

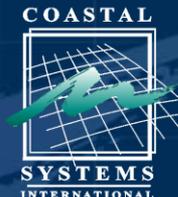


**COASTAL SYSTEMS
INTERNATIONAL, INC.**

Regional Approaches to Resiliency
Addressing the Impacts of
Sea Level Rise

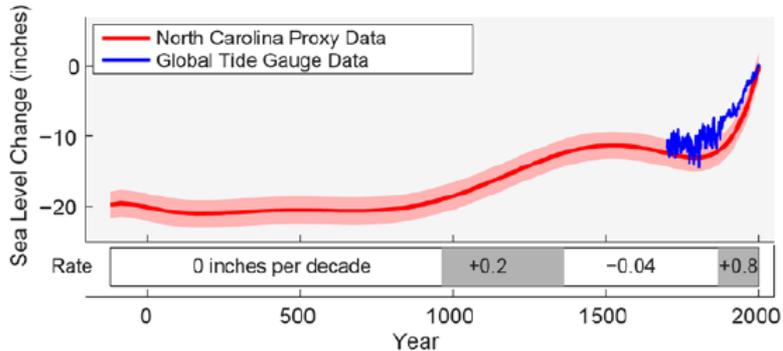
COJ Environmental Symposium
September 9, 2016

Danielle H. Irwin, PWS, LEED AP

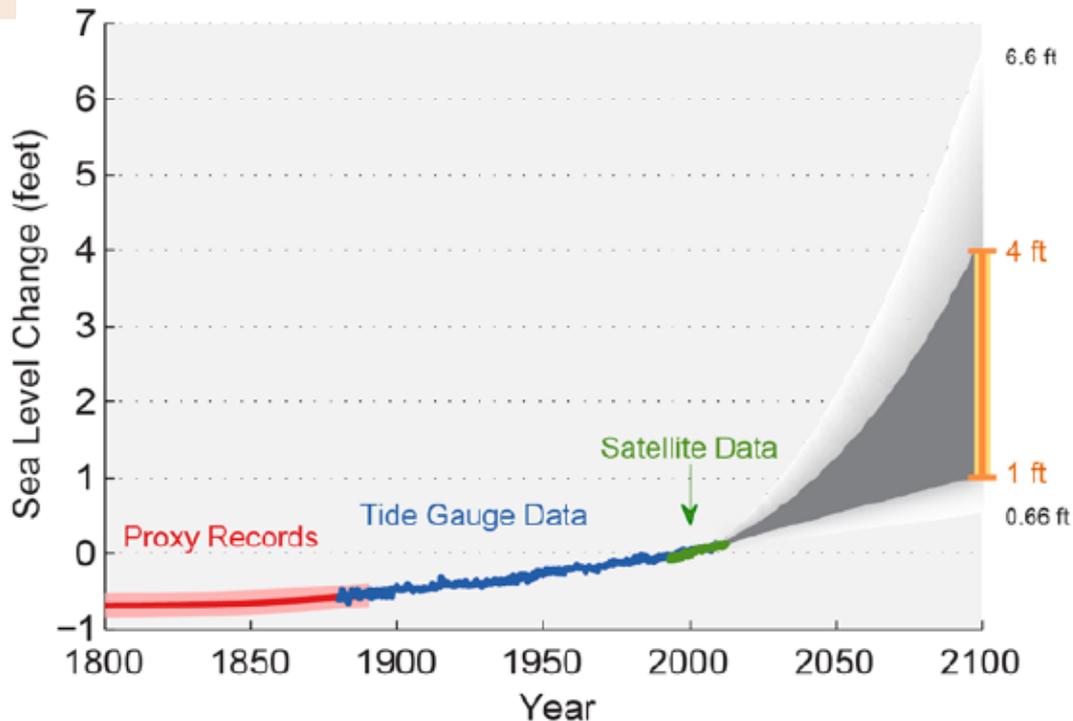


Globally, the sea is expected to rise 1' – 4' by 2100; Uncertain about ice sheet contribution.

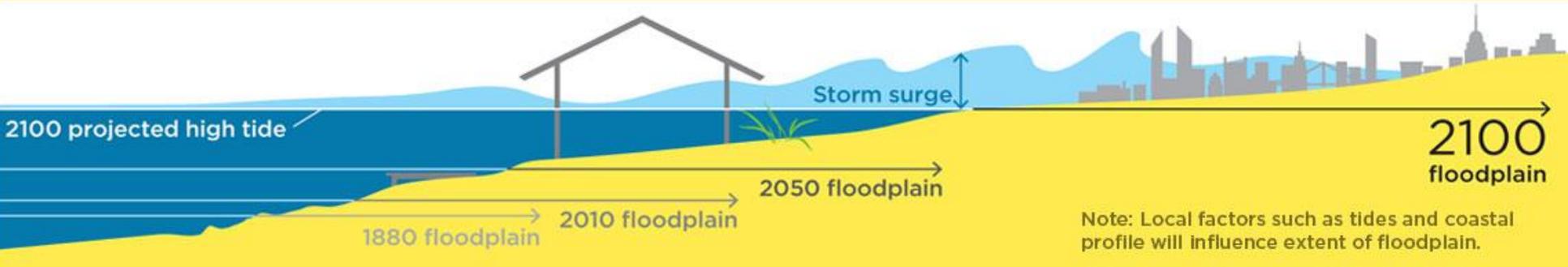
North Atlantic Sea Level Change



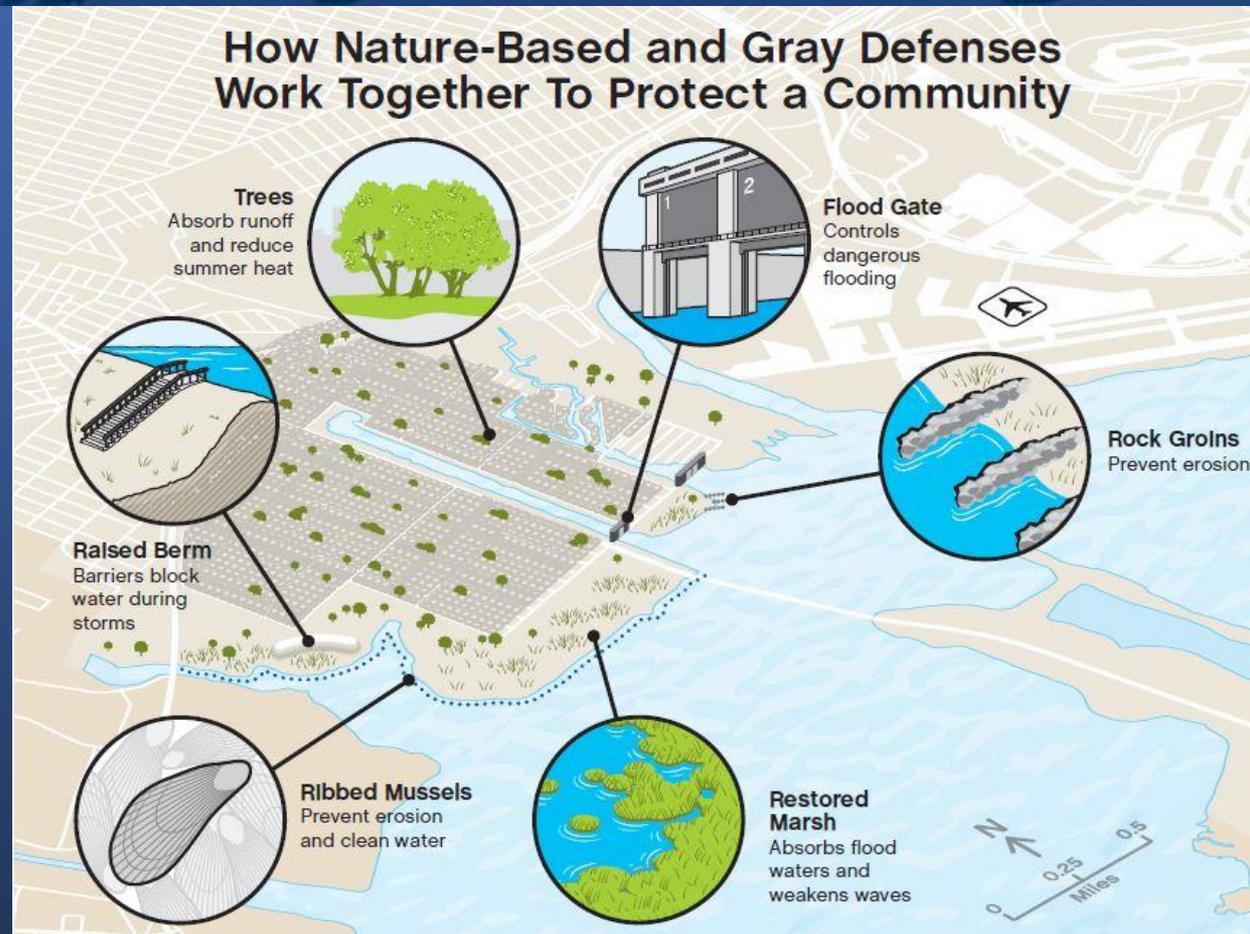
Past and Projected Changes in Global Sea Level Rise



