

7 YEARS BENEFICIAL REUSE OF SAND LOWER FOX RIVER REMEDIATION PROJECT

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Project Overview

- **Combination Remedy:** designed to reduce risk to human health & environment caused by presence of PCBs in the river sediments
- **Scope:** fast track design-build of dredging, desanding & dewatering, water treatment, capping/covering, transportation & disposal
- **Size:** remains one of the largest environmental/sediment remediations in the world; Lower Fox River Operable Units 2-5 → 21.4 kilometer (13.3 mile) stretch of the river.



Project Team

- ❖ **Client:** Lower Fox River Remediation LLC

- ❖ **Regulatory agencies:**
 - ❖ United States Environmental Protection Agency (USEPA)
 - ❖ Wisconsin Department of Natural Resources (WDNR)
 - ❖ The Agencies/Oversight Team (A/OT) – consultants for USEPA & WDNR

- ❖ **General Contractor:** Tetra Tech EC, Inc. (design, construction, and operation of the wastewater treatment plant)

- ❖ **Subcontractors:**
 - ❖ J.F. Brennan Company, Inc. (dredging, capping and sand covering)
 - ❖ Stuyvesant Projects Realization Inc. with engineering & equipment from Dutch sister company, Boskalis Dolman (sediment desanding and dewatering)

- ➔ **Integrated Approach** = seamless integration of all aspects of the work by all parties

- ➔ **Memorandum of Understanding** = defines scope/“ownership” and methods for collaboration and conflict prevention/resolution among Tetra Tech, Brennan and Stuyvesant

Why Separate Sand?

- 1) Avoid unnecessary transportation & disposal (T&D) cost;
- 2) Produce a product that can possibly be beneficially reused, thereby conserving valuable landfill space; and,
- 3) Prevent additional wear and tear on downstream processing equipment.



Project Approach

Early Contractor Involvement

Key benefits:

1. Identify data gaps & how best to fill them to enhance design
2. Apply proven field implementation experience & lessons learned
3. Ensure the constructability of remedial alternatives

Sediment Testing Program

Necessary components:

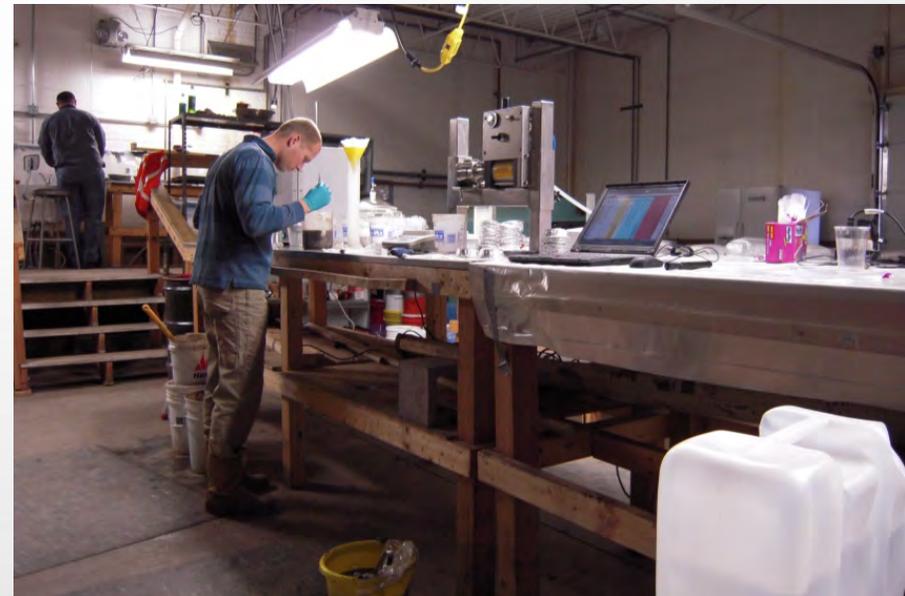
1. Review available sampling info;
2. Sampling plan (*important to note when debris & oily waste are encountered);
3. Chemical analysis;
4. Geotechnical testing; and,
5. Desanding & Dewaterability testing (*simulate “real world” conditions).



Geotechnical Testing

Parameters to test include:

- ✓ Density (*in situ*);
- ✓ Dry solids (water content);
- ✓ Organic content (Loss on ignition);
- ✓ Particle Size Distribution (using a method that takes into account the presence of organics such as Protocol BS 1377 "Methods of test for soil for civil engineering purposes"; 1990; British Standard Institute);
- ✓ Clay content; and,
- ✓ Atterberg limits.



Desanding & Dewaterability Testing

Both lab-scale & onsite pilot tests were performed:

- ➔ Including separation of the coarser fraction (debris, gravel and sand) to simulate full-scale processing;
- ➔ To establish the size, number & type of filter presses, most suitable filter cloths; and,
- ➔ In collaboration with local labs, filter press & polymer manufacturers.

