Post-Dredging:
Amendment Enhanced Backfill and Reactive Capping
– Case Studies –

WEDA
Western Dredging Association

July 27, 2022

AquaBlok®
Composite Particle System

www.aquablok.com

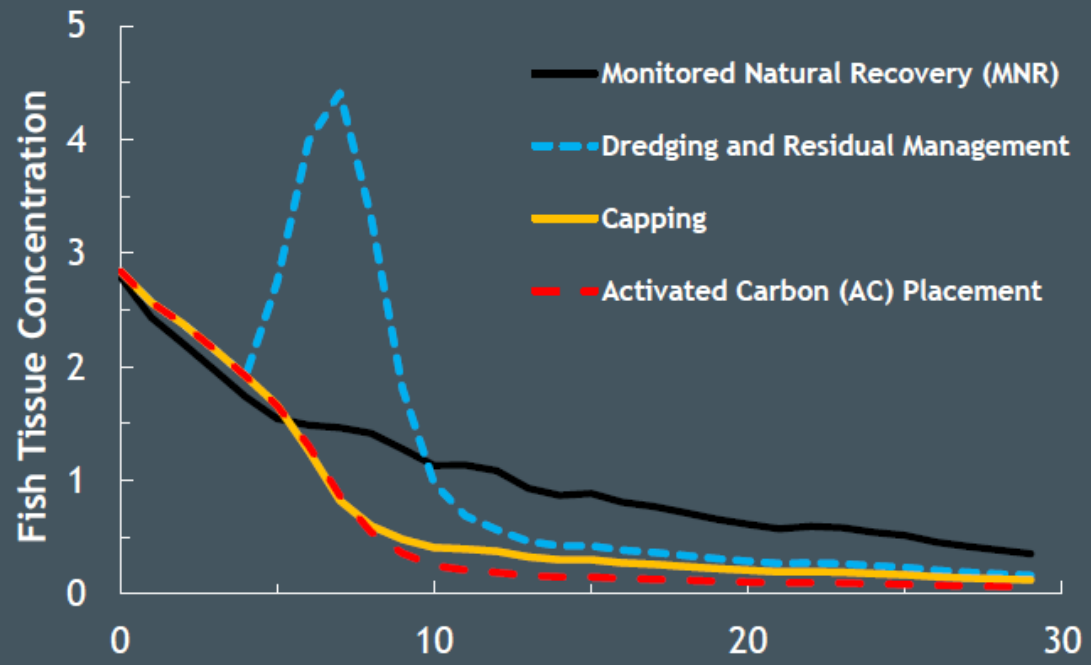
Topics for Discussion

I. Why Amendments – Regulatory Acceptance
II. Background – AquaBlok Technology Platform
III. Case Studies – Three Project Examples
IV. Summary / Questions

