Monitoring of the Active Capping Demonstration Project in the Anacostia River

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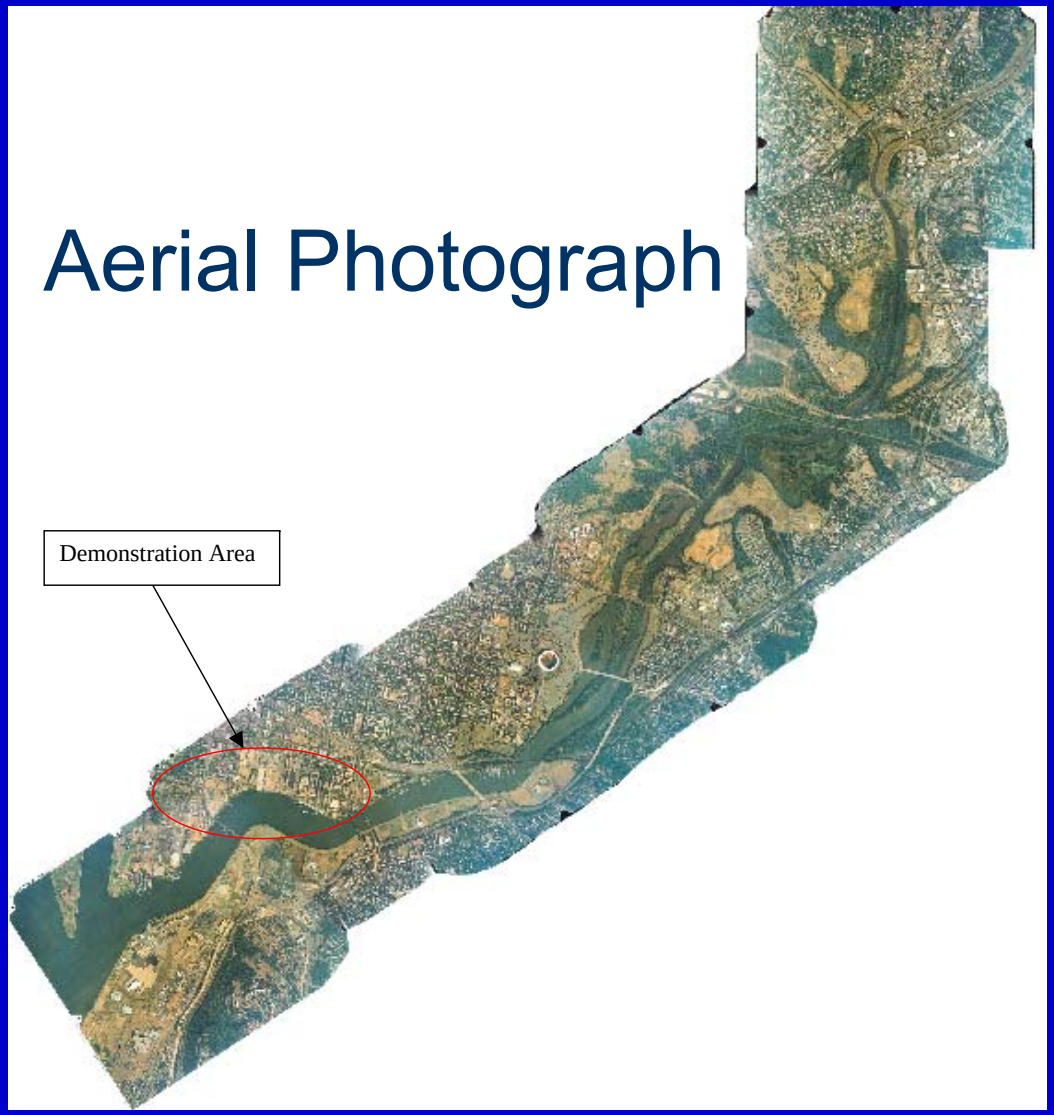
Support : AWTA, HSRC/S&SW, DoD ESTCP

Anacostia River Site



Anacostia River Site

- Contaminant Loadings

Contaminant	Loading
Phenanthrene	1000-4000 µg/kg
Chrysene	800-3500 µg/kg
Benzo[a]pyrene	1000-4500 µg/kg
Zn	1000 mg/kg
Cr	80 mg/kg
Cu	280 mg/kg
Pb	500 mg/kg
Cd	4 mg/kg

