



Real Time Data Collection and Interpretation Equipment and Techniques Overview


NEWMOA Workshops
March 22-24, 2016




Outline

- Rationale for High Resolution, Real Time Site Characterizations
- HRSC Approach
- Overview of Tools And Techniques


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Rationale for High Resolution, Real Time Site Characterizations



Subsurface Environments:



- Porosity
- Hydraulic Conductivity
- Hydraulic Head/Hydraulic Gradient
- Capillary pressure
- Geochemistry

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Problems with Conventional Investigations

- Expectations typically set too low
- Phased approach is slow and leads to inefficiencies
- Little or no ability to react to data
- Data Sets often not very comprehensive
- Data sets not high enough in resolution to adequately describe and understand transport and fate of contaminants

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Advantages of High Resolution, Real Time Investigations