Comparison of Sediment Remediation Approaches

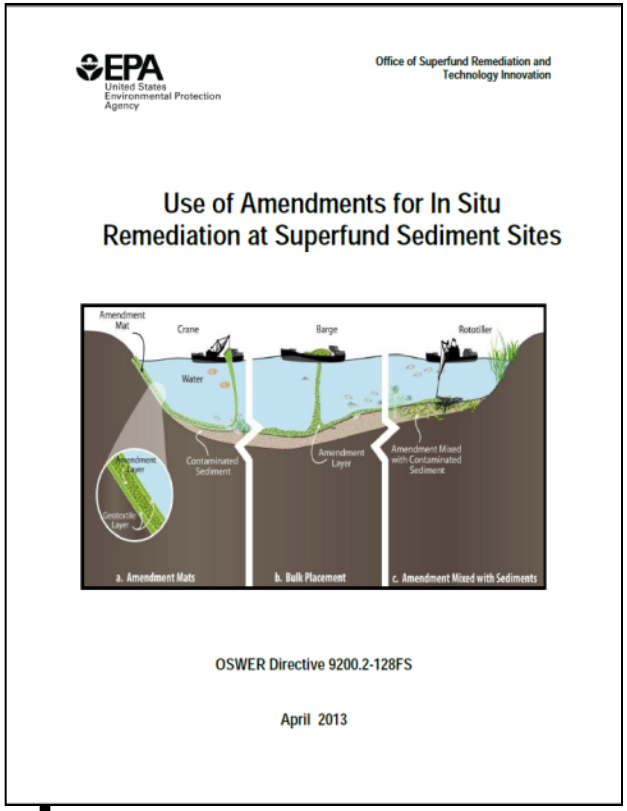
AC Placement Sediment Cleanup Remedy

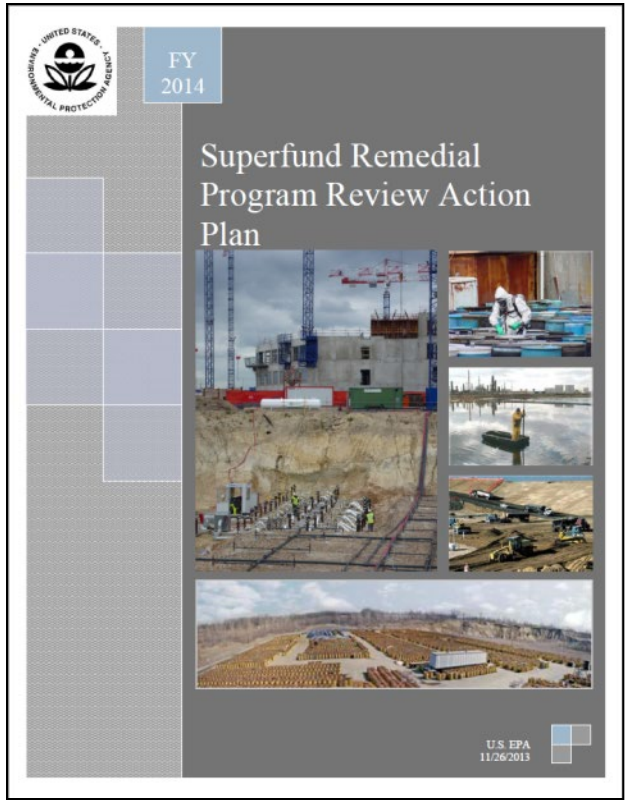
- AC placement has similar or better effectiveness than dredging or capping in low net sedimentation rate environments



In Situ Sediment Treatment Using Activated Carbon . A Demonstrated Sediment Cleanup Technology; et al C*layton R. Patmont*
Integrated Environmental Assessment and Management — Volume 9999, Number 9999—pp. 1–13 Published 2014 SETAC.

Amendments & Acceptance





"The appropriate use of amendments has much potential to limit exposure to contaminants and, thus, to reduce risks."

- Can reduce dredging impacts
- Focused on contaminant bioavailability
- Shorten recovery time
- Less costly and more expedient

What is Driving Progress in Application of Treatment/Active Materials

Improvements by the Academic, Consulting, and Construction

Improved Modeling & Design

- Greater Understanding of Relative Model Impact Sensitivity
- Better Understanding of Treatment/Contaminant Kinetics
- Leads to Greater Confidence in Design → Reduced Dependence on Redundancies

Incorporation of Adaptive Management Principles

- Leads to Less Reliance on "One-shot" approaches
- More Emphasis on Post-remediation Monitoring

Improved Remediation Means & Methods

- Achieving tighter tolerances
- Results in reduced site preparation application/installation costs
- More emphasis on QA/QC

AquaBlok Ltd. Technology Background

Uniform Delivery of

High-Value Materials in Low Quantities

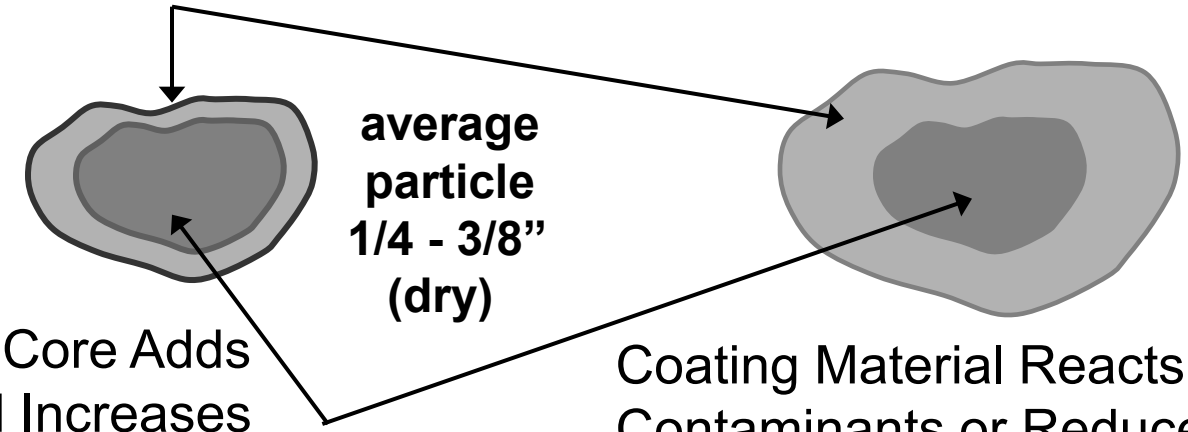
powder coating

+

aggregate core

=

AquaBlok “composite particle”



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Sequestration and/or Treatment

AquaBlok®

- Low Permeability Chemical Isolation Material
- Variable Particle Size & Densities
- High Shear Strength (Erosion Resistance)
- Proven Long-term Performance (Superfund Sites)

AquaGATE+ PAC/Organoclay/Sorbster/Other

- Permeable (Variable)
- Powdered Treatment Amendments
  - Generally Increased Sorption Rate/Reduced Resident Time
  - Higher Surface area
  - Uniform Distribution at Low Levels
  - Targeted Placement within a Composite Cap

