

# Level-Up Palm Beach

Coastal Resilience Implementation Plan

DRAFT FINAL REPORT FRAMEWORK



# Introductions



## Bob Hamilton

President, Senior Coastal Engineer.

- › 20+ years of experience with Palm Beach
- › Oversaw technical review of Comprehensive Coastal Management Program, Coastal Flood Vulnerability Assessment



## Nasser Brahim

Senior Climate Resiliency Specialist.

- › 15 years of climate resiliency and infrastructure experience
- › Led development of Implementation Plan resilience recommendations

# Content of Draft Final Report Framework

## 1. Purpose, Goals, and background

## 2. Level Up recommendations

Town facilities and infrastructure

Lake Worth shoreline

Floodplain development

Comprehensive Plan

## 3. Next Steps

## 4. Discussion

This Framework Document is not the presentation for June 8

- Nor is it the format for the Report
- It is intended to provide background update information as basis for discussion on June 8 so the Draft Final Report can be delivered as a next step.





# Level-Up Palm Beach

## The Concept for Implementation Planning has Evolved

Palm Beach has incorporated coastal resilience measures via the coastal program, asset-specific designs, and evolving policy to enhance.

Primary sources for present and future coastal flood risk are from the Lake Worth side, including diverse public and private property...

...Which makes it complex to achieve community resilience - there is not a single independent Town-owned solution.

Although certain Town assets are at risk and can be improved independently, community coastal flood resilience will depend on public/private cooperation, including forward-thinking policies & programs.

# Enabling Legislation

## Town of Palm Beach Comprehensive Plan (Ordinance No. 9-2017)

**Objective 15:** The Town shall adopt and implement policies that increase community resiliency and protect property, infrastructure, and cultural and natural resources from the impacts of climate change, including sea level rise, changes in rainfall patterns, and extreme weather events.

- **Policy 15.1:** The Town will continue to participate in the National Flood Insurance Program Community Rating System (CRS) and strive to maintain or improve its current CRS rating.
- **Policy 15.2:** The Town will require that the impact of sea level rise be addressed in all Future Land Use Map amendments.
- **Policy 15.10:** Continue to examine community-wide strategies to increase the resiliency of the Town to address future effects of coastal storms and climate change on the community.
- **Policy 15.11:** The Town shall collaborate with Palm Beach County to increase regional resilience by sharing technical expertise, assessing local vulnerabilities, advancing agreed upon mitigation and adaptation strategies, and developing joint state and federal legislation policies and programs.
- **Policy 15.12:** The Town shall continue to utilize best practices and initiate mitigation strategies to reduce the risk of flooding in coastal areas that may results from high tide events, storm surge, flash floods, stormwater runoff, and the related impacts of sea level rise.

Coastal Flood Vulnerability Assessment also included in the 10-Year Coastal Management Program Plan

# Recent Developments

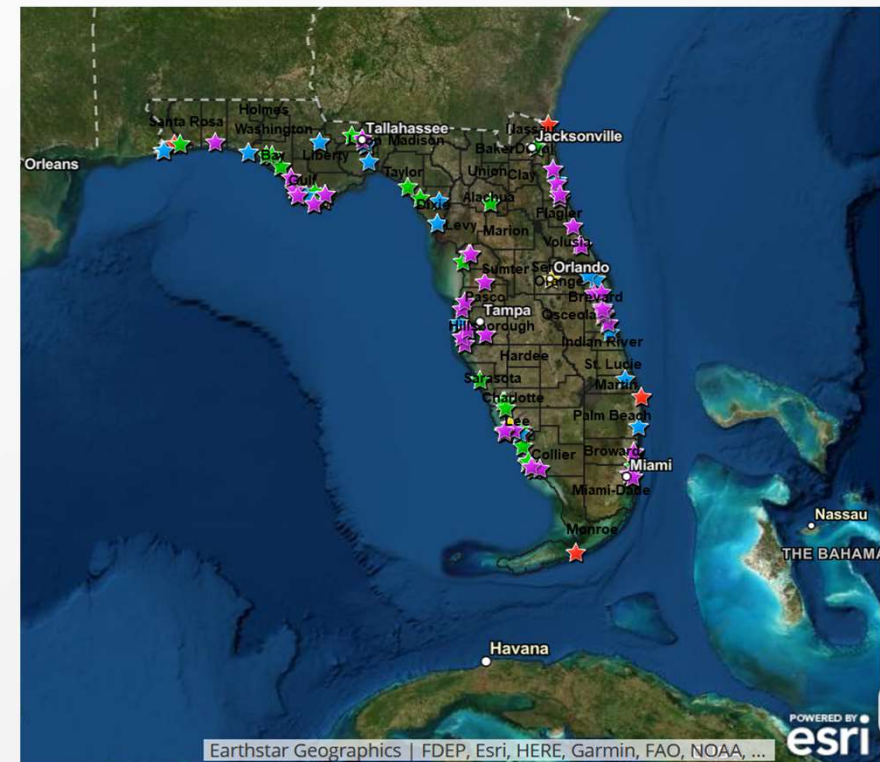
- Implementation Plan initiated late 2019 as natural next step from the Coastal Flood Vulnerability Assessment
- Process affected by COVID-19 by rescheduling public engagement component
- Palm Beach demonstrating leadership for coastal resilience planning
- Ongoing work revealed tremendous opportunity for action in Palm Beach, both in terms of:
  - Assets to protect now
  - Policies to establish to promote longer-term meaningful change to engrain coastal resilience into Town culture
- Meanwhile state of Florida programs have strengthened; new opportunities for Palm Beach to participate
- 2020 Florida Building Code with higher elevation requirements
- FL Senate Bill 1954: Statewide Flooding and Sea Level Rise Resilience
  - <https://www.flsenate.gov/Session/Bill/2021/1954>
  - <https://www.flgov.com/2021/05/12/governor-ron-desantis-signs-bill-to-further-strengthen-floridas-resiliency-efforts/>
  - Contemplates \$640M investment



# Florida Resilient Coastlines Program

<https://floridadep.gov/rcp/florida-resilient-coastlines-program>

- **Resilience Planning Grants (RPG)** for communities with coastal program in comprehensive plan (< \$75k)
  - Comply with Peril of Flood Statute
  - Vulnerability Assessments
  - Adaptation and Resilience Plans
  - Regional Collaboration Efforts
- **Resilience Implementation Grants (RIG)** (<\$500k)
  - Nature-Based Erosion & Flood Control
  - Elevation of Public Structures
  - Projects in Adaptation / Resilience Plans
- **New Sea Level Impact Projection (SLIP) Studies**
  - New Rule for State-Financed Constructors
  - Requires Consideration of Sea Level Rise in Planning/Design
  - Enforceable
- **Statewide vulnerability study** will be conducted per Senate Bill 1954



# Level-Up Palm Beach Goal and Purpose

The goal of Level-Up is to set Palm Beach on a path to identify and achieve high standards of resilience to sea level rise, future storms, and related coastal flooding from climate change.

Recommendations are phased over time, allowing for an adaptive approach to build a resilient and layered system of protection.



Town Facilities and Infrastructure



Lake Worth Shoreline



Floodplain Development



Comprehensive Plan



# Level-Up Implementation Plan Components



## Refined Coastal Flood Vulnerability Assessment

- › Updated asset tables
- › Added critical elevation data
- › Updated priorities/CVI



## Level-Up Policies, Codes, and Guidelines

- › Design Flood Elevations
- › Lake Worth Shoreline
- › Floodplains
- › Comprehensive Planning



## Level-Up Town Facility and Infrastructure Floodproofing

- › High Priority Assets Now
- › Medium Term Assets Pending Data
  - Elevation Surveys
- › Longer Term Assets to Monitor



## Other Components

- Monitoring and Triggers
- Budgetary Considerations
- FEMA Implications
- Alignment with FDEP Resilient Coastlines and Funding Opportunities

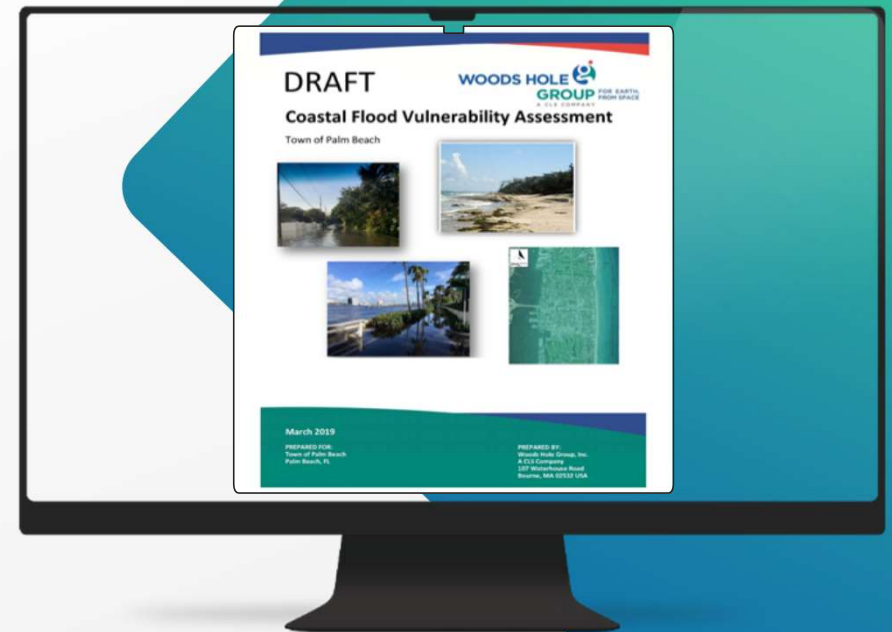
## Prior Work – CFVA

The Coastal Flood Vulnerability Assessment (CFVA) was completed in 2019 to examine future coastal flood risk resulting from sea level rise and storms of increasing severity and intensity.

