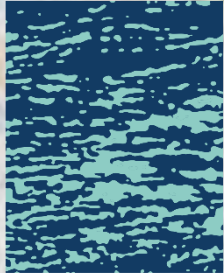




**National Conference on
Beach Preservation Technology
February 7-9, 2024
St. Augustine Beach, FL**



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Coastal Engineering



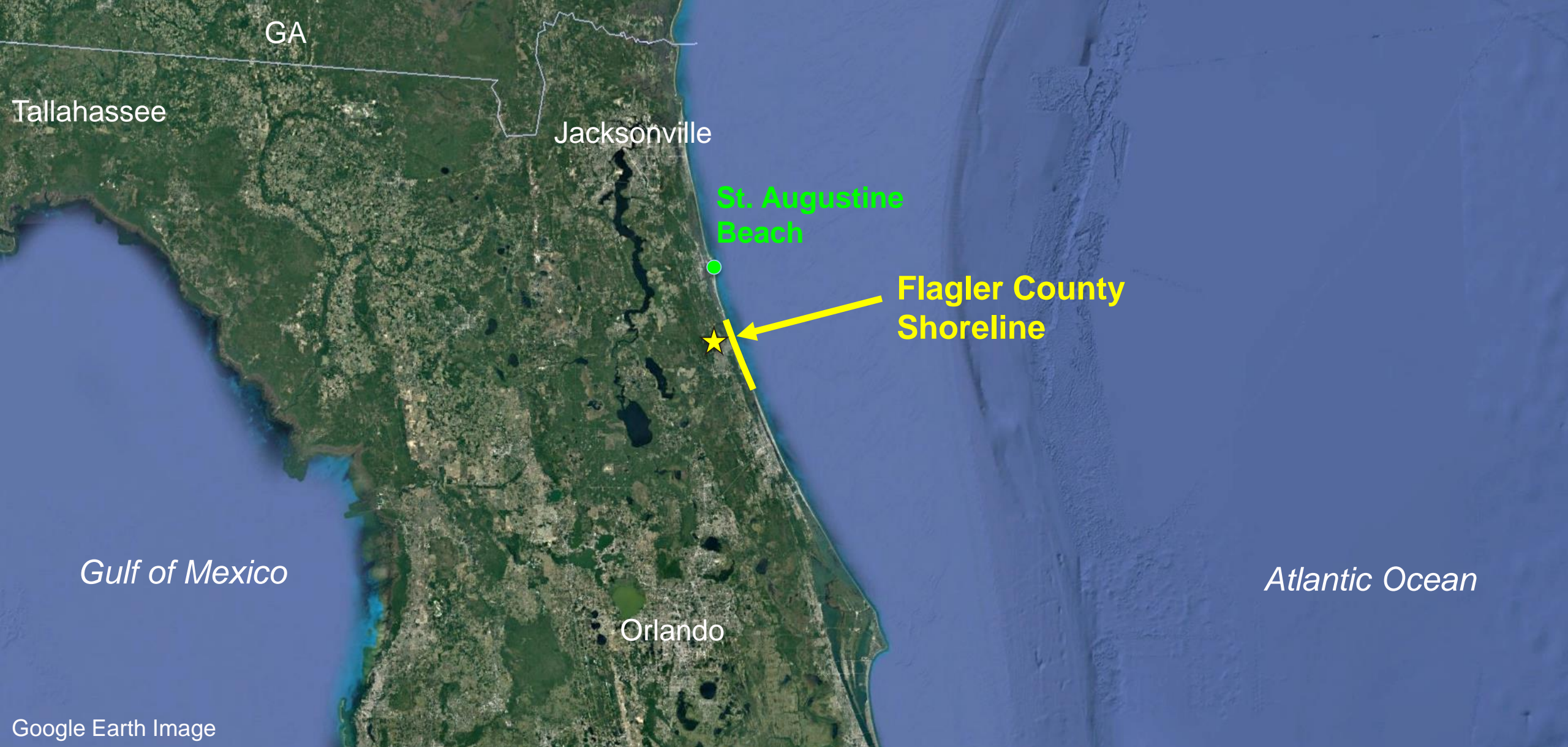
**FLAGLER
COUNTY
FLORIDA**

Post-Storm North County Dune Restoration – Flagler County, FL

Zachary Bedell, P.E.
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Ansley Wren-Key, Ph.D.
Flagler County, FL

Christopher G. Creed, P.E., D.CE
Olsen Associates, Inc.



Google Earth Image



Location



St. Johns County

R-1

Marineland (R-2.3)

Washington Oaks Gardens
State Park

Hammock Communities

Painters Hill

Beverly Beach
(R-65)

City of Flagler Beach

Gamble Rogers
State Park

Volusia County

R-101

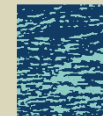


Coquina Limerock
"Beachrock"

18 Miles

4 miles

Atlantic
Ocean



olsen
associates, inc.
Coastal Engineering

Google Earth Image

St. Johns County

R-1

Marineland (R-2.3)

Washington Oaks Gardens
State Park

Hammock Communities

Painters Hill

18 Miles

Beverly Beach
(R-65)

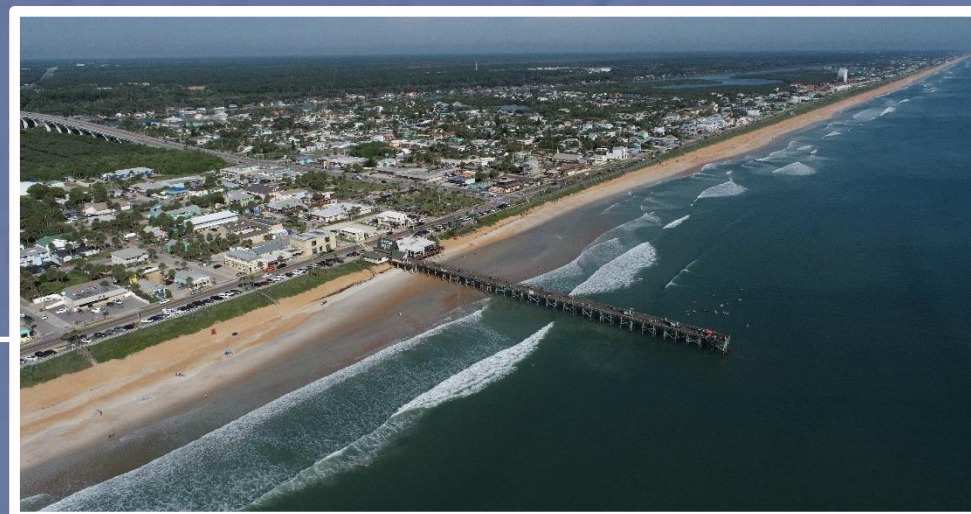
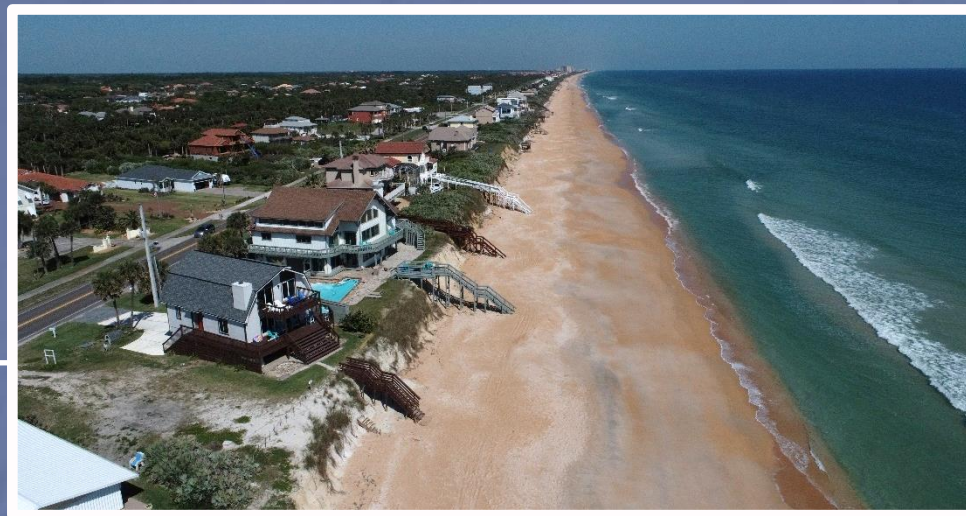
City of Flagler Beach

Gamble Rogers
State Park

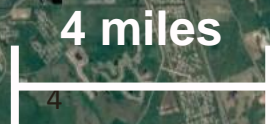
Volusia County

R-101

N



Atlantic
Ocean



Google Earth Image



St. Johns County

R-1

Marineland (R-2.3)

Washington Oaks Gardens
State Park

Hammock Communities

Painters Hill

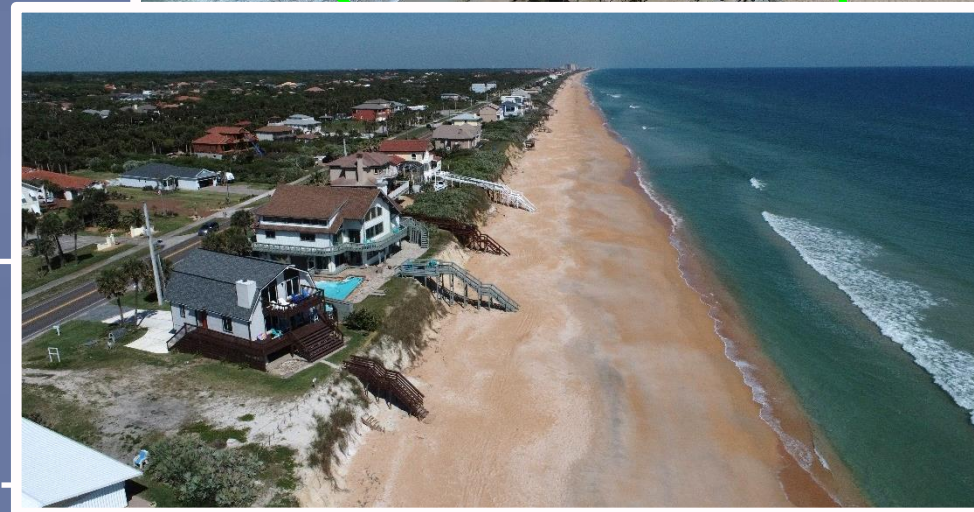
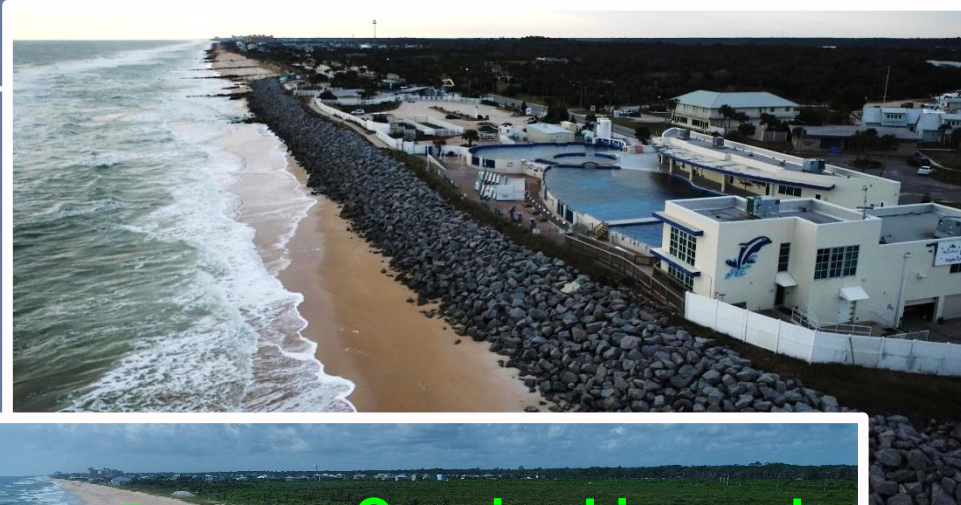
Beverly Beach
(R-65)

