Engineering, Construction and Best Management Practices for TLP Projects

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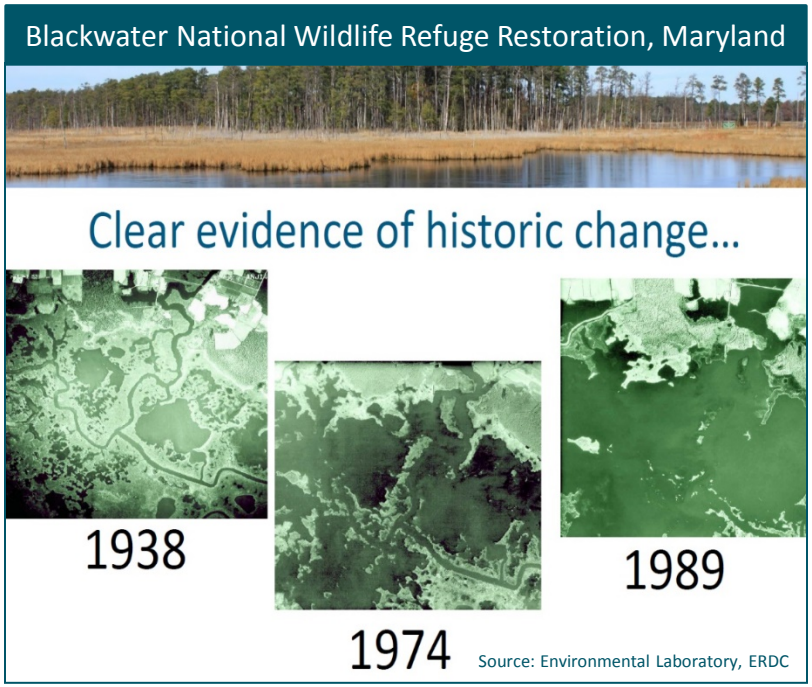
TLP - Design Considerations

- Design parameters include
  - Site geometry
  - Thin layer thickness
  - Marsh-to-channel surface area ratios
  - Volume of available dredge material
    - Cut-to-fill ratios
  - Schedule/frequency of filling
  - Site capacity and operational life



TLP - Design Considerations (cont.)

- Characteristics specific to placement site
  - Discharge points
    - Location, orientation, and their impacts on dredging logistics (production rates, booster pumps, construction duration, and costs)
  - Fill needs - alignment with dredge production needs (timing/schedule, holding capacity, geometry, etc.)
  - Water drainage
  - Effluent management

Bob Blama (Former USACE) Sediment Site Capacity - Rule of Thumb	
Sediment Type	Footprint Volume (cy/acre-ft)
Silt	800
Mixed	1,000
Sand	1,200

Pipeline Corridor Design and Access

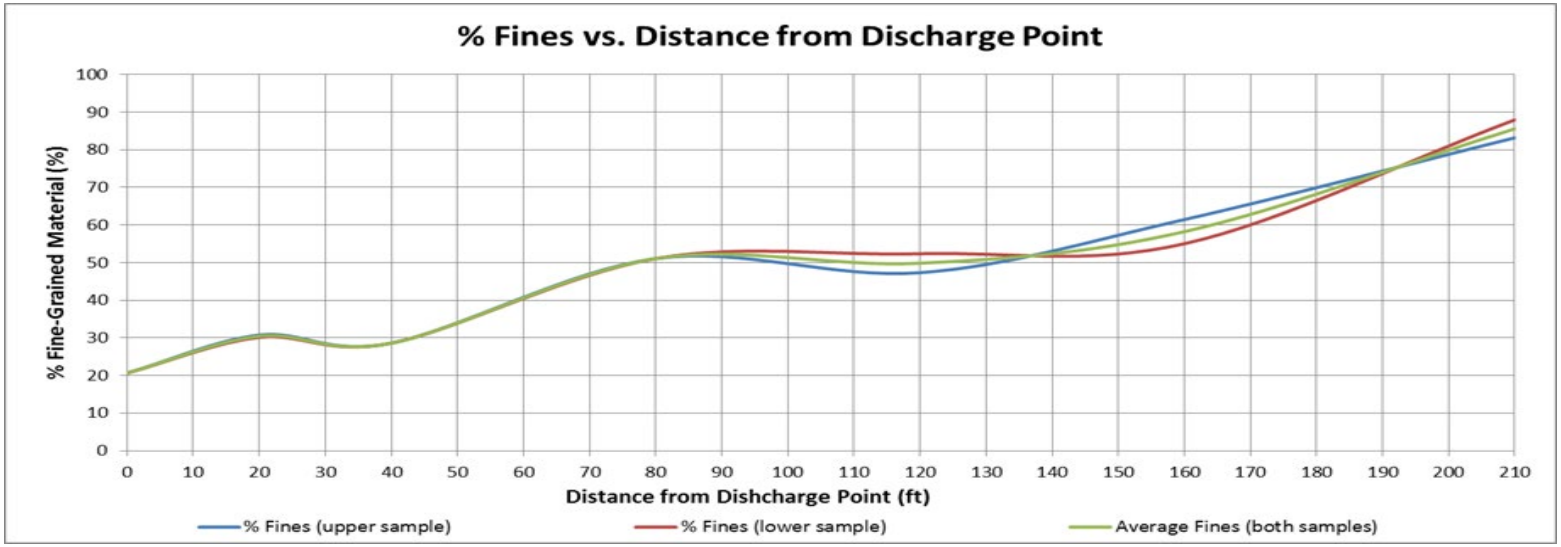
- Impact of pipeline length and layout on fill placement method and construction costs
- Booster pump considerations
  - Pressure changes near pumps; optimal distance
  - Impacts: Noise, navigation, etc.
- Optimal corridor width for placement, maintenance, and work limits (e.g., 60 to 100 ft)
- Corridor survey requirements
- Construction equipment requirements

