SEA LEVEL RISE IN THE FLORIDA KEYS

FSBPA ANNUAL CONFERENCE

Hawks Cay

September 24, 2015

Rhonda Haag, Monroe County

SUSTAINABILITY AND CLIMATE MILESTONES

YEAR 2014

- GreenKeys! Launched
- SLR Data collection
- SLR modeling for 2030 and 2060
- Community SLR Modeling
- Community Outreach
- Plan Development

YEAR 2015

- Finalize GreenKeys! 5-year Sustainability Plan
- Begin implementation of Recommendations

THE PROJECT TEAM

Erin L. Deady, Esq., AICP, LEED AP

Jason Evans, PhD, Stetson University

Chris Bergh, The Nature Conservancy

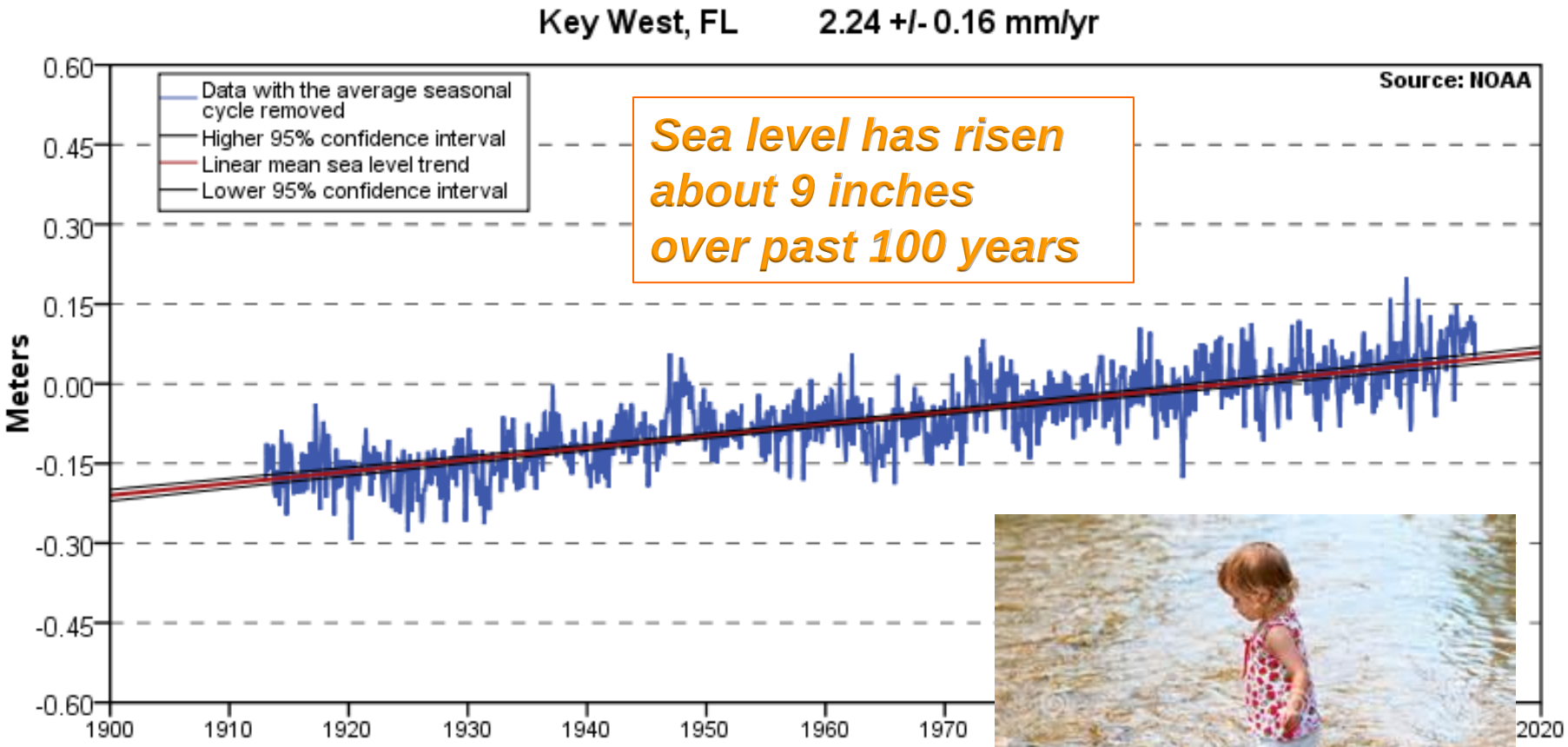
VHB/Miller Sellen

Catalysis Adaptation Partners

Quest Ecology

EcoSmart