Locally, effects felt on the floodplain with storm surge & high tide flooding.



Note: Local factors such as tides and coastal profile will influence extent of floodplain.



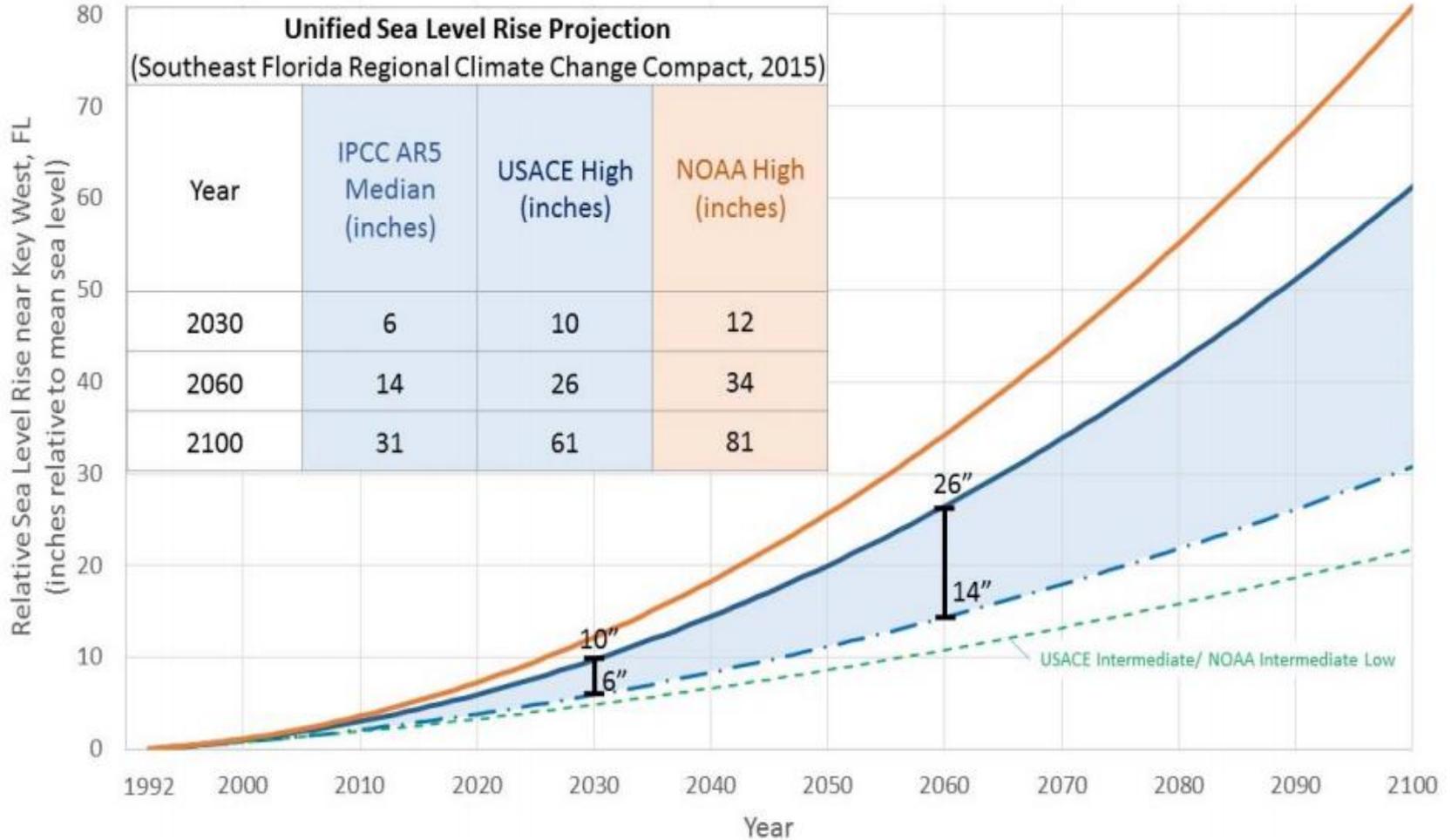
“Coastal Resilience means building the ability of a community to “bounce back” after hazardous events such as hurricanes, coastal storms, and flooding – rather than simply reacting to impacts.” – National Ocean Service, NOAA

South Florida is pioneering climate resilience through regional action.

SOUTHEAST FLORIDA
REGIONAL COMPACT
CLIMATE CHANGE



Planning capital improvement investments in light of rising seas.



Efforts now expanding beyond just readiness for water-related issues.

