Beach Nourishment

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LRE SBAS Training
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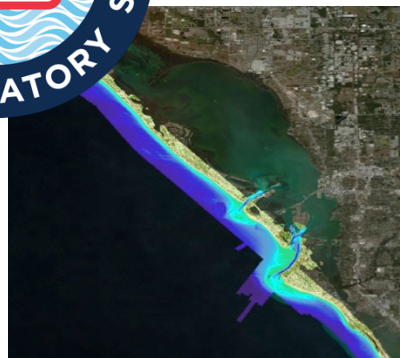
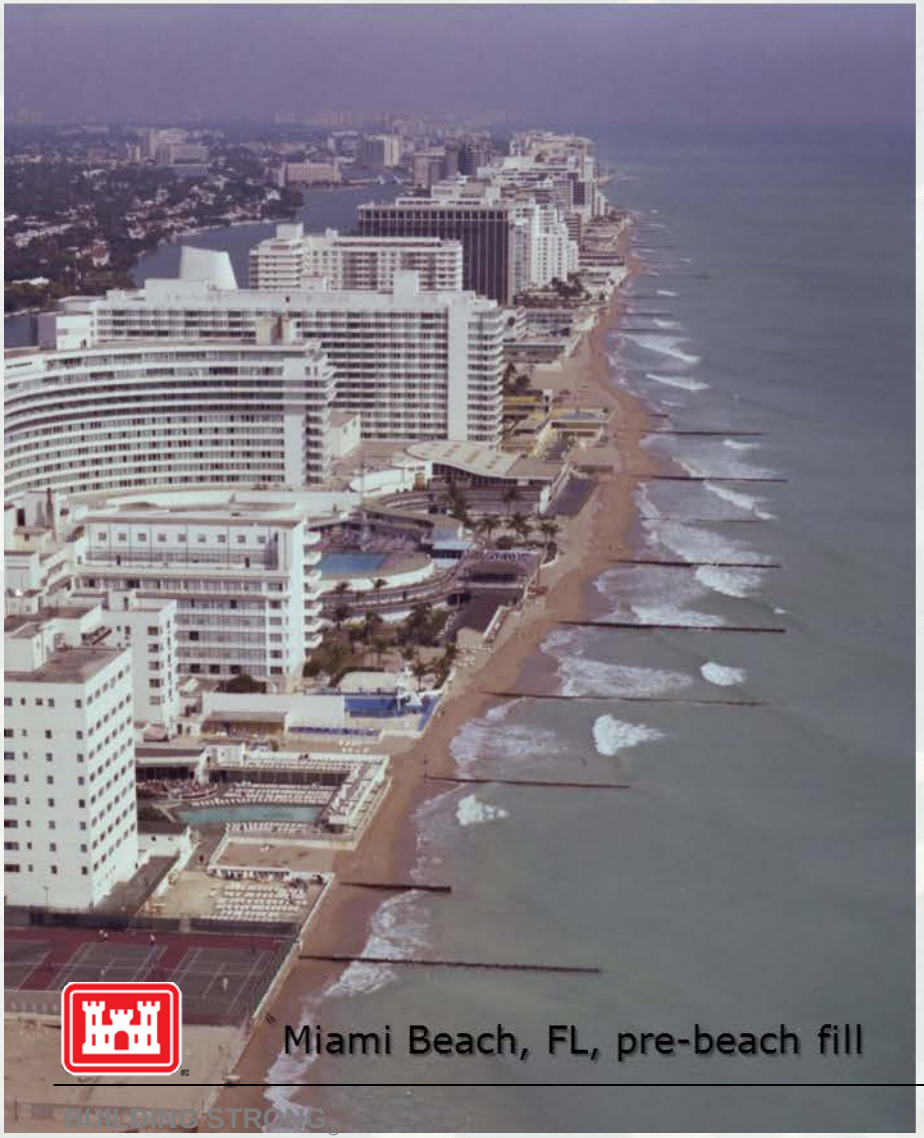


