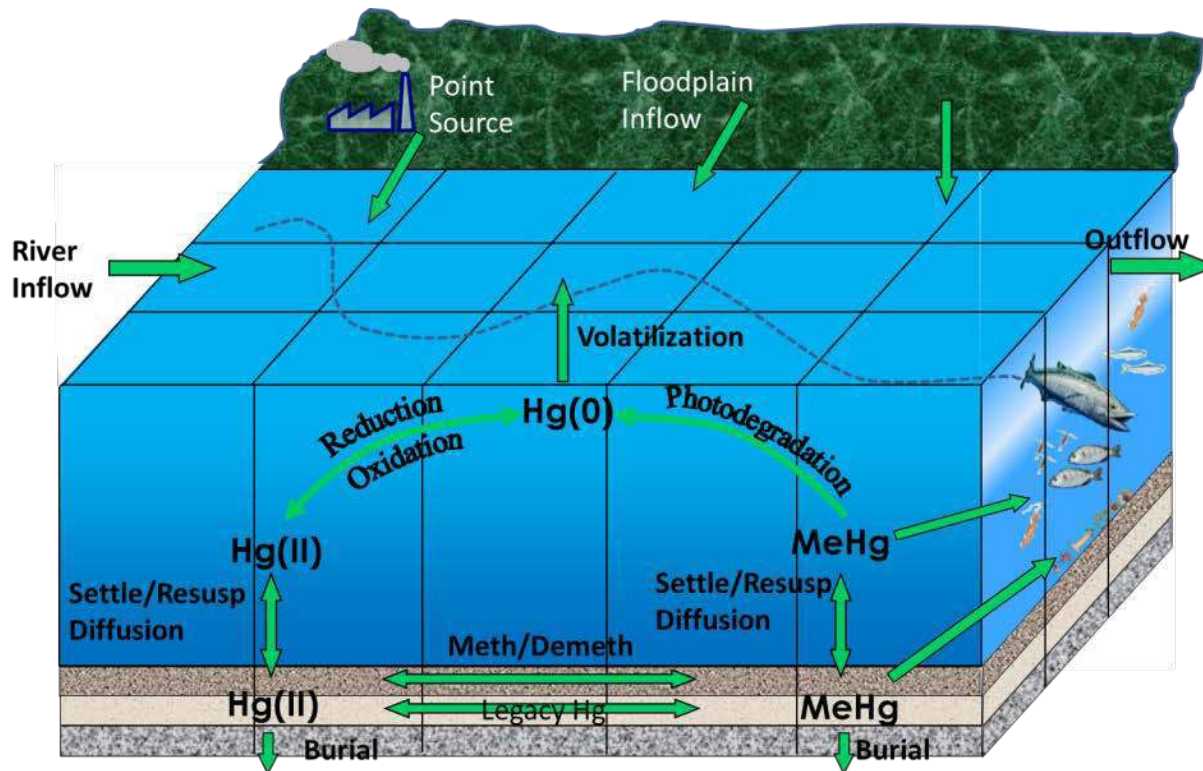


Mechanistic Mercury Modeling in the South River



Reed Harris and David Hutchinson
RHE Ltd.

October 21, 2015

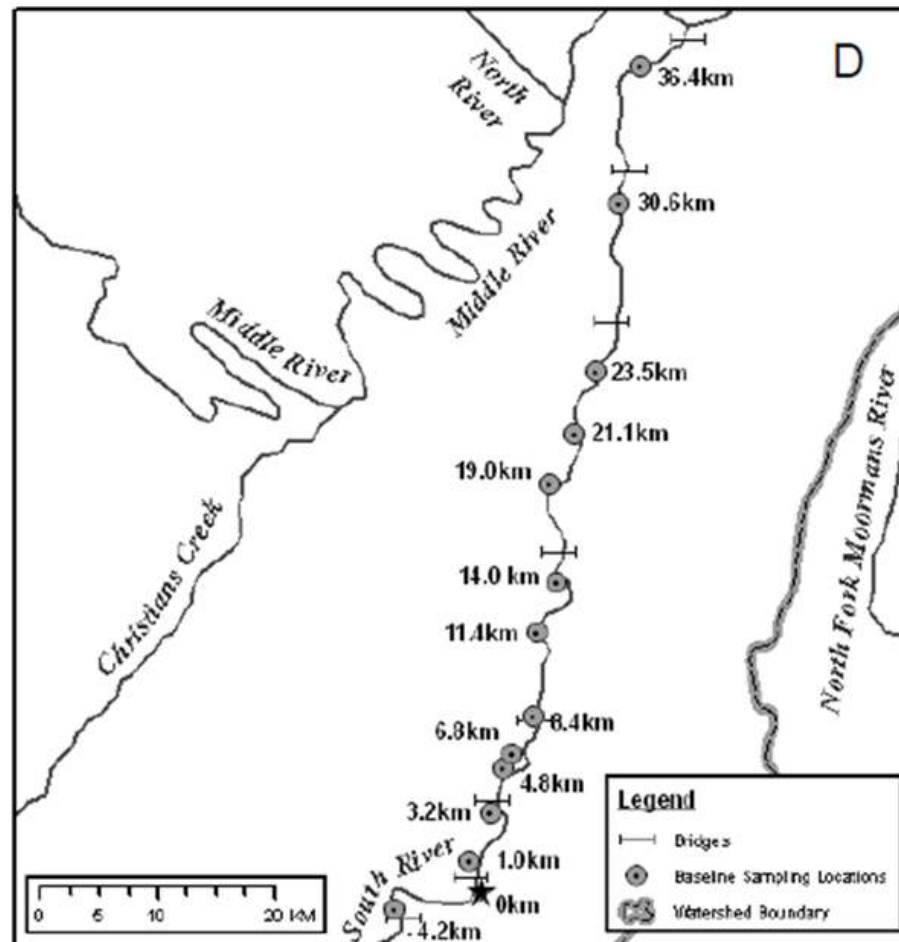
Objectives

- Help predict benefits of bank stabilization.
- Help interpret monitoring data.
- Integrate multi-disciplinary studies.
- Help address uncertainty
- Provide another line of support for decisions (EAM).

