Innovative Erosion Control Technology In Florida

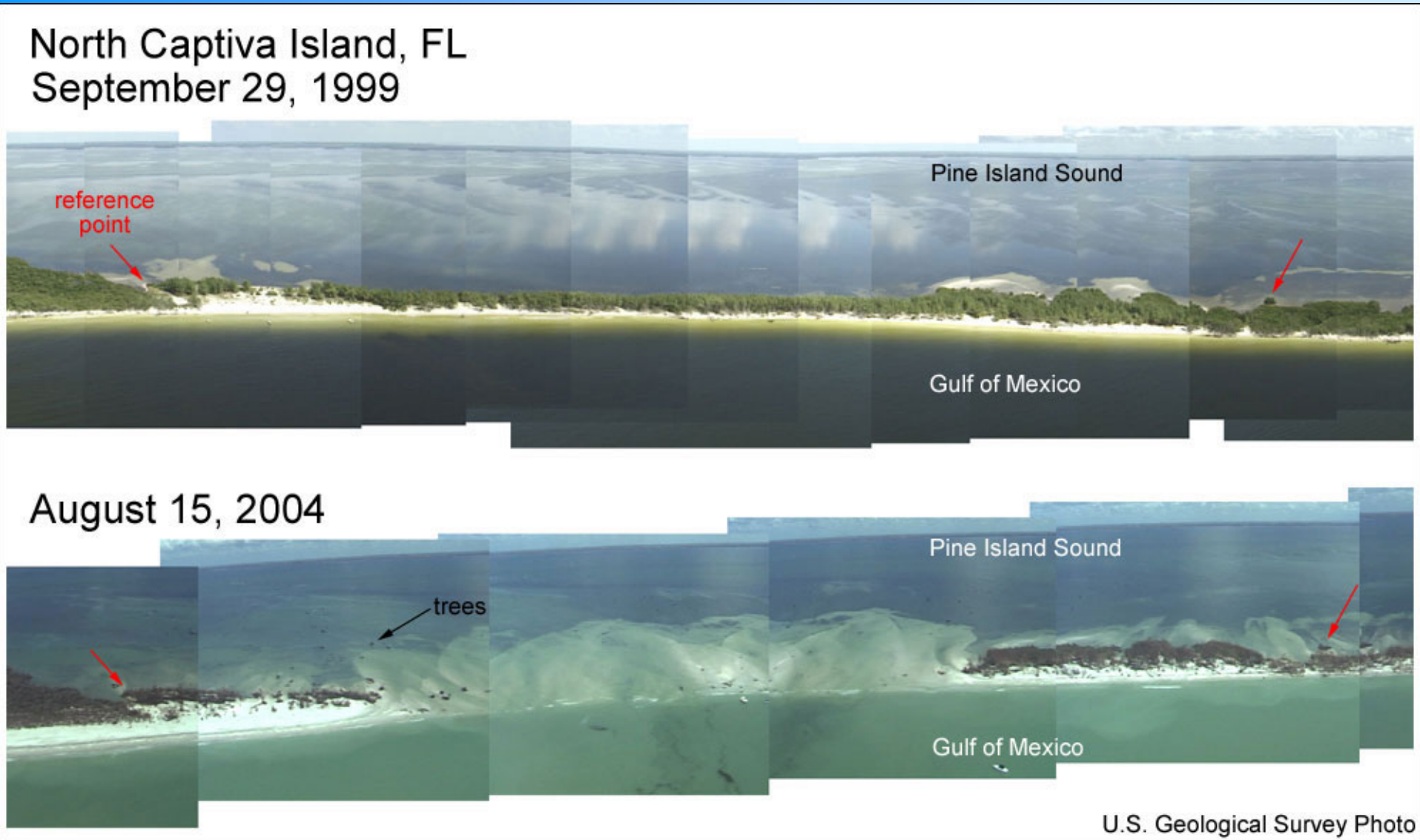
Paden E. Woodruff

Bureau of Beaches and Coastal Systems

Florida Department of Environmental Protection

Greatest cause of erosion is improved inlets

Second cause is storm damage



U.S. Geological Survey Photo

Third cause is construction of structures

Early Experiences

Before 1989, no organized program to evaluate innovative technologies

No performance criteria

No test plan

Therefore, insufficient data to assess performance or effectiveness

Section 27 of Laws of Florida 89-175

Legislative intent to encourage development of new and innovative methods for dealing with erosion problems

Rule 62B-41.0075
Florida Administrative Code
“Experimental Coastal Construction”

Rule requires a “test plan” with specific criteria to evaluate performance

Early 1980's: Artificial Seaweed

Problems included:

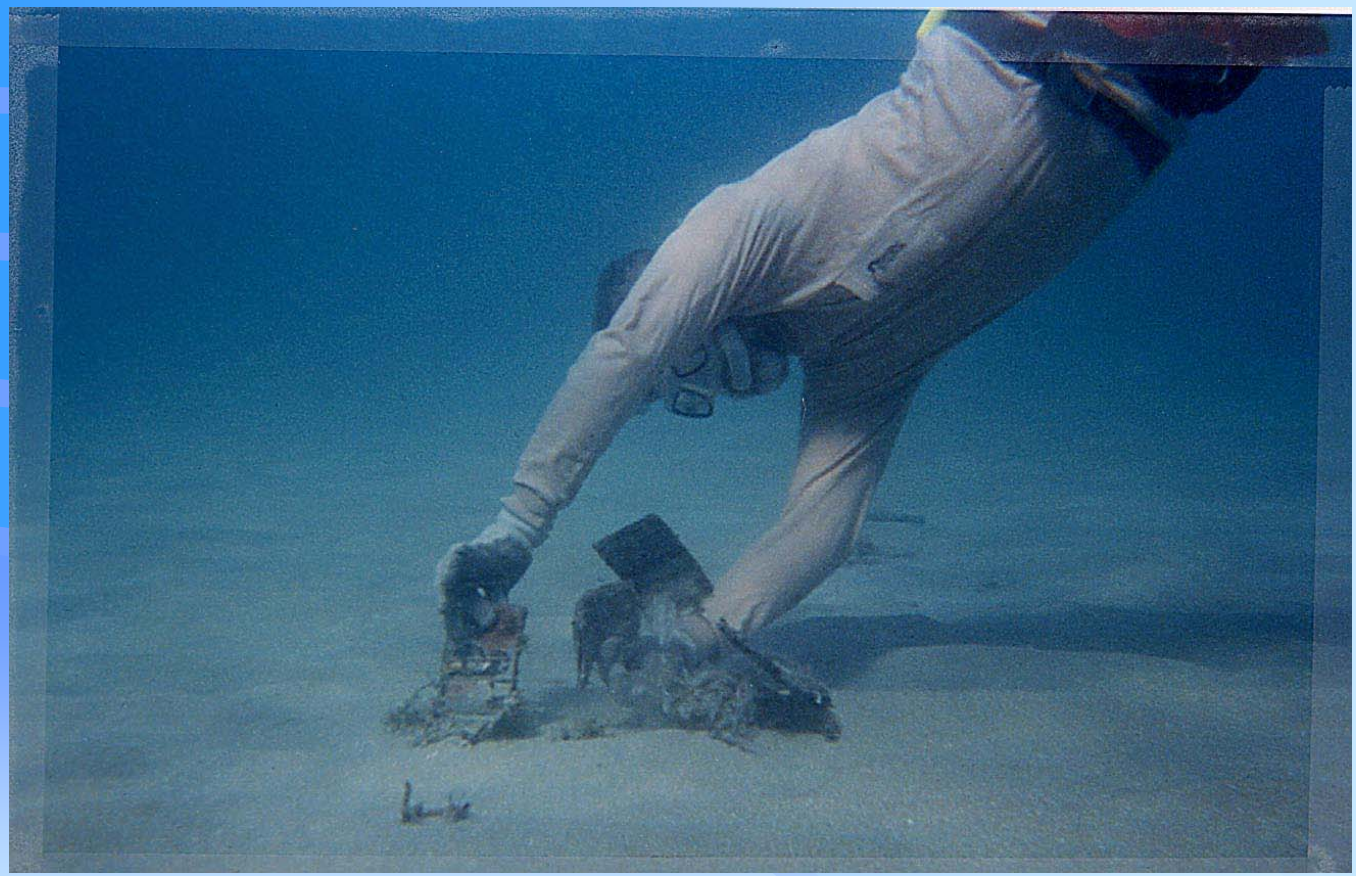
- **Inadequate anchoring system**
- **Individual fronds would lose buoyancy**
- **Unknown environmental impact**

Artificial Seaweed

1983	100' to 300' south of R-90, Collier Co.	Synthetic strips 2" wide X 5' long anchored w/ a sand filled tube. 8 rows, 500' long each.	Analysis of comparative profiles indicated the project was ineffective. Department recommended removal. Diver inspection revealed the fronds were either buried, washed away or removed.
1984	100' to 300' south of T-15, Manatee Co.	A grid was located 210' seaward of the mean high-water line. Grid consisted of 4 interlocking sandbag tubes with 4 rows of seaweed fronds.	Monitoring required as a permit condition was not conducted, a removal order was issued by the Department, and the project removed. Department conclusion was the project was ineffective.
1984	500' N of T-203 to 300' N of T-204, Highland Beach, Palm Beach Co.	5 rows of seaweed, 10' apart approx. 1200' long were located approx. 300' seaward of mean high-water	The 6 mo. report indicated 65% of the project ineffective, and no further monitoring was completed. A 1992 inspection showed no trace of project.

Artificial Seaweed Theory

Artificial Seaweed in Reality



“Net Groins”

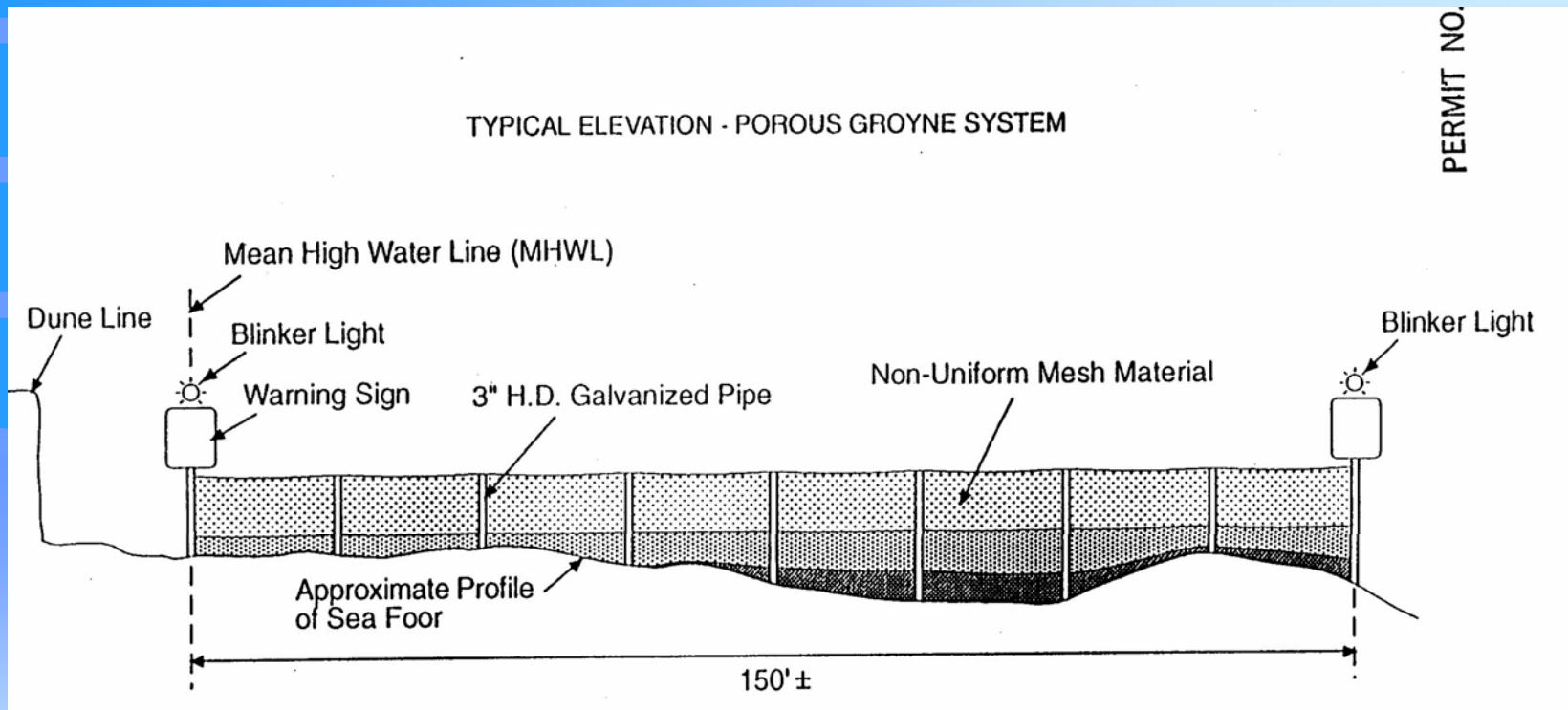
Department has permitted, and in some cases, cost-shared, in projects referred to as “net groins”

