TOWN OF BAY HARBOR ISLANDS

Environmental Vulnerability Study

Part 1 - Vulnerability Assessment

Figure 27: Bulkheads used to protect the Islands from flooding have limited capacity against sea level rise and associated storm surge levels

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First Public Engagement Meeting

- Welcome!
- Please make sure that you have signed in;
- Comments and Questions - the floor will be open for questions after the presentation.
- First Meeting is focused on the Vulnerability Assessment;
- There will be two more meetings coming up to review Community Risks and how best to Adapt – dates to be announced.

TOWN OF BAY HARBOR ISLANDS

PLEASE JOIN US FOR A PUBLIC ENGAGEMENT MEETING

TUESDAY, JUNE 9, 2020 5:00 PM - 7:00 PM

INTRODUCTION TO THE FLOOD VULNERABILITY ASSESSMENT PROJECT

Join us on June 9th for a virtual Town Hall meeting to introduce the Flooding Vulnerability Assessment Project, conducted by Coastal Risk Consulting LLC (Coastal Risk) for the Town of Bay Harbor Islands. Your attendance at this meeting is important to gauge the existing perceptions of Town residents and community members relating to flooding vulnerability and risks and obtain feedback and information from residents on the socioeconomic and other impacts of physical flooding risks, now and in the future.

This Meeting will be conducted virtually via the Zoom Platform. Members of the public who wish to participate and/or view the meeting may do so by logging in through the Zoom Platform as follow:

Zoom Link: https://zoom.us/j/96403853394
Meeting ID: 964-0385-3394

In addition, any member of the public who does not wish, or is unable to participate through the Zoom video conferencing platform, but would still like to participate can do so by listening to the meeting as it happens by dialing the following Toll-free numbers below:

877 853 5247 US Toll-free
888 788 0099 US Toll-free
Meeting ID: 964-0385-3394

For additional details, please visit our website at: https://www.bayharborislands-fl.gov or call 305-866-6241

BAY HARBOR ISLANDS

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What Is This All About?

- In 2019, Florida DEP awarded Bay Harbor Islands, Florida (BHI), a grant to assess its current and future vulnerabilities to sea level rise, floods, extreme weather and climate change; and,
- To develop strategies and policies that: (1) enhance the City's short-and-long-term resiliency; (2) comply with "Peril of Flood" legislation established by the FL Senate Bill 1094; and, (3) consider the designation of Adaptation Action Areas (AAAs) within the Town.
- Following the award, Coastal Risk Consulting, LLC, (Coastal Risk) was retained by BHI to conduct the Vulnerability and Adaptation Study, in coordination with Town officials.
- The Vulnerability Assessment will be available on the Town website.

Participant Questions –

Please think about these and, we'll discuss them after the presentation

- What do you think are the biggest threats to Bay Harbor Islands? [Can be any type of threat]
- Rank them 1-5, with #1 being the biggest threat.
- Have you experienced flooding in your neighborhood or on BHI? Where? Has it been repetitive? King Tide? Heavy rainfall? Storms?
- Has flooding on BHI ever caused you any damage or inconvenience? If so, please specify.
- Do you have NFIP or Private Flood Insurance on your property?
  - If not, why not?
- Does your property have a seawall? Have King Tides ever overtopped your seawall?
- What are your ideas to increase public awareness and public engagement in BHI vulnerability issues?
- What aspects of BHI infrastructure (roadways, bridges, storm sewers, etc.) should be improved first? Why?

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What Do We Hope to Accomplish, Here?

- Promote a better understanding and appreciation by the Town's elected officials, its Administration, residents and businesses of the vulnerabilities that BHI is facing.
- Help BHI begin a process to get ahead of the "risk curve" and stay ahead over the next 30-50 years.
- Guide BHI in the right direction towards short-term, medium-term and long-term Adaptation Investments.

Florida Adaptation Planning Guidebook

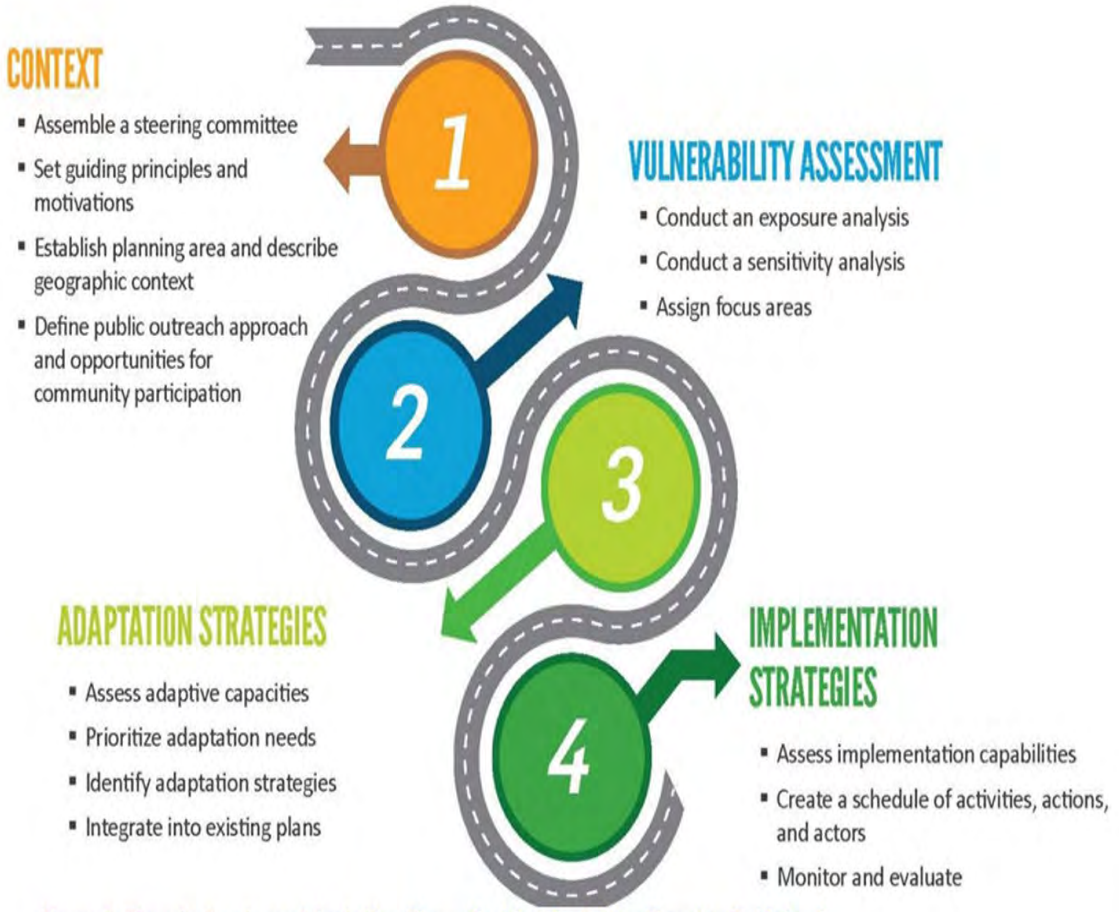

Figure 1: Steps to Create an Adaptation Plan – Florida Adaptation Planning Guidebook

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Are Other Florida Communities Doing These Studies? Yes!
Bal Harbour Just Completed Theirs…

