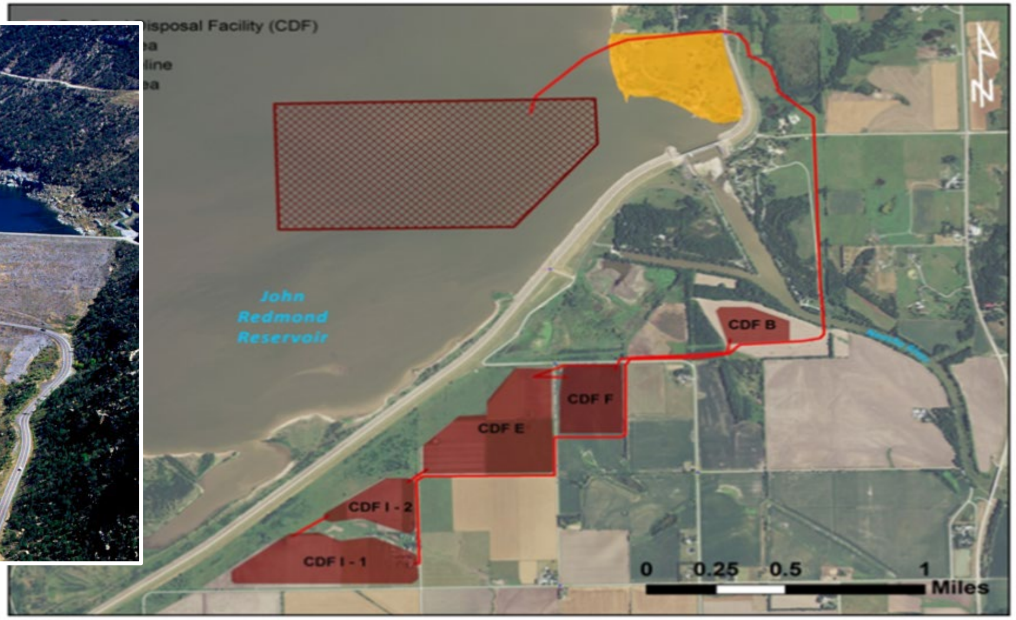
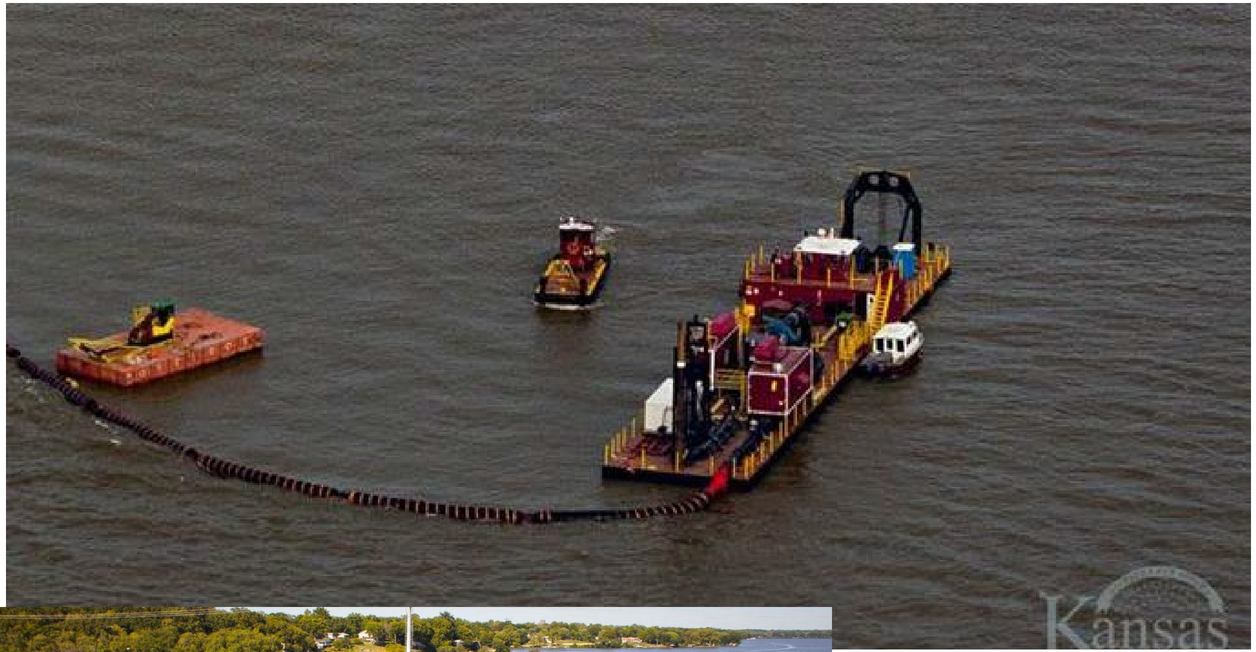
Construction Considerations and Challenges Related to Dredging in a Reservoir Environment



