CITY OF VIRGINIA BEACH
Public Works

Croatan Beach Informational Briefing

LJ Hansen, Dan Adams | March 28, 2023

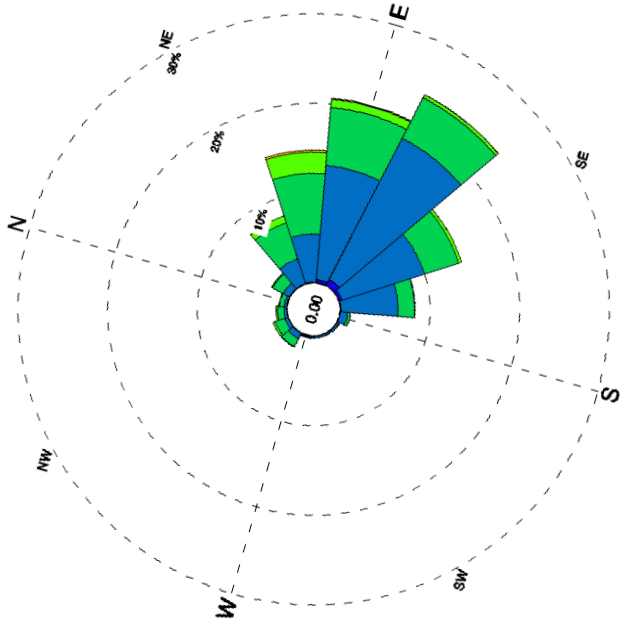
Presentation Outline

- History of Rudee Inlet Sand Bypass Operation and Croatan Beach
- Chronology of Significant Prior Studies & Reports
- Croatan Beach Shoreline Assessment
- Sand placement history
- Ongoing Monitoring
- Next Steps
  - Widen beach berm
  - Install sand fence and plant dune grass
  - Rudee Inlet/Croatan Weir replacement and modifications
  - Ongoing monitoring and maiantance

Inlet Evolution (1949 – 1986)

Net Sand Transport Rates: 1,000s of cubic yards in average year

Average Annual Wave Height Distribution



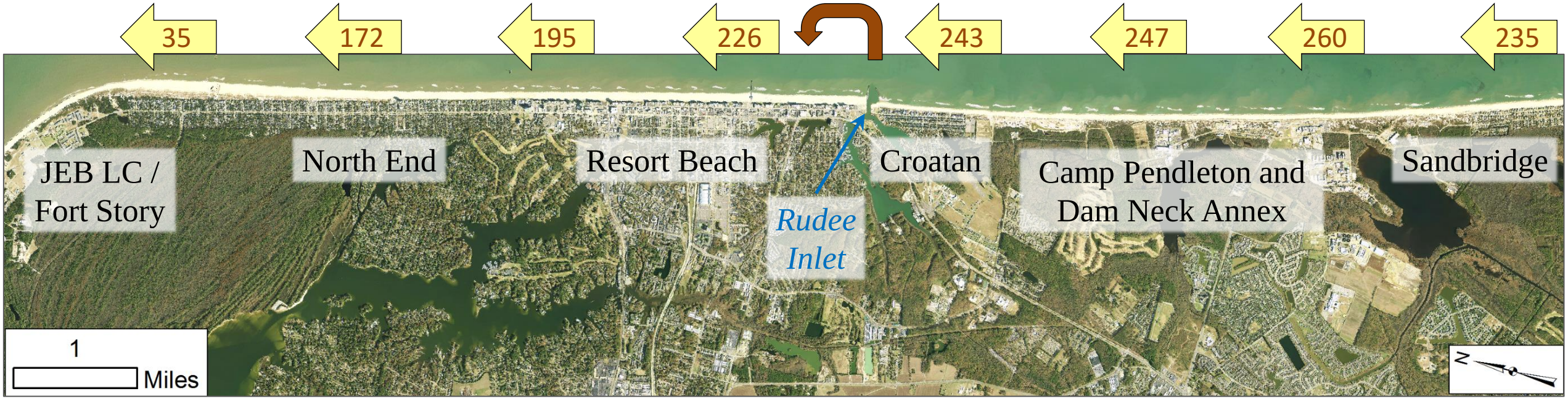
≥ 5
3.3 – 5
1.9 – 3.3
1 – 1.9
0.4 – 1
0.1 – 0.4

