

Using PAH Compositions in Sediment Pore Water to More Accurately Interpret “Total PAH” Concentrations

Laura McWilliams, PhD
Helder Costa
Haley & Aldrich, Inc.

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Presentation Overview

- 1 Role of pore water in evaluating and monitoring sediment PAH sites
- 2 Evaluating pore water PAH data generated using different field sampling and laboratory procedures
- 3 Distinguishing dissolved-phase from particle-sorbed PAHs
- 4 Avoid over-estimation of dissolved-phase PAH concentrations

Background: Why Analyze Pore Water?

Better represents bioavailable contaminant fraction

- Assess risk to benthic receptors
- Assess groundwater discharge to surface water (along flowpath)
- Characterize sediment-pore water interaction for cap modeling/design
- Monitor remedial success

All require distinguishing entrained particle-sorbed PAHs from true dissolved-phase PAHs

Confounding Factors

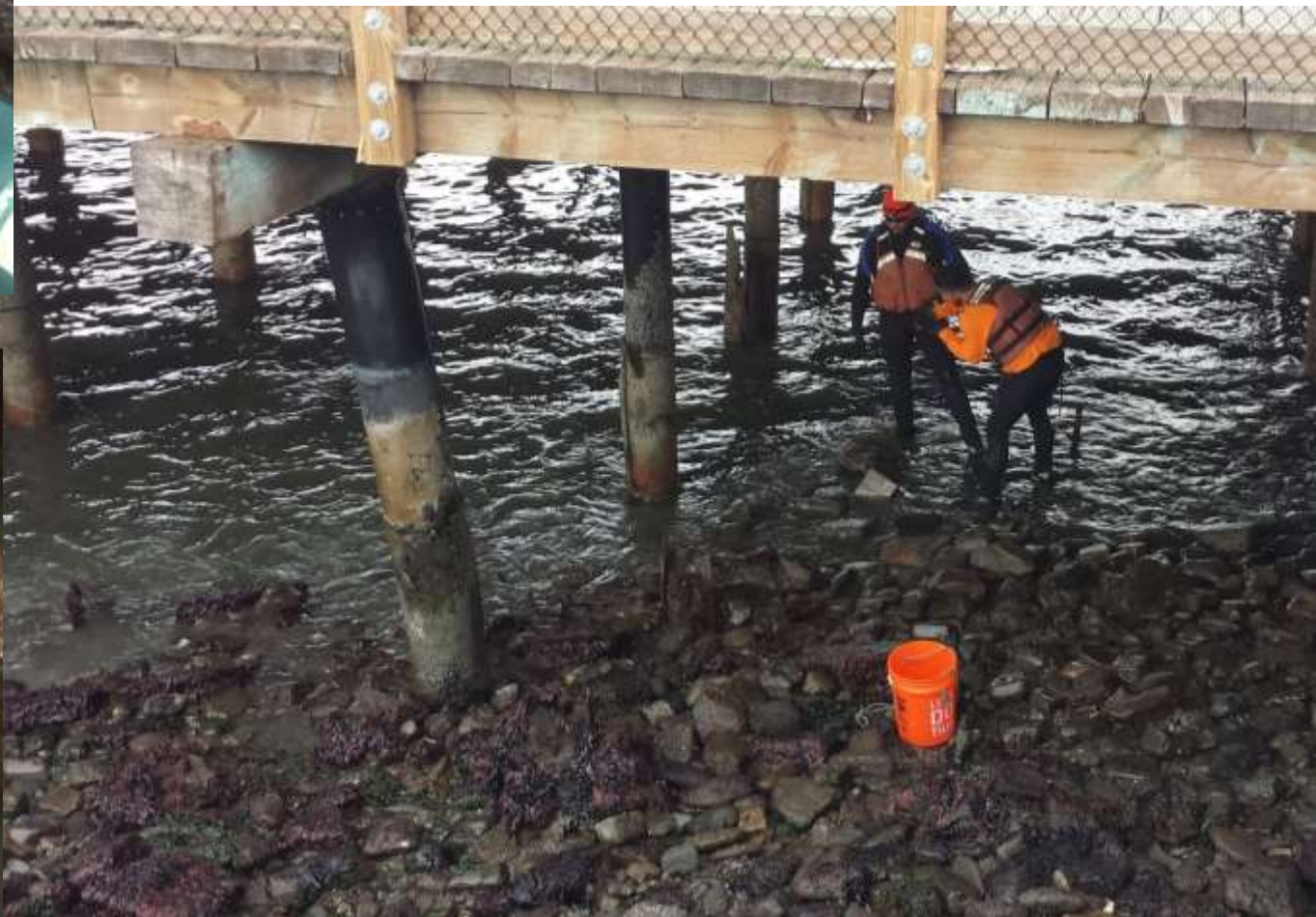
- Sediment - pore water equilibrium vs. steady state conditions
 - Evaluate influence from deeper underlying contaminated sediment
- Sampling methods – advantages & limitations
 - Passive sampling, depends on equilibrium assumptions, requires concentration adjustment
 - *Ex situ* extraction via centrifugation – assures co-located sediment, limited volume
 - *In situ* low-flow sampling with piezometers – real-time assurance of successful sample
- Particle inclusion: biasing “dissolved-phase” concentrations
 - Particle “flushing” or filtering can help, but may not eliminate sediment from pore water analysis



