Engineering with Nature: Nearshore Berm Placements at Fort Myers Beach and Perdido Key, Florida, USA

Katherine E. Brutsché, Ph.D.
Research Physical Scientist
ERDC-Coastal & Hydraulics Laboratory
May 14, 2015

Ping Wang, Ph.D., USF

Julie D. Rosati, Ph.D., P.E., ERDC-CHL

Cheryl E. Pollock, ERDC-CHL

ERDC
Engineer Research and Development Center

US Army Corps of Engineers®

What are EWN and RSM?

- Engineering with Nature (EWN)
  - The intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes
- Regional Sediment Management (RSM)
  - Managing sediment within a watershed to benefit a region; potentially saving money, allowing use of natural processes to solve engineering problems and improving the environment

Strategic Placement

- Dredged material placement in a manner and at locations that permits natural forces to disperse the dredged material toward other locations where it can deliver benefits
  - ► Maximize benefits
  - ► Minimize rehandling
  - ► Minimize negative environmental impacts
  - ► Reduced cost (vs. direct placement)
  - ► Increase beneficial use applications
- Nearshore berms are an example of strategic placement

Nearshore Berms

- Sediment placed in the nearshore in either an elongate (bar-like) feature or a mound
  - Stable berms- remain stationary for years
  - Active/Feeder berms- sediment dispersed by waves and currents
- Typically consist of dredged sediment from navigation projects that is incompatible with natural beach sediment
- Goals:
  - Reduce O&M cost
  - Nourish adjacent beaches
  - Selectively move fine sediment offshore, while beach quality material moves onshore
  - Efficiently and beneficially utilize greater volumes of dredged material

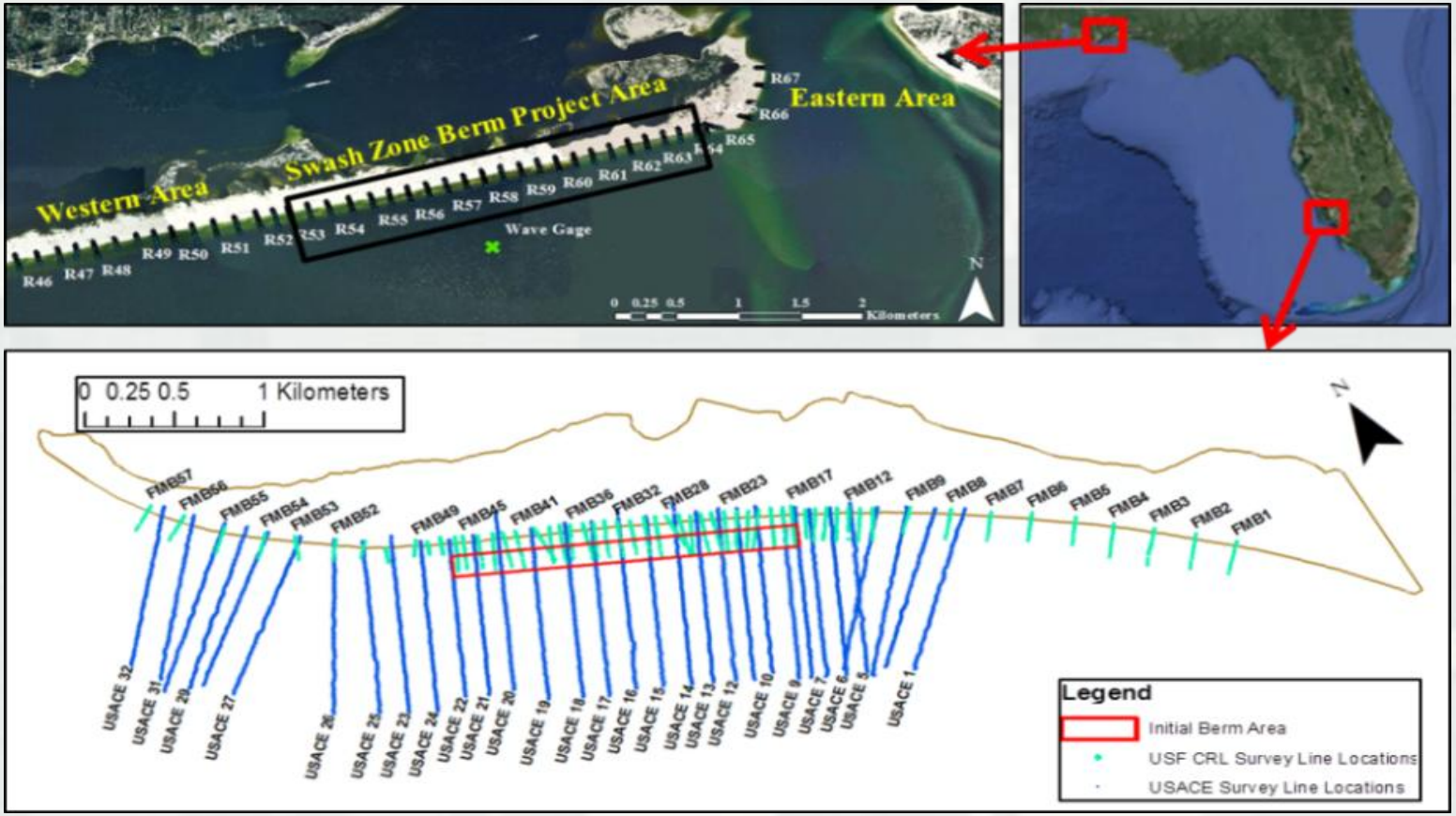
Nearshore Berms

- Fort Myers Beach
  - Elongate submerged nearshore berm placed in 2009
  - Placed at -2 m NAVD88 contour
  - Contained mixed sediment, up to 16% fines (sediment less than 0.063 mm)
  - Designed to allow fine material to move offshore while providing storm protection to the beach
- Perdido Key
  - Swash-zone placement
  - Placed up to +0.91 m NAVD88 contour
  - Designed to rapidly mobilize sediment to nourish downdrift beaches

