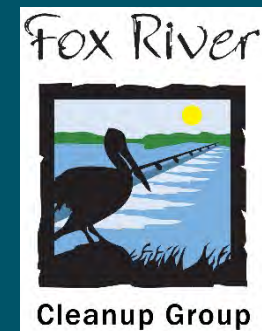




Lower Fox River Remediation History and Background of OUs 2-5 Design and Implementation

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Richard Feeney, P.E. and Terri Blackmar, P.E., Tetra Tech, Inc.

WODCON XXI
June 13-17, 2016



Presentation Overview

- History and Background
- Components of the Remedy
- Contracting Method
- Cultural Resources
- Riparian Property Owner Coordination
- Remedy Selection Tools
- Constructible Designs
- Submerged Utilities
- Construction Integration
- Engineering During Construction

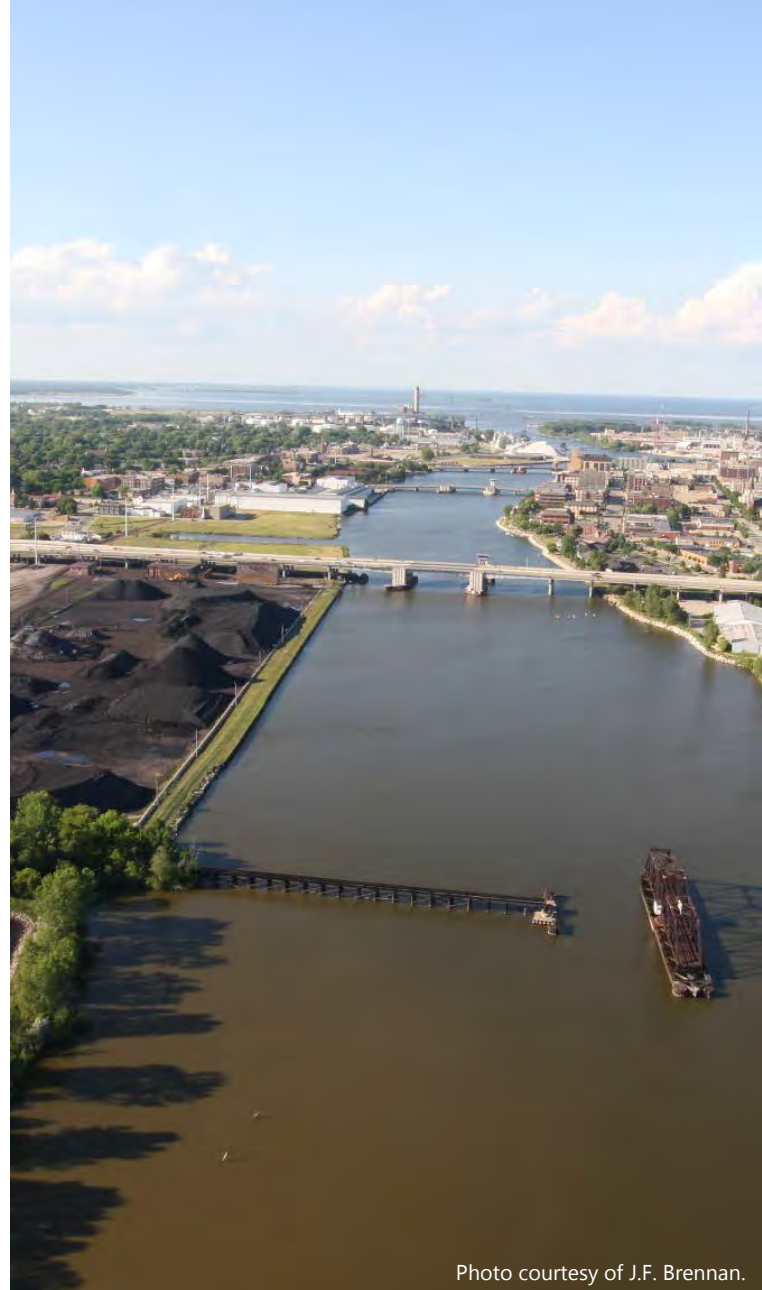


Photo courtesy of J.F. Brennan.

