

Funded Through: DEP AGREEMENT NO. CM238

# **Working Towards Resilient Coastal Communities**

## **Town of Lauderdale-by-the-Sea Vulnerability to Sea Level Rise Assessment Report**



Prepared on: April 14

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# Town of Lauderdale-by-the-Sea Vulnerability to Sea Level Rise Assessment Report for CM238

## Working Towards Resilient Coastal Communities



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# Report Summary

## *The Town of Lauderdale-by-the-Sea Vulnerability Report*

### **Introduction**

In the past century, sea level rise in South Florida rose 8-10 inches. In the future, the rate of sea level rise is expected to accelerate due to processes associated with global climate change. Broward County is highly vulnerable to sea level rise (SLR) due to its low lying topography. As a result, inundation, episodic flooding, drainage issues in low-lying areas and saltwater intrusions are significant threats. This document contains the vulnerability assessment of major municipal infrastructure in the Town of Lauderdale-by-the-Sea during one and two foot SLR scenarios using a regional inundation digital elevation model (DEM) which incorporates 2007 LiDAR elevation data. Vulnerable areas are displayed by a grid with a 50 foot cell size, categorized as “possible” and “more likely”:

<p><b>LEGEND</b></p> <p> Possible</p> <p> More Likely</p>	<p>The individual colors are used to describe the uncertainty associated with the variability of the tidal data measurements and LiDAR elevation measurements. The purple areas have a 75-100% certainty of identifying elevations below the high tide and therefore are “More likely” to be vulnerable. Orange areas have a 25-74% certainty of being at elevations below the high tide and represent areas of “Possible” vulnerability.</p>
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### **Municipal Infrastructure Assessments**

Mapping of different sea level rise scenarios can help to identify areas at potential risk and aid in planning for a sustainable community. This Geographic Information Systems (GIS) based study specifically assessed the following municipal infrastructure for the potential impacts of sea level rise:

1. Airports
2. Bridges
3. City Arterial Roads
4. City Hall
5. City Parks
6. Regional Parks
7. Community Redevelopment Areas (CRAs)
8. Evacuation Routes
9. Fire Rescue Stations
10. Hospitals
11. Law Enforcement Assets
12. Schools
13. Potable Water Treatment
14. Waste Water Treatment

Areas of special interest for the Town of Lauderdale-by-the-Sea:

15. Palm Club and Terra Mar Island

This work was funded, in part, through a grant agreement from the Florida Department of Environmental Protection, Florida Coastal Management Program.

**Municipal Scale Inundation Maps**

Municipal scale inundation maps provide at-a-glance overviews of areas within the Town of Lauderdale-by-the-Sea municipal boundary that are low lying and likely to be vulnerable to flooding associated with sea level rise. The maps on the following pages show the Town of Lauderdale-by-the-Sea overlaid with the inundation grid for a one and two foot sea level rise scenario. No areas of the inundation grid intersected with the Town of Lauderdale-by-the-Sea during a one foot sea level rise scenario. The maps primary purpose is to aid in the assessment of vulnerabilities to sea level rise.

