

# Sea Level Rise

## Case Study: From Planning to Implementation



April 8, 2016



Erin L. Deady, P.A.



# January 26, Monroe County Workshop Overview

## ■ **Goal: Overview and interactive discussion of GreenKeys! project, next steps**

- Introduction
- Planning Approach – summary of GreenKeys! Plan approach and GHG summary
- Executive Summary - overview of GreenKeys! Plan results and vulnerabilities:
- Two Part Workshop

- Part 1: Sustainability

- STAR Assessment
- Sustainability Recommendations
- 5 Year Implementation Plan (with Projects and Costs)
- When to Implement, Cross Departmental Budgeting, Strategic Planning
- Sustainability as a Part of Ordinary Planning

- Part 2: Sea Level Rise Big Picture Issues

- “Big Picture Issues” from the GreenKeys! Plan Development
  - Issue 1 – Integrating Road, Stormwater, Tidewater Design
  - Issue 2 – Land Acquisition Priorities
  - Issue 3 – Where People Develop and How
  - Issue 4 – How do we Collaborate, Plan for and Fund Issues
- Future of Monroe County and Keys: Creative Adaptation. Smart Design. New Uses

- **Wrap Up and Actions**



# Approach to the GreenKeys! Planning Process



## GreenKeys!

A Plan to Create a Sustainable Florida Keys



Climate/Sea Level Rise:  
Forecasting Tools & Modeling

Sustainability and  
GHGs

County Assets  
Infrastructure  
Habitat

Community  
Impacts

Government Operations  
Natural Systems  
Built Environment  
Health & Safety  
Education, Arts & Community  
Economy & Jobs  
Equity & Empowerment  
Climate & Energy

# Data Collected: Climate/Sea Level Rise Analysis

## Nuisance Flooding

- NOAA Digital COAST 2030 and 2060 scenarios

## Water/Wastewater

- FCAA As Built Drawings and GIS 2030 and 2060 scenarios

## Water Supply

- USGS Integrated surface - groundwater model to determine saltwater intrusion impacts for wellfields at 2030 and 2060

## Roads

- FDOT Sketch Tool and County Pavement Condition Index (2014) 2030 and 2060 scenarios

## Habitat

- Sea Level Affecting Marsh Model (SLAMM), the Florida Cooperative Land Cover Classification (FCLCC), the Critical Lands and Waters Identification Project (CLIP), Monroe County's "Habitat" shapefile and Strategic Habitat Conservation Area (SHCA)

## Electric Utility

- FKEC and Keys Energy facilities data and GIS 2030 and 2060 scenarios

## County Facilities

- Point locations of County-owned buildings (2006 GIS Mapping) 2030 and 2060 scenarios

## Elevation Data

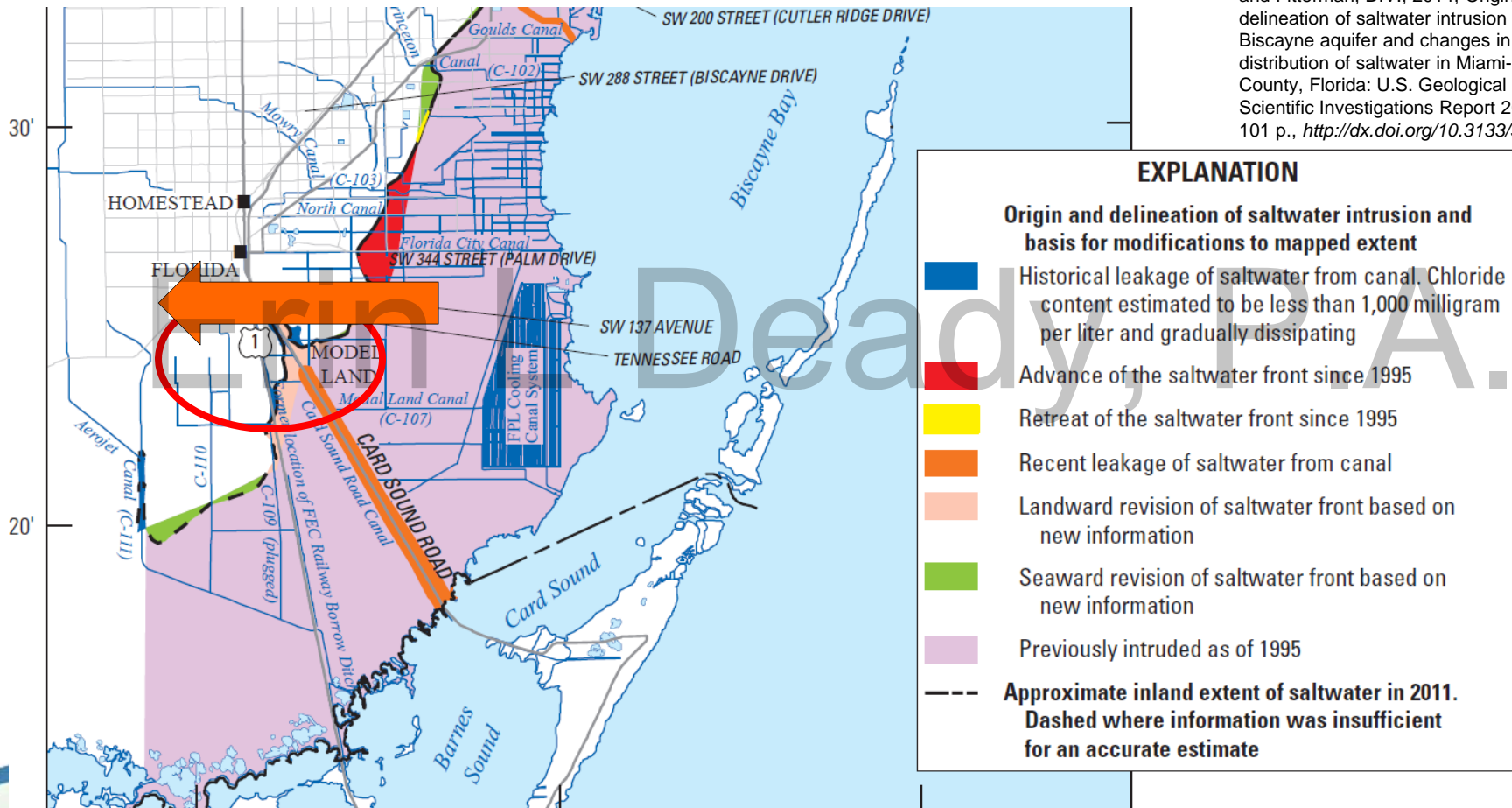
- 2008 Department of Emergency Management LiDAR (Light Detection and Ranging)



