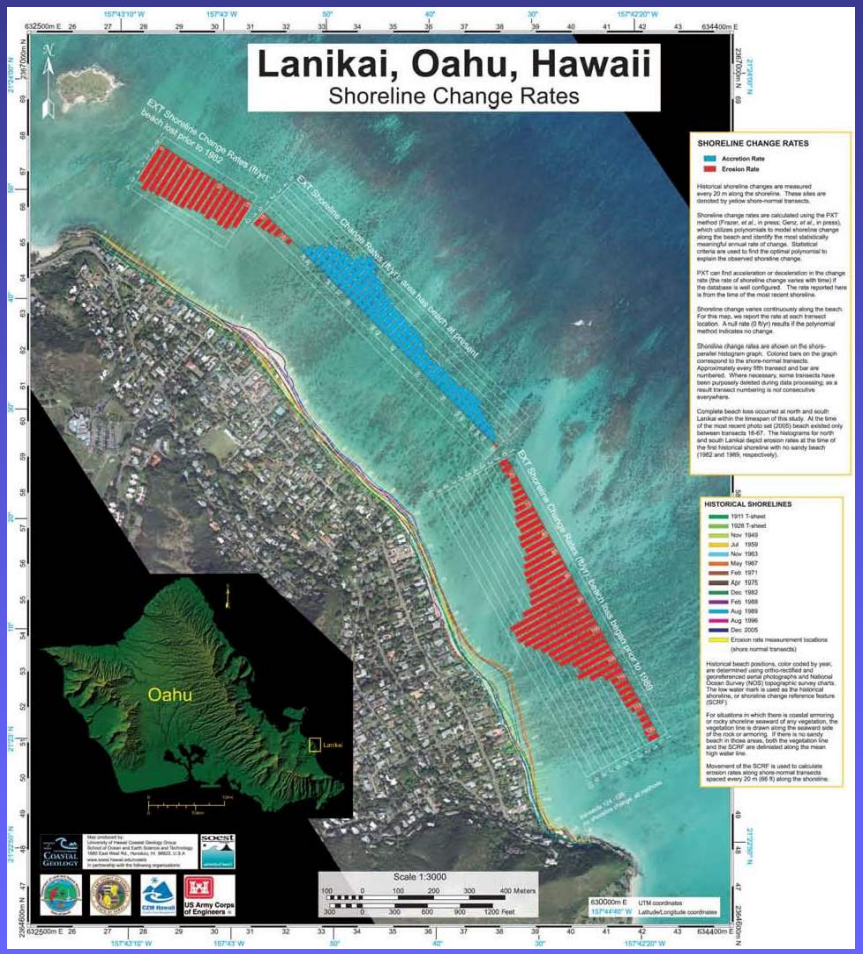
Lanikai Beach Nourishment

Study Investigations

- Provide protection against wave attack
- Increase recreational opportunities
- Investigate beach nourishment with and without structures
- Identify volume of sand needed, sand sources, and sand placement requirements



Study Location

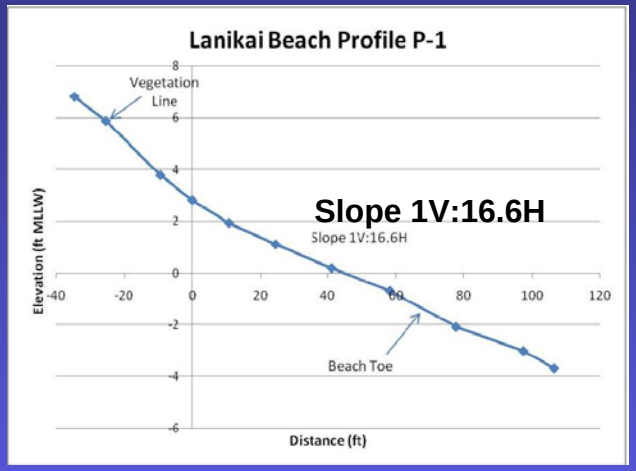
Existing Conditions

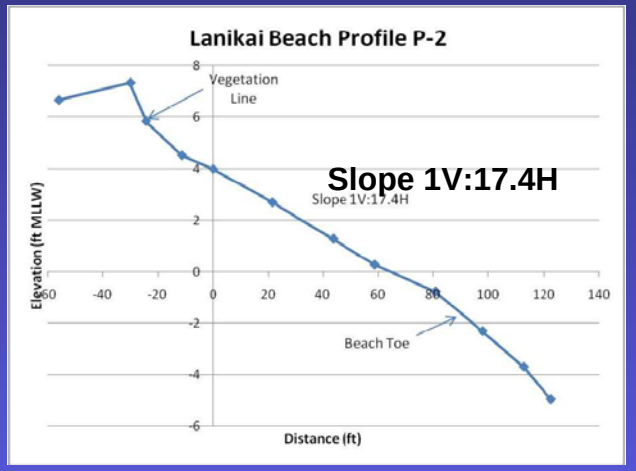
- Shallow Reef Outcrops
- Beach Rock
- Erosion Scarps & Exposed Tree Roots
- Armoring (Revetments & Seawalls)
- Temporary Shoreline Protection (Sandbags)
- Areas of “Healthy” Beach

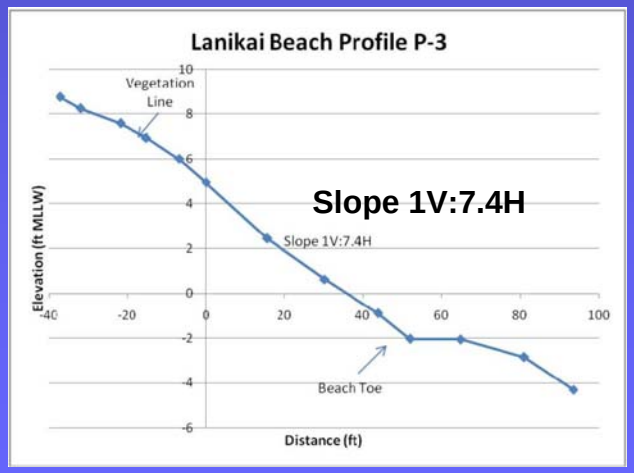
Existing Lanikai Beach Conditions Cont…

Lanikai Beach Profile Locations

Lanikai Beach Profiles







	February 1999	August 1999
OLNK 2-1	1V:14.5H	1V:10.8H
OLNK 2-5	1V:11.4H	1V:12.7H
OLNK 2-6	1V:7.5H	1V:7.7H
OLNK 3-4	1V:12.0H	1V:10.9H
Source: U.S. Geological Survey		

Wind & Waves

Wave Climate

- **Directional distribution of wave heights and wave periods determined from UH's Mokapu buoy data**
- **Waves are predominantly out of the east through northeast**
- **North swells impact the study area**

