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Working Towards Resilient Coastal Communities

City of Dania Beach **Vulnerability to Sea Level Rise Assessment Report**



Prepared on: April 14

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City of Dania Beach Vulnerability to Sea Level Rise Assessment Report for CM238

Working Towards Resilient Coastal Communities



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Contents

Report Summary.....	7
Introduction.....	7
Municipal Infrastructure Assessments.....	7
Municipal Scale Inundation Maps	8
Unified Sea Level Rise Projection	11
Vulnerability Assessment Methodology.....	12
Results	12
Conclusion	14
Definitions	14
Bridges.....	15
City Arterial Roads.....	16
Table of Vulnerable City Arterial Roads.....	17
City Parks	21
Table of Vulnerable City Parks.....	22
Regional Parks & Nature Centers	28
Table of Vulnerable Regional Parks & Nature Centers.....	29
Community Redevelopment Areas (CRA).....	34
Table of Vulnerable Community Redevelopment Areas (CRA)	35
Evacuation Routes	38
Table of Vulnerable Evacuation Routes.....	39
Schools.....	40
Table of Vulnerable Schools	41



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Report Summary

The City of Dania Beach 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 City of Dania Beach 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>LEGEND</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 & Nature Centers
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

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

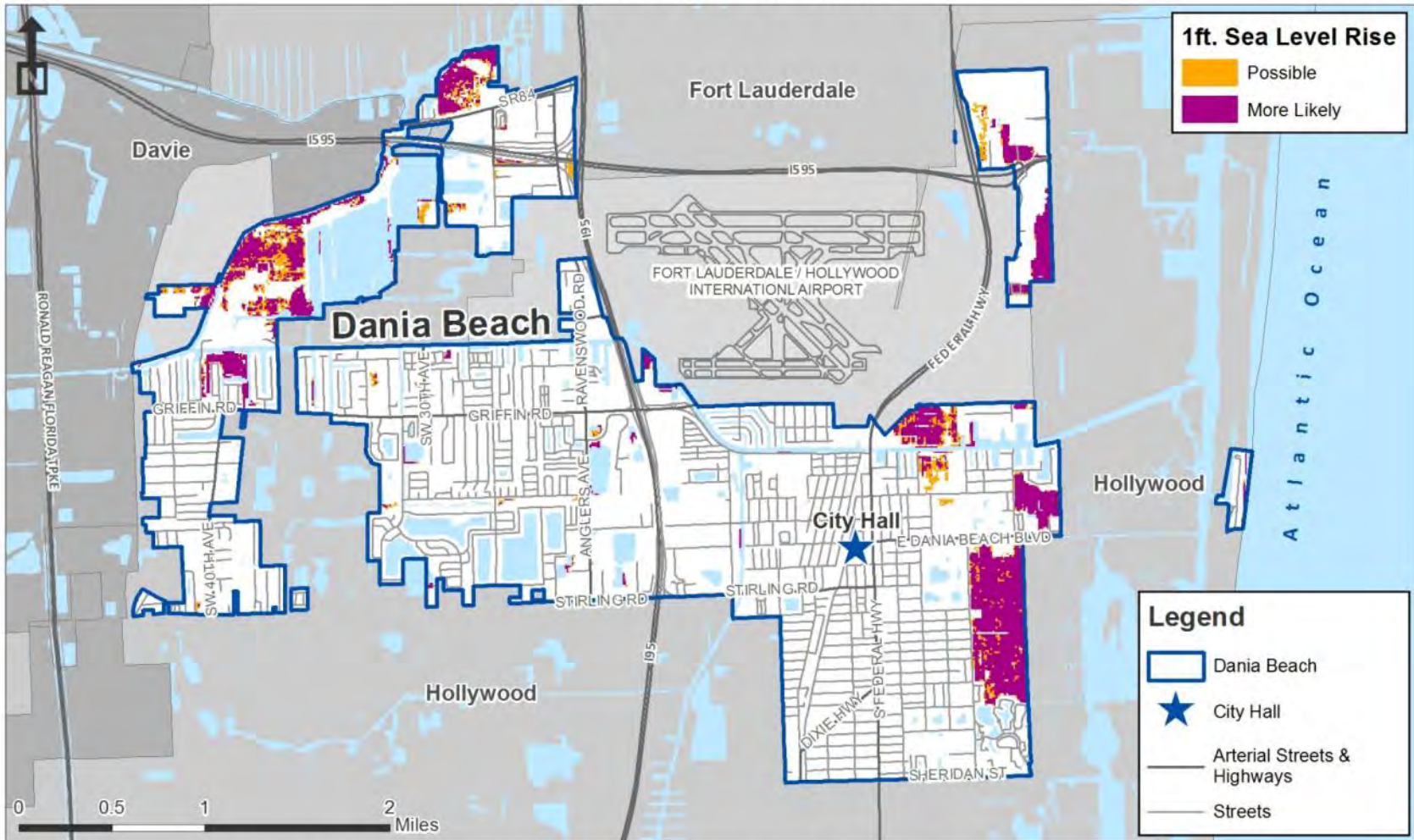
Municipal scale inundation maps provide at-a-glance overviews of areas within the City of Dania Beach Municipal boundary that are low lying and likely to be vulnerable to flooding associated with sea level rise. The maps on the following pages show the City of Dania Beach overlaid with the inundation grid for a one and two foot sea level rise scenario. These 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.

City of Dania Beach Vulnerability to Sea Level Rise Table							
City of Dania Beach	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	
		5314.92	371.42	109.52	480.94	592.66	169.56
		6.99%	2.06%	9.05%	11.15%	3.19%	14.34%

CITY OF DANIA BEACH INUNDATION MAP

One Foot Sea Level Rise



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

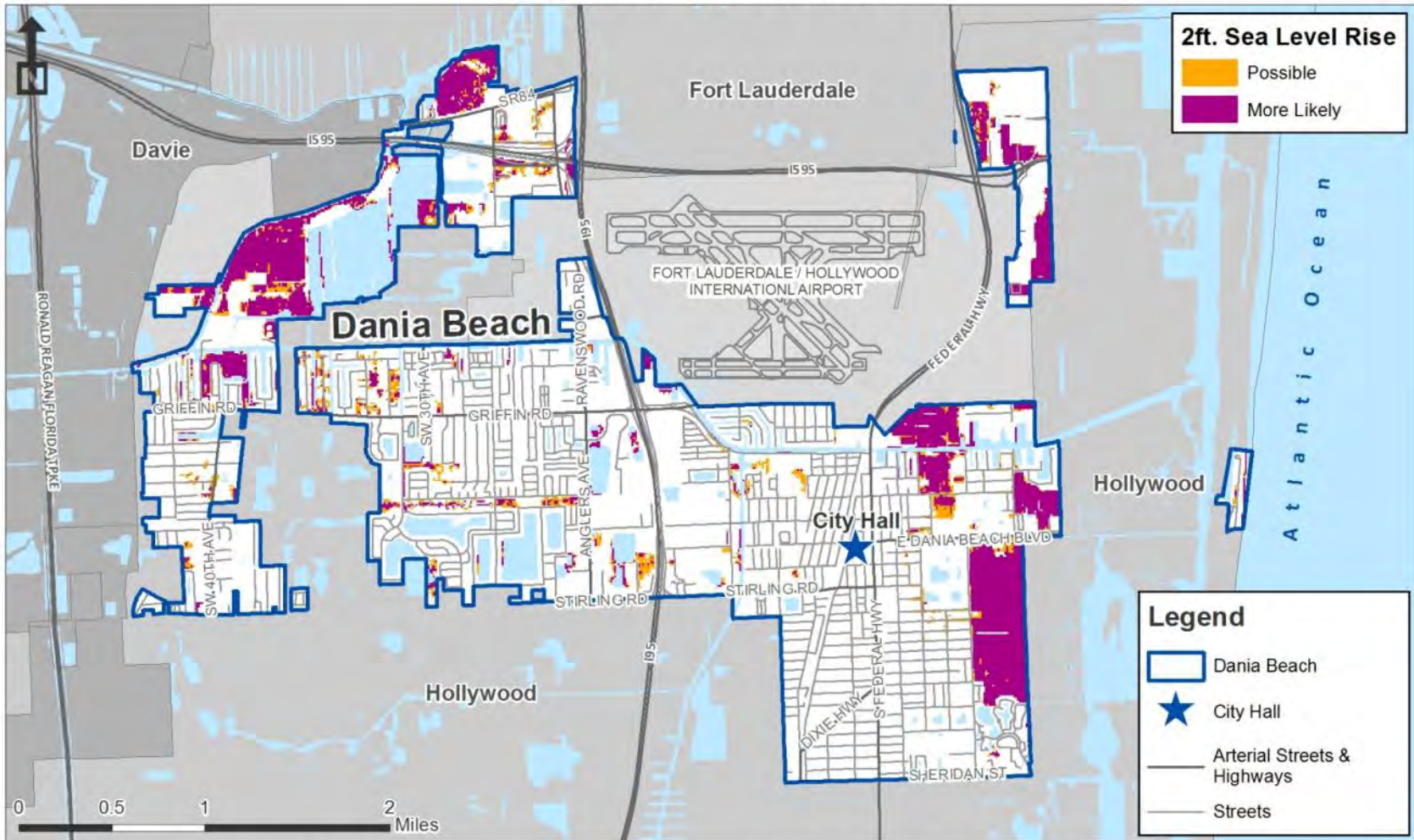


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Date: 12/24/2013
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CITY OF DANIA BEACH INUNDATION MAP

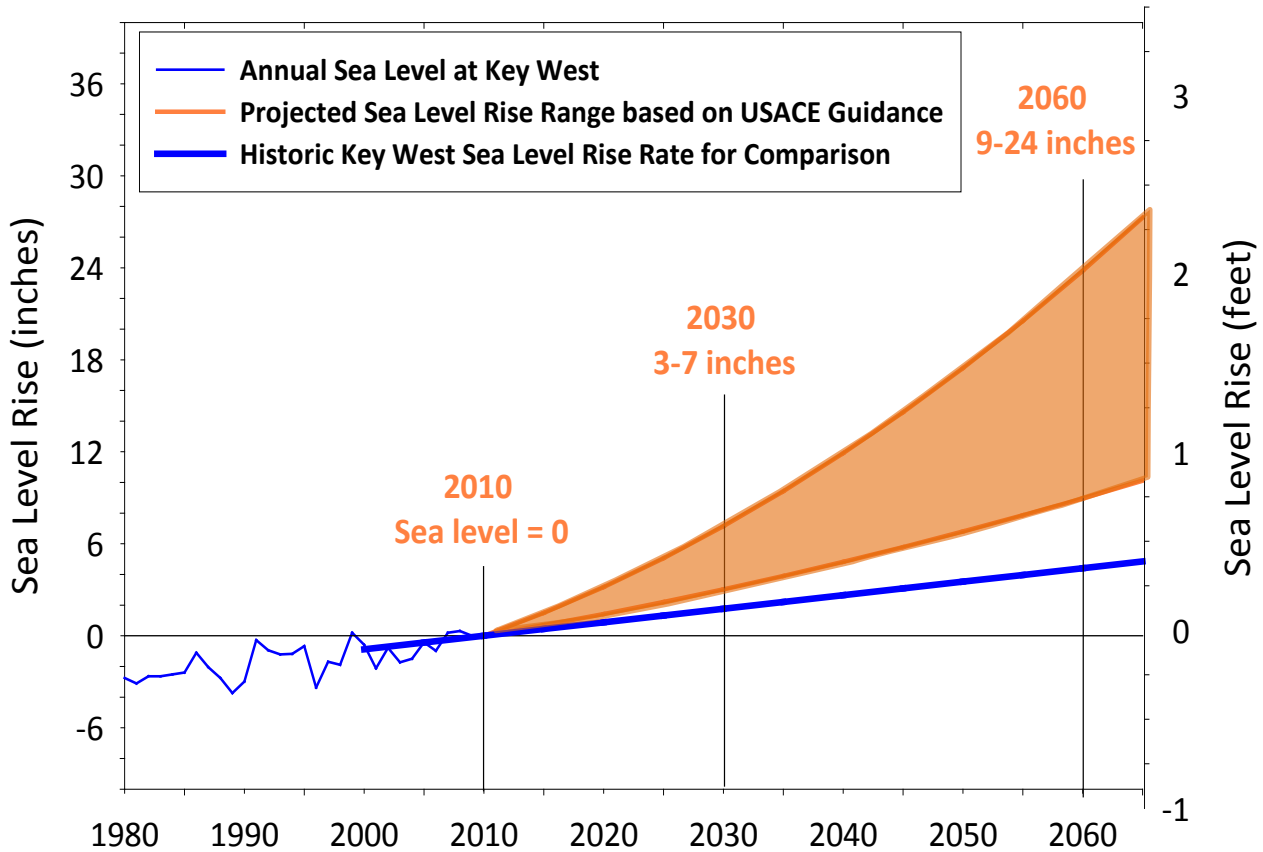
Two Foot Sea Level Rise



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 the one and two foot scenarios. 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 City of Dania Beach municipal infrastructure in the list. Detailed maps and tables follow.

