Natural Hazard Risk and Vulnerability Analysis
Satellite Beach, Florida

STORM SURGE | COASTAL EROSION | SEA LEVEL RISE | FLOODING

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Prepared by the East Central Florida Regional Planning Council for the City of Satellite Beach and the Florida Department of Environmental Protection.

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Vulnerability Analysis Map Disclaimer

These data and maps are for planning, educational, and awareness purposes only and should not be used for site-specific analysis, navigation, and flood rates or permitting. As with all data, all features should be verified with a site visit. The data and maps in this report are provided "as is".

ECFRPC makes no warranty explicit or implied, regarding the accuracy or use of this information. Use at your own risk. The purpose of this data is to provide a preliminary look at sea level rise, erosion, and coastal flooding impacts. The data and maps in this report illustrate the scale of potential flooding, not the exact location. The inundation areas depicted in the Sea Level Rise analysis are not as precise as they may appear. The data, maps, and information provided should be used only as a screening-level tool for management decisions.

The mapping does not incorporate future changes in coastal geomorphology and assumes present conditions will persist, which will not be the case. The digital elevation model used to map sea level rise does not incorporate a detailed pipe network analysis. The Florida Department of Transportation Sea Level Rise Sketch Tool was designed for use at the statewide and regional scale. The 5-meter horizontal resolution of the statewide and regional DEMs limits the granularity of the analysis. This level of resolution does not provide local and site-specific features such as roadway and bridge elevations, gullies, ditches, dikes, and levees. Also, the selection procedure and the small scale of analysis may in some cases overestimate the affected infrastructure.

Applied at the appropriate scale, the errors discussed above, while potentially significant, do not diminish from the utility of the data as a useful statewide and regional indicator of potentially vulnerable infrastructure under various SLC and tidal scenarios.

The entire risk associated with the results and performance of these data is assumed by the user. There is not 100% confidence in the elevation data and/or mapping process. It is important not to focus on the exact extent of inundation, but rather to examine the level of confidence that the extent of inundation is accurate.

Satellite Beach Hazard Analysis

Overview of Hazards and Methodology

The hazard analysis portion of this report utilizes hazard-specific data to determine the short and long-term vulnerabilities facing the residents and critical infrastructure within the City of Satellite Beach. The following hazards were analyzed in terms of their impacts on the City of Satellite Beach, Florida.

- **Storm Surge**
- **Flooding**
- **Coastal Erosion**
- **Sea Level Rise**

Utilizing Geographic Information System (GIS) data provided by Brevard County GIS, the Brevard County Property Appraiser's Office, the National Oceanic and Atmospheric Administration (NOAA), HAZUS and the Federal Emergency Management Agency (FEMA), the project team was able to determine vulnerabilities from five perspectives:

1. **Financial Exposure**: The financial exposure hazard analysis determines the total land value, building value, assessed property value and taxable property value located within each hazard zone. For example, for the Category 1 Hurricane Storm Surge zone, the financial exposure analysis determines the cumulative financial values of all parcels located partially or entirely within the Category 1 Storm Surge Zone.
2. **Exposure to Built Parcels by Build Year**: This analysis summarizes the build year of all parcels within all hazard zones by decade. With this analysis, the City can guage the number of parcels within each hazard zone that may have been constructed before critical building code or infrastructure ordinances, further expanding the detail provided within the financial exposure analysis.
3. **Land Use Exposure**: The land use exposure analysis summarizes the land uses of all parcels located within all hazard zones identified in the hazard analysis. The land uses analyzed include Low Density Residential, Medium/High Density Residential, Commercial of Office, Industrial, Institutional (or Publicly-Owned) and Recreational.
4. **Critical Facility Exposure**: This matrix details the hazard zones that each critical facility within the City of Satellite Beach is located in, utilizing the four hazards identified above.
5. **Environmental and Ecological Exposure**: This analysis determines the critical ecological and environmental areas located within each hazard zone identified within this report.

Storm Surge

Hazard Description and Overview

Storm surge is defined as the increase in water level along a shoreline during wind and wave-induced storm events. Storm surge typically occurs when there are low atmospheric pressure levels, which is typical of Tropical Storm and Hurricane events. Relative to tidal norms for a particular geographic area, storm surge is measured as the "difference of the observed water level minus the predicted tide", thus becoming more severe during higher tides (Source: Brevard LMS 2015). While Satellite Beach does not have a bay, which could increase the effects of storm surge, the City is located between to two water bodies (the Indian River Lagoon and the Atlantic Ocean) which increases the risk from a community-wide perspective.

Exposure Analysis

Satellite Beach is located on a barrier island of Brevard County, Florida, an elongated peninsular feature that would become completely inundated under Category 5 Hurricane Conditions. The western portion of the City of Satellite Beach is at the highest risk for storm surge damage, as all of the parcels located adjacent to the Indian River Lagoon are within the Category 1 Hurricane Storm Surge Zone. Moreover, more than 50% of parcels located in the western portion of the City are located within the Category 2 Hurricane Storm Surge zone. This portion of the City includes State Highway 513, a roadway that could be completely inundated from the northern city limit, south to the Desoto Parkway.

While the eastern portion of the city (fronting the Atlantic Ocean) is not as susceptible to low grade storm surge damage due to the ridge system, many parcels adjacent to State Highway A1A are located within the Category 3 Storm Surge Zone. Additionally, more than 90% of the parcels located north of Jackson Avenue that are adjacent to the Atlantic Ocean could be considerably inundated in the event of a Category 1, 2 or 3 Hurricane. The Category 3 Storm Surge Zone encompasses more than 99% of the total taxable value within the City.

Pictured: Hurricane-induced Storm Surge takes its toll on the Satellite Beach shoreline (Source: Palm Beach Post)

TABLE 1: 2014 Satellite Beach Parcel Exposure to Storm Surge Zones

Financial Exposure to Hazard Zones – ***Cumulative*** *Financial Values within Zones (*Built % of Built Parcels in Specific Hazard Zone)*

Hazard Zone	Parcels in Zone	Built Parcels*	Land Value	Building Value	Assessed Value	Taxable Value
Category 1	*323* *7.2%*	*283* *87.6% built*	*$72, 739,510*	*$54,239,780*	*$181,378,740*	*$131,356,490*
Category 2	*1,904* *42.5%*	*1,636* *85.9% built*	*$168,511,090*	*$172,305,380*	*$561,803,770*	*$351,630,330*
Category 3	*4,455* *99.4%*	*4,007* *89.9% built*	*$324,793,540*	*$379,398,120*	*$993,705,020*	*$634,952,640*
Category 4	*4,480* *100.0%*	*4,026* *89.9% built*	*$327,668,670*	*$382,240,860*	*$999,306,190*	*$639,261,090*
Category 5	*4,480* *100.0%*	*4,026* *89.9% built*	*$327,668,670*	*$382,240,860*	*$999,306,190*	*$639,261,090*

Build-Year Summary of Built Parcels within Hazard Zones – *Build Year Breakdown by Hazard Zone*

Hazard Zone	Built Parcels	Built Pre-1970*	Built 1970-1979	Built 1980-1989	Built 1990-1999	Built 2000-2014
Category 1	*283*	*66 Parcels* *23.3% of built within Cat. 1*	*63 Parcels* *22.3% of built within Cat. 1*	*92 Parcels* *32.5% of built within Cat. 1*	*15 Parcels* *5.3% of built within Cat. 1*	*47 Parcels* *16.6% of built within Cat. 1*
Category 2	*1,636*	*662 Parcels* *40.5% of built within Cat. 2*	*367 Parcels* *22.4% of built within Cat. 2*	*347 Parcels* *21.2% of built within Cat. 2*	*116 Parcels* *7.1% of built within Cat. 2*	*144 Parcels* *8.8% of built within Cat. 2*
Category 3	*4,007*	*1,602 Parcels* *40.0% of built within Cat. 3*	*1,193 Parcels* *29.8% of built within Cat. 3*	*657 Parcels* *16.4% of built within Cat. 3*	*160 Parcels* *4.0% of built within Cat. 3*	*395 Parcels* *9.9% of built within Cat. 3*
Category 4	*4,026*	*1,609 Parcels* *40.0% of built within Cat. 4*	*1,194 Parcels* *29.7% of built within Cat. 4*	*661 Parcels* *16.4% of built within Cat. 4*	*164 Parcels* *4.1% of built within Cat. 4*	*398 Parcels* *9.9% of built within Cat. 4*
Category 5	*4,026*	*1,609 Parcels* *40.0% of built within Cat. 5*	*1,194 Parcels* *29.7% of built within Cat. 5*	*661 Parcels* *16.4% of built within Cat. 5*	*164 Parcels* *4.1% of built within Cat. 5*	*398 Parcels* *9.9% of built within Cat. 5*

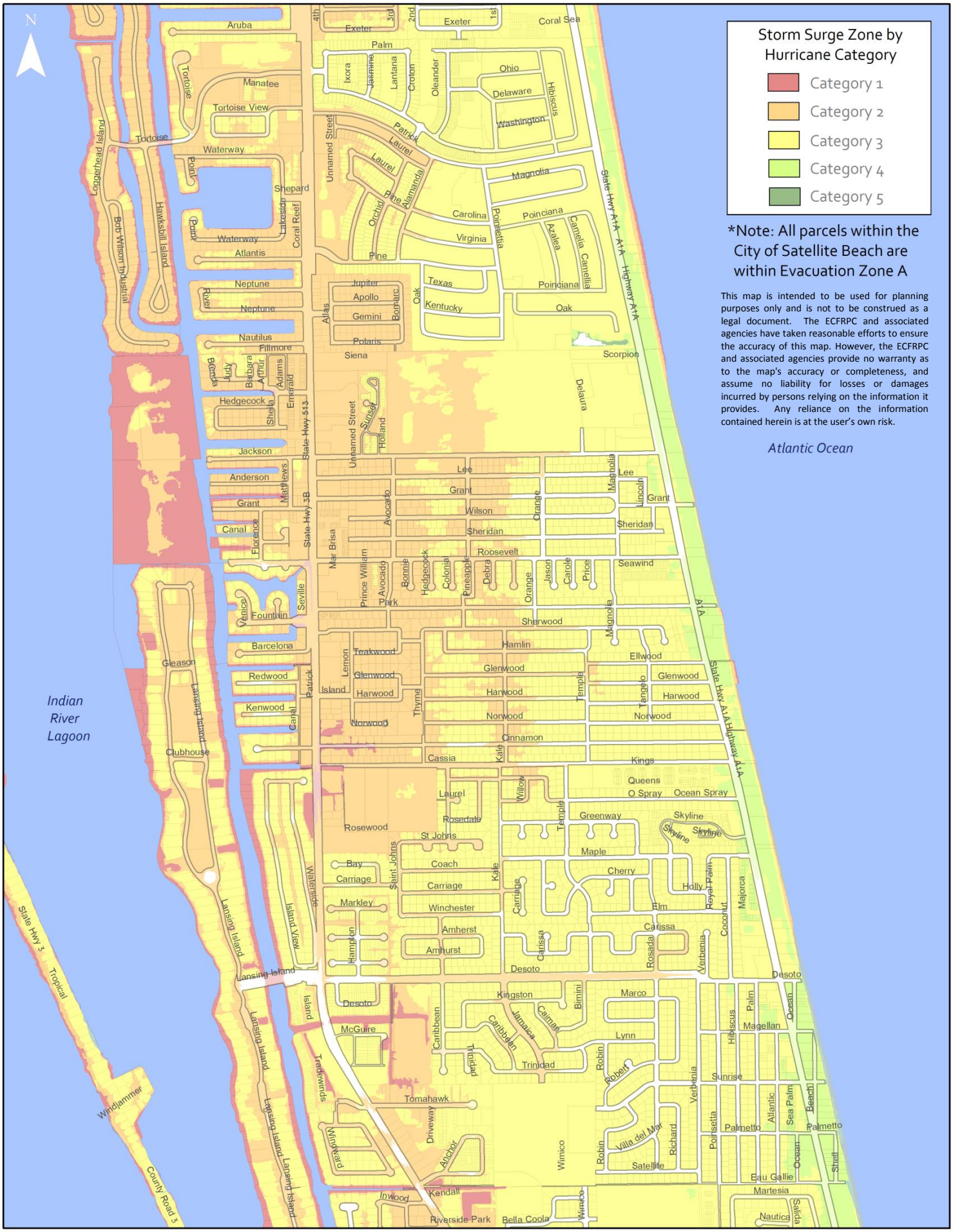
Future Land Use Summary of Parcels within Hazard Zones – *Number of Parcels Per Land Use (Built and Non-Built)*