Key question to help address with a model:

What will happen to fish mercury levels after bank stabilization?

- Magnitude
- Timing
- Effects at different locations



Observed Hg concentrations along the South River (Source: VDEQ, 2008)

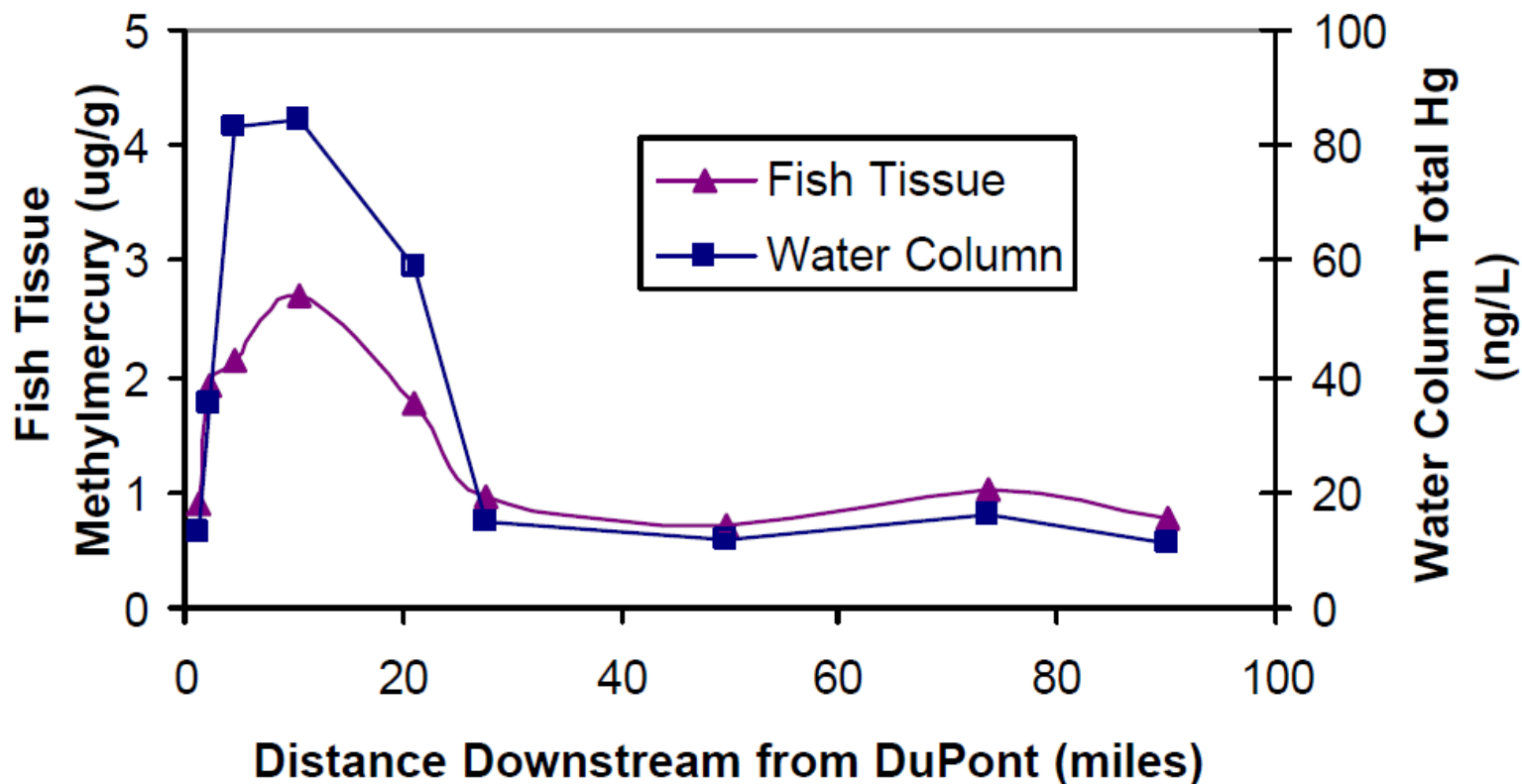
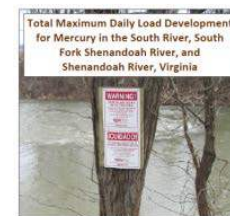