1. Airports:

There are no airports in the City of Dania Beach.

2. Bridges:

Included is a graphic that provides the location of all 24 bridges located in the City of Dania Beach 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:

A total of four segments of arterial roads maintained by the City of Dania Beach were found to be potentially vulnerable to sea level rise. No segments have areas below projected sea levels during the one foot scenario. Four segments showed vulnerabilities during the two foot scenario. SW 32nd St may have as much as 97% of the roadway located at or below projected sea levels during the two foot scenario. Included in this report is an overview map of the City of Dania Beach with the locations of all vulnerable arterial road segments, a table to assess each vulnerable segment, and large-scale maps of the vulnerable segments.

4. City Hall:

The City of Dania Beach city hall showed no vulnerability to sea level rise during the one or two foot scenarios.

5. City Parks:

A total of five city parks in the City of Dania Beach were found to be potentially vulnerable to sea level rise. Two parks were found to be vulnerable during the one foot scenario. Five parks were vulnerable during the two foot scenario. Included in this report is an overview map of the City of Dania Beach with the locations of the five vulnerable city parks, a table to assess each vulnerable park, and large-scale maps of the vulnerable parks.

6. Regional Parks & Nature Centers:
Two nature centers within the City of Dania Beach may be vulnerable to sea level rise: Secret Woods and Anne Kolb / West Lake. Both parks have over 60% of land located at or below projected sea levels beginning during the one foot scenario. Included is an overview map of the City of Dania Beach with the location of the vulnerable nature centers, a table to assess each vulnerable nature center, and large-scale maps for the one and two foot scenarios.
7. Community Redevelopment Areas (CRA):
The Dania Beach CRA has areas with elevations below sea level during the one and two foot scenarios. Much of the vulnerable area is located within open space and agricultural land. Included is an overview map of the City of Dania Beach with the location of the vulnerable CRA, a table to provide information on the vulnerable CRA, and large-scale maps of the CRAs during the one and two foot scenario.
8. Evacuation Routes:
There is one designated evacuation route within the City of Dania Beach with land located at or below projected sea levels; Dania Beach Blvd. Included is an overview map of the City of Dania Beach with the location of the vulnerable evacuation route segment, and a table to provide information on the vulnerable route.
9. Fire Rescue Stations:
No fire rescue stations in the City of Dania Beach showed potential vulnerability to sea level rise during the one or two foot scenarios.
10. Hospitals:
There are no hospitals in the City of Dania Beach.
11. Law Enforcement Assets:
No law enforcement assets in the City of Dania Beach showed potential vulnerability to sea level rise during the one or two foot scenarios.
12. Schools:
One school, Collins Elementary School, may have land located at or below projected sea levels during the two foot scenario. The vulnerable area is limited to the open land on the North-East side of the parcel. The building footprint is not vulnerable.
13. Potable Water Treatment:
No potable water treatment plants in the City of Dania Beach showed potential vulnerability to projected sea level rise during the one and two foot scenarios.
14. Waste Water Treatment:
There are no waste water treatment plants in the City of Dania Beach.

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 Dania Beach 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.

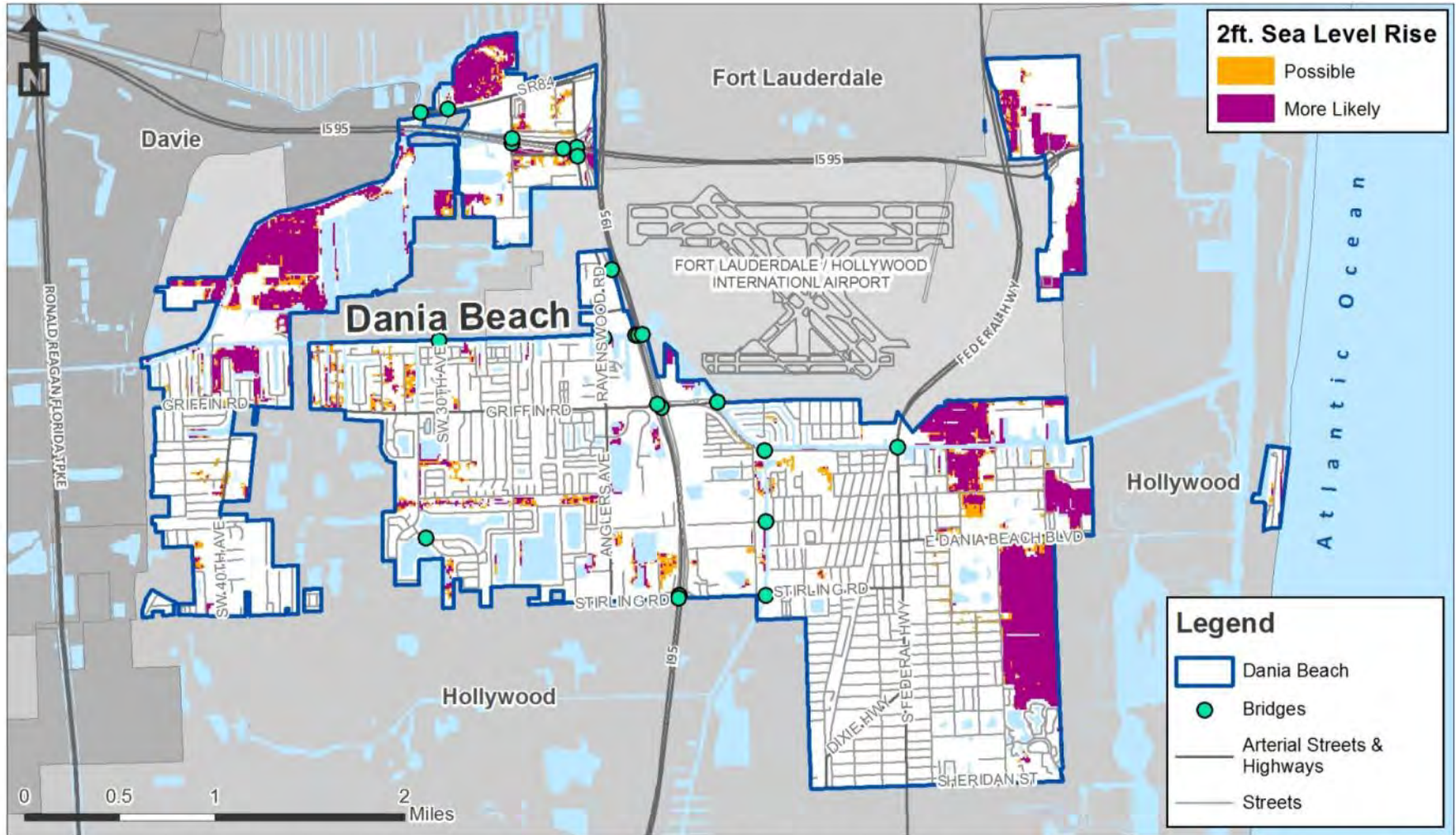
Python Script: A widely-used general purpose programming language. It is used in ArcGIS to automate processes whereby new geographic information is created from existing data.

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

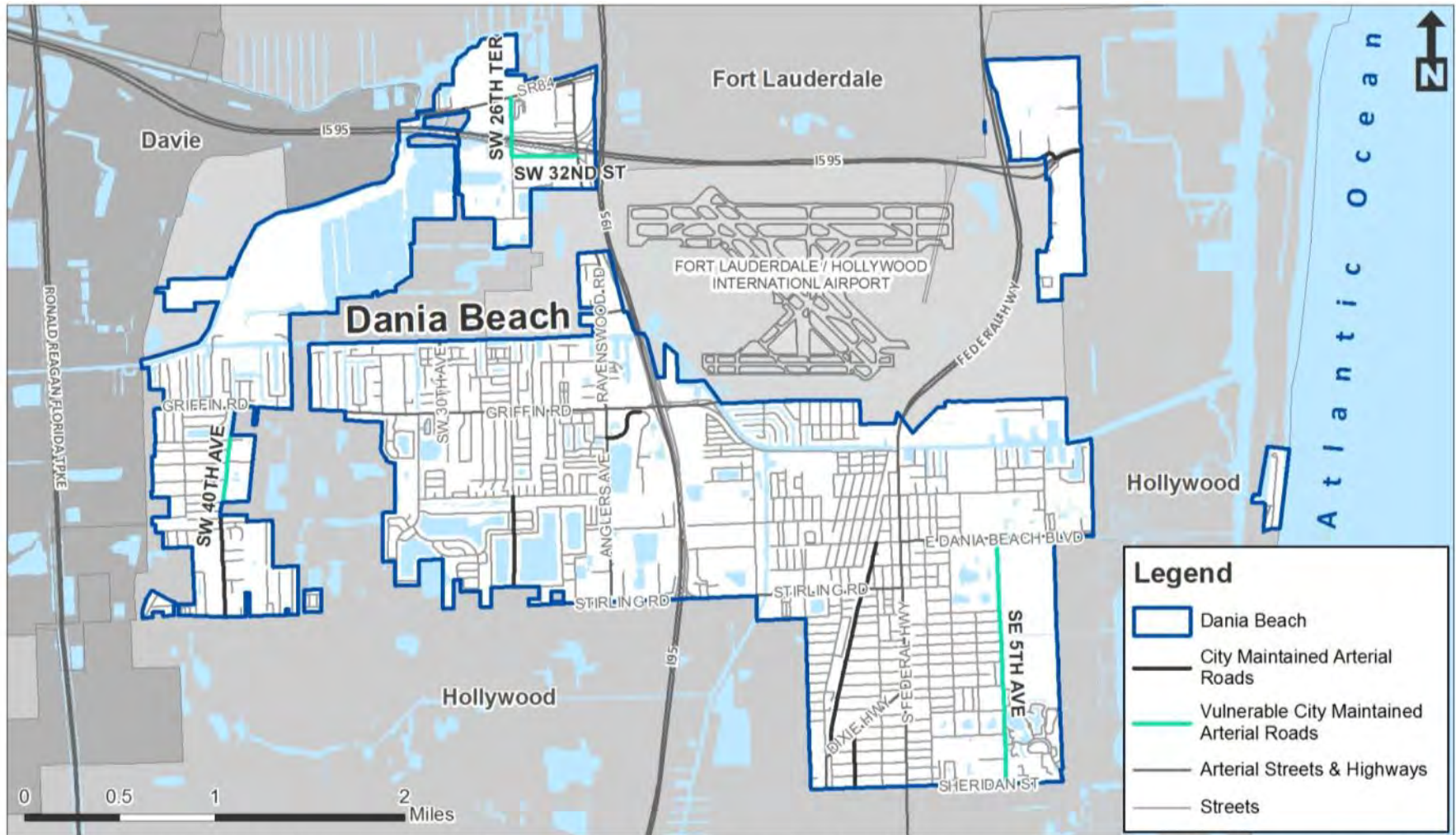


This Map identifies areas at increased risk of inundation up to a two foot sea level rise scenario, projected to occur as soon as 2060.
 This map is for conceptual purposes only and should not be used for legal boundary determinations.