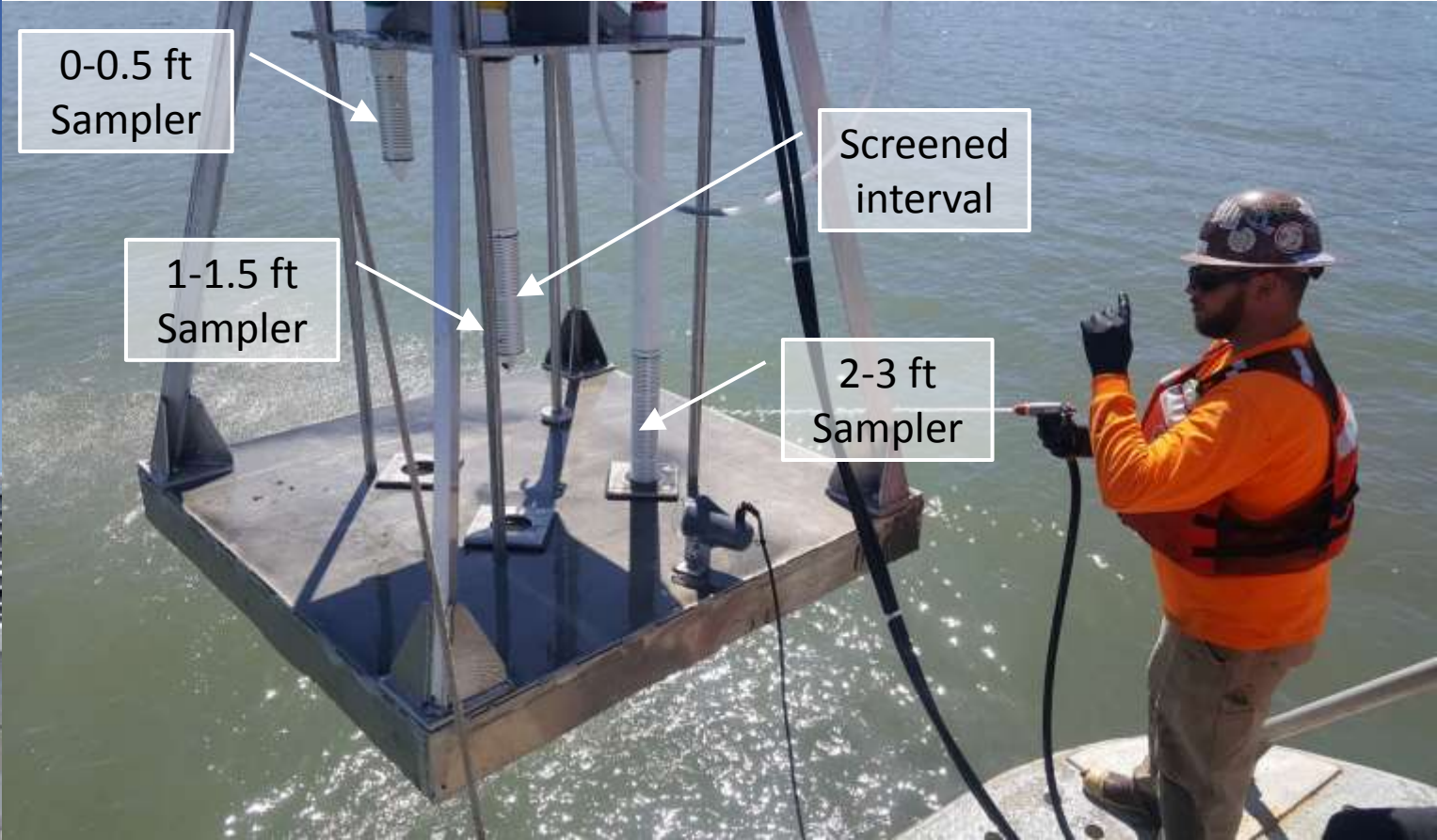
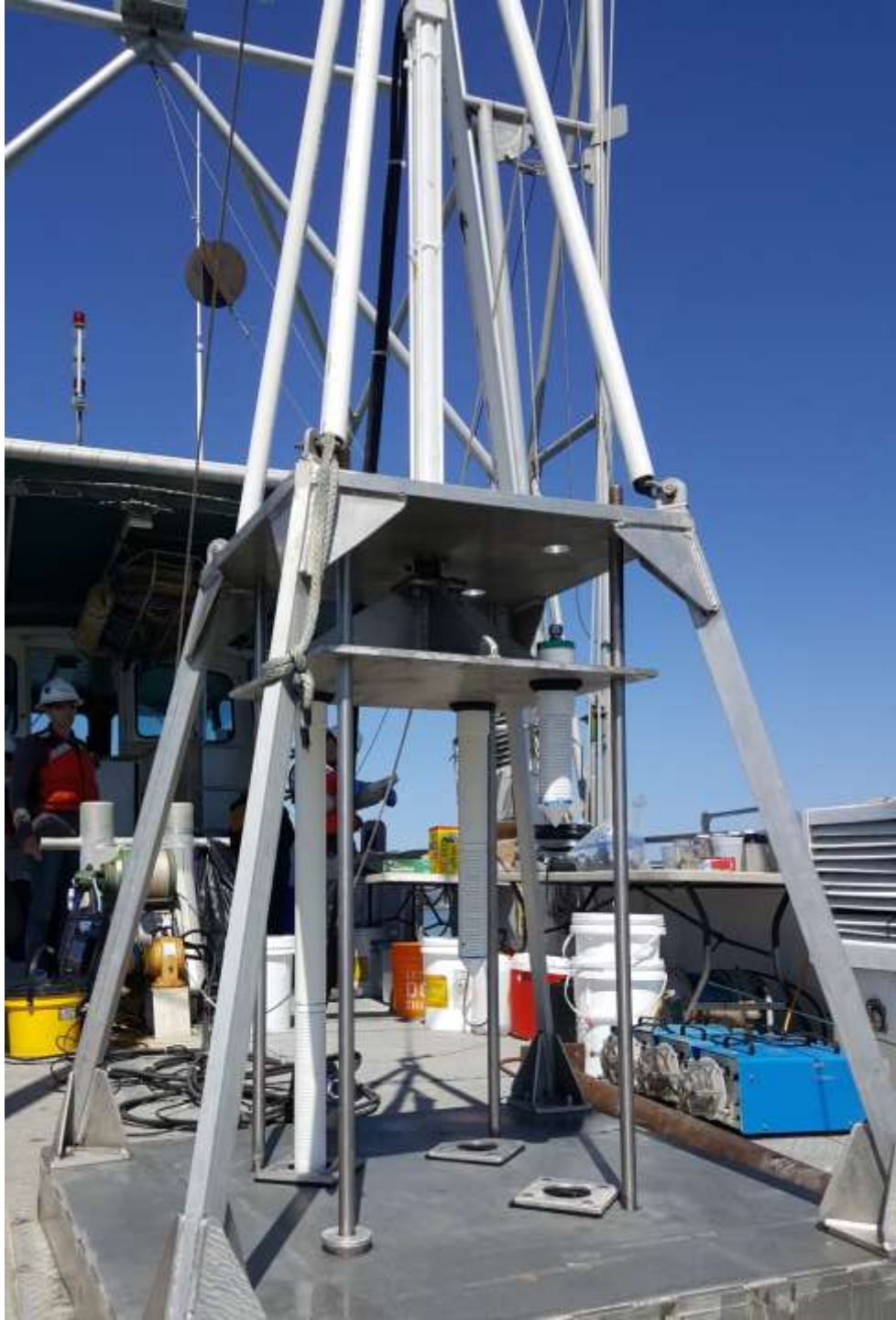
LEGEND

