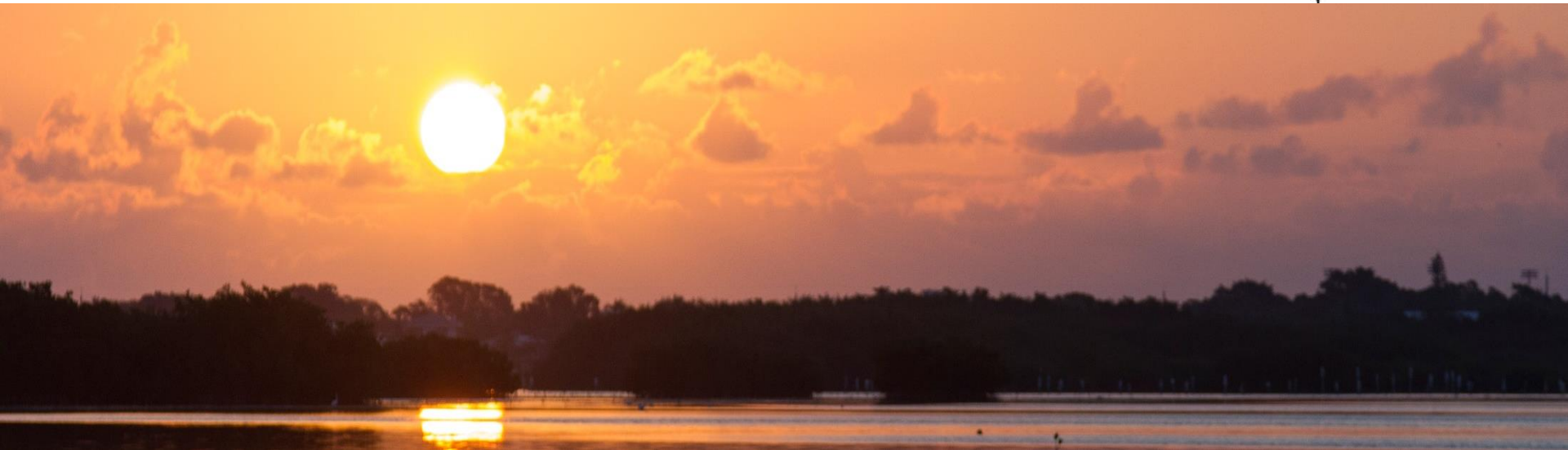


GreenKeys!:

A Case Study on SLR in the Florida Keys

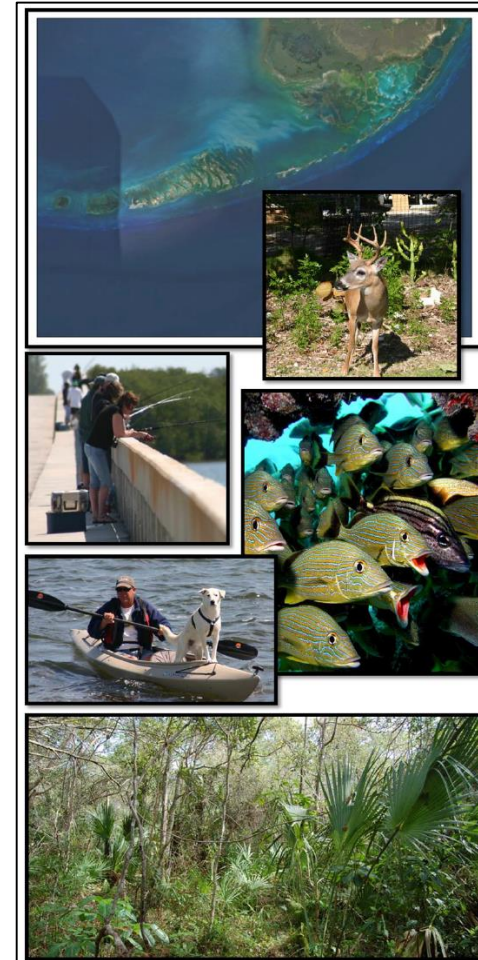
Erin Deady, Esq., AICP, LEED AP



2010- Monroe County Comprehensive Plan



- Decision to create new Energy and Climate Element
- Two (2) specific references to sea level rise in the Coastal Management Element of their updated Comprehensive Plan
- No comments back from DEO on need for further compliance with SB 1094 (“Peril of Flood”)
- Comprehensive Plan Amendment through 2030 approved by DEO June 2016