CLIMATE ACTION PLAN

2015



Local Strategy to Address
Global Climate Change



Policy



**Natural
Systems**



**Water
Supply**



**Energy
Resources**

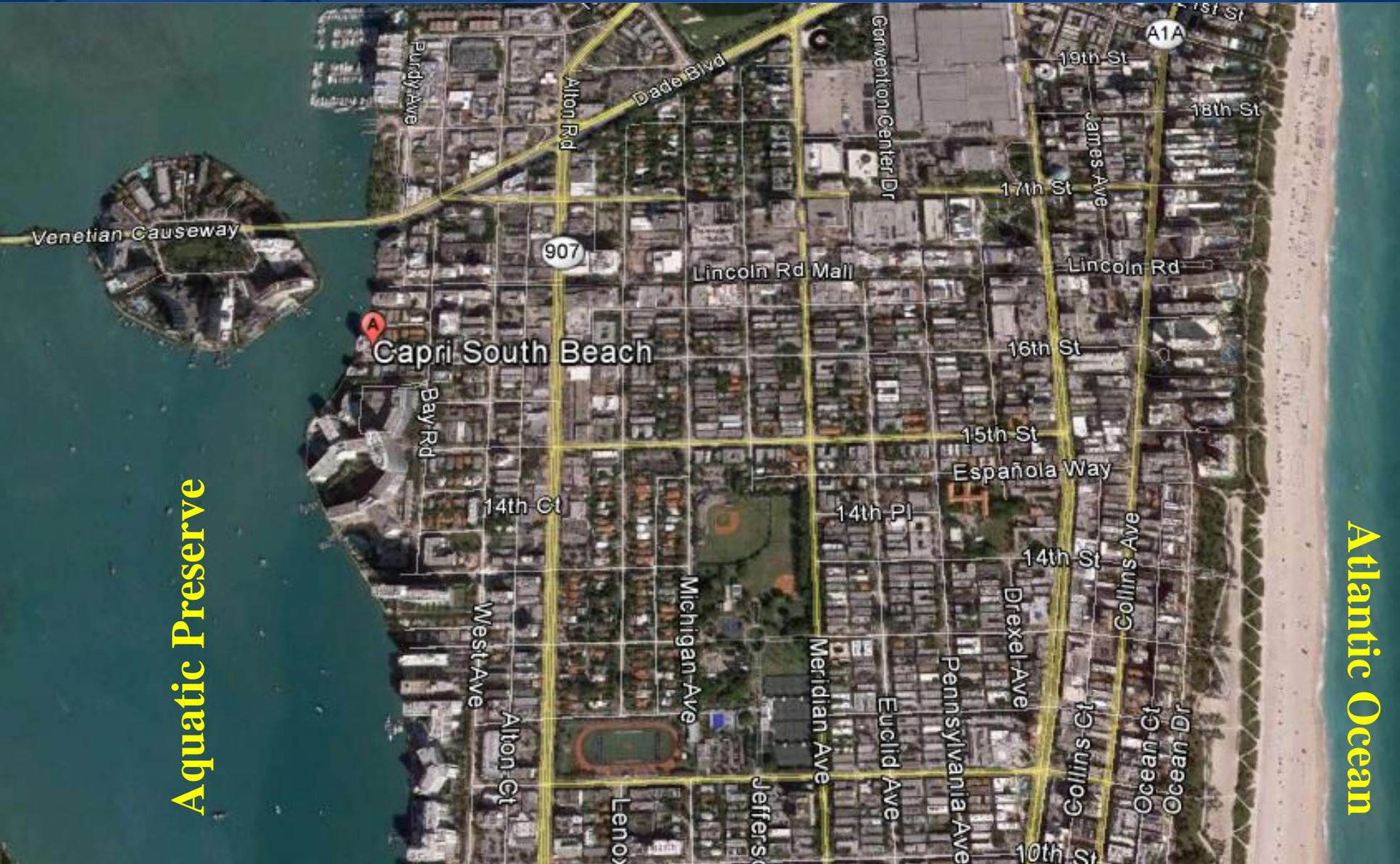


**Built
Environment**



**Community
Outreach**

Managing flood waters is complicated by existing development & proximity to resources.



Aquatic Preserve

Atlantic Ocean

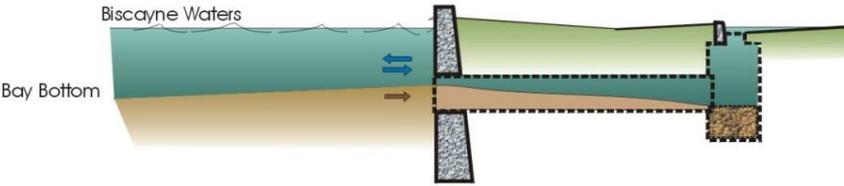
Miami Beach is living with flooding & creating solutions.



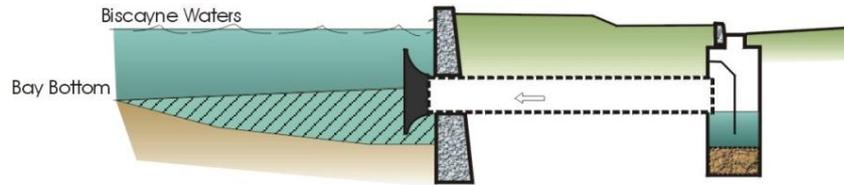
Miami Beach Prepares For Annual 'King Tide' Flooding And A Taste Of Future Sea Level Rise

Flooding adaptation at Miami Beach street-end outfalls led to new stormwater standards.

