Dialysis sampler evaluation of groundwater-surface water interactions

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Outline

• Tools for assessing groundwater/surface water interface
• Case study: Marvin Jonas Transfer Station, NJ
• Treatment opportunities at the interface
• Case study: 22\textsuperscript{nd} Street Landfill, Aberdeen Proving Ground, Maryland
Groundwater-surface water interface

- VOCs commonly discharge to surface water bodies and wetlands
- Identifying the location and nature of the discharge is a common problem
- Scale of the changes in biogeochemical conditions changes rapidly as the groundwater-surface water interface is approached
Tools for identification of groundwater discharge zones

- Nested piezometers
- Dialysis samplers
- Passive vapor samplers
- Seepage meters
- Thermal imagery
Marvin Jonas Transfer Station, NJ

- Site adjacent to small creek (Mantua Creek) in Wenonah, NJ
  - Solvent/waste reprocessing facility
  - COCs primarily chlorinated solvents and BTEX
- Natural attenuation remedy pursued
  - Circumstantial evidence that Mantua Creek is discharge point for VOCs. However, all stream grab samples non-detect for VOCs.
  - Direct evidence required to demonstrate that stream is not impacted
MJTS dialysis sampler sampling

- Objective: identify location of groundwater discharge and directly measure porewater concentrations of VOCs
  - 34 samplers utilized at 25’ increments along stream
  - Samplers approximately 18” long and inserted until 3 of the dialysis cells were above the sediment-water interface
  - High resolution at the groundwater-sediment interface needed
  - Dynamic sediment environment expected and observed

- Retrieved 2 weeks following insertion and selected cells sampled
Top View

1 0
2 0
3 0

Side View

1 1 1
2 1 1
3 1 1 1 1 1 1 1

1 Rigid cover
2 0.20 μm membrane filter
3 Base with wells
Groundwater discharge zone #1
April 2001

July 2001
All cells non-detect

Groundwater discharge zone #2
April 2001

July 2001 - sampled cells
Below quantitation

Groundwater discharge zone #3
Regulatory interaction

• “Convincing evidence of biodegradation in plume prior to discharging to creek”
• However, detects of benzene of 3.1 ug/L and 4.9 ug/L in groundwater discharge zones 1 and 2, respectively exceeded NJDEP surface water quality criteria. This creates problem.
• De minimis zone? Need for a ecological risk assessment?
Treatment Opportunities at interface?

Constructed wetland approach

• A constructed wetland to treat both chlorinated and non-chlorinated VOCs maximizing biodegradation, minimizing volatilization while operating year-round

• Wetland is constructed as an alternative discharge point for the groundwater plume within the site boundary either passively intercepting the plume or serving as a component of a pump and treat system
DETRITUS
WATER
ATMOSPHERE
RHIZOSPHERE
SUB-RHIZOSPHERE

METHANOTROPHIC BIODEGRADATION
PLANT UPTAKE

REDUCTIVE DECHLORINATION

ATMOSPHERE
WATER
DETRITUS
RHIZOSPHERE
SUB-RHIZOSPHERE

VOCs
SORPTION
Contaminant profiles in mesocosms

**Constructed**

Low CH$_4$, lower H$_2$

- ○ TCE
- △ Cis-1,2-DCE
- ● Vinyl chloride

**Natural**

High CH$_4$, higher H$_2$
22nd Street Landfill- APG

- Landfill for municipal waste and chemical disposal, also UXO issues
- Built directly adjacent to s. Bush River within an existing wetland
  - Few remedial options without directly attacking landfill
  - Treatment wetland concept very familiar at APG

- Motivation: passively treat plume/landfill leachate prior to discharge to Chesapeake Bay
Treatment wetland plan for 22nd Street Landfill

- Assess discharge zone seasonally using dialysis samplers and other approaches
- Construct treatment wetland over discharge zone. Depth of peat material dictated by concentrations in groundwater.
- Passive treatment accomplished by rhizospheric biodegradation, sorption, and other relevant processes