NAME	Pages	Date	VULN TO SEA LEVEL RISE	PLAN HORIZON	STORM SURGE	HEAVY RAINFALL	FLUVIAL	GROUND WATER	COST DOING NOTHING?	INFRASTR RISKS CRITICAL FACIL	ADAPT REC'S	Future Climate Change (Heat, Precip) YES/NO	BLDG CODES YES/NO	AAA'S YES/NO	CRS Review	PERIL OF FLOOD Comp Plan	Comments
Village of Miami Shores	70	6/2018	Yes	2048	Yes	Yes	NA	WATER	No	Yes	Yes	No	Yes	Yes	Yes	No	Done by AS
Village of Atlantic Beach	4	7/2019	Yes FEMA Method	25, 50, 100 yrs	Yes	No	No	No	Yes Lost tax revenue	Yes	Next Phase	No	No	No	No	No	Done by AS
City of Titusville	130	5/2019	Yes - USACE 2013 and NOAA 2017 - Digital Coast Sea Level rise Viewer Intermediate and High Projections.100 year and nuisance flood, Discuss financial exposure.	2040, 2060, 2080,2100	Yes, CAT 1-5 impacts on Land use - Hurricane levels, financial and transportation exposure	Yes	No	Salt water intrusion expected as SLR occurs.Vulnerability through stormwater outfalls to Lagoon. Strategies for groundwater extraction regulations.	Yes, vulnerabilities to critical facilities, parcels and roadways are reviewed, property values are indicated.	Yes	Strategies were outlined for adoption.	Yes, SLR, 100 Year Flood, Nuisance Flooding.	Identifies impacts to critical facilities. Mentions Bldg codes as a strategy.	To be adopted by 2020 from report. Recommends certain areas.	Mention strategies that would probably qualify as CRS, but not directly discussed.	No POF policies included, but could be done from the VA.	Good example. Year long process and $200,000 funded.VA done as part of the Regional Resiliency Collaborative by ECFRPC.
City of Rockledge	53	1/18-6/19	NOAA Coastal Flood Exposure Mapper - shallow coastal flooding. DEM SLOSH 2017 - Storm Surge.	2040, 2060, 2080,2100	Yes	No	No	No	Yes. Looking at land use impacts from flooding.	Yes, looking at storm surge Cat 1-5, SLR, FLU.	Shallow flooding, storm surge, SLR, Surge & SLR, 100 yr. flood.	Looks at impacts from the specifice changes to roadways.	No	Yes	Some mention of basic strategies that would boost this rating but not direct discussion.	Yes	Good example. Year long process and $200,000 funded.VA done as part of the Regional Resiliency Collaborative by ECFRPC. Also did stormwater Assessment.

Bay Harbor Islands Faces Significant Flood and Climate Risks Now and In The Future

Figure 21: King Tide events are causing regular flooding throughout Florida

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BHI Elevations Are Low

Table 1: Range of Elevations over Land Area of BHI

Elevation Value	Area in Acres	Cumulative Percent	No. of Buildings	Cumulative Percent	Acres of Road Right of Way	Cumulative Percent
0 - 1 Feet	1.05	0.4	0	0	0.02	.03
1.01 - 2 Feet	8.56	3.79	8	0.99	6.00	10.29
2.01 - 3 Feet	61.07	27.89	34	5.19	32.57	65.93
3.01 - 4 Feet	108.38	70.65	303	42.65	17.95	96.60
4.01 - 5 Feet	58.26	93.64	368	88.13	1.39	98.97
5.01 - 6 Feet	11.1	98.02	87	98.89	0.14	99.21
6.01 - 7 Feet	4.79	99.91	9		0.41	99.91
7.01 - 8 Feet	0.21	99.99	0		0.04	99.98
8.01 - 9 Feet	0.01	**100%**	0	**100%**	0.01	**100%**
Totals	**253.43**		**809**		**58.53**	

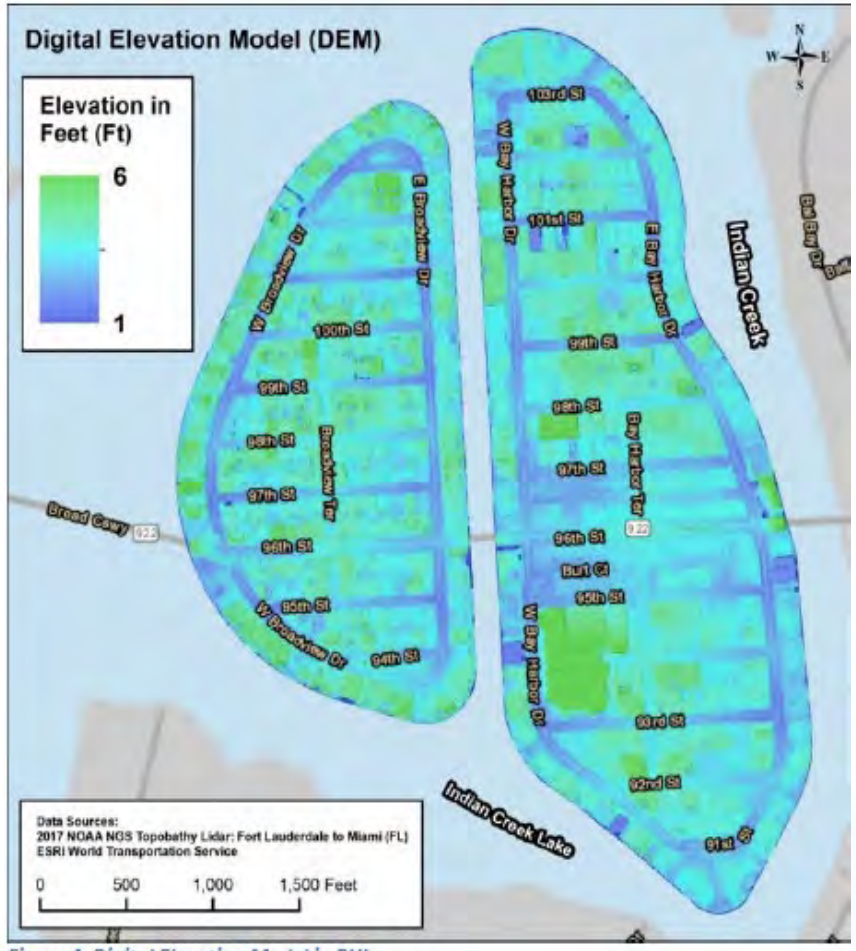

Figure 4: Digital Elevation Model in BHI

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Inches Matter!

Due low elevations, BHI is vulnerable to:

- Flooding from sea level rise;
- Flooding from storm surges;
- Flooding from heavy rainfall;
- Storm sewer overflows;
- Inundation of and damage to roadways;
- Inundation of and damage to buildings;
- Ingress/Egress/Evacuation issues.
- These are all discussed in the Study

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Where Do We Get Our Sea Level Rise Estimates?
SE Florida Climate Compact

- **Palm Beach County**
- **Broward County**
- **Miami-Dade County**
- **Monroe County**