History and Background

History and Background

- Lower Fox River
 - Located between Appleton and Green Bay, Wisconsin
 - Client: Lower Fox River Remediation LLC
 - Agencies/Oversight Team: USEPA, WDNR, industry firms
- History
 - Home to 24 historical and active paper and pulp mills
 - PCBs released into river between 1950s and 1970s
 - Fish Advisory since 1976

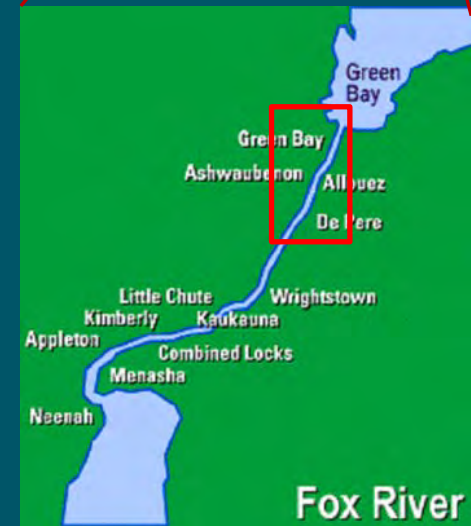
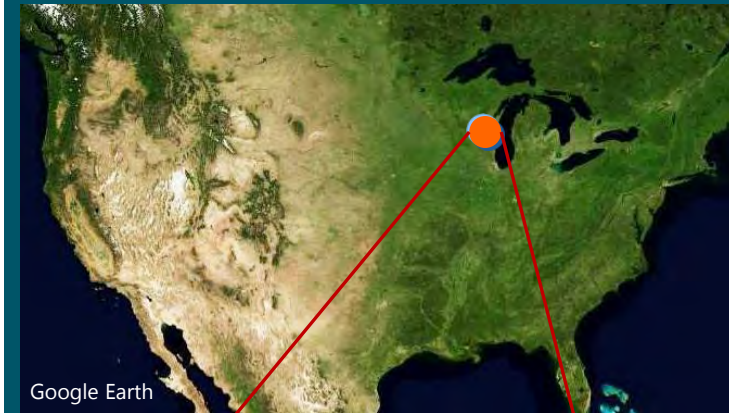


Image courtesy of Wisconsin DNR.

History and Background

- Remediation of the Lower Fox River
 - Record of Decision (ROD) issued in 2003
 - ROD Amendment issued in 2007
 - Unilateral Administrative Order (UAO) required start of full-scale remediation by May 2009
 - 11,000+ sediment cores collected for remedial design



Components of the Remedy

Components of the Remedy

- Dredging
 - Neatline with variable cut thickness
 - Some dredge-and-cap areas
- Engineered capping
 - 13 to 33 inches thick
 - Site-specific shoreline caps
- Sand cover
 - 6 to 9 inches thick

