Urban Community Adaptation to Changing Environmental Hazard

RESILIENCE PLANNING OUTREACH IN BROWARD COUNTY

BROWARD COUNTY, ENVIRONMENTAL PLANNING AND COMMUNITY RESILIENCE DIVISION

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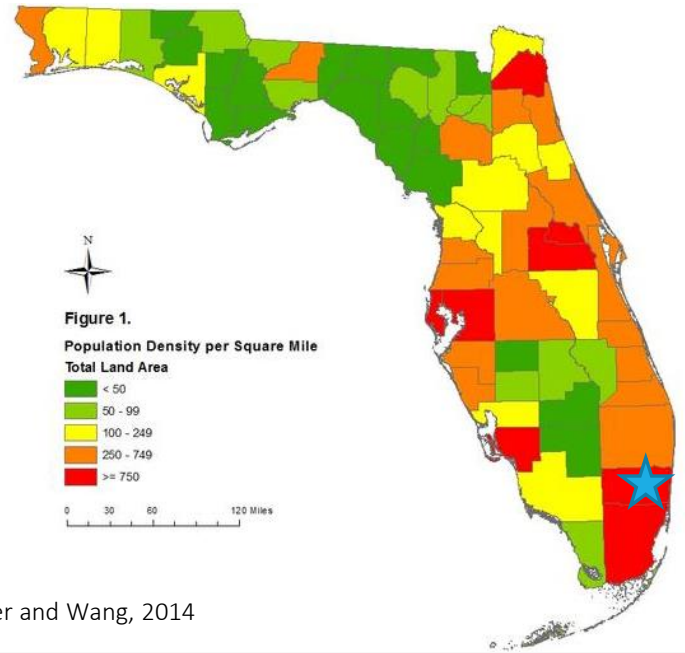
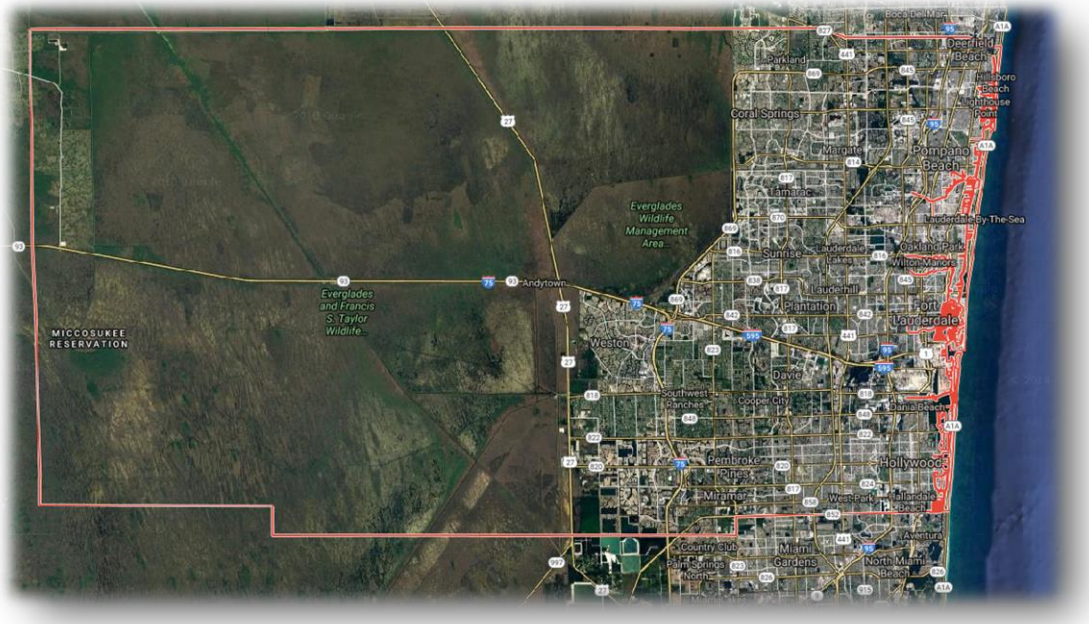
Broward County, Florida

- Nearly 2 million residents – second most populous county in Florida
- Total land area = 1,225 miles^2
- Urban devo. area = 429 miles^2
- Urban population density of 5070 people per square mile – We're #1!