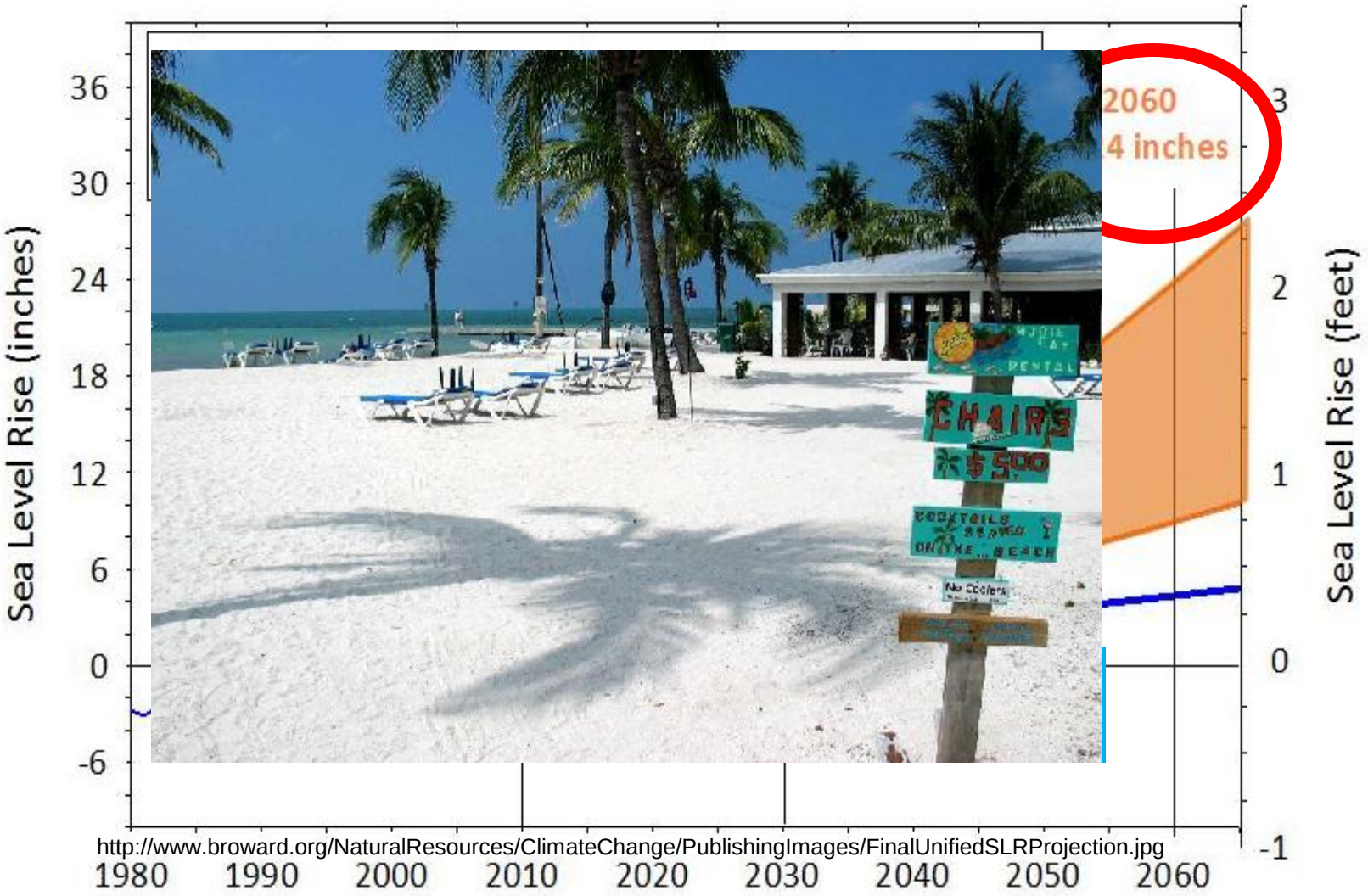
SEA LEVEL RISE IN MONROE COUNTY



Sea level has risen about 9 inches over past 100 years

SEA LEVEL RISE SCENARIOS

Adopted by Southeast Florida Regional Climate Compact



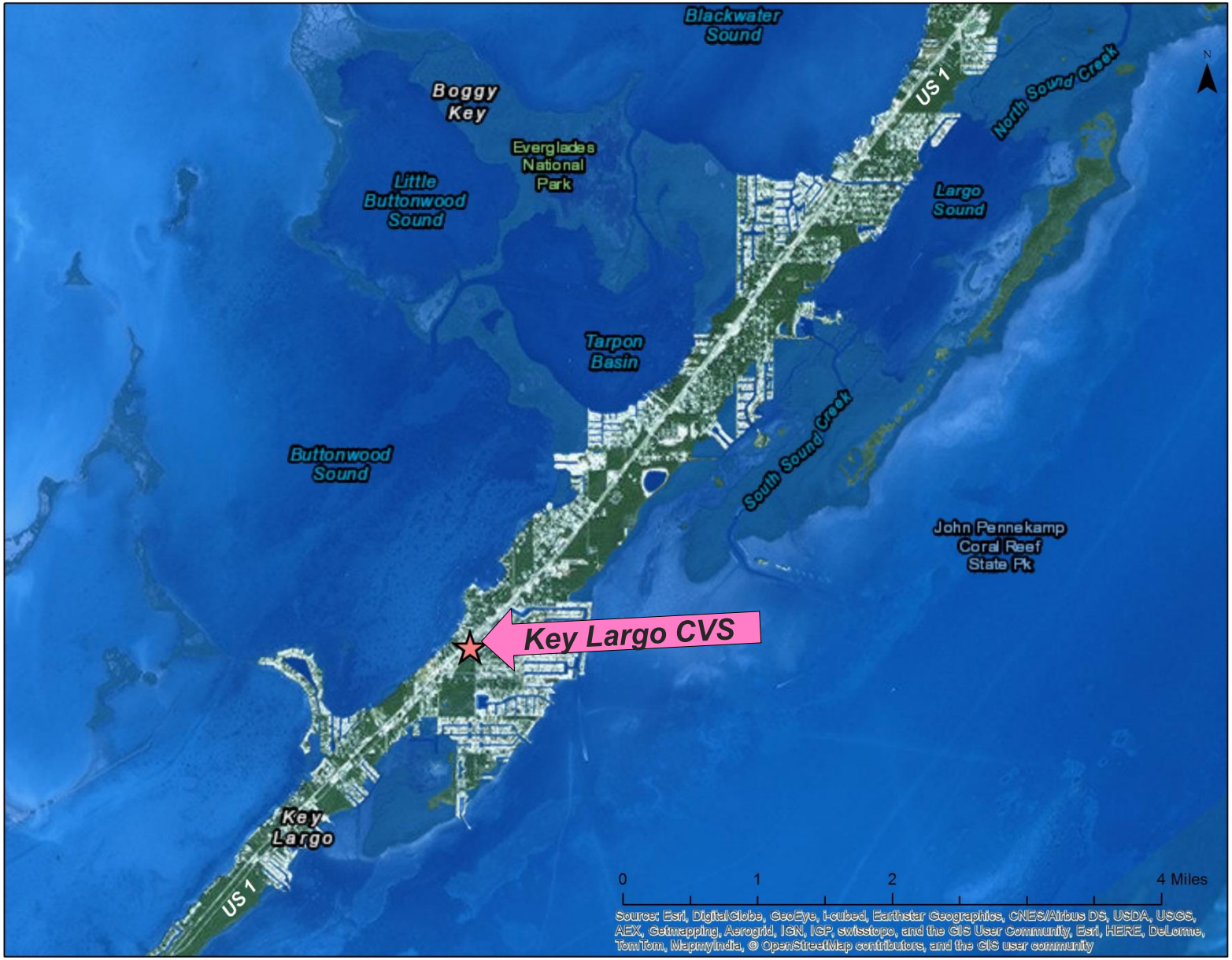
http://www.broward.org/NaturalResources/ClimateChange/PublishingImages/FinalUnifiedSLRProjection.jpg

THE BURNING QUESTIONS RELATED TO SEA LEVEL RISE

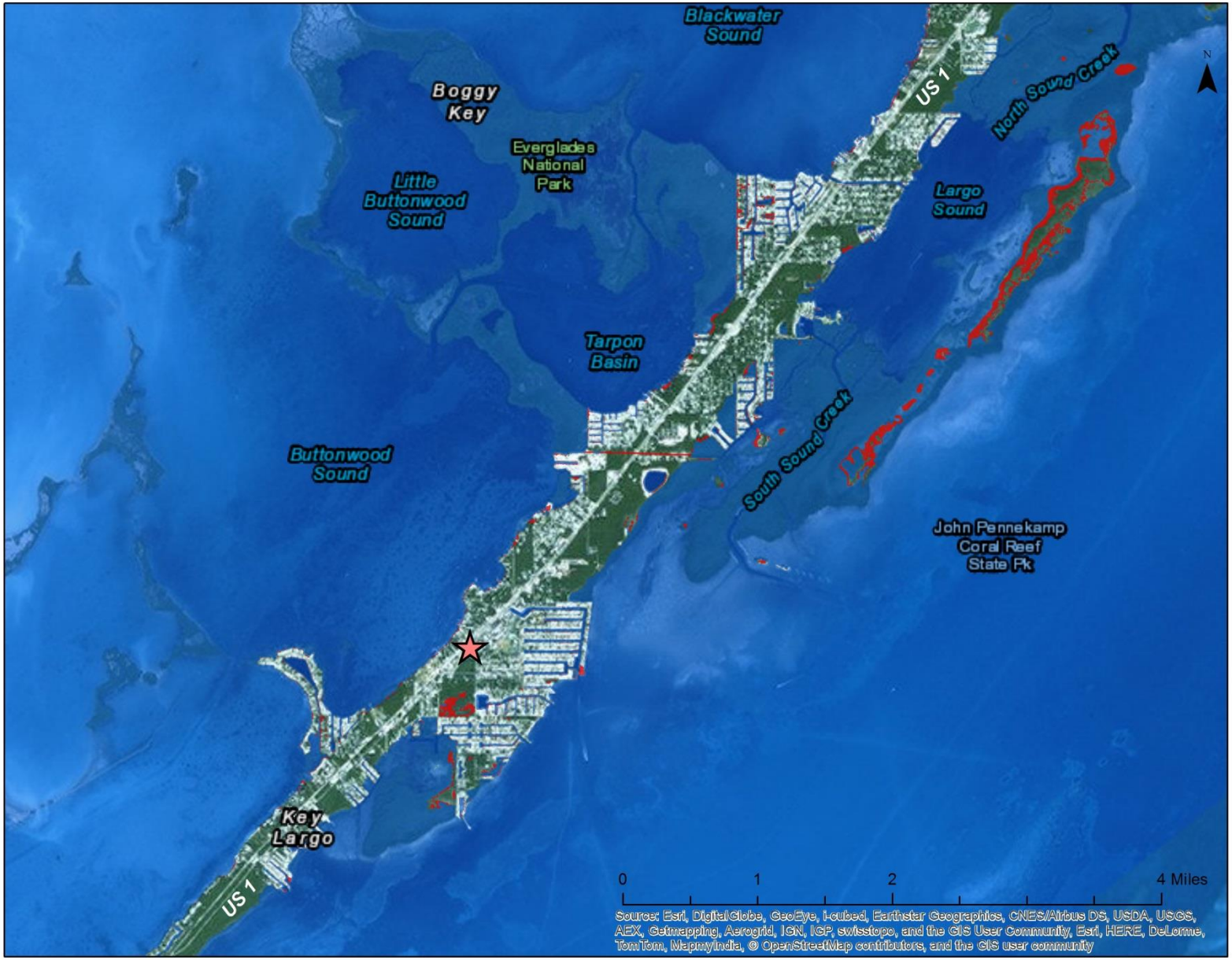
1. What impacts to County assets, infrastructure and habitat will occur from sea level rise in 2030 (at 3” and 7”) and in 2060 (9” and 24”)?
    - Today’s presentation
2. How can the County address those impacts?
    - Next phase of analysis