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 Natural Resources Planning and Management Division

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City Arterial Roads Vulnerability Assessment



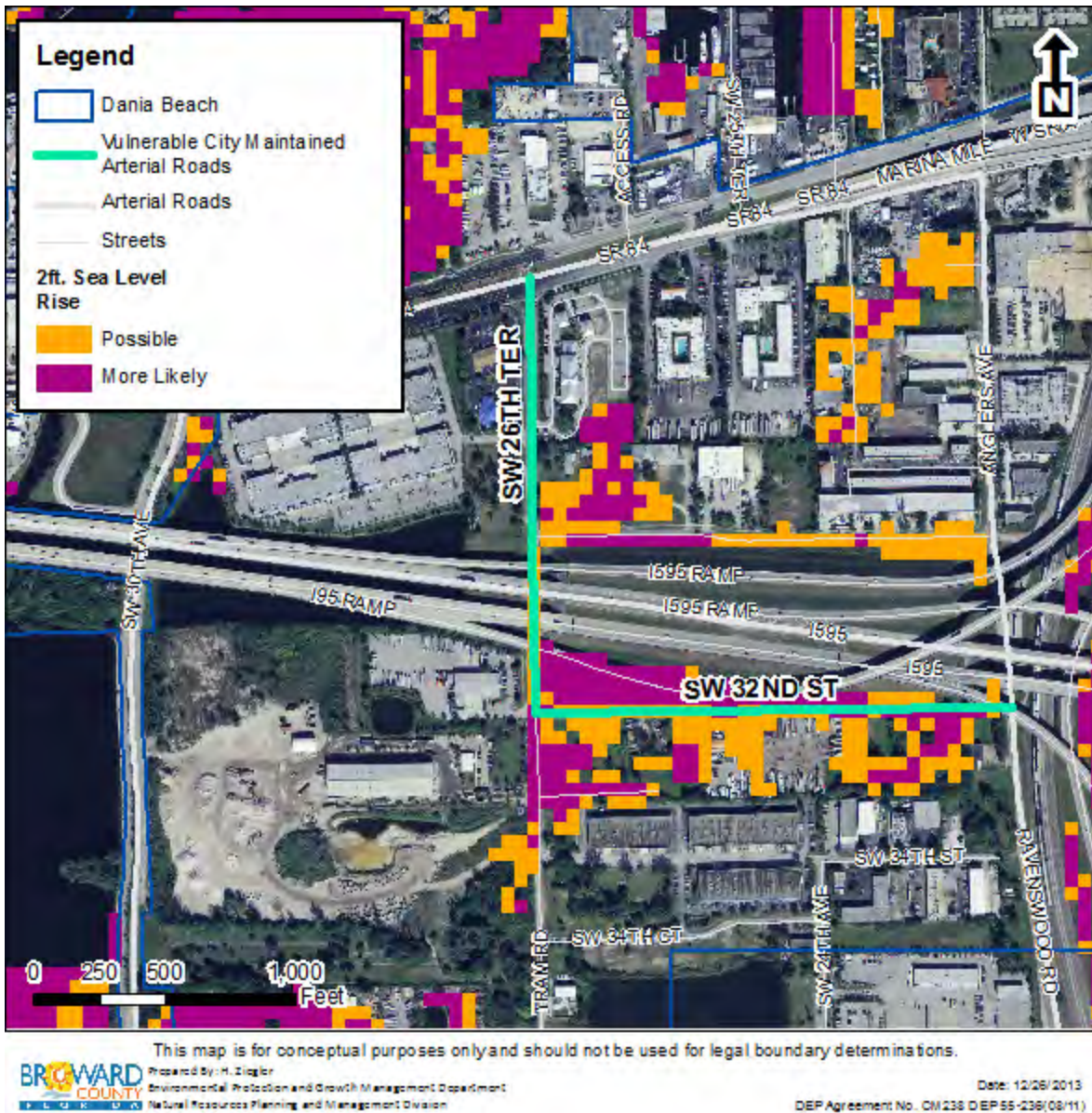
This Map identifies areas at increased risk of inundation up to a two foot sea level rise scenario, projected to occur as soon as 2060.
 This map is for conceptual purposes only and should not be used for legal boundary determinations.

Table of Vulnerable City Arterial Roads

The following table lists the four vulnerable segments of arterial roads maintained by the City of Dania Beach. For each segment, the table provides the miles of vulnerable roadway and the total length with vulnerability expressed in percent during both the one and two foot sea level rise scenarios.

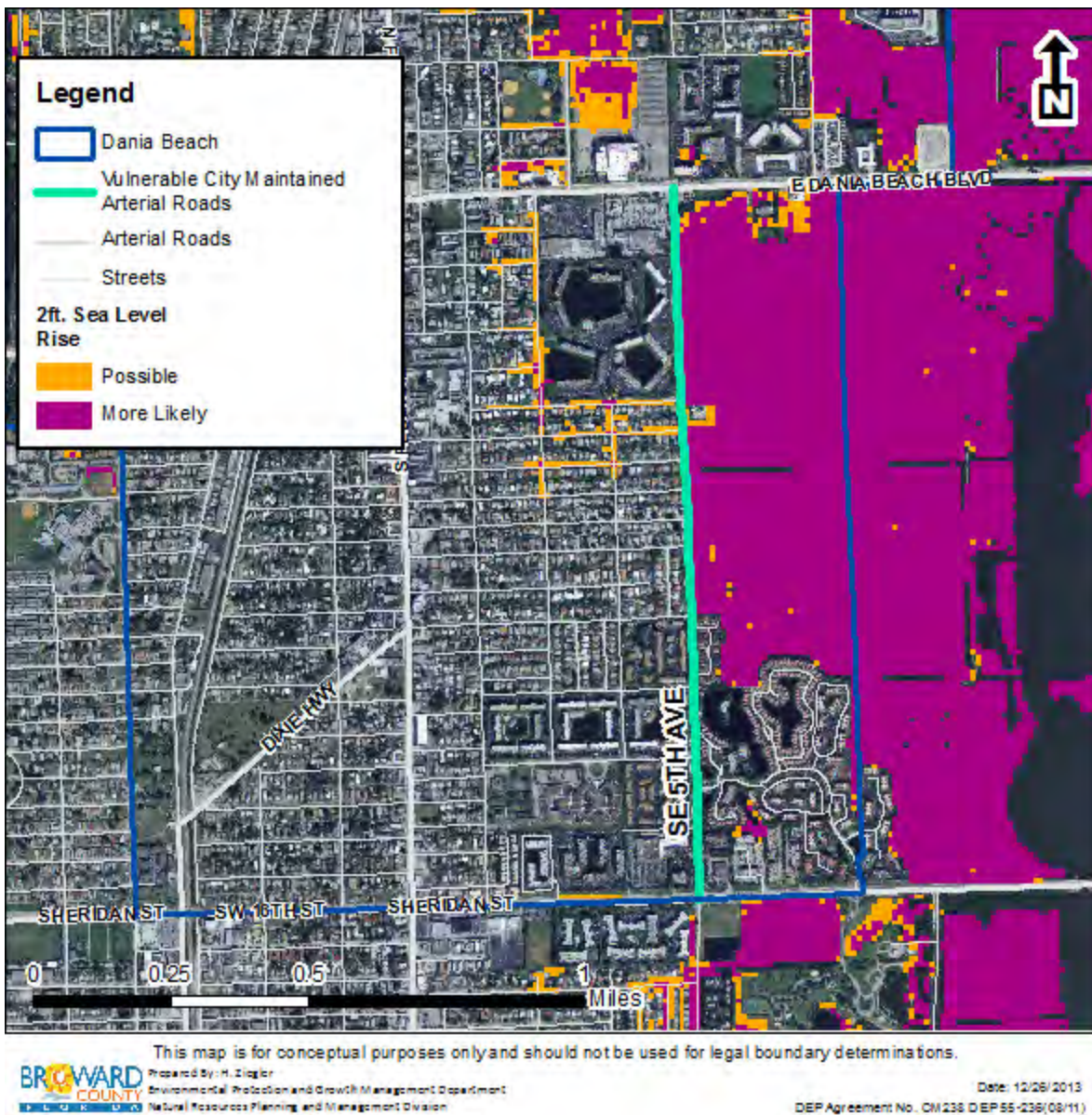
SE 5 Ave, Sheridan St to Dania Beach Blvd			Total Miles
			1.29
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	0.07	0.00	6%
SW 26 Ter, from SW 36 St to SR 84			Total Miles
			0.31
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	0.11	0.01	38%
SW 32 St, from SW 26 Ter to Ravenswood Rd			Total Miles
			0.34
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	0.20	0.14	97%
SW 40TH AVE			Total Miles
			0.37
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	0.11	0.05	43%

SW 26th Ter & SW 32nd St Two Foot Sea Level Rise Scenario



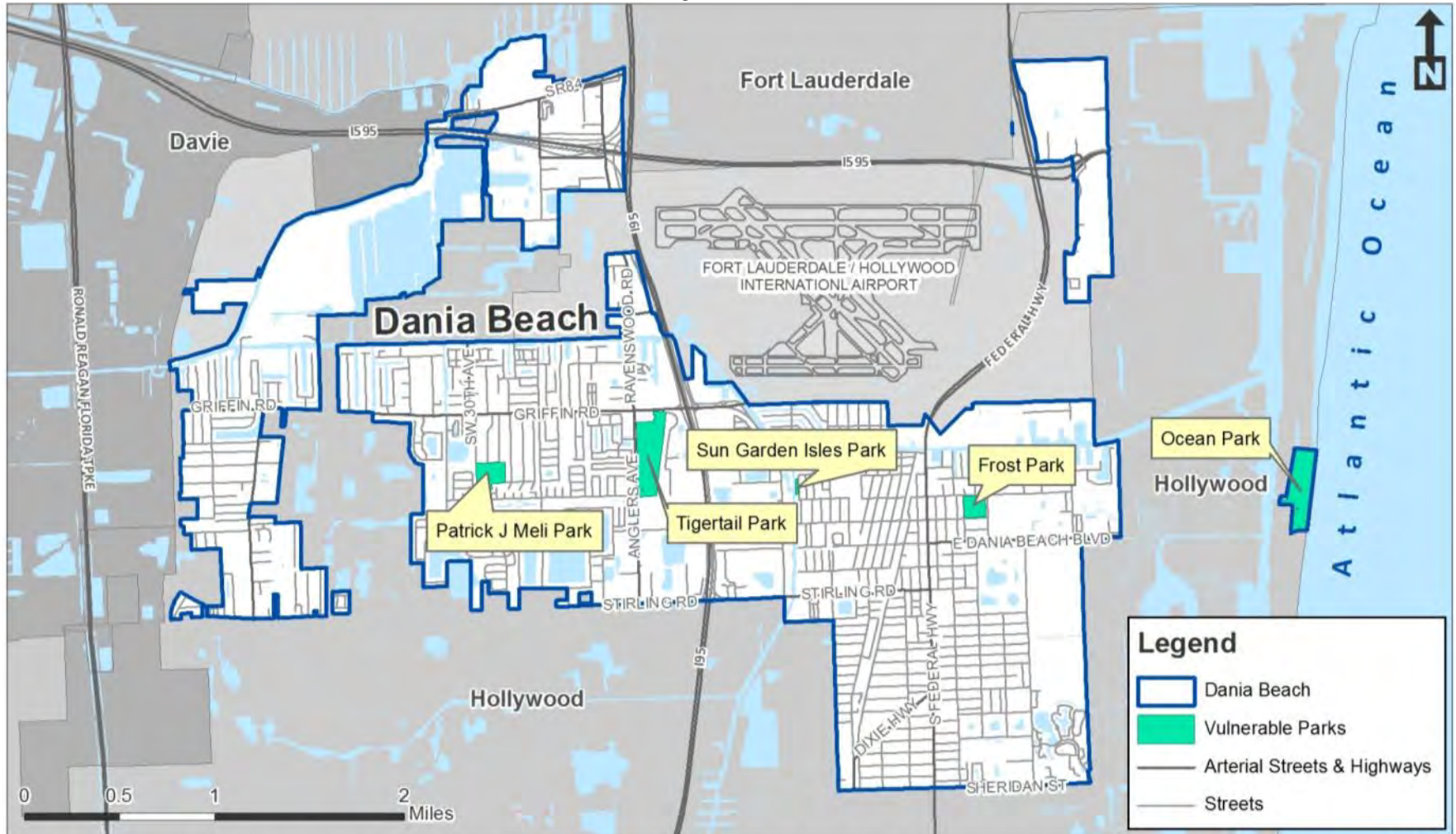
This Map provides a view of SW 26th Ter and SW 32nd St. The 0.34 mile SW 32nd St may have as much as 97% of the roadway located at or below projected sea levels during the two foot scenario. A 0.31 mile segment of SW 26th St may have up to 38% of its length located at or below projected sea levels during the two foot scenario. Neither road is vulnerable during the one foot scenario.

