Comments after EPA presentation by Marcelo Garcia (April 24, 2005)

Besides the questions submitted earlier, the main comments I have at this stage relate to the characteristics of the computational grid used for the hydrodynamic modeling of the Housatonic River.

When modeling the river and its floodplain, the size of the elements in the computational grid (20m by 20m) is too large to obtain the degree of spatial resolution needed to assess parameters such as local mean flow velocity, bed shear stress and sediment entrainment into suspension.

The erosion tests done with SEDFLUME provide a measure (i.e. the surface area of the sediment cores) of the spatial scales that should “ideally” be resolved by a numerical model used for sediment erosion, transport and deposition in the Housatonic.

While the size of the computational domain results in very intense and long computational experiments, its is not possible to resolve the hydrodynamics of a meandering stream such as the Housatonic, with a computational mesh having a size equivalent to the width of the river. How will streambank erosion processes be resolved during the model validation if such scale is used for the simulations?

To model the main channel, the computational grid should have a minimum of three “streamtubes”, one along the centerline of the channel (having almost the channel width) and the two other narrower ones would run along the streambanks. Otherwise it is almost impossible to capture channel curvature effects (e.g. secondary flows, water-surface superelevation), which influence what portions of the river banks can be expected to experience more erosion.

Knowing the behavior of the river (i.e. lateral migration) will make it possible to manage/control erosion-prone areas thus reducing the amount of sediments/contaminants incorporated into the flow during storms.

Another important issue relates to the well-known exchange of momentum that takes place between the main channel and the floodplain during overbank flows. This momentum exchange will in turn dictate how much of the sediment resuspended from the bottom and the streambanks will be fluxed towards the floodplain. Can the hydrodynamic/sediment transport model capture these processes with the current discretization of the computational domain?

For extremely high flows, such as in the aftermath of Hurricane Bertha, the size of the computational grid will be less relevant since the river and its floodplain will behave as a single channel. However, there is a whole range of flows ranging from bankfull to large floods, where proper simulation of the flow in the river itself and its interaction with the floodplain are crucial to assess the transport/fate of sediments and PCBs.

Perhaps “model nesting” should be performed, where a coarse grid is initially used to model the whole system but a finer mesh is then used to model smaller subdomains using as boundary conditions the results of the coarser-grid simulations. Also the possibility of coupling a 3D version of EFDC for the river channel with a 2D version of EFDC for the floodplain could be explored.

A plot showing flow discharge and/or stage versus percentage of floodplain under water could be useful for assessing beforehand what version of EFDC (1D, 2D, 3D) or combinations (river/floodplain) should be used in order to resolve the appropriate spatial and temporal flow and sedimentation scales in the Housatonic River. It is apparent that a hierarchy of hydrodynamic/transport models is needed to accomplish the goals of the project.