

# Freshwater Dredged Material Evaluation: Regulatory and Analytical Challenges (and Solutions) in the Portland Harbor Superfund Site, Lower Willamette River Federal Navigation Channel, Portland, Oregon

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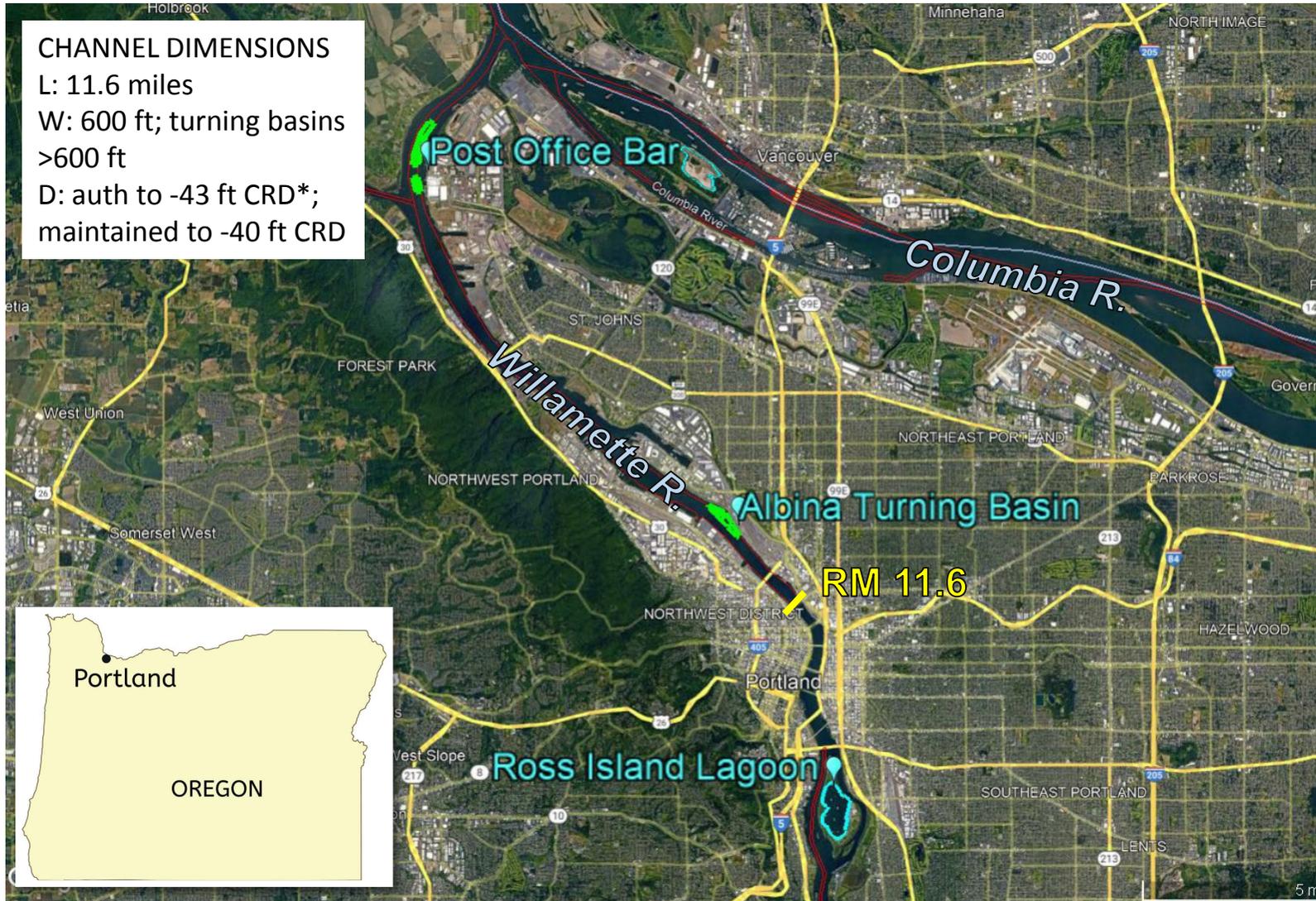
James McMillan, USACE Portland District