### Flood Risk Model



### ID /Rank Assets at Risk



# Key Questions Addressed by CFVA



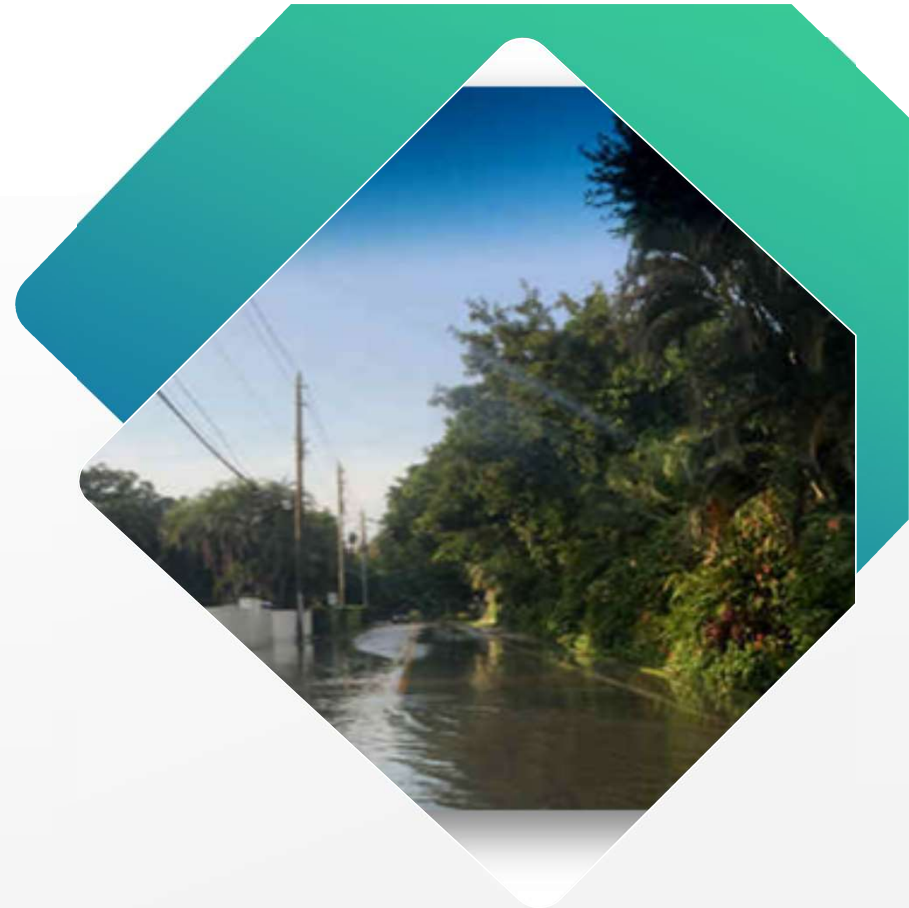
What are the chances that Palm Beach will flood today and how is this expected to change in the future with climate change?



What Town assets are vulnerable and what is the present and future probability of flooding?



What conceptual solutions can be implemented to address today's flooding risk and to reduce risk, build long-term coastal resilience, and save \$\$\$?



## Where We Left off from CFVA...

### The CFVA provided the Town:

- Updated picture of its present and future flood risk
- Identification and ranking of its assets at risk

### Town pursued an Implementation Plan to:

- Identify specific actions to pursue to build coastal resilience based on the flood risk and assets defined in the CVFA

The new findings follow – Introducing Level-Up Palm Beach!

# Level-Up Palm Beach Implementation Plan

## Summary of Near-Term Recommendations

1. Identify first-, second-, and third-priority floodproofing projects and thresholds for action, with future action depending on monitoring data.
2. Implement first-priority floodproofing projects for vulnerable critical facilities to minimize future costs of damage and impacts to level of service. (*Policy 15.12*)
3. Strengthen bulkhead and seawall construction, maintenance, and certification standards to initiate the transition towards higher coastal flood mitigation performance, while minimizing temporary transitional impacts. (*Policy 15.12*)
4. Add coastal flood control to the municipal services charter to facilitate future neighborhood-scale coastal flood control. (*Policy 15.10*)
5. Strengthen standards for residential and non-residential development in the future floodplain to protect people and property from high and increasing flood risks. (*Policies 15.1 and 15.2*)
6. Collaborate with Palm Beach County and neighboring jurisdictions to request a US Army Corps of Engineers feasibility study for Lake Worth coastal storm risk management measures, including inlet surge barrier(s), and advocate for Congressional authorization and budgetary appropriations. (*Policy 15.11*)
7. Pursue compliance and collaboration with emerging FDEP Resilient Coastlines and related programs



# Level-Up Palm Beach

## Town Facilities and Infrastructure



Design, construct, and maintain Town assets to mitigate future risks from coastal flooding.



# Facilities and Infrastructure - Contents

Design Flood Elevations

Near-Term Specific Recommendations

Medium- and Long-Term Potential Risks



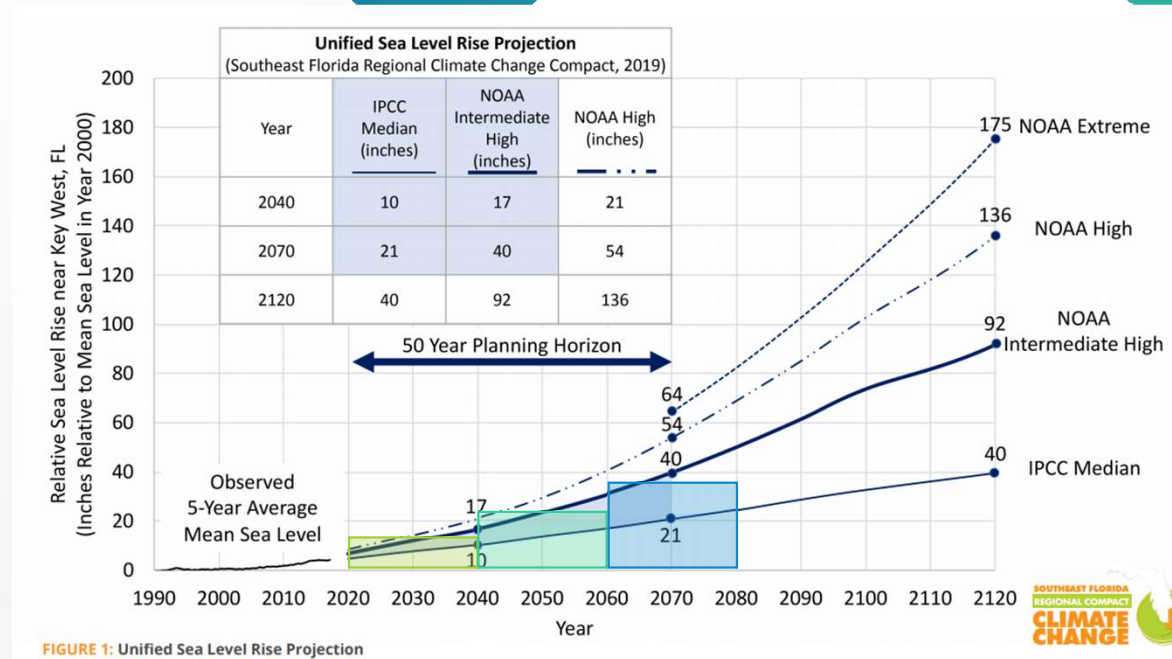
# Design Flood Elevations for Facilities

FEMA BFE = 6' NAVD88

**+1'** **Maintenance Projects**  
End of service life in 2040 or sooner

**+2'** **Major Rehabilitation Projects**  
End of service life in 2041-2060

**+3'** **New Construction Projects**  
End of service life later than 2060



SOURCE: UNIFIED SEA LEVEL RISE PROJECTION FOR SOUTHEAST FLORIDA (2019)

## Near-Term Recommendations

Facility	Recommendation (*to be verified)	Flood Risk	Present   Future   Value	Order of Magnitude Capital Cost
D-12 SPS (Bldg)	Floodproof with deployable barriers, conduit sealant, floor drain backflow valve	5%	>20% 70	\$
D-6 SPS (Bldg)	Raise proposed main disconnect and existing 30KVA transformer* and Panel L1*	5%	>20% 67	\$
E-6 WPS	Raise pump junction box and electrical/control panels	3%	20% 70	\$
D-12 SPS (Wet Well)	Extend pump electrical gear wall, raise electrical panels, and provide higher access	2%	10% 70	\$
D-5	Raise proposed control panel	3%	20% 63	\$
D-17 SPS	Raise proposed electrical/controls	2%	10% 57	\$
A-6 WPS	Raise proposed equipment 1 ft higher than planned	1%	10% 73	\$
D-8 SPS	Raise proposed air-cooled radiators, pump control panel	1%	10% 63	\$