INUNDATION

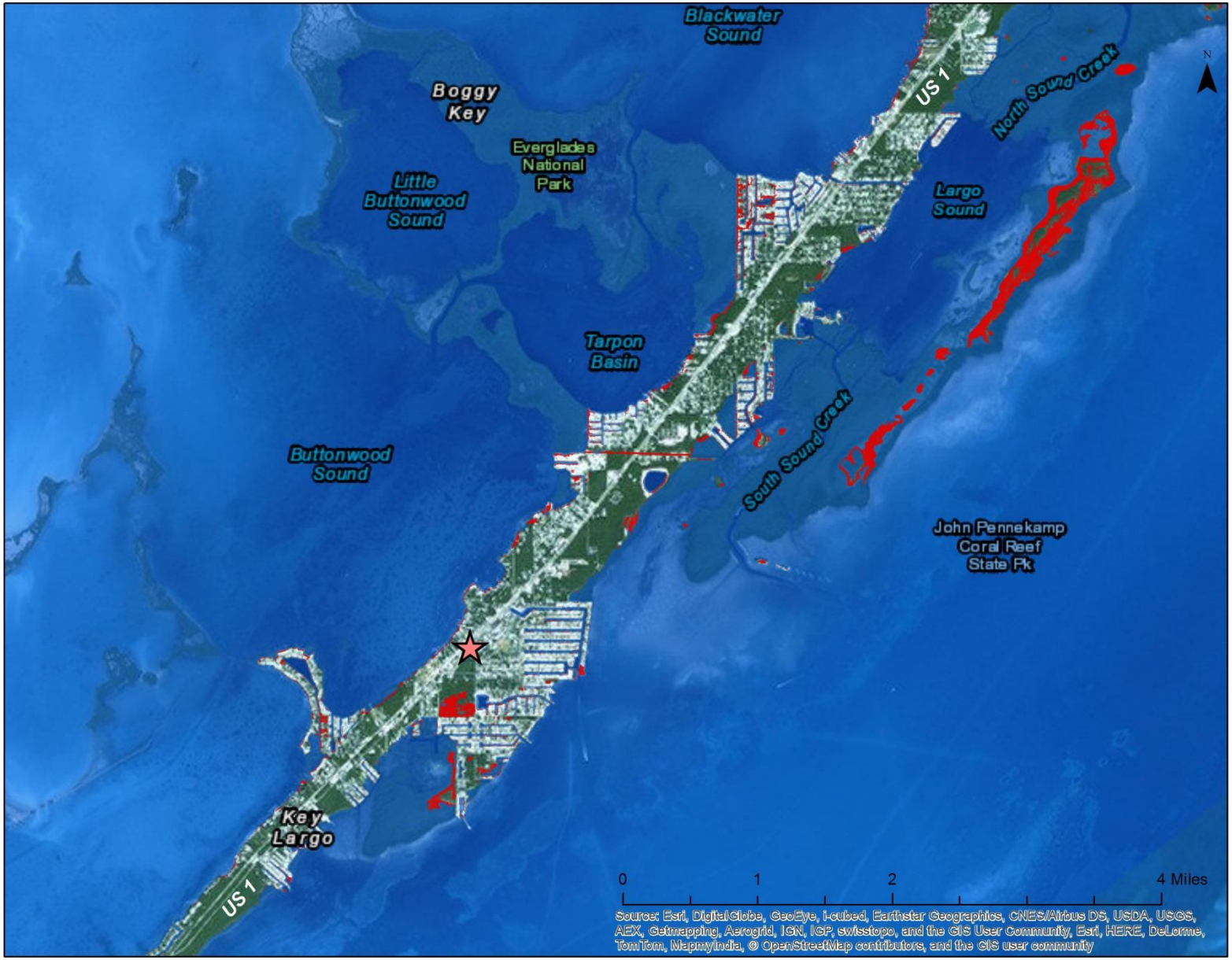
Key Largo, Present Day



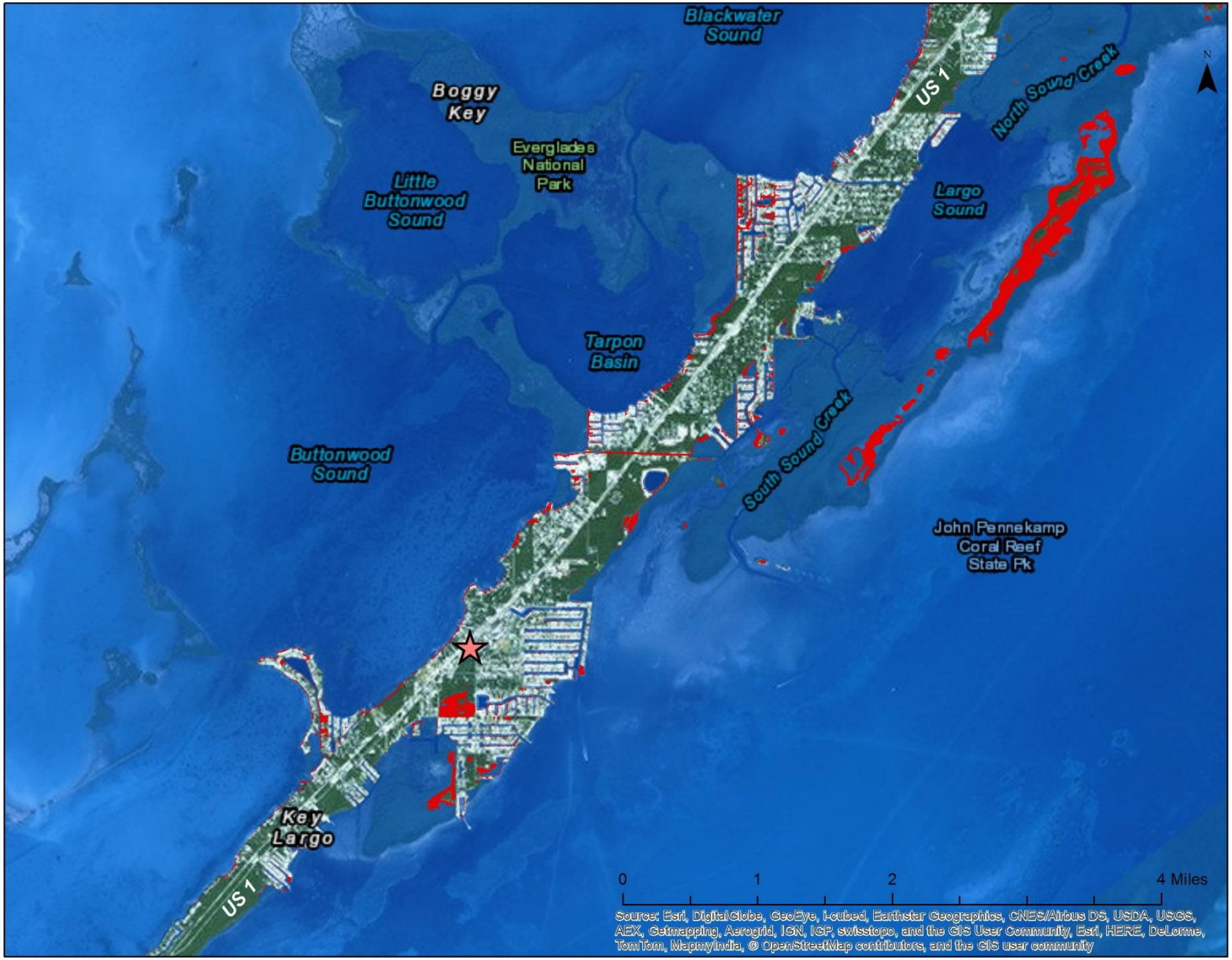
Key Largo, 3 inches Sea Level Rise (2030, Low Scenario)