Outline

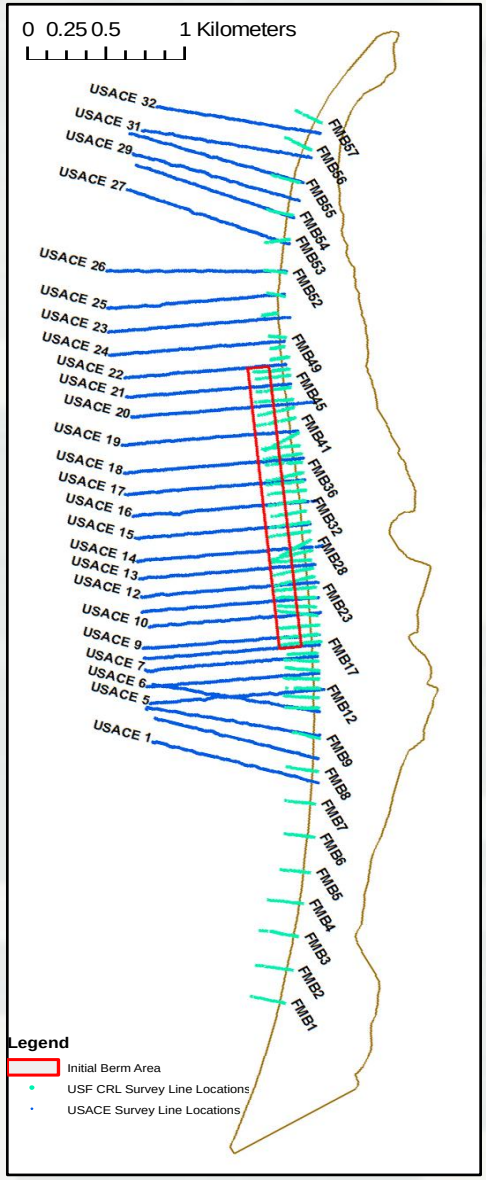
- Fort Myers Beach
  - Study area
  - Morphologic evolution
  - Sedimentologic evolution
- Perdido Key
  - Study area
  - Morphologic Evolution
- Discussion of EWN principles and benefits
  - Sustainability of placement site
  - Benefits of placement to the dry beach
  - Use of mixed sediment (Fort Myers Beach)
- Summary and conclusions

Study Areas

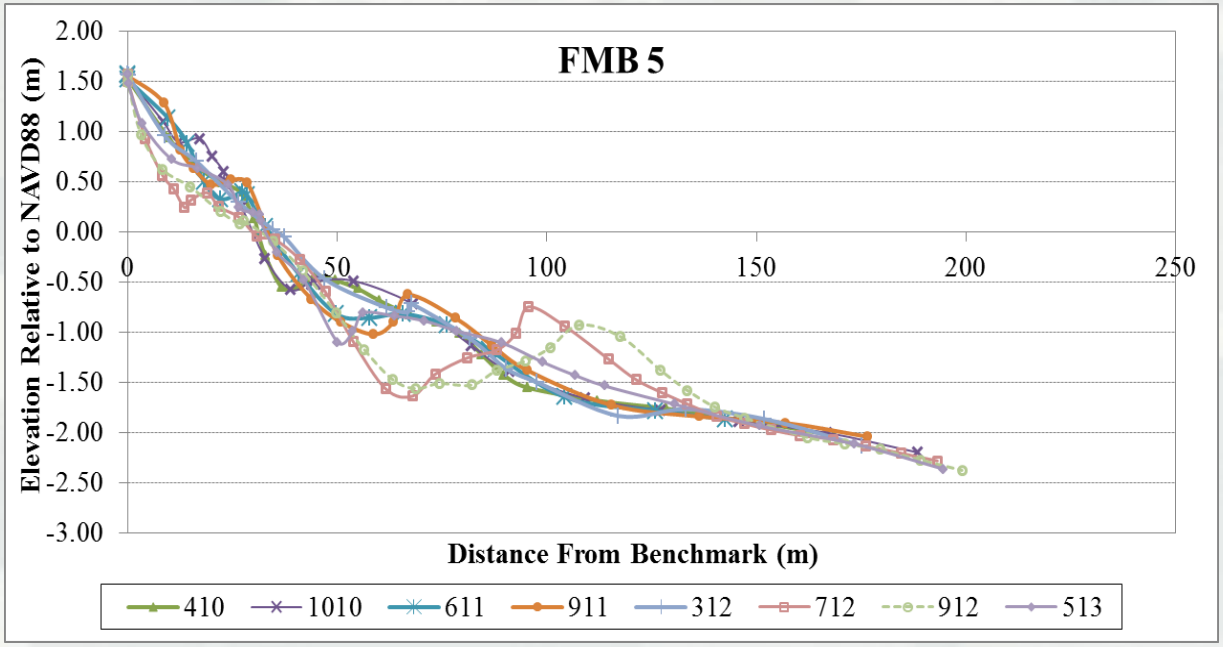

Western Area
Swash Zone Berm Project Area
Eastern Area
Wave Gage
R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67
0 0.25 0.5 1 1.5 2 Kilometers
N
0 0.25 0.5 1 Kilometers
FMB67 FMB66 FMB55 FMB54 FMB53 FMB52 FMB49 FMB45 FMB41 FMB36 FMB32 FMB28 FMB23 FMB17 FMB12 FMB9 FMB8 FMB7 FMB6 FMB5 FMB4 FMB3 FMB2 FMB1
USACE 32 USACE 31 USACE 29 USACE 27 USACE 26 USACE 25 USACE 23 USACE 24 USACE 22 USACE 21 USACE 20 USACE 19 USACE 18 USACE 17 USACE 16 USACE 15 USACE 14 USACE 13 USACE 12 USACE 10 USACE 9 USACE 7 USACE 6 USACE 5 USACE 1
Legend
Initial Berm Area
USF CRL Survey Line Locations
USACE Survey Line Locations