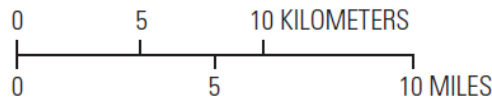
# Water Supply Vulnerability

New research indicates a wedge of saltwater intrusion toward the Monroe County wellfield in south Dade County

Prinos, S.T., Wacker, M.A., Cunningham, K.J., and Fitterman, D.V., 2014, Origins and delineation of saltwater intrusion in the Biscayne aquifer and changes in the distribution of saltwater in Miami-Dade County, Florida: U.S. Geological Survey Scientific Investigations Report 2014-5025, 101 p., <http://dx.doi.org/10.3133/sir20145025>.



Base from Miami-Dade County, South Florida Water Management and U.S. Geological Survey digital data, Universal Transverse Mercator projection, zone 17N, NAD 83



# Time for Decision Making Paradigm Shift



Land and Infrastructure  
Species, Habitat considerations  
Adaptation/Mitigation for infrastructure

Policy Implementation  
Departmental Collaboration,  
Comp Plan, Code, Legal Issues



Project Planning  
Addressing Priority Vulnerabilities,  
Budget Implications (New Cost Considerations),  
Also Departmental Collaboration

# Big Picture Issues from GreenKeys! Plan Development

## Big Picture Issues:

1. Integrating Road, Stormwater and Tidewater Design
2. Land Acquisition Priorities
3. Where We Develop and How
4. How Do We Collaborate, Plan for and Fund these Issues



Photo Credit: Unknown



Photo Credit: S. Russo



# Issue #1: Integrating Road, Stormwater, Tidewater Design

## ■ Issues:

- Roads flooding now, will continue in future
- Rain driven road flooding to become more unpredictable
- Roadwork will impact adjacent parcels – stormwater issues
- Road design will need to factor in:
  - Additional tidewater impacts from extreme, more regular inundation
  - Reduced capacity for drainage
  - Additional environmental/regulatory constraints
- Use adopted LOS for varying infrastructure to manage County's financial responsibility and people's expectations

Road Miles Vulnerable to Nuisance Flooding by Sea Level Rise Scenario.