Rayer and Wang, 2014



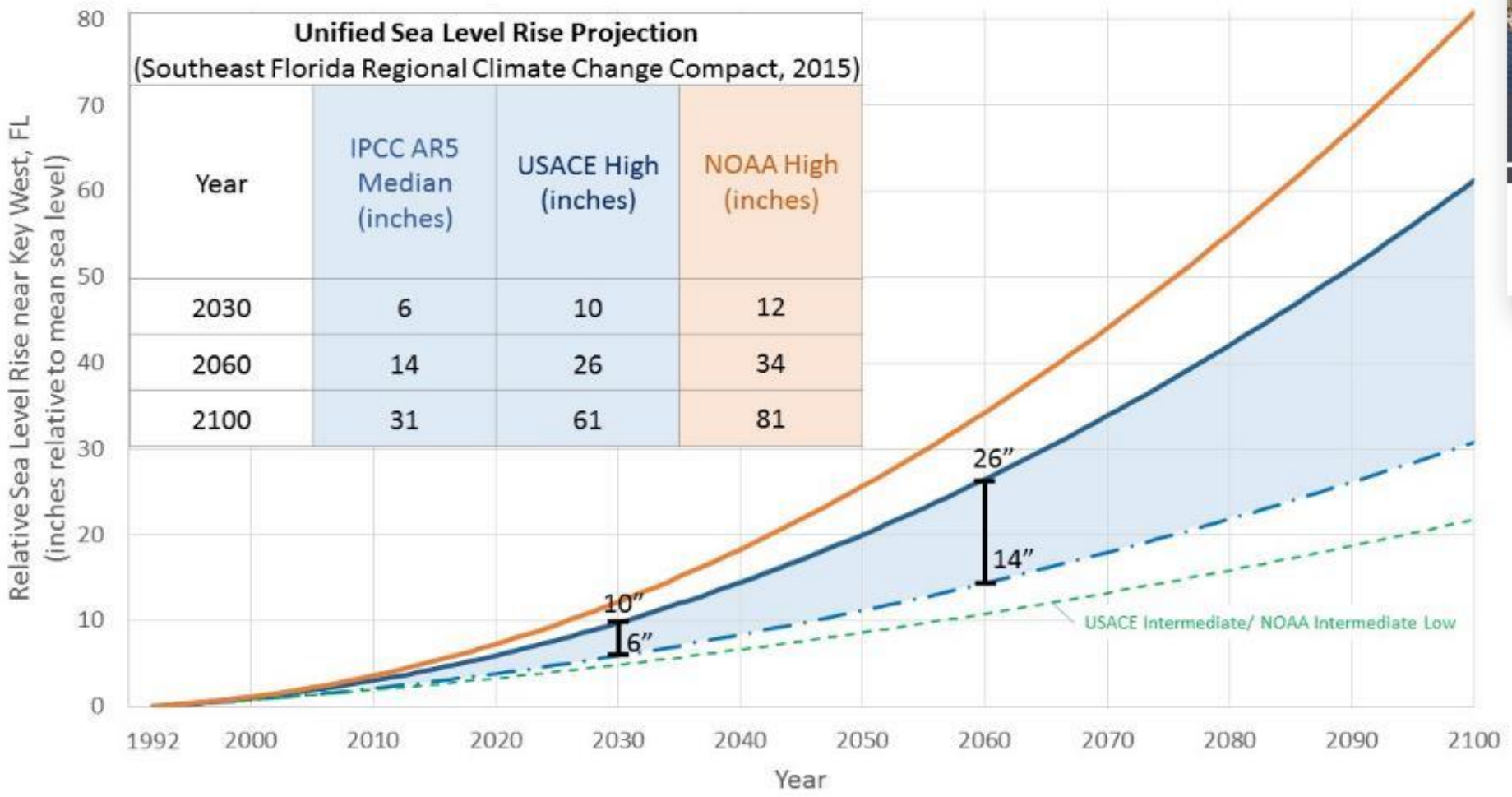
Resiliency Challenges

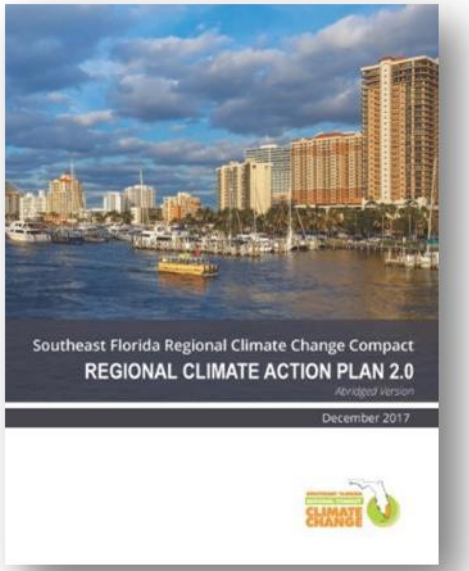
- Extreme rainfall and drought
- Saltwater intrusion
- Beach erosion
- Rising Temperatures
- Ocean acidification
- Sea level rise
- Increased storm intensity

Resiliency Challenges

Unified Sea Level Rise Projection
(Southeast Florida Regional Climate Change Compact, 2015)

Year	IPCC AR5 Median (inches)	USACE High (inches)	NOAA High (inches)
2030	6	10	12
2060	14	26	34
2100	31	61	81

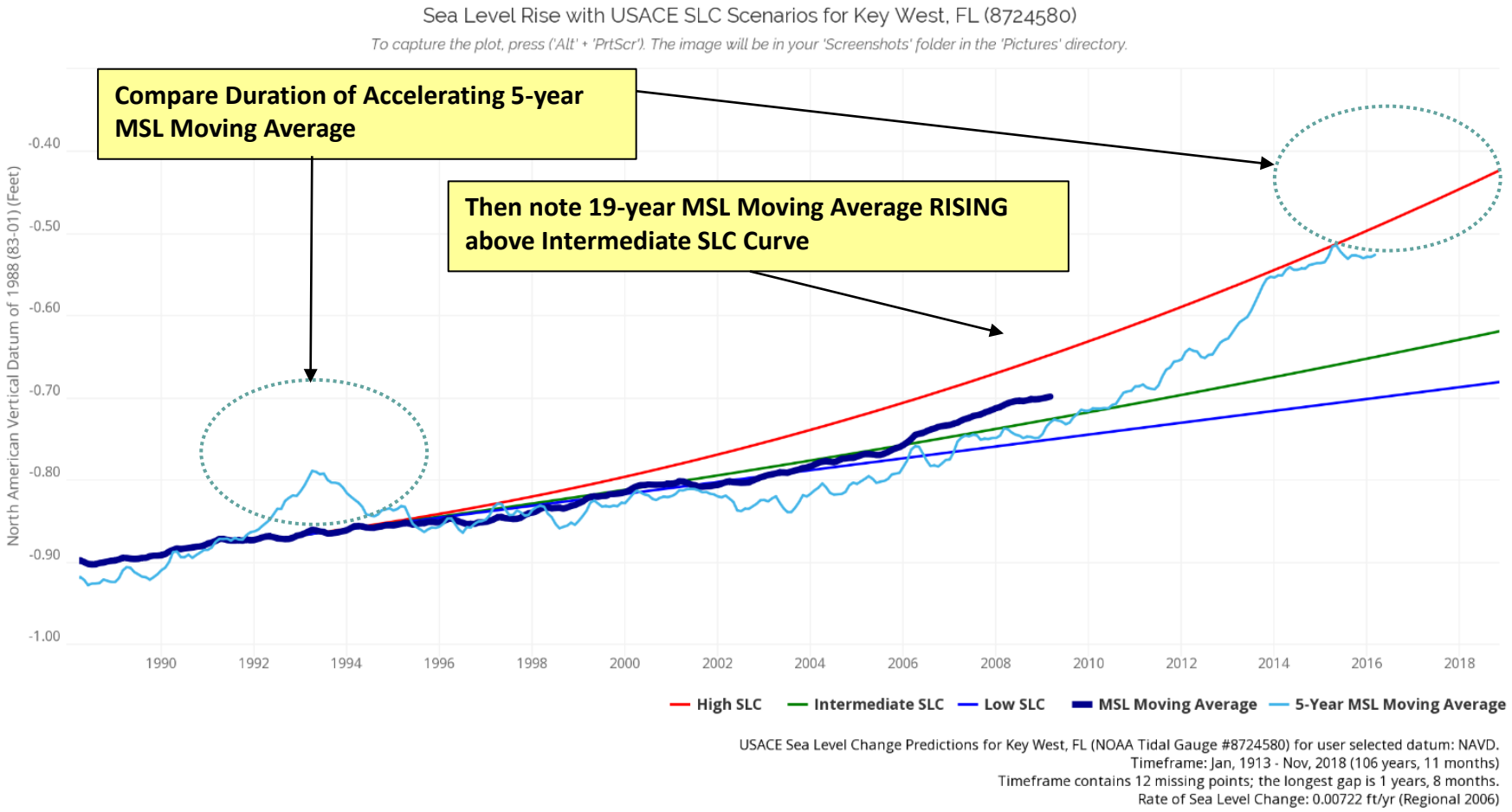




http://www.southeastfloridaclimatecompact.org/news/southeast-florida-regional-climate-change-compact-provides-update-to-regional-sea-level-rise-projection/

Resiliency Challenges

Accelerating Sea Level Change, 30-Year Trends 1988 to Nov 2018, Key West, FL



USACE SEA LEVEL TRACKER TOOL - HTTPS://CLIMATE.SEC.USACE.ARMY.MIL/SLR_APP/

Resiliency Challenges

Flood Risk Prominent and on the Rise

Risk From Rising Seas Could Sink South Florida's Economy Before The Water Even Arrives

WLRN Miami | South Florida

By KATE STEIN • JUL 20, 2018

Hurricanes are slowing, which could be a big problem

By Brandon Miller, CNN

Updated 2:40 PM ET, Thu June 7, 2018

New climate report warns of more rain, hurricanes and flooding in Florida and elsewhere Tampa Bay Times

