South Carolina Planning Education Advisory Committee
(SCPEAC)

February 16, 2026

NOTICE OF DECISION

Title of Program: Beaches 101

Organization: Elko Coastal Consulting, Inc.

The following action has been taken by the SCPEAC on this application:

APPLICATION RECEIVED	Date: February 9, 2026
APPLICATION REVIEWED	Date: February 12, 2026
ACCEPTED WITHOUT OBJECTION	Date: N/A

a) __X__ ACCREDITED for: 180 minutes (3.0 hours) CE credit hours: 4.0

b) DENIED ACCREDITATION

b) _____RETURNED for more information

If accredited:

a) Authorized Course No.: 2026-02

b) Date of accreditation: February 16, 2026

Certification Signature, MASC Administrative Representative: L P. Floyd

Certification Signature, SCPEAC Representative: Stephanie Monroe Tillerson

For further information, contact Urica Floyd at 803-354-4754 or the committee at SCPEAC@masc.sc.

Municipal Association of SC • 1411 Gervais Street • Columbia, SC • 29201
Phone: 803.354.4754
Email: SCPEAC@masc.sc
Website: https://www.scstatehouse.gov/SCPEAC/

Application for Accreditation of a Continuing Education Program or as a Sponsor Organization

NOTE: This certification form, together with the required information referenced therein, shall be submitted to the South Carolina Planning Education Advisory Committee (SCPEAC). Applications are due no later than at least 30 days prior to the first scheduled presentation of a program or class. Once submitted, as the applicant, if you have not been contacted within 5 business days of a submittal, you should reach out with an email or phone call to scpeac@masc.sc or to 803.354.4754 for application status. Approvals are generally granted within 24 to 48 hours. If no objections are raised by a member of the SCPEAC within 10 business days of receipt, the program shall be considered accepted. If an objection is raised, a teleconference meeting shall be scheduled with appropriate public notice, as soon as reasonably possible, to review the application. The Committee will consider extenuating circumstances where the 30-day deadline cannot be met.The primary applicant or staff member organizing the training must meet the minimal educational requirements of at least an undergrad degree, plus 5 years experience in the planning field.

Reason for Application

Choose one:

⊙ Request as a Local Official for Continuing Education Program Approval ○ Request as an Organization for Accreditation of a Continuing Education Training ○ Request as an Organization to be an Approved Sponsor of Continuing Education Programs

Applicant Information

*The primary applicant or staff member submitting the training for approval must meet the minimal educational requirements of at least **an undergrad degree, plus 5 years experience in the planning field**. The submitting applicant certifies the proposed Continuing Education Program meets the educational requirements in Section 6-29-1340 of the South Carolina Code of Laws and that the proposed presenter is qualified to give the presentation.*

Name

Nicole	Elko
First	Last

Municipality/County/Organization
Elko Coastal Consulting, Inc.

Position
President

Phone
(843) 371-7082

Email
nelko@elkocoastal.com

If you are a COG Director, indicate which jurisdiction the certification is being requested for:

Applicant Resume/Vita
Elko-CV2026.docx

Information About Organization Providing the Training

Organization Name
Elko Coastal Consulting, Inc.

Organization Address
P.O. Box 1451
Address Line 1

PO Box 1451
Address Line 2

Folly Beach
City

South Carolina
State

29439
Zip Code

Organization Phone
(843) 371-7082

Organization Website
https://www.elkocoastal.com

Name of Training Contact
Nicole Elko, Ph.D.

Title of Training Contact
President

Training Contact's Phone
(843) 371-7082

Training Contact's Email
nelko@elkocoastal.com

Training Program Information

Title of Planned Training or Program
Beaches 101

Date of Training
4/6/2026

Length of Training Session (i.e. 60 minutes, 90 minutes, 3-hours, etc.)
3 hours

Training Location

City of Folly Beach

Brief description of the Training or Program and its relevant content:

The Beaches 101 Training Course offered by Elko Coastal Consulting provides participants with a comprehensive introduction to coastal environments, focusing specifically on beach dynamics and management. This course covers essential topics such as coastal processes, shoreline erosion, restoration techniques, and sustainable beach management practices. Designed for both professionals and enthusiasts, Beaches 101 combines classroom instruction with hands-on fieldwork, ensuring attendees gain practical knowledge relevant to real-world coastal challenges. By completing this training, participants will be equipped with foundational skills to assess, maintain, and enhance beach environments effectively.

Method of presentation (in-person; virtual; or other):

in-person

When will materials be distributed (before or at the time of the program):

at the time of program

Description of materials to be distributed:

Slides of the training presentation and relevant references/reports/studies

Method of Advertisement (Describe how you plan to notify local officials of the program):

City announcement, The course is sponsored by the City of Folly Beach, intended to be taken by elected officials and their designees. The City will "market" the training course internally.

Additional Comments

Required Attachments

Brochure, if available:

Course Presenter(s) and credentials (include brief resumes and qualifications, combine into one .pdf document):
Elko bio short 2026.pdf

Copies of all handouts and course materials (combine into one .pdf document). If the course materials is a video/webinar recording include an informational sheet with video summary, links to the host site of the video, etc.:
Beaches 101-Day1-2018.pdf

day 2.pdf

Beaches101-Day3-2018.pdf

Evaluation Form and method of evaluation (each program must be evaluated, combine into one .pdf document):
Beaches 101 Training Course Evaluation Form.docx

Certification. By submitting this application, the applicant agrees to:

1. Allow in-person observation, without charge, of the Program by the SCPEAC Committee members. Any food, travel, or lodging costs will be the responsibility of the Committee member.

2. The applicant acknowledges that its approval for this Program may be withdrawn for violations of the regulations or failure to comply with the agreements and representations contained herein and as may be required by the SCPEAC.

Dr. Nicole Elko is President of Elko Coastal Consulting based in Folly Beach, SC. She provides non-profit management services at the Executive Director for the American Shore and Beach Preservation Association (ASBPA); an Executive Director of the U.S. Coastal Research Program; and Administrator of the South Carolina Beach Advocates. Dr. Elko has 25 years of experience in coastal science and management, leading many coastal resilience projects along the U.S. Southeast and Gulf coasts. She served on Governor McMaster's South Carolina Floodwater Commission in 2019.

Dr. Elko received her Ph.D. (Geology) from the University of South Florida after working with the USGS Coastal Marine Geology Program, St. Petersburg, and while serving as the coastal coordinator for Pinellas County, FL. She is presently serving as an emeritus civilian member of the U.S. Army Corps of Engineers' Coastal Engineering Research Board (CERB) and also as a member of NOAA's Hydrographic Services Review Panel (HSRP). Both the CERB and HSRP are Federal Advisory Committees that provide advice to agency leadership on national coastal research and development needs. Dr. Elko teaches a "Beaches 101" training course to regulators and elected officials in the Carolinas and advises several graduate and undergraduate students.

In her free time, she enjoys surfing with her family. She has served as the Director of the Folly Beach Wahine Classic since 2018 where her non-profit experience helps advocate for overcoming gender stereotypes and barriers in women's surfing.

Beaches 101: A Training Course for Coastal Managers

Nicole Elko, Ph.D.

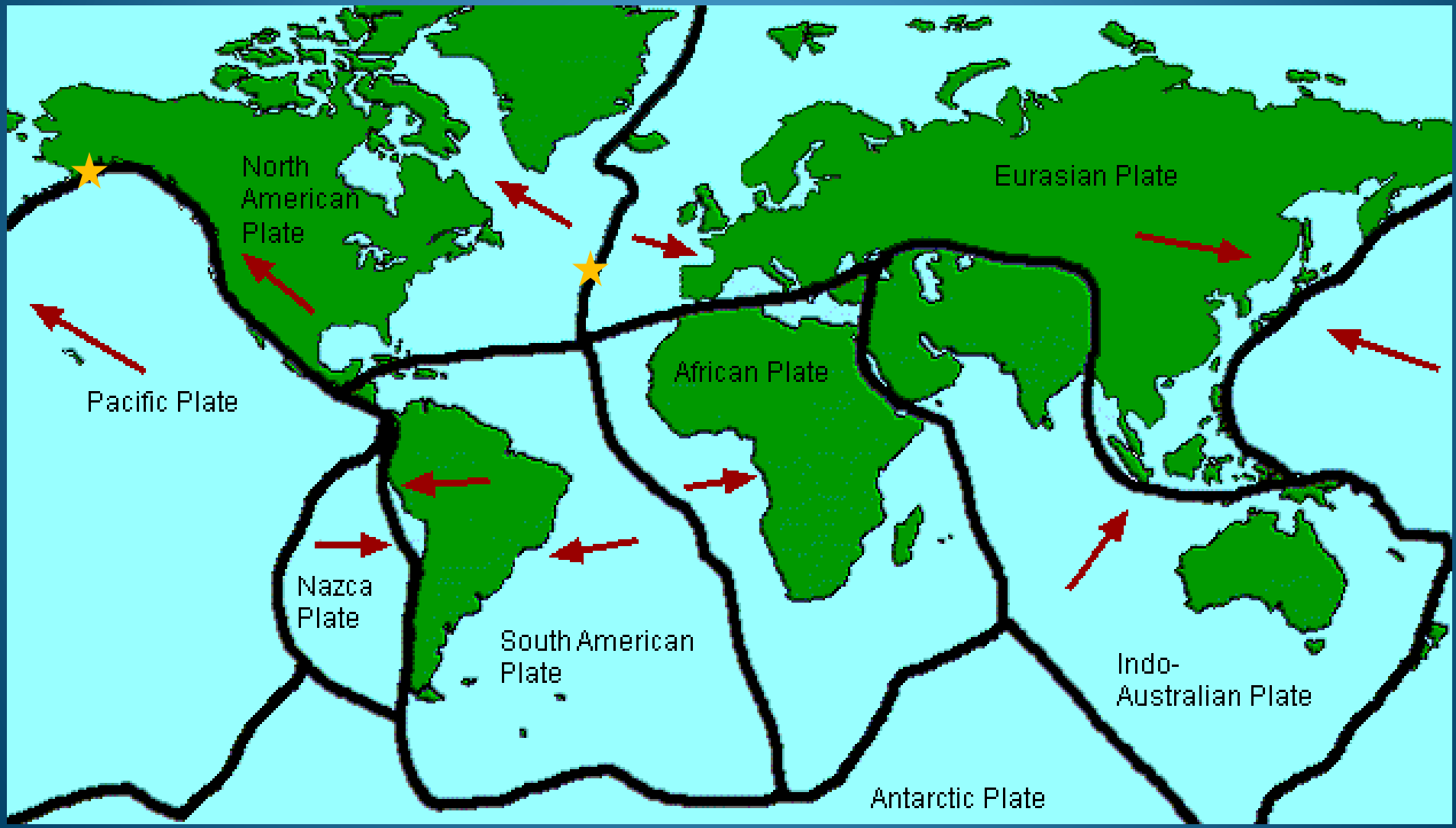
October 3, 2018

Coastal Processes Primer Beaches & Inlets

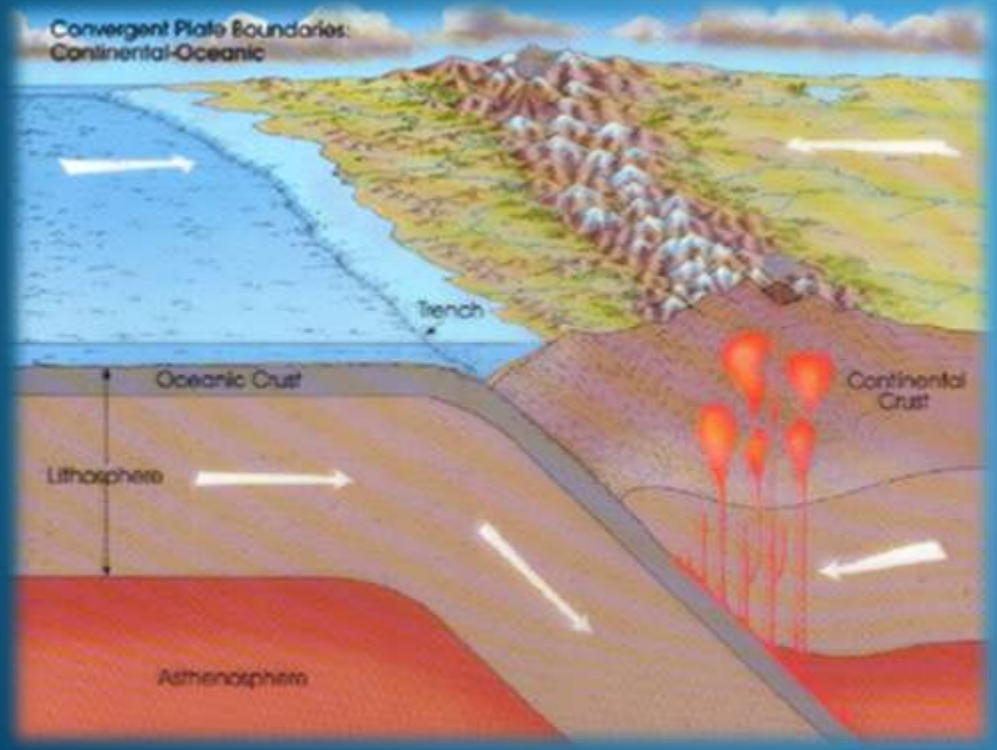
Outline

- Why do our beaches look this way?
  - Tectonics
  - Sediment
- Processes & Features
  - Sea Level & Barrier Island chains
  - Waves & Beaches
  - Longshore Sediment Transport & Spits
  - Tides & Inlets
- Human modifications to beaches and inlets
  - Jetties
  - Coastal development

Plate Tectonics



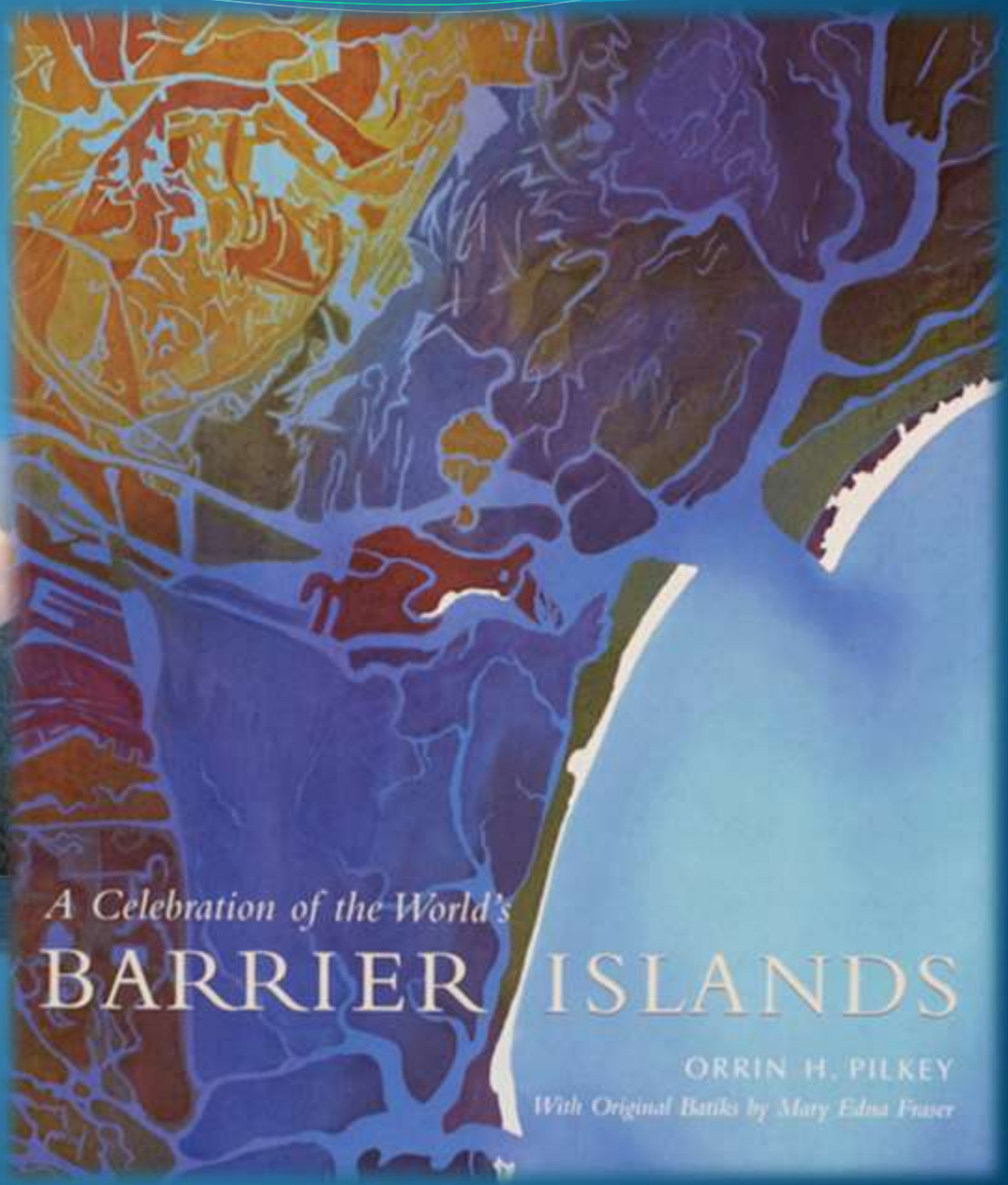
Tectonics: Types of Coastlines



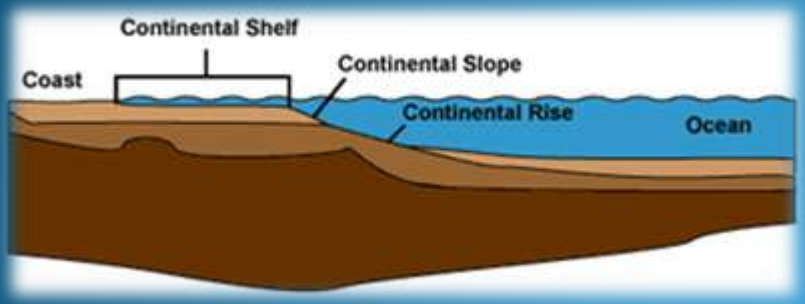
Collision Coast (e.g., Alaska)

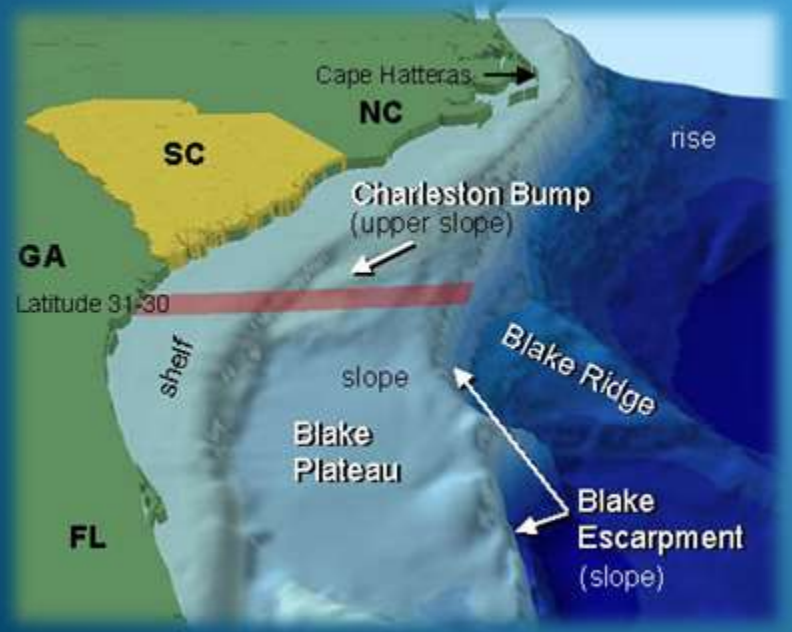
Trailing Edge Coast (e.g., S.C.)

Tectonics: Types of Coastlines



Continental Shelf Width





Beach Sediment

...erodes from neighboring uplands

"Appalachian" Granite

Quartz & Shells

Beach Sedim

Granularmetric Report

Depths and elevations based on measured values

Project Name: Big Hickory Beach Composites
Sample Name: -8.0 ft COMP
Analysis Date: 09-09-09
Analyzed By: PB

Coastal Planning & Engineering
2481 NW Boca Raton Blvd, Boca Raton
FL 33431
ph (561) 391-8102
fax (561) 391-9116

Easting (ft): | Northing (ft): | Coordinate System: Florida State Plane West | Elevation (ft):

USCS: SP | Munsell: | Comments: Composite data. Average wet Munsell Value is 5.

Dry Weight (g)	Wash Weight (g)	Pan Retained (g)	Sieve Loss (%)	Fines (%)	Organics (%)	Carbonates (%)	Shell Hash (%)
100.00	100.00	1.50	0.01	#200 - 1.59 #230 - 1.51		7	

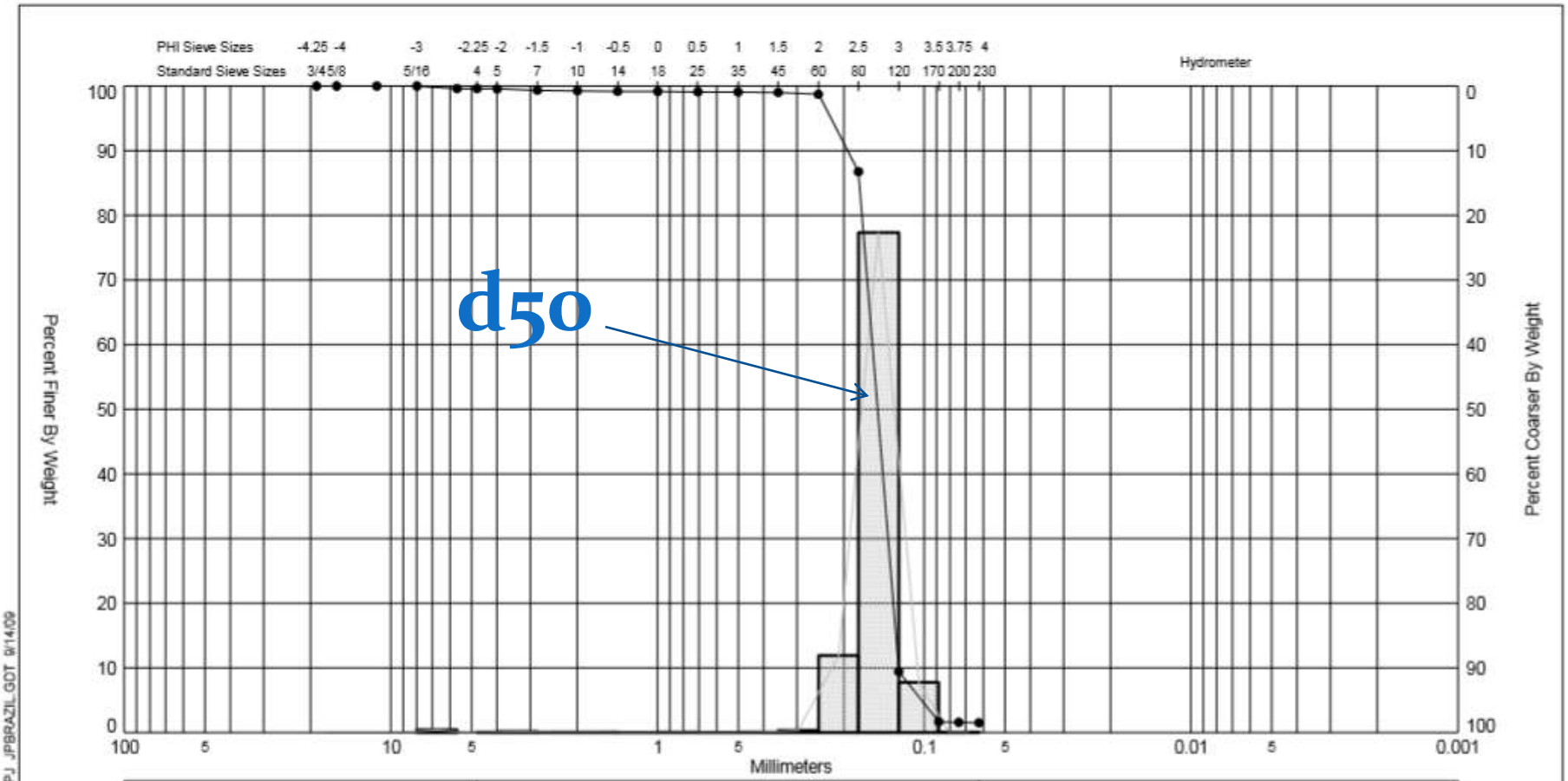
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	C. % Weight Retained
3/4"	-4.25	19.03	0.00	0.00	0.00	0.00
5/8"	-4.00	16.00	0.00	0.00	0.00	0.00
7/16"	-3.50	11.31	0.00	0.00	0.00	0.00
5/16"	-3.00	8.00	0.15	0.15	0.15	0.15
3.5	-2.50	5.66	0.50	0.50	0.65	0.65
4	-2.25	4.76	0.10	0.10	0.75	0.75
5	-2.00	4.00	0.23	0.23	0.98	0.98
7	-1.50	2.83	0.45	0.45	1.43	1.43
10	-1.00	2.00	0.45	0.45	1.88	1.88
14	-0.50	1.41	0.50	0.50	2.38	2.38
18	0.00	1.00	0.42	0.42	2.80	2.80
25	0.50	0.71	0.53	0.53	3.33	3.33
35	1.00	0.50	0.55	0.55	3.88	3.88
45	1.50	0.35	0.80	0.80	4.68	4.68
60	2.00	0.25	2.78	2.78	7.46	7.46
80	2.50	0.18	12.53	12.53	19.99	19.99
120	3.00	0.13	68.66	68.66	88.65	88.65
170	3.50	0.09	9.44	9.44	98.09	98.09
200	3.75	0.07	0.32	0.32	98.41	98.41
230	4.00	0.06	0.08	0.08	98.49	98.49

Shell Hash calculated from visual estimate of shell <4.75mm and >2.8mm.

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.34	2.97	2.90	2.72	2.54	2.34	1.56

Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
	2.55	0.17	0.82	-4.28	24.1

GRANULARMETRIC REPORT BEACH_COMPOSITES.GPJ JBERADELGOT 10/14/09



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
R-222.5+450 (-8.0 ft)	—●—	-8.0	SP	#200 - 1.59 #230 - 1.52		3	2.74	2.68	-7.49	74.89	0.5

Comments:

Depths and elevations based on measured values

Sample Information	
Project Name:	Big Hickory Beach Samples
Analysis Date:	08-27-09
Analyzed By:	PB
Easting (X, ft):	741,770
Northing (Y, ft):	697,944
Horizontal System:	NAD 1983
Vertical System:	NAVD 88

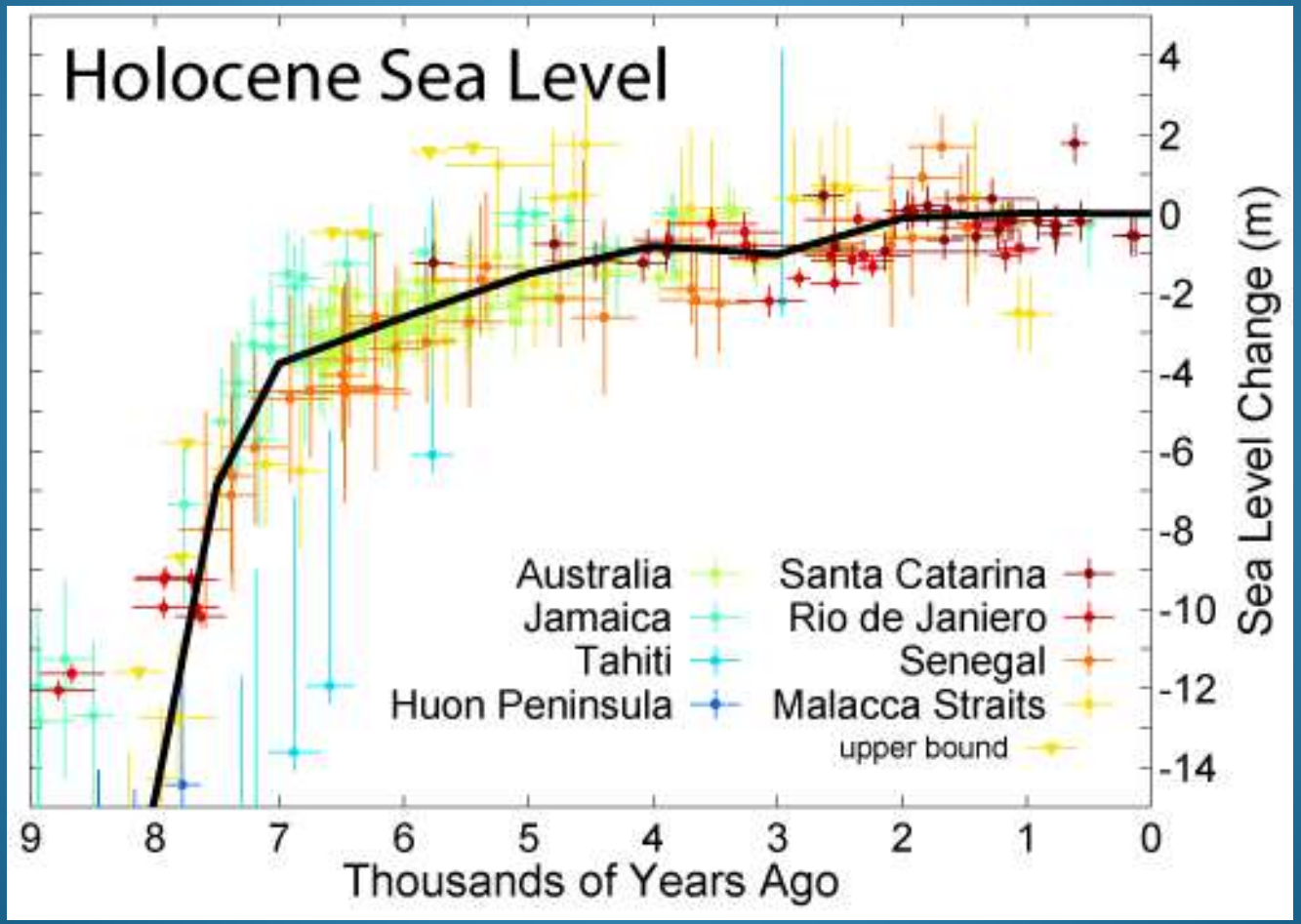
Coastal Planning & Engineering
2481 NW Boca Raton Blvd, Boca Raton
FL 33431
ph (561) 391-8102
fax (561) 391-9116

EVE ANALYSIS BIG_HICKORY_BEACH_SAMPLES.GPJ JPBRAZIL.GDT 9/14/09

Outline

- Processes & Features
  - Sea Level & Barriers
  - Waves & Beaches
  - Wind & Dunes
  - Wave-generated currents (LST) & Spits
  - Tides & Inlets

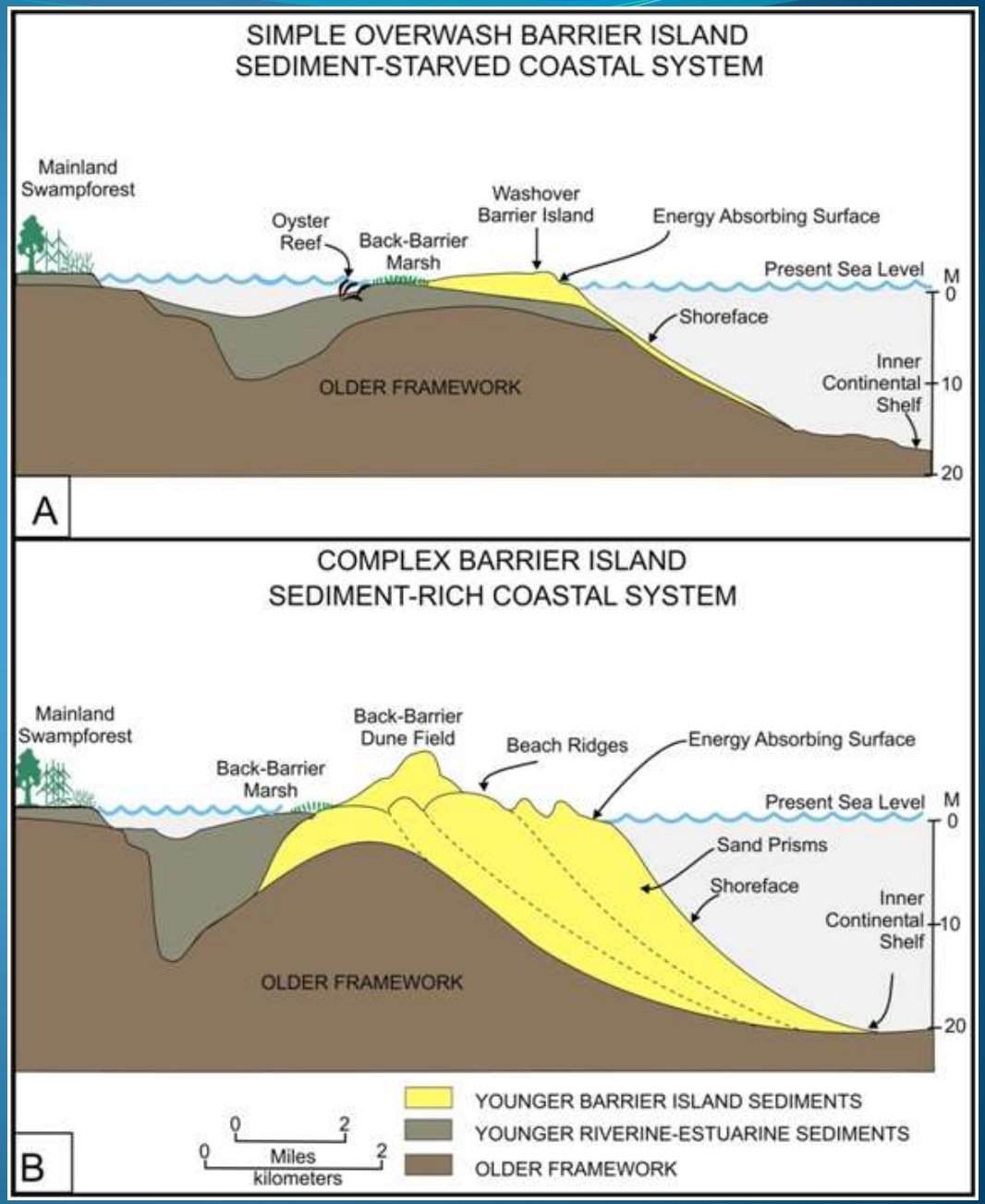
Sea Level Change & Barrier Islands



SLR in Charleston since 1921: 3.2 mm/yr (1ft/century)

Barrier Islands: Retrograding or Prograding

- **Sediment Supply**
- Rate of sea level change
- Storminess/erosion



Barrier Islands: Prograding

SLR = 2-4mm

Barrier Islands: Retrograding

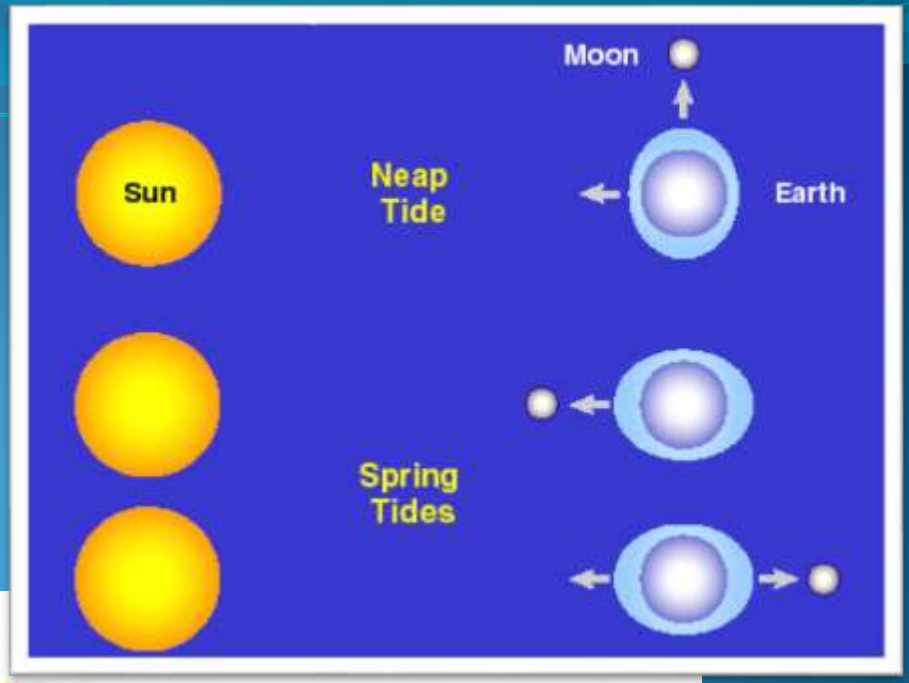
SLR = 2-4mm

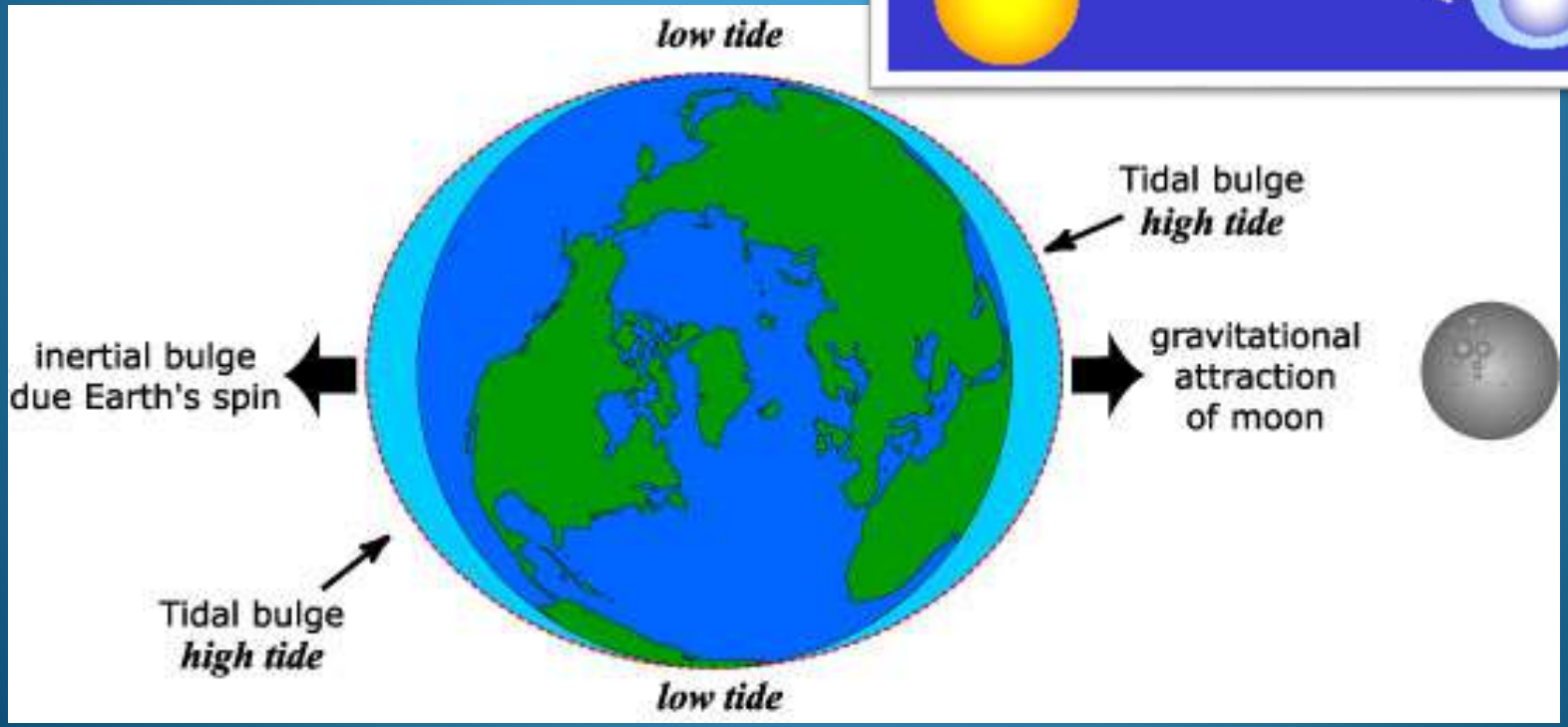
Barrier Islands: Retrograding

- Folly Beach, SC

- April 2013

Tides & Barrier Islands

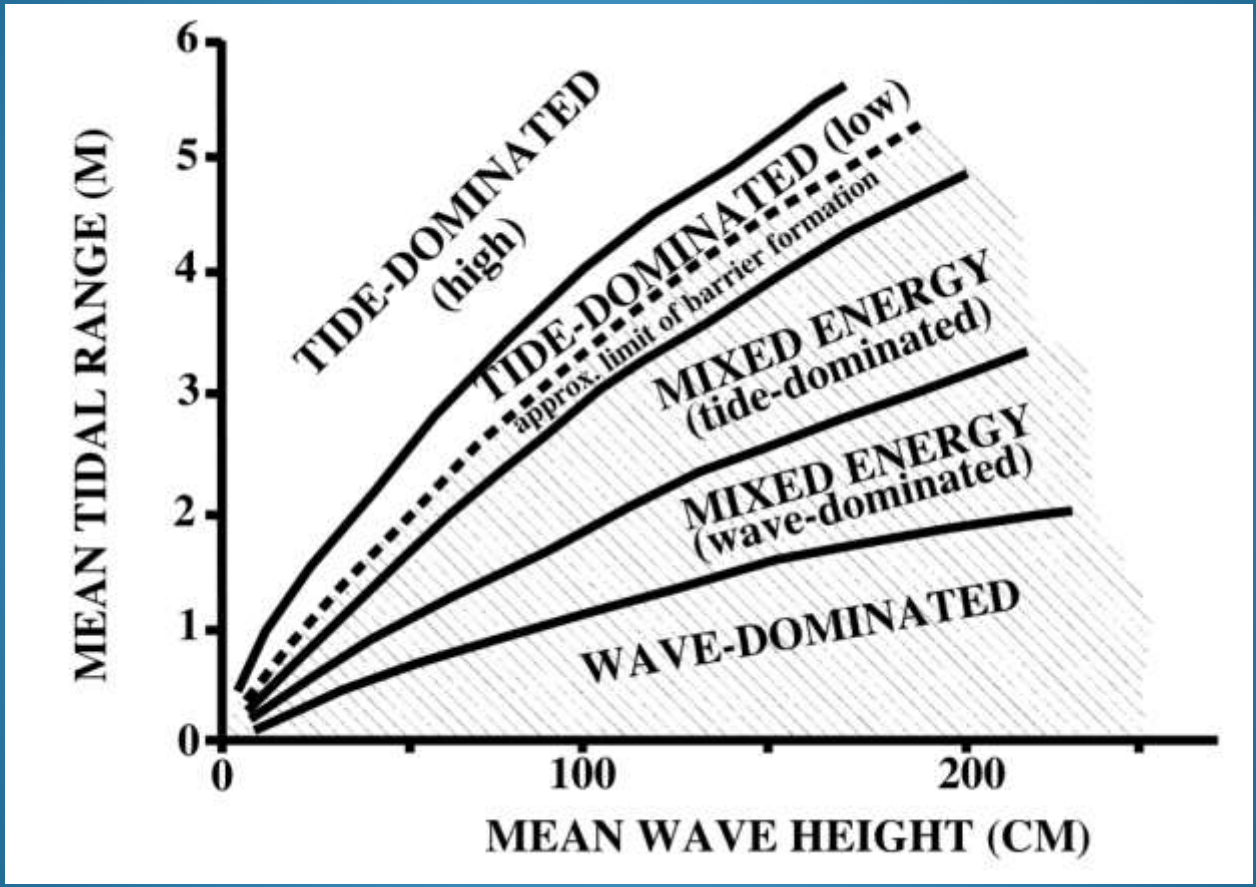




Tides


3 ft Cape Hatteras
6 ft Charleston
2.5 ft Delray Beach
Nassau
The Bahamas

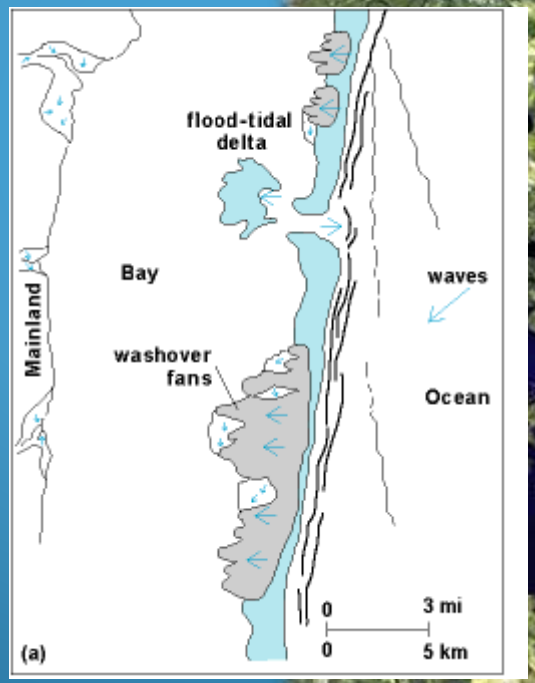
Barrier Island Chains



- Relative influence of waves and tides (short-term processes) on barriers (large-scale features)

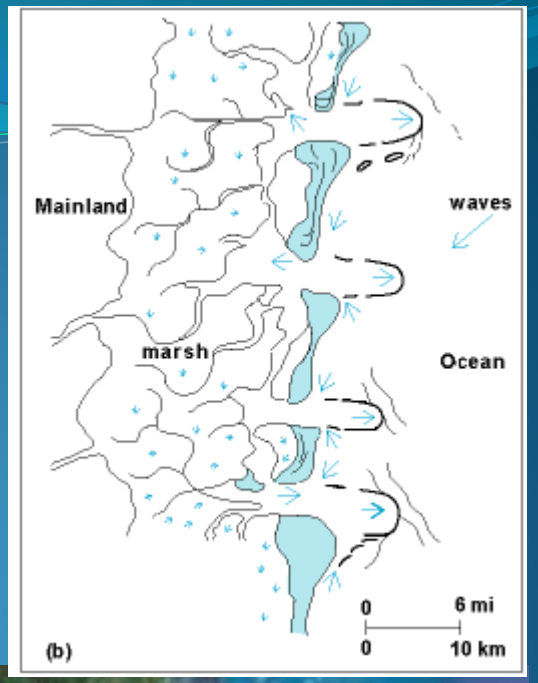
Barrier Island Chains

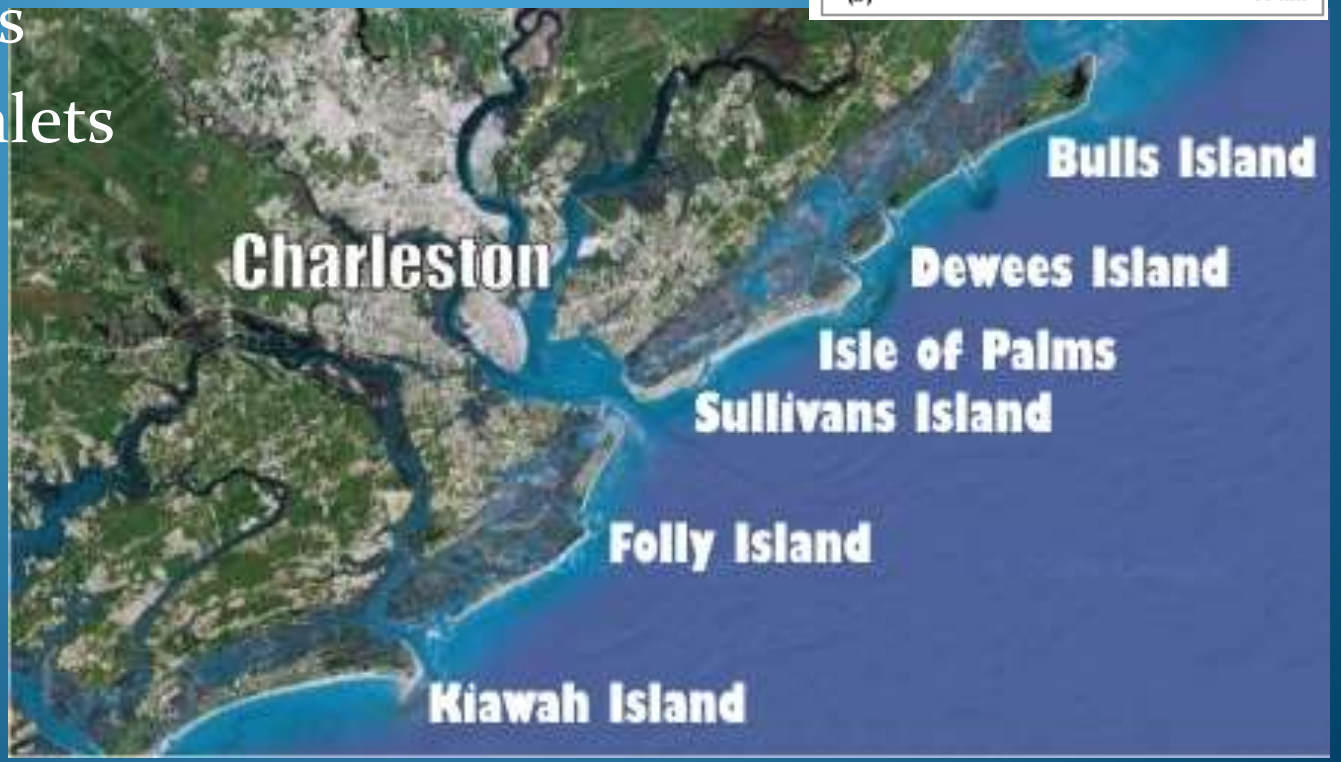
- **Wave-dominated coast**
- Waves > Tides
- Long barriers
- Few tidal inlets
- Broad, shallow bay
- Outer Banks, NC
- Laguna Madre, TX



Barrier island chains

- **Mixed-energy coast**
- South Carolina/Georgia
- Tides >= Waves
- Short barriers
- Many tidal inlets
- Salt marsh





Review

- Wave-dominated
- Mixed-energy
- Tide-dominated?