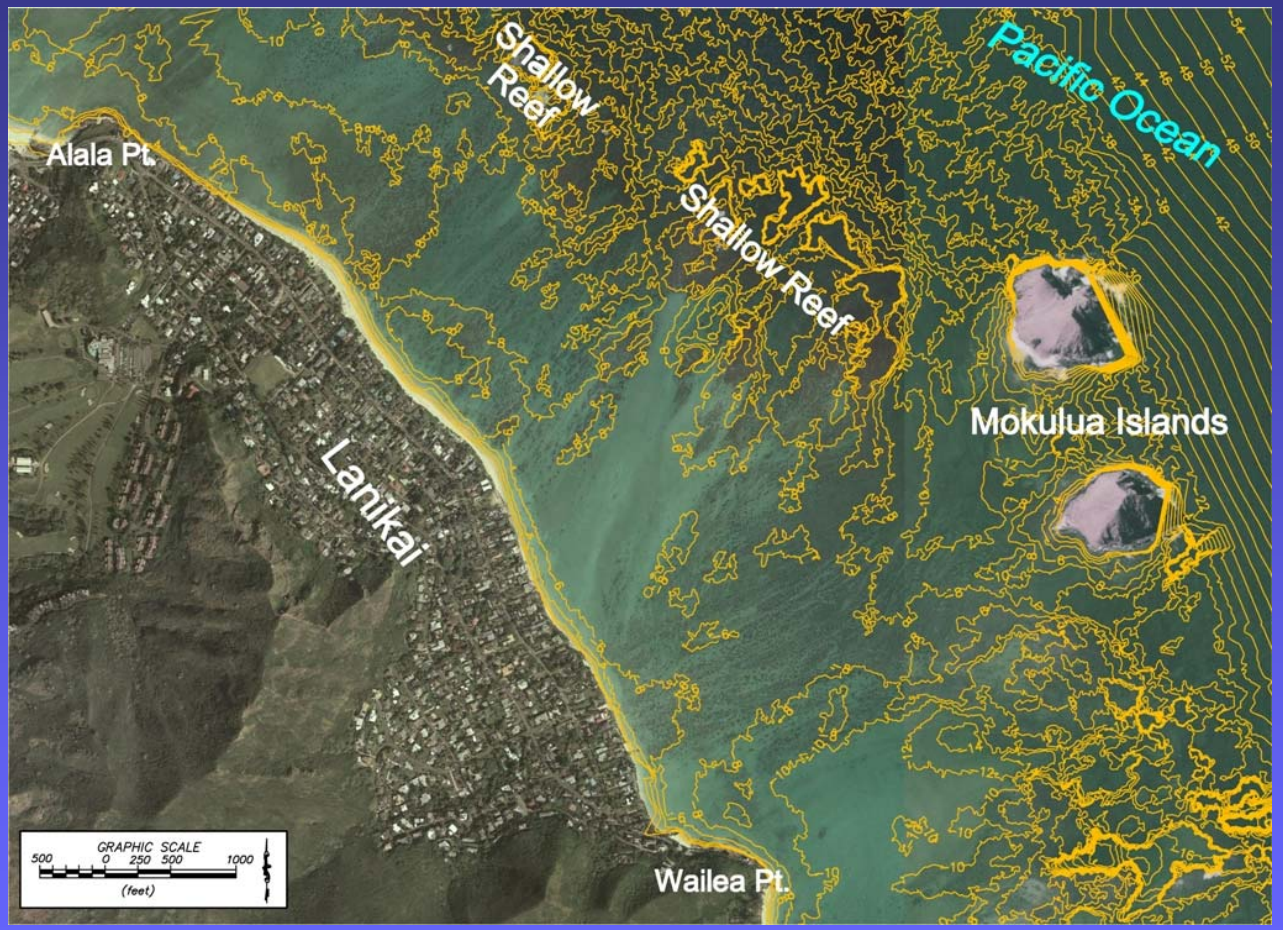
Wave Modeling

- **Input Wave Conditions:**
  - **D = 0 degrees, T = 14 seconds, H = 6 feet**
  - **D = 45 degrees, T = 8 seconds, H = 6 feet**
  - **D = 90 degrees, T = 9 seconds, H = 8 feet**
- **East through northeast waves bracket the trade wind wave energy**
- **Water Levels Considered:**
  MSL and MHHW plus 1.0 feet

Wave Modeling Results

- **Shoreline orientation dominated by the influence of trade wind wave energy**
- **Small changes in wave direction can change sediment transport in the region**
- **Wave modeling shows convergence at location of stable beach in middle of Lanikai shoreline**