NORTH COUNTY DUNE
11.4 Miles

4 miles

Google Earth Image

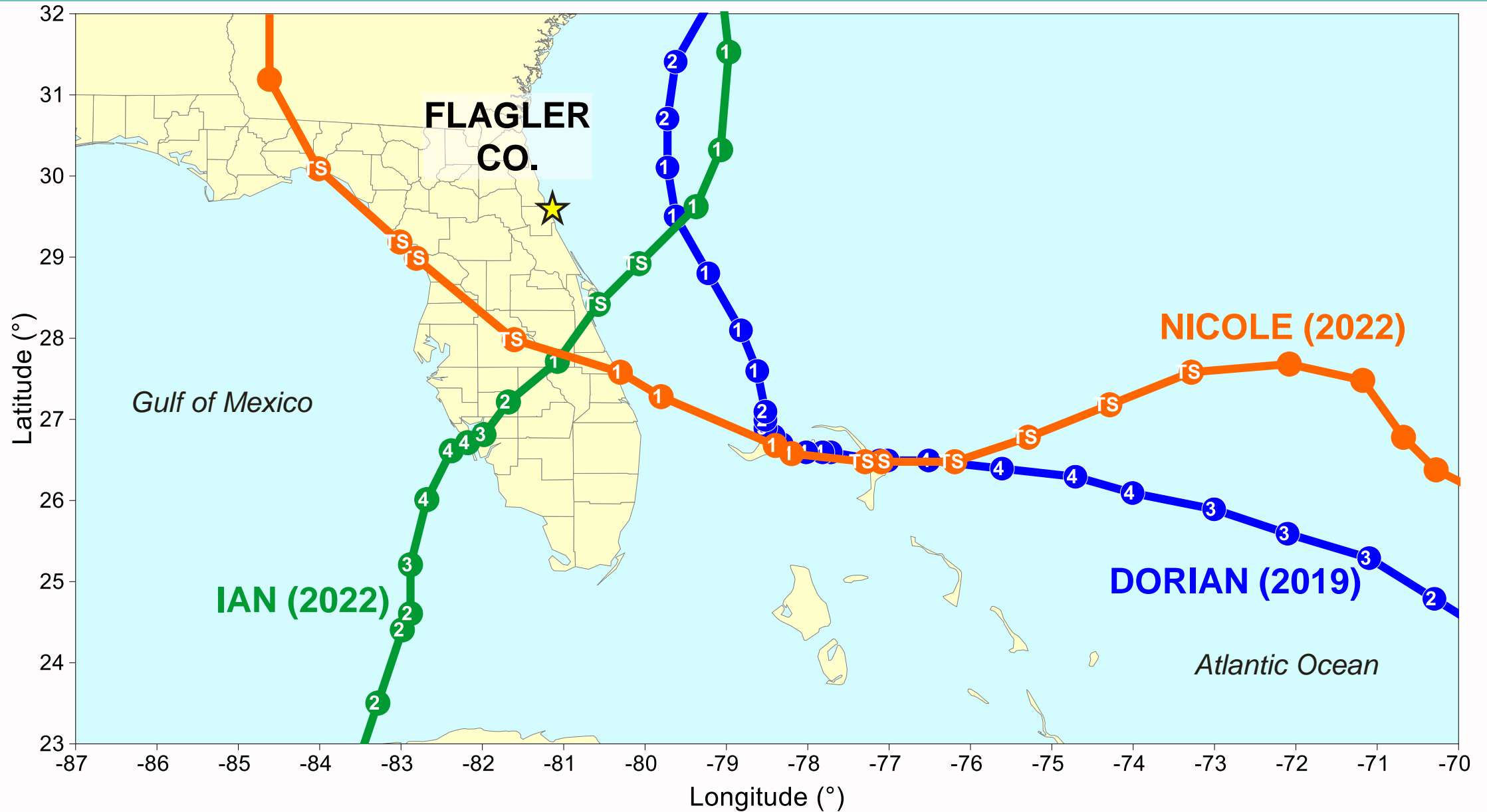
Volusia County



Atlantic
Ocean



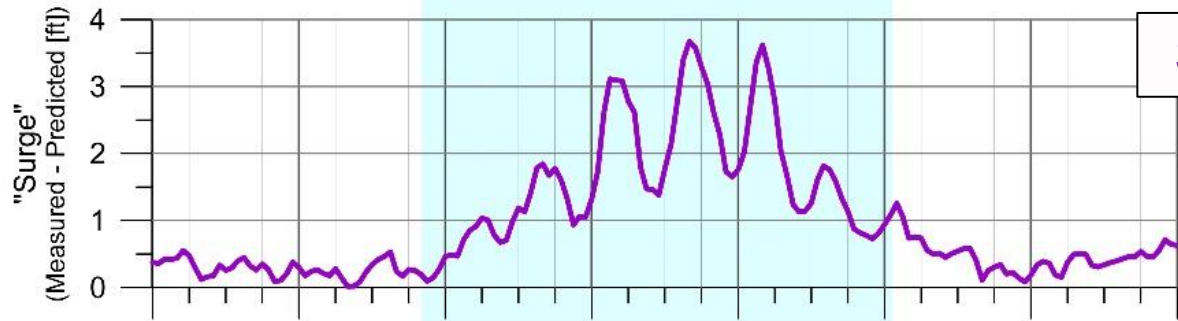
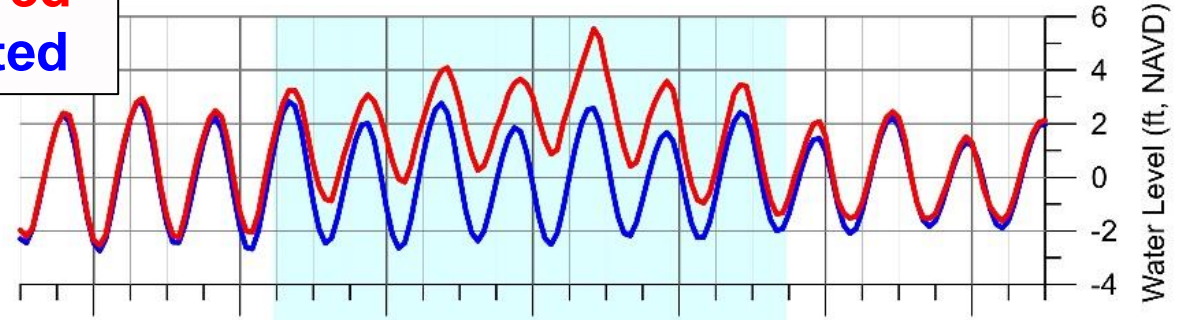
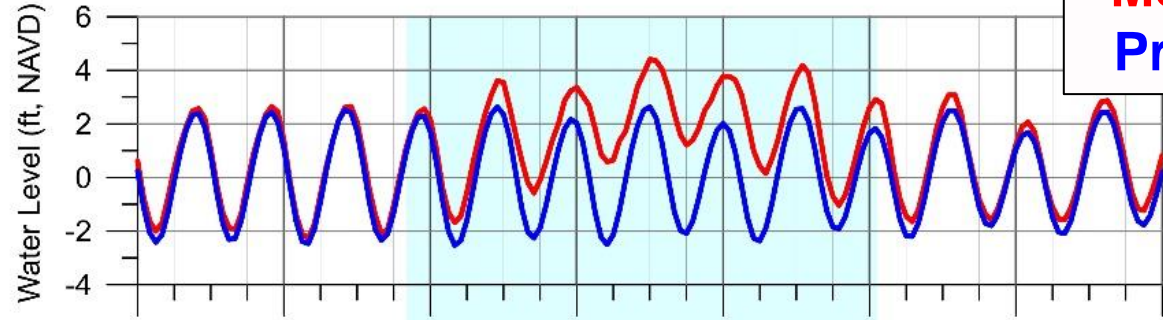
Flagler Storm History (2019-2022)



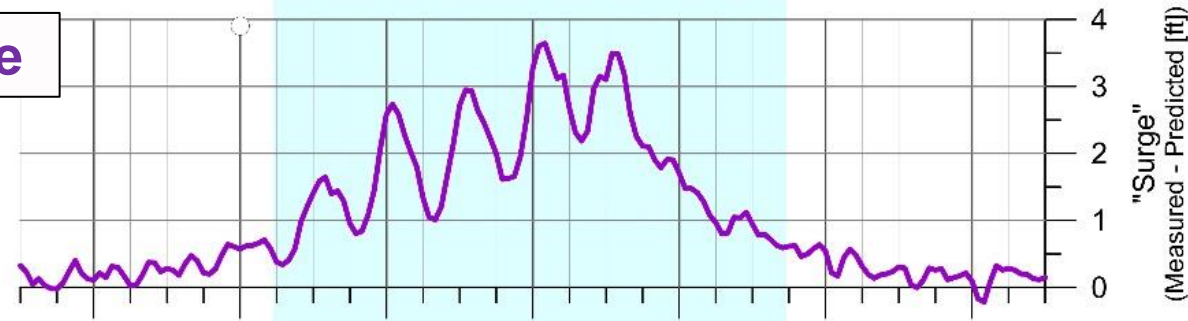
Hurricane Ian
Landfall: 9/28/2022

Water Level
Measured
Predicted

Hurricane Nicole
Landfall: 11/10/2022



Surge



Wave Height (ft)



