Patrol to promote speedy and safe evacuation, communicates with base operations, field personnel, and emergency shelters.

Marathon Fire Department. The Fire Department is responsible for all life safety in connection with duties that include fire control, fire prevention, emergency medical services, emergency public education, and emergency management. Within the Department is the Emergency Management Division. It plays the lead role in planning and response for all emergencies. During a declared State of Local Emergency, the Emergency Management Director serves in the capacity of the Incident Manager under the direct control of the City Manager. This holds true for all four phases of emergency management: Preparedness, response, recovery and mitigation. Additionally, the Emergency Management Director is responsible for the year round program management as well as development and maintenance of all emergency and/or disaster related plans and procedures, including this document.

12.3 Hazards and Risk in Marathon

Historic Storms that have affected the Marathon Area:

- 1929 Hurricane (September 22 to October 4) – The hurricane crossed over Key Largo on a northerly course. Key Largo reported winds estimated at over 100 mph, a central barometric pressure of 28 inches, and tide levels of 8-9 feet above MSL. Key West experienced tide levels of 5-6 feet above MSL and winds of 66 mph.
- 1935, Hurricane (August 29-September 10) - The small, extremely violent, Category 5 hurricane crossed the Florida Keys on a northwesterly track. The Tavernier-Islamorada area reported sustained winds estimated at 120 mph with gusts from 190-210 mph. Tide levels in the Florida Keys ranged from 14 feet above MSL in Key Largo to 18 feet above MSL in Lower Matecumbe Key. The storm was so intense and tightly wrapped that Key West had tide levels of only 2 feet above MSL and average sustained winds of less than 40 mph. One of the most tragic aspects of the 1935 storm was the unfortunate death of many

WWI veterans who were working on construction of Henry Flagler's Overseas Railroad.

- Hurricane Donna, 1960 (August 29-September 19) – Hurricane Donna curved northwestward over the Middle Keys near Long Key/Layton and then traveled northward toward the Gulf Coast towns of Naples and Fort Myers. Areas in the vicinity of the storm experienced winds speed of 128 mph and a central pressure of 28.44 inches. The storm affected the Everglades with estimated winds of 150 mph. Tide levels were reported at Upper Matecumbe Key of 13.5 feet above MSL, at Plantation Key 10+ feet above MSL, and 8.9 feet above MSL in Key Largo. As of 1992 Hurricane Donna, a Category 4 storm is listed as the 6th most intense hurricane in the US.
- Hurricane Betsy, 1965 (August 26-Septmber 12) – Hurricane Betsy passed over Marathon while moving westward into the Gulf of Mexico. The lowest central pressure was measured in Tavernier at 28.12 inches and wind speeds were estimated to be 120 mph. Tide levels in Tavernier were 7.7 feet above MSL and Key Largo had tide levels of around 9 feet above MSL. Betsy was a Category 3 storm and is ranked 25th in intensity.
- Ground Hog's Day Storm (February 2, 1998) involved multiple F-2 tornado touchdowns resulting from a severe thunderstorms characterized by dangerous cells with high, cold cloud tops affected the Florida Keys. Areas most affected were primarily in the Middle Keys including Grassy Key and Valhalla Beach in the vicinity of Duck Key. Several buildings were damaged. Also significant problems occurred from the displacement of lobster traps which contributed to seaborne debris and navigational problems; the fishing industry suffered considerable loss of income.
- Severe thunderstorms (July 4, 1998). Severe thunderstorms with lightning and high winds came up quickly in the Middle Keys. The Weather Service Office in Key West recorded wind speeds up to 70 mph sustained. Because it was July 4th, many boats were offshore celebrating and waiting for the fireworks. Although, this event did not warrant a presidential disaster declaration, it did result in loss of life.
- Hurricane Georges, 1998 (September 25, 1998), a Category 2 when made landfall in the Lower Keys, affecting the entire county to some extent. Damage estimates approached $300 million, including insured and uninsured damage and infrastructure loss. Maximum sustained winds at the Naval Air Station (Boca Chica) near Key West were 92 mph; gusts up to 110 mph were reported by the Emergency Operations Center in Marathon. According to the Key West Weather Service, precipitation levels in the Lower Keys were as 8.65 inches on the south side of Sugarloaf Key, 8.38 inches at Key West International Airport, and 8.20 inches on Cudjoe Key. Tavernier in the Upper Keys recorded 8.41 inches.
- Tropical Storm Mitch, 1998 (November 4 and 5). Feeder bands from Mitch containing dangerous super cells spawned several damaging tornadoes in the Upper Keys. Sections with mobile homes were especially hard hit. Islamorada experienced an F-1 tornado; Rock Harbor and Key Largo were hit

by F-2 tornadoes. According to the Department of Community Affairs, damages were estimated at $11 million.

- Hurricane Irene, October 1999. Hurricane Irene hit the Florida Keys and Southeastern Florida. This Category 1 Hurricane dumped 10 to 20 inches of rain resulting in severe flooding in the Florida Keys and Southeastern Florida causing total damage estimated at $800 million
- Tropical Storm Gabrielle, September 2001. Although it did not reach hurricane strength, this storm hit the southwest coast of Florida and caused flooding problems; Marathon did see some effects from the storm.
- Hurricane Wilma, October 2005. During the night of October 23 to 24, Hurricane Wilma visited Monroe County, resulting in at least 2 injuries and at least $33 million in damage countywide. Over the Upper Keys from Craig Key to Ocean Reef, maximum winds were measured at 65 knots with gusts to 79 knots. Overall, average winds across the inhabited Lower Keys were estimated at 70 to 80 mph with gusts up to 90 mph with general Category 1 Saffir-Simpson Damage noted. Wilma primarily produced one storm tide along the bayside of the Upper Keys, ranging from 4 to 5 feet above sea level with the worst in Lower Matecumbe Key. U.S. Route 1 north of Key Largo was temporarily flooded at least 3 inches at maximum surge during the afternoon hours on October 24.

Hurricane Flooding as Predicted by SLOSH Modeling

The National Hurricane Center's surge model, called SLOSH (Sea, Lake, and Overland Surges from Hurricanes), estimates surges associated with different characteristics of tropical cyclones (track, forward speed, wind speed, etc.). This information is carried forward from the 2010 Plan as it provide more site-specific potential surge impacts and is to be used in conjunction with the Hazus results from Chapter 5. The results can be combined with topographic mapping to delineate inland areas subject to flooding (with a margin of error of +/- 20%). The predicted storm surges that may affect the Marathon area for various storm categories and tracks are shown in Table 12-2.

Table 12-2. SLOSH Maximum Predicted Water Depths (ft above MSL)

Ocean Side Mile-Marker 50						Ocean Side Mile Marker 61					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
WSW	4	5	6	7	8	WSW	4	5	6	7	8
W	4	5	7	8	9	W	4	5	7	8	9
WNW	4	6	7	8	9	WNW	4	6	7	9	10
WN	4	6	7	8	9	NW	4	5	7	8	10
NNW	4	5	7	8	9	NNW	4	5	7	8	9
N	4	5	7	8	9	N	4	5	6	8	9
NNE	4	5	6	7	9	NNE	4	5	6	8	9

Table 12-2. SLOSH Maximum Predicted Water Depths (ft above MSL)

Ocean Side Mile-Marker 50						Ocean Side Mile Marker 61					
Track Direction	Storm Categories					Track Direction	Storm Categories				
	1	2	3	4	5		1	2	3	4	5
NE	4	5	6	7	8	NE	4	5	6	7	9
ENE	3	5	6	7	8	ENE	3	5	6	7	8
E	3	4	5	6	7	E	3	4	5	6	8

Floodplain Management & Compliance with the NFIP

The City entered the National Flood Insurance Program when it incorporated in 2000 by adoption of an ordinance that complies with the requirements of the program. The City reviews all development proposals in special flood hazard areas and enforces the requirements of the ordinance. To ensure continued compliance with the NFIP, the City will continue to:

- Enforce the adopted floodplain management ordinance, including inspection of permitted development and unpermitted activities;
- Maintain records pertaining to floodplain development, including flood maps and Letters of Map Change, which shall be available for public inspection;
- Notify the public when there are proposed changes to the ordinance or Flood Insurance Rate Maps; and
- Promote the purchase of NFIP flood insurance policies as financial protection.

