



# **River Systems Investigations Update TVA Kingston Ash Recovery Project**

**Presentation 5 of 6**

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**May 17, 2012**

- Purpose
- Overview of presentation series
- Human Health Risk Assessment
- Baseline Ecological Risk Assessment



# Purposes of Briefings

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- Process leading to residual ash decision
- Information that will support decision
- Preview results of river investigations



# Preview of “Upcoming Attractions”

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## Tonight’s focus:     *Risk Assessment Process and Results*

April 5:     Residual ash nature & extent, transport modeling

April 19:   Aquatics Results  
(toxicity testing, bioaccumulation in invertebrates & fishes)

May 3:     Wildlife Results  
(birds, turtles, mammals, plants)

May 17:   **Human Health Risk Assessment**  
**Ecological Risk Assessment Process**

June 7:    Development of General Response Actions  
Alternatives Evaluation

## Purposes:

- Support decision-making process for the River System
  - Engineering Evaluation/Cost Analysis (EE/CA)
- Human Health Risk Assessment (HHRA) evaluates the potential effects on people of ash residuals in the river system
- Baseline Ecological Risk Assessment (BERA) evaluates the potential effects on biota of ash residuals in the river system



# HHRA Receptors and Exposures

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- Adult and Child Off-Site Residents
  - Surface water – household use (i.e., potable water)
  - Fish Consumption – fillet only  
(approximately 1 pound/week, every week)
- Adult and Adolescent Recreators
  - Surface water – swimming
  - Sediments – during winter pool when Watts Bar Reservoir is lowered (e.g., beachcombing)
- Risks evaluated reach-by-reach

- Cancer Risk
  - EPA acceptable excess cancer risk range of  $10^{-6}$  to  $10^{-4}$
  - Acceptable risk: *increase above background cancer rate* of one additional person in 1 million to 1 additional person in 10,000 developing cancer

- Non-Cancer Hazards

- Expressed in terms of Hazard Quotient (HQ) and Hazard Index (HI)

$$\text{HQ} = \text{Daily intake/Reference Dose}$$

$$\text{HI} = \text{HQ}_1 + \text{HQ}_2 + \text{HQ}_3 + \dots$$

- Reference Dose: An estimated daily dose that is likely to cause no adverse effects over a 70-year lifetime of exposure
- HQ or HI > 1 indicates concern for potential non-cancer health effects



# HHRA Results—Residents and Recreators

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- No unacceptable human health risks associated with residual ash
  - Ash-related excess cancer risks generally well below  $10^{-4}$
  - Ash-related HQs & HIs typically ranging from 0.01—1.0
  
- Continuing risks for fish consumption due to legacy contamination (Hg, PCBs)
  - Excess cancer risk slightly greater than  $10^{-4}$
  - Non-cancer risk Hazard Index  $>1$  for fish consumption





# River System BERA Approach

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- Comprehensive and Robust
  - All potentially exposed and sensitive receptors evaluated
  - Emphasis on site-specific data
  - Several types of data collected
- Lines of Evidence (LOEs) combined using Weight-of-Evidence (WOE) process
- Recommendations for Risk Management
  - Final step in characterization of risk



# BERA Agenda

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- BERA Bottom Line (key findings)
- What is Ecological Risk Assessment?
- BERA Approach for the River System Investigation
- Summary and Recommendations by Receptor
- Summary and Recommendations by Reach
- Conclusions