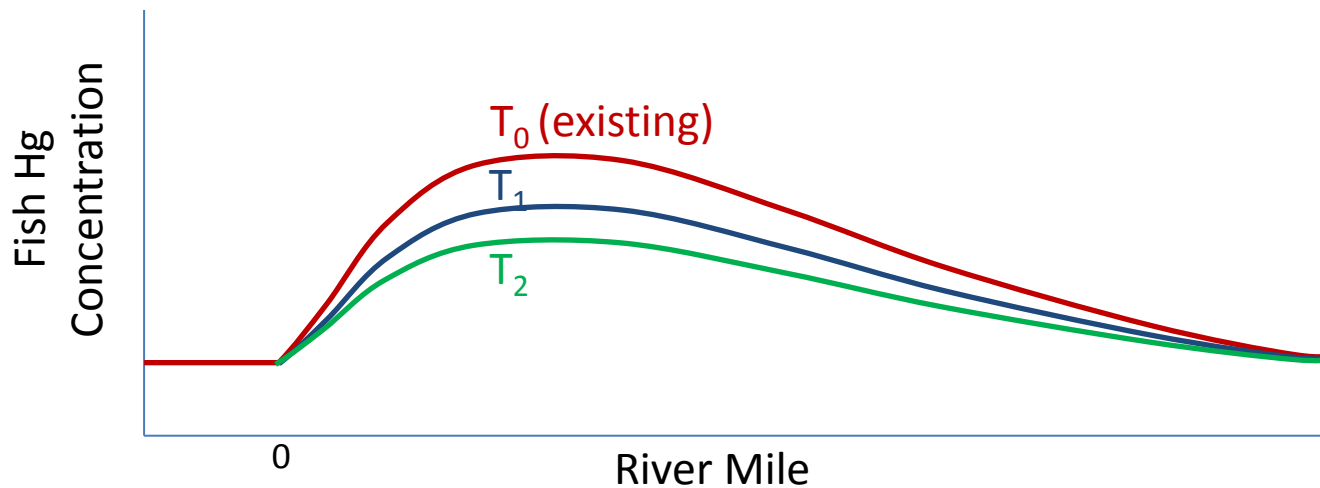
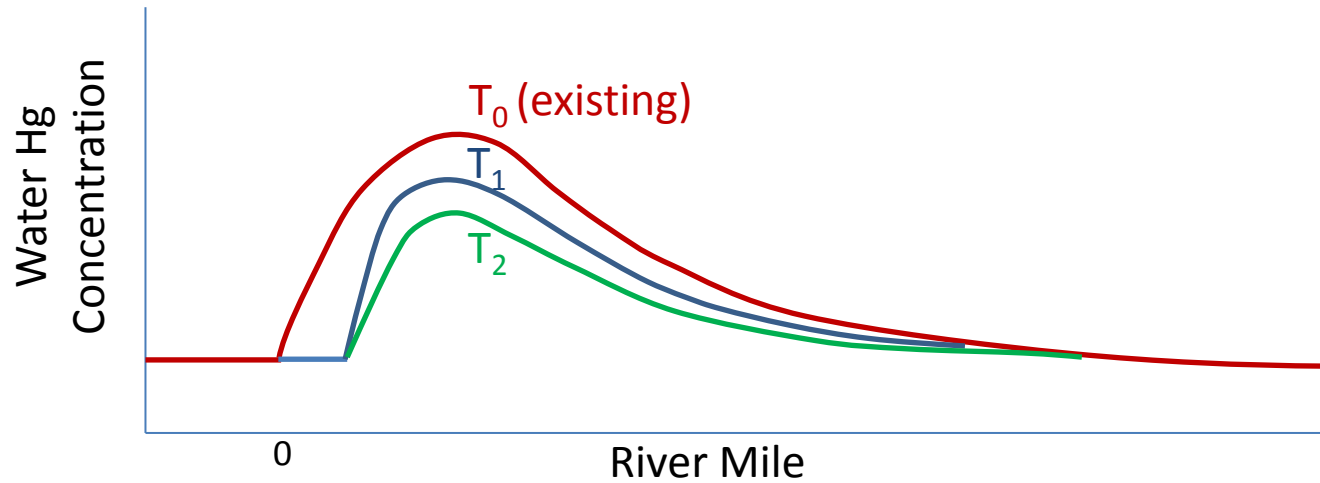
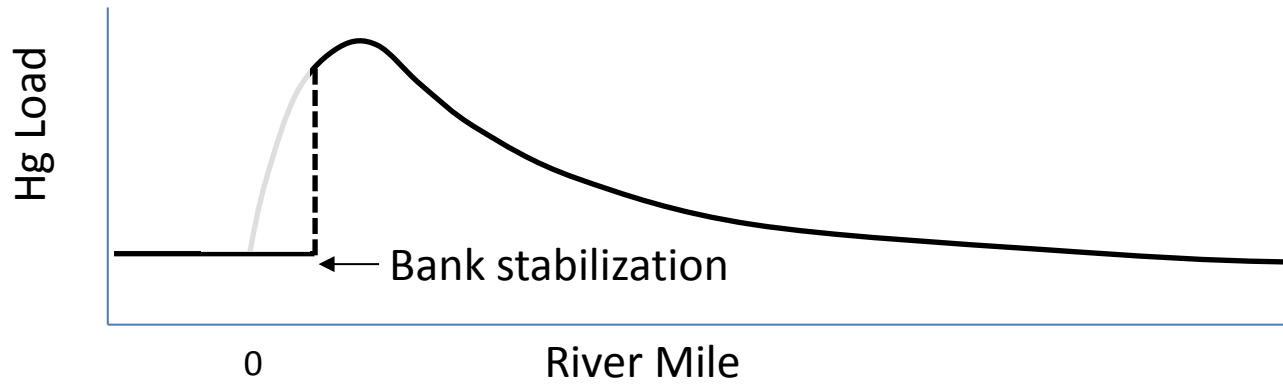
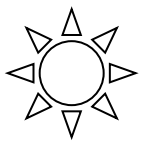


Figure 2-8. Size-normalized Fish Tissue Methylmercury and Water Column Mercury in the South River and South Fork Shenandoah River Downstream from DuPont in Waynesboro, VA.