Monroe County
Year 2030
Comprehensive
Plan
Policy Document



As Adopted by the Board of County
Commissioners on April 13, 2016

Decision Making Paradigm Shift



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

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

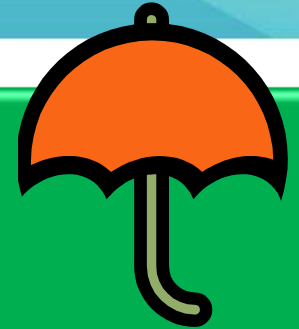


Project Planning-
Addressing Priority Vulnerabilities,
Budget Implications (New Cost Considerations),
Also Departmental Collaboration

Overview of GreenKeys! Planning Process

GreenKeys!

A Plan to Create a Sustainable Florida Keys



Climate: Forecasting Tools & Modeling

County Assets
Infrastructure
Habitat

Community
Impacts

Sustainability: GHGEs

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

Data Collected: Climate/Sea Level Rise Analysis

| | |
|------------------------------|---|
| Nuisance Flooding | <ul style="list-style-type: none">• NOAA Digital COAST 2030 and 2060 scenarios |
| Water/ Wastewater | <ul style="list-style-type: none">• FCAA As Built Drawings and GIS 2030 and 2060 scenarios |
| Water Supply | <ul style="list-style-type: none">• USGS Integrated surface - groundwater model to determine saltwater intrusion impacts for wellfields at 2030 and 2060 |
| Roads | <ul style="list-style-type: none">• FDOT Sketch Tool and County Pavement Condition Index (2014) 2030 and 2060 scenarios |
| Habitat | <ul style="list-style-type: none">• 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 | <ul style="list-style-type: none">• FKEC and Keys Energy facilities data and GIS 2030 and 2060 scenarios |
| County Facilities | <ul style="list-style-type: none">• Point locations of County-owned buildings (2006 GIS Mapping) 2030 and 2060 scenarios |
| Elevation Data | <ul style="list-style-type: none">• 2008 Department of Emergency Management LiDAR (Light Detection and Ranging) |

Increase in “Nuisance Flooding”



1980-
1982

**.67 per
year**



2010-
2012

**2.3 per
year**



2030 at 3”

**20 per
year**



2030 at 7”

**78 per
year**



2060 at 9”

**139 per
year**



2060 at
24”

