Dredge Sediment Reuse: Expanded Approach with Broad Applications

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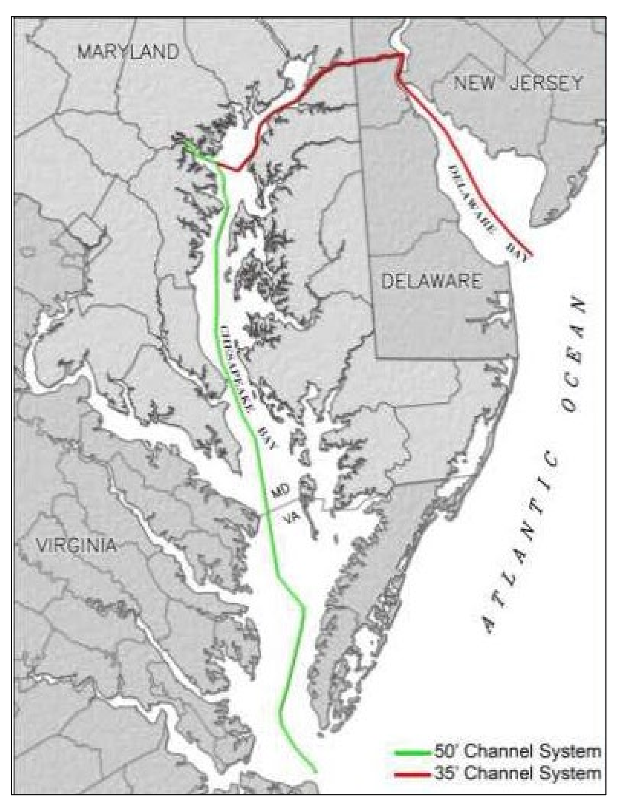
BACKGROUND & OBJECTIVE

An increase in the size of cargo ships has required construction of deeper and wider ship channels resulting in the generation of large volumes of dredged sediments. Coupled with the limited suitable shoreline sites to build new containment facilities and restrictions on ocean dumping, this has resulted in the need to collaborate with many stakeholders to manage economically viable and large-scale innovative dredge material reuse projects. In addition, stream and river sediment is more frequently being managed as a pollutant by USEPA, particularly in East Coast fish habitats such as the Chesapeake Bay, further complicating dredging disturbance and reuse placement.

PORT OF BALTIMORE

- Over 30 million tons of cargo annually
- Over 100,000 jobs connected to the port
- Contributes nearly $3 billion in annual wages and salaries



Reference - http://www.marylandrecyclingnetwork.org/2018Conference/Carr.pdf

Port of Baltimore's marine highway

- Maintaining a 50' depth keeps channels clear, safe and allows the port to remain open for business

Annual maintenance and management

- Over 130 miles of dredged channels serve the port (USACE)
- Long-term placement capacity a challenge (MDOT MPA)

Up to 5 million cubic yards removed per year

image from bayjournal.com

APPROACH & ACTIVITIES

The team conducted an in-depth review of tidal and non-tidal sediment characteristics in the Mid-Atlantic region, USEPA and state dredge material reuse regulations and guidance documents, and the various geographic environments for the purpose of developing innovative dredged sediments reuse plans and partners. Critically, these plans and partners are designed to leverage detailed cost-benefit analyses and local expertise to maximize the economic benefit of dredge material reuse.

To effectively manage dredged sediments with varying physical and chemical characteristics within a defined water body, a wide variety of sediment reuses are typically necessary. Reuse partners identified for fine grain sediments are very different from the many reuse options available for predominantly sand-sized sediments. In addition, sediment generated from projects in the Mid-Atlantic often contain both "clean" sediments suitable for many reuse applications and contaminated sediments with limited reuse applications, prompting the need for a diversified reuse plan. Establishing these varied reuse partners is the foundation of successful and economically sustainable projects.

SEDIMENT REUSE EVALUATION

REUSE	MATERIAL CONSTRAINTS	ECONOMIC CONSIDERATIONS
Thermal treatment		
Four proprietary reuses using thermal treatment developed including reuse partners and products		
Sediment blending		
Four proprietary reuses using soil blending developed including reuse partners and products.		
Sediment relocation		**Direct application**
Soil and fill material	Soil or fill material environmental quality must meet potential end-use requirements. Quality will be based on concentrations of hazardous substance or oil concentrations and excess lifetime cancer risk.	Use as fill material is among the lowest-cost alternatives because it requires the least amount of processing, lower aggregate quality requirements and transportation costs can be minimized for local fill areas.
Shoreline protection/engineered wave breaks	Material requirements determined by project engineers. Adding stabilization materials and adjusting gradation may be required for optimal performance.	Transportation cost is favorable. Material may be transported by barge and placed by standard marine construction equipment.
Wetlands restoration	Sediment quality, grain size, organic content, suitability for habitat end use, contaminant levels. Must meet regulatory ecological screening sediment quality criteria.	Largest constraints are sediment quality and transportation/placement costs. Tidal wetland restoration is most effective if the wetlands are proximate to dredging.
Beach nourishment	Sediment must be equal to or larger in grain size and character than existing beach material and less than 10% silts and clays. Sediment must also be relatively free of organic matter and must meet applicable regulatory sediment quality criteria.	High demand for this application. Transportation cost can be a limiting factor.
Agricultural land spreading	Sediment quality, grain size, organic content, suitability for agricultural use, conditioning requirements, contamination. Must meet stringent regulatory sediment quality criteria for agricultural use.	Transportation limited to trucking which is expensive compared to alternative transport mechanisms such as barge, pump and pipe. Also requires broad spreading in a relatively thin layer, which adds complexity and cost.