Equipment used:

- Jar test equipment at a local lab facility;
- Lab-scale dewatering using benchtop plate & frame filter press to simulate mechanical forces on the sediment; and,
- Plate & frame membrane filter press simulator.



Results of Testing

Data from sediment testing program enabled:

- Analysis of all sediment types;
- Development of mass balance → estimate the total amount of sand and fines to be produced during full-scale remediation;
- Selection & sizing of appropriate sediment processing approach and equipment (*along with estimated dredge production rate → to avoid operational constraints); and,
- Evaluation of reuse and disposal options & costs.



Design

The design of the Sediment Desanding and Dewatering Plant (SDDP) for the Lower Fox River sediment remediation project included four major unit operations:

1. Feed system;
2. Sand separation;
3. Chemical addition; and,
4. Mechanical dewatering.



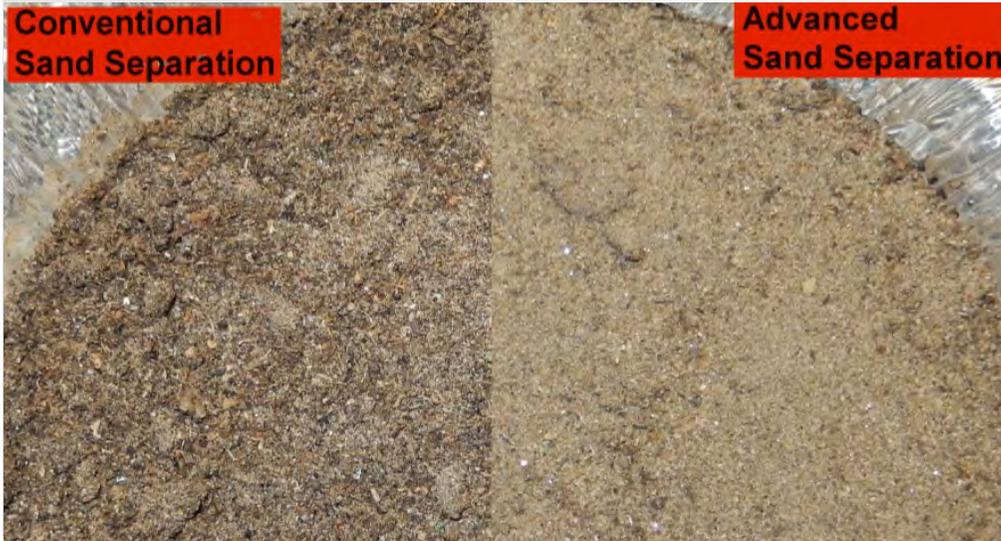
Advanced sand separation

Scalping screen > 6 mm

Sand separation, 2 cut points 150 μ m and 63 μ m

Our design basis assumed at least 40% sand content in the feed.

Approach based on our extensive experience, the aim for beneficially reusing the sand, and the fact that PCBs typically adhere to organic particles, which are significantly present in the sediments (ranging 12-20% by weight).



Regulatory approval

USEPA's 2007 Record of Decision (ROD) Amendment for the Lower Fox River and Green Bay Site contemplated the beneficial reuse of sand processed at the Site as follows:

“Sediment de-sanding. In general, PCBs tend to adhere to smaller sediment particles (such as silt or some clays) rather than to larger-sized sediment particles (such as sand and gravel). For that reason, the sand fraction of sediment that is removed from the River may be recovered, washed or otherwise treated, and beneficially reused. Thus, under the Amended Remedy, relatively uncontaminated sand and/or gravel may be recovered from dredged sediments, if USEPA and WDNR have approved specific beneficial uses of such sand and/or gravel. The PCB concentration of the recovered sand would generally need to be less than 0.25 ppm before it could be beneficially reused, although USEPA and WDNR may approve an alternate concentration threshold for particular uses. Some examples of potential beneficial uses would be use as partial fill for staging areas, road fill, or daily cover for a landfill. It is estimated that approximately 172,025 cubic meters (225,000 cubic yards) of segregated sand and/or gravel material may be available for potential beneficial reuse under the Amended Remedy.”

Regulatory approval

Timeline:

July 2, 2010 – Tetra Tech submitted project’s 1st Low Hazard Exemption Request to WDNR.

→ The overall procedure for obtaining WDNR approval requires:

- Each request must be for a specific offsite project(s); and,
- Proposed location, use, tons shipped, schedule, analytical & geotechnical data.

Tetra Tech addressed WDNR’s comments & conducted a public hearing

October 18, 2010 - WDNR issued Tetra Tech a “Conditional Grant of Low Hazard Exemption for the Beneficial Reuse of Separate Sand” from dredging non-TSCA sediment.

2011 - Our team began shipping sand from the project.

Timeline (continued):

2012 - WDNR modified the original exemption to extend the expiration date, expand the uses of the material, and relax notification requirements.