Hazard Zone	Low Density Residential	Med/Hi. Density Residential	Commercial and Office	Industrial	Institutional	Recreational
Category 1	*291*	*16*	*8*	*0*	*2*	*5*
Category 2	*1,485*	*355*	*38*	*1*	*11*	*10*
Category 3	*3,589*	*735*	*99*	*2*	*15*	*11*
Category 4	*3,589*	*758*	*100*	*2*	*15*	*12*
Category 5	*3,589*	*758*	*100*	*2*	*15*	*12*

Source(s): NOAA (SLOSH), Brevard County GIS/Property Appraiser (2014), ECFRPC (FLU)

Note: All Storm Surge Zones are cumulative (ex: Category 3 zone includes Zone 1, Zone 2 and Zone 3 parcels)
All transportation networks depicted in white are located within the Category 3 Zone

Satellite Beach, Florida - Storm Surge Zones by Hurricane Category



Source(s): ECFRPC, Brevard County GIS, NOAA (SLOSH)

Flooding

Hazard Description and Overview

Flooding is defined as "the inundation of a normally dry area caused by an increased water level in an established watercourse, such as a river, stream, drainage ditch, or ponding of water at or near the point where the rain fell" (Source: Brevard County LMS, 2015).

The Federal Emergency Management Agency (FEMA) produces Flood Insurance Rate Maps (FIRM), which, through LIDAR topographic imagery, measures the lands that would be inundated by the average "100-year storm". 100-year storms are based on historical weather data and are meant to be statistically relevant to a defined geographical area, typically a County or Parrish.

Flooding is one of Florida's most notable hazards, and can occur during thunderstorm conditions triggered by tropical cyclones or low pressure systems moving slowly over the Florida peninsula. Melbourne, Florida, which is located near Satellite Beach, has an average of 116 rain days and 52.0 inches of rain per year, which are both significant figures from a regional (Southeastern United States) and national perspective (Source: National Climatic Data Center, 2014). The East Central Florida region is susceptible to inland-flooding due to its low, gently rising topography.

Most of the flooding events that occur in Florida are defined as "short duration flooding events", or flash flooding events. These storm events are defined by short periods of significant rainfall that can quickly inundate once-dry areas (Source: Brevard County LMS, 2015). Insufficient storm water systems with high rain fall rates can impact flooding potential and increase vulnerability and risk.

Desoto Parkway in the City of Satellite Beach is primarily susceptible to flooding from rainfall. (Source: City of Satellite Beach).

Exposure Analysis

While the 100-year floodplain only affects parcels within Satellite Beach that are located adjacent to the Atlantic Ocean or the Indian River Lagoon, these parcels are among the highest-valued within Satellite Beach, increasing financial risk relative to the other forms of risk measured in this report.

Parcels located along the Atlantic Ocean are primarily exposed to the "VE" Flood Zone, which the Federal Emergency Management Agency defines as "Areas subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action (Source: FEMA). By contrast, parcels located adjacent to the Indian River Lagoon are located within the "AE" Flood Zone, which is not caused by velocity wave action. The 100-year floodplain does not cross west of State Road A1A or east State Road 513. Although the city does not have a large area within the floodplain, the City is currently experiencing flooding, particularly roadway, outside of these designated 100-year floodplain areas.

The taxable value of the properties within the 100-year flood hazard zone account for 33.5% of the total taxable value of all properties within the City of Satellite Beach.

TABLE 2: 2014 Satellite Beach Parcel Exposure to FEMA 100-Year Flood Hazard Zones

Financial Exposure to Hazard Zones – *Cumulative Financial Values within Zones (*Built % of Built Parcels in Specific Hazard Zone)*

Hazard Zone	Parcels in Zone	Built Parcels	Land Value	Building Value	Assessed Value	Taxable Value
Zone AE (100 year)	*265 5.9%*	*236 89.1% built*	*$56,506,630*	*$48,453,630*	*$118,055,870*	*$90,392,920*
Zone VE (100 year)	*73 1.6%*	*48 65.8% built*	*$28,134,670*	*$6,092,670*	*$166,881,580*	*$123,706,880*

Build-Year Summary of Built Parcels within Hazard Zones – *Build Year Breakdown by Hazard Zone*

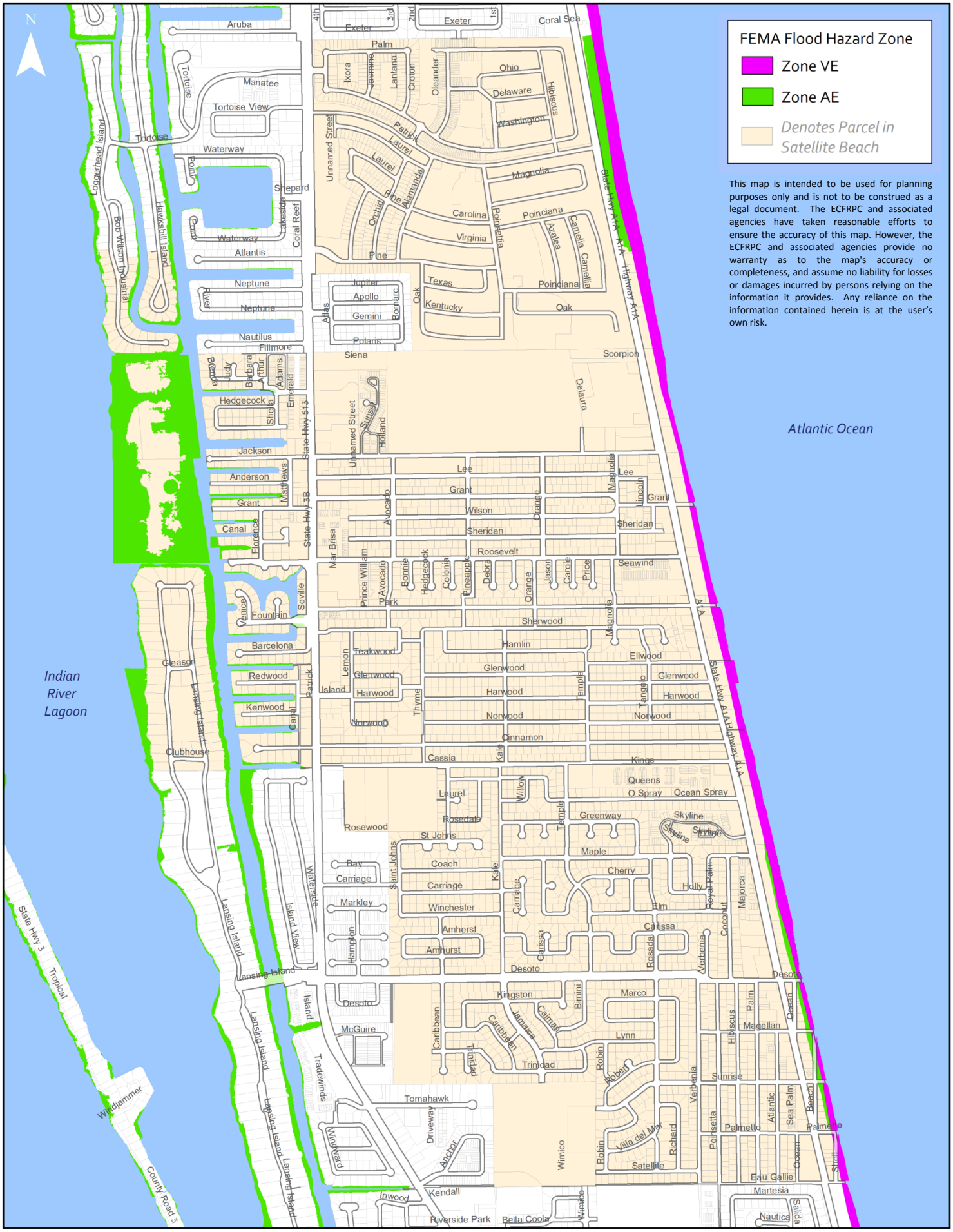
Hazard Zone	Built Parcels	Built Pre-1970	Built 1970-1979	Built 1980-1989	Built 1990-1999	Built 2000-2014
Zone AE (100 year)	*236*	*51 Parcels 21.6% of built within Zone AE*	*53 Parcels 22.5% of built within Zone AE*	*81 Parcels 34.3% of built within Zone AE*	*13 Parcels 5.5% of built within Zone AE*	*38 Parcels 16.1% of built within Zone AE*
Zone VE (100 year)	*48*	*10 Parcels 20.8% of built within Zone VE*	*5 Parcels 10.4% of built within Zone VE*	*15 Parcels 31.2% of built within Zone VE*	*6 Parcels 12.5% of built within Zone VE*	*12 Parcels 25.0% of built within Zone VE*

Future Land Use Summary of Parcels within Hazard Zones – *Number of Parcels Per Land Use (Built and Non-Built)*

Hazard Zone	Low Density Residential	Med/Hi. Density Residential	Commercial and Office	Industrial	Institutional	Recreational
Zone AE (100 year)	*259*	*1*	*0*	*1*	*1*	*3*
Zone VE (100 year)	*0*	*64*	*0*	*0*	*0*	*5*

Source(s): FEMA (DFIRM 2011), Brevard County GIS/Property Appraiser (2014), ECFRPC (FLU)

Satellite Beach, Florida - 100 Year Flood Hazard Zone



Source(s): ECFRPC, Brevard County GIS, FEMA (2011)

0 0.125 0.25 0.5 0.75 1 Miles

Coastal Erosion

Hazard Description and Overview

As defined in the 2015 Brevard County Local Mitigation Strategy, coastal erosion is "the wearing away of land by the action of natural forces embodied in waves, water currents and wind". Typical outcomes of coastal erosion include the depletion of dune systems, which can be seen in the image at the bottom of this page, as well as damage to water-front properties and infrastructure. Additionally, coastal erosion can occur along streams, canals, drainage ditches and rivers, which can effect inland properties.