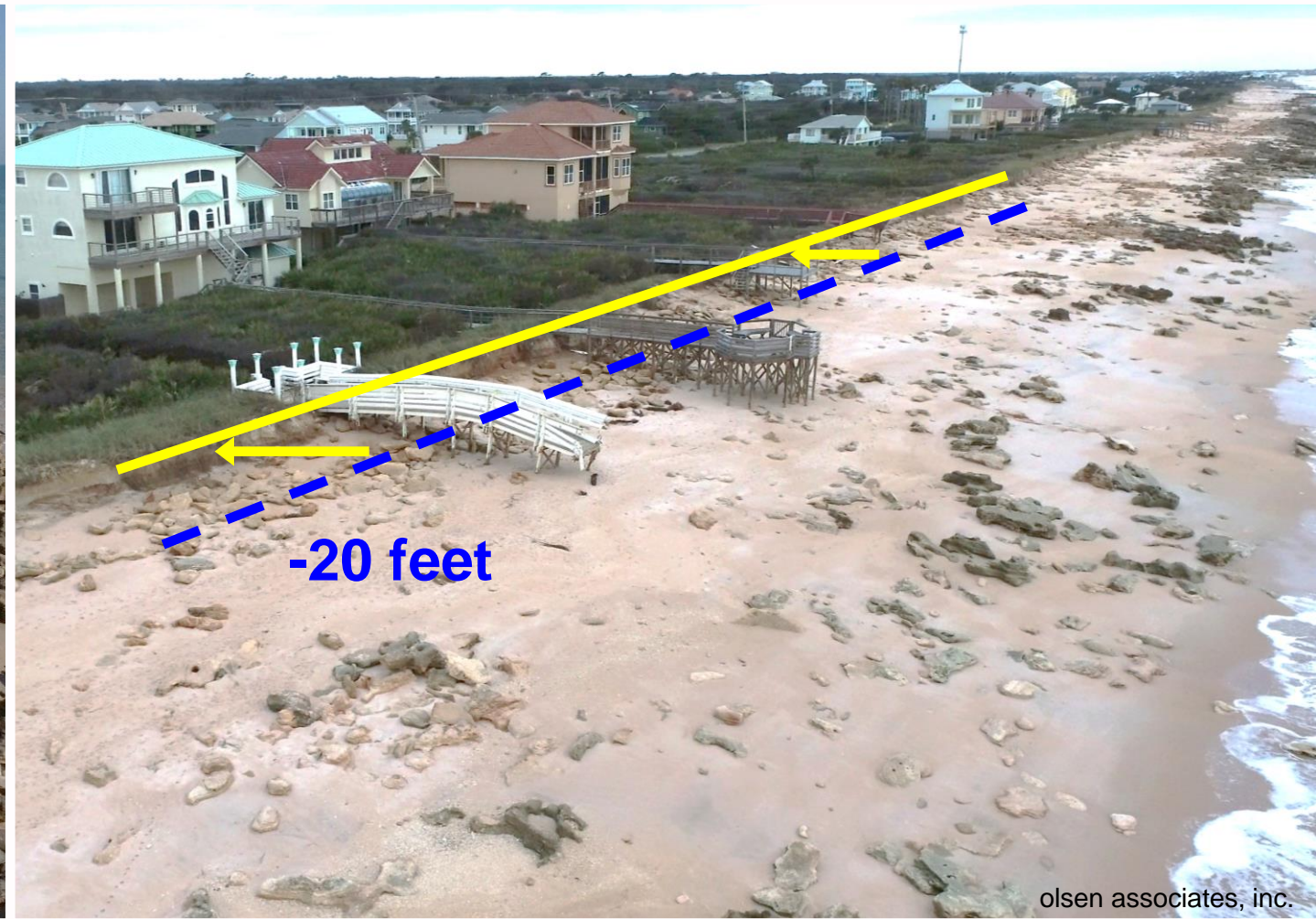
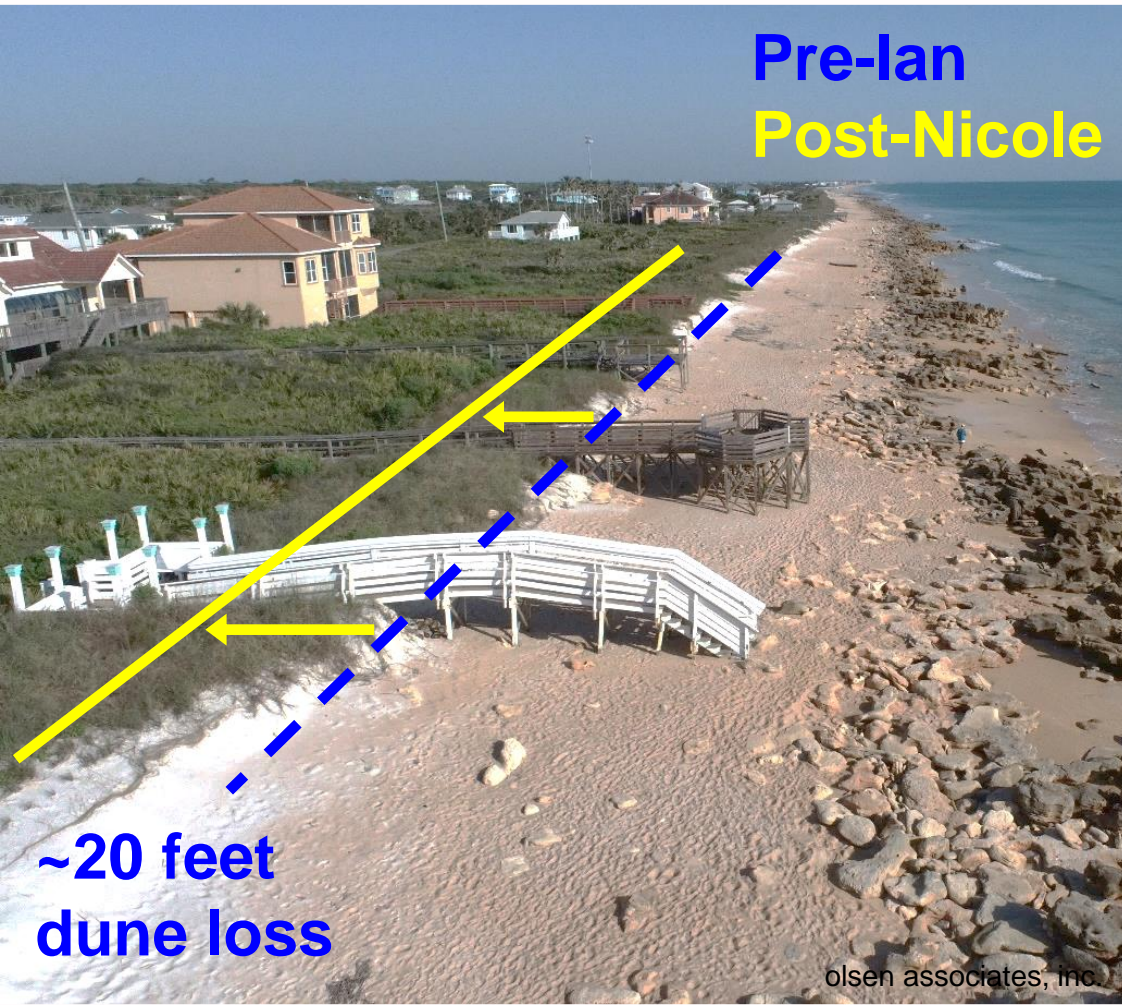
9/26/22 9/27/22 9/28/22 9/29/22 9/30/22 10/1/22 10/2/22 10/3/22 11/7/22 11/8/22 11/9/22 11/10/22 11/11/22 11/12/22 11/13/22

Nicole's effects were more prolonged than Ian

Storm Conditions



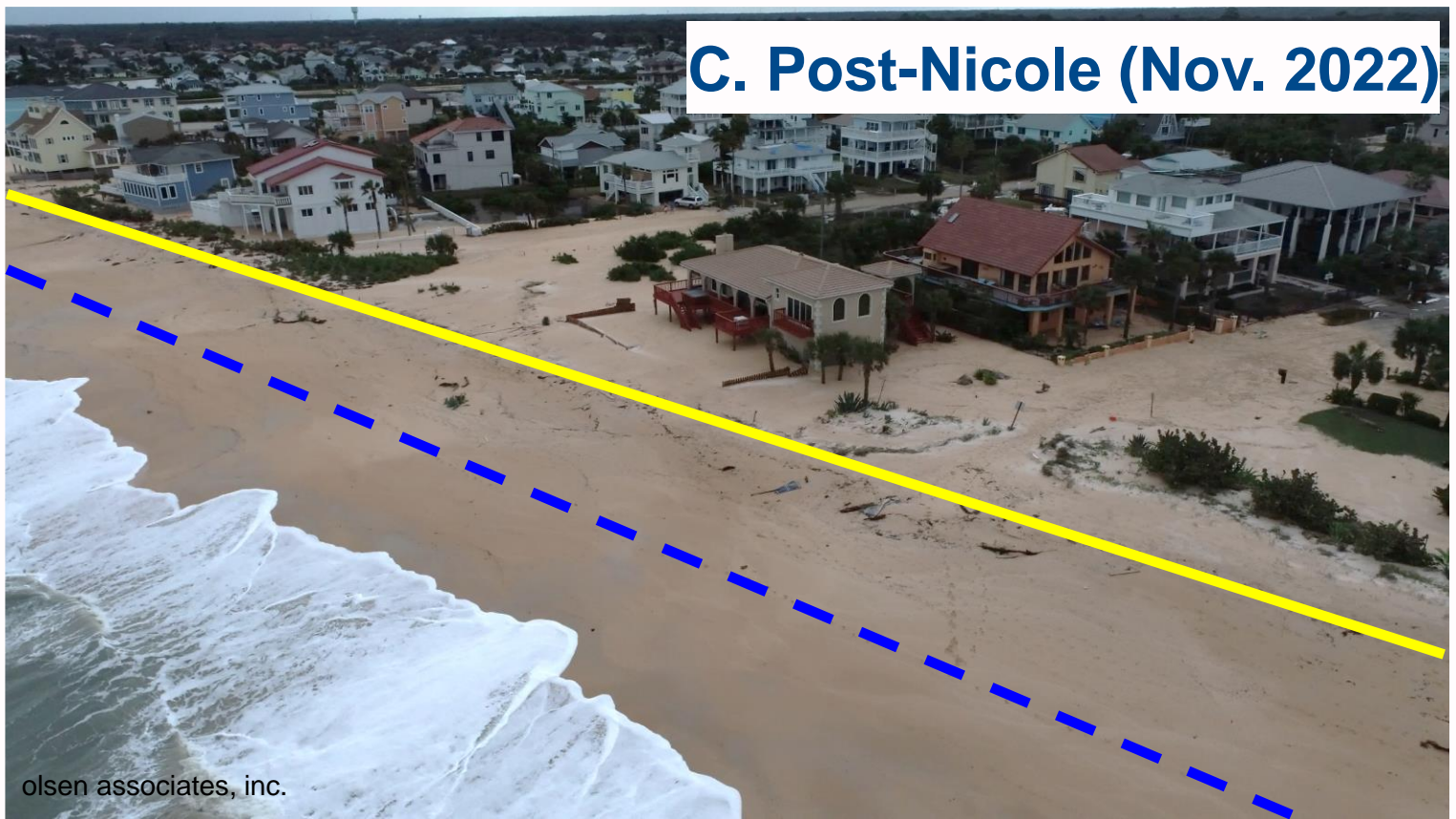
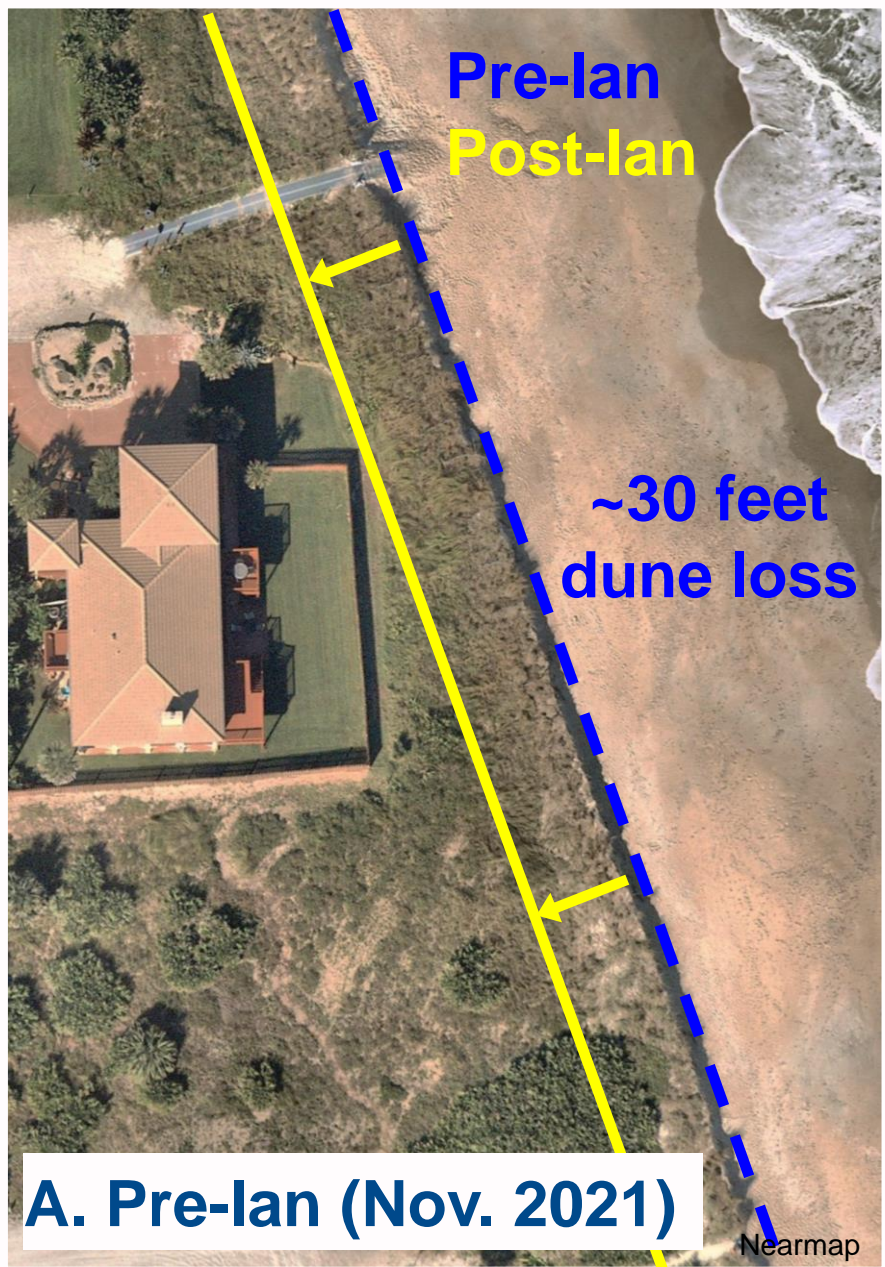
Storm Impacts (Matanzas Shores, R-7)