**672 per
year**

3x 2010

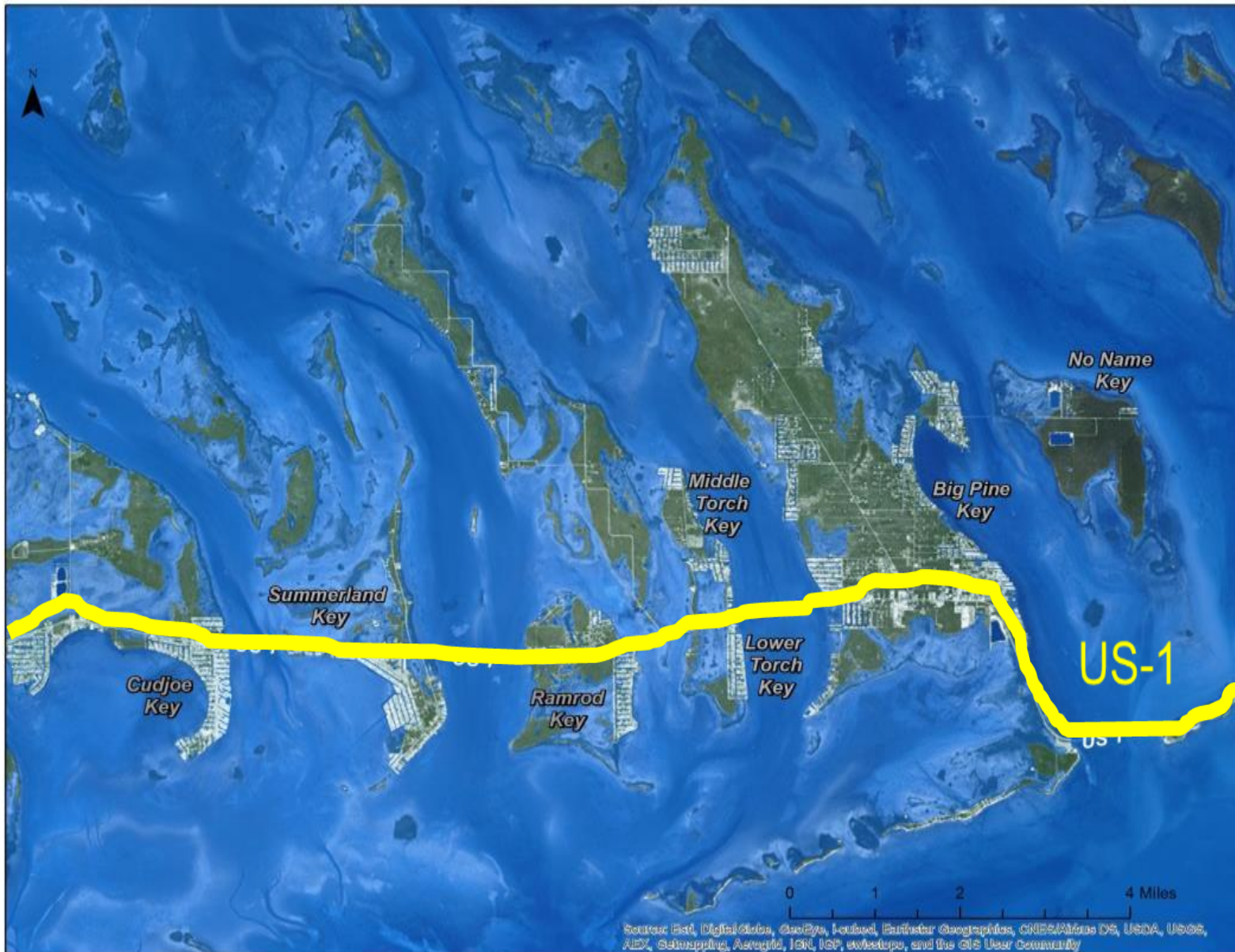
9x 2010

34x 2010

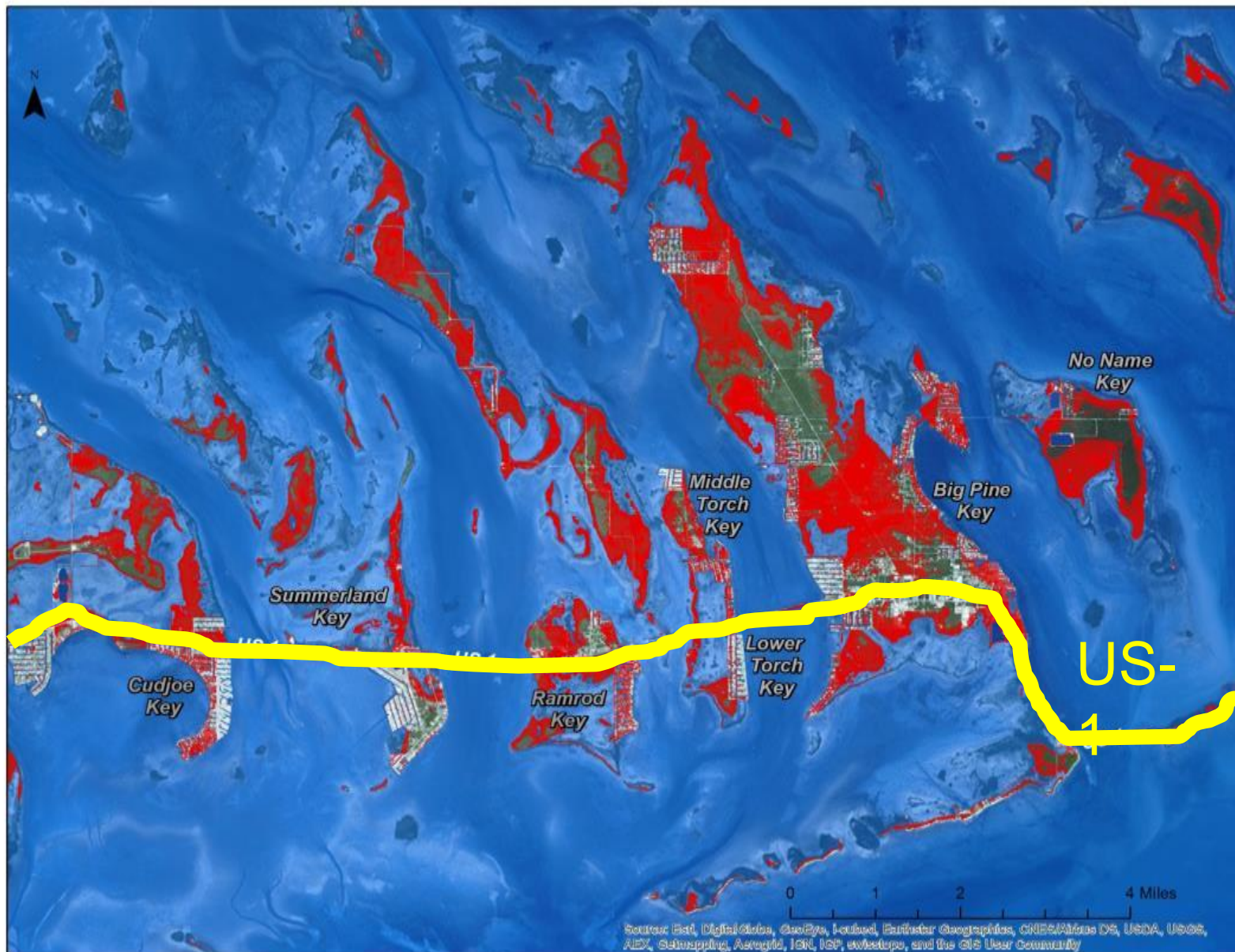
60x 2010

Flooding
more than
1x per day

Big Pine Key and Vicinity, Present Day



Big Pine Key and vicinity, 24 inches Sea Level Rise (2060, High Scenario)



GreenKeys! Project Update

- The following documents were completed as part of the
 - GreenKeys! Sustainability Action Plan At a Glance
 - GreenKeys! Sustainability Action Plan Executive Summary
 - Plan Doc with Technical Appendices
 - 5-Year Projects Plan (181)



5-YEAR WORK PLAN



GreenKeys! provides 165 recommendations for the County and its residents to become more resilient and sustainable.