Michael Beton

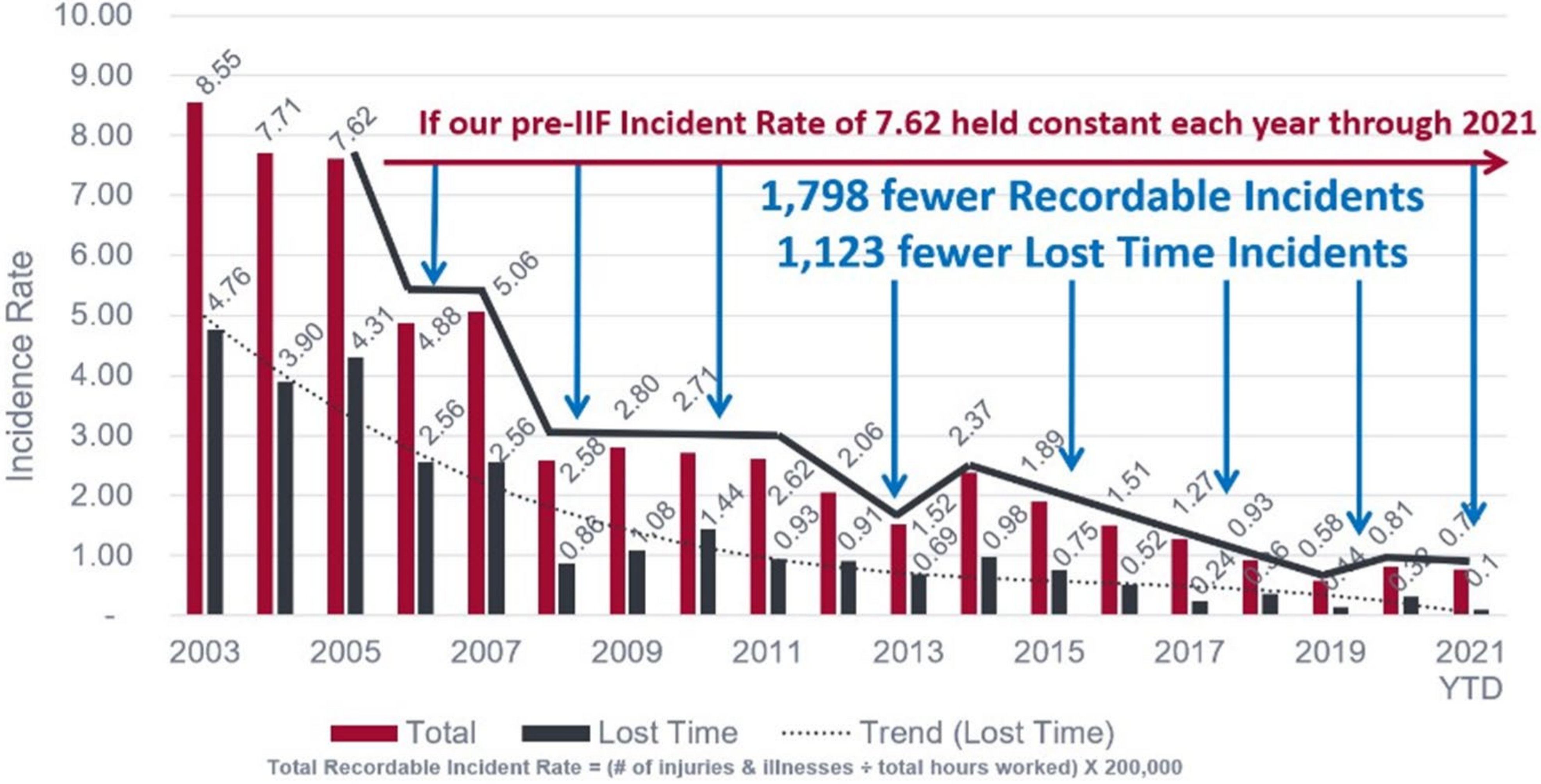
DREDGING SOLUTION TO REMOVE RESERVOIR SEDIMENT