Beaches & Waves

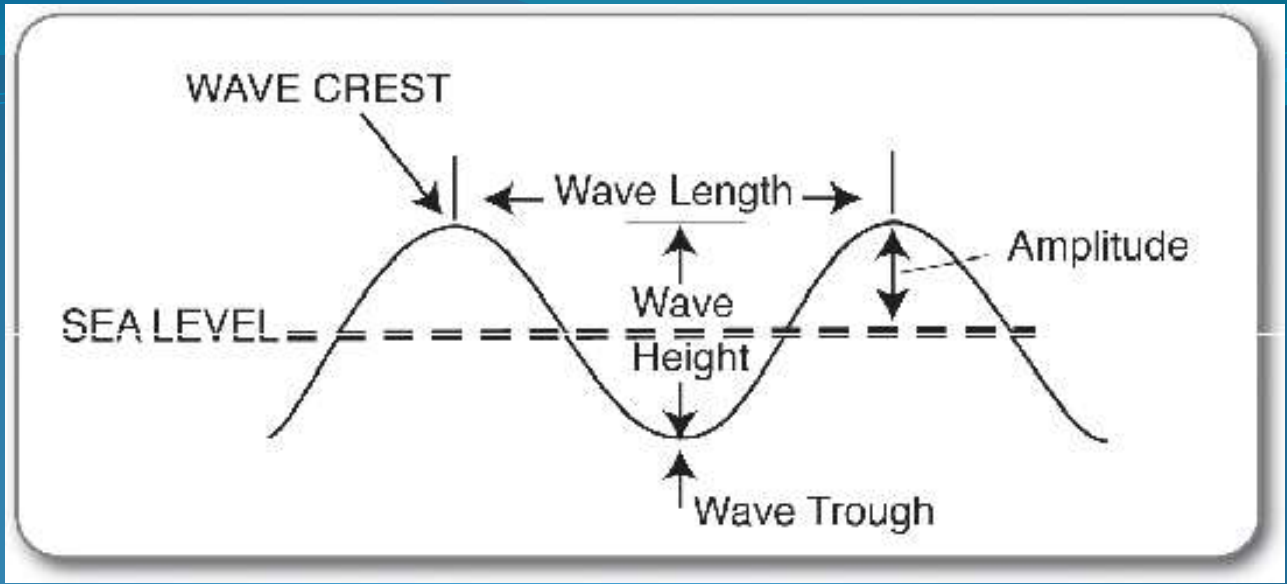
Pasco County, FL

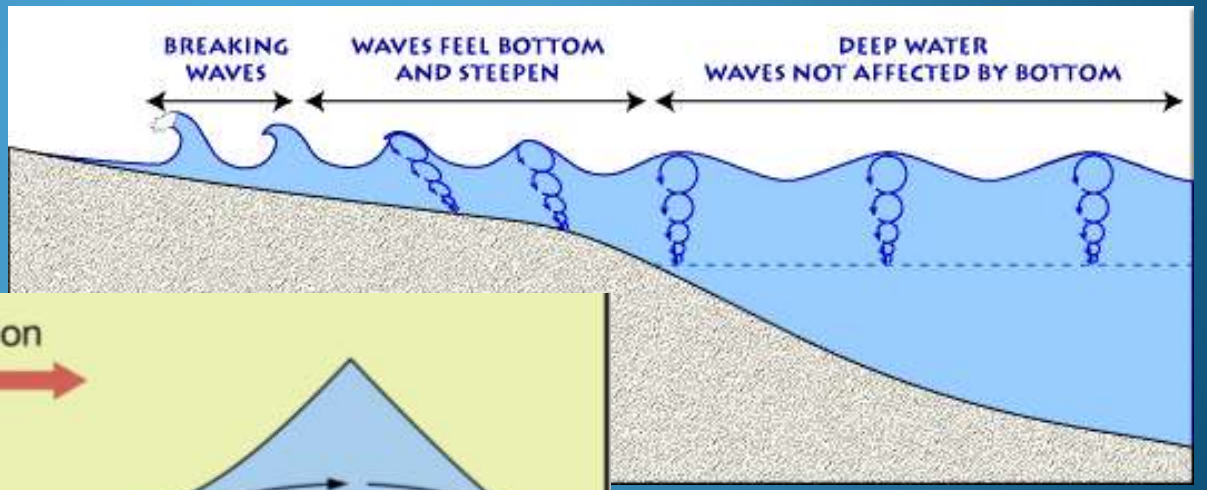
Tide-dominated Coast

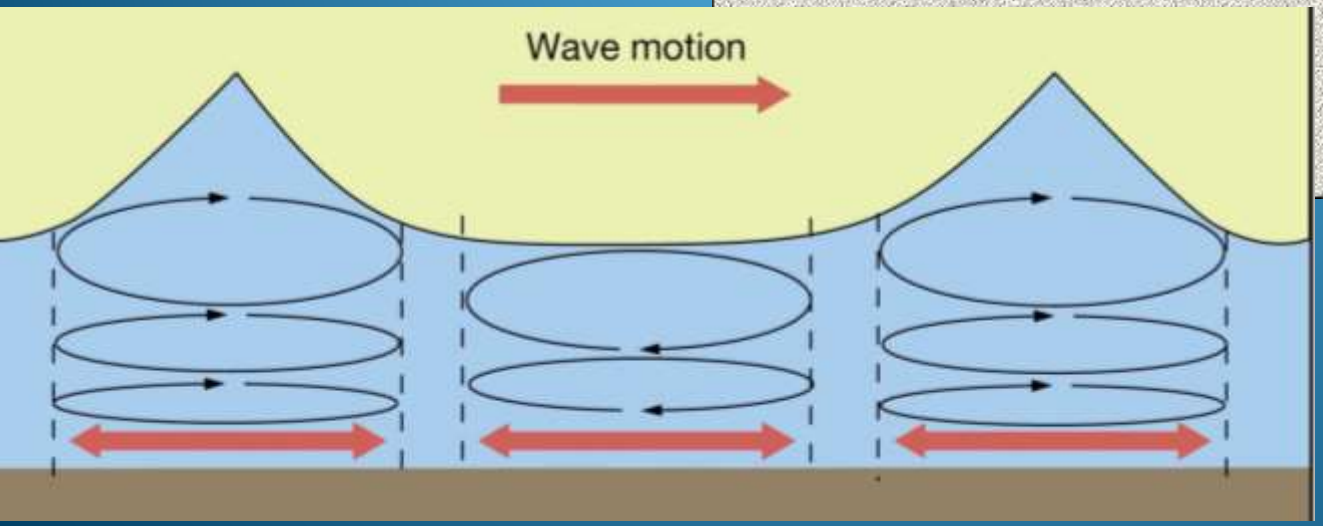
Tides >> Waves

Waves

- H
- L
- T
- S=H/L







Waves: Generation, Wind Waves

- Wind speed
- Duration
- Fetch*

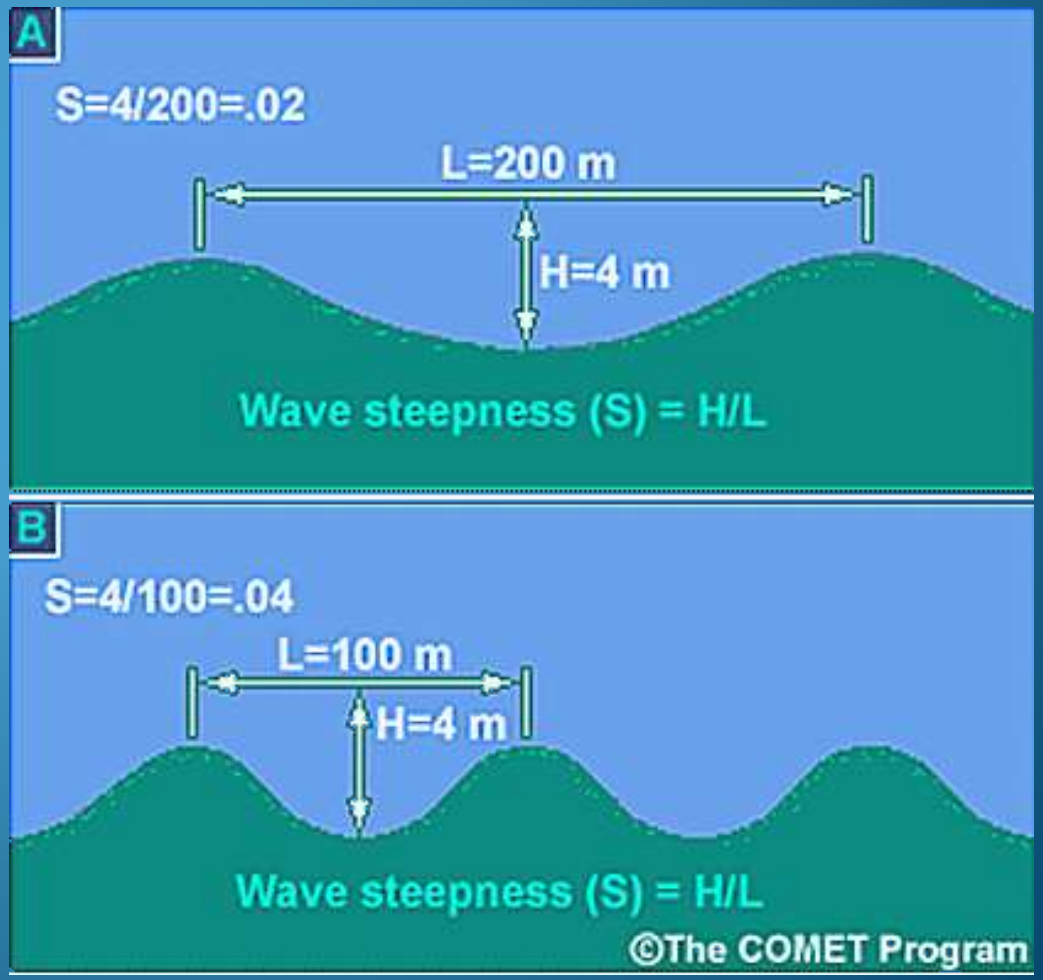
- Dispersion

Waves: Swell

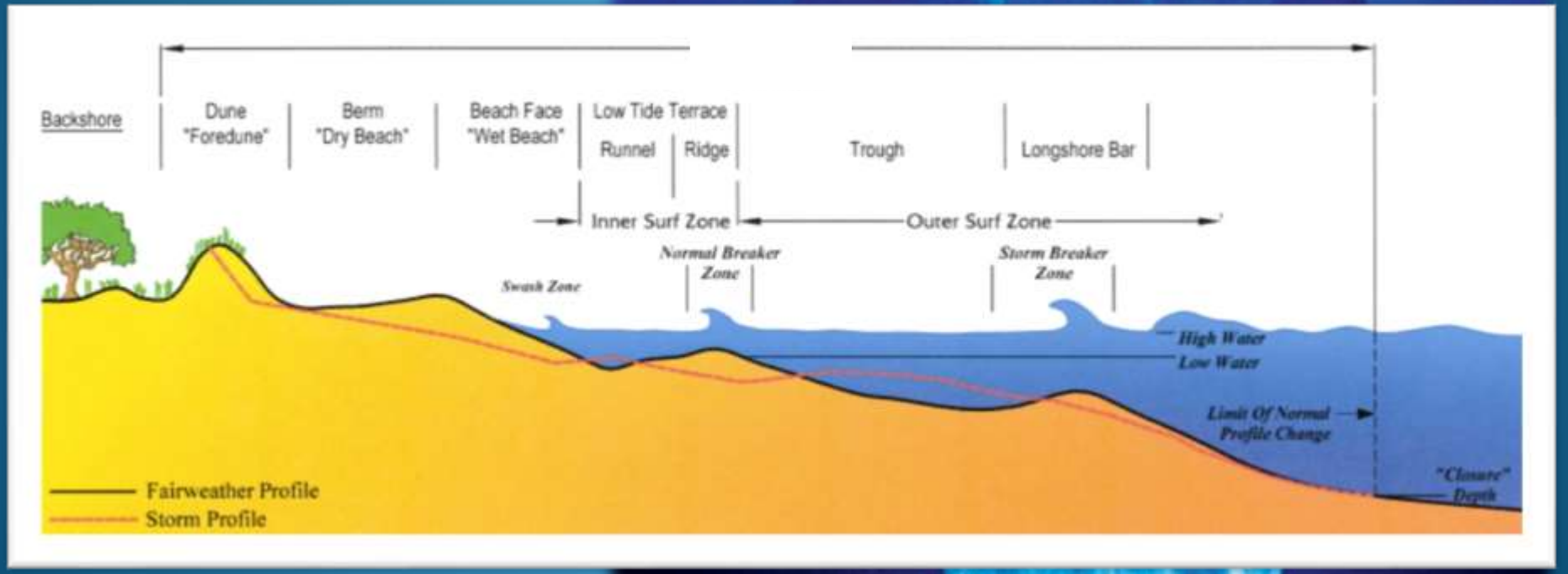
Waves: Wave Steepness

Waves: Wave Steepness

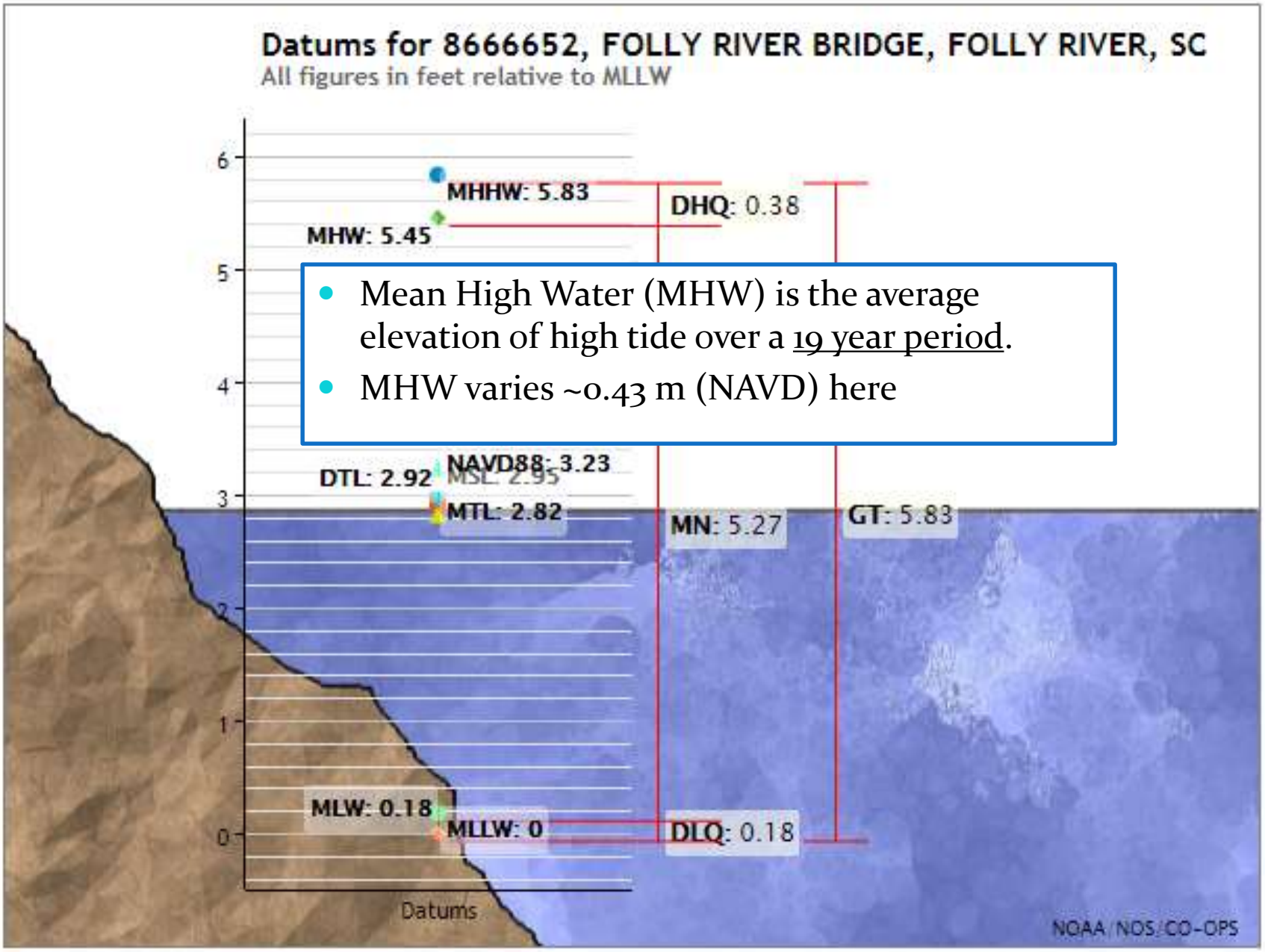
- Constructive
- Destructive
  - Wave Energy



Beaches



Beach Profile



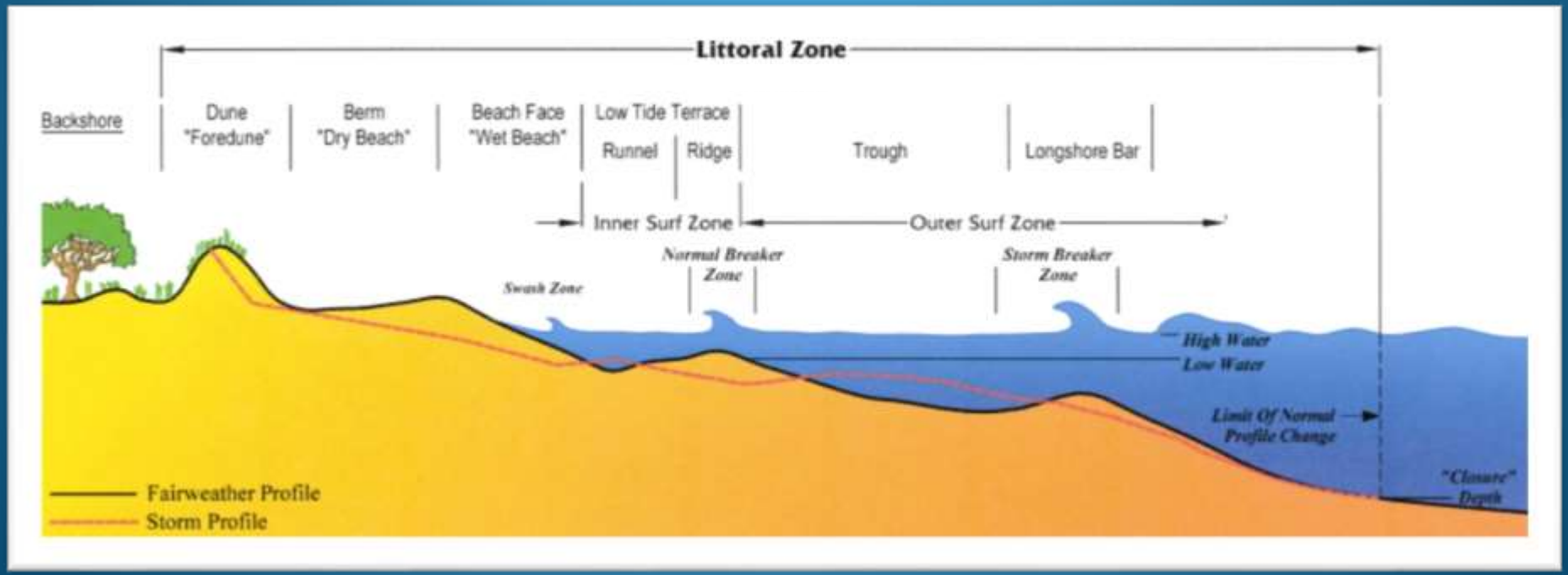
- Mean High Water (MHW) is the average elevation of high tide over a 19 year period.
- MHW varies ~0.43 m (NAVD) here

Beach Morphology: Ridge and Runnel

Beach Morphology: Bubble Sand!

Beach Morphology

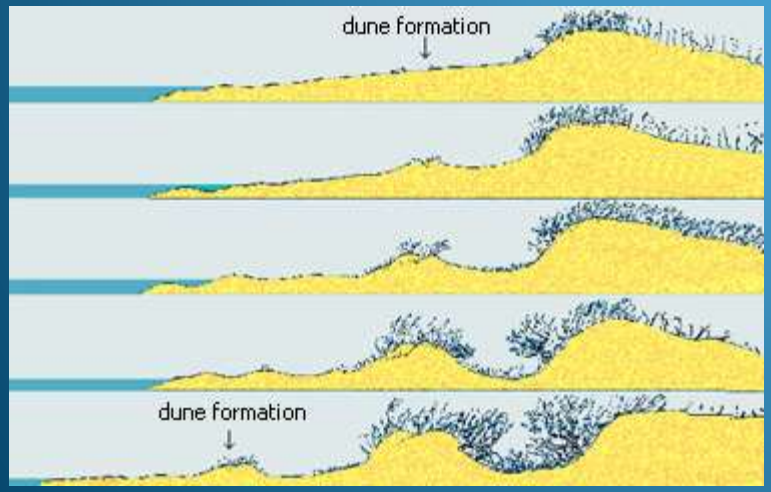
- Summer/Winter or Fairweather/Storm Profile
- Sediment & Wave Characteristics

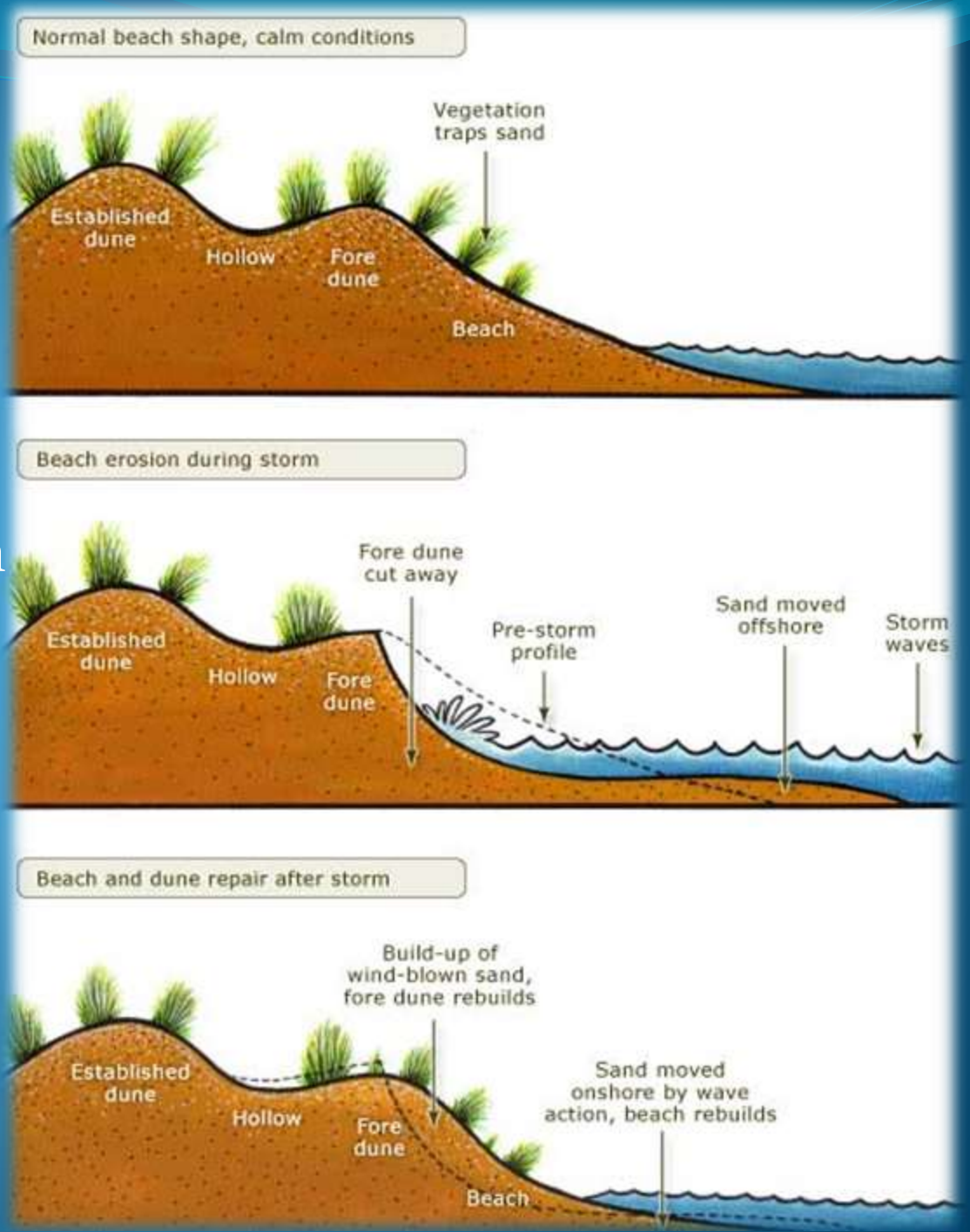


Equilibrium Beach Profile

Dunes & Wind

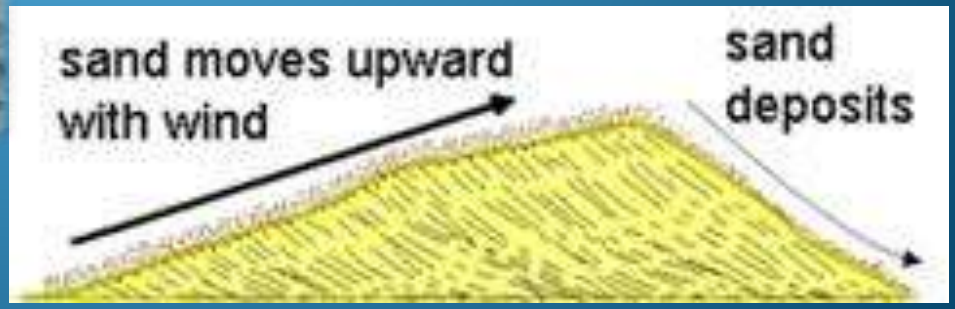
- Sediment supply
- Reliable winds
- Infrequent inundation
- Barrier to slow wind



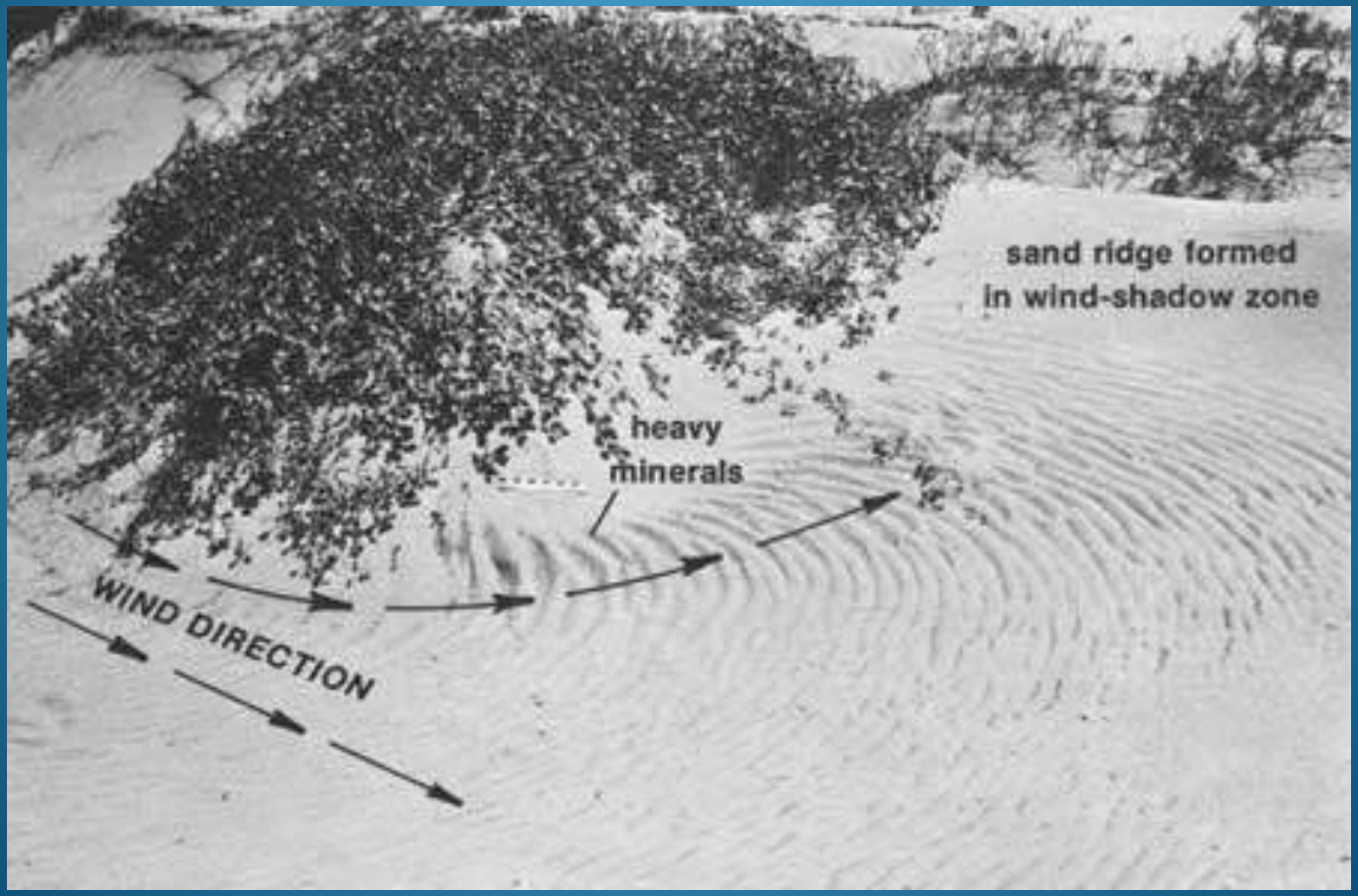


Dunes: Cross-bedding

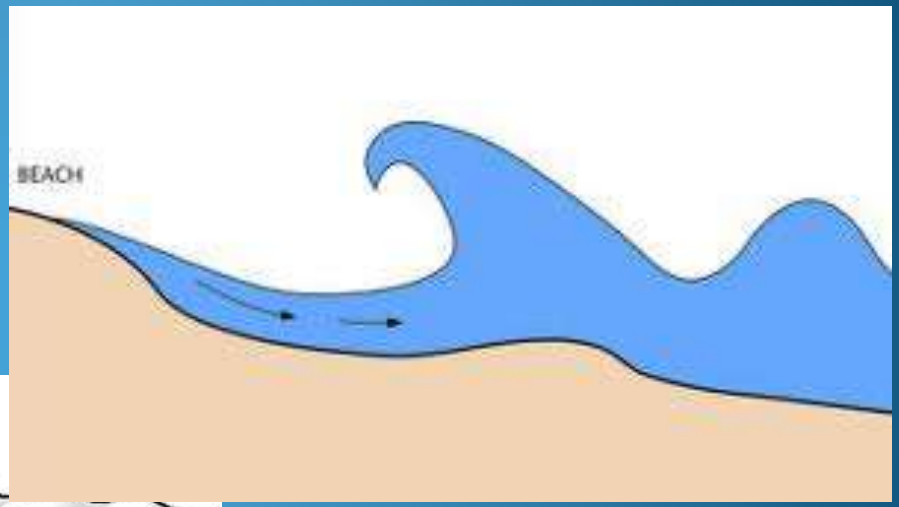
Vermillion Cliffs, AZ

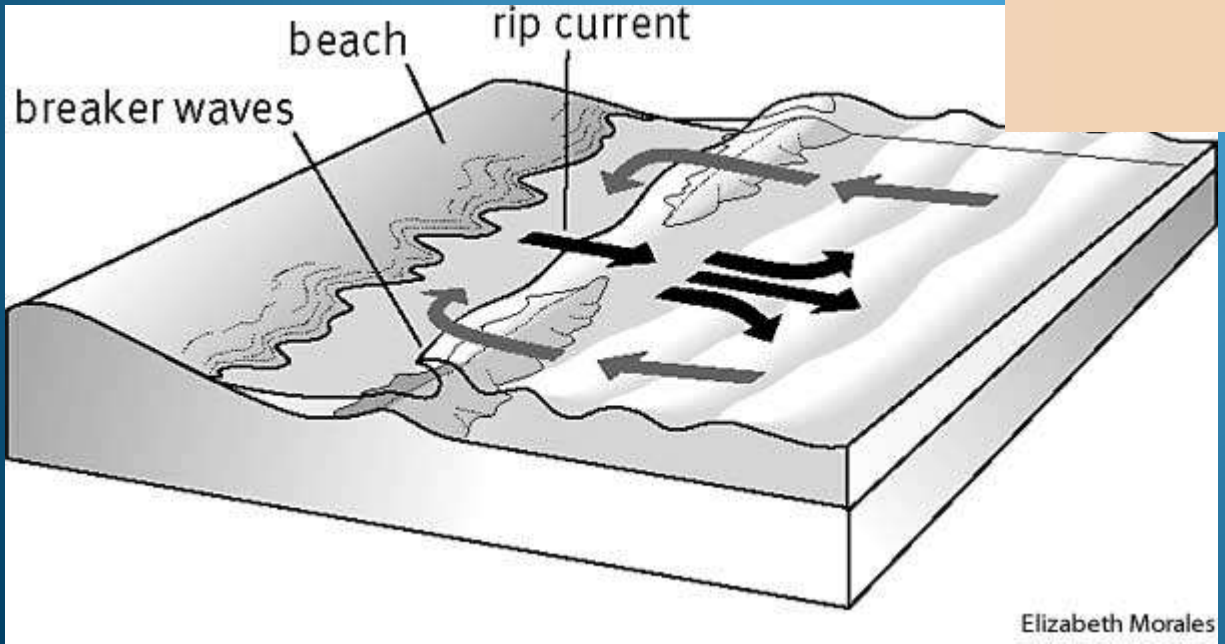


Dunes: Wind Ripples



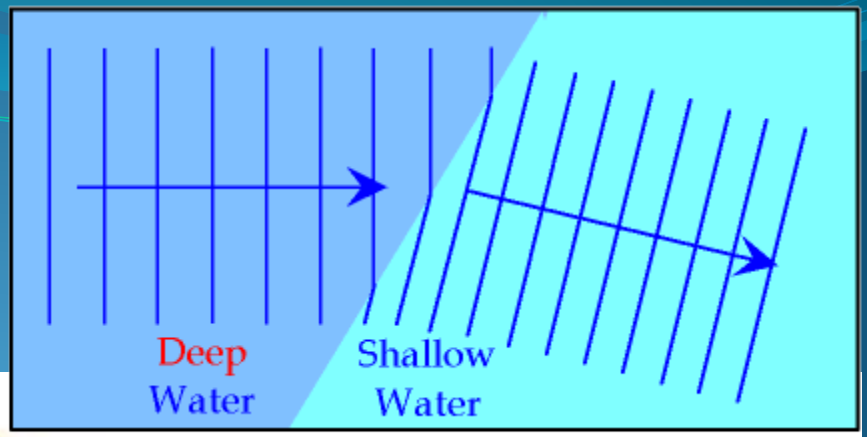
Wave Generated Currents: Undertow & Rip Currents

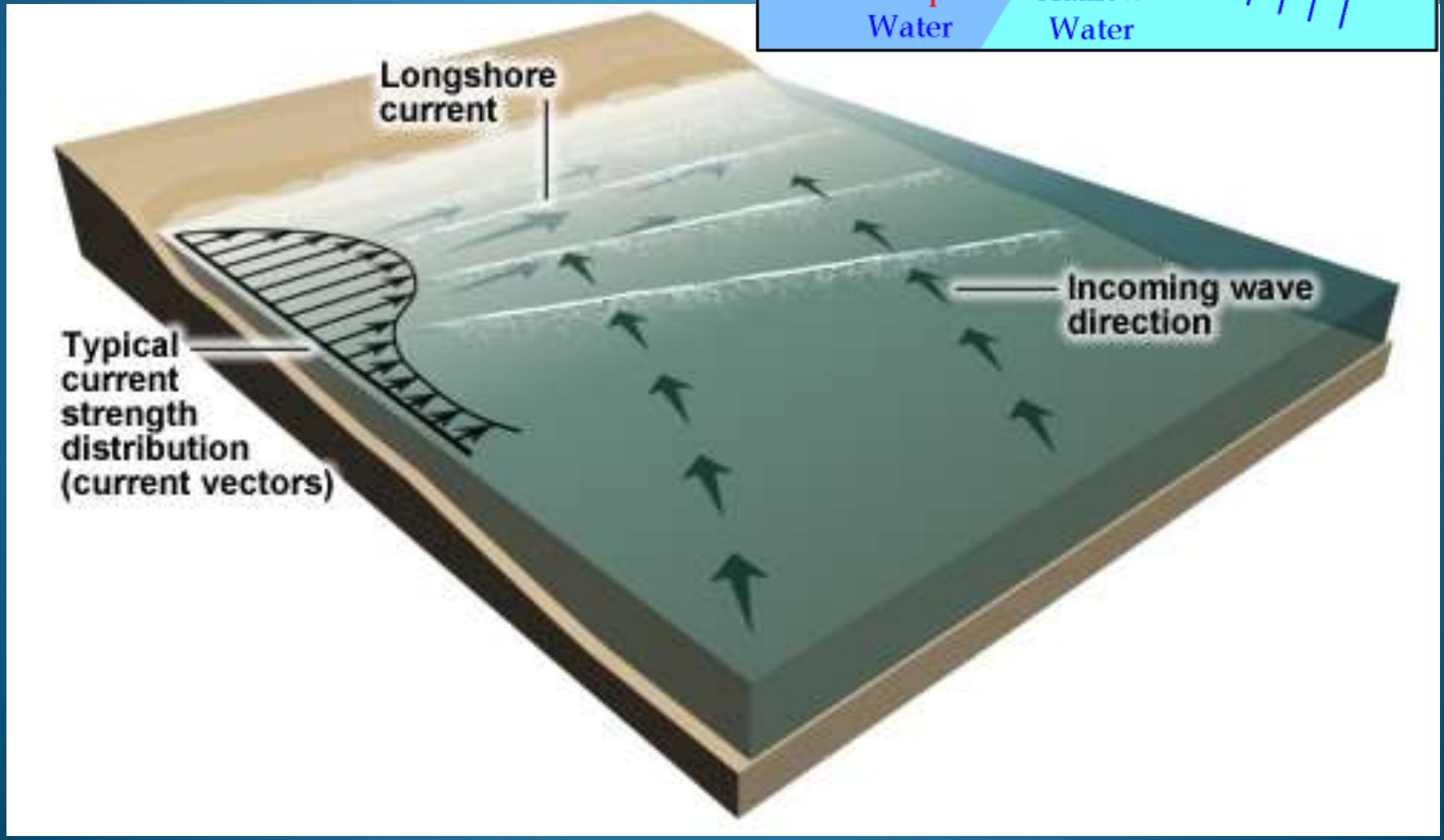




Assume normal waves

Wave Refraction & Longshore Current

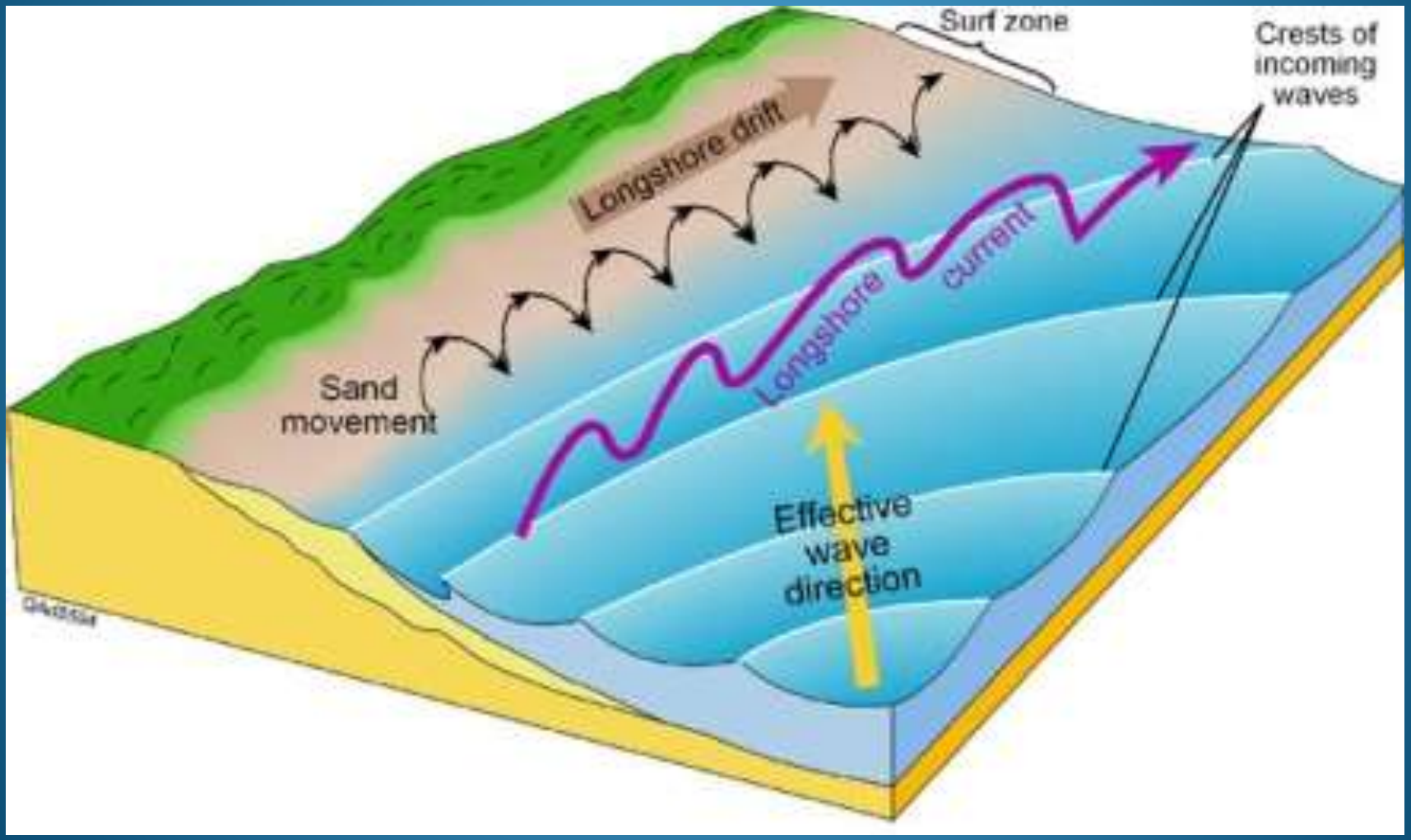




Longshore Current

AKA Littoral Drift

Longshore Sediment Transport



Spits

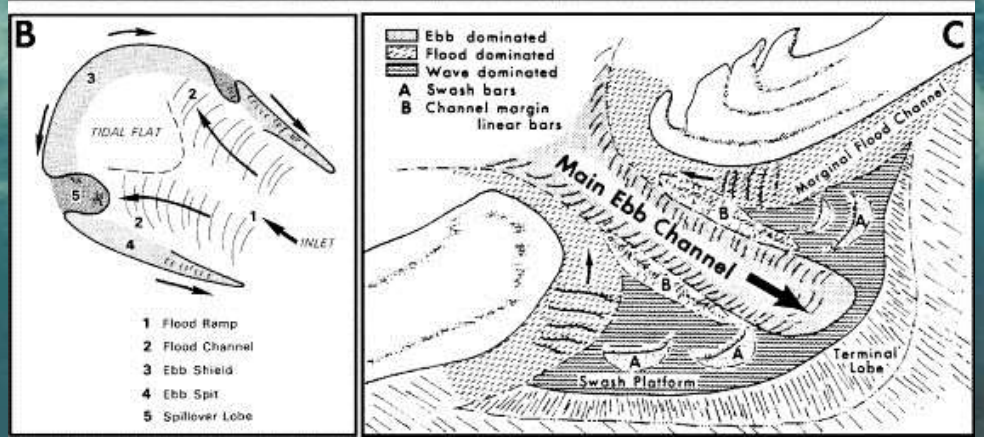

original coastline
saltmarsh
estuary
fastest river current
longshore (littoral) drift
second most dominant wind and fetch
prevailing winds
fetch