As king tide season arrives, more South Florida cities brace for sea-level rise

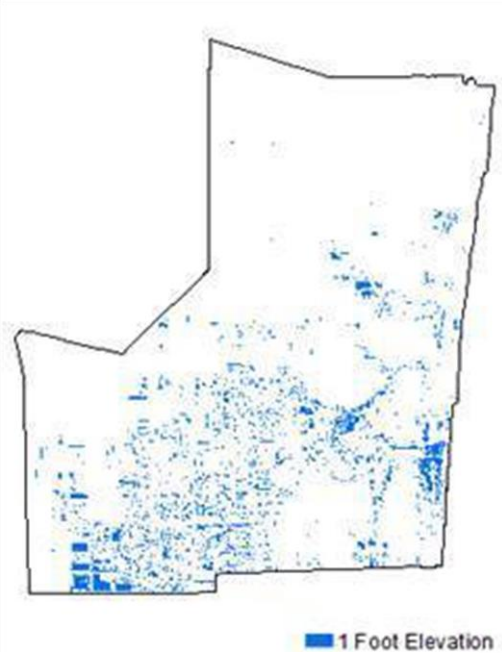
South Florida Sun Sentinel

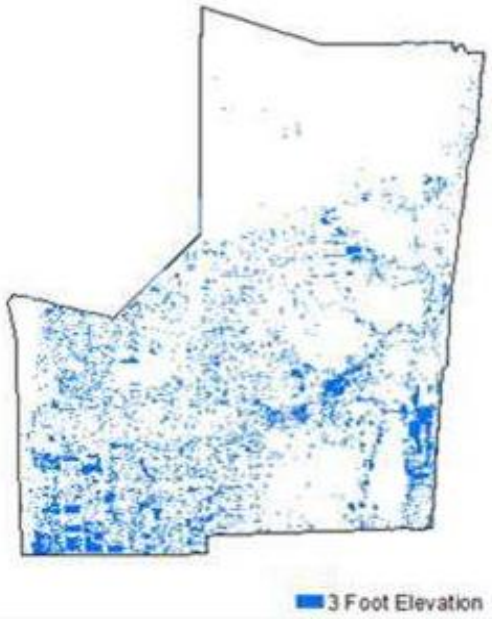
Resiliency Challenges

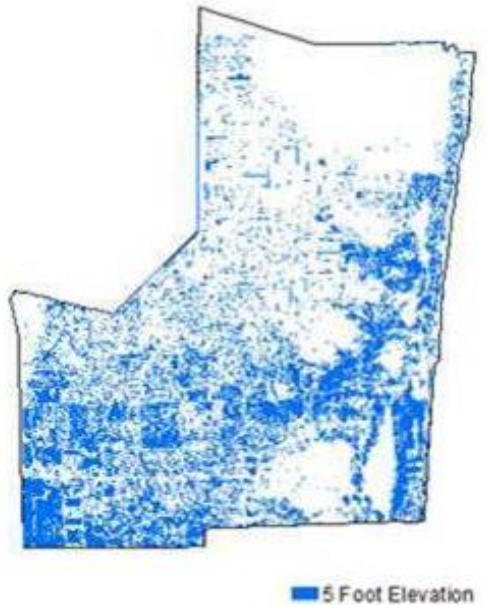
Urban area at or below 1 ft elevation NAVD 88: 23 miles (6%)

Urban area at or below 3 ft elevation NAVD 88: 51 miles (12%)

Urban area at or below 5 ft elevation NAVD 88: 123 miles (29%)

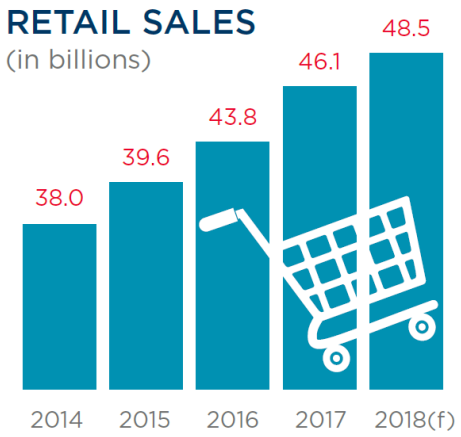




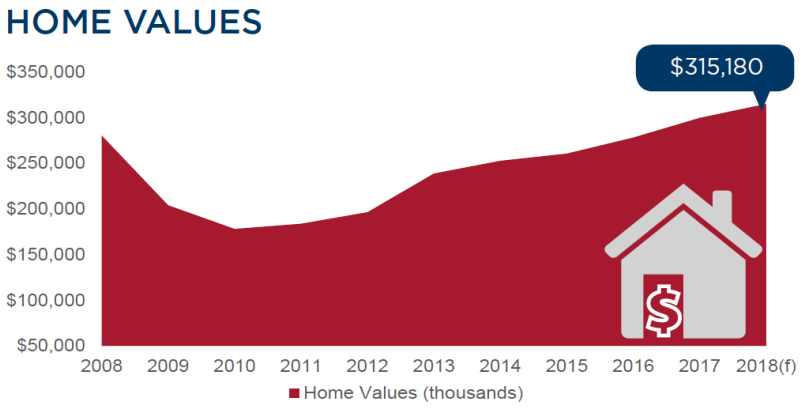


Resiliency Challenges

"quality-of-life amenities that are attractive to people of all ages"



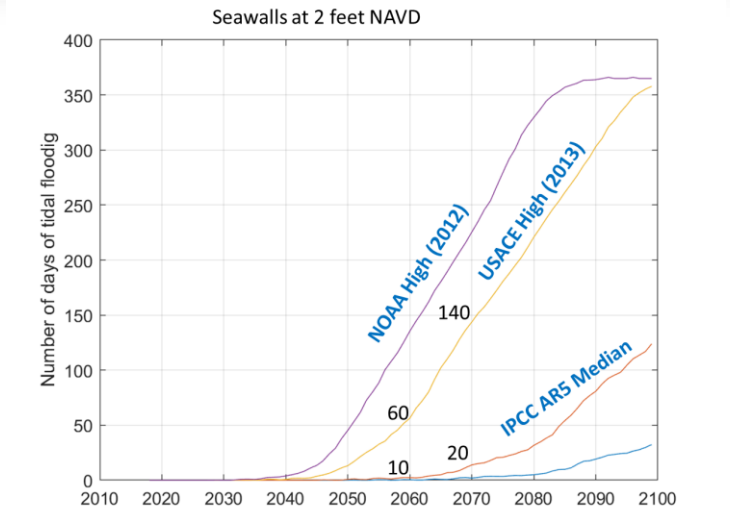
Trends "indicative of solid population growth and in the potential for continued expansion"



Resiliency Challenges

Stormwater Infrastructure

Pumping Infrastructure

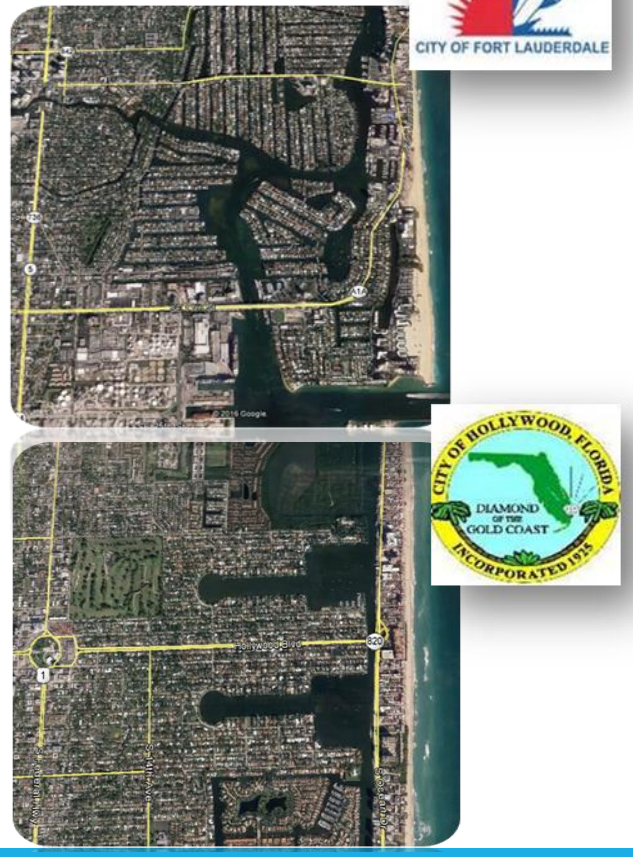


Berms and Coastal Flood Barriers

Future Coastal Flood Modeling USACE, 2018

Today			Year 2060		
Typical High Tide	King Tide	Surge (33% occurrence annually)	Typical High Tide	King Tide	Surge (33% occurrence annually)
0.4	1.5 to 1.8	< 2.5	2.6	3.7 to 4	< 4.7

Focal Areas:
Fort Lauderdale Isles
Hollywood Lakes



Water Level Scenarios:

- King Tide in 2060, 3- 4 feet NAVD
- King Tide in 2060 plus 3 year return interval storm surge, 5 feet NAVD
- King Tide in 2060 plus 20 year return interval storm surge, 6 feet NAVD

Future Coastal Flood Modeling USACE, 2018

Existing Seawall Conditions:

