Considerations for Mechanical Dredging, Hydraulic Dredging and Mechanical Dewatering of Sediments

WODCON XXI

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Contractor's Perspective

- Previous Dredging and Dewatering Projects - 20 plus years experience
- Impoundments
- Lakes
- Rivers
- Bays
- Canals
- Case Studies

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Pre-Project Evaluation

- Depth of Water
- Sediment Depth
- Sediment Characterization
- Site Considerations

Water Depth

- Will Impact Equipment & Process Selection
- Less than 0.9 meters (3 ft) – Hydraulic Dredging – May Not be Viable
- Less than 0.9 meters (3 ft) – Mechanical Excavation/LGP Equipment
- Over 0.9 meters (3 ft) – Hydraulic Dredging - 15 to 30 cm (6-12 in) pump discharge
- Consider Tidal Influences

Sediment Depth

- Determined from core sampling or probes
- Less than 0.3 meters (1 ft) – not suitable for efficient hydraulic dredging
- Less than 0.3 meters (1 ft) – more suitable for mechanical excavation
- Over 0.3 meters (1 ft) – hydraulic dredging

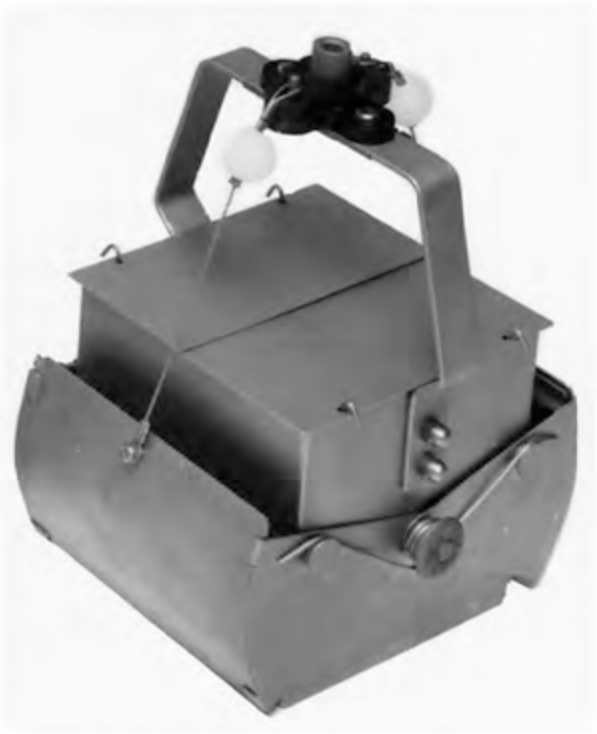
Sediment Characterization

- Collect Representative Samples
- Geotechnical Properties
- Physical and Chemical Analysis
- Dewatering Treatability Studies
- Chemical Conditioning Evaluation

Representative Sampling

- Establish a grid
- Sample to proposed dredge depth
- Composite and Label Samples
- Segregate Unique Samples

Sampling



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Sampling

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Geotechnical Evaluation

- Sieve Analysis
- % Total Solids Content
- Bulk Density
- Specific Gravity
- Blow Counts
- Debris Content

Chemical Conditioning

- Separate Coarse Material with Screens before Chemical Trials
- Polymers, Coagulants, Other Additives
- Simulate Field Process In Laboratory Bench Tests(ex. – sediment dilution rates)
- Evaluate Multiple Process Options