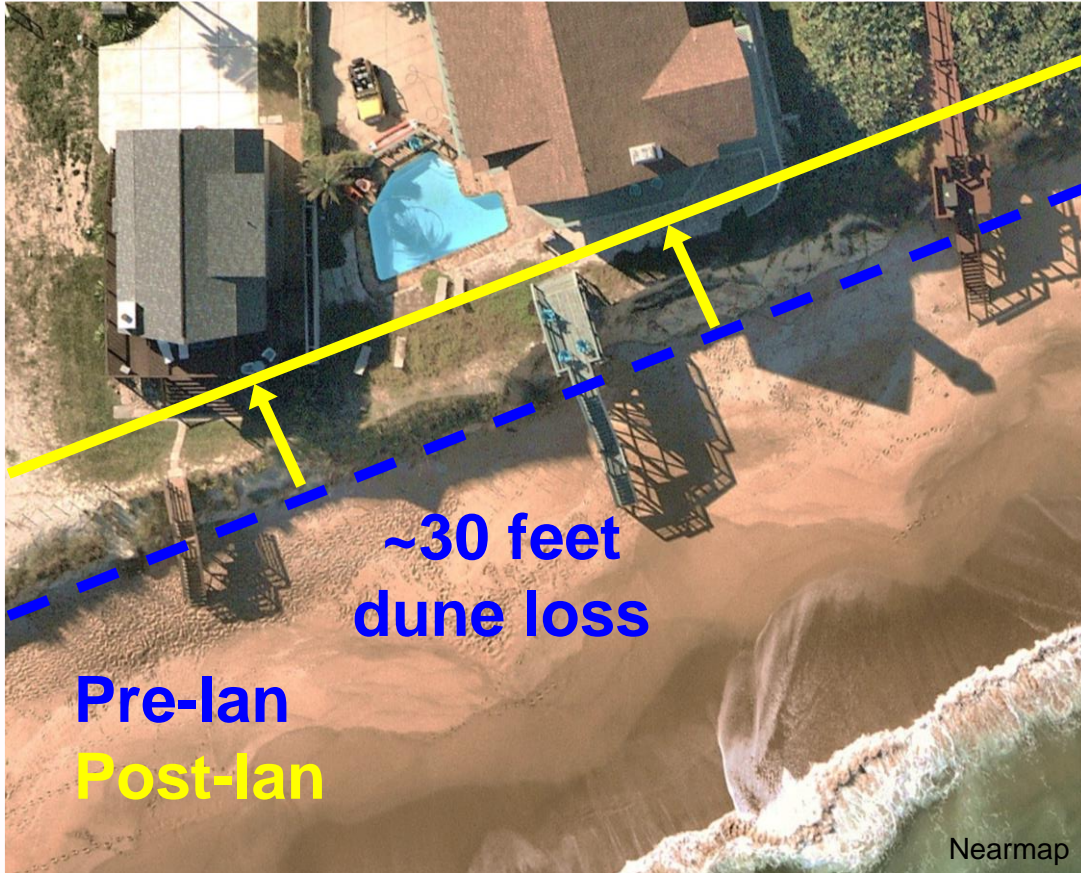
A. Pre-Ian (Mar. 2022)

B. Post-Nicole (Nov. 2022)

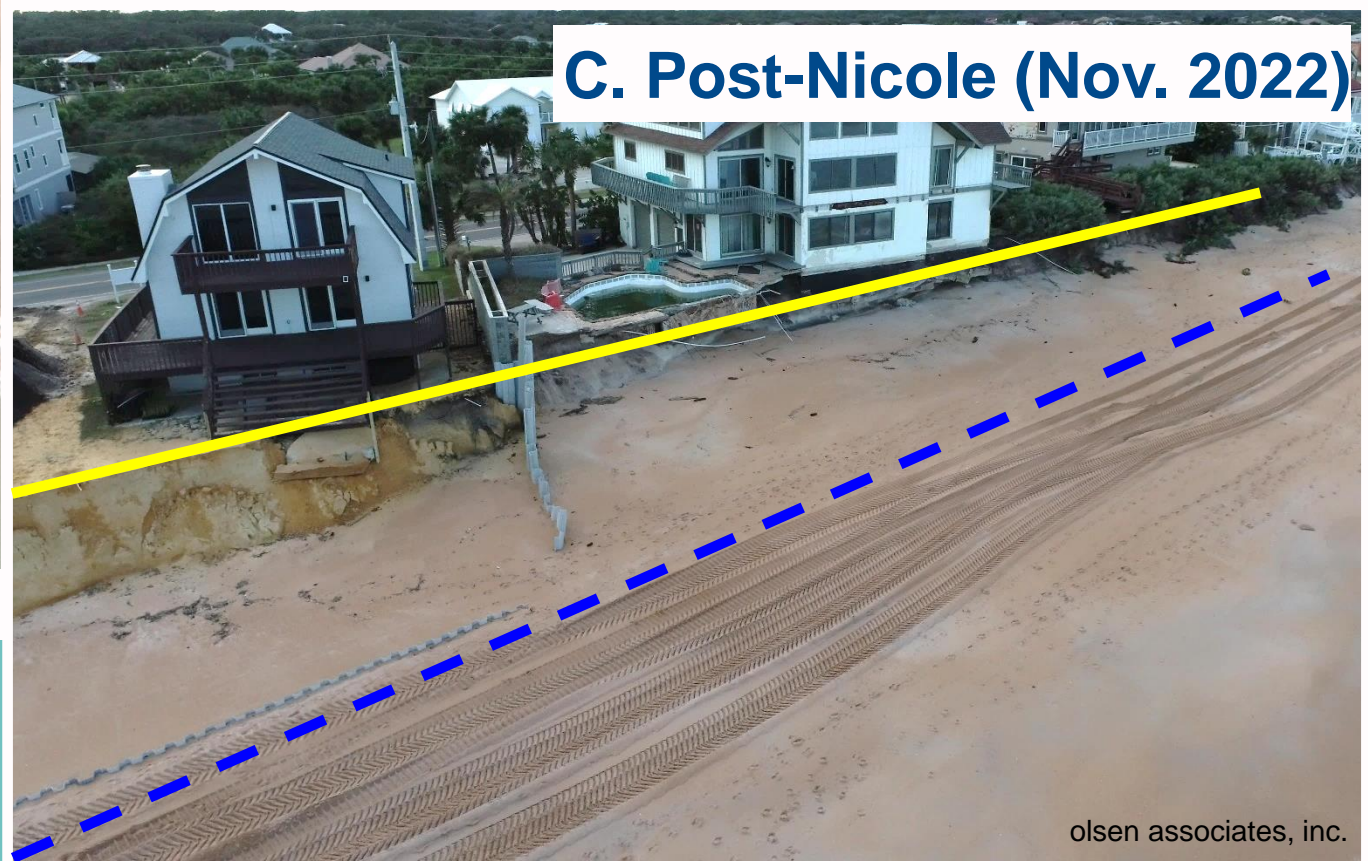
Storm Impacts (Sea Colony, R-17)



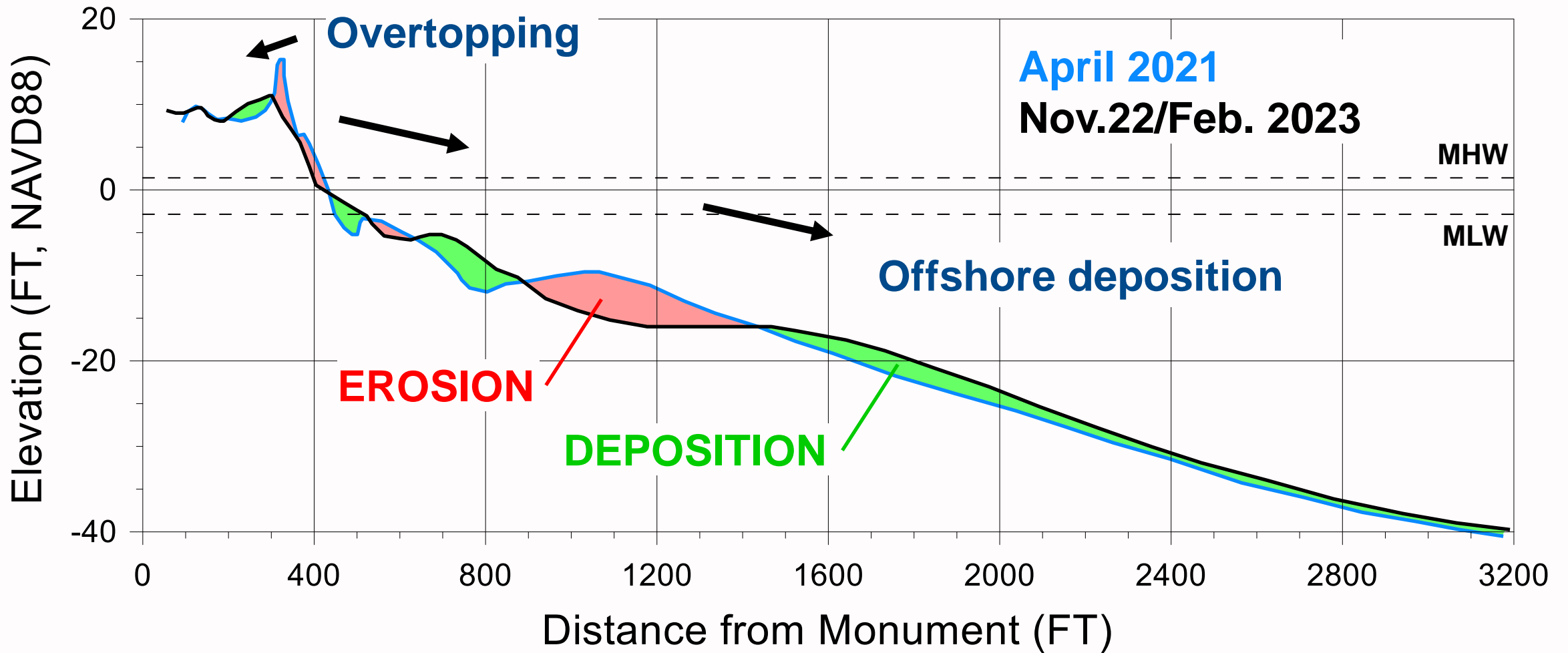
Storm Impacts (Painters Hill, R-51)