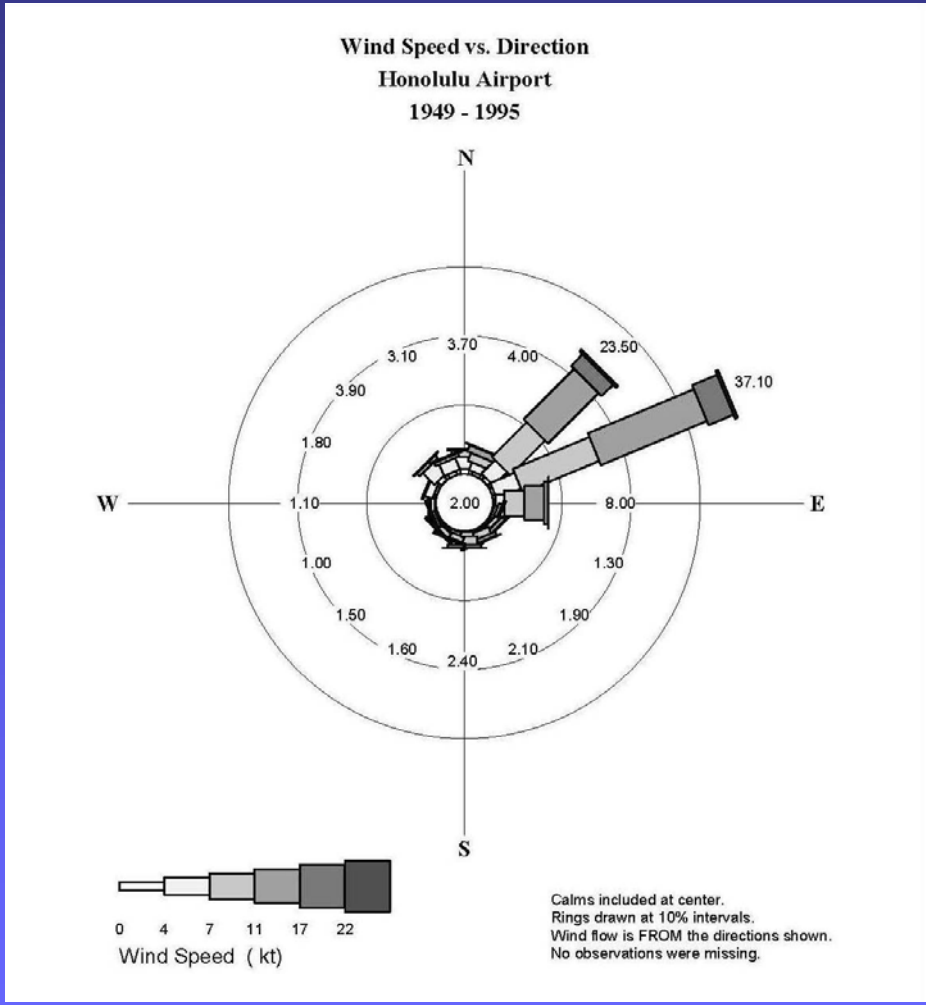
Lanikai Bathymetric Map



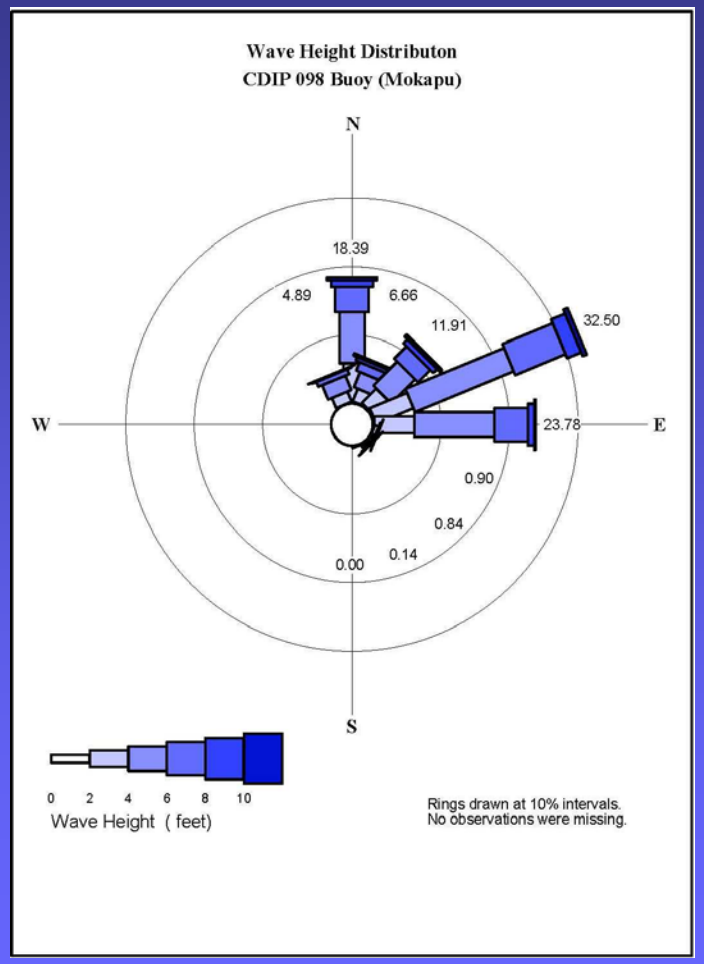
Bathymetric Contours – Contours are in feet relative to MLLW in 2-foot intervals.

