SECTION 227

ASBPA 2005 Conference & Annual Meeting
San Francisco, California
12 October 2005

Multi-Purpose Submerged Reef at Oil Piers in Ventura County, California for the National Erosion Control Development and Demonstration Program (Section 227)

Susie Ming, P.E.
U.S. Army Corps of Engineers
Los Angeles District

What is Section 227?

SECTION 227

The National Shoreline Erosion Control Development and Demonstration Program

- ❖Authorized under ***Section 227*** of WRDA'96
- ❖6-year, $21M R&D effort beginning FY00
- ❖In cooperation with other Federal and non-Federal agencies to address coastal erosion challenges
- ❖Focus: development and <u>demonstration</u> of innovative or non-traditional technologies
- ❖Develop design guidance & assessment tools
- ❖ Tech transfer to coastal engineer, scientist manager

MOTIVATION

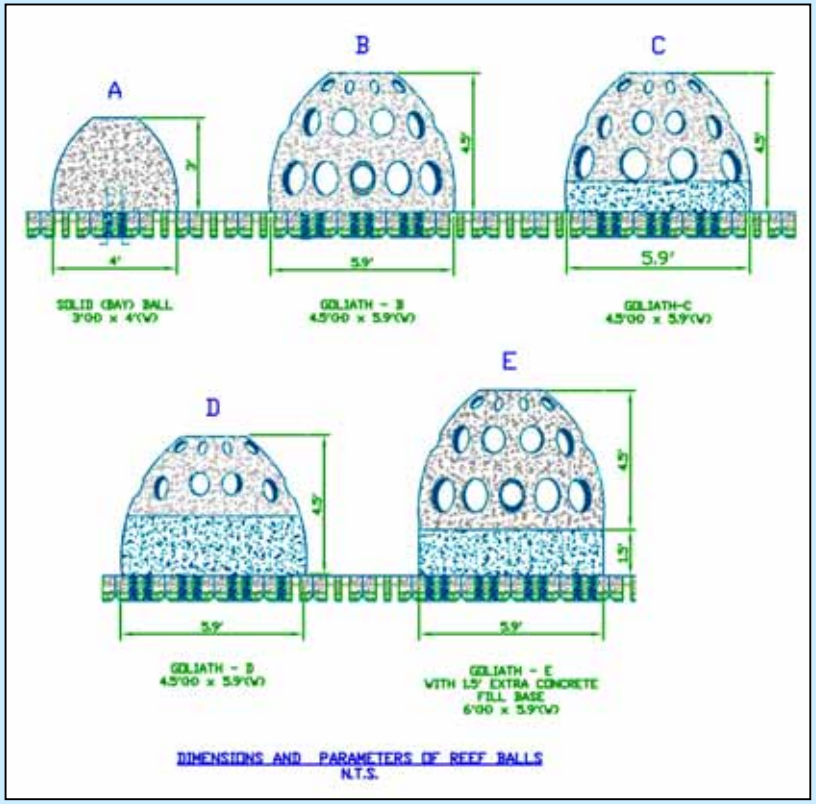
Modern coastal engineering practice requires demonstration and testing of today's innovative approaches and materials to continue positive evolution in the profession

Geotextile Tube Repair, Bolivar, TX

APPROACH CONSIDERATIONS

SECTION 227

- ❖Interaction with coastal system
- ❖Performance projection
  - ❖Spatial and temporal
  - ❖Define success
- ❖Life-cycle cost evaluation
- ❖Monitor-able
- ❖Engineering considerations
- ❖Institutional considerations
- ❖Innovative/non-traditional



Reefball-articulated mat design concept

MONITORING CONSIDERATIONS

- Established on per-site basis and performance statement
- Control area/baseline data
- Functional performance
- Structural stability
- Site conditions
  - Hydrodynamic
  - Sediment transport
- Environmental impact
- <u>Transferability assessment</u>

Sand probing

SITE CONSIDERATIONS

- ❖Manageable rate of erosion
- ❖Non-unique coastal system
- ❖Adequate spatial scale
- ❖Monitor-able
- ❖Baseline data/control area
- ❖Minimal negative impact
- ❖Public access

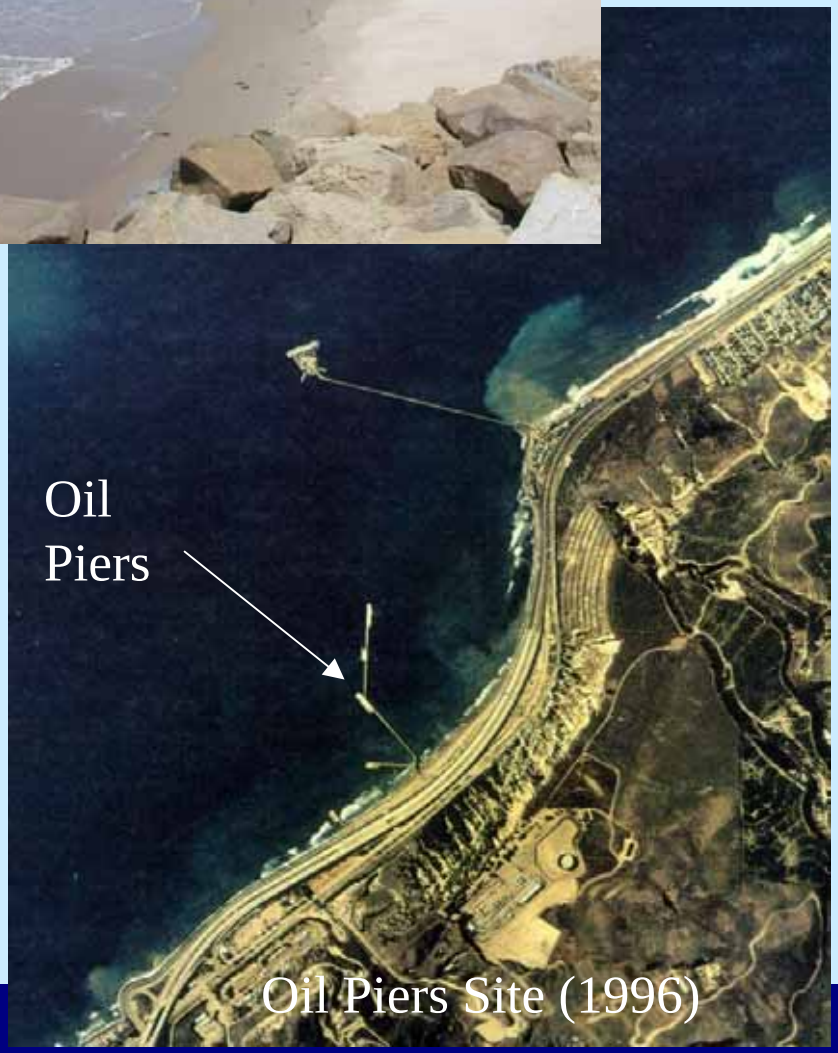
POTENTIAL DEMONSTRATION SITES

- Oil Piers, Ventura County
- South Carlsbad State Beach, Carlsbad
- Moonlight State Beach, Encinitas
- Fletcher Cove, Solana Beach

OIL PIERS SITE

SECTION 227

- Land owned by County of Ventura and California State Lands Commission
- Located in northern Ventura County along Highway 101.
- The beach is backed by a rock revetment and bluff.
- Beach access



