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

Data Quality Objectives

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)

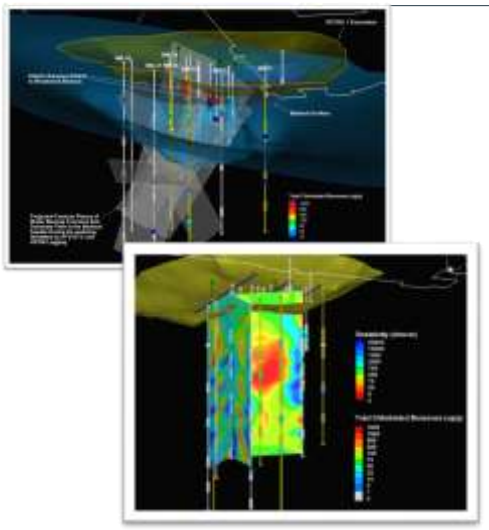
Data Quality Objectives

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

Monitoring Wells

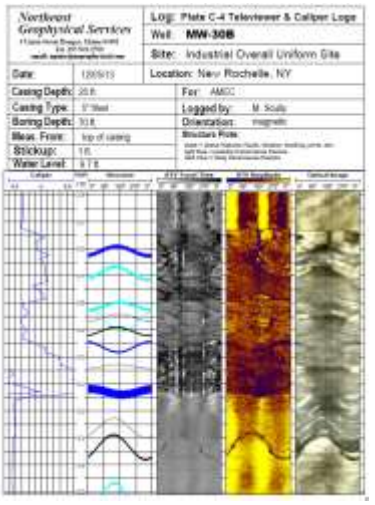
Selecting Monitoring Locations



- 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



Selecting Monitoring Locations

- 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

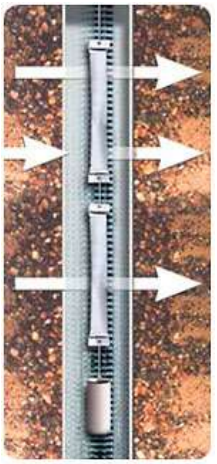
- Assumes water within the screen is at equilibrium
- Most applicable for long term monitoring
- Generally not appropriate during early investigations

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

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- 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

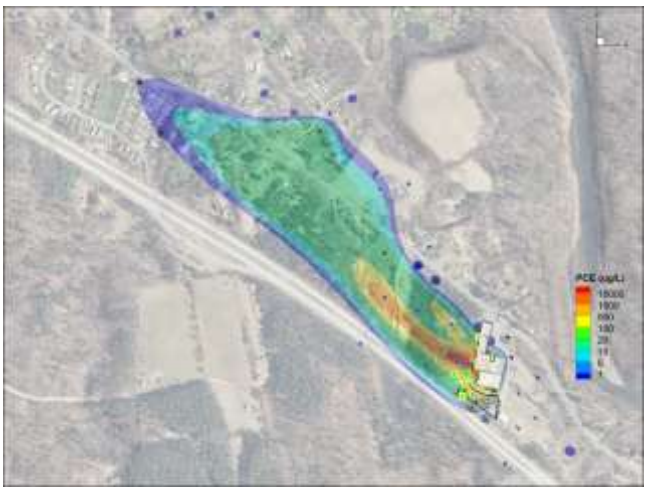
Private Client
American Thermostat, South Ciaro, New York
Cold Regions Research Engineering Laboratory, Hanover, New Hampshire

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

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American Thermostat, South Cairo, NY

