**"Preliminary Review Summary of Housatonic River Modeling Framework and Data Needs" Prepared by Marcelo H. Garcia**

This preliminary review is based on the questions presented in the charge to the Review Panel

1. Do the modeling frameworks used by EPA include the significant processes affecting PCB fate, transport, and bioaccumulation in the Housatonic River; and are the descriptions of these processes in the modeling framework(s) sufficiently accurate to represent the hydrodynamics, sediment transport, PCB fate and transport, and PCB bioaccumulation in the Housatonic River?

**The modeling framework proposed by EPA does include most of the processes that need to be accounted for in order to model PCB transport and fate in the Housatonic River. However, several processes such as floodplain sedimentation, erosion, transport, and deposition of sediment mixtures, streambank erosion, lateral stream migration and morphological changes , will not be modeled with the degree of sophistication needed in an effort of this magnitude. At this stage, the proposed modeling framework might be adequate to explore future remedial alternatives, but provides only a reasonable starting point and should not be considered as an accurate way of predicting the dynamics of PCB in the Housatonic River.**

2. Are the modeling approaches suitable for representing the relevant external forcing functions (e.g., hydraulic flows, solids and PCB loads, initial sediment conditions, etc.), describing quantitative relationships among those functions, and developing quantitative relationships between those functions and PCB concentrations in environmental media (e.g., water column, sediments, fish and other biota, etc.)?

    a. Are the models adequate for describing the interactions between the floodplains and the river? **Not in their present stage. The dynamics of sediments in floodplains is very poorly understood, in particular the role of vegetation on trapping sediments and associated pollutants. Simply increasing roughness coefficients will not tell much about the fate and transport of PCB in woody areas commonly found in the floodplain of the Housatonic River. A useful reference on this topic is Lopez F. and Garcia, M., "Open-Channel Flow Through Simulated Vegetation: Suspended Sediment Transport Modeling," Water Resources Research ,vol. 34, No9, p. 2341-2352, 1998.**

    b. Are the models adequate for describing the impacts of rare floods events? **The hydrodynamic model might be capable of predicting flood routing through the Housatonic River. However, sediment resuspension and transport during floods can be substantially different from normal flow conditions. The hydrologic record**

**indicates that sediment transport in the Housatonic River is mainly driven by storm events. The proposed models do not account for the lag effects and adaptation lengths commonly observed for suspended sediment transport by unsteady flows. A useful reference is Admiraal, D. et al., "Entrainment Response of Bed Sediment to Time-Varying Flows," Water Resources Research, vol. 36, No1, p. 335-348, 2000.**

c. **Sediment itself could have an impact on fisheries regardless of whether or not its laden with PCB (Huang, X., and Garcia, M., "Pollution of Gravel Spawning Grounds by Deposition of Suspended Sediment," Journal of Environmental Engineering, vol. 126, No10, October, 2000)**

3. Are the spatial and temporal scales of the modeling approaches adequate to address the principal need for the model – producing sufficiently accurate predictions of the time to attain particular PCB concentrations in environmental media under various scenarios (including natural recovery and different potential active remedial options) to support remedial decision-making? **The challenge for this modeling effort is that time and space scales are quite different depending on what process is to be modeled. For example, most streambank erosion takes place during and right after floods associated with storm events. So the time scale here can extend from a couple of hours to a few days, depending on the duration of the hydrologic event responsible for the flood. While overbank flows will take place during a flood as well, sediment deposition and accumulation on the floodplain will take place over time scales that are much longer, on the order of several years. Thus the need to determine very clearly what are the spatial (i.e. local erosion or watershed-scale erosion) and temporal scales (i.e. sediment transport event or natural recovery) being addressed by the modeling effort. This issue is not clearly addressed in the proposed modeling framework.**

4. Is the level of theoretical rigor of the equations used to describe the various processes affecting PCB fate and transport, such as settling, resuspension, volatilization, biological activity, partitioning, etc., adequate? **It is barely adequate but far from complete. The references provided above could shed some light for the development of more sound algorithms.**

5. What supporting data are required for the calibration/validation of the model on the spatial and temporal scales necessary to address the principal need for the model? What supporting data are required to achieve the necessary level of process resolution in the model? **The data already available should be useful for the calibration of the models. However, I am troubled by the use of a model calibrated with short-term observations to predict long-term fate of PCB in the Housatonic River. This undertaking should be**

**done very carefully while being aware of the model limitations and shortcomings. Uncertainties and risks associated with model predictions should be clearly stated by the modeling team. The are tools available in the literature to help with this (See Lopez and Garcia, "Risk of Sediment Erosion and Suspension in Turbulent Flows," Journal of Hydraulic Engineering, vol. 127, No3, March, 2001)**

6. Are the available data, together with the data proposed to be obtained by EPA, adequate for the development of a model? **The available data seems adequate for the development of a model for predictive purposes. One concern is the lack of any information about streambank erosion data and how this will be modeled without such data (i.e. erodibility properties of streambanks). A meandering stream model developed for Illinois streams in the 1990's has shown that sediment resulting from bank erosion can be a major source of pollution to streams (Garcia et al., "Mathematical Modeling of Meandering Streams in Illinois: a tool from stream management and engineering," Civil Engineering Studies, Hydraulic Engineering Series No43, UILU-ENG-94-2012, University of Illinois, November 1996).**