Laboratory Simulation

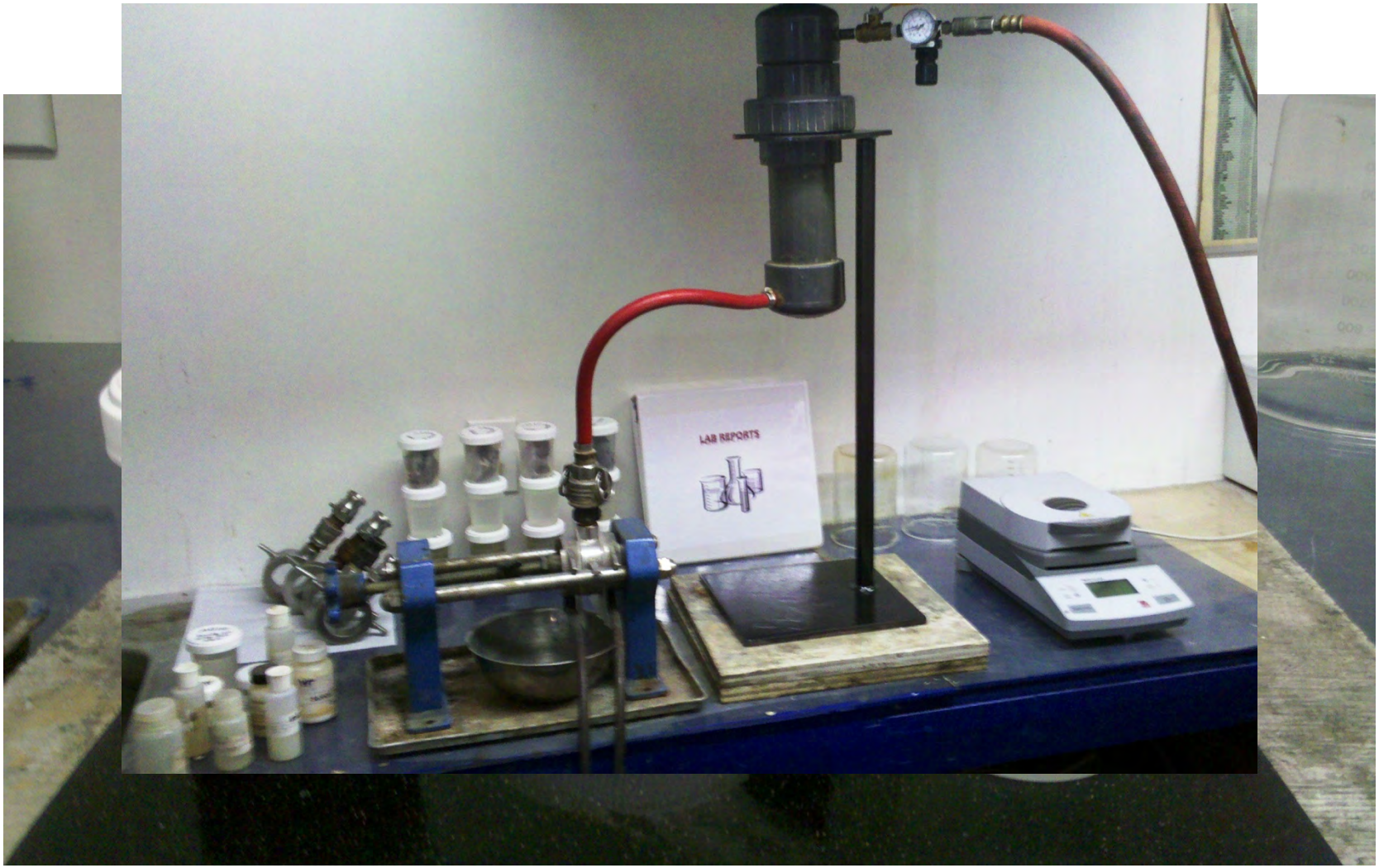
- Mechanical Screening
- Potential Mechanical Dewatering Options
- Belt Filter Press
- Plate and Frame (Recessed Chamber) Press
- Centrifuge
- Geotextile Tubes

Chemical Conditioning

- Polymer
- Pre-coat
- Body feed
- Other Chemicals (lime, Ferric)
- Dosage – dry weight basis
- Aquatic Toxicity
- Other Filtrate Issues (pH, Contaminants)

