Environmental Sediment Dredging to Remediate Contaminated Sediments

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Photo by Bill Rhodes

What Is Environmental Dredging?

- *"Environmental dredging: the removal of contaminated sediments from a waterbody for purposes of sediment remediation"* (Palermo et al. 2008).
- Dredging is an established and effective remedial approach for contaminated sediment sites, used successfully at Superfund sites nationwide
- Environmental dredging is typically part of a combined remedy (NRC 2001, USEPA 2005) that may include:
  - Capping
  - In situ stabilization
  - Monitored natural recovery
- For Newtown Creek's East Branch, USEPA selected a combined remedy incorporating dredging based on site-specific conditions, including the extent of contamination and physical characteristics of the Creek
- Best management practices are used throughout dredging operations to minimize short- and long-term impacts to protect water quality during construction and ensure continued protectiveness of environmental dredging

Example of Environmental Dredging, Sediment Processing, and Disposal

1. Dredge

2. Transport to Processing Area

3. Offload Dredged Sediment

4. Sediment Processing/Dewatering

5. Load Dewatered Sediment For Off-site Disposal

Environmental Dredging Equipment

- Mechanical
  - Crane and cable
  - Fixed arm excavator
- Hydraulic
  - Cutterhead
  - Horizontal auger
- Equipment selection is site specific
  - Targeted sediment volume and type (e.g., silt, sand, gravel, or clay)
  - Dredge cut thickness/depth
  - Water depth
  - Presence of structures (e.g., bridges) and debris
  - Sediment processing location and method
  - Waterway dimensions, navigation requirements

Crane and Cable Mechanical Dredge

Fixed Arm Excavator Dredge

Hydraulic Cutterhead Dredge

Mechanical and Hydraulic Dredging Technologies

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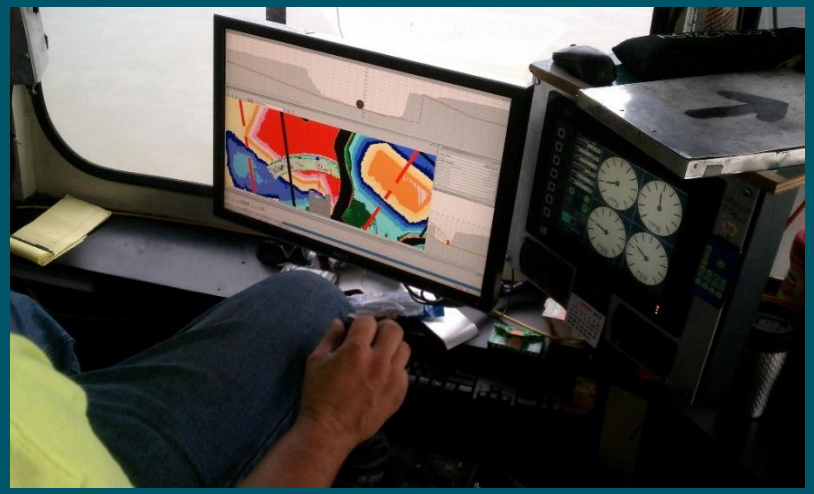
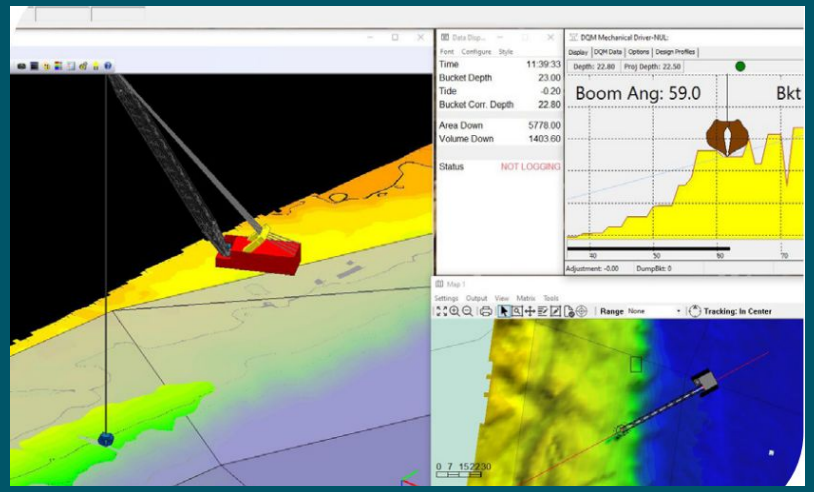
Dredge Positioning and Verification

- Dredges are equipped with sensors to track the precise location of the dredge head (e.g., bucket)
- Onboard software provides the operator a real-time view of the dredge head location relative to the sediment surface and target dredge prism
- Surveys performed following dredging to verify that design elevations have been achieved