5-Year Projects Plan

MONROE COUNTY SUSTAINABILITY ACTION PLAN

ADDENDUM



GREENKEYS! SUSTAINABILITY ACTION PLAN 5-YEAR WORK PLAN

| Year 1 Projects (2016) | | | | | |
|--|-------------------|---|--------------|------------------------------|--|
| Recommended Projects | Year to Implement | Projected Cost/Level of Effort | STAR Overlap | Grant Available ¹ | Responsible Department |
| 1-1 Hold three (3) community workshops to discuss sea level rise with stakeholders. | Ongoing | Staff time - 90 hrs.; \$1,500 Advertisement Cost | | N | Sustainability |
| 1-2 Provide annual progress reports on the implementation of the GreenKeys! Sustainability Action Plan. | Ongoing | Staff time - 20 hrs. | | N | Sustainability |
| 1-3 Maintain and enhance programs, like canal restoration, to improve water quality nearshore and offshore to reduce environmental stressors exacerbated by sea level rise and increasing ocean temperatures. | Ongoing | Staff time - 200 hrs.+ cost of canal restorations | | N | Sustainability |
| 1-4 Address sea level rise and climate change resilience in annual County budgeting process. | Ongoing | Staff time - 40 hrs. | | N | Sustainability Budget |
| 1-5 Update annual legislative package to include sustainability and sea level rise practices. | Ongoing | Staff time - 30 hrs. Coordination | | N | Legislative Affairs Sustainability |
| 1-6 Continue canal restoration, sea level rise, and land acquisition programs. | Ongoing | Coordination | | N | Sustainability IFAS Land Authority |
| 1-7 Encourage worksite wellness programs that provide physical activity and weight loss programs at work. | Ongoing | Staff time - 30 hrs. | | N | Employee Services |
| 1-8 Create an internal and external Sustainability Newsletter for distribution. | Ongoing | Staff time - 40 hrs. | | N | Sustainability IFAS |
| 1-9 Continue supporting the implementation of traditional coral reef management actions as strategies for supporting the maintenance of functional coral reef systems under rapid climate change. Such actions should include decreasing nutrient and sediment loads, continued restoration of apex predator populations, and creation of physical reef structures that may enhance recruitment of hard coral species. | Ongoing | Coordination | | N | All Departments |
| 1-10 Continue cooperation with federal, state, and private partners in support of coral reef restoration initiatives to support the implementation of strategies that may promote long-term recovery and resilience of the Florida Keys coral barrier reef system in the face of future climate change. | Ongoing | Staff time - 100 hrs. Coordination | | N | All Departments and Coordination with other Agencies |
| 1-11 Continue invasive exotic species management. | Ongoing | Staff time - 50 hrs. annually | | N | Land Authority |

¹ See the Implementation Matrix in Appendix G of the GreenKeys! Sustainability Action Plan for more detail on available grants.

Page 1

Year 1



YEAR 1
42
PROJECTS

YEAR 2
49
PROJECTS

YEAR 3
44
PROJECTS

YEAR 4
24
PROJECTS

YEAR 5
22
PROJECTS

- Provides the recommended projects (181) for implementation over the next five (5) years
- Projects provided in tabular format for Years 1-5
- In addition to the project list, includes:
 - Associated cost/staff time (hours) to implement
 - Department responsible for implementation
 - Availability of grants to assist with project funding
 - Cross reference to other initiatives like Regional Climate Action Plan

5-Year Projects Plan Details

| Year to Implement | Number of Projects | Staff Time (Hours) Required to Complete All Projects | Financial Cost of Project Implementation* |
|-------------------|--------------------|--|---|
| Year 1 | 42 | 2,835 | \$1,489,500 |
| Year 2 | 49 | 4,265 | \$2,866,500 |
| Year 3 | 44 | 3,965 | \$744,500 |
| Year 4 | 24 | 2,035 | \$936,500 |
| Year 5 | 22 | 1,620 | \$621,500 |

*Cost totals may not be completely accurate or all inclusive. Estimations used for select recommended projects (e.g. require per fixture energy and water conservation improvements, perform next round of energy audits, or those involving per facility feasibility assessments) for total cost generation purposes.