NFIP Flood Insurance Policies in Marathon: 2,948
Claims paid since 1978: 806*

https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13 (as of March 31, 2015)

*records prior to incorporation included in claims for Monroe County

For several years the City participated in the Community Inspection Pilot Program required by FEMA as resolution of long-standing problems with conversion of enclosures below elevated buildings to non-permitted uses. FEMA suspended the program in July of 2013. However, the concept of compliance inspections remains a viable tool for the real estate market and the City continues inspections on a volunteer basis.

NFIP Floodplain Mapping

The National Flood Insurance Program (NFIP) prepared a Flood Insurance Rate Map for Monroe County and incorporated municipalities (current effective map is dated February 18, 2005). The FIRM delineates areas that have been determined to be subject to flooding by the "base flood," the flood that has a 1-percent-annual chance of flooding in any given year (commonly called the 100-year flood).

The entire City is located in areas designated as VE Zones (coastal flood with velocity hazard wave action) and AE Zones (areas subject to flooding but waves are predicted to be less than 3-feet in height). As such, all new development in the City is subject to the floodplain management standards established in the City's Land Development Regulations. FEMA initiated a coastal study to revise the FIRM, expected to be completed in 3 to 4 years.

NFIP Repetitive Loss Properties

Data provided by the Florida Division of Emergency Management identifies properties that are (or have been) insured by the National Flood Insurance Program and that have received two or more claims of at least $1,000. As of March 2015, 34 individual properties have received 74 claims, totally approximately $4.1 million (average payment of $55,405). Of these 34 properties, 33 are residential and 1 is non-residential. Figure 12-1(end of chapter) shows property locations of those records that were able to be plotted. Some of the repetitive loss properties that are listed for Monroe County may fall within Marathon; because the data cannot be geocoded based on the addressing, the actual number is unknown.

Severe Storms, Tornadoes, Water Spouts and High Winds (Other than Hurricane)

Marathon, like the rest of the Keys, has low-lying terrain. Section 6.2 characterizes the entire area encompassed by Monroe County and the cities as having equal distribution of winds. The risk of severe storms, tornadoes, water spouts and high winds in Marathon does not vary from the rest of the planning area. All new buildings, replacement buildings, and additions to existing buildings must comply with the Florida Building Code's wind load requirements.

Rainfall/Ponding Flooding

Unlike most areas in Monroe County and the other cities, Marathon has areas that are subject to rainfall or ponding flooding. This type of flooding results from longer duration storms, which occur almost annually. As a result, residents experience access problems and water has damaged some older, non-elevated, buildings. The area with the most significant problem is 107th Street to 109th Street. Access to about 200 buildings is limited during heavy and prolonged storms. While many of the buildings are elevated, about 50 older buildings are built on-grade and have experienced flooding. In Hurricane Georges, water up to one-foot deep caused damage.

Marathon's Stormwater Management Master Plan, prepared in 2002, identifies areas of localized flooding and a generalized overview of suggested methods to minimize local flooding such as closed drainage systems, exfiltration/slab covered trenches, and injection wells. The priority areas identified include 39th Street and Sombrero Boulevard.

Because all of Marathon is mapped as Special Flood Hazard Area, all new buildings and replacement buildings must comply with the floodplain management ordinance and be elevated or floodproofed (nonresidential only). Therefore, this type of flood damage is unlikely to affect buildings built in the future.

Marathon's Engineering Department, responsible for roads and drainage, designs all new and improved storm drainage facilities to hand the 25-year frequency rainfall.

Drought Hazards

Drought hazards for the planning area are described in Section 6.4. Marathon's risk due to drought is comparable the drought risk throughout the area.

Wildland Fire Hazards

The Florida Forestry Department indicates that in Marathon, Grassy Key is the area that is most prone to wildland/brush fires.

The Florida Forestry Department indicates that in Marathon, Grassy Key is the area that is most prone to wildland /brush fires. Based on data provided by Monroe County Property Appraiser in 2005, Grassy Key includes a total of 9,391 parcels of land of which 6,498 are improved. The total assessed value of improvements is $1,562,786,704. It is important to note that this summary is not to imply that all properties would be vulnerable in any given wildfire outbreak. All new construction must comply with environmental restrictions.

Marathon's Critical and Important Facilities

The City's facilities that are listed in Table 12-3 are plotted in Figure 2-3.

Table 12-3. Critical and Important Facilities in Marathon

Critical/Essential Facilities:	**Marinas: (from the draft Marine Siting Plan)**
• City Hall • Fisherman's Hospital • Florida Keys Electric Co-op • Schools (Stanley Switlick, Marathon Middle, and Marathon High) • Marathon Airport • City Marina • Florida Keys Aqueduct Authority • Crawl Key Sewer Treatment Plant (future) • Fire Station #14 and #15 (completed 2008) • 33rd Street Fire Station (future) • Monroe County Operation Center • Little Venice Sewer Treatment Plant	• 7 Mile Grill • Abaco Sails & Marine • Banana Bay Marina • Blackfin Resort and Marina • The Boat House • Bonefish Bay Motel • Bonefish Yacht Club and Marina • Boot Key Harbor City Marina • Border Patrol • Burdines Water Front • Cannon Marine & Harbor Point • Captain Hook's Marina • Captains Three Fisheries

Table 12-3. Critical and Important Facilities in Marathon

Hazardous Materials Sites (302 Facilities):

- Monroe County Mosquito Control
- Florida Keys Aqueduct Authority

Mobile Home and Recreational Vehicle Parks:

- Aloha Trailer Park
- Farnsworth Trailer Park
- Galway Bay RV and Mobile Home Park
- Jolly Roger Travel Park
- Key RV Park
- Knights Key Campground
- Lion's Lair Travel Park
- Ocean 25 Company, Inc.
- Ocean Breeze Park West
- Ocean Breeze Trailer Park
- Old Towne Village
- Palms Subdivision Trailer
- Pelican Motel & Trailer Park
- Sundance
- Terra Marine Park
- Trailer Ranch by the Sea
- Trailerama Park
- Whispering Pines
- Trailers by the Sea

- Coco Plum Marina & Storage, Inc.
- Coconut Cay Resort & Marina
- Coconut Palmas, Inc.
- Coral Island Yachts
- Crystal Bay Resort & Marina
- D & D Seafood
- Driftwood Marina & Storage
- Faro Blanco Resort Gulfside
- Faro Blanco Resort Oceanside
- Galway Bay Trailer Park and Marina
- Grassy Key Marina of Marathon
- Hidden Harbor
- Holiday Inn
- Jolly Roger RV Park
- Keys Boat Works, Inc.
- Keys Fisheries Market & Marina
- Keys Fisheries (Joe's Stone Crab)
- Kingsail Resort Motel
- Knight's Key Campground
- Lion's Lair RV Park
- Marathon Marina & Boat Yard
- Marathon Yacht Club
- Marie's Yacht Harbor & Marina
- Ocean Breeze RV Park & Marina
- Oceanside Marine Service, Inc.
- Outta The Blue Marina
- Pelican Resort
- Pancho's Fuel Dock
- Rainbow Bend Resort & Marina
- Royal Hawaiian Motel/Botel
- Sea Cove Motel
- Seascape Resort
- Seven Mile Marina
- Shelter Bay Marine
- Sombrero Marina & Dockside
- Sombrero Resort Lighthouse Marina
- Vaca Key Marina
- Valhalla Beach
- Yardarm Motel

12.4 Damage Reduction Activities

On-Going Activities

- Participate in public awareness activities, including distribution of the "Official Hurricane Information Guide."
- Administer the stormwater utility that was implemented as part of construction in six wastewater management service areas. Tax revenues received by the utility have been utilized to construct a stormwater management system for all streets within the City. This system was installed simultaneously with the wastewater management system.

On-Going Stormwater and Wastewater Initiatives

In July 2005 the City of Marathon entered into an agreement with Weiler Engineering for design of the City's wastewater treatment system. The proposed project provides an affordable, long-term solution to meeting the City's 2010 wastewater treatment goals. Weiler examined various technologies and service areas within the City of Marathon and determined that no single type of system was best for the entire City. Instead, the recommendations addressed the most practical and cost effective system for various neighborhoods. As a result, projects will be implemented in seven separate Service Areas.