Technical Advantages for AquaGATE+ Amendment Placement

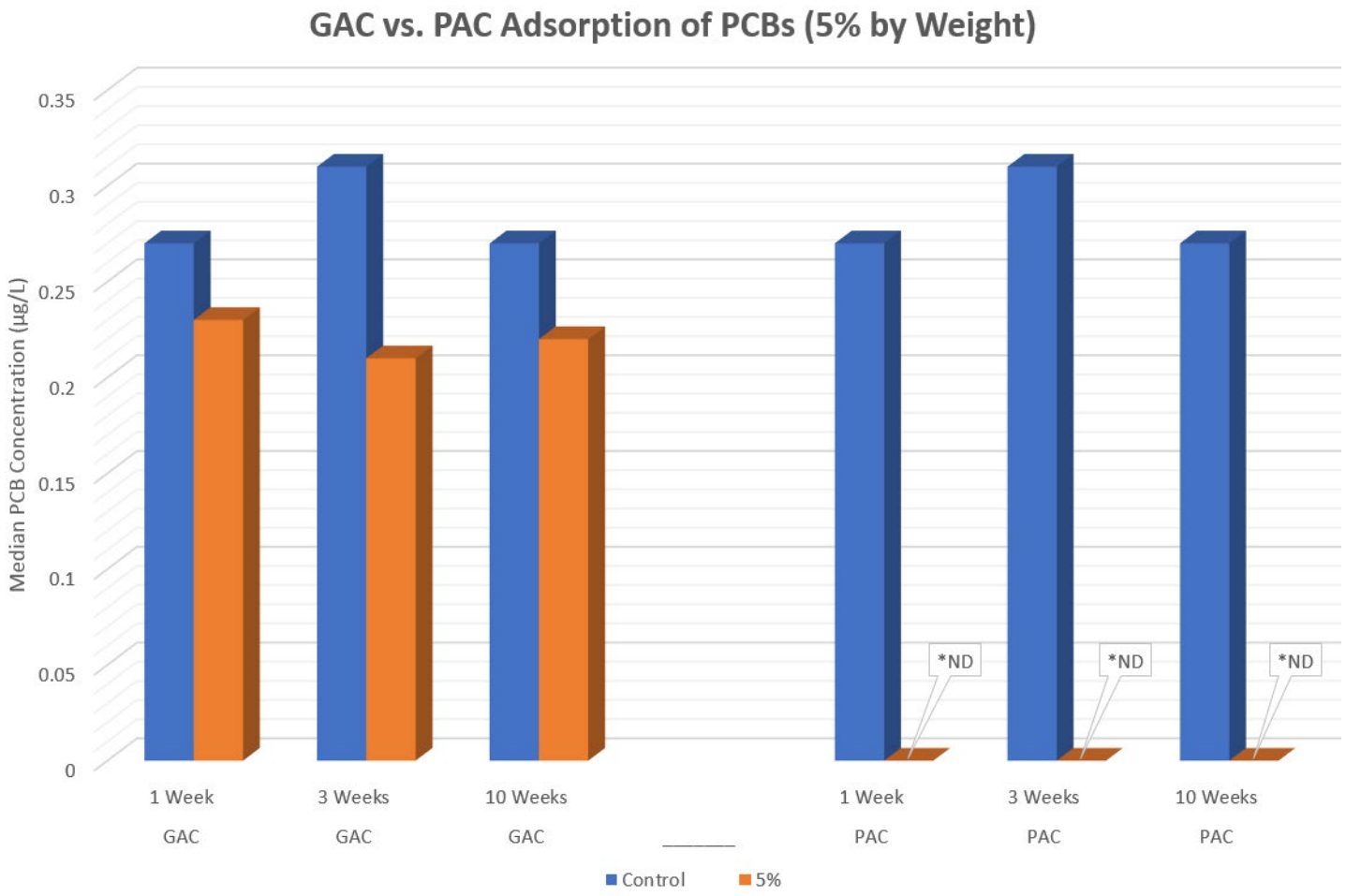
- Allows use of *Powder Materials* – which can provide improved material performance
- High Bulk Density – allows for *placement through deep/moving water*
- *Eliminates Risk of Separation* – compared to mixing bulk materials
- *No Pre-Saturation of Materials Required*
- *Flexible/Rapid Installation* (Low Cost) – using conventional equipment

Performance Considerations: Powder vs. Granular Forms of Activated Carbon

Evaluation of Powdered vs Granular Forms of Amendments for In Situ Sequestration of Sediment Contamination

Matt Vanderkooy, Tom Krug – Geosyntec Consultants
John Hull, John Collins – AquaBlok, Ltd.
Jeff Roberts – SiREM Laboratories

Kinetics vs. Capacity (Equilibrium): GAC Adsorbs Slower and Less PCBs As Compared to PAC over 10 Week Time Frame



Source: Geosyntec - Evaluation of Poweder vs. Granular Forms of Amendment for In-Situ Sequestration of Sediment Contamination (*ND: Non-Detect)