Las Olas Isles

- Minimum seawall elevation is 0.81 feet NAVD
- Average seawall elevation is 3 feet NAVD.
- To raise all walls to 5 feet NAVD
  - 4% would meet the resilience standard
  - 28% would need to be raised ~1 foot
  - 44% would need to be raised ~2 feet
  - 25% would need to be raised ~3 feet
  - 2% would need to be raised more than 3 feet

Hollywood Lakes

- Minimum seawall elevation is -1.64 feet NAVD.
- Average elevation is 2.5 feet NAVD.
- To raise all walls to 5 feet NAVD
  - 1% would meet the resilience standard
  - 11% would need to be raised ~1 foot
  - 48% would need to be raised ~2 feet
  - 27% would need to be raised ~3 feet
  - 12% would need to be raised more than 3 feet

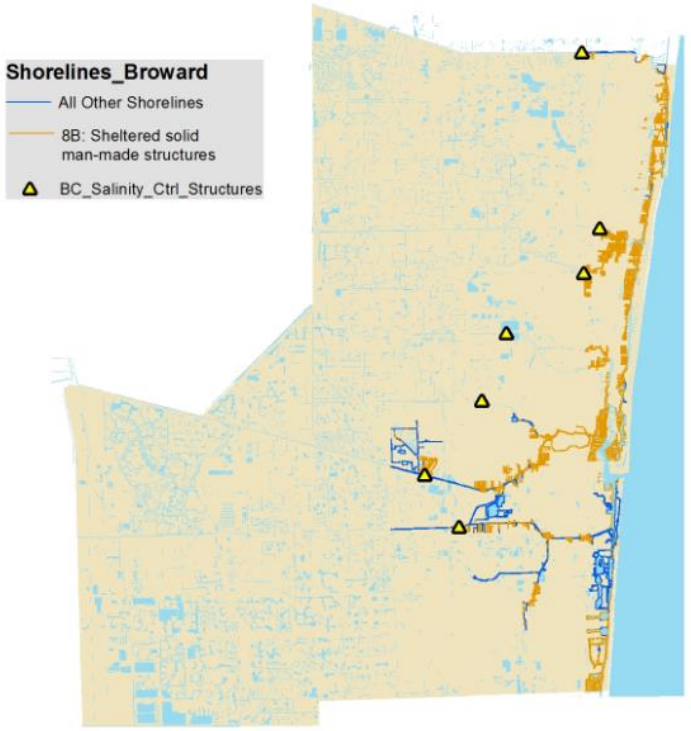
Hollywood Lakes – shoreside residential

Hollywood Lakes – inshore residential

Fort Lauderdale

Las Olas Isles

Over 290 miles of armored estuarine shoreline, but no historical consistency in development standards.



MSTSENDES	LengthMiles
10A: Salt- and brackish- water marsh	0
10B: Freshwater marsh	2
10C: Swamps	8.1
10D: Scrub-shrub wetlands	40.9
4: Coarse-grained sand beaches	1.2
5: Mixed sand and gravel beaches	1.2
8A: Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay	2.2
8B: Sheltered solid man-made structures	286.5
8C: Sheltered riprap	5.7
9B: Vegetated low banks	42.6

Standards! We don’t need no stinkin’ standards!

A rising tide raises all seawalls?

Proposed Resilience Standard – Minimum Seawall Height Policy

- Based on USACE Flood Risk Management Study
- Uniform standard for seawalls & flood barriers of **+5 feet NAVD**
- Allow for **4 feet NAVD until 2035**
  - Future tidal flooding avoided, through 2070.
  - Limited or no surge protection.
- Require **5 feet NAVD by 2050**
  - High frequency storm surge protection provided (~1 foot).
  - 71-87% of County seawalls will need to be raised more than 2 feet.

For more information got to http://www.broward.org/Climate/Pages/Seawalls.aspx

Timeline


Cities and states could see their credit ratings crash if they don't start preparing for climate change

Jeremy Berke
Dec. 1, 2017, 9:16 AM 2,407

- ✓ September 4, 2018 - Climate Change Task Force Briefing
- ✓ September 10, 2018 - Stakeholder Workshop
- ✓ November 9, 2018 - Water Advisory Board Briefing
- ✓ November 13, 2018 - BOCC Motion to Initiate Land Use Plan Amendment
- ✓ November 16, 2018 - Municipal Workshop - http://www.broward.org/Climate/Pages/Seawalls.aspx
- ❑ Winter/Spring - Stakeholder presentations, Community Outreach
- ❑ May 2019 - Final submittal to Broward Planning Council
- ❑ August 2019 - Planning Council Transmittal to State
- ❑ October 2019 - Planning Council Consideration
- ❑ December 2019 - BOCC approval

Policy Rollout

"The best time to integrate habitat features with seawalls will be during this mass implementation process. Habitat could be supported if seawalls were reimagined to serve ecological functions as well continuing to be protective barriers with watercraft accessibility."

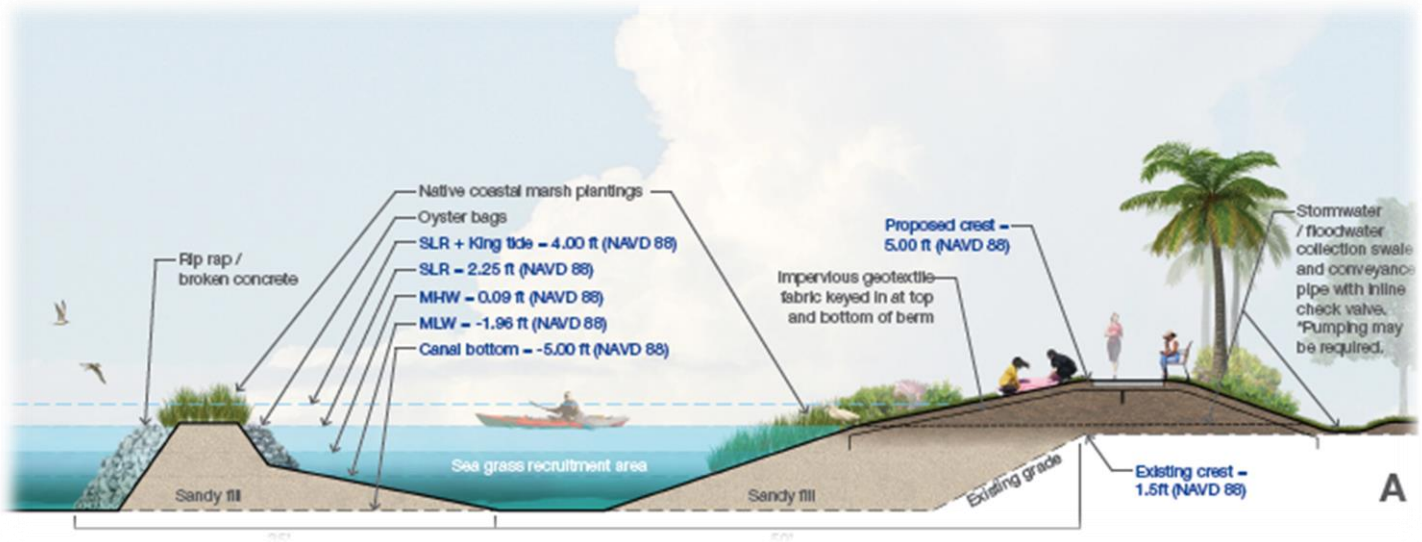
County Comprehensive Plan and Land Use Plan:

- Objective A.03.00, Protect property and infrastructure from impacts of climate change
- Policy A.01.02, Promote green infrastructure, softened shorelines, historic vegetation cover
- Policy A.03.02, Adopt green building practices
- Policy A.03.03, Promote climate resilient designs
- Policy 9.03.09, New dock compatibility with littoral and submerged vegetation

Enhanced Local Mitigation Strategy: Address priority hazards of coastal erosion and flood economic vulnerabilities

Policy Rollout – Outreach Materials

"conceptual artistic renderings (demonstration projects), associated permit processing documentation, cost-benefit analysis, and community outreach materials for habitat supporting flood protection barriers (living shorelines)"