- PASSIVE SAMPLER
- PHASE 1 VIBRACORE
- PHASE 1 GRAB SAMPLE
- PHASE 2 VIBRACORE
- PHASE 2 GRAB SAMPLE
- PHASE 2A VIBRACORE
- PHASE 2A GRAB SAMPLE
- GRAVITY CORE, PORE WATER, AND SURFACE WATER STATION

Passive Samplers



Pore Water Sampler



0-0.5 ft
Sampler

1-1.5 ft
Sampler

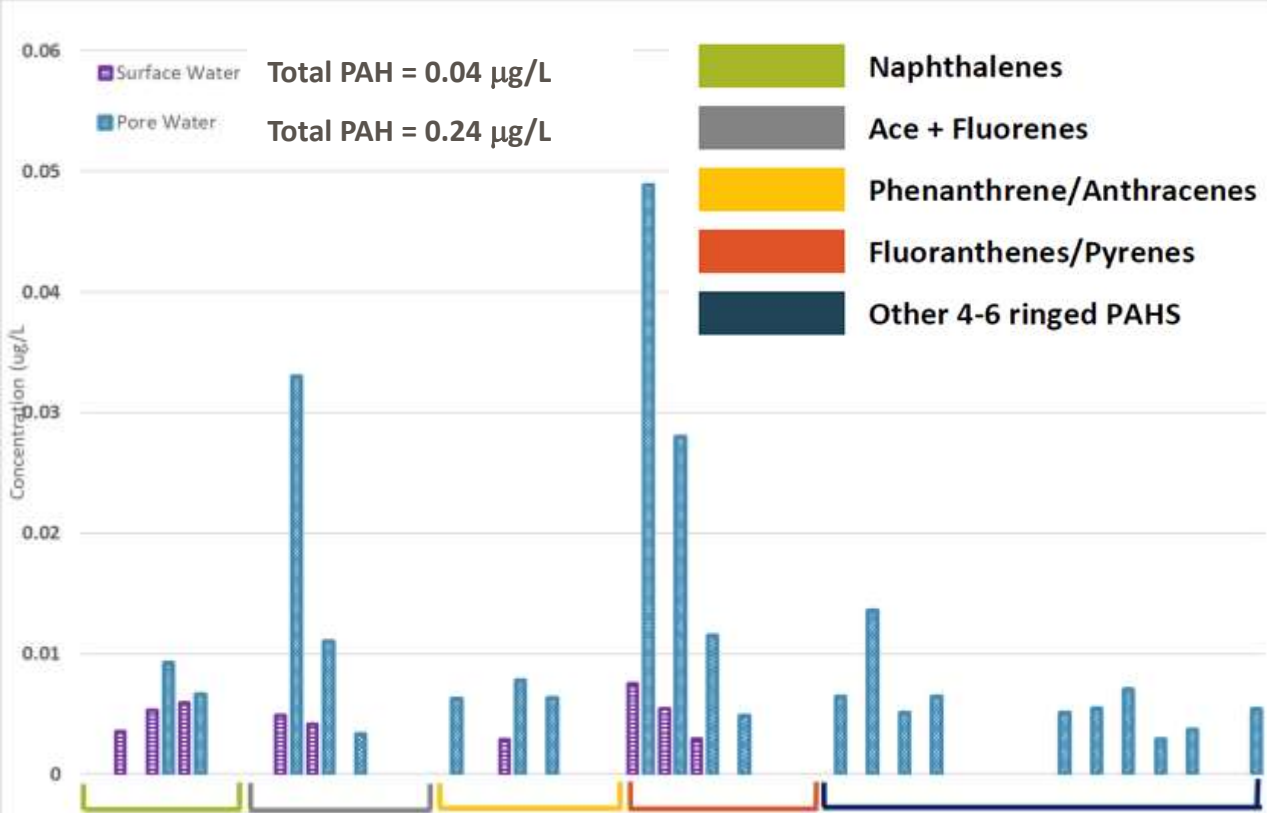
Screened
interval

2-3 ft
Sampler

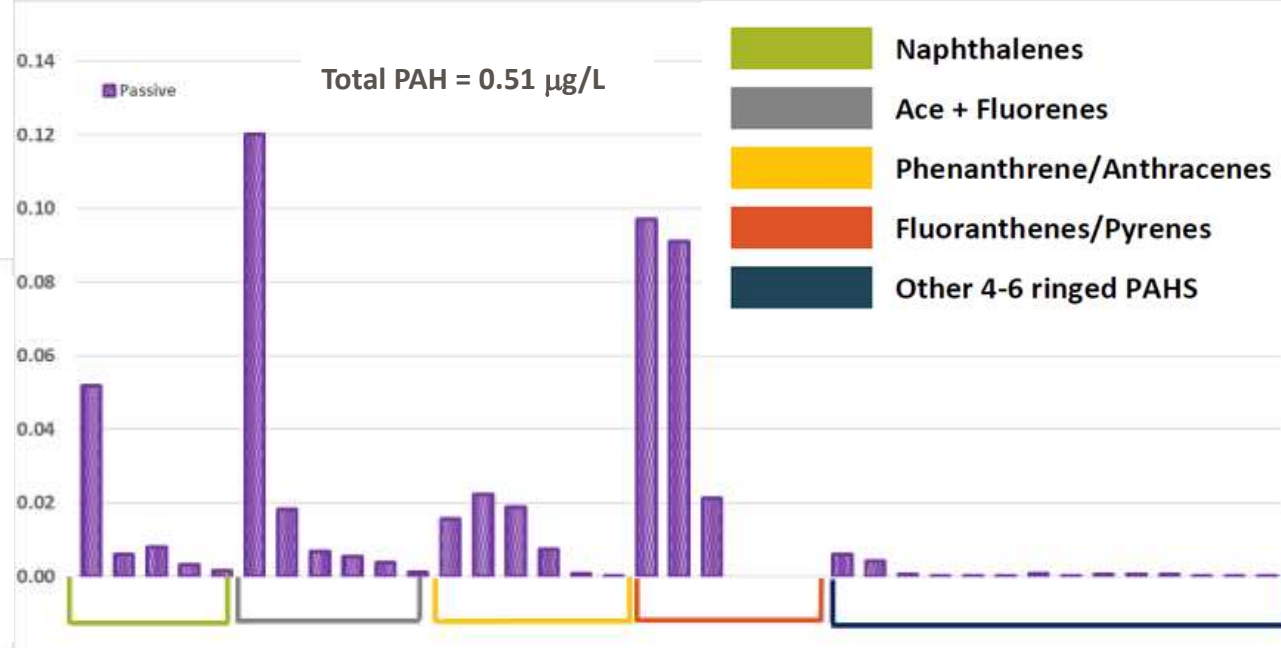
Comparing Surface Water Measurements using Direct in-situ Surface/Pore Water vs. Passive Sampler Methods

Note dilution in SW
 PW contains sediment?