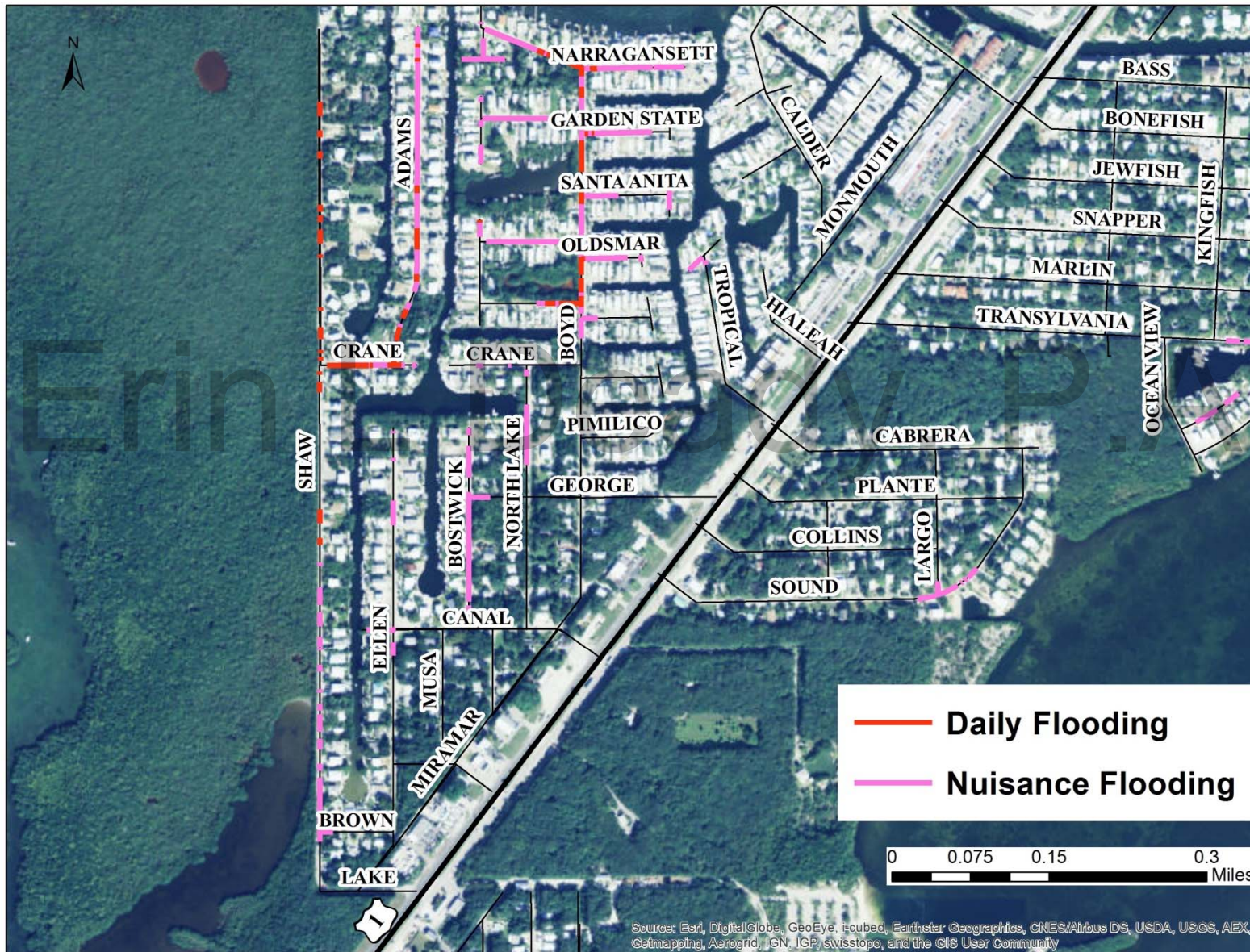
	Original Road Miles	2030 Low	2030 High	2060 Low	2060 High
US	112.5	2.3	3.2	4.0	14.3
Highway 1					
All Roads	830.0	143.6	188.0	217.6	449.9