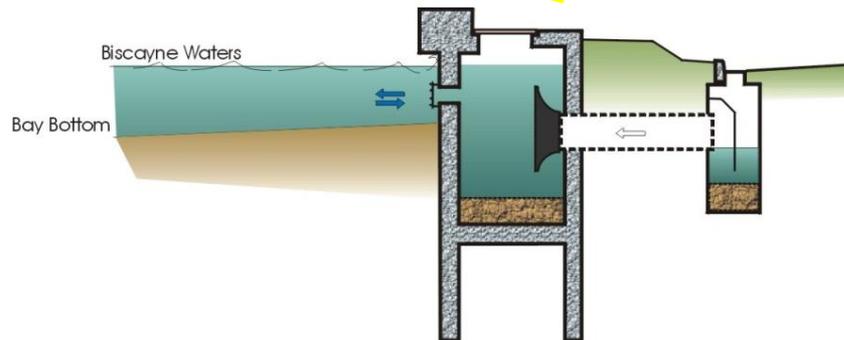
Outfall Box (OB) Structure



Pre-Development Conditions - Problem



Pre-Development Improvement - Remedy



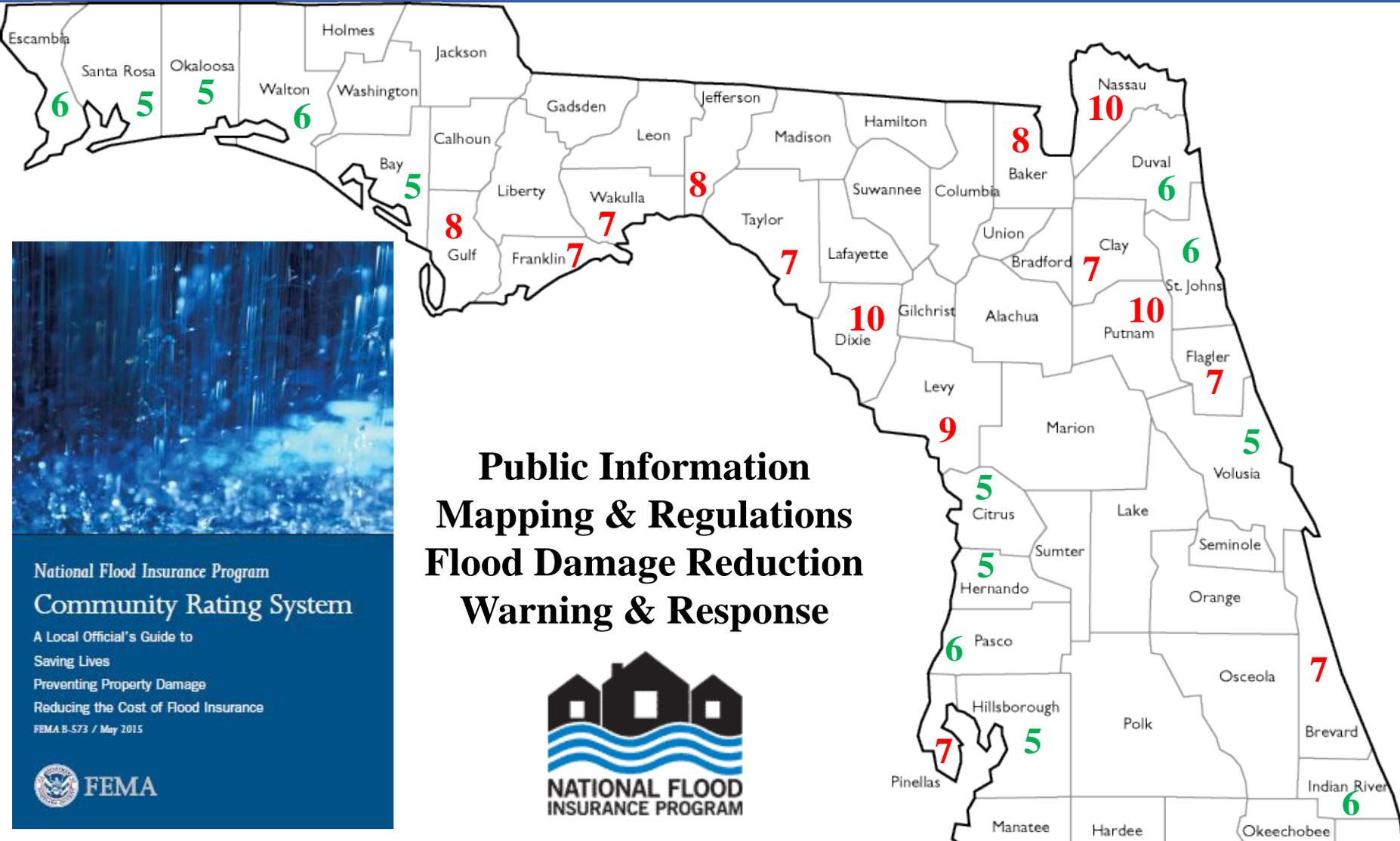
Development Improvement - Solution



Innovative Design



North Florida's resiliency efforts are more about flood protection & emergency preparedness.



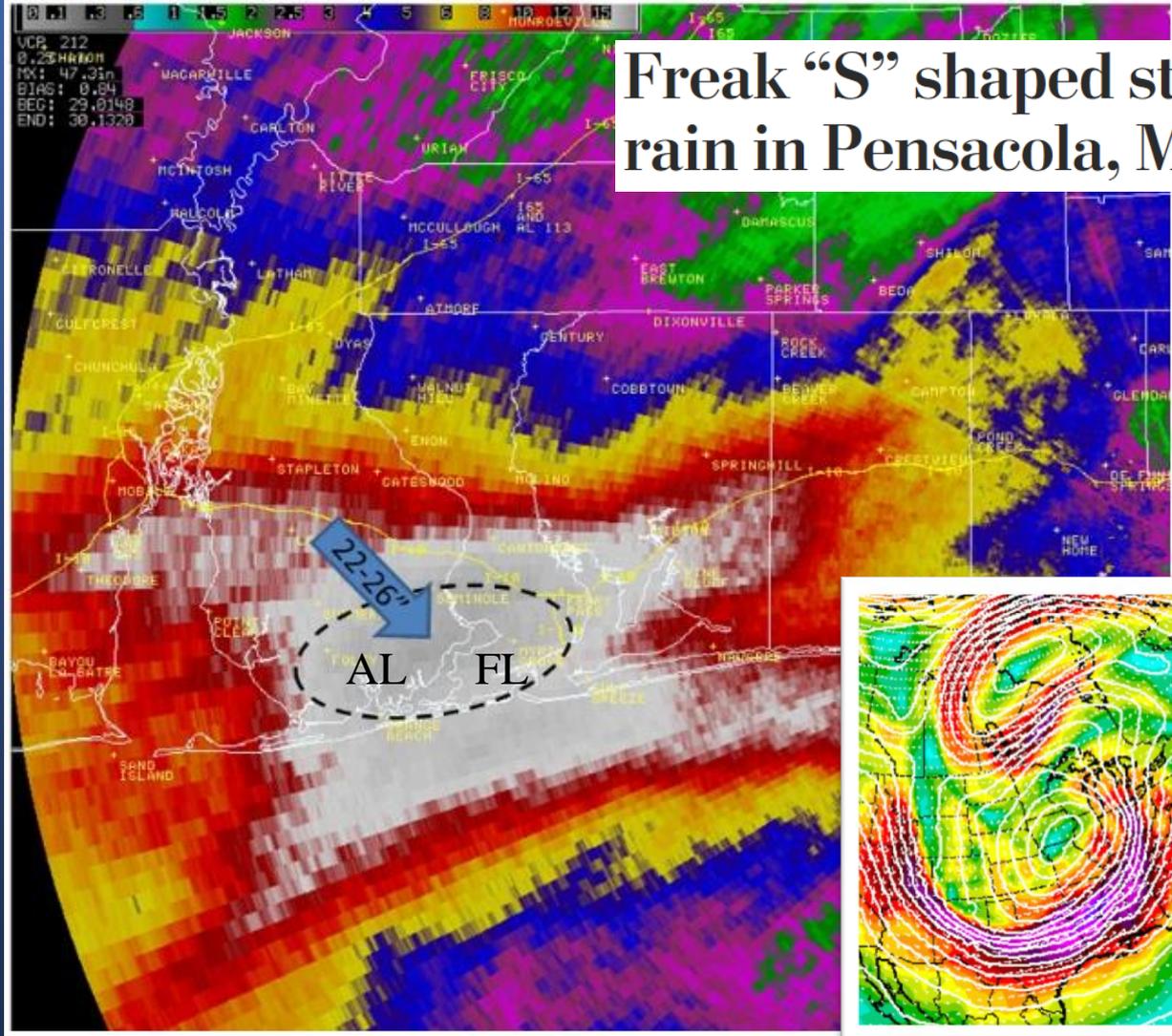
Public Information Mapping & Regulations Flood Damage Reduction Warning & Response



National Flood Insurance Program
Community Rating System
A Local Official's Guide to
Saving Lives
Preventing Property Damage
Reducing the Cost of Flood Insurance
FEMA B-573 / May 2015

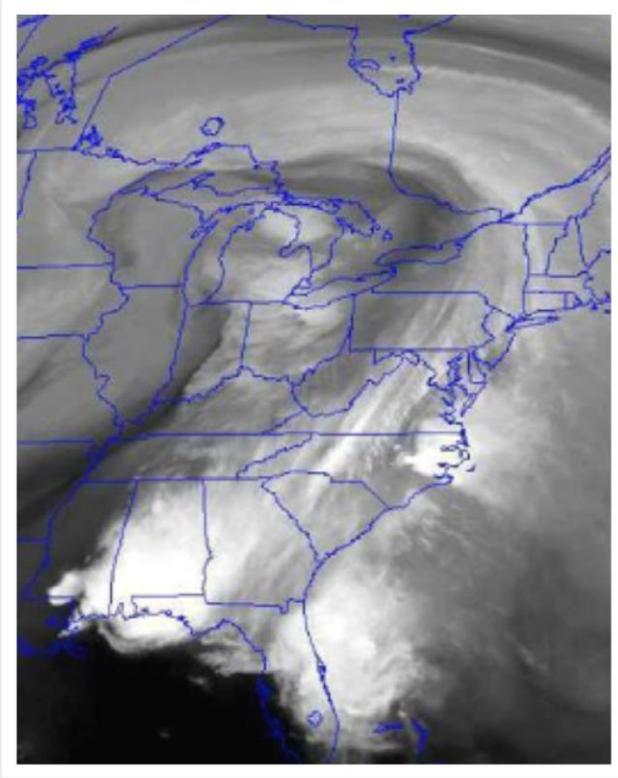
North Central Gulf Coast experienced a historic rainfall event in April 2014.

