City of Miami Beach
Sea Level Rise Vulnerability Assessment Report

September 2024

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MIAMIBEACH RISING ABOVE

Acknowledgments

Client

City of Miami Beach, Florida

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Table of Contents

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Acronyms

CDC	Center for Disease Control
DEM	Digital Elevation Model
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
LiDAR	light detection and ranging
MHHW	Mean Higher High Water
NAVD88	North American Vertical Datum of 1988
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
SWMMP	Stormwater Modeling and Master Plan

Key Terms

10-year rainfall (10-percent annual chance rainfall): A rainfall event with a 10-percent chance of being equaled or exceeded in any given year. For this report, 8.75-inches of rainfall over a 24-hour period represents the 10-year (10-percent annual chance) rainfall flooding event as determined by the City of Miami Beach's Stormwater Modeling and Master Plan.

100-year flood (1-percent annual chance flood): A flood event with a 1-percent chance of being equaled or exceeded in any given year. For this report, 6.2-feet (NAVD88) above mean sea level is used to represent the 100-year (1-percent annual chance) storm tide (storm surge) flooding event.

Adaptation: The process of adjustment to actual or expected stressors in order to moderate effects or exploit beneficial opportunities.

Adaptive Capacity: The potential or ability of an asset, system, or community to adapt to the effects or impacts of a stressor (e.g., climate change).

Asset: City owned or regionally significant infrastructure, as defined by the Resilient Florida grant program (§.380.093, F.S.), within the City of Miami Beach boundary.

Assessment: Sea Level Rise Vulnerability Assessment.

City: The City of Miami Beach.

Compact: Southeast Florida Regional Climate Change Compact.

Compound Flooding: The combined effect of two or more flood sources (e.g., rainfall and king tide) occurring simultaneously.

Consequence: The severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable due to flood exposure.

Exposure: The presence of people, livelihoods, ecosystems, infrastructure, or other assets in places that could be adversely affected.

Flood Scenarios: Term used to collectively refer to the twenty-one modeled flooding conditions used in the Assessment. Includes the existing conditions, NOAA Intermediate Low, NOAA Intermediate High, and NOAA High projections for each flood type for 2040 and 2070.

Flooding: Temporary occurrence of water levels exceeding normally dry elevations; typically associated with an episodic event, such as a storm tide (storm surge).

Groundwater Flooding: The ponding of water in low-lying areas due to an elevated water table raising water to the surface.

Inundation: The process of normally dry areas being submerged.

King Tide: Higher than normal, but predictable, seasonal tides that occur each year during a new or full moon.

Mean Higher High Water: Average of the highest of two high tides occurring each day over the National Tidal Datum.

Resilience: Degree to which a system or asset rebounds, recuperates, or recovers from exposure to stressors.

Risk: Potential losses or impacts (consequences) that could occur if an asset or system is inoperable due to exposure.

Sea Level Rise: Refers to the increase in average global sea levels, often due to melting glaciers and thermal expansion.

Sensitivity: The likelihood an asset will fail, incur significant damage, or become unusable due to flood exposure.

Social Vulnerability: Refers to the demographic and socioeconomic factors (such as poverty, age, race/ethnicity, english language proficiency, lack of access to transportation, and crowded housing) that adversely affect communities that encounter hazards and other community-level stressors.

Socially Vulnerable Neighborhood: A census tract classified by the CDC's Social Vulnerability Index as being in the Top-25% (quartile) of social vulnerability based on socioeconomic, race/ethnicity, age, english language proficiency, disability, and housing characteristics from the US Census.

Storm Tide: Temporary, short-term increase in sea level above predicted astronomical tide levels due to atmospheric pressure changes, wind, and/or freshwater inflows. Also referred to as storm surge.

Stressor: Events and trends, both climate-related and not, that have an important effect on an asset or system that can increase risk and vulnerability.

Tidal Flood Days: The frequency of nuisance flooding conditions (i.e., frequent, minor flooding during high tides).

Vulnerability: The predisposition of an asset or system to be adversely affected by climate change. It is typically defined by a combination of exposure, sensitivity, and adaptive capacity.

1. Introduction

1.1 Project Overview

The City of Miami Beach (City) has long been a leader in recognizing the threat posed by sea level rise and in taking proactive adaptation actions to establish a resilient City, ready for a changing future. The City has been, and will continue to be, at the forefront of sea level rise impacts due to the relatively low elevations and porous geology found in this region of Southeast Florida. **Figure 1.1** conceptually illustrates the various sources of flooding impacting the City and how future sea level rise will raise the baseline of flooding events.

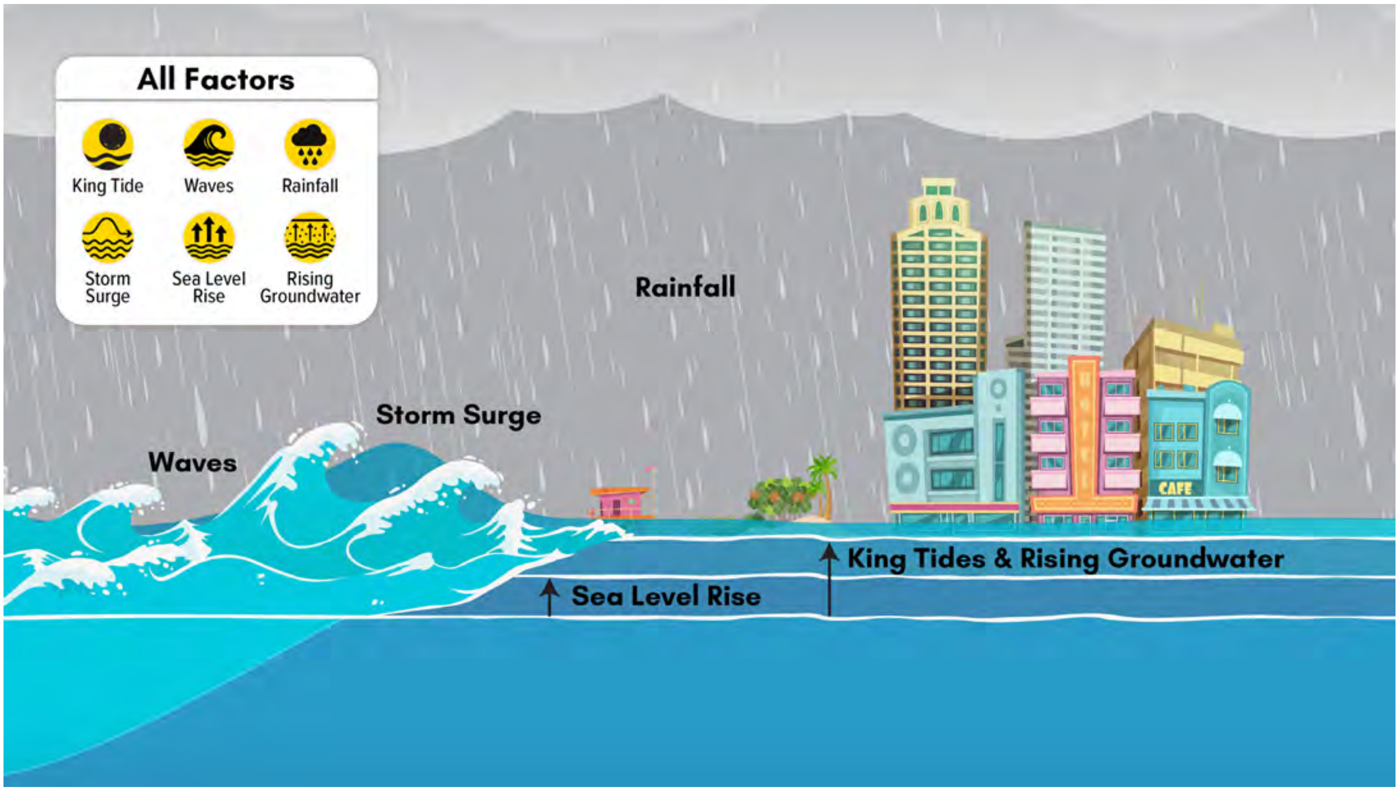


Figure 1.1: Representation of contributing flood scenarios in compound flooding.

In recent decades, the City has begun to face the impacts of sea level rise. This has included more frequent flooding of coastal roadways and low-lying areas during king tide events and more widespread ponding during heavy rainfall events. These events cause travel disruptions, damage to City infrastructure and private property, and during extreme events, can pose threats to life and safety. Future sea level rise is projected to increase flooding scale and severity, as coastal floodwaters become more likely to overtop current shoreline infrastructure and elevated bay and ocean water levels further decrease the effectiveness of the existing stormwater drainage system.

To more comprehensively understand the risk that future sea level rise poses, the City conducted this Sea Level Rise Vulnerability Assessment (Assessment) to identify the City-owned and regionally significant assets most vulnerable to different flood sources across a range of current and future sea level conditions. The Assessment provides a means for the City to identify and prioritize assets most vulnerable to impacts of sea level rise. The Assessment highlights key vulnerabilities that will inform the City's ongoing adaptation planning efforts.

The objectives of the Assessment include:

- Identification and prioritization of critical City assets at risk to current and future flood events;
- Identification of critical assets that serve the City's most socially vulnerable communities;
- Engagement of the public and stakeholders and incorporation of feedback into the Assessment methodology and prioritization criteria and;
- Development of outreach materials to communicate the findings of the Assessment to City department leads and the public.

The Assessment was developed to be compliant with Section 380.093 of the Florida Statute (§.380.093, F.S.), which defines a coordinated statewide effort organized through the Resilient Florida Program to adapt communities to the risks associated with increased precipitation, extreme weather, and sea level rise. Completion of the Assessment meets the requirements outlined in §.380.093, F.S. and allows the City to remain eligible for funding assistance for implementation projects that address specific flood vulnerabilities identified in the Assessment.

1.2 Project Area and Setting

Bordered by the Atlantic Ocean to the east and Biscayne Bay to the west, the City is a narrow barrier island and thus is vulnerable to flooding hazards from all directions, including from groundwater underneath the City. Ground elevations throughout the City are relatively low, particularly on the west side where elevations average only five feet above sea level. Strong coastal flooding events, such as king tides and storm tides (storm surges) from tropical storms, can overtop low shorelines and create pathways for floodwaters to other low-lying areas. Elevated coastal water levels can also prevent stormwater drainage at coastal outfalls, creating rainfall ponding throughout the City during heavy rainfall events, particularly on roadways or low-lying areas. The City's porous limestone bedrock also allows king tides to elevate groundwater to the surface, flooding low-lying areas and impeding natural stormwater infiltration.

The City is comprised of three regions: North Beach, Mid Beach, and South Beach. Within these regions, the City is divided into 14 major neighborhoods (**Figure 1.2**). The findings of the Assessment will be discussed in the context of these well-established geographic areas to more easily communicate results.

The City is heavily urbanized, which exacerbates flood impacts. Buildings, roadways, and other impervious surfaces impede stormwater drainage and accelerate runoff to low-lying areas. The City is reliant on its stormwater infrastructure to capture and convey stormwater away from critical assets. Much of the City's existing stormwater infrastructure is projected to become overwhelmed by future flooding conditions due to sea level rise.

In recent decades, the increasing frequency of flooding has forced both the South Florida region and the City specifically to evolve its relationship with water. Established in 2009, the Southeast Florida Regional Climate Change Compact is a partnership between Broward, Miami-Dade, Monroe, and Palm Beach counties to work collaboratively to reduce regional greenhouse gas emissions, implement adaptation strategies, and build climate resilience across the Southeast Florida region. The City utilizes the best available science and engineering to inform sea level rise planning efforts, including this assessment.

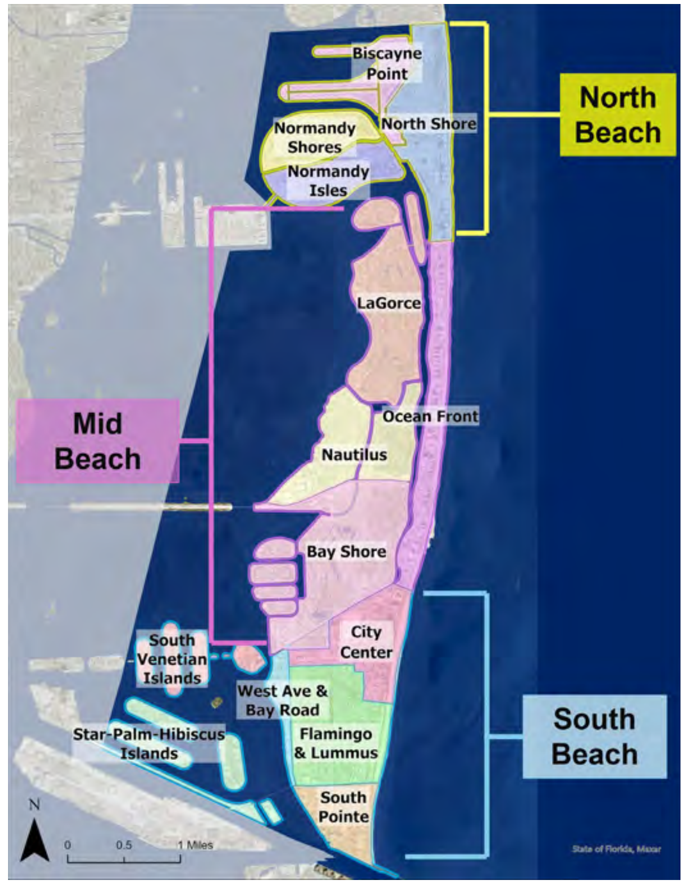


Figure 1.2: Miami Beach regions and neighborhoods.

In 2014, the Blue Ribbon Panel on Flooding and Sea Level Rise was established by the City Commission to provide localized planning recommendations and ordinance updates to adapt the City's shorelines to sea level rise. Since this time, the City's planning and projects have continued to evolve and grow through extensive efforts such as the Urban Land Institute Study, the Resilience Code, and the Stormwater Modeling and Master Plan. The City has utilized this guidance to take several physical actions to respond to sea level rise, including elevating flooded roadways, installing stormwater pump stations, and enacting multiple, forward-planning initiatives such as increasing seawall minimum height requirements. Future adaptation strategies developed from the findings of this Assessment will provide the opportunity for the City to continually increase its sea level rise resilience and preserve its culture and way of life as a coastal city.

1.3 Community Perspectives of Sea Level Rise Hazards

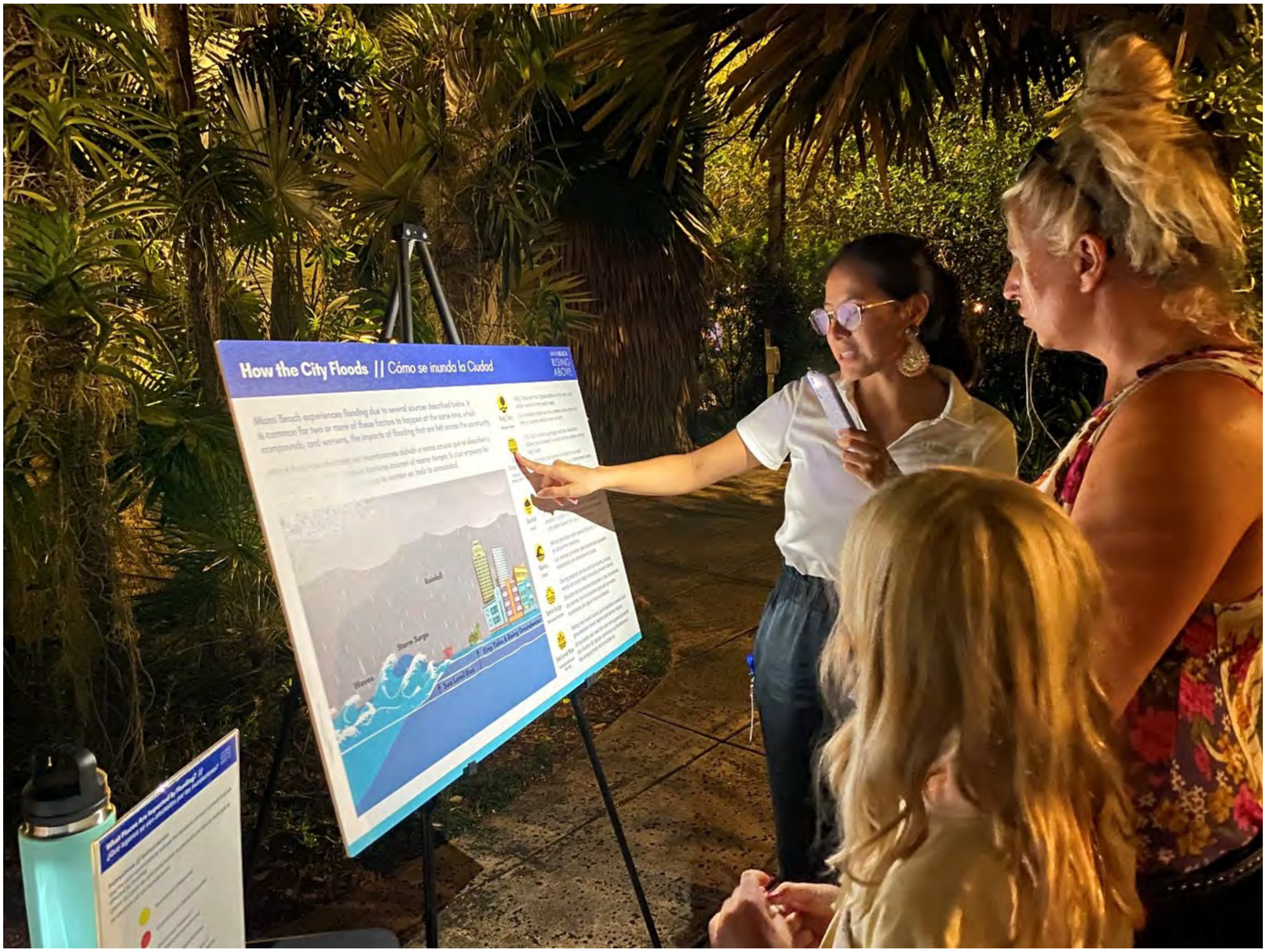


Figure 1.3: City staff discussing how the City floods with residents at a pop-up event.

Early in the Assessment process, the City engaged in conversations with community members to integrate local knowledge on flood hazards into the planning process. Community engagement events included a series of eight small focus group interviews with residents and business owners and three pop-up engagement workshops (**Figure 1.3**) that coincided with ongoing community events. At each event, participants were provided an opportunity to detail how flooding events currently impact their life and what assets or infrastructure they consider the most valuable in their community. These community engagement opportunities and conversations influenced the Assessment by:

- Providing an understanding of community flood concerns,
- Identifying the populations most vulnerable to flood hazards,
- Recording areas where flooding has been worsening over time, and
- Identifying City assets highly valued by the community.

Public input informed asset vulnerability ratings in the Assessment and prioritization criteria for ongoing infrastructure needs described in the accompanying Adaptation Plan. Key themes raised across all community engagement events included:

- **Recognition of higher flood vulnerabilities along Biscayne Bay:** City infrastructure located along the western Biscayne Bay shore experience more flooding than those located near the eastern dune areas. The increase in flood exposure is due to two main factors: lower land elevations along the Bay allow for more shoreline overtopping and groundwater flooding and decrease the ability for gravity-based stormwater systems to drain efficiently.
- **Importance of roadway access:** Dependable roadway access throughout the City, and to the mainland via bridges and causeways, was consistently identified as a vulnerability. Residents and business owners frequently expressed concerns about limited mobility and inaccessible roadways during annual flood events, impeding their ability to access homes, businesses, and basic amenities. These events commonly produced frustrating traffic congestion, which participants believe will be exacerbated by sea level rise and increased precipitation intensity in the future.
- **Community facilities and public spaces are already at risk:** Residents identified several community facilities and public spaces (e.g., Scott Rakow Youth Center, Flamingo Park, and Fisher Park) that already experience flooding. Parks and other outdoor spaces significantly contribute to quality of life in highly urbanized Miami Beach and serve as a social hub for many residents. Several public schools (e.g., Biscayne Elementary and Nautilus Middle School) were also noted as frequently flooded, which affects school pick up/drop off.
- **Concern over long-term real estate and property value:** Homeowners and business owners expressed concern about the potential effect of sea level rise on property values, insurance, and local investment in the City. Many residents have experienced sharp increases in insurance rates in the last few years, and fear that they will be forced to leave the City due to high property and insurance costs even before the City becomes unlivable due to the physical effects of sea level rise, if no action is taken.
- **Aging flood protection structures:** The City's sea level rise issues are compounded by a reliance on an aging flood protection network. Large portions of the City currently depend on a system of seawalls and gravity-based stormwater drainage infrastructure that was designed in the early to mid-1900s without consideration of changing climate conditions. Property owners noted that seawater commonly seeps through cracks in their seawalls, particularly during high tides. Many interviewees also noted ponding water due to undersized and aging stormwater inlets and pipes.
- **Vulnerable populations are most at risk:** Community members noted that flooding vulnerabilities are unequally distributed across the City. Many hospitality and service industry employees are more likely to rely on bus and non-motorized forms of transportation, such as bicycles and walking, to access jobs and City amenities, and thus experience longer commute times during flood events. Elderly residents also face higher vulnerabilities as flooding and ponding water limit mobility, increase the likelihood of flood-related medical emergencies (e.g., slip or fall), and can increase social isolation.
- **Need for coping mechanisms on an individual scale:** Many residents have already been forced to adopt coping mechanisms to adapt to flooding on a personal level. Examples include raising the elevations of homes, docks, and private seawalls, purchasing high-clearance vehicles to drive through flooded streets, cleaning debris built up around local storm drains, and carrying flip-flops or rubber boots in the summer to commute on flooded sidewalks.

The public engagement events assisted the City in identifying additional assets to include in the Assessment that were highly valued by the community. The experiences and impacts voiced by the community align with the key vulnerabilities identified by the Assessment, and key themes captured through community engagement are integrated throughout the Assessment. A more detailed description of the community engagement process is provided in Appendix A.

1.4 Sea Level Rise Resilience Goals and Approach

This Assessment represents the City's latest step forward in achieving its flood resilience vision. Assessment findings will lead to better protection of the City's critical infrastructure from future sea level rise, alleviate travel disruptions during heavy rainfall events, and ensure that community valued assets are safeguarded into the future.

The City established the following goals specific to this approach:

- Increase the resilience of the City to immediate and long-term sea level rise challenges.
- Protect and enhance City infrastructure, natural resources, and the overall quality of life for all.
- Prioritize adaptation strategies for locations that align with communities that may experience inequitable impacts of sea level rise.

This Assessment is the first phase in this approach (**Figure 1.4**). In Phase 1, the City's critical assets were assessed for vulnerability to current and future flooding. The Assessment resulted in a list of key assets and areas most vulnerable to sea level rise. The key vulnerabilities informed the development of several adaptation pathways to reduce asset risk and community impacts from flooding in the City's Adaptation Plan (Phase 2). The City will use the findings from this plan and the pathways developed in the Adaptation Plan to design policies and projects that address the key vulnerabilities identified (for example, through annual grant applications to the Resilient Florida program or other sources of state and federal funding) (Phase 3).

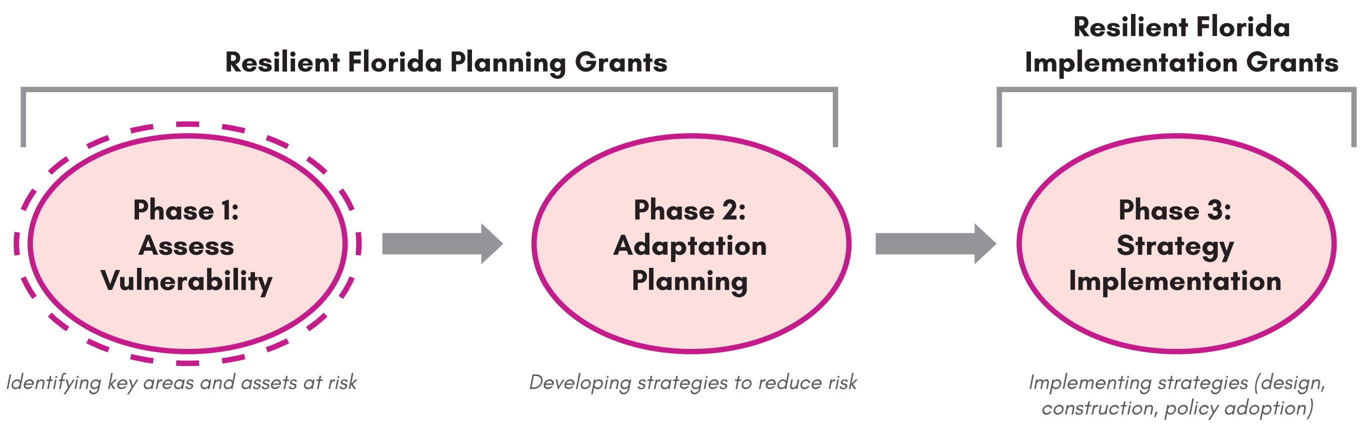


Figure 1.4: Vulnerability Assessment and adaptation planning process.

1.5 Planning Context and Coordination

This Assessment is positioned within a broader history of City plans and projects focused on addressing sea level rise impacts. The findings from this Assessment and the accompanying Adaptation Plan will add to and progress these ongoing initiatives. While climate change considerations are embedded in many City plans and projects, the following plans are the primary documents that guide the City's vulnerability and adaptation planning process:

- **Stormwater Modeling and Master Plan (SWMMP, 2024):** The SWMMP conducted a comprehensive assessment of the City's existing stormwater drainage infrastructure and water management features to identify capacity, water quality, and potential flooding issues. The SWMMP modeled the anticipated flood impacts from the interaction of a 10-year, 24-hour rain event and varying levels of sea level rise through 2060. The SWMMP model incorporated recently completed stormwater projects and proposed stormwater pumps to determine their impact on flooding issues. The SWMMP provides incremental adaptation actions in critical areas, which can be adapted to changing future changing conditions and are designed to be implemented over 10 years. The findings from this Assessment can be incorporated into the planning and design of these initial adaptation actions to reduce stormwater flooding risk to highly vulnerable assets in the identified critical areas.
- **Neighborhood Project Prioritization Report (Jacobs 2020a):** This report evaluated and prioritized the City's future capital infrastructure projects based on the projected flood risk, threats to public safety, and the need to maintain key City services. The recommendations include incentivizing nature-based solutions into project design to address water quality issues and improve floodplain management. The findings from this report and the Assessment can be utilized cooperatively to identify adaptation pathways that incorporate green infrastructure aspects into projects to protect key City assets from future sea level rise.
- **Sea Level Rise Vulnerability Assessment Guidebook (Guidebook, 2017):** The City's 2017 Sea Level Rise Vulnerability Assessment provided an initial prioritization of assets for adaptation planning and identified key vulnerable assets within each City department. This Assessment builds upon the Guidebook by identifying vulnerable critical assets, refining the vulnerability assessment methodology, and placing a stronger emphasis on the incorporation of public input. The updated Assessment also maintains the City's compliance with the Florida Statute (§.380.093, F.S.), and allows the City to apply for implementation funds based on the findings.

A list of additional complementary City initiatives and their relevance to the Assessment is included in Appendix B.

1.6 Report Organization

This report describes the approach to complete the Assessment and key findings. The report is organized as follows:

- **Section 1. Introduction:** project overview, project area and setting, community perspectives, resilience goals and approach, planning context and coordination, and report organization.
- **Section 2. Sea Level Rise Vulnerability Assessment:** vulnerability assessment approach, critical assets, sea level rise hazard mapping, and key vulnerability findings.
- **Section 3. Next Steps:** summary of Assessment purpose and the City's planned use of key findings.

Section 2 of the report is intended to serve as an overview summary of the Assessment methodology and findings. Appendices provide more technical details on the methodology for each Section 2 subsection. The Appendix structure is as follows:

- **Appendix A:** Stakeholder Engagement
- **Appendix B:** Gap Analysis
- **Appendix C:** Asset Inventory
- **Appendix D:** Review Sea Level Rise Science and Flood Hazard Mapping
- **Appendix E:** Vulnerability Assessment
- **Appendix F:** Asset Exposure Matrix and Flooding Severity Maps

2. Sea Level Rise Vulnerability Assessment

2.1 Vulnerability Assessment Approach

Climate vulnerability assessments provide a systematic approach to evaluate a community's risk to future climate conditions. This Assessment provides information about the potential timing, extent, and consequence of future flooding events influenced by sea level rise. The objective of the Assessment is to identify the City assets most vulnerable to future flooding scenarios, so that these assets can be prioritized for future adaptation actions. The findings of this Assessment informed the development of the City's Adaptation Plan that includes strategies to integrate sea level rise adaptation into City planning, design, and operations.

The approach for this Assessment began with extensive community engagement (Appendix A) to gather stakeholder perspectives on current flooding impacts and highly valued assets. The City then collected information on critical City assets and regionally significant assets (Appendix C) and identified which are projected to be exposed to future flooding conditions (Appendices D & E). In addition to general flood exposure, the Assessment also considered an asset's function and importance to the community to evaluate its relative sea level rise vulnerability (Appendix E). For each asset, vulnerability was determined by evaluating the following measures:

- **Exposure – "How many flooding scenarios impact the asset?"** Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Sensitivity – "What are the impacts and potential damage to the asset if it is flooded?"** Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Consequence – "What are the community impacts if the asset fails?"** Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring methodology (more information in Section 2.4 and Appendix E) was developed to quantify each of these three vulnerability criteria. Scores for each were summed to establish a total vulnerability score for each asset (**Figure 2.1**). Assets were then organized into a list ranked by total vulnerability scores to establish the City's most vulnerable assets. These assets had the highest combined exposure, sensitivity, and consequence scores.

Additional information for each of the principal steps in this approach are provided in Sections 2.2 and 2.3. Section 2.4 provides the key vulnerability findings from the Assessment.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Figure 2.1: Vulnerability Assessment methodology.

2.2 Critical Assets

An important first step in understanding an asset's flood vulnerability is accurately capturing the asset's location and characteristics. This information is necessary to analyze the asset's exposure to current and future flood scenarios, and sensitivity to and consequences of flooding. Completing this analysis required the compilation and organization of relevant City asset datasets from previous vulnerability assessments and from other City departments and partners (see Appendix B for more information on data sources and gap analysis). This inventory was also supplemented by assets identified during the community engagement events.

The final asset inventory included nearly 60,000 City-owned and regionally significant assets. Inventoried assets were classified into four categories[1] based on asset function and the managing entity responsible for their maintenance. A more detailed description, including the full list of inventoried assets within each category, and supporting data sources are described in Appendix C.

Source: City of Miami Beach.

Figure 2.2: Ocean Drive, Miami Beach.

Source: City of Miami Beach.

Figure 2.3: Star Island Bridge, Miami Beach.

Below are descriptions of the four categories:

- **Transportation Assets and Evacuation Routes** The City's transportation network links residents and visitors with community facilities, jobs, recreation, and neighborhoods. It also provides critical connection points to the mainland and evacuation routes. Evaluated assets in this category include roadways, evacuation routes, bridges, marinas, and bus stops. Transportation assets include those owned by the City, Miami-Dade County, and the Florida Department of Transportation.
- **Critical Infrastructure** The City is responsible for the preservation of public welfare and providing basic services for residents and visitors. To accomplish this goal, the City relies on a network of utility infrastructure, including wastewater, electrical, stormwater, potable water, and communication assets. Critical infrastructure included in the Assessment represent a combination of individual assets owned and maintained by the City, private telecommunication companies, and Florida Power and Light. This asset category also includes disaster debris management sites, which provide a temporary staging area for post-storm debris collection and removal.

[1] The four categories align with the requirements established by the Resilient Florida grant program (s.380.093 F.S.).

Source: City of Miami Beach.

Figure 2.4: Sunset Harbour Stormwater Pump

- **Critical Community and Emergency Facilities** The City includes numerous public facilities that provide community services promoting the safety, health, and well-being of residents and visitors. These include public safety facilities, such as fire stations, law enforcement, hospitals, City administrative buildings, schools, libraries, affordable housing areas, and community centers.
- **Historical, Cultural, and Natural Resources** There are numerous public sites that are significant to the City's social livelihood and multicultural community. This includes the City's park system which was repeatedly noted by residents during the community engagement events to increase their quality of life in the City. Environmental resources, such as the coastal dune system, also enhance local ecosystems and provide natural resilience to flood hazard events. Resources evaluated in the assessment include parks, natural shorelines, historical sites, art, and cultural points of interest.

Source: City of Miami Beach.

Figure 2.5: Fire Station #1.

Source: City of Miami Beach.

Figure 2.6: Police Headquarters.

Source: City of Miami Beach.

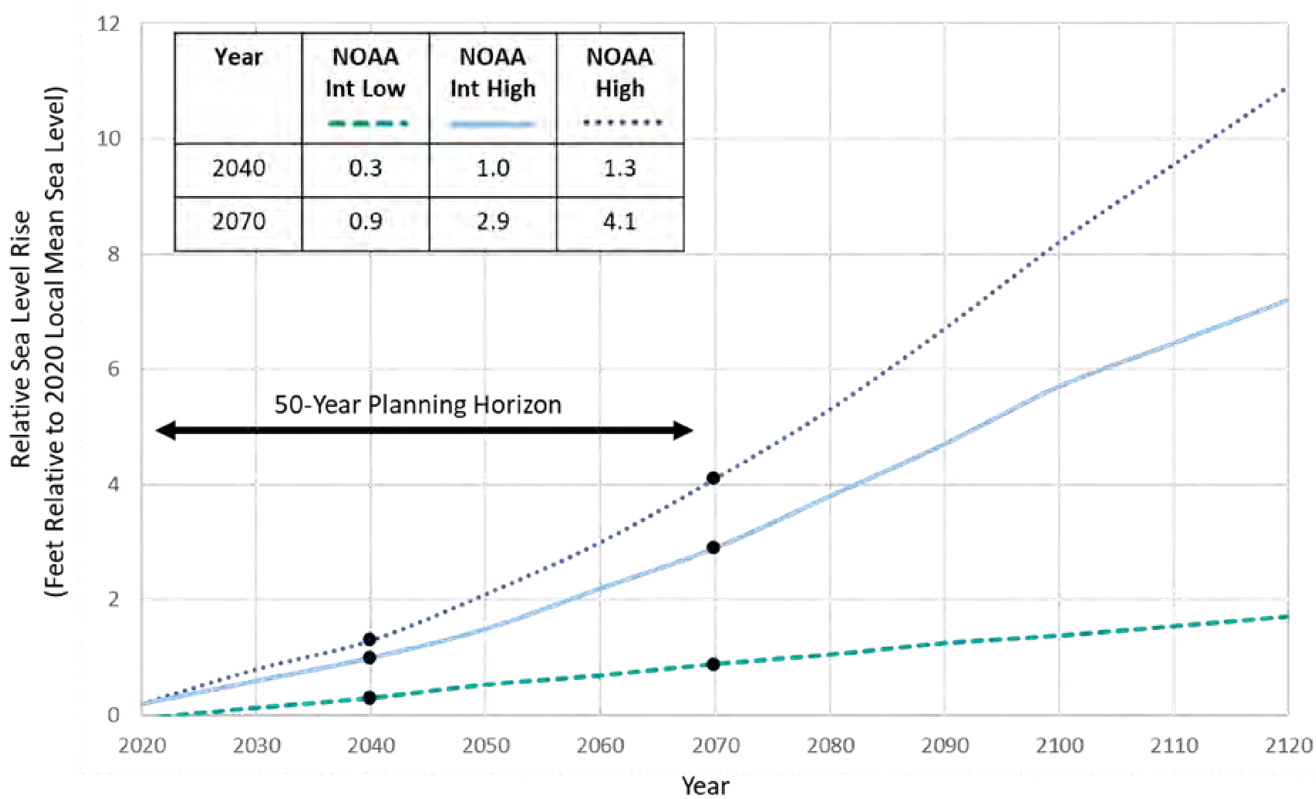
Figure 2.7: Flamingo Park

2.3 Sea Level Rise Hazard Mapping

As sea levels rise, flood extents are projected to increase for both expected events, such as annual high tides and heavy rainfall events, as well as for unexpected events, such as coastal storms (e.g., hurricanes). As flooding extents increase due to rising sea levels, so too will the number of impacted City assets. To understand the potential worsening impacts, the City created a series of flood hazard maps that could be compared to the locations of inventoried assets. Each map considered one primary flood source (king tide, compound flooding, and coastal storm tide) and included the potential flooding extent based on existing water levels or several future water levels due to continued sea level rise.

Three sea level rise scenarios and associated sea level rise amounts were selected to estimate the extent of future flooding at select future dates (**Figure 2.8**). The years 2040 and 2070 were chosen because they represent a near- and long-term planning horizon, respectively. Two of the sea level rise scenarios (NOAA 2017 Intermediate Low and NOAA 2017 Intermediate High) were selected to comply with the Resilient Florida program[2]. The City included a third scenario (NOAA 2017 High), which represents a more rapid rise in future sea level, as a more extreme scenario that can potentially be used for developing adaptation strategies for critical infrastructure (e.g., emergency facilities)[3].

The following subsections further describe the three considered flood sources and how rising sea levels will worsen flooding impacts for each. Each section includes an example flood hazard map with the 2040 NOAA Intermediate High scenario (1 foot of sea level rise) to detail the increase in flood extents compared to existing conditions. More detailed information and documentation of the methodology used to create the mapped flood hazard layers and a full set of maps showing the progression of flooding from existing conditions to 2070 for each flood source is provided in Appendix D.



Note: A 0.4-foot offset was applied to the NOAA projections to adjust the baseline year from 2000 to 2020. This is based on Compact guidance that states 0.3 feet of sea level rise occurred from 2000 to 2017, which extrapolates to 0.4 feet from 2000 to 2020.

Figure 2.8: NOAA Sea level rise scenarios considered in the Vulnerability Assessment. Sea level rise values are in feet (NAVD88).

[2] http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0380/Sections/0380.093.html

[3] The use of the NOAA High Curve is also recommended by the Unified Sea Level Rise for this purpose: (https://southeastfloridaclimatecompact.org/initiative/regionally-unified-sea-level-rise-projection/)

2.3.1 King Tide Flooding

King tides in the City occur annually in late fall and generate the highest regularly occurring tides each year and may persist for several days. During king tide events, elevated coastal waters can overtop low-lying shorelines and can also cause groundwater to emerge on the ground surface, flooding low-lying inland areas. Sea level rise will further elevate coastal water levels during these annual events. This will allow tidal waters to more frequently overtop shoreline areas and flood low-lying coastal areas.

Figure 2.9: High tide (king tide of 1.8 ft (NAVD, 88)) flooding map example and 1.0 ft of sea level rise (2040 NOAA Intermediate High scenario).

Baseline (i.e., existing) king tide flooding extent was determined from the City's median annual king tide water elevation from 1994 to 2020 (1.8-feet NAVD88) determined by tidal elevation data at the National Oceanographic and Atmospheric Administration's (NOAA) Virginia Key Tide Gauge. Future high tide flood extents were created by adding the projected sea level rise amounts (**Figure 2.8**) to baseline king tide conditions. King tide flooding in 2040 (baseline king tide conditions + 1.0 ft of sea level rise) is shown in **Figure 2.9**. Depths of flooding are shown in blue shades, with darker shades indicating deeper depths. Groundwater flooding areas are shown in purple and shoreline areas projected to be overtopped in this scenario are yellow.

In the 2040 Intermediate High scenario, king tide flooding is primarily concentrated along the west side of the City adjacent to Biscayne Bay and canals. This is similar to existing king tide flooding patterns but is more extensive. In this scenario, tidal water levels overtop many of the City's existing public and privately-owned seawalls, providing a pathway for coastal flooding to move inland and impact properties and infrastructure. Throughout most of the City, flood depths do not exceed 1 foot. However, several low-lying streets (e.g., Alton Rd, North Bay Rd, Crespi Blvd, and 5th St) may have flood depths of up to 2 feet. Groundwater flooding areas are less prominent than during the existing king tide scenario as these previously disconnected areas are now flooded by king tide. Groundwater flooding is still the main source of flooding projected for southern portions of the Ocean Front neighborhood.

Additional areas of interest exposed to the 2040 Intermediate High scenario are further described by City region and neighborhood below. The letter before each description is paired to a text box on the map (**Figure 2.9**) identifying the area of interest.

North Beach

- [A] The most extensive flooding and shorelines projected to be overtopped occur in Normandy Isles and Normandy Shores. Many low-lying roadways in these neighborhoods could be exposed to flooding, but depths are not anticipated to be greater than one foot.
- [B] Overtopping of the Tatum Waterway could cause flooding as far west as Hawthorne Ave. in the Biscayne Point neighborhood and as far east as Harding Ave. in the North Shore neighborhood. Streets and property in the northwest area of the La Gorce neighborhood are also exposed to flooding.
- [C] Groundwater flooding is concentrated in Biscayne Point, North Shore, and the northern areas of the La Gorce neighborhood.

Mid Beach

- [D] The majority of the king tide (+1 foot of sea level rise) flooding extent is anticipated to be concentrated on the west side of Mid Beach.
- [E] Nearly all roadways within the Nautilus neighborhood north of Mt. Sinai Hospital are exposed to flooding. The Bayshore neighborhood is projected to experience flooding along much of Royal Palm Ave. The northern two Sunset Islands (Sunset Islands I and II) are also exposed to flooding, especially along the low-lying roadways.
- [F] Collins Ave. between 26th St. and W 41st St. are exposed to groundwater flooding. Roads within the Sunset Harbor neighborhood that have not been elevated and the roadways of the southern-most Sunset Island (Sunset Island IV) are also projected to be impacted by groundwater flooding.

South Beach

- [G] The western half of South Beach has the most exposure to expansive king tide flooding due to its uniform low elevation.
- [H] Once king tides overtop shoreline areas in this scenario, flooding is projected to impact most of the West Ave neighborhood. This is also projected to flood many of the roadways in the western portion of the Flamingo and Lummus neighborhood, extending as far east as Pennsylvania Ave. The deepest areas of flooding (depths of 1-2 feet) occur in the southern portion of the Flamingo and Lummus neighborhood. Belle Isle and the western half of Palm Island are also exposed to flooding from king tide water levels overtopping the shoreline.
- [I] Groundwater flooding areas include the Venetian Islands, Palm Island, and the South Shore area bounded by Alton Rd., Washington Ave., and 1st St.

Although flooding due to king tides is temporary, it can last for several hours before and after peak high tide cycles and occur over a period of several days, causing sustained flooding if floodwaters are unable to drain between successive high tides. This may result in depths and extents that exceed mapped projections.

Tidal Flood Days

In addition to mapping king tide flood extents, the City also examined the frequency of existing nuisance flooding conditions (i.e., frequent, minor flooding during high tides) and how this frequency may change due to future sea level rise.

An hourly record of historical tidal observations[4] from the Virginia Key tide station was used to reflect existing and future (2040, 2070) water level conditions for the NOAA Intermediate Low, Intermediate High, and High sea level rise projections. Future tidal levels were estimated by adding the sea level rise amounts for each scenario to the existing king tide baseline (+1.8 ft NAVD88) and were overlaid onto Citywide ground elevations. The average number of days that areas may be tidally flooded was calculated for each of the 2040 and 2070 scenarios (**Figure 2.8**). The number of average annual tidal flood days was classified by frequency (**Table 2.1**).

Figure 2.11 shows an example Tidal Flood Days map considering the 2040 NOAA Intermediate High scenario (baseline king tide conditions + 1.0 ft of sea level rise). Areas with the most frequent tidal flooding days are located along the City's western shoreline adjacent to Biscayne Bay. These areas are also reflective of the baseline king tide tidal flooding map and were noted in the community engagement events to be commonly impacted by high tide flooding already.

The most frequent 'high' and 'very high' risk tidal flood days are concentrated along low-lying roadways, including the majority of Alton Rd. throughout the Flamingo and Lummus and Bayshore neighborhoods and the southern portion of Collins Ave. in the Ocean Front neighborhood.

Multiple residential roads in the Bayshore, La Gorce, and West Ave and Bay Rd neighborhoods, and three of the City's golf courses are projected to see tidal flooding over 52 times per year. The narrow eastern edge of the city, which has the highest local ground elevations, is not affected by tidal flood days under this scenario.

Table 2.1: Frequency classification for Tidal Flood Days.

Tidal Flood Day Frequency	Description
> 52 days per year (Very High)	Tidal flooding occurs more than once a week.
< 52 days per year (High)	Tidal flooding impacts occurs multiple times per month.
< 12 days per year (Moderate)	Tidal flooding occurs almost once a month, likely during high tide events.
< 1 day per year (Low)	Tidal flooding in these areas is rare and may only occur during the highest of high tide events (king tides).

Figure 2.10: King Tide Flooding.

4 Tidal observations were obtained from the Virgina Key tide station (NOAA #8723214)

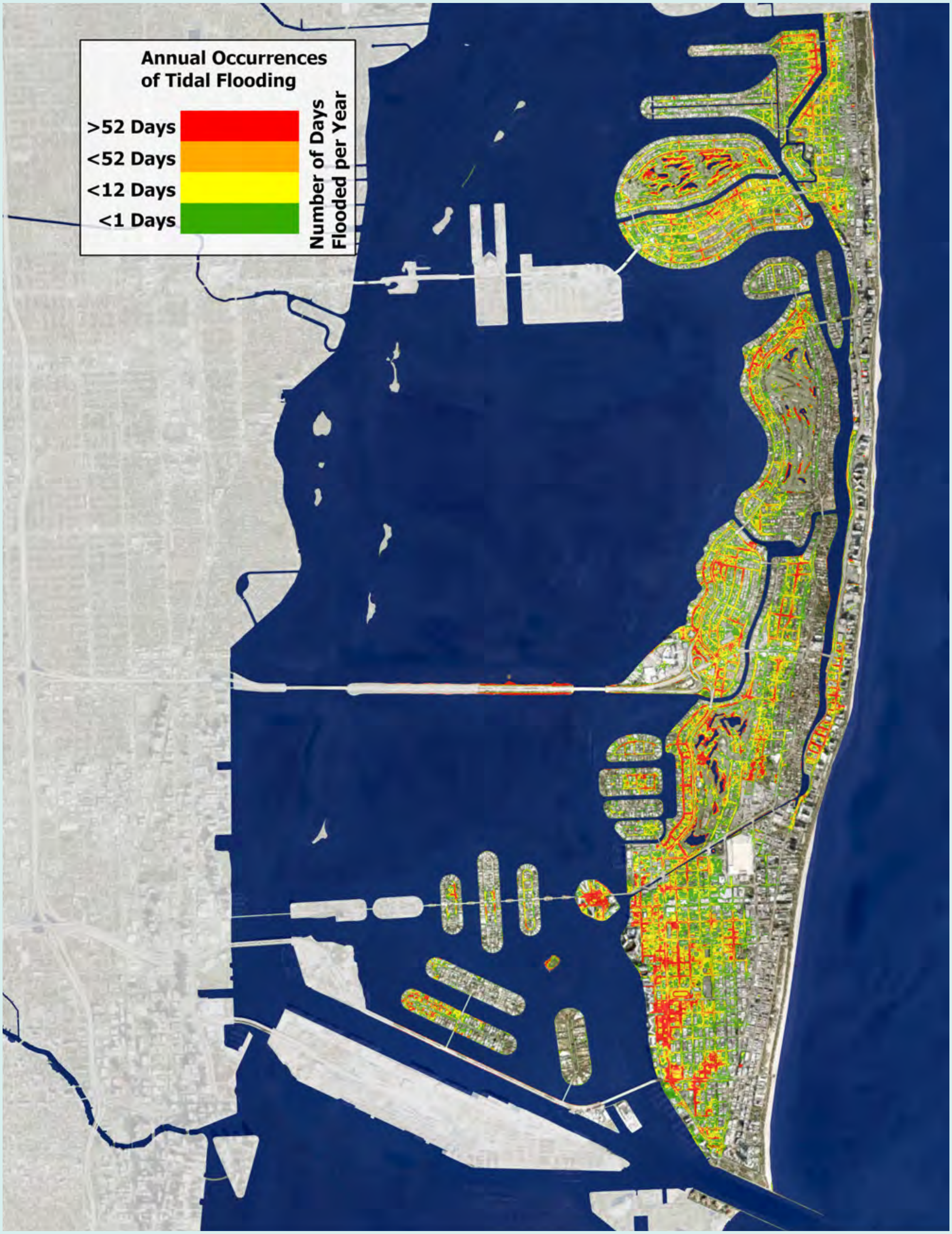


Figure 2.11: Example 2040 Tidal Flood Days flood map (NOAA 2040 Intermediate High scenario).

2.3.2 Compound Flooding

Compound flooding refers to a flooding event caused by two or more flood sources happening at the same time (e.g., a heavy rainfall event during a king tide). Compound flood events increase the flood extents and depths beyond what would be expected for a single flood source. High-intensity rain events can generate runoff that exceeds the City's existing stormwater network capacity, leading to flooding of low-lying areas. Intense rainfall flooding is further worsened during a king tide, as elevated coastal water levels restrict stormwater discharge at coastal outfalls (**Figure 2.12**). In some areas, high tides can also backflow into the stormwater system and reduce storage capacity of the stormwater pipe network or flow to the ground surface through storm drains. This results in rainfall ponding in areas where stormwater infrastructure is unable to drain runoff efficiently.

In this Assessment, the existing compound flooding event was represented by the simultaneous occurrence of a 10-year[5], 24-hour rainfall event (8.75 inches[6]) and a king tide. Future compound flood extents were considered by adding projected sea level rise amounts (**Figure 2.8**) to existing king tide water levels but maintained the same rainfall event for all scenarios. The compound flooding extent for the 2040 NOAA Intermediate High scenario (10-year, 24-hour rainfall event + 1.8 ft king tide + 1.0 ft of sea level rise) is shown in **Figure 2.13**.

King tide extents (shown in blue shades) and groundwater ponding areas (purple) will match those found in **Figure 2.9** as the coastal flood source (i.e., 2040 NOAA Intermediate High king tide) is the same. The pink areas represent the increased flood extent due to rainfall ponding.

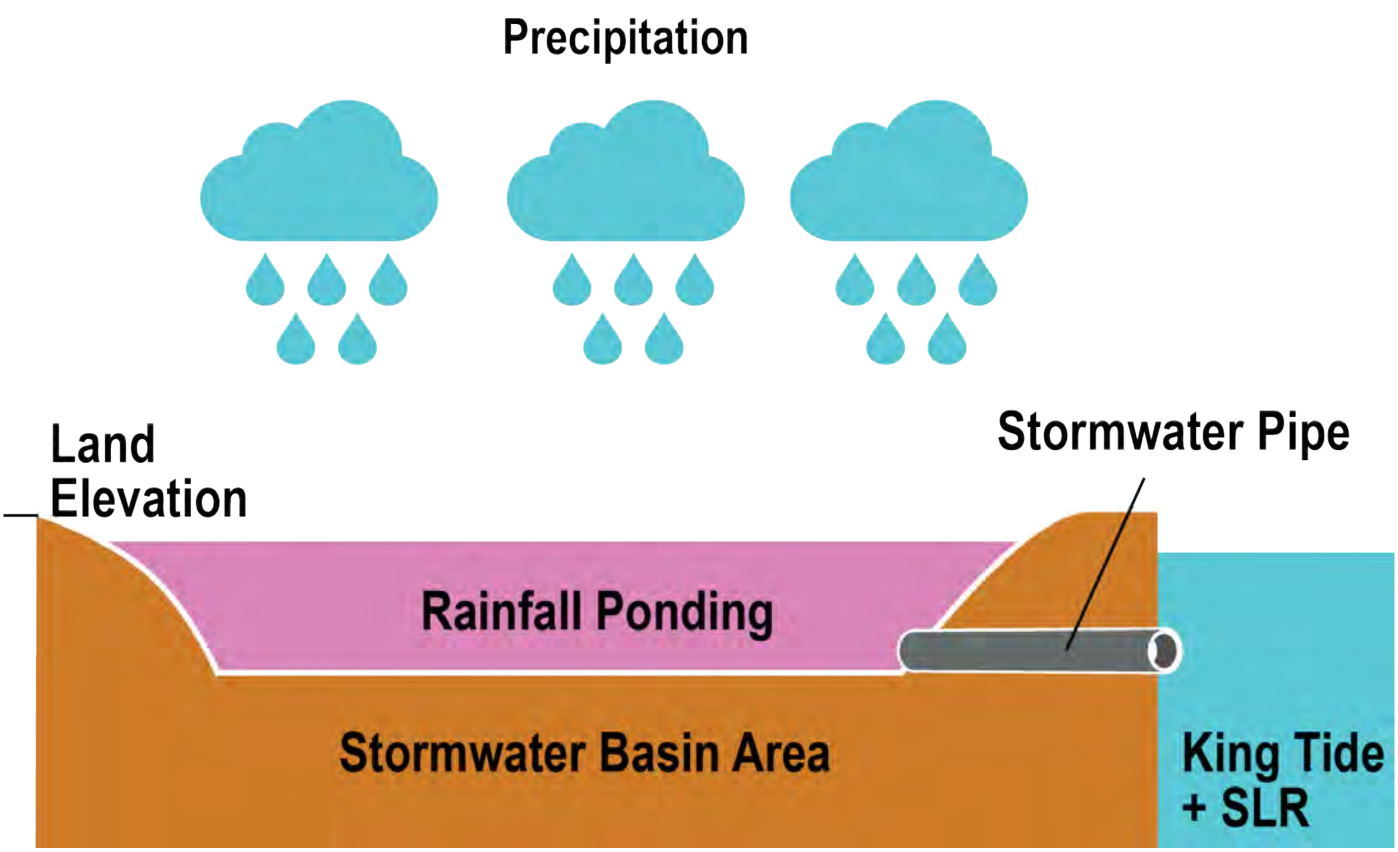


Figure 2.12: Conceptual diagram of compound flooding.

[5] The 10-year rainfall event has a 10 percent chance of occurring in any given year.
[6] The total Design Storm rainfall event is 8.75-inches, which was derived by multiplying the South Florida Water Management District published value of 7.00-inches for the Miami Beach area multiplied by a factor of safety of 1.25 (CDM Smith, 2017).

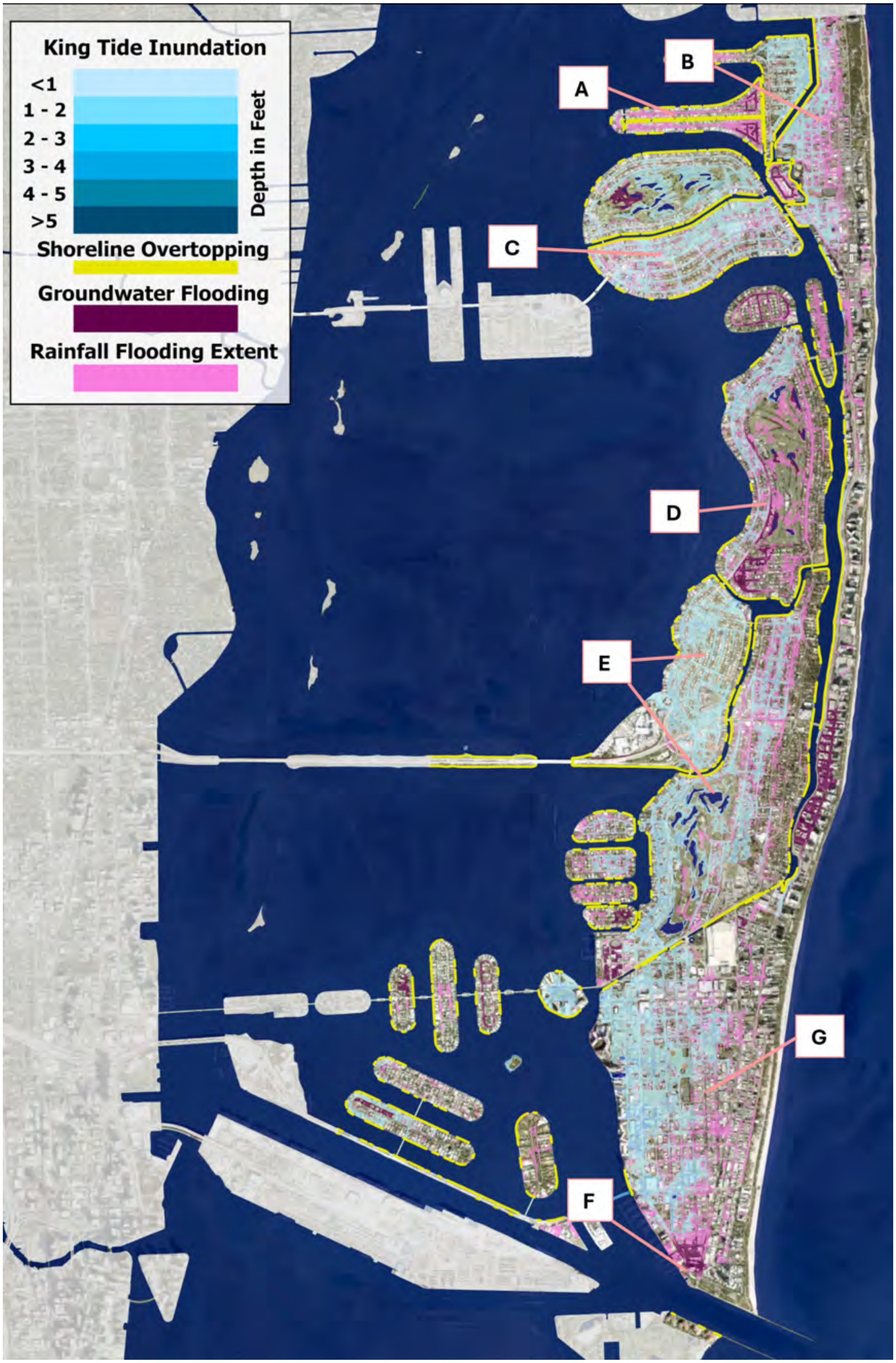


Figure 2.13: Compound flooding map example with a 10-year, 24-hour rainfall event (8.75 inches), king tide of 1.8 ft (NAVD, 88), and 1.0 ft of sea level rise (2040 NOAA Intermediate High Sea Level Rise).

Additional areas of interest exposed to the 2040 scenario are further described by City region below. The letter before each description is paired to a text box on the map (**Figure 2.13**) identifying the area of interest.

North Beach

- [A] Compound flooding impacts are the most extensive in the Biscayne Point neighborhood along Daytonia Rd., Cleveland Rd., and Stillwater Dr. Although this neighborhood is projected to experience limited flooding during high tide conditions, the combination of rainfall and high tide inhibits efficient stormwater drainage, flooding low-lying streets.
- [B] In the North Shore neighborhood, the addition of rainfall increases the flooding extent to the east, roughly doubling the projected flooded area compared to king tide flooding alone. The expanded flooding extent would affect important north-south connector roadways such as Dickens Ave. and Harding Ave.
- [C] The Normandy Isles neighborhood is projected to experience a greater increase in flood extents due to additional rainfall ponding on Normandy Shores, which is likely caused by more impervious surfaces and development on Normandy Isles.

Mid Beach

- [D] The addition of rainfall flooding more than doubles king tide-only flood extents in the La Gorce neighborhood, affecting large areas of the La Gorce Golf Course and La Gorce Dr., which is a major connector roadway on the island.
- [E] Rainfall flooding also expands flood extents in the eastern Nautilus and Bayshore neighborhoods. All major roads in these neighborhoods, including the full length of Pine Tree Dr., are exposed to flooding with the addition of rainfall flooding.

South Beach

- [F] The addition of rainfall ponding to king tide extents increases the areas exposed to flooding to include the South Pointe neighborhood and several major roadways, including South Pointe Dr. and 2nd St.
- [G] Rainfall ponding expands flood extents to include the eastern areas of the Flamingo and Lummus neighborhood, affecting at least a portion of every major roadway in these neighborhoods.

Figure 2.14: 100-year (1-percent annual chance) storm tide (surge) flood map example at 6.2-feet above mean sea level with 1-foot of sea level rise (2040 NOAA Intermediate High scenario).

2.3.3 Storm Tide (Storm Surge) Flooding

Storm tide (or storm surge) flooding is caused by the high onshore wind speeds and low atmospheric pressure of large tropical storms and hurricanes, which temporarily elevate coastal water levels. Due to the City's low elevation and flat topography, even small increases in water levels during coastal storms can allow storm tide (storm surge) flooding to overtop shoreline protections and spread far inland, creating significant flooding impacts to the City's roadways and other coastal infrastructure.

The baseline (i.e., existing) storm tide (storm surge) flooding extent is represented by the Federal Emergency Management Agency (FEMA)[7] 1-percent annual chance (i.e., 100-year) coastal water elevation[8] (6.2 feet NAVD88). Future storm tide (storm surge) flood extents were considered by adding projected sea level rise amounts (**Figure 2.8**) to the baseline existing 1-percent annual chance coastal water elevation. Coastal storm flooding for the year 2040 (baseline 1-percent annual chance coastal water elevation + 1.0 ft of sea level rise) is shown in **Figure 2.14**. Depths of flooding are shown in shades of blue, with darker shades indicating deeper flooding. Shoreline areas projected to be overtopped are shown in yellow.

Under this scenario, storm tide (storm surge) water levels overtop most shoreline areas and widespread flooding occurs across the entire City, except for small portions of the eastern ridge where land elevations are the highest. Similar to the high tide flood maps (**Figure 2.9**), the bay side of the City experiences the deepest flood depths due to the lower relative elevation in this area of the City.

Additional areas of interest exposed to this future scenario are further described by City region below. The letter before each description is paired to a text box on the map (**Figure 2.14**) identifying the area of interest.

North Beach

- [A] Shorelines adjacent to Biscayne Bay and the canals are overtopped during this event, resulting in extensive flooding in all neighborhoods of North Beach. The Biscayne Point, Normandy Isles, and Normandy Shores neighborhoods experience large areas of deep floodwaters (>5 ft).
- [B] North Shore's eastern shoreline is largely protected by the high elevations of the coastal dune system. However, most of the neighborhood is still affected by flooding from the west.

Mid Beach

- [C] All shorelines adjacent to Biscayne Bay and the canals are overtopped with expansive flooding of the entire area, except for the Mt. Sinai Hospital complex. The western areas of the La Gorce, Nautilus, and Bayshore neighborhoods experience the greatest flood depths (>5 feet).
- [D] The Ocean Front neighborhood is partially protected due to the higher elevation of the coastal dune system. While flooding is still present through this narrow coastal neighborhood, flood depths are projected to be slightly lower.

South Beach

- [E] Similar to North and Mid Beach, shorelines along Biscayne Bay and the canals are overtopped in this scenario, resulting in widespread flooding across all South Beach neighborhoods. Flood depths are the deepest (>5 feet) in the Flamingo and Lummus, West Ave. and Bay Rd., and South Pointe neighborhoods. Flooding depths of four-to-five feet may extend as far inland as Washington Ave.
- [F] Shoreline overtopping and extensive flooding is also projected for the Venetian Islands and the Star, Palm, and Hibiscus Island neighborhoods.
- [G] Only a narrow area on the east side of the City Center, Flamingo and Lummus, and South Pointe neighborhoods are projected to avoid flooding.

The duration of flooding due to a coastal storm event was not modeled as part of this mapping approach. Flood depths associated with an extreme coastal storm can cause flooding that persists for several hours to a week. These storms are also often associated with strong winds that generate large waves, which could cause shoreline erosion and more extensive and deeper flooding than indicated on the maps.

[7] FEMA South Florida Flood Insurance Study Report
[8] The 1-percent annual chance coastal storm elevation has a 1-percent chance of occurring in any year. This projected flood level does not include the effect of waves.

2.4 Vulnerability Assessment

With the critical assets identified and flooding scenarios mapped, the next step was to analyze the overlap between the two data sources to evaluate each asset's vulnerability to future sea level rise. As outlined in Section 2.1 and shown in **Figure 2.1**, a scoring methodology was developed to quantify the relative vulnerability of the City's assets and allow for comparison among assets. The three primary measures of this methodology were: exposure, sensitivity, and consequence. Additional information, including how scores were captured for each, is provided below.

Flood Exposure

Exposure scores were established by summing the number of flood scenarios that would impact an asset. If a modeled flood scenario extent overlapped with an asset's location, the asset was considered exposed and would receive a point (1) for that scenario. As there were three flood sources (king tide, compound flooding, storm tide (storm surge)) modeled for seven sea level rise scenarios[9] , exposure scores ranged from 0-21. An asset projected to be exposed to all flood scenarios would receive an exposure score of 21.

Sensitivity and Consequence

While an asset's exposure measure was determined quantitatively, the sensitivity and consequence measures were evaluated and scored based on qualitative classifications. For sensitivity, an asset was classified and scored based on the likelihood that it would fail, incur significant damage, or become unusable due to flood exposure. Assets more likely to be sensitive when exposed to floodwaters received higher scores. The classifications were rated: Not Sensitive, Low, Moderate, or High. Sensitivity scores were based on a maximum score of 21 to maintain equality with the exposure measure. Scoring classifications[10] are shown in **Table 2.2**.

For consequence, an asset was classified based on the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable due to flood exposure. Assets more likely to generate significant, widespread community impacts due to their failure received higher scores. No assets were determined to have 'No Consequence' of failure, so consequence classifications could be: Low, Moderate or High. Consequence scores were also based on a maximum score of 21 (**Table 2.3**), however an asset received an additional point if it was located within a socially vulnerable neighborhood (**Figure 2.15**).

Table 2.2: Sensitivity classifications and scoring used in the Vulnerability Assessment.

Classification	Score
Not Sensitive	0
Low	7
Moderate	14
High	21

Table 2.3: Consequence classifications and scoring used in the Vulnerability Assessment.

Classification	Score	Within a Socially Vulnerable Neighborhood
Low	7	+1
Moderate	14	
High	21	

[9] The seven sea level rise scenarios for each flood source were: Existing conditions, the NOAA 2040 Intermediate (Int.) Low, 2040 Int. High, 2040 High, and 2070 Int, Low. Int. High, and High scenarios.

[10] Most assets were scored based on the sensitivity and consequence classification applied at the Asset Type (e.g., Stormwater Pump Stations), as individual asset information was not available for all assets (See Appendix E.3 for additional information).

Figure 2.15: Miami Beach Socially Vulnerable Neighborhoods.

Socially vulnerable neighborhoods were identified as the City census tracts in the Top 25% of the Center for Disease Control's Social Vulnerability Index (SVI). These census tracts have larger populations of the elderly, children, individuals with a disability, lower-income families, residents without access to a personal vehicle, or other demographic and household characteristics that make it harder for these individuals to properly prepare for and recover from natural hazard events, such as flooding (CDC, 2020).

During the stakeholder engagement events (see Appendix A), several participants noted that socially vulnerable populations are already being disproportionately impacted by current flooding events. Impacts mentioned included a higher risk of injury for elderly residents, increased social isolation for these individuals, and longer commute times for those who lack personal vehicles and are dependent on public transportation. The additional point added to the consequence score of assets in the socially vulnerable neighborhoods provides the City an opportunity to identify assets that serve the City's most disadvantaged residents and account for the increased impacts to these communities should the asset fail. (See Appendix G for more information on how flooding may impact socially vulnerable populations).

Vulnerability Score

Scores for each of the Assessment measures (exposure, sensitivity, and consequence) were then totaled per asset to determine an asset-specific vulnerability score. Vulnerability scores could range from '7' to '64' and assets were ranked by their associated score from highest to lowest. The assets with higher scores indicated a greater vulnerability to future sea level rise and represent the City's key vulnerabilities to this hazard. (For additional information on the Assessment methodology and scoring, see Appendix E). The following section provides an overview of these key vulnerabilities, including the most vulnerable City assets throughout different areas of the City.

2.5 Vulnerability Assessment Findings

The Assessment resulted in a ranked list of the nearly 60,000 assets based on vulnerability scores. The assets with the highest vulnerability scores were wastewater pipelines located in socially vulnerable neighborhood areas. Older wastewater pipelines, particularly those installed more than 70 years ago, received high sensitivity and consequence classifications and scores due to their older age and critical service provided to the City's residents and businesses. The distributed nature of these assets also led to many wastewater pipeline segments in low-lying areas to be exposed to most, if not all, of the considered flooding scenarios. The high scores received across all Assessment measures resulted in these wastewater pipeline segments receiving the highest vulnerability scores among City assets and representing the only assets to receive the maximum possible vulnerability score of 64. The two assets with the lowest vulnerability scores of 14 were two minor roadways (Pennsylvania Ct. and Alton Rd/I-195 onramp) with no projected exposure to any of the considered flood scenarios.

Identifying the most vulnerable assets is useful for the City to prioritize adaptation measures that address these key vulnerabilities. However, the sheer number of assets throughout Miami Beach considered in the Assessment can make it difficult to determine and discuss vulnerabilities beyond those at the top of the list. Therefore, additional Assessment findings have been organized based on Asset Type and geographic location to more easily understand the City's most vulnerable assets and areas. The following sections provide the key findings of the Assessment in the context of this organization. More information on each is provided below.

Asset Subcategories

The City's asset inventory includes a mix of single location assets (e.g., buildings, pumps), distributed infrastructure assets (e.g., roadways, pipelines), and site-based assets (e.g., parks). The dimensional differences (i.e., location vs. length vs. area) make it difficult to describe flooding exposure, and therefore vulnerability, collectively. Assessment findings in this section are organized based on like-footprints (i.e., location vs. length vs. area) and findings are referred to in the context of three generalized asset subcategories: 'Structures & Facilities' for single location assets, 'Roadways & Pipelines' for distributed infrastructure assets, and 'Natural Resources' for site-based assets. **Table 2.4** provides a crosswalk of which Asset Types are included in each of these subcategories.

Table 2.4: Crosswalk of Asset Types in each Assessment Subcategory.

FDEP Asset Category	Asset Subcategory	Asset Types Included	
Critical Infrastructure	Structures & Facilities	• Wastewater Lift Stations • Electrical Substations • Potable Water Pump Stations • Potable Water Storage Tanks	• Stormwater Pump Stations • Telecommunication Towers • Disaster Debris Management Sites
	Roadways & Pipelines	• Wastewater Pipelines	• Drinking Water Pipelines
Critical Community and Emergency Facilities	Structures & Facilities	• Schools • Colleges and Universities • Community Centers • Emergency Operations Centers • Fire Stations	• Hospitals • Law Enforcement Facilities • Local Government Facilities • Logistical Staging Areas • Affordable Public Housing • State Government Facilities
Natural, Cultural, and Historical Resources	Structures & Facilities	• Historical and Cultural Assets	
	Natural Resources	• Parks	• Living Shorelines
Transportation Assets and Evacuation Routes	Structures & Facilities	• Bridges • Bus Stop	• Marinas
	Roadways & Pipelines	• Major Roadways	

City Subregions

Additionally, due to the number of assets considered in the Assessment, key vulnerabilities will be discussed geographically based on the City's three main regions (i.e., North, Mid, and South Beach) and at a subregional (i.e., neighborhood) scale. The neighborhoods contained in each subregion are shown in **Table 2.5** (Refer to **Figure 1.2** for neighborhood locations).

Table 2.5: City subregions and neighborhoods used to describe Assessment findings.

City Region	City Subregion	Neighborhood(s) Included
North Beach	A	Biscayne Point
	B	Normandy Shores Normandy Isles
	C	North Shore
Mid Beach	A	La Gorce
	B	Nautilus Bayshore
	C	Ocean Front
South Beach	A	South Venetian Islands Star-Palm-Hibiscus Islands
	B	West Ave & Bay Road City Center Flamingo & Lummus
	C	South Pointe

The following discussion of key vulnerabilities will first be framed by introducing each City region with a high-level overview of the assets located there and where the assets with higher vulnerability scores are located. Following this, the specific assets with higher vulnerability in each subregion will be provided. Higher vulnerability assets are those with scores in the highest quantile of vulnerability scores (Refer to Appendix E.7 for additional information). Each subsection will conclude with the key vulnerabilities of each City region. City-wide key takeaways will be provided at the end of this section.

2.5.1 North Beach Vulnerability

The North Beach region includes areas north of W 63rd St. to the City's northern border, known as the North Shore neighborhood, and the island neighborhoods of Normandy Isles, Normandy Shores, and Biscayne Point to the west. For ease in discussing the key findings of the Vulnerability Assessment, these areas of North Beach have been divided into three subregions based on neighborhood boundaries (**Table 2.5**) and are shown in **Figure 2.16**.

Figure 2.16: North Beach subregions and neighborhoods for Vulnerability Assessment.

North Beach Higher Vulnerability Assets

North Beach includes 118 (22%) of the City's Structures & Facilities, 154 miles (24%) of the City's Pipelines & Roadways and 16 (33%) of the City's Natural Resources. The region has the largest number of community centers and affordable public housing in the City. The largest socially vulnerable neighborhood areas are also in North Beach and represent the entire Normandy Isles neighborhood and nearly all of the North Shore neighborhood. **Figure 2.17** shows the locations of North Beach assets with higher vulnerability[11].

Figure 2.17: Map of higher vulnerability assets in North Beach.

[11] Higher vulnerability assets were those in the top 33% of vulnerability scores for Structures & Facilities and Natural Resources subcategories, but the top 10% of vulnerability scores for Pipelines & Roadways due to the number of pipeline and roadway feature segments.

In addition to having the most assets for the region, the North Shore neighborhood also has the highest proportion of higher vulnerability assets, except for Pipelines & Roadways (**Table 2.6**). **Table 2.7** through **Table 2.9** provide the higher vulnerability assets within each North Beach subregion. The North Beach Structures & Facilities that are characterized to have higher vulnerability are primarily located in areas adjacent to the Biscayne Bay canals of the North Shore and Biscayne Point neighborhoods.

All segments of higher vulnerability Pipelines & Roadways are represented by wastewater pipelines because of the higher sensitivity and consequence classifications for these assets relative to drinking water pipelines and roadways. All of the higher vulnerability wastewater pipeline sections were installed over 70 years ago. These are primarily located along roadways that are parallel to Biscayne Bay or canal shorelines. However, there are also higher vulnerability wastewater pipelines further inland from the shoreline in both the North Shore and Normandy Shores and Normandy Isles neighborhoods.

All North Beach higher vulnerability Natural Resources areas are in socially vulnerable neighborhoods and are all but one are located on or only one street away from Biscayne Bay or a canal shoreline.

North Beach Assets with Highest Vulnerability Scores

Structure & Facility:

Stormwater Pump Station #23 located at 86th St. and Hawthorne Ave. in Biscayne Point (Score = 61).

Pipeline & Roadway:

Wastewater pipelines located at the end of Bay Dr. in the Normandy Isles neighborhood (64).

Natural Resource:

North Shore Park and Youth Center in the North Shore neighborhood (55).

Table 2.6: Number of higher vulnerability assets per North Beach subregion.

	A (Biscayne Point)	B (Normandy Shores + Normandy Isles)	C (North Shore)	Total
Structures & Facilities	9 sites	6 sites	11 sites	26 sites
Pipelines & Roadways	2 miles	11 miles	10 miles	22 miles
Natural Resources	1 area	2 areas	4 areas	7 areas

Higher vulnerability assets were those in the top 33% of vulnerability scores for Structures & Facilities and Natural Resources subcategories, but the top 10% of vulnerability scores for Pipelines & Roadways due to the number of pipeline and roadway feature segments.

Table 2.7: North Beach Subregion A (Biscayne Point) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Affordable Public Housing	Madeleine Village Apartments 1	40.5
	Madeleine Village Apartments 3	41
	Madeleine Village Apartments 4	40.5
Bridges	SST61308	47
Bus Stop	85th ST & Crespi Blvd	41
Natural Resources	Stillwater Park	48
Stormwater Pump Stations	#23	61
	#30	51
Wastewater Pump Stations	PS 24	53
Wastewater Pipelines*	1.5 miles	64*

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

Table 2.8: North Beach subregion B (Normandy Shores and Normandy Isles) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Bus Stop	71st & Rue Notre Dame	41
Community Centers	Fairway Park Pavilion	48
	Coral House Senior Center	44
Natural Resources	Fairway Park	48
	Normandy Shores Park	48
Wastewater Pump Stations	PS 22	54
	PS 21	49
Water Pump Station	Normandy Isle	57
Wastewater Pipelines*	11 miles	64*

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

Table 2.9: North Beach Subregion C (North Shore) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Affordable Public Housing	Lottie Apartments	40.5
Bridge	SST61313	47
Bus Stops	85th St & Byron Ave	42
Electrical Substations	Harding Ave Substation North	60
	Harding Ave Substation	54
Fire Station	#4	45.5
Law Enforcement Facility	Sailport/Police Substation	41
Natural Resources	Brittany Bay Park	48
	North Beach Oceanside Park	52
	North Shore Park and Youth Center	55
	Tatum Park	48
School	Biscayne Elementary	50
Wastewater Pump Stations	PS 19	52
	PS 23	55
	PS 29	50
Water Pump Station	75th Street	54
Wastewater Pipelines*	9 miles	64*

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

North Beach Key Vulnerabilities

- North Beach assets with higher vulnerability scores are primarily located near canal shorelines, such as those along Crespi Blvd. in the Biscayne Point neighborhood and the Tatum Waterway Dr. and Indian Creek Dr. roadways in the North Shore neighborhood. At these locations, these assets are projected to be impacted by king tide flooding when sea levels rise by one foot (2040 NOAA Intermediate High scenario).
- Many North Beach critical assets, such as electrical substations, water pump stations, stormwater pump stations and wastewater pump stations, are highly vulnerable to future sea level rise. Without adaptation measures, sea level rise impacts to these assets could make it challenging for them to continue providing service to residents.
- North Beach has the largest proportion of higher vulnerability wastewater pipelines in the City. All of these pipeline segments were installed over 70 years ago (or have an unknown age) and are primarily located in socially vulnerable neighborhood areas.
- The North Beach region includes the largest socially vulnerable neighborhood areas and the greatest number of assets within these neighborhoods, primarily in the North Shore neighborhood. More than half of the community centers in North Beach are in socially vulnerable areas, including the Coral House Senior Center which is classified with higher vulnerability.

2.5.2 Mid Beach Vulnerability

The City's Mid Beach region includes areas north of Dade Blvd. and south of W 63rd St. and is comprised of the La Gorce, Nautilus, Bayshore and Ocean Front neighborhoods. To more easily discuss Assessment findings, the neighborhoods have been organized into the subregions shown in **Table 2.5** and **Figure 2.18**.

Figure 2.18: Mid Beach subregions and neighborhoods for Vulnerability Assessment.

Mid Beach Assets

The Mid Beach region includes 199 (38%) of the City's total Structures & Facilities, 261 miles (41%) of all Pipelines & Roadways and 16 (33%) of the Miami Beach's Natural Resource areas. This region includes both City emergency operations centers, Mt. Sinai Hospital and three fire stations. The region also includes the greatest number of bridges among the three regions, connecting the multiple neighborhoods. Socially vulnerable neighborhood areas are limited to the southern Ocean Front neighborhood. **Figure 2.19** shows the locations of Mid Beach assets with higher vulnerability[12].

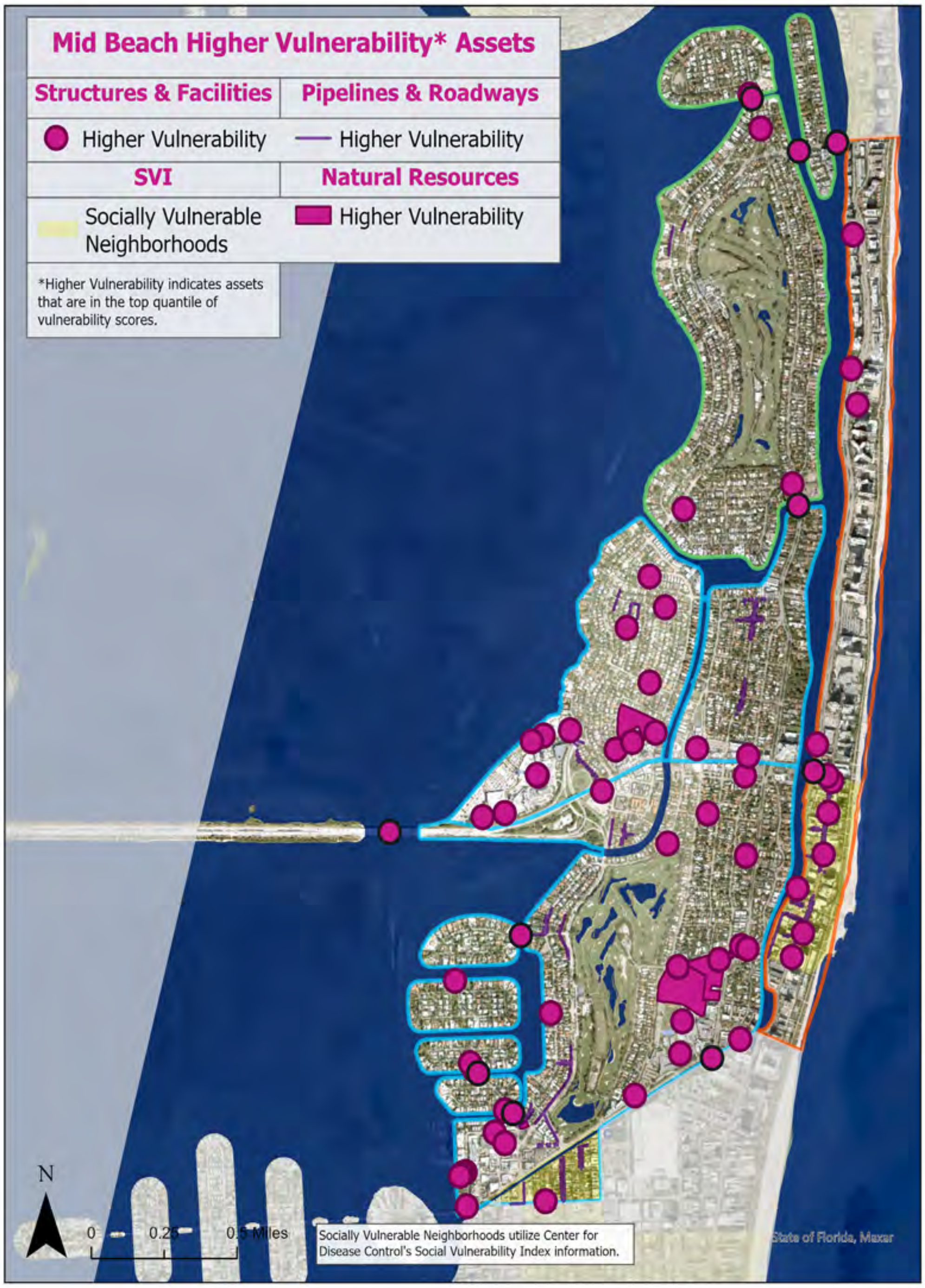


Figure 2.19: Map of higher vulnerability assets in Mid Beach.

[12] Higher vulnerability assets were those in the top 33% of vulnerability scores for Structures & Facilities and Natural Resources subcategories, but the top 10% of vulnerability scores for Pipelines & Roadways due to the number of pipeline and roadway feature segments.

The Nautilus and Bayshore subregion includes both the greatest number of Mid Beach assets and the largest number of those with higher vulnerability in the Mid Beach region. The La Gorce and Ocean Front neighborhoods have the fewest higher vulnerability assets among City subregions (**Table 2.10**). In Subregion B, the higher vulnerability Structures & Facilities are generally spread throughout the neighborhoods, including inland away from Biscayne Bay or canal shorelines.

As with North Beach, all higher vulnerability Pipelines & Roadways are represented by wastewater pipelines due to the higher sensitivity and consequence scores. All of these wastewater pipeline sections were installed over 70 years ago. These segments of wastewater pipelines are distributed throughout Mid Beach's neighborhoods, but most segments are located near Biscayne Bay or canal shorelines.

Four of the five Mid Beach's Natural Resource areas classified to have higher vulnerability are in the southern Nautilus or Bayshore neighborhood. **Table 2.11** through **Table 2.13** provide the higher vulnerability assets within each Mid Beach subregion.

Mid Beach Assets with Highest Vulnerability Scores

Structure & Facility: Two stormwater pump stations (#11, #13) located in the Nautilus neighborhood and one (#22) located in Bayshore (Score = 62).

Pipeline & Roadway: Wastewater pipelines located in the Ocean Front socially vulnerable neighborhood area (63).

Natural Resource: Scott Rakow Youth Center Grounds and Park Area in Bayshore (55). This specifically refers to the greenspaces and larger footprint of the Scott Rakow grounds. It currently includes portions of what will be Bayshore Park.

Table 2.10: Number of higher vulnerability assets per Mid Beach subregion.

	A (La Gorce)	B (Nautilus + Bayshore)	C (Ocean Front)	Total
Structures & Facilities	7 sites	46 sites	13 sites	66 sites
Pipelines & Roadways	< 1 mile	4 miles	1 mile	5 miles
Natural Resources	1 area	4 areas	0 areas	5 areas

Higher vulnerability assets were those in the top 33% of vulnerability scores for Structures & Facilities and Natural Resources subcategories, but the top 10% of vulnerability scores for Pipelines & Roadways due to the number of pipeline and roadway feature segments.

Table 2.11: Mid Beach Subregion A (La Gorce) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Bridges	SST61319	49
	SST61320	44
	SST61348	49
Community Centers	La Gorce Park Pavilion	47
	Fisher Park Pavilion	47
Natural Resources	La Gorce Park	41
Wastewater Pump Stations	PS 18	49
	PS 15	53
Wastewater Pipelines	<1 mile	63

Table 2.12: Mid Beach subregion B (Nautilus and Bayshore) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Bridges*	SST61326 SST61328* SST61329 SST61330 SST61335	51*
Bus Stop	17th St. & Lennox Ave.	42
Community Centers	Scott Rakow Center	45
	Jewish Learning Center	47
Electrical Substations	West Ave. Substation	61
	W 40th St. Substation	59
Hospital	Mt. Sinai Hospital Buildings	50
Law Enforcement Facilities	Marine Patrol Building	41.5
Schools	Miami Beach Senior High School	44
	Nautilus Middle School	49
	North Beach Elementary School	48
Stormwater Pump Stations*	#1 #2 #2A #3 #8 #9 #10 #11* #12 #13* #14 #17 #18 #19 #20 #21 #22* #24 #43 #44	62*
Natural Resources	Scott Rakow Youth Center Grounds and Park Area	55
	Bayshore Park	49
	Polo Park	48
	20th St. Pocket Park	42
Wastewater Pump Stations	PS 14	51
	PS 13	53
	PS 28	53
Water Pump Station	41st St.	60
	25th St.	51
Wastewater Pipelines	4 miles	63

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

Table 2.13: Mid Beach Subregion C (Ocean Front) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Bridge	SST61324	54
	SST61329	43
Bus Stops	Collins Ave & 38th St.	42
	Collins Ave & 29th St.	42
	Collins Ave & 27th St.	42
	Collins Ave & 41st St.	42
	Collins Ave & 35th St.	43
	Collins Ave & 41st St.	42
Electrical Substations	Collins Ave Substation	53
Fire Station	#3	41.5
Stormwater Pump Stations	#29	61
	#50	59
Wastewater Pump Station	PS 27	53
Wastewater Pipelines	1 mile	63

Mid Beach Key Vulnerabilities

- Mid Beach assets with higher vulnerability are primarily located in the southern part of the region, in the Nautilus, Bayshore, and Ocean Front neighborhoods. These assets are roughly split between being located near the shoreline and more inland.
- All of Mid Beach's emergency response facilities are considered to have higher vulnerability including Mt. Sinai Hospital, Fire Station #3, and the marine patrol building.
- Several of the bridges connecting the neighborhoods in this region are classified with higher vulnerability. Should these assets become inaccessible due to flooding, residents and commuters may become stranded.
- The City's most vulnerable bus stop locations are in the socially vulnerable neighborhood area in Ocean Front. These bus stops are projected to be exposed to groundwater flooding under existing conditions and all future sea level rise scenarios as well.
- Mid Beach has the largest number of Pipelines & Roadway mileage in the City but has half of the higher vulnerability mileage of North Beach. Similar to North Beach, all the wastewater pipelines with higher vulnerability were installed over 70 years ago. The Mid Beach segments are more distributed than in North Beach, however there are several in the Ocean Front socially vulnerable neighborhood area.

2.5.3 South Beach Vulnerability

The South Beach region of the City is comprised of areas south of Dade Blvd. to South Pointe, which includes the City Center, West Ave & Bay Road, Flamingo and Lummus, and South Pointe neighborhoods. This region also includes the western island neighborhoods of the South Venetian Islands and the Star-Palm-Hibiscus Islands. The South Beach neighborhoods have been organized into the subregions shown in **Table 2.5** and **Figure 2.20** to describe the findings of the Assessment for this area of the City.

Figure 2.20: South Beach subregions and neighborhoods for Vulnerability Assessment.

South Beach Assets

South Beach includes the largest proportion of the City's Structures & Facilities with 213 (40%), 220 (35%) miles of Pipelines & Roadways, and 16 (33%) Natural Resource areas. The main police headquarters, Fire Station #1, the Convention Center and most local government buildings are located in South Beach. The region also includes the greatest number of stormwater and wastewater pumps stations. South Beach's socially vulnerable neighborhood areas are primarily located in the north and south of the Flamingo and Lummus neighborhoods. **Figure 2.21** shows the locations of assets with higher vulnerability[13] in South Beach.

