

# Dredging Contaminated Sediments

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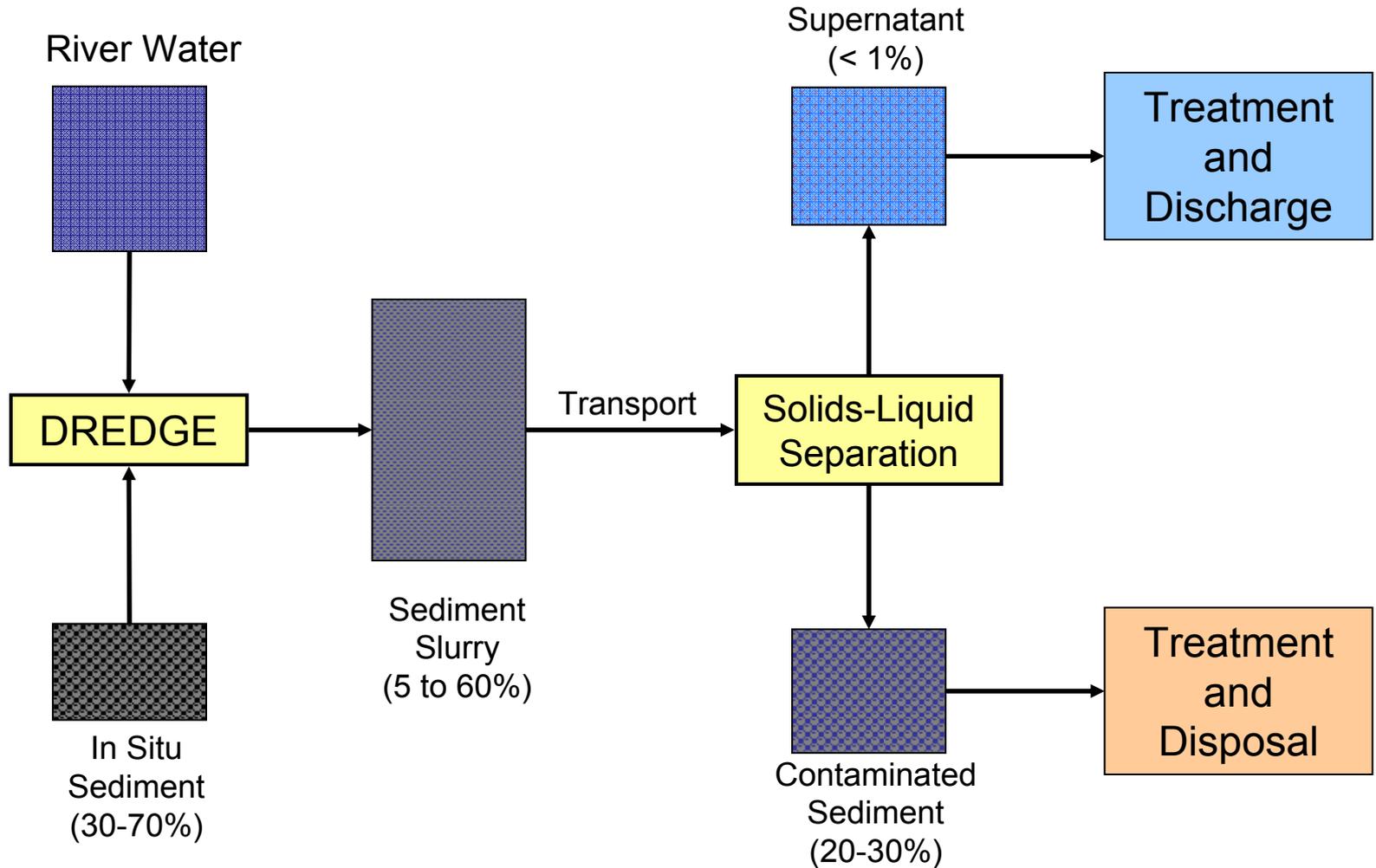