# D-12 Stormwater Pump Station

Built in 2001 (20 years old)

Upgrades planned in 2022

Critical for access and property protection:

- › 120-acre, largely residential area
- › North Fire Station
- › Master Wastewater Pump Station
- › Recreational and historic resources,
- › Large commercial area with the only supermarket on the island

Vulnerabilities at present FEMA BFE:

1. Control Building
  - Muffler\*
  - Motor Control Center (MCC)
  - Automatic Transfer Switch (ATS)
  - 30KVA step-down transformer\*
  - Switchgear\*
2. Wet Well
  - Electrical panels\*

\*Field verification required



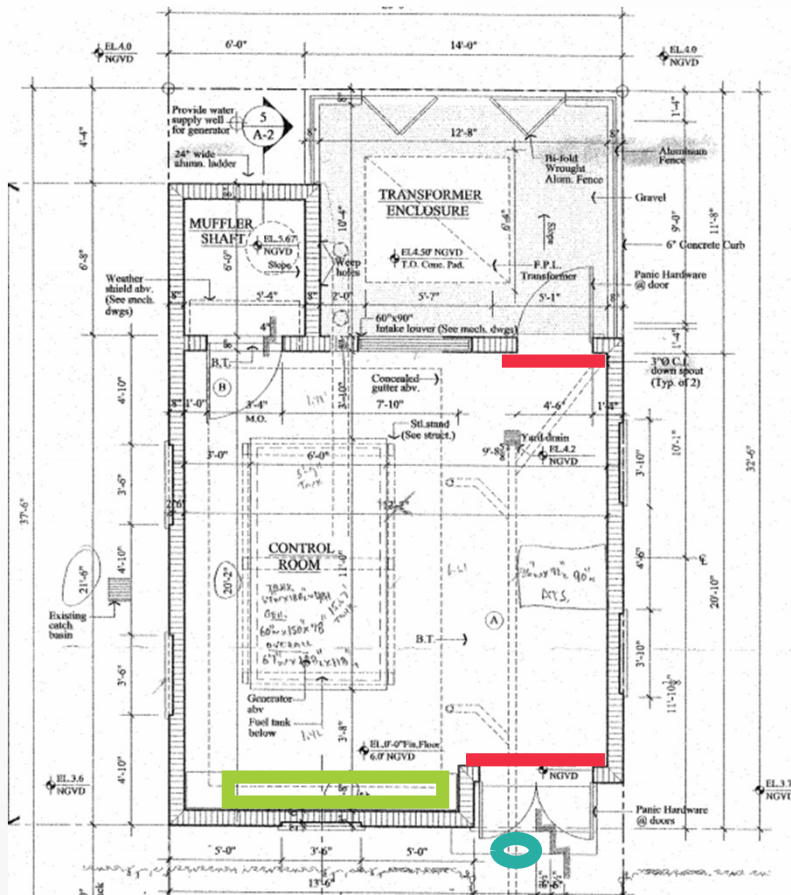
SOURCE: PHOTO FROM MOCK ROOS STORMWATER PUMP STATION CONDITION ASSESSMENT (2015)

## D-12 Stormwater Pump Station: Control Building

Recommendation	Pros	Cons	Order of Magnitude Capital Cost
<b>Option 1.</b> Floodproof control building with deployable barriers interior of doors, conduit sealant, floor drain backflow valve	<ul style="list-style-type: none"> <li>Higher level of flood protection achievable (e.g., 3' high barriers = BFE + 1.5')</li> <li>Eliminates need for elevating interior equipment</li> </ul>	<ul style="list-style-type: none"> <li>Requires planning and labor to install barriers before flood</li> <li>Capacity of walls to bear flood loads needs to be evaluated</li> </ul>	\$\$ Standalone project
<b>Option 2.</b> Wait for electrical upgrades (<10 years) and then elevate new equipment to max height feasible	<ul style="list-style-type: none"> <li>Leverage natural capital cycle</li> <li>Avoid repeated disruption</li> </ul>	<ul style="list-style-type: none"> <li>Living with flood risk</li> <li>Lower level of flood protection achievable due to limited headroom (e.g., ~3' above top of MCC)</li> </ul>	\$\$ Marginal added cost



# D-12 Stormwater Pump Station: Control Building (Option 1)



SOURCE: DAMES & MOORE RECORD DRAWINGS (2001)



## Deployable Barriers

To block the main entry points for flooding, install deployable flood barriers across the interior of the doorways – this avoids the aesthetic impact and high cost of flood doors.



## Seal Utility Conduits In/Out

To prevent flood water from leaking into the building through electrical conduits, inject watertight foam sealant in interior conduit openings for incoming and outgoing wires.

## Drain Backflow Valve

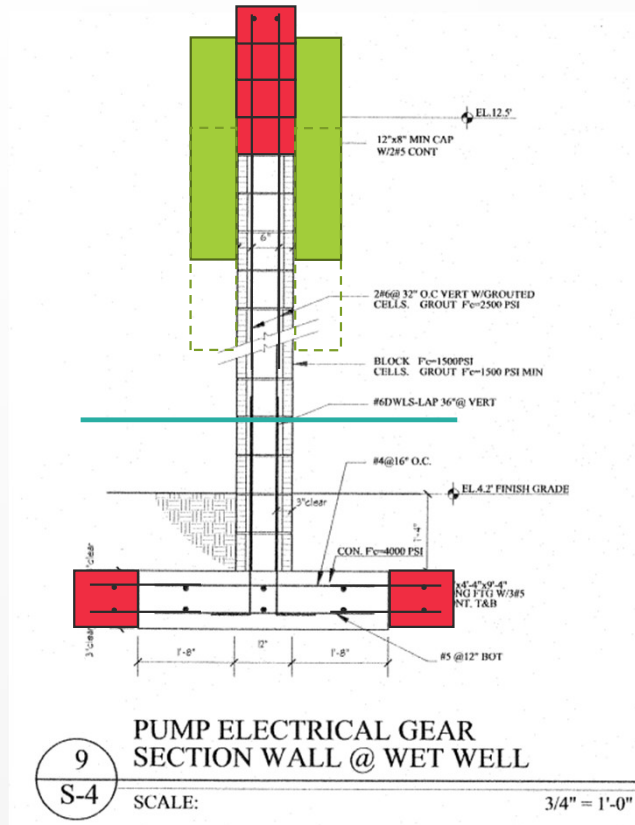
To prevent flood water from backflowing into the building from the drainage system, install a check valve in the drain line.



## D-12 Stormwater Pump Station: Wet Well Electrical Panels

Recommendation	Pros	Cons	Order of Magnitude Capital Cost
<b>Option 1.</b> Proactive - extend pump electrical gear wall, (replace and) raise electrical panels, and provide higher access	<ul style="list-style-type: none"><li>• Near-term risk mitigation</li></ul>	<ul style="list-style-type: none"><li>• Repeated disruption or early capital replacement</li></ul>	\$\$
<b>Option 2.</b> Wait for electrical upgrades (<10 years) - extend pump electrical gear wall, raise electrical panels, and provide higher access	<ul style="list-style-type: none"><li>• Leverage natural capital cycle</li><li>• Avoid repeated disruption</li></ul>	<ul style="list-style-type: none"><li>• Living with flood risk</li></ul>	\$\$

# D-12 Stormwater Pump Station: Wet Well Electrical Panels



## Extend Wall/Foundation

To enable the pump electrical panels to be raised, extend the existing reinforced wall vertically and reinforced foundation horizontally, if needed.

## Raise Electrical Panels

Once the wall is vertically extended, the electrical panels can be mounted at the higher elevation and wired. Protect any splices below the DFE with watertight connectors.

## Provide Higher Access

If needed due to code requirements for panel access, raise the existing concrete pad or provide a platform. Backfill adjacent grade or add railing if required by code.

# A-6 Wastewater Pump Station

## Major rehabilitation planned in 2021

- › Replacing all major electrical/controls systems
- › All electrical equipment to be installed at FEMA BFE +1'

Critical for protecting public health and environment, sanitary sewage service to:

- › Town Hall
- › Police Station
- › Central Fire Station
- › Elementary school
- › Worth Ave commercial area

## Vulnerabilities at present FEMA BFE:

1. Under Intermediate-High projections, sea level rise of +1' could occur by 2030, and almost +2' by 2050, therefore +1' freeboard may be inadequate for service life of improvements



SOURCE: PHOTO FROM MOCK ROOS WASTEWATER PUMP STATION CONDITION ASSESSMENT (2016)

## A-6 Wastewater Pump Station

Recommendation	Pros	Cons	Order of Magnitude Capital Cost
Raise proposed equipment to BFE + 2', instead of BFE + 1'.	<ul style="list-style-type: none"><li>Desired level of flood protection throughout asset lifetime, including sea level rise</li></ul>	<ul style="list-style-type: none"><li>May be limited by available headroom</li><li>Adjusting final designs</li></ul>	\$\$ Marginal added cost