COASTAL AND HYDRAULICS LABORATORY

ERDC
Engineer Research and Development Center

BEACH NOURISHMENT

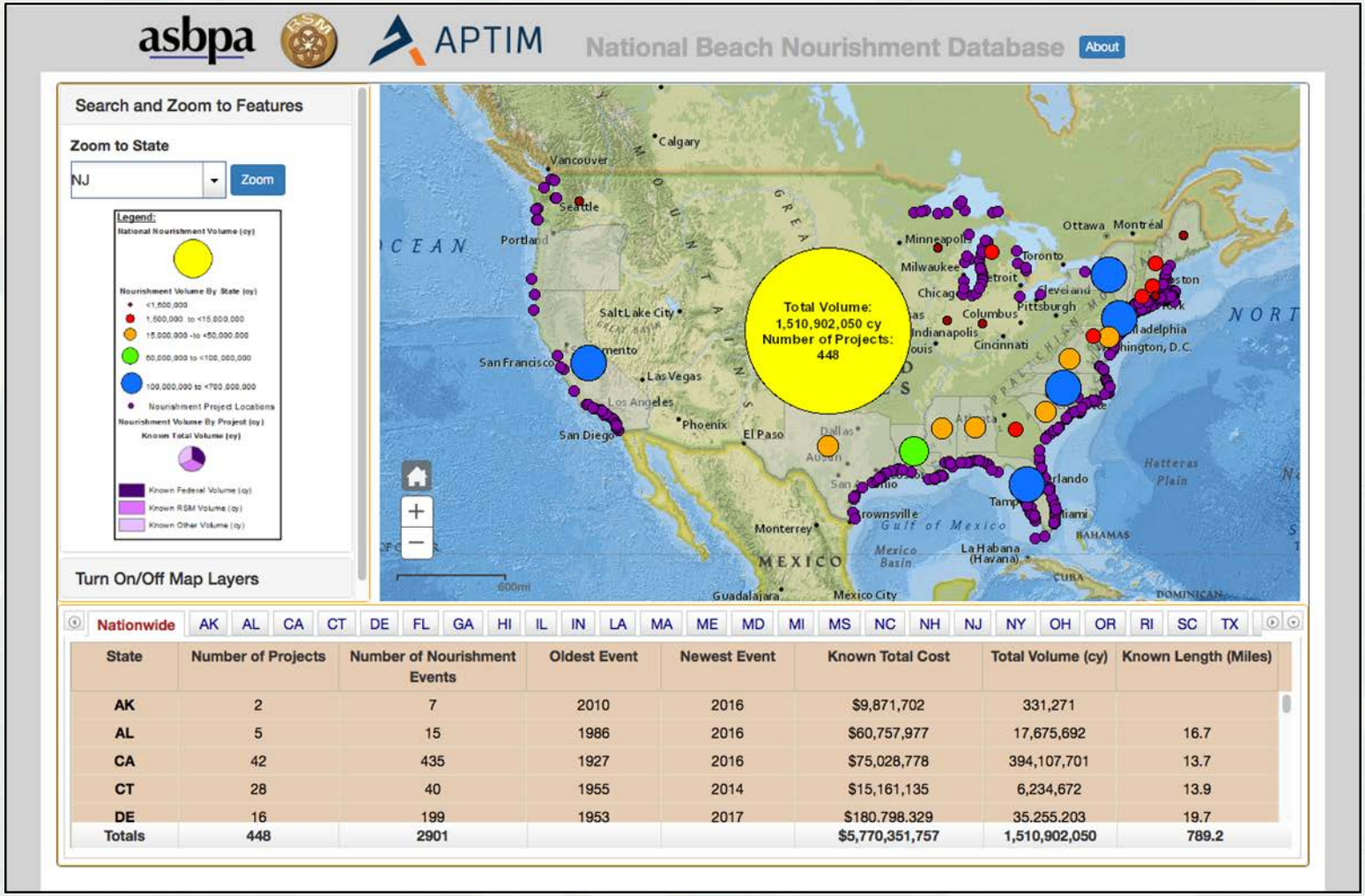


Miami Beach, FL, pre-beach fill

Beach Fill Project Goals

- Erosion Control
  - Reduce land loss
  - Mitigate chronic erosion
- Reduce Flooding Damages
  - Storm surge coastal flooding
  - Upland infrastructure inundation
- Reduce Wave Impact Damages
  - Storm damage reduction
- Increase Recreation
  - Economic benefits
- Habitat Enhancement
  - Threatened & endangered species
- Integrate with Navigation Project
  - Beneficial use of dredge materials