- Service Area 1: Knight's Key (Entire Island)
- Service Area 2: Boot Key (Entire Island)
- Service Area 3: Vaca Key West (11th St to 39th St)
- Service Area 4: Vaca Key Central (39th St to 60th St)
- Service Area 5: Vaca Key East (60th St to Vaca Cut)
- Service Area 6: Fat Deer Key West–Coco Plum (Vaca Cut to Coco Plum)
- Service Area 7: Grassy Key (Fat Deer Key East through Grassy Key)

Concurrent with the City's wastewater project construction, the City is also constructing stormwater management facilities and repaving City roads in these seven areas. A water re-use component is included for large users.

Past and Recent Projects

These projects are intended to reduce rainfall/ponding flooding and improve overall drainage and water quality of stormwater runoff:

- Sombrero Beach Injection Well: under drain in the park area leading to a 24' injection well in the parking lot. (Completed September 2004)
- 39th Street Drainage Improvements: was designed to improve existing drainage conditions at the location of 39th Street (2nd Ave), which will provide a means for discharge through two drainage wells and thereby allow bleed-down of the ponding areas. Because the wells will serve as a source for discharge during storm events, the proposed system will help to alleviate the extent of ponding. Runoff will be collected through a series of inter-connected

swales, ditches and bubble up structures and converged to two drainage wells. (Completed March 2005)

- 20th Street Gulf (Boot Key Road): designed to improve existing drainage conditions on 20th Street Gulf. The work included grading shoulders, grading the drainage swales at north end of the project, place drainage structures on both sides of the road and 100 linear feet of French Drain. (Completed March 2005)
- 4th Ave Gulf Drainage: designed to improve existing drainage conditions on 4th Ave Gulf. The work included installing a catch basin at the low point of the intersection; 15" pipe installed across 4th Ave to 24" injection well. (Completed March 2005)
- 46th Street Gulf: designed to improve existing drainage conditions on 46th Street Gulf. The work included installing a catch basin and 150 linear foot French drain at the low point of the road. (Completed March 2005)
- 42nd Street Gulf: designed to improve existing drainage conditions on 42nd Street Gulf. The work included installing a catch basin and 150 linear foot French drain. (Completed March 2005)
- Ave D Drainage: designed to improve existing drainage conditions on Ave D. The work included installing a 24" Injection well and one double chamber Baffle Box. (Completed March 2005)
- 107th to 109th Street Stormwater Improvement Project: includes the installation of drainage and retention structures to minimize the impacts from rainfall/flood events with a 25-year frequency. (Completed 2006/07)
- West 105th to 116th Street Stormwater Improvement Project: includes the installation of drainage and retention structures to minimize the water quality impacts from rainfall/flood events with a 25-year frequency. (Completed 2006/07)

12.5 2015 Updates

The City reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 12.2: Reported number of issued permits; added description of utilities department
- Section 12.3: Added text and figure for repetitive loss properties.

References:

City of Marathon, Comprehensive Plan (2005).

City of Marathon, Stormwater Management Master Plan (October 2002).

City of Marathon Comprehensive Emergency Management Plan (June 2008)

Figure 12-1. Repetitive Loss Properties (2015).

Chapter 13. Mitigation Initiatives

13.1 LMS Goals and Priority Hazards

Earlier chapters describe Monroe County and its incorporated municipalities, identify hazards and characterize risk, summarize how the local governments address hazards in their development processes and other functions, and re-affirmed existing mitigation goals:

Monroe County Local Mitigation Strategy Goals

1. *Preservation of sustainability of life, health, safety and welfare.*
2. *Preservation of infrastructure, including power, water, sewer and communications.*
3. *Maintenance and protection of roads and bridges, including traffic signals and street signs.*
4. *Protection of critical facilities, including public schools and public buildings.*
5. *Preservation of property and assets.*
6. *Preservation of economy during and after disaster, including business viability.*
7. *Preservation and protection of the environment, including natural and historic resources.*

Hurricanes and their associated hazards (high wind and surge flooding) are described in Chapter 5 and other hazards are overviewed in Chapter 6 (strong storms, tornadoes and water spouts; rainfall/fresh water flooding; drought; wildland fire; coastal erosion; and climate change and sea level rise). For the purposes of actively pursuing damage reduction activities, the Monroe County LMS Work Group focuses on initiatives that address one or more of the mitigation goals and that address the hazards that have relative vulnerability ranking of "high" and "moderate" (Table 13-1, which is identical to Table 6-15).

Table 13-1. Hazards: Relative Vulnerability

Hazard	Vulnerability	Impact	Frequency	Distribution
Hurricane/Tropical Storm	High	Moderate to Severe	1-2 per year	Countywide
Sea Level Rise	Moderate	Moderate to Severe	Continuously increasing	Coastal and low-lying areas
Flooding (rainfall ponding)	High (locally)	Moderate	6-12 times each year	Key West
Strong Storms/ Tornado/Lightning	Moderate	Moderate	1-2 per year	Countywide
Wildfire	Low	Low	Less than 1 per year	Selected areas

Table 13-1. Hazards: Relative Vulnerability

Hazard	Vulnerability	Impact	Frequency	Distribution
Drought	Low	Low	1-2 per decade	Countywide
Coastal Erosion	Low	Low	1-2 per year (with coastal storms)	Limited selected areas

13.2 Range of Mitigation Initiatives

Six general categories or approaches to mitigation, outlined in the 2013 CRS Coordinators Manual, to mitigation are described in Table 13-2. The list is not intended to be exhaustive; other activities may meet the intent but not be listed. The members of the Monroe County LMS Working Group consider these categories when identifying initiatives within their jurisdictions. Each participating local government undertakes a number of these activities on an ongoing basis.

Table 13-2. Categories of Mitigation Initiatives.

PREVENTIVE MEASURES keep problems from getting started or getting worse. When hazards are known and can be factored in to development decisions early in the process, risks are reduced and future property damage is minimized. Building, zoning, planning, and/or code enforcement officials usually administer these activities: • Planning and zoning • Open space preservation • Building codes and enforcement • Infrastructure design requirements • Coastal setback/erosion requirements • Floodplain regulations • Stormwater management, including injection wells, and drainage system maintenance • Clear defensible space for wildfire
PROPERTY PROTECTION measures are actions that go directly to permanently reducing risks that are present due to development that pre-dates current codes and regulations and include: • Property acquisition in floodplains • Relocation out of hazard-prone areas • Elevation of structures in floodplains • Demolition and reconstruction of structures in floodplains • Retrofit of structures in high wind zones and/or floodplains • Safe rooms and shelter hardening • Sewer backup protection • Insurance

Table 13-2. Categories of Mitigation Initiatives.

EMERGENCY SERVICES MEASURES are taken immediately before or during a hazard event to minimize impacts. These measures are the responsibility of city or county emergency management staff, operators of major and critical facilities, and other local emergency service organizations and include: • Alert warning systems • Hazard/weather monitoring systems • Emergency response planning and operations • Evacuation • Critical facilities protection • Preservation of health and safety • Post-disaster mitigation actions
STRUCTURAL PROJECTS are usually designed by engineers and managed and maintained by public entities. They are designed to reduce or redirect the impact of natural disasters (especially floods) away from at-risk population areas: • Levees, floodwalls, dunes and berms • Drainage diversions • Storm drain improvements • Channel modifications • Shoreline protection against erosion
NATURAL RESOURCE PROTECTION projects preserve or restore natural areas or their natural functions. Park and recreation organizations, conservation agencies or wildlife groups may implement such measures: • Wetland protection or restoration • Natural area preservation and restoration • Water quality improvements • Coastal barrier protection • Beach and dune protection • Erosion and sediment control • Environmental corridors • Natural functions protection
PUBLIC INFORMATION PROGRAMS advise property owners, potential property owners, and others of prevalent hazards and ways to protect people and property. A public information office usually implements these activities, often with private partner support: • Flood maps and data • Public information, brochures, and outreach projects • Library • Technical assistance for property owners • Real estate disclosure information • Environmental education programs

13.3 Mitigation Initiatives

Elements of the Monroe County LMS Goals highlight the importance of reducing potential damage to critical facilities such as public schools and public buildings, infrastructure (power, water, sewer, communications, roads and bridges), and the economy, including

damage to privately owned homes and businesses. Progress is made toward those goals through implementation of ongoing actions and responsibilities of local governments as well as through initiatives undertaken explicitly to reduce future impacts.