SE 5th Ave Two Foot Sea Level Rise Scenario



This Map provides a view of SE 5th Ave. The roadway is located adjacent to the low lying West Lake – Anne Kolb Nature Center. Up to 6% of the 1.29 mile roadway may be vulnerable during the two foot scenario. The roadway is not vulnerable during the one foot scenario.

City Parks Vulnerability Assessment



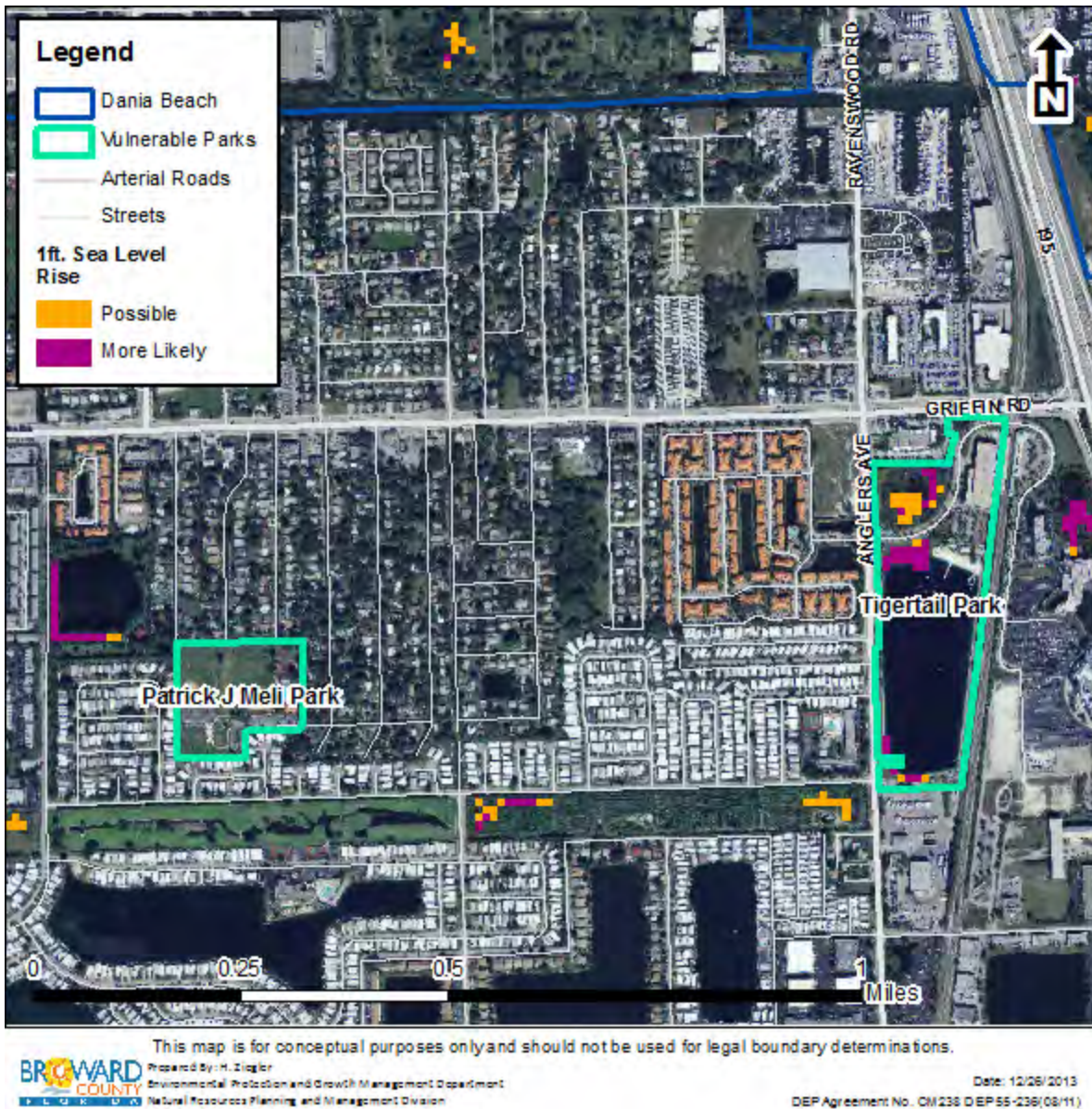
This Map identifies areas at increased risk of inundation up to a two foot sea level rise scenario, projected to occur as soon as 2060.
 This map is for conceptual purposes only and should not be used for legal boundary determinations.

Table of Vulnerable City Parks

The following table lists the five city parks within the City of Dania Beach with vulnerabilities. Two parks are vulnerable during the one foot scenario. Five parks are vulnerable during the two foot scenario. For each park the table provides the acreage of vulnerable area, and the total area of the park with vulnerability expressed in percent. These estimates are based on the area of the entire park and the inundation grid and do not subtract existent water bodies within the park to determine the percent value.

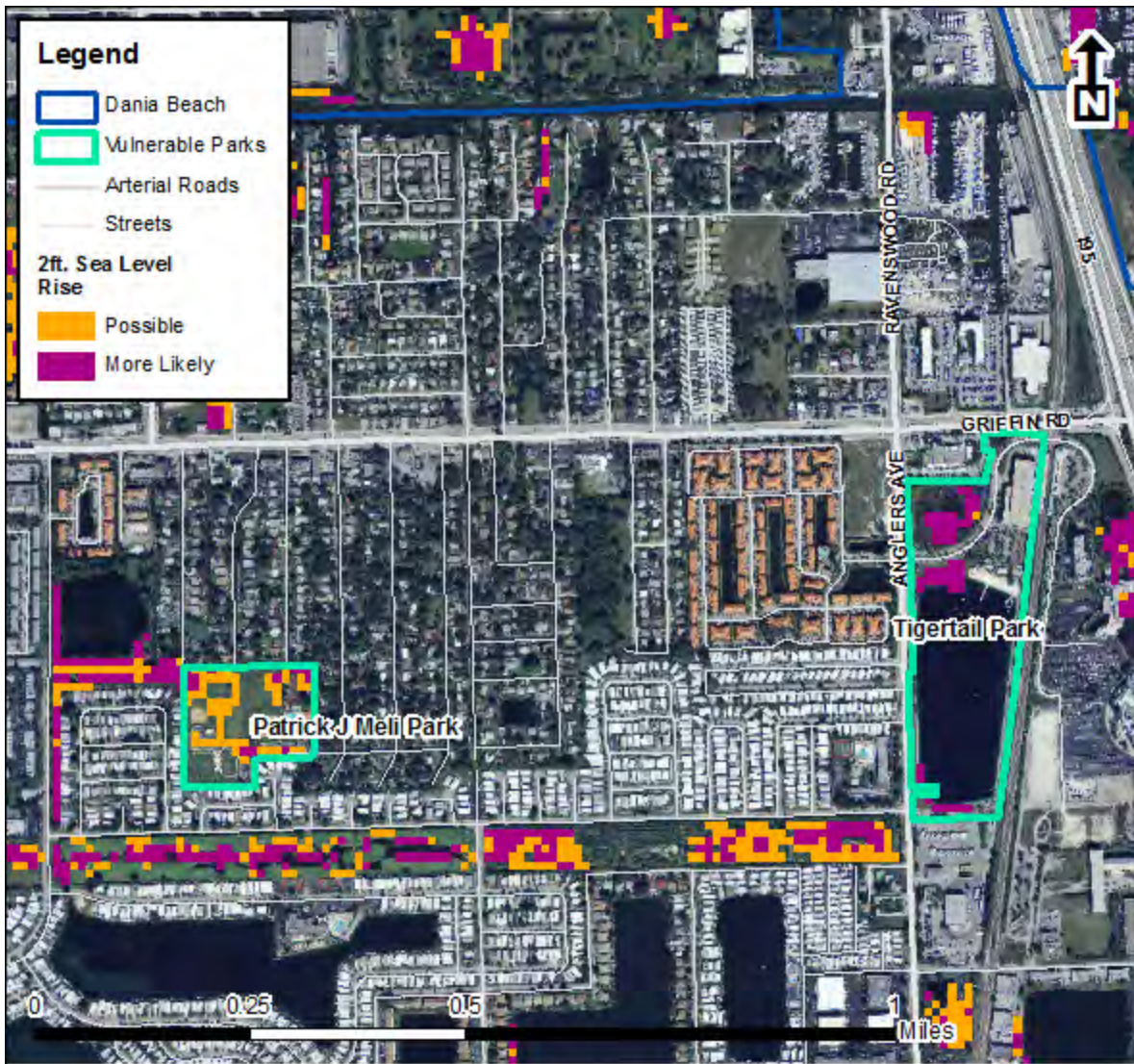
Frost Park, 300 NE 2nd St			Total Acres
			8.53
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	0.18	0.00	2%
Sun Garden Isles Park, 239 NW 14th Way			Total Acres
			0.65
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	0.36	0.13	76%
Tigertail Park, 580 Gulfstream Way			Total Acres
			33.75
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.98	1.61	8%
2 Foot	0.06	2.75	8%
Ocean Park, 100 N Beach Rd			Total Acres
			31.44
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.36	1.96	7%
2 Foot	1.50	2.87	14%
Patrick J Meli Park, 2901 SW 52nd St			Total Acres
			12.30
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	0.00	0.00	0%
2 Foot	2.92	0.81	30%

Patrick J Meli Park & Tigertail Park One Foot Sea Level Rise Scenario



This map provides a view of Patrick J. Meli Park and Tigertail Park during the one foot sea level rise scenario. Patrick J. Meli Park is not vulnerable during the one foot scenario. Tigertail Park may have up to 8% of land located at or below projected sea levels during the one foot scenario. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Patrick J Meli Park & Tigertail Park Two Foot Sea Level Rise Scenario



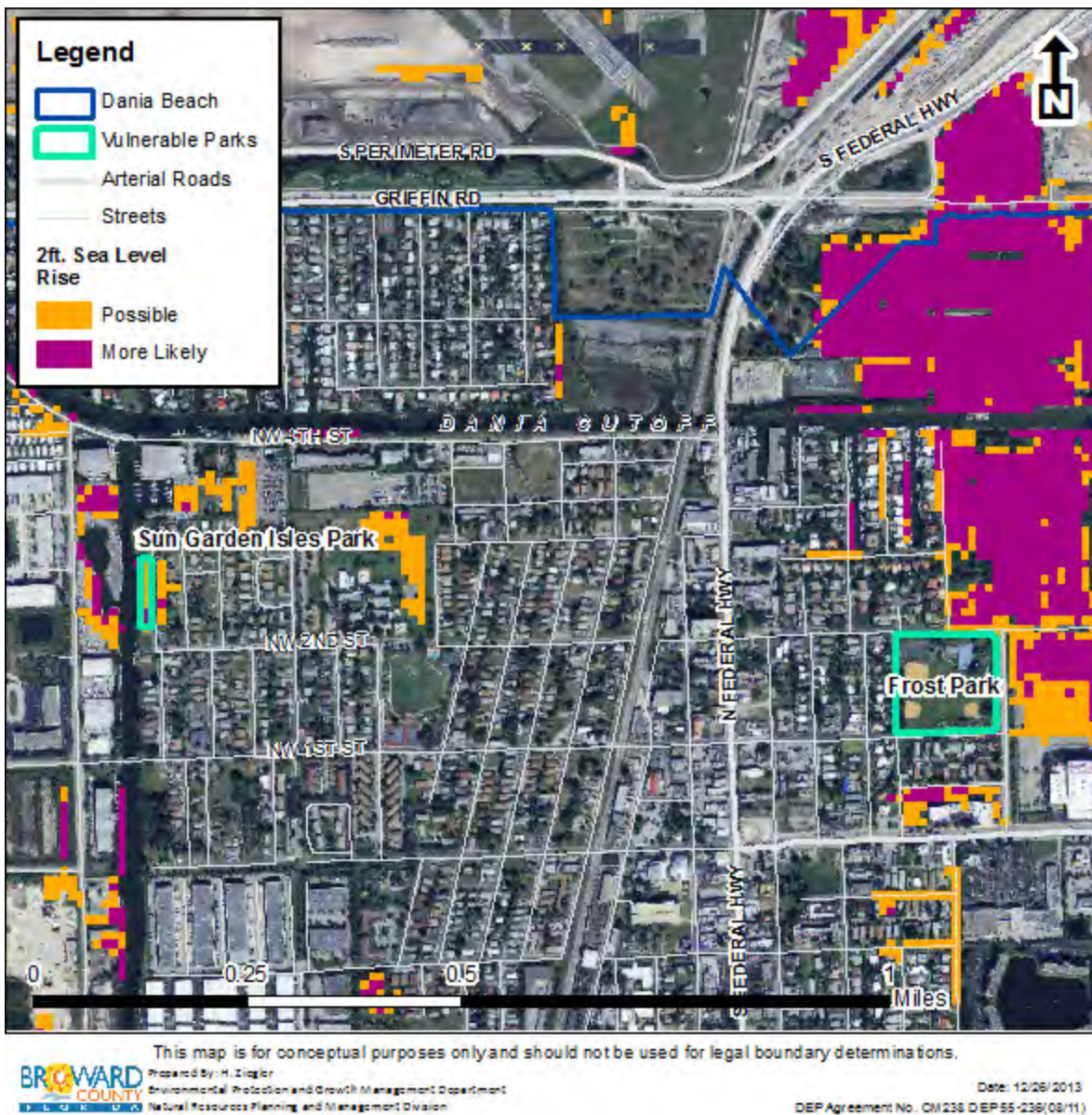
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 Environmental Protection and Growth Management Department
 Natural Resources Planning and Management Division

