Remedial Design and Construction Using an Adaptive Management Approach for the Lower Fox River Remediation Project

Presented by:
T. Blackmar, PE, Tetra Tech, Inc.
P. LaRosa, PE, Anchor QEA, LLC

Coauthors:
D. Binkney, Anchor QEA, LLC
G. Berken, The Boldt Company
D. Roznowski, PE, Foth Infrastructure & Environment, LLC

Overview

- History and Background
- Adaptive Management and Lessons Learned
  - Handling Toxic Substances Control Act (TSCA)-impacted sediment
  - Refined delineation
  - High subgrade
  - Remediation adjacent to uplands and in-water structures
  - Submerged utilities
- Conclusions

Source: J.F. Brennan, 2019

History and Background

History and Background

- **Project site**: Operable Units (OUs) 2 to 5
- **History:**
  - Home to 24 historical and active paper and pulp mills
  - PCBs released between the 1950s and 1970s
  - Fish Advisory since 1976
- **Active Construction Timeline**: 2009 to 2020
- **Total Estimated Dredge Volume**: >6.2 million cy
- **Total Estimated Cap and Cover Placement**: 790 acres (estimated at project completion)
- **Total Estimated Separated and Reused Sand**: 766,500 tons

Source: Wisconsin Department of Natural Resources

History and Background – Project Team

- **Client:** Lower Fox River Remediation, LLC
- **Agencies/Oversight Team:** USEPA, Wisconsin Department of Natural Resources, The Boldt Company, and technical experts
- **Lead Design Build Contractor:** Tetra Tech EC, Inc.
- **Subcontractors:**
  - **Construction:** J.F. Brennan Marine
  - **Sediment Processing:** Stuyvesant Projects Realization, Inc.
  - **Engineering:** Anchor QEA, LLC and Tetra Tech CES, LLC
- **Quality Assurance:** Foth Infrastructure and Environment, LLC

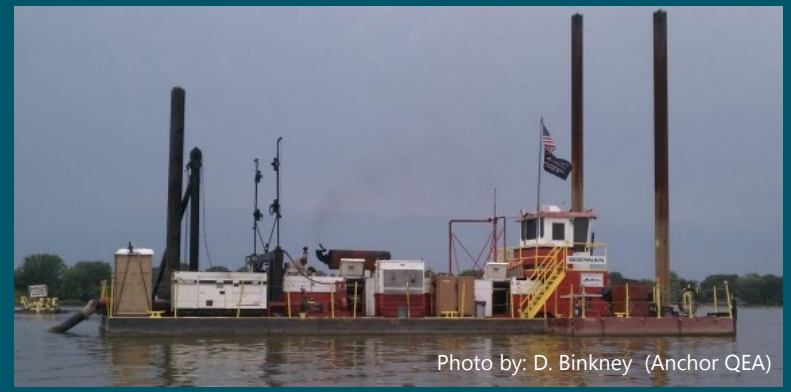


Photo by: D. Binkney (Anchor QEA)