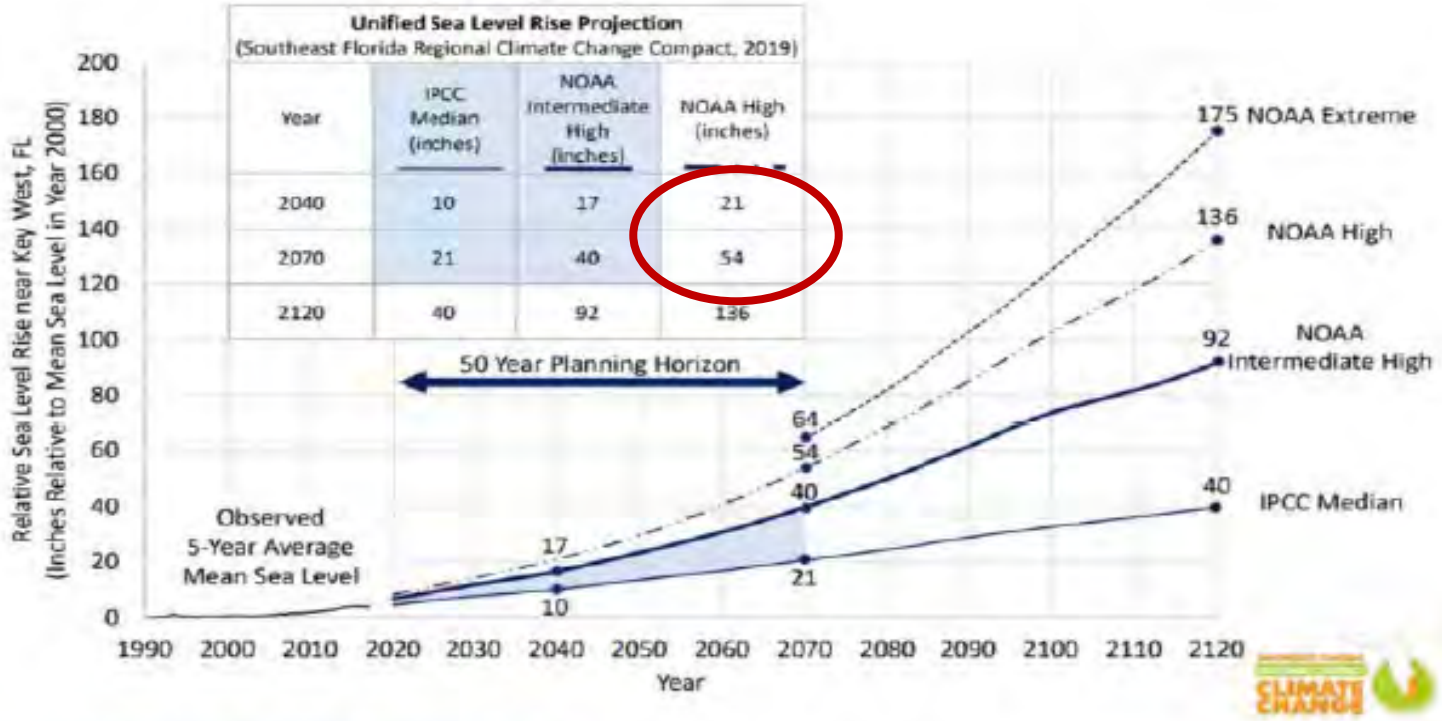

Figure 6: Sea Level Rise Projections, December 2019

https://southeastfloridaclimatecompact.org/

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King Tides 2020

<u>Main arterial roads at risk</u> - Broadview Drive on the West Island and Bay Harbor Drive on the East Island, as well as low-lying pockets and streets in interior of the islands, may flood up to a depth of 1-foot (AGL);

Approximately 21-acres may be flooded during 2020 King Tides. 16-acres, roadways; 5-acres, properties. 29 properties are expected to experience flooding of 10% or more over the property area.

Tidal flooding can be exacerbated by on-shore winds, storms, and other conditions in the Atlantic Ocean

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Tidal Flooding in 2020

Figure 8: Potential King Tide Flooding in 2020

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King Tides 2030

Using the Four County Compact and NOAA Tide Gauge Data, Coastal Risk extended the tidal flood analysis into the future, using the SLR “High Curve” recommended by the Compact.

- By 2030, tidal flooding over the affected areas is expected to rise to 1.7 feet Above Ground Level (AGL), given SLR of 1.6 feet;
- Several more properties are affected. Ground water is also higher because of SLR, and, it will take longer to drain the areas of inundation.
- Increases flooding to 38-acres; 27-acres of which are roadways, and, 11-acres impacting properties, with 48 properties experiencing flooding of 10% or more over the property area.

Figure 9: Potential Flooding - 2030 Sea Level Rise with King Tide Events

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King Tides 2050

- Between 2030 and 2050, without mitigation investment, tidal flooding is projected to affect ever-increasing areas, including almost all the roadways and a significant number of private residential properties.
  - This is the “tipping point”.
- For 2050, a King Tide flooding of 2.7 feet (AGL) given SLR of 2.48 feet and could potentially result in 92.5% of the properties on Bay Harbor Islands having over 10% of their parcels inundated.
- Approximately 164 acres flooded covering 65% of the island. 306 properties inundated over 50% or more o the property, if no mitigation and/or adaption measures are taken.

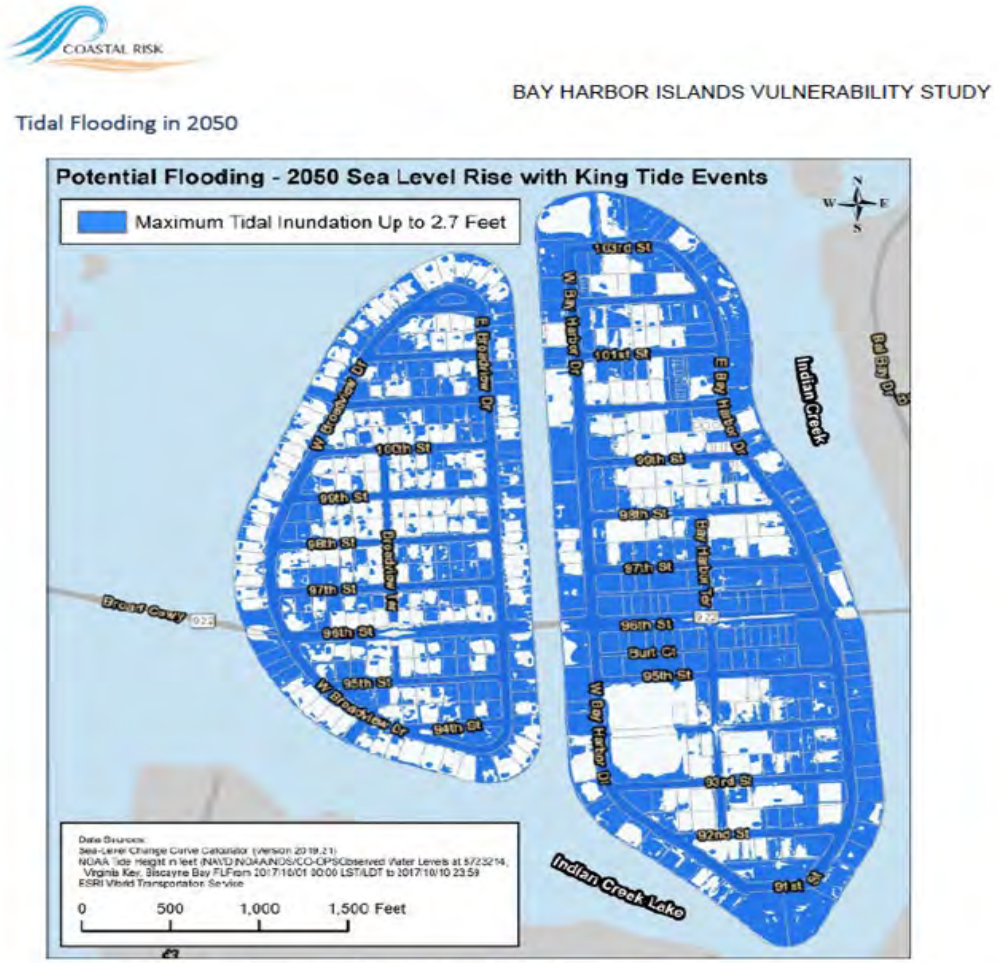

Figure 10: Potential Flooding - 2050 Sea Level Rise with King Tide Events

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Hurricane Storm Surges 2020

In addition to Sea Level Rise, which now causes "nuisance" level flooding, keep in mind that the National Hurricane Center calculates the annual risk of a Category 1 Hurricane at 23% per year and a Category 3 Hurricane at 13% per year for BHI. FEMA estimates that the annual recurrence of a 100-year flood in BHI is 1% per year.

Category 1 Storm Surge in 2020

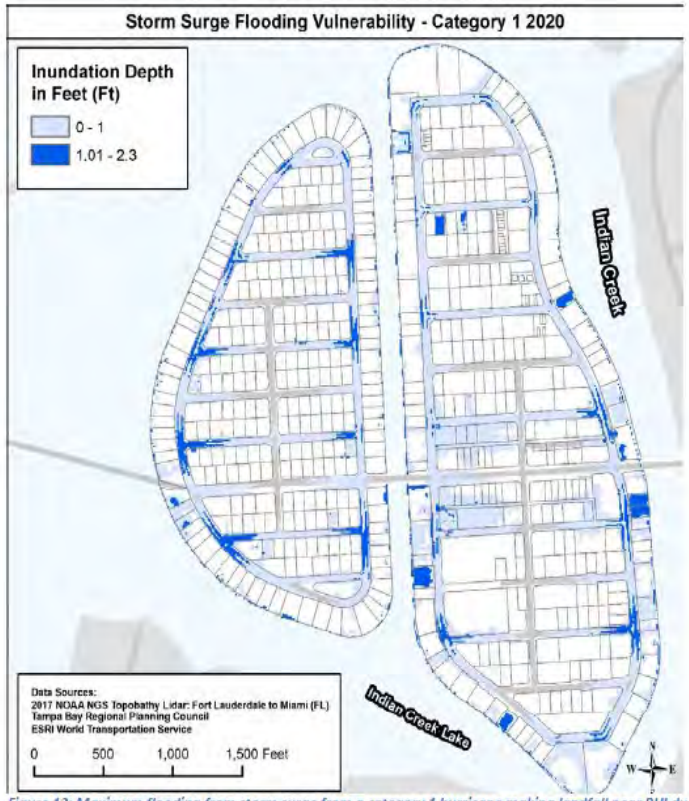

Figure 12: Maximum flooding from storm surge from a category 1 hurricane making landfall near BHI during high tide in 2020