Net = Northward Transport – Southward Transport

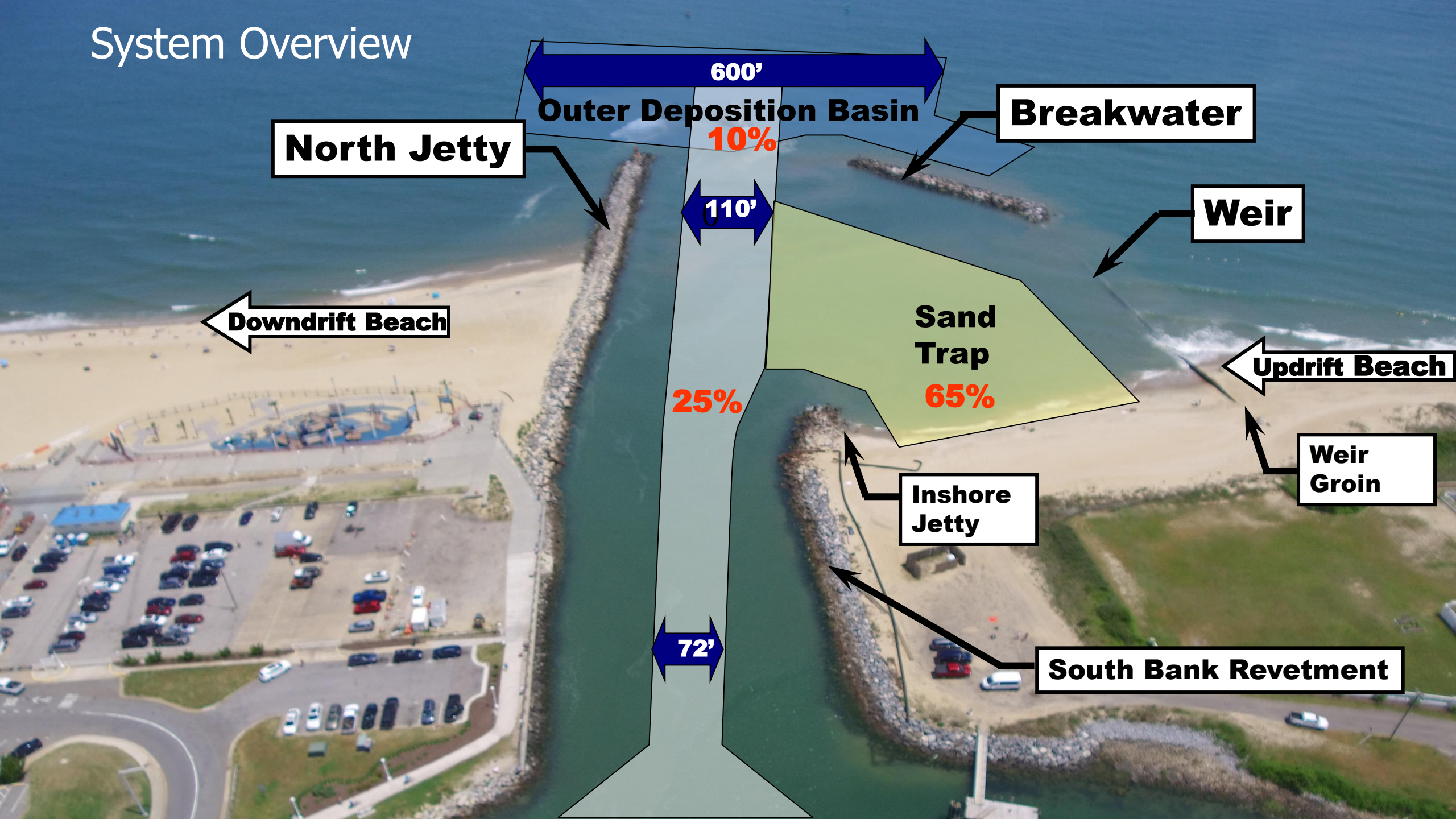
Waves approach <u>from</u> east and southeast most of the time, driving Net transport for the year toward the North.