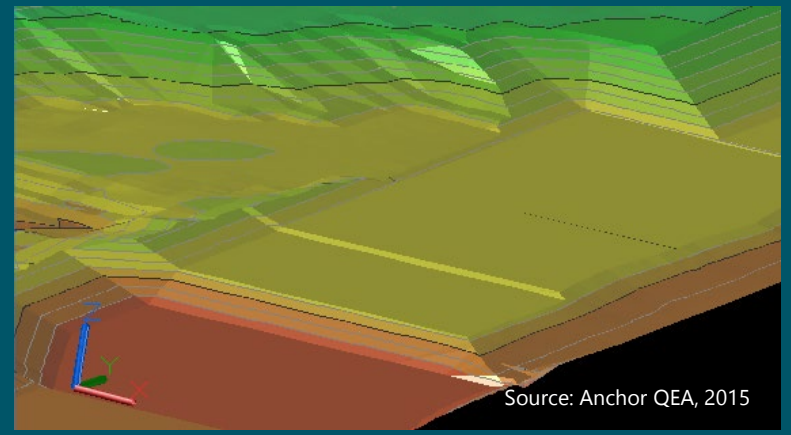
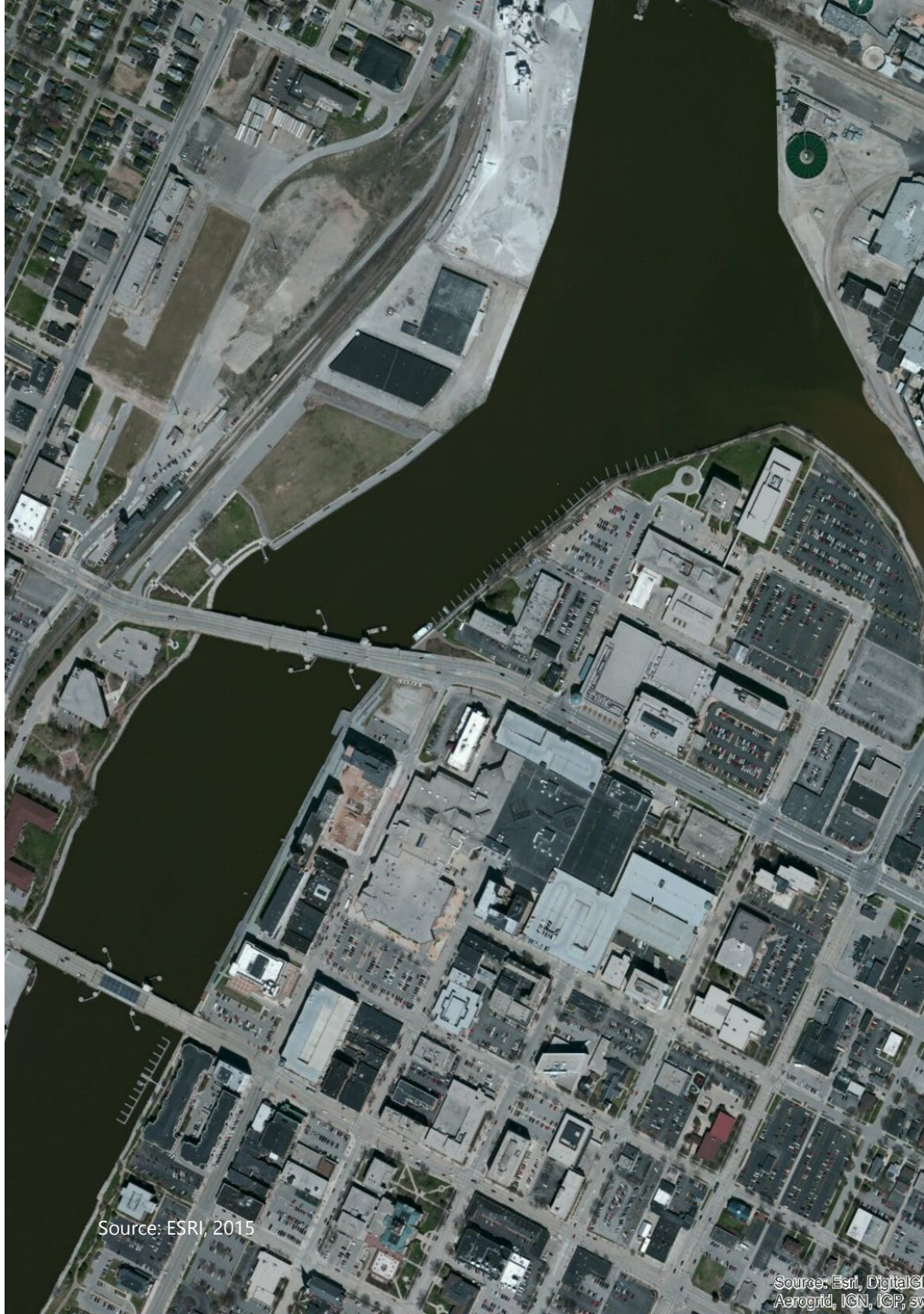

Source: Anchor QEA, 2015

Photo by: P. LaRosa (Anchor QEA)

History and Background

- Record of Decision (ROD) issued in 2003
- ROD Amendment issued in 2007
- Remedial design phases: 30%, 60%, 90%, and 100%
- Adaptive Management (AM)/Value Engineering (VE) Plan developed during design
- More than 8,000 sediment cores collected for remedial design