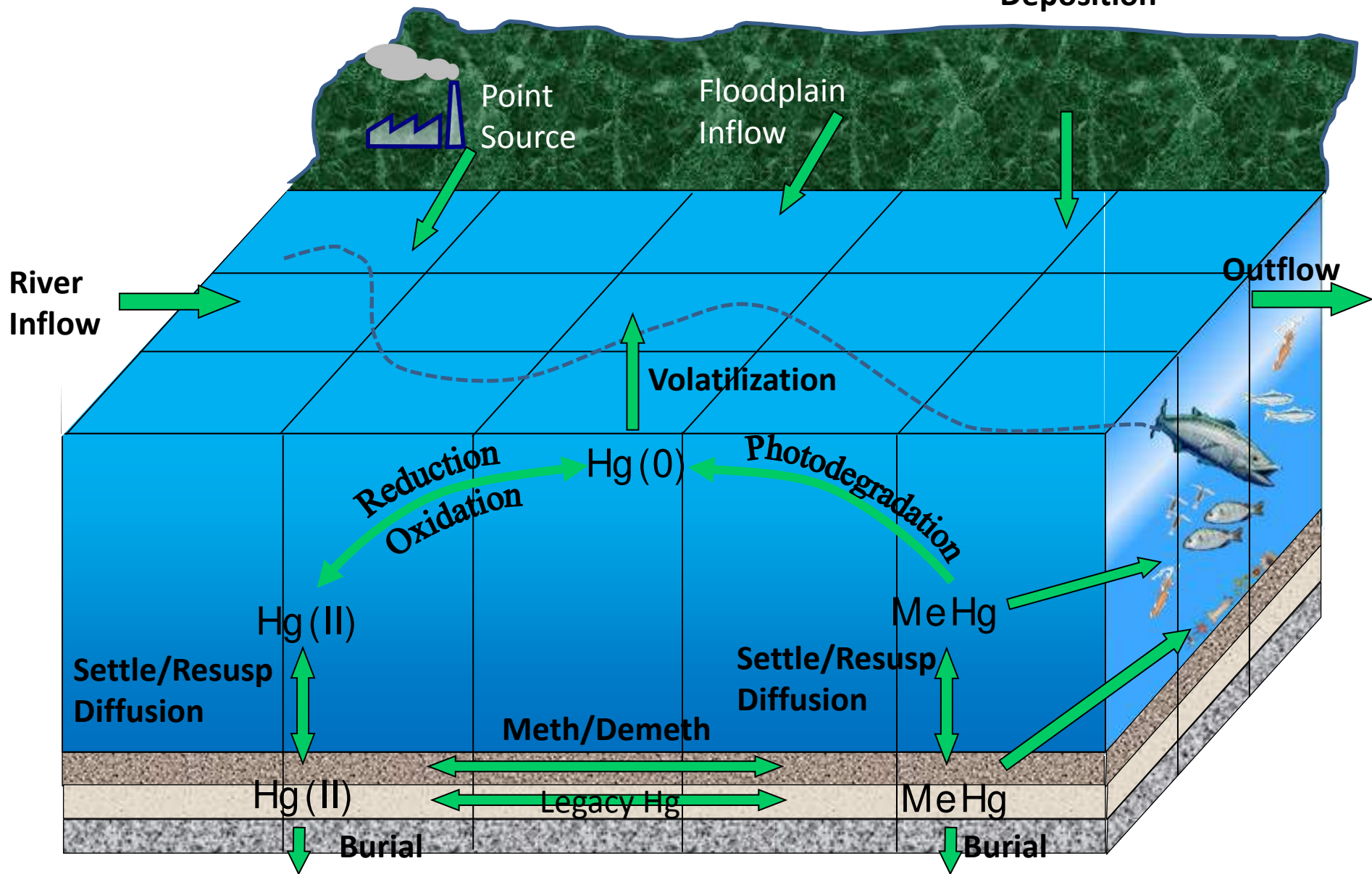
**Predict response
as a function of
location and time**



D-MCM setup for South River

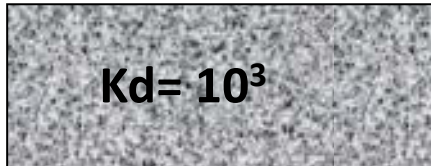


Atmospheric
Deposition



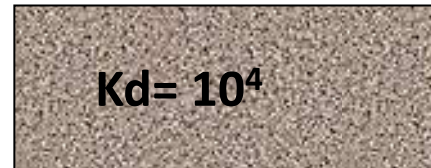
Four types of particulate matter in D-MCM