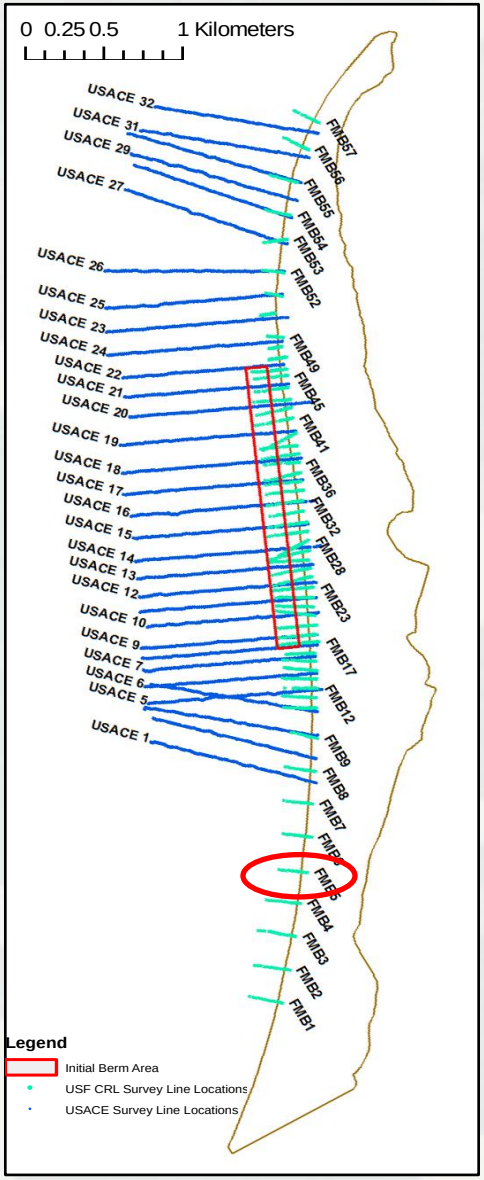
Fort Myers Beach

- Located in west-central Florida
- Relatively low wave energy (Hs= 0.16 m)
- Tidal range: 0.75-1.2 m
- Material dredged from Matanzas Pass/Bowditch Point
- Placed in a berm (non-uniform alongshore)
  - ► Height= ~1 m
  - ► Base width= ~120 m
  - ► Length= ~1.6 km
  - ► Volume= ~175,000 m^3



