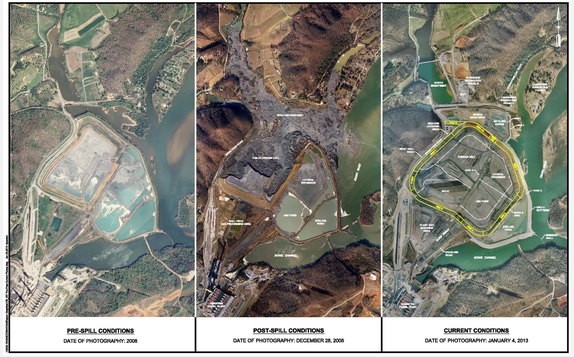
Lessons Learned - Biological Collection, Preparation, and Analysis Associated with the TVA Kingston Ash Recovery Project

Erin E. Rodgers, Ruth L. Forman, Rock J. Vitale, Jennifer N. Gable - Environmental Standards, Inc.
Mark Stack - Jacobs Engineering
Suzy Walls - Arcadis

Abstract

On December 22, 2008, an ash storage cell dike failure at the Tennessee Valley Authority (TVA) Kingston Fossil Plant in Kingston, Tennessee, resulted in the release of an estimated 5.4 million cubic yards of fly ash into the surrounding environment. As part of the comprehensive monitoring program initiated following the release, TVA expanded its historical biological monitoring activities to include the sampling of a broad variety of biological specimens (*e.g.*, tree swallows, blue heron, osprey, benthic macro invertebrates, amphibians, turtles, and raccoons) for analysis of a suite of 26 ash-related metals constituents. Personnel from several organizations collaborated during the sample collection, processing, analysis, quality control, and data evaluation processes. A coordinated effort was vital to ensuring data collected was of the highest quality.



Biological Matrices Sampled

Fish

Bluegill, Channel Catfish, Bass, Gizzard Shad

Birds

Tree Swallows, Blue Heron, Osprey, Canada Geese

Benthic Invertebrates

Mayfly Adults, Mayfly Nymphs, and Snails

Amphibians

Chorus Frogs, Spring Peepers

Turtles

Common Musk, Slider, Snapping Turtle

Raccoons

Lessons Learned

Early Communication and Planning between Field Personnel, Laboratories, Data Reviewers, and End Data Users is Necessary

Field readiness reviews ensure all project personnel are aware of requirements and goals of sampling event and highlight health and safety concerns.

- Reduces redundant or unnecessary collections
- Ensures collections meet project needs
- Attain regulatory requirements or variances
- Allows laboratories to plan for influx of large numbers of samples
- Establishes priorities for collection
- Establishes priorities for analysis

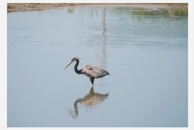
Sampling

- Collection of biological samples timed to correspond with breeding season
- Tree swallow eggshells are not strong enough to write field IDs directly on eggshells. Goose, heron, and osprey eggs are.
- When storing amphibians, keep aquariums moist to avoid desiccation of specimens.
- Turtles can escape! Hold turtles in bins with secured lids.
- Control snapping turtles with bite stick and rope wrapped around the end of the carapace.
- Mark snapping turtles with a sanding tip attached to a dremel.

Chain-of-Custody Preparation

- Proper, complete COC Records are the focal point of maintaining data defensibility.
- Multiple levels of COC review help ensure COCs are complete and correctly filled out.
- Preservation, labeling, packing, and shipping expectations should be shared with all parties.
- UPS and FedEx have non-declared dry ice limit of 5.5 pounds. Dry ice over this amount needs to be marked as requested by the carrier.

Analysis and Quality Assurance Oversight



- Weekly coordination calls to prioritize large number of samples.
- Due to large number of samples, laboratory added capacity in the form of additional facilities and purchased new instrumentation.
- Low RLs that were also highly defensible were requested. Verified lab could see RLs with each sequence.
- Published storage requirements and holding times have not been established for metals and mercury in freeze-dried tissue samples. Several lines of evidence exist to support long-term ambient storage of freeze-dried samples. The project utilized a conservative 1-year holding time.
- Due to small sample masses for several biological matrices, ICP/MS was used to analyze both metals and mercury. Split sample comparability revealed a low bias for mercury using ICP/MS. Project moved to direct mercury analysis (DMA) to analyze biological samples for mercury. DMA results on SRM samples showed good comparability. DMA utilizes very small sample masses.
- Biological data must be reported in the same basis as benchmark values - Dry-weight, Wet-weight, Freeze-dried, or as-received
- Sufficient sample mass should be submitted if percent moisture determinations are required to report data on a dry-weight basis.
- Additional QC samples, above and beyond normal, were required to be analyzed with all biological samples:
  - Processing equipment blanks – aqueous samples or product samples used during sample collecting, handling, aliquoting.
  - Homogenization rinsate blanks – Ice chips samples carried through the homogenization apparatus used to prepare samples.
  - Matrix-metered laboratory spikes – Chicken breast matrix used as the medium for LCS samples.
  - Standard reference materials – Commercially available biological tissue references with certified concentrations of target analytes.

Acknowledgements