Upland Placement: Assessment and Management Session

Biological Pathway Evaluations

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Conceptual Model-Upland CDF Contaminant Migration Pathways

- **Dike**
- **Plant / Animal Uptake**
- **Precipitation**
- **Volatilization**
- **Surface Runoff**
- **Leachate**
- **Surface Water**
- **Air Quality**

- **Birds/Wildlife**
- **Unsaturated**
- **Infiltration**
- **Ground Water**
- **Effluent**
CDF: Dredging Disposal Site to Ecologically Productive Site?

- End uses of CDFs: contaminant storage (closed to public), nature preserves, etc.
- Potential for Contaminants of Concern (COCs) from dredging material to bioaccumulation in tissues of plants & animals
- COCs can be passed up the food chain within and outside CDFs
- No regulatory standards for COC uptake by plants & animals in CDFs
- Compliance with CWA & other Federal laws
Potential Issues of Contaminants of Concern (COC) Exposure in CDFs

- End uses of CDFs:
  - Closed to public (contaminant storage)
  - Open to public (nature preserves, recreation)

- Wildlife potential exposure in soil, wetlands, & ponds

- Wildlife migrate in and out of CDF, eating vegetation & other wildlife

- COCs can be passed up the food chain within and outside CDFs

- Humans can eat vegetation in CDFs and hunt wildlife that has eaten in CDFs

- Concern of threatened and Endangered species in CDFs

Deer ⇄ Seagull

Raccoon
How to Evaluate CDF COCs on Terrestrial Fauna?

• Examine COC bioaccumulation

• Bioaccumulation is not an indicator of effect on the on-site organisms, but...

• Bioaccumulation is considered a component of exposure for off-site organisms (receptors of concern (ROCs) (not effects)

  Exception: when ROCs are humans or endangered species

Deer  Seagull  Raccoon
Animal Uptake: Tiered Approach

Evaluated in the context of the conceptual site model:

- Populations of ROCs outside the CDF
- COCs
- Complete exposure routes

Tier I: Initial Evaluation of Animal Bioaccumulation

Tier II: Theoretical Bioaccumulation Potential (nonpolar organic chemicals)

Tier III: Animal Bioaccumulation Test

Tier IV: Regional/Site-Specific Investigation of Animal Uptake & Bioaccumulation
Tier I: Initial Evaluation of Animal Bioaccumulation

- Compilation and evaluation of existing information
- Development of conceptual site model: site characterization and defining complete exposure routes
  1. Describe the dredged material management activity
  2. Identify the kinds and spatial extent of habitats and land uses present in and around the CDF
  3. Identify the off-site animal species and humans that may consume animals that have bioaccumulated COC from the dredged material
  4. Specify the COC for animal bioaccumulation
  5. Describe the mechanisms that may bring COC into contact with a human or ecological ROC
  6. Describe the potential processes of contact between COC and ROC
  7. Describe the complete exposure routes, and eliminate from further evaluation those potential routes that are not complete
Tier II: Theoretical Bioaccumulation Potential (TBP)

Evaluates bioaccumulation potential of nonpolar organic chemicals in earthworms

Bioaccumulation estimated from

- the dredging material’s organic carbon content
- the earthworm lipid content
- the relative affinities of the chemical for sediment organic carbon and animal lipid content (e.g., $K_{ow}$ or $K_d$)

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TBP = BSAF \times \frac{Cs}{TOC \, (\%)} \times \text{Organism Lipid Content (\%)}
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Tier III-Earthworm Bioaccumulation Test

Methods
- Based on ASTM Method E-1676-04
- Approximately 30g biomass
- 28-day exposure to reference soil & dredging materials

Results & Data Interpretation
- Control survival (≥ 90% for test validity)
- Compare results between reference soil & dredging material
  - Life history effects: e.g., individual survival, growth, reproduction
  - COC bioaccumulation
- Extrapolation to conceptual site model and evaluate wildlife at risk of exposure
How to Evaluate CDF COCs on Terrestrial Flora?

- Examine COC bioaccumulation in flora:
  - Plant COCs: Metals >> organic chemicals
  - Unique characteristics of dried sediment that colonizes with plants and animals
  - Bioaccumulation **is not** an indicator of effect on the on-site plants
  - Bioaccumulation **is considered** a component of exposure for off-site ROCs (not effects)

**Exception:** when ROCs are humans or endangered species
Plant Uptake: Tiered Approach

Evaluated in the context of the conceptual site model:
- Populations of ROCs
- COCs
- Complete exposure routes

Tier I: Initial Evaluation of Plant Bioaccumulation

Tier II: Prediction of Plant Bioaccumulation Potential

Tier III: Plant Bioaccumulation Test

Tier IV: Regional/Site-Specific Investigation of Plant Uptake & Bioaccumulation
Tier I-Initial Evaluation of Plant Bioaccumulation

- Demonstrates that contaminant evaluations are needed and that plant bioaccumulation is a contaminant mobility pathway of concern for the project
- Uses the same project-specific conceptual site model developed for animal bioaccumulation
- ROC populations outside the CDF for plant bioaccumulation will be the same as animal bioaccumulation
- Emphasizes identification of complete exposure routes in the context of the conceptual site model.
Tier II-Predicting Plant Bioaccumulation Potential

- Prescreen evaluation of field plant tissue
- DTPA procedure for prediction of plant bioaccumulation potential
- Plant uptake program (PUP): prediction of heavy metals uptake by freshwater plants
Tier III-Plant Bioaccumulation Test

Methods
- *Cyperus*: saltwater terrestrial, freshwater wetland, and freshwater terrestrial habitat; 45-day exposure to reference soil & dredged material
- *Spartina*: saltwater wetland habitat; 90-day exposure to reference soil and dredged material

Results & Data Interpretation
- Control survival (≥ 90% for test validity)
- Compare results between reference soil & dredging material
  - Survival & growth
  - COC bioaccumulation
- Extrapolation to conceptual site model and evaluate wildlife at risk of COC exposure
CDF Management & Controls

- Manage vegetative cover
- Amendments/treatments to reduce bioavailability
- Cap to reduce exposure
- Others more site specific depending on target species
Summary—Biological Pathway Evaluations

• No regulatory standards or criteria for COC uptake by plants & animals in CDFs

• Animal & plant bioaccumulation evaluation is based on a tiered risk-assessment approach
  • Tier I: Conceptual site model
  • Tier II: Animal and plant bioaccumulation potential
  • Tier III: Animal and plant bioaccumulation tests
    • Earthworms, upland (Cyperus) and wetland (Spartina) plants
  • Tier IV: Case-specific uptake & bioaccumulation investigations

• Data from each tier taken into account for weight-of-evidence approach to determining potential risks of COC exposure to off-site ROCs in order to make management decision
Tonight, 7:05 EST on ESPN

Boston Red Sox vs. New York Yankees

Boston introduces its Rookie left-handed pitcher, Bruce Banner, to replace Curt Schilling in the pitching rotation

“He’s got a monster fastball!” says Varitek