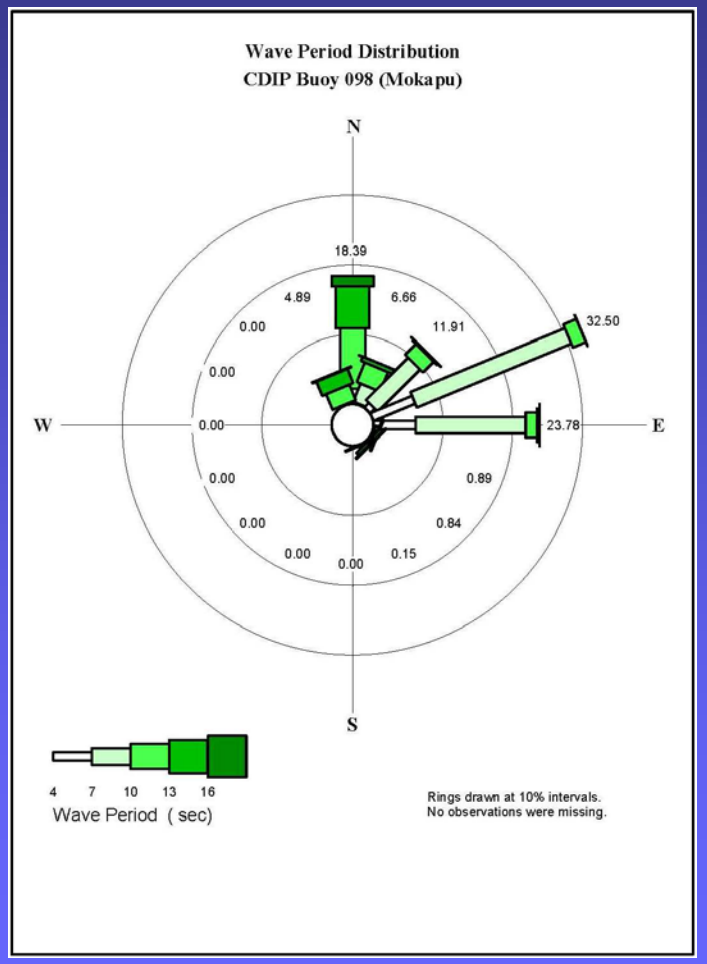
Wind Speeds & Directions

Wind Rose Diagram for Honolulu International Airport, 1949-1995

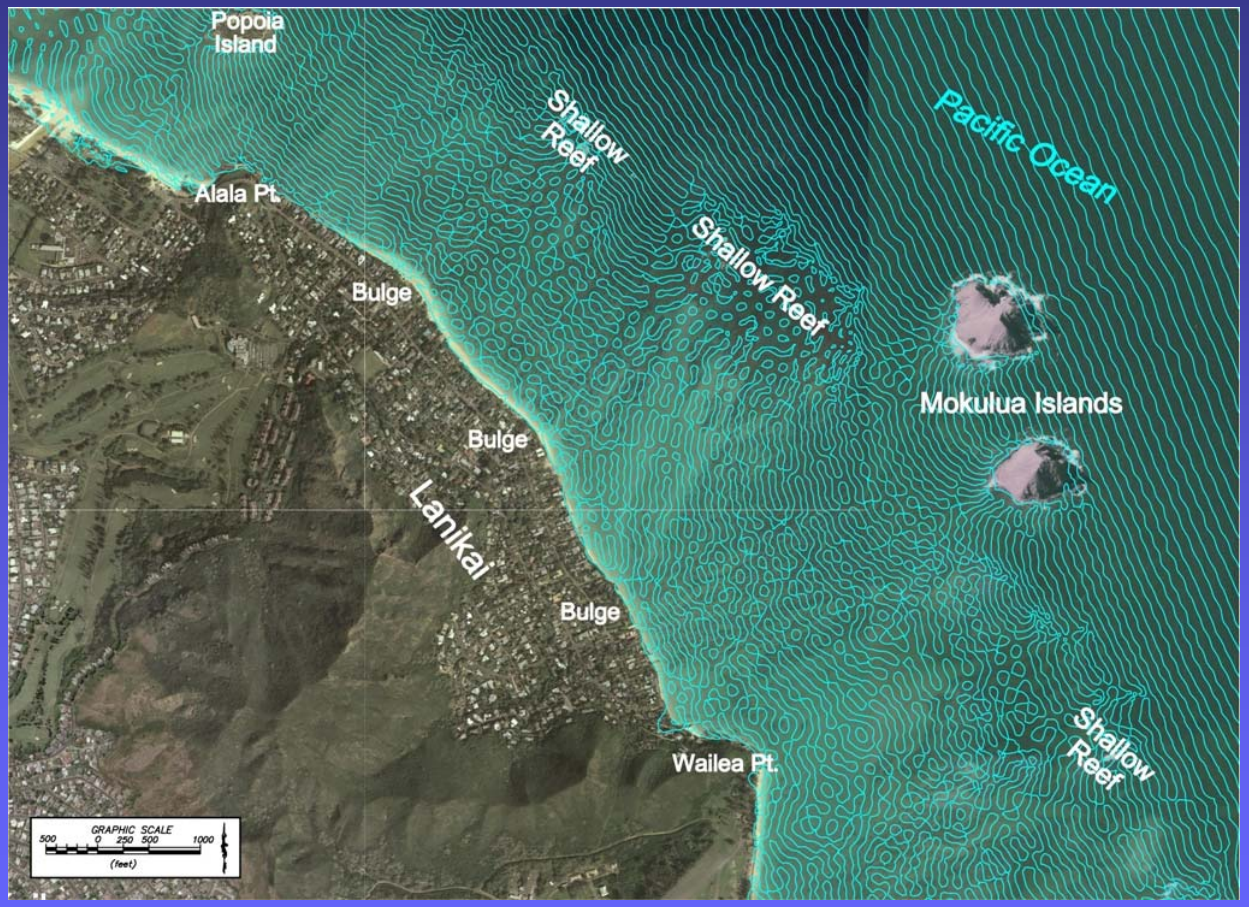


Wave Buoy Data





Wave Crest Orientation



**** Wave Conditions for numerical model BOUSS2D, Dir = ENE, H = 6 ft., T = 8 sec.**

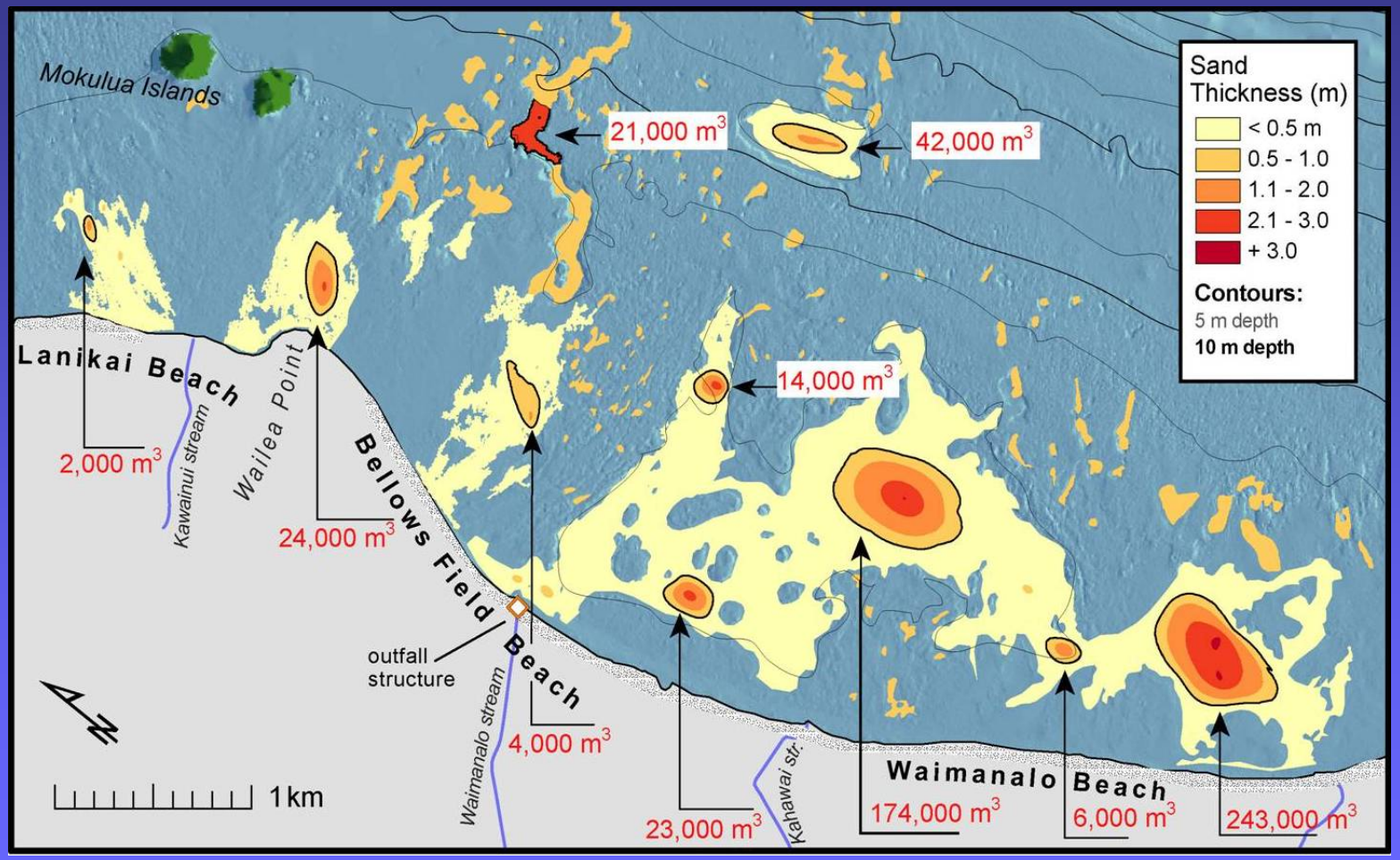
Sand Sources

Hawaii DLNR
Beach Sand Guidelines

- Must not contain more than 6% silt material (sand grain size smaller than 0.074 mm)
- Must not contain more than 10% coarse material (sand grain size greater than 4.76 mm)
- Must have a grain size distribution that falls within 20% of the existing beach grain size distribution
- The overfill ratio of the fill sand shall not exceed 1.5
- No more than 50% of the fill sand shall have a grain diameter less than 0.125 mm
- Must be free of contaminants such as silt, clay, sludge, organic matter, turbidity, grease, pollutants, and others
- Must be dominantly composed of naturally occurring carbonate beach or dune sand.