Category 3 Storm Surge in 2020

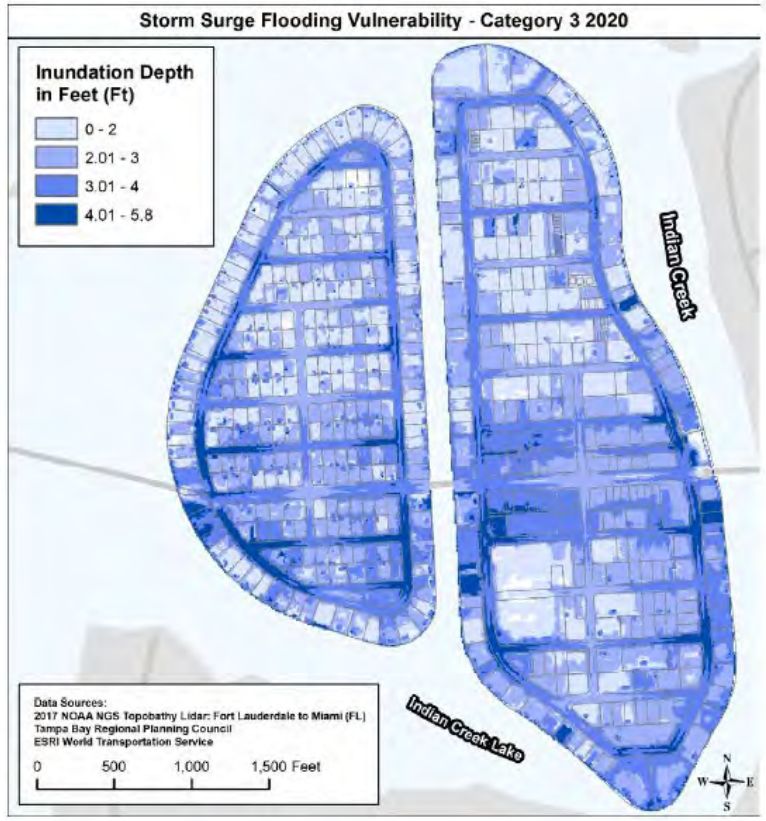

Figure 13: Maximum flooding from storm surge from a category 3 hurricane making landfall near BHI during high tide in 2020

Category 5 Storm Surge in 2020

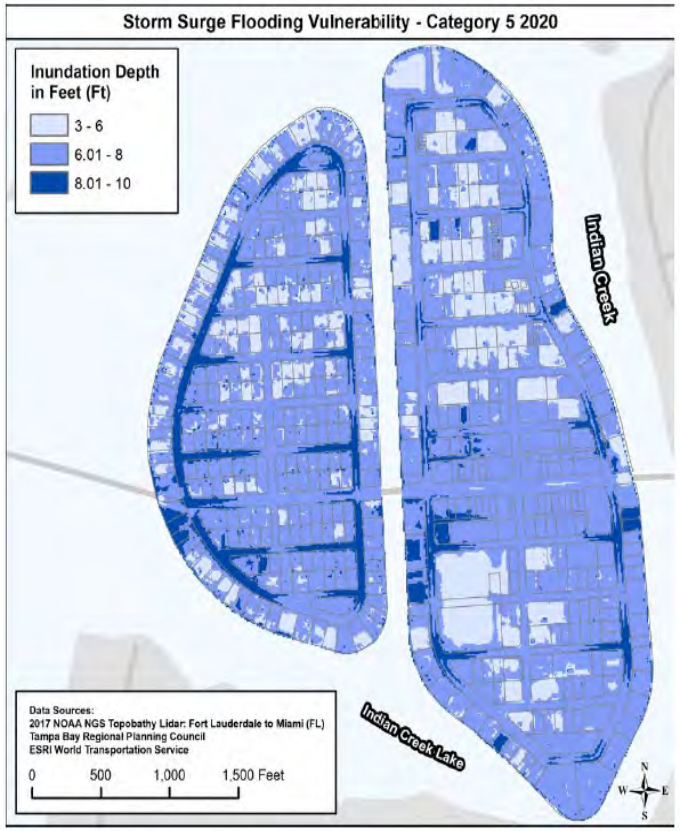

Figure 14: Maximum flooding from storm surge from a category 5 hurricane making landfall near BHI during high tide in 2020

What Would Storm Surge Flooding Look Like in BHI?