Net Groins

1986	150' N to 350' S of R-90, Collier Co.	Flexible netting at 50' to 100' intervals for 700'. Located from mean high-water to 50' seaward.	Project was never constructed.
1987	130' to 630' S of R-71, Collier Co.	Nets at 50' to 100' intervals for 500'. Located from mean high-water to 50' seaward.	Definitive conclusions on performance cannot be drawn due to the experiments' short duration, magnitude, location and insufficient monitoring.
1997	400' W to 800' E of R-169, Dog Island, Franklin Co.	Nylon net groins of various mesh size extended 150' seaward from mean high-water at 150-200' intervals. Stanchion system to raise nets as sediment acculmulates.	Project not installed.

2000	2 locations on Eglin Air Force Base, Okaloosa Co.	Netting on stanchions from upper beach to -3 ft.	3rd party review: minimal effect on shorelines
2001	Naples, Collier Co. R 76-79	Netting spread 100 ft. for 3,000 ft.	3rd party review: minimal accretion in groin field; significant loss in adjacent areas
2005	Inlet Beach, Walton Co.	14 groins 150 ft. apart	3rd party review: Success criteria not met

Net Groins


PERMIT NO.
TYPICAL ELEVATION - POROUS GROYNE SYSTEM
Mean High Water Line (MHWL)
Dune Line
Blinker Light
Warning Sign
3" H.D. Galvanized Pipe
Non-Uniform Mesh Material
Blinker Light
Approximate Profile of Sea Foor
150' ±


DANGER
Beach Reclamation Project
Underwater and above water
mesh and stanchions.
• Stay at least 25 feet away from the project area.
• Do not run, walk, surf, swim, boat, or jet-ski within 25 feet of the mesh and stanchions.
• Collision with the stanchion may cause death or serious injury.
• Entanglement or entrapment in the mesh may cause death or serious injury.

Other types of beach erosion control can be referred to as “beach manipulation”

Beach Scraping

Usually conducted following storm events to accelerate natural recovery.

Can have adverse impact on the beach and dune system

Department has developed guidelines for permitting to minimize potential adverse impacts.

Beach Dewatering

Lowers the water table beneath the beach and in theory reduces fluidization of material. This effect reduces sediment suspension in the swash zone.

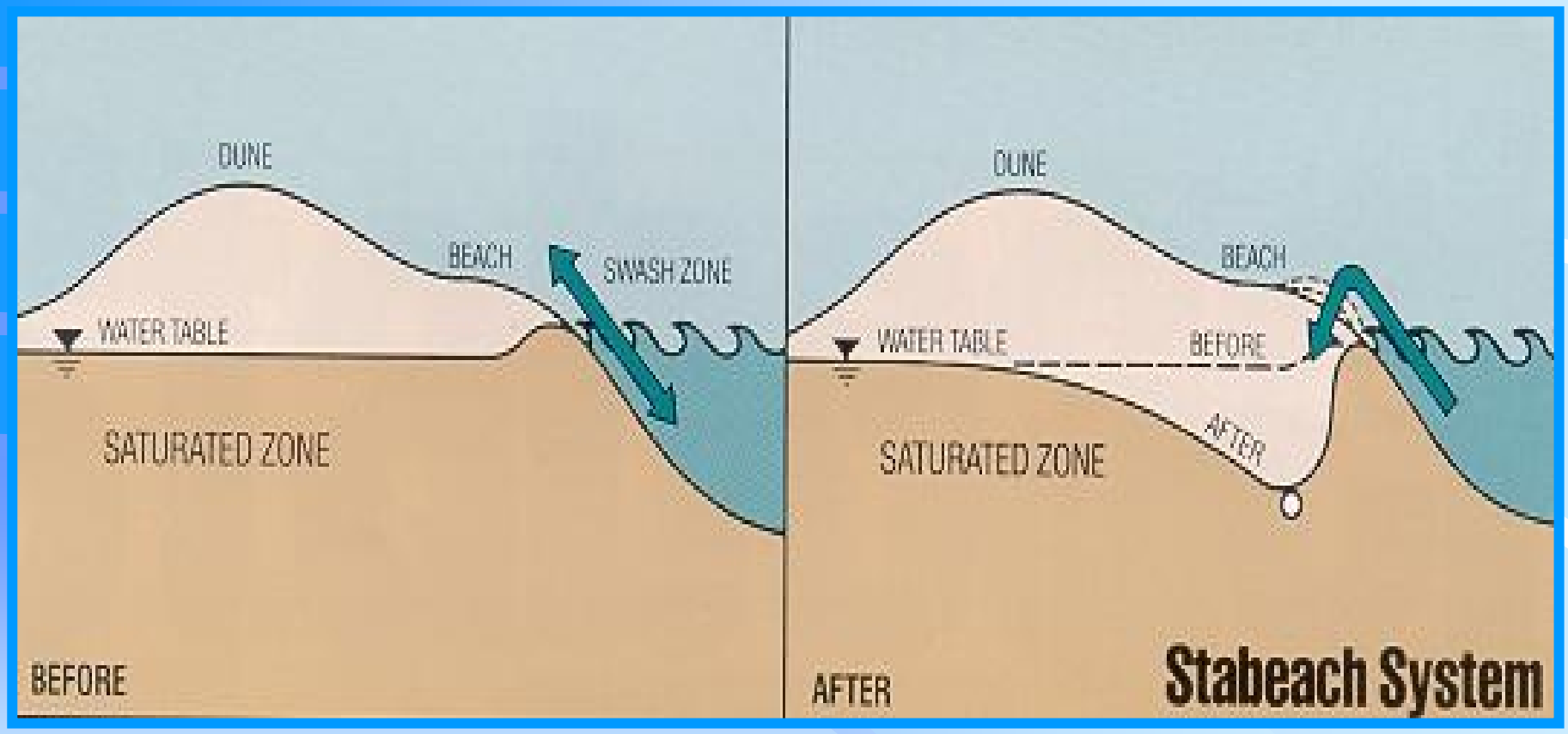
Beach Manipulation

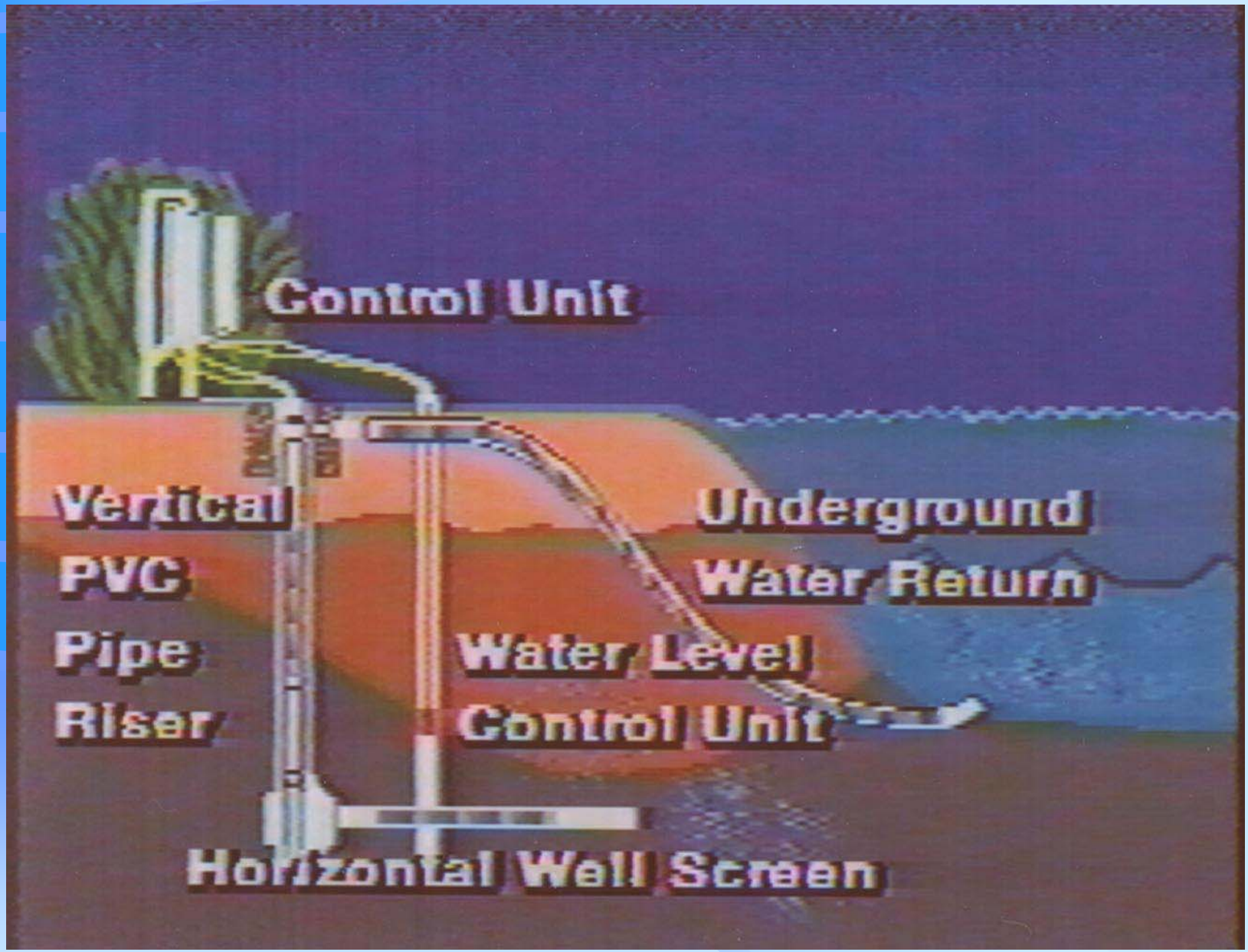
Beach Builder Screws	**1985**	**50’ S R-27 Flagler Co.**	**2 auger screws (40’ sections) laid from MHW seaward of MLW**	**Project was ineffective at moving material and was discontinued**
Beach Scraping	**1985**	**R-29 to R-46 City of Cocoa Beach, Brevard Co.**	**Scraping of 3 mi. of beach from MLW to MHW with placement at toe of escarpment.**	**Monitoring was inconclusive. Small quantity of material and inadequate spacing of profiles**
Beach Scraping	**2004**	**Walton Co., City of Destin, Okaloosa Co.**	**MLW to MHW, placement at toe of escarpment**	

Beach Manipulation

Beach Dewatering	**1988**	**297’S to 280’ N of R36, Sailfish Point, Martin Co.**	**Submersible pump and piping system beneath beach**	**Inadequate information to determine natural vs. system induced change. Beach was stable**

Beach Dewatering




Control Unit
Vertical
PVC
Pipe
Riser
Underground
Water Return
Water Level
Control Unit
Horizontal Well Screen

Physical Structures

Various types of physical structures have been tried, and continue to be permitted and funded, including a variety of sand filled geotextile structures in various configurations.