Sand Sample Locations

Sand Source Locations

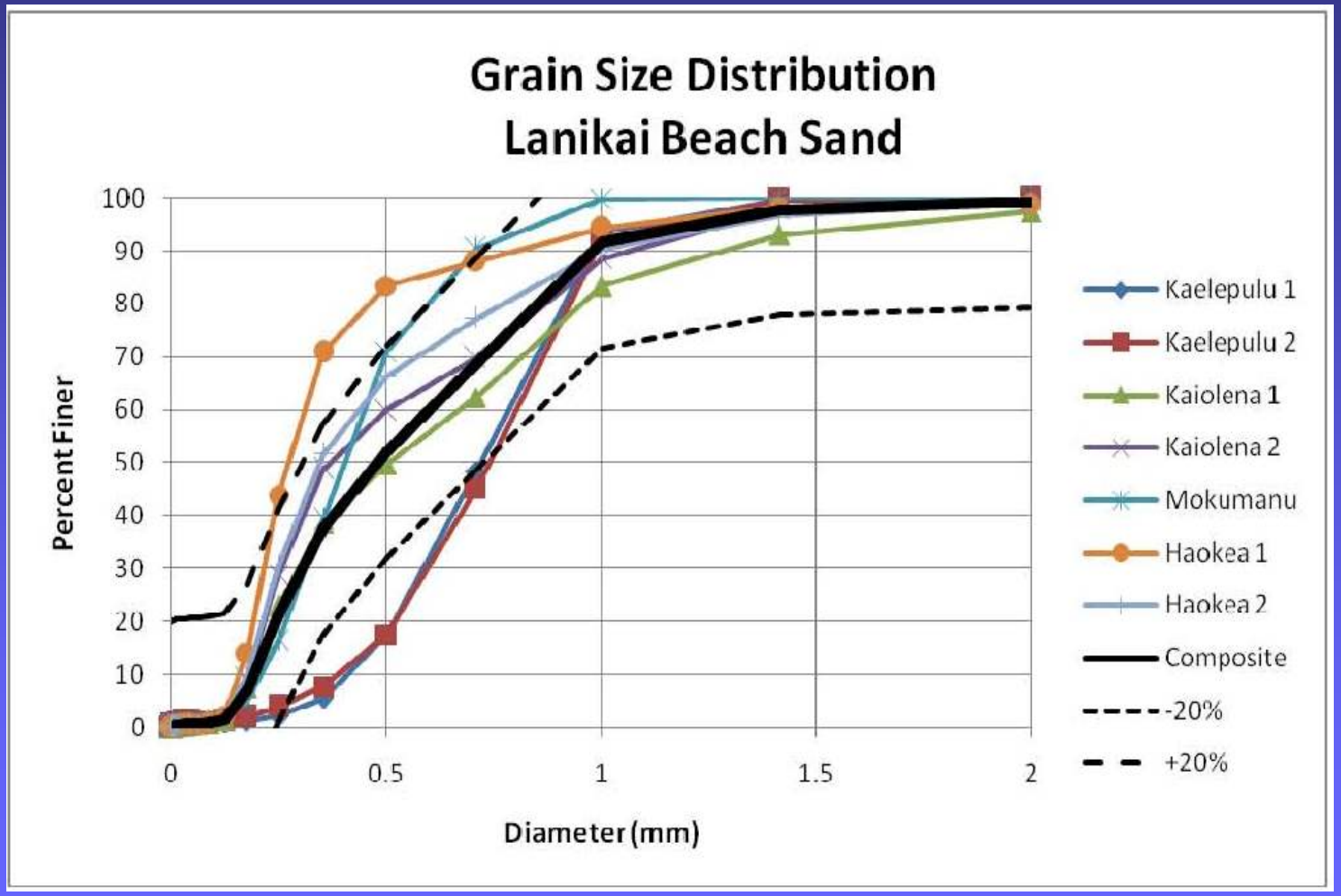


Possible Sand Sources

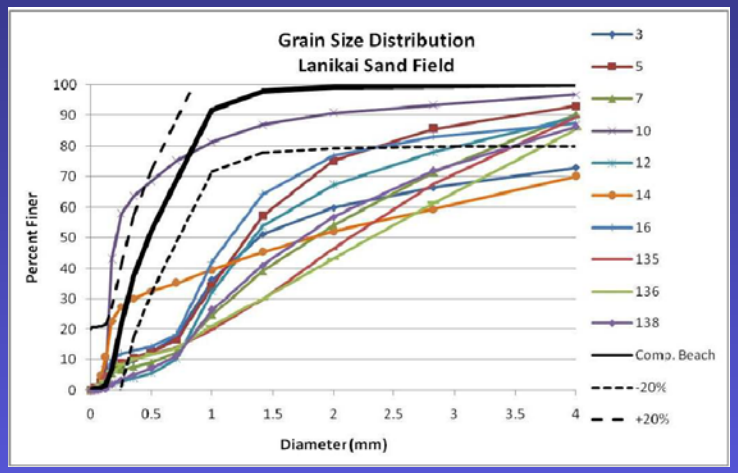
	Volume (cubic yards)			
	Fossil Channel	Karst Depression	Sand Field	Total
Kailua Bay	1,079,210	197,128	0	1,276,338
Lanikai	30,889	57,161	170,017	258,067
Waimanalo Bay	0	659,725	26,337	686,062
Total	1,110,099	914,014	196,354	2,220,467

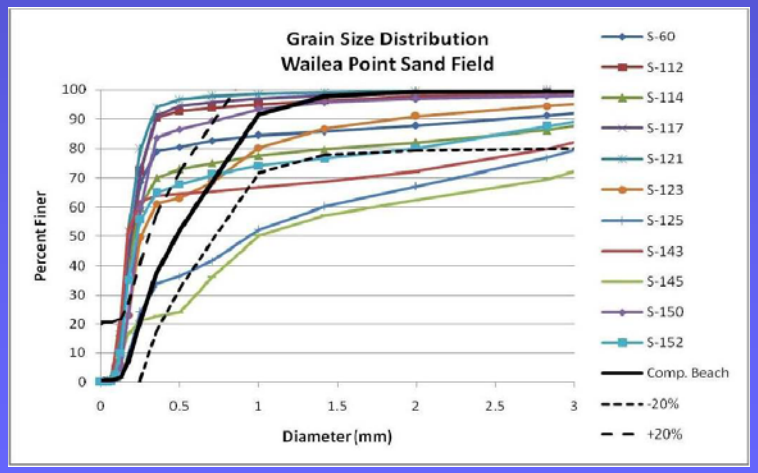
- Kailua Sand channel has sufficient volume but the sand characteristics do not meet Hawaii DLNR guidelines
- Lanikai and Waimanalo Bay contains the Lanikai and Wailea Point sand fields
- The Lanikai and Wailea Point sand fields are the most likely candidates for the Lanikai Beach nourishment.

