Groundwater Sampling

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Presentation Overview

• Developing Groundwater Sampling Plans
  – Data Quality Objectives
  – Selecting Monitoring Locations
  – Monitoring Wells
    • New
    • Existing
  – Groundwater Sampling Techniques
    • Low Flow
    • No Purge
    • Grab
  – Sampling Drinking Water
    • Residential
    • Public Supplies
• Data Interpretation
  – Conceptual Site Model
  – Data Quality
  – Interpretation
• Case Studies

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Data Quality Objectives

What will the data be used for?

• Presence/absence
• Nature and extent
• Impacts to receptors
• Remedial Options
• Remedial effectiveness/Long Term Monitoring
Data Quality Objectives

What will the data be used for?

• Presence/absence
  – Site Characterization/Site Inspection
    • May be the first investigation
      – Limited subsurface information
      – Need to install wells
    • Previously investigated
      – Have some understanding of the subsurface
      – Wells already installed
  • Sampling program design
    – Sample locations biased
    – Longer well screens

Data Quality Objectives

What will the data be used for?

• Nature and extent
  – Remedial Investigation
  – Vertical and horizontal evaluation
    • What are your contaminants of concern?
    • Subsurface conditions
  – Sample program design
    • Discreet sampling
    • Multi level sampling
Data Quality Objectives

What will the data be used for?

• Impacts to receptors
  – Drinking water wells
    • Monitoring well depths representative of drinking water wells in the area
    • Residential sampling
      – Analytical
      – Borehole geophysics
      – Packer sampling
      – Effect of residential pumping
  – Surface water discharge
    • Multi level monitoring points
      – Evaluate gradients
    • Pore water (groundwater/surface water interface)

Data Quality Objectives

What will the data be used for?

• Remedial Options
  – Geochemistry
  – Focused on where the contamination is
    • Borehole geophysics
    • High resolution profiling
• Remedial effectiveness and Long Term Monitoring
Selecting Monitoring Locations

- Data Quality Objectives
- Conceptual Site Model
- In-situ Evaluations
  - Borehole geophysics
  - High resolution profiling
- Existing monitoring locations
Selecting Monitoring Locations

- Borehole Geophysics
  - Structure
  - Interaction between wells
  - Where contaminants might be migrating
  - You are more likely to get it right

- Groundwater profiler
  - VOC
  - Membrane interface probe (MIP)
  - Laser induces fluorescence (LIF) LNAPL/DNAPL
  - Discreet groundwater samples within a foot
  - Allows to more accurately place monitoring wells

- Limitations
  - Expensive
Monitoring Wells

• Installing New Wells
  – Data Quality Objectives
  – Contaminants of Concern
    • Screen interval
      – LNAPL or DNAPL
  – Water depth
    • Well diameter needed for pump

Monitoring Wells

• Standard wells
• Open hole
• Hybrid
• Multi-Level Monitoring Wells:
  – Single-Casing Systems:
    • Continuous Multi-channel Tubing (CMT)
    • Westbay
    • Waterloo System
    • Flexible Liner Underground Technologies (FLUTe)
  – Multiple-Casing Systems:
    • Nested Wells
    • BARCAD Wells
CMT Well

Existing Monitoring wells

- Why was it installed?
  - Is it in the right location to meet your needs?
- Do you know how it was constructed?
  - Bore hole camera
  - Optical televiewer
- When was it sampled last?
  - Redevelop
Groundwater Sampling Techniques

Low Flow Sampling

- Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells from USEPA September 19, 2017
Low Flow Sampling

- Contaminants of concern
  - Applicable for most
- Pumps
  - Peristaltic
    - <22 feet to water
  - Submersible
    - Grundfos
    - Hurricane
    - Bladder

Low Flow Sampling

- Why are you collecting the field parameters?
  - Indicate the well is at equilibrium with formation water
  - Evaluate specific conditions related to site contamination or migration
    - High or low pH may result in forming other contaminants
    - Conductivity/ORP may be used to evaluate elevated chemicals in the groundwater
    - Dissolved Oxygen discharge or recharge areas
No Purge Sampling

- Assumes water within the screen is at equilibrium
- Most applicable for long term monitoring
- Generally not appropriate during early investigations

No Purge Sampling

- Hydrasleeve™
  - Open LDPE or HDPE bag
  - Valve at the top
  - Installed closed and opens when removed
No Purge Sampling

- Passive diffusion bag
  - LDPE bag with deionized water
  - Left in the well for 2 to 4 weeks
- COCs
  - VOCs (except MTBE, MIBK and styrene)

Grab Samples

- Packer sampling
- Direct push sample point sampler
Grab Samples

• Data Quality Objectives
• Contaminants of concern
• Limitations
  – Where is the sample coming from?
  – Is the sample representative?

Sampling Drinking Water
Residential Drinking Water Sampling

- Plumbing
  - Contaminants of Concern
    - Metals (lead and copper)
    - Teflon (PFAS)
  - Is there any treatment?
    - Sediment filters
    - Water softeners
    - Carbon
- Well construction
  - Depth
  - Drilled/dug

Data Quality and Interpretation
Data Quality

- QA/QC
  - Field Blanks
  - Equipment/Material Blanks
  - Rinsate Blanks
  - Duplicate

Data Interpretation

- Conceptual site model
  - Does the data fit?
- QA/QC
  - How do the results affect usefulness of the data?
- Sampling methods
  - Turbidity
  - Pumps
  - Field parameters
Case Studies

Private Client
American Thermostat, South Ciaro, New York
Cold Regions Research Engineering Laboratory, Hanover, New Hampshire

Private Client

- Extensive groundwater sampling
- Geophysics and 3-D Visualization
  - Identified the most transmissive fractures
- Allowed focused in-situ treatment
  - Concentrations reduced and have met the clean up criteria
American Thermostat, South Ciaro, NY

- Background
  - PCE and TCE
  - Investigations conducted beginning in the early 1980s
  - Remediation completed in the late 1990s
  - Groundwater plume ~3,000 feet

• American Thermostat, South Cairo, NY
American Thermostat, South Cairo, NY

- PCE Plume: 2012/2018
Cold Regions Research Laboratory, Hanover, NH

- TCE site with initial investigations in the 1980s-1990s
- Existing mw network inadequate to characterize what was going on with the groundwater plume, did not span the vertical extent of the plume in the overburden
- Conducted groundwater profiling
- Showed higher levels of contamination at the vadose zone interface

Well MW-14-107

[Graph showing TCE Concentration vs Depth Below Water Table (ft)]

- S-10M µg/m3
- Depth: 0, 10, 20, 30 ft
- Concentrations: 65,000 µg/L, 310 µg/L, 98 µg/L, 38 µg/L
Soil Gas – Groundwater Relationship
SVE Operation Influence on Groundwater

MW-14-107
SVE PLOT TIMELINE

AOC2 Pilot Start
AOC2 Rebound Shutdown
AOC2 Restart
AOC2 Shut Down
AOC9 Pilot Start
AOC2 Shallow Restart
AOC 2 Shallow Switch to Deep
AOC 2 Shallow Restart

Summary

• Where are your samples coming from?

• What does your data mean?