Developing Rapid and Cost-Effective Tools for Assessing Groundwater Impacts on Contaminated Sediments

Research Value:

How contaminants interact with sediments and aquatic organisms is often complex. In cases where groundwater discharges into surface waters such as lakes, the picture can get even more complicated, as groundwater input may influence the concentrations and availability of contaminants in sediments.

The flux of sediment contaminants, which are influenced by groundwater discharge, may vary in space and time. The variability in contaminant discharge presents a challenge for restoration efforts, since assessing the magnitude of its contribution to sediment impairment can be a time and cost-intensive effort. Natural resource managers need cost-effective tools to rapidly assess the impact of groundwater discharge on surface water bodies at varying scales.

EPA is developing approaches to combine routine physical measurements of the impacted surface water body, as a function of space and time, with aquatic chemical measurements to support design of restoration activities.

Research Details:

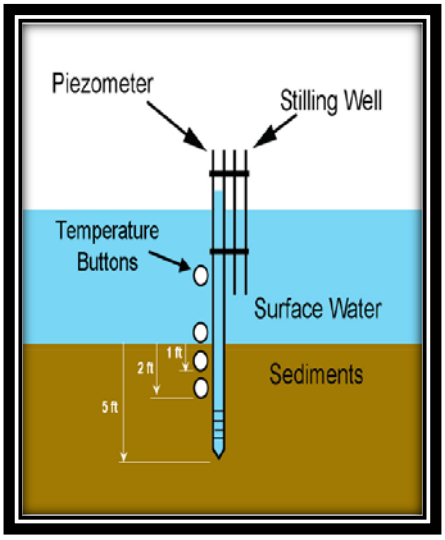
EPA land risk management researchers conduct field and lab research to:

1) Develop methods to best characterize hydrologic and chemical processes at the groundwater / surface water (GW/SW) interface.

2) Understand the role of groundwater flow on sediment processes that govern levels and types of sediment contaminants.

This research aims to characterize the interaction of water and solids within the GW/SW transition zone to explain processes that occur during physical contact between groundwater and sediments. The first step in characterizing the influence of groundwater discharge on sediment contamination is identification of the locations of discharge and the variability in magnitude over space and time. Measurement of water parameters such as temperature and conductivity provides an inexpensive approach to efficiently define the need for more detailed data acquisition. These measurements are conducted to capture the spatial and temporal variability that is commonly encountered in these natural systems.

EPA is developing methods that make use of self-contained, off-the-shelf devices to efficiently assess the spatial and seasonal variability in groundwater discharge. As an example, changes in water temperature data with depth and time within a surface water body can be measured using small temperature buttons and evaluated to quickly assess the distribution and magnitude of groundwater discharge.



Use of self-contained, off-the-shelf devices (temperature buttons) to continuously monitor water temperature as a way to detect the presence and estimate the magnitude of GW discharge.

U.S. Environmental Protection Agency
Office of Research and Development (ORD), National Risk Management Research Laboratory (NRMRL)
Land Remediation and Pollution Control Division (LRPCD)

A plunger used to place temperature buttons at different depths in sediment.

Outcomes and Impacts:

Groundwater discharge may serve as a long-term source of contaminants to sediments within a watershed and/or may affect processes controlling the properties of existing contaminants.

This research provides EPA with practical knowledge to guide site characterization and remediation, at sites where groundwater influences sediment contamination.

Field and laboratory studies have enabled the EPA to better predict the fate of contaminants in sediments, including their mobility, their ease of uptake by plants and animals (bioavailability), and to develop remediation strategies that effectively manage risks to human and ecosystem health.

Research impacts include:

Identification of links between groundwater discharge and sediment contaminants, especially arsenic, lead and zinc.

Development of new approaches to identify spatial variability of groundwater discharge into surface-water ecosystems using direct measurements and cost-effective surrogate measures. EPA Region 1 office and ORD field researchers coordinate to design restoration approaches. They also collaborate on monitoring strategies to evaluate success of sediment remediation efforts at sites impacted by contaminated groundwater discharge.

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Examples of type of buttons used to log temperatures. Foreground: intact button, showing size. Background: opened to show the computer chips enclosed in durable weather resistant stainless steel.

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