## Near-Term Recommendations – Plan Review Needed

Facility	Potential Strategies	Flood Risk (to be verified)			Planned Improvements Year
		Present	Future	Value	
G-7 WPS	Raise electrical/controls equipment to be replaced	10%	>20%	60	2021
A-42 WPS	Raise electrical/controls equipment to be replaced	5%	>20%	60	2023
E-5 WPS	Raise electrical/controls equipment to be replaced	3%	20%	63	2022
A-43 WPS	Raise electrical/controls equipment to be replaced	3%	>20%	60	2023
A-39 WPS	Raise electrical/controls equipment to be replaced	2%	>20%	70	2023
Town Hall	Dry or wet floodproof	2%	20%	73	2025
Police	Dry or wet floodproof	1%	10%	80	2023/4
Central Fire	Dry or wet floodproof	1%	10%	73	2022
South Fire	Dry or wet floodproof, or perimeter barrier	1%	10%	53	2022
North Fire*	Dry or wet floodproof	0.5%	5%	70	2024/5

\*Due to low probability, consider scale of planned improvements, possibly move to medium-term

## Medium-Term – Conduct Survey and Prioritize (\*exceptions)

Refined elevation surveys are recommended for certain at-risk assets to close data gaps and confirm priorities

### Stormwater

Facility
D-18
D-6
D-7
D-14
D-2
D-4
D-9
D-16
D-17 (Generator)
D-10

### Wastewater

Facility	Facility	Facility
E-15	E-17	G-1*
E-50	E-18	A-7
E-9	E-20	E-1*
E-10	E-22	E-2*
E-12	E-23	E-13*
E-14	A-41	S-2*
E-16	E-19	A-5
E-4	E-3*	E-24
E-7	E-21	E-25
E-8	E-38	E-44
E-11	E-40	

### Recreation

Facility
Rec Center
Par 3 Maintenance
Phipps North Restrooms
Chilean Ave Restrooms
Phipps South Restrooms
Par 3 ProShop



## Long-Term Risks

Medium-term risks may extend to long-term implementation (10+ years from present).

Facility	Flood Risk (to be verified)		
	Present	Future	Value
G-9 WPS	0%	2%	60
A-4 WPS (Bldg)	0%	1%	60
E-27 WPS	0%	1%	60
A-4 WPS (Wet Well)	0%	1%	60
Memoria Fountain	0.1%	2%	27



# Level-Up Palm Beach

## Lake Worth Shoreline

Strengthen bulkhead and seawall construction, maintenance, and certification standards to initiate the transition towards a consistent, higher level of coastal flood mitigation performance, while minimizing temporary transitional impacts.

Improve the efficiency and effectiveness with which Lake Worth shoreline flood mitigation infrastructure is improved and maintained to higher standards

# Lake Worth Shoreline



Perspective: Lake side flooding is the primary source for present and future flooding



Construction Specifications



Maintenance and Certification



Lake Worth Inlet Surge Barrier



## Introductory Perspective

- Lake Worth is the source of flooding for the vast majority of Palm Beach's floodplains, present and future, and the people, infrastructure, buildings, and open spaces therein.
  - › Sunny day flooding is documented on the Lake Trail during King Tides.
  - › More severe storm exposure is evident from the 2017 FEMA FIRMs and the 2019 Coastal Flood Vulnerability Assessment present and future flood risk maps. The latter illustrate the Lake Worth shoreline has an increasing likelihood of being flooded in the future by high tides and storm surges, expected to increase due to climate change.
  - › The dominant source of flood water is coastal storm surge entering through Lake Worth Inlet. Inland precipitation runoff contributes as well, but the CFVA demonstrated coastal surge is the dominant contributor.
  - › The existing shoreline infrastructure is inadequate to mitigate either present or future coastal flooding risks. Given the flood risk mapped by both FEMA and the present-day CFVA maps, it is fortunate that the Town has not experienced a major coastal flooding event from Lake Worth in quite some time.
- Flood mitigation infrastructure on the Lake Worth shoreline must be raised and strengthened to mitigate the substantial and increasing public risks from coastal flooding to Palm Beach derived from the Lake Worth shoreline flood pathways.
  - › Although development in the floodplain can be made more resilient by implementing recommendations presented elsewhere in this report, elevating and hardening buildings will not keep salt water off roads, trails, parks, or landscaping, or out of underground infrastructure. Controls are needed at the source along the Lake Worth shoreline to mitigate flood risk and build resilience.
  - › Even storm surge barriers at the inlet(s) to Lake Worth would not mitigate the risks of future high tide sunny day flooding, since navigation and commerce must be maintained at the inlets.
  - › Engineered and natural shoreline infrastructure can serve a public purpose as a critical line of defense against future high tides, storm surges, or both.

## Sunny Day Flooding on the Lake Trail during King Tides



January 2018



September 2019



October 2019



October 2019

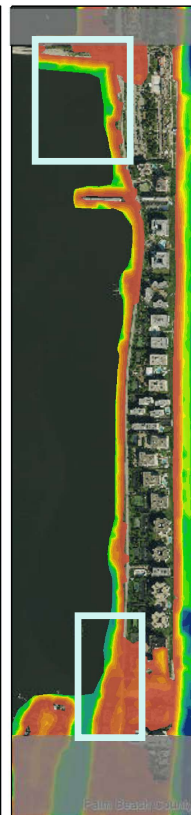
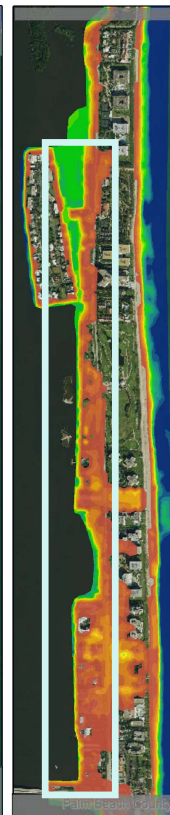
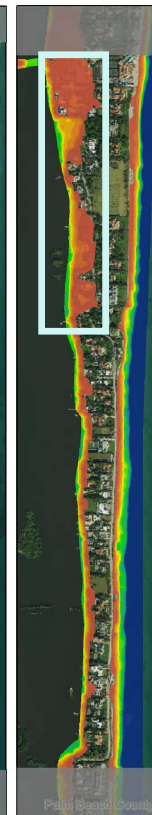
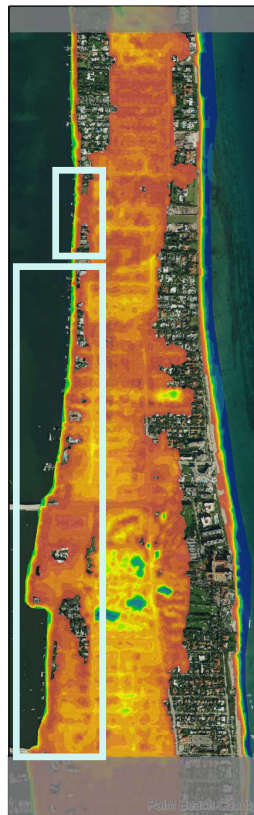
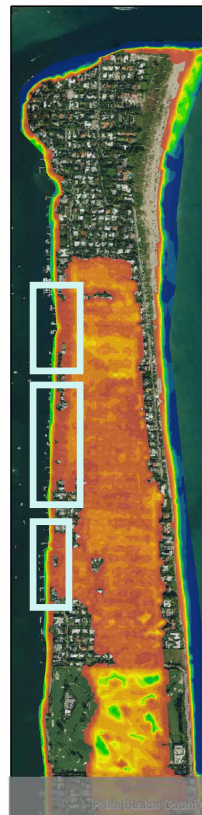
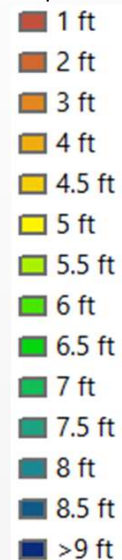


# Higher Probability Shoreline Flood Pathways

There are limited opportunities to implement small, independently-effective coastal flood control projects due to the long, low-lying shoreline and expansive, interconnected floodplain