Physical Structures

Protect Tube II	1989	190' to 920' S of T-15, Longboat Key, Sarasota Co.	3-celled, sand-filled geotextile tube structure w/ crest elevation +6.5 ft. NGVD. 15 ft. wide, 600' were placed as emergency work in 1988, and a 125' added and monitored.	Beach remained stable during 2 yr. monitoring period, and no downdrift problems noted. Unusually calm peroid. Inhibition of turtle nesting remains a concern.
Longard Tubes	1992	350' N of R-59 to R-60, Sand Key, Sarasota Co.	70" and 40" diameter sand-filled tubes arranged as groins connecting to an offshore sill. Groin compartments filled w/ 99,000 cyd of sand.	Project performed well. Tubes were damaged and settlement occurred. Area now has a restoration project.
Undercurrent Stabilizers	1984	92' to 742' S of R-96, Captiva Island, Lee Co.	Groins constructed using 2, side by side, sand-filled bags, 13' X 5', and underlaid by anchored filter fabric.	Consultants and department concluded no beneficial effect and no improved sediment accretion rates.

Longard Tube Installation

Proprietary Reef Structures

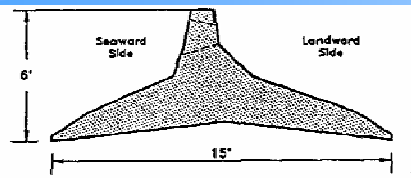
Another class of physical structures

Also known as

“thin-line submerged breakwaters”

A submerged breakwater modifies both the wave and current fields landward of the breakwater, with modification depending substantially on the crest elevation relative to the still water level.

Proprietary Reef Structures

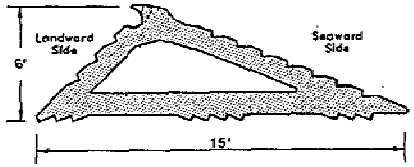


P.E.P. Reef

Proprietor : American Coastal Engineering, Inc.

Weight/foot : 4167 lb/ft

Installation Locations : Palm Beach, Fl.

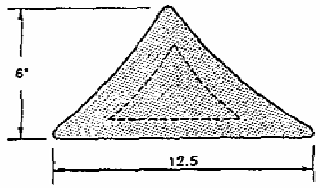


Beachsaver

Proprietor : Breakwaters International, Inc.

Weight/foot : 4200 lb/ft

Installation Locations : Sea Isle City, N.J. Avalon, N.J.

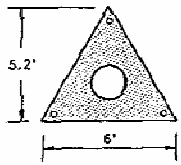


Beach Beam

Proprietor : Advanced Erosion Control, Inc.

Weight/foot : 2000 lb/ft

Installation Locations : Maryland

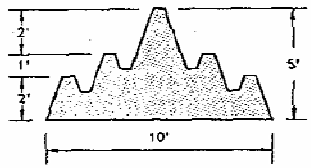


Beach Prism

Proprietor : Beach Prisms, Inc.

Weight/foot : 1232 lb/ft

Installation Locations : Bennetts Point, Md.



Campbell Module

Proprietor : Campbell Module

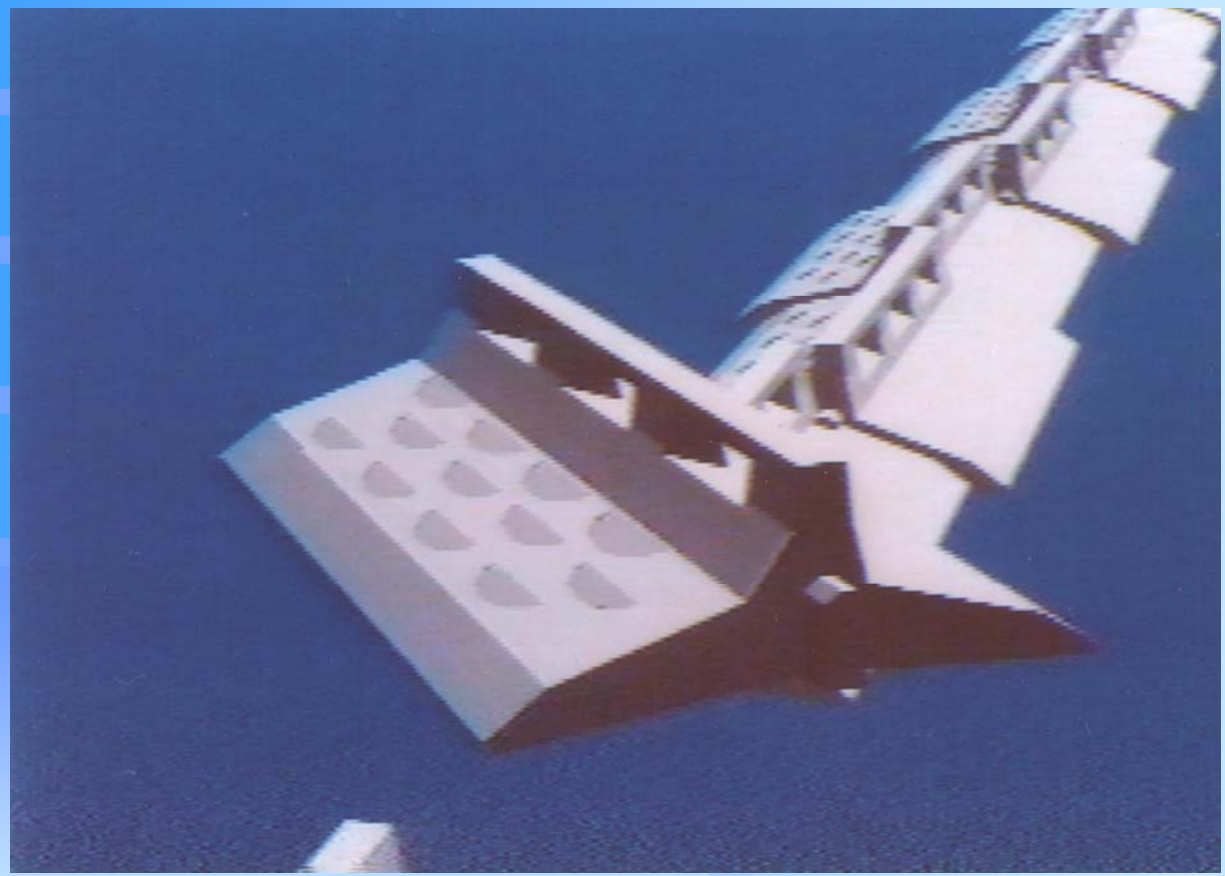
Weight/foot : 3500 lb/ft

Installation Locations : Sea Island, Ga.

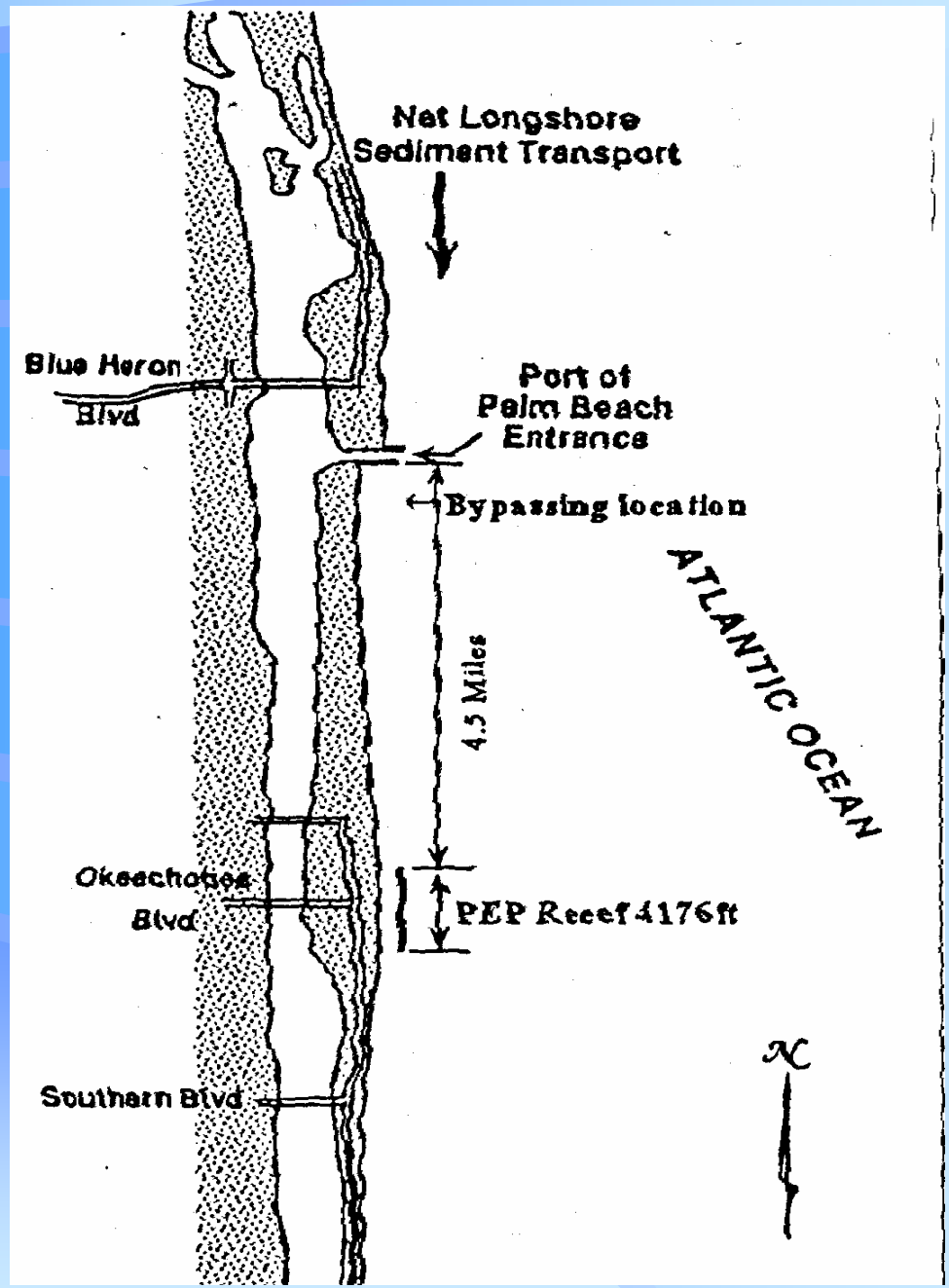
Midtown Beach Prefabricated Erosion Prevention (P.E.P.) Reef

