BASELINE ECOLOGICAL RISK ASSESSMENT STRATEGY FOR THE TVA KINGSTON FLY ASH RECOVERY PROJECT

D. Jones[1], S. Young[1], A. Stojak[1], N. Carriker[2], M. Stack[3]

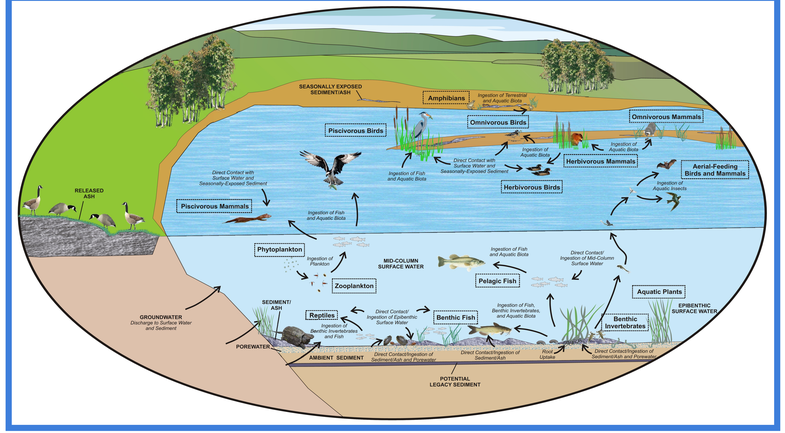
[1] ARCADIS, Knoxville, TN; [2] Tennessee Valley Authority, Kingston Ash Recovery Project, Kingston, TN; [3] Jacobs, Oak Ridge, TN

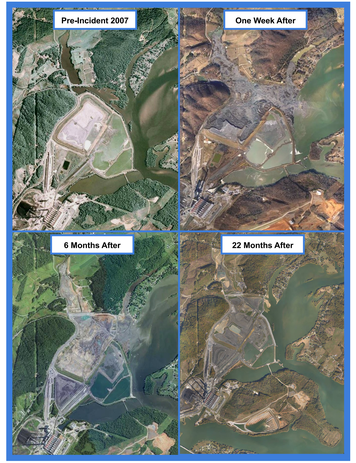
ABSTRACT

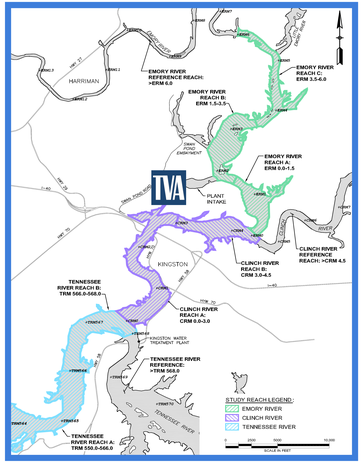
The release of fly ash at the Tennessee Valley Authority (TVA) Kingston Fossil Plant on December 22, 2008 discharged approximately 5.4 million cubic yards of coal ash slurry into the adjacent aquatic and terrestrial systems. The initial response focused on public protection and stabilization of the released ash, but rapidly evolved to include comprehensive monitoring of ambient media and ecological receptors. Metals and metalloids are the primary constituents of potential concern for fly ash. A Conceptual Site Model (CSM) was developed to summarize and illustrate the ecological receptors and potential exposure pathways associated with the release.

The Screening Level Ecological Risk Assessment (SLERA) indicated that a Baseline Ecological Risk Assessment (BERA) is warranted for the River System. The direct exposure pathways being evaluated for the River System include exposures to ash as sediment, sediment porewater, groundwater discharging to surface water, surface water, and seasonally-exposed sediment. Dietary exposures are also a concern for some ash-related constituents, including arsenic and selenium. The ecological receptors for which bioaccumulation and food web pathways are being studied at this site include fish, benthos, emergent insects, piscivorous birds and mammals, aerial-feeding insectivores, herbivorous birds, omnivorous mammals, amphibians, reptiles, and others. The BERA strategy presented in this poster was used to develop data quality objectives for the River System Investigation and identify additional data needs. The CSM and BERA Strategy were then used to refine the numerous field and laboratory studies being performed or supported by TVA, many of which are presented in this poster session.

CONCEPTUAL SITE MODEL: PICTOGRAPH



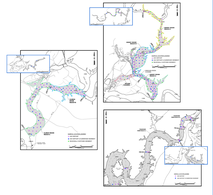




SAMPLING PLAN SUMMARY

RIVER REACHES:

- Emory River
  - Reference; Reaches A, B, C
- Clinch River
  - Reference; Reaches A, B
- Tennessee River
  - Reference; Reaches A, B



ASH DEPOSITS:

- Vibracore samples taken from upper 6 inches of sediment
- Locations: Emory, Clinch, and Tennessee Rivers

SEASONALLY-EXPOSED SEDIMENT:

- Hand-auger samples taken of upper 6 inches of sediment that is exposed on river banks during winter pool when the reservoir is low
- Locations: Emory and Clinch Rivers

SUBMERGED SEDIMENT:

- Ponar or Vibracore samples taken of upper 6 inches of completely submerged sediment
- Locations: Emory, Clinch, and Tennessee Rivers
- Bioassays –
  - Locations: Emory and Clinch Rivers
  - Whole sediment samples
  - Screening and long-term exposures
  - Test organisms: *H. azteca*, *C. dubia*, *C. tentans*

SEDIMENT POREWATER:

- Box core samples taken of upper 6 inches of interstitial water and surrounding grains of sediment
- Co-located with sediment bioassay tests
- Locations: Emory and Clinch Rivers

SURFACE WATER:

- Epibenthic and mid-column water depths
- Locations: Emory, Clinch, and Tennessee Rivers
- Bioassays –
  - Test organisms: *C. dubia*, *P. promelas*

BENTHIC INVERTEBRATES:

- Bioaccumulation and Community Studies –
  - Snails, Mayflies (nymphs and adults)
  - Benthic invertebrate community metrics
  - Locations: Emory, Clinch, and Tennessee Rivers

FISH:

- Bioaccumulation and Community Studies –
  - Largemouth bass, bluegill, channel catfish, gizzard shad, threadfin shad
  - Locations: Emory and Clinch Rivers
  - Fish community metrics

WILDLIFE AND AQUATIC VEGETATION:

- Bioaccumulation Studies –
  - Tree swallow and great blue heron eggs/nestlings
  - Locations: Nest colonies on the site
  - Emergent vegetation and periphyton
  - Locations: Emory, Clinch, and Tennessee Rivers
- Community Surveys –
  - Tree swallow and great blue heron
  - Evaluating: clutch size, hatchling success, physical conditions
  - Locations: Nest colonies on the site

ASSESSMENT ENDPOINTS

PELAGIC FISH
BENTHIC FISH
BENTHIC INVERTEBRATES
AQUATIC PLANTS
AQUATIC- OR RIPARIAN-FEEDING HERBIVOROUS BIRDS
(wood duck; *Aix sponsa*)
AQUATIC- OR RIPARIAN-FEEDING OMNIVOROUS BIRDS
(mallard; *Anas platyrhynchos*)
(killdeer; *Charadrius vociferous*)
AQUATIC- OR RIPARIAN-FEEDING PISCIVOROUS BIRDS
(osprey; *Pandion haliaetus*)
(great blue heron; *Ardea herodias*)
AQUATIC- OR RIPARIAN-FEEDING HERBIVOROUS MAMMALS
(muskrat; *Ondatra zibethicus*)
AQUATIC- OR RIPARIAN-FEEDING OMNIVOROUS MAMMALS
(raccoon; *Procyon lotor*)
AQUATIC- OR RIPARIAN-FEEDING PISCIVOROUS MAMMALS
(mink; *Neovision vision*)
AERIAL-FEEDING INSECTIVOROUS BIRDS
(tree swallow; *Tachycineta bicolor*)
AERIAL-FEEDING INSECTIVOROUS MAMMALS
(gray bat; *Myotis grisescens*)
AQUATIC- OR RIPARIAN-FEEDING REPTILES
AQUATIC- OR RIPARIAN-FEEDING AMPHIBIANS

ECOLOGICAL MEASUREMENT ENDPOINTS

LITERATURE VALUES: DIRECT CONTACT

Constituent concentrations in ambient media compared with no-observed-adverse-effect levels (NOAELs), lowest-observed-adverse-effect levels (LOAELs), and chronic values.

- Fish: Pelagic Benthic
- Benthic Invertebrates
- Aquatic Plants: Emergent Vegetation Periphyton
- Amphibians (?) Reptiles (?)

LITERATURE VALUES: FOODWEB

Measured or estimated concentrations in prey and in incidentally ingested ambient media compared with literature derived toxicity reference values (TRVs).

- Birds: Herbivores Omnivores Piscivores
- Mammals: Herbivores Omnivores Piscivores
- Aerial-Feeding Insectivores: Birds Mammals

BIOSURVEYS

Direct measurements of the quality of the biological community. Biological studies conducted for the river system include biological characterization, monitoring, and assessment data from a variety of studies and sources.

- Benthic Invertebrates: Body burden, community metrics
- Pelagic and Benthic Fish: Body burden, community metrics
- Amphibians: Body burden
- Piscivorous Birds: Eggs, nestlings, community surveys (clutch size, hatchling success, etc.)
- Reptiles: Body burden
- Aerial-Feeding Insectivorous Birds: Eggs, nestlings, community surveys (clutch size, hatchling success, etc.)
- Omnivorous Mammals: Blood, organ status

LITERATURE VALUES: BODY BURDEN

Body burden effects data (whole or organ) compared with toxicity data found in the literature. Specific focus on arsenic and selenium.

- Fish: Pelagic Benthic
- Amphibians
- Birds: Herbivores Omnivores Piscivores
- Reptiles
- Mammals: Herbivores Omnivores Piscivores
- Aerial-Feeding Insectivores: Birds

BIOASSAYS

Bioassays, or toxicity testing, may be appropriate when the evaluation of chemical data indicates that toxicity to fish or invertebrates is possible, but the likelihood of toxicity is uncertain. Conducted on submerged sediment, and surface water.

- Fish: Pelagic Benthic
- Benthic Invertebrates