Blackwater National Wildlife Refuge Restoration, Maryland

Source: Environmental Laboratory, ERDC

General Placement Considerations

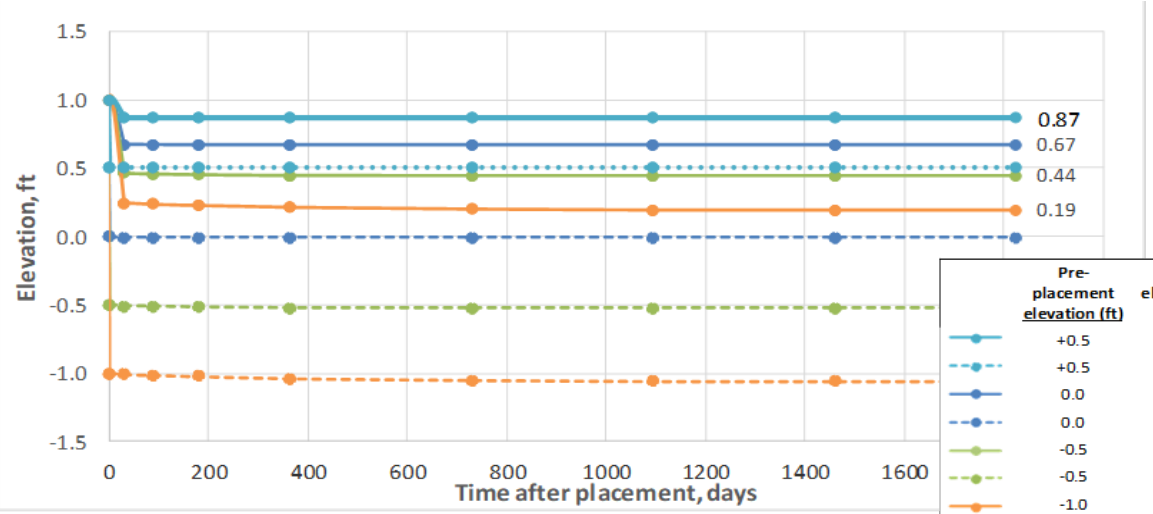
- Evaluate number of lifts and lift thickness
- Hydraulic sorting
  - Sand deposits near discharge
  - Fine-grained material settles further away
  - Build containment and channeling structures?
- Match sediment characteristics with lift capabilities
  - Sandy channel areas versus wetland lift areas
  - Decrease material flow points (wetland fringe, beaches)
  - Fine-grained material and thinner lift areas



Source: USACE ERDC – Bailey et al., 2017

General Placement Considerations (cont.)