Workshop Overview- January 26, 2016

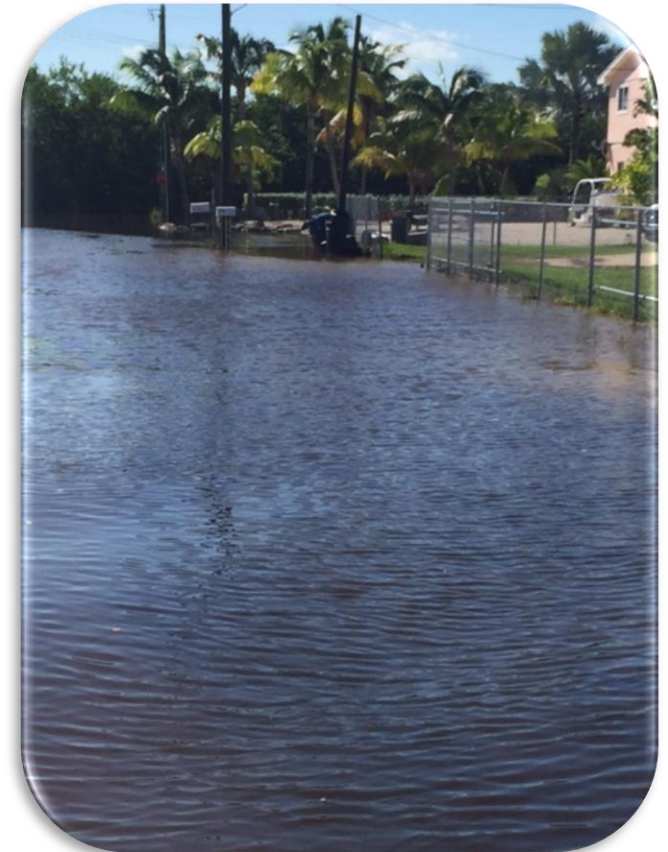
■ Goal: Overview and interactive discussion of GreenKeys! project, next steps

- Introduction
- Planning Approach – summary of GreenKeys! Plan approach and GHG summary
- Executive Summary - overview of GreenKeys! Plan results and vul
- 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



BIG PICTURE Issues from GreenKeys! Plan Development

1. **Integrating Road, Stormwater and Tidewater Design**
2. Land Acquisition Priorities
 - Do we buy environmentally sensitive land subject to future sea level rise?
3. Where Do We Develop and How?
 - Do we avoid building on the coast or where SLR will inundate the property?
4. How Do We Collaborate, Plan for and Fund these Projects?
 - More than 300 miles of County roads may need elevation



Specific Case Study: Pilot Roads Analysis



- “Pilot” Roads project to establish design scenarios in Big Pine and Key Largo (with future LOS)- Landing in November
- NOAA grant for better vulnerability analysis (HAZUS)
- Elevation data – LIDAR countywide (RFP Pending)
- Countywide roads/stormwater/tidewater analysis (RFP in development)

October 2015 King Tide- Key Largo,
Shaw Drive
15-18” of saltwater for 3 weeks

Integrating Road, Stormwater & Tidewater Design

1. Roads flooding now, will continue in future
2. Rain driven road flooding to become more unpredictable
3. Roadwork will impact adjacent parcels – stormwater issues
4. Road design will need to factor in:
 - a) **Additional tidewater impacts** from extreme, more regular inundation
 - b) **Reduced capacity for drainage**
 - c) Additional environmental / regulatory constraints
5. Use adopted Levels of Service for varying infrastructure to manage County's financial responsibility and people's expectations
 - a) Some roads may be abandoned or have high levels of water several times through the year.