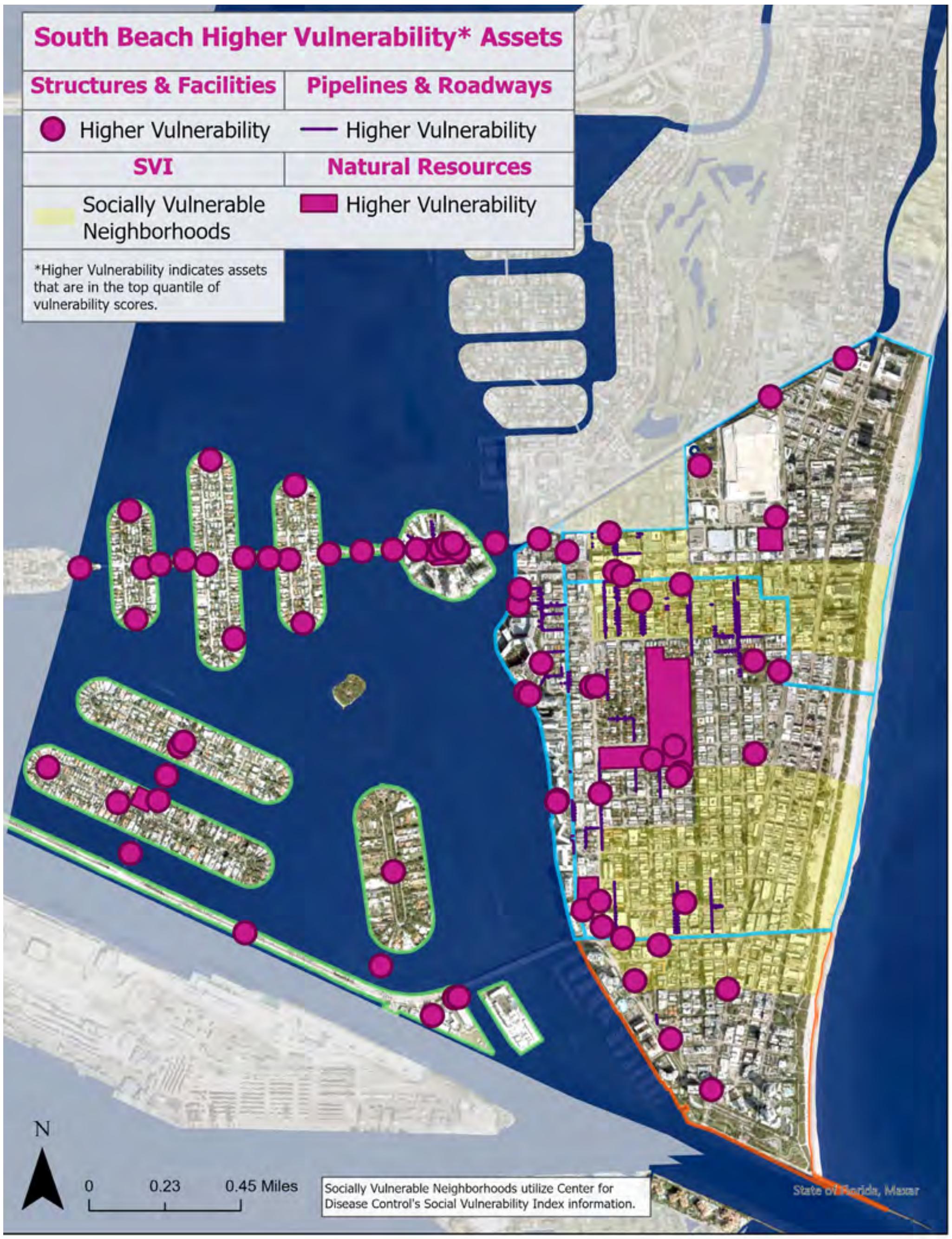


Figure 2.21: Map of higher vulnerability assets in South Beach.

[13] Higher vulnerability assets were those in the top 33% of vulnerability scores for Structures & Facilities and Natural Resources subcategories, but the top 10% of vulnerability scores for Pipelines & Roadways due to the number of pipeline and roadway feature segments.

Table 2.14 provides an additional breakdown of where these higher vulnerability assets are in each South Beach subregion. Subregion A includes the greatest number (37) of higher vulnerability Structures & Facilities, of which 13 are bridges connecting the island neighborhoods. Subregion B also has a large proportion of South Beach's higher vulnerability Structures & Facilities and the greatest percentage of Pipelines & Roadways and Natural Resource areas.

Similar to the other two City regions, all of South Beach's higher vulnerability Pipelines & Roadways are wastewater pipeline segments due to the high sensitivity and consequence classifications for the Asset Type. These pipeline segments are located in the West Ave and Bay Rd neighborhood and the northern socially vulnerable neighborhood area of the Flamingo and Lummus neighborhood.

Flamingo Park is the most vulnerable Natural Resource area in South Beach and the City. The South Beach region includes five of the Natural Resource areas with the highest vulnerability scores in the City. None of these natural resource areas are located within South Beach's socially vulnerable neighborhood areas.

South Beach Assets with Highest Vulnerability Scores

Structure & Facility: Stormwater pump station (#33) located at the end of Bay Rd. in the West Ave. and Bay Rd. neighborhood (Score = 63).

Pipeline & Roadway: Wastewater pipelines located in the West Ave & Bay Rd neighborhood and the socially vulnerable neighborhood area of the Flamingo and Lummus neighborhood (63).

Natural Resource: Flamingo Park in the Flamingo and Lummus neighborhood (56).

Table 2.14: Number of higher vulnerability assets per South Beach subregion.

	A (South Venetian Islands + Star-Palm-Hibiscus Islands)	B (West Ave. & Bay Rd + City Center + Flamingo & Lummus)	C (South Pointe)	Total
Structures & Facilities	37 sites	33 sites	6 sites	76 sites
Pipelines & Roadways	< 1 mile	5 miles	<1 mile	5 miles
Natural Resources	2 areas	3 areas	0 areas	5 areas

Higher vulnerability assets were those in the top 33% of vulnerability scores for Structures & Facilities and Natural Resources subcategories, but the top 10% of vulnerability scores for Pipelines & Roadways due to the number of pipeline and roadway feature segments.

Tables 2.15 through 2.17 provide an overview of the higher vulnerability (i.e., highest quantile) assets within each South Beach subregion.

Table 2.15: South Beach Subregion A (South Venetian Islands + Star-Palm-Hibiscus Islands) higher vulnerability assets.

Asset Type	Asset Name/ Mileage		Vulnerability Score (max = 64)
Bridges*	SST61341 SST61342 SST61343* SST61344 SST61345 SST61346	SST61347 SST61350 SST61351 SST61352 SST61353 SST61354	56*
Bus Stop	Venetian Way & E Island Ave		42
	Venetian Way & W Island Ave		42
Electrical Substations	MacArthur Causeway Substation		58
Natural Resources	Belle Isle Park		42
	Palm Island Park		43
Stormwater Pump Stations*	#5* #34 #35 #36 #37	#39 #40 #41 #42	61*
Wastewater Pump Stations*	PS 2 PS 4 PS 5 PS 6	PS 7 PS 8 PS 10* PS 30	61*
Water Pump Stations	Belle Isle		62
	Terminal Isle		49
Wastewater Pipelines*	< 1 mile		63*

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

Table 2.16: South Beach subregion B (West Ave. & Bay Rd + City Center + Flamingo & Lummus) higher vulnerability assets.

Asset Type	Asset Name/ Mileage		Vulnerability Score (max = 64)
Affordable Public Housing	Neptune Apartments		50
Bridges	SST61332		58
Bus Stops*	5th St. & Lenox Ave. 6th St & Alton Rd. 14th St & Alton Rd. 10th St. & Alton Rd.	17th St. & Lenox Ave. 14th St. & Alton Rd. 16th St. & Michigan Ave. 5th St. & Michigan Ave.*	43*
Community Centers	Miami Beach Police Athletic League Facility		43
	South Shore Community Center		50
	Flamingo Park Tennis Center		43
Electrical Substation	Liberty Ave Substation		56
Fire Station	#1		49
Historical and Cultural Resources	Colony Theatre		42
Law Enforcement Facilities	Police Station HQ		46
Natural Resources	Flamingo Park		56
	Miami Beach Soundscape		51
	Canopy Park		49
Schools	Fienberg Fisher Adult School		49
	Fienberg Fisher Elementary School		50
Stormwater Pump Stations*	#4 #6 #15 #25 #26 #27	#28 #31 #32 #33* #45 #48	63*
Wastewater Pump Stations	PS 11		59
	PS 1		51
Wastewater Pipelines*	5 miles		63*

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

Table 2.17: South Beach Subregion C (South Pointe) higher vulnerability assets.

Asset Type	Asset Name/ Mileage	Vulnerability Score (max = 64)
Bus Stops	5th St. & Lenox Ave.	42
	5th St. & Michigan Ave.	43
Community Center	South Shore Branch Library	47
School	South Pointe Elementary	50
Stormwater Pump Stations	#16	59
Wastewater Pump Stations	PS 31	53
Wastewater Pipelines*	<1 mile	63*

* Due to the number of higher vulnerability assets for this Asset Type, only the highest score is shown.

South Beach Key Vulnerabilities

- The South Beach Structures & Facilities classified with higher vulnerability are primarily located in two areas. The first is on the island neighborhoods of subregion A, where nearly all bridges connecting the islands, nine stormwater pump stations and eight wastewater pump stations are considered to have higher vulnerability. The second area is from the Biscayne Bay shoreline in the West Ave. and Bay Rd. neighborhood to Meridian Ave. An additional 13 stormwater pump stations are considered to have higher vulnerability in this area.
- The subregion B neighborhoods include several critical emergency facilities that are classified to have higher vulnerability, including Fire Station #1, the police station headquarters, and the Convention Center which serves as a logistical staging area during emergencies. The roadways surrounding these facilities are also projected to be flooded during higher sea level rise events which would complicate emergency response operations.
- Twelve of the City's 48 stormwater pump stations are in subregion B and are classified to have higher vulnerability. Should these assets be damaged due to flood exposure, low-lying areas of South Beach are likely to be inundated with deeper floodwaters as current stormwater infrastructure may not be able to compensate for the increased volumes.
- There are several higher vulnerability wastewater pipelines located in the socially vulnerable neighborhood areas. Like the other two regions, all these segments were installed over 70 years ago.

Asset Group Profiles

The City recognizes the impacts from a failed asset are rarely contained to that single asset and the services it provides. Individual assets are one piece of a larger infrastructure system. For example, if one City stormwater pump station were to fail due to flood exposure, this could generate increased runoff conditions for adjacent stormwater pump stations, which may be unable to drain the increased volume. This could result in increased flooding impacts in areas larger than the area of the damaged stormwater pump drainage basin. Similar examples can be used to describe how flooding impacts to certain facilities (e.g., emergency response facilities, community centers, etc.) could result in unexpected impacts to related infrastructure.

To more comprehensively understand and visualize these infrastructure relationships, the City further organized the asset subcategories (**Table 2.4**) into 10 Assets Groups. The Asset Groups consist of closely related asset types that share similar functions or services. For example, the Emergency Facilities Asset Group includes the City's emergency response structures (e.g. fire stations, police stations, hospitals) and important recovery facilities, such as debris and logistical staging areas).

Table 2.18 provides an overview of the 10 Asset Groups and a description of the assets included.

The Asset Groups provide a refined assessment of the vulnerability of City-wide infrastructure systems. The organization of this information also allows for easier communication of system vulnerabilities to the public and City staff who may be responsible for the assets (e.g., the Department of Public Works). The Asset Group findings have been developed into profiles that provide additional details of the sea level rise vulnerability for assets within each group. These profiles can be found in Appendix E.7.

Table 2.18: Asset Groups and description of assets included.

Asset Group	Description of Assets Included
Community Centers	Includes assets that provide important community services, including recreational activities, extracurricular programs, and housing to City residents.
Critical Buildings	Includes assets that provide access services that are critical to daily function in the City, including places of business, schools, and local government offices.
Drinking Water	Includes assets responsible for the distribution and supply of drinking water to the City's residents and businesses.
Electrical & Communication	Includes electrical substations necessary for dependable electricity production for residents and businesses and communication towers.
Emergency Facilities	Includes emergency response and recovery facilities critical to ensuring access to medical care and protecting residents and businesses from risk and damages.
Natural Resources	Includes natural areas, such as parks, that serve as recreational spaces and community event spaces.
Public Transportation	Includes the public transportation network of bus stops and trolley stops.
Roads and Bridges	Includes the major transportation assets that enable the daily transport of people and goods throughout the City
Stormwater	Includes the stormwater pump stations necessary for the efficient movement of runoff from critical assets.
Wastewater	Includes the infrastructure assets responsible for the proper removal, conveyance, and disposal of wastewater

2.5.4 Key Takeaways

The Assessment conducted in this report allowed the City to identify and prioritize critical assets and infrastructure based on the projected impacts from future sea level rise. The City leveraged datasets from previous reports and City departments to develop an asset inventory of nearly 60,000 individual assets. The City also conducted several community engagement events in the early stages of the project to identify the assets most valued by residents and capture the flooding issues that are already impacting the community.

With this information, the City developed a scoring methodology to compare vulnerability among the considered assets. Flood maps were created to determine the projected flood exposure for each asset to seven sea level rise scenarios. To obtain a vulnerability score for each asset, the City determined each asset's sensitivity to flooding and the community consequences if the asset failed due to flooding. The Assessment resulted in a list of assets based on these vulnerability scores. Assets were organized into asset subcategories and asset group profiles to more effectively communicate the key findings of the Assessment, including where the most vulnerable assets are in the City.

These key findings are provided below:

- The City assets with higher vulnerability scores are often located near Biscayne Bay shorelines, particularly in South Beach in the West Ave and Bay Rd neighborhood. In North Beach, several of the higher vulnerability assets are located along the canal shorelines. These assets may be located near low-lying sections of shoreline or seawall that are projected to be more frequently overtopped due to future sea level rise. City assets located behind the eastern coastal dune area have relatively lower vulnerability than those in the western part of the City.
- The assets with the highest vulnerability scores are wastewater pipelines that were installed more than 70 years ago. This older infrastructure is often located in low-lying areas projected to be exposed to most sea level rise flooding scenarios. These sections of wastewater pipelines were also found in several of the City's most socially vulnerable neighborhood areas.
- Future sea level rise is projected to extend king tide flooding inland, generally following along roadways which are expected to serve as flood pathways. Sea level rise will also increase the extent of rainfall ponding areas during compound events in numerous City areas that currently do not tend to flood. As nearly the whole City is projected to be impacted during a storm tide (storm surge) event at current conditions, the flooded area will not increase significantly. However, storm tide (storm surge) flood depths will increase, likely exacerbating impacts to assets.
- Forty-two of the City's 48 stormwater pump stations are considered to have a higher vulnerability to future sea level rise. The City has taken several measures to assess the risk to this infrastructure, including the detailed analysis included in the SWMMP. The results of this assessment encourage continued efforts to adapt these critical flooding mitigation assets to future sea level conditions.
- The City's primary emergency response facilities (e.g., police station headquarters, Fire Station #1, Mt. Sinai hospital, and the Convention Center) are considered to have higher vulnerability. Previous efforts by the City, including road raisings and the elevation of critical equipment, have sought to mitigate flooding impacts at and near these facilities. This Assessment highlights the importance of continuing to develop adaptation measures to protect these critical facilities.
- The City's bridges connect the individual island neighborhoods of Miami Beach and the City to the mainland. The bridges also serve as primary evacuation routes during emergency events. More than half (24 of 47) of the City's bridges and nine-of-ten connecting the South Venetian Islands are classified to have higher vulnerability.
- Several of the City's community centers and affordable public housing assets are considered to have higher vulnerability, particularly in North Beach. Many are also located in the City's socially vulnerable neighborhood areas. Adaptation measures should be pursued to mitigate flooding impacts to these assets so that they may continue to provide services and resources to the City's disadvantaged populations.

- Anecdotal stories and experiences shared during community engagement activities aligned with the vulnerabilities and flood extents mapped in this study. These include:
  - Residents recognize higher flood vulnerabilities along Biscayne Bay.
  - Roadways are critical for daily travel, but several low-lying streets are already facing flooding impacts under existing conditions.
  - The City's parks and community centers are highly valued community assets, but several, including Flamingo Park and the Scott Rakow Youth Center, currently face frequent flooding impacts.
  - The City's aging flood protection structures (e.g., wastewater pipelines) should be replaced in order for the infrastructure to be designed for a higher sea level future.
  - The City's most vulnerable populations and neighborhoods are already withstanding sea level rise impacts and these are expected to worsen without proactive action.

By 2070, sea levels are projected to be high enough that nearly the entire City is expected to face some impacts from any of the three flooding sources assessed. However, these projections and assumptions are based on the City's current infrastructure and do not consider future City actions to mitigate flood impacts. The takeaways from this Assessment provide the City with a starting point for efficient adaptation efforts by highlighting which assets are currently the most vulnerable to sea level rise. Moreover, the ranking of vulnerability scores allows the City to identify the order in which to prioritize addressing assets before sea level rise impacts may cause them to fail.

This Assessment also highlights that there are regional and neighborhood differences in terms of the City's sea level rise vulnerability. For example, an additional foot of sea level rise by 2040 (NOAA Intermediate High scenario) is projected to produce relatively more extensive king tide flooding in South Beach than in North or Mid Beach. The City regions also include multiple types of critical assets and systems that will respond in different ways to more frequent flooding events. Addressing the potential impacts to these assets will therefore need more than one approach.

Improving resilience City-wide, both now and into the future, will require a collection of adaptation strategies that can be applied to the varying flooding risks of numerous asset types located in every part of the City. As a step towards this goal, the key vulnerabilities identified by this Assessment have provided a foundation for developing the adaptation pathways outlined in the Adaptation Plan. The goal of these pathways is to integrate the findings of this Assessment into future City planning initiatives and infrastructure projects in order to reduce the City's vulnerability to future sea level rise and maintain the City's leadership in enacting forward-thinking climate adaptation actions.

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3. Next Steps

The objective of this Assessment was to identify the City's assets and infrastructure that are most vulnerable to current and future flooding events. The Assessment considered an asset's exposure to flooding as well as the asset's flooding sensitivity and consequence to community to determine a vulnerability score. The Assessment resulted in a list of assets ranked by this vulnerability score. This list reflects City assets that are most at risk to future flooding due to sea level rise.

With these findings, and associated Asset Group Vulnerability Profiles, the City is well equipped to communicate to residents and other City departments the magnitude, extent, and severity of flooding impacts the City could expect from future sea level rise. The list of prioritized assets allows the City to pursue project funding for implementation, from sources such as the Florida Department of Environmental Protection (FDEP) Resilient Florida grant program, to develop targeted adaptation measures for identified flood susceptibilities across the City. These key vulnerability findings also served as the foundation for the adaptation pathways developed in the Adaptation Plan. The adaptation pathways incorporated City asset vulnerability information to develop place-based strategies that can evolve with changing conditions, such as future sea levels.

Finally, this Assessment represents the latest in the City's ongoing effort to understand, communicate, and prepare for a future influenced by climate change. The sea level rise vulnerabilities identified in this report fit into the City's resilience vision and this Assessment builds on the work of many previous City plan and initiatives. The vulnerabilities identified here expand the assets considered in the City's 2017 Vulnerability Assessment (Guidebook, 2017) and refine the methodology to improve how assets can be prioritized by the City. These findings also can be used in coordination with findings and actions outlined in other recent City plans, such as the SWMMP and Neighborhood Project Prioritization Plan. Additionally, the Assessment findings can inform future updates to the City's Local Hazard Mitigation Strategy, which describes the overall City approach to hazard protection and allows the City to maintain eligibility to receive pre-disaster mitigation grant funds from FEMA.

The completion of this Sea Level Rise Vulnerability Assessment provides the City and the State of Florida a comprehensive resource evaluating the vulnerability of its most critical assets to flooding and sea level rise. This Assessment will help guide the City's future planning and project efforts as it continues to adapt to the immense challenge of sea level rise.

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Appendices

Appendix A: Stakeholder Engagement

Municipal planning for flood hazards is commonly focused on addressing identified impacts to physical infrastructure, such as utilities, facilities, and roadways. In addition to developing traditional strategies to protect this infrastructure, the City's Sea Level Rise Vulnerability Assessment (Assessment) aimed to increase public preparedness and build community resilience by integrating community engagement into the process through a multi-stakeholder approach. Early and ongoing conversations with community members regarding flood hazards provides an important perspective to integrate local knowledge into the Assessment process by:

- **Providing an understanding of community flood concerns:** The City currently experiences flooding from a variety of sources (e.g., king tides, rainfall, rising groundwater). Engagement with community members across the City provided insight into the factors (or combination of factors) that are the greatest threats to quality of life, emergency response, and community assets.
- **Identifying most vulnerable populations:** Although any resident exposed to flood hazards is vulnerable, the impacts are often not experienced equally. Varying levels of vulnerability exists across the City and some community members may have characteristics that disproportionately increase their sensitivity to flood hazards compared to their neighbors.
- **Monitoring the worsening effects of flooding over time:** Sea level rise exacerbates flood impacts by increasing the frequency, flood depth, and inland extent. Although the City has implemented numerous projects to reduce the frequency and extent of flooding across the island, some areas and residents may be experiencing worsening flood conditions. Conversations with residents can assist with the quantification and identification of areas experiencing continued worsening flood impacts to prioritize the need for additional strategies.
- **Prioritizing highly-valued City and community assets to protect:** Engagement of community members helps develop an understanding of assets that are highly utilized and integral to the daily lives of residents. This understanding provided a means to prioritize assets and ensure that the City continues to provide protection of their services to the community.

The following sections document details of the community engagement events used to inform the Assessment. Public input received through each of the community engagement events was used to inform the assignment of qualitative sensitivity and consequence ratings in the vulnerability assessment, as described in Section 2 and Appendix E and provide a foundation for adaptation strategies described in the Adaptation Plan.

A.1 Community Sensitivity Focus Group Interviews

For the initial step to community engagement for the Assessment, the City conducted a series of focus group discussions in June and July of 2023 to understand the community's experience with flooding, the variability of impacts across the City and the differences in impacts to the various demographics of residents. The sections below describe the approach to the focus group discussions and the key findings.

Methodology - Approach to Focus Interviews

The City hosted a series of eight, small group interviews, consisting of up to five interviewees per session. Six sessions were focused on each region of the City (North, Mid, and South Beach) with two additional sessions that engaged with members of the Business Community and local Subject Matter Experts. Residents and business owners were contacted through communications to homeowners associations, business networks, local community facilities, newsletters, and social media. Focus interview participants were selected by the City for residents who signed up for their local session until the maximum number of interviewees was reached. Generally, three to four participants attended each focus group for roughly 24 participants in total. During the interviews, participants were guided through a series of standard questions centered around three discussion topics:

- **Experiences with Flooding:** Identified the frequency, locations, and types of flooding affecting interview participants.
- **Flooding Impacts to Community Spaces:** Identified the valued community assets and facilities that are exposed to flooding and examined the potential consequences or impacts that could occur due to loss of access or use.
- **Influence of Sea Level Rise:** Inquired about the changing frequency and severity of flood impacts, concerns about sea level rise effects on the community, and places to prioritize for intervention.

Use of consistent questions allowed for comparisons to be made across the City to identify geographic differences in sensitivities as well as understand the overlapping vulnerabilities at a citywide scale. Key findings of the focus group discussions are discussed in the following sections.

Focus Group Key Findings - Awareness and Understanding of Sea Level Rise

The focus group discussions confirmed that Miami Beach residents are intimately familiar with sea level rise and its associated flood risks. The City's residents have a history of living with water and have witnessed firsthand the impacts of sea level rise with more frequent flood events during high tides and heavy rainfall. Regular exposure to flooding has prompted many residents to become informed about the causes and risks of flood hazards. This concern has spurred activity in public meetings, workshops, and initiatives to address flooding issues.

Perceptions of Sea Level Rise

Most interview participants shared that they experience frequent flooding and find that it impedes daily activities. Residents expressed that flood events, which historically occurred several times each year, are now being experienced more frequently. Interviewees consistently stated what was once a slow progression of flood severity has accelerated in intensity in the past 5-10 years, affecting community amenities, private property, and transportation access throughout the City.

"I remember seeing water come up over the canal for the first time and I thought it was crazy. Now that happens every high tide, and I never think anything of it." -North Beach Resident

Most participants felt that although flood hazards are increasing with sea level rise, that the effects have been mitigated in many areas due the City's interventions, such as raising roads, installation of pump stations, and increasing drainage capacity. Participants acknowledged that construction of projects is temporarily disruptive, yet effective in

Many residents also understand the complexities associated with the City's flood sources. For example, interviewees often discussed how the severity of flooding during rainfall events is often worsened during high tides and seasonal high groundwater levels. Interviewees shared that flooding is often unpredictable due to compound flooding.

"The City's work is very important, and what they are doing is working. But we are in a race against time, and we don't have the time we thought we did" – North Beach Resident reducing flood impacts. Residents also commonly acknowledged that flooding is a multifaceted issue for the City and cannot be addressed by a single strategy. A common example provided is that the City is raising seawalls, but flooding still occurs landward of the structure due to emergent groundwater levels during high tides and rainfall.

Community Response

Residents of Miami Beach have undergone a transformation in their attitudes toward flooding. Once a cause for concern and disruption, frequent flooding has become a normalized part of daily life for the community. The increased flood exposure due to sea level rise has forced residents to adapt and find ways to coexist with the water.

Community Coping Mechanisms:

- Clearing debris from local stormwater drains prior to storm events
- Carrying flip-flops or rubber boots for wading through water
- Purchasing large vehicles (trucks, SUVs) to navigate flooded streets
- Carrying children over flooded school pickup zones
- Elevating private homes, docks, and seawalls

In addition to the implementation of municipal capital projects, such as the installation of stormwater pump stations and raising of roads, many residents are also adapting on an individual property scale by raising their homes, docks, and private seawalls. Interview participants also shared that many have traded their smaller vehicles for a higher clearance option such as SUVs and trucks to be able to navigate regularly flooded streets. To cope with unpredictable flooding, many participants expressed a shared personal adaptation strategy of also carrying flip-flops to avoid water damage to shoes when crossing submerged sidewalks and streets.

Many residents also routinely perform preventative measures, such as periodically clearing debris and garbage that can build up on storm drain grates and catch basins near their homes. Preventative maintenance of storm drains was reported by residents to be an effective way to reduce ponding of floodwater, particularly during rainfall events.

While the normalization of flooding in Miami Beach showcases the resilience and adaptability of its residents, it also raises concerns about the long-term sustainability of day-to-day life in the City. Residents feel like they are getting used to the "new normal," but worry how much they will be able to accommodate in the future. As the impacts of sea level rise continue to intensify, the challenge for many residents remains to strike a balance between adapting to the City's rapidly changing environment and acknowledging the financial risk sea level rise poses to property values and the insurability of homes.

> "I'm 54, and I don't want to deal with adaptation when I'm 80. I already raised my dock twice, but it doesn't look like I will have a reprieve once I'm 80" - North Beach Resident

Focus Group Key Findings - Identifying Geographic Differences in Sensitivities

Miami Beach's three regions (North Beach, Mid Beach, and South Beach) exhibit varying degrees of vulnerability and risk due to their geographical locations, elevations, and amenities. The following sections summarize key themes of vulnerability that are unique to each region and key assets of concern based on findings of the focus group interviews.

North Beach

North Beach, a largely residential area situated at the northernmost end of the City, tends to experience a relatively lower flood exposure compared to its southern counterparts. Its slightly higher elevation reduces the frequency of coastal flooding and increases the ability to effectively drain stormwater. However, it is not immune to floods, especially during extreme weather events or king tides. Residents located along Biscayne Bay are particularly prone to flooding due to lower elevations. Residents along Biscayne Bay reported observations of monthly flooding during high tides, especially during king tides, and expressed that flooding occurs more frequently and for longer durations than the previous decade.

Key assets of concern to the North Beach community:

- Beaches and Dunes
- Roadways
- Schools
- Residences
- At-grade and Underground Utilities
- Fire Stations

Flood issues in North Beach commonly affect side streets and parks with several locations experiencing more severe flood concerns. One resident shared that the Biscayne Elementary School and Lehrman Community Day School, both located along one of the City's waterways adjacent to Biscayne Bay, experience frequent and severe flooding during rain events (**Figure A.1**). Afternoon rainfall affects school pickup routines with parents having to carry children over ponding water and school guards often wear high rubber boots to direct traffic. Underground and at-grade utilities were also a concern with residents reporting often seeing electrical utilities underwater when flood levels are high.

Residents also expressed concern that the beaches and dunes in North Beach are experiencing accelerated rates of retreat. Loss of the beach and dune width has reduced the natural flood protection offered by these features for assets and properties located along the open coast. In addition to beach loss, residents shared that the beach access paths that bisect the dunes provide a direct pathway for ocean floodwaters to reach inland areas. They can act as a funnel for water to access properties and assets during storm events, citing a recent example from Hurricane Ian in 2022.

Figure A.1: Existing North Beach flood concerns identified by focus group participants.

Mid Beach

Mid Beach encompasses the middle stretch of the City and includes a diverse combination of residential, hotel, and resort areas. Interviewed residents consistently expressed that flood issues are becoming more frequent and extensive in some areas of the City, especially in residential areas, during heavy rainfall. Many residents shared that neighborhood driveways and roads experience stormwater ponding that persists for hours after rain events. However, in areas where pump stations have been installed and roadways elevated, such as along Sunset Harbour and Sunset Islands 3 and 4, flooding has been largely reduced or eliminated.

Extensive roadway flooding, including major arterial routes such as Alton Road, inhibits the ability of residents to access common and critical amenities, such as grocery and drug stores. Flooded roadways were also reported to further aggravate already congested transportation routes in the area (**Figure A.2**).

Key assets of concern to the Mid Beach community:

- Private Property
- Parks and Outdoor Recreational Spaces
- Waterway Bridges
- Access to Mainland
- Grocery/Drug Stores
- Utilities
- Emergency and First Responders
- Mount Sinai Hospital
- Roadway Access

In addition to the City's roadways, waterway access was shared as a concern. One Mid Beach resident experiences waterway access issues during high tide events, which make some bridges in the City impassable by boat due to insufficient clearance.

Parks and outdoor recreational spaces were highlighted as a growing concern for Mid Beach residents. Several interviewees shared that parks and other outdoor spaces significantly contribute to their quality of life in Miami Beach and serve as a social hub for both parents and children. Following rain events, some parks, such as Fisher Park, are unusable due to ponding water and muddy playgrounds for several days, which largely impacts families seeking to find alternative activities for children. The groups shared that a daily dependence on outdoor park spaces extends to dog owners, who rely on the City's dog parks for exercise and socializing.

"...having an SUV to navigate flooded streets is a must" – Mid Beach Resident

Figure A.2: Existing Mid Beach flood concerns identified by focus group participants.

South Beach

South Beach is the iconic and cultural hub of the City. In addition to its world-famous beaches, hotels, restaurants, and a large collection of modern art deco architecture, South Beach is also the location of the City's government facilities and Convention Center complex. This high concentration of public amenities, combined with its low elevation and highly urbanized setting, makes this region particularly vulnerable to sea level rise. Many interviewees expressed that private property flooding was a growing concern with water levels often so high that they are not able to leave their homes. Flooding has become so frequent in areas of South Beach that some apartment complexes have started keeping sandbags on hand and issue vouchers to relocate tenant vehicles elsewhere to avoid property damage. While sandbag protection reduces flood impacts from regular king tides and rainfall, they may not offer enough protection from larger tropical storms. One participant shared that, although sandbags were in place, the first floor of his building was flooded during Hurricane Irma in 2017.

Key assets of concern to the South Beach community:

- Private Property
- Art Deco Historic District
- Restaurants and Shops
- Parks and Outdoor Recreational Spaces
- Bus Stops
- Parking Lots
- Roadway Access
- Sidewalks
- Post Office
- Grocery Stores

There was consistent agreement among interviewees regarding the concern and importance of preserving the historic areas of South Beach, such as the Art Deco Historic District. Iconic buildings in this district represent a unique and irreplaceable cultural site that receives global recognition. Residents view it as integral to the City's identity, noting that it also provides a significant draw for the tourism industry.

Parks and other outdoor recreational spaces were also highlighted as an especially valued and vulnerable asset type by the community (**Figure A.3**). Interview participants shared that due to the highly urbanized setting of South Beach, loss of access to green space can have a large, and often cascading, impact on the daily lives of residents. One participant shared that many retirees play tennis at the park in the mornings, which is usually followed by brunch and social events through the afternoon. A disruption to this sequence of events can affect the likelihood of consistent social activities for the retirement community. Although some parks, such as South Pointe, have recently been renovated and experience limited flood issues, other parks, including Flamingo Park and Belle Isle Park, can remain flooded and muddy for days after a rainfall event.

In addition to valued public places, the interview also revealed a difference between resident lifestyles and a correlation to relative flood exposure. While some residents admitted to having the ability to stay indoors until flooding recedes, they acknowledged that South Beach has a higher concentration of car-free residents and visitors that rely on walking, bikes, scooters, or buses. Car-free residents and visitors commonly must wade through standing water on streets and sidewalks to navigate throughout the area. Several dog owners stated that they have no choice but to go outside with their pets regardless of flood conditions. One interviewee shared that during a particularly bad rain event in November 2022, she had to carry her dog three blocks to return to her building due to knee-high flooding.

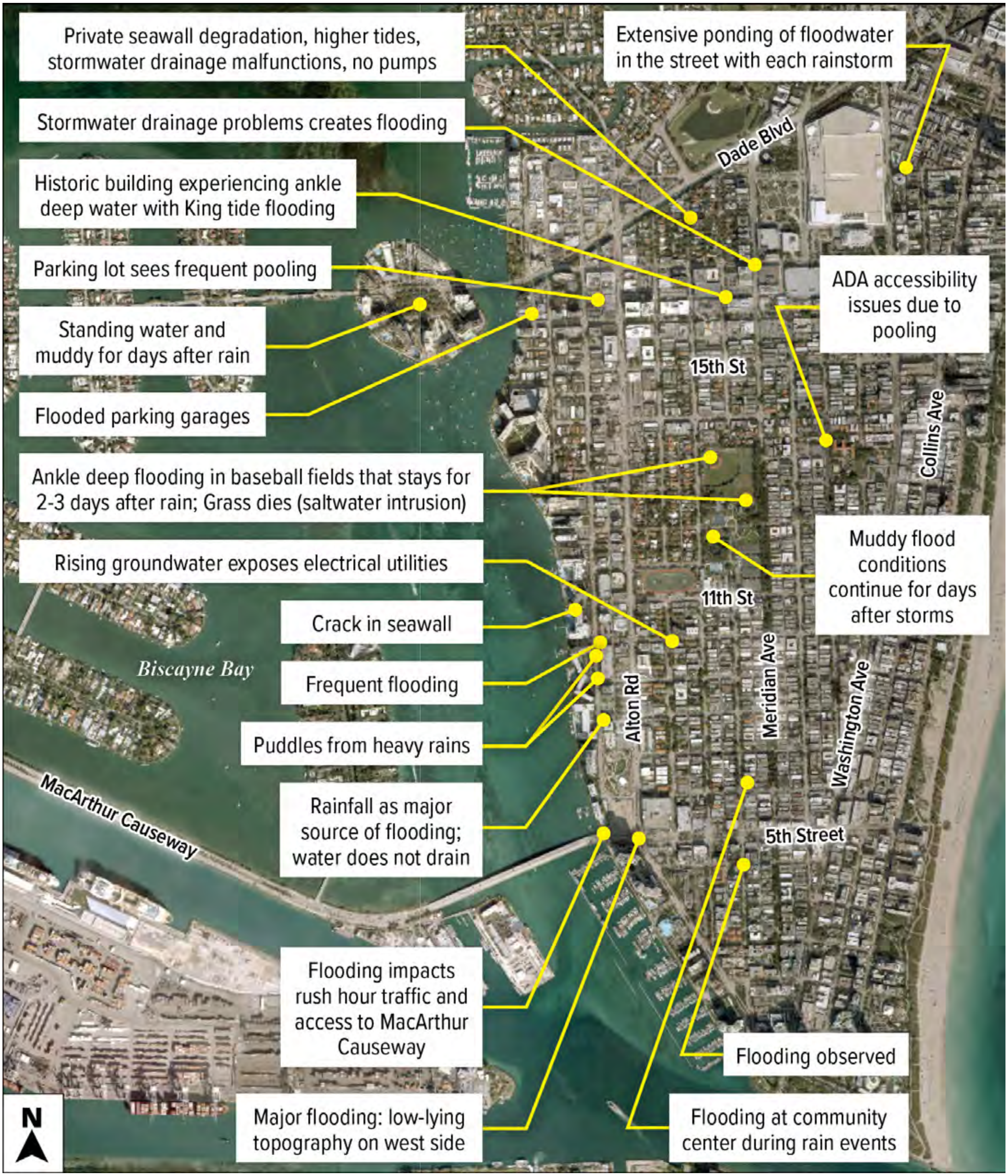

Figure A.3: Existing South Beach flood concerns identified by focus group participants.

Business Community

As a popular tourist destination and vibrant economic hub, Miami Beach's business community faces significant risks from potential flood impacts. During a focus group discussion with several of the City's local business leaders, many shared the concern of how flooding could affect their near-term vitality and long-term livelihood. Similar to residents, business owners are seeing frequent flooding of storefronts during rainfall and king tide events across the City.

Business Access Impacts:

Business owners noted that the immediate effect of flooding is a temporary decrease in customers, causing businesses to experience a decline in sales and revenue. Easy access to storefronts is essential to attracting customers and flooding can make it difficult or even dangerous for customers to visit. Despite the importance of access, many business owners expressed that roads and right of ways in the commercial areas of the City, such as Lincoln Road, are prone to regular flooding, affecting local businesses.

It was also noted that preferred modes of access are changing, and the City's residents are becoming increasingly reliant on multimodal forms of transportation, such as walking, biking, and electric scooters. Flooding presents a major hurdle for potential foot traffic and non-motorized pedestrians in affected areas until floodwaters recede.

> "When people come to shop, they don't want to swim to the store" - South Beach Business Owner

In addition to customer access, flooded roads and infrastructure damage can disrupt regional transportation networks, leading to delays in product deliveries, inventory replenishment, and trash pickup. This often results in supply chain disruptions and impacts businesses' ability to fulfill orders and meet customer expectations. Business owners in the City shared that delivered goods, which are vital for business, often arrive wet or significantly delayed during flood events.

Operational Impacts:

Flooding also affects daily business operations. Businesses in flood-prone regions of the City face substantial clean-up after flood events, which is often an unplanned cost. The need to repair and restore damaged properties, equipment, and inventory can strain financial resources and affect profitability. Business owners shared that they commonly rely on the mobilization of staff, diverting them from normally assigned duties for pre-flood merchandise protection and post-flood debris cleanup. However, this affects the number of staff able to handle day-to-day operational tasks of providing services for customers.

> "We don't have the financial padding post-Covid and are trying to survive" - South Beach Business Owner

Flooding also exacerbates the growing challenge of increased regional competition among business owners. Interview participants shared that entertainment, dining, and shopping options for customers have grown significantly within the City, and Miami-Dade Country region. Business owners fear that potential customers will prefer to patron other entertainment and shopping centers that are less likely to be flooded during rain or high tide events. This increases strain on business located in flood-prone locations and particularly affects small businesses that have continued to struggle economically from post-pandemic losses.

Tenant Vulnerabilities:

Adding to the challenge of flooding is the increased vulnerability presented for business owners that lease from out-of-state property owners. Interviewees shared that out-of-state property owners are often not familiar with the flood patterns and common flood issues facing their business tenants. This can lead to a lack of preparation or a coordinated response plan for post-storm repairs.

Loss of National Businesses:

> "The second we are no longer insurable, the entire real estate economy will collapse" - South Beach Resident

Interview participants noted that although the City's business community continues to endure the challenges of flooding, there is concern that national and international retail brands located in flood-prone areas will relocate, taking their customers and tax revenue out of Miami Beach. Many large corporations have 10-year leases that are almost expired and there is concern that they will not renew due to rising property costs and flood concerns.

Focus Group Key Findings - Overlapping Vulnerabilities

While Miami Beach's physical and demographic setting creates subtle regional differences in flood vulnerability, there were several overlapping themes that occurred across interviews conducted for all three regions of the City.

- **Higher vulnerabilities along Biscayne Bay:** In addition to an increase in flood exposure from north to south, the City's flood frequency and duration also increases from east to west. Within all three regions (North, Mid, and South Beach), assets located near the eastern dune areas on the open coast experience less flooding than those located along western Biscayne Bay shore. This increase in flood exposure along Biscayne Bay is due to a combination of factors. Lower land elevations along the bay allow for more shoreline overtopping, emergent groundwater, and decreased ability for efficient drainage. The west side of the City is also more urbanized with higher amounts of impervious surfaces, which further hinders drainage and leads to ponding.

- **Importance of roadway access:** Access throughout the City and to/from the mainland through bridges and causeways was consistently identified as a vulnerability for interview participants. Residents and business owners frequently discussed concerns of limited mobility and inaccessible roadways during regular flood events occurring every year, impeding their ability to access businesses, basic amenities, and homes.. There was also a common frustration of traffic congestion, which participants believe will be exacerbated by continued flooding.

- **Concern over long-term real estate and property value:** In all interviews, there was significant concern among homeowners and businesses about the effect that sea level rise, and its associated flood impacts, could have on diminishing property values, raising insurance, and driving local investment out of the City. Most residents indicated sharp increases in insurance rates in the last few years, and fear that even before the City becomes unlivable due to the physical effects of sea level rise, they will be forced to leave due to high property and insurance costs.

- **Aging flood protection structures:** The City's sea level rise issues are compounded by reliance on a network of aging flood protection structures. Large portions of the City currently depend on a system of seawalls and gravity-based stormwater drainage infrastructure that was designed in the early to mid-1900s without the consideration of changing climate conditions. Private seawall owners noted that water commonly seeps through cracks in their seawalls, particularly during high tides during a full or new moon. Many interviewees also noted ponding water due to undersized and aging stormwater inlets and pipes.

- **Socially vulnerable populations are most at risk:** Vulnerabilities to flooding are unequally distributed across the City. Many hospitality and service industry employees that live farther from their jobs have longer commute times during flood events and are more likely to rely on bus and non-motorized forms of transportation to access jobs and City amenities. Elderly residents also face higher vulnerabilities to flooding. It was noted during the interviews that flooding and ponding water limits mobility of the elderly, increases the likelihood of flood-related medical emergencies (e.g., slip or fall), and increases social isolation.

Focus Group Key Findings - Resident Preferences on Adaptation Strategies

While most participants expressed similar concerns about flood impacts to the Miami Beach community, most were optimistic that the issue was solvable through continued engineering interventions. Although participants largely agreed that adaptation was necessary, there were differing opinions over the preferred approach.

- **Elevating Roadways:** Most residents agreed that flooded roadways are an ongoing problem across the City. While there is general support for modifying roadway infrastructure to reduce flood risks, there is also concern about the selected adaptation approaches. Some residents expressed concern after seeing complications experienced with the Sunset Harbour Neighborhood Improvement Project. This project included raising West Avenue and adjacent sidewalks, which inadvertently increased the flood impacts of several neighboring properties and businesses until adequate stormwater drainage features were installed. Others in the focus groups were eager to implement road raising projects in their neighborhoods if constructed in a way that minimizes stormwater risk to adjacent properties and interruptions to their daily commutes.

- **Stormwater Pump Stations:** Most of the interviewees indicated that the introduction of pump stations has reduced or eliminated issues for areas of the City that once flooded regularly, including Sunset Harbor, Belle Isle, and Sunset Islands 3 and 4. Others shared concerns over potential impacts to the ecological health of Biscayne Bay due to increased turbidity.

- **Elevating Buildings:** While most residents were in favor of elevating public buildings and private homes, there was concern for how to pay for the retrofits, particularly for historic buildings. Nearly 20-percent of the City is located within designated historic districts with buildings constructed on concrete foundations and at-grade first floor elevations. Some interview participants shared that saltwater has deteriorated the footings of many older buildings in the area, leaving the properties vulnerable without structural repairs. Some disagreements emerged over the approach of maintaining and preserving these historic buildings versus rebuilding replicas to more resilient design standards. For private residences, many shared that they do not have the financial means to raise their existing homes and that preservation standards may place additional restrictions on types of adaptation that can be pursued.

- **Nature-based Solutions:** Nature-based approaches to flood protection were viewed favorably among most of the interview participants. Some residents supported creating more floodable spaces, such as Canopy Park in South Beach, that are designed to retain and treat stormwater. Support for other nature-based approaches included beach nourishment, dune restoration, and planting of mangroves.

- **Preventative Maintenance:** Residents consistently agreed on the effectiveness of preventative measures, such as the regular clearing of storm drains, which can often become clogged by debris. Participants agreed that simple and low-cost changes to the City's maintenance schedule could further reduce localized flooding across the City.

> "In 2010 Miami Beach was coined as 'ground 0' for climate change, and all eyes are on us to see how we are dealing with this." - South Beach Resident

A.2 Pop-up Workshops

To gain an even wider understanding of flood vulnerability and how it varies across the community, the City hosted a series of three "pop-up workshops" that coincided with ongoing public events. Pop-up workshops provided a casual approach to hearing from members of the community, especially those who may not typically attend a traditional City meeting or workshop. The events are summarized in **Table A.1**.

Table A.1: List of community events attended as part of the pop-up workshop series.

Date	Event	Location	# of Participants
October 13, 2023	Hispanic Heritage Festival	North Beach Oceanside Park (North Beach)	52
October 19, 2023	Culture Crawl	Botanical Garden (South Beach)	56
November 5, 2023	Chess Challenge	Scott Rakow Rec Center (Mid Beach)	35

At each pop-up event, participants learned about the City's flood vulnerabilities and were able to provide feedback at a series of stations designed to understand community impacts from flooding and community-valued infrastructure that should be prioritized for adaptation. **Table A.2** describes the information collected at each station.

Figure A.4: City staff providing an overview of the City's flood hazards to residents.

Table A.2: Description of pop-up workshop stations.

Station Number	Station Goal	Methodology
1	Locate places and spaces already experiencing flooding	Participants were provided color-coded push pins that correspond to types of community infrastructure (parks, transportation, utilities, etc.). Pins were used to identify locations on a City map and infrastructure types that are already affected by flooding.
2	Prioritize the protection of valued assets and infrastructure	Participants were provided three voting dots and asked to select the asset types that should be prioritized for flood protection.
3	Document the ongoing impacts that flooding has on the community	Participants were provided blank sticky labels and asked to provide a short description of how they were affected when each type of infrastructure experienced flooding.

Key findings for each of the pop-up workshop stations is summarized below.

Station 1: Locations Already Experiencing Flooding

Digitized locations of assets and infrastructure already experiencing flooding are shown in **Figure A.6**. Key findings of community infrastructure identified as already at risk to flooding included:

- Most identified locations of flood-prone assets were concentrated along the west side of the City in North and South Beach. Specific neighborhoods with a high concentration of flood locations include: North Shore, Normandy Isles, City Center, West Avenue Bay Road, and Flamingo Lummus.
- Transportation infrastructure was the most selected community asset type experiencing existing flood impacts.
- Several parks and community facilities, including the Scott Rakow Youth Center and Flamingo Park, received multiple pins to note previous flood impacts, indicating the relative importance of these facilities to the community.
- Multiple locations along Collins Avenue and Indian Creek Drive, which serve as primary corridors through Mid Beach, were identified as exposed to flooding.

Figure A.5: Participants adding pinned locations of assets experiencing flooding.

Figure A.6: Community-identified assets currently exposed to flooding.

Station 2. Prioritized Community Assets and Infrastructure for Flood Protection

A total of 224 residents across all three pop-up workshops participated in the exercise to provide input on infrastructure that should be prioritized for flood adaptation based on value to the community. Most participants (61%) attended the North Beach pop-up event, while 30% of the participants attended the South Beach event, and 9% attended the Mid Beach event.

Figure A.7: Workshop participants voting on infrastructure to prioritize for flood protection.

A breakdown of the overall prioritized community assets and infrastructure selected by pop-up workshop participants is shown in **Figure A.8**. Transportation and life safety facilities received the overall largest number of votes, followed closely by utilities. This finding indicates that residents recognize and value the critical infrastructure that is necessary for maintaining day-to-day services and access throughout the community.

An overall prioritization for protecting transportation assets also aligns with findings of the Station 1 exercise where the majority of selected asset types identified as already at risk to flood impacts was dominated by transportation infrastructure. Flood impacts to roadways, sidewalks, and bus stops are already affecting residents, highlighting the priority for adapting these asset types.

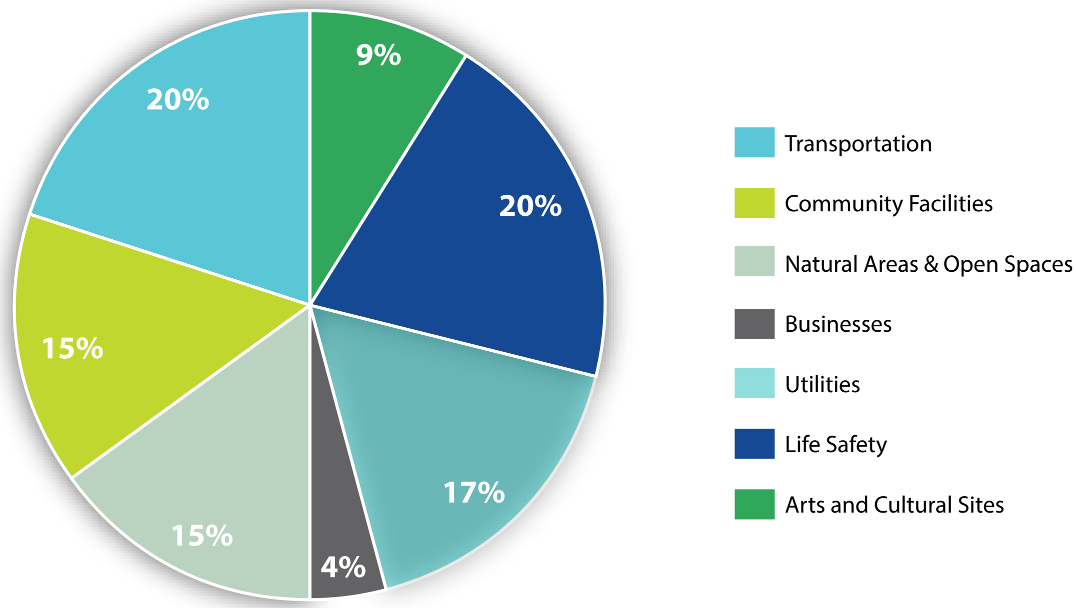

Figure A.8: Prioritized asset types selected by pop-up workshop participants.

Ongoing Impacts of Flooding on the Community

In general, participants shared the largest number of comments for the transportation infrastructure and community facility categories. There were numerous comments documenting the widespread effects that flooded transportation assets have on the community, including preventing access to grocery stores and pharmacies, damage to vehicles, inability to commute to/from work, and decreased pedestrian safety due to flooded sidewalks. Many of the community facility comments discussed impacts to schools, primarily due to flooded pickup/drop off zones that are already regularly flooded at several locations (Nautilus Middle School and Biscayne Elementary School).

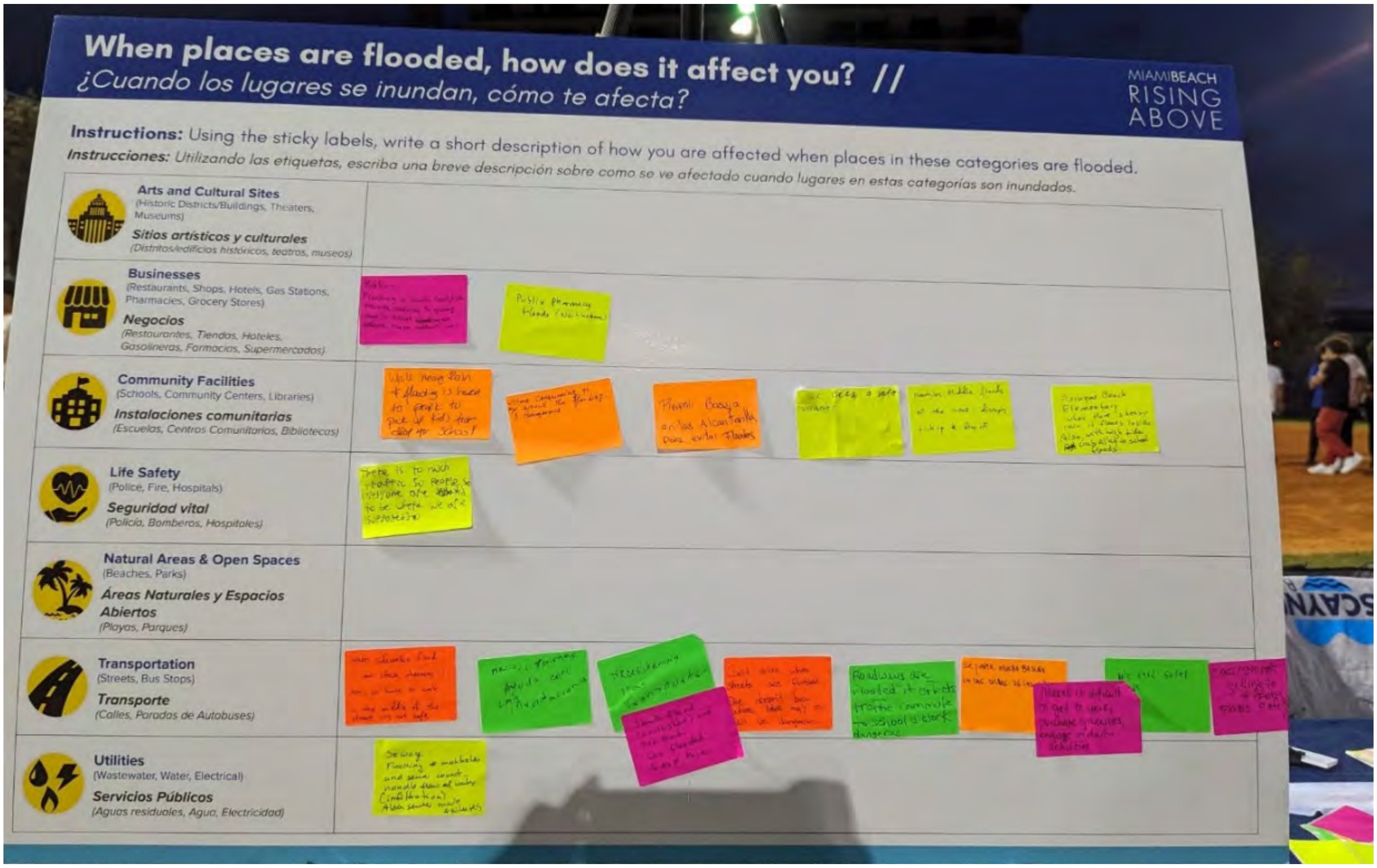

Figure A.9: Example of pop-up workshop board where participants documented community flood impacts.

Figure A.10 shows examples of the comments received during the pop-up workshop events. A full set of comments is provided in **Table A.3**.

Figure A.10: Example flood impact comments received from pop-up workshop participants.

Table A.3: Flood impacts comments from pop-up workshop participants.

Arts and Cultural Sites	Businesses	Community Facilities	Life Safety	Natural Areas and Open Spaces	Transportation	Utilities
	Publix – Flooding prevents walking to grocery stores in Sunset area and affects those without food.	While heavy rain and flooding is hard to park to pick up kids from drop off after school	There is too much traffic so everyone are delayed to where we are supposed to be.	Unable to visit parks/ open spaces if flooded	When sidewalks flood, I am stuck wherever I am or have to walk in the middle of the street. It's not safe.	Sewage flooding from manholes and sewer cannot handle flow of water. Also, sewer main failures.
	Publix Pharmacy floods	Time consuming to go around the flooding and dangerous	After a storm or hurricane, hospitals are going to be damaged so lots of people are not treated so hospitals should get protection from storm and hurricanes	Affects my ability to be outside in fresh air	Streets flood in North Shore and Mid Beach. Car flooded in Cespi Park	As someone without a car, sewage issues in the streets is a huge issue for me. Cleanliness in the streets is a must.
	Without grocery stores we cannot get food	We need a safer community	Imagine there is an emergency and nobody can help you		Can't drive when streets are flooded. Doesn't know how high water may be and it can be dangerous.	Catch basins are filled with debris.
	There was a storm and it had been raining a lot. I needed to get groceries from the store, but was not able to get out of my car because it was flooded.	Nautilus Middle floods all the time – disrupts pickup and dropoff			Roadways are flooded it affects traffic commute to work and school.	Sewage water all around
		Flooding causes difficulty for children to go home with parents			Makes it difficult to get to work, purchase groceries, engage in daily activities.	Poop water in streets

Table A.3: Flood impacts comments from pop-up workshop participants (continued).

Arts and Cultural Sites	Businesses	Community Facilities	Life Safety	Natural Areas and Open Spaces	Transportation	Utilities
		Biscayne Beach Elementary when there is heavy rain it floods inside. Also with high tides, alley to school floods.			We need safer roads.	
		It used to hurt me when I saw Biscayne Beach flood			Flooding by the beach prevents an enjoyable visit and bicycle transportation	
		Nautilus Middle floods all the time – disrupts pickup and dropoff			Streets would be flooded with water there would be waves.	
		Flooding causes difficulty for children to go home with parents			We live in Normandy Isles. When the tide is high, there is a lot of water in the street.	
		It's important to have a safe school path for all our students. Going to school wet is not in the best interest of the community. Sick kids lead to parents staying at home will understaff businesses.			Street flooding in neighborhoods. Not able to travel until water recedes.	
		When there is no school, there is not chess.			If the land gets flooded, we won't be able to drive.	
		I am worried about down power lines around schools.			When street floods sidewalk is affected too. It is hard to walk home from work.	
		Affected the time I would have to leave after work.			Roadways are flooded it affects traffic commute to work and school.	

Table A.3: Flood impacts comments from pop-up workshop participants (continued).

Arts and Cultural Sites	Businesses	Community Facilities	Life Safety	Natural Areas and Open Spaces	Transportation	Utilities
					Makes it difficult to get to work, purchase groceries, engage in daily activities.	
					It affects that cars can't move to a lot of places.	
					Getting stuck on the way to and from work	
					Damaged cars	
					Getting stuck on roads due to flooding	
					Damaged to car	
					Roads are flooded difficult to get to places.	
					Flooding on Belle Isle led me to move my car to Publix garage. I walked home over Venetian in calf deep water	

Appendix B: Gap Analysis

A foundational step to begin the City's Vulnerability Assessment was to complete a gap analysis to review previously completed and ongoing pertinent studies, supplement the City's asset inventory and reflect the latest datasets to comply with the Resilient Florida Program. The following sections summarize each component of the gap analysis and describe how any potential gaps were rectified.

B.1 Previously Completed and Ongoing Studies

The City is situated within a broader context of state and regional policies and studies aimed at addressing potential flood impacts due to existing and future sea level conditions. **Table B.1** below presents summaries of regulations and studies that support the Assessment. This is not an exhaustive list of sea level rise or flood studies completed in the region to date but represents a subset of the most relevant documents for the City and projects to inform the development of this plan.

Table B.1: Regulations and studies related to sea level rise planning.

Policy, Resource, or Study Lead Agency	**Description**
City Policies	
Resolution No. 2017-30039 (City of Miami Beach, 2017)	• Ordinance to update standards for the construction of new roads, stormwater systems, and development • Level of protection increased to a 10-year, 24-hour rainfall event (8.75 inches of rainfall) • Ordinance builds on subsequently adopted standards, including a 50-year planning horizon for increasing seawall heights due to sea level rise, increasing design criteria to consider 2.7 feet NAVD88 tidal boundary conditions, and considering sea level rise over the next 20 years for the City's stormwater infrastructure
City Studies and Initiatives	
Road Elevation Study and Recommended Sea Level Rise/Tidal Flood Adaptation Projects (Jacobs 2020a)	• Review of the City's road elevation policy to consider the following design elements: sea level rise, surface water elevation, groundwater elevation, road clearance, harmonization with neighboring private properties, and the general urban fabric. • Identifies road segments currently at highest potential flood risk considering sea level rise • Findings and policy recommendations are used to inform the City's Stormwater Master Plan, Public Works Manual, CIP Standard Operating Procedures, and other guidance documents for planning and design

Table B.1: Regulations and studies related to sea level rise planning (continued).

Policy, Resource, or Study Lead Agency	**Description**
Neighborhood Prioritization – Methodology and Results (Jacobs 2020b)	• Evaluation system to prioritize implementation of the City's capital infrastructure projects • Prioritization of projects consider flood risk management, public safety, and supply reliability of key City services • Projects were scored and ranked to develop a prioritized list of projects to be sequenced and costed for available CIP funding • Recommendations include incentivizing nature-based solutions and green infrastructure into project design to address water quality issues, augment flood management, and increase aesthetics of the City's landscape
Sea Level Rise Vulnerability Assessment Guidebook (AECOM 2017)	• Guidance to inform the prioritization of assets for adaptation planning and identification of thresholds for a consistent level of flood protection for the City • Guidance included an Excel-based database and tool to identify most vulnerable assets within each department and note key asset functions and considerations to assist with adaptation planning
The Business Case for the City of Miami Beach Stormwater Resilience Program (ICF 2020)	• Study to evaluate stormwater resilience investments considering the factors of flood damages, property values, insurance premiums, tax revenues, business disruptions • Multiple scale analysis of strategies was considered: individual home, neighborhood, and Citywide • Findings suggest that actions outlined in the stormwater resiliency program can reduce the risks and the cost of adaptation outweigh the economic cost of inaction • Study highlighted the significance of individual property adaptation to City's overall resilience
The Buoyant City Historic District Resiliency and Adaptation Guidelines (Shulman + Associates 2020)	• Guidance to incorporate sea level rise, storm surge, and stormwater flood resilience considerations into the preservation standards of the City's historic districts • Study provides general recommendations for the City's approach to adapting historic districts and specific guidelines for common historic building types, including cost estimates • Focuses on the adaptation approaches of "raising" and "adapting in place" considering preservation of existing building characteristics
Stormwater Master Plan Update (CDM Smith 2011, updated 2017; AECOM updated in 2024)	• Comprehensive assessment of the City's roads and drainage infrastructure to identify improvements to address capacity, water quality, and flooding issues • Capital improvements being implemented from the plan include elevating roadways and sidewalks, installing pump stations, and raising design standards for seawall heights to 5.7 feet NAVD88 • Updated by AECOM to account for sea level rise, recently completed stormwater projects, proposed stormwater pump stations, and for the latest stormwater modeling software • Updated Stormwater Master Plan will also include incremental adaptation in prioritized critical areas to be implemented over the first 10 years and adapted to the larger Neighborhood Improvement Projects (NIP)

Table B.1: Regulations and studies related to sea level rise planning (continued).

Policy, Resource, or Study Lead Agency	**Description**
Stormwater Facilities Plan (AECOM 2019)	• Describes the City's comprehensive stormwater infrastructure projects to improve system performance over the next 30 years • Serves as the basis for the Stormwater Master Plan update • Plan found that constructing pump stations, discharge structures, backflow preventers, catch basins, and raising roadway elevations, which were more effective than conventional approaches of detention ponds, gravity wells, and exfiltration trenches, particularly when considering sea level rise effects to drainage efficiency
Stormwater Needs Analysis – Technical Memorandum of Capital Plan Cost Development (AECOM 2022)	• Developed to satisfy House Bill 53 requirement for providers of stormwater management services to develop a 20-year infrastructure needs analysis • Provides backup information and list of assumptions used to draft projected annual stormwater project costs and funding sources • Includes a project implementation timeline following the prioritized list of NIP
Stormwater Management and Climate Adaptation Review (Urban Land Institute 2018)	• Recommendations compiled by a ULI panel for a holistic stormwater strategy • Considerations for recommendations include upgrades to hard infrastructure, opportunities for green and blue infrastructure, regulatory update, finance, and communications strategies • Provides design considerations that consider the City's range of physical typologies (beach/bowl/bay) and opportunities for creative placemaking to integrate art and culture into flood protection infrastructure • Includes communication strategies for engaging with the public and marketing the City's approach to sea level rise adaptation
Regional	
Unified Sea Level Rise Projections for Southeast Florida (Southeast Florida Regional Climate Change Sea Level Rise Work Group 2020)	• Regional guidance on a range of future projections of sea level rise anticipated through 2120 • Provides recommendations and examples on how to apply projections to a range of projects for local governments, planners, engineers, designers, and developers

Table B.1: Regulations and studies related to sea level rise planning (continued).

Policy, Resource, or Study Lead Agency	**Description**
State	
Florida Senate [Florida Statute 380.093] (Florida Department of Environmental Protection, 2021a)	• Statute establishes the Resilient Florida Grant Program to build resilience into Florida's infrastructure • Directs DEP to create a statewide flood vulnerability and sea level rise dataset and assessment using locally-developed analyses funded through the program • Establishes minimum requirements for sea level rise vulnerability assessments
Florida Senate [Florida Statute 161.551] (Florida Department of Environmental Protection, 2021b)	• Requires completion of a Sea Level Rise Impact Projection (SLIP) Study prior to new state-financed construction of structure located in the coastal building zone, which includes portions of the City • SLIP Study standards require evaluation of flood risk to the project considering the FEMA 1% annual chance water surface elevation, a 50-year planning horizon or the structure's expected life (whichever is less), and NOAA Intermediate High sea level rise projections
Federal	
National Flood Insurance Rate Maps (FIRM) (Federal Emergency Management Agency [FEMA] 2021) Effective maps: 2009 Preliminary maps released: 2021	• Flood hazard maps that depict areas of the City that are within the 100-year and 500-year coastal floodplain • Both the effective and preliminary maps include large areas of the City in the 100-year coastal floodplain • FIRMs are based on historical and existing sea level conditions and do not account for future sea level rise

B.2 Description of updated datasets

In 2017, the City completed a Sea Level Rise Vulnerability Assessment Guidebook (Guidebook) to inform the prioritization of assets for adaptation planning and identify flood thresholds for a consistent level of protection for City assets. The evaluated assets included in the 2017 Guidebook dataset serve as the foundational source of asset-level information for the updated vulnerability assessment but have been revised to reflect assets that have been updated since 2017. The updated asset inventory also includes the addition of new datasets that are now required as part of the Resilient Florida Program statute.

The asset inventory was revised to reflect post-2017 data updates through a collaborative process between the City and AECOM. A comparison was performed between assets evaluated in the City Guidebook with new information regarding asset locations and the removal/addition of individual assets. In general, most assets included in the 2017 City Guidebook were still applicable with several instances of an increase in the number of individual assets within each asset category.

To comply with the Resilient Florida Program statutes, the asset inventory was supplemented with the following critical asset types:

- Community centers
- Communication facilities
- Marinas
- Wastewater lift stations
- Potable water pump stations and storage tanks
- Electrical substations
- Disaster recovery centers
- Natural Shorelines
- Historical and cultural assets

More information about the development and organization of the asset inventory is described in Section 2.2 and Appendix C.

Before the vulnerability assessment could begin, the City needed to collect and organize a comprehensive inventory of assets that may be vulnerable to the considered flood sources. The purpose of the asset inventory was to assemble a GIS-based dataset of both City-owned and regionally important (i.e., county-, state- and federally owned) located within the City's boundary. Asset location and characteristics were then used in the exposure (See Section D) and sensitivity and consequence analyses (see Section E) to assess each asset's overall flood risk.

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Appendix C: Asset Inventory

C.1 Critical Asset Data Sources and Gap Analysis

It is not possible, or necessary, to evaluate the vulnerability of all individual assets within the City. Assets included in the inventory were prioritized for evaluation of potential flooding impacts and significance to the City and local communities. To begin identifying assets for this Assessment, the City first reviewed the inventory that was created for the previous (2017) Vulnerability Assessment. This inventory was the compared to the list of required assets for the Resilient Florida grant program (s.380.093 F.S.). The required assets found in this gap analysis were added (or updated) from the City's extensive geospatial data for asset locations. Further supplemental asset data was retrieved through the Miami-Dade County's Geospatial Data Hub, as well as through review and discussions with AECOM and City staff.

The datasets for the inventory were mostly acquired from publicly available sources and typically downloaded from the relevant websites or requested from the appropriate City department. Asset datasets were requested in GIS-capable formats for the required analyses (See Sections D and E). Data were reviewed by the City to confirm the datasets represent the best-available information for the considered assets. In several cases, the attributes of certain assets (e.g., asset name, asset ownership, etc.) were updated to reflect current information. Similarly, certain asset locations and boundaries were required to be modified to accurately reflect the asset.

Certain asset types required for this Assessment were not publicly available and required additional coordination. In addition to this inter-departmental gap analysis, the City's public engagement events (See Appendix A) allowed for the inclusion of publicly identified assets in Assessment. Including assets and facilities from these events provided the City with a preliminary list of highly-valued assets that would negatively impact City residents should they be damaged by flooding.

C.2 Final Asset Inventory

The City's final asset inventory comprised 57,637 individual asset features. Nearly all (99%) of these features were represented by linear segments associated with the City' s roadway and pipeline infrastructure and natural features, including sections of shoreline. Excluding these linear features, there were 597 structures, facilities, parks and other point-based infrastructure in the inventory. Once collected, all individual assets were organized into the Asset Categories required by the Resilient Florida grant program (s.380.093 F.S.):

- **Transportation Assets and Evacuation Routes:** Includes the City's major transportation networks and ancillary infrastructure.
- **Critical Infrastructure:** Includes the infrastructure and facilities essential to daily operations within the City.
- **Critical Community and Emergency Facilities:** Includes structures essential to everyday community well-being, as well as facilities critical to emergency response and recovery.
- **Natural, Cultural, Historical Resources:** Includes the City's natural features, recreational spaces and historically or culturally important assets.

The required asset attributes were added and modified to comply with these requirements. The metadata for these data was also updated to reflect the source, methods (where applicable) description, constraints, and purpose of the datasets.

The list of City assets that were evaluated as part of the Assessment are presented in **Table C.1**. Structures, facilities, parks and other named assets are identified individually. Linear features and assets that do not have simple identifiers (e.g., drinking water storage tanks) are captured collectively.

Table C.1: Inventory of City assets included in the Assessment.

Asset Category	Asset Subcategory	Asset	Total
Transportation Assets and Evacuation Routes	Major Roadways	Roadways (owned by City of Miami Beach, Miami-Dade County, Florida Department of Transportation)	169 miles
Transportation Assets and Evacuation Routes	Major Roadways	Evacuation Routes	2 miles
Transportation Assets and Evacuation Routes	Bridges	Bridges	47
Transportation Assets and Evacuation Routes	Marinas	Marinas	2
Transportation Assets and Evacuation Routes	Public Transit	Bus Stops	283
Critical Infrastructure	Wastewater Treatment Facilities and Lift Stations	Wastewater Lift Stations	23
Critical Infrastructure	Wastewater Treatment Facilities and Lift Stations	Wastewater Force Mains and Gravity Mains	262 miles
Critical Infrastructure	Electricity Production and Supply Facilities	Electrical Substations	7
Critical Infrastructure	Drinking Water Facilities	Potable Water Pump Stations	6
Critical Infrastructure	Drinking Water Facilities	Potable Water Storage Tanks	6
Critical Infrastructure	Water Utility Conveyance Systems	Potable Water Mains and Laterals	255 miles
Critical Infrastructure	Stormwater Treatment Facilities and Pump Stations	Stormwater Pump Stations	48
Critical Infrastructure	Communication Facilities	Telecommunication Towers	5
Critical Infrastructure	Disaster Debris Management Sites	Normandy Golf Course	1
Critical Infrastructure	Disaster Debris Management Sites	Lummus Park	1
Critical Infrastructure	Disaster Debris Management Sites	Miami Beach Golf Course	1
Critical Infrastructure	Disaster Debris Management Sites	Par 3 Golf Course	1

Table C.1: Inventory of City assets included in the Assessment (continued).

Asset Category	Asset Subcategory	Asset	Total
Critical Infrastructure	Disaster Debris Management Sites	North Beach Oceanside Park	1
Critical Community and Emergency Facilities	Schools	South Pointe Elementary	1
Critical Community and Emergency Facilities	Schools	Fienberg/Fisher Elementary	1
Critical Community and Emergency Facilities	Schools	Fienberg/Fisher Adult	1
Critical Community and Emergency Facilities	Schools	Miami Beach Senior High School	1
Critical Community and Emergency Facilities	Schools	North Beach Elementary	1
Critical Community and Emergency Facilities	Schools	Nautilus Middle	1
Critical Community and Emergency Facilities	Schools	Biscayne Beach Elementary	1
Critical Community and Emergency Facilities	Colleges and Universities	Florida International University Wolfsonian	1
Critical Community and Emergency Facilities	Colleges and Universities	Florida International University Urban Studios	1
Critical Community and Emergency Facilities	Community Centers	South Shore Community Center	1
Critical Community and Emergency Facilities	Community Centers	Flamingo Park and Michigan	1
Critical Community and Emergency Facilities	Community Centers	Unidad Center	1
Critical Community and Emergency Facilities	Community Centers	Coral House Senior Center	1
Critical Community and Emergency Facilities	Community Centers	North Shore Youth Center	1
Critical Community and Emergency Facilities	Community Centers	Scott Rakow Youth Center	1
Critical Community and Emergency Facilities	Community Centers	Flamingo Tennis Center	1
Critical Community and Emergency Facilities	Community Centers	Miami Beach Police Athletic League Facility	1
Critical Community and Emergency Facilities	Community Centers	Muss Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Stillwater Park Pavilion	1

Table C.1: Inventory of City assets included in the Assessment (continued).

Asset Category	Asset Subcategory	Asset	Total
Critical Community and Emergency Facilities	Community Centers	Fairway Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Crespi Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	North Beach Oceanside Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Parkview Island Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Normandy Isle Park and Pool	1
Critical Community and Emergency Facilities	Community Centers	La Gorce Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Fisher Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	South Pointe Park Pavilions	1
Critical Community and Emergency Facilities	Community Centers	Marjory Stoneman Douglass	1
Critical Community and Emergency Facilities	Community Centers	Lummus Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Shane Rowing Center	1
Critical Community and Emergency Facilities	Community Centers	Allison Park Pavilion	1
Critical Community and Emergency Facilities	Community Centers	Miami Beach Regional Library	1
Critical Community and Emergency Facilities	Community Centers	North Shore Branch Library	1
Critical Community and Emergency Facilities	Community Centers	South Shore Branch Library	1
Critical Community and Emergency Facilities	Community Centers	Jewish Learning Center & Library	1
Critical Community and Emergency Facilities	Emergency Operations Centers	Mt Sinai Hospital	1
Critical Community and Emergency Facilities	Emergency Operations Centers	Fire Station #2	1
Critical Community and Emergency Facilities	Fire Stations	Fire Station #1, 2, 3, 4	4
Critical Community and Emergency Facilities	Fire Stations	Fire Administration	1

Table C.1: Inventory of City assets included in the Assessment (continued).

Asset Category	Asset Subcategory	Asset	Total
Critical Community and Emergency Facilities	Fire Stations	Beach Patrol/Ocean Rescue	1
Critical Community and Emergency Facilities	Hospitals	Mt Sinai Hospital Buildings	6
Critical Community and Emergency Facilities	Law Enforcement Facilities	Sub Stations (Sailport, North End)	2
Critical Community and Emergency Facilities	Law Enforcement Facilities	Police Station Headquarters	1
Critical Community and Emergency Facilities	Law Enforcement Facilities	Beach Patrol/Ocean Rescue	1
Critical Community and Emergency Facilities	Law Enforcement Facilities	Marine Patrol	1
Critical Community and Emergency Facilities	Local Government Facilities	Fleet Maintenance Complex – Electro Wave Garage	1
Critical Community and Emergency Facilities	Local Government Facilities	Fleet Maintenance Complex – Shop #1, 2, 3	3
Critical Community and Emergency Facilities	Local Government Facilities	Bayshore Maintenance Building (Golf Course)	1
Critical Community and Emergency Facilities	Local Government Facilities	Parks Plant Nursery	1
Critical Community and Emergency Facilities	Local Government Facilities	Public Works Yard	1
Critical Community and Emergency Facilities	Local Government Facilities	Facilities Management	1
Critical Community and Emergency Facilities	Local Government Facilities	Convention Center	1
Critical Community and Emergency Facilities	Local Government Facilities	City Hall	1
Critical Community and Emergency Facilities	Local Government Facilities	Old City Hall/Justice Center	1
Critical Community and Emergency Facilities	Local Government Facilities	Miami Beach Golf Course Club House	1
Critical Community and Emergency Facilities	Local Government Facilities	Internal Affairs	1
Critical Community and Emergency Facilities	Local Government Facilities	South Pointe Park Ranger Station	1
Critical Community and Emergency Facilities	Logistical Staging Areas	Convention Center Loading Dock	1
Critical Community and Emergency Facilities	Affordable Public Housing	Lottie Apartments	1

Table C.1: Inventory of City assets included in the Assessment (continued).

Asset Category	Asset Subcategory	Asset	Total
Critical Community and Emergency Facilities	Affordable Public Housing	Madeleine Village Apartments 1, 2, 3, 4	4
Critical Community and Emergency Facilities	Affordable Public Housing	Barclay Plaza Apartments	1
Critical Community and Emergency Facilities	Affordable Public Housing	Neptune Apartments	1
Critical Community and Emergency Facilities	Affordable Public Housing	The London (1965)	1
Critical Community and Emergency Facilities	Affordable Public Housing	The London (1975)	1
Critical Community and Emergency Facilities	Affordable Public Housing	Coral Apartments	1
Critical Community and Emergency Facilities	State Government Facilities	Coast Guard Station	1
Critical Community and Emergency Facilities	State Government Facilities	Social Security Office	1
Critical Community and Emergency Facilities	State Government Facilities	Court Facility in Old City Hall	1
Natural, Cultural, and Historical Resources	Parks	City Parks	51
Natural, Cultural, and Historical Resources	Surface Water Bodies	Bayshore Park Retention Pond	1
Natural, Cultural, and Historical Resources	Natural Resources	Natural Shorelines	4
Natural, Cultural, and Historical Resources	Natural Resources	Shoreline	1
Natural, Cultural, and Historical Resources	Natural Resources	Dune System	1
Natural, Cultural, and Historical Resources	Natural Resources	Dune Cross Overs	173
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Miami Beach Bandshell	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Byron Carlyle Theatre	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Bass Museum of Art	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Colony Theater	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Holocaust Memorial	1

Table C.1: Inventory of City assets included in the Assessment (continued).

Asset Category	Asset Subcategory	Asset	Total
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Jackie Gleason Theater	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Miami City Ballet	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Rotunda Building	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Old City Hall	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Botanical Garden	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	New World Center	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Wolfsonian Museum	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Jewish Museum of FL	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Art Deco Center	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	28th St Obelisk	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	41st St Fountain	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Flagler Monument	1
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Normandy Fountain	1

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Appendix D: Review Sea Level Rise Science and Hazard Mapping

D.1 Sea Level Rise Science

Scientific research and global measurements collected over many decades reveal a clear trend of increasing global atmosphere and ocean average temperatures. The warming trend represents a rapid deviation relative to historic climate trends. As a direct consequence of this warming, average sea levels are also rising (Compact 2020).

The primary drivers of global sea levels rising are melting land ice (e.g., glaciers, snowpack) and the thermal expansion of seawater, as the oceans eventually absorb and retain much of the excess heat trapped by the atmosphere. Recent analysis of coastal tide stations and satellite data of ocean surface elevations also indicate an annual acceleration in the rate of sea level rise (Sweet et al. 2017).

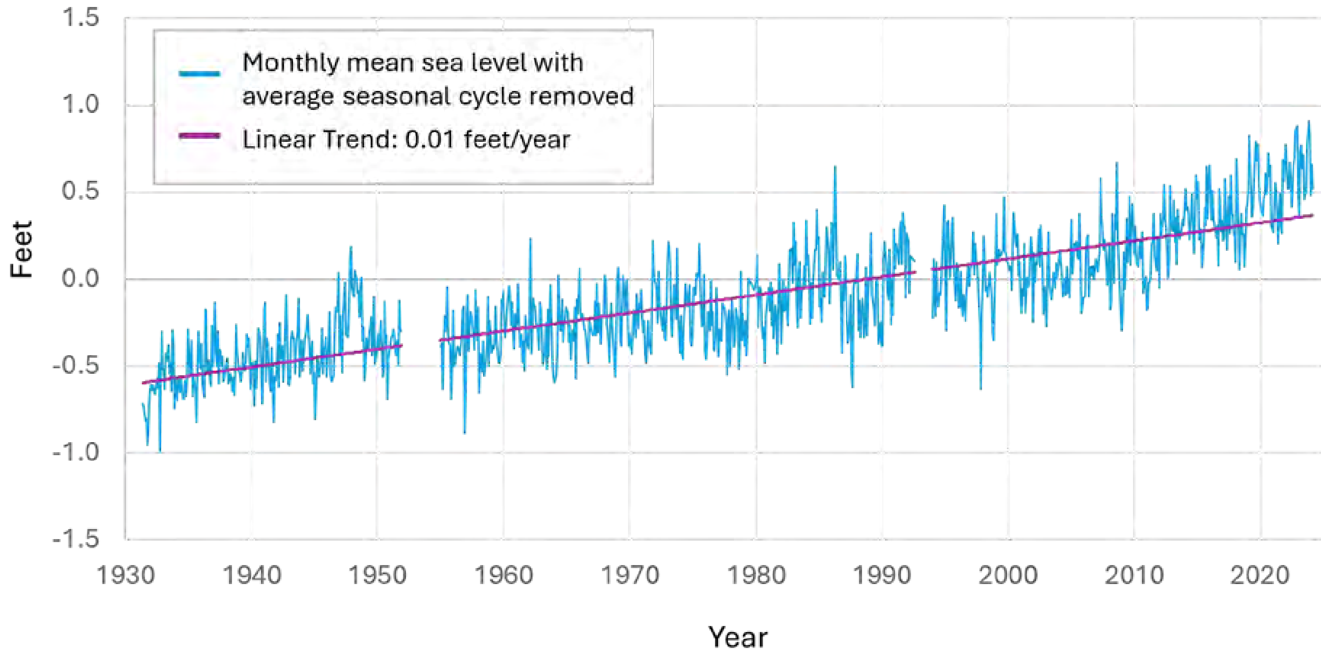
Local factors such as changes in ocean currents and vertical land movement also influence the relative sea level change rates in a location. Southeast Florida is at increased risk of sea level rise due its low elevation above current mean sea level, increased seawater infiltration into the porous limestone bedrock as sea levels rise, and the slowing of the offshore Florida Current, which could allow additional seawater to build along the shoreline (Compact 2020).

Current water levels elevated by recent sea level rise are already causing noticeable impacts in the City by intensifying high tide events, raising the groundwater table, eroding shorelines, and impairing the function of stormwater management systems. Further sea level increases will worsen flooding in low-lying areas of the City and expand the floodplain inland to affect locations that were once at a lower risk of flood exposure. Sea level rise may also increase the impacts associated with extreme events, such as coastal storms and king tides, by elevating the average baseline water level condition and allow floodwaters to reach higher land elevations. Without adaptation measures, growing flood frequency and extents will constrain daily operations in the City and greatly increase capital costs to repair, replace, or relocate assets and infrastructure.

The following sections provide an overview of existing local water levels conditions as well as historical and projected changes in sea level. These sections will also describe the approach to mapping sea level rise and water level scenarios used for the Vulnerability Assessment.

D.1.1 Observed Sea Level Rise Trends

The Virginia Key tide station (NOAA #872314), located in Biscayne Bay is the nearest tide station to the City. The station has measured more than a 0.9-foot (11-inch) increase in mean sea level since its installation in 1931 (**Figure D.1**). When averaged over the full observational period, this equates to 0.01 feet/year (0.12 inches/year). Since 2006, the observed rate has been closer to 0.03 feet/year (0.35 inches/year) due to localized effects, such as changes in the speed and thermodynamics of the Florida Current and Gulf Stream (Domingues et al. 2018; Sweet et al. 2018; Volkov et al. 2019, NOAA/NESDIS/STAR 2019).



Source: NOAA Sea Level Rise Trends (Station #8723214).

Figure D.1: Observed sea level rise measurements and trends in Biscayne Bay, FL.

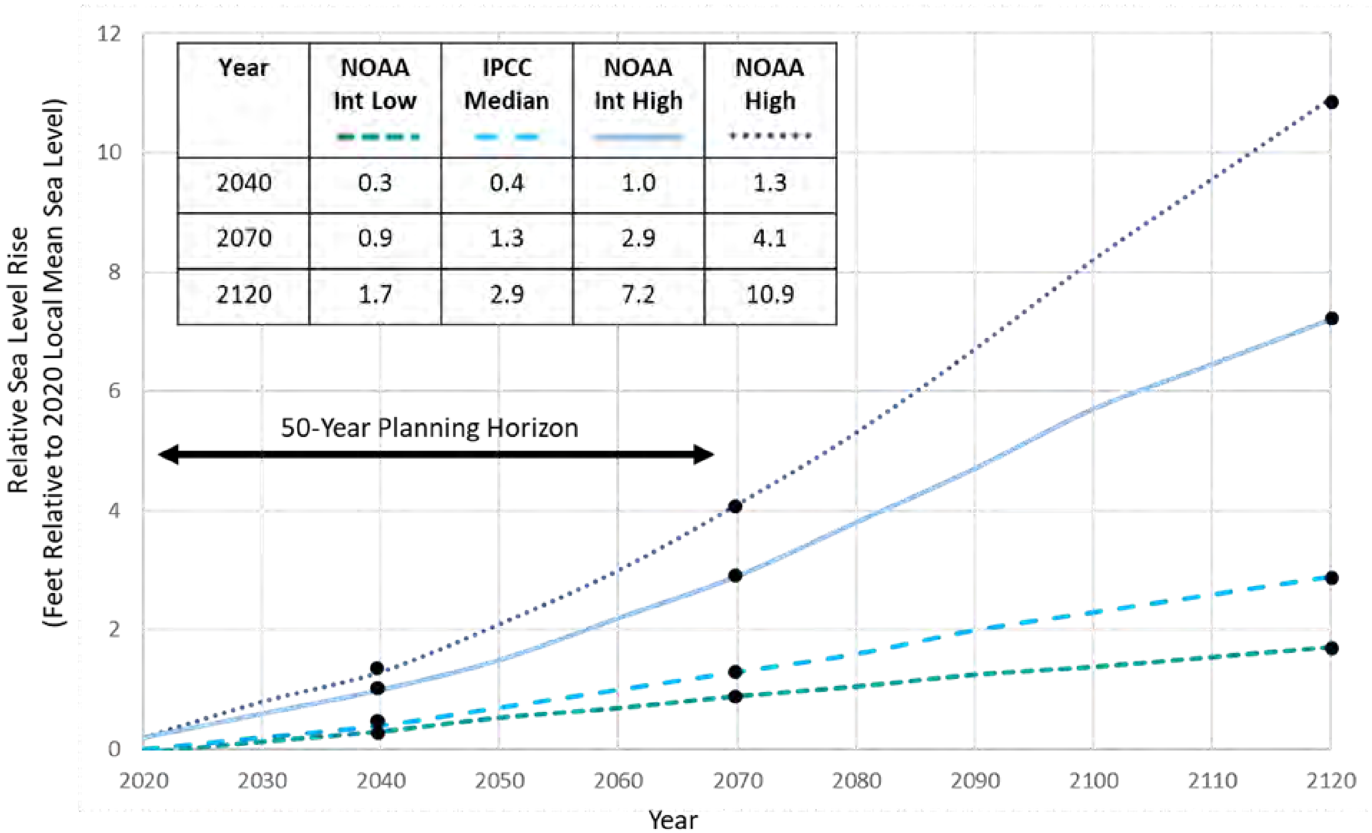
D.1.2 Projected Sea Level Rise

The most recent Unified Sea Level Rise Projections Guidance Report (Compact Report) released by the Southeast Florida Regional Climate Change Compact in 2020 details recent sea level rise trends for Southeast Florida and provides regional sea level rise projections through the year 2120. The Compact Report synthesizes the latest peer-reviewed science and climate modelling data to provide the best-available sea level rise projections for Southeast Florida. The projections are intended to support local governments and regional entities in the development of science-based adaptation strategies, policies, and infrastructure design that are consistent across the region.

The sea level rise projections recommended by the Compact Report are sourced from the International Panel on Climate Change (IPCC)'s 5th Annual Report (IPCC 2013) and the National Oceanic and Atmospheric Administration (NOAA)'s 2017 Global and Regional Sea Level Rise Scenarios for the United States (Sweet at al. 2017) and include a range of sea level possibilities derived from current and modeled greenhouse gas (GHG) emission trends. The Compact Report has adjusted these projections to include Southeast Florida regional factors.

The Compact Report provides three projections (i.e., curves) for consideration during planning processes: (1) IPCC Median, (2) NOAA Intermediate High, and (3) NOAA High. The inclusion of multiple curves are intended to assist local governments and entities to consider sea level rise in planning and design based on specific project needs (e.g., infrastructure life cycle, criticality risk tolerance to flooding, and adaptability to sea level rise). In addition to regional guidance, the State of Florida requires an evaluation of potential flood risk based on the NOAA 2017 Intermediate Low and NOAA 2017 Intermediate High projections for adaptation projects seeking funding through the Resilient Florida Grant Program (s. 380.093, Florida Statute).

From these projections, the City's expected sea levels may be between 0.3 to 1.3 feet above 2020 water levels by mid-century and 1.7 to 10.9 feet higher in by next century (**Figure D.2**).



Note: A 0.4-foot offset was applied to the NOAA projections to adjust the baseline year from 2000 to 2020. This is based on Compact guidance that states 0.3 feet of sea level rise occurred from 2000 to 2017, which extrapolates to 0.4 feet from 2000 to 2020.

Figure D.2: Sea level rise projections for Miami Beach.

D.2 Sea Level Rise Flood Analysis

To evaluate the potential exposure of City assets to future water level conditions, a sea level rise flood analysis was performed. The analysis produced a series of flood hazard maps that provide a useful means of examining the timing and extent of future flooding that may be experienced based on projections of sea level rise.

The sections below describe the selection of sea level rise scenarios evaluated as part of the Vulnerability Assessment, development of flood mapping layers, and mapping assumptions.

D.2.1 Water Level Scenario Selection

In accordance with the Resilient Florida Grant Program (s. 380.093, Florida Statute), sea level rise projections were selected to align with the planning horizons of 2040 and 2070. An existing conditions (2020) planning horizon was added to provide a baseline year for comparison. Each future planning horizon considers three sea level rise curves described in Section D1.2.: (1) the NOAA 2017 Intermediate Low, (2) NOAA 2017 Intermediate High, and (3) NOAA 2017 High scenarios to provide a comprehensive examination of potential flood hazard exposure under a range of sea level conditions (**Table D.2**).

Table D.1: Sea level rise projections for 2040 and 2070 based on 2020 water level conditions at the Viriginia Key NOAA Tide Guage.

Year	NOAA Intermediate Low	NOAA Intermediate High	NOAA High
Existing Conditions (2020)	0	0	0
2040	0.3	1.0	1.4
2070	0.9	2.9	4.1

Note: A 0.4-foot offset was applied to the NOAA projections to adjust the baseline year from 2000 to 2021. This is based on Compact guidance that states 0.3 feet of SLR occurred from 2000 to 2017, which extrapolates to 0.4 feet from 2000 to 2020.

Future sea levels were evaluated under three water level conditions:

High Tide

High tide flooding was represented by the City's median annual king tide water elevation (1.8-feet NAVD88) determined by tidal elevation data from the Virginia Key NOAA Tide Gauge. King tides occur annually in late fall and generate the highest tides that impact the City each year and may persist for several days. During king tide events, coastal waters more easily overtop low-lying shorelines and cause groundwater to rise to the surface, flooding low-lying inland areas.