Figure 1 - Radar estimated event rainfall totals (in.) between 848 PM CDT Mon., 28 April – 920 AM CDT Wed., 30 April.
See scale on top.



Freak “S” shaped storm unleashes biblical rain in Pensacola, Mobile

The Washington Post



What did the 2014 Panhandle storm leave behind?



- State of Emergency in 26 counties
- Rainfall totals leading up to event were 200-600% of normal
- Widespread flooding, sinkholes, road wash-outs
- Pensacola Regional Airport: 1 in 500 yr event in 1 hr
- Escambia: 22" in 29 hrs; \$89M+ in damage



Flooding damage in Escambia motivates resiliency.

- 82% of stormwater improvement / repair projects complete
- Floodplain/stream/wetland restoration projects planned
- Funding from many sources



Status of County Infrastructure Projects



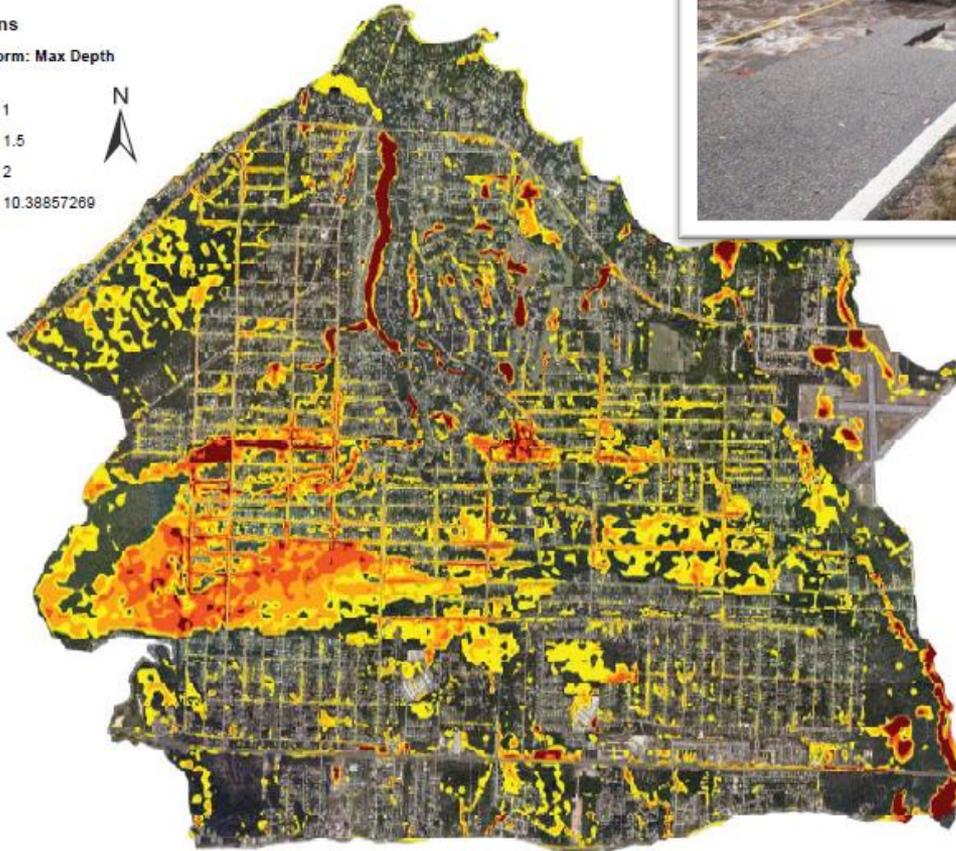
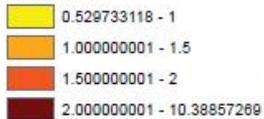
Over half of the remaining projects are scheduled for completion by the end of 2016, and the remainder expected in 2017.

Flood response is community specific. Santa Rosa – Holley by the Sea Flood Plan



Existing Conditions

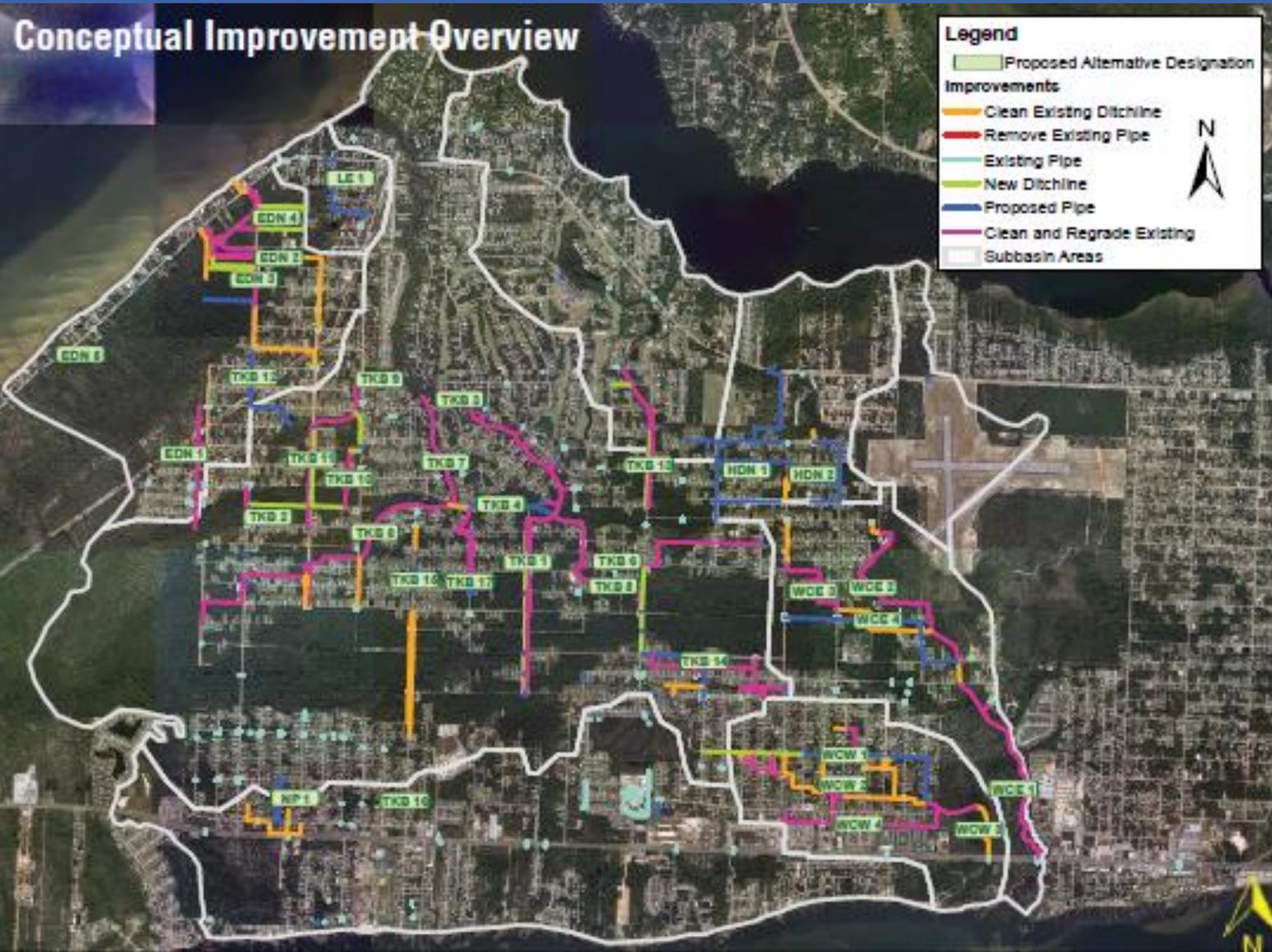
100-Year, 24-Hour Storm: Max Depth
Depth (Feet)