Dredging: 175 to 250

Average Annual Net Sand Transport Rates

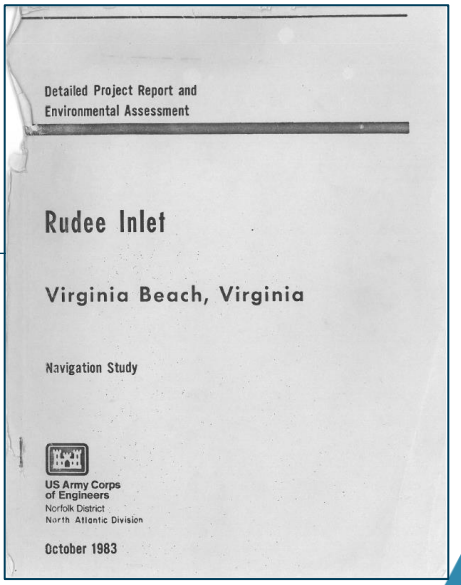


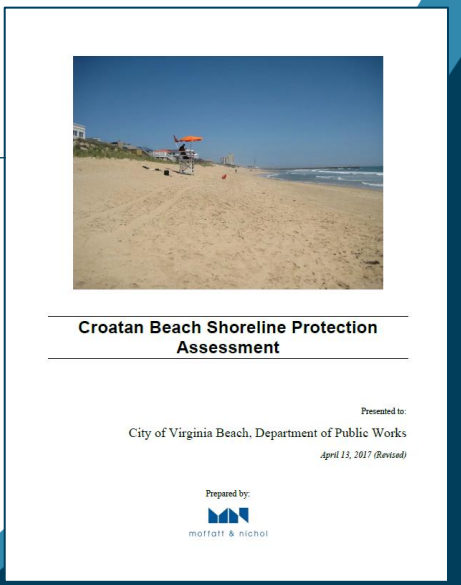
System Overview



Croatan & Rudee Inlet Prior Studies

Rudee Inlet Navigation Study – Detailed Project Report and Environmental Assessment, USACE	**October 1983**
Rudee Inlet Maintenance Dredging Alternatives Study, Langley & McDonald	1997
Rudee Inlet Management Study, Waterway Surveys & Engineering Ltd., Olsen Associates, Inc.	December 2001
Rudee Inlet Operational Needs, Waterway Surveys & Engineering Ltd.	January 2004
Rudee Inlet Dredge Efficiency Study, Waterway Surveys & Engineering Ltd.	January 2006
Rudee Inlet Weir Repairs Letter Report, Waterway Surveys & Engineering Ltd., Olsen Associates, Inc.	October 2013
Croatan Beach Shoreline Assessment, Moffatt & Nichol	**April 13, 2017**
Rudee Inlet Sediment Budget Analysis and Sand Trap Borrow Impacts Evaluation (408 Study); Moffatt & Nichol	April 11, 2017
Croatan Beach Nourishment Coastal Modeling and Analysis Report (408 Study), Moffatt & Nichol	April 2018





Croatan Shoreline Assessment (2017)

A costal engineering study of Croatan Beach shoreline and beach profile behavior in context of historical and present sand bypassing and dredging practices at Rudee Inlet