Case Studies

I. *East Branch Grand Calumet River*
II. Passaic River – RM10.9
III. Potrero – San Francisco Bay

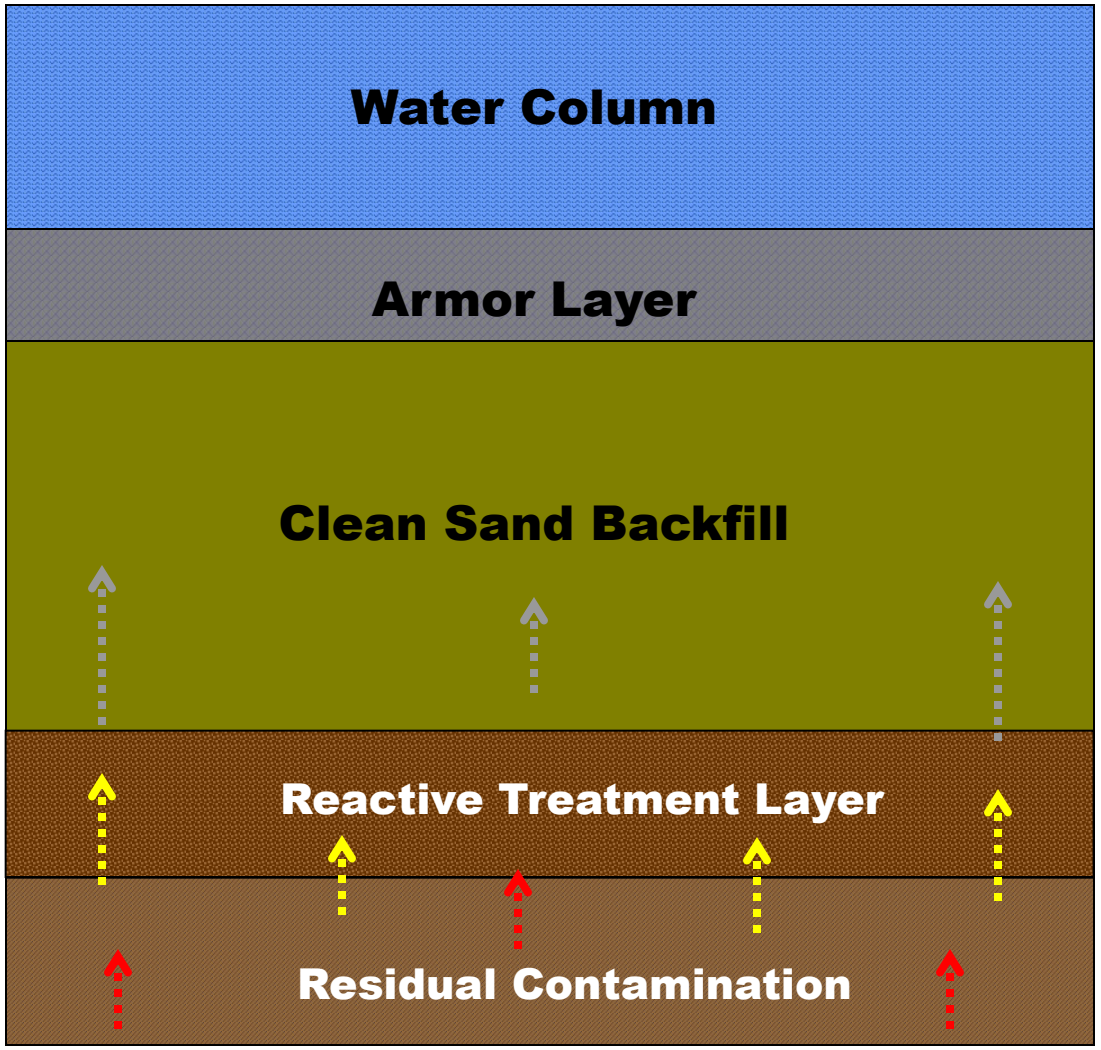
Grand Calumet River
Great Lakes Legacy Act (GLLA) Clean-up
Grand Calumet River Area of Concern

East Branch (Zone B) of the Grand Calumet River:

- **1.8-mile stretch of the river from Indianapolis Boulevard to Holhman Avenue**
- **350,000 cubic yards of sediment were removed**
- **A cap was placed over the dredged sediment.**
- **Near shore habitats were restored with native plants**
- **Completed in 2015.**

Reactive Cap Model & Design Considerations

- Model Assumes *Uniform Distribution* of Organoclay within Layer
- Thickness = *Residence Time* for Adsorption (Hydrologic Conditions)
- Adsorption Capacity of Organoclay *Expressed by Partition Coefficient*
- Adsorption Capacity Must Protect from Possible *Isolated Seep Zones*
- Material Approach Must Allow for *Reduction in Permeability* Due to Swell of Organoclay



not to scale

Data to Develop & Run Cap Model

- Contaminant characteristics
  - Site specific data
- Sediment characteristics
  - Site specific data
- Active layer characteristics
  - Material characteristics (study/literature based data)
- Conventional cap characteristics