Tidal Inlets: Significance

- Navigation
- Recreation
- Conduits for nutrient & salinity exchange
- Nursery & feeding grounds
- Interrupt LST, affecting adjacent beaches
- Largest shoreline changes

Tidal Inlets: Morphology

- Tidal deltas
  - Ebb
  - Flood (rare in SC)




Marginal Flood Channel
Channel Margin Linear Bars
Main Ebb Channel
Swash bars
Gulf of Mexico
Bunces Pass, FL
Tide-dominated

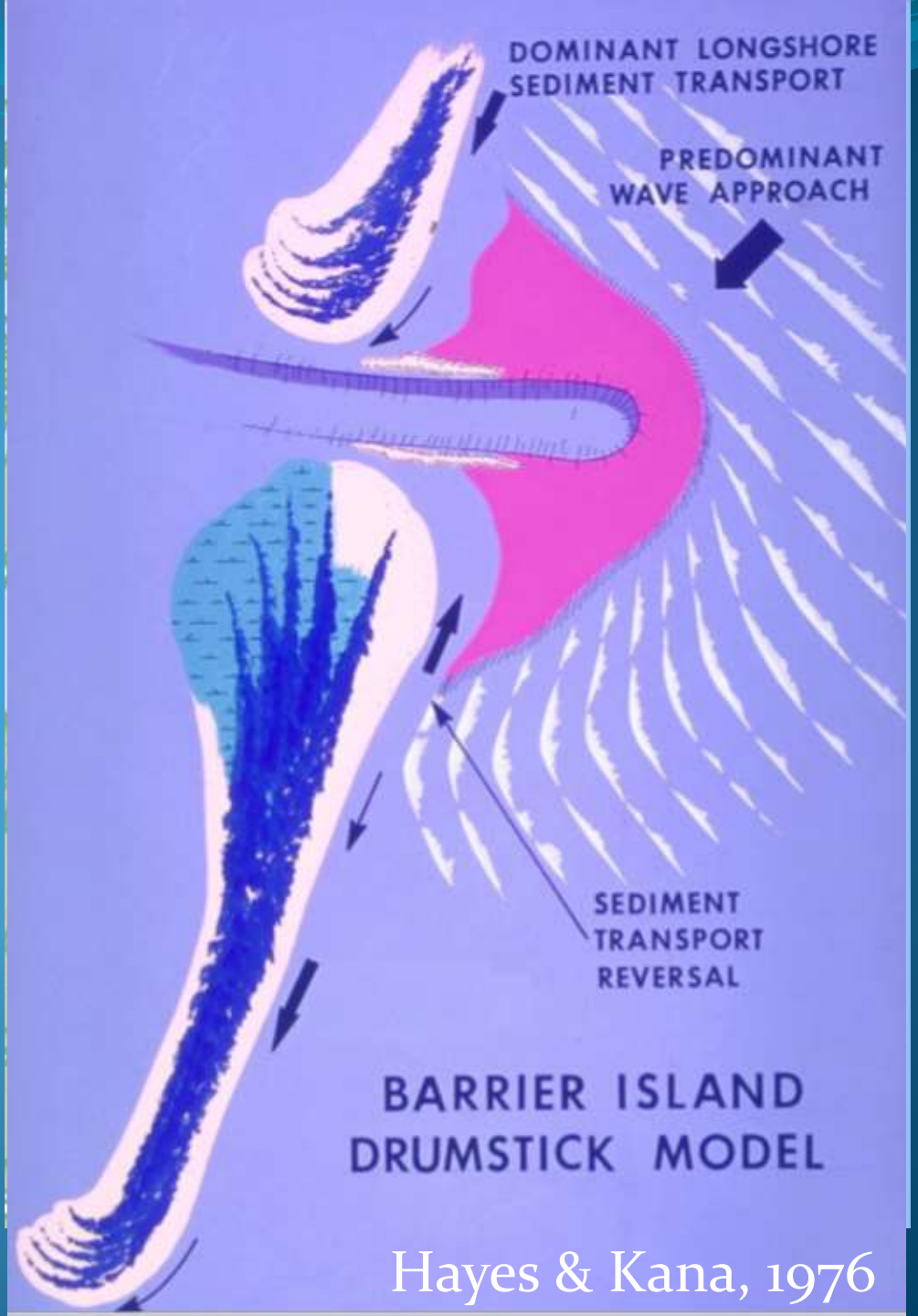
TIDAL PRISM

Tidal Inlets: Migration

Murrells Inlet, SC
Wave-dominated

Tidal Inlets: Bypassing

- Wave refraction
- Sand bars migrate onshore
- Updrift: Beach ridges
- Downdrift: Spit



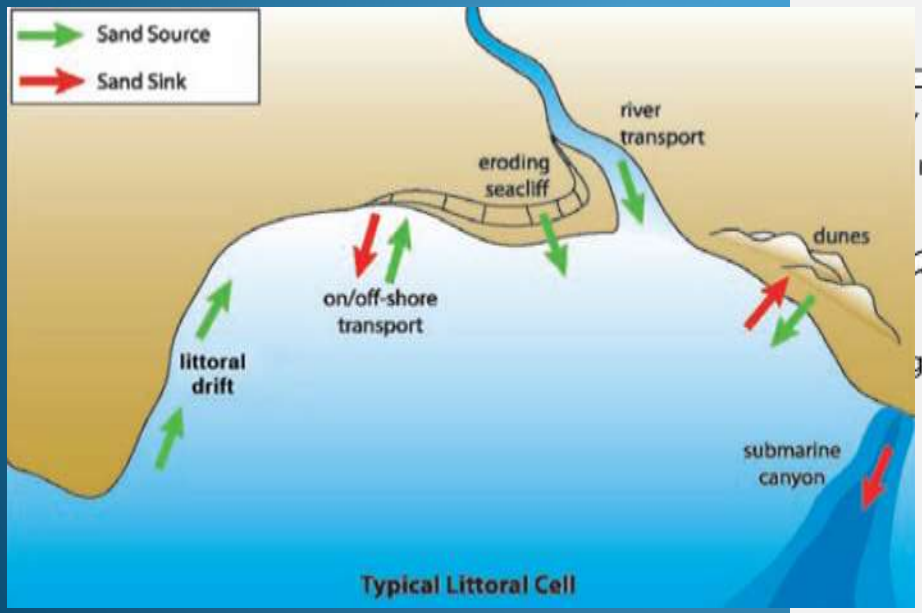
Hayes & Kana, 1976

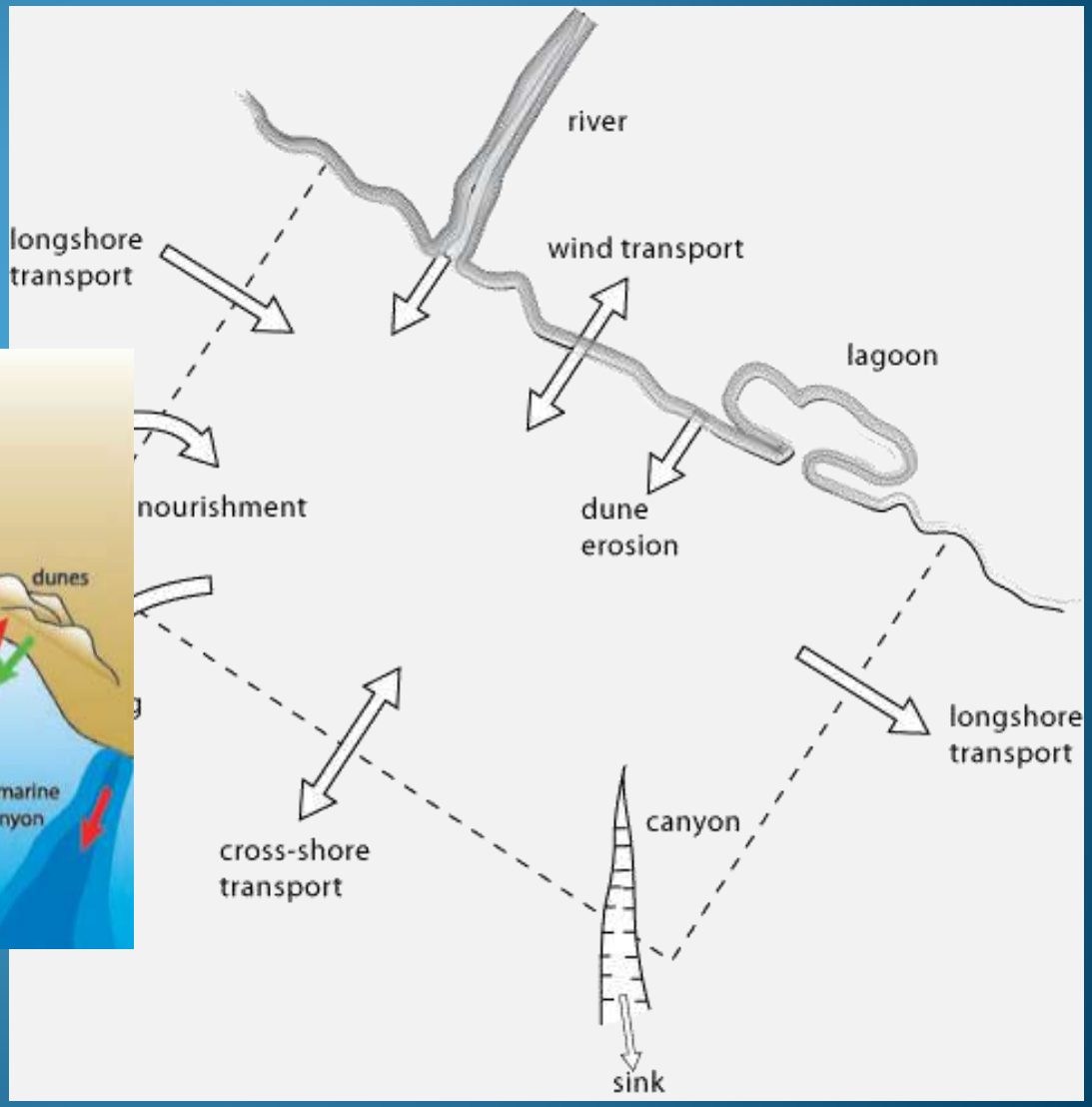

M.O. Hayes


Bull Island, SC
Digital Orthophoto 1994

What is beach erosion?

- Sediment Budget
  - Q_{in}
  - Q_{out}



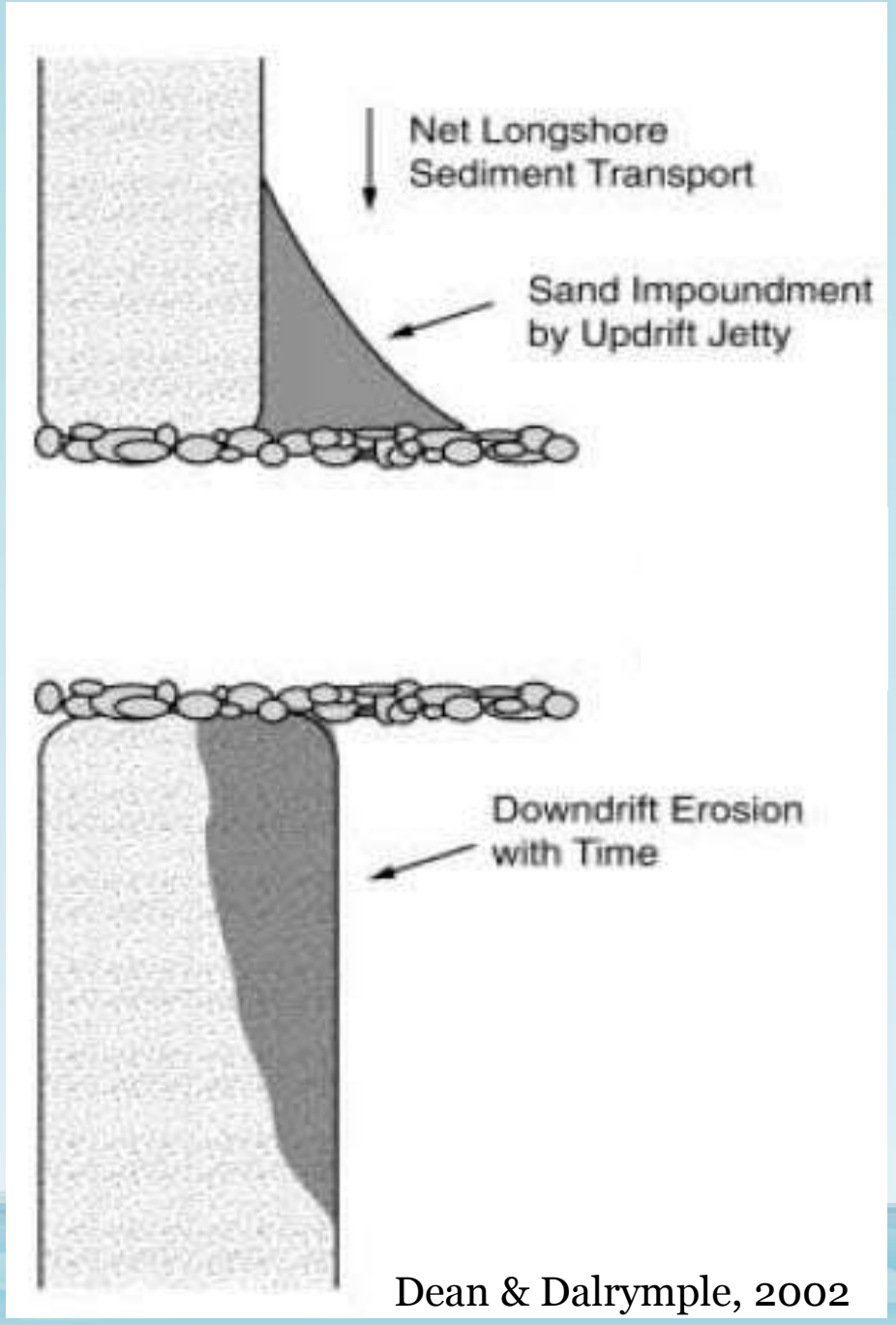


Human Modifications to Beaches and Inlets

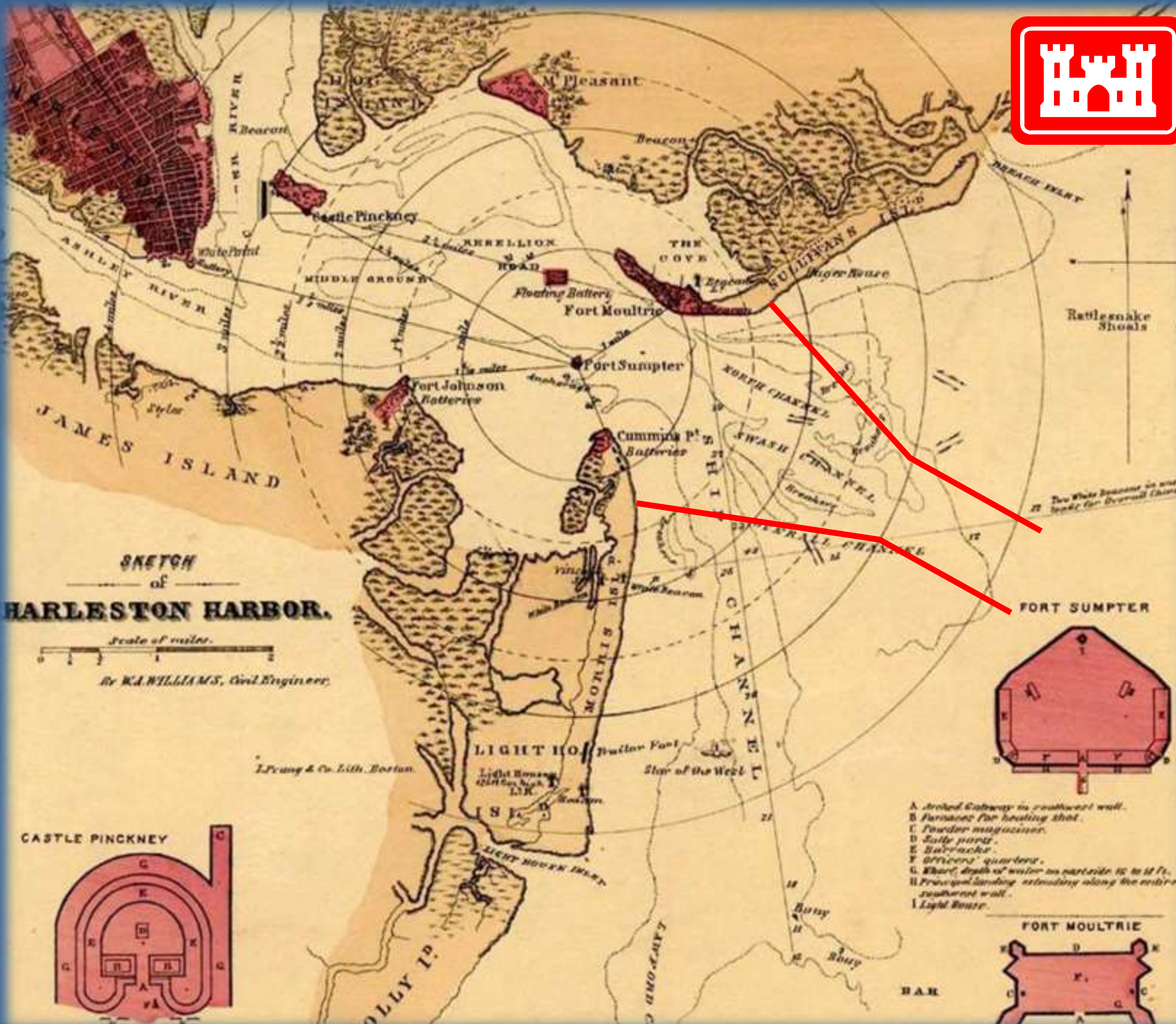
- Jetties
- Unregulated Beachfront Development

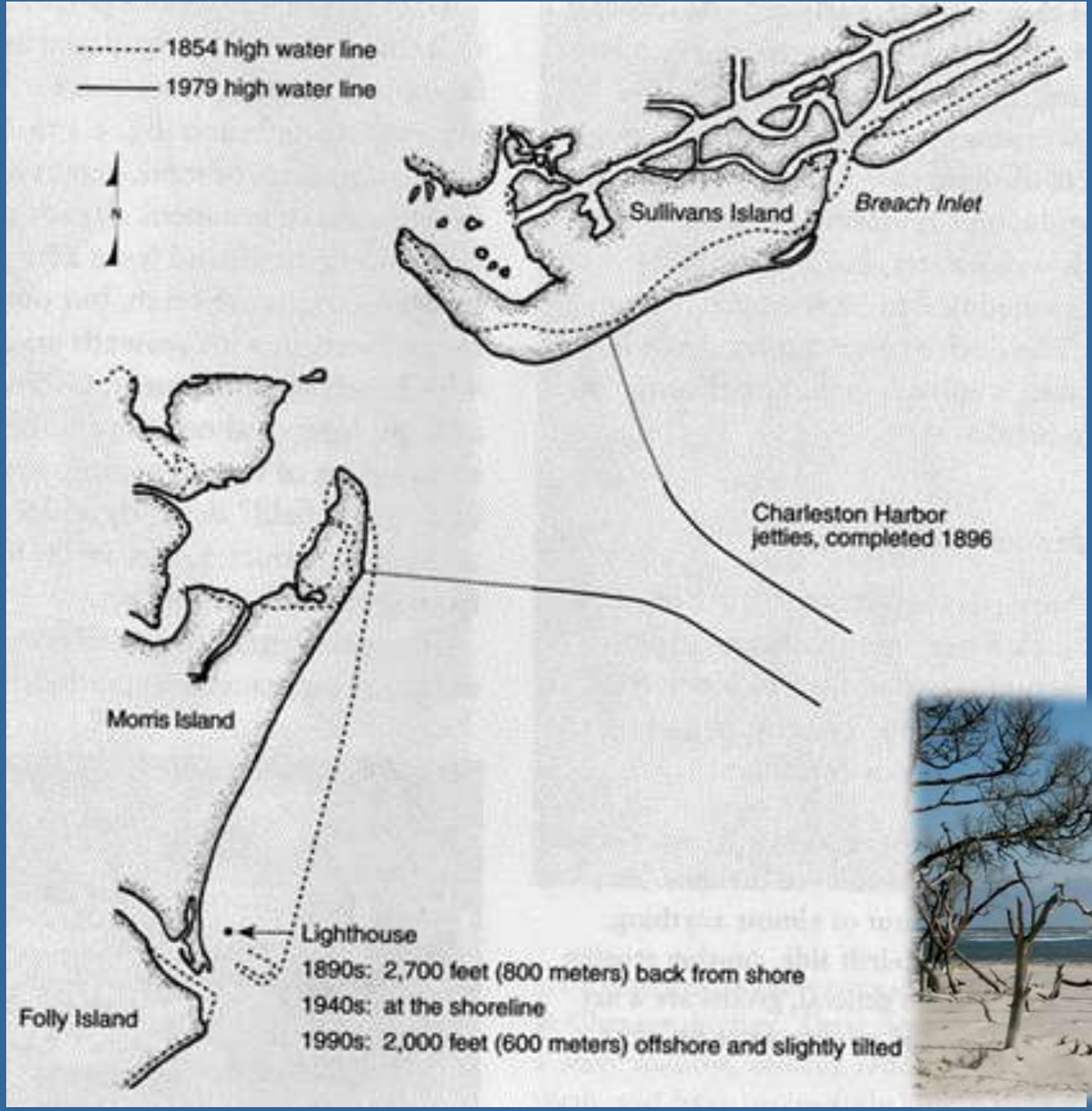
Effect of Jetties on Adjacent Shorelines

Port Canaveral, FL
1948



Dean & Dalrymple, 2002


SKETCH
of
HARLESTON HARBOR.
Scale of miles.
By W.A. WILLIAMS, Civil Engineer.
L. Prang & Co. Lith. Boston.
M^t Pleasant
Beacon
Castle Pinckney
REBELLION ROAD
THE COVE
MIDDLE GROUND
ASHLEY RIVER
White Point Battery
Floating Battery
Fort Moultrie
SULLIVANS ISLAND
Fort Sumpter
Fort Johnson Batteries
JAMES ISLAND
Cummins P^t Batteries
NORTH CHANNEL
SWASH CHANNEL
SHIP CHANNEL
Rattlesnake Shoals
BREACH INLET
MORRIS ISLAND
LIGHT HO. ISLAND
Star of the West
LIGHT HOUSE INLET
FOLLY I^D.
BAR
Buoy
CASTLE PINCKNEY
FORT SUMPTER
A Arched Gateway in southwest wall.
B Furnaces for heating shot.
C Powder magazines.
D Sally ports.
E Barracks.
F Officers' quarters.
I Light House.
FORT MOULTRIE


1854 high water line
1979 high water line
N
Sullivans Island
Breach Inlet
Charleston Harbor
jetties, completed 1896
Morris Island
Lighthouse
1890s: 2,700 feet (800 meters) back from shore
1940s: at the shoreline
1990s: 2,000 feet (600 meters) offshore and slightly tilted
Folly Island

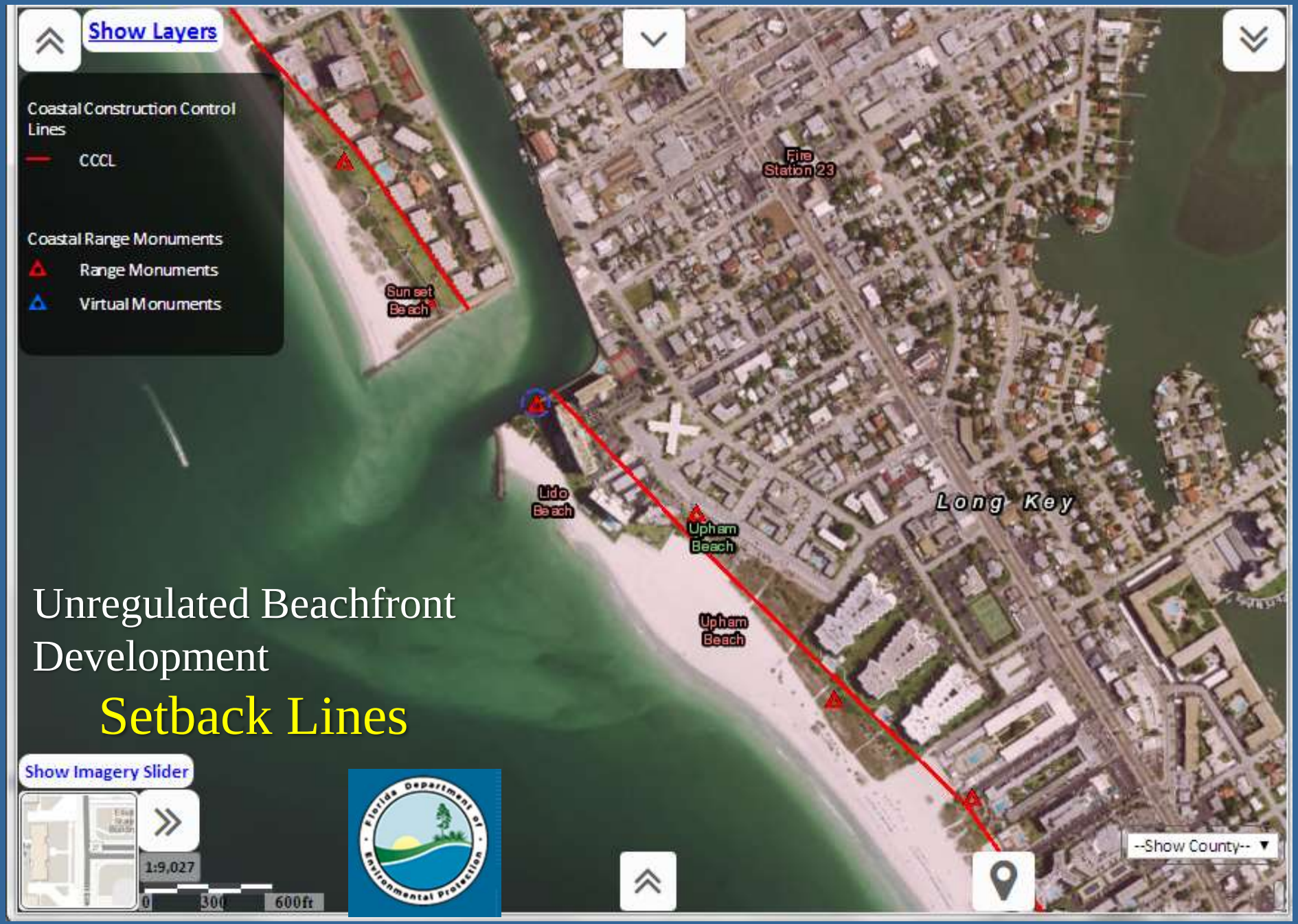
Beachfront Development

Stabilizing dynamic systems

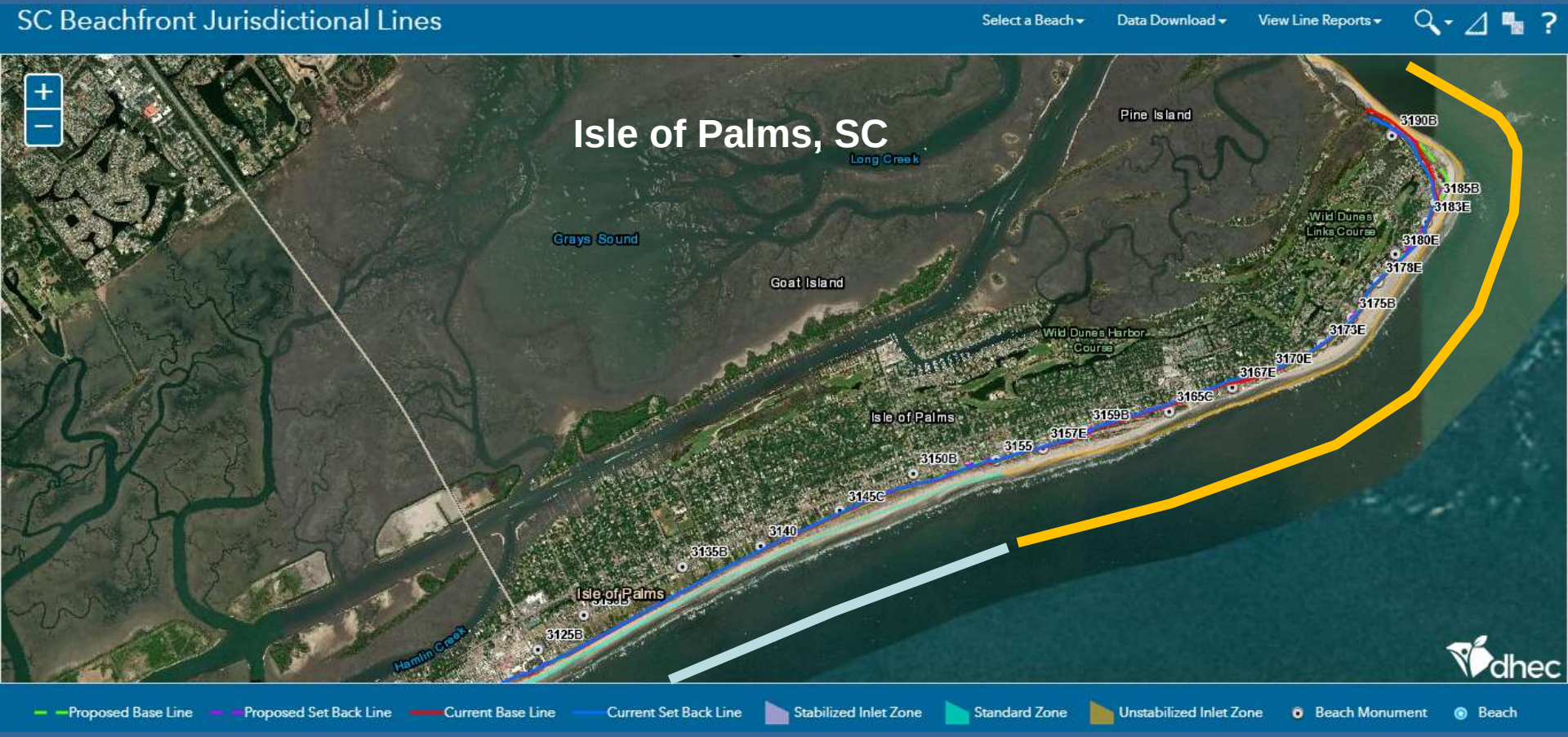

1951


1967

Beach Erosion “Problem”


Show Layers
Coastal Construction Control Lines
CCCL
Coastal Range Monuments
Range Monuments
Virtual Monuments
Sun set Beach
Fire Station 23
Lido Beach
Upham Beach
Upham Beach
Long Key
Unregulated Beachfront Development
Setback Lines
Show Imagery Slider
1:9,027
0
300
600ft
--Show County--

Standard and Inlet Zones



- **Unstabilized Inlet Zone**
- **Standard Zone**

OCRM Beachfront Jurisdictional Lines

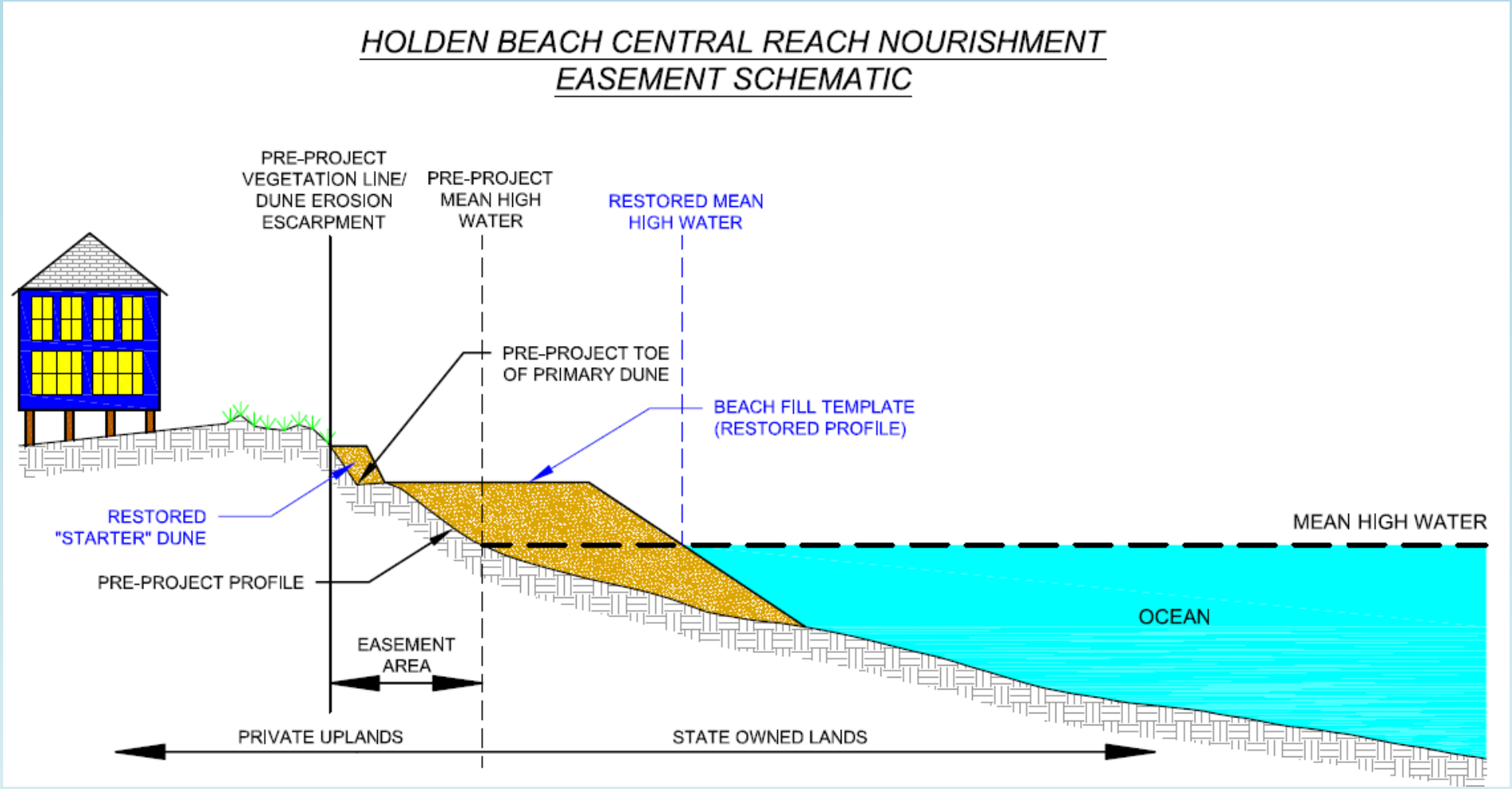
- Baseline
  - Standard Zones, away from inlets = dune crest
  - Inlet Zones = most landward shoreline position during the past 40 years
- Setback line
  - At least 20 feet landward of the baseline
  - Distance = 40x the long-term erosion rate (ft/yr)
- The setback line is NOT a "no-build" line

(Eiser, 2013)

Baseline and Setback Line:
Wild Dunes

Folly Beach: Special Exemption

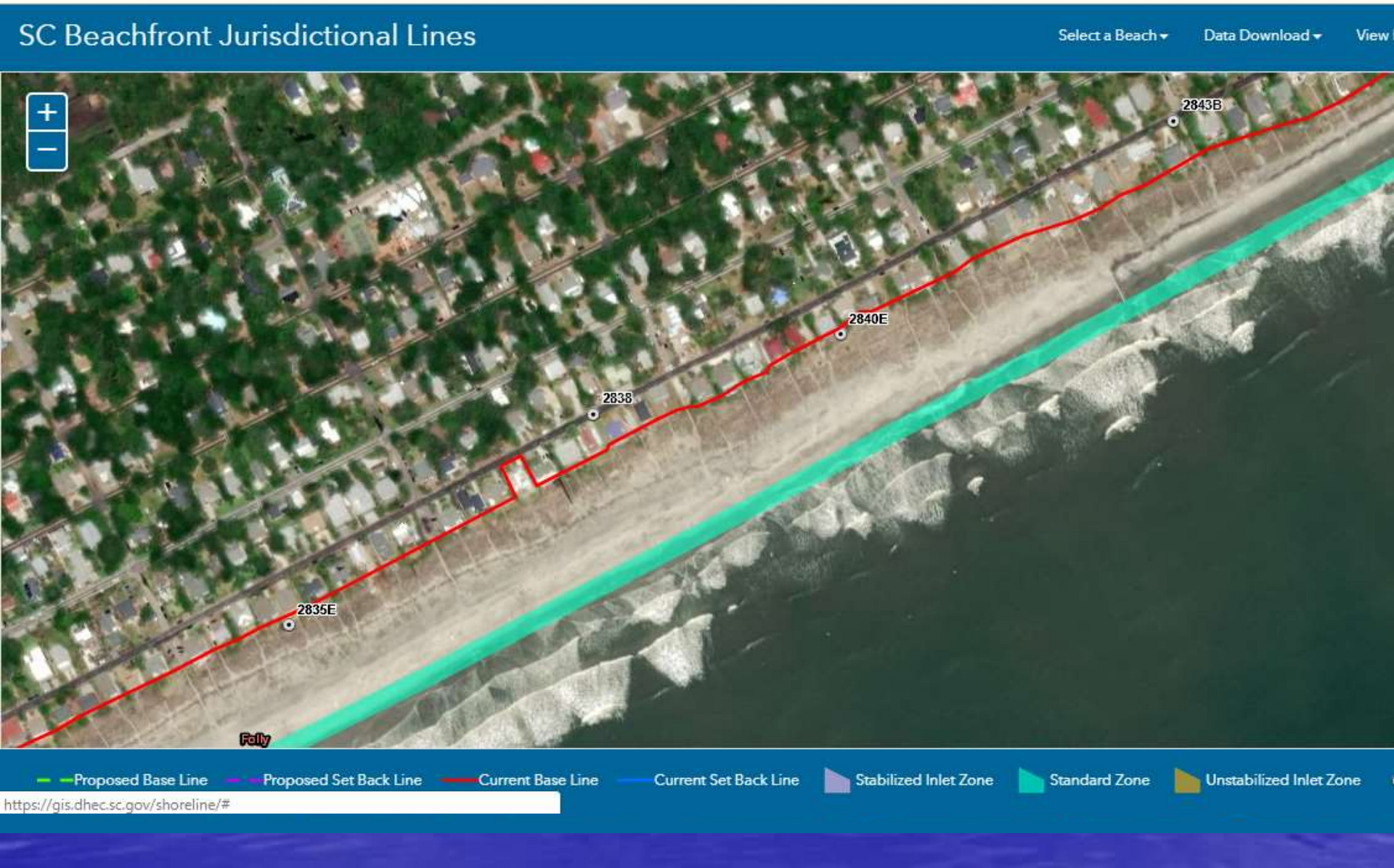
- Most of the erosion at Folly is attributed to the Charleston Harbor Jetties
- There is a baseline. No 40-year setback line
- The baseline, set in 1994, is not updated
- Existing seawalls, bulkheads and revetments can be rebuilt even if damaged more than 50%



Future Challenges: Sand Rights

APPLIED TECHNOLOGY & MANAGEMENT

Folly Beach Baseline




1
Lighthouse Inlet
Heritage Preserve
2
Folly Beach County Park

Field Trip

Beaches 101:
A Training Course for Coastal Managers

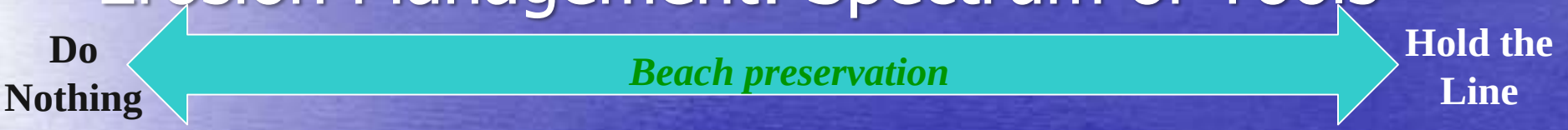
Nicole Elko, Ph.D.

October 9, 2018

Erosion Management: From Retreat to Structures

Outline

- Why preserve beaches and shores?
- Erosion Management: Spectrum of Tools



  - Structures
    - Armoring
    - LST
  - Soft shore protection
    - Hybrid projects*
    - Beach nourishment
    - Dunes
  - Managed Retreat

Why Preserve Beaches and Shores?

- Storm protection,
- Economics, Recrea
- Environmental en

Non-nourished beach

N.J. sand dunes protected Shore towns from Hurricane Sandy's wrath

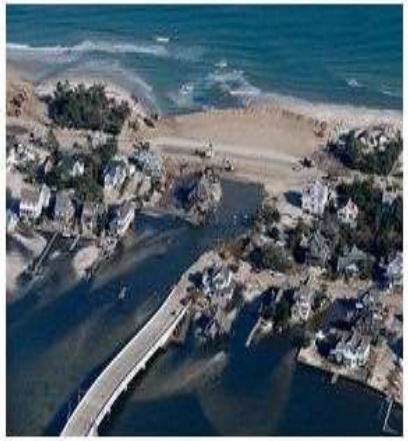
By Star-Ledger Staff
on November 06, 2012 at 7:05 AM, updated November 06, 2012 at 11:44 AM

Email Print

By Ryan Hutchins and Seth Augenstein/The Star-Ledger

Hurricane Sandy did something unusual to Long Beach Island, a narrow 18-mile strip of land: The storm's raging winds and powerful surge of water carved two communities out of one.

There are the places that had a protective dune system installed and, as a result, sustained minimal damage. Then there are the areas where there were no tall dunes, where Sandy



Enlarge Andrew Mills/The Star-Ledger

Workers have closed a breach in the barrier island at the base of the Mantoloking Bridge where Barnegat Bay met the Atlantic Ocean here after Hurricane Sandy pummeled the Jersey Shore last week. 11/5/12 (Andrew Mills/The Star-Ledger)

Aerial photos of the Jersey Shore as repairs begin after Sandy gallery (17 photos)

N.J. News Essentials

See top photos from The Star-Ledger

Find fun events in New Jersey

Search New Jersey business listings

Most Comments Most Read

539 N.J. Assembly gun control bills would save lives: Editorial

481 N.J. braces for 'doomsday' budget cuts as sequestration deadline looms

257 N.J. Assembly passes package of gun bills despite Republicans' protest

Why Preserve Beaches and Shores?