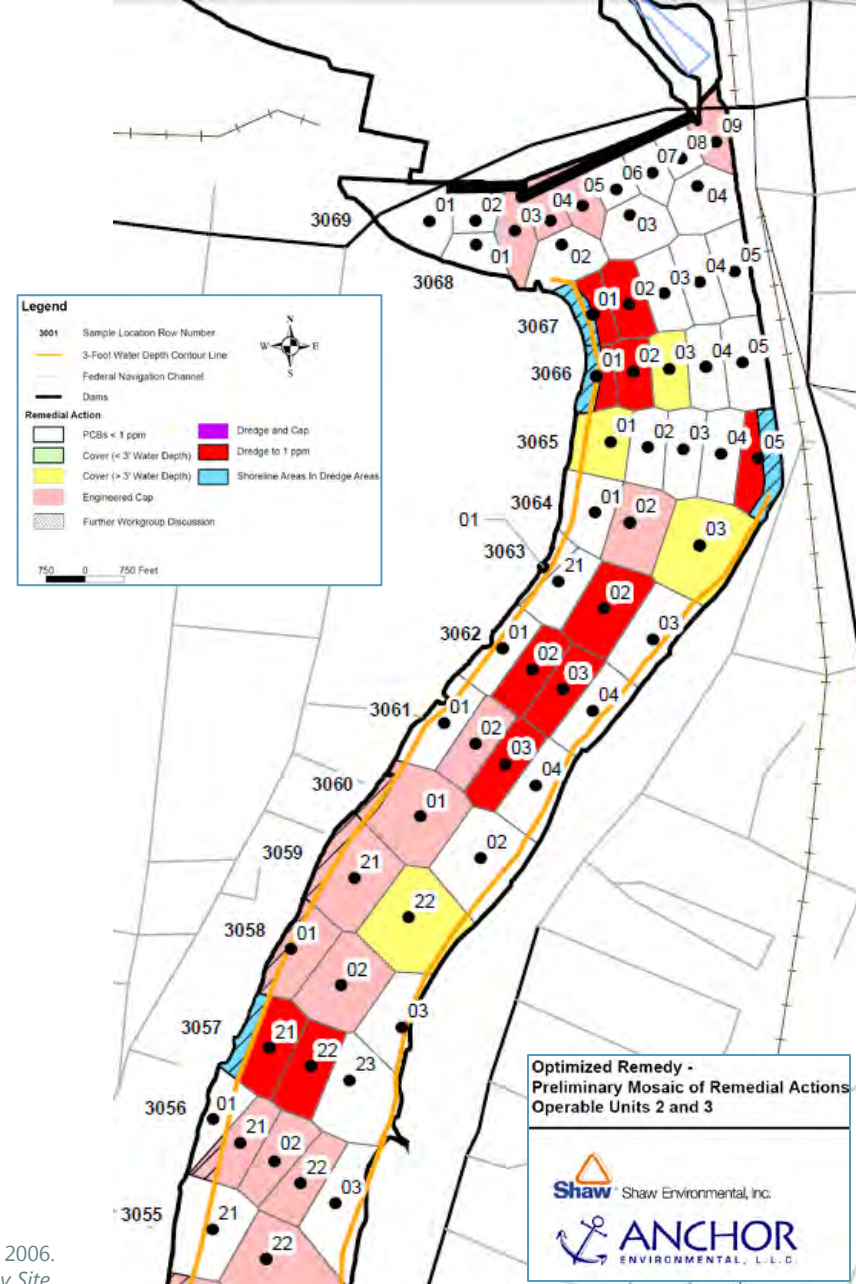
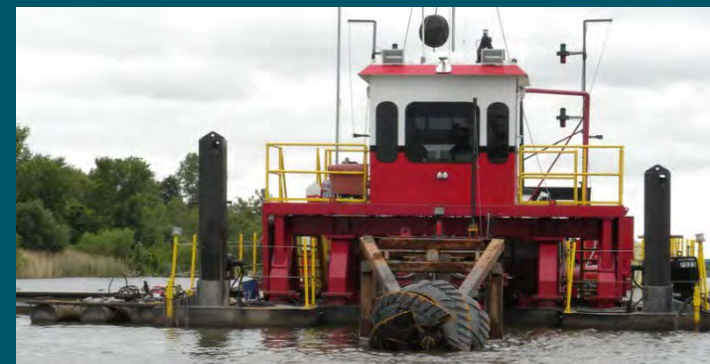


Figure courtesy of Shaw Environmental and Anchor Environmental, 2006.
Final Basis of Design Report, Lower Fox River and Green Bay Site.

Contracting Method

Contracting Method

- Design-build
- Lead contractor:
Tetra Tech EC, Inc.
 - Subcontractors:
 - Construction: J.F. Brennan Company, Inc.
 - Sediment Processing: Stuyvesant Projects Realization, Inc.
 - Engineering: Anchor QEA, LLC and Tetra Tech CES
- Quality assurance:
Foth Infrastructure & Environment, LLC



Cultural Resources

Cultural Resources

- Timely identification of historically significant items is critical
- Accommodation options
 - Exclude area from remedial action
 - Alternate remedy
 - Remove/rebuild/relocate
 - Scale model representation
 - Interpretive display for memorialization



Cultural Resources

Shipwrecks of Fox River

Unearthing the Story of Green Bay's Shipping Heyday

For more than three-quarters of a century, the workhorses of Green Bay's early shipping days lay sunken in the Fox River Ship Graveyard. These ships had been the lifeblood of Green Bay's economy in the late 1800s and early 1900s. But by 1936 they had all been abandoned, left to slowly sink into the river along with the pier to which they were moored.