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This map provides a view of Patrick J. Meli Park and Tigertail Park during the two foot sea level rise scenario. Patrick J. Meli Park may have up to 30% of land located at or below projected sea levels during the two foot scenario. In Tigertail Park, land located at or below projected sea levels remains at 8% during the two foot scenario. However, a larger portion of that 8% of land is “more likely” to be vulnerable. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

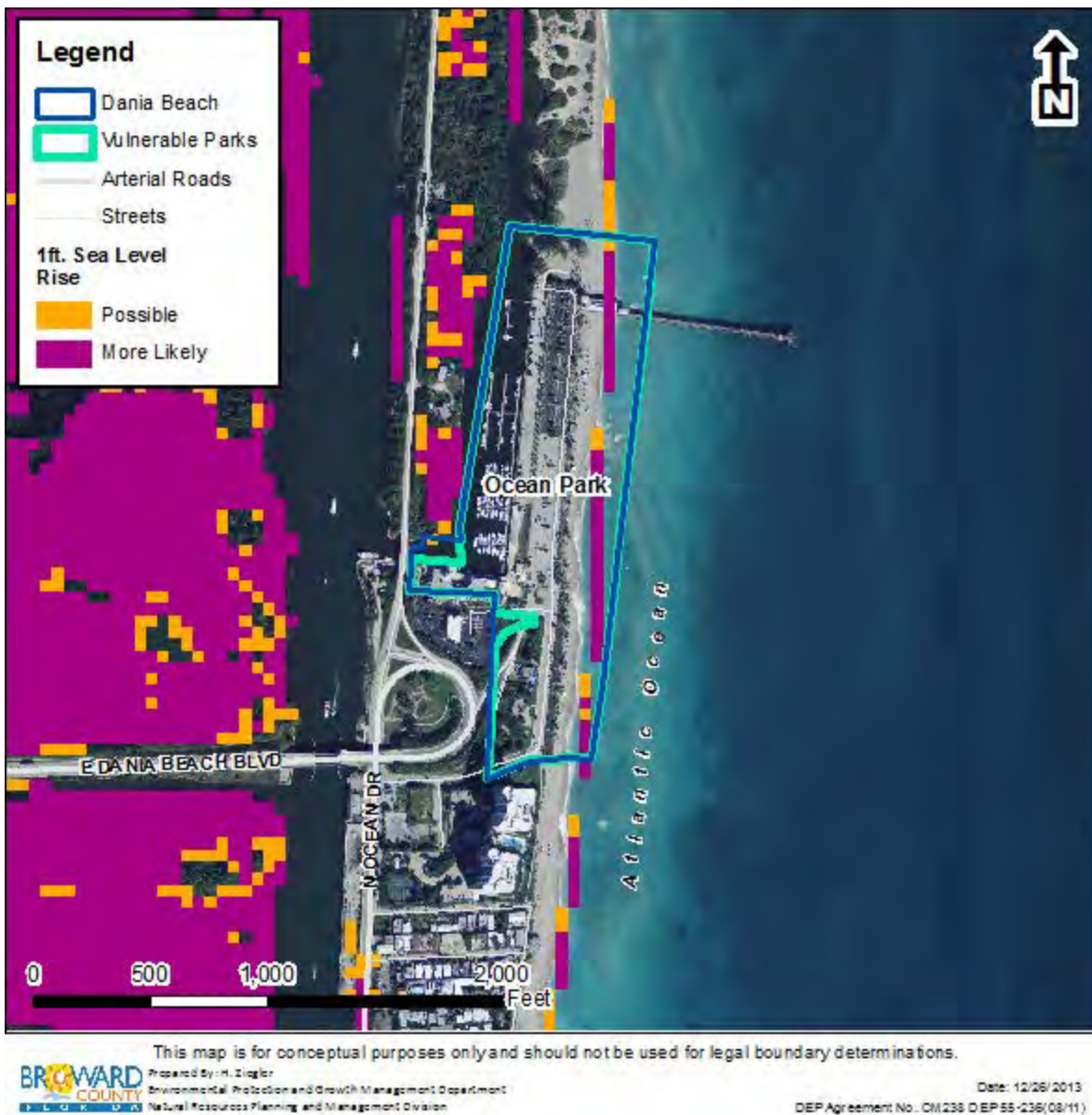
Sun Garden Isles Park & Frost Park Two Foot Sea Level Rise Scenario



This map provides a view of Sun Garden Isles Park and Frost Park during the two foot sea level rise scenario. Sun Garden Isles Park may have up to 76% of land located at or below projected sea levels during the two foot scenario. Frost Park may have up to 2% of land vulnerable, with the vulnerable land being marginal where the park borders low lying land. Neither park is vulnerable during the one foot sea level rise scenario.

Ocean Park

One Foot Sea Level Rise Scenario



This map provides a view of Ocean Park during the one foot sea level rise scenario. During this scenario, Ocean Park may have up to 7% of land located at or below projected sea levels. The vulnerable area is located along the beach, parallel with the Atlantic Ocean. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Ocean Park

Two Foot Sea Level Rise Scenario



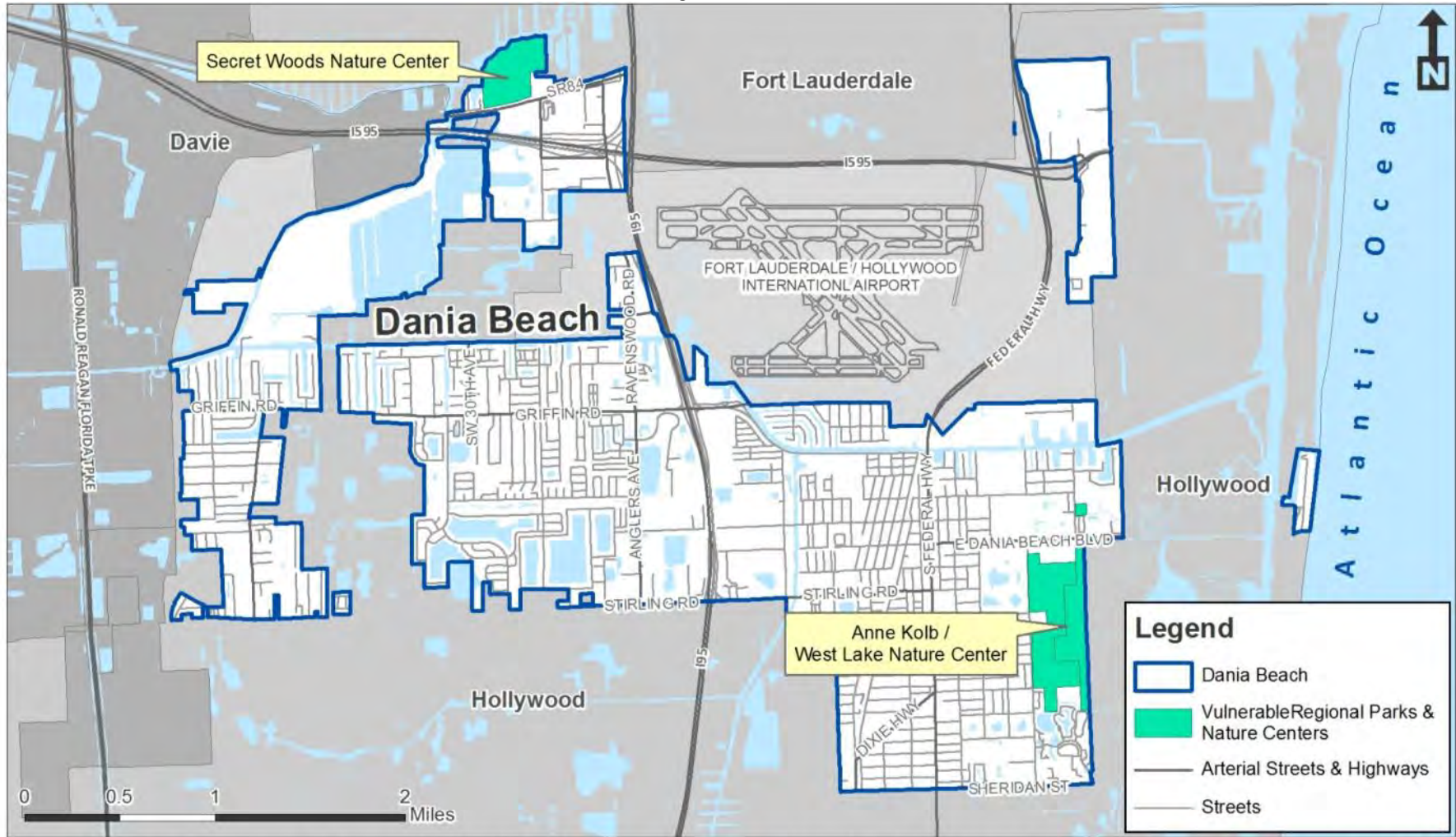
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This map provides a view of Ocean Park during the two foot sea level rise scenario. During this scenario, Ocean Park may have up to 14% of land located at or below projected sea levels. Much of the vulnerable area is located along the beach parallel to the Atlantic Ocean. A portion of the parking lot is also vulnerable. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Regional Parks & Nature Centers 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.

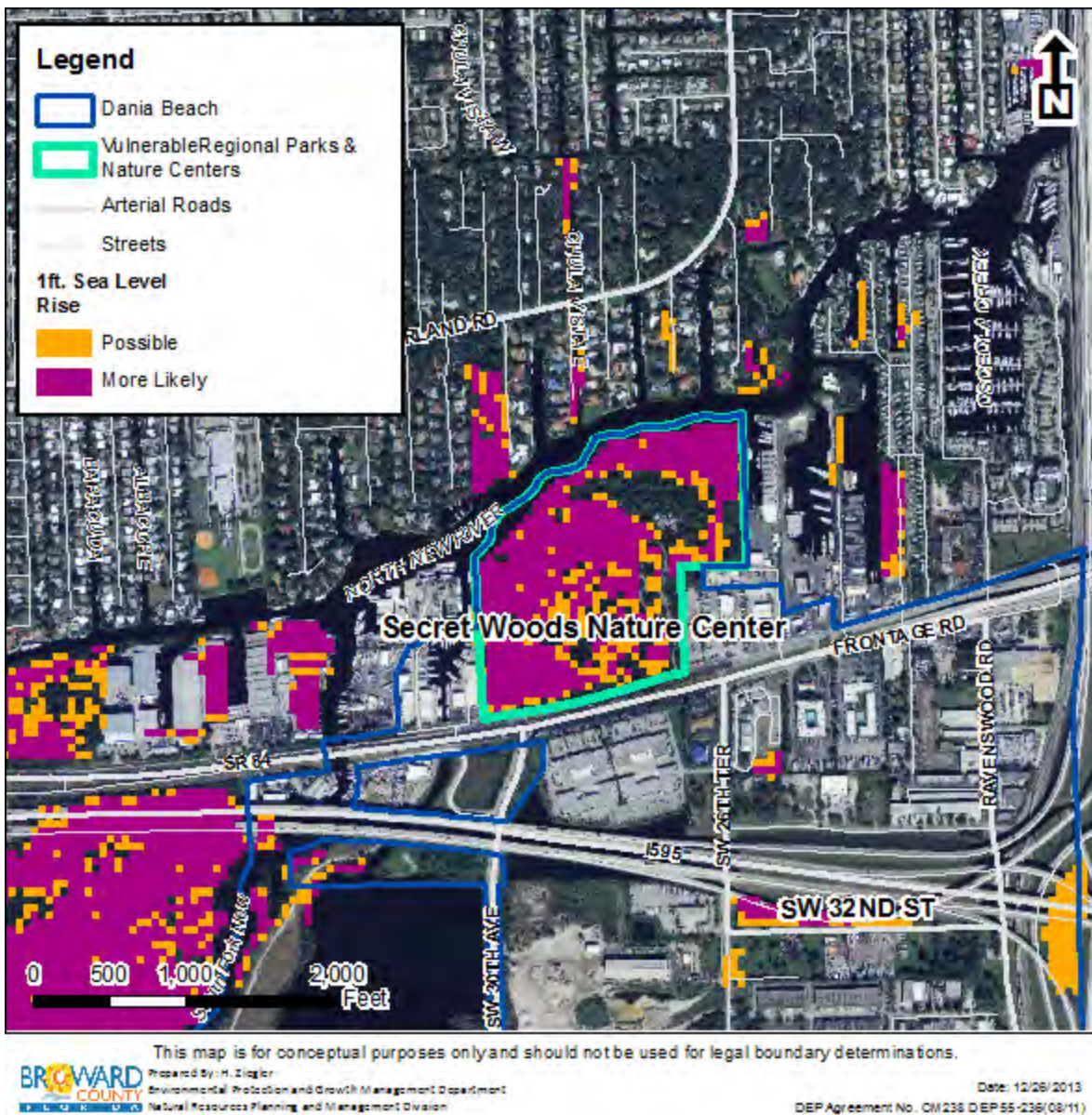
This map is for conceptual purposes only and should not be used for legal boundary determinations.