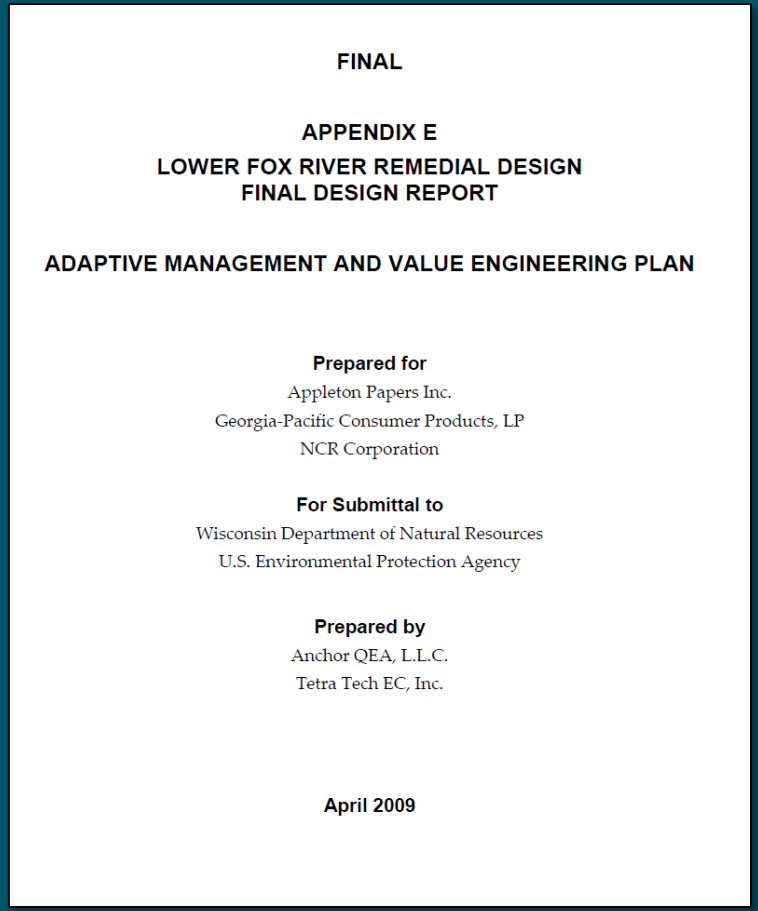


History and Background – Components of the 100% Design

- Dredging
  - "Neatline" surface based on geostatistical models
  - Targeted elevation prisms
  - Dredging to accommodate caps to meet post-cap water depth criteria
- Engineered capping
  - 13- to 33-inch-thick cap types
  - Shoreline caps 43 inches thick or more
- Sand covering
  - 6 inches thick

History and Background – Adaptive Management and Value Engineering

- AM and VE Plan
  - First conceived as part of Remedial Design Work Plan
  - VE to achieve schedule and cost savings with equivalent protection
  - AM and VE elements documented in annual Remedial Action Work Plans



FINAL

APPENDIX E
LOWER FOX RIVER REMEDIAL DESIGN
FINAL DESIGN REPORT

ADAPTIVE MANAGEMENT AND VALUE ENGINEERING PLAN

Prepared for
Appleton Papers Inc.
Georgia-Pacific Consumer Products, LP
NCR Corporation

For Submittal to
Wisconsin Department of Natural Resources
U.S. Environmental Protection Agency

Prepared by
Anchor QEA, L.L.C.
Tetra Tech EC, Inc.

April 2009

Handling TSCA Sediment

Adaptive Management and Lessons Learned

Handling TSCA Sediment

- Objective
  - Accurately delineate TSCA and identify cost-effective disposal
- Approach
  - Accurate delineation based on anticipated removal method
  - Risk-based disposal