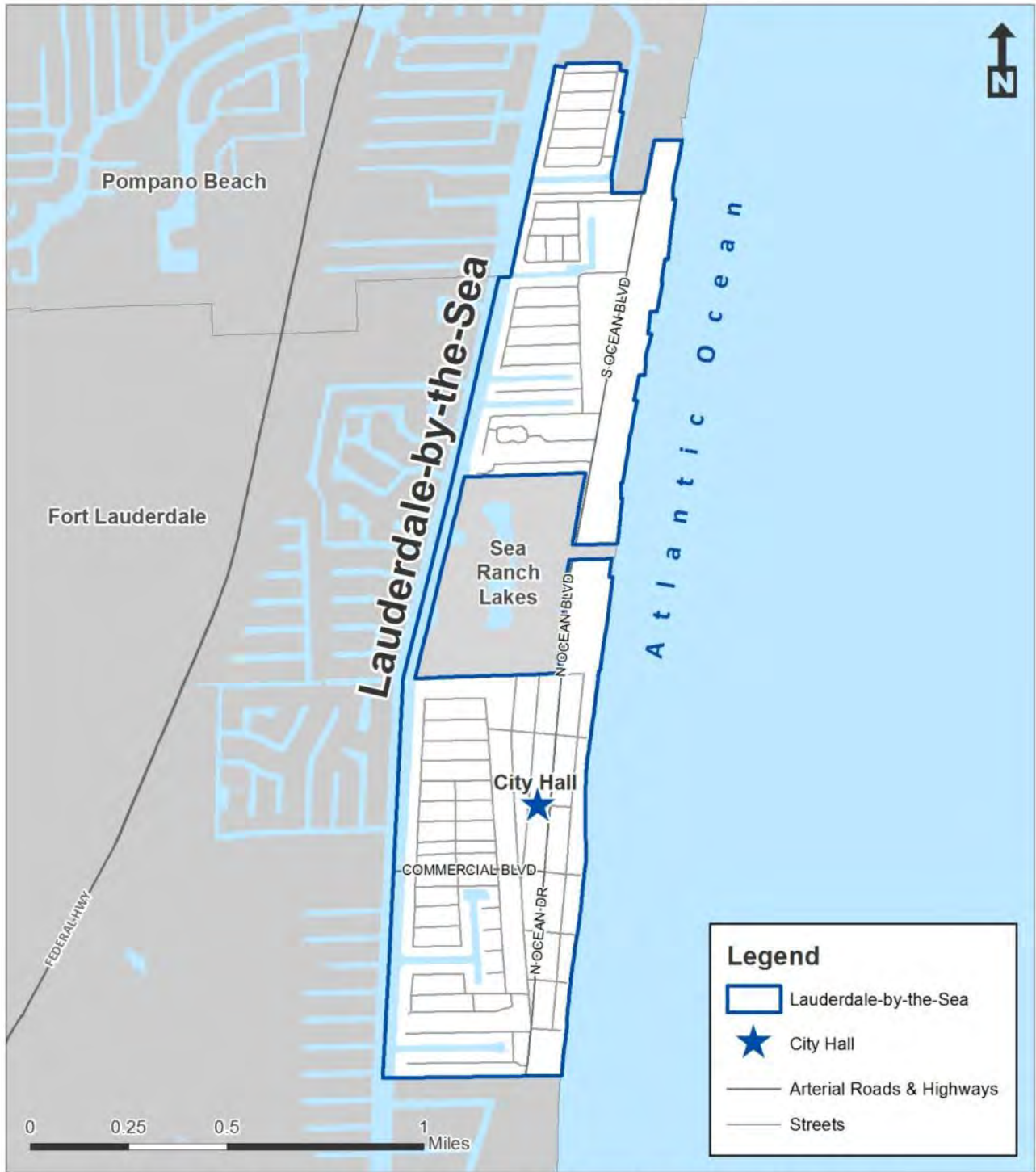
The following table summarizes the area of land (in acres) affected during both the one and two foot scenarios, as shown in the municipal scale inundation maps. The table breaks down the vulnerable acres for each scenario into “more likely,” “possible,” and total. Additionally, the table shows the percentage of the total area of the city that is vulnerable. Note that percent values are rounded to the nearest two decimal places.

Town of Lauderdale-by-the-Sea Vulnerability to Sea Level Rise Table							
Town of Lauderdale-by-the-Sea	Total Area (Acres)	Area Vulnerable during One (1) Foot Scenario (Acres)		Total Area Vulnerable during One (1) Foot Scenario (Acres)	Acreage Vulnerable during Two (2) Foot Scenario (Acres)		Total Area Vulnerable during Two (2) Foot Scenario (Acres)
		More Likely	Possible		More Likely	Possible	
		588.00	0.00	0.00	0.00	0.17	1.21
		0.00%	0.00%	0.00%	0.03%	0.21%	0.23%



