What We Know, or Think We Know
Status – October 2008

After a number of years of significant investigation, the South River Science Team (SRST) has been able to refine a conceptual system model and prepare a number of working hypotheses to explain the continued presence of mercury in the aquatic and terrestrial food webs. Briefly, we have found that the bulk of mercury loading to the South River occurs downstream of the former DuPont facility (Relative River Mile, RRM, 0), and tapers off substantially by RRM 12. Estimations of the loading that stems from the former facility are not complete, but initial results suggest there are sources other than the facility that provide inputs to the system. These sources remain the focus of investigation, both on and off the site itself.

This loading in the upper 12 miles is paralleled by elevated body burdens of mercury in a diverse array of aquatic and terrestrial organisms sampled over the past 7 years. The so-called “hump” is the section of the South River from about RRM 3 to 10 where elevated mercury has been found in surface water, sediments, and aquatic as well as riparian biota. Tissue levels of mercury continue to be elevated in fish of the South River, resulting in the continuation of a consumption advisory for the 25-mile stretch of the system. From a geo-morphological standpoint, this loading appears to coincide with the observation that river banks in this same area are subject to erosion in greater frequency than those further downstream of river mile 12. While it is tantalizing to conclude that bank erosion is the sole cause of increased loading to the South River in this upper reach of the river, that conclusion is premature. For example, we have investigated a number of areas in the upper 12 miles using a variety of in-situ methods (pore water sampling, sediment coring and analysis, benthic flux chambers deployment, tributary loadings / overland flow measurements, storm / flooding events, rapid biological assessment, and other measurements). These studies have limited spatial coverage, but have tended to support the hypothesis that slow, but chronic bank erosion is one of the major mechanisms for replenishment of inorganic, and in some cases organic, mercury to the system. These studies have also shown that mercury flux, albeit limited, does occur through the underlying river bed substrate. We do knot know with high certainty whether this flux is due to mercury in groundwater that expresses to the river bed, or from mercury that resides in the river bed sediments themselves. In addition, we have not yet designed and implemented in-situ studies that would provide the direct evidence to support or refute the role that bank erosion plays in the fate and dynamics of mercury in the South River. Such studies are the subject of discussion between DuPont and experts from the NRDC. We also have not fully evaluated the role played by historical dams and sediment depositional areas in the production of methyl mercury.

Despite the loading that occurs in this upper 12 mile reach, and the mercury residues that result in biological tissues, the biological data for aquatic species have yielded relatively strong evidence that aquatic populations and communities are structurally and functionally viable, and do not seem to have suffered significant decline as a result of exposure to mercury. It is speculative, but plausible, that this observation may be due to compensatory biological mechanisms in these populations and communities that have managed to offset the effects of mercury over the past 20-30 years. This statement is not yet supported by a wealth of direct evidence on the South River, has not been discussed among the SRST, but is supported by similar work in other aquatic systems where chemical contaminants have been at work over lengthy time periods.

We have yet to fully investigate and elucidate the mechanism whereby mercury that enters the South River system through bank erosion in this upper reach becomes available to aquatic organisms and thus sustains their body burdens. We continue to believe there is a process, currently undefined, that may allow the mercury on soil and sediment particles to become biologically available. What factors, including season, temperature, flow, etc. that influence this process are yet unknown. While body burdens of mercury have been found in reptiles, amphibians, avian species and bats that inhabit or frequent the riparian or terrestrial environment in this upper reach, there is little evidence thus far that this body burden has impacted population or community viability. More work is needed however to reduce the uncertainty in this statement as it relates to populations of amphibians and avian species.

As noted earlier, above RRM 12, the gradient is shallow and river flows reduced. However, further downstream of relative river mile 12, bank erosion declines as the river becomes constrained by bedrock, the gradient increases, and subsequently the flows increase. There is also a similar decline in body burdens of mercury in aquatic and terrestrial species with increasing distance from river mile 12. By the confluence of the South River with the North River at Port Republic, mercury in the environment and the aquatic and terrestrial food web has declined substantially. Because this drop in mercury levels has been observed repeatedly, we now believe it more important that the SRST focus its efforts on the upper 12 miles of the South River. This will help to reduce the size of the study area, and allow existing resources to be brought to bear more effectively.

Bank erosion, unfortunately, does not explain the continued presence of mercury in the terrestrial food web. More work is needed before suitable working hypotheses can be refined and tested for mercury dynamics in the terrestrial food web, regardless of location within the South River. As 2008 draws to an end, the SRST faces two major challenges in 2009: 1. elucidating the mechanism whereby inorganic mercury in soils and sediments enters the South River and becomes biologically available; and, 2. determining the underlying mechanism that sustains mercury burdens in the terrestrial food web.