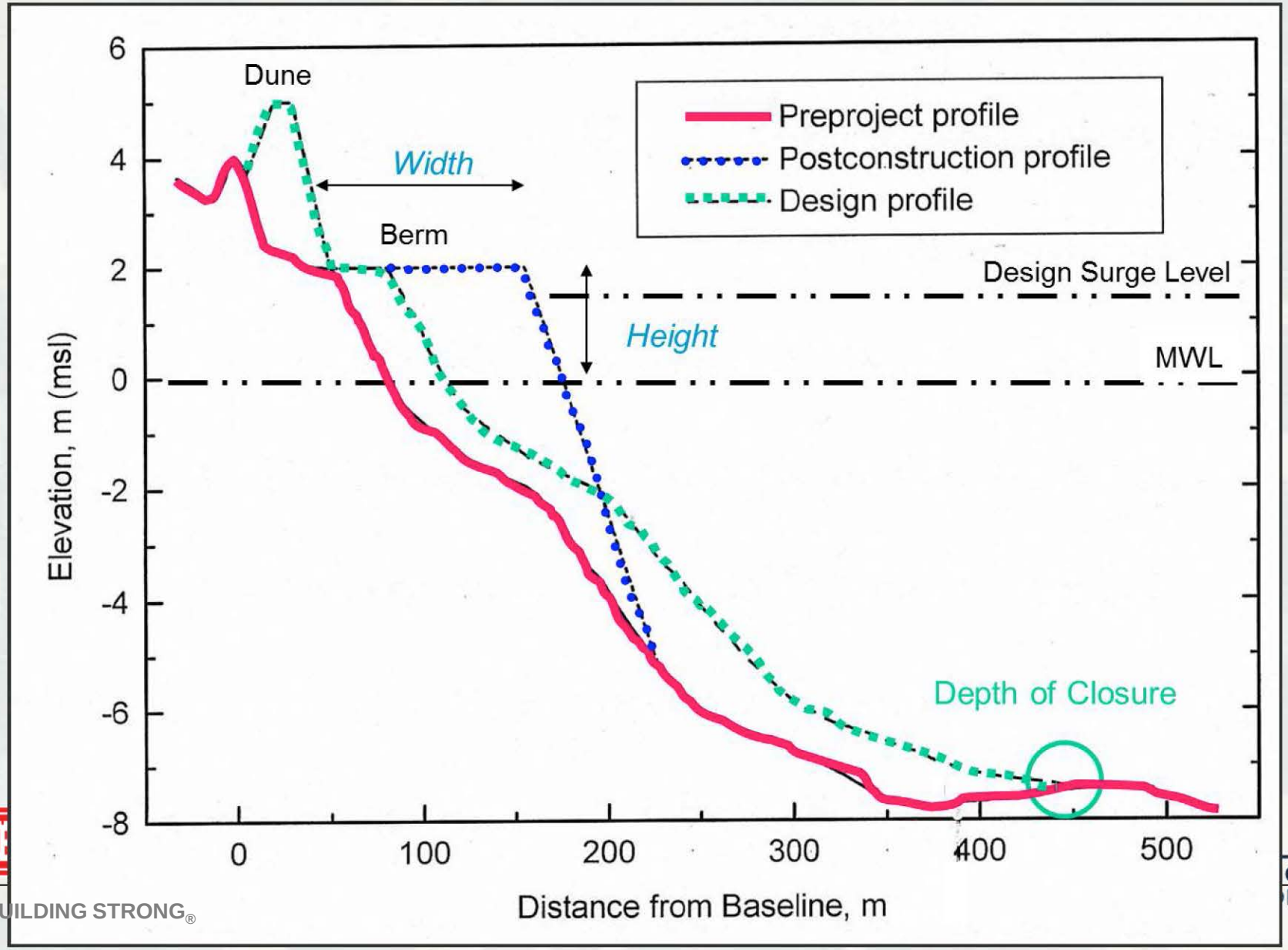
National Beach Nourishment Database



State	Number of Projects	Number of Nourishment Events	Oldest Event	Newest Event	Known Total Cost	Total Volume (cy)	Known Length (Miles)
AK	2	7	2010	2016	$9,871,702	331,271	
AL	5	15	1986	2016	$60,757,977	17,675,692	16.7
CA	42	435	1927	2016	$75,028,778	394,107,701	13.7
CT	28	40	1955	2014	$15,161,135	6,234,672	13.9
DE	16	199	1953	2017	$180,798,329	35,255,203	19.7
Totals	448	2901			$5,770,351,757	1,510,902,050	789.2