WB-98 - In Situ Surface Water and 0-0.5 ft Pore Water

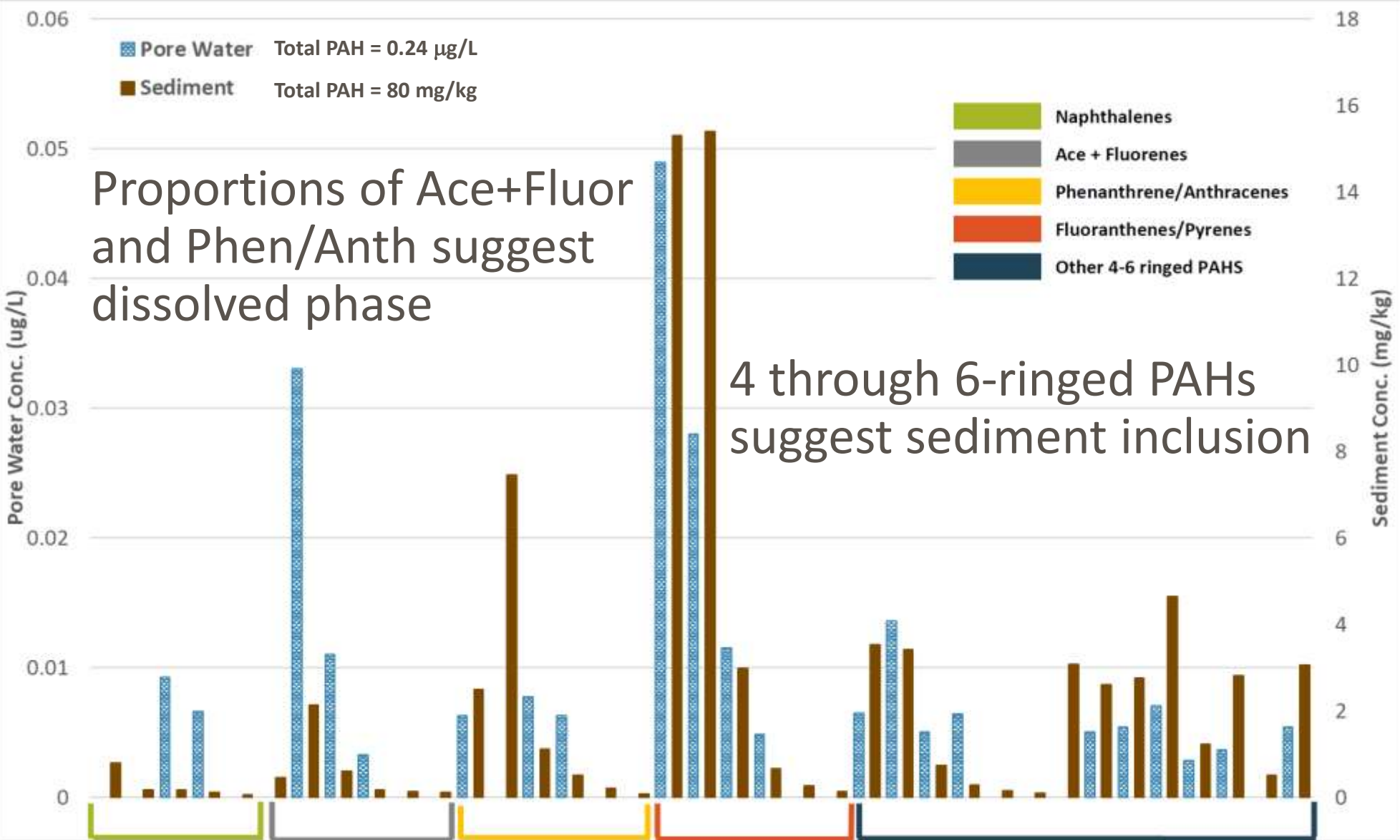


PS-01 – Passive sampler deployed at surface

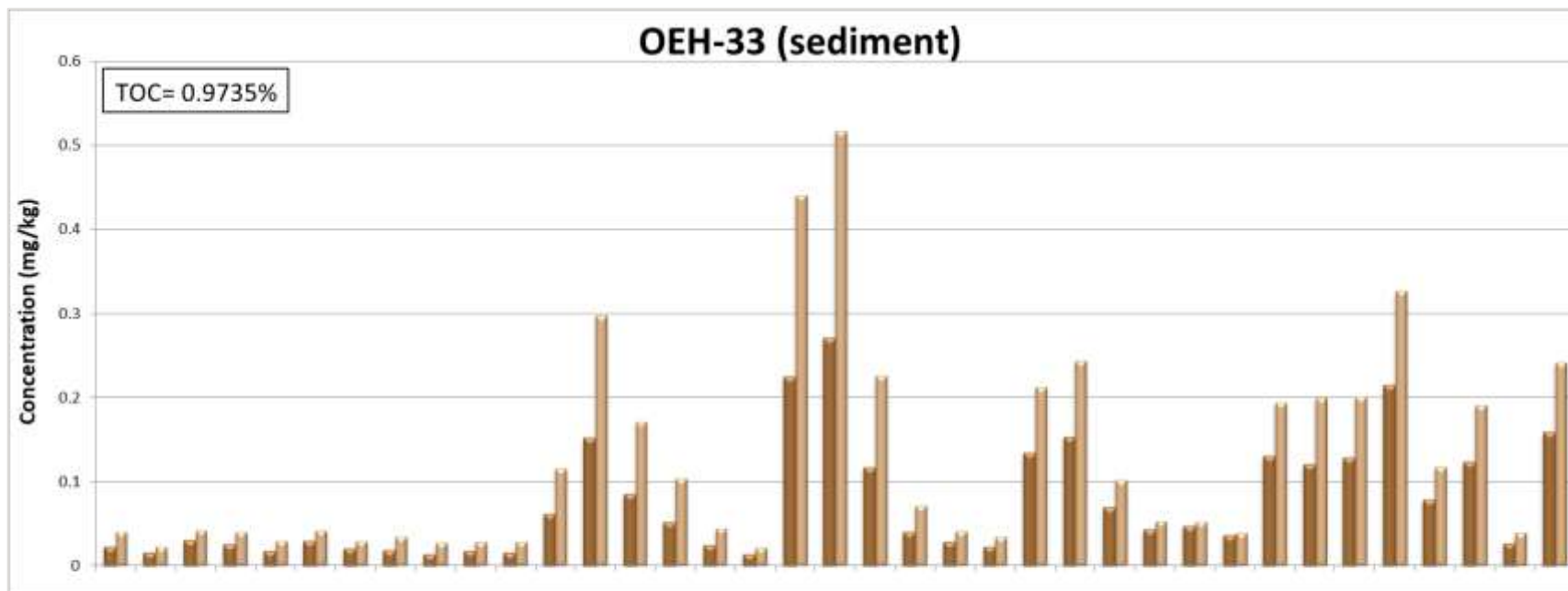


SW dilution diminished/eliminated
 Passive sampler at surface and
 0-0.5 ft pore water compositions
 very consistent

Sediment vs. Pore Water (0-0.5 ft) (Sta WB-98)



Pore Water Collected by Centrifugation (Sta OEH-33)

