Predictive Modeling and Design Solutions for Beneficial Use of Dredged Material

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Integrated Approach is Key to Success

Design for Beneficial Use (BU)

- Environmental Considerations
- Goals of BU Project
- Predictive Modeling
- Construction Equipment and Methods
Beneficial Use (BU) Opportunities
Beneficial Use Opportunities

- Confined Placement Facility (CPF)–Shoreline Development
- Confined Aquatic Placement (CAD)
- Remediation Caps

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Beneficial Use Opportunities (cont.)

- Habitat Restoration - Mitigation
- Beach Nourishment
Predictive Modeling for BU Projects
Physical Stability of Placed Sediment

• Objective: Evaluate short- and long-term physical stability of placed material due to hydrodynamic forcing

• Tools: ADCIRC, STWAVE, Delft-3d, SWAN, M2D and others

• Data needs
  - Site conditions
  - Design conditions
  - Sediment characteristics
Physical Stability of Placed Sediment

- Tidal currents
- Wind-waves
- Vessel wakes
- Propeller wash
- Riverine currents
- Outfalls/stormdrains
- Storms/hurricanes

Simulation of Hurricane Katrina for Port of Gulfport (wind stress)
Keyport Lagoon, U.S. Navy
Tidal Currents (ADCIRC) and Excess Shear Stress
Hancock County Living Shorelines, Mississippi Sound

Wave Energy Along Shoreline (Delft 3D Wave)
Sustainability (SLR)

- **Objective:** Evaluate impacts to project over design life based on predictions of sea level rise
- **Tools:** Hydrodynamic models and GIS spatial modeling tools
- **Data needs**
  - Site conditions
  - Design conditions
  - Habitat conditions and characteristics
  - Sea level rise estimates (typically through 2100)

Transformation of Tidal Wetlands in DE
Contaminant Mobility (Benthic)

- Mobility of contaminants through the placed sediments
- Groundwater pathways
- AQFATE
Contaminant Mobility (Suspended)

- **Objective:** Assess water quality impacts resulting from dredging
  - Turbidity
  - Dissolved contaminants

- **Tools:** ADDAMS, DREDGE and STFATE modules; EPA Plumes

- **Data needs**
  - Site conditions
  - Sediment characteristics
  - Dredge characteristics and operations
  - Placement operations
Geotechnical Modeling

- Dredged material bulking and settlement (short-term)
- Foundation consolidation (long-term)
- PSDDF Model
  - Settlement during construction
  - Long-term consolidation
## Summary of Predictive Modeling for BU

<table>
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<th>Beneficial Use Options</th>
<th>Physical Stability</th>
<th>Sustainability</th>
<th>Contaminant Mobility (Benthic)</th>
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<td>Confined Placement Facility/Shoreline Development</td>
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+    Considered  
++   Important    
+++  Critical for Design
Confined Placement Facilities
CPF Design Considerations

• Containment design
  – Static and seismic stability
  – Contaminant mobility

• Size and capacity
  – Short-term bulking and settlement
  – Long-term consolidation
  – Ponding area to meet water quality criteria

• Pumping distance
  – Water content

• Site final use
  – Habitat
  – Shoreline development
  – Recreation
Confined Aquatic Placement
CAP Design Considerations

- Submerged or emergent
- Containment design
  - Static and seismic stability
  - Erosion protection
  - Contaminant mobility
- Size and capacity
  - Short-term bulking and settlement
  - Long-term consolidation
- Sustainability
- Pumping distance
  - Water content
- Site final use
  - Typically habitat function
  - Navigation and anchoring restrictions
Port Hueneme Beneficial Use

Place Contaminated Sediment in CAP

Place CAP Clean Sediment as Beach Nourishment
Port Hueneme CAP Cross-Section

Note:
MLLW = mean lower low water
Port Hueneme – Barge Placement
Beach Nourishment and Habitat Restoration
Other Beneficial Uses

- Beach nourishment
- Agriculture and products
  - Topsoil
  - Aquaculture
- Berms
  - Stable and feeder
- Habitat restoration
- Land improvement
- Marsh and intertidal habitat
Deer Island Marsh Creation

- Design elements
  - 7- to 8-foot-high dike
  - Easterly wing dike
  - Flash board riser weirs
  - Offset to provide bayou
- Dredged material from Biloxi Lateral Channel
- Approximately 40 acres were filled with 365,000 cy of sediment
Enhancing Existing Marsh

Illustration of conceptual model for marsh recovery after thin-layer placement
Questions?