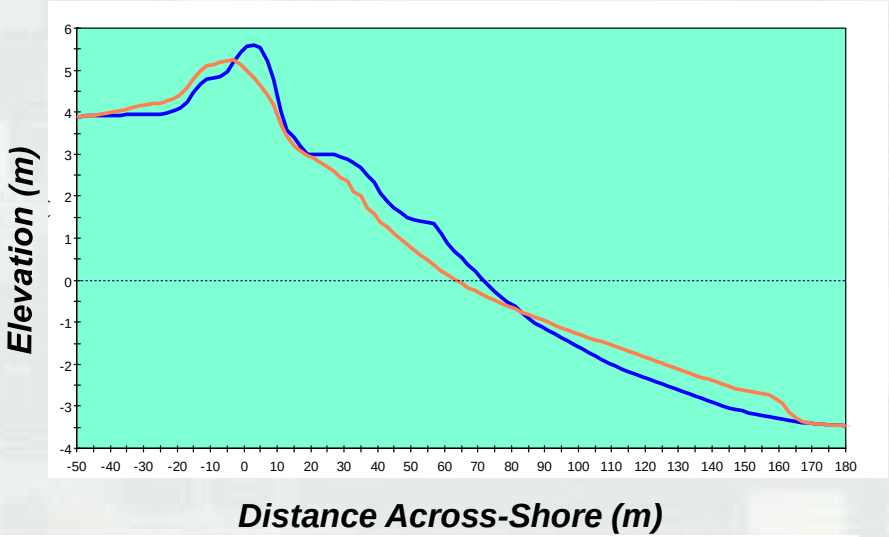
- 449 projects placed >1.5 Bcy sand US beaches since 1920's
- Federal coastal storm damage reduction projects
- Beneficial placement of navigation sediment on beaches
- State/Local/Private beach nourishment projects