The Fox River Ship Graveyard Archaeological Site, with six of ten shipwrecks visible



Propeller guard and hull skeg, from one of the tug vessels, stern view.



Scow-dredge No. 004, built in 1884 in the U.S. and abandoned in 1906. A similar vessel was located at the site. Photo taken late 1800s to early 1900s.



Similar to tugboats found at the site, two tugboats (Bob Teed and Bountin) towing a barge circa 1900.

Old and Out of Business

Some may have been old and beyond repair. Some were probably put out of business by the Great Depression. Perhaps some were replaced by the new steel ships that could haul more and heavier cargo. For whatever reason, these ships disappeared, but their legacy emerged after almost 80 years.



Riparian Property Owner Coordination

Riparian Property Owner Coordination

- Early and frequent communication is vital
- Commercial or industrial riparian property owners have operational requirements
 - Vessel draft for berthing and maneuvering
 - Future use of properties
 - Potential future environmental liabilities
- Caps adjacent to commercial properties are subject to owner review and acceptance

Riparian Property Owner Coordination

- Challenges due to deteriorated bulkheads and unstable shorelines

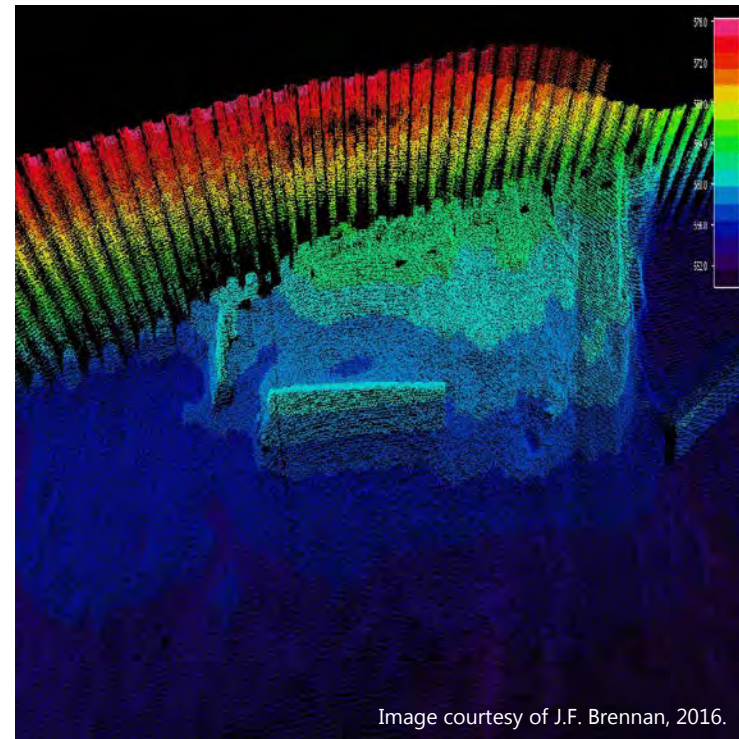


Image courtesy of J.F. Brennan, 2016.

Remedy Selection Tools

Remedy Selection Tools

- Main factors for remedy selection
 - Sediment PCB concentration
 - Surficial and at depth
 - Thickness of PCB contamination
 - Post-construction water depths (including navigation channel considerations)
 - Cost
 - Riparian owner operations, acceptance, and future use
 - Stability of adjacent shoreline and in-water structures
 - Stability of caps
 - Propeller wash
 - River hydrodynamics
 - Consolidation of cap and underlying sediment
 - Ice and other erosive forces

Remedy Selection Tools

- Main factors for remedy selection (cont.)
 - Presence and depth of submerged utilities
 - Presence of cultural artifacts
 - Location relative to federal navigation channels and turning basins