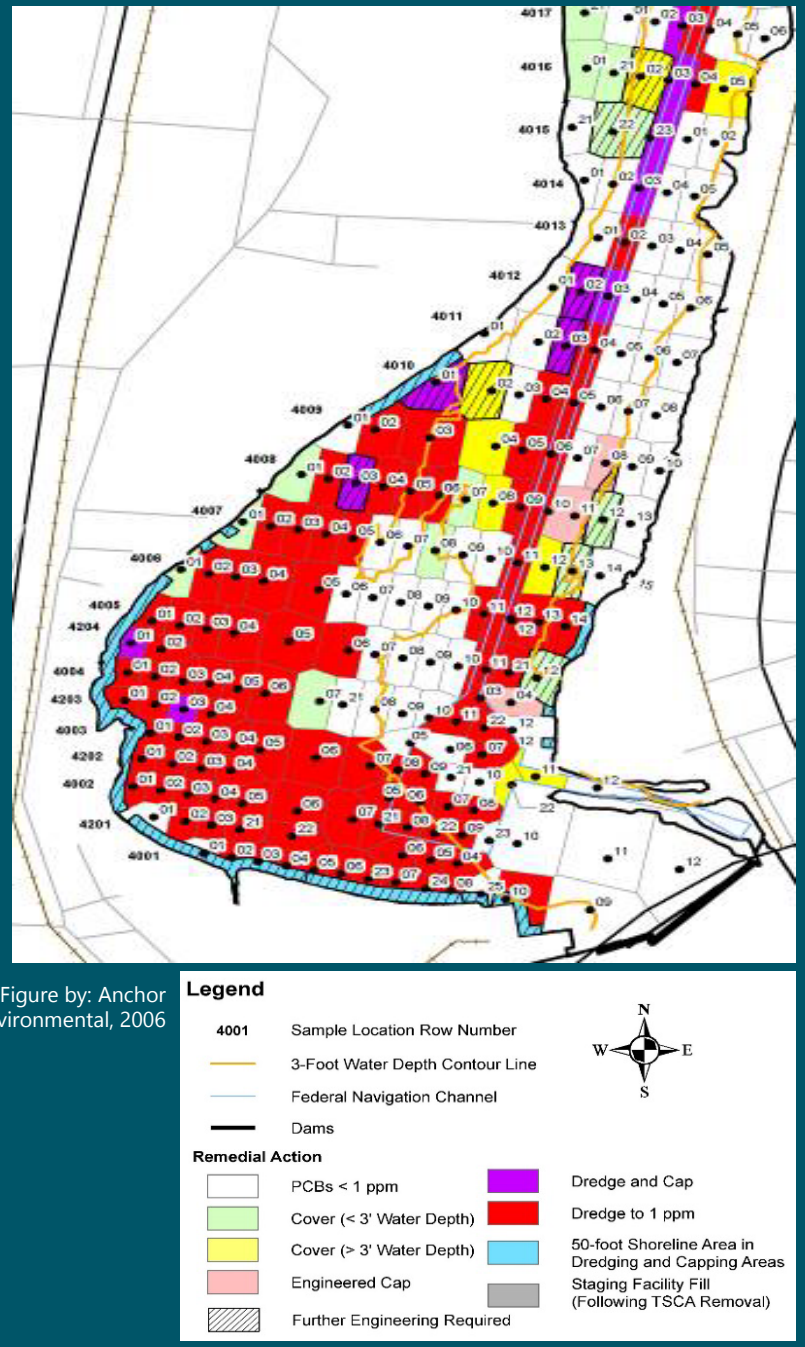