Coastal erosion caused millions of dollars in damage in Florida during the 2004 hurricane season and initiated a major dune maintenance project in Satellite Beach and other Brevard County municipalities that was completed in 2007. This project, named the 2005 Emergency Dune Stabilization Project, provided extensive buffering to the dune systems within Brevard County. In response to erosion caused by Hurricane Sandy, the Brevard County Board of County Commissioners approved funding for a full-scale dune restoration project. This project is located in the 7.8 mile Mid Reach between Patrick AFB and Flug Avenue (Indialantic) and includes placing 195,863 cubic yards of sand on Mid Reach beaches between December, 2013 and March, 2014.

However, as noted in the 2015 Brevard County Local Mitigation strategy, "the probability of future erosion along the Brevard County coastline is "considerably likely", so many of the mitigation actions taken to prevent property loss to these types of events are inevitably short to medium-term mitigation strategies. However, these initiatives are needed, as a substantially damaged dune system – such as the one seen in Brevard County in 2004 – can lead to ecological and economic impacts.

Coastal erosion is at its worst during tropical cyclone scenarios and can be substantially devastating when paired with the effects of wind and wave-induced storm surge.

Above: Coastal erosion along the shores of Satellite Beach from Hurricane Jeanne - 2004.
(Source: Orlando Sentinel)

Exposure Analysis

The City of Satellite Beach has approximately 14,953 linear feet (2.83 miles) of coastline along the Atlantic Ocean, comprising of 76 parcels with a cumulative assessed property value of $64,206,150. Of these parcels, 67 are classified as medium or high density residential, while five parcels have recreational land uses. Moreover, of the 51 built parcels (approximately 2/3 of all waterfront parcels in Satellite Beach); more than one-quarter were built before the 1970, increasing infrastructure concerns. In addition, 4 conservation parcels are located in this zone (not classified in the table below).

Adding to the impacts posed by coastal erosion within the City are the disproportionately-high values of the properties adjacent to the Atlantic Ocean. The 76 parent parcels located along the Atlantic Ocean within Satellite Beach have an average assessed property value of $844,817, or more than 400% greater than the average city-wide assessed property value of $198,644. This is a significant disproportionality that dramatically heightens the financial risk to coastal erosion within the City of Satellite Beach. The taxable value of these properties (including individual condos) accounts for approximately 20% of the total taxable value of all properties within the City of Satellite Beach. While the coastal erosion GIS analysis did not take into account the parcels located along the canal systems in the western portion of the City, these parcels could be susceptible to coastal erosion if combined with the effects of storm surge. For an analysis of these parcels, please reference the storm surge hazard analysis section of this report.

TABLE 3: 2014 Satellite Beach Parcel Exposure to Coastal Erosion Hazard Zones

Financial Exposure to Hazard Zones – *Cumulative Financial Values within Zones*

Hazard Zone	Parcels in Zone	Built Parcels	Land Value	Building Value	Assessed Value	Taxable Value
Parcels Adjacent to Erosion Zone	*76* *1.7%*	*51* *67.1% built adjacent to erosion zone*	*$27,738,510*	*$5,857,630*	*$168,612,910*	*$129,442,010*

Build-Year Summary of Built Parcels within Hazard Zones – *Build Year Breakdown by Hazard Zone*

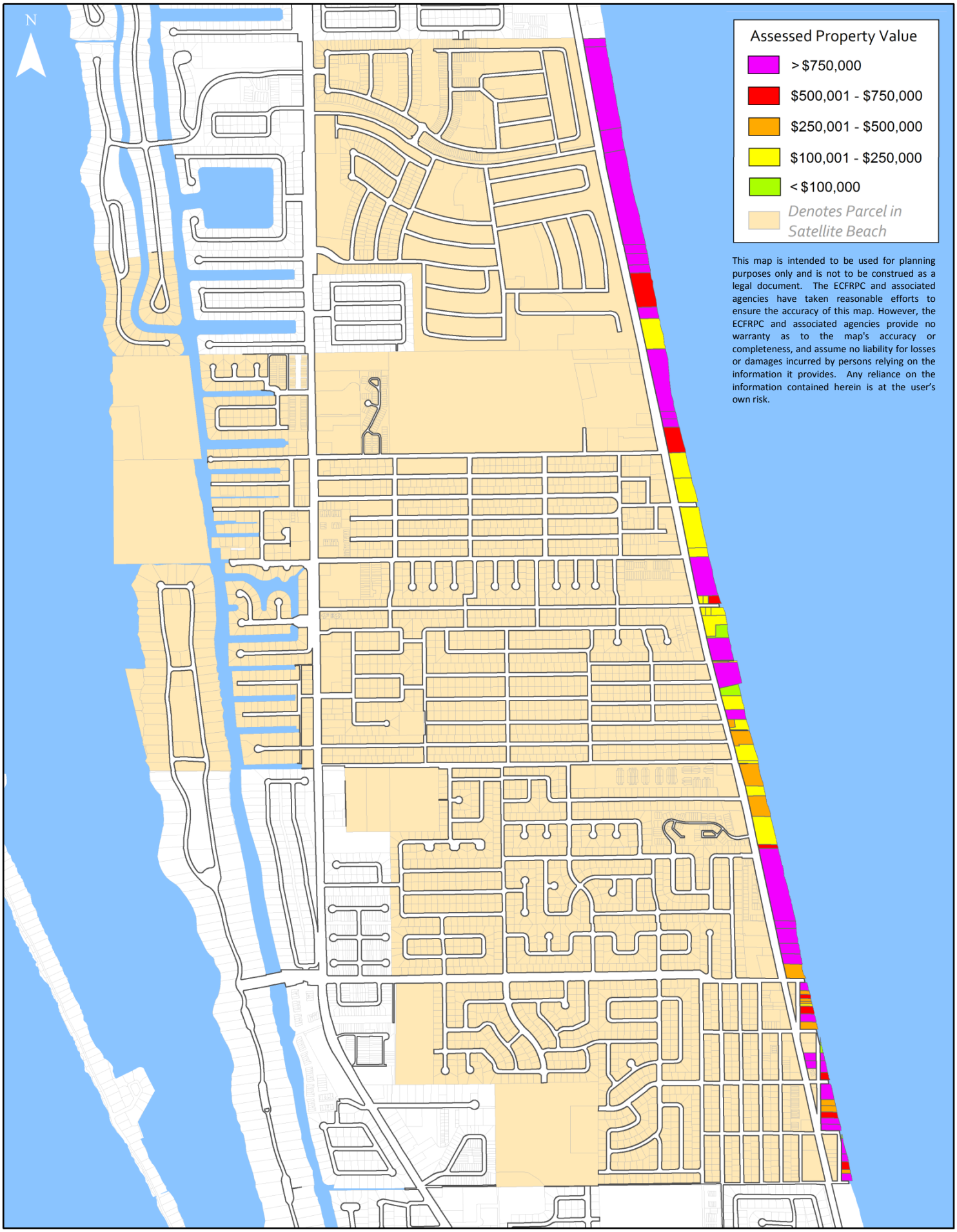
Hazard Zone	Built Parcels	Built Pre-1970	Built 1970-1979	Built 1980-1989	Built 1990-1999	Built 2000-2014
Parcels Adjacent to Erosion Zone	*51*	*14 Parcels* *27.5% of built adjacent to erosion zone*	*5 Parcels* *9.8% of built adjacent to erosion zone*	*15 Parcels* *29.4% of built adjacent to erosion zone*	*6 Parcels* *11.8% of built adjacent to erosion zone*	*11 Parcels* *21.6% of built adjacent to erosion zone*

Future Land Use Summary of Parcels within Hazard Zones – *Number of Parcels Per Land Use (Built and Non-Built)*

Hazard Zone	Low Density Residential	Med/Hi. Density Residential	Commercial and Office	Industrial	Institutional	Recreational
Parcels Adjacent to Erosion Zone	*0*	*67*	*0*	*0*	*0*	*5*

Source(s): Brevard County GIS/Property Appraiser (2014), ECFRPC (FLU)
Note: There are 535 condos located on parcels within the coastal erosion hazard zone
The four (4) conservation properties are not shown in the table due to classification

Property Values of Parcels Adjacent to Coastal Erosion Zone



Source(s): ECFRPC, Brevard County GIS, NOAA

Sea Level Rise

Hazard Description and Overview

Sea level rise includes the long term hydrologic, atmospheric and geographic effects of rising seas as caused by climate change. While there is a debate as to the rate at which sea level rise is impacting the Earth's surface, historical trends and data support the notion that many locales are experiencing higher water levels. This is especially true when looking at historical data collected for the state of Florida.

The FDOT Sea Level Rise Sketch Tool was utilized to analyze the impacts of sea level rise on the City of Satellite Beach. This tool was developed by University of Florida GeoPlan Center for the Florida Department of Transportation. This tool utilizes the Army Corps of Engineers low, intermediate and high projects. For additional information on the model itself, visit http://sls.geoplan.ufl.edu/about.

To account for differences in daily tides in the Indian River Lagoon and the Atlantic Ocean, the sea level rise model was run to account for the effects on the lagoon side separately from the effects on the Atlantic side. Due to the nominal daily tides within the Indian River Lagoon, sea level rise relative to the NAVD88 vertical datum for Mean Annual High Water (MAHW) was utilized while sea level rise relative to NAVD88 from Mean Higher High Water (MHHW) on the Atlantic was modeled. The Army Corps of Engineers low, intermediate and high projections for years 2040, 2070 and 2100 were modeled on both water bodies. A full methodology describing the steps to model the lagoon side can be found in Appendix I of this report. The table below describes the level of inundation for each scenario.

Modeled Projections

***Based on Army Corps of Engineers Sea Level Rise Projections*
***All projections measured at years 2040, 2070, 2100 relative to NAVD88 vertical datum*
***Inundation levels are considered the water level after the sea level rise amount is added on top of MAHW/MHHW and then converted to NAVD88.*

1) **Low ACOE Projection** *(relative to NAVD88)*

- 2040: **36** inch inundation using MHHW (Atlantic), **9** inch inundation using MAHW (Lagoon)
- 2070: **39** inch inundation using MHHW (Atlantic), **12** inch inundation using MAHW (Lagoon)
- 2100: **41** inch inundation using MHHW (Atlantic), **14** inch inundation using MAHW (Lagoon)

2) **Intermediate ACOE Projection** *(relative to NAVD88)*

- 2040: **38** inch inundation using MHHW (Atlantic), **11** inch inundation using MAHW (Lagoon)
- 2070: **45** inch inundation using MHHW (Atlantic), **18** inch inundation using MAHW (Lagoon)
- 2100: **54** inch inundation using MHHW (Atlantic), **27** inch inundation using MAHW (Lagoon)

3) **High ACOE Projection** *(relative to NAVD88)*

- 2040: **46** inch inundation using MHHW (Atlantic), **19** inch inundation using MAHW (Lagoon)
- 2070: **66** inch inundation using MHHW (Atlantic), **39** inch inundation using MAHW (Lagoon)
- 2100: **93** inch inundation using MHHW (Atlantic), **66** inch inundation using MAHW (Lagoon)

The tables and maps within this analysis reflect the inundation levels from a land use, financial and building perspective of the Low, Intermediate and High sea level rise projections for the years 2040, 2070 and 2100 as determined by the U.S. Army Corps of Engineers. The maps provide a visual depiction of the summary data.