Photo Credit: S. Russo

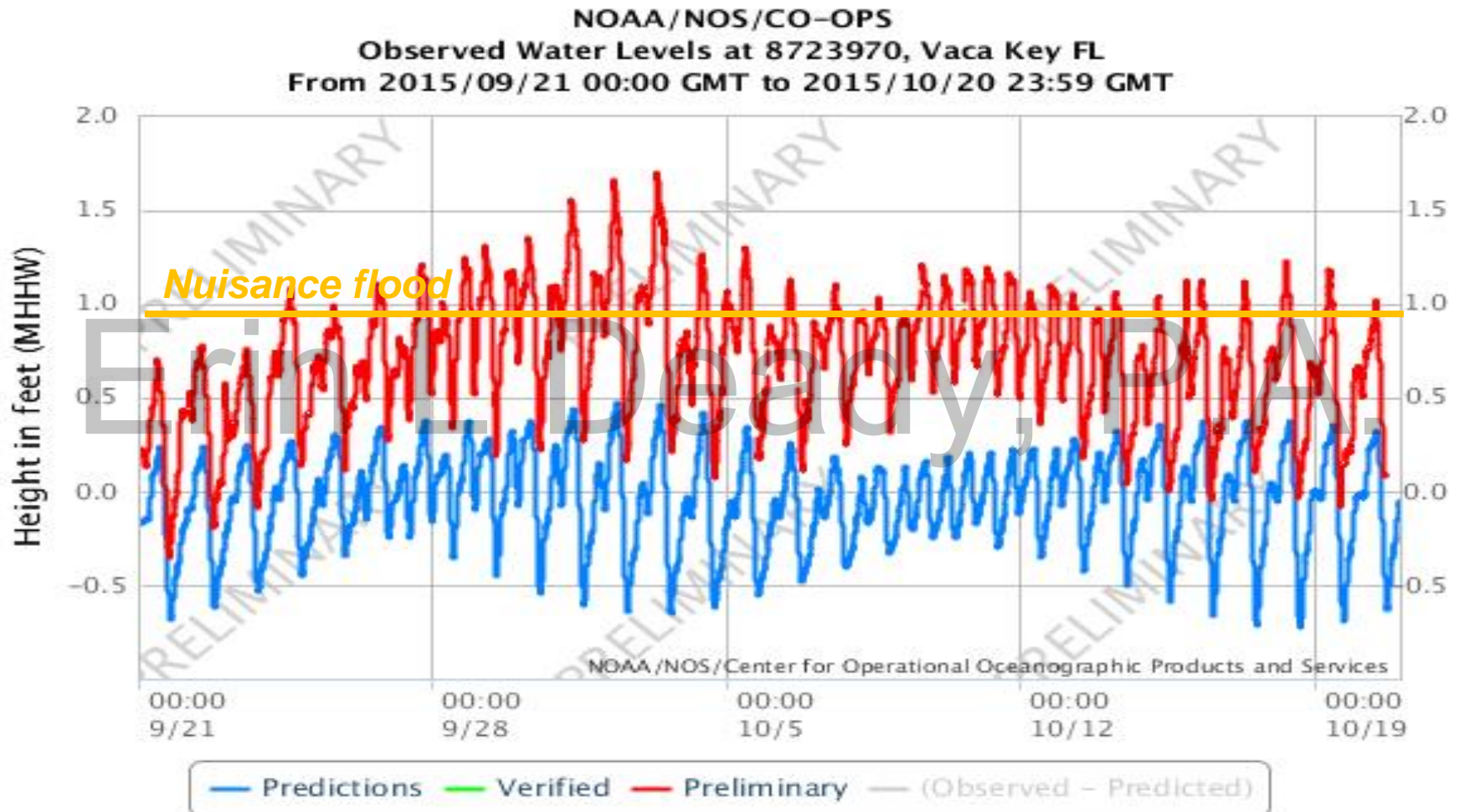


# Key Largo: Shaw Drive 7" of Sea Level Rise (2030 High Scenario)





# Fall 2015: Predicted vs. Observed



September 21 – October 20 tides

# Issue #1: Integrating Road, Stormwater, Tidewater Design

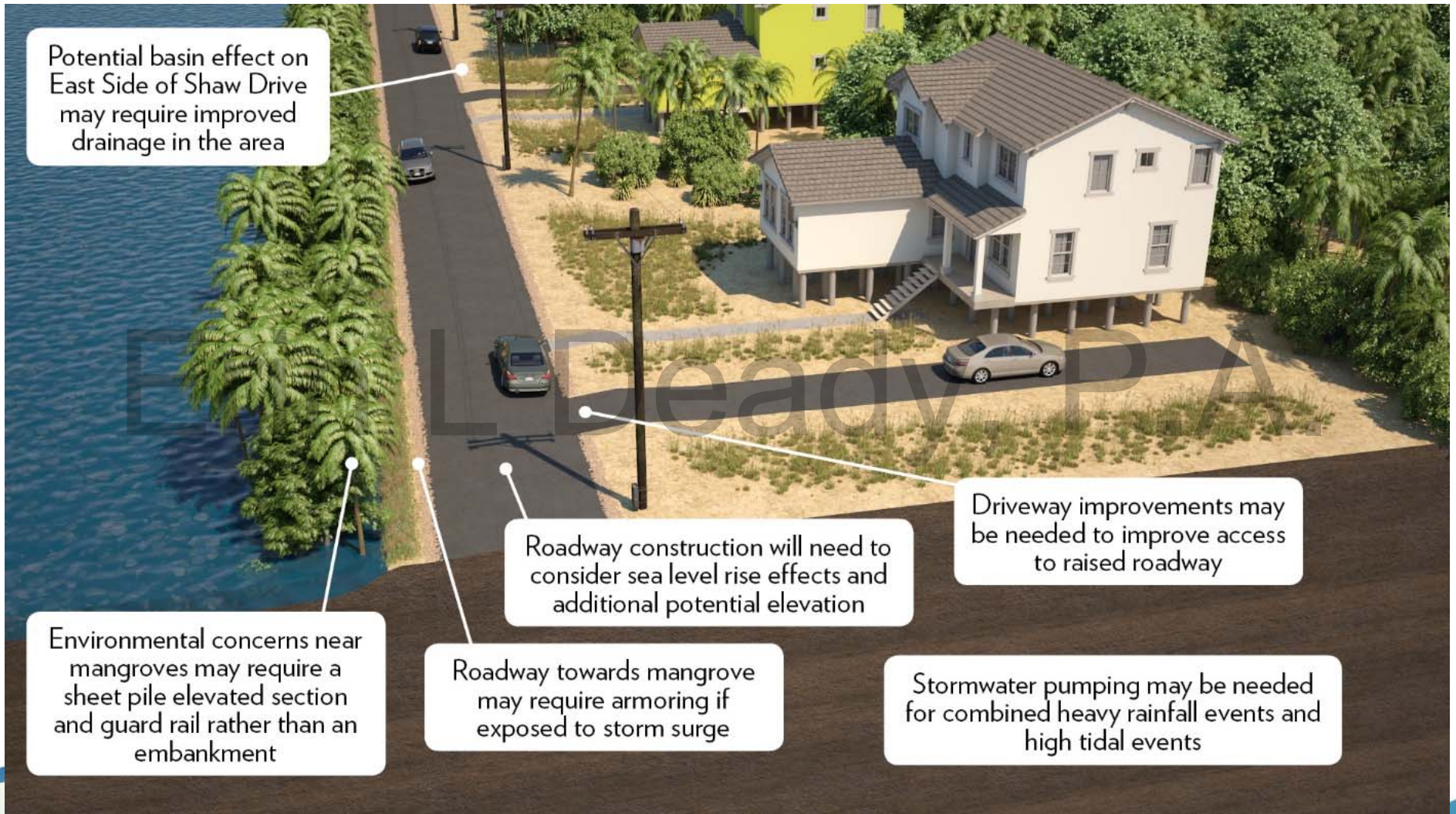
- County's Current Approach:
  - County currently maintains LOS per Comprehensive Plan
  - Road requirements in the Code:
    - CR905 & secondary roads – level D
    - US Highway 1 - level C
  - **Current approach does not consider impacts of sea level rise on LOS**
- Potential Solutions:
  - Environmentally Challenging Locations
  - Minimum Maintenance Roads
  - Flood Protection Level of Service