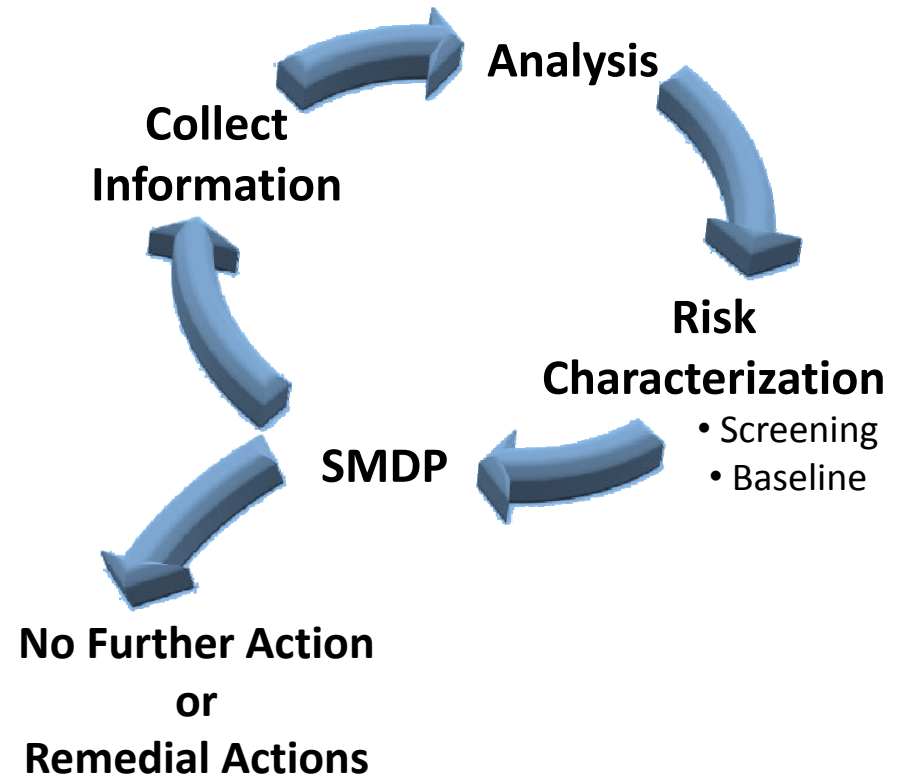
# Key Findings

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- No ecological receptors at High Risk
- One receptor at Moderate Risk w/ Risk Management Recommended
  - Benthic invertebrate community in Emory River.
- Two receptors at Low Risk w/ Risk Management Recommended
  - Birds feeding on benthic invertebrates (e.g., killdeer) in the Emory and Clinch Rivers.
  - Birds feeding on flying insects (e.g., tree swallow) over the Emory and Clinch Rivers.
- All other receptors at Negligible or Low Risk w/ No Risk Management Recommended
  - Fish community, aquatic vegetation, and populations of heron, osprey, mallard, wood duck, mink, raccoon, muskrat, gray bat, amphibians, and reptiles.

# What is Ecological Risk Assessment?

- Iterative Process
  - Starts simple and highly conservative
  - Becomes more detailed and realistic
  - Focus on potential risk drivers
- Estimates the magnitude and likelihood of adverse effects
- Scientifically sound
- Transparent
  - Details and assumptions provided
  - Uncertainties described
- Based on EPA guidance





# River System BERA Approach

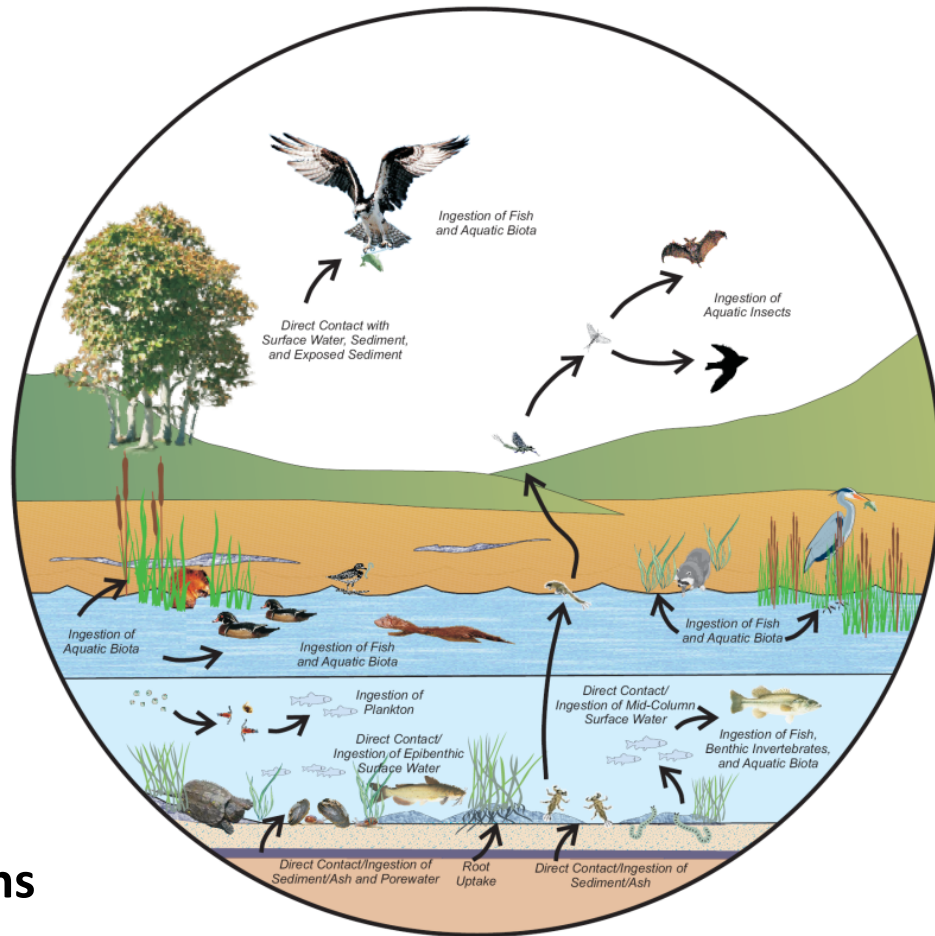
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# Plants and Animals Evaluated (Assessment Endpoints)