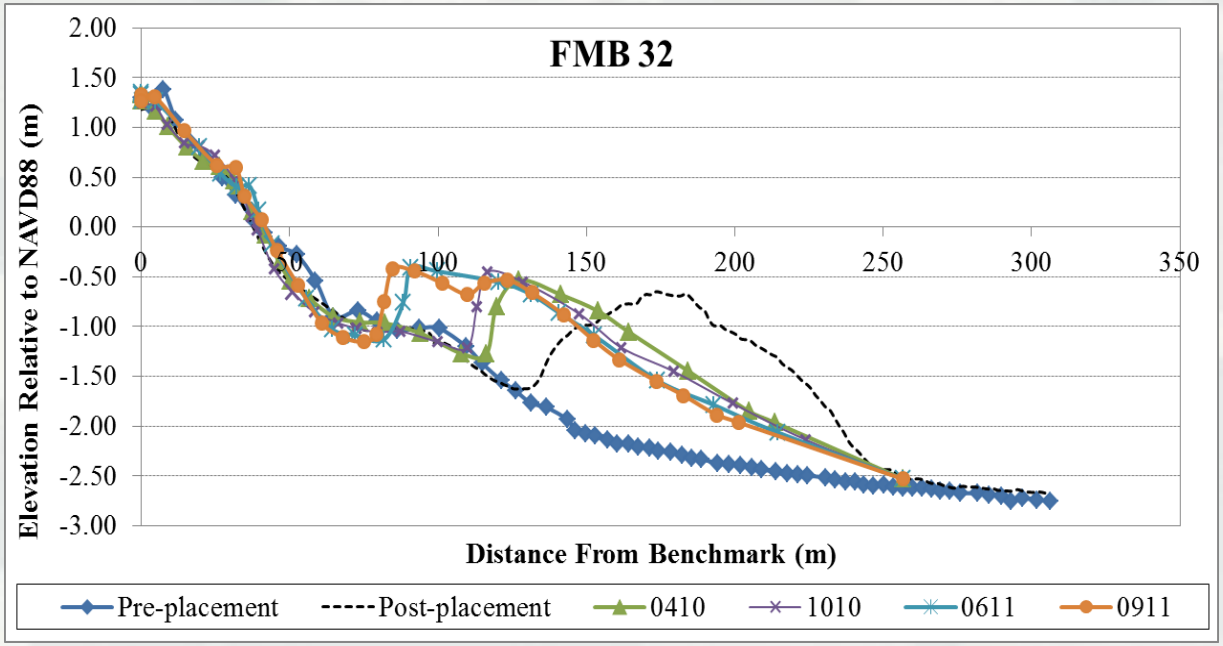
FMB Control Area

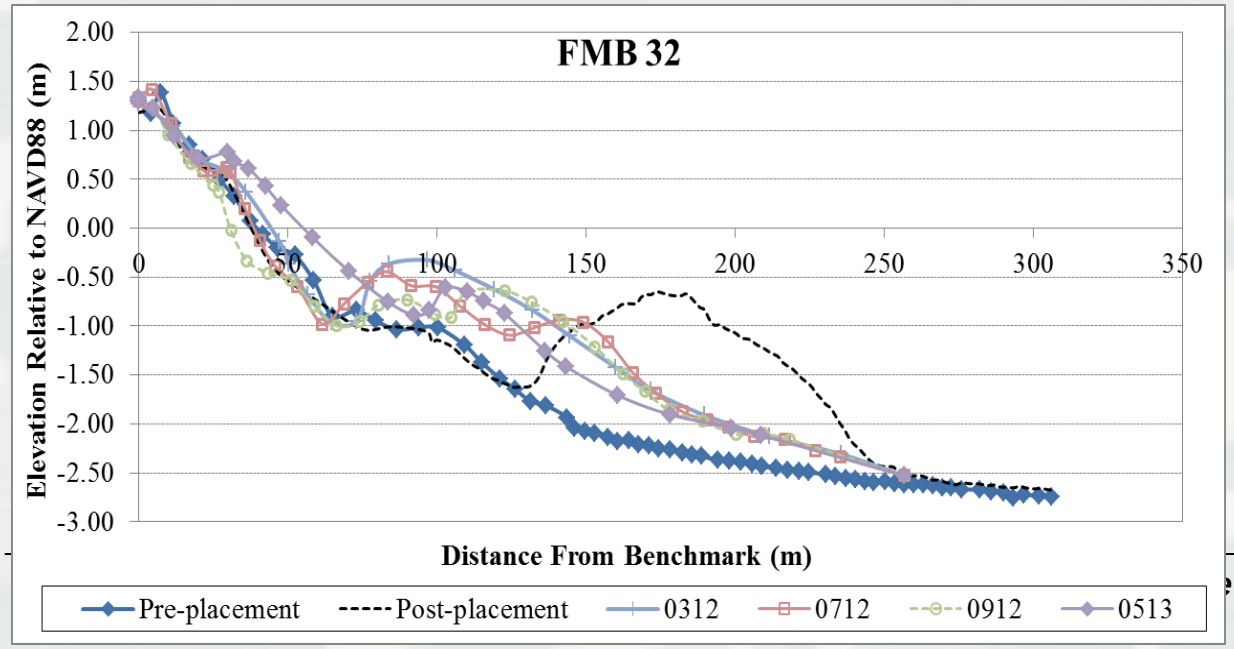


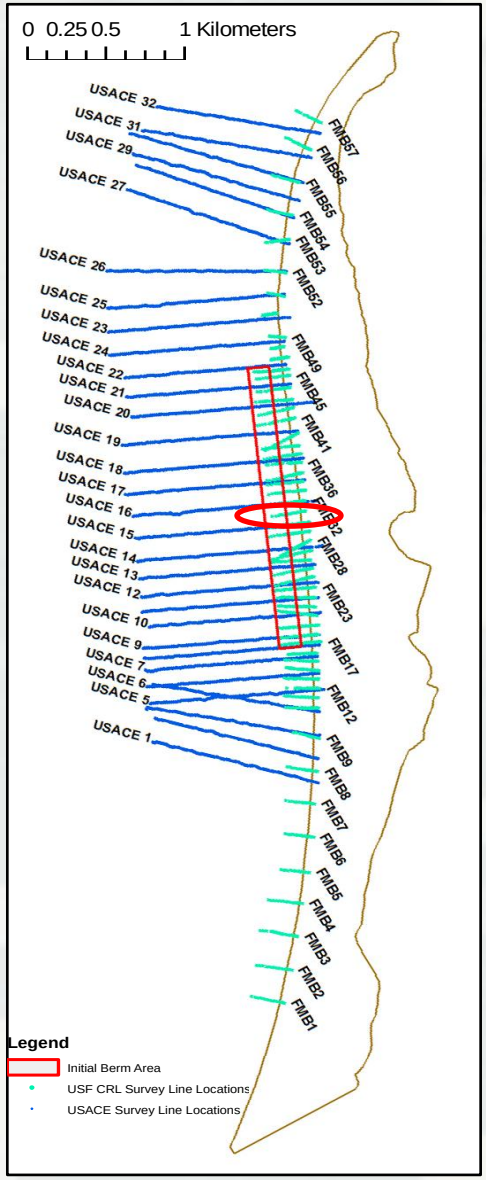


- Small natural bar
- Dynamic beach
- Beach erosion and large storm bar offshore following passage of TS Debby and Hurricane Isaac

