Groundwater/Surface Water Interactions at the Transition Zone: Utilizing an In Situ Passive Sampling Program to Evaluate Groundwater Upwelling

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Background/Objectives. Passive sampling devices (PSDs) present many advantages over conventional sample collection methods for quantifying hydrophobic organic compound (HOC) and inorganic compound availability in sediment, soil, surface water and storm water in terms of cost and data quality. PSDs provide data to estimate contaminant bioavailability and toxicity to environmental receptors that are more accurate than conventional grab or mechanically extracted samples, as PSDs quantify freely dissolved contaminant concentrations (C_{free}). PSDs can be deployed directly in situ to capture the influence of groundwater flux, changes in field conditions and the heterogeneity of a site on the freely dissolved concentrations of the compounds of interest.

Approach/Activities. Polyethylene-based PSDs with rare PCB congener performance reference compounds (PRCs) were deployed and sampled to assess groundwater parent and alkylated polycyclic aromatic hydrocarbon (PAH) concentrations in Pump Slough bottom sediments and surface water adjacent to a former wood preserving site in Louisiana. Horizontal and vertical groundwater gradients and hydraulic conductivity suggested that the sands beneath the Pump Slough are in hydrogeologic communication with the Pump Slough; groundwater primarily discharges to the Pump Slough with brief periods of recharge . Twenty-four passive samplers (nineteen in sediment, two in surface water and three trip blanks) were deployed for 30 days. Upon retrieval, they were shipped to the analytical laboratory and analyzed for parent and alkylated PAHs and PRCs and C_{free} values were calculated. Data screening evaluation of the C_{free} results based on the human health benchmark values, the Louisiana Department of Environmental Quality standards and the USEPA equilibrium partitioning PAH sediment benchmarks for aquatic life were performed. Additionally, hierarchical cluster analysis (HCA) and principal component analysis (PCA) were used to provide insight into the extent of groundwater PAH discharge along the Pump Slough respectively.

Results/Lessons Learned. Site-specific background (upstream) locations in Pump Slough indicated that PAHs were present but are likely originating from recreational use and/or urban runoff. The USEPA's toxic unit sediment quality guidelines designed to evaluate toxicity of 34 parent and alkylated PAHs were used and indicated exceedances of the benchmark in only three of the 21 sediment pore water samplers. PAH cluster analysis by HCA and PCA identified two common groups of samples. The three locations with toxic unit benchmark exceedances were in the first cluster and had the highest total PAH concentrations with acenaphthene as the largest contributor to the overall composition. The second cluster containing the remaining sample locations had concentrations one to two orders of magnitude lower with naphthalene and 2-methylnaphthalene as the largest contributors to the composition. The combination of these results demonstrated the potential extent of the groundwater discharge along the Pump Slough was spatially defined with all other areas not affected by groundwater discharge. These data are consistent with previous investigations of Pump Slough that evaluated bulk sediment

chemistry; however, all the bulk sediment chemistry data were within the range of typical urban background sediments. The more in-depth analysis of the pore water by SP3™ provided PAH C_{free} values that are clearly distinguishable in the groundwater discharge zone compared to PAH C_{free} values from samplers used to measure background values. The analysis described herein has demonstrated that if corrective action were required, it would be of limited spatial extent and supported a monitoring regulatory closure.