- Platted in 1970s, low elevation roads with swales, flat topography, high groundwater table,
- 100-year storm (County's design event) used for stormwater modeling
- Focus on increasing capacity of existing drainage system

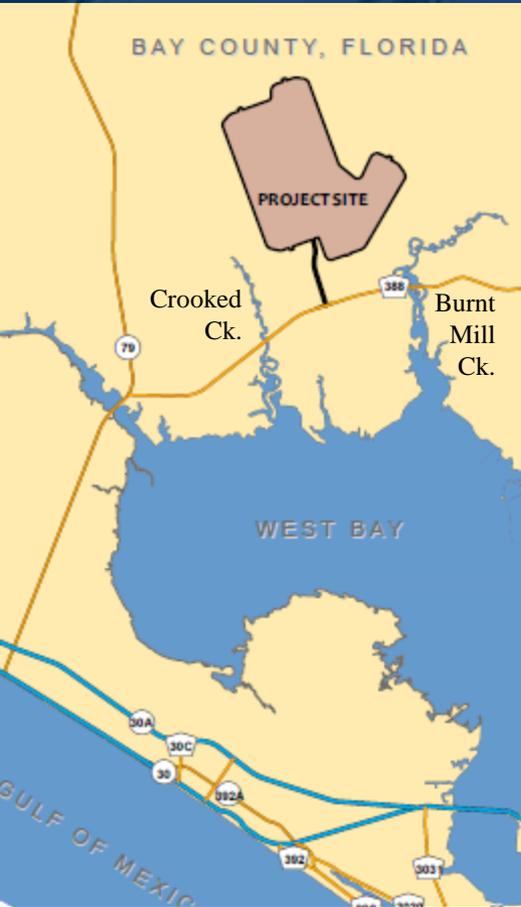
Project scoring & ranking informs decision makers on where to start.

Conceptual Improvement Overview



- \$86M down to \$64M after scoring
- Project sequencing crucial

Critical infrastructure needs different planning / design. Bay – NW FL Beaches International Airport



- 2014 storm overwhelmed the stormwater system – berm breach, channel erosion, flooding
- Models re-run: 100-yr & 500-yr events
- Corrective actions – conveyance improvements & flood protection
 - Bigger berm, ditch clearing, enhanced culverts, added pumps & flumes

NE Florida Regional Council is leading the local resiliency discussion.

- 7 County Region: Baker, Clay, Duval, Flagler, Nassau, Putnam, & St. Johns
- 2013 Regional Action Plan
 - Assumptions: 1'-3' rise by 2060; 3'-6' rise by 2110



Summary and Regional Action Plan

A Report of the
Emergency Preparedness Committee on Sea Level Rise

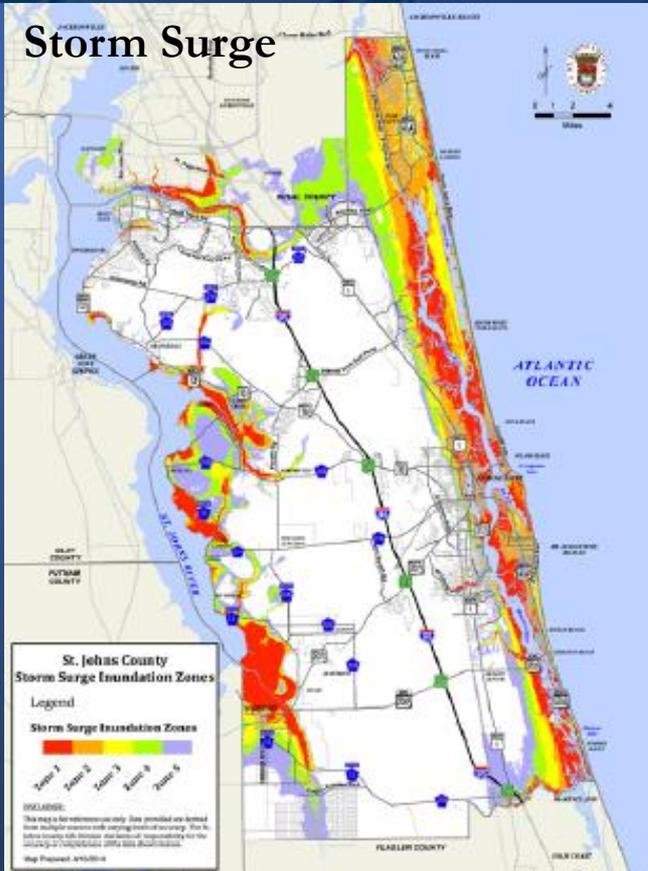


Regional Community Institute of Northeast Florida, Inc.
September 2013
Northeast Florida Regional Council
November 2013

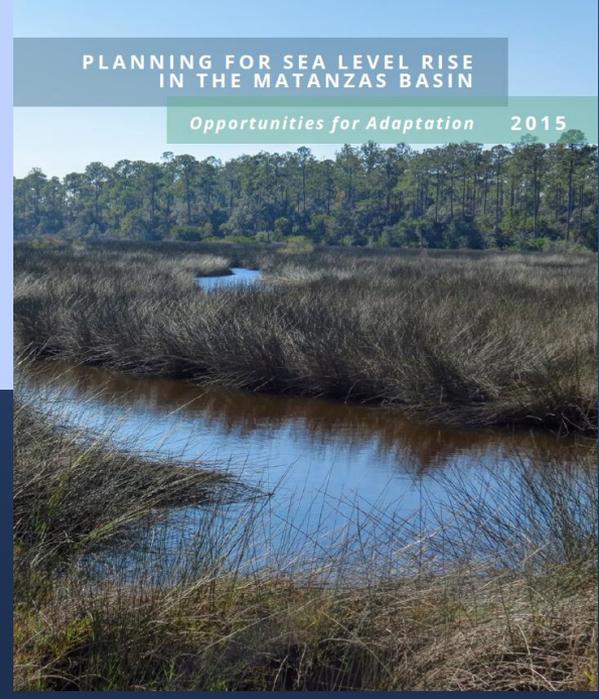
**Public/Private Regional Resiliency:
Good for Business**



GTMNERR & St. Augustine are studying their vulnerable areas & developing strategies.