Oil Piers Site (1996)

EROSION CHALLENGE

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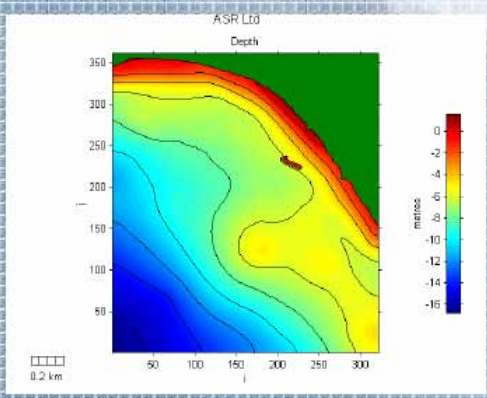
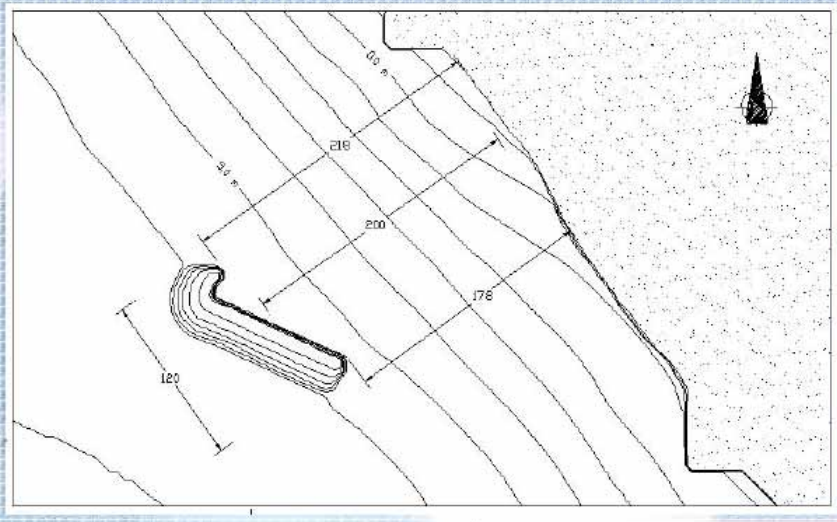
Oil Piers looking North

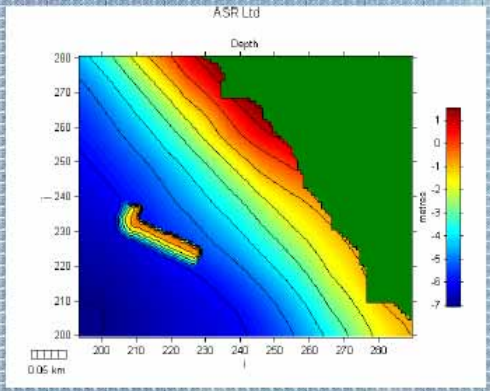
Oil Piers looking South

30% Design – ASR

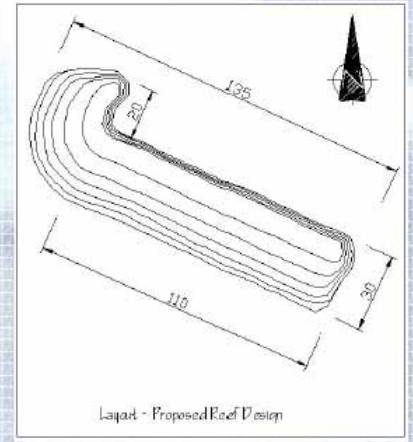
Functional Assessment - Preliminary Reef Design





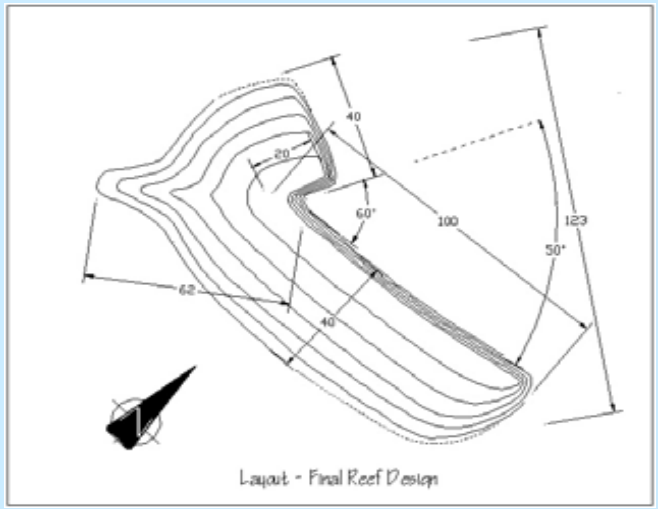


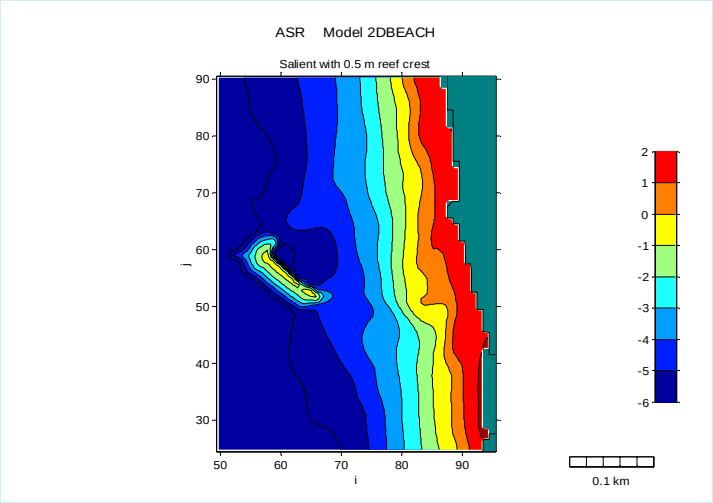
The Oil Piers Reef is 200 m offshore and 120 m alongshore, and has a volume of ~15,000 m³, crest height –0.5 m



