Current Research (2007-2008)

Focus areas:

- Improved characterization of metal and nonpolar organic fluxes in sediments, focusing on the physical and chemical factors that dominant fate and bioavailability.
- Improved characterization, prediction and linkage of exposure to effects of freshwater invertebrates, focusing on the following compartments: sediments, stormwaters, low flows, and groundwater/surface water exchange zones.
- Improved identification, separation and ranking of dominant stressors in freshwater systems (all compartments). Stressors and interactions of primary interest are habitat, solids, flow, temperature, ammonia, metals, and organics.
- Improved weight-of-evidence approaches for identifying potential stressors (natural or anthropogenic) in watersheds, using statistically based, GIS models that assess spatial and temporal variation.
- These research areas are primarily field (*in situ*) based, with model development and method refinement being based in the laboratory. Since improved assessments of stressor identification, hazard and risk are the goals of this research, we integrate multiple types of methods (physical, chemical, ecological, toxicological, modeling/GIS) in a weight-of-evidence context.

On-going projects:

1. City of Dayton. Stormwater Quality Assessment of the Mad River.

- The impacts of stormwater runoff into the Mad River are being evaluated in a integrated assessment that incorporates the following lines-of-evidence: *in situ* toxicity to *Daphnia* and *Hyalella*, indigenous benthic community responses, habitat quality and physicochemical conditions. Special focus on effects of suspended solids and embeddedness on invertebrate populations.

2. Copper Development Association, RioTinto, and International Copper Association. An Assessment of Copper Effects on Benthic Invertebrates in Freshwater Ecosystems.

- The effect of copper on indigenous benthic macroinvertebrate communities will be evaluated in 4 widely varying freshwater sediments using short to long term colonization studies. The flux of copper will be evaluated in both laboratory sediment flume studies and in the field using various flux characterization methods to better characterize dynamic exposures and link to biological effects. Factors controlling bioavailability, such as AVS, Fe-MnOOH, TOC, and pH are being evaluated in these exposure systems.

3. U.S. Environmental Protection Agency STAR Grant Program. Defining and Predicting PCB Fluxes and Their Ecological Effects in River Systems for Risk Characterizations.

- The fate and associated biological effects of PCB flux in various types of freshwater riverine sediments are being characterized in dynamic exposures. During years 1 and 2 models will be developed using DDE and PCBs in laboratory sediment flumes with initial field validation studies in year 3. These studies will allow for more accurate ecological risk assessments of problematic nonpolar compounds.

4. Nickel Producers Environmental Research Association. Comparison of Nickel Sensitivity in Cultured and Field Collected *Ceriodaphnia* spp.

- Organisms that are cultured in reconstituted laboratory waters for many generations may evolve through time from field populations. This evolution may alter their sensitivity to chemicals and raises the question of whether they are appropriate as surrogates of field populations. Multiple populations of laboratory raised and field collected *Ceriodaphnia dubia* will be compared in their sensitivity to nickel.

5. Strategic Environmental Restoration and Demonstration Program (SERDP). USDOD, USDOE, USEPA. Sediment Ecosystem Assessment Protocol (SEAP): An Accurate and Integrated Weight-of-Evidence Based System.

- Fate and transport of migrating sediment and groundwater contaminants will be assessed near real-time and linked to biological effects. Development of an integrated system (Sediment Ecosystem Assessment Protocol – SEAP) incorporating rapid *in situ* hydrological, chemical, biological and toxicological measurements will provide concise, decision-oriented scientific and ecological information to improve the overall management of contaminated sediment sites. The resulting data from these multiple lines-of-evidence will then be integrated into a Weight-of-Evidence based Geographic Information System (WoE-GIS). Objective: The purpose of this research is to develop an efficient, accurate and integrated approach for the assessment of ecosystem risk and recovery at sites where contaminated sediments exist, or previously existed.

6. Copper Development Association, and International Zinc Association. Copper and Zinc in Sediments: Defining the State-of-the-Science and Key DataGaps.

- The literature was reviewed to define what the state-of-the-science is for copper and zinc fate and ecosystem effects in fresh and marine sediments. Key research issues and data gaps were identified and recommendations provided to advance our ability to assess hazard and risk of copper and zinc in aquatic ecosystems, particularly sediments.

7.Nickel Producers Environmental Research Association. Determining Realistic Sediment Toxicity Threshold Effect Levels for Freshwater Species.

- Threshold effect concentrations for surrogate test species, indigenous species, and benthic macroinvertebrate populations is being determined in streamside channels. Two sediments with high and low metal binding capacity were spiked with Ni and allowed to colonize over a period of 16 weeks. They are being subsampled through time, following Ni flux and key bioavailability factors and relating exposures to effects using in situ caged organisms and indigenous benthic colonization responses. Effects will be linked to flux processes and used to predict threshold effects.