Low ACOE Curve Exposure Analysis

TABLE 4: 2014 Satellite Beach Parcel Exposure to Low Curve Sea Level Rise Projections (ACOE)

Financial Exposure to Hazard Zones – *Cumulative Financial Values within Zones*

Year	Parcels in Zone	Built Parcels	Land Value	Building Value	Assessed Value	Taxable Value
2040	*199* *4.4%*	*167* *83.9% built*	*$56,235,130*	*$39,529,200*	*$129,945,730*	*$93,084,110*
2070	*225* *5.0%*	*192* *85.3% built*	*$60,437,410*	*$43,116,260*	*$137,849,020*	*$98,336,580*
2100	*245* *5.5%*	*212* *86.5% built*	*$65,880,160*	*$45,772,200*	*$148,795,800*	*$103,059,050*

Build-Year Summary of Built Parcels within Hazard Zones – *Build Year Breakdown by Hazard Zone*

Year	Built Parcels	Built Pre-1970	Built 1970-1979	Built 1980-1989	Built 1990-1999	Built 2000-2014
2040	*167*	*23 Parcels* *13.8% of built in 2040 Zone*	*31 Parcels* *18.6% of built in 2040 Zone*	*55 Parcels* *32.9% of built in 2040 Zone*	*19 Parcels* *11.4% of built in 2040 Zone*	*39 Parcels* *23.4% of built in 2040 Zone*
2070	*192*	*29 Parcels* *15.1% of built in 2070 Zone*	*43 Parcels* *22.4% of built in 2070 Zone*	*59 Parcels* *30.7% of built in 2070 Zone*	*21 Parcels* *10.9% of built in 2070 Zone*	*40 Parcels* *20.8% of built in 2070 Zone*
2100	*212*	*35 Parcels* *16.5% of built in 2100 Zone*	*50 Parcels* *23.6% of built in 2100 Zone*	*64 Parcels* *30.2% of built in 2100 Zone*	*21 Parcels* *9.9% of built in 2100 Zone*	*42 Parcels* *19.8% of built in 2100 Zone*

Future Land Use Summary of Parcels within Hazard Zones – *Number of Parcels Per Land Use (Built and Non-Built)*

Year	Low Density Residential	Med/Hi. Density Residential	Commercial and Office	Industrial	Institutional	Agricultural
2040	*184*	*9*	*0*	*0*	*1*	*0*
2070	*209*	*9*	*0*	*0*	*1*	*0*
2100	*228*	*9*	*0*	*0*	*1*	*0*

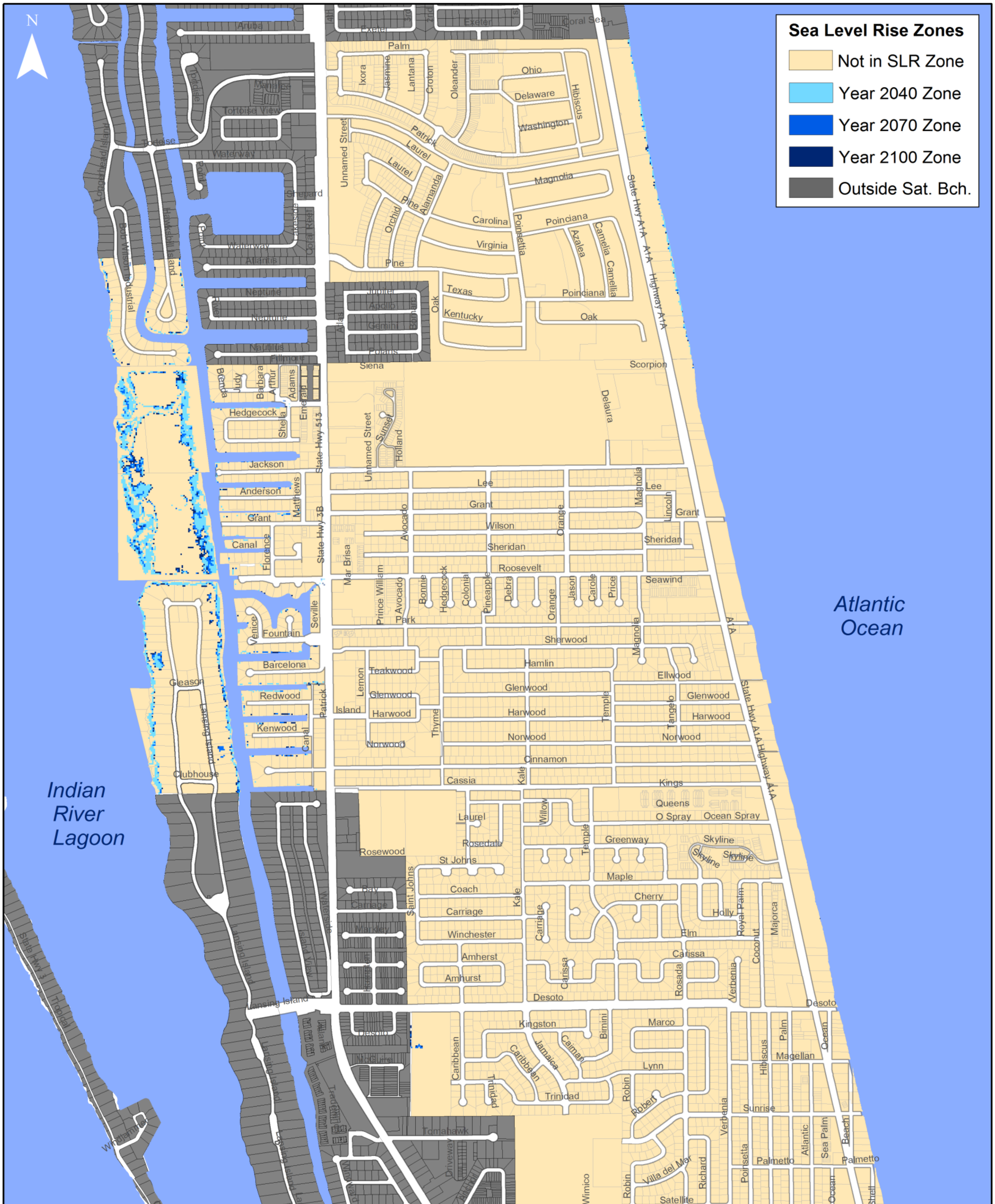
Source(s): FDOT SLR Sketch Tool (2014, Brevard County GIS/Property Appraiser (2014), ECFRPC (FLU)

The “Low” Army Corps of Engineers sea level rise projections estimate a 9-36 inch, 12-39 inch, and 14-41 inch inundation for the 2040, 2070 and 2100 time periods for the Indian River Lagoon (measured from MAHW) and Atlantic Ocean (measured from MHHW) sides of the city, *respectively*.

This level of inundation would primarily affect parcels located on the western portion of the city, as the topographic elements of the dune system and uplands adjacent to the Atlantic Ocean in Satellite Beach provide protection from the effects of sea level rise. The only areas of the city exposed to sea level rise using this scenario are located west of State Highway 513 (South Patrick Drive), with most exposure located adjacent to the Indian River Lagoon or its system of interconnected canal systems. The table below summarizes the financial, land use and building-specific vulnerability to the “Low” Army Corps of Engineers sea level rise projections.

Norfolk's Colonial Place neighborhood as high tide approaches during a nor'easter Friday, Nov. 13, 2009. (Source: Hampton Roads -Stephen M. Katz | Virginian-Pilot file photo)

Simulation of Low Projection Rate Curve – Sea Level Rise



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Source(s): ECFRPC, Brevard County GIS, FDOT, UF GeoPlan Center

0 0.125 0.25 0.5 0.75 1 Miles

Intermediate ACOE Curve Exposure Analysis

The "Intermediate" Army Corps of Engineers sea level rise projections estimate a 11-38 inch, 18-45 inch, and 27-54 inch inundation for the 2040, 2070 and 2100 time periods for the Indian River Lagoon (measured from MAHW) and Atlantic Ocean (measured from MHHW) sides of the city, *respectively*.

This scenario would primarily affect the western portion of the city, with increasing impacts to the beach in the northern portion of the city at an earlier time frame than the "Low" Curve. Also, areas east of State Highway 513 may begin to be affected, primarily in the 2070 to 2100 year range. Partial inundation could occur during the 2070 to 2100 time frames along a limited number of transportation networks, including the heavily-traveled State Highway 513 (South Patrick Drive), Cassia Boulevard (near multiple public and critical facilities) as well as Cinnamon Drive. This model depicts a higher rate of inundation post 2040 thus impacting a larger portion of the city in the 2070 and 2100 scenarios.

TABLE 5: 2014 Satellite Beach Parcel Exposure to Intermediate Curve Sea Level Rise Projections (ACOE)

Financial Exposure to Hazard Zones – *Cumulative Financial Values within Zones*

Year	Parcels in Zone	Built Parcels	Land Value	Building Value	Assessed Value	Taxable Value
2040	*249* *5.6%*	*196* *78.7% built*	*$63,938,620*	*$46,915,460*	*$171,867,060*	*$103,270,410*
2070	*310* *6.9%*	*255* *82.3% built*	*$75,775,970*	*$54,454,550*	*$194,926,640*	*$116,724,620*
2100	*410* *9.2%*	*341* *83.2% built*	*$87,112,230*	*$67,924,630*	*$226,830,540*	*$133,910,070*

Build-Year Summary of Built Parcels within Hazard Zones – *Build Year Breakdown by Hazard Zone*