*Photo Credit: Terence Cake, Taylor Engineering*



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# 2 Critical Shoals: Post Office Bar & Albina Turning Basin Lower Willamette River Federal Channel, Portland, OR



\* CRD = Columbia R. Datum

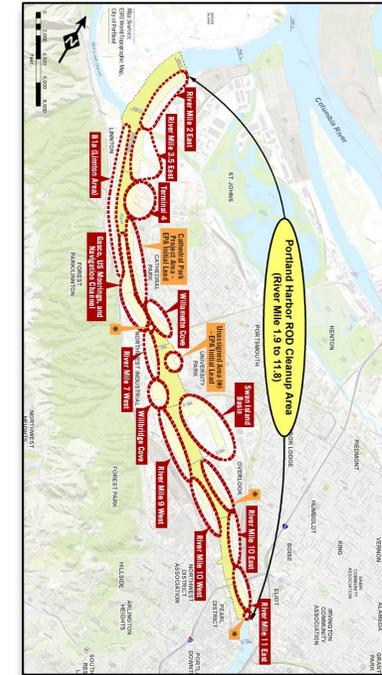
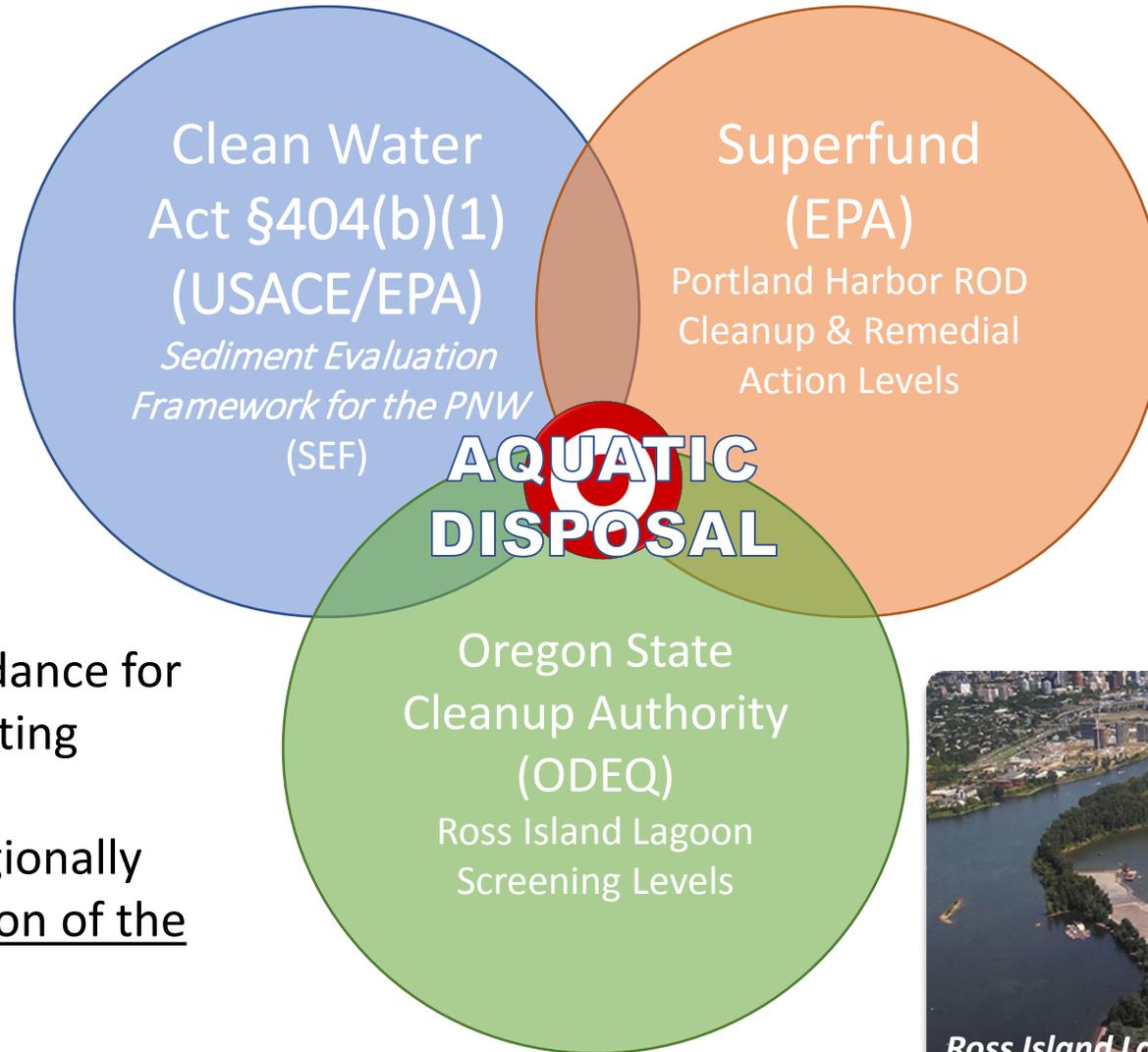
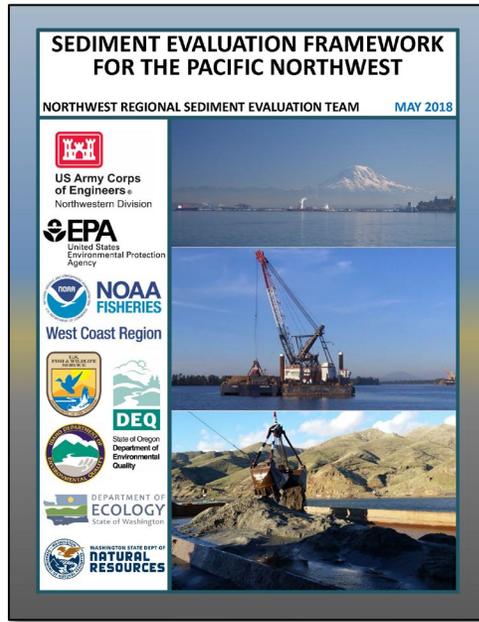
## PROJECT DETAILS