Primary objective

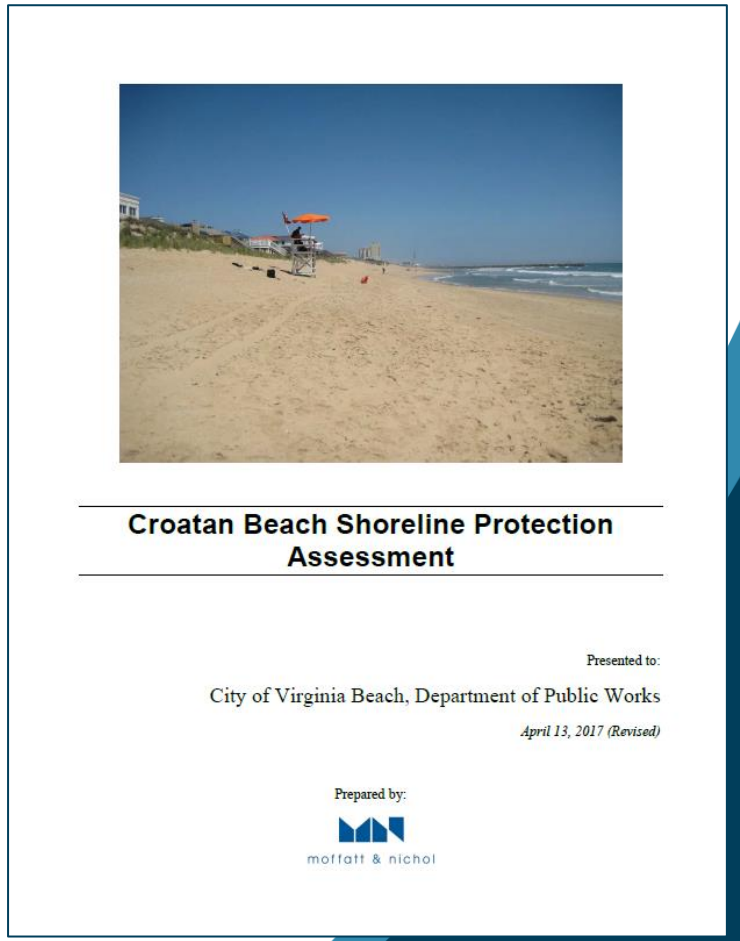
- Determine whether the current level of protection provided by the beach and dune to upland structures and infrastructure meets “adopted criteria”

Related objectives

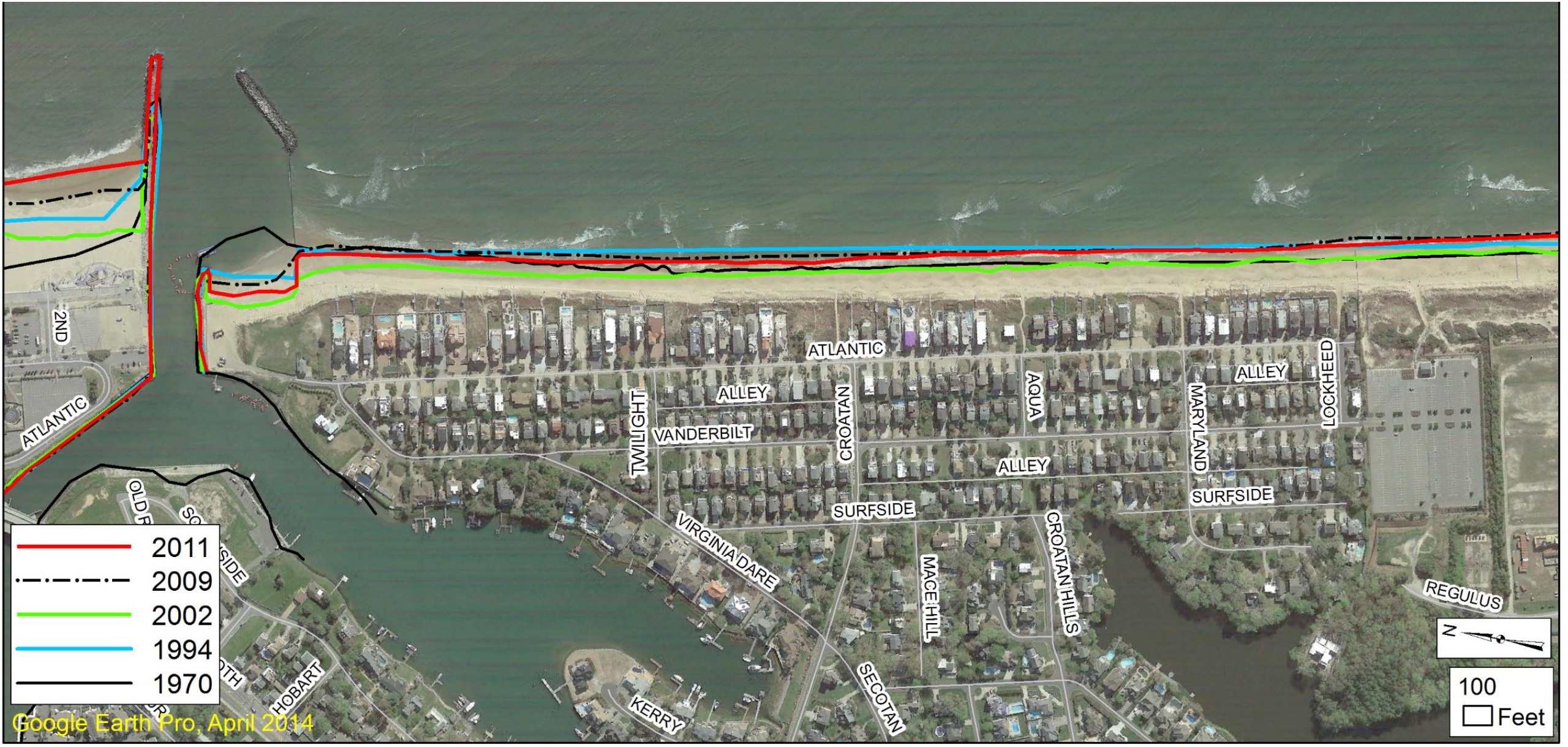
- Determine whether inlet, dune, and beach mamangment practices have affected the level of protection, and if any changes may be needed to these practices to maintain a sufficient level of protection