Table of Vulnerable Regional Parks & Nature Centers

The following table lists vulnerable regional parks & nature centers in the City of Dania Beach. Keep in mind that only a portion of Anne Kolb / West Lake lies within Dania Beach, the majority of the park is located within the City of Hollywood. Both parks have over 60% of land located at or below projected sea levels beginning during the one foot scenario. These estimates are based on the area of the entire park and the inundation grid and do not subtract the area of water bodies within the park to determine the percent value.

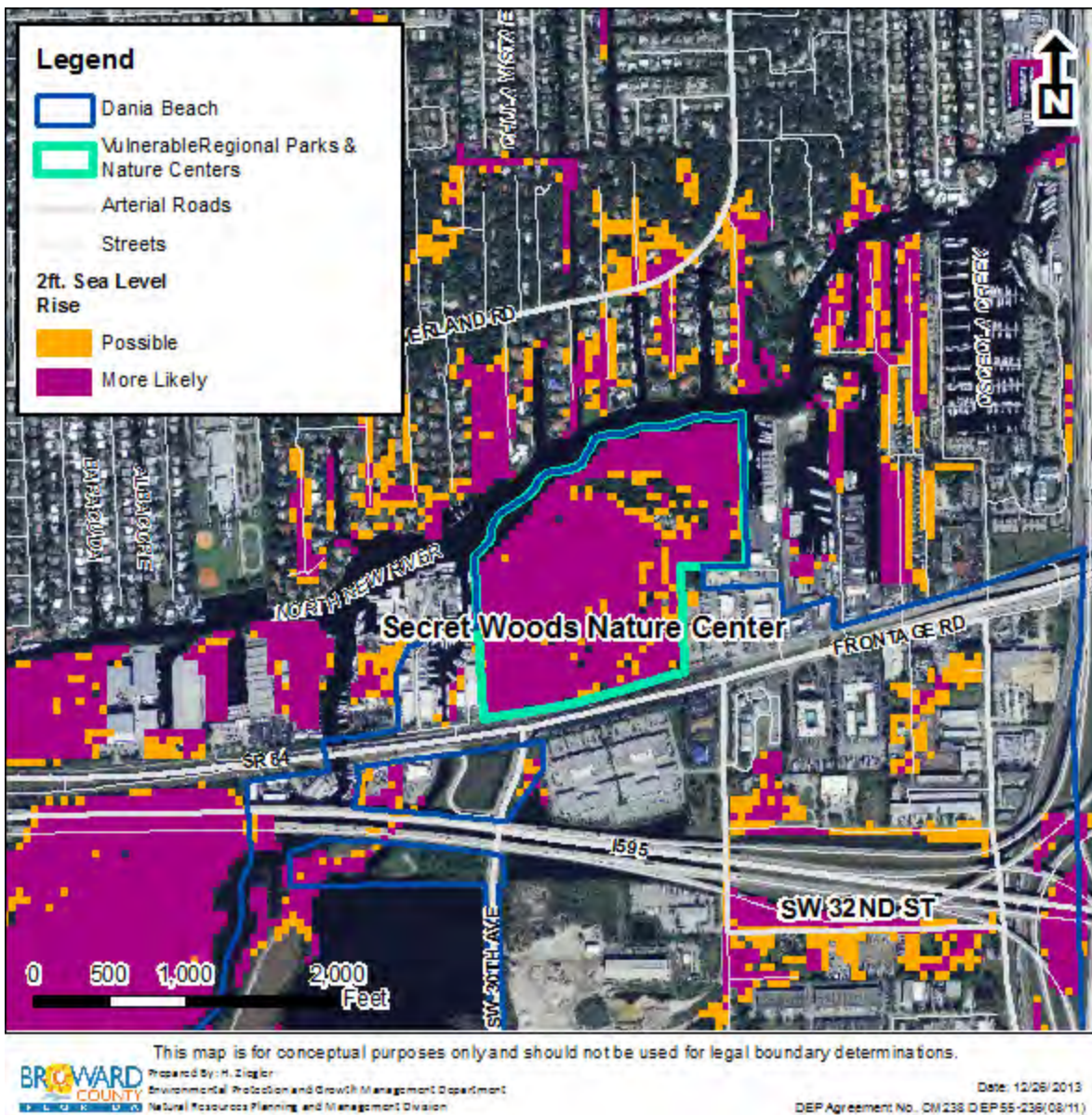
Secret Woods Nature Center, 2701 W State Rd 84			Total Acres
			56.87
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	9.56	28.70	67%
2 Foot	5.23	43.55	86%
Anne Kolb / West Lake Nature Center, 1240 Sheridan Street			Total Acres
			1565.04
SLR Scenario	Possible	More Likely	Percent Total
1 Foot	92.00	981.87	69%
2 Foot	24.94	1101.64	72%

Secret Woods Nature Center One Foot Sea Level Rise Scenario



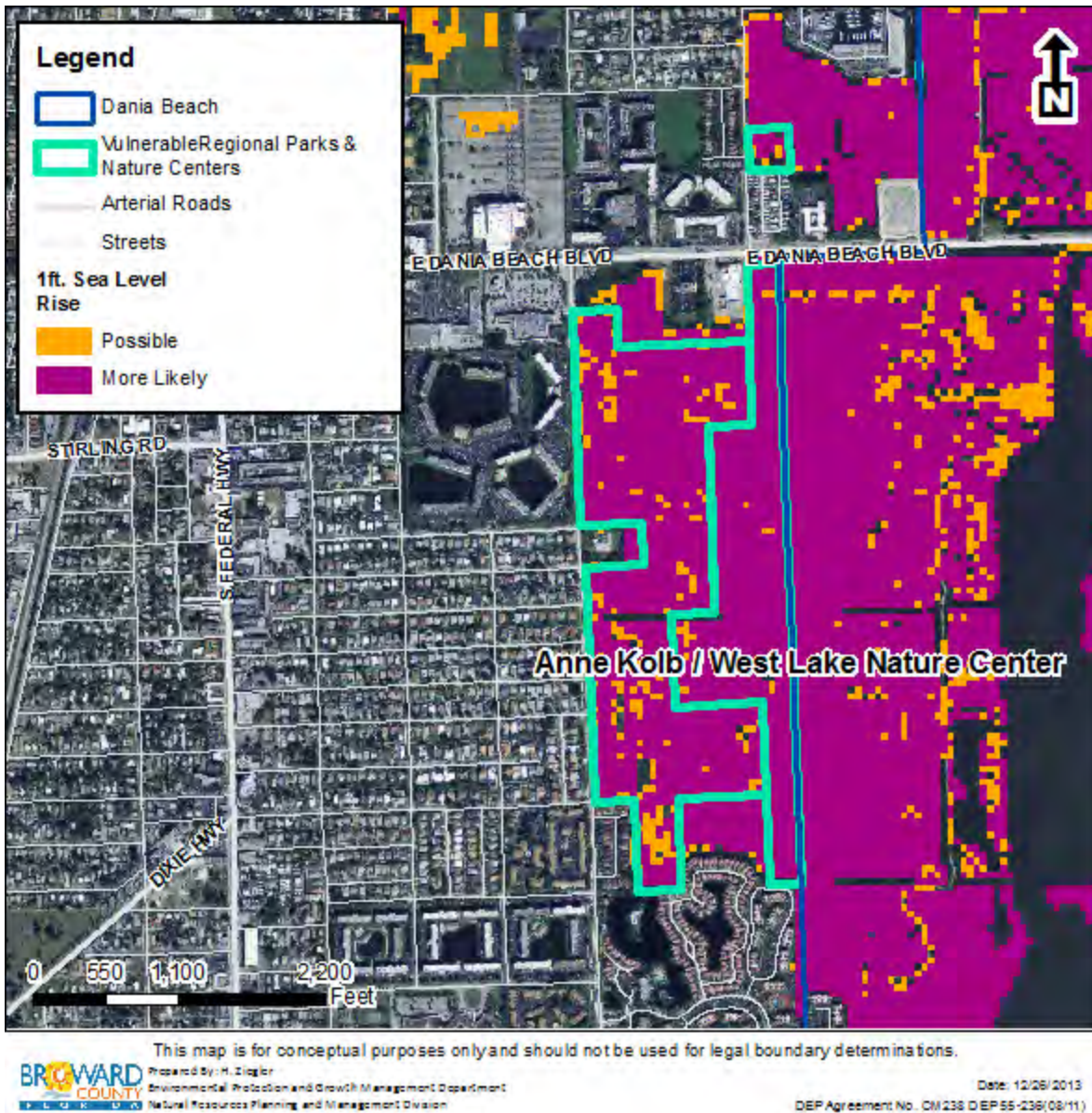
This map provides a view of the Secret Woods Nature Center during the one foot sea level rise scenario. Secret Woods lies adjacent to the tidally influenced North New River and may have up to 67% of land located at or below projected sea levels during the one foot scenario. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Secret Woods Nature Center Two Foot Sea Level Rise Scenario



