SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR
28-30 NOVEMBER 2018
GALVESTON, TX

Dredging and Dredged Material Disposal Overview
Paul R. Schroeder
Overview

- Dredging
- Equipment
- Placement
Early Development of Dredging

Dredging began in rivers (Nile, Euphrates, Tigris, Yellow, & Indus, etc.) many 1000s of years ago.

Source: Science and Civilisation in China
Joseph Needham, Wang ling, and Lu Gwei-Djen
Development of Dredging

Sources:
Herbich, 2000
Ports and Dredging
Dr. Bob Randall

Technical Press Limited, London
Dredging

The dredging process generally consists of the following components:

- Dislodging sediment from the bed.
- Removal of the bed material.
- Transportation of the dredged material to the placement area.
- Placement of the dredged material.
Dredging Definitions

- **Sediment**: Unconsolidated material on the bottom of the waterway
- **Dredged Material**: Sediment which has been excavated by a dredge and has been or is being transported to a placement site
- **Dredged Spoil**: Term from past, implies waste material, to be avoided in use since dredged material should be considered a resource
- **Disposal/Placement Site**: More politically correct term is placement site – where the dredged material is placed following dredging
- **Dredge Plant**: Dredge, supporting equipment and attendant vessels
- **Dumping**: Placement in open water, term from the past, best not used for most effective communications
- **Environmental Dredging**: The removal of contaminated sediments from a waterbody to achieve sediment remediation/risk reduction often with controls on resuspension, release and residuals.

Basic Dredge Types

- Mechanical
  - Clamshell (Bucket)
  - Backhoe

- Hydraulic
  - Pipeline (Cutterhead & Dustpan)
  - Hopper
  - Side-caster

- Other / Combinations
Factors in Selection of Dredging Equipment

- Physical characteristics of sediments
- Quantities to be dredged
- Dredging depth
- Distance to disposal (placement) area
- Physical environment: site usage, infrastructure, access
- Contamination level of sediments
- Placement/material requirements and use
- Placement method
- Production required
- Types of dredges available
Clamshell (Bucket) Mechanical Dredge
Bucket Dredge Excavation Process
Backhoe (Bucket) Mechanical Dredge
Barge Discharge

Split hull scow

Hydraulic Off-loaders

Mechanical Off-loaders

Source: Great Lakes Dredge and Dock Co.
Mechanical Dredges

Advantages
- Rugged and capable of removing hard packed materials
- Can remove debris
- Can work tight areas
- Efficient for disposal at long haul distances

Limitations
- Difficult to retain fine loose material in conventional buckets
- Production low compared to pipeline dredges
- Resuspension can be an issue, especially in presence of debris
Hydraulic Pipeline Cutterhead Dredge
Cutterhead Excavation Process

Source: Great Lakes Dredge and Dock Co.
Types of Discharge Pipeline

- **Floating Line**
- **Shore Line**
- **Submerged Line**
Traditional Hydraulic Placement
Thin Layer Placement
Booster Pumps

Source: Great Lakes Dredge and Dock Co.

Source: GIW
Spider Barge

Pipeline from hydraulic pipeline dredge

1 of 4 discharge T's
Cutterhead Dredges

Advantages
- Can excavate most materials
- Can pump directly to the placement site
- Almost continuous dredging
- Often least expensive if placement is within two miles

Limitations
- Limited safe operational capability in waves
- Not self-propelled
- Add 3 -10 parts water to 1 part dredged material
- Interfere with Navigation (pipeline, anchor barges, etc.)
- Debris can reduce efficiency
Dustpan Dredge
Dustpan Excavation Process
Dustpan Dredges

Advantages
- Are self-propelled, mob/bemob relatively quickly
- Can move out of channel to minimize traffic interference
- Pumps directly to the placement site
- Almost continuous dredging
- Design/methodology allows quicker channel opening

Limitations
- Limited safe operational capability in waves
- Designed for unconsolidated sediment (sands/gravels)
- Relatively short pumping distance capacity
- Debris can reduce efficiency
Hopper (Hydraulic) Dredge
Draghead Excavation Process
Hopper Dredge
Essayons – Portland District
Hopper Dredge Discharge