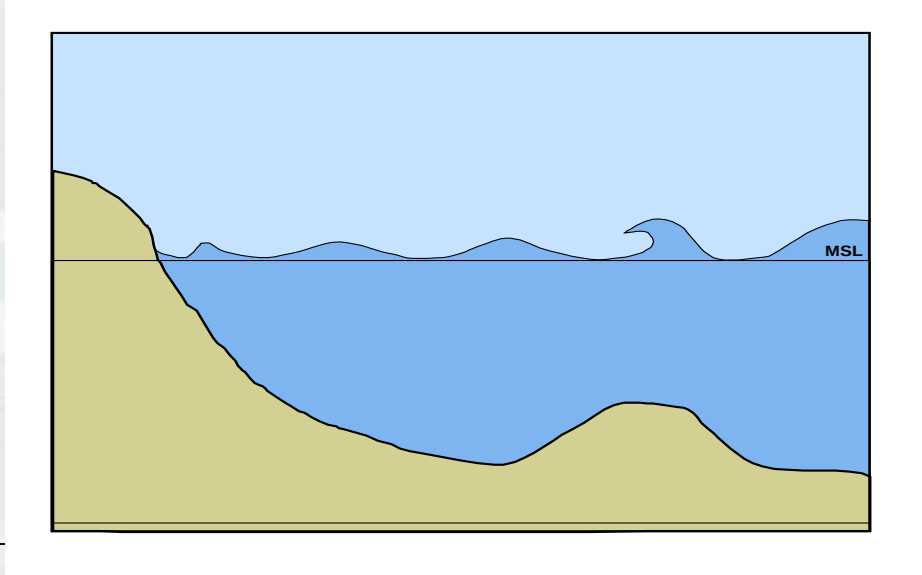
Elements of Fill Design Template



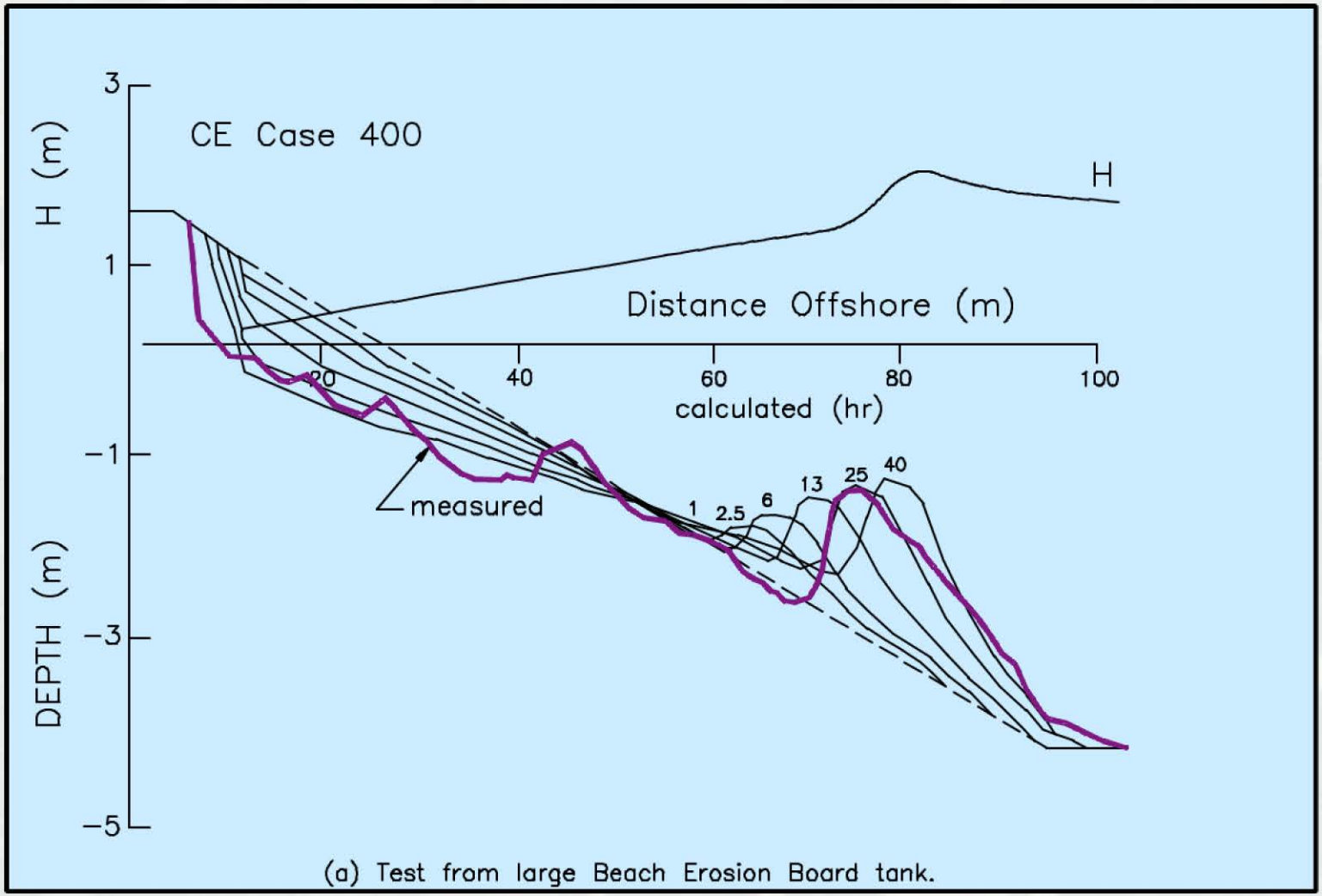
Profile Change Models

- Models:
  - SBEACH (ERDC)
  - C2SHORE
- Uses:
  - Short-term beach/dune erosion
  - Beach fill design
  - Coastal flooding
- Processes:
  - Wave-driven cross-shore sediment transport
  - Equilibrium profile concept
  - Good for erosion, less accurate for accretion





SBEACH



(a) Test from large Beach Erosion Board tank.