Detailed Design

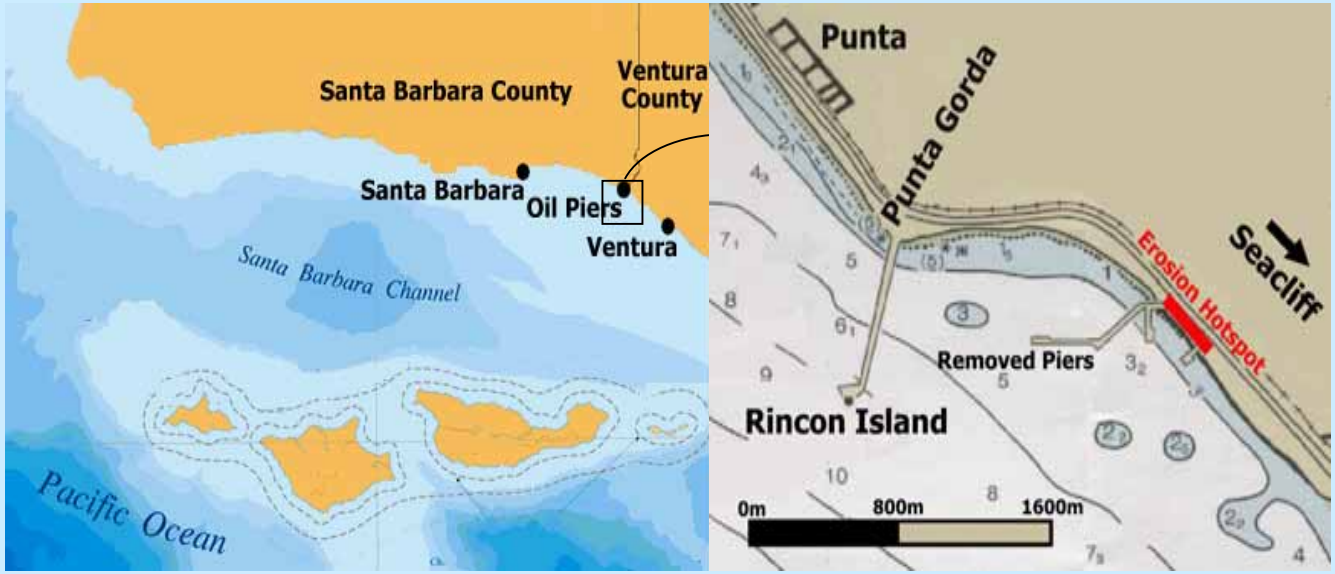
- ❖Field Program
- ❖Detailed Analysis of Wave Climate
- ❖Model Calibration
- ❖Design
- ❖Assessment of Functional Performance
- ❖Sensitivity Testing of Crest Height





ASSESSMENT OF COASTAL PROCESSES

- ❖Existing Technical Reports (e.g. Noble, 1989a, b)
- ❖Existing Data (e.g. Beach Profiles, wave buoy data, etc.)
- ❖Bathymetric Grid Generation
- ❖Wave Transformation (Numerical Modeling) – regional and local



EXISTING DATA ANALYSIS

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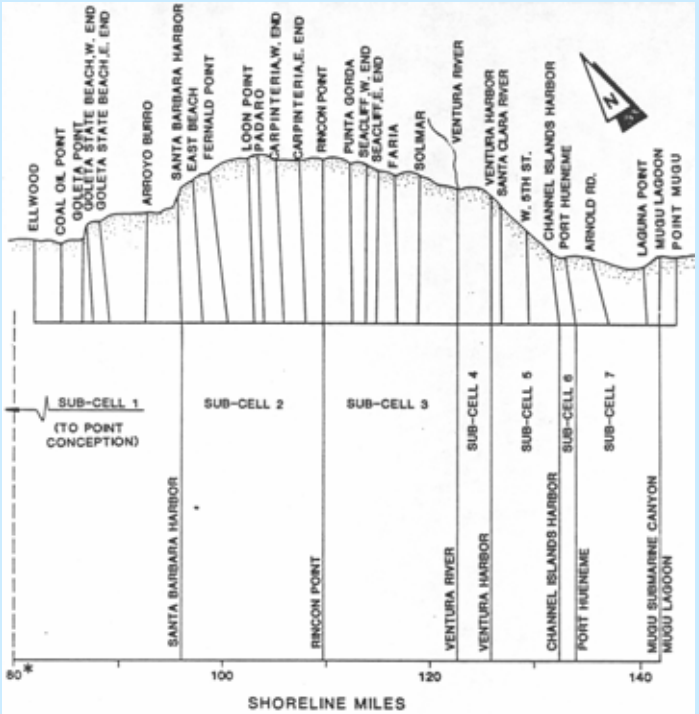

The Santa Barbara Littoral Cell

- ❖ Uni-Directional sediment transport to the East = ~ 250,000 cubic yards
- ❖Limited sediment supply from minor stream discharges
- ❖ Large offshore sediment deposits
- ❖ Most sediment movement and erosion occurs during large wave events generated by eastern Pacific low pressure systems

SITE-SPECIFIC DATA

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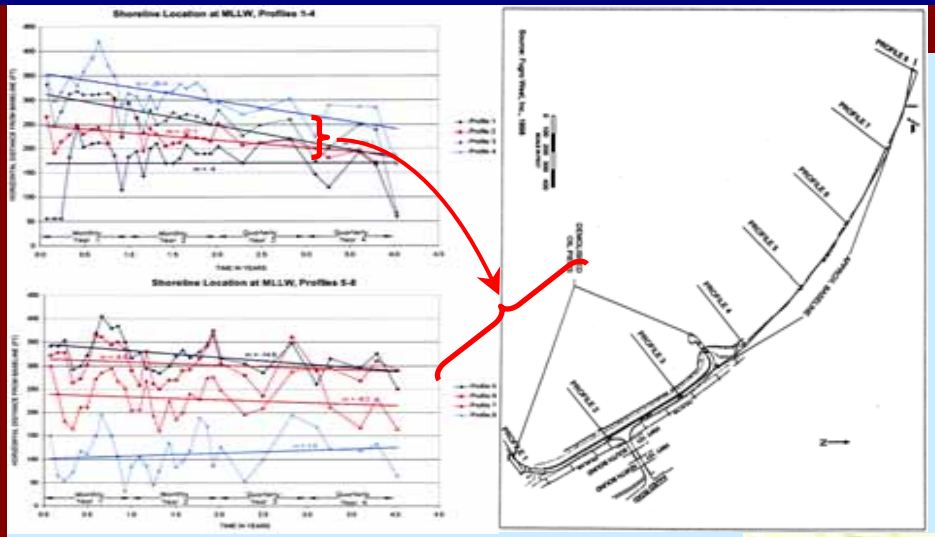
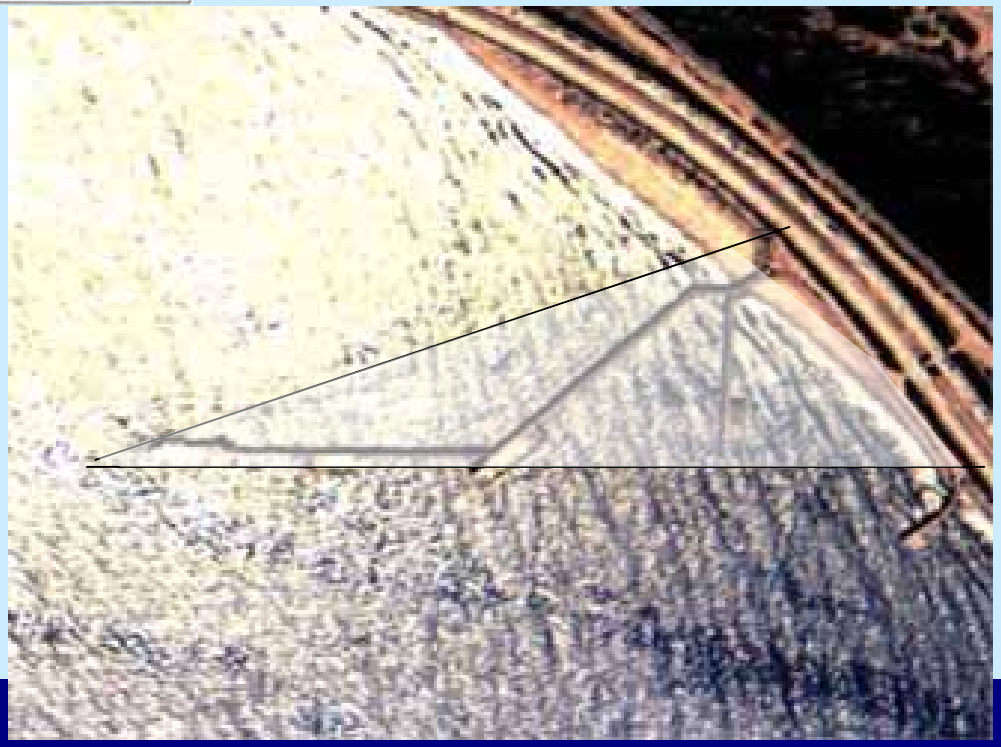


Erosion at Oil Piers is mostly restricted to the eastern part of the beach, between the remains of the oil pier access trestles (~300 m), demonstrating that the removal of the piers has caused this local erosion

Solution: An offshore submerged reef that reduces wave heights at the shoreline during high wave events, while still allowing sediment to by-pass alongshore between the structure and the beach, will provide a sediment retention mechanism for Oil Piers beach.



