Sea Level Rise Vulnerability Analysis

PHASE 1

OCTOBER 2022

SUBMITTED TO

Captiva Erosion Prevention District (CEPD)
11513 Andy Rosse Lane
Captiva, FL 33924

SUBMITTED BY:

Aptim Coastal Planning & Engineering, LLC (APTIM)
6401 Congress Avenue, Suite 140
Boca Raton, FL 33487

Table of Contents

List of Tables

List of Figures

Executive Summary

Continuing to protect coastal infrastructure and valued resources through strategic adaptation will become increasingly pertinent as sea level rise accelerates and tidal flooding and severe storm surge events increase in frequency. The Captiva Erosion Prevention District (CEPD) has actively invested in coastal resilience for decades through beach and dune nourishment and shoreline enhancement projects. The CEPD authorized the development of the "Sea Level Rise Vulnerability Analysis" for Captiva Island to identify geographic areas and physical assets vulnerable to current and future flooding. This effort supports the incorporation of future conditions planning into the CEPD's Beach and Shore Preservation Program and will serve as the first phase of development of a comprehensive resilience strategy.

To maximize grant funding potential from the Resilient Florida Program, this vulnerability assessment was conducted in alignment with state guidance and legislation. The analysis accounts for sea level rise projected for 2040 and 2070, tidal flooding, storm surge, and rainfall and surge flooding expected from a 100-year storm and 500- year storm under existing sea level conditions. The flood and sea level scenarios were visualized and mapped to determine the extent of the island and the on and off island critical infrastructure that would be exposed. The potential impacts associated with each scenario were summarized by asset type including critical infrastructure, critical facilities, and valued resources on the island. The likelihood of occurrence of specific scenarios and the associated magnitude of impact of the flooding was analyzed island-wide and by asset to assess risk and rank vulnerabilities. The findings of the vulnerability assessment are intended to support subsequent funding pursuits and project conceptualization to increase community and coastal resilience.

Key Findings:

- Bayfront shorelines are more vulnerable to frequent flooding than the oceanfront shorelines. Flood trespassing across the bayfront shorelines causes critical infrastructure like the fire station to be vulnerable in the near term.
- Vulnerabilities that may be addressed through policy and adaptation measures are clustered in four Adaptation Action Areas (AAA): Chadwick Bayou AAA, Central Captiva AAA, Roosevelt Channel AAA, and Blind Pass AAA. The assets primarily affected in these areas are shorelines, roads (including the evacuation route), critical facilities (wastewater plants, fire station, recovery center, communication), and critical infrastructure (stormwater).
- The following three flood scenarios represent "tipping points" or points of significant change in overall island inundation and in degree of impact to critical assets:
    - The tidal flooding occurring in recent years has impacted stormwater management and water supply facilities, compounded impacts of simultaneous rainfall flooding and disrupted traffic on some roads, creating a nuisance for the community today with minimal impacts. Approximately 37% of buildings on the island (based on footprints) are affected on the island and experience less than one foot of flooding by tides.
    - The next tipping point may occur during a storm with ocean surge elevations predicted to occur every 10 years or during the highest high tides in year 2040 or during typical conditions in 2070. These flood elevations are similar and may cause flooding along most of the bayfront parcels and within the mangrove areas, along most of the roads south of the library, and impacting the evacuation route, fire station and the north end of the island, creating disruption for the community. Approximately 71% of buildings on the island (based on footprints) would be affected on the island by this point. 30% of impacted buildings would experience less than one foot of flooding and 70% would experience between 1-2 feet of flooding during a 10 year surge event or during the highest tides in 2040.

- The most severe tipping point may be represented by the 100-year flood scenario, as was observed during Hurricane Ian. Flooding across most oceanfront parcels may occur, resulting in catastrophic damage to the community. While this type of extreme event occurs rarely today, with predicted sea level rise by 2070, the anticipated frequency of storm surge of this magnitude is anticipated to occur once every 25 years rather than once every 100 years. More than 95% of buildings (based on footprints) on the island would be affected on the island by this point and experience greater than two feet of flooding.

This organization of this document is outlined on the next page. A glossary is included to define key technical terms. To simplify the presentation of analysis findings, the aforementioned three primary tipping points are described in detail in the main document sections while the results from the ten scenarios analyzed are included in the appendices. The appendix also included an introductory presentation to the topics discussed in this analysis (Appendix VIII).

Introduction

Provides background context, technical definitions, introduces sea level rise scenarios and planning horizons, and discusses Hurricane Ian in context

Exposure Analysis

Determines what parts of the island are likely to be affected by each flooding scenario and when flooding may occur. Compares difference in flood extents and ranks flood scenarios based on tipping points in land area exposed.

Sensitivity Analysis

Determines the depth of flooding for each scenario. Summarizes impacts and flood depths by asset sectors. Asset impacts described in five sections: critical infrastructure, transportation and evacuation route, critical facilities and island resources.

Risk Assessment

Ranks risks to assets based on likelihood of flood scenario occurrence and impact of flooding.

Adaptation Action Areas Consideration

Identifies vulnerable areas based on the exposure, sensitivity and risk analyses for focus in resilience and adaptation planning. Shares preliminary adaptation strategies for future evaluation.

Next Steps

Highlights opportunities for CEPD to enhance resilience strategy

Introduction

Glossary

The following definitions provide explanation of technical terms and provide context for how the terms are used in the report. The introductory community presentation attached in Appendix VIII provides additional visuals for improved understanding of some of the listed terms.

100 Year Flood

The level of flooding that has a 1% chance of occurring in any given year, and has an equal chance of occurring every year, regardless of whether or not it occurred in previous years.

500 Year Flood

The flood level that has a 0.2% chance of occurring in any given year.

Asset

A physical resource containing economic value and/or future benefit. A critical asset is one whose loss, damage, disruption, or degradation would result in significant adverse impacts to human life, health, or security,

Compound Flooding

Compound flooding results from two or more flooding sources occurring simultaneously or subsequently within a short period of time. The combination of flood sources (storm surge, sea level rise, and heavy rainfall) can lead to higher inundation levels. Compound flooding is often the result of major storms or hurricanes.

Disturbance

Higher levels of inundation than nuisance flooding (1-2 feet) that poses more significant threats to public safety or causes greater property damage.

Exposure

A measure of how much change in inundation an asset or community is likely to experience.

Heavy Rainfall

Inland flooding caused by rainfall occurs as the result of steady rainfall occurring over several days and/or a short and intense period of rainfall, often associated with a storm or hurricane.

Impact

Extreme levels of inundation than nuisance flooding (>2 feet) associated with rainfall flooding, that poses extreme threats to public safety or causes major property damage.

Inundation

The rising of a body of water and its overflowing onto normally dry land. Generally refers to the condition of being flooded.

Nuisance

Low levels of inundation (<1 foot) associated with rainfall flooding, river flooding, and/or coastal flooding. Nuisance flooding does not pose significant threats to public safety or cause major property damage, but can disrupt routine day-to-day activities, put added strain on infrastructure systems such as roadways and sewers, and cause minor property damage.

Risk

A function of the likelihood of inundation occurrence and the impact of inundation.

Sea Level Rise

Global warming is causing global mean sea level to rise in two ways- thermal expansion caused by warming of the ocean (water expands as it warms) and increased melting of land-based ice (glaciers and ice sheets). The ocean is absorbing more than 90 percent of the increased atmospheric heat associated with emissions from human activity, which causes sea level to rise. Sea level plays a role in flooding, shoreline erosion, and hazards from storms. Higher sea level also means more frequent high-tide flooding or "nuisance flooding"

Sensitivity

A measure of whether and how an asset or community is likely to be affected by a given change in inundation.

Storm Surge

Storm surge is the rise in seawater level caused solely by a storm. The surge is caused primarily by a storm's winds pushing water onshore. Higher sea levels mean that storm surges push farther inland.

Tidal Flooding

The temporary inundation of low-lying areas, especially streets, during exceptionally high tide events, such as at full and new moons. The highest tides of the year may be known as the king tide, with the month varying by location.

Vulnerability

A measure of how susceptible a given asset or community is to the impacts of flooding.

Background

As the frequency and intensity of climate- related hazards increases, it is becoming extremely important for local municipalities and entities to identify and quantify vulnerability and determine appropriate measures to address risk. Flooding caused by sea level rise, storm surge, and precipitation, is a major climate-related hazard impacting communities worldwide, nationwide, and especially within the state of Florida. The Captiva Erosion Prevention District (CEPD) recognizes this threat and has contracted APTIM to produce a state regulation compliant, flood vulnerability analysis. This assessment is necessary for state funding eligibility and additional immediate preparatory actions to support applications for resilience and coastal infrastructure funding.

In 2020, Integral Consulting produced a Captiva Island Resiliency Assessment, which served to summarize if roads, parcels, structures and specific on-island critical facilities would be affected under 1, 2, 4 and 7 foot sea level rise scenarios. The results of this assessment helped lay the foundation for understanding flood vulnerability for this area, however it did not account for various causes and intensities of flooding, nor did it quantify risk.

In 2021, state legislation 380.093 F.S. provided criteria for establishing a statewide risk assessment and resilience plan inclusive of projects ranked by priority for potential funding allocations. The Florida Department of Environmental Protection has initiated implementing this legislation by collecting grant applications for resilience projects to be included in the state plan and providing guidance on vulnerability assessments with the requirement that guidance-consistent reports and geodata from assessments to be submitted with applications.

This "Flood Vulnerability Analysis" (2022) accounts for the sea level rise scenarios required by the state (NOAA Intermediate High and Intermediate Low in 2040 and 2070) and several additional scenarios. These scenarios represent inundation levels caused by storm surge, tidal flooding, and additional extreme flood events, which paints a comprehensive picture of flood vulnerability. Moreover, it completes the analysis of the regional asset inventory of Captiva Island (including on and off island critical infrastructure) for both exposure and sensitivity to flooding and ranks the island's vulnerabilities by risk level. Preliminary actions and next steps are outlined to support development of the next phase of the comprehensive resilience strategy and funding applications.

Datums, Flood Scenarios and Planning Horizons

In order to determine, discuss, and compare water elevation levels for various flood scenarios, it is first necessary to understand the relevant vertical datum and tidal datums that will be referenced. The following definitions were derived directly from the NOAA Tides and Currents glossary. In general, a **datum** is a base elevation used as a reference from which to reckon heights or depths. A **vertical datum** is a surface of zero elevation to which heights of various points are referenced. The current vertical datum for the contiguous United States and Alaska is the North American Vertical Datum of 1988 (NAVD88).

A **tidal datum** is a standard elevation defined by a certain phase of the tide. Tidal datums are used as references or benchmarks to measure local water levels. The National Tidal Datum Epoch is a 19-year period adopted by the National Ocean Service as the official time period over which tide observations are taken to determine mean values for tidal datums. Elevation and water levels utilized for the purpose of this analysis are measured in feet NAVD with reference to local tidal datum. Specific tidal datums that will be referenced within this report include the following:

Mean Higher High Water (MHHW)

The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch.

Mean High Water(MHW)

The average of all the high water heights observed over the National Tidal Datum Epoch.

Mean Sea Level (MSL)

The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch.

Mean Low Water (MLW)

The average of all the low water heights observed over the National Tidal Datum Epoch.

The Captiva Erosion Prevention District (CEPD) is located in close proximity to two tide gauges- station 8725520 in Fort Myers, FL and station 8725110 in Naples, FL (see Figure 1). Both gauges are operated and maintained by NOAA/NOS/CO-OPS, and published on NOAA's Tides & Currents website (http:\\tidesandcurrents.noaa.gov).

Figure 1. Tide Gauge Locations Near Captiva, FL

Sea level data utilized for mapping purposes in this assessment was retrieved from the Fort Myers station as it is the closest gauge with the highest mean sea level (-0.41 NAVD, compared to -0.62 MSL at the Naples, FL gauge). Relative to the current Mean High High Water (MHHW) level at the Fort Myers gauge, the sea level change scenarios for Fort Myers indicate a water level of 0.63 ft NAVD according to the 2040 Intermediate Low scenario, a water level of 1.31 ft NAVD according to the 2040 Intermediate High scenario and a water level of 3.22 ft NAVD according to the 2070 Intermediate High scenario. These projections are consistent with the most recent state requirements for resiliency grant funding eligibility. Figure 2 depicts the NOAA 2017 relative sea level rise change scenarios for Fort Myers.

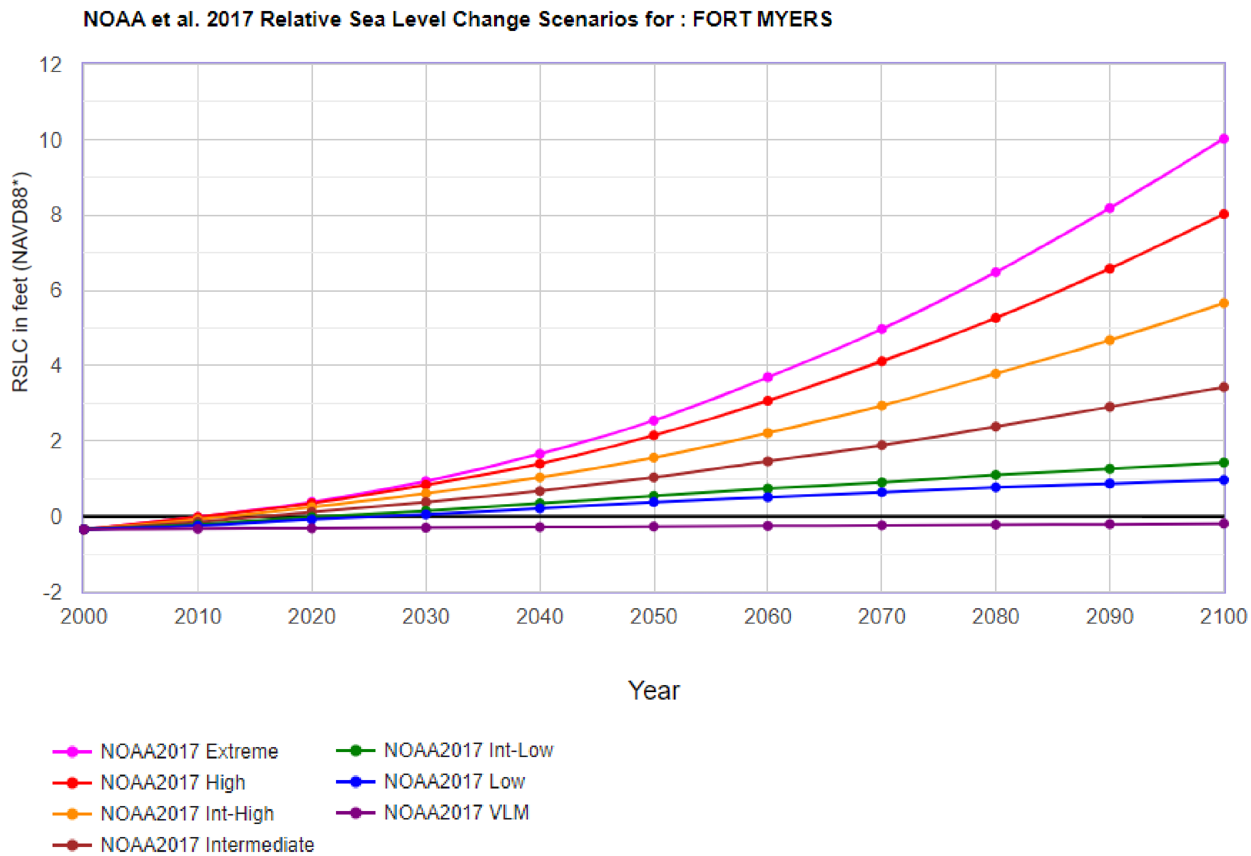


Figure 2. NOAA 2017 Relative Sea Level Change Scenarios for Fort Myers, FL

Water levels reflecting +1 ft SLR, +2 ft SLR, +4 ft SLR, and +7 ft SLR relative to the current Mean High High Water (MHHW) level at the Fort Myers gauge were also projected. The inclusion of these water level elevations represents the intent to compare levels and associated impacts to those measurements of identical methodology from the 2020 Captiva Island Resiliency Assessment.

Additional conditions and associated water level elevations that may occur such as a tidal flooding event and a 10 year return interval storm surge event, were also mapped. The 2017 king tides have been the highest experienced in recent past, and serve as a tidal flooding extreme. Thus, the highest king tide elevation in Fort Myers during this time is used to represent the upper bound of current or existing tidal flooding (2.31 ft NAVD on October 7, 2017).

The water level for the 10 YR Surge was derived from the Lee County FEMA Flood Insurance Study (FIS). The FIS indicated that the stillwater elevation for a 10-year storm for Matlacha Pass would be 3.5 feet NAVD. Also derived from the FIS, were the stillwater elevations for a **1 percent annual chance flood or an Existing 100 Year Flood Event** (8.8 ft NAVD) and a **0.2 percent annual chance flood or an Existing 500 Year Flood Event** (11.1 ft NAVD).

The water level elevations are outlined in Table 1 and associated island inundation maps are included in the CEPD Exposure Analysis section of this report. Technical water level names are listed and those in red represent "duplicate" elevations, as there is a difference of less than six inches between them and other water levels.

Table 1. Original Water Level Elevations for Captiva, FL

Scenarios	Feet NAVD
2040 NOAA Intermediate Low MHHW	0.6
2070 NOAA Intermediate Low MHHW	1.2
MHHW 0.28 'NAVD @ Fort Myers +1' SLR	1.3
2040 NOAA Intermediate High MHHW	1.3
MHHW 0.28' NAVD @ Fort Myers +2' SLR	2.3
Tidal Flooding, Existing	2.3
2070 NOAA Intermediate High MHHW	3.2
Tidal Flooding, 2040	3.3
10YR Surge, Existing	3.5
MHHW 0.28' NAVD @ Fort Myers +4' SLR	4.3
10YR Surge, 2040	4.5
Tidal Flooding, 2070	5.2
10YR Surge, 2070	6.4
MHHW 0.28' NAVD @ Fort Myers +7' SLR	7.3
1 percent annual chance flood	8.8
.2 percent annual chance flood	11.1

These scenarios were not mapped for exposure or sensitivity purposes as their inundation extent and resulting impact are accounted for by proxy by the water elevations close in measurement. More specifically:

- 2070 NOAA Intermediate Low scenario (1.2 ft NAVD) and MHHW 0.3 'NAVD @ Fort Myers +1' SLR are "duplicates" of 2040 NOAA Intermediate High scenario (1.3 ft NAVD)
- MHHW 0.3' NAVD @ Fort Myers +2' SLR (2.3 ft NAVD) is a "duplicate" of Existing Tidal Flooding scenario (2.3 ft NAVD)
- 2040 Tidal Flooding scenario (3.3 ft NAVD) and Existing 10 YR Surge scenario (3.5 ft NAVD)are "duplicates" of 2070 NOAA Intermediate High MHHW (3.2 ft NAVD)
- 2040 10 YR Surge scenario (4.5 ft NAVD) is a duplicate of MHHW 0.3' NAVD @ Fort Myers +4' SLR scenario (4.3 ft NAVD)

Table 2 depicts the finalized ten scenarios that were utilized for the exposure and sensitivity analysis of Captiva, FL. The updated scenario names in table reflect the consolidation of the identified "duplicate" water levels and represent simplified terminology. These names will be utilized throughout the report.

Table 2. Consolidated Water Level Elevations for Captiva, FL.

Scenarios	Feet NAVD
2040 NOAA Int Low	0.6
2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR	1.2-1.3
2017 Tidal Flooding / + 2 ft SLR	2.3
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	3.2-3.5
2040 10 YR Surge/ + 4 ft SLR	4.3-4.5
2070 Tidal Flooding	5.2
2070 10 YR Surge	6.4
+ 7 ft SLR	7.3
Existing 100 Year Flood	8.8
Existing 500 Year Flood	11.1

The process of consolidation involved an in-depth review of the individual comparable scenarios. Specifically, the comparable flood scenarios were overlaid with critical infrastructure to identify any significant differences in impact between the incremental water levels between the scenarios. The results of this review demonstrated very minimal differences between the individual scenarios that were grouped. Thus, no resolution was lost in the sensitivity analysis by consolidating scenarios, and in fact the consolidation helped to streamline and identify major benchmarks of inundation.

The Existing 100 and 500 year flood extents proved to be slightly different from their associated **current** (effective) FIRM flood zone(s). Instead, they are more consistent with the **future** (preliminary) FIRM zones resulting from FEMA's Coastal Flood Risk Study. The future flood zones align with the Category 1 and Category 2 storm surge risk zones, and thus, the storm surge zones were utilized to conduct the sensitivity analysis for the Existing 100 Year and 500 Year Flood Events.

Figure 3 depicts the Fort Myers water elevations for relevant tidal datums in comparison to the flood scenarios outlined in Table 2. The purpose of this comparison is to help visualize the depth discrepancy and incrementation between the mean local elevations and the predicted flood elevations. All levels are in NAVD88.

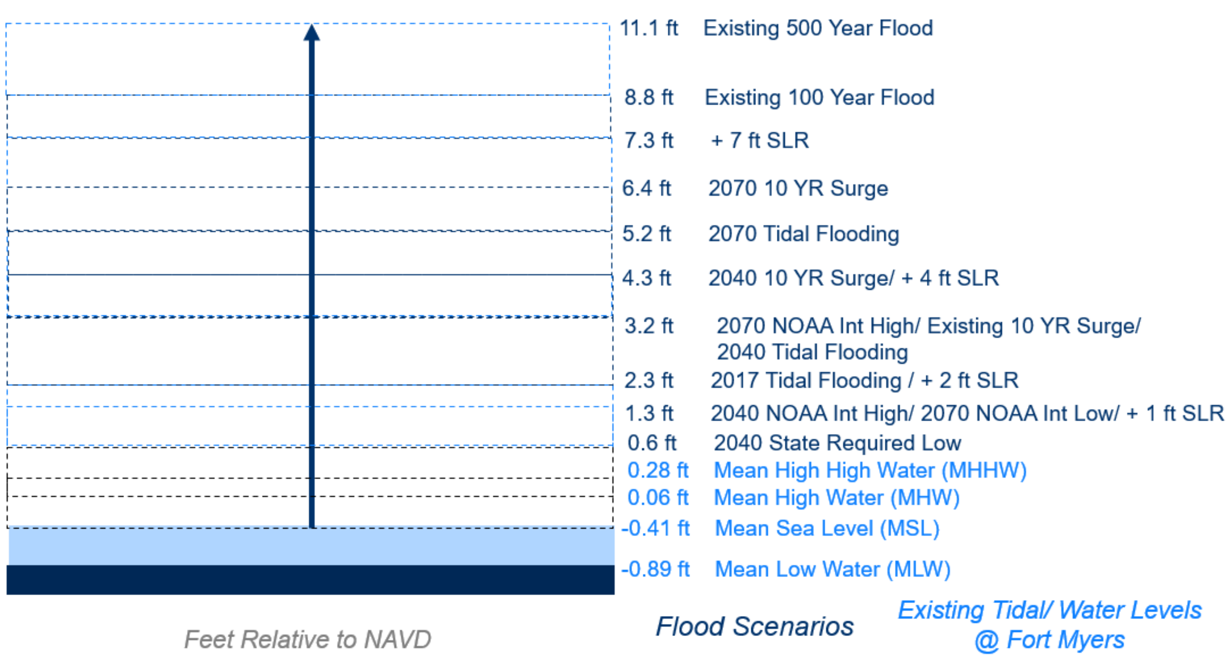


Figure 3. Comparison of Local Tidal Datum Elevations and Flood Elevations

Local Context and Recent Storms

Figure 4. Captiva Island

Captiva Island is located off the southwest coast of Florida and is part of the barrier islands along the state's southern peninsula (Figure 4). The island connects to Sanibel Island, through a road bridge at Blind Pass. The coastline of Captiva Island including its beaches, the bayside and inlets is 19 miles long. According to the Captiva Island Resiliency Assessment from 2020, Captiva's coastline is comprised of mangroves (39%), beaches (27%) and a mix of intermittent mangroves and landscaping (22%).

Since 1900, there have been eight hurricanes within 20 nautical miles from the island of Captiva. The geomorphic composition of the island is actually the result of a 1921 hurricane which separated Captiva into two islands (now Captiva and North Captiva) at Redfish Pass. Tropical Storm Eta devastated the island in 2020, causing significant erosion to its beach and dunes. The structural impacts of this event have put the island at greater risk of flooding with future storm surges and sea level rise.

On September 28, 2022, during the completion of this assessment, Captiva was significantly impacted by Hurricane Ian. Hurricane Ian made landfall on the island as a Category 4 storm with storm surge nearing 12 feet, and 155 mph sustained winds. More specifically, according to the Sanibel- Captiva Conservation Foundation (SCCF) team, who located an intact water logger on west Sanibel, the maximum depth recorded was 11.6 feet at 2:05 p.m. on September 28, 2022, and there was over 8 feet of water from 12-3:30 p.m (Figure 5). The storm surge experienced was comparable but one foot higher than flooding anticipated for a 500-year flood event in the area.

The SCCF team also noted a significant decrease in beach elevation relative to mean sea level across Sanibel and Captiva after Hurricane Ian. The average elevation of Captiva's sea turtle nest sites was of 7.2 feet before the storm, and decreased to 3.6 feet after the storm.

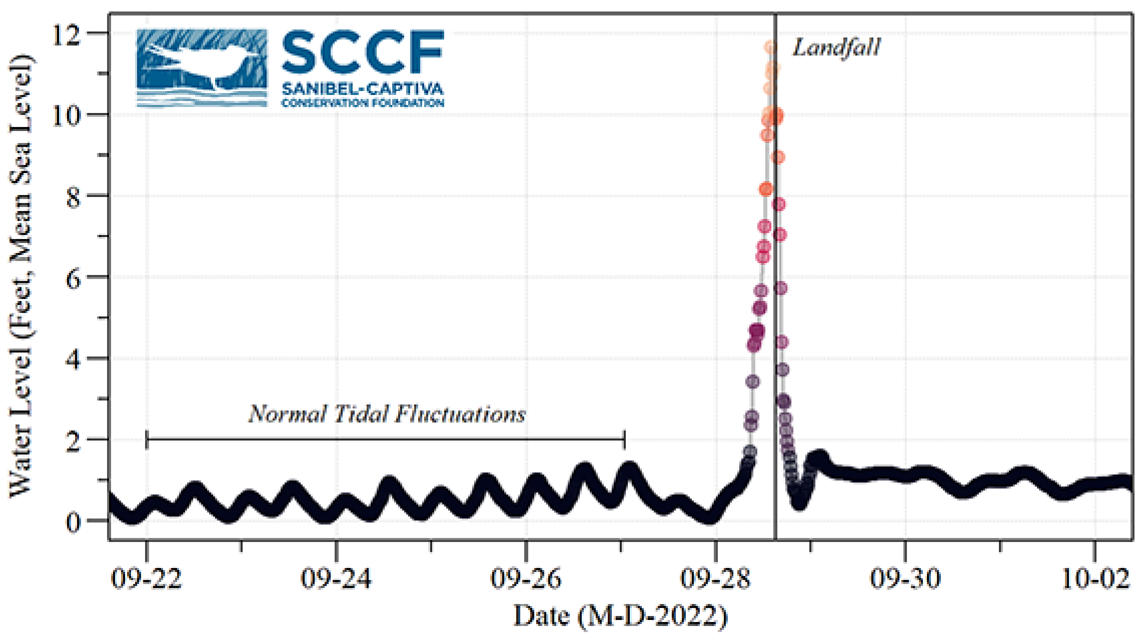


Figure 5. Hurricane Ian Water Elevation Data near Sanibel, FL

The experienced water level exceeded the level anticipated for a 10-year storm surge event in 2070, which serves as the second highest water level mapped for the purpose of this assessment. Figure 6 depicts the approximate inundation extent for the area, under these conditions, according to the NOAA Sea Level Rise Viewer.

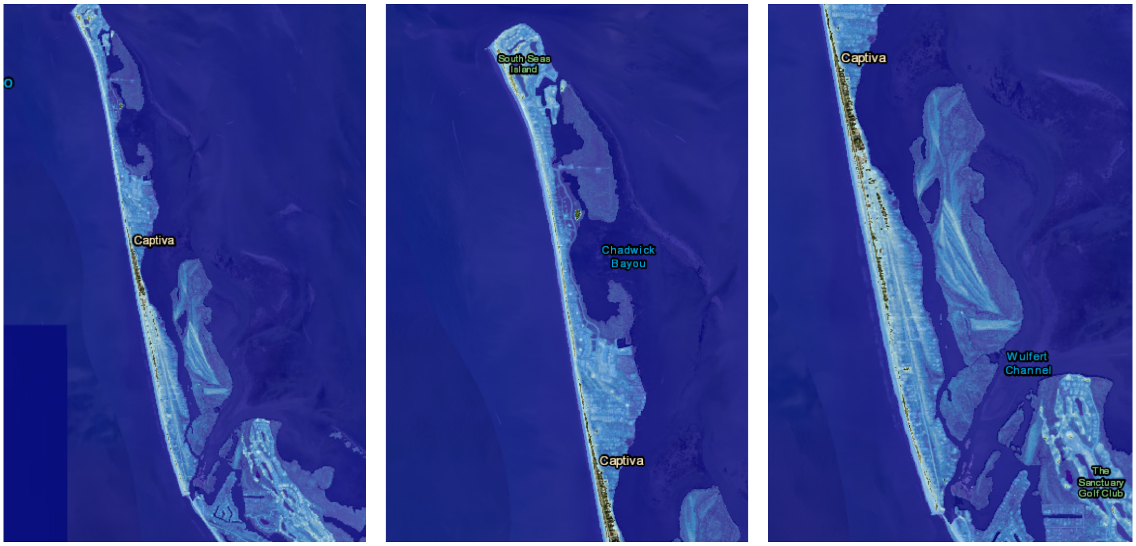


Figure 6. Captiva Inundation Under Eight Feet SLR- NOAA Sea Level Rise Viewer

The bayside of the island experienced the greatest degree of flooding, which resulted in significant infrastructure, communication, and roadway damage. According to FPL's Power Tracker, 85% of Lee County FPL customers were without power the morning after the storm. Much of Captiva's key infrastructure such as its local Fire Station, water treatment plants, and evacuation route were all impacted by inundation. Figure 7 highlights examples of infrastructure damage in the aftermath of Ian. The storm's aggressive storm surge and powerful winds resulted in the collapse of approximately 50 to 65 feet of the Sanibel Causeway bridge (Figure 7). This bridge serves as the only vehicle connection from Captiva and Sanibel to the mainland of Florida, and thus its destruction served as a catastrophic threat to on island residents as they were unable to access resources and aid

Figure 7. Hurricane Ian Damage on Captiva

CEPD Exposure Analysis

Overview

To provide a comprehensive view of inundation, it is important to review the exposure predictions of Captiva Island under all relevant scenarios and planning horizons mentioned. By doing so, various inundation depths and spatial extents can be compared to each other and in relation to the depths utilized in the 2020 Captiva Island Resiliency Assessment and more incremental flooding can be visualized (Figures 9-12). Figure 8 compares the overall percentage of island inundation for each of the scenarios.

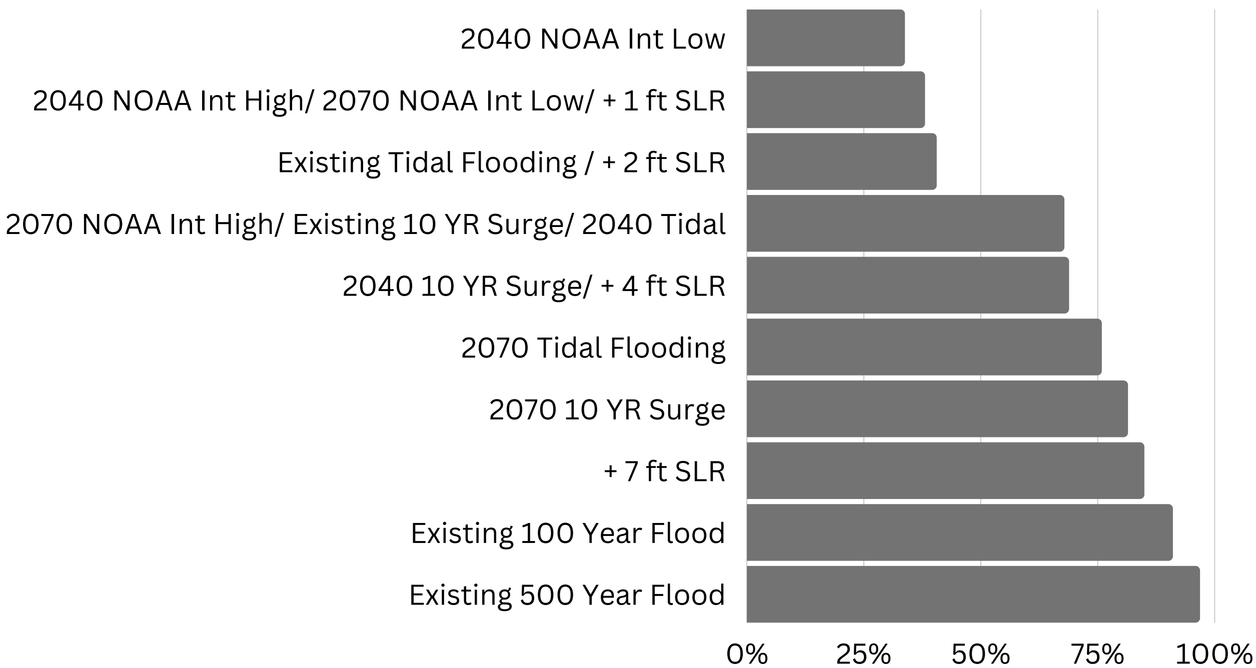


Figure 8. Percentage of Island Inundation Across All Flood Scenarios

For this effort, rainfall flooding was not uniquely analyzed like the other flooding scenarios. Rainfall flooding is not as severe as storm surge and future flooding scenarios. According to the NOAA Precipitation Frequency Data Server, rainfall during a 5-year event would cause similar flooding to the Existing Tidal Flooding scenario if no drainage capacity is assumed. A 100 Year rainfall event would precipitate between 8 to 12 inches for a 6 hour and 24-hour duration storm. Even an event of this magnitude would not result in impactful flooding. For example, the June 4, 2022 rainfall event precipitated over 11 inches overnight but resulted in only a few inches of standing floodwaters. Severe rainfall in addition to surge, known as compound flooding, has the potential for exacerbating severe flooding.

NOAA Scenario Consolidation

The state guidance for vulnerability assessments requests the use of the 2017 NOAA intermediate-low and intermediate-high sea level rise projections for the planning horizons of 2040 and 2070. As stated previously, due to the close proximity of water elevation levels, the 2040 NOAA Intermediate High (1.2 ft NAVD) and 2070 NOAA Intermediate Low (1.3 ft NAVD) do not represent significant differences in inundation extent or depth. Because of this the two scenarios were compared for the purpose of the sensitivity analysis. Figure 9 displays no difference between the scenarios' exposure analysis, which further validated the comparison.

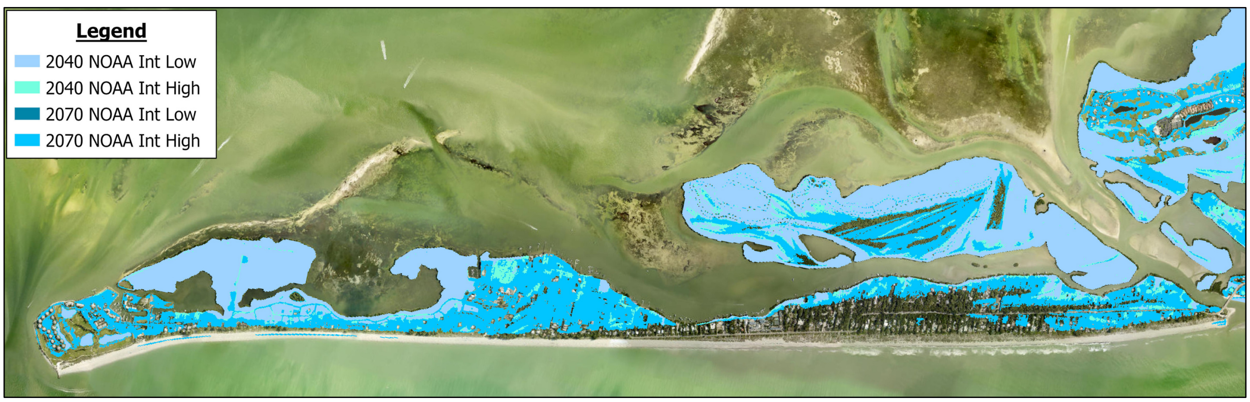


Figure 9. Island Inundation Comparison Map for NOAA Scenarios- 2040 NOAA Intermediate High and 2070 NOAA Intermediate Low

Island Exposure Maps

The results of the exposure analysis for the ten scenarios outlined in Table are represented in Figures 10-12. Scenarios were layered and mapped in order of increasing water elevation to show incremental inundation change across the island. The ten scenarios were mapped across three figures in order to show relative change within specific water elevation level increments and to prevent visual confusion.

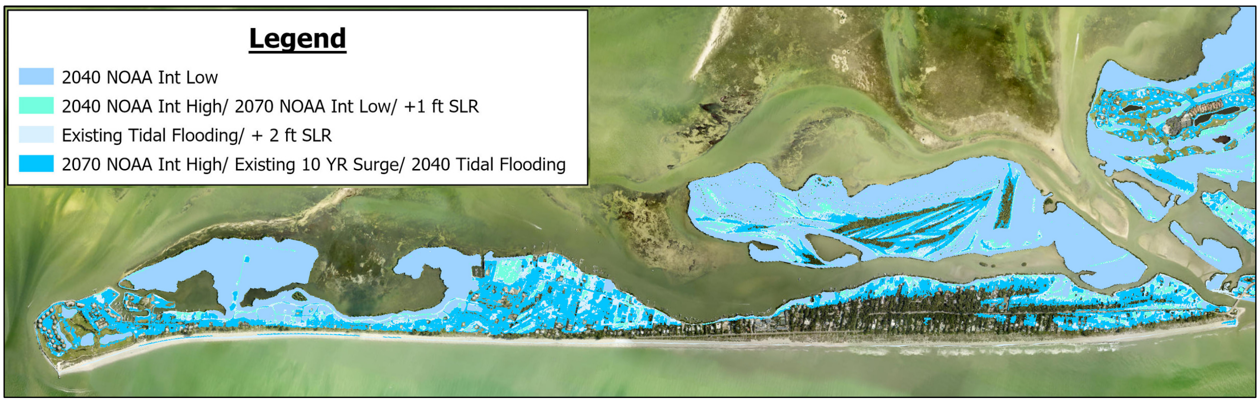


Figure 10. Island Exposure Map 1

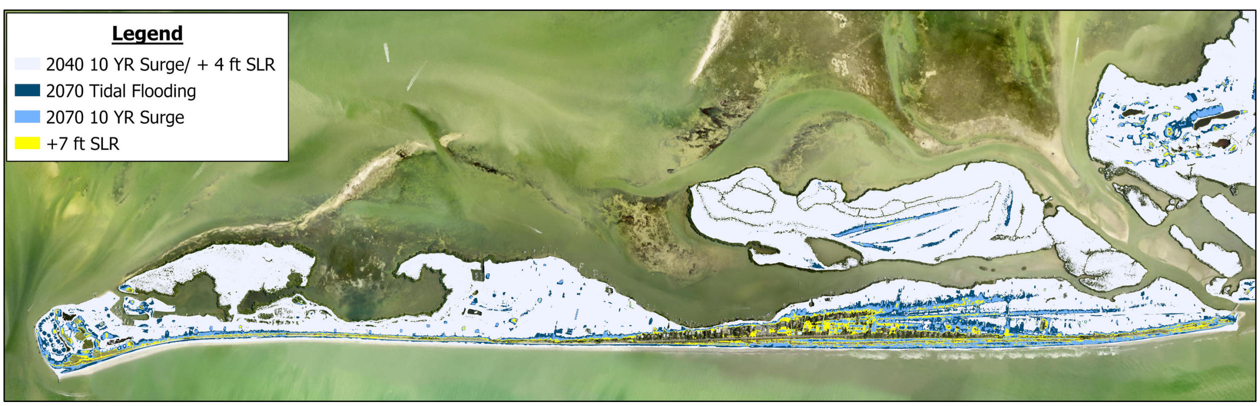


Figure 11. Island Exposure Map 2

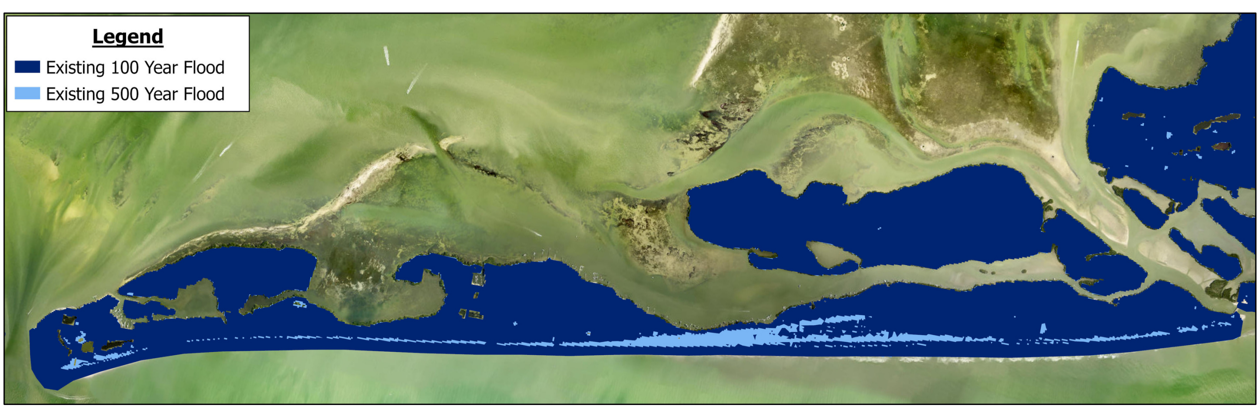


Figure 12. Island Exposure Map 3

Inundation Tipping Point Scenarios

The assessment of asset and infrastructure sensitivity was conducted for all of the ten flood scenarios outlined in Table 2, in order to satisfy the new state requirements for resiliency grant funding eligibility. Throughout this report, the overall sensitivity per scenario will be briefly outlined at a high level, however the entirety of the analysis results per critical asset will be detailed in Appendices II-VI. For the purpose of this report and to identify key areas of concern, three of the twelve scenarios were identified as "tipping points" of impact for the island of Captiva and these three scenarios will be fully explored and addressed within the report. These three scenarios, outlined below, represent significant changes in overall island inundation and in degree of impact to critical assets and thus will be the focus of this analysis:

1

Existing Tidal Flooding/ +2 ft SLR

Begin to see inundation from bay front, flooding around fire station and stormwater infrastructure, minimal flooding of evacuation route, and flooding impacts to some roads.

2

2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding

Begin to see more significant flooding of roads south of the Captiva Library, flooding of all parcels along the shoreline, and mangrove inundation.

3

Existing 100 Year Flood Event

Flooding of all oceanfront parcels.

Critical Infrastructure Sensitivity Analysis

Parcels

Parcel data was obtained from the Florida Department of Revenue (FDOR) and analyzed for inundation impact from the various flood scenarios. A total of 1,118 parcels exist within Captiva. Figure 13 depicts the number of parcels likely to experience flooding per scenario.

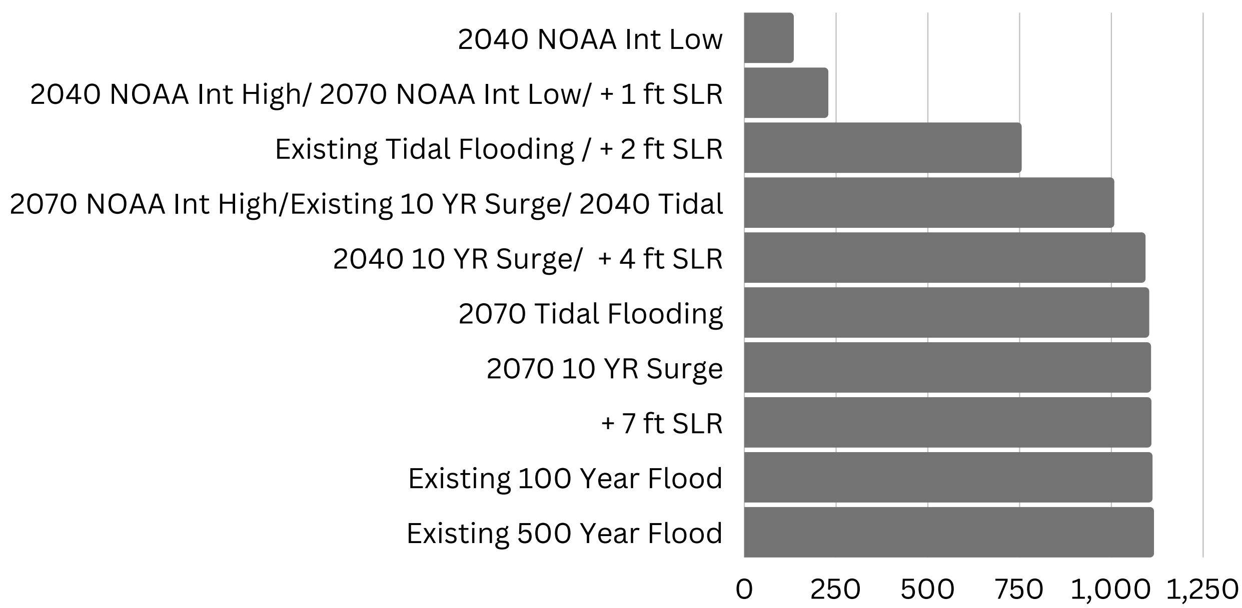


Figure 13. Predicted Parcel Inundation Across All Flood Scenarios

Figure 14 displays the number and percentage of inundated parcels for each of the three inundation tipping point scenarios. Figure 15 depicts a spatial view of the results of this analysis.