Photo Credit: J. Stiner



# Shaw Drive: Issues and Considerations





# Issue #1: Integrating Road, Stormwater, Tidewater Design

## ■ Next Steps for Monroe County:

- Review current road design criteria and permitting considerations
- Identify opportunities/constraints in areas that see future flood impacts near term
- Develop alternative designs to address alternative LOS
  - Sea level rise LOS – what should be considered? And to what extent?
    - SLR only? El Nino? Other things?
- Decide on LOS for various infrastructure County-wide
- Adopt policy to manage expectations on future LOS



Photo Credit: [www.thebyard.com](http://www.thebyard.com)

## Issue #2: Land Acquisition Priorities

### ■ Issues:

- County facing large commitments on future land acquisition as ROGO units diminish
- Numerous factors influence land acquisition strategy such as location, environmental quality, value, future quality and maintenance responsibility
- Factors will be impacted by SLR and climate change



Photo Credit: Unknown



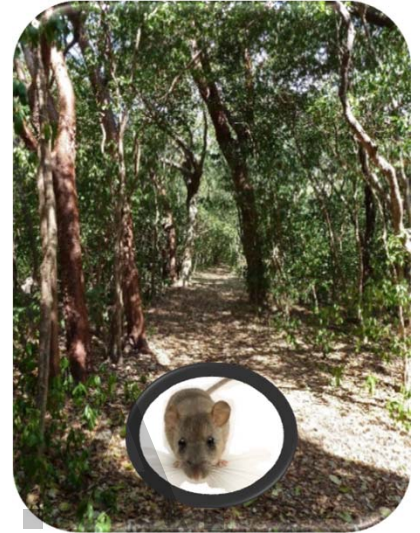
Photo Credit: Unknown



## Habitat Vulnerability Results

- 3" SLR (2030, Low Scenario) could bring daily saltwater tides into 19% of County's freshwater wetland areas\*
- 24" SLR (2060, High Scenario) could bring daily saltwater tides into **94%** of County's freshwater wetland areas\*
- 3" SLR (2030, Low Scenario) could bring daily saltwater tides into 2.3% of County's remaining tropical hardwood hammock\*
- 24" SLR (2060, High Scenario) could bring daily saltwater tides into **42%** of County's remaining tropical hardwood hammock\*
- 3" SLR (2030, Low Scenario) could bring daily saltwater tides into 1.8% of County's pine rockland forest areas\*
- 24" SLR (2060, High Scenario) could bring daily saltwater tides into **45.1%** of County's remaining pine rockland forest areas\*

\*Analysis based on Monroe County Habitat dataset (2009)



# Issue #2 Potential Solution: July 25, 2014 BOCC Action

■ 2015 TPL Report:

- Identified 4 viable opportunities for financing acquisitions
  - General obligation bonds
  - Property tax
  - Sales and use tax
  - Special district
- Appendix D provides Model Criteria for Land Acquisitions (dated January 26, 2015)

Goal	Criteria	Criteria Weight
<b>Significant Constraints</b>	Submerged Land	50%
	Incidental Take Permits	50%
TOTAL		100%
<b>Conservation Priorities</b>	Upland native habitat	15%
	Tier 1 Assessments	20%
	Wetland type	10%
	Species focus area	10%
	Species focus area buffer areas	10%
	Florida Forever projects boundary	20%
	FEMA CRS areas	15%
TOTAL		100%
<b>Development Compatibility</b>	Tier 1 and NIA Assessments	15%
	Tier III Assessments	10%
	Canal frontage	10%
	FEMA V zones	20%
	Clear Zones	20%
	AICUZ > 65 DNL	20%
	Infrastructure facilities	5%
TOTAL		100%
<b>Sea Level Rise</b>	Sea Level rise 1" or Greater	100%
TOTAL		100%



## Issue #2: Land Acquisition Priorities

- Next Steps for Monroe County:
  - Review future land acquisition needs and constraints
  - Summary of current factors driving land acquisition decisions
  - Determine what considerations are missing to address SLR and climate vulnerability
  - Determine data needs and updates (such as re-running SLAMM with better elevation data)
  - Adopt policy or direction to address more comprehensive criteria



Photo Credit: [www.thebyard.com](http://www.thebyard.com)

## Issue #3: Where People Develop and How

### ■ Issue:

- In future, SLR will impact infrastructure that serves neighborhoods
- Certain infrastructure may be unable to be maintained the way it is today
- In more vulnerable areas, public health, safety and welfare may dictate that development/redevelopment may not be able to occur or be more regulated

### ■ County's Current Approach:

- New Development limited by ROGO; current regulations include setbacks/buffer, require elevation
- Redevelopment influenced by TDR program but not currently structured to include SLR; no current consideration of rolling easements



Photo Credit: B. Shillinger

## Issue #3: Where People Develop and How

### ■ Potential Solutions:

- Adaptation Action Areas
- Sea Level Rise Overlay Zones
- Codes and Regulations
  - Resilient Design Standards
  - Setback and Buffer Zones
  - Rolling Easements
  - Transfer Development Rights
- Relocation



Photo Credit: A. Higgins



Photo Credit: G. Corning



## Issue #3 Potential Solution: Codes and Regulations

### ■ Resilient Design Standards:

- FORTIFIED Home standards added to Code to incentivize stringent building standards; add to ROGO.
  - AL, MS, NC - enforced mandatory insurance credits if home has one of these certifications at state level
    - Orange Beach, AL put into code
    - Moore, OK put in place measures to strengthen properties against tornadoes that reflect recommendations in FORTIFIED program
  - FORTIFIED Home™ is set of engineering/building standards designed to help strengthen new/existing homes through system-specific building upgrades to minimum building code requirements that will reduce damage from specific natural hazards. Three levels of designation:
    - Bronze - addresses improving roof system, attic ventilation system
    - Silver - addresses improving exterior opening protection
    - Gold - addresses design/installation of continuous load path