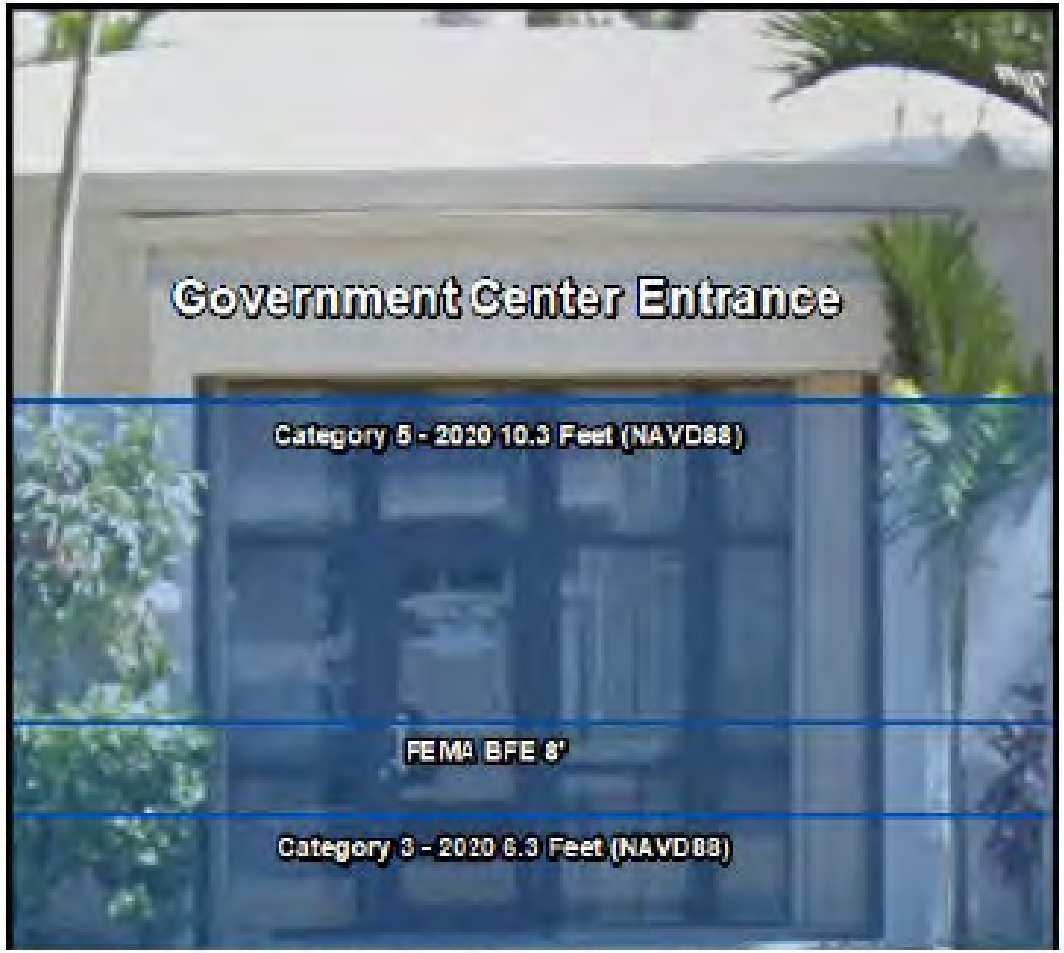

Figure 17: Potential 2020 Flood levels – Town Hall BH

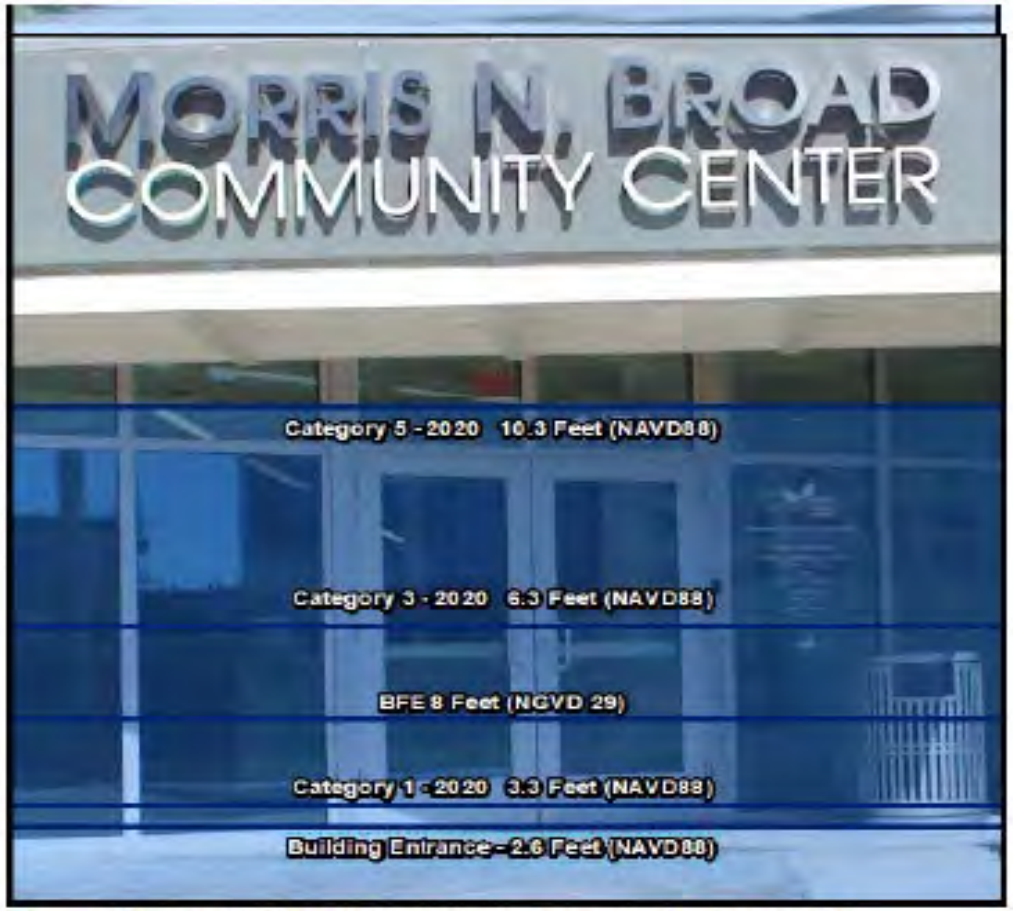

Figure 18 Potential 2020 Flood levels - Community Center BHI

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Tidal Flooding and Property Values

As Sea Levels Rise and more and more properties are affected, their market/assessed values may decrease and, as a result, the Town's tax revenues and budgets decrease.

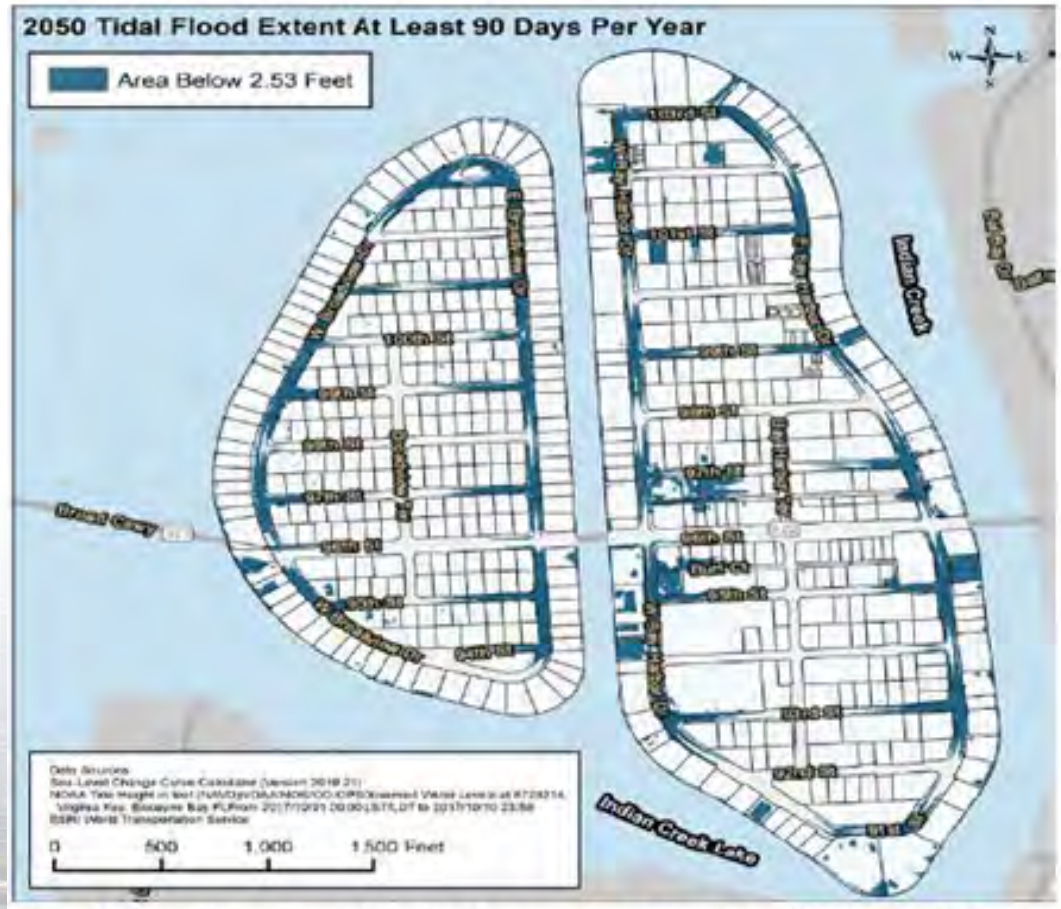

Figure 19: Properties and Roads Flooding 90 or more days a year during High Tides in 2050

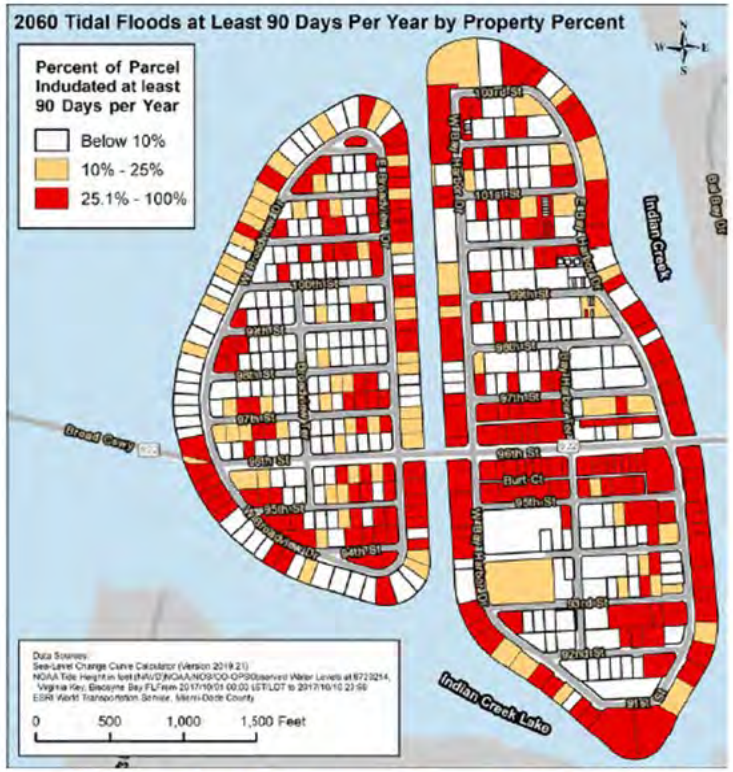

Figure 20: Percentage of Parcels Flooding 90 or more days a year during High Tides in 2060

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Loss of Property Values Due to Sea Level Rise

Table 3: Impact of High Tide Flooding on Property Values in 2060

Land Use Type	No. of Properties in BHI	Total Assessed Value	2060 – No. of Properties with 10% of Parcel Flooded at Least 90 Days a Year	Total Assessed Value
Residential	499	$1,613,724,265	296	$1,234,464,503
Commercial	70	$304,545,364	62	$290,696,324
Institutional / Government	23	$94,824,879	19	$88,971,425
Totals	592	$2,013,094,508	377	$1,614,132,252

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How Much Potential Damage to BHI Town Buildings Due to Storm Surges 2020?