Belt Press Bench Test

PLATE PRESS BENCH SCALE



Screening Bench Test

Dewatered Cake Samples

- % TS
- Paint Filter Test
- Density
- pH

Bench Test Projections

- Equipment Selection
- Throughput for the Process
- Processing Time Required
- Volume Reduction
- Filtrate Treatment
- PPE

Disposal Requirements

- Beneficial Use
- Contaminated Sediments
- Hazardous Sediments
- Volume Reduction
- Paint Filter Test
- % TS Requirements

Filtrate/Effluent Requirements

- TSS Limits
- Turbidity Limits
- Other Limits (PCBs)
- Requirement for Treatment of Effluent

Dredging Equipment Selection

- Mechanical Dredging
- Hydraulic Dredging

Mechanical Dredging Equipment

- Excavators
- Conventional Buckets
- Clamshell Buckets
- Environmental Clamshell Buckets

Mechanical Dredging Equipment

- Suitable for Tidal/Low Water Depth Environments
- Marsh Buggy/LGP Equipment
- May Require Temporary Roads/Geogrid/Mats
- Stable Spudded Work Platform for Deeper Water

Hydraulic Dredging Equipment

- Auger Dredges
- Cutter Suction Dredges
- Booster Pumps

Auger Dredges

- Typically 10 to 20 cm pumps (4 to 8 inch)
- Cable and Winch System Movement
- Paddle Wheel Propulsion
- Suitable for Unconsolidated Sediments

Auger Dredging Equipment

- Maximum Digging Depth – 9.1 meters (30 ft)
- Slurry Pump Rates – 1.5 – 7.5 cubic meters/minute (400-2,000 gpm)

Cutter Suction Dredging Equipment

- Typically 15 to 40 cm pumps for contaminated sediment dredging (6 to 16 inch)
- Winch, Spuds, Swing Anchor System Movement
- Swinging Ladder Option – Kicker Spud
- Suitable for Unconsolidated and non-hard pack Sediments

Cutter Suction Dredging Equipment

- Maximum Digging Depth – 9.1 meters (30 ft)
- Slurry Pump Rates – 7.5 – 15 cubic meters/minute (2,000-4,000 gpm)

Dewatering Equipment

- Mechanical Screens
- Hydrocyclones
- Rapid Dewatering Screens
- Belt Filter Presses
- Centrifuges
- Plate and Frame (Recessed Chamber) Presses

Mechanical Screening Equipment

- Separate and Dewater Vegetative/Organic Material
- Separate Debris
- Separate and Dewater Oversized Material
- Protect Downstream Equipment

Hydrocyclone Dewatering Equipment

- Separate and Dewater Sand and Gravel
- Separate High Density Material

Rapid Dewatering Screens Equipment

- Inclined Screen Decks with Limited Mechanical Motion
- Polymer Required
- High Throughput/Continuous Process
- Low Dewatered Sediment Solids Content
- Dewatered Sediment Requires Stockpiling or Additional Treatment before Loading

Belt Filter Press Dewatering Equipment

- Polymer Required
- High Throughput/Continuous Process – Multiple Presses
- Good Dewatered Cake Solids
- Can Load Directly for Disposal
- Filtrate May Need Additional Treatment

Centrifuge Dewatering Equipment

- Higher Polymer Dose
- Large Electric Requirement
- High Throughput/Continuous Process
- Good Dewatered Cake Solids
- Potential Damage – Grit/Sandy Sediments
- Higher Capital and R&M Cost
- Centrate May Need Additional Treatment

Plate and Frame Dewatering Equipment

- Plate and Frame (Recessed Chamber) Press
- Polymer/Other Chemicals May be Required
- Batch Process- May be Lower Throughput
- Potential for Higher Dewatered Cake Solids
- Cleaner Filtrate
- May reduce need for Filtrate Treatment Equipment