- Portland Harbor Superfund Site
  - PCBs
  - PAHs
  - OC-Pesticides
- Critical Shoals (volume):
  - PO Bar (148 Kcy)
  - Albina TB (180 Kcy)

## DISPOSAL OPTIONS

- Suitable material:
  - Aquatic disposal of PHSS sediment not allowed in the Columbia R.
    - Aquatic disposal at **Ross Is.** (\$)
- Unsuitable material: **landfill** (\$\$\$)

# 3 Authorities Govern LWR Disposal



SEF provides regional guidance for dredged material testing

SEF testing methods regionally accepted, but interpretation of the results varies



**ALL THREE REGULATORY REVIEWS MUST BE SATISFIED FOR AQUATIC DISPOSAL AT ROSS ISLAND**

# Sampling Design and Results

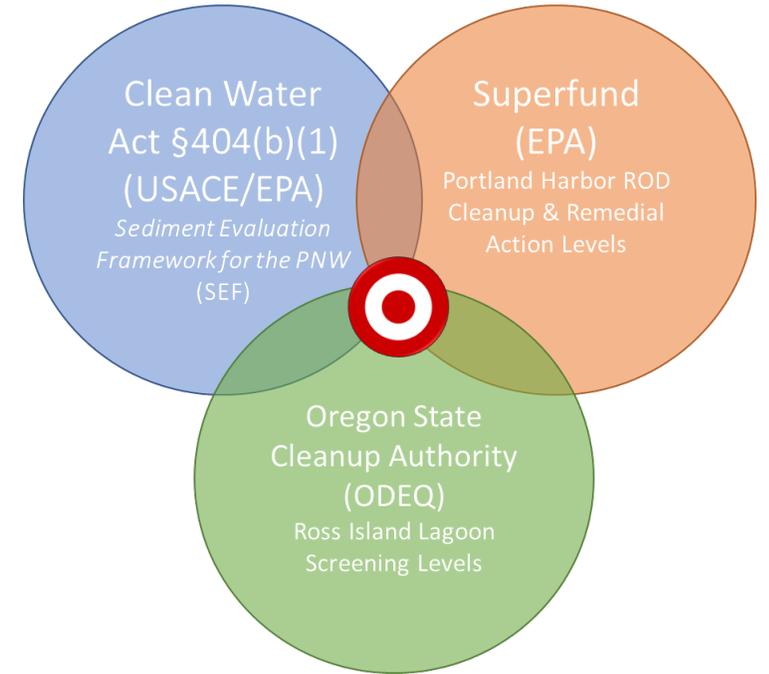
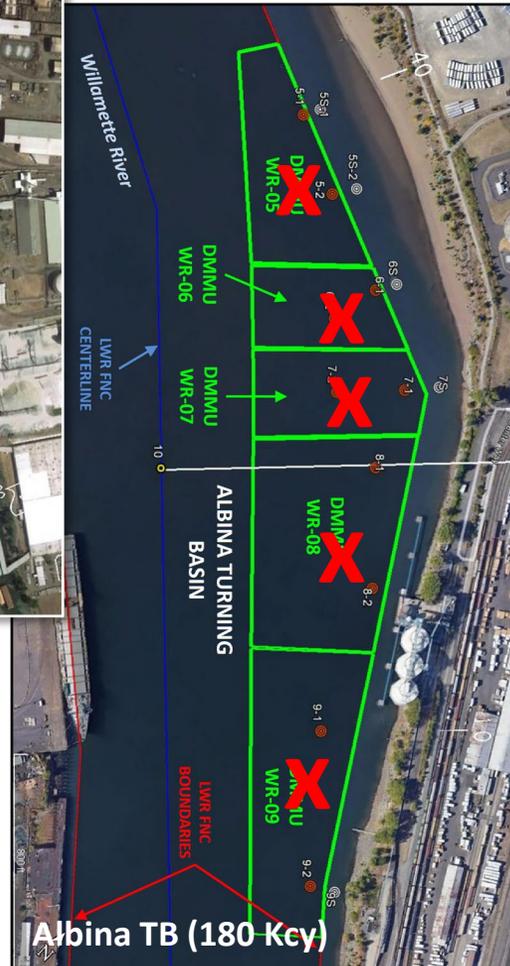
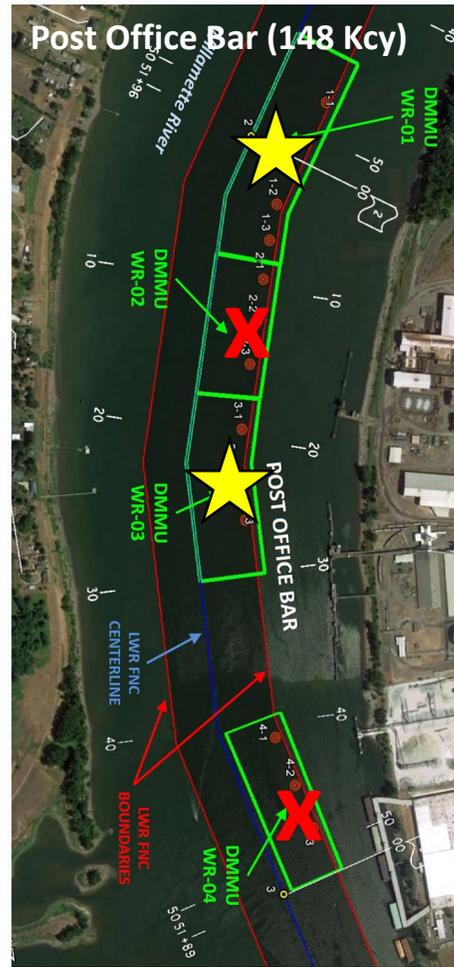
## SEDIMENT EVAL