## Issue #3 Potential Solution: Relocation

### ■ Longboat Key Case Study:

- Defense against coastal erosion and SLR is beach renourishment and relocation, demolish susceptible/destroyed ones and replace with inland, elevated homes
- Property value in land not structures, so moving homes is economically unfeasible
- Owners choose to demolish rather than purchase new land to move shoreward
- Example of difficulty of relocation as response to SLR, no government action taken
- What can be learned from Longboat Key:
  - relocation is feasible response to shifting coastlines
  - buildings that are realistic to move and availability of space to which to move are minimum requisites
  - when property value resides almost exclusively in land, little likelihood of structures being moved.



Photo Credit: [www.premiumpropertiessarasota.com](http://www.premiumpropertiessarasota.com)

## Issue #3: Where People Develop and How

### ■ County's Next Steps:

- Determining what developable areas in County will be impacted the greatest and where enhanced data can put a finer point on those impacts (elevation data)
- Determine what County's responsibilities are for maintaining infrastructure supporting those areas
- Make level of service determinations on what is feasible in those areas in future
- Modify land development regulations and land uses accordingly

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*next steps*

Photo Credit: [www.thebyard.com](http://www.thebyard.com)

## Issue #4: How Do We Collaborate, Plan for and Fund these Issues

### ■ Issue:

- Issues related to this type of future planning are complex
- In government, silos form where cross-departmental coordination is not clear
- Several areas where collaboration could occur
  - infrastructure design
  - facilities retrofits
  - land development regulations
  - legislative goals
  - capital planning and budgetary process
  - legal input

### ■ County's Current Approach:

- Numerous places where this collaboration occurs at high level, but it needs to occur at a more detailed level on a more consistent basis
- Collaboration is preliminarily beginning for current projects and can be expanded for projects in the CIP (through 2020) and all future capital projects beyond



Photo Credit: [www.collativepro.com](http://www.collativepro.com)



## Issue #4: How Do We Collaborate, Plan for and Fund these Issues

### ■ County's Next Steps:

- Policy direction to make collaboration a leading principle in service delivery
- Specific coordination to manage implementation of Plan recommendations
- Collaboration on project design to address future flood risk
- Assuring project design or County equipment/asset acquisitions factor in most energy efficient alternatives to reduce cost and GHG emissions
- Coordinate on budget development/review to assure climate/SLR issues addressed
- Coordination between emergency management (LMS process), floodplain management, land development process to address future flood risk from SLR
- Aligning legislative opportunities with new climate/SLR priorities
- Legal issues – LOS, takings, etc.



Photo Credit: [www.thebyard.com](http://www.thebyard.com)

## Five Year Implementation Plan

- 162 recommendations from Action Plan were translated to a 5-Year Implementation Plan for Monroe County
- 5-Year Implementation Plan includes specific projects with cost and staff time estimates
- It also provides timeframes to implement specific projects and cross departmental coordination/budgeting for strategic planning purposes
- Plan is very inclusive – Monroe County can limit total projects / initiatives dependent on staff and financial resources

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# Five Year Implementation Plan – Sustainability Projects

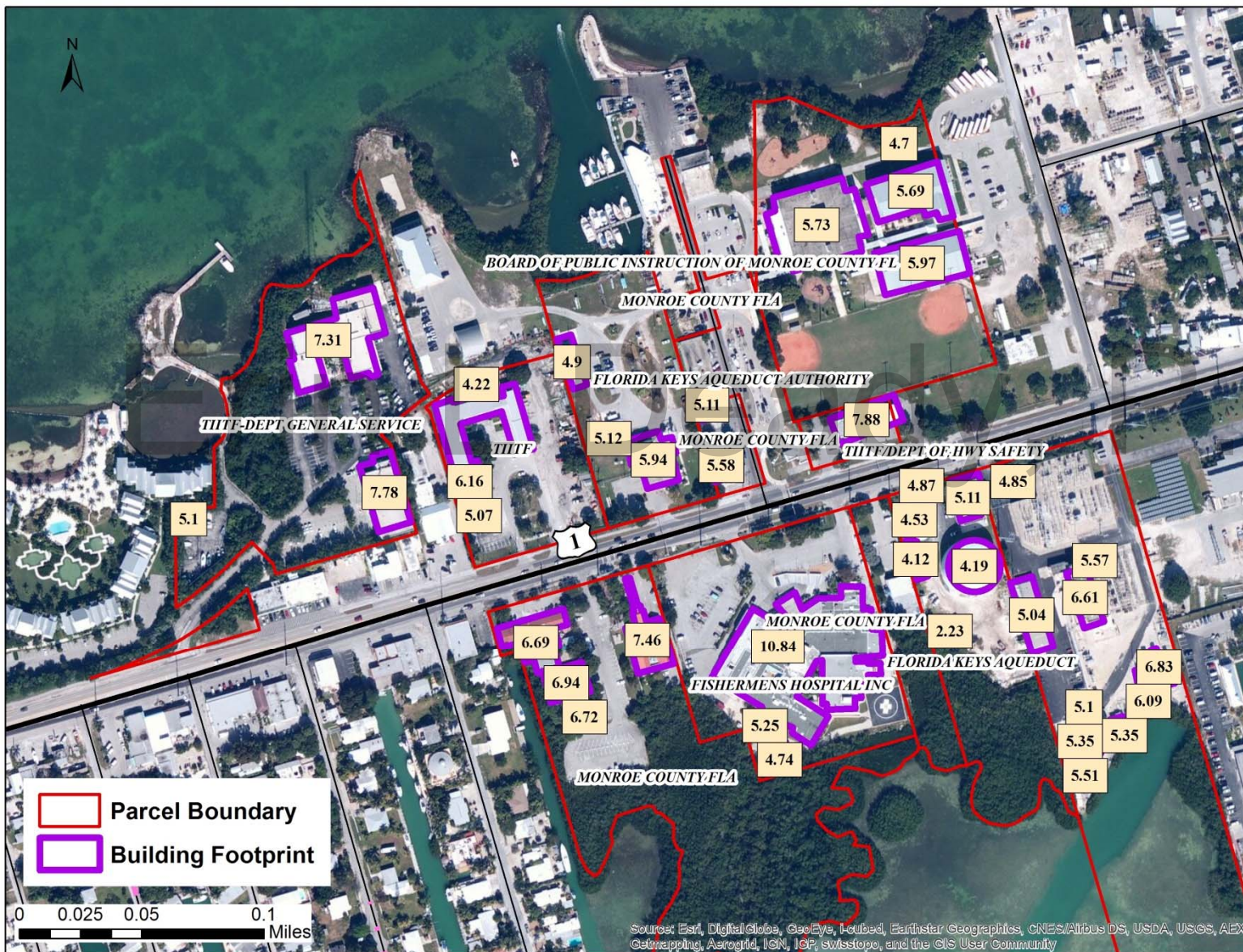
## Year 1 Projects:

1. Conduct next phase of energy auditing on County facilities and link upgrades to capital asset improvements. Install low-flow water conserving fixtures throughout County facilities.
2. Expand County's use of renewable energy (and vehicle charging stations) through a Solar Feasibility Study.
3. Develop better elevation data (LIDAR) County-wide.
4. Develop adaptation alternatives for vulnerable County facilities and infrastructure based on 2030 sea level rise scenarios.
5. Pilot project to conduct a Comprehensive Feasibility Study for Enhanced Stormwater and Tidewater Criteria (prioritizing areas) for near-term areas subject to inundation risk, including nuisance flooding (in two locations).
6. Perform further analysis with improved elevation data for the Bay Manor assisted living retirement home (subject of a pending grant application).
7. Develop a geographic database to document nuisance flooding events.
8. Hold three (3) community workshops to discuss sea level rise with different stakeholders including realtors and Chambers.
9. Develop a Sustainability Handbook for business owners on the County's GreenKeys! website.
10. Continue invasive exotic species management.
11. Develop an analysis of useful infrastructure energy and sustainability rating systems to optimize planning for infrastructure, facilities and assets.

Can be done with existing staff resources



# Building Footprints: Government Infrastructure Marathon Government Center and Vicinity with Ground Elevations



Source: Esri, DigitalGlobe, GeoEye, Icube, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

A.

# Building footprints developed for 1,316 structures

## Local, state, federal government, and other critical infrastructure

FACILITY NAME	ADDRESS	FT ABOVE MHHW	TIDAL FLOOD RISK, HIGH SEA LEVEL RISE SCENARIO	TIDAL FLOOD RISK, LOW SEA LEVEL RISE SCENARIO
TOWER 31 CRAIN ST	TOWER 31 CRAIN ST	1.04	Possible Inundation, 2030	Likely Nuisance, 2030
HARRY HARRIS OCEAN PARK	DOVE CREEK	1.11	Likely Nuisance, 2030	Likely Nuisance, 2030
MURRAY NELSON GOVERNMENT COMPLEX	102050 OVERSEAS HWY	1.17	Likely Nuisance, 2030	Likely Nuisance, 2030
SUGARLOAF SCHOOL	255 CRANE BLVD	1.24	Likely Nuisance, 2030	Possible Nuisance, 2030
310 AVENUE B	310 AVENUE B	1.26	Likely Nuisance, 2030	Possible Nuisance, 2030
BERNSTEIN PARK	6751 5TH ST	1.33	Likely Nuisance, 2030	Possible Nuisance, 2030
320 AVENUE B	320 AVENUE B	1.42	Likely Nuisance, 2030	Possible Nuisance, 2030
SALT PONDS BUNKER AREA	SOUTH OF LINDA AVE	1.46	Likely Nuisance, 2030	Possible Nuisance, 2030
AIR CARGO AMERICA/FEDERAL EXPRESS DRIVE-IN THEATER	3491 S ROOSEVELT BLVD	1.54	Possible Nuisance, 2030	Possible Nuisance, 2030
BERNSTEIN PARK	5030 5TH AVE	1.56	Possible Nuisance, 2030	Possible Nuisance, 2030
BERNSTEIN PARK	6751 5TH ST	1.57	Possible Nuisance, 2030	Possible Nuisance, 2030
POINCIANA ELEMENTARY SCHOOL	1212 14TH ST	1.65	Possible Nuisance, 2030	Possible Nuisance, 2030
MURRAY NELSON GOVERNMENT COMPLEX	102050 OVERSEAS HWY	1.68	Possible Nuisance, 2030	Possible Nuisance, 2030
330 AVENUE B	330 AVENUE B	1.77	Possible Nuisance, 2030	Possible Nuisance, 2030
MURRAY NELSON GOVERNMENT COMPLEX	102050 OVERSEAS HWY	1.84	Possible Nuisance, 2030	Possible Nuisance, 2060
KEY WEST INTERNATIONAL AIRPORT	3491 S ROOSEVELT BLVD	1.88	Possible Nuisance, 2030	Possible Nuisance, 2060
KEY WEST INTERNATIONAL AIRPORT	3491 S ROOSEVELT BLVD	1.88	Possible Nuisance, 2030	Possible Nuisance, 2060
KEY WEST INTERNATIONAL AIRPORT	3501 S ROOSEVELT BLVD	1.88	Possible Nuisance, 2030	Possible Nuisance, 2060
OVERSEAS HWY	OVERSEAS HWY	1.88	Possible Nuisance, 2030	Possible Nuisance, 2060
340 AVENUE B	340 AVENUE B	1.92	Possible Nuisance, 2030	Possible Nuisance, 2060
POINCIANA ELEMENTARY SCHOOL	1212 14TH ST	1.99	Possible Nuisance, 2030	Possible Nuisance, 2060