A. Pre-lan (Nov. 2021)



Typical Profile Response



Cinnamon Beach (R-31)

Storm Impact Summary

- **Countywide (R-1 to R-101):**

- -1.9 Mcy (-20 cy/ft) loss above Depth of Closure
- -550,000 cy (-5.7 cy/ft) loss above +6' NAVD (dune toe)
- -16 ft average retreat at +6' NAVD

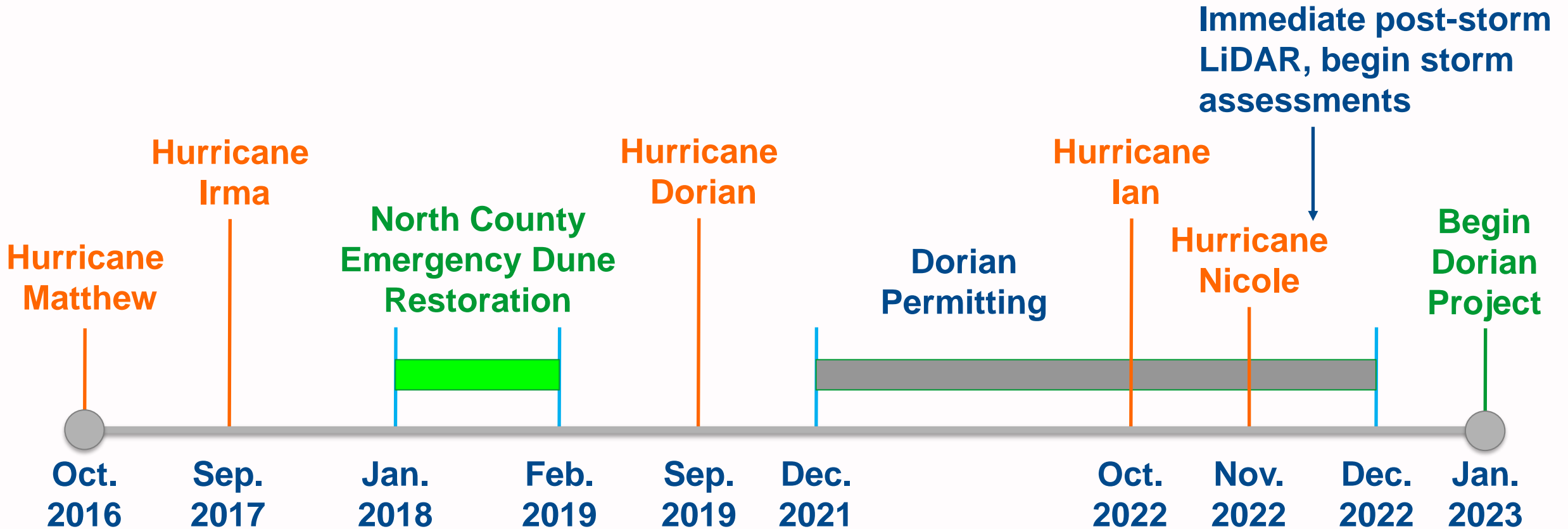
- **North County (R-1 to R-65):**

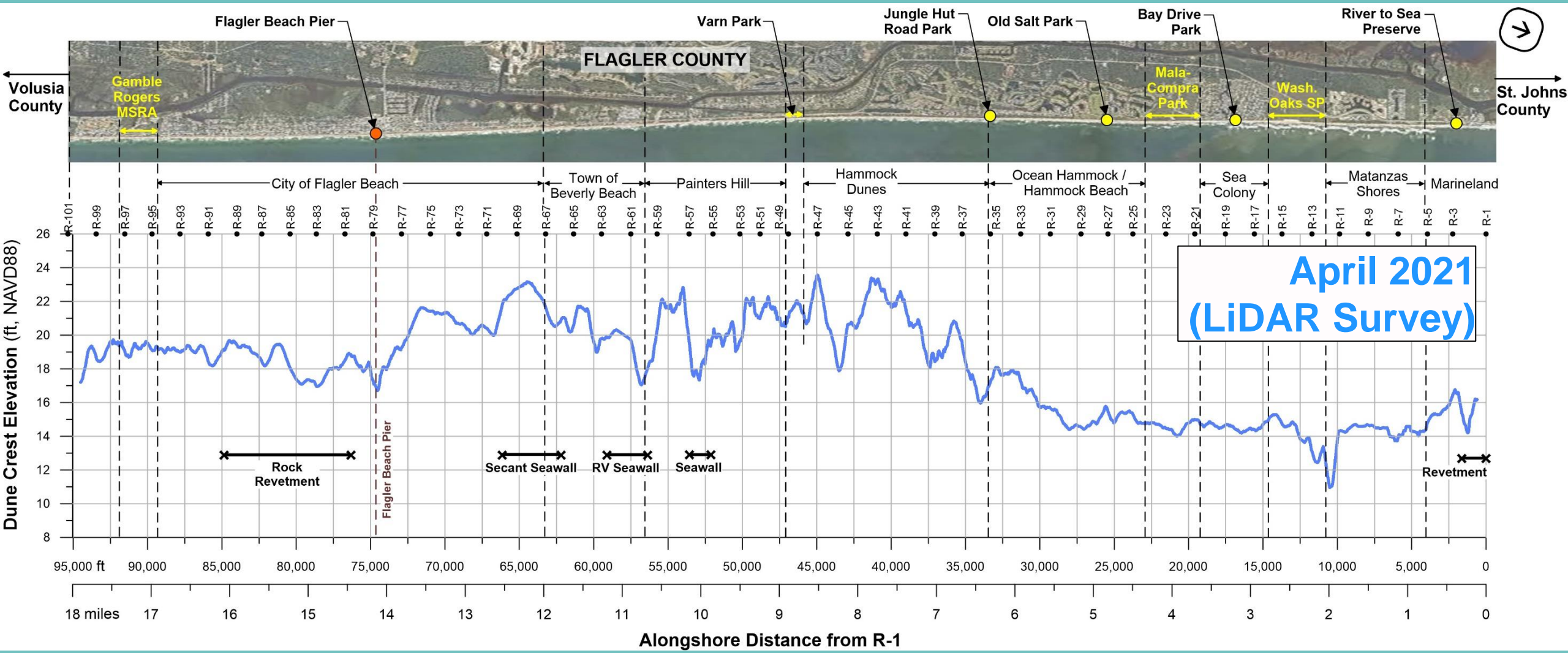
- -1 Mcy (-16 cy/ft) loss above Depth of Closure
- -400,000 cy (-6.5 cy/ft) loss above +6' NAVD (dune toe)
- -16 ft average retreat at +6' NAVD

Depth of Closure: Seaward extent of beach profiles beyond which profile elevation changes are not anticipated to typically occur, excepting storm events (hurricanes, nor'easters, etc.)