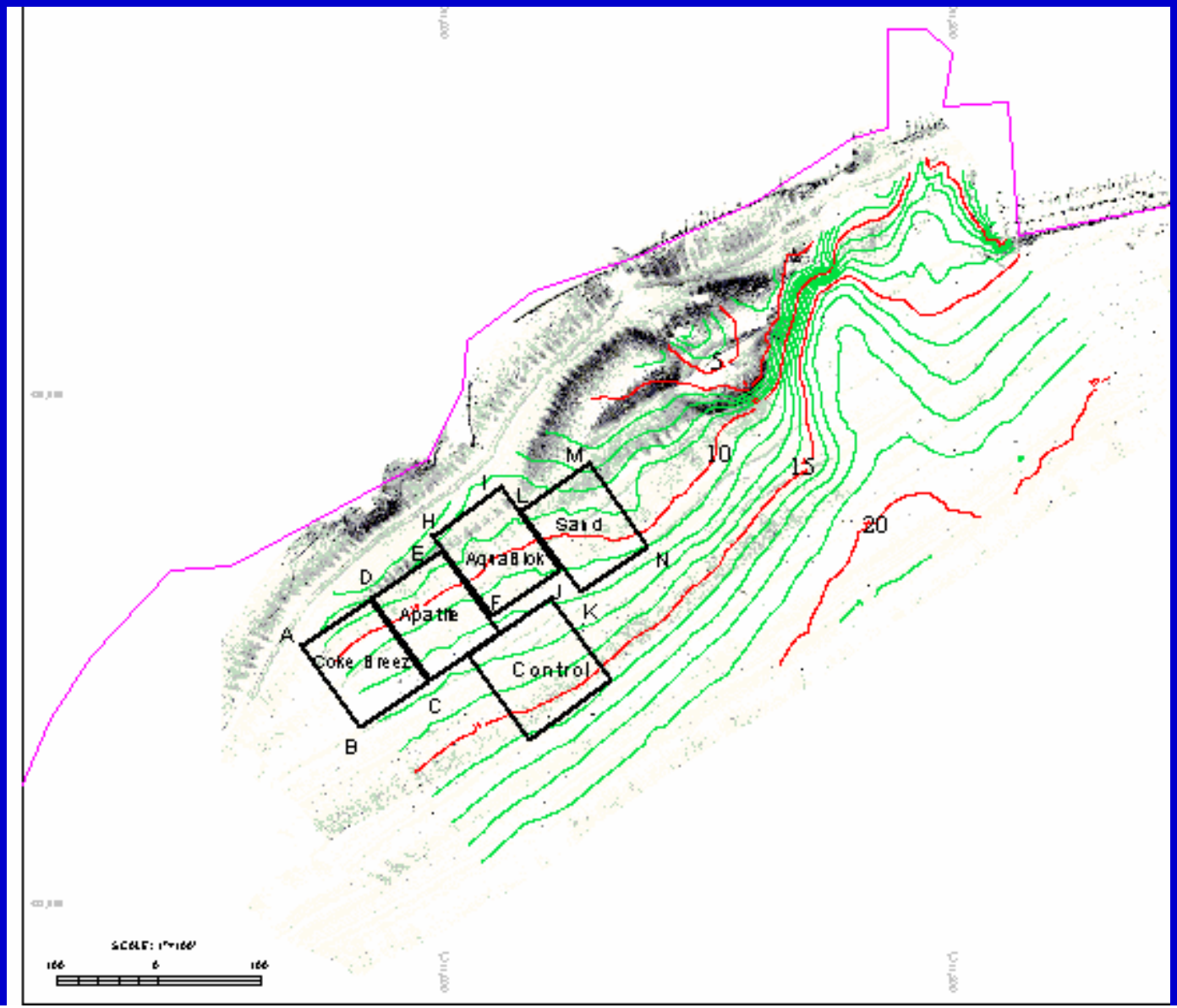
Anacostia River Site

- Project Objective
  - To demonstrate on a field scale the ability to design and construct caps that combine containment and treatment of contaminated sediments

Capping Materials

- AquaBlok
  - A bentonite material that forms a low-permeability barrier between the contaminated sediment and the overlying aquatic ecosystem.
- Apatite
  - Mineral that sorbs metals through a surface precipitation reaction
- Coke Breeze
  - By-product of coal refining process that strongly sorbs organic compounds
- Sand

