Modeling of Hydrology, Sediment Transport, and Mercury Fate and Transport in Upper East Fork Poplar Creek, Oak Ridge, TN

FIU's Applied Research Center (ARC) developed an integrated surface/subsurface numerical model for the hydrology, sediment and mercury (Hg) transport at the Upper East Fork Poplar Creek watershed (UEFPC) as part of the DOE's mercury remediation project at the Oak Ridge Reservation.

In order to analyze the mercury cycle in the environment and provide forecasting capabilities for the flow and transport of mercury within the UEFPC, an integrated surface/subsurface flow and transport model was developed using the comprehensive numerical software package, MIKE by DHI. Daily fluctuations in stream flow as a result of scattered rainfall, flooding, and flow augmentation resuspend the contaminated streambed sediments, and provide a major source of mercury (> 90%) to the creek. Sediment transport and interactions between sediment particles, mercury species and water are the key factors responsible for the mercury mobilization and transport in the creek, and has been incorporated in the numerical model in detail for better representation of real field conditions. The model has been constructed and calibrated using an extensive collection of historical records (i.e., hydrological data and mercury concentration measurements in groundwater, soil and sediment) obtained from the Oak Ridge Environmental Information System (OREIS) database.

Project Objectives

- Develop an integrated surface/subsurface model using the MIKE numerical software package to study the multiphase transport of Hg species in the saturated and unsaturated zones of the UEFPC watershed, including physical, biological and chemical transformations under site-specific environmental conditions.
- Investigate sediment-mercury-water interactions and their impact on the fate and transport of mercury species in UEFPC.
- Assess the effectiveness of ongoing and future remedial actions at the site.
- Provide stakeholders with a tool for "what if" analyses in order to achieve lower uncertainty and considerably better spatial and temporal forecasting of the mercury contamination.

Project Benefits

- Forecasts Hg fate and transport in soil and groundwater under varying environmental conditions.
- Evaluates the risks associated with D&D operations and potential mobilization of mercury.
- Reduces cleanup costs and accelerates cleanup.

Project Accomplishments

- Calibrated the model for hydrology, sediment and mercury transport in UEFPC for the period of 1996 to present.
- Provided the U.S. DOE with assessment reports on the effectiveness of eight (8) different remedial scenarios.

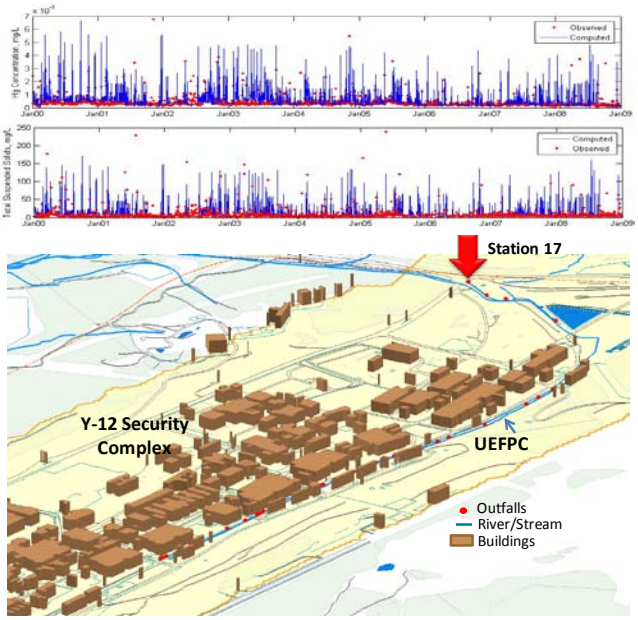

Figure 1. Total suspended solids and Hg concentration compared with historical data at Station 17

- During high flows, resuspension of sediments and transport of mercury particulates elevate the total mercury concentrations downstream.
- Redirection of augmented flow decreases sediment resuspension and thus reduces Hg loads. It also decreases the recharge of groundwater with contaminated surface water through infiltration.

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