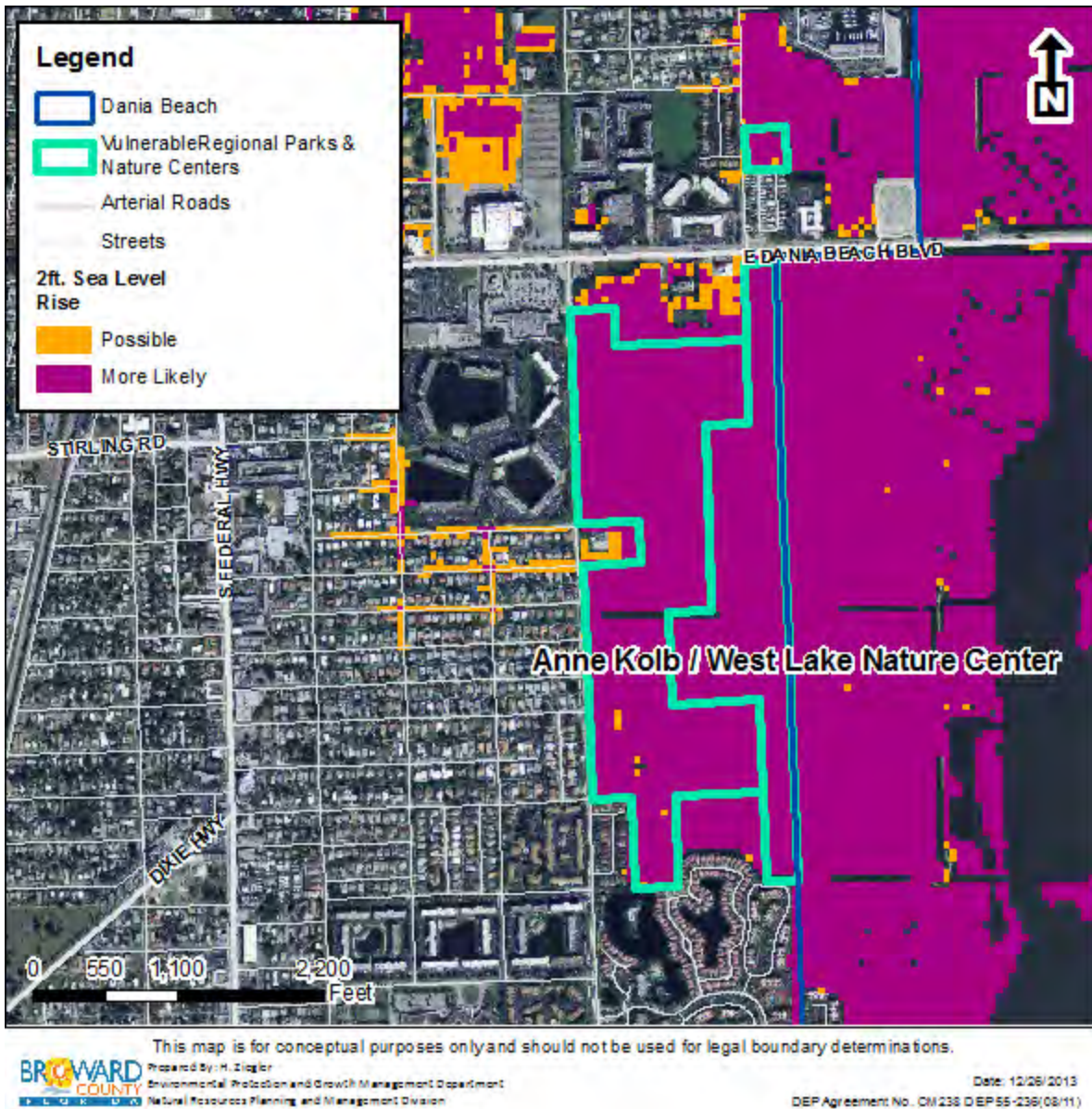
This map provides a view of the Secret Woods Nature Center during the two foot sea level rise scenario. Secret Woods lies adjacent to the tidally influenced North New River and may have up to 86% of land located at or below projected sea levels during the two foot scenario. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Anne Kolb / West Lake Nature Center One Foot Sea Level Rise Scenario



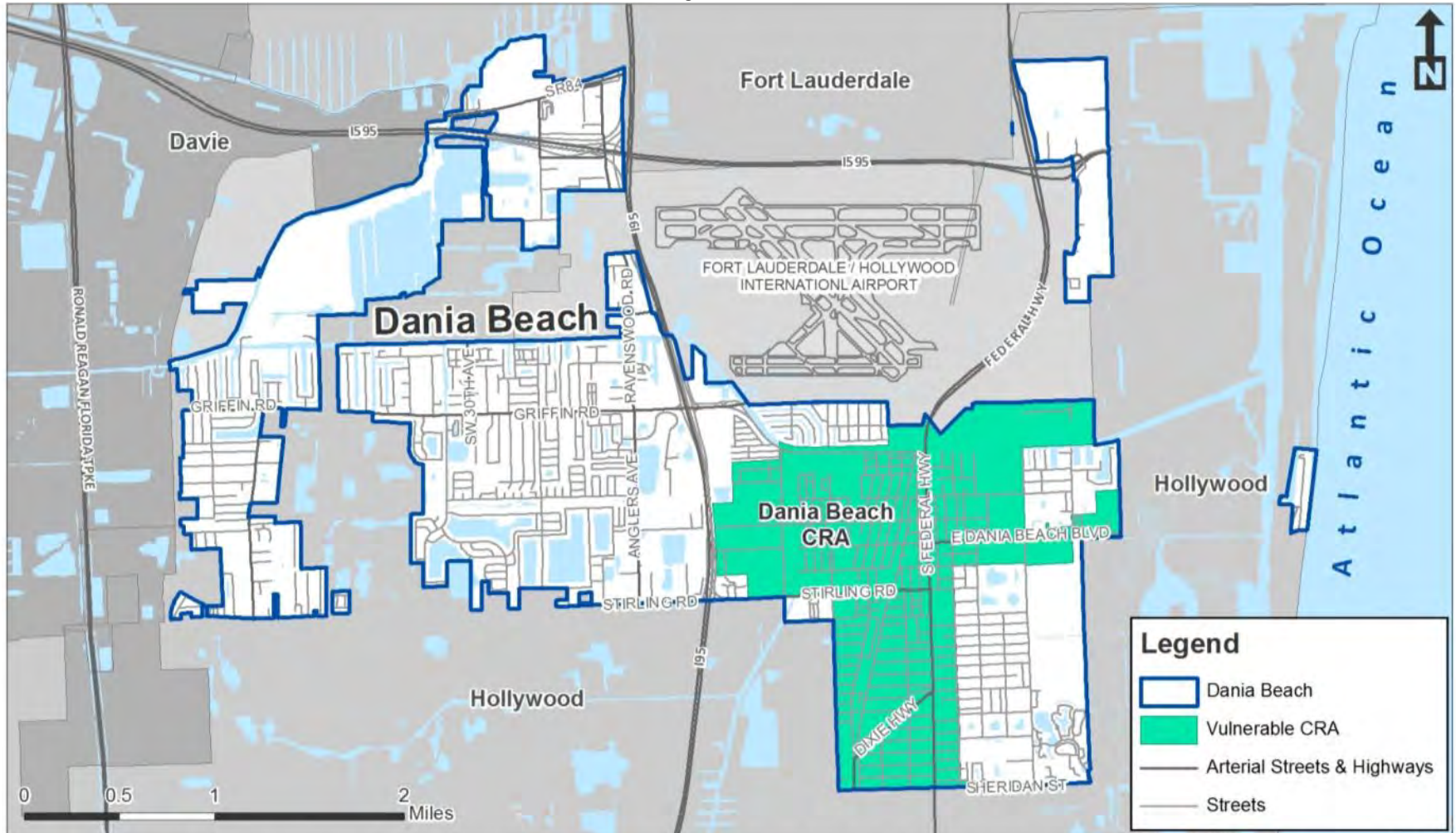
This map provides a view of a portion of the Anne Kolb / West Lake Nature Center during the one foot sea level rise scenario. The remaining portion of the Anne Kolb Nature Center is located within the City of Hollywood. Up to 69% of land within the park may be located at or below projected sea levels during the one foot scenario. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Anne Kolb / West Lake Nature Center Two Foot Sea Level Rise Scenario



This map provides a view of a portion of the Anne Kolb / West Lake Nature Center during the two foot sea level rise scenario. The remaining portion of the Anne Kolb Nature Center is located within the City of Hollywood. Up to 72% of land within the park may be located at or below projected sea levels during the two foot scenario. Note that these estimates are based on the area of the entire park and do not subtract the area of water bodies within the park to determine the percent value.

Community Redevelopment Areas (CRA) 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.

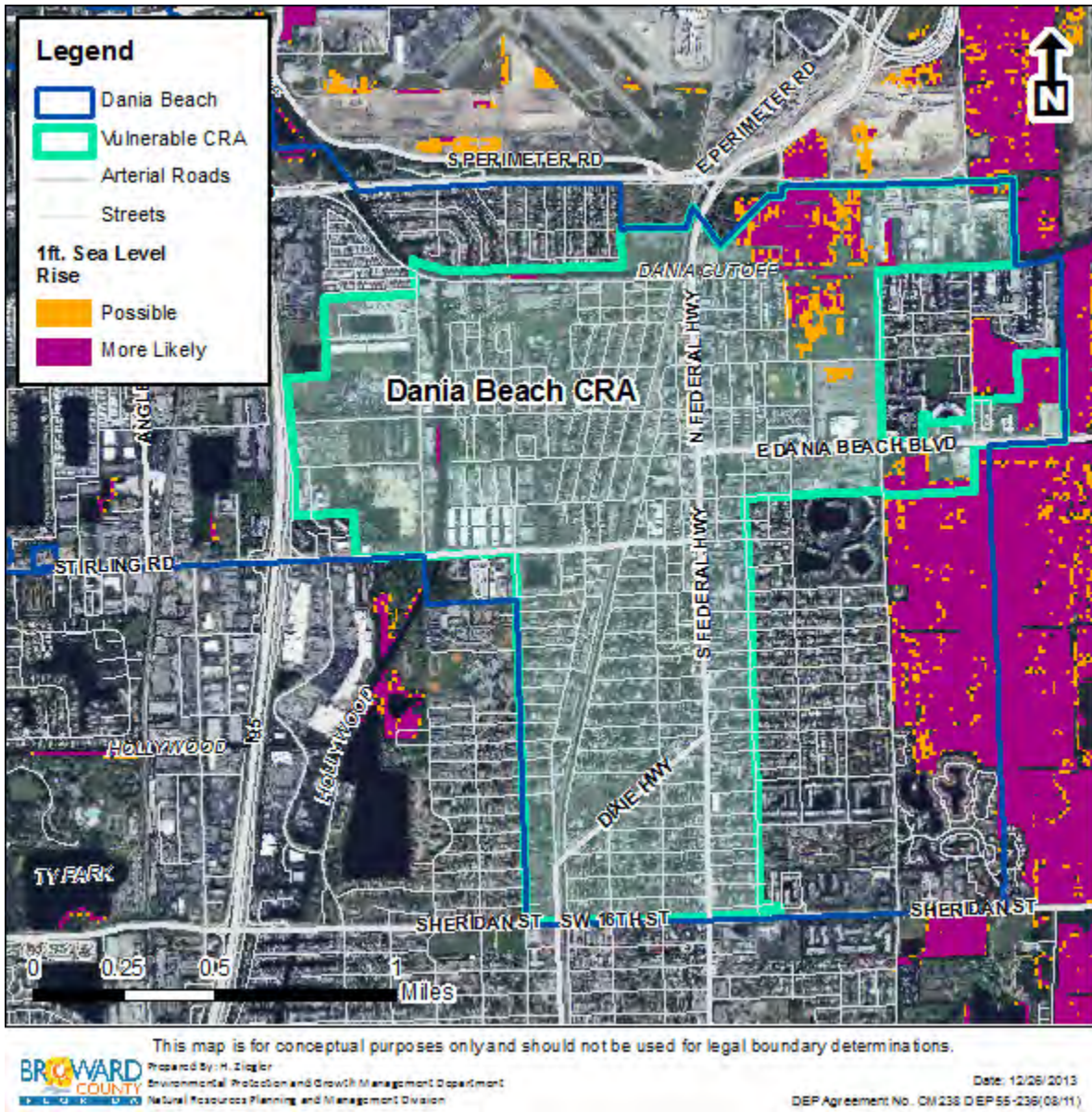
Table of Vulnerable Community Redevelopment Areas (CRA)

The following table lists vulnerable CRAs within the City of Dania Beach during the one and two foot sea level rise scenarios. There is only one CRA in the City of Dania Beach, the Dania Beach CRA, and it is affected during both the one and two foot scenarios.