Study documented

- Shoreline and dune change over time
- Present-day storm protection
- Consideration of sea level rise
- Concepts for beach and dune improvements
- Purpose and criteria
- Permitting considerations
- Impacts to Rudee Inlet dredging project



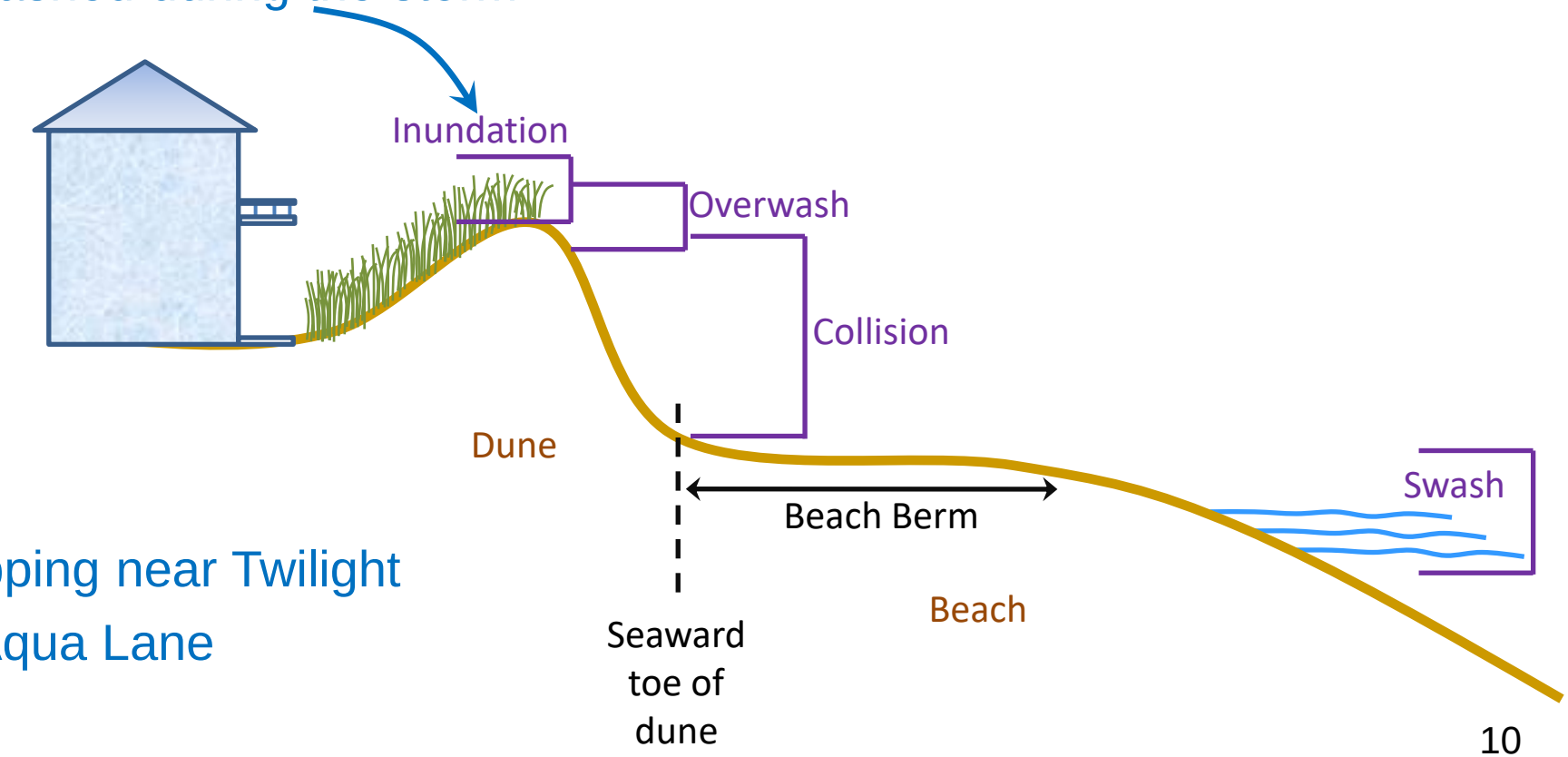
Shorelines: 1970 to 2011



Definitions

Level of Protection Provided by the Beach and Dune

- Some criteria discussed in working meetings:
  - Avoid dune overtopping in storm events up to and including the 1% annual chance storm surge and associated waves at all locations along Croatan Beach.
    - True breaching: waves have completely removed the dune or the dune is continuously over washed during the storm
    - Overtopping
    - Potential for overtopping near Twilight Lane and south of Aqua Lane



Level of Protection Provided by the Beach and Dune

- Some criteria discussed in working meetings:
  - Avoid impacts to habitable structures at the 1% annual chance (a.c.) level of protection (LoP), while providing a lower level of protection for non-habitable structures.
  - Avoid impacts to both habitable and non-habitable structures at the 100-year return period (1% annual chance) level of protection.
- Present beach and dunes meet these criteria, except around Twilight Lane

Level of Protection Summary

Other Criteria (2017 Assessment)

- Beach berm width at Mean High Water (MHW)
  - Sufficient beach berm width for recreational usage and accessibility; minimum usable beach berm width of approximately 50 feet