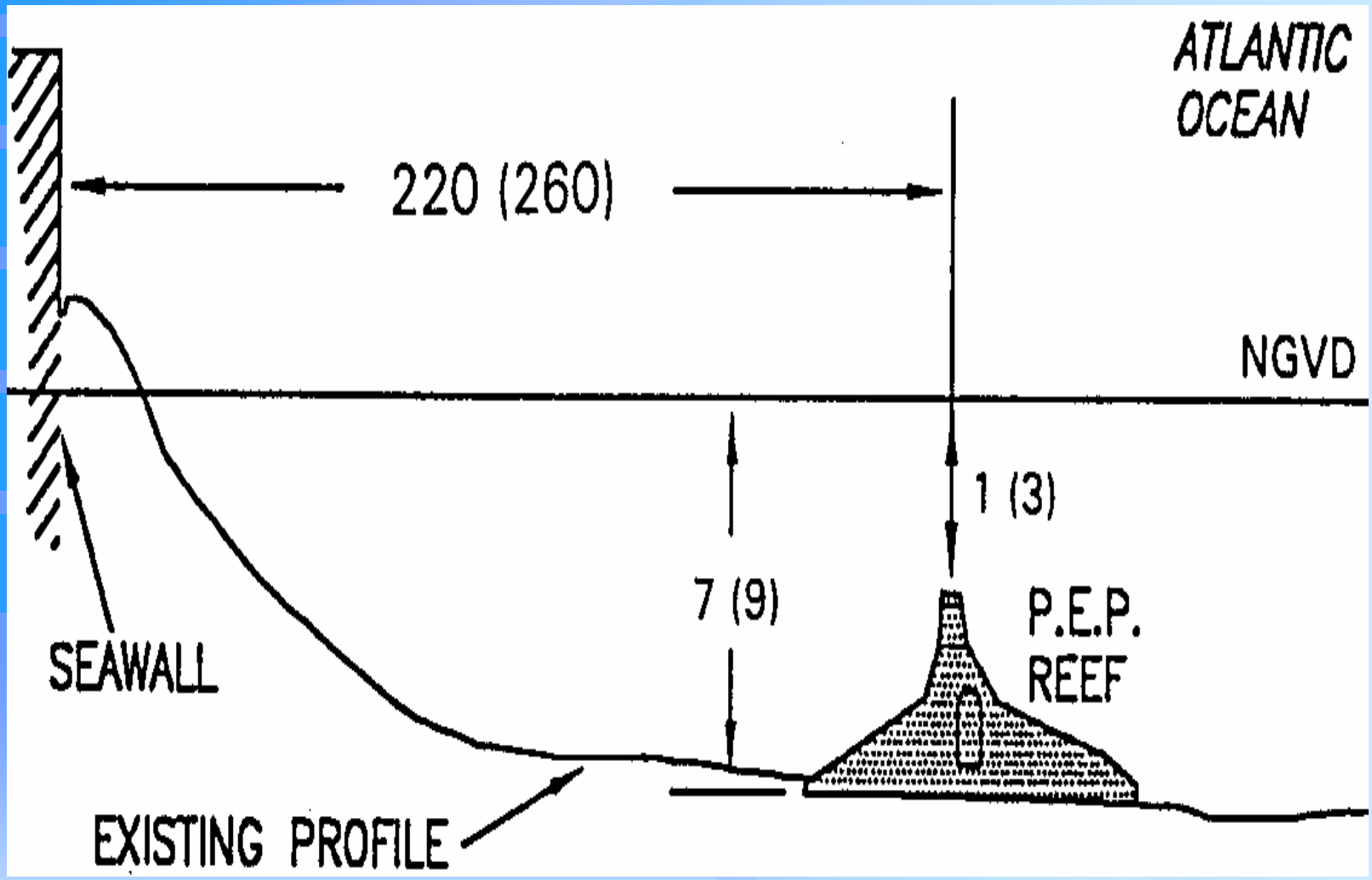
- 57 units installed June of 1992
- Additional 273 in 1993
- 4,176 ft. long, 6 ft. high, at -9.5 NGVD
- Purpose was to reduce wave heights and to accumulate sand in it’s lee.
- Natural reef 700 ft. seaward

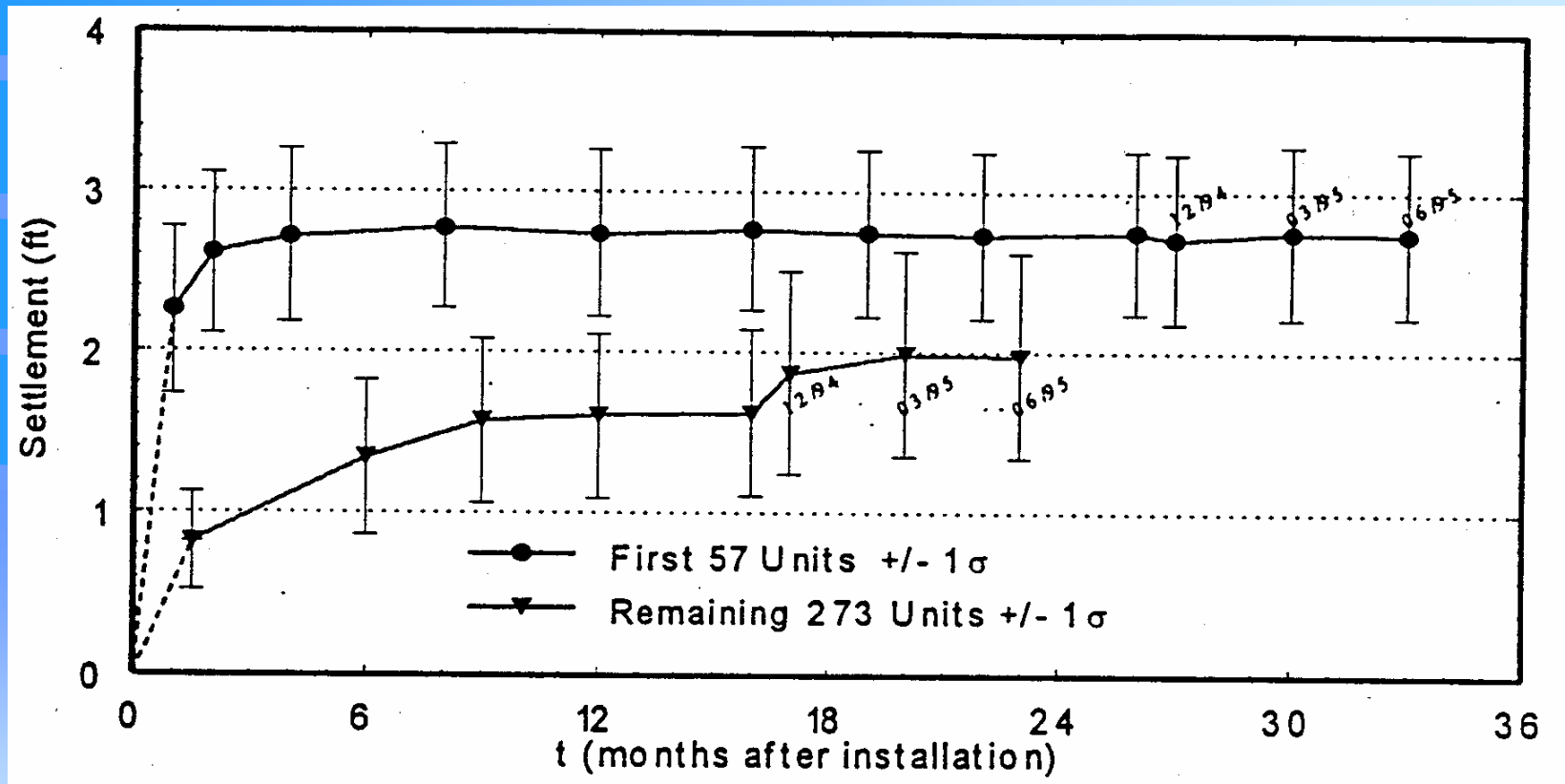
PEP Reef



PEP Reef Over Time


Net Longshore
Sediment Transport
Blue Heron
Blvd
Port of
Palm Beach
Entrance
Bypassing location
ATLANTIC OCEAN
4.5 Miles
Okeechobee
Blvd
PEP Reef 4176ft
Southern Blvd
N


ATLANTIC
OCEAN
220 (260)
NGVD
1 (3)
7 (9)
P.E.P.
REEF
SEAWALL
EXISTING PROFILE


Settlement (ft)
4
3
2
1
0
0
6
12
18
24
30
36
t (months after installation)
First 57 Units +/- 1σ
Remaining 273 Units +/- 1σ

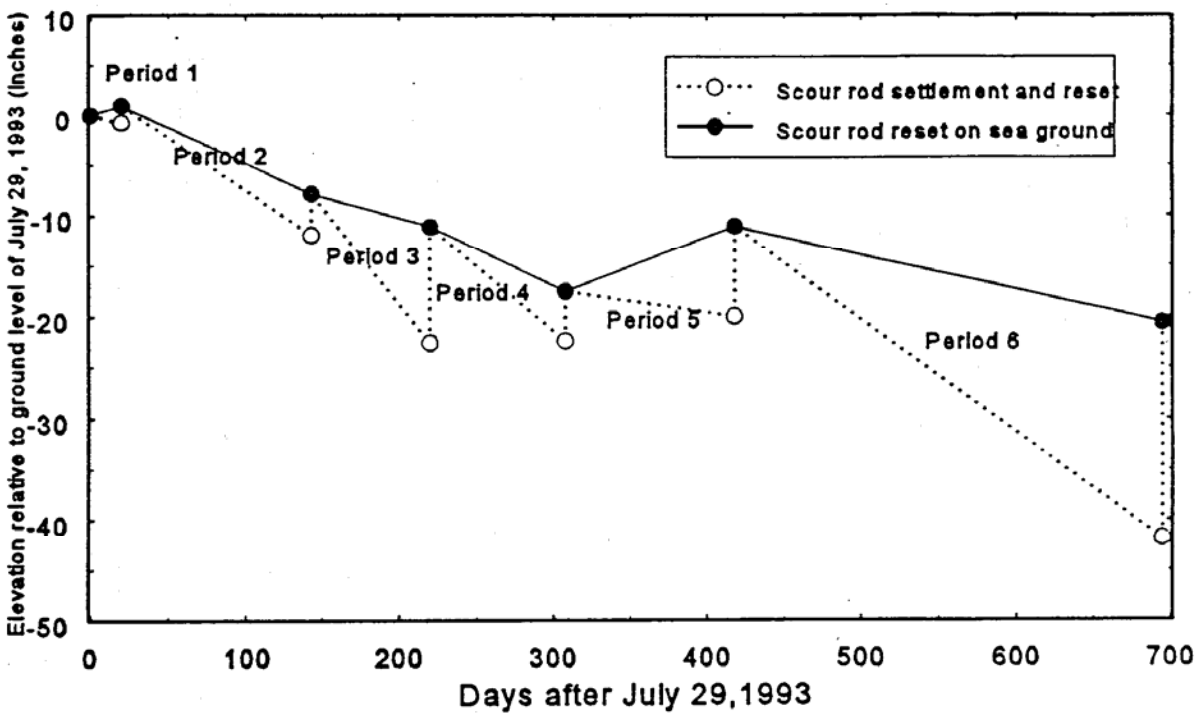
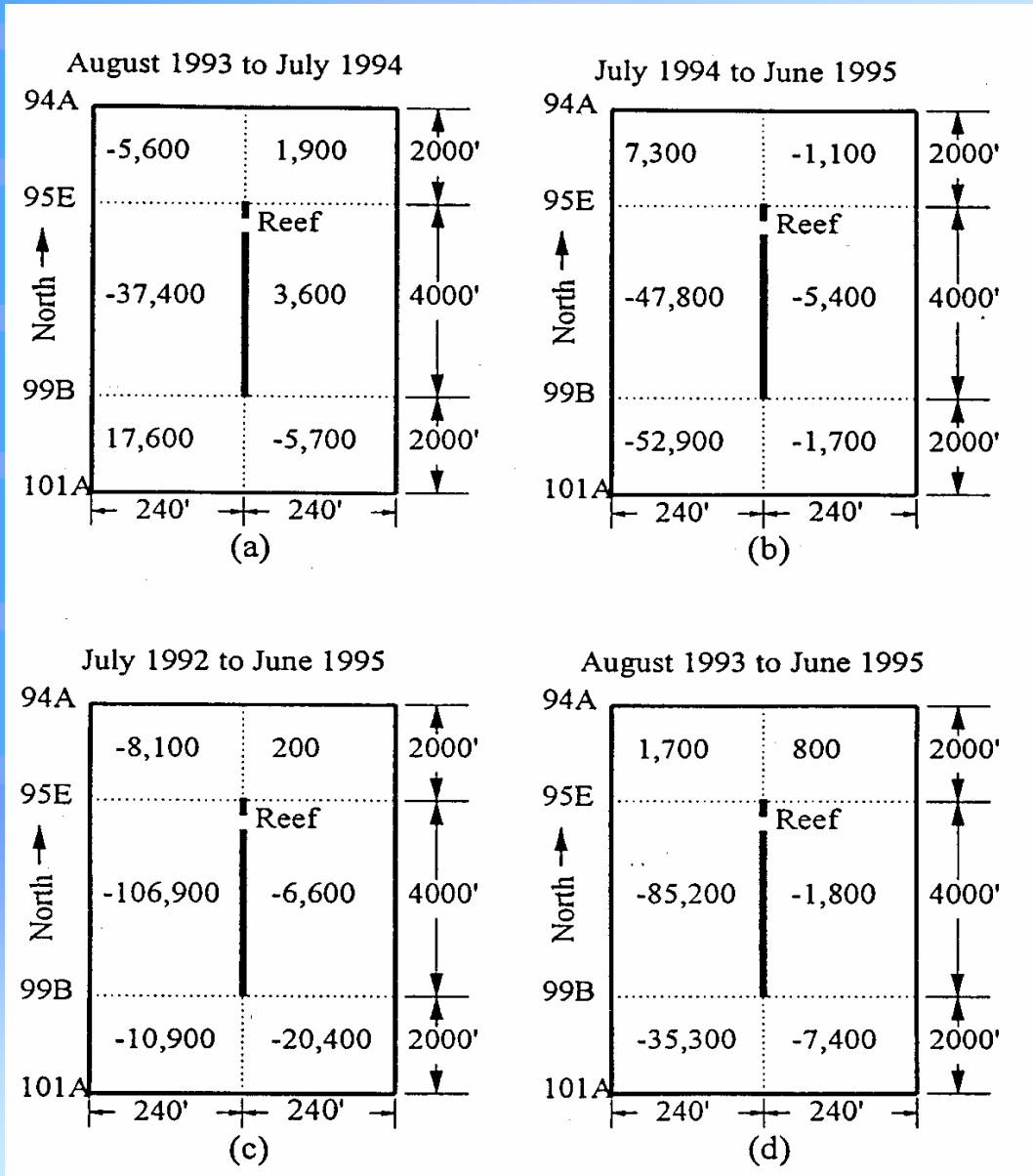