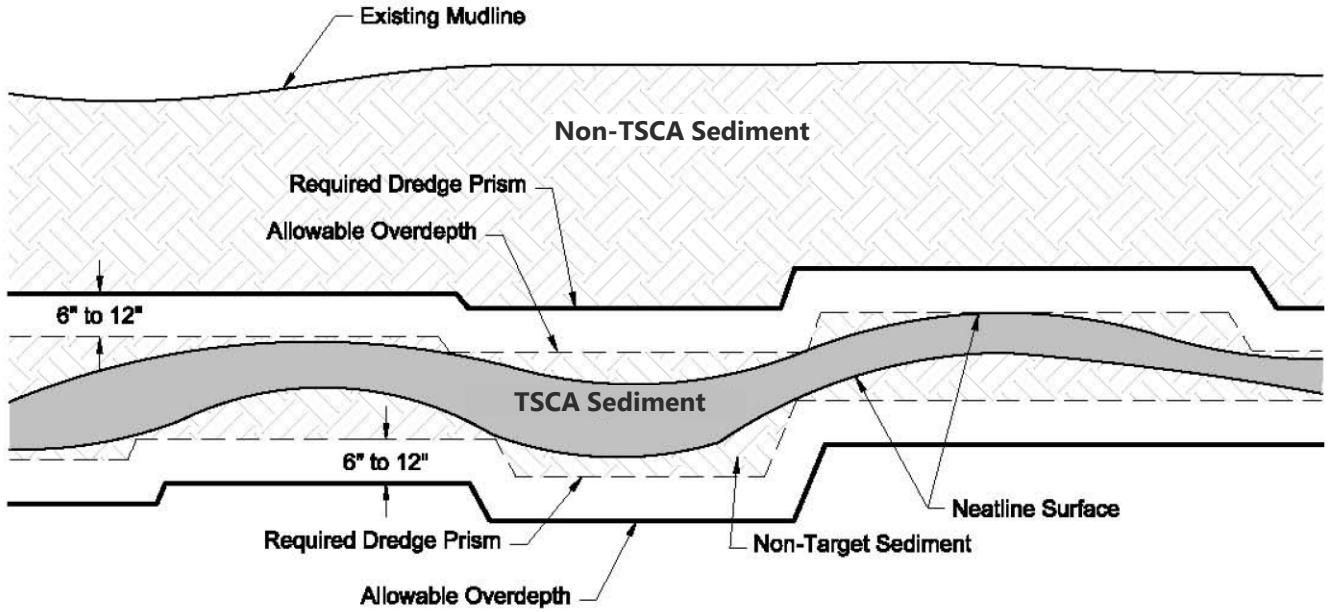