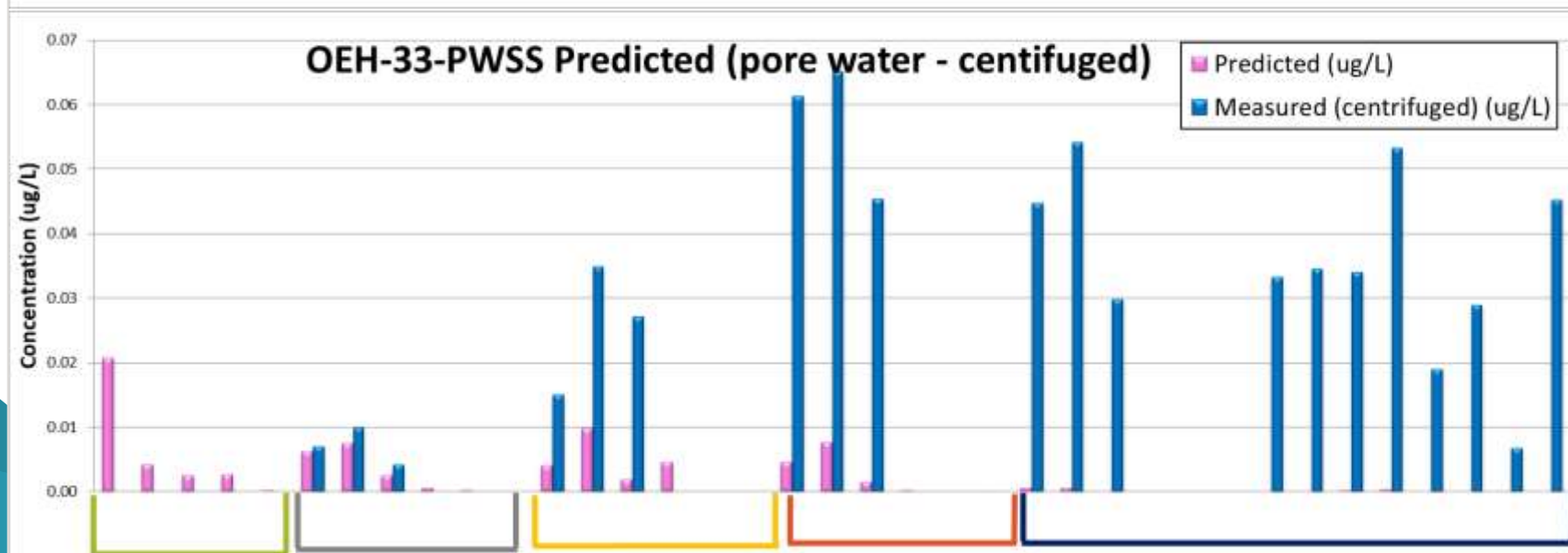


Sediment inclusion limits data usability

Total PAH

Sediment = 2.7 mg/kg

Pore water = 0.51 µg/L



- Naphthalenes
- Ace + Fluorenes
- Phenanthrene/Anthracenes
- Fluoranthenes/Pyrenes
- Other 4-6 ringed PAHS

Why is Dissolved Phase vs Entrained Sediment so Important?

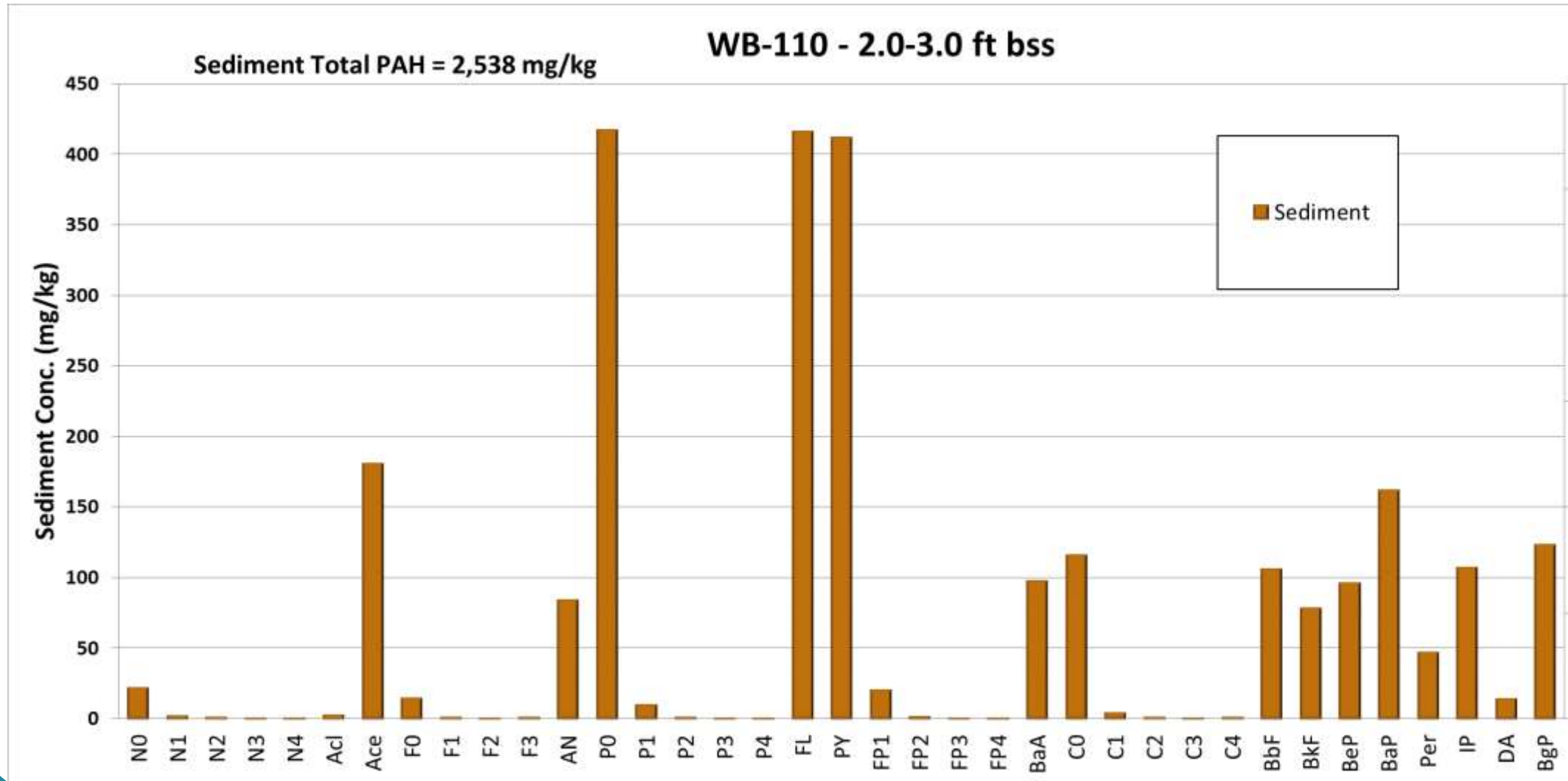
- Risk Assessment
 - Dissolved-phase is more bioavailable fraction
 - Better suited for comparison with aqueous screening concentrations
- Groundwater discharge to surface water
 - Dissolved phase is mobile, entrained sediment is not (under low flow conditions)
- Sediment – pore water interaction for capping design
 - Advection/diffusion modeling assumes dissolved phase
- Post-Remediation Monitoring
 - Performance criteria based on dissolved phase

