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From Source to Surface Water: Using Groundwater Geochemistry and Age Dating to Assess the Natural Attenuation of Chlorinated-Ethene Contaminated Groundwater

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Background/Objectives. The past use of chlorinated ethenes (CEs), such as trichloroethylene (TCE), at Naval Air Station (NAS) Whiting Field near Milton, Florida has resulted in several separate and mixed source areas. At each source area, CEs migrated vertically through over 100 ft of unsaturated sand to the water table, formed plumes, and were transported more than 1,000 ft downgradient to Clear Creek, a major spring-fed surface-water receptor. Contaminants from source areas closer to Clear Creek also have become superimposed on these longer plumes. As such, the natural attenuation processes that occur near Clear Creek necessarily become an important part of any remedial strategy implemented at NAS Whiting Field. The present study presents groundwater geochemistry, natural attenuation parameters, and age dating data that are being collected to provide a baseline assessment of the natural attenuation capacity near Clear Creek.

Approach/Activities. Concentrations of dissolved oxygen and other gases, dissolved iron, and chlorofluorocarbons (CFCs) used for age dating were measured in groundwater pumped from wells located along a groundwater-flow pathway from source areas located at higher altitudes to wells near Clear Creek. The groundwater-flow pathway sampled was located adjacent to more highly CE-contaminated groundwater in order to provide more accurate CFC data. Porewater samples from the hyporheic zone will be collected during the fall of 2016, to take advantage of higher rates of groundwater discharge due to lower evapotranspiration rates. Preliminary sampling of CEs in trees in the floodplain indicates that the native plants are playing a currently unquantified role in the natural attenuation of the CEs.

Results/Lessons Learned. The deep water table was predominately aerobic (dissolved oxygen greater than 4 mg/L), low in specific conductance (less than 20 microsiemens per centimeter), and contained less than 1 mg/L dissolved iron. The lowest concentrations of dissolved oxygen were observed in wells located closet to Clear Creek. This may reflect the microbial respiration of natural dissolved organic matter (DOM), such as leaf tannins. The age dates determined from CFC concentrations in groundwater sampled along the flow pathway were youngest near Clear Creek (apparent ages of the late 1970s to early 1980s) compared to older apparent ages of the later 1960s to early 1970s for groundwater pumped from wells located farther from the Creek at higher altitudes. This scenario of younger groundwater near the Creek challenges the classic relation of older groundwater near discharge areas, and invites the following hypotheses to explain the data collected so far. For example, the younger groundwater in wells located near Clear Creek may be due to (1) recharge of surface water during floods, (2) recharge from stormwater at point sources, or (3) accelerated groundwater flow through recently discovered “paleochannels”. These hypotheses will be tested as work at the site progresses.