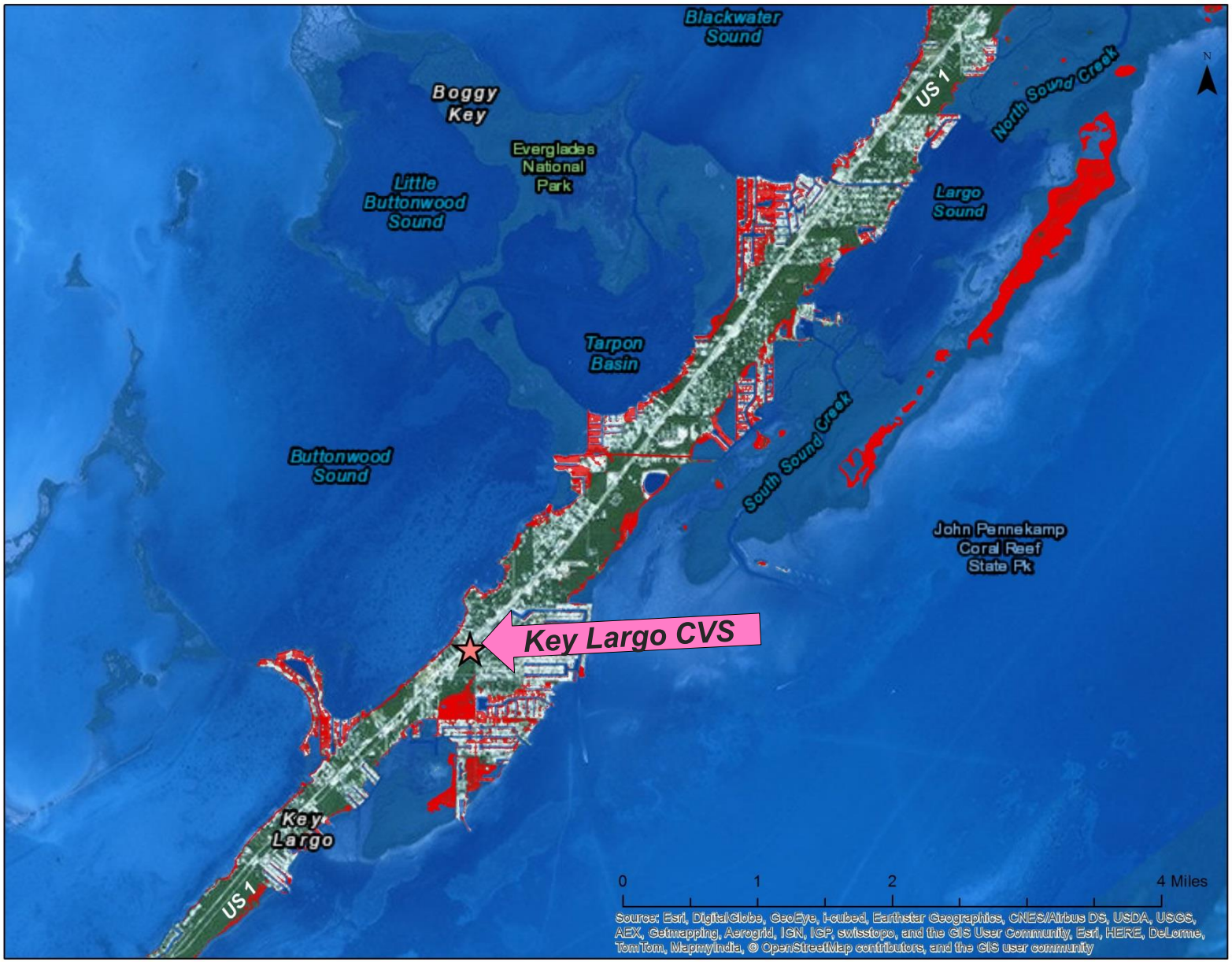
Key Largo, 7 inches Sea Level Rise (2030, High Scenario)



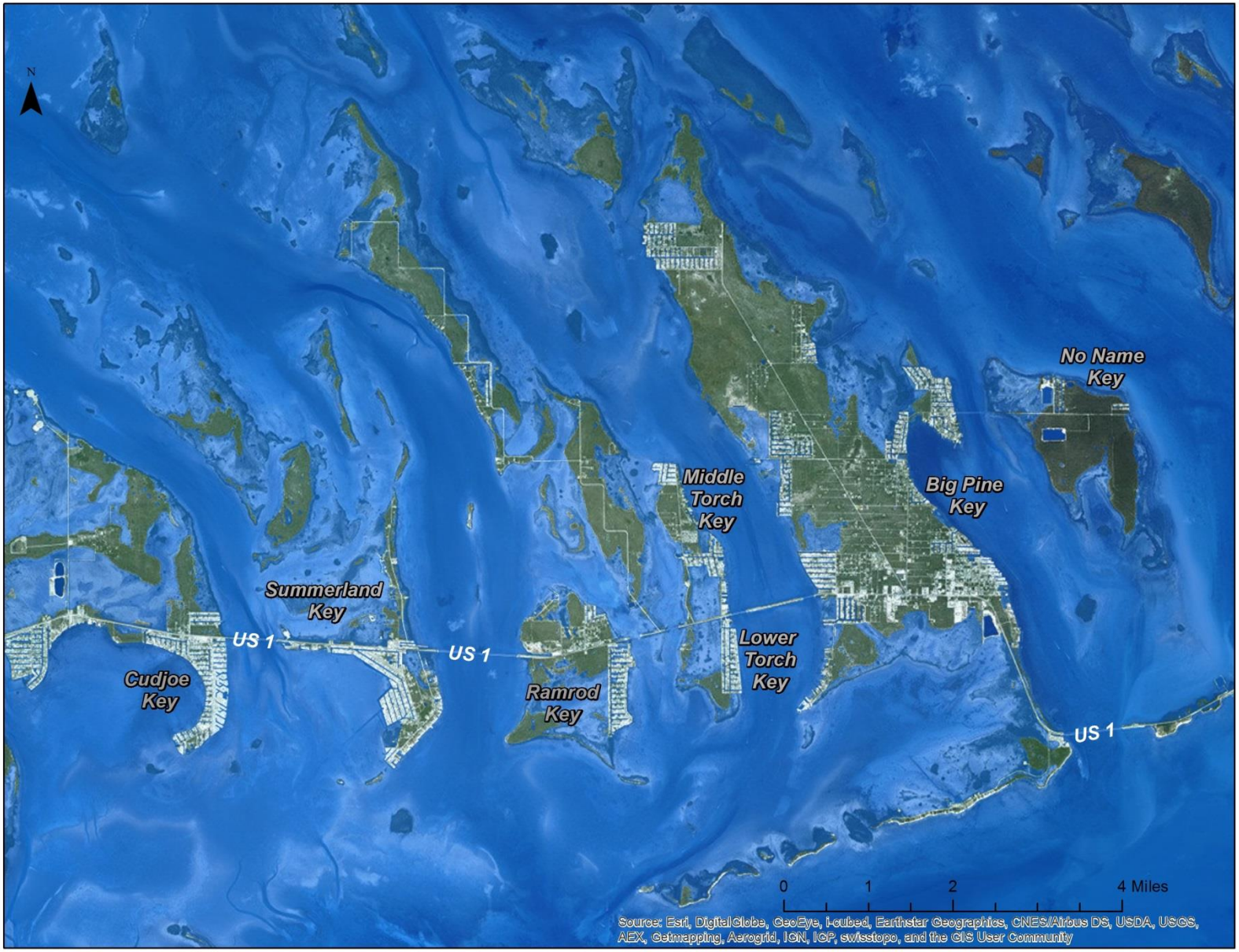
Key Largo, 9 inches Sea Level Rise (2060, Low Scenario)