    - 15 feet for vehicles to traverse the back of the beach
    - 10 feet for lifeguard stands
    - 25 feet seaward of the lifeguard stands for beachgoers

- August 2016 beach profiles show greater than 50 feet between the toe of the dune and the shoreline. However:
  - Most locations have beach slopes steeper than preferred for recreation and access
  - Between 20 to 30 feet of very mild-sloped beach in three segments:
    - just south of the weir
    - just north of Maryland Avenue
    - at Lockheed Avenue

Notes on Meeting the Criteria (2017 Assessment)

- The study was done mainly using the November 2015 post-storm survey profiles
- August 2016 site visit and survey indicate profile is eroded landward of November 2015
- A conceptual plan is needed to restore / maintain dune height and volume at stations 05+00, 10+00, and possibly 15+00
- Meeting the community's beach width criteria will require construction of a beach berm, in addition to the dune restoration above

Conceptual Plan to Enhance the Beach Profile (2017 Assessment)

- Developed an outline design for
  - restoring dune volume, and
  - increasing beach width

- The plan creates 50 feet of flat beach berm between a dune toe at +8 feet MLW and the seaward edge of the berm.
  - 40 feet of berm adjacent to the weir

- The total beach width between the toe of the dune and the MHW shoreline varies between 100 and 120 feet.