Figure 12 Average Sea Floor Elevation History and Changes in Average Elevations for Scour Rod Numbers 14 through 19

Changes Over Time



Landward Volumetric Changes

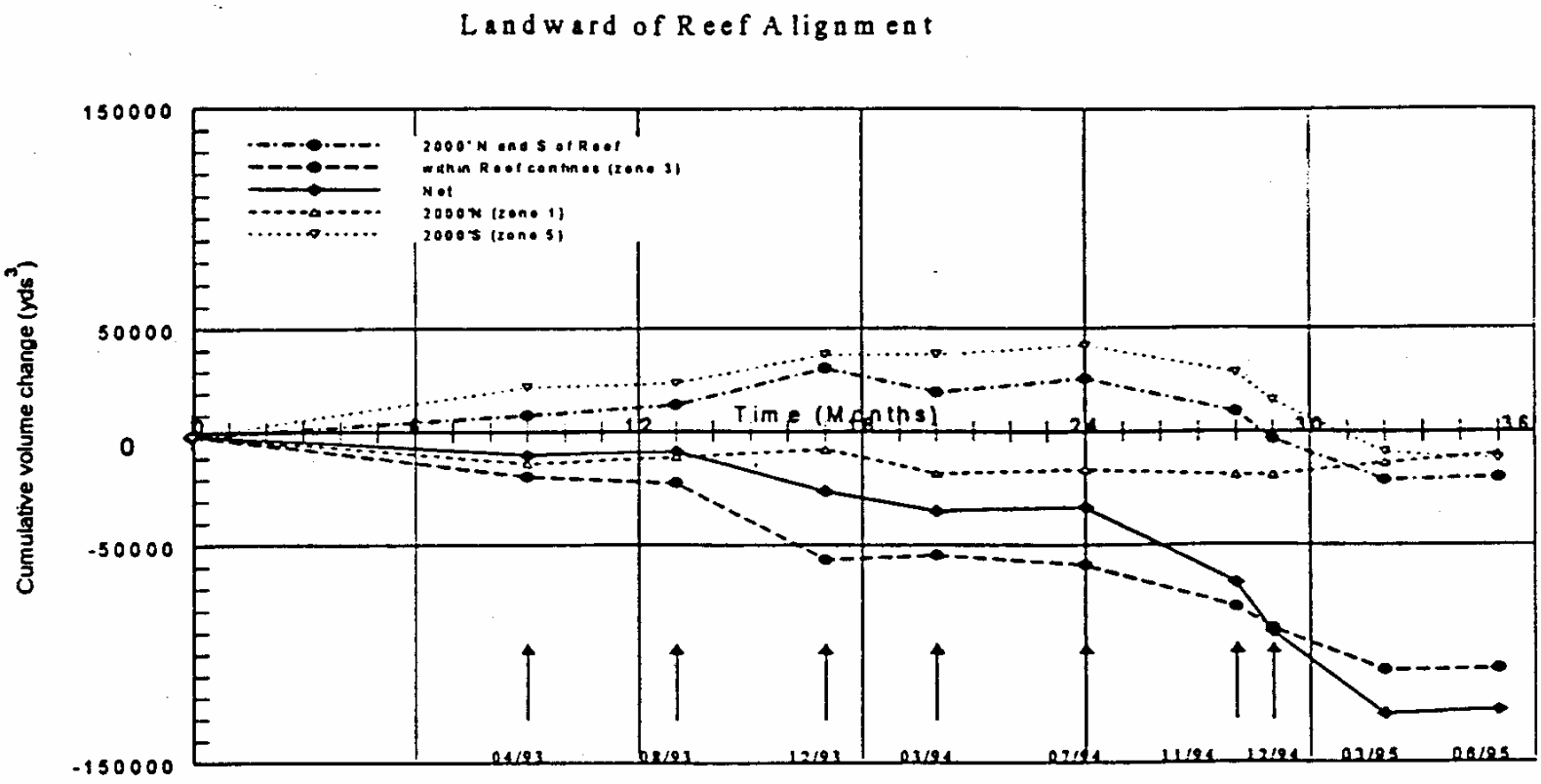


Figure 32 Histories of Cumulative Volume Changes for Three Inner Zones.

Seaward Volumetric Change

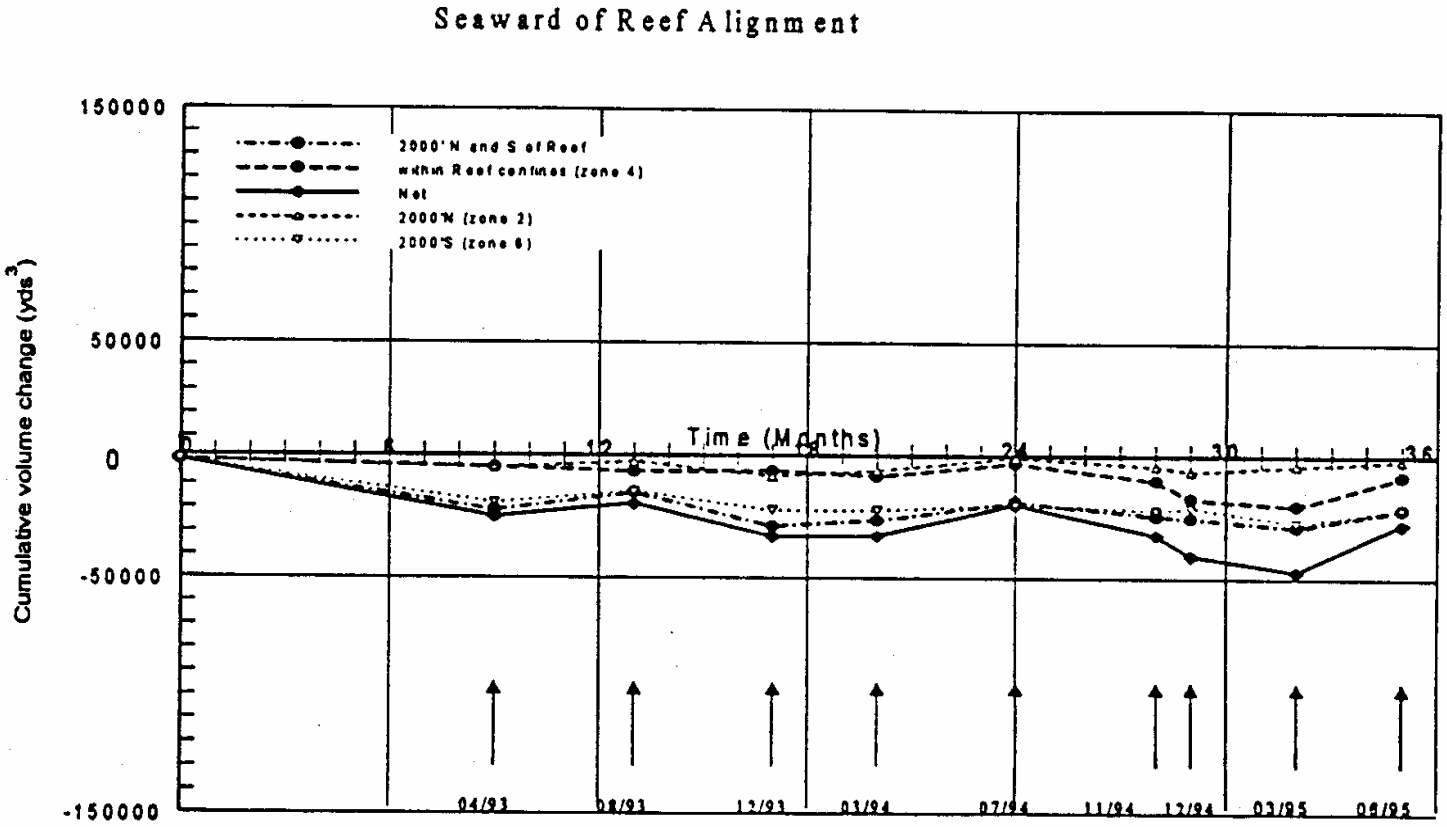


Figure 33 Histories of Cumulative Volume Changes for Three Outer Zones.

23 months following installation, the Town of Palm Beach elected to remove the PEP reef and construct a beach restoration project. The PEP reef units were used to construct a groin field within the project area.

Vero Beach Prefabricated Erosion Prevention Reef (P.E.P.)