FMB Berm Area



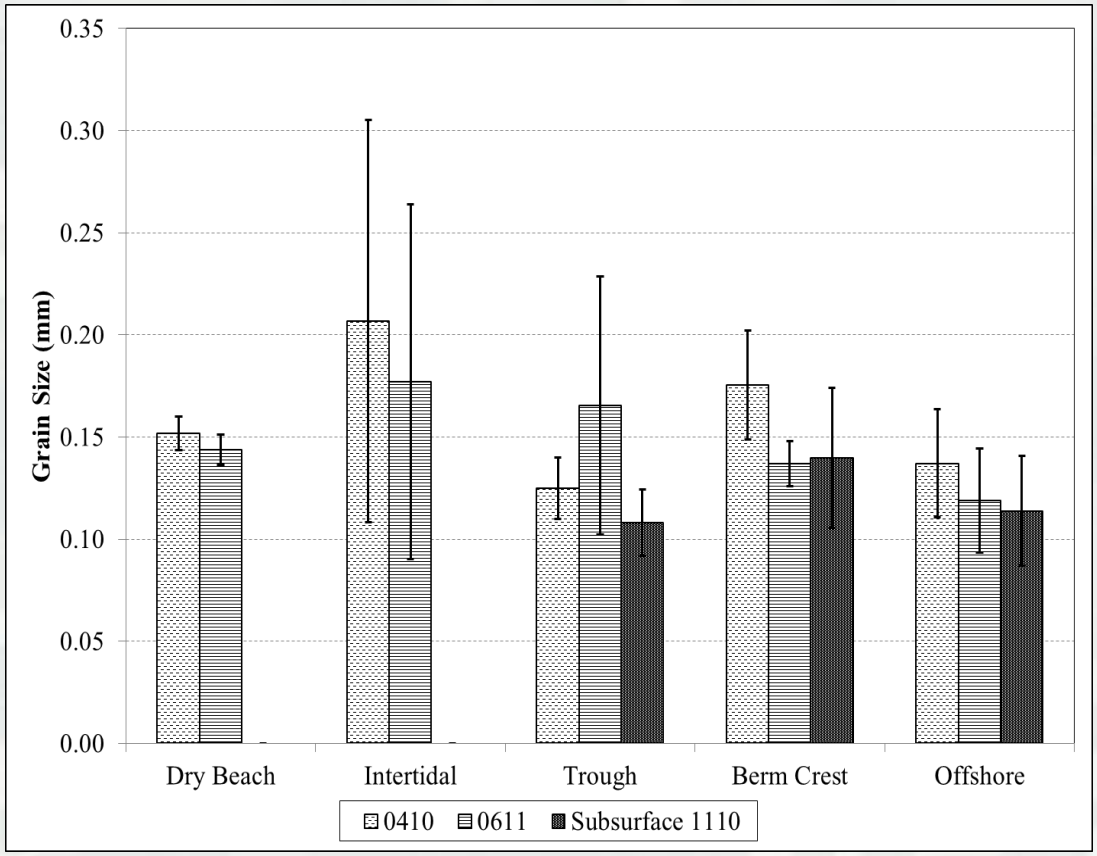




ERDC

e solutions for a safer, better world

FMB Sediment

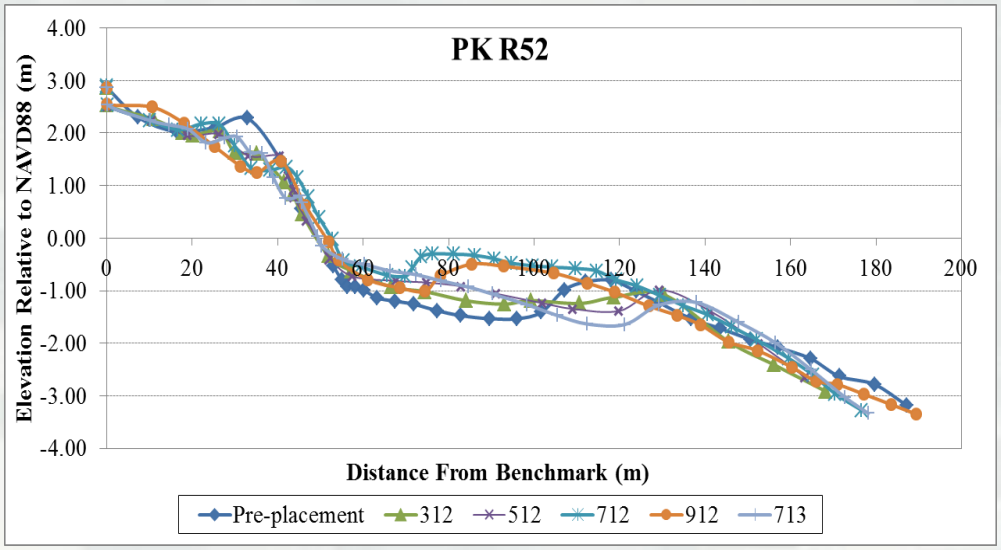


- In 2010, finest sediment found in the trough landward of the berm
- By 2011, sediment over the crest and in the offshore was finer than the trough
- Dry beach remained constant throughout study period

Perdido Key

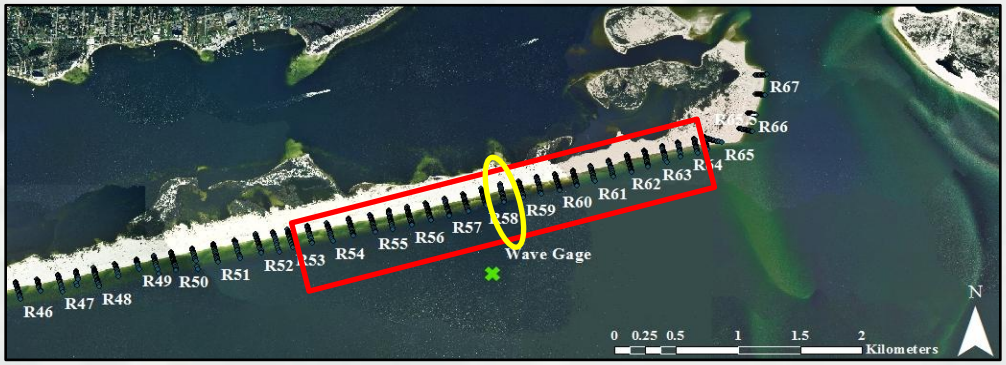
- Located in the Panhandle of Florida
- Low to moderate wave energy (Hs=0.64 m)
- Tidal range: 0.18-0.6 m
- Material dredged from Pensacola Pass
- Swash-zone berm (subaerial, NTE +0.91 m NAVD88)
  - Length= 3.2 km
  - Width= 60 m
  - Volume= 400,000 m^3