WAVE ENERGY ATTENUATION

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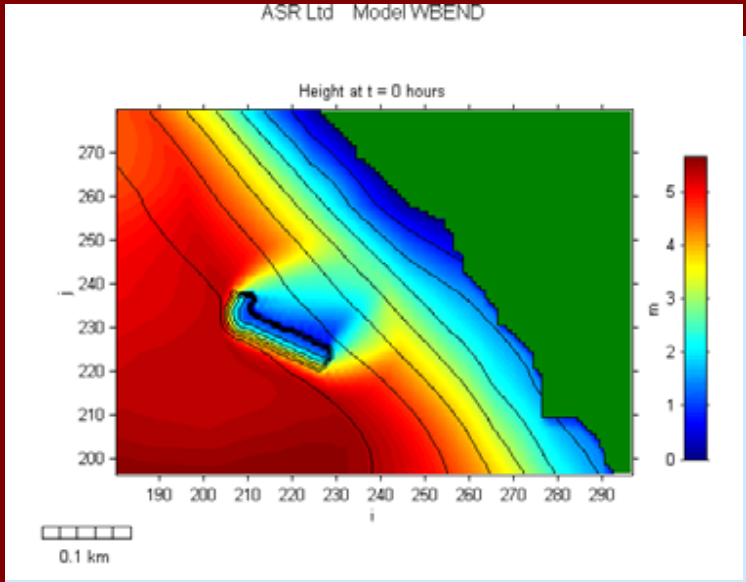
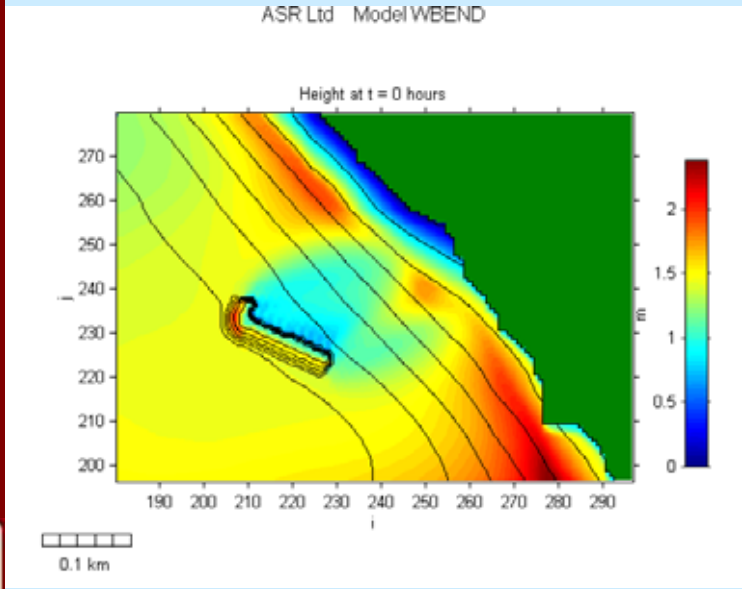


Design Event – 4 m waves, 2.43 m tide

4.0 m Wave Height (1 in 10 year storm event) - during a storm event with storm surge combined with a yearly maximum tide level, any waves over 3.5 m high would be dissipated by the reef

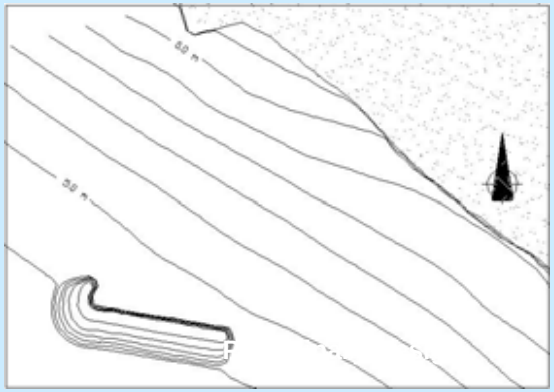


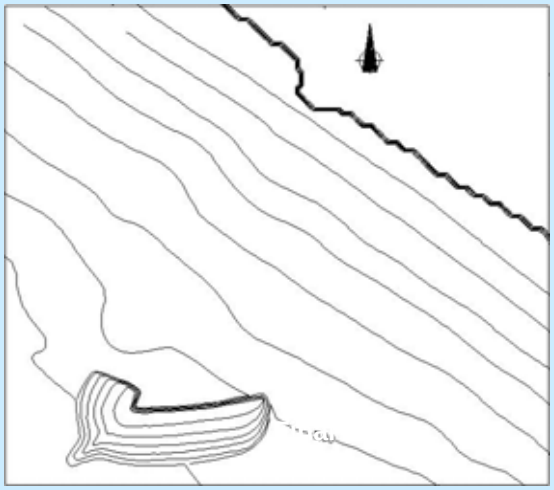
Mean Waves – 0.87 m waves, 0.85 m tide

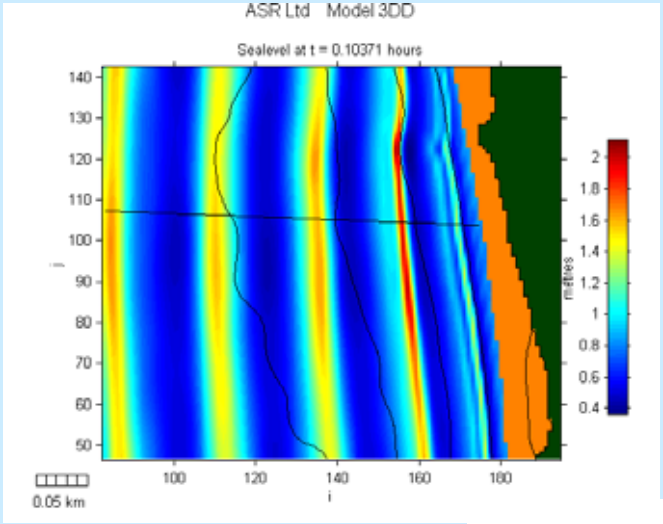
1.2 m Wave Height - at mean low tide waves of over 0.65 m would break on the reef

Model simulations with the complete set of boundary conditions over a range of tidal levels indicated that the reef provided sufficient wave height attenuation for the coast protection