It is important to recognize and acknowledge that Monroe County and the municipalities all have on-going programs and activities that contribute to disaster resistance even if those actions were not initiated in response to the Local Mitigation Strategy process. Examples include:

- Every jurisdiction issues building permits and administers a floodplain management ordinance. New buildings and infrastructure must comply with the Florida Building Code and other regulations; those regulations are deemed to be sufficient to minimize future damage to due hurricanes, high winds and flooding.
- Every jurisdiction maintains its roads, which reduces the likelihood of washout damage.
- Every jurisdiction cooperates with water suppliers during periods of drought and issues notices about water restrictions.
- Key West and other communities pursue projects to improve poor drainage in areas subject to rainfall flooding.

Monroe County and the municipalities participate in public information and outreach, encouraging residents and visitors to be aware of the potential for hurricanes and actions to take both to reduce property damage and to facilitate safe evacuation.

Similarly, the utilities have on-going responsibilities intended to reduce the impacts of natural hazards. The Florida Keys Aqueduct Authority has contingencies for drought. The Florida Keys Electric Cooperative, the Keys Energy System, and Florida Power and Light take steps to minimize damage to their infrastructure and distribution systems to be able to recover as quickly as possible after hurricanes.

Wind protection measures observed during 2015 site visit.

13.4 Property Owner Initiatives

Many residents of Monroe County and incorporated municipalities have taken their own steps to protect their property from natural hazards. For example, property owners have

converted sliding glass doors to in-fill walls with windows, to protect against flooding. Many owners install hurricane shutters or are prepared to mount window coverings when hurricanes are predicted to impact the area.

13.5 Initiatives for Working Group as a Whole

13.5.1 Working Group Initiatives: 2015

At the March 5, 2015 meeting, three initiatives for the Working Group "as a whole" were discussed and accepted and two initiatives were discussed and added during the June 23, 2015 conference call (see Table 13-3). The value of for developing new initiatives and projects to address risk was discussed at both the January and March meetings. Several of the primary initiatives to address flood risk are participation or advancement in CRS program and addressing increase future risk caused by sea level rise. CRS is a priority because it is an established program that provides incentives to take multiple approaches to address flood risk and it provides flood policy holders with discounts once thresholds are met. Several Working Group and community-specific initiatives are geared toward CRS participation.

The basis for the additional initiatives and projects listed in this section and Appendix F are to address areas of greatest risk and hazards with greatest impacts. As a chain of islands, Monroe County is dependent on critical infrastructure along the Overseas Highway right-of-way which if damaged, would have a devastating impact to most residents and businesses. For this reason, evaluating protection of critical infrastructure is a top priority.

Table 13-3. 2015 High Priority Mitigation Initiatives: Working Group

Initiative 2015-001	**Establish a Monroe County CRS User's Support Group**
Jurisdiction/Entity	Monroe County and municipalities
Description	Establish a CRS User's Support Group for both current participating jurisdictions, for efforts to improve their ratings, and the other four communities that are looking to join the program. This group initiative supports several of the community specific initiatives. Currently, Layton participates in the Miami-Dade User's Group which is inconvenient due to distance.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time and external support as needed
Estimated Time Frame	2016
Initiative 2015-002	**Repetitive Loss Areas (Flood)**
Jurisdiction/Entity	Monroe County and municipalities
Description	**Verify Repetitive Loss Property Data** Monroe County and municipalities that decide to participate in the CRS or that already participate in the CRS will verity the repetitive loss property data obtained from FEMA. The NFIP maintains records of past flood insurance claims and tracks

Table 13-3. 2015 High Priority Mitigation Initiatives: Working Group

	properties that have received multiple claims. These properties and similarly situated buildings present likely opportunities for mitigation. Verifying the data serves two purposes: it helps the NFIP improve its records, and it helps identify Repetitive Loss Areas. **Prepare Repetitive Loss Area Maps** Monroe County and municipalities that prepare Repetitive Loss Area Analyses will identify repetitive loss areas within their jurisdiction using the methods described in FEMA/CRS guidance. The County Growth Management Department will use the identifications, along with the address list of repetitive loss properties provided by the municipalities, to prepare Repetitive Loss Area Maps. Key Colony Beach is preparing its Repetitive Loss Area map in 2015 and a county-sponsored workshop was held on 03/05/15 to help other communities. Identification of Repetitive Loss Areas helps identify property owners who may be interested in reducing their exposure and working with the communities to seek mitigation funds.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	Data verification (annually for CRS communities) Repetitive Loss Area Maps (upon request)
Initiative 2015-003	**Support efforts in Monroe County to address the potential negative impacts related to climate change including sea level rise**
Jurisdiction/Entity	Monroe County and municipalities
Description	Monroe County is the most vulnerable partner that participates in the SE FL Compact with respect to climate change induced sea level increases. Critical resources like the primary source of drinking water as well as homes, businesses and infrastructure are directly at risk. The LMS should actively support its own Climate Change actions plans (Monroe County and Key West) and support the implementation of a Regional Collaborative Climate Action Plan with the neighboring counties through the Southeast Florida Regional Climate Compact to address the impacts of sea level rise and other related climate change impacts.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Initiative 2015-004	**Promote hurricane and flood awareness to residents and businesses.**
Jurisdiction/Entity	Monroe County and municipalities
Description	Once residents and businesses become more aware of their risk, they are more likely to take steps to mitigate their property and support community efforts to mitigate. Risk awareness can be challenging in most parts of Florida with long intervals between events and with new residents moving from other parts of the country. The LMS Working Group should actively seek effective risk communication information and opportunities to promote steps businesses and residents can take to reduce their flood and hurricane risk.

Table 13-3. 2015 High Priority Mitigation Initiatives: Working Group

Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Initiative 2015-005	**As a group, the LMS should coordinate with agencies and utility providers responsible for critical infrastructure to express the need to incorporate flood, wind, sea level rise and coastal erosion protection into infrastructure maintenance, upgrades, and new construction.**
Jurisdiction/Entity	Monroe County and municipalities
Description	When infrastructure maintenance and upgrade projects are planned by agencies and utility providers such as Florida DOT or the Florida Keys Aqueduct Authority (e.g., repaving or elevating a road), the Working Group should express an opinion, as appropriate, that mitigation should be considered with the proposed project. These infrastructure investments represent an opportunity to add in a mitigation component like a drainage upgrade during a road project for an incremental cost. Examples for consideration include for energy infrastructure: harden facilities and service lines, conjunction boxes, and weather heads to reduce vulnerability. Monroe County should consider mitigation efforts toward raising the wastewater treatment system to an elevation which will escape future sea level tidal increases. This may include an enhanced pump-out capability with redundancies and backups. This initiative supports recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard Identification and Risk Assessment (THIRA).
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing

13.5.2 Status of Working Group Initiatives 2010

In 2010, the Monroe County LMS Work Group identified three initiatives for the Work Group as a whole. The status on these initiatives was discussed in the March 5, 2015 Working Group meeting. Table 13-4 describes those initiatives and reports on their status as of early 2015.

Table 13-4. 2010 – High Priority Mitigation Initiatives: Work Group

Initiative 2010-001: Establish LMS Working Group Procedures The Working Group will review how at least two other LMS Working Groups manage their regular business (e.g., written procedures / by-laws), determine if it is appropriate for the Monroe LMS Working Group to develop operating procedures, and if determined appropriate, develop such procedures. Operating	**Status as of 2015: Completed**