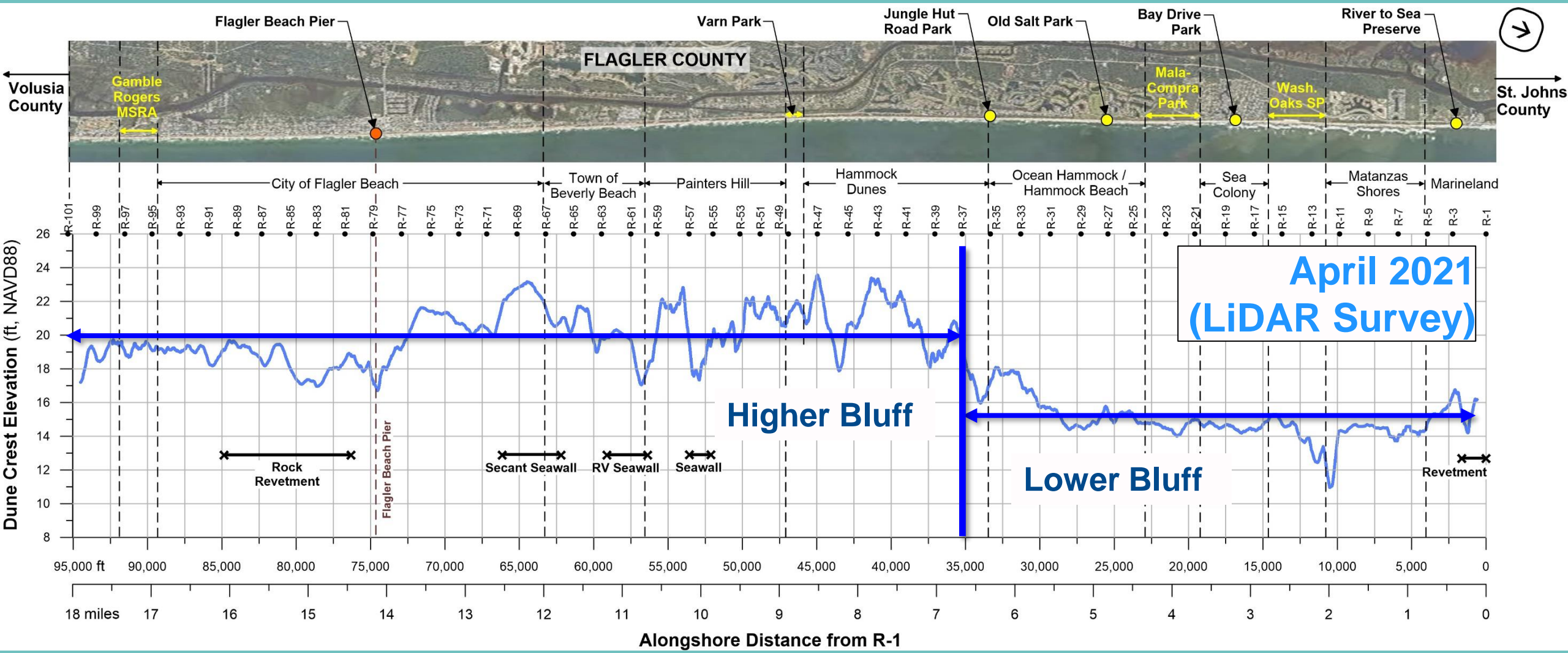
Timeline of Events



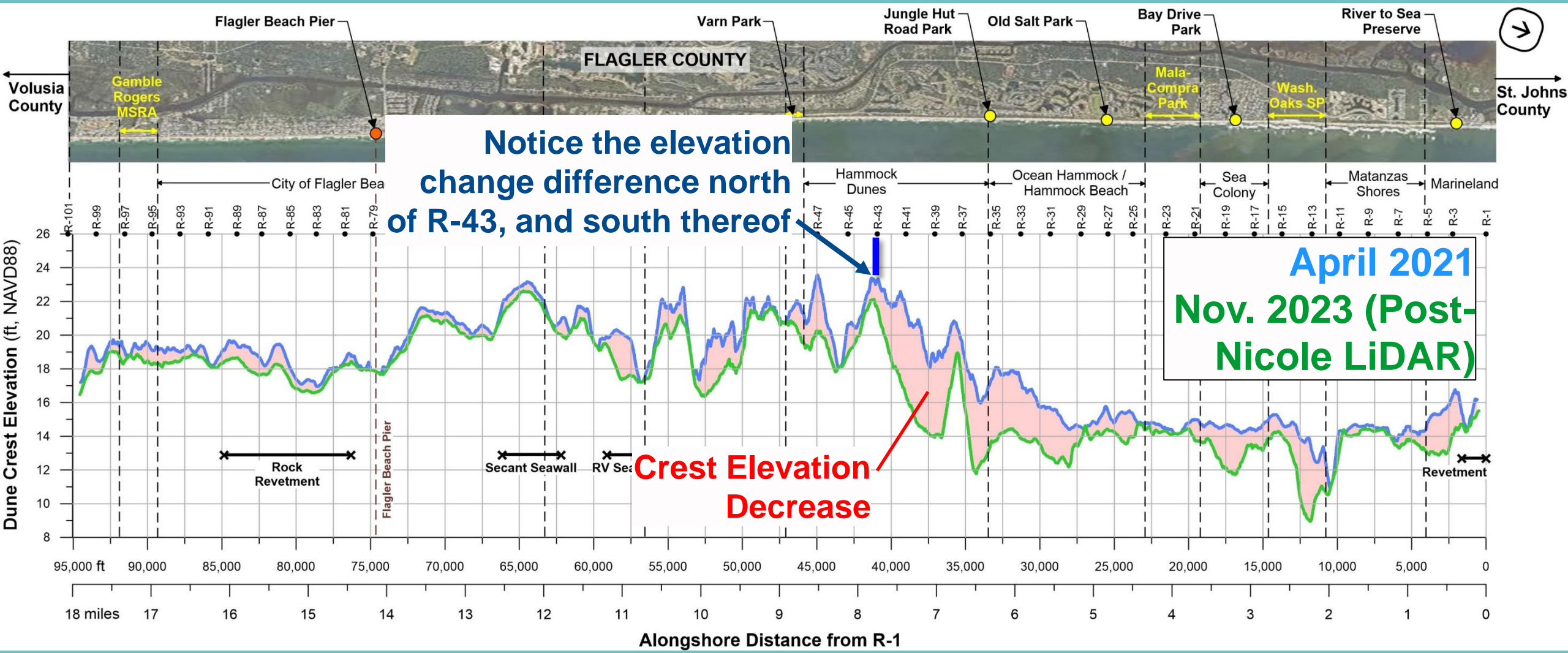


Pre-Ian Dune Elevation



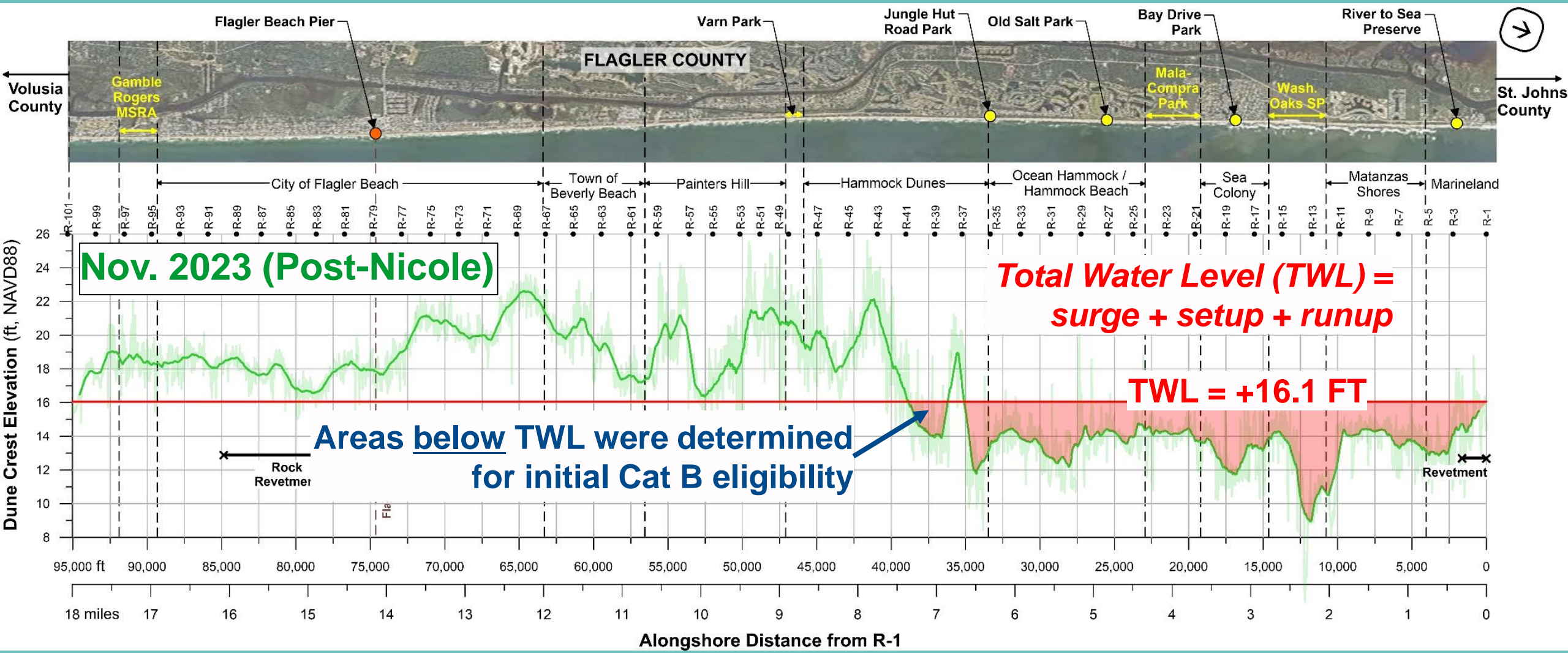


Pre-lan Dune Elevation

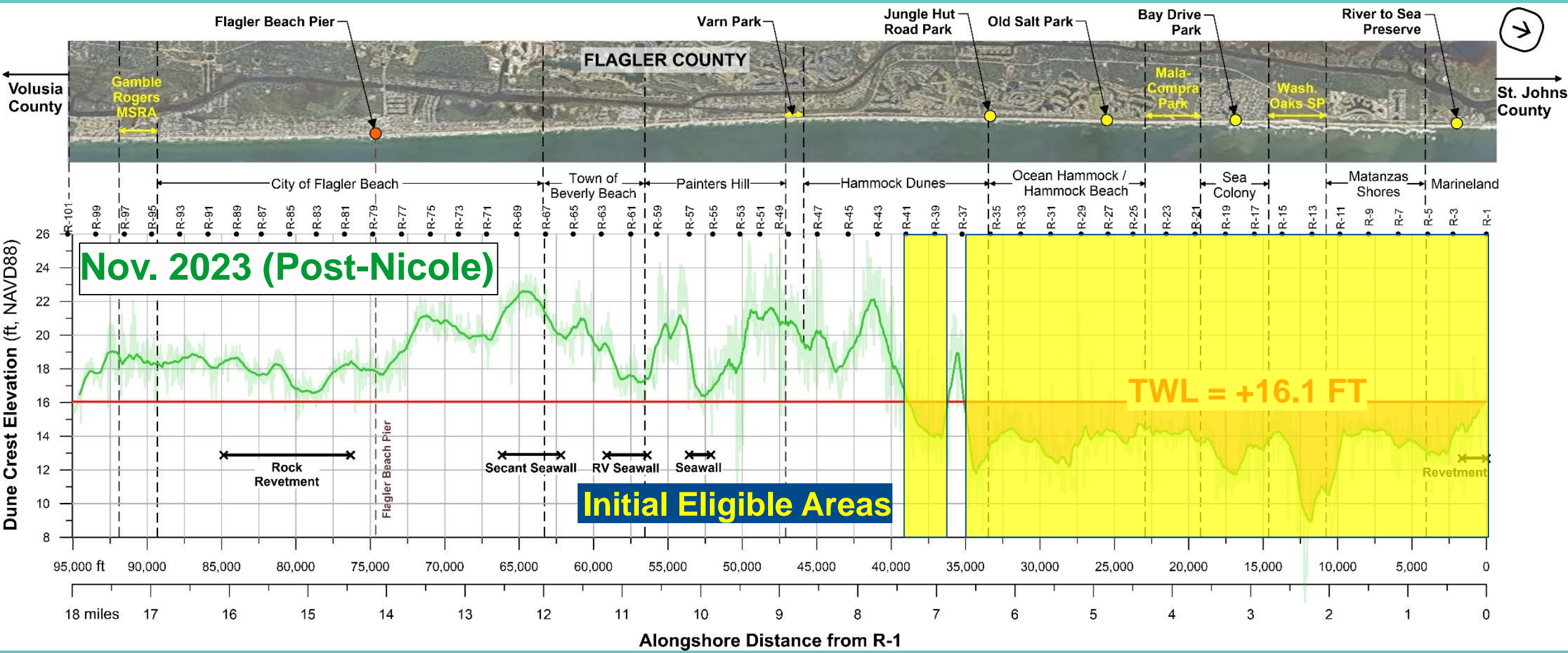


Post-Ian/Nicole Dune Elevation Change

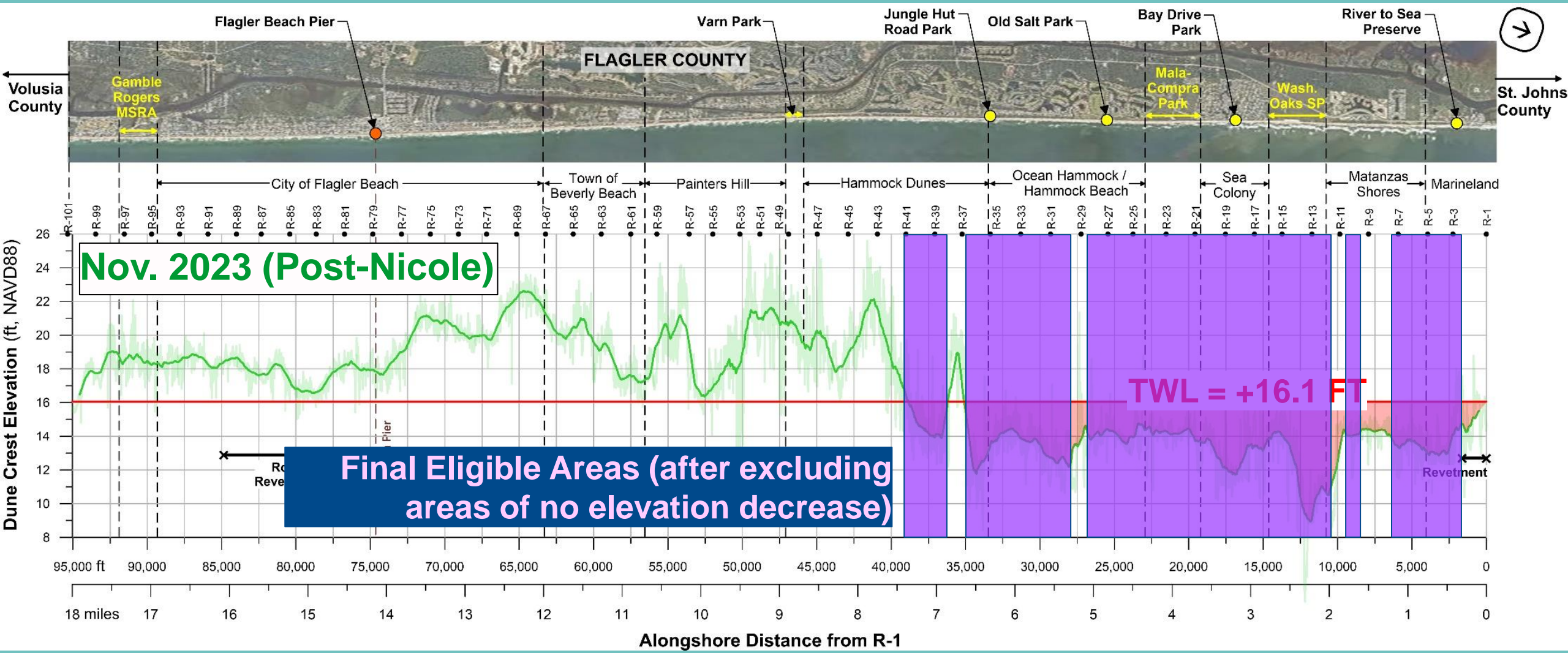




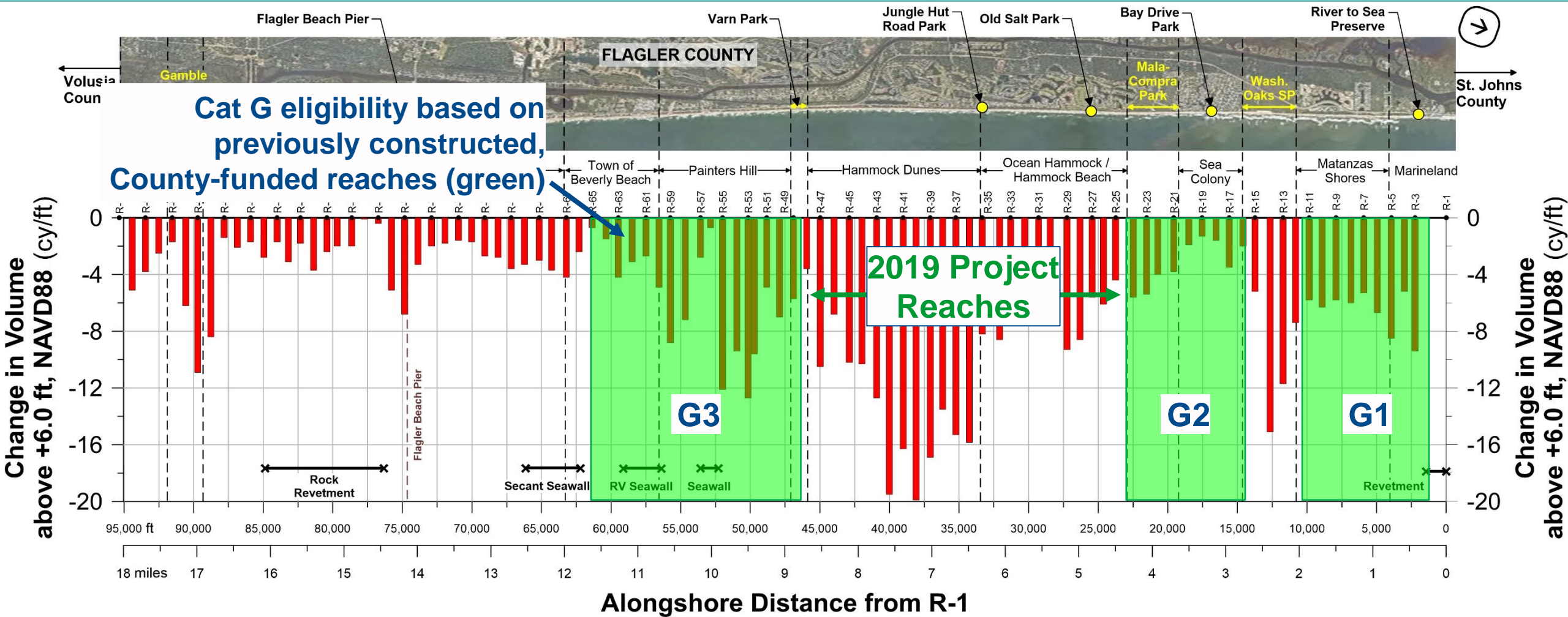
FEMA Cat B Eligible Areas



FEMA Cat B Eligible Areas

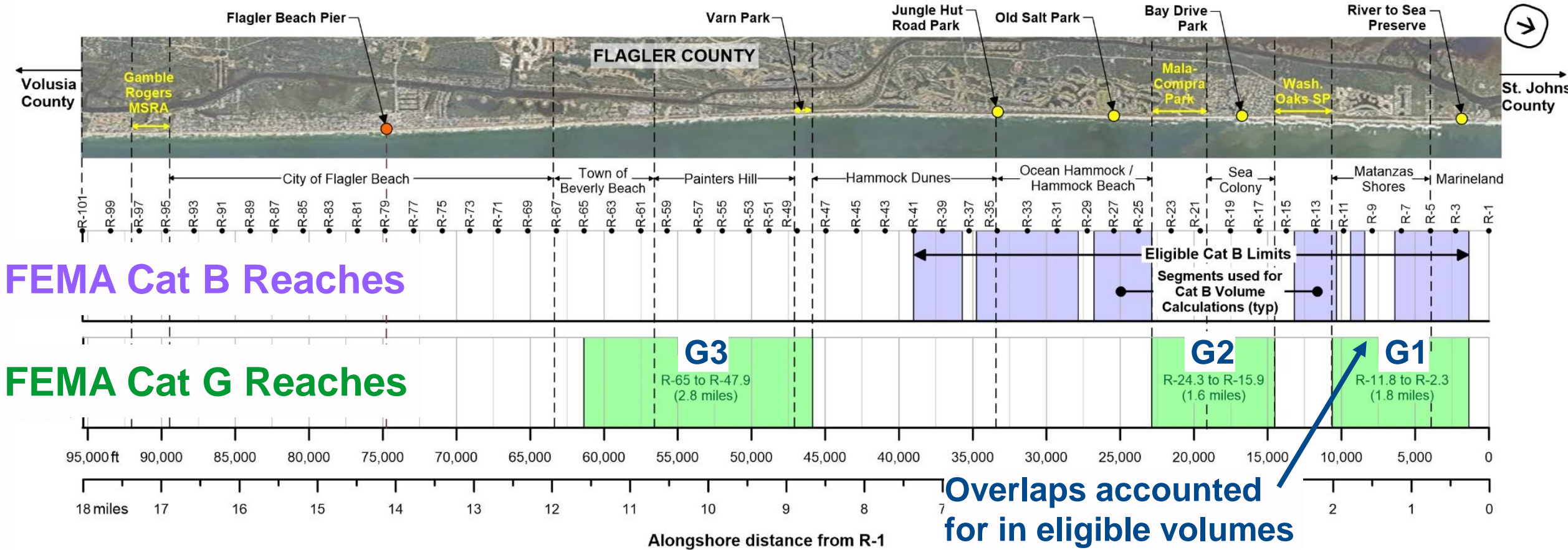


FEMA Cat B Eligible Areas



FEMA Cat G Eligible Areas

