Panel 3 Synthesis – Processes of Relevance to Selecting Remedies

October 28, 2004

Presentations

- Contaminant Releases During Dredging
- Evaluating Post-Dredging Residuals
- Physical and Chemical Processes Affecting CAP Design and Performance
- Biological Processes Affecting Remedial Design and Performance
- Physical and Chemical Stability of Contaminants in Sediments

Dredging Releases

- Primary Releases: Suspended Particulate and Releases to Water Column
- What we know:
  - Production dredging for "aquatic superhighway" different than environmental dredging
  - Need good design specs and experienced dredging contractor
  - Solid and contaminant releases (within an order-of-magnitude)
  - Dredging models available but, unlike disposal models, not validated
    - Data collection not authorized by Congress – Some data from Corps suggests little impact to water column
    - Data difficult to collect – need more
  - International Group ("ACCORD") formed and developing monitoring protocols – Relevant data may become available within next two years

Questions/Comments

- Corps has studied effects of dredging on water quality using clam shells and hydraulic dredging – Never saw water quality exceedances
- Environmental dredging different than navigational dredging – especially in areas of elevated impacts
- Need to interpret impacts in terms of changes in exposure to receptors: short- and long-term
- Have calibrated, but few validated, models

Post-Dredge Residuals

- Fluidized mud flows (nepheloid layer) can be primary mode of transport
- Characteristics:
  - Dry weight solids concentration: Similar to what has been dredged
  - Depth-averaged constituent concentration of dredged sediment during single pass is reasonable estimate of constituent concentration in residual sediment resulting from that dredge pass
  - Thickness: Inches
  - Volume: 10% to 20% of dredge volume

Post-Dredge Residuals

- Case Studies
  - 70,000 to 700,000 cubic yards removed
  - Sandy silt, soft silt/clay, soft silt over dense sand or gravel/cobbles
  - Cable arm/clam shell buckets with BMPs and digging and closed bucket with BMPs
  - Results:
    - 85% to 90% clean after first pass; Natural recovery for residuals in 6 months based on biological testing
    - Assuming second pass required, dredge one foot and place 6-inch cap (adaptive decision matrix)
    - Required 50% re-dredging of cells
- Need: Post-Dredge Monitoring Data

Questions/Comments

- Natural recovery – Should include subaquatic vegetation as well as benthic community
- Details regarding limitations of use of environmental bucket available in literature
- Need for definition of critical specifications for dredge operations – Corps conference planned
- If capping required after dredging, why not cap in the first place?
- Some field data (Canada) suggest that marginal benefit associated with multiple passes

CAP Design and Performance

- Definition of CAPs
  - EPA: Isolation Only
  - Thin Layer CAPS not CAPS
- “Emerging Technology”?
  - Sand CAPS: No
  - Active CAPs: Yes? Anacostia River Study in Progress
- Niche applications for hydrophobic chemicals – Primary transport mechanisms becomes pore water migration following placement of CAP
- Models and guidance documents available

CAP Design and Performance

- Anacostia River Study – Active CAPs
  - Sand
  - Apatite
  - Aqua Block
  - Coke
- Observations:
  - Can place material in thin layers
  - Gas evolution can be significant
  - Groundwater upwelling/seepage modified by CAP
  - DNAPL migration possible through voids

CAP Design and Performance

- Case Study: Dredged Material Disposal in San Juan Bay
  - Examine "Contained Aquatic Disposal"
  - Chemical of Interest: Selenium
- Conclusions:
  - Thin CAPs work – Question: How thin can they be?
  - Thickness of bioturbation is important

Questions/Comments

- Sand and Aquablock were not mixed during testing in Anacostia River
- Addition of carbon to sand can help slow down contaminant flux but will not eliminate it, at least at steady state conditions

Biological Processes: Biodegradation and Bioturbation

- Limiting processes for biodegradation: Kinetics of desorption and/or dissolution or lack of substrate (energy source) for growth of microbial population?
- Sediment as Source or Sink? Effects of CAP on biological processes and contaminant transport?
- Role of bioturbation?
  - Mixing
  - Transport
  - Biodegradation
- Laboratory characterization protocol or determining bioturbation coefficients: Importance based on time-scale and spatial scale of interest
- Plants not considered important contributor to biological action, i.e., rhizosphere; help stabilization

Questions/Comments

- Literature suggests that presence of soot carbon dramatically affects partitioning of contaminants to water column – Likely to affect biodegradation?
  - Microbes can attach directly to contaminants and achieve degradation
  - Typically will do best in transition zones – more mixing and more oxygen
- Large spatial variability re: density of organisms
- Information regarding fluxes of PAHs into water column available from Thibodeaux study on contaminant fluxes from turbated sediments
- Few examples of scaling bioturbation to large scales – Are these data of great value? Hard to get.
  - Particle mixing has been addressed
  - Little regarding solute transport from sediment to pore water

Physical and Chemical Stability – Multiple Lines of Evidence

- Important for in-place Sediment Management Options: MNR, Capping, and Residuals
- Physical Stability
  - Extreme event analysis
  - Focus on potential for elevated risk; Movement of sediments will not necessarily result in an elevated level of risk
- Chemical stability
  - Need end state assessments to account for changes in chemical concentration, partitioning, and bioavailability
  - Assumed constant during extreme events

Reducing Uncertainty

- Options to Reduce Uncertainty
  - Improve Science
  - Collect Additional Data (As Appropriate)
  - Use Multiple Lines of Evidence
- Incorporate Multiple Lines of Evidence in an Iterative Assessment

Key Questions/Comments: Panel Discussion

- Dredging Decreases Uncertainty Associated with Sediment Management
  - Can point to impacted sediment and say its been removed from the waterway
  - How much risk reduction has really been achieved?
  - Evidence that greater uncertainty drives more aggressive solutions?
- Sediments: Sources or Sinks?
  - Significant anthropogenic carbon content acts as strong sorbent for hydrophobic organics
  - Capping: Influence (reduce) biodegradation and result in contaminant movement?

Key Questions/Comments: Panel Discussion

- Don’t forget iron chemistry and importance as contaminant scavenger
- Importance of transient Nepheloid layer over long periods of dredging?
- How do we integrate current state of knowledge to make informed decisions regarding remedies?
  - Define future use (Consider expansion of ecological habitat)
  - Use CSM to define plausible pathways to achieve desired end state: Be honest about what is known or unknown
  - Eliminate options based on ability to achieve future end use conditions and associated risk to get there

Key Questions/Comments: Panel Discussion

- Try to avoid using quantitative limits for criteria such as resuspension as basis for making remedial decisions – Too much uncertainty
- Need good contractors who are part of the process from the beginning and who have been given proper incentives
  - Example provided: One pass dredge meeting criteria using four different buckets to address different conditions and with an incentivized contractor