Figure by: Anchor Environmental, 2006

Handling TSCA Sediment

- Lower Fox River TSCA delineation
  - Horizontal delineation using Thiessen polygons
  - Vertical delineation based on an average of 50 parts per million (ppm) over 2.5-foot depth intervals



Handling TSCA Sediment

- Dredged in separate events from non-TSCA sediment
  - TSCA: approximately 115,000 cy
  - Non-TSCA: >6.1 million cy
- PCB concentrations measured ex situ in filter cake prior to disposal
  - Results significantly below 50 ppm


Source: Tetra Tech, 2018


Photo by: R. Feeney (Tetra Tech)

Handling TSCA Sediment

- TSCA filter cake disposal
  - Local Subtitle-D landfill permitted to accept waste with up to 50 ppm PCB, regardless of characterization
  - Required permit modification
  - Dewatered filter cake from TSCA-delineated sediment has been carefully monitored, with no exceedances to date
- Resulted in significant cost savings of approximately $1.4 million

Refined Delineation

Adaptive Management and Lessons Learned

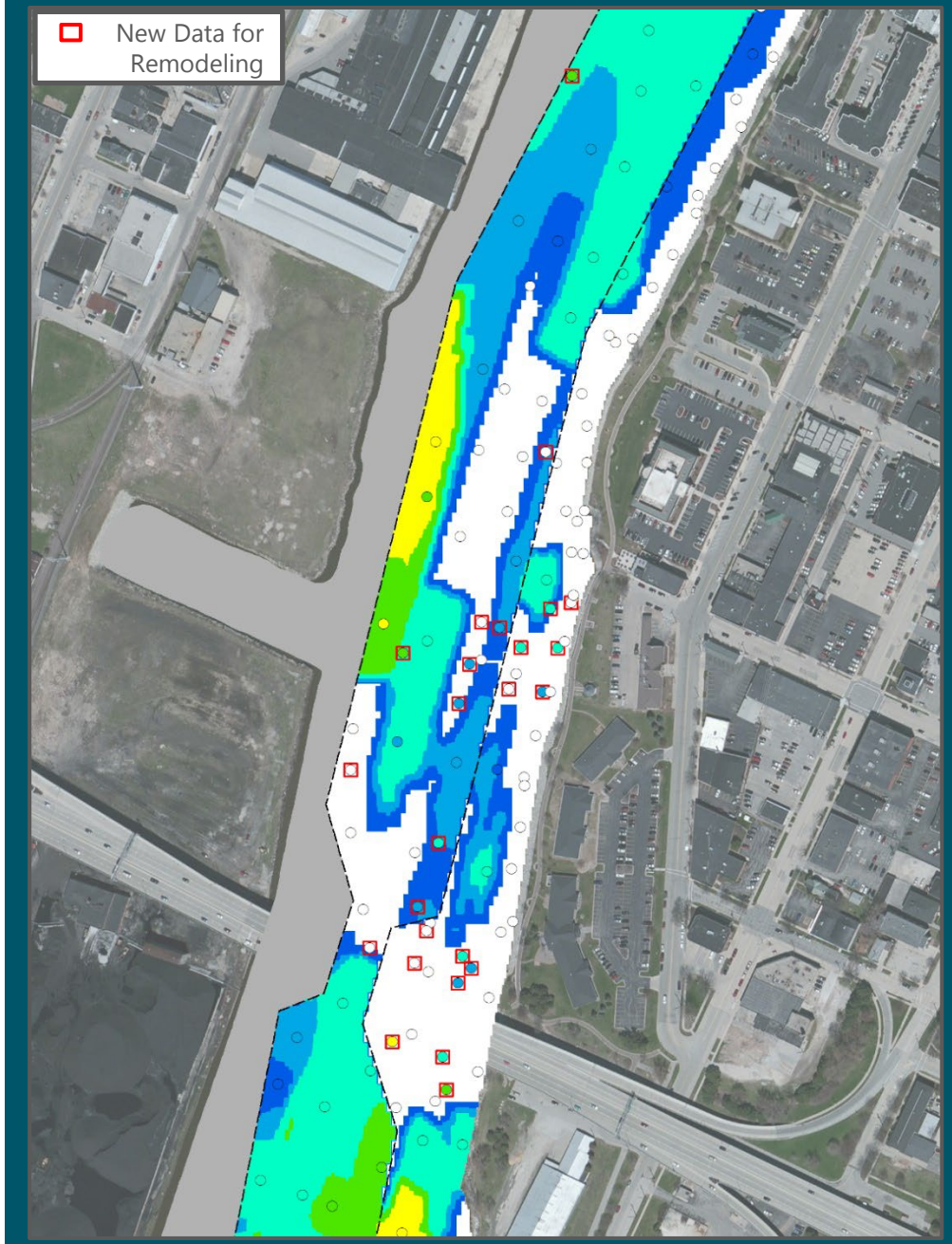
Refined Delineation

- Objective
  - Minimize removal of non-target sediment
- Approach
  - Geostatistical modeling to delineate neatline target dredging surface
  - Infill and design refinement sampling to improve delineation
- Infill sample locations
- Design refinement sample locations
- Able to target specific depths for processing
  - Results in cost and schedule savings

Source: Anchor Environmental, 2004

Refined Delineation

- Infill and design refinement sampling used to remodel geostatistical neatline
- Revised remedial design presented in annual work plans
- 100% Design based on approximately 3,600 sample locations in OU 4
- By the end of the 2020 construction season, design was based on >8,000 sample locations in OU 4