Source: https://www.xylem.com/siteassets/brand/hypack/resources/brochure/dredgepack-product-brochure.pdf

Sediment Processing and Disposal

- Transport
  - Barge or direct load rail/truck
  - Hydraulic pipeline
- Processing/conditioning
  - Debris management
  - Dewatering/water treatment
  - Treatment (e.g., solidification/stabilization)
- Disposal
  - In-water confined facilities and upland landfills

Sediment Dewatering

- Gravity dewatering
  - Stockpiles or in barge dewatering
  - Confined disposal facility
  - With or without stabilization polymer/additives
- Passive dewatering – Geotextile tubes
  - Permeable “bags” that contain solids and allow water to drain
  - Significant water treatment needs

Stockpile

Geotextile Tubes

Sediment Dewatering – Mechanical Methods

- Filter presses
  - Mechanical presses to “squeeze” water out of sediment
  - Significant infrastructure and water treatment needs

Filter Press

Permitted Offsite Sediment Processing Facility

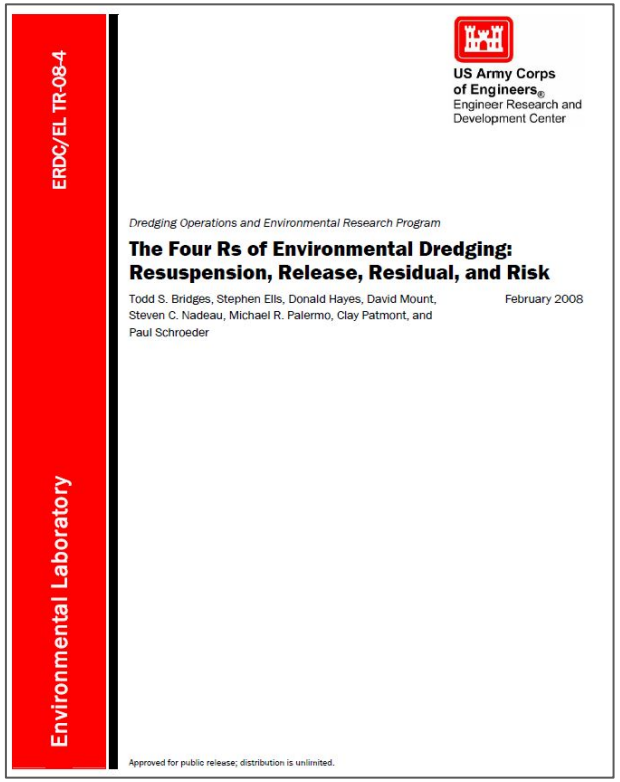
- Sediment may be transported to a permitted, offsite commercial processing facility or a project-specific facility
- Selection of project-specific facility is dependent on:
  - Dredge/dewatering method and location
  - Water treatment method
  - Production rate
- 1–3 acres needed for small-scale projects
- 10+ acres needed for large-scale project

Water Treatment

- Required for:
  - Stormwater from upland staging/processing areas
  - Water removed from sediment
    - Dewatering (e.g., filter press, geotextile tubes, stockpiles)
  - Decontamination fluids

Key Considerations – The 4Rs of Environmental Dredging

- **Resuspension** of sediment, which occurs to some degree during dredging operations
- **Release** of contaminants from the resuspended sediments and bottom sediments occurs in connection to dredging
- **Residual** contaminated sediment is left behind during dredging and/or results from settling of sediment resuspended by dredging
- **Risks** are associated with the contaminated sediment before, during, and after dredging



Source: USACE 2008 https://apps.dtic.mil/sti/tr/pdf/ADA477867.pdf

Best Practices for Mitigating Resuspension and Release

- Sediments are resuspended by the dredging operations (for all dredging methods)
- Dissolved phase contaminants can be released into the water column and transported beyond the dredging areas by currents and tides
- Best management practices include turbidity curtains and other barriers and controlled operations

Bubble Curtains

Releases from Environmental Dredge Bucket

Turbidity Curtains

Best Management Practices for Residuals

- Remaining contaminated sediment mass in a dredge area
  - Undisturbed residuals: contaminated sediments uncovered as a result of dredging but not fully removed
    - Sediment that was not identified for removal during the study and design phases
    - Engineering limitations (e.g., bedrock and side slopes)
  - Generated residuals: contaminated sediment dislodged, but not removed, by dredging
- Best management practices include proper dredge depth determination and post-dredge backfill or capping

Risk Management Practices

- Experience from other sites indicates that there are potential risks to aquatic organisms resulting from resuspension, release, and residuals
- The success and effectiveness of an environmental dredging remedy is often driven by the post-dredge residuals management – e.g., backfilling or capping (NRC, 2007)

Questions?

References

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