- Safety
- Existing Reservoir Practices
- Dredging Solution
- Design Considerations
- Conclusions



GLDD'S SAFETY FOCUS

Making sure that everyone goes home safe



Existing Reservoir Practice

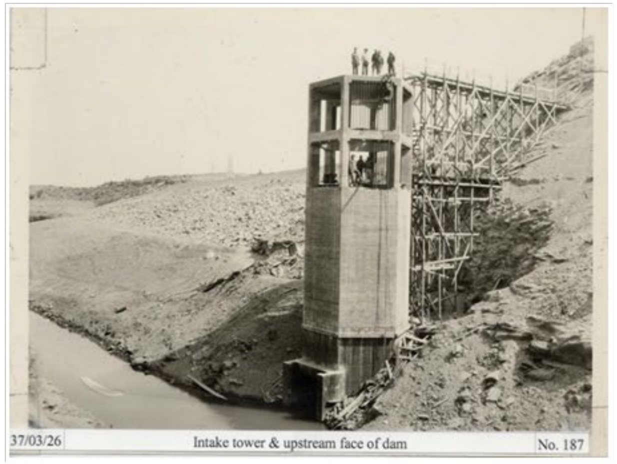
- In the United States, reservoirs are functioning as originally authorized and designed
- This means they trap sediment that would naturally flow with the water source
- People may not be aware that the numerous benefits provided by the nation’s reservoirs are not sustainable over the long term
- Require purposeful sediment management plan



Without Reservoir Sediment Management

The eventual costs can be expensive

- Lost storage capacity over time for water supply & flood control (increasing water storage needs)
- Buried or impaired dam outlets, reservoir water intakes, impairing hydro electric, boat ramps, & marinas
- Long term effect on industries that rely on the reservoir such as Agriculture



Without Reservoir Sediment Management

- Damaged reservoir infrastructure such as turbines, outlets, or spillways
- Reduced surface area for recreational use
- Downstream channel degradation, infrastructure erosion, and habitat loss



Without Reservoir Sediment Management

- Dam decommissioning
- New dam construction to create replacement water storage
- With 90,000 dams in the national inventory, the best dam sites have already been taken

Sediment Removal

There are several Options for Sediment Removal

- Mechanical/Hydraulic dredging or dry excavation
- Transport of material can be achieved by slurry pipeline, truck, or conveyor belt for discharge



The Dredging Solution

Collect reservoir sediment for transport to the downstream channel, beneficial use, or disposal site

Understanding your reservoir needs:

- Can the reservoir be drained or must maintain water
- Water depth all year around
- Annual vs One off capacity creation
  - Dredging past decades of sedimentation may be possible for small reservoirs
  - However, large reservoirs would focus on annual dredging to keep up with future sediment inflow

Dredging Design Considerations

Key Considerations:

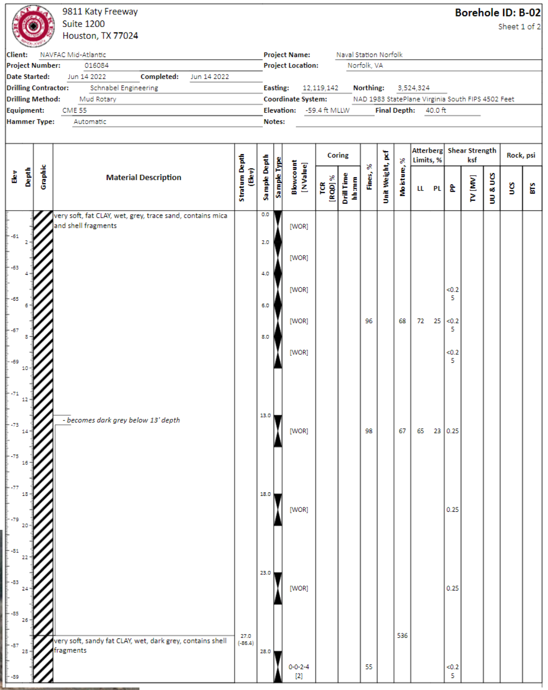
- Reservoir location, topography, and bathymetry
- Reservoir soils/site investigation
- Sediment disposal behavior
- Dredging depths
- Sediment slurry pipeline routes
- Environmental compliance and required permits