Coarse Inorganic



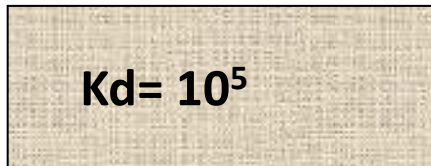
**Does not
decompose**

Fine Inorganic



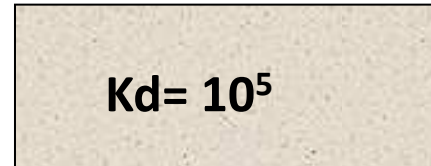
**Does not
decompose**

Labile Organic



**Decomposes
quickly**

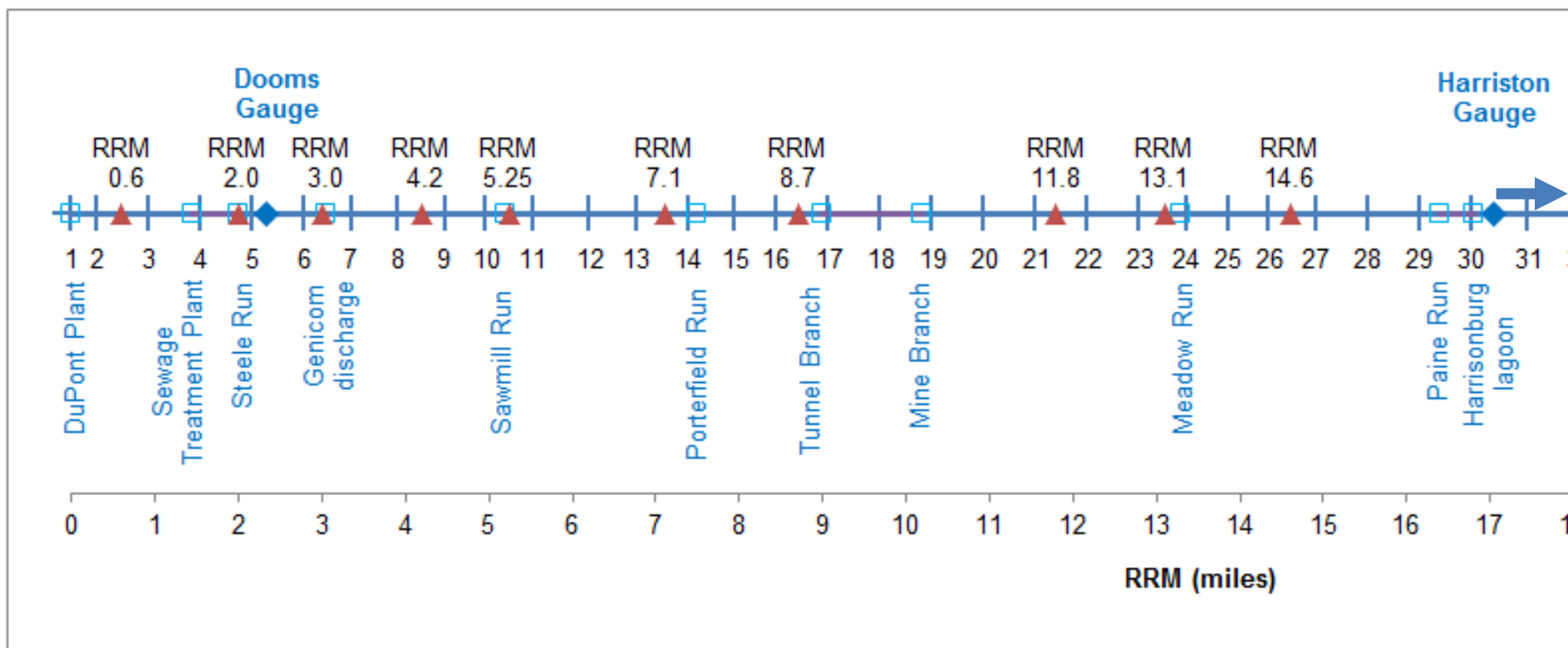
Refractory Organic



**Decomposes very
slowly**

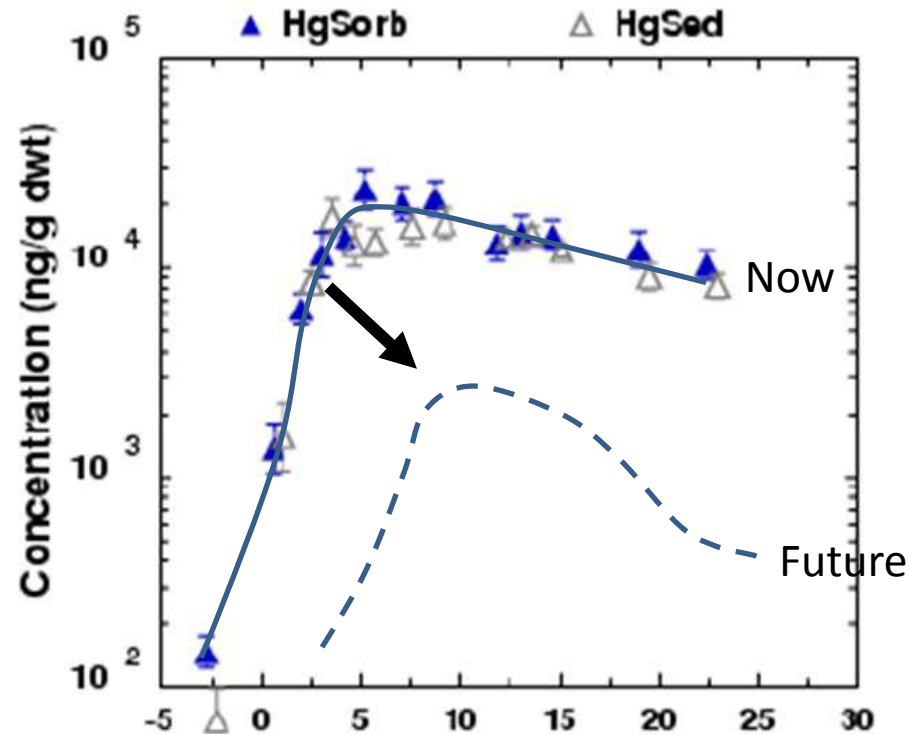
Model Grid

- 47 cells, each roughly 1 km long
- Simulation spans RRM 0 to ~RRM 27
- Tributary inputs increase flow along river



~ 1 km segments designed to accommodate rate of change of conditions.