- 2015 Matanzas Basin Study
- Conservation priorities
- Smart growth



- New spin-offs – DEO & UF Resiliency Initiatives
- Cultural & natural resource impacts, infrastructure, public health

St. Augustine's Avenida Menendez seawall makes the community more resilient.

- Historic preservation / flood protection project
- Cat 1 storm surge (7.4' above MSL)
- Revamped drainage system, added promenade
- 1200' long; \$6.7M (FEMA & City funded)



Tropical Storm Gabrielle 2001



Tropical Storm Faye 2008



— Avenida Menendez Seawall
- - - APE for Above-Ground Resources
- - - APE for Archaeological Resources
— St. Augustine Town Plan Historic District (approximate boundary)

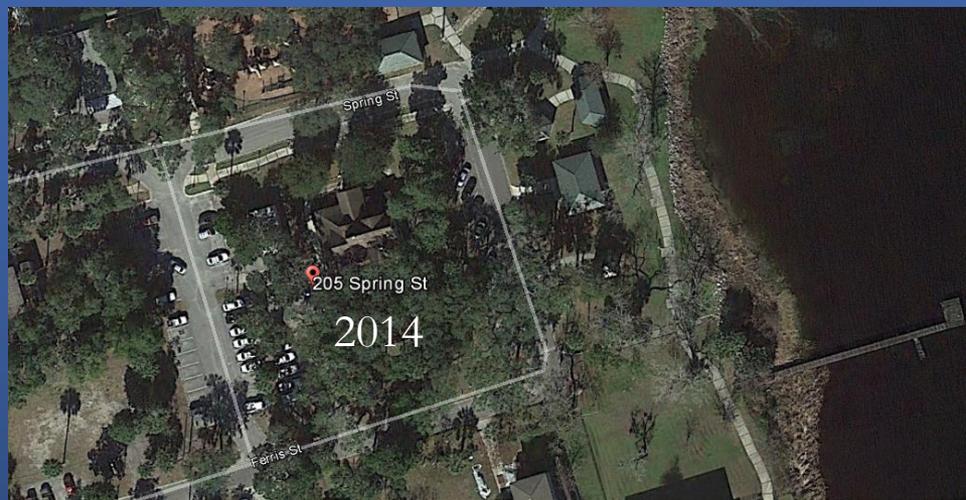
— National
— Individual
 Photographic



← old → new
← 12' waterward →



City of Green Cove Springs relocates their police department & becomes more resilient.

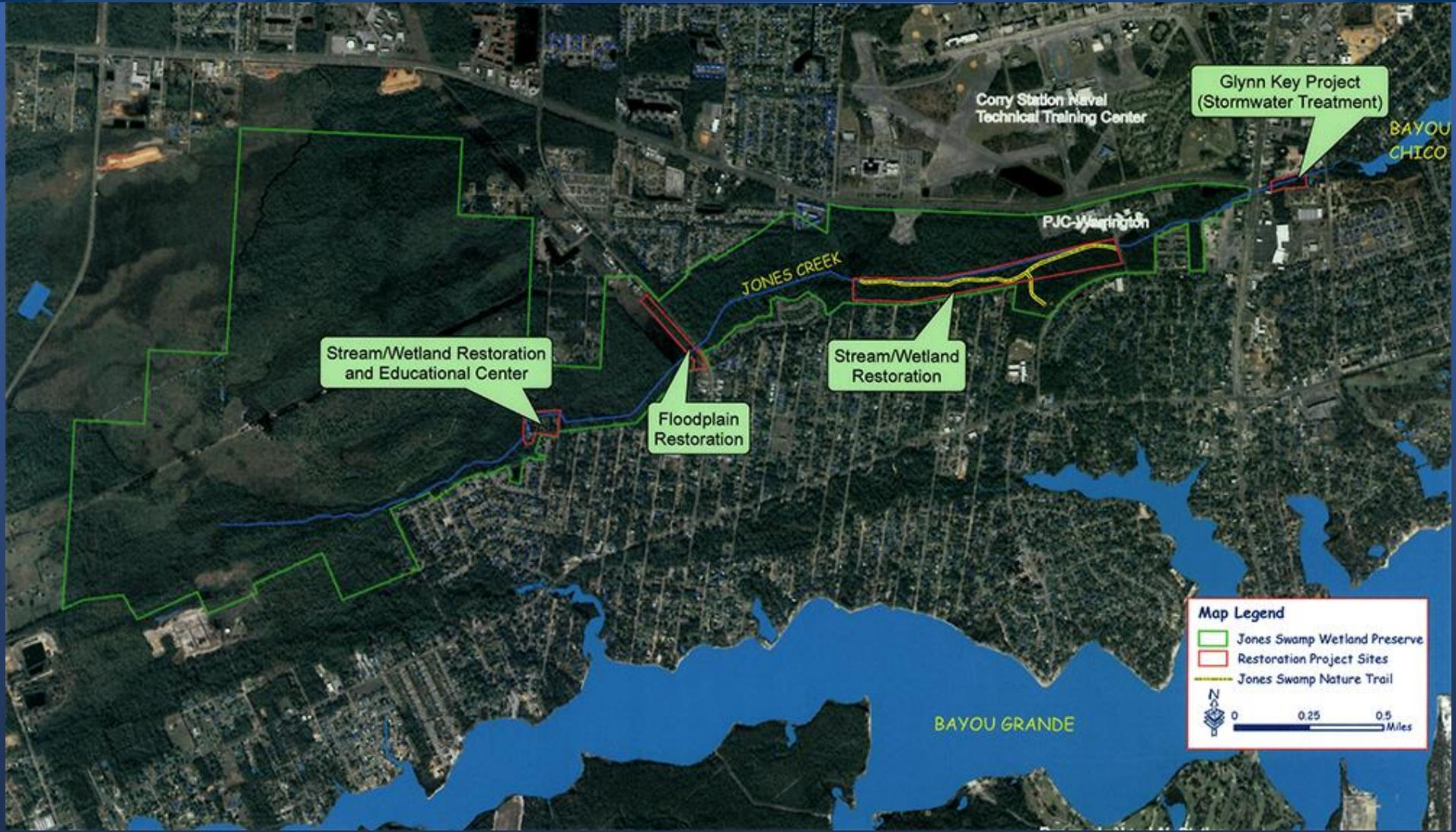


- Relocated off St. Johns River
- Designed for Cat 5 hurricane, 160 mph wind
- \$3.9M City-funded (\$400K FL emergency mgmt grant)

By [Teresa Stepzinski](#) Wed, Apr 24, 2013 @ 12:41 am | updated Wed, Apr 24, 2013 @ 1:01 am

GREEN COVE SPRINGS | The city will build a combination police station and emergency operations center that will be smaller and less expensive than originally planned but still designed to withstand a Category 5 hurricane.

Resiliency includes floodplain restoration. Escambia County – Bayou Chico / Jones Creek Area



Living shorelines offer protection through buffers to inundation on low energy shorelines.