# Dredging vs. Excavation

- Excavation
  - Sediment/soil removal without overlying water
  - Mechanical equipment
- Dredging
  - Sediment removal below overlying water
  - Mechanical or Hydraulic



# Dredging Process



# Dredging is Common

- Navigational Dredging
  - US Army Corps of Engineers, Port Authorities, other government agencies, and private companies dredge millions of cubic yards of sediment each year from channels, berths, and docks for navigational purposes
  - Contaminated sediments and environmental impact issues are common to navigational dredging, but cost effectiveness is the driving factor
- Environmental Dredging
  - Removal of contaminated sediments for the primary purpose of environmental remediation
  - Costs are secondary to project goals

# Goals of Environmental Dredging

- Remove contaminated sediments current environment to isolate contaminants
- Minimize water quality impacts
- Minimize residual contamination
- Community impacts are a concern
- Cost secondary to environmental goals

# Outline

- Dredging Technologies
- Dredging Concerns
- Sediment Management

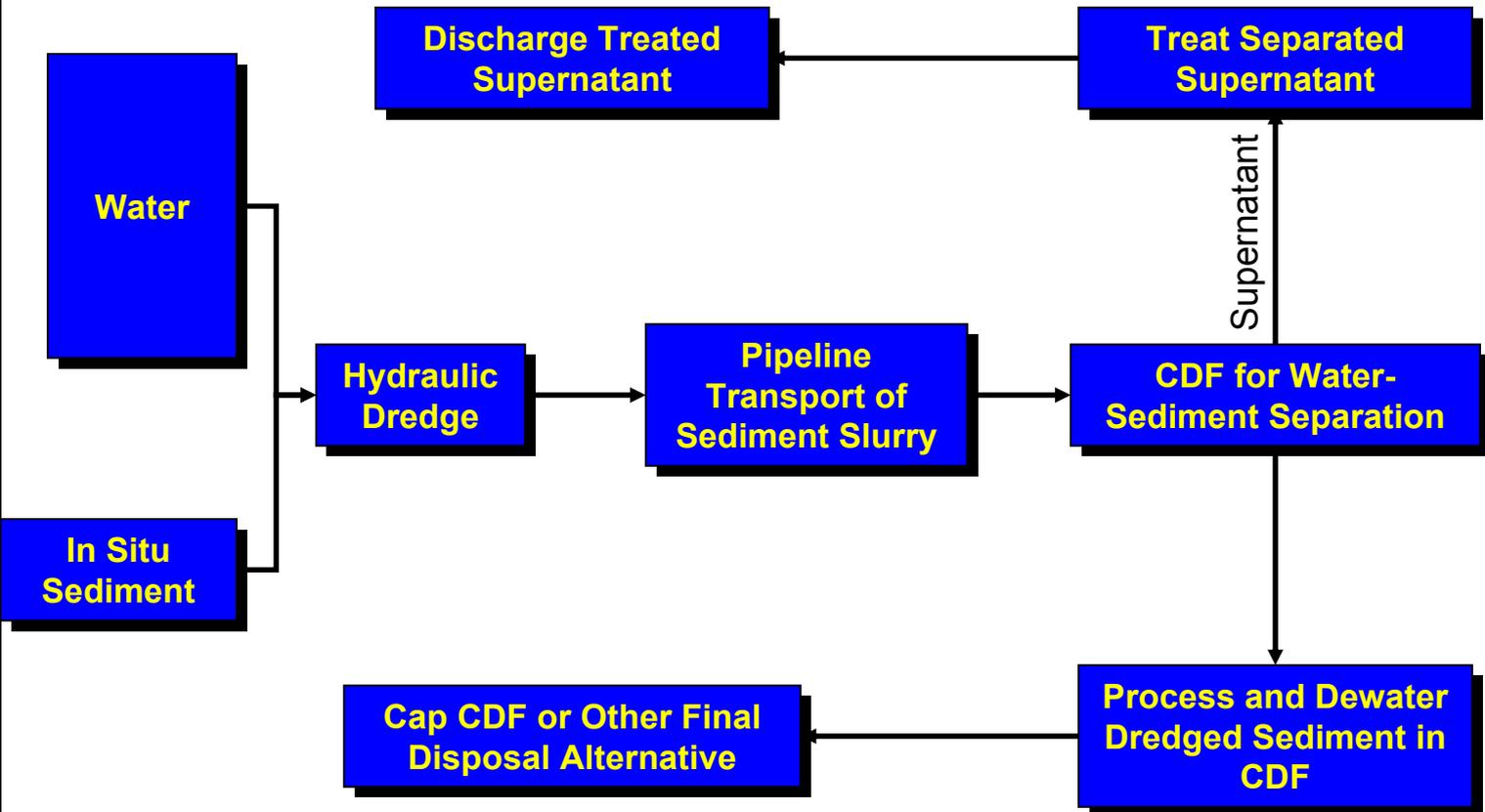
# Available Dredging Technologies



# Dredge Types

- Hydraulic Dredges
  - Pump sediments from the bottom of the river in enclosed pipeline
  - Most pump sediment to on-shore location
- Mechanical Dredges
  - Lift sediments mechanically to surface
  - Transport is usually via barge
- Hybrid Dredges
  - Combine mechanical lifting of sediments with hydraulic transport

# Hydraulic Dredging System



# Hydraulic Dredges

- Hopper Dredges
  - Rapidly-moving, Self-propelled
  - Not applicable to the Housatonic
- Pipeline dredges
  - Stationary platform, swinging head
  - Slow moving platform, wide head
  - Portable dredges

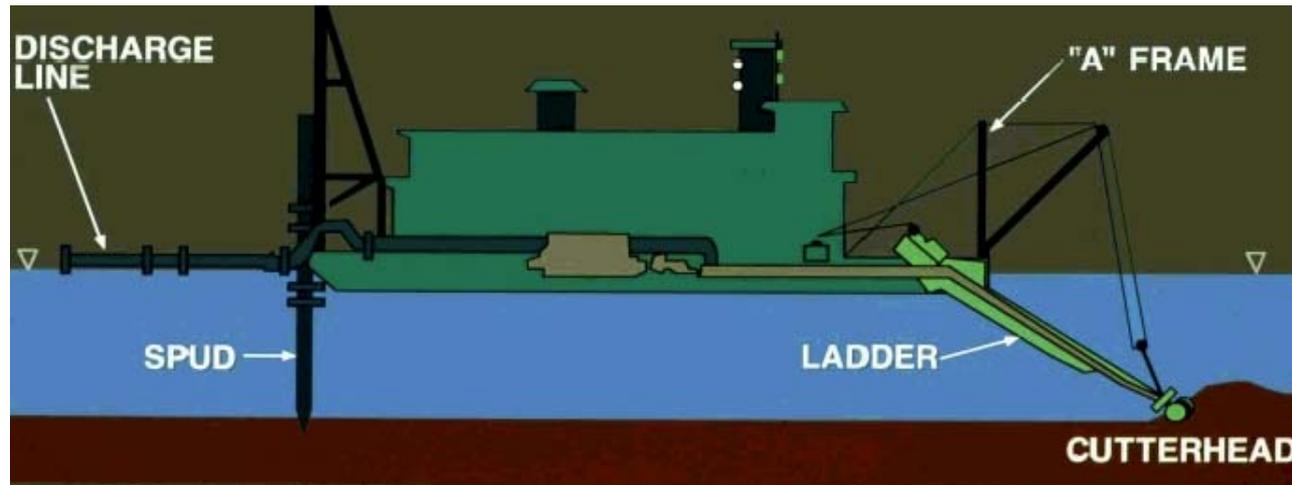
# CUTTERHEAD DREDGES

## ADVANTAGES

- Efficient
- Direct pumping to Disposal Site
- Versatile

## DISADVANTAGES

- Could impede river access and use
- Debris is an issue
- Large volumes of dilution water