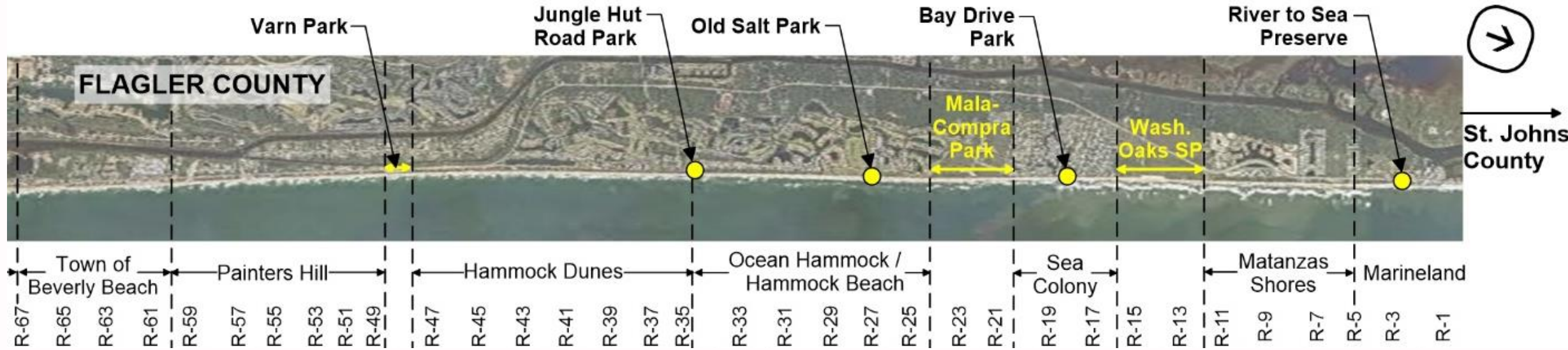
FEMA Eligible Volumes



Cat B Eligible Volume: ~134,000 cy

Cat G Eligible Volume: ~140,000 cy (Ian: ~63,000 cy, Nicole: ~77,000 cy)

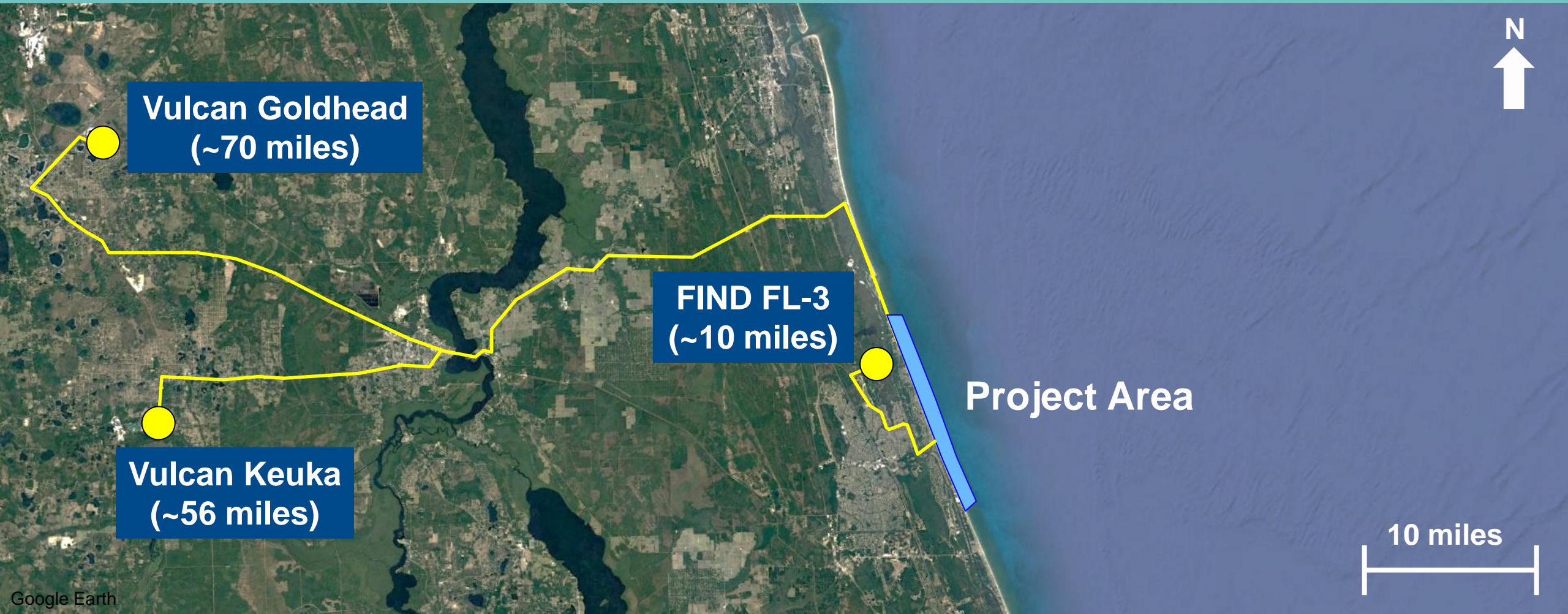
2023 Project Areas and Funding Sources



| | | | | | |
|--------------------|----------------|-------------------------|-------------------------|---------------|-------------------------|
| | 3 | 4 | 1 | 2 | 5 |
| | FDEP | Nicole Cat B | Dorian Cat G | FDEP | Nicole Cat B |
| VOLUME (cy) | 100,000 | 86,000 | 48,000 | 24,000 | 45,000 |