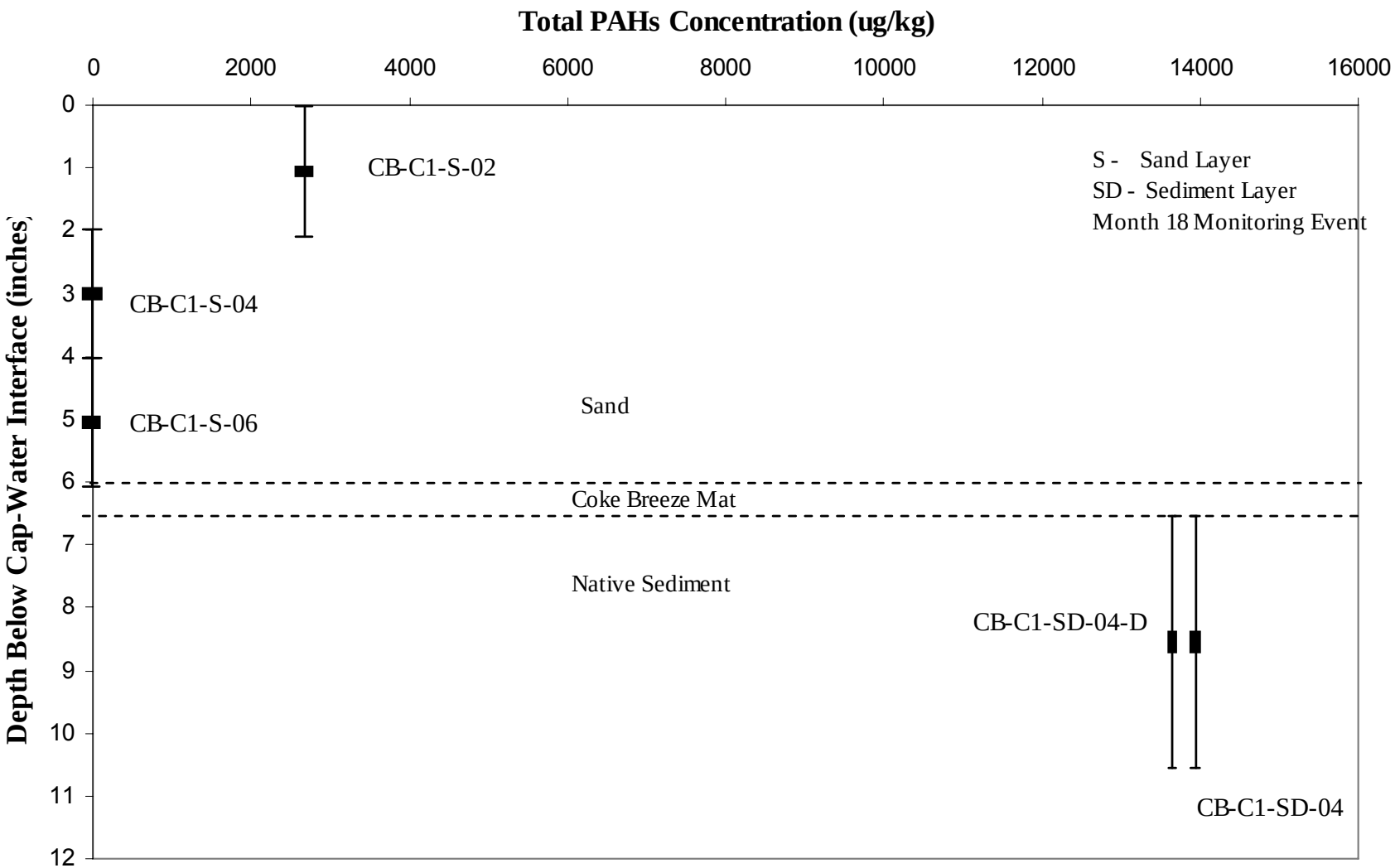
Anacostia River Site



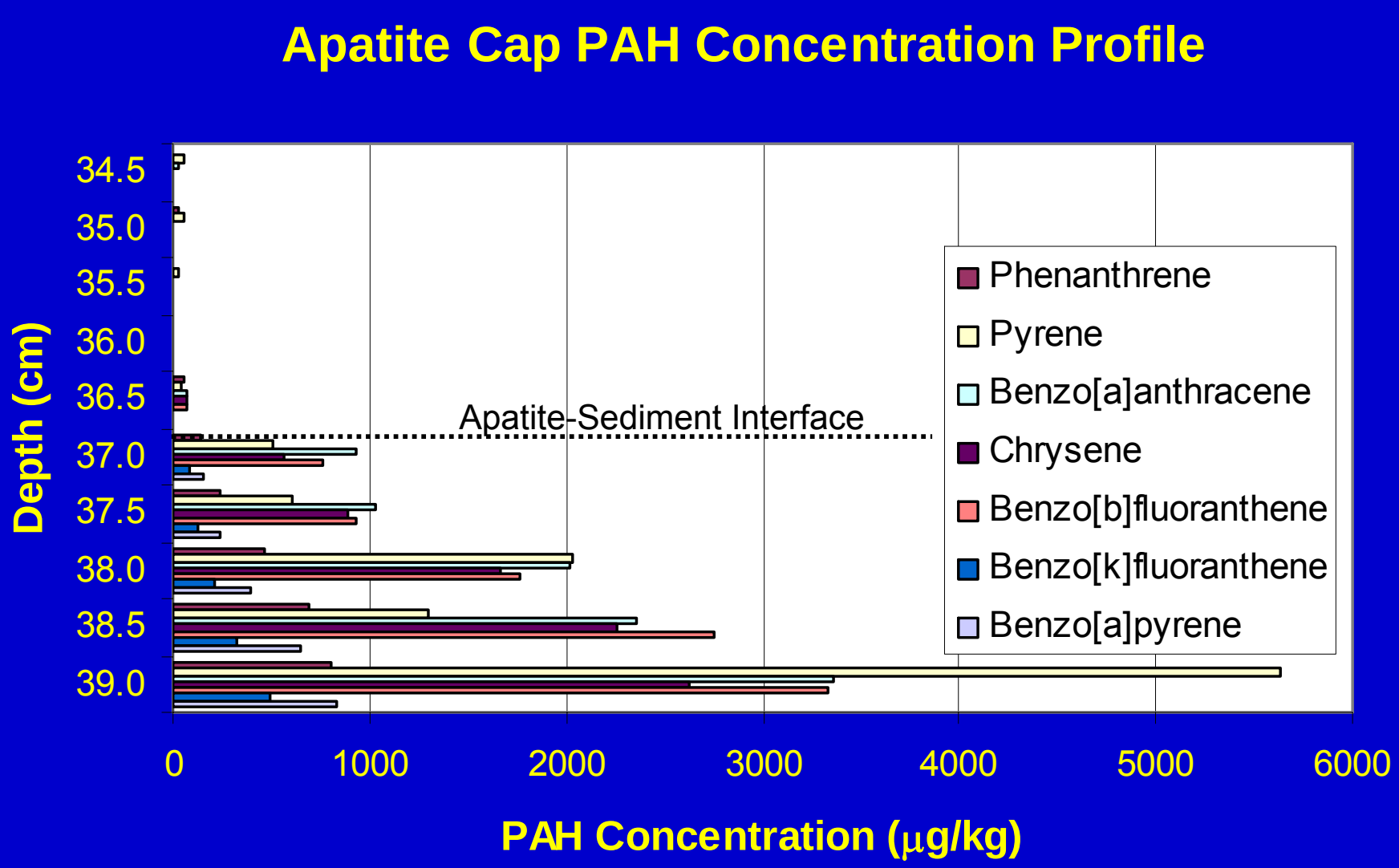
Evaluation Approach

- Measure
  - Cap sediment concentrations
  - Pore water concentrations
  - Accumulation in benthic organisms (lab)
- Model migration through caps
  - Pore water flow rates
  - Adsorption parameters
  - Degradation (if any?)
- Compare effectiveness of different cap materials