## Present 10-Year Flood

### Depth



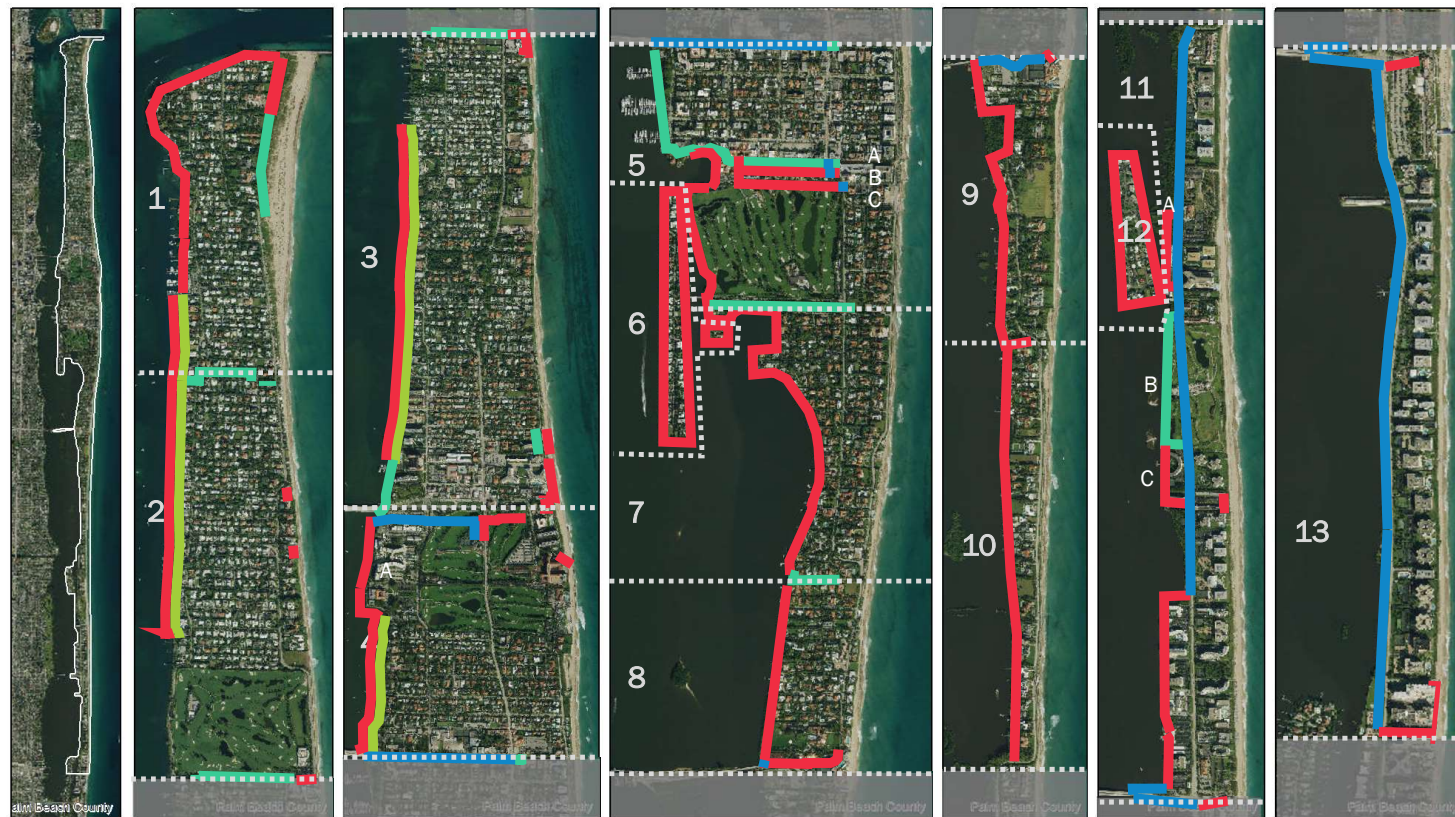


# Potential Neighborhood-Scale Flood Control System Alignments

As many as thirteen areas have been identified which could conceptually be served by large, independently-effective flood control systems with a performance goal of meeting FEMA base flood elevations plus two feet of freeboard

## Ownership

- Town
- ROW Easement
- Private
- State

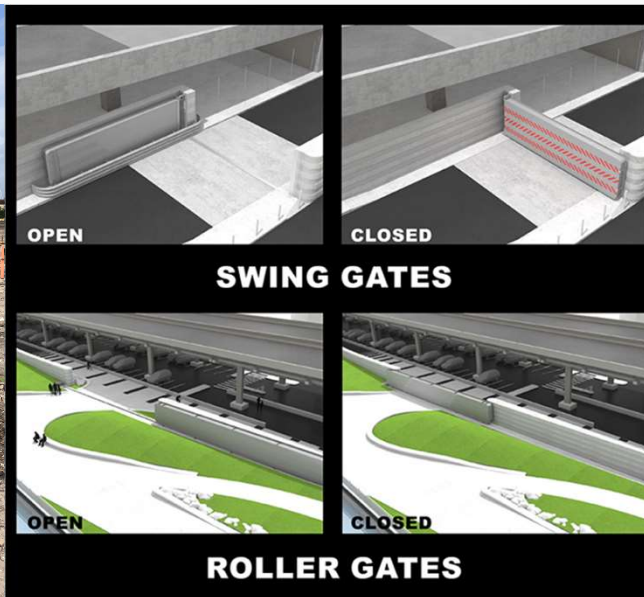


# Typical Strategies

- The primary strategy would be to raise bulkheads and adjacent grades along the Lake Worth shoreline, which would also address recurring tidal flooding on the Lake Trail. Floodwalls screened by vegetation would tie back to high ground on the coastal ridge, aligning with public rights-of-way, with deployable gates at intersections. Limited interventions would be required along the Atlantic shoreline.



Elevated Bulkhead at Town Marina



Flood Walls+Gates from NYC East Side Project

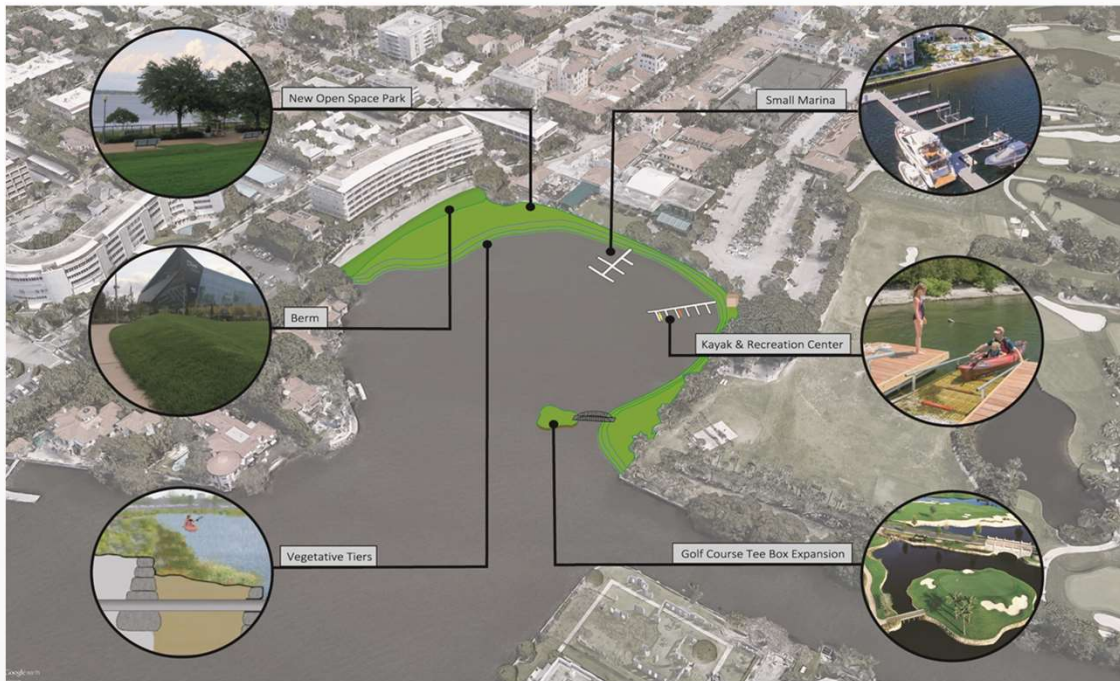


Conceptual Strategy at Root Trail



# Nature-Based Strategies

- Nature-based strategies would be applicable mostly along golf course and State road shorelines along Lake Worth, and coastal dunes on the northeast Atlantic coast ("Reach 1")



Conceptual Strategies at the Everglades Club



Sand Replenishment at Reach 1

## Challenges and Opportunities

- In all the identified potential areas, local improvements would need to be sited on private property (e.g., replacing bulkheads), and, in most areas, some improvements (generally tie-back flood walls and gates) would need to be sited on State rights-of-way.
- The independent effectiveness of almost all these systems depends on tying back to higher ground located around the coastal ridge of the island, including flood gates that would temporarily close across evacuation routes - operational protocols would hold off such closures for as long as possible, until flooding was imminent.
  - › Because of the long, low-lying condition of the Lake Worth shoreline, several areas could also be combined into larger areas served by longer flood control systems with fewer across-road closures, if so desired.
- A benefit of designing flood control systems at smaller units of independent effectiveness, from a resiliency perspective, is that no single point of failure would affect the entire system. Smaller units also allows priorities and phasing over time.

# Town Role



The Town owns very little shoreline infrastructure on Lake Worth but is taking action to increase the flood mitigation capacity of what it does own. For example, the Town Marina bulkhead has been raised two feet higher as part of its recent reconstruction, in part informed by PB-FRM and the CFVA.



The Town sets and enforces standards for the construction, maintenance, and certification of private shoreline infrastructure through the Code of Ordinances. Higher standards are recommended for consideration herein.



In the future, whether for urgency, efficiency, or to leverage 3rd party public funding sources, the Town municipal services entity could also be empowered to provide neighborhood-scale coastal flood control capital or services.



Collaborate with neighbors to engage federal and state partners and advocate for potential regional solutions and funding for Lake Worth.