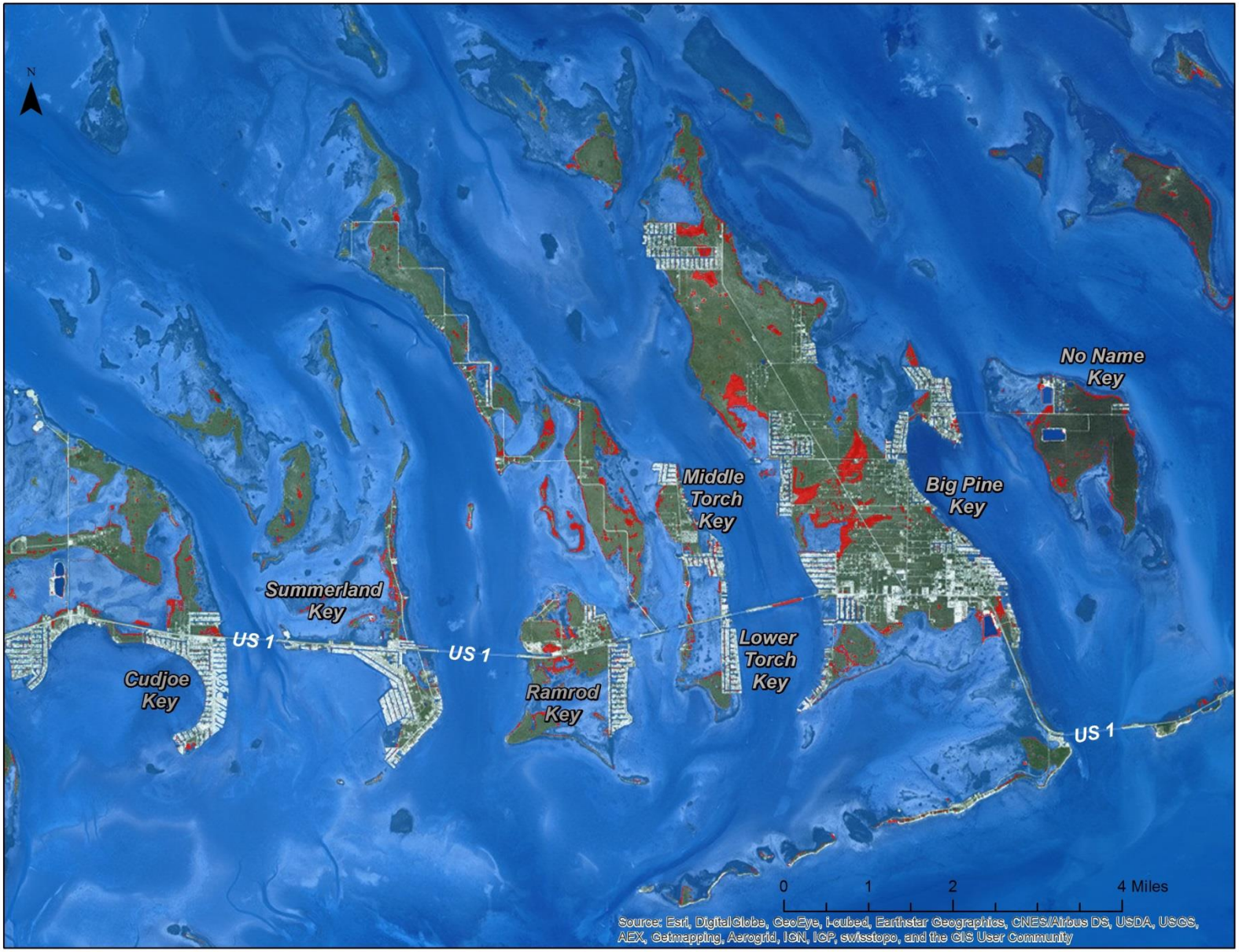
Key Largo, 24 inches Sea Level Rise (2060, High Scenario)



BIG PINE KEY AND VICINITY, PRESENT DAY



Big Pine Key and vicinity, 3 inches Sea Level Rise (2030, Low Scenario)



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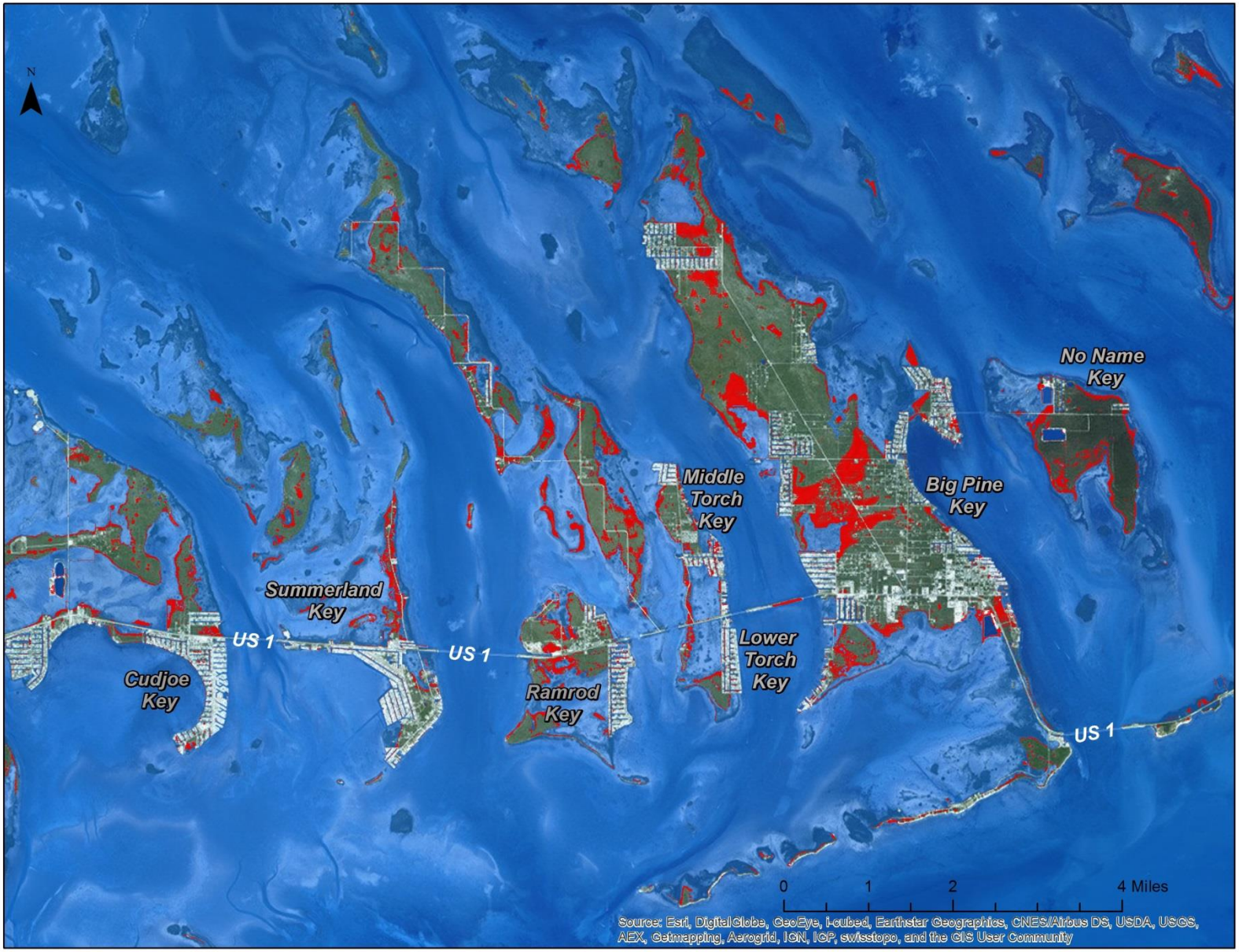
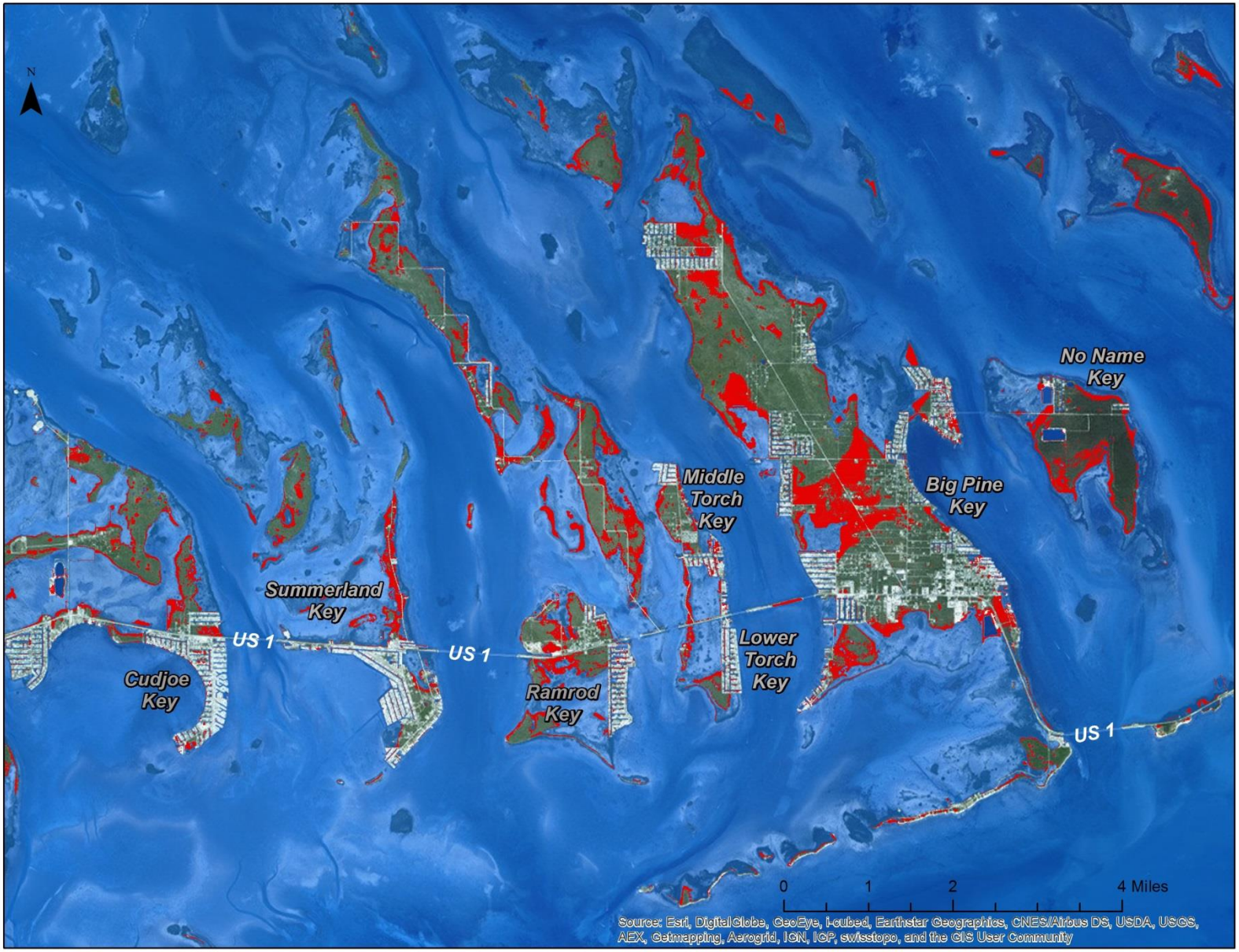