Coke - Core 1 Total PAHs vs Depth October 2005



18-Month Coring Results – Apatite Cap



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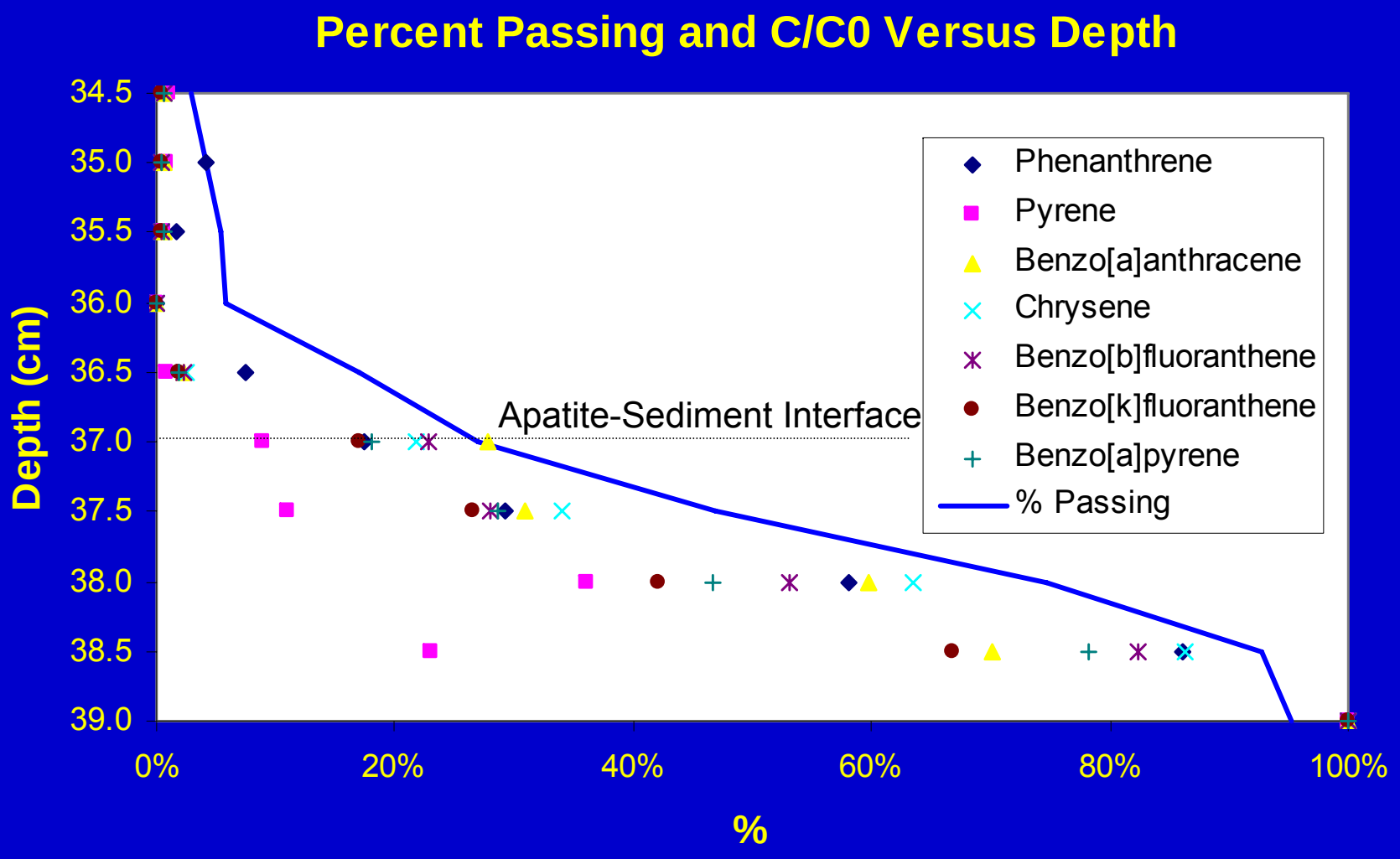
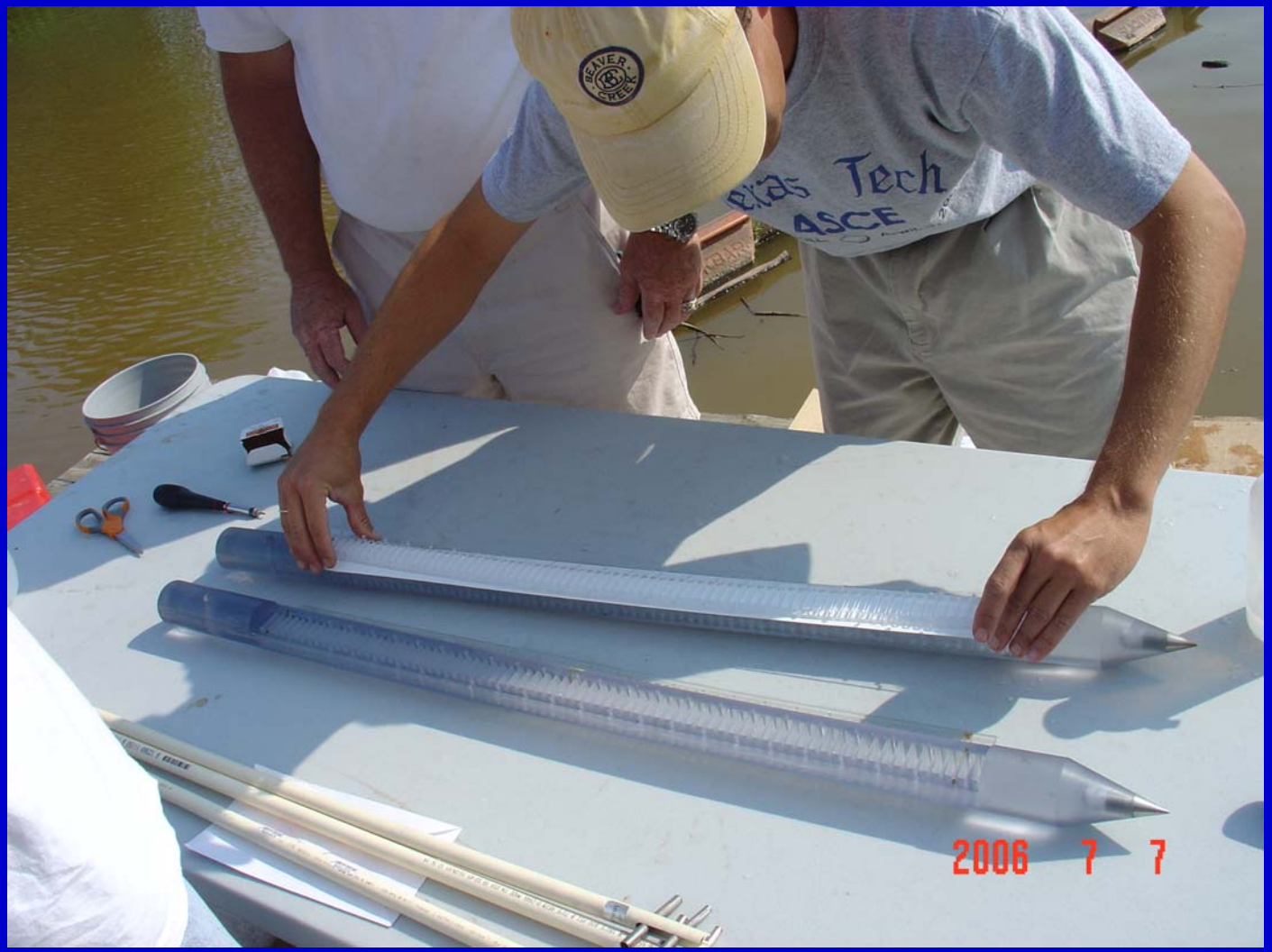


