Overview of the Hydrogeology of GW/SW Interactions

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Outline

1. Definitions
2. Factors controlling interactions
3. Conceptualizing GW/SW interactions
4. Implications for transport and fate of plumes
5. Monitoring and Remediation Issues

Definitions

- Hyporheic Zone
  - Areas beneath and adjacent to a stream that contain some portion of channel water or has been altered by surface water (White 1993).
- Groundwater/Surface-water Interface
  - The boundary (i.e., surface) in the subsurface between groundwater and surface water.
- Transition Zone
  - The general area beneath and near surface water bodies where conditions go from a groundwater dominated system to a surface water system.

Important and Unique Features of Transition Zone

- Complex and dynamic hydrological, geological, and biogeochemical zone.
- Spatial and temporal variability make it difficult to determine exact GW flow paths.
- Transition zone has potential to change shape, size, and composition of plumes.

Factors Affecting Transport and Fate

- Geology
- Hydraulics
- Reactions
- Plume
- Time
- Sediment Conc.
- Mass Flux
- Surface Water Conc.

Idealized Discharge of a Plume to a River

Regional Flow
Monitoring of Natural Attenuation

Figures of recommended monitoring for a GW plume discharging to SW do not appear to include any investigation of or in the streambed.

Redox Zonation of GW/SW Interface, Lake Michigan

Figure showed how redox conditions vary both laterally with depth, and in proximity of the lake and shoreline.

Flow to and From Lakes

Figure illustrated local and regional flow effects, flow lines, areas of capture, stagnation points and how flow-through conditions can occur.

GW Plume Discharging to Pond

- Vapor diffusion samplers
- Discovered previously unknown higher concentration TCE plume
- TCE plume had gone under an adjacent pond to get there.

Redox Conditions for Freshwater Wetland

Modified from Lunn et al. (1997) USGS WRIR 97-4111

Tidally Influenced Water Bodies

Bay of Fundy, New Brunswick
Tidally Influenced Systems and an Ultrasonic Seepage Meter

Figure showed how specific discharge varies inversely with tidal stage over time

Monitoring Goals and Objectives

1. Representative samples
2. Understand fate and transport of contaminants
3. Concentrations (exposures) & fluxes (loading)
4. A predictive conceptual model
5. Provide information for Eco Risk Assessment

How much monitoring is enough?

Investigations - Typical Questions To Ask

1. Distribution of contaminants in streambed
2. Delineating and quantifying GW discharge
3. Determining total mass discharge
4. Quantifying mass losses in streambed

Increasing Difficulty

Implications for Remediation

- Initial characterization
- Remedial design
- Performance monitoring