# TOWN OF LAUDERDALE-BY-THE-SEA INUNDATION MAP

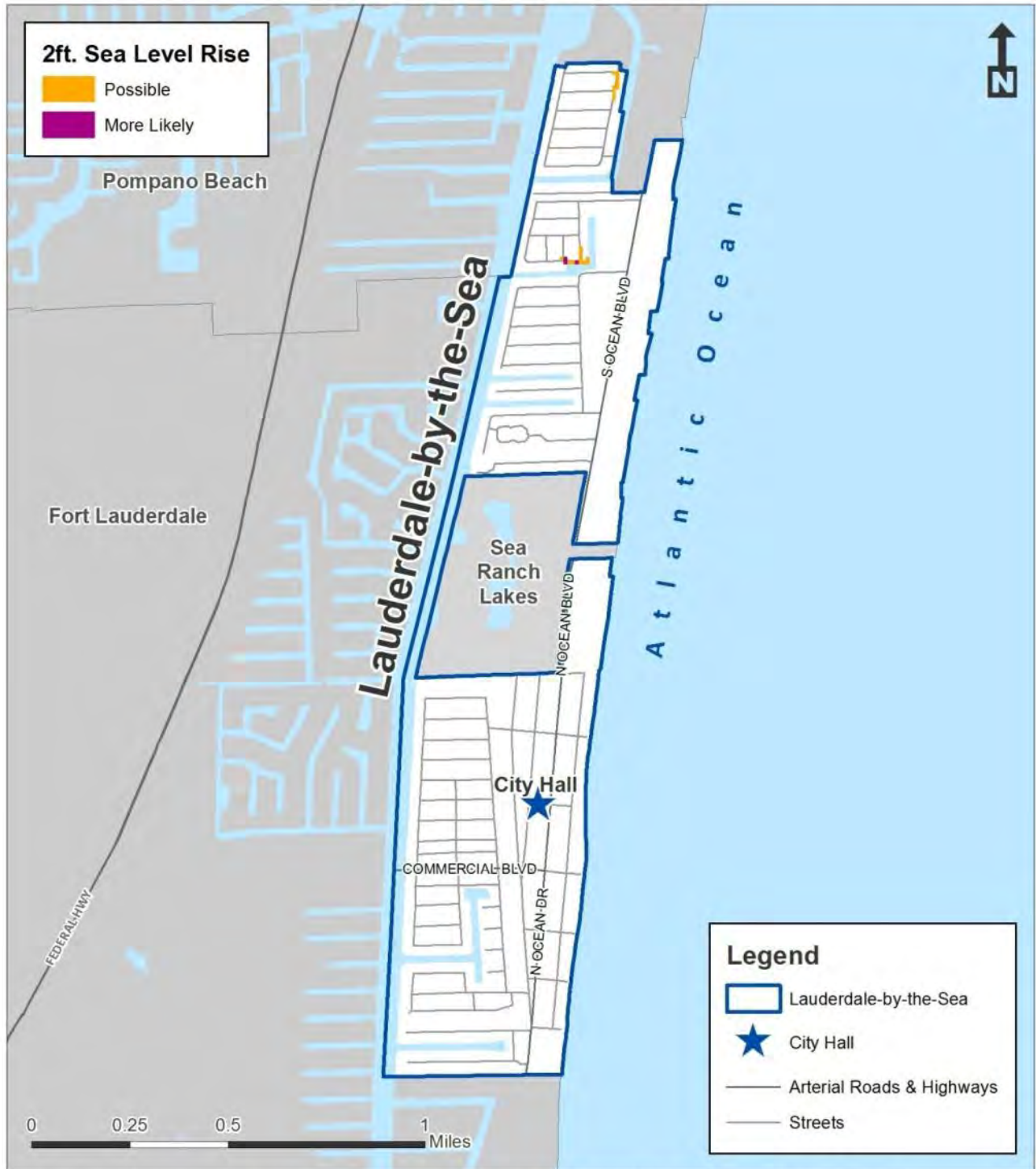
## One Foot Sea Level Rise



This map is for conceptual purposes only and should not be used for legal boundary determinations.