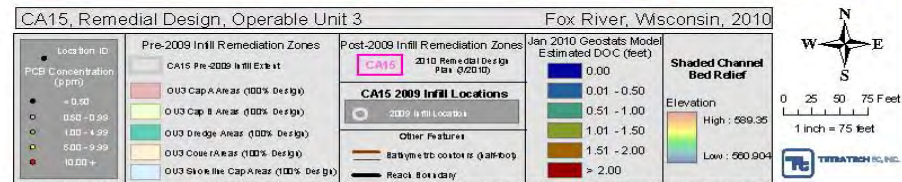
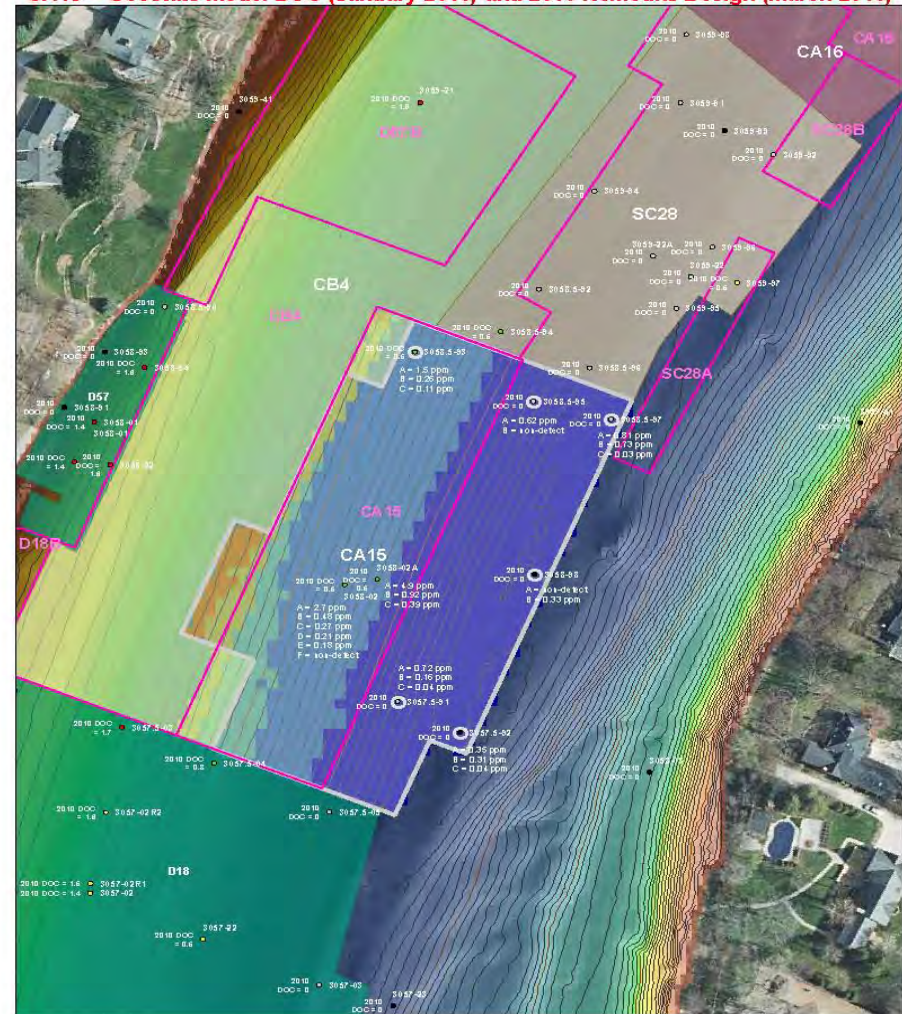


Figure courtesy of Tetra Tech, 2010.

Constructible Designs

Constructible Designs

- Geostatistical modeling delineates the dredging design surface
- Model surface requires occasional manual overrides
 - New data
 - Elevation or depth-based prisms
 - Pre-cap surfaces (water depth consideration)
 - Transition slope corrections

Image courtesy of J.F. Brennan, 2013.

Submerged Utilities

Submerged Utilities

- Initial step is research
- Collect as-built plans from owners
- NOAA/USACE maps
- Information on abandoned and active utilities
- Dig-Safe
- Specialized field location for hazardous or unknown utilities
 - Remote sensing technologies



Photo courtesy of Central Brown County Water Authority.

