Savannah Harbor Beneficial Use Study

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Project Specific Sediment Management

Past and present practice isolates sediment from the littoral/beach system
Regional Sediment Management

RSM considers dredged material as a resource to benefit the region. How can we best use the material to mitigate erosion on north Tybee?

Maintenance material is generally not beach quality.

Savannah Nearshore Placement Study Issues:

- Benefits to Tybee Island littoral system?
- Negative impacts to Tybee Island shoreline?
- Minimize sediment rehandling
- Nearshore turbidity
- Identify optimal placement locations and orientation for nearshore placement.
Savannah Nearshore Placement Study Methods:

- Collect appropriate data at Savannah
- Model hydrodynamics, waves and sediment transport at Savannah
- Improve and increase confidence in Savannah predictions by validating methods and models at Brunswick.
  - Collect nearshore mound migration data
  - Model same processes at Brunswick

Attachment Bar 1854
Understanding Transport of Mixed Dredged Material:

- Savannah dredged material will be more resistant to erosion than pure sand due to cohesive forces
- Site-specific erosion tests on dredged material
- Incorporate critical shear stress for erosion and erosion rates into GTRAN
Wave Model Grids

Parent Grid
36 km x 67 km
dx: 200 m

Nested Grid
15 km x 30 km
dx: 50 m

Water Level Influence on Wave Transformation

Low Tide
High Tide
Nearshore Placement Scenarios

Crest Elevation

Berm 01: 2.1 m
Berm 02: 2.1 m
Berm 03: 3.0 m
Berm 04: 4.0 m
Berm 05: 4.0 m
Berm 06: 3.5 m
Berm 07: 2.5 m
Berm 08: 1.5 m
Berm 09: 2.5 m
Berm 12: 3.0 m
Berm 13: 2.0 m
Berm 14: 2.0 m

Transport direction and magnitude
Transport direction and magnitude

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Effect of Nearshore Placement on Waves and Longshore Transport

- Nearshore bathymetric relief influences wave transformation
- Changes in transformation influence longshore transport
- Longshore transport affects shoreline change

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Wave Focusing by Nearshore Berms

Wave Direction

Lower Waves

Higher Waves

Submerged Shoal

Wave Focusing at Nearshore Berm 01

Low Tide

Mid Tide

High Tide
Conclusions

- Offshore or channel adjacent placement will not benefit Tybee shoreline
- Berms placed closer to shore more likely to provide sand to Tybee shoreline and nearshore platform
- Nearshore berm location is critical in maximizing nourishment and minimizing rehandling
- Transport patterns remove sediment from north Tybee nearshore platform
**Recommendations**

- Move mixed material from channel to Berm 13/14
- Allow natural winnowing to remove fine content
- Longshore transport patterns will move sediment into sand-starved north Tybee littoral zone

**Validation**

- New models developed from verified theories applied to nearshore berm placement at Savannah
- Opportunity to validate and improve new models applied at Savannah by monitoring ongoing nearshore placement at Brunswick
- Model validation is critical to improve and increase confidence in the Savannah nearshore placement results
Nearshore Placement at Brunswick
Main Issues

• Rate and direction of mound migration
• Does sand-sized material re-enter the littoral system or the channel?
• Do fines deposit in the nearshore area?
• Do numerical models of dredging process and sediment transport models accurately represent nature?
Fate of Sediment
Field Techniques

Sediment Tracer
(Feb – Aug 2003)
- Sand
- Fines (Silt and Clay)

Instrumentation
- Currents
- Roving Survey
- Waves
- Suspended Sediment

Bathymetric Surveys
(Feb, Apr, Jul 2003)
- Survey Bounds

Sediment Sampling
(Feb, Apr, Jul 2003)
- Grab and Core Samples

Mounds B & C

- Disposal method results in annular (donut-shaped) mounds
- Analysis
  - Mound relief at similar scale as natural (?) features
  - Mound evolution (Feb-July)
  - Mound evolution consistent with tracer movements
  - Backscatter (sediment sorting)
Morphology of Mound C

ADCIRC: Calibration to currents
Results of ADCP current profile analysis behind Mound C

Present BL Approach

With BL Separation

Tidal Currents

Tidal Currents

Potential Effect of Vertical Structure on Mound Evolution

Present BL Approach

With BL Separation

Tidal Currents

Tidal Currents

Near-bed currents in the lee of the mound tend to transport sediments away. Result is a more dispersive mound.

Near-bed currents in the lee of the mound are toward the mound crest. Result is a less dispersive mound.
Summary: Current profiles

- Significant structure exists in the vertical current profiles near the navigation channel and dredged material mounds.
- Spatial variance exists in the profiles and appears to be associated with gradients in the bathymetry.
- Three-dimensional structure of currents may be important in the evolution and dispersion of the mounds.

High-Resolution Bathymetry

- 3 sets of high-resolution bathymetry covering large area (27 km², 10 mi², or 6600 acres)

  Analysis and Data Use
  - Provides best available bathymetry for numerical models
  - Accurate enough for detailed volume-change analysis
  - Supplementary data for tracer analysis
Summary: Preliminary analysis of survey and tracer data

- Surveys and tracer movement indicate net migration of mound to the SSW.
- Acoustic backscatter and cores suggest winnowing of sediments.

Sand Tracer Movement (Feb – June 2003)

- Flood-dominant transport at nearshore mound
- Ebb-dominant transport with longshore current influence at offshore mound
Other Tracer Study Observations

- Silt tracer
  - disperses rapidly.
  - Small amount temporarily found in nearshore
  - At end of study, majority of silt tracer unaccounted for (deep burial or transport outside study area)

- Sand tracer
  - Transported rapidly from mound crest
  - Majority of sand tracer mass buried in migrating mound
  - Tracer movement consistent with bathymetric surveys

Modeling at Brunswick

- Modeling is ongoing
- Hydrodynamic and wave model results compare well to field data
- Hydrodynamics is very similar to Savannah
- Preliminary sediment transport modeling results are consistent with field data
- BL separation has a significant impact on transport at Mound C