Approach: Distinguishing Dissolved-Phase PAHs

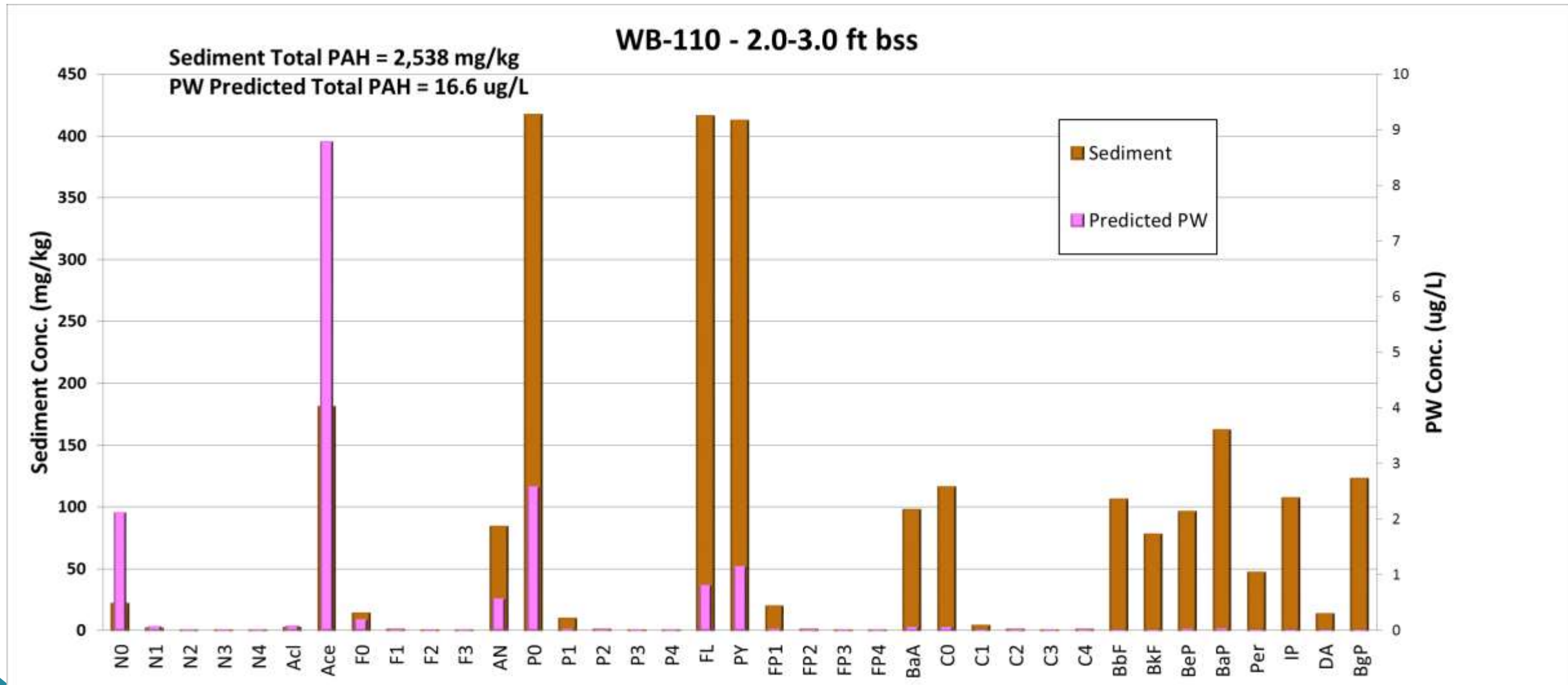
Use expanded PAH list for compositional interpretation, e.g., “PAH-34”

1. Plot PAH compositions in sediment
2. Plot PAH compositions in PW predicted applying Equilibrium Partitioning to sediment
3. Plot “co-located” measured PAH compositions in PW
4. Compare PAH compositions in PW vs predicted PW
 - Tease out dissolved vs particle-sorbed PAHs in PW