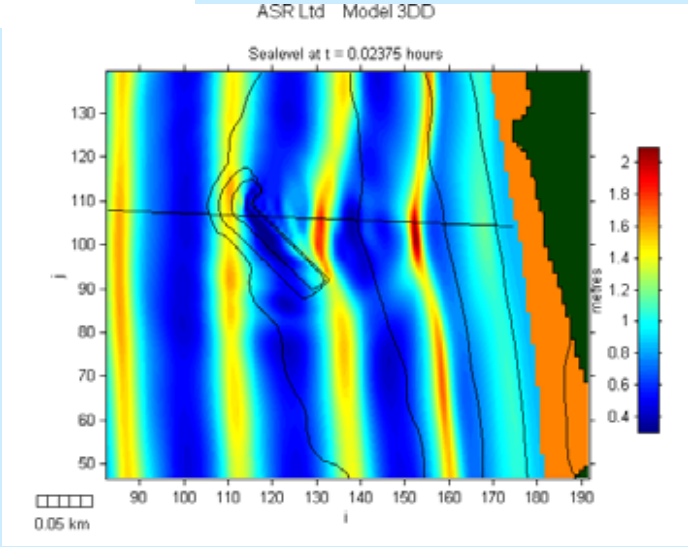
WAVE ROTATION







Waves rotated 10 degrees northward at break point



Re-aligns wave crests and/or spreads wave energy to reduce wave driven-currents

Salient Formation

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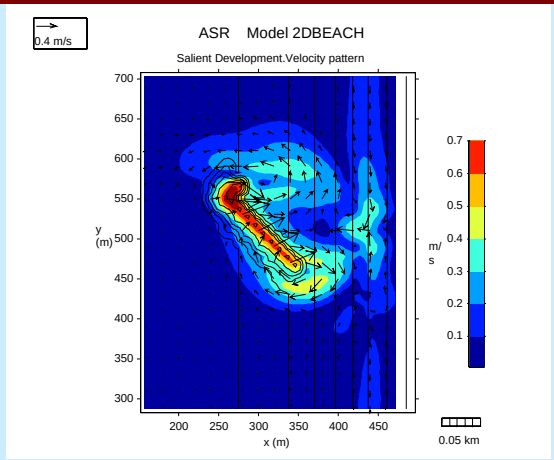
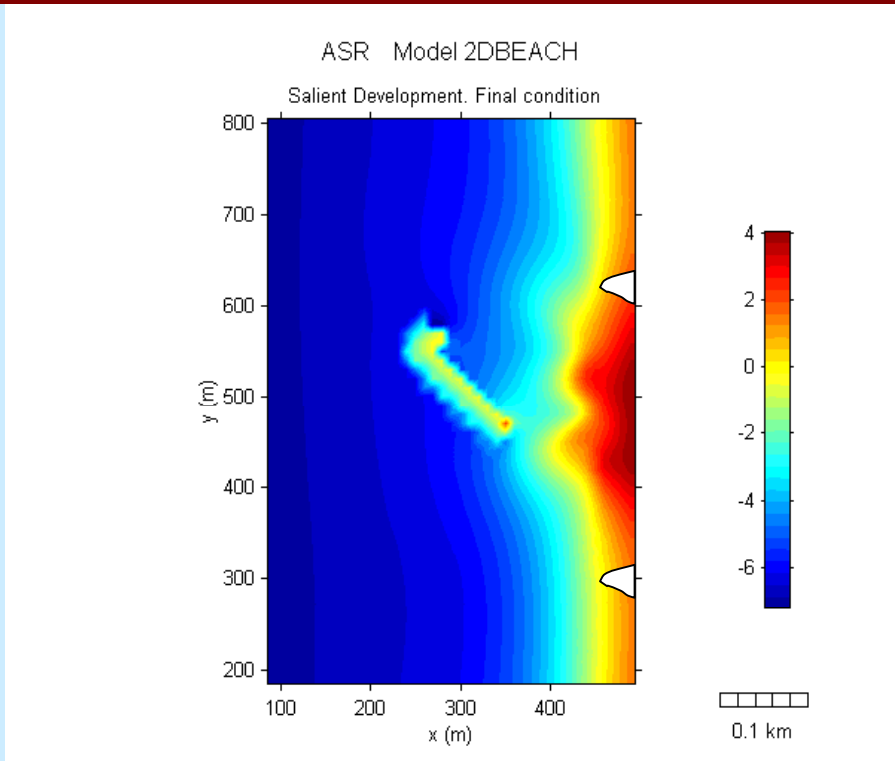


Wave induced currents around the reef



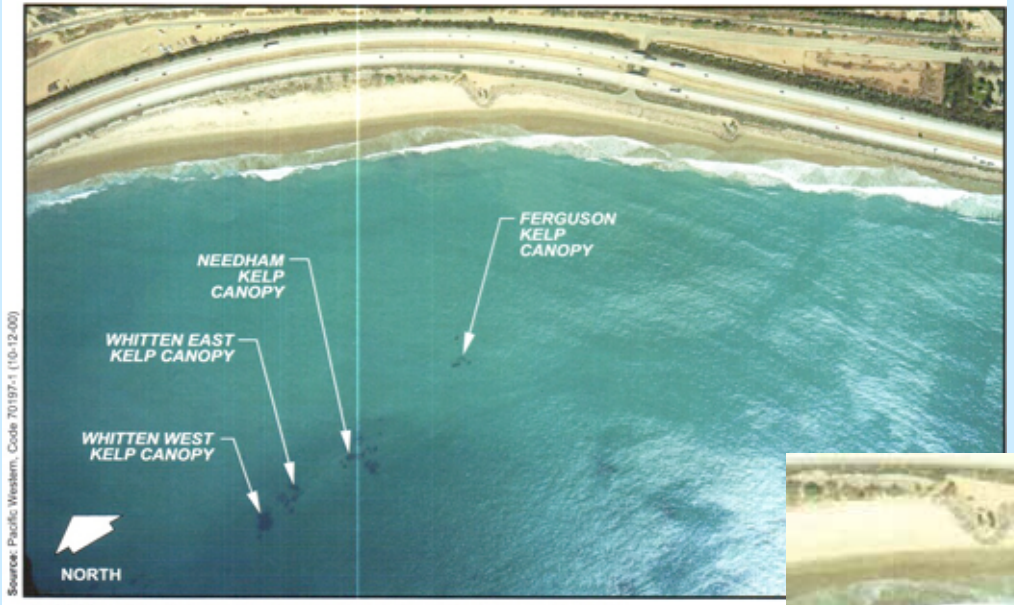
Evolution modeling

The predicted size of the salient that will form in the lee in the preliminary reef design will <u>widen the beach by 90-110 m</u> at its widest point behind the reef and <u>extending at least 400 m alongshore</u>

Ecological Impacts

SECTION

August 2003
Project No. 0302-0151



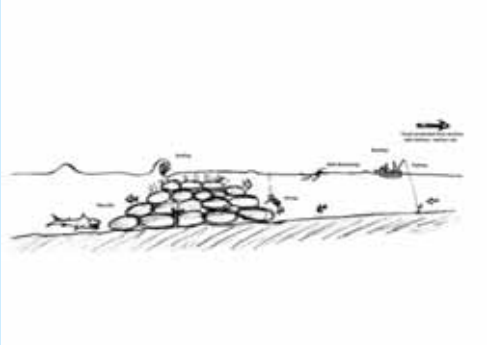
Source: Pacific Western, Code 70197-1 (10-12-00)