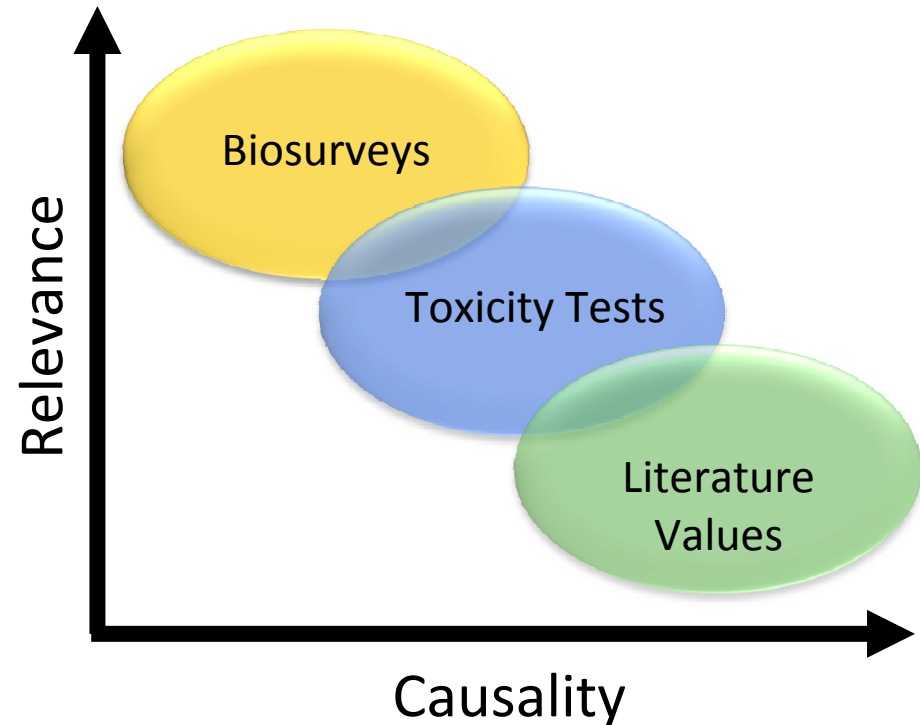
## Protection of balanced communities or populations of:

- **Fishes**
- **Benthic invertebrates**
- **Aquatic plants**
- **Aquatic- or riparian-feeding birds**
  - Herbivores (wood duck)
  - Omnivores (mallard; killdeer)
  - Piscivores (osprey; great blue heron)
- **Aquatic- or riparian-feeding mammals**
  - Herbivores (muskrat)
  - Omnivores (raccoon)
  - Piscivores (mink)
- **Aerial-feeding insectivores**
  - Birds (tree swallow)
  - Mammals (gray bat)
- **Aquatic- or riparian-feeding amphibians**
- **Aquatic- or riparian-feeding reptiles**



# Types of Data (Lines of Evidence)

- Field Studies (Biosurveys)
  - Population and community data
  - Fish community
  - Benthic Invertebrate Community
  - Tree swallow nest box surveys
  - Turtle trapping
- Laboratory Studies
  - Toxicity tests
  - Surface water
  - Sediment and ash
- Toxicity Benchmarks
  - Literature-derived effects values
  - Concentrations in water and sediment
  - Concentrations in the receptor (tissue)
  - Concentrations in food items (diet)



# Putting it All Together (Weight-of-Evidence)

- Not a Mathematical Formula
  - Analyses are quantitative, but
  - Conclusions are qualitative
- Potential Risk
  - High
  - Moderate
  - Low
  - Negligible
- Confidence in Risk Determination
  - High
  - Moderate
  - Low
- Risk Management Recommended?
  - Yes or No
  - If Yes, what are the Constituents of Ecological Concern (COECs)







# BERA Risk Summary by Receptor

**Table ES-1. Weight of Evidence Risk Characterization Summary by Receptor**  
 Tennessee Valley Authority      Kingston, Tennessee