- Pipe discharge points
  - Single vs. multiple, and when to switch?
- Placement areas on site
  - Single vs. multiple
  - Maximize placement capacity
- Placement strategy
  - Place while advancing/retreating
  - Consolidation/settlement
- Tidal elevation
  - Influence on work window
  - Effluent: TSS/turbidity



Pre-placement elevation (ft)	Fill elevation (ft)	Modeled surface
+0.5	1.0	Fill
+0.5	1.0	Foundation
0.0	1.0	Fill
0.0	1.0	Foundation
-0.5	1.0	Fill
-0.5	1.0	Foundation
-1.0	1.0	Fill
-1.0	1.0	Foundation

Blackwater National Wildlife Refuge Restoration, Maryland

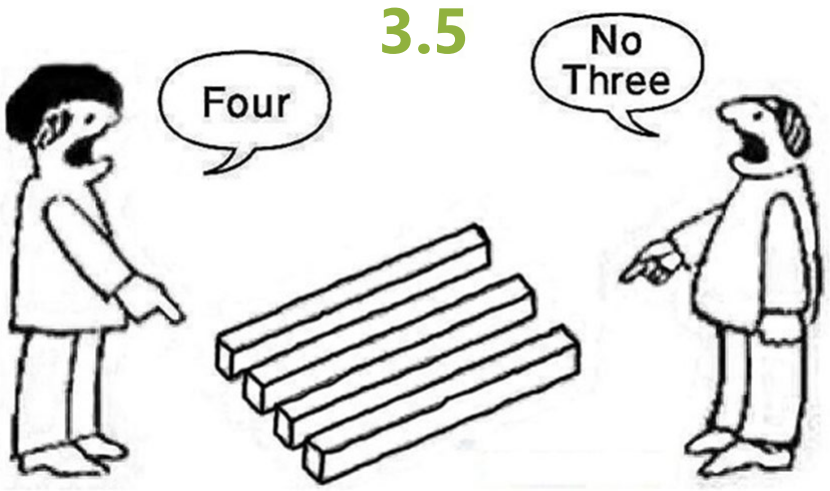
Source: Environmental Laboratory, ERDC

Summary: Common Design Elements

Placement Area Layout	Placement Site Capacity
Project Area (Limits of Work)	Target Elevations/Depths
Channel/Borrow Dredge Volumes	Dredge Material Characteristics
Marsh Elevation Target	Consolidation/Settlement
Placement Tolerances	Equipment Type
Pipeline Layout	Access Corridors (Pipelines/Equipment)
Buffer Zones	Construction Access & Staging Areas
Erosion/Sediment Control	Sediment Transport (During/After Placement)
Flood/Scour Protection	Real Estate Considerations
Sediment Biogeochemistry	Planting/Restoration
Containment Systems (if any)	Turbidity Control
Environmental Impacts	Permit Conditions
Contractor Incentives (M&P)	Long-Term Monitoring

Construction Considerations

- Requires coordination and cooperation between:
  - Owner, Contractor, and Stakeholders
- Role of Specifications and Contractor Work Plan
- Project execution
  - Safety first!
  - Adaptive Management should be incorporated into construction phase as well



Source: https://qph.ec.quoracdn.net/main-qimg-b2f3c1af916f729567f8a57456b7b0c7-c?convert_to_webp=true; bryanridgley.com

Suggested Contractor Work Plan Contents

- Construction equipment types (land and water-based)
- Equipment access routes and staging area(s)
- Site Access - channel dredging, or roadways/mats?
- Dredge
  - Channel or borrow area dredging plan and schedule
  - Pipeline corridor
  - Dredge pipe type, diameter, thickness, and length
  - Schedule for layout (booster), installation, maintenance, and removal
- TLP Site:
  - Containment features and schedule
  - Placement layout, grade stake placement, and fill schedule
  - Dredge production rates, lift thickness to be monitored during placement
- Construction survey methodology and data processing software
- Post-construction restoration plan

Sediment Control Structure Considerations

- Intended application: lateral sediment containment, maintain/promote creeks, drainage, etc.
- Design configuration, installation, and maintenance requirements
- Removal requirements

Construction Equipment Considerations

- Evaluate for operational performance in site-specific conditions; and to minimize impacts to wetlands
- Operating areas should be designed, and best management practices employed to further reduce impacts