procedures might address such items as posting public notices of meetings, basis for not holding a required quarterly meeting, basis for determining when a meeting may be held by conference call, location and scheduling of meetings, composition of the project ranking subcommittee, submission of updates to the LMS coordinator to compile for the State-required annual report, etc. Concurrently, review how other LMS WG handle requests from private property owners. The Working Group will talk with DEM and other counties to determine how they prioritize and process many requests. Monroe County has a checklist that homeowners use to gather building-specific information; this checklist will be reviewed and modified if appropriate.	
Initiative 2010-002: Evaluate Hazard Identification and Risk Assessment Tools The Working Group will evaluate the Hazard Identification and Risk Assessments that were prepared for at least two other counties and determine whether using different tools (e.g., FEMA's Hazards US) would significantly improve the outcomes reflected in the 2010 Update. The anticipated update of the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) projections may also influence future updates of the HIRA.	**Status as of 2015: Mostly completed.** For the 2015 LMS update, results and explanations of Hazus runs from the up-to-date versions (at the time) were completed by FDEM and were included in the draft and presented at the 2nd LMS meeting for the 2015 update. The City of Key West has several innovative ways for analyzing repetitive loss properties and the Working Group identified the Repetitive Loss Maps a 2015 WG Initiative. The County and municipalities are also awaiting updates to future flood maps which is in process as of early 2015 (South Florida Coastal Study).
Initiative 2010-003: Continue to Verify and Improve Repetitive Flood Loss Data The National Flood Insurance Program maintains records of past flood insurance claims and tracks properties that have received multiple claims (referred to as "repetitive loss" properties). These properties present likely opportunities for mitigation, such as elevation-in-place, and FEMA funding may be available to support cost-effective measures. The NFIP records date to the mid-70s and are known to contain inconsistencies. Verifying the data serves two purposes: it helps the NFIP improve its records, and it results in an accurate list of the area's most flood-prone properties. Owners of these properties may be interested in reducing their exposure and working with the communities to seek mitigation funds.	**Status as of 2015: See Initiative 2015-002** This is a continual activity. Action from 2010-2014: • Key West has evaluated GIS data and made changes, particularly for manufactured home parks that were defaulting to the City Hall location. Improvements there have resulted in most locations to be mapped. This initiative is an on-going need and will be carried forward to the 2015 Update and augmented with preparing Repetitive Loss Area maps (see Initiative 2015-002). • Layton has no repetitive loss properties

13.6 Community-Specific Initiatives

13.6.1 Community-Specific Initiatives: 2015

In 2015, the County and municipalities identified community-specific "programmatic" initiatives described in Table 13-5, in addition to the site-specific initiatives (see Section 13.7).

Table 13-5. Community-Specific Initiatives

Islamorada Initiative 2015-001	**Seek Participation in CRS**
Jurisdiction/Entity	Islamorada
Description	Islamorada, Village of Islands, will examine its activities to determine eligibility for CRS activity points and determine what it needs to do to enter the program. As of March 2015, it had been cleared by FEMA to seek participation. The Village has 16 Repetitive Loss Properties and will need to prepare a Repetitive Loss Area map. City staff will seek advice from the Florida Division of Emergency Management, the ISO CRS Specialist, and other CRS communities in Monroe County.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	2016
Key West Initiative 2015-001	**Seek Participation in CRS**
Jurisdiction/Entity	Key West
Description	The City of Key West will examine its activities to determine eligibility for CRS activity points and determine whether it is feasible to qualify. The City has more than 220 repetitive loss properties and 8 Severe Repetitive Loss properties. City staff have begun to prepare a repetitive loss area map. City staff will seek advice from the Florida Division of Emergency Management, the ISO CRS Specialist, and other CRS communities in Monroe County.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	2016
Monroe County Initiative 2015-001	**Seek Participation in CRS**
Jurisdiction/Entity	Monroe County
Description	Monroe County will examine its activities to determine eligibility for CRS activity points and determine whether it is feasible to qualify. City staff will seek advice from the Florida Division of Emergency Management, the ISO CRS Specialist, and other CRS communities in Monroe County. As of March 2015, Growth Management has brought in external support to evaluate the steps necessary to meet FEMA compliance requirements before preparing a formal application.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	2017

Table 13-5. Community-Specific Initiatives

City of Marathon Initiative 2015-001	**Seek Participation in CRS**
Jurisdiction/Entity	Marathon
Description	The City of Marathon will examine its activities to determine eligibility for CRS activity points and determine whether it is feasible to qualify. City staff will seek advice from the Florida Division of Emergency Management, the ISO CRS Specialist, and other CRS communities in Monroe County.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	2016
Monroe County Initiative 2015-002	**Integrated Flood Risk Reduction Approach**
Jurisdiction/Entity	Monroe County
Description	Monroe County will examine the various department responsibilities and activities that address flooding and seek ways to develop a more integrated approach. The departments that should be involved include Emergency Management, Growth Management, etc. Some integration options include coordination with recovery plan preparations, review and commenting on comprehensive plan updates, and evaluating capital improvement budgeting programs.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	2017
Key Colony Beach Initiative 2015-001	**Improve CRS Class**
Jurisdiction/Entity	Key Colony Beach
Description	Key Colony Beach is a CRS Class 8 community. The City will examine its activities currently receiving CRS activity points and determine if that are other activities that can be included in the next submission. City staff will complete actions necessary to finalize the Repetitive Loss Area Analysis and present it to Council for adoption as an addendum to the 2015 Monroe County LMS.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	2016
Layton Initiative 2015-001	**Improve CRS Class**
Jurisdiction/Entity	Layton
Description	Layton is a CRS Class 8 community and is approximately 140 points from becoming a Class 7. The City will examine its activities currently receiving CRS activity points and determine if that are other activities that can be included in the next submission.
Hazards	Flooding, Hurricane/Tropical Storm, Sea Level Rise
Potential Funding Sources	Staff time
Estimated Time Frame	November 2015
Monroe County Initiative 2015-003	**Evaluate existing and proposed infrastructure and facilities to identify recommendations to increase**

Table 13-5. Community-Specific Initiatives

	resilience and account for dynamic hazards including flood, wind, sea level rise, coastal erosion and strong storms.
Jurisdiction/Entity	Monroe County
Description	Infrastructure and facilities provide services the whole community depends on for basic functioning. Monroe County will review new projects for recommendations to increase resiliency prior to inclusion in the Capital Improvements Element of the Comprehensive Plan and evaluate options for protecting infrastructure in vulnerable areas. Infrastructure includes new, renovated and replacement public facilities such as streets and bridges, water and wastewater treatment plants, police stations and fire stations, and any other public buildings and facilities. Options may include hardening, elevating, relocating, or not building new infrastructure in the areas with highest risk associated with flooding, sea level rise, and erosion. This initiative supports the objectives in the proposed 2030 Comprehensive Plan and the recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard Identification and Risk Assessment (THIRA).
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Key West Initiative 2015-002	**Evaluate protective measures for critical infrastructure and facilities to protect against dynamic hazards including flood, wind, sea level rise, coastal erosion and strong storms.**
Jurisdiction/Entity	Key West
Description	Critical infrastructure and facilities provides services that the whole community depends on for basic functioning. Key West will evaluate the need for protecting its critical facilities and infrastructure including energy infrastructure, water/wastewater infrastructure, port facilities, emergency services, and healthcare facilities. This includes hardening, elevating and potential relocation. This initiative supports recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard Identification and Risk Assessment (THIRA).
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Marathon Initiative 2015-002	**Evaluate protective measures for critical infrastructure and facilities to protect against dynamic hazards including flood, wind, sea level rise, and strong storms.**
Jurisdiction/Entity	Marathon
Description	Critical infrastructure and facilities provides services that the whole community depends on for basic functioning. Marathon will evaluate the need for protecting its critical facilities and infrastructure including energy infrastructure,

Table 13-5. Community-Specific Initiatives

	water/wastewater infrastructure, port facilities, emergency services, and healthcare facilities. This includes hardening, elevating and potential relocation. This initiative supports recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard Identification and Risk Assessment (THIRA). Specific options for consideration include for energy infrastructure: harden facilities and service lines, conjunction boxes, and weather heads to reduce vulnerability. Marathon will consider mitigation efforts toward raising the wastewater treatment system to an elevation above anticipated future sea level tidal increases. This may include an enhanced pump-out capability with redundancies and backups. Consider code revisions requiring additional elevation of first floor residential dwellings, commercial buildings, facilities deemed of critical facility importance, to build new, or reconstruct older facilities, at a higher elevation. This would include airports (runways), hospitals, etc.
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Islamorada Initiative 2015-002	**Evaluate protective measures for critical infrastructure and facilities to protect against dynamic hazards including flood, wind, sea level rise, and strong storms.**
Jurisdiction/Entity	Islamorada
Description	Critical infrastructure and facilities provides services that the whole community depends on for basic functioning. Islamorada will evaluate the need for protecting its critical facilities and infrastructure including energy infrastructure, water/wastewater infrastructure, port facilities, emergency services, and healthcare facilities. This includes hardening, elevating and potential relocation. This initiative supports recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard Identification and Risk Assessment (THIRA).
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Key Colony Beach Initiative 2015-002	**Evaluate protective measures for critical infrastructure and facilities to protect against dynamic hazards including flood, wind, sea level rise, and strong storms.**
Jurisdiction/Entity	Key Colony Beach
Description	Critical infrastructure and facilities provides services that the whole community depends on for basic functioning. Key Colony Beach will evaluate the need for protecting its critical facilities and infrastructure including energy infrastructure, water/wastewater infrastructure, port facilities, emergency services, and healthcare facilities. This includes hardening, elevating and potential relocation. This initiative supports recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard

Table 13-5. Community-Specific Initiatives

	Identification and Risk Assessment (THIRA).
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing
Layton Initiative 2015-002	**Evaluate protective measures for critical infrastructure and facilities to protect against dynamic hazards including flood, wind, sea level rise, and strong storms.**
Jurisdiction/Entity	Layton
Description	Critical infrastructure and facilities provides services that the whole community depends on for basic functioning. Layton will evaluate the need for protecting its critical facilities and infrastructure including energy infrastructure, water/wastewater infrastructure, port facilities, emergency services, and healthcare facilities. This includes hardening, elevating and potential relocation. This initiative supports recommendations from the 2012 Miami-Fort Lauderdale Urban Areas Security Initiative Threat and Hazard Identification and Risk Assessment (THIRA).
Hazards	Strong Storms/Lightning/Tornado, Flooding, Hurricane/Tropical Storm, Sea Level Rise, Coastal Erosion
Potential Funding Sources	Staff time
Estimated Time Frame	Ongoing

13.6.2 Status of Community-Specific Initiatives 2010

In 2010, the County and municipalities did not identify any community-specific "programmatic" initiatives that are not already listed.

13.7 Site-Specific Initiatives

Mitigation projects or initiatives are actions that focus on specific locations such as public buildings, public infrastructure, or privately-owned property. Examples of project initiatives that have been or are likely to be implemented in Monroe County and the municipalities include, but are not limited to:

- Wind retrofit of public buildings and facilities.
- Wind retrofit of private non-profit buildings and low income homes.
- Installation of storm drainage improvements.
- Floodproofing or mitigation reconstruction of public buildings and facilities.
- Elevation, mitigation reconstruction, or acquisition of private homes in floodplains.

Site-specific structural projects, such as levees and reservoirs are not appropriate for the island environment. Large scale floodwalls around multiple properties are similarly unlikely.

The Monroe County LMS Work Group maintains an evolving list of project initiatives that includes many site-specific initiatives (Appendix F, as of mid-2015). This list may be modified periodically. The list has three distinct "tabs" that result from distinct steps in the process (illustrated below and described in more detail in Section 13.8):

- **Step One: Preliminary Identified Mitigation Initiatives – Notice of Intent** (initiatives may be placed on the list with a minimum amount of information).
- **Step Two: Prioritized Mitigation Initiatives** (when an entity is prepared to seek funding and has sufficient detail, the Characterization Form is completed and the LMS Ranking Subcommittee develops the prioritization ranking).
- **Step Three: Completed/Removed/Unconfirmed Mitigation Initiatives** (initiatives that have been completed, with or without external funding, or which have been removed/dropped, or for which the entity has not provided sufficient information to keep it on one of the other lists).

Quarterly
- Step One: Accept NOIs to "bank" projects
- LMS WG Coordinator updates spreadsheet (Tab One)

Post-Disaster or When NOFA Issued
- Step Two: Entities electing to move projects from the "bank" to the prioritized list submit Characterization Forms
- Ranking Subcommittee reviews Characterization Forms and completes Prioritization Form
- LMS WG Coordinator updates Prioritized list (Tab Two)

Annually
- Step Three: Entities asked to review lists (Tab One and Tab Two) to identify projects that are completed, to be removed, or to be retained
- LMS WG Coordinator updates spreadsheet (all tabs)
- LMS WG Coordinator reports to DEM (9G-22)

13.8 Prioritizing Mitigation Initiatives

Florida Administrative Code 27P-22 delegates to the LMS Work Group the authority to set priorities and identify projects. The Florida Division of Emergency Management encourages Work Groups not only to pre-identify (and "bank") projects, but to gather initial data to facilitate the priority setting process in part to help with more rapid consideration in the post-disaster period. As indicated in Step One (NOI), detailed cost estimates and engineering are not necessary in order to bank potential projects because long periods of time may elapse between initial identification of an initiative and actual application for funds (Step Two). Initiative proponents are responsible for providing information on which the prioritizations are based.

The Monroe LMS does not outline how each jurisdiction or non-profit organization decides to prioritize its own projects. It is expected that initiatives will be identified based on available hazard information, past hazard events, the number of people and types of property exposed to those hazards, and the feasibility and cost-effectiveness of the measure. Initiatives are expected to be consistent with current policies and regulations, technically feasible, likely to have high political and social acceptance, and be achievable using existing authorities and staff.

The Work Group adopted the phased process described here for identification and prioritization of mitigation initiatives. The process results in the evolving list of initiatives in Appendix F, which also includes the forms. This list is maintained by Monroe County Emergency Management on behalf of the Work Group.

Step One: Preliminary Identified Mitigation Initiatives (Notices of Intent)

Initiatives may be placed on the list by any eligible entity that provides minimum information. The Work Group anticipates allowing submission on at least a quarterly basis so that eligible entities are not constrained by an annual opportunity to identify and pursue projects and funding. Initiative proponents are encouraged to bank initiatives by submission of notices of intent. The NOI form (Appendix F) requires the following minimum information:

- Name of owner/entity;
- Name of the initiative/project;
- Brief description of initiative/project, project type, and any special considerations;
- "Best estimate" of project costs; and
- Identification of the mitigation goal(s) and the hazards addressed.

Step Two: Prioritized Mitigation Initiatives (Characterization Form)

Implementation of site-specific mitigation initiative usually is dependent upon the availability of funding (see Section 13.9 for sources of funding). A project that is on the Step One (NOI) list is moved to the Step Two (Prioritized) list when the owner/entity anticipates developing and submitting the formal application to DEMA and FEMA, and when the Work Group is charged with prioritizing projects for available funding. Notices of Funding Availability (NOFA) may be issued annually (e.g., for FEMA's Flood Mitigation Assistance Program or the Pre-Disaster Mitigation Program) or after disasters that yield Hazard Mitigation Grant Program (HMGP) funds, in which case NOFAs usually are issued within 90 days. Whether on an annual basis or post-disaster, the Work Group members would be notified and eligible entities would then decide whether they are prepared to formalize initiatives that are on the Step One (NOI) list.

Pursuant to State requirements (Chapter 27P-22.006) the LMS Work Group is charged with developing a prioritized list of initiatives. At any given time, priorities may change due to various factors such as recent damage, availability of non-federal cost share, or changes in priorities of the funding agency.

When a NOFA is anticipated or received, the LMS Coordinator will notify entities that have initiatives in the Step One (NOI) list. In order to have an initiative forwarded to the funding agency, detailed data specified in the Characterization Form (Appendix F) are required so that the Work Group's Ranking Subcommittee can process and determine priorities (Step Two list). The following minimum information will be required:

- Name of owner/entity and the point of contact responsible for providing the detailed information;
- Initiative/project title, description of the project, whether it benefits a critical facility; and whether the applicant has the legal authority to undertake the project;
- Estimate of how quickly the project could be started and how long it would take to complete;
- The LMS goals addressed a(scope of work) and need, and the hazard(s) and problem(s) it would address;
- Identification of the mitigation goal(s) and the hazards addressed;
- Description of general benefits, including number of people impacted, economic benefits, social benefits, environmental benefits, and whether historic resources are affected;
- Estimated total project costs and whether a formal Benefit-Cost Analysis has been prepared or if the estimated benefits are based on the worksheet to approximate a Benefit-to-Cost Ratio;

- Statements regarding feasibility; consistency with other plans, policies, codes and ordinances; permits and approvals necessary; level of effort to implement; and likely reception by the community (i.e., the public);
- Identification of potential funding sources; and
- An attachment to approximate benefits and costs.

Step Three: Completed/Removed/Unconfirmed Mitigation Initiatives

In order to maintain records that demonstrate progress towards the Mitigation Goals, the Work Group recognizes that it is important to track completed initiatives, as well as initiatives that are completed or removed from the list, including those for which sufficient information was not provided in order to retain on one of the other lists. At least once a year entities that have undertaken mitigation initiatives (regardless of source of funding) will report to the Work Group. At any time, entities may request that an initiative be removed from the Step One (NOI) list or the Step Two (Prioritized) list, in which case it is moved to the Step Three list.