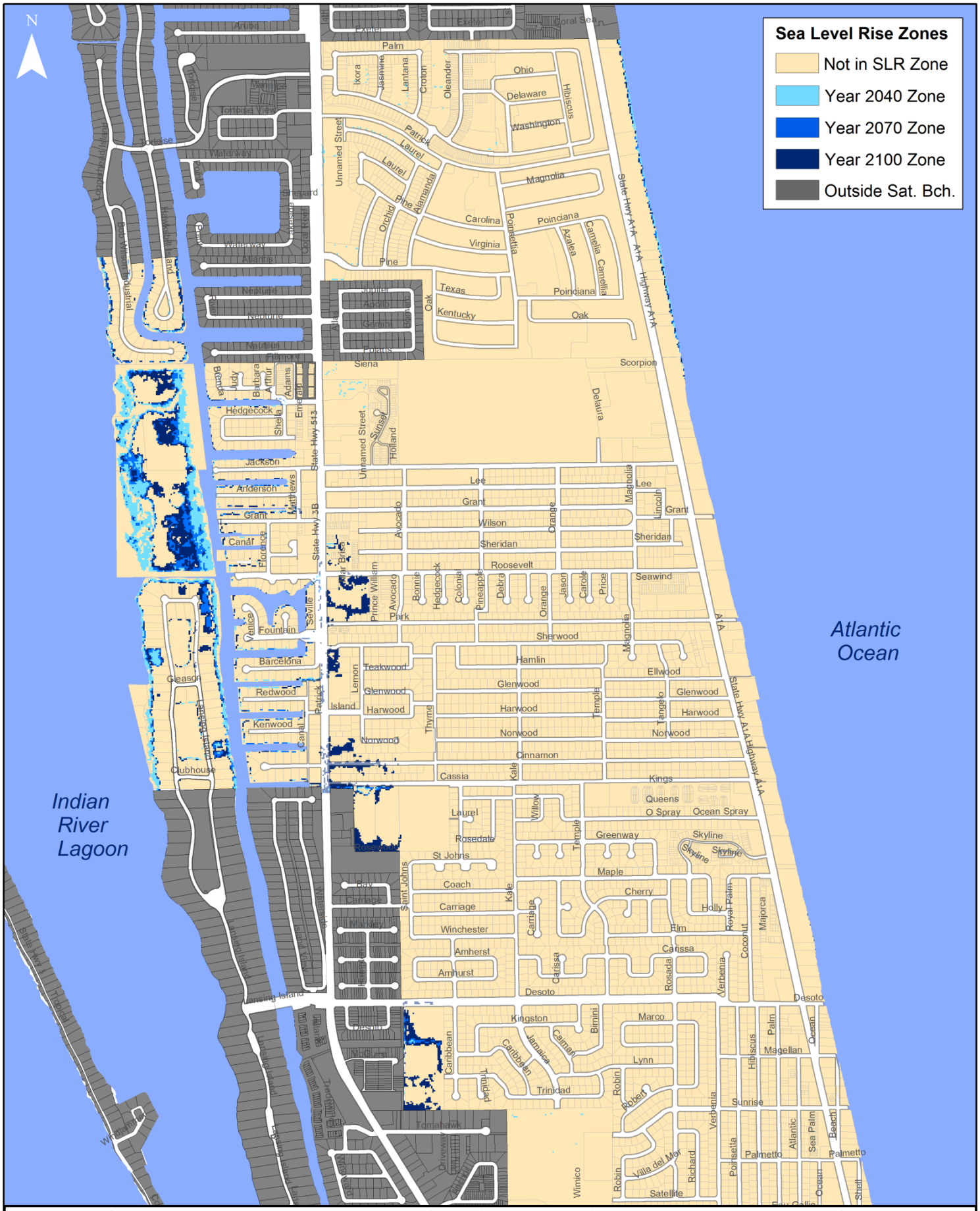
Year	Built Parcels	Built Pre-1970	Built 1970-1979	Built 1980-1989	Built 1990-1999	Built 2000-2014
2040	*196*	*26 Parcels* *13.3% of built in 2040 Zone*	*43 Parcels* *21.9% of built in 2040 Zone*	*58 Parcels* *29.6% of built in 2040 Zone*	*21 Parcels* *10.7% of built in 2040 Zone*	*48 Parcels* *24.5% of built in 2040 Zone*
2070	*255*	*44 Parcels* *17.3% of built in 2070 Zone*	*60 Parcels* *23.5% of built in 2070 Zone*	*76 Parcels* *29.8% of built in 2070 Zone*	*22 Parcels* *8.6% of built in 2070 Zone*	*53 Parcels* *20.8% of built in 2070 Zone*
2100	*341*	*68 Parcels* *19.9% of built in 2100 Zone*	*85 Parcels* *24.9% of built in 2100 Zone*	*94 Parcels* *27.6% of built in 2100 Zone*	*24 Parcels* *7.0% of built in 2100 Zone*	*70 Parcels* *20.5% of built in 2100 Zone*

Future Land Use Summary of Parcels within Hazard Zones – *Number of Parcels Per Land Use (Built and Non-Built)*

Year	Low Density Residential	Med/Hi. Density Residential	Commercial and Office	Industrial	Institutional	Agricultural
2040	*226*	*11*	*2*	*0*	*3*	*0*
2070	*285*	*11*	*3*	*0*	*3*	*0*
2100	*357*	*22*	*16*	*1*	*5*	*0*

Source(s): FDOT SLR Sketch Tool (2014, Brevard County GIS/Property Appraiser (2014), ECFRPC (FLU)

Simulation of Intermediate Projection Rate Curve – Sea Level Rise



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Source(s): ECFRPC, Brevard County GIS, FDOT, UF GeoPlan Center

High ACOE Curve Exposure Analysis

The "High" Army Corps of Engineers sea level rise projections estimate a 19-46 inch, 39-66 inch, and 66-93 inch rise in sea level for the 2040, 2070 and 2100 time periods for the Indian River Lagoon (measured from MAHW) and Atlantic Ocean (measured from MHHW) sides of the city, *respectively*.

As with the "Low" and "Intermediate" Army Corps of Engineers projections, this level of inundation would primarily affect land areas located on the western portion of the city; however, severe inundation could occur along beachfront properties in the northern portion of the city, as well as near Desoto Parkway. This scenario inundates a large portion of the city adjacent to and within 1 mile of the Indian River Lagoon, and completely inundates the South Patrick Drive corridor. Additionally, east-west roadways, including but not limited to Cassia Boulevard and Desoto Parkway, could be severely inundated in this scenario by 2070.

TABLE 6: 2014 Satellite Beach Parcel Exposure to High Curve Sea Level Rise Projections (ACOE)

Financial Exposure to Hazard Zones – *Cumulative Financial Values within Zones*

Year	Parcels in Zone	Built Parcels	Land Value	Building Value	Assessed Value	Taxable Value
2040	285 6.4%	250 87.7% built	$72,031,220	$51,568,020	$163,192,320	$111,298,580
2070	672 15.0%	595 88.5% built	$103,105,260	$91,504,860	$261,643,760	$173,717,010
2100	2,252 50.3%	1,975 87.7% built	$191,026,300	$203,302,030	$592,226,270	$364,876,880

Build-Year Summary of Built Parcels within Hazard Zones – *Build Year Breakdown by Hazard Zone*

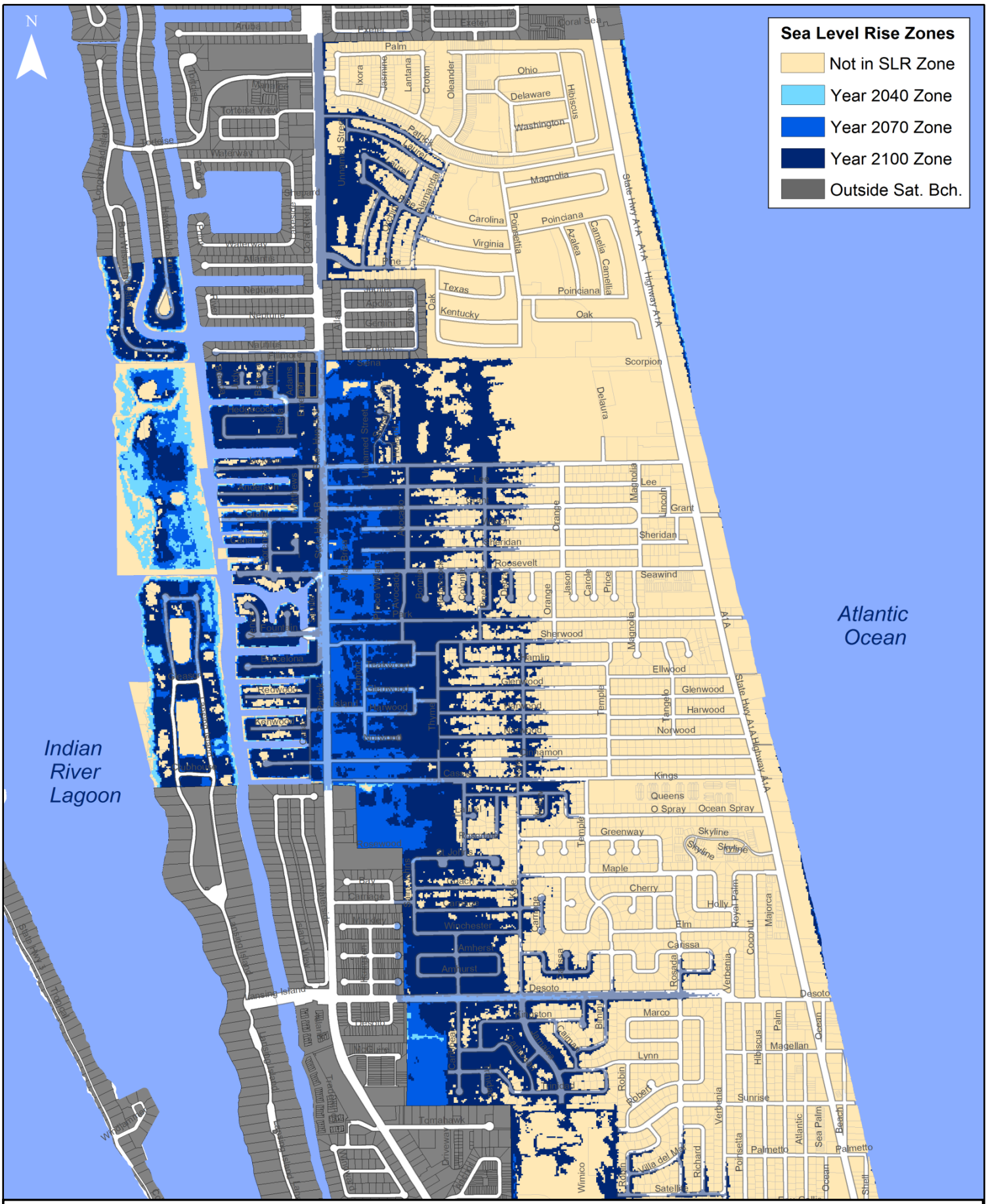
Year	Built Parcels	Built Pre-1970	Built 1970-1979	Built 1980-1989	Built 1990-1999	Built 2000-2014
2040	250	44 Parcels 17.6% of built in 2040 Zone	63 Parcels 25.2% of built in 2040 Zone	77 Parcels 30.8% of built in 2040 Zone	21 Parcels 8.4% of built in 2040 Zone	45 Parcels 18.0% of built in 2040 Zone
2070	595	177 Parcels 29.7% of built in 2070 Zone	148 Parcels 24.9% of built in 2070 Zone	133 Parcels 22.4% of built in 2070 Zone	48 Parcels 8.1% of built in 2070 Zone	89 Parcels 15.0% of built in 2070 Zone
2100	1,975	741 Parcels 37.5% of built in 2100 Zone	549 Parcels 27.8% of built in 2100 Zone	415 Parcels 21.0% of built in 2100 Zone	118 Parcels 6.0% of built in 2100 Zone	152 Parcels 7.7% of built in 2100 Zone

Future Land Use Summary of Parcels within Hazard Zones – *Number of Parcels Per Land Use (Built and Non-Built)*

Year	Low Density Residential	Med/Hi. Density Residential	Commercial and Office	Industrial	Institutional	Agricultural
2040	265	9	1	0	3	0
2070	507	110	35	1	9	0
2100	1,824	364	38	1	12	0

Source(s): FDOT SLR Sketch Tool (2014, Brevard County GIS/Property Appraiser (2014), ECFRPC (FLU)

Simulation of High Projection Rate Curve – Sea Level Rise



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Source(s): ECFRPC, Brevard County GIS, FDOT, UF GeoPlan Center

0 0.125 0.25 0.5 0.75 1 Miles

Critical Facility Vulnerability Analysis

Analysis of the effects of each natural hazard on the critical facilities within Satellite Beach

The Critical Facility Vulnerability Analysis outlines the hazard zone(s) (flooding, storm surge, coastal erosion and sea level rise) in which each of the City's critical facilities are either completely or partially located within.