# Cutterhead Dredges

- Sizes Range From 6-inch (Pump Size) To > 36 Inches
- Most Common Dredged Used For Navigational Channel Maintenance
- Have been effectively used on other contaminated sites
- WQ impacts tend to be low when operated properly



# Horizontal Auger Dredges

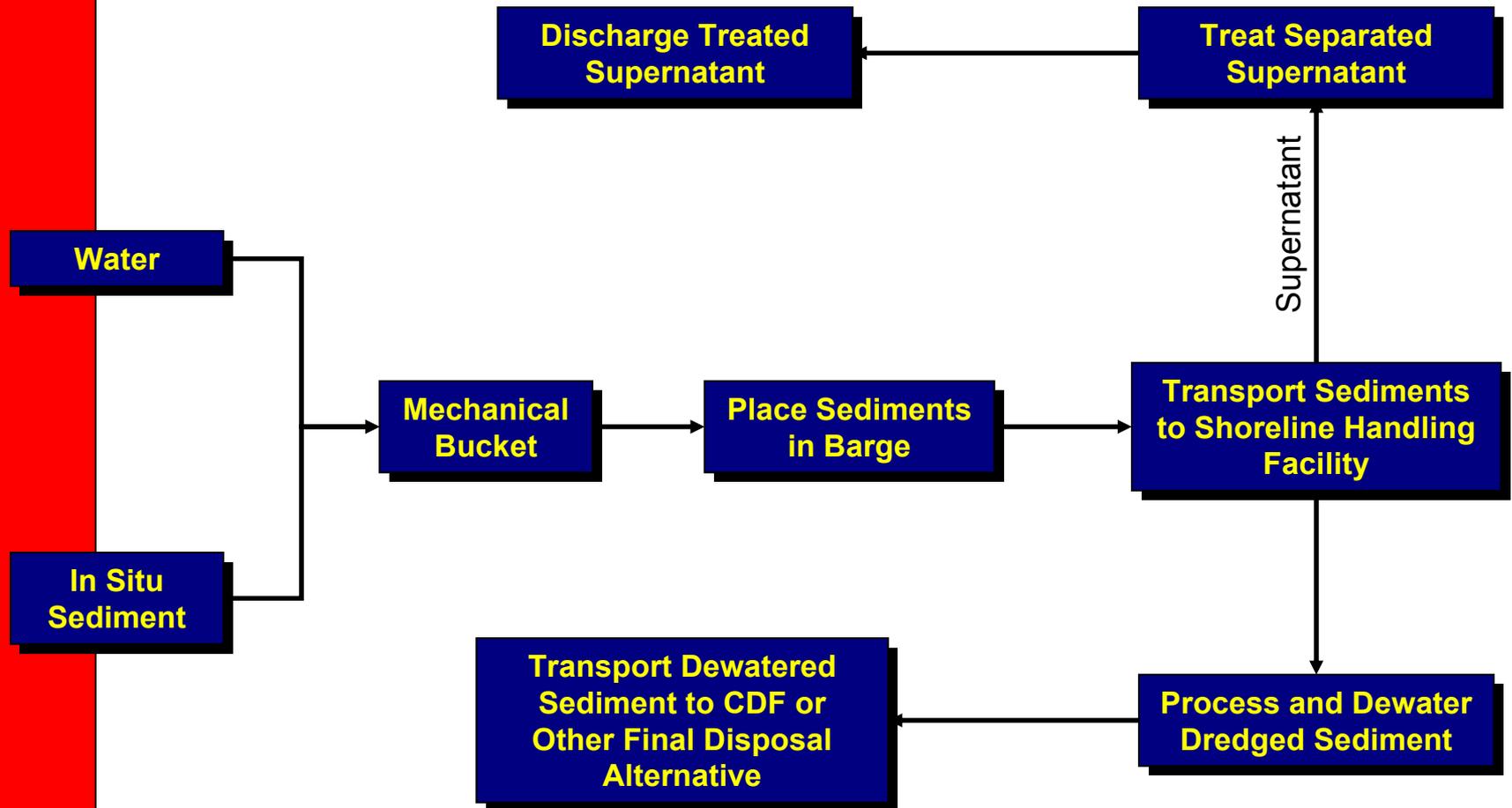
- Convenient and Inexpensive
- Smaller dredges
- Easily transportable
- Low production, low solids
- Resuspension and residuals a concern
- Successfully used on several sites