# County Awarded Sea Grant Funding

Obtain all available Elevation Certificates for Monroe County facilities

Digitize into building footprint layer and parcel dataset in cooperation with Monroe County GIS and Property Appraiser's Office

Collate and digitize information on stormwater infrastructure for US 1 corridor in unincorporated County

Use new data to develop advanced flood assessment models using the FEMA Hazus program

Facilitation assistance for prioritization of adaptation projects, as well as identification of potential funding options

"Official" start date is February 1, 2016, but more likely to receive federal funds by April or May

## South Atlantic Regional Research on Coastal Community Resilience



### SOUTH ATLANTIC REGIONAL RESEARCH ON COASTAL COMMUNITY RESILIENCE

Call for Proposals for Applied Community-Based Research Projects

Deadline: May 29, 2015  
(4:00 PM Eastern Standard Time)

This document is in two sections:  
**A. Funding and Proposal Information**  
**B. Proposal Guidelines**

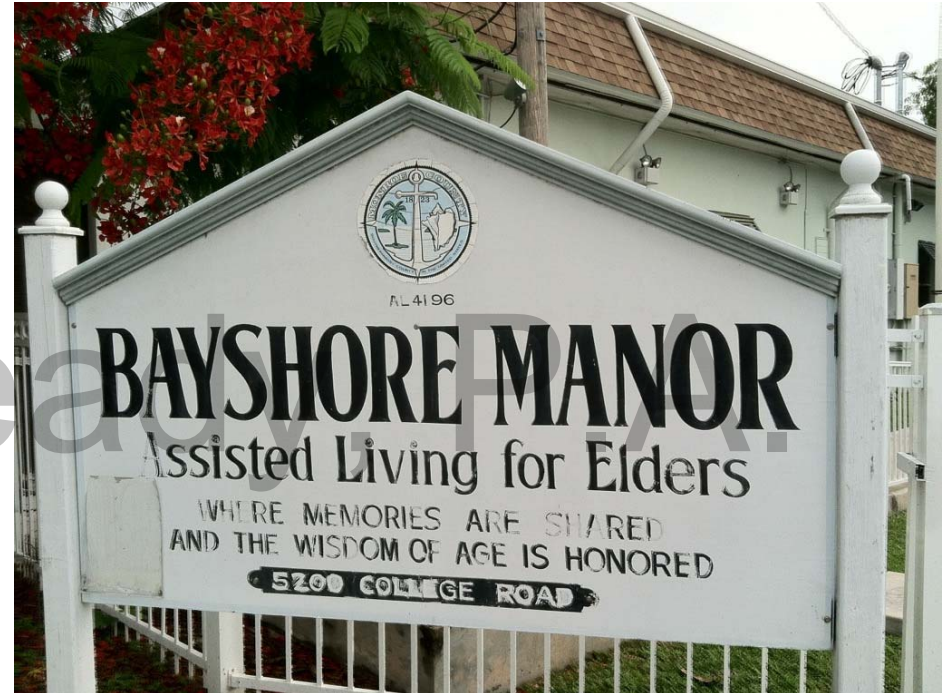
For electronic access to this document:

April 6 to May 29, 2015  
<https://www.flseagrant.org/funding/open/>



# County Awarded Coastal Partnership Initiative Grant

- Vulnerability Assessment for Bayshore Manor Assisted Living Facility
- Facility was identified as vulnerable being 4.19' above MHHW
- Analysis will include failure points, cost of repair, alternatives analysis and impacts to community on loss of facility



## Next Steps



Climate and Energy



Government Operations



Health and Safety



Natural Systems



Built Environment



Economy and Jobs



Equity and Empowerment



Education, Arts and Community

- Finalize graphics/lay out of GreenKeys Plan
- Launch NOAA Grant
- Launch CPI Grant
- Determine path on County LIDAR elevation data
- Complete Pilot on Alternative Road Design for Big Pine and Key Largo Neighborhoods
- Initiate first suite of projects in 5 Year Work Plan



[www.greenkeys.info](http://www.greenkeys.info)