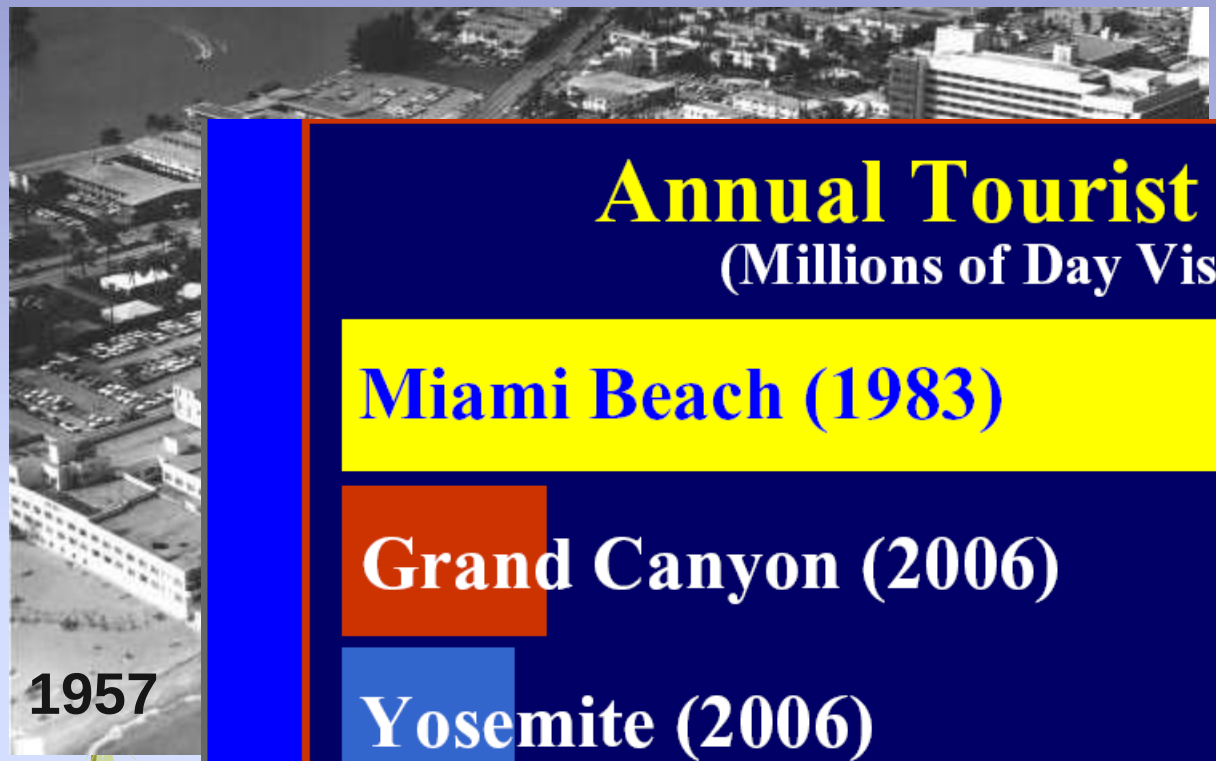
- Storm protection, resilience
- Economics, Recreation
- Environmental enhancement

•85% of all tourism related revenue in the U.S. is generated in coastal states

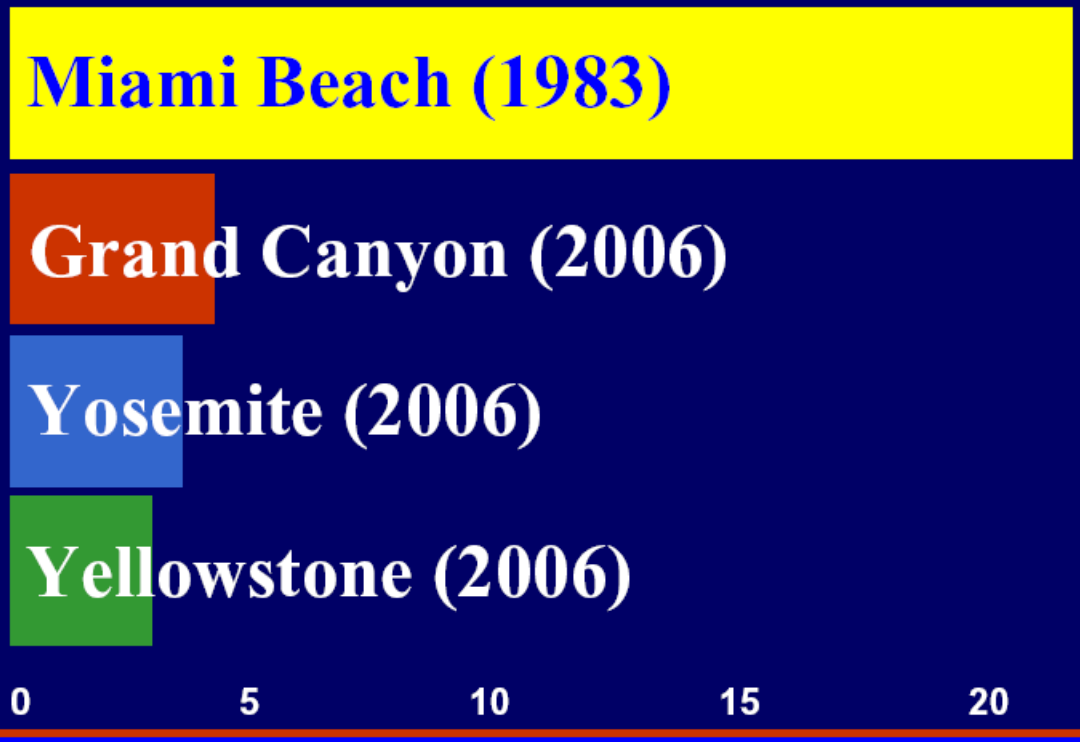
•Beach tourists contribute $225 billion to US economy

Houston, 2013

Increase Property Value: Miami Beach



Annual Tourist Visits
(Millions of Day Visits)



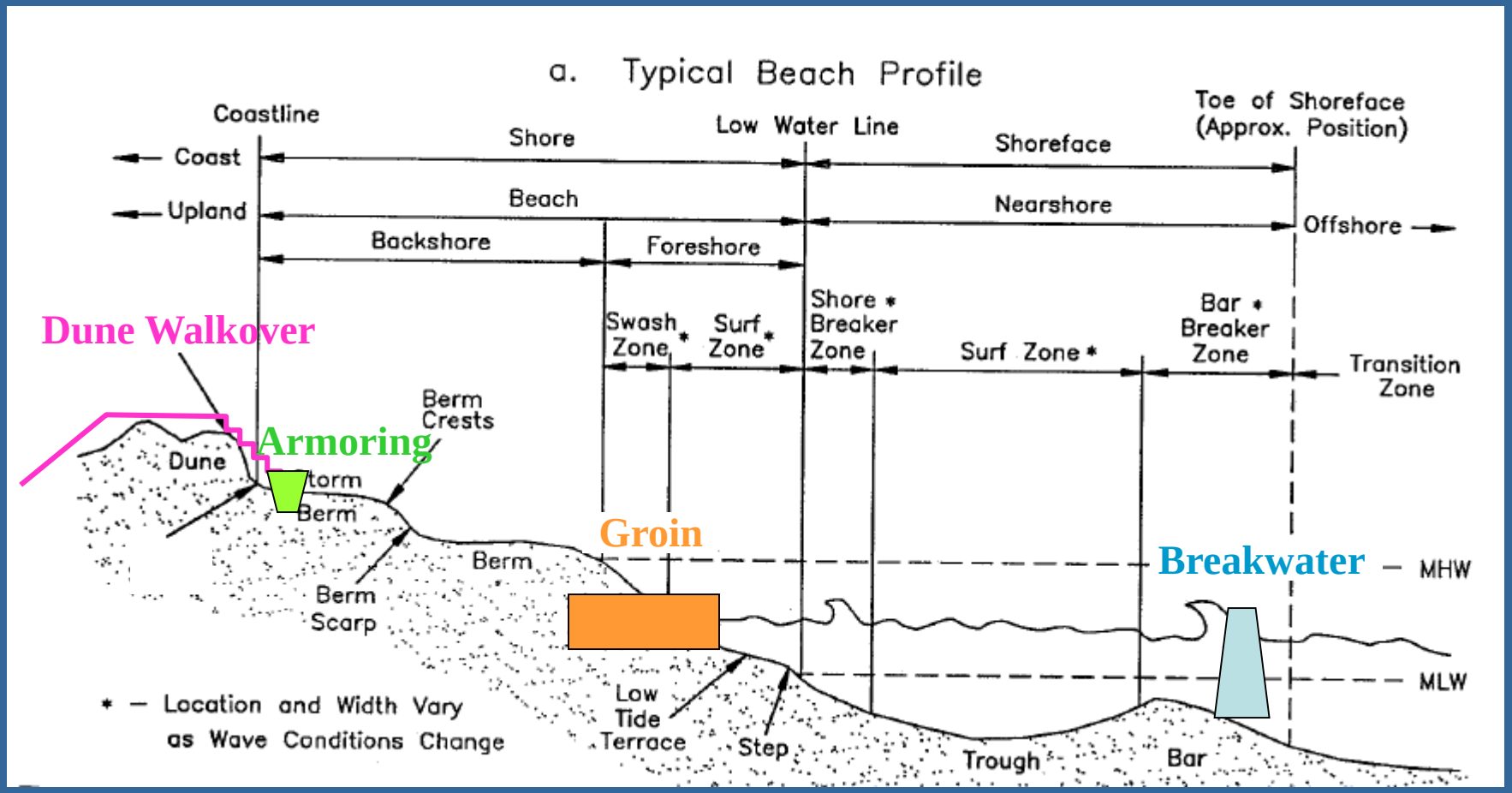
Why Preserve Beaches?

- Storm protection, resilience
- Economics, Recreation
- Environmental enhancement

Outline

- Why preserve beaches and shores?
- Erosion Management: Spectrum of Tools
  - Retreat ←→ Protect
  - Structures
    - Armoring
    - LST
  - Soft shore protection
    - Hybrid projects
    - Beach nourishment
    - Dunes
  - Managed Retreat

Beach Profile Terminology



ARMORING STRUCTURES

- Shore-parallel
- Purpose: protect upland from wave energy, limit landward erosion.
- Seawall: vertical walls at MHW-dune toe, deep foundations, high wave energy.
- Revetment: sloped on surface of backbeach or dune toe, reduce backwash.
- Bulkhead: vertical wall, low wave energy.
- Examples – TX, FL

Types of Walls:

Fetch

Hundreds of Feet — Thousands of Miles

Water Body

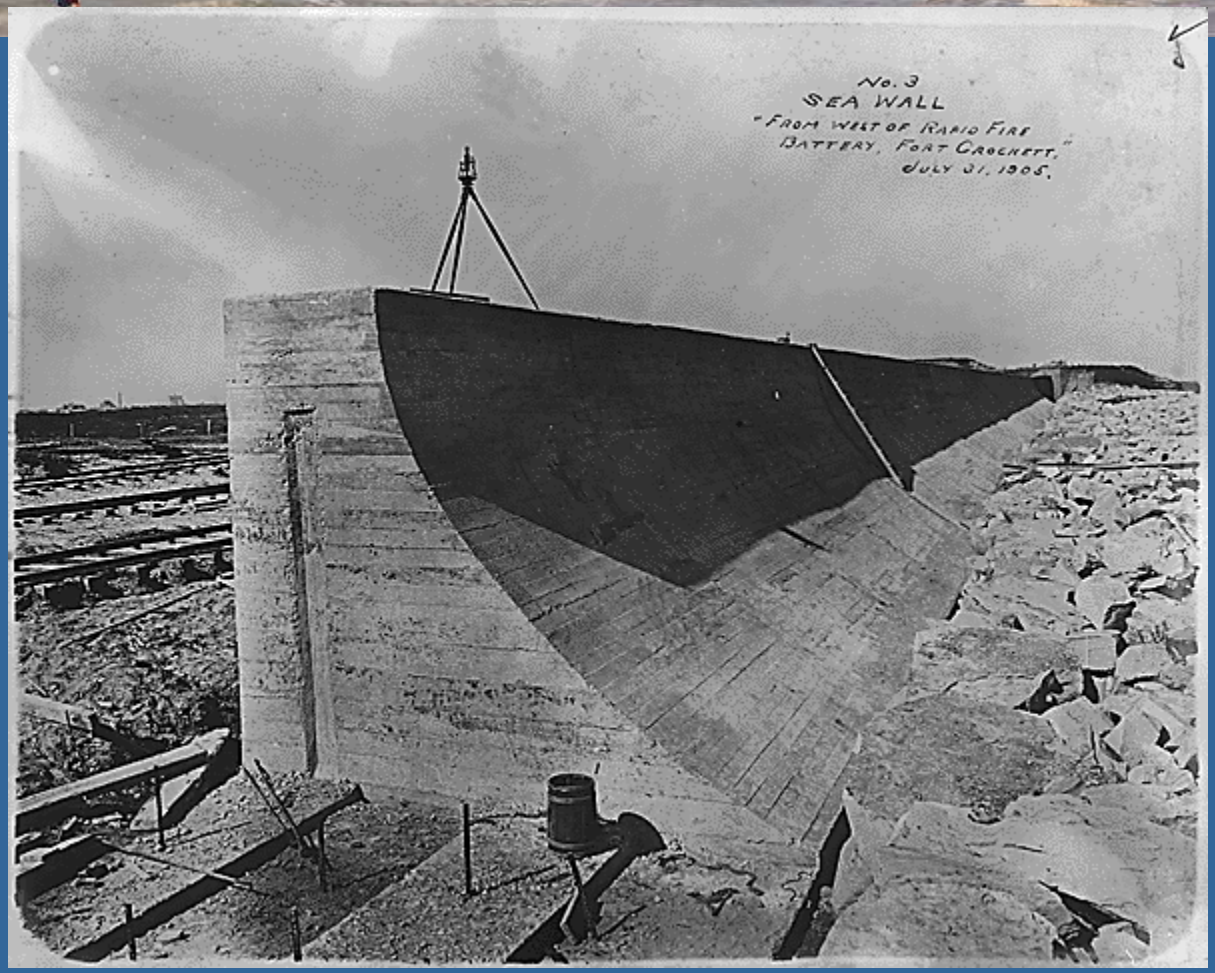
Rivers — Lakes & Bays — Oceans

Design Wave Height

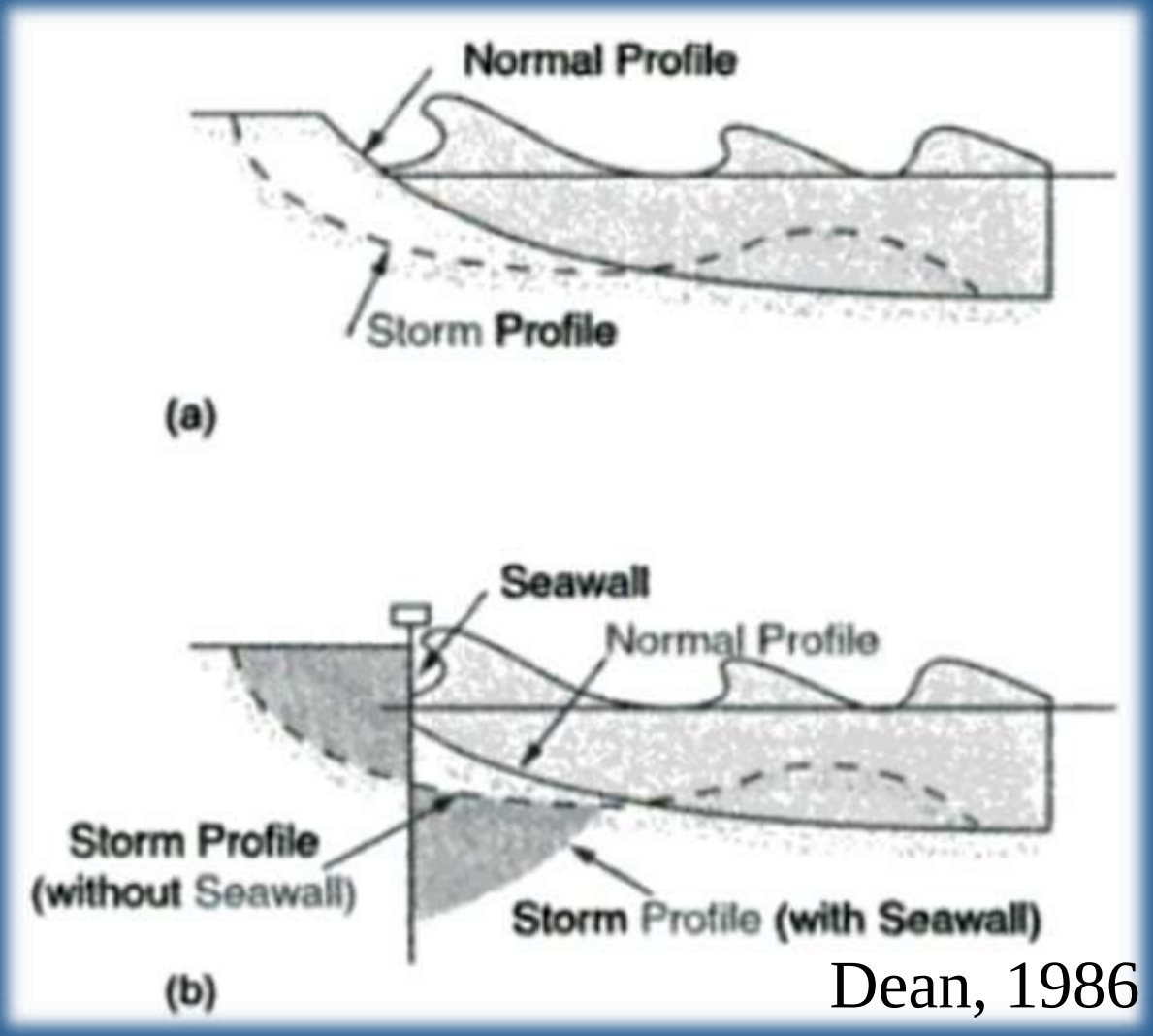
Small — Large — Very Large

Bulkhead	Revetment	Seawall
		


GALVESTON, TEXAS
TEXAS
EXPLORER
George Hosek


No. 3
SEA WALL
"FROM WEST OF RAPID FIRE
BATTERY, FORT CROCKETT."
JULY 31, 1905.

Profile deepening/scour

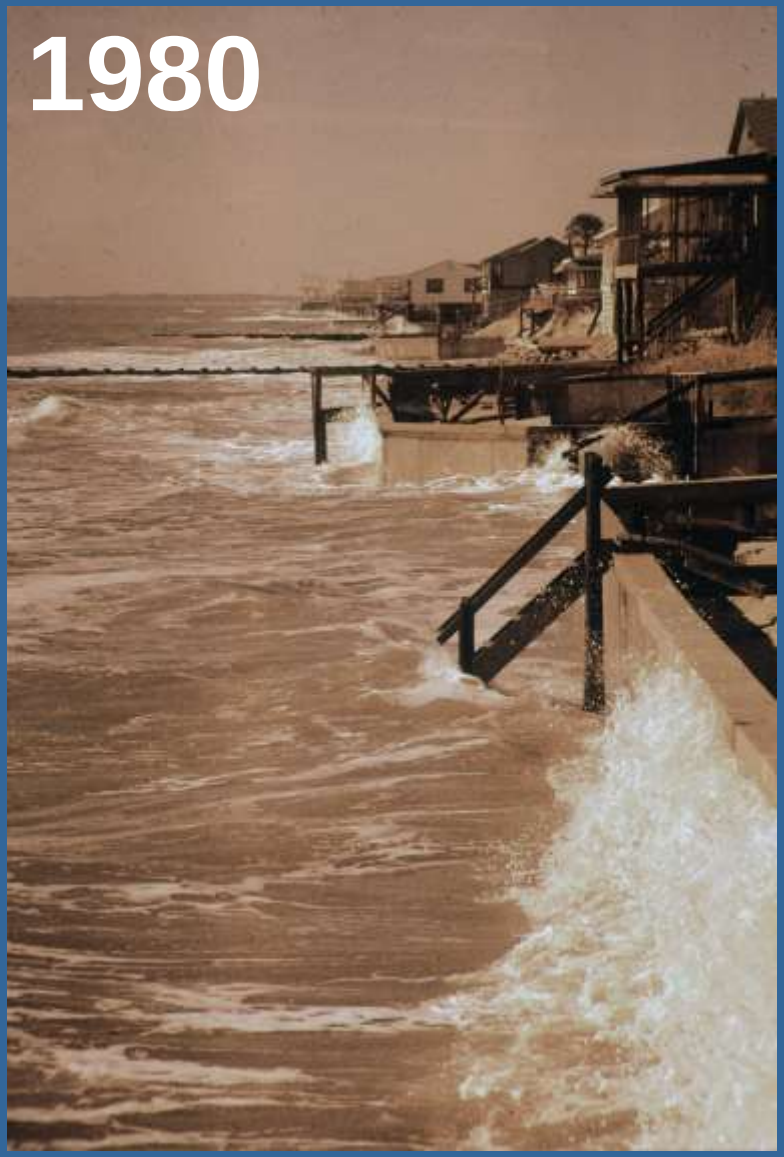


Dean, 1986

S.C. Beachfront Management Act (1988)

- "(5) The use of **armoring** in the form of hard erosion control devices such as seawalls, bulkheads, and rip-rap to protect erosion-threatened structures adjacent to the beach has not proven effective. These armoring devices have given a false sense of security to beachfront property owners…have increased the vulnerability of beachfront property to damage from wind and waves while contributing to the deterioration and loss of the dry sand beach..."
- No new seawalls
- Existing seawalls can be rebuilt if damaged <50%.

Buried Seawall



Revetment

Preserve the slope

Bulkhead

1986

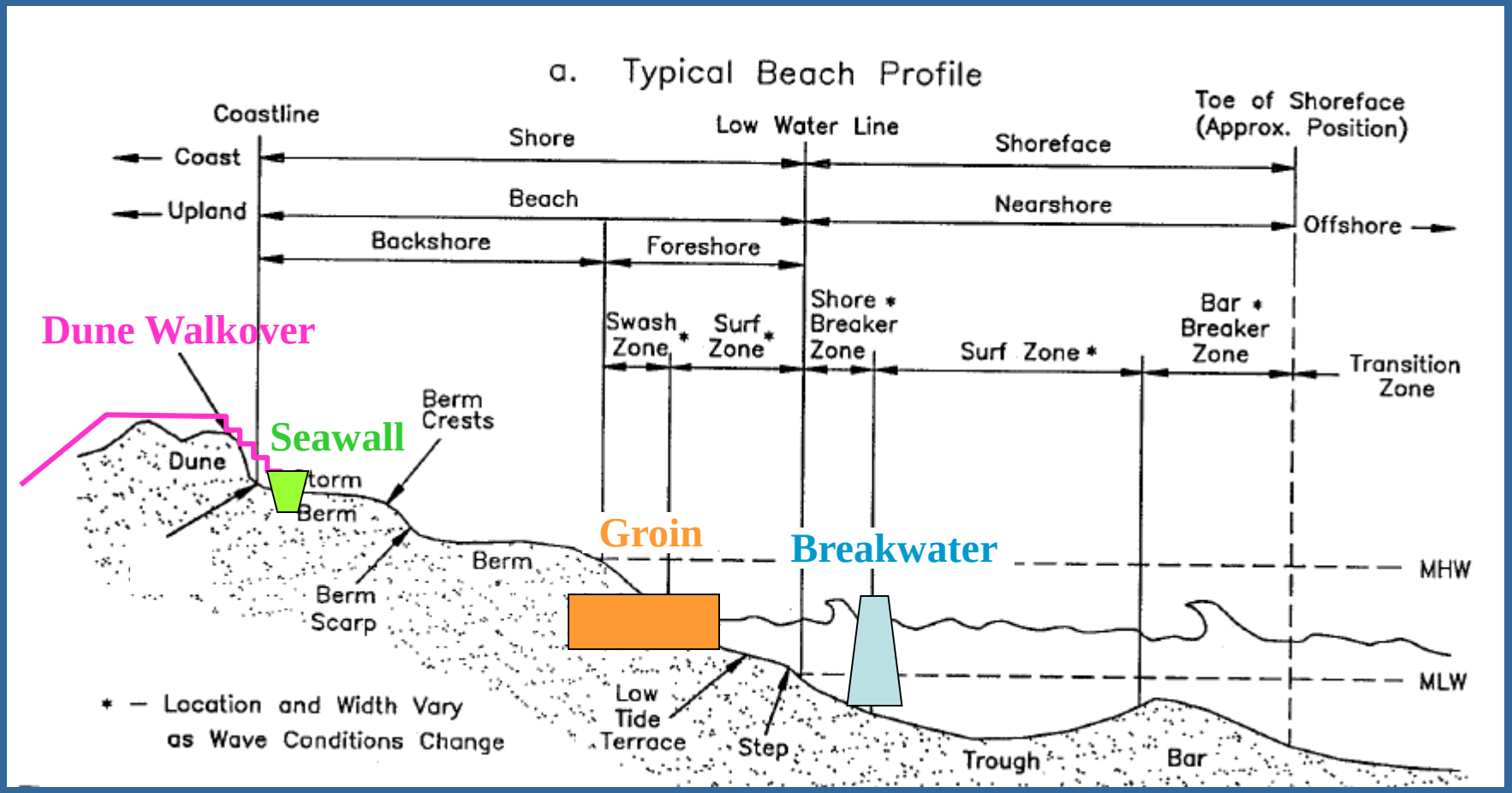
1989 BULKHEAD FAILURE

Material: Geotextile tubes

- Shore-parallel or shore-perpendicular
- Purpose: to replace rock structures and provide an “easily-modified” or “temporary” structural option.
- Canvas-like or polyester sand bags.
- Environmentally friendly?
- Life span < 10 years?

Armored Inlet Shoreline

Beach Profile Terminology



Longshore Sediment Transport Structures

Beach Planform Terminology

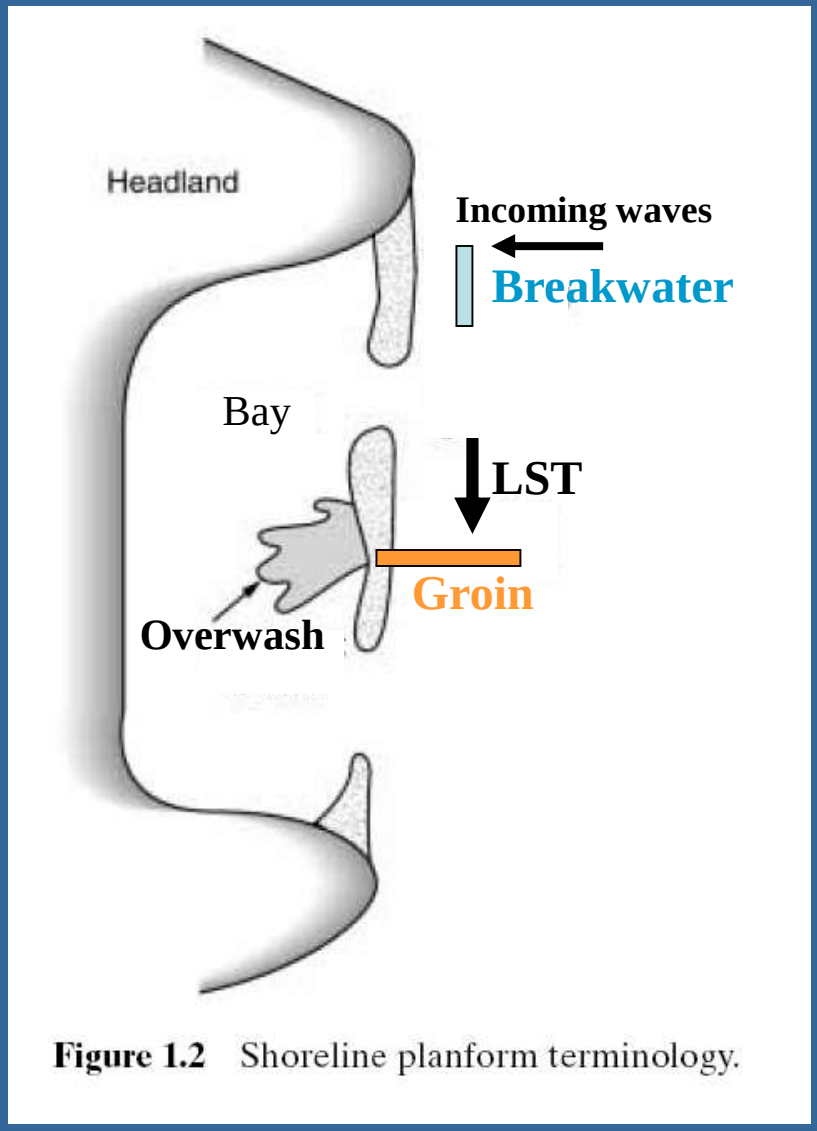
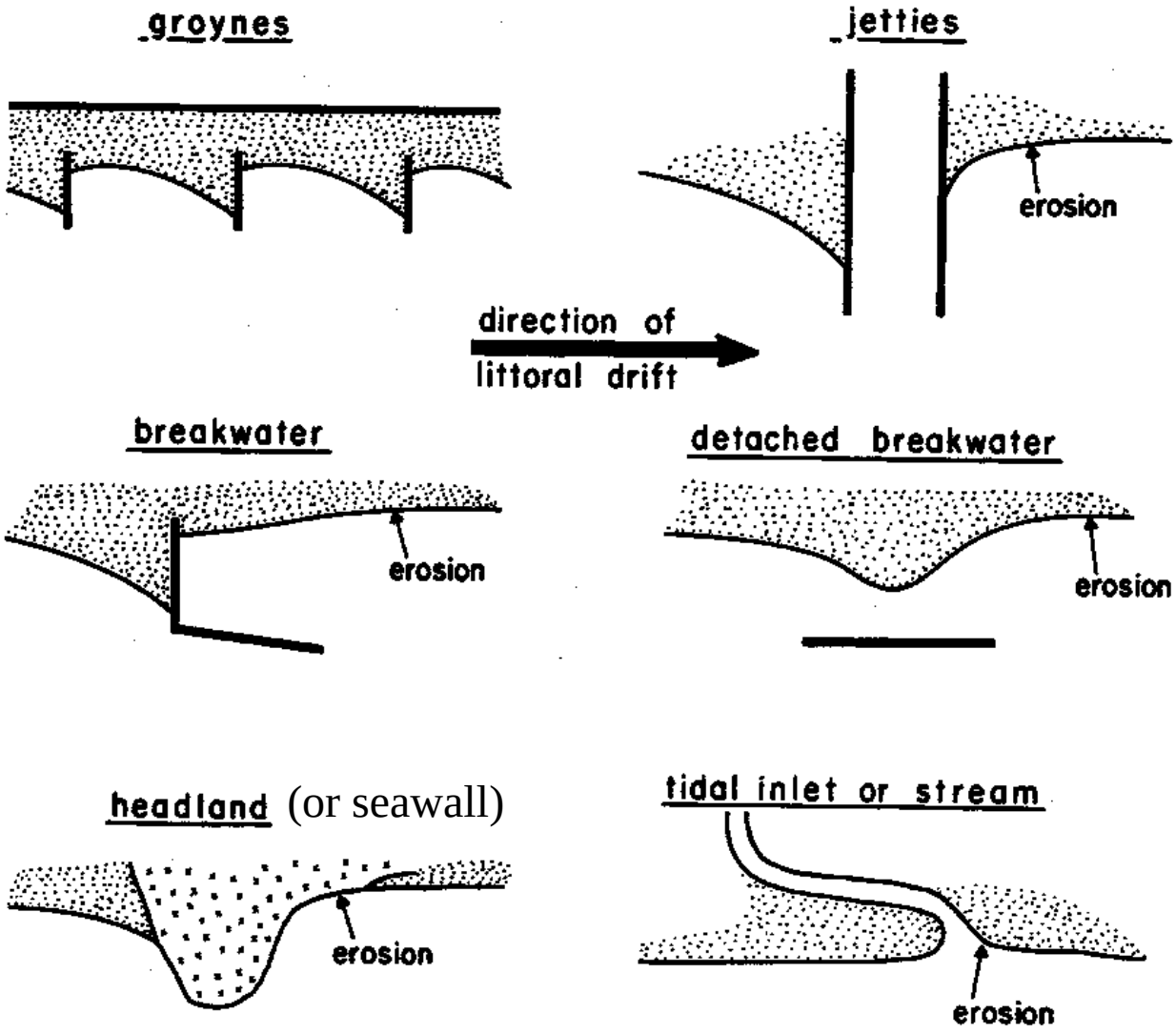


Figure 1.2 Shoreline planform terminology.

Indicators of LST Direction

LST Structures redistribute sand
=
Downdrift erosion

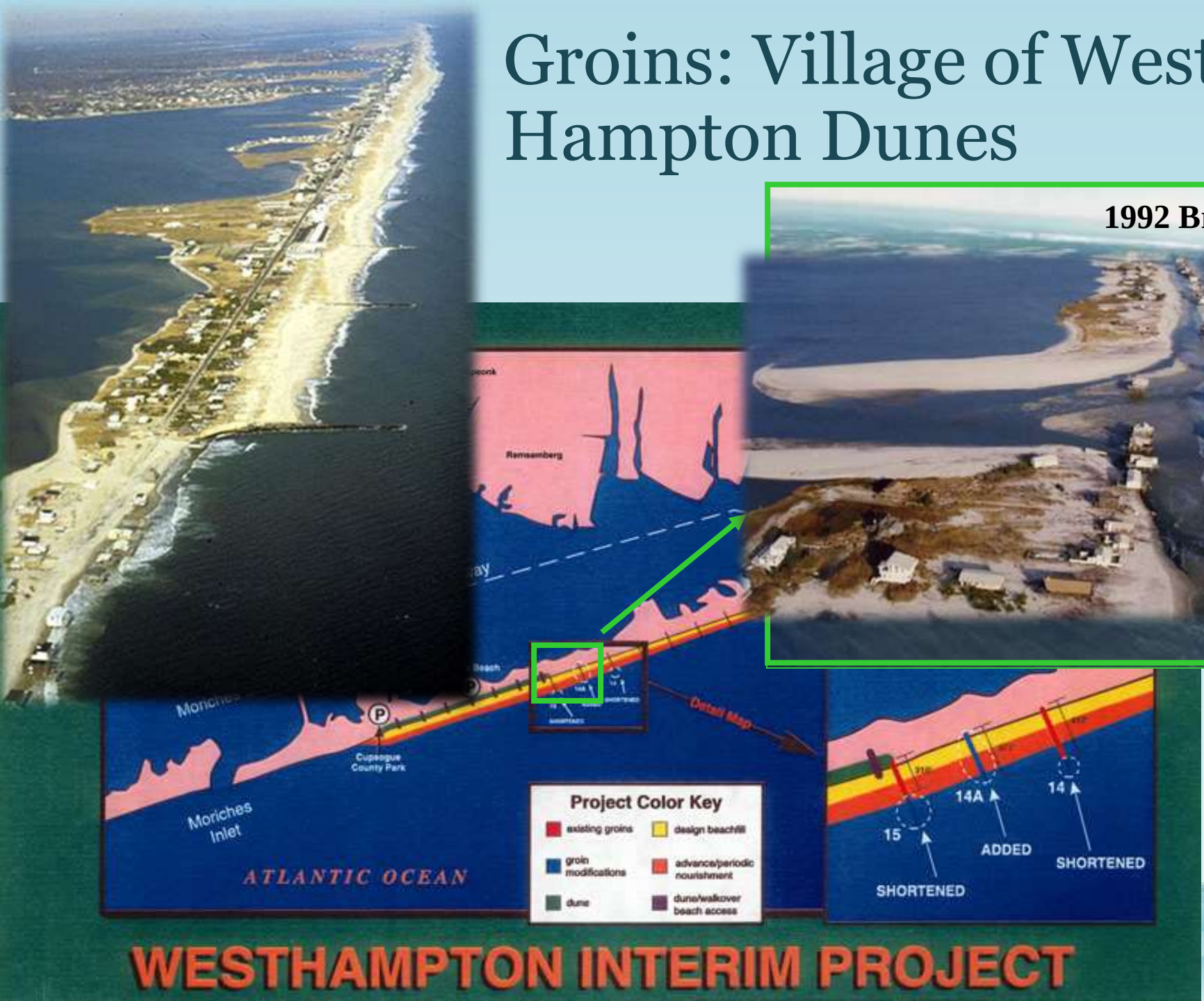


LST STRUCTURES: Groins

- Shore-perpendicular
- Purpose: to impound LST on the updrift side to widen the beach.
- Result: equal amount of downdrift erosion.
- Built as a vertical barrier extending offshore.
- Types
  - Single, multiple (field)
  - Terminal groin
  - Low-profile, notched, adjustable, permeable

Not Jetties!

Groins: Village of West Hampton Dunes



Lesson Learned: Groin Design

- *"Each fixed structure used in conjunction with a beach nourishment project should be filled to the upper limit of its holding capacity if its function is to retain sand."* -**National Academy of Sciences** (NRC, 1995)

Groin Field Design

- Pre-filled structures
- Pre-mitigation

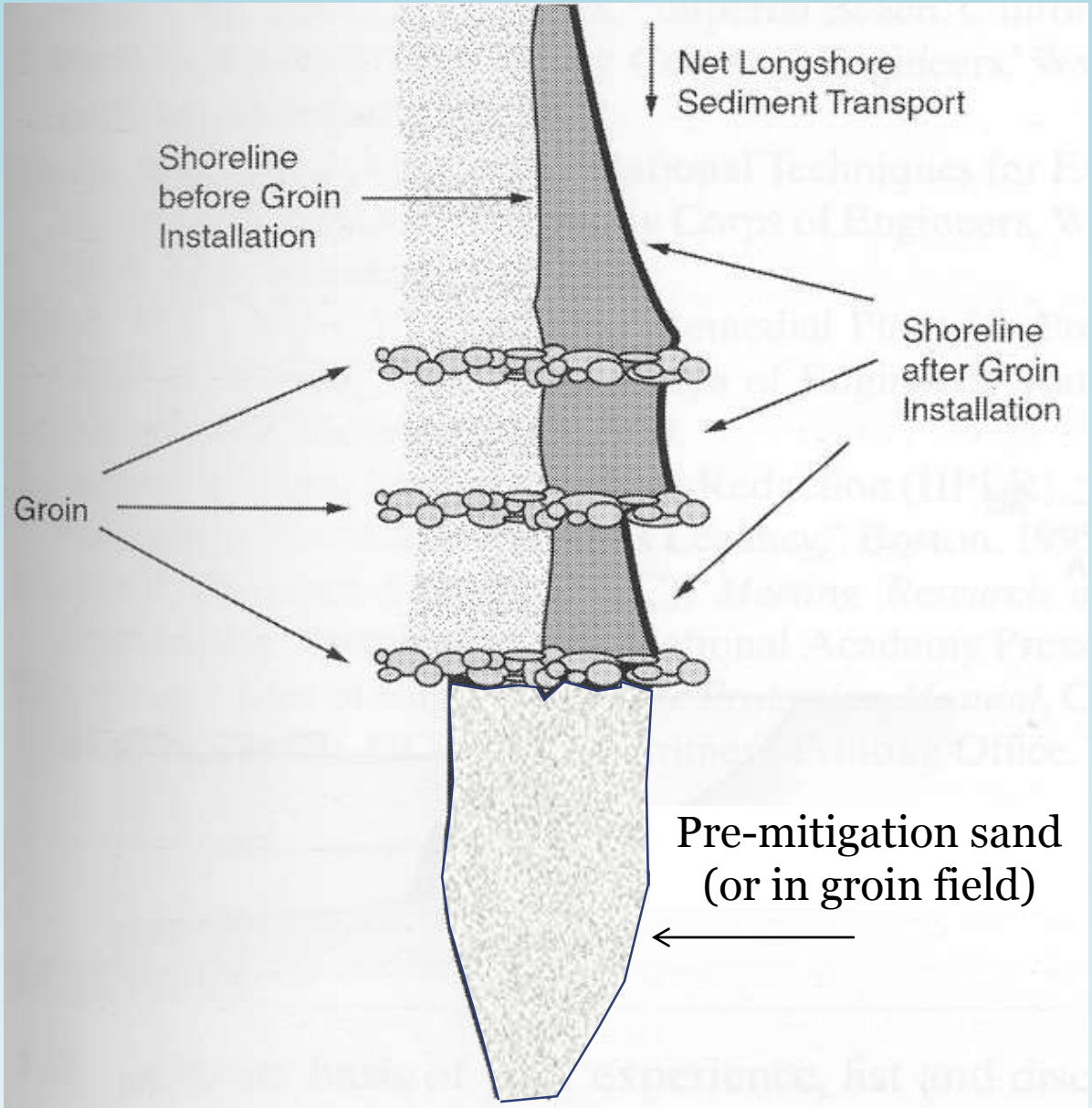


Figure 1.12 Effects of groins interacting with longshore sediment transport.

Modified from Dean & Dalrymple, 2002

Groins: Materials

Adjustable, Low-Profile, Permeable Groins

← Typical king-pile groin
w/ adjustable panels

S.C. Beachfront Management Act

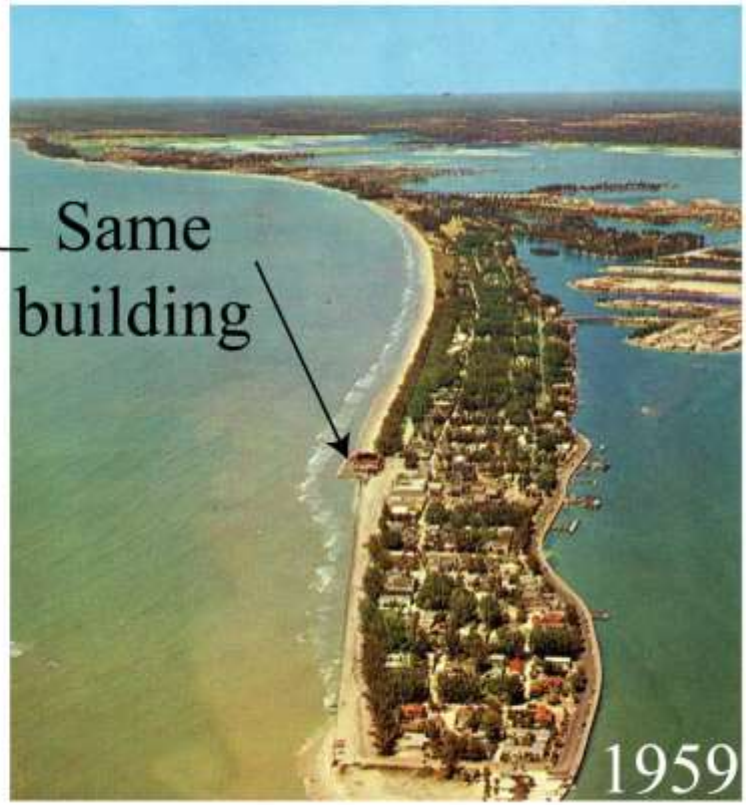
- Exemptions for construction seaward of baseline
- (8) existing **groins**, which may be reconstructed, repaired, and maintained. New groins may be allowed only on beaches that have high erosion rates with erosion threatening existing development or public parks. In addition to these requirements, new groins may be constructed, and existing groins may be reconstructed, only in furtherance of an ongoing beach renourishment effort…

Seawalls & LST

LST STRUCTURES: Terminal Groins

- Shore-perpendicular
- Placed near inlets and sometimes are confused with jetties.
- Purpose: To retain sand on the beach directly updrift of the inlet
- Once filled to capacity, allow sand moving in the littoral zone to flow past the structure.
- Most effective structure – placed at end (terminus) of littoral system

Terminal Groin: Pass-a-Grille Channel



Terminal Groins

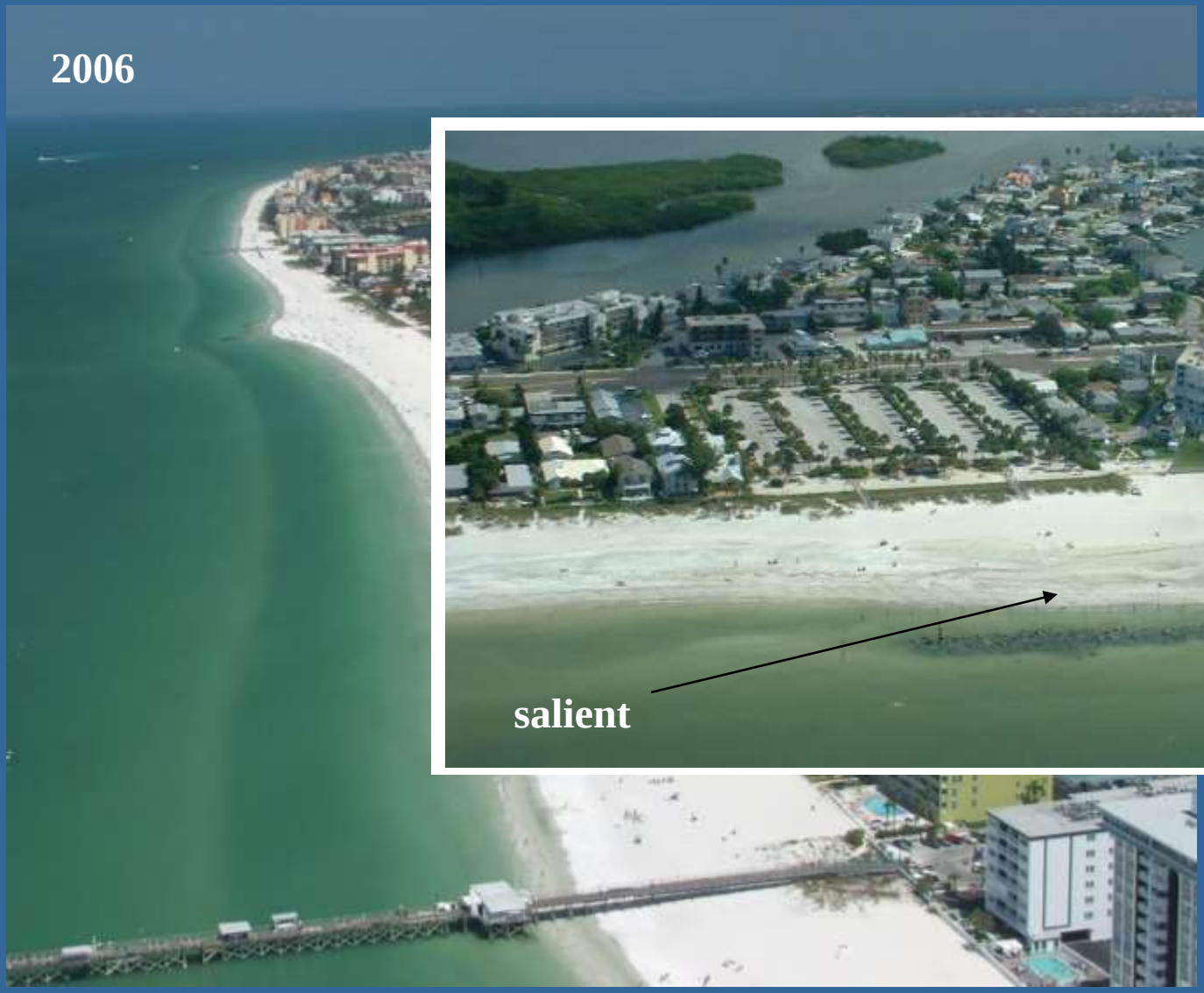
- Reduce beach erosion near inlet
- Reduce frequency of beach nourishment
- Enhance recreation & habitat by creating sandy beach near inlet
- Moderate large-scale inlet fluctuations
- ~Improve recreational navigation by reducing sand in inlet
- Somewhat unintrusive by design
  - Trapping capacity < volume of inlet shoals

Where is the smartest place to install a structure on this island?