Big Pine Key and Vicinity, 9 inches Sea Level Rise (2060, Low Scenario)



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

KEY WEST, PRESENT DAY

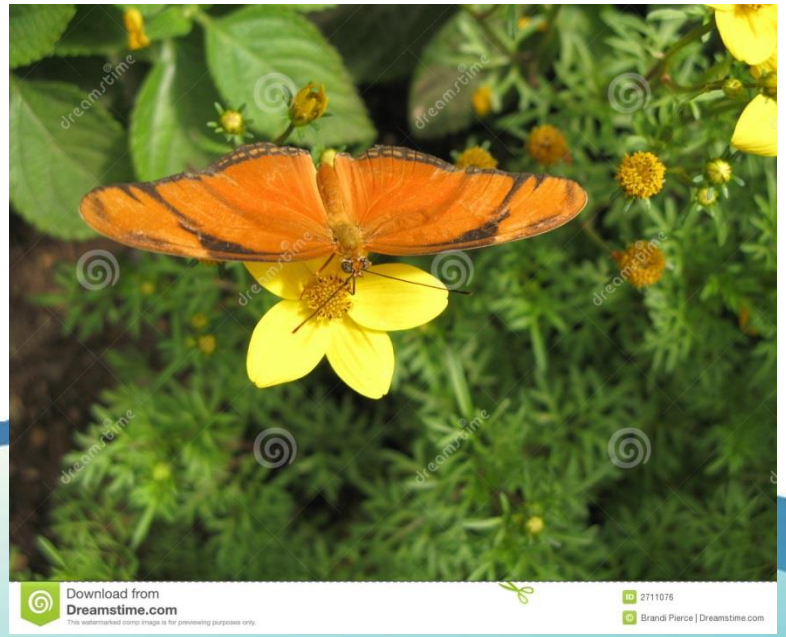
Key West, 3 inches Sea Level Rise (2030, Low Scenario)

Key West, 7 inches Sea Level Rise (2030, High Scenario)

Key West, 9 inches Sea Level Rise (2060, Low Scenario)

Key West, 24 inches Sea Level Rise (2060, High Scenario)

HABITAT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HABITAT CHANGE

3 inches of sea level rise (2030, Low Scenario) could bring *daily* saltwater tides into 19% of Monroe County's Freshwater Wetland Areas*

Analysis based on Monroe County Habitat dataset (2009)

Freshwater pond on Big Pine Key

http://rcrackliffe.com/images/FloridaVacation/2004-12-28-14.jpg

HABITAT CHANGE

24 inches of sea level rise (2060, High Scenario) could bring *daily* saltwater tides into 94% of Monroe County's Freshwater Wetland Areas*

Key deer on Big Pine Key
http://s3.amazonaws.com/trazzler-images/af/1505/00.jpg

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

HABITAT CHANGE

3 inches of sea level rise (2030, Low Scenario) could bring *daily* saltwater tides into 2.3% of Monroe County's remaining Tropical Hardwood Hammock*

Analysis based on Monroe County Habitat dataset (2009)

Tropical hardwood hammock
Lignumvitae State Park
http://3.bp.blogspot.com/-I6rkce85yqI/T5QYIYE2dZI/AAAAAAAAFDk/7BHEUgYDDMY/s1600/LignumTrail.jpg

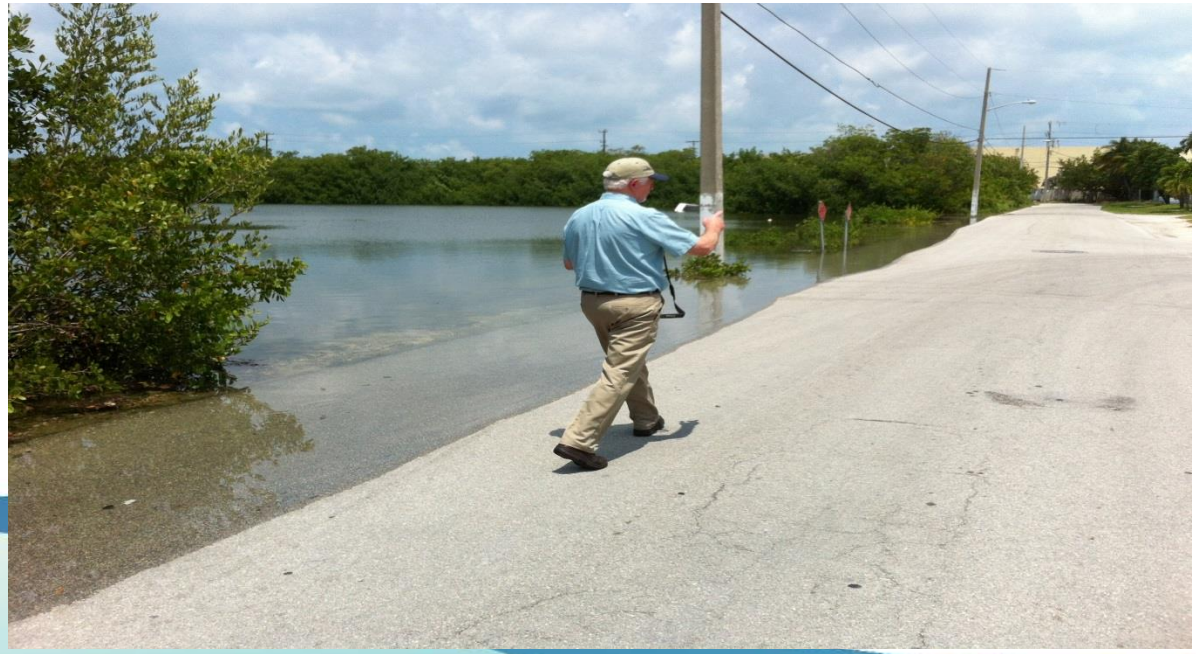
HABITAT CHANGE

24 inches of sea level rise 2060, High Scenario) could bring *daily* saltwater tides into 42% of Monroe County's remaining Tropical Hardwood Hammock*