# Summary of Code of Ordinances Recommendations

**Strengthen bulkhead and seawall construction, maintenance, and certification standards to initiate the transition towards higher coastal flood mitigation performance, while minimizing temporary transitional impacts.**

- **Amend the Code of Ordinances, Chapter 62, Article II [and Article III], Construction Specifications for bulkheads and seawalls on [the Atlantic Ocean and] Lake Worth[, respectively].**
  - › Specify flood-based design requirements for Lake Worth bulkheads to make explicit that they perform coastal flood mitigation functions, not only land retention and erosion control.
  - › Specify minimum top elevations for bulkheads and seawalls on Lake Worth and Atlantic Ocean to mitigate higher flood levels. (FEMA BFE + 2 ft)
  - › Specify bulkhead and seawall cap requirements to mitigate potential negative aesthetic or functional impacts due to differences in adjoining structure heights.
  - › Specify adjacent grade elevations, relative to bulkhead or seawall top elevations to mitigate potential negative impacts to accessibility and scenic vistas of Lake Worth from the Lake Trail and private property. (FEMA BFE - 0.5 ft)
  - › Create a mechanism, proposed as a system of temporary waivers and easements, to facilitate a smoothing of adjacent grades across property lines as adjoining shoreline structures are brought up to a consistent higher top elevation over time.
  - › Provide more explicit expectations for engineering information to be submitted with bulkhead and seawall permit applications to facilitate consistency and ease of review.
  - › Require notification at critical construction milestones to facilitate timely inspection.
- **Amend the Code of Ordinances, Chapter 62, Sec. 62-77. – Maintenance and Certification of All Bulkheads and Seawalls.**
  - › Strengthen maintenance standards in terms of flood mitigation performance.
  - › Require more frequent recertification. (10 years)
  - › Specify timeline for correcting violations of maintenance standards to increase the speed of transition. (1 year)
  - › Define more stringent conditions under which improvements or repairs will trigger the need to comply with stronger construction specifications to increase the speed of transition. (new construction or substantial improvement of primary structure, improvement to 25% of structure length, overland flow through property up to FEMA BFE + 2 ft)



# Establish Coastal Flood Control as a Municipal Service

The Town may reasonably determine that improvement and maintenance of Lake Worth shoreline and other related flood control infrastructure are needed for public purposes and would more efficiently and effectively be delivered by the Town than by individual property owners. The Town could use its powers under the Florida Constitution, Article VIII, Section 2(b) and F.S. 166.021 and 166.041 and specified in the Code of Ordinances, Chapter 90, Article II to implement such improvements and services as are needed and spread the costs across the Town (“One Palm Beach”).

This strategy would be particularly critical if State or federal funding is sought for implementation, also considering emerging state SLIP and related policies and funding sources. The use of such public funds for projects on private property are generally restricted, requiring local governments to either use eminent domain or otherwise obtain rights for access, inspection, and repair.

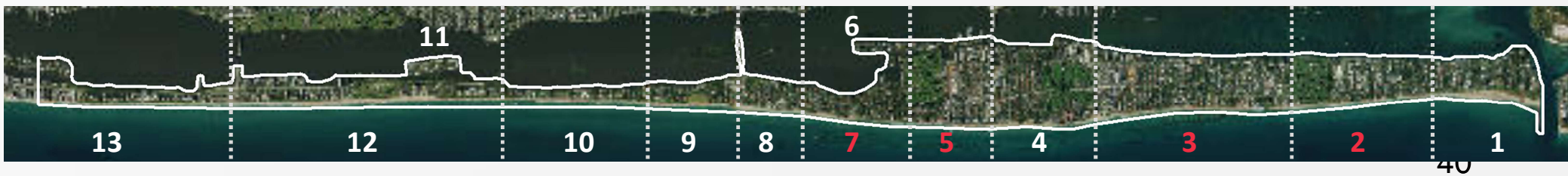
The Town should consider amending the Code of Ordinances, Chapter 90, Article II, Division 5 to include “coastal flood mitigation” or “coastal flood control” in the list of services, facilities, programs, and local improvements it is chartered to provide.<sup>1</sup> The list appears in multiple sections within Division 5 and would need to be modified in each instance. This change should be reflected in an amendment to the Comprehensive Plan.

<sup>1</sup> Alternatively, the Town could create a new Division within Article II, creating a similar Coastal Flood Control mechanism. Punta Gorda, FL established two special districts with specific powers to maintain seawalls for public benefit (see Code of Ordinances, Chapter 6. – Vessels, Docks and Waterways, Articles 3 through 5). Monroe County also recently approved a special district ordinance establishing a new municipal service benefits unit that will be used for implementing and funding coastal resiliency infrastructure projects (see Ordinance No. 002-2021)..



# Neighborhood-Scale Coastal Flood Control System Planning

- Conduct a high-resolution shoreline elevation and condition survey along the Lake Worth to inform prioritization, design, and cost estimating.
- Update list of first-, second-, and third-priority neighborhood-scale flood mitigation systems considering updated elevation survey data amongst other criteria.
  - › Areas 2 and 3 have the most linear feet of roadway and gravity sewer at risk. The primary strategy would be to raise bulkheads and adjacent grades along the Lake Worth shoreline, which would also address recurring tidal flooding on the Lake Trail. Floodwalls screened by vegetation would tie back to high ground on the coastal ridge, aligning with public rights-of-way, with deployable gates at intersections. Limited interventions would be required along the Atlantic shoreline, including at North Ocean Blvd beach access points (e.g., Root Trail).
  - › Areas 3, 5, and 7 have the most critical public facilities at risk, including sewer and stormwater pump stations and public safety facilities. Strategies on the Lake Worth shoreline would include more natural and nature-based infrastructure in addition to raised bulkheads. Floodwalls screened by vegetation would tie back to high ground on the coastal ridge, aligning with public rights-of-way, with deployable gates at intersections.
  - › Neighborhood-scale flood control systems for these areas, or others, could be planned individually, as two larger areas, or a single area bridging main island areas from Area 2 to Area 7.
- Begin planning potential flood control systems.



# “Back Bay” Coastal Storm Risk Management Studies

US Army Corps of Engineers

- The US Army Corps of Engineers has been conducting several “Back Bay” Coastal Storm Risk Management Studies, focused on communities along Intercoastal Waterways, including in Miami-Dade County and coastal New Jersey.
- These studies evaluate the costs, benefits, and environmental impact of various non-structural measures (e.g., elevating homes) and structural measures (e.g., perimeter protection and surge barriers) to mitigate coastal flood risks, with recommendations for federal funding of Army Corps implementation projects.

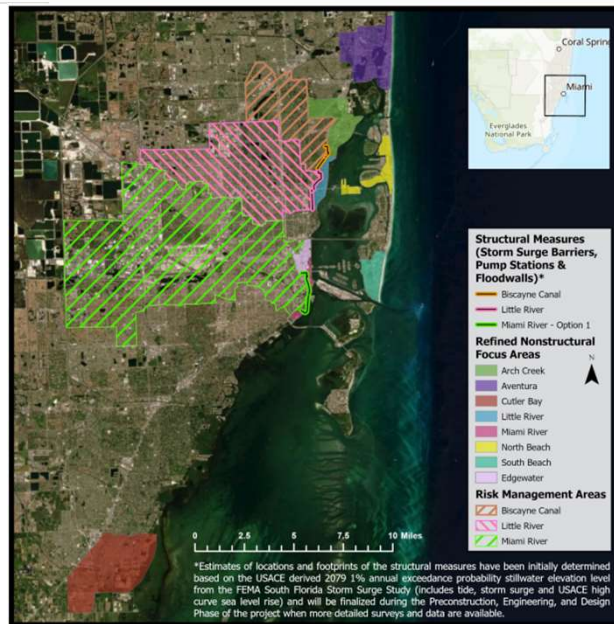
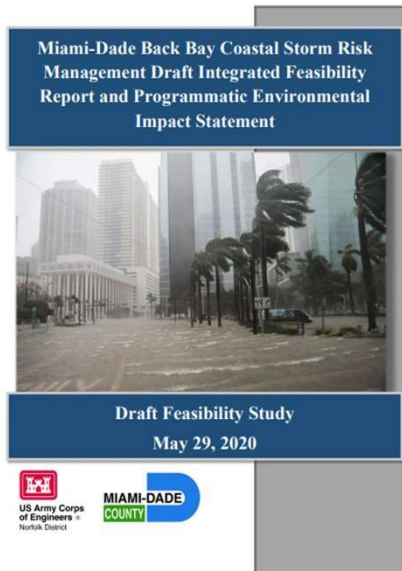


Figure 1. Tentatively Selected Plan

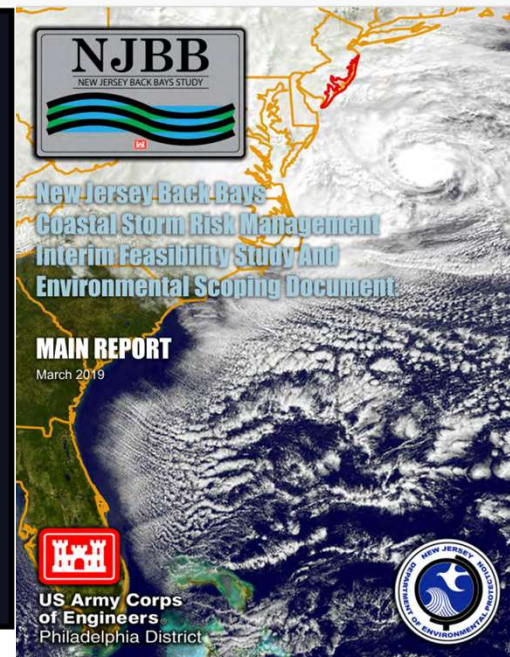


Figure S-1: Constructed NJ Intracoastal Waterway, Inlet Navigation and Oceanfront CSRM Projects in the NJBB Study Area

# Potential Surge Barrier at Lake Worth Inlet

A surge barrier at the Lake Worth Inlet, or several inlets, if feasible, could benefit the Town and its neighbors along the Lake Worth shoreline by mitigating the increasing risk of coastal flooding from storms. Such a solution would limit the height to which bulkheads and other shoreline infrastructure need to be raised to mostly deal with future high tide flood levels, which would not be mitigated by a surge barrier since the barrier would only be activated for storms.