- PCE Plume: 2012/2018

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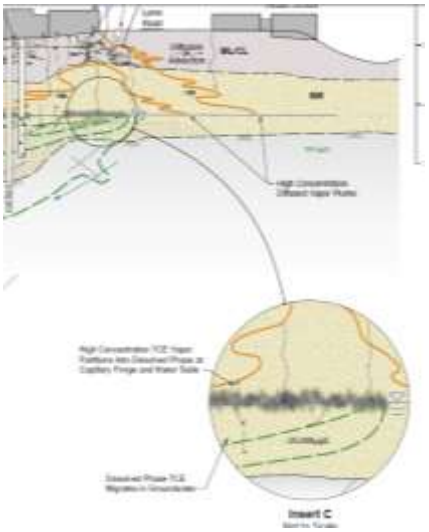
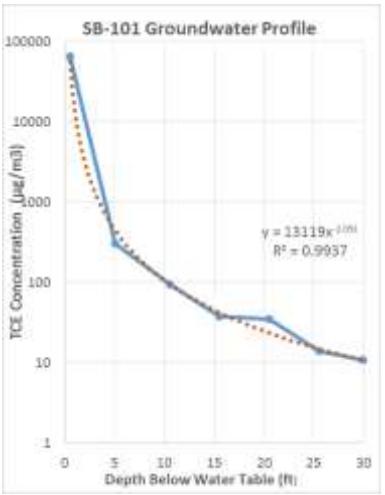
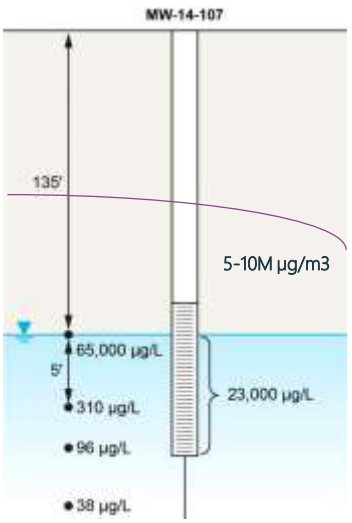
Cold Regions Research Laboratory, Hanover, NH



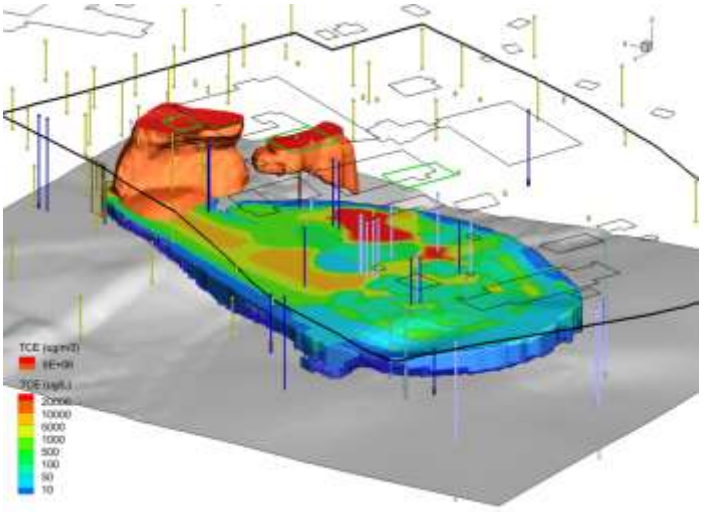
- TCE site with initial investigations in the 1980s- 1990s
- Existing mw network inadequate to characterize what was going on with the groundwater plume, did not span the vertical extent of the plume in the overburden
- Conducted groundwater profiling
- Showed higher levels of contamination at the vadose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

Well MW-14-107

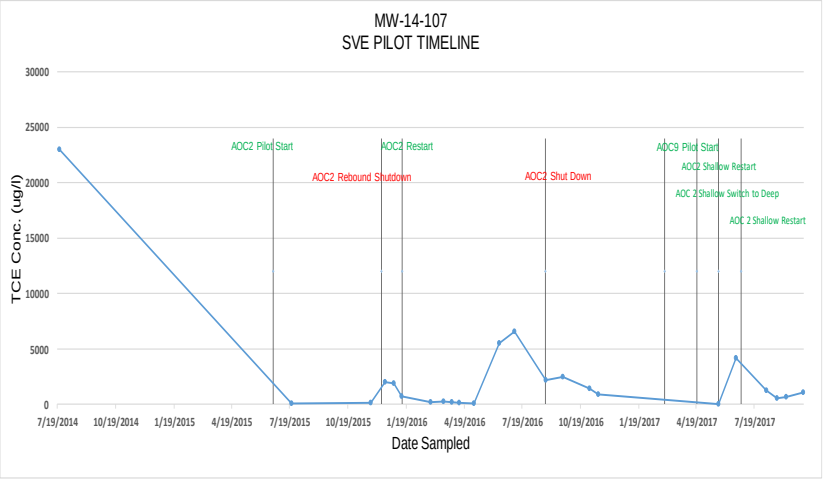




Soil Gas – Groundwater Relationship



SVE Operation Influence on Groundwater



Summary

- Where are your samples coming from?
- What does your data mean?

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