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# Incorporating Bioavailability Considerations into the Evaluation of Contaminated Sediment Sites

ITRC Contaminated Sediments Team

The Contaminated Sediments Team is a group of toxicologists, geologists, chemists, biologists and other environmental professionals from 11 State Agencies, DoD, DoE, EPA, 23 Private Industries, Universities and Stakeholders.



Introduction

In 2011, the ITRC Contaminated Sediments Team developed a Web-based Technical Regulatory Guidance on the concepts, process, and use of bioavailability in a risk-based decision framework at contaminated sediment sites. This Guidance describes the fundamental concepts of bioavailability in contaminated sediment management by:

- > outlining how bioavailability considerations can be incorporated into the conceptual site model (CSM) ;
- > identifying and describing available tools (biological, chemical, and predictive) and models that are used to measure and characterize the fate and transport and potential bioavailability of contaminants;
- > modifying remedial goals based on estimates of bioavailability during the exposure assessment and risk evaluation; and,
- > becoming resource to communicate these bioavailability-based conclusions, especially to the public.

## What is Bioavailability?

“...individual physical, chemical, and biological interactions that determine the exposure of plants and animals to chemicals associated with soils and sediment.”  
 (National Research Council, 2003)

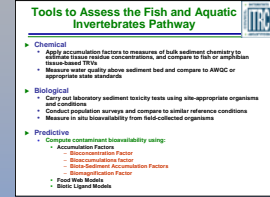
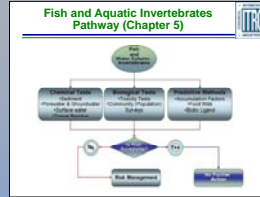
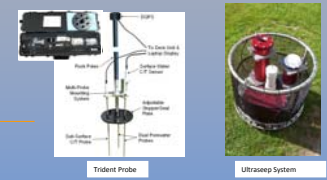
Specifically, **bioavailability** addresses the fact that only a **fraction of the contaminant** concentration present in the environment may be taken up or result in an effect on an organism.

## The Guidance

Provides a description of available tools used for the evaluation of bioavailability in the context of evaluating exposure pathways of benthic invertebrates, fish and aquatic invertebrates, wildlife, plants and human health.

## Why is Bioavailability Important?

- > If contaminants are not physically accessible, or chemically or biologically available, they should not be included in the calculation of risk;
- > Can define the extent of cleanup required to be protective and can be an important factor in balancing the risks caused by remedial action with the risks addressed by remedial action; and,
- > Can provide optimization of remedial approach and cost.



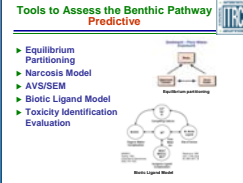
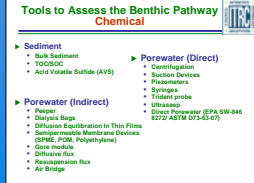
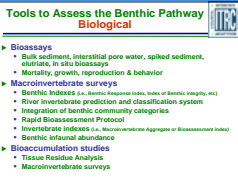
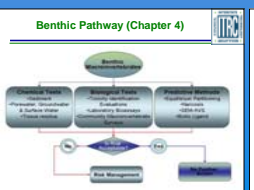
Fish and Aquatic Invertebrates

## Case Studies

A total of 35 case studies were received primarily from state and federal regulators. These case studies incorporated bioavailability considerations into the risk assessment process to obtain a clearer understanding of contaminant toxicity, such that remedy selection decisions can be optimized. An example of how bioavailability was used to understand exposure to contaminants is presented in the Mocks Pond case study:



## Benthic Exposure Pathway & Bioavailability Tools



### Case Study: Mocks Pond Area Muncie, Indiana

- Site History:**
  - Abandoned limestone quarry received treatment sludge from galvanizing (zinc-coated) wire product manufacturer
  - Line added to neutralize the waste solutions before discharge, forming insoluble metal hydroxides.
  - COPI's were heavy metals (i.e., lead, zinc) - present at high conc. (greater than sediment screening criteria).
  - Pond bottom consisted of unconsolidated sediment devoid of organic material & bottom-dwelling insects.
  - Testing suggested that deposited material were stabilized and not biologically available.
- Potential Receptors:**
  - Pelagic fish, snapping turtles, belted kingfishers, great blue herons, raccoon and potentially river otter
  - Limited human exposure with fence.
- CSM:** Hypothesis that sludge-sediment would not support aquatic life and that metal hydroxides are not biologically available through dissociation in porewater or surface water

### Case Study: Mocks Pond Area Muncie, Indiana

- Remedial Action:** Metal contaminated sediments were remediated with installation of a sand cap. The effectiveness of the cap was evaluated through the collection of:
  - in situ* porewater samples collected via large diameter passers (targets only the bioavailable fraction of the metal contamination)
  - surface water samples - metals analysis
- Results of post-remedial monitoring:** metals were tightly sequestered and not biologically available - porewater and surface water results were below applicable standards.

Peppers consisted of dialysis tubing that was diver-operated water placed into a protective mesh, and then inserted for a depth of 10 cm into the sediment

This Guidance was completed in March 2011. A free Internet-based training will be offered during 2011 – 2013 on the proper use of this Guidance visit Contaminated Sediment Project Home page at [www.itrcweb.org](http://www.itrcweb.org).