13.9 Potential Funding for Selected Initiatives

Funding to support mitigation initiatives may be available from several sources, each with its own timing and requirements. The list in Table 13-6 is not intended to be exhaustive, but to characterize the variety of funding. The State Hazard Mitigation Plan includes a more detailed list of potential funding sources. The LMS Work Group will endeavor to maintain familiarity with funding sources and availability. The Florida Division of Emergency Management is the primary contact for notifications and processing of federal funds, especially those that derive from the U.S. Department of Homeland Security (FEMA). FEMA publishes annual guidance for its programs. The guidance summarizes programmatic changes and limitations which may vary from year to year.

Table 13-6. Primary Potential Funding for Mitigation

Program	Fund Source Contact
Hazard Mitigation Grant Program (HMGP) To prevent future losses of lives and property due to disasters; to implement State or local hazard mitigation plans; to enable mitigation measures to be implemented during immediate recovery from a disaster; and to provide funding for previously identified mitigation measures to benefit the disaster area. Eligible projects include but are not limited to: • Property acquisition or relocation • Structural and non-structural retrofitting (e.g. elevation, storm shutters and hurricane clips) • Minor structural hazard control (e.g. culverts, floodgates, retention basins) • Localized flood control projects that are designed to protect critical facilities and are not part of a larger flood control system • Other feasible and cost-effective measures • Post-disaster code enforcement	Source: FEMA Contact: Florida Division of Emergency Management (DEM)

Table 13-6. Primary Potential Funding for Mitigation

Program	Fund Source Contact
Ineligible activities include: • Major flood control projects • Engineering designs not integral to a proposed project • Feasibility and drainage studies that are not integral to a proposed project • Flood studies that are not mapping • Response and communication equipment (e.g., warning systems, generators that are not integral to a proposed project)	
Pre-Disaster Mitigation (PDM) Competitive Grants The PDM program was authorized by Section §203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended by Section §102 of the Disaster Mitigation Act of 2000, to assist communities to implement hazard mitigation programs designed to reduce overall risk to the population and structures before the next disaster occurs. Annual guidance is issued and may include national priorities. See HMGP for eligible activities.	Source: FEMA Contact: DEM
Flood Mitigation Assistance Program To fund cost effective measures implemented by States and communities to reduce or eliminate the long term risk of flood damage to buildings, manufactured homes, and other structures uninsurable by the National Flood Insurance Program. See flood-related activities under PDM. Only property owners with flood insurance are eligible under FMA. The Severe Repetitive Loss Program and the Repetitive Flood Claims Program have now been rolled into the FMA. SRL properties can get up to 100% federal funding and RL-eligible properties up to 90%.	Source: FEMA Contact: DEM
Residential Construction Mitigation Program (RCMP) Funds from the Florida Hurricane Catastrophe State to harden homes and tie-down mobile homes.	Source/Contact: DEM
Community Development Block Grant The Community Development Block Grants Disaster Recovery program (CDBG-DR) provide for long-term needs, such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and redevelopment of disaster-affected areas. Funds may also be used for emergency response activities, such as debris clearance and demolition, extraordinary increases in the level of necessary public services. Eligible projects include: • Voluntary acquisition or if appropriate, elevation of storm damaged structures (can be used as match for FEMA mitigation projects in low income areas) • Relocation payments for displaced people and businesses • Rehabilitation or reconstruction of residential and commercial buildings • Assistance to help people buy homes, including down payment assistance and interest rate subsidies • Improvement to public sewer and water facilities	Source: HUD Contact: Florida Department of Economic Opportunity t
Community Facilities Loan Program (10.423) To construct, enlarge, extend, or otherwise improve community facilities providing essential services to rural residents.	Source/Contact: Florida Rural Economic and Community Development
Conservation and Recreation Lands (CARL) This grant program is intended to conserve environmentally endangered lands and provide resource conservation measures for other lands.	Source/Contact: Florida Department of Environmental Protection, Division of State Lands
Florida Communities Trust (FCT) Facilitates the purchase of lands for conservation and/or recreation purposes by local governments; helps to implement conservation, recreation, open space, and coastal elements of local comprehensive plans. The Board of Florida Communities Trust has latitude to consider innovative financing arrangement, loans, and land swaps. However, most of the Trust's funding is	Source/Contact: Florida Department of Environmental Protection, Communities Trust

Table 13-6. Primary Potential Funding for Mitigation

Program	Fund Source Contact
for land acquisition. Land acquisition projects in which matching funds are available will receive more favorable consideration, although a portion of available funds may be awarded as outright grants.	
Community Development Block Grants/Entitlement Grants To develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low to moderate income individuals.	Source: HUD Contact. Office of Block Grant Assistance
Community Development Block Grants/State Program To develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low to moderate income individuals.	Source: HUD Contact: Small Cities Division, Office of Block Grant Assistance
Economic Injury Disaster Loans (EIDL) To assist business concerns suffering economic injury as a result of certain presidential, Secretary of Agriculture, and/or Small Business Administration declared disasters.	Source: SBA Contact: Office of Disaster Assistance
Emergency Solutions Grants Program (ESG) To provide financial assistance to renovate or convert buildings for use as emergency shelters for the homeless. Grant funds may also be used to operate the shelter (excluding staff) and pay for certain support services.	Source/Contact: Florida Department of Children and Families
SBA Physical Disaster Loans (Businesses and Homeowners) To provide loans to businesses and homeowners affected by declared physical type disasters for uninsured losses; may include costs to mitigate future damage.	Source: SBA Contact: Office of Disaster Assistance
Post-Disaster Public Assistance Program To provide supplemental assistance to States, local governments, and certain private non-profit organizations to alleviate suffering and hardship resulting from major disasters or emergencies declared by the President. Costs for feasible and cost-effective mitigation can be included under Section 406.	Source: FEMA Contact: FDEM
Flood Plain Management Services To promote appropriate recognition of flood hazards in land and water use planning and development through the provision of flood and flood plain related data, technical services (such as floodproofing evaluations of public buildings), and guidance.	Source: U.S. Army Corps of Engineers Contact: Jacksonville District COE

13.10 LMS Actions to Support Grant Applications

Table 13-7 illustrates that certain mitigation grant programs require that projects "be in conformance with" or be "consistent with the goals and objectives" in local hazard mitigation plans (regulations cited below the table). Specific actions are required when post-disaster Hazard Mitigation Grant Program funds become available and if an eligible subapplicant elects to submit an application for FEMA's Pre-Disaster Mitigation grant program.

Table 13-7. LMS Actions to Support Grant Applications

Program	State Requirement	Federal Requirement
Hazard Mitigation Grant Program (FEMA)	• LMS WG to prioritize projects [27P-22.006(1)(a)] • LMS WG to provide endorsement letter [27P-22.007(4)]	• Subapplicant to provide evidence of consistency with LMS [§ 206.435]
Pre-Disaster Mitigation (FEMA)	• None	• LMS WG coordinator to provide endorsement letter with ranking [HMA Guidance]
Flood Mitigation Assistance (FEMA)	• FDEM has prepared a Severe Repetitive Loss Outreach Strategy as part of its current approved State Hazard Mitigation Plan (Section 6.0); which is a prerequisite for greater than 75% federal cost shares (90% RFC/ 100% SRL)	• Subapplicant to provide evidence of consistency with LMS [§ 79.6 and HMG Guidance]
Residential Construction Mitigation Program (State)	• None	• Not applicable (State program)

State Regulations:

27P-22.006 County Allocations and Project Funding.

(1)(a) Eligible and submitted projects for each county included in the relevant presidential disaster declaration will be funded in order of priority as outlined in the LMS until the allocated funds are exhausted, or all eligible projects are funded, whichever occurs first.

27P-22.007 Application.

(4) A letter shall accompany each application from the Chairperson or Vice-Chairperson of the LMS Working Group endorsing the project. The endorsement shall verify that the proposed project does appear in the current LMS and state its priority in relation to other submitted projects. Applications without this letter of endorsement will not be considered.

Federal Regulations & Guidance:

HMGP: § 206.435 Project identification and selection criteria.

(a) Identification. It is the State's responsibility to identify and select eligible hazard mitigation projects. All funded projects must be consistent with the State Mitigation Plan. Hazard Mitigation projects shall be identified and prioritized through the State, Indian tribal, and local planning process.