# Hydraulic Sediment Removal Rates

- Solids Content: 5 – 15% Solids
- Pipeline Velocity: 10 – 20 ft/Sec
- Downtime Can Be Significant
- Debris can be Problematic
- Solids Content and Pipeline Velocities Typically Low for Portable Dredges

# Mechanical Dredging System



# Bucket Dredges



## ADVANTAGES

- Capable of removing stiff materials
- Can remove debris
- Works in tight areas
- Easy mobilization

## DISADVANTAGES

- Cannot work in rough waters
- Requires additional barges & tugs
- Less efficient than hydraulic dredges

# Clamshell Types

- Conventional
  - Commonly Available
  - Limited Water Entrainment
  - Highest Production Rate
  - Highest Loss Rate
- Enclosed
  - Some Manufactured, Some Modified Clamshells
  - Higher Water Contents
  - Lower Loss Rate
  - Lower Production Rate
- Specialty



# CableArm<sup>©</sup> Clamshell

- Creates a flat bottom
- Lighter than other buckets
- Environmental buckets available
- Significant contaminated sediment project experience



# Alternative Bucket Dredges

## Horizontal Profiler Bucket

- Tested at New Bedford Harbor in 2001
- Hydraulic closure reduces debris issues
- Creates a flat bottom
- Fixed arm and raised platform allow precision lateral and vertical positioning



# Bucket Dredge Production

- Cycle Time: 1 To 5 Minutes
- Sediment Concentration
  - 30% To 60% Solids
- Significant Downtime for Moving, Barge Changes, etc.
- Debris is an issue

# Dredging Issues

- Precision vs. Characterization
- Water quality impacts
- Residual sediments

# Precision Dredging

- Most dredges can operate to within 0.5 ft (vertically)
- Fixed arms and platforms increase vertical and lateral precision
- How Important Is Precision In Dredging?
  - Dredging Is A Minor Amount Of Overall Remedial Costs, So It Is A Ripe Area For Improving Effectiveness To Reduce Other Costs
  - GPS And Automated Control Technologies Are Widely Used To Control Dredging Operations
- Sediment characterization is limiting factor

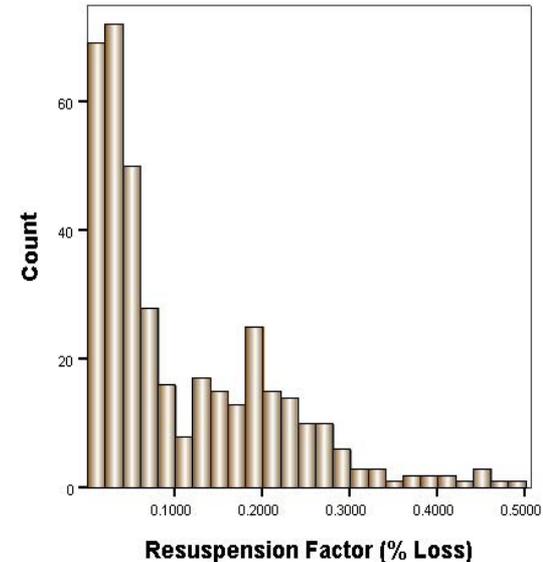
# Bucket Dredge WQ Impacts

- Data for bucket dredges show 0.2 to 0.9% loss
- Additional sediment resuspension results from
  - Tender vessels
  - Barge/tug movement
  - Dredge repositioning