Table 4: Building Characteristics for Damage Loss Modeling

Building	Total Building Valuation	Total Contents	Number of Stories	Total Square footage	First Floor Square Footage	First Floor Building Valuation	First Floor Content	First Floor Height (AGL)
Community Center - Fire Station	$13,143,690	$50,000	4	141,330	12,638	$2,897,585	$30,355	0.3
Community Center - Library					8,179	$1,487,285	$19,645	0.3
Community Center - Parking Garage					14,515	$1,054,953	$0	-0.8
Town Hall/Police Station/	$2,822,950	$575,000	2	12,590	5,195	$1,164,831	$237,262	0.5
Town Hall Annex			1		2,200	$493,288	$100,477	0.5
Sewer Bypass Pump	$44,276	—	—	—	—	$44,276	—	0.0

Table 5: Modeled Damage Loss and Restoration Time Estimates

Building/Structure	Scenario	Storm Surge Inundation (feet)	Building First Floor Loss (Percent)	Building First Floor Repair Cost	Building First Floor Content Loss	Restoration Time in Days (minimum)	Restoration Time in Days (maximum)
Community Center - Fire Station	Cat 1	—	0%	$0	$0	0	0
	Cat 3	2.7	11%	$310,042	$9,896	300	480
	Cat 5	7.7	22%	$640,366	$28,928	450	630
Community Center - Library	Cat 1	—	0%	$0	$0	0	0
	Cat 3	2.7	8%	$124,932	$9,528	300	480
	Cat 5	7.7	14%	$214,169	$14,557	450	630
Community Center - Parking Garage	Cat 1	—	0%	$0	$0	0	0
	Cat 3	3.8	7%	$71,737	$0	0	30
	Cat 5	8.8	20%	$213,101	$0	0	30
Town Hall/Police Station	Cat 1	—	0%	$0	$0	0	0
	Cat 3	2.5	11%	$122,307	$68,806	300	480
	Cat 5	6.5	19%	$215,494	$201,673	450	630
Town Hall Annex	Cat 1	—	0%	$0	$0	0	0
	Cat 3	2.5	11%	$51,795	$66,817	300	480
	Cat 5	6.5	16%	$78,926	$100,477	450	630
Sewer Bypass Pump	Cat 1	—	0%	$0	—	(No standardized estimate has been published)	
	Cat 3	3.0	0%	$0	—		
	Cat 5	7.0	10%	$4,428	—		

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How Will Climate Change Impact BHI?

Future increased rainfall and future increased heat

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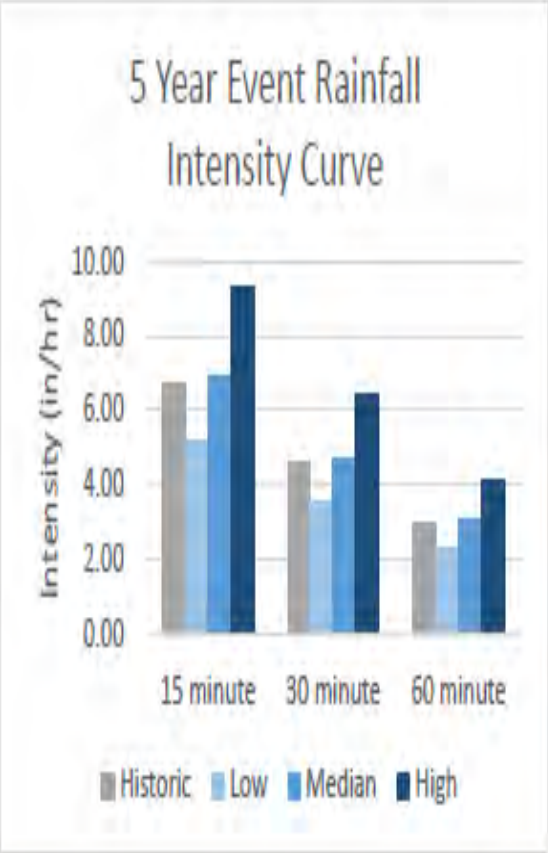