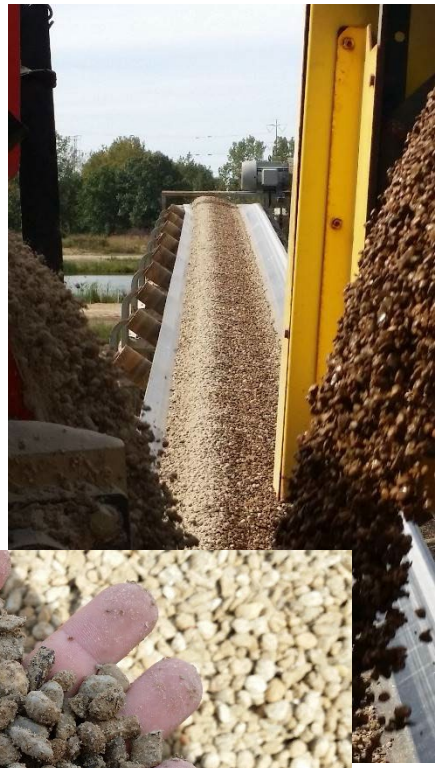
TABLE 1B
DESIGN SPECIFIC MODEL INPUTS

Material Property	Value	Unit
Effective adsorption partition coefficient (K_d)*		
Area A (STA 5+54 to STA 55+00)	19,950	L/Kg
Area B (STA 55+00 to STA 95+15)	39,810	L/Kg
Active layer thickness		
Area A (STA 5+54 to STA 55+00)	10.14	cm
Area B (STA 55+00 to STA 95+15)	10.14	cm
Active adsorbent loading		
Area A (STA 5+54 to STA 55+00)	4.1	kg/m2/cm
Area B (STA 55+00 to STA 95+15)	1.37	kg/m2/cm

TETRA TECH

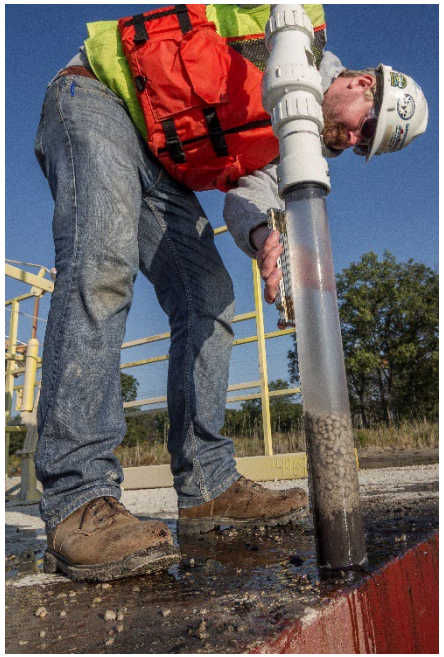
J.F. Brennan – Broadcast Capping System (BCS™)

- Able to accurately place over soft sediment with limited intermixing
- Limits resuspension of in-situ sediments
- Onboard tracking system records thickness, volume, and position of material placement
- Can accurately spread materials in very thin lifts, while achieving even distribution.



Post-Placement Confirmation of Active Material Design Characteristics: Conclusions

- Ability to ***confirm the quantity of high-value amendment material*** (organoclay coating weight) being supplied and placed.
- ***Confirmation of material placement assumptions*** such as bulk density (*determines layer thickness*) which is critical to demonstration that this key design parameter is met.
- ***Verification of uniform distribution*** of active-treatment materials is achieved through the thickness of the capping layer.
- Enables ability to perform post-placement confirmation of active-treatment material testing of ***adsorption capacity*** (partition coefficient) that satisfies the specification.
- ***Modeling assumptions can be confirmed*** through comparison of input/assumptions to post-placement physical and material property data.
- Results can support modeling assumptions and be used to ***reduce costs associated with excessive factors of safety*** due to lack of certainty of achievement of a design / specification as well as the ability to provide post-placement verification.



Full-scale verification of quantity and post-placement material properties relative to project objectives

