Primer on Coastal Erosion And Habitat Creation

Timothy Kana Ph.D

DOWN AND OUT. What was a row of homes at Point O' Woods, Fire Island, is a shambles after being battered by waves and wind yesterday for the second day in a row. Near Westhampton Beach, the surging waters created a new 300-foot-wide ocean-to-bay inlet. A dramatic sequence of photos on Back Page shows how two homes vanished at Ocean Beach.

Source: Newsday 1962

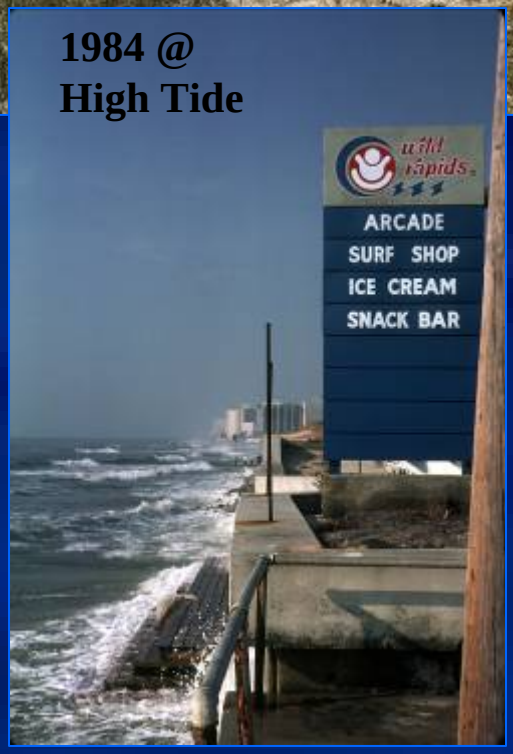
Photo by Kelsey Aerials 1978

Source: U Mass Coastal Research Group

Public Perceptions

Coastal Erosion is:

- Inevitable
- Expensive to Manage
- Only A Problem Where There is Development



20-yr Cost To Restore & Maintain:

$20/foot/year.

Outline of Presentation

- Fundamental Processes
- Scales of Change
- Barrier Island Evolution
- Erosion Signatures
- Implications For Wildlife Habitat

Storm Surge - 1978 Northeaster - Cape Cod
Photo by Kelsey Aerial Photography

Frames of Reference

The Coast Evolves as a Function of:	*Time/Space Scales:*
•Tectonic Setting	*>1 million yrs/ 100s kilometers (hor)*
•Sea Level Position – epoch scale	*~100,000 yrs / ~100 meters (vert)*
•Sea Level Fluctuation – historical	*~10,000 yrs / ~ 10 meters (vert)*
•Sediment Supply	*@ All Time Scales*
•Climate & Coastal Processes	*Millenium To Decadal*
• Waves	*Processes That Mold*
• Tides	*& Shape The Coast*
• Currents	*From Year to Year*
•Post-Storm	*Weeks to Months*
•Storm	*Hours to Days*

"Unless The Time Scale of Interest Is Specified, There Will Always Be Confusion and Disagreement Regarding Coastal Erosion!"

The Beach Cycle

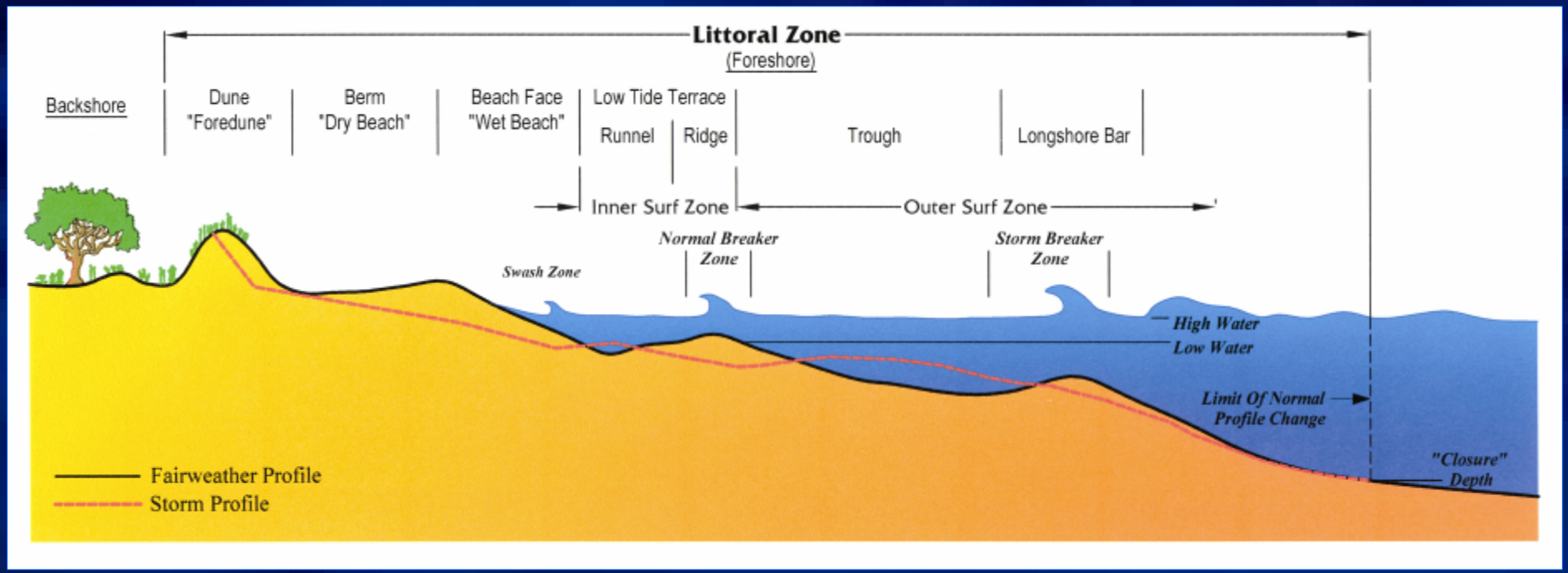
Tides & Storm Surges Control The Water Level - But <u>Waves Do The Work!</u>

Photos Courtesy: U of Mass Coastal Research Group & U of South Carolina Coastal Research Division

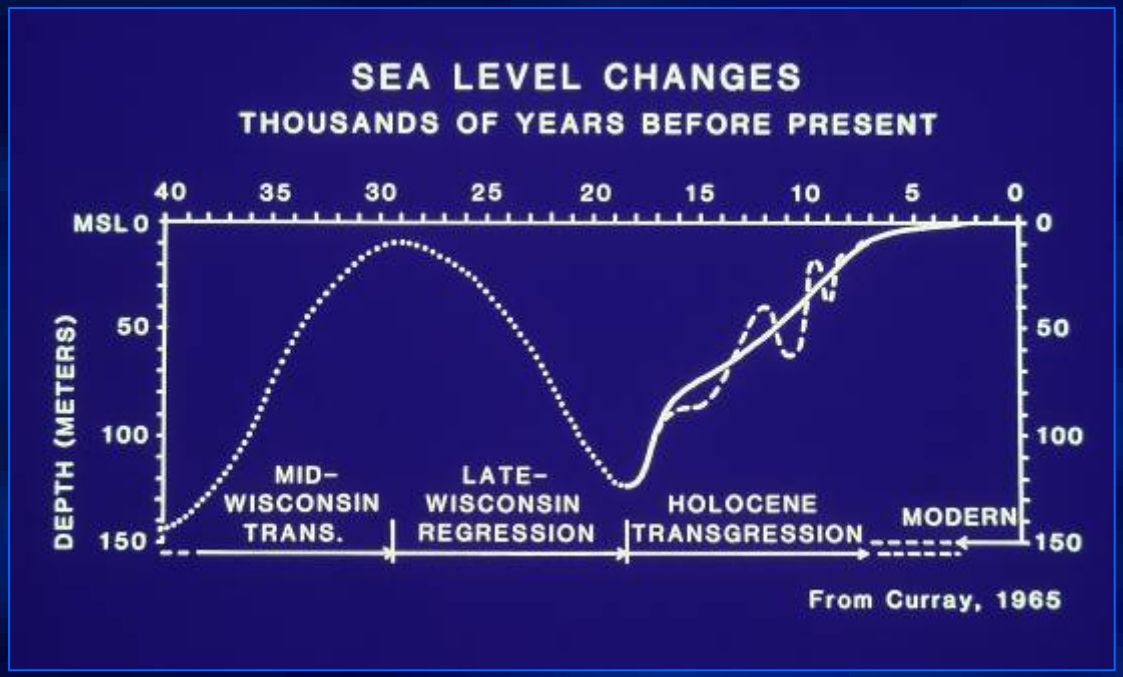
Storm Erosion vs Long-term Erosion Rates