Source: Anchor QEA, 2015

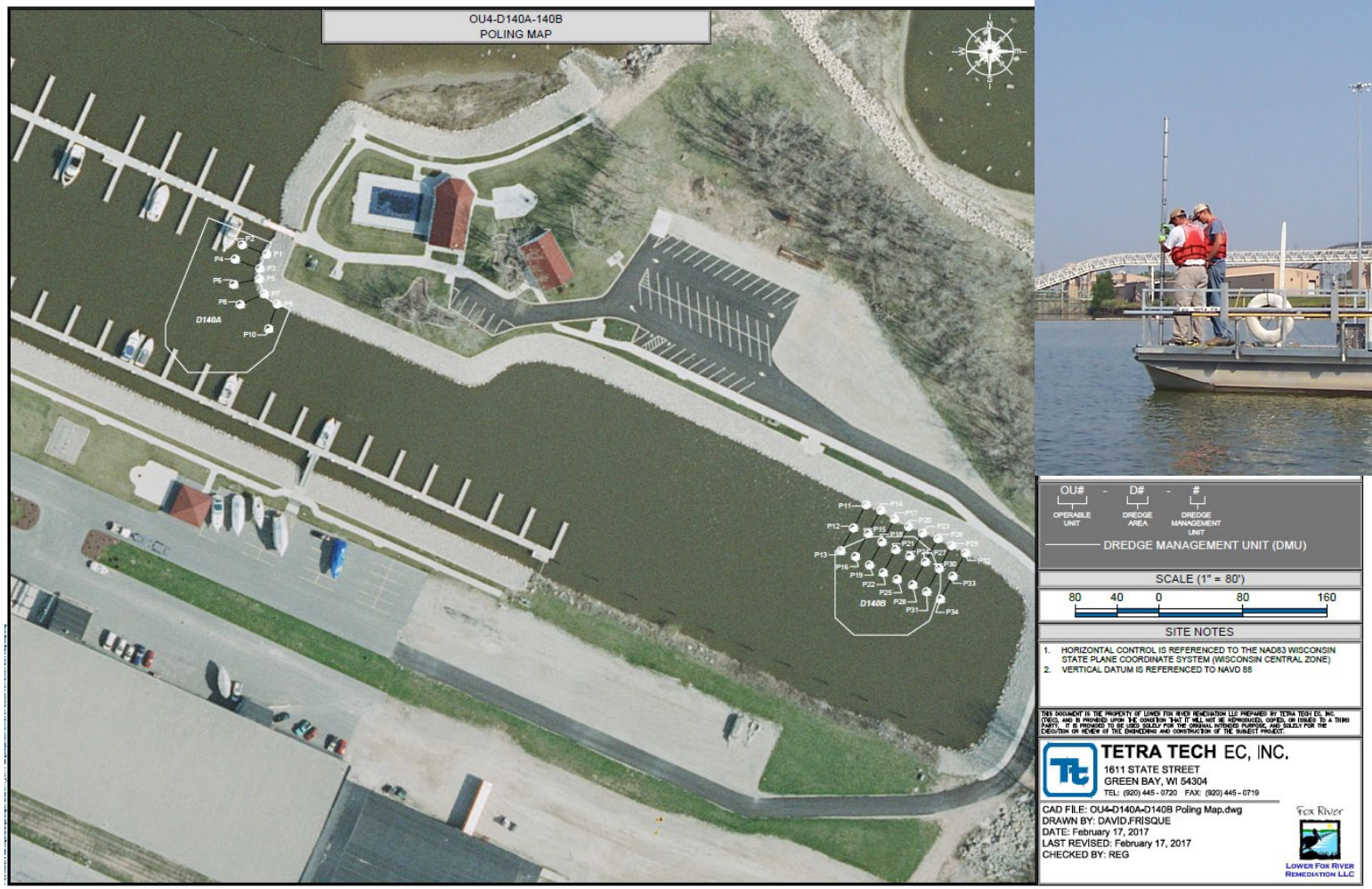
High Subgrade

Adaptive Management and Lessons Learned

High Subgrade

- Objectives
  - Minimize dredge of “clean” materials
  - Avoid dredging clay that is problematic for dredging and dewatering
- Approach
  - High subgrade noted in field by dredger
  - Manual poling: ≤0.3 foot of advancement indicates high subgrade
  - 1-foot cores collected to confirm presence of clay
  - Minimum of six sample locations per 0.5 acre