Policy Rollout – Outreach Materials

Materials to address four general environmental conditions:

- Atlantic ICW, Deep Water/High Wake
- Atlantic ICW, Deep Water/Low Wake
- Interior Canal, Shallow Water/High Wake
- Interior Canal, Shallow Water/Low Wake -->

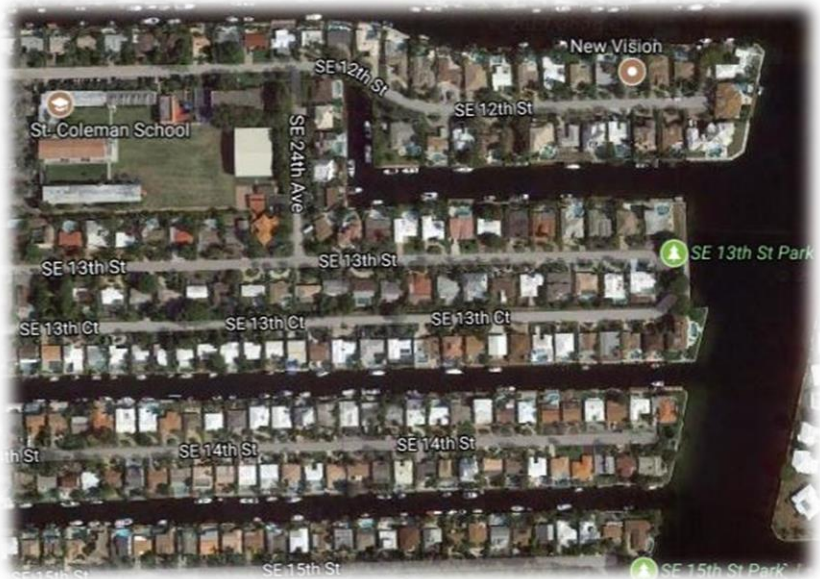
Deep Water - greater than ~5 feet depth

High Wake (Wave) – greater than ~2 feet

Outreach Materials

Deep Water/High Wake Conditional Design

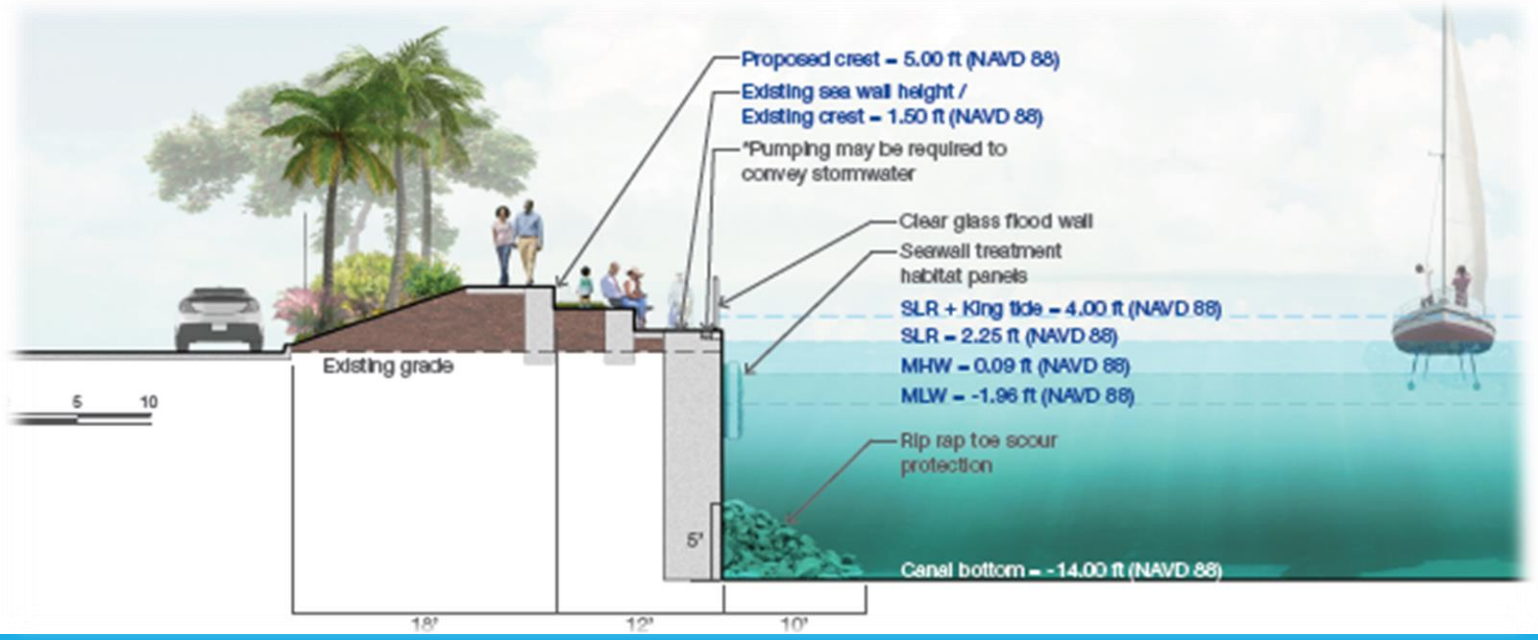
- ICW Pocket Park, street terminus
- Prevalent in County
- Little Room for expansion beyond current footprint

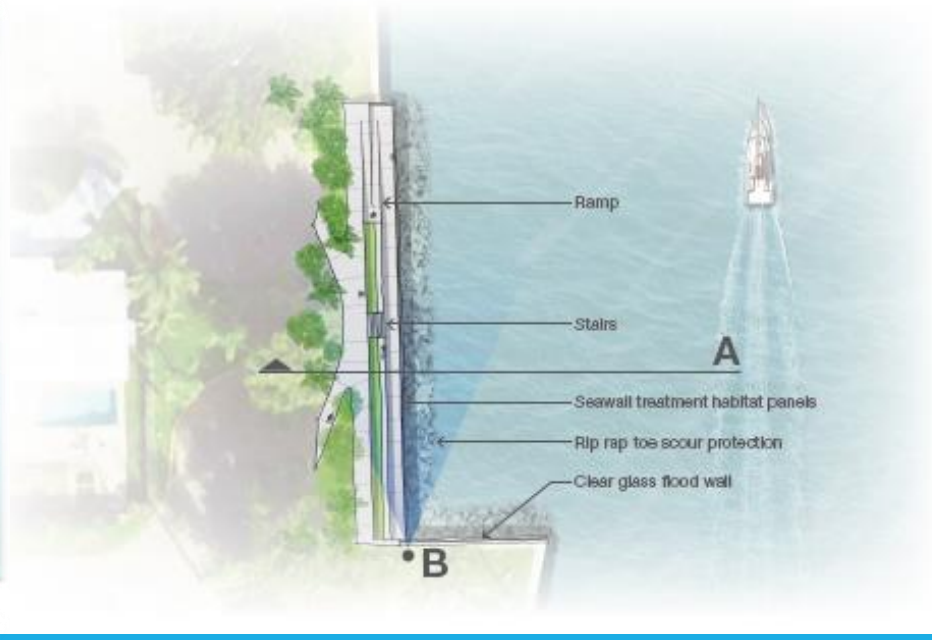


Outreach Materials

Deep Water/High Wake Conditional Design

- Tiered Seat-wall with ADA access ramp for recreational benefit
- Designed to periodically flood – possible habitat enhancement
- Rip-rap toe and habitat panels also provide longevity benefits