.... Now and in the future.



Building Blocks for Mercury Simulations (2006-2014)

Hg Loading

- Upstream inputs (field data)
- Atmospheric Deposition (MDN)
- Facility (Data after 2006; sediment record before 2006?)
- Bank Erosion
- Floodplain loads?

Hydrodynamics

- USGS stations on river
- Tributary flows

Hg bioavailability

- Waterloo

Mercury Cycling and
Bioaccumulation

D-MCM

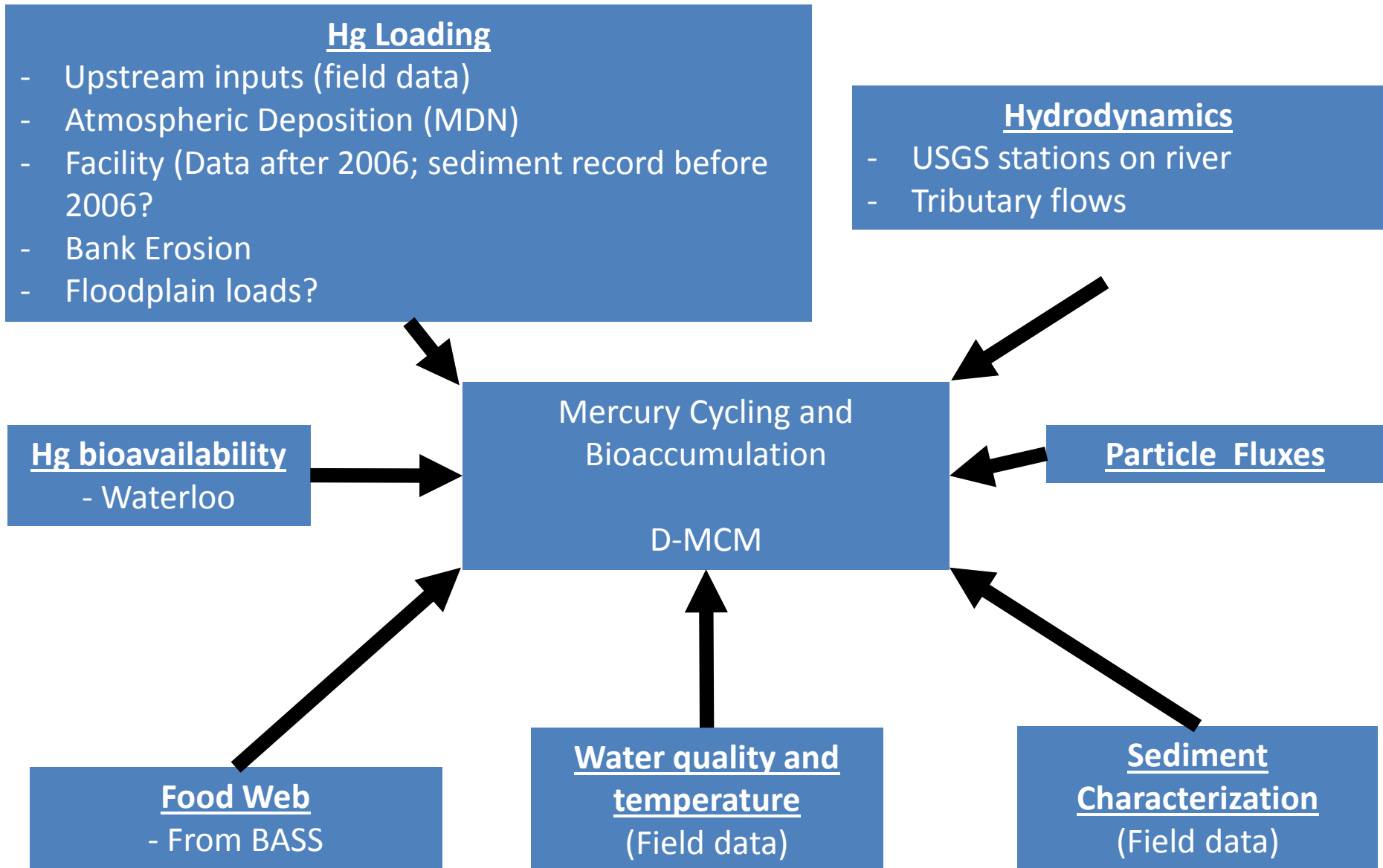
Particle Fluxes

Food Web

- From BASS

Water quality and
temperature
(Field data)