Reservoir Location, Topography & Bathymetry

- Economic value of reservoir storage
- Reservoir topography and bathymetry for material needed to be removed, and dredge sizing/power requirements
- Location of reservoir affect on site access complexity of mobilization of dredging equipment

Reservoir Sediment Investigation

- Spatial distribution and thickness, particle grain-size distribution, bulk density, cohesion, abrasion characteristics, presence of organic wood material, and concentration of any contaminants
- Remaining debris types such as trees, tree stumps, and trash (recreation or other)



9811 Katy Freeway
Suite 1200
Houston, TX 77024

Borehole ID: B-02
Sheet 1 of 2

Client: NAVFAC Mid-Atlantic | **Project Name:** Naval Station Norfolk
Project Number: 016084 | **Project Location:** Norfolk, VA
Date Started: Jun 14 2022 **Completed:** Jun 14 2022
Drilling Contractor: Schnabel Engineering | **Easting:** 12,119,142 **Northing:** 3,524,324
Drilling Method: Mud Rotary | **Coordinate System:** NAD 1983 StatePlane Virginia South FIPS 4502 Feet
Equipment: CME 55 | **Elevation:** -59.4 ft MLLW **Final Depth:** 40.0 ft
Hammer Type: Automatic | **Notes:**

Material Description	Stratum Depth (Elev)	Sample Depth	Blowcount [N Value]	Coring: TCR [RQD] %	Coring: Drill Time hh:mm	Fines, %	Unit Weight, pcf	Moisture, %	Atterberg Limits, %: LL	Atterberg Limits, %: PL	Shear Strength ksf: PP	Shear Strength ksf: TV [MV]	Shear Strength ksf: UU & UCS	Rock, psi: UCS	Rock, psi: BTS
very soft, fat CLAY, wet, grey, trace sand, contains mica and shell fragments		0.0	[WOR]												
		2.0	[WOR]												
		4.0	[WOR]								<0.25				
		6.0	[WOR]			96		68	72	25	<0.25				
		8.0	[WOR]								<0.25				
- becomes dark grey below 13' depth		13.0	[WOR]			98		67	65	23	0.25				
		18.0	[WOR]								0.25				
		23.0	[WOR]								0.25				
very soft, sandy fat CLAY, wet, dark grey, contains shell fragments	27.0 (-86.4)							536							
		28.0	0-0-2-4 [2]			55					<0.25				

Reservoir soils/site investigation

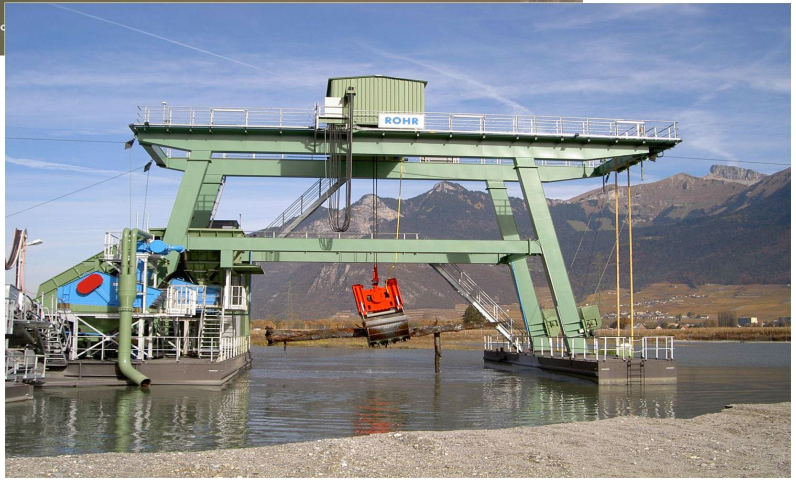
- Geotechnical/Site Investigation:
  - Boreholes
    - Enough holes and test samples to characterize the dredge area
    - Drill deeper than the planned dredging depth
  - Provide prospective bidders with complete geotechnical reports
  - Utility Locations
  - Know debris and infrastructure