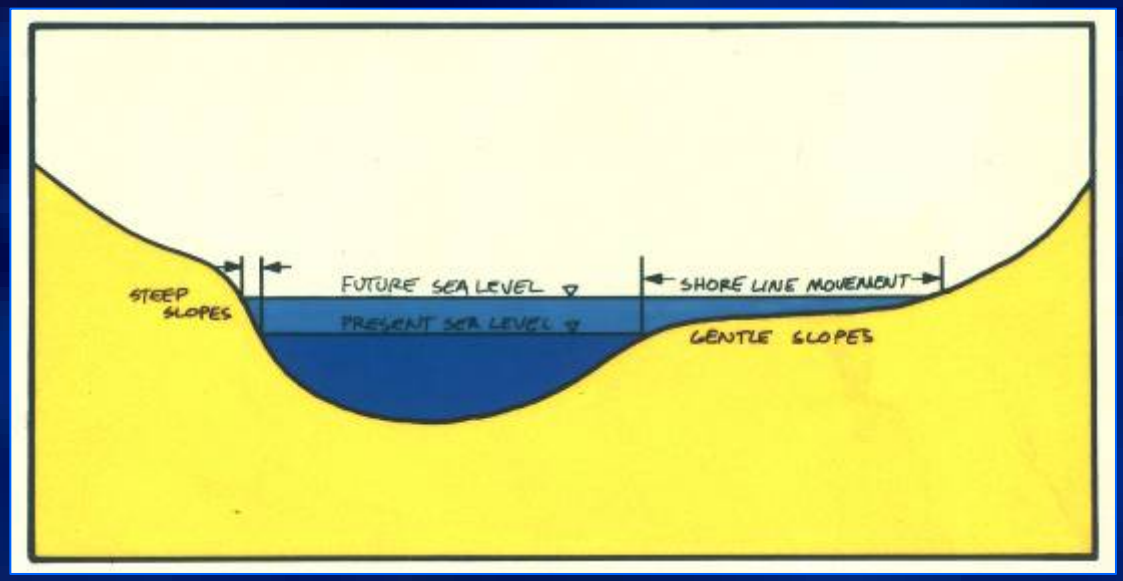
What Is The Appropriate Erosion Rate And Time Period For Planning?

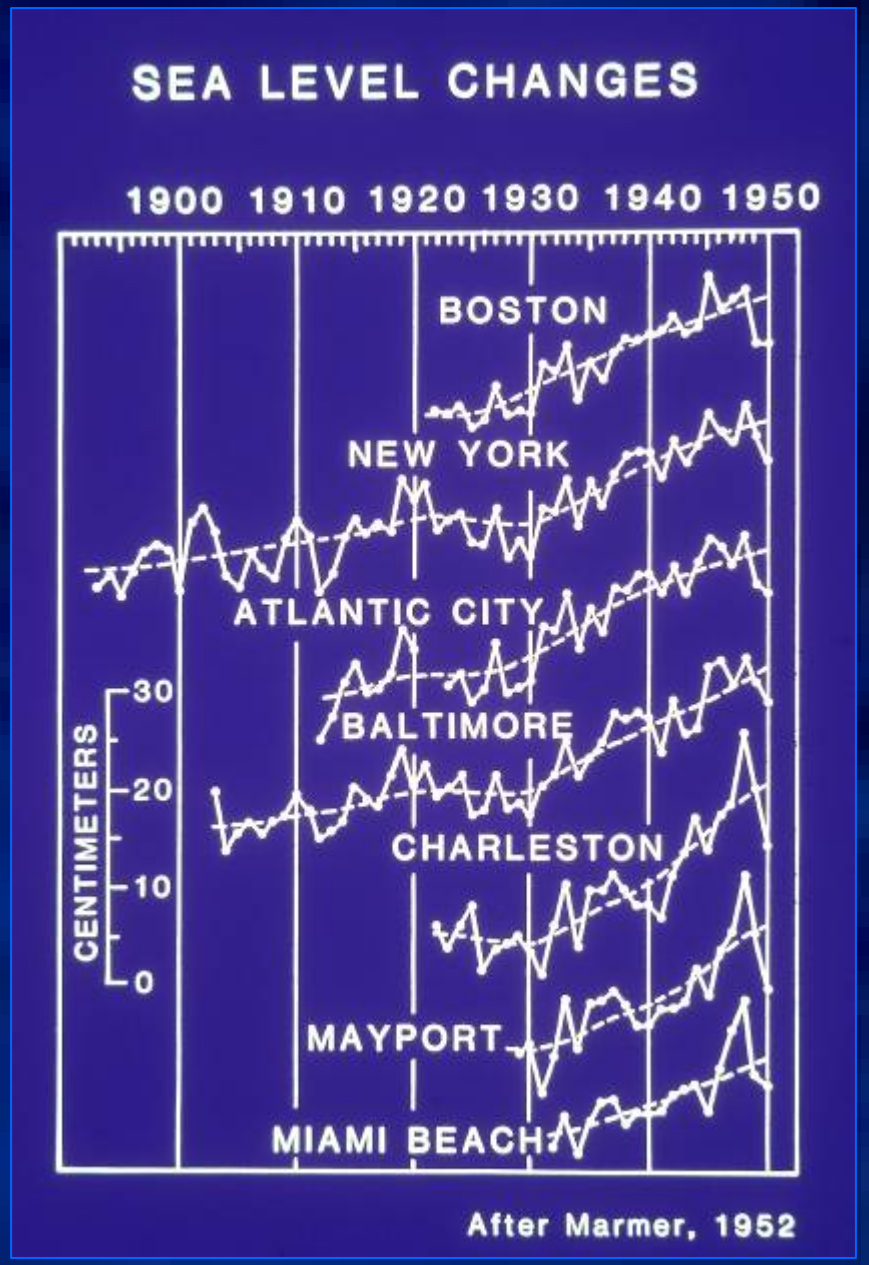
"Most developed shorelines are changing by less than 3 ft per year at decade to century time scales." *Source: Dolan et al (1990).*



Sea level Rise As A Cause Of Erosion







Sea-Level Rise

SLR @ 1 Ft Per Century (20th Century Rate)

= ~30 Feet Of Beach Recession, or

= ~ 0.3 Ft/Year Erosion Rate

Therefore, SLR @ 2 - 3 Ft Per Century

= ~ 0.6 - 1.0 Ft/Year Erosion

Barrier Island Types

Edingsville Beach SC

"Planter's" Cottages
Abandoned by 1893

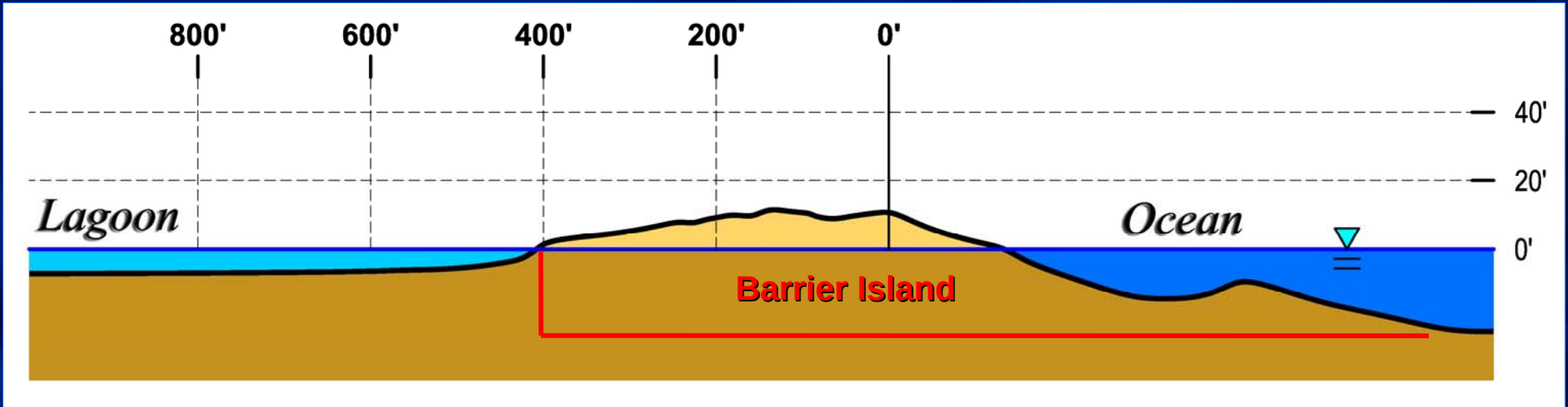
Century Erosion Rates:

10-15 ft/yr

Washover Barrier Island

"A Low Sandy Island That Is Flooded Often By Storm Tides & Waves"