The process is long to obtain a study, complete the study, and then move through phases of implementation, including obtaining funding for each. The Town should begin the process in the near-term by collaborating with Palm Beach County and neighboring jurisdictions, including the Port, to determine if there is shared interest and determine the roles each partner would play.

If shared interest in pursuing a surge barrier, the Town and its partners should request a US Army Corps of Engineers Feasibility Study for Lake Worth coastal storm risk management measures, including inlet surge barriers, and then advocate for Congressional authorization and budgetary appropriations for the Army Corps to implement the study. Future steps would be based on whether the request is granted, the Town's role in the study process, and the outcomes of the study.

Source: Esri, Maxx Community



Inlets to Lake Worth and the Intercoastal Waterway



# Level-Up Palm Beach

## Floodplain Development



Strengthen standards for residential and non-residential development in the future floodplain to protect people and property from high and increasing flood risks.



# Development in Palm Beach's Floodplain is Particularly At-Risk

**Most**

Palm Beach residences, businesses, roads, and public infrastructure and facilities are located within the regulatory floodplain

**\$2  
Billion**

In total flood insurance in-force in Town of Palm Beach, covering only a fraction of at-risk value

**1st**

In flood insurance losses and loss payments in aggregate since 1978 out of all local jurisdictions in Palm Beach County

**4th**

In number of flood insurance policies out of all incorporated jurisdictions in Palm Beach County

**1st**

In repetitive loss properties and repetitive loss payments out of all local jurisdictions in Palm Beach County, accounting for almost a third of each

**2nd**

In total flood-insured value in-force policies out of all incorporated jurisdictions in Palm Beach County

SOURCES: PALM BEACH COUNTY LOCAL MITIGATION STRATEGY (2020), TOWN OF PALM BEACH ANNUAL FLOOD REPORT (2019)

# Change in Conditions Warrant Change in Policies

August 2017, the Town of Palm Beach adopted Comprehensive Plan Amendments (2017-2027), flood-related amendments to the Florida Building Code - 6<sup>th</sup> Edition, and new FEMA flood maps

2020 Florida Building Code– Residential 7th Edition, in force January 1, 2021, has new flood-resistant construction standards that are in several instances higher than those set in the Town of Palm Beach’s technical amendments to the 6th Edition, adopted in 2017.

2019 Coastal Flood Vulnerability Assessment future coastal flood risk maps show that, with 1.45 ft of relative sea level rise and future storm intensification, the present day 100-year flood elevation and floodplain could be like the 5- to 10-year flood elevation and floodplain in mid-to-late century.

Florida Statute 161.551, effective July 1, 2021, requires a Sea Level Impact Projection (SLIP) study for any major structures proposed to be constructed by a public entity in the “coastal building zone” (all of Palm Beach) with State funding. FDEP has developed draft rules for implementing the law.

# Summary of Floodplain Development Recommendations

**Strengthen standards for residential and non-residential development in the future floodplain to protect people and property from high and increasing flood risks. (Policies 15.1 and 15.2)**

- **Amend the Code of Ordinances, Chapter 18, Article IV. – Florida Building Code, Division 1 and Division 2.**
  - › Define substantial improvement and substantial damage more stringently than the 2020 FBC to increase the speed at which existing buildings are brought into compliance with higher standards for flood-resistant construction. Earns CRS credit points. (25% of value over 10 years)
  - › Set elevation requirements for non-residential structures (including Town facilities) higher than the 2020 FBC minimums to increase resilience to higher flood levels by adding freeboard. Earns CRS credit points, compliance lowers individual insurance premiums. (FEMA BFE + 3 ft)
  - › Set elevation requirements for residential structures higher than the 2020 FBC minimums to increase resilience to higher flood levels by adding freeboard. Earns CRS credit points compliance lowers individual insurance premiums. (FEMA BFE + 3 ft)
- **Amend the Code of Ordinances, Chapter 50, Article II, Division 2, Sec. 50-38. – Submission of Additional Data to Establish Flood Hazard Areas.**
  - › Expand the definition of flood hazard areas wherein new construction and substantial improvement is subject to floodplain management and flood-resistant construction standards to increase resilience in areas beyond the current 100-year flood zone. Earns CRS credit points compliance lowers individual insurance premiums. (ground elevation below FEMA BFE + 3 ft)
- **Amend the Code of Ordinances, Chapter 31, Article 1, Sec. 134-2. – Definitions for building heights.**
  - › Mitigate disincentives to redevelopment and substantial improvement caused by higher elevation requirements by setting the new construction and substantial improvement zero datum for building height calculations at the minimum flood elevation including freeboard.



# Implications for Recently Developed Policy

## Options for Determining Maximum Fill - Examples

14

Example: 216 Sandpiper Drive - FFE 7 Feet / Highest COR 4.19' / Approved Fill 2.72'

With FEMA + 3':

$\frac{\text{FFE } 9' - \text{Highest COR } 4.19 \text{ ft}}{2}$

= 2.4' or 28.8"  
(70% higher)

However, the increase is mitigated if the recommendation to also set a maximum "not to exceed" depth of fill is adopted.

### Option A: Set Amounts per Ranges of Highest COR

Highest COR 0' to 3' = 2.5' or 30" Max. Fill Permitted by Right

Highest COR 3' to 5' = 2' or 24" Max. Fill Permitted by Right

Highest COR 5' to 7' = 1.5' or 18" Max. Fill Permitted by Right

### Option B: Calculation Method

$\frac{(7 - 4.19) \text{ or } (\text{COR} - \text{FFE})}{2}$

= 1.405' or 16.86" Max. Fill Permitted by Right





# Level-Up Palm Beach

## Comprehensive Plan



Update Comprehensive Plan data and analysis, goals, objectives, and policies for coastal flood resilience, and designate Adaptation Action Areas for prioritized coastal flood risk mitigation planning and infrastructure funding

# Executive Summary

- **The issue of coastal flood risk emanating largely from the Lake Worth shoreline should be described in the Executive Summary.**
  - › The 100-Year Floodplain Map (I-6) should be updated to correct a reversed coloring error for the 100-year flood zone.
- **The issue of increasing coastal flood risk due to projected sea level rise and climate change and proposed actions should be described in the Executive Summary under a new Adaptation Action Areas section.**
  - › Adaptation Action Areas (AAAs), in accordance with F.S. 163.3164(1) and F.S. 163.3177(6)(g)(10), are intended to identify areas at high risk from coastal flooding and sea level rise for prioritized flood risk mitigation planning and infrastructure funding. Maps from the Coastal Flood Vulnerability Assessment should also be referenced and included in the Support Documentation.

# Future Land Use Goals, Objectives, and Policies

## Future Floodplain Development

The Town should consider amending Comprehensive Plan, Future Land Use, Goal 1, Objective 3 and Policy 3.1. Approval of future development in the floodplain, or “flood hazard areas” as recommended to be redefined in the Code of Ordinances, should be based on compliance with the FBC as amended by the Town Code of Ordinances, not simply the FEMA Flood Insurance Rate Map (FIRM) elevations.

The Town should also consider adding Policy 3.2, stating that approval of new development or redevelopment on the Lake Worth shoreline [within Adaptation Action Areas] shall be issued only if shoreline coastal flood control measures meeting the Town’s construction specifications and maintenance and certification requirements are met.

# Future Land Use Goals, Objectives, and Policies

## Future Floodplain Development

### Supporting information:

- Under the 2020 FBC 7th Edition, the only types of buildings and structures permitted to meet the base flood elevations identified in FIRMs, with no additional freeboard, are Flood Design Class 1 (e.g., temporary structures, minor non-commercial storage facilities, small parking structures, and certain agricultural structures).<sup>1</sup>
- The Town has the ability to adopt amendments to the FBC that set higher standards for elevation requirements based on local conditions and needs.

<sup>1</sup> ASCE 24, Table 1-1 Flood Design Class of Buildings and Structures; Table 2-1 Minimum Elevation of the Top of Lowest Floor – Flood Hazard Areas Other Than Coastal High Hazard Areas, Coastal A Zones, and High Risk Flood Hazard Areas

# Future Land Use Goals, Objectives, and Policies

The AAAs for coastal flood control the Town wishes to designate must be mapped and included in the Index of Maps and Charts and Additional Information sections. There are a few options for delineating the boundaries of these areas:

- › The entire Town could be designated,
- › The Town could designate areas within the flood hazard area, as recommended herein to be redefined in the Code of Ordinances, Sec. 50-38 based on the FEMA base flood elevation plus three feet,
- › The Town could designate each of the potential neighborhood-scale coastal flood control areas identified herein or a subset of priority areas, or
- › The Town could create a Policy establishing the intent to designate AAAs following the completion of a subsequent technical and/or public planning process.