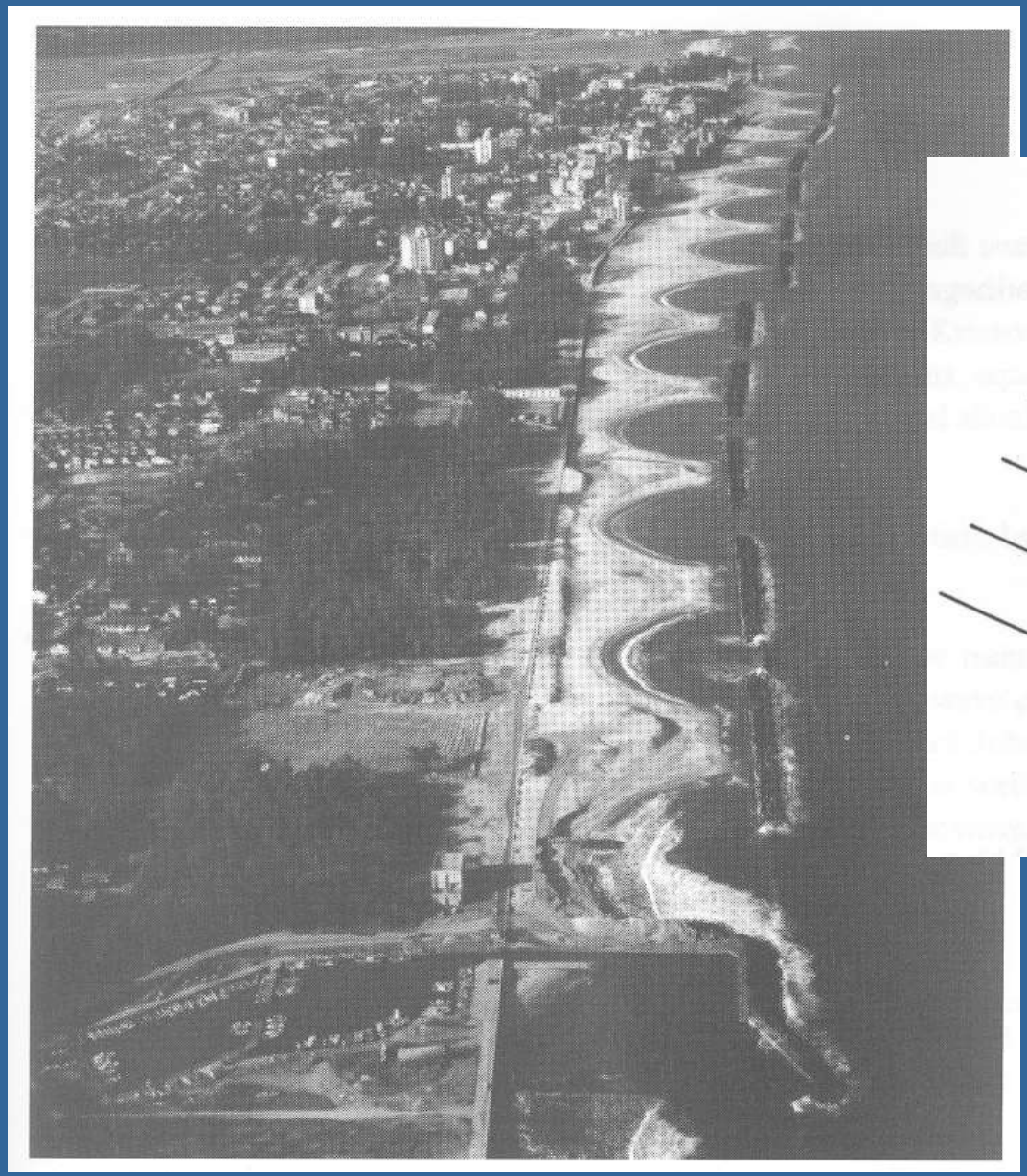
LST STRUCTURES: Breakwaters

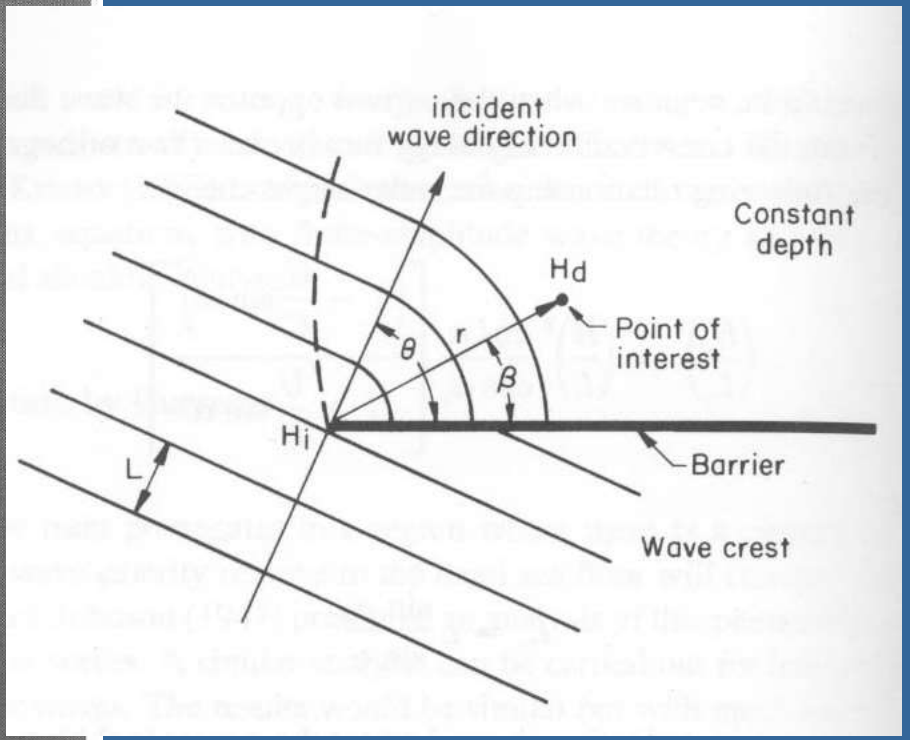
- Shore-parallel
- Purpose: reduce wave energy to shoreline to limit erosion or create safe harbor.
- Built seaward of breaker line.
- Wave sheltering causes
- Single, multiple, detache emergent, submerged.
- May form tombolos or sa

Redington Shores, FL



Multiple Offshore Breakwaters





Kaike coast, Japan

If y/L > 6, no salient

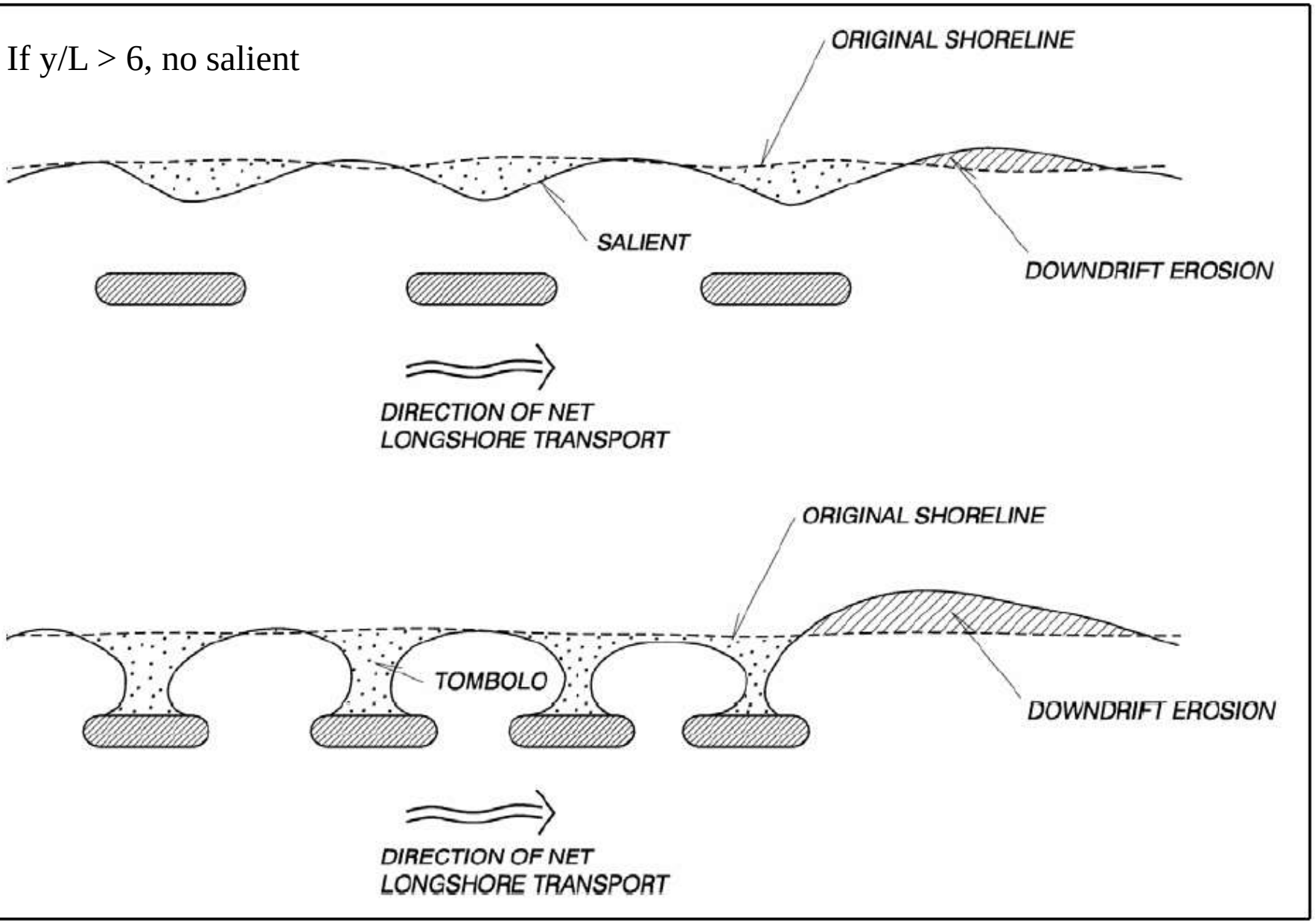
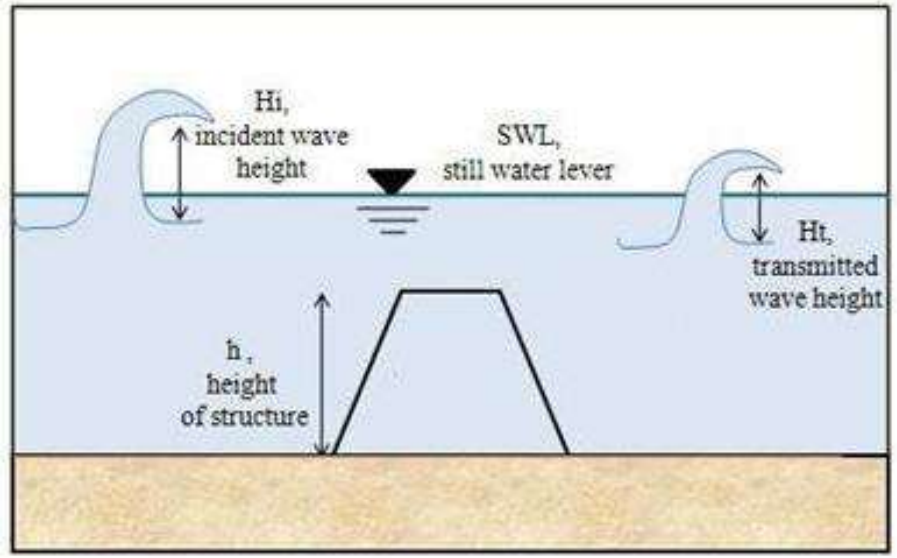


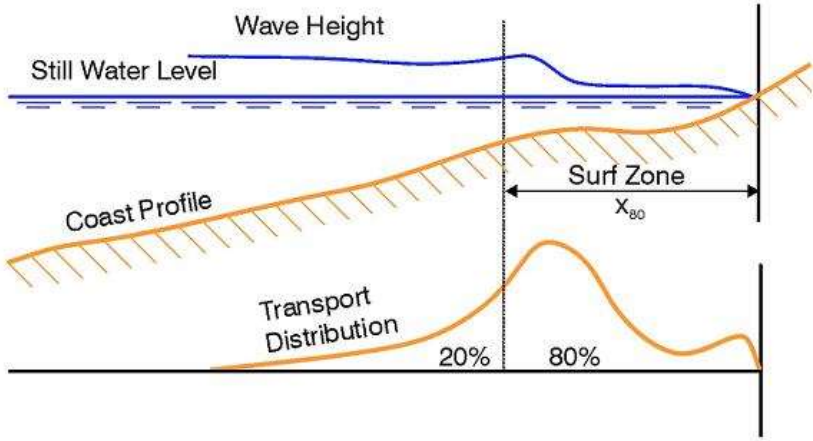
Figure VI-2-10. Typical beach configurations with detached nearshore breakwaters

Breakwaters

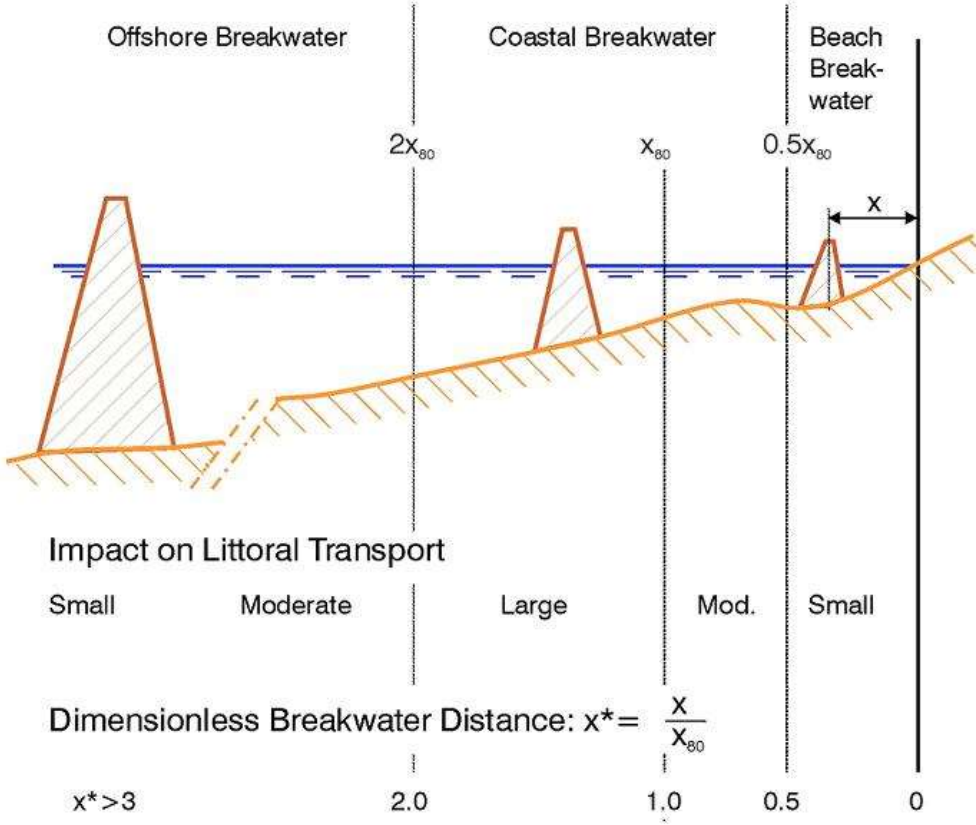


- Near SWL: Reduces H by 20%
- d=1H: Reduces H by only 10%
- Less effective as tide/surge incr.

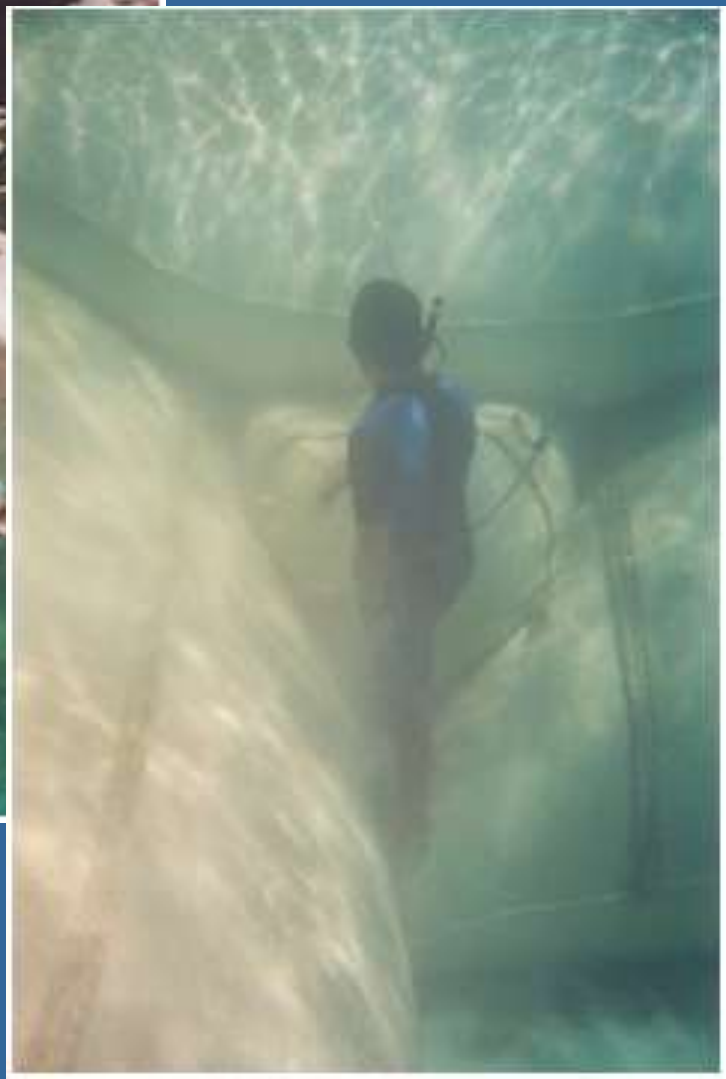
Natural Conditions



Breakwater Types



Geotube Breakwaters



El Dorado Royal, Mexico
Not permeable

T-groins

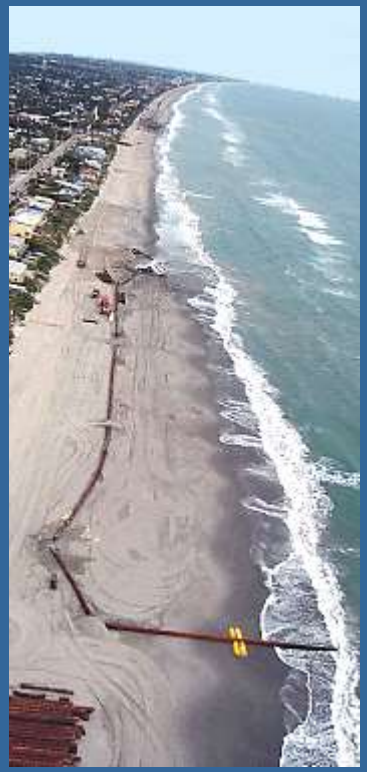
Structures: A *Hard* Decision

- Hardening the coastline is the most intrusive method of shore protection.
- To avoid downdrift impacts, advance fill with sand and maintain sand
  - In front of armoring structures
  - Around littoral drift structures
- Most effective at the end of a littoral system
- Difficult to implement along an open coast without downdrift effects (permeable)
- Redistribute sand, Do not create sand!

Outline: Beach Nourishment

- Planform & Profile response
- Design considerations
- Case studies: FL, Folly
- ….
- Borrow area considerations
  - Location & Sediment characteristics
- Dredging: Sand placement methods
- Costs
- Monitoring

Beach Nourishment

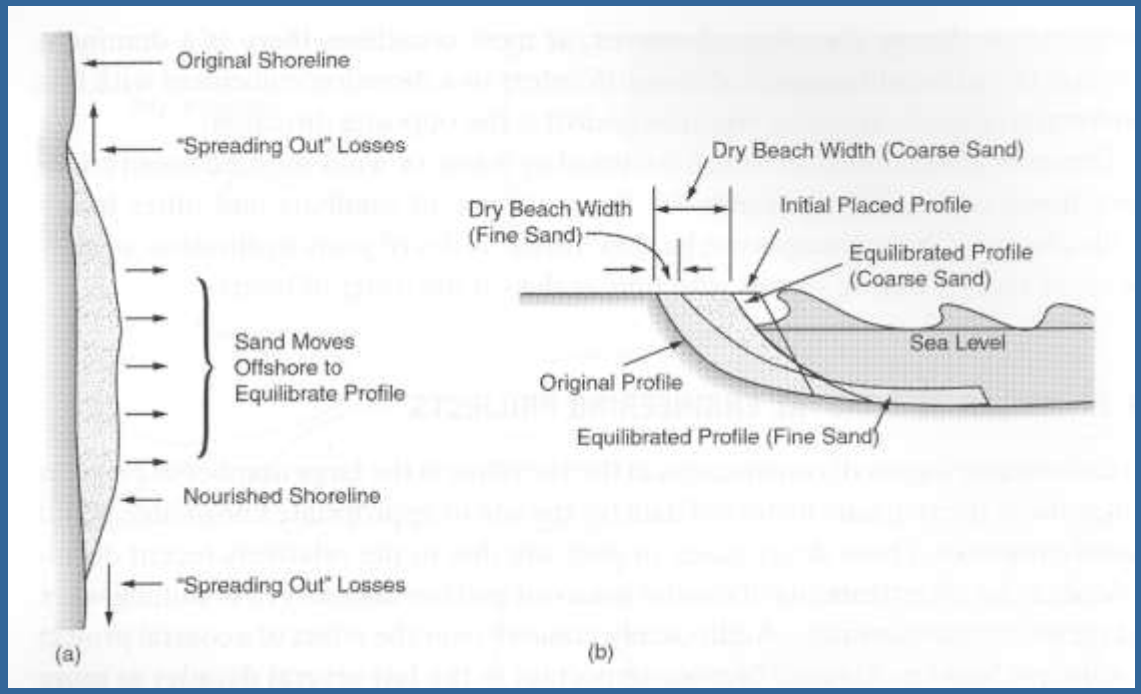


Nourished Beaches?

Terminology

- Beach nourishment = Placement of sediment along a typically eroding beach to advance the shoreline seaward (widen the beach).
  - AKA: “replenishment”, “beach fill”, “restoration”, “renourishment”
- Borrow area = sand source, on/offshore.
- Sediment compatibility = native vs. nourished
- Planform = longshore
- Profile = cross-shore

Beach Nourishment 101



- Placement of sediment on an eroding beach to advance shoreline seaward to promote storm protection, recreation, and habitat.
- Nearshore perturbation that equilibrates with surrounding beaches via cross- and longshore transport.
- Longshore transport: “Planform Spreading”
- Cross-shore transport: “Profile Equilibration”

Sediment Compatibility

Summary of THE SAND RULE: F.A.C. Chapter 62B-41.007

- Beach compatible fill = material that maintains the general character and functionality of the beach and dune system.
  - **Composition:** Carbonate, quartz or similar material
  - **Size:** ranging between 0.062mm and 4.76mm, within **5%**
  - **Color:** similar to native
  - Shall not exceed native beach by:
    - 1. **>5% silt**, clay or colloids passing the #230 sieve;
    - 2. >5% fine gravel retained on the #4 sieve;
    - 3. 0% Coarse gravel, cobbles or material retained on the 3/4 inch sieve;
  - If rocks or other non-specified materials appear on the surface of the filled beach in excess of 50% of background, then surface rock should be removed. These areas shall also be tested for subsurface rock percentage and remediated as required.

Volume of Sand

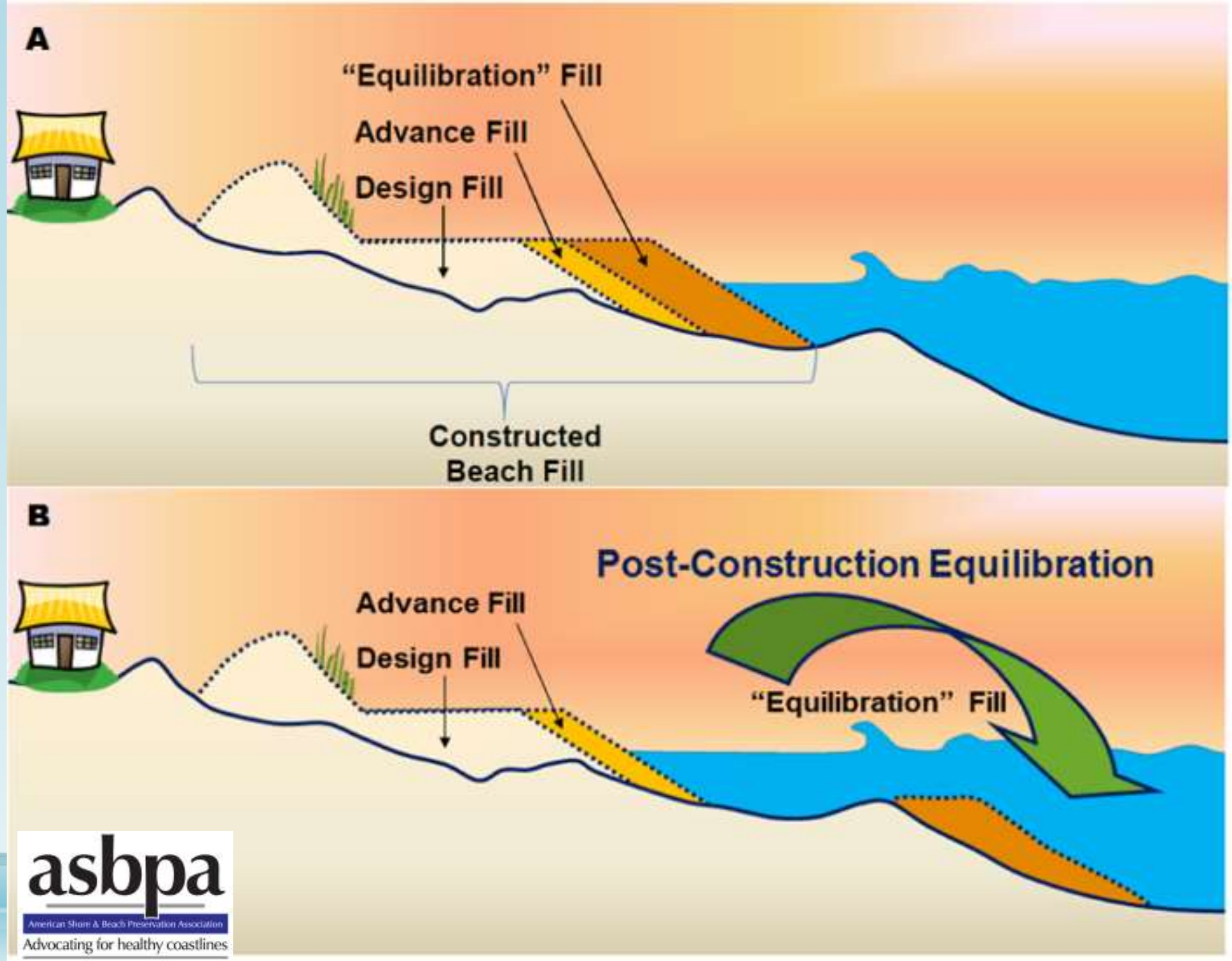
- Cubic yards (cy)
- ¾ cy = 1 ton of sand
- 1 dump truck = 9-10 cy

- Beach nourishment projects
  - Folly County Park: 400,000 cy
  - USACE Folly Beach: 1.8 M cy

- Nourishment Volume Density: 40-100 cy/ft

Profile (Cross-section) Response

- Redistribution of sand across profile
  - Not a loss of sand from project area
- Wide constructed berm narrows as sand transported offshore to sandbar
- “Profile equilibration”
- Immediate
- Transition period: Engineered to Natural

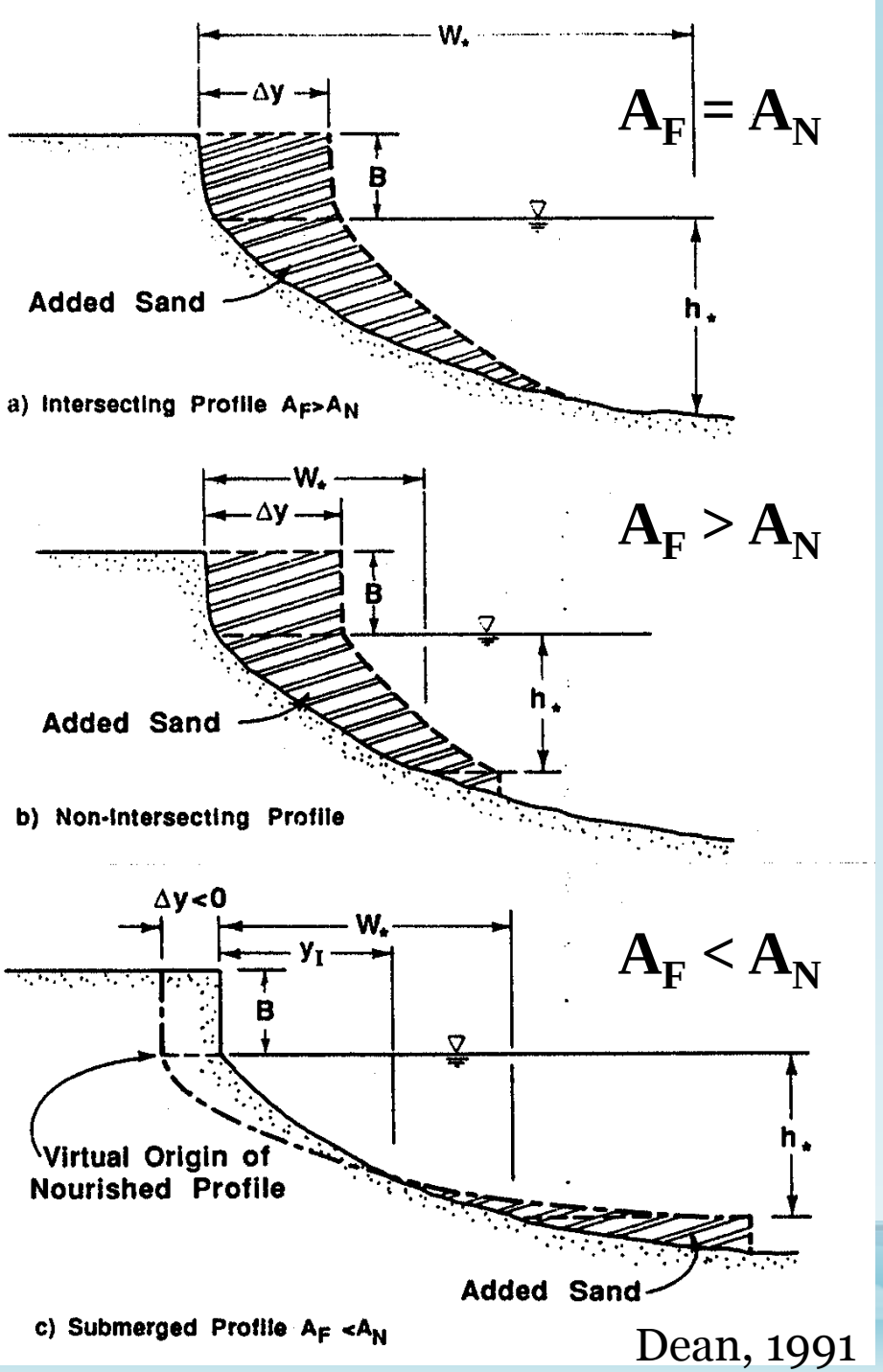


asbpa
American Shore & Beach Preservation Association
Advocating for healthy coastlines

Grain size & Profile Equilibration

$$h = Ay^{2/3}$$

- Coarser sand tends to move onshore.
- Finer sand tends to move offshore.



Dean, 1991

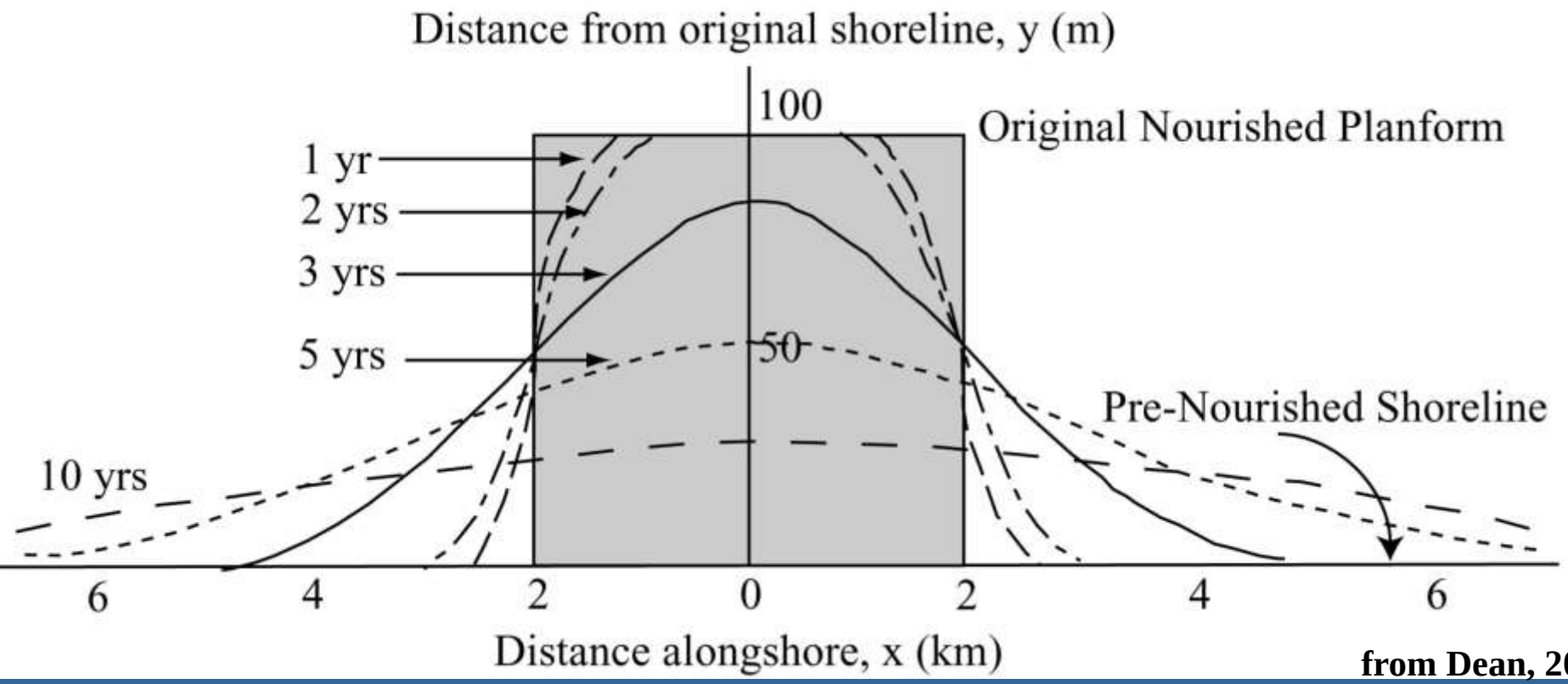
Grain size

Location	Grain size (mm)
NATIVE	~0.2
Longboat Key	0.6
Venice	0.6
Upham Beach	0.5

Planform Response

- Loss of sand from project area
- Adjacent beaches gain sand
- “Longshore spreading”
- Rate of spreading determines success of project
  - Nourishment interval
  - Feeder beach

Planform Response



from Dean, 2002

$$y(x,t) = \frac{Y}{2}\left\{ erf\left[\frac{l}{4\sqrt{Gt}}\left(\frac{2x}{l}+1\right)\right] - erf\left[\frac{l}{4\sqrt{Gt}}\left(\frac{2x}{l}-1\right)\right]\right\}$$

Planform Response

- …is proportional to the project length (l).
- …and inversely proportional to wave height (H).

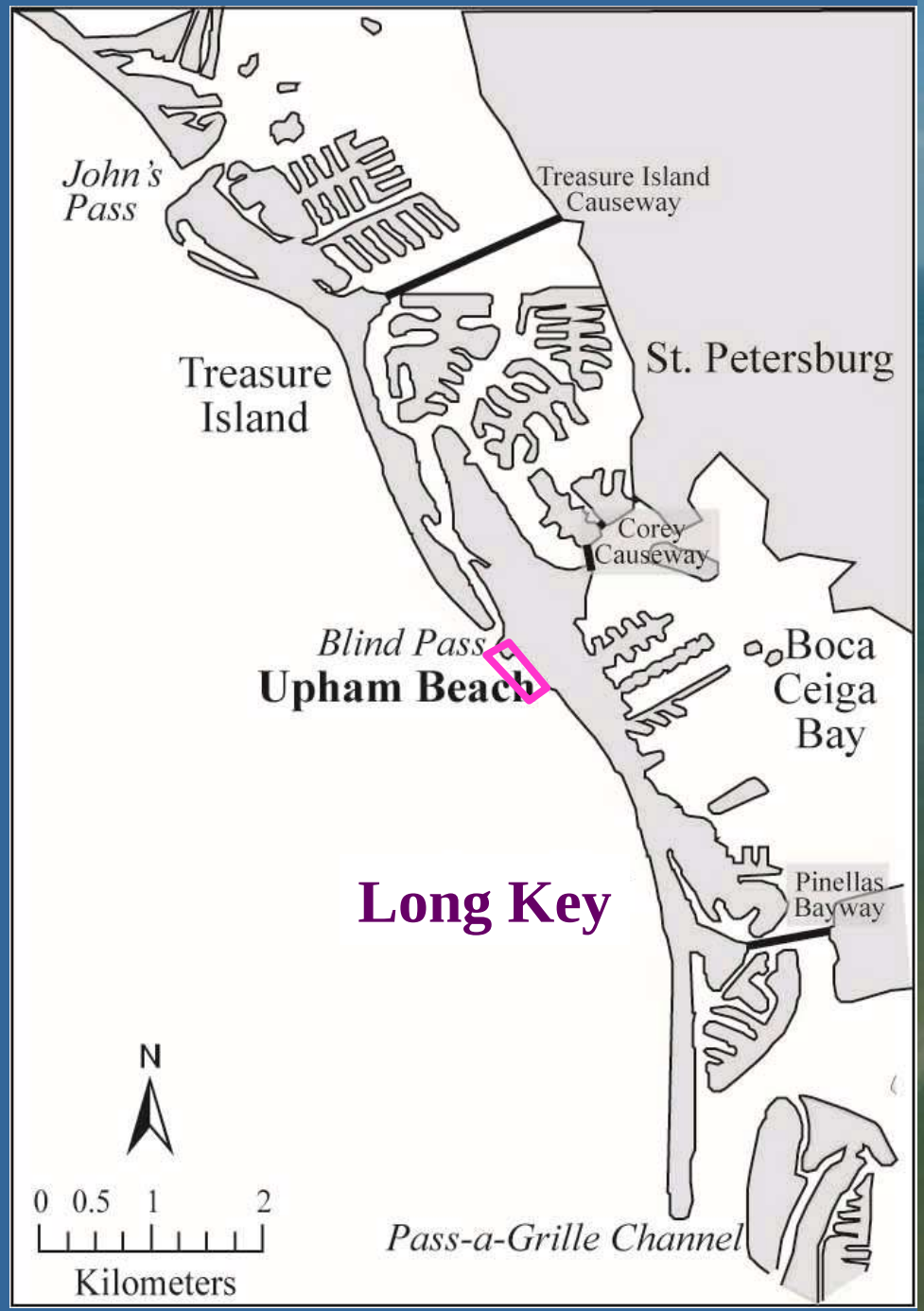
$$t_{50} = K' \frac{l^2}{H_b^{5/2}}$$

If a nourishment project is performing poorly, what is an option to improve it?

Upham Beach Nourishment Projects: Feeder Beach

- 1975, 1980, 1986, 1991, **1996**, 2000, 2004, 2006, 2010, 2014, 2018.

Daily images: Oct 96 - Apr 98

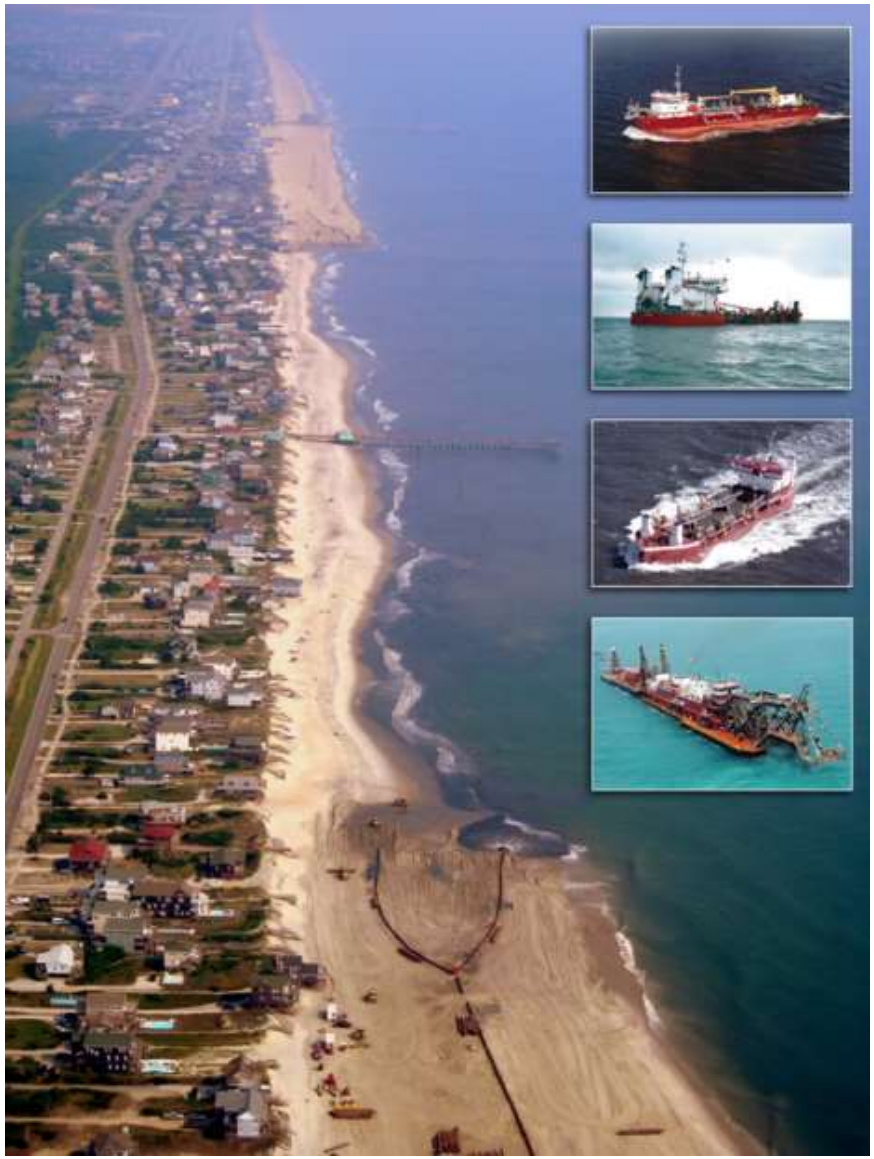

John's Pass
Treasure Island Causeway
Treasure Island
St. Petersburg
Corey Causeway
Blind Pass
Upham Beach
Boca Ceiga Bay
Long Key
Pinellas Bayway
N
0 0.5 1 2
Kilometers
Pass-a-Grille Channel

Upham Beach

Nags Head, NC 2011

- 10 miles long
- 4.6 M cy sand

- 2016: 90% sand remained



High Value Services
Sustainable Solutions
CSE
COASTAL SCIENCE & ENGINEERING

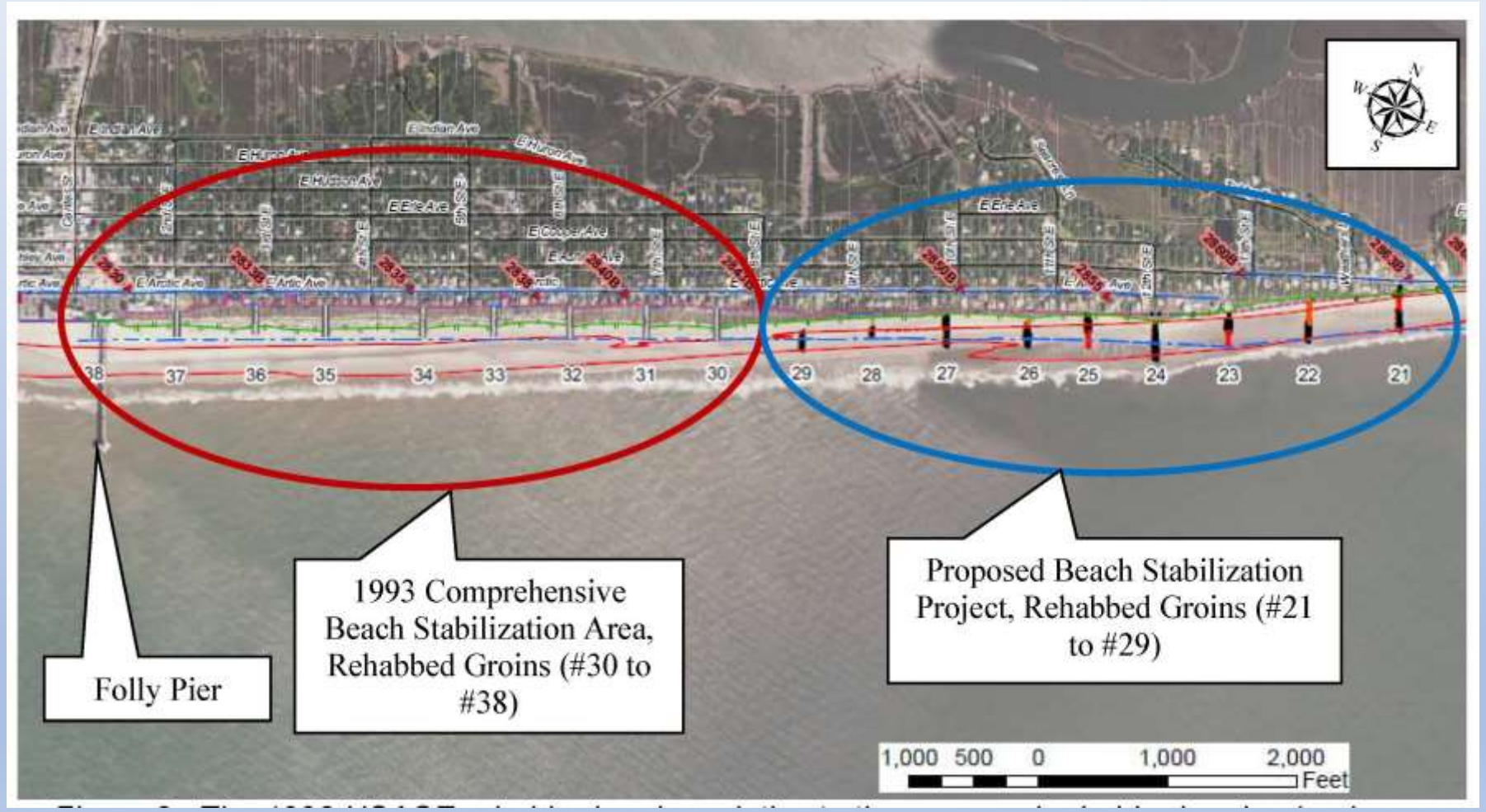
Hybrid Projects

Folly Beach 2018 Beach and Dune Stabilization Project

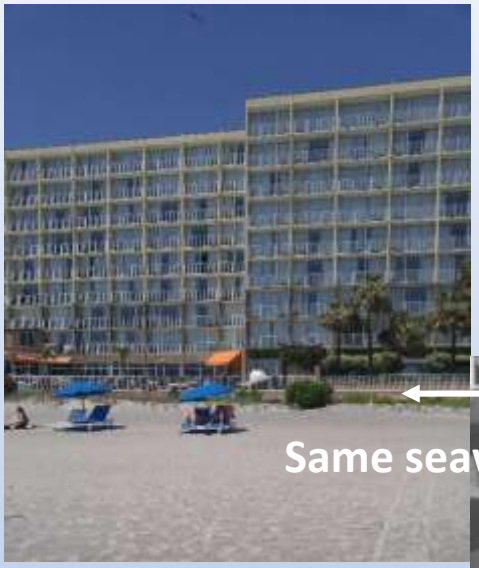
Hybrid Beach & Dune Stabilization Project

- Beach nourishment:
  - Sand from USACE dredging of Folly River
  - Dune Restoration: Planting native vegetation & installing sand fencing
  - Groin Rehabilitation: Nine (9) groins
- Project Area: 8th St. E. to 14th St. E.
  - 5,000 ft
- Intent: To benefit the public interest and improve the usefulness of the project by **retaining nourished sand** in the template longer than without the stabilization effort.