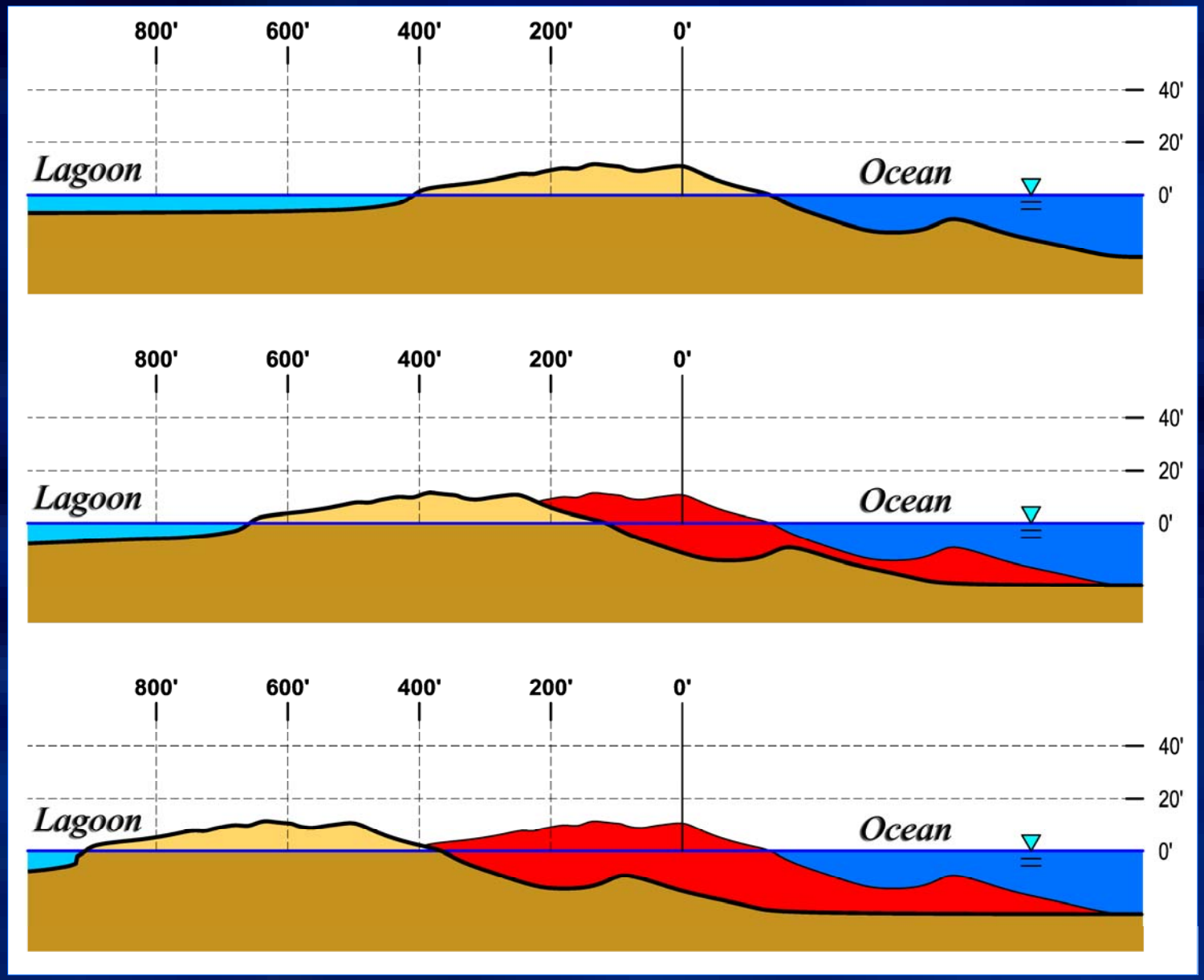
Typical Dimensions



Assume Average Erosion Rate = 5 ft/yr

Washover Barrier Island - 100 Years Erosion

"The Beaches Are Moving!" *Kaufman & Pilkey, 1979*



@ 5 ft/yr

Volume Erosion Rate: **~5 CY/ft/yr**

50-Yr Loss:

~250 CY/ft

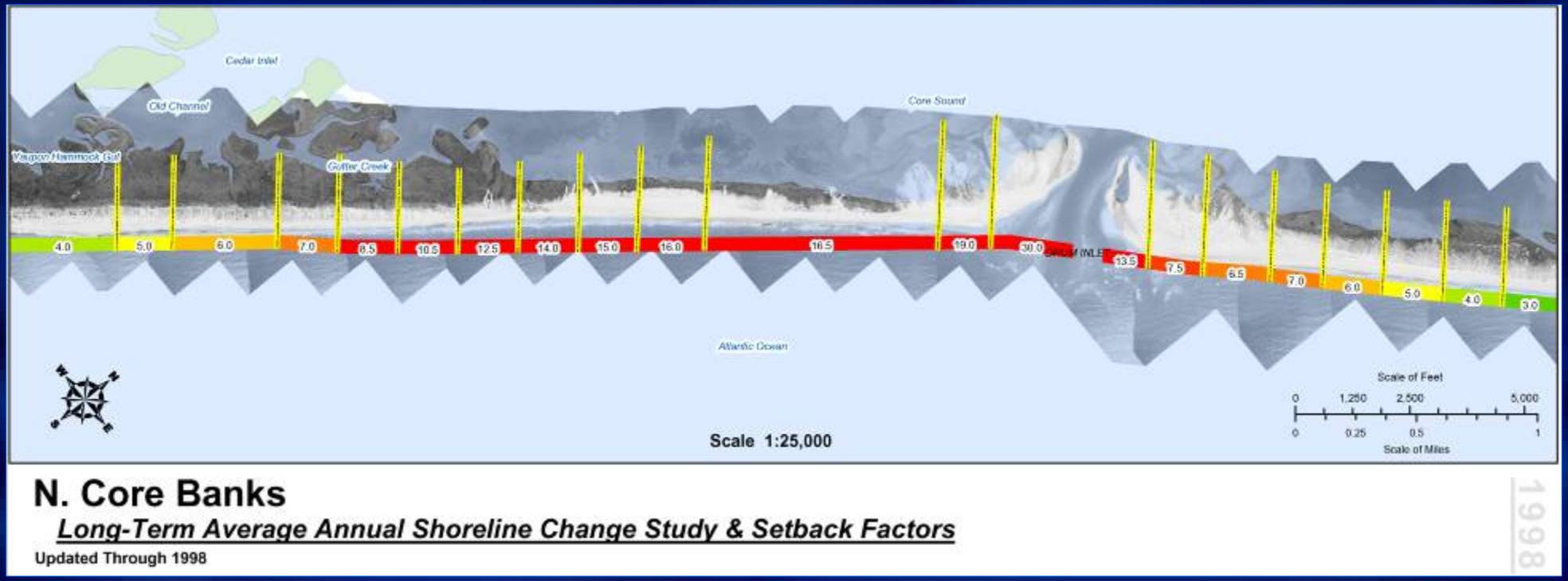
100-Yr Loss:

~500 CY/ft

Or, ~30 truckloads of sand per ft of beach

Core Banks NC

~50 Year Erosion Rate: 5 to 15 Ft/yr

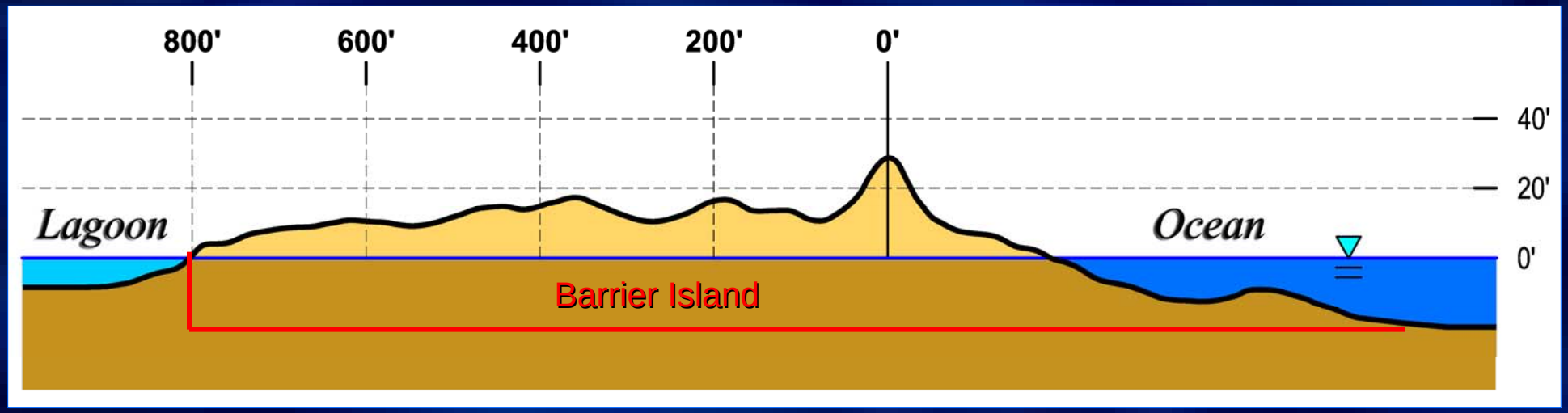


Source: NC Div of Coastal Management (May 2003)

Are Washover Beaches Typical?