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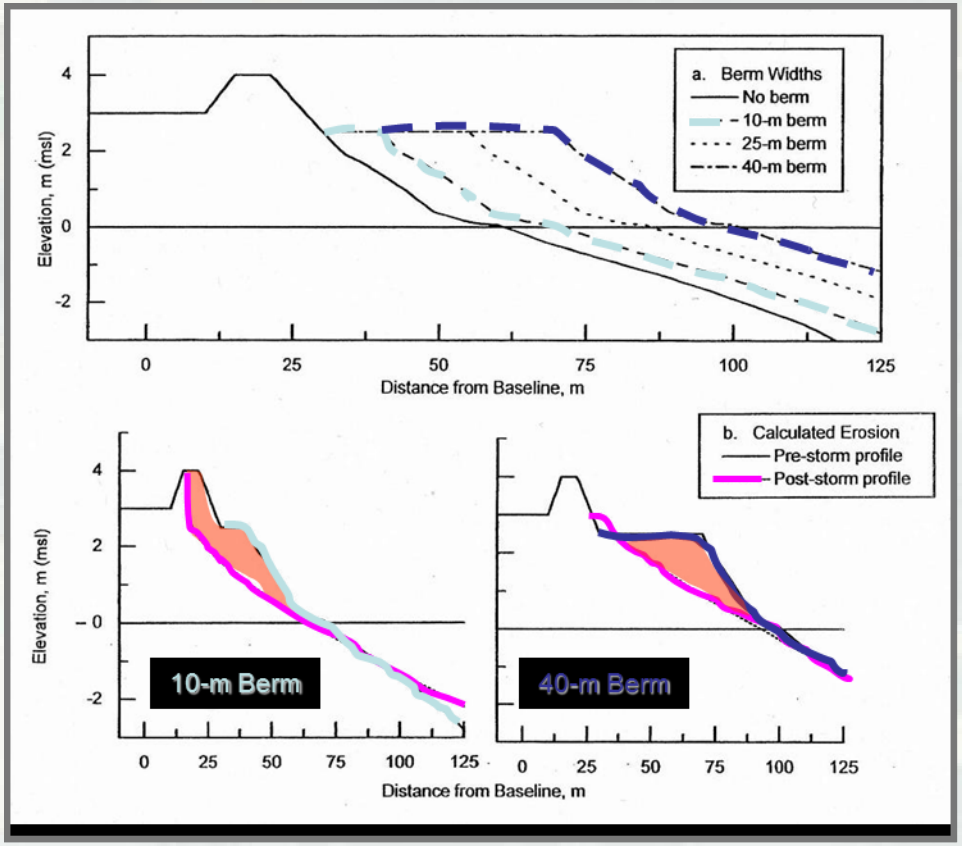
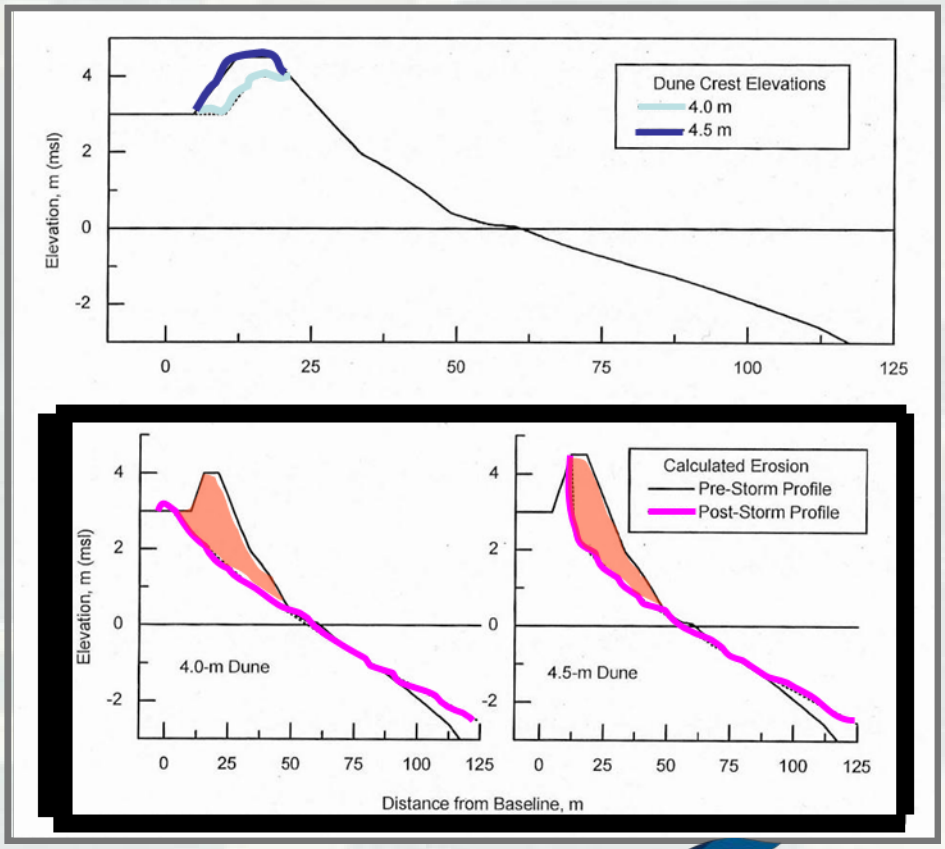
Width and Height Design Considerations