Central Folly Project Area



Central Folly Beach, SC Before and After 1993 USACE Project

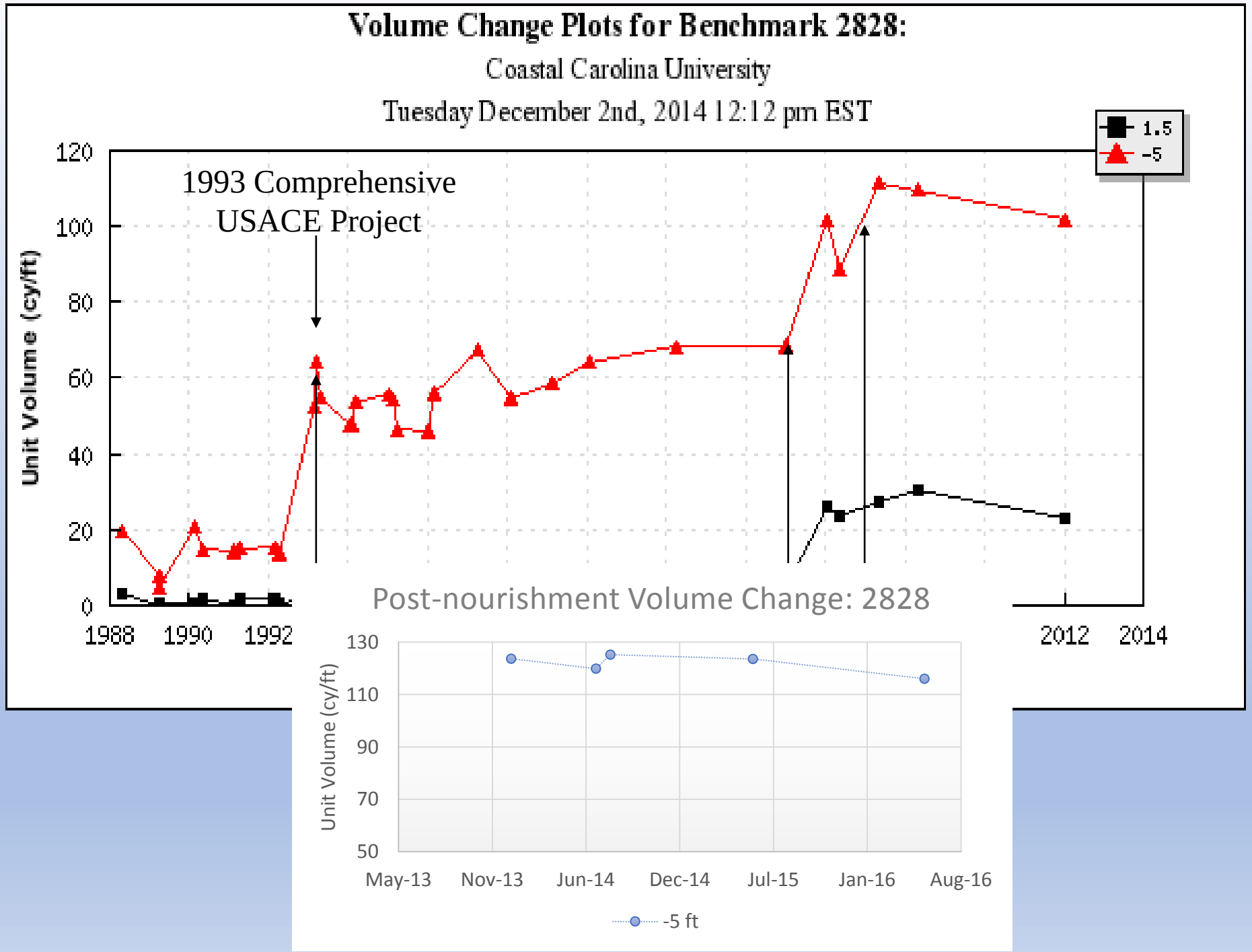


2017

Same seawall cap

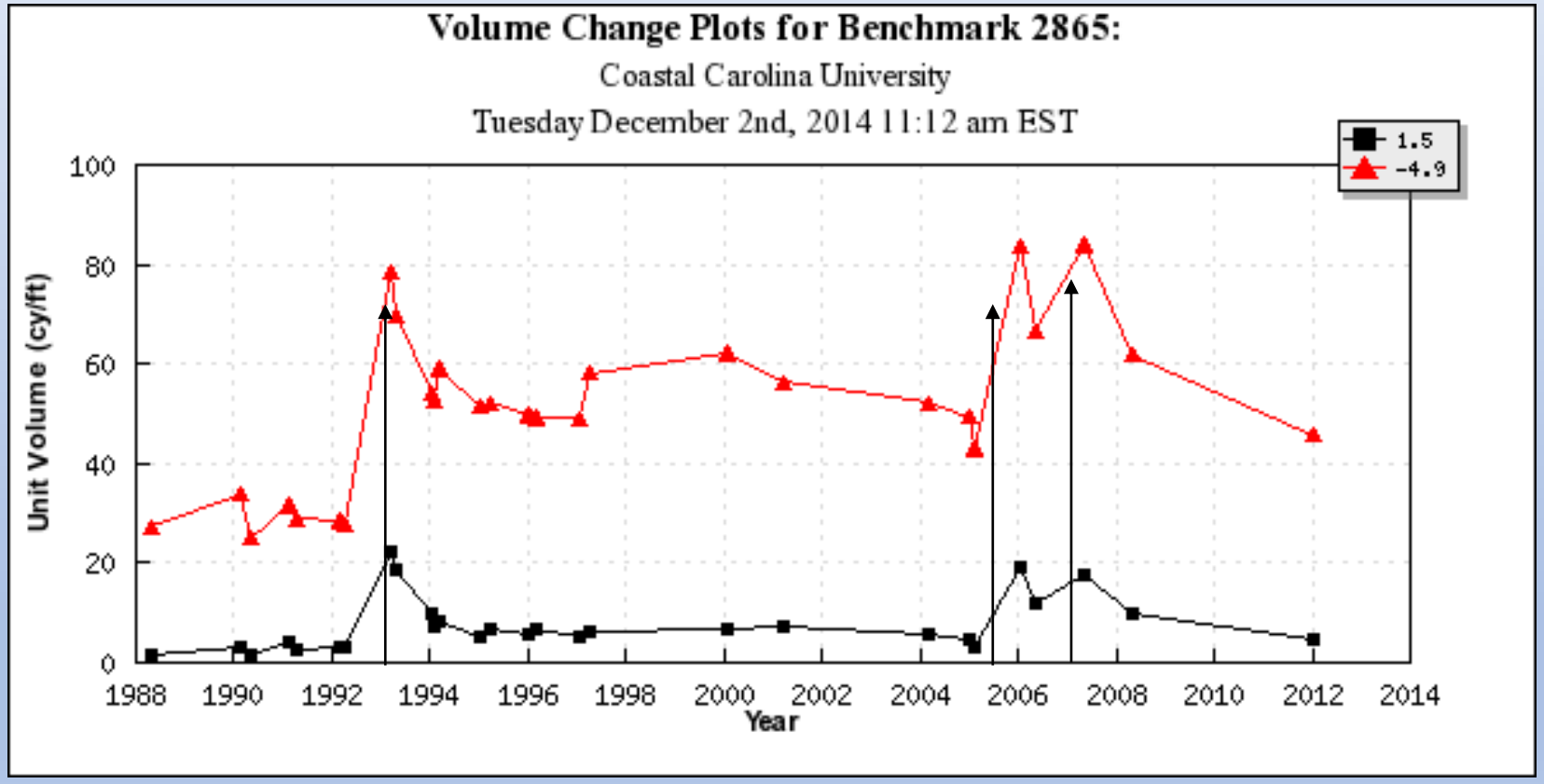
Central Folly Beach: Shoreline Change Analysis

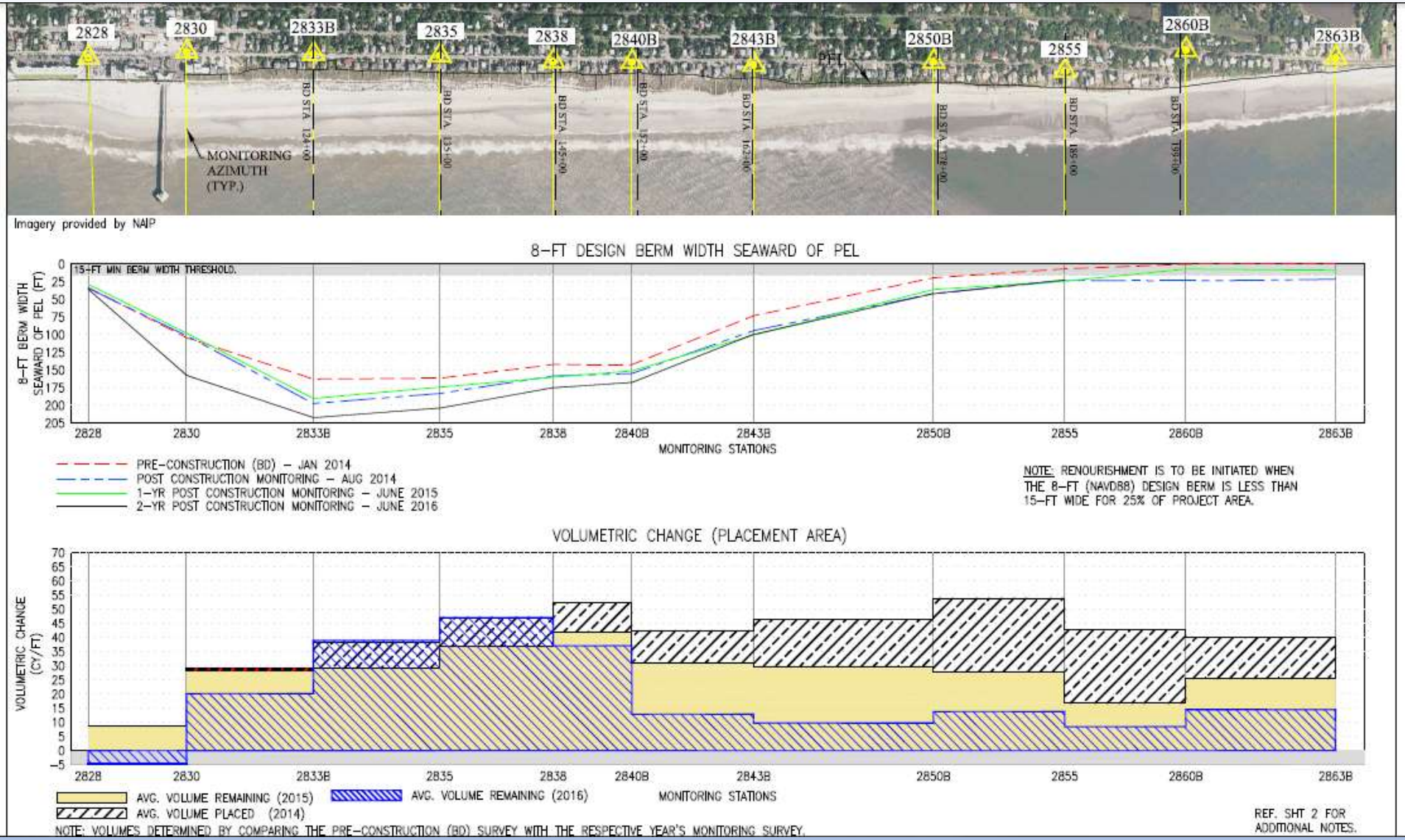
"The central portion of the island has become increasingly stable since a comprehensive beach stabilization effort, that included dune restoration and the rehabilitation of nine dilapidated groins, was initiated in conjunction with the 1993 Federal beach nourishment project." -2015 FB LCBMP


Volume Change Plots for Benchmark 2828:
Coastal Carolina University
Tuesday December 2nd, 2014 12:12 pm EST
1.5
-5
1993 Comprehensive
USACE Project
Unit Volume (cy/ft)
120
100
80
60
40
20
0
1988
1990
1992
2012
2014
Post-nourishment Volume Change: 2828
Unit Volume (cy/ft)
130
110
90
70
50
May-13
Nov-13
Jun-14
Dec-14
Jul-15
Jan-16
Aug-16
-5 ft

Project Area Folly Beach: Shoreline Change Analysis

Project Area Folly Beach: Shoreline Change Analysis





2016 Monitoring Report

From this…

to this…

2018 Folly Groin Rehabilitation: Impermeable Low-Profile Groins

Field Trip Preview

Folly Beach 2018 Groin Rehabilitation Project and

Federal Hurricane Recovery Renourishment

Land-based placement equipment

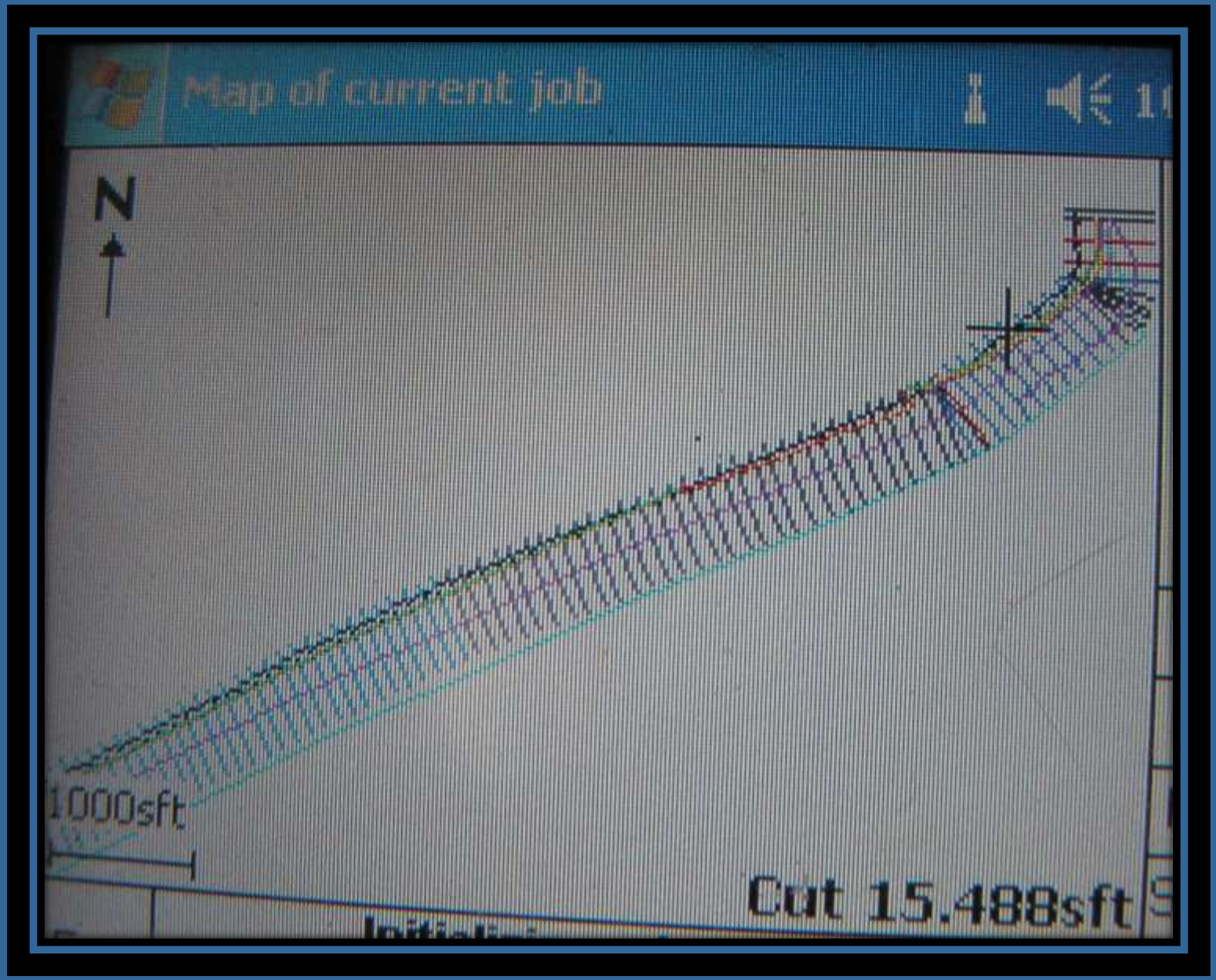
Start Up

Pumping Sand

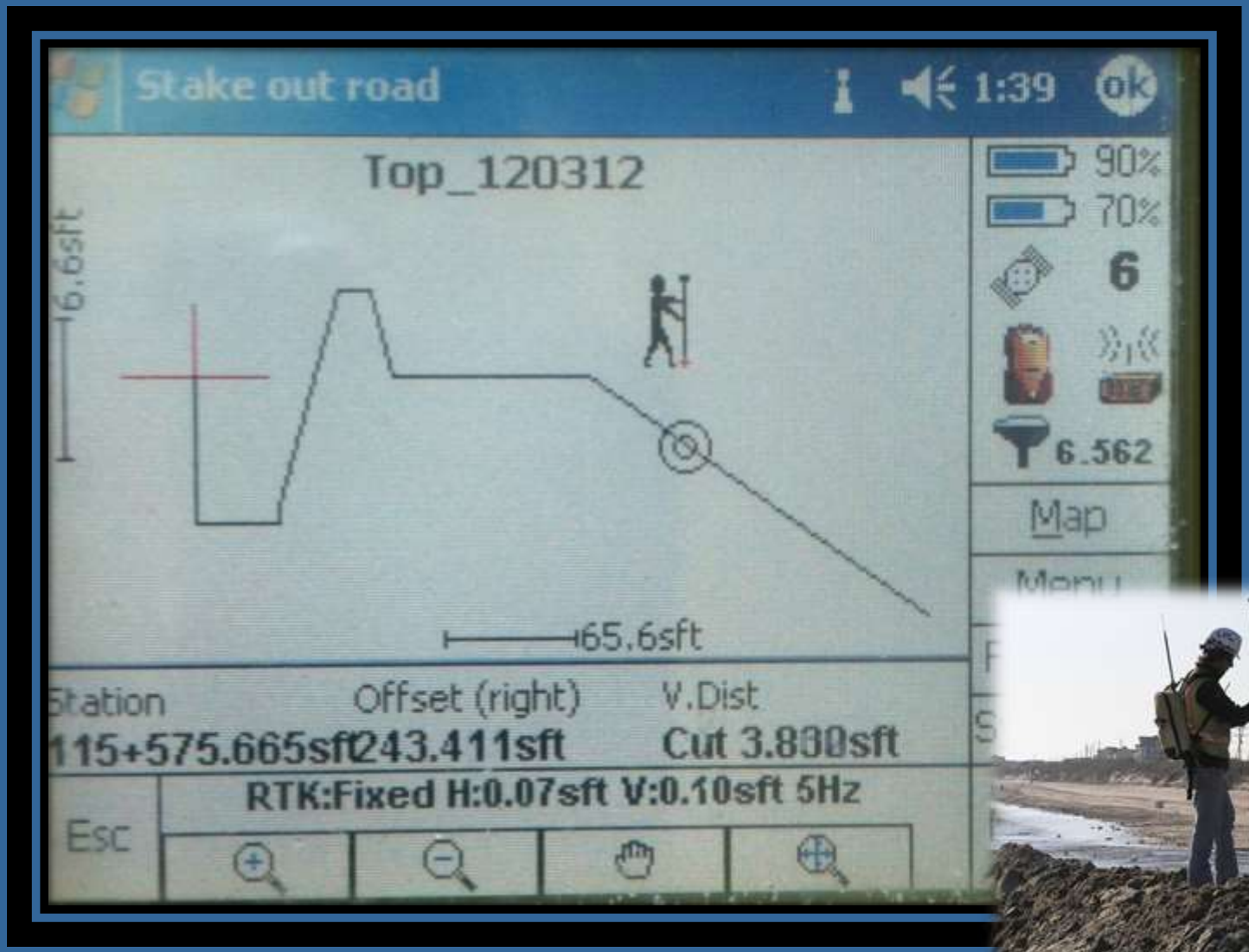
- Slurry: Sand/water mixture requires a minimum velocity to avoid deposition
  - Increases with grain size
  - 20% sand

Typical Beach Construction Area

Multiple Valve Set-up



DXF Map View



Cross-Section View

Field Trip

Beaches 101: A Training Course for Coastal Managers

Nicole Elko, Ph.D.

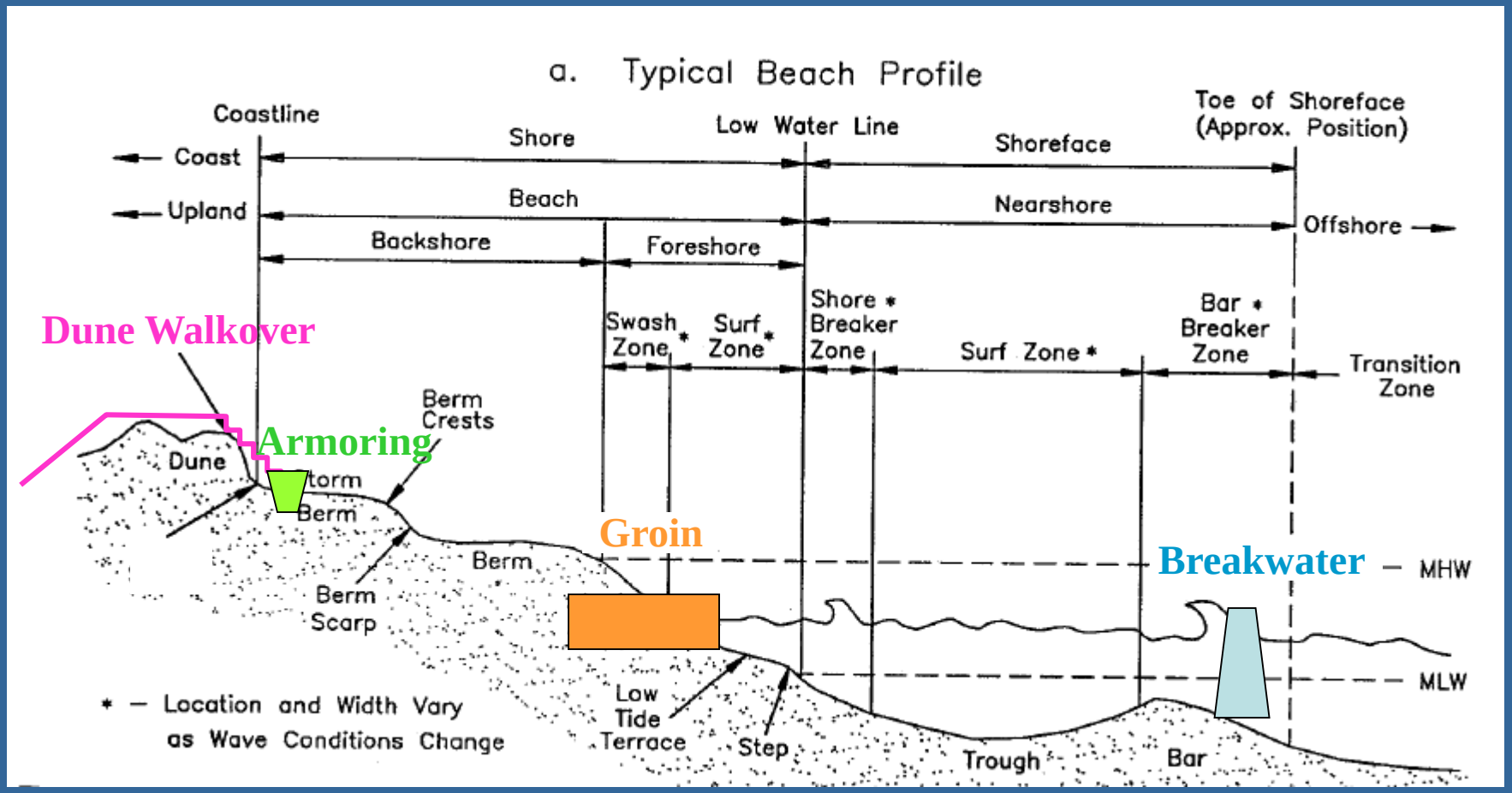
October 16, 2018

Dunes, Retreat, Dredging & Funding

Outline

- **Erosion Management: Spectrum of Tools**
  - Retreat ←→ Protect
  - Structures
    - Armoring
    - LST
  - Soft shore protection
    - Hybrid projects
    - Beach nourishment
    - Dunes
  - Managed Retreat

Beach Profile Terminology



Dunes: Benefits & Limitations

- Features of the wind
- Natural dunes migrate landward under erosional pressure
  - Engineered dunes typically cannot
- Stable only in areas that aren't regularly reworked by waves.
- Not necessarily vast reservoirs of sand
  - $Vol_{dune} < Vol_{berm}$
- NOT effective protection from long-term erosion

N.J. sand dunes protected Shore towns from Hurricane Sandy's wrath

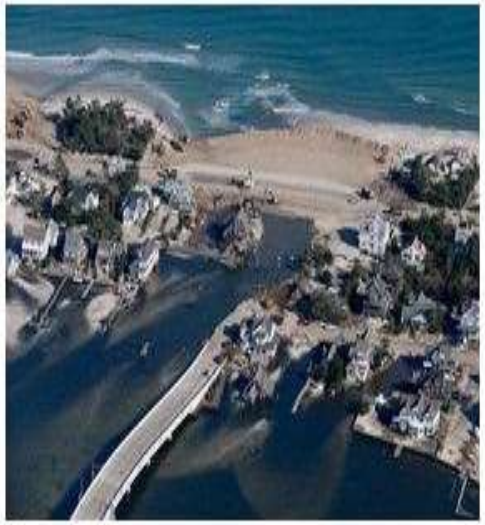
By Star-Ledger Staff
on November 08, 2012 at 7:05 AM, updated November 08, 2012 at 11:44 AM

Email Print

By Ryan Hutchins and Seth Augenstein/The Star-Ledger

Hurricane Sandy did something unusual to Long Beach Island, a narrow 18-mile strip of land: The storm's raging winds and powerful surge of water carved two communities out of one.

There are the places that had a protective dune system installed and, as a result, sustained minimal damage. Then there are the areas where there were no tall dunes, where Sandy



Enlarge Andrew Mills/The Star-Ledger

Workers have closed a breach in the barrier island at the base of the Mantoloking Bridge where Barnegat Bay met the Atlantic Ocean here after Hurricane Sandy pummeled the Jersey Shore last week. 11/5/12 (Andrew Mills/The Star-Ledger)

Aerial photos of the Jersey Shore as repairs begin after Sandy gallery (17 photos)

N.J. News Essentials

See top photos from The Star-Ledger

Find fun events in N Jersey

Search New Jersey business listings

Most Comments Most

539 N.J. Assembly gun control b save lives: Editorial

481 N.J. braces for 'doomsday' budget cuts as sequestration deadline looms

257 N.J. Assembly passes package of gun bills despite Republicans' protest

Matthew 2016
North Myrtle Beach

*Wide beaches + High **continuous** dunes + Elevated structures = Storm damage reduction*

Walling, Herrington, & Miller, 2016

Hurricane Florence: $12.8B

Coastal Review Online

A Daily News Service Covering North Carolina's Coast

Front Page | News & Features | Our Coast | Science | Commentary | Special Reports | Photos | Videos

Braxton Davis

On Monday, Division of Coastal Management Director Braxton Davis told legislators that an inventory of the damage is underway. The key takeaway, he said, was natural infrastructure did very well in the storm.

"Beach nourishment projects that resulted in high dunes and wide beaches did what they were supposed to do. They buffered the storm," he said. Living shorelines also worked well, he said. "We're seeing that these structures, where they've been implemented, performed extremely well during the storm, were not damaged in any way and nearby you see bulkheads that have collapsed and you see scouring of property."

Sandy, NJ:
Dune erosion
Infrastructure protection

DUNE MANAGEMENT CHALLENGES

http://asbpa.org/wpv2/wp-content/uploads/2016/03/dunes_84_1.pdf

Limited research, design guidance

Dune Vegetation/Fencing

- Shore-parallel
- Purpose: to trap wind-blown sand and promote dune growth.
  - Protect & retain sand
- Materials:
  - Seedlings of native vegetation
  - Sand Fencing
- Planted at landward limit of backbeach, landward of active beach.

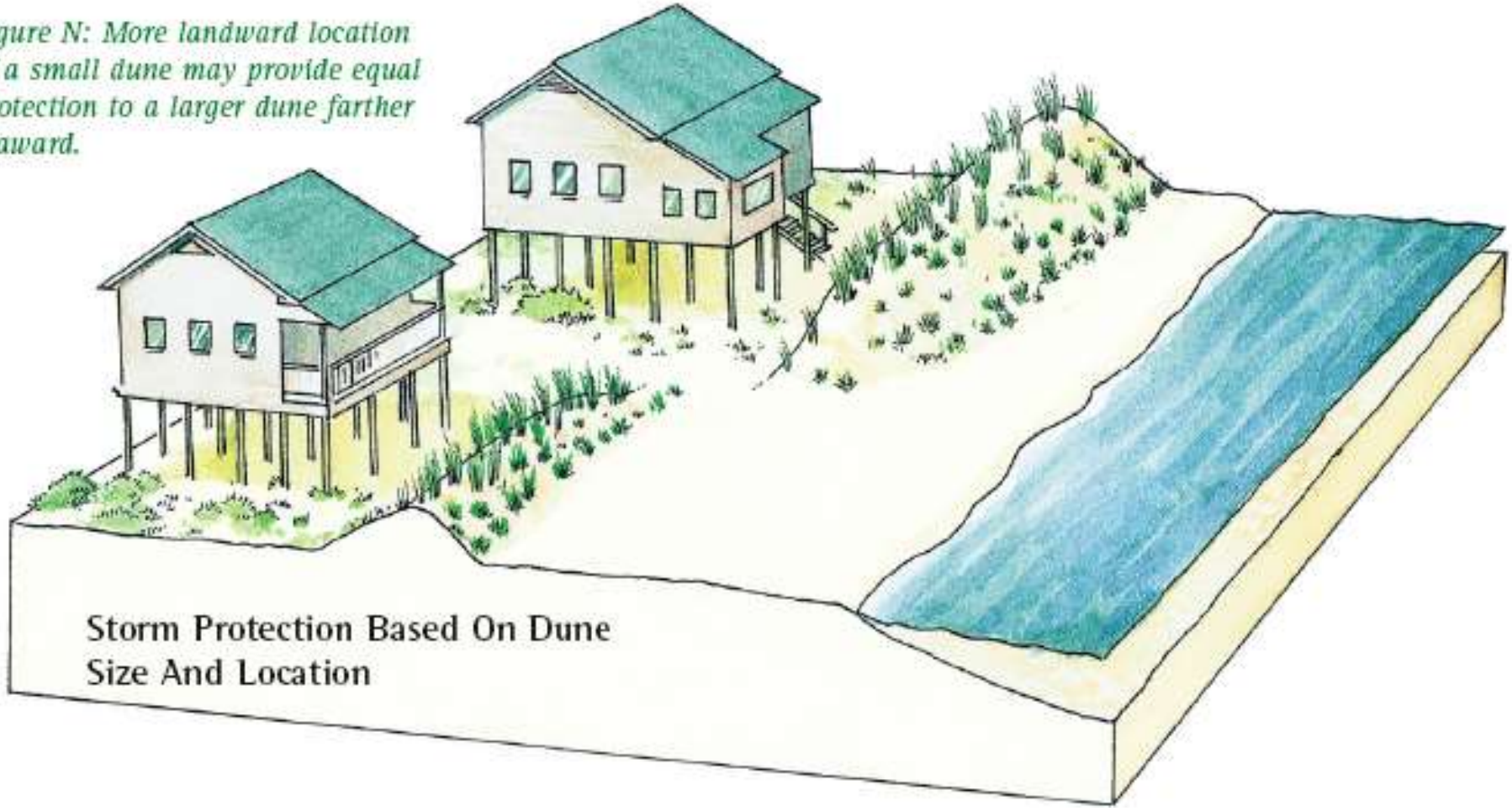


Figure N: More landward location of a small dune may provide equal protection to a larger dune farther seaward.

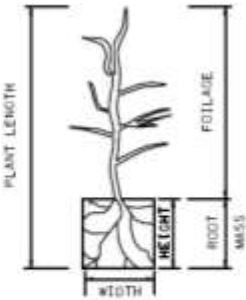
Where to install fencing/vegetation?

Rogers & Nash, 2003, The Dune Book:
http://www.seagrant.umaine.edu/files/chg/RogersNashdune_booklet.pdf

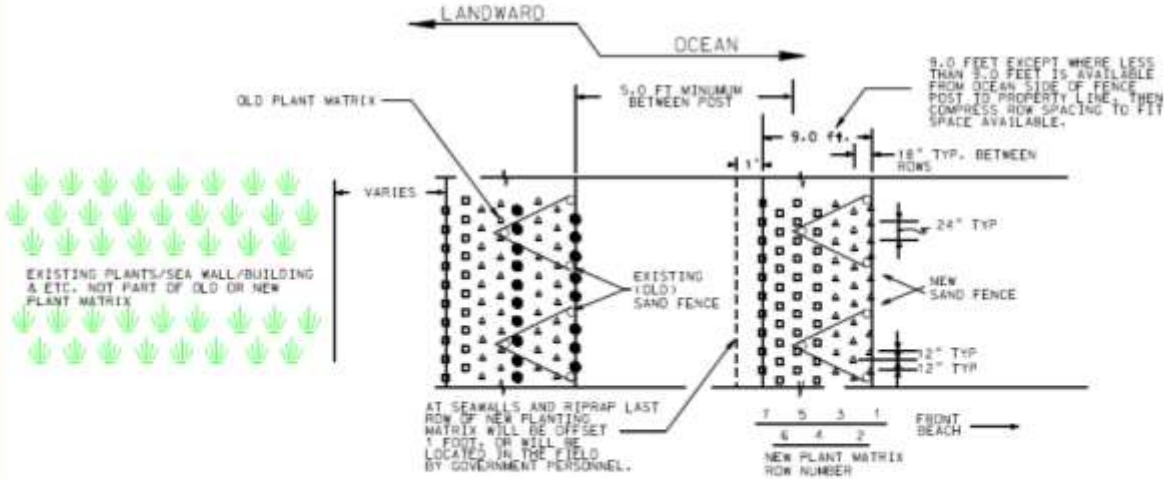
USACE Fence/Vegetation Spec

PLANT REQUIREMENT SCHEDULE

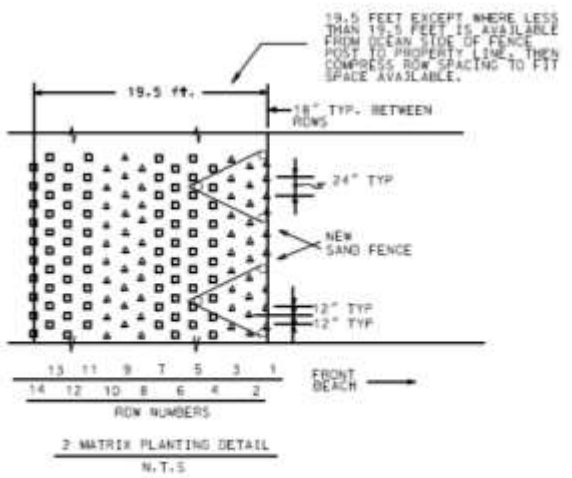
Ledgend	Botanical Name	Common Name	Accession Number	Required Planting Dates	Planting Specifications	Fertilization
▫	Uniola paniculata	Sea Oats	N/A	1 MARCH THRU 7 APRIL 2019	Plants shall be containerized nursery seedlings. Each plug shall have a minimum of 2 individual seedlings per container. Plants shall have a root mass of no less than 1.75" wide x 1.75" wide and 4" deep or 50 cell flat size with foliage not less than 14" long. Plant 8" deep. See Containerized Plant Detail A. See Dune Matrix Planting Detail for spacing.	FERTILIZER: 18-6-12 GRANULAR FERTILIZER SHALL BE USED WITH THE FOLLOWING APPLICATIONS: 1ST APPLICATION - MIX 1 LEVEL TEASPOON OF FERTILIZER WITH BACKFILL THAT IS TO BE USED WITH EACH PLANTING. 2ND APPLICATION - FERTILIZER SHALL BE BROADCAST AT A RATE OF 300 POUNDS PER ACRE THE FOLLOWING YEAR BUT NOT BEFORE 1 MARCH, AND NOT LATER THAN 30 APRIL.
▲	Panicum amarum 'northpa'	Bitter Panicum	Northpa (PI 421957)	1 March THRU 7 APRIL 2019	Plants shall be containerized nursery cuttings. Individual plants shall have a root mass of no less than 1.25" wide x 1.25" wide and 2" deep 98 cell flat with foliage not less than 10" long. Plant 5"-7" deep. See Containerized Plant Detail A. See Dune Matrix Planting Detail for spacing.	
●	Ammophila breviligulata 'Bogue'	American Beachgrass 'Bogue'			This plant is existing from last planting in certain areas of the beach. See Note 7.	



CONTAINERIZED PLANT DETAIL A



OLD AND NEW PLANTING MATRIX DETAIL
N.T.S



2 MATRIX PLANTING DETAIL
N.T.S

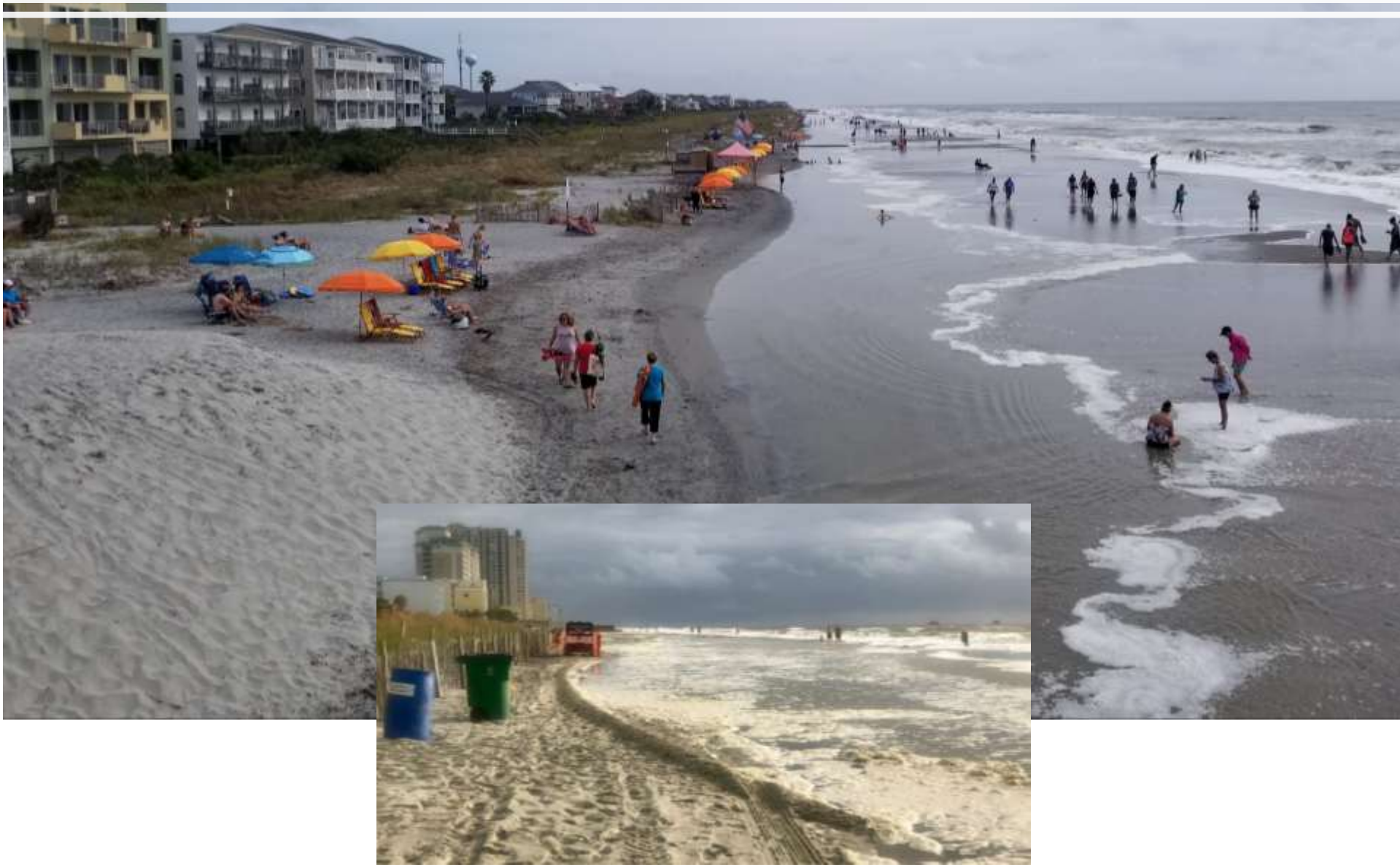
NOTE: ALL NOTES ON "OLD AND NEW PLANTING MATRIX DETAIL" APPLY EXCEPT, REPLACE "9.0 FEET" WITH "19.5 FEET".

S.C. Native Dune Vegetation

Sea oats

Bitter panicgrass

Balancing storm protection with recreation

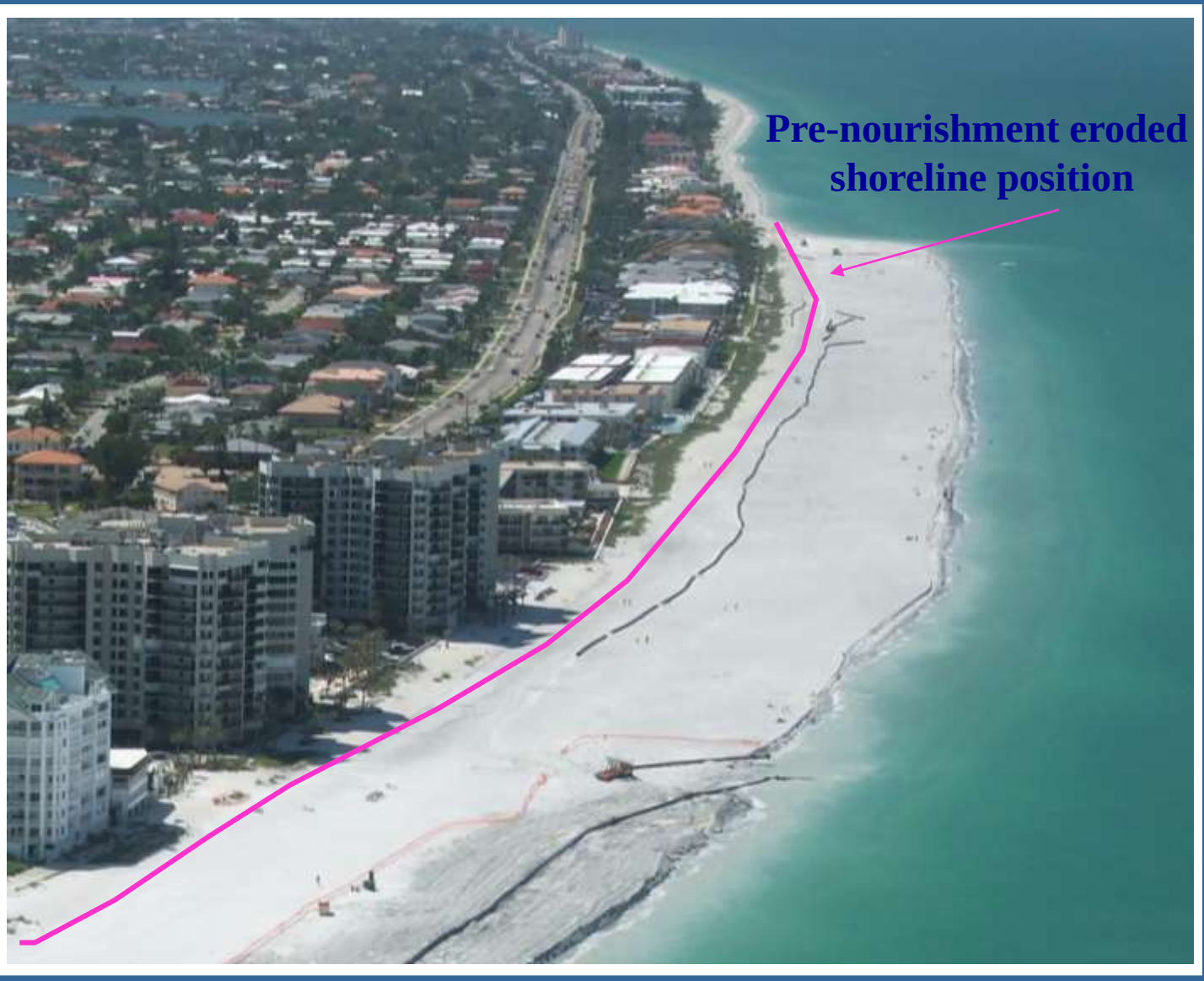


Post-storm debris removal

To restore dunes?

Dune enhancement

Dune Planning



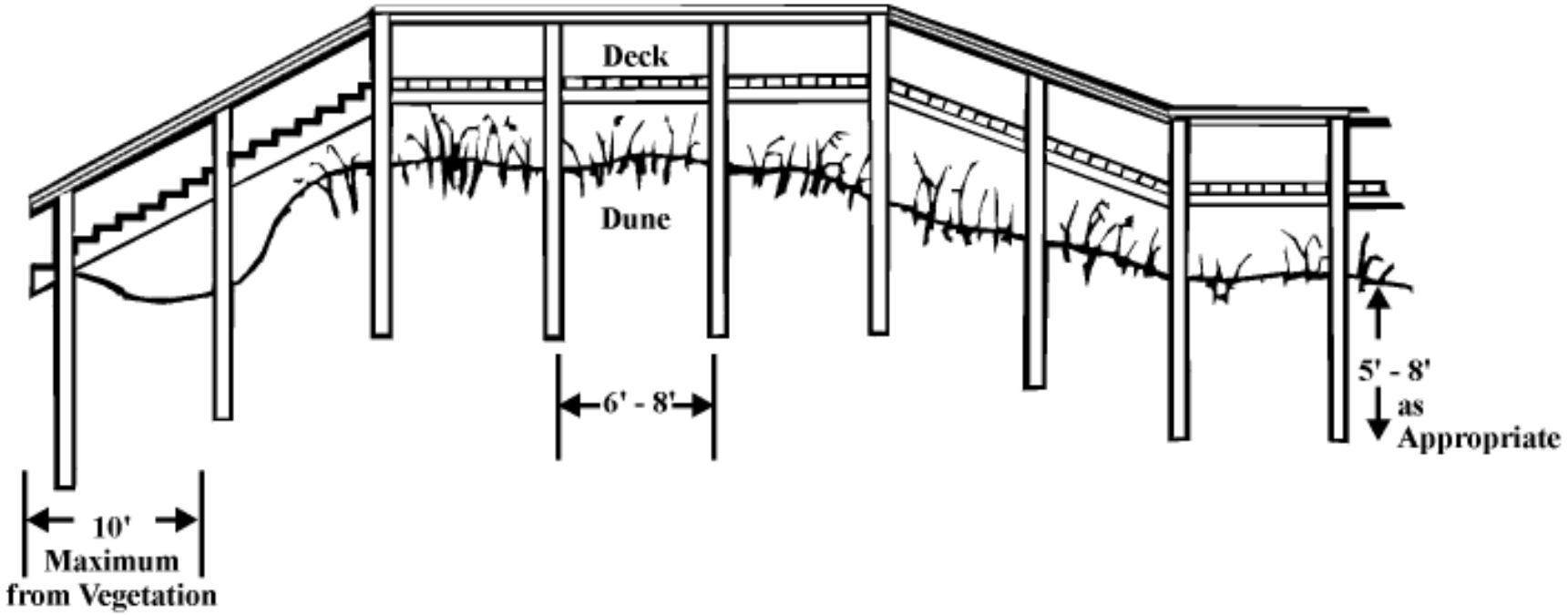
Dune Walkovers

- Shore-perpendicular
- Purpose: to provide beach access to pedestrians (vehicles) with minimal impact to dune.
- Built as wooden boardwalks or as sand paths from upland to backbeach.
- Challenge: Balance pedestrian traffic and sediment supply.