Geotextile Tube Dewatering

- Effective on Coarse Grained Sediments
- Fine Grained Sediments Require Polymer
- Large Flat Area and Time Required for Cost Effective Use
- Batch Process- May be Lower Throughput
- Process Throughput Decreases as Tubes Fill
- Lower Final Dewatered Sediment Solids Content

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Effluent Considerations

- Effluent Treatment can be most expensive and limiting factor in the process
- Silt Curtains – Containment of Effluent Solids
- Clarifiers
- Sand Filters
- Geotextile bag filters
- Carbon Canisters

Case Studies

- Pond Sediment – Waltham, MA
- Lake Sediment – Columbia, MD
- Pond Sediment – Haddonfield,NJ

Hardy Pond, Waltham, MA

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Hardy Pond, MA

- 230,000 CM (300,000 CY) of Sediment Removed
- Peat Like Sediments, Low Density
- 7% TS in-situ
- Very Little Coarse Grained Material
- Water Depth – 0.8 – 2.5 M (2.5 – 8 ft)

Hardy Pond, MA

- Process Site – 60 by 30 meters (200 x 100 ft) – next to a baseball field
- Hydraulic Dredging – 20 cm(8 in) auger dredge
- Mechanical Dewatering – 4 – 2.5 M Belt Filter Presses
- Dredge Throughput- 53 CM/HR – 70 CY/HR
- Dewatered Sediments – 18-19 % TS – almost 3:1 volume reduction

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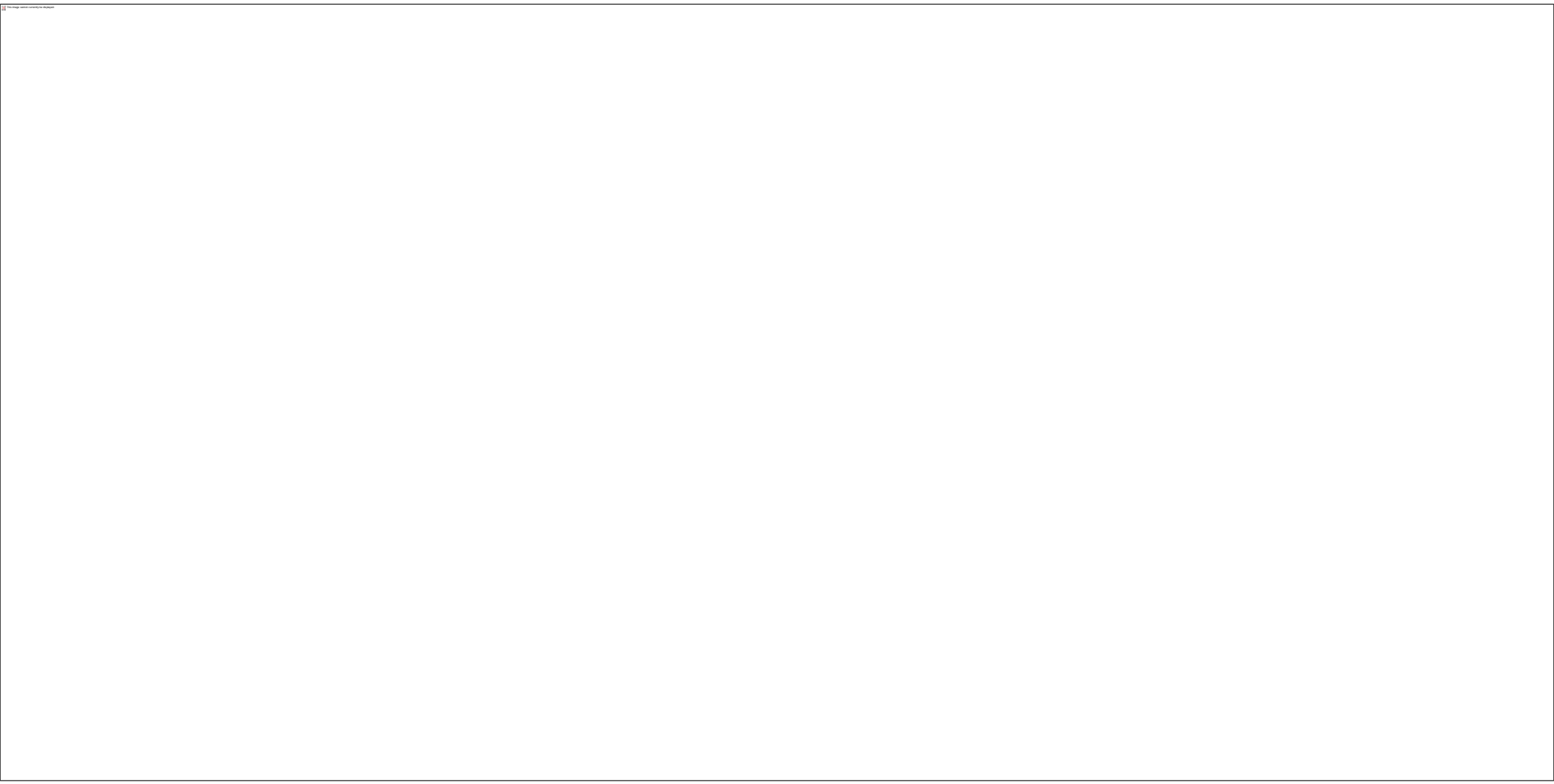
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Hardy Pond, MA