SBEACH software

Design berm WIDTH response to storms



Design dune HEIGHT response to storms



Now: $BEACH_{Fx}$ for economic analysis

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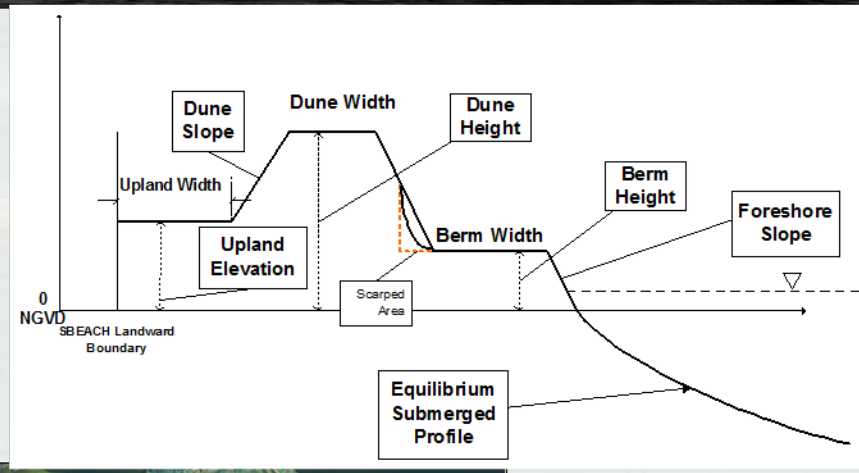
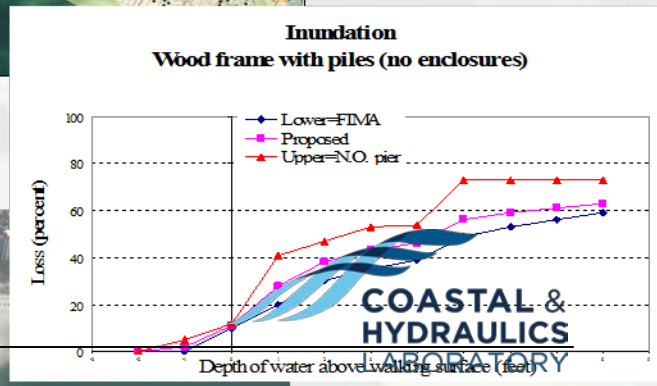
Profile Change Tools