Source: Avalon NJ, Jackie Jahn


Source: WILCO


Source: New Jersey DOT

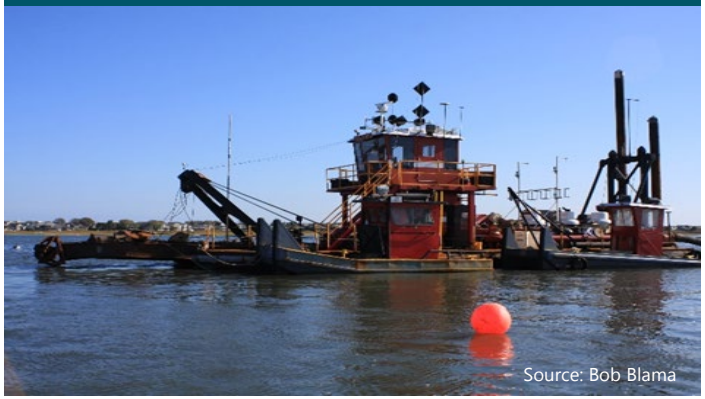
Dredging Equipment Considerations

- Sediment characteristics
- Dredge depth and quantities
- Distance to placement area
- Dredge types
- Method(s) of placement
- Production rates
- Environmental considerations
  - Physical environments
  - Contamination levels

10-inch diameter discharge Ellicott 470 SL

Source: http://www.dredge.com

14-inch diameter discharge "Fullerton"



Source: Bob Blama

Sediment Deposition Equipment Considerations

- Equipment should be able to efficiently achieve design target elevation(s) while minimizing impacts on wetlands and dredge production
- Project-specific conditions that can influence equipment selection include:
  - Placement area dimensions and layout
  - Type of sediment
  - Dredge production and access
  - Lift thickness to meet design target elevation

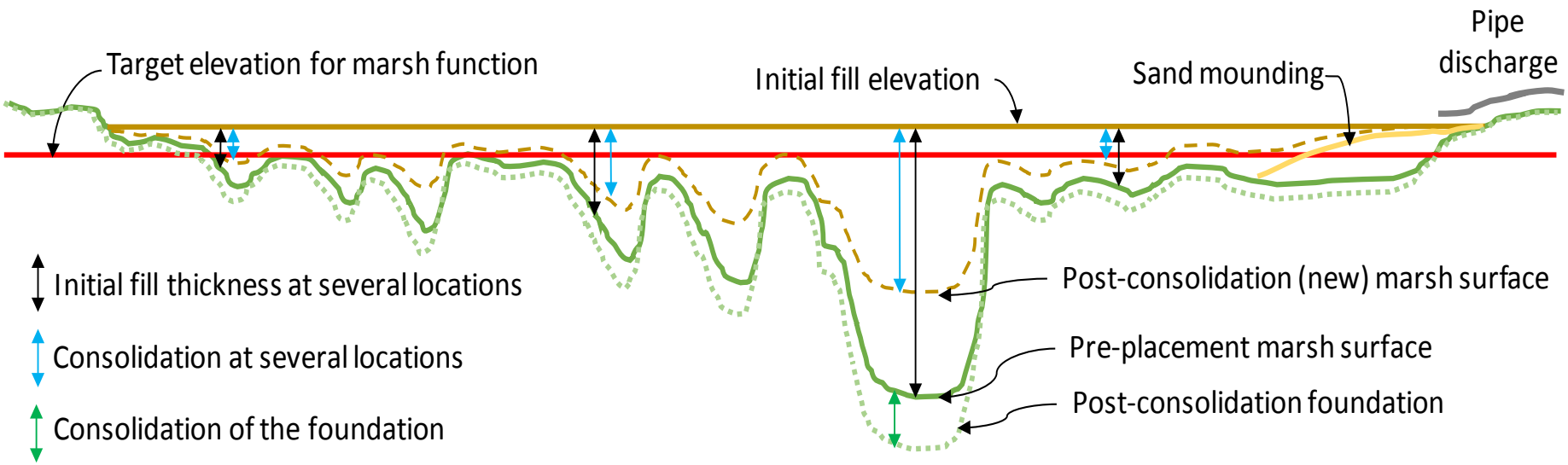

Avalon, New Jersey


Prime Hook, USFWS


Pepper Creek DNREC

Other Considerations

- Constructability
  - Measuring attainment of grade
    - Survey grade stakes, etc.
  - Placement accuracy
  - Lift thickness and tolerance
- Cost
  - Economies of scale
  - Phasing of costs
    - Planning, design, construction, monitoring
  - Cost reduction strategies