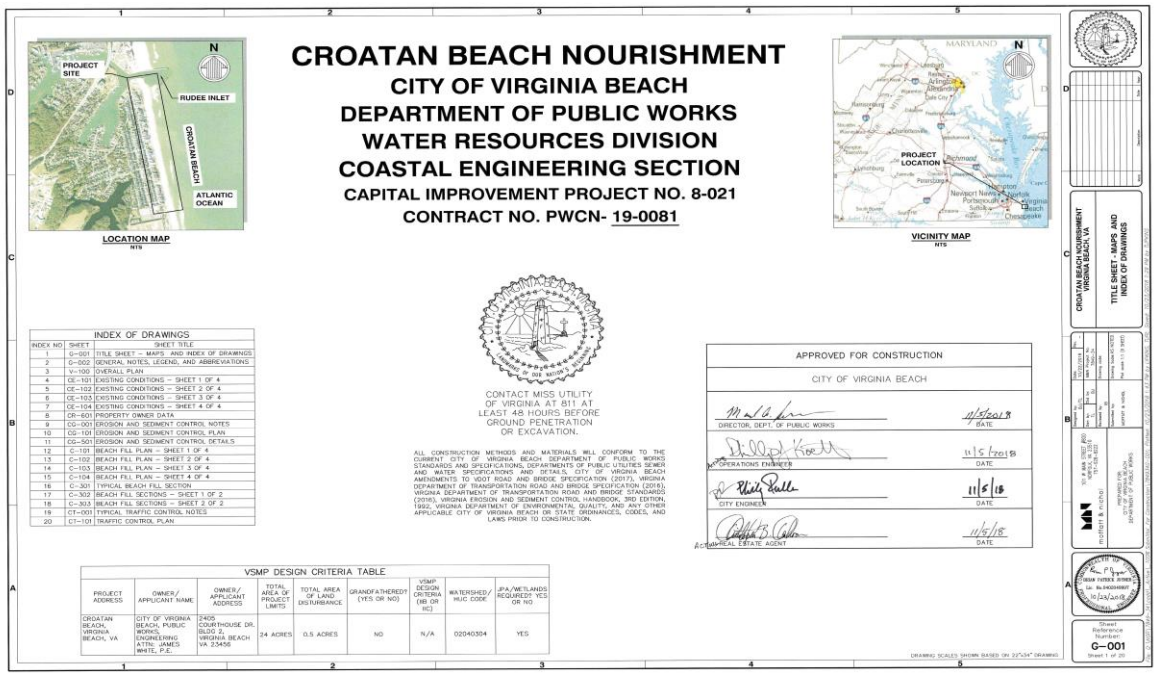
- Requires approximately 130,000 cubic yards for initial construction
  - 20,000 annually should be sufficient for maintenance in “average” years

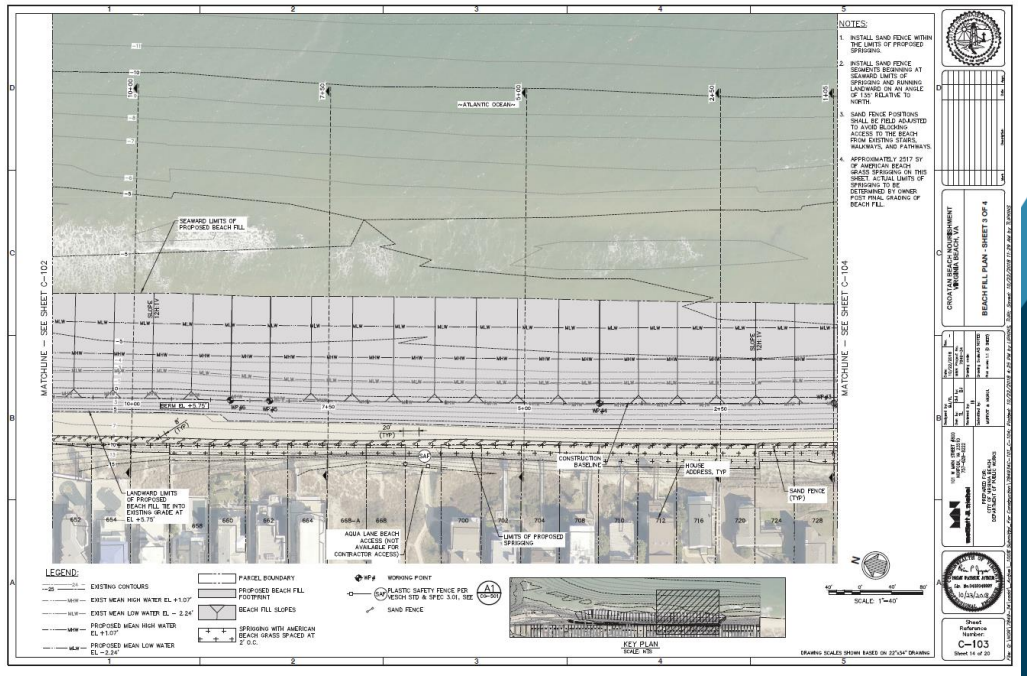
Conceptual Design to Restore Dune and Increase Beach Width