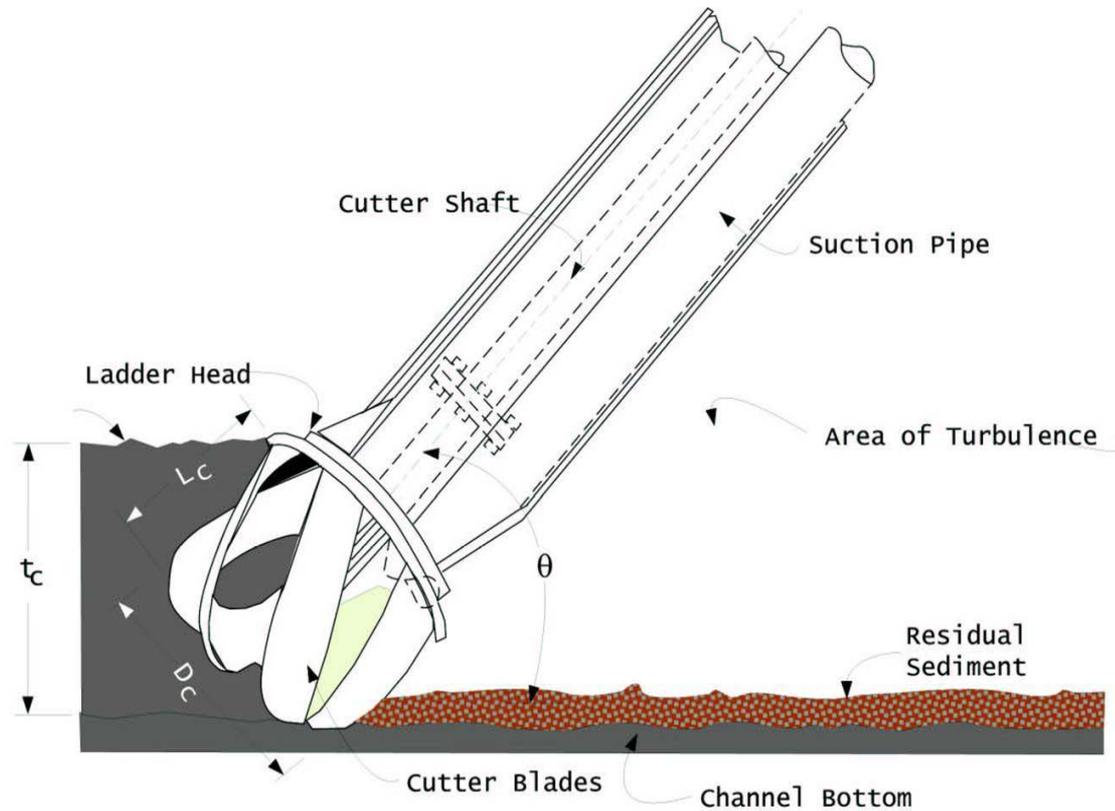


# Hydraulic Dredge WQ Impacts

- Cutterhead dredges
  - Available data show some lower resuspension than mechanical dredges; generally  $< 0.5\%$
  - Operational restrictions may modify results
  - Ancillary vessels, pipe management will increase resuspension
- Limited data for other hydraulic dredges