Table 7. Critical Facility Exposure to Hazards

Critical Facility Exposure to Sea Level Rise Zones

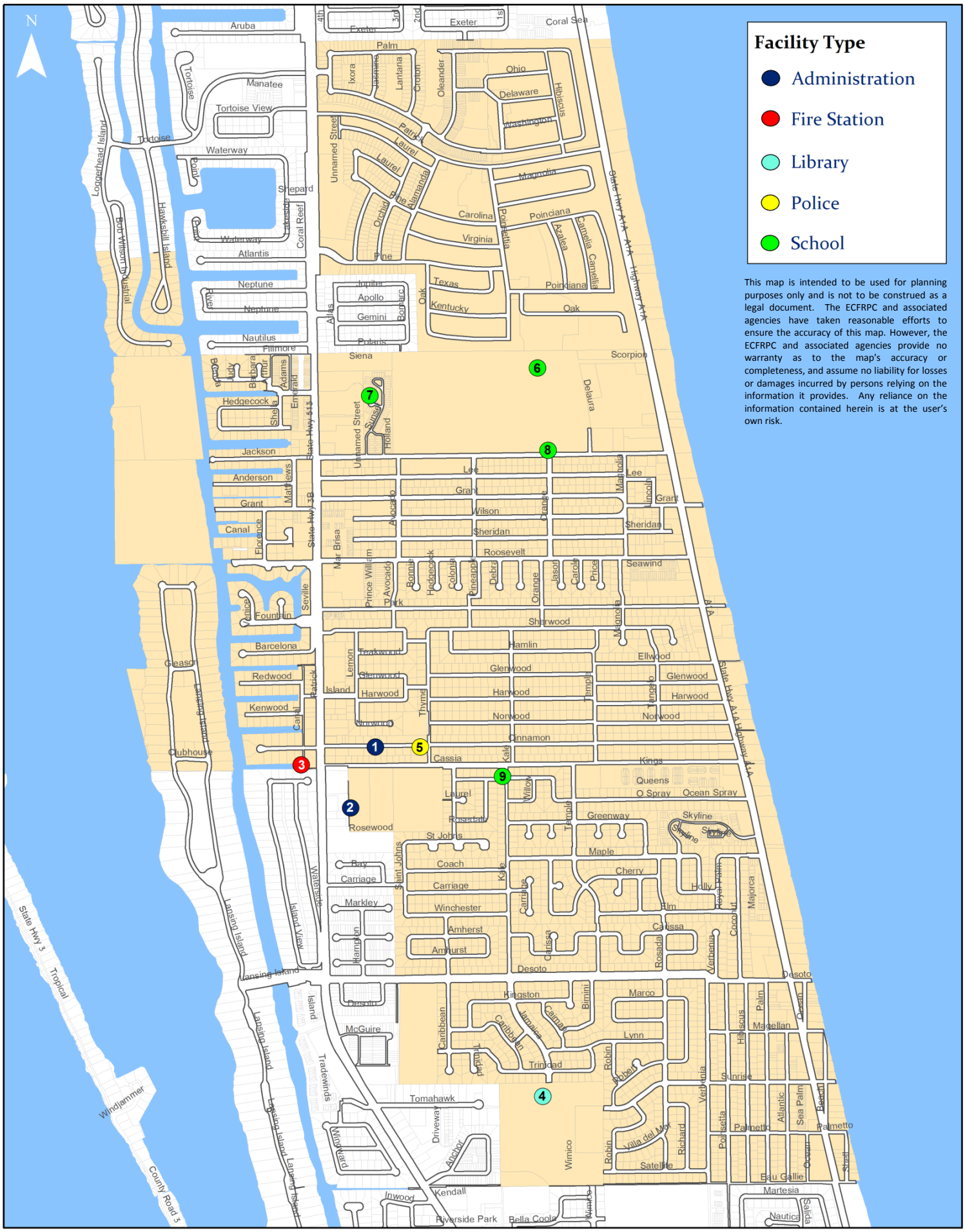
#	Facility Name	Type	Low SLR Inundation	Med SLR Inundation	High SLR Inundation
1	Public Works Building	Admin	None	2100	2070
2	City Hall	Admin	None	None	2070
3	Fire Department	Fire	None	None	None
4	Public Library	Library	None	None	None
5	Police Department	Police	None	None	2100
6	Satellite H.S	School	None	None	None
7	S.L. Holland E.S	School	None	None	2100
8	Delaura M.S	School	None	None	None
9	Surfside E.S.	School	None	None	2100

Critical Facility Exposure to Storm Surge, Flood and Erosion Zones

#	Facility Name	Type	Storm Surge Zone	Flood Zone (FIRM	Coastal Erosion Zone
1	Public Works Building	Admin	Category 1	X – 500 Year	Not Adjacent
2	City Hall	Admin	Category 2	X – 500 Year	Not Adjacent
3	Fire Department	Fire	Category 1	Zone AE	Not Adjacent
4	Public Library	Library	Category 3	X – 500 Year	Not Adjacent
5	Police Department	Police	Category 2	X – 500 Year	Not Adjacent
6	Satellite H.S	School	Category 3	X – 500 Year	Not Adjacent
7	S.L. Holland E.S	School	Category 3	X – 500 Year	Not Adjacent
8	Delaura M.S	School	Category 3	X – 500 Year	Not Adjacent
9	Surfside E.S.	School	Category 2	X – 500 Year	Not Adjacent

The map on the following page depicts the locations and types of critical facilities located within Satellite Beach, Florida.

Critical Facilities within Satellite Beach



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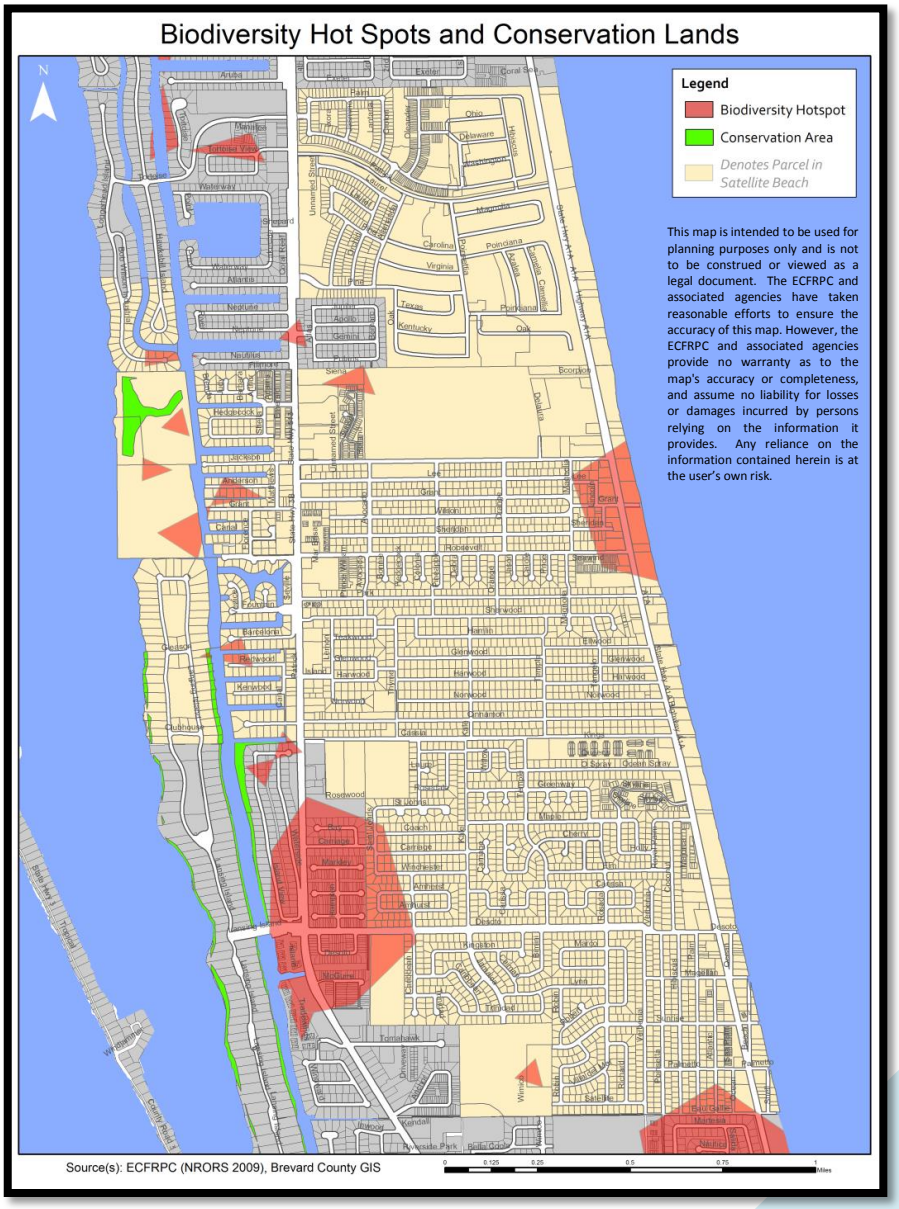
Source(s): ECFRPC, Brevard County GIS

Ecosystem Services – Environmental and Ecological Risk Analysis

Analysis of the Ecological and Environmental Effects of Sea Level Rise

Satellite Beach, like other barrier island communities located on the Indian River Lagoon, is home to diverse plant and animal life that could be impacted if environmental hazards threaten their natural ecosystems. Satellite Beach has a number of mangrove, salt-marsh and estuarine species located along the western portion of the city, while the eastern portion of the town has immense diversity of dune and beach-prone species. According to the Biodiversity Hotspot data from the Century Commission CLIPv1 Database (2009) which identifies areas of overlapping vertebrate species habitat thus indicating high species richness based upon the statewide potential habitat model created by The Florida Fish and Wildlife Conservation Commission, a number of bird species thrive within the interior portions of the city. Common animals and mammals found in this area of Florida include pileated woodpeckers, red shouldered hawks, barred owls, crested caracaras, the Florida sandhill crane and the Florida grasshopper sparrow, as well as sea life including numbers of species of sharks, fish, sea turtles, dolphins and manatees.