Conceptual Design to Restore Dune and Increase Beach Width

Engineered Beach Design

- Croatan Beach Restoration CIP was created in FY 2017/18
- Beach Profile was design as recommended
- Permits were obtained for placement via truck haul
- Project was bid in 2018 with unfavorable bid results





Sand Placement History

Croatan Beach Sand Placement History		
Date(s) of Activity	Volume Placed, cubic yards	Beach Segment
2008	50,000 cy	berm
May 2013	15,000 cy	dune
April 2015	20,000 cy	dune
April 2016	1,917 cy	dune
November 2016	10,000 cy	dune
Feb., Apr., Aug., Oct./Nov. 2018	19,200 cy	dune
April/May 2022	49,000	berm
Total Volume Placed	165,117	

Consideration of Weir and Jetty Modification (2017 Assessment)

- The conceptual plan's MHW shoreline position is seaward of the range of surveyed shorelines since 2006 (after 2004 weir modification).

- Modifications to the weir would not be required in order to construct and maintain the conceptual dune and beach profiles for present sea levels.

- Meeting the level of protection criteria in a future 1.5 feet SLR would require more dune volume and beach width than present-day conditions. Expanding the profile to keep pace with 1.5 feet of SLR would likely require weir modifications and possibly modifications to the south jetty.
  - Beyond the scope of this study*

**Part of Rudee Inlet Weir Replacement Project (CIP 100617)*

Conclusions (2017 Assessment)

- Historical data show a relatively low rate of shoreline retreat (about 1 foot per year) between 2002 and 2015.
  - Shoreline advance of from 2002 to 2009, average of 8 to 9 feet per year; the City placed sand from the inlet onto the beach in 2008
  - Consistent retreat since 2012
  - Differences in wave climate in the last few years is driving it

- Addition of this much sand and expansion of the beach width is likely to require a Section 408 review during Federal permitting

- Future sea level rise will eventually require additional dune volume to maintain levels of protection
  - This is a long-term planning consideration, not an immediate action, since sea level rise is a relatively slowly-occurring process.

Additional Recommendations (2017 Assessment)

- Beach maintenance
  - Annual checks on beach width, beach elevation and dune shape
  - Sand added to the beach and dune based on these annual reviews
    - Amount needed in any particular year will vary
    - Sand borrowed from the sand trap
  - Beach grooming at intervals to be determined

- Beach monitoring
  - Surveys at regular intervals
  - Photos at consistent locations with repeatable views

Next Steps

- Berm widening – City is seeking up to 120,000 cubic yards of sand as part of the next Resort Beach renourishment cycle sourced from the Norfolk Harbor Deepening Project
  - Permit application filed to change sand source
  - MOA between City and USACE
  - Favorable bids
- Plant beach grass & install sand fencing
- Ongoing profile survey & monitoring and periodic renourishments as needed
- Croatan Wier Replacement and Modifications
  - Nearing end of 25 yr. life cycle
  - Consideration of design modifications to enhance Croatan Beach profile
- Future considerations - VB Comprehensive SLR Study SLR recommendati

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Discussion