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Case Studies

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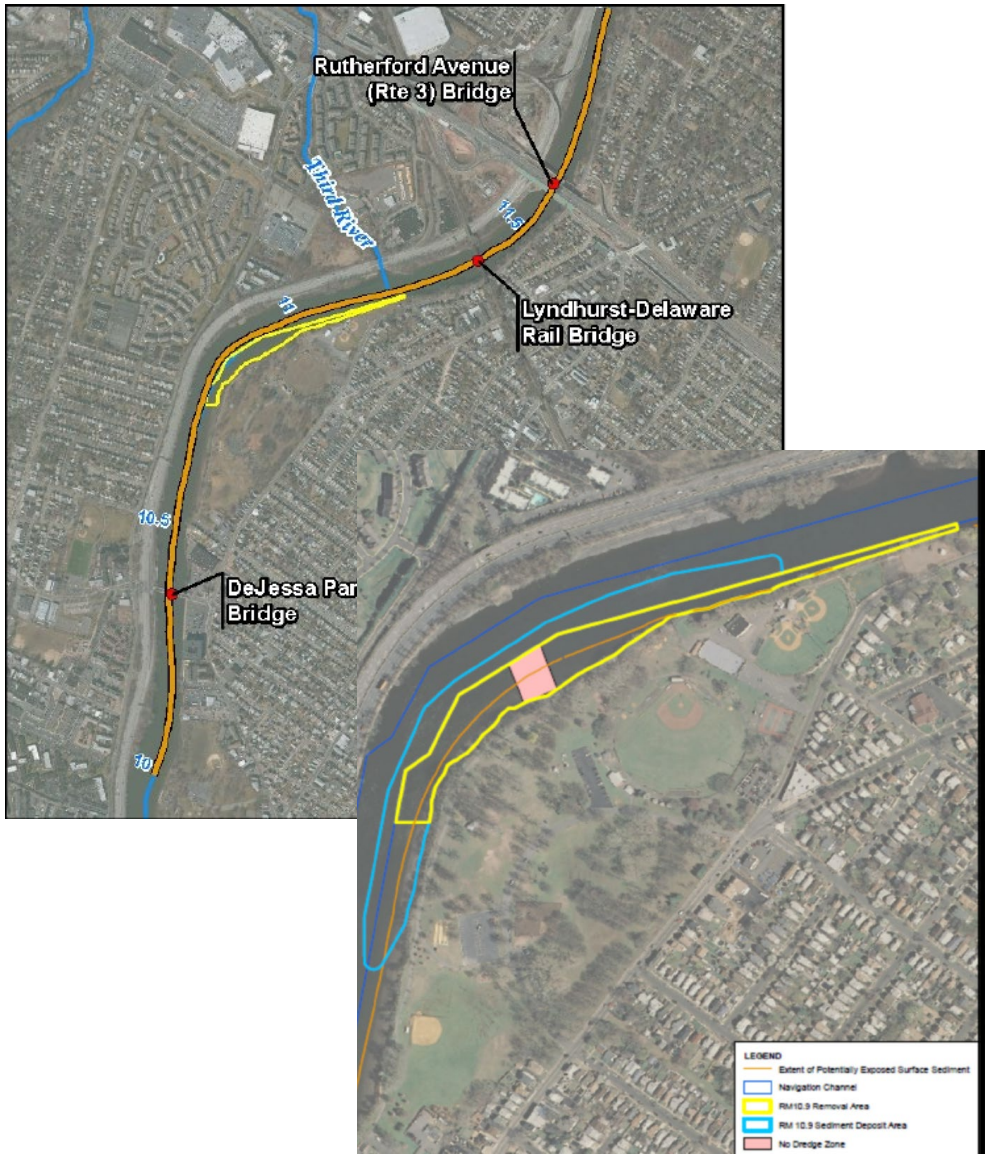
III. Potrero – San Francisco Bay

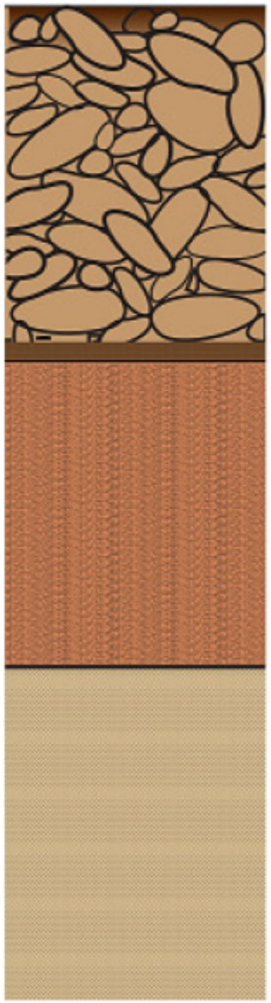
Passaic River (RM 10.9) Active Cap

In 2012, EPA signed an agreement with 70 companies to remove 1,5000 CY of contaminated sediment from a mudflat adjacent to Riverside Park in Lyndhurst, New Jersey followed by placement of a 5.5 acre amended cap. Monitoring is to be performed until a final remedy for the river is selected and implemented.

The specification and design for the amended cap was determined based on modeling that indicated a loading requirement for activated carbon mixed with a sand/aggregate layer.



Reduction in Dredge Volume from Application of Passaic River (RM 10.9) Active Cap



Thin Sand Layer

12-inch-thick Type A Armor Layer (D50 = 4.5 inches)

Geotextile

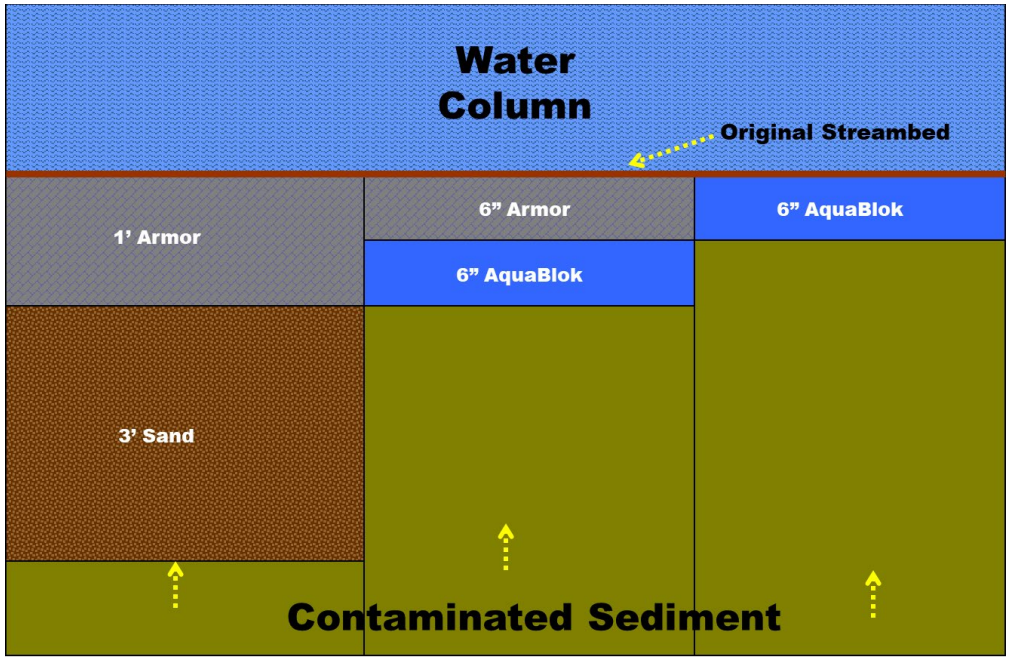
10-inch-thick Active Material/Sand Mixture