# TOWN OF LAUDERDALE-BY-THE-SEA INUNDATION MAP

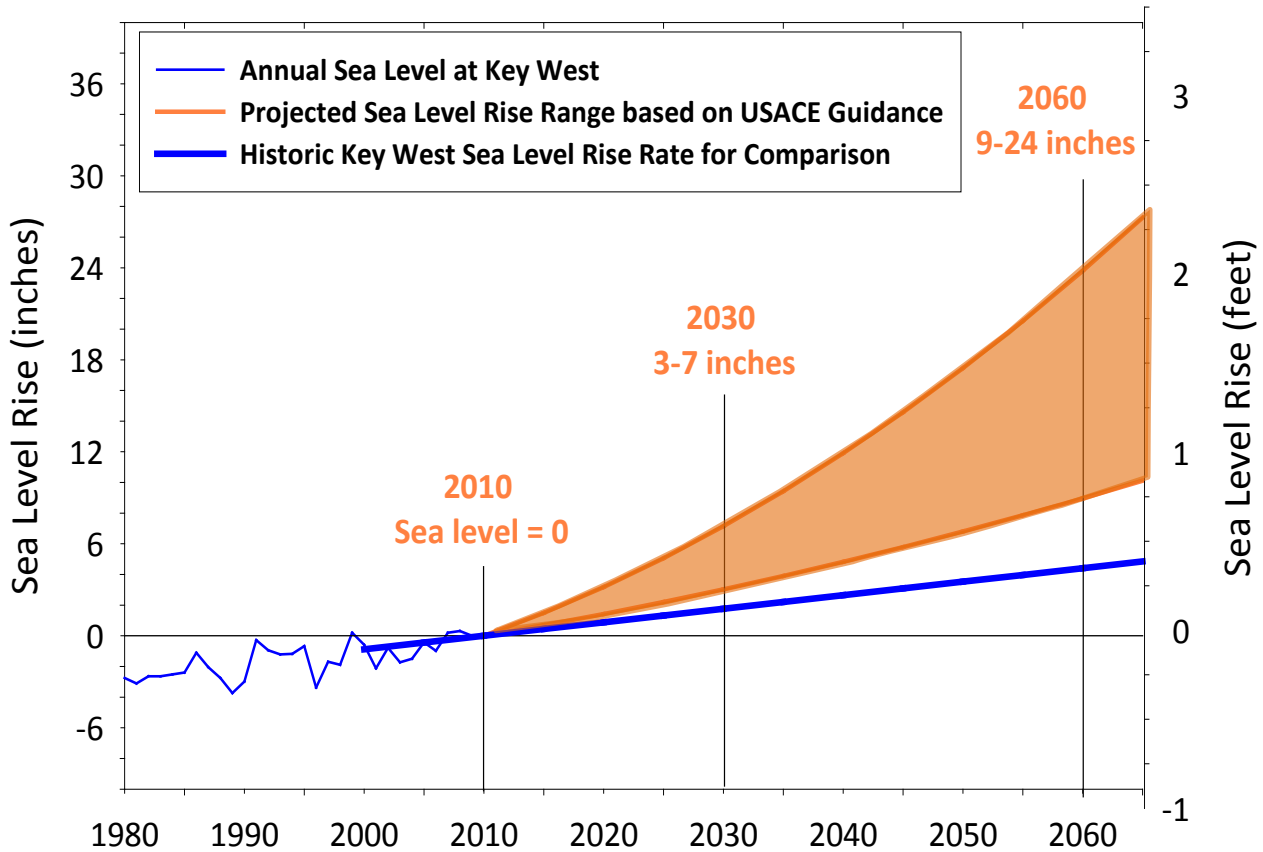
## Two Foot Sea Level Rise



This map is for conceptual purposes only and should not be used for legal boundary determinations.

### Unified Sea Level Rise Projection

The Southeast Florida Regional Climate Change Compact, collaboration among Monroe, Miami-Dade, Broward and Palm Beach Counties, convened a group of scientists and local experts to develop the Unified Southeast Florida Sea Level Rise Projection. This projection allows us to assign timeframes to the given sea level rise scenarios with a one foot sea level rise projected to occur between 2040-2070 and a two foot rise likely to occur between 2060 – 2115.



**Unified Southeast Florida Sea Level Rise Projection for Regional Planning Purposes** - This projection uses historic tidal information from Key West and was calculated by Kristopher Esterson from the United States Army Corps of Engineers using USACE Guidance (USACE 2009) intermediate and high curves to represent the lower and upper bound for projected sea level rise in Southeast Florida. Sea level measured in Key West over the past several decades is shown. The rate of sea level rise from Key West over the period of 1913 to 1999 is extrapolated to show how the historic rate compares to projected rates.

## ***Vulnerability Assessment Methodology***

Municipal infrastructure (fire rescue stations, schools, city owned arterial roads, etc.) was overlaid with the sea level rise inundation grid to review which infrastructure may be located at or below projected sea levels during a one or two foot scenario. This process was expedited with the creation of a python script that quickly locates infrastructure which may be vulnerable during a given sea level rise scenario. Each location was reviewed visually for confirmation. The report uses inundation maps developed in collaboration with the Southeast Florida Regional Climate Change Compact with vulnerability methods and oversight by the GIS Section of the Planning and Redevelopment Division. All measurements of area and length are based on GIS datasets of the county and depend on these for accuracy. Additionally, measurements and percent values given in this report are rounded, which may contribute to minor inconsistencies.

## ***Results***

The following findings pertain to the vulnerability assessments performed for each of the Town of Lauderdale-by-the-Sea municipal infrastructure in the list. Detailed maps and tables follow.