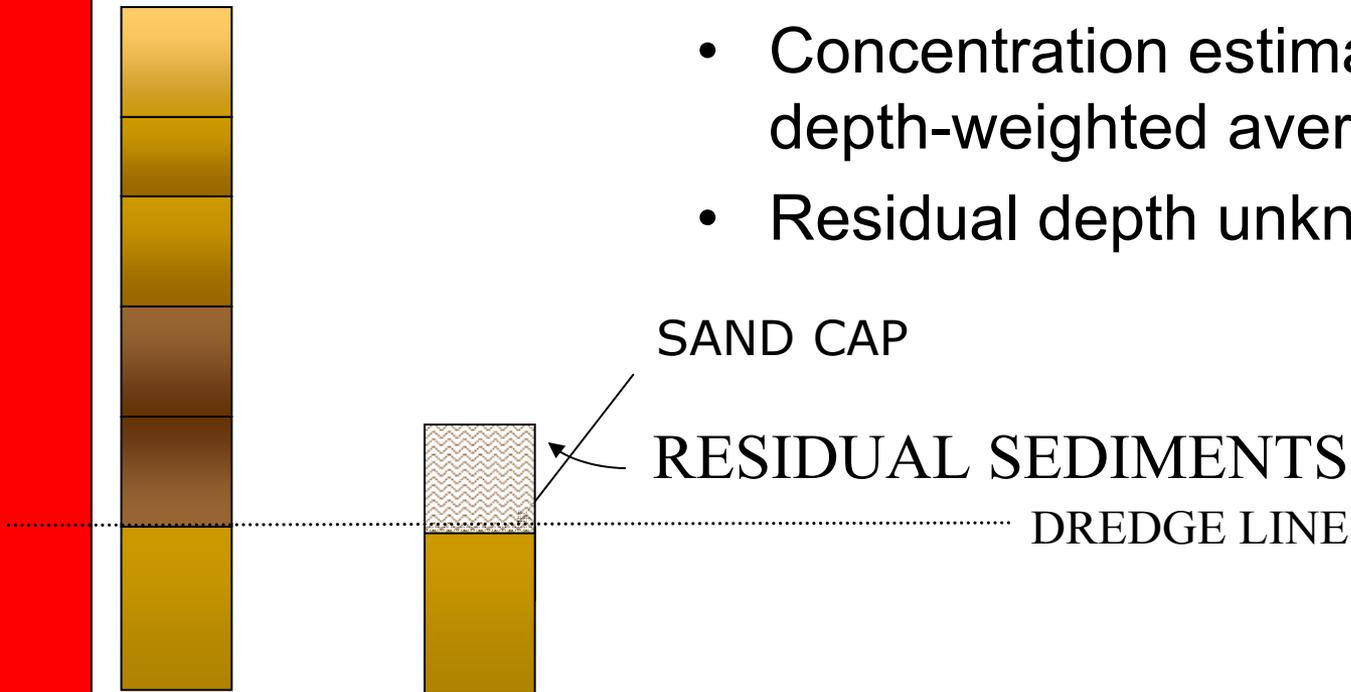


# Residual Sediments



# Post-dredging Residual Sediments

- Available data show a post-dredging residual layer will exist
- Concentration estimated as depth-weighted average
- Residual depth unknown



# Dredge Selection

- Each dredge type has
  - advantages & disadvantages
  - similar impacts & effectiveness
- Dredge selection involves matching equipment to
  - physical setting
  - sediment management alternatives
- Complex sites such as the Housatonic may require multiple dredge types