- **Installed August 1996**
- **3,000 ft. long, 250 ft. seaward, -7 to -9 NGVD**
- **Environmentally sensitive area**
- **Purpose to reduce wave height, stabilize shoreline and volumetric changes, and reduce storm wave energy.**

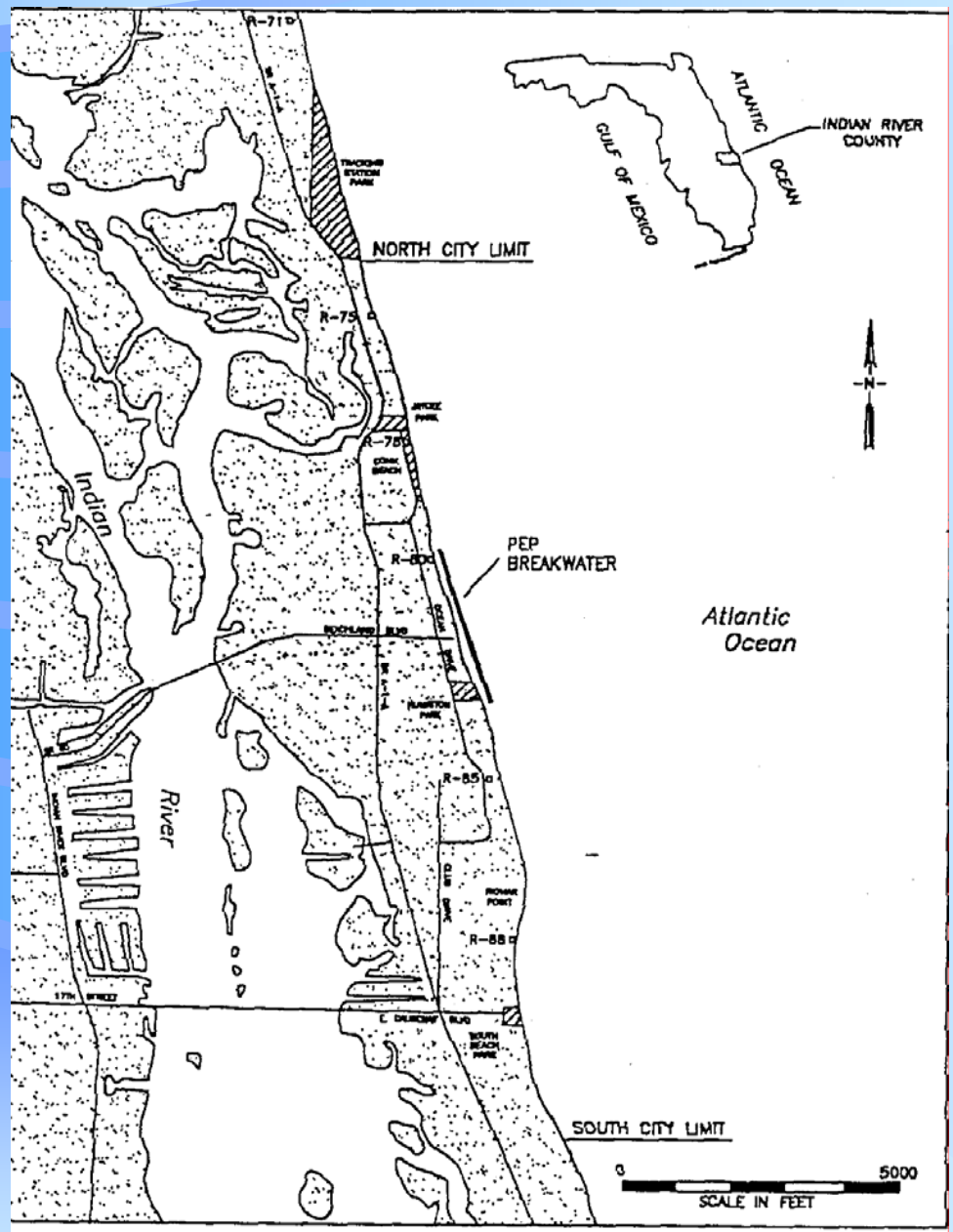
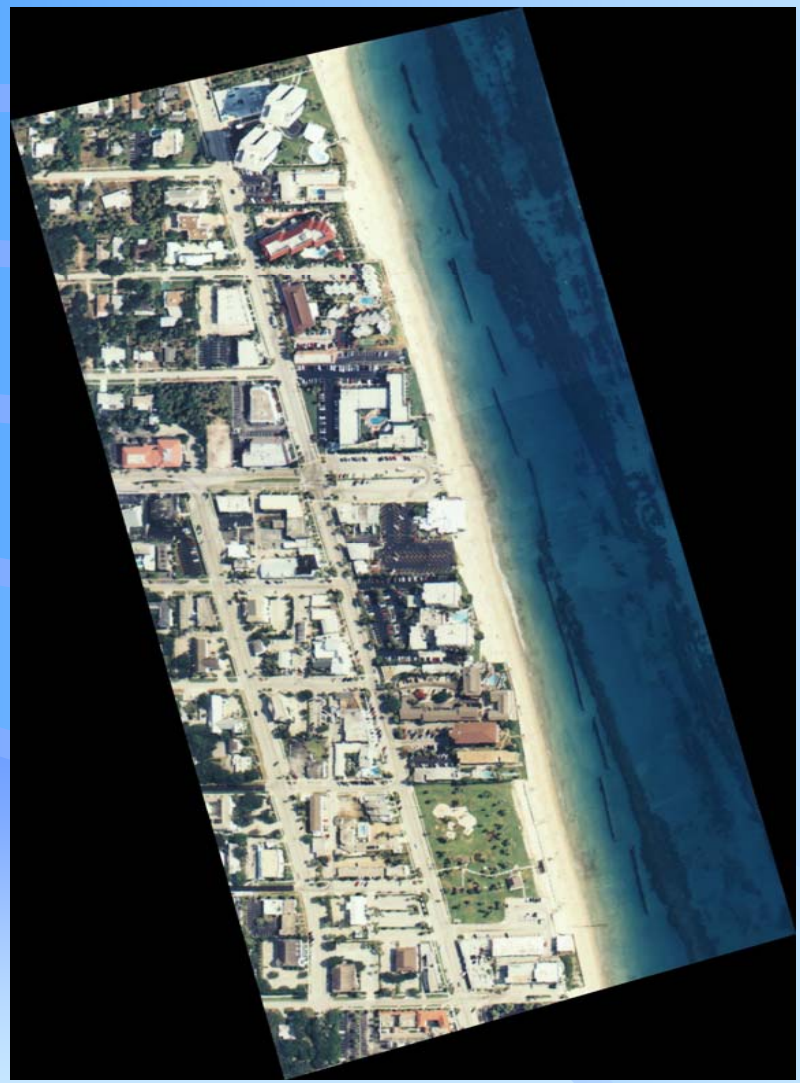
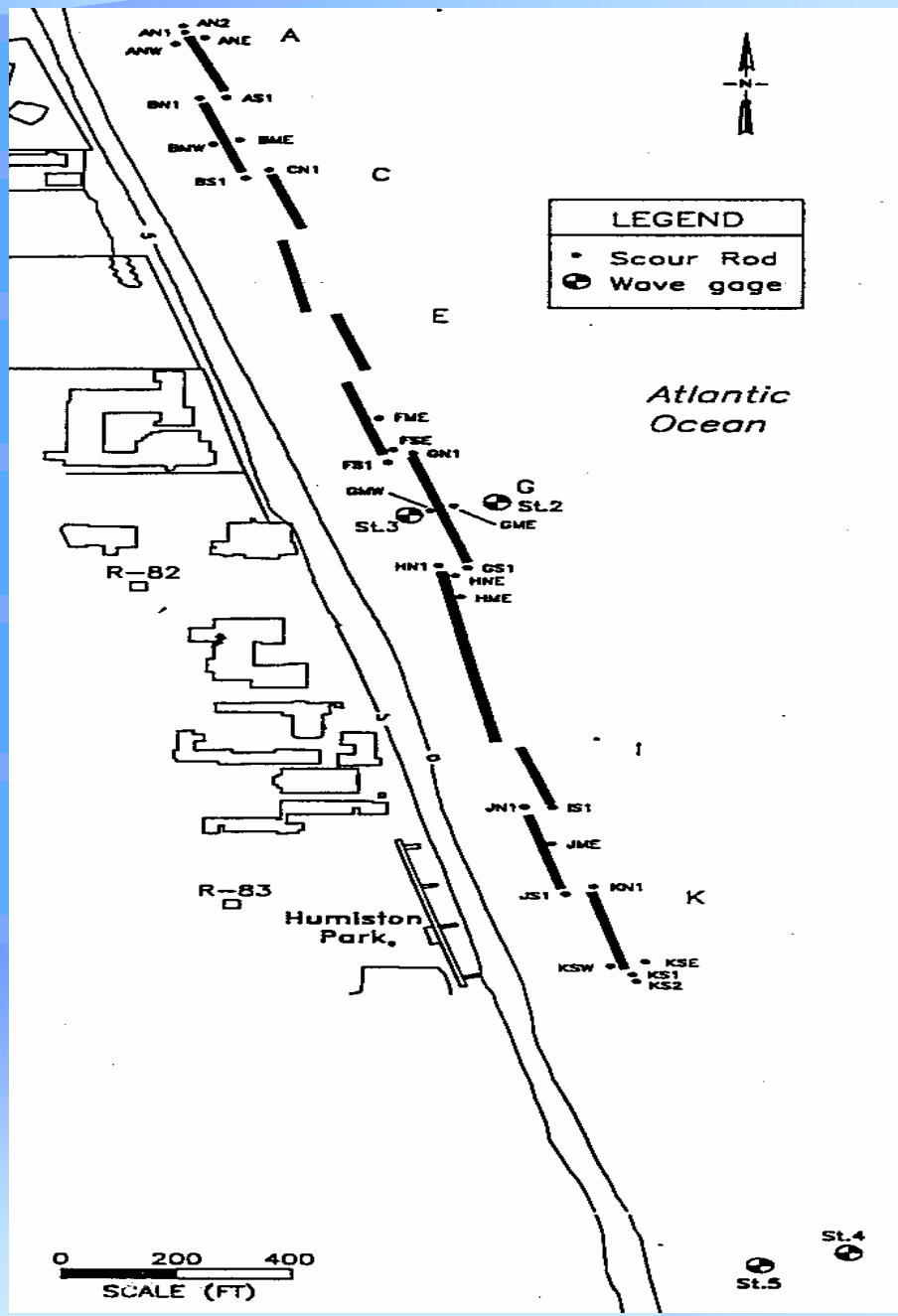
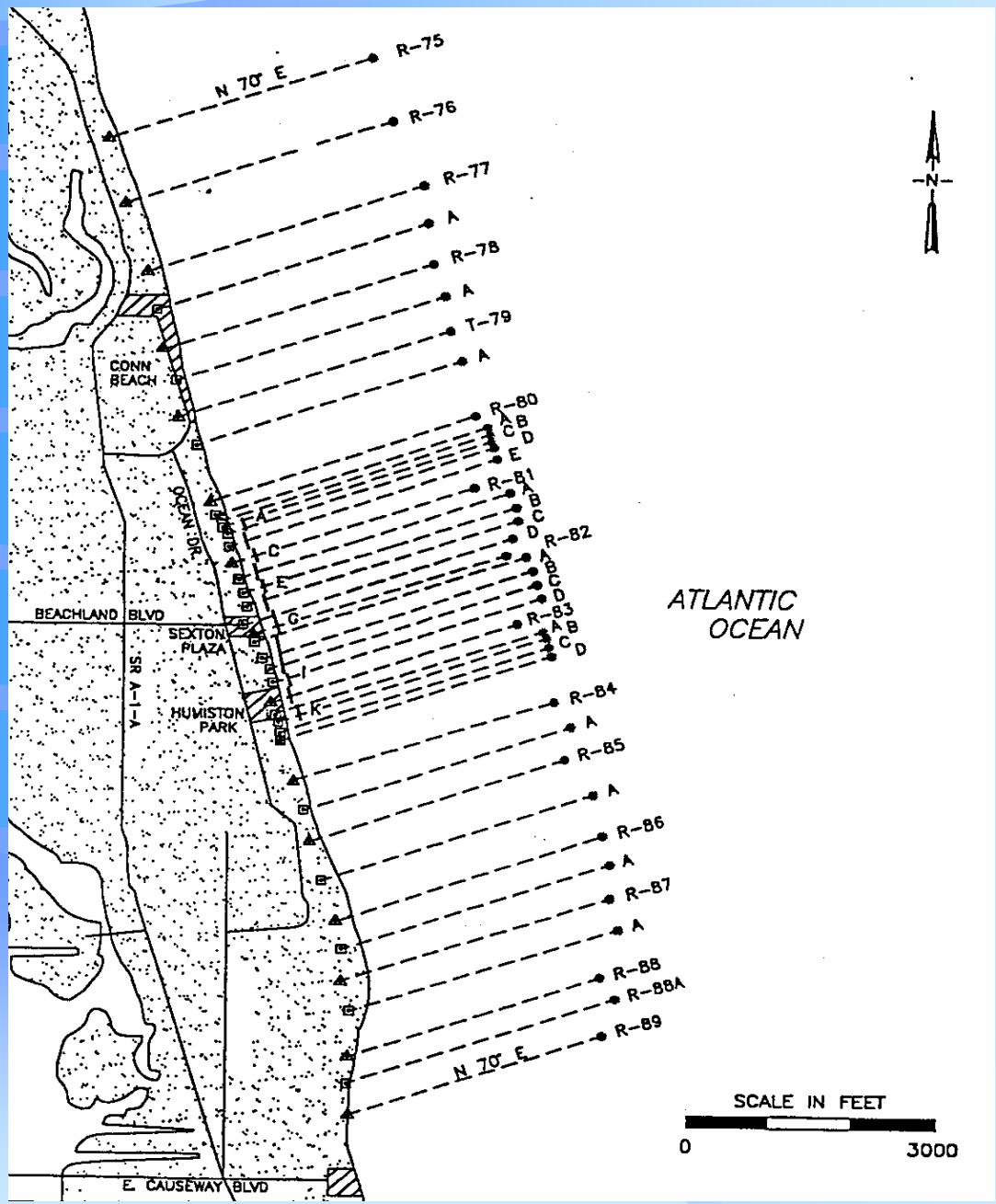


Figure 2. Location of the City of Vero Beach with location of the P.E.P. Reef.