1. Airports:  
There are no airports in the Town of Lauderdale-by-the-Sea.
2. Bridges:  
Included is a map that provides the location of the two bridges located in the Town of Lauderdale-by-the-Sea overlaid by the inundation grid. The idea is to provide at-a-glance overviews of the vulnerability of bridges with the understanding that most navigable bridges are located on tidally influenced water bodies. Sea level will reduce the clearance under these bridges thereby reducing the number and size of craft that can pass under them.
3. City Arterial Roads:  
No arterial roads maintained by the Town of Lauderdale-by-the-Sea showed potential vulnerability to sea level rise during the one or two foot scenarios.
4. City Hall:  
The Town of Lauderdale-by-the-Sea city hall showed no vulnerability to sea level rise during the one or two foot scenarios.
5. City Parks:  
No city parks in the Town of Lauderdale-by-the-Sea showed potential vulnerability to sea level rise during the one or two foot scenarios.
6. Regional Parks:  
There are no regional parks in the Town of Lauderdale-by-the-Sea.
7. Community Redevelopment Areas (CRA):  
There are no CRAs in the Town of Lauderdale-by-the-Sea.
8. Evacuation Routes:  
No evacuation routes in the Town of Lauderdale-by-the-Sea showed potential vulnerability to sea level rise during the one or two foot scenarios.

9. Fire Rescue Stations:  
No fire rescue stations in the Town of Lauderdale-by-the-Sea showed potential vulnerability to sea level rise during the one or two foot scenarios.
10. Hospitals:  
There are no hospitals in the Town of Lauderdale-by-the-Sea.
11. Law Enforcement Assets:  
No law enforcement assets in the Town of Lauderdale-by-the-Sea showed potential vulnerability to sea level rise during the one or two foot scenarios.
12. Schools:  
No school building footprints in the Town of Lauderdale-by-the-Sea showed potential vulnerability to sea level rise during the one or two foot scenarios.
13. Potable Water Treatment:  
There are no potable water treatment plants in the Town of Lauderdale-by-the-Sea.
14. Waste Water Treatment:  
There are no waste water treatment plants in the Town of Lauderdale-by-the-Sea.
15. Palm Club and Terra Mar Island  
The Palm Club and Terra Mar Island neighborhoods are the only areas in the Town of Lauderdale-by-the-Sea with land located at or below projected sea levels during the two foot sea level rise scenario. Neither of the neighborhoods have land located at or below projected sea levels during the one foot scenario. During the two foot scenario, several neighborhood streets may be vulnerable. Included is an overview map of the Town of Lauderdale-by-the-Sea with the location of the vulnerable neighborhoods, a table to provide information on the vulnerable streets within neighborhoods, and a large-scale map of the area.

## ***Conclusion***

The information contained in this report is intended to be used for planning purposes to begin to identify and address municipal infrastructure at risk. Understanding that a one foot rise could occur in the next 30 years, adaptation strategies should be developed for locations identified as vulnerable in the first scenario. In addition to the vulnerability of infrastructure identified to lie at or below projected sea levels up to a two foot scenario; the municipality may also be at risk due to secondary threats such as flooding events and ponding, storm drainage, erosion, bridge clearance, etc. Sea level may continue to rise beyond two feet. The Lauderdale-by-the-Sea municipal authorities should begin the development of policies to address these risks and institutionalize the consideration of climate issues for adaptation strategies.

## Definitions

ArcGIS: Software for working with maps and geographic information.

Arterial Roads: A major or main road, but not a highway.

DEM: Digital Elevation Model – A digital model or 3D representation of a terrain’s surface using topographic information.

Geographic Information Systems (GIS): A system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.

LiDAR: A remote sensing technology whereby elevation is measured by illuminating a target with a laser and analyzing the reflected light.

PPA: Priority Planning Areas – Identifies areas influenced by tidal water bodies at increased risk of inundation under a 2 foot sea level rise scenario, projected to occur as soon as 2060.

Python Script: A widely-used general purpose programming language. It is used in ArcGIS to automate processes whereby new geographic information is created from existing data.

