



### Problem Summary & Decision Context

OLEM-OSRTI (Superfund) and Great Lakes National Program Office (GLNPO) have numerous sites with contaminated sediments. Sites with contaminated sediments:

- Costly to remediate,
- Take years to decades to complete remedial action,
- Use complex models to evaluate remedial options,
- Requires numerous environmental samples for site characterization, and
- Requires monitoring to document remedial success.

To improve the site cleanup process, Superfund and GLNPO have expressed the following research questions and needs:

- 1) **Passive Sampling:** Improve analytical technology for the evaluation of hydrophobic organic contaminants and metals in sediment and in sediment interstitial water, and develop guidance on how to apply the resulting measurements within the Superfund process,
- 2) **Bioaccumulation:** Improve our understanding of linkages between contaminant concentrations in sediment and fish tissue concentrations,
- 3) **Remedy Effectiveness:** Evaluate the effectiveness of contaminated sediment remediation alternatives and their associated impacts in meeting Remedial Action Objectives at Superfund sites and in support of the Great Lakes Legacy Act and Great Lakes Restoration Initiative,
- 4) **Source Identification:** Develop methods, metrics, and approaches to identify, track, and apportion contaminant sources at Great Lakes Legacy Act sediment sites,
- 5) **Restoration Effectiveness:** Develop long-term assessment methods, metrics, and guidance to characterize, monitor, and maintain habitat restoration following remediation and restoration activities at AOC sediment sites, and.
- 6) **Toxicity:** Revise and publish the 3<sup>rd</sup> edition of EPA's *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*.

### Task Overview

Remediating contaminated sites, lowers health risks to communities and ecosystems, and improves quality of life.

#### Field Studies at Contaminated Sediment Sites

- Determine how a methodology should be applied
- Validate the methodology
- Develop guidance for Superfund and/or GLNPO
  - Can small fish and/or benthic invertebrates be used to document remedy success quicker than larger fish?
  - How long and how should passive samplers be deployed in the field?
  - How to use passive samplers for source tracking.



#### Laboratory Studies

- Based upon numerous reviews of sediment toxicity test data from Superfund and GLNPO sites, the impacts of poor control performance and not using recommended test conditions were evaluated. The knowledge gained will be used to revise EPA's *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*.
  - Improved diet regime for the chronic sediment test with *Hyalella azteca*
  - The importance and effects of organism loading rate with the sediment bioaccumulation test with *Lumbriculus variegatus*
- Passive samplers
  - What chemicals should be used as performance reference chemicals with passive samplers?
  - What are the polymer partition coefficients for passive samplers?



### Accomplishments

#### Toxicity – Methods Revisions and Improvements in Sediment Toxicity Tests

- **Method refinements:** Burkhard et al. (2016) Sediment Bioaccumulation Test with *Lumbriculus variegatus*: Effects of Organism Loading. *Arch Environ Contam Toxicol* 71(1), 70–77
- **Method revision and validation:** Ivey et al. (2016) Using an interlaboratory study to revise methods for conducting 10- to 42-d water or sediment toxicity tests with *Hyalella azteca*. *Environ Toxicol Chem* (in press)

#### Interstitial Water Measurements using Passive Sampling – Application to Superfund Sites

- **Field demonstration and validation of passive sampling technique:** Burgess et al. (2015) Application of passive sampling for measuring dissolved concentrations of organic contaminants in the water column at three marine Superfund sites. *Environ Toxicol Chem* 34(8), 1720-1733.
- **Assessing the use of passive samplers as surrogates for biomonitoring organisms:** Joyce et al. (2016). Evaluating the relationship between equilibrium passive sampler uptake and aquatic organism bioaccumulation. *Environ Sci Technol* (in press)
- **Guidance document for use of passive sampling measurements at Superfund sites:** US-EPA EPA/600/R-15/289 Deriving Sediment Interstitial Water Remediation Goals (IWRGs) at Superfund Sites for the Protection of Benthic Organisms from Direct Toxicity

#### Remedy Effectiveness – Validation of the Use of Benthic Species For Documenting Remedy Effectiveness

- **Method validation:** Meier et al. (2015) Monitoring exposure of brown bullheads and benthic macroinvertebrates to sediment contaminants in the Ashtabula River before, during, and after remediation. *Environ Toxicol Chem* 34(6), 1267-1276.
- **Method validation:** Lazorchak et al. (2015) Proof of concept for the use of macroinvertebrates as indicators of polychlorinated biphenyls (PCB) contamination in Lake Hartwell. *Environ Toxicol Chem* 34 (6), 1277-1282

### Future Directions

#### Toxicity

- FY17 Product: Publication of 3<sup>rd</sup> Edition of EPA's *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*.
- Improved sediment toxicity testing implementation and interpretation of results at Superfund Site
  - Training courses on data interpretation and use
  - Examples illustrating proper implementation and interpretation



#### Passive Sampling

- Development of methods and guidance for predicting residues in higher trophic level aquatic species.
  - FY18 Product: Efficacy of passive sampler-based interstitial water measurements to improve predictions of contaminant concentrations in fish and shellfish
- Development of source identification and tracking methods and guidance
  - FY 17 Product & FY19 Finalize Guidance: A guidance to conduct an assessment to identify and characterize legacy and on-going sources to contaminated sediment sites

#### Remedy & Restoration Effectiveness

- Development and validation of tools and measures for documenting remedy & restoration effectiveness
  - FY 17 Product & FY19 Finalize Guidance: Weight of evidence for assessing remedy effectiveness at a contaminated sediment site

#### Bioaccumulation

- Reduce uncertainties in the prediction of chemical residues in fish and shellfish.
  - Organized session at Battelle Ninth International Conference on Remediation and Management of Contaminated Sediments to generate/start discussions leading to improvements food chain models
  - FY19 Product: Determination of processes causing the apparent increase in bioaccumulation as concentrations in sediments decrease