PEP Reef Installation




AN1
AN2
ANW
ANE
A
BN1
AS1
BNW
BME
BS1
CN1
C
LEGEND
Scour Rod
Wave gage
E
Atlantic
Ocean
FME
FSE
FS1
GN1
GMW
G
St.2
St.3
GME
HN1
GS1
HNE
HME
R-82
I
JN1
IS1
JME
JS1
KN1
K
R-83
Humiston
Park
KSW
KSE
KS1
KS2
St.4
St.5
0
200
400
SCALE (FT)


N 70° E
R-75
R-76
R-77
A
R-78
A
T-79
A
CONN BEACH
OCEAN DR
R-80
A
B
C
D
E
R-81
A
B
C
D
R-82
A
B
C
D
R-83
A
B
C
D
BEACHLAND BLVD
SEXTON PLAZA
SR A-1-A
HUMISTON PARK
R-84
A
R-85
A
R-86
A
R-87
A
R-88
R-88A
R-89
N 70° E
E. CAUSEWAY BLVD
ATLANTIC OCEAN
N
SCALE IN FEET
0
3000

The monitoring program indicated minimal effect on shoreline. Indian River County is now pursuing a beach restoration project.

Workshop on Innovative Shore Protection Technology
February 22-23, 2006
Tallahassee, FL

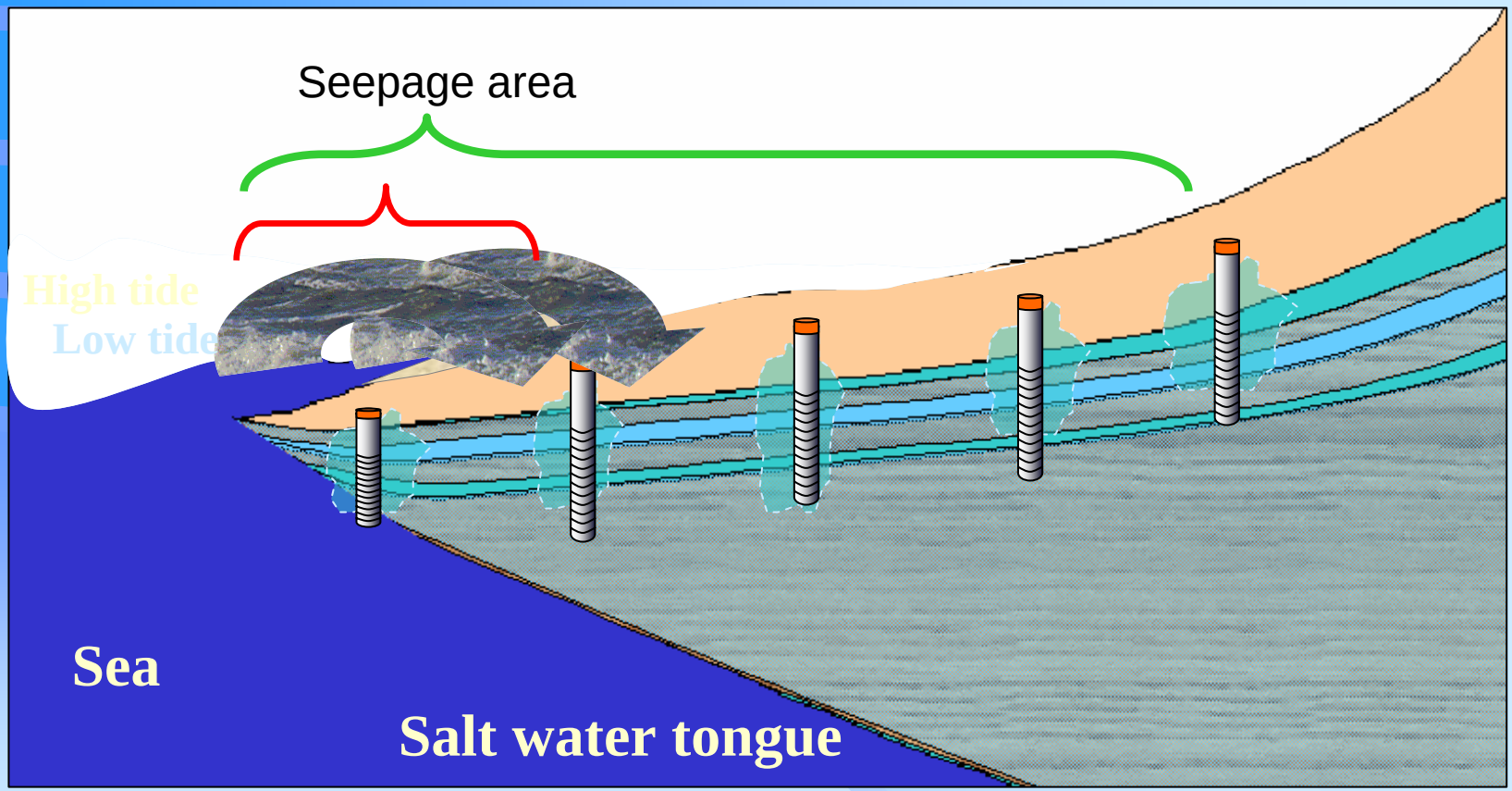
Moderated by an independent coastal engineer from North Carolina

PURPOSE

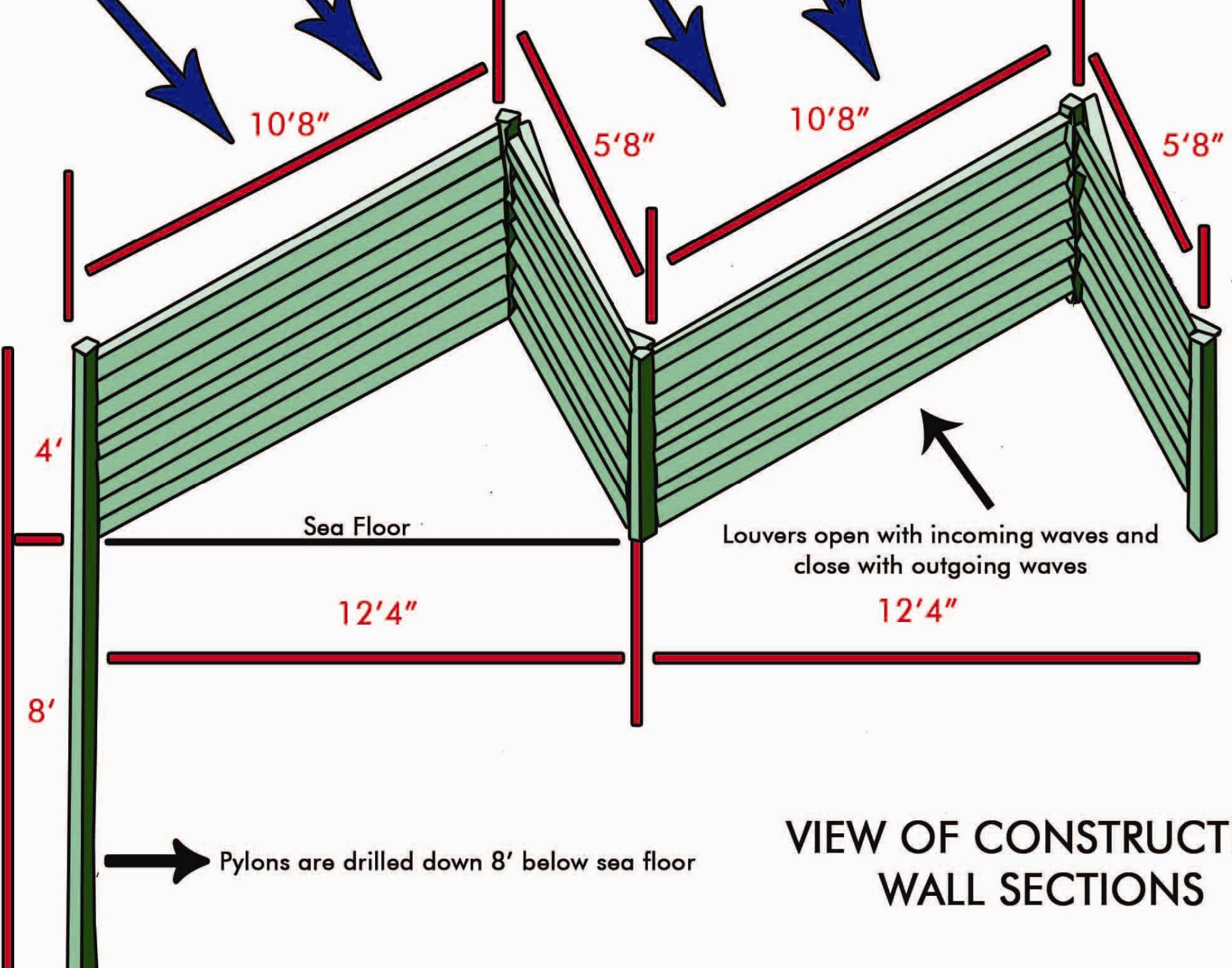
- Explain Regulatory Process
- Explain Funding Opportunities
- Include Other State and Federal Agencies
- Review Innovative Presentations