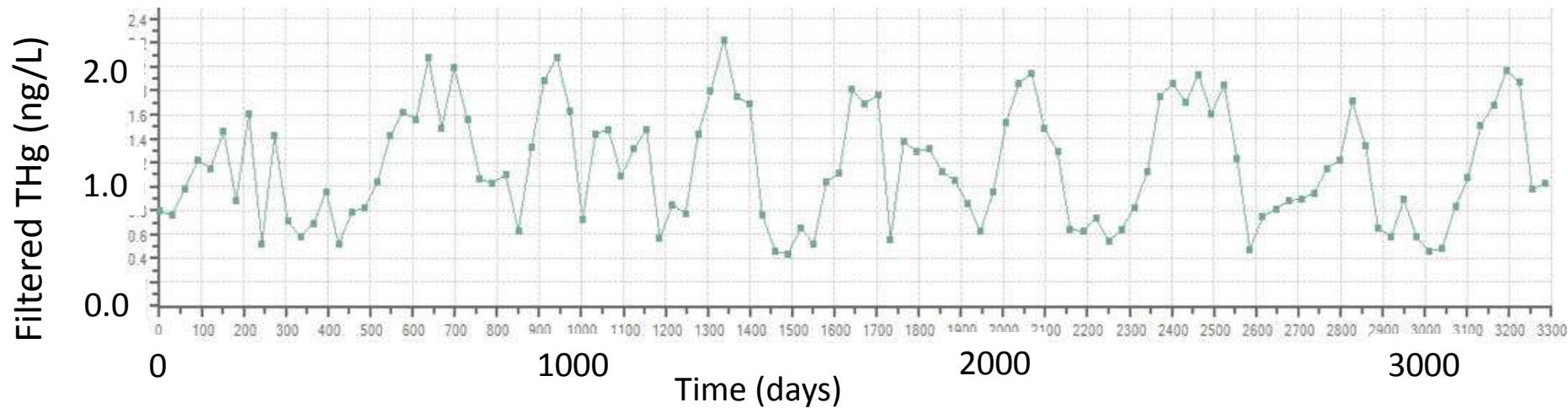
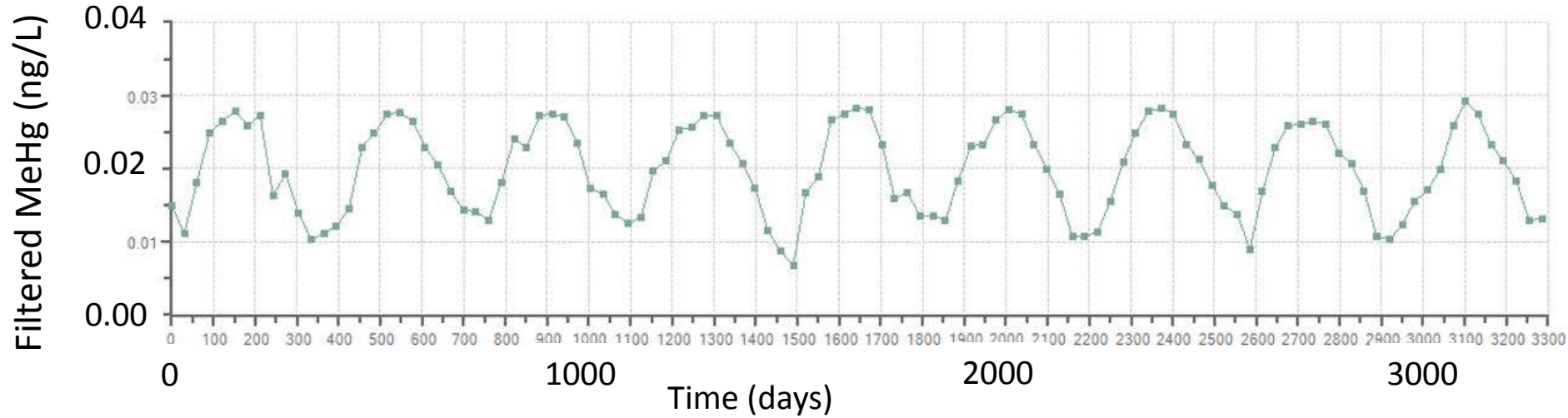
Sediment
Characterization
(Field data)



Status

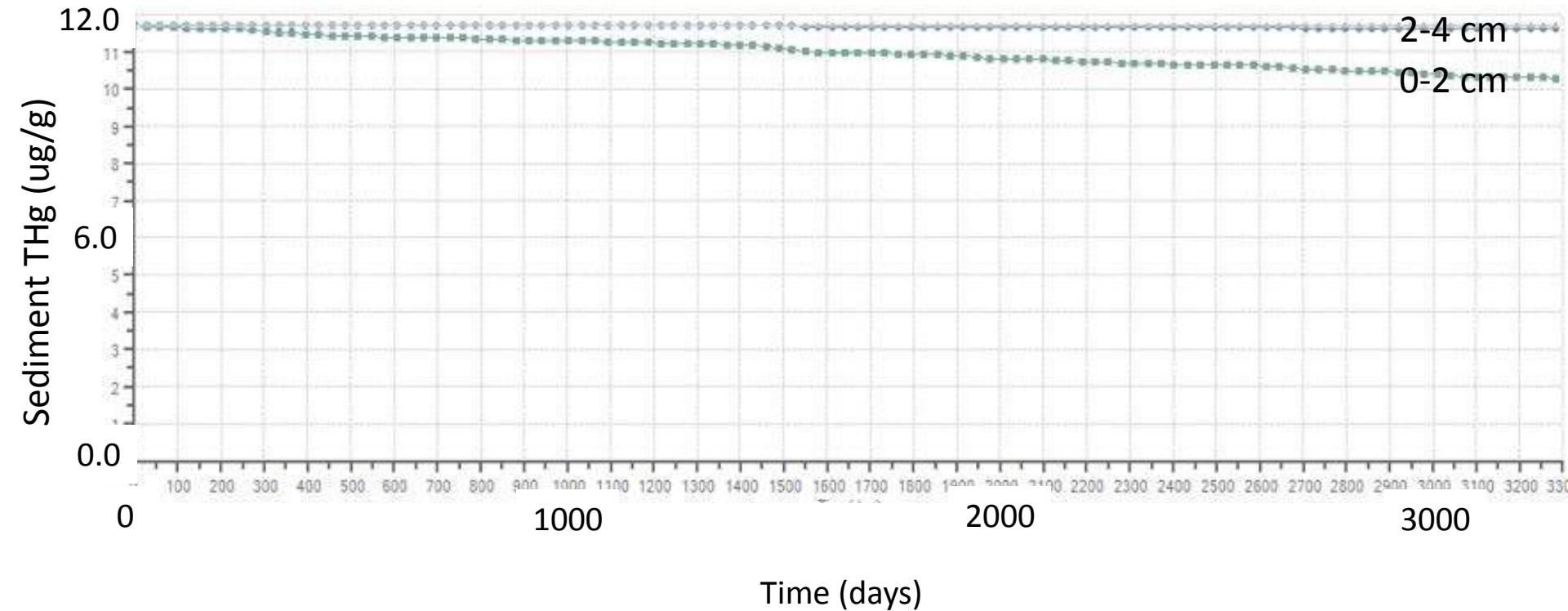
- Model is running for water and sediments for RRM 0-19.
- Adding cells to RRM 27.
- Adding food web.
- Still entering site specific conditions so results are not yet realistic
- Full simulations in November.