Vulnerable Community Redevelopment Areas City of Dania Beach		
CRA	One Foot Scenario (Y/N)	Two Foot Scenario (Y/N)
Dania Beach CRA	Y	Y

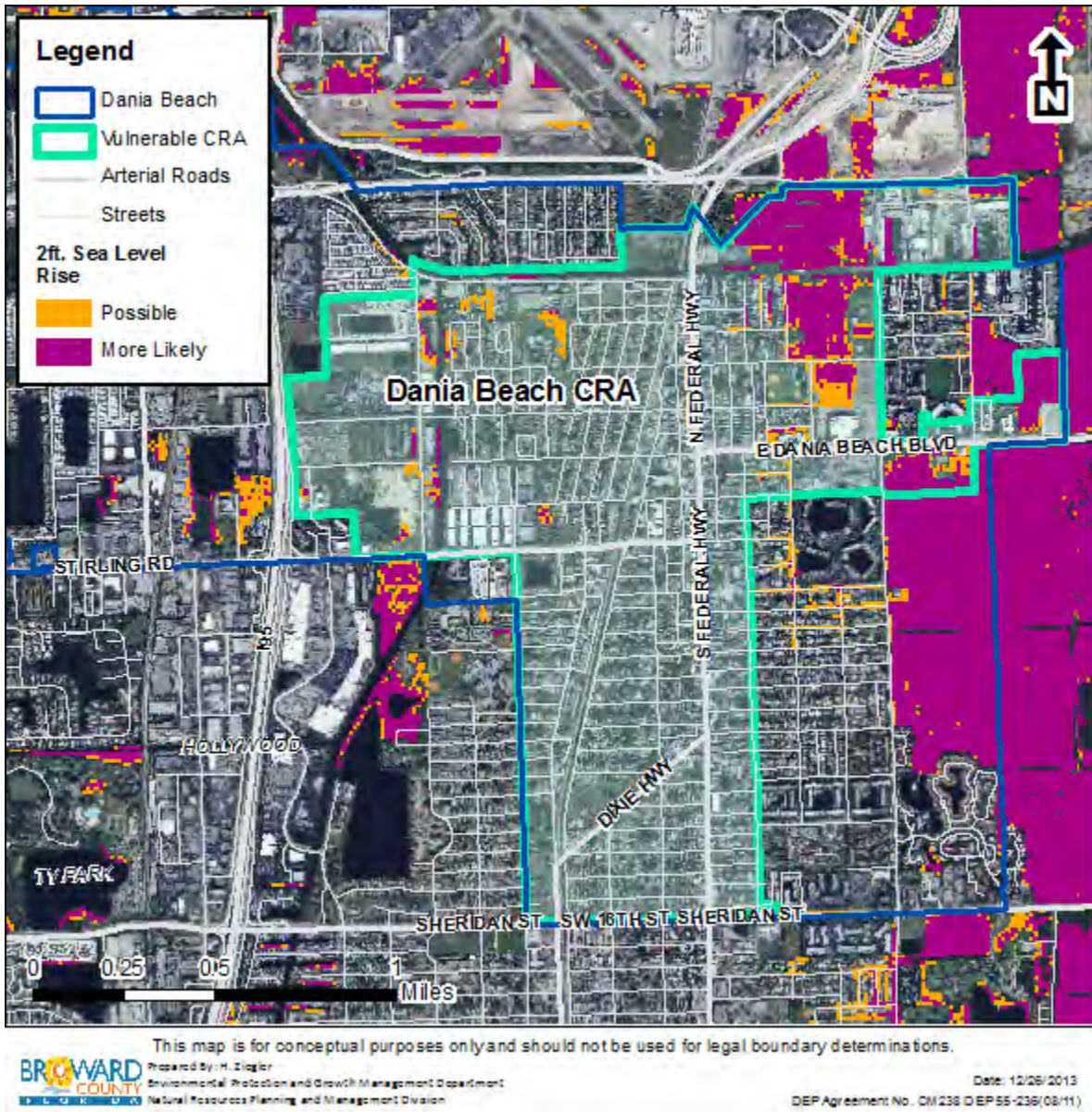
Key: For Y/N, Y = Yes, N = No

Dania Beach Community Redevelopment Area (CRA) One Foot Sea Level Rise Scenario



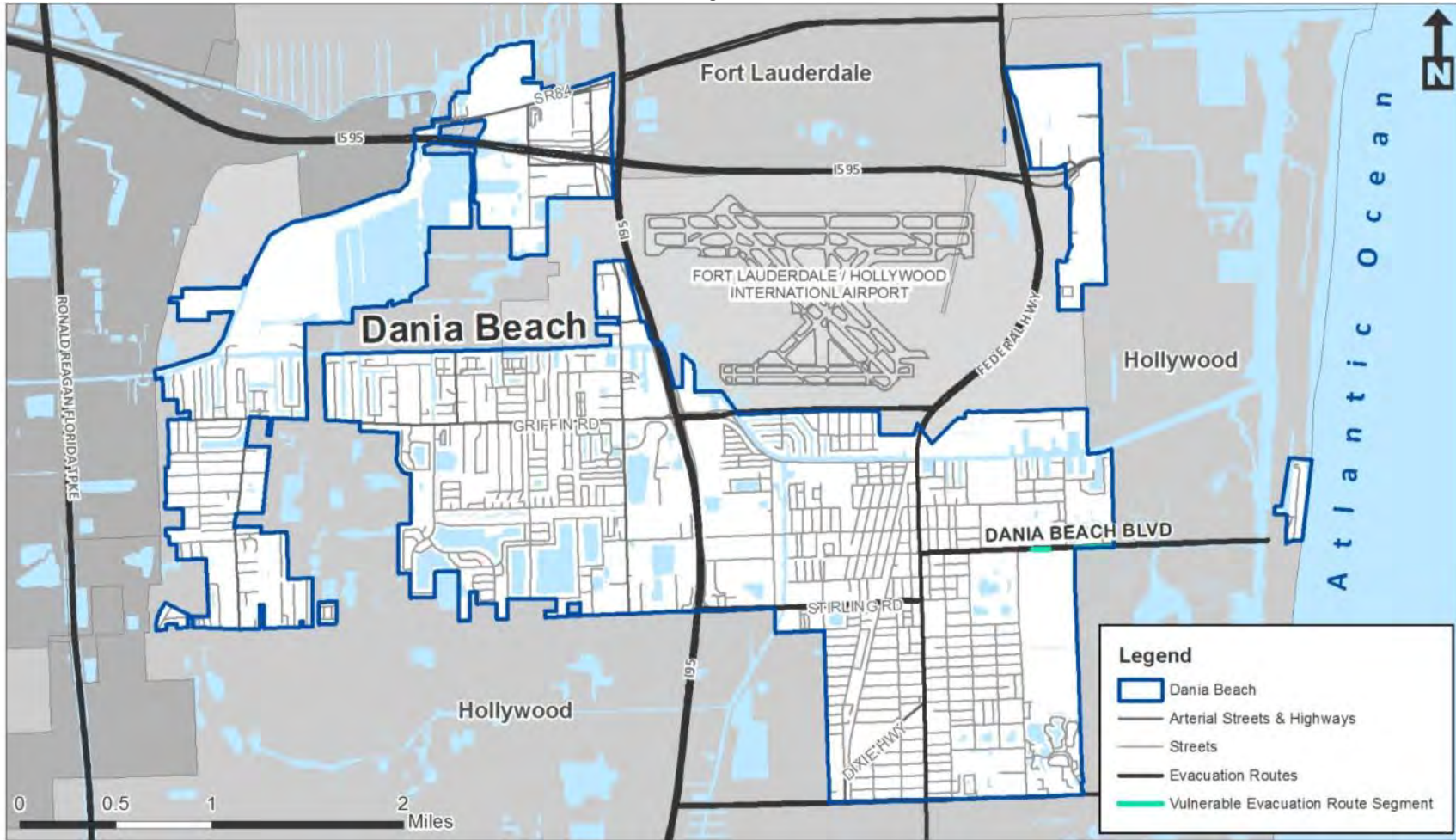
This map shows the Dania Beach CRA overlaid by the one foot sea level rise scenario. Areas in the North-Eastern portion of the CRA are located at or below sea levels during this scenario. Much of the vulnerable land is open space or agricultural.

Dania Beach Community Redevelopment Area (CRA) Two Foot Sea Level Rise Scenario



This map shows the Dania Beach CRA overlaid by the two foot sea level rise scenario. Areas located at or below projected sea level in the North-Eastern portion of the CRA become greater during this scenario, spreading to adjacent streets. Much of the vulnerable land is open space or agricultural.

Evacuation Routes 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.

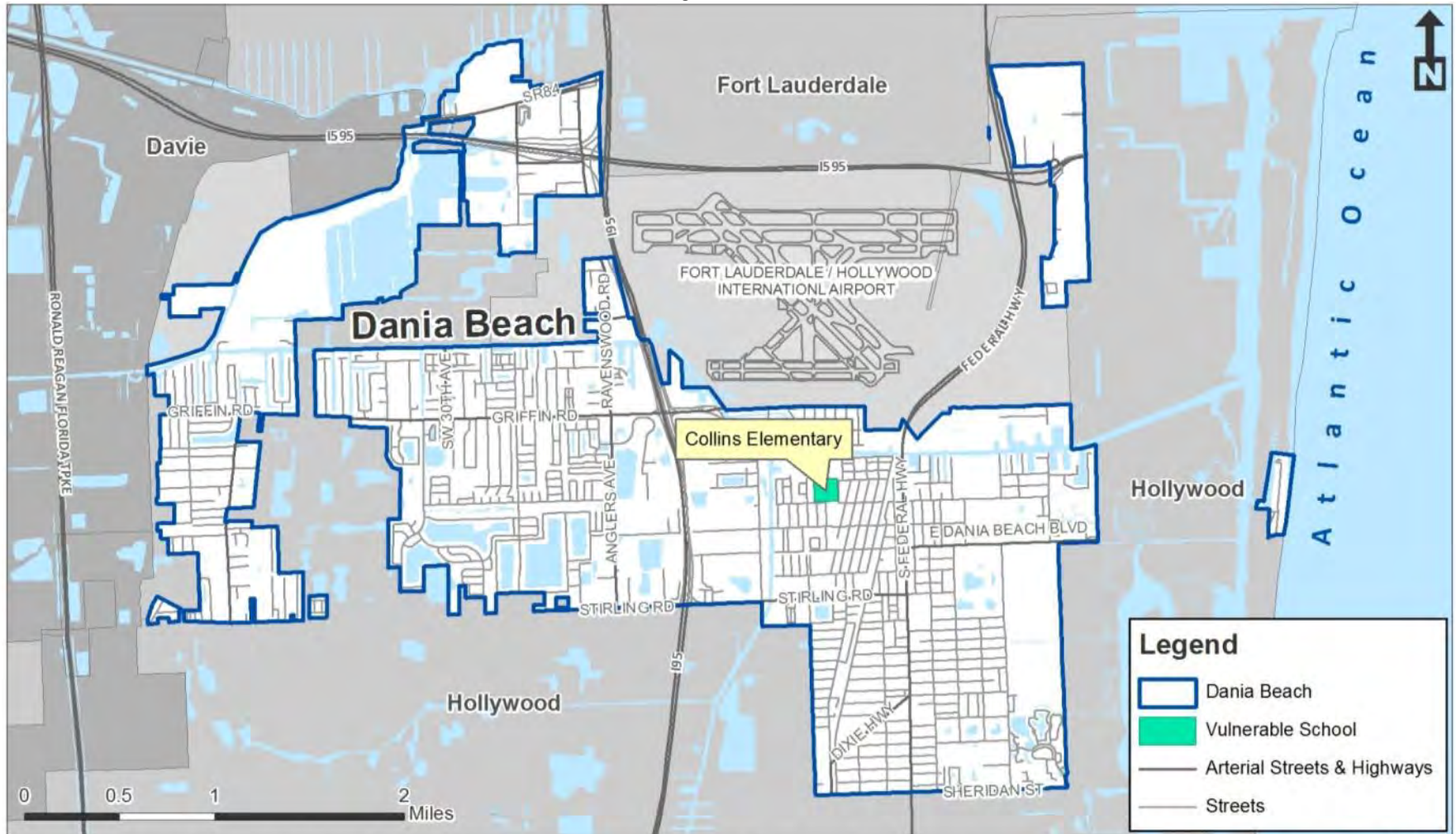
Table of Vulnerable Evacuation Routes

The following table lists road names for all evacuation routes within the City of Dania Beach that have areas located at or below projected sea levels during the one or two foot scenarios. For each scenario, vulnerable routes receive a Y for yes, or an N for no.

Vulnerable Evacuation Routes City of Dania Beach		
Roadway	One Foot Scenario(Y/N)	Two Foot Scenario (Y/N)
Dania Beach Blvd	N	Y

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

Schools 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.
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Table of Vulnerable Schools

There is only one school within the City of Dania Beach with land located at or below projected sea levels, Collins Elementary. Collins Elementary School is vulnerable beginning during the two foot sea level rise scenario, as detailed in the table below.

Vulnerable Schools City of Dania Beach		
School	One Foot Scenario (Y/N)	Two Foot Scenario (Y/N)
Collins Elementary	N	Y

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



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 Environmental Protection and Growth Management Department
 Natural Resources Planning and Management Division
 Date: 12/26/2013
 DEP Agreement No. CM238 DEP 55-236(08/11)

This map shows Collins Elementary School overlaid by the two foot sea level rise scenario. Land located at or below projected sea level during this scenario lies in the open fields to the North-East side of the parcel. The building footprint is not affected