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

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



Integrating Road, Stormwater & Tidewater Design

1. COUNTY'S CURRENT APPROACH:

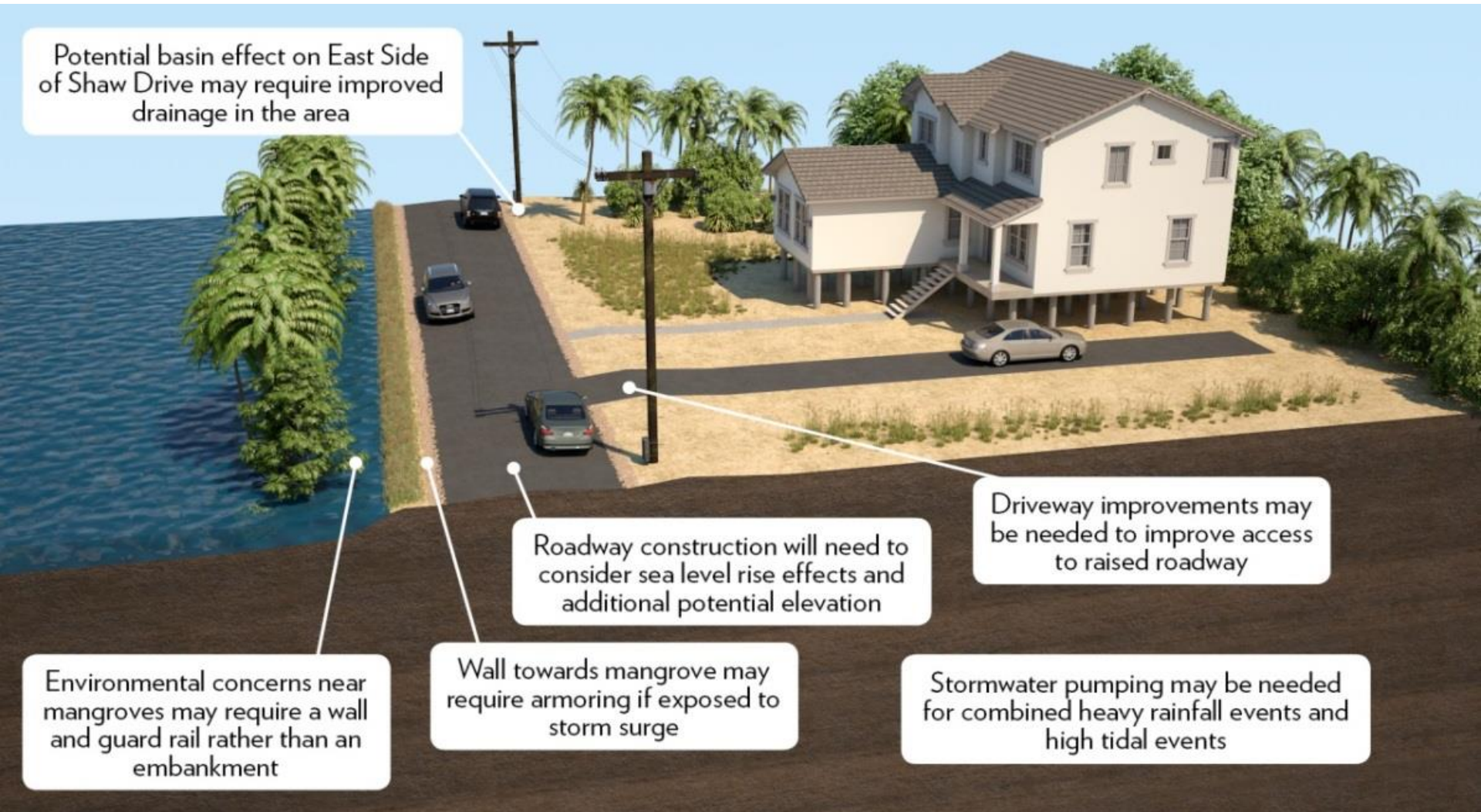
- a) County currently *maintains* Levels of Service per Comprehensive Plan
- b) Road requirements in the Code:
 - CR905 & secondary roads – level D
 - US Highway 1 - level C
- c) Current approach does *not* consider impacts of sea level rise on Levels of Service

2. POTENTIAL SOLUTIONS:

- a) Environmentally Challenging Locations
- b) *Minimum Maintenance* Roads
- c) Flood Protection *Level of Service*
 - How many times a year will some level of flooding be allowed?



Initial Results – Cost Estimates



Tidal Flooding October 2015 – Key Largo & Big Pine Key



Drainage Conditions Today

Raise the Road to
Address Flooding -
Respond to
Stormwater
Requirements



Gravity and Infiltration

Future Drainage Conditions With SLR

Recommendation for
a Closed drainage
system



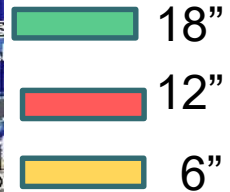
Limited/No Drainage Capacity

Roads “Pilot Project”

1. Conduct a Pilot of Sea Level Rise Effects on Design Strategies
2. Analyze Tidal Data to Determine Future Effects of Sea Level Rise and Identify Target Elevations
3. **Estimate Costs of Design Strategies to Roadway Design Out-Year (2040)**
4. Facilitate a Dialogue on Potential County Roadway Design Policies