**Conventionals** (grain size, TOC, sulfides, ammonia)

**Sediment Chemistry** (heavy metals, SVOCs incl. PAHs, PCB Aroclors, OC-Pesticides, organo-tins, dioxins & furans)

**Bioassays** (benthic toxicity & bioaccumulation eval)

At Albina TB and PO Bar, **bioaccum eval** driven by **PCB Congeners**



## RESULTS

**Post Office Bar**  
 2 suitable DMMUs (WR-01, WR-03)  
 2 unsuitable DMMUs (WR-02, WR-04)

**Albina Turning Basin**  
 All 5 DMMUs unsuitable (WR-05 thru WR-09)

# Analytical Considerations – Comparison of PCB Methods

| Method     | EPA 8082 (Aroclors & Congeners)   | EPA 1668 (Congeners)  |
|------------|---|---|
| Rationale: | <ul style="list-style-type: none"> <li>2019: Analyzed for Aroclors only on sediment chemistry</li> </ul>  | <ul style="list-style-type: none"> <li>2021: Analyzed for 209 Congeners in sediment and tissues</li> <li>Used to meet lower TTLs for bioaccumulation</li> </ul>                 |
| Pros:      | <ul style="list-style-type: none"> <li>&lt;\$</li> <li>Standard laboratory equipment (gas chromatogram)</li> <li>Detection limits meet most project requirements</li> </ul> | <ul style="list-style-type: none"> <li>209 PCB congeners</li> <li>Lower detection &amp; reporting limits</li> </ul>   |
| Cons       | <ul style="list-style-type: none"> <li>Higher detection &amp; reporting limits which may not meet all regulatory requirements</li> </ul>                                    | <ul style="list-style-type: none"> <li>\$\$\$</li> <li>Specialized equipment (hi res mass spec) = fewer laboratories</li> <li>Preparation &amp; analysis take longer</li> </ul> |

# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design



# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Issues

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- Test Duration – national standard is 28 days; PNW regulatory framework prefers 45 days; Willamette R. study was 28 to 35 days
- Co-exposure of test species – One non-native species, *Corbicula fluminea*, had poor health and had to be replaced after exposure began, resulting in different exposure durations between the species, 28d for clams, 35d for worms
- Low tissue mass recovery – the supplier provided less mass than requested requiring a stagger-start of replicates, recovery was challenging, replacement clams were smaller than expected

# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Solutions

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## Test Duration

- In *Lumbricus* PCBs, DDTs, TCDD and PBDEs reach steady state in 28 days
- *Lumbricus* reproduce by splitting approximately every 2 weeks



## Recommendation

Run bioaccumulation for protocol-standard 28 days

# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Solutions

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## Co-exposure of test organisms

### PROS

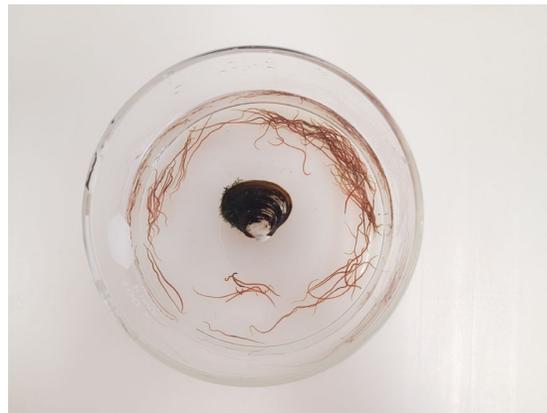
- Uses less sediment
- Reduces field and lab effort

### CONS

- Risky if one of the organisms has poor health
- Potential for insufficient food for both species

## Recommendation

NO CO-TESTING



# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Solutions

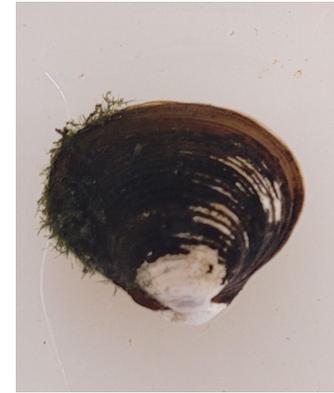
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## Poor Health of *Corbicula*

- Only field-collected (not cultured)
- Non-native
- No official test method

## Recommendation

- Consider native species to better represent and assess potential impacts/ecological response
- Western pearl shell mussel (*Margaritifera falcata*) a possible option; USGS is developing bioaccumulation testing methods for freshwater mussels
- OR test with *Lumbriculus* only, like the rest of the nation