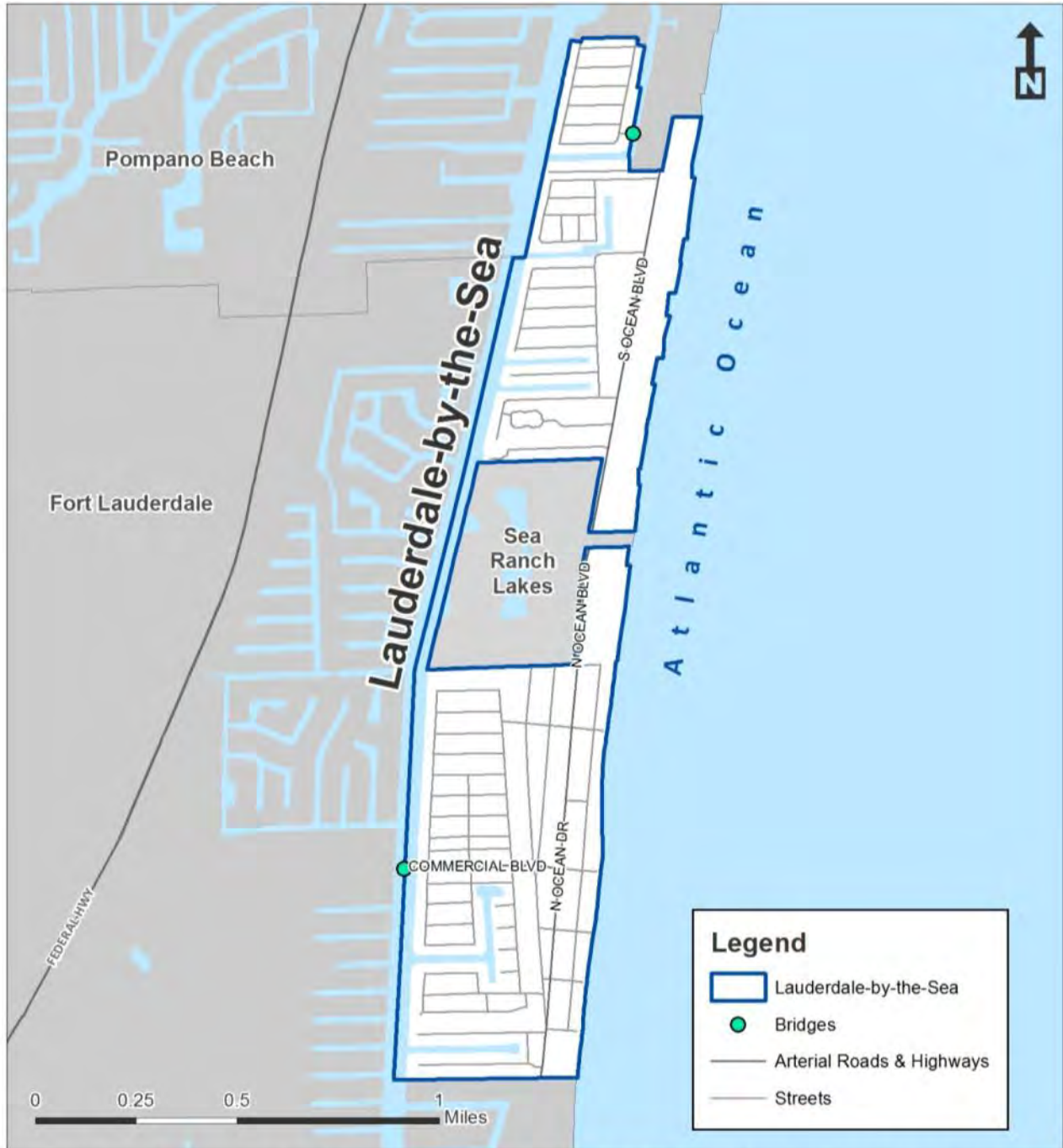
SLR: sea level rise grid

- “More Likely”: areas that have a 75-100% certainty of identifying elevations below the high tide and therefore are “More likely” to be vulnerable
- “Possible”: Orange areas have a 25-74% certainty of being at elevations below the high tide and represent areas of “Possible” vulnerability.

Vulnerable Area: The phrase “Vulnerable Area” as used in this document refers to land elevation at or below a given sea level rise scenario (one to two foot) as determined by the unified sea level rise projection grid.

# Bridges

## Vulnerability Assessment



**This Map identifies areas at increased risk of inundation up to a two foot sea level rise scenario, projected to occur as soon as 2060.**