● Completed/Current LSI Sites
▲ Future LSI Sites

SOUTH ATLANTIC
Living Shorelines SUMMIT
APRIL 12 & 13, 2016



Escambia Bay, Site 2 in 2001



Escambia Bay, Site 2 in 2008

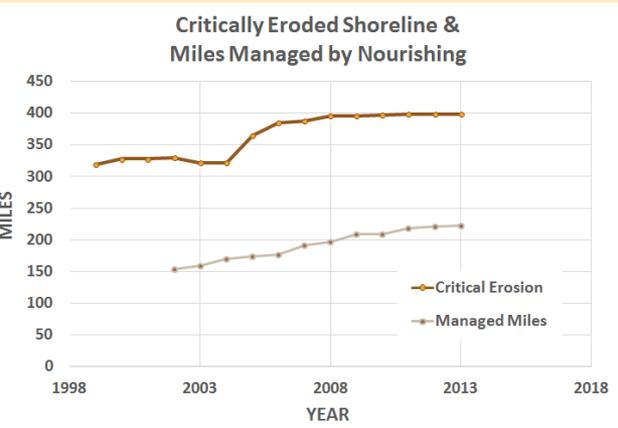
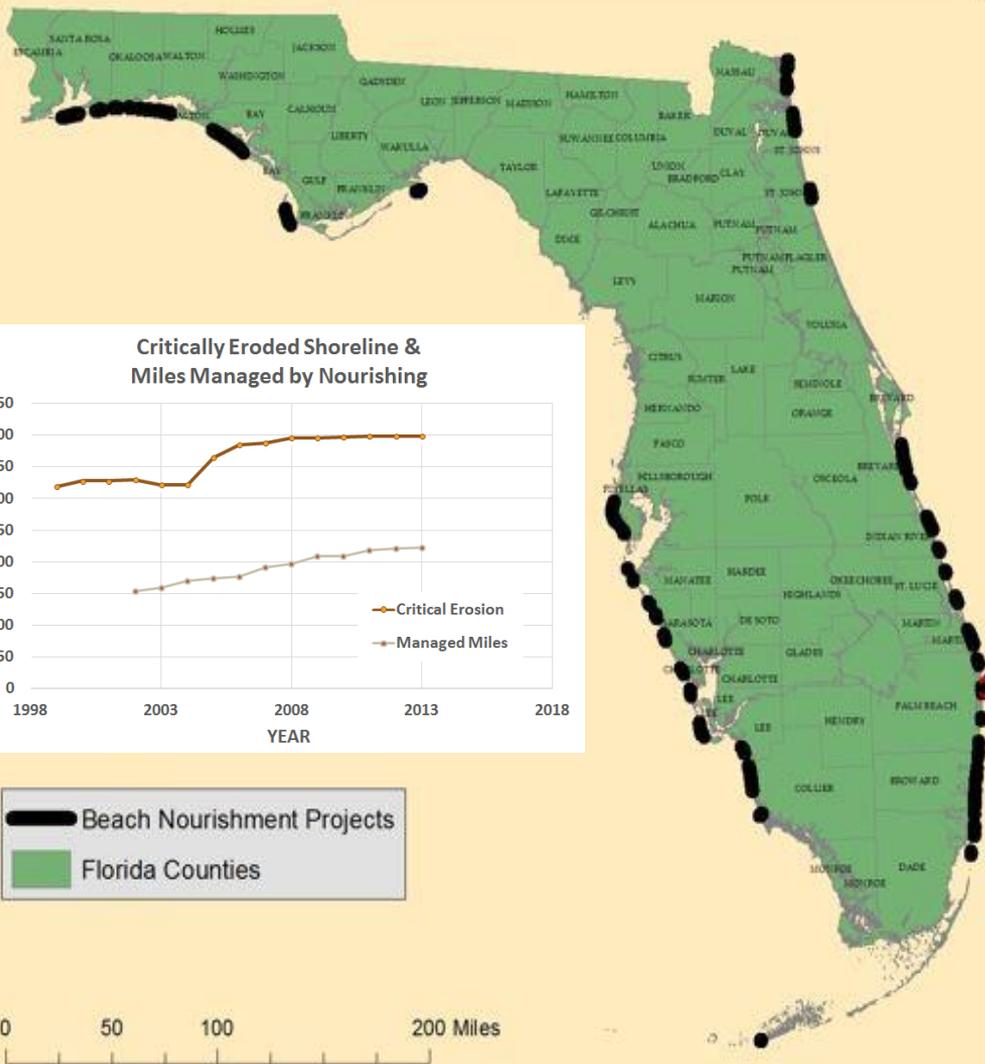


Pensacola Bay's Award Winning Living Shoreline; Oyster reef, salt marsh & seagrass restoration.



Battling coastal erosion with sand: A common resiliency effort statewide.

Statewide Beach Nourishment Monitoring



Beach Nourishment Projects
 Florida Counties



Nourishment projects temporarily advance the shoreline & offer storm protection.



St. Augustine



Miami Beach

What does beach nourishment look like?



Bay County



Pensacola Beach



Navarre Beach



Okaloosa County



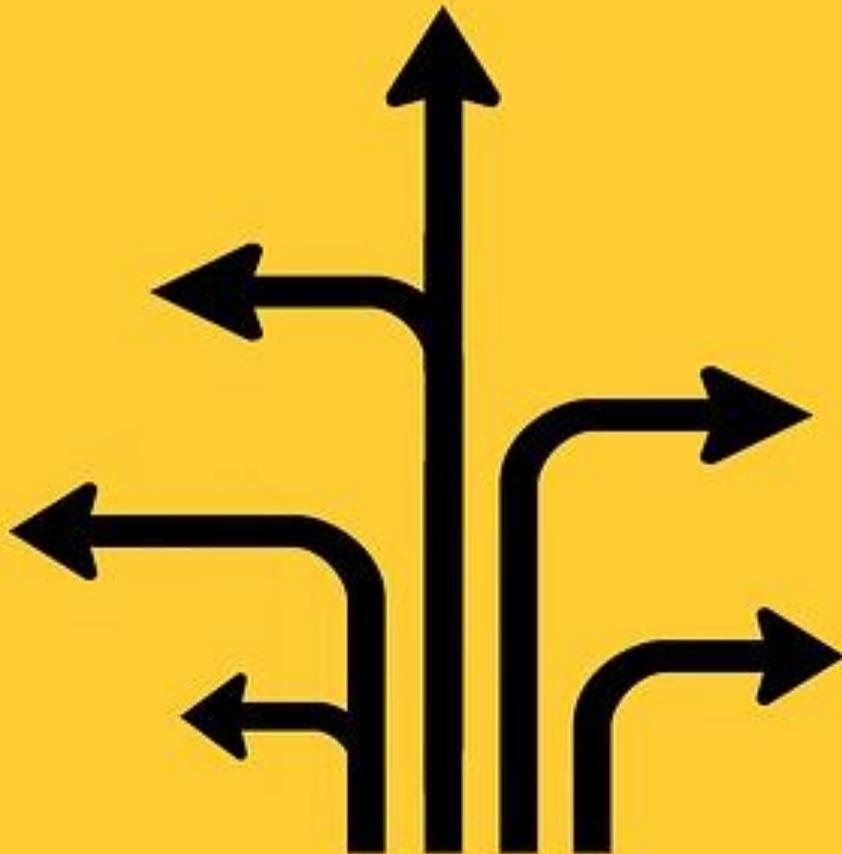
Eglin Air Force Base

St. Johns County 2014 Emergency Declarations

Beach & dunes preferable; not always practical.



Where do we go from here?





COASTAL SYSTEMS INTERNATIONAL, INC.



Coastal Engineering

Waterfront & Marinas

Civil Engineering

Regulatory Permitting

Site Investigations

Marine Environmental

Construction

Destination Development