2023 Placed Volume ~303,000 cy (~5.3 cy/ft)

Upland Sand Sources

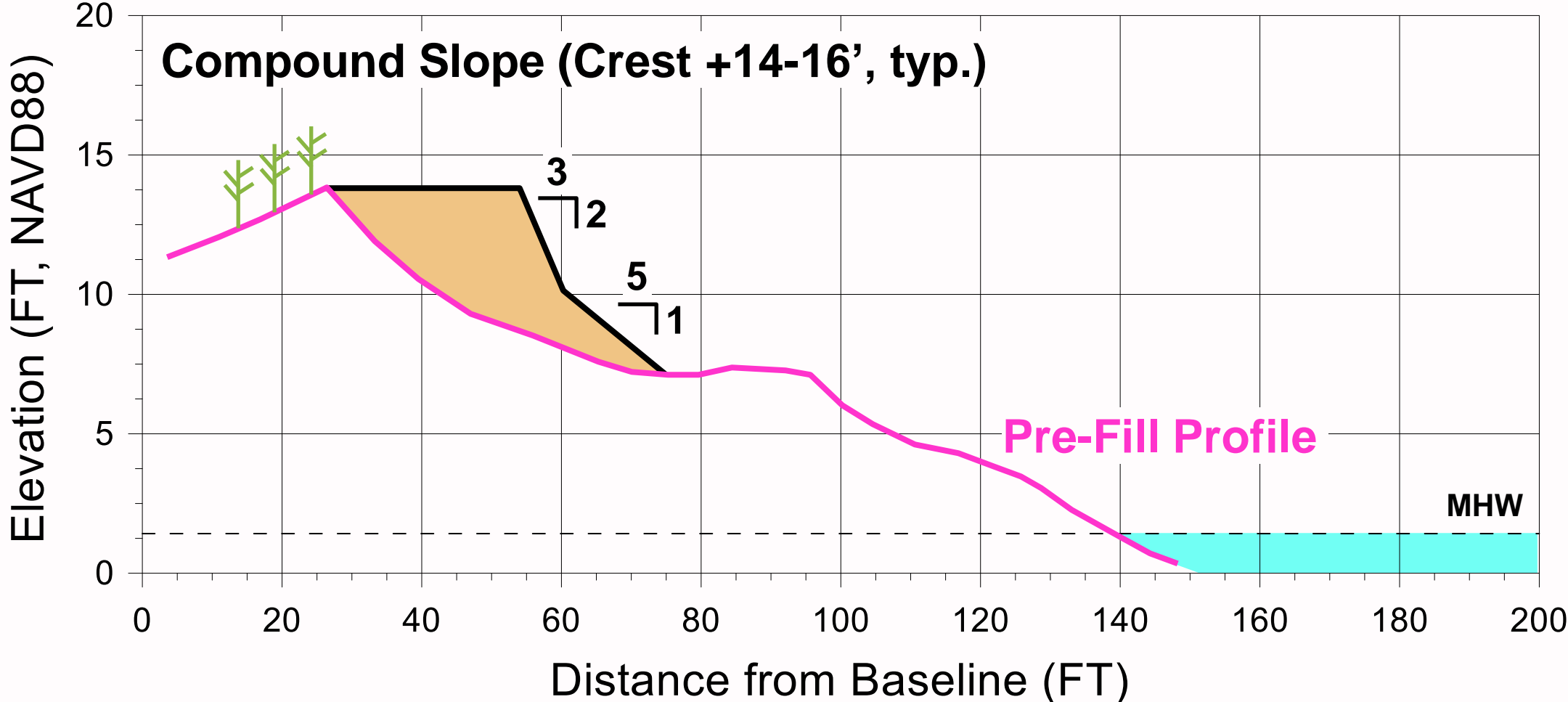


Florida Inland Navigation District (FIND) FL-3 Site

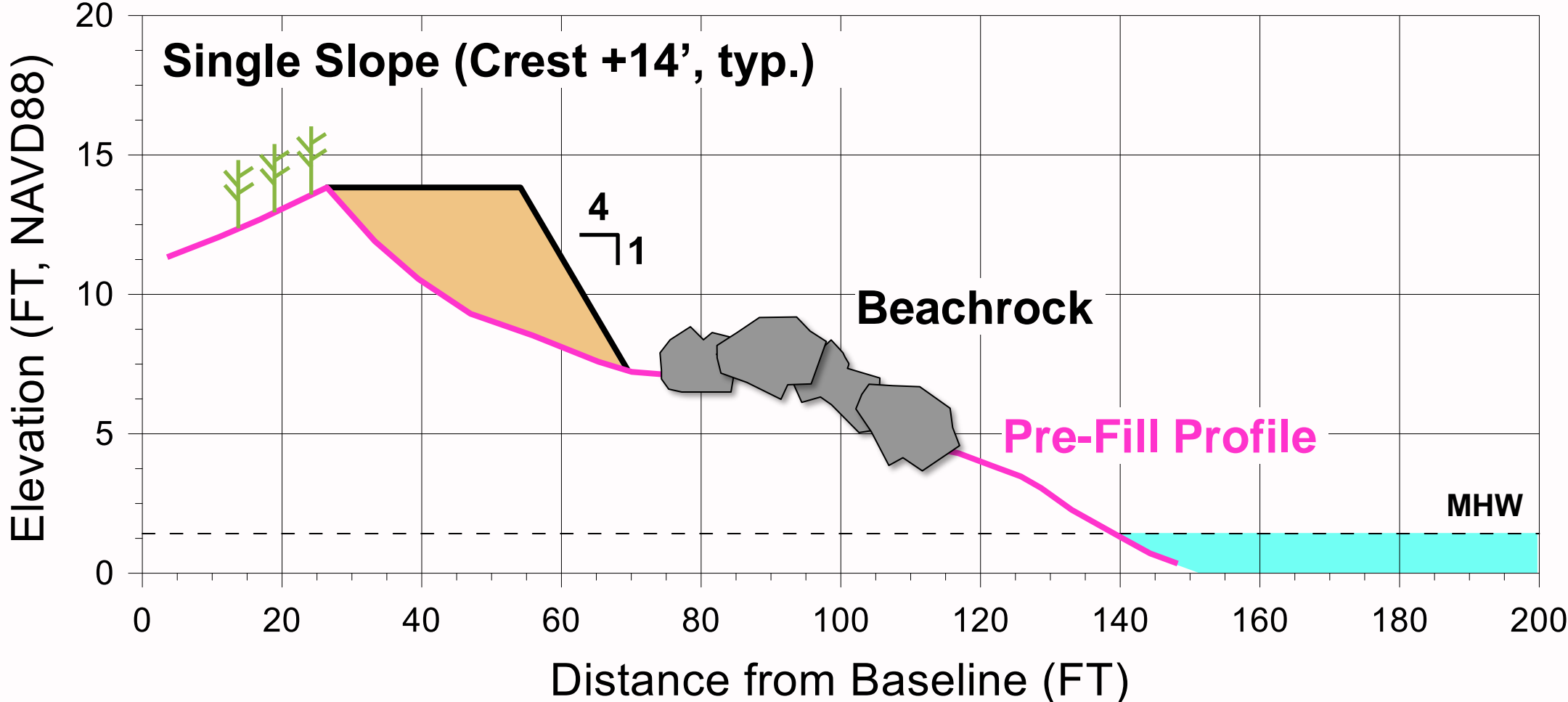
Vulcan Keuka and Goldhead



Typical Dune Fill Section



Typical Dune Fill Section



Old Salt Park Access (R-27)



olsen associates, inc.

Hammock Dunes (R-37)

+16' NAVD

3H:2V

+10' NAVD

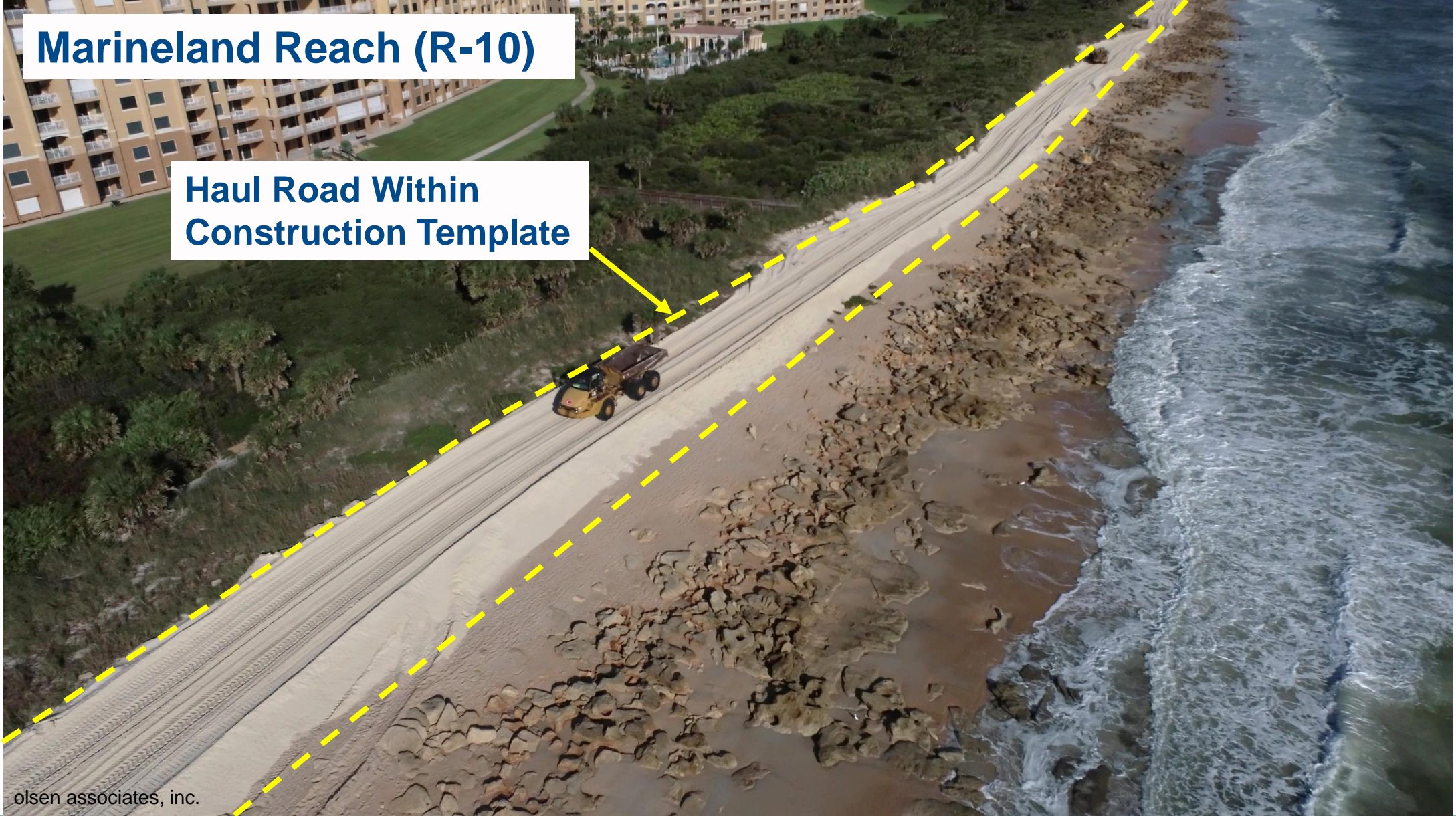
5H:1V

olsen associates, inc.

Project Construction

Marineland Reach (R-10)

Haul Road Within Construction Template



olsen associates, inc.

Summary

- **2023 projects restored 10.8 miles of eroded dune (R-2.3 to R-65):**
 - Contractor (Eastman) placed ~303,000 cy (~5.3 cy/ft) of upland sand
 - Widening of dune by 23 feet, average
 - Entire dune vegetated after placement
 - Total project cost: \$22.9M (\$75/cy)

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Thank You