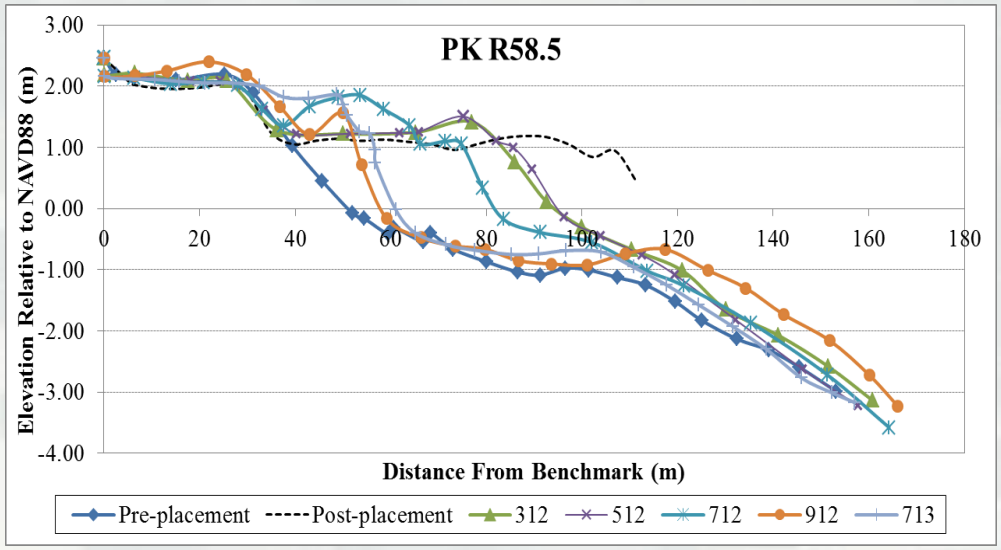
PK Control Area



- Natural berm crest at approximately +2.0 m NAVD88
- Steep foreshore slope
- Small bar approximately 60 m offshore
- Sediment from nourishment deposited in the nearshore

PK Berm Area



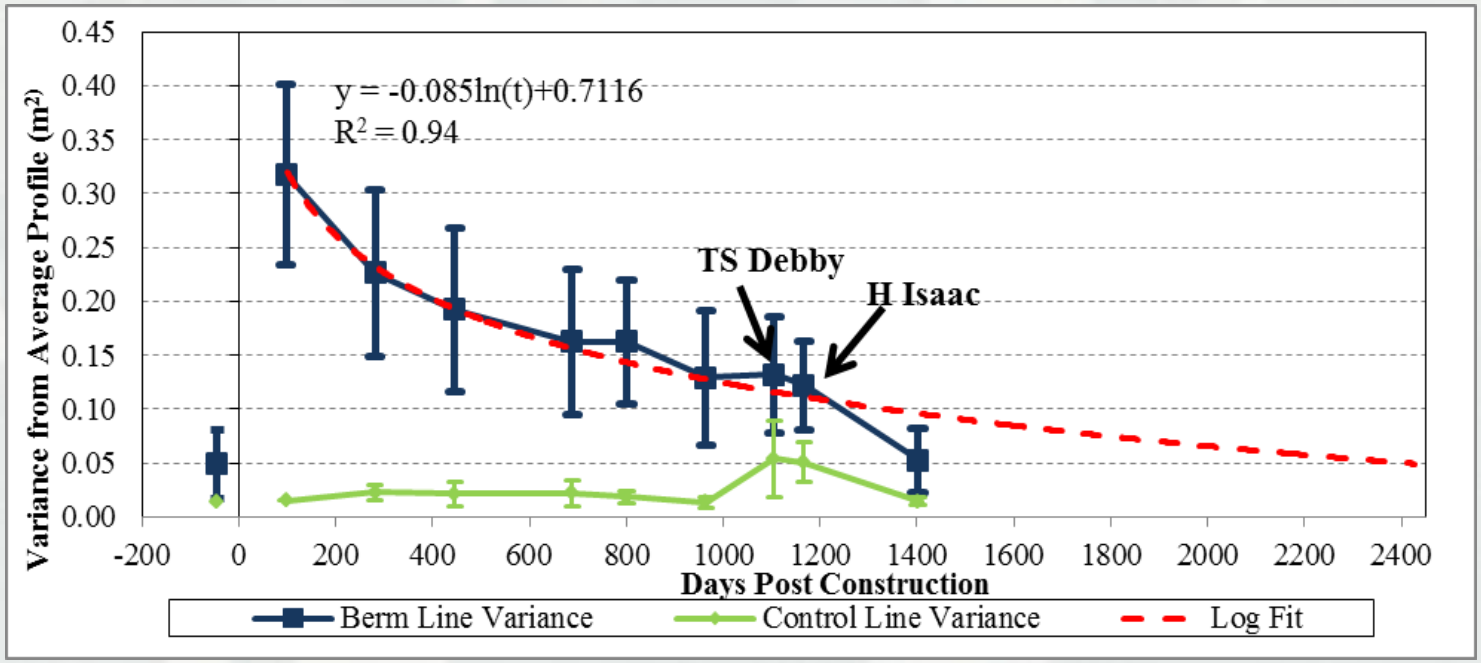


- Nourishment placed up to +0.91 m NAVD88
- Erosion of the foreshore and subsequent deposition on the dry beach creating an active berm
- Active berm grew to +2.0 m NAVD88

