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Introduction

Between 1929 and 1950, mercury (Hg) was released to the South River from a former textile plant in Waynesboro, Virginia. These releases resulted in increased Hg concentrations in biotic and abiotic media, which have not declined over the past thirty years, as originally expected. Interim remedial measures (IRM), have been designed to reduce Hg loading within the first few river miles to mitigate potential human and ecological exposure to Hg. A monitoring program incorporating multiple lines of evidence, has been initiated to document the potential reduction in Hg concentrations in a range of endpoints at differing spatial and temporal scales. Details of the monitoring plans and focus on the benefit of concurrent data collection are presented.

Approach

- Spatial extent: South River and South Fork Shenandoah River, Virginia
- Short-term Monitoring (STM): 2 to 10 years, ~2 river miles
- Long-term Monitoring (LTM): >10 years, ~160 river miles
- Multiple lines of evidence (Table 1 and Figure 1)
- Adaptive management to inform remedial decision-making

Table 1: Monitoring Elements

Monitoring Element	STM	LTM
Hg in Biotic Media		
Bass (largemouth and smallmouth) (muscle tissue)		✓
Snapping Turtle (toenails)		✓
Mallard Duck (muscle tissue)		✓
Mayfly (whole body)		✓
Transplanted Clam (tissue)	✓	✓
Periphyton	✓	✓
Carolina Wren (blood)		✓
Wolf Spider (whole body)		✓
Earthworm (whole body)		✓
Hg in Abiotic Media		
Sediment	✓	✓
Soil		✓
Surface Water		✓
Pore Water	✓	
Habitat Metrics		
Benthic Invertebrate Community	✓	✓
Substrate Condition	✓	✓
Terrestrial and Aquatic Habitat	✓	

Figure 1: Monitoring Elements
A) Periphyton; B) Wolf Spider; C) Interstitial Sediment; D) Transplanted Clams; E) Benthic Invertebrate Community

Lines of Evidence

- LTM lines of evidence (monitoring media)
- Pre-remedy, baseline total mercury (THg) conditions in select exposure media
- Strong relationship evident among LTM aquatic ecological exposure media (Figure 2) and LTM terrestrial ecological exposure media (Figure 3)

Figure 2: LTM Aquatic Ecological Exposure[1]

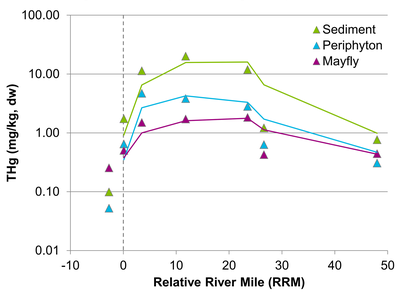
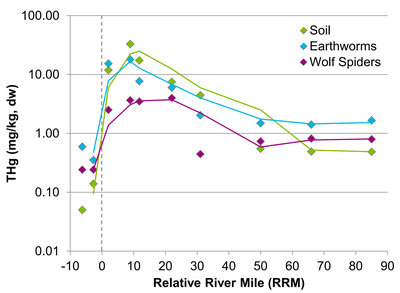


Figure 3: LTM Terrestrial Ecological Exposure[1]



- Strong relationship evident among LTM human exposure media (Figure 4)
- Bass tissue and snapping turtle (*Chelydra serpentina*) toenail THg are positively correlated (R2=0.94) (Figure 5)

Figure 4: LTM Human Exposure[1]

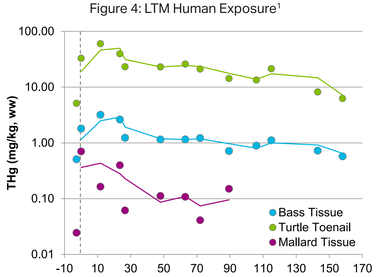
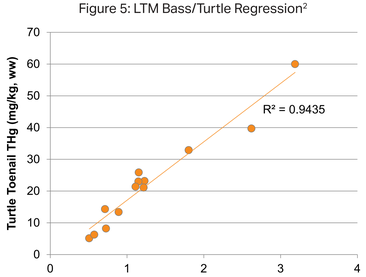


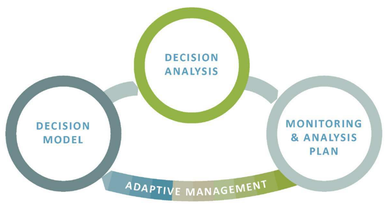
Figure 5: LTM Bass/Turtle Regression[2]



Adaptive Management

- Structured/iterative decision-making process (Figure 6)
- Defines specific objectives of remediation
- Reduces uncertainty
- Integrates STM and LTM data
- Evaluates remedial effectiveness / potential attainment of remedial action objectives
- Recognizes natural variability in ecological systems and measures of remedial effectiveness
- Provides a range of alternatives

Figure 6:Adaptive Management Approach



Discussion

- Synergistic lines of evidence establish pre-remedy conditions on a large spatial scale
- Strong relationship among exposure media indicate the opportunity to revisit the design of the monitoring program, as per the adaptive management framework
- Post-remedy monitoring intends to evaluate progress toward attainment of remedial action objectives

[1] *Individual points represent location-specific mean THg concentrations based on multiple replicate samples collected from 2014 to 2016; moving average (rolling mean; 2 points) trendline represents the average trend of data on a downstream spatial scale.*

[2] *Individual points represent location-specific mean THg concentrations based on multiple replicate samples collected from 2014 to 2016; linear trendline represents regression between bass tissue and turtle toenail THg concentrations (calculated R-squared value displayed).*

The work described in this poster has been performed in conjunction with the South River Science Team (SRST),a multi-stakeholder group including representatives from local, state and federal governments, academia, environmental groups and DuPont. The SRST is a collaborative team created to provide input into the watershed-level, risk-based assessment framework to address mercury in the system.

For more information visit the South River Science Team website! ➔ http://southriversciencteam.org/