- Dewatered Sediment – Loaded by Conveyor Directly into Trucks
- Project Cost – Approx. $14.50 -15.70/CM - $11-12/CY
- Sediment – High Organic Matter Content Beneficially Reused

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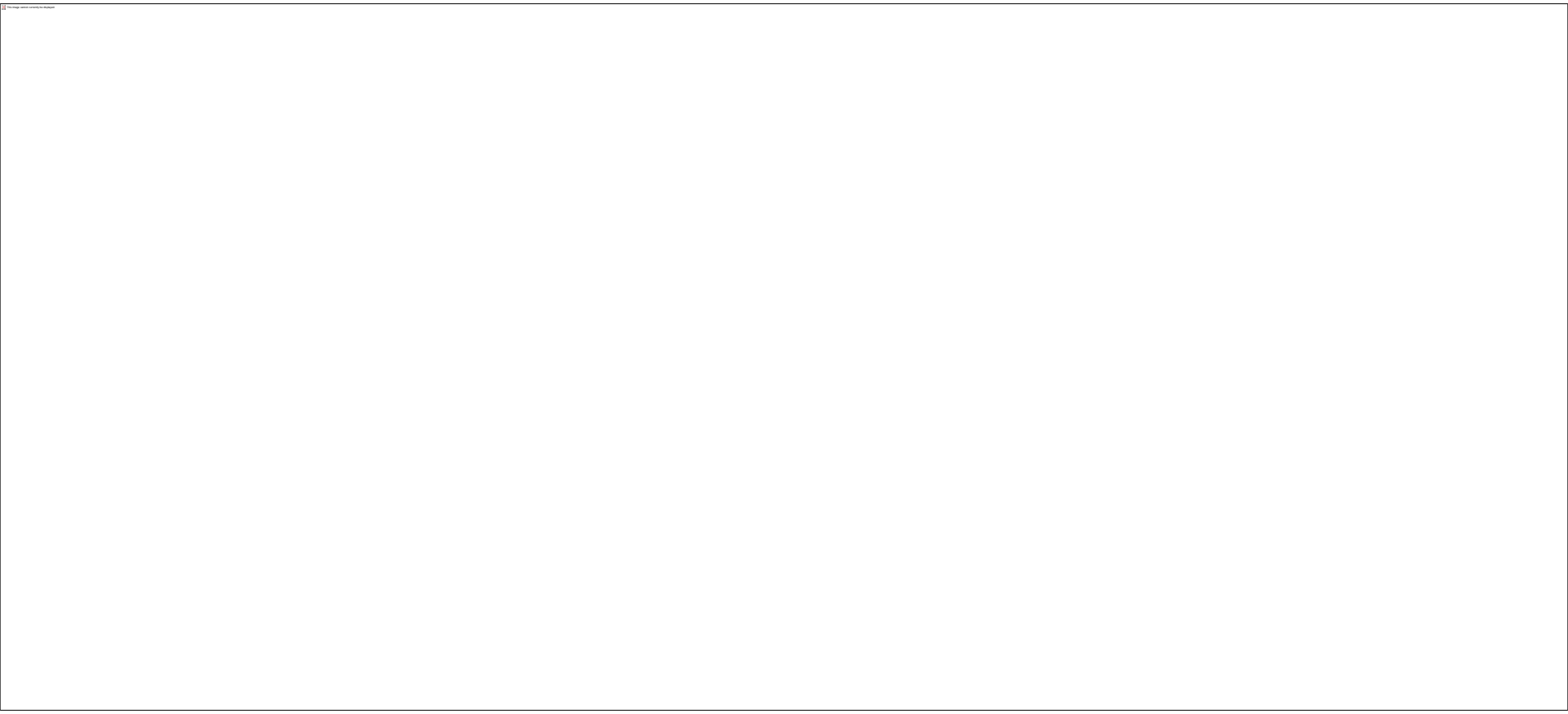
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Hardy Pond, MA