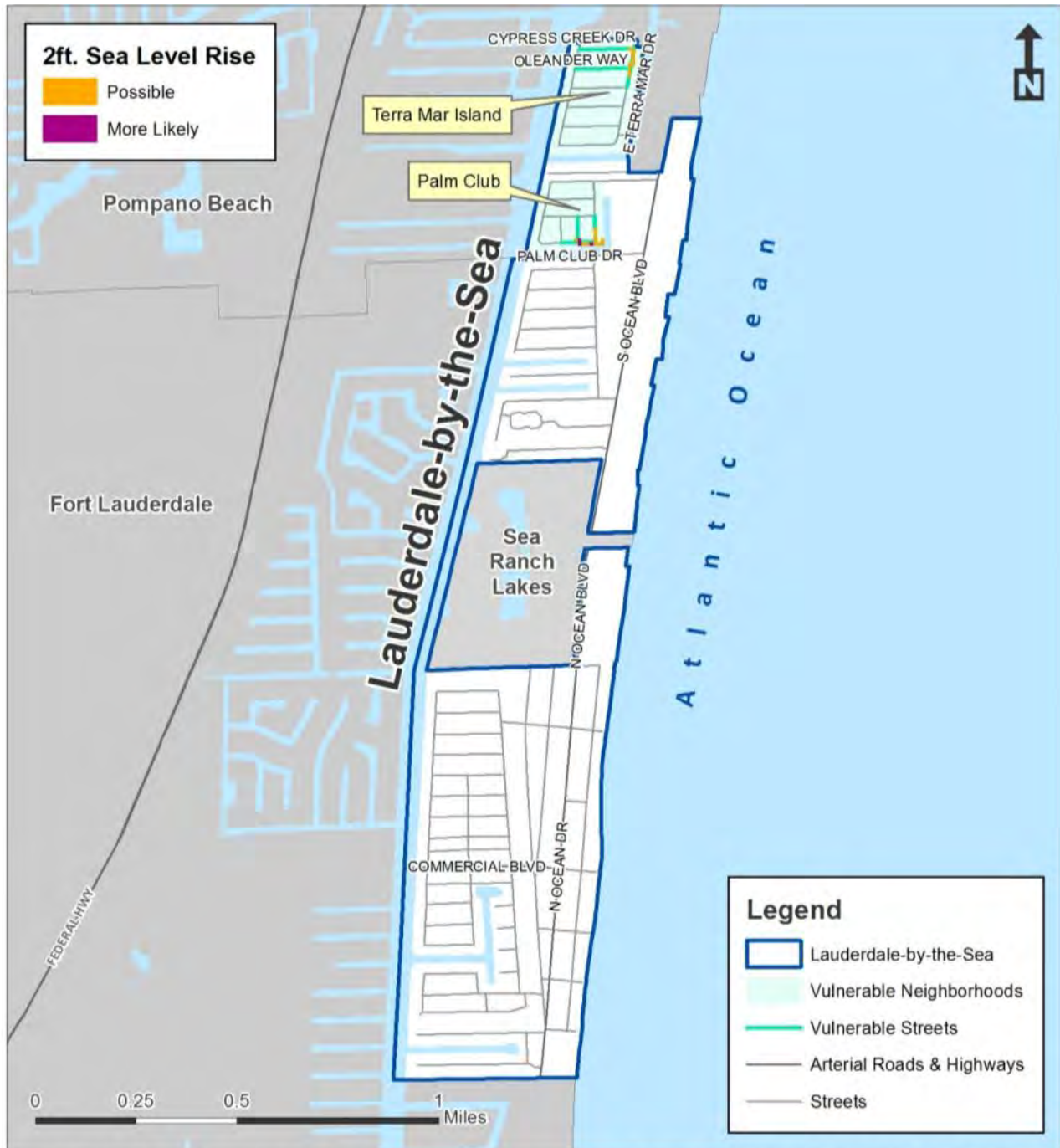
This map is for conceptual purposes only and should not be used for legal boundary determinations.



Prepared By: Hannes Ziegler  
 Environmental Protection and Growth Management Department  
 Natural Resources Planning and Management Division

Date: 12/17/2013  
 DEP Agreement No. CM238 DEP 55-236(08/11)

# Palm Club and Terra Mar Island Neighborhoods Vulnerability Assessment



**This Map identifies areas at increased risk of inundation up to a two foot sea level rise scenario, projected to occur as soon as 2060.**

This map is for conceptual purposes only and should not be used for legal boundary determinations.



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DEP Agreement No. CM238 DEP 55-236(08/11)