2013 - USEPA confirmed that based on input from their Region 5 TSCA program, they had no objection to the proposed beneficial reuses provided that the PCB concentration of the sand is less than 1 mg/kg, however the WDNR amended the PCB limit to match that for sand separated from dredging non-TSCA sediment, a maximum 0.49 mg/kg PCB concentration.

USEPA further clarified that their 2013 approval includes all sand material generated by our project regardless of *in situ* TSCA or non-TSCA designation.

Regulatory approval

Process:

WDNR approval required a test frequency for the separated sand to be reused:

- ✓ One sample per 765 cubic meters (1,000 cubic yard [cy]) for the first 7,650 cubic meters (10,000 cy), beginning each dredge season;
- ✓ Then one sample per 7,650 cubic meters (10,000 cy) thereafter.

WDNR provided the Maximum Allowable Contaminant Concentrations as part of their conditional approval → Table 1(next slide).

Concentrations shown pertain to sand that is not capped in place, and are therefore conservative if applied to sand that will be capped.

Target limit of 0.49 mg/kg established by WDNR as an alternate concentration threshold based on the particular uses.

Therefore, separated sand from all sediment is eligible as beneficial reuse material (BRM) provided it meets the WDNR requirements specified in Table 1.

Regulatory approval

Table 1. Chemical and Geotechnical Characterization Criteria for Separated Sand Beneficial Reuse Projects

Chemical Parameters	Maximum Allowable Contaminant Concentrations (mg/kg, unless otherwise noted¹)
PCB, Total	0.49
Total 2,3,7,8 TCDD	0.19 (ug/kg)
Total 2,3,7,8 TCDF	0.19 (ug/kg)
DDT (and its metabolites DDD & DDE)	1.0
Arsenic	8.0
Barium	500
Cadmium	7.8
Chromium	14.5
Copper	150
Cyanide	100
Iron	20,000
Lead	50
Manganese	1,100
Mercury	4.7
Nickel	250
Selenium	63
Zinc	1,500
Geotechnical Properties	
Total Organic Carbon	Max. 5% by weight
Grain Size analysis, percent moisture/solids content, permeability	Information purposes only

Performance to date

Table 2. Average PCB concentration in sand for beneficial reuse

Average PCB Concentration (mg/kg) vs. target of 0.49 mg/kg	2009	2010	2011	2012	2013	2014	2015
Fine sand (63 µm to 150 µm)	0.266	0.184	0.137	0.101	0.088	0.085	0.198
Coarse sand (150 µm to 6 mm)	0.353	0.113	0.075	0.079	0.053	0.063	0.191
Running average (combined fractions)	0.280	0.148	0.100	0.091	0.075	0.075	0.196

Note: these numbers represent test results from all produced sand during each specific operational season, dredged from both TSCA and non-TSCA designated areas. The running average is not the result over the entire 7 years.

It is of interest to note that approximately 90% of all sand separated from dredged sediment during the 7 years of project operations has been beneficially reused.

Logistics

- Public works such as infrastructure projects are preferred for such beneficial reuse opportunities, and WDNR does not require public hearings as part of approval process.
- Sand from our project has been shipped to various reuse locations including several construction sites managed by the Wisconsin Department of Transportation (WisDOT).
- Commercial arrangements were made between our client, the local trucking company and the receiving party.
- Tetra Tech implemented tracking & reporting of sand shipments from the Lower Fox River site to the approved reuse sites, and provides annual reports to WDNR on amounts shipped & test results.
- Onsite stockpiles were initially covered with liner. Later replaced by sprayed-on polymer emulsion bonding agent.

WisDOT construction using project sand



Approved sand from Lower Fox River project being used in road base construction

Shawano-US 41 intersection (facing north east)



Production & Lessons Learned

Wide variety in sediment composition:

- Sand content 10% - 80%; average 24%
- Fines content 35% - 95%; average 74%
- Remaining 2% represents the fraction > 6 mm (ranging 0% - 15%)

Sand totals to date:

- ~319,000 metric tons separated;
- ~286,000 metric tons reused hauled offsite to construction projects;
- ~ 33,000 metric tons reused onsite, remainder disposed.

Successfully separated sand meeting regulatory criteria for reuse in local infrastructure projects.

➔ 1st implementation on full-scale contaminated sediment remediation project in the US.

Win-Win for 2 major projects:

- ❖ Client saved substantial cost by not having to transport the sand for landfill disposal;
- ❖ WisDOT benefitted from local sand at no cost (instead of purchasing from commercial sources).

Conclusions

Project success achieved to date on beneficial reuse due to:

- ✓ Experienced project team using the integrated approach;
- ✓ Early contractor involvement, including pre-proposal (2007) sediment testing program;
- ✓ Collaboration with regulatory agencies (2007 ROD Amendment) and other stakeholders;
- ✓ Support of the local community;
- ✓ Operation of advanced sand separation unit; and,
- ✓ Identification of suitable local reuse sites.

Questions?