Lanikai Beach
Sand Grain Size Distribution



Offshore Sand Sources
Grain Size Distribution





Lanikai Sand Field

- Sand is coarser than native Lanikai Beach sand
- Sand may not meet State guidelines for beach nourishment

Wailea Point Sand Field

- Sand is finer than the material found in the Lanikai Sand Field
- Consider blending with Lanikai Sand Field material to produce acceptable grain size distribution

Concept 1

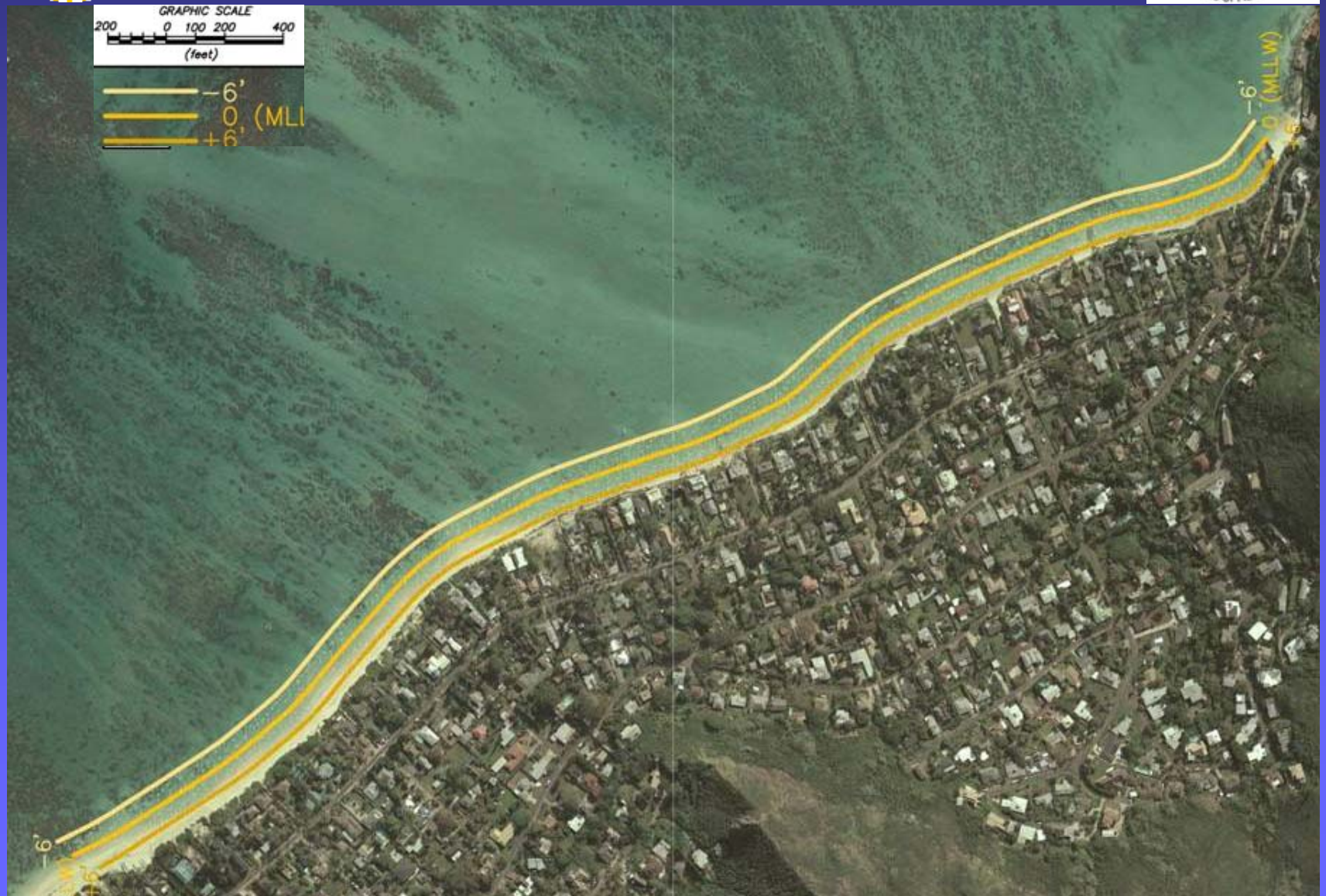
Beach Nourishment without Structures

Concept 1

- No structures involved in nourishment
- North section would start south of Alala Point and merge with existing beach to the south.
- South section would start at Wailea Point and also merge with accreted beach to the north.
- Beach cross section would match existing beach crest elevation and slope
- Designed for a 30-foot dry beach

Concept 1
North Lanikai Beach

Concept 2
South Lanikai Beach



Estimated Construction Cost Concept 1

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Site Investigations & Preparation	1	Job		1,050,000
Environmental Protection	1	Job		100,000
Sand Fill (Includes Mob/Demob)	182,000	Cu. Yd.	150	27,300,000
Sub-Total				**$28,450,000**
Contingency (15%)				4,268,000
Total Cost				**$32,718,000**