Better Indicator of Migration?

- Pore Water Concentrations
  - Peepers
    - Place core with 3 mL sample ports every 1 cm into caps, then remove and analyze for metals/PAHs
  - Solid-Phase Membrane Extraction (SPME)
    - Study aqueous-phase concentrations (not bound to colloids)
    - Potential to determine concentrations at lower levels (ppt)

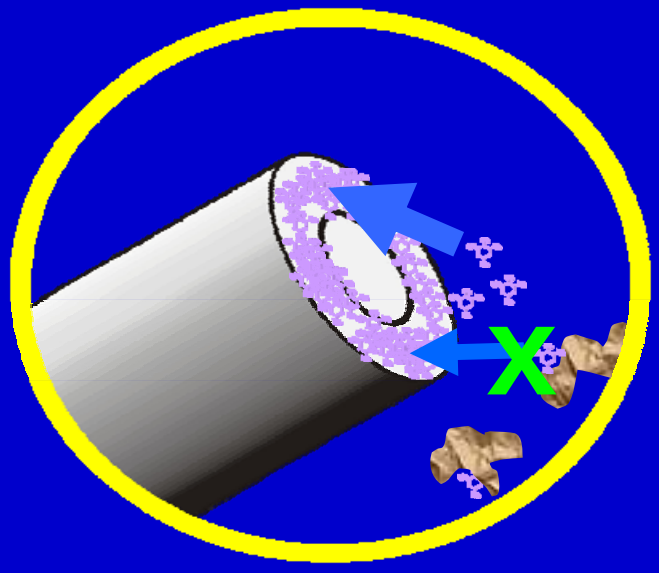
Peepers Sampling



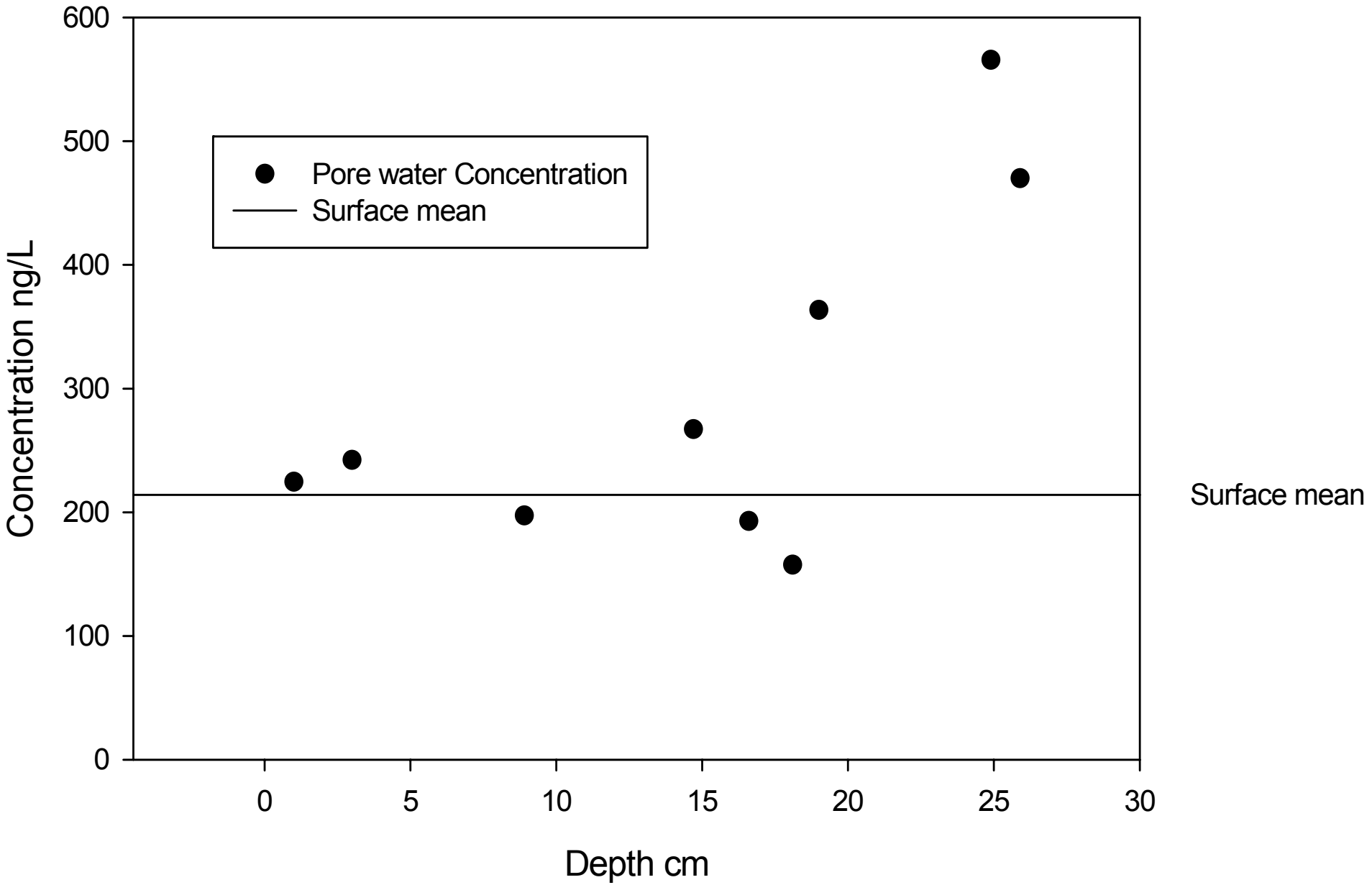
Peepers Sampling

Solid Phase MicroExtraction
Sorbent Polymer

- PDMS (poly-dimethylsiloxane)
  - Thickness of glass core: 114-108 µm
  - Thickness of PDMS coating: 30-31 µm
  - Volume of coating: 13.55 (±0.02) µL PDMS per meter of fibre



Slotted tube for SPME


SPME Measured Porewater Profile
Concentration ng/L
600
500
400
300
200
100
0
Pore water Concentration
Surface mean
0
5
10
15
20
25
30
Depth cm
Surface mean

Measured and estimated pore-water concentrations of PAHs (ng/L)

PAH	Measured SPME	Measured by LLE	Theoretical*
Phenanthrene	210	370	1810
pyrene	610	730	990
chrysene	7.1	7.8	83
B[*b*]F	2.1	5.3	70
B[*k*]F	1.8	2	55
B[*a*]P	1.9	2	68

*Estimated from log *K*oc=log *K*ow-0.21
(reversibly sorbed with $K_{SW} \sim K_{oc} f_{oc}$)