Trees killed by saltwater intrusion (Big Pine)
http://www.worldviewofglobalwarming.org/risingseas/FLKeysPinesKilledSaltSLRWeb.jpg

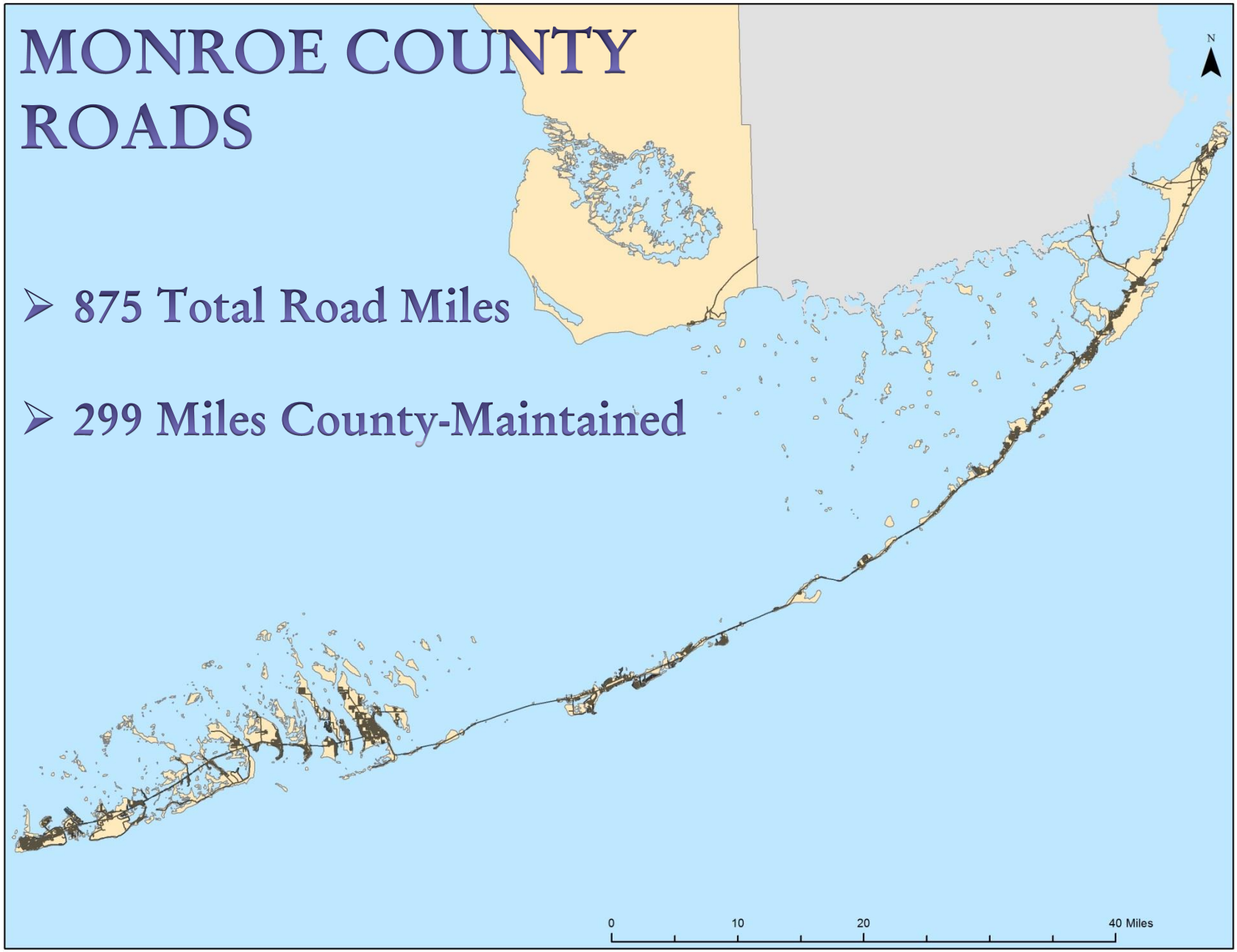
****Analysis based on Monroe County Habitat dataset (2009)***