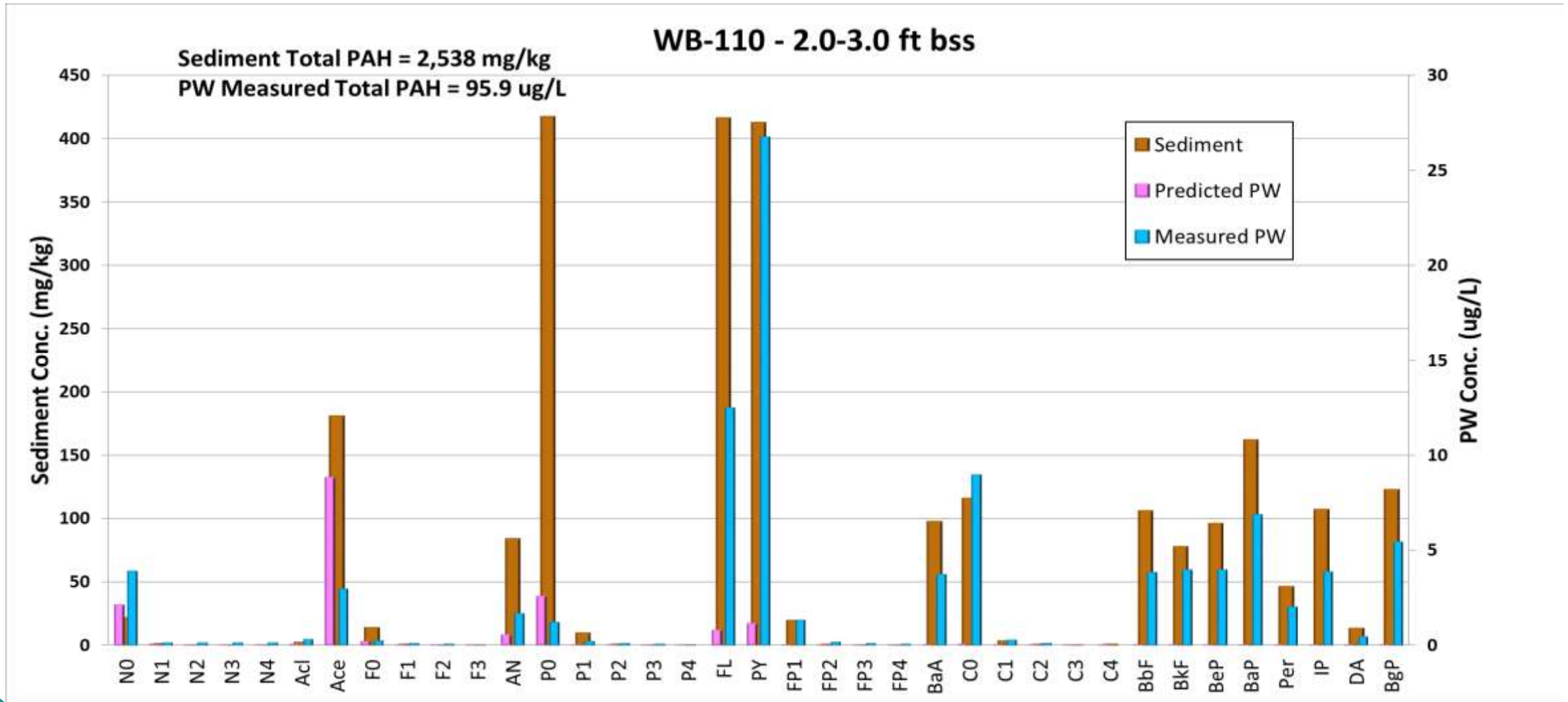
1) Plot PAHs in Sediment



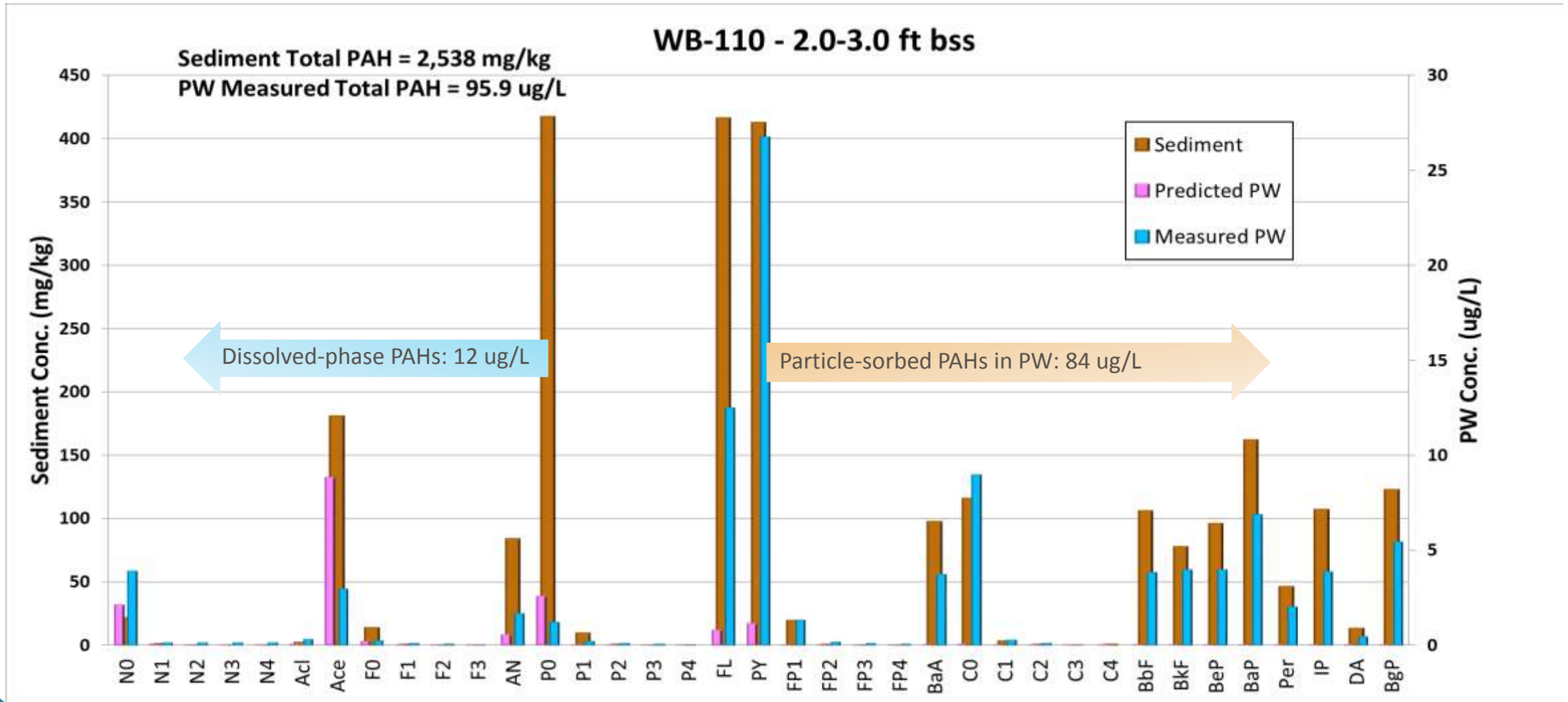
2) Plot PAHs Predicted in Pore Water



3) Plot PAHs Measured in “co-located” Pore Water



4) Compare PAH compositions in PW vs predicted PW



➤ Tease out dissolved vs particle-sorbed PAHs in PW

Results/Lessons Learned

- Dissolved phase matters!
- Minimize the need to recognize & adjust for particle influence through careful PW sampling, processing, analysis
- Recognize particle-sorbed PAH influence in PW
- Conservative assumptions are ok, even GOOD...but at least recognize the extent of conservatism:
 - Potential cost savings (e.g., reactive vs isolation/sand capping), or
 - Credit for conservative margin of safety