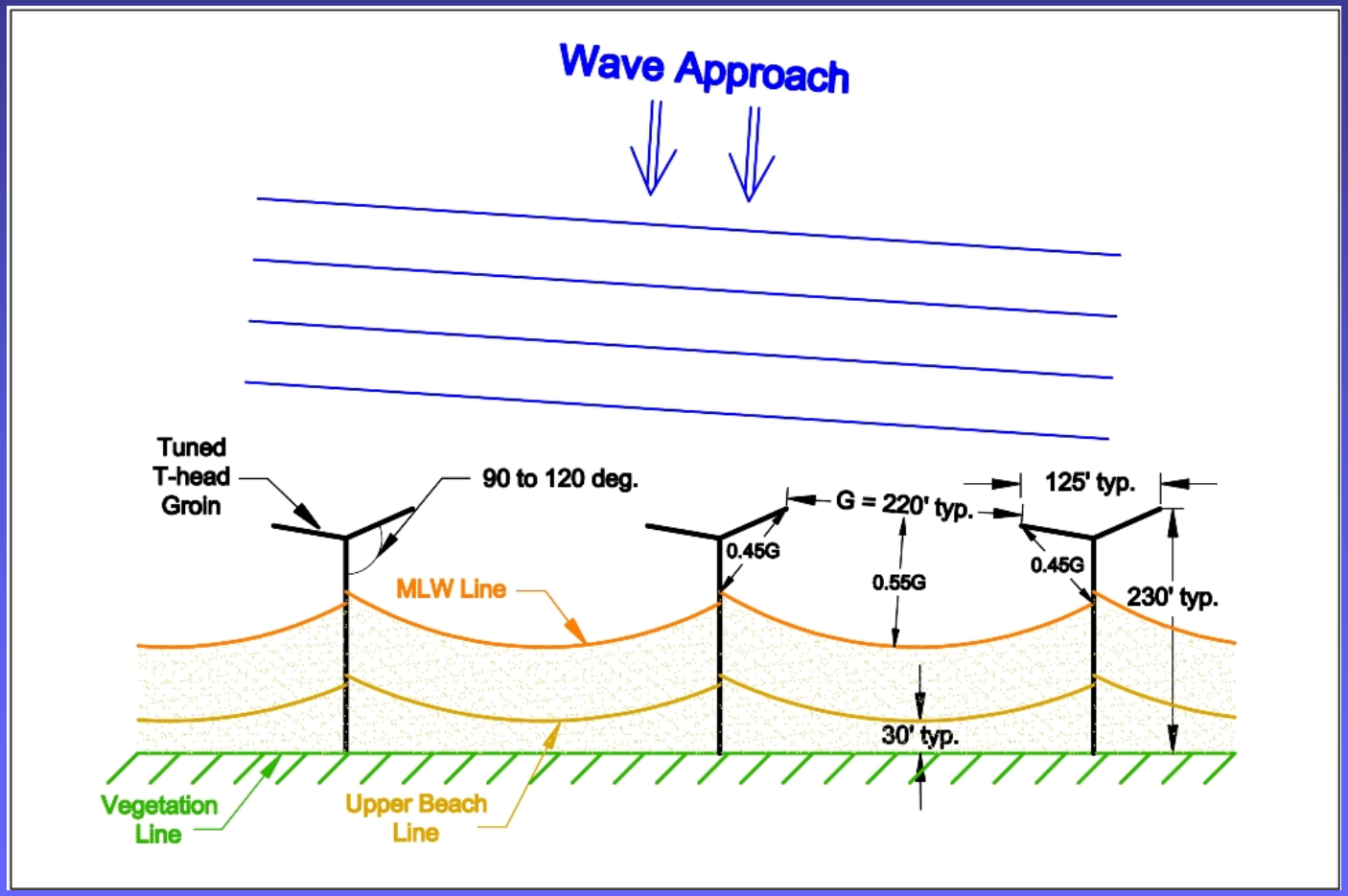
Concept 2

Beach Nourishment with Structures

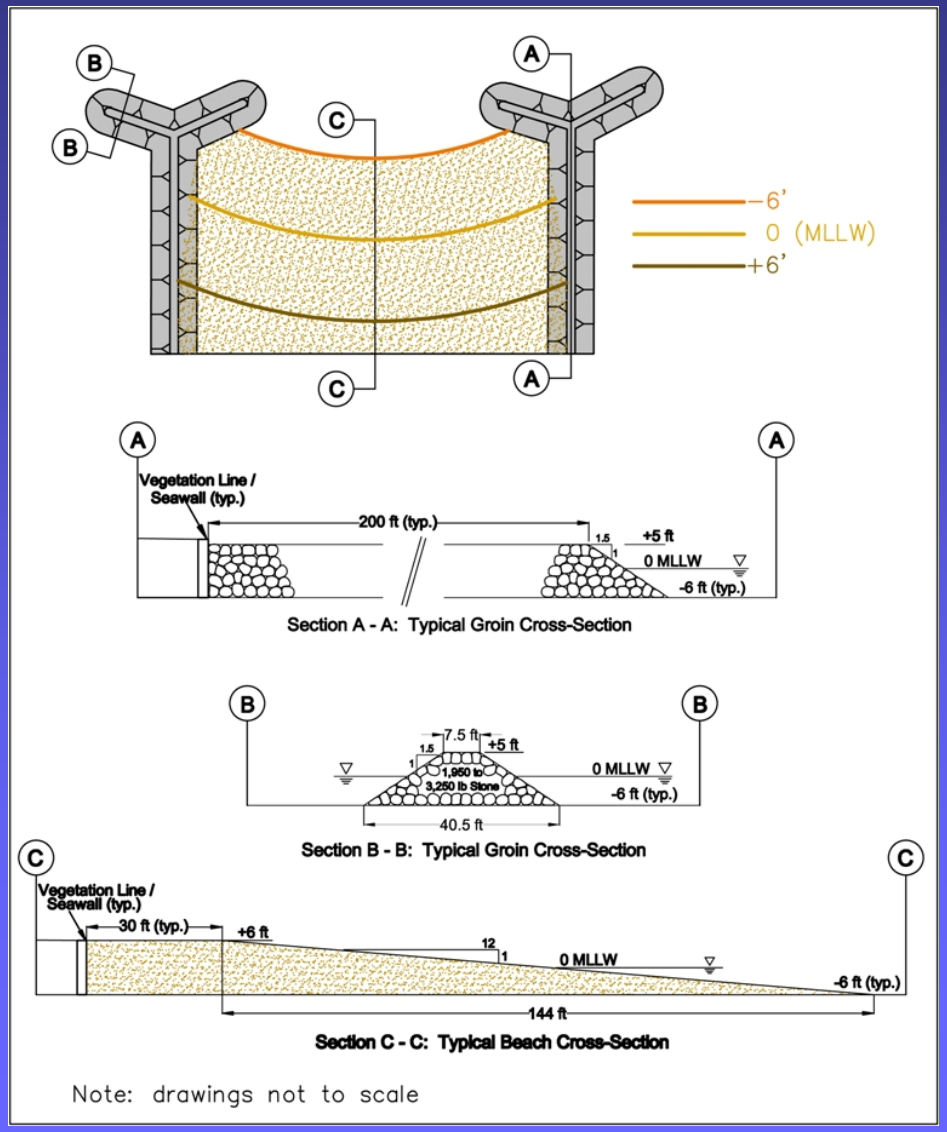
Concept 2 Details

- Strategically placed T-head groins
- Positions tuned to wave approach
  - Openings aligned with wave crests
- Crescent-shaped beach created
  - Berm elevation +5 to +6 feet
  - Designed to provide at least 30 feet of dry beach