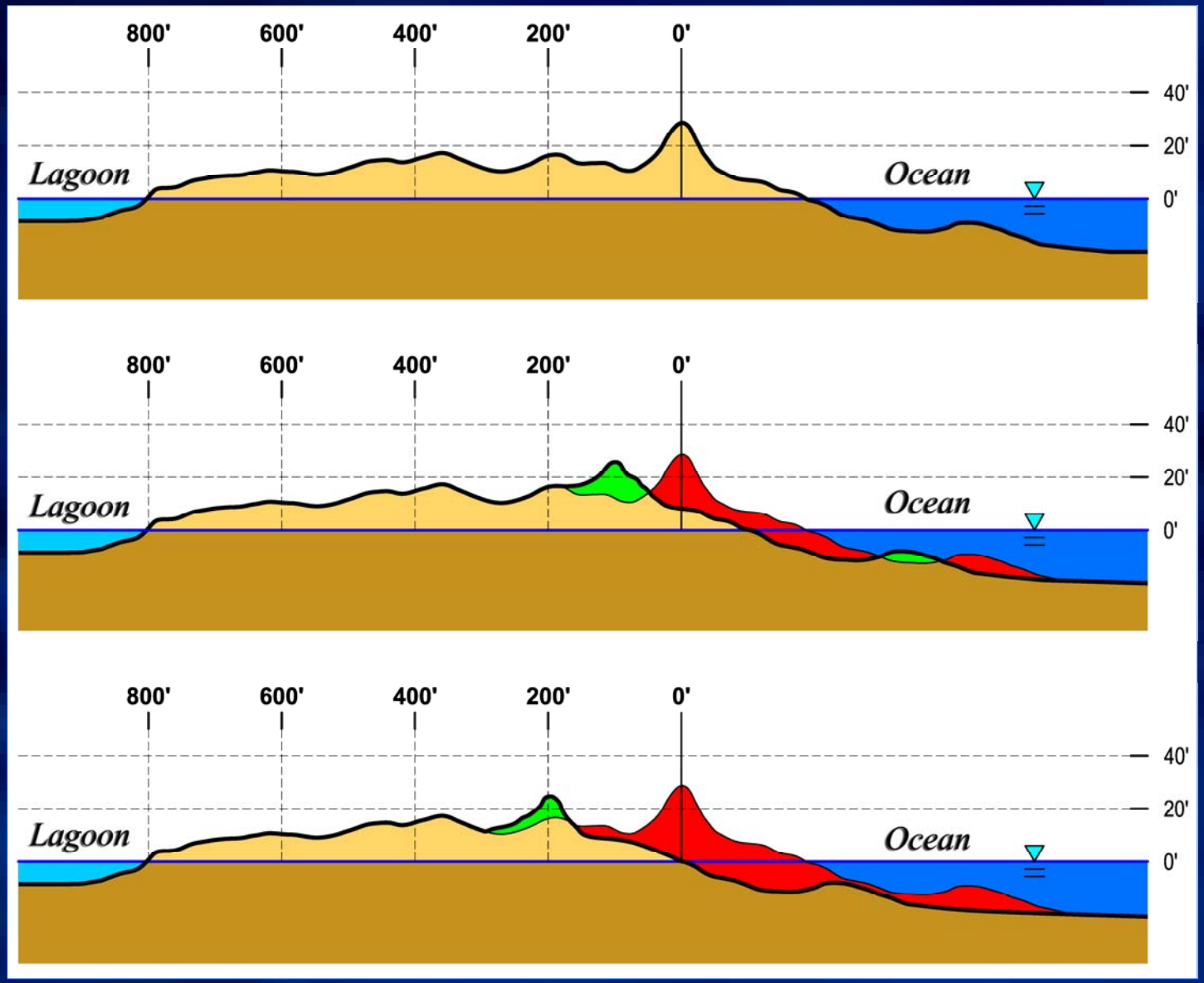
Beach Ridge Barrier Island

Many Barrier Islands Are >1000 ft - wide!



Assume Erosion Rate = 2 ft/yr

Beach Ridge Barrier Island - 100 Yrs Erosion



@ 2 ft/yr

Volume Erosion Rate:

~2 CY/ft/yr

50-Yr Loss:

~100 CY/ft

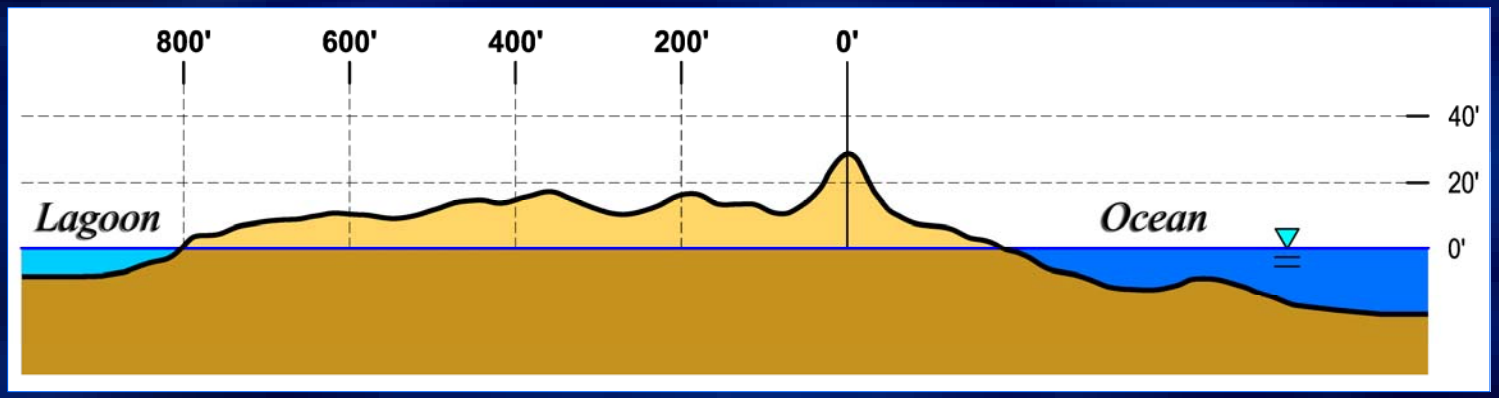
100-Yr Loss:

~200 CY/ft

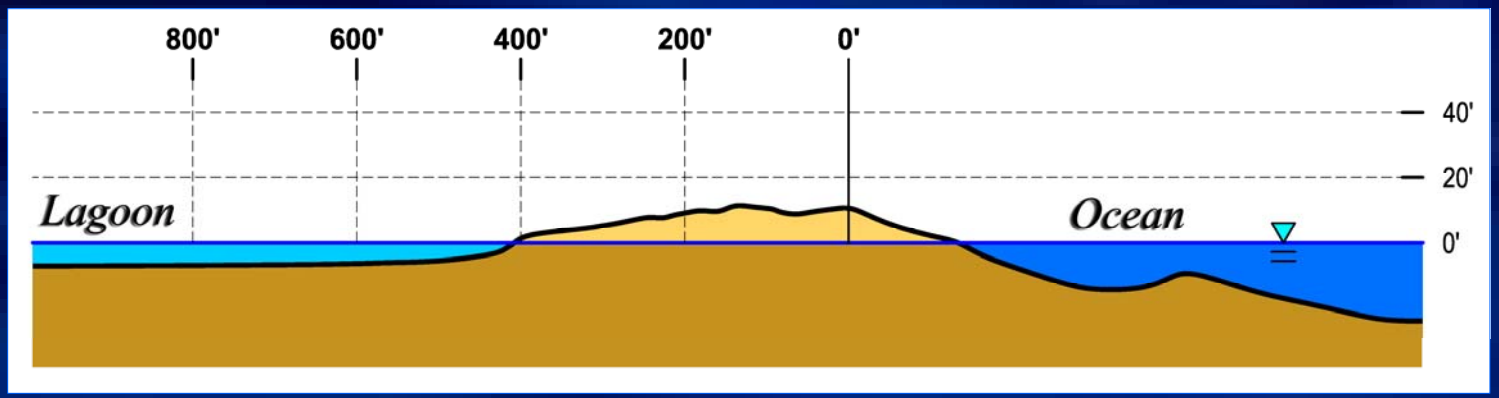
Or, ~12 truckloads of sand per ft of beach

Barrier Island Sections

Common Developed Barrier Island



Washover Barrier Island



Present Cost to Maintain Beach:

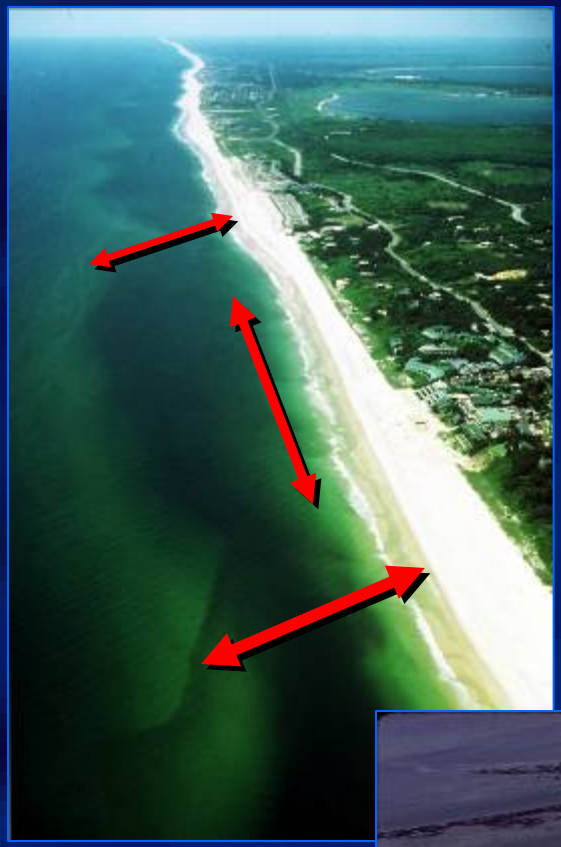
@ 2 CY/ft/yr Erosion Rate =

~$10-16/ft/yr

@ 10 CY/ft/yr Erosion Rate =

~$50-80/ft/yr

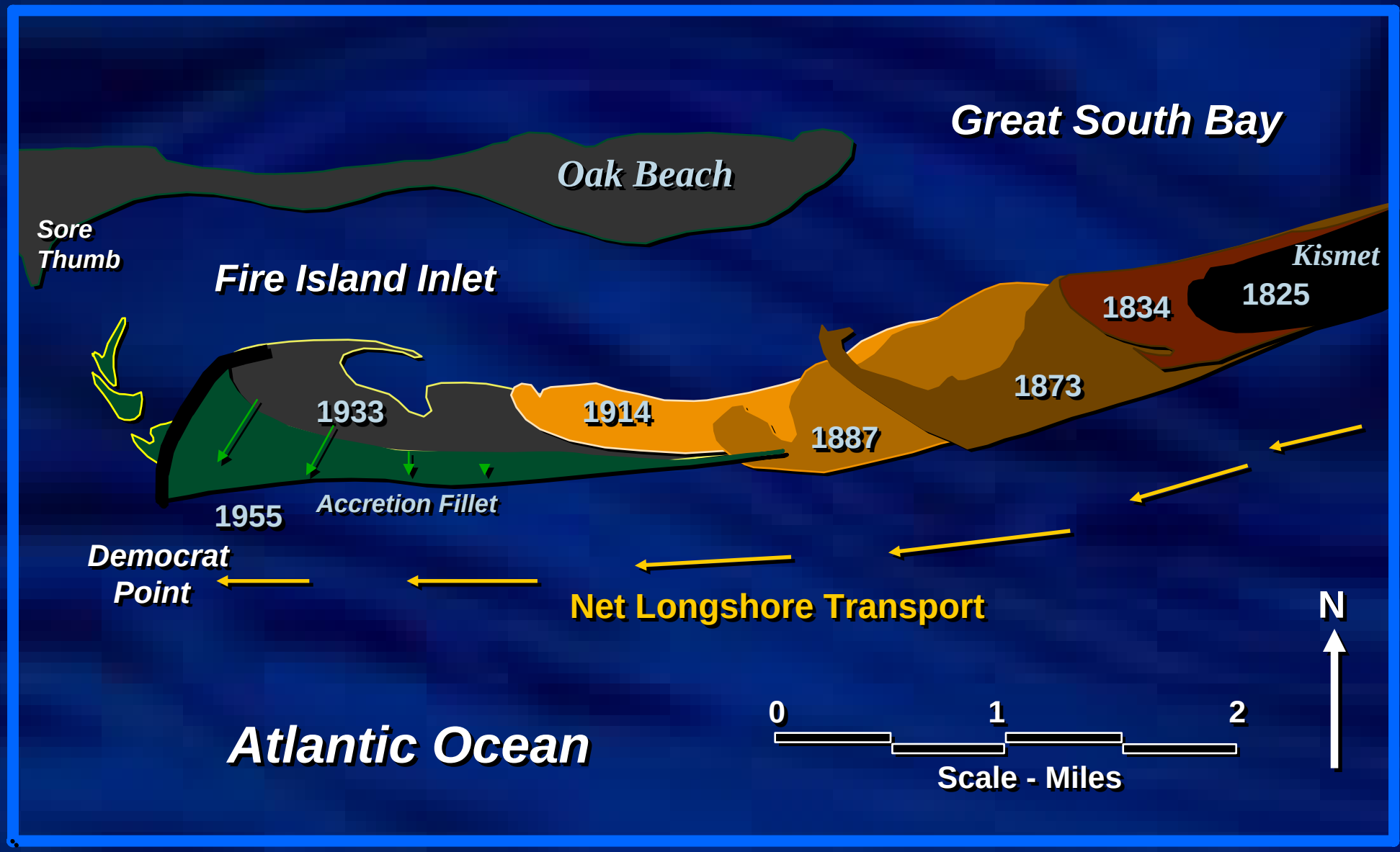
Directions Sand Moves



How Do We Know This?