A. 2000 aerial photograph showing kelp canopies at the project site.

MULTI-USE ASPECTS

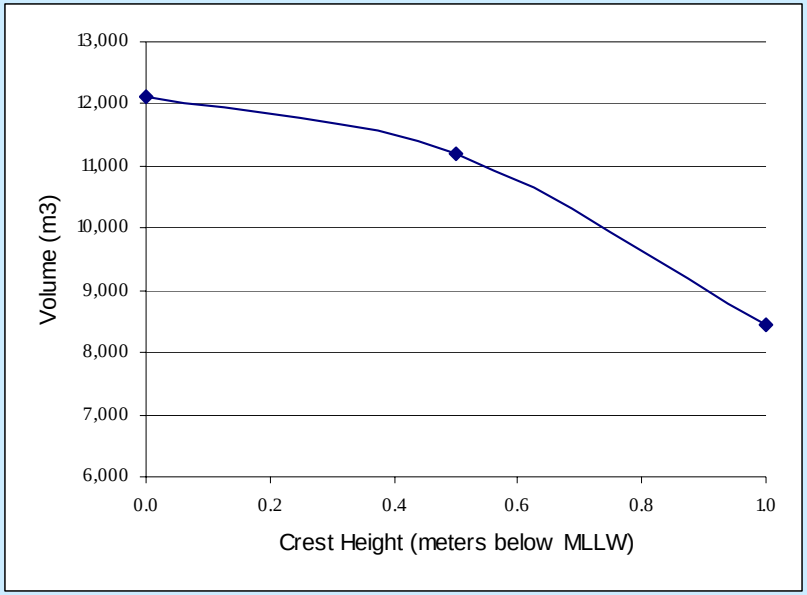
- Coastal Protection
- Surfing
- Diving
- Swimming

A technology inspired by Nature

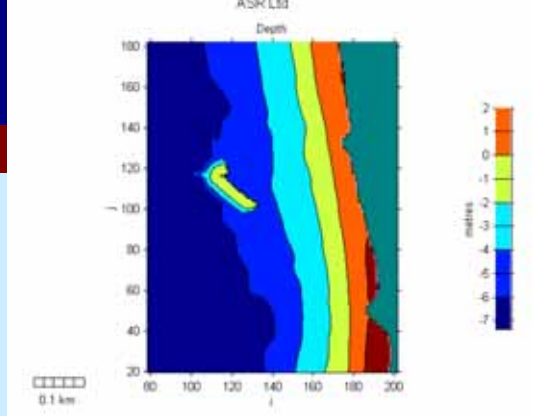


Nature's way. Offshore reefs naturally protect the coast

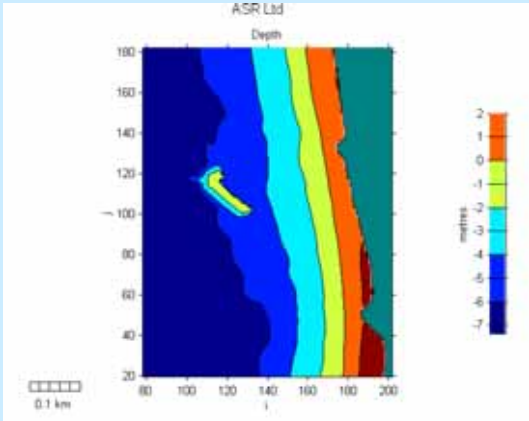
SENSITIVITY TESTING



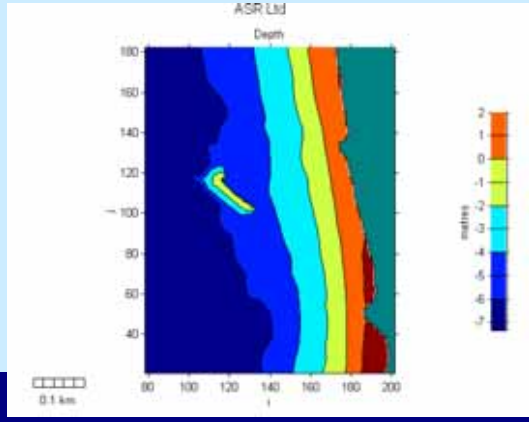
Case	Volume (m^3)
0.0 m crest height	12,100
-0.5 m crest height	11,200
-1.0 m crest height	8,440



MLLW (0.0 m)



-0.5 m



-1.0 m

If the crest was to be set at <u>0.0 m</u>, the reef would be exposed ~<u>14%</u> of the time (compared to <u>0.3%</u> at a crest level of <u>-0.5</u>). In addition, the volume of a 0.0 m crested reef is some <u>33%</u> greater than a reef with a -0.5 m crest level, which adds significantly to construction costs.

100% DESIGN - ASR

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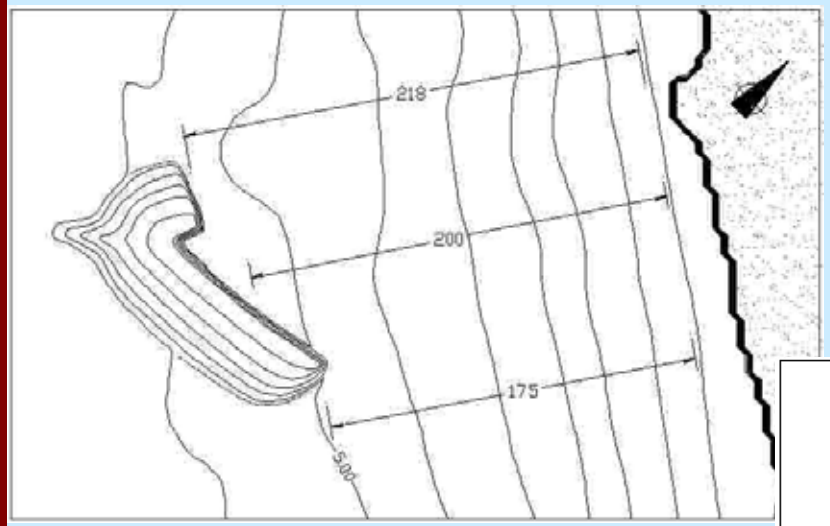
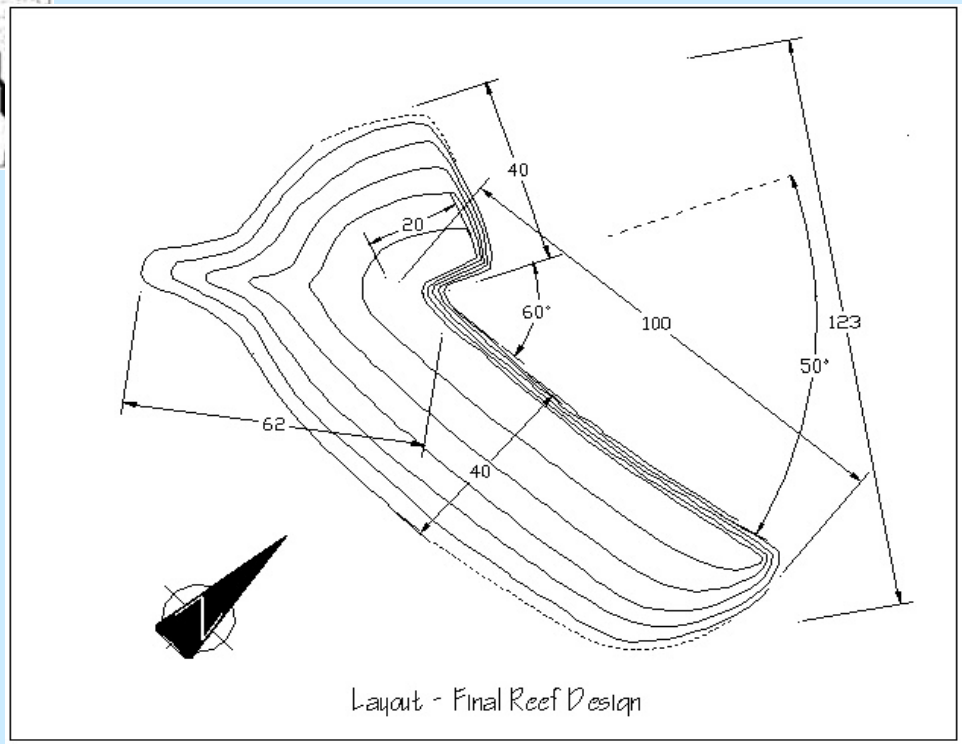