Source: USACE ERDC – Bailey et al., 2017

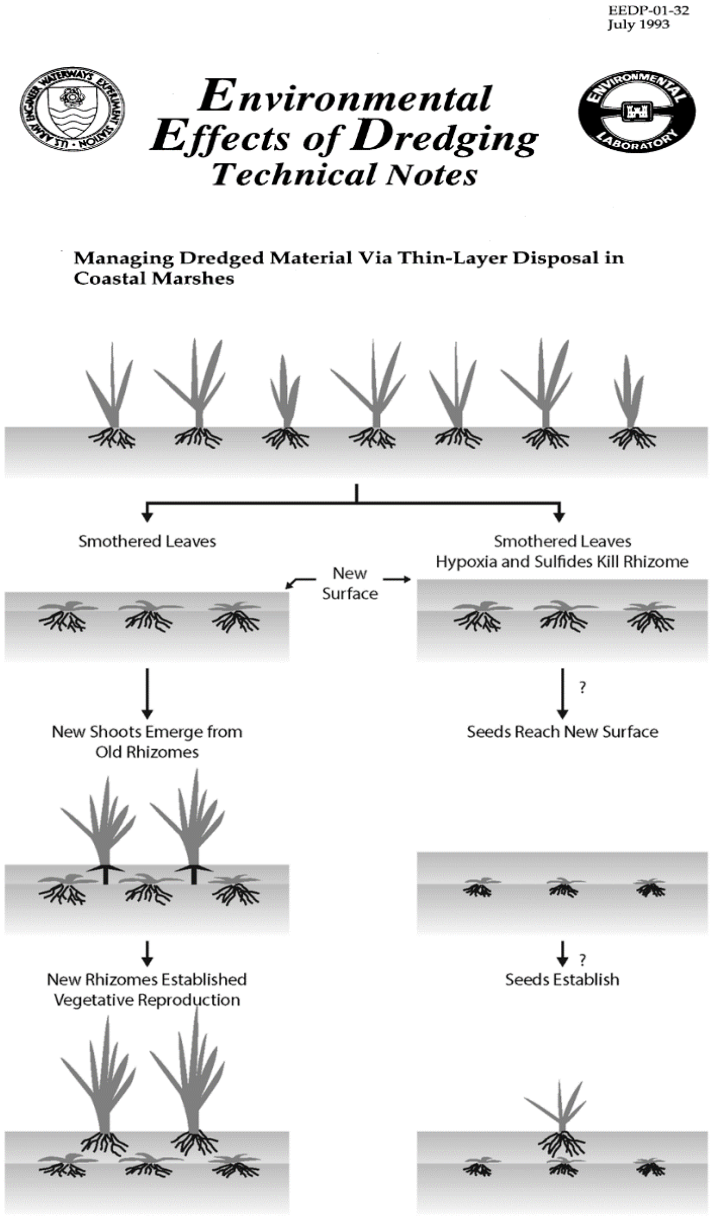
Lessons Learned - Ideal Application

- TLP is best for projects where:
  - Elevation has been lost considerably (from subsidence or sea level rise)
  - Natural sediment inputs alone are insufficient to nourish the marsh over time
- TLP is not well suited for degraded marshes affected by invasive species or sediment overloads
- TLP should be a “restoration” project, and not designed as a “dredged material placement” (or “disposal”) project


Photo Credit: Dredge America – Blackwater Restoration Project

Lessons Learned - Design

- Protect key features (edges, channels/creeks)
- Material/Elevation Balance:
  - Bulking noted: 2-4 times in situ
  - Shrinkage: 10-40% in first 10-15 days
- Vegetation responds well to TLP generally in the range of 6-12 in
- Recovery times vary, but is generally on the order of 2-5 years
- Natural recovery is possible, particularly for thin (<12 in) placement
  - Natural recolonization is preferred
  - Planting should therefore be a secondary (contingency) criterion



Lessons Learned - Construction

- Well engineered design is key to success
  - Use experienced engineering and construction teams to avoid costly field changes and/or delays
  - Avoid redundancies
- Do not overengineer or over-prescribe
- Prequalify contractors
  - Evaluate for demonstrated experience on similar projects
  - Weed out ones with violations
  - Provide the contractor with the ability to innovate in the field
- Adaptive management can be key to success


Source: Bob Blama – Blackwater Restoration

Use TLP as ONE of the Tools for Managing Coastal Adaptation of Wetlands

- Wetlands enhance coastal resiliency by acting as buffers
- There are many restoration tools:
  - Control edge erosion
  - Enhance sediment supply
  - Manage water balance
  - Improve drainage
- Adaptive management is key!
  - Re-nourish as needed, if feasible
  - Control invasive species
  - Facilitate marsh migration
    - Remove dead trees and upland barriers
    - Conserve lands in potential migration pathways

Source: Mohan et al 2016 – Lessons Learned from Three Decades of Coastal Restoration Projects

Questions?

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