New Dewatering System

PEM Function dewatering the beach



New Structures



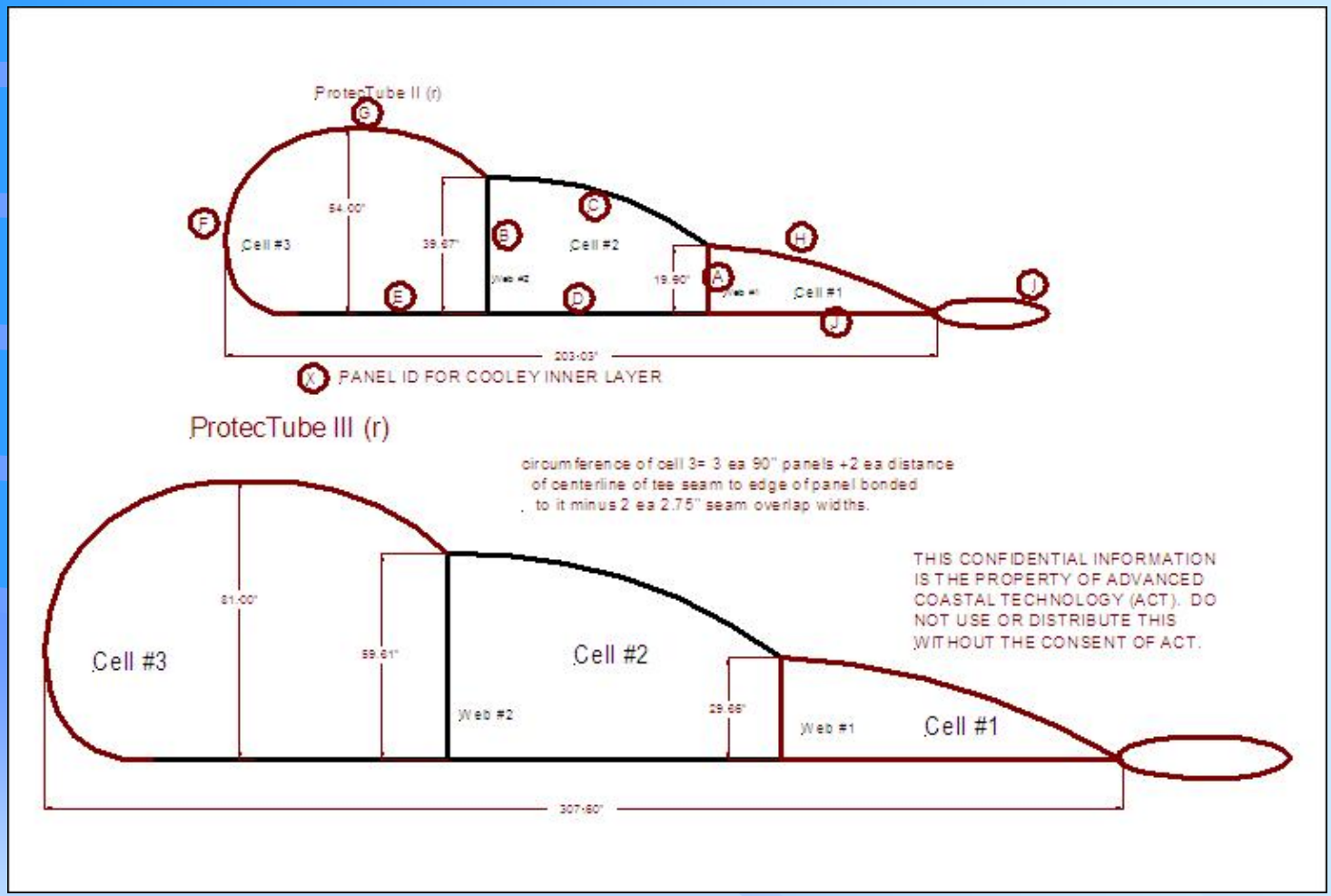
VIEW OF CONSTRUCTED WALL SECTIONS

SEAMOD Variable Sizes

- **Built on ideas from NavSea for the modular building of ships**
- **Same idea – precast concrete modules**
- **More cost effective than steel**
- **Easier to construct than steel**
- **Greater durability than steel**
- **Less maintenance**

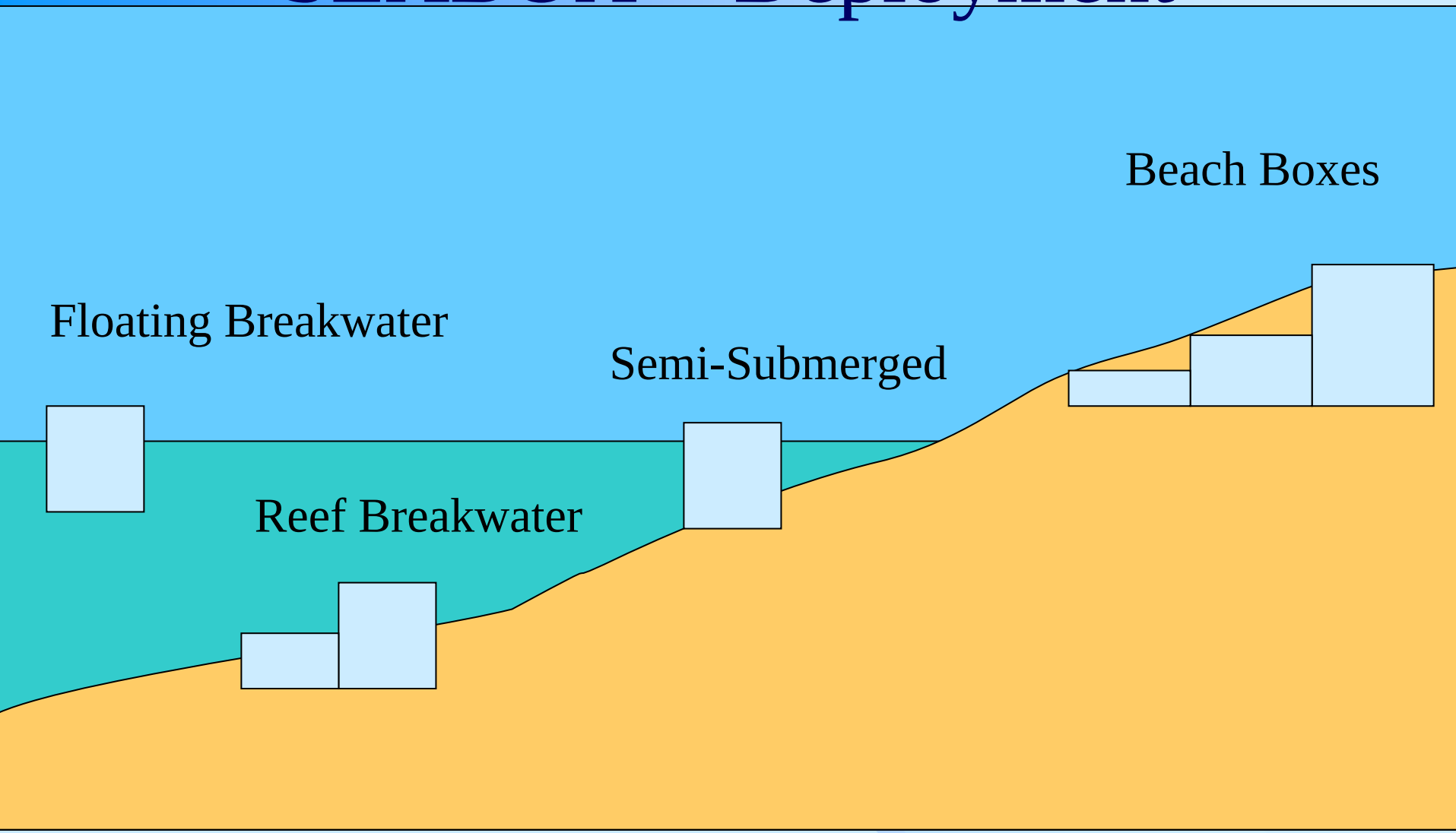
Subsurface Dune Protection Systems

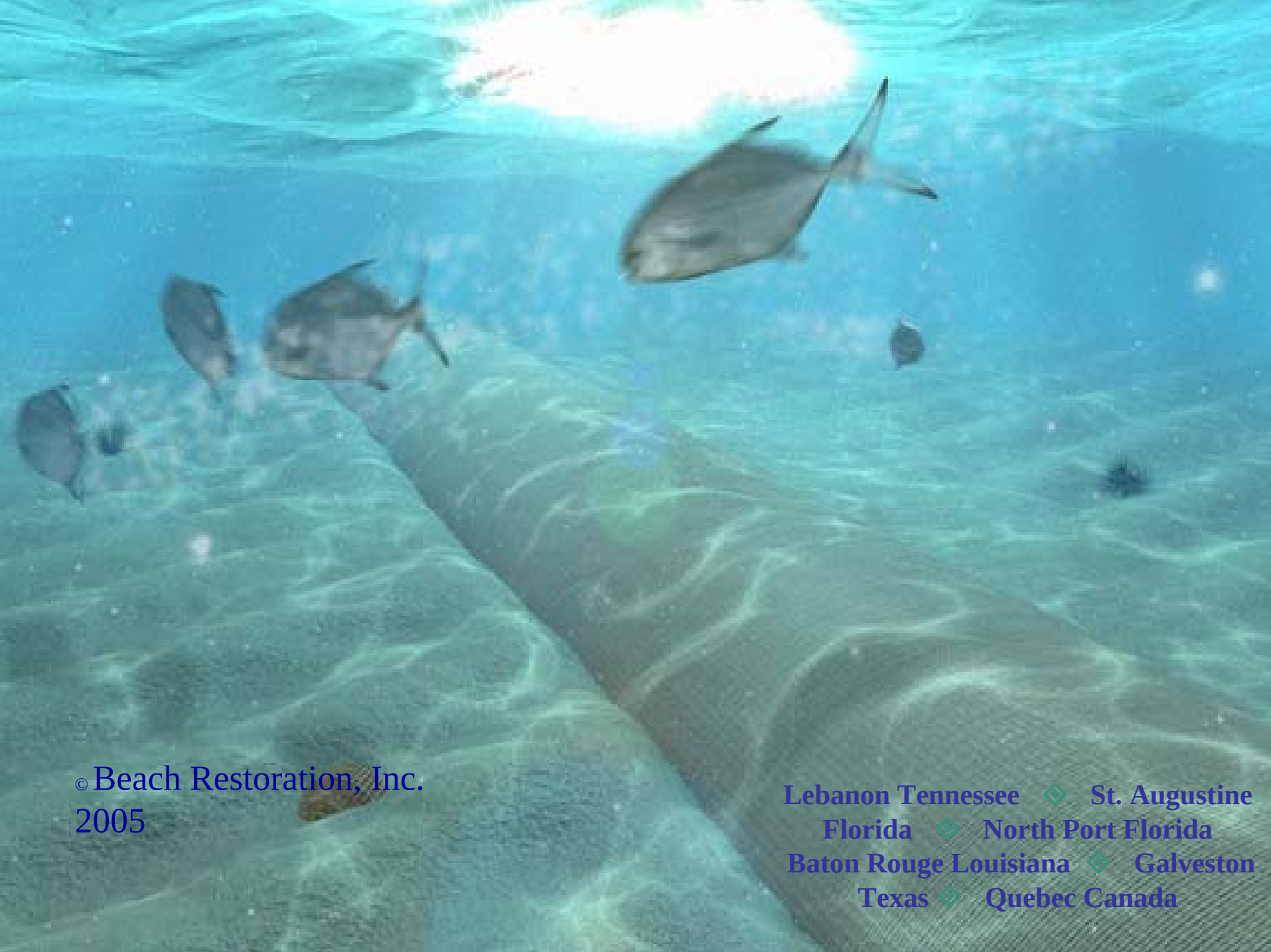
ProTecTube™ II & III Comparison



Water & sand “inflatable” Emergency Response Device

SEABOX™ Deployment





Lebanon Tennessee ◇ St. Augustine Florida ◇ North Port Florida Baton Rouge Louisiana ◇ Galveston Texas ◇ Quebec Canada

New Mitigation Solutions

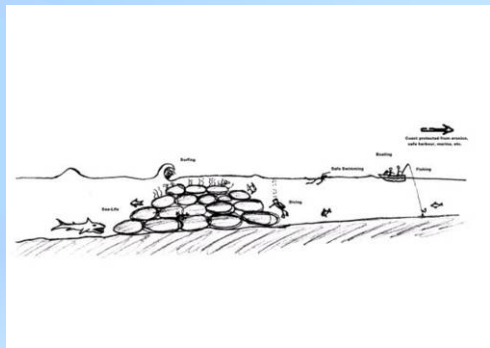
Multi-Purpose Reefs

Coastal Protection

- **Surfing**
- **Diving**
- **Swimming**
- **Windsurfing**
- **Fishing**

Multi-use aspects

A technology inspired by Nature



Nature's way. Offshore reefs naturally protect the coast

Reef Ball™ Units

Where Do We Go From Here?

More Scientifically Based Approach to Investigate Innovative Technologies…

- **Numerical & physical modeling**
- **Peer review & analysis**
- **Use of experimental test plan**

Where Do We Go From Here?

Develop Innovative Applications Using Conventional Technologies…..

- **Structures to improve beach restoration project performance**
- **Different construction technologies to reduce environmental concerns**
- **Construction design to improve project performance and reduce environmental impact.**

Where Do We Go From Here?

New Dredging Systems…..

- **More efficient dredging vessels and deep water systems**
- **Separation technology such as the hydrocyclone to utilize marginal material**
- **Improve quality control**

The End