# Hg in the South River Conceptual System Model
## as Working Hypotheses and Observations

South River Science Team
Expert Panel Meeting
Oct 21-22, 2008
Nancy R Grosso

# Conceptual Model Working Hypotheses / Observations

A. External Sources of mercury to the river

   E. Distribution of mercury in the floodplain

B. Internal Sources of mercury to the river

C. Methyl mercury in the river system

D. Mercury loading and transport

   DB. Baseline Flow Conditions

   DA. Storm Flow Conditions

F. Mercury in Biological Tissue

**Working Hypotheses and Observations:**

## A. External Sources of Total Mercury to the River

- A1: The largest inventory of mercury in the SR system is in the 5 year flood plain (confirmed)
- A6: The floodplain from RRM 0 to 12 contains more mercury mass than the floodplain from RRM 12 to 25
- A2: THg is introduced to the river from floodplain soils primarily through eroding banks. Banks with elevated THg concentrations are a significant source of THg to the river.
- A5: Plant site outfalls are the most upstream source and may account for more than five percent of dissolved mercury loading in the upper river reach (first 12 miles)

**Working Hypotheses and Observations:**

# E. Distribution of Mercury in the Floodplain / Bank

- E2: Distribution of THg in the floodplain is determined by geomorphic setting and distance from the plant site.
- E3: In places, river bank soils are enriched in THg within a discrete zone approximately 1 to 2 ft. above ordinary high water. This interval may represent a time period of peak Hg release (ca. 1945)
- E4: In general, Hg concentrations in soil decrease with distance from the river. Overall Hg distribution is patchy partially due to local historic topography. Some of the historic mill races also show relatively high concentrations of mercury depending on the time of dam failure.

**Working Hypotheses and Observations:**

# B. Internal Sources of Total Mercury to the River

- B1: Fine-grained particles in the river upstream are enriched in THg compared to downstream. Furthermore, the volume of fine-grained river deposits in the upstream reach of SR is greater than in the downstream reach.

- B4: Some of the fine-grained deposits in / near the river were accreting during the period of mercury use at the site and a subset of these “age-release” deposits are currently eroding.

- B6: In-stream gravel bars/beds contain entrained fine-grained particles with associated Hg. This mercury partitions to pore water and is released to the water column through hyporheic flow or bed turnover.

**Working Hypotheses and Observations:**

# C. Methyl Mercury in the South River

- C1: In the water column, the bioavailable pool of Hg is a fraction of the filtered Hg.
- C2: Current MeHg production rates are at a system maximum.
- C4: The decline of MeHg production in summer relative to spring may be due to:
  - Increase in demethylation rates
  - Change in mercury speciation to non-bioavailable forms
  - Shift in the types of microbial organisms, or
  - Decrease in periphyton
- C7, 8, 10, 11: Sites within the South River that are conducive to MeHg production are low in DO and occur in discontinuous patchy areas: just below the sediment water interface, within periphyton biomass, or within biofilms. Initial estimates indicate that river bottom flux can account for approximately 20% of the FMeHg measured in the water column.

**Working Hypotheses and Observations:**

# DA. Mercury Loading and Transport - Storm Flow

- DA3: During higher flows when bank full conditions are nearly met (1000 to 2000 cfs), THg increases in the water column as a result of entrainment of bed sediments and additional bank soil erosion.
- DA4: During storm events an overall dilution effect is seen on the concentration of THg on TSS due to an influx of fine ”clean” particles
- DA6: During storm events, the majority of filtered mercury is loaded above RRM 9.9 (Observation)
- DA7: During storm events, THg mercury loading notably occurs at RRM 5.1 and RRM 9.9 (Observation)

**Working Hypotheses and Observations:**

# DB. Mercury Loading and Transport – Baseline Flow

- DB.5: Baseline flow conditions are more significant for ecological exposure because low- to moderate-flow conditions predominate over the course of a year.
- DB.4: At baseline flow conditions, the majority of MeHg loading occurs between RRM 3.0 to RRM 11.8 (Observation)
- DB.3: As discharge rate in the river increases, the location of the maximum filtered THg loading migrates downstream (Observation)

**Working Hypotheses and Observations:**

# F. Mercury in biological Tissue

- F.1: MeHg concentrations in biological tissue increase 4.6 fold for every trophic level increase (observation).

- F.2: Feeding behavior influences methylmercury concentrations in the South River aquatic food web.
  - Clam tissue methylmercury concentrations show seasonal trends that are similar to those seen in surface water concentrations
  - Crayfish tissue show little seasonal variation

# CSM and Working Hypotheses (spreadsheet)

- Spreadsheet updates are ongoing
- Following October Expert Panel Meeting,
  - Working Hypotheses regarding Biological components to be added
  - Latest working hypotheses to be circulated
- Input, updates and corrections will be requested. Comments from team members are tracked on the spreadsheet