Outreach Materials

Deep Water/Low Wake Conditional Design

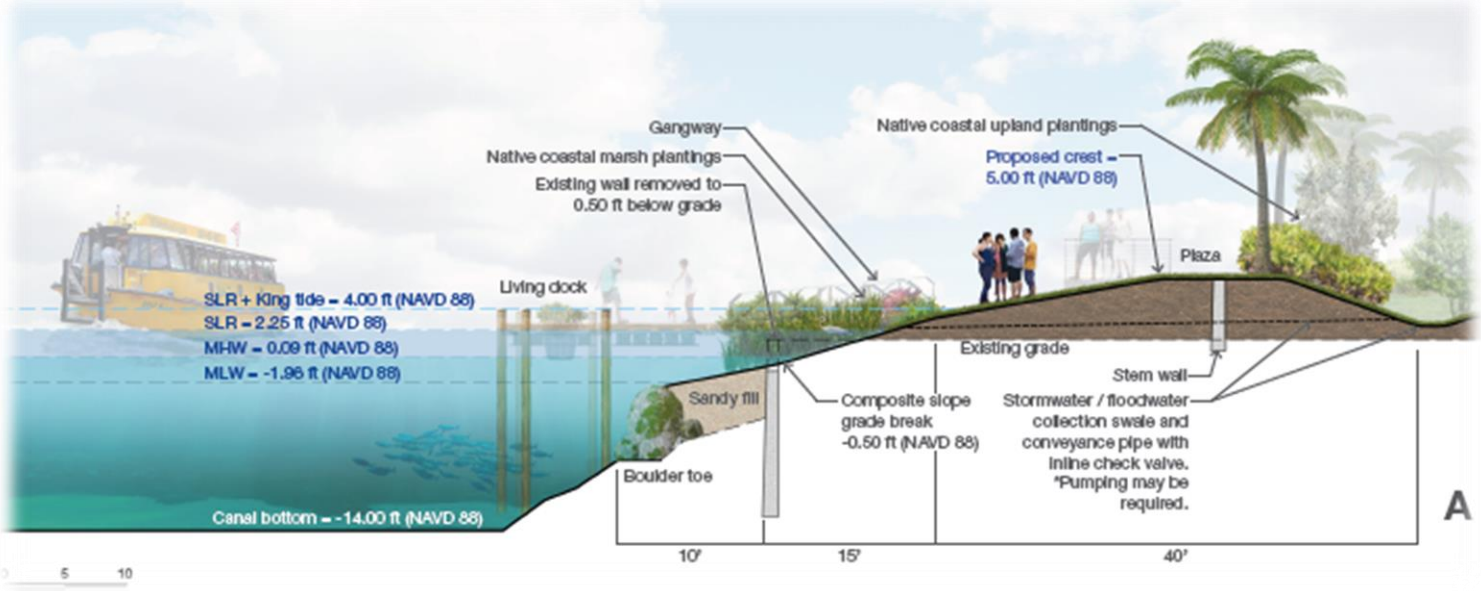
- Fort Lauderdale, Tarpon River, No Wake Zone
- Room for landward expansion beyond current footprint
- Limited seaward to 10-feet

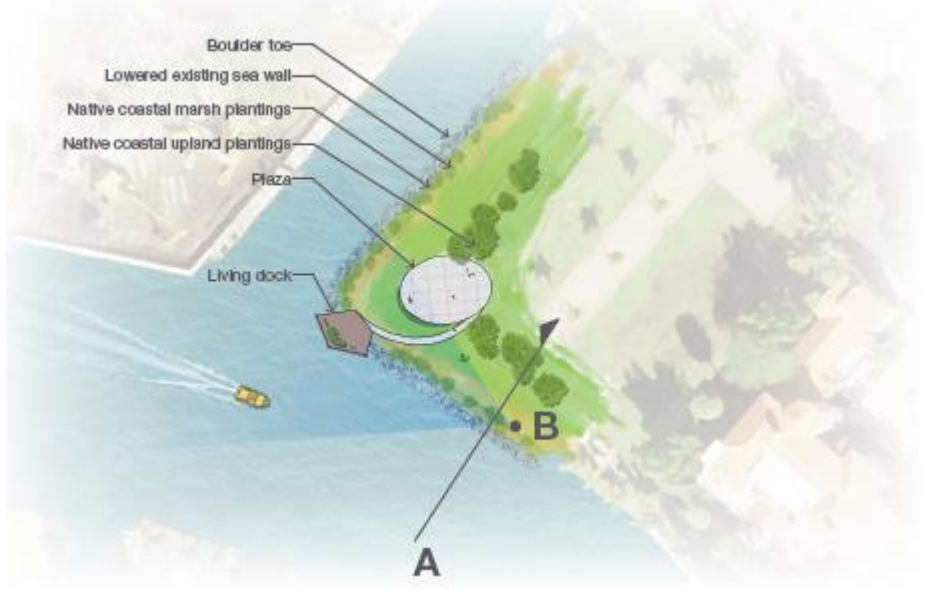
Note: recent seawall construction to pre-existing grade

Outreach Materials

Deep Water/Low Wake Conditional Design

- Existing seawall cap lowered below sea level, back slope grade to stem wall barrier
- Intertidal flood zone – potential habitat creation
- Addition of offshore rip-rap can allow back filled subtidal habitat creation (seagrass)





Outreach Materials

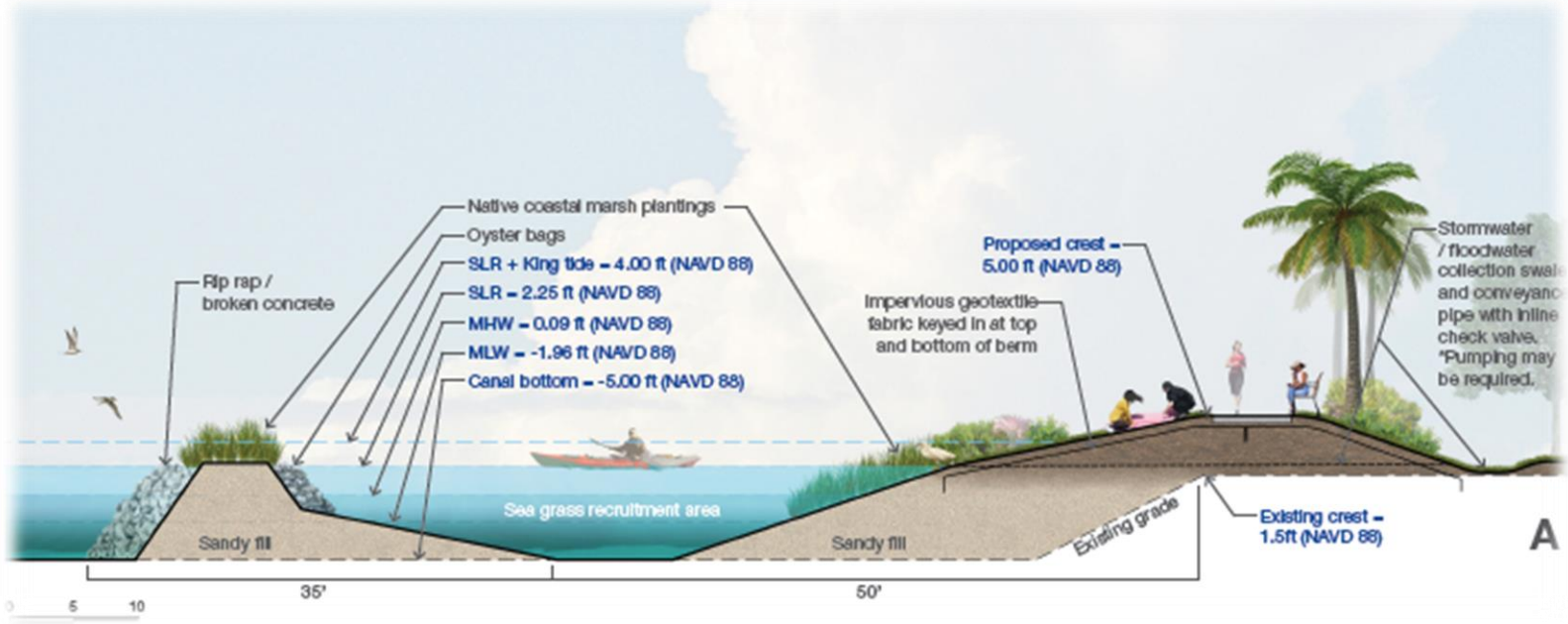
Shallow Water/High Wake Conditional Design