Compound Flood

Compound flooding was represented by the simultaneous occurrence of a 10-year, 24-hour rainfall event (8.75 inches) and a king tide (1.8 feet NAVD88). A 10-year rainfall event has a 10 percent chance of occurring in any given year. Such high-intensity rain events can generate stormwater runoff that exceeds the City's existing stormwater network capacity leading to flooding of low-lying areas. Rainfall flooding impacts are worsened during a king tide, as high coastal water levels reduce the ability of the stormwater system to discharge floodwaters through coastal outfall structures.

Coastal Storm Flooding

Coastal storm flooding is represented by the 1-percent annual chance (i.e., 100-year) coastal water elevation. This event has a 1-percent chance of occurring in any given year and is modeled by FEMA to be approximately 6.2 feet NAVD88. Such water levels are typically associated with large tropical storms and hurricanes which have high winds and low atmospheric pressure that temporarily elevate coastal water levels. Due to the City's low elevation and flat topography, even small increases in water levels during coastal storms can push floodwater inland from the shoreline.

D.2.2 Developing Coastal Flood Layers

Development of the coastal (high tide and coastal storm) flood hazard data layers utilized two primary data sources: (1) base topographic data and (2) water surface elevations, with and without the considered sea level rise scenarios, to represent each evaluated flood condition. Existing water levels correspond to the current (2020) king tide and 1-percent annual chance coastal storm water levels detailed in Section D2.1. These water levels represent the extension of the ocean water surface at the shoreline and projected flooding of inland areas. Future surface water elevations were developed by adding each sea level rise projection to each of the baseline coastal flood conditions. More detailed information on this methodology is provided below.

Base Topographic Data

The coastal flood maps require a high-quality (1.5-meter resolution) merged bathymetric/topography digital elevation model (DEM) for shoreline and inland elevations across the City. The DEM was developed by NOAA using airborne bathymetric and topographic light detection and ranging (LiDAR) survey data collected in 2018-2019. This dataset represents the most up-to-date elevation dataset for the area, which is important for capturing ongoing capital improvement projects throughout the City. This dataset represents the "bare earth" elevations of the City and excludes buildings and vegetation. The DEM has a vertical accuracy of ±0.062 meters (0.2 feet) for non-vegetated areas and a raster cell size of 1.5 meters (3 feet) and is consistent with guidelines presented in the National Standard for Spatial Data Accuracy (NSSDA) (FGDC 1998). Elevations across the City range from 0-to-22-feet NAVD88.

In several locations, the DEM was revised to include elevated roadways that were completed since collection of the 2018 LiDAR dataset. Revisions included merging updated elevations collected from as-built engineering drawings into the baseline DEM to represent accurate existing elevations of the roadway. Roadway elevation modifications to the DEM were performed for Palm and Hibiscus Islands and Indian Creek.

Shoreline Delineation

An accurate shoreline delineation was required to identify locations of shoreline overtopping and potential flood pathways that may result in coastal flooding of low-lying inland areas. The shoreline was delineated manually using the DEM and orthoimages. Using this information, the edge of seawalls, revetments, vegetated areas, and dune crests were used to identify the land-sea interface as the shoreline (**Figure D.3**).

Shoreline elevations at seawall structures were also revised to reflect a recent citywide seawall survey collected using drones to measure elevations. Surveyed seawall elevations were merged into the baseline DEM to represent more detailed existing seawall features and elevations along the shoreline than can be observed in LiDAR data used to develop the DEM.

Figure D.3: Delineated City shoreline.

High Tide Water Surface

The high tide flood hazard was calculated by using an evaluation of monthly and annual maximum water elevations observed at the Virginia Key tide station from 1994 through 2020. The median annual maximum tide elevation of 1.8 feet NAVD88 was determined as the baseline high tide water level. This estimate corresponds with other capital planning and design efforts for the City of Miami Beach (Jacobs 2020).

The median king tide water level elevation was used to develop a baseline water surface grid, which was then adjusted by adding each evaluated sea level rise scenario. Three sea level rise scenarios across two future time horizons resulted in six future high tide water level mapping layers.

Coastal Storm Water Surface

The coastal storm flood hazard was evaluated using the 1-percent annual chance storm tide elevation (i.e., 100-year coastal storm). The coastal storm elevation is a statistically derived water elevation that has a 1 percent chance of occurring in any given year and includes the effects of elevated water levels due to winds, low atmospheric pressure, and astronomical tides.

The baseline coastal storm conditions were leveraged from a regional coupled hydrodynamic model developed as part of the FEMA South Florida Flood Insurance Study (FEMA 2021b). The model output provides a spatially variable water surface grid of statistically derived water elevations along the City's shoreline. Average water elevations corresponding to this event were 6.2 feet NAVD88.

The average coastal storm water level elevation was used to develop a baseline water surface grid, which was then adjusted by adding each evaluated sea level rise scenario. Three sea level rise scenarios across two future time horizons resulted in six future coastal storm water level mapping layers.

D.2.3 Developing Compound Flood Layers

Compound flood hazard layers were represented by the simultaneous occurrence of a 10-year, 24-hour rainfall event and a king tide. Water elevations associated with this flood hazard were generated using the Environmental Protection Agency (EPA)'s Storm Water Management Model (SWMM). This model was used to identify areas of the City that may be unable to drain efficiently and experience stormwater ponding due to high coastal water levels at the City's stormwater outfall structures. This section describes the SWMM modeling process. The process to obtain king tide elevations used as an input to the model are described in Section D.2.2.

Storm Water Management Model (SWMM)

An existing SWMM model was developed in 2013 by CDM Smith as part of a Citywide Stormwater Management Master Plan. This model was leveraged for the Vulnerability Assessment. The SWMM model, shown conceptually in **Figure D.4**, consists of a two-dimensional (2D) dynamic rainfall-runoff-routing simulation model used to estimate runoff from a specified rainfall event based on the City's existing stormwater network. The runoff component of the model operates assuming a collection of 416 stormwater catchment basins located across the City that receive precipitation and generate runoff. The routing component of the model simulates the drainage of stormwater runoff through a system of pipes, culverts, storage areas, pumps, and outfall structures that make up the City's existing stormwater network connecting the basins. Updates to the model included the addition of two stormwater pump stations that have been added to the City's stormwater network since the model was originally developed.

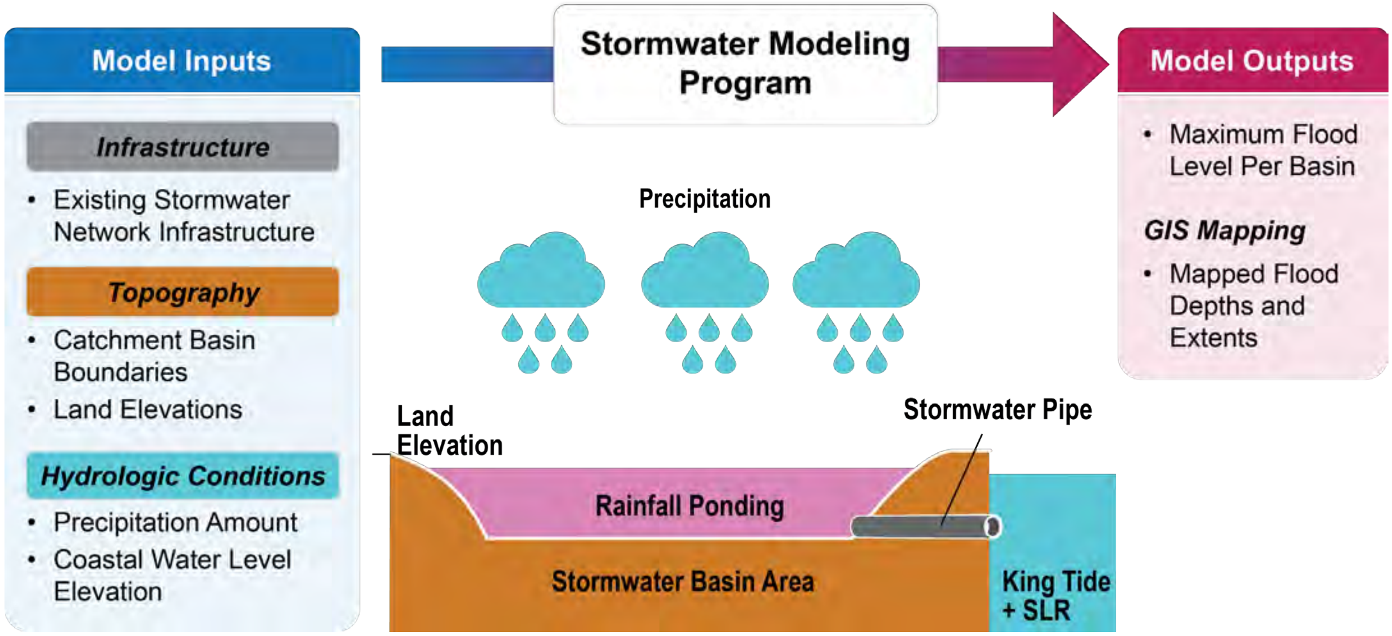


Figure D.4: Conceptual diagram of stormwater model components.

Model inputs included the 10-year, 24-hour rainfall event (8.75 inches) and a king tide water level elevation (1.8 feet NAVD88) to estimate the ability of the existing stormwater network to convey and drain stormwater during elevated coastal water level conditions. The rainfall event was derived from return period design storms recommended by the South Florida Water Management District (SFWMD) for the Miami Beach area (7.0-inches), with a 125-percent increase factor included to account for potential increases in rainfall intensity. This future 10-year, 24-hour rain event also complies with City requirements for the level of service for roadways adopted by the Mayor's Blue Ribbon Panel (Resolution 2017-30039) and the stormwater flood considerations that were evaluated in the City's Updated Stormwater Master Plan.

The coastal water elevation used to represent a king tide in the model aligns with the high tide flood hazard, as described in Section D.2.2. Consideration of king tides was used in the model to inform the existing stormwater network's ability to discharge water at outfall structures that may be exceeded during extreme high tide events. Sea level rise projections (described in Section D.2.1) were added to the existing king tide elevation to understand the effect that rising coastal water levels could have on the ability to efficiently drain or pump stormwater from the City's developed areas in the future.

In total, seven model simulations were completed for the Citywide SWMM model to analyze changes in flood extents. These included one simulation for existing (2020) conditions and the six future (2040 and 2070) sea level rise scenarios. Each model simulation resulted in a maximum flood level per basin. The elevation values were exported to GIS to map associated flood extents and depths.

D.2.4 Mapping Flood Hazards

The mapping of the considered flood hazard sections described in Section D2.2 and D2.3 is comprised of two components: (1) the creation of flood extent and depth layers for all flood sources and with each sea level rise scenario and (2) a shoreline overtopping analysis to identify flood pathways for coastal flood sources (high tide and coastal storms).

Depth and Extent of Flooding

Depth of flooding was estimated by subtracting the land surface DEM from the water surface grids created for each evaluated flood sources. Both land and water surface grids were generated using the same horizonal resolution and grid spacing allowing for a simple raster cell subtraction. The resulting DEM provides the inland extent and depth of projected flooding.

For coastal flood sources (high tide and coastal storms), an additional step was needed to account for hydraulic connectivity. The methodology described by Marcy et al. (2011) employs two rules for assessing whether a grid cell is inundated by floodwaters. A cell must be below the mapping scenario water level, and it must be connected to an adjacent grid cell that is either flooded or open water. NOAA's methodology builds on this approach by applying an "eight-sided rule" for connectedness, where the grid cell is considered "connected" if any of its cardinal or diagonal directions are connected to a flooded grid cell. This approach decreases the inundated area over earlier inundation methods that considered a grid cell to be inundated solely based on its elevation (i.e., all grid cells with an elevation below the reference water level were shown as inundated). The assessment of hydraulic connectivity removes areas from the inundation zone if they are protected by seawalls or other topographic features that are not overtopped.

The hydraulic connectivity assessment also provides a means to identify areas that may be prone to flooding due to groundwater that rises above the ground surface. Due to the City's limestone geology, groundwater is often at the same level as coastal water levels. Therefore, flooded areas that are not hydraulically connected to a coastal flood source (e.g., shoreline, canal) were identified on the maps as potential groundwater flood areas (**Figure D.5**).

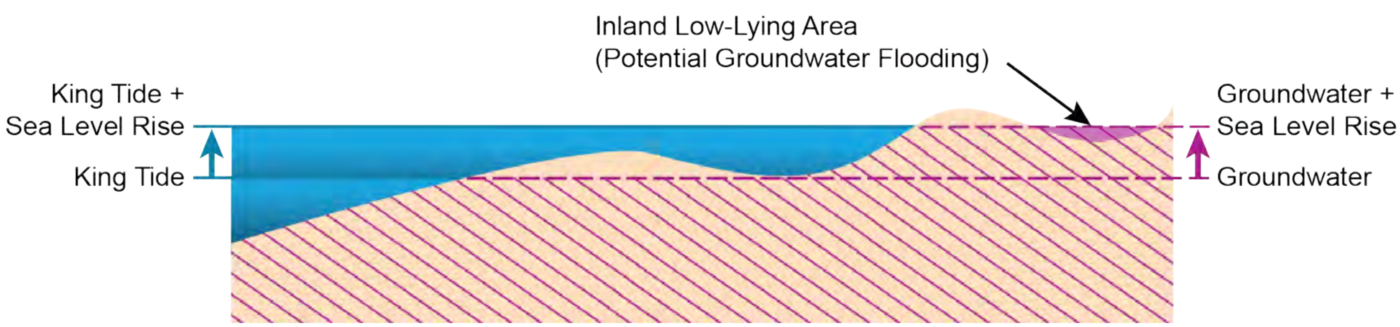


Figure D.5: Conceptual groundwater flooding cross section.

Shoreline Overtopping

A shoreline overtopping analysis was completed to identify low-lying shoreline segments that may act as pathways for the flooding of inland areas. Overtopping layers were created for each coastal flood hazard mapping scenario (high tide and coastal storm) using the delineated shoreline developed with the base topographic DEM. The delineated shoreline was overlaid on the flood layers to evaluate locations where the shoreline elevation is exceeded by the water surface (see **Figure D.6**). The length and depth of shoreline overtopping increases with higher sea level rise scenarios.

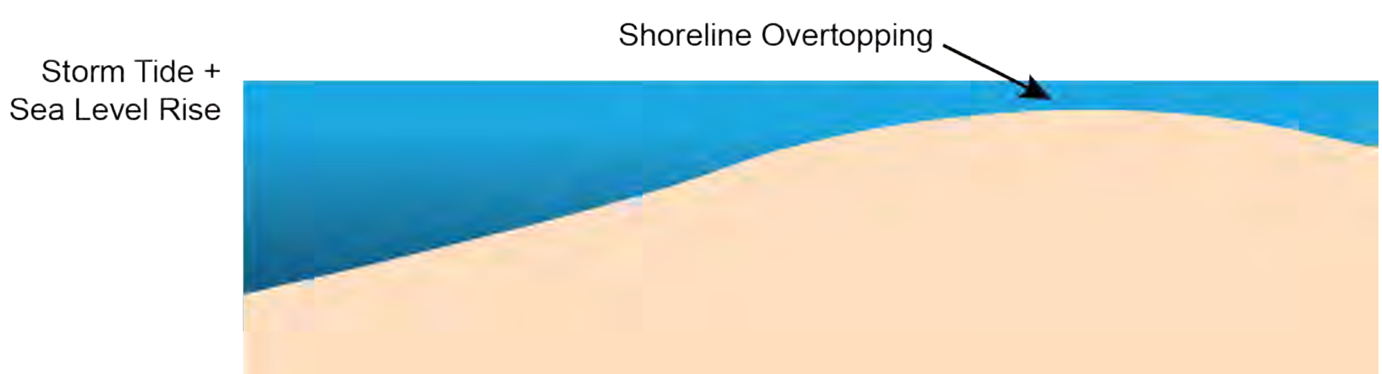


Figure D.6: Conceptual shoreline cross section illustrating overtopping.

Mapping Assumptions and Limitations

The flood hazard maps are intended as a screening tool to assess exposure to existing and future flood events. They represent a "do nothing" approach, where future mitigation and potential flood protection projects are not considered. Although they rely on the best-available information and data sources, they are still associated with a series of assumptions and caveats. The following assumptions and caveats apply to the flood hazard maps:

- Changes in storm characteristics, including climate change-driven changes in the frequency and intensity of storms, shift in storm tracks, magnitude of storm tides, and wave heights were not considered in this analysis.
- Shoreline elevations and the height of other topographic features that may affect floodwater conveyance are derived from a combined-source LiDAR dataset and are accounted for in the flood hazard layers. The data have not been extensively confirmed, and elevations could be overrepresented or underrepresented by the LiDAR data.
- The coastal flood source (high tide and coastal storm) mapping methodology is a GIS-based "bathtub model approach," which assumes areas hydraulically connected to the coast with a lower elevation than the evaluated water condition are at risk of being flooded. It is often a conservative approach used for planning-level studies that and does not consider the associated physics of overland flow, dissipation, drainage, or potential erosion associated with extreme water levels and waves.
- Extreme coastal storm flood conditions of the 1-percent annual chance storm (i.e., 100-year storm) depicted in the maps are a conservative estimate of areas that may be exposed to coastal storm flooding. The duration of the storm event is not accounted for in the modeling of temporary flood conditions. As a result, the limit of flooding depicted on the maps may overestimate the actual extent of flooding during a storm event.

To account for these caveats, a more sophisticated modeling effort would be required. However, given the uncertainties associated with sea level rise and future land use changes, development, and geomorphic changes that will occur over the next century, a more sophisticated modeling effort may not necessarily provide more accurate results.

Interpreting Flood Maps

The flood hazard maps were developed to assist visualizing areas of the City at risk to flooding from each of the considered flood sources (high tide, compound flooding, coastal storms). Example map panels for high tide conditions are shown in **Figure D.7** through **Figure D.9** to illustrate the +1.0-foot sea level rise associated with the NOAA Intermediate High scenario in the year 2040. The legend along the right side of the map provides key information for interpreting the displayed data:

Map Scenario

The sea level rise scenario and water level condition shown on the map is indicated at the top of the legend.

Depth of Flooding

The legend indicates the depth of high tide flooding. Light blue areas indicate shallow flooding and dark blue areas indicate deeper flooding. Purple areas indicate the extent, but not depth, of low-lying inland areas that are prone to potential groundwater flooding.

Shoreline Overtopping

Yellow areas of the shoreline indicate low-lying elevations that are lower than the evaluated water level condition and may be overtopped, providing a flood pathway for the City.

The resulting output mapping layers were used as input for the spatial analysis to estimate the exposure of City assets. Flood hazard layers were overlaid on asset feature locations to evaluate for overlap, indicating potential flood exposure.

The complete set of flood hazard map books are presented in Section D4 (Flood Hazard Maps).

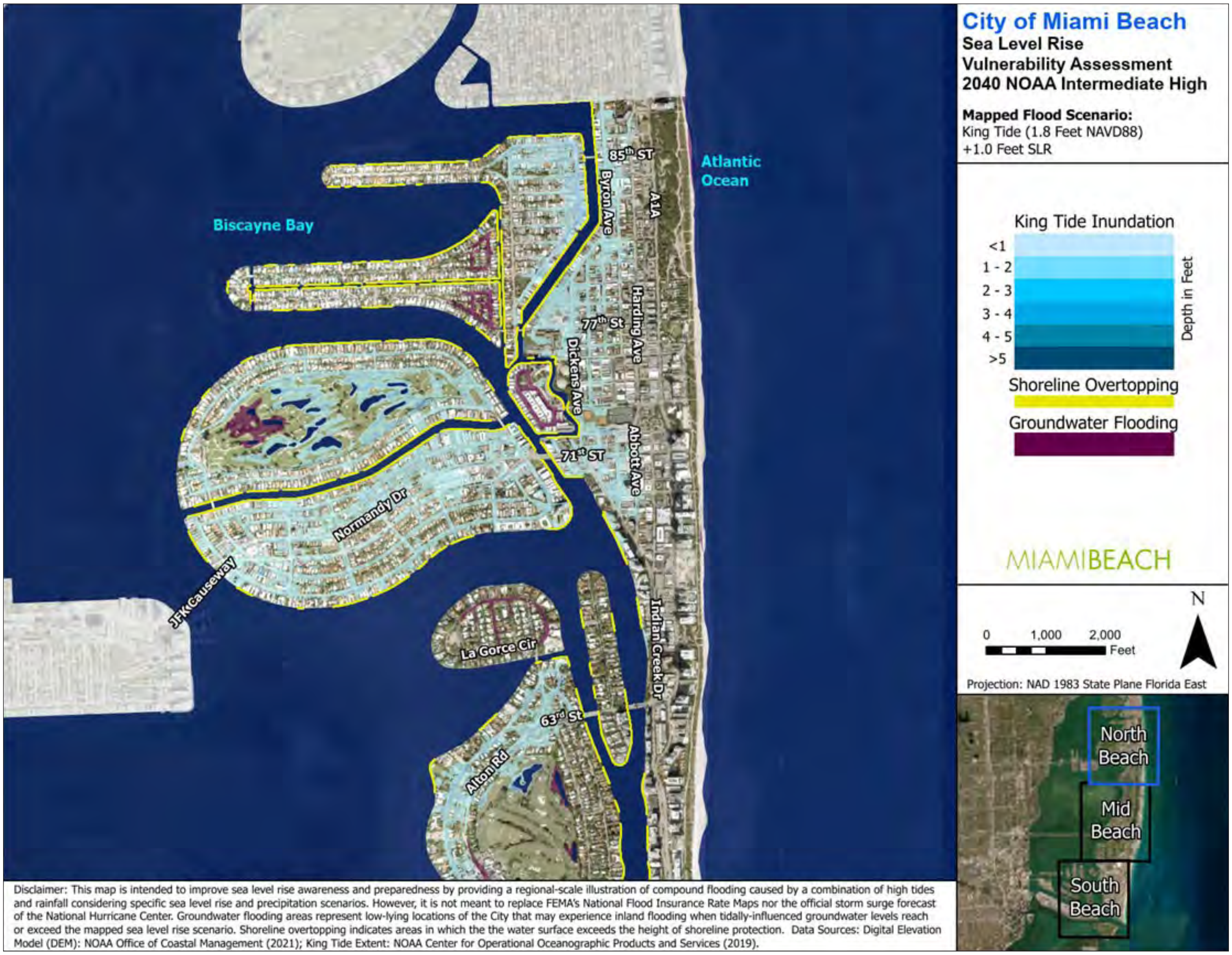


Figure D.7: Miami Beach (North Beach) high tide flooding with 1 foot of sea level rise (2040 NOAA Intermediate High scenario).

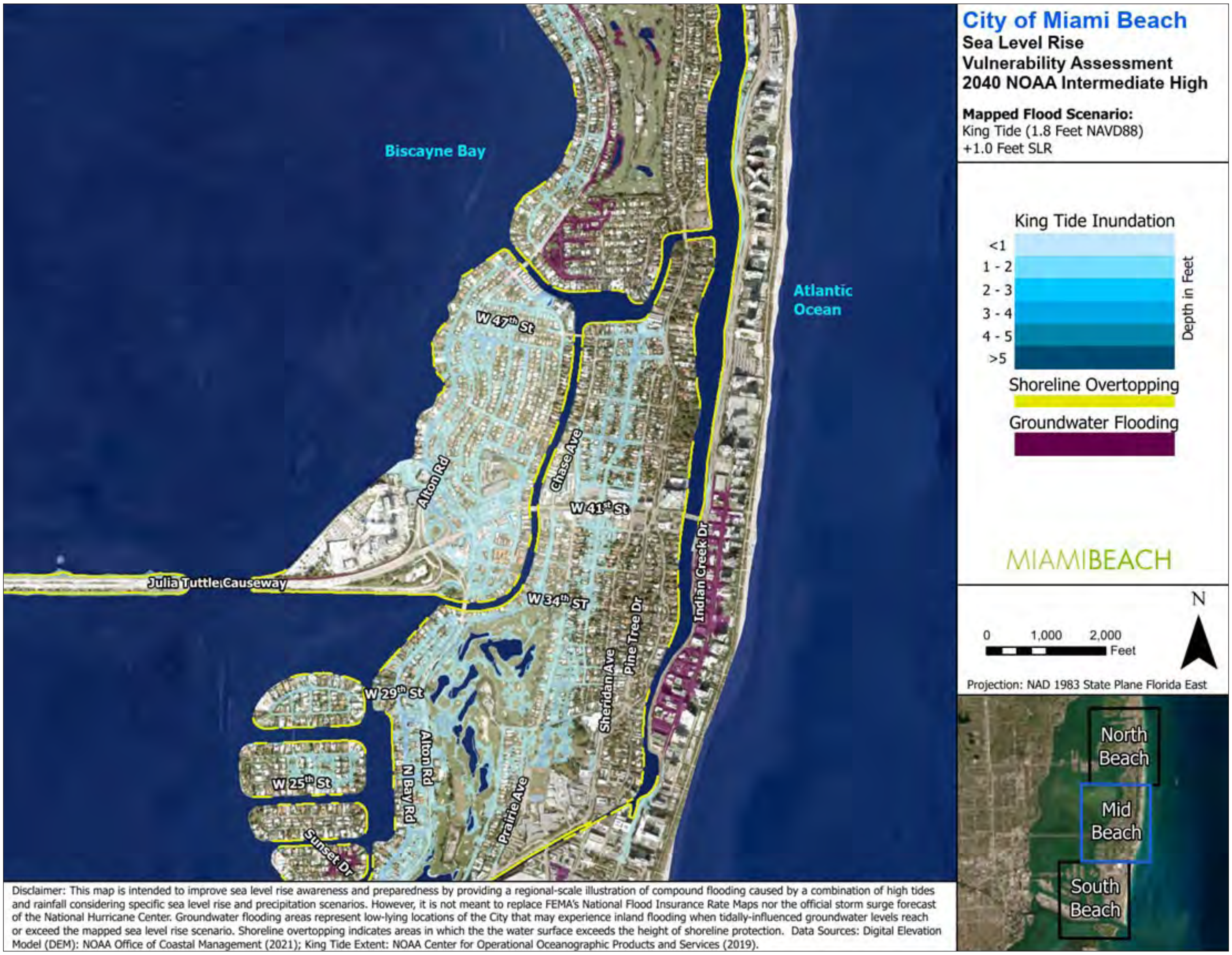


Figure D.8: Miami Beach (Mid Beach) high tide flooding with 1 foot of sea level rise (2040 NOAA Intermediate High scenario).

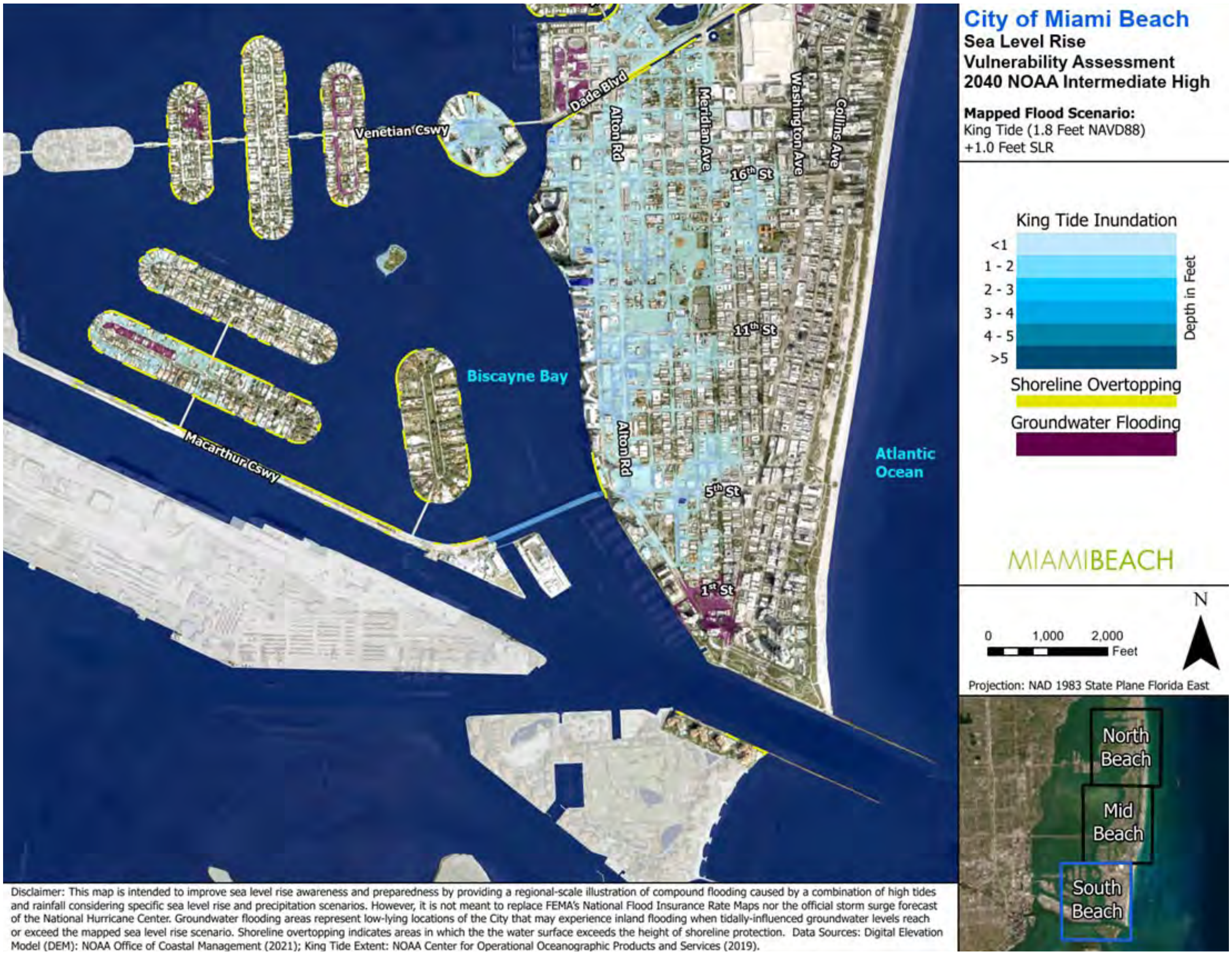


Figure D.9: Miami Beach (South Beach) high tide flooding with 1 foot of sea level rise (2040 NOAA Intermediate High scenario).

D.3 Tidal Flood Days

In addition to evaluating the spatial extent of extreme flood events, an examination of the City's vulnerability to flood hazards considered the potential for increased frequency of nuisance flooding events (i.e., frequent minor flooding that occurs during annual king tides, high tides, etc.). For this evaluation, an hourly record of historical tidal observations (January 1994 to March 2023) was downloaded for the Virgina Key tide station (#8723214) and adjusted to reflect present day (2020) and 2040 and 2070 sea level conditions, considering the NOAA Intermediate Low, NOAA Intermediate High, and NOAA High sea level rise projections. The adjusted tidal elevation time series were compared with the City's topography elevations to calculate the average number of days areas of the City are projected to be flooded.

To spatially display the findings, the resulting number of average annual tidal flood days for each sea level scenario was categorized as 'low' (<1 day per year), 'moderate' (1 to 12 days per year), 'high' (12 to 52 days per year), and 'very high' (>52 days per year). This breakdown allows a comparison of potential flood frequencies that include nuisance flood conditions (e.g., up to 1 day a month for 'low' and 'moderate' flood frequency areas of the City), to higher frequency and problematic conditions (e.g., up to 1 day per week for 'high' flood frequency areas and more than 1 day per week for 'very high' flood frequency areas of the City). **Table D.2** provides the average annual number of tidal flood days projected for a range of topographic elevations across the City.

Table D.2: Number of high tide flood days per year under existing, intermediate-high, intermediate-low, and high NOAA sea level rise projections.

		Average Annual Exceedances for Land Elevations (ft NAVD88)																				
Scenario	**SLR (ft)**	**1.00**	**1.25**	**1.50**	**1.75**	**2.0**	**2.25**	**2.5**	**2.75**	**3.0**	**3.25**	**3.5**	**3.75**	**4.0**	**4.25**	**4.5**	**4.75**	**5.0**	**5.25**	**5.5**	**5.75**	**6.0**
Existing Conditions	0.0	52	24	9	3	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate Low	0.3	117	60	28	11	4	1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.9	307	230	146	80	38	17	6	2	<1	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate High	1.0	328	263	178	103	52	24	9	3	<1	<1	0	0	0	0	0	0	0	0	0	0	0
	2.9	365	365	365	365	365	365	363	350	307	230	146	80	38	17	6	2	<1	0	0	0	0
High	1.4	363	350	307	230	146	80	38	17	6	2	<1	0	0	0	0	0	0	0	0	0	0
	4.1	365	365	365	365	365	365	365	365	365	365	365	361	344	294	212	131	70	33	14	5	1

None	0 days per year
Low	<1 day per year
Mod	<12days per year (every few months)
High	<52days per year (once a month or more)
Very High	>52days per year (once a week or more)

Example Tidal Flood Day map panels are shown in **Figure D.10** through **Figure D.12** and illustrate the impacts of the +1.0-foot sea level rise of the NOAA Intermediate High scenario in the year 2040. The complete set of flood hazard map books are presented in Section D4 (Flood Hazard Maps). To illustrate areas most at risk to high frequency (or nuisance) flood events, a threshold of 0.2 days/year (i.e., one flood event every five years on average) was set as a lower bound for areas that would be mapped. Areas projected to experience flooding less frequently than once every five years were excluded from the tidal flood days maps (these areas are shown on the map as areas with no color); however, these areas may still be at risk to flooding due to extreme coastal storm events and water levels.

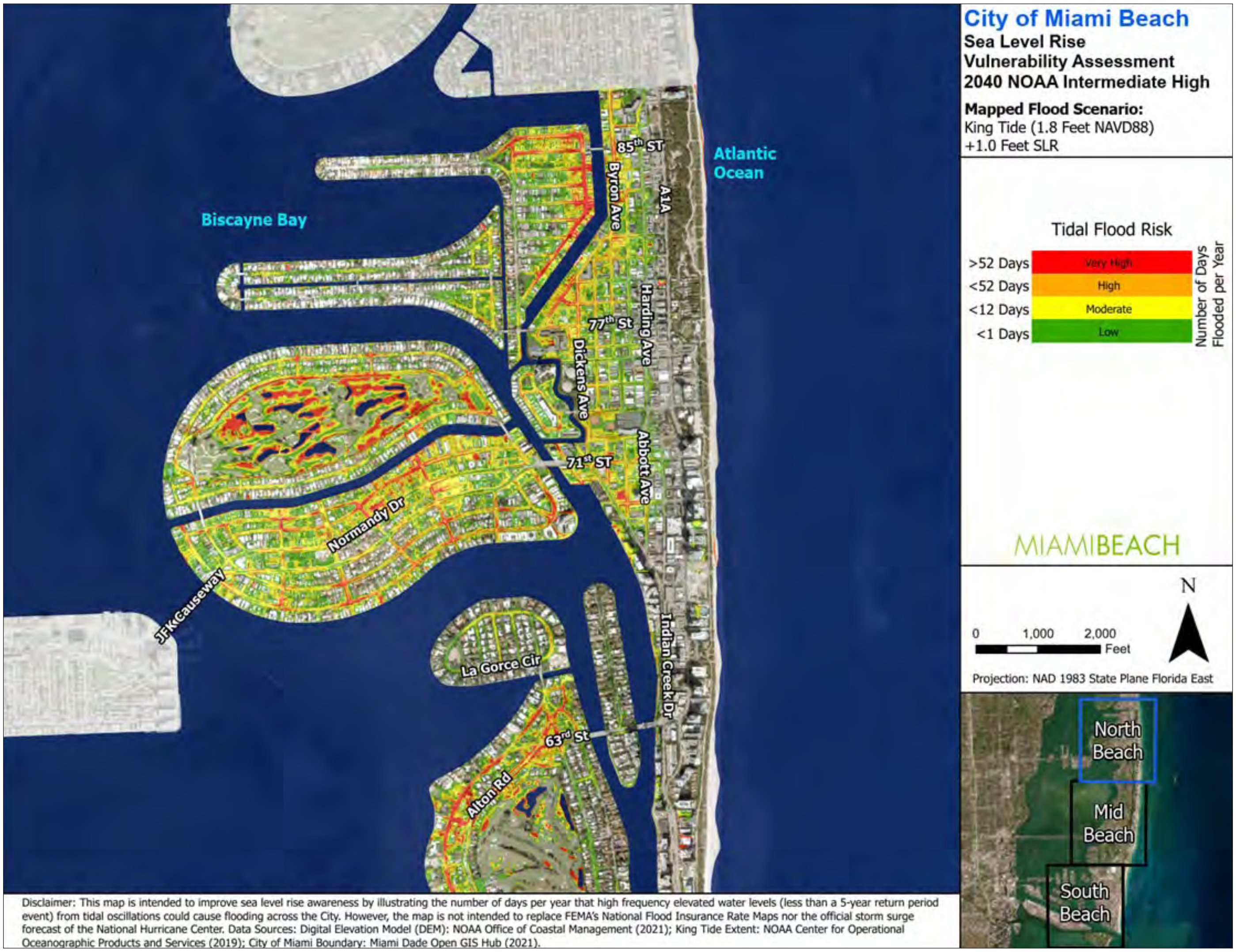


Figure D.10: Miami Beach (North Beach) tidal flood days with 1 foot of sea level rise (2040 NOAA Intermediate High scenario).

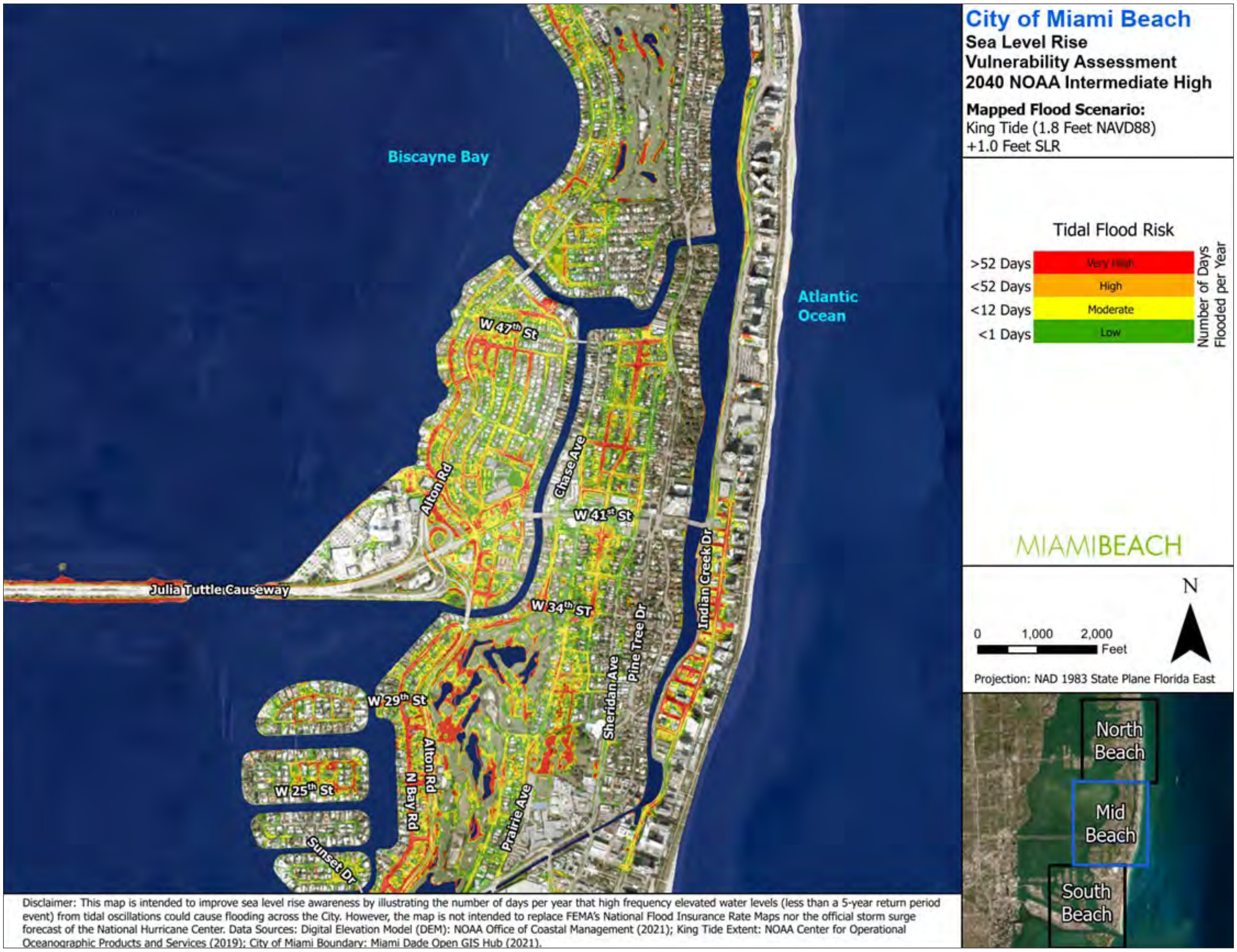


Figure D.11: Miami Beach (Mid Beach) tidal flood days with 1 foot of sea level rise (2040 NOAA Intermediate High scenario).

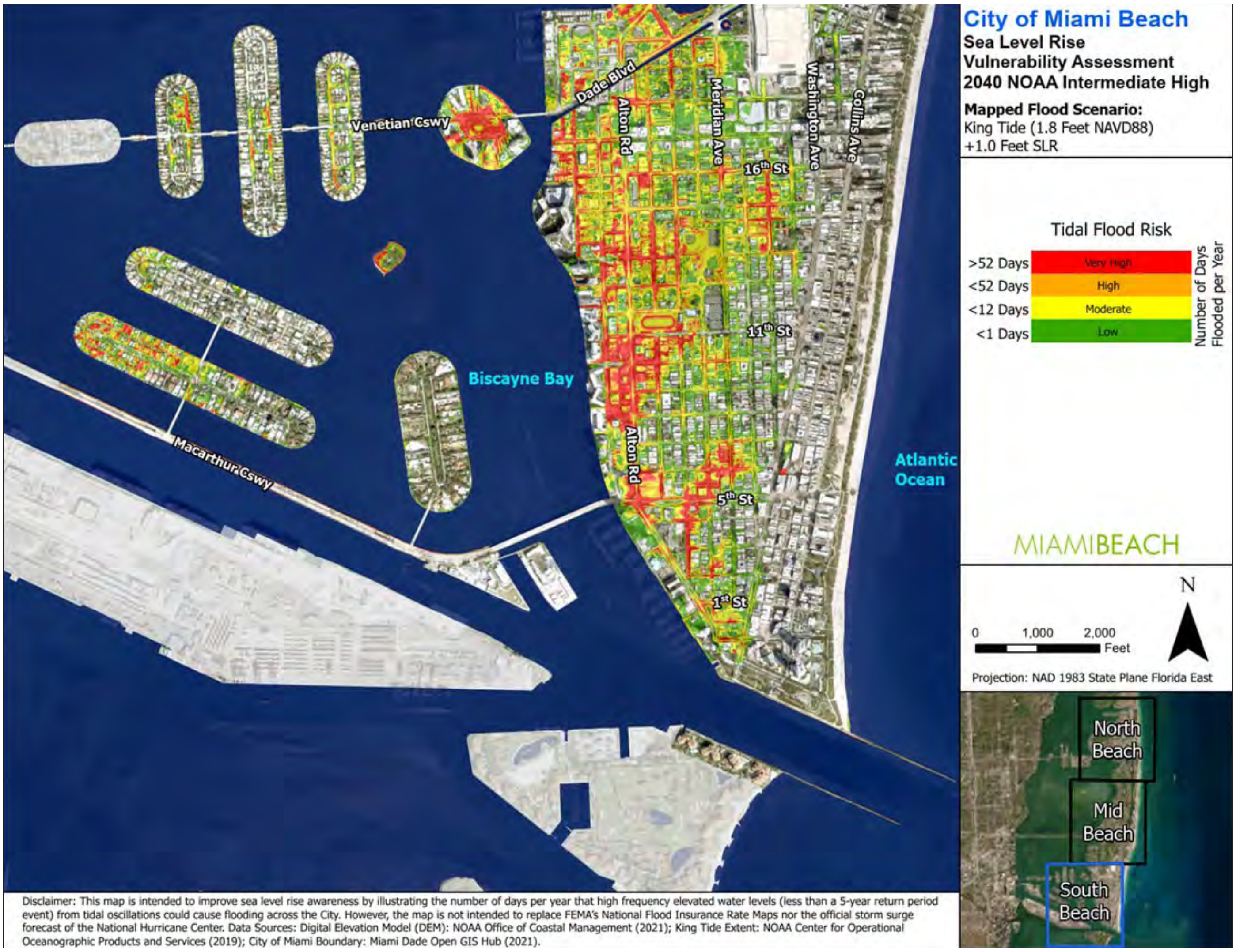


Figure D.12: Miami Beach (South Beach) tidal flood days with 1 foot of sea level rise (2040 NOAA Intermediate High scenario).

D.4.Flood Hazard Maps

D.4.1. King Tide Flood Hazard Maps

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

King Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

Shoreline Overtopping

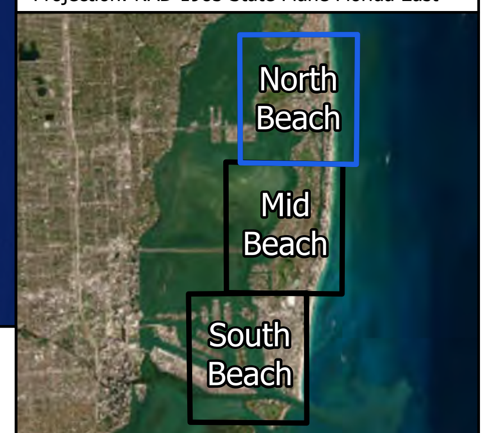
Groundwater Flooding

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



Disclaimer: This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of compound flooding caused by a combination of high tides and rainfall considering specific sea level rise and precipitation scenarios. However, it is not meant to replace FEMA's National Flood Insurance Rate Maps nor the official storm surge forecast of the National Hurricane Center. Groundwater flooding areas represent low-lying locations of the City that may experience inland flooding when tidally-influenced groundwater levels reach or exceed the mapped sea level rise scenario. Shoreline overtopping indicates areas in which the the water surface exceeds the height of shoreline protection. Data Sources: Digital Elevation Model (DEM): NOAA Office of Coastal Management (2021); King Tide Extent: NOAA Center for Operational Oceanographic Products and Services (2019).

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

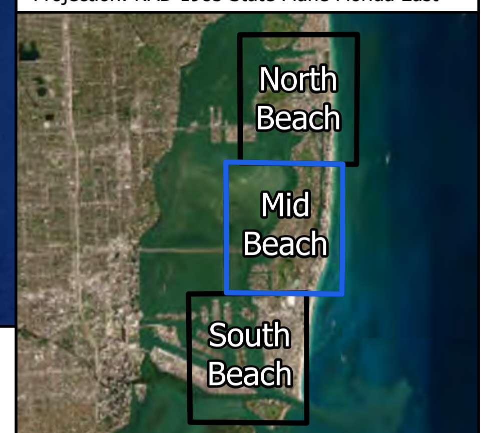
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

King Tide Inundation

Depth in Feet

<1	
1 - 2	
2 - 3	
3 - 4	
4 - 5	
>5	

Shoreline Overtopping

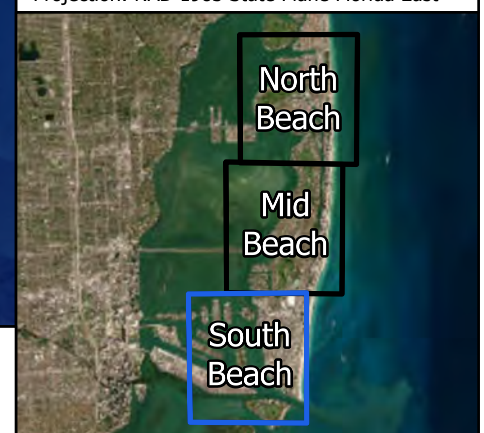
Groundwater Flooding

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

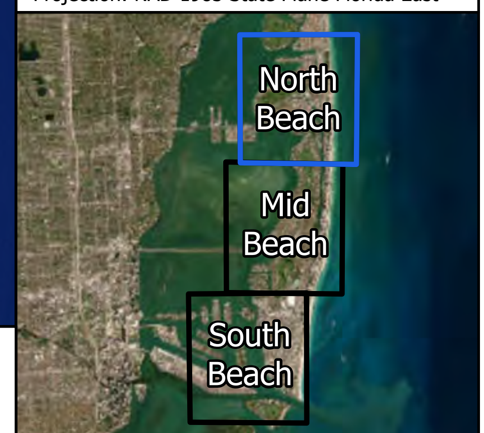
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

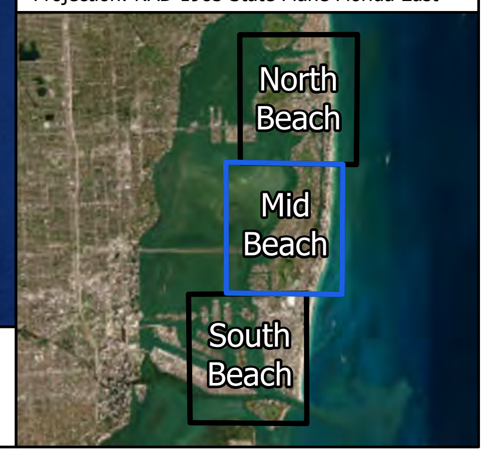
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

King Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

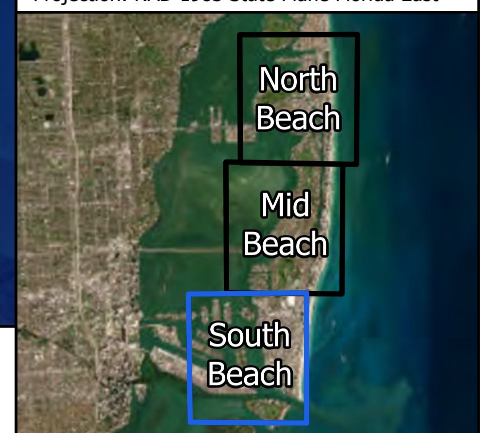
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

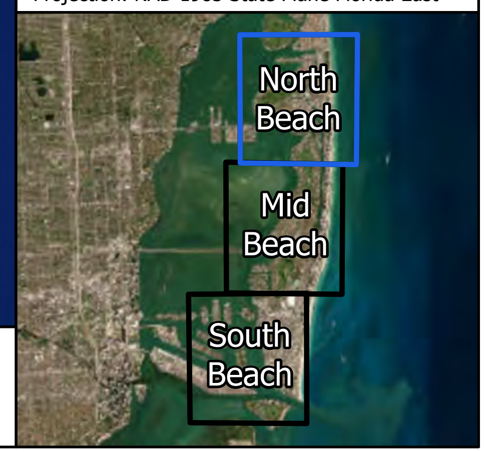
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



Disclaimer: This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of compound flooding caused by a combination of high tides and rainfall considering specific sea level rise and precipitation scenarios. However, it is not meant to replace FEMA's National Flood Insurance Rate Maps nor the official storm surge forecast of the National Hurricane Center. Groundwater flooding areas represent low-lying locations of the City that may experience inland flooding when tidally-influenced groundwater levels reach or exceed the mapped sea level rise scenario. Shoreline overtopping indicates areas in which the the water surface exceeds the height of shoreline protection. Data Sources: Digital Elevation Model (DEM): NOAA Office of Coastal Management (2021); King Tide Extent: NOAA Center for Operational Oceanographic Products and Services (2019).

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

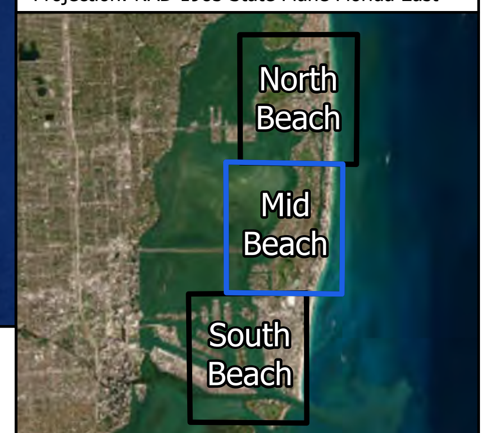
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

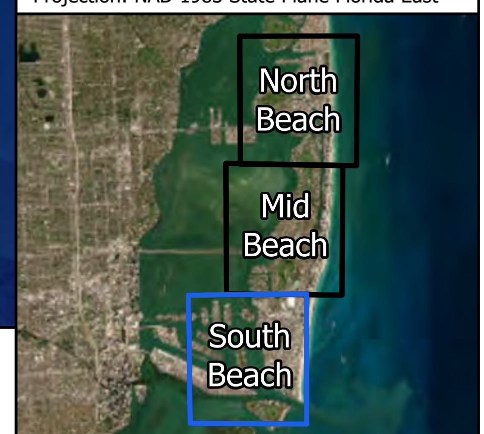
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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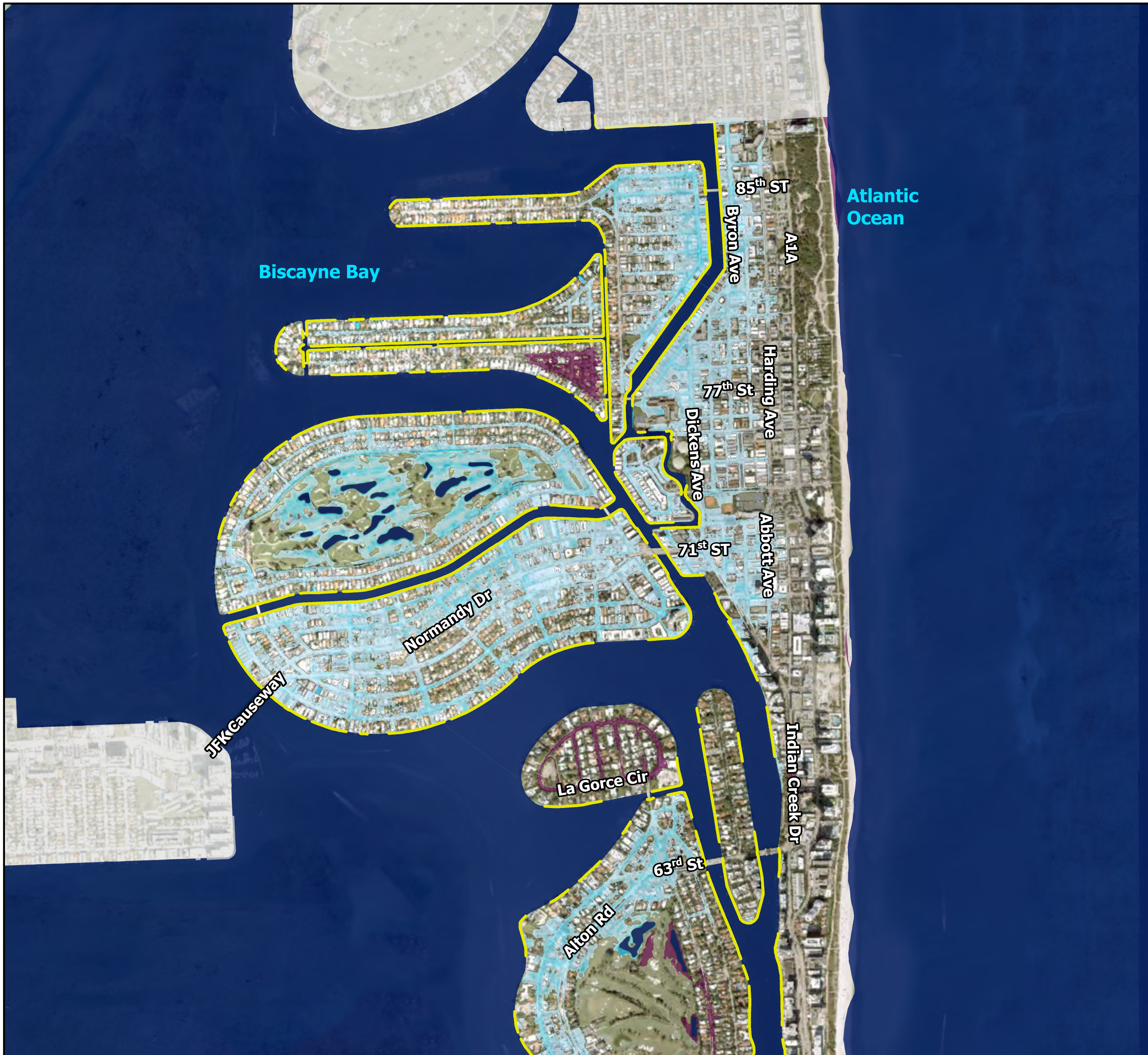
City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR



King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

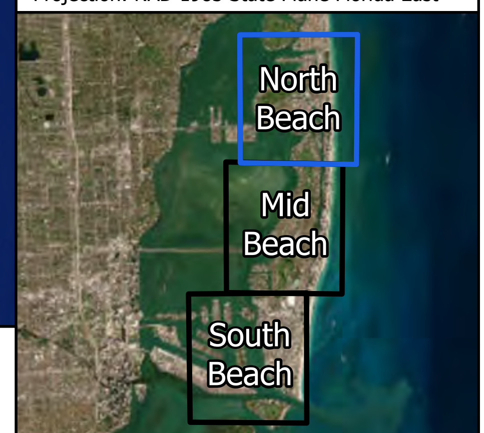
Groundwater Flooding

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

King Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

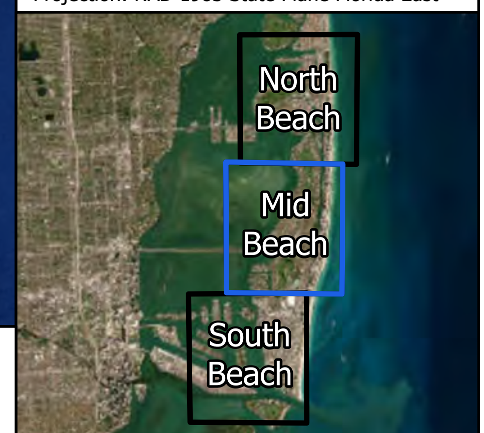
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

King Tide Inundation (Depth in Feet)

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

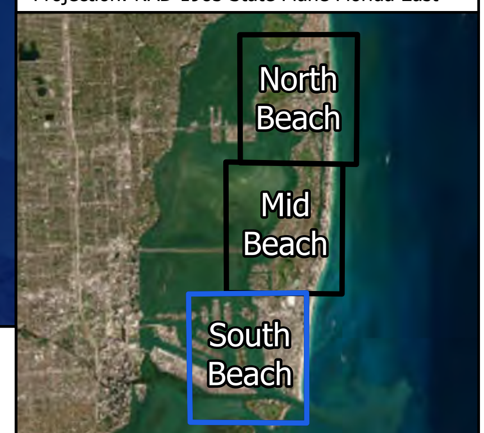
Groundwater Flooding

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

King Tide Inundation (Depth in Feet)

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

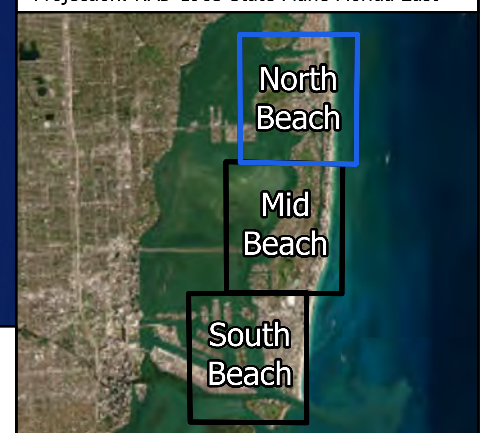
Groundwater Flooding

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

King Tide Inundation (Depth in Feet)

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

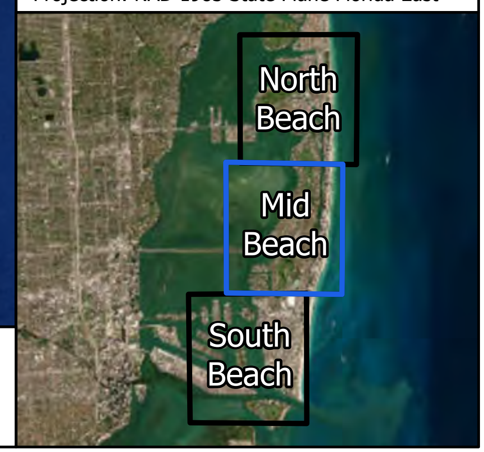
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

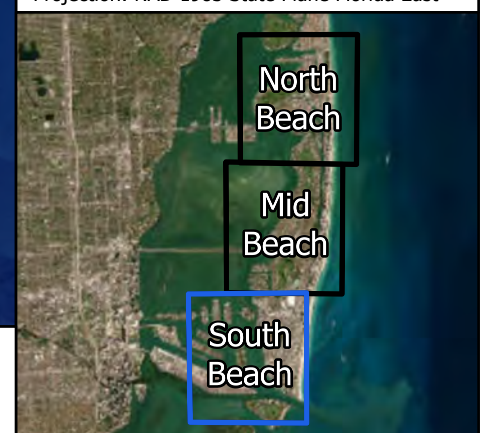
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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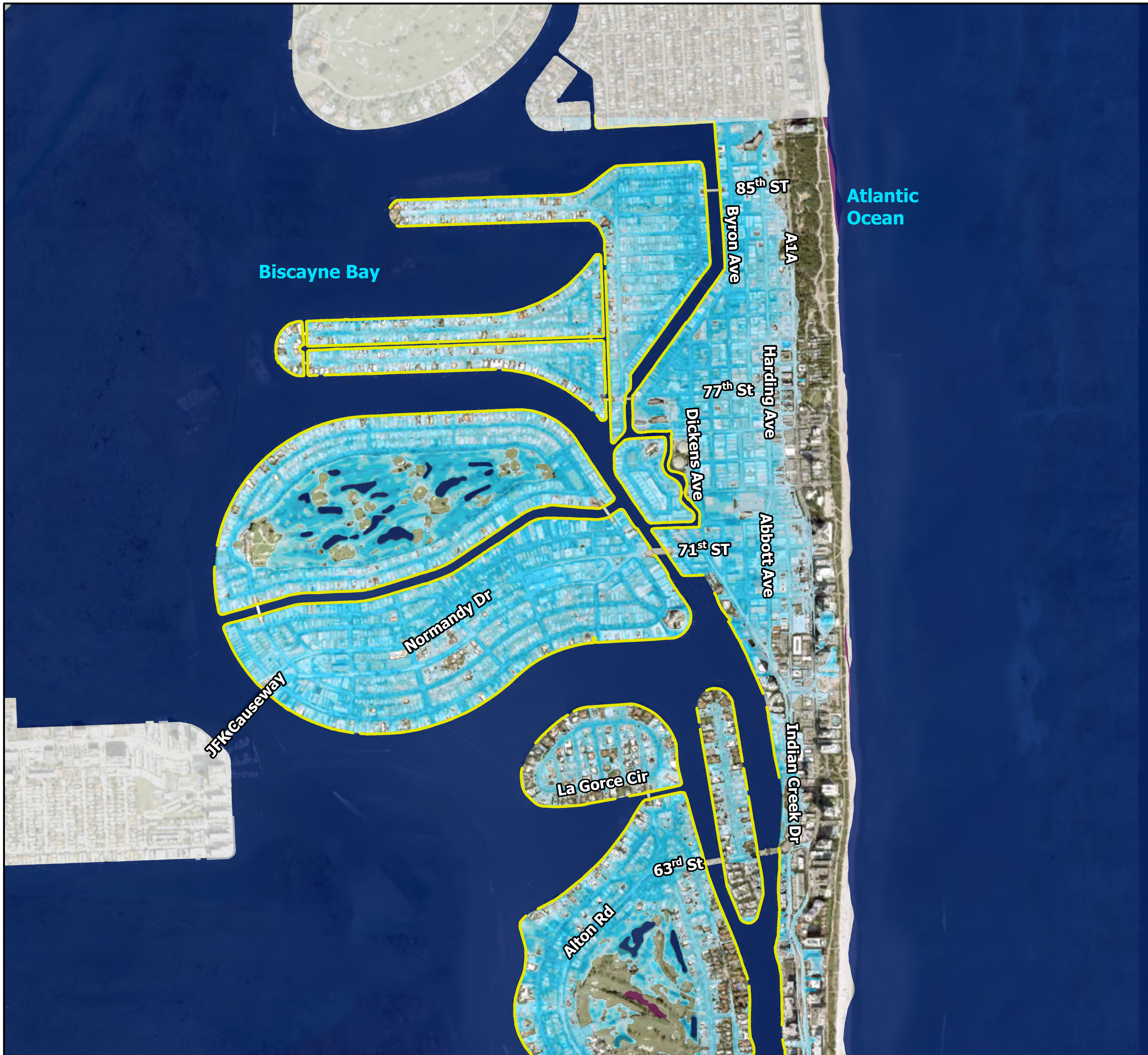


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

King Tide Inundation (Depth in Feet)

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

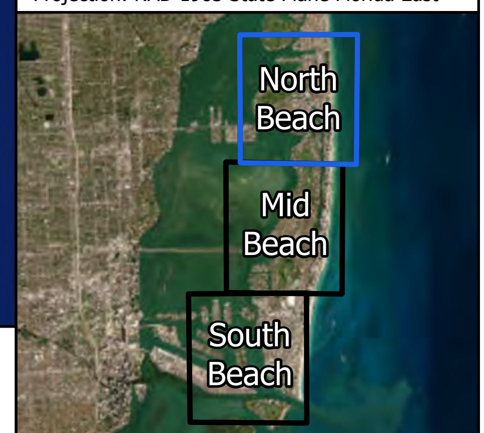
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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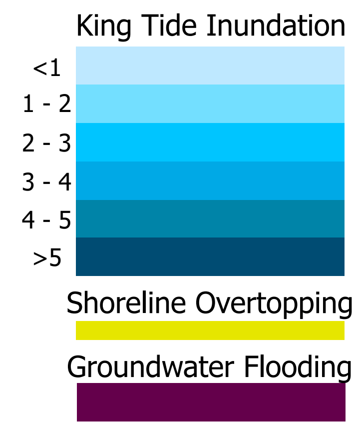
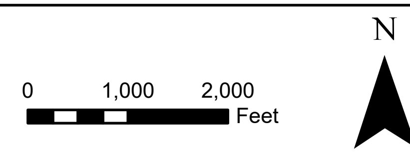
City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

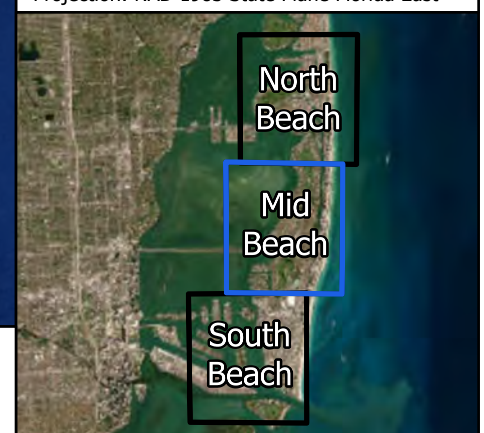
Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR



MIAMIBEACH



Projection: NAD 1983 State Plane Florida East



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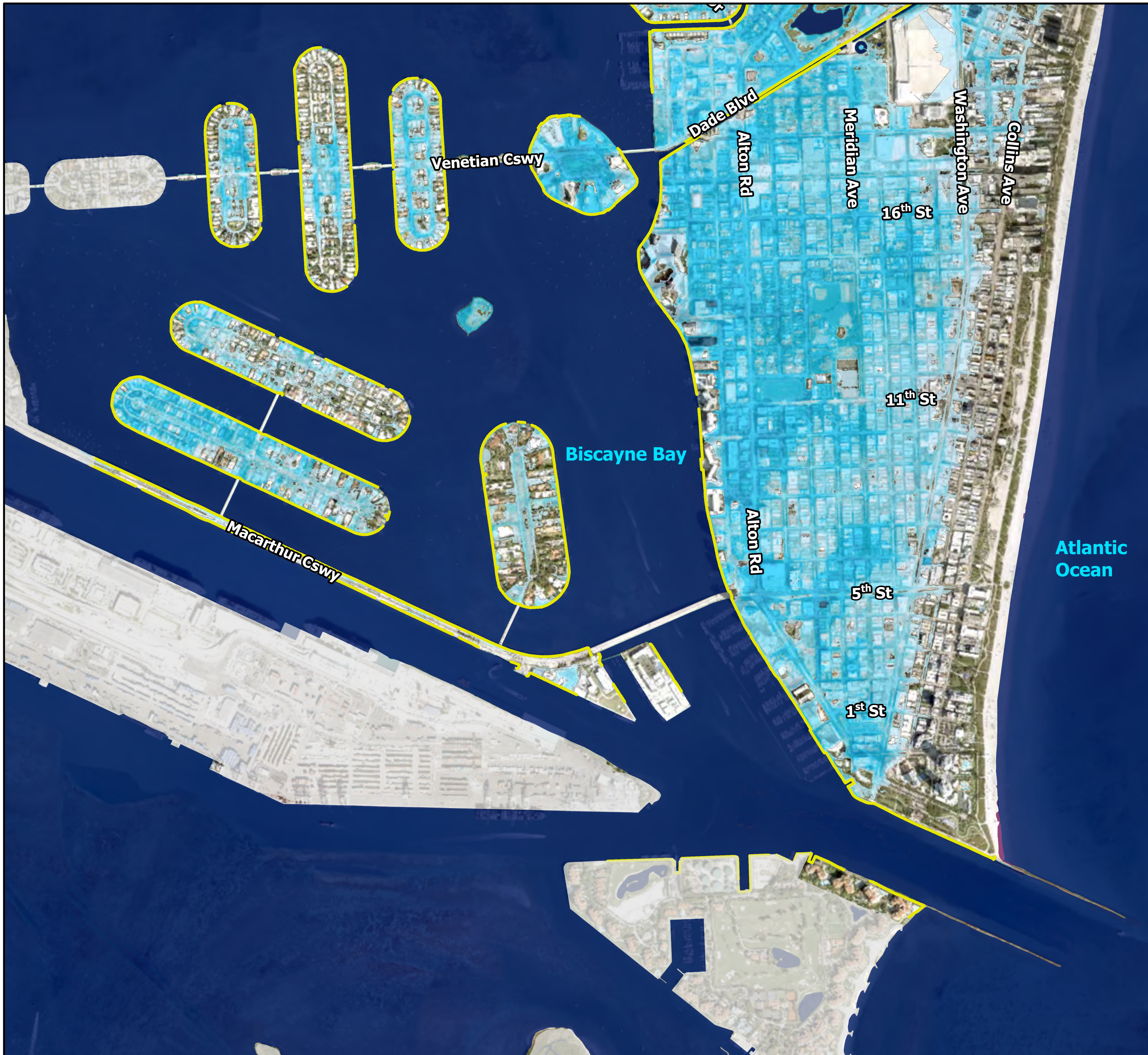


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

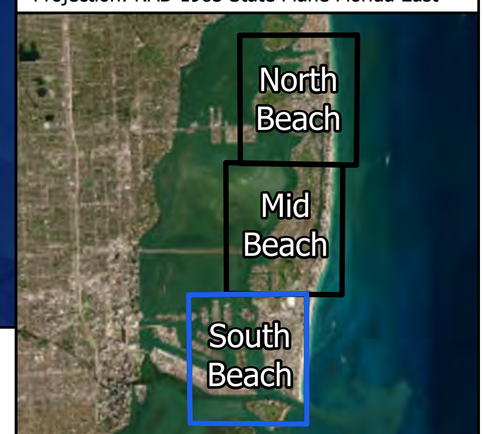
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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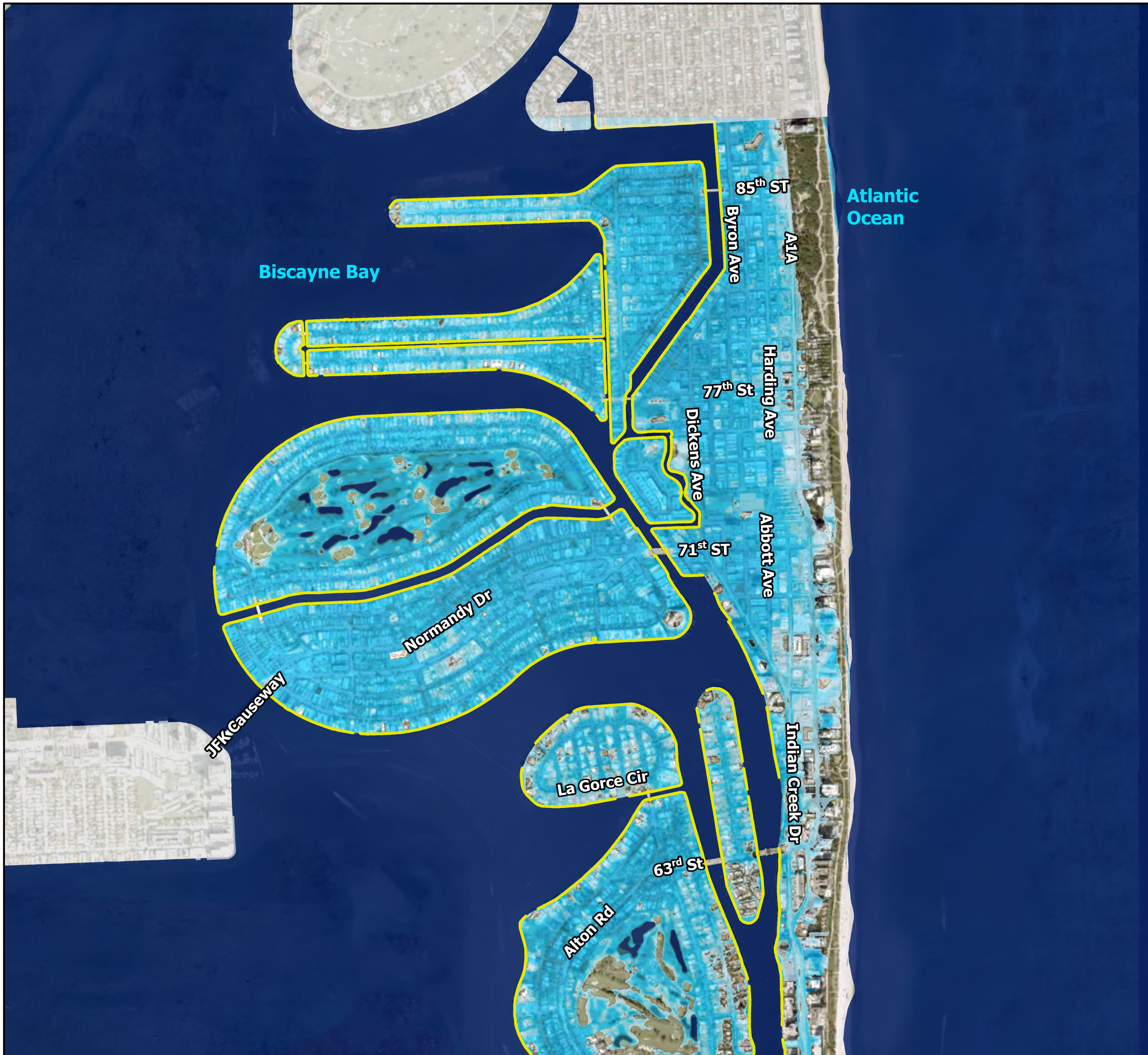


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

King Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

Shoreline Overtopping

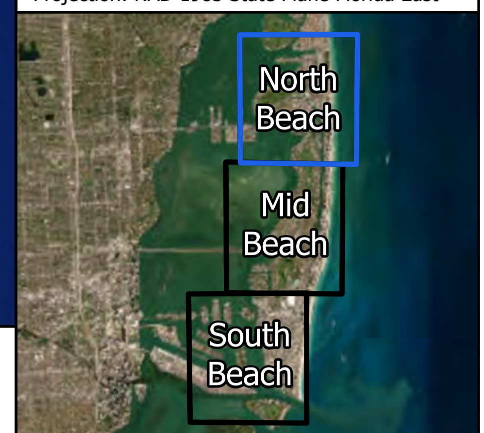
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

King Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

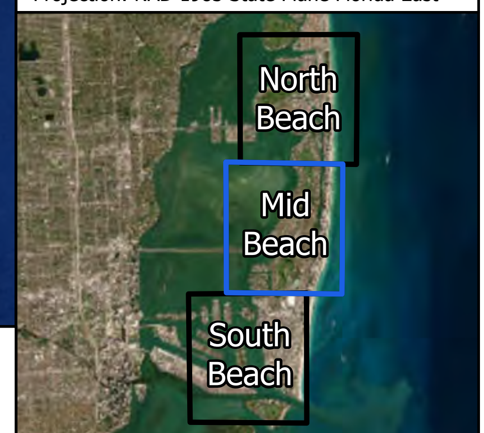
Groundwater Flooding

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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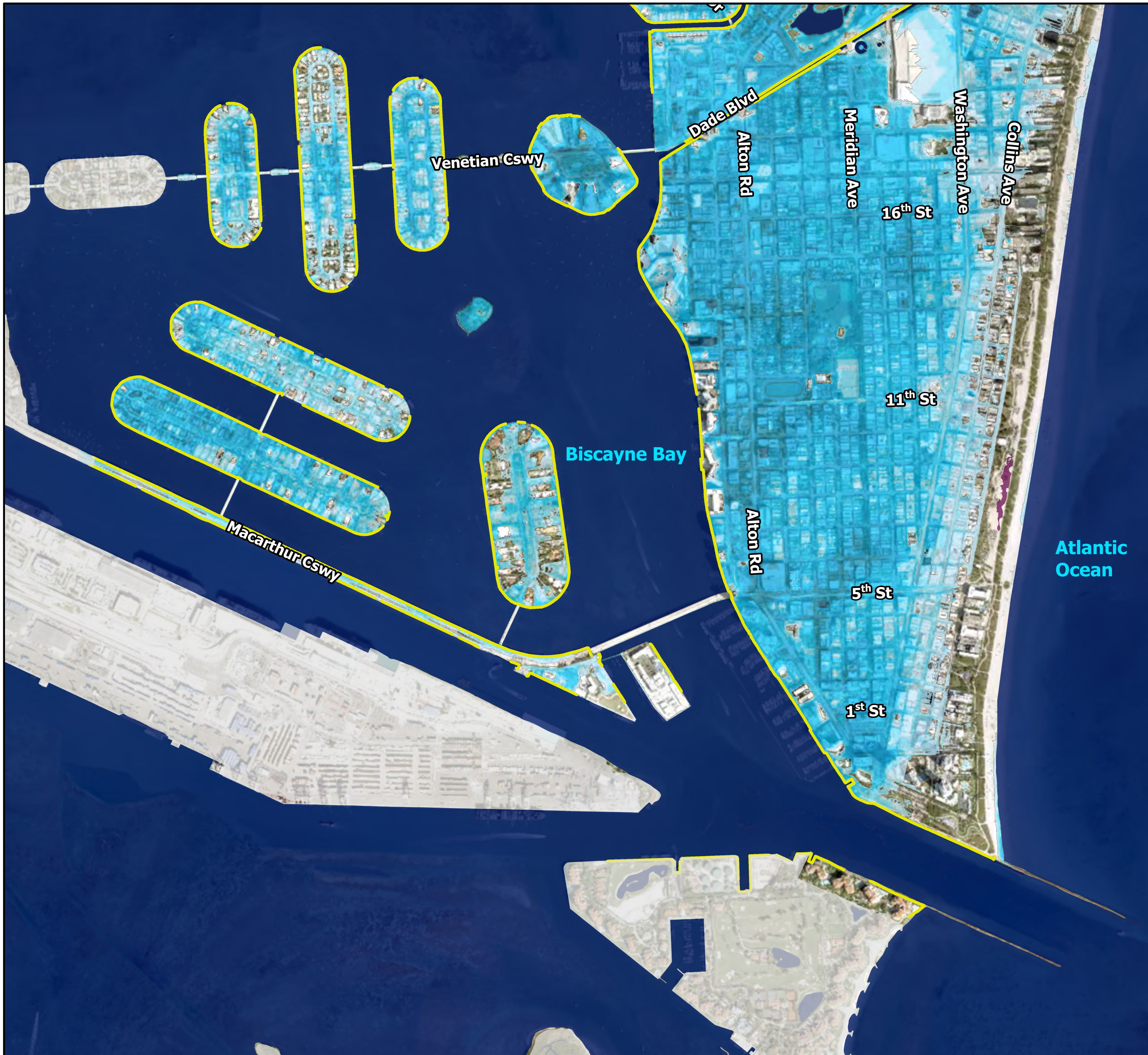


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

King Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

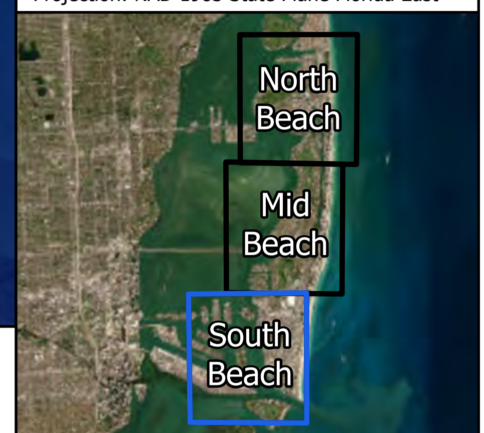
Groundwater Flooding

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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D.4.2. Tidal Flood Days Maps

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

Tidal Flood Risk

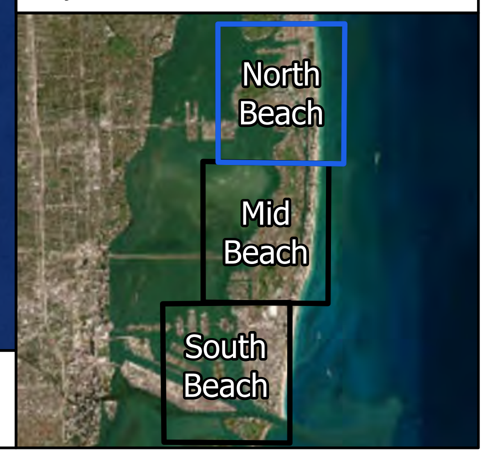
>52 Days	Very High	Number of Days Flooded per Year
<52 Days	High	
<12 Days	Moderate	
<1 Days	Low	

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

Tidal Flood Risk

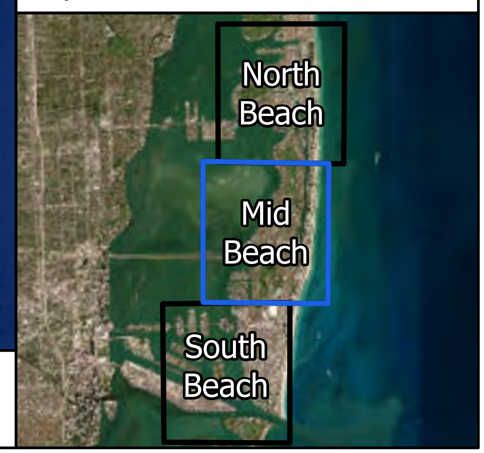
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

Tidal Flood Risk

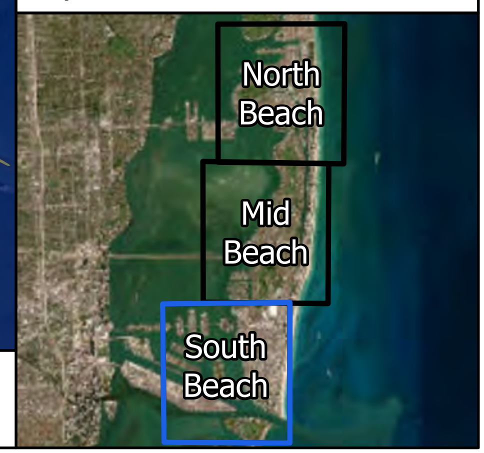
Number of Days Flooded per Year	
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

Tidal Flood Risk

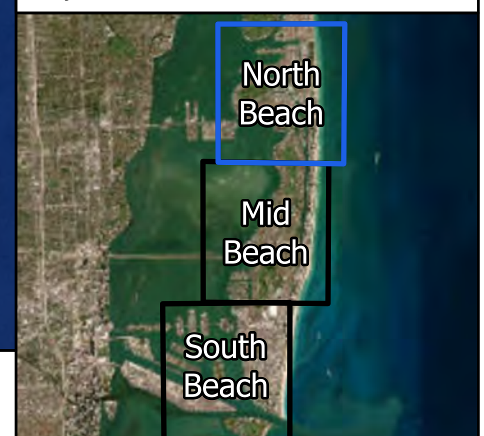
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

Tidal Flood Risk

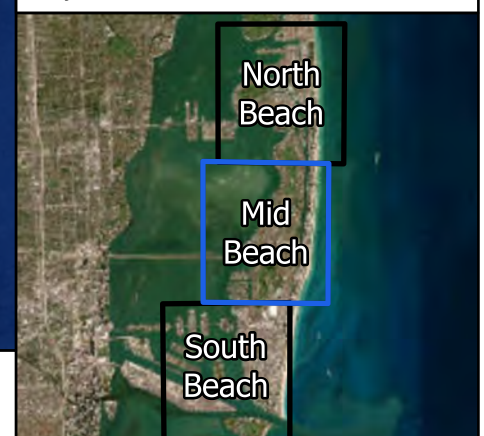
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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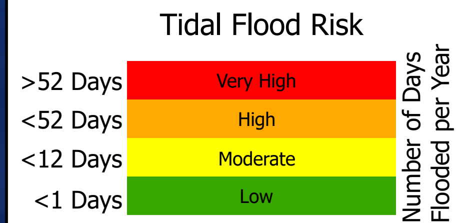
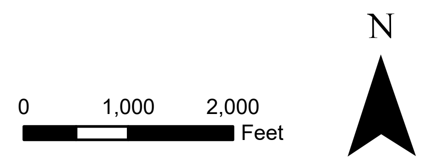
City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

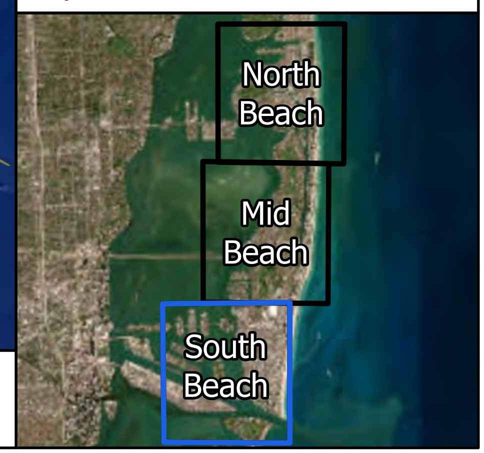
Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR



MIAMIBEACH



Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

Tidal Flood Risk

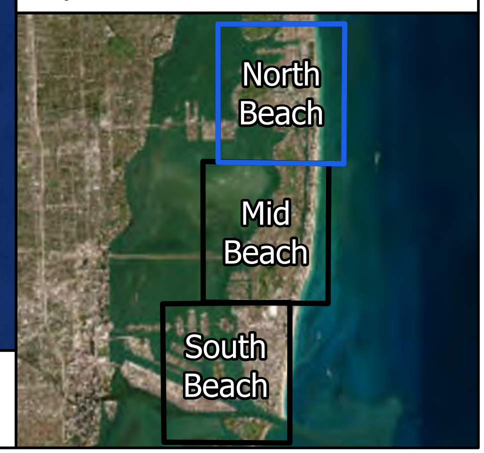
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

Tidal Flood Risk

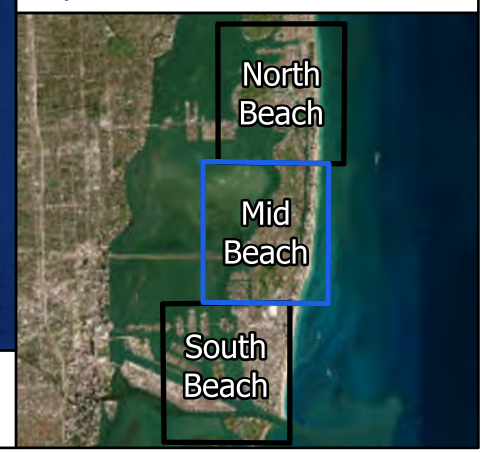
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

Tidal Flood Risk

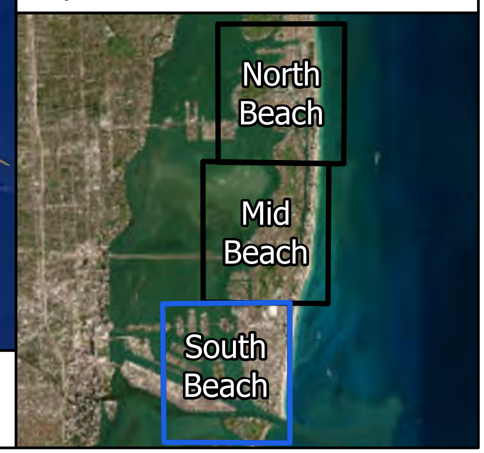
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

Tidal Flood Risk

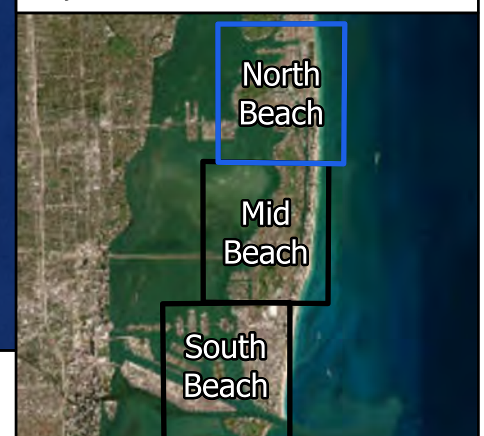
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

Tidal Flood Risk

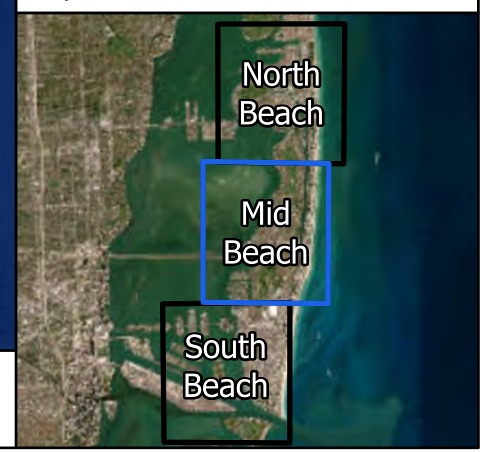
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

Tidal Flood Risk

	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

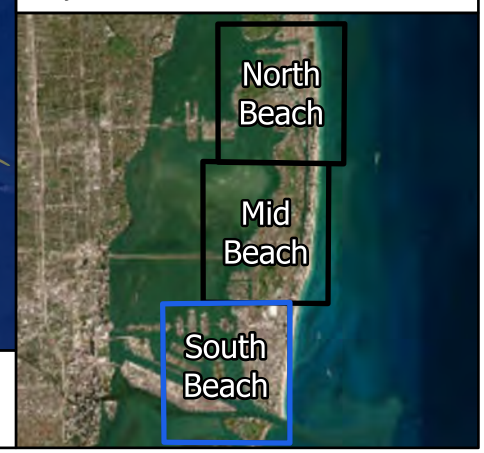
Number of Days Flooded per Year

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

Tidal Flood Risk

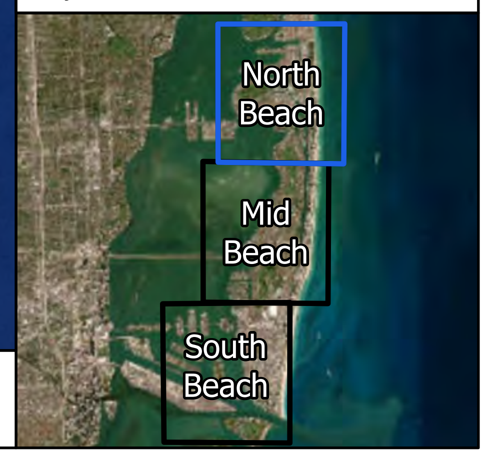
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

Tidal Flood Risk

>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

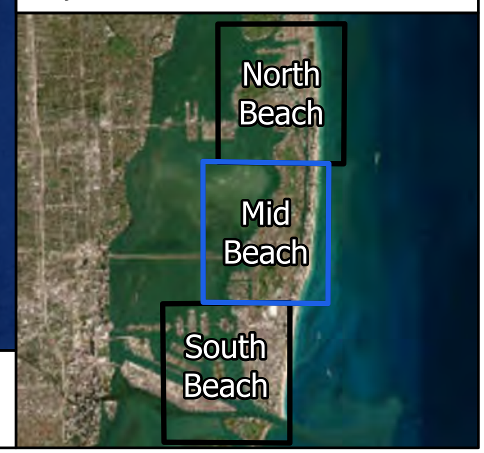
Number of Days Flooded per Year

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

Tidal Flood Risk

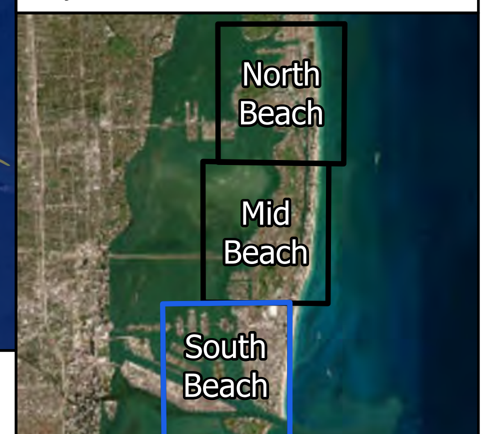
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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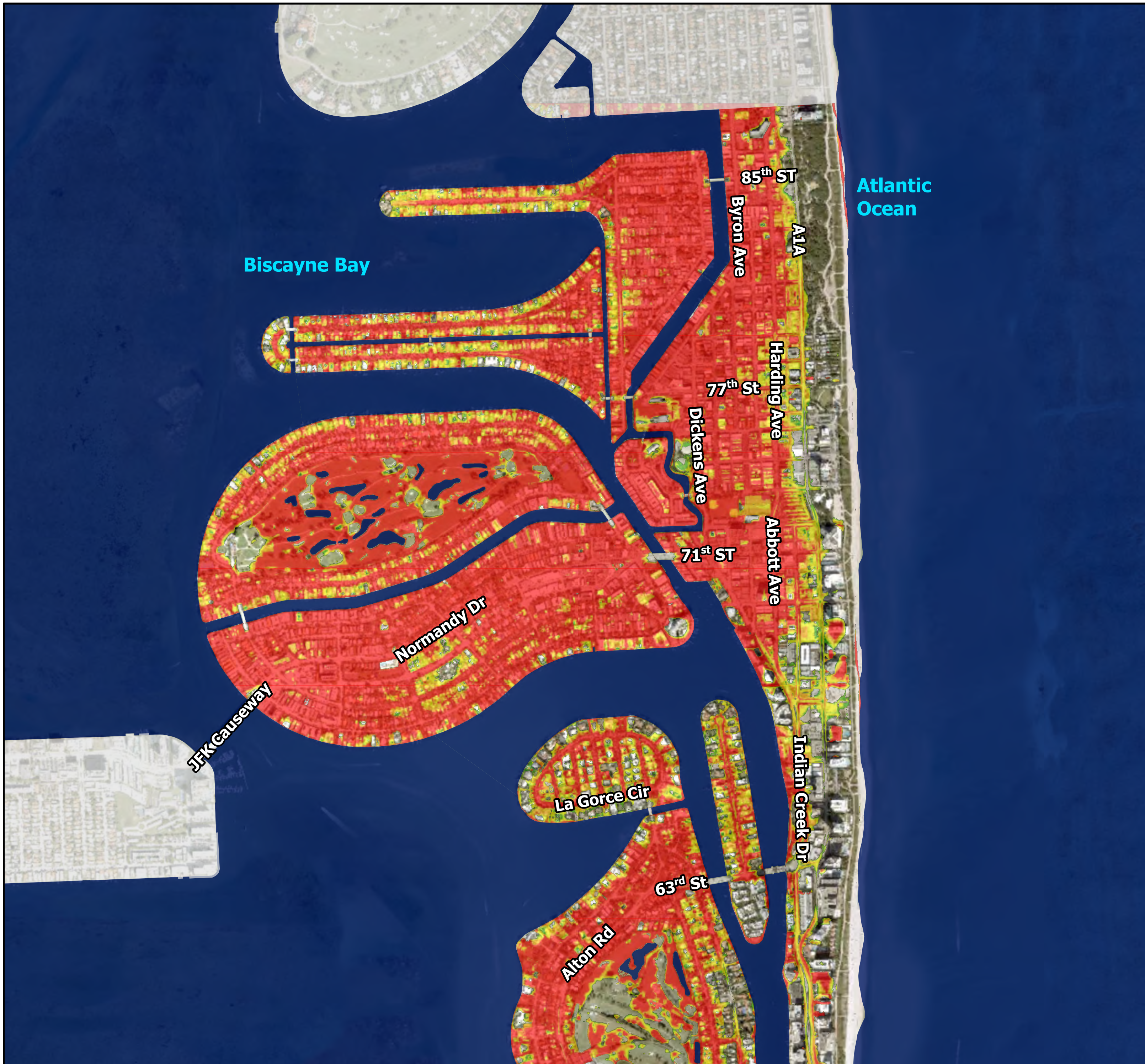
City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR



Tidal Flood Risk

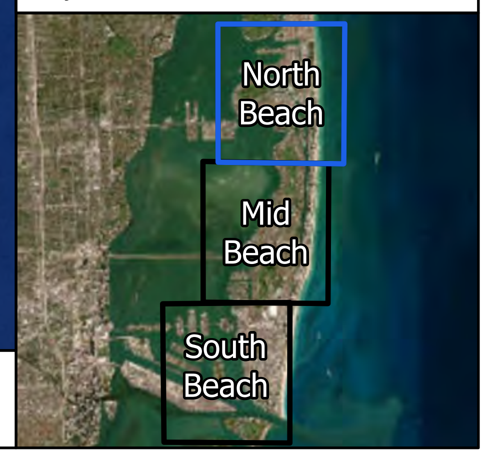
Number of Days Flooded per Year	Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

Tidal Flood Risk

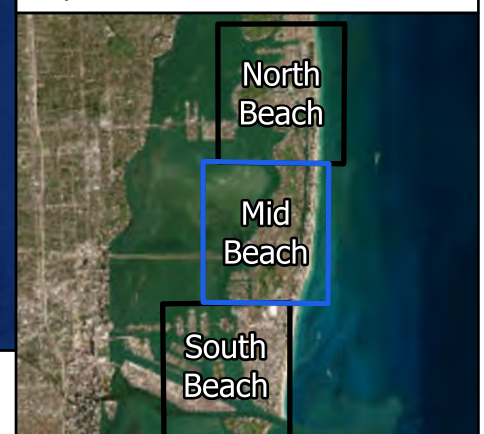
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

Tidal Flood Risk

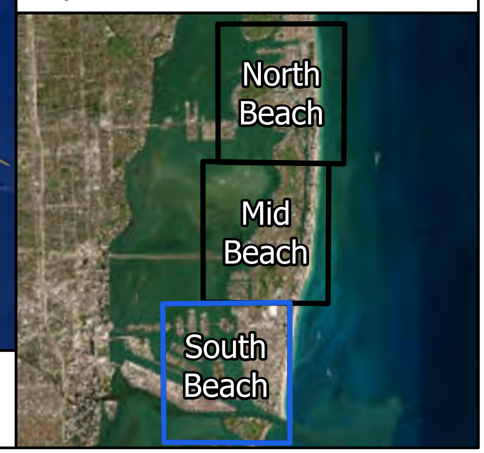
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

Tidal Flood Risk

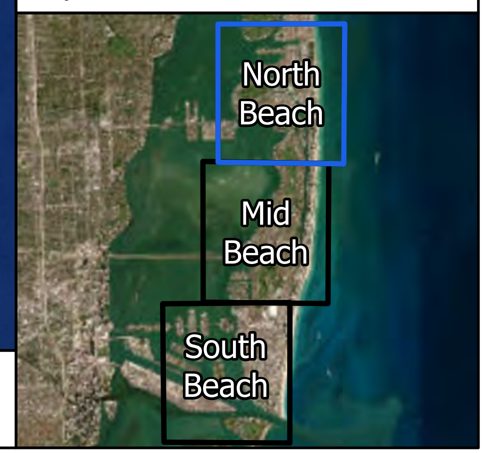
Number of Days Flooded per Year	
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

Tidal Flood Risk

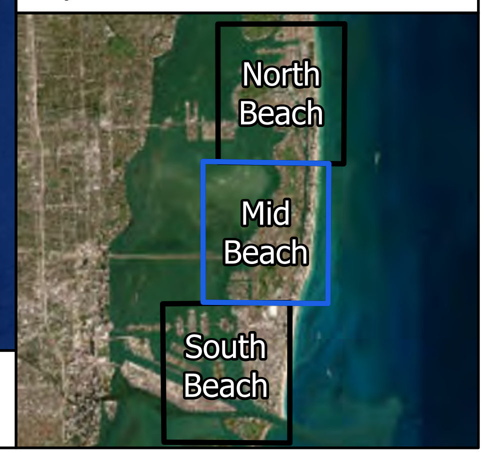
Number of Days Flooded per Year	Tidal Flood Risk
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

Tidal Flood Risk (Number of Days Flooded per Year)

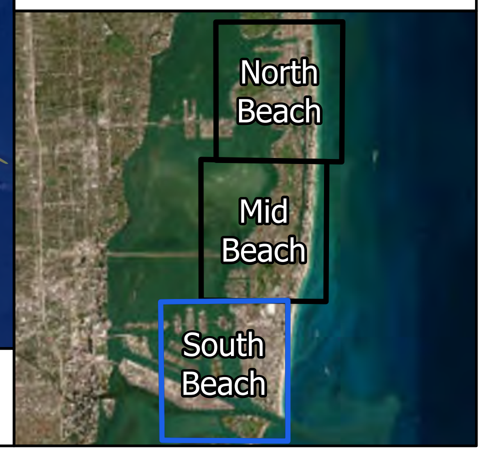
>52 Days	Very High
<52 Days	High
<12 Days	Moderate
<1 Days	Low

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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D.4.3. Compound Flood Hazard Maps

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

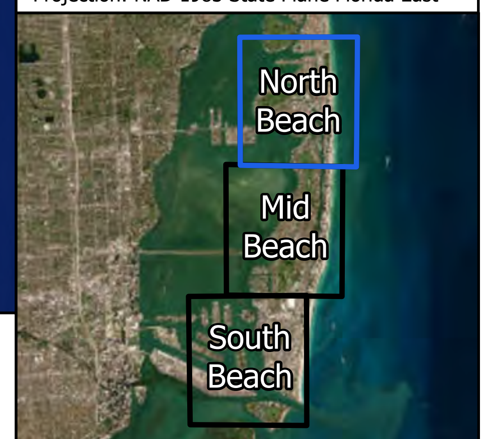
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



Disclaimer: This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of compound flooding caused by a combination of high tides and rainfall considering specific sea level rise and precipitation scenarios. However, it is not meant to replace FEMA's National Flood Insurance Rate Maps nor the official storm surge forecast of National Hurricane Center. Groundwater flooding areas represent low-lying locations of the City that may experience inland flooding when tidally-influenced groundwater levels reach or exceed the mapped sea level rise scenario. Shoreline overtopping indicates areas in which the the water surface exceeds the elevation of shoreline protection. Data Sources: Digital Elevation Model (DEM): NOAA Office of Coastal Management (2021); King Tide Extent: NOAA Center for Operational Oceanographic Products and Services (2019); City of Miami Boundary: Miami Dade Open GIS Hub (2021). Rainfall Data: South Florida Water Management District (SFWMD); Compound flooding was modeled with EPASWMM5.