Predicted BSAF ~ Ratio of measured to theoretical concentration

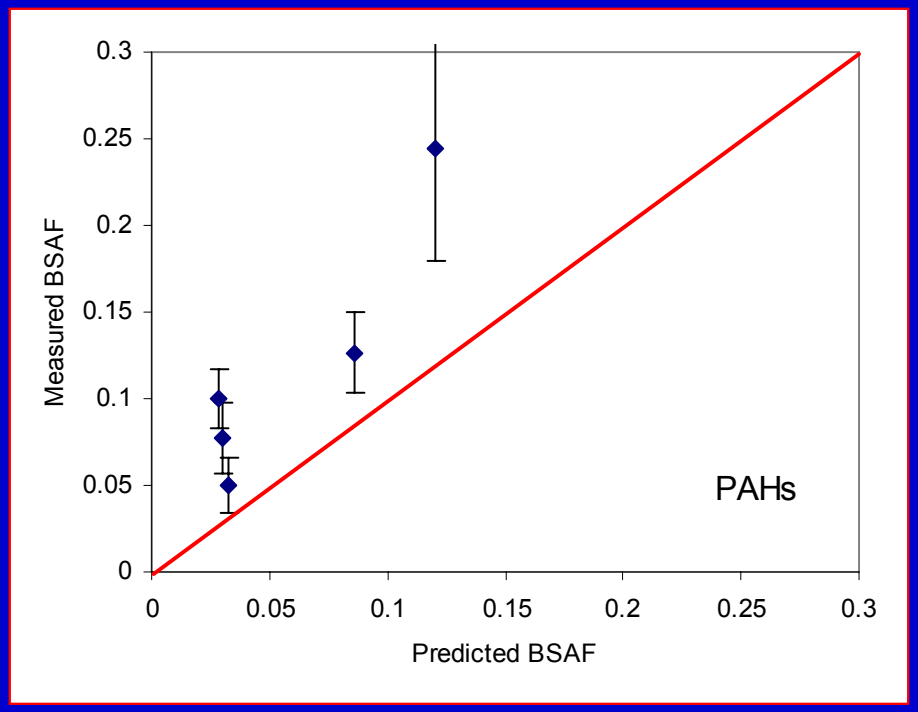
Assumes $K_{lipid} \sim K_{oc}$

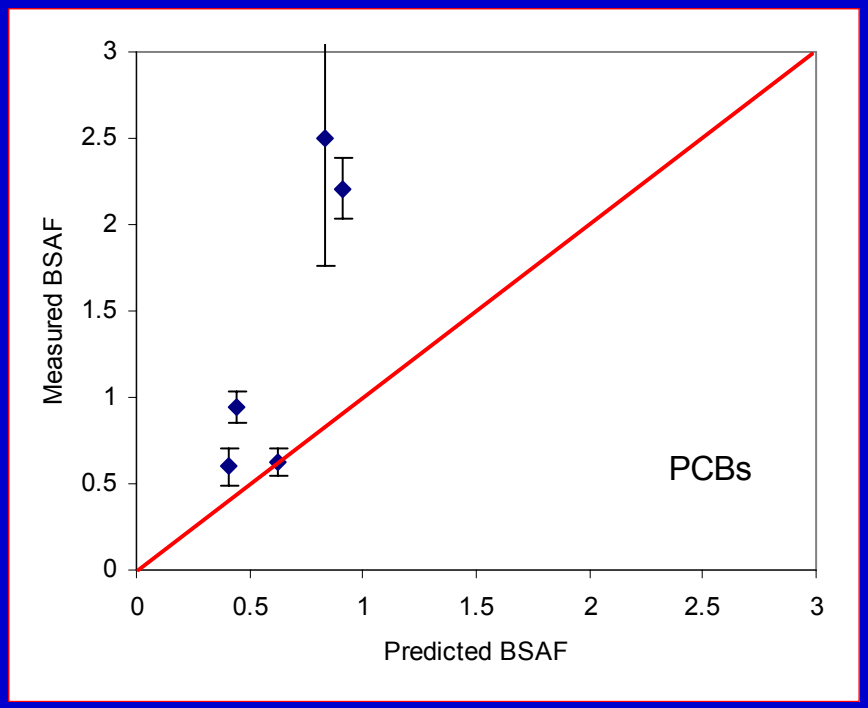
Measured and estimated pore-water concentrations of PCBs (ng/L)

PCB	Measured	Theoretical*
#28	1.9	2.5
#52	2.0	2.0
#153	0.4	0.77
#138	0.45	0.60
#180	0.38	0.16

*Estimated from Log *K*oc=1.03* log *K*ow-0.61

Biota-sediment accumulation factors of PAHs and PCBs(Measured vs predicted)





Lessons being Learned

- Innovative cap materials possible to place using conventional equipment with experienced contractor
- Possible to apply thin (6”) layer of cap material using clamshell techniques
- A laminated mat provides opportunities for controlled placement of light and/or high value materials (e.g. μ scale zero valent iron or activated carbon)
- AquaBlok effectively diverted groundwater flow
- Gas accumulated under AquaBlok but was released rapidly and irregularly with no observable negative consequences
- Contaminant profiles consistent with sediment-cap/sand intermixing – no observed migration
- Pore water assessments may provide more information