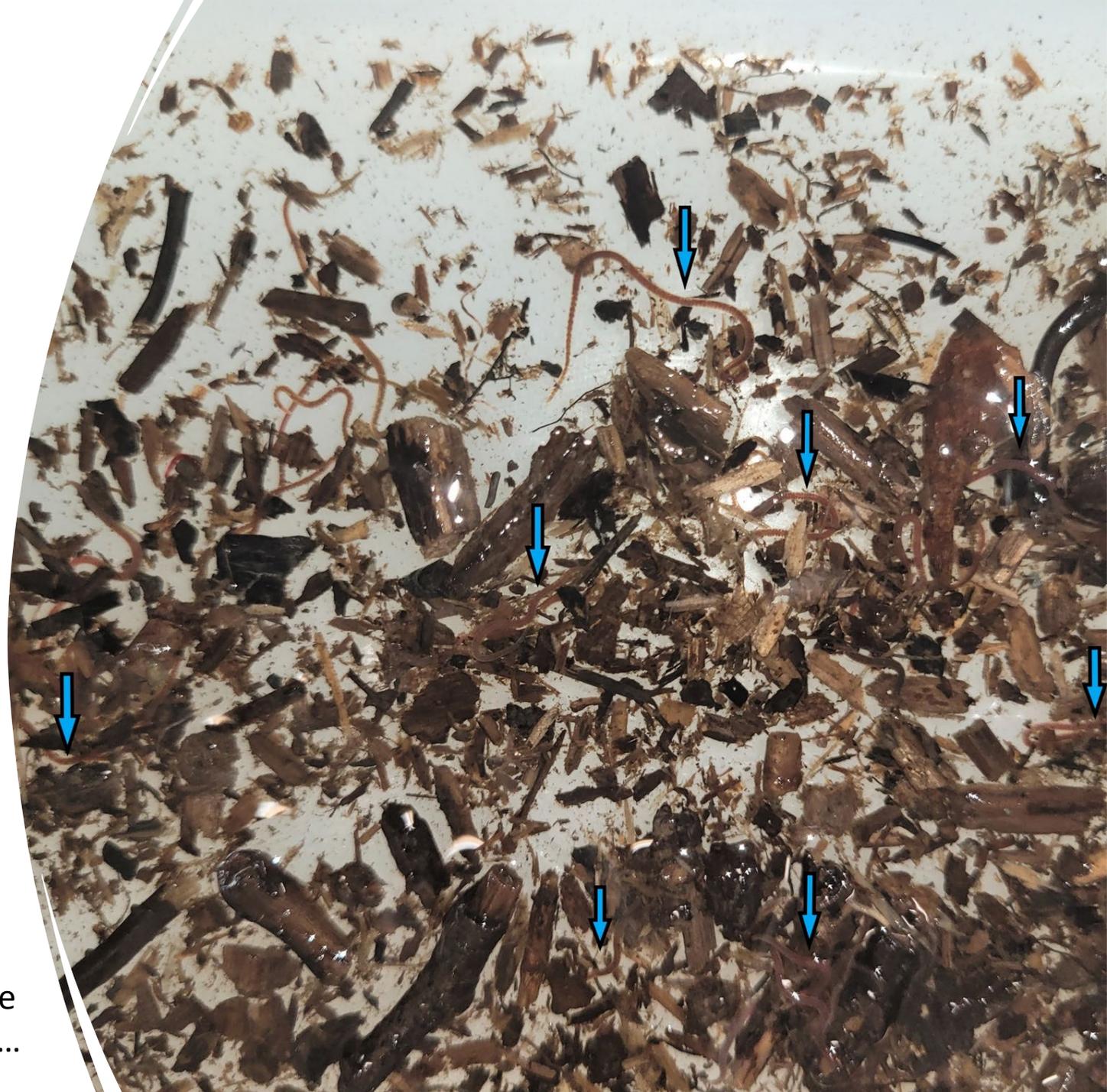


# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Solutions

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## Tissue Mass

Extraction of worms from samples with high woody debris and/or detritus like LWR is challenging