This map depicts the areas of 'committed conservation' as well as the areas identified as 'Biodiversity Hot Spots', or areas containing 8 to 13 different species of animals in one defined geographic location as identified in the ECFRPC's *Strategic Regional Policy Plan* in 2009.



Population Exposure by Natural Hazard and Hazard Zone

Analysis of the Ecological and Environmental Impacts of Sea Level Rise

The population vulnerability analysis identifies the vulnerable single family units (classified as "Low Density Residential") as well as condominium and multi-family units (classified as "Medium to High Density Residential") within the City of Satellite Beach. Population impacted by each of the natural hazard zones identified in this report was estimated by utilizing property data, in conjunction with Persons per Household, Demographics and Vacancy Rates data from the U.S. Census and the Office of Economic and Demographic Research (O.E.D.R).

The tables below summarize the results of this analysis. The methodology for deriving these figures can be found in Appendix II of this Report (Natural Hazard Exposure Methodology).

Storm Surge Exposure

TABLE 8: Satellite Beach Estimated Population Exposure to Storm Surge Zones

Population Exposure to Hazard Zones – *Storm Surge*

Zone	Residential Units in Zone	Estimated Population in Zone	Percent of Satellite Beach Population	Estimated Elderly Population (+65)
Category 1	*450*	***961***	*9.30%*	*195*
Category 2	*2,370*	***5,062***	*48.99%*	*1,028*
Category 3	*4,818*	***10,291***	*99.59%*	*2,088*
Category 4	*4,837*	***10,333***	*100.00%*	*2,097*
Category 5	*4,837*	***10,333***	*100.00%*	*2,097*

Source(s): ECFRPC, US Census (Cat. 4, 5), NOAA (SLOSH), Volusia County GIS (Cat. 1, 2), E.O.D.R

Above: Storm surge impact in Satellite Beach – Sept. 26, 2004.
Source: Orlando Sentinel

Flooding Exposure

TABLE 9: Satellite Beach Estimated Population Exposure to FEMA Flood Zones

Population Exposure to Hazard Zones – *Flooding*

Zone	Residential Units in Zone	Estimated Population in Zone	Percent of Satellite Beach Population	Estimated Elderly Population (+65)
Zone AE	*260*	***555***	*5.37%*	*113*
Zone VE	*598*	***1,277***	*12.36%*	*259*

Source(s): ECFRPC, US Census, FEMA (DFIRM), Volusia County GIS, E.O.D.R

Coastal Erosion Exposure

TABLE 10: Satellite Beach Estimated Population Exposure to Coastal Erosion

Population Exposure to Hazard Zones – *Storm Surge*

Zone	Residential Units in Zone	Estimated Population in Zone	Percent of Satellite Beach Population	Estimated Elderly Population (+65)
Adjacent to Ocean	*558*	***1,192***	*11.53%*	*242*

Source(s): ECFRPC, US Census, NOAA (SLOSH), Volusia County GIS, E.O.D.R

Coastal erosion along the beaches of Satellite Beach
Source: NPR, 2014

Sea Level Rise (Low Curve) Exposure

TABLE 11: Satellite Beach Estimated Population Exposure to Sea Level Rise Zones

Population Exposure to Hazard Zones – *Sea Level Rise*				
Timeframe	**Residential Units in Zone**	**Estimated Population in Zone**	**Percent of Satellite Beach Population**	**Estimated Elderly Population (+65)**
2040	*274*	***585***	*5.66%*	*119*
2070	*299*	***639***	*6.18%*	*130*
2100	*318*	***679***	*6.57%*	*138*

Sea Level Rise (Intermediate Curve) Exposure

TABLE 12: Satellite Beach Estimated Population Exposure to Sea Level Rise Zones

Population Exposure to Hazard Zones – *Sea Level Rise*				
Timeframe	**Residential Units in Zone**	**Estimated Population in Zone**	**Percent of Satellite Beach Population**	**Estimated Elderly Population (+65)**
2040	*349*	***745***	*7.21%*	*151*
2070	*408*	***871***	*8.43%*	*177*
2100	*491*	***1,049***	*10.15%*	*213*

Sea Level Rise (High Curve) Exposure

TABLE 13: Satellite Beach Estimated Population Exposure to Sea Level Rise Zones

Population Exposure to Hazard Zones – *Sea Level Rise*				
Timeframe	**Residential Units in Zone**	**Estimated Population in Zone**	**Percent of Satellite Beach Population**	**Estimated Elderly Population (+65)**
2040	*355*	***758***	*7.34%*	*154*
2070	*742*	***1,585***	*15.34%*	*322*
2100	*2,668*	***5,699***	*55.15%*	*1,157*

Source(s): ECFRPC, US Census, FDOT Sketch Tool, UF GeoPlan Center, Volusia County GIS, E.O.D.R

Transportation Network Inundation by Sea Level Rise Scenario

GIS Analysis

The sea level rise scenarios presented in this analysis could inundate portions of major transportation networks within the city. Additionally, in concurrence with a natural hazard such as a hurricane, intra-city mobility, access to community shelters and the accessibility of evacuation routes could be severely impacted for populations within the city.

The table below summarizes the total roadway mileage that would be inundated in the event of the low, intermediate and high sea level rise projections for the 2040, 2070 and 2100 time frames.

TABLE 14: Transportation Network Inundation by Sea Level Rise Scenario

Approximate Linear Roadway Mileage Inundated, by Rate Curve and Year			
Sea Level Rise Rate Curve	**Year 2040** *(Mileage Inundated)*	**Year 2070** *(Mileage Inundated)*	**Year 2100** *(Mileage Inundated)*
Low	*0.00 Linear Miles*	*0.00 Linear Miles*	*0.00 Linear Miles*
Intermediate	*0.00 Linear Miles*	*0.12 Linear Miles*	*0.66 Linear Miles*
High	*0.13 Linear Miles*	*5.22 Linear Miles*	*23.46 Linear Miles*

Source(s): FDOT (Road Center Lines), UF GeoPlan Center (Lagoon Sea Level Rise Zones), FDOT Sketch Tool
Note: Linear mileage figures depict roadway segments that are *partially or completely* inundated.

Impacts of rising water on infrastructure
Source: NOAA

Appendix I: Lagoon Sea Level Rise Data Methodology

Methodology

Methods for Creating GIS Layers of Sea Level Rise Inundation on Indian River Lagoon

City of Satellite Beach, FL
Crystal Goodison, University of Florida GeoPlan Center
September 2014

The project team worked with the University of Florida GeoPlan center is assist in the development of ArcGIS shapefiles to utilize in this project. Through a number of meetings including all working members, the team tailored the inundation output to the specific conditions of southern Brevard County. All mapping products developed by the GeoPlan team were utilized by the ECFRPC data team to analyze for financial and land use exposure analysis.

Methods for Calculating Sea Level Rise on the Indian River Lagoon Using USACE Methods

The U.S. Army Corp of Engineers (USACE) methods were used to calculate the projected amount of relative sea level rise (SLR) on the Indian River Lagoon side of Satellite Beach. To calculate relative sea level rise, the following equation from the USACE's SLC Curve Calculator was used (http://www.corpsclimate.us/ccaceslcurves.cfm), which is based on Engineer Circular EC 1165-2-212, Equation 2:

$$T(t) = (E+M)t + bt^2$$

Where:

T(t) = Total relative sea level rise at time "t"
E = Eustatic sea level change (mm/yr) 1.7mm – eustatic sea level change
M = Local subsidence or uplift rates (mm/yr) * taken from NOAA regional estimates - Estimating Local Vertical Land Motion from Long-term Tide Gauge Records
t = Time period (in years) between 1992 (Base Year) and year of interest
b = Coefficient of sea level rise
- Historic (Low) - 0
- Curve II (Intermediate) – 7.00 E-5 (0.00007)
- Curve III (High) – 1.13E-4 (0.000113)

Table 1: Sea Level Change Projection (inches) - Daytona Beach Shores: No. 8721120

Calculated using USACE Sea-Level Change Curve Calculator:
https://corpsclimate.us/ccaceslcurves.cfm

Sea Level Change (inches) - Daytona Beach Shores: 8721120			
Year	Low	Intermediate	High
2040	4.38	6.84	14.63
2070	7.12	13.62	34.19
2100	9.86	22.31	61.76

Calculations of projected sea level rise on both the Atlantic side and Indian River Lagoon (IRL) side used the Daytona Beach tide station's sea level trend values, which incorporate local subsidence or uplift rates. Hence, the amount of projected sea level rise under each scenario is the same for both sides of the municipality. What differs is the starting water level. On the Atlantic side, the projected amount of SLR was added on top of MHHW datum. Since the Indian River Lagoon does not experience the same tidal variations as the Atlantic, the projected amount of SLR was added on top of the Carter's Cut Mean Water Level (MWL) + 1 foot (to represent the average of highest seasonal tide).

The calculated sea level rise projections are expressed relative to mean sea level (MSL). In order to utilize these results for the determination and analysis of potential impacts to coastal and terrestrial features, the values must be translated to the North American Vertical Datum of 1988 (NAVD88), which is the vertical datum of the Digital Elevation Model (DEM). This correction is unique for each tide station and varies throughout the statewide coastal area. Calculations of projected sea level rise along the Indian River Lagoon were translated using the NAVD88 adjustment calculated at the Carter's Cut gauge (-0.189 m or -0.62 feet NAVD88).

The following equation was used to calculate projected inundation on the land, incorporating starting water levels and the vertical adjustment to NAVD88 (the vertical datum of the Digital Elevation Model).

$$PI = SLCP_T + NAVD88_{diff} + TD$$

Where:

PI = Projected Inundation Level

$SLCP_T$ = the sea level change projection at time "T" (expressed in years) derived from USACE equations (i.e. – amount of sea level rise)

$NAVD88_{diff}$ = the difference in reference height of the tide gauge level point between the NAVD88 and MWL (Carter's Cut)

$NAVD88_{diff}$ Carter's Cut (for Indian River Lagoon side) = - 7.44 inches (-0.62 feet)

TD – Tidal Datum or Seasonal High Water Level

Average of Seasonal High Tide (Carter's Cut) = 1 feet above MWL

For example, to calculate inundation at 2040 using the USACE Intermediate projection, start with 6.84 inches calculated using USACE Curve Calculator, then account for NAVD88 adjustment and tidal datum:

$$PI = SLCP_T + NAVD88_{diff} + TD$$

$$PI = 6.84 \text{ inches} + -7.44 \text{ inches} + 12 \text{ inches}$$

$$PI = 11.4 \text{ inches}$$

Table 2: Projected Inundation Level (inches) – Indian River Lagoon

The following projected inundation levels were calculated using Mean Water Level and NAVD88 adjustment from Carter's Cut (No. 8721789) tide gauge and Sea Level Trend data from Daytona Beach Shores, No. 8721120.