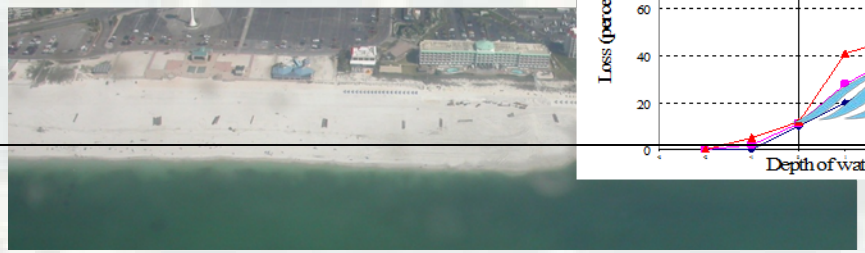
- Models:
  - BMAP/RMAP
- Uses:
  - Profile analysis
    - Comparison
    - Combining profiles
    - Volumes
    - Averages
  - Beach fill placement

Beach-*fx*

- **Meteorology**
  - Plausible storm suite
  - Seasonal probabilities
  - Synthetic storm sequence generator
- **Coastal Morphology**
  - Simplified profile representation
  - Process Models (SBEACH GENESIS)
  - Shore Response Database
    - Profile response
    - Damage parameter profiles
- **Economics**
  - Reach => Lot => Damage Element
  - Damage Functions
- **Management Measures**
  - Emergency nourishment
  - Planned nourishment







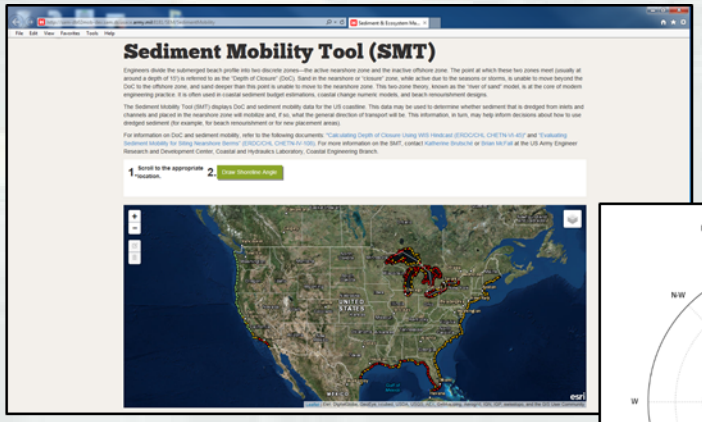
Nearshore Berms

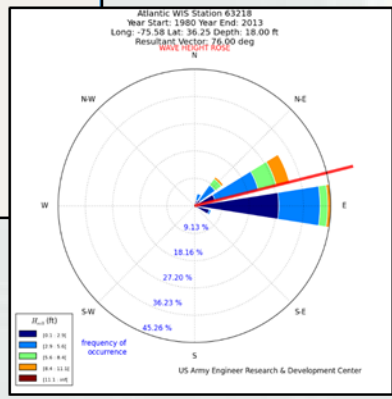
- Increasingly chosen form of beneficial use of dredged material
- Material dredged from nearby inlets and channels
- Placement of sediment in the nearshore
  - Usually completely submerged
- May use non-beach compatible sand
- Attenuates high energy waves
- Less cost
- May nourish the beach

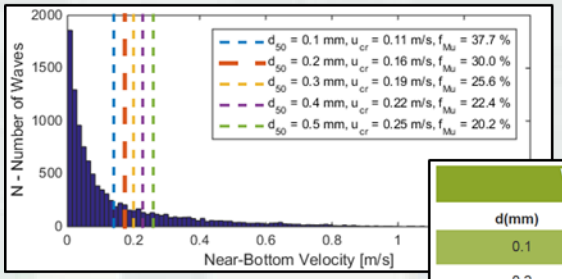
- Can be Active (feeder) or Stable
  - Active/feeder- sediments mobilized by waves and currents
  - Stable- berm remains in the same place for years

Sediment Mobility Tool

- Sediment Mobility Tool (SMT) is a web tool that predicts:
  - Frequency of sediment mobilization at nearshore placement sites
  - Cross-shore sediment migration direction
  - Axis of wave dominated sediment transport







- WIS data are downloaded from the THREDDS server in real-time to calculate SMT predictions
- Useful for nearshore placement of dredged material

WIS Station 63218, 155° Shoreline Angle, Nearshore Placement Depth: 18 ft

d(mm)	Predicted Sediment Migration
0.1	53% offshore
0.2	95% onshore
0.3	100% onshore
0.4	100% onshore
0.5	100% onshore