Some initial model outputs (Cell 10, 2006-2014)



Not yet realistic – some inputs not site specific..

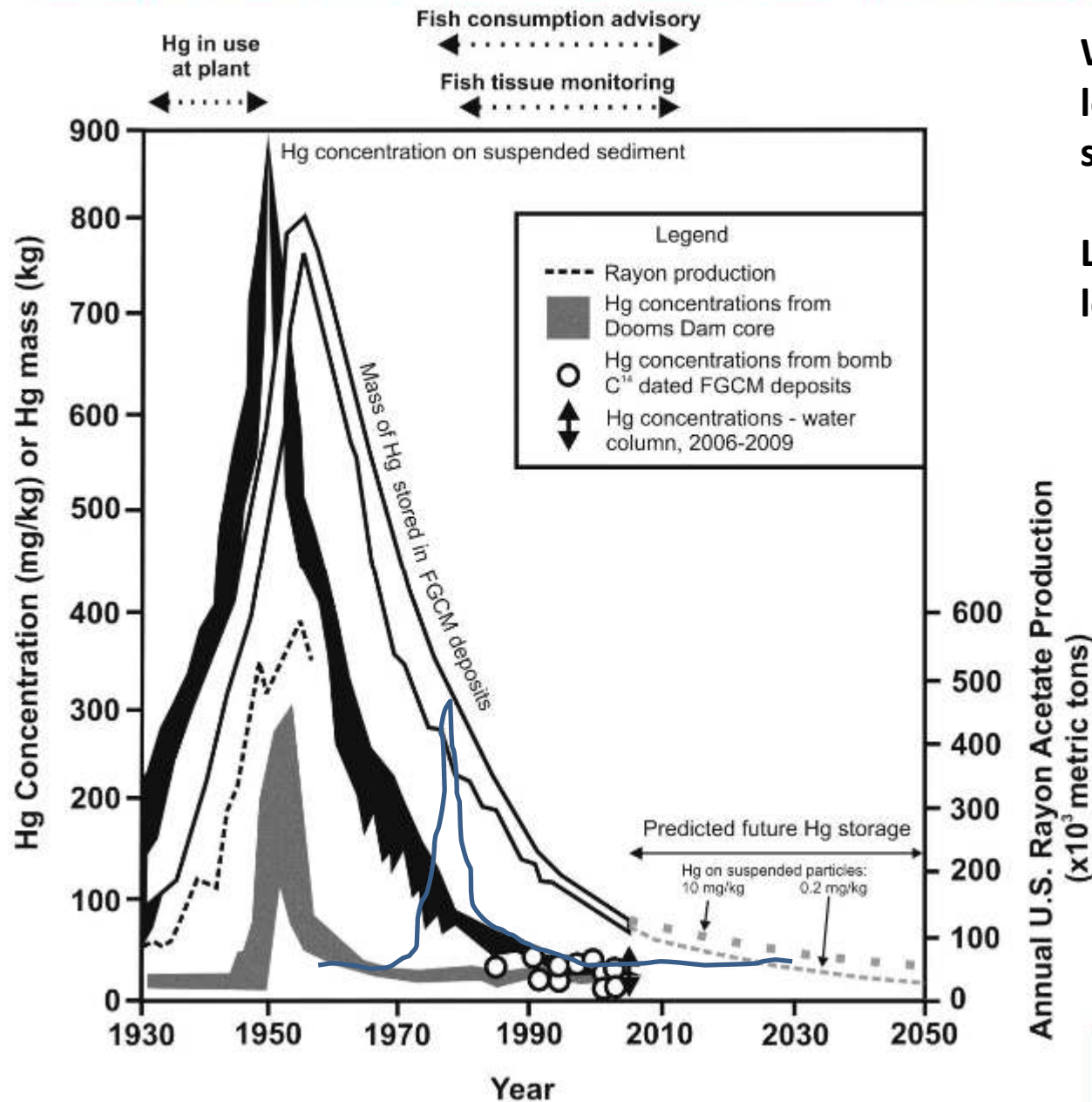
Some initial model outputs (Cell 10, 2006-2014)



Not yet realistic – some inputs not site specific..

Issues to sort out..

- **Hydrology:**
 - Surface water vs groundwater inputs
 - Bank leaching
- **Particles:** Estimating particle fluxes (resuspension, settling, permanent burial, downstream export)
- **Model setup:** Where is dividing line between sediments and banks
- **Duration of simulation:** Could we do a long term simulation the spans the period of Hg releases?



Would be valuable to do long term historical simulation.

Lacking information on loading rates over time

Questions?