Receptors	Potential Risk	Confidence in Risk Determination	Risk Management Recommended?	COECs
Fish	⊘	Moderate		
Benthic Invertebrates	● (ER) ○ (CR)	High	✓	As, Se, Ash
Aquatic Vegetation	○	Moderate		
<i>Birds</i>				
Piscivore - Heron	⊘	Moderate		
Piscivore - Osprey	⊘	Moderate		
Insectivore - Killdeer	○	Low	✓	As, Se
Omnivore - Mallard	○	Moderate		
Herbivore - Wood Duck	⊘	Moderate		
Aerial Insectivore - Tree Swallow	○	Moderate	✓	Se
<i>Mammals</i>				
Carnivore - Mink	○	Low		
Omnivore - Raccoon	○	Low		
Herbivore- Muskrat	⊘	Low		
Aerial Insectivore - Gray Bat	○	Low		
<i>Amphibians</i>				
American Toad, Spring Peeper and Chorus Frogs	⊘	Moderate		
<i>Reptiles</i>				
Musk, Snapping, and Softshell Turtles	⊘	Moderate		

⊘ = risks are negligible; ○ = risks are low; ◐ = risks are moderate; ● = risks are high; ✓ = risk management is recommended.

COECs = Constituents of ecological concern.

ER = Emory River; CR = Clinch River.



# BERA Risk Summary by Reach

Table ES-2. Receptor Risk Management Recommendations by Reach  
Tennessee Valley Authority      Kingston, Tennessee

Receptors	Emory River			Emory River			Emory River			Clinch River			Clinch River			Tennessee River			Tennessee River		
	Reach C			Reach B			Reach A			Reach B			Reach A			Reach B			Reach A		
	Risk	Mgt?	COECs	Risk	Mgt?	COECs	Risk	Mgt?	COECs	Risk	Mgt?	COECs	Risk	Mgt?	COECs	Risk	Mgt?	COECs	Risk	Mgt?	COECs
Fish	∅			∅			∅			∅			∅			∅			∅		
Benthic Invertebrates	●	↓	As, Se, Ash	●	↓	As, Se, Ash	●	↓	As, Se, Ash	○			○			○			○		
Aquatic Vegetation	○			○			○			○			○			∅			∅		
<i>Birds</i>																					
Piscivore - Heron	∅			∅			∅			∅			∅			∅			∅		
Piscivore - Osprey	∅			∅			∅			∅			∅			∅			∅		
Insectivore - Killdeer	∅			○	↓	Se	○	↓	As, Se	○	↓	Se	○	↓	Se	∅			∅		
Omnivore - Mallard	∅			∅			∅			∅	↓	Se	∅	↓	Se	∅			∅		
Herbivore - Wood Duck	∅			∅			∅			∅			∅			∅			∅		
Aerial Insectivore - Tree Swallow	∅			○	↓	Se	○	↓	Se	○	↓	Se	○	↓	Se	∅			∅		
<i>Mammals</i>																					
Carnivore - Mink	∅			○			∅			○			○			∅			○		
Omnivore - Raccoon	∅			○			∅			○			○			∅			○		
Herbivore - Muskrat	∅			∅			∅			∅			∅			∅			∅		
Aerial Insectivore - Gray Bat	∅			○			○			○			○			∅			∅		
Amphibians	∅			∅			∅			∅			∅			∅			∅		
Reptiles	∅			∅			∅			∅			∅			∅			∅		

∅ = risks are negligible; ○ = risks are low; ● = risks are moderate; ● = risks are high; ↓ risk management is recommended.  
COECs = Constituents of ecological concern; Mgt = Management.

# BERA Summary and Recommendations

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- Ecological risks from exposure to ash or ash-related COECs are, at most, moderate in the Emory River and low or negligible elsewhere in the river system.
- None of the assessment endpoints are estimated to be at high potential risk in any of the river reaches.
- Ecological risks related to residual ash and ash-related COECs are primarily associated with:
  - Direct exposures to ash, arsenic, and selenium in surface sediment
  - Dietary exposures to arsenic and selenium via consumption of invertebrates that inhabit ash-impacted surface sediments
- Risk Management is Recommended for:
  - Benthic invertebrate community in Emory River.
  - Birds feeding on benthic invertebrates (e.g., killdeer) in the Emory and Clinch Rivers.
  - Birds feeding on flying insects (e.g., tree swallow) over the Emory and Clinch Rivers.



# Preview of “Upcoming Attractions”

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June 7: Development of General Response Actions  
Alternatives Evaluation