Post-dredge Sediment

RM 10.9 Design

Dredging of approximately 2 feet of sediment

Placement of an approximate 2 foot cap



6,400 CY/Acre

1,600 CY/Acre

800 CY/Acre

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Passaic River (RM 10.9) Active Cap

Powder Activated Carbon Demonstrated to be Uniformly Placed and Remain when Applied in a 'Bed' or Mixed with Sand/Aggregate

Full Scale Field Mixing & Placement of Active Cap

Lab Testing – Flow Through

Above: Intact AB+PAC 5% after perm test

Above: Flex-wall permeameter – Flow 14,774 cm/day or greater used in three runs - ***No loss of activated carbon at high advective flow rates.***

Case Studies

I. East Branch Grand Calumet River

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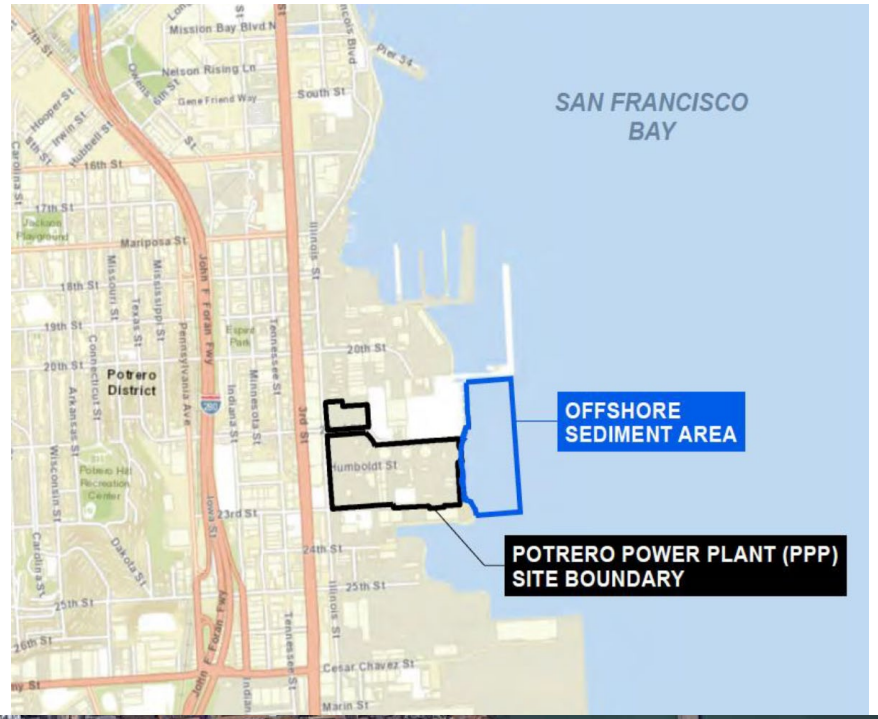
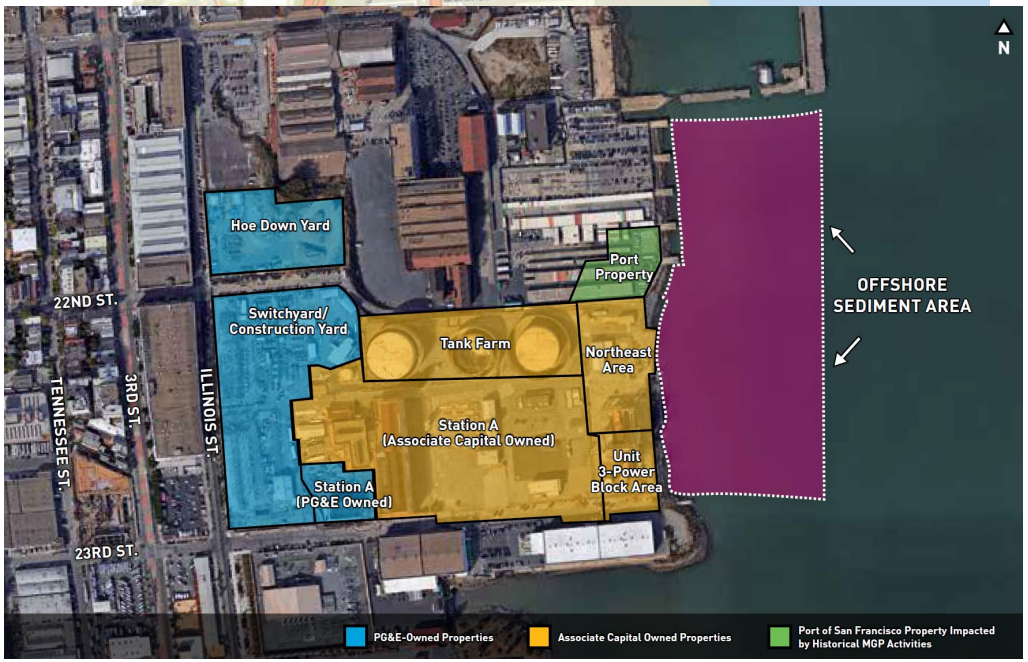
Potrero Power Plant – San Francisco