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

King Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

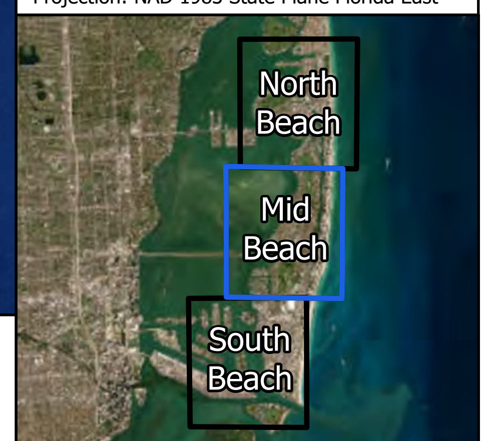
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.0 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

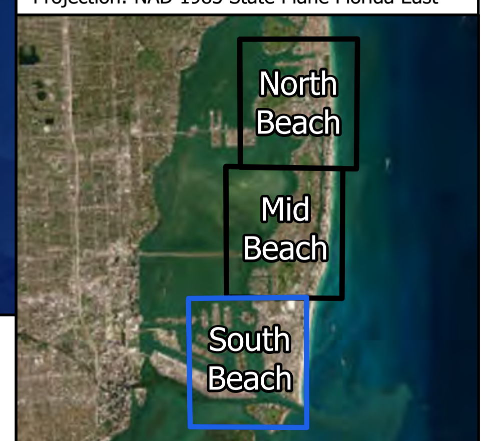
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

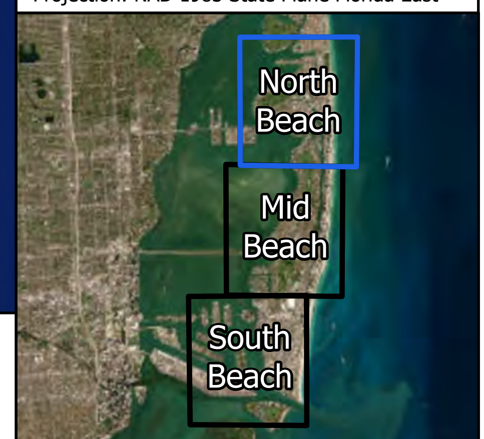
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

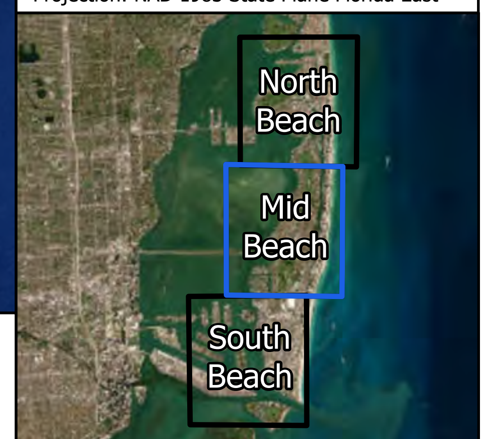
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



Disclaimer: This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of compound flooding caused by a combination of high tides and rainfall considering specific sea level rise and precipitation scenarios. However, it is not meant to replace FEMA's National Flood Insurance Rate Maps nor the official storm surge forecast of National Hurricane Center. Groundwater flooding areas represent low-lying locations of the City that may experience inland flooding when tidally-influenced groundwater levels reach or exceed the mapped sea level rise scenario. Shoreline overtopping indicates areas in which the the water surface exceeds the elevation of shoreline protection. Data Sources: Digital Elevation Model (DEM): NOAA Office of Coastal Management (2021); King Tide Extent: NOAA Center for Operational Oceanographic Products and Services (2019); City of Miami Boundary: Miami Dade Open GIS Hub (2021). Rainfall Data: South Florida Water Management District (SFWMD); Compound flooding was modeled with EPASWMM5.

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.3 Feet SLR

King Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

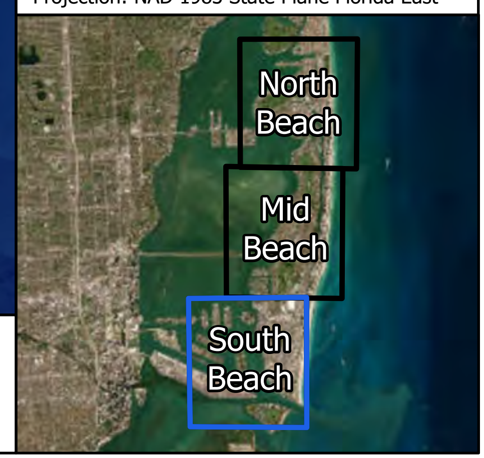
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

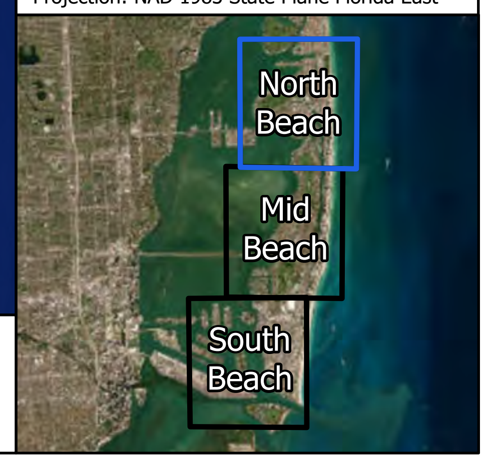
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

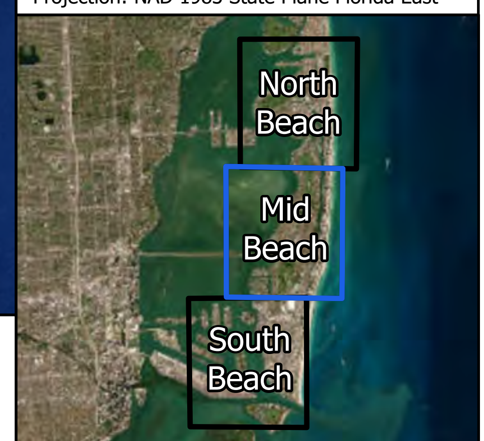
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.0 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

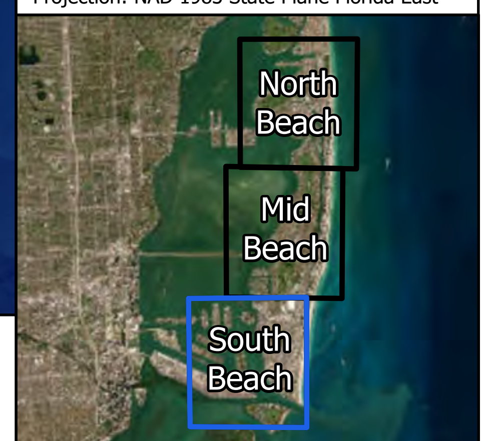
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

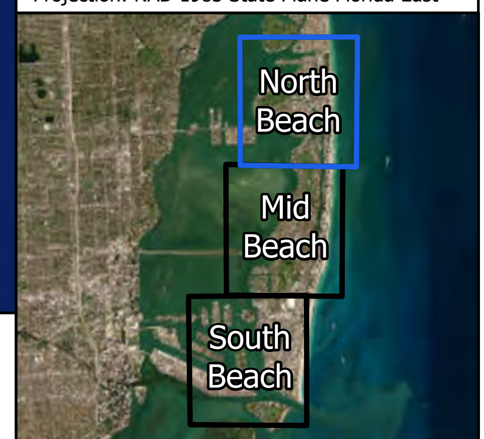
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

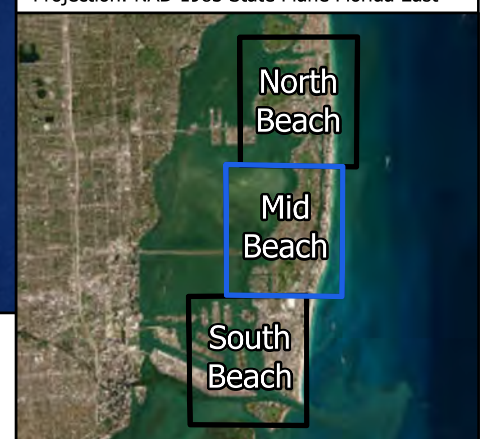
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.4 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

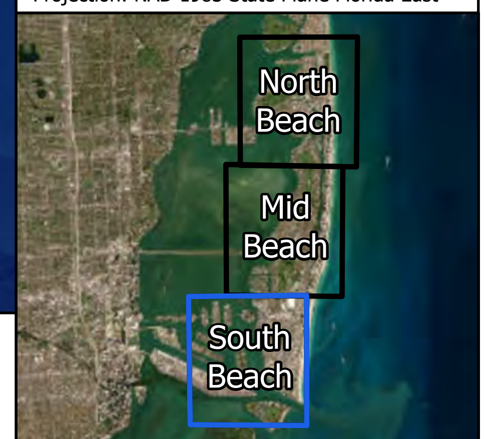
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

King Tide Inundation

Depth in Feet

<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

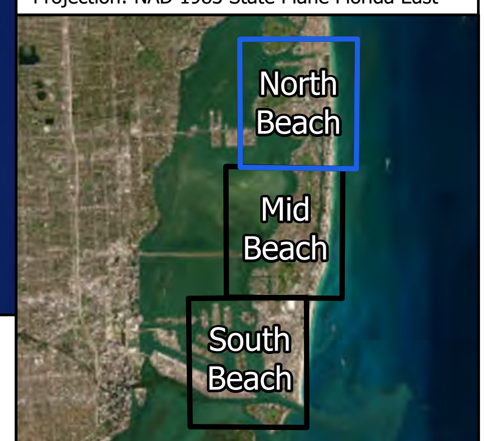
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

King Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

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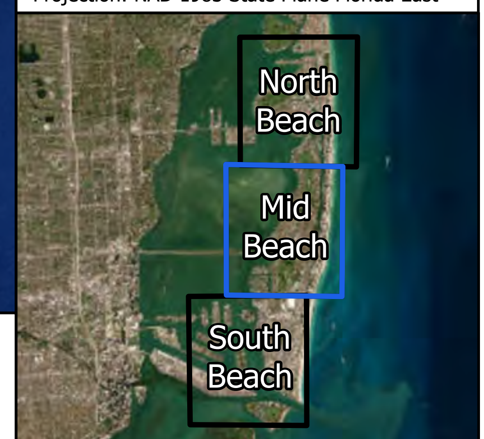

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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.9 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

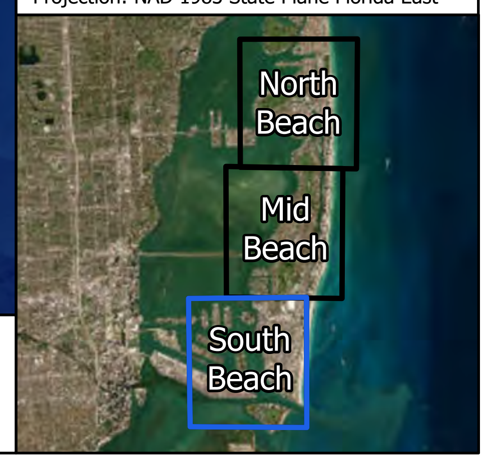
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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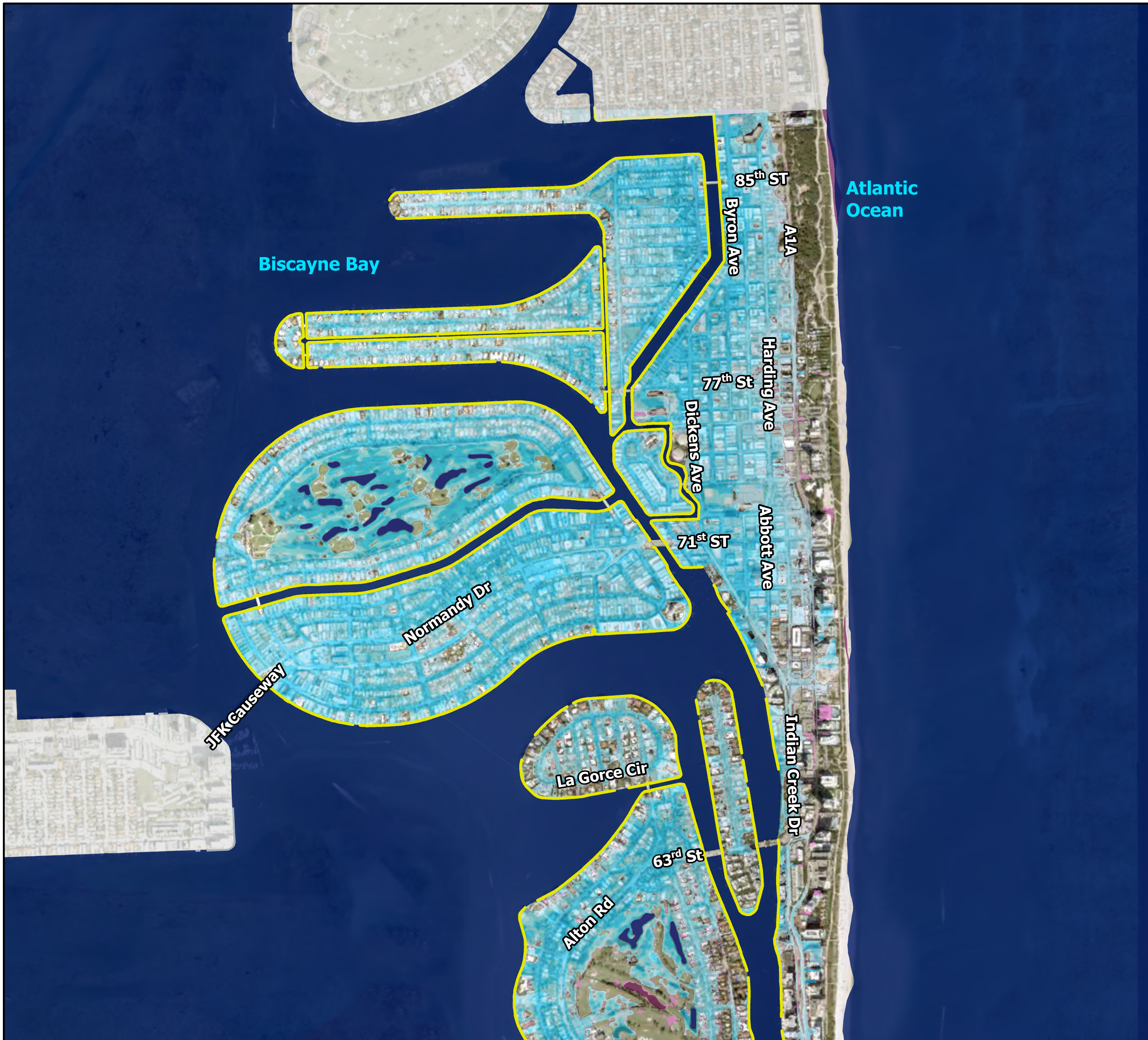


City of Miami Beach

Sea Level Rise Vulnerability Assessment
2070 NOAA Intermediate High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

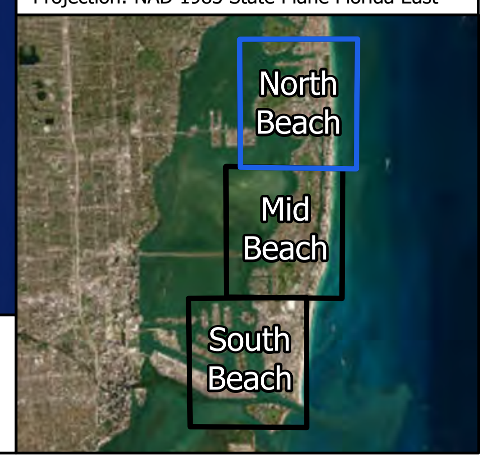
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

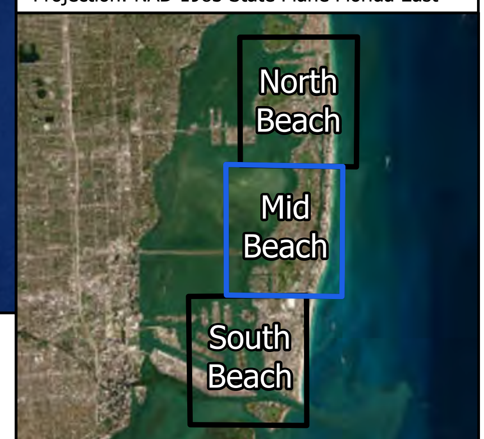
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+2.9 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

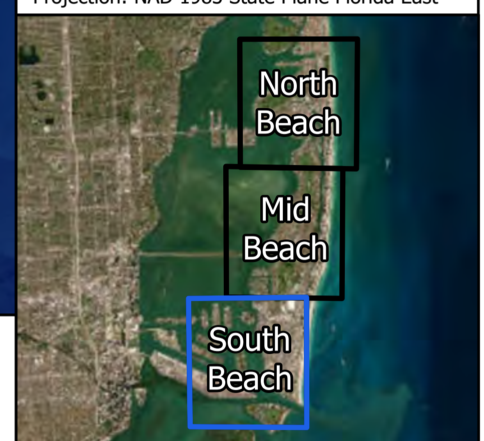
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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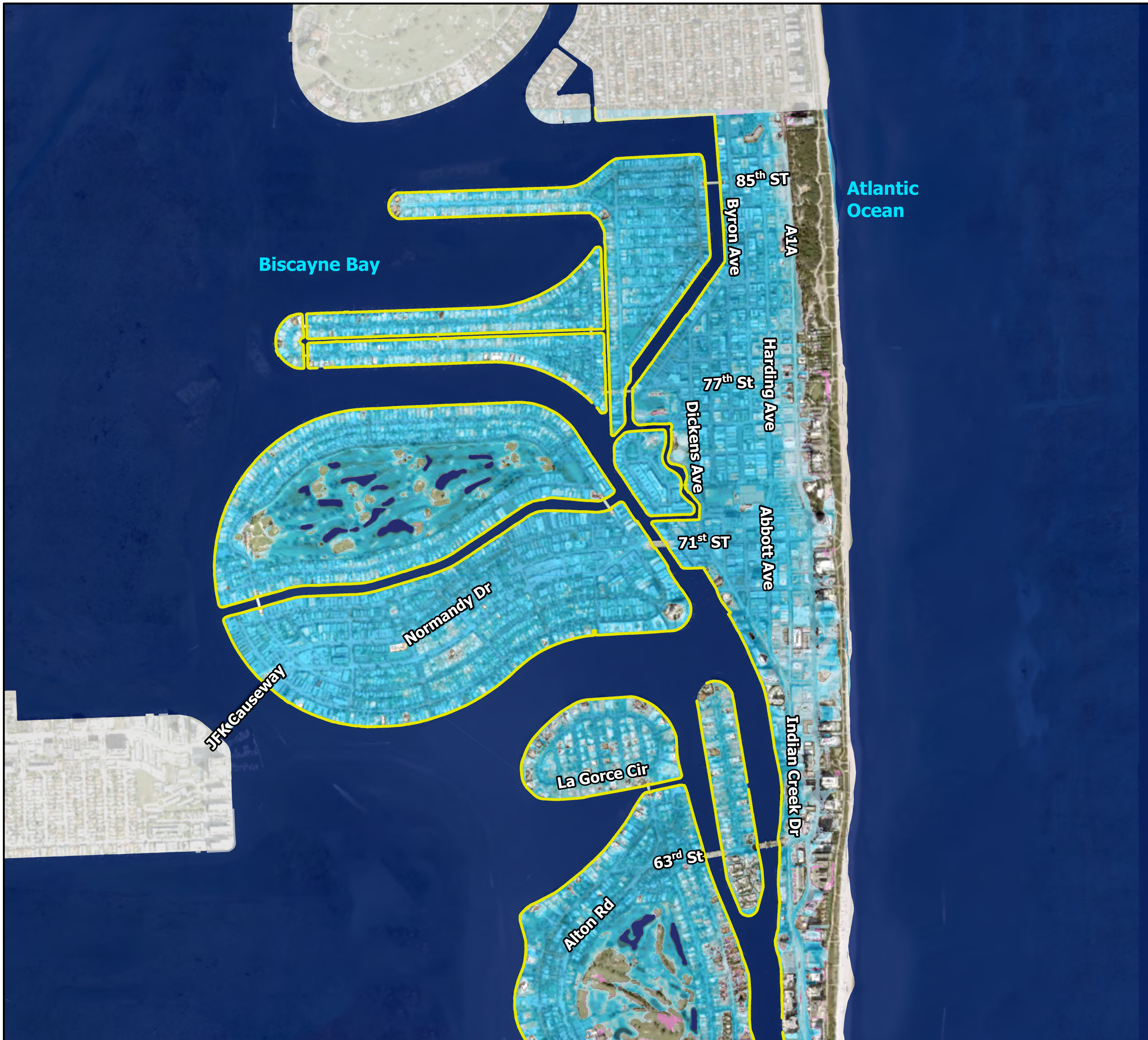


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

King Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

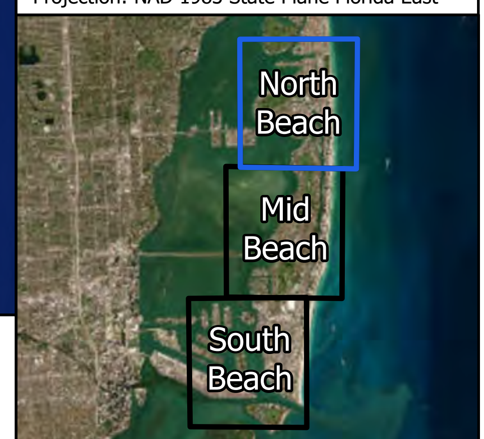
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

King Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

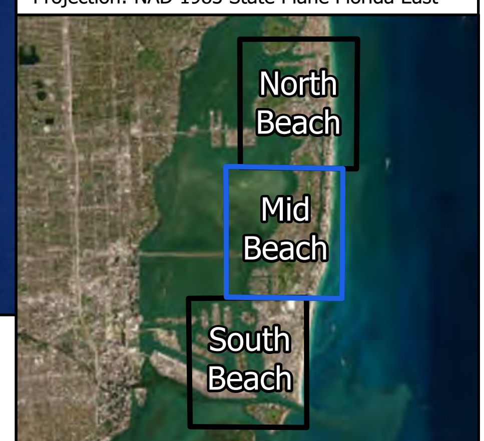
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



Disclaimer: This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of compound flooding caused by a combination of high tides and rainfall considering specific sea level rise and precipitation scenarios. However, it is not meant to replace FEMA's National Flood Insurance Rate Maps nor the official storm surge forecast of National Hurricane Center. Groundwater flooding areas represent low-lying locations of the City that may experience inland flooding when tidally-influenced groundwater levels reach or exceed the mapped sea level rise scenario. Shoreline overtopping indicates areas in which the the water surface exceeds the elevation of shoreline protection. Data Sources: Digital Elevation Model (DEM): NOAA Office of Coastal Management (2021); King Tide Extent: NOAA Center for Operational Oceanographic Products and Services (2019); City of Miami Boundary: Miami Dade Open GIS Hub (2021). Rainfall Data: South Florida Water Management District (SFWMD); Compound flooding was modeled with EPASWMM5.

City of Miami Beach
Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
Compound Flooding
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+4.1 Feet SLR

King Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

Shoreline Overtopping

Groundwater Flooding

Rainfall Flooding Extent

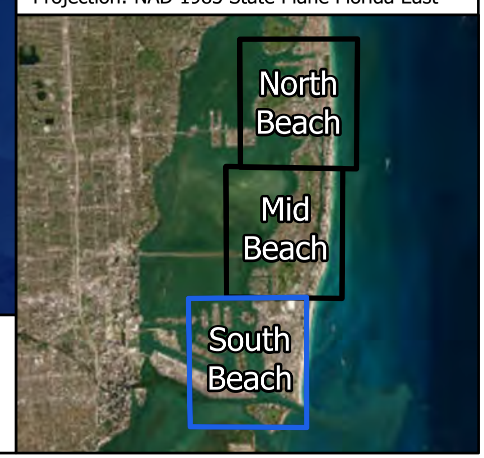
Note: Rainfall flood extents represent areas at risk of rainfall ponding beyond the influence of King Tide or groundwater flooding. Rainfall flood depths are less than 2 feet.

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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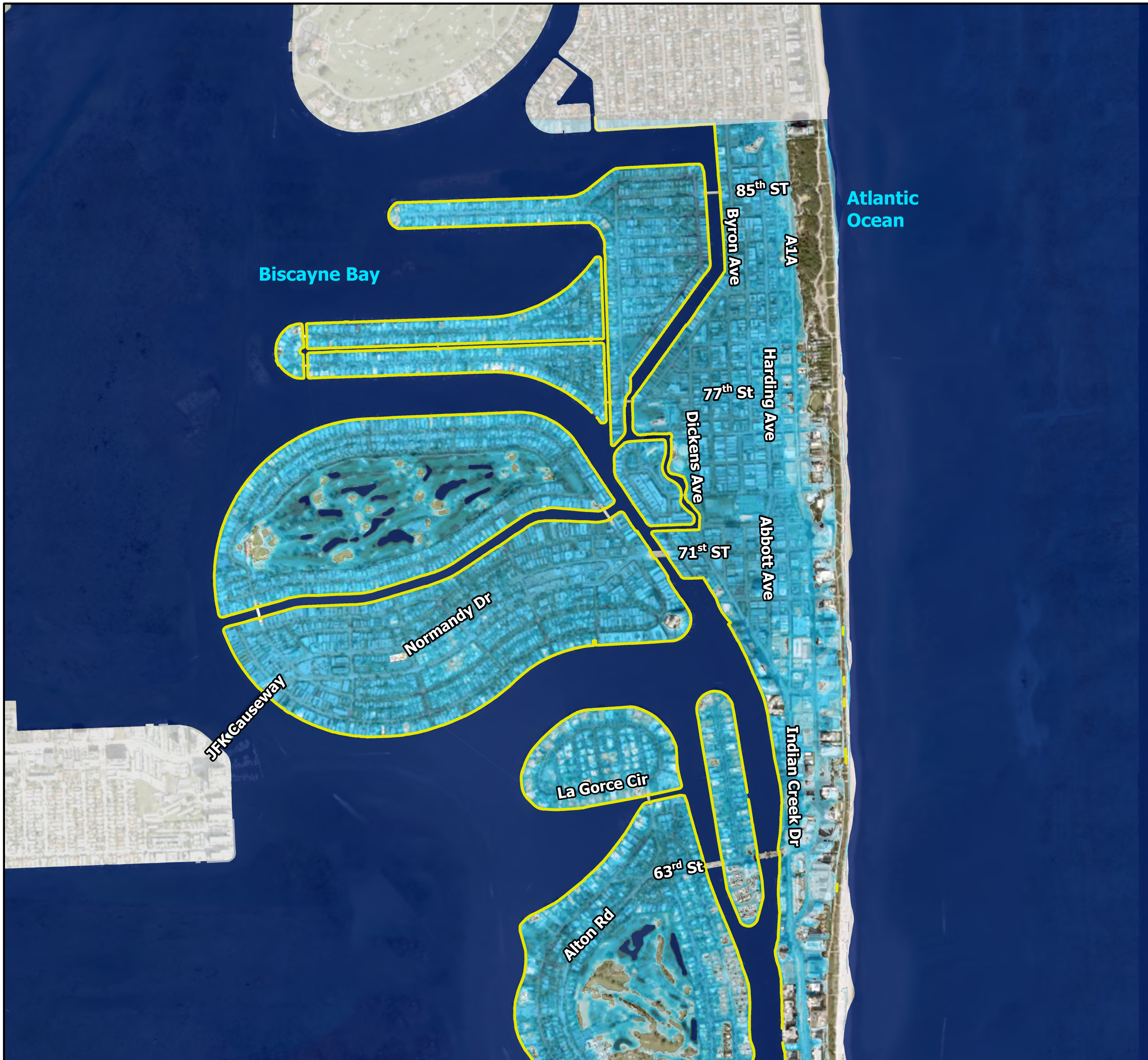
D.4.4. Storm Tide (Storm Surge) Flood Hazard Maps

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +0.0 Feet SLR



Storm Tide Inundation

Depth in Feet
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

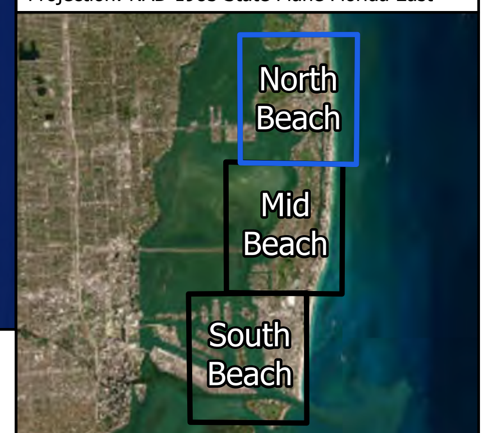
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+0.0 Feet SLR

Storm Tide Inundation (Depth in Feet)
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

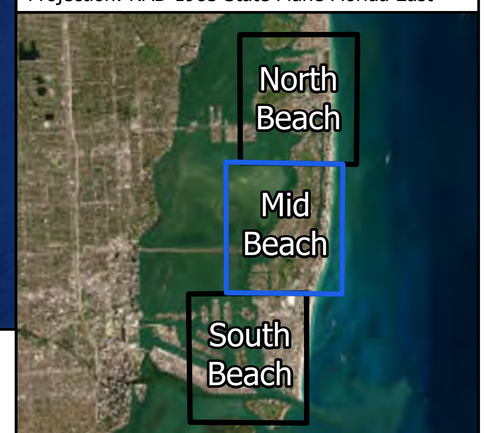
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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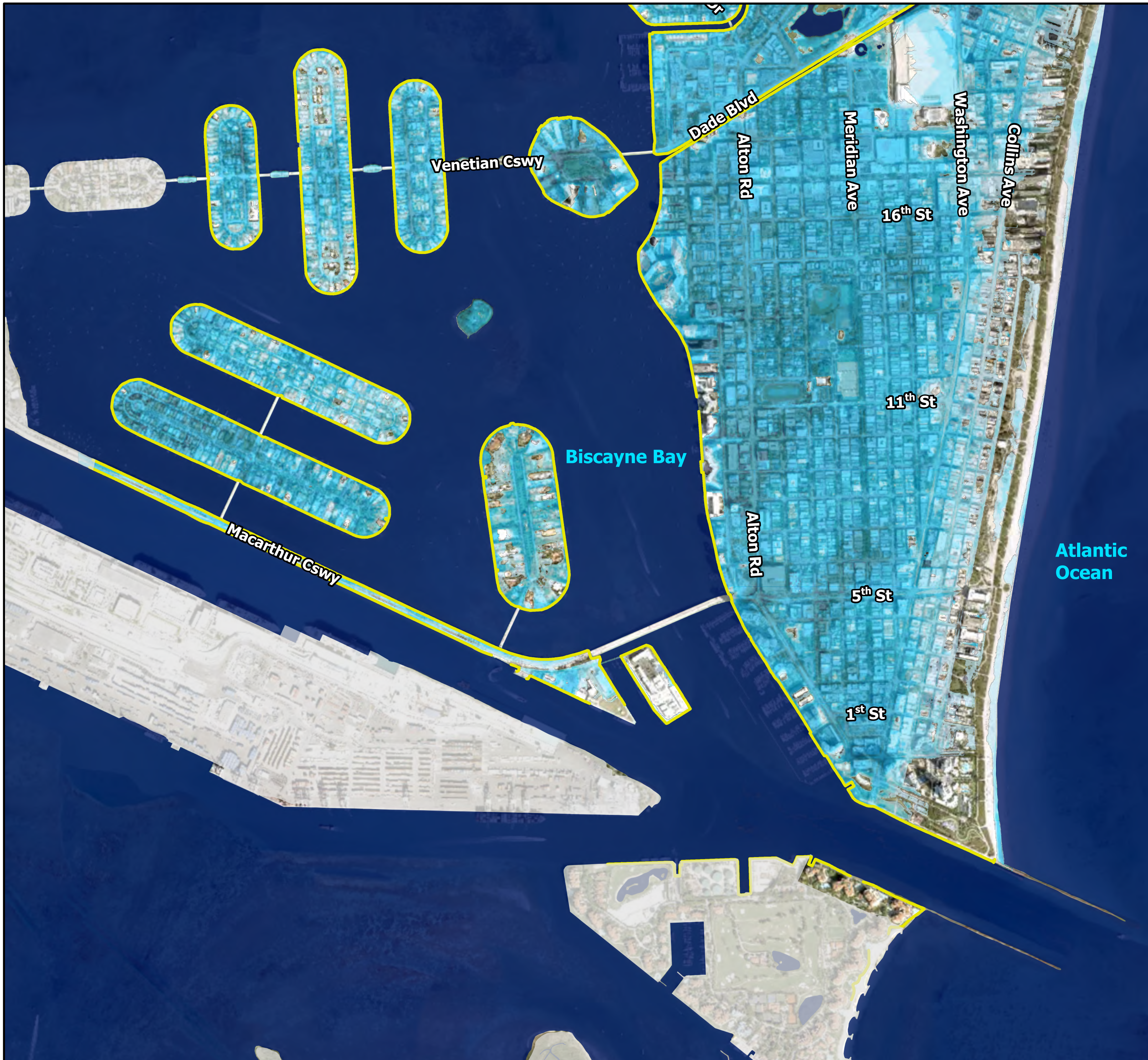


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2020 Existing Conditions

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+0.0 Feet SLR

Storm Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

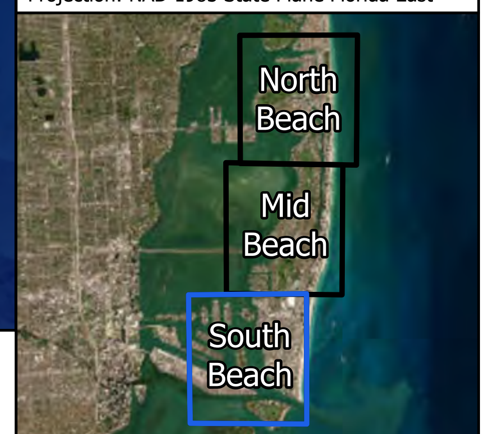
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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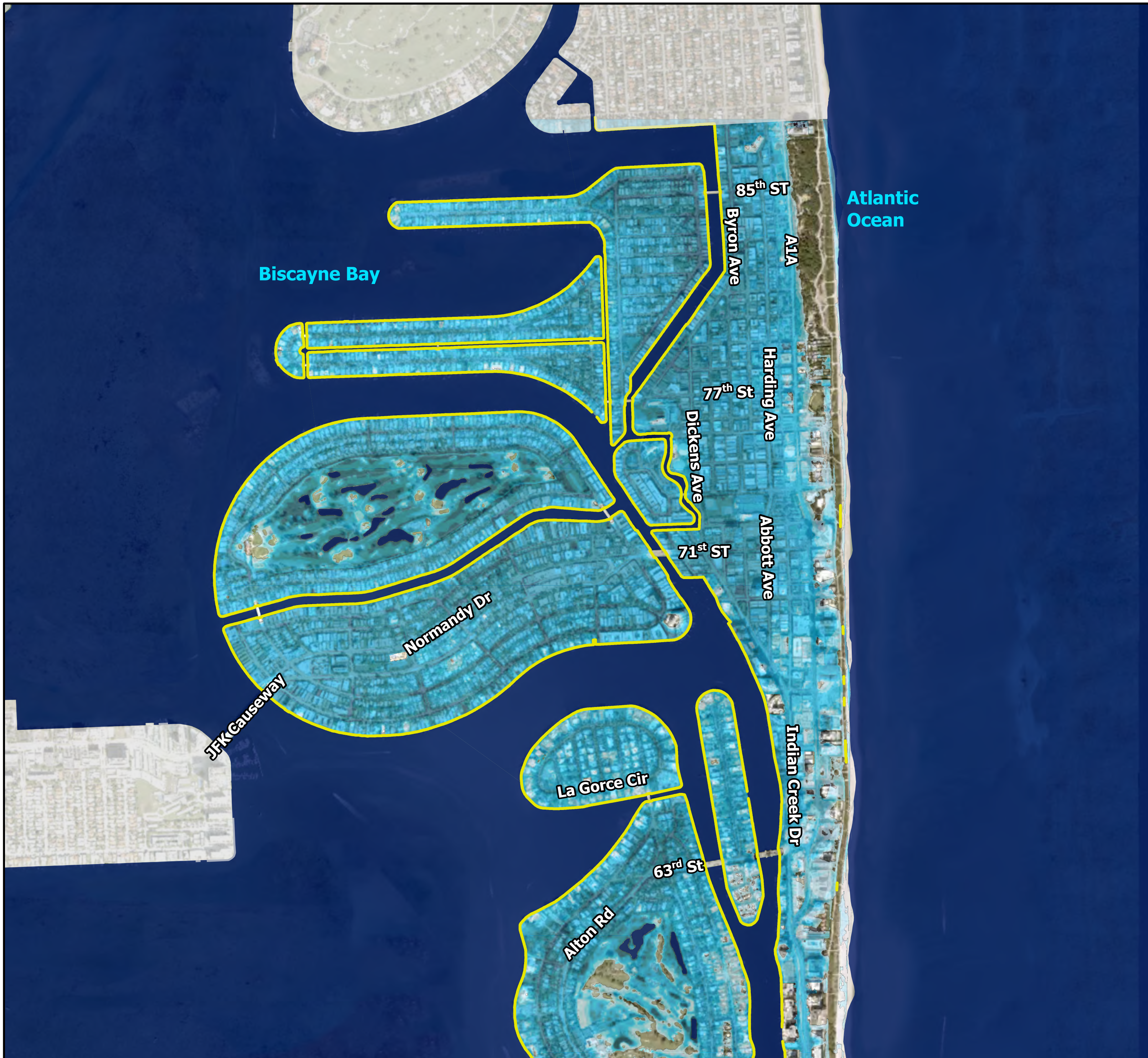


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +0.3 Feet SLR

Storm Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

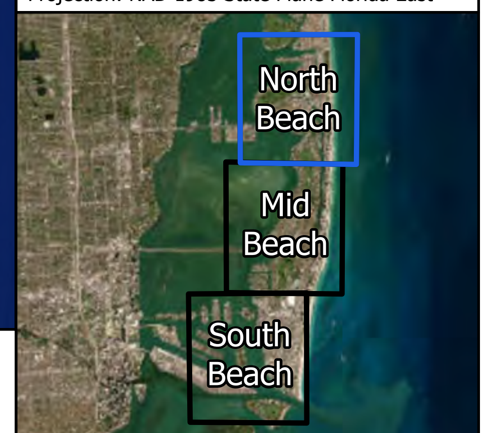
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+0.3 Feet SLR

Storm Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

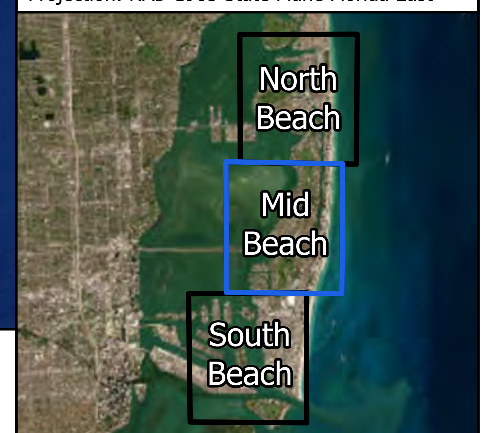
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate Low

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+0.3 Feet SLR

Storm Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

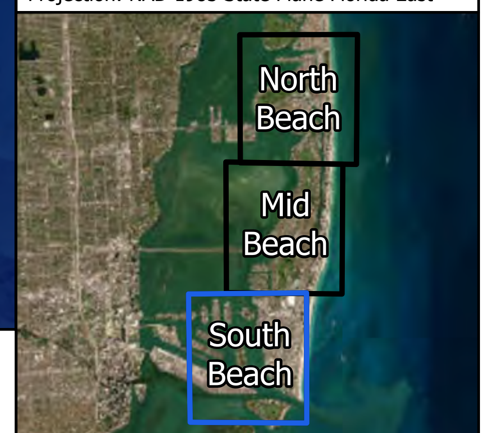
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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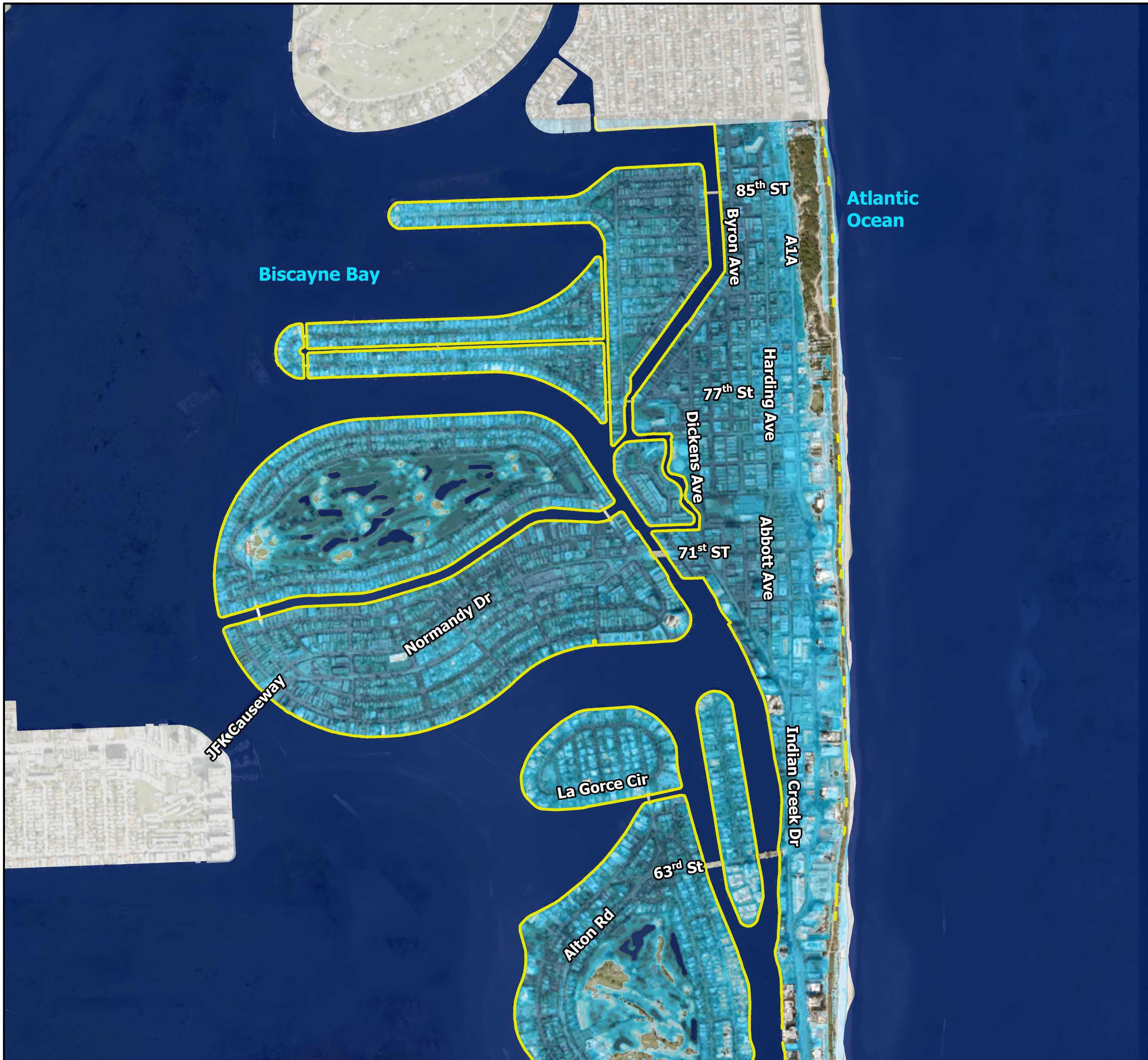


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +1.0 Feet SLR

Storm Tide Inundation (Depth in Feet)

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

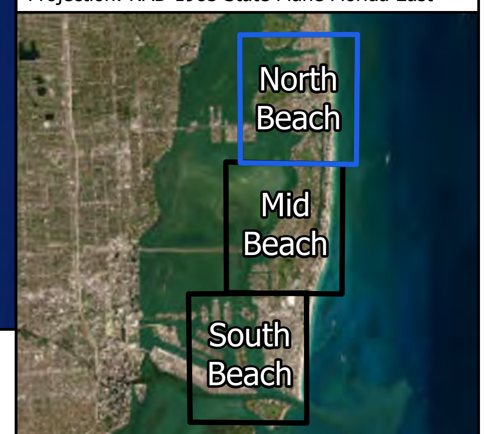
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +1.0 Feet SLR

Storm Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

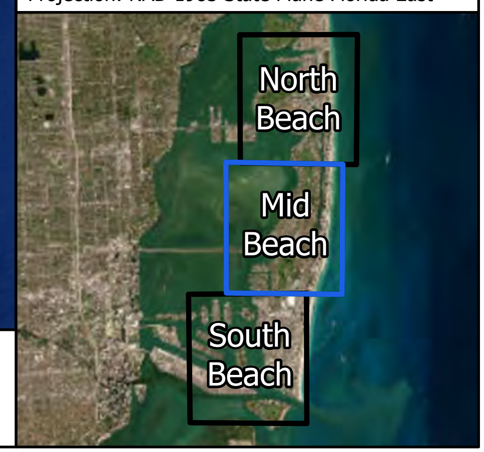
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA Intermediate High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+1.0 Feet SLR

Storm Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

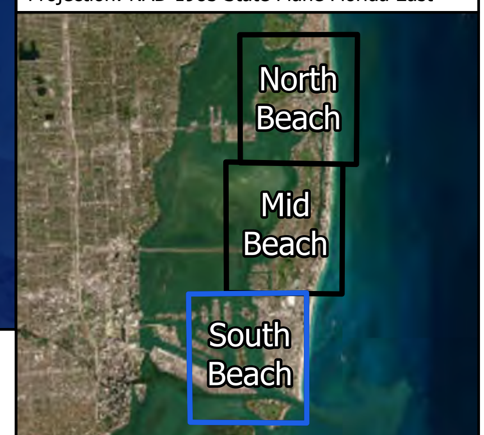
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +1.4 Feet SLR

Storm Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

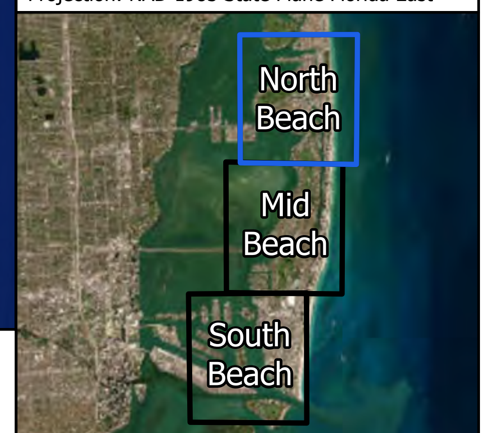
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +1.4 Feet SLR

Storm Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

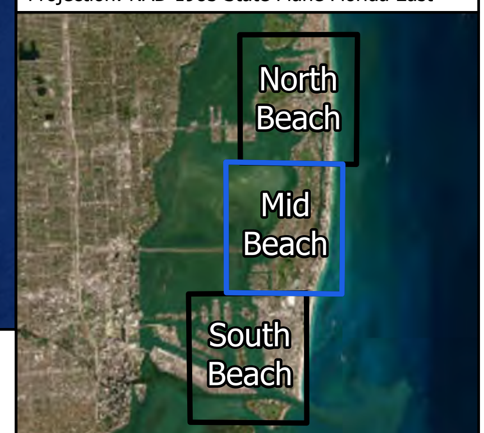
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2040 NOAA High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+1.4 Feet SLR

Storm Tide Inundation

Depth in Feet:
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

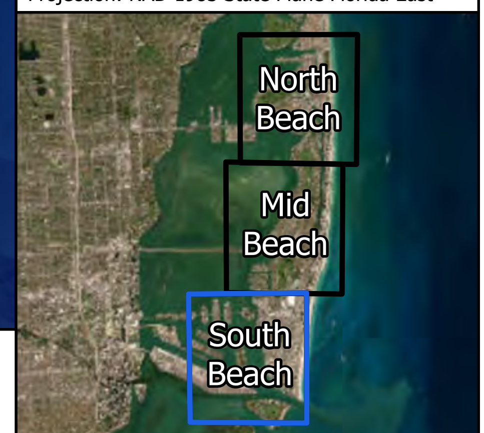
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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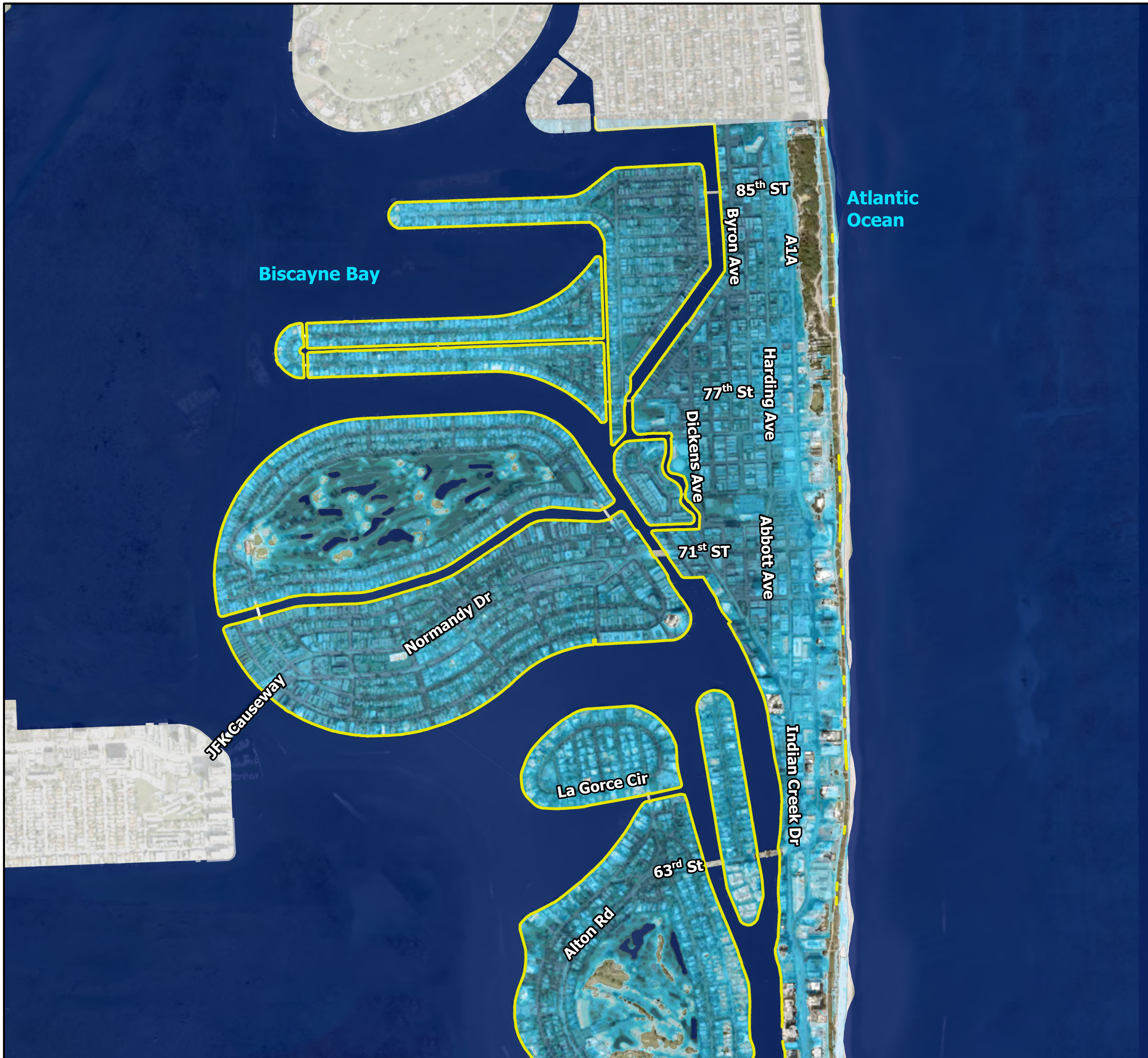


City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +0.9 Feet SLR

Storm Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

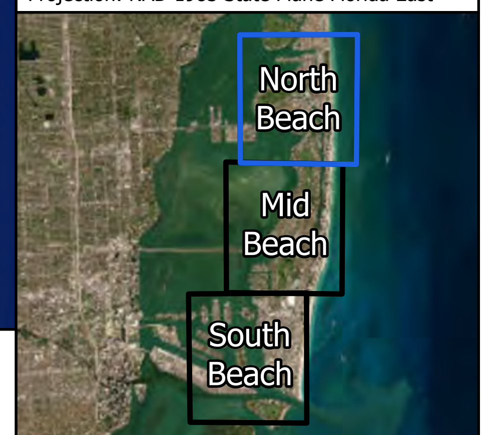
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +0.9 Feet SLR

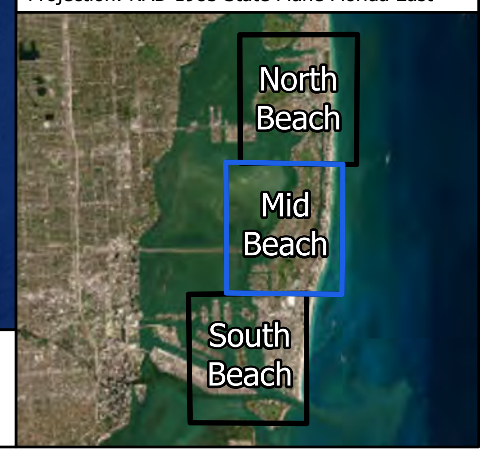
Storm Tide Inundation (Depth in Feet)
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

Shoreline Overtopping

0 1,000 2,000 Feet

N

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate Low

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+0.9 Feet SLR

Storm Tide Inundation

Depth in Feet
<1
1 - 2
2 - 3
3 - 4
4 - 5
>5

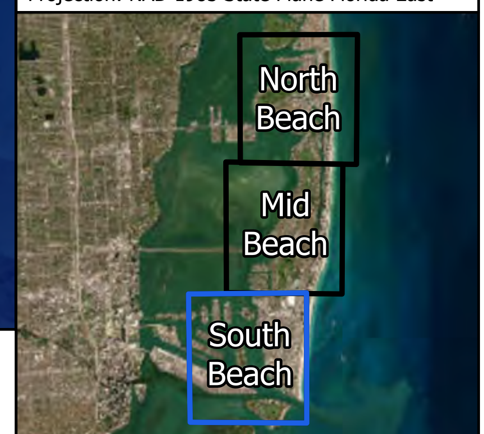
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+2.9 Feet SLR

Storm Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

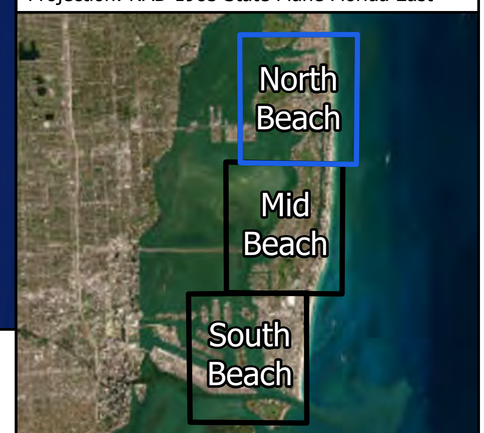
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



Disclaimer: This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of inundation and coastal flooding due to specific sea level rise and storm surge scenarios. However, it is not meant to replace FEMA's National Flood Insurance Rate Maps nor the official storm surge forecast of the National Hurricane Center. Groundwater flooding areas represent low-lying locations of the City that may experience inland flooding when tidally-influenced groundwater levels reach or exceed the mapped sea level rise scenario. Shoreline overtopping indicates areas in which the the water surface exceeds the height of shoreline protection. Data Sources: Digital Elevation Model (DEM): NOAA Office of Coastal Management (2021); Storm Tide Extent: FEMA Flood Insurance Study (2021); City of Miami Boundary: Miami Dade Open GIS Hub (2021).

City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +2.9 Feet SLR

Storm Tide Inundation

Depth in Feet

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

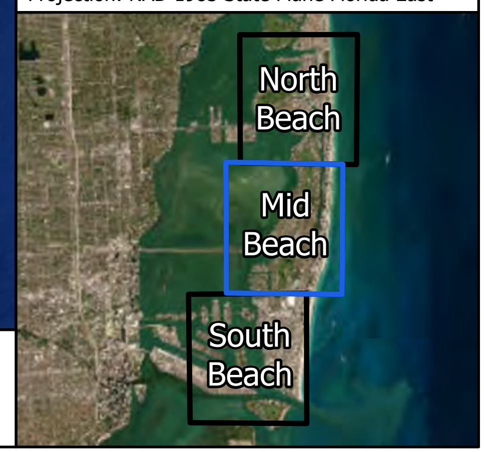
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA Intermediate High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year)
Storm Tide (6.2 Feet NAVD88)
+2.9 Feet SLR

Storm Tide Inundation

Depth in Feet
- <1
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Shoreline Overtopping

MIAMIBEACH

0 1,000 2,000 Feet

N

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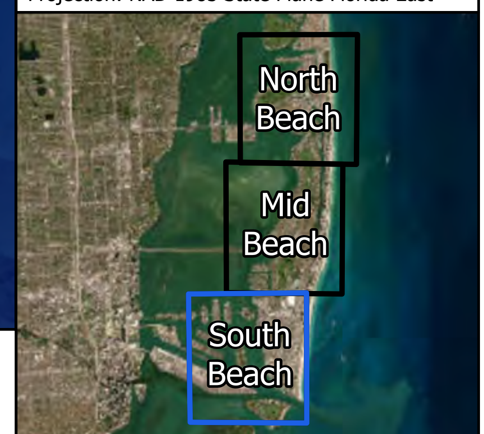

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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
1-Percent Annual Chance (100-Year) Storm Tide (6.2 Feet NAVD88) +4.1 Feet SLR

Storm Tide Inundation (Depth in Feet)

- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- >5

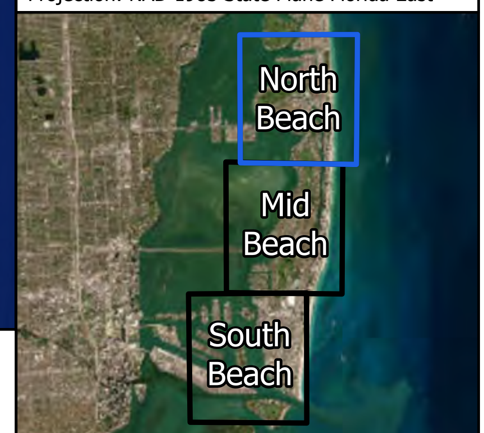
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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City of Miami Beach
Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
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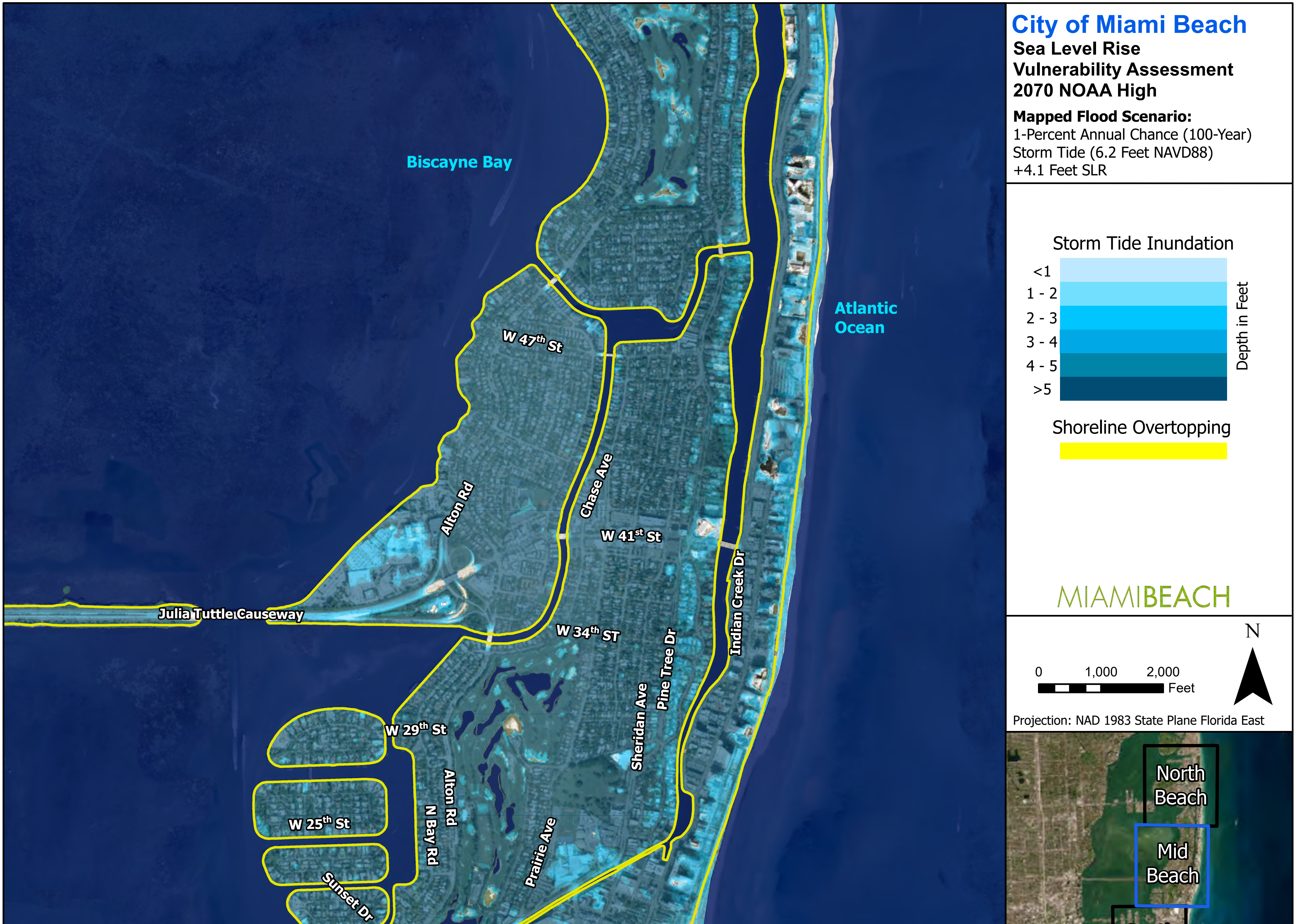

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City of Miami Beach

Sea Level Rise Vulnerability Assessment 2070 NOAA High

Mapped Flood Scenario:
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Storm Tide Inundation

Depth in Feet: <1; 1 - 2; 2 - 3; 3 - 4; 4 - 5; >5

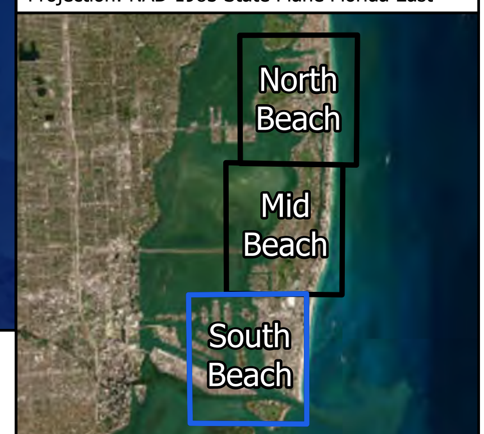
Shoreline Overtopping

MIAMIBEACH

N

0 1,000 2,000 Feet

Projection: NAD 1983 State Plane Florida East



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Appendix E: Vulnerability Assessment

The Vulnerability Assessment (Assessment) identified the City's assets and services that are most at risk from the existing and future flooding scenarios detailed in Appendix D. The Assessment consider an individual asset's characteristic and risk of flooding to determine a vulnerability score. Scores among assets could then be compared to establish the City's most vulnerable assets that can be prioritized for adaptation actions. This section details the Assessment approach that was conducted for each asset.

E.1 Assessment Approach Overview

Based on recommendations from the FDEP Florida Adaptation Planning Guidebook, vulnerability for each asset was assessed in terms of the following components:

- **Exposure:** the timing and extent to which an asset or system is introduced to the flooding hazard.
- **Sensitivity:** the degree to which the physical condition and function of an asset or system is affected by flooding.
- **Consequence:** the magnitude and scale of community impacts that would be incurred should the asset or system fail to function due to flooding.

A scoring methodology was developed to quantify each of the three components based on asset characteristics. Asset scores for each component were summed to establish an asset's total vulnerability score (**Figure E.1**). Once scored, assets were organized into a list ordered by total vulnerability score. This list provided a means for the City to compare vulnerability across individual assets and prioritize those with higher vulnerability scores. The list of prioritized assets will inform the City's development of adaptation focus areas and strategies the City can pursue to reduce flooding vulnerability.

Additional detail for how scoring was determined for each component and a summary of findings are described in the following sections.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Figure E.1: Vulnerability Assessment Scoring Methodology.

E.2 Exposure

The Exposure component of the Assessment considered if and when an asset was exposed to the flooding scenarios described in Appendix D. The exposure of an asset was determined using the GIS layers for each of the flood scenarios (king tide, compound flooding, and storm tide) and the location of the asset. If the modeled flood extent covered (i.e., was overlaid on top of) the asset location, this indicated that the flood water surface elevation was greater than the elevation of the asset. Therefore, the asset was considered exposed to that flood scenario.

Scores for the Exposure component were captured in a binary manner. If an asset was considered exposed to a flood scenario, it received a '1' for that scenario. If the asset was considered not exposed to a flood scenario, it received a '0' for that scenario. As there were three (3) flood hazard sources considered across seven (7) sea level rise scenarios, an individual asset could receive an exposure score ranging from '0', meaning the asset has no flood exposure to any scenario, to a score of '21', indicating that the asset is exposed to all the flood hazard scenarios. An example exposure scoring table for Fire Station #1 is provided below.

Table E.1: Example Exposure scoring table for Fire Station #1.

NOAA Sea Level Rise (SLR) Scenario	Exposure to Flood Scenarios		
	King Tide	Storm Tide (100-Year Coastal Storm)	Compound Flood (10-Year, 24-hr Rainfall + King Tide)
Existing Conditions	0	1	0
2040 Intermediate Low	0	1	0
2040 Intermediate High	0	1	1
2040 High	1	1	1
2070 Intermediate Low	0	1	0
2070 Intermediate High	1	1	1
2070 High	1	1	1
Total Exposure Score = 14			

For most assets evaluated in the Assessment, the ground surface elevation was the only elevation information available to compare to the water surface elevations of the flood scenarios. However, for certain City facilities, first-floor elevation (FFE) information was available and could be utilized to evaluate if the water surface elevations exceeded these values. For these facilities, Exposure scores were captured in two calculations. The asset received a half-point (0.5) if the water surface level exceeded the ground surface elevation but did not exceed the FFE. This accounted for facilities that are not inundated by floodwaters, but where building access could be impacted. An additional half-point (0.5) was given if the water surface elevation exceeded the FFE and the facility is expected to be inundated. Assets that did not have FFE information available were given the full Exposure point (1) per scenario where the flood water surface elevation exceeded the ground surface elevation.

E.3 Sensitivity

The Sensitivity component examined the degree to which an asset is affected by flood exposure. In this Assessment, degrees of sensitivity (High, Moderate, Low, or Not Sensitive) were assigned to assets based on general characteristics of each asset category. Assets with the greatest relative sensitivity to flood exposure (e.g., electrical substations) received the High classification, while assets with limited to no sensitivity to flood exposure (e.g., telecommunication towers) received Low or Not Sensitive classifications.

Sensitivity Example

Not Sensitive:
Telecommunication towers and the connected electrical infrastructure are typically elevated high above potential floodwaters, likely producing no impacts to function if the surrounding area floods.

High Sensitivity:
Electrical substations contain many delicate components that could corrode and require replacement if exposed to floodwaters.

Scores for the Sensitivity component were determined by these qualitative degree classifications. Scores associated with each classification are shown in **Table E.2**. Sensitivity scores also ranged from 0 to 21 to match Exposure scoring and maintain a proportional contribution of each Assessment component to an asset's final vulnerability score.

Table E.2: Sensitivity classifications.

Rating	Definition	Score
Not Sensitive	No impact to asset function	0
Low Sensitivity	Short-term, minor, or reversible damage to asset or system function	7
Moderate Sensitivity	Significant, but reversible damage to asset or system function	14
High Sensitivity	Irreversible damage to asset or system and permanent loss of function	21

Generally, sensitivity scores were applied uniformly for all assets within an Asset Type since most individual assets lacked additional information relevant to flooding sensitivity that would distinguish it from other assets. For example, there was no additional characteristics available to distinguish one City stormwater pump from another, other than where it is located. Therefore, all stormwater pumps were given a uniform Sensitivity score based on characteristics typical of stormwater pumps.

However, Asset Types with distinguishing information available (e.g., age or amenities present) were able to be further refined in the assignment of sensitivity scores. Asset Types with asset-specific sensitivity scores were:

- **Drinking Water and Wastewater Pipelines:** (based on pipeline age)
  - <40 years – Low Sensitivity
  - 40-70 years – Moderate Sensitivity
  - >70 years or Unknown Age – High Sensitivity

- **Parks:** (based on structures and amenities present at the park)
  - Passive Green Space – Not Sensitive
  - Linear and Mini Parks – Low Sensitivity
  - Neighborhood and Major Parks – Moderate Sensitivity

More information on the assignment of sensitivity classifications for each Asset Type, including details for each assignment, is provided in Appendix E.8.

E.4 Consequence

The Consequence component considered the degree of community impacts that would result if the asset failed to function. For this assessment degrees of consequence (High, Moderate, Low) were assigned based on the function or service the asset currently provides to the community and the scale of impacts should the function or service be lost. Assets that provide significant and community-wide services and benefits (e.g., public schools) were classified with a High Consequence, while assets that provide more localized or less essential services were classified with a Low Consequence.

Consequence Example

Low Consequence:
College facilities damaged by floodwaters will be limited to the campus and impacted buildings.

High Consequence:
Public school closures due to flood damage can create food insecurity concerns for disadvantaged children, additional childcare burdens for families, and lead to a "learning loss" among students.

Like Sensitivity scoring, Consequence component scores were established using these qualitative classifications. Asset scores for the Consequence component were applied in a similar fashion to Sensitivity and ranged from 7 to 21, shown in **Table E.3**. No assets considered in the Assessment were determined to have a 'No Consequence' classification should they fail to function.

Table E.3: Consequence classifications.

Rating	Definition	Score
Low Consequence	Localized and temporary (less than 24 hours) impacts. Normal community functionality, but with some inconvenience and economic disruption. Some impacts on the environment, but with no long-term effects.	7
Moderate Consequence	Widespread, but reversable impacts. Community assets experience damage that requires costly repairs. Some impacts to the environment with long-term effects, but with the ability to recover.	14
High Consequence	Significant loss and long-lasting setbacks. Community is unable to function without external financial support. Long-lasting and/or permanent loss of habitats and environmental services.	21

As with the assignment of Sensitivity scores, most Consequence scores were applied uniformly to all assets within an asset subcategory. Where asset-specific characteristic information was available, the approach was modified to assign varying levels of consequence scores. Asset Types with asset-specific consequence scores included:

- **Roadways:** (based on road connectedness and typical traffic volumes).
  - Local Roads – Low Consequence
  - Minor Arterial Roads – Moderate Consequence
  - Principal Arterial Roads – High Consequence

- **Parks:** (based on size, community use, and type of events held at the park).
  - Passive Green Space– Low Consequence
  - Neighborhood, Linear and Mini Parks – Moderate Consequence
  - Major Parks – High Consequence

More information on the assignment of Consequence classification for each asset subcategory, including details for each assignment, is provided in Appendix E.8.

E.4.1 Additional Community Considerations

The City recognizes that flooding impacts do not affect all residents equally. Socially vulnerable populations often face the greatest consequences from hazard events. For example, while flooded roadways restrict travel across the City, disruptions to public transportation routes can isolate individuals who rely on these systems from home or work. As another example, certain older and disabled populations will also be less to likely to have the resources needed to prepare for a flooding event to prepare or the financial means and physical capability to recover following an event. These and other socially vulnerability populations require additional consideration in the City's planning and design of sea level rise adaptation strategies to ensure projects and outcomes are distributed equitably.

To incorporate these equity considerations in the Assessment, the City determined the assets that were located in the 12 census tracts identified by the Center for Disease Control as the Top-25% most socially vulnerable census tracts based on the population demographics of the people that lived there[1] (**Figure E.2**). Based on the communities served, assets located within these census tracts were assessed to generate increased community consequences should they fail. These assets received an additional (1) point towards the Consequence score.

Figure E.2: Miami Beach Socially Vulnerable Neighborhoods.

1 Center for Disease Control – Social Vulnerability Index

E.5 Vulnerability Assessment Key Findings

The scores for each component (Exposure, Sensitivity, and Consequence) were then summed to establish the vulnerability score for each asset. Final asset vulnerability scores could range from 7 to 64. This standardized approach generated a list of the City's critical assets and services that could be compared and prioritized by vulnerability. This section provides the key findings from the Assessment, which are provided at a City-wide scale. A more detailed and focused discussion of vulnerabilities among different asset types is provided in Section E.6.

Most Vulnerable Assets

From the prioritized list of nearly 60,000 City assets, the assets found to have the highest relative vulnerability were wastewater pipelines that are older than 70 years old (or the age of the pipeline was unknown). While only representing 5-percent of the total wastewater pipeline sections, these older pipelines represent the first 1,072 assets in the City-wide list. These sections of wastewater pipelines are also the only assets that received the maximum possible vulnerability score (64) and represent all but one of the assets that received a 63 score.

Older sections of wastewater pipelines rise to the top of the prioritized list due to high scores across the three components of the Assessment. Sections of wastewater pipelines are found all throughout the City, which raises the possibility that sections will be exposed to both coastal and rainfall flood hazard scenarios. Wastewater pipelines older than 70 years old (or those with an unknown age) were also classified to have both High Sensitivity and High Consequence of failure.

These highly vulnerable wastewater pipeline sections are found throughout the City. However, there is a higher concentration in areas of South Beach, particularly near Biscayne Bay (**Figure E.3**). Other areas where these sections are concentrated is within the socially vulnerable communities of the Bayshore, City Center, and Flamingo and Lummus neighborhoods.

Figure E.3: Most Vulnerable Wastewater Pipelines.

A similar trend exists for the City's other linear features (e.g., drinking water pipelines and roadways). The numerous and varying lengths of these pipelines and roadways throughout the City led to an increased opportunity for exposure. The higher exposure scores raise the vulnerability scores for these features above many of the City's structures which are represented by individual points. Therefore, when discussing City-wide impacts to assets and services it can be helpful to divide the point-based assets into a generalized category of 'Structures & Facilities' and linear features into a 'Pipelines & Roadways' category[2]. The next two sections include key Assessment findings for these categories, including identification of areas of most vulnerable assets.

Structures & Facilities Vulnerability

Excluding linear features, stormwater pump stations, water pump stations and electrical substations are the next assets with the highest vulnerability scores. The most vulnerable of which are located in areas of highly exposure to multiple flood sources, such as South Beach and areas adjacent Biscayne Bay. These types of facilities were also classified to have High Sensitivity and High Consequence. The Top-10 Structures & Facilities are shown in **Table E.4**.

Table E.4: Top-10 Most Vulnerable Structures & Facilities.

Asset Type	Asset Name/Location	Vulnerability Score
Stormwater Pump Station	#33 (17th St)	63
Water Pump Station	Belle Island	62
Stormwater Pump Station	#31 (6th St)	62
Stormwater Pump Station	#13 (N Meridian Ave)	62
Stormwater Pump Station	#5 (Venetian Way)	62
Stormwater Pump Station	#11 (Nautilus Dr)	62
Stormwater Pump Station	#22 (Prairie Ave)	62
Electricity Production and Supply Facility	West Ave Substation	61
Stormwater Pump Station	#4 (Bay Rd)	61
Stormwater Pump Station	#10 (W 46th St)	61

The South Shore Community Center is the City structure (i.e., building) with the highest vulnerability score (50). The South Shore Community Center is considered exposed to every considered flood scenario. Subsequent structures in the list represent a more diverse list of the City buildings including hospitals, schools, fire stations, police stations, and other community centers.

Generally, structures were considered to have a Moderate Sensitivity to flooding, while pump stations and electrical substations received a High classification due to the numerous delicate electronic components which are critical to the function of the facility. This distinction elevates the vulnerability score for most of these facilities above most structures, except for the structures with very high Exposure scores.

The City's most vulnerable Structures & Facilities are generally spread throughout the City (**Figure E.4**) This is because both the compound flooding and storm tide flooding scenarios are extensive enough to impact nearly half and nearly all assets (43%, 97%, respectively) even under current conditions. Exposure to king tide extents also increases from 6% exposure from existing conditions to 86% by 2070 (NOAA Intermediate High scenario).

Still, most of South Beach and southern areas of Mid Beach include the majority (88%) of the Structures & Facilities with Higher vulnerability scores (Top-33% of scores). All Structures & Facilities within West Ave and Bay

2 The City's parks are not included in either category. A more focused analysis specific to park vulnerability can be found in the Parks Asset Group Profile.

Road neighborhood are classified with higher vulnerability due to high flood exposure to most scenarios in this area. Similarly, all but six of the Structures & Facilities located in the Venetian Islands and Star, Palm, and Hibiscus Islands are classified with higher vulnerability. For the rest of Mid Beach and North Beach, the assets with higher vulnerability are spread throughout the regions. Although, assets located near the bay side of each region noticeably have higher vulnerability classifications.

Less than one-third (28%) of Structures & Facilities are located in socially vulnerable neighborhoods and only one-quarter (24%) of those are considered to have higher vulnerability scores. The socially vulnerable community area of the Ocean Front neighborhood between W 41st St and 27th St includes more higher vulnerability assets than the rest of the neighborhood. The North Beach neighborhood, all of which is considered a socially vulnerable community contains more than half (62%) of the Structures & Facilities in the North Beach region of the City.

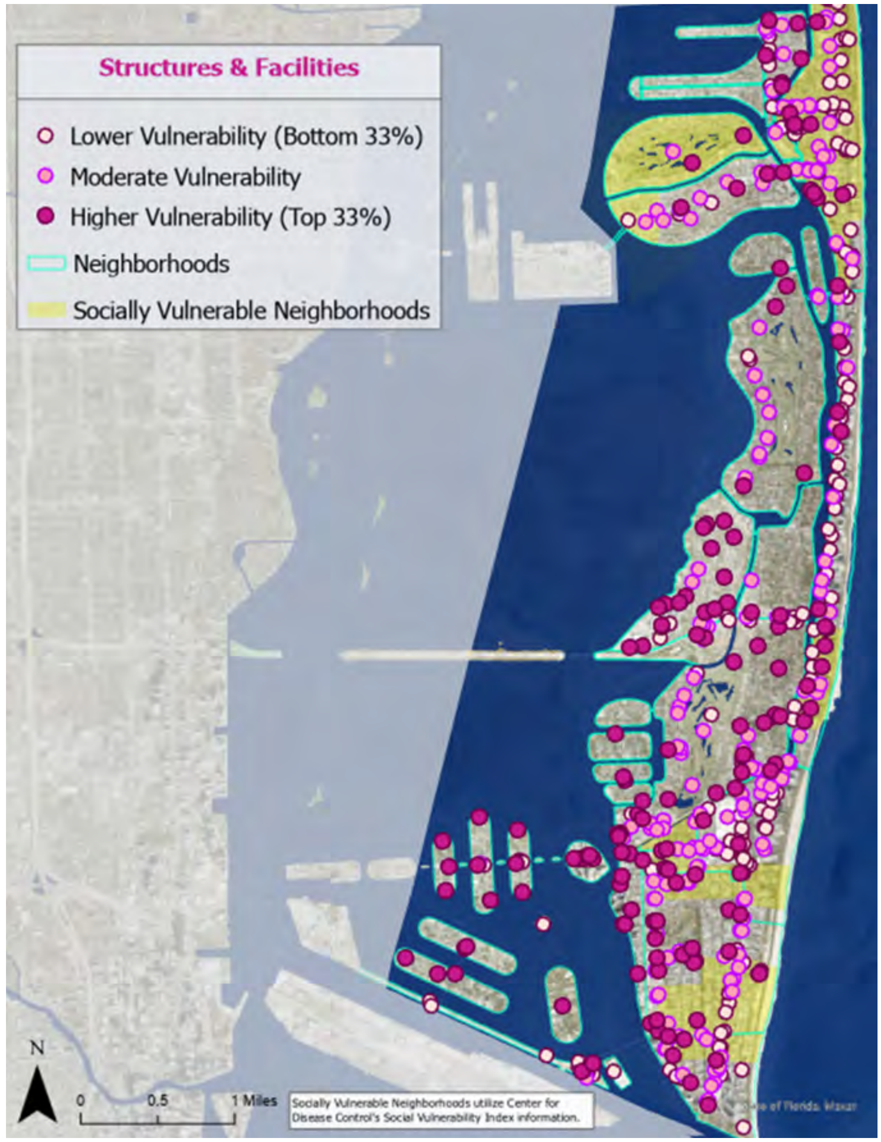


Figure E.4: Structures & Facilities Vulnerability.

Pipelines & Roadways

As mentioned, the most vulnerable linear features are the wastewater pipelines due to high scores across the three components. As Pipelines & Roadways received additional scoring refinement due to pipelines ages and road classifications, there was a greater spread among Sensitivity and Consequence scores within these Asset Types. Therefore, the most vulnerable sections of pipeline that are older or stretches of major roadways. Of these, the linear features with the highest vulnerability scores are those located in more exposed areas of the City.

Figure E5 shows the distribution of vulnerable Pipelines & Roadways. The sections of higher vulnerability are mostly located in the socially vulnerable neighborhoods in all three City regions. South Beach includes the most numerous sections of higher vulnerability, particularly on the west. There is also a concentration of moderate-to-higher vulnerable sections in much of Mid Beach east of the Mount Sinai hospital and northeast of the Miami Beach Golf Club. In North Beach, the higher vulnerability sections are generally adjacent the canals, though sections of Moderate Vulnerability are present throughout the northeast portion of the Biscayne Point and Normandy Isles neighborhoods.

There are noticeable differences between where higher vulnerability Pipelines & Roadways are located when compared to the Structures & Facilities map (**Figure E.5**). For example, the Pipelines & Roadways of the Venetian Islands and Star, Palm, and Hibiscus Islands show Lower Vulnerability. More than half (60%) of the pipelines on these islands are considered new and therefore have Low Sensitivity scores contrasting the higher vulnerability classification for most Structures & Facilities located here. Also, in contrast to **Figure E.4**, the neighborhoods of La Gorce, Nautilus and Bayshore show few areas of higher vulnerability assets adjacent to Biscayne Bay, relative to the rest of the neighborhood.

Figure E.5: Pipelines & Roadways Vulnerability.

In South Beach there is more agreement in the most vulnerable assets for both. On the west side of South Beach, higher vulnerability sections of Pipelines & Roadways align with areas of higher vulnerability Structures & Facilities (except for the offshore islands as discussed). These areas of South Beach have some of the lowest elevations in the City and therefore more often exposed all assets located there. There is also some similar representation of higher vulnerability assets in the socially vulnerable community areas of the Ocean Front neighborhood between W 41st St and 27th St and areas of the North Beach neighborhood.

E.6 Asset Group Vulnerability

Separating linear and point-based features allows for some pattern recognition among the Assessment findings. However, it remains difficult to identify specific assets at this scale. To provide more meaningful insights from the Assessment, the City developed Vulnerability Profiles, which compared vulnerability scores among further refined categories, termed Asset Groups. Asset Types that reflected a shared City function or service were organized into 10 Asset Groups (**Table E.4**) This additional refinement allowed the City to compare vulnerability among "like" assets, rather than considering one asset against all others. In other words, the Asset Groups remove the need to consider the vulnerability of the City's major parks only in relation to other vulnerable assets, such as wastewater pipelines.

For example, the Emergency Facilities Vulnerability Profile included the City's police, fire, hospital, emergency operation centers, debris staging areas, and logistical staging areas. Vulnerability scores were considered among only these assets to identify the most vulnerable Emergency Facilities. Organizing assets in this manner makes it easier for City Departments to communicate the findings of this Assessment and the City's most vulnerable assets. The findings from the Asset Groups also provide the City with more targeted vulnerability information that can better inform future adaptation plans and designs.

Table E.5: Organization of Asset Groups.

Asset Group Name	Asset Types Included	
Community Centers	• Community Centers • Affordable Public Housing	
Critical Buildings	• Local Government Buildings • Historic and Cultural Buildings • College Buildings	• State and Federal Government Buildings • School Buildings
Drinking Water	• Drinking Water Pumps • Drinking Water Storage Tanks	• Drinking Water Pipelines
Electrical & Communication	• Electrical Substations • Telecommunication Towers	
Emergency Facilities	• Emergency Operations Centers • Police Stations • Debris Staging Areas	• Mt. Sinai Hospital Buildings • Fire Stations • Logistical Staging Areas
Natural Resources	• Parks • Dune Crossovers • Surface Water Bodies	
Public Transportation	• Bus Stops • Marinas	
Roads and Bridges	• Bridges	• Roadways
Stormwater	• Stormwater Pump Stations	
Wastewater	• Wastewater Lift Stations	• Wastewater Pipelines

E.7 Asset Group Vulnerability Profiles

The 10 Asset Group Vulnerability Profiles are provided. Each profile includes the following:

Asset Group Characteristics

Describes the importance of the Asset Group to the City and the asset types included.

Key Vulnerabilities

Highlights the most vulnerable assets within the Asset Group and where they are located. Provides main takeaways for current and future flood exposure of assets.

Vulnerability Map

Provides a City-scale view of the Asset Group's vulnerability and where assets are located. Asset vulnerability scores for point and polygon features were divided into three equal quantiles to differentiate assets with higher vulnerability. In other words, the 'Higher Vulnerability' classification contains the Top-33-percent of asset scores within the Group, while the 'Lower Vulnerability' classification contains the Bottom-33-percet. Asset vulnerability classifications correspond to the color chart shown in Figure E6.

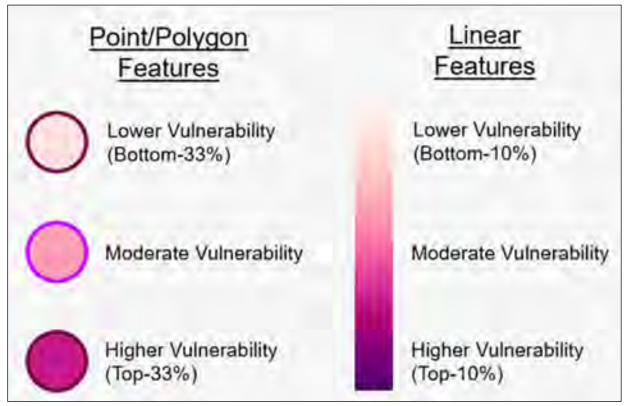


Figure E.6: Asset Group symbology

Linear feature vulnerability is considered separately from both point or polygon features. This was necessary as linear feature sizes were not uniform and often extended through and between multiple areas of the City (e.g., roads). This made linear features more likely to exposed than point or polygon features, raising the final scores for these assets. If considered collectively, linear features would overwhelmingly represent the Top-33% and effectively hide the vulnerability of points or polygons.

Linear feature scores were also classified into 10 quantiles, instead of 3. This allowed for greater separation among the thousands of similarly scored linear features and more accurately displayed the most vulnerable assets. The 'Higher Vulnerability' classification color therefore indicates the Top-10-percent most vulnerable linear features, and the 'Lower Vulnerability' indicates the Bottom-10-percent **Figure E.6**.

The Top 10 most vulnerable assets within the Group are listed in order of vulnerability score. The City's neighborhood and socially vulnerable neighborhoods boundaries are also included.

Flood Exposure

Includes a high-level description of how each flood source impacts assets within the Group under existing and future water level conditions. A summary table capturing the percentage of assets exposed for three flood hazard scenarios is also included.

Sensitivity to Flooding

Details how the Sensitivity component was determined for each asset within the Group and includes the Sensitivity classification and description for each asset type.

Community Impacts

Details how the Consequence component was determined for each asset within the Group and includes the Consequence classification and description for each asset type.

Top 10 Most Vulnerable City-Owned Assets

A table that includes the Top 10 most vulnerable assets within the Group that are City owned. The table also includes the asset's final vulnerability score and captures if the asset is exposed to each flood source under existing conditions. This table is only included for Asset Groups that include City-owned assets.

Both Top-10 asset lists reflect assets with the highest scores determined by the Assessment methodology. These higher vulnerability assets may not necessarily reflect the City's current flooding challenges or the City's current priorities for flooding adaptation measures.

Community Centers Vulnerability Profile

Vulnerability

The City's community centers were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The facilities included in this asset group provide important community services, including recreational activities, extracurricular programs, and housing to City residents. For the City's most disadvantaged individuals, these facilities may be the only location where they are able to access such services. After a hazard event, these facilities may operate in an enhanced capacity providing response and recovery services to impacted individuals. The Community Centers asset group includes:

- Community Centers (26)
- Affordable Public Housing (10)

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.

Community Centers Asset Group Vulnerability Map

Key Vulnerabilities

- The South Shore Community Center located at Jefferson Ave and 6th St is the most vulnerable community center asset.
- South Beach and Mid Beach include some of the community centers with the highest vulnerabilities. Four of the Top-10 most vulnerable community centers and 46% of those with higher vulnerability are in South Beach. There are only five community centers in Mid Beach, but four of them are in the Top-10 most vulnerable.
- North Beach has the highest proportion of community centers (50%), however just three are classified with higher vulnerability, with two in the Top-10. Over half (61%) of the community centers in North Beach are in socially vulnerable neighborhoods.
- Two of the Top-10 most vulnerable community centers provide housing to socially vulnerable individuals: Neptune Apartments (affordable public housing) and the Coral House Senior Center.
- Existing king tide conditions are projected to impact nearly one-third (31%) of the City's community centers, while existing storm tide (storm surge) conditions are projected to impact 83%.

Flood Exposure

The City community centers projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of community centers exposed to select flooding scenarios.

	Community Centers Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0' SLR	2070 Int High Scenario w/ 2.9' SLR
King Tide	11 (31%)	18 (50%)	28 (78%)
Compound Flooding	13 (36%)	15 (42%)	28 (78%)
Storm Tide (Storm Surge)	30 (83%)	33 (92%)	35 (97%)

Notes: Community Centers n = 36

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

The community centers projected to be exposed to existing king tide conditions are those along the canal shorelines in the Biscayne Point neighborhood and those impacted by groundwater flooding in the Flamingo and Lummus neighborhood. By 2040, half of the City's community centers are projected to be exposed to king tides, with exposure for additional community centers near canal shorelines. By 2070, 78% of the City's community centers are projected to be exposed. The eight facilities located directly behind the coastal dune system are the only community centers projected to remain unexposed.

Compound Flooding

Existing compound flooding is projected to impact many of the same assets as an existing king tide event. However, the addition of rainfall ponding is projected to impact additional community centers in South Beach. Compound flooding impacts to community centers under 2040 conditions is projected to increase marginally. By 2070, the community centers not projected be exposed are those in the Biscayne Point neighborhood and behind the coastal dune system.

Storm Tide (Storm Surge)

Most community centers (83%) are projected to be exposed to existing storm tide conditions. Only those located behind the coastal dune system are projected to be protected from impacts. By 2070, only the North Beach Oceanside Park Pavilion in the northern North Shore neighborhood is projected to not be exposed to storm tide flooding.

Sensitivity to Flooding

All community centers were assigned the same sensitivity score. Although the degree of flood damage may vary based on individual building characteristics, such as its age, condition, and existing flood-proofing measures, this information was not uniformly available.

Moderate Sensitivity: All Community Center Assets

Depending on flood depths, the first floor of buildings could experience structural, electrical, and material damage. Flood exposure to the foundation could have structural impacts and increase the likelihood of mold growth. Flooding can also restrict access to the buildings.

Community Impacts

Community centers were assigned consequence scores based on the severity of community impacts due to a loss of functionality. As they each serve specific functions for their communities, all community centers were rated with the same consequence score.

Moderate Consequence: All Community Center Assets

Community centers offer recreational areas, spaces for social gatherings, and activities for children that may not be accessible elsewhere in the community. Loss of these assets would have the greatest impact on disadvantaged community members, impacting their life safety and mental health. The City's most vulnerable populations likely require coordinated assistance to gather supplies, evacuate during a flood event, and navigate resources for recovery. If housing communities are impacted, the City may need to provide temporary housing until the structures are repaired.

Consequence

Sensitivity	Low	Moderate	High
High			
Moderate		• Community Centers • Affordable Public Housing	
Low			

Top 10 Most Vulnerable City-Owned Community Centers

	Exposed to Existing Flooding? King Tide	Compound Flooding	Storm Tide
1. South Shore Community Center *Vulnerability Score: 50*	**Yes**	**Yes**	**Yes**
2. Neptune Apartments *Vulnerability Score: 50*	**Yes**	**Yes**	**Yes**
3. Fairway Park Pavilion *Vulnerability Score: 48*	No	**Yes**	**Yes**
4. La Gorce Park Pavilion *Vulnerability Score: 47*	No	**Yes**	**Yes**
5. Fisher Park Pavilion *Vulnerability Score: 47*	No	**Yes**	**Yes**
6. Scott Rakow Center *Vulnerability Score: 45*	No	**Yes**	**Yes**
7. Miami Beach Police Athletic League Facility *Vulnerability Score: 43*	No	**Yes**	**Yes**
8. Flamingo Park Tennis Center *Vulnerability Score: 43*	No	No	**Yes**
9. Madeleine Village Apartments 3 *Vulnerability Score: 41*	**Yes**	No	**Yes**
10. Lottie Apartments *Vulnerability Score: 40.5*	**Yes**	**Yes**	**Yes**

Total possible Vulnerability Score – 64

Fairway Park, Source: City of Miami Beach

Scott Rakow Center, Source: City of Miami Beach

Critical Buildings Vulnerability Profile

Vulnerability

The City's critical buildings were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The City's residents and visitors rely on access to certain buildings and facilities to access community services critical to daily function in the City. These facilities include the City's places of business, schools, and local government offices. Other critical facilities support the daily well-being of residents through public programs and cultural services. The Critical Buildings asset group includes the following:

- Local Government Buildings (14)
- Historic and Cultural Buildings (18)
- School Buildings (7)
- State and Federal Government Buildings (3)
- College Buildings (2)

Critical Buildings Asset Group Vulnerability Map

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures

Key Vulnerabilities

- The most vulnerable critical building in the City is the Biscayne Elementary School located in the North Shore neighborhood.
- The higher vulnerability critical buildings are concentrated within the Bayshore, City Center, and Flamingo and Lummus neighborhoods. Nearly half of the City's critical buildings are in the southern part of the Bayshore (21%) and the City Center (25%) neighborhoods. These assets are projected to have higher flooding exposure due to the relatively lower ground elevations in the area.
- Many schools have higher vulnerability. Schools received high consequence scores as they serve large populations and can provide additional services, such as childcare and food programs. Biscayne Elementary and South Pointe Elementary also serve socially vulnerable communities, elevating their overall vulnerability ranking.
- No critical buildings are considered exposed to existing king tide flooding. However, nearly all schools and half of the historic and local government buildings are exposed to existing compound flood events. Only one critical building, the Art Deco Center, is projected to not be exposed to an existing storm tide (storm surge) event.

Flood Exposure

The City's critical buildings projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of critical buildings exposed to select flooding scenarios.

	Critical Building Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0' SLR	2070 Int High Scenario w/ 2.9' SLR
King Tide	0 (0%)	10 (23%)	34 (77%)
Compound Flooding	19 (43%)	22 (50%)	34 (77%)
Storm Tide	43 (97%)	43 (97%)	44 (100%)

Notes: Critical Buildings n = 44.

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

Existing king tide conditions impact no critical buildings. By 2040, king tide extents are projected to overtop Biscayne Bay and canal shorelines to impact critical buildings in the Bayshore and North Beach neighborhoods. By 2070, only critical buildings located in the eastern parts of the City, near the coastal dune system, and those on Terminal Island are not projected to be exposed to king tide flooding.

Compound Flooding

Existing compound flooding conditions impact nearly half (43%) of critical buildings, primarily near Biscayne Bay and canal shorelines. Flooding extents grow slightly in the same areas under 2040 conditions. By 2070, compound flooding is projected to impact the same critical buildings as exposed to king tides; similarly, only the critical buildings nearest the coastal dune system are projected to not be exposed.

Storm Tide (Storm Surge)

All critical buildings, except the Art Deco Center in the southeast of the Flamingo and Lummus neighborhood, are projected to be exposed to existing and 2040 storm tide events. By 2070, all critical buildings are projected to be exposed if adaptation measures are not taken.

Sensitivity to Flooding

All critical buildings were assigned the same sensitivity score. Although the degree of flood damage may vary based on individual building characteristics, such as its age, condition, and existing flood-proofing measures, this information was not uniformly available.

Moderate Sensitivity: All Assets

Depending on flood depths, the first floor of buildings could experience structural, electrical, and material damage. Flood exposure to the foundation could have structural impacts and increase the likelihood of mold growth. Flooding can also restrict access to the buildings and ancillary facilities, such as school playgrounds, vehicle garages, and supply buildings.

Community Impacts

Critical buildings were assigned consequence scores based on the severity of community impacts due to a loss of functionality. Buildings that provide significant community services have a higher consequence of failure.

High Consequence: Schools

Extended school closures can have negative consequences for the community, including student learning deficits, increased childcare burden and food insecurity concerns for disadvantaged families.

Moderate Consequence: Local Government Buildings

Closed offices may limit municipal functions such as providing assistance to low-income residents, processing building permits and bill payments and coordinating local infrastructure repairs.

Low Consequence: State/Federal, Historic and Cultural, and College Buildings

Closure impacts are likely to be limited to the structure itself or the managing organization and are not expected to create community-wide impacts.

Consequence

Sensitivity	Low	Moderate	High
High			
Moderate	• State/Federal Government Buildings • Historic and Cultural Buildings • Colleges	• Local Government Buildings	• Schools
Low			

Top 10 Most Vulnerable City-Owned Critical Buildings

	Exposed to Existing Flooding? King Tide	Compound Flooding	Storm Tide
1. Miami Beach Convention Center *Final Score: 40*	No	No	**Yes**
2. Parks Division Plant Nursery *Final Score: 39*	No	No	**Yes**
3. Property Management Facility *Final Score: 37.5*	No	**Yes**	**Yes**
4. Fleet Maintenance Complex #1 *Final Score: 36*	No	**Yes**	**Yes**
5. Public Works Yard Control Building *Final Score: 36*	No	No	**Yes**
6. Fleet Maintenance Complex #3 *Final Score: 35.5*	No	**Yes**	**Yes**
7. City Hall *Final Score: 35*	No	No	**Yes**
8. Miami Beach Golf Course Club House *Final Score: 35*	No	No	**Yes**
9. Historic Old City Hall *Final Score: 34.5*	No	No	**Yes**
10. Internal Affairs (South Pointe) *Final Score: 34.5*	No	No	**Yes**

Notes:

Total possible Vulnerability Score – 64.

Indicates asset has received adaptation strategies to reduce vulnerability. Refer to Adaptation Plan for more information.

Historic Old City Hall

Miami Beach Convention Center

Drinking Water Vulnerability Profile

Vulnerability

The City's drinking water assets were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

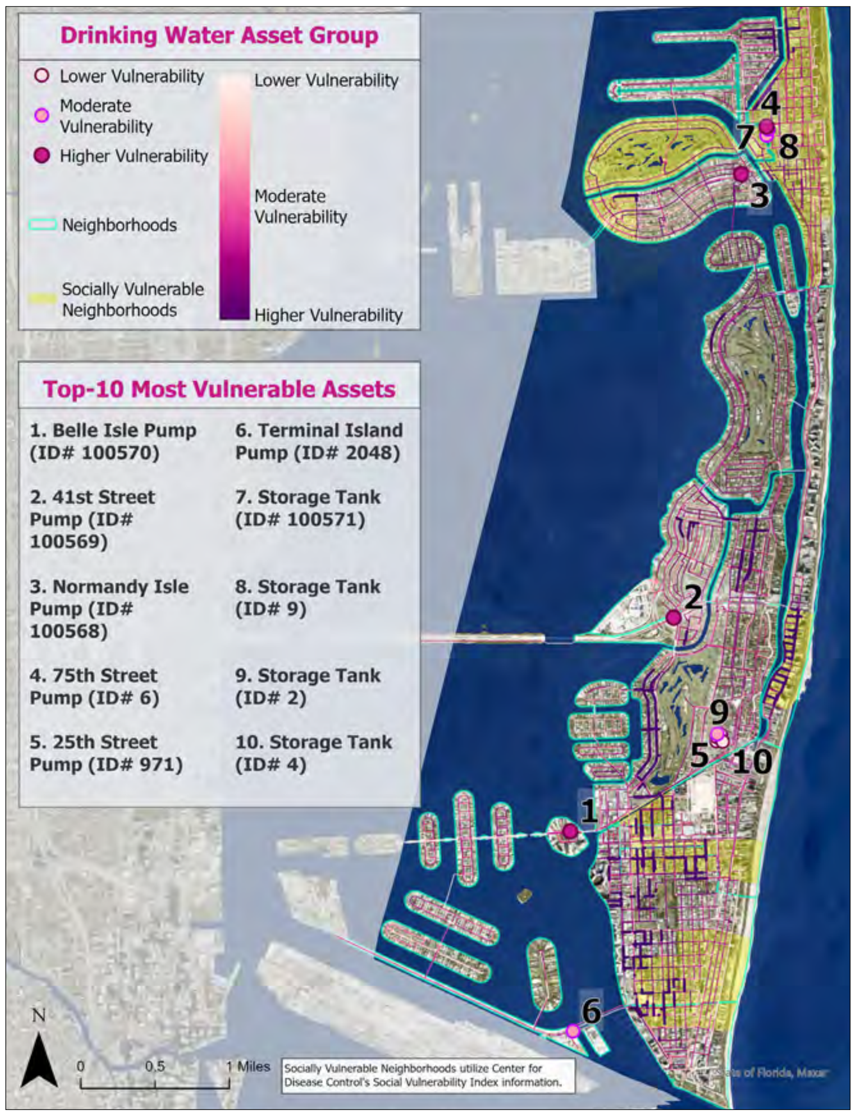
A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The distribution and supply of drinking water to the City's residents and businesses relies on hundreds of miles of pipelines and the continued function of multiple pump stations and storage tanks. Failure of this service would impact the daily lives of residents and operations of local businesses. The Drinking Water asset group includes the following:

- Drinking Water Pumps (6)
- Drinking Water Storage Tanks (6)
- Drinking Water Pipelines (255 miles)



Point features represent drinking water pump stations and storage tanks.
Linear features represent drinking water pipelines.
The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.

Drinking Water Asset Group Vulnerability Map

Key Vulnerabilities

- Drinking water pumps are the most vulnerable assets in this group. The most vulnerable water pump is located on Belle Isle and services the Venetian Islands. This pump station is projected to be exposed to all of the considered flood scenarios
- Sections of drinking water pipelines classified with higher vulnerability are found throughout the City, but there is a concentration within the socially vulnerable areas of the Flamingo and Lummus and Ocean Front neighborhoods.
- An existing storm tide (storm surge) flood event is projected to impact all of the City's drinking water pumps and storage tanks and nearly all (96%) of the drinking water pipeline network.
- All drinking water assets are projected to have relatively low exposure to king tide flooding under existing conditions. However, exposure increases to over half (58%) of pumps and storage tanks and 85% of the drinking water pipeline network by 2070.

Flood Exposure

The City's drinking water assets projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of drinking water assets exposed to select flooding scenarios.

	Drinking Water Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	**2040 Int High Scenario w/ 1.0' SLR**	**2070 Int High Scenario w/ 2.9' SLR**
King Tide	0 Pump and Tanks (0%)	2 Pumps and Tanks (17%)	7 Pumps and Tanks (58%)
	12 Pipeline Miles (5%)	112 Pipeline Miles (44%)	217 Pipeline Miles (85%)
Compound Flooding	1 Pumps and Tanks (8%)	3 Pumps and Tanks (25%)	4 Pumps and Tanks (33%)
	130 Pipeline Miles (51%)	149 Pipeline Miles (58%)	207 Pipeline Miles (81%)
Storm Tide (Storm Surge)	12 Pumps and Tanks (100%)	12 Pumps and Tanks (100%)	12 Pumps and Tanks (100%)
	244 Pipeline Miles (96%)	248 Pipeline Miles (97%)	249 Pipelines Miles (98%)

Notes: Drinking Water Pumps and Storage Tanks n = 12 (6 Storage Tanks, 6 Pump Stations);

Drinking Water Pipelines n = 255 miles.

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

No drinking water pumps or storage tanks are projected to be exposed to existing king tide conditions. The 5% of pipelines projected to be exposed to existing king tide are primarily adjacent to the Biscayne Bay shoreline in the West Ave and Bay Rd neighborhood. The two water pump stations projected to be impacted under 2040 king tide conditions are located at Belle Isle and 41st St. The 44% of pipelines projected to be exposed include nearly all those located in the western half of the City. Only pipelines located behind the coastal dune system are projected to be not exposed. By 2070, only the pumps, storage tanks, and pipelines projected to remain unexposed are those most immediately west of the coastal dune system in North Beach and South Beach.

Compound Flooding

The pumps stations that are projected to have exposure to compound flooding through 2070 are located at Belle Isle, 41st St, Normandy Isle, and 75th St. The remaining pumps and storage tanks are not projected to have compound flood exposure. The pipelines projected to be exposed to existing and 2040 compound flooding are predominantly located in the western half of the City. By 2070, only the pipelines immediately behind the coastal dune system are projected to not be exposed.

Storm Tide (Storm Surge)

All drinking water pump stations and storage tanks and the majority (96%) of pipelines are exposed to existing storm tide conditions. All drinking water assets are projected to remain exposed by 2070 if adaptation measures are not taken.

Sensitivity to Flooding

Drinking water pipeline sensitivity is dependent on the age of the pipeline. Older pipes (>70 yrs.) are likely to have exceeded their intended lifespan and may be under-designed for current flood conditions, while newer pipelines likely follow the latest design standards. Pump stations include multiple electrical and mechanical components that could be at risk of failure if exposed to flooding. Storage tanks lack similarly sensitive components.

High Sensitivity: Water Pipelines (>70 yrs. old); Drinking Water Pump Stations

Aged pipelines are beyond their functional lifespan and are more likely to experience damage due to flooding or infiltration of contaminants.

Water pump stations have sensitive electrical and mechanical components that may be damaged or require replacement if exposed to flooding.

Moderate Sensitivity: Water Pipelines (40-70 yrs. old)

Pipelines in this age range may be reaching the end of their functional lifespan and may experience damage due to flooding or infiltration of contaminants.

Low Sensitivity: Water Pipelines (<40 yrs. old); Drinking Water Tanks

Newer pipelines are less likely to experience damage due to flooding or infiltration of contaminants.

Water tanks do not have electrical or mechanical equipment that may experience damage from flood events. However, floodwaters may move unanchored tanks off foundations

Community Impacts

Community impacts from the failure of drinking water assets is dependent on the service provided. Pump stations are key nodes in the delivery of drinking water, and failure can greatly restrict access. Failure of drinking water pipelines is likely to be localized, and delivery could be maintained through alternative pipelines. Impacts from the failure of a single drinking water storage tank could be temporarily relieved using the City's other tanks.

High Consequence: Drinking Water Pump Stations

Pump failure could cause inadequate water supply or pressure needed for sanitation and firefighting. This could also allow back-siphonage of contaminants into the system.

Moderate Consequence: All Drinking Water Pipelines, regardless of age

Water line breaks generally occur in localized areas, limiting their impact, although repair costs could be significant if they occur at multiple locations. Frequent pipe replacement could greatly increase City capital costs and impacts to neighboring communities.

Low Consequence: Drinking Water Storage Tanks

A storage tank failure will increase the use of water pumps to meet peak demand, affecting energy costs and repair and replacement costs.

Sensitivity \ *Consequence*	Low	Moderate	High
High		• Drinking Water Pipelines (>70yrs old)	• Drinking Water Pump Stations
Moderate		• Drinking Water Pipelines (40-70yrs old)	
Low	• Drinking Water Storage Tanks	• Drinking Water Pipelines (<40yrs old)	

Top 10 Most Vulnerable City-Owned Drinking Water Assets

	Exposed to Existing Flooding? King Tide	Compound Flooding	Storm Tide
1. Belle Isle Pump (#100570) *Vulnerability Score: 62*	No	**Yes**	**Yes**
2. 41st St Pump (#100569) *Vulnerability Score: 60*	No	No	**Yes**
3. Normandy Isle Pump (#100568) *Vulnerability Score: 57*	No	No	**Yes**
4. 75th St Pump (#6) *Vulnerability Score: 54*	No	No	**Yes**
5. 25th St Pump (#971) *Vulnerability Score: 51*	No	No	**Yes**
6. Terminal Island Pump (#2048) *Vulnerability Score: 49*	No	No	**Yes**
7. Storage Tank (#100571) *Vulnerability Score: 24*	No	No	**Yes**
8. Storage Tank (#9) *Vulnerability Score: 24*	No	No	**Yes**
9. Storage Tank (#2) *Vulnerability Score: 23*	No	No	**Yes**
10. Storage Tank (#4) *Vulnerability Score: 23*	No	No	**Yes**

Total possible Vulnerability Score - 64.

Electrical and Communications Vulnerability Profile

Vulnerability

The City's electrical and communications infrastructure was evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

Dependable electrical and communication service are expected by residents and businesses to support most daily activities. Following a hazard event, these services are essential to response and recovery efforts, particularly for first responders. The Electrical and Communications asset group includes:

- Electrical Substations (7)
- Telecommunication Towers (5)

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.

Electrical and Communications Asset Group Vulnerability Map

Key Vulnerabilities

- The West Ave substation located in the southwest Bayshore neighborhood was identified as the most vulnerable electrical and communications asset. This substation is projected to be exposed to 90% of the considered flood scenarios.
- All of the City's electrical substations are among the Top-10 most vulnerable electrical and communication assets. Radio communication towers are less vulnerable, as their components are often fixed to buildings and elevated above potential flooding.
- The Harding Ave substation is the only substation within a socially vulnerable neighborhood.
- No electrical substations are projected to be exposed to existing king tide flooding conditions. However, all seven are projected to be exposed under 2070 king tide conditions.
- Existing storm tide (storm surge) conditions are projected to impact all assets within this group.

Flood Exposure

The City's electrical and communication assets projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of electrical and communication assets exposed to select flooding scenarios.

	Electrical and Communication Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0' SLR	2070 Int High Scenario w/ 2.9' SLR
King Tide	1 (8%)	3 (25%)	10 (83%)
Compound Flooding	5 (42%)	6 (50%)	11 (92%)
Storm Tide (Storm Surge)	12 (100%)	12 (100%)	12 (100%)

Notes: Electrical and Communication Assets n = 12 (7 Substations, 5 Communication Towers)

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

The Pine Tree Drive communication tower is the single asset projected to be exposed to existing king tide conditions. Under 2040 conditions, the West Ave substation and Liberty Ave substation are also projected to be exposed. By 2070, all electrical substations are projected to be exposed to king tide conditions if adaptation measures are not taken.

Compound Flooding

The addition of rainfall ponding increases asset exposure from zero under existing king tide conditions to four electrical substations under the existing compound flooding scenario. The same four substations are projected to remain exposed by 2040. By 2070, all substations are projected to be exposed.

Storm Tide (Storm Surge)

All electrical substation and communication towers are projected to be exposed to existing and future storm tides.

Sensitivity to Flooding

Electrical infrastructure and communications equipment typically include components that are critical to asset function and are highly sensitive to flood exposure. The degree of sensitivity is dependent on the elevation of these components above projected floodwaters.

High Sensitivity: Electrical Substations

Substations are highly sensitive to flooding as water and salt exposure can corrode delicate electrical components, cause electrical arcs, or blow fuses leading to a failure of the substation to transfer power. Substations can be elevated above ground level to avoid floodwaters; however, the elevation height must still allow access for maintenance and operation of the substation.

Low Sensitivity: Telecommunication Towers

Communication tower function generally has negligible sensitivity to flooding as these assets are typically fixed to buildings at high elevations.

Community Impacts

Both electrical substations and communication towers are highly important to daily life. These assets are also essential infrastructure during response and recovery efforts. However, if a telecommunication tower is damaged, radio traffic can often be quickly redirected to a nearby tower temporarily. The failure of an electrical substation is more likely to cause cascading damages throughout the power system, impacting large numbers of residents and businesses.

High Consequence: Electrical Substations

Failure of substations may cause widespread power outages to residents, businesses, and critical facilities and utilities that lack back-up generators. Prolonged outages may affect public health due to lack of air conditioning, reduced pressurization of potable water mains, and the inability to refrigerate medications. Prolonged outages will incur economic costs to affected residents, businesses, and the local economy.

Low Consequence: Telecommunication Towers

Flood waters could impact access to communication towers or the buildings where they are located. Damage or loss of a tower could impact first responders and general communications until rerouted or repaired.

Consequence

Sensitivity	Low	Moderate	High
High			• Electrical Substations
Moderate			
Low	• Telecommunication Towers*		

* – Telecommunication Towers are considered 'Not Sensitive' to flood impacts.

Miami Beach City Hall with Radio Tower on the roof, Source: Miami Herald

Harding Ave substation, also showing elevated infrastructure, Source: Google Maps

Emergency Facilities Vulnerability Profile

Vulnerability

The City's emergency facilities were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

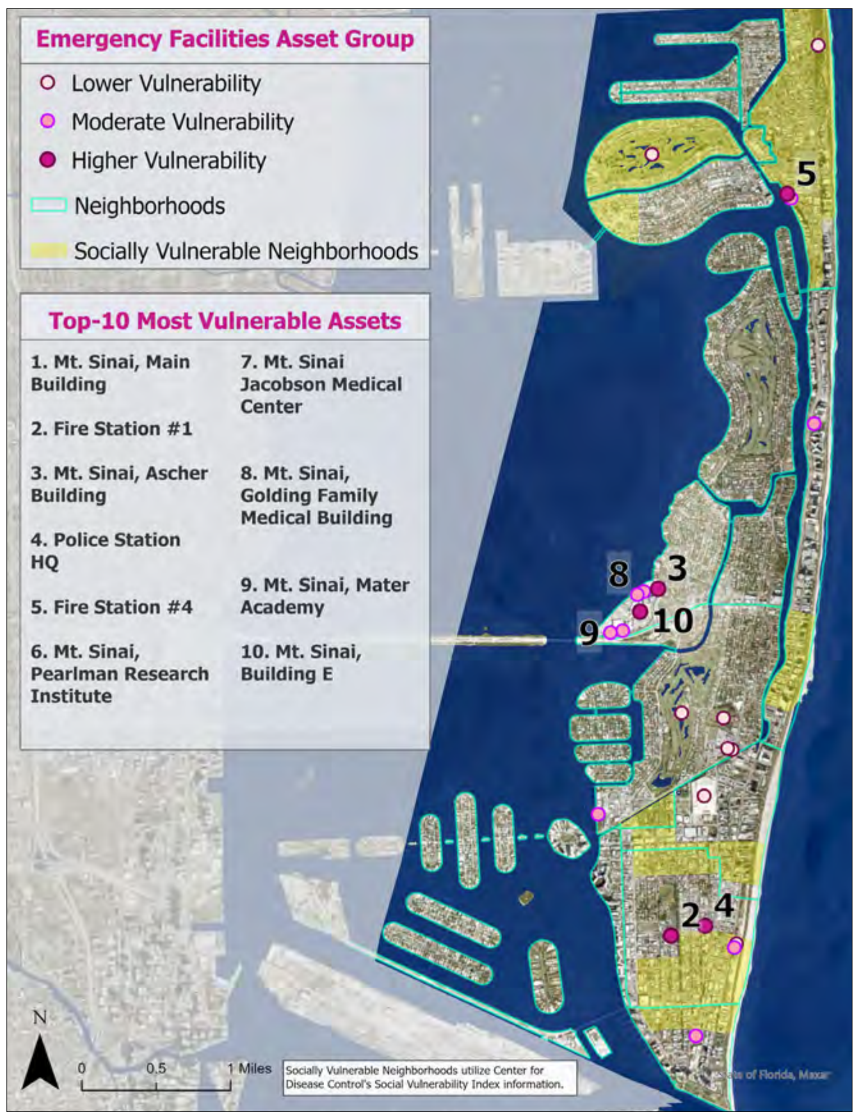
A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The emergency facilities considered in this asset group serve a critical community role by providing emergency, health, and safety services within the City. Following a hazard event, these facilities and first responders are critical to ensuring access to medical care and further protecting residents and businesses from additional risk and damages. The Emergency Facilities asset group includes:

- Emergency Operation Centers (2)
- Mt. Sinai Hospital Buildings (6)
- Police Stations (4)
- Fire Stations (6)
- Debris Staging Areas (5)
- Logistical Staging Areas (1)



Emergency Facilities Asset Group Vulnerability Map

Key Vulnerabilities

- The Mt. Sinai hospital main building is the City's most vulnerable emergency facility. All six Mt. Sinai buildings are within the Top-10 most vulnerable.
- Other major critical response facilities (Fire Stations #1 and #4 and the Police Station Headquarters) are also within the Top-10. These three facilities are exposed to at least half of the considered flood scenarios.
- Existing king tide conditions are projected to expose three debris staging areas, but no structures. By 2070, king tide is projected to expose 76% of the City's emergency facilities.
- Existing storm tide (storm surge) conditions are projected to expose 75% of emergency facilities. All facilities are projected to be exposed to storm tide conditions by 2040.
- All of the Top-10 most vulnerable emergency facilities are located near the Biscayne Bay shoreline or a canal shoreline, except for Fire Station #1 and the Police Station Headquarters. These two facilities are primarily exposed to storm tide and compound flooding events.

Flood Exposure

The City's emergency facilities projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of emergency facilities exposed to select flooding scenarios.

	Emergency Facilities Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0′ SLR	2070 Int High Scenario w/ 2.9′ SLR
King Tide	3 (12%)	4 (16%)	19 (76%)
Compound Flooding	7 (28%)	11 (44%)	16 (64%)
Storm Tide (Storm Surge)	20 (75%)	25 (100%)	25 (100%)

Notes: Emergency Facilities n = 25

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

Existing king tide exposure is projected to impact three of the City's debris staging areas. By 2040, the Sailport Police substation is also projected to be exposed. Under 2070 king tide conditions, over three-quarters (76%) of facilities are projected to be exposed, including those with major emergency response roles such as the Police Station Headquarters, three Fire Stations (#1, #4, and #3), all Mt. Sinai Hospital buildings, and the Convention Center.

Compound Flooding

Existing compound flooding is projected to expose all debris staging areas, the Sailport Police substation, and the Police Station headquarters. By 2040, compound flooding impacts are projected to expose nearly half (44%) of emergency facilities, including the Convention Center and Fire Station #1. Under 2070 compound flooding conditions, exposure is projected to impact all emergency facilities, except for four Mt. Sinai hospital buildings and Fire Station #2.

Storm Tide (Storm Surge)

Existing storm tide conditions are projected to impact all City emergency facilities, except for Fire Station #2 and Beach Patrol/Ocean Rescue buildings. By 2040, 100% of emergency facilities are projected to be exposed if adaptation measures are not taken.

Sensitivity to Flooding

All emergency facility buildings were assigned the same sensitivity score. Although the degree of flood damage may vary based on individual building characteristics, such as its age, condition, and existing flood-proofing measures, this information was not uniformly available. Debris storage areas received a lower sensitivity score as these areas are typically open spaces and lack additional structures at risk of flooding.

High Sensitivity: Logistical Staging Areas, Emergency Operation Centers, Fire Stations, Main Police Station & Substations, Mt. Sinai Hospital Buildings

Flooding of these emergency facility buildings could compromise low-lying equipment, electronics, and facility access, which would limit function. Floodwaters could also damage accessory equipment, including vehicles and medical equipment, potentially impacting response and recovery efforts.

Low Sensitivity: Debris Storage Areas

Debris storage areas are often open spaces and used only when floodwaters have receded, leading to a low sensitivity.

Community Impacts

All emergency facilities in this asset group serve important daily functions and critical roles in response and recovery efforts. The 'High' classification indicates those assets with increased roles in protecting life and safety due to their size, equipment and assets, and irreplaceable critical functions.

High Consequence: Fire Stations, Main Police Station, Mt. Sinai Hospital

Flooding damage to fire stations, the hospital, or the police headquarters will greatly impact the City's first responder efforts. Flood impacts could affect access to emergency medical care or restrict dispatch and response capabilities.

Moderate Consequence: Emergency Operation Centers, Police Substations

Flooding impacts to emergency operations centers and police substations may force the relocation of certain functions until flooding conditions recede and the structure is repaired. This could temporarily impact emergency response in local neighborhoods.

Low Consequence: Logistical Staging Areas, Debris Storage Areas

Flooding damage to staging areas and storage areas may require the use of alternative sites or coordination with neighboring communities but will likely not generate community-wide impacts.

Consequence

Sensitivity	Low	Moderate	High
High			
Moderate	• Logistical Staging Areas	• Emergency Operation Centers • Police Substations	• Fire Stations • Main Police Station • Mt. Sinai Hospital
Low	• Debris Storage Areas		

Top 10 Most Vulnerable City-Owned Emergency Facilities

	Exposed to Existing Flooding? King Tide	Compound Flooding	Storm Tide
1. Fire Station #1 *Final Score: 49*	No	No	**Yes**
2. Police Station HQ *Final Score: 46*	No	**Yes**	**Yes**
3. Fire Station #4 *Final Score: 45.5*	No	No	**Yes**
4. Mt. Sinai Hospital*, Building E (EOC) *Final Score: 43*	No	No	**Yes**
5. Marine Patrol Building (adaptation strategies received) *Final Score: 41.5*	No	No	**Yes**
6. Fire Station #3 *Final Score: 41.5*	No	No	**Yes**
7. Sailport Police Substation *Final Score: 41*	No	**Yes**	**Yes**
8. Beach Patrol Building / Ocean Rescue HQ *Final Score: 41*	No	No	No
9. Police North End Sub Station *Final Score: 39*	No	No	**Yes**
10. Fire Station #2 *Final Score: 38*	No	No	No

Notes:

* – Mt. Sinai is privately owned; however, this building serves as the backup emergency operations center (EOC) for the City.

Indicates asset has received adaptation strategies to reduce vulnerability. Refer to Adaptation Plan for more information.

Total possible Vulnerability Score – 64.

Vulnerability

The City's natural resources were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The City's natural resource areas provide a range of community benefits, including serving as recreational spaces, providing facilities and amenities for community and cultural events, mitigating flood impacts by retaining stormwater, and providing public access to the City's beaches. These areas and the services provided are highly valued by community members who noted that parks are important to daily routines, including exercising, socializing, and relaxation. Residents also stated that flood damage to these natural resources would affect their quality of life in the City. The Natural Resources asset group includes:

- Parks (51)
- Dune Crossovers (173)
- Natural Shorelines (4)
- Bayshore Park Retention Pond (1)

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.

Natural Resources Asset Group Vulnerability Map

Key Vulnerabilities

- Flamingo Park, located in central South Beach, is the most vulnerable park (natural resource) in the City. Five of the Top-10 most vulnerable parks are in South Beach.
- The socially vulnerable neighborhood in North Beach includes 10 parks, four of which have higher vulnerability. The two largest parks in this neighborhood (the North Shore Youth Center and Oceanside Park) are among the Top-10 most vulnerable.
- Nearly one-third (31%) of parks are projected to be exposed to all considered flood scenarios, and 94% are exposed to at least half of the flood scenarios.
- The City's coastal dune system is not projected to have significant king tide exposure even under 2070 conditions, though specific crossovers could become inaccessible.
- All parks are exposed to existing storm tide (storm surge) conditions. Currently, about 50% of dune crossovers are projected to be at risk of being inundated by storm tides, but this increases to nearly all (99%) by 2070.

Flood Exposure

The City's natural resources projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of natural resources exposed to select flooding scenarios.

	Natural Resource Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	**2040 Int High Scenario w/ 1.0' SLR**	**2070 Int High Scenario w/ 2.9' SLR**
King Tide	9 Crossovers (5%)	26 Crossovers (15%)	35 Crossovers (20%)
	10 Parks (20%)	32 Parks (63%)	44 Parks (86%)
Compound Flooding	29 Crossovers (17%)	33 Crossovers (19%)	38 Crossovers (22%)
	38 Parks (75%)	41 Parks (80%)	48 Parks (94%)
Storm Tide (Storm Surge)	85 Crossovers (49%)	133 Crossovers (77%)	171 Crossovers (99%)
	51 Parks (100%)	51 Parks (100%)	51 Parks (100%)

Notes: Dune Crossovers n = 173;
Parks n = 51

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

Existing king tide exposure is projected to impact parks located along the Biscayne Bay and canal shorelines in all three regions, while Flamingo Park and the Miami Beach Golf Club are impacted by rising groundwater flooding. By 2040, all parks except those in the easternmost areas of the City are projected to be exposed to king tide flooding. By 2070, only six smaller parks located near the dunes are not projected to be exposed. Dune crossovers maintain limited exposure through 2070.

Compound Flooding

Compound flooding under existing conditions is projected to impact 75% of parks throughout the City. With additional sea level rise, this exposure is projected to increase and impact all but three City parks located immediately behind the coastal dune system. Dune crossovers are not projected to have relatively high exposure to compound flooding in any scenario.

Storm Tide (Storm Surge)

All City parks and nearly half of dune crossovers are projected to be exposed to existing storm tide conditions. The percentage of dune crossovers projected to be exposed increases to 77% in 2040 and becomes nearly all (99%) under 2070 conditions.

Sensitivity to Flooding

Natural resource areas with structures and other amenities that could be damaged by floodwaters have higher sensitivities. The coastally located dune crossovers may require intervention to maintain intended functional use if altered by frequent wave action.

Moderate Sensitivity: Neighborhood Parks, Major Parks, Dune Crossovers

Major parks often include multiple facilities and amenities that could be damaged if exposed to flooding. The associated equipment may require replacement, and these parks may experience longer closure times due to repairs.

Dune crossovers are tolerant to occasional temporary flooding during storm events but may experience erosion and vegetation diebacks due to saltwater intrusion if flooding is frequent or severe.

Low Sensitivity: Linear/Mini-parks, Bayshore Park Retention Pond

Parks without amenities lack facilities that could sustain damage but may sustain flooding impacts to landscaping or natural features.

The Bayshore Park Retention Pond will receive and retain water during most flood events; however, strong and frequent flood events may exceed the capacity of the retention pond.

Not Sensitive: Passive Greenspace Parks

Open space, passive parks are likely to quickly resume function once floodwaters recede.

Community Impacts

Natural resources, particularly major parks, serve as important community and cultural spaces. If damaged, residents may lose access to meeting spaces, afterschool programs, recreational activities, and important community events such as festivals and concerts.

High Consequence: Major Parks

Major parks provide important functions, typically serving as gathering spaces, social hubs and pop-up distribution centers following emergency events. Amenities may be damaged or degraded by floodwaters, creating an economic cost for the City to repair, replace, or remove the feature. Loss of these spaces may bring increased impacts to the City's most socially vulnerable individuals that rely on parks for recreation and social interaction.

Moderate Consequence: Neighborhood Parks, Linear/Mini-parks, Dune Crossovers

Smaller parks still often provide multiple recreational amenities (playgrounds, sports facilities, and open spaces) to nearby residents, which may be restricted if the park is flooded.

Frequent or severe flooding events may erode beaches, dunes, and crossovers, impacting vegetation and requiring renourishment and restoration.

Low Consequence: Passive Greenspace Parks, Surface Water Bodies

Passive parks generally serve smaller populations, limiting impacts from flooding damage.

If water levels exceed design levels, the Bayshore Park Retention Pond may fail to retain water.

Sensitivity \ Consequence	Low	Moderate	High
High			
Moderate		• Neighborhood Parks • Dune Crossovers	• Major Parks
Low	• Passive Greenspace Parks* • Surface Water Body	• Linear/Mini Parks	

* – Passive Green Space Parks are considered to be 'Not Sensitive' to flooding.

Top 10 Most Vulnerable City-Owned Natural Resources

	Exposed to Existing Flooding?		
	King Tide	Compound Flooding	Storm Tide
1. Flamingo Park *Vulnerability Score: 56*	**Yes**	**Yes**	**Yes**
2. North Shore and Youth Center *Vulnerability Score: 55*	No	**Yes**	**Yes**
3. Scott Rakow Youth Center Grounds and Park Area *Vulnerability Score: 55*	No	**Yes**	**Yes**
4. Maurice Gibb Memorial Park *Vulnerability Score: 54*	**Yes**	No	**Yes**
5. South Pointe Park *Vulnerability Score: 54*	No	**Yes**	**Yes**
6. North Beach Oceanside Park *Vulnerability Score: 52*	No	**Yes**	**Yes**
7. Lummus Park *Vulnerability Score: 51*	No	**Yes**	**Yes**
8. Miami Beach Soundscape *Vulnerability Score: 51*	No	**Yes**	**Yes**
9. Pine Tree Park *Vulnerability Score: 49*	**Yes**	**Yes**	**Yes**
10. Bayshore Park *Vulnerability Score: 49*	**Yes**	**Yes**	**Yes**

Total possible Vulnerability Score – 64

Public Transportation Vulnerability Profile

Vulnerability

The City's public transportation assets were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

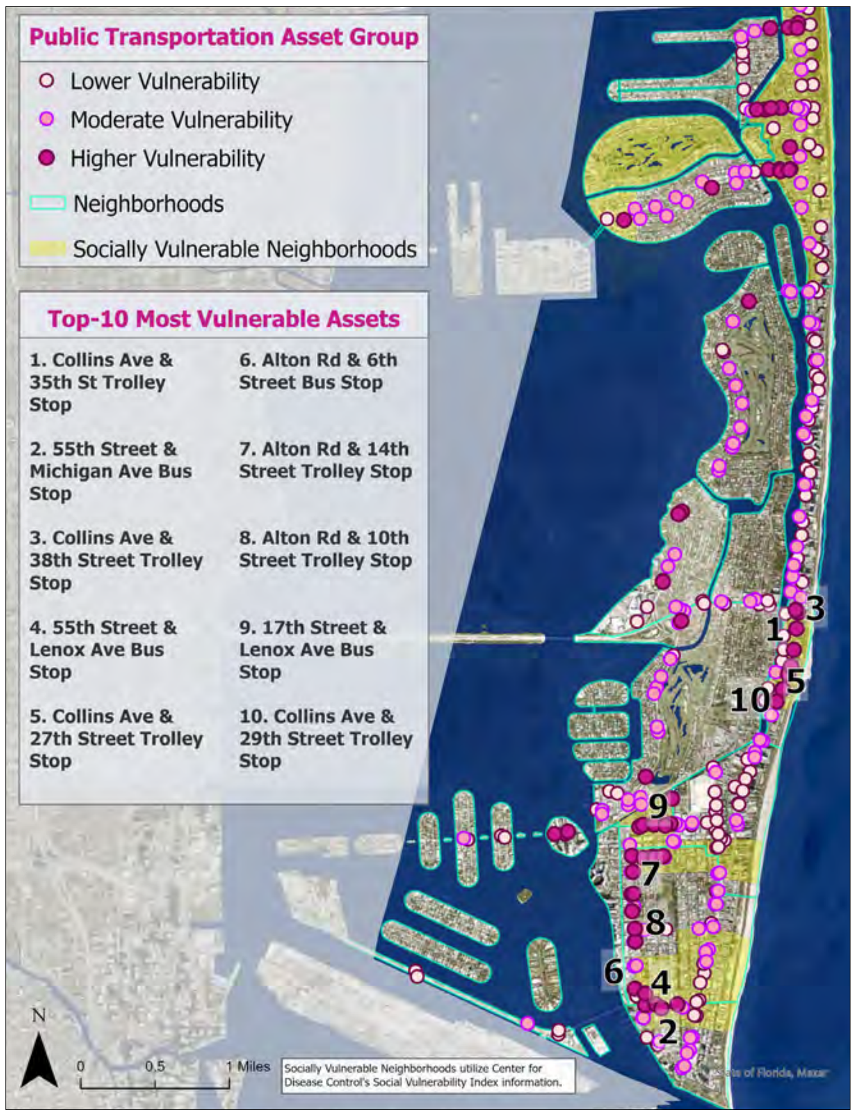
Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The City's public transportation network includes routes for both the Miami-Dade Metro and the Citywide trolley. Both have numerous stops throughout the City and provide a critical means of transportation for residents and workers. The public bus and trolley system may also serve as the only available transportation option for the City's most disadvantaged residents.

There are also two public marinas located in South Beach, which provide maritime transportation to and from the City. The marinas also support recreational opportunities such as sports fishing and boat charters and support local businesses in the area. The Public Transportation asset group includes:

- County Bus Stops (82)
- City Trolley Stops (201)
- Marinas (2)



Public Transportation Asset Group Vulnerability Map

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.

Key Vulnerabilities

- The trolley stop located at Collins Ave & 35th St, located in the southern Ocean Front neighborhood, is the most vulnerable public transportation asset. Three other trolley stops within the Top-10 most vulnerable assets are also located along the same stretch of Collins Ave. All four are within the socially vulnerable neighborhood in this area of Ocean Front.
- Due to their location density, many bus and trolley stops share similar flooding exposure. All bus and trolley stops were also assigned the same sensitivity and consequence scores. Therefore, the higher vulnerability stops are often those located within socially vulnerable neighborhoods. Of the 57 bus and trolley stops with higher vulnerability, 39 (68%) are in socially vulnerable neighborhoods.
- The higher vulnerability bus and trolley stops are also in areas projected to have high exposure to multiple flooding scenarios, such as the western area of the Nautilus neighborhood and along Alton Rd in South Beach.
- Existing king tide impacts are projected to impact 13 (5%) bus and trolley stops; however, this exposure increases to 46% by 2040 and 92% by 2070.
- All but three of the City's bus and trolley stops are projected to be exposed to existing storm tide (storm surge) conditions. Two of the unexposed stops are on Collins Ave behind the coastal dune system, and the other is on Terminal Isle.

Flood Exposure

The City's public transportation assets projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of public transportation assets exposed to select flooding scenarios.

	Public Transportation Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0' SLR	2070 Int High Scenario w/ 2.9' SLR
King Tide	13 (5%)	131 (46%)	264 (92%)
Compound Flooding	145 (51%)	160 (56%)	251 (88%)
Storm Tide (Storm Surge)	281 (99%)	283 (99%)	283 (99%)

Notes: Public Transportation Assets n = 285; (82 bus stops, 201 trolley stops, and 2 marinas).

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

Existing king tide conditions are projected to impact 13 bus and trolley stops. Of these, 12 are located along Collins Ave in South Beach or the Venetian Islands. Under 2040 king tide conditions, nearly half (46%) of the bus and trolley stops are projected to be exposed. These are primarily located along the Biscayne Bay shoreline, though about half of the stops in the southern Ocean Front neighborhood are also projected to be exposed. By 2070, 92% of bus and trolley stops and the Purdy Public Boat Marina are projected to be impacted.

Compound Flooding

Existing compound flooding conditions impact over half of the City's bus and trolley routes. Most unexposed bus and trolley stops are in the eastern side of the City. Compound flooding under 2040 conditions only marginally increases bus and trolley stop exposure. By 2070, the only bus and trolley stops not projected to be exposed are on the eastern edge of the North Shore neighborhood and southwest Nautilus neighborhood near Mt. Sinai hospital.

Storm Tide (Storm Surge)

For all storm tide scenarios, 99% bus and trolley stops are projected to be exposed. Two of the three stops that remain unexposed to any storm tide scenario are on Collins Ave behind the coastal dune system, and the other is on Terminal Isle.

Sensitivity to Flooding

The ability of bus and trolley stops to function during and following a flood event is primarily influenced by the roadway where it is located. If the roadway and associated stormwater management system can convey water away from sidewalks and bus lanes, the stops can be expected to function. Marinas are often subjected to strong coastal water events but are designed to reduce exposure of sensitive equipment and property.

Low Sensitivity: Bus and Trolley Stops, Marinas

Bus and trolley stop infrastructure generally consists of simple structures with limited sensitivity to infrequent flooding, though flooding may temporarily prevent the use of certain bus stops. Bus and trolley stops can typically resume function once roadways are free of floodwaters and debris.

Marinas are likely to be designed to withstand typical water level variations, but extreme water levels could compromise sensitive electronic equipment. Additionally, marinas with floating docks, such as several in the Miami Beach Marina in South Pointe, can adjust to moderate tidal fluctuations. However, extreme tidal fluctuations, such as during a storm tide, may damage docks and require repairs.

Community Impacts

Flooding damage to bus and trolley stops can temporarily disrupt resident and worker commute schedules. These impacts are likely to disproportionately impact the City's most disadvantaged community members who utilize the bus system as a main means of transportation. Flooding damage to marinas can be localized to boat owners and business reliant on the marina. However, significant flooding events can result in more widespread impacts, including for related commercial businesses, and economic impacts could spread to local businesses.

Moderate Consequence: Bus and Trolley Stops

Flooding of bus and trolley stops can affect access to public transportation for residents, workers, and visitors and impede their ability to access healthcare, work, grocery stores, and other needs. Frequent flooding may cause temporary changes in stop locations but could also result in permanent alterations to bus and trolley routes, impacting dependent users.

Low Consequence: Marinas

Frequent flooding events may bring costly repairs or operational changes for marinas and tenants. Marinas may require structural retrofits (e.g., floating docks, elevated docks), which may be costly and affect slip fees. Extreme flooding could also result in damages to boats and force the closure of the marina until docks are repaired.

Consequence

Sensitivity	Low	Moderate	High
High			
Moderate			
Low	• Marinas	• Bus Stops • Trolley Stops	

Top 10 Most Vulnerable City-Owned Trolley Stops

	Exposed to Existing Flooding?		
	King Tide	Compound Flooding	Storm Tide
1. Collins Ave & 35th St Trolley Stop *Vulnerability Score: 43*	**Yes**	**Yes**	**Yes**
2. Collins Ave & 38th St Trolley Stop *Vulnerability Score: 42*	No	**Yes**	**Yes**
3. Collins Ave & 27th St Trolley Stop *Vulnerability Score: 42*	No	**Yes**	**Yes**
4. Alton Rd & 14th St Trolley Stop *Vulnerability Score: 42*	**Yes**	**Yes**	**Yes**
5. Alton Rd & 10th St Trolley Stop *Vulnerability Score: 42*	**Yes**	**Yes**	**Yes**
6. Collins Ave & 29th St Trolley Stop *Vulnerability Score: 42*	No	**Yes**	**Yes**
7. Collins Ave & 41st St Trolley Stop *Vulnerability Score: 42*	No	**Yes**	**Yes**
8. Alton Rd & 14th St Trolley Stop *Vulnerability Score: 42*	**Yes**	**Yes**	**Yes**
9. Michigan Ave & 16th St Trolley Stop *Vulnerability Score: 42*	No	**Yes**	**Yes**
10. E Island Ave & Venetian Way Trolley Stop *Vulnerability Score: 42*	**Yes**	**Yes**	**Yes**

Total possible Vulnerability Score – 64

Roads and Bridges Vulnerability Profile

Vulnerability

The City's roads and bridges were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

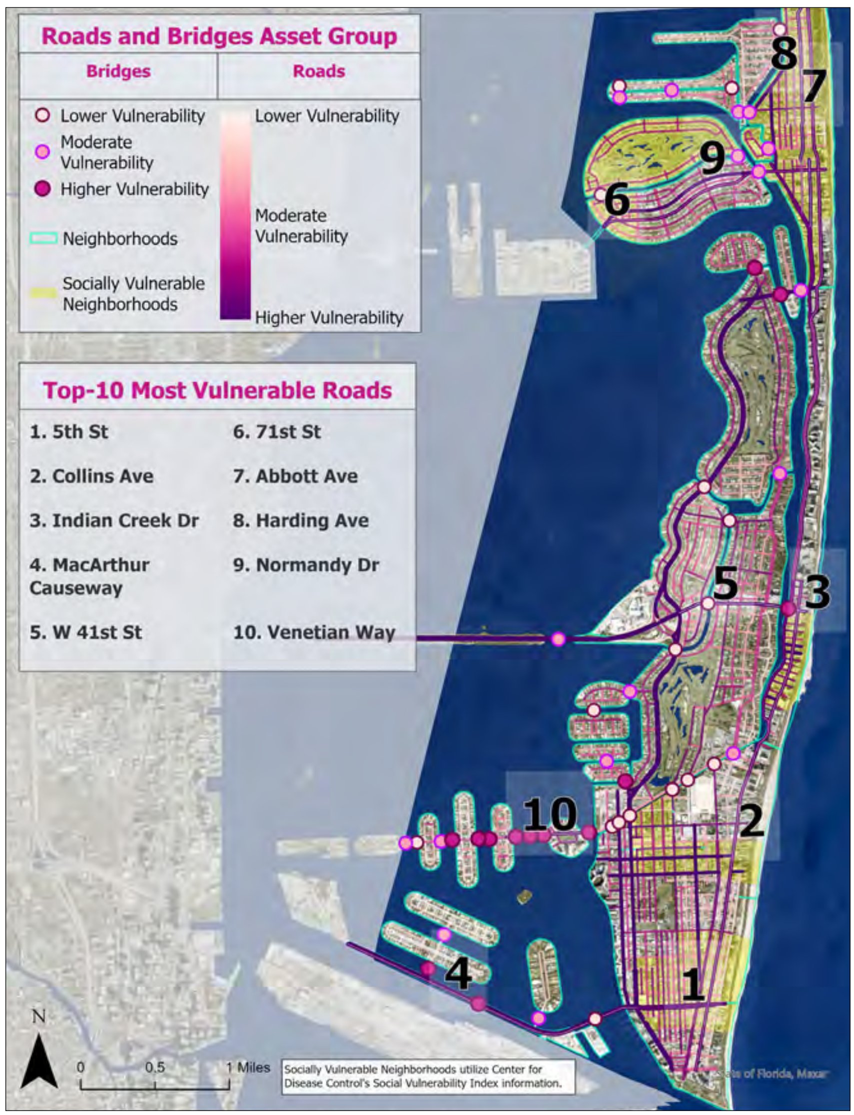
A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

Road and bridge assets represent the major transportation infrastructure that enable the daily transport of people and goods throughout the City and connect the City to the larger region. City bridges also are critical to connect to island neighborhoods. Before and after a hazard event, this infrastructure is also essential for evacuations and the movement of first responder personnel. The Roads and Bridges asset group includes:

- Roadways (169 miles)
- Bridges (47)



Roads and Bridges Asset Group Vulnerability Map

Point features represent bridge centers.
Linear features represent roadways.

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.

Key Vulnerabilities

- The most vulnerable section of City roadway is 5th St, located in South Beach from Alton Rd to Ocean Dr. Other roadways in South Beach with higher vulnerability include Collins Ave, Pennsylvania Ave, Alton Rd, 16th St, and 15th St. Multiple major roadway sections that are classified with higher vulnerability are located within socially vulnerable neighborhoods.
- The primary evacuation routes from all City three regions have roadways and bridges classified with higher vulnerability. Sections of 5th St, the MacArthur Causeway, the Venetian Causeway, I-195, and the 79th St Causeway have lower elevations that are susceptible to inundation and may restrict evacuation traffic.
- About 19 miles of the City's roadways are projected to be exposed to existing king tide flooding. These roadways are primarily located in the West Ave and Bay Dr neighborhood along Alton Rd in South Beach. By 2070, nearly all (94%) roadways are projected to be impacted by king tide flooding.
- Nearly the entirety (99.7%) of the City's roadway network and bridges (89%) are projected to have some inundation during a storm tide (storm surge) event under existing conditions.
- Of the 16 bridges classified with higher vulnerability, 12 (75%) are in South Beach. These higher vulnerability bridges primarily connect the Venetian Islands. Of the 10 bridges connecting the Venetian Islands, seven are classified with higher vulnerability.

Flood Exposure

The City's road and bridge assets projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of road and bridge assets exposed to select flooding scenarios.

	Road and Bridges Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0' SLR	2070 Int High Scenario w/ 2.9' SLR
King Tide	10 Bridges (21%)	19 Bridges (40%)	32 Bridges (68%)
	19 Roadway Miles (11%)	100 Roadway Miles (59%)	159 Roadway Miles (95%)
Compound Flooding	2 Bridges (4%)	2 Bridges (4%)	12 Bridges (25%)
	121 Roadway Miles (72%)	128 Roadway Miles (76%)	152 Roadway Miles (90%)
Storm Tide (Storm Surge)	42 Bridges (89%)	44 Bridges (94%)	47 Bridges (100%)
	168 Roadway Miles (99%)	168 Roadway Miles (100%)	169 Roadway Miles (100%)

Notes: Bridges n = 47 Bridges

Roads n =169 miles

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

The roadways projected to be exposed to existing king tide conditions are primarily located adjacent to Alton Rd in the West Ave and Bay Dr neighborhood. The City bridges projected to be exposed to existing king tide conditions are spread throughout the three regions. Under 2040 king tide conditions, more than half (59%) of the City's roadways are projected to be exposed and are primarily in the western part of the City. By 2070, nearly all (95%) roads are projected to have some king tide flooding, and 68% of bridges, could be impassable during these conditions.

Compound Flooding

Existing compound flooding events are projected to expose nearly three-quarters (72%) of City's roadways, including nearly every roadway adjacent to the Biscayne Bay shoreline. By 2040, compound flooding is projected to expose slightly more roadways to the east. Under 2070 compound flooding conditions, all roadways except minor side streets behind the City's coastal dune system are projected to be exposed.

Storm Tide

Every City roadway is projected to be exposed to existing storm tide conditions, except minor side roads behind the coastal dunes. All but five bridges that span the canal separating Mid and South Beach are projected to be exposed.

Sensitivity to Flooding

City roadways may be temporarily blocked during heavy rainfall or coastal flooding events, but with proper stormwater management infrastructure, most of these roads can quickly resume carrying traffic once floodwaters recede. Bridge sensitivity is evaluated by its Sufficiency Rating established by the Federal Highway Administration and based on characteristics such as age and construction materials used.

High Sensitivity: Bridges with Low Sufficiency Ratings

Low Sufficiency-rated bridges may have structural deficiencies or could be functionally obsolete due to age, which may increase the structure's sensitivity to flooding.

Moderate Sensitivity: Bridges with Moderate Sufficiency Ratings

Moderate Sufficiency-rated bridges may have minor structural deficiencies, or some characteristics may be functionally obsolete due to age.

Low Sensitivity: Bridges with High Sufficiency Ratings, All Roads

High Sufficiency-rated bridges are determined to be in good structural and functional.
Roadway materials are generally not sensitive to temporary flooding, but frequent floods may cause deterioration. Roads inundated by a few inches of floodwaters may become impassable but will resume functionality quickly after floodwaters recede.

Community Impacts

The community consequences of roadway and bridge flooding are dependent on the populations served. Major City roadways are intended to serve most traffic at some point during travel, while smaller, local roads may only serve a certain neighborhood, limiting impacts. Bridges often serve as the only means of ingress and egress for certain neighborhoods, and should they be impacted, affected residents would likely require evacuation assistance.

High Consequence: Evacuation Routes, Principal Arterial Roads, All Bridges

Flooding of major roadways could cause widespread access issues across the City, affecting emergency response and restricting access to large areas of homes and businesses. If these roads serve as evacuation routes, the life and safety of residents could be impacted.
Bridges may serve as the only entry and exit for neighborhoods. Residents may be trapped in dangerous conditions if bridge access is lost due to flooding and no alternative routes are available.

Moderate Consequence: Minor Arterial and Collector Roads

Flooding of minor arterials and collector roads may affect the ability to access major roadways and evacuation routes.

Low Consequence: Local Roads

Flooding of local roads may affect neighborhood access to individual homes until floodwaters recede. Such flooding may be localized, but could restrict resident access to work, schools, and grocery stores. Socially vulnerable populations may require additional assistance, while emergency services access to these neighborhoods could be restricted.

Sensitivity \ Consequence	Low	Moderate	High
High			• Bridges (Low Sufficiency Rating)
Moderate		• Neighborhood Parks • Dune Crossovers	• Bridges (Moderate Sufficiency Rating)
Low	• Local Roads	• Minor Arterial and Collector Roads	• Principal Arterial Roads • Evacuation Routes • Bridges (High Sufficiency Rating)

Top 10 Most Vulnerable City-Owned Roads

	Exposed to Existing Flooding?		
	King Tide	Compound Flooding	Storm Tide
1. 15th St *Final Score: 43*	**Yes**	**Yes**	**Yes**
2. Pennsylvania Ave *Final Score: 43*	**Yes**	**Yes**	**Yes**
3. Alton Rd (South of 5th Street) *Final Score: 43*	**Yes**	**Yes**	**Yes**
4. Byron Ave *Final Score: 42*	No	**Yes**	**Yes**
5. 16th St *Final Score: 42*	No	**Yes**	**Yes**
6. Meridian Ave *Final Score: 42*	No	**Yes**	**Yes**
7. West Ave *Final Score: 42*	**Yes**	**Yes**	**Yes**
8. 11th St *Final Score: 42*	**Yes**	**Yes**	**Yes**
9. 17th St *Final Score: 42*	No	**Yes**	**Yes**
10. Dickens Ave *Final Score: 42*	No	**Yes**	**Yes**

Total possible Vulnerability Score – 64

Stormwater Vulnerability Profile

Vulnerability

The City's stormwater infrastructure was evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

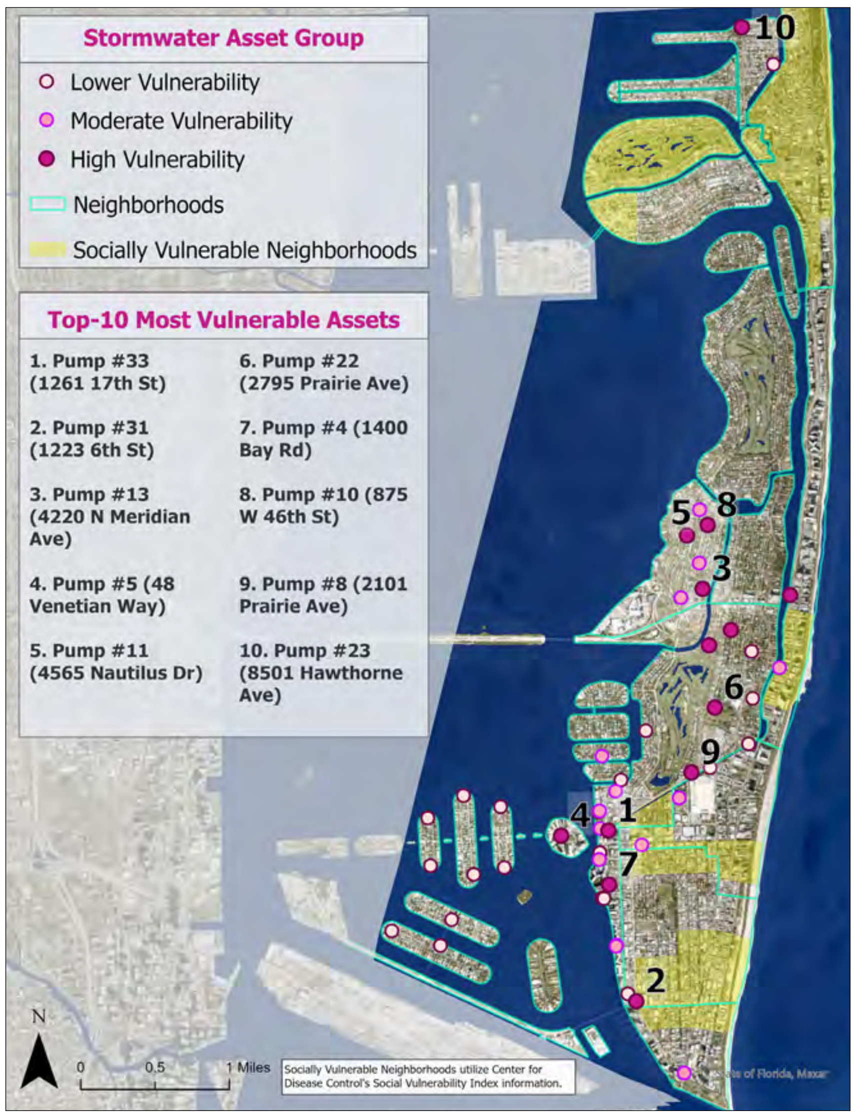
Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

Asset Group Characteristics

The effective capture and movement of stormwater runoff away from both City and private property and infrastructure is necessary to mitigate impacts from extreme flood events. Stormwater pump stations are a critical component of this system and are responsible for transporting tidal and rainfall runoff. The Stormwater asset group includes:

- Stormwater Pumps (48)

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.



Stormwater Asset Group Vulnerability Map

Key Vulnerabilities

- The most vulnerable stormwater pump (#33) is located at the northern end of Bay Rd in South Beach and adjacent to a Biscayne Bay canal.
- Four of the Top-10 most vulnerable pumps are in the West Ave and Bay Rd neighborhood and located near Biscayne Bay shorelines. The low-elevation shorelines in this area are projected to be overtopped in most coastal flooding scenarios, impacting these pumps.
- Only three stormwater pumps service North Beach. There are 22 (44%) in Mid Beach, and none in the La Gorce neighborhood. More than half (54%) of the City's stormwater pumps are in South Beach and all are located on the Biscayne shoreline of the West Ave and Bay Rd neighborhood or island neighborhoods.
- Among the Top-10 most vulnerable pumps, Pump #31 is the only one located in a socially vulnerable neighborhood.
- Pump #33 is the only pump projected to be exposed to existing king tide conditions, but by 2070, nearly all (82%) of the stormwater pumps are projected be impacted by king tide events.
- Under existing storm tide (storm surge) conditions, all stormwater pumps are projected to be exposed.

Flood Exposure

The City's stormwater pumps projected to be exposed to flooding varies based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of stormwater pumps exposed to select flooding scenarios.

	Stormwater Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	2040 Int High Scenario w/ 1.0' SLR	2070 Int High Scenario w/ 2.9' SLR
King Tide	1 (2%)	17 (35%)	39 (81%)
Compound Flooding	18 (36%)	24 (50%)	35 (73%)
Storm Tide (Storm Surge)	48 (100%)	48 (100%)	48 (100%)

Notes: Stormwater Pump Stations n = 48.

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

Pump #33 at the northern end of Bay Rd is the single stormwater pump projected to be impacted during an existing king tide event. Under 2040 conditions, king tide flooding extent is projected to extend eastward and impact more than half of the pumps in the West Ave and Bay Rd neighborhood, one-third of pumps in the Bayshore neighborhood, and all pumps in the Nautilus neighborhood. By 2070, all pumps except for nine located on the Venetian Islands and adjacent inland canal shorelines are projected to be exposed to king tide flooding.

Compound Flooding

Existing compound flooding conditions are projected to impact 36% of stormwater pumps, primarily in the West Ave and Bay Rd, Nautilus, and Bayshore neighborhoods. Under 2040 conditions, compound flooding impacts to stormwater pumps are projected to grow slightly in these same neighborhoods. By 2070, fewer stormwater pumps are projected to be impacted by compound flooding than by the king tide scenario, as four pumps in the southern island neighborhoods and one in the North Shore neighborhood are modeled to effectively manage rainfall runoff in these areas.

Storm Tide (Storm Surge)

All stormwater pump stations are exposed to existing storm tide conditions. The pump stations are projected to have continued exposure by 2070 if adaptation measures are not taken.

Sensitivity to Flooding

Stormwater pump stations are intended to receive and convey stormwater runoff. However, significant runoff amounts can overwhelm pump stations, leading to elevated flooding levels. Stormwater pumps that are not properly elevated or hardened (e.g., floodproofed) face increased likelihood of damage to sensitive electrical and mechanical components. Specific hardening characteristics for stormwater pumps were not known, and therefore all were assumed to be unhardened.

High Sensitivity: Stormwater Pump Stations

Unhardened stormwater pump stations have sensitive electrical and mechanical components that may be damaged or require replacement if exposed to flooding. Elevating these components or wet-floodproofing the pump can reduce flooding sensitivity.

Community Impacts

If a stormwater pump station is flooded and the electronic components are damaged, the pump will likely fail to function. This may increase flooding in the immediate surrounding area and areas that typically do not flood during similar events.

High Consequence: Stormwater Pump Stations

Stormwater pump failure impacts may be localized, but the impacts of flooded roadways and property can increase the risks to resident life and safety, complicate flood response efforts, and increase management and operational costs for the City. Frequent flooding may require relocation, retrofit, or raising of pump components.

Consequence

Sensitivity	Low	Moderate	High
High			• Stormwater Pump Stations
Moderate			
Low			

Stormwater outfall discharging stormwater runoff into Biscayne Bay, Source: Miami Herald

Car drives through flood street in Miami Beach, Source: WPLG

Top 10 Most Vulnerable City-Owned Stormwater Pumps

	Exposed to Existing Flooding?		
	King Tide	Compound Flooding	Storm Tide
1. **Stormwater Pump Station #33 (1261 17th St)** *Vulnerability Score: 63*	**Yes**	**Yes**	**Yes**
2. **Stormwater Pump Station #13 (4220 N Meridian Ave)** *Vulnerability Score: 62*	No	**Yes**	**Yes**
3. **Stormwater Pump Station #5 (48 Venetian Way)** *Vulnerability Score: 62*	No	**Yes**	**Yes**
4. **Stormwater Pump Station #11 (4565 Nautilus Dr)** *Vulnerability Score: 62*	No	**Yes**	**Yes**
5. **Stormwater Pump Station #22 (2795 Prairie Ave)** *Vulnerability Score: 62*	No	**Yes**	**Yes**
6. **Stormwater Pump Station #4 (1400 Bay Rd)** *Vulnerability Score: 61*	No	**Yes**	**Yes**
7. **Stormwater Pump Station #10 (875 W 46th St)** *Vulnerability Score: 61*	No	**Yes**	**Yes**
8. **Stormwater Pump Station #8 (2101 Prairie Ave)** *Vulnerability Score: 61*	No	**Yes**	**Yes**
9. **Stormwater Pump Station #23 (8501 Hawthorne Ave)** *Vulnerability Score: 61*	No	**Yes**	**Yes**
10. **Stormwater Pump Station #19 (3405 Chase Ave.)** *Vulnerability Score: 61*	No	**Yes**	**Yes**

Total possible Vulnerability Score – 64

Wastewater Vulnerability Profile

Vulnerability

The City's wastewater assets were evaluated based on the following measures to determine each asset's vulnerability to future sea level rise:

- **Asset Exposure** – Exposure is associated with the number of scenarios under which an asset would be flooded.
- **Asset Sensitivity** – Sensitivity is associated with the likelihood an asset will fail, incur significant damage, or become unusable for any duration of time due to flood exposure.
- **Asset Consequence** – Consequence is associated with the severity of community impacts that would occur should the asset fail, incur significant damage, or become unusable.

A scoring framework was used to quantify each measure. Scores were summed to establish a total vulnerability score for each asset. Assets were ranked based on this vulnerability score.

Exposure + **Sensitivity** + **Consequence** = **Total Vulnerability Score**

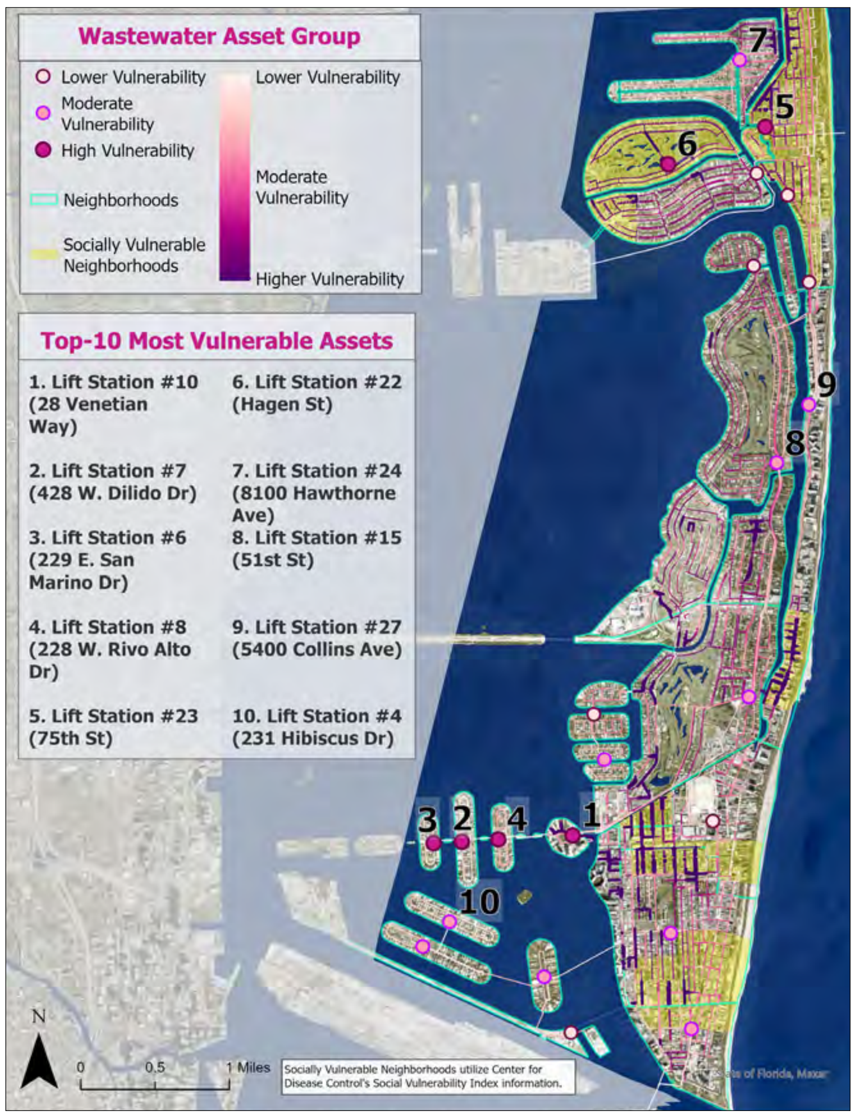
Asset Group Characteristics

The proper removal, conveyance, and disposal of wastewater is an essential City function to maintain both public and environmental health. The failure of any of the related components would result in detrimental social, economic, and environmental impacts. The Wastewater asset group includes the following:

- Wastewater Lift Stations (20)
- Wastewater Pipelines (263 miles)

Point features represent wastewater lift stations. Linear features represent wastewater pipelines.

The Top-10 list reflects assets with the highest scores determined by the Vulnerability Assessment methodology. These assets may not necessarily reflect the City's current flooding challenges or current priorities for flooding adaptation measures.



Wastewater Asset Group Vulnerability Map

Key Vulnerabilities

- The most vulnerable wastewater lift station (#10) is on Belle Isle of the Venetian Island chain in South Beach. The top four most vulnerable lift stations are all in the Venetian Islands.
- The most vulnerable sections of wastewater pipelines are located in South Beach near West Ave and Bay Rd and the southern portion of the Oceanfront neighborhood. Many of these sections are also located within socially vulnerable neighborhoods.
- The 4% of wastewater pipelines projected to be exposed to existing king tide conditions are primarily located near the West Ave and Bay Rd neighborhood. No lift stations are exposed during existing king tide conditions; however, 70% are projected to be exposed to king tides by 2070.
- All wastewater lift stations are projected to be exposed to current storm tide (storm surge) events. Nearly all (92%) wastewater pipelines are projected to be exposed to existing storm tide conditions.

Flood Exposure

The City's wastewater assets projected to be exposed to flooding vary based on the flooding source and the amount of future sea level rise (SLR). The table below identifies the number (and percentage of the total) of wastewater assets exposed to select flooding scenarios.

	Wastewater Assets Exposed (% of total assets)		
	Existing Conditions Scenario w/ no SLR	**2040 Int High Scenario w/ 1.0' SLR**	**2070 Int High Scenario w/ 2.9' SLR**
King Tide	0 Lift Stations (0%)	2 Lift Stations (9%)	16 Lift Stations (70%)
	11 Pipeline Miles (4%)	101 Pipeline Miles (38%)	216 Pipeline Miles (82%)
Compound Flooding	3 Lift Stations (13%)	3 Lift Stations (13%)	16 Lift Stations (70%)
	127 Pipeline Miles (48%)	144 Pipeline Miles (55%)	210 Pipeline Miles (80%)
Storm Tide (Storm Surge)	23 Lift Stations (100%)	23 Lift Stations (100%)	23 Lift Stations (100%)
	242 Pipeline Miles (92%)	245 Pipeline Miles (93%)	246 Pipeline Miles (94%)

Notes: Wastewater Lift Stations n = 23
Miles of Wastewater Pipelines n = 263 miles

Refer to Appendix E.8 for NOAA Intermediate (Int) Low and High SLR exposure results.

King Tide

Existing king tide exposure is projected to impact 4% of wastewater pipelines and no wastewater lift stations. Most of the exposed pipelines are in the West Ave and Bay Rd neighborhood. Groundwater flooding is projected to impact some pipeline sections in the Nautilus and Oceanfront neighborhoods. King tide conditions by 2040 are projected to impact all pipeline segments except for those in the easternmost parts of the City. Under 2070 king tide conditions, all lift stations on the Venetian Islands and Star, Palm, and Hibiscus Islands are projected to be exposed; only the pipeline segments directly behind the coastal dune system are projected to not be exposed.

Compound Flooding

Existing compound flooding conditions are projected to expose nearly half (48%) of wastewater pipelines and three of four Venetian Island lift stations. By 2040, compound flooding exposure is projected to marginally increase for wastewater pipelines. By 2070, 70% of wastewater lift stations are projected to be exposed, along with 82% of wastewater pipelines. Four of the lift stations projected to not be exposed are adjacent to canals near Allison Island and the La Gorce neighborhood.

Storm Tide (Storm Surge)

All wastewater lift stations and the majority (92%) of wastewater pipelines are exposed to existing storm tide conditions. All wastewater pump stations and the majority (94%) of pipelines continue to have projected exposure to storm tide events by 2070 if adaptation measures are not taken.

Sensitivity to Flooding

Wastewater lift stations contain multiple electrical and mechanical components that are sensitive and could fail if exposed to flooding. Wastewater pipeline sensitivity is highly dependent on the age. Older pipelines have a higher sensitivity as these segments are more likely to have exceeded intended lifespans and may be under-designed for current flood conditions.

High Sensitivity: Wastewater Lift Stations, Wastewater Pipelines (>70 yrs. old)

Wastewater lift stations have sensitive electrical and mechanical components that could cause the lift station to fail if exposed to flooding.

Pipes older than 70 years are beyond their functional lifespan, are due for replacement, and are more likely to experience damage due to flooding or inflow and infiltration through the pipe structure if exposed.

Moderate Sensitivity: Wastewater Pipelines (40-70 yrs. old)

Pipelines 40 to 70 years old may be reaching the end of their functional lifespan and may experience damage due to flooding or inflow or infiltration through the pipe structure if exposed.

Low Sensitivity: Wastewater Pipelines (<40 yrs. old)

Newer pipelines are less likely to experience damage due to flooding or inflow and infiltration through the pipe structure if exposed.

Community Impacts

Failure of individual wastewater lift stations or sections of pipelines may only generate localized impacts but can lead to numerous cascading social, health, and economic impacts for residents and businesses. Failure of multiple lift stations or large areas of pipelines would compound these impacts.

High Consequence: Wastewater Lift Stations, All Wastewater Pipelines, regardless of age

Failures of lift stations and pipelines could lead to wastewater spills, potentially impacting neighboring waterways and leading to environmental damages and the risk of spreading disease. Wastewater spills often require costly clean-up measures. Frequent flooding may require relocation or reburying of pipelines.

Consequence

Sensitivity	Low	Moderate	High
High			• Wastewater Pipelines (>70 yrs. old) • Wastewater Lift Stations
Moderate			• Wastewater Pipelines (40-70 yrs. old)
Low			• Wastewater Pipelines (<40 yrs. old)

Top 10 Most Vulnerable City-Owned Wastewater Assets

	Exposed to Existing Flooding? King Tide	Compound Flooding	Storm Tide
1. Lift Station #10 (28 Venetian Way) *Vulnerability Score: 61*	No	**Yes**	**Yes**
2. Lift Station #7 (428 W. Dilido Dr) *Vulnerability Score: 59*	No	**Yes**	**Yes**
3. Lift Station #6 (229 E. San Marino Dr) *Vulnerability Score: 58*	No	**Yes**	**Yes**
4. Lift Station #8 (228 W. Rivo Alto Dr) *Vulnerability Score: 56*	No	No	**Yes**
5. Lift Station #23 (75th St) *Vulnerability Score: 55*	No	No	**Yes**
6. Lift Station #22 (Hagen St) *Vulnerability Score: 54*	No	No	**Yes**
7. Lift Station #24 (8100 Hawthorne Ave) *Vulnerability Score: 53*	No	No	**Yes**
8. Lift Station #15 (51st St) *Vulnerability Score: 53*	No	No	**Yes**
9. Lift Station #27 (5400 Collins Ave) *Final Score: 53*	No	No	**Yes**
10. Lift Station #4 (231 Hibiscus Dr) *Vulnerability Score: 53*	No	No	**Yes**

Total possible Vulnerability Score – 64

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E.8 Sensitivity and Consequence Ratings Matrix

This section provides the Sensitivity and Consequence Ratings applied to the City's various asset types.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix.

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Transportation Assets and Evacuation Routes	Roadways	Principal Arterials – City, State, Federal (Class 11,14)	26 Miles	Low	• Roadway materials are not generally sensitive to infrequent temporary flooding, but frequent floods may cause deterioration. • If roads are submerged by a depth of more than a few inches, roadways may become impassable, but should be able to resume functionality quickly after waters recede.	High	• Flooding of major roadways (interstate, freeways, principal arterials) could cause widespread access issues across the city, affecting the ability to respond to emergencies and restrict access to large areas of homes and businesses. • Major roadway flooding can exacerbate traffic congestion, prevent the movement of goods/supplies to the city and impact the quality of everyday life for residents. • Roadway damage due to frequent flooding and/or wave action may reduce the design life of roadways, requiring more frequent maintenance or repairs.
Transportation Assets and Evacuation Routes	Roadways	Minor Arterials and Collectors – City, State, Federal (Class 16, 17,18)	36 Miles	Low	• Roadway materials are not generally sensitive to infrequent temporary flooding, but frequent floods may cause deterioration. • If roads are submerged by a depth of more than a few inches, roadways may become impassable, but should be able to resume functionality quickly after waters recede.	Moderate	• Flooding of minor arterials and collector roads may affect the ability for neighborhoods to access major roadways and evacuation routes. • Roadway damage due to frequent flooding and/or wave action may reduce the design life of roadways, requiring more frequent maintenance or repairs. • Flooding of minor arterials may impact response time for emergencies.
Transportation Assets and Evacuation Routes	Roadways	Local Roadways – City, State, Federal (Class 19, 20)	107 Miles	Low	• Roadway materials are not generally sensitive to infrequent temporary flooding, but frequent floods may cause deterioration. • If roads are submerged by a depth of more than a few inches, roadways may become impassable, but should be able to resume functionality quickly after waters recede.	Low	• Flooding of local roads may affect neighborhood access to individual homes until floodwaters recede. • Flooding of local roads may impact response time for emergencies.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Transportation Assets and Evacuation Routes	Major Roadways	Evacuation Routes	2 miles	Low	• Evacuation routes are not generally sensitive to infrequent temporary flooding, but frequent floods may cause deterioration. • If submerged by a depth of more than a few inches, routes may become impassable, but should be able to resume functionality quickly after waters recede.	High	• Flooded evacuation routes can prevent evacuation of residents and increase risks to life safety. • Damaged or blocked evacuation routes may restrict access by first responders and prevent individuals from accessing their property. • Frequent flooding damage could reduce the effectiveness of the route and require finding/constructing alternatives.
Transportation Assets and Evacuation Routes	Bridges	Bridges – Low Sufficiency Rating (<50)	8	High	• Bridges with Low Sufficiency Ratings are determined to be in need of replacement by the Federal Highway Association. • Low Sufficiency Ratings may indicate that a bridge has structural deficiencies or could be functionally obsolete due to construction age.	High	• Bridges may serve as the only entry and exit for neighborhoods. Residents may be trapped in dangerous conditions if bridge access is lost due to flooding and no alternative routes are available. • Bridge structures could be damaged by frequent flooding, requiring costly repairs or replacement.
Transportation Assets and Evacuation Routes	Bridges	Bridges – Moderate Sufficiency Rating (50-80)	18	Moderate	• Bridges with Moderate Sufficiency Ratings are determined to be in need of repair by the Federal Highway Association. • Moderate Sufficiency Ratings may indicate that a bridge has minor structural deficiencies or that some characteristics may be functionally obsolete due to construction age.	High	• Bridges may serve as the only entry and exit for neighborhoods. Residents may be trapped in dangerous conditions if bridge access is lost due to flooding and no alternative routes are available. • Bridge structures could be damaged by frequent flooding, requiring costly repairs or replacement.
Transportation Assets and Evacuation Routes	Bridges	Bridges – High Sufficiency Rating (>80)	21	Low	• Bridges with High Sufficiency Ratings are determined to be in good structural and functional standing by the Federal Highway Association.	High	• Bridges may serve as the only entry and exit for neighborhoods. Residents may be trapped in dangerous conditions if bridge access is lost due to flooding and no alternative routes are available. • Bridge structures could be damaged by frequent flooding, requiring costly repairs or replacement.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Transportation Assets and Evacuation Routes	Marinas	Marinas	2	Low	• Marinas have low to moderate sensitivity to flooding, depending on their design. Although they are dependent on proximity to the shoreline making them prone to flooding, many marinas are on floating docks, providing built-in capacity to adjust to fluctuating water levels. • If water levels exceed marina design criteria, flooding would impede daily operations and reduce functionality.	Low	• Frequent flooding events may bring costly repairs or changes to operations for the marina and tenants. • Loss of functionality will affect boat access for tenants and affect recreational opportunities for city residents and visitors. • Marinas may require structural retrofits (e.g., floating docks, elevated docks), which may be costly and affect slip fees.
Transportation Assets and Evacuation Routes	Public Transit	Bus Stops	283	Low	• Bus stop infrastructure generally consist of simple structures with limited vulnerability to infrequent flooding. • Flooding may temporarily prevent the use of certain bus stops.	Moderate	• Flooding of bus stops can affect public transportation options for city residents, workers and visitors and disrupt the ability to access city amenities. • Frequent flooding may require temporary changes, or in extreme cases, permanent alterations to bus routes and stops, impacting dependent users.
Critical Infrastructure	Wastewater Treatment Facilities and Lift Stations	Wastewater Lift Stations	23	High	• Wastewater lift stations have sensitive electrical and mechanical components that may be damaged or require replacement if exposed to flooding.	High	• Failure of lift station functionality could disrupt wastewater conveyance for affected neighborhoods until repaired. • Damaged lift stations may require costly repairs or complete replacement of electrical components. • Failure could lead to wastewater spills potentially impacting neighboring and adjacent waterways and requiring costly clean-up measures. • Frequent flooding may require relocation or elevation of assets.
Critical Infrastructure	Wastewater Treatment Facilities and Lift Stations	Force Mains / Gravity Mains (Age <40 years)	8 miles / 26 miles	Low	• Newer pipelines are less likely to experience damage due to flooding or inflow/infiltration through the pipe structure if exposed to flood water.	High	• Failure could lead to wastewater spills potentially impacting neighboring and adjacent waterways and requiring costly clean-up measures. • Frequent flooding may require relocation or reburying/tie downs of pipelines.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Critical Infrastructure	Wastewater Treatment Facilities and Lift Stations	Force Mains / Gravity Mains (Age 40 to 70 years)	19 miles / 66 miles	Moderate	• Pipelines 40 to 70 years old may be reaching the end of their functional lifespan and may experience damage due to flooding or inflow/infiltration through the pipe structure if exposed to flood water.	High	• Failure could lead to wastewater spills potentially impacting neighboring and adjacent waterways and requiring costly clean-up measures. • Frequent flooding may require relocation or reburying/tie downs of pipelines.
Critical Infrastructure	Wastewater Treatment Facilities and Lift Stations	Force Mains / Gravity Mains (Age > 70 years)	11 miles / 132 miles	High	• Pipes older than 70 years are beyond their functional lifespan, are due for replacement, and are more likely to experience damage due to flooding or inflow/ infiltration through the pipe structure if exposed to flood water.	High	• Failure could lead to wastewater spills potentially impacting neighboring and adjacent waterways. • Frequent flooding may require relocation or reburying/tie downs of pipelines.
Critical Infrastructure	Electricity Production and Supply Facilities	Electrical Substations	7	High	• Substations are highly sensitive to flooding as water and salt exposure can corrode delicate electrical components leading to a failure of the substation to transfer power.	High	• Failure of substations may cause widespread and cascading power outages to residents, businesses, and critical facilities and utilities that lack back-up generators. • Prolonged outages may affect public health due to lack of air conditioning, reduced treatment of wastewater, and reduced pressurization of potable water mains. • Prolonged outages will incur economic costs to affected businesses and the local economy.
Critical Infrastructure	Drinking Water Facilities	Potable Water Pump Stations	6	High	• Water pump stations have sensitive electrical and mechanical components that may be damaged or require replacement if exposed to flooding.	High	• Failure of pumps could cause inadequate water supply / pressure to provide water needed for sanitation and firefighting. • Inadequate system pressure could allow back-siphonage of contaminants into the system resulting in a boil water advisory or do not use notice. The need to buy bottled water will disproportionately impact socially vulnerable communities.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Critical Infrastructure	Drinking Water Facilities	Storage Tanks	6	Low	• Water tanks do not have electrical or mechanical equipment that may experience damage to temporary flood events; If unanchored, tanks can be moved off foundations by flooding.	Low	• Failure of water tanks will increase the use of water pumps to meet peak demand, affecting energy costs, repair, and replacement costs.
Critical Infrastructure	Water Utility Conveyance Systems	Potable Water Mains and Laterals (Age <40 years)	100 miles	Low	• Newer pipelines are less likely to experience damage due to flooding or infiltration of contaminants through the pipe structure if water pressure is lost.	Moderate	• Water line breaks generally only occur in localized areas, containing impacts, though city costs to repair could be significant if they occur at multiple locations. • Water supply to residents and businesses would be disrupted and there may be a need for alternative distributions, likely at cost to the city. • Frequent underground pipe replacement could require the city to dig into previously elevated roadways, greatly increasing capital costs and impacting neighboring communities.
Critical Infrastructure	Water Utility Conveyance Systems	Potable Water Mains and Laterals (Age 40 to 70 years)	60 miles	Moderate	• Pipelines 40 to 70 years old may be reaching the end of their functional lifespan and may experience damage due to flooding or infiltration of contaminants through the pipe structure if water pressure is lost.	Moderate	• Water line breaks generally only occur in localized areas, containing impacts, though city costs to repair could be significant if they occur at multiple locations. • Water supply to residents and businesses would be disrupted and there may be a need for alternative distributions, likely at cost to the city and impacting neighboring communities. • Frequent underground pipe replacement could require the city to dig into previously elevated roadways, greatly increasing capital costs and impacting neighboring communities.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Critical Infrastructure	Water Utility Conveyance Systems	Potable Water Mains and Laterals (Age >70 years)	95 miles	High	• Pipes older than 70 years are beyond their functional lifespan, are due for replacement, and are more likely to experience damage due to flooding or infiltration of contaminants through the pipe structure if water pressure is lost.	Moderate	• Water line breaks generally only occur in localized areas, containing impacts, though city costs to repair could be significant if they occur at multiple locations. • Water supply to residents and businesses would be disrupted and there may be a need for alternative distributions, likely at cost to the city. • Frequent underground pipe replacement could require the city to dig into previously elevated roadways, greatly increasing capital costs.
Critical Infrastructure	Stormwater Treatment Facilities and Pump Stations	Stormwater Pump Stations	48 active	High	• Unhardened stormwater pump stations have sensitive electrical and mechanical components that may be damaged or require replacement if exposed to flooding.	High	• Flood conditions will be greatly exacerbated if stormwater pumps fail to function. • Flooding may occur in unexpected areas, impacting life safety, complicating response efforts and may increase management and operation costs for the city. • Frequent flooding may require relocation or elevation of pumps.
Critical Infrastructure	Communication Facilities	Telecommunication Towers	5	Not Sensitive	• Communication tower function generally has negligible sensitivity to flooding due to the elevation and design of the structures.	Low	• Flood waters could impact access to cell towers. • Damage or loss of a tower could impact first responder and general communications until rerouted or repaired.
Critical Infrastructure	Disaster Debris Management Sites	Debris Storage Areas	5	Low	• These sites are typically open space and used only when floodwaters have receded leading to a low sensitivity.	Low	• Clearing impacted debris sites will take time and may slow the recovery post-event. • Damage to identified debris sites may require the use of alternative sites and/or coordination with neighboring communities, if possible. • Use of alternative sites could bring environmental impacts at selected site.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Critical Community and Emergency Facilities	Schools	Schools	7	Moderate	• Depending on flood depths, the first floor of schools could experience structural, electrical, and/or material damage. • Even if the building is not affected, access to the school outdoor areas, such as drop-off/pick-up locations and playgrounds may be affected until flooding recedes.	High	• Extended school closures can create food insecurity concerns for disadvantaged children and lead to a "learning loss" among students. • Long-term school closures can create childcare burden for families. • Loss of equipment or other assets may temporarily impair teaching capacity. • Repairs and remediation (e.g., mold removal) can be a significant, but necessary cost.
Critical Community and Emergency Facilities	Colleges and Universities	FIU Campuses	2	Moderate	• Depending on flood depths, the first floor of campus buildings could experience structural, electrical, and/or material damage. • Accessory structures, such as sport fields, may be affected until flooding recedes.	Low	• Community impacts will be limited to the campus and impacted buildings will likely be closed or limited until repaired. • Classes can transition to remote learning, where possible.
Critical Community and Emergency Facilities	Community Centers	City-owned community centers and pavilions	26	Moderate	• Flood waters that enter the structure may compromise structural components or electrical systems that may restrict use of the community center until repaired.	Moderate	• Loss of these assets can have the greatest impact on the most vulnerable members of the community impacting their life safety and mental health. • Repairs and remediation (e.g., mold removal) can be a significant cost to the city.
Critical Community and Emergency Facilities	Emergency Operation Centers (EOCs)	Mt. Sinai Hospital + Fire Station #2	2	Moderate	• Typically, EOCs are designated and designed to have low sensitivity to hazards, including flooding. • Floodwaters that do enter EOCs can compromise electrical equipment and cause structural and/or material damage.	Moderate	• Should flooding impact the structures, EOC functions may need to be limited or relocated until flooding conditions recede and/or the structure is repaired, impacting the ability to access emergency medical care and emergency response in the community. • Frequent flooding may require relocation or elevation of assets.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Critical Community and Emergency Facilities	Fire Stations	Fire Stations	6	Moderate	• Depending on flood depths, stations may experience drywall damage. The ability of fire apparatuses to respond is sensitive to standing water in the apparatus bay.	High	• Delays in response time and danger to public health and safety. • Delays in response times could increase recovery costs.
Critical Community and Emergency Facilities	Hospitals	Mt. Sinai Hospital	1	Moderate	• Flooding could restrict access to hospital entrances, elevators, and first floor administration (e.g., intake). • Flooded roads could inhibit ability of emergency vehicles to access individuals in need.	High	• First floor functions, including access and in-take, could severely restrict use of the hospital. • Flood impacts to hospital could affect the ability to access emergency medical care for city residents and visitors. • Frequent flooding may require costly adaptation measures.
Critical Community and Emergency Facilities	Law Enforcement Facilities	Main Police Stations	1	Moderate	• Flooding could compromise low-lying equipment, electronics, and access to law enforcement facilities limiting function under these conditions.	High	• Damage to the police headquarters building or assets will greatly impact the ability of response and recovery efforts in the city. • Loss of function at this site will greatly impact the ability to dispatch proper response efforts and could compromise life safety and security. • Long-term impacts may bring negative community safety impacts unless resources were sourced from surrounding jurisdictions.
Critical Community and Emergency Facilities	Law Enforcement Facilities	Police Substations	3	Moderate	• Flooding could compromise low-lying equipment, electronics, and access to law enforcement facilities limiting function under these conditions.	Moderate	• Damage to the substations could impact and delay regional response efforts, potentially impacting life safety and security.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Critical Community and Emergency Facilities	Local Government Facilities	Municipal Buildings	14	Moderate	• The first floors and equipment located there are sensitive to flooding within government buildings. • Government buildings are likely to be closed or limited until the structure or equipment is replaced, though some functions may be able to be done remotely.	Moderate	• Building permits, bill payments, and other government services could be suspended or limited. • Repairs and remediation (e.g., mold removal) can be a significant, but necessary cost.
Critical Community and Emergency Facilities	Logistical Staging Areas	Convention Center Loading Dock	1	Moderate	• Significant flood depths could prevent access to the loading dock causing a temporary loss of function and ability to stage resources.	Low	• Impacts to loading dock are likely to be temporary. • If compromised, other staging areas may be used as alternatives, although multiple smaller staging areas could impact recovery.
Critical Community and Emergency Facilities	Affordable Public Housing	Public Housing Buildings	10	Moderate	• The first floor of these structures and the equipment and personal contents within, are vulnerable to strong flood events. • Access into and out of the structures may also be restricted until floodwaters recede.	Moderate	• The city's most vulnerable populations likely require coordinated assistance to gather supplies, potentially evacuate a flood event, and navigate resources for recovery. • If these housing communities are impacted, the city may need to provide temporary housing for these populations until the structures are repaired.
Critical Community and Emergency Facilities	State Government Facilities	State Government Facilities	3	Moderate	• The first floors and equipment located there are sensitive to flooding within government buildings. • Government buildings are likely to be closed until the structure or equipment is replaced, though some functions may be able to be done remotely.	Low	• Government services could be limited, though neighboring communities may be able to assist.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Natural, Cultural, and Historical Resources	Parks	Major Parks	9	Moderate	• Major parks provide multiple community amenities and contain facilities that could be damaged if exposed to flooding. Associated equipment may require replacement to resume function. • Parks with amenities may experience longer closure times due to repairs following flood events.	High	• Major parks serve important functions for the city, typically acting as gathering spaces/social hubs for residents and pop-up distribution centers after extreme floods or other emergency events. • Long-term closures of larger parks can impact multiple communities, or the larger region through the loss of community events, social programs, public access, and recreational activities, • Park amenities may be damaged or degraded by floodwaters creating an economic cost for the city to repair, replace or remove the feature. • Loss of these spaces are likely to impact the most disadvantaged individuals in the community that rely on parks for low-cost recreational opportunities.
Natural, Cultural, and Historical Resources	Parks	Neighborhood Parks	11	Moderate	• Parks with amenities include facilities or structures that could be damaged or required facility/equipment replacement if exposed to flooding. • Parks with amenities may experience longer closure times due to repairs following flood events.	Moderate	• Neighborhood parks typically provide multiple recreational amenities (playgrounds, sports facilities, and open spaces) to nearby residents, which may be restricted if the park is flooded. • Park amenities may be damaged or degraded by floodwaters creating an economic cost for the city to repair, replace or remove the feature.
Natural, Cultural, and Historical Resources	Parks	Linear Parks, Mini Parks	18	Low	• Parks without amenities do not include facilities or structures that could sustain damage during a flood event. • Parks may experience short-term closures or limited use for several days after flood events, but most parks will be able to resume services after floodways recede.	Moderate	• Mini parks contain limited physical amenities provided that could be lost or unusable by the community. • Linear and mini parks may not have city-sponsored programs (e.g., youth sports, recreational opportunities) that the community relies upon.

Table E.6: Asset Type Sensitivity and Consequence Ratings Matrix (continued)

FDEP Asset Category	Asset Type	Assets Included	Total	Sensitivity		Consequence	
Natural, Cultural, and Historical Resources	Parks	Passive Green Space	7	Not Sensitive	• Passive parks are open space areas that lack physical amenities vulnerable to flood damage. • The greenspaces are likely to quickly resume function once floodwaters recede.	Low	• Flooded greenspaces may temporarily restrict public access. • Passive parks generally serve local neighborhoods, limiting the population affected while the park may be unusable.
Natural, Cultural, and Historical Resources	Surface Water Bodies	Lakes	1	Low	• The lake will continue to receive and retain water during most flood events. • Strong and frequent flood events could overflow the lake's banks.	Low	• If water levels exceed lake design levels, increased flooding will occur for adjacent properties. • Any contaminants within the lake may affect adjacent water bodies.
Natural, Cultural, and Historical Resources	Natural Resources	Wetlands, Shoreline, Dunes, Dune Crossovers	179	Moderate	• Natural areas are tolerant to occasional temporary flooding during storm events, but may experience erosion or vegetation diebacks if flooding is frequent or severe.	Moderate	• Loss of or damage to natural features could impact local bird and aquatic species that rely on this habitat. • Loss of dune crossover locations will affect public access to beaches. • Loss of beaches, dunes, and wetlands will require an increase in dependence on other forms of flood protection such as armoring and nourishment. • Restoration of these systems could incur significant costs for the city.
Natural, Cultural, and Historical Resources	Historical and Cultural Assets	Historical Buildings and Monuments, Museums, Art Centers, Cultural Sites	17	Moderate	• Historic structures are often not elevated to current building codes, leaving lower portions sensitive to flood events. • Damage to historic portions of these structures could compromise the assets designation if portions cannot be restored.	Low	• Repair of historic structures to original character could prove costly for the city. • Permanent losses to these structures could impact the character of neighborhoods and/or the city and affect local tourism.

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Appendix F:
Asset Exposure Matrix and Flooding Severity Maps

Description

This document is part of the City of Miami Beach's Sea Level Rise Vulnerability Assessment (VA) report. The tables presented in this document capture the flooding exposure threat for each asset in the VA considering each flood scenario.

The tables are colored coded based on the 'Critical Asset Threat Matrix Classification' table below to classify the exposure threat. Note that point features are classified by the depth of flooding at the asset location, while linear and polygon (i.e., parcel) features are classified by percentage of the asset exposed to that flooding scenario. The Site Analysis table for parcel features and the Linear Analysis table for linear features are provided at the end of the document.

Assets are organized into Asset Category tables as defined by the Resilient Florida grant program (s.380.093 F.S.). For more information, please see the full VA report.

Critical Asset Threat Matrix Classification

Critical Asset Categories	**Critical Community & Emergency Facilities**	**Critical Infrastructure**		**Natural, Cultural, and Historic Resources**		**Transportation**	
Exposure Threat Classification	*Point Feature Assets (Inundation Depth)*	Point Feature Assets *(Inundation Depth)*	Linear Features *(Percent Inundation)*	Point Feature Assets *(Inundation Depth)*	Parcels & Linear Features *(Percent Inundation)*	Point Feature Assets *(Inundation Depth)*	Linear Features *(Percent Inundation)*
Low	<3”	<3”	<25%	<3”	<25%	<3”	<25%
Medium	3” – 15”	3” – 15”	25% - 50%	3” – 15”	25% - 50%	3” – 15”	25% - 50%
High	> 15”	> 15”	>50%	> 15”	>50%	> 15”	>50%

Glossary	
100-year	A flood event with a 1-percent change of being equaled or exceed in any given year.
Compound Flooding	The combined effect of two or more flood sources (e.g., rainfall and king tide) occurring simultaneously.
Critical Community & Emergency Facility Assets	Includes structures essential to everyday community well-being, as well as facilities critical to emergency response and recovery.
Critical Infrastructure	Includes the infrastructure and facilities essential to daily operations within the City.
King Tide	Unusually large, but predictable tides that occur each year when the Earth is particularly close to the moon and Sun.
H	Refers to NOAA's 2017 High sea level rise projection curve.
IH	Refers to NOAA's 2017 Intermediate High sea level rise projection curve.
IL	Refers to NOAA's 2017 Intermediate Low sea level rise projection curve.
Natural, Cultural, and Historic Resources	Includes the City's natural features, recreational spaces and historically or culturally important assets.
Transportation	Inlcudes the major transportation networks and ancillary infrastructure within the City
Storm Tide	Temporary, short-term increase in sea level above predicted astronomical tide levels as a result of changes in atmospheric pressure, wind, and/or freshwater inflows. Also referred to as storm surge.

Critical Community and Emergency Facilities Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Lot Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Affordable Public Housing	The London (1975)	3.76	3.94	4.20	4.91	5.27	4.81	6.84	8.02	0.00	0.00	1.00	1.00	1.00	2.62	3.71	0.17	0.28	0.60	0.98	0.51	2.45	3.74
Affordable Public Housing	Lottie Apartments	3.07	4.57	4.84	5.49	5.85	5.39	7.42	8.60	0.00	0.00	0.50	0.87	0.40	2.41	3.62	0.81	0.88	1.07	1.22	1.04	2.45	3.64
Affordable Public Housing	Barclay Plaza Apartments	4.55	3.13	3.40	4.25	4.61	4.15	6.18	7.36	0.00	0.00	0.00	1.00	0.00	1.94	2.91	0.00	0.00	0.00	0.23	0.00	1.71	3.00
Affordable Public Housing	Neptune Apartments	2.79	4.09	4.36	5.02	5.38	4.92	6.95	8.13	0.00	0.00	0.74	1.09	0.63	2.71	3.85	0.93	0.93	1.01	1.40	0.96	2.74	3.93
Affordable Public Housing	Madeleine Village Apartments 1	2.63	5.12	5.38	6.08	6.44	5.98	8.01	9.19	0.13	0.40	1.09	1.45	0.99	3.06	4.20	0.00	0.00	0.00	0.00	0.00	2.96	4.08
Affordable Public Housing	Madeleine Village Apartments 2	2.99	4.54	4.80	5.49	5.85	5.39	7.42	8.60	0.00	0.00	0.50	0.87	0.40	2.51	3.62	0.00	0.00	0.00	0.00	0.00	2.28	3.40
Affordable Public Housing	Madeleine Village Apartments 3	2.52	5.30	5.57	6.34	6.70	6.24	8.27	9.45	0.34	0.61	1.27	1.63	1.17	3.36	4.38	0.00	0.00	0.00	0.00	0.00	3.14	4.26
Affordable Public Housing	Madeleine Village Apartments 4	3.03	4.84	5.11	5.75	6.11	5.65	7.68	8.86	0.00	0.00	0.82	1.18	0.72	2.64	3.93	0.00	0.00	0.00	0.00	0.00	2.03	3.15
Affordable Public Housing	The London (1965)	4.72	2.98	3.25	4.33	4.69	4.23	6.26	7.44	0.00	0.00	0.00	0.00	1.00	2.47	2.76	0.00	0.00	0.00	0.00	0.00	1.64	2.93
Affordable Public Housing	Coral Apartments	3.47	4.08	4.35	4.97	5.33	4.87	6.90	8.08	0.00	0.00	0.00	0.35	0.00	1.85	3.10	0.00	0.00	0.00	0.00	0.00	1.91	3.01
Colleges and Universities	FIU Urban Studios	4.07	3.97	4.24	4.96	5.32	4.86	6.89	8.07	0.00	0.00	0.64	1.00	0.54	2.69	3.75	1.05	1.05	1.10	1.35	1.07	2.66	3.85
Colleges and Universities	FIU Wolfsonian	4.10	2.80	3.07	3.76	4.12	3.66	5.69	6.87	0.00	0.00	0.00	0.00	0.00	1.52	2.51	0.20	0.20	0.31	0.37	0.31	1.52	2.70
Community Centers	South Pointe Park Pavillions	7.38	0.00	0.00	0.74	1.10	0.64	2.67	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Centers	PAL	2.61	4.97	5.24	5.93	6.29	5.83	7.86	9.04	0.00	0.00	1.49	1.85	1.39	3.46	4.60	1.40	1.42	1.62	2.10	1.56	3.42	4.61
Community Centers	South Shore Community Center	2.14	5.01	5.28	5.97	6.33	5.87	7.90	9.08	1.00	1.00	1.52	1.88	1.42	3.51	4.63	1.92	1.97	2.11	2.36	2.09	3.59	4.77
Community Centers	Muss Park Pavillion	4.35	2.80	3.07	3.67	4.03	3.57	5.60	6.78	0.00	0.00	0.00	0.00	0.00	1.09	2.33	0.00	0.00	0.00	0.00	0.00	1.21	2.38
Community Centers	North Beach Oceanside Park Pavillion	10.29	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Centers	North Shore Youth Center	4.36	4.40	4.67	5.41	5.77	5.31	7.34	8.52	0.00	0.00	0.29	0.63	0.00	2.25	3.39	0.48	0.53	0.63	0.81	0.62	2.25	3.44
Community Centers	Lummus Park Pavillion	8.46	0.00	0.00	0.69	1.03	0.59	2.60	3.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Centers	Shane Rowing Center	4.53	2.67	2.94	3.63	3.99	3.53	5.56	6.74	0.00	0.00	0.00	0.00	0.00	0.54	1.72	0.00	0.00	0.00	0.00	0.00	0.55	1.72
Community Centers	Scott Rakow Center	6.59	3.92	4.19	4.74	5.10	4.64	6.67	7.85	0.00	0.00	0.37	0.73	0.00	2.06	3.48	0.76	0.79	0.87	0.98	0.86	2.31	3.46
Community Centers	Unidad Center	9.97	0.00	0.00	0.00	0.00	0.00	1.04	2.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Centers	Stillwater Park Pavillion	3.64	3.58	3.85	4.48	4.84	4.38	6.41	7.59	0.00	0.00	0.00	0.00	0.00	1.32	2.58	0.00	0.00	0.00	0.00	0.00	1.40	2.59
Community Centers	Normandy Isle Park and Pool	7.13	0.00	0.00	2.43	2.79	2.33	4.36	5.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Centers	Marjory Stoneman Douglass	7.56	0.00	0.00	0.00	0.38	0.00	1.95	3.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Centers	Parkview Island Park Pavillion	3.62	3.43	3.70	4.42	4.78	4.32	6.35	7.53	0.00	0.00	0.00	0.00	0.00	1.34	2.49	0.00	0.00	0.00	0.00	0.00	1.37	2.56
Community Centers	Flamingo Park Tennis Center	4.05	3.51	3.77	4.50	4.86	4.40	6.43	7.61	0.00	0.00	0.00	0.39	0.00	2.06	3.14	0.00	0.00	0.17	0.65	0.11	1.97	3.16
Community Centers	Crespi Park Pavillion	3.70	3.62	3.89	4.43	4.79	4.33	6.36	7.54	0.00	0.00	0.00	0.00	0.00	1.37	2.70	0.00	0.00	0.00	0.00	0.00	1.46	2.58
Community Centers	Flamingo Park and Michigan	5.02	4.10	4.37	5.03	5.39	4.93	6.96	8.14	0.00	0.00	0.61	0.97	0.51	2.27	3.72	0.52	0.54	0.74	1.22	0.68	2.54	3.73
Community Centers	Fairway Park Pavillion	3.00	4.24	4.51	5.20	5.56	5.10	7.13	8.31	0.00	0.00	0.18	0.54	0.08	2.11	3.29	0.18	0.20	0.25	0.72	0.24	2.12	3.31
Community Centers	La Gorce Park Pavillion	2.91	4.20	4.47	5.17	5.53	5.07	7.10	8.28	0.00	0.00	0.23	0.59	1.00	2.14	3.34	0.29	0.38	0.69	0.86	0.66	2.36	3.48
Community Centers	Fisher Park Pavillion	2.74	4.16	4.43	5.12	5.48	5.02	7.05	8.23	0.00	0.00	1.00	0.87	1.00	2.44	3.62	0.78	0.82	0.99	1.14	0.97	2.55	3.71
Community Centers	Allison Park Pavillion	6.39	1.14	1.41	2.12	2.48	2.02	4.05	5.23	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.22
Community Centers	Coral House Senior Center	4.16	4.25	4.52	5.21	5.57	5.11	7.14	8.32	0.00	0.00	0.30	0.66	0.00	2.23	3.41	0.00	0.00	0.54	0.79	0.45	2.11	3.33
Community Centers	MIAMI BEACH REGIONAL LIBRARY	4.98	3.11	3.38	4.07	4.43	3.97	6.00	7.18	0.00	0.00	0.00	0.00	0.00	1.52	2.70	0.00	0.00	0.00	0.00	0.00	1.50	2.71

Critical Community and Emergency Facilities Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Lot Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Community Centers	NORTH SHORE BRANCH LIBRARY	6.15	1.66	1.93	2.63	2.99	2.53	4.56	5.74	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.73
Community Centers	SOUTH SHORE BRANCH LIBRARY	3.46	4.65	4.92	5.53	5.89	5.43	7.46	8.64	0.00	0.00	1.00	1.35	1.00	2.84	4.10	1.39	1.45	1.67	1.78	1.67	2.88	4.05
Community Centers	JEWISH LEARNING CENTER & LIBRARY	2.70	4.02	4.29	5.07	5.43	4.97	7.00	8.18	0.00	0.00	0.43	0.80	0.34	2.32	3.55	0.68	0.66	0.97	1.13	0.94	2.41	3.57
Emergency Operation Centers	Fire Station #2	7.39	0.00	0.25	0.99	1.34	0.89	2.91	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emergency Operation Centers	Mt. Sinai Hospital, Emergency Pavilion, Buiding E	6.14	5.89	6.16	6.85	7.21	6.75	8.78	9.96	0.00	0.00	0.00	0.50	0.00	4.27	5.45	0.00	0.00	0.20	0.39	0.16	2.13	3.32
Fire Stations	Fire Station #4	5.92	3.74	4.01	4.53	4.89	4.43	6.46	7.64	0.00	0.00	0.00	0.00	0.00	1.39	2.76	0.00	0.00	0.00	0.13	0.00	1.46	2.64
Fire Stations	Beach Patrol Building / Ocean Rescue HQ	8.46	0.00	0.00	0.69	1.03	0.59	2.60	3.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fire Stations	Fire Station #1	3.54	3.37	3.63	4.31	4.67	4.21	6.24	7.42	0.00	0.00	0.00	0.28	0.00	1.90	3.03	0.00	0.00	0.14	0.62	0.00	1.94	3.13
Fire Stations	Fire Station #2 (Admin building)	7.76	0.00	0.00	0.25	0.64	0.15	2.21	3.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fire Stations	Fire Station #2	7.39	0.00	0.25	0.99	1.34	0.89	2.91	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fire Stations	Fire Station #3	4.88	2.69	2.96	3.68	4.04	3.58	5.61	6.79	0.00	0.00	0.00	0.00	0.00	0.81	2.01	0.00	0.00	0.00	0.00	0.00	1.06	2.33
Hospitals	Mt Sinai Hospital - Harry Pearlman Biomedical Research Institute	4.96	2.46	2.72	3.35	3.71	3.25	5.28	6.46	0.00	0.00	0.00	0.00	0.00	0.61	1.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hospitals	Mt Sinai Hospital - Samuel L Jacobson Medical Center	4.43	3.16	3.42	4.26	4.62	4.16	6.19	7.37	0.00	0.00	0.00	0.00	0.00	1.53	2.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hospitals	Mt Sinai Hospital - Ascher Building	3.69	3.53	3.80	4.56	4.92	4.46	6.49	7.67	0.00	0.00	0.00	0.34	0.00	1.88	3.09	0.00	0.00	0.00	0.15	0.00	1.85	3.04
Hospitals	Mt Sinai Hospital - Donald L Golding Family Medical Building	4.67	3.36	3.62	4.31	4.67	4.21	6.24	7.42	0.00	0.00	0.00	0.00	0.00	1.73	2.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hospitals	Mt Sinai Hospital - Main Building	6.14	7.28	7.55	8.24	8.60	8.14	10.17	11.35	0.00	0.00	0.00	0.50	0.00	4.27	6.84	0.00	0.00	0.20	0.39	0.16	2.13	3.32
Hospitals	Mt Sinai Hospital - Mater Academy	4.39	3.17	3.44	4.13	4.49	4.03	6.06	7.24	0.00	0.00	0.00	0.00	0.00	1.49	2.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Law Enforcement Facilities	Sailport/Police Sub Station	4.19	4.41	4.68	5.37	5.73	5.27	7.30	8.48	0.00	0.00	0.30	0.66	0.20	2.23	3.41	0.60	0.64	0.75	0.90	0.73	2.24	3.42
Law Enforcement Facilities	Police Station HQ	4.99	3.33	3.59	4.46	4.82	4.36	6.39	7.57	0.00	0.00	0.00	0.00	0.00	2.24	2.99	0.14	0.15	0.18	0.57	0.17	1.87	3.06
Law Enforcement Facilities	Beach Patrol Building / Ocean Rescue HQ	8.46	0.00	0.00	0.69	1.03	0.59	2.60	3.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Law Enforcement Facilities	Police North End Sub Station	4.16	2.60	2.87	3.56	3.92	3.46	5.49	6.67	0.00	0.00	0.00	0.00	0.00	1.02	2.11	0.00	0.00	0.00	0.00	0.00	0.97	2.15
Law Enforcement Facilities	Marine Patrol Building	4.37	2.54	2.81	3.40	3.76	3.30	5.33	6.51	0.00	0.00	0.00	0.00	0.00	0.80	2.02	0.00	0.00	0.00	0.00	0.00	0.85	2.05
Local Government Facilities	Historic Old City Hall / Justice Center	4.70	2.11	2.38	3.10	3.46	3.00	5.03	6.21	0.00	0.00	0.00	0.00	0.00	0.75	1.85	0.00	0.00	0.00	0.00	0.00	0.68	1.87
Local Government Facilities	City Hall	6.36	3.12	3.39	4.16	4.52	4.06	6.09	7.27	0.00	0.00	0.00	0.13	0.00	1.89	2.88	0.00	0.00	0.00	0.25	0.00	1.71	2.91
Local Government Facilities	Property Management Facility	2.93	4.74	5.01	5.70	6.06	5.60	7.63	8.81	0.00	0.00	1.00	1.00	1.00	3.03	4.21	0.09	0.15	1.11	1.50	1.03	3.04	4.22
Local Government Facilities	Convention Center	5.26	4.23	4.50	5.14	5.50	5.04	7.07	8.25	0.00	0.00	0.00	0.00	0.00	2.66	4.01	0.00	0.44	0.76	1.31	0.67	2.80	4.09
Local Government Facilities	Fleet Maint. Complex - Shop #1 (Car Service Warehouse)	6.74	2.70	2.97	3.66	4.02	3.56	5.59	6.77	0.00	0.00	0.00	0.00	0.00	0.83	2.01	0.82	0.84	0.88	0.90	0.88	0.99	2.02
Local Government Facilities	Fleet Maint. Complex - Shop #2 (Office)	6.87	0.71	0.95	1.68	2.04	1.58	3.61	4.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Local Government Facilities	Fleet Maint. Complex - Electric Wave Garage	6.15	1.16	1.42	2.08	2.44	1.98	4.01	5.19	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.52

Critical Community and Emergency Facilities Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Lot Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Local Government Facilities	Fleet Maint. Complex - Shop #3 and Sanitation	5.53	1.40	1.67	2.35	2.71	2.25	4.28	5.46	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.08	0.10	0.14	0.16	0.14	0.25	0.76
Local Government Facilities	Public Works Yard / Control Bldg.	3.88	3.01	3.28	3.97	4.33	3.87	5.90	7.08	0.00	0.00	0.00	0.00	0.00	1.51	2.69	0.00	0.00	0.00	0.22	0.00	1.55	2.71
Local Government Facilities	Bayshore Maintenance Bldg. (Golf Course)	4.80	1.84	2.11	2.77	3.13	2.67	4.70	5.88	0.00	0.00	0.00	0.00	0.00	0.44	1.50	0.00	0.00	0.00	0.00	0.00	0.31	1.50
Local Government Facilities	Parks Division Plant Nursery (Green space Warehouse)	4.50	2.28	2.54	3.30	3.66	3.20	5.23	6.41	0.00	0.00	0.00	0.00	0.00	0.99	2.03	0.00	0.00	0.00	0.00	0.00	1.35	2.46
Local Government Facilities	Internal Affairs (South Pointe)	4.16	2.60	2.87	3.56	3.92	3.46	5.49	6.67	0.00	0.00	0.00	0.00	0.00	1.02	2.11	0.00	0.00	0.00	0.00	0.00	0.97	2.15
Local Government Facilities	Miami Beach Golf Course Club House	2.55	4.59	4.86	5.58	5.94	5.48	7.51	8.69	0.00	0.30	0.99	1.35	0.89	2.91	4.10	0.54	0.62	1.06	1.45	0.99	2.90	4.10
Local Government Facilities	South Pointe Park Ranger Station	4.81	2.34	2.60	3.32	3.68	3.22	5.25	6.43	0.00	0.00	0.00	0.00	0.00	0.73	1.85	0.00	0.00	0.00	0.00	0.00	0.65	1.82
Logistical Staging Areas	Convention Center	5.26	4.23	4.50	5.14	5.50	5.04	7.07	8.25	0.00	0.00	0.00	0.00	0.00	2.66	4.01	0.00	0.44	0.76	1.31	0.67	2.80	4.09
Schools	BISCAYNE ELEMENTARY	4.37	4.82	5.09	5.73	6.09	5.63	7.66	8.84	0.00	0.00	0.82	1.18	0.72	2.64	3.93	1.18	1.24	1.42	1.57	1.39	2.80	3.98
Schools	MIAMI BEACH SENIOR HIGH	6.77	6.05	6.31	7.00	7.36	6.90	8.93	10.11	0.00	0.00	0.00	0.00	0.00	1.41	5.75	1.43	1.44	1.46	1.47	1.46	1.50	2.45
Schools	NAUTILUS MIDDLE	4.54	4.05	4.32	4.82	5.18	4.72	6.75	7.93	0.00	0.00	0.48	0.84	0.38	2.40	3.59	0.00	0.00	0.34	0.66	0.30	2.44	3.63
Schools	NORTH BEACH ELEMENTARY	4.09	3.71	3.98	4.77	5.13	4.67	6.70	7.88	0.00	0.00	0.00	0.53	0.00	2.26	3.26	0.39	0.35	0.68	0.83	0.65	2.12	3.29
Schools	FIENBERG FISHER ADULT	3.43	3.57	3.84	4.53	4.89	4.43	6.46	7.64	0.00	0.00	0.24	0.60	0.08	2.17	3.35	0.57	0.57	0.62	0.87	0.59	2.18	3.37
Schools	FIENBERG/FISHER ELEMENTARY	4.37	3.64	3.91	4.60	4.96	4.50	6.53	7.71	0.00	0.00	0.31	0.67	0.21	2.57	3.42	0.67	0.67	0.71	0.97	0.69	2.28	3.47
Schools	SOUTH POINTE ELEMENTARY	4.62	3.40	3.67	4.36	4.72	4.26	6.29	7.47	0.00	0.00	0.00	0.00	0.00	1.69	2.87	0.21	0.22	0.38	0.50	0.37	1.68	2.86
State Government Facilities	SS Administration	3.44	3.60	3.87	4.41	4.77	4.31	6.34	7.52	0.00	0.00	0.22	0.55	0.12	2.01	3.31	0.00	0.00	0.36	0.68	0.29	2.82	4.59
State Government Facilities	US Coast Guard Station	8.14	0.67	0.94	1.69	2.05	1.59	3.62	4.80	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
State Government Facilities	Miami Beach Courthouse (Old City Hall)	4.70	2.11	2.38	3.10	3.46	3.00	5.03	6.21	0.00	0.00	0.00	0.00	0.00	0.75	1.85	0.00	0.00	0.00	0.00	0.00	0.68	1.87

Critical Infrastructure Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Communications Facilities	Radio Tower at Rebecca Towers Condominiums	6.60	1.98	2.25	2.94	3.30	2.84	4.87	6.05	0.00	0.00	0.00	0.00	0.00	0.00	1.42	0.00	0.00	0.00	0.00	0.00	0.00	1.41
Communications Facilities	Radio Tower on Parkview Point Condominium	4.38	6.76	7.02	7.71	8.07	7.61	9.64	10.82	1.88	2.15	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.23	0.31	0.20	1.73	2.92
Communications Facilities	Radio Tower on Tower 41 at Pine Tree Drive	10.15	5.84	6.11	6.80	7.16	6.7	8.73	9.91	0.00	0.00	0.00	0.00	0.00	0.00	1.39	2.10	2.08	2.66	2.95	2.58	4.20	5.36
Communications Facilities	Radio Tower at Council Towers North	5.09	1.98	2.25	2.94	3.30	2.84	4.87	6.05	0.00	0.00	0.00	0.00	0.00	0.50	1.68	0.00	0.00	0.00	0.00	0.00	0.53	1.71
Communications Facilities	Radio Tower on MB City Hall	6.36	3.12	3.39	4.16	4.52	4.06	6.09	7.27	0.00	0.00	0.00	0.13	0.00	1.89	2.88	0.00	0.00	0.00	0.25	0.00	1.71	2.91
Disaster Debris Management Sites	NORMANDY GOLF COURSE-106273	2.97	7.42	7.69	8.38	8.74	8.28	10.31	11.49	1.00	1.00	3.40	3.76	3.30	5.33	6.51	3.40	3.41	3.51	3.99	3.47	5.39	6.58
Disaster Debris Management Sites	LUMMUS PARK-106643	7.33	1.83	2.10	2.79	3.15	2.69	4.72	5.90	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.55	0.55	0.55	0.55	0.55	0.55	0.96
Disaster Debris Management Sites	MIAMI BEACH GOLF COURSE-106271	3.09	7.38	7.65	8.34	8.70	8.24	10.27	11.45	1.00	1.00	4.03	4.39	3.71	5.96	7.14	4.02	4.04	4.43	4.65	4.36	5.95	7.15
Disaster Debris Management Sites	NORTH BEACH OCEANSIDE PARK	8.50	7.70	7.97	8.66	9.02	8.56	10.59	11.77	0.00	0.00	0.00	0.00	0.00	1.45	2.63	3.59	3.64	3.82	3.97	3.79	5.12	6.31
Disaster Debris Management Sites	PAR 3 GOLF COURSE	3.12	5.39	5.66	6.35	6.71	6.25	8.28	9.46	1.00	1.00	1.94	2.30	1.84	3.87	5.05	2.10	2.12	2.26	2.60	2.22	3.93	5.09
Electricity Production and Supply Facilities	MacArthur Causeway Substation	4.01	3.42	3.69	4.38	4.74	4.28	6.31	7.49	0.00	0.00	0.00	0.00	0.00	1.60	2.78	1.22	1.23	1.26	1.28	1.26	1.58	2.79
Electricity Production and Supply Facilities	West Avenue Substation	2.71	4.95	5.22	5.91	6.27	5.81	7.84	9.02	0.00	0.00	1.34	1.70	1.24	3.27	4.45	0.76	0.82	1.37	1.76	1.29	3.24	4.44
Electricity Production and Supply Facilities	Harding Avenue Substation North	3.33	4.47	4.73	5.42	5.78	5.32	7.35	8.53	0.00	0.00	0.00	0.31	0.00	2.17	3.35	0.64	0.69	0.87	1.02	0.84	2.17	3.36
Electricity Production and Supply Facilities	Liberty Avenue Substation	4.32	6.23	6.50	7.53	7.89	7.43	9.46	10.64	0.00	0.00	2.62	2.98	2.52	5.50	5.73	0.00	0.00	0.00	0.00	0.00	1.00	2.21
Electricity Production and Supply Facilities	W 40th Street Substation	3.73	3.63	3.90	4.54	4.90	4.44	6.47	7.65	0.00	0.00	0.00	0.38	0.00	1.90	3.13	0.23	0.22	0.52	0.71	0.49	2.00	3.16
Electricity Production and Supply Facilities	Collins Avenue Substation	5.34	2.45	2.72	3.55	3.91	3.45	5.48	6.66	0.00	0.00	0.00	0.00	0.00	0.45	1.66	0.00	0.00	0.00	0.00	0.00	0.69	2.16
Electricity Production and Supply Facilities	Harding Avenue Substation	4.84	3.10	3.37	4.11	4.47	4.01	6.04	7.22	0.00	0.00	0.00	0.00	0.00	0.95	2.15	0.00	0.00	0.00	0.00	0.00	1.03	2.18
Water Pump Stations	Normandy Isle	3.62	3.97	4.24	4.93	5.29	4.83	6.86	8.04	0.00	0.00	0.00	0.29	0.00	1.26	3.04	0.00	0.00	0.21	0.46	0.14	1.84	3.04
Water Pump Stations	Terminal Island	5.96	0.47	0.74	1.46	1.82	1.36	3.39	4.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Pump Stations	41st Street	2.61	3.89	4.16	4.84	5.20	4.74	6.77	7.95	0.00	0.00	0.25	0.61	0.16	2.19	3.36	0.00	0.12	0.33	0.52	0.29	2.23	3.42
Water Pump Stations	75th Street	3.75	3.17	3.44	4.22	4.58	4.12	6.15	7.33	0.00	0.00	0.00	0.00	0.00	1.23	2.27	0.00	0.00	0.00	0.00	0.00	1.27	2.46
Water Pump Stations	25th Street	4.15	2.15	2.42	3.31	3.67	3.21	5.24	6.42	0.00	0.00	0.00	0.00	0.00	0.98	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Pump Stations	Belle Island	1.95	4.60	4.87	5.58	5.94	5.48	7.51	8.69	0.00	1.00	0.95	1.31	0.85	2.89	4.06	0.25	0.32	0.79	1.35	0.61	2.87	4.09
Water Storage Tanks	WTR_STR_100571	4.99	1.92	2.19	2.89	3.25	2.79	4.82	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	1.02
Water Storage Tanks	WTR_STR_9	5.01	1.85	2.12	2.81	3.17	2.71	4.74	5.92	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Water Storage Tanks	WTR_STR_2	3.38	3.12	3.39	4.08	4.44	3.98	6.01	7.19	0.00	0.00	0.00	0.00	0.00	1.55	2.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Storage Tanks	WTR_STR_24	4.84	1.44	1.71	2.40	2.76	2.30	4.33	5.51	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Storage Tanks	WTR_STR_27	4.86	1.42	1.68	2.38	2.74	2.28	4.31	5.49	0.00	0.00	0.00	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Storage Tanks	WTR_STR_4	4.38	2.08	2.35	3.05	3.41	2.95	4.98	6.16	0.00	0.00	0.00	0.00	0.00	0.57	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#32	3.83	2.58	2.85	3.53	3.89	3.43	5.46	6.64	0.00	0.00	0.00	0.00	0.00	0.94	2.13	0.00	0.00	0.00	0.00	0.00	0.95	2.13
Stormwater Pump Stations	#25	3.11	3.34	3.61	4.14	4.50	4.04	6.07	7.25	0.00	0.00	0.00	0.00	0.00	1.47	2.85	0.00	0.00	0.00	0.26	0.00	1.58	2.77

Critical Infrastructure Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Stormwater Pump Stations	#31	2.34	3.98	4.25	5.16	5.52	5.06	7.09	8.27	0.00	1.00	0.44	0.80	0.34	2.80	3.55	0.35	0.52	0.81	1.18	0.77	2.45	3.63
Stormwater Pump Stations	#4	2.22	4.25	4.52	5.14	5.50	5.04	7.07	8.25	0.00	0.00	0.61	0.97	0.51	2.45	3.72	0.21	0.27	0.69	1.13	0.60	2.51	3.71
Stormwater Pump Stations	#33	1.72	4.72	4.99	5.68	6.04	5.58	7.61	8.79	1.00	1.00	1.12	1.48	1.02	3.05	4.23	0.56	0.57	1.18	1.61	1.05	3.09	4.28
Stormwater Pump Stations	#45	5.12	1.06	1.32	2.01	2.37	1.91	3.94	5.12	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#48	2.69	4.04	4.30	4.63	4.99	4.53	6.56	7.74	0.00	0.00	0.00	1.09	0.00	1.84	3.79	0.42	0.38	0.62	0.98	0.56	2.44	3.62
Stormwater Pump Stations	#24	3.30	3.08	3.35	4.03	4.39	3.93	5.96	7.14	0.00	0.00	0.00	0.00	0.00	1.38	2.57	0.00	0.00	0.00	0.00	0.00	1.39	2.58
Stormwater Pump Stations	#40	5.92	0.68	0.95	1.67	2.03	1.57	3.60	4.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#42	3.57	3.87	4.14	4.74	5.10	4.64	6.67	7.85	0.00	0.00	0.00	0.00	0.00	2.04	3.09	0.00	0.00	0.00	0.00	0.00	0.00	3.25
Stormwater Pump Stations	#35	4.16	2.72	2.99	3.66	4.02	3.56	5.59	6.77	0.00	0.00	0.00	0.00	0.00	0.78	1.98	0.00	0.00	0.00	0.00	0.00	0.00	1.96
Stormwater Pump Stations	#34	3.55	3.18	3.45	4.18	4.54	4.08	6.11	7.29	0.00	0.00	0.00	0.00	0.00	1.35	2.51	0.00	0.00	0.00	0.00	0.00	1.30	2.50
Stormwater Pump Stations	#37	6.01	0.80	1.07	1.77	2.13	1.67	3.70	4.88	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#36	5.08	1.66	1.93	2.64	3.00	2.54	4.57	5.75	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.90
Stormwater Pump Stations	#39	4.74	2.02	2.29	2.96	3.32	2.86	4.89	6.07	0.00	0.00	0.00	0.00	0.00	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#3	2.45	4.40	4.66	5.36	5.72	5.26	7.29	8.47	0.00	0.00	0.00	0.00	0.00	2.73	3.88	0.20	0.26	0.81	1.20	0.73	2.68	3.88
Stormwater Pump Stations	#13	1.59	4.91	5.18	5.87	6.23	5.77	7.80	8.98	0.00	1.00	1.33	1.69	1.23	3.26	4.44	0.31	0.50	1.05	1.50	0.98	3.29	4.48
Stormwater Pump Stations	#10	2.53	3.94	4.21	5.08	5.44	4.98	7.01	8.19	0.00	0.00	0.32	0.68	0.22	2.40	3.43	0.15	0.18	0.34	0.55	0.29	2.32	3.51
Stormwater Pump Stations	#43	3.74	2.80	3.07	3.80	4.16	3.70	5.73	6.91	0.00	0.00	0.00	0.00	0.00	1.05	2.22	0.00	0.00	0.04	0.10	0.03	1.00	2.20
Stormwater Pump Stations	#8	2.74	3.55	3.82	4.51	4.87	4.41	6.44	7.62	0.00	0.00	0.20	0.56	0.10	2.12	3.31	0.21	0.23	0.29	0.55	0.28	2.14	3.32
Stormwater Pump Stations	#44	3.89	2.35	2.61	3.56	3.92	3.46	5.49	6.67	0.00	0.00	0.00	0.00	0.00	1.41	2.03	0.00	0.00	0.00	0.00	0.00	0.94	2.14
Stormwater Pump Stations	#5	1.97	4.63	4.90	5.65	6.01	5.55	7.58	8.76	0.00	1.00	0.92	1.28	0.82	2.80	4.03	0.14	0.21	0.68	1.24	0.50	2.76	3.97
Stormwater Pump Stations	#2	3.04	3.78	4.05	4.74	5.10	4.64	6.67	7.85	0.00	0.00	0.00	0.00	0.00	2.07	3.25	0.00	0.00	0.16	0.55	0.00	2.07	3.27
Stormwater Pump Stations	#1	2.70	3.95	4.22	4.88	5.24	4.78	6.81	7.99	0.00	0.00	0.00	1.00	0.00	2.26	3.44	0.00	0.00	0.32	0.71	0.24	2.30	3.85
Stormwater Pump Stations	#23	2.16	4.84	5.11	5.82	6.18	5.72	7.75	8.93	0.00	0.00	0.72	1.08	0.62	2.67	3.83	0.64	0.66	0.76	0.95	0.72	2.66	3.85
Stormwater Pump Stations	#17	4.83	1.69	1.96	2.82	3.18	2.72	4.75	5.93	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#41	3.11	4.58	4.85	5.07	5.43	4.97	7.00	8.18	0.00	0.00	0.00	1.00	0.00	2.23	3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#2A	3.59	2.85	3.12	3.92	4.28	3.82	5.85	7.03	0.00	0.00	0.00	0.00	0.00	1.34	2.32	0.00	0.00	0.00	0.00	0.00	1.22	2.42

Critical Infrastructure Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Stormwater Pump Stations	#6	2.68	4.07	4.34	4.92	5.28	4.82	6.85	8.03	0.00	0.00	0.40	0.76	0.30	2.08	3.51	0.00	0.00	0.32	0.82	0.00	2.23	3.42
Stormwater Pump Stations	#7	3.38	3.24	3.51	4.15	4.51	4.05	6.08	7.26	0.00	0.00	0.00	0.00	0.00	1.37	2.67	0.00	0.00	0.00	0.00	0.00	1.43	2.62
Stormwater Pump Stations	#9	2.17	4.31	4.58	5.33	5.69	5.23	7.26	8.44	0.00	0.00	0.68	1.04	0.58	2.66	3.79	0.00	0.32	0.65	0.88	0.60	2.65	3.84
Stormwater Pump Stations	#11	2.04	4.34	4.61	5.32	5.68	5.22	7.25	8.43	0.00	1.00	0.77	1.13	0.67	2.70	3.88	0.34	0.42	0.75	0.97	0.69	2.74	3.93
Stormwater Pump Stations	#12	2.45	4.02	4.29	4.99	5.35	4.89	6.92	8.10	0.00	0.00	0.42	0.78	0.32	2.40	3.53	0.00	0.00	0.00	0.19	0.00	2.38	3.57
Stormwater Pump Stations	#14	2.16	4.25	4.51	5.21	5.57	5.11	7.14	8.32	0.00	0.00	0.70	1.06	0.60	2.54	3.81	0.00	0.23	0.54	0.85	0.50	2.63	3.82
Stormwater Pump Stations	#15	2.84	3.30	3.57	4.37	4.73	4.27	6.30	7.48	0.00	0.00	0.00	0.00	0.00	1.85	2.88	0.00	0.00	0.00	0.47	0.00	1.80	3.00
Stormwater Pump Stations	#16	2.66	3.90	4.17	4.99	5.35	4.89	6.92	8.10	0.00	0.00	0.00	0.64	0.00	2.44	3.39	0.66	0.74	1.09	1.16	1.08	2.26	3.43
Stormwater Pump Stations	#18	5.00	1.30	1.57	2.53	2.89	2.43	4.46	5.64	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.83
Stormwater Pump Stations	#22	2.04	4.21	4.47	5.15	5.51	5.05	7.08	8.26	0.00	1.00	0.75	1.11	0.65	2.67	3.86	0.91	0.93	1.07	1.41	1.03	2.74	3.90
Stormwater Pump Stations	#26	2.41	4.21	4.48	5.16	5.52	5.06	7.09	8.27	0.00	0.00	0.00	0.97	0.00	2.53	3.72	0.27	0.39	0.74	1.22	0.66	2.54	3.73
Stormwater Pump Stations	#28	4.63	1.91	2.18	2.91	3.27	2.81	4.84	6.02	0.00	0.00	0.00	0.00	0.00	0.19	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stormwater Pump Stations	#27	4.10	2.41	2.67	3.34	3.70	3.24	5.27	6.45	0.00	0.00	0.00	0.00	0.00	0.64	1.83	0.00	0.00	0.00	0.00	0.00	0.32	0.32
Stormwater Pump Stations	#29	2.25	4.27	4.53	5.24	5.60	5.14	7.17	8.35	0.00	0.00	0.62	0.98	0.52	2.54	3.73	0.50	0.56	0.68	1.01	0.65	2.57	3.78
Stormwater Pump Stations	#30	4.97	1.80	2.07	2.99	3.35	2.89	4.92	6.10	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.94
Stormwater Pump Stations	#38	5.07	1.76	2.03	2.72	3.08	2.62	4.65	5.83	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.99
Stormwater Pump Stations	#50	2.63	5.50	5.77	6.40	6.76	6.30	8.33	9.51	0.00	0.00	0.00	0.00	0.00	4.02	4.98	1.68	1.78	1.90	2.22	1.86	3.80	5.01
Stormwater Pump Stations	#19	2.11	4.18	4.45	5.16	5.52	5.06	7.09	8.27	0.00	0.00	0.64	1.00	0.54	2.59	3.75	0.49	0.63	1.08	1.30	1.03	2.61	3.78
Stormwater Pump Stations	#20	2.70	3.69	3.96	4.63	4.99	4.53	6.56	7.74	0.00	0.00	0.15	0.51	1.00	2.09	3.26	0.31	0.31	0.61	0.85	0.56	2.15	3.31
Stormwater Pump Stations	#21	3.63	2.79	3.06	3.76	4.12	3.66	5.69	6.87	0.00	0.00	0.00	0.00	0.00	1.13	2.31	0.00	0.00	0.00	0.00	0.00	1.18	2.34
Wastewater Pump Station	PS 24	3.59	3.57	3.84	4.51	4.87	4.41	6.44	7.62	0.00	0.00	0.00	0.00	0.00	1.33	2.58	0.00	0.00	0.00	0.00	0.00	1.34	2.48
Wastewater Pump Station	PS 19	5.46	1.50	1.77	2.43	2.79	2.33	4.36	5.54	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.50
Wastewater Pump Station	PS 23	3.68	3.42	3.69	4.34	4.70	4.24	6.27	7.45	0.00	0.00	0.00	0.00	0.00	1.26	2.52	0.00	0.00	0.00	0.14	0.00	1.35	2.54
Wastewater Pump Station	PS 29	6.23	0.65	0.91	1.56	1.92	1.46	3.49	4.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wastewater Pump Station	PS 22	4.20	2.78	3.05	3.56	3.92	3.46	5.49	6.67	0.00	0.00	0.00	0.00	0.00	0.42	1.93	0.00	0.00	0.00	0.00	0.00	0.69	1.88
Wastewater Pump Station	PS 21	6.26	0.29	0.56	1.18	1.54	1.08	3.11	4.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Critical Infrastructure Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Wastewater Pump Station	PS 18	6.15	1.01	1.31	2.21	2.57	2.11	4.14	5.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wastewater Pump Station	PS 15	4.61	2.30	2.57	3.13	3.49	3.03	5.06	6.24	0.00	0.00	0.00	0.00	0.00	0.48	1.67	0.00	0.00	0.00	0.00	0.00	0.54	1.70
Wastewater Pump Station	PS 27	3.76	3.02	3.29	3.93	4.29	3.83	5.86	7.04	0.00	0.00	0.00	0.00	0.00	1.18	2.33	0.00	0.00	0.00	0.00	0.00	1.33	2.60
Wastewater Pump Station	PS 11	5.58	0.72	0.99	1.72	2.08	1.62	3.65	4.83	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.55
Wastewater Pump Station	PS 4	4.27	2.56	2.83	3.49	3.85	3.39	5.42	6.60	0.00	0.00	0.00	0.00	0.00	0.58	1.78	0.00	0.00	0.00	0.00	0.00	0.58	1.79
Wastewater Pump Station	PS 5	3.02	4.04	4.31	5.03	5.39	4.93	6.96	8.14	0.00	0.00	0.00	0.42	0.00	2.02	3.19	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Wastewater Pump Station	PS 10	2.41	4.19	4.46	5.19	5.55	5.09	7.12	8.30	0.00	0.00	0.54	0.90	0.44	2.46	3.65	0.34	0.35	0.41	0.95	0.38	2.46	3.67
Wastewater Pump Station	PS 7	2.54	4.22	4.49	5.16	5.52	5.06	7.09	8.27	0.00	0.00	0.00	1.00	0.00	2.28	3.47	0.46	0.40	0.42	0.46	0.47	2.29	3.47
Wastewater Pump Station	PS 6	2.39	4.45	4.72	5.43	5.79	5.33	7.36	8.54	0.00	0.00	0.00	0.00	0.00	2.53	3.68	0.57	0.58	0.57	0.57	0.59	0.59	0.57
Wastewater Pump Station	PS 8	2.36	4.48	4.74	5.43	5.79	5.33	7.36	8.54	0.00	0.00	1.00	1.00	1.00	2.60	3.78	0.00	0.00	0.00	0.00	0.00	1.06	3.79
Wastewater Pump Station	PS 30	5.49	1.10	1.37	2.05	2.41	1.95	3.98	5.16	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.08	0.58
Wastewater Pump Station	PS 2	4.24	2.28	2.55	3.26	3.62	3.16	5.19	6.37	0.00	0.00	0.00	0.00	0.00	0.56	1.71	0.00	0.00	0.00	0.00	0.00	0.53	1.73
Wastewater Pump Station	PS 14	5.66	1.06	1.33	1.96	2.32	1.86	3.89	5.07	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Wastewater Pump Station	PS 13	4.61	1.90	2.16	2.94	3.30	2.84	4.87	6.05	0.00	0.00	0.00	0.00	0.00	0.42	1.48	0.00	0.00	0.00	0.00	0.00	0.31	1.51
Wastewater Pump Station	PS 28	4.62	2.93	3.20	3.97	4.33	3.87	5.90	7.08	0.00	0.00	0.00	0.00	0.00	1.22	2.48	0.00	0.00	0.00	0.00	0.00	1.09	2.35
Wastewater Pump Station	PS 31	3.80	2.60	2.87	3.52	3.88	3.42	5.45	6.63	0.00	0.00	0.00	0.00	0.00	0.92	2.14	0.00	0.00	0.00	0.00	0.00	0.98	2.16
Wastewater Pump Station	PS 1	3.86	2.42	2.69	3.39	3.75	3.29	5.32	6.50	0.00	0.00	0.00	0.00	0.00	0.93	2.08	0.00	0.00	0.00	0.00	0.00	0.91	2.10

Natural, Historical, and Cultural Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Historical and Cultural Assets	BYRON CARLYLE THEATRE	2.78	5.38	5.65	6.17	6.53	6.07	8.10	9.28	0.00	0.00	1.29	1.65	1.19	3.24	4.40	1.40	1.45	1.57	1.75	1.56	3.13	4.32
Historical and Cultural Assets	BASS MUSEUM OF ART	4.67	2.92	3.19	4.00	4.36	3.9	5.93	7.11	0.00	0.00	0.00	0.00	0.00	1.38	2.43	0.46	0.50	0.58	0.63	0.57	1.29	2.50
Historical and Cultural Assets	COLONY THEATER	3.20	4.74	5.01	5.68	6.04	5.58	7.61	8.79	0.00	1.00	1.21	1.57	1.11	3.19	4.32	1.28	1.29	1.40	1.84	1.34	3.20	4.39
Historical and Cultural Assets	HOLOCAUST MEMORIAL	2.88	4.43	4.70	5.39	5.75	5.29	7.32	8.50	0.00	0.00	0.00	0.00	0.00	3.01	4.19	0.91	0.87	1.12	1.48	1.06	3.00	4.18
Historical and Cultural Assets	JACKIE GLEASON THEATER (FILLMORE)	6.90	0.87	1.14	1.93	2.29	1.83	3.86	5.04	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.70
Historical and Cultural Assets	JEWISH MUSEUM OF FLORIDA	3.80	2.91	3.17	3.87	4.23	3.77	5.80	6.98	0.00	0.00	0.00	0.00	0.00	1.33	2.45	0.10	0.11	0.14	0.21	0.14	1.36	2.54
Historical and Cultural Assets	MIAMI CITY BALLET	4.50	3.26	3.52	4.23	4.59	4.13	6.16	7.34	0.00	0.00	0.00	0.00	0.00	1.73	2.77	0.72	0.76	0.84	0.89	0.83	1.57	2.78
Historical and Cultural Assets	NEW WORLD CENTER	5.16	2.79	3.05	3.74	4.10	3.64	5.67	6.85	0.00	0.00	0.00	0.00	0.00	1.38	2.56	0.00	0.00	0.00	0.00	0.00	1.39	2.57
Historical and Cultural Assets	FLAGLER MEMORIAL	3.48	3.42	3.69	4.42	4.78	4.32	6.35	7.53	0.00	0.00	0.00	0.00	0.00	1.63	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Historical and Cultural Assets	BANDSHELL	6.58	0.53	0.80	1.49	1.85	1.39	3.42	4.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Historical and Cultural Assets	ART DECO CENTER	8.61	0.00	0.00	0.00	0.00	0.00	1.91	3.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Historical and Cultural Assets	BOTANICAL GARDENS	5.23	1.59	1.86	2.55	2.91	2.45	4.48	5.66	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	0.00	0.00	0.00	0.00	0.00	1.34
Historical and Cultural Assets	ROTUNDA BUILDING	4.98	1.79	2.06	2.75	3.11	2.65	4.68	5.86	0.00	0.00	0.00	0.00	0.00	0.24	1.47	0.00	0.00	0.00	0.00	0.00	0.23	1.38
Historical and Cultural Assets	OLD CITY HALL	4.70	2.11	2.38	3.10	3.46	3.00	5.03	6.21	0.00	0.00	0.00	0.00	0.00	0.75	1.85	0.00	0.00	0.00	0.00	0.00	0.68	1.87
Historical and Cultural Assets	28TH STREET OBILISK	5.54	1.45	1.72	2.50	2.86	2.40	4.43	5.61	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.99
Historical and Cultural Assets	41ST STREET FOUNTAIN	6.10	1.08	1.35	2.04	2.40	1.94	3.97	5.15	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.62
Historical and Cultural Assets	NORMANDY FOUNTAIN	3.64	3.77	4.04	4.72	5.08	4.62	6.65	7.83	0.00	0.00	0.00	0.09	0.00	1.68	2.84	0.00	0.00	0.00	0.22	0.00	1.62	2.82
Historical and Cultural Assets	WOLFSONIAN MUSEUM	4.10	2.80	3.07	3.76	4.12	3.66	5.69	6.87	0.00	0.00	0.00	0.00	0.00	1.52	2.51	0.20	0.20	0.31	0.37	0.31	1.52	2.70

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bridges	SST61306	5.79	1.44	1.71	2.40	2.76	2.3	4.33	5.51	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61307	5.01	6.19	6.46	7.12	7.48	7.02	9.05	10.23	0.00	0.00	0.00	0.00	0.00	0.00	5.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61308	6.12	6.97	7.24	7.93	8.29	7.83	9.86	11.04	0.00	0.00	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61309	5.97	6.98	7.25	7.93	8.29	7.83	9.86	11.04	0.00	0.00	2.92	3.33	0.00	4.89	6.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61310	6.38	6.81	7.08	7.77	8.13	7.67	9.70	10.88	1.88	2.15	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61311	5.87	2.55	7.27	7.96	8.32	7.86	9.89	11.07	0.00	0.00	0.00	0.00	0.00	0.52	1.52	0.00	0.00	0.00	0.00	0.00	0.41	1.59
Bridges	SST61313	4.10	2.51	2.78	3.53	3.89	3.43	5.46	6.64	0.00	0.00	0.00	0.00	0.00	0.36	1.46	0.00	0.00	0.00	0.00	0.00	0.26	1.44
Bridges	SST61315	4.68	4.12	4.38	5.08	5.44	4.98	7.01	8.19	0.00	0.00	0.00	0.00	0.00	2.07	3.25	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Bridges	SST61316	8.99	6.84	7.11	7.80	8.16	7.70	9.73	10.91	1.88	2.15	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.42	1.60
Bridges	SST61317	8.25	6.71	6.98	7.67	8.03	7.57	9.60	10.78	0.00	0.00	0.00	0.00	0.00	4.65	5.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61318	6.28	6.86	7.13	7.82	8.18	7.72	9.75	10.93	0.00	0.00	2.04	2.40	0.00	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61319	6.38	6.79	7.06	7.75	8.11	7.65	9.68	10.86	1.88	2.15	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61320	11.34	6.90	7.17	7.86	8.22	7.76	9.79	10.97	0.00	0.00	0.00	0.00	0.00	0.00	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Bridges	SST61321	10.86	6.79	7.05	7.72	8.08	7.62	9.65	10.83	0.00	0.00	2.88	3.24	2.78	4.77	5.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61322	10.02	6.63	6.90	7.59	7.95	7.49	9.52	10.70	0.00	0.00	2.89	3.28	0.00	4.84	6.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61323	6.50	5.08	5.35	6.04	6.40	5.94	7.97	9.15	0.00	0.00	0.00	0.00	0.00	3.35	4.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61324	5.15	6.48	6.75	7.44	7.80	7.34	9.37	10.55	0.00	0.00	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61325	9.85	0.22	0.49	1.15	1.51	1.05	9.29	10.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61326	5.73	6.47	6.74	7.43	7.79	7.33	9.36	10.54	0.00	0.00	2.84	3.20	2.74	4.25	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61327	5.08	6.47	6.74	7.43	7.79	7.33	9.36	10.54	0.00	0.00	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61328	6.32	8.39	8.66	9.57	9.93	9.47	11.50	12.68	3.78	4.05	4.74	5.10	4.64	6.54	7.85	0.00	0.00	0.00	0.00	0.00	0.22	1.44
Bridges	SST61329	5.47	6.39	6.66	7.40	7.76	7.30	9.33	10.51	0.00	0.00	0.00	0.00	0.00	0.46	1.59	0.00	0.00	0.00	0.00	0.00	0.36	1.57
Bridges	SST61330	21.73	6.17	6.44	7.11	7.47	7.01	9.04	10.22	0.00	0.00	0.00	0.00	0.00	0.00	5.96	0.00	0.00	0.00	0.00	0.00	0.00	0.75
Bridges	SST61332	4.36	6.29	6.55	7.24	7.60	7.14	9.17	10.35	1.88	2.15	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.57	1.77
Bridges	SST61333	7.02	5.63	5.90	6.59	6.95	6.49	8.52	9.70	0.00	0.00	0.00	2.51	0.00	4.08	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61335	7.50	2.89	3.16	3.85	4.21	3.75	5.78	6.96	0.00	0.00	0.00	0.00	0.00	1.17	2.38	0.00	0.00	0.00	0.00	0.00	1.23	2.78
Bridges	SST61336	7.32	1.99	2.26	2.96	3.32	2.86	4.89	6.07	0.00	0.00	0.00	0.00	0.00	0.41	1.52	0.00	0.00	0.00	0.00	0.00	0.45	2.00
Bridges	SST61337	8.16	0.00	0.00	0.28	0.64	0.18	2.21	3.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61338	7.35	0.00	0.00	0.00	0.17	0.00	1.74	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61339	6.48	0.00	0.00	0.00	0.00	0.00	1.06	2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61340	7.02	0.00	0.00	0.00	0.23	0.00	1.80	2.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61341	3.78	0.50	0.77	1.44	1.80	1.34	3.37	4.55	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	1.25
Bridges	SST61342	6.48	6.71	6.98	7.67	8.03	7.57	9.60	10.78	2.12	2.39	3.08	3.44	2.98	5.01	6.19	2.23	2.40	2.69	3.06	2.65	4.33	5.51
Bridges	SST61343	3.05	6.81	7.08	7.77	8.13	7.67	9.70	10.88	2.12	2.39	3.08	3.44	2.98	5.01	6.19	0.09	0.10	0.14	0.17	0.13	1.09	2.29
Bridges	SST61344	3.41	3.04	3.31	3.97	4.33	3.87	5.90	7.08	0.00	0.00	0.00	0.00	0.00	1.11	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61345	4.95	7.05	7.31	8.01	8.37	7.91	9.94	11.12	2.12	2.39	3.08	3.44	2.98	5.01	6.19	0.00	0.00	0.00	0.67	0.00	1.92	2.73
Bridges	SST61346	5.14	3.22	3.49	4.80	5.16	4.70	6.73	7.91	0.00	0.00	0.00	0.00	0.00	1.85	2.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61347	9.04	4.29	4.56	5.26	5.62	5.16	7.19	8.37	0.00	0.00	0.00	0.00	0.00	0.16	1.33	0.00	0.00	0.00	0.00	0.00	0.12	1.33
Bridges	SST61348	5.41	6.63	6.90	7.59	7.95	7.49	9.52	10.70	1.96	2.23	2.92	3.28	2.82	4.85	6.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61349	8.51	1.60	1.86	2.62	2.98	2.52	4.55	5.73	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bridges	SST61350	5.27	6.80	7.07	7.76	8.12	7.66	9.69	10.87	0.00	0.00	2.84	3.20	0.00	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bridges	SST61351	5.42	2.12	2.39	3.12	3.48	3.02	5.05	6.23	0.00	0.00	0.00	0.00	0.00	0.25	1.42	0.00	0.00	0.00	0.00	0.00	0.00	1.38
Bridges	SST61352	5.45	1.86	2.13	2.80	3.16	2.70	4.73	5.91	0.00	0.00	0.00	0.00	0.00	0.00	1.19	0.00	0.00	0.00	0.00	0.00	0.00	1.15
Bridges	SST61353	5.19	1.88	2.15	2.91	3.27	2.81	4.84	6.02	0.00	0.00	0.00	0.00	0.00	0.00	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.92
Bridges	SST61354	5.39	6.77	7.04	7.73	8.09	7.63	9.66	10.84	1.96	2.23	2.92	3.28	2.82	4.85	6.03	0.00	0.00	0.00	0.00	0.00	0.00	0.99
Bridges	SST61355	5.31	6.78	7.05	7.74	8.10	7.64	9.67	10.85	0.00	0.00	0.00	0.00	0.00	0.00	6.03	0.00	0.00	0.00	0.00	0.00	0.00	0.69
Bridges	SST61356	7.80	0.00	0.12	0.92	1.28	0.82	2.85	4.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	WashingtonAvenue & 17Street SB	4.03	2.09	2.36	3.11	3.47	3.01	5.04	6.22	0.00	0.00	0.00	0.00	0.00	0.82	1.87	0.00	0.00	0.00	0.00	0.00	0.71	1.90
Bus Stops	LincolnRoad & WashingtonAvenue EB	4.65	1.61	1.88	2.63	2.99	2.53	4.56	5.74	0.00	0.00	0.00	0.00	0.00	0.22	1.39	0.00	0.00	0.00	0.00	0.00	0.19	1.37
Bus Stops	HardingAvenue & 72Street SB	3.00	4.02	4.29	4.95	5.31	4.85	6.88	8.06	0.00	0.00	0.00	0.25	0.00	1.84	3.00	0.04	0.09	0.19	0.37	0.18	1.81	3.00
Bus Stops	LincolnRoad & WashingtonAvenue WB	4.60	1.70	1.97	2.61	2.97	2.51	4.54	5.72	0.00	0.00	0.00	0.00	0.00	0.42	1.48	0.00	0.00	0.00	0.00	0.00	0.42	1.60
Bus Stops	IndianCreekDr & 41Street SB	2.73	4.09	4.36	5.04	5.40	4.94	6.97	8.15	0.00	0.00	0.45	0.81	0.00	2.40	3.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	IndianCreekDr & 43Street SB	2.46	4.08	4.35	5.01	5.37	4.91	6.94	8.12	0.00	0.00	0.44	0.80	0.34	2.39	3.55	0.33	0.39	0.51	0.84	0.48	2.40	3.61
Bus Stops	CollinsAvenue & 43Street NB	3.66	4.03	4.29	5.23	5.59	5.13	7.16	8.34	0.00	0.00	1.00	0.69	1.00	2.11	3.47	0.23	0.29	0.41	0.81	0.38	2.32	3.54
Bus Stops	AbbottAvenue & 69Street SB	2.55	4.28	4.55	5.18	5.54	5.08	7.11	8.29	0.00	0.00	0.21	0.56	0.00	2.26	3.31	0.46	0.50	0.61	0.76	0.59	2.10	3.28
Bus Stops	CollinsAvenue & 69Street NB	4.33	2.96	3.23	4.06	4.42	3.96	5.99	7.17	0.00	0.00	0.00	0.00	0.00	0.68	1.99	0.00	0.00	0.00	0.00	0.00	0.89	2.07
Bus Stops	WashingtonAvenue & LincolnRoad SB	4.36	1.86	2.13	2.86	3.22	2.76	4.79	5.97	0.00	0.00	0.00	0.00	0.00	0.50	1.64	0.00	0.00	0.00	0.00	0.00	0.49	1.67
Bus Stops	CollinsAvenue & 72Street NB	5.72	1.30	1.57	2.32	2.68	2.22	4.25	5.43	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.35
Bus Stops	17Street & WashingtonAvenue WB	3.85	2.48	2.75	3.43	3.79	3.33	5.36	6.54	0.00	0.00	0.00	0.00	0.00	1.13	2.26	0.00	0.00	0.00	0.00	0.00	1.13	2.31
Bus Stops	CollinsAvenue & 38Street NB	2.02	4.59	4.86	5.66	6.02	5.56	7.59	8.77	0.00	1.00	1.00	1.29	1.00	2.81	4.04	0.84	0.94	1.06	1.38	1.02	2.95	4.16
Bus Stops	CollinsAvenue & 17Street NB	3.93	2.69	2.96	3.73	4.09	3.63	5.66	6.84	0.00	0.00	0.00	0.00	0.00	1.42	2.38	0.50	0.50	0.51	0.55	0.51	1.26	2.46
Bus Stops	IndianCreekDr & 29Street SB	3.71	2.72	2.99	3.63	3.99	3.53	5.56	6.74	0.00	0.00	0.00	0.00	0.00	1.01	2.28	0.00	0.00	0.00	0.00	0.00	1.17	2.40
Bus Stops	WashingtonAvenue & 9Street NB	3.30	3.17	3.44	4.13	4.49	4.03	6.06	7.24	0.00	0.00	0.00	0.00	0.00	1.70	2.88	0.76	0.77	0.79	0.93	0.79	1.76	2.92
Bus Stops	CollinsAvenue & 17Street SB	3.89	2.50	2.77	3.44	3.80	3.34	5.37	6.55	0.00	0.00	0.00	0.00	0.00	0.94	2.15	0.21	0.21	0.22	0.26	0.22	0.97	2.16

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	CollinsAvenue & 22Street NB	3.19	3.24	3.50	4.33	4.69	4.23	6.26	7.44	0.00	0.00	0.00	0.00	0.00	1.83	2.76	0.00	0.00	0.00	0.14	0.00	1.58	2.79
Bus Stops	WashingtonAvenue & 5Street NB	4.18	2.22	2.49	3.33	3.69	3.23	5.26	6.44	0.00	0.00	0.00	0.00	0.00	0.99	1.85	0.00	0.00	0.00	0.00	0.00	0.76	1.94
Bus Stops	AltonRoad & LincolnRoad SB	3.07	3.53	3.80	4.49	4.85	4.39	6.42	7.60	0.00	0.00	0.00	0.37	0.00	1.93	3.11	0.00	0.00	0.00	0.57	0.00	1.92	3.12
Bus Stops	20Street & BayRd EB	4.38	2.39	2.66	3.36	3.72	3.26	5.29	6.47	0.00	0.00	0.00	0.00	0.00	0.62	1.82	0.00	0.00	0.00	0.00	0.00	0.58	1.78
Bus Stops	WashingtonAvenue & 13Street SB	3.78	2.76	3.02	3.84	4.20	3.74	5.77	6.95	0.00	0.00	0.00	0.00	0.00	1.44	2.53	0.60	0.60	0.60	0.60	0.60	1.40	2.59
Bus Stops	WashingtonAvenue & 5Street SB	3.77	2.54	2.81	3.47	3.83	3.37	5.40	6.58	0.00	0.00	0.00	0.00	0.00	0.94	2.17	0.00	0.00	0.00	0.00	0.00	1.02	2.20
Bus Stops	CollinsAvenue & 21Street SB	4.29	2.19	2.46	3.15	3.51	3.05	5.08	6.26	0.00	0.00	0.00	0.00	0.00	0.73	1.91	0.00	0.00	0.00	0.00	0.00	0.71	1.92
Bus Stops	WashingtonAvenue & 9Street SB	3.43	2.93	3.20	3.89	4.25	3.79	5.82	7.00	0.00	0.00	0.00	0.00	0.00	1.49	2.64	0.52	0.53	0.55	0.69	0.55	1.52	2.68
Bus Stops	HardingAvenue & 85Street SB	2.73	4.64	4.91	5.48	5.84	5.38	7.41	8.59	0.00	0.00	0.48	0.84	0.38	2.54	3.59	0.91	0.96	1.14	1.29	1.11	2.45	3.64
Bus Stops	AltonRoad & 8Street SB	1.92	4.46	4.73	5.66	6.02	5.56	7.59	8.77	1.00	1.00	0.93	1.29	0.83	3.27	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	5Street & LenoxAvenue WB	1.87	4.53	4.80	5.49	5.85	5.39	7.42	8.60	0.00	1.00	1.00	1.36	0.90	2.93	4.11	0.83	1.00	1.29	1.66	1.25	2.93	4.11
Bus Stops	HardingAvenue & 81Street SB	2.90	4.13	4.40	5.16	5.52	5.06	7.09	8.27	0.00	0.00	0.00	0.43	0.00	1.93	3.18	0.50	0.55	0.74	0.89	0.71	2.11	3.29
Bus Stops	WashingtonAvenue & 13Street NB	3.65	2.77	3.04	3.71	4.07	3.61	5.64	6.82	0.00	0.00	0.00	0.00	0.00	1.34	2.55	0.54	0.54	0.54	0.54	0.54	1.36	2.55
Bus Stops	CollinsAvenue & 67Street NB	4.26	3.15	3.42	4.23	4.59	4.13	6.16	7.34	0.00	0.00	0.00	0.00	0.00	0.80	2.16	0.00	0.00	0.00	0.00	0.00	1.03	2.20
Bus Stops	CollinsAvenue & 85Street NB	5.46	1.87	2.14	2.98	3.34	2.88	4.91	6.09	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Bus Stops	17Street & PennsylvaniaAvenue EB	3.72	2.50	2.77	3.56	3.92	3.46	5.49	6.67	0.00	0.00	0.00	0.00	0.00	0.98	2.26	0.00	0.00	0.00	0.00	0.00	0.94	2.14
Bus Stops	HardingAvenue & 75Street SB	3.63	3.65	3.91	4.55	4.91	4.45	6.48	7.66	0.00	0.00	0.00	0.00	0.00	1.50	2.64	0.00	0.00	0.12	0.27	0.04	1.50	2.69
Bus Stops	AltonRoad & 6Street NB	2.28	4.31	4.58	5.20	5.56	5.10	7.13	8.31	0.00	0.00	0.77	1.13	0.67	2.48	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	CollinsAvenue & 24Street NB	2.37	4.33	4.60	5.40	5.76	5.30	7.33	8.51	0.00	0.00	0.63	0.99	0.53	2.65	3.76	0.90	0.92	0.93	1.10	0.94	2.52	3.73
Bus Stops	IndianCreekDr & 27Street SB	3.29	3.58	3.85	4.67	5.03	4.57	6.60	7.78	0.00	0.00	0.00	0.00	0.00	1.72	3.06	0.00	0.00	0.00	0.00	0.00	1.75	2.98
Bus Stops	HardingAvenue & 77Street SB	3.62	3.49	3.76	4.53	4.89	4.43	6.46	7.64	0.00	0.00	0.00	0.00	0.00	1.26	2.51	0.00	0.00	0.00	0.23	0.00	1.45	2.63
Bus Stops	41Street & PineTreeDr EB	6.08	0.66	0.93	1.72	2.08	1.62	3.65	4.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
Bus Stops	CollinsAvenue & 31Street NB	2.91	4.92	5.18	5.88	6.24	5.78	7.81	8.99	0.00	0.00	1.00	1.62	1.00	3.19	4.37	1.13	1.23	1.35	1.67	1.31	3.25	4.46

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	CollinsAvenue & 27Street NB	2.13	4.77	5.04	5.73	6.09	5.63	7.66	8.84	0.00	1.00	1.00	1.48	1.00	3.05	4.23	0.99	1.09	1.21	1.53	1.18	3.13	4.36
Bus Stops	41Street & AltonRoad WB	2.27	4.17	4.44	5.03	5.39	4.93	6.96	8.14	0.00	0.00	0.64	1.00	0.54	2.49	3.75	0.38	0.46	0.60	0.86	0.56	2.62	3.81
Bus Stops	AltonRoad & 6Street SB	1.78	4.67	4.94	5.65	6.01	5.55	7.58	8.76	1.00	1.00	1.13	1.49	1.03	3.12	4.24	0.12	0.12	0.11	0.12	0.11	0.08	0.10
Bus Stops	AltonRoad & 19Street NB	2.62	4.08	4.35	5.14	5.50	5.04	7.07	8.25	0.00	0.00	0.60	0.96	0.50	2.69	3.70	0.24	0.34	0.66	1.02	0.58	2.51	3.71
Bus Stops	IndianCreekDr & 65Street SB	4.07	2.98	3.25	3.94	4.30	3.84	5.87	7.05	0.00	0.00	0.00	0.00	0.00	0.85	2.03	0.00	0.00	0.00	0.27	0.00	0.86	2.03
Bus Stops	AltonRoad & 10Street SB	1.91	4.70	4.97	5.66	6.02	5.56	7.59	8.77	1.00	1.00	1.18	1.54	1.08	3.11	4.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	CollinsAvenue & 24Street SB	2.56	3.78	4.04	4.68	5.04	4.58	6.61	7.79	0.00	0.00	0.32	0.68	0.22	2.17	3.43	0.59	0.61	0.62	0.79	0.63	2.22	3.43
Bus Stops	NormandyDr & RueGranville WB	2.72	4.21	4.48	5.12	5.48	5.02	7.05	8.23	0.00	0.00	0.26	0.62	0.00	2.14	3.37	0.00	0.00	0.53	0.78	0.43	2.16	3.36
Bus Stops	WashingtonAvenue & 4Street NB	4.03	2.49	2.76	3.68	4.04	3.58	5.61	6.79	0.00	0.00	0.00	0.00	0.00	1.37	2.07	0.00	0.00	0.00	0.00	0.00	0.99	2.17
Bus Stops	HardingAvenue & 87Street SB	3.47	3.79	4.06	4.62	4.98	4.52	6.55	7.73	0.00	0.00	0.00	0.00	0.00	1.61	2.69	0.00	0.00	0.00	0.36	0.00	1.51	2.70
Bus Stops	Mt.SinaiHospital & MainDoor SB	5.59	0.86	1.13	1.86	2.22	1.76	3.79	4.97	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	CollinsAvenue & 4747 NB	4.85	1.91	2.17	2.87	3.23	2.77	4.80	5.98	0.00	0.00	0.00	0.00	0.00	0.13	1.33	0.00	0.00	0.00	0.00	0.00	0.18	1.44
Bus Stops	IndianCreekDr & 31Street SB	2.64	4.91	5.18	5.78	6.14	5.68	7.71	8.89	0.00	0.00	1.00	1.66	0.00	2.94	4.39	1.19	1.29	1.41	1.73	1.37	3.28	4.49
Bus Stops	NormandyDr & RueVersaillesDr WB	2.85	4.04	4.31	4.95	5.31	4.85	6.88	8.06	0.00	0.00	0.00	0.38	0.00	1.91	3.13	0.00	0.00	0.22	0.47	0.15	1.86	3.06
Bus Stops	CollinsAvenue & 77Street NB	4.14	3.02	3.29	4.06	4.42	3.96	5.99	7.17	0.00	0.00	0.00	0.00	0.00	0.72	2.02	0.00	0.00	0.00	0.00	0.00	0.96	2.14
Bus Stops	71Street & BiarritzDr EB	2.29	4.76	5.03	5.76	6.12	5.66	7.69	8.87	0.00	0.00	0.71	1.07	0.61	2.66	3.82	0.71	0.64	1.06	1.30	0.96	2.67	3.87
Bus Stops	AltonRoad & 15Street SB	2.25	4.15	4.41	5.09	5.45	4.99	7.02	8.20	0.00	0.00	0.59	0.95	0.49	2.47	3.70	0.15	0.17	0.64	1.10	0.54	2.47	3.66
Bus Stops	IndianCreekDr & 63Street SB	3.67	3.17	3.44	4.03	4.39	3.93	5.96	7.14	0.00	0.00	0.00	0.00	0.00	1.24	2.32	0.55	0.56	0.60	0.62	0.59	1.09	2.27
Bus Stops	23Street & LibertyAvenue EB	4.19	2.31	2.58	3.21	3.57	3.11	5.14	6.32	0.00	0.00	0.00	0.00	0.00	0.67	1.79	0.00	0.00	0.00	0.00	0.00	0.66	1.87
Bus Stops	41Street & AltonRoad EB	2.10	4.64	4.91	5.60	5.96	5.50	7.53	8.71	0.00	0.00	1.10	1.46	1.00	3.04	4.21	0.82	0.90	1.04	1.30	1.00	3.06	4.25
Bus Stops	WashingtonAvenue & 15Street SB	3.15	3.52	3.79	4.56	4.92	4.46	6.49	7.67	0.00	0.00	0.00	0.65	0.00	2.12	3.30	1.19	1.19	1.19	1.21	1.19	2.14	3.33
Bus Stops	41Street & PrairieAvenue EB	3.35	3.26	3.53	4.29	4.65	4.19	6.22	7.40	0.00	0.00	0.00	0.00	0.00	1.57	2.80	0.00	0.00	0.00	0.30	0.00	1.59	2.76
Bus Stops	AltonRoad & 8Street NB	1.62	4.78	5.05	5.77	6.13	5.67	7.70	8.88	1.00	1.00	1.27	1.63	1.17	3.32	4.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	WashingtonAvenue & 8Street NB	3.57	2.92	3.18	3.79	4.15	3.69	5.72	6.90	0.00	0.00	0.00	0.00	0.00	1.25	2.60	0.44	0.45	0.47	0.61	0.47	1.44	2.60
Bus Stops	SheridanAvenue & 41Street SB	2.19	4.32	4.59	5.22	5.58	5.12	7.15	8.33	0.00	0.00	0.73	1.09	0.63	2.51	3.84	0.95	0.93	1.24	1.40	1.21	2.68	3.84
Bus Stops	71Street & RueNotreDame EB	2.21	5.05	5.32	6.01	6.37	5.91	7.94	9.12	0.00	1.00	1.04	1.40	0.94	2.97	4.15	1.08	1.09	1.33	1.57	1.26	2.94	4.14
Bus Stops	AltonRoad & 2Street SB	4.07	3.15	3.42	4.07	4.43	3.97	6.00	7.18	0.00	0.00	0.00	0.00	0.00	1.35	2.59	0.00	0.00	0.00	0.20	0.00	1.36	2.54
Bus Stops	WashingtonAvenue & 2Street NB	3.01	3.68	3.95	4.85	5.21	4.75	6.78	7.96	0.00	0.00	0.00	0.45	0.00	2.33	3.18	0.73	0.76	0.90	0.99	0.90	2.09	3.26
Bus Stops	CollinsAvenue & 76Street NB	4.94	1.99	2.26	2.93	3.29	2.83	4.86	6.04	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	1.04
Bus Stops	71Street & RueVersaillesDr EB	2.79	4.34	4.61	5.30	5.66	5.20	7.23	8.41	0.00	0.00	0.29	0.65	0.19	2.24	3.40	0.24	0.25	0.55	0.80	0.48	2.19	3.39
Bus Stops	71Street & ByronAvenue WB	2.46	4.65	4.92	5.64	6.00	5.54	7.57	8.75	0.00	0.00	0.56	0.92	0.46	2.51	3.67	0.82	0.87	0.99	1.17	0.98	2.55	3.74
Bus Stops	73Street & ByronAvenue EB	2.60	4.80	5.07	5.76	6.12	5.66	7.69	8.87	0.00	0.00	0.68	1.04	0.58	2.53	3.79	0.98	1.05	1.26	1.43	1.23	2.67	3.85
Bus Stops	CollinsAvenue & 63Street NB	4.91	2.17	2.44	3.15	3.51	3.05	5.08	6.26	0.00	0.00	0.00	0.00	0.00	0.18	1.32	0.00	0.00	0.00	0.00	0.00	0.16	1.32
Bus Stops	41Street & SheridanAvenue WB	5.21	1.88	2.15	2.84	3.20	2.74	4.77	5.95	0.00	0.00	0.00	0.00	0.00	0.26	1.40	0.00	0.00	0.00	0.00	0.00	0.30	1.47
Bus Stops	AbbottAvenue & IndianCreekDr SB	3.61	3.65	3.91	4.58	4.94	4.48	6.51	7.69	0.00	0.00	0.00	0.00	0.00	1.51	2.64	0.00	0.00	0.00	0.12	0.00	1.46	2.64
Bus Stops	CollinsAvenue & 4700BLK SB	2.45	4.46	4.73	5.45	5.81	5.35	7.38	8.56	0.00	0.11	0.79	1.13	0.69	2.69	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	WashingtonAvenue & 12Street SB	4.38	1.86	2.13	2.74	3.10	2.64	4.67	5.85	0.00	0.00	0.00	0.00	0.00	0.33	1.58	0.00	0.00	0.00	0.00	0.00	0.41	1.60
Bus Stops	AltonRoad & 41Street NB	2.24	4.39	4.66	5.54	5.90	5.44	7.47	8.65	0.00	0.00	0.86	1.22	0.76	2.83	3.97	0.65	0.73	0.87	1.13	0.83	2.89	4.08
Bus Stops	17Street & ConventionCenterDr WB	2.74	3.66	3.93	4.60	4.96	4.50	6.53	7.71	0.00	0.00	0.00	0.68	0.00	2.26	3.43	0.51	0.50	0.65	0.93	0.60	2.29	3.47
Bus Stops	CollinsAvenue & 81Street NB	4.44	2.41	2.67	3.35	3.71	3.25	5.28	6.46	0.00	0.00	0.00	0.00	0.00	0.27	1.43	0.00	0.00	0.00	0.00	0.00	0.31	1.49
Bus Stops	5Street & LenoxAvenue EB	2.80	3.87	4.14	4.82	5.18	4.72	6.75	7.93	0.00	0.00	0.00	0.69	0.00	2.16	3.44	0.00	0.00	0.47	0.84	0.43	2.11	3.29
Bus Stops	71Street & DickensAvenue WB	2.31	4.73	5.00	5.73	6.09	5.63	7.66	8.84	0.00	0.00	0.64	1.00	0.54	2.61	3.75	0.88	0.94	1.06	1.24	1.05	2.62	3.81
Bus Stops	CollinsAvenue & 23Street SB	2.16	4.46	4.73	5.46	5.82	5.36	7.39	8.57	0.00	0.00	0.73	1.09	0.63	2.75	3.84	1.02	1.04	1.05	1.22	1.06	2.65	3.86
Bus Stops	71Street & BonitaDr WB	2.40	4.59	4.86	5.57	5.93	5.47	7.50	8.68	0.00	0.00	0.51	0.87	0.41	2.46	3.62	0.65	0.71	0.84	1.03	0.83	2.43	3.62

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	AltonRoad & 14Street SB	1.58	4.76	5.03	5.71	6.07	5.61	7.64	8.82	1.00	1.00	1.19	1.55	1.09	3.08	4.30	0.84	0.89	1.30	1.76	1.21	3.11	4.30
Bus Stops	17Street & MeridianAvenue WB	2.25	3.93	4.20	4.86	5.22	4.76	6.79	7.97	0.00	0.00	0.58	0.94	0.48	2.54	3.69	0.67	0.67	0.82	1.18	0.77	2.59	3.79
Bus Stops	41Street & SheridanAvenue EB	3.87	2.95	3.22	3.95	4.31	3.85	5.88	7.06	0.00	0.00	0.00	0.00	0.00	1.29	2.46	0.00	0.00	0.00	0.04	0.00	1.32	2.48
Bus Stops	CollinsAvenue & 5000BLK SB	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	Mt.SinaiHospital & GumenickBldg WB	6.04	0.57	0.84	1.48	1.84	1.38	3.41	4.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	20Street & LibertyAvenue WB	3.82	2.81	3.08	3.77	4.13	3.67	5.70	6.88	0.00	0.00	0.00	0.00	0.00	1.21	2.39	0.00	0.00	0.00	0.00	0.00	1.18	2.37
Bus Stops	AltonRoad & 10Street NB	1.63	5.10	5.37	6.06	6.42	5.96	7.99	9.17	1.00	1.00	1.59	1.95	1.49	3.39	4.70	1.23	1.33	1.66	2.14	1.58	3.46	4.65
Bus Stops	AltonRoad & 15Street NB	2.24	4.26	4.53	5.28	5.64	5.18	7.21	8.39	0.00	0.00	0.71	1.07	0.61	2.71	3.82	0.71	0.71	0.83	1.28	0.77	2.63	3.82
Bus Stops	SPointeDr & WashingtonAvenue EB	2.23	4.53	4.80	5.52	5.88	5.42	7.45	8.63	0.00	0.00	1.00	1.26	1.00	2.89	4.01	1.28	1.36	1.71	1.78	1.70	2.88	4.05
Bus Stops	AltonRoad & 13Street SB	2.12	4.36	4.63	5.34	5.70	5.24	7.27	8.45	0.00	1.00	0.80	1.16	0.70	2.75	3.91	0.46	0.51	0.92	1.39	0.83	2.74	3.93
Bus Stops	WashingtonAvenue & SPointeDr SB	2.41	4.13	4.39	5.00	5.36	4.90	6.93	8.11	0.00	0.00	1.00	0.87	1.00	2.30	3.62	0.84	0.92	1.27	1.34	1.26	2.44	3.61
Bus Stops	NormandyDr & WBayDrive WB	3.87	3.16	3.43	4.15	4.51	4.05	6.08	7.26	0.00	0.00	0.00	0.00	0.00	1.22	2.32	0.00	0.00	0.00	0.00	0.00	1.06	2.26
Bus Stops	CollinsAvenue & 4441 NB	4.89	1.92	2.19	2.96	3.32	2.86	4.89	6.07	0.00	0.00	0.00	0.00	0.00	0.10	1.37	0.00	0.00	0.00	0.00	0.00	0.30	1.53
Bus Stops	WashingtonAvenue & 11Street NB	3.90	2.70	2.97	3.62	3.98	3.52	5.55	6.73	0.00	0.00	0.00	0.00	0.00	1.19	2.41	0.27	0.27	0.27	0.29	0.27	1.21	2.40
Bus Stops	AltonRoad & 16Street NB	2.30	4.20	4.47	5.09	5.45	4.99	7.02	8.20	0.00	0.00	0.66	1.02	0.56	2.45	3.77	0.65	0.66	0.77	1.21	0.71	2.57	3.76
Bus Stops	AltonRoad & 4Street SB	2.66	3.90	4.17	4.92	5.28	4.82	6.85	8.03	0.00	0.00	0.32	0.68	0.23	2.36	3.42	0.19	0.37	0.66	1.02	0.62	2.29	3.47
Bus Stops	CollinsAvenue & 5660 SB	4.04	2.79	3.05	3.78	4.14	3.68	5.71	6.89	0.00	0.00	0.00	0.00	0.00	0.82	2.03	0.00	0.00	0.00	0.00	0.00	1.00	2.47
Bus Stops	WashingtonAvenue & 7Street NB	3.56	2.81	3.08	3.82	4.18	3.72	5.75	6.93	0.00	0.00	0.00	0.00	0.00	1.36	2.46	0.00	0.00	0.00	0.00	0.00	1.32	2.50
Bus Stops	18Street & PurdyAvenue WB	2.68	4.97	5.24	5.89	6.25	5.79	7.82	9.00	0.00	0.00	1.00	1.00	1.00	3.06	4.45	0.26	0.32	1.31	1.70	1.23	3.15	4.35
Bus Stops	CollinsAvenue & 18Street NB	4.29	2.11	2.38	3.07	3.43	2.97	5.00	6.18	0.00	0.00	0.00	0.00	0.00	0.38	1.63	0.00	0.00	0.00	0.00	0.00	0.44	1.63
Bus Stops	CollinsAvenue & 5500BLK SB	4.40	2.78	3.04	3.73	4.09	3.63	5.66	6.84	0.00	0.00	0.00	0.00	0.00	0.85	2.03	0.00	0.00	0.00	0.00	0.00	0.98	2.45

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	CollinsAvenue & 18Street SB	3.97	2.64	2.91	3.60	3.96	3.50	5.53	6.71	0.00	0.00	0.00	0.00	0.00	0.99	2.17	0.00	0.00	0.00	0.00	0.00	0.99	2.18
Bus Stops	HardingAvenue & 83Street SB	2.90	4.19	4.46	5.22	5.58	5.12	7.15	8.33	0.00	0.00	0.09	0.45	0.00	1.95	3.20	0.56	0.61	0.78	0.93	0.75	2.13	3.31
Bus Stops	WashingtonAvenue & 7Street SB	3.91	2.65	2.92	3.70	4.06	3.60	5.63	6.81	0.00	0.00	0.00	0.00	0.00	1.23	2.30	0.00	0.00	0.00	0.00	0.00	1.18	2.36
Bus Stops	17Street & LenoxAvenue EB	1.92	4.55	4.81	5.53	5.89	5.43	7.46	8.64	0.00	1.00	1.11	1.47	1.01	3.01	4.22	0.90	0.96	1.16	1.55	1.10	3.00	4.19
Bus Stops	CollinsAvenue & 65Street NB	5.45	1.45	1.71	2.40	2.76	2.30	4.33	5.51	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.49
Bus Stops	CollinsAvenue & 23Street NB	2.83	4.24	4.51	5.22	5.58	5.12	7.15	8.33	0.00	0.00	0.37	0.88	0.00	2.46	3.62	0.81	0.83	0.84	1.01	0.85	2.44	3.65
Bus Stops	17Street & MeridianAvenue EB	2.42	3.92	4.19	4.96	5.32	4.86	6.89	8.07	0.00	0.00	0.57	0.93	0.47	2.53	3.68	0.51	0.51	0.66	1.02	0.61	2.43	3.63
Bus Stops	CollinsAvenue & 5333 SB	2.53	4.14	4.41	5.06	5.42	4.96	6.99	8.17	0.00	0.00	0.36	0.72	0.26	2.38	3.47	0.36	0.38	0.41	0.75	0.38	2.46	3.73
Bus Stops	CollinsAvenue & 4900BLK SB	2.77	4.14	4.41	5.09	5.45	4.99	7.02	8.20	0.00	0.00	0.43	0.79	0.33	2.36	3.54	0.61	0.61	0.60	0.85	0.60	2.43	3.64
Bus Stops	CollinsAvenue & 29Street NB	1.82	5.01	5.28	6.03	6.39	5.93	7.96	9.14	0.00	1.00	1.00	1.72	1.00	3.34	4.47	1.25	1.35	1.47	1.79	1.44	3.39	4.62
Bus Stops	CollinsAvenue & 5200BLK SB	2.29	4.29	4.56	5.19	5.55	5.09	7.12	8.30	0.00	0.00	0.52	0.88	0.42	2.50	3.63	0.67	0.67	0.66	0.91	0.66	2.49	3.70
Bus Stops	AltonRoad & 4Street NB	2.37	4.16	4.43	5.06	5.42	4.96	6.99	8.17	0.00	0.00	0.57	0.93	0.47	2.39	3.68	0.37	0.54	0.83	1.20	0.79	2.47	3.65
Bus Stops	CollinsAvenue & 20Street NB	4.74	1.89	2.16	3.03	3.39	2.93	4.96	6.14	0.00	0.00	0.00	0.00	0.00	0.42	1.44	0.00	0.00	0.00	0.00	0.00	0.12	1.39
Bus Stops	WashingtonAvenue & 1Street NB	2.64	4.25	4.52	5.21	5.57	5.11	7.14	8.32	0.00	0.00	0.00	1.00	0.00	2.57	3.75	1.09	1.14	1.37	1.47	1.36	2.58	3.75
Bus Stops	41Street & PrairieAvenue WB	3.22	3.44	3.71	4.37	4.73	4.27	6.30	7.48	0.00	0.00	0.00	0.24	0.00	1.82	2.97	0.00	0.00	0.32	0.56	0.27	1.85	3.02
Bus Stops	CollinsAvenue & 41Street NB	1.83	5.05	5.32	6.00	6.36	5.90	7.93	9.11	0.00	1.00	1.00	1.75	1.00	3.29	4.50	1.28	1.35	1.47	1.80	1.44	3.34	4.56
Bus Stops	CollinsAvenue & 5445 NB	4.18	2.66	2.93	3.71	4.07	3.61	5.64	6.82	0.00	0.00	0.00	0.00	0.00	0.59	1.93	0.00	0.00	0.00	0.00	0.00	0.99	2.26
Bus Stops	CollinsAvenue & 5601 NB	3.52	3.41	3.68	4.34	4.70	4.24	6.27	7.45	0.00	0.00	0.00	0.00	0.00	1.51	2.65	0.44	0.45	0.47	0.48	0.47	1.60	3.07
Bus Stops	IndianCreekDr & 44Street SB	2.93	3.83	4.09	4.78	5.14	4.68	6.71	7.89	0.00	0.00	0.00	0.53	0.00	2.10	3.28	0.00	0.00	0.25	0.58	0.22	2.14	3.35
Bus Stops	CollinsAvenue & 87Street NB	5.95	1.49	1.76	2.45	2.81	2.35	4.38	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.45
Bus Stops	CollinsAvenue & 26Street NB	2.67	4.39	4.66	5.35	5.71	5.25	7.28	8.46	0.00	0.00	1.00	1.18	1.00	2.75	3.93	0.69	0.79	0.91	1.23	0.88	2.83	4.06
Bus Stops	71Street & BayDr EB	5.09	1.90	2.16	2.89	3.25	2.79	4.82	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.98
Bus Stops	AltonRoad & 14Street NB	1.51	4.88	5.15	5.87	6.23	5.77	7.80	8.98	1.00	1.00	1.33	1.69	1.23	3.40	4.44	1.36	1.36	1.48	1.94	1.42	3.28	4.47

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	AltonRoad & 39Street SB	2.16	4.25	4.52	5.29	5.65	5.19	7.22	8.40	0.00	0.00	0.63	0.99	0.53	2.56	3.74	0.38	0.48	0.69	0.88	0.65	2.59	3.78
Bus Stops	HawthorneAvenue & StillwaterDr SB	2.56	4.48	4.75	5.42	5.78	5.32	7.35	8.53	0.00	0.00	0.38	0.74	0.28	2.23	3.49	0.26	0.28	0.38	0.56	0.34	2.27	3.46
Bus Stops	17Street & MeridianAvenue WB	2.38	4.11	4.38	5.04	5.40	4.94	6.97	8.15	0.00	0.00	0.76	1.12	0.66	2.68	3.87	0.77	0.77	0.92	1.28	0.87	2.69	3.89
Bus Stops	71Street & IndianCreekDr EB	2.20	5.22	5.49	6.13	6.49	6.03	8.06	9.24	0.00	0.00	1.13	1.49	1.03	2.98	4.24	1.25	1.30	1.42	1.60	1.41	2.98	4.17
Bus Stops	CollinsAvenue & 4500BLK SB	2.40	4.36	4.63	5.32	5.68	5.22	7.25	8.43	0.00	0.00	0.69	1.05	0.59	2.62	3.80	1.24	1.26	1.30	1.30	1.29	2.69	3.93
Bus Stops	NormandyDr & RueNotreDame WB	2.06	5.04	5.31	5.97	6.33	5.87	7.90	9.08	0.00	0.00	1.08	1.44	0.98	2.97	4.19	1.03	1.03	1.34	1.59	1.26	2.98	4.18
Bus Stops	WashingtonAvenue & 14Street SB	4.31	2.03	2.30	2.99	3.35	2.89	4.92	6.10	0.00	0.00	0.00	0.00	0.00	0.59	1.81	0.00	0.00	0.00	0.00	0.00	0.60	1.78
Bus Stops	AltonRoad & 11Street NB	1.99	4.37	4.64	5.48	5.84	5.38	7.41	8.59	0.00	1.00	0.84	1.20	0.74	2.98	3.95	0.78	0.80	1.00	1.48	0.94	2.80	3.99
Bus Stops	WashingtonAvenue & 20Street NB	2.82	3.93	4.20	4.89	5.25	4.79	6.82	8.00	0.00	0.00	1.00	1.00	0.00	2.49	3.67	0.00	0.00	0.59	0.97	0.50	2.46	3.75
Bus Stops	CollinsAvenue & 5875 NB	3.63	3.42	3.69	4.52	4.88	4.42	6.45	7.63	0.00	0.00	0.00	0.00	0.00	1.39	2.60	0.99	1.00	1.03	1.05	1.03	1.51	2.91
Bus Stops	85Street & HawthorneAvenue WB	2.57	4.44	4.71	5.41	5.77	5.31	7.34	8.52	0.00	0.00	0.34	0.70	0.25	2.29	3.45	0.21	0.22	0.32	0.51	0.28	2.22	3.41
Bus Stops	WashingtonAvenue & 14Street NB	4.00	2.52	2.78	3.47	3.83	3.37	5.40	6.58	0.00	0.00	0.00	0.00	0.00	1.11	2.29	0.18	0.18	0.18	0.20	0.18	1.13	2.32
Bus Stops	CollinsAvenue & 44Street NB	4.59	2.25	2.52	3.20	3.56	3.10	5.13	6.31	0.00	0.00	0.00	0.00	0.00	0.00	1.66	0.00	0.00	0.00	0.00	0.00	0.55	1.78
Bus Stops	AltonRoad & 13Street NB	2.43	4.05	4.31	5.02	5.38	4.92	6.95	8.13	0.00	0.00	0.50	0.86	0.40	2.44	3.61	0.51	0.51	0.62	1.08	0.57	2.42	3.61
Bus Stops	11Street & LenoxAvenue WB	2.32	4.03	4.30	5.00	5.36	4.90	6.93	8.11	0.00	0.00	0.53	0.89	0.43	2.53	3.64	0.48	0.50	0.70	1.18	0.64	2.50	3.69
Bus Stops	PurdyAvenue & 18Street NB	2.44	4.78	5.05	5.57	5.93	5.47	7.50	8.68	0.00	0.00	1.00	1.00	1.00	2.94	4.27	0.17	0.23	1.15	1.54	1.07	3.13	4.33
Bus Stops	WashingtonAvenue & 19Street SB	3.54	2.79	3.06	3.79	4.15	3.69	5.72	6.90	0.00	0.00	0.00	0.00	0.00	1.43	2.57	0.00	0.00	0.00	0.00	0.00	1.40	2.69
Bus Stops	WashingtonAvenue & 18Street SB	4.31	2.07	2.34	3.14	3.50	3.04	5.07	6.25	0.00	0.00	0.00	0.00	0.00	0.88	1.85	0.00	0.00	0.00	0.00	0.00	0.71	1.90
Bus Stops	CollinsAvenue & 4925 NB	3.93	2.74	3.01	3.68	4.04	3.58	5.61	6.79	0.00	0.00	0.00	0.00	0.00	0.98	2.13	0.00	0.00	0.00	0.00	0.00	1.01	2.22
Bus Stops	71Street & RueGranville EB	2.89	3.98	4.25	4.92	5.28	4.82	6.85	8.03	0.00	0.00	0.00	0.29	0.00	1.84	3.04	0.00	0.01	0.20	0.44	0.12	1.81	3.01
Bus Stops	MeridianAvenue & LincolnRoad NB	2.77	3.60	3.87	4.57	4.93	4.47	6.50	7.68	0.00	0.00	0.28	0.61	0.00	2.16	3.36	0.37	0.37	0.46	0.83	0.41	2.19	3.38
Bus Stops	65Street & CollinsAvenue EB	5.41	2.72	2.99	3.62	3.98	3.52	5.55	6.73	0.00	0.00	0.00	0.00	0.00	0.56	1.78	0.00	0.00	0.00	0.00	0.00	0.55	1.72

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	WashingtonAvenue & 8Street SB	4.09	2.43	2.70	3.27	3.63	3.17	5.20	6.38	0.00	0.00	0.00	0.00	0.00	0.70	2.11	0.00	0.00	0.00	0.00	0.00	0.98	2.16
Bus Stops	WashingtonAvenue & 15Street NB	3.28	3.27	3.54	4.33	4.69	4.23	6.26	7.44	0.00	0.00	0.00	0.00	0.00	2.05	3.05	0.98	0.98	0.98	1.00	0.98	1.93	3.12
Bus Stops	17Street & LenoxAvenue WB	2.05	4.38	4.65	5.33	5.69	5.23	7.26	8.44	0.00	1.00	1.01	1.39	0.93	3.02	4.14	0.91	0.97	1.16	1.55	1.10	3.00	4.19
Bus Stops	77Street & TatumWaterwayDr EB	2.34	4.95	5.21	5.90	6.26	5.80	7.83	9.01	0.00	0.00	0.96	1.32	0.86	2.87	4.07	1.35	1.41	1.59	1.74	1.56	2.97	4.15
Bus Stops	CollinsAvenue & 6365 NB	5.59	1.52	1.78	2.48	2.84	2.38	4.41	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.61
Bus Stops	CollinsAvenue & 5101 NB	3.47	3.52	3.79	4.61	4.97	4.51	6.54	7.72	0.00	0.00	0.00	0.00	0.00	1.62	2.89	0.00	0.00	0.00	0.00	0.00	1.87	3.08
Bus Stops	CollinsAvenue & 79Street NB	4.13	2.84	3.11	3.84	4.20	3.74	5.77	6.95	0.00	0.00	0.00	0.00	0.00	0.70	1.90	0.00	0.00	0.00	0.00	0.00	0.82	2.00
Bus Stops	CollinsAvenue & 5750 SB	4.34	2.69	2.96	3.68	4.04	3.58	5.61	6.79	0.00	0.00	0.00	0.00	0.00	0.76	1.90	0.00	0.00	0.00	0.00	0.00	0.86	2.33
Bus Stops	HawthorneAvenue & 81Street SB	3.23	3.72	3.99	4.75	5.11	4.65	6.68	7.86	0.00	0.00	0.00	0.00	0.00	1.74	2.73	0.00	0.00	0.00	0.00	0.00	1.54	2.68
Bus Stops	41Street & PineTreeDr WB	2.49	3.84	4.11	4.81	5.17	4.71	6.74	7.92	0.00	0.00	0.25	0.62	0.18	2.31	3.37	0.67	0.65	0.97	1.13	0.94	2.41	3.57
Bus Stops	CollinsAvenue & 5005 NB	4.08	3.37	3.64	4.38	4.74	4.28	6.31	7.49	0.00	0.00	0.00	0.00	0.00	1.52	2.75	0.00	0.00	0.00	0.00	0.00	1.67	2.87
Bus Stops	IndianCreekDr & 37Street SB	3.25	3.71	3.97	4.95	5.31	4.85	6.88	8.06	0.00	0.00	0.00	0.00	0.00	2.90	3.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	WashingtonAvenue & 1Street SB	2.43	4.29	4.56	5.25	5.61	5.15	7.18	8.36	0.00	0.00	1.00	1.03	1.00	2.60	3.78	1.12	1.17	1.40	1.50	1.39	2.61	3.78
Bus Stops	CollinsAvenue & 35Street NB	2.15	4.71	4.98	5.72	6.08	5.62	7.65	8.83	1.00	1.00	1.00	1.42	1.00	2.96	4.17	0.95	1.05	1.17	1.48	1.13	3.05	4.26
Bus Stops	71Street & TrouvilleEsplanade EB	2.77	4.41	4.68	5.30	5.66	5.20	7.23	8.41	0.00	0.00	0.36	0.72	0.26	2.36	3.47	0.25	0.22	0.57	0.81	0.48	2.19	3.39
Bus Stops	NormandyDr & TrouvilleEsplanade WB	2.73	4.14	4.41	5.08	5.44	4.98	7.01	8.19	0.00	0.00	0.20	0.55	0.00	2.13	3.30	0.16	0.07	0.48	0.72	0.39	2.10	3.30
Bus Stops	85Street & CrespiBlvd WB	1.95	5.33	5.60	6.29	6.65	6.19	8.22	9.40	0.00	0.54	1.21	1.57	1.12	3.19	4.32	1.21	1.23	1.34	1.54	1.30	3.26	4.45
Bus Stops	AltonRoad & 2Street NB	3.01	3.40	3.67	4.42	4.78	4.32	6.35	7.53	0.00	0.00	0.00	0.11	0.00	1.77	2.86	0.30	0.31	0.38	0.50	0.37	1.68	2.86
Bus Stops	CollinsAvenue & 5400 SB	3.13	3.75	4.02	4.76	5.12	4.66	6.69	7.87	0.00	0.00	0.00	0.35	0.00	1.88	3.05	0.00	0.00	0.00	0.41	0.00	2.12	3.39
Bus Stops	19Street & AltonRoad EB	2.21	3.88	4.15	4.85	5.21	4.75	6.78	7.96	0.00	0.00	0.53	0.89	0.43	2.47	3.64	0.18	0.28	0.60	0.97	0.52	2.46	3.66
Bus Stops	MacArthurCswy & BridgeRoad WB	3.40	2.51	2.78	3.65	4.01	3.55	5.58	6.76	0.00	0.00	0.00	0.00	0.00	0.68	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	PineTreeDrive & 41Street NB	5.45	1.16	1.43	2.05	2.41	1.95	3.98	5.16	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.87

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	WashingtonAvenue & 16Street NB	4.36	1.86	2.13	2.83	3.19	2.73	4.76	5.94	0.00	0.00	0.00	0.00	0.00	0.47	1.64	0.00	0.00	0.00	0.00	0.00	0.48	1.66
Bus Stops	CollinsAvenue & 4833 NB	4.81	2.04	2.31	2.91	3.27	2.81	4.84	6.02	0.00	0.00	0.00	0.00	0.00	0.27	1.45	0.00	0.00	0.00	0.00	0.00	0.26	1.51
Bus Stops	CollinsAvenue & 5313 NB	3.36	3.30	3.57	4.32	4.68	4.22	6.25	7.43	0.00	0.00	0.00	0.00	0.00	1.41	2.63	0.00	0.00	0.00	0.00	0.00	1.67	2.94
Bus Stops	17Street & MichiganAvenue WB	2.52	3.93	4.20	4.84	5.20	4.74	6.77	7.95	0.00	0.00	0.61	0.94	0.51	2.61	3.69	0.52	0.58	0.79	1.16	0.73	2.61	3.80
Bus Stops	NormandyDr & BayRd WB	2.12	5.23	5.49	6.15	6.51	6.05	8.08	9.26	0.00	0.00	1.18	1.54	1.08	3.08	4.29	1.14	1.15	1.45	1.70	1.38	3.09	4.29
Bus Stops	MeridianAvenue & 19Street NB	2.51	3.71	3.98	4.74	5.10	4.64	6.67	7.85	0.00	0.00	0.36	0.72	0.26	2.45	3.47	0.31	0.31	0.49	0.85	0.44	2.31	3.50
Bus Stops	41Street & MeridianAvenue WB	4.62	2.23	2.50	2.97	3.33	2.87	4.90	6.08	0.00	0.00	0.00	0.00	0.00	0.71	1.78	0.00	0.00	0.00	0.00	0.00	0.74	1.92
Bus Stops	41Street & MeridianAvenue EB	4.75	1.82	2.09	3.04	3.40	2.94	4.97	6.15	0.00	0.00	0.00	0.00	0.00	0.00	1.37	0.00	0.00	0.00	0.00	0.00	0.00	1.33
Bus Stops	CollinsAvenue & 83Street NB	5.28	1.95	2.22	3.00	3.36	2.90	4.93	6.11	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	1.06
Bus Stops	DickensAvenue & 75Street SB	3.63	3.34	3.61	4.38	4.74	4.28	6.31	7.49	0.00	0.00	0.00	0.00	0.00	1.62	2.40	0.00	0.00	0.00	0.00	0.00	1.28	2.47
Bus Stops	71Street & RueBordeauxDr EB	3.05	3.76	4.03	4.72	5.08	4.62	6.65	7.83	0.00	0.00	0.00	0.17	0.00	1.77	2.92	0.00	0.00	0.00	0.31	0.00	1.69	2.89
Bus Stops	WashingtonAvenue & 4Street SB	3.74	2.96	3.22	3.86	4.22	3.76	5.79	6.97	0.00	0.00	0.00	0.00	0.00	1.11	2.54	0.00	0.00	0.00	0.00	0.00	1.39	2.57
Bus Stops	77Street & HawthorneAvenue EB	3.30	3.43	3.69	4.35	4.71	4.25	6.28	7.46	0.00	0.00	0.00	0.00	0.00	1.34	2.55	0.00	0.00	0.00	0.24	0.00	1.47	2.65
Bus Stops	CollinsAvenue & 4525 NB	4.16	2.67	2.94	3.61	3.97	3.51	5.54	6.72	0.00	0.00	0.00	0.00	0.00	0.92	2.11	0.00	0.00	0.00	0.00	0.00	0.97	2.21
Bus Stops	CollinsAvenue & 5555 NB	4.31	2.63	2.90	3.93	4.29	3.83	5.86	7.04	0.00	0.00	0.00	0.00	0.00	0.00	1.87	0.00	0.00	0.00	0.00	0.00	1.01	2.48
Bus Stops	CollinsAvenue & 5775 NB	3.87	2.91	3.18	3.84	4.20	3.74	5.77	6.95	0.00	0.00	0.00	0.00	0.00	0.97	2.12	0.00	0.00	0.00	0.00	0.00	1.06	2.53
Bus Stops	6Street & LenoxAvenue EB	2.28	4.25	4.52	5.21	5.57	5.11	7.14	8.32	0.00	0.00	0.72	1.08	0.62	2.61	3.83	0.53	0.66	0.92	1.29	0.89	2.56	3.75
Bus Stops	WashingtonAvenue & LincolnRoad NB	4.32	2.09	2.36	3.10	3.46	3.00	5.03	6.21	0.00	0.00	0.00	0.00	0.00	0.75	1.87	0.00	0.00	0.00	0.00	0.00	0.74	1.93
Bus Stops	HardingAvenue & 79Street SB	3.57	3.36	3.62	4.38	4.74	4.28	6.31	7.49	0.00	0.00	0.00	0.00	0.00	1.19	2.43	0.00	0.00	0.00	0.00	0.00	1.36	2.54
Bus Stops	IndianCreekDr & 33Street SB	-0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	WashingtonAvenue & 2Street SB	2.79	3.88	4.15	4.83	5.19	4.73	6.76	7.94	0.00	0.00	0.00	0.62	0.00	2.21	3.37	0.75	0.80	1.03	1.13	1.02	2.24	3.41

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	5Street & MeridianAvenue WB	2.37	4.18	4.45	5.15	5.51	5.05	7.08	8.26	0.00	0.00	0.67	1.03	0.57	2.59	3.78	0.88	0.93	1.07	1.33	1.05	2.56	3.75
Bus Stops	16Street & MichiganAvenue WB	1.97	4.61	4.88	5.58	5.94	5.48	7.51	8.69	0.00	1.00	1.10	1.46	1.00	3.07	4.21	1.10	1.11	1.22	1.66	1.16	3.02	4.21
Bus Stops	WestAvenue & 20Street SB	3.38	3.22	3.49	4.18	4.54	4.08	6.11	7.29	0.00	0.00	0.00	0.00	0.00	1.53	2.71	0.00	0.00	0.00	0.00	0.00	1.50	2.70
Bus Stops	WashingtonAvenue & 17Street NB	4.07	2.10	2.37	3.00	3.36	2.90	4.93	6.11	0.00	0.00	0.00	0.00	0.00	0.59	1.88	0.00	0.00	0.00	0.00	0.00	0.69	1.88
Bus Stops	CollinsAvenue & 5225 NB	3.86	3.10	3.37	4.26	4.62	4.16	6.19	7.37	0.00	0.00	0.00	0.00	0.00	1.10	2.45	0.00	0.00	0.00	0.00	0.00	1.43	2.64
Bus Stops	CollinsAvenue & 33Street NB	2.83	4.38	4.65	5.45	5.81	5.35	7.38	8.56	0.00	0.00	1.00	1.05	1.00	2.49	3.84	0.58	0.69	0.81	1.09	0.77	2.67	3.88
Bus Stops	MacArthurCswy & FountainStreet WB	3.07	4.45	4.71	6.73	7.09	6.63	8.66	9.84	0.00	0.00	0.00	0.00	0.00	2.72	3.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	IndianCreekDr & 35Street SB	2.24	5.76	6.03	6.70	7.06	6.60	8.63	9.81	0.00	0.00	0.00	0.00	0.00	4.04	5.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	WashingtonAvenue & 18Street NB	5.04	1.15	1.42	2.08	2.44	1.98	4.01	5.19	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.93
Bus Stops	CollinsAvenue & 5800 SB	3.79	3.16	3.43	3.92	4.28	3.82	5.85	7.03	0.00	0.00	0.00	0.00	0.00	1.32	2.35	0.52	0.53	0.56	0.58	0.56	1.04	2.44
Bus Stops	5Street & MichiganAvenue WB	2.18	4.33	4.60	5.30	5.66	5.20	7.23	8.41	0.00	0.00	0.82	1.18	0.72	2.85	3.93	1.22	1.27	1.41	1.67	1.39	2.90	4.09
Bus Stops	11Street & JeffersonAvenue WB	3.27	3.50	3.77	4.63	4.99	4.53	6.56	7.74	0.00	0.00	0.00	0.00	0.00	2.29	3.15	0.00	0.00	0.00	0.69	0.00	2.00	3.19
Bus Stops	17Street & JeffersonAvenue EB	2.44	4.03	4.30	4.99	5.35	4.89	6.92	8.10	0.00	0.00	0.68	1.04	0.58	2.61	3.79	0.68	0.68	0.83	1.19	0.78	2.60	3.80
Bus Stops	VenetianWay & ElslandAvenue EB	1.59	5.14	5.40	6.12	6.48	6.02	8.05	9.23	1.00	1.00	1.45	1.81	1.35	3.34	4.56	0.70	0.77	1.24	1.80	1.06	3.32	4.53
Bus Stops	73Street & HardingAvenue WB	4.11	2.85	3.12	3.91	4.27	3.81	5.84	7.02	0.00	0.00	0.00	0.00	0.00	0.71	1.80	0.00	0.00	0.00	0.00	0.00	0.85	2.03
Bus Stops	MacArthurCswy & TerminalIsle EB	6.71	0.00	0.00	0.68	1.04	0.58	2.61	3.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	NormandyDr & RueBordeauxDr WB	2.16	4.81	5.08	5.71	6.07	5.61	7.64	8.82	0.00	0.00	0.85	1.21	0.75	2.72	3.96	0.77	0.74	1.09	1.33	1.00	2.71	3.91
Bus Stops	11Street & PennsylvaniaAvenue WB	3.01	3.80	4.07	4.77	5.13	4.67	6.70	7.88	0.00	0.00	0.00	0.00	0.00	2.32	3.46	0.64	0.65	0.68	1.07	0.67	2.40	3.59
Bus Stops	DadeBlvd & MichiganAvenue WB	2.47	3.74	4.01	4.80	5.16	4.70	6.73	7.91	0.00	0.00	0.38	0.75	0.28	2.42	3.50	0.00	0.08	0.38	0.76	0.31	2.90	4.67

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	WashingtonAvenue & 21Street SB	4.93	1.33	1.60	2.23	2.59	2.13	4.16	5.34	0.00	0.00	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	1.21
Bus Stops	16Street & LenoxAvenue EB	2.09	4.40	4.67	5.27	5.63	5.17	7.20	8.38	0.00	0.00	0.87	1.23	0.77	2.72	3.98	0.93	0.94	1.05	1.49	0.99	2.85	4.04
Bus Stops	AltonRoad & 39Street NB	1.76	4.84	5.11	5.92	6.28	5.82	7.85	9.03	0.00	0.56	1.25	1.61	1.15	3.24	4.36	0.98	1.06	1.26	1.47	1.22	3.13	4.32
Bus Stops	MacArthurCswy & BridgeRoad EB	2.74	5.62	5.89	6.99	7.35	6.89	8.92	10.10	0.00	1.18	1.87	2.23	1.77	3.79	4.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	16Street & MichiganAvenue EB	2.28	4.07	4.34	4.98	5.34	4.88	6.91	8.09	0.00	0.00	0.56	0.92	0.46	2.43	3.67	0.59	0.60	0.71	1.15	0.65	2.51	3.70
Bus Stops	16Street & JeffersonAvenue EB	2.68	3.63	3.90	4.55	4.91	4.45	6.48	7.66	0.00	0.00	0.15	0.51	0.00	2.03	3.26	0.29	0.29	0.37	0.76	0.32	2.10	3.29
Bus Stops	AltonRoad & DelawareAvenue NB	2.77	3.81	4.08	4.76	5.12	4.66	6.69	7.87	0.00	0.00	1.00	0.52	1.00	2.20	3.27	0.39	0.44	0.63	0.78	0.60	2.20	3.35
Bus Stops	MacArthurCswy & FountainStreet EB	2.28	3.63	3.90	4.59	4.95	4.49	6.52	7.70	0.00	0.00	0.00	0.00	0.00	1.54	2.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	MacArthurCswy & TerminalIsle WB	3.83	3.57	3.84	4.45	4.81	4.35	6.38	7.56	0.00	0.00	0.00	0.27	0.00	1.70	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	77Street & AbbottAvenue EB	3.55	3.65	3.92	4.58	4.94	4.48	6.51	7.69	0.00	0.00	0.00	0.00	0.00	1.42	2.69	0.00	0.00	0.00	0.24	0.00	1.47	2.65
Bus Stops	MeridianAvenue & LincolnRoad SB	2.49	3.93	4.20	4.89	5.25	4.79	6.82	8.00	0.00	0.00	0.58	0.94	0.00	2.51	3.69	0.70	0.70	0.79	1.16	0.74	2.52	3.71
Bus Stops	CollinsAvenue & 5401 NB	3.70	3.32	3.59	4.26	4.62	4.16	6.19	7.37	0.00	0.00	0.00	0.00	0.00	1.32	2.62	0.00	0.00	0.00	0.00	0.00	1.65	2.92
Bus Stops	85Street & ByronAvenue WB	1.81	5.33	5.60	6.26	6.62	6.16	8.19	9.37	0.00	1.00	1.18	1.54	1.08	3.11	4.29	1.61	1.66	1.84	1.99	1.81	3.15	4.34
Bus Stops	AltonRoad & 51Street SB	2.88	3.90	4.17	4.85	5.21	4.75	6.78	7.96	0.00	0.00	0.23	0.59	1.00	2.29	3.34	0.44	0.49	0.68	0.83	0.65	2.25	3.40
Bus Stops	77Street & CarlyleAvenue EB	3.09	3.85	4.11	4.77	5.13	4.67	6.70	7.88	0.00	0.00	0.00	0.21	0.00	1.68	2.94	0.23	0.27	0.45	0.60	0.42	1.83	3.01
Bus Stops	AltonRoad & W44Ct NB	2.75	3.86	4.13	4.82	5.18	4.72	6.75	7.93	0.00	0.00	0.28	0.65	0.17	2.42	3.40	0.00	0.00	0.33	0.51	0.29	2.23	3.42
Bus Stops	AltonRoad & 47Street NB	2.10	4.43	4.70	5.44	5.80	5.34	7.37	8.55	0.00	1.00	0.82	1.18	0.72	3.02	3.93	0.54	0.61	0.80	1.02	0.75	2.77	3.96
Bus Stops	AltonRoad & 53Street SB	2.08	4.91	5.18	5.75	6.11	5.65	7.68	8.86	0.00	0.00	1.18	1.54	1.00	2.79	4.29	1.34	1.39	1.65	1.81	1.63	3.25	4.40
Bus Stops	AltonRoad & 57Street NB	2.47	4.25	4.52	5.09	5.45	4.99	7.02	8.20	0.00	0.00	1.00	0.76	1.00	2.19	3.51	0.44	0.50	0.79	0.95	0.76	2.45	3.57
Bus Stops	63Street & AllisonRoad WB	3.00	4.29	4.56	5.30	5.66	5.20	7.23	8.41	0.00	0.00	0.00	0.00	0.00	2.32	3.45	1.58	1.63	1.77	1.91	1.74	2.38	2.60
Bus Stops	77Street & CollinsAvenue WB	3.69	3.61	3.88	4.58	4.94	4.48	6.51	7.69	0.00	0.00	0.00	0.00	0.00	1.47	2.64	0.00	0.00	0.00	0.00	0.00	1.55	2.73

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	16Street & JeffersonAvenue WB	2.26	4.60	4.87	5.51	5.87	5.41	7.44	8.62	0.00	0.00	1.12	1.47	1.02	2.99	4.22	1.19	1.19	1.27	1.66	1.22	3.00	4.19
Bus Stops	CollinsAvenue & 4441Entrance SB	2.83	3.95	4.22	4.95	5.31	4.85	6.88	8.06	0.00	0.00	0.32	0.65	0.00	2.22	3.40	0.81	0.83	0.87	0.87	0.86	2.26	3.50
Bus Stops	41Street & CollinsAvenue EB	1.88	5.19	5.46	6.24	6.60	6.14	8.17	9.35	0.00	1.00	1.00	1.89	1.00	3.49	4.64	1.45	1.54	1.66	1.99	1.63	3.53	4.75
Bus Stops	AltonRoad & DadeBoulevard SB	2.19	4.64	4.91	5.54	5.90	5.44	7.47	8.65	0.00	0.00	1.08	1.44	0.98	2.98	4.22	0.51	0.57	1.12	1.51	1.04	3.05	4.25
Bus Stops	AltonRoad & NMichiganAvenue NB	2.12	4.18	4.44	5.23	5.59	5.13	7.16	8.34	0.00	0.12	0.82	1.18	0.72	2.86	3.93	0.38	0.43	0.88	1.25	0.80	2.73	3.92
Bus Stops	AltonRoad & 23Street NB	2.84	3.75	4.02	4.64	5.00	4.54	6.57	7.75	0.00	0.00	0.16	0.52	0.00	1.93	3.27	0.00	0.00	0.22	0.61	0.16	2.06	3.25
Bus Stops	AltonRoad & 29Street NB	2.68	4.04	4.31	5.28	5.64	5.18	7.21	8.39	0.00	0.00	0.43	0.76	0.00	2.59	3.50	0.00	0.00	0.53	0.92	0.47	2.36	3.55
Bus Stops	AltonRoad & ChaseAvenue NB	3.52	3.18	3.45	4.17	4.53	4.07	6.10	7.28	0.00	0.00	0.00	0.00	0.00	1.63	2.63	0.00	0.00	0.00	0.12	0.00	1.53	2.72
Bus Stops	AltonRoad & 47Street SB	2.23	4.55	4.82	5.54	5.90	5.44	7.47	8.65	0.00	0.15	0.94	1.30	0.84	2.78	4.05	0.52	0.57	0.88	1.08	0.83	2.84	4.03
Bus Stops	AltonRoad & 52Street NB	2.50	4.31	4.58	5.26	5.62	5.16	7.19	8.37	0.00	0.00	0.61	0.98	1.00	2.71	3.73	0.76	0.81	1.07	1.23	1.05	2.67	3.81
Bus Stops	AltonRoad & 54Street NB	3.34	3.55	3.82	4.60	4.96	4.50	6.53	7.71	0.00	0.00	0.00	0.00	0.00	1.87	2.86	0.00	0.00	0.24	0.40	0.23	1.88	3.01
Bus Stops	AltonRoad & 58Street NB	3.79	2.95	3.22	3.91	4.27	3.81	5.84	7.02	0.00	0.00	0.00	0.00	0.00	1.01	2.19	0.00	0.00	0.00	0.00	0.00	1.19	2.31
Bus Stops	AltonRoad & 60Street NB	2.34	4.58	4.85	5.49	5.85	5.39	7.42	8.60	0.00	0.00	0.70	1.06	1.00	2.56	3.81	0.70	0.79	1.10	1.27	1.07	2.77	3.89
Bus Stops	AltonRoad & 63Street SB	1.84	4.92	5.19	5.88	6.24	5.78	7.81	8.99	0.00	1.00	1.03	1.39	1.00	2.89	4.14	1.08	1.17	1.48	1.65	1.45	3.15	4.27
Bus Stops	AltonRoad & 57Street SB	4.15	2.91	3.18	3.88	4.24	3.78	5.81	6.99	0.00	0.00	0.00	0.00	0.00	0.98	2.15	0.00	0.00	0.00	0.00	0.00	1.16	2.28
Bus Stops	AltonRoad & 58Street SB	4.15	2.91	3.18	3.88	4.24	3.78	5.81	6.99	0.00	0.00	0.00	0.00	0.00	0.98	2.15	0.00	0.00	0.00	0.00	0.00	1.16	2.28
Bus Stops	AltonRoad & 56Street SB	2.33	4.52	4.78	5.50	5.86	5.40	7.43	8.61	0.00	0.00	0.71	1.07	1.00	2.67	3.82	0.86	0.93	1.21	1.37	1.18	2.83	3.96
Bus Stops	AltonRoad & 52Street SB	2.81	3.56	3.82	4.50	4.86	4.40	6.43	7.61	0.00	0.00	0.00	0.21	0.00	1.79	2.96	0.00	0.00	0.29	0.45	0.27	1.89	3.03
Bus Stops	AltonRoad & 44Street SB	2.07	4.54	4.81	5.35	5.71	5.25	7.28	8.46	0.00	0.00	0.99	1.35	0.89	2.74	4.10	0.74	0.85	1.06	1.25	1.02	2.96	4.15
Bus Stops	AltonRoad & NBayRoad SB	2.00	4.38	4.65	5.30	5.66	5.20	7.23	8.41	0.00	0.15	0.83	1.19	0.73	2.70	3.94	0.57	0.68	0.90	1.09	0.86	2.80	3.99
Bus Stops	AltonRoad & 41Street SB	1.93	4.73	5.00	5.58	5.94	5.48	7.51	8.69	0.00	0.00	1.21	1.57	1.11	2.85	4.32	0.95	1.05	1.26	1.45	1.22	3.16	4.35
Bus Stops	AltonRoad & NorthBayRd(Chase Ave) SB	2.11	4.51	4.78	5.40	5.76	5.30	7.33	8.51	0.00	0.00	0.85	1.21	0.75	2.69	3.96	0.69	0.72	0.95	1.36	0.84	2.80	3.98

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	AltonRoad & #2992 SB	2.40	4.44	4.71	5.42	5.78	5.32	7.35	8.53	0.00	0.00	0.77	1.13	0.67	2.70	3.88	0.62	0.65	0.89	1.29	0.78	2.72	3.90
Bus Stops	AltonRoad & 29Street SB	2.16	4.28	4.55	5.18	5.54	5.08	7.11	8.29	0.00	0.00	0.63	0.99	0.53	2.51	3.74	0.17	0.25	0.69	1.09	0.62	2.55	3.74
Bus Stops	AltonRoad & 23Street SB	2.34	4.25	4.52	5.33	5.69	5.23	7.26	8.44	0.00	0.00	0.65	1.01	0.55	2.82	3.76	0.00	0.34	0.77	1.16	0.70	2.61	3.81
Bus Stops	HawthorneAvenue & 77Street NB	3.45	3.43	3.69	4.45	4.81	4.35	6.38	7.56	0.00	0.00	0.00	0.00	0.00	1.54	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bus Stops	HawthorneAvenue & 79Street NB	3.55	3.22	3.49	4.23	4.59	4.13	6.16	7.34	0.00	0.00	0.00	0.00	0.00	1.25	2.28	0.00	0.00	0.00	0.00	0.00	1.08	2.21
Bus Stops	HawthorneAvenue & 80Street NB	3.44	3.46	3.72	4.40	4.76	4.30	6.33	7.51	0.00	0.00	0.00	0.00	0.00	1.35	2.49	0.00	0.00	0.00	0.00	0.00	1.28	2.42
Bus Stops	HawthorneAvenue & 82Street NB	3.66	3.31	3.58	4.35	4.71	4.25	6.28	7.46	0.00	0.00	0.00	0.00	0.00	1.28	2.28	0.00	0.00	0.00	0.00	0.00	1.11	2.30
Bus Stops	HawthorneAvenue & 83Street NB	3.16	3.71	3.98	4.60	4.96	4.50	6.53	7.71	0.00	0.00	0.00	0.00	0.00	1.52	2.72	0.00	0.00	0.00	0.00	0.00	1.49	2.68
Bus Stops	5Street & MichiganAvenue EB	1.36	5.20	5.47	6.22	6.58	6.12	8.15	9.33	1.00	1.00	1.69	2.05	1.59	3.67	4.80	1.86	1.91	2.05	2.31	2.03	3.54	4.73
Bus Stops	5Street & MeridianAvenue EB	2.58	4.17	4.44	5.09	5.45	4.99	7.02	8.20	0.00	0.00	0.00	1.03	0.00	2.53	3.78	1.06	1.08	1.12	1.27	1.11	2.48	3.66
Bus Stops	VenetianWay & WIslandAvenue WB	1.72	4.98	5.25	5.93	6.29	5.83	7.86	9.04	1.00	1.00	1.31	1.67	1.21	3.18	4.42	0.56	0.63	1.10	1.66	0.92	3.18	4.40
Bus Stops	VenetianWay & ERivoAltoDr WB	3.16	3.52	3.79	4.42	4.78	4.32	6.35	7.53	0.00	0.00	0.00	0.00	0.00	1.54	2.84	0.00	0.00	0.00	0.00	0.00	1.64	2.84
Bus Stops	VenetianWay & EDilidoDr WB	3.62	3.10	3.37	4.13	4.49	4.03	6.06	7.24	0.00	0.00	0.00	0.00	0.00	1.07	2.35	0.00	0.00	0.00	0.00	0.00	1.03	2.22
Bus Stops	VenetianWay & ESanMarinoDr WB	3.52	3.31	3.58	4.37	4.73	4.27	6.30	7.48	0.00	0.00	0.00	0.00	0.00	1.38	2.56	0.18	0.20	0.15	0.00	0.00	1.29	2.48
Bus Stops	VenetianWay & ESanMarinoDr EB	3.09	3.72	3.99	4.62	4.98	4.52	6.55	7.73	0.00	0.00	0.00	0.23	0.00	1.83	2.97	0.00	0.00	0.00	0.00	0.00	1.84	3.02
Bus Stops	VenetianWay & EDilidoDr EB	3.16	3.61	3.88	4.56	4.92	4.46	6.49	7.67	0.00	0.00	0.00	0.14	0.00	1.71	2.86	0.00	0.00	0.00	0.00	0.00	1.71	2.89
Bus Stops	VenetianWay & ERivoAltoDr EB	3.39	3.50	3.77	4.46	4.82	4.36	6.39	7.57	0.00	0.00	0.00	0.00	0.00	1.64	2.82	0.00	0.00	0.00	0.00	0.00	0.00	2.80
Bus Stops	VenetianWay & WIslandAvenue EB	1.50	5.20	5.47	6.13	6.49	6.03	8.06	9.24	1.00	1.00	1.47	1.83	1.37	3.40	4.58	0.78	0.85	1.32	1.88	1.14	3.40	4.61
Bus Stops	VenetianWay & EIslandAvenue WB	1.72	4.98	5.25	5.93	6.29	5.83	7.86	9.04	1.00	1.00	1.31	1.67	1.21	3.18	4.42	0.56	0.63	1.10	1.66	0.92	3.18	4.40
Bus Stops	63Street & AllisonRoad EB	2.87	4.07	4.34	5.08	5.44	4.98	7.01	8.19	0.00	0.00	0.00	0.00	0.00	2.08	3.23	1.36	1.41	1.55	1.69	1.52	2.16	2.38
Bus Stops	63Street & IndianCreekDr EB	4.63	2.50	2.77	3.49	3.85	3.39	5.42	6.60	0.00	0.00	0.00	0.00	0.00	0.48	1.65	0.00	0.00	0.00	0.00	0.00	0.50	1.67
Bus Stops	77Street & AbbottAvenue WB	3.65	3.26	3.53	4.22	4.58	4.12	6.15	7.33	0.00	0.00	0.00	0.00	0.00	1.12	2.31	0.00	0.00	0.00	0.00	0.00	1.20	2.38

Transportation Asset Threat Matrix

Asset Characteristics			Scenario Flood Depth (feet)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Bus Stops	77Street & CarlyleAvenue WB	2.73	4.12	4.39	5.08	5.44	4.98	7.01	8.19	0.00	0.00	0.11	0.47	0.01	2.05	3.22	0.51	0.56	0.75	0.90	0.72	2.12	3.30
Bus Stops	77Street & DickensAvenue WB	2.31	4.56	4.82	5.51	5.87	5.41	7.44	8.62	0.00	0.00	0.56	0.92	0.46	2.47	3.67	0.94	1.00	1.18	1.33	1.15	2.56	3.74
Bus Stops	77Street & TatumWaterwayDr WB	2.21	4.67	4.93	5.61	5.97	5.51	7.54	8.72	0.00	0.00	0.68	1.04	0.58	2.59	3.79	1.08	1.14	1.32	1.47	1.29	2.70	3.88
Bus Stops	85Street & HardingAvenue EB	2.45	4.54	4.81	5.48	5.84	5.38	7.41	8.59	0.00	0.00	0.39	0.75	0.29	2.36	3.50	0.87	0.92	1.10	1.25	1.07	2.41	3.60
Bus Stops	AltonRoad & SunsetDrive SB	1.94	4.64	4.91	5.66	6.02	5.56	7.59	8.77	0.00	0.00	1.14	1.50	1.04	3.12	4.25	0.61	0.67	1.22	1.61	1.14	3.09	4.29
Bus Stops	71Street & ByronAvenue EB	2.42	4.59	4.86	5.58	5.94	5.48	7.51	8.69	0.00	0.00	0.50	0.86	0.40	2.43	3.61	0.74	0.79	0.91	1.09	0.90	2.47	3.66
Marinas	Purdy Public Boat Ramp/Marina	3.42	3.13	3.40	4.10	4.46	4.00	6.03	7.21	0.00	0.00	0.00	0.00	0.00	1.38	2.60	0.00	0.00	0.00	0.00	0.00	1.38	2.58
Marinas	Miami Beach Marina (private)	7.01	0.00	0.00	0.63	1.00	0.53	2.57	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Site Analysis Threat Matrix

Asset Characteristics			Scenario Flood Inundation (Percent)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Natural Resources	Dune System	9.10	5	8	17	23	15	61	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Resources	Bayshore Park Retention Pond	2.35	100	100	100	100	100	100	100	21	42	73	82	71	99	100	77	77	81	87	80	99	100
Natural Shoreline	Brittany Bay	3.05	100	100	100	100	100	100	100	0	0	7	10	6	92	100	0	0	0	0	0	0	0
Natural Shoreline	Maurice Gibb	2.08	95	95	95	95	86	95	95	8	8	8	67	8	80	95	0	0	34	53	29	53	53
Natural Shoreline	Muss Park	3.24	100	100	100	100	98	100	100	0	0	0	0	0	89	100	0	0	1	1	0	10	10
Natural Shoreline	Pinetree Park	2.99	93	93	93	93	86	93	93	17	18	25	31	24	56	93	0	0	0	0	0	1	1
Parks	21 Street Recreation Area	4.29	0	96	99	99	98	100	100	0	0	0	0	0	34	90	0	0	0	2	0	21	53
Parks	Crespi Park	3.19	0	100	100	100	100	100	100	0	0	5	28	2	100	100	0	0	0	0	0	100	100
Parks	Fairway Park	2.44	0	100	100	100	100	100	100	0	0	74	94	69	100	100	77	79	83	99	82	100	100
Parks	Flamingo Park	2.91	0	98	99	100	99	100	100	0	7	64	73	58	93	97	64	65	68	78	67	94	97
Parks	Fisher Park	2.69	0	100	100	100	100	100	100	0	0	63	92	51	99	100	86	89	95	95	94	99	100
Parks	La Gorce Park	2.69	0	100	100	100	100	100	100	0	4	35	84	26	100	100	37	47	97	100	91	100	100
Parks	Lummus Park	7.40	0	42	67	79	64	94	96	0	0	0	0	0	0	7	0	0	0	0	0	0	2
Parks	Maurice Gibb Memorial Park	3.08	0	100	100	100	100	100	100	0	0	0	49	0	99	100	0	0	31	53	28	94	94
Parks	Marjory Stoneman Douglas Park	6.73	0	51	78	91	75	100	100	0	0	0	0	0	0	2	0	0	0	0	0	0	5
Parks	Miami Beach Golf Club	3.09	0	78	81	82	79	84	84	8	12	31	42	28	68	76	46	47	54	61	51	82	90
Parks	Muss Park	3.67	0	100	100	100	100	100	100	0	0	1	9	1	94	100	7	5	19	27	17	86	89
Parks	Normandy Shores Park	2.81	0	100	100	100	100	100	100	0	0	27	78	20	100	100	27	30	41	76	37	86	86
Parks	North Beach Oceanside Park	8.57	2	20	31	36	29	68	93	0	0	0	0	0	2	7	0	0	0	0	0	3	9
Parks	Tatum Park	2.61	0	100	100	100	100	100	100	0	0	57	84	48	100	100	86	88	97	100	95	100	100
Parks	North Shore and Youth Center	3.38	0	100	100	100	100	100	100	0	0	26	38	23	95	97	34	36	42	48	42	95	98
Parks	Palm Island Park	2.58	0	100	100	100	100	100	100	0	3	74	98	58	100	100	0	0	0	0	0	85	87
Parks	Pine Tree Park	4.60	0	93	94	94	93	94	94	1	1	2	2	2	33	75	1	1	1	1	1	33	63
Parks	Polo Park	3.12	0	100	100	100	100	100	100	0	1	22	59	17	98	99	6	6	14	41	12	98	99
Parks	Scott Rakow Youth Center and Ice Rink	4.47	0	82	89	95	88	97	100	0	3	12	15	8	65	77	16	17	19	23	18	66	78
Parks	South Pointe Park	7.11	0	40	63	69	61	84	89	0	0	0	0	0	6	24	0	0	0	0	0	6	23
Parks	Stillwater Park	3.10	0	100	100	100	100	100	100	0	2	12	40	7	100	100	7	8	13	25	11	100	100
Parks	Parkview Island Park	3.00	0	100	100	100	100	100	100	0	0	10	48	4	100	100	12	22	54	61	51	100	100
Parks	Bandshell Park	6.72	0	69	81	84	80	94	100	0	0	0	0	0	0	23	0	0	0	0	0	4	26
Parks	Altos Del Mar	7.98	17	26	40	47	38	84	97	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Parks	Normandy Isle Park and Pool	4.15	0	70	98	99	97	100	100	0	0	12	41	8	66	68	10	8	33	54	25	66	68
Parks	Poinciana Park	2.43	0	100	100	100	100	100	100	0	1	94	100	79	100	100	96	99	100	100	100	100	100
Parks	Brittany Bay Park	3.70	0	98	98	98	98	98	98	0	0	5	9	4	69	92	23	26	33	37	32	47	65

Site Analysis Threat Matrix

Asset Characteristics			Scenario Flood Inundation (Percent)																				
Asset Type	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IL	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Parks	Allison Park	6.36	0	92	97	98	97	100	100	0	0	0	0	0	0	19	0	0	0	0	0	0	22
Parks	La Gorge Golf Course	4.71	0	79	84	85	82	91	93	2	2	7	15	6	49	66	32	33	34	35	34	57	73
Parks	Beach View Park	6.88	0	77	98	100	97	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Parks	Mid Beach Park	6.10	0	76	94	99	92	100	100	0	0	0	0	0	1	43	0	0	0	0	0	3	48
Parks	Beachfront Park	4.36	0	82	86	89	85	100	100	0	1	33	44	29	69	78	27	30	35	45	34	69	79
Parks	Sunset Isle II Park	2.58	0	100	100	100	100	100	100	0	0	76	92	69	100	100	93	94	99	100	98	100	100
Parks	Sunset Lake Park	3.24	0	100	100	100	100	100	100	0	0	3	51	2	99	100	0	0	0	22	0	81	82
Parks	Belle Isle Park	1.83	0	100	100	100	100	100	100	47	78	100	100	99	100	100	83	86	99	100	97	100	100
Parks	Collins Park	4.52	0	100	100	100	100	100	100	0	0	0	0	0	53	100	3	4	6	7	5	52	100
Parks	Washington Park	4.21	0	100	100	100	100	100	100	0	0	0	0	0	75	100	1	1	1	2	1	80	100
Parks	South Beach Park	6.25	0	69	89	96	88	100	100	0	0	0	0	0	0	33	7	7	7	7	7	8	33
Parks	Buoy Park	4.09	0	100	100	100	100	100	100	0	0	0	0	0	88	100	21	21	22	24	22	87	100
Parks	Hibiscus Island Park	4.47	0	100	100	100	100	100	100	0	0	0	0	0	67	100	0	0	0	0	0	17	99
Parks	Botanical Garden	4.66	0	96	97	97	97	98	98	0	0	0	0	0	37	94	0	0	1	4	1	35	88
Parks	MB Soundscape	4.96	0	80	95	98	92	100	100	0	0	0	0	0	46	69	3	3	5	10	4	46	69
Parks	Washington Park Annex	5.04	0	100	100	100	100	100	100	0	0	0	0	0	1	100	0	0	0	0	0	4	100
Parks	Collins Canal Park	2.91	0	74	74	75	73	79	79	0	0	0	0	0	72	74	1	1	4	6	3	26	26
Parks	Bayshore Park	2.89	0	100	100	100	100	100	100	12	27	55	64	52	92	100	58	60	65	71	63	91	97
Parks	Pride Park	3.18	0	99	100	100	100	100	100	0	0	24	67	19	96	98	22	22	37	75	32	96	98
Parks	82nd Street Skate Park	4.94	0	99	100	100	100	100	100	0	0	0	0	0	27	82	1	2	3	4	3	31	87
Parks	Parkview Park Annex	3.10	0	99	99	99	97	99	99	2	2	16	31	12	97	99	25	28	40	50	39	81	82
Parks	20th Street Pocket Park	2.24	0	100	100	100	100	100	100	17	38	96	98	94	100	100	72	77	95	98	95	100	100
Parks	Canopy Park	2.64	0	100	100	100	100	100	100	0	1	68	85	63	100	100	24	37	57	70	52	77	77
Parks	63rd Street Greenspace	3.52	0	100	100	100	100	100	100	0	0	0	6	0	98	100	1	1	8	20	7	69	69

Linear Analysis Threat Matrix

Asset Characteristics			Scenario Flood Inundation (Percent)																				
Asset Class	Asset Name	Asset Elevation (NAVD88)	Storm Tide 100yr 2020	Storm Tide 100yr 2040IL	Storm Tide 100yr 2040IH	Storm Tide 100yr 2040H	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070IH	Storm Tide 100yr 2070H	King Tide 2020	King Tide 2040IL	King Tide 2040IH	King Tide 2040H	King Tide 2070IL	King Tide 2070IH	King Tide 2070H	Compound Flooding 2020	Compound Flooding 2040IL	Compound Flooding 2040IH	Compound Flooding 2040H	Compound Flooding 2070IL	Compound Flooding 2070IH	Compound Flooding 2070H
Critical Infrastructure	Drinking Water Pipelines	-	96	96	97	97	97	97	97	5	13	44	56	40	85	94	51	53	58	63	57	84	88
Critical Infrastructure	Wastewater Pipeline	-	92	92	93	93	94	94	94	4	12	39	50	35	82	91	48	50	55	60	54	86	88
Transportation	Roadways	-	96	96	97	97	69	97	97	5	13	42	55	39	84	93	51	53	56	64	58	86	88
Natural, Cultural, Historical Resources	Dune Crossovers	-	6	10	26	38	23	69	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Flooding Severity Summary Tables per Asset Category - Coastal Flooding Sources
Assets Exposed (% of Total Assets in Category)

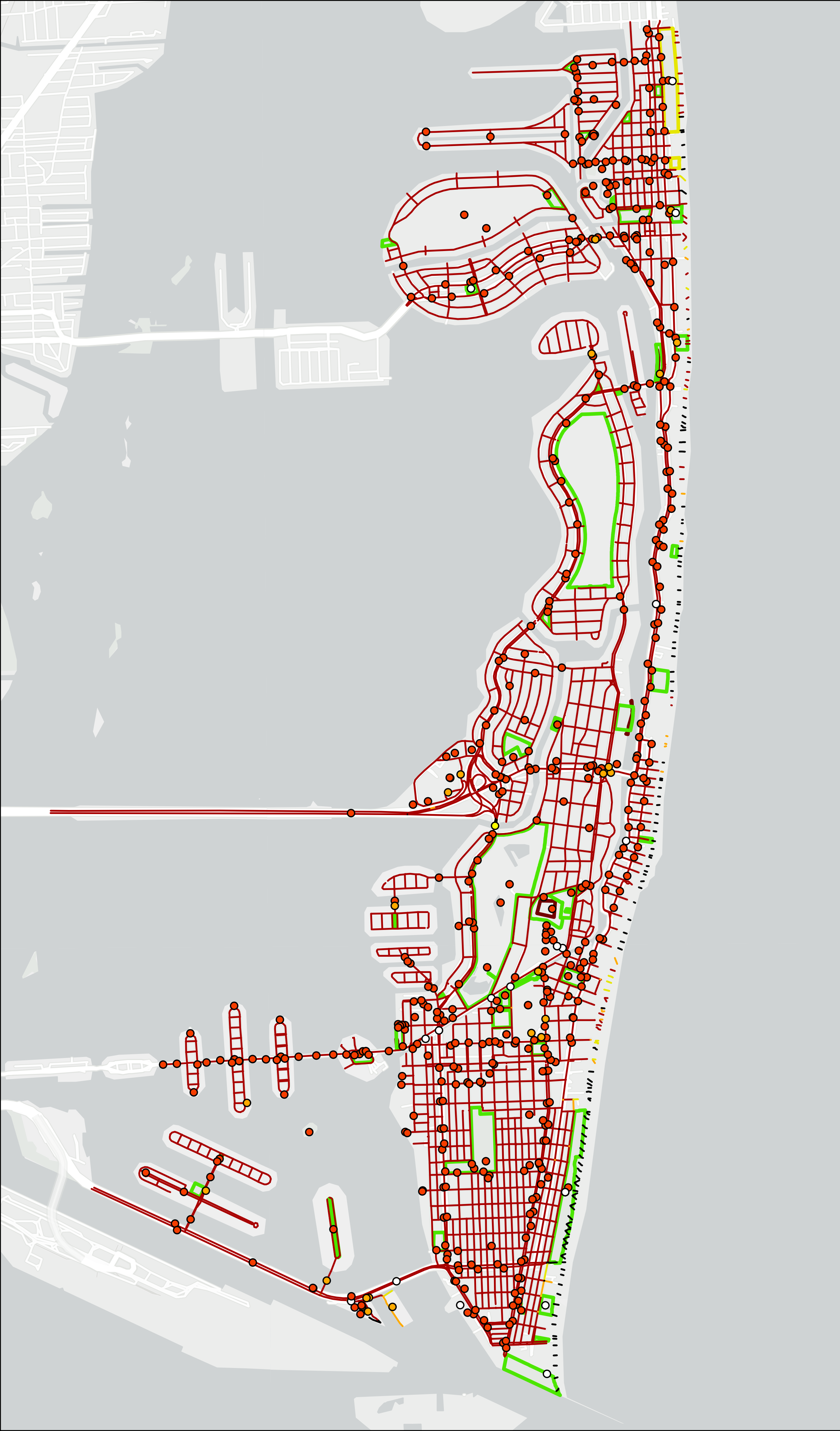
Asset Descriptions			1 Percent Annual Chance - 100 Year Storm Tide (Storm Surge)							1 Year Stillwater - King Tide (2.0' NAVD88)						
Asset Group	Assets Types Included	Asset Total	Existing Conditions Flood Depth	2040 Intermediate Low Flood Depth	2040 Intermediate High Flood Depth	2040 High Flood Depth	2070 Intermediate Low Flood Depth	2070 Intermediate High Flood Depth	2070 High Flood Depth	Existing Conditions Flood Depth	2040 Intermediate Low Flood Depth	2040 Intermediate High Flood Depth	2040 High Flood Depth	2070 Intermediate Low Flood Depth	2070 Intermediate High Flood Depth	2070 High Flood Depth
Critical Community and Emergency Facilities	Affordable Housing Colleges & Universities Community Centers Emergency Operations Centers Fire Stations Hospitals Law Enforcement Facilities Local Government Facilities Logistical Staging Area Schools State Government Facilities	82	71 (86.6%)	73 (89.0%)	79 (96.3%)	80 (97.6%)	79 (96.3%)	81 (98.8%)	82 (100.0%)	3 (3.7%)	4 (4.9%)	27 (32.9%)	36 (43.9%)	25 (30.5%)	65 (79.3%)	70 (85.4%)
Critical Infrastructure	Communication Towers Debris Management Sites Electrical Substation Potable Water Pump Station Potable Water Storage Tanks Stormwater Pump Stations Wastewater Lift Stations	104	104 (100.0%)	104 (100.0%)	104 (100.0%)	104 (100.0%)	104 (100.0%)	104 (100.0%)	104 (100.0%)	5 (4.8%)	11 (13.4%)	29 (35.4%)	40 (48.8%)	29 (35.4%)	80 (76.9%)	99 (95.2%)
	Potable Water Main* Sewer Main (Gravity/Force)*	518 Miles	486 (93.8%)	488 (94.2%)	493 (95.2%)	494 (95.4%)	491 (94.8%)	494 (95.4%)	494 (95.4%)	24 (4.6%)	64 (12.4%)	213 (41.1%)	275 (53.1%)	194 (37.5%)	432 (83.4%)	476 (91.9%)
Natural, Cultural, and Historical Resources	Cultural & Historical Buildings	18	17 (94.4%)	17 (94.4%)	17 (94.4%)	17 (94.4%)	17 (94.4%)	18 (100%)	18 (100%)	0 (0.0%)	1 (5.6%)	2 (11.1%)	3 (16.7%)	2 (11.1%)	12 (66.7%)	16 (88%)
	Shorelines Dune Cross Overs	70 Miles	30 (42.9%)	30 (42.9%)	31 (44.3%)	32 (45.7%)	31 (44.3%)	35 (50.0%)	38 (54..3%)	3 (4.3%)	5 (7.1%)	11 (15.7%)	14 (20.0%)	10 (14.3%)	24 (34.3%)	29 (41.4%)
Transportation and Evacuation Routes	Bridge Marinas Bus Stops	332	323 (97.3%)	324 (97.6%)	327 (98.5%)	329 (99.1%)	327 (98.5%)	330 (99.4%)	330 (99.4%)	23 (6.9%)	45 (13.6%)	150 (45.2%)	173 (52.1%)	132 (39.8%)	296 (89.2%)	320 (96.4%)
	Roads	169 Miles	161 (95.3%)	163 (96.4%)	164 (97.0%)	164 (97.0%)	162 (95.9%)	163 (96.4%)	163 (96.4%)	8 (4.7%)	21 (12.4%)	710 (42.0%)	93 (55.0%)	65 (38.5%)	142 (84.0%)	158 (93.5%)
Site Analysis - Area	Parks	512 Acres	1 (0.2%)	390 (76.2%)	420 (82.0%)	432 (84.4%)	413 (80.7%)	460 (89.8%)	473 (92.4%)	17 (3.3%)	29 (5.7%)	102 (19.9%)	146 (28.5%)	92 (18.0%)	278 (54.3%)	337 (65.8%)
	Surface Water Natural Shorelines Dune System	93 Acres	10 (10.8%)	12 (12.9%)	20 (21.5%)	26 (28.0%)	19 (20.4%)	59 (63.4%)	74 (79.6%)	1 (1.1%)	2 (2.2%)	3 (3.2%)	4 (4.3%)	3 (3.2%)	5 (5.4%)	6 (6.4%)

* Indicates Asset not included on maps due to feature density at scale

Flooding Severity Summary Tables per Asset Category - Compound Flooding Sources
Assets Exposed (% of Total Assets in Category)

Asset Descriptions			10-Year Rainfall - Compound Flooding						
Asset Group	Assets Types Included	Asset Total	Existing Conditions Flood Depth	2040 Intermediate Low Flood Depth	2040 Intermediate High Flood Depth	2040 High Flood Depth	2070 Intermediate Low Flood Depth	2070 Intermediate High Flood Depth	2070 High Flood Depth
Critical Community and Emergency Facilities	Affordable Housing Colleges & Universities Community Centers Emergency Operations Centers Fire Stations Hospitals Law Enforcement Facilities Local Government Facilities Logistical Staging Area Schools State Government Facilities	82	27 (32.9%)	29 (35.4%)	36 (43.9%)	41 (50.0%)	35 (42.9%)	62 (75.6%)	65 (79.3%)
Critical Infrastructure	Communication Towers Debris Management Sites Electrical Substation Potable Water Pump Station Potable Water Storage Tanks Stormwater Pump Stations Wastewater Lift Stations	104	33 (31.7%)	36 (34.6%)	43 (41.3%)	48 (46.2%)	41 (39.4%)	74 (71.2%)	87 (83.7%)
	Potable Water Main* Sewer Main (Gravity/Force)*	518 Miles	22 (4.2%)	62 (12.0%)	207 (40.0%)	266 (51.4%)	188 (36.3%)	419 (80.9%)	462 (89.2%)
Natural, Cultural, and Historical Resources	Cultural & Historical Buildings	18	7 (38.9%)	7 (38.9%)	7 (38.9%)	8 (44.4%)	7 (38.9%)	11 (61.1%)	15 (83.3%)
	Shorelines Dune Cross Overs	70 Miles	1 (1.4%)	3 (4.3%)	6 (8,6%)	7 (10.0%)	5 (7.1%)	15 (21.4%)	18 (25.7%)
Transportation and Evacuation Routes	Bridge Marinas Bus Stops	332	147 (44.3%)	150 (45.1%)	162 (48.8%)	177 (53.3%)	161 (48.5%)	263 (79.2%)	286 (86.1%)
	Roads	169 Miles	7 (4.1%)	20 (11.8%)	70 (41.4%)	90 (53.2%)	64 (37.9%)	138 (81.7%)	151 (89.3%)
Site Analysis - Area	Parks	512 Acres	17 (3.3%)	28 (5.5%)	101 (19.7%)	144 (28.1%)	91 (17.8%)	278 (54.3%)	337 (65.8%)
	Surface Water Natural Shorelines Dune System	93 Acres	1 (1.1%)	2 (2.2%)	3 (3.2%)	4 (4.3%)	3 (3.2%)	5 (5.4%)	6 (6.5%)

* Indicates Asset not included on maps due to feature density at scale



City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
Existing Conditions
6.2' NAVD88 Water Elevation
+0.0' Sea Level Rise

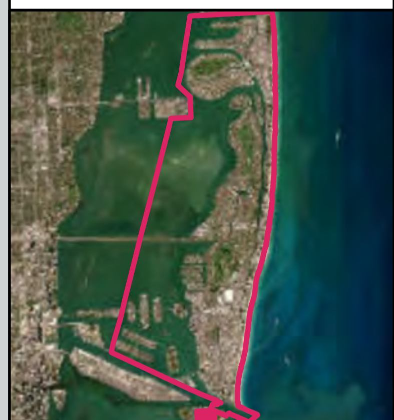
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

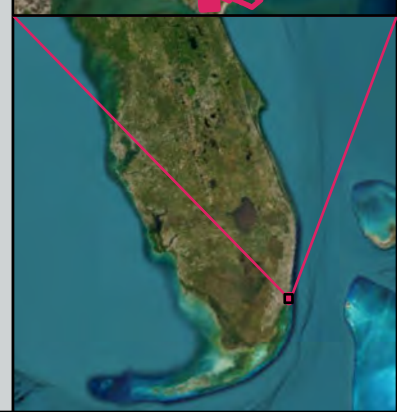
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000





City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
2040 NOAA Intermediate Low
6.2' NAVD88 Water Elevation
+0.3' Sea Level Rise

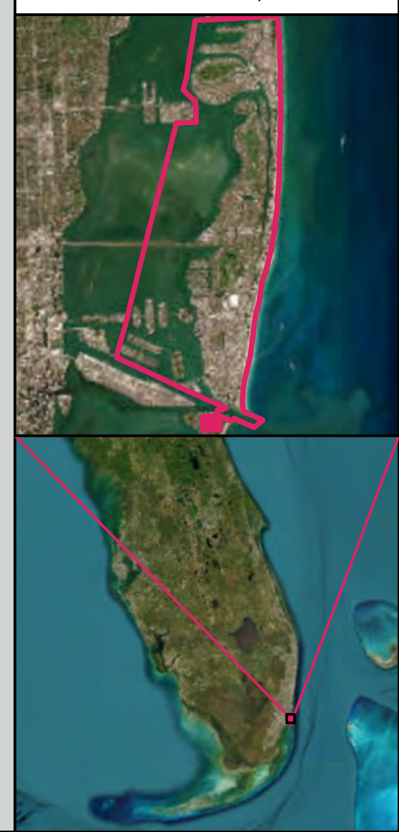
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000



City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
2040 NOAA Intermediate High
6.2' NAVD88 Water Elevation
+1.0' Sea Level Rise

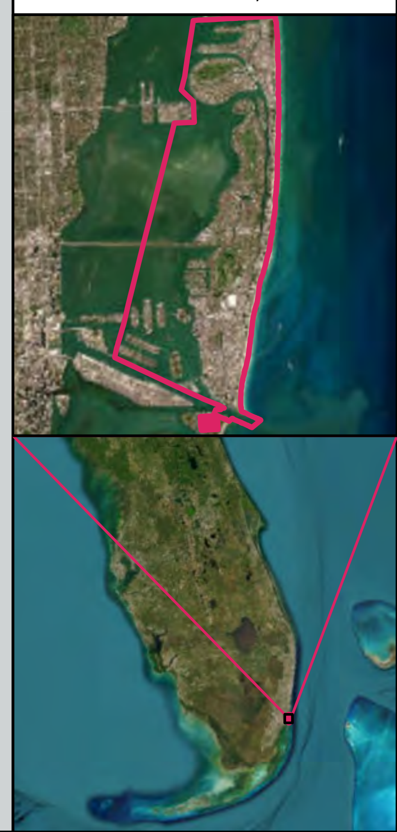
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

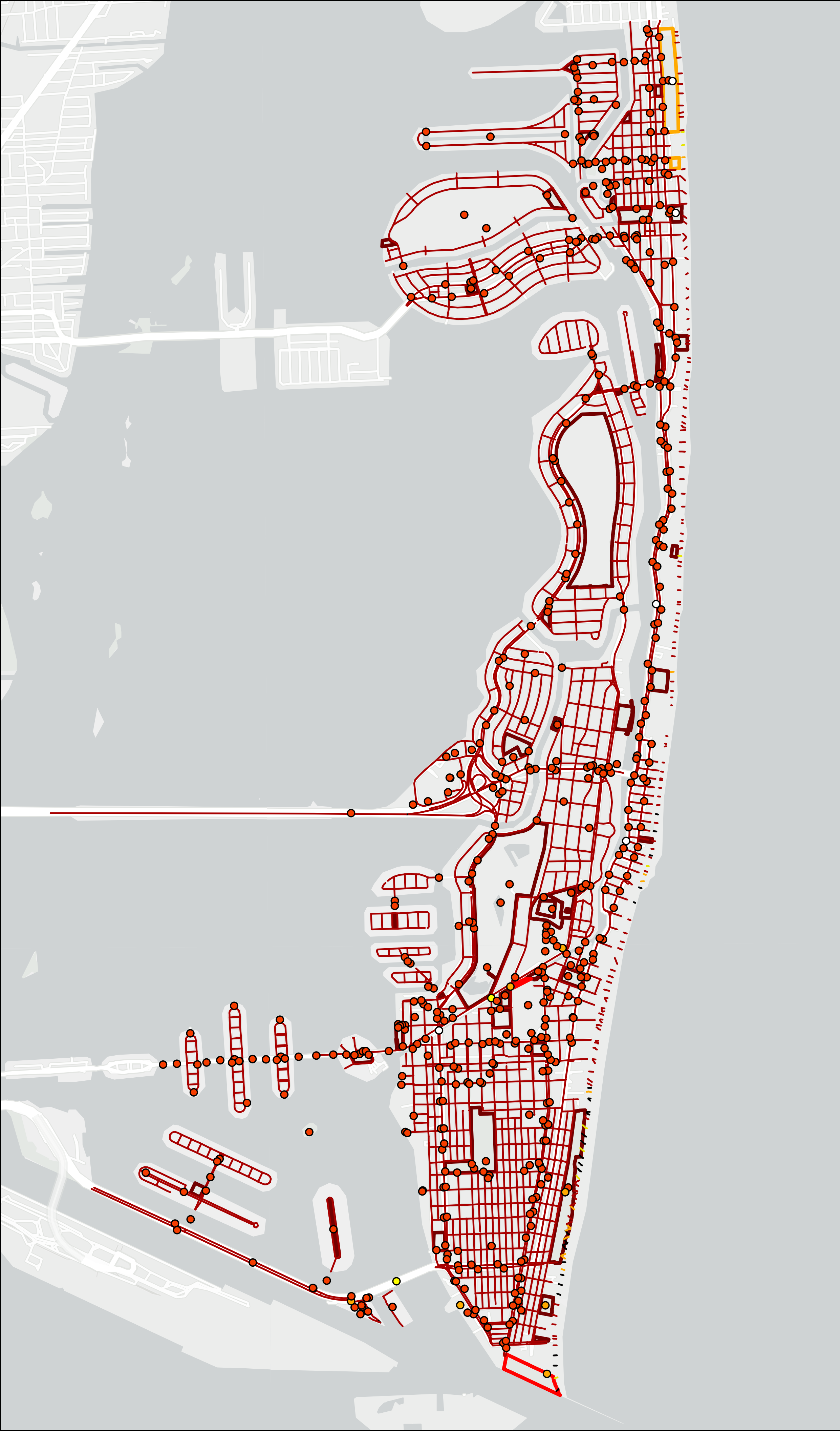
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000





City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
2040 NOAA High
6.2' NAVD88 Water Elevation
+1.4' Sea Level Rise

Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

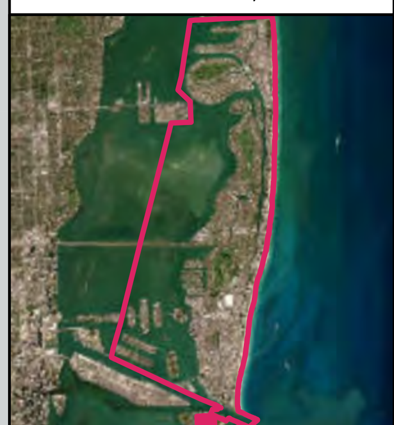
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

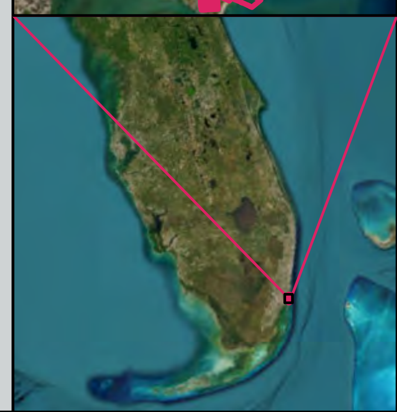
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

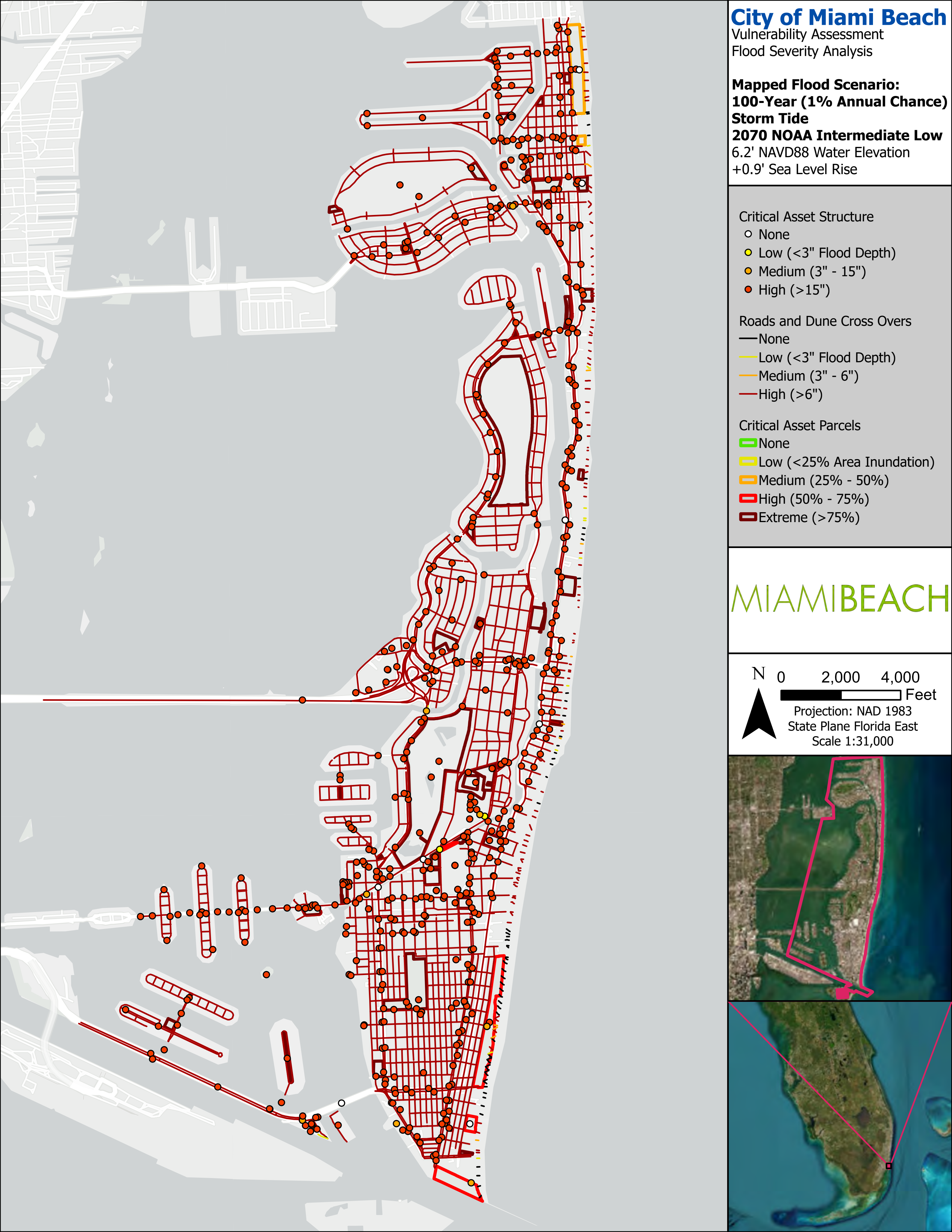
MIAMIBEACH

N 0 2,000 4,000 Feet

Projection: NAD 1983
State Plane Florida East
Scale 1:31,000






City of Miami Beach
Vulnerability Assessment
Flood Severity Analysis
Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
2070 NOAA Intermediate Low
6.2' NAVD88 Water Elevation
+0.9' Sea Level Rise
Critical Asset Structure
None
Low (<3" Flood Depth)
Medium (3" - 15")
High (>15")
Roads and Dune Cross Overs
None
Low (<3" Flood Depth)
Medium (3" - 6")
High (>6")
Critical Asset Parcels
None
Low (<25% Area Inundation)
Medium (25% - 50%)
High (50% - 75%)
Extreme (>75%)
MIAMIBEACH
N
0
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Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000

City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
2070 NOAA Intermediate High
6.2' NAVD88 Water Elevation
+2.9' Sea Level Rise

Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

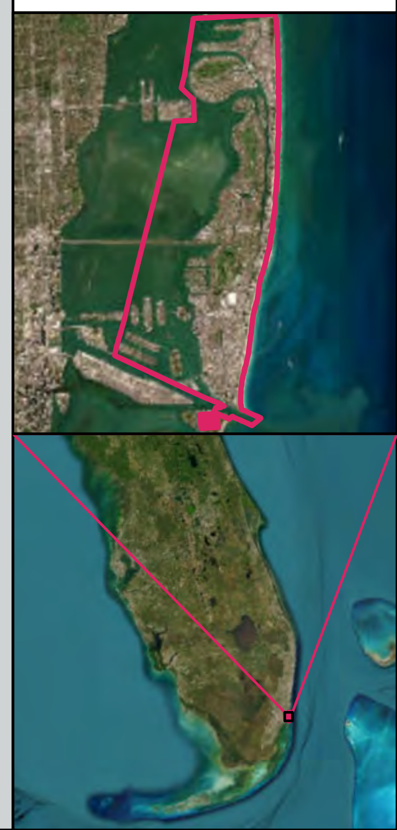
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet

Projection: NAD 1983
State Plane Florida East
Scale 1:31,000



City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
100-Year (1% Annual Chance)
Storm Tide
2070 NOAA High
6.2' NAVD88 Water Elevation
+4.1' Sea Level Rise

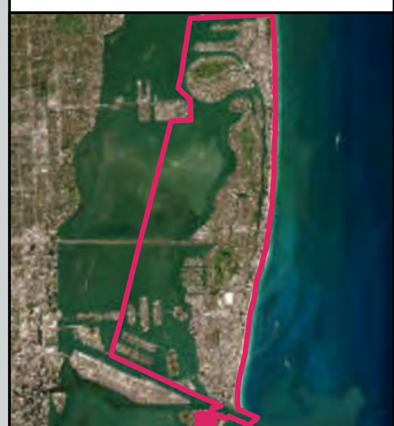
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

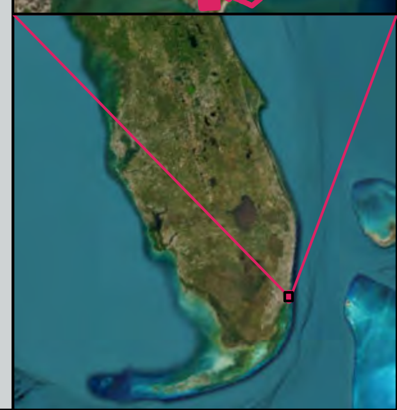
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

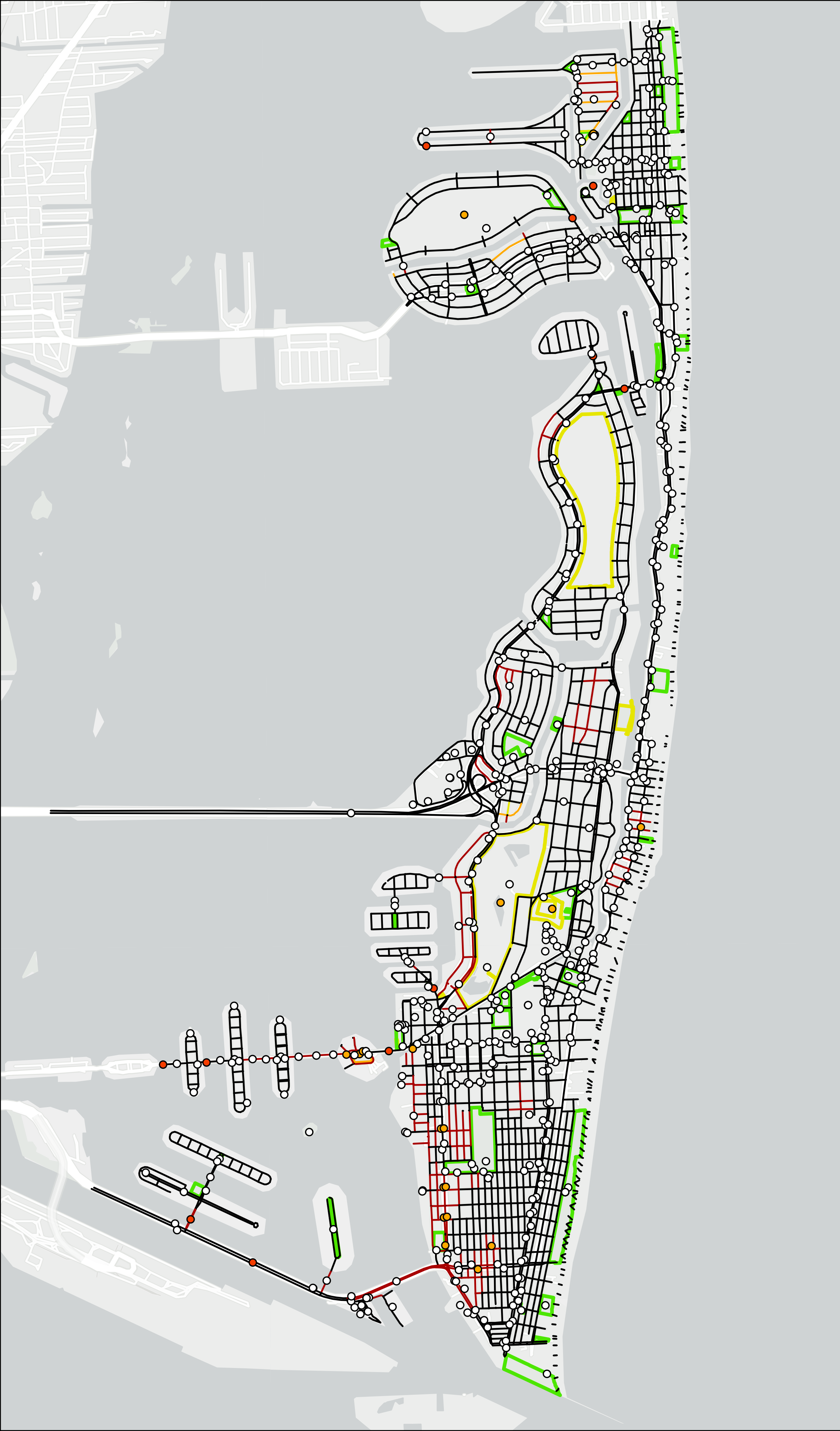
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario
King Tide
Existing Conditions
1.8' NAVD88 Water Elevation
+0.0' Sea Level Rise

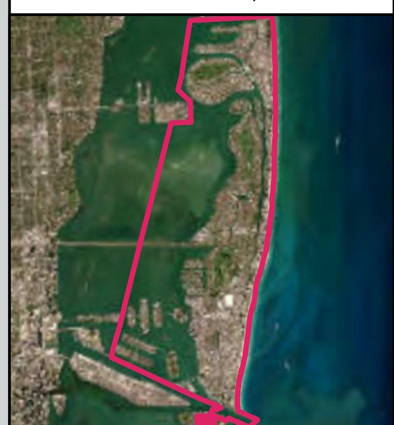
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

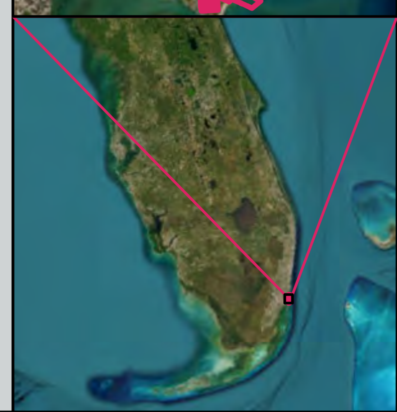
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

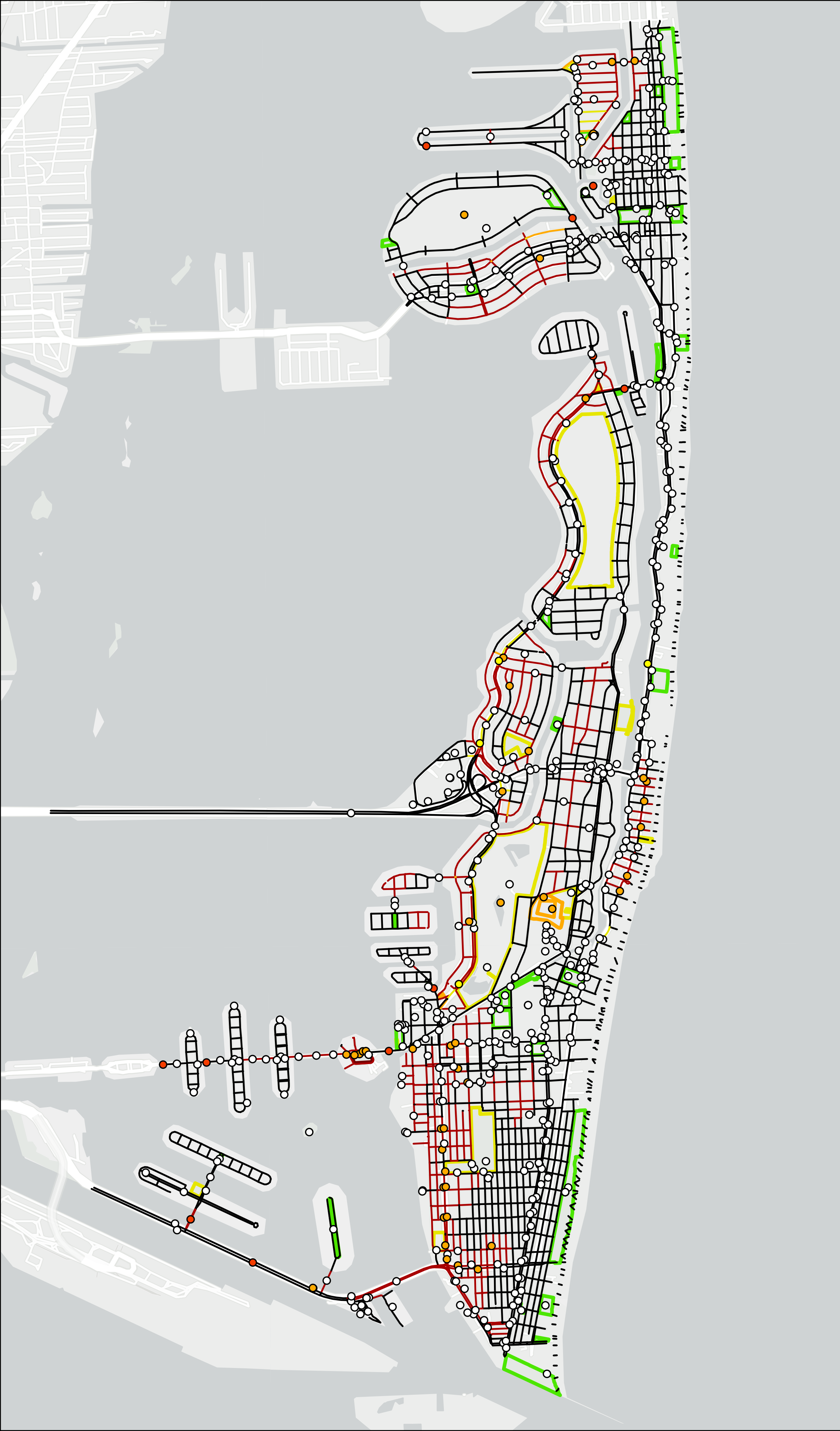
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario
King Tide
2040 NOAA Intermediate Low
1.8' NAVD88 Water Elevation
+0.3' Sea Level Rise

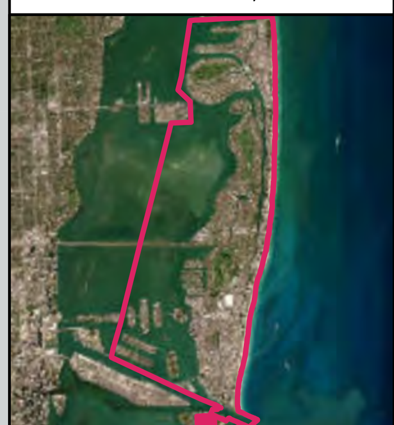
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

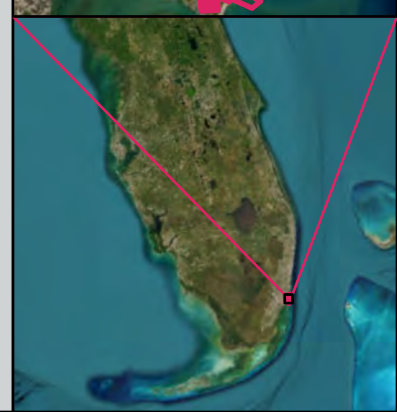
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

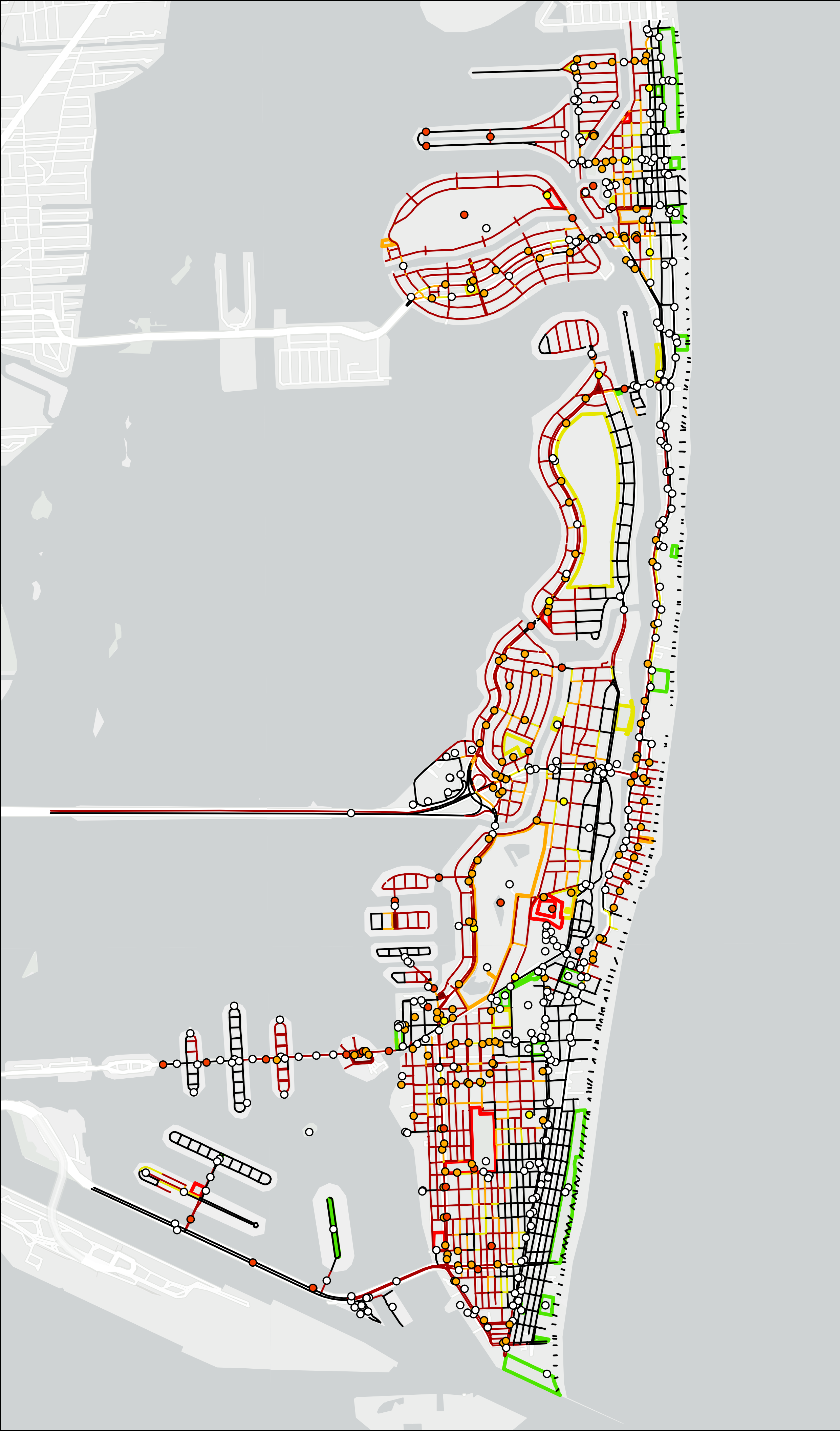
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario
King Tide
2040 NOAA Intermediate High
1.8' NAVD88 Water Elevation
+1.0' Sea Level Rise

Critical Asset Structure

- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

Roads and Dune Cross Overs

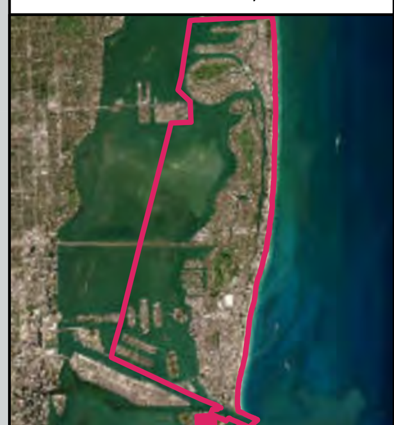
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

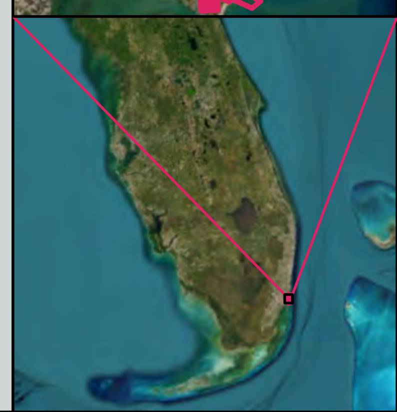
Critical Asset Parcels

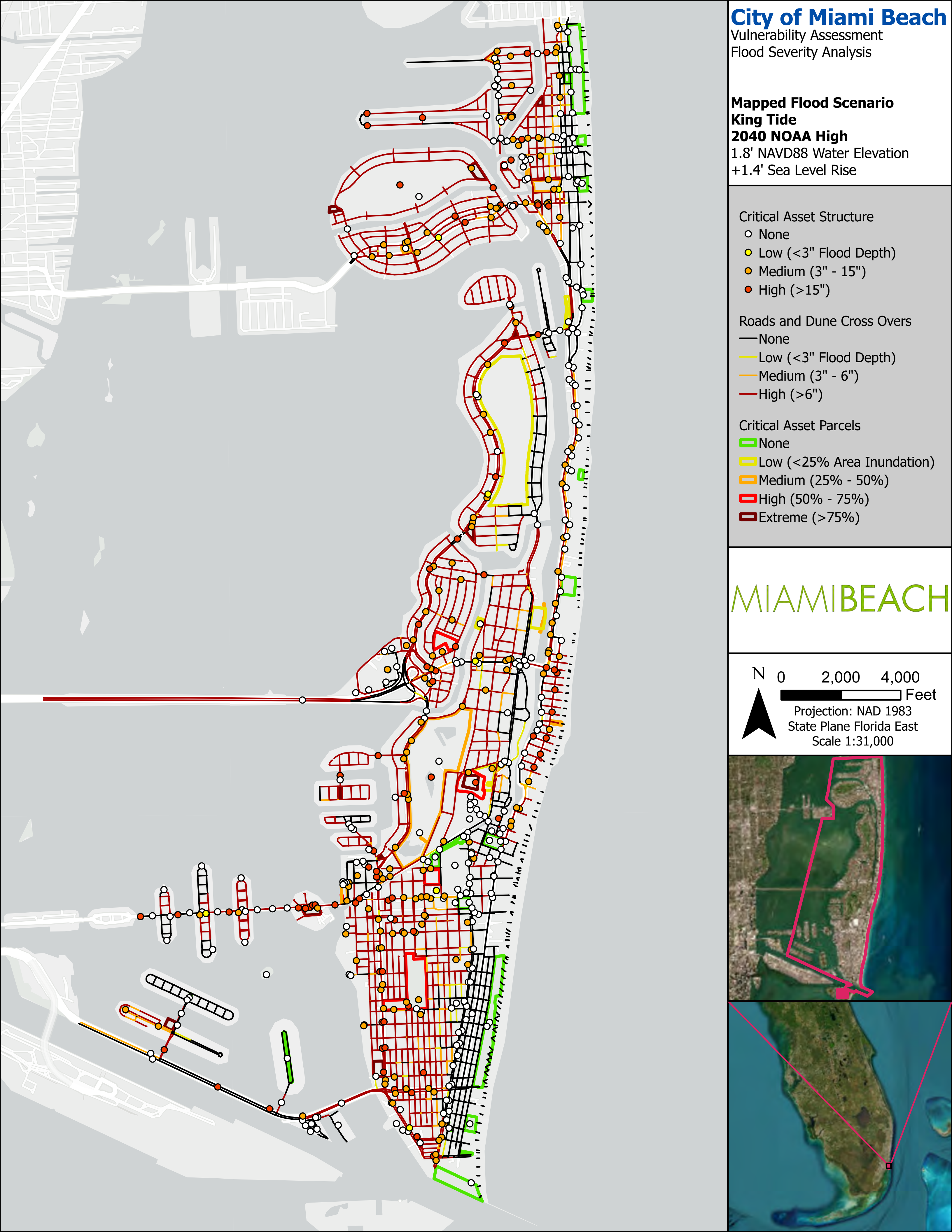
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

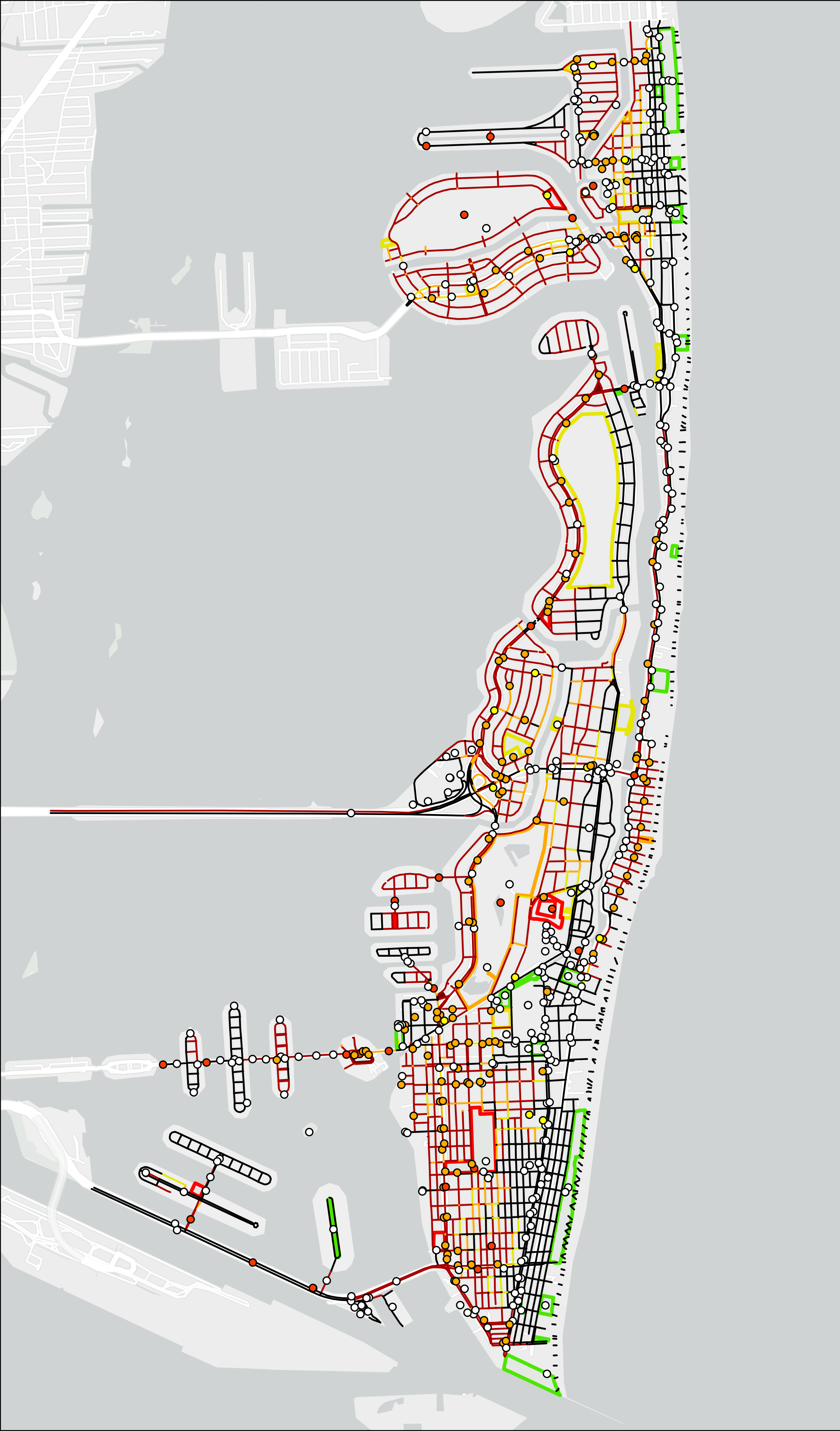
MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000






City of Miami Beach
Vulnerability Assessment
Flood Severity Analysis
Mapped Flood Scenario
King Tide
2040 NOAA High
1.8' NAVD88 Water Elevation
+1.4' Sea Level Rise
Critical Asset Structure
None
Low (<3" Flood Depth)
Medium (3" - 15")
High (>15")
Roads and Dune Cross Overs
None
Low (<3" Flood Depth)
Medium (3" - 6")
High (>6")
Critical Asset Parcels
None
Low (<25% Area Inundation)
Medium (25% - 50%)
High (50% - 75%)
Extreme (>75%)
MIAMIBEACH
N
0 2,000 4,000
Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000



City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario
King Tide
2070 NOAA Intermediate Low
1.8' NAVD88 Water Elevation
+0.9' Sea Level Rise

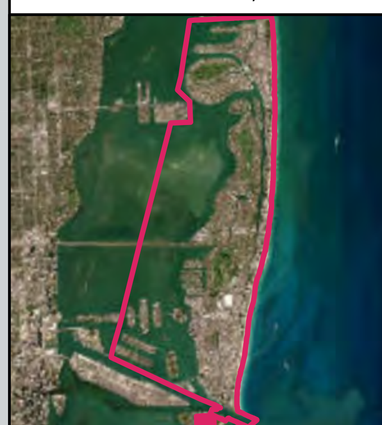
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

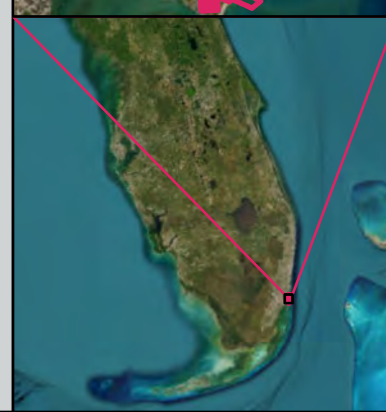
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

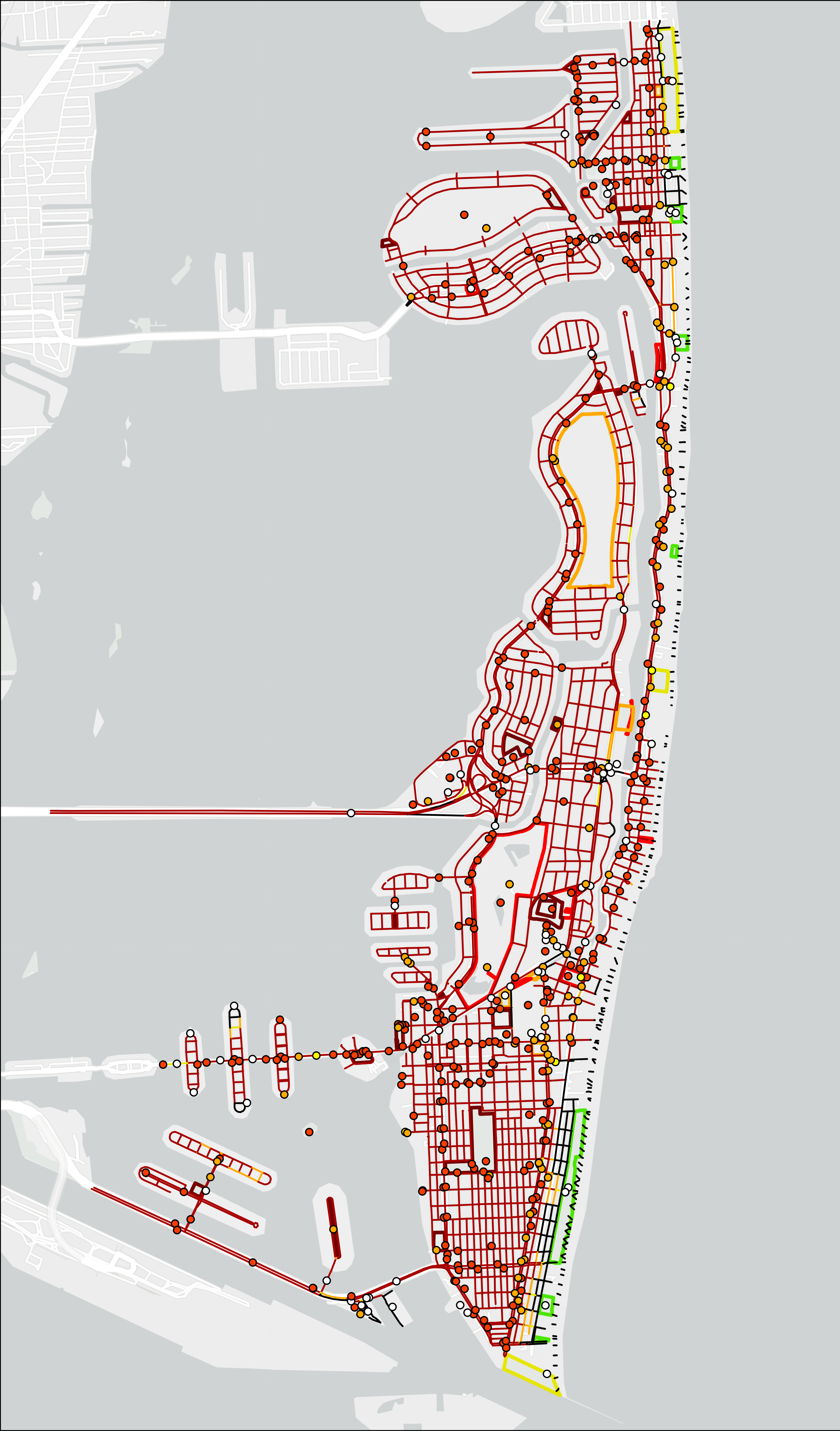
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario
King Tide
2070 NOAA Intermediate High
1.8' NAVD88 Water Elevation
+2.9' Sea Level Rise

Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

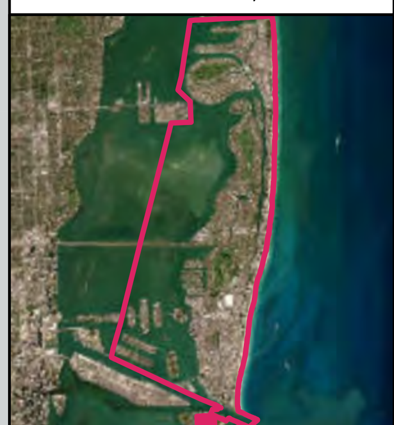
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

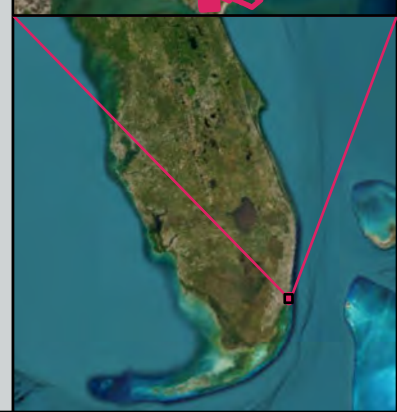
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

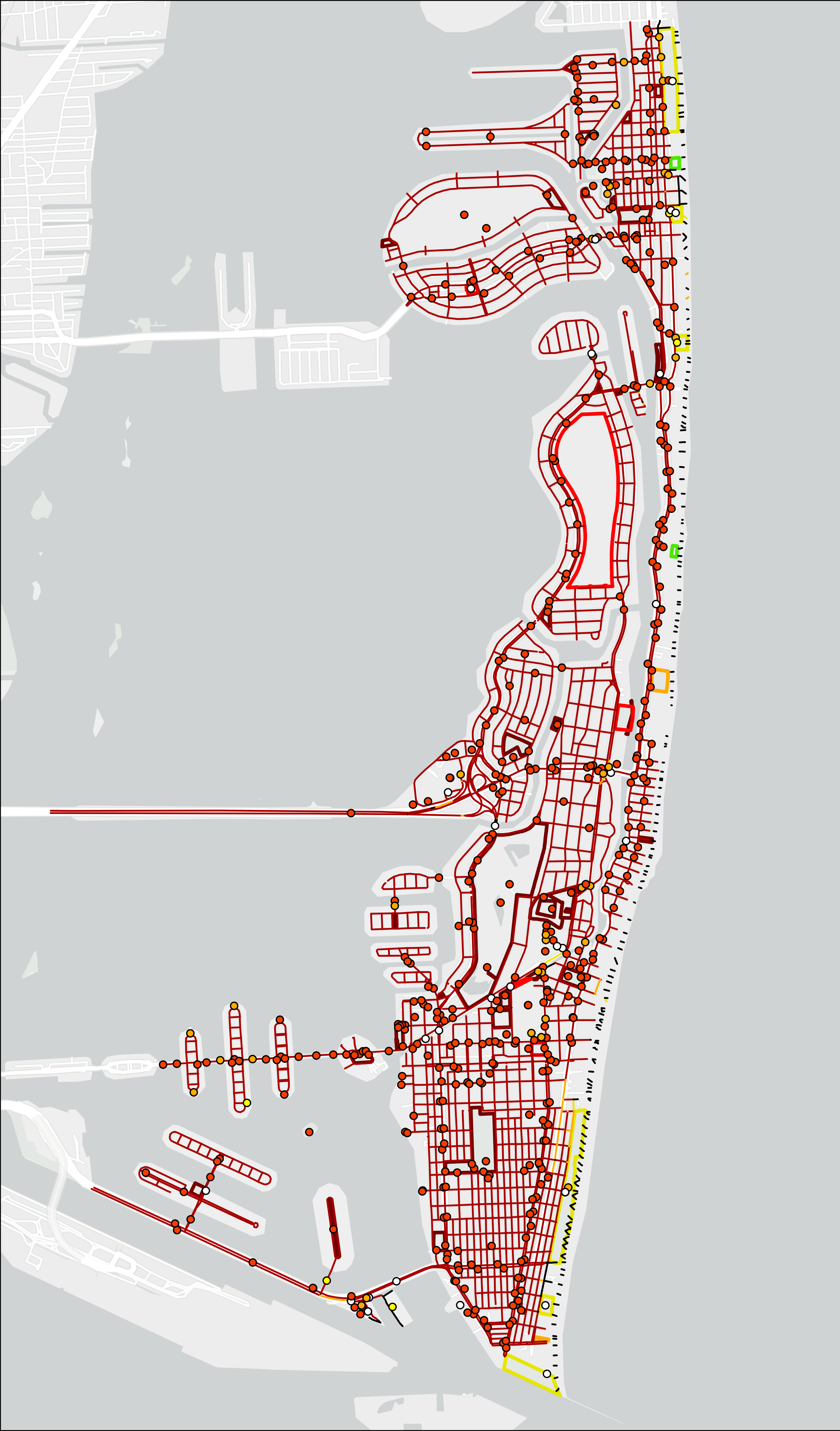
MIAMIBEACH

N 0 2,000 4,000 Feet

Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario
King Tide
2070 NOAA High
1.8' NAVD88 Water Elevation
+4.1' Sea Level Rise

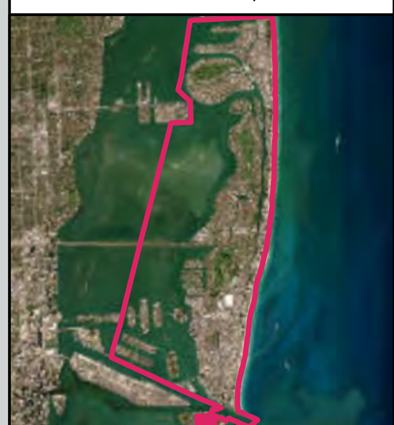
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

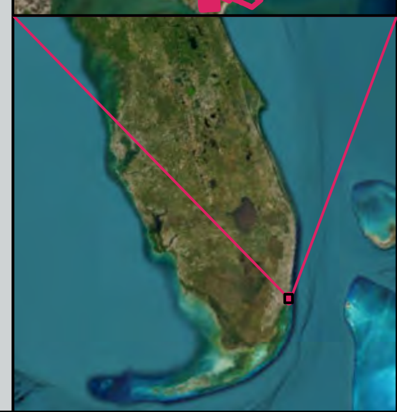
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

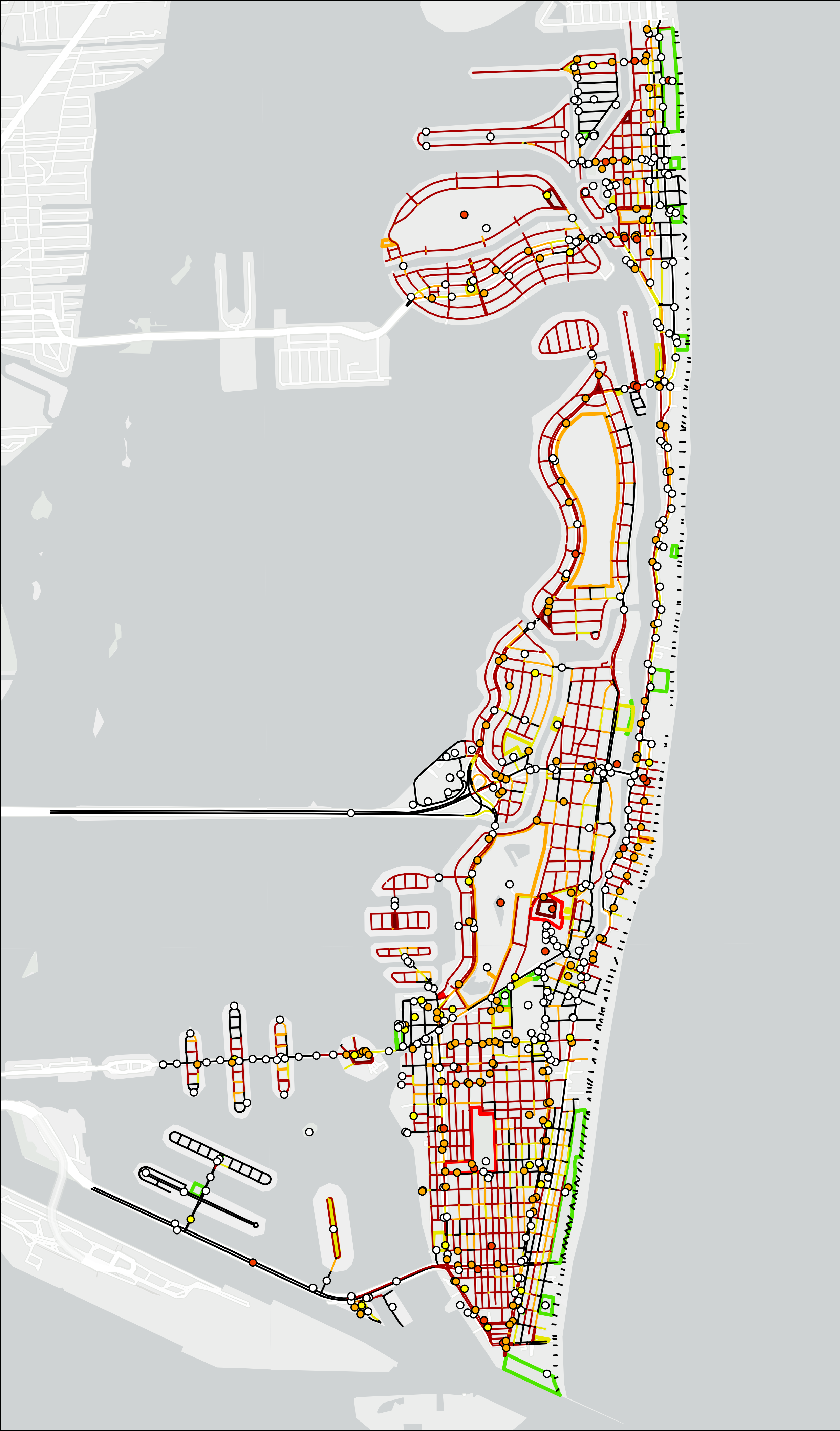
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
Existing Conditions
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.0' Sea Level Rise

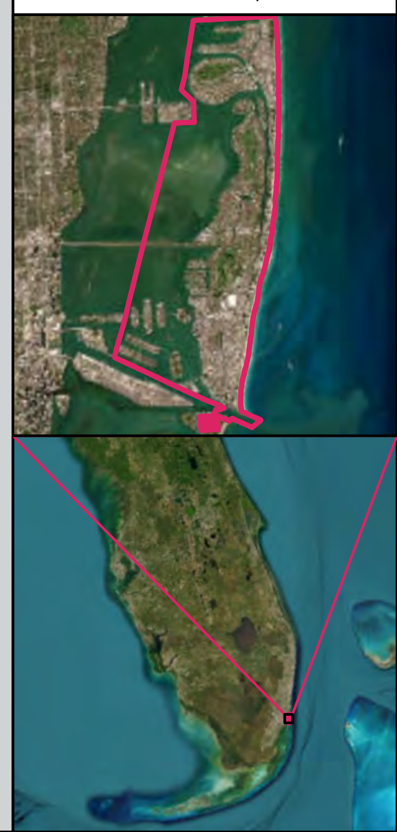
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

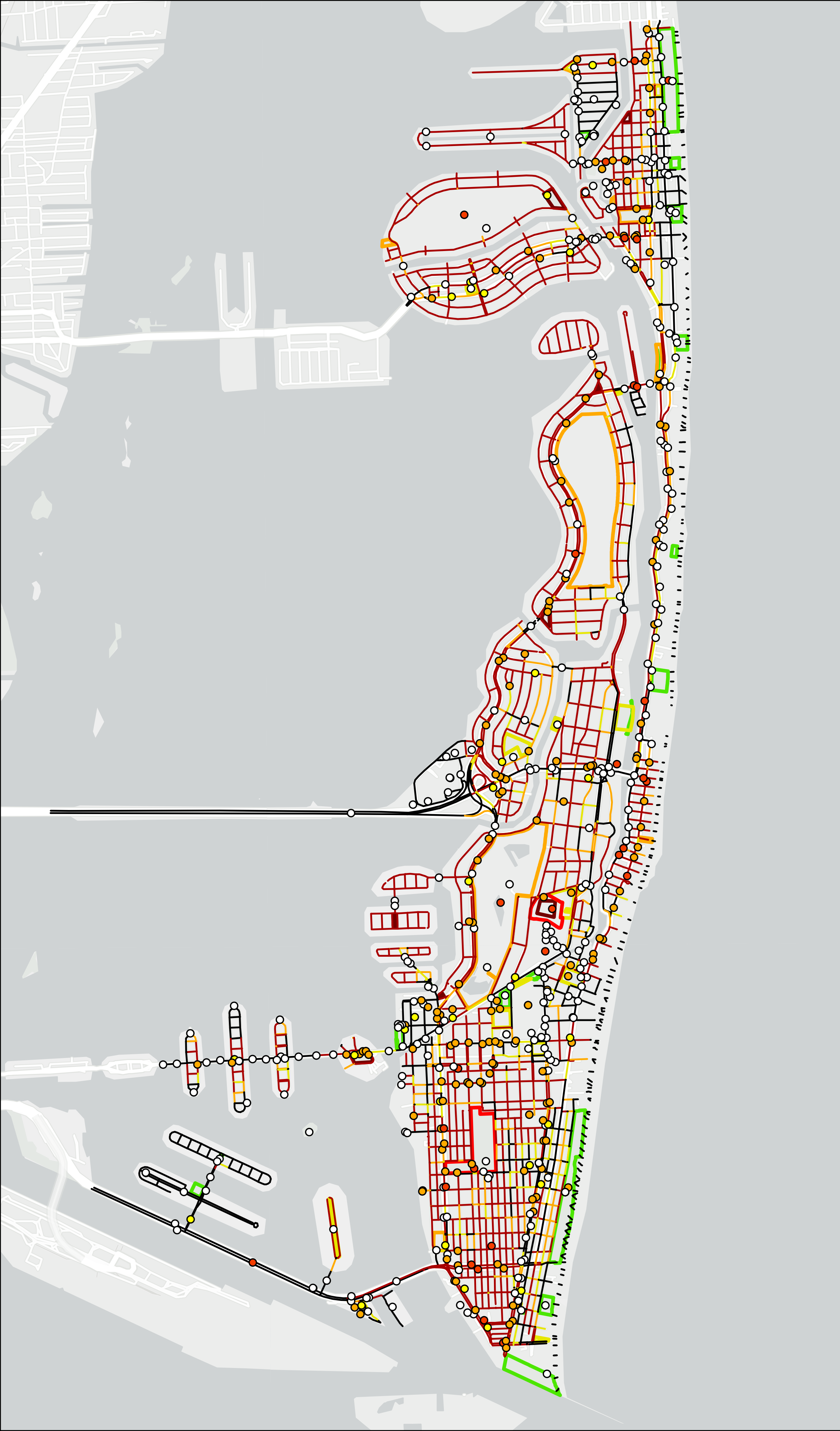
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000





City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
2040 NOAA Intermediate Low
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.3' Sea Level Rise

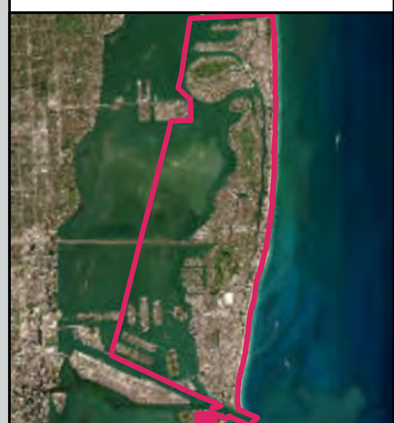
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

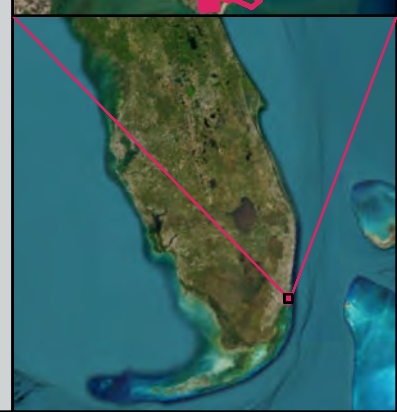
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

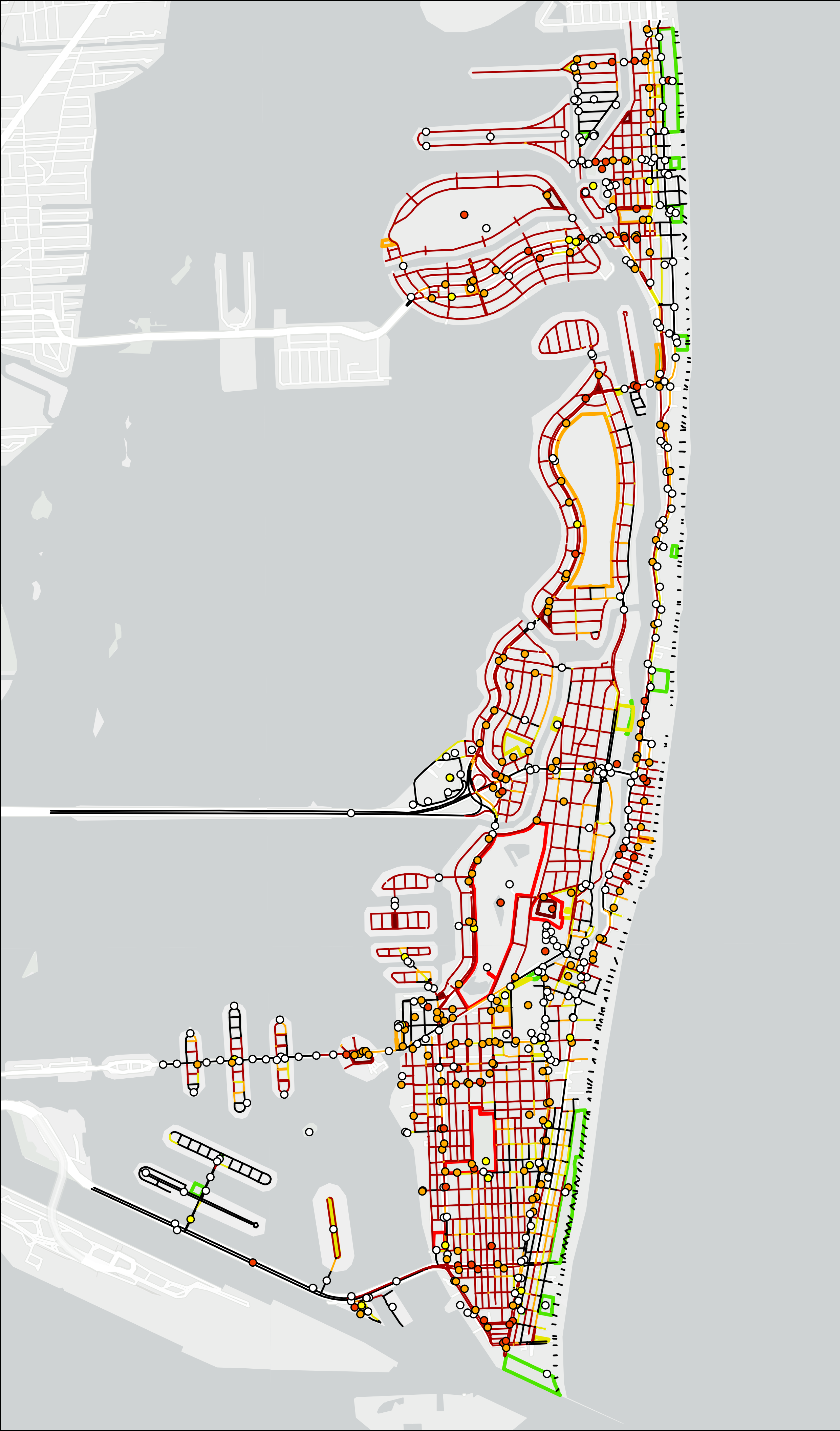
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
2040 NOAA Intermediate High
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.0' Sea Level Rise

Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

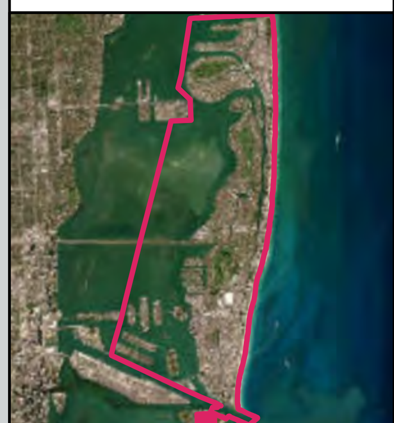
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

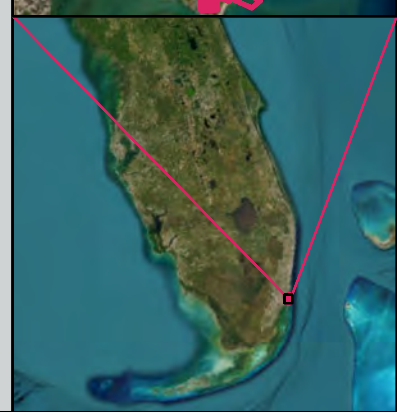
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

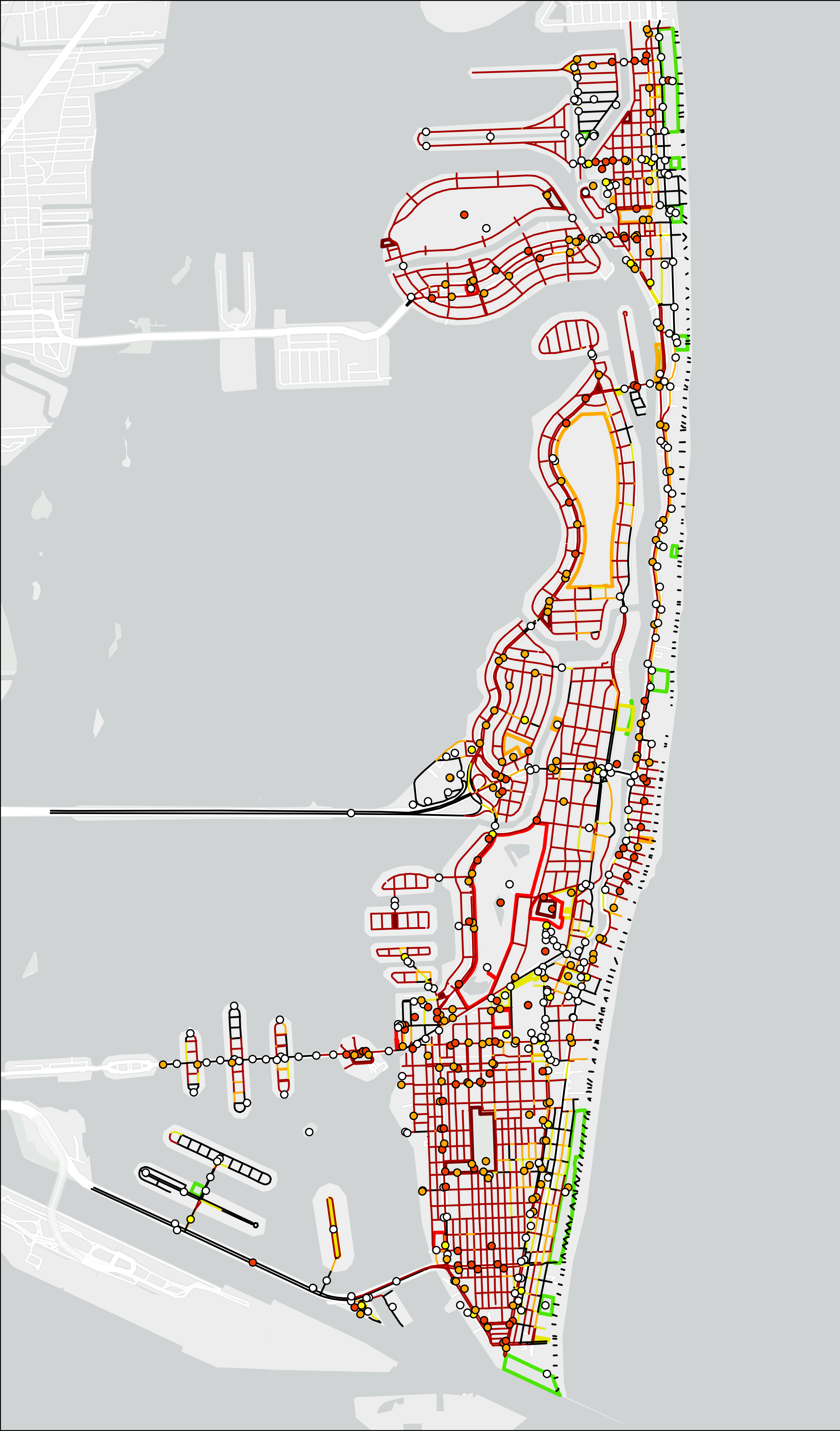
MIAMIBEACH

N 0 2,000 4,000 Feet

Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
2040 NOAA High
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+1.4' Sea Level Rise

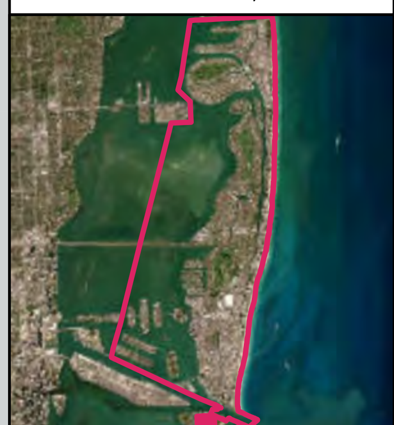
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

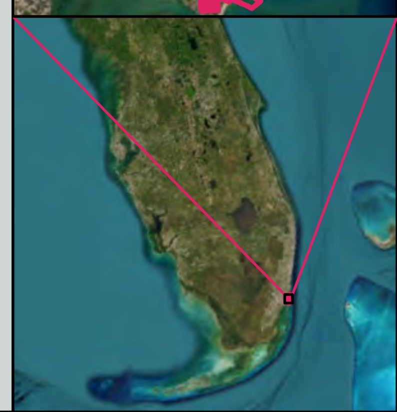
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

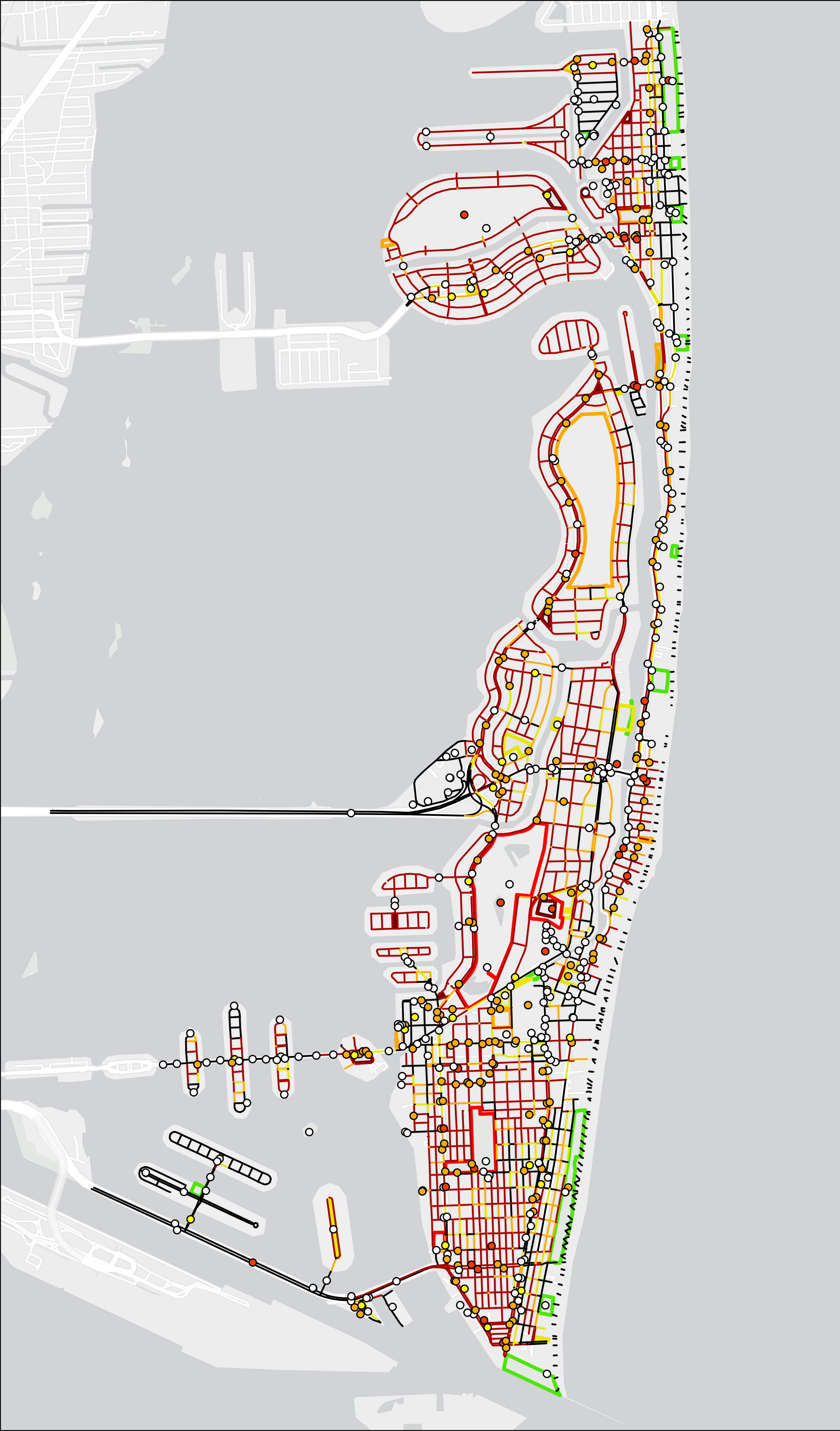
Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
2070 NOAA Intermediate Low
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+0.9' Sea Level Rise

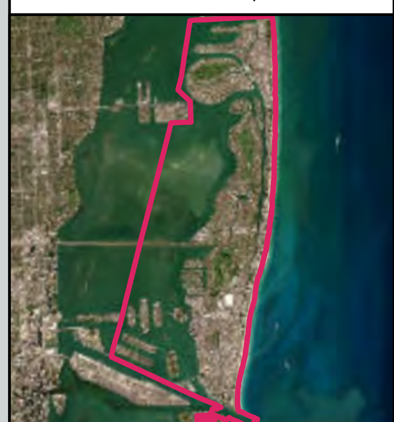
Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

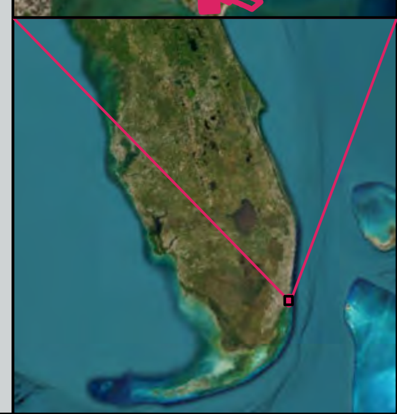
Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
- High (50% - 75%)
- Extreme (>75%)

MIAMIBEACH

N 0 2,000 4,000 Feet
Projection: NAD 1983
State Plane Florida East
Scale 1:31,000

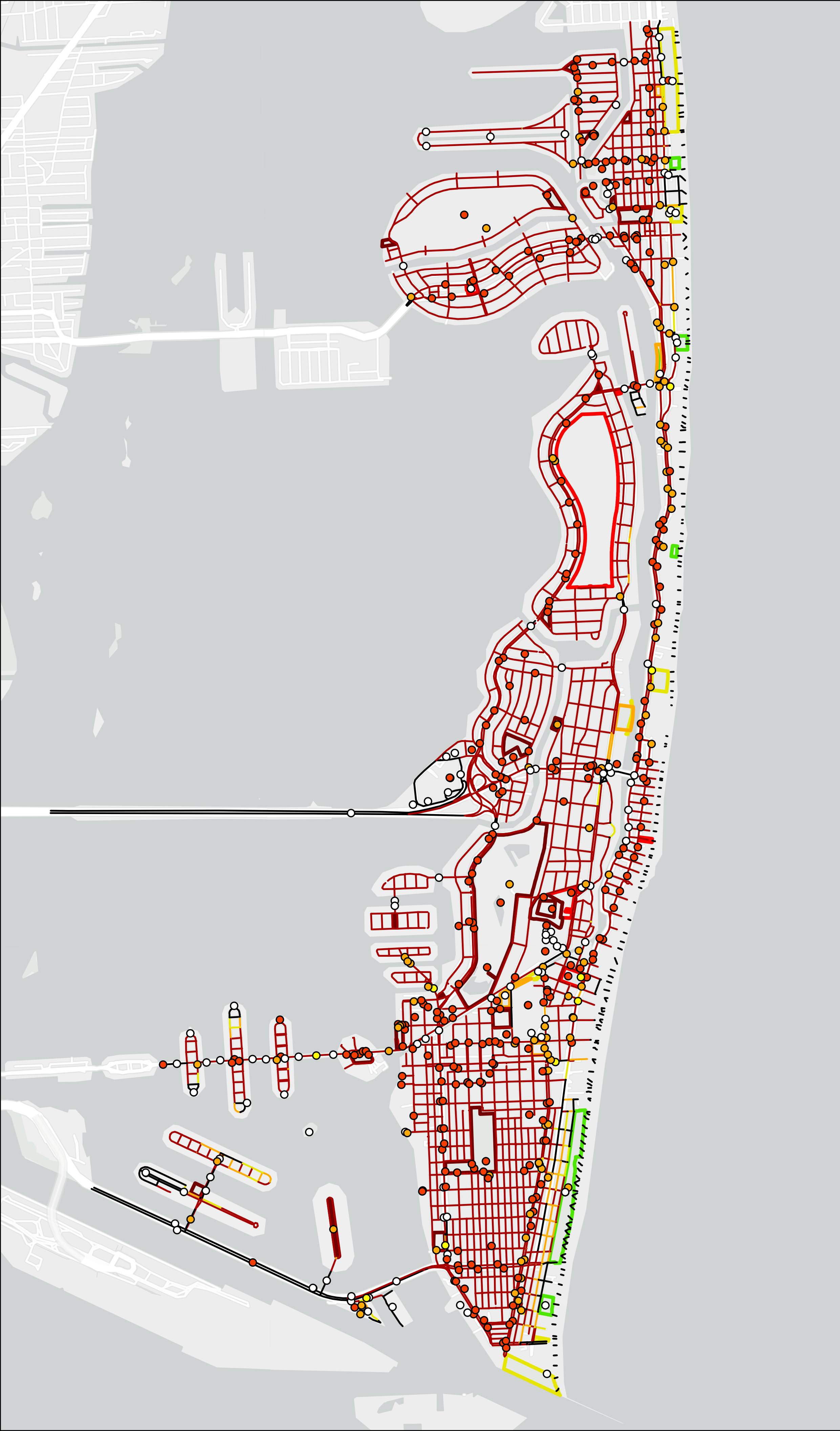


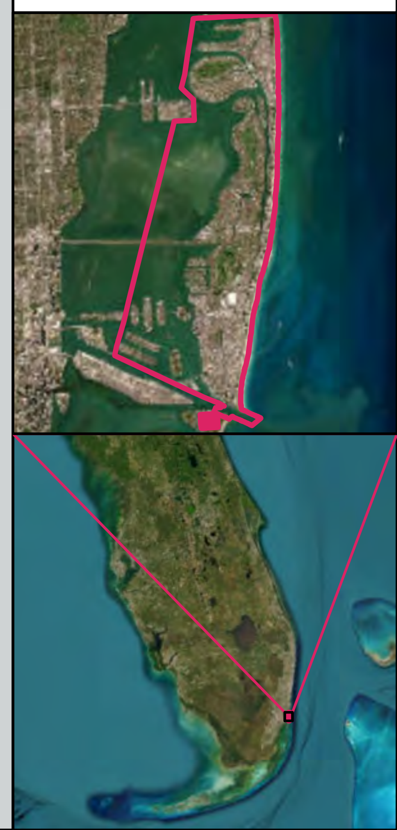


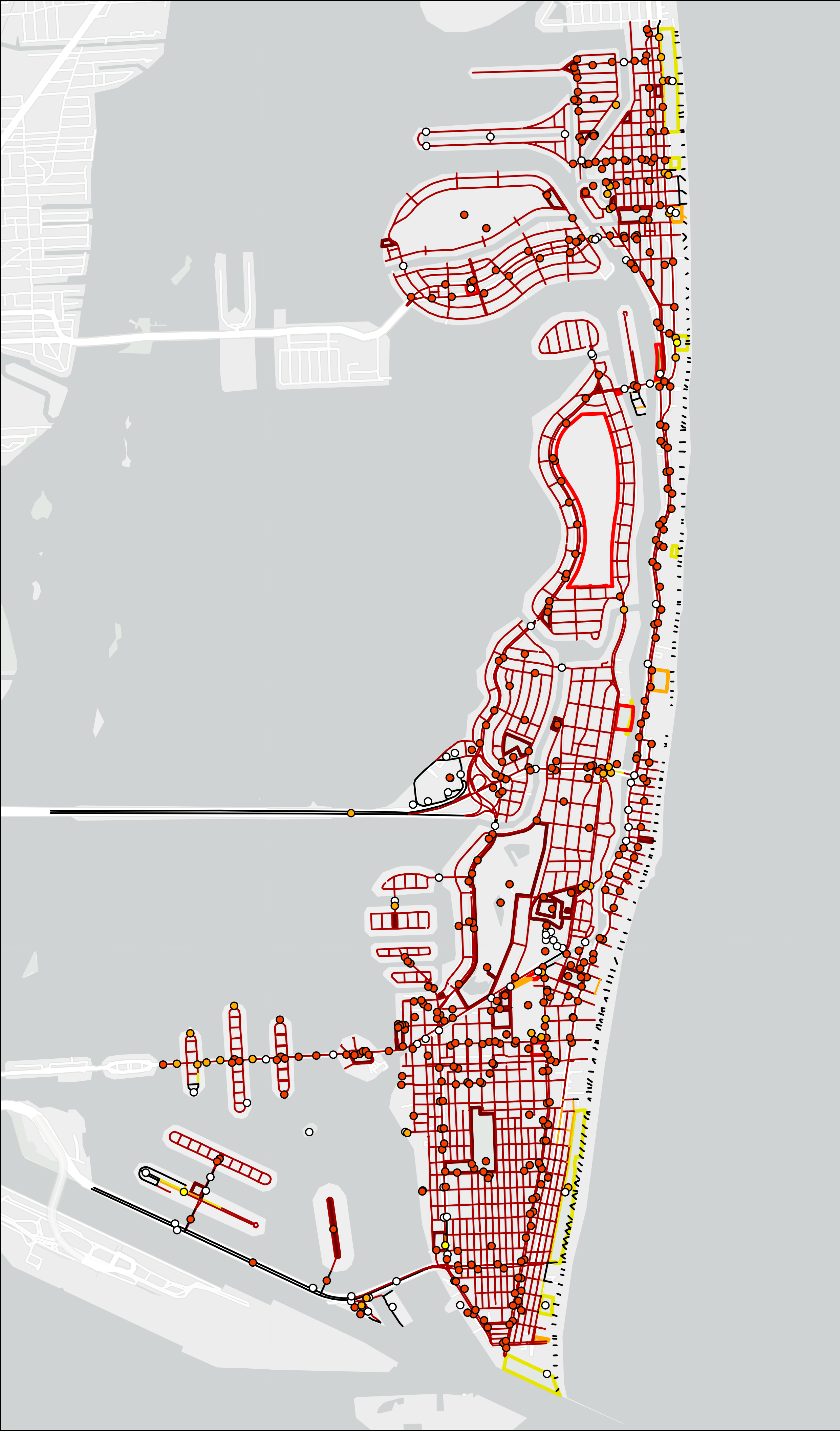
City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
2070 NOAA Intermediate High
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+2.9' Sea Level Rise







City of Miami Beach

Vulnerability Assessment
Flood Severity Analysis

Mapped Flood Scenario:
Compound Flooding
2070 NOAA High
10 Year, 24 Hour Rainfall Event
+King Tide (1.8 Feet NAVD88)
+4.1' Sea Level Rise

Critical Asset Structure
- None
- Low (<3" Flood Depth)
- Medium (3" - 15")
- High (>15")

Roads and Dune Cross Overs
- None
- Low (<3" Flood Depth)
- Medium (3" - 6")
- High (>6")

Critical Asset Parcels
- None
- Low (<25% Area Inundation)
- Medium (25% - 50%)
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MIAMIBEACH

N 0 2,000 4,000 Feet
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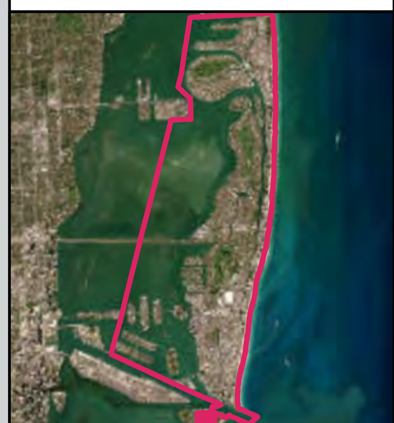
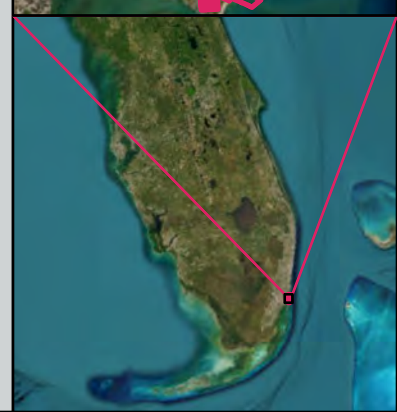
State Plane Florida East
Scale 1:31,000





Appendix G: Community Sensitivity Analysis Summary

Protecting Socially Vulnerable Populations from Flood Impacts

Climate Change and Socially Vulnerable Populations

Most residents of Miami Beach have encountered some level of disruption due to flooding, however, not all residents experience flood impacts in the same way. Socioeconomic factors can create disproportionate impacts, with some individuals lacking the resources to prepare effectively for flood events or face limited alternatives when essential services or facilities are unavailable. As climate change increases the frequency and severity of flood events, these historically disadvantaged populations are at a higher risk of experiencing worsening impacts unless proactive measures are taken. The City's Sea Level Rise Vulnerability Assessment (Assessment) recognizes these disparate experiences and integrates social vulnerability as a key factor in its analysis. Assets serving vulnerable populations are weighted to reflect this vulnerability and draw attention to the needs of these residents and communities.

Where Are Miami Beach's Socially Vulnerable Communities?

Defining a 'socially vulnerable community' can be challenging as there is no one-size-fits-all definition due to the many factors that influence an individual's risk. However, the Center for Disease Control's Social Vulnerability Index (SVI) provides a widely accepted dataset designed to assess factors increasing an individual's vulnerability to natural hazard events. The SVI uses U.S. Census information to measure certain demographic (e.g., age, disability, race), economic (e.g., income, rent-burden, unemployment) and housing characteristics (e.g., lack of personal vehicles, household size) for each census tract in the country[1]. Together, these factors can affect an individual's ability to prepare for and respond to disasters.

Census tracts with higher percentages of the population having these characteristics are considered more vulnerable to hazard events. The most vulnerable populations of the City are located within the following neighborhoods: Normandy Shores, Normandy Isles, North Shore, Ocean Front, City Center, Flamingo and Lummus and South Pointe (Figure 1).

Figure 1 Map of socially vulnerable communities

[1] For more information on the SVI (https://www.atsdr.cdc.gov/placeandhealth/svi/index.html).

Flooding Risk to Socially Vulnerable Populations

The City's Assessment evaluates City assets and facilities at risk to existing and future flooding. In the Assessment, the City used the SVI to identify infrastructure serving socially vulnerable populations to prioritize adaptation efforts that provide a direct benefit for the City's most vulnerable residents. Of the nearly 60,000 assets evaluated in the Assessment, 27% are in socially vulnerable neighborhoods. The following City assets were identified as susceptible to flooding:

- **Public Transportation** - One-third (33%) of the City's at-risk bus and trolley stops are in socially vulnerable neighborhoods. If these roadways are blocked or stops are moved, residents may struggle to commute, run errands, or travel within the City, restricting their mobility.
- **Evacuation Routes** - One-quarter (25%) of the City's roadway network is within socially vulnerable neighborhoods, including evacuation routes, such as 5th St, Collins Ave, and Normandy Ave. Should these roads become inaccessible during a flood event, vulnerable residents could become isolated and require emergency assistance to evacuate or be rescued.
- **Community Centers** - Community Centers provide essential services, including recreational activities, extracurricular programs, and childcare. North Beach has the largest SVI areas in the City and includes half (18) of the City's at-risk community centers. Flooding could result in a loss of access to critical low-cost or free programs or services offered at these locations.
- **Emergency Facilities** –Emergency response facilities, such as the Police Station Headquarters and Fire Station #1, are located just outside the SVI areas in the Flamingo and Lummus neighborhood. If these facilities are damaged during a flood event, first responders' ability to assist vulnerable individuals in South Beach would be restricted, increasing the life safety risk.
- **Parks** – Over one-quarter (28%) of the City's at-risk parks are in vulnerable neighborhoods, with many others within short walking distance. Flooding impacts to these parks would significantly impact residents by restricting access to community and recreational spaces.

Throughout the Assessment, the City hosted a series of community engagement events to understand how residents across the City experience flooding and to seek feedback on the prioritization of infrastructure protection. Residents noted several ways that socially vulnerable populations are particularly affected by flood hazards, including an increased risk of falls for elderly residents, loss of after school social programs due to closed community centers and parks, and a loss of transit opportunities for car-free residents due to flooded sidewalks and bus stops. It was also noted that while many residents can avoid flooding by staying indoors or working from home, the City is largely dependent on tourism and the service industry, which requires many working-class residents to commute across the City regardless of flood conditions.

Next Steps

The findings of the Assessment underscore disproportionate effects of flooding and provide the City a more comprehensive understanding of the increasing risk due to future sea level rise. The City can use these findings to highlight potential impacts to socially vulnerable populations from projected future flooding scenarios due to sea level rise. Information collected for the Assessment allows infrastructure risk to be viewed through an equity lens, which can be used to prioritize actions enhancing the flood resilience of infrastructure located in socially vulnerable neighborhoods across the City.

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Addendum: Draft Miami Beach's Sea Level Rise Vulnerability Assessment – Public Comments

Public Comment #1

Please include my power point linked below in Adobe Cloud Links in the public comments for the draft Miami Beach Vulnerability Assessment. My power point focuses on the fact that Miami Beach needs to do more to incentivize owners of commercial and multi-family buildings and Condo HOAs to make their buildings safer and more resilient to flooding from heavy rainfall, hurricane storm surges, tidal flooding and sea level rise and extreme winds from tropical storms and cyclones starting as soon as possible. Thank you.

Here's the attachment as a link for your review:

CRCMiamiBeachFutureDRAFTAJSVerTen080224r2.pdf

Add your comments and collaborate with others in real time. You don't need to download Acrobat or sign up to access the file.

Public Comment #2

An overarching analysis comprehending protection of identified vulnerable assets in South Beach (with MBPD, Fire Station 1, Pump Station 1, City Hall and Convention Center as well as the privately owned Baptist Health featuring critically among these) as well as conservation of Contributing Buildings, especially as concentrated in South Beach, in particular within the bounds of the federally defined Historic District necessitates calculation of aggregate benefits/savings resulting from sufficient elevation of the de facto island that is South Beach, with seawall and road raising most critical along Biscayne Bay as per the report. The implications of the report seem to require a surrounding seawall OR wholesale elevation to a given height. A seawall risks being overtopped, necessitating at best, further individual asset-protecting measures and at worst in case of catastrophic failure, results in significant damage to, or temporary or long term unavailability to fulfill the asset's intended function. This approach would take advantage of the possibilities of a single sacrificial ground floor for those conservable mid-century condo buildings characteristic of the West Ave neighbourhood, with dingbats likely easiest to adapt. The ensuing voids must in any case be waterproofed so as to protect foundations and can serve as stormwater cisterns for later release. Elevating bay-adjacent frontage also would raise outfalls and may help avoid street flooding. The focus on protecting individual assets seems shortsighted and vulnerable to system-failure

Public Comment #3

Given that NOAA data can't predict weather more than a few hours in advance, it's highly unlikely that their models – not actual data –can predict weather decades in advance. Having written this, it's good to be forward looking but please don't let 'possibility' turn into some climate hysteria campaign.

Public Comment #4

To whom it may concern,

I read the entire report on sea level rise in the City of Miami Beach and have feedback to share. Before I begin, allow me to introduce myself. My name is Dries Darrow and I have engaged the community for my projects, including pop-up events, disability access, and climate-related events. I was born and raised in Mid-Beach and still reside here till this day. After recently finishing my Master's, I teamed up with another Dutch entrepreneur to tackle sea level rise in South Florida, and started two companies. One is a climate consultancy for entrepreneurs, investors, and municipalities like yours, and the other is a subsurface barrier solution to sea level rise.

My experience and knowledge on sea level rise is limited to the last two months. Before then, I was unaware of the dire situation the City of Miami Beach is in to respond to climate-related events. Upon reading your report, I commend the City for being factual rather than optimistic. The critique I share are recommendations for responding to flooding in the short-term, and sea level rise over time.

The obvious problem is wastewater pipes that are old and eroded. I assume that replacing them is cost-intensive and a nuisance for residents. What if the pipes were raised above ground rather than below it? In Frankfurt, for example, they creatively and elegantly placed the pipes over streets to not be intrusive or obstructive. I encourage the City not to resort to old construction techniques and innovate since our problem is unique. Replacing old wastewater pipes in current construction projects works till there are no more projects. If you do replace them, reinforce them so that they can operate under pressure in saline conditions.

With that, I have to ask why all the pumps were placed in flood prone areas. The second most vulnerable city asset seems to be stormwater pump stations. I recommend that if we elevate anything, we start by raising the platform on which the pumps were placed. It is illogical, in my view, to elevate roads and properties anyways. No matter how much you increase the height, the groundwater levels will rise, and it seems unfeasible to elevate the whole City.

My second point is related to seawalls. The most vulnerable areas on Miami Beach are places that are close to Biscayne Bay or water canals. We must increase the resiliency of seawalls by employing new techniques, like those used by Kind Designs. Another approach is planting mangroves to reduce the burden on seawalls (nature-based solutions) and/or building dunes along these areas.

I have many more ideas I would like to share, but first, I look forward to your response.

Public Comment #5

Re: Vulnerable populations; definition is limited to low income. Arguably at least three other(and possibly overlapping)subpopulations show possible vulnerabilities as regards receiving emergency and evacuation instructions. Homeless individuals; non-English fluent, esp Spanish-speakers; and should such instructions be issued on Shabbos, shomer Shabbos households will need special contact protocols as appropriate to each community such as Homeless Outreach team and MBPD doing a sweep; leaflet and loudspeaker as well as media/social media announcements and any and all evacuation information being available in Spanish as well as basic proficiency for communicating emergency instructions in Spanish and ideally Creole by Officers; and an emergency point of contact for an orthodox congregation/in a substantially orthodox apt building to activate a verbal contact tree.

Public Comment #6

I am opposed to the use of property taxes to "combat sea level rise".

Sea level rising; is a ruse perpetuated by the left to scare the population. They attempt to extrapolate from whatever data that suits their narrative. What little long term data that exists, documented sea level rise to be 0 to 1 foot per century. My house in Miami Beach is a testament to this. It is nearly 100 years old and I am 2 blocks from the bay and 3 blocks from the intracoastal, and still dry! Not even Andrew or Katrina produced flood insurance claims. Their end game is for government control, whether it is by outlawing carbon dioxide, raising fuel prices, or finding another way to raise taxes. "Never let a crisis go to waste." If you disagree with their bogus arguments, you are slandered as a denier. Although floods are not my area of professional expertise, I am a real scientist and hold a Master's degree in Environmental Science from Rutgers University.

Over my 28 year residency, I have studied the "excuse", sea level rise. You will not find a satellite image with sufficient resolution to document sea level rise in MB before the year 2000. Why doesn't anyone see the folly in attempting to extrapolate from 0 to 1 foot in 100 years? Meteorologists cannot get today's rain forecast correct! MB is the worst possible place to study sea level rise, where every possible square inch has been developed and paved. Where is expected rain to go? All of the inland water has been channeled from the Everglades to coastal communities. Do they also account for the volume of sewage from Miami-Dade dumped offshore? I do not expect anyone to offer the data, although I have studied their dazzling graphics on the NOAA website. Others have reported sea level rise as one inch per decade, which is obviously too small to measure, where we have tidal variations measured in feet per hour. The recent 100 year record breaking storm brought floods several inches above my garage floor, and I live in one of the lowest flood zones in MB, the Muss Park area.

That being said, I do not oppose small measures to mitigate flooding, realizing that any effort will be only as effective as the condition of my neighbor's bulkhead.

Of greatest urgency is overhaul of FEMA with respect to the flood insurance crisis. My flood insurance premium exceeds my homeowner's insurance premium for about 1/3 the coverage. How is this possible? I am told that flooding outweighs all other perils. Another socialist government program out of control. All federal, state, and local politicians must prioritize the insurance crisis, which is my largest source of inflation.

Public Comment #7

Maintenance draining street system please!

I live on Tatum waterway drive and gets flooded because the street storm drains are always clogged with leaves and trash.

MIAMIBEACH
RISING ABOVE

City Liaison
Amy Knowles

Neighborhood Resiliency Projects Advisory Committee
Committee Members
Clare McCord, Chair
Curt Dyer, Vice Chair
Alon Alexander
Galen Treuer
Karin Matos
Ronald Starkman

MEETING AGENDA
Wednesday, September 18, 2024 – 4:30 - 6:00 PM

Building Department Conference Room
1700 Convention Center Drive, 2nd Floor
Miami Beach, FL 33139
Zoom Information**
Link: https://us06web.zoom.us/j/86485629755
Or Telephone: +1 305 224 1968 US
Webinar ID: 864 8562 9755
Please note that Committee members are required to attend in person

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Call to Order/Roll Call

Committee Business

Approval of Minutes

Sea Level Rise Vulnerability Assessment
- Noel Webber and Juanita Ballesteros, Environment and Sustainability

Referral C4 A 07/24/24: Discuss incorporation of Green and Blue Solutions for Future Infrastructure Projects

Future Committee Topic/Focus Discussion

Fall Meeting Date Review
- October 23 @4:30 pm
- November 13 @4:30 pm

Staff Updates

Current/Future Project Updates

Public Comment

Adjournment

Next Meeting

October 23 @4:30 pm

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Neighborhood Resiliency Projects Advisory Committee

Committee Members
Clare McCord, Chair
Curt Dyer, Vice Chair
Alon Alexander
Galen Treuer
Karin Matos
Ronald Starkman

City Liaison
Amy Knowles

Committee Purpose

The purpose of the Neighborhood Resilience Projects Advisory Committee is to act as an advisory board to City Commission and City Manager on neighborhood infrastructure programs and private property matters related to the City's resilience projects. This includes helping build awareness of existing and future projects within the community and seeking resident ideas and feedback to improve the planning and delivery of future projects. The Committee will not advise on matters that have specifically been reviewed by the City Commission to avoid creating fiscal impacts or undue delays in the implementation of critical resiliency projects.

Powers and Duties

The Committee shall have the following powers and duties:

(1) Provide advisory recommendations and feedback on best approaches to enhance resident education and resident engagement.

(2) Provide advisory recommendations and feedback regarding process improvements for flood mitigation.

(3) Share input and evaluate general neighborhood aesthetics and utility and infrastructure improvements, such as location decision criteria for pump stations or other improvements.

(4) Provide a forum for the Committee to share best practices and lessons learned from completed projects and/or ongoing projects, for potential incorporation as part of future projects.

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OFFICE OF THE CITY MANAGER

LTC #

LETTER TO COMMISSION

TO: Honorable Mayor Steven Meiner and Members of the City Commission

FROM: Rafael E. Granado, City Clerk

DocuSigned by: Rafael E. Granado
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DATE: September 20, 2024

SUBJECT: Neighborhood Resilience Projects Advisory Committee Motion

The purpose of this Letter to Commission is to provide the motion made at the Neighborhood Resilience Projects Advisory Committee meeting held on September 18, 2024.

Attachment: Neighborhood Resilience Projects Advisory Committee motion.

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Neighborhood Resilience Projects Advisory Committee
Committee Members
Clare McCord, Chair
Amy Knowles, Liaison

Members:

Clare McCord (Chair-present), Curt Dyer (Vice-Chair present), Alon Alexander (virtual), Julie Basner (present), Karin Matos (present), Ron Starkman (present), Galen Treuer (present)

TO: Honorable Mayor Steven Meiner and Members of the City Commission

FROM: Clare McCord, Neighborhood Resilience Projects Advisory Committee Chair

DATE: September 20, 2024

SUBJECT: Neighborhood Resilience Projects Advisory Committee motion regarding the City of Miami Beach Sea Level Rise Vulnerability Assessment and Adaptation Plan update

The Neighborhood Resilience Projects Advisory Committee (NRPAC) met on September 18, 2024 and passed the following motion:

On September 18, 2024, the Neighborhood Resilience Projects Advisory Committee was presented the City's Sea Level Rise Vulnerability Assessment report and Adaptation Plan. The Committee enthusiastically supports this work and the continued development of an Adaptation Plan focused on changing conditions, which is a more flexible and innovative approach than traditional planning.

Motion passed: 6-0

Sincerely,

DocuSigned by:
Clare McCord
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Clare McCord
Chair, Neighborhood Resilience Projects Advisory Committee Chair

City of Miami Beach

Sea Level Rise Vulnerability Assessment Report

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