***Table of Vulnerable Streets in the Palm Club and Terra Mar Island  
Neighborhoods***

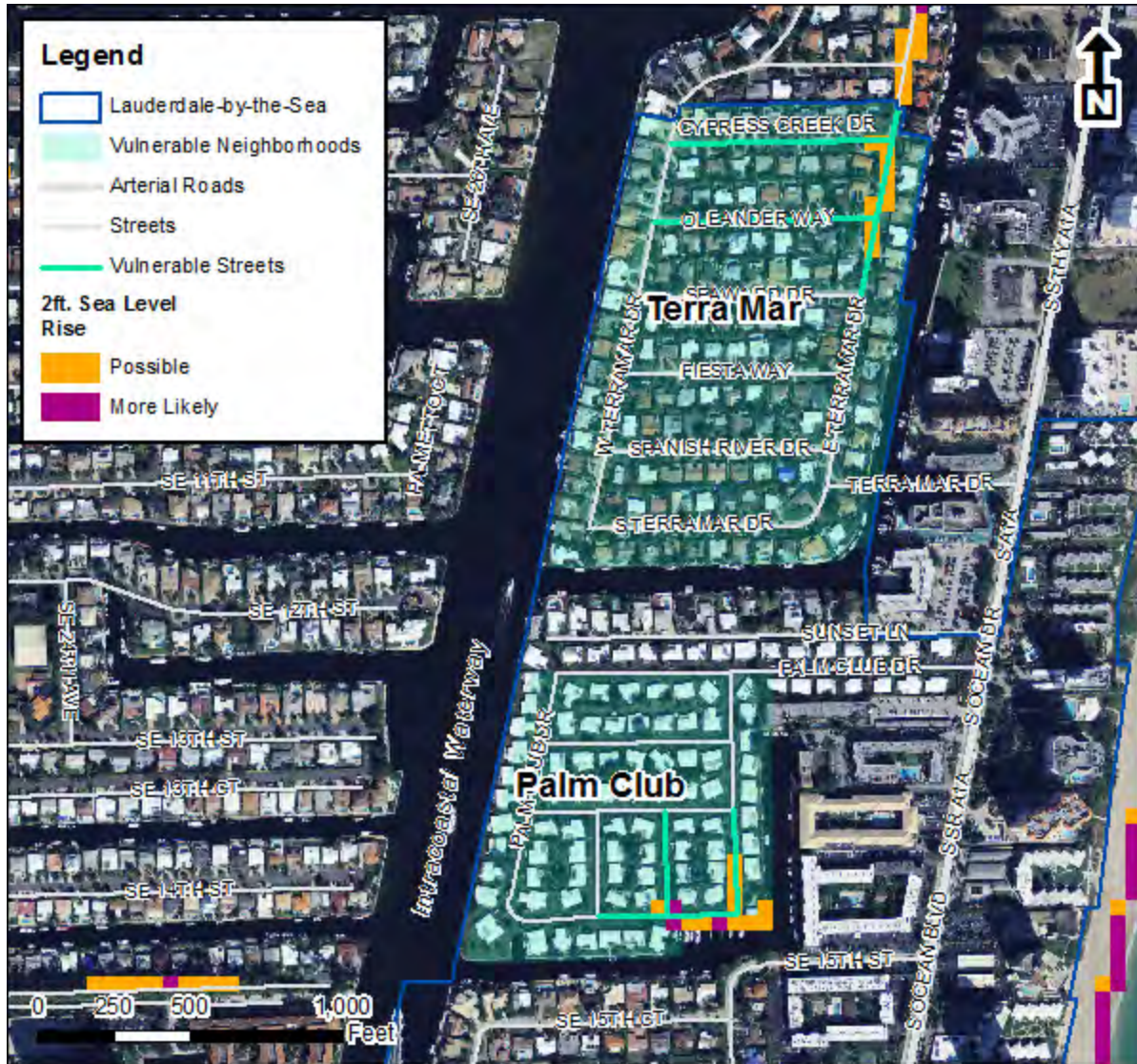
The following table lists streets within the Palm Club and Terra Mar Island neighborhoods that have vulnerable areas during the one or two foot sea level rise scenarios. For each scenario, vulnerable neighborhood streets receive a Y for yes, or an N for no.

<b>Vulnerable Neighborhood Streets in Palm Club and Terra Mar Island Town of Lauderdale-by-the-Sea</b>		
Street	One Foot Scenario (Y/N)	Two Foot Scenario (Y/N)
Cypress Creek Dr.	N	Y
Oleander Way	N	Y
E Terra Mar Dr.	N	Y
Palm Club Dr.	N	Y

**Key:** For Y/N, Y = Yes, N = No

## Palm Club and Terra Mar Neighborhoods

### Two Foot Sea Level Rise Scenario



This map is for conceptual purposes only and should not be used for legal boundary determinations.

**BROWARD COUNTY**  
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 Environmental Protection and Growth Management Department  
 Natural Resources Planning and Management Division

Date: 2/13/2014  
 DEP Agreement No. CM238 DEP 55-236(08/11)

This map shows the Palm Club and Terra Mar Island neighborhoods. Both neighborhoods have neighborhood streets located at or below projected sea levels during the two foot scenario. The affected streets are Cypress Creek Dr, Oleander Way, E Terra Mar Dr, and Palm Club Dr. The neighborhoods are not vulnerable during the one foot sea level rise scenario.