County-Maintained and All Roads



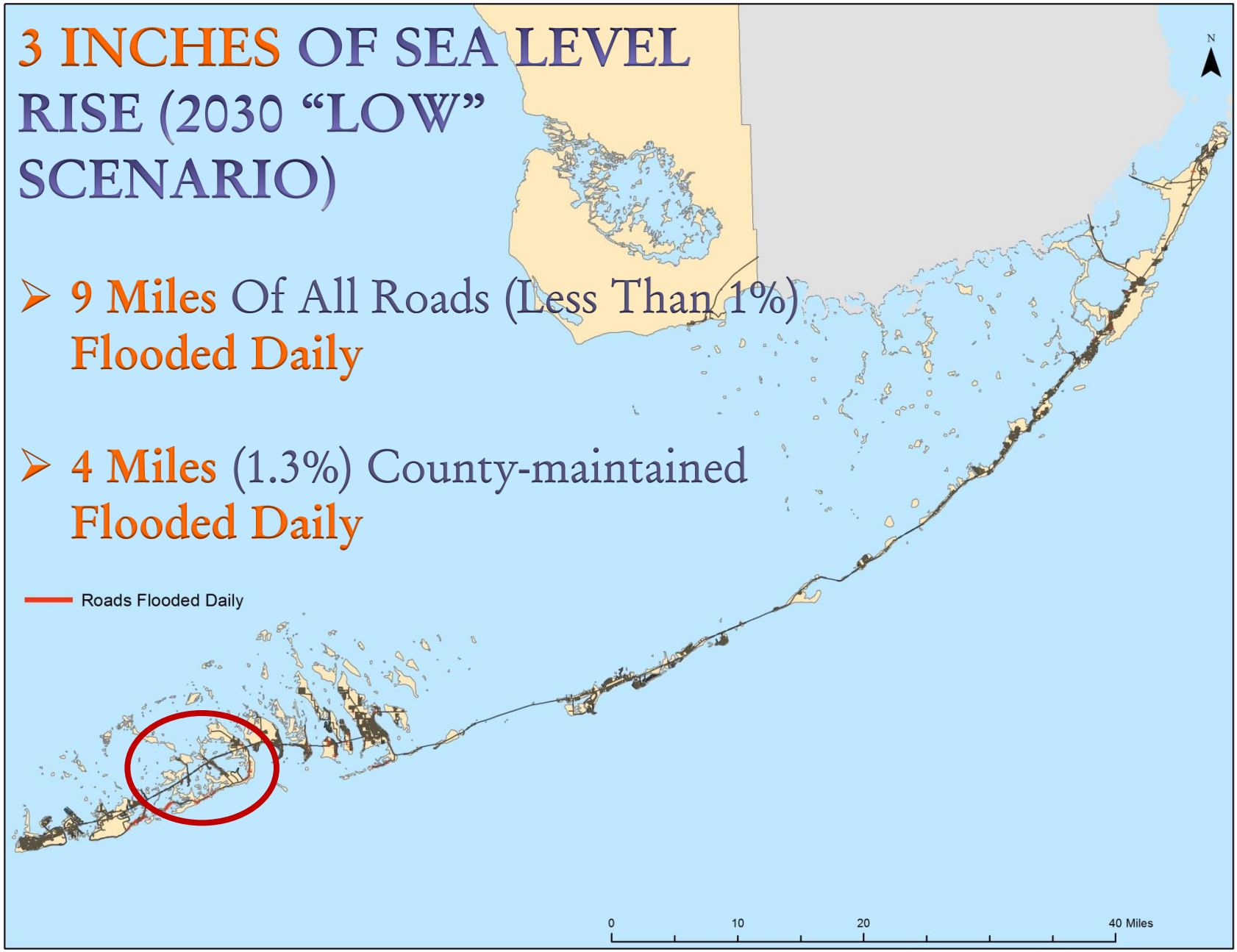
MONROE COUNTY ROADS

- 875 Total Road Miles
- 299 Miles County-Maintained



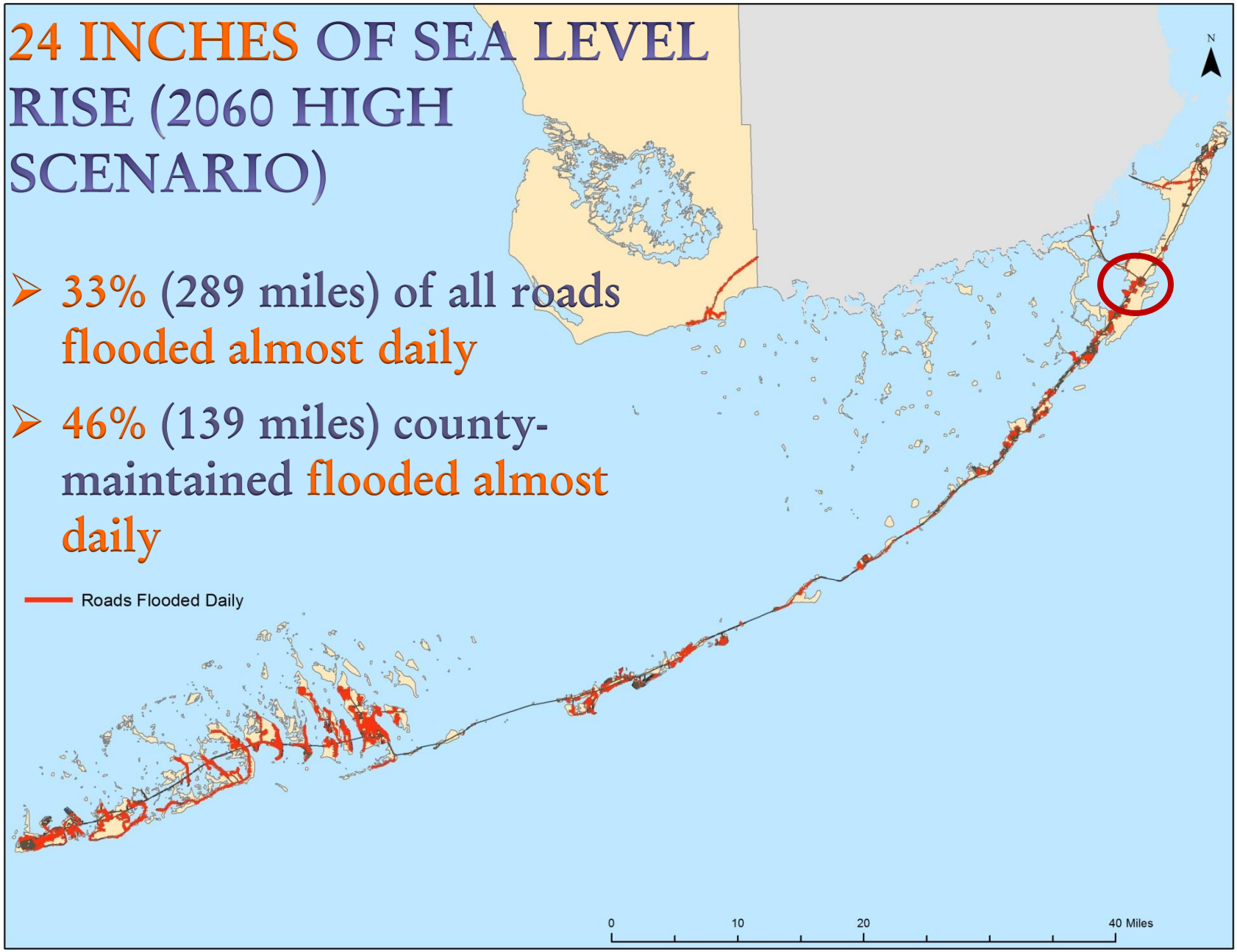
3 INCHES OF SEA LEVEL RISE (2030 "LOW" SCENARIO)

- **9 Miles** Of All Roads (Less Than 1%) **Flooded Daily**
- **4 Miles** (1.3%) County-maintained **Flooded Daily**



24 INCHES OF SEA LEVEL RISE (2060 HIGH SCENARIO)

- 33% (289 miles) of all roads flooded almost daily
- 46% (139 miles) county-maintained flooded almost daily



RECOMMENDATIONS FOR ROADS

1. Use results from this analysis to inform flood mitigation for near-term paving projects

2. Systematically document locations and dates for nuisance flood events

3. Develop survey-grade digital elevation data for road surfaces

COUNTY FACILITIES AND BUILDINGS

1. Evaluated 74 parcels with County-owned buildings and facilities
2. 41% (26 parcels) show flooding encroachment at 3 inches of sea level rise
3. 53% (36 parcels) show flooding encroachment at 24 inches sea level rise
4. Overlays with aerial photos show buildings generally located on highest ground

TECHNICAL RECAP

1. The Florida Keys are clearly vulnerable to impacts from long-term sea level rise
2. Roads will be the "canary in the coal mine"
3. Lower and Middle Keys will feel earlier and more widespread effects as compared to the Upper Keys
4. Impacts to other infrastructure will gradually increase through 2030 scenarios
5. High sea level rise scenario brings a *Wilma-like event* to Key West twice *a year by 2060*
6. Effective adaptation planning requires continuous development and enhancement of information

WHAT COULD THIS MEAN?

http://activerain.trulia.com/image_store/uploads/3/9/8/6/1/ar117798897116893.jpg

"STILTSVILLE", NEAR MIAMI

WHAT HAS THE COUNTY DONE TO BEGIN PREPARING?

STOCK ISLAND FIRE STATION (KEY WEST)

Station Floor Located Here

2/13/13

Under Construction, Elevation 1.5 ft. above Code

STOCK ISLAND FIRE STATION (KEY WEST)

- **Cost To Elevate: $100,000.**
  - More fill
  - Longer drive for the garage area
  - More concrete to raise the elevated floor of the other part of the building (living areas)
  - Longer stairs and ramps.
  - Equipment (a/c condensers and generator) needed to be elevated more.
  - More labor on the plumbing
- **TOTAL COST $3.2 Million**

COMMUNITY MODELING

KEY LARGO
Scenario 1: Elevate and Floodproof

ELEVATE AND FLOODPROOF

- Elevation in V-Zones (red)
- Floodproofing in A-Zones (green)
- Action to different heights.
- 100% of parcels are protected.

Elevate

Floodproof

Key Largo
Scenario 2: Construct Breakwater

BREAKWATER:

- Two 1-mile constructed barriers.
- At water level.
- Near to shore.

Note: will not protect against sea level rise. Will only protect against some wave action during extreme flooding events, and only for some parcels.

Key Largo
Scenario 3: Relocate Over Time

ROLLING EASEMENTS:

- Voluntary buyouts are offered in two phases across the Key.
- Phase 1: for parcels expected to have high tide at their center in 2030 (red).
- Phase 2: for parcels expected to have high tide at their center in 2045 (green).
- 100% of land owners accept the buyout in each phase.

Parcels in red = lost to sea level rise 2010-2030.
Parcels in green = Parcels lost to sea level rise 2030-2060.

Note: No title transfer until 2045 or when the "high" Four-County Compact sea level rise scenario hits 14" – whichever comes first. Voluntary buyouts not offered for undeveloped land.

Avoided Damages by 2060 – With High or Low SLR

Scenarios Considered	Avoided Damages Low SLR (9”)	Avoided Damages High SLR (24”)
	($ Millions)	($ Millions)
Action 1: Elevate & Floodproof	$850.6	$1,209.8
Action 2: Construct Breakwater	$12.8	$13.2
Action 3: Voluntary Relocation 10% Participation Now; 50% Participation in 2030	$26.8	$4.5

Figures Discounted 3.3%

Cost Estimates By Year 2060 – For Each Action: COSTS

	Low Cost Estimate ($ millions)	High Cost Estimate ($ millions)
Action 1: Elevate & Floodproof	$79.2	$162.2
Action 2: Construct Breakwater	$6.0	$8.0
Action 3: Voluntary Relocation 10% Participation Now, 50% in 2030	$60.7	$91.0

Figures Discounted 3.3%

Benefit Cost Ratios of Actions by Year 2060

	Benefit/Cost Ratios – Using Low Cost Estimate	
	Low SLR	High SLR
Action 1: Elevate & Floodproof	10.75	15.28
Action 2: Construct Breakwater	2.12	2.2
Action 3: Voluntary Relocation 10% Participation Now, 50% in 2030	0.44	0.07

Discounted 3.3%, Values over 1.0 are considered positive.

QUESTIONS?

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7th Annual
SE FL Climate Leadership Summit

December 1-3, 2015
Casa Marina
Key West, FL 33040