Sustainability of the Placement Site

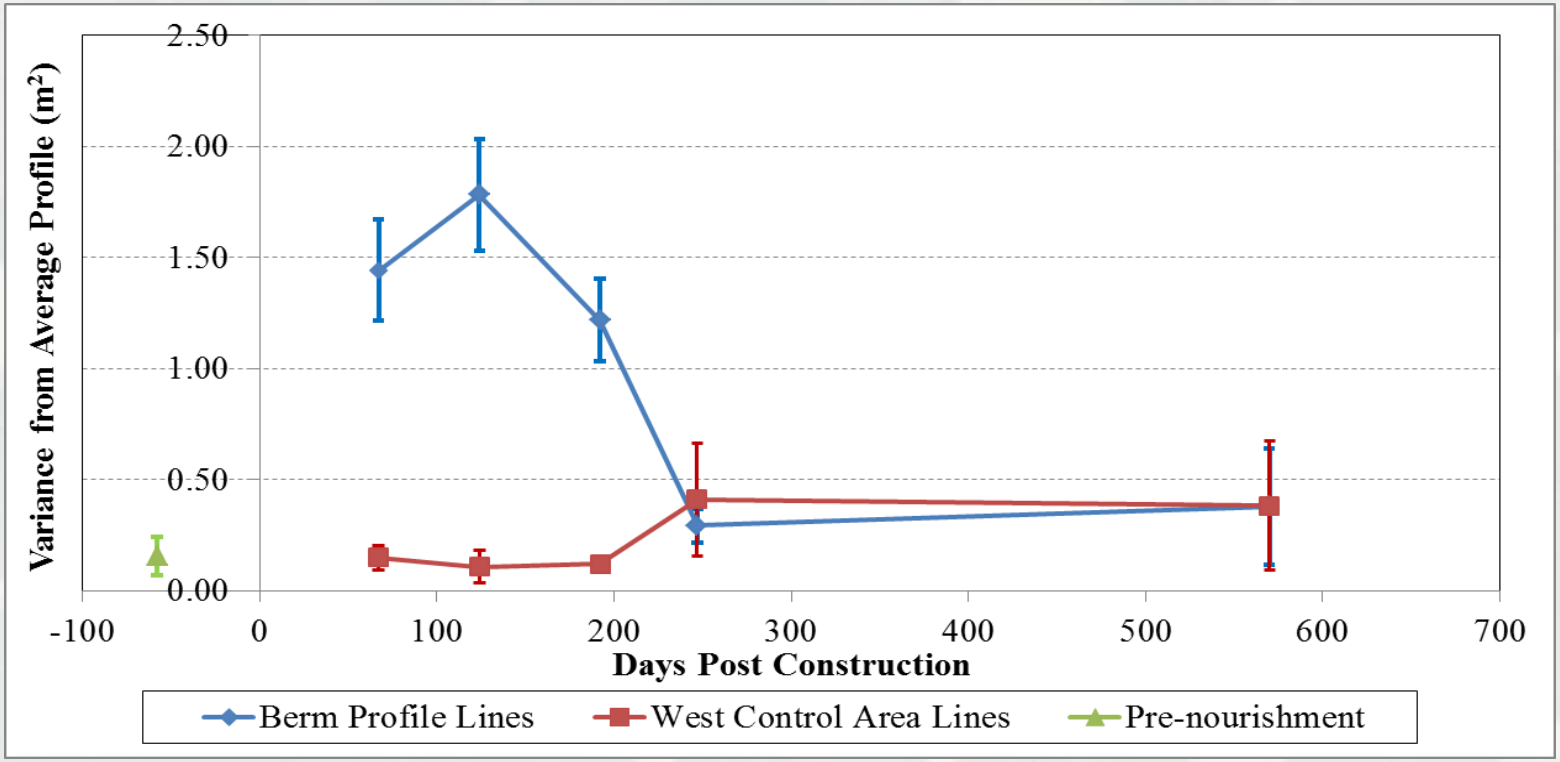
- EWN/RSM projects strive to design the placement in such a way that sediment will transport outside of the placement site, so that the site may be used again
- In other words, return to the pre-placement conditions (or equilibrium shape) so that the site may be reused for future nearshore placement projects
- In the following, average (equilibrium) profiles are used to determine whether the sediment has moved out of the placement site so that it may be used for future projects

Sustainability of the Placement Site



- By the end of the study period, the site had returned to pre-nourishment conditions, so that it may be used in future strategic placement projects