The project involves remediating Bay and shoreline sediments contaminated with PAHs from historic power plant operations

Remediation elements include:

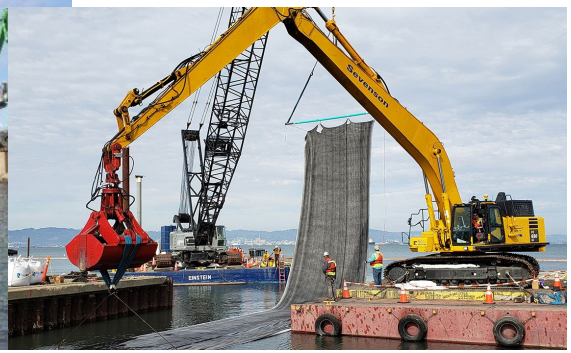
(1) mechanical dredging areas of contaminated sediment;
(2) excavating and replacing riprap;
(3) capping the dredged and excavated areas with both chemical and physical isolation materials to prevent further contact of residual PAHs into the Bay;

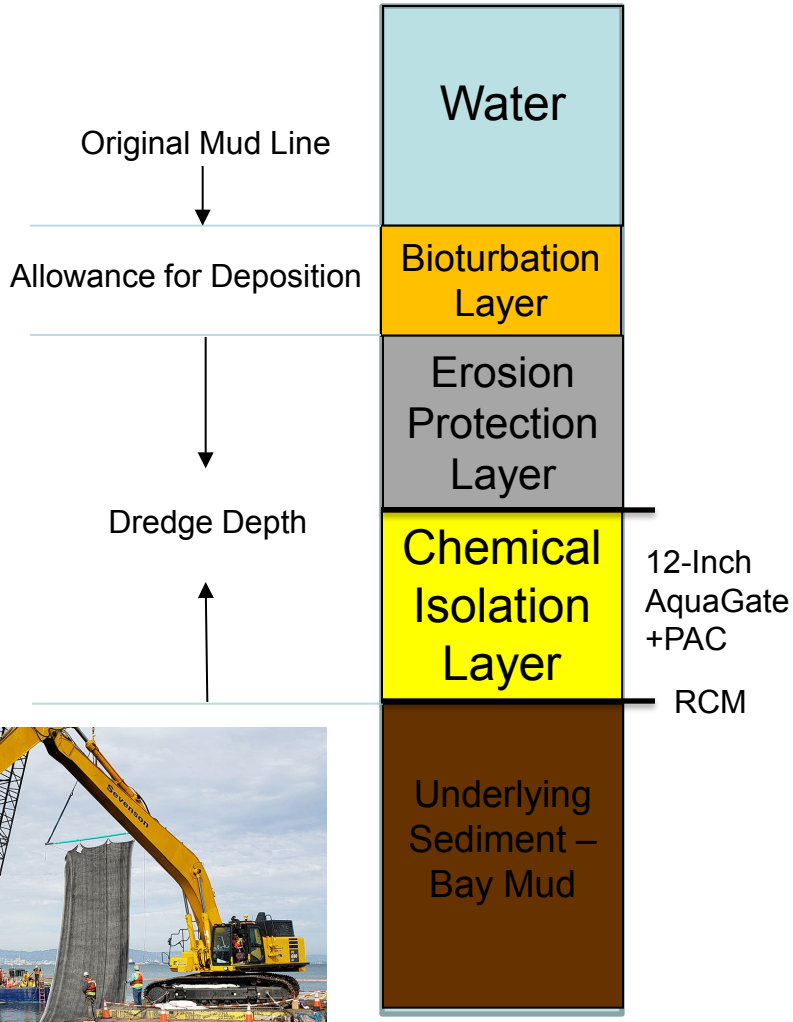


Dredge with Reactive Cap

Overview of Project Site During Construction

Placement of Bulk Capping Material and Erosion Protection with Clamshell Mounted Excavator





Summary – *Key Take-Aways*

1. Post-Dredging Amendment Backfill and Reactive Capping Can Limit Dredge Volumes and Reduce Project Costs

2. Use of Post-Dredging Amendment Backfill and Reactive Capping Addresses Potential Dredge Residuals and Provides a 'Clean Layer' for Recovery of Benthic Community

3. Critical to *Understand Placement Methods* & Impacts on Achievement of Design Objectives – Ensure that *Adequate QA/QC Activity is Included to Document Outcome*

4. Use of Powder Form of Amendments Improves Remedy Performance

AquaBlok **AquaBlok a Low-Permeability Material for Remediation & Geotechnical Applications**

AquaGATE+ **Permeable Treatment Material for Remediation Applications**

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