Submerged Utilities

- Submerged utilities can present a significant risk to remedial activities
- Negotiation of alternate remedies where significant risk exists
 - Capping, sand cover, no action
 - Diver-assisted dredging

Construction Integration

Construction Integration

- Hydraulic dredging requires extensive sediment processing facility
- Typical dredging production rate: 115 in situ m³/hour (150 in situ cy/hour)
- Sediment processing includes:
 - Scalping of oversized material
 - Sand separation
 - Sediment de-watering
 - Water treatment
 - Filter cake management
 - Sand beneficial reuse



Construction Integration

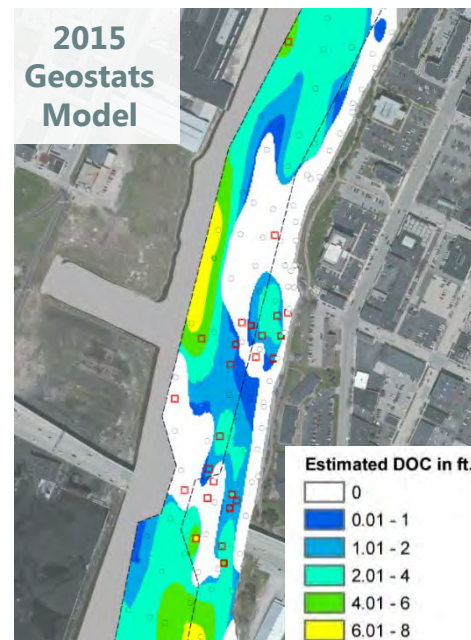
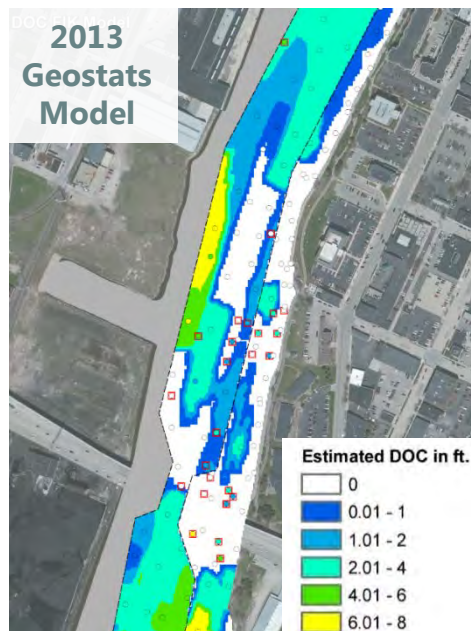
- Typical water treatment production rate:
19,000 liters/minute
(5,000 gallons/minute)
- Offsite transportation and disposal of filter cake
- Typical disposal operation includes more than 100 haul trucks per day, transporting 2,268 metric tons/day (2,500 short tons/day)



Engineering During Construction

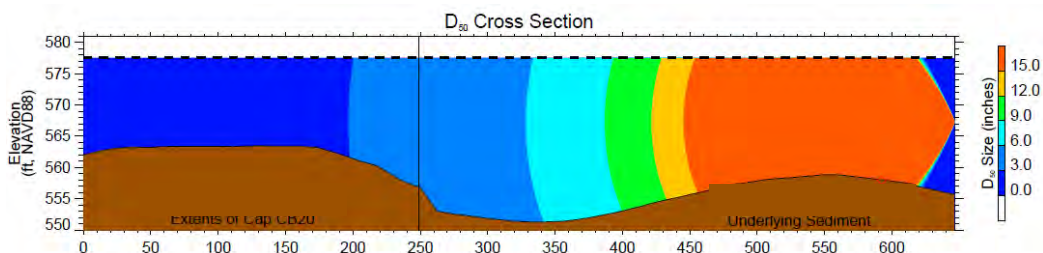
Engineering During Construction

- Additional “design refinement” sampling has been conducted since 100 Percent Design and continues
- Localized remodeling to refine extent of contamination



Engineering During Construction

- Toxic Substances Control Act (TSCA) areas
- Manual overrides of geostatistical models
- Site-specific shoreline or riparian property owner designs
- Post-dredge residuals management
- Cap armor stone refinement





Questions?

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