High Subgrade



Source: Anchor Environmental, 2006

ANCHOR QEA TETRA TECH BOLDT Foth

Remediation Adjacent to Uplands or In-Water Structures

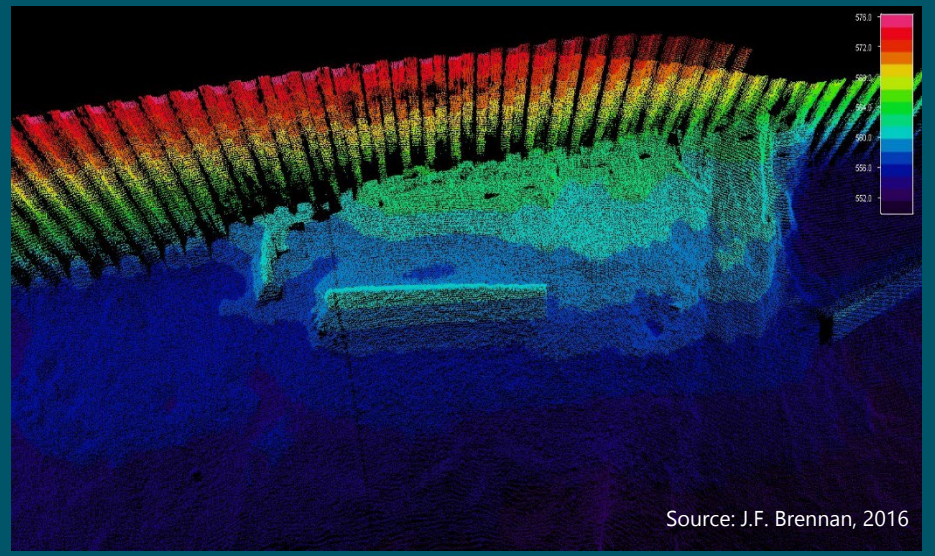
Adaptive Management and Lessons Learned

Remediation Adjacent to Uplands or In-Water Structures

- Objective
  - Remove contaminated sediment to the extent possible adjacent to shorelines and structures
- Approach
  - Site-specific evaluations of stability
  - Remediation offsets
  - Improvements or replacements, if warranted

Remediation Adjacent to Uplands or In-Water Structures

- Temporary removal of surcharge loads on the adjacent uplands
- Installation of clean post-dredge buttress
- Installation of new steel structural members
- Temporary excavation behind sheet pile walls



Source: J.F. Brennan, 2016


Source: J.F. Brennan, 2016

Remediation Adjacent to Uplands or In-Water Structures

Temporary removal of surcharge loads on adjacent uplands

Remediation Adjacent to Uplands or In-Water Structures


Source: Tetra Tech, 2018

Source: J.F. Brennan, 2018

Installation of clean post-dredge buttress

Remediation Adjacent to Uplands or In-Water Structures

Source: J.F. Brennan, 2018


Source: J.F. Brennan, 2018

Installation of steel structural members

ANCHOR QEA TETRA TECH BOLDT Foth

Remediation Adjacent to Uplands or In-Water Structures

Installation of steel structural members

Remediation Adjacent to Uplands or In-Water Structures

Excavation behind sheet pile walls and removal of upland surcharge load

Submerged Utilities

Adaptive Management and Lessons Learned

Submerged Utilities

- Objective
  - Remediate near submerged utilities
- Approach
  - Determine accurate location
    - Research
    - Dig Safe
    - Field locating
    - Remote sensing
  - Design modifications


Photo by: Central Brown County Water Authority, 2011

Submerged Utilities

- Field Locating via remote sensing
  - Primarily performed by DoC Mapping, LLC
  - Electromagnetic tracing conducted using submerged towfish
  - Provides 95% confidence level of utility elevation and horizontal location

Lower Fox River – Operable Unit 4B

Submerged Utility No. 043 Plan View

Submerged Utilities – Design Modifications

- 100% design
  - 25- to 50-foot offset depending on utility
- Refined design during construction
  - Minimum 5-foot vertical and horizontal offset from the standard deviation zone with 95% probability
  - Capping, sand cover, or no action within offset zone
  - Coordination with utility owner and in some cases the USACE
- Modifications to dredging
  - Dredging outside of offset zone
  - Use of spudded guide barge to safely straddle utility
  - Use of excavator with mounted dredge head
  - Open-suction dredging with diver assistance
  - J.F. Brennan's patented VIC VAC dredge head

Submerged Utilities

J.F. Brennan's VIC VAC includes flexible agitating tines to allow for increased productivity in areas of dense sediment

Submerged Utilities

- Modifications to capping
  - Within the offset zone around utilities, use of specially designed caps (SRA Caps)
    - Maintain federal navigational channel depths and width restrictions including buffers
    - Commercial vessel propeller wash considerations
  - Variable thickness sand isolation caps, some amended with carbon, with gravel armor where applicable
  - Assumes that portions will mix with underlying sediment to reduce concentrations

Conclusions

- Incorporating lessons learned was valuable for streamlining design and construction
- Minimized uncertainty in designs
- AM/VE resulted in overall cost and schedule savings
- Frequent communication shown to be critical to success
- Over-the-shoulder reviews beneficial
- Included focus on worker safety
- Not every idea worked, but the project team was able to modify on the fly due to the AM/VE process

Questions

- Terri Blackmar, PE
- Paul LaRosa, PE
- Daniel Binkney
- Denis Roznowski, PE
- George Berken