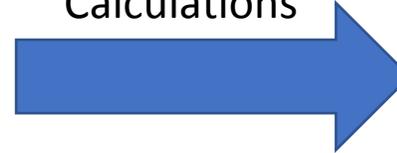
# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Solutions

Target is 10 g TOC : 1 g worms  
(dry weight) per testing protocol

Inputs:

TOC  
Percent solids  
Sediment density  
Mass of worms  
needed for analysis

Calculations



Output:

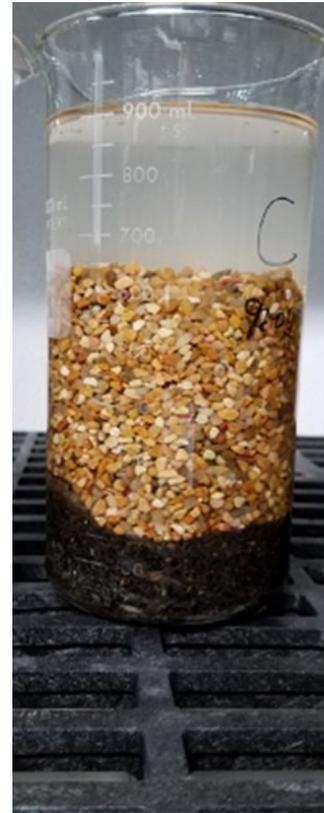
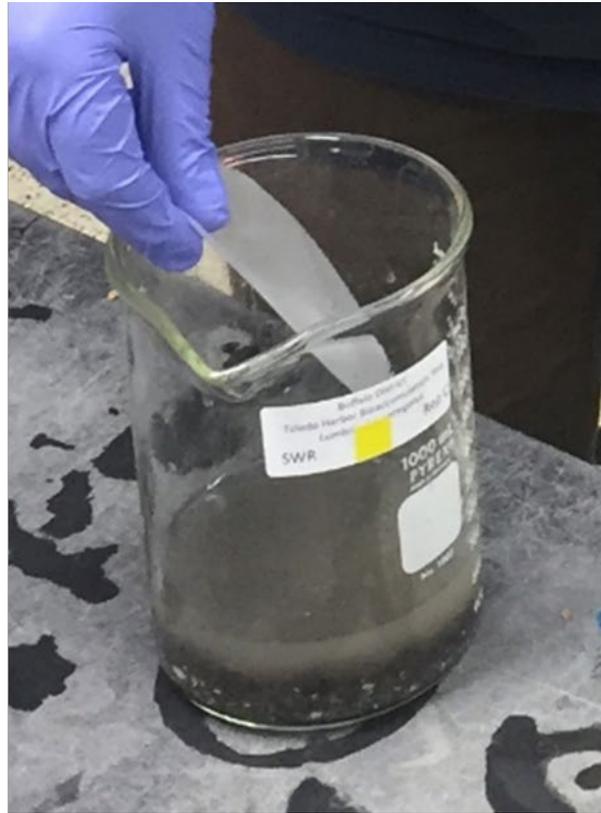
Volume of sediment  
needed for testing  
(wet)

## Tissue Mass Recommendations

- If TOC data are not available, target a 0.12 L sediment : 1 g tissue (wet weight) ratio when sampling, as this will usually provide adequate TOC:tissue ratio for sediments with at least 1% TOC.
- Stock chambers with 50% more tissue than needed. Order 30 to 50% more mass than that from supplier. Use USACE ERDC self-extraction method for *Lumbriculus*

# Regulatory and Analytical Challenges Related to Bioaccumulation Study Design – Solutions

USACE ERDC Self-Extraction Method – Let The Worms Do The Work



0 hour

24 hour

Photo Credits: USACE ERDC

# Summary & Conclusions

- Early and ongoing coordination
- Know your guidelines and reporting requirements
- Bioaccumulation Evaluation
  - Plan ahead to ensure sufficient tissue mass (overstocking test species in chamber)
  - 28-day exposure period
  - No co-testing of organisms
  - Find NW-specific filter feeder (mussel) OR *Lumbriculus* only



Photo Credits: Jessica Stokke, USACE (top); Terence Cake, Taylor Engineering (bottom)

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