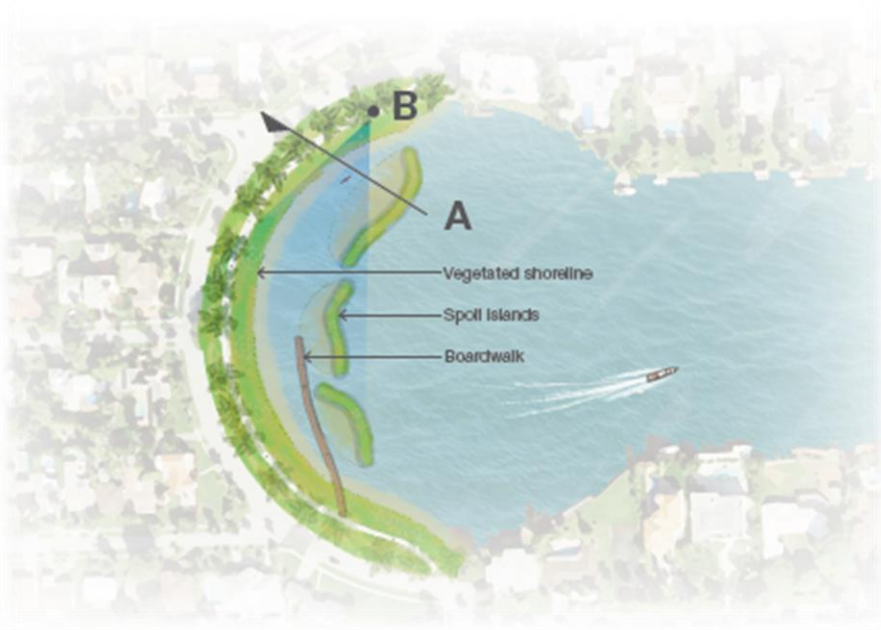
- Hollywood Lakes, public space – bike path/walkway
- Room for expansion both landward and seaward
- Currently concrete slope

Outreach Materials

Shallow Water/High Wake Conditional Design

- Regraded slope and berm, keyed into impermeable geotextile
- Offshore breakwater creates recreation and habitat opportunity
- Removal of concrete slope increases recreation and habitat value





Outreach Materials

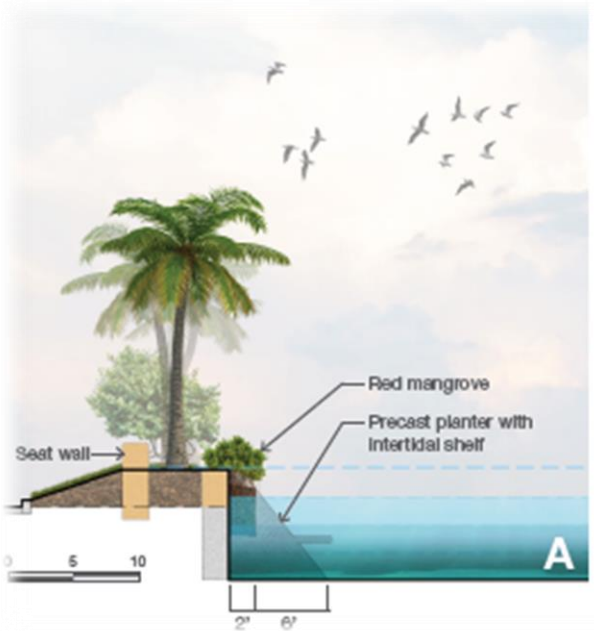
Shallow Water/Low Wake Conditional Design

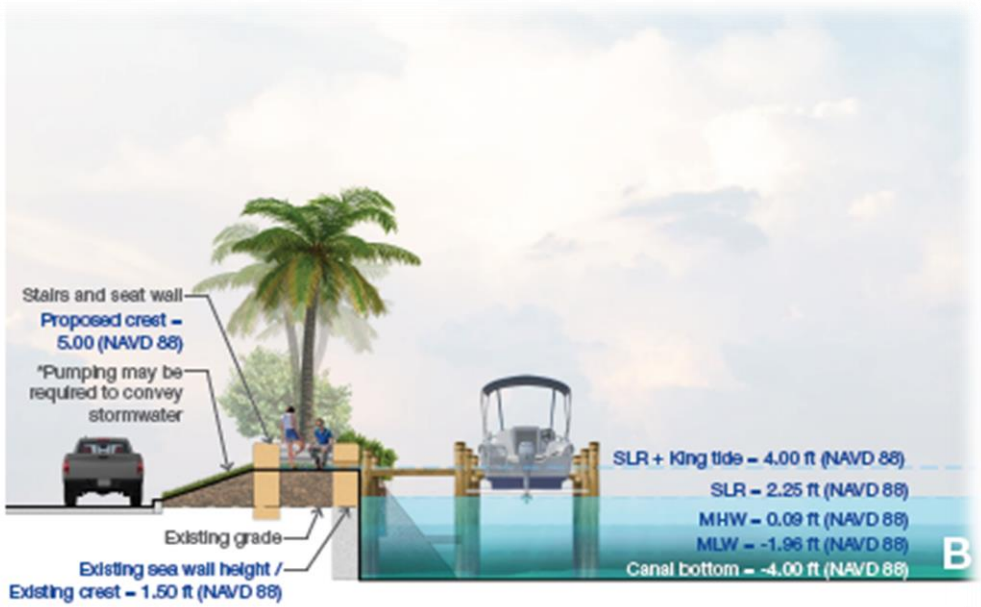
- Fort Lauderdale or Las Olas Isles, residential finger canals
- Little to no room for expansion landward or seaward
- Wake restricted by law or convention

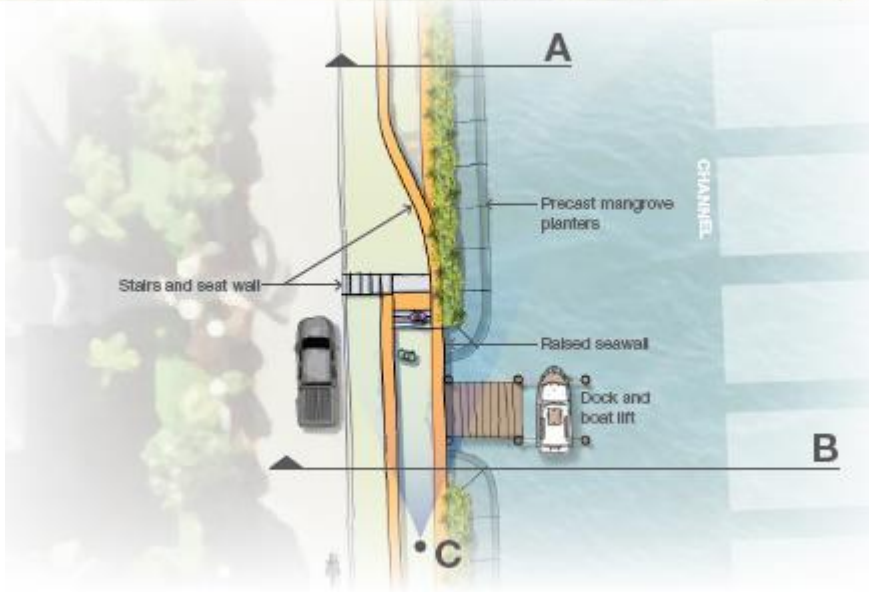
Outreach Materials

Shallow Water/Low Wake Conditional Design

- Tiered seat-wall can be set-back based on space availability
- Intermittently flooded crest can provide habitat and recreational value
- Mangrove planters for additional habitat benefit