Sustainability of the Placement Site

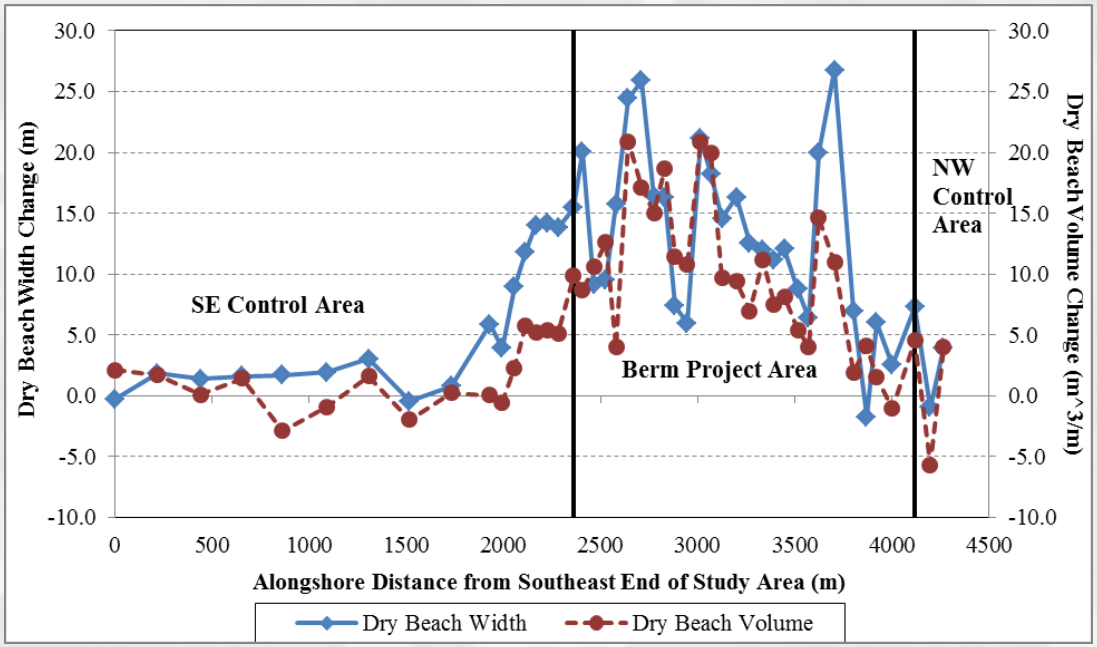


- By the end of the study period, the site had returned to pre-nourishment conditions, so that it may be used in future strategic placement projects

Benefits of the Strategic Placements

- One of the over-arching goals of RSM and EWN is to maximize benefits while also minimizing negative impacts to the placement site and surrounding areas.
- In the following, benefits are measured by the amount of sediment gained on the dry beach in the two study sites

Benefits of the Strategic Placements

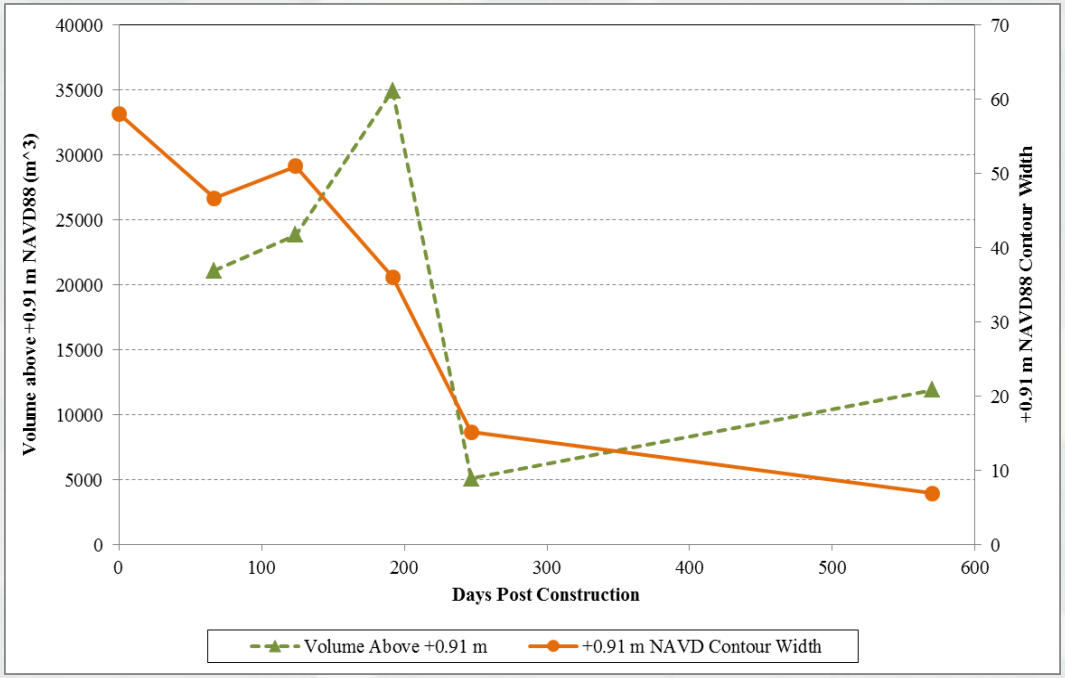


- Gain of sediment on the dry beach within the berm project area
- Up to 25 m in dry beach width

- Up to 20 m^3/m in dry beach volume gain
- Little to no erosion in the control area beaches
- Some dry beach gain in the southeast control

Benefits of the Strategic Placements

- Volume gain above the +0.91 m NAVD88 contour as well as increased width of the contour were considered positive impact



- At the end of the 18 month study period, on average, the contour was 7 m wider, and just over 10,000 m^3 of sediment was gained above it

Use of Mixed Sediments

- Place mixed, non-beach compatible sediments in such a way that fine material moves offshore while coarser, beach quality moves onshore
- At Fort Myers Beach, the design proved to be successful
- Fine material initially found in the trough landward of the berm moved offshore
- Beach quality material moved onshore, keeping dry beach sediment characteristics the same as pre-nourishment characteristics

Summary and Conclusions

- Although different designs, both the Fort Myers Beach and Perdido Key strategic placement projects can be considered successes in RSM and EWN
- Maximized benefits to the beach and nearshore, while minimizing negative impacts

Summary and Conclusions

- Equilibration (i.e. movement of sediment out of the placement site) of the berms allows for future reuse of placement site
- Both projects added up to 10% of the placement volume to the dry beach
- Fine sediment initially found in the trough landward of the Fort Myers Beach nearshore berm moved offshore, while beach quality material moved onshore

Acknowledgements

- These two studies were funded by the U.S. Army Corps of Engineers Coastal Inlets Research Program (CIRP) and the Regional Sediment Management (RSM) program. Field assistance was provided by numerous students within the University of South Florida Coastal Research Lab.