Balancing storm p cess

Appropriate Dune Walkover

If pedestrian traffic > sediment supply



Geotubes

FEMA: Hazard Mitigation Assistance Program

- Elevated 1,985 Private Homes
- Federal Share: $232.5M

https://www.fema.gov/media-library/assets/videos/153336

Courtesy: Tucker Mahoney

Managed Retreat

Tools for Managed Retreat

- Coastal management planning
- Setback lines
- Prevent private coastal armoring
- Rebuilding Restrictions
  - SC Beachfront Management Act
- Acquisitions: Easements/Buyout programs
  - Property information disclosure to potential buyers

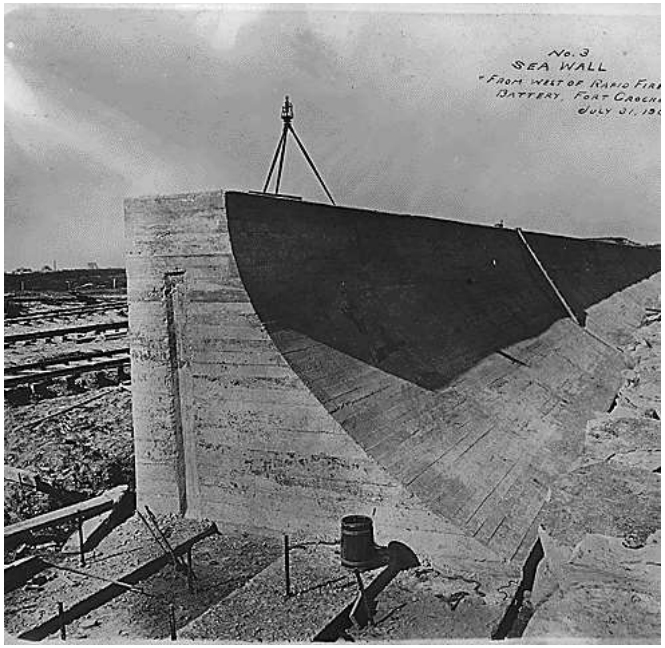
COLUMBIA LAW SCHOOL

CENTER FOR CLIMATE CHANGE LAW

MANAGED COASTAL RETREAT

A LEGAL HANDBOOK ON SHIFTING DEVELOPMENT AWAY FROM VULNERABLE AREAS

BY ANNE SIDERS



Galveston, TX seawall

Erosion Management: Managed Retreat

Summary

- Erosion Management: Spectrum of Tools

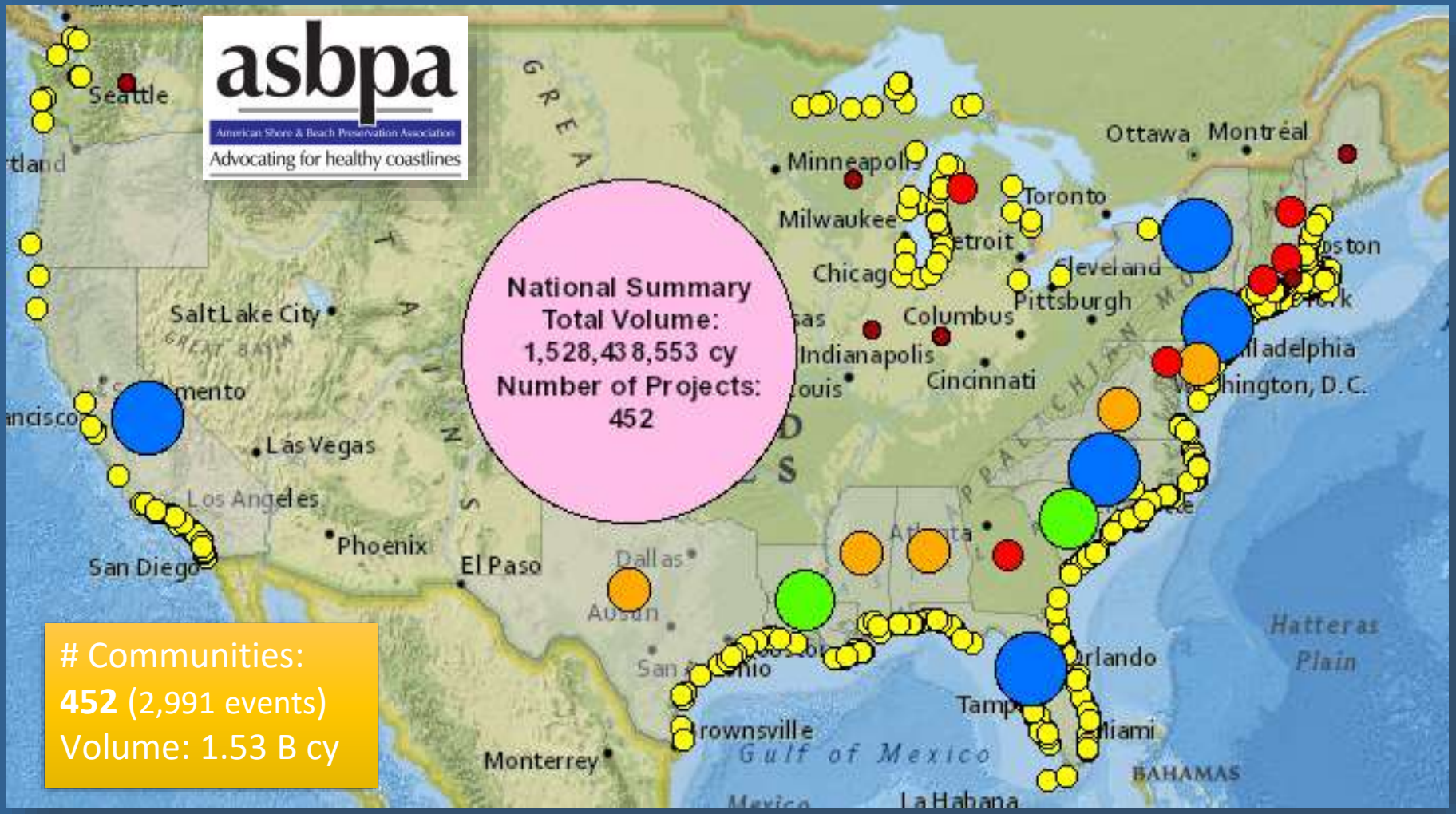
Do Nothing ← *Beach preservation* → **Hold the Line**

– Structures
  - Armoring
  - LST

– Soft shore protection
  - Hybrid projects
  - Beach nourishment
  - Dunes

– Managed Retreat

National Beach Preservation Statistics since 1920's



www.asbpa.org

For updates and additional information, visit **MoreBeachtoLove.com**

- Latest project updates
- Additional FAQs
- Interactive project maps showing progress of construction
- Subscribe to receive email updates in your inbox
- Video updates

MORE BEACH TO LOVE.COM
OUTER BANKS SHORELINE MANAGEMENT

2017 Beach Nourishment Projects

Nourishment areas shown in red.

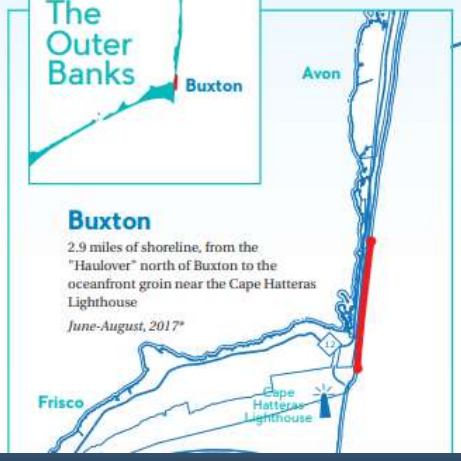
Duck
1.7 miles of shoreline, from Oyster Catcher Lane to the Army Corps of Engineers Field Research Facility
*May - July, 2017**

Southern Shores
2,500 feet of shoreline, from the Kitty Hawk town line to 44 Ocean Boulevard

Kitty Hawk
3.58 miles of shoreline, from the Southern Shores to Kill Devil Hills town lines
*June - August, 2017**

Kill Devil Hills
2.6 miles of shoreline, from the Kitty Hawk town line to Prospect Avenue
*August - September, 2017**

Buxton
2.9 miles of shoreline, from the "Haulover" north of Buxton to the oceanfront groin near the Cape Hatteras Lighthouse
*June-August, 2017**



MORE BEACH TO LOVE
OUTER BANKS
SHORELINE MANAGEMENT

Improvements **today** for a better beach **tomorrow.**

National Beach Nourishment Database

Search and Zoom to Features

Zoom to State

SC ▾ Zoom

Legend:

National Nourishment Volume (cy)

Nourishment Volume By State (cy)

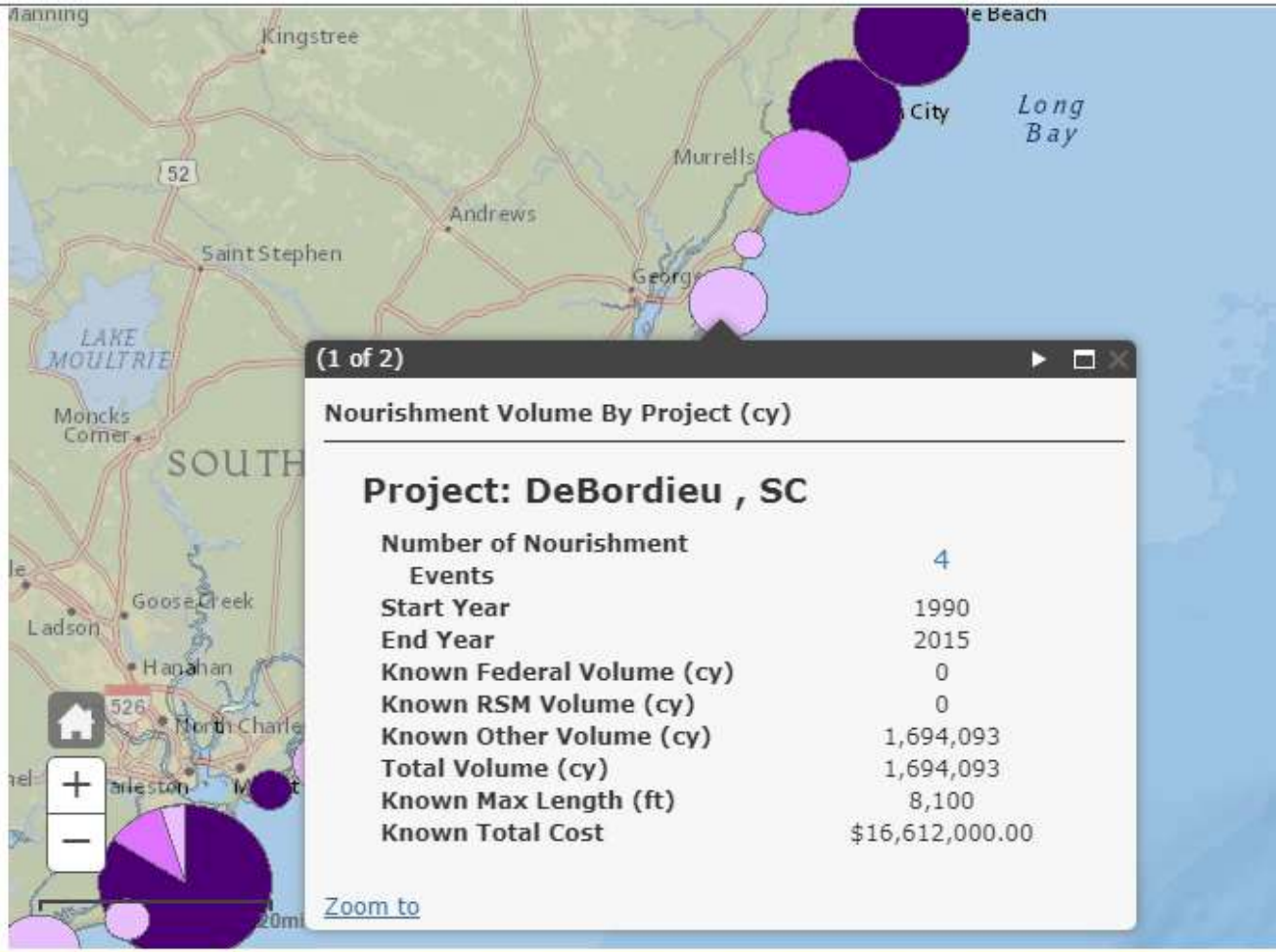
- <1,500,000
- 1,500,000 to <15,000,000
- 15,000,000 -to <50,000,000
- 50,000,000 to <100,000,000
- 100,000,000 to <700,000,000
- Nourishment Project Locations

Nourishment Volume By Project (cy)

Known Total Volume (cy)

- Known Federal Volume (cy)
- Known RSM Volume (cy)
- Known Other Volume (cy)

Turn On/Off Map Layers



(1 of 2)

Nourishment Volume By Project (cy)

Project: DeBordieu , SC

Number of Nourishment Events	4
Start Year	1990
End Year	2015
Known Federal Volume (cy)	0
Known RSM Volume (cy)	0
Known Other Volume (cy)	1,694,093
Total Volume (cy)	1,694,093
Known Max Length (ft)	8,100
Known Total Cost	$16,612,000.00

Zoom to

Nationwide | AK | AL | CA | CT | DE | FL | GA | HI | IL | IN | LA | MA | ME | MD | MI | MS | NC | NH | NJ | NY | OH

Project Name	Number of Nourishment Events	Start Year	End Year	Total Volume (cy)	Known Max

Outline: Beach Nourishment

- Planform & Profile response
- Design considerations
- Case studies: FL, Folly
- ….
- Borrow area considerations
  - Location & Sediment characteristics
  - Environmental Protections
- Dredging: Sand placement methods
- Costs
- Monitoring

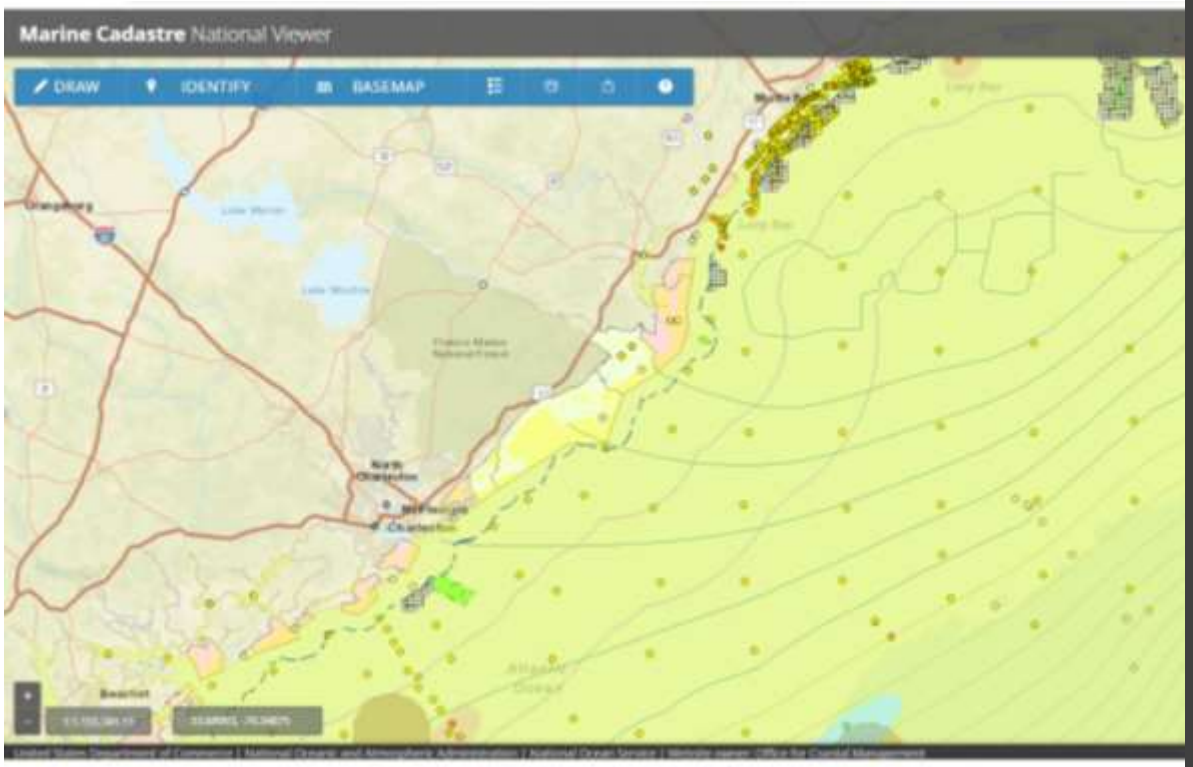
Borrow Area Considerations

SAND SOURCE

- Location: upland, inlet shoals, or offshore
- Distance from beach to borrow area
- Planform extent of borrow area
- Depth of water
- Thickness of sand deposit
- Sediment grain size, composition, color
- Undesirable: rocks, silt/mud, historic resources, hardbottom, turtles.

Borrow Area Locations

- Nearshore (inlets, channel shoals, navigation channels)
- Offshore (offshore “pits”, ebb deltas)

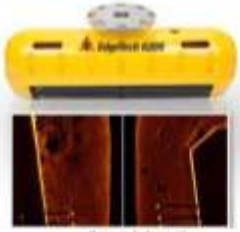
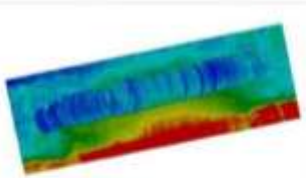
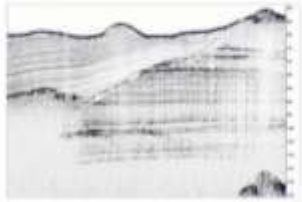
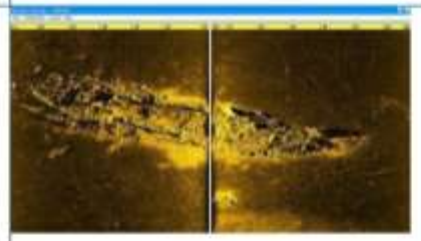
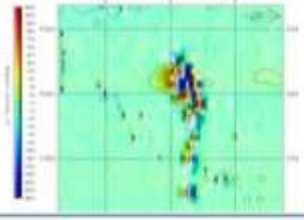


Sand Search Procedure

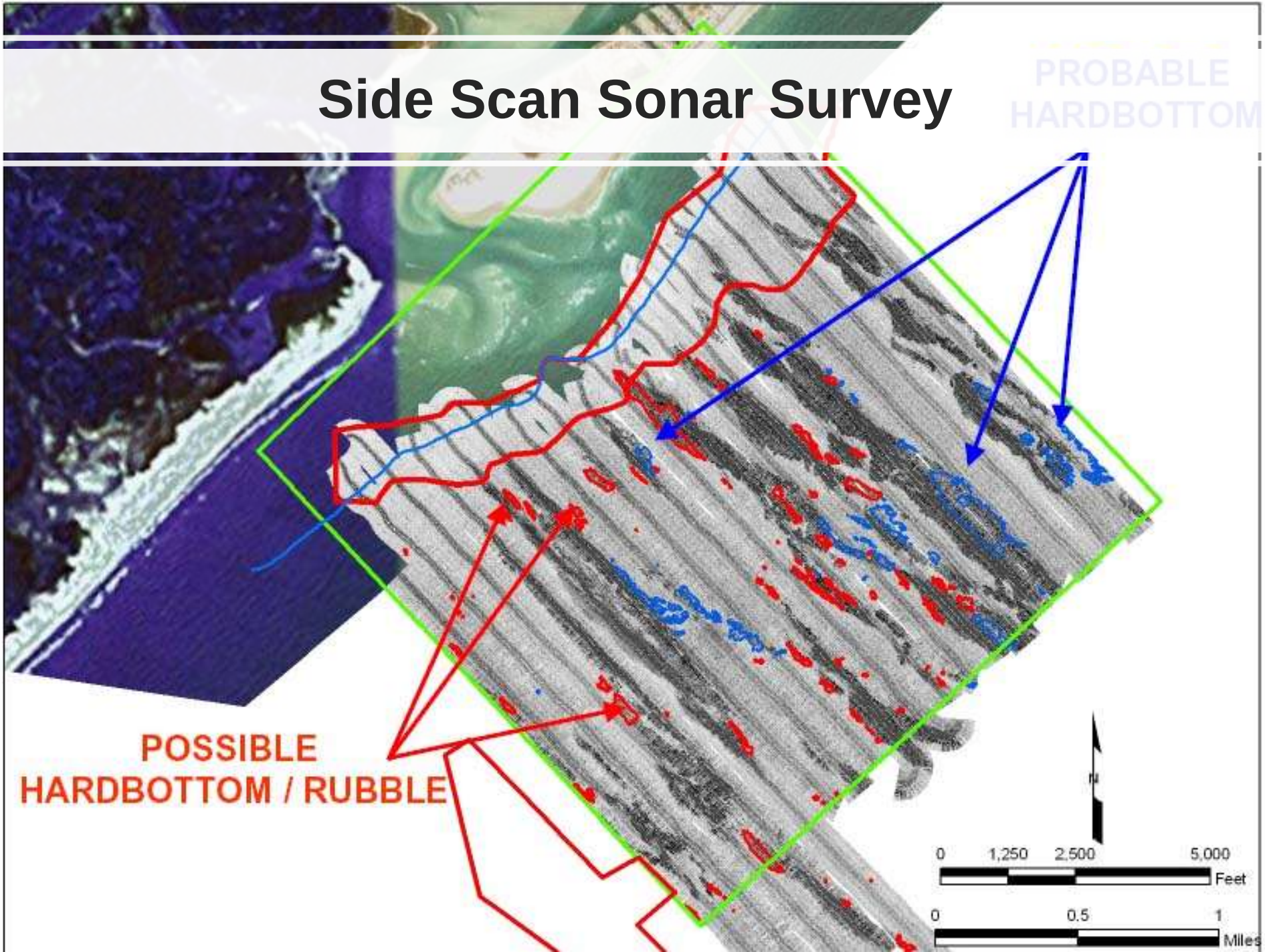
- Historical data collection
- Preliminary analysis
- Reconnaissance surveys
- Detailed field investigation & analysis
  - Bathymetric survey
  - Side scan sonar survey (reefs/hardbottom)
  - Seismic survey
  - Cultural resource survey
  - Vibracores
- Final borrow area plan

BOEM Atlantic Sand Assessment Project

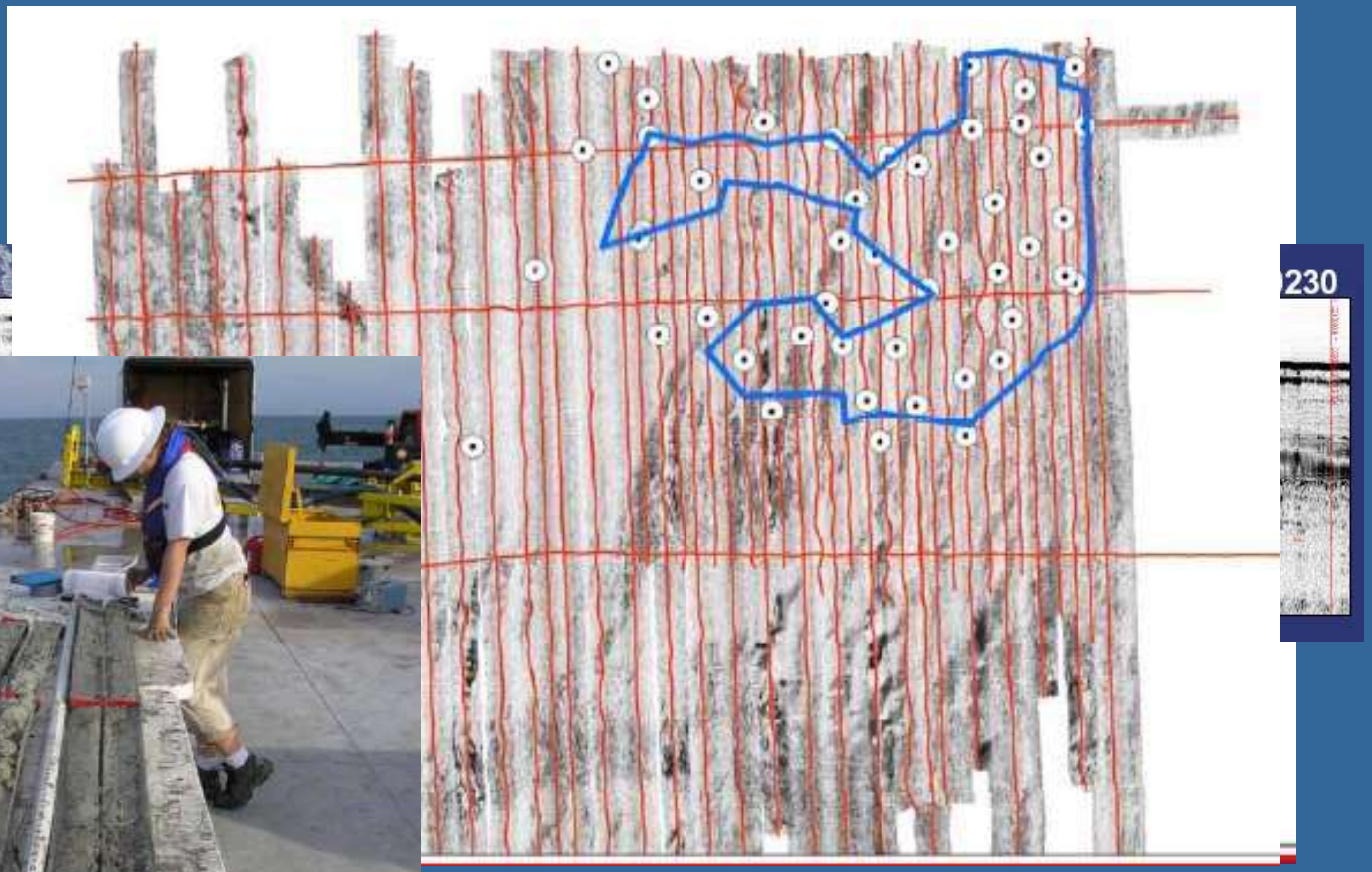
- 2015-17
- $6.2M
- Mass to FL
- 3-8 nmi

Type of Technology	Output	How it Works
 Combined Swath Bathymetry Side-Scan Sonar EdgeTech 6205		Sends out an acoustic pulse and captures a return signal to measure the depths of oceans, seas or other large bodies of water. The data is used to compile a topographic map and image of the seafloor, archaeological resources and benthic habitat potential.
 Sub-bottom Profiler EdgeTech 3200		Towed just above seafloor, emits a chirping sound, and the return signal is collected as reflected and refracted sound through different layers of sediment. Operates between 500 Hz – 24 kHz. Pulse lasts <1 ms (millisecond, or a thousandth of a second.).
 Side Scan Sonar Multi-Purpose Survey System EdgeTech 4200		Data from acoustic backscatter creates a 2-dimensional image of the seafloor, archaeological resources, benthic habitat potential, and relic landscapes. Operates on a surface tow > 180– 900 kHz. Frequency above hearing range of cetaceans, manatees, seals, sea turtles, and most fish. Pulse lasts <0.5 ms.
 Magnetometer Geometrics G-882		Measures the magnetic field to detect archaeological resources and potential hazards, including Munitions and Explosives of Concern (MEC), also known as unexploded ordnance (UXO). Map indicates UXO off Hawaii. Images courtesy of Geometrics.
 Alpine Vibracore		Penetrates a maximum of 20 feet into the sediment to verify geophysical data, determine sediment attributes and beach compatibility, and delineate sand resource areas. On right, BOEM Vibracore samples for the Lamont-Doherty Core Repository. BOEM photo.

Side Scan Sonar Survey



Seismic Survey & Vibracores



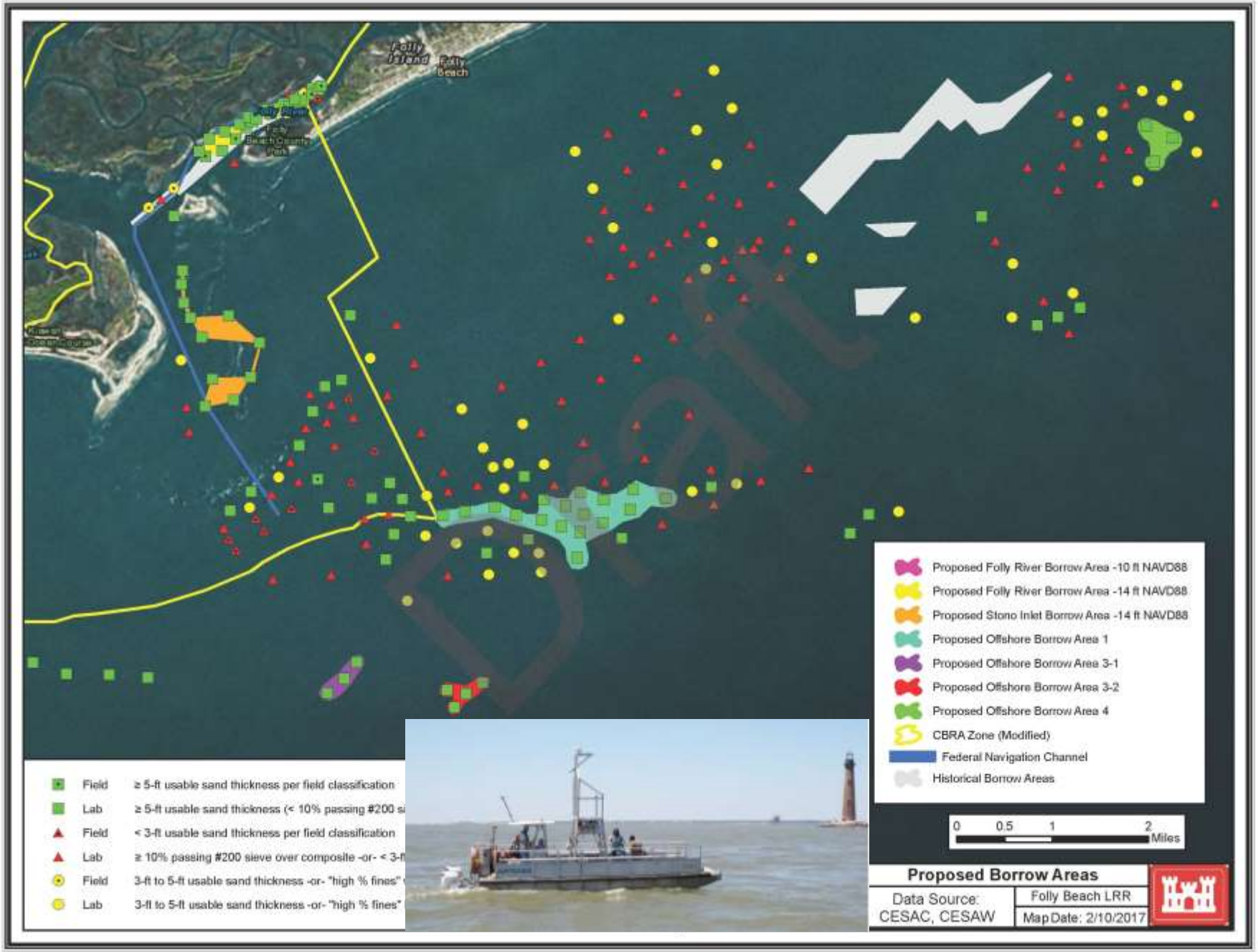
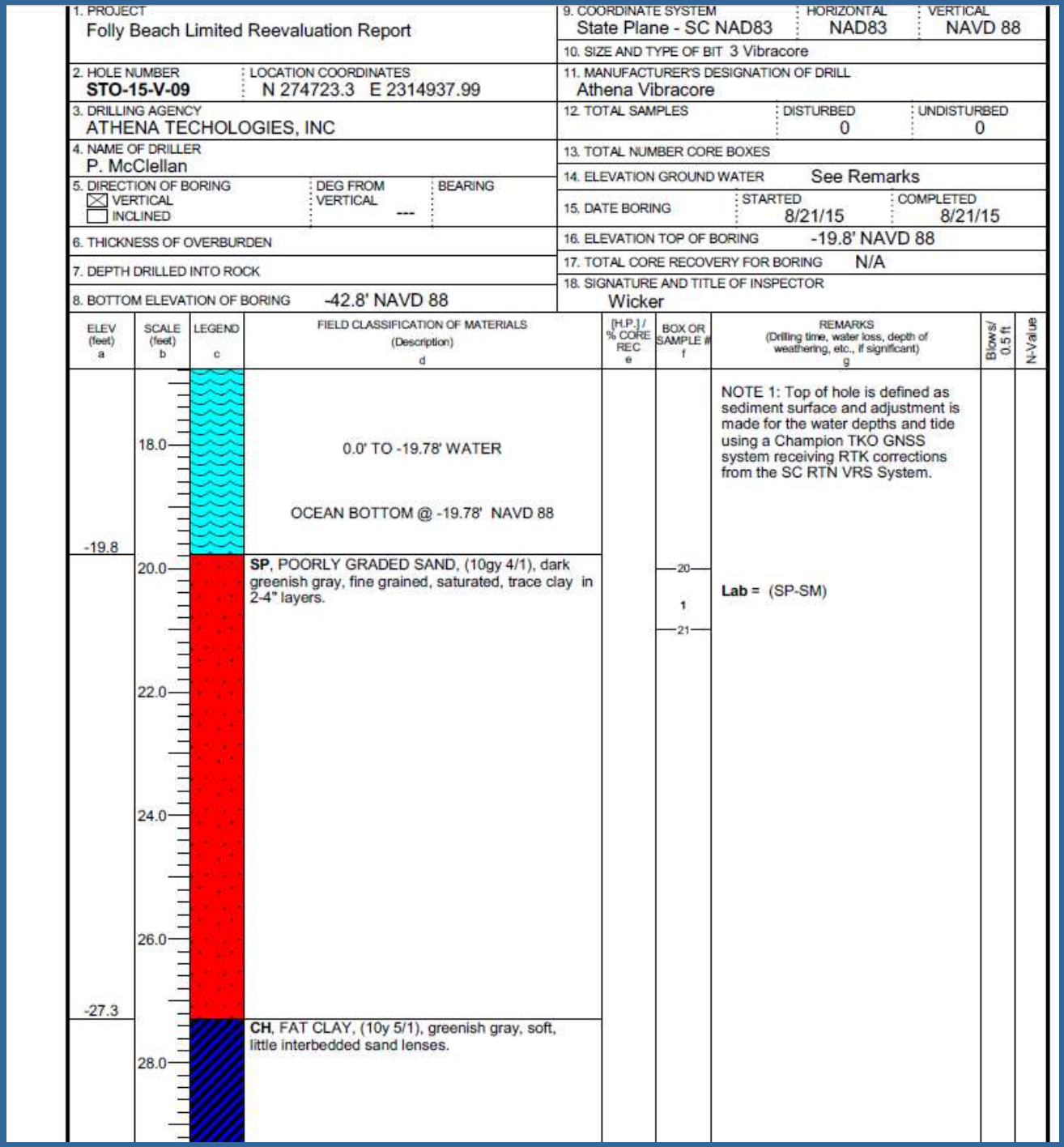

Folly Island
Folly Beach
Proposed Folly River Borrow Area -10 ft NAVD88
Proposed Folly River Borrow Area -14 ft NAVD88
Proposed Stono Inlet Borrow Area -14 ft NAVD88
Proposed Offshore Borrow Area 1
Proposed Offshore Borrow Area 3-1
Proposed Offshore Borrow Area 3-2
Proposed Offshore Borrow Area 4
CBRA Zone (Modified)
Federal Navigation Channel
Historical Borrow Areas
Field ≥ 5-ft usable sand thickness per field classification
Lab ≥ 5-ft usable sand thickness (< 10% passing #200 s
Field < 3-ft usable sand thickness per field classification
Lab ≥ 10% passing #200 sieve over composite -or- < 3-f
Field 3-ft to 5-ft usable sand thickness -or- "high % fines"
Lab 3-ft to 5-ft usable sand thickness -or- "high % fines"
0 0.5 1 2 Miles
Proposed Borrow Areas
Data Source: CESAC, CESAW
Folly Beach LRR
Map Date: 2/10/2017

Figure 6.

How deep to dig?

Dredging limit?



1. PROJECT	Folly Beach Limited Reevaluation Report
2. HOLE NUMBER	STO-15-V-09
LOCATION COORDINATES	N 274723.3 E 2314937.99
3. DRILLING AGENCY	ATHENA TECHOLOGIES, INC
4. NAME OF DRILLER	P. McClellan
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	
7. DEPTH DRILLED INTO ROCK	
8. BOTTOM ELEVATION OF BORING	-42.8' NAVD 88
9. COORDINATE SYSTEM	State Plane - SC NAD83
HORIZONTAL	NAD83
VERTICAL	NAVD 88
10. SIZE AND TYPE OF BIT	3 Vibracore
11. MANUFACTURER'S DESIGNATION OF DRILL	Athena Vibracore
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING	
STARTED	8/21/15
COMPLETED	8/21/15
16. ELEVATION TOP OF BORING	-19.8' NAVD 88
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Wicker

ELEV (feet) a	SCALE (feet) b	LEGEND c	FIELD CLASSIFICATION OF MATERIALS (Description) d	[H.P.] / % CORE REC e	BOX OR SAMPLE # f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows/ 0.5 ft	N-Value
	18.0		0.0' TO -19.78' WATER OCEAN BOTTOM @ -19.78' NAVD 88			NOTE 1: Top of hole is defined as sediment surface and adjustment is made for the water depths and tide using a Champion TKO GNSS system receiving RTK corrections from the SC RTN VRS System.		
-19.8	20.0		**SP**, POORLY GRADED SAND, (10gy 4/1), dark greenish gray, fine grained, saturated, trace clay in 2-4" layers.		20 1 21	**Lab** = (SP-SM)		
	22.0							
	24.0							
	26.0							
-27.3			**CH**, FAT CLAY, (10y 5/1), greenish gray, soft, little interbedded sand lenses.					
	28.0							

Relocation of Capt Sams Inlet (SC)

- Moved inlet ~1 mile updrift ('83 & '96)
- Added ~2 million CY
- <$500,000 each event

Sep 1983

May 1984

Feb 1986

Mar 1996

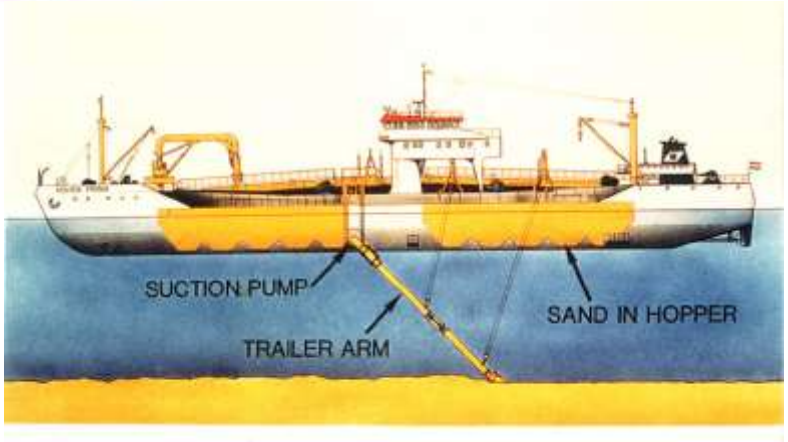
Jan 1987

https://vimeo.com/129696325

NEPA Process

- Environmental Assessment (EA)
- Consultations
  - USFWS
  - NOAA NMFS

NOAA FISHERIES SERVICE



Dredging at the Borrow Site

- **Entrainment** of larval, juvenile, and adult organisms into the dredge (especially hopper dredges);
- Physical damage to **habitat** within dredge cut footprint, from anchors and cables as dredge and work boats move about, immediate slumping or slumping that soon occurs;
- **Burial** of habitat (includes smothering) by sediments away from slumping areas; and
- Abrasion to organisms and clogging of gills from elevated levels of total suspended solids (TSS) (including turbidity)

NOAA FISHERIES SERVICE

Filling at the Nourishment Site

- Desiccation of organisms left on beach at discharge point (especially hydraulic dredges)
- Machinery crushing organisms discharged onto beach (especially hydraulic dredges and bulldozers)
- Physical damage to **habitat** from fill
- Physical damage to habitat from fill equilibrating over short-term
- Burial of habitat (including smothering) by sediments away from equilibration area
- Abrasion to organisms and clogging of gills from elevated levels of TSS (including turbidity)

NOAA FISHERIES SERVICE

Folly Beach Re-Nourishment
April- October 2005
2,000,000 cy^3 over 8 kms beach

- Sediment from a nearshore (5.3 km offshore) subtidal borrow area;
- SCDNR conducted monitoring for one year: sediment characteristics and densities of burrowing macro-invertebrates, ghost crab (*Ocypode quadrata) &* ghost shrimp (*Callichirus major)* (Berquist et al., 2008)

<u>Findings</u>

- Sediments within the borrow area became increasingly fine (more silt/clay, larger sand phi size, less calcium carbonate) following dredging and showed little evidence of recovery one year after completion of dredging.

NOAA FISHERIES SERVICE

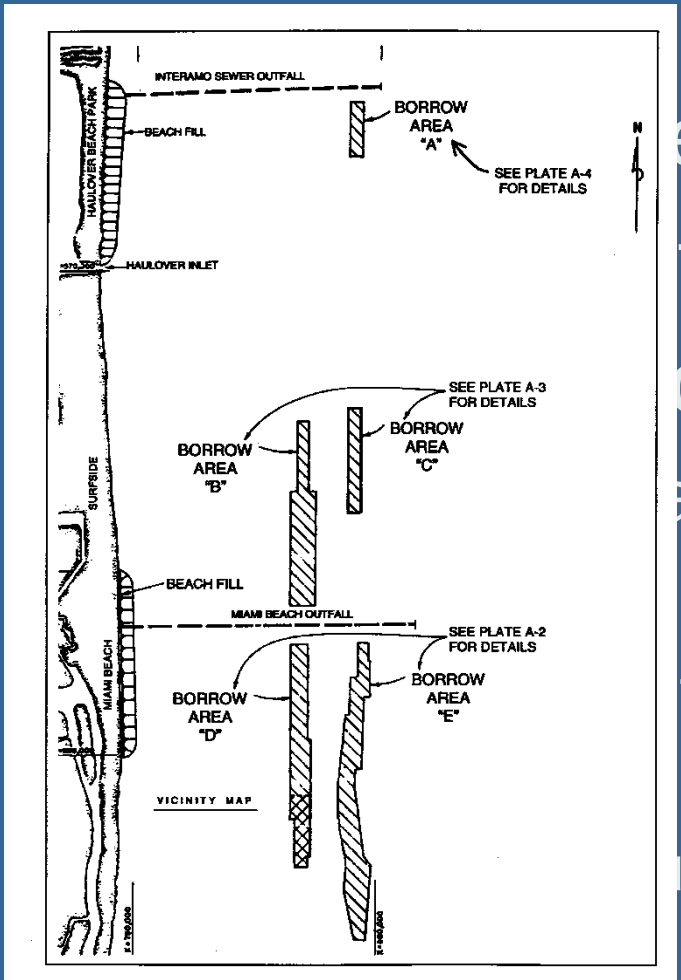
Folly Beach Re-Nourishment April and October 2005

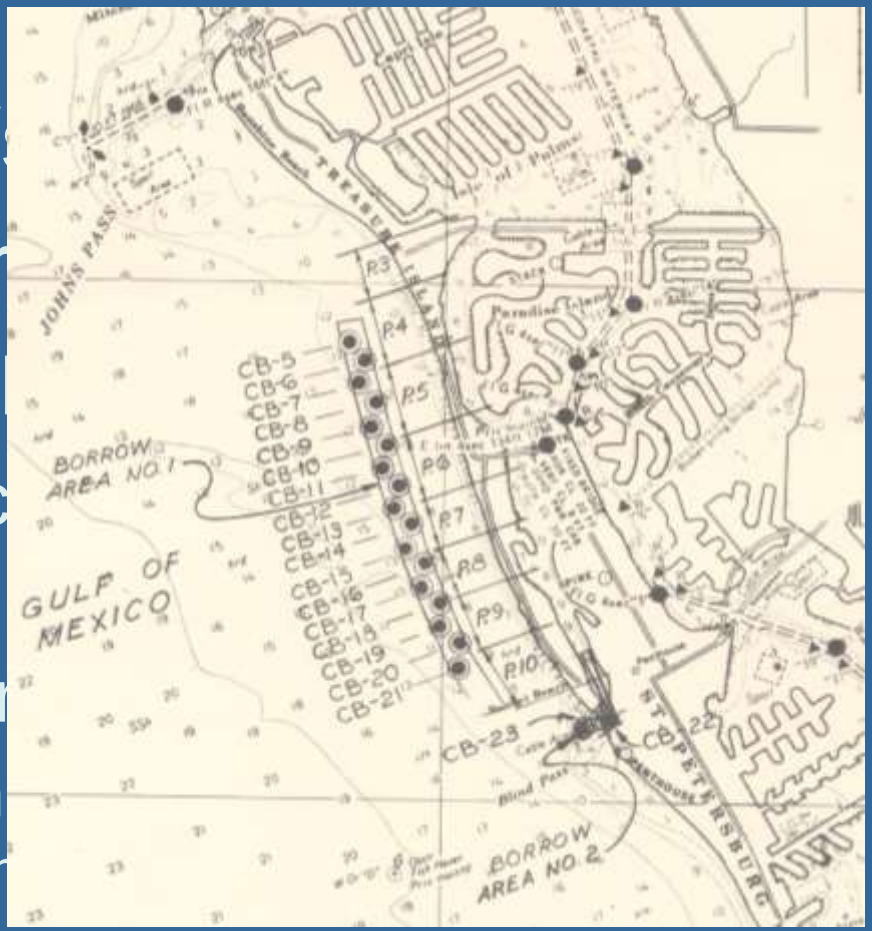
- The biological community at borrow site significantly changed following dredging and continued to diverge from the reference area over the next year, likely in response to changing sediment characteristics.

Issues: The refilling of the borrow area with fine (muddy) material is probably due to dredging to 3 meters below grade and the proximity of the borrow area to Charleston Harbor, a source of terrigenous sediments.

Recommendations: Borrow areas in South Carolina be dredged to less than 3 meters below grade and located at the southern ends of barrier islands where beach-compatible sands tend to accumulate.