Dredging Depth

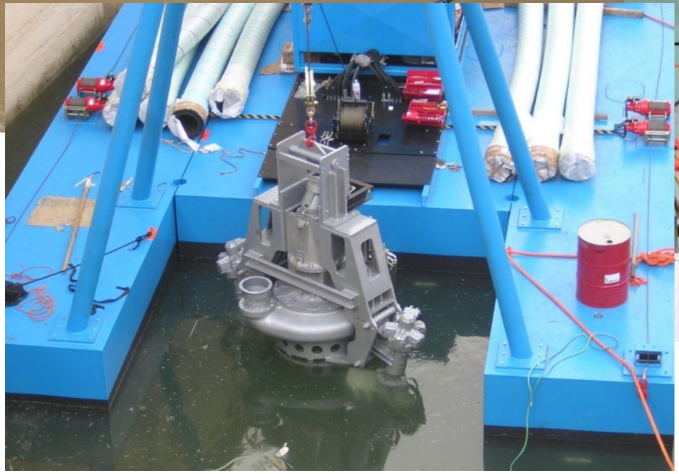
- Portable cutter-suction dredges work in depth from 15 to 60 FT
- Modified dredging plant for deeper than 60 feet
- Clamshell dredges can work as deep as 120 feet.
- Dredging is technically possible deeper than 150 feet, but may be cost prohibitive / specialized equipment

<u>Important to select right tool for the job</u>

20" Portable Diesel Dredge *Sandpiper* digging po
Photo by GLDD



Cutter Suction Dredge Solution



Beneficial Reuse of Dredged Sediment

- Downstream channel
- Soil augmentation for agriculture
- Land development
- Construction fill
- Concrete aggregate
- Wetland and other shallow water habitat creation
- Shoreline beach development or augmentation

 |

GLDD Beneficial Reuse of Dredge Material

SAN JACINTO RIVER

- FLOOD CONTROL PROJECT
- USACE, Galveston District
- 1,920,700 CY
- Portable Electric CSD
- Pump Distance 34,000 lf to 50,000 lf

Dredged material to be reused for resale in the Houston sand market.

JOHN REDMOND RESERVOIR

- Kansas Water Office
- 3,000,000 CY
- Portable Electric CSD
- Pump Distance 30,000 lf to 35,000 lf

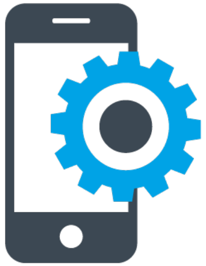
Dredged material reused for farmland augmentation, grass land development, and habitat use.

Dredge sizing and power requirements

- Pumping costs can be significant and increase with distance and elevation
- Booster pumps are needed for long distances
- Land alignments:
  - Topographic elevations changes
  - Crossings of stream channels, roads, and oil & gas pipelines
- Reservoir alignments:
  - Floating on surface
  - Submerged on the bottom Crossing the dam
- Pipe Selection:
  - Steel pipelines (large and long-term)
  - HDPE pipelines (small and short-term)
  - Pumping energy and abrasion depend on sediment size and transport regime

Complexity of mobilization of dredging equipment

- Includes all dredging equipment, slurry pipelines, and any confined placement facilities ready for dredging operations
- Size of staging area/pipelines to receive equipment
- Easy of access for dredge insertion and pipeline laying
- Topography, access roads, and local infrastructure constraints
- Cost is a function of the schedule, project complexity, and contract risk
- Cost becomes less significant for long-term dredging projects



Conclusions

- Dredging costs would have to be compared with of other sediment management options.
- Sediment management costs should be compared with the cost of eventually losing the reservoir benefits and the cost dam decommissioning.
- Each reservoir is unique requiring individual assessment and planning

Q&A