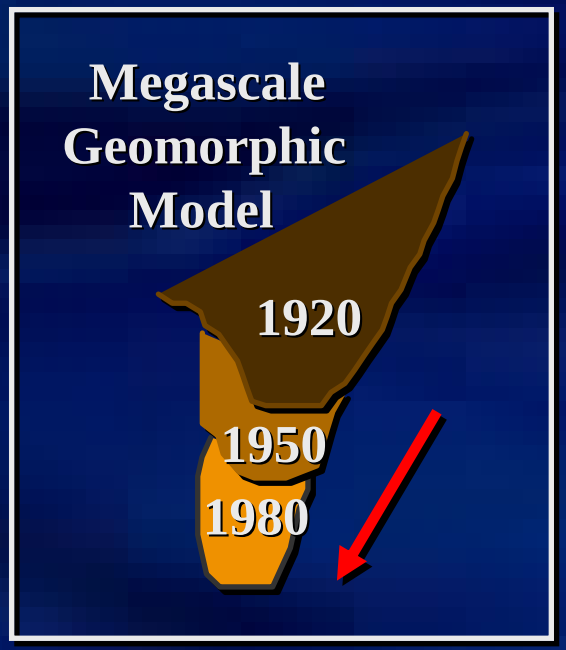
Photos by T.W. Kana

Western Fire Island Evolution



Based On USACE 1958; Saville 1960

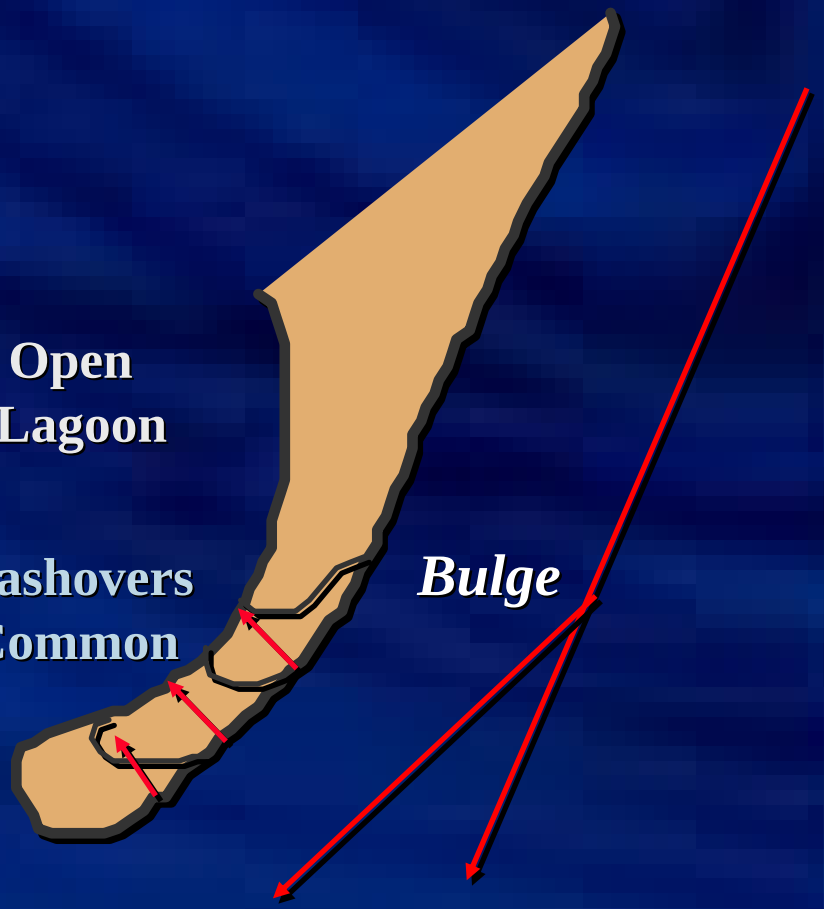
Spit Growth & Rotation



No Rotation

eg. Kiawah Island, SC
Cape Litchfield, SC

With Rotation

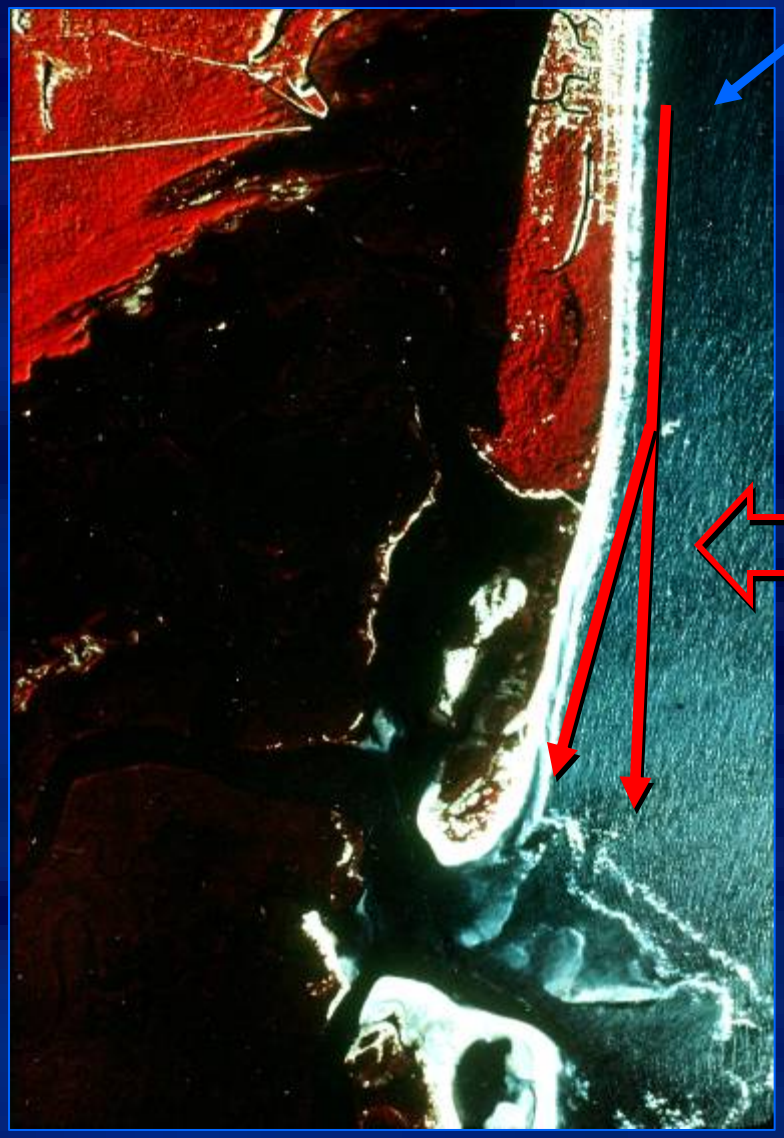


eg. Western Fire Island, NY
Garden City, SC

Spit Growth & Rotation

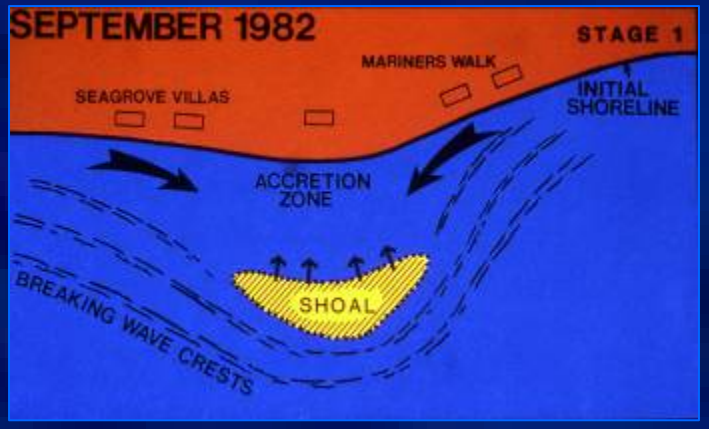
Capt Sams Inlet SC

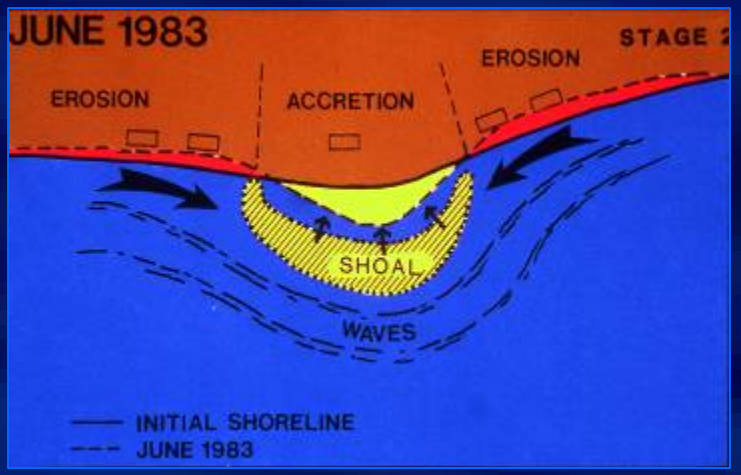
North Inlet SC

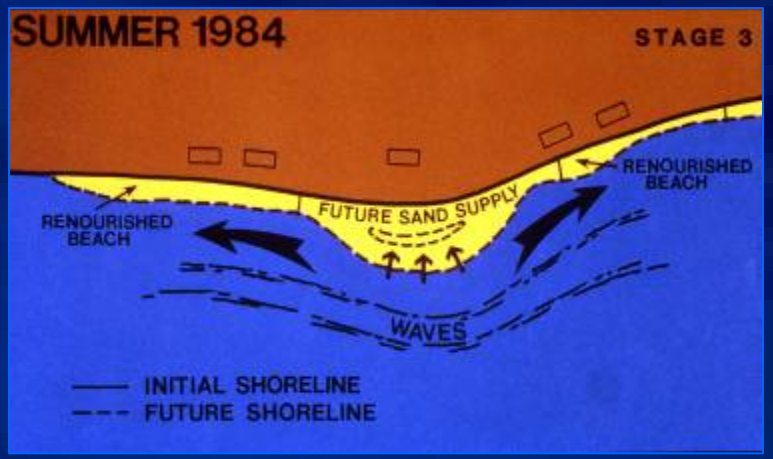


Which Spit Is Likely To Create The Most Habitat for Least Terns?

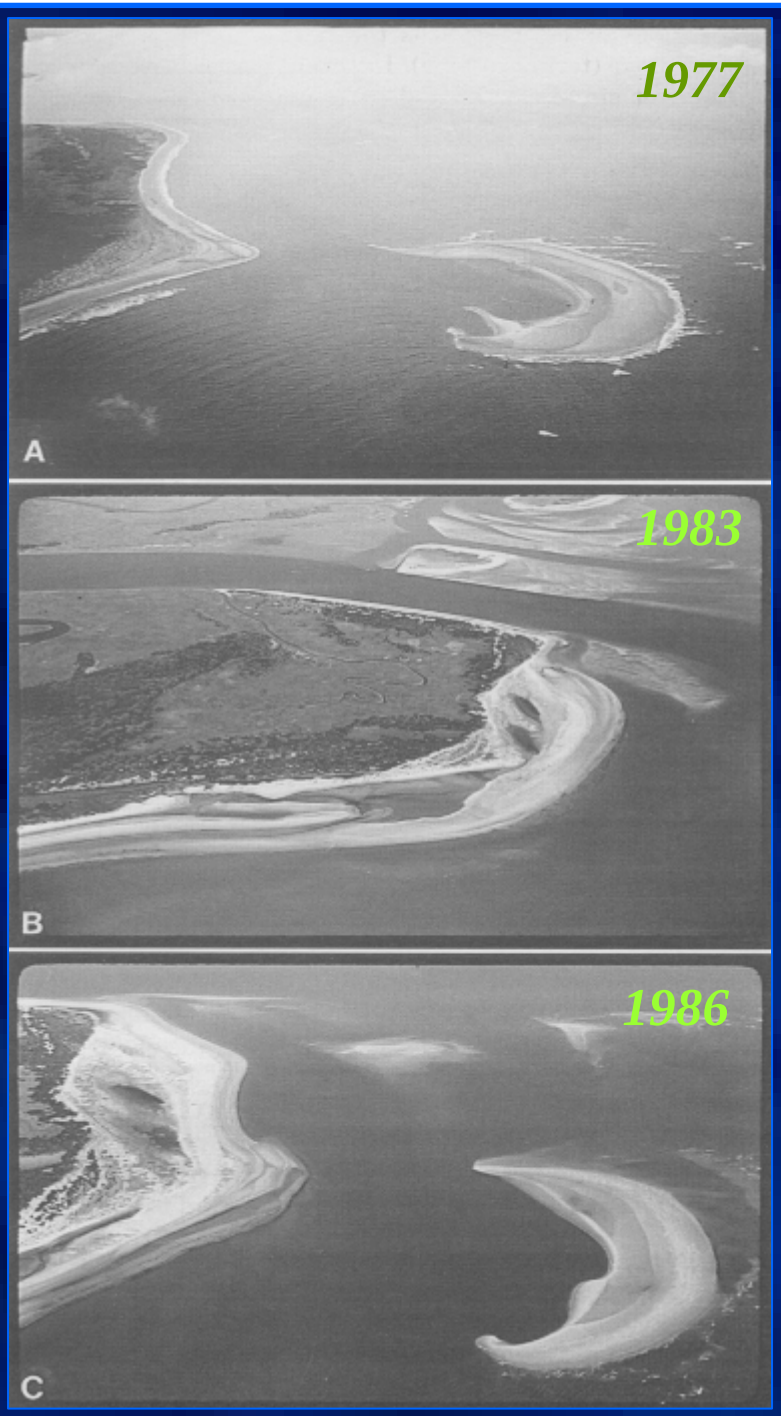
Inlet Sand Trapping & Bypassing







Shoal Bypassing at Kiawah Island – 1970s to 1980s



Shoal Bypassing: ***The release of sand bars from inlet deltas due to changes in channel position and excess sediment supply.***

Bypass Volumes:

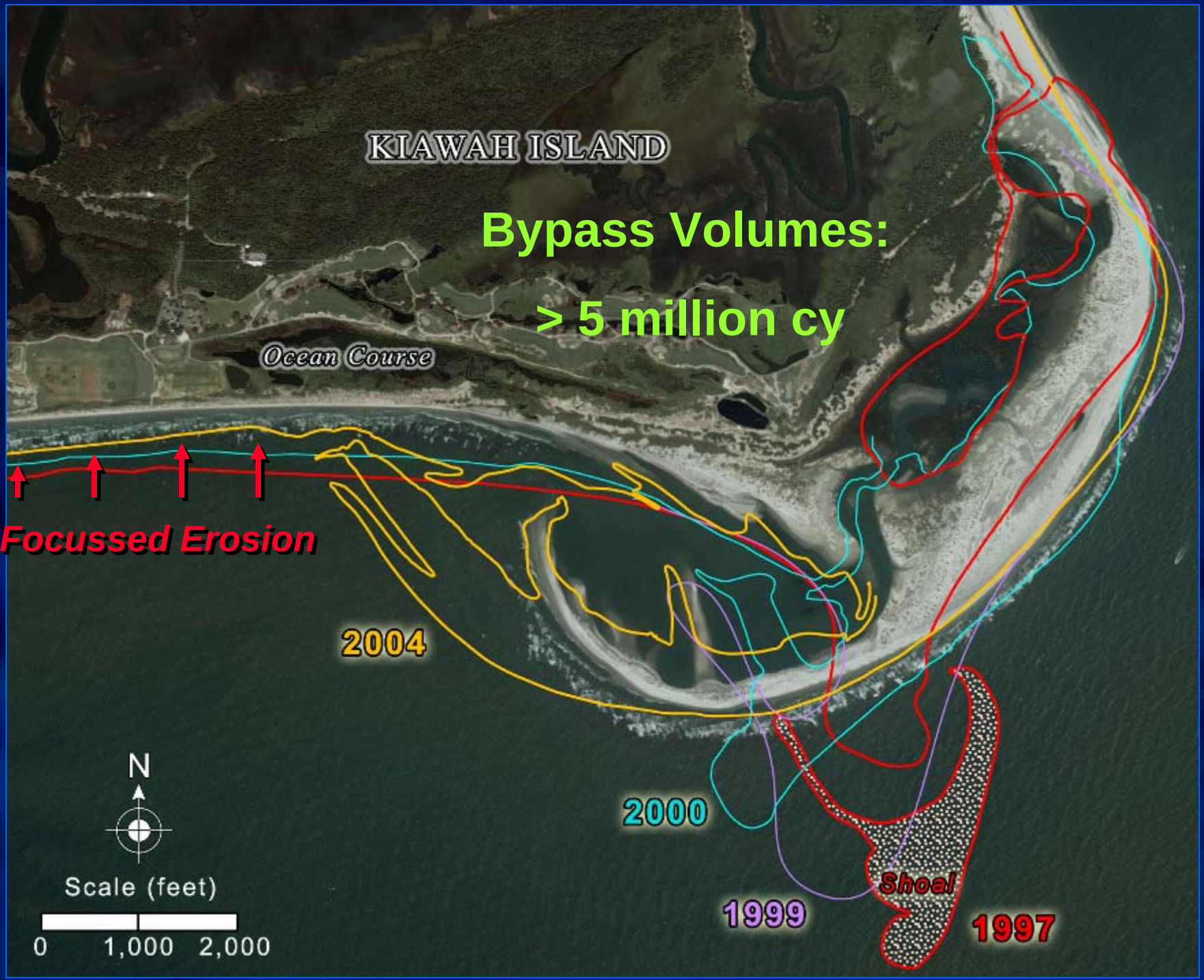
~ 1 million cy

This is why some beaches are healthy at century time scales!

Kiawah Island – Dec 1998

Source: Miles Hayes (USC)

Shoal Bypassing at Kiawah Island – 1990s



Type of Habitat Some Threatened Birds Like

Dynamic Shoreline

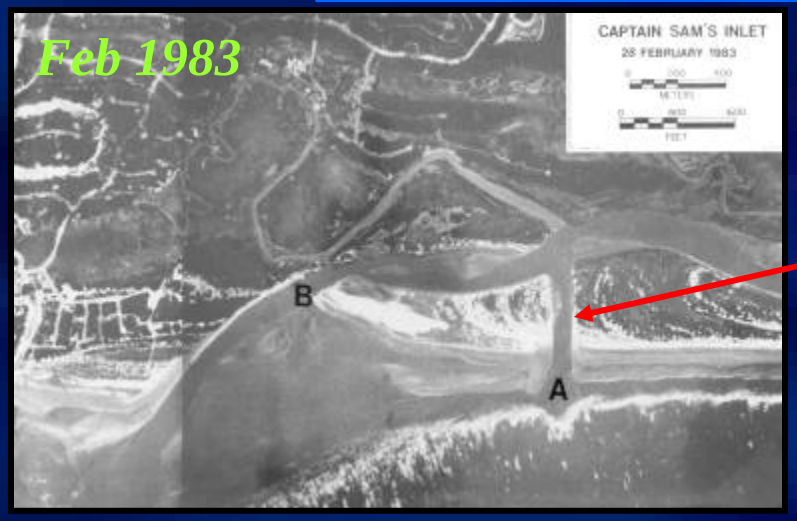
Unstable

Large Sand Surplus

Nearby Food Source

No Predators

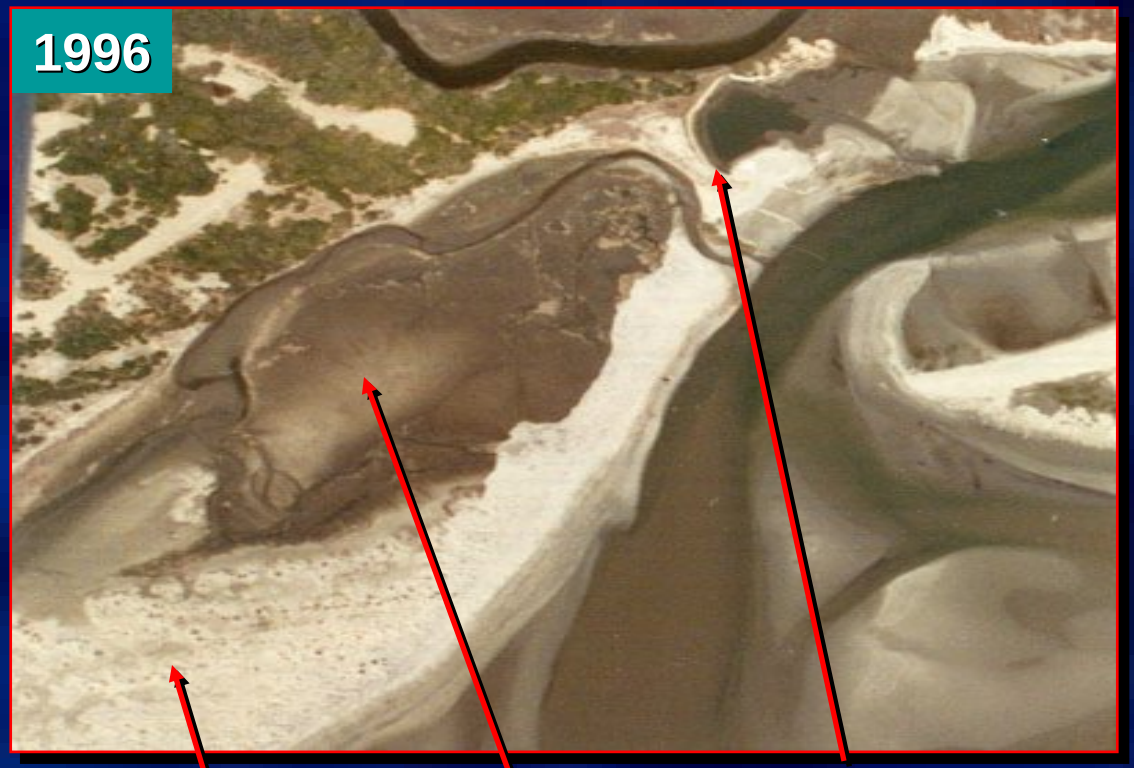
Captain Sams Inlet Relocation - 1983



New Channel

- ~150,000 cy to move channel
- ~1,500,000 cy added to Seabrook
- Cost: $300,000

1983 Inlet Relocation - Habitats



1983 - 1987 Habitat Changes

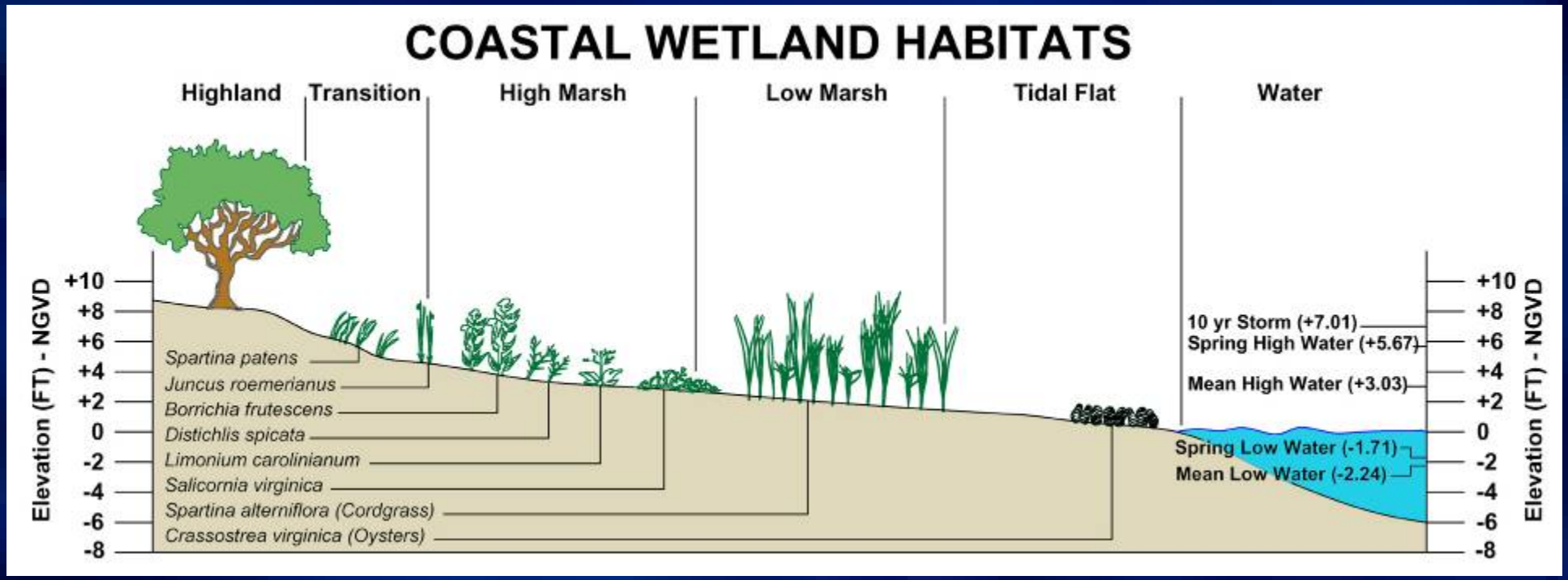
Habitat Type	Total Area	
	1983	1987
Original dunes	5.2	1.6
Closure dike (dune)	–	0.9
New dunes (by accretion)	0.8	3.0
Washover terraces	1.8	1.0
New beach	–	**10.3**
Intertidal bars	47.4	36.0
Subtidal (lagoon)	11.7	23.2
Totals	**66.9**	**76.0**