Assessed Design Elevations – Example Key Largo



Total =
Elevation
&
Extent

Matching Design Elevations to Policy Responses

| Shaw Drive Community - Key Largo | | | | | | | | | |
|---------------------------------------|-------|------|---------------------|--------------------|-------------------|---------------------------|---------------------------|--|-----------------------------|
| All Elevations Shown in Inches NAVD88 | | | | | | | | | |
| | MSL | MHHW | 30 Days Annually | 7 Days Annually | 1 Day Annually | Avg Fall 2015 Event | Max Fall 2015 Event | | Key to Color Scheme |
| 2015 - Tidal Record | -11.0 | -7.0 | -4.0 | -1.0 | 2.0 | 6.7 | 18.0 | | 6" Roadway Elevation |
| 2040 Med SLR (+5.4") | -5.6 | -1.6 | 1.4 | 4.4 | 7.4 | 12.1 | 23.5 | | 12" Roadway Elevation |
| 2040 High SLR (+10.1") | -0.9 | 3.0 | 6.0 | 9.0 | 12.0 | 16.7 | 28.1 | | 18" Roadway Elevation |
| 2060 Med SLR (+11.5") | 0.5 | 4.4 | 7.4 | 10.4 | 13.4 | 18.1 | 29.5 | | 28" Roadway Elevation |
| 2060 High SLR (+22.1") | 11.1 | 15.1 | 18.1 | 21.1 | 24.1 | 28.8 | 40.2 | | Above 28" Roadway Elevation |

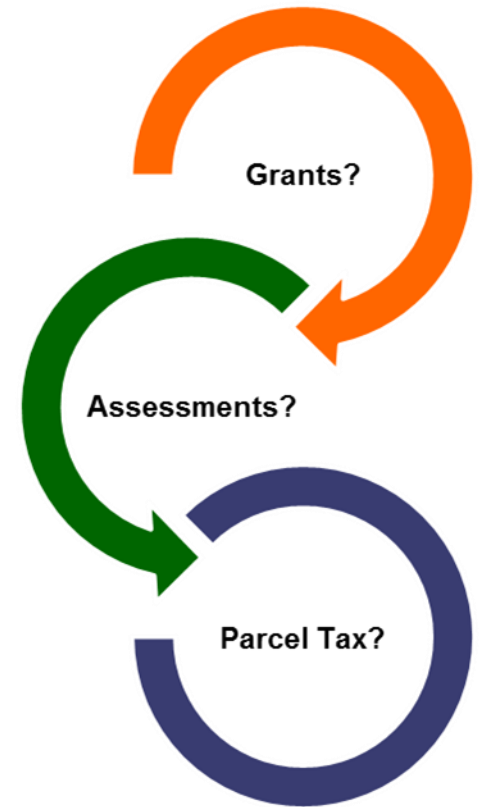
Where the Rubber Meets the Road

| Key Largo Community - Shaw Drive | | |
|----------------------------------|-----------------------------|---------------------------------------|
| | Length of Roadway Inundated | Total Elevation / Reconstruction Cost |
| 6" | 0.3 miles | \$0.92 million |
| 12" | 0.7 miles | \$4 million |
| 18" | 0.77 miles | \$5.8 million |
| 28" | 0.91 miles | \$7.3 million |
| Big Pine Key | | |
| 6" | 0.28 miles | \$2.22 million |
| 12" | 0.34 miles | \$2.63 million |
| 18" | 1.29 miles | \$8.9 million |
| 28" | 1.46 miles | \$10.5 million |

Implementation Issues

■ Long Term Roads/Capital Planning through Countywide Road/Tide/**Stormwater Assessment**

1. Identify *countywide vulnerabilities* and timing for retrofitting and *develop plan* for doing so
2. Adopt new County *policy* (Comp Plan)
3. *Levels of Service Ordinance* for specific projects or neighborhoods
4. Address County *design criteria* if needed
5. Work with State/Federal agencies on *rulemaking* to *remove barriers* for implementing projects that design to accommodate future flood risk
6. *Work with Communities* to Discuss Final Recommendations (Week of October, BOCC November)



Thank You