FMA & SRL: § 79.6 Eligibility.
(d) Minimum project criteria. In addition to being an eligible project type, mitigation grant projects must also:

(1) Be in conformance with mitigation plans approved under part 201 of this chapter for the State and community where the project is located;

HMA Guidance (FY2014): D.5.2 Conformance with Hazard Mitigation Plans
Projects submitted for consideration for HMA funding must be consistent with the goals and objectives identified in the current, FEMA-approved State or Tribal (Standard or Enhanced) Hazard Mitigation Plan and local or Tribal hazard mitigation plan for the jurisdiction in which the activity is located.

13.11 2015 Updates

- Section 13.1: Added sea level rise to Table 13-1.
- Section 13.2: Modified Table 13.2 to expand categories of mitigation initiatives to be considered.
- Section 13.4: Added new section to describe actions some private property owners have taken to mitigate future damage.
- Section 13.5: Added three new initiatives for the Working Group as a whole.
- Section 13.6: Added several new community-specific initiatives.
- Section 13.9: Modified description of FMA and deleted previously separate programs for Severe Repetitive Loss and Repetitive Flood Claims; made additional revisions to update grant agencies.

Chapter 14. Evaluation, Updates & Revisions

14.1 Distribution

Upon adoption, the LMS 2015 Update will be posted on the Monroe County Emergency Management Department's web site and notices of its availability will be distributed to the federal and state agencies that were notified and the organizations, agencies, and elected officials who received notices of public meetings.

14.2 Annual Evaluation & Updates (Monitoring)

As required by State statute (Chapter 27P-22) and to ensure the Local Mitigation Strategy is current and continues to serve the interests of residents and visitors, the LMS Working Group will perform an evaluation by comparing the text of the LMS to actual events and status of ongoing or completed mitigation initiatives listed in Chapter 13 and, as applicable, each community's chapter. If appropriate, annotations will be prepared every year. Minor revisions may be handled by addenda. If significant revisions are prepared before the 2020 Update, they are to be submitted to the Florida Division of Emergency Management no later than the last workday of each January.

The Monroe County Emergency Management Department, the LMS Coordinator, will monitor hazard events, reports of damage, and progress on implementation of projects that Working Group members report are undertaken. The LMS Coordinator will coordinate the annual review and preparation of revisions that may be identified. The participating Working Group members are responsible for recommending revisions pertinent to their jurisdiction or organization. Revisions may be appropriate due to:

- Hazard events that have occurred that prompt a change in the characterization of risk or warrant consideration of additional initiatives.
- Significant changes to the critical facilities list (addition or deletion of facilities).
- Changes to the NFIP's list of Repetitive Loss Properties (if the list is provided for this purpose).
- Changes in knowledge and understanding of the people and property that are at risk which may be reflected in hazard maps.
- Changes to the list of mitigation initiatives (addition of new initiatives, deletion or completion of previously-listed initiatives).
- Changes in department organization, regulations, comprehensive plans, and the like.
- Changes necessary to comply with State and federal program requirements.

To assess the LMS's effectiveness in meeting the goals (see Chapter 4), the LMS Working Group will follow this monitoring schedule (subject to changes as a function of hazard events):

- On a quarterly basis the Working Group will report on the status of active initiatives in order to maintain currency of the list, including instances where the Working Group made recommendations to include mitigation in a utility or infrastructure construction/reconstruction project, the number of buildings and assets protected or mitigated over the previous year, and the number of critical facilities protected over the previous year.
- On a quarterly basis the Working Group will accept new initiatives to be placed on the list of Preliminary Identified Mitigation Initiatives.
- On a quarterly basis the Working Group members will be asked to identify any community plans that are in the process of being updated (e.g., comprehensive plan) and will determine if suggested input from the LMS Working Group, or individual LMS Working Group members, is appropriate.
- By the end September of each year, the LMS Coordinator will notify Working Group members of the need to review the LMS and identify revisions; Working Group members will submit proposed revisions to Emergency Management which will be discussed at a Working Group meeting. Emergency Management will compile the proposed revisions and, with Working Group approval, will forward the revisions to the Department of Community Affairs by the last working weekday of January.

In the event of a major hazard event such as a hurricane or tropical storm, the LMS Working Group will convene after the event to discuss its impacts and initiate a discussion on how the Working Group can influence mitigation in the recovery process. Whether shortly after an event or in response to receiving notice from FDEM that mitigation funds are available, the Working Group will consider which projects and initiatives could be elevated in importance and whether communities may develop and submit new initiatives (see procedure outlined in Section 13.7).

Between 2010 and 2015, the Monroe County LMS Working Group coordinator submitted annual reports. A few facilities were added to the list of critical facilities and progress was noted on some grant-funded projects to mitigate repetitive loss properties.

14.3 Five-Year Revision

The LMS Working Group will conduct a comprehensive review of and revisions to the LMS on a five-year cycle. In part, this revision will be to incorporate the material collected for the previous four annual updates. Because the LMS is adopted in 2015, it will enter the next evaluation and review cycle sometime in 2019, with adoption and publication anticipated in 2020.

Based on the mitigation planning process outlined in Section 3.2, the LMS Working Group anticipates the following activities will be undertaken as part of the 2020 Update:

- The LMS Coordinator will notify the LMS Working Group and all interested parties on the e-mail listserve when the five-year revision cycle is initiated and when each subsequent meeting or conference call is scheduled.
- For communities that may apply to join CRS and have to prepare a Repetitive Loss Area map, inclusion of that map and status of application.
- Reflect any changes to State or federal grant or planning requirements.
- Review any changes to community plans, such as comprehensive plans or climate change action plans.
- An initial meeting to review the update process, State and federal requirements, and the major steps, assignments, and schedule. All members will contribute to updating hazard information and events. Each local government member will be responsible for ensuring that their chapters are reviewed and reflect current organization and procedures.
- The mitigation initiatives lists will be reviewed and revised (if not already accomplished in the annual reports and updates).
- The Working Group will review all changes and concur with making the Public Review Draft available for public review. The LMS will be made available for public review and citizens will be encouraged to comment. A public meeting will be held.
- The Working Group will review and address public comments and comments received from DEM and FEMA review.
- Each local jurisdiction will formally adopt the LMS Update.

14.4 Incorporating Mitigation Plan Requirements into Other Local Planning Mechanisms

The effects of high winds and storm surge flooding associated with hurricanes are recognized by everyone in Monroe County as significant hazards. All local governments acknowledge those risks in all local plans. Chapters 7 through 12 describe how Monroe County and the cities of Key West, Marathon, Key Colony Beach, Layton, and Islamorada address hazards as part of their current planning mechanisms and processes, including comprehensive plans, land development, infrastructure design, and public outreach. The 2015 Update of the LMS did not reveal any significant gaps in how hazards are addressed in existing planning mechanisms and processes.

To assure continued incorporation of the goals of the LMS, the LMS Working Group members from the local jurisdictions will participate in the internal processes that each jurisdiction will follow to review and revise its comprehensive plan, comprehensive emergency management plans, and wildfire protection plans. Information from the LMS can

be used to inform these other plans and vice versa. The 2015 LMS incorporates information from three climate change/sea level rise plans. Several LMS Working Group members from the local jurisdictions are also coordinating with their respective floodplain management programs to strive toward CRS participation.

Many mitigation initiatives are capital projects. Implementation of site-specific projects usually is dependent upon the availability of funding (see Section 13.7 for sources of funding). When those initiatives are prioritized and funding is sought, each jurisdiction will comply with its existing rules regarding inclusion of projects in its Capital Improvement Plan or other budget and planning document or process.

14.5 Continued Public Participation in Plan Maintenance

Monroe County will continue to ensure public access to the LMS by posting the LMS Update, information on meetings, and other relevant LMS material on the County's Emergency Management website. The LMS Working Group meetings will continue to be open to the public and the Working Group roster will continue to maintain members from the general public. As instructed on the Emergency Management website, the public is invited to Working Group meetings and may contact Monroe County Emergency Management about the LMS at any time. Public comments on the LMS will be considered in future revisions.

14.6 2015 Update

The LMS Working Group reviewed and updated the pertinent sections. Some of the more significant changes include:

- Section 14.2: Addition to monitoring schedule.
- Section 14.3: Additions to the update process.
- Section 14.4: Made a few revisions to describe how information from other plans is incorporated into the LMS and to recognize emphasis on CRS participation.
- Section 14.5: Added new section to describe how public involvement will continue in the future.