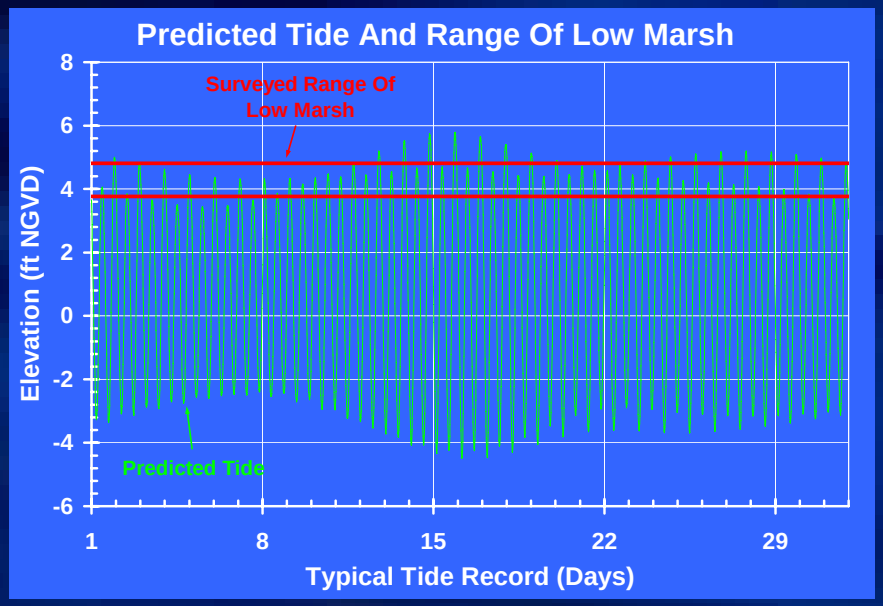
*Source: Baca & Lankford, 1987

Habitats Created At Decadal Scales

Why Salt Marsh In Some Areas & Open Water Elsewhere?

Controls On Tidal Wetland Formation





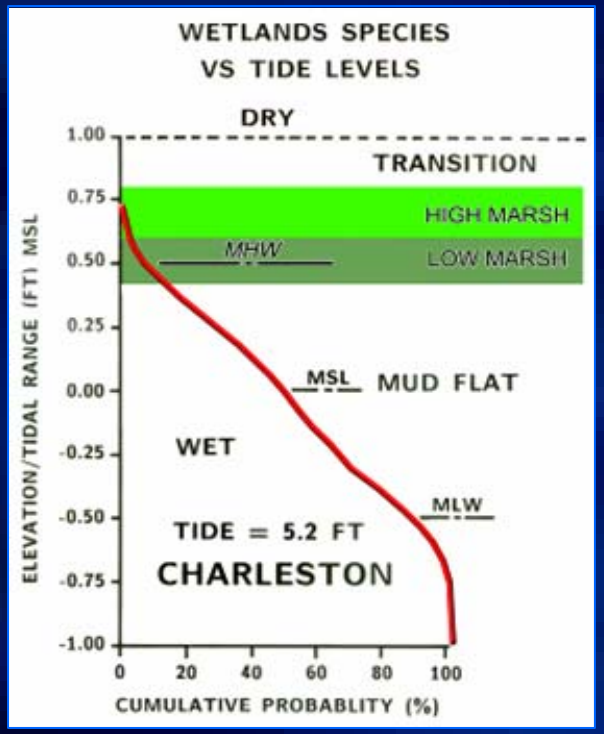
Building Blocks:

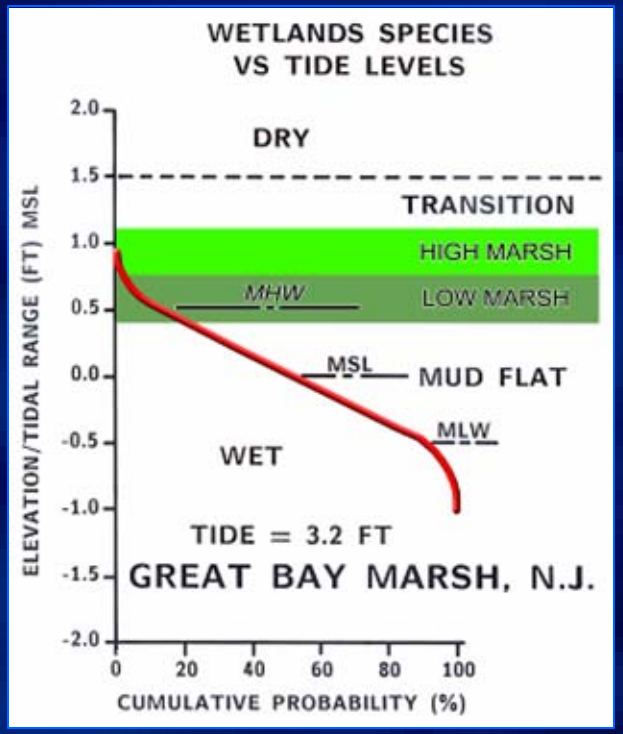
- Barrier Beach
- Wetland Habitats function of

- land elevation (w/res Sea Level)

- flooding frequency (w/res Tide)

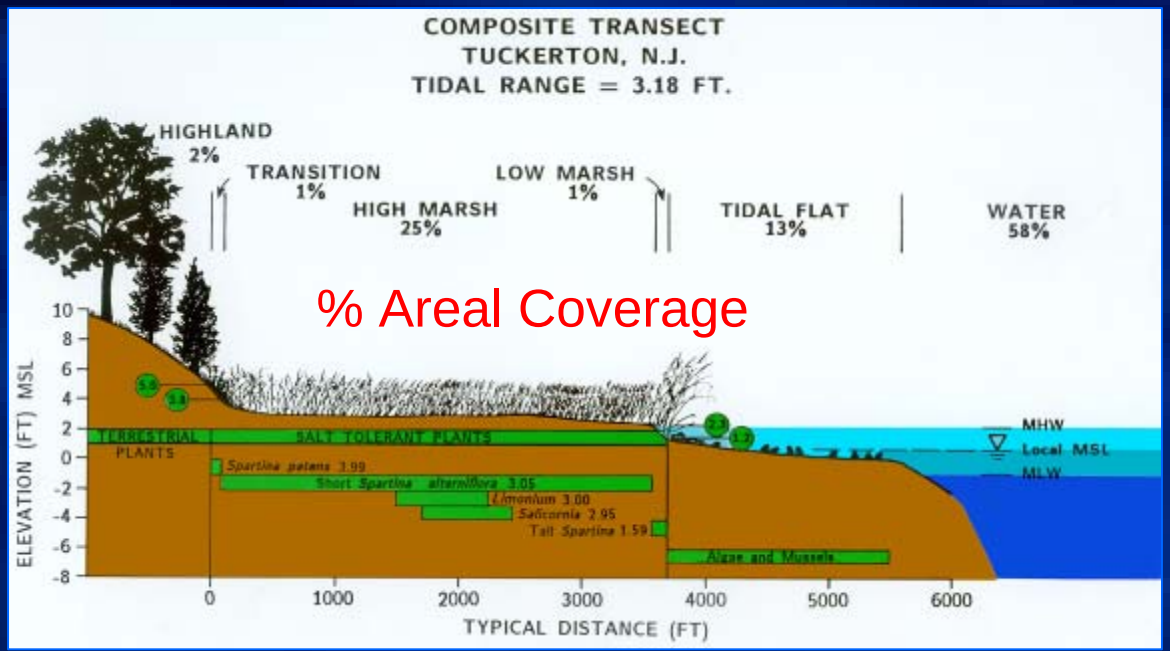
EPA Case Studies





Flooding frequency:

- High Marsh ~1%
- Low Marsh ~ 10%



Source: Kana & Baca 1988

Summary

- Coastal Erosion Operates At A Continuum of Scales
- The Present Coast Is Dependent On A Balance Between SLR & Sediment Supply
- There Are Many Site-specific Signatures Of Erosion
- Conflicts Regarding Shoreline Management Arise Because Of Differing Time Frames Of Reference
- It Is Possible To Create Habitat Artificially And Thereby Accelerate or Decelerate Natural Processes In Some Cases, <u>If Done With Care</u>!