# Sediment Management

Mechanically Dredged Sediments

Hydraulically Dredged Sediments

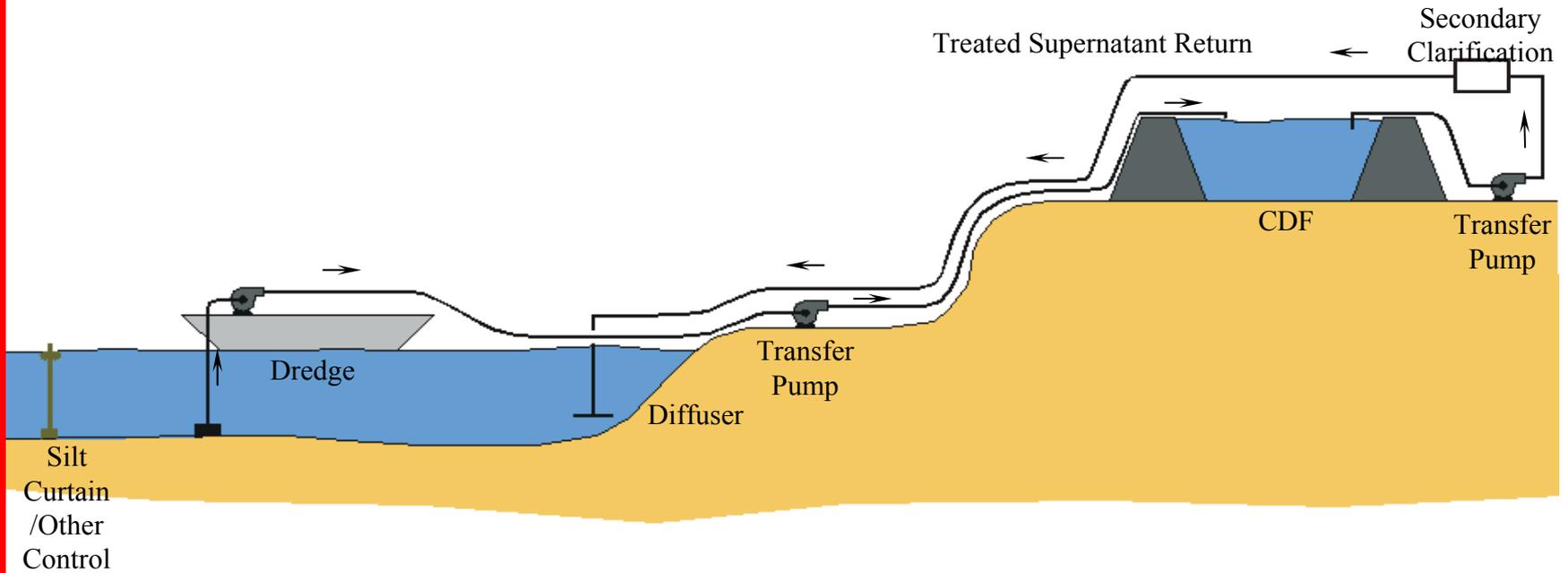
# Mechanically Dredged Sediments

- Sediment must be moved efficiently from the dredging site to an immediate storage location
  - hopper barges typical
  - Shallow water and limited access may complicate moving these barges around in the Housatonic
- Shoreline rehandling and processing facility
  - On-site trucking may be required
  - Water management and treatment may be necessary
  - Similar to on-going efforts, but may generate more water
- Sediment stabilization for transport and disposal
  - Similar to on-going efforts

# Mechanically Dredged Sediments

- Stabilized sediment transported to landfill
  - Trucks
  - Rail
- Concerns
  - Increased traffic
  - Noise
  - Leakage
  - Cost

# Hydraulic Dredge and CDF System



# Example CDFs



Calumet, IL



Mobile, AL



Indiana Harbor, IN

## USEPA/USACE Guidance Documents for Design Provide

- Tiered Evaluation of Potential Contaminant Migration Pathways
- Proven test methods, models, and procedures exist to evaluate SCA Effluent, Surface Runoff, Leachate, Air, Plant Uptake, Animal Uptake
  - Requires site-specific engineering controls designed to address site-specific migration pathways and risks
- Overall Objective – Design CDF to be Protective of Human Health and the Environment

# Supernatant Water Treatment

- High flow rates from hydraulic dredging result in high water treatment costs
- Possible Treatment Options
  - Primary Treatment
  - Enhanced Primary Treatment
  - Multimedia Filtration
  - Advanced Treatment

Questions?