Split Hull

Bottom Dump Door

Pump-out

Rainbow Nozzle

Source: Michael.D.MarineTraffic.com
Hopper Dredges

Advantages

- Only dredge type for rough open water
- Can move quickly to job under its own power
- Minimizes traffic interference
- Improves navigation depth quickly
- Economical for medium haul distance

Limitations

- Cannot work in shallow depths
- Cannot dredge continuously
- Excavates with less precision
- Difficulty dredging hard banks
- Difficulty dredging consolidated materials
Side-Caster Dredge

Advantages
- Self-propelled, can rapidly move from one project location to another
- Can immediately go to work once at the site
- Effective dredging tool removing bar channels in small coastal inlets

Limitations
- Needs flotation depths before it can begin to work
- Cannot move the relatively large volumes of material
- Some of the material removed can return to the channel prism
- Only open-water placement capability
Special Purpose Dredges
Currituck & Murden – Wilmington District

Advantages
• Effective dredging tool for use in shallow-draft inlets
• Dredged material can be placed in the littoral zone

Limitations
• Production rates limited by relatively small hopper capacity
• Not effective on major navigation channels
Water Injection Dredge

Advantages
• In optimum conditions capable of very high production rates.
• Can rapidly mob/demob
• Reduced dredge plant = reduced workforce levels = reduced operating costs
• Minimizes traffic interference
• Injection head rides on sediment surface/safer operations around utilities

Limitations
• Can be used only where in-water placement of dredged material is allowed
• Can effectively operate only where favorable conditions exist
• Cannot be used in contaminated sediment where unacceptable environmental impacts occur
Bed Levelers

Source: Weeks Marine, Inc.

Source: Bean Dredging Company

Source: Great Lakes Dredge and Dock Company
Dredged Material Placement Alternatives

- **Open Water Disposal**
  - Ocean ~ Estuarine ~ Lakes ~ Rivers

- **Confined Disposal**
  - Confined Disposal Facilities (CDFs)
  - Contained Aquatic Disposal (CADs)

- **Beneficial Use Applications**
Planning Considerations

▪ Project Requirements
  • Volumes and Frequency of Dredging
  • Planning Horizon
  • Stage of Evaluation

▪ Material Characterization
  • Physical and Dredgability
  • Chemical / Biological

▪ Regulatory or Other Constraints
Open Water Placement

- Site Characterization
- Site Designation / Selection
- Material Suitability
- Design Evaluations
- Operational Considerations
- Control Measures / Management Actions
- Monitoring
- Site Management Plan
Confined Disposal Facilities (CDFs)

- CDFs used because:
  - More economical for some projects
  - Most common option for material unsuitable for open water

- Regulated under CWA
  - Discharge to US waters by definition
  - 404 permit
  - 401 state water quality certification
CDF Considerations

- Site characterization / selection
- Engineering design
- Operational considerations
- Contaminant pathways and controls
- Long-term management
- Monitoring
Types of CDFs

Upland

Island

Near shore
Contained Aquatic Disposal (CAD)
Beneficial Use (BU) Applications

- BU is alternative of first choice
- Needs and opportunities
- Material suitability
- Logistical constraints
- Regulatory requirements vary
  - CWA / MPRSA
  - Other
Beneficial Uses Categories

- Wetland Habitat / Shoreline Protection
- Beach Nourishment
- Mine land Restoration
- Recreation
- Agriculture
- Island Habitat
- Construction Fill
- Construction Materials

https://budm.el.erdc.dren.mil/
Basic References

- EM Dredging and Dredged Material Disposal
- EM Beneficial Uses of Dredged Material
- EM Confined Disposal of Dredged Material
- Technical Framework for Environmental Evaluations
- Ocean Testing Manual (OTM)
- Inland Testing Manual (ITM)
- Upland Testing Manual for Confined Disposal (UTM)
- Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material

https://dots.el.erdc.dren.mil/guidance.html
Questions?