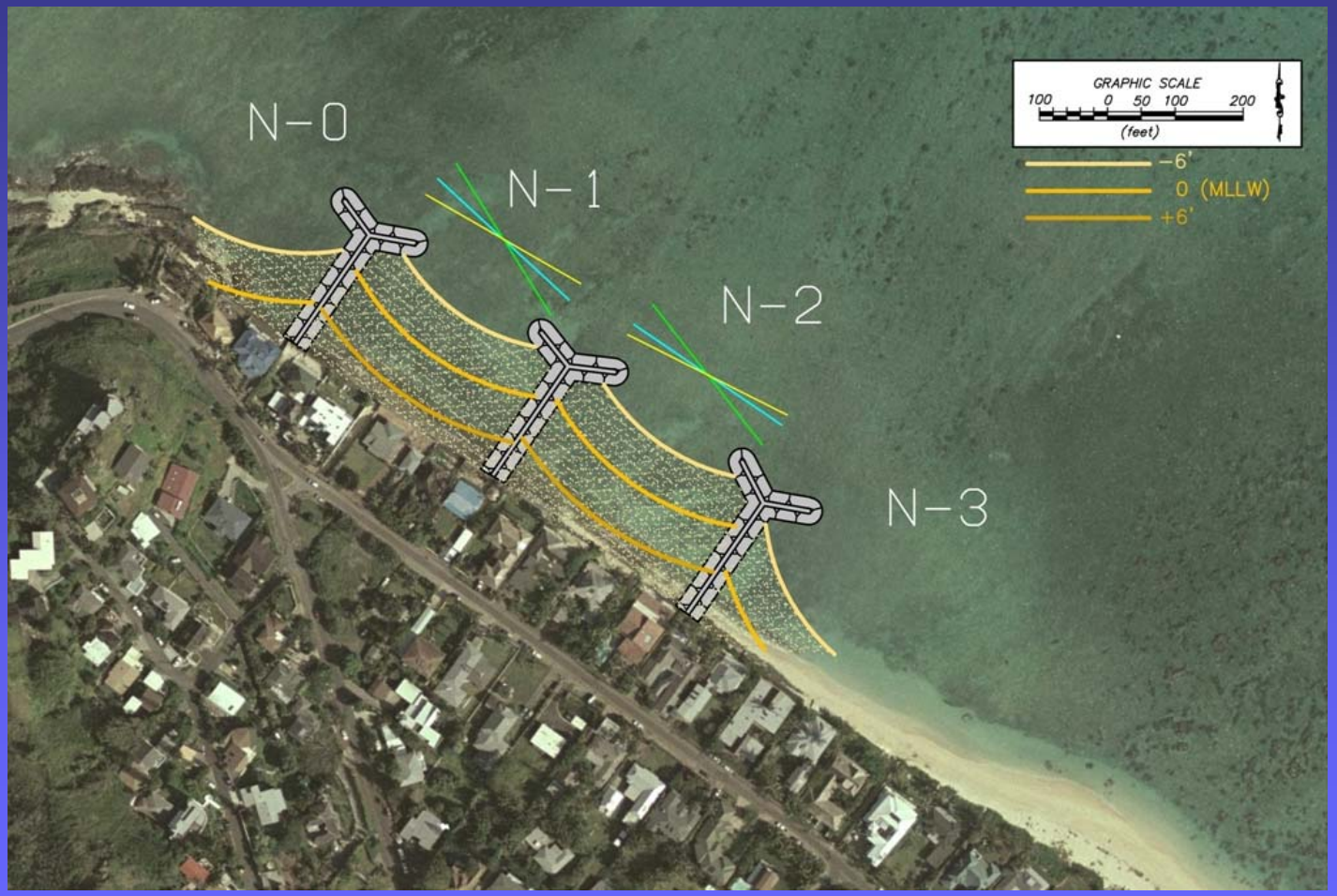
Tuned T-Head Groins



Typical Groin and Beach Cross Sections



Concept Groin Field for North Section of Lanikai Beach



Concept Groin Field for South Section of Lanikai Beach

Overall Concept Groin Field for Lanikai Beach

Cell No.	Required Fill (cubic yards)	Min. Beach Width (feet)	Max. Beach Width (feet)	Gap width (feet)
N-0	882	---	---	---
N-1	11,352	30	65	225
N-2	14,169	29	72	226
N-3	2,472	---	---	---
S-0	1,277	---	---	---
S-1	17,845	75	133	207
S-2	16,520	66	110	217
S-3	14,815	42	100	212
S-4	11,702	27	86	203
S-5	12,349	32	78	211
S-6	11,437	35	81	211
S-7	10,511	48	98	204
S-8	7,227	---	93	212
Total	**132,558**	**---**	**---**	**---**

Estimated Construction Cost Concept 1

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Site Investigations & Preparation	1	Job		1,050,000
Environmental Protection	1	Job		100,000
Rock Groins				
Stone	39,900	Cu. Yd.	50	1,995,000
Construct Groins	39,900	Cu. Yd.	100	3,990,000
Sand Fill (Includes Mob/Demob)	146,000	Cu. Yd.	150	21,900,000
Sub-Total				**$29,035,000**
Contingency (15%)				4,355,000
Total Cost				**$33,390,000**

Concept 1 & 2 Comparison

Concept 1 Nourishment w/o Structures		Concept 2 Nourishment w/ Structures	
• Total Volume:	182,000 CY	• Total Volume:	146,000 CY
• Renourishment Interval:	9 Yrs	• Annual Maintenance:	0.5%
• First Cost:	$33 M	• First Cost:	$33 M
• **50-Yr Total Cost:**	**$109 M**	• **50-Yr Total Cost:**	**$42 M**

Thank You!

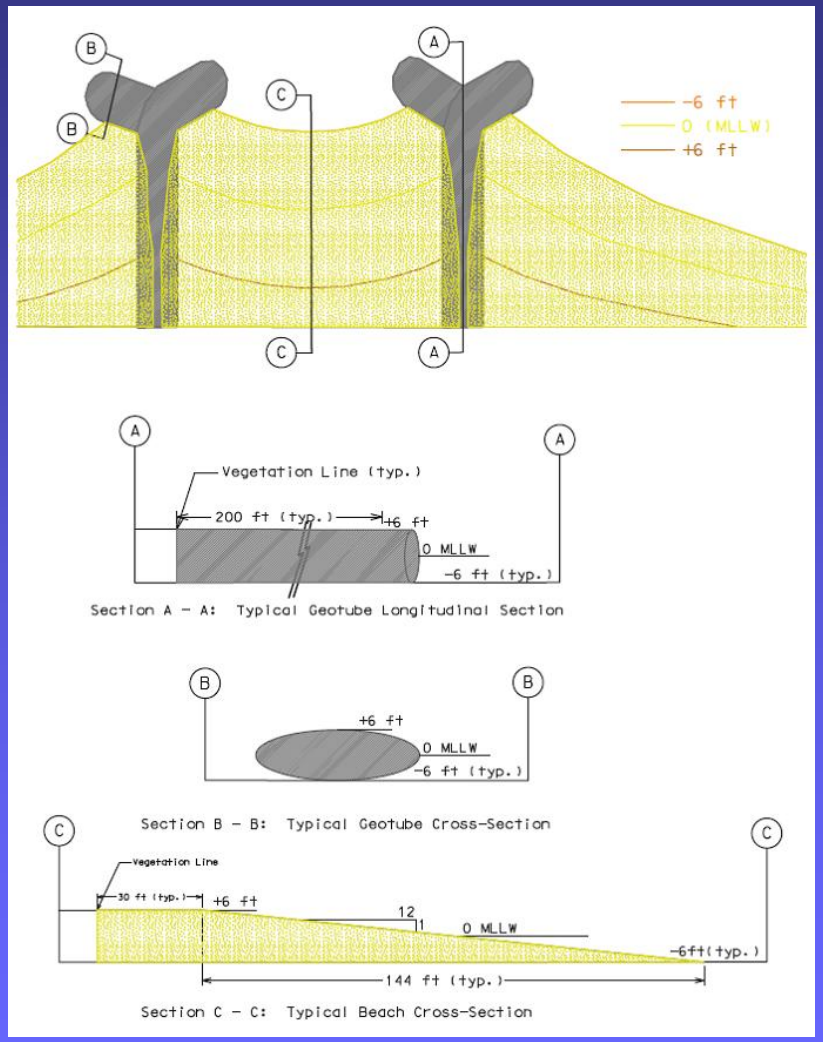
Pilot Project

Pilot Project Details

- Geotubes or other alternative materials would be used to simulate T-head groins
- Beach cross section would have a 6-foot berm elevation with a slope of 1V:12H
- Conduct physical model investigations to validate T-head groin concept
- Modeling would provide hard data to decision makers

Pilot Project Location

Pilot Project - Geotube Details



Pilot Project - Site Plan

Geotube Groin

*** Upham Beach, City of St. Petersberg, Pinellas County, Florida

THANK YOU