## **Additional Recommendations include:**

- › Under Goal 1, Objective 5, Policy 5.2, relating to levels of service for stormwater, consider setting a specific and more stringent data source for rainfall design storm (e.g., NOAA Atlas 14+ or 14++) to account for future increases in rainfall intensity, to the extent feasible.
- › Under Goal 1, Objective 8, Policy 8.4, relating to dune restoration on the Atlantic shore, consider specifically calling out Reach 1 as an area where dune restoration is needed for adaptation.
- › Under Goal 1, Objective 8, Policy 8.6, relating to development over submerged land, consider listing coastal flood control as an “essential service” of the Town.
- › Under Goal 1, Objective 13, Policy 13.4, relating to the siting of marinas, consider adding coastal flood control to the list of criteria to be reviewed and considered by the Planning Department.

# Coastal Management Element

- **The Town should consider amending the Comprehensive Plan, Coastal Management Element, to address the relevant issues in this report and recommendations that the Town wishes to adopt.**

## **Recommendations:**

- **The issue of coastal flood risk emanating largely from the Lake Worth shoreline should be described in the Executive Summary.**
  - › The 100-Year Floodplain Map (V-2) should be updated to correct a reversed coloring error for the 100-year flood zone.
- **The issue of increasing coastal flood risk due to projected sea level rise and climate change, based on the CFVA, and proposed actions, based on the Implementation Plan, should be described in the Executive Summary under a new Adaptation Action Areas section.**
- **Existing Objectives and Policies related to coastal flooding and climate change should be consolidated and expanded under a new Adaptation Action Areas Objective:**
  - › Objective 15 should be disaggregated, with Policies specific to the Coastal High Hazard Area requirements moved to a separate Objective, and Policies, and perhaps repeated and modified for future coastal flood hazard areas.
  - › Integrate Lake Worth seawall and bulkhead construction specifications and maintenance and certification policies, as recommended herein, under Policy 5.6, 8.2, and a new Policy 12.2.
  - › Integrate strengthened floodplain development standards, as recommended herein, under Objective 12 or Policy 15.3.
  - › A Policy indicating that the Town will begin planning for future neighborhood-scale flood control alignments and the Town's potential role in future development of such systems, within Adaptation Action Areas and Intergovernmental Coordination.
  - › A Policy identifying the need for a US Army Corps coastal storm risk management study for the Lake Worth, including a potential surge barrier at the Inlet should be added, or integrated with Policy 15.10 and Intergovernmental Coordination.



# Other Elements

## Transportation

- › Under Objective 1, consider adding Policy 1.4 indicating the Town will consider future needs for flood control system infrastructure within the Town and State rights-of-way. These preliminarily identified locations could be mapped here or as part of Adaptation Action Area maps. This should also be integrated into the Intergovernmental Coordination Element.

## Infrastructure

- › Under Executive Summary, consider integrating a description of potential vulnerabilities of Sanitary Sewer Services and Drainage systems to coastal flooding and sea level rise, based on the CFVA and updated risk analysis.
- › Under Drainage, consider noting the need to evaluate future precipitation events, expected to be more intense due to climate change, and the resulting change in performance of the drainage system for flood protection. The analysis could also address coastal flooding (i.e., how fast could the drainage system clear the streets of coastal flooding, assuming all drainage pumping infrastructure remained operational). These actions could be included in Objective 7, Policy 7.4 – referring to future climate change scenarios. Policy 7.4 could also refer to the SLIP study law and rules. Under Objective 8, relating to levels of service for stormwater, consider setting a specific and more stringent data source for rainfall design storm (e.g., NOAA Atlas 14+ or 14++) to account for future increases in rainfall intensity, to the extent feasible.
- › Under Underground Utilities, consider the need to evaluate potential points of water entry into sensitive underground and above ground power and telecommunications infrastructure. Note potential problems if vulnerable, or opportunities, if resilient.

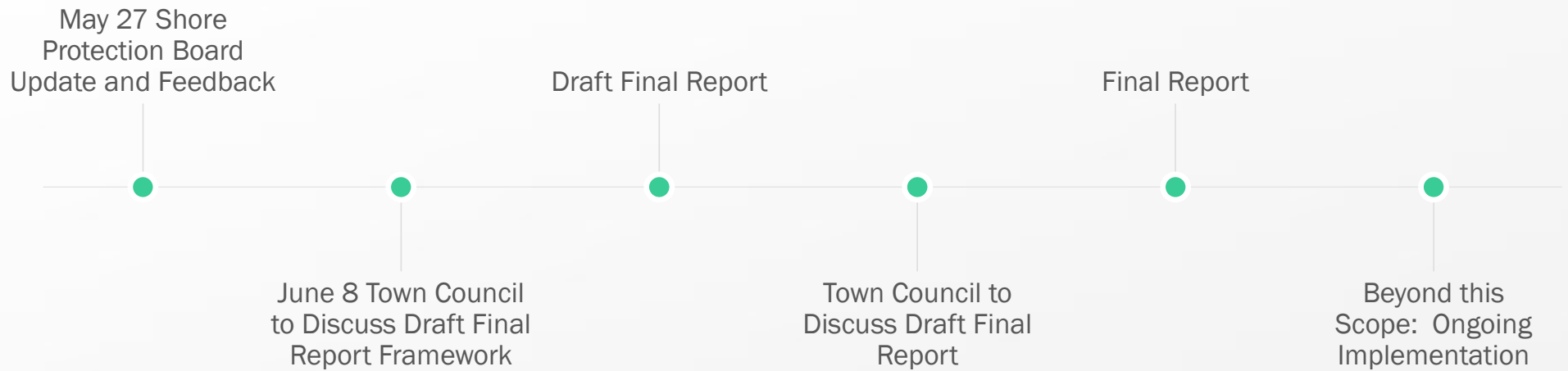
## Intergovernmental Coordination

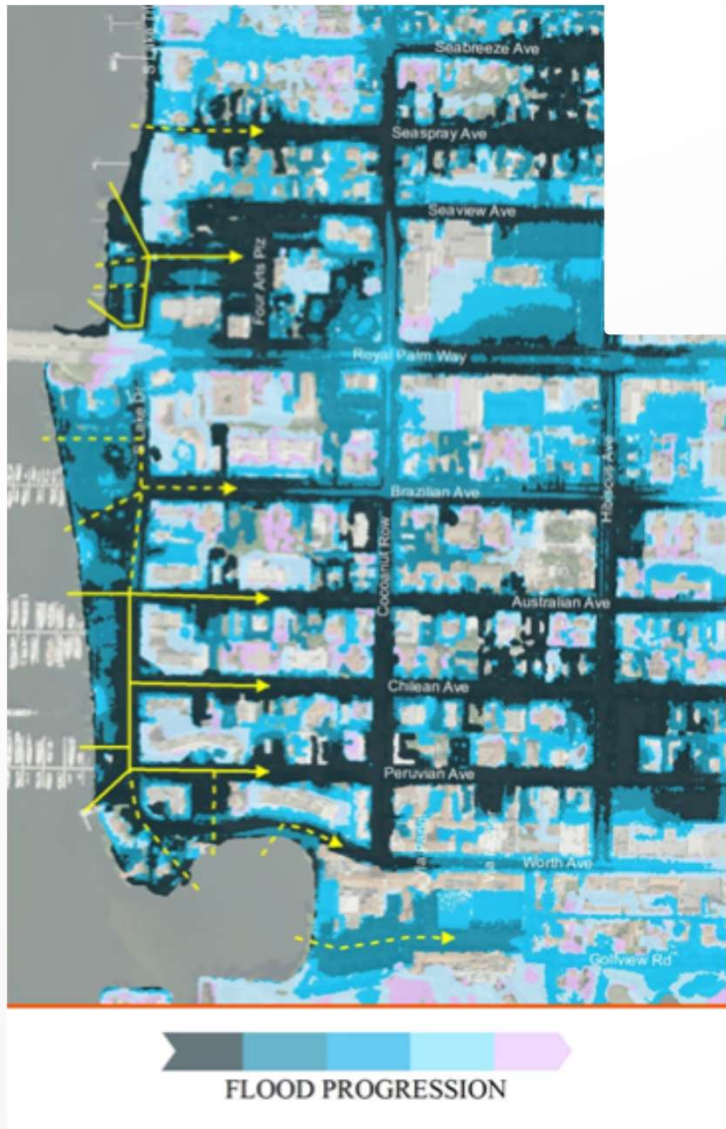
- › Add policies identified in other sections (Army Corps study, neighborhood flood control systems) under relevant Policies.

## Capital Improvements

- › Add flood protection improvements to vulnerable Town facilities (pump stations, etc.) and neighborhood flood control systems under relevant Policies.

## Next Steps to Complete this Scope of Work





Thank you

### Key Input Needed on the Level-Up Implementation Plan

- Overall evolving concept? Need feedback on the balanced approach emphasizing both asset specific actions, and Town-wide policies.
- Comments on the asset-specific actions; other assets to consider?
- Opinions on the Town-wide policy recommendations, specifically:
  - Design flood elevation (DFE) recommendations
  - Policy recommendations for private properties
  - Town interest in taking responsibility for actions including private property on Lake Worth
  - Degree to pursue inlet surge barrier with USACE and other stakeholders
- How to make Draft Final Report most helpful?
  - Contents and format
  - What level of budgetary information short-term tangible actions and/or larger-scale, longer-term coastal resilience?
  - How much focus on monitoring and trigger points?
  - Other information to include?