Borrow Areas: Recovery



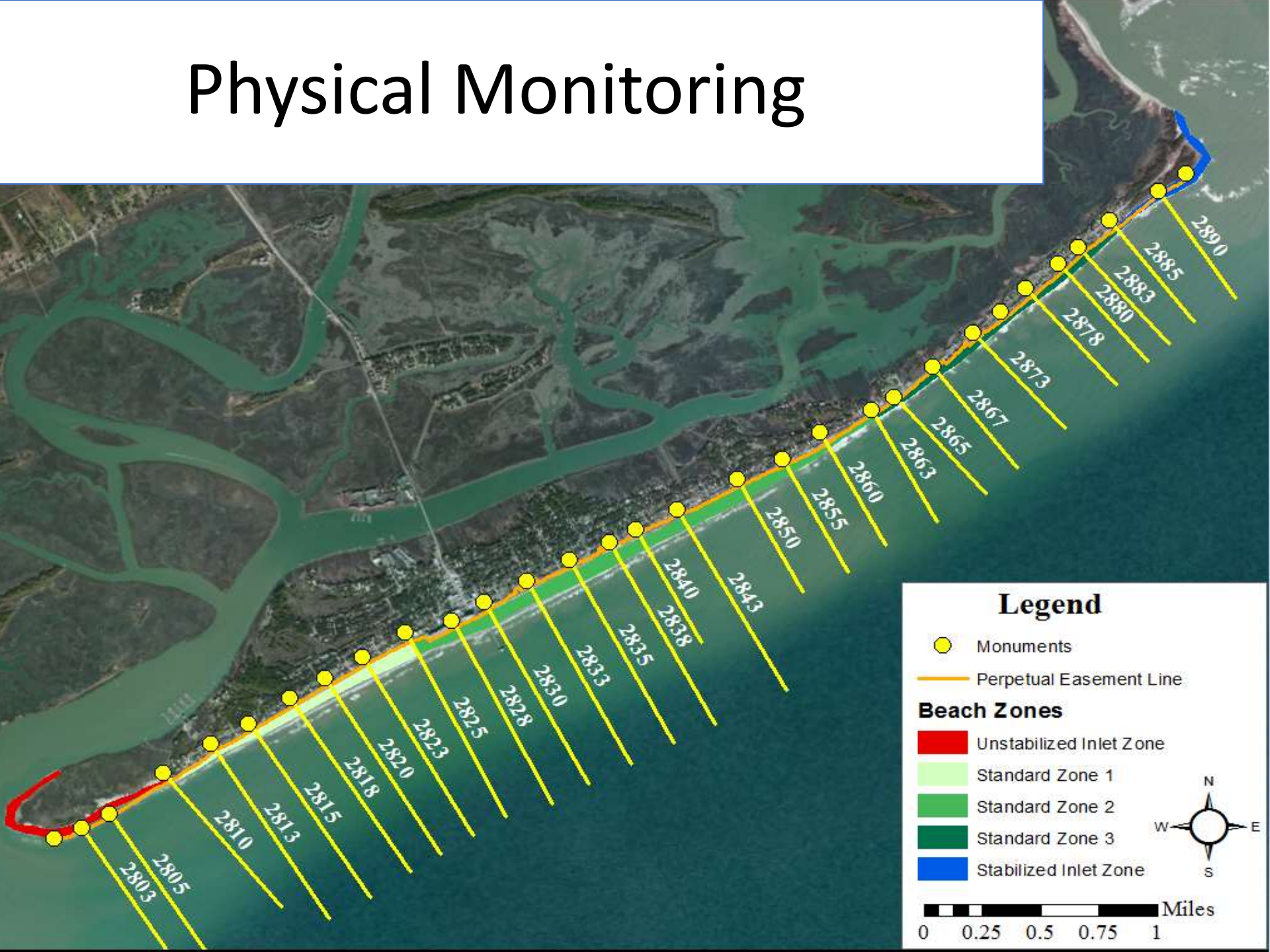


http://asbpa.org/wpv2/wp-content/uploads/2016/03/White_Paper_Infaunal_Communities_Summer2016_84_3.pdf

Commonly Required Monitoring

- Sediment sampling
- Daily sea turtle/shorebird nesting
  - Nighttime lighting requirements
- Turbidity samples
- Manatee protection at dredge
- Sea turtle trawling (hopper)
- Dredge location control
- Beach performance monitoring (physical)
- Turtles
  - Nesting success
  - Lighting surveys
- Compaction testing

Physical Monitoring



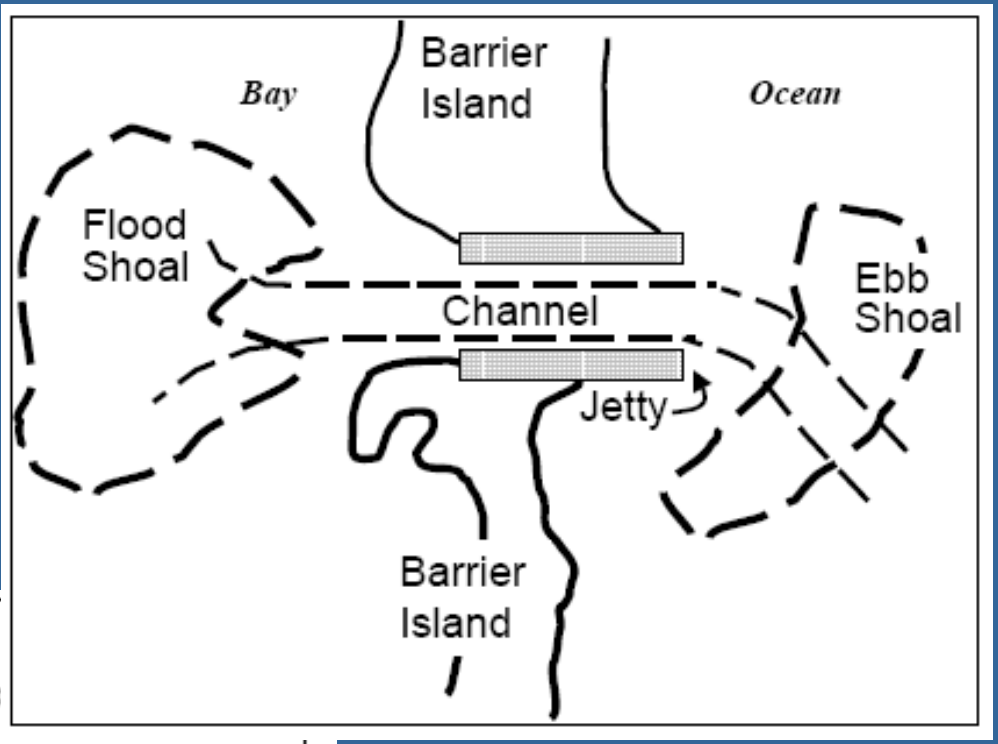
Navigation Control Structures: Jetties

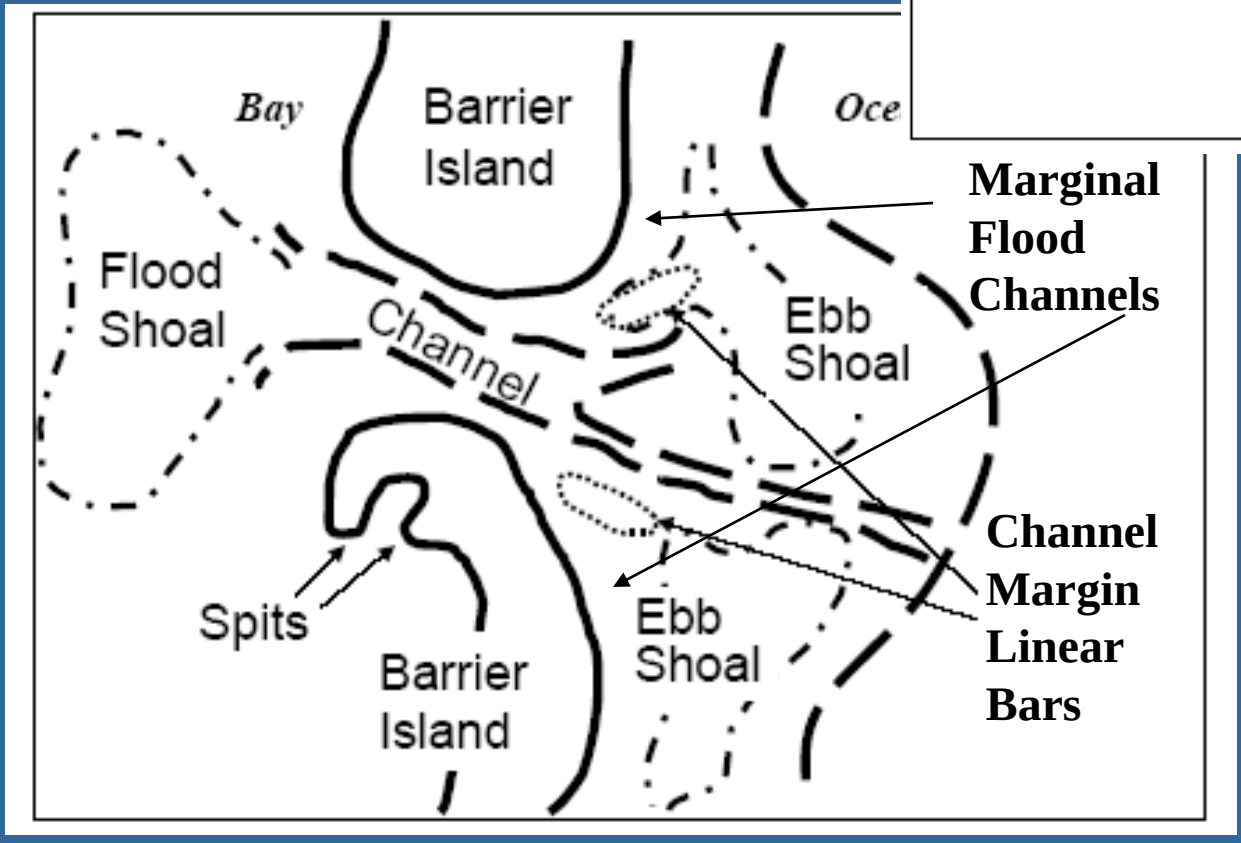
- **Jetties**
  - **Port Canaveral**
  - **Ocean City Inlet, MD**
- **Coastal Engineering Design**
- **Sand Bypassing Plants**

Jetties

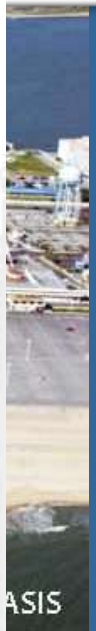
- Shore-perpendicular
- Purpose: to reduce infilling of navigational channel by LST and to provide wave sheltering for vessels.
- Result on shoreline: updrift impoundment and downdrift erosion.
- Typically two stone jetties are built on either side of navigational entrance (tidal inlet).
- Good indicator of LST direction.

Tidal Inlet Terminology

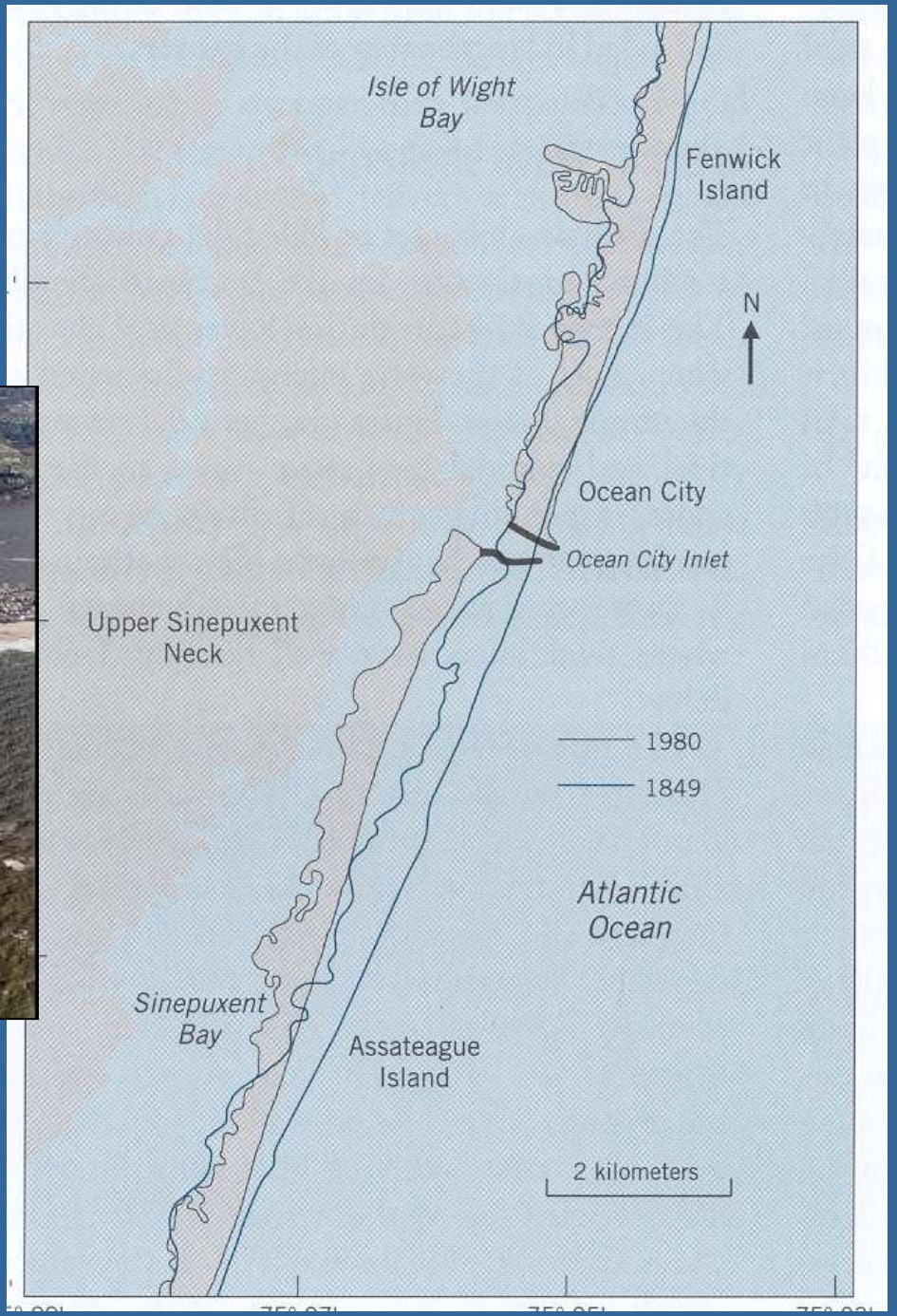




Exampl Jetties



Ocean City Inlet



Design of Barbers Point Harbor, Oahu, Hawaii

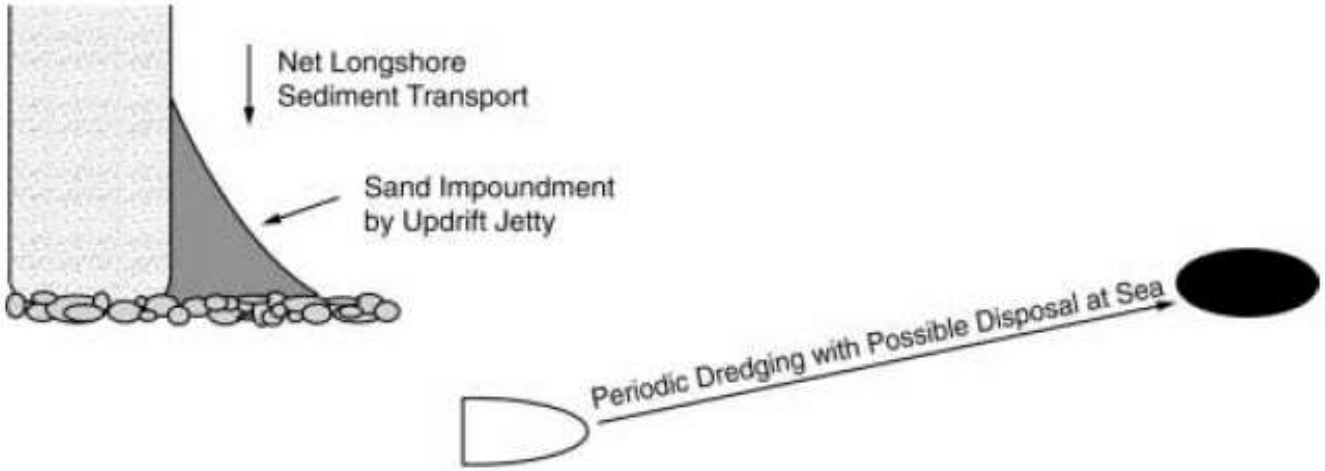
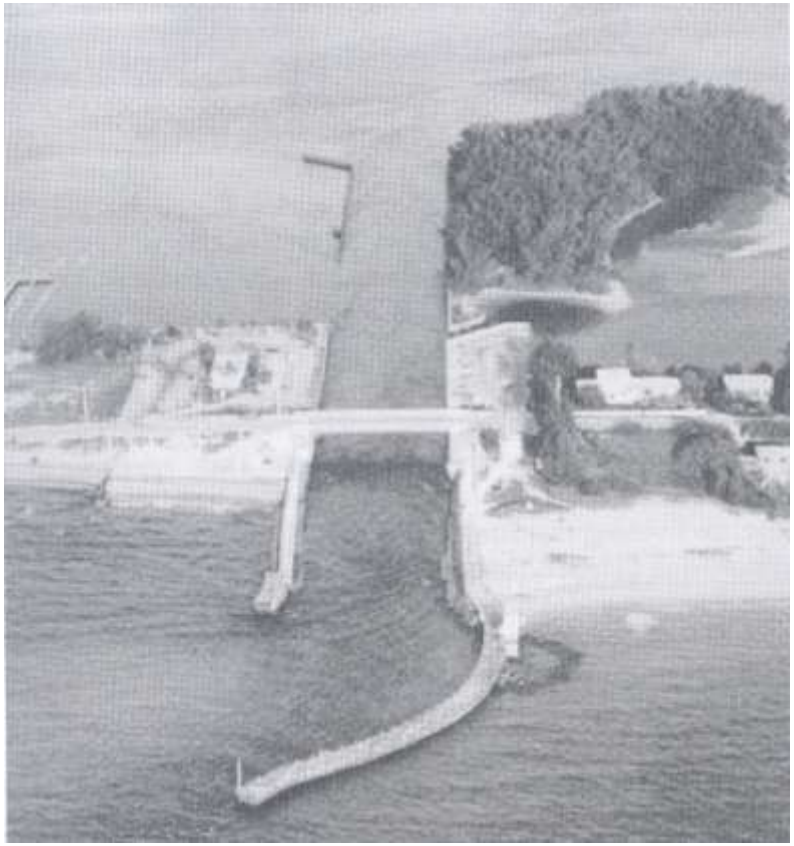
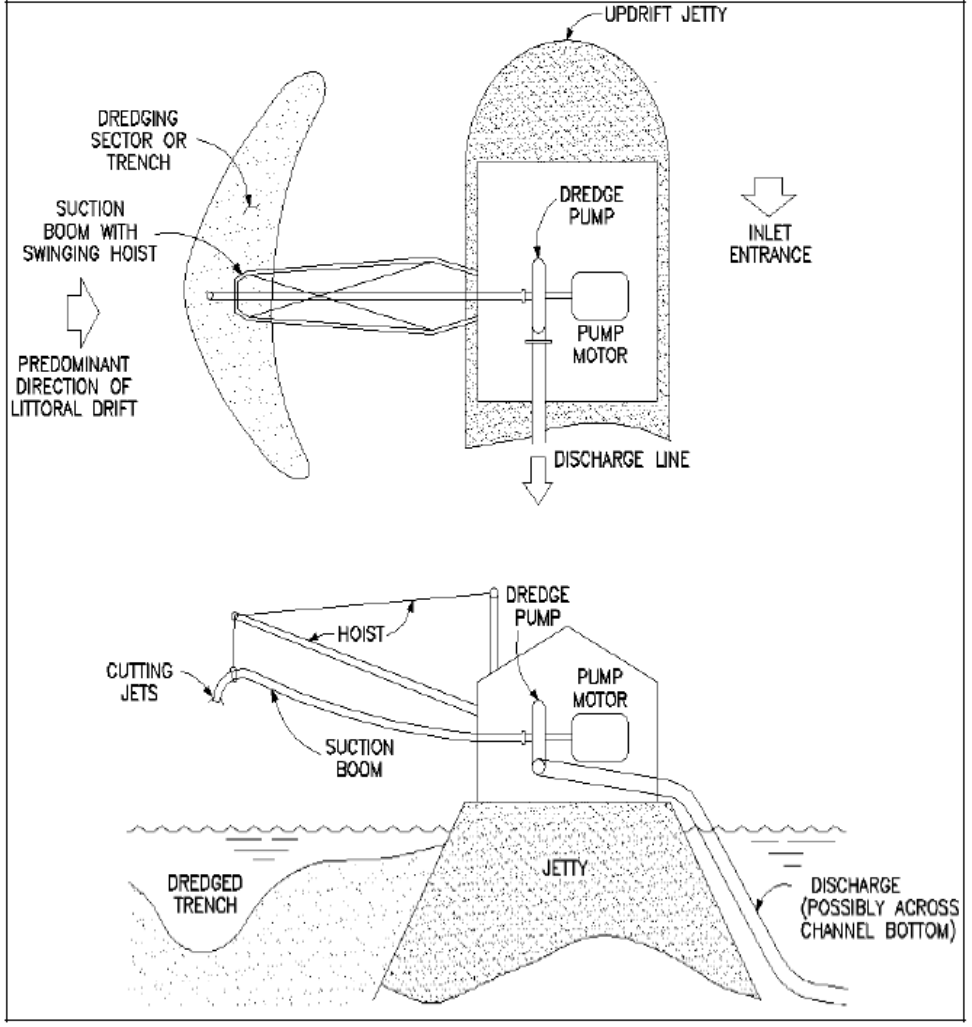


Figure 1.5 Effect of navigational entrance





South Lake Worth Inlet, FL

Indian River Inlet, DE - Sand Bypassing Components

Discharge Pipeline Crosses Bridge

Pump House

North Beach Discharge

Mobile Crane and Eductor

"Most successful sand bypass system"

Sand Placement Methods

Pumping sand through pipeline	**Hydraulic: Cutterhead dredge**
	Hopper dredge
	Mechanical: Bucket dredge with scows (and hydraulic unloader)
Dry placement of sand	**Dump trucks**
Land-based equipment: Distribute	**Bulldozers**

Cutterhead Dredge (Hydraulic)

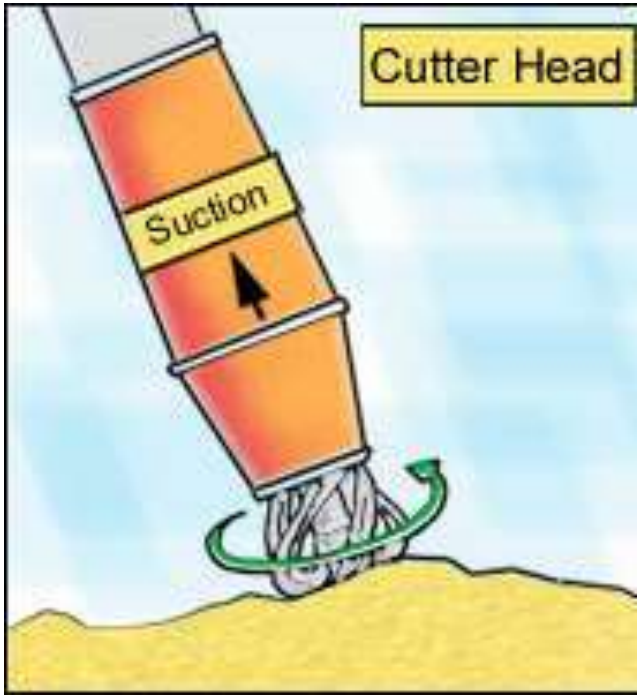
Submerged pipeline to beach

Floating pipeline

Ladder with cutterhead

spuds

24” (25,000cy/day)



Cutterhead suction arm

Cutterhead Dredge

- Practical when borrow area is close to beach.
- Can operate in shallow water (7’)
- Spudded: swings through borrow area.
- Sand is constantly in motion
- Cuts/sucks sand from bottom
- Pumps to beach through submerged pipeline.

Hopper Dredge

Hopper Dredge Suction Arms

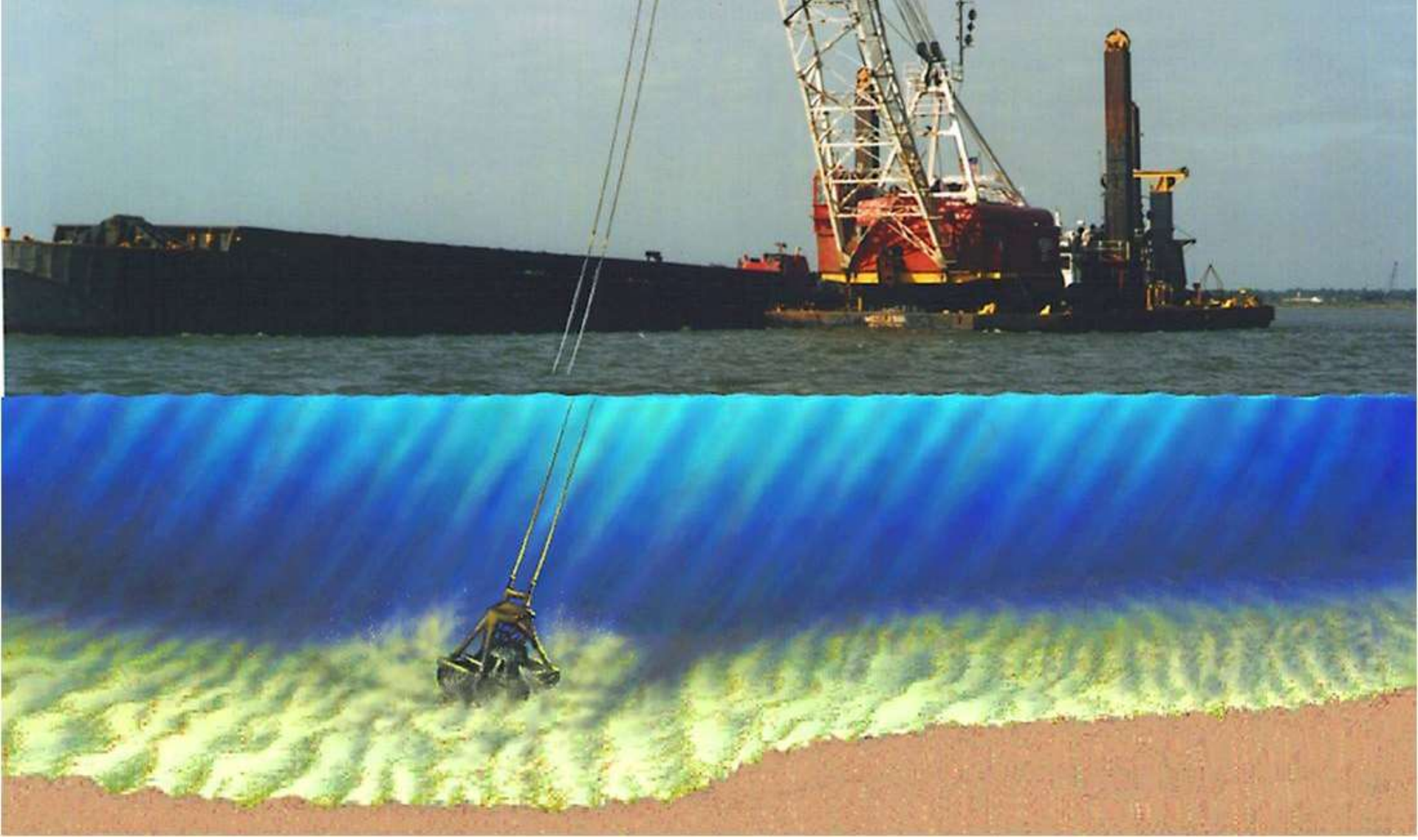
Hopper Dredge full of sand

Capacity = ~6,500 cy

Hopper Dredge “pumping out”

Hopper Dredge

- Practical when borrow area is far away from beach.
- Can only operate in deep water (25’draft).
- Makes straight cuts through borrow area.
- Sucks sand from bottom through drag arms.
- Sand is held in hopper while in transit.
- Dredge hooks up to submerged pipeline and pumps sand to beach.



Bucket (Mechanical) Dredge

Bucket dredge w/ scows (Mechanical)

Capacity = ~4,000 cy

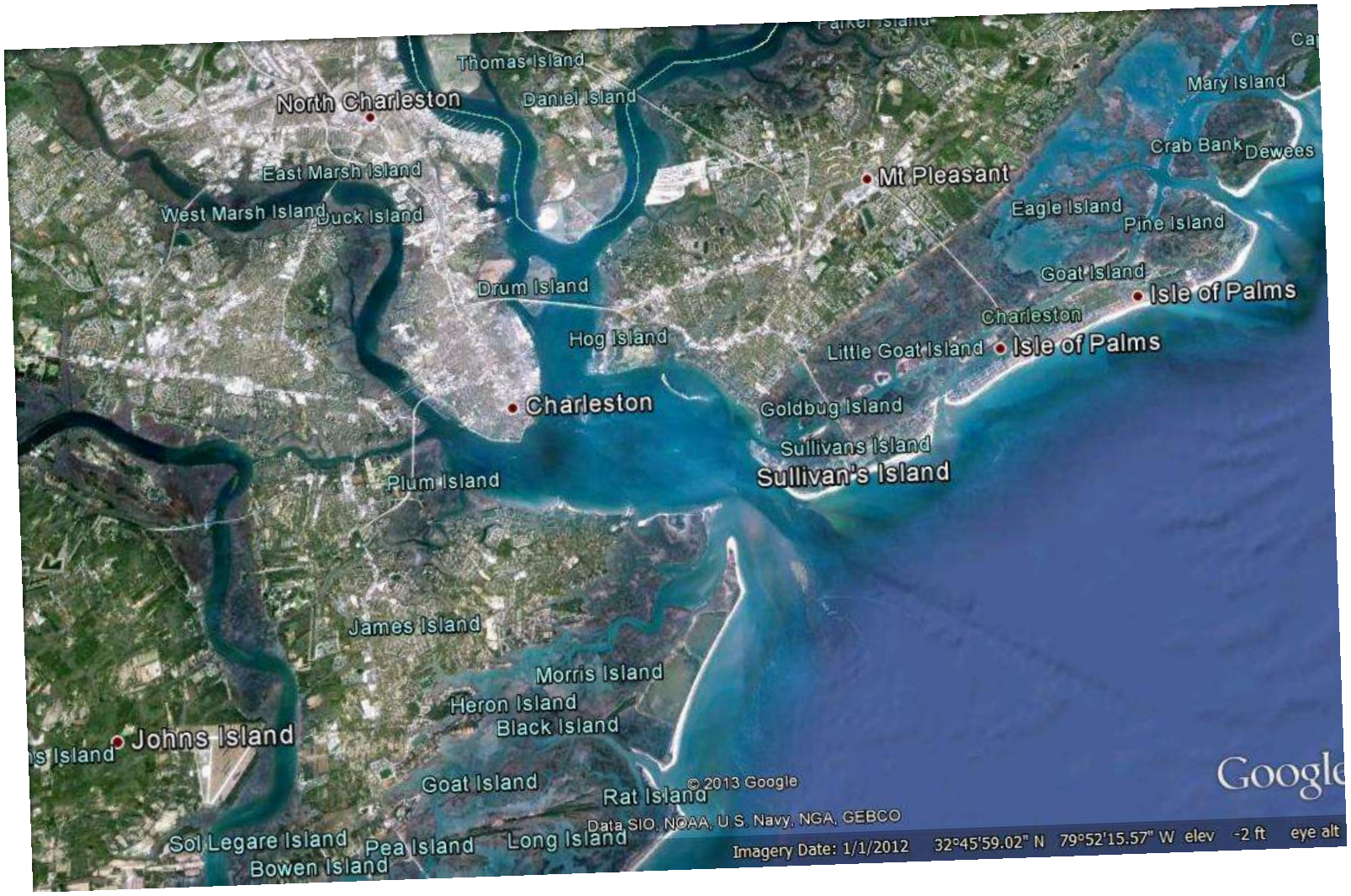
Unloader “pumping out” a scow

(Hydraulic)

Unloader “pumping out” a scow

Bucket Dredge with scows and unloader

- Practical when
  - Borrow area is far away or very deep
  - Offshore is shallow.
- Spudded: swings through borrow area.
- Scoops sand from bottom with bucket and puts sand into scows (sand barges).
- Tug boats push scows to unloader.
- Stationary unloader pumps sand out of scows and through submerged pipeline.


Thomas Island
North Charleston
Daniel Island
Mary Island
Crab Bank
Dewees
East Marsh Island
Mt Pleasant
West Marsh Island
Eagle Island
Pine Island
Goat Island
Drum Island
Isle of Palms
Charleston
Hog Island
Little Goat Island
Isle of Palms
Charleston
Goldbug Island
Sullivans Island
Sullivan's Island
Plum Island
James Island
Morris Island
Heron Island
Black Island
Johns Island
Goat Island
Rat Island
© 2013 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Sol Legare Island
Pea Island
Long Island
Bowen Island
Imagery Date: 1/1/2012
32°45'59.02" N
79°52'15.57" W
elev
-2 ft
eye alt

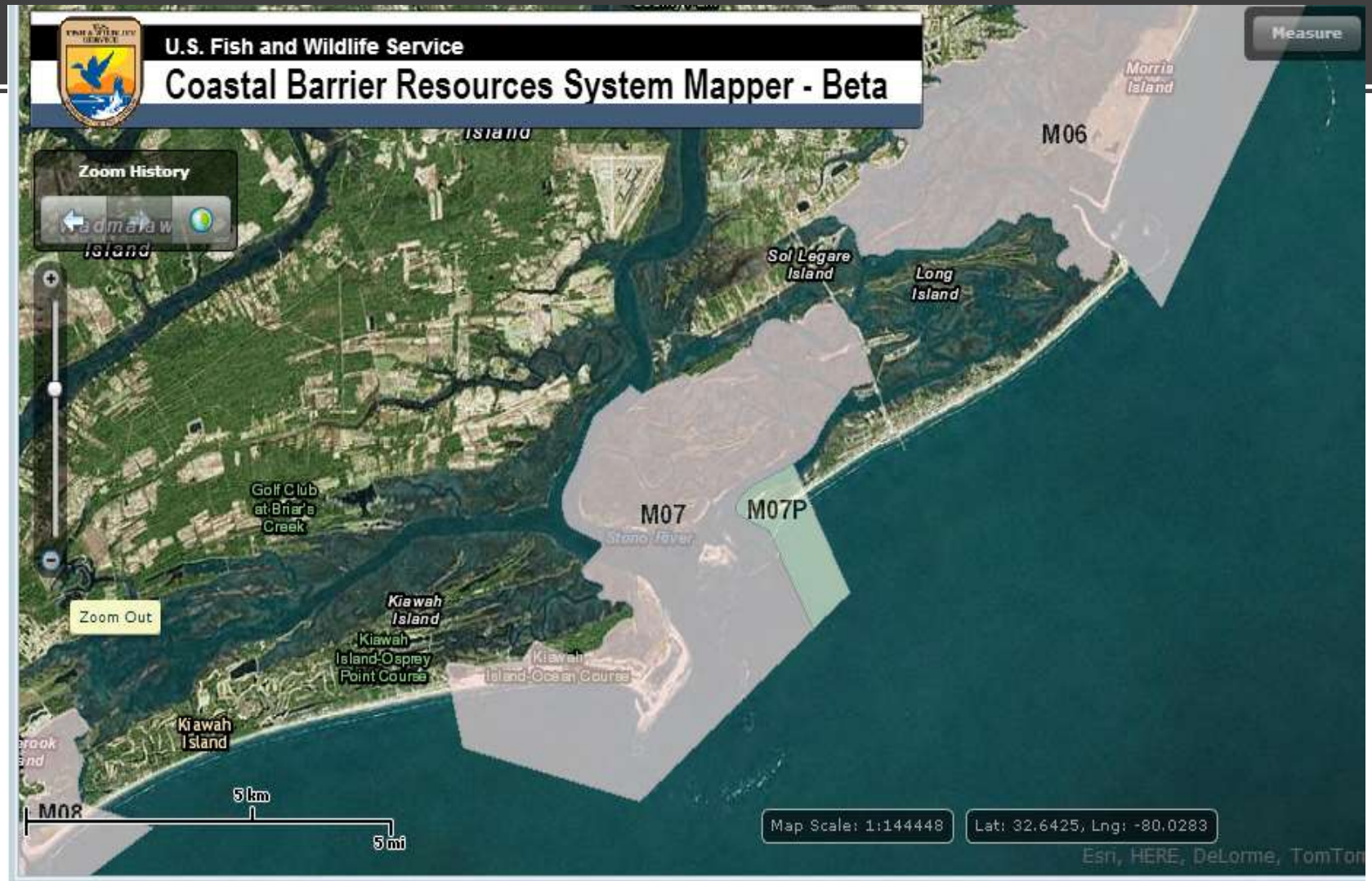
Submerged Pipeline to the Beach

Dredging Costs Factors

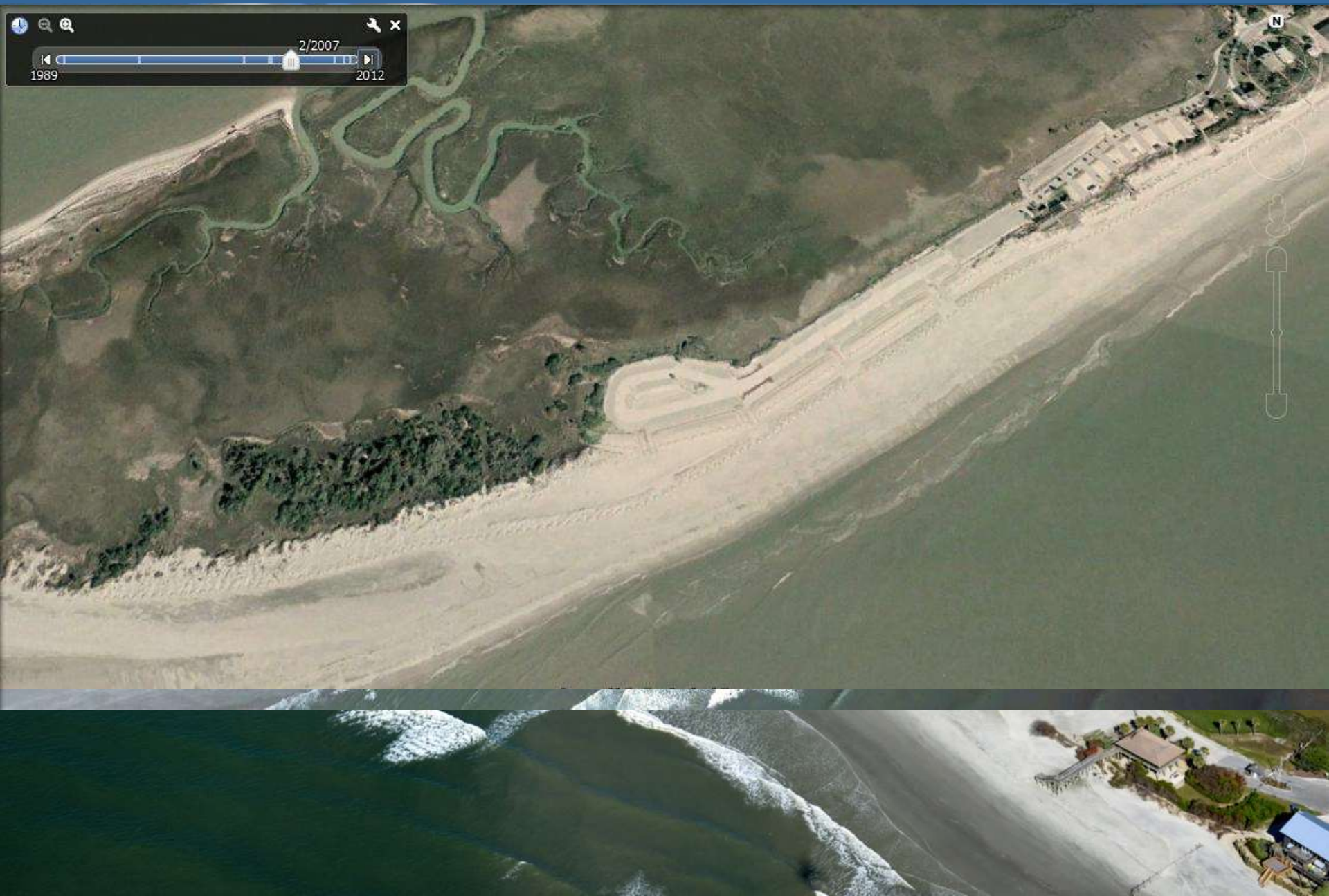
- # Plant (Fuel & Payroll)
- Borrow area proximity to beach area
- Protection from offshore waves
- Accessibility of equipment
- Sediment quality
- Multiple benefits

	2018 Federal Renourishment	2014 Federal Renourishment
Borrow area location	Folly River	Offshore
Pumping Distance	34,000 ft	37,000 ft
Volume	1.3M cy	1.4M cy
Length of project	5 mi	5.3 mi
Total Cost	$17M	$30.9M
Mobilization	$3M	$ 7.8M
Cubic yard cost	$8-9.25/cy	$14.90/cy

US Fish & Wildlife Service
Coastal Barrier Resource Act (CBRA)

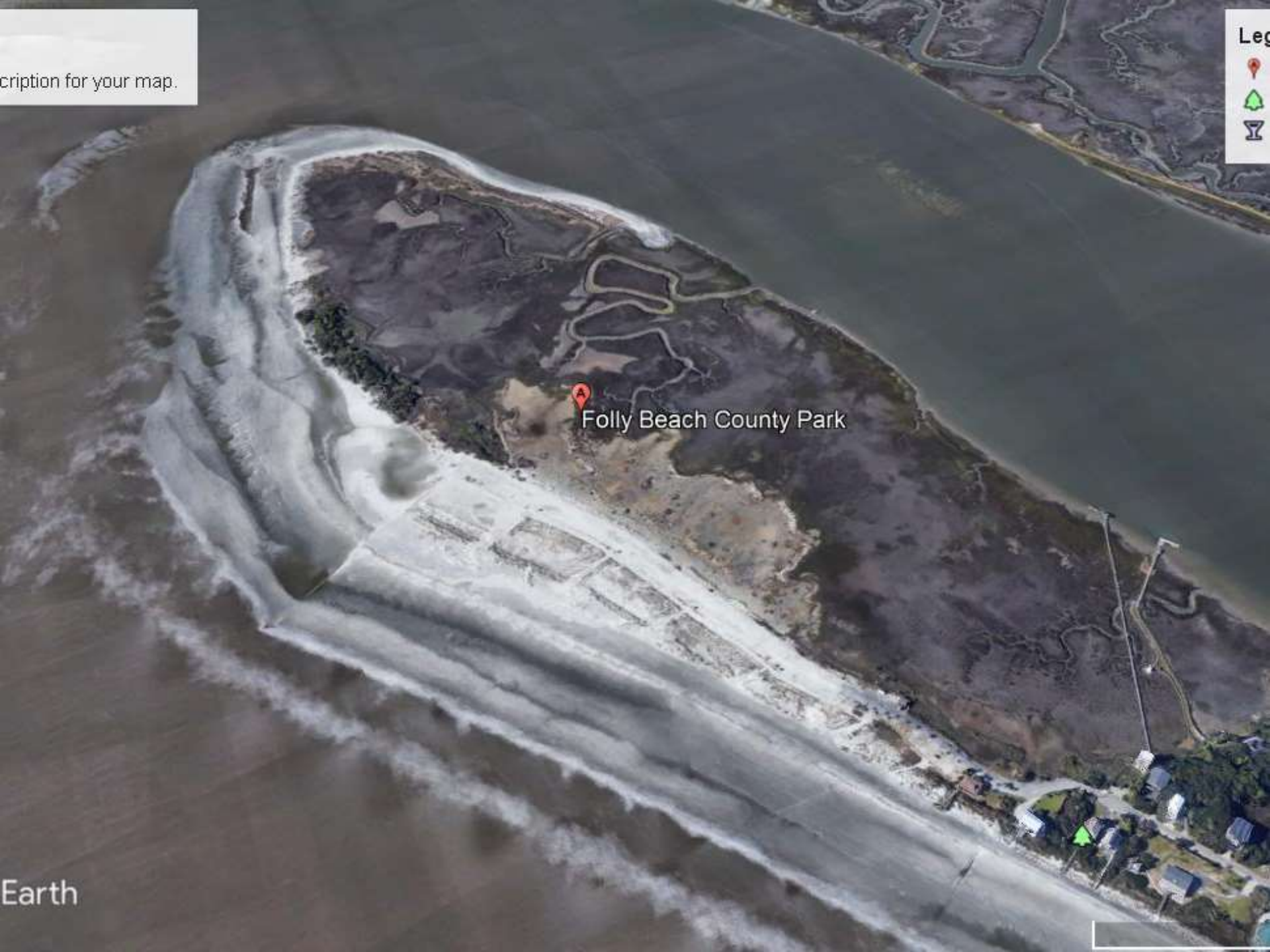


Erosion Management: Hybrid Project



Folly Beach County Park, SC

DUNE MANAGEMENT PLAN: OVERVIEW


cription for your map.
Folly Beach County Park
Earth

Field Trip

1. Folly Beach County Park
2. Sunset Cay Marina, 66 9th St W

Sediment Compaction

- Cone penetrometer
- USFWS 500 psi
- Threshold study conducted in FL
  - Quartz/Shell
- SC sediment
  - Quartz
  - Grain size, porosity

Beaches 101 Training Course Evaluation Form	
Participant Name:	_____
Date:	_____

Section	Evaluation	Comments
Course Content		
Coastal processes	☐ Excellent ☐ Good ☐ Fair ☐ Poor	
Shoreline erosion	☐ Excellent ☐ Good ☐ Fair ☐ Poor	
Restoration techniques	☐ Excellent ☐ Good ☐ Fair ☐ Poor	
Sustainable beach management practices	☐ Excellent ☐ Good ☐ Fair ☐ Poor	

| Instruction Quality | | | | Classroom instruction | ☐ Excellent ☐ Good ☐ Fair ☐ Poor | | | Hands-on fieldwork | ☐ Excellent ☐ Good ☐ Fair ☐ Poor | |

| Practical Application | | | | Practical knowledge relevant to real-world coastal challenges | ☐ Yes ☐ Somewhat ☐ No | | | Confidence in assessing, maintaining, and enhancing beach environments | ☐ Very confident ☐ Confident ☐ Somewhat confident ☐ Not confident | |

| Overall Experience | | | | Most valuable aspect of the course | | | | Suggestions for improvement | | | | Would you recommend this course to others? | ☐ Yes ☐ No | |

| Additional Feedback | | |