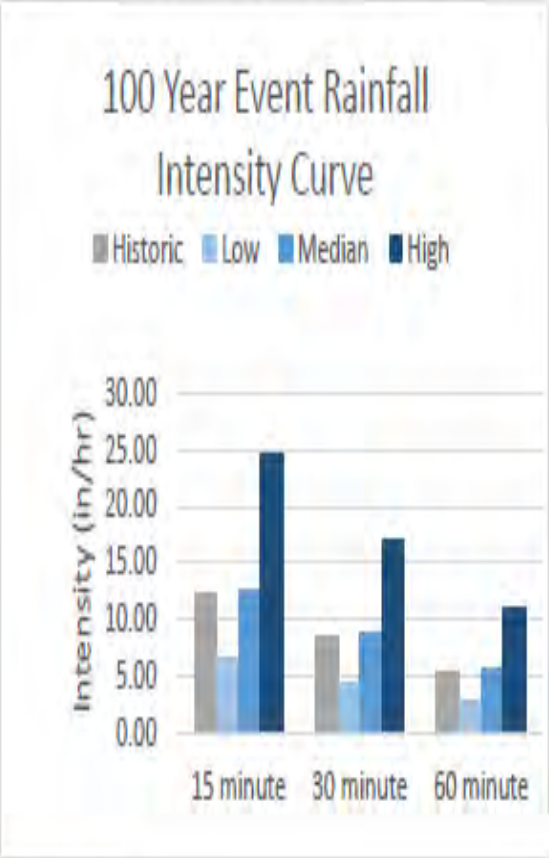

Figure 23: Intensity projections for low, median, and high models

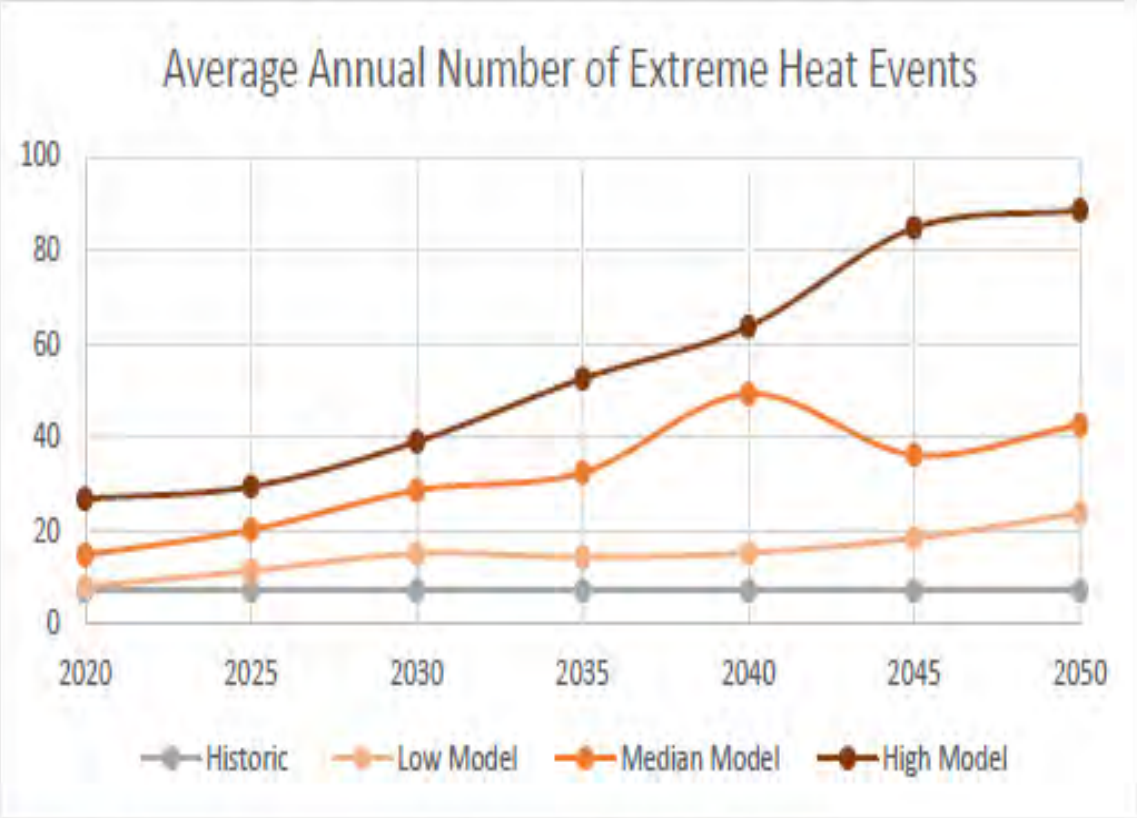

Figure 24: Extreme heat event projections for low, median and high models

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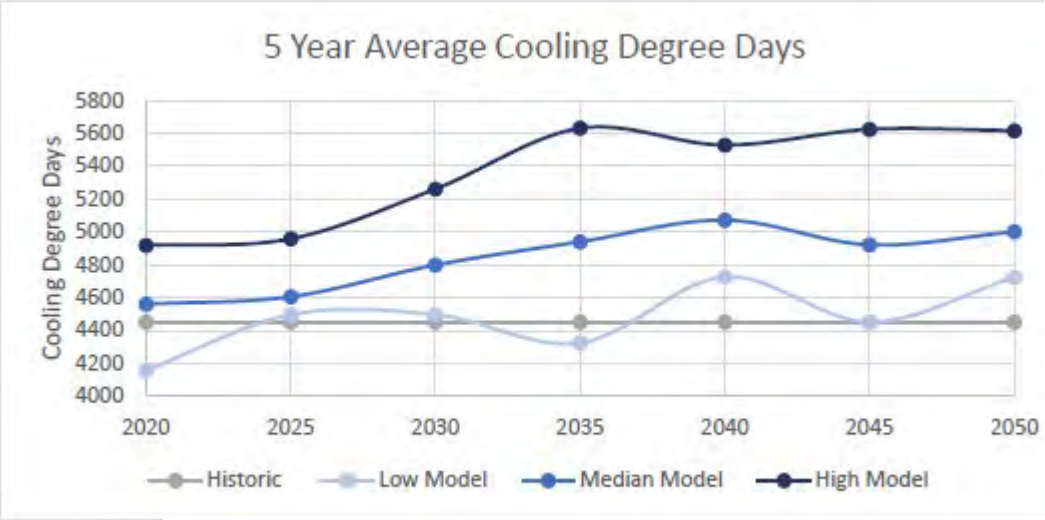
Why Is This Important? Energy Costs Increase Due to Climate Change!



- All climate models show significant increases in CDDs. This increase indicates a direct increase in cooling energy demand for BHI. This increase is estimated to be 6%, 12% and 26% by 2050 for the low, median, and high models, respectively.

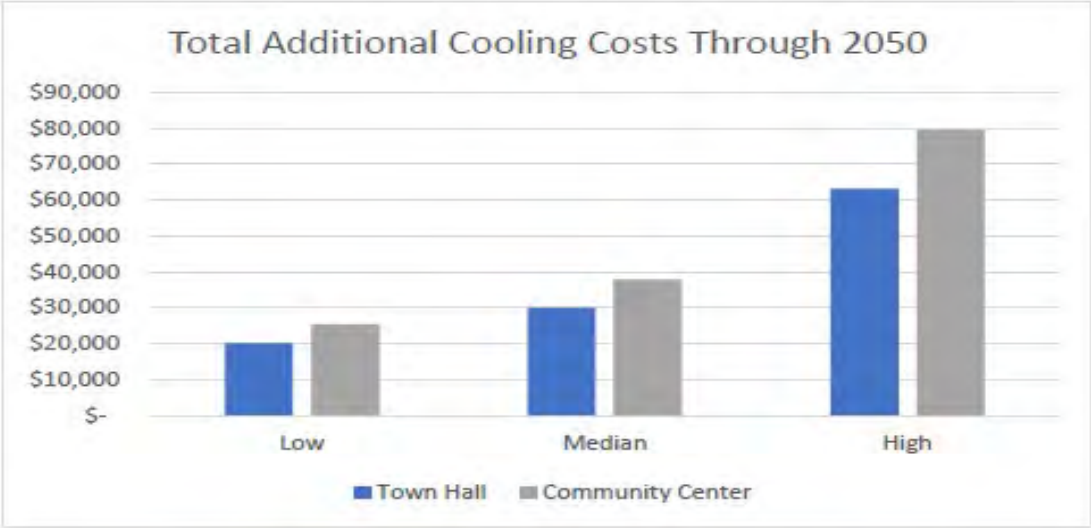


Figure 50 Cooling costs through 2050 for low, median, and high scenarios.

Figure 49: Community Center will absorb additional cooling costs due to increasing temperatures

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Private Sea Walls Will Need Upgrading

The condition of the sea walls and docks are a major vulnerability for BHI especially given our analysis of future flooding potential. Attention to this problem taking account of expected future conditions including those in the short-term future will be part of our recommendations in Part 2 of our Study – Adaptation Strategies. The overall conditions of the seawalls and docks are summarized in Table 11

Table 10: Condition of Seawalls and Docks in BHI

Condition	East Island		West Island		Causeway Island	
	Seawall	Dock	Seawall	Dock	Seawall	Rock Revetment
Good	0%	1%	0%	0%	0%	0%
Satisfactory	4%	11%	2%	19%	0%	70%
Fair	50%	28%	71%	47%	92%	0%
Poor	42%	22%	26%	10%	8%	30%
Serious	1%	11%	1%	1%	0%	0%
Critical	3%	8%	0%	9%	0%	0%
N/A	-	19%	-	14%	-	-

*N/A = dock demolished or not existing

Source:
https://trustedpartner.azureedge.net/docs/library/TownofBayHarborIslands2015/Content/BHI_Report_Final_SEA_WALL(1).pdf

Figure 26: Existing seawalls are in poor condition in many places resulting in increased vulnerability for Bay Harbor Islands.

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BHI Seawall Compliance Program

- https://www.bayharborislands-fl.gov/153/Code-Compliance
- "Seawalls and Docks - The Town Council recently commissioned an engineering inspection to identify deficiencies as well as assess the condition of seawalls and docks in the Town. The report covered the Causeway Island, East Island and West Island and it categorized each seawall as good, satisfactory, fair, poor, serious or critical.
- Some residents have already received letters from the Town's Code Compliance Department advising them of their property's condition. Depending on the condition of your seawall and/or dock, a more detailed inspection and repairs might be recommended.
- Seawall Condition and Resiliency Assessment Report:
  - https://www.bayharborislands-fl.gov/DocumentCenter/View/800/Seawall-Condition-and-Resilliancy-Assessment-October-2019-Updated