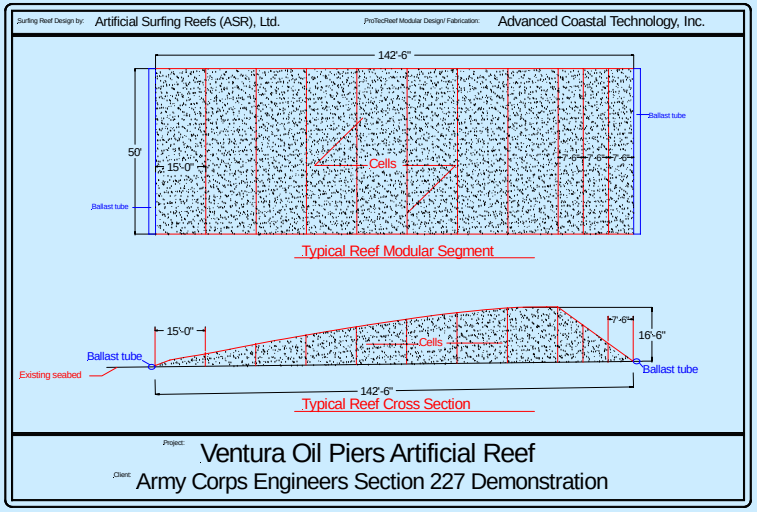


- 200 m offshore
- 123 m alongshore
- Volume of ~17,100 m^3
- Crest height –0.5 m
- Beach Nourishment
- Cost - $2 to 2.5M

CONSTRUCTION MATERIALS AND METHODS

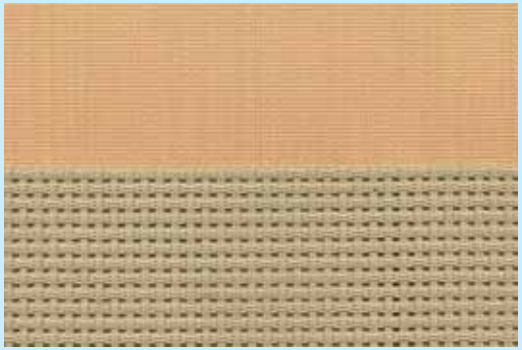
SECTION 227

- ❖Much Better Construction Tolerances
- ❖ No Difficulties with Depth of Reef Crest
- ❖ Local Manufacturer and US Technology



Large SFC's can be made to reef profile

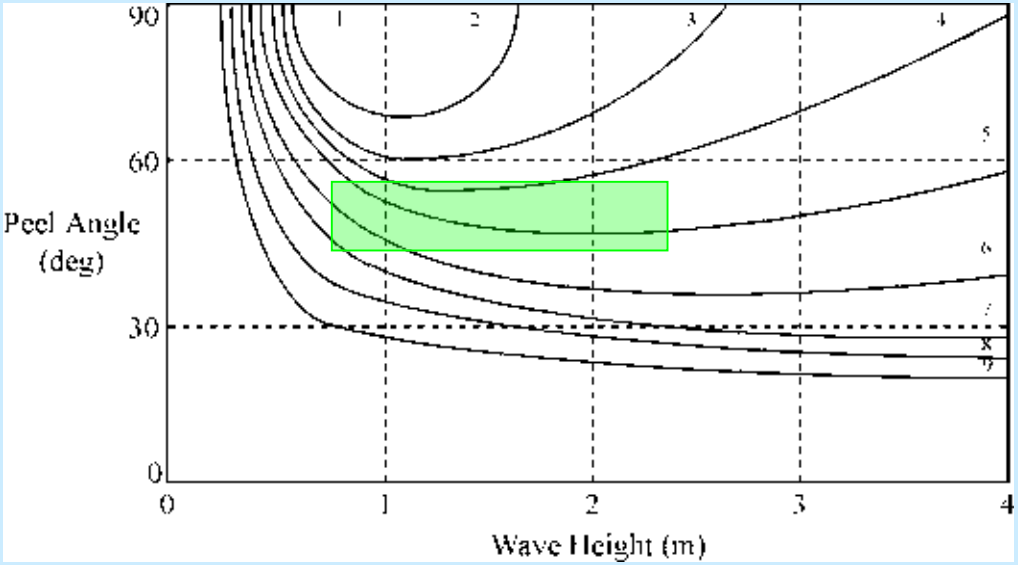
- ❖ Constructed from 11 Segments
- ❖ Each approximately 40 m x 15 m x 5.5 m
- ❖ Secured on the Seabed by Divers
- ❖ Filled with Sand in situ
- ❖ Sand either in Barges or on Land



Perfect Pore inner is protected by the ProTecShield outerarmour

Sand Filled Containers (SFC's) are filled *in situ*

SURFING ASPECTS



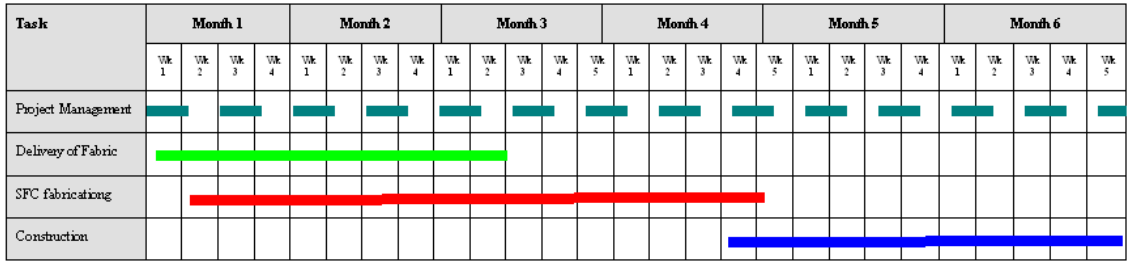
Surfing difficulty is rated 4-7, which relates to skill levels from <u>intermediate to competent surfers</u>

Oil Piers reef is likely to provide waves suitable for surfing at low tide on up to <u>160 days of the year</u> (~43% of the time), taking into account wave height and period