MULTIPLE DEWATERING TECHNIQUES EXIST AND ARE CONTINGENT ON CONDITIONS AND FINAL PRODUCT REQUIREMENTS

In addition to reuse partners, partnerships with dredging and dewatering companies were created to allow for effective identification and implementation of the dredging and dewatering techniques best suited to specific follow-on reuse applications. Minimizing the disturbance of sediment, chemicals and nutrients in the water, along with a well-designed dewatering system, is critical to the success of a long-term sediment removal and reuse operation. Accordingly, plans and partners for innovative dredged sediments reuse were developed to account for this complexity.

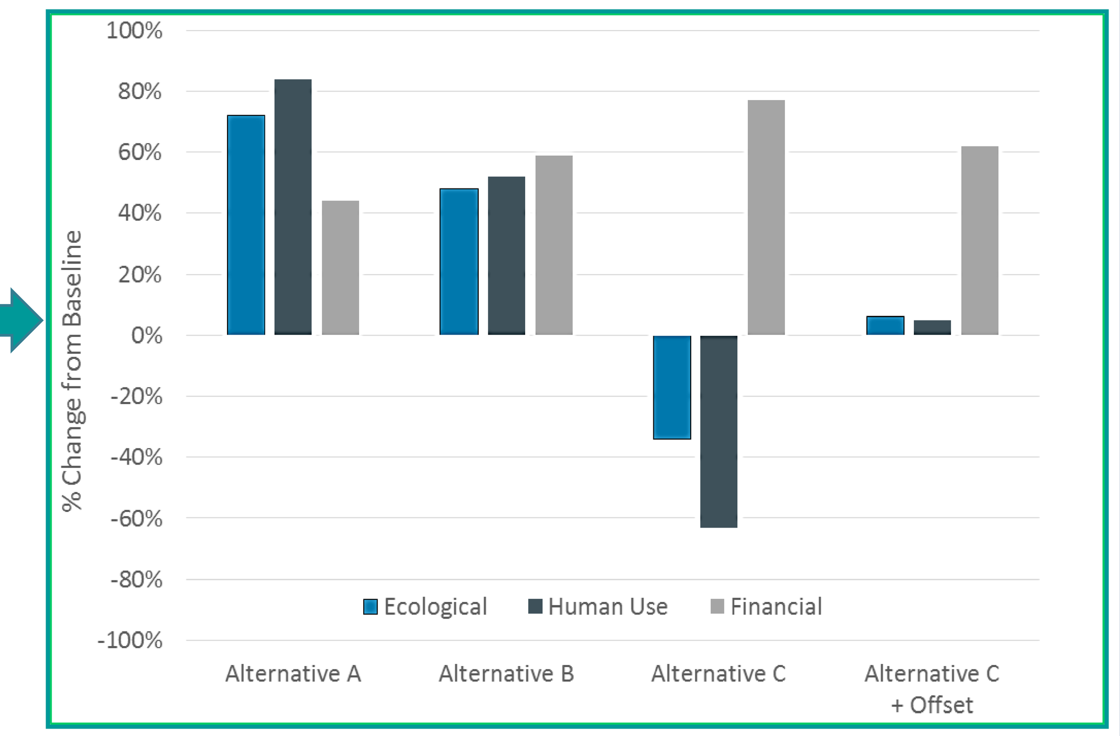
RESULTS & LESSONS LEARNED

Prior practice of establishing a single large volume reuse that can address all types of sediment and contaminants is not economically viable for many jurisdictions with varying degrees of contamination nor is it flexible enough to withstand a changing product marketplace. An in-depth understanding of the numerous physical, regulatory and stakeholder considerations is required for innovative reuse to be successful. This work highlights the need for the establishment of a team of environmental professionals and contractors working together to quickly respond to and solve the complex problems associated with the removal and reuse of dredge materials from Mid-Atlantic water bodies.

CONCLUSIONS OF NET ECOSYSTEM SERVICE ANALYSIS

The Measurement of Environmental and Resource Values

- Travel cost method
- Hedonic pricing
- Contingent valuation
- Choice/conjoint analysis
- Benefit transfer
- Averting behavior/avoided cost
- Ecosystem market pricing
- Resource equivalency analysis



- ✓ **Uses US government (USACE, USDOI, USDOC, OMB, etc.) accepted valuation methods**
- ✓ **Compares options/alternatives within a cost benefit framework**
- ✓ **Accounts for non-tangibles or difficult to measure monetary values in a consistent manner**

SUCCESSFUL CASE STUDY EXAMPLES

Upper Newport Bay Ecosystem Restoration

- Removal of 1.5 million cubic yards of accumulated sediment from the Upper Newport Bay
- Used a combination of an amphibious excavator and portable hydraulic suction dredge for semi-submerged dredging, pumping and capping
- Reused sediment to build habitat islands within the Upper Bay for the endangered California Least Tern and other migratory waterfowl

Hamilton Army Airfield Wetlands Restoration Project

- Beneficially reused over 6 million cubic yards of dredged sediment from the Port of Oakland 50-foot deepening project
- Pumped material onto 988 acres of a former army airfield adjacent to bay
- By using the sediment, airfield was transformed into tidal and seasonal wetlands, upland ponds and grasslands, tidal ponds, a wildlife corridor, an intertidal channel and a mudflat area
- Material was dredged and transported via scows and then pumped up to seven miles throughout the site using a system of 5 high-powered pumps

Point Isabel: Sediment Reuse on Former Industrial Site

- Lead impacted dredge sediment was encapsulated within levees and capped to create a 22-acre shoreline park
- The dredged sediment was dewatered and contained onsite as upland fill
- The shoreline was stabilized with a geotextile and rip-rap, and the shellfish bed habitat was restored with clean sediment