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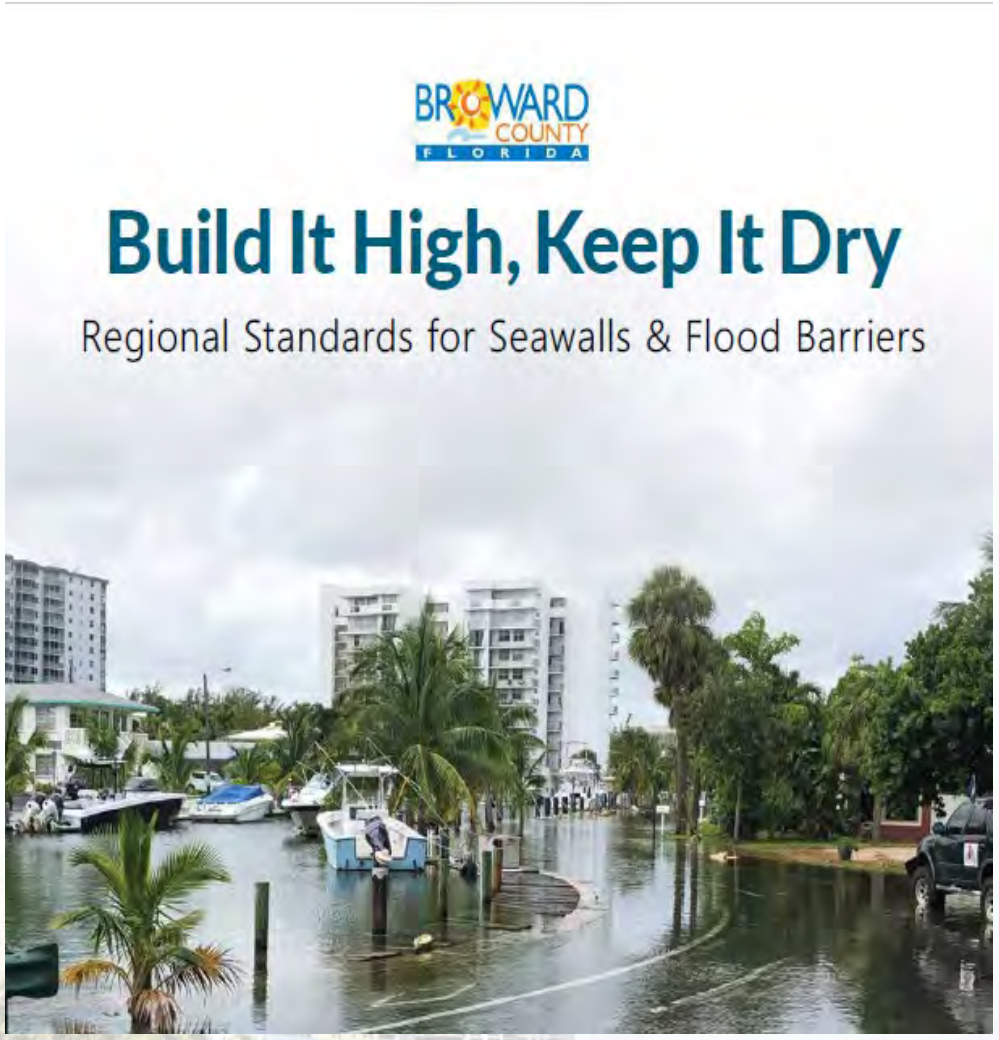
Broward County Seawall Ordinance

- **Minimum elevations set of 5-feet NAVD88** for all new or substantially repaired or rehabilitated seawalls and banks, berms, etc.
- **Maintain tidal flood barriers in good repair**. Seawall, is "presumed to be in disrepair, if it allows tidal water to flow unimpeded through or over the barrier and onto adjacent property or public right-of-way."
- **Sellers to disclose if property is located in a "tidally-influenced area"** and, must contain the following language:

"THIS REAL ESTATE IS LOCATED IN A TIDALLY INFLUENCED AREA. THE OWNER MAY BE REQUIRED BY COUNTY OR MUNICIPAL ORDINANCE TO MEET MINIMUM TIDAL FLOOD BARRIER ELEVATION STANDARDS DURING CONSTRUCTION OR SUBSTANTIAL REPAIR OR SUBSTANTIAL REHABILITATION OF SEAWALLS, BANKS, BERMS, AND SIMILAR INFRASTRUCTURE OR WHEN REQUIRED TO ABATE NUISANCE FLOODING."



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Climate Change Will Also Increase Road Repair Costs

BHI Roads – Impacts of Extreme Precipitation

- Surface and Sub-surface damage
- Water Infiltration through cracks
- Significant additional annual maintenance costs are likely, without adaptation investments.

When considering the additional damages due to climate change factors, including issues described earlier such as road cracking and base erosion, the additional cost for repairs is estimated to average $158,000 annually.

Table 8 Cumulative and annual costs by road level

	Primary	Secondary	Tertiary	TOTAL
Cost	$1,219,629	$3,486,802	$33,582	$4,740,013
Annual Cost	$40,654	$116,227	$1,119	$158,000

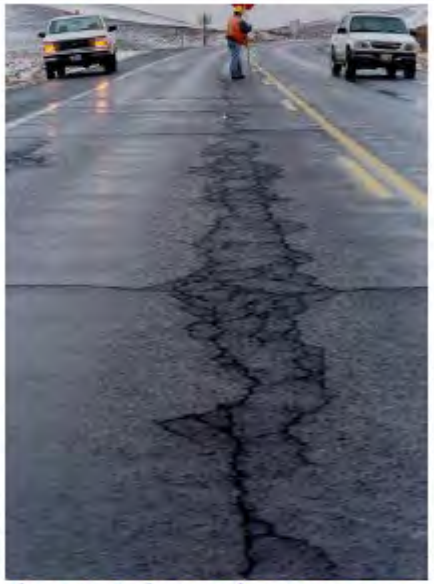

Figure 43: Typical cracking that can occur as surfaces weaken due to increased intensity of precipitation events.

Figure 29: Typical residential street on Bay Harbor Islands.

Figure 30 Typical commercial street in Bay Harbor.

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Increased Rainfall Will Impact Roofs (Residential and Commercial

- Increased heavy rainfall (rate and intensity) can cause potential roof damage, because they produce water levels that exceed roof drainage systems.
- This results in ponding on flat roofs, which can lead to roof leaks and water infiltration behind walls.
- Climate Change-induced heavy rainfall can significantly impact building operating costs in the future.

Figure 48: Typical commercial buildings on the Islands have flat roof profiles which are susceptible to ponding.

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Bridge Ingress and Egress Is Threatened By 2050

All bridge access points have elevations between 2 to 4 feet. If these access points are cut off, it eliminates access to the bridges even though the bridge deck is at a higher elevation. When put in the context of King Tide vulnerability, these access points begin to be cut off under the 2050 SLR and King Tide scenarios, if action is not taken to address this access risk such as raising the access roads.

Figure 51: Bridge elevation creates vulnerability between the islands.

The primary vulnerability associated with the bridge network is sea level rise and storm surge. In order to stay open, the access points to the bridge must be above sea level in any condition. Figure 52 includes details of the elevation profile of each bridge segment and nearest inland intersection.

Summary of Vulnerability Analysis and Introduction to Adaptation Strategies

Flooding Risks

The community of Bay Harbor Islands consists of approximately 6000 people on 253 acres of land. Although buffered from the Atlantic Ocean by Bal Harbour to its east, the Town is vulnerable to tidal flooding, sea level rise, storm surge and rainstorm flooding given its low-lying nature with 70% of the land area having elevations of less than 4-feet NAVD88 and a high point in the Town of just over 7-feet.

At present in 2020, the community is already experiencing localized flooding mostly impacting roadways at seasonal King tides. Those low-lying areas are also flooded following heavy rainfall. Modeling shows that in ten years, tidal flooding rising to almost 2-feet, will periodically flood almost three miles of secondary roads and significantly impact more than 48 land parcels. By 2050, tidal flooding will rise to almost 3-feet impacting most of the roads including the primary through road, Kane Causeway, and 65 percent of the properties on the islands. 2070 presents an even more dire picture with tidal flooding impacting around 92% of properties. **These projections assume that that no further remedial measures are taken and emphasizes the urgency of implementing well-planned risk mitigation and adaptation solutions. The current vulnerability of the Town to flooding risks is further exacerbated by the generally poor condition of the surrounding seawalls.**

Sneak Preview of Adaptation Report

- In this report, we assessed and modeled the Vulnerability of Bay Harbor Islands to flooding and climate change impacts.
- In the next phase, we will be presenting a range of short-term, medium-term and long-term adaptation recommendations -- again to stay ahead of the vulnerability curve.
- One of the Adaptation Recommendations (spoiler alert) will be road raising in specific areas, like they are doing in Miami Beach.
- Stay Tuned!

Image from Miami Herald

Image by WadeTrim

Figure 2: Examples of raising the road profile currently underway in Miami.

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Thank You and Next Steps!

- If you were not able to provide your comments and questions using Zoom, then, please email them to Marlene Siegel, msielgel@bayharborislands-FL.gov.
- The second phase of this effort, the Adaptation Report, will be posted on the BHI website when complete later this month.
- Please be on the look out for notices of the second and third public engagement sessions. Try to attend and provide us with your feedback!

- **A Final Note**
- While the Vulnerability Assessment reveals that the Town of Bay Harbor Islands faces significant flooding and climate issues in the future, other communities have used studies like these to obtain millions of dollars in State and Federal Grants to help them solve these problems.
- Some grant opportunities will be discussed in the Adaptation Report due out by the end of the month.

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