Construction Costing and Timeline

SECTION 227

Item	Amount	Cost Basis	Cost
Geosynthetic Fabrication	20 wk lead time	lump sum	$ 794,431.13
Project Mobilization			45,000.00
DGPS Survey	2 days	14,626.00/day	29,252.00
Install PTR Restraints	5 days	11,608.00/day	58,040.00
Sand Transport	30 barge loads	7,575.00	227,250.00
Diving/ PTR Modular Sections Deployment	33 days	15,134.00	499,422.00
Sand Slurry Operations	33 days	10,625.00	350,625.00
Materials (estimated)			25,000.00
Equipment/ fabrication			112,567.00
Demobilization			45,000.00
Estimated Project Totals			**$2,186,587.13**

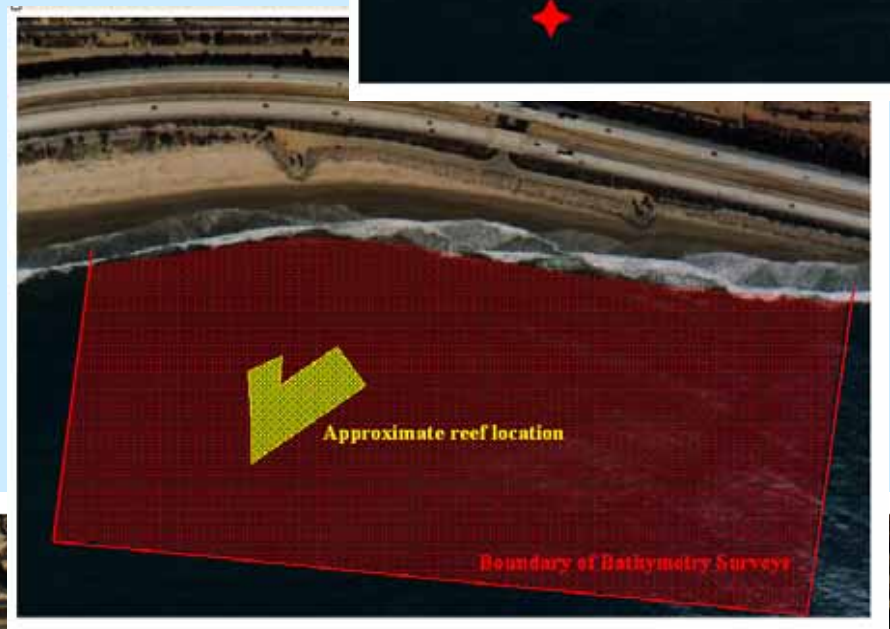


PROPOSED MONITORING

SECTION 227

- ❖Beach Profiling
- ❖Bathymetric Survey
- ❖Wave/Current Metering
- ❖Grain Size Analysis
- ❖Aerial Photography
- ❖Diver Inspections
- ❖Numerical Modeling
- ❖Ecology
- ❖Surfing

Wave/Current Metering and Sediment Sampling



Bathymetry Survey

Beach Profiles

PROJECT DELIVERY TEAM

SECTION 227

- ASR Team
  - Shaw Mead
  - Kerry Black
  - Brad Scarfe
  - Chris Blenkinsopp
  - Lee Harris - FIT
  - Jay Sample - Advanced Coastal Technology Inc.
  - Ted Roche - DiveCon
- CERB Member
  - Joan Oltman-Shay, Ph.D.
- Corps Team
  - Susie Ming – Planning
  - Art Shak – Coastal Engineering
  - Lisa Louie – Environmental
  - John Sunshine – Real Estate
  - Stan Fujimoto – Construction
  - Heather Sumerell – Planning
  - Don Ward - ERDC
- Non Federal Sponsor – BEACON
  - Brian Brennan – Executive Director
  - Jim Bailard
  - Karl Treiberg
  - Gerald Comati
  - Kevin Ready
- Regulatory
  - State Lands – Jane Smith
  - Coastal Commission – Audrey McCombs

Status

SECTION 227

- 100% Design Complete
- Project Team Meeting – January 2005
- Plans and Specification in progress
- Environmental Assessment
  - Public Review – October 2004
  - BEACON approved EA document – January 2005
  - FONSI – March 2005
- Permitting
  - California State Lands Lease – BEACON application - December 2005
  - California Coastal Commission
    - BEACON coastal permit - December 2005
    - Corps – Consistency Determination for Construction
  - USACE – BEACON 404 Permit for O&M
- Memorandum of Agreement and Decision Support Statement – HQ for comments – received, responding to comments

Status

SECTION

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- Sand Sources – Potential West Beach in Santa Barbara
- Fabrication of Geotextile Containment Cells –4-month lead time (or 8 months)
- Proposed Construction Spring/Summer 2006 (depending on authority and appropriations)!

SECTION 227

Coastal and Hydraulics Laboratory - Microsoft Internet Explorer provided by USACE, Los Angeles District

http://chl.erdc.usace.army.mil/section227/

CHL Coastal and Hydraulics Laboratory

Meeting Tomorrow's Water Resources Challenges Today

US Army Engineer Research and Development Center

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- Fish Studies
- Flood Control
- Groundwater
- Harbors
- Hydraulic Structures
- Inlets
- Navigation
- Soils/Sediments
- Warfighter Support
- Watersheds
- Waves
- Wetlands
- R&D Applications
- Conferences

National Shoreline Erosion Control Development and Demonstration Program (Section 227)

Cape Lookout State Park, Oregon, adjacent to Netarts Bay, one of the Section 227 demonstration sites.

Enlarge: **1800x1205 (417kb) - 800x536 (84kb)**

Commonly referred to as Section 227 (of the U.S. Water Resources and Development Act of 1996), this program is an applied research effort by the U.S. Army Corps of Engineers. Monitored by the U.S. Army Engineer Research and Development Center (ERDC), its objectives are to provide state-of-the-art coastal shoreline protection. Its emphasis is on evaluation of innovative or nontraditional approaches to help prevent coastal erosion and to improve shoreline sediment retention.

A variety of shore protection devices and methods are being constructed, administered, and evaluated at a number of sites throughout the United States with diverse shoreline morphologies. The program requires a minimum of two on the Atlantic coast, two on the Pacific coast, two on the Great Lakes, and one on the Gulf of Mexico. These shore protection structures must have scientific support for projected performance and must not affect the aesthetic appeal of the area. Both patented devices and nonproprietary methods are permissible.

In Depth

Overview | Demonstration Sites | References

Coastal Shore Protection Structures and Techniques
A range of structural and non-structural shore protection types and techniques involve innovative methods of construction or implementation.

Oversight Committee

Section 227 Authorizing Language

Print Page Content...

Contacts
Curtis, William
Program Manager

Related Information
Organization

Publications
Low Cost Shore Protection - A Guide for Engineers and Contractors - *Section 54*
Low Cost Shore Protection - A Guide for Local Government Officials
...More

Media Downloads
2000 Workshop on Advancements in Shore Protection Technology
Authorizing Language of the 1996 Water Resource and Development Act of (WRDA '96)
...More

Research Areas
Coastal Structures
Coastlines

Projects
Allegan County, Michigan - *Section 227 Demonstration Site*
Alligator Point, Florida - *Section 227 Demonstration Site*
...More

Coastal and Hydraulics Laboratory - Engineer Research and Development Center
Waterways Experiment Station - Vicksburg, Mississippi
Web Master