Inundation Level (inches) w/ Carters Cut Data			
Year	Low	Intermediate	High
2040	9	11	19
2070	12	18	39
2100	14	27	66

Methods for Creating GIS Layers SLR Inundation

The input Digital Elevation Model (DEM) used was from the Florida Geographic Data Library (FGDL) and compiled by the University of Florida GeoPlan Center: Florida Digital Elevation Model Mosaic (FGDL filename: FLIDAR_MOSAIC_IN). The DEM cell size (horizontal resolution) is 5.4 meters and the vertical units are inches.

Steps for Creating GIS Layers of Inundation using ArcGIS 10.1 SP1:

- Extracted Satellite Beach city limits from FGDL Layer PAR_CITYLM_2011 (City Limits – Derived from Florida Parcel Data – 2011).
- Buffered Satellite Beach city limits by 100 feet
- Converted city limits to raster at 5.4m cell size to match DEM, set snap raster to DEM
- Clipped DEM to buffered Satellite Beach City Limits, and re-classed -1 values (representing water) to no data.
- Created bathtubs with SLR Calculator using SLR projected inundation amounts calculated with USACE methods (Table 2 above)
- Ran Hydro-connectivity Model in ArcMap Model Builder. To delineate Oceans and Rivers for hydrologic connectivity – used data from Water Management District and DEM. Used the DEM to create a modified oceans and rivers layer to better represent the Indian River Lagoon shore. Our existing layer of oceans & rivers was created with Water Management District (WMD) data didn't line up exactly in some areas on the IRL side. If projected inundated area was adjacent to or overlapping with an area delineated as ocean or river, then that inundated area was kept in the output layer.
- Processed in raster environment. Exported to polygon feature classes in a File Geodatabase.

Appendix II: Natural Hazard Exposure Methodology

Methodology

Methods for Delineating Financial, Land Use, Building and Population Exposure

City of Satellite Beach, FL
PJ Smith, East Central Florida Regional Planning Council
November 2014

The project team utilized geographic information system (GIS) data from county, state and federal sources to identify the 'exposure' to the natural hazards identified in this report from a financial, build year, land use and population perspective. To do this, the project team compiled a master parcel file and cross-referenced that file with environmental layers from sources and programs including NOAA (SLOSH), HAZUS and FEMA. The project team also utilized customized data from the University of Florida GeoPlan center for the lagoon side of the city, as base inundation models for the lagoon had to be regenerated to accurately represent local conditions (see Appendix I).

Summary data from ArcGIS was utilized once the cross-reference (via a 'Selection by Location' query in the ArcGIS 10.2) was completed, and summary tables were completed to determine the figures representative in the tables.

Financial values within this report were derived from the Brevard County Property Appraiser's database, which was linked with condominium information to extract full economic values, as opposed to only extracting the values of the parent (or base) parcels. Financial figures within this document are relevant as of 2014. Similar to financial information, build year information was acquired from the Brevard County Property Appraiser's office and cross-referenced with base parcel tables via Microsoft Access before input into ArcGIS. Land use summaries were acquired from "Land Use Codes" provided by the Brevard County Property Appraiser's office, and there is a standalone cross-reference table (on hand at the ECFRPC) detailing the exact transition from raw land use codes to the generalized land uses provided in this document.

Population figures within this document were derived from the ArcGIS data (and the methodology summarized above) alongside the most recent U.S. Census Bureau and Office of Economic and Demographic Research for the City of Satellite Beach. The following figures were taken from the following sources and applied to the equation below to derive approximate population figures within each hazard zone:

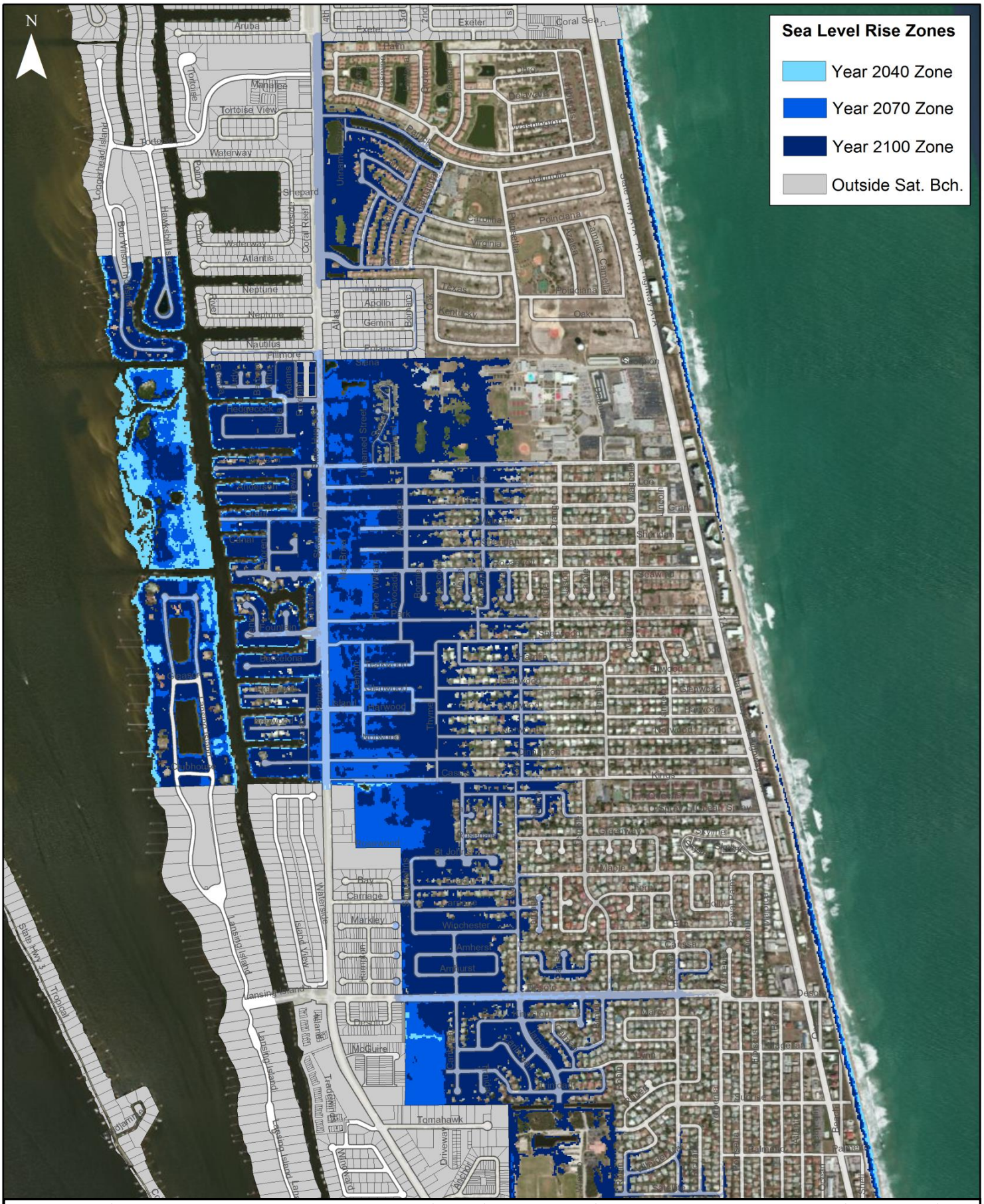
Statistic	Figure	Source
Persons per Household (Satellite Beach)	2.510	U.S. Census Bureau (2013)
Elderly Population as % of Total (Satellite Beach)	0.203	U.S. Census Bureau (2013)
Population (Satellite Beach)	10,333	U.S. Census Bureau (2013)
Vacancy Rate (Brevard County)	0.851	Office of O.E.D.R. (2014)

Population = (Units in Zone) x (Persons per Household) x (100% - Vacancy Rate)

Appendix III: Satellite Imagery of Sea Level Rise Zones

Map Series

Simulation of High Projection Rate Curve – Sea Level Rise



These data and maps are for planning, educational, and awareness purposes only and should not be used for site-specific analysis, navigation, and flood rates or permitting. As with all remotely sensed data, all features should be verified with a site visit. The data and maps in this tool are provided "as is". ECFRPC makes no warranty explicit or implied, regarding the accuracy or use of this information. Use at your own risk. The purpose of this data is to provide a preliminary look at sea level rise and coastal flooding impacts. The data and maps in this tool illustrate the scale of potential flooding, not the exact location. The inundation areas depicted in the Sea Level Rise tab are not as precise as they may appear. The data, maps, and information provided should be used only as a screening-level tool for management decisions.

Source(s): ECFRPC, Brevard County GIS, FDOT, UF GeoPlan Center

0 0.125 0.25 0.5 0.75 1 Miles

Simulation of Intermediate Projection Rate Curve – Sea Level Rise

These data and maps are for planning, educational, and awareness purposes only and should not be used for site-specific analysis, navigation, and flood rates or permitting. As with all remotely sensed data, all features should be verified with a site visit. The data and maps in this tool are provided "as is". ECFRPC makes no warranty explicit or implied, regarding the accuracy or use of this information. Use at your own risk. The purpose of this data is to provide a preliminary look at sea level rise and coastal flooding impacts. The data and maps in this tool illustrate the scale of potential flooding, not the exact location. The inundation areas depicted in the Sea Level Rise tab are not as precise as they may appear. The data, maps, and information provided should be used only as a screening-level tool for management decisions.

Source(s): ECFRPC, Brevard County GIS, FDOT, UF GeoPlan Center

0 0.125 0.25 0.5 0.75 1 Miles

Simulation of Low Projection Rate Curve – Sea Level Rise

These data and maps are for planning, educational, and awareness purposes only and should not be used for site-specific analysis, navigation, and flood rates or permitting. As with all remotely sensed data, all features should be verified with a site visit. The data and maps in this tool are provided "as is". ECFRPC makes no warranty explicit or implied, regarding the accuracy or use of this information. Use at your own risk. The purpose of this data is to provide a preliminary look at sea level rise and coastal flooding impacts. The data and maps in this tool illustrate the scale of potential flooding, not the exact location. The inundation areas depicted in the Sea Level Rise tab are not as precise as they may appear. The data, maps, and information provided should be used only as a screening-level tool for management decisions.

Source(s): ECFRPC, Brevard County GIS, FDOT, UF GeoPlan Center

0 0.125 0.25 0.5 0.75 1 Miles

Appendix IV: Historic Disaster Events in Satellite Beach

As Documented in the Brevard County Local Mitigation Strategy, 2014

Disaster Events and Costs over 10-Year Period (2004-2014) – Table 14

Event Name	Presidential Disaster No.*	Primary Hazard	Total Cost
Hurricane Jeanne	DR-1561 FL	High Winds	$42,600,000
Hurricane Frances	DR-1545 FL	High Winds	$27,050,000
Fire Management	2765	Wildland Fire	Not Available
Tropical Storm Fay	EM-3288	High Winds	Not Available
Hurricane Wilma	DR-1609	High Winds	Not Available
Tropical Storm Fay	DR-1785	High Winds	Not Available
Hurricane Charlie	DR-1539 FL	High Winds	$48,000
Totals for Jurisdiction:			**$69,698,000**

Pictured: The Satellite Beach dunes rise above the beach system.