- Lesson Learned – Substantial Movement of Sediments in Pond during Dredging
- Hydrographic Surveys Did Not Accurately Document Quantity of Material Removed
- All Trucks Weighed to Document Dredge Quantity

Lake Elkhorn, Columbia, MD

Lake Elkhorn, MD

- 26,750 CM (35,000 CY) of Sediment Removed
- Medium to High Density Sediments
- 43 – 76 % TS in-situ
- High Concentrations of Coarse Grained Material
- Water Depth – 0 – 3.7 M (0 – 12 ft)

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Lake Elkhorn, MD

- Process Site – 120 by 30 meters (400 x 100 ft) – Public Park
- Mechanical Excavation – Feeder Channel
- Hydraulic Dredging – 20 cm(8 in) Swinging Ladder Cutter Suction Dredge
- Mechanical Dewatering – Screens, Hydrocyclones, 4 – 2.5 M Belt Filter Presses
- Dredge Throughput- 27 CM/HR – 35 CY/HR
- Dewatered Sediments – 50-70 % TS – 15-20% volume reduction


CAT


MX131HDC

Lake Elkhorn, MD

- Dewatered Sediment – Stockpiled on Pad and Loaded by FEL into Trucks
- Project Cost – Approx. $115/CM - $88/CY
- Sediment – Disposed at Mine Site

Crystal Lake, NJ

Crystal Lake , NJ

- 2,350 CM (3,000 CY) of Contaminated Sediment Removed
- Medium Density Sediments
- 30 % TS in-situ
- Organic Matter mixed with Fine/Coarse Grained Material
- Water Depth – 0.8 – 1.8 M (2.5 – 6 ft)

Crystal Lake , NJ

- Process Site – 106 by 55 meters (350 x 180 ft) – Soccer Field in Public Park
- Hydraulic Dredging – 15 cm(6 in) Auger Dredge
- Geotextile Tube Dewatering
- Dredge Throughput- 19 CM/HR – 25 CY/HR
- Dewatered Sediments – 40 % TS – 20-30% volume reduction

Crystal Lake , NJ

- Dewatered Sediment – Loaded by Excavator into Trucks after 4-5 months of dewatering
- Project Cost – Approx. $105/CM - $80/CY
- Sediment – Subtitle D Landfill Disposal

Conclusions

- Understand Project Scope
- Representative Samples
- Treatability Study
- Process Area Footprint & Schedule
- Cost Evaluation
- Environmental and Local Impacts

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- Thank You
- Questions