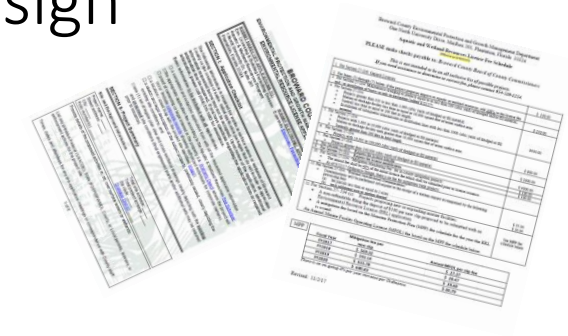




Outreach Materials

Permitting Pathways

- Give guidance on design permitting pathways, and agency contact information, enough to remove perceived barriers to implementation
- Provide example permitting documentation for each design



BROWARD COUNTY FLORIDA

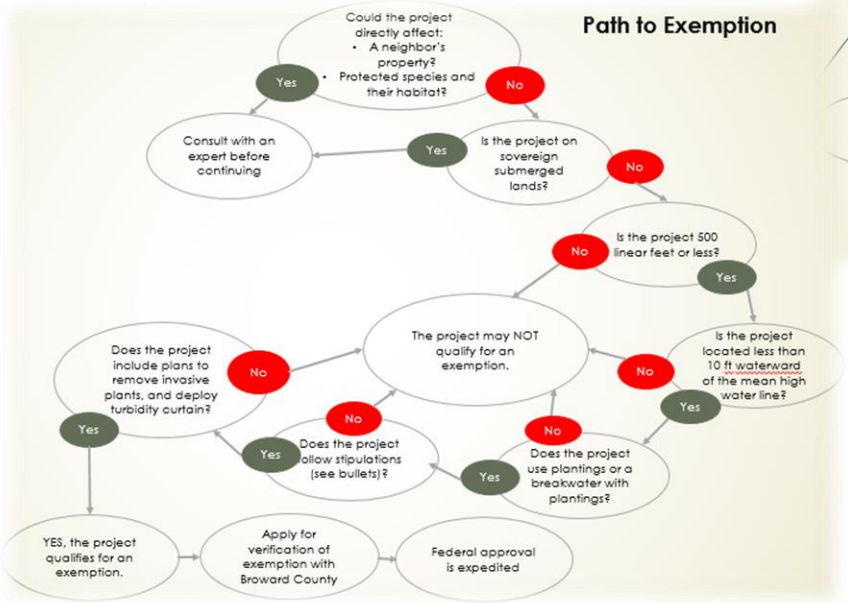
DEPARTMENT OF ENVIRONMENTAL PROTECTION FLORIDA

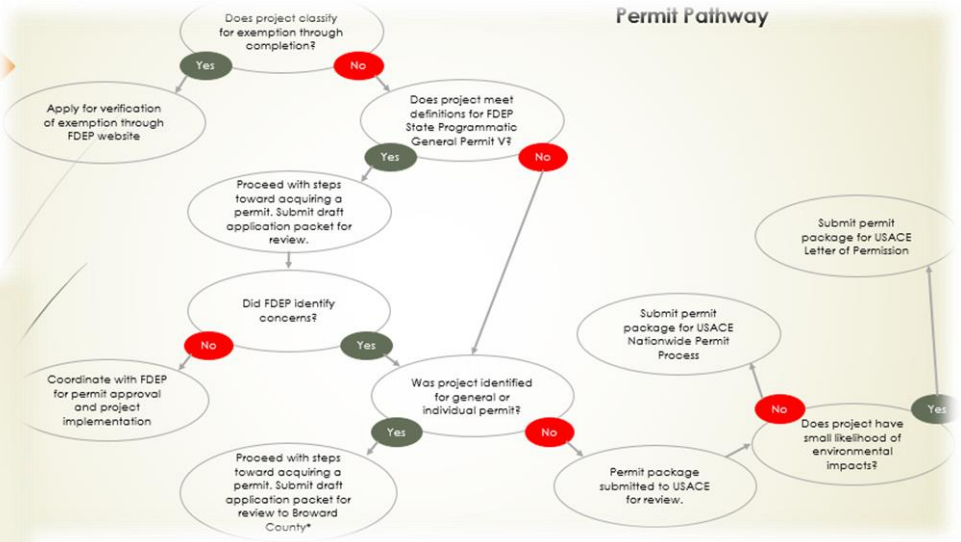
US Army Corps of Engineers ®

Outreach Materials

Permitting Pathways

For example, general decision trees that are highlighted to logically follow specifications for each of the designs shown





Outreach Materials

Probable Costing Guidance

- Give guidance on labor and material costing for design specification upgrades and retrofits, relative to redevelopment of traditional vertical bulkhead

Deep Water/Low Wake (Pompano) wall	Amount	Unit Cost	Units	Total	
Design Survey	1	$1,000	LS	$1,000	
As-built Survey	1	$1,000	LS	$1,000	
Environmental Assessment	1	$5,000	LS	$5,000	
Sediment Samples	5	$250	EA	$1,250	Design &
Design & Engineering	1	$10,000	LS	$10,000	Permitting
Permitting Fees (Local, State & Federal)	1	$1,000	LS	$1,000	$19,250
Turbidity Curtain	200	$17	LF	$3,400	
Silt Fence	200	$8	LF	$1,600	
Clearing & Grubbing	0.1	$11,000	AC	$1,100	
Precast Seawall	100	$1,300	EA	$130,000	Construction
Addtl 3 ft height	100	$350	LF	$35,000	$171,100
			TOTAL	$190,350	

Deep Water/High Wake (Pompano)	Amount	Unit Cost	Units	Total	
Design Survey	1	$1,000	LS	$1,000	
As-built Survey	1	$1,000	LS	$1,000	
Environmental Assessment	1	$5,000	LS	$5,000	
Sediment Samples	5	$250	EA	$1,250	Design &
Design & Engineering	1	$10,000	LS	$10,000	Permitting
Permitting Fees (Local, State & Federal)	1	$1,000	LS	$1,000	$19,250
Turbidity Curtain	200	$17	LF	$3,400	
Silt Fence	200	$8	LF	$1,600	
Clearing & Grubbing	0.1	$11,000	AC	$1,100	
Earthen Berm/Embankment Fill	260	$36	CY	$9,360	
Rip Rap	175	$300	TN	$52,500	
Concrete Seatwall	100	$350	LF	$35,000	Construction
Concrete Stairs	1	$5,000	EA	$5,000	$107,960
			TOTAL	$127,210	
Habitat Panels	100	$40	LF	$4,000	
Glass/Plexiglass Wall	100	$450	LF	$45,000	

Thank you!

Questions?

Adaptation Strategy	Number of Days of Flooding in 2070	Surge Protection from 3 to 20-Year Storm Plus King Tide and 2' Sea Level Rise (% of Storms When Overtopping Occurred)	50-Year Return Period Losses with 2 Feet of Sea Level Rise (Total)	50-Year Return Period Losses with 2 Feet of Sea Level Rise (Hollywood)	50-Year Return Period Losses with 2 Feet of Sea Level Rise (Fort Lauderdale)	Range of Median Storm Losses	Evaluation	Selection
No Action	20 to 140	0%	$243M	$147M	$107M	$0 to $268M	Flood frequency exceeds 30 days	
Fill Gaps (4 feet NAVD in FTL and 2.5 feet in HWD)	0 to 25	0%					No surge protection	
Raise walls to 4 feet NAVD	0	25%	$243M	$147M	$107M	$0 to $340M	No cost benefit	
Raise old walls to 6 feet, newer walls remain at 4 feet	0		$233M	$146M	$98M		~$10M savings	
Raise walls to 6 feet	0	75%	$228M	$146M	$96M	$0 to $112M	~$15M- $112M savings	Justifies ~21 miles of seawall adaptation, 24% of study area
Raise walls to 8 feet	0		$51M	$28M	$20M		~$192M savings	