Palos Verdes Shelf Pilot Capping – Dredged Material Fate Modeling For Cap Placement

Joe Gailani, Steven Bratos, Billy Johnson, James Clausner
U. S. Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory

PVS modeling Outline

• PV Site Description
• STFATE and MDFATE Model Objectives
• MDFATE Input and Results
• STFATE Input and Results
• Summary/Conclusions
PVS Site Description

- 22 square km are contaminated from storm sewer outfall
- Water depth of 30-100m
- Storm-driven currents and surface waves as well as internal waves can resuspend bottom sediments
- Can a cap be placed in this deep-water environment?
Placement Methods

Conventional (point placement)
Queen’s Gate
Sediments in LU and SU
Spreading (cracked hull)
All Borrow Material in LD

Hopper Dredge “Sugar Island”
PVS Modeling Objectives

• Determine Fate models’ ability to predict capping process
  – MDFATE
    • Extent of single and multiple placement mounds
    • Estimate required volumes (hopper & in-situ) to build cap
    • Guidance on spacing and locations of single loads – monitoring plans

• Determine Fate models’ ability to predict capping process
  – STFATE
    • Impact velocity and surge speed
    • Plume movement and size
    • Hindcast: model with measured data and compare results to additional data
STFATE Processes Modeled

- Single Placement
- Water Column
- Bottom Footprint

STFATE Limitations

- 2D non-time varying currents
- Sloping bottom (SURGE)
- Model sensitivity to geotechnical parameters
- Source - rate of material leaving barge
- No resuspension by surge current
- Coefficients
- Model Validation
MDFATE Processes Modeled

- Predicts Mound geometry from multiple open water disposals
- Conventional and Spreading
- Uses modified versions of STFATE and LTFATE
- Time Scale - Days to years (during & after disposal)

MDFATE Limitations

- STFATE process limitations
- Does not include resuspension
- 2D non spatially varying currents
- Model sensitivity to geotechnical parameters
MDFATE Simulations

- Predictive/Scoping
  - (Jan-June 00), > 50 Simulations
  - Vary GSD, Currents, Dredge Velocity
- Operations
  - Jul-Aug 00 (10 Simulations)
  - Some actual data, original void ratios
- Hindcast
  - Mar 01 – July 01 (>30 Simulations)
  - Lack definitive full cap thickness LU

Sources of MDFATE Input

- ADISS – position, duration, velocity, heading, load, draft
- Hopper Samples – GSD, SG
- Cores – In situ void ratio
- Currents – ARESS, ADCP, ADCIRC
- Hindcast thickness – SPI/Cores*
MDFATE Input
Typical Values

<table>
<thead>
<tr>
<th>Variables</th>
<th>LU and SU (Queens Gate Conventional)</th>
<th>LD (AIII Spreading)</th>
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<tbody>
<tr>
<td>Load</td>
<td>1,000 cu m</td>
<td>1,200 cu m</td>
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<tr>
<td>Duration</td>
<td>3.5 - 4.5 minutes</td>
<td>7.5 minutes</td>
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<tr>
<td>Velocity</td>
<td>0.3 – 0.4 knots</td>
<td>2 knots</td>
</tr>
<tr>
<td>In situ Void Ratio</td>
<td>1.05*</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Placement Cells with Typical MDFATE Grid

- Initially 30 m cell size
- Hindcast 15 m cell size
LU 45 No Tides

LU 45 Placements With Tides

LU 45 Placements With Currents
Compare to SPI
LU 71 With Tidal Current

LU 71 No Tides or Current
SU 1 - Preliminary

SU 21 With Tides

- Using LU sediments and void ratio
LD1 Conventional

LD Single Placement Spreading

LD Initial Spreading Load
MDFATE and SPI
MDFATE Modeling Summary

• Conventional Placement
  – Single loads, cap thickness underpredicted, extent good agreement, no currents
  – Full (45 loads) – thickness and extent, reasonable agreement with tidal currents
  – Slope effects not well modeled
  – Void Ratio is critical for good thickness predictions

• Spreading
  – Reasonable agreement on single load (no currents)
  – Reasonable agreement on multiple loads

• Additional sensitivity testing needed

STFATE Simulations

• Predictive/Scoping
  – (Jan-June 00), ~ 5 Simulations
  – Impact Velocities, Far Field – Kelp Impacts

• Hindcast
  – Mar – May 01 (>10 Simulations)
  – Surge Velocity Comparisons
  – Far Field Comparisons
Average Surge Speed Computation

Measured vs Predicted Surge Currents
Measured vs Predicted Surge Currents

**Average Surge Speed - Measured (M) & STFATE (S)**

- **Placements**
  - LU4 (M)
  - LU4 (S)
  - LU5 (M)
  - LU5 (S)
  - SU1 (M)
  - SU1 (S)

**Distance from Release (m)**

**Average Surge Speed (cm/s)**

- 0 50 100 150 200 250 300

STFATE FAR-Field Plume Comparisons

- STFATE Far Field Plume dimensions compared well qualitatively with ADCP
STFATE Modeling Summary

- STFATE surge speeds compared reasonably well to measured surge speeds
  - STFATE tends to under estimate with increasing distance from release
  - For steeper slope at SU agreement not as good
- Plume characteristics
  - Qualitative agreement
- Impact Velocity
  - Averaged 10 ft/s

PV Modeling- Summary

- MDFATE - Reasonable agreement for mound thickness, good agreement on mound extent, volume losses still to be predicted
  - Lack of resuspension – under predicts single load thickness
- STFATE – Surge predictions agree well with measurements
  - Slope effects, >200 m not well predicted
- Insufficient data for quantitative far field plume comparisons