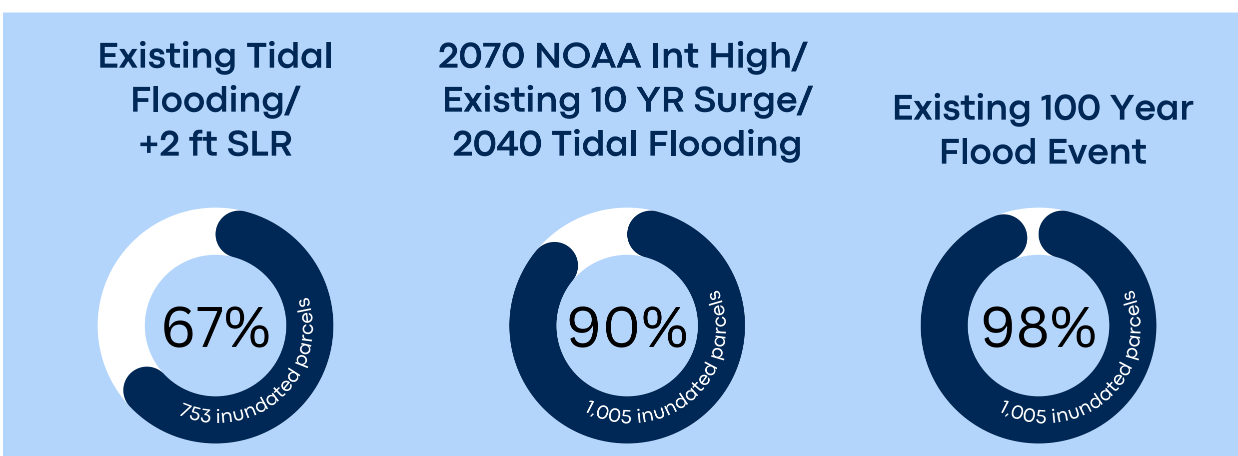


Figure 14. Percentage of Parcel Inundation Under Inundation Tipping Point Scenarios

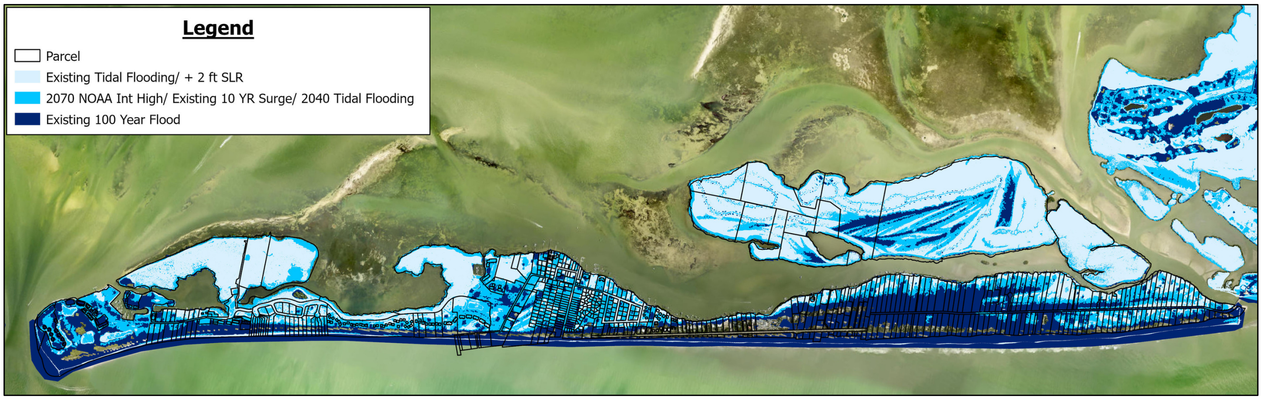


Figure 15. Parcel Inundation Map for Inundation Tipping Point Scenarios.

A subsequent deeper analysis included estimating the average inundation depth of parcels per scenario and utilizing the building footprint estimated value to help estimate the value of inundated parcels. Average depth is represented by the center of the inundation grid per parcel, and thus the total impacted number of parcels is reduced as not every parcel that intersects the inundation polygons has the center point that falls on it. These center points were averaged across the parcel if there were multiple. The overall results of the inundation depth analysis can be seen in Figure 16.

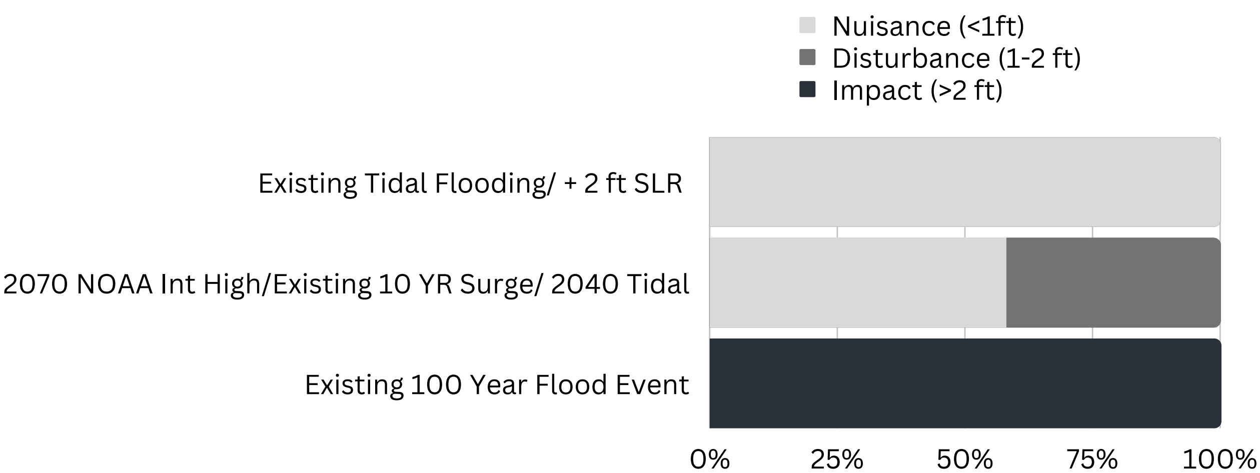


Figure 16. Parcel Inundation Depth Under Inundation Tipping Point Scenarios

Under the Existing Tidal Flooding/ +2 ft SLR scenario, 100% of inundated parcels will experience nuisance flooding of a depth of below one foot. The market value of affected parcels is of $1,144,851,123, however, damage costs of nuisance flooding would be anticipated to be minimal or null.

Under the 2070 NOAA Int High/Existing 10 YR Surge/ 2040 Tidal Flooding, 42% of parcels are potentially subject to nuisance flooding and 58% of all parcels are potentially subject to flooding >1 foot of depth. The inundation from this scenario is projected to impact parcels totaled at a value of $1,348,535,683. Of the 1109 parcels projected to be impacted by inundation via the Existing 100 Year Flood Event, 98% of them will experience flooding at a depth greater than 2 ft. The value of the parcels impacted equates to $1,591,834,927.

The age of the structures built were reviewed in relation to the 1983 FEMA base flood elevation standard (Figure 17). For presentation purposes, structure ages were grouped by decade and compared to 1980 rather than 1983. Specifically, under the Existing Tidal Flooding/ +2 ft SLR scenario, 60% of vulnerable parcels were built before 1980, with an estimated present market value of $495,093,551 . Under the 2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding, 64% of the total vulnerable parcels were built before 1980, with an estimated present market value of $612,140,970. According to the Existing 100-year Flood Event, 60% of impacted parcels were built before 1980, and 40% were built after. The impacted parcels have an estimated present market value of $649,760,664 .For the purpose of this evaluation, those parcels without a designated built year (labeled "N/A"), were not included in the total parcel count as it is unclear if these parcels were built before or after the implementation of the 1983 FEMA base flood elevation standard.

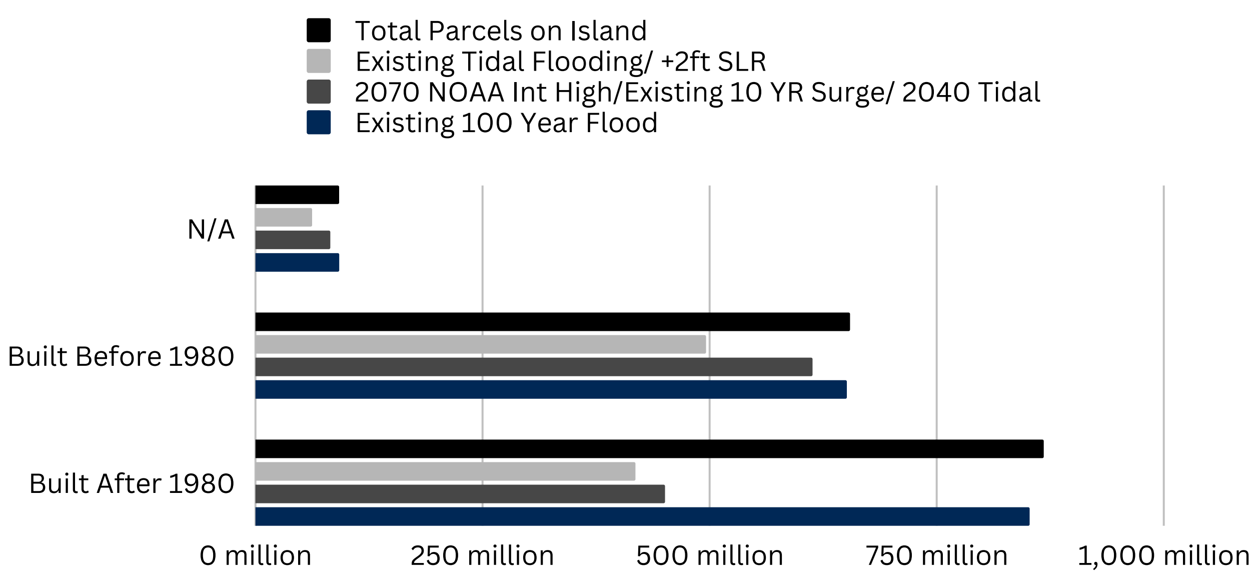


Figure 17. Impacted Parcels by Decade Built and Parcel Value

Buildings

Seven hundred and forty-seven buildings are located on Captiva. The building footprints for Captiva were obtained from Lee County and analyzed for initial inundation impact under the various flood scenarios. Figure 18 displays the number of building footprints that may experience flooding if their elevations is at ground level. This analysis does not account for elevation certificates or actual structure first floor elevations.

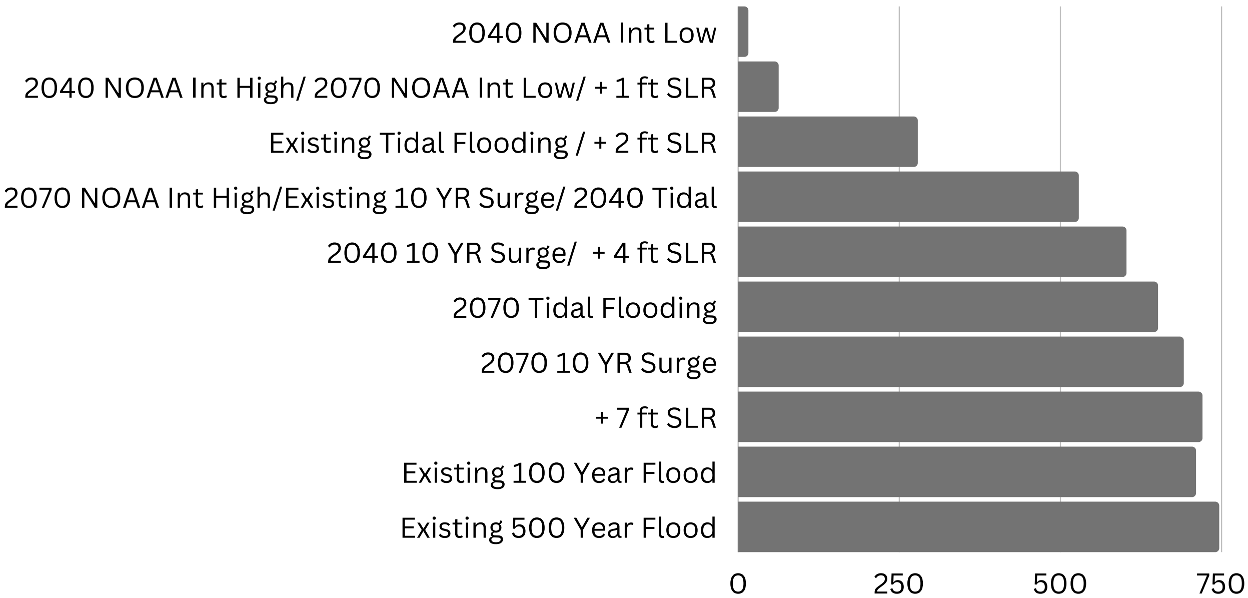


Figure 18. Building Footprint Inundation Across All Flood Scenarios

Figure 19 displays the number and percentage of inundated building footprints for each of the three inundation tipping point scenarios. The location and extent of building impact per scenario can be seen in Figure 20 .

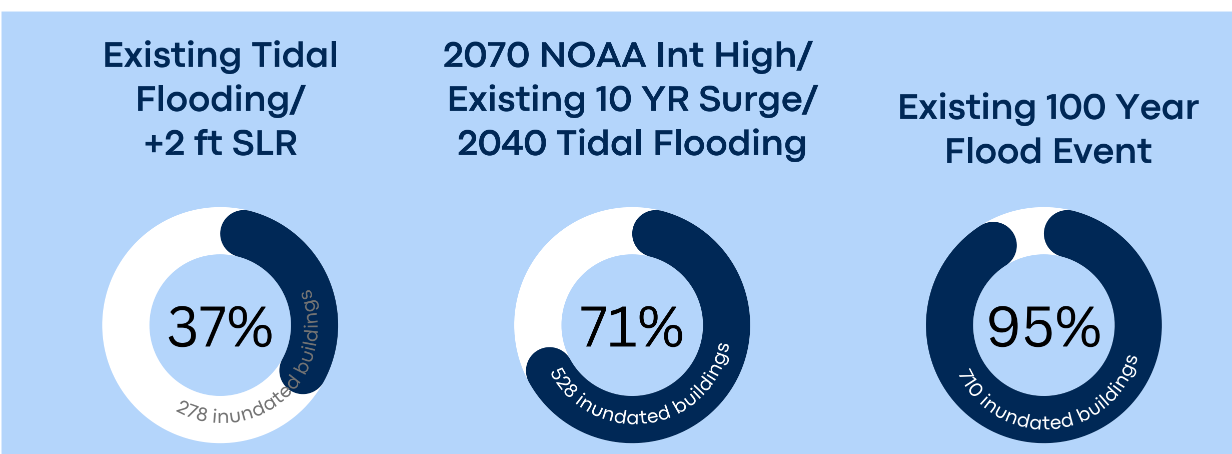


Figure 19. Percentage of Building Footprint Inundation Under Inundation Tipping Point Scenarios

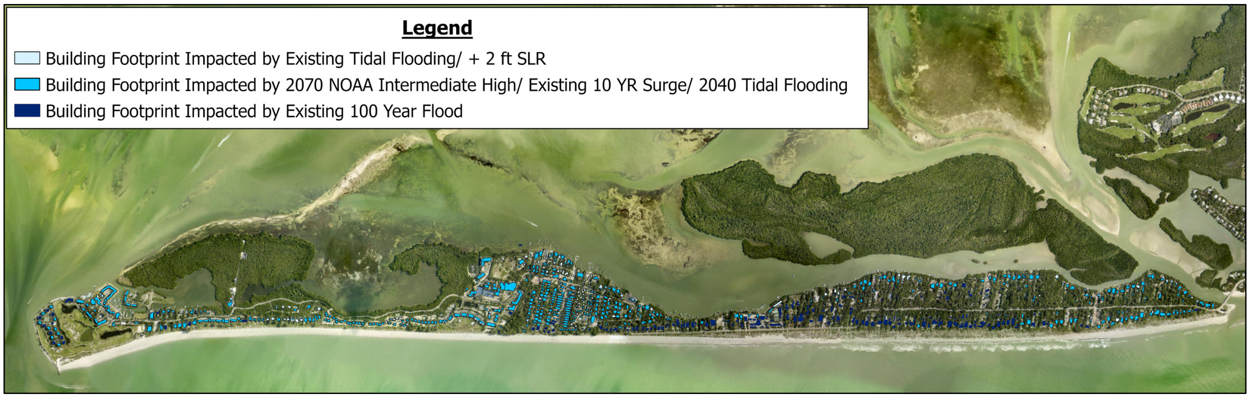


Figure 20. Building Footprint Inundation Map for Inundation Tipping Point Scenarios

A more thorough analysis of building footprint inundation included estimating average building footprint inundation depth, classifying the building footprint data by decade built, and estimating building value per scenario. The methodology used here is the same as that used to complete the parcel inundation analysis. As stated previously, average depth is represented by the center of the raster grid of inundation, and thus the total impacted number of building footprints is reduced as not every footprint that spatially intersects the inundation polygons has the center point that falls on it. Figure 21 details building sensitivity per scenario and the associated flooding type- nuisance (< 1 foot of flooding), disturbance (1-2 feet of flooding), and impact (> 2 feet of flooding).

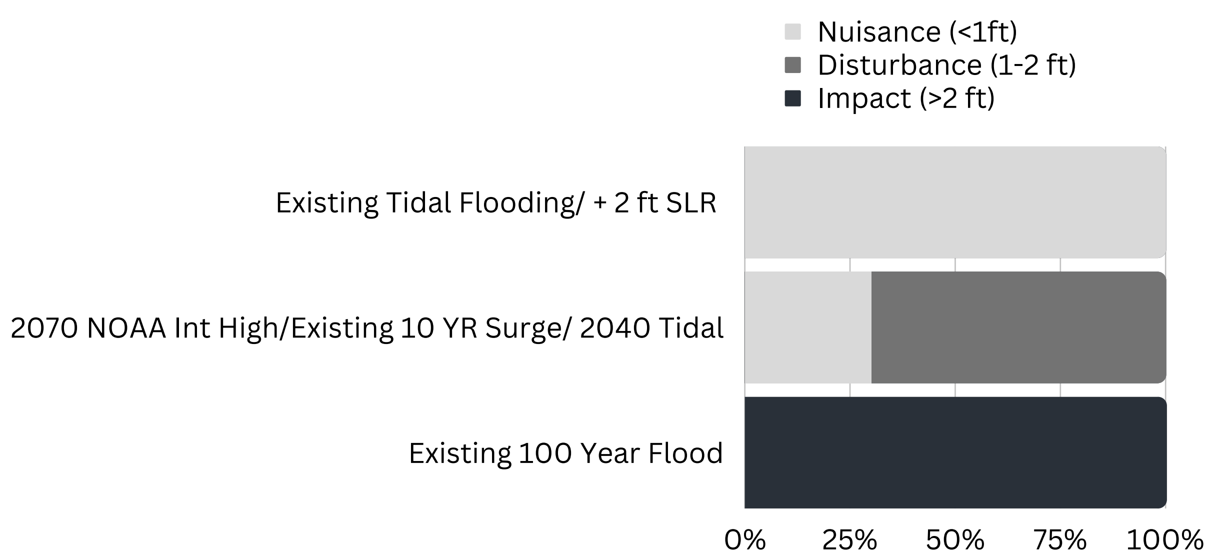


Figure 21. Building Footprint Inundation Depth Under Inundation Tipping Point Scenarios

When classifying projected inundated buildings by flooding type, 100% of all impacted buildings under the Existing Tidal Flooding/ +2 ft SLR scenario will experience flooding at a depth below 1 foot. This percentage decreases to 30% under the 2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding scenario, with 60% of buildings projected to experience flooding of 1-2 feet deep. both the degree and depth of flooding across impacted buildings increases. Under the Existing 100-year flood event, 100% of all impacted buildings will experience flooding at a depth greater than 2 feet.

When reviewing the distribution of the predicted inundated buildings and their associated estimated value over the decades (Figure 22), it is clear that the approximately half of the vulnerable buildings were built before the flood insurance standard (before 1983). Under tidal flooding conditions experienced today, 36% of the buildings experiencing inundation will have been built before 1980. These buildings have a combine estimated value of $149,263,455 . According the 2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding scenario, 49% of the buildings predicted to be inundated are buildings built before 1980, with a total estimated value of$236,912,497. Under the Existing 100 Year Flood Event, 46% of effected buildings were built before 1980, with an estimated value of $248,084,248. As stated previously, parcels without a designated built year were not included in the total parcel count.

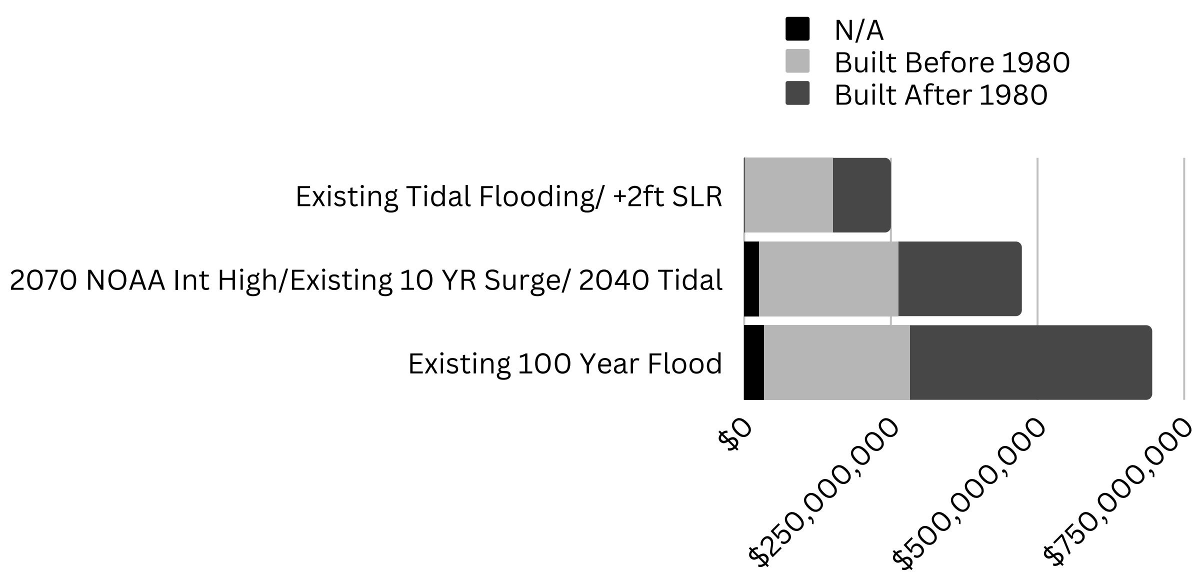


Figure 22 Impacted Building Footprints by Decade Built and Property Value

Seawalls

Seawalls line portions of Captiva's shoreline, serving as a source of coastal defense against erosion, high tides and surges. Specifically, Captiva's seawalls shield the most vulnerable areas of private land and residences, protecting them from severe flooding events. Local seawalls along Captiva were digitized from 2021 aerial imagery. It is important to note that a considerable degree of vegetation exists along the shoreline of the island which obscures the view of some areas, and thus it is possible that not all seawalls were seen and digitized. As-built survey data was not available for the analysis of seawall height, so an alternate method was performed using available ground elevation data for parcels.

To obtain the greatest level of accuracy as possible, Lee County parcels were consulted and reviewed for recorded seawall distinctions and any additional information recovered was used to inform the final database. The result of this digitization depicts a total of 8,556.9 linear feet of seawall along Captiva. The predicted inundation of seawalls per scenarios is depicted in Figure 23.

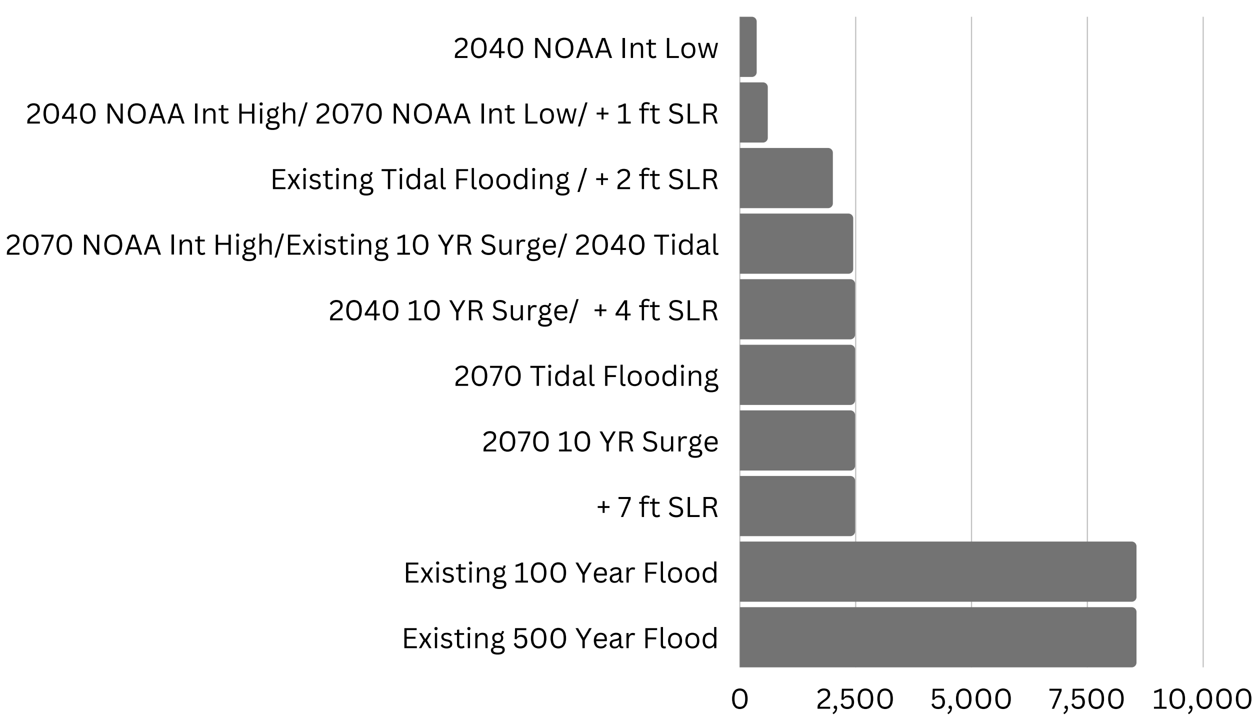


Figure 23. Seawall Inundation Across All Flood Scenarios

A total of 8,557 linear feet of seawalls exists along Captiva Island. The seawall inundation trend across the island depicted in Figure 24 serves as a visual justification for the inundation tipping point scenarios. These three scenarios driving the content of this report represent distinct increases in water level across local flood scenarios. Specifically, inundation impacts only 591 linear feet of seawall before increasing to 1,997 linear feet by the first inundation tipping point scenario (Existing Tidal Flooding/ +2 ft SLR). Seawall inundation increases significantly again (2,437 linear feet) under the 2070 NOAA Int High/Existing 10 YR Surge/ 2040 Tidal scenario. As is evident in Figure 24, the degree of seawall inundation remains rather constant across the island under the incremental scenarios between this scenario and the next tipping point scenario (Existing 100-year Flood Event). At this water level, all of Captiva's seawalls will experience flooding. The locations and extents of inundated seawalls per sea level rise scenario can be viewed in Figure 25.

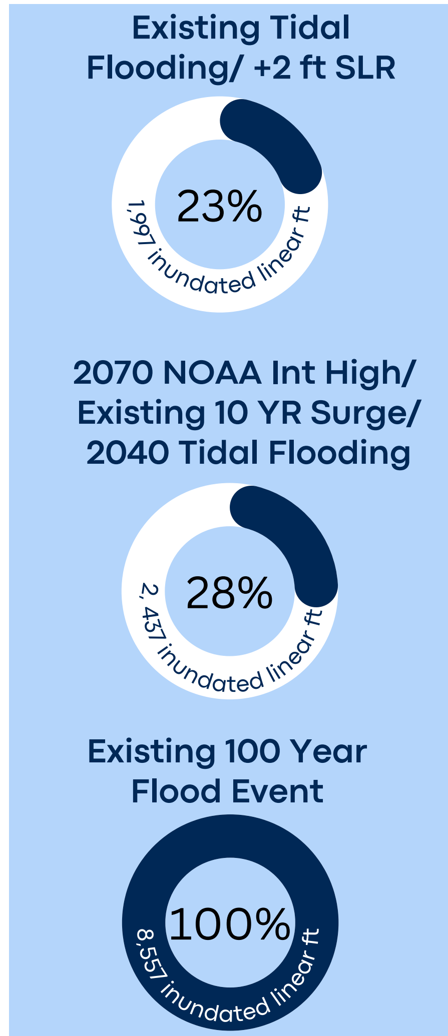


Figure 24. Percentage of Seawall Inundation Under Inundation Tipping Point Scenarios

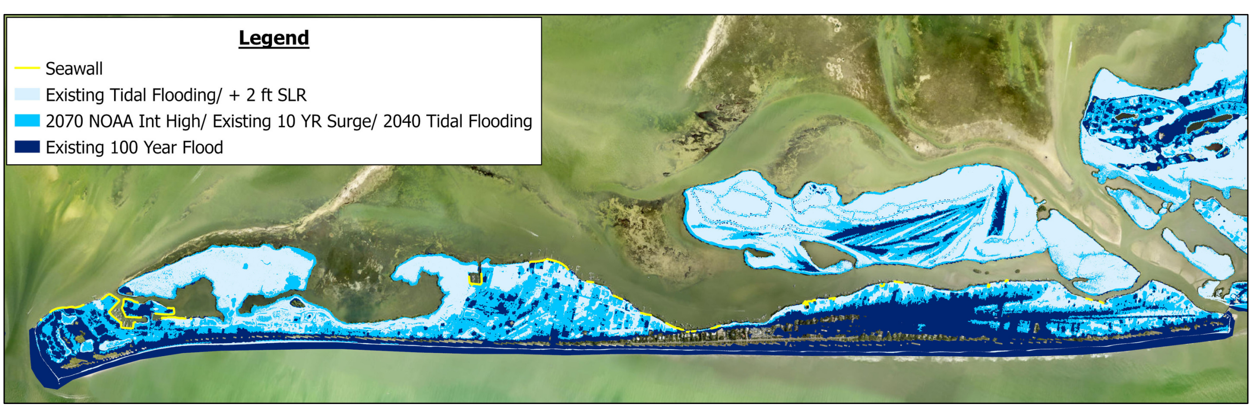


Figure 25. Seawall Inundation Map for Inundation Tipping Point Scenarios

Wastewater Treatment Facilities and Lift Stations

In July 2021, Kimley-Horn completed an engineering study to determine the best ways a central sewer system can fit within Captiva's landscape. The firm prepared a conceptual layout for a wastewater collection and conveyance system for the unsewered portion of Captiva that consists of the areas outside the South Seas Resort, which has its own system. More specifically, this includes three areas currently serviced by package Wastewater Treatment plants- the Village Service Area, the Tween Waters Service Area, and the Estates Service Area (Figure 26).

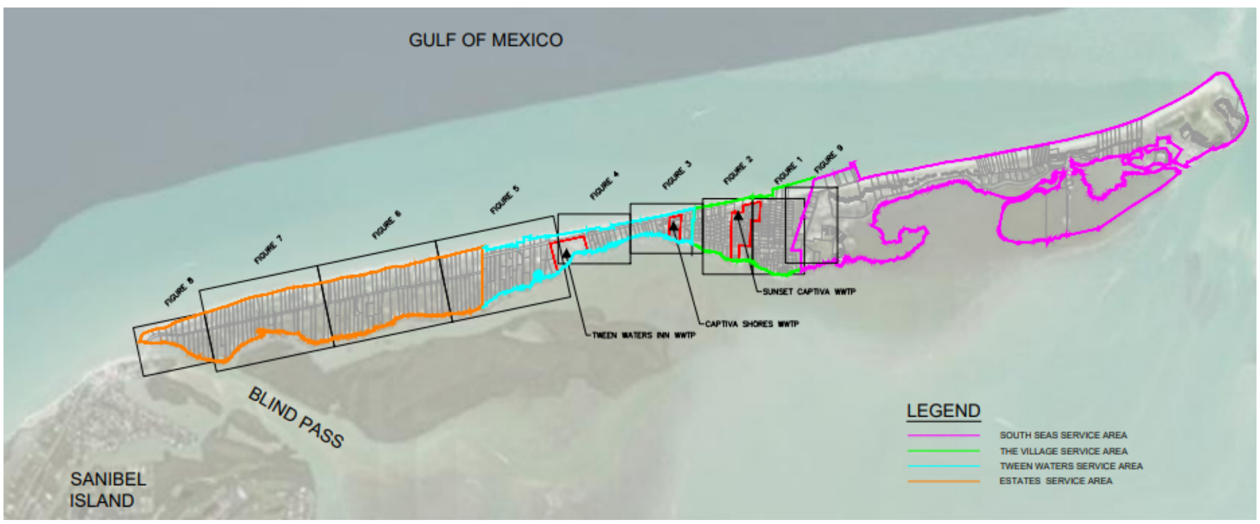


Figure 26. July 2021 Kimley-Horn Study- Unsewered Service Areas of Captiva

Data acquired from Lee County was utilized to map the four Wastewater Treatment Plants (WWTP) located on Captiva to determine potential inundation impacts. The analysis results depict the greatest average depth of inundation occurring at the South Seas Plantation WWTP, which is the only WWTP at risk of inundation across the three inundation tipping point scenarios. The South Seas Plantation WWTP is likely to experience inundation at an average depth of 0.3 feet under existing tidal flooding conditions, 3.4 feet under the 2070 NOAA Int High, and 6 ft under the Existing 100 Year Flood Event (Table 3). The Tween Waters Inn WWTP is not expected to experience flooding under any of the three inundation tipping point scenarios.

The results of the analysis depict an average flood depth of 1.5 feet for the Captiva Shores Condominium WWTP under Scenario 2 and an average depth of 4 feet under Scenario 3. Lastly, for the Sunset Captiva WWTP, nuisance flooding is anticipated under the 2070 NOAA Int High scenario (average depth of 0.7 ft), and flooding with an average depth of 3 feet is anticipated under the Existing 100 Year Flood Event (Table 3).

Table 3. Wastewater Treatment Plant Average Inundation Depth (in feet) Under Inundation Tipping Point Scenarios

WWTP Location	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
South Seas Plantation	0.3	3.4	6
Tween Waters Inn	None	None	None
Captiva Shores Condominium	None	1.5	4
Sunset Captiva	None	0.7	3

Five lift stations are located on the island of Captiva- one at each of the three package plant stations, one small lift station associated with the Sunset Captiva Condominiums, and one City of Sanibel lift station at Turner Beach that serves the Lee County Park. The locations of the lift stations were identified in Kimley Horns project design and were approximated for the purposes of this assessment. Figure 27 highlights the locations of the lift stations, and the wastewater treatment plants on Captiva.

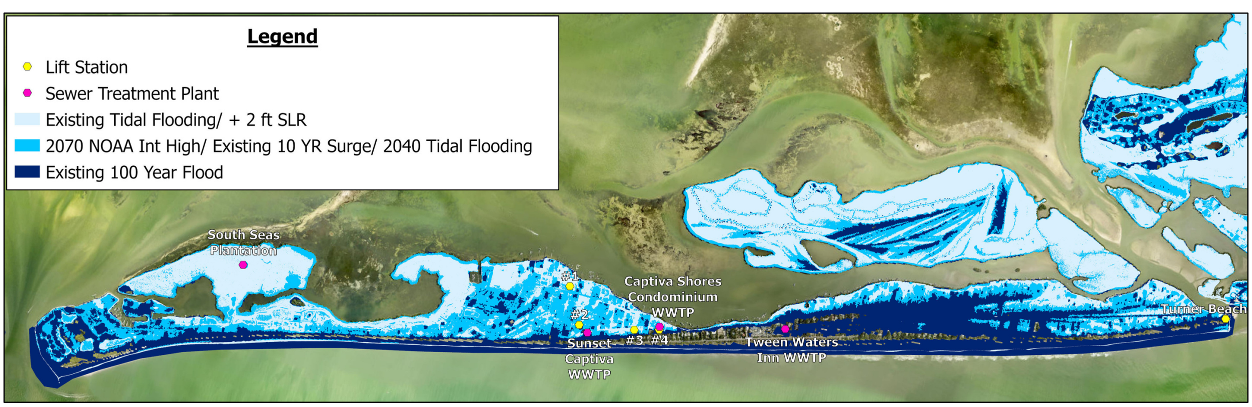


Figure 27. Wastewater Treatment Plant and Lift Station Inundation Map for Inundation Tipping Point Scenarios

Lift Station #3 is the only station predicted to experience some degree of flooding across all three major scenarios. Specifically, the predicted average inundation depth for tipping point Scenario 1 is 0.6 feet (nuisance, for tipping point Scenario 2 is two feet (disturbance), and for tipping point Scenario 3 is five feet (impact). While not flooded at tipping point Scenario 1, lift stations #1 and #2 will likely flood at the remaining two scenarios. Under tipping point Scenario 2, the average inundation depths are 0.9 ft and 1 ft for station #1 and #2, respectively. Under tipping point Scenario 3, both stations are predicted to experience an average flood depth of four feet.

Lift station #4 and the Turner Beach lift station are not likely to experience flooding under inundation tipping point Scenarios 1 and 2 but will experience flooding under inundation tipping point Scenario 3 with an average depth of four and three feet, respectively. Average inundation depths are outlined in Table 4.

Concern for sea level rise is one of the motivators for a wastewater collection system, as the existing septic systems will become largely inoperable due to high ground water if sea level rises as predicted. Consideration of the impacts of sea level rise, following NOAA guidance, helped guide the collection system design. In order for the collection systems to be functional in high ground water situations, lift stations will need to be hardened to storm surge and existing lift stations will need to be rebuilt to a higher "utility grade" standard.

Table 4. Lift Station Average Inundation Depth (in feet) Under Inundation Tipping Point Scenarios

Lift Station	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Lift station #1	None	0.9	4
Lift station #2	None	1	4
Lift station #3	0.6	2	5
Lift station #4	None	None	4
Turner Beach Lift Station	None	None	3

Stormwater Treatment Facilities and Pump Stations

Comprehensive stormwater data for the island of Captiva was not available for the purpose of this assessment. Instead, limited longitudinal data was extracted from the 2011 Captiva Water Quality Assessment Project Final Report prepared by the SCCF Marine Laboratory in Sanibel, FL. This report was generated for the Lee County Tourist Development Council (TDC) and the Captiva Community Panel (CCP) and its overall purpose was to investigate the conditions of Captiva's nearshore waters and the potential problems contributing to local water quality. Included within the data collection was a list of all water quality sites established for the project, which included site types related to stormwater infrastructure and storm water occurrences. Specifically, longitudinal data for Captiva catch basins and pipes, swales and retention ponds, standing water, sewer, and outfalls from the report were plotted and assessed for inundation impacts (Figure 28).

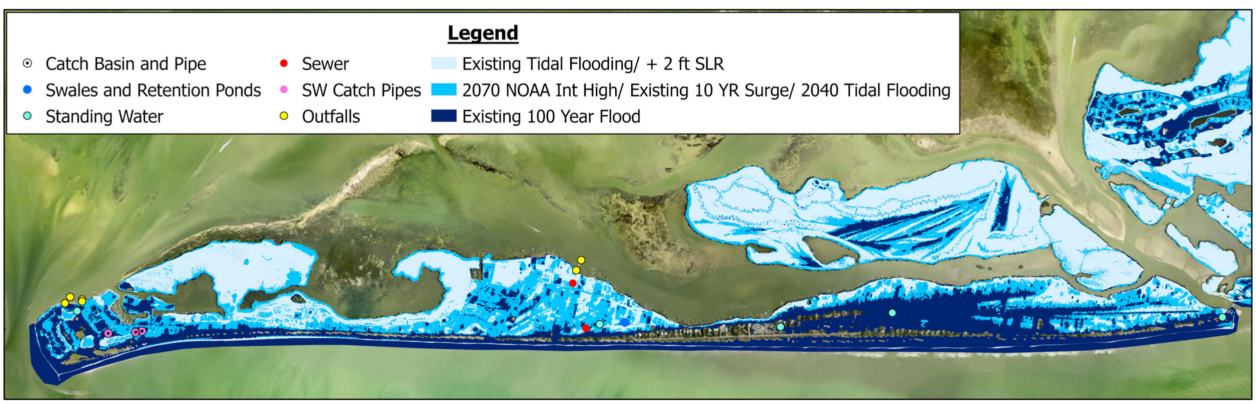


Figure 28. Stormwater Infrastructure Inundation Map for Inundation Tipping Point Scenarios

The water quality report includes sites for three catch basin pipes, one retention pond, six standing water areas, two sewers, and two outfalls located on Captiva Island. These assets do not represent the entirety of the stormwater infrastructure on the island, and with more complete surveying, a future, more comprehensive analysis should be completed. The retention pond is vulnerable to flooding across all three inundation tipping point flood scenarios. Regarding the other stormwater infrastructure types, the number of assets impacted by flooding increase across the tipping point scenarios (Table 5). Similarly, the average depth of the predicted inundated increases across tipping point scenarios (Table 6).

Table 5. Stormwater Infrastructure Inundation for Inundation Tipping Point Scenarios

Type	Total Number	Inundation (feet)		
		Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Catch Basin Pipe	3	0	2	3
Swales and Retention Pond	1	1	1	1
Standing Water	6	2	2	5
Sewer	2	0	1	1
Outfalls	2	2	2	1

Table 6. Stormwater Infrastructure Average Inundation Depth (in feet)
Under Inundation Tipping Point Scenarios

Type	Average Inundation (feet)		
	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Catch Basin Pipe	N/A	0.9	3.7
Swales and Retention Pond	0.5	1.9	5
Standing Water	0.4	2.4	3.5
Sewer	N/A	1.5	5
Outfalls	1.8	1.2	6

Solid and Hazardous Waste Facilities

A Solid and Hazardous Waste Facility does not exist on Captiva Island. The nearest facility, the Sanctuary Golf Club was examined for the purpose of this assessment and is located one mile from Captiva's southern tip (Figure 29). The average depth of anticipated inundation under the three inundation tipping point scenarios are as follows:

1. **Existing Tidal Flooding/ +2ft SLR:** 0.4 feet
2. **2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding:** 0.8 feet
3. **Existing 100 Year Flood Event:** 3.1 feet

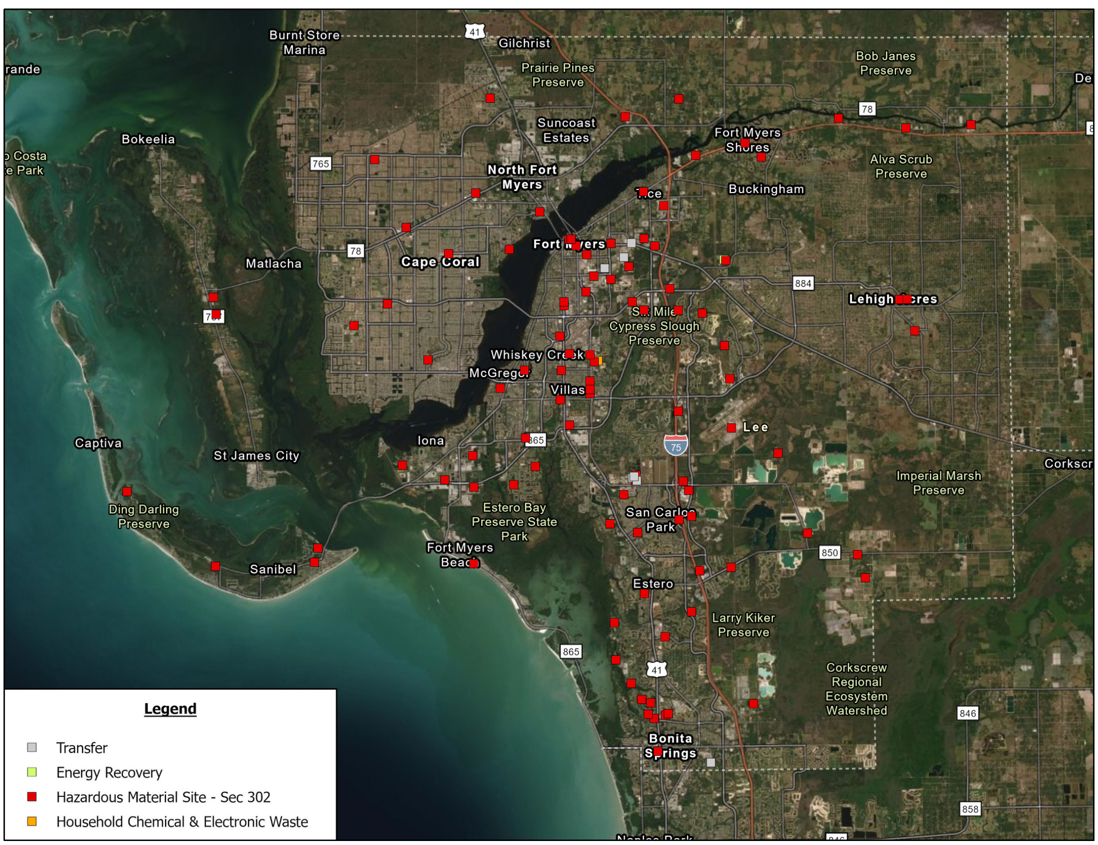


Figure 29. Lee County Solid and Hazardous Waste Facilities

Drinking Water Facilities

Captiva's drinking water facility is located adjacent to the South Seas Wastewater Treatment plant. Flooding is anticipated at this location under all ten flood scenarios utilized for the purpose of this assessment. Figure 30 displays the inundation extent for the three inundation tipping point scenarios.

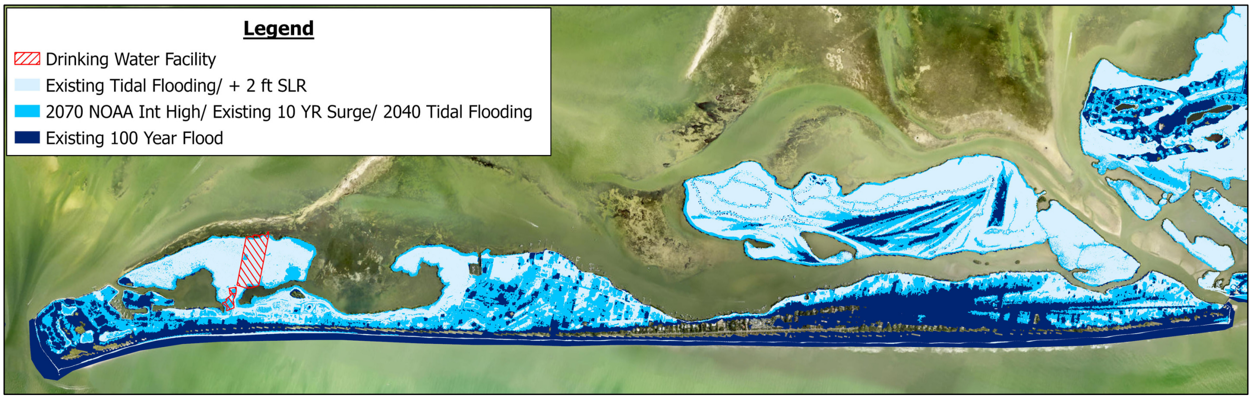


Figure 30. Drinking Water Facilities Inundation Map for Inundation Tipping Point Scenarios

Across all three scenarios, there is a high probability that the drinking water facility will experience flooding. Under existing tidal flooding conditions, 81% of the facility is projected to experience inundation and under the 2070 NOAA tipping point scenario, 96% of the facility will likely flood. Lastly, the entire facility will be inundated under the Existing 100 Year Flood Event. Average inundation depths for the three scenarios are as follows:

1. **Existing Tidal Flooding/ +2ft SLR:** 1.1 feet
2. **2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding:** 2.3 feet
3. **Existing 100 Year Flood Event:** 6.7 feet

Communication Facilities

Individuals rely on communication facilities to relay information, connect with pothers, call for help, etc. If a communication tower is flooded and inoperable, it could result in nearby residents and facilities being unable to reach or receive calls which can be dangerous, especially because the local Emergency Medical Services (EMS) facility is located on the island. Figure 31 displays the two communication facilities on Captiva-one located at the East Side of Chadwick's Square Shopping Center and one located directly west of the South Seas Wastewater Treatment Plant. The South Seas tower was identified in the 2020 Captiva Island Resiliency Assessment produced by Integral consulting. Additional communication facilities across Lee County can be viewed in Appendix I.

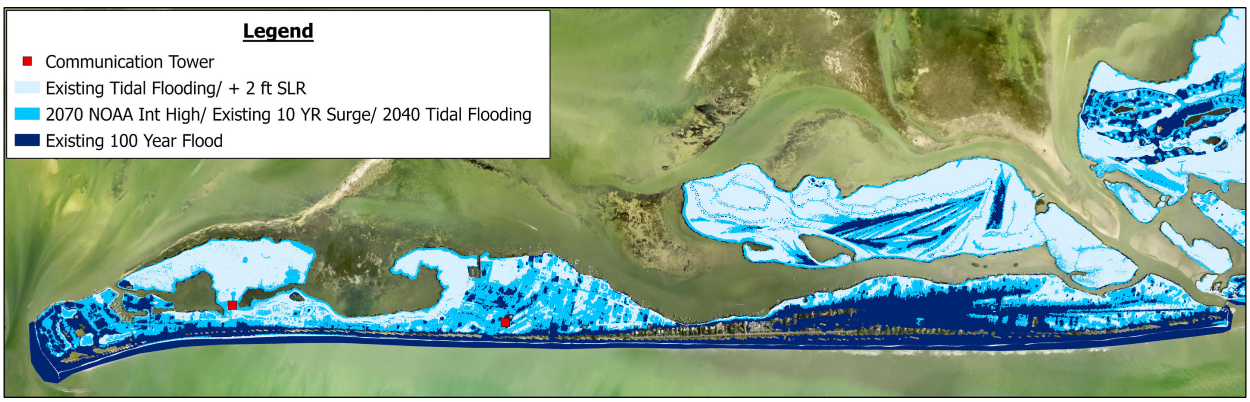


Figure 31. Communications Facilities Inundation Map for Inundation Tipping Point Scenarios

The closest inundation point was utilized to predict potential flood impacts to the communication towers. The results of this analysis predict that under existing tidal flooding conditions, neither communication tower will be impacted. According to the 2070 NOAA High tipping point scenario, the Chadwhick's Square tower will experience inundation with an average depth of one foot and the South Seas Tower will experience inundation with an average depth of .8 feet. The flooding threat to both of the communication towers increases significantly under the Existing 100 Year Flood Event- the Chadwhick's Square tower is projected to flood at an average depth of five feet and the South Seas tower is projected to flood at an average depth of six feet.

Disaster Debris Management Sites

One Disaster Debris Management Site (DDMS) is located on Captiva Island (Figure 32. A DDMS is a temporary staging area for disaster debris including demolition waste and yard waste. If the site becomes unreachable, residents will be unable to concentrate storm debris.

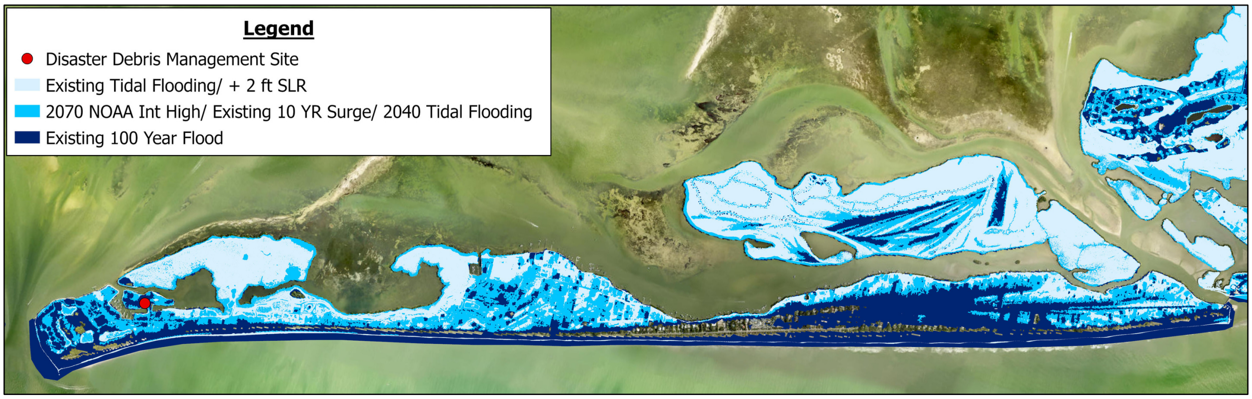


Figure 32. Disaster Debris Management Sites Inundation Map for Inundation Tipping Point Scenarios

The site itself does not intersect with the inundation projections for existing tidal flooding or the 2070 NOAA Int High scenarios. However, the surrounding parcels, roads, and infrastructure are projected to be inundated by 2070, which would decrease or eliminate the accessibility of the site. Under the Existing 100-year Flood Event, the site will be impacted by inundation with an average depth of 3 feet.

Transportation Assets and Evacuation Routes Sensitivity Analysis

Roadways and Bridges

Major roadways along Captiva Island are essential not only in emergencies, but in everyday life as residents depend on them to sustain their lifestyles. The functionality of roadways determines the mobility of people and the accessibility of places and resources. Flooding can significantly impact road networks making them unusable and unreliable. To determine the level of impact flooding is predicted to have on roads within Captiva, roadway data was downloaded from UF Geoplan Center. Linear footage of roadway inundation and roadway type were identified for each flood scenario.

A total of 108,579 linear feet of roads exists on Captiva and Figure 33 outlines roadway inundation percentages per scenario. Under existing tidal flooding conditions, 11% of roads will be impacted by flooding, and under the 2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding scenario, 33% of roads will be impacted. The percentage of roadway inundation increases to 40% under a Existing 100 Year Flood Event.

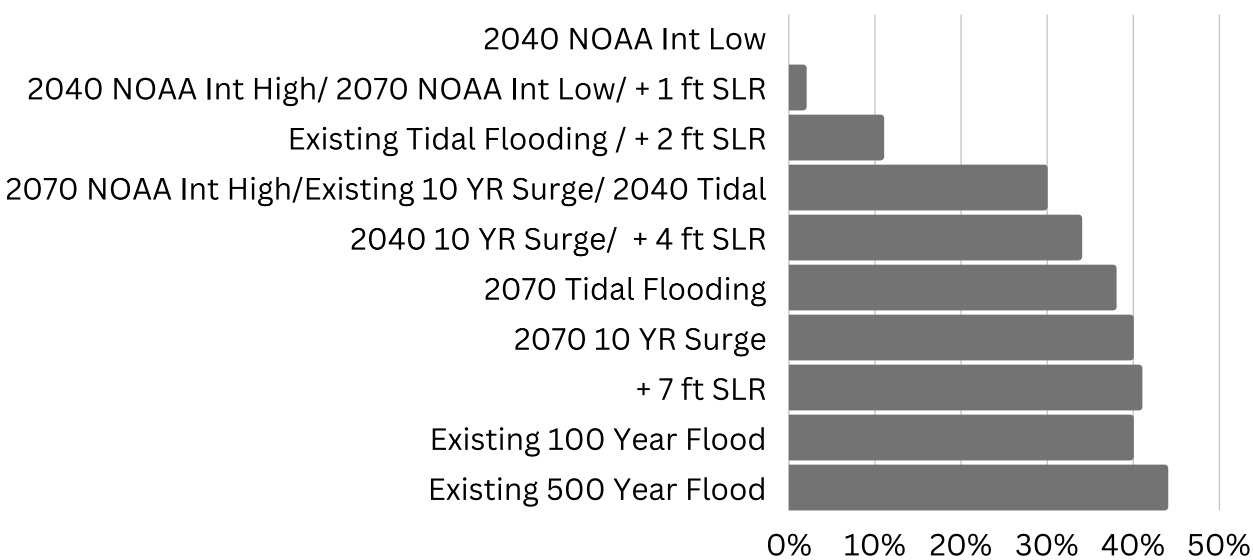


Figure 33. Percentage of Roadway Inundation Across All Flood Scenarios

Figure 34 depicts road elevation for all roads on Captiva, which helps to visualize low lying areas and road segments that would be the first to flood. It is evident that the majority of roads on the northern half of the island are at a significantly lower elevation than roads on the southern half of the island.

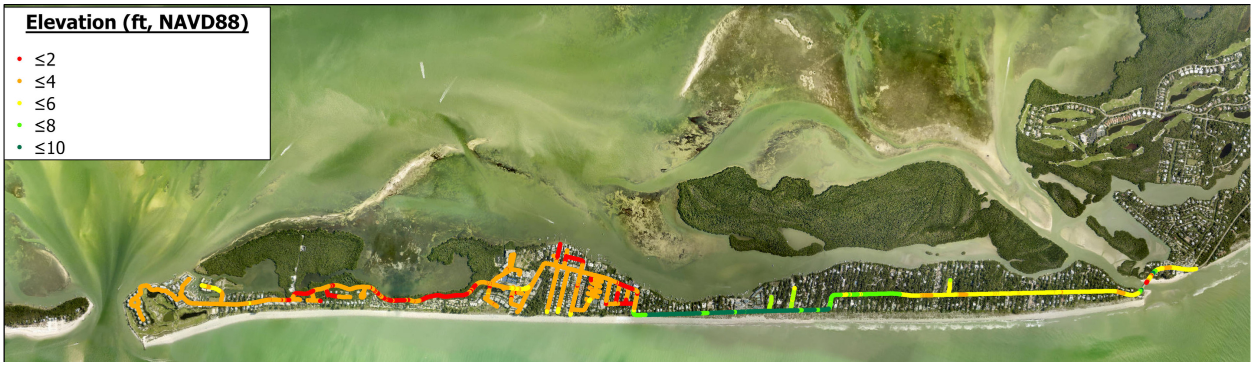


Figure 34. Captiva Roads Elevation Map

Inundated roads were also classified by owner (Table 7). For the purpose of this analysis, minor collector roads refer to roads that collect traffic from local roads and conduct it to a higher class of road. This evaluation and level of detail helps to characterize the impact of inundation on major larger roads versus minor collector roads, or smaller, more localized roads. Moreover, it helps determine jurisdiction and inform decision making regarding adaptation and mitigation. Figure 35 displays this breakdown via percentages to show approximately half of inundation impacts occur to minor collector roads and half occur to Local Neighborhood Roads and City Streets, under the three tipping point scenarios.

Table 7. Inundated Roadways Classified by Owner Under Inundation Tipping Point Scenarios

	Road Owner - Linear feet (% of total)			
	Urban: Minor Collector Roads (federal aid)	Local Neighborhood Road, Rural Road, or City Street	Private Roads for Service Vehicles	Total Roadways
Existing Tidal Flooding/ ~2 ft SLR	6,551 (55%)	5,448 (45%)	0 (0%)	11,999
2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding	16,149 (46%)	19,097 (54%)	45 (0.1%)	35,291
Existing 100 Year Flood Event	22,028 (51%)	20,877 (49%)	45 (0.1%)	42,950

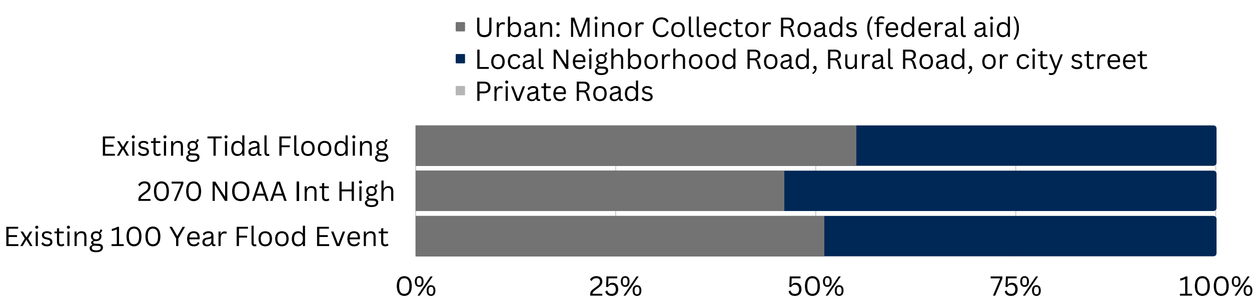


Figure 35. Percentage of Roadway Inundation by Roadway Type for Inundation Tipping Point Scenarios

When evaluating the vulnerability of roadways, it is important to identify any bridges along major routes that may also be vulnerable to flooding. The only bridge that exists on Captiva Island connects the Island to Sanibel Island. The road before the bridge on the Captiva side is predicted to experience inundation as is the parcel adjacent to the bridge (Figure 36). The vulnerability of the surrounding infrastructure and connected roadways will consequently impact the bridge's accessibility and reliability. If connected roadways are flooded and residents are unable to access the bridge, the mobility and movement of people and resources will be severely impacted.

The elevation of the lowest point of the ascending bridge is 6.9 ft NAVD, resulting in anticipated flooding of the bridge itself at 7 feet of sea level rise, and during an Existing 100 year and 500 year flood event. Table 7 depicts the predicted average inundation depths for each of these scenarios.

Table 8. Bridge Average Inundation Depth (in feet) for Relevant Scenarios

Scenario	Average inundation Depth (feet)
+ 7 ft SLR	0.4
Existing 100 Year Flood Event	1.92
Existing 500 Year Flood Event	4.22

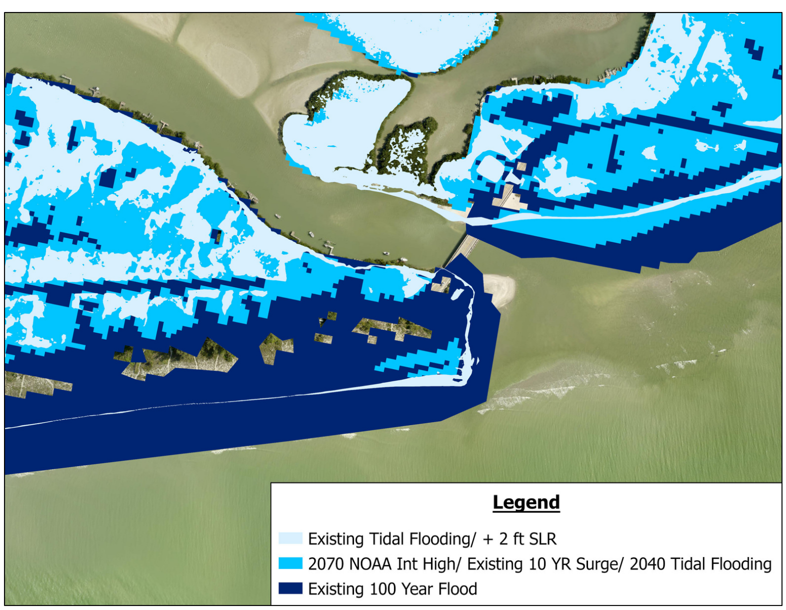


Figure 36. Bridge Inundation for Inundation Tipping Point Scenarios

Evacuation Routes

Captiva Drive serves as the island's evacuation route and its only connection to Sanibel. Inundation along this roadway could result in service interruptions, road closures, traffic delays, emergency service delays and overall loss of evacuation. The elevation of this roadway was assessed to determine the specific segments of the roadway at the lowest elevations, as these areas are most likely to flood first and to pose the greatest threat to service and evacuation interruptions. Figure 37 depicts the results of the initial elevation evaluation. Overall, the Northern portion of Captiva Island sits at a lower elevation than the remainder of the roadway and runs in close proximity to the bayside edge of the island with little to no buffer against the water body.

Figure 37. Captiva Evacuation Route Elevation

Utilizing the approximate centerline of Captiva Drive, road segments were then assessed to determine specific locations and magnitudes of inundation per scenario. The average inundation depth in feet for the evacuation route per scenario is outlined in Figure 38.

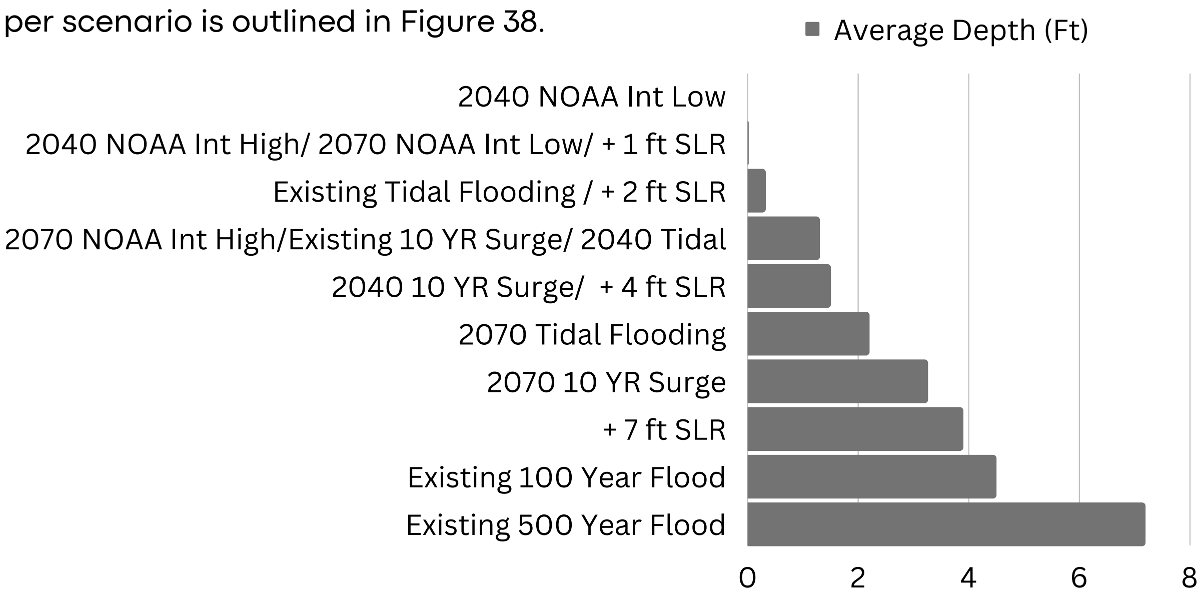


Figure 38. Captiva Evacuation Route Average Inundation Depth Across All Flood Scenarios

The average, minimum, and maximum, inundation depth for each inundation tipping point scenario is outlined in Table 9.

Table 9. Evacuation Route Elevation Summary Under Inundation Tipping Point Scenarios

	Inundation Depth (feet)		
	Average	Minimum	Maximum
Existing Tidal Flooding	0.3	0	0.9
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	1.3	0	2.4
Existing 100 Year Flood Event	4.5	1	8

Flooding depths greater than one foot have the ability to not only inhibit mobility but can eliminate the ability of emergency response and evacuation to and from the northern region of the island. In instances of hurricanes and storms, this can be extremely dangerous, leaving residents stranded without the ability to reach resources and aid. Figures 39 depicts the predicted evacuation route inundation for the three inundation tipping point scenarios.

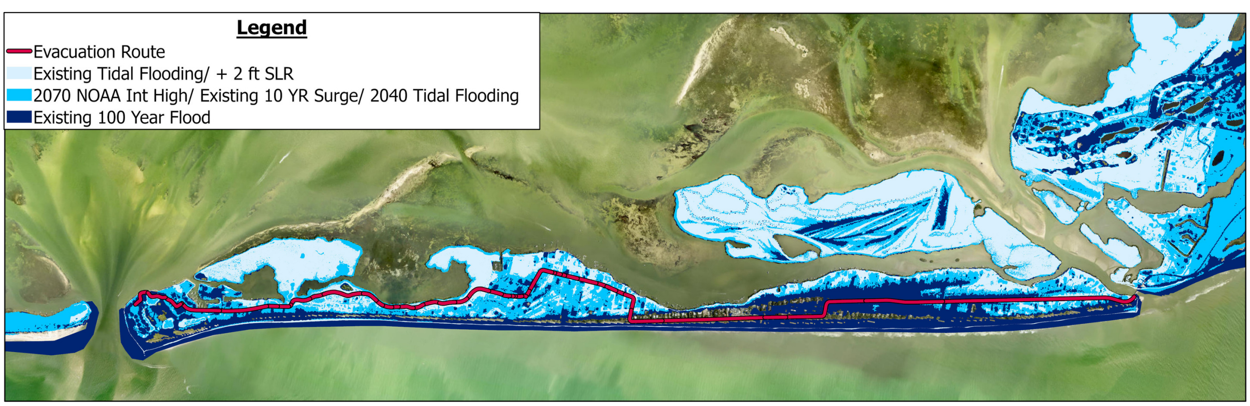


Figure 39. Evacuation Route Inundation Map for Inundation Tipping Point Scenarios

Marinas

Seven marinas exist on Captiva Island (Figure 40). The associated parcel for each marina coordinate point was utilized to estimate inundation under the ten flooding scenarios.

Figure 40. Captiva Marinas

All scenarios cause flooding to all seven marinas, except for the 2040 NOAA Intermediate Low and the 2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR, which impact four and six marinas respectively. To better understand the magnitude of this inundation, inundation depth was estimated for each marina, under each flood scenario. The results of this analysis for the three inundation tipping point scenarios are summarized in the subsequent pages, in Figures 41-47 and Table 10 and Table 11.

Depth represents the average across the relevant parcel so while a greater extent of inundation may exist under certain scenarios, the flooding depths across the expanded area vary and reduced depths in some areas can result in a reduced overall average depth. Under existing tidal flood conditions, six of the seven marinas will experience nuisance flooding (<1 ft deep), and one marina (located at 2800-5640 South Seas Plantation Road) will experience more significant flooding at 1.6 ft deep. According to the 2070 NOAA tipping point scenario, the average inundation at all impacted marinas will be greater than 1.5 feet. Again, the marina located at 2800-5640 South Seas Plantation Road is anticipated to experience flooding at a greater depth than the others, at an average of 2.8 ft deep. The marina located at 15903 Captiva Drive is also projected to experience more impactful flooding, with an average inundation depth of 2.4 feet. The extent of flooding exposure for each marina was examined in detail to identify specific impacts on infrastructure and accessibility. The results of this qualitative review for inundation tipping points 1 and 2 are summarized in Table 12 .The Existing 100 Year Flood Event was not included in Table 12 because the majority of the island is inundated under this scenario, resulting in the inundation of all marinas.

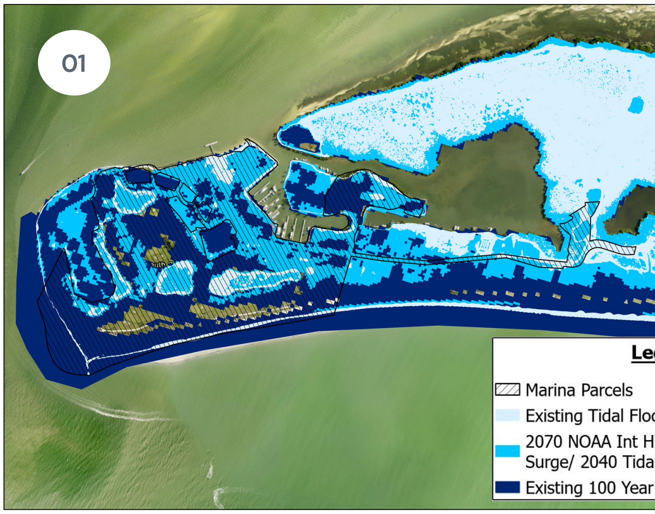


Figure 41. 1057-1900 South Seas Plantation Road Marina Inundation Map

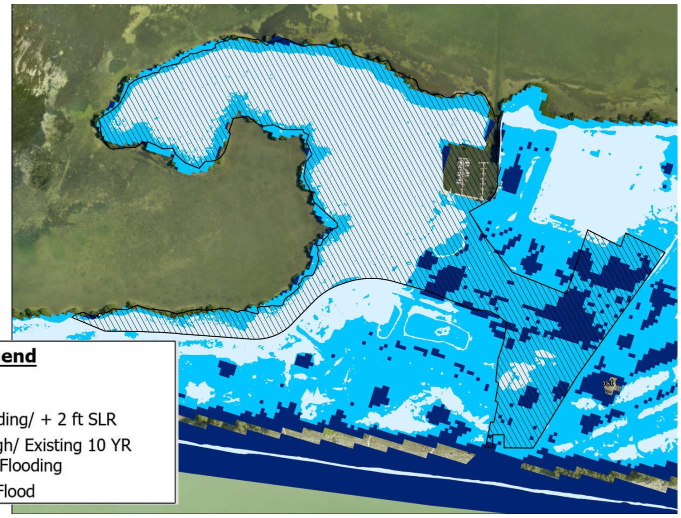


Figure 42. 2800-5640 South Seas Plantation Road Marina Inundation Map

Table 10. Marina Average inundation Depth (in feet) Under Inundation Tipping Point Scenarios-Part 1

		Average Inundation Depth (feet)		
	Marina Address	Existing Tidal Flooding	2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
01	1057-1900 South Seas Plantation Road	0.7	1.6	4
02	2800-5640 South Seas Plantation Road	1.6	2.8	6
03	11401 Andy Rosse Lane	0.2	1.7	6
04	15107 Captiva Drive	0.3	1.7	6

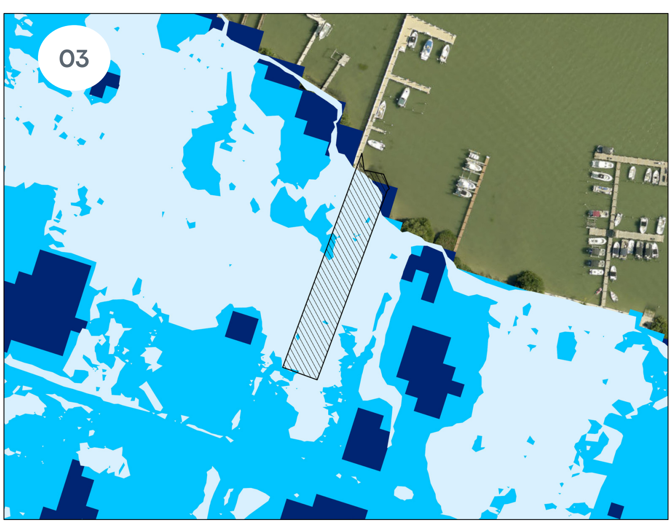


Figure 43. 11401 Andy Rosse Lane Marina Inundation Map

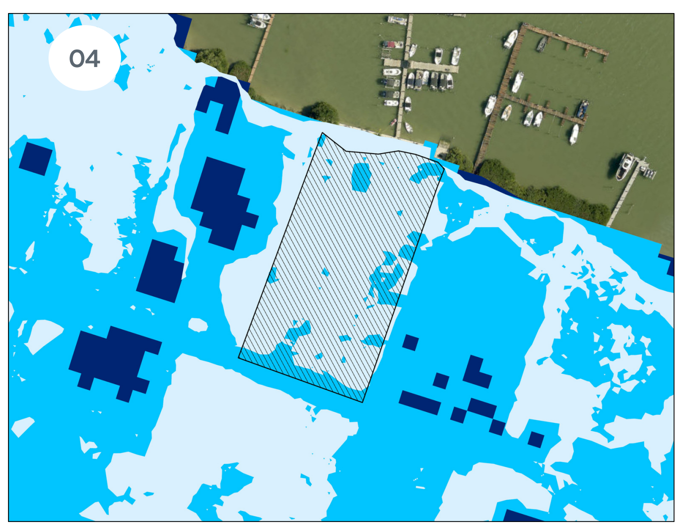


Figure 44. 15107 Captiva Drive Marina Inundation Map

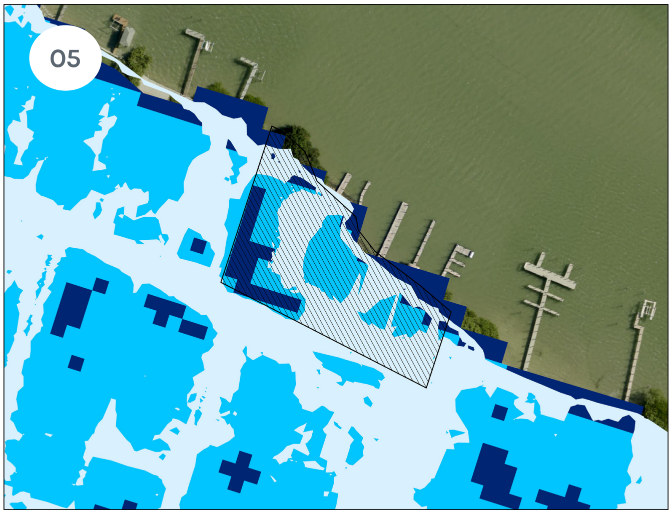


Figure 45. 15183 Captiva Drive
Marina Inundation Map

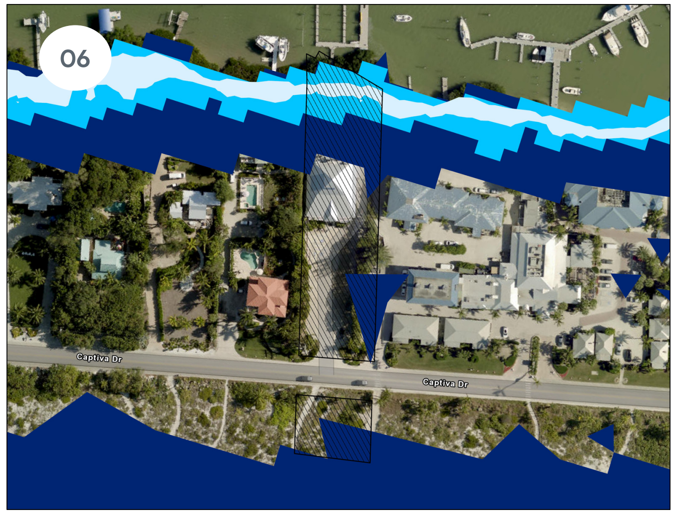


Figure 46. 15903 Captiva Drive
Marina Inundation Map

Table 11. Marina Average inundation Depth (in feet) Under Inundation Tipping Point Scenarios-Part 2

		Average Inundation Depth (feet)		
	Marina Address	Existing Tidal Flooding	2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
05	15183 Captiva Drive	0.2	1.5	5
06	15903 Captiva Drive	0.7	2.4	3
07	15951 Captiva Road	0.9	1.8	3

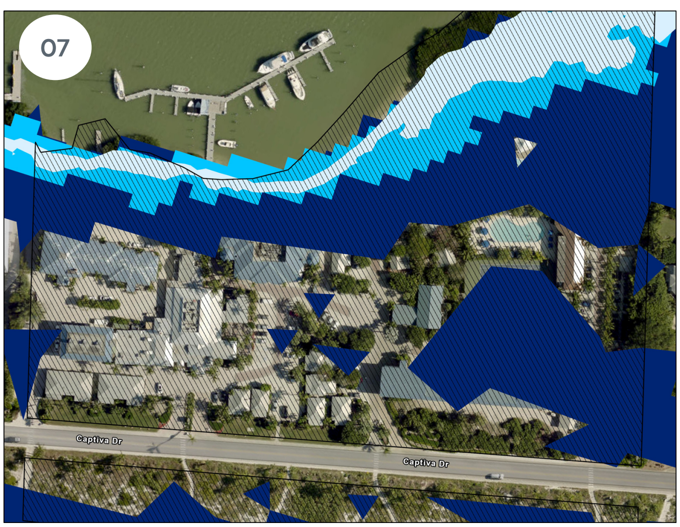


Figure 47. 15951 Captiva Road
Marina Inundation Map

Table 12. Marina Impact Under Inundation Tipping Point Scenarios

	Marina Address	Existing Tidal Flooding	2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding
01	1057-1900 South Seas Plantation Road	Entire mangrove area impacted by flooding. Southern portion of Plantation Road and bayside parcels begin to flood. Portions of South Seas Resort flooded.	The majority of Plantation Road and local roads experience inundation. Major points of entry, bayside properties, resorts, and marina infrastructure impacted.
02	2800-5640 South Seas Plantation Road	Significant portions of mangroves and inland greenspace flooded, along with Plantation Road, local roads surrounding marina, and bayfront properties.	Anticipated flooding along major segments of Bayside VIs and Bayside Marina and other local roads, and along the parking lot and structures at the entrance of marina.
03	11401 Andy Rosse Lane	Initial inundation to the entire marina parcel- major roads, parking lot, and marina structures.	All land access to marina is estimated to be inundated- major roads, parking lot, and marina structures.
04	15107 Captiva Drive	Initial inundation to majority of marina parcel and to bayfront. Majority of Captiva Drive not impacted.	All land access to marina is estimated to be inundated- major roads, parking lot, and marina structures.
05	15183 Captiva Drive	Majority of marina parking lot and building impacted by flooding. Neighboring parcels and Captiva Drive flooded.	The remainder of the marina parking lot is inundated, along with all nearby roads and parcels.
06	15903 Captiva Drive	Minor anticipated flooding along the pathway from marina to parking lot and vegetation.	Greater extent of anticipated flooding along the pathway from marina to parking lot and inland along eastern edge of parking lot.
07	15951 Captiva Road	Similar conditions as observed for Marina 6, as they are adjacent. Initial flooding along bayside impacting pathway from marina to parking lot.	More severe flooding along the pathway from marina to parking lot and along eastern edge of parking lot.

Airports, Ports, Bases, and Bus Terminals

While there are no airports, ports, or seaplane bases located on Captiva, the nearest facilities were mapped (Figure 48). There are no bus terminals or routes on Captiva either. Table 13 depicts the names of these facilities and the distance to them from Captiva.

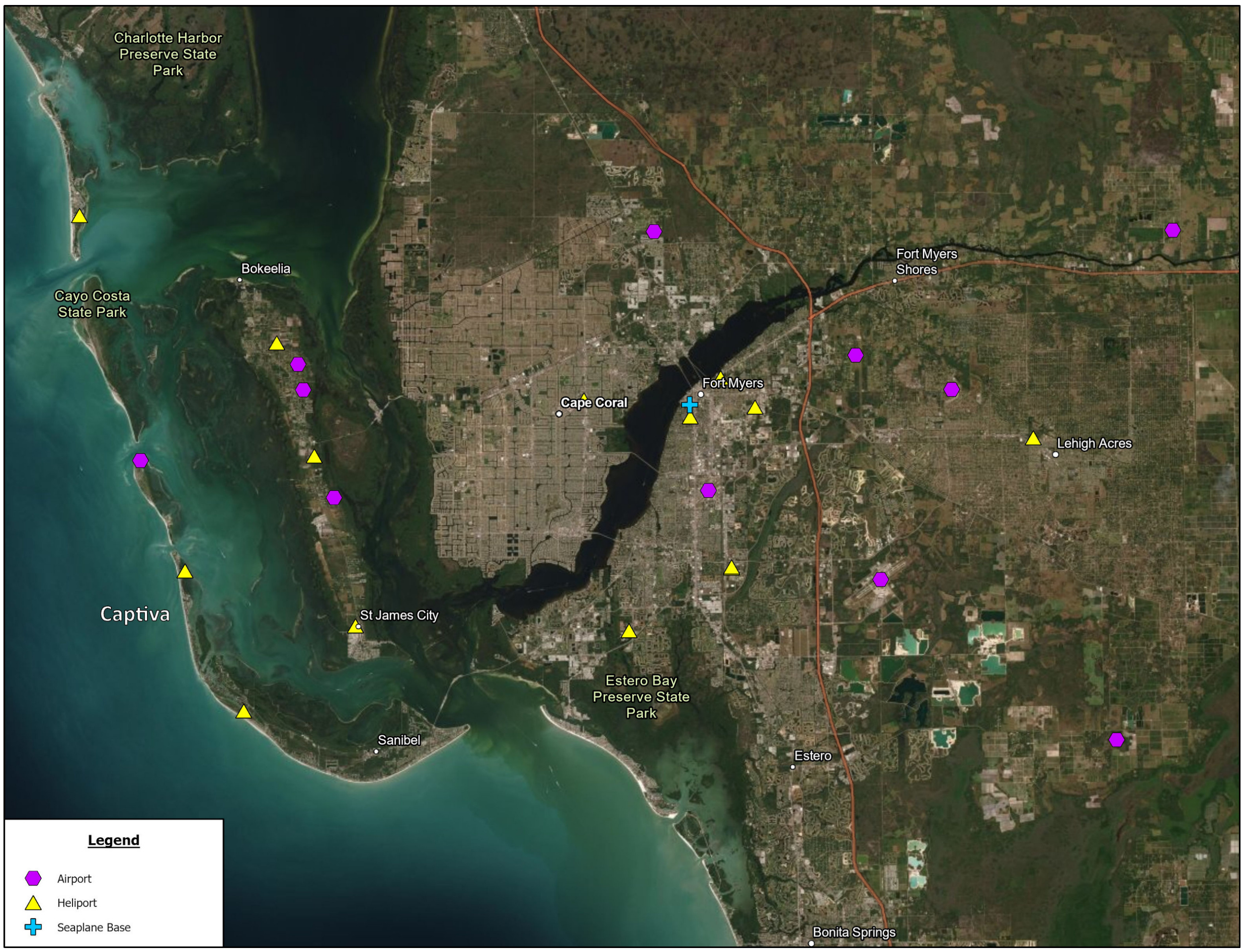


Figure 48. Lee County Airports, Ports, Bases, and Bus Terminals

Table 13. Nearest Bus terminal, Airport, Port, and Seaplane Base

Facility Type	Facility Name	Approximate Distance from Captiva (miles)
Bus Terminal	Lee Tran Intermodal Transfer Center	15
Airport	Page Field Airport	21
Seaplane Base	Caloosa Downtown Seaplane Base	22
Port	Port Manatee	85

The heliport location on Captiva was assessed for anticipated inundation. According to the analysis results, the Captiva heliport, is likely to experience flooding with an average depth of 1.8 feet under existing tidal flooding conditions, an average doeth of 3.6 feet under the 2070 NOAA Int High scenario, and an average depth of 7 feet under the Existing 100 Year Flood Event scenario. A flooding depth greater than one foot is expected to disturb functioning and accessibility, and greater than two feet is expected to have serious impacts on the facility. Thus, depths of 3.6 feet and 7 feet would likely pose disastrous impacts to the heliport.

Critical Community and Emergency Facilities Sensitivity Analysis

Critical Community Facilities

Critical community facilities are those facilities that are vital to the community's functioning, safety, and health. For the island of Captiva, critical facilities include schools, community centers, fire stations, law enforcements facilities, correctional facilities, local and state government facilities, healthcare facilities and hospitals. Point data for the nearest critical facilities were obtained and utilized for this analysis. As is evident in Figure 49, while some critical facilities serving the island are located on the island, many are located outside of the CEPD boundary. These facilities within the larger area of Lee County were still included within this analysis as they are critical to the functioning and wellbeing of the CEPD community and any risk of inundation and potential disturbance to these facilities would impact the lives of the CEPD residents dependent on them.

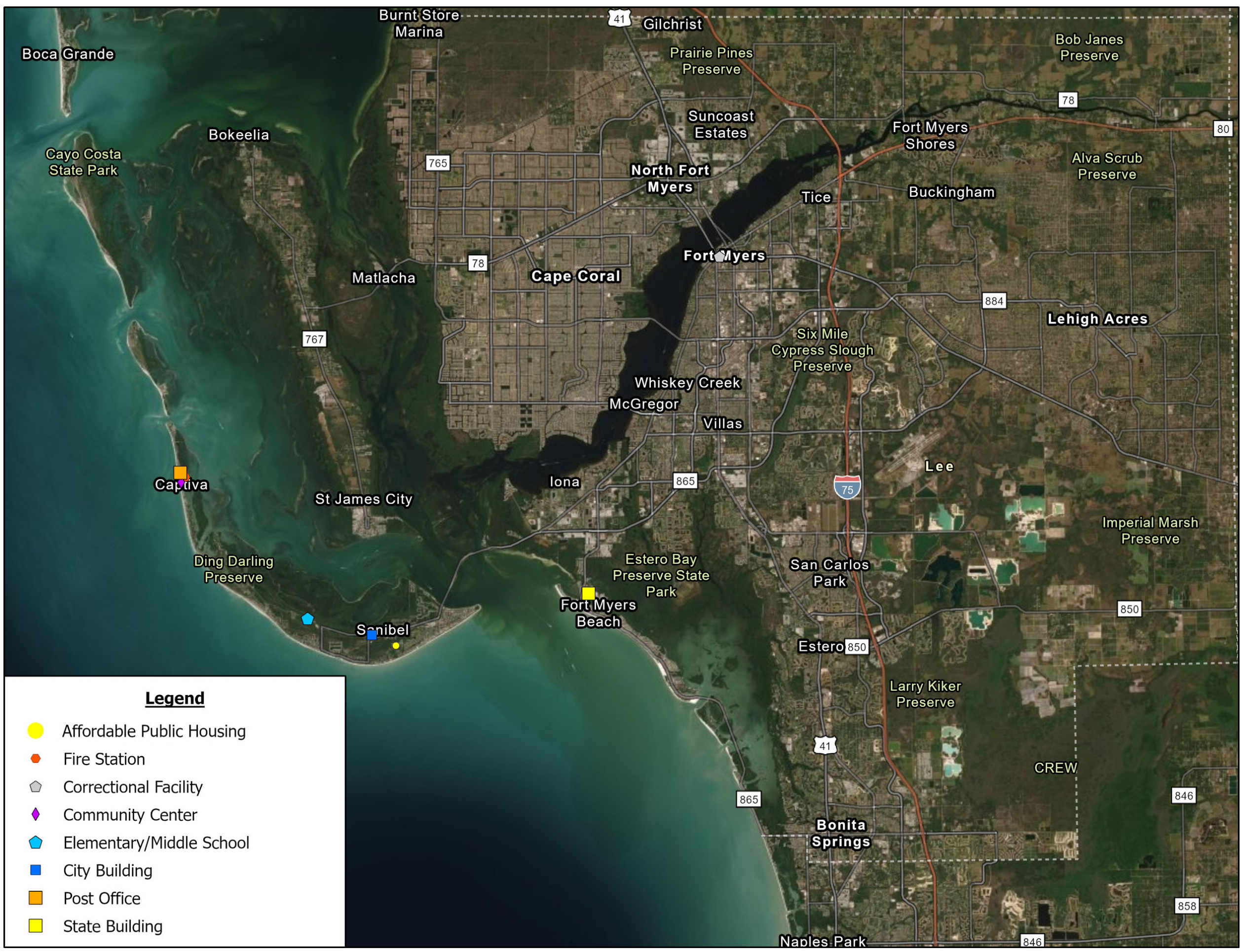


Figure 49. Off Island Critical Community Facilities Map

In summary, point data for the closest major critical facilities to CEPD were analyzed for initial inundation impact under the three inundation tipping point scenarios. One community center (Captiva Civic Association, Inc), one fire station (Captiva Fire Station #181), and one federal government facility (U S. Postal Service Captiva) are located on the island of Captiva and serve the island's community (Figure 50).

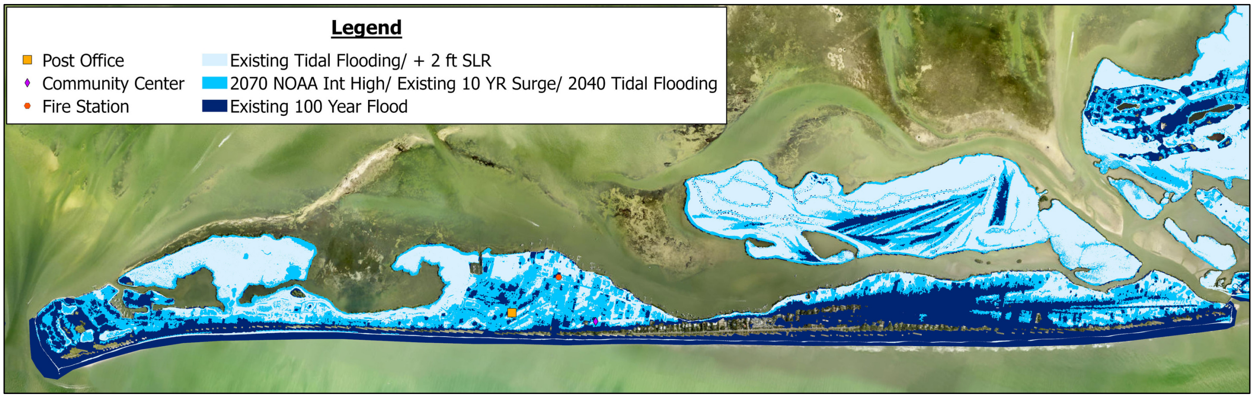


Figure 50. On Island Critical Community Facilities Map

It is anticipated that these three facilities will experience flooding under all three inundation tipping point scenarios. The specificities of inundation depth for each asset under each scenario is outlined in Table 14. The three assets are expected to experience nuisance flooding under existing tidal flooding conditions and the 2070 NOAA Int High topping point scenario. However, more severe flooding with a depth of three feet or more is expected under the Existing 100 Year Flood Event, which would have extreme impacts. Major transportation routes and adjacent parcels may also experience inundation which could further reduce the accessibility to these critical structures.

Table 14. On Island Critical Community Facilities Inundation Depth (in feet) Under Inundation Tipping Point Scenarios

Facility Type	Island Total	Facility Name	Inundation Depth (feet)		
			Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Community Centers	1	Captiva Civic Association, Inc	0.7	0.7	5
Fire Stations	1	Captiva Fire -Station #181	0.2	0.9	3.6
Federal Government Facilities	1	U S. Postal Service Captiva	.1	0.3	3

The remaining critical facility types included in this assessment do not exist on the island of Captiva, and thus, for the purpose of this analysis, the closest location within Lee County representing each facility type was assessed for future inundation. Table 15 details the facility type, the approximate distance in miles to the closest facility outside of Captiva (straight line from end of island to facility), the facility name, and the estimated inundation under the three inundation tipping point scenarios.

Correctional Facility, Hospital, and Local Government Facility

The nearest correctional facility (Lee County Jail), located 5 miles from Captiva, is not estimated to experience any inundation across the scenarios. The nearest hospital (Lee Health- HealthPark Hospital) located 17 miles from Captiva and the nearest local government facility (Island Civic Center) located 7 miles from Captiva will not experience flooding under the inundation tipping points 1 and 2, however will experience impactful inundation under an Existing 100 Year Flood Event. The average inundation depth for these two facilities under this scenario is around 3 feet.

School and Health Care Facility

The closest school serving the island of Captiva is the Sanibel School K-8, located 5 miles off the Southern tip of Captiva. Flooding is anticipated at this location for all tipping point scenarios at a depth of 1.3 feet, 1.8 feet, and 5 feet, respectively. The San-Cap Medical Center serves as the health care facility for Captiva residents and is approximately 4 miles from the island's southern tip. This center proves to be at risk for inundation, with an estimated inundation depth of 1.8 feet under the 2070 NOAA Int High Tipping Point scenario and a depth of 5.8 feet under an Existing 100 Year Flood Event.

Law Enforcement Facility and State Government Facility

The nearest law enforcement facility (Sanibel Police Dept) and the nearest affordable housing unit (unit 2) experience a similar incremental inundation pattern. Very minimal flooding (<.08 feet) under existing tidal flooding conditions is unlikely to cause disruption or impact the functionality of these facilities. However, under the 2070 NOAA Int High scenario, both facilities will experience disturbance from flood levels which could limit or prohibit normal operations and under the Existing 100 Year Flood Event, the facilities will be inoperable. Flooding of the police department could result in reduced response time and reduced ability and accessibility to immediate aid. The state government facility (SW Florida Marine Institute) would not be of highest priority in the case of a flood, but similar to other facilities, it still proves to be highly vulnerable under the Existing 100 Year Flood Event (average flood depth is 7.5 feet). The inundation depths per scenario are outlined in Table 15.

Table 15. Off Island Critical Community Facilities Inundation Depth (in feet) Under Inundation Tipping Point Scenarios

			Inundation Depth (feet)		
Facility Type	Distance to Closest (mi)	Facility Name	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Schools and colleges	5	The Sanibel School K-8	1.3	1.8	5
Correctional Facilities	22	Lee County Jail	0	0	0
Health Care Facilities	4	San-Cap Medical Center	0	1.8	5.8
Hospitals	17	Lee Health - HealthPark Hospital	0	0	3.1
Law Enforcement	7	Sanibel Police Dept	.05	1.7	5.7
Local Government Facilities	7	Island Civic Center	0	0	3
State Government Facilities	15	SW Florida Marine Institute	0	.3	7.5
Affordable Public Housing	8	Community Housing and Resources Minor Subdivision at Sanibel Highlands Desc in Instr # 2016000176662 Unit 2	.08	1.2	7

Emergency Facilities

Emergency facilities included in this assessment consist of three facilities on Captiva and two outside of Captiva, displayed in Figure 51. These facilities can be critical to the safety and survival of residents during and after a hazard or disaster.

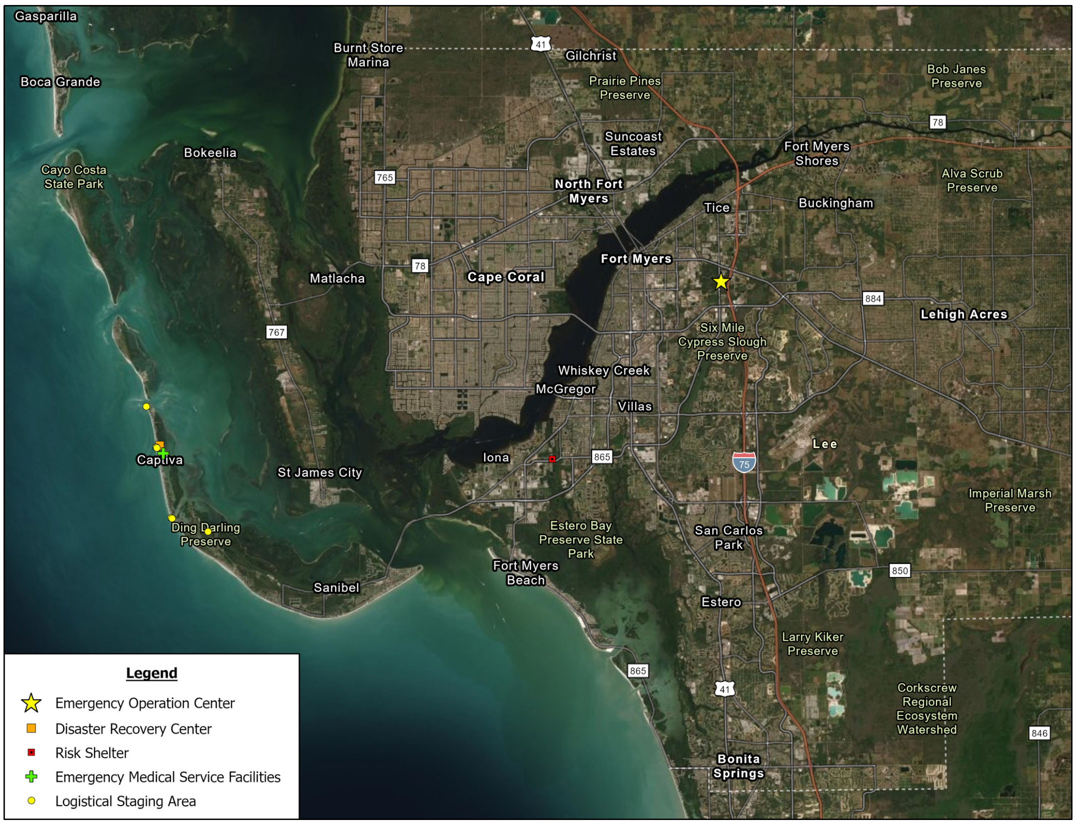


Figure 51. Off Island Emergency Facilities Map

The emergency medical service facility, disaster recovery center, and logistical staging area, are located on the island of Captiva (Figure 51). The local fire station (Captiva Fire Station #18) mentioned previously serves as the local emergency medical service facility and will respond to emergency calls on the island of Captiva. The results of the fire station inundation analysis were reviewed in the previous section.

The Chadwick's at South Seas Plantation is the on-island disaster recovery center (DRC) which serves as the dedicated, accessible and established location where survivors are assisted through the recovery process via information and resources. This DCR is not expected to experience any flooding under existing tidal conditions.

However, according to the NOAA 2017 Int High scenario and the Existing 100 Year Flood Event, Chadwick's is likely to experience impactful inundation at an average depth of 2.8 and 5.8 feet, respectively. This degree of flooding has the potential to make the DCR inoperable, which would prohibit residents from receiving the aid and assistance needed. The logistical staging areas along the island are predicted to experience nuisance flooding under Existing Tidal Conditions (with an average depth of 0.6 feet) and under the 2070 NOAA Int High Tipping Point (with an average depth of 0.1 feet). While a higher water level is expected for the 2070 NOAA Int High scenario, the type of flooding impacts the direction and introduction of water to the area, and when averaged across multiple parcels, the average can sometimes be reduced. Inundation depths for the individual Staging Areas can be reviewed in Appendix VI. Table 16 summarizes inundation depths and Figure 52 represents the spatial impacts to the facilities under the three inundation scenarios.

Table 16. On Island Emergency Facilities Inundation Depth (in feet) Under Inundation Tipping Point Scenarios

Facility Type	Island Total	Facility Name	Inundation Depth (feet)		
			Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Emergency Medical Service Facilities	1	Captiva Fire -Station #181	0.2	0.9	3.6
Disaster Recovery Centers	1	Chadwick's at South Seas Plantation	0	2.8	5.8
Logistical Staging Areas	5	Multiple	0.6	0.1	4

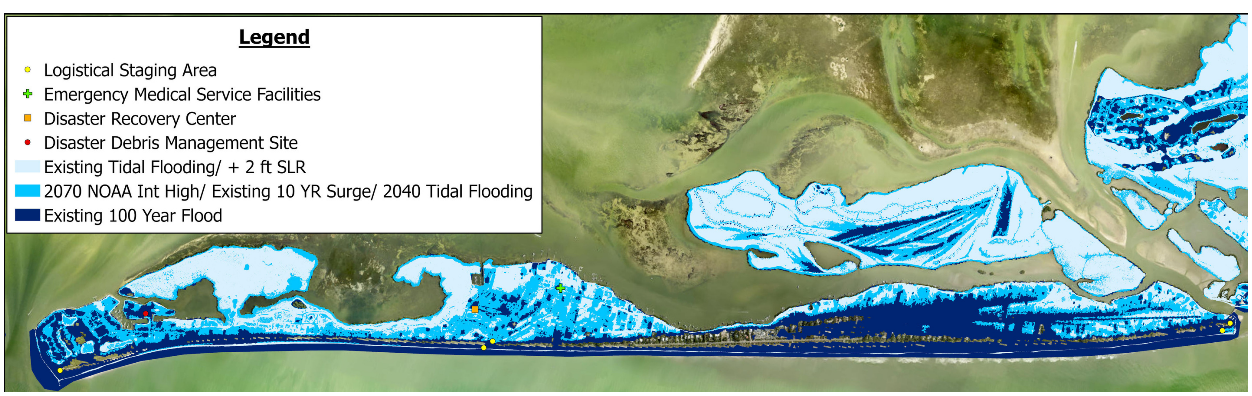


Figure 52 On Island Emergency Facilities Map

Table 17 outlines the off-island emergency facilities and their average inundation depths under the relevant scenarios. The closest emergency operations center to Captiva is located in Fort Myers, about 25 miles from the Southern tip of Captiva. According to FEMA, an Emergency Operations Center is a protected site from which State and local civil government officials coordinate, monitor, and direct emergency response activities during an emergency. Situated inland and away from the coast, no inundation is anticipated for this center, however, road inundation between Captiva and the center could serve as an obstacle for Captiva residents under various flood scenarios.

Approximately 16 miles from Captiva, the nearest risk shelter (Heights Elementary School) will likely not experience flood risk under existing tidal conditions and would thus be operable and accessible to Captiva residents. Under the greater water elevation levels predicted for the 2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding scenario and for the Existing 100 Year Flood Event, flooding is predicted at a depth of 2.2 ft and 5 ft, respectively. Flooding at these depths would eliminate the accessibility and protection of the shelter. A shelter slightly closer to Captiva is located on Fort Myers but was not included in this assessment because the included shelter at approximately the same distance is located more mainland and should experience less severe flooding.

Table 17. Off Island Emergency Facilities Inundation Depth (in feet) Under Inundation Tipping Point Scenarios

			Inundation Depth (feet)		
Facility Type	Distance to Closest (mi)	Facility Name	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Emergency Operations Centers	25	Emergency Operations Center	0	0	0
Risk Shelter Inventory	16	Heights Elementary School	0	2.2	5

Natural, Cultural, and Historical Resources Sensitivity Analysis

Conservation Lands

While not necessarily critical to the survival or basic functionality of the island, the natural and cultural and historical resources on Captiva prove to be essential to the island's integrity and identity. Protecting them against flooding and prioritizing lands and structures will be a key facet of adaptation moving forward. The natural resources considered in this report include conservation lands, parks, and wetlands. Conservation land data was downloaded from the Florida Natural Areas Inventory and was analyzed for impact and average depth over the entire areas. Figure 53 depicts the acreage of conservation lands inundated for each flood scenario. It is important to note that the results of this analysis and the subsequent analysis of mangrove inundation represent some degree of overlap.

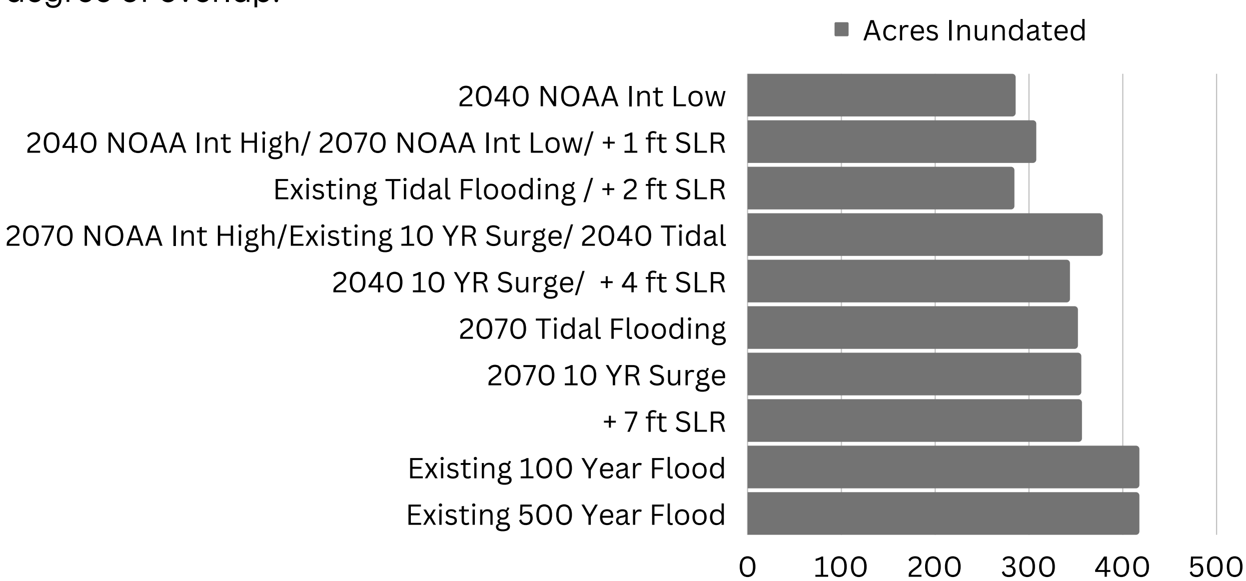


Figure 53. Conservation Land Inundation Across All Flood Scenarios

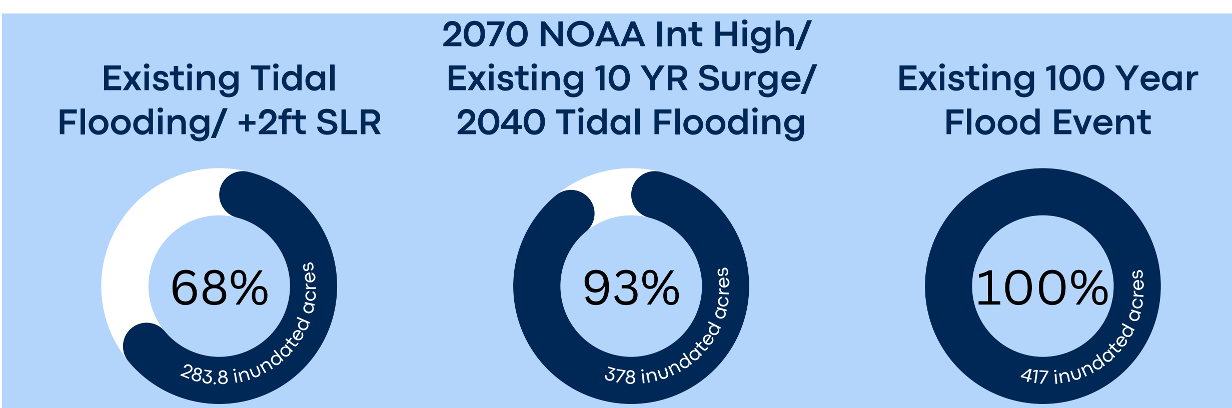


Figure 54. Percentage of Conservation Land Inundation Under Inundation Tipping Point Scenarios

Figure 54 serves as a comparison of inundation percentage between the three inundation tipping point scenarios. Under existing tidal flooding conditions, 68% of conservation lands will flood at an average depth of 1.7 feet and under the 2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding scenario 93% of conservation lands will flood at an average depth of 3.3 feet. The entirety of conservation lands on Captiva Island are expected to be inundated under the Existing 100 Year Flood Event scenario, with an average inundation depth of 6.5 feet. The difference in location and spatial extent of inundated conservation lands between the three inundation tipping point scenarios is evident in Figure 55.

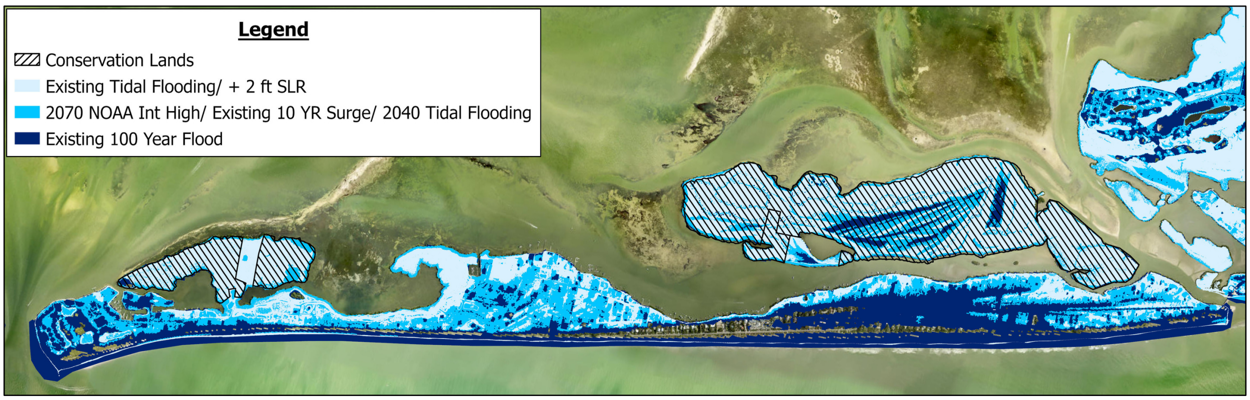


Figure 55. Conservation Land Inundation Map for Inundation Tipping Point Scenarios

Figure

Wetlands

Data from the Fish and Wildlife Research Institute painted a picture of the location and extent of the mangroves along Captiva Island. As previously stated, when analyzing mangroves for inundation extent and depth, it is important to note that some of these areas overlap with conservation lands and thus some of the resulting metrics may be duplicative in nature. Figure 56 represents the inundation comparison of Captiva's wetlands for all scenarios.

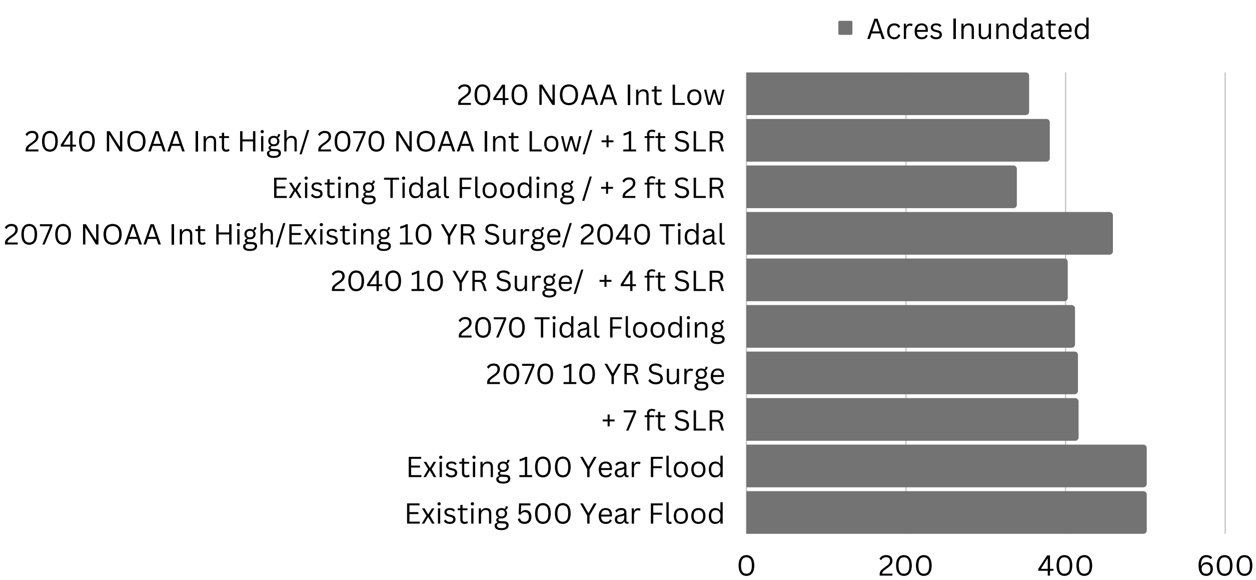


Figure 56. Wetland Inundation (in acres) Across All Flood Scenarios

The results of the analysis show that 68% of the total 501 acres of mangroves on the island will experience flooding according to the Existing Tidal flooding scenario with an average depth of 1.5 feet. The 2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding scenario depicts 92% of mangroves inundated with an average depth of 3.2 feet. lastly, 100% of all Captiva Mangroves will be inundated under the Existing 100 Year Flood Event Scenario with an average depth of 6.5 feet.

Parks

County parks, preserves, and zoned parks related to greenspace, totaling 2.4 acres, were included in the following analysis as they are mostly all managed by CEPD. Figure 57 depicts projected inundation impacts for all parks along Captiva Island under the inundation tipping point scenarios. Park inundation does not prove to be a major anticipated threat under the existing tidal flooding conditions, which estimate that only 8% of parks will experience flooding with an average depth of .7 feet. The predicted average inundation depth is the same under the 2070 NOAA tipping point scenario, with only 12% of parks inundated. As was the case with the conservation lands and wetlands, under the Existing 100 Year Flood Event scenario, 100% of all parks will experience flooding (average depth: 6.5 feet).

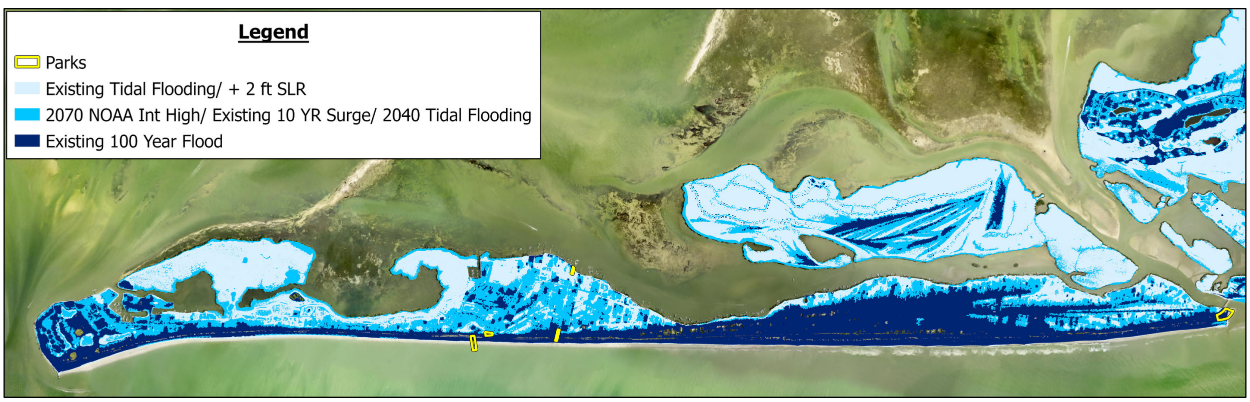


Figure 57. Wetland Inundation Map for Inundation Tipping Point Scenarios

Shorelines and Surface Waters

To determine estimated shoreline inundation, the Erosion Control Line (ECL) was assessed under the relevant inundation scenarios. To determine estimated shoreline inundation, the Erosion Control Line (ECL) was assessed under the relevant inundation scenarios. Figure 58 highlights the elevation of Captiva's shoreline.

Figure 58. Shoreline Elevation Map.

Captiva possesses 25,823 linear feet of shoreline and under existing tidal flooding conditions, 0% of the shoreline will experience inundation. The degree of shoreline inundation increases to only 1% according to the 2070 NOAA Int High tipping point scenario. Shoreline inundation increases drastically under the Existing 100 Year Flood Event scenario, which anticipates that 60% of shorelines will be impacted by flooding (Figure 59).

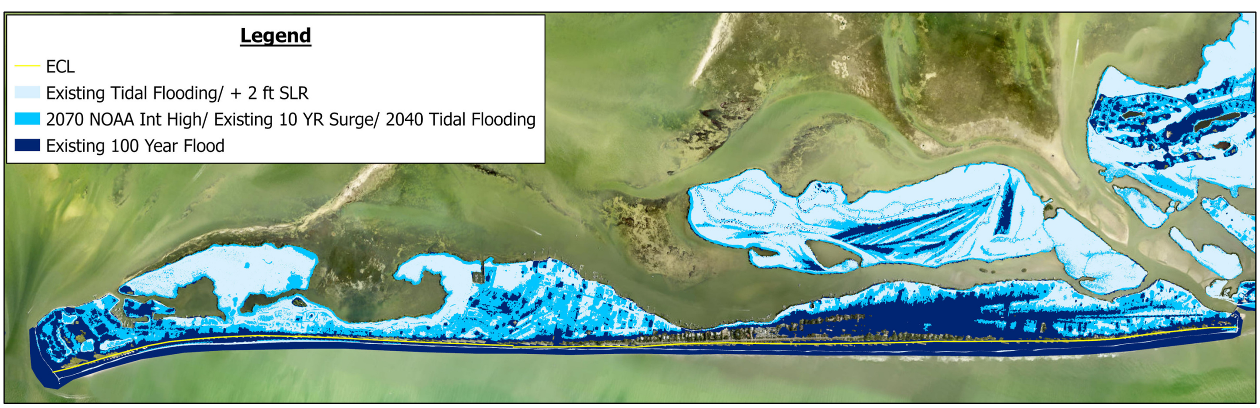


Figure 59. Shoreline Inundation Map for Inundation Tipping Point Scenarios.

According to Lee County's data reserve, six surface water bodies exist in Captiva, shown in Figure 60. The surface waters equate to a total of 40.4 acres.

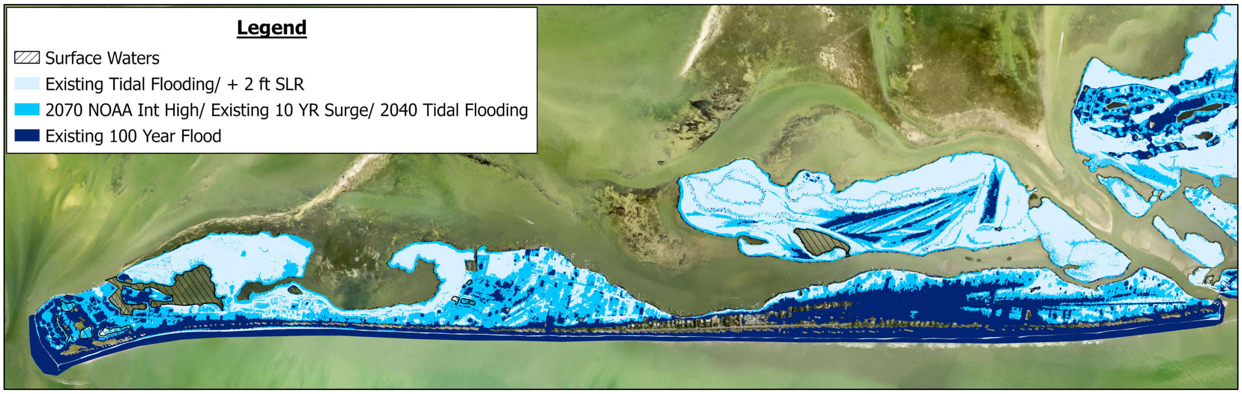


Figure 60. Surface Waters Inundation Map for Inundation Tipping Point Scenarios.

Minimal surface water inundation is anticipated for the first two inundation tipping point scenarios, however 100% of surface waters are expected to experience inundation under the third inundation tipping point scenario. The specific results of the analysis are outlined in Figure 61.

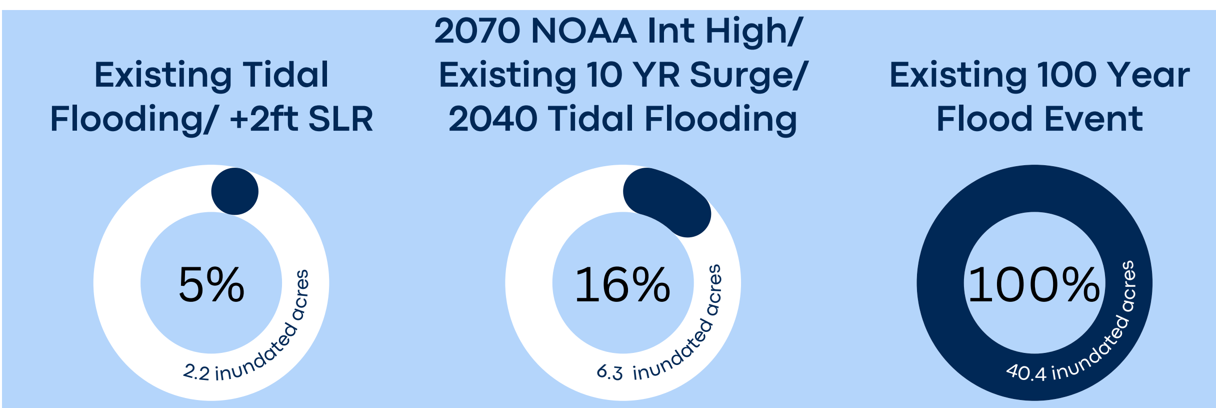


Figure 61. Surface Waters Inundation Map for Inundation Tipping Point Scenarios.

Historical and Cultural Assets

Historic and cultural facility data are logged and maintained at the state level by the Florida's State Historic Preservation Offices (SHPO) of the Florida Bureau of Historic Preservation (BHP). Nationally, facilities are tracked by the National Park Service (NPS) who compile the National Register of Historic Places (NRHP). The NRHP is the official list of properties and areas recognized as historical and nationally preserved, two of which are located within Captiva (the Captiva School and Chapel-by-the-Sea Historic Districts). Figure 62 depicts the general locations of these historic districts, indicated by stars on the map. An additional 73 properties have been identified by the SHPO as potential historical and cultural sites, labeled on Figure 62 as "Not Evaluated by SHPO".

When assessing the NRHP districts and the SHPO potential historical places for predicted inundation, 21% are likely to experience flooding under the existing tidal flooding conditions, 45% are likely to experience flooding under the 2070 NOAA Int High Tipping Point scenario, and 69% are likely to experience flooding under the 100 Year Flood Event.

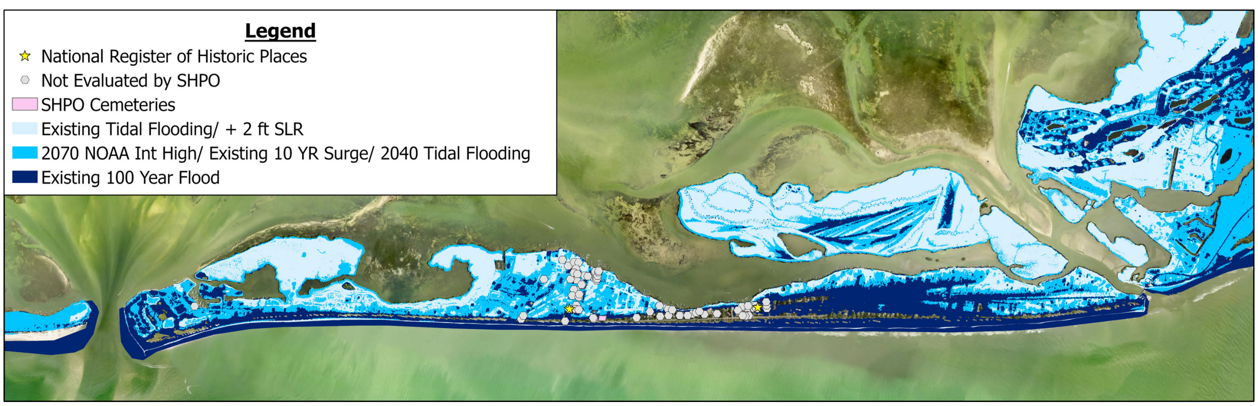


Figure 62. Historical and Cultural Assets Inundation Map for Inundation Tipping Point Scenarios

Risk Assessment

Determining the risk of the various types, degrees, and occurrences of flooding helps to qualify the susceptibility of critical assets on the island of Captiva. Determined inundation depths and flood scenarios are utilized to generate a standardized risk score on a scale to help compare risks of assets and prioritize them for adaptation purposes.

More specifically, flood risk is a combination of the probability (likelihood or chance) of an event happening and the consequences (impact) if it occurred. Risk was calculated by multiplying likelihood by impact and then assigning a rank of high low, medium, or high risk based on value. The following equation and descriptions outline the evaluation of risk per asset:

Likelihood (or probability) of a given flood scenario occurring in a year [Table 17] **X** **Impact Score** (based on the anticipated depth) of the asset under the given flood scenario [Table 18] **=** **Risk Score** [Table 19]

The likelihood of occurrence of each flood scenario was assigned a probability based on annual probability of occurrence. Annual probability of occurrence ranges are outlined in Table 18.

Table 18. Flood Likelihood per Scenario

Scenario	Likelihood/ Probability
2040 NOAA Int Low	4.345
2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR	1.873
Existing Tidal Flooding/ +2ft SLR	.53
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	.143
2040 10 YR Surge/ +4 ft SLR	.075
2070 Tidal Flooding	.053
2070 10 YR Surge	.031
+ 7 ft SLR	.021
Existing 100 Year Flood	.01
Existing 500 Year Flood	.002

The impact of hazard was determined by the anticipated inundation depth of an asset under the relevant flood scenario. Each asset was assigned an impact score of 0,1, 33, 66, or 100 based on the inundation depth ranges outlined in Table 19. Calculated risk scores were then assigned a qualitative risk rank based on the risk score value according to the ranges outlined in Table 20.

Table 19. Impact Score per inundation Depth Range (in feet)

Inundation Depth (feet)	Impact Score
0	0
0-1 foot	1
1-2 feet	33
2-5 feet	66
>5 feet	100

Table 20. Risk Ranks per Score Range

Risk Score	Risk Rank
0	No Foreseeable Risk
0 -4.5	Low Risk
4.5 -20	Medium Risk
> 20	High Risk

An example of the risk calculation is outlined below for an asset under the 2070 Tidal Flooding Scenario experiencing inundation at a depth of 2.5 feet:

.053 (Likelihood) **X** **66** (Impact Score) **=** **3.5 Low Risk**

Table 21 displays the finalized risk matrix that was utilized to determine risk per asset for this assessment. Table 22 summarizes risk across the inundation tipping point scenarios for singular on island assets and Table 23 summarizes risk rank counts for grouped island assets.

Table 21. Risk Matrix

		Water Depth =0	Water Depth 0-1 ft	Water Depth 1-2 ft	Water Depth 2-5 ft	Water Depth >5 ft
		0	1	33	66	100
2040 NOAA Int Low (P=434.5%)	4.345	No Foreseeable Risk	Low Risk	High Risk	High Risk	High Risk
2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR (P=187.3%)	1.873	No Foreseeable Risk	Low Risk	High Risk	High Risk	High Risk
Existing Tidal Flooding/ +2ft SLR (P=53.4%)	0.534	No Foreseeable Risk	Low Risk	Medium Risk	High Risk	High Risk
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding (P=14.3%)	0.143	No Foreseeable Risk	Low Risk	Medium Risk	Medium Risk	Medium Risk
2040 10 YR Surge/ +4 ft SLR (P=7.5%)	0.075	No Foreseeable Risk	Low Risk	Low Risk	Medium Risk	Medium Risk
2070 Tidal Flooding (P=5.3%)	0.053	No Foreseeable Risk	Low Risk	Low Risk	Low Risk	Medium Risk
2070 10 YR Surge (P=3.1%)	0.031	No Foreseeable Risk	Low Risk	Low Risk	Low Risk	Low Risk
+ 7 ft SLR (P=2.1%)	0.021	No Foreseeable Risk	Low Risk	Low Risk	Low Risk	Low Risk
Existing 100 Year Flood (P=1%)	0.01	No Foreseeable Risk	Low Risk	Low Risk	Low Risk	Low Risk
Existing 500 Year Flood (P=.2%)	0.002	No Foreseeable Risk	Low Risk	Low Risk	Low Risk	Low Risk

Table 22. Risk Ranks for On Island Singular Assets

		Asset Risk		
Asset Type	Name of Asset(s)	Existing Tidal Flooding/ +2ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Community Centers	Captiva Civic Association, Inc. (11550 Chapin Lane, Captiva, FL 33924)	Low Risk	Low Risk	Low Risk
Fire Station/ EMS	Captiva Fire Station #181 (14981 Captiva Dr, Captiva, FL 33924)	Low Risk	Low Risk	Low Risk
Federal Government Facilities	U S. Postal Service Captiva (14812 Captiva Dr SW, Captiva, FL 33924)	Low Risk	Low Risk	Low Risk
Disaster Recovery Centers	Chadwick's at South Seas Plantation (5400 Plantation Rd, Captiva, FL 33924)	No Foreseeable Risk	Medium Risk	Low Risk
Heliport	Captiva Heliport	Medium Risk	Medium Risk	Low Risk
Wastewater Treatment Facilities	South Seas Plantation	Low Risk	Medium Risk	Low Risk
	Tween Waters Inn WWTP	No Foreseeable Risk	No Foreseeable Risk	No Foreseeable Risk
	Captiva Shores Condominium WWTP	No Foreseeable Risk	Medium Risk	Low Risk
	Sunset Captiva WWTP	No Foreseeable Risk	Low Risk	Low Risk
Lift Stations	Lift station #1	No Foreseeable Risk	Low Risk	Low Risk
	Lift station #2	No Foreseeable Risk	Medium Risk	Low Risk
	Lift station #3	Low Risk	Medium Risk	Low Risk
	Lift station #4	No Foreseeable Risk	No Foreseeable Risk	Low Risk
	Turner Beach Lift Station	No Foreseeable Risk	No Foreseeable Risk	Low Risk
Communications Facilities	East Side of Chadwick's Square Shopping Center	No Foreseeable Risk	Medium Risk	Low Risk
	Communication Tower at north end near Wastewater Treatment	No Foreseeable Risk	Low Risk	Low Risk

		Asset Risk		
Asset Type	Name of Asset(s)	Existing Tidal Flooding/ +2ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Marinas	1057-1900 South Seas Plantation Road	Low Risk	Medium Risk	Low Risk
	11401 Andy Rosse Lane	Low Risk	Medium Risk	Low Risk
	15107 Captiva Drive	Low Risk	Medium Risk	Low Risk
	15183 Captiva Drive	Low Risk	Medium Risk	Low Risk
	15903 Captiva Drive	Low Risk	Medium Risk	Low Risk
	15951 Captiva Drive	Low Risk	Medium Risk	Low Risk
	2800-5640 South Seas Plantation Road	Medium Risk	Medium Risk	Low Risk
Historical and Cultural Assets	Tween Waters Inn Historic District	No Foreseeable Risk	No Foreseeable Risk	No Foreseeable Risk
	Captiva School and Chapel-by-the-Sea Historic District	No Foreseeable Risk	No Foreseeable Risk	Low Risk
Conservation Lands/ Wetlands	Mangrove Swamp North	Medium Risk	Medium Risk	Low Risk
	Mangrove Swamp South	Medium Risk	Medium Risk	Low Risk
	J. N. Ding Darling National Wildlife Refuge 1	Medium Risk	Medium Risk	Low Risk
	J. N. Ding Darling National Wildlife Refuge 2	Medium Risk	Medium Risk	Low Risk
	J. N. Ding Darling National Wildlife Refuge 3	Medium Risk	Medium Risk	Low Risk
	J. N. Ding Darling National Wildlife Refuge 4	High Risk	Medium Risk	Low Risk
	Sanibel-Captiva Conservation Foundation Conservation Lands 1	Medium Risk	Medium Risk	Low Risk
	Sanibel-Captiva Conservation Foundation Conservation Lands 2	Medium Risk	Medium Risk	Low Risk

		Asset Risk		
Asset Type	Name of Asset(s)	Existing Tidal Flooding/ +2ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Parks	Turner Beach	Low Risk	No Foreseeable Risk	Low Risk
	Andy Rosse Lane Kayak Launch	Low Risk	Medium Risk	Low Risk
	Andy Rosse Lane Beach Access	Low Risk	Low Risk	Low Risk
	Alison Hagerup Beach Park 1	Medium Risk	No Foreseeable Risk	Low Risk
	Alison Hagerup Beach Park 2	No Foreseeable Risk	Low Risk	Low Risk
Logistical Staging Areas	South Seas Island Resort	Medium Risk	No Foreseeable Risk	Low Risk
	Allison Hangerup Beach Park A	Medium Risk	No Foreseeable Risk	Low Risk
	Allison Hangerup Beach Park B	No Foreseeable Risk	Low Risk	Low Risk
	Turner Beach A	Low Risk	Low Risk	Low Risk
	Turner Beach B	No Foreseeable Risk	No Foreseeable Risk	Low Risk
Stormwater Treatment Facilities and Pump Stations	SSPGCCB1	No Foreseeable Risk	Low Risk	Low Risk
	SSPGCCB2	No Foreseeable Risk	Medium Risk	Low Risk
	SSPGCCB3	No Foreseeable Risk	No Foreseeable Risk	Low Risk
	Retention Pond	Low Risk	Medium Risk	Low Risk
	Swale10	No Foreseeable Risk	No Foreseeable Risk	Low Risk
	Swale19	No Foreseeable Risk	No Foreseeable Risk	Low Risk
	Swale20	No Foreseeable Risk	No Foreseeable Risk	Low Risk
	Swale21	Low Risk	Medium Risk	Low Risk
	Swale23	No Foreseeable Risk	Low Risk	Low Risk
	Sewer 1- ST62	Low Risk	Medium Risk	Low Risk
	Sewer 2- Influent at Sunset Captiva WWTP	No Foreseeable Risk	No Foreseeable Risk	No Foreseeable Risk
	AROUT	High Risk	Low Risk	Low Risk
	SSPOutFall1	Medium Risk	Low Risk	Low Risk

Table 23. Risk Rank Counts for Grouped Island Assets

	Risk (NFR, L, M, H)	Existing Tidal Flooding/ +2ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event
Parcels (#)	No Foreseeable Risk	378	891	240
	Low Risk	682	16	878
	Medium	57	211	0
	High	1	0	0
Building Footprints (#)	No Foreseeable Risk	469	228	253
	Low Risk	272	268	494
	Medium	6	251	0
	High	0	0	0
Roadways (ft)	No Foreseeable Risk	96,607	78,542	66,435
	Low Risk	11799	9421	42144
	Medium	0	20616	0
	High	173	0	0
Shorelines (ft)	No Foreseeable Risk	25,810	25,618	7,143
	Low Risk	5	156	18,680
	Medium	5	49	0
	High	3		0
Surface waters (acres)	No Foreseeable Risk	30.4	30.4	28.4
	Low Risk	0	0	12
	Medium	0	10	0
	High	10	0	0

The risk ranks for individual and grouped assets across Captiva and across flood scenarios help to identify the assets most susceptible when considering not only flood extent and depth but also timeframe. All conservation lands and Captiva marinas prove to be at risk across all inundation tipping point scenarios, all of which are at medium risk under Scenario 2. The Marina located at 2800-5640 South Seas Plantation Road and the J. N. Ding Darling National Wildlife Refuge 4 are most at risk under existing tidal conditions.

The Captiva Civic Association, Fire Station, U.S Postal Service, Captiva Heliport, South Seas Plantation WWTP, and Lift Station # 3, prove to be at risk across all tipping point scenarios. It is important to note the assets that are under no risk across the topping point scenarios- Tween Waters Inn WWTP, Tween Waters Inn Historic District, and Sewer #2. Aside from these assets, all individual assets are at low risk under the inundation tipping point Scenario 3. The following subsection outlines additional takeaways from the risk assessment for each of the three inundation tipping point scenarios. Risk per asset for the remaining scenarios can be viewed in Appendices V and VI.

1 Existing Tidal Flooding/ +2 ft SLR

70% of parcels at risk (92% at ow risk)
37% of buildings at risk (98% at low risk)
11% of linear ft of roads at risk (99% at low risk)

2 2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding

20% of parcels at risk (7% at ow risk)
36% of buildings at risk (52% at low risk)
3% of linear ft of roads at risk (31% at low risk)

3 Existing 100 Year Flood Event

79% of parcels at risk (100% at ow risk)
66% of buildings at risk (100% at low risk)
39% of linear ft of roads at risk (100% at low risk)

Adaptation Action Areas Considerations

Adaptation Action Areas Overview

The findings of this assessment were reviewed as a whole to identify areas most at risk and to determine applicable adaptation strategy options. Based on the results presented in this report, four major Adaptation Action Areas (AAA) were identified- Chadwick Bayou AAA, Central Captiva AAA Roosevelt Channel AAA, and Blind Pass AAA (Figure 63). Each Adaptation Action Area is projected to experience inundation and presents a unique opportunity for both green and gray infrastructure adaptation to minimize flooding impacts. The following subsections propose general potential strategies for each AAA, the specifics of which will be explored and determined in the next phase of work.

An Adaptation Action Area

is an area that experiences coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea levels for the purpose of prioritizing funding for infrastructure needs and adaptation planning.

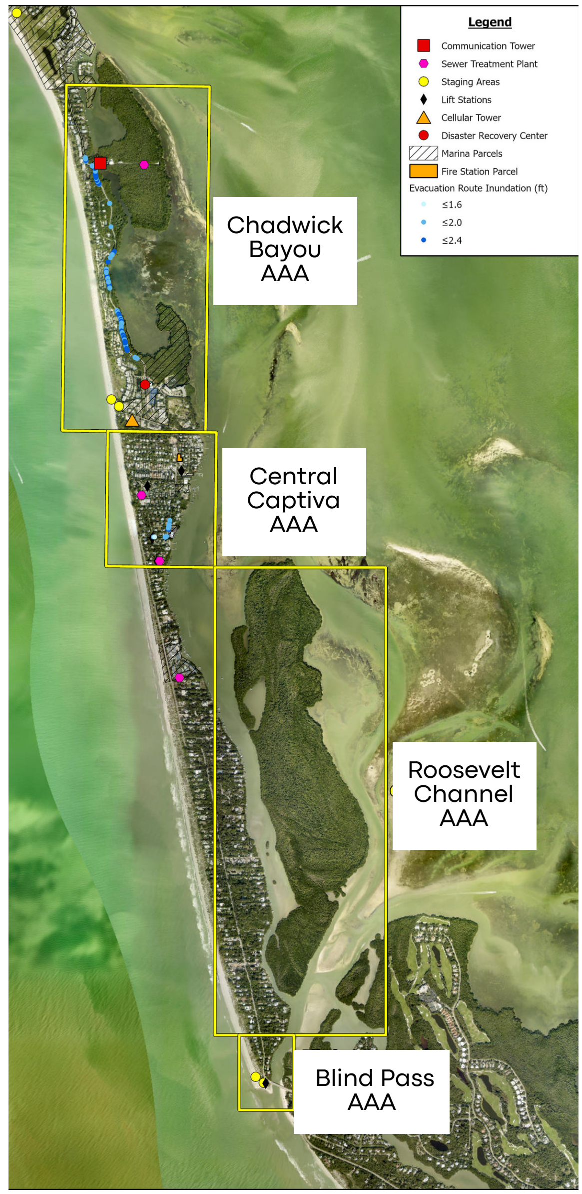


Figure 63. AAA Overview Map

CHADWICK BAYOU AAA

The Chadwick Bayou AAA is the Northern most AAA identified on Captiva (Figure 64). This area contains various vulnerable critical facilities including a sewer treatment plant, a disaster recovery center, the Captiva post office, logistical staging areas, marinas, and low-lying evacuation route road segments. The flood risk for this area is along the bayside of the island, as little land buffers Captiva's roads and infrastructure from the Chadwick Bayou's waters. To create protection along this area, the following strategies can be implemented:

- Mangrove enhancement
- Connect mangroves or design something to allow flushing at high tide level that can be adapted over the years
- Sediment supply for mangroves coupled with shoreline protection (long term adaptation strategy)
- Enhance seagrass to stabilize the narrow island portion
- Elevate or protect vulnerable low-lying road segments

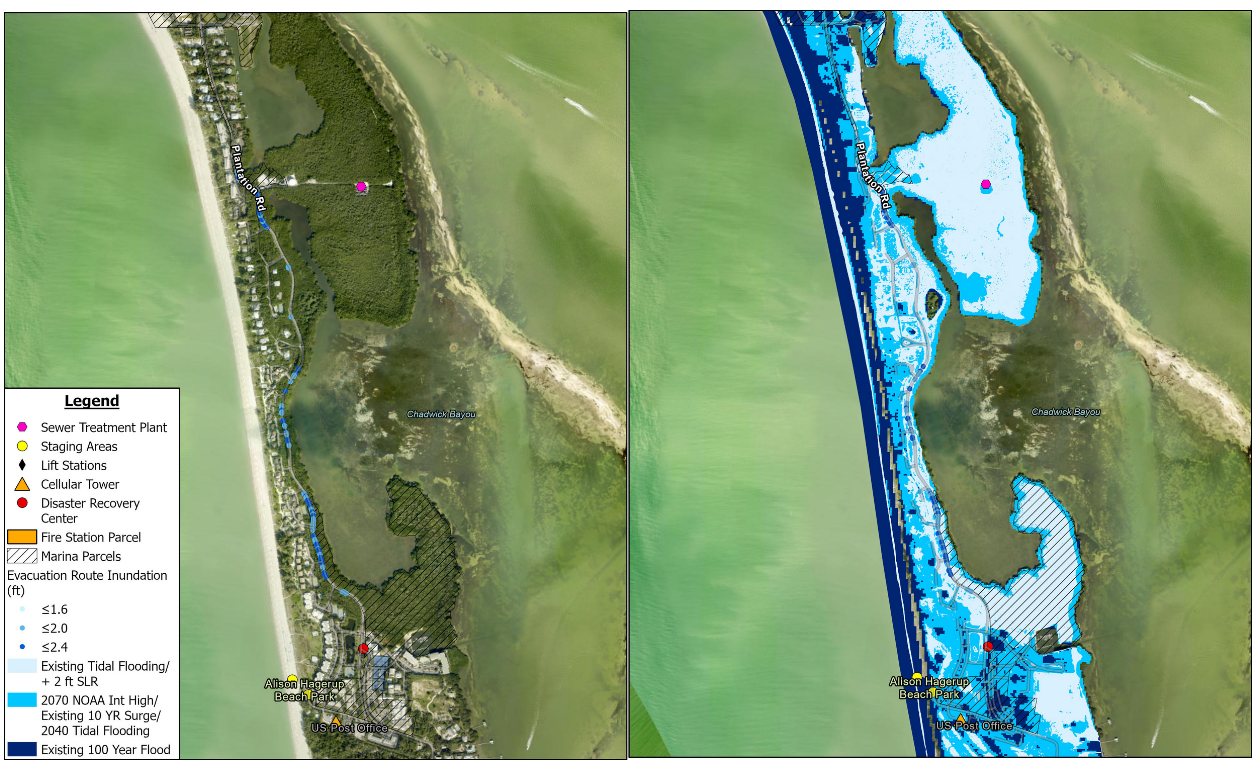


Figure 64. Chadwick Bayou AAA Map

CENTRAL CAPTIVA AAA

Predicted future inundation for the Central Captiva AAA is also predicted mostly along the bayside of the island (Figure 66). More specifically, a few areas of sea level rise flooding along the bayside of Captiva serve as entry points for inland flooding, allowing water to move towards and threaten critical infrastructure. Such infrastructure includes the Captiva Fire Station, Captiva Memorial Library, two treatment plants, four lift stations, marinas, and low-lying evacuation route road segments. Initial adaptation strategies could include:

Figure 65. Central Captiva AAA Context Map

- Introduce sill or encourage seagrass between sandbars depicted in Figure 65 to reduce surge, wave action, and erosion at the narrowest point of the island on the backside
- Seal up vulnerable bayside area with seawalls or berms to prevent flow across property onto main road (policy)
- Harden fire station and tide valves
- Establish sill to slow surge around this area

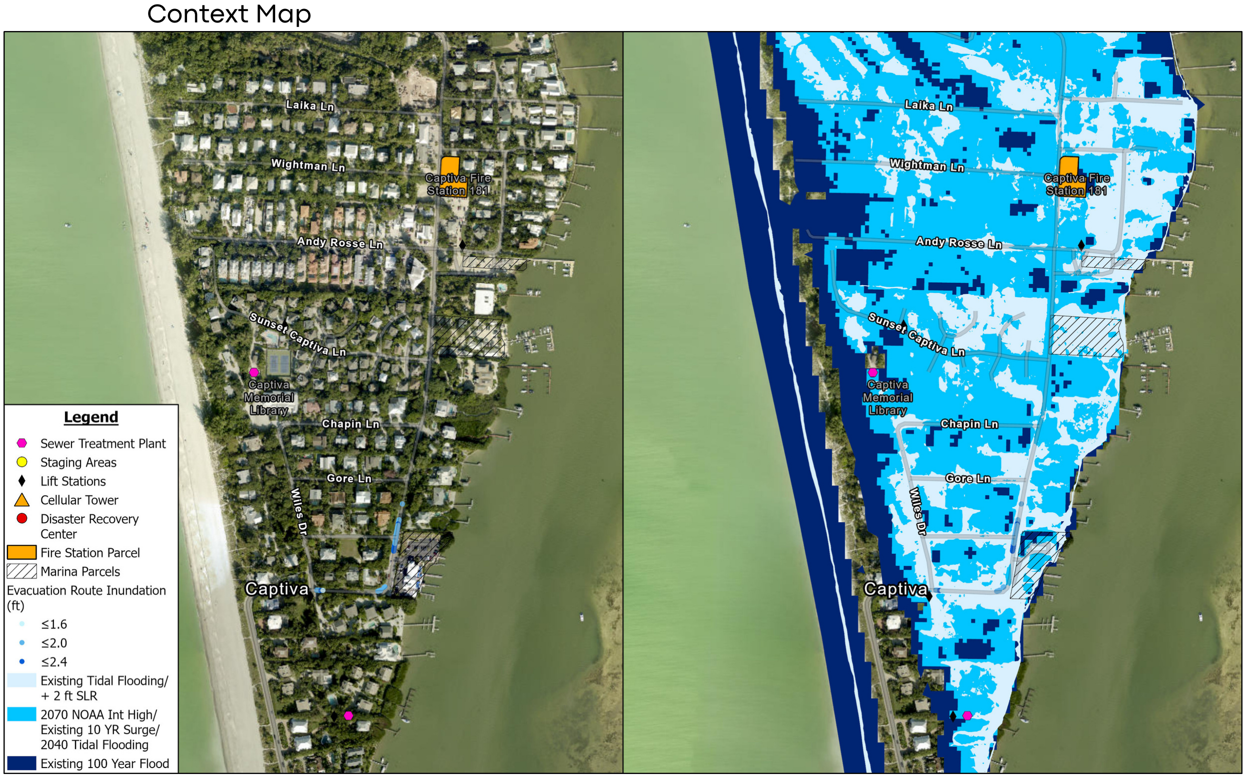


Figure 66. Central Captiva AAA Map

ROOSEVELT CHANNEL AAA

The focus of the Roosevelt Channel AAA is the area anticipated to flood along the eastern shoreline, west of the mangrove island (Figure 67). Of particular concern are the few concentrations of flood water in the southeastern portion of the AAA, where rising sea level is projected to slowly encroach inland across properties and roads. Flooding is also anticipated to threaten the treatment plants in the northern section of the AAA. To reduce and help contain the projected flooding, strategies include:

- Install flood gates at the north and south end of Roosevelt Channel
- Elevate buildings along eastern bayfront
- Install seawalls along the shoreline to property against flooding (policy)

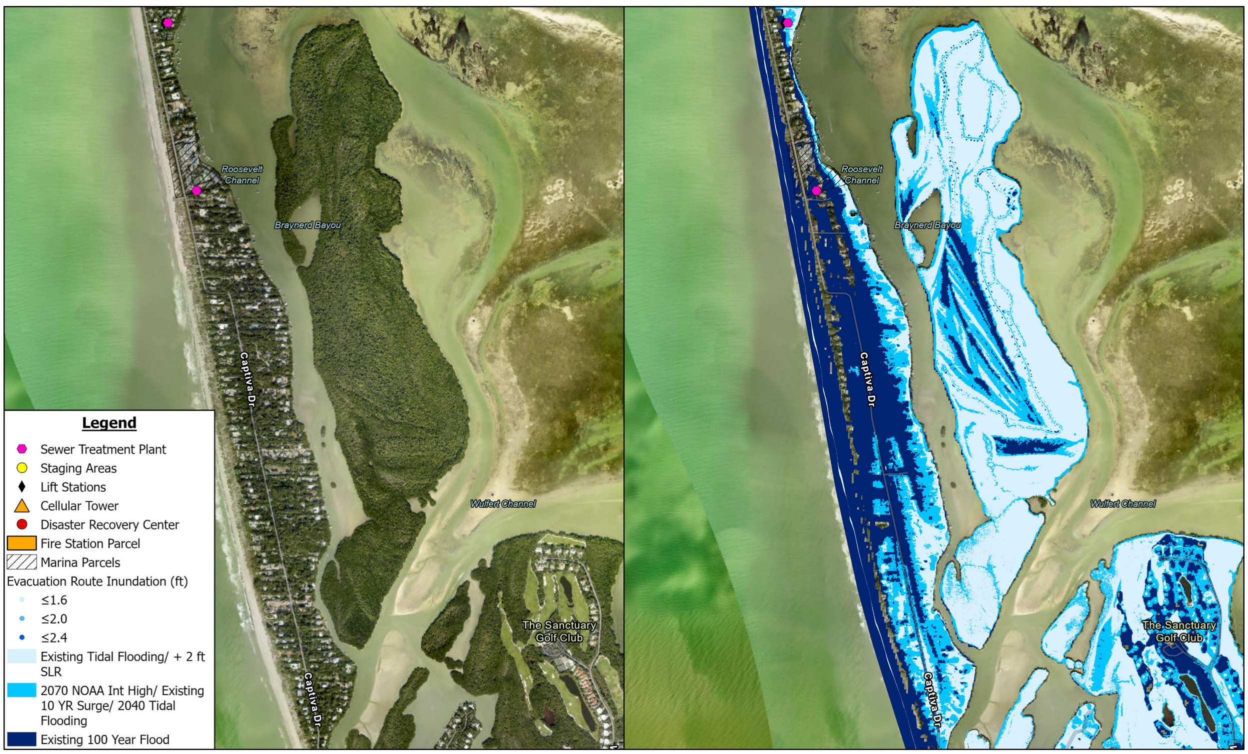


Figure 67. Roosevelt Channel AAA Map

BLIND PASS AA

The Blind Pass AAA is the smallest and most southern area in need of adaptation. Specifically, there is a major entry point for sea level rise flooding (Figure 68) which if not prevented or minimized could spread inland and impact the major evacuation route on the island. To address this, the bayside area requires seawall policy implementation to seal up this vulnerable area and to prevent flow across property.

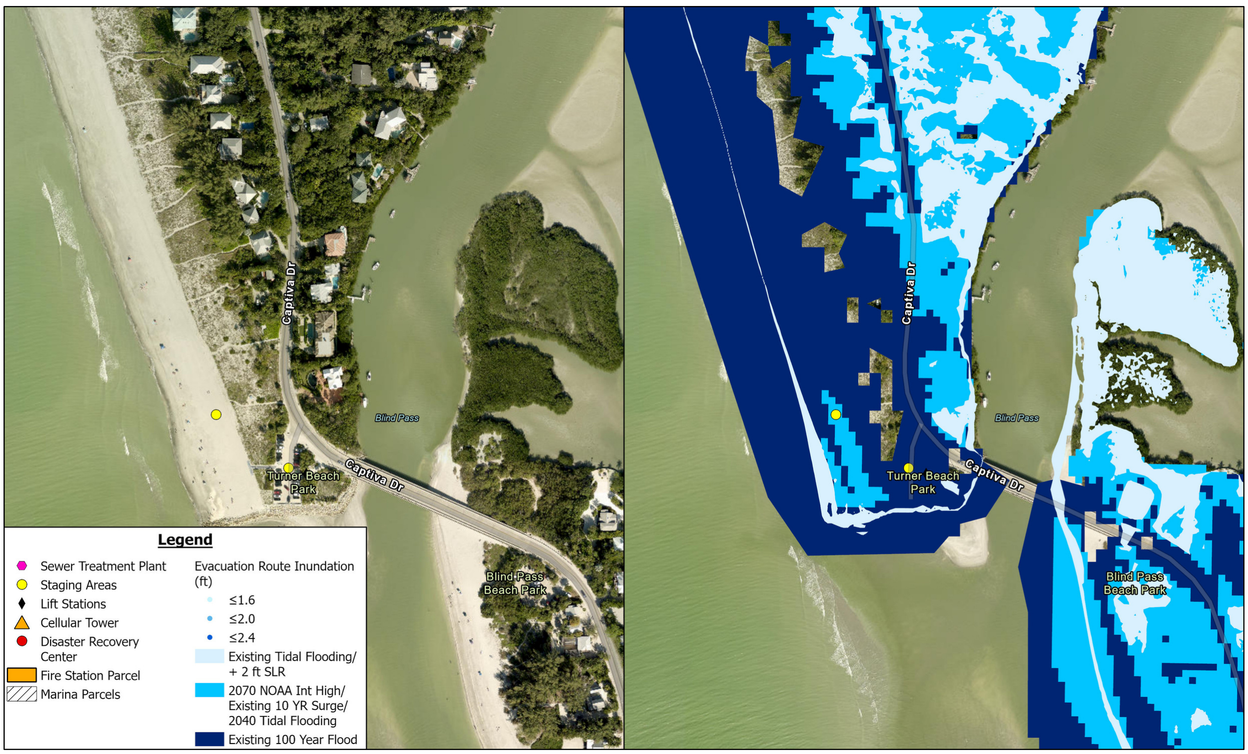


Figure 68. Blind Pass AAA Map

Next Steps

CEPD Authority

In order to recommend tangible next steps and feasible strategies for CEPD to pursue, it was necessary to analyze the scope of the legal authority of the Captiva Erosion Prevention District (CEPD) to implement sea level rise infrastructure and resilience projects. To do so, the statutory history of Part II of Chapter 161, F.S. creating the statutory framework for beach and shore preservation districts was reviewed and the legislative history of Ch. 71-730, 76-403, 81-413, 88-449, 97-255 and 2000-399, Laws of Fla. creating specifically the CEPD, were reviewed.

In summary, there is nothing specifically related to sea level rise in either the legal authority establishing the CEPD pursuant to special law or anything in Chapter 161, F.S. Both legal authorities were established and enacted well before the State of Florida began promulgating statutes or rules related to sea level rise planning, adaptation or funding. The only current treatment in the law is relative to Section 380.093(5)(d)2.c., F.S. allowing erosion control districts to submit proposed projects to the state that mitigate the risks of flooding or sea level rise on water supplies or water resources of the state for consideration in the Statewide Flooding and Sea Level Rise Resilience Plan.

In furtherance of guiding the research, three primary issues were evaluated:

Issue 1. The structure of the CEPD and determination of CEPD's authority to implement sea level rise infrastructure and resilience projects

Issue 2. CEPD jurisdiction over adaptations by private property on Captiva

Issue 3. Existing enforcement mechanisms

The following subsections summarize the findings related to each issue.

Issue 1: The structure of the CEPD and determination of CEPD's authority to implement sea level rise infrastructure and resilience projects

The CEPD can regulate and supervise all physical work or activity along the county shoreline which is likely to have a material physical effect on existing coastal conditions or natural shore processes including, but not be limited to, installation of groins, jetties, moles, breakwaters, seawalls, revetments, and other coastal construction as defined herein. Coastal construction is defined broadly. The CEPD may develop standards and criteria, issue permits and conduct inspections. The statute does not make any limitation on that to a certain type of property, for example public or private. The CEPD can construct, acquire, operate and maintain works and facilities and make rules and regulations to carry out its purposes. There is no limitation on the regulations related to private property. It can also bond and assess for project costs. If the CEPD is implementing a resilience project, and if it is addressing an impact created by sea level rise such as coastal flooding or erosion, the cause of it such as sea level rise, is likely of little consequence or distinction. Such projects can be implemented on beaches and shores. There is no definition for shore or shoreline in Chapter 161, F.S.

Issue 2: CEPD jurisdiction over adaptations by private property on Captiva

The territorial boundary of the CEPD is the entire island of Captiva from the centerline of Blind Pass to centerline of Redfish Pass and extend 300' into the Gulf of Mexico and Pine Island Sound including Roosevelt Channel. This boundary is without distinction between publicly and privately owned property. CEPD can exercise jurisdiction, control, and supervision over the construction of any Erosion Prevention Project, by CEPD, a public entity or a private one. There are no distinctions between public projects or private ones.

Issue 3:Existing enforcement mechanisms

CEPD can make and enforce such rules and regulations for the maintenance and operation of any such Projects as may in the judgment of the District Board be necessary or desirable for the efficient operation of such Project. CEPD can restrain, enjoin, or otherwise prevent any person, firm, or corporation, public or private, from establishing or constructing any Erosion Prevention Project within the District without the prior written approval of the District Board. CEPD can restrain, enjoin, or otherwise prevent the violation of any provision of this act or of any resolution, rule, or regulation adopted pursuant to its powers. The CEPD also has a related enforcement mechanism through assessments as long as it follows all procedures in developing the supporting technical information and processes to levy such an assessment.

In conclusion, the CEPD has broad authority to implement projects to prevent erosion on beaches and shorelines with a territorial scope that encompasses then entirety of Captiva including some nearshore resources. There are procedures required for the development of an overall plan of improvement (beyond the scope of this research), but implementation of sea level rise adaptation and flooding projects, with the purpose of improving beaches or shorelines within the territorial boundaries, and regulating those projects on public or private lands, is likely within the scope of CEPD’s legal authority.

Conclusions

The Sea Level Rise Vulnerability Analysis for Captiva Island has identified the geographic areas and physical assets vulnerable to current and future flooding. Higher frequency storm surge and mid-term sea level rise pose medium level risk to the island's assets and resources. Extreme storms and sea level rise in 2070 pose less risk comparatively given their lower likelihood of severe impacts. Adapting coastal infrastructure to resist flood elevations of at least 3.5 feet NAVD would be prudent. Without this level of protection, evacuation routes, 27% of roads, the fire station, two water treatment facilities, the post office, the library and up to 70% of building footprints are at risk of some flooding in the near to mid-term. Adaptation is primarily the responsibility of private owners on Captiva; however, there are funding partnership opportunities that would likely assist in addressing the vulnerabilities of the evacuation route, the oceanfront shorelines and recurrent flood risks in the floodplain. In order to guide private adaptation and increase the likelihood that the community has systemic resilience to flooding, new policy regarding tidal flood barriers along shorelines and enhancement of green infrastructure along the waterfront is recommended.

Four geographic areas were noted as having concentrated vulnerabilities co-located with key critical assets within Captiva Island. These areas include properties and resources adjacent to Chadwick Bayou, Central Captiva, the Roosevelt Channel and Blind Pass. In addition, the bayside of the island was found to be more vulnerable to flooding than the oceanside. Short term, flooding of various types along the bay could lead to flood trespassing across bayfront shorelines. Addressing the vulnerabilities in these areas through policy and strategy will be a primary focus of the next phase of effort, the resilience plan.

Three tipping points were defined through the analysis as leading to particularly problematic flooding for the community. The first, tidal flooding under present conditions, was found to affect 67% of all Captiva parcels with an average inundation depth under one foot. The second, storm surge typically occurring once a decade or tidal flooding in 2040, was determined to potentially affect 90% of Captiva parcels. While more than half of these parcels may flood less than one foot, the remainder may flood up to two feet. Tidal flooding in 2040 is projected to occur over 200 days per year. The third resulted in catastrophic flooding island wide.

Mapping assets and projected conditions and analyzing risk was an essential first step for resilience strategy development. Planning now for future water levels benefits property owners in multiple ways including risk mitigation, value preservation, bond rating security and insurance and maintenance cost avoidance. With consideration of CEPD's responsibilities and authority to prevent erosion and protect shorelines, an adaptation strategy consisting of alternative pathways or sequences of progressive actions triggered by changing conditions can be developed as a next step. The findings of this analysis will directly support advancement of future work including the forthcoming conceptualization, feasibility analysis and evaluation of adaptation and resilience strategies for the community, funded in part by a 2022 state resilience grant to CEPD.

Appendices

Appendix I: Lee County Facilities Maps

Appendix II: Parcel and Building Impacts for all Scenarios

Appendix III: Parcel Impacts, Inundation Depths, and Estimated Values for all Scenarios

Appendix IV: Building Impacts, Inundation Depths, and Estimated Values for all Scenarios

Appendix V: Evacuation Route Inundation for all Scenarios

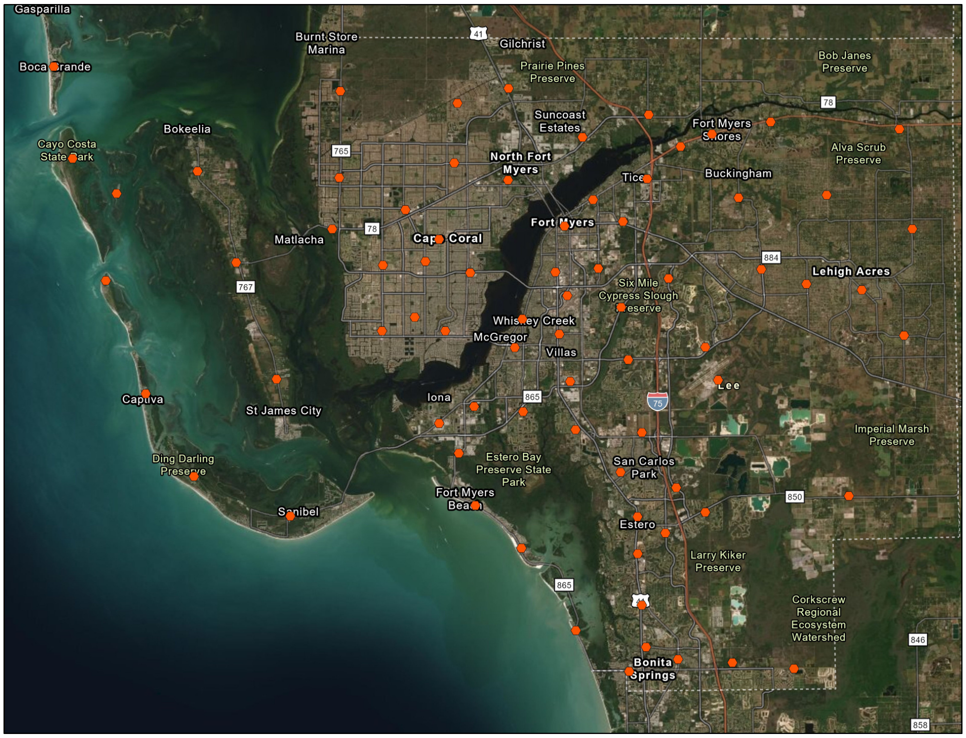
Appendix VI: On Island Singular Asset Inundation Depths and Risk Scores for all Scenarios

Appendix VII: Risk Rank Counts for Grouped Island Assets for all Scenarios

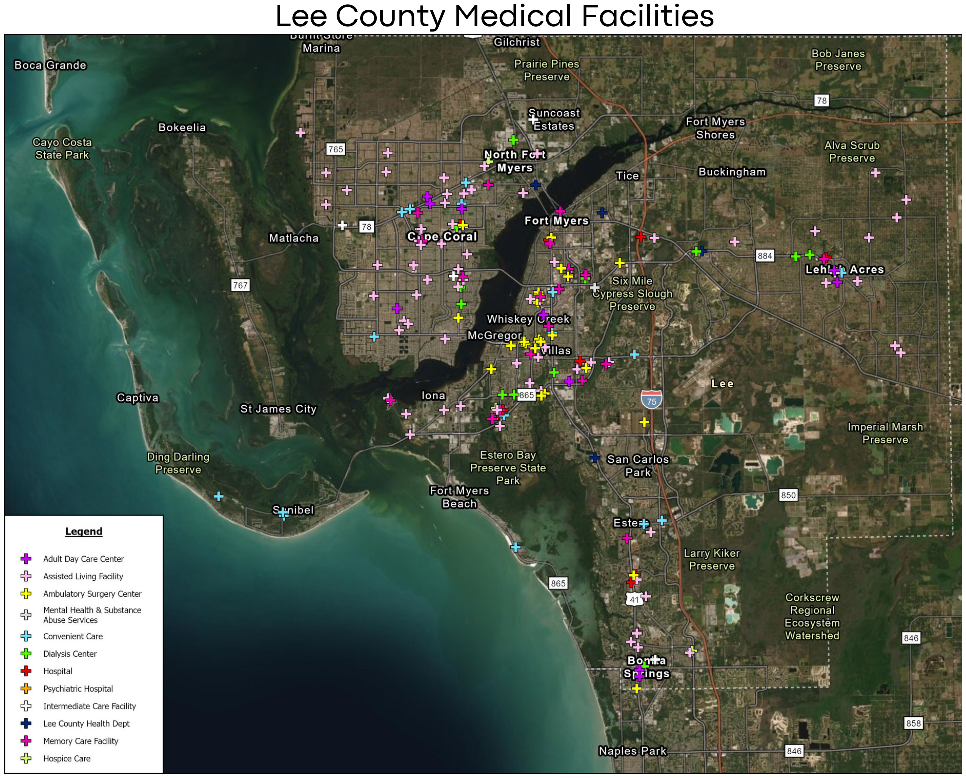
Appendix VIII: Community Presentation

Appendix I: Lee County Facilities Maps

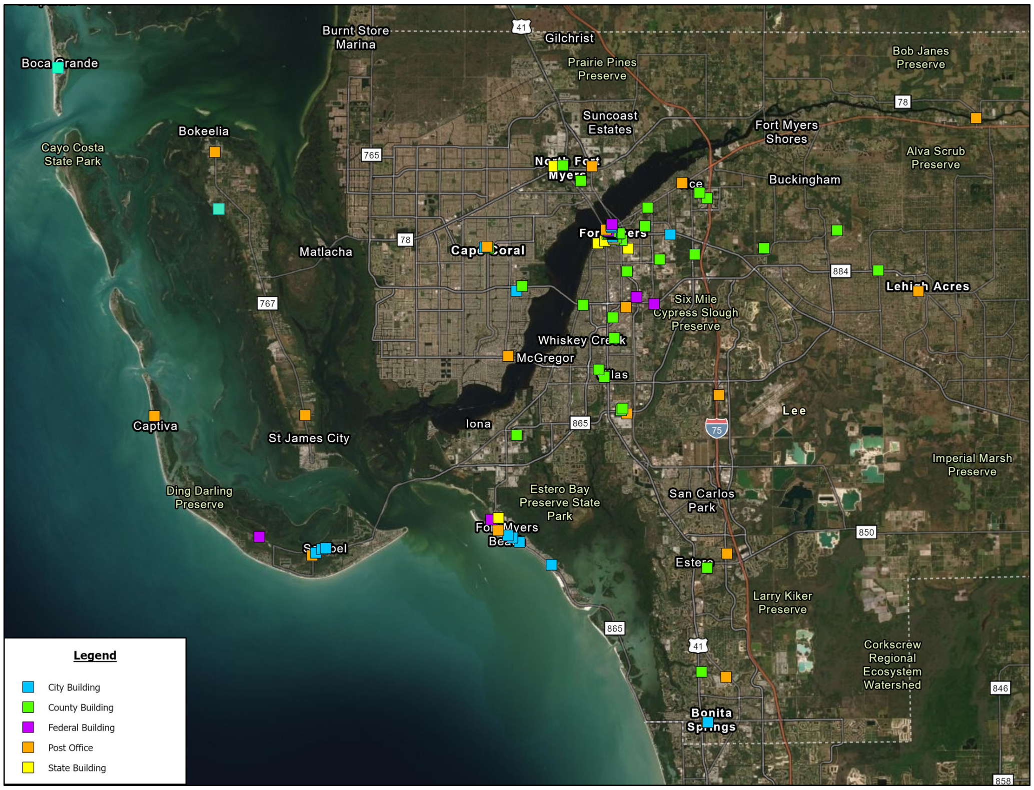
Lee County Fire Stations



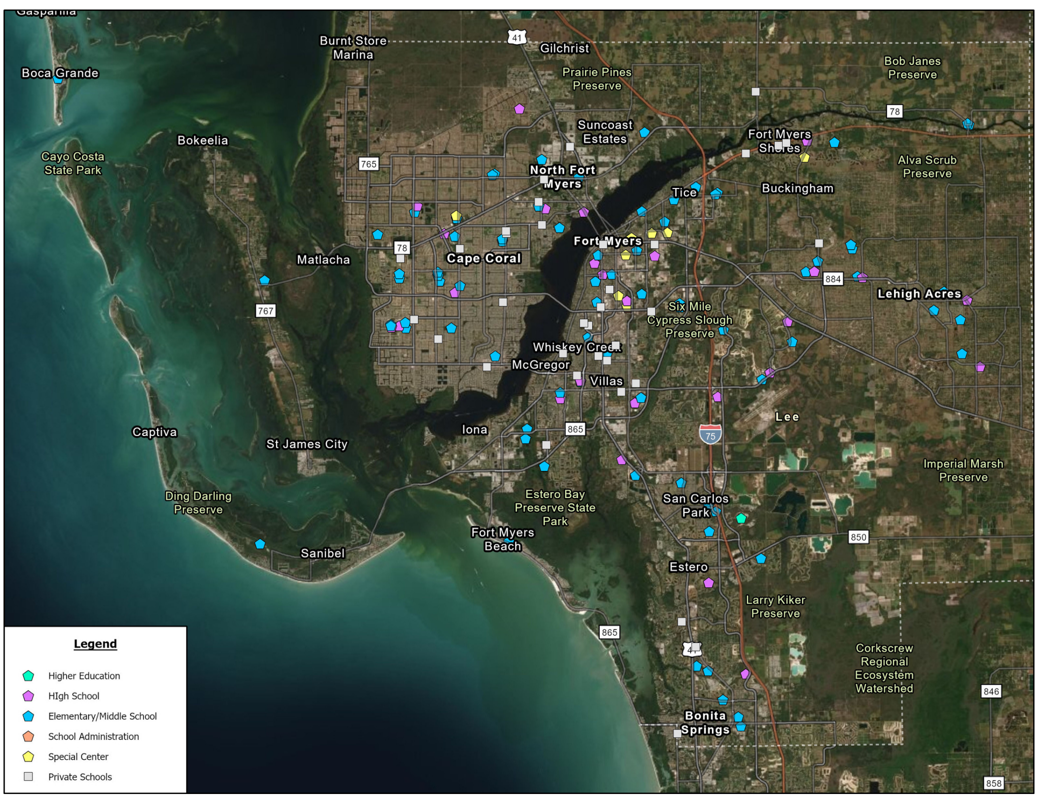
Lee County Medical Facilities



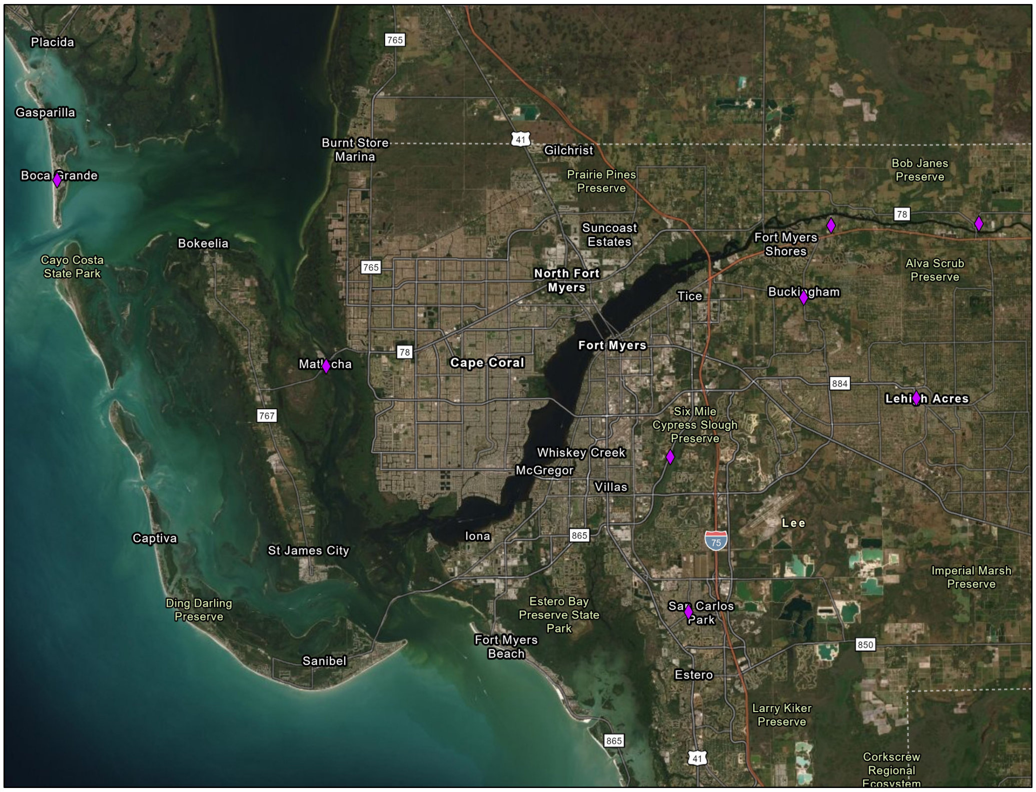
Lee County Local Government.



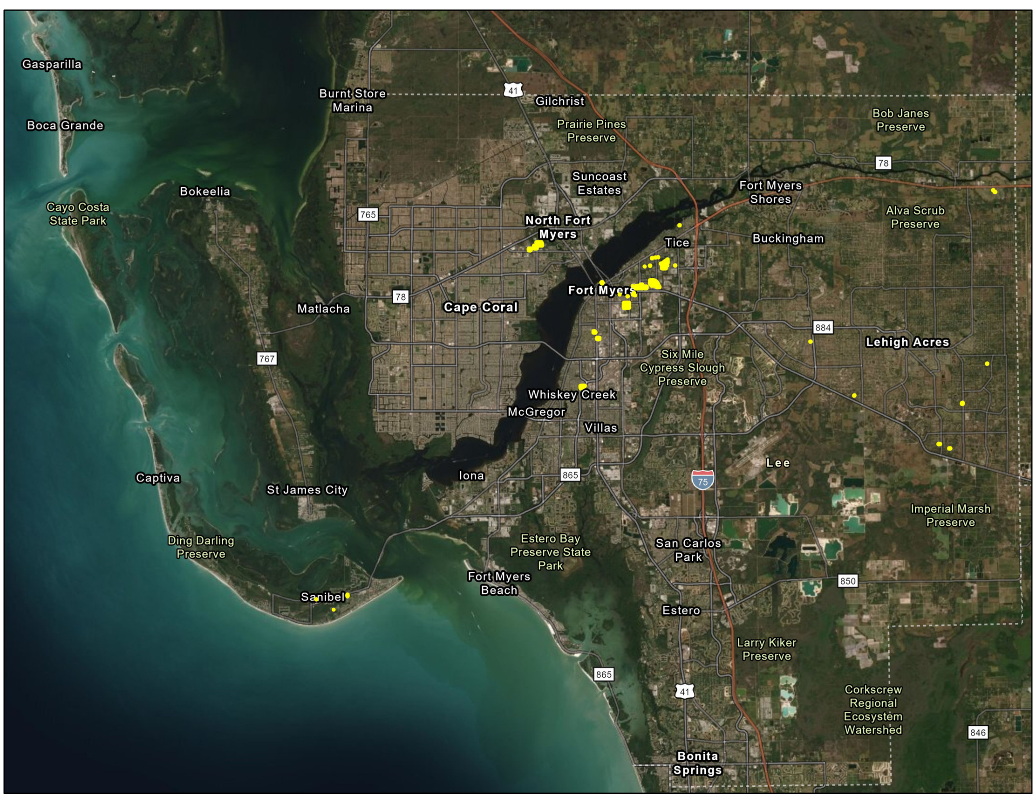
Lee County Schools



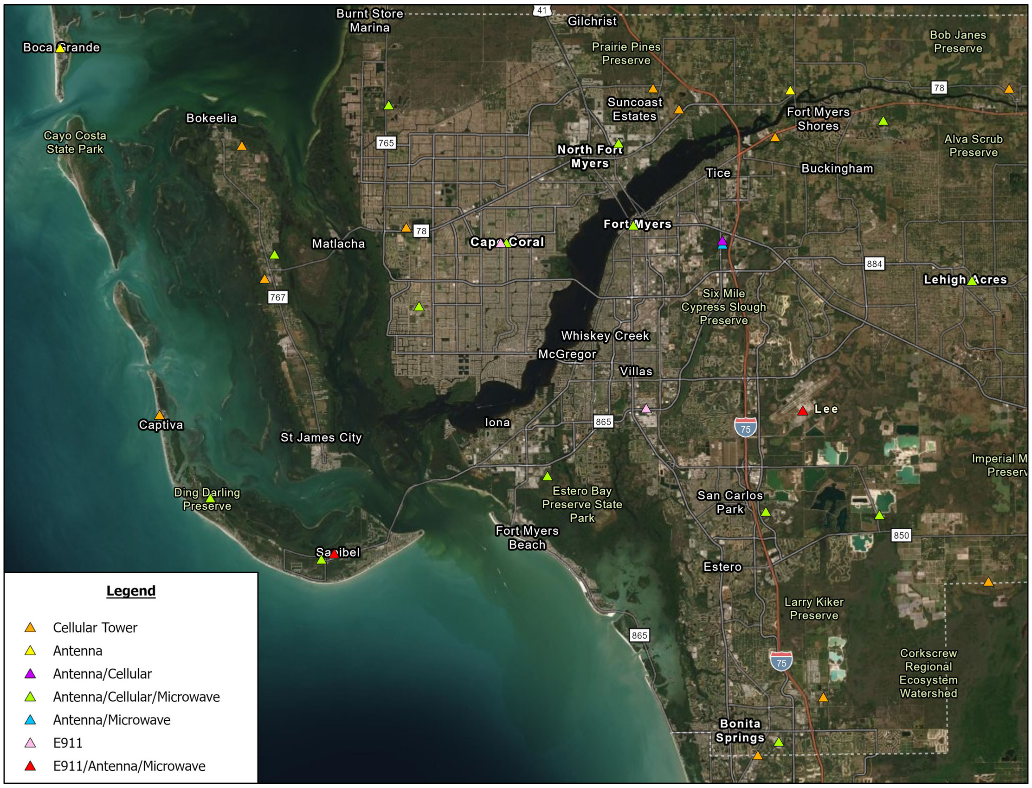
Lee County Community Centers



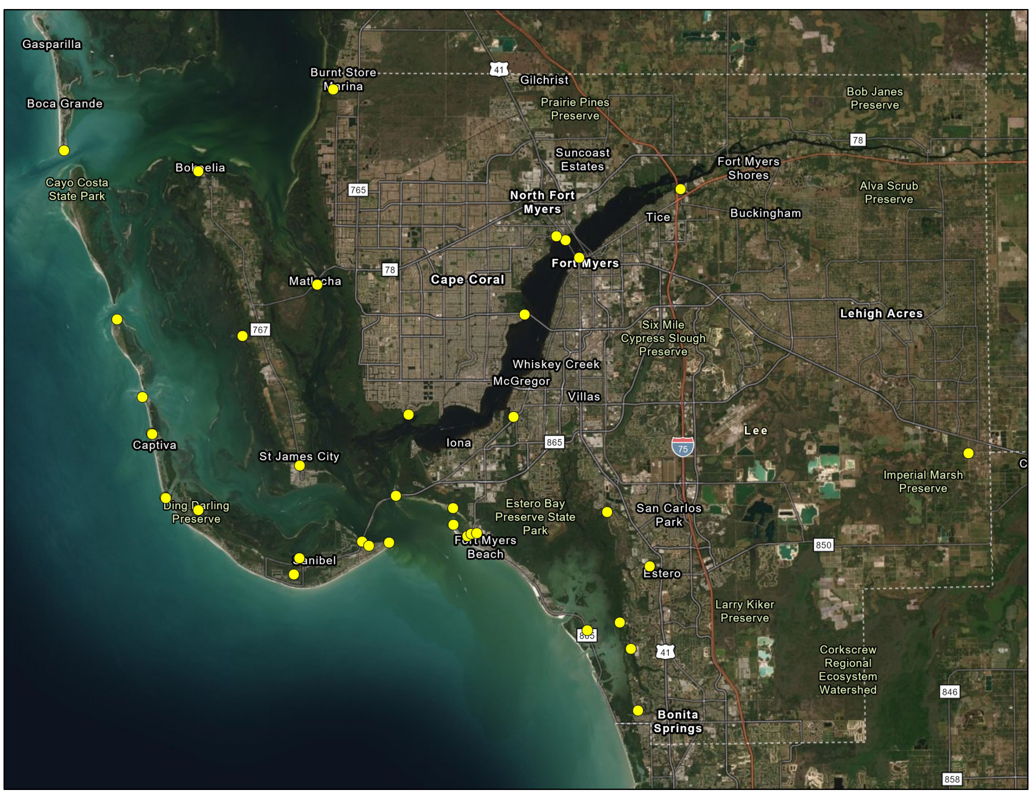
Lee County Affordable Housing



Lee County Communication Facilities



Logistical Staging Areas



Appendix II: Parcel and Building Impacts for all Scenarios

Parcels					
		# Impacted	Nuisance Flooding <1 ft)	Disturbance (1-2 ft)	Impact (> 2ft)
NOAA SLR Impact	NOAA 2040 Intermediate Low	133	50	83	-
	NOAA 2040 Intermediate High	227	137	90	-
	NOAA 2070 Intermediate High	1,005	585	419	1
Tidal Flooding Inundation Impact	Existing (~+2ft slr)	753	753	-	-
	2040 (~ Existing 10 YR surge)	1033	907	126	-
	2070	1100	-	231	869
Storm Surge Inundation Impact	2040 10 YR Surge (~+4 ft slr)	1090	1	1088	1
	2070 10 YR Surge	1105	-	-	1105
Integral Scenarios Inundation Impact	(+1ft slr)	282	282	-	-
	(+7ft slr)	1106	-	-	1106
Flood Event Impact	100 Yr Flood	1099	-	-	1099
	500 Yr Flood	1113	-	-	1113

Buildings					
		# Impacted	Nuisance Flooding <1 ft)	Disturbance (1-2 ft)	Impact (> 2ft)
NOAA SLR Impact	NOAA 2040 Intermediate Low	15	13	1	1
	NOAA 2040 Intermediate High	62	62	-	-
	NOAA 2070 Intermediate High	528	160	367	1
Tidal Flooding Inundation Impact	Existing (~+2ft slr)	278	278	-	-
	2040 (~ Existing 10 YR surge)	370	266	104	
	2070	651	-	243	408
Storm Surge Inundation Impact	2040 10 YR Surge (~+4 ft slr)	602	90	507	5
	2070 10 YR Surge	691	-	-	691
Integral Scenarios Inundation Impact	(+1ft slr)	53	53	-	-
	(+7ft slr)	720	-	-	720
Flood Event Impact	100 Yr Flood	710	-	-	710
	500 Yr Flood	746	-	-	746

Appendix III: Parcel Impacts, Inundation Depths, and Estimated Values for all Scenarios

Decade	NOAA 2040 Intermediate Low			NOAA 2040 Intermediate High			NOAA 2070 Intermediate High		
	Number of Parcels	Average Depth (ft)	Just Value	Number of Parcels	Average Depth (ft)	Just Value	Number of Parcels	Average Depth (ft)	Just Value
N/A	46	1	$29,068,134	59	1.1	$34,038,077	108	1.6	$81,408,531
1900	1	1.1	$15,617,220	1	0.4	$15,617,220	1	2.2	$15,617,220
1910	-	-	-	-	-	-	1	0.7	$995,772
1920	2	0.7	$30,676,252	4	0.4	$36,351,098	5	1.5	$37,152,100
1930	1	0.9	$2,965,497	1	1.3	$2,965,497	4	1.3	$7,574,339
1940	2	0.5	$4,119,682	9	0.4	$18,850,891	16	1.2	$32,750,494
1950	1	0.3	$2,541,832	4	0.4	$10,680,977	16	1	$34,023,897
1960	4	0.4	$17,379,795	16	0.3	$53,662,508	30	1.2	$74,928,377
1970	20	0.9	$48,867,379	38	0.7	$81,732,678	500	1	$409,098,771
1980	20	0.8	$54,430,432	46	0.6	$91,596,807	163	1.1	$204,786,700
1990	10	1	$26,742,615	19	0.7	$51,229,525	67	1	$173,997,581
2000	21	1.2	$92,794,755	24	1.3	$105,431,315	69	1.1	$207,849,124
2010	5	1.3	$16,361,955	6	1.4	$19,520,171	24	1.2	$66,971,214
2020	-	-	-	-	-	-	1	0.4	$1,381,563
Total	**133**		**$341,565,548**	**227**		**$521,676,764**	**1,005**		**$1,348,535,683**

Decade	MMHW 1.28			MMHW 2.28			MMHW 4.28			MHHW 7.28		
	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value
N/A	74	0.55	$45,081,879	107	0.7	$61,626,843	118	1.76	$89,474,865	122	4.312058928	$91,074,865
1900	1	0.11	$15,617,220	1	0.7	$15,617,220	1	2.6	$15,617,220	1	5.59863318	$15,617,220
1910	-	-	-	-	-	-	1	1.28	$995,772	1	4.276079504	$995,772
1920	4	0.33	$36,351,098	5	0.48	$37,152,100	5	1.94	$37,152,100	5	3.85059183	$37,152,100
1930	4	0.29	$7,574,339	4	0.71	$7,574,339	4	1.69	$7,574,339	6	2.467011403	$11,870,586
1940	9	0.22	$19,165,016	15	0.41	$31,508,855	17	1.36	$34,396,177	20	3.067861622	$38,676,655
1950	4	0.3	$10,680,977	16	0.27	$35,641,979	20	1.13	$44,519,678	20	3.223568023	$44,519,678
1960	18	0.21	$60,162,089	28	0.39	$73,767,143	30	1.64	$74,928,377	30	4.27927891	$74,928,377
1970	39	0.41	$92,133,396	321	0.18	$293,831,915	505	1.43	$427,702,294	505	4.349126193	$427,702,294
1980	49	0.29	$105,404,044	114	0.39	$170,423,678	207	1.26	$274,597,523	210	3.926074846	$277,635,346
1990	32	0.37	$100,072,790	58	0.38	$146,145,457	71	1.24	$188,919,503	75	3.474572591	$200,649,481
2000	32	0.48	$139,920,832	62	0.55	$205,756,249	80	1.23	$266,911,791	82	3.316771703	$273,285,515
2010	16	0.62	$56,123,601	22	0.59	$65,805,345	30	1.31	$97,335,438	31	3.526568126	$105,992,942
2020	-	-	-	-	-	-	1	0.86	$1,381,563	1	3.627939537	$1,381,563
Total	**282**		**$688,287,281**	**753**		**$1,144,851,123**	**1,090**		**$1,561,506,640**	**1,106**		**$1,598,053,841**

	Tidal Fooding, 2040			Tidal Fooding, 2070			10 Year Surge, 2070			1 percent			.2 percent		
	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value	Number of Parcels	Average Depth (ft)	Estimated Value
N/A	116	1.14	$82,846,065	120	2.53	$91,074,865	122	3.56	$91,074,865	122	4.81	$91,074,865	122	8.25	$91,074,865
1900	1	1.65	$15,617,220	1	3.56	$15,617,220	1	4.76	$15,617,220	1	6.00	$15,617,220	1	10.00	$15,617,220
1910	1	0.37	$995,772	1	2.24	$995,772	1	3.44	$995,772	1	4.00	$995,772	1	8.00	$995,772
1920	5	1.22	$37,152,100	5	2.69	$37,152,100	5	3.48	$37,152,100	5	4.60	$37,152,100	5	7.20	$37,152,100
1930	4	1.26	$7,574,339	5	1.89	$10,168,568	5	2.59	$10,168,568	5	3.80	$10,168,568	7	5.29	$13,747,776
1940	17	0.83	$34,396,177	20	1.74	$38,676,655	20	2.53	$38,676,655	20	3.75	$38,676,655	20	6.90	$38,676,655
1950	18	0.74	$39,545,580	20	1.78	$44,519,678	20	2.61	$44,519,678	20	3.65	$44,519,678	20	6.80	$44,519,678
1960	30	0.93	$74,928,377	30	2.46	$74,928,377	30	3.52	$74,928,377	30	4.60	$74,928,377	30	7.83	$74,928,377
1970	501	0.63	$415,519,708	505	2.36	$427,702,294	505	3.53	$427,702,294	505	4.70	$427,702,294	505	8.17	$427,702,294
1980	164	0.78	$207,713,247	207	2.09	$274,597,523	207	3.21	$274,597,523	202	4.30	$272,206,354	209	7.65	$278,934,277
1990	68	0.74	$178,108,227	74	1.88	$198,133,024	75	2.8	$200,649,481	74	3.74	$198,133,024	79	6.78	$206,861,779
2000	79	0.75	$262,224,378	80	1.87	$266,911,791	82	2.72	$273,285,515	82	3.84	$273,285,515	82	7.00	$273,285,515
2010	28	0.77	$84,804,962	31	1.9	$105,992,942	31	2.83	$105,992,942	31	4.26	$105,992,942	31	7.68	$105,992,942
2020	1	0.17	$1,381,563	1	1.75	$1,381,563	1	2.79	$1,381,563	1	5.00	$1,381,563	1	8.00	$1,381,563
Total	**1,033**		**$1,442,807,715**	**1,100**		**$1,587,852,372**	**1,105**		**$1,596,742,553**	**1,099**		**$1,591,834,927**	**1,113**		**$1,610,870,813**

Appendix IV: Building Impacts, Inundation Depths, and Estimated Values for all

	NOAA 2040 Intermediate Low			NOAA 2040 Intermediate High			NOAA 2070 Intermediate High			MMHW 1.28			MMHW 2.28			MMHW 4.28			MHHW 7.28		
Decade	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value
N/A	-	-	-	-	-	-	14	0.4	$25,295,530	-	-	-	1	0.06	$832,760	16	0.77	$33,485,450	16	3.73	$33,485,450
1900	-	-	-	1	0.2	$66,886	1	2.1	$66,886	1	0.08	$66,886	1	0.64	$66,886	1	2.64	$66,886	1	5.64	$66,886
1910	-	-	-	-	-	-	1	0.6	$314,020	-	-	-	-	-	-	1	1.21	$314,020	2	2.57	$349,425
1920	-	-	-	-	-	-	4	1.4	$346,044	1	0.45	$155,030	4	0.43	$346,044	4	2.01	$346,044	9	2.2	$1,688,614
1930	-	-	-	-	-	-	3	1.1	$2,010,915	1	0.64	$34,429	4	0.45	$2,045,344	5	1.49	$2,131,090	6	3.77	$2,440,127
1940	1	2.2	$59,098	4	0.4	$437,274	17	1.4	$1,704,824	3	0.46	$344,545	11	0.43	$1,180,144	18	1.81	$1,905,457	29	3.23	$3,765,123
1950	1	1.3	$96,790	3	0.8	$165,450	25	1.1	$2,170,080	1	0.55	$96,790	14	0.28	$1,348,623	28	1.4	$3,206,825	42	3.16	$5,042,273
1960	1	0.8	$105,839	4	0.3	$686,361	30	1.1	$6,591,120	3	0.28	$1,063,754	23	0.24	$4,995,622	33	1.46	$6,915,668	37	3.91	$7,349,919
1970	5	0.5	$2,674,620	13	0.3	$4,859,456	169	1	$223,708,608	10	0.25	$4,010,152	97	0.2	$139,280,792	180	1.43	$225,448,143	195	4.08	$229,516,696
1980	4	0.8	$1,980,882	23	0.4	$13,233,907	119	1.1	$81,843,587	19	0.18	$9,011,111	74	0.34	$49,472,502	146	1.35	$162,168,689	165	3.92	$180,050,531
1990	1	0.2	$688,365	5	0.2	$3,984,540	54	0.7	$41,059,242	5	0.16	$3,125,100	21	0.22	$17,555,368	63	1	$56,956,707	77	3.37	$72,601,942
2000	1	0.5	$737,299	4	0.3	$2,697,766	62	0.7	$57,664,971	4	0.2	$1,714,076	19	0.3	$20,350,624	74	0.97	$75,739,084	98	3.1	$119,169,829
2010	1	0.7	$861,262	4	0.4	$2,477,630	26	0.8	$24,113,332	5	0.19	$4,525,637	8	0.44	$6,495,738	30	1.14	$27,616,215	40	3.32	$44,423,218
2020	-	-	-	1	0	$3,483,206	3	0.5	$4,620,373	-	-	-	1	0.36	$3,483,206	3	1.01	$4,620,373	3	3.98	$4,620,373
Total	**15**		**$7,204,155**	**62**		**$32,092,476**	**528**		**$471,509,532**	**53**		**$24,147,510**	**278**		**$247,453,653**	**602**		**$600,920,651**	**720**		**$704,570,406**

	Tidal Fooding, 2040			Tidal Fooding, 2070			10 Year Surge, 2070			Cat 1			Cat 2		
Decade	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value	Number of Buildings	Average Depth (ft)	Estimated Value
N/A	5	0.2	$8,874,830	16	1.7	$33,485,450	16	2.89	$33,485,450	16	4.44	$33,485,450	16	8.00	$33,485,450
1900	1	1.69	$66,886	1	3.6	$66,886	1	4.8	$66,886	1	6.00	$66,886	1	10.00	$66,886
1910	1	0.26	$314,020	2	1.15	$349,425	2	2.07	$349,425	2	2.50	$349,425	2	6.00	$349,425
1920	4	0.87	$346,044	4	2.78	$346,044	5	3.1	$366,959	9	3.11	$503,452	17	4.65	$2,062,673
1930	4	0.89	$2,045,344	5	2.36	$2,131,090	6	2.98	$2,440,127	6	4.33	$2,440,127	9	6.11	$2,683,604
1940	14	1.17	$1,519,875	22	2.3	$2,671,636	27	2.78	$3,257,302	28	3.89	$3,469,990	30	7.23	$4,016,365
1950	18	0.93	$1,696,163	34	1.93	$4,233,252	40	2.58	$4,931,181	42	3.62	$5,042,273	43	6.91	$5,187,004
1960	24	0.79	$4,239,849	35	2.17	$7,025,622	37	3.1	$7,349,919	37	4.19	$7,349,919	38	7.68	$7,375,435
1970	132	0.78	$173,996,963	186	2.27	$226,872,002	191	3.34	$228,823,072	191	4.50	$228,862,176	196	7.94	$229,594,350
1980	89	1.01	$66,413,450	155	2.13	$174,768,574	159	3.24	$175,182,555	162	4.40	$176,478,453	168	7.67	$183,740,631
1990	27	0.73	$21,800,024	71	1.68	$65,971,345	73	2.74	$68,311,983	77	3.84	$70,550,330	84	6.89	$82,143,586
2000	31	0.61	$22,749,124	83	1.67	$89,972,248	92	2.53	$113,998,878	96	3.69	$116,047,174	99	7.09	$120,475,611
2010	19	0.54	$18,250,450	34	1.81	$32,525,759	39	2.61	$43,577,368	40	4.18	$44,423,218	40	7.73	$44,423,218
2020	1	0.26	$3,483,206	3	1.94	$4,620,373	3	3.14	$4,620,373	3	4.33	$4,620,373	3	8.33	$4,620,373
Total	**370**		**$325,796,228**	**651**		**$645,039,706**	**691**		**$686,761,478**	**710**		**$693,689,246**	**746**		**$720,224,611**

Appendix V: Evacuation Route Inundation for all Scenarios

		Average Depth (Ft)	Min Depth (Ft)	Max Depth (Ft)
NOAA SLR Impact	NOAA 2040 Intermediate Low	Doesn’t intersect	Doesn’t intersect	Doesn’t intersect
	NOAA 2040 Intermediate High	0.01	0	0.4
	NOAA 2070 Intermediate High	2.1	1.6	2.4
Tidal Flooding Inundation Impact	Existing (~+2ft slr)	0.32	0.01	0.88
	2040 (~ Existing 10 YR surge)	1	0.01	1.93
	2070	2.2	0.01	3.84
Storm Surge Inundation Impact	2040 10 YR Surge (~+4 ft slr)	1.5	0.01	2.9
	2070 10 YR Surge	3.26	0.01	5
Integral Scenarios Inundation Impact	(+1ft slr)	Doesn’t intersect	Doesn’t intersect	Doesn’t intersect
	(+7ft slr)	3.9	0.01	5.9
Rainfall Impact	100 Yr Flood	4.5	0.02	7.4
	500 Yr Flood	6.8	2	9.2

Appendix VI: On Island Singular Asset Inundation Depths and Risk Scores for all Scenarios

			2040 NOAA Int Low			2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR			Existing Tidal Flooding / + 2 ft SLR			2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding			2040
			4.345			1.873			0.534			0.143			
Asset Type	Number on Captiva	Name of Asset(s)	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth
Community centers	1	Captiva Civic Association, Inc. (11550 Chapin Lane, Captiva, FL 33924)	0	0	0.00	0	0	0	0.73	1	0.534	0.7	1.0	0.1	1.19
Fire stations	1	Captiva Fire - Station #181 (14981 Captiva Dr, Captiva, FL 33924)	0	0	0.00	0	0	0	0.15	1	0.534	0.9	1.0	0.1	1.15
Federal government facilities	1	U S. Postal Service Captiva (14812 Captiva Dr SW, Captiva, FL 33924)	0	0	0.00	0	0	0	0.05	1	0.534	0.3	1.0	0.1	0.36
Disaster recovery centers	1	Chadwick's at South Seas Plantation (5400 Plantation Rd, Captiva, FL 33924)	1.0	33.0	143.39	0.0	0.0	0	0.0	0	0	2.8	66.0	9.4	1.92
Heliport	1	CAPTIVA	1.1	33.0	143.39	1.7	33	61.809	1.8	33	17.622	3.6	66.0	9.4	3.8
Wastewater treatment facilities	4	South Seas Plantation	0.9	1.0	4.35	1.5	33	61.809	0.25	1	0.534	3.4	66.0	9.4	2.25
		Tween Waters Inn WWTP	0.9	1.0	4.35	0.9	1.0	1.873	0	0	0	0.0	0.0	0.0	0
		Captiva Shores Condominium WWTP	0.4	1.0	4.35	0.5	1	1.873	0	0	0	1.5	33	4.7	1.58
		Sunset Captiva WWTP	0	0.0	0.00	0	0	0	0	0	0	0.7	1.0	0.1	0.28
lift stations	5	Lift station #1	0	0.0	0.00	0	0	0	0	0	0	0.9	1.0	0.1	1.39
		Lift station #2	0	0.0	0.00	0	0	0	0	0	0	1.0	33.0	4.7	0.93
		Lift station #3	0	0.0	0.00	0	0	0	0.58	1	0.534	2.0	33.0	4.7	2.58
		Lift station #4	0	0.0	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.76
		Turner Beach Lift Station	0	0.0	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0
Communications facilities	2	EAST SIDE OF CHADWICK'S SQUARE SHOPPING CENTER	0	0.0	0.00	0	0	0	0	0	0	1	33	4.7	1.57
		Communication Tower at north end near Wastewater Treatment	0	0.0	0.00	0	0	0	0	0	0	0.8	1.0	0.1	1.45
Marinas	7	1057-1900 SOUTH SEAS PLANTATION RD	1.6	33	143.39	1.9	33	61.809	0.7	1	0.534	1.6	33	4.7	1.22
		11401 ANDY ROSSE LN	0	0	0.00	0	0	0	0.24	1	0.534	1.7	33	4.7	2.23
		15107 CAPTIVA DR	0	0	0.00	0.2	1	1.873	0.32	1	0.534	1.7	33	4.7	2.2
		15183 CAPTIVA DR	0	0	0.00	0.1	1	1.873	0.23	1	0.534	1.5	33	4.7	2.04
		15903 CAPTIVA DR	1.9	33	143.39	2.1	66	123.618	0.74	1	0.534	2.4	66	9.4	0.93
		15951 CAPTIVA DR	0.9	1	4.35	0.9	1	1.873	0.94	1	0.534	1.8	33	4.7	2.12
		2800-5640 SOUTH SEAS PLANTATION RD	1	33	143.39	1.6	33	61.809	1.55	33	17.622	2.8	66	9.4	1.83
Historical and cultural assets****	2	Tween Waters Inn Historic District	0	0	0.00	0	0	0	0	0	0	0	0	0.0	0
		Captiva School and Chapel-by-the-Sea Historic District	0	0	0	0	0	0	0	0	0	0	0	0	0.33
Conservation lands/ wetlands	146.85	Mangrove Swamp North	1.17	33	143.385	1.67	33	61.809	1.54	33	17.622	3.58	66	9.438	3.41
	354.13	Mangrove Swamp South	0.92	1	4.345	1.42	33	61.809	1.47	33	17.622	2.83	66	9.438	2.92
	43.46	J. N. Ding Darling National Wildlife Refuge 1	1.08	33	143.385	1.67	33	61.809	1.84	33	17.622	3.58	66	9.438	3.76
	27.05	J. N. Ding Darling National Wildlife Refuge 2	1.17	33	143.385	1.75	33	61.809	1.90	33	17.622	3.75	66	9.438	3.90
	283.00	J. N. Ding Darling National Wildlife Refuge 3	0.83	1	4.345	1.33	33	61.809	1.40	33	17.622	2.67	66	9.438	2.79
	1.59	J. N. Ding Darling National Wildlife Refuge 4	1.42	33	143.385	2.00	66	123.618	2.08	66	35.244	4.00	66	9.438	4.08
	13.14	Sanibel-Captiva Conservation Foundation Conservation Lands 1	0.92	1	4.345	1.33	33	61.809	1.18	33	17.622	3.00	66	9.438	3.04
	48.79	Sanibel-Captiva Conservation Foundation Conservation Lands 2	1	33	143.385	1.58	33	61.809	1.90	33	17.622	3.58	66	9.438	3.90
Parks (acres)*	1.18	Turner Beach	0	0	0	0	0	0	0.40	1	0.534	0	0	0	1.26
	0.13	Andy Rosse Lane Kayak Launch	0	0	0	0	0	0	0.47	1	0.534	1.5	33	4.719	2.30
	0.23	Andy Rosse Lane Beach Access	0	0	0	0	0	0	0.00	1	0.534	0.25	1	0.143	0.64
	0.58	Alison Hagerup Beach Park 1	0	0	0	0	0	0	1.20	33	17.622	0	0	0	1.48
	0.23	Alison Hagerup Beach Park 2	0	0	0	0	0	0	0.00	0	0	0.33	1	0.143	0.60
Logistical staging areas	3.01	South Seas Island Resort	0.0	0.0	0	0	0.0	0	1.07	33	17.622	0.00	0.0	0.0	0.71
	0.70	Allison Hangerup Beach Park A	0.0	0.0	0	0	0.0	0	1.13	33	17.622	0.00	0.0	0.0	1.48
	0.29	Allison Hangerup Beach Park B	0.0	0.0	0	0	0.0	0	0	0	0	0.08	1.0	0.1	0.70
	0.98	Turner Beach A	0.0	0.0	0	0	0.0	0	0.14	1	0.534	0.08	1.0	0.1	0.78
	0.28	Turner Beach B	0	0.0	0	0	0.0	0	0	0	0	0.0	0.0	0.0	0.07
Stormwater treatment facilities and pump stations	3 (Catch Basin Pipes)	SSPGCCB1	0	0	0	0	0	0	0	0	0	0.42	1	0.143	0.75
		SSPGCCB2	0	0	0	0	0	0	0	0	0	1.33	33	4.719	1.61
		SSPGCCB3	0	0	0	0	0	0	0	0	0	0.00	0	0	0
	1 (Swales and Retention Pond)	Swale11	0	0	0	0	0	0	0.52	1	0.534	1.92	33	4.719	2.52
	6 (Standing Water Areas)	Swale10	0	0	0	0	0	0	0.00	0	0	0.00	0	0	0.00
		Swale19	0	0	0	0	0	0	0.00	0	0	0.00	0	0	0.00
		Swale20	0	0	0	0	0	0	0.00	0	0	0.00	0	0	0.00
		Swale21	0	0	0	0	0	0	0.33	1	0.534	2.08	66	9.438	2.33
		Swale23	0	0	0	0	0	0	0	0	0	0.33	1	0.143	0.56
		ST62	0	0	0	0	0	0	0.01	1	0.534	1.42	33	4.719	2.01
	2 (Sewers)	Influent at Sunset Captiva WWTP	0	0	0	0	0	0	0.00	0	0	0.00	0	0	0
	2** (Outfalls)	AROUT	0	0	0	0	0	0	2.29	66	35.244	0.08	1	0.143	4.29
		SSPOutFall1	0	0	0	0	0	0	1.25	33	17.622	0.92	1	0.143	3.25

10 YR Surge/ + 4 ft SLR		2070 Tidal Flooding			2070 10 YR Surge			+ 7 ft SLR			Category 1			Category 2		
0.075			0.053			0.031			0.021			0.01			0.002	
Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK	Inundation Depth	Impact Score	RISK
33	2.475	2.15	66	3.498	3.35	66	2.046	4.19	66	1.386	5	66	0.66	8	100	0.2
33	2.475	1.64	33	1.749	2.45	66	2.046	3.29	66	1.386	3.56	66	0.66	7.4	100	0.2
1	0.075	0.71	1	0.053	1.42	33	1.023	1.91	33	0.693	3	66	0.66	6	100	0.2
33	2.475	2.88	66	3.498	4.08	66	2.046	4.92	66	1.386	5	66	0.66	8	100	0.2
66	4.95	4.78	66	3.498	5.61	100	3.1	6.34	100	2.1	7	100	1	11	100	0.2
66	4.95	3.21	66	3.498	4.41	66	2.046	5.25	100	2.1	6	100	1	10	100	0.2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	66.0	0.132
33	2.475	2.54	66	3.498	3.74	66	2.046	4.58	66	1.386	4	66	0.66	8	100	0.2
1	0.075	1.24	33	1.749	2.44	66	2.046	3.28	66	1.386	3	66	0.66	7	100	0.2
33	2.475	2.35	66	3.498	3.55	66	2.046	4.39	66	1.386	4	66	0.66	7	100	0.2
1	0.075	1.89	33	1.749	3.09	66	2.046	3.93	66	1.386	4	66	0.66	8	100	0.2
66	4.95	3.54	66	3.498	4.74	66	2.046	5.58	100	2.1	5	66	0.66	9	100	0.2
1	0.075	1.72	33	1.749	2.92	66	2.046	3.76	66	1.386	4	66	0.66	7	100	0.2
0	0	0.37	1	0.053	1.57	33	1.023	2.41	66	1.386	3	66	0.66	6	100	0.2
33	2.475	2.53	66	3.498	3.73	66	2.046	4.57	66	1.386	5	66	0.66	9	100	0.2
33	2.475	2.41	66	3.498	3.61	66	2.046	4.45	66	1.386	6	100	1	10	100	0.2
33	2.475	1.74	33	1.749	2.54	66	2.046	3.14	66	1.386	4	66	0.66	7	100	0.2
66	4.95	3.19	66	3.498	4.39	66	2.046	5.23	100	2.1	6	100	1	9	100	0.2
66	4.95	3.16	66	3.498	4.36	66	2.046	5.2	100	2.1	6	100	1	9	100	0.2
66	4.95	2.95	66	3.498	4.01	66	2.046	4.65	66	1.386	5	66	0.66	9	100	0.2
1	0.075	1.54	33	1.749	1.98	33	1.023	1.09	33	0.693	3	66	0.66	4	66	0.132
66	4.95	2.8	66	3.498	2.75	66	2.046	2.13	66	1.386	3	66	0.66	5	66	0.132
3	0.225	2.7	66	3.498	3.88	66	2.046	4.72	66	1.386	6	100	1	10	100	0.2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	66	0.132
1	0.075	1.29	33	1.749	2.49	66	2.046	3.33	66	1.386	4	66	0.66	7	100	0.2
66	4.95	4.32	66	3.498	5.47	100	3.1	6.27	100	2.1	7	100	1	11	100	0.2
66	4.95	3.77	66	3.498	4.90	66	2.046	5.73	100	2.1	6	100	1	9	100	0.2
66	4.95	3.76	66	3.498	5.58	100	3.1	6.32	100	2.1	7	100	1	11	100	0.2
66	4.95	4.97	66	3.498	6.06	100	3.1	6.90	100	2.1	7	100	1	11	100	0.2
66	4.95	3.38	66	3.498	4.75	66	2.046	5.58	100	2.1	6	100	1	9	100	0.2
66	4.95	5.01	100	5.3	6.24	100	3.1	7.08	100	2.1	7	100	1	10	100	0.2
66	4.95	3.88	66	3.498	5.20	100	3.1	6.04	100	2.1	6	100	1	10	100	0.2
66	4.95	5.27	100	5.3	6.06	100	3.1	6.90	100	2.1	6	100	1	10	100	0.2
33	2.475	0.98	1	0.053	1.77	33	1.023	2.42	66	1.386	3	66	0.66	6	100	0.2
66	4.95	3.26	66	3.498	4.46	66	2.046	5.30	100	2.1	6	100	1	9	100	0.2
1	0.075	1.16	33	1.749	1.93	33	1.023	2.69	66	1.386	2	33	0.33	5	66	0.132
33	2.475	1.88	33	1.749	2.89	66	2.046	3.57	66	1.386	5	66	0.66	8	100	0.2
1	0.075	1.49	33	1.749	2.69	66	2.046	3.53	66	1.386	4	66	0.66	8	100	0.2
1	0.075	1.11	33	1.749	1.91	33	1.023	2.66	66	1.386	5	100	1	9	100.0	0.2
33	2.475	1.74	33	1.749	2.89	66	2.046	3.71	66	1.386	5	100	1	8	100.0	0.2
1	0.075	1.58	33	1.749	2.78	66	2.046	3.62	66	1.386	4	66	0.66	8	100.0	0.2
1	0.075	1.56	33	1.749	2.43	66	2.046	3.21	66	1.386	4	66	0.66	6	100.0	0.2
1	0.075	0.46	1	0.053	1.65	33	1.023	2.49	66	1.386	2	66	0.66	6	100	0.2
1	0.075	1.71	33	1.749	2.91	66	2.046	3.75	66	1.386	4	66	0.66	7	100	0.2
33	2.475	2.57	66	3.498	3.77	66	2.046	4.61	66	1.386	5	100	1	9	100	0.2
0	0	0	0	0	0.34	1	0.031	1.18	33	0.693	2	66	0.66	6	100	0.2
66	4.95		66	3.498		66	2.046		100	2.1	5	100	1	9	100	0.2
		3.48			4.68			5.52								
0	0	0.80	1	0.053	2.00	66	2.046	2.84	66	1.386	3	66	0.66	7	100	0.2
0	0	0.00	0	0	0.24	1	0.031	1.08	33	0.693	2	66	0.66	6	100	0.2
0	0	0.00	0	0	0.00	0	0	0.60	1	0.021	1	33	0.33	5	100	0.2
66	4.95	3.29	66	3.498	4.49	66	2.046	5.33	100	2.1	5	100	1	9	100	0.2
1	0.075	1.52	33	1.749	2.72	66	2.046	3.56	66	1.386	5	100	1	8	100	0.2
66	4.95	2.97	66	3.498	4.17	66	2.046	5.01	100	2.1	5	100	1	8	100	0.2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	66	0.132
66	4.95	5.25	100	5.3	6.45	100	3.1	7.29	100	2.1	7	100	1	11	100	0.2
66	4.95	4.21	66	3.498	5.41	100	3.1	6.25	100	2.1	5	100	1	9	100	0.2

Appendix VII: Risk Rank Counts for Grouped Island Assets for all Scenarios

	Total	Risk (L, M, H)	2040 NOAA Int Low	2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR	Existing Tidal Flooding / + 2 ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	2040 10 YR Surge/ + 4 ft SLR	2070 Tidal Flooding	2070 10 YR Surge	+ 7 ft SLR	Category 1	Category 2
Parcels	1,118	No Forseable Risk	987	904	378	891	32	18	13	9	240	97
		Low	67	127	682	16	942	1099	1105	1109	878	1021
		Medium	0	0	57	211	144	1	0	0	0	0
		High	64	87	1	0	0	0	0	0	0	0
Buildings	747	No Forseable Risk	732	697	469	228	145	96	56	27	253	119
		Low	10	44	272	268	482	651	691	720	494	628
		Medium	0	0	6	251	120	0	0	0	0	0
		High	5	6	0	0	0	0	0	0	0	0
Roadways	108,579	No Forseable Risk	108,519	107,008	96,607	78,542	71,978	68,360	66,788	65,385	66,435	60,595
		Low	49	1521	11799	9421	24629	40181	41791	43194	42144	47984
		Medium	0	0	0	20616	11972	38	0	0	0	0
		High	11	50	173	0	0	0	0	0	0	0
Shorelines	25,823	No Forseable Risk	25,823	25,823	25,810	25,618	24,900	21,847	16,719	9,789	7,143	1
		Low	0	0	5	156	910	3,973	9,104	16,034	18,680	25,822
		Medium	0	0	5	49	13	3	0	0	0	0
		High	0	0	3		0	0	0	0	0	0
Surface waters	40.4	No Forseable Risk	30.4	30.4	30.4	30.4	30.4	30.4	30.4	30.4	28.4	28.4
		Low	0	0	0	0	0	10	10	10	12	12
		Medium	0	0	0	10	10	0	0	0	0	0
		High	10	10	10	0	0	0	0	0	0	0

FLOOD VULNERABILITY AND FUTURE CONDITIONS

Captiva, FL

APTIM

AGENDA

Background and Data Collection

Flooding- Causes and Scenarios for Captiva

Critical Asset inventory and Data Collection

Flood Exposure Analysis

Extent of Potential Inundation Under Various Flood Scenarios

(SLR, tidal flooding, storm surge, 100- and 500-Year Flood Events)

Critical Asset Sensitivity Analysis

Impact of inundation for each inundation tipping point scenario

Risk Matrix

Risk determination for assets based on likelihood and impact

Adaptation Action Areas

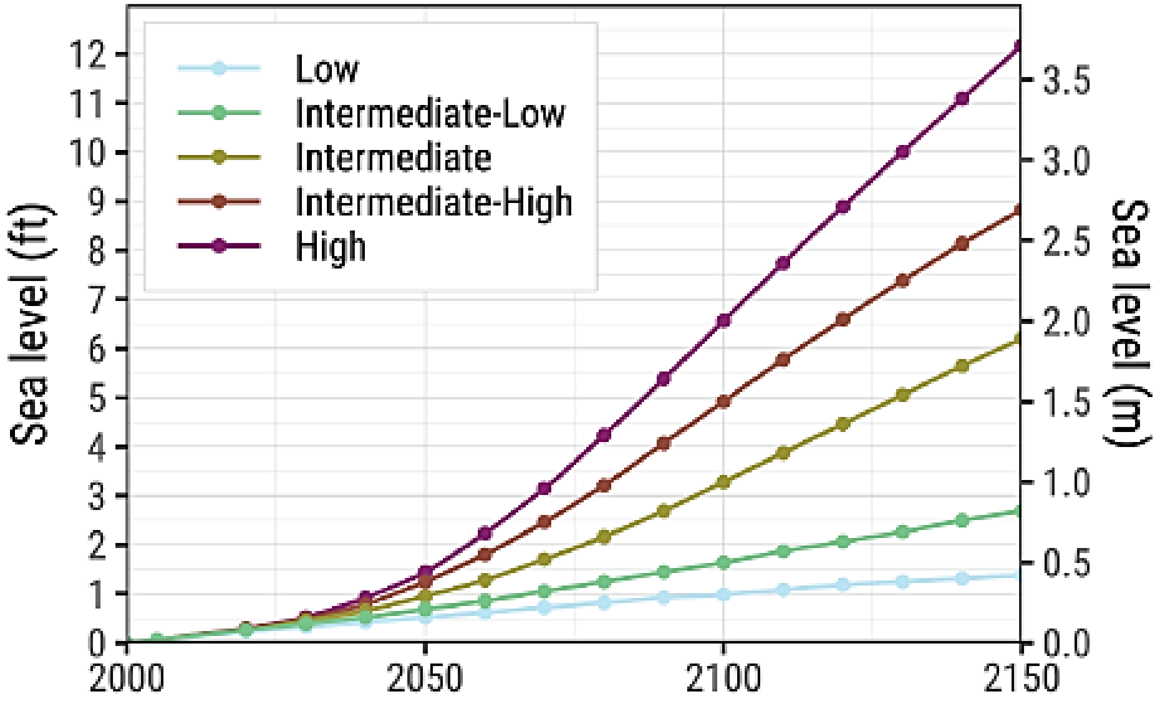
Areas and assets most at risk for inundation

BACKGROUND

SEA LEVEL RISE

- Global warming is causing global mean sea level to rise in two ways.
  - Thermal expansion caused by warming of the ocean (water expands as it warms)
  - Increased melting of land-based ice (glaciers and ice sheets)
- The ocean is absorbing more than 90 percent of the increased atmospheric heat associated with emissions from human activity.
- Sea level plays a role in flooding, shoreline erosion, and hazards from storms.
- Higher sea level also means more frequent high-tide flooding or “nuisance flooding”

THE GLOBAL PICTURE

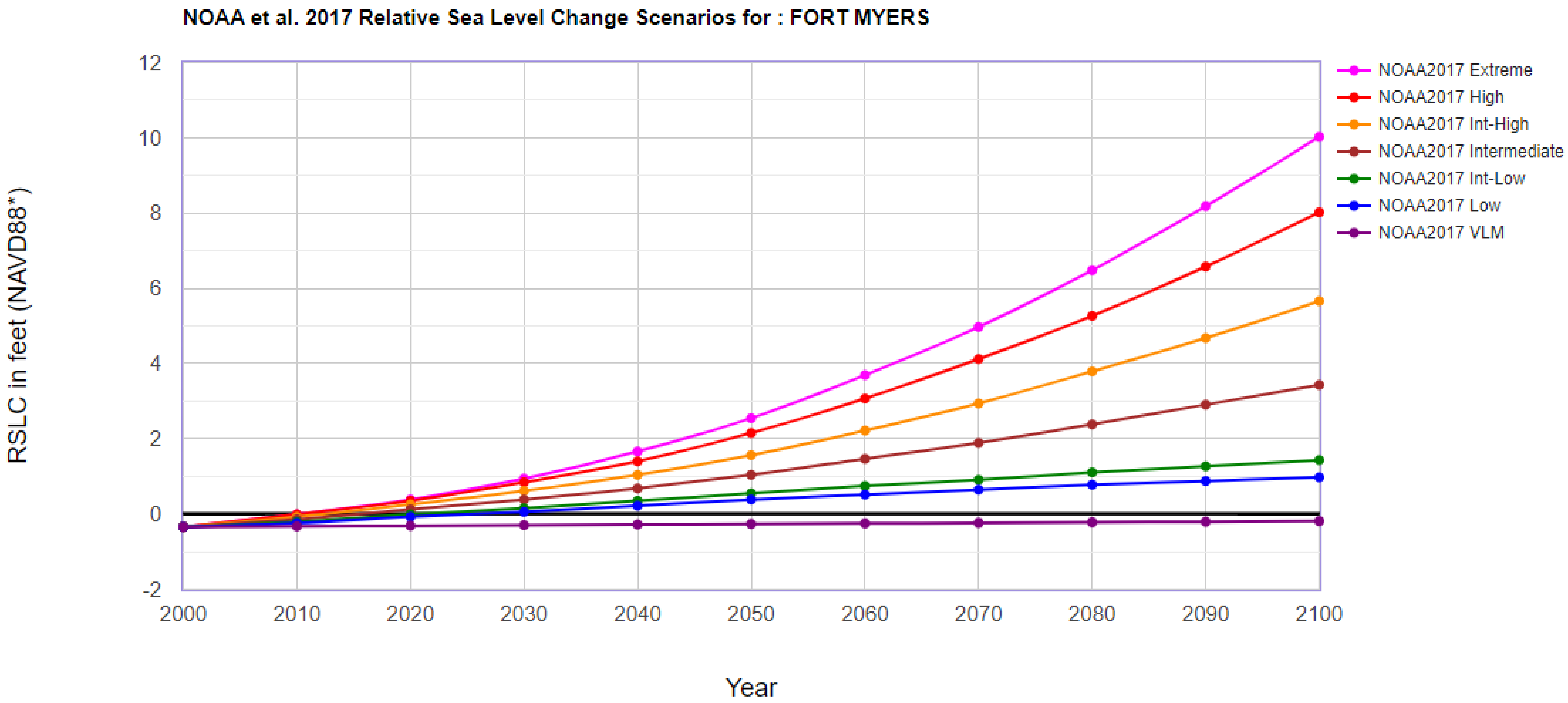


	Year		
Scenario	**2050**	**2100**	**2150**
Low	0.5	1.0	1.4
Intermediate-Low	0.7	1.6	2.7
Intermediate	1.0	3.3	6.2
Intermediate-High	1.2	4.9	8.8
High	1.4	6.6	12.2

Units in feet relative to year 2000

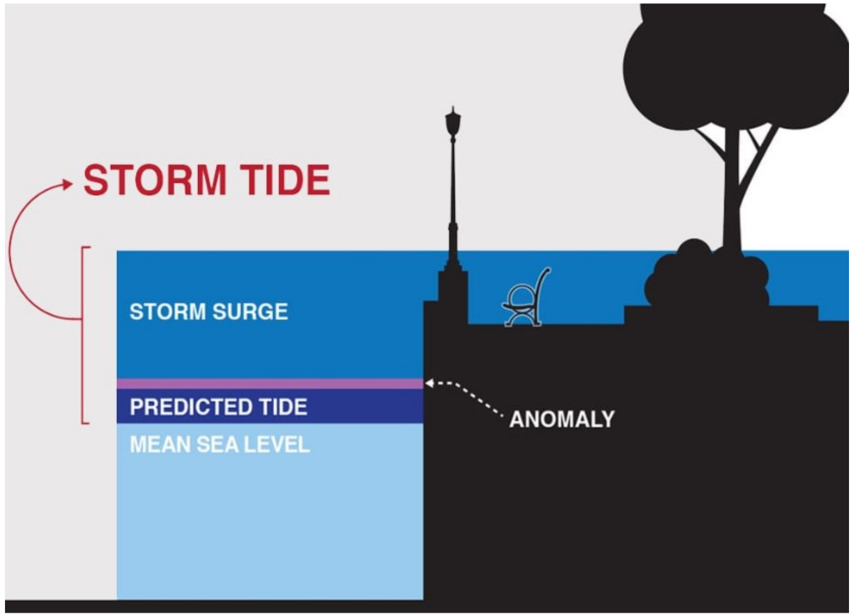
Global sea level rise scenarios from the 2022 Sea Level Rise Technical Report, including projected values for the years 2050, 2100, and 2150. All values are referenced to a year 2000 baseline.

THE LOCAL PICTURE



STORM SURGE

- Storm surge is the rise in seawater level caused solely by a storm.
- The surge is caused primarily by a storm's winds pushing water onshore.
- Higher sea levels mean that storm surges push farther inland than they once did.



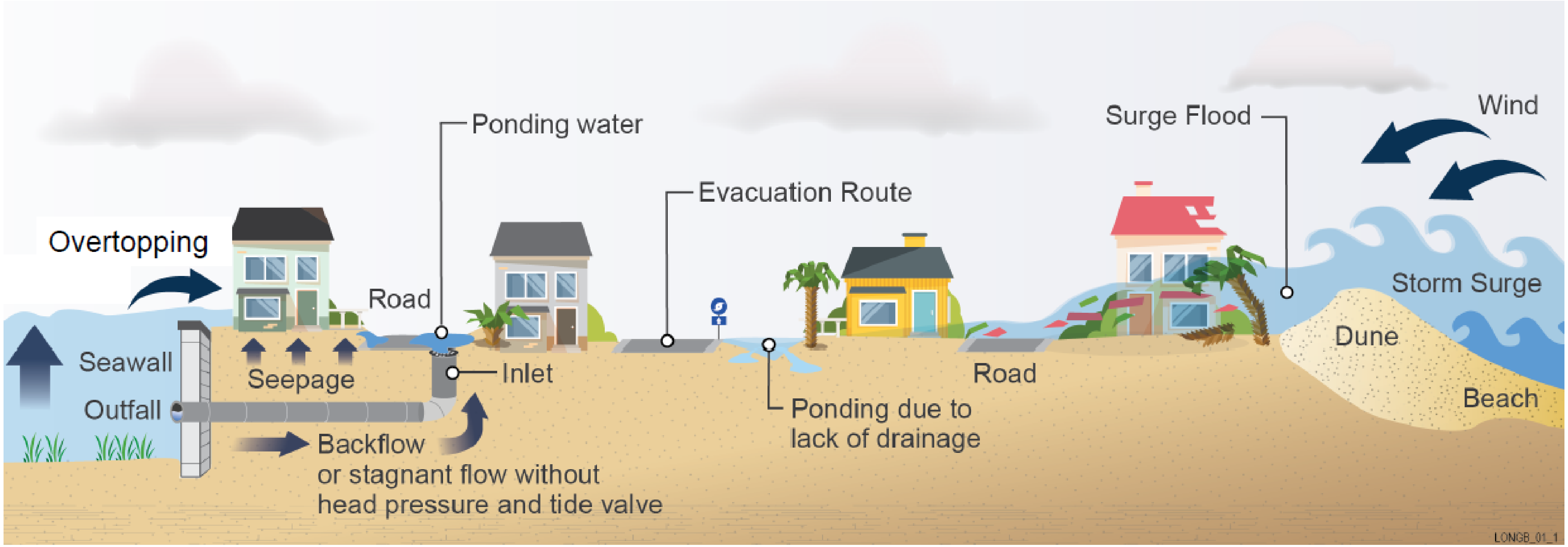
RAINFALL

- Inland flooding caused by rainfall occurs as the result of:
  - Steady rainfall over several days.
  - A short and intense period of rainfall, often associated with a storm or hurricane.

COMPOUND FLOODING

- Compound flooding results from **two or more flooding sources** occurring simultaneously or subsequently within a short period of time.
- The combination of flood sources (storm surge, sea level rise, and heavy rainfall) can lead to higher inundation levels.
- Often the result of major storms or hurricanes.

CAPTIVA VULNERABILITY



VULNERABILITY ASSESSMENT TO PREDICT AND BETTER PLAN FOR IMPACTS

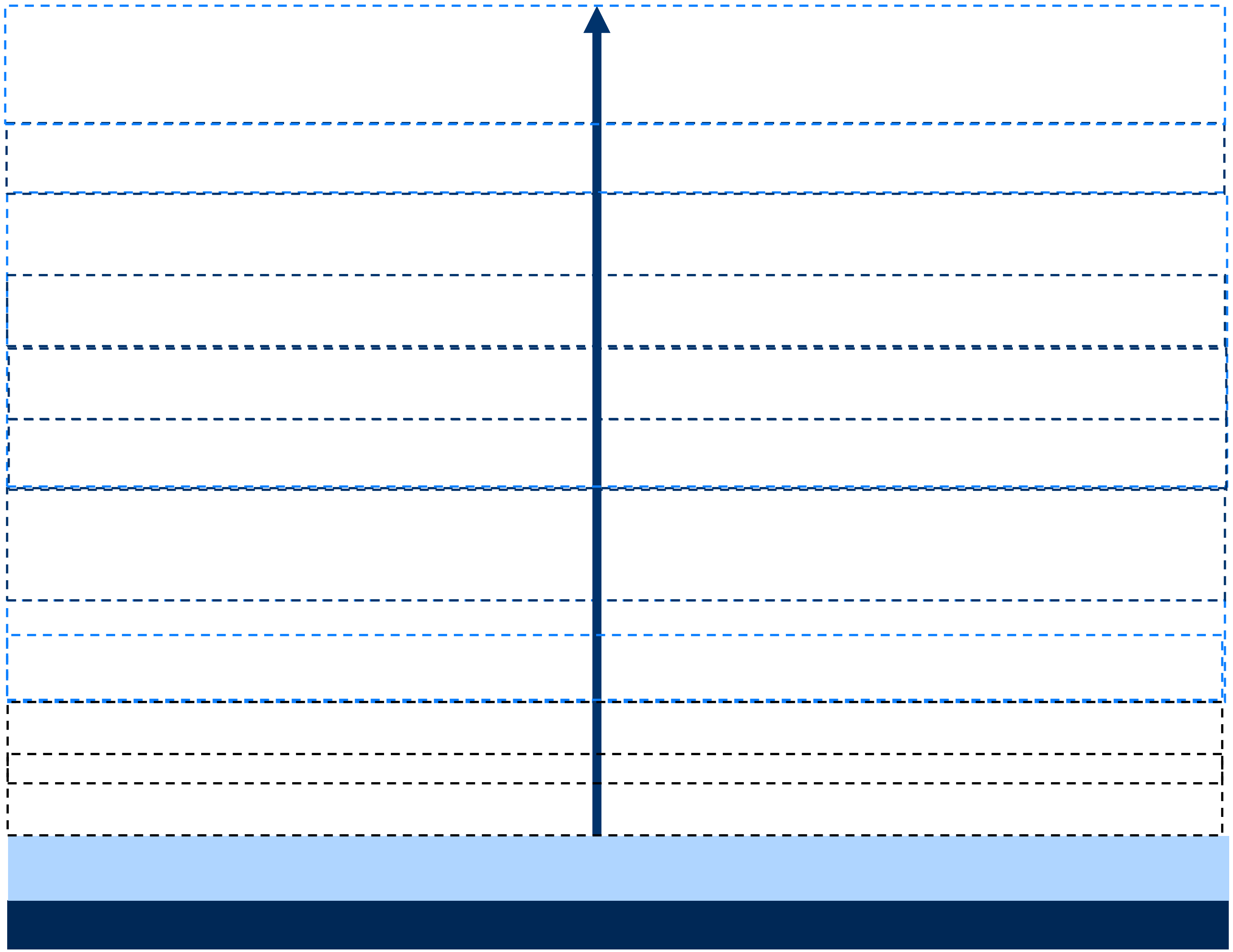
- **Funding:** Florida Department of Environmental Protection (FDEP) Resilient Florida Planning Grant
  - CEPD received funding assistance to analyze and plan for flood and sea level rise vulnerabilities, as well as implement projects for adaptation and mitigation.

- **Vulnerability Assessment General Requirements:**
  - Include entire city or county and all critical assets.
  - Assess flooding using, at least, Intermediate Low and Intermediate High scenarios from NOAA 2017 for at least 2040 and 2070.
  - Address tidal flooding, including future high tide flooding, current and future storm surge flooding, rain-fall induced flooding to the extent practicable and compound flooding.

DATA COLLECTION AND INUNDATION TIPPING POINTS DETERMINATION

FLOOD VULNERABILITY SCENARIOS AND WATER LEVELS FOR CAPTIVA

Scenarios	Feet NAVD
2040 NOAA Int Low	0.63
2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR	1.31
Existing Tidal Flooding / + 2 ft SLR	2.28
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	3.22
2040 10 YR Surge/ + 4 ft SLR	4.28
2070 Tidal Flooding	5.24
2070 10 YR Surge	6.44
+ 7 ft SLR	7.28
100 Year Flood	8.8
500 Year Flood	11.1



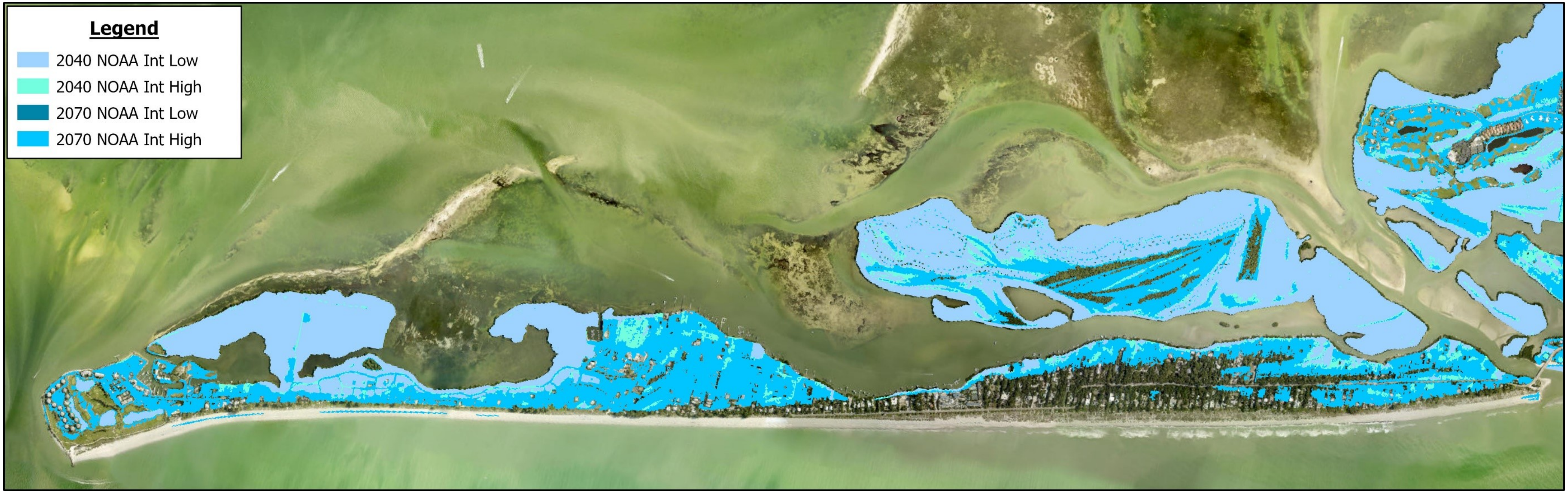
11.1 ft	Existing 500 Year Flood
8.8 ft	Existing 100 Year Flood
7.3 ft	+ 7 ft SLR
6.4 ft	2070 10 YR Surge
5.2 ft	2070 Tidal Flooding
4.3 ft	2040 10 YR Surge/ + 4 ft SLR
3.2 ft	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding
2.3 ft	2017 Tidal Flooding / + 2 ft SLR
1.3 ft	2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR
0.6 ft	2040 State Required Low
0.28 ft	Mean High High Water (MHHW)
0.06 ft	Mean High Water (MHW)
-0.41 ft	Mean Sea Level (MSL)
-0.89 ft	Mean Low Water (MLW)

Feet Relative to NAVD

Flood Scenarios

Existing Tidal/ Water Levels @ Fort Myers

NOAA SCENARIO CONSOLIDATION



INUNDATION TIPPING POINT SCENARIOS

1. Existing Tidal Flooding/ +2 ft SLR
2. 2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding
3. 100 Year Flood Event

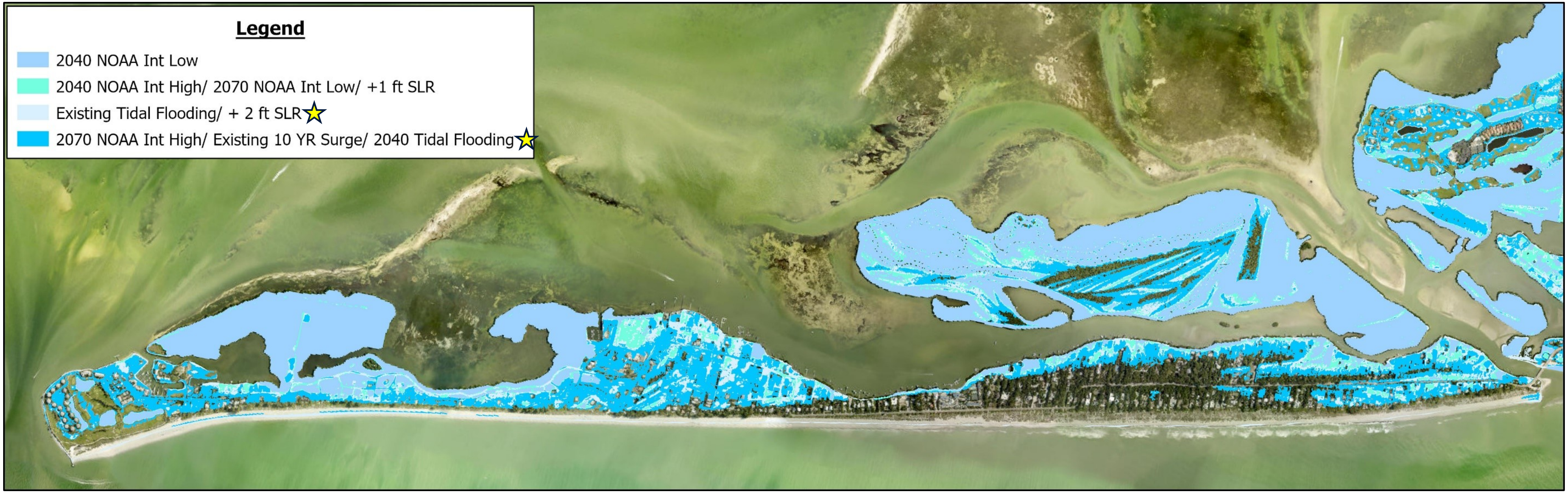
CRITICAL/REGIONALLY SIGNIFICANT ASSETS INVENTORY

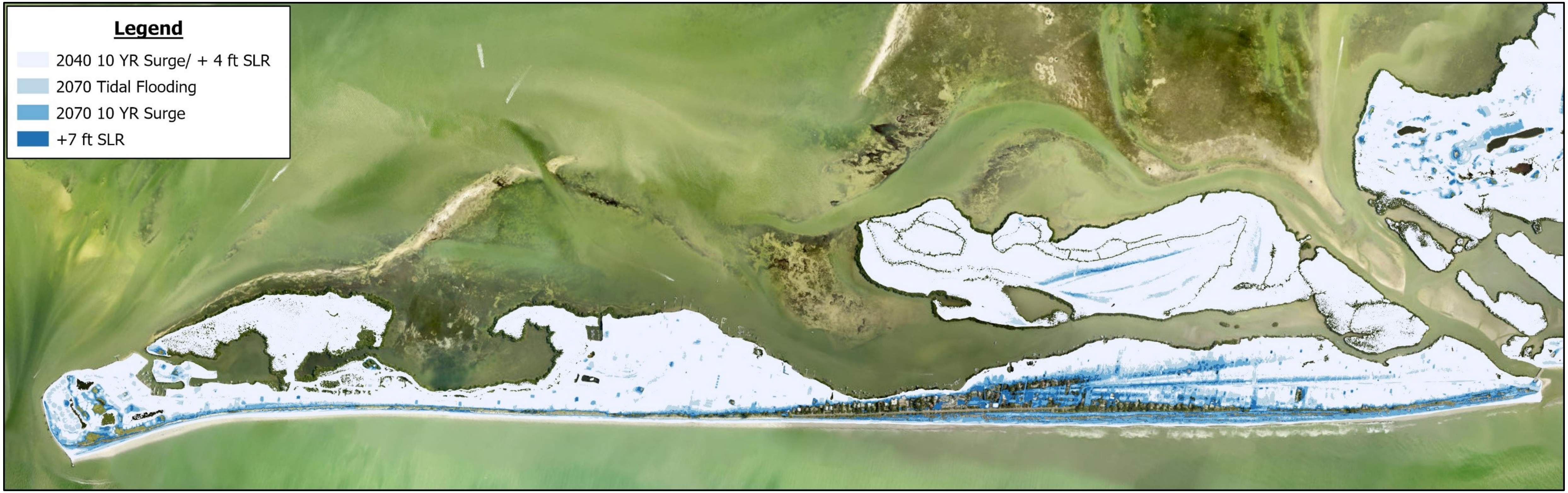
Asset Group	Assets
Critical Infrastructure	Parcels Buildings Seawalls Wastewater treatment facilities and lift stations Stormwater treatment facilities and pump stations Solid and hazardous waste facilities Drinking water facilities Communications facilities Disaster debris management sites
Transportation Assets and Evacuation Routes Sensitivity Analysis	Roadways and bridges Evacuation routes Marinas Airports, Ports, and Bases

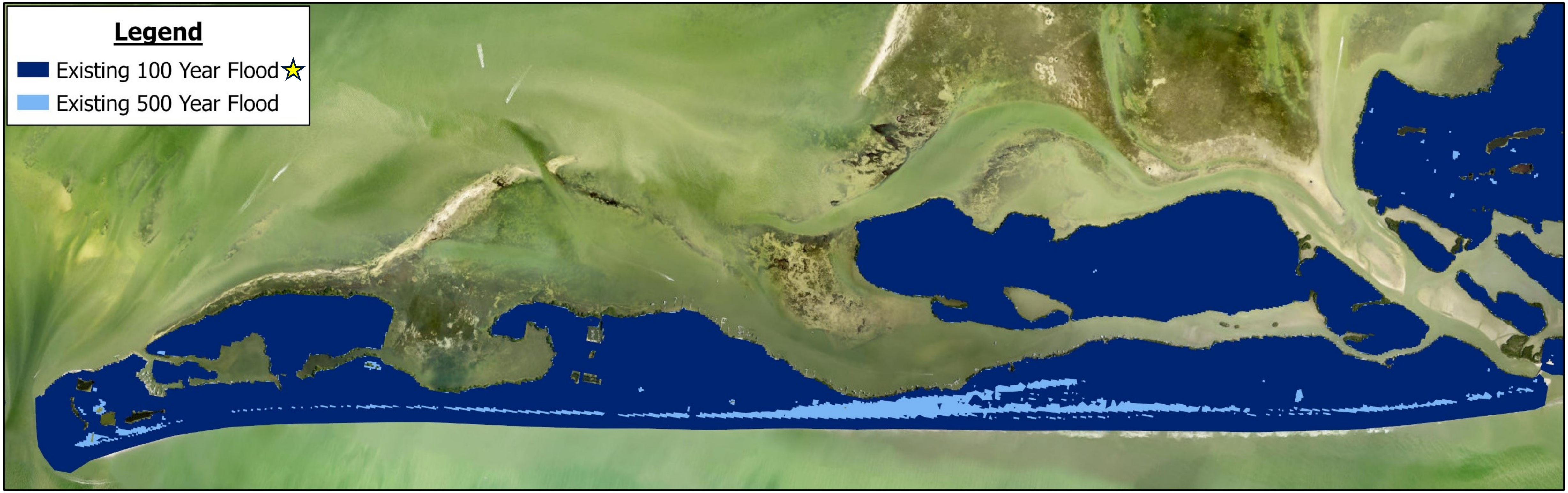
CRITICAL/REGIONALLY SIGNIFICANT ASSETS INVENTORY

Asset Group	Assets
Critical Community Facilities	Schools and colleges Community centers Correctional facilities Fire and police stations Health care facilities and hospitals Local and state government facilities Affordable public housing
Emergency Facilities	Disaster recovery centers Emergency medical service facilities Emergency operation centers Logistical staging areas Risk shelter inventory
Natural, Cultural, and Historical Resources	Conservation lands Wetlands Parks Shorelines and surface waters Historical and cultural assets

FLOOD EXPOSURE ANALYSIS

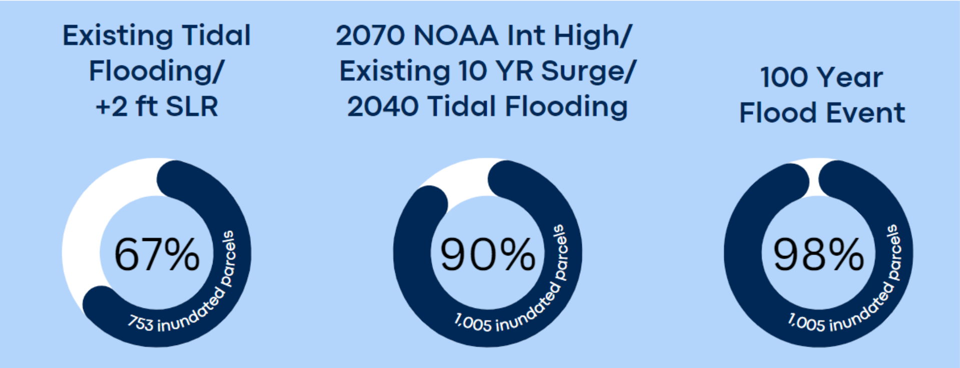

Legend
2040 NOAA Int Low
2040 NOAA Int High/ 2070 NOAA Int Low/ +1 ft SLR
Existing Tidal Flooding/ + 2 ft SLR
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding


Legend
2040 10 YR Surge/ + 4 ft SLR
2070 Tidal Flooding
2070 10 YR Surge
+7 ft SLR

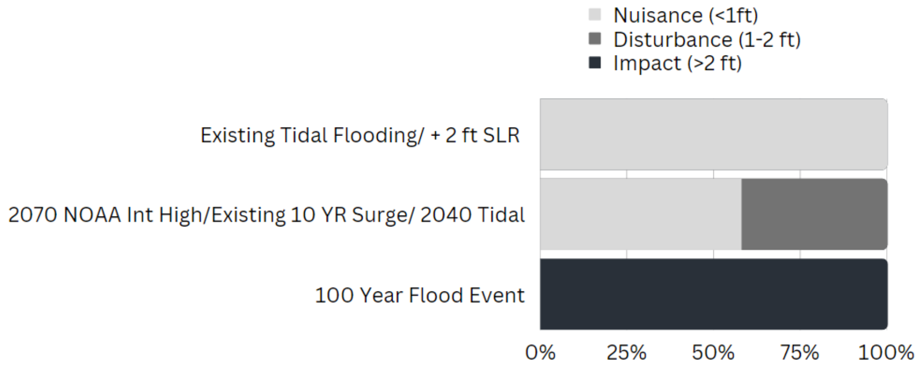

Legend
Existing 100 Year Flood
Existing 500 Year Flood

CRITICAL INFRASTRUCTURE SENSITIVITY ANALYSIS

PARCELS



Existing Tidal Flooding/ +2 ft SLR
67%
753 inundated parcels
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding
90%
1,005 inundated parcels
100 Year Flood Event
98%
1,005 inundated parcels

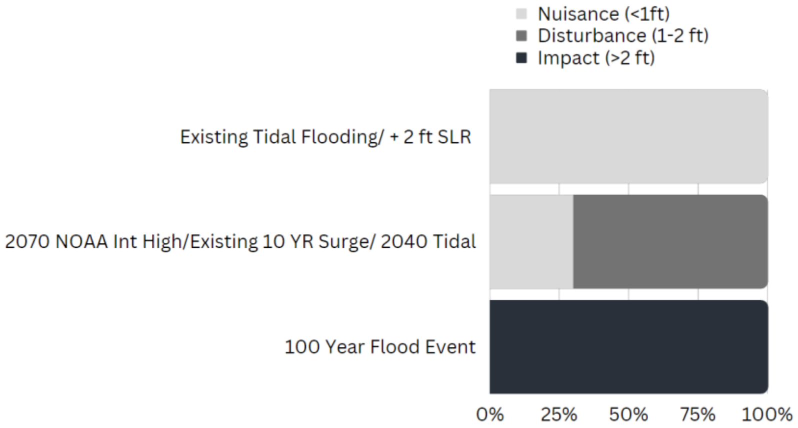


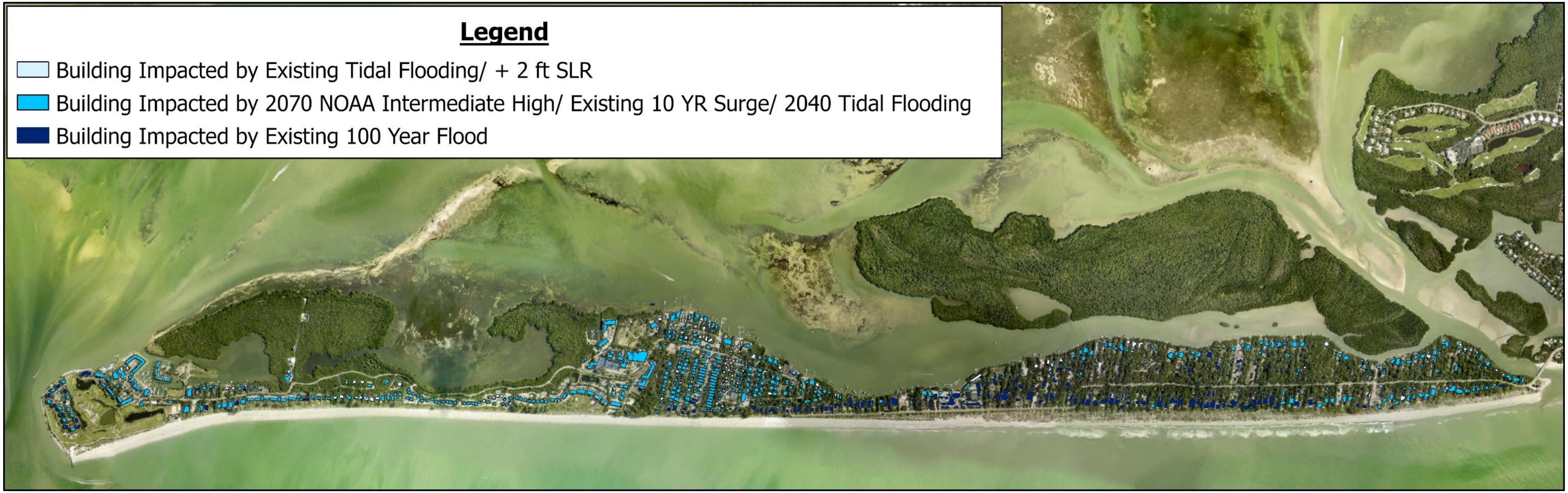
Nuisance (<1ft)
Disturbance (1-2 ft)
Impact (>2 ft)
Existing Tidal Flooding/ + 2 ft SLR
2070 NOAA Int High/Existing 10 YR Surge/ 2040 Tidal
100 Year Flood Event
0%
25%
50%
75%
100%

Legend
Parcel
Existing Tidal Flooding/ + 2 ft SLR
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding
Existing 100 Year Flood

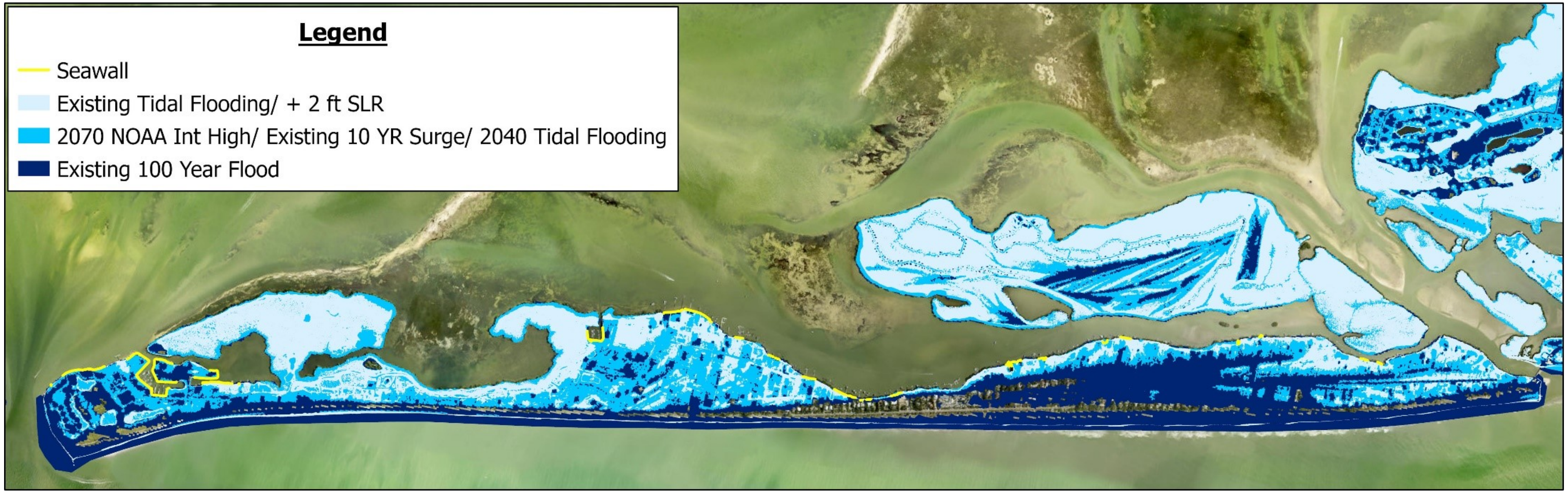
BUILDINGS

Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	100 Year Flood Event

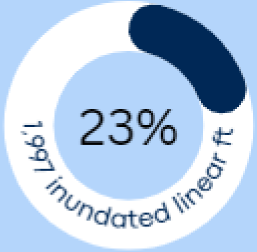




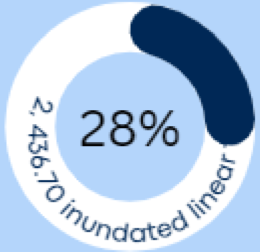
SEAWALLS



Existing Tidal Flooding/ +2 ft SLR



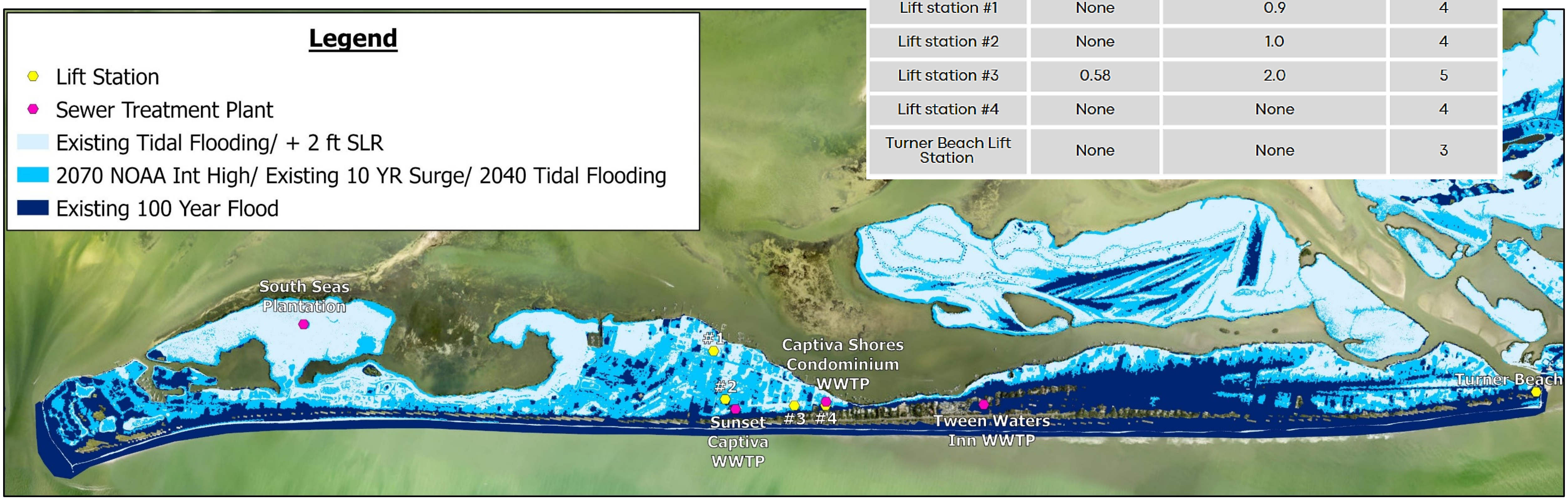
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding



100 Year Flood Event

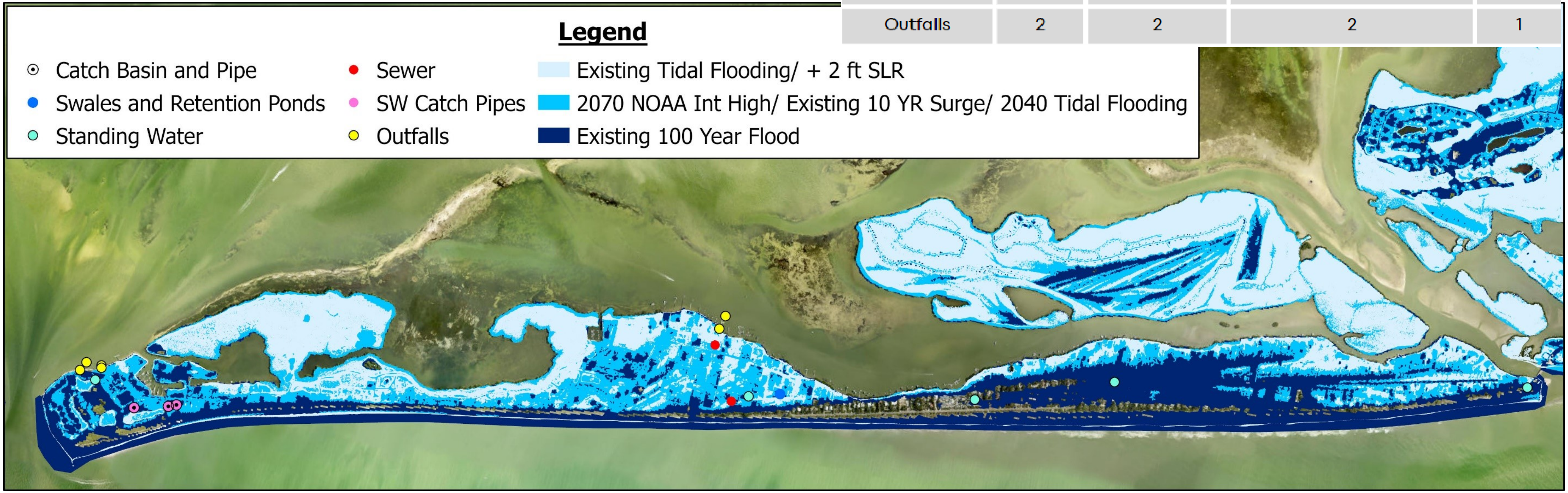
WASTEWATER TREATMENT FACILITIES AND LIFT STATIONS

Asset Location	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	100 Year Flood Event
South Seas Plantation	0.25	3.4	6
Tween Waters Inn	None	1.8	None
Captiva Shores Condominium	None	1.5	4
Sunset Captiva	None	0.7	3
Lift station #1	None	0.9	4
Lift station #2	None	1.0	4
Lift station #3	0.58	2.0	5
Lift station #4	None	None	4
Turner Beach Lift Station	None	None	3



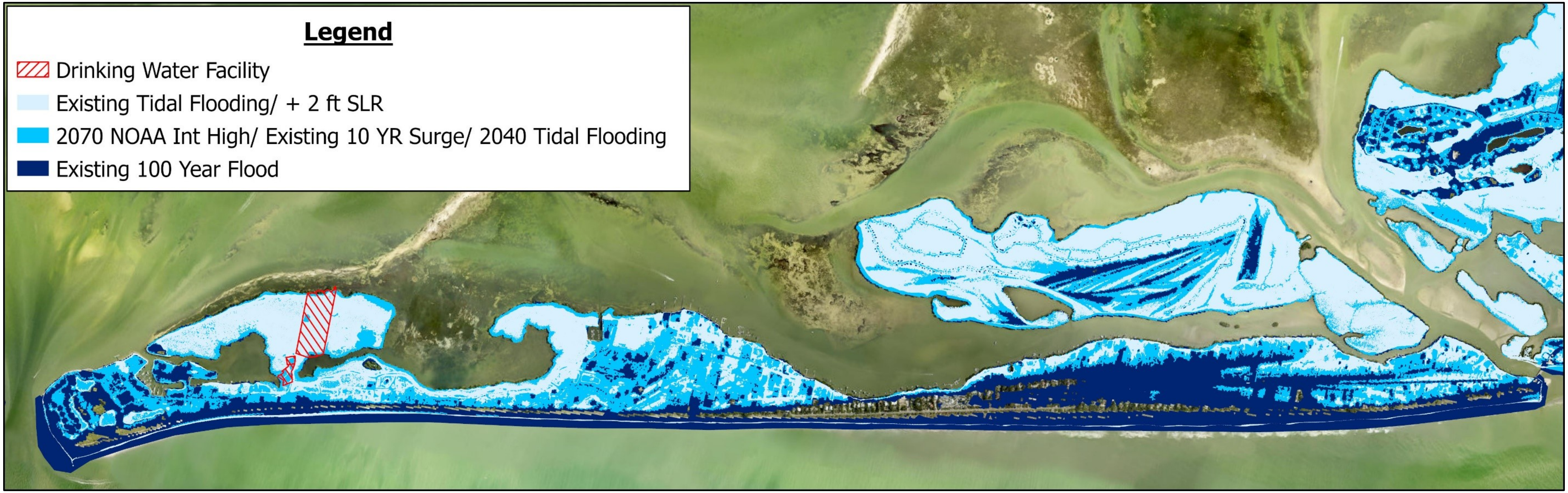
STORMWATER TREATMENT FACILITIES AND PUMP STATIONS

Type	Total Number	Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	100 Year Flood Event
Catch Basin Pipe	3	0	2	3
Swales and Retention Pond	1	1	1	1
Standing Water	6	2	2	5
Sewer	2	1	1	1
SW Catch Pipes	4	1	3	4
Outfalls	2	2	2	1



DRINKING WATER FACILITIES

1. Existing Tidal Flooding/ +2ft SLR: 1.08 feet
2. 2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding: 2.25 feet
3. 100 Year Flood Event: 6.7 feet

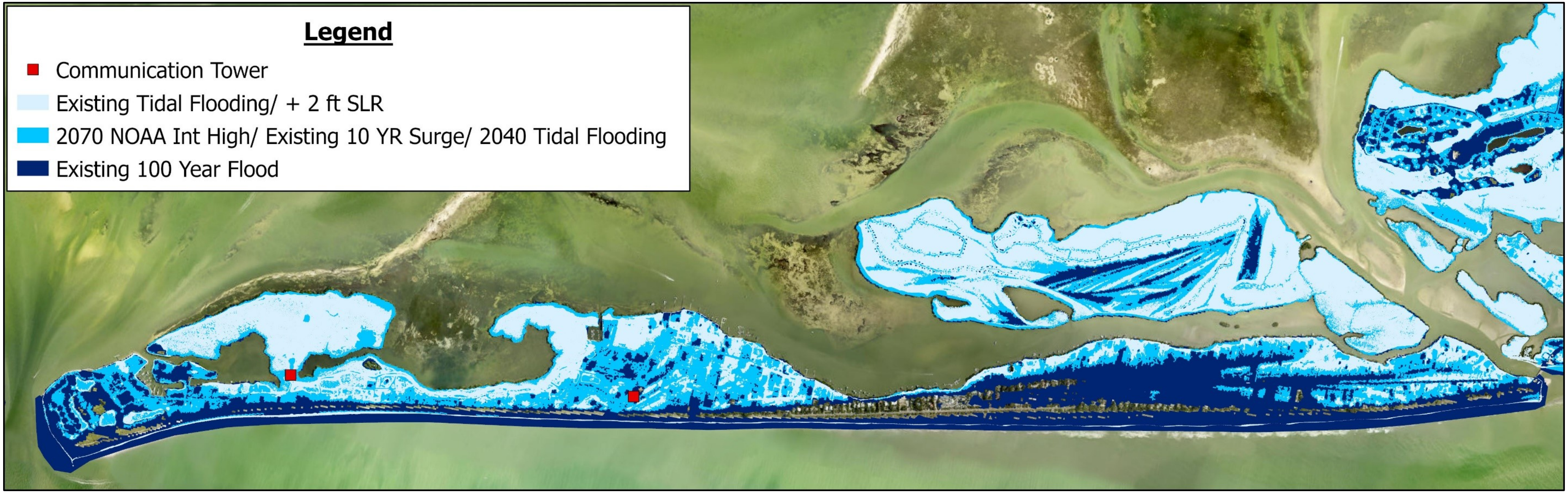


COMMUNICATIONS FACILITIES

1 Existing Tidal Flooding/ +2ft SLR: 1.08 feet

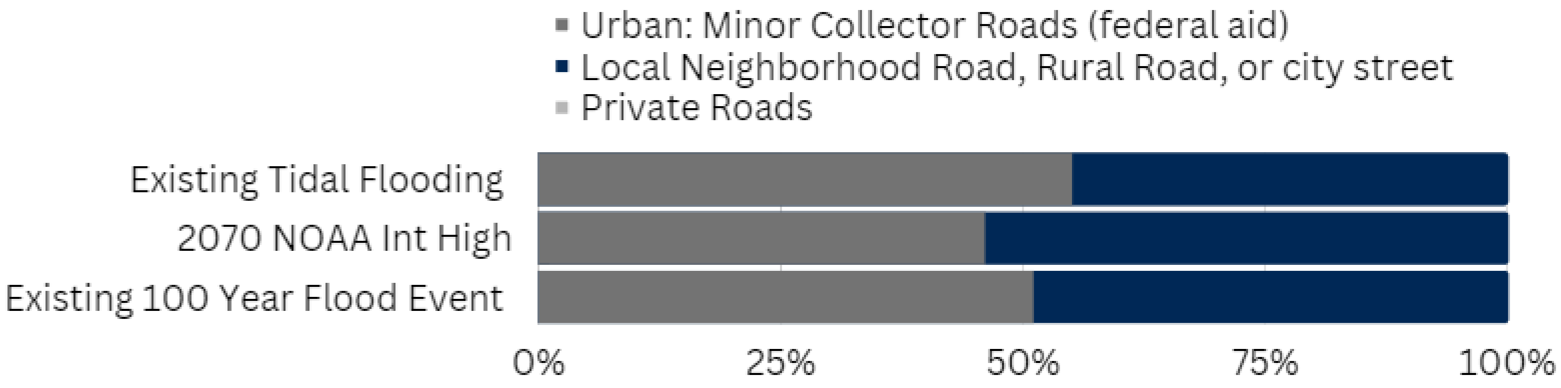
2 2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding: 2.25 feet

3 100 Year Flood Event: 6.7 feet



TRANSPORTATION ASSETS AND EVACUATION ROUTES SENSITIVITY ANALYSIS

ROADWAYS

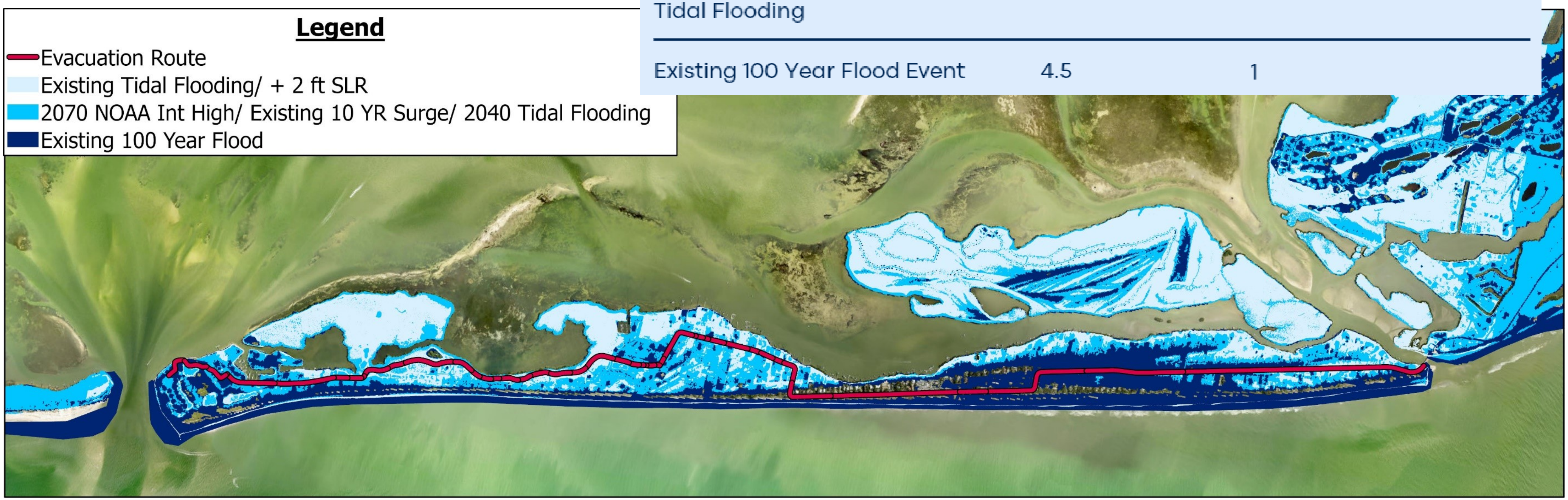


Urban: Minor Collector Roads (federal aid)
Local Neighborhood Road, Rural Road, or city street
Private Roads
Existing Tidal Flooding
2070 NOAA Int High
Existing 100 Year Flood Event
0%
25%
50%
75%
100%

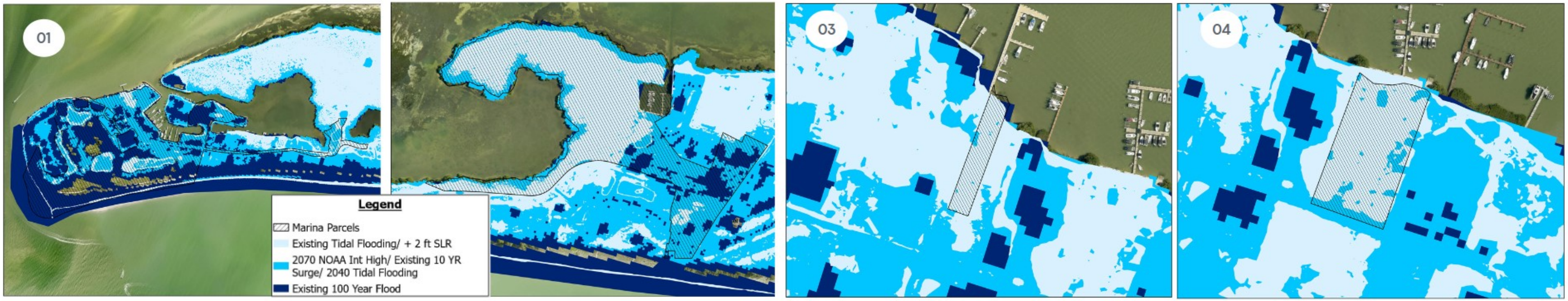
Elevation (ft, NAVD88)
≤2
≤4
≤6
≤8
≤10

EVACUATION ROUTES

	Inundation Depth (feet)		
	Average	Minimum	Maximum
Existing Tidal Flooding	0.32	0.01	
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	1.3	0	
Existing 100 Year Flood Event	4.5	1	

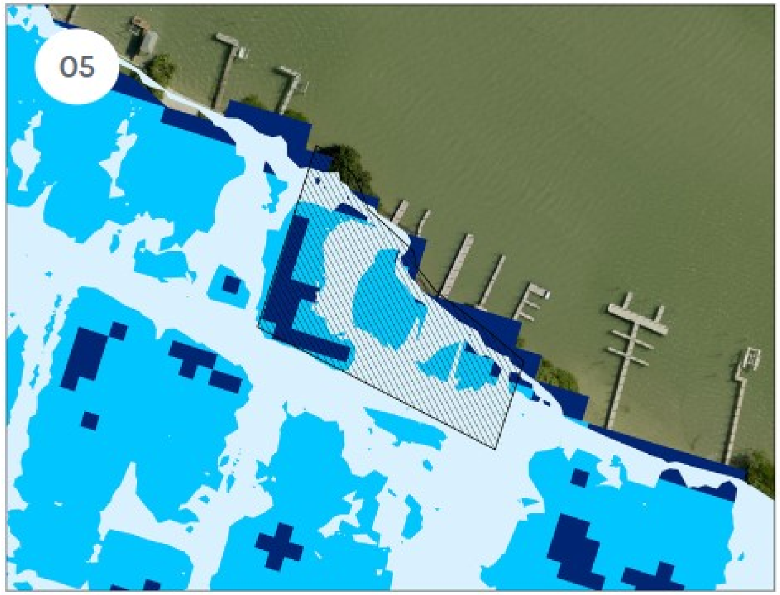


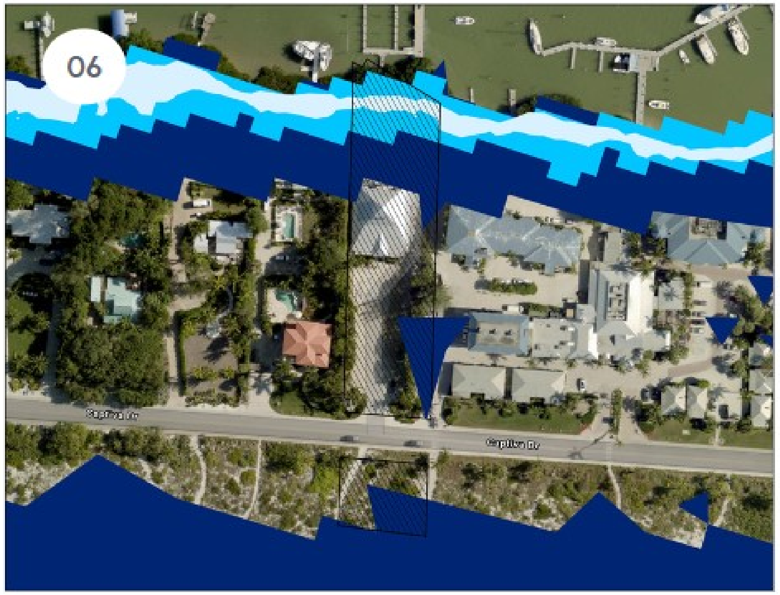
MARINAS

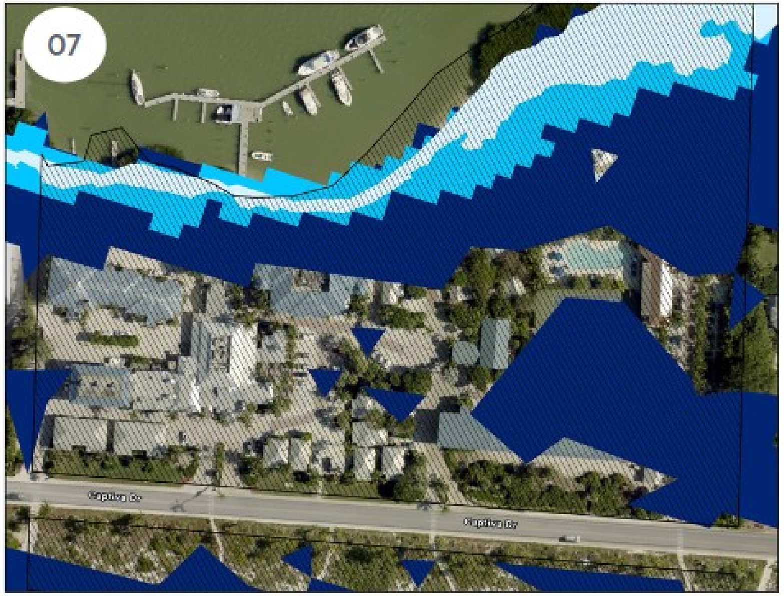


		Average Inundation Depth (feet)		
	Marina Address	Existing Tidal Flooding	2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding	100 Year Flood Event
01	1057-1900 South Seas Plantation Road	0.70	1.6	4
02	2800-5640 South Seas Plantation Road	1.55	2.8	6
03	11401 Andy Rosse Lane	0.24	1.7	6
04	15107 Captiva Drive	0.32	1.7	6

MARINAS (CONTINUED)





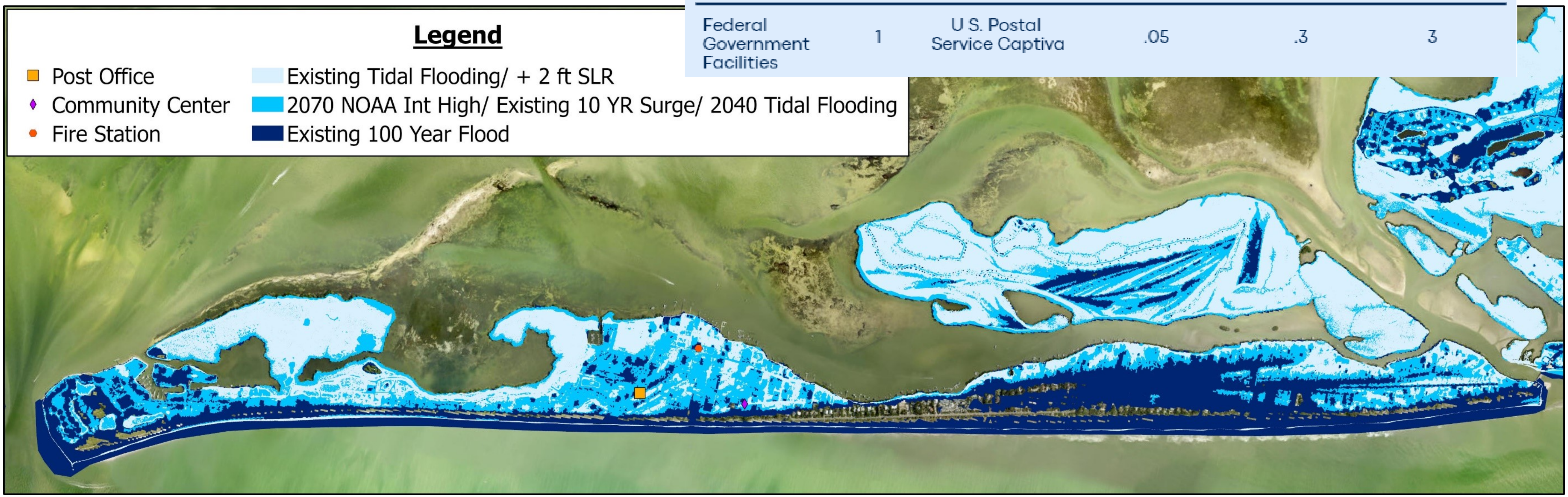


	Average Inundation Depth (feet)		
Marina Address	Existing Tidal Flooding	2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding	100 Year Flood Event
05 15183 Captiva Drive	0.23	1.5	5
06 15903 Captiva Drive	0.74	2.4	3
07 15951 Captiva Road	0.94	1.8	3

CRITICAL COMMUNITY AND EMERGENCY FACILITIES SENSITIVITY ANALYSIS

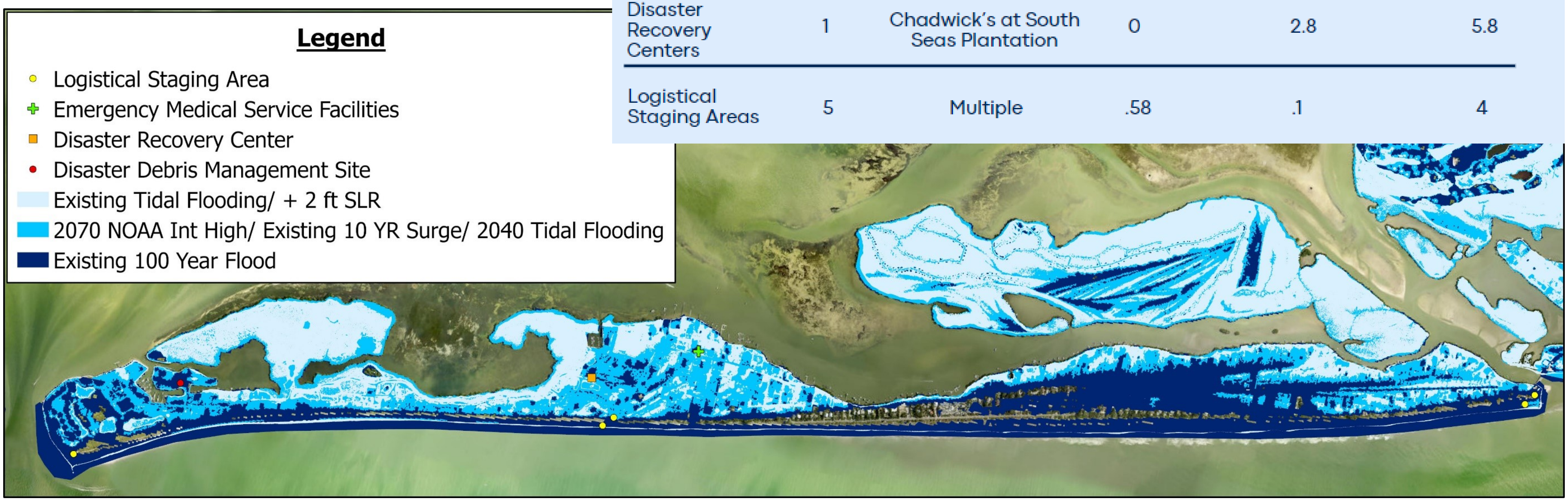
CRITICAL COMMUNITY FACILITIES

Facility Type	Island Total	Facility Name	Inundation Depth (feet)		
			Existing Tidal Flooding/ +2 ft SLR	2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	100 Year Flood Event
Community Centers	1	Captiva Civic Association, Inc	.7	.7	5
Fire Stations	1	Captiva Fire -Station #181	.15	.9	3.56
Federal Government Facilities	1	U S. Postal Service Captiva	.05	.3	3



EMERGENCY FACILITIES

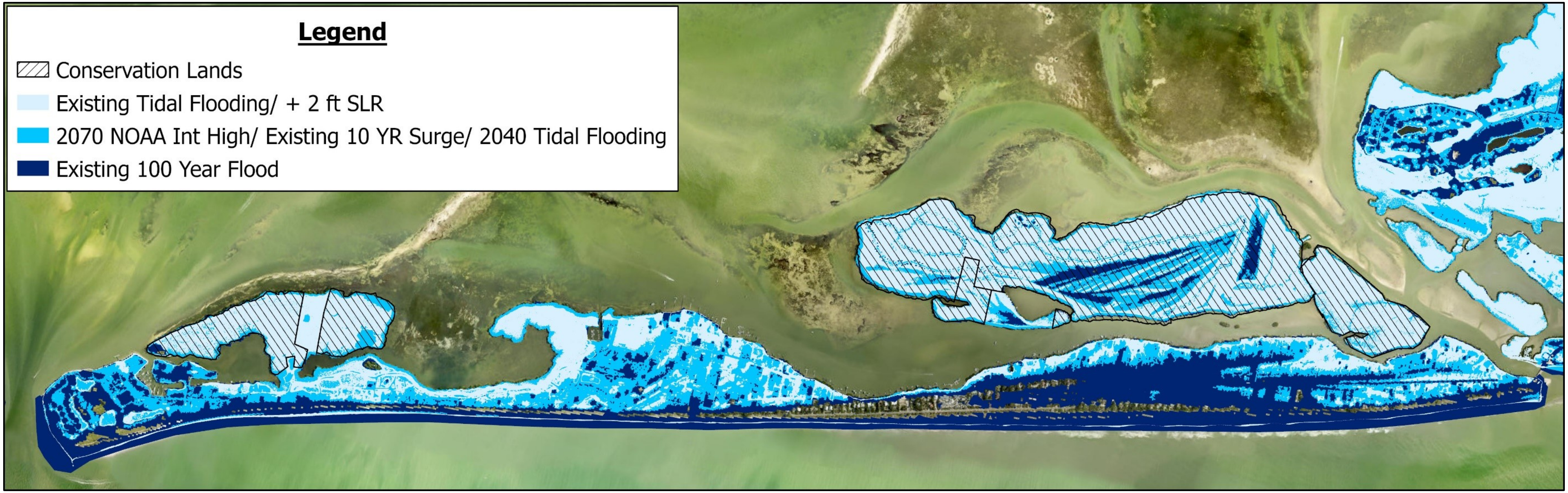
Facility Type	Island Total	Facility Name	Inundation Depth (feet): Existing Tidal Flooding/ +2 ft SLR	Inundation Depth (feet): 2070 NOAA Intermediate High/ Existing 10 Year Surge/ 2040 Tidal Flooding	Inundation Depth (feet): 100 Year Flood Event
Emergency Medical Service Facilities	1	Captiva Fire -Station #181	,15	.9	3.56
Disaster Recovery Centers	1	Chadwick's at South Seas Plantation	0	2.8	5.8
Logistical Staging Areas	5	Multiple	.58	.1	4



NATURAL, CULTURAL, AND HISTORICAL RESOURCES SENSITIVITY ANALYSIS

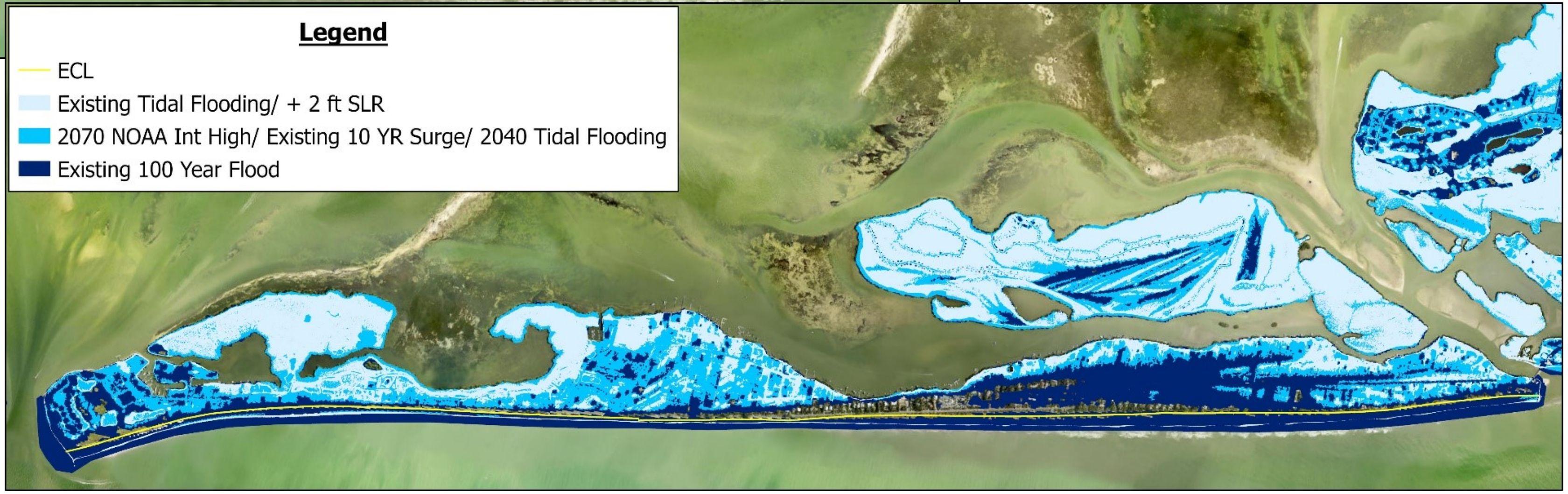
CONSERVATION LANDS

Existing Tidal Flooding/ +2ft SLR	2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	Existing 100 Year Flood Event



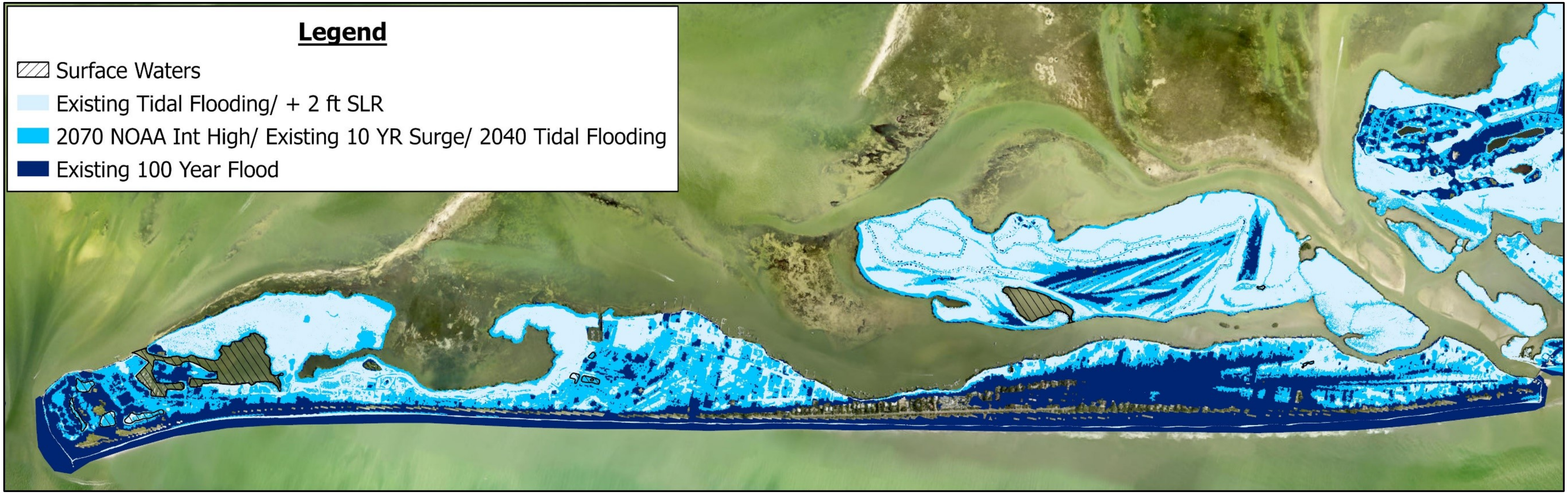
SHORELINES

Elevation (ft, NAVD88)
≤1
≤2
≤3
≤4
≤5
≤6
≤7
≤8
≤12

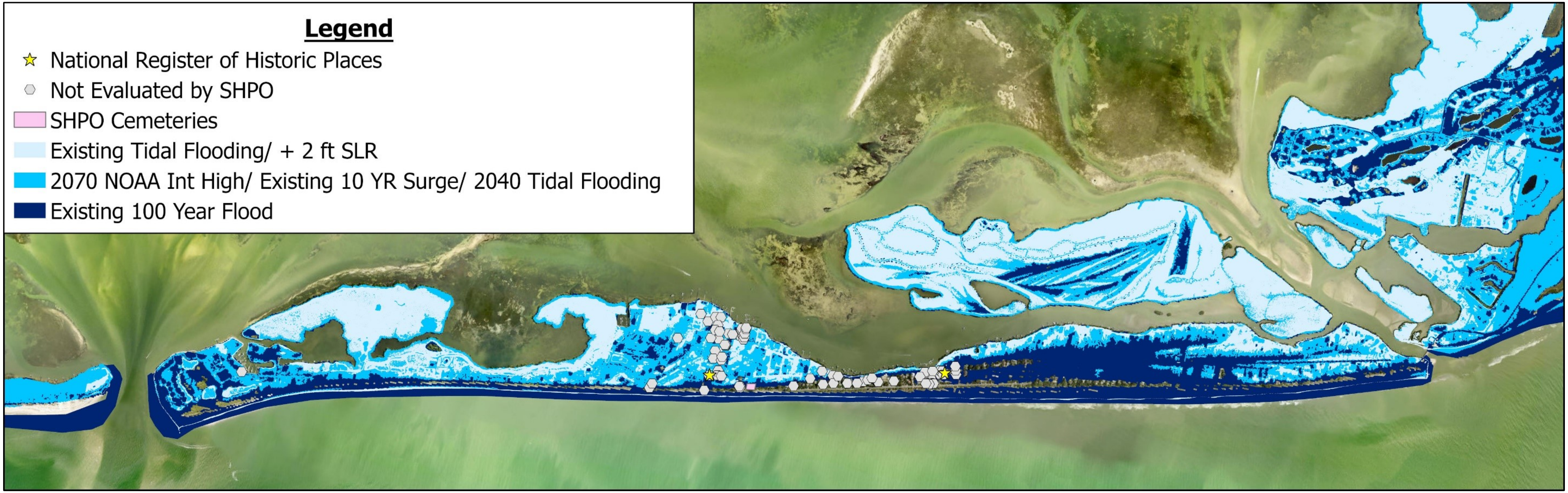


Legend
ECL
Existing Tidal Flooding/ + 2 ft SLR
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding
Existing 100 Year Flood

SURFACE WATERS



SURFACE WATERS



RISK

METHODOLOGY

Likelihood (or probability) of a given flood scenario occurring in a year **X** **Impact Score** (based on the anticipated depth) of the asset under the given flood scenario **=** **Risk Score**

Scenario	Likelihood/ Probability
2040 NOAA Int Low	4.345
2040 NOAA Int High/ 2070 NOAA Int Low/ + 1 ft SLR	1.873
Existing Tidal Flooding/ +2ft SLR	.53
2070 NOAA Int High/ Existing 10 YR Surge/ 2040 Tidal Flooding	.143
2040 10 YR Surge/ +4 ft SLR	.075
2070 Tidal Flooding	.053
2070 10 YR Surge	.031
+ 7 ft SLR	.021
Existing 100 Year Flood	.01
Existing 500 Year Flood	.002

Inundation Depth (feet)	Impact Score
0	0
0-1 foot	1
1-2 feet	33
2-5 feet	66
>5 feet	100

Risk Score	Risk Rank
0	No Foreseeable Risk
0 -4.5	Low Risk
4.5 -20	Medium Risk
> 20	High Risk

FINDINGS

- All conservation lands and Captiva marinas prove to be at risk across all inundation tipping point scenarios, all of which are at medium risk under Scenario 2.
- The Marina located at 2800-5640 South Seas Plantation Road and the J. N. Ding Darling National Wildlife Refuge 4 are most at risk under existing tidal conditions.
- The Captiva Civic Association, Fire Station, U.S Postal Service, Captiva Heliport, South Seas Plantation WWTP, and Lift Station # 3, prove to be at risk across all tipping point scenarios
- It is important to note the assets that are under no risk across the topping point scenarios- Tween Waters Inn WWTP, Tween Waters Inn Historic District, and Sewer #2.
- Aside from these assets, all individual assets are at low risk under the inundation tipping point Scenarios 3.

FINDINGS (CONTINUED)

1 Existing Tidal Flooding/ +2 ft SLR

70% of parcels at risk (92% at ow risk)
37% of buildings at risk (98% at low risk)
11% of linear ft of roads at risk (99% at low risk)

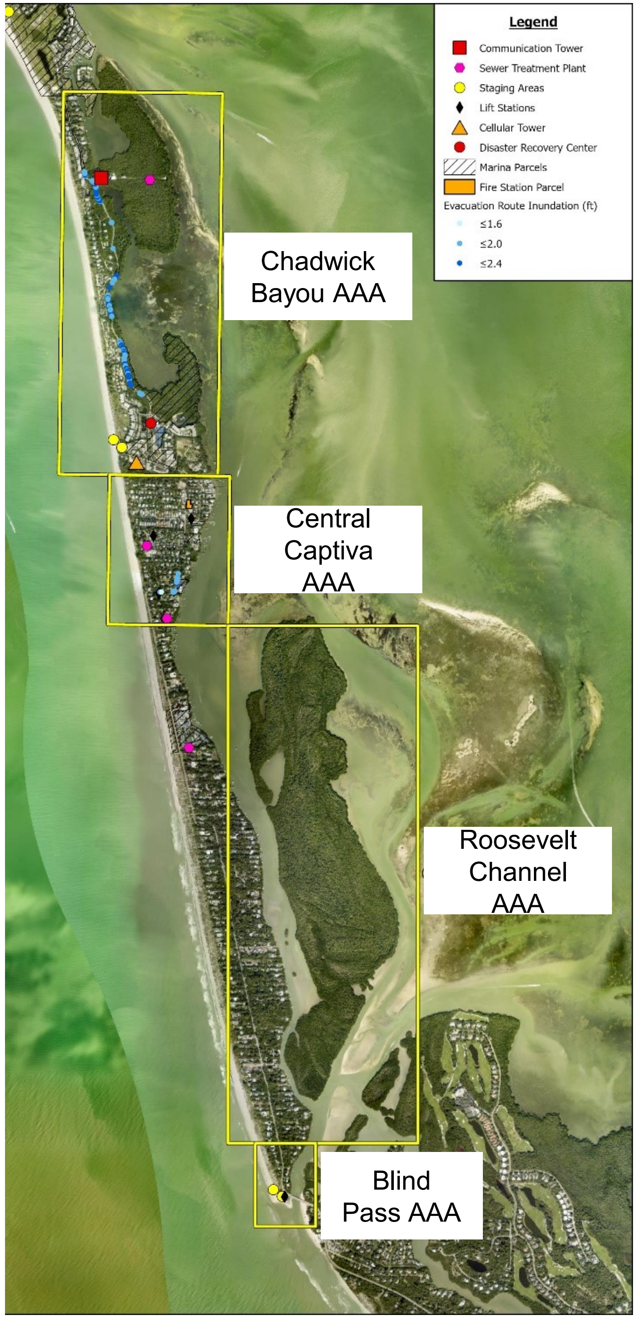
2 2070 NOAA State Required High/ Existing 10 YR Surge/ 2040 Tidal Flooding

20% of parcels at risk (7% at ow risk)
36% of buildings at risk (52% at low risk)
3% of linear ft of roads at risk (31% at low risk)

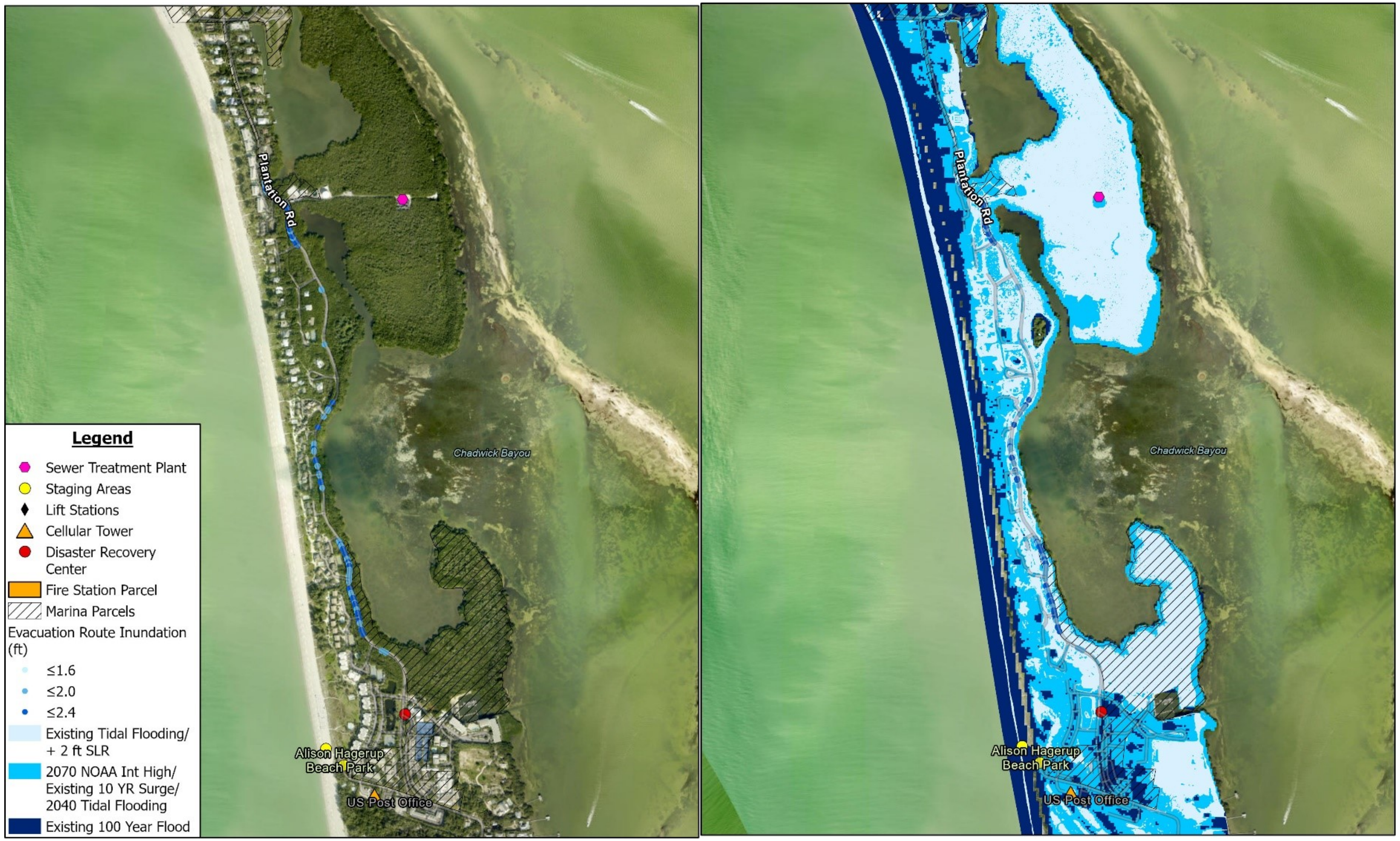
3 Existing 100 Year Flood Event

79% of parcels at risk (100% at ow risk)
66% of buildings at risk (100% at low risk)
39% of linear ft of roads at risk (100% at low risk)

ADAPTATION ACTION AREAS


Legend
Communication Tower
Sewer Treatment Plant
Staging Areas
Lift Stations
Cellular Tower
Disaster Recovery Center
Marina Parcels
Fire Station Parcel
Evacuation Route Inundation (ft)
≤1.6
≤2.0
≤2.4
Chadwick Bayou AAA
Central Captiva AAA
Roosevelt Channel AAA
Blind Pass AAA

CHADWICK BAYOU AAA

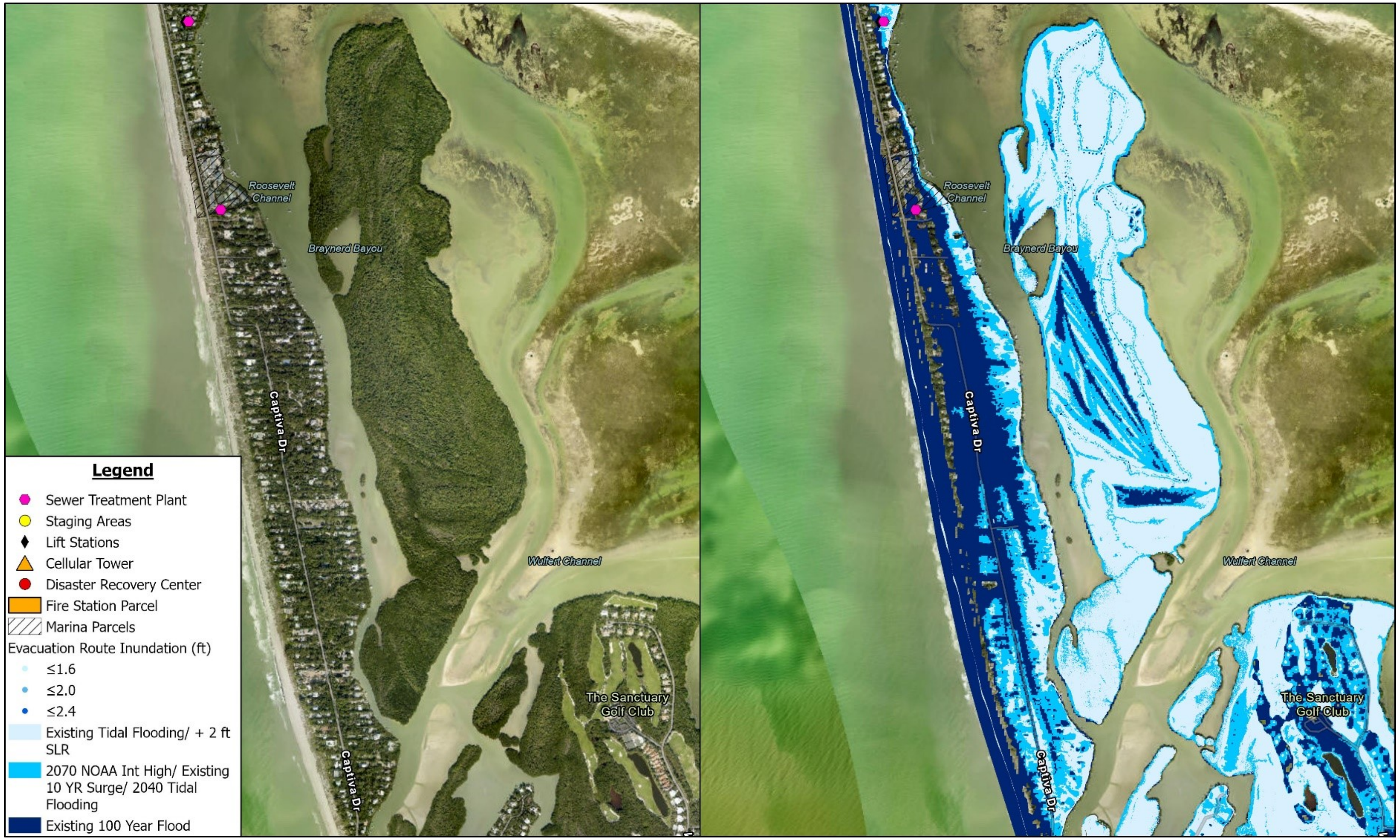


- Mangrove enhancement area
  - Sediment supply for mangroves coupled with shoreline protection (long term adaptation strategy)
- Connect mangroves or design something to allow flushing at high tide level that can be adapted over the years
- Enhance seagrass to stabilize the narrow island portion
- Elevate or protect vulnerable low-lying road segments

CENTRAL CAPTIVA AAA

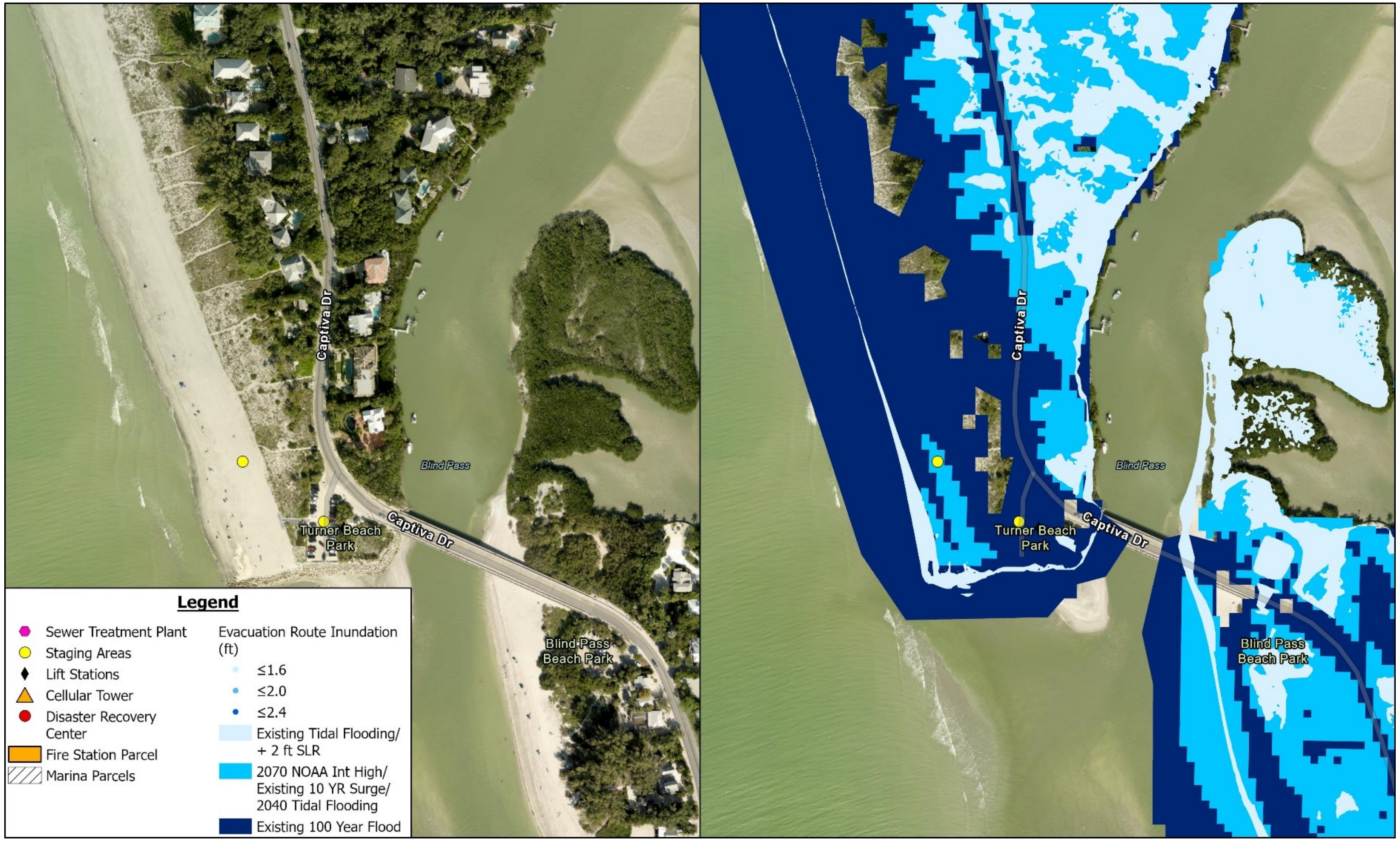
- Introduce sill or encourage seagrass between sandbars to reduce surge, wave action, and erosion at the narrowest point of the island on the backside
- Seal up vulnerable bayside area with seawalls or berms to prevent flow across property onto main road (policy)
- Harden fire station and tide valves
- Establish sill to slow surge around this area

ROOSEVELT CHANNEL AAA



- Install flood gates at North and South end of channel or focus on flood
- Elevate buildings along shoreline
- Seawalls (policy)

BLIND PASS AAA



- Seal up vulnerable bayside area with seawalls or berms to prevent flow across property onto main road (policy)

QUESTIONS

SAMANTHA DANCHUK, PHD, PE
Samantha.Danchuk@aptim.com
561 361 3199

APTIM

Expect the Extraordinary.

Contact us.

Aptim Coastal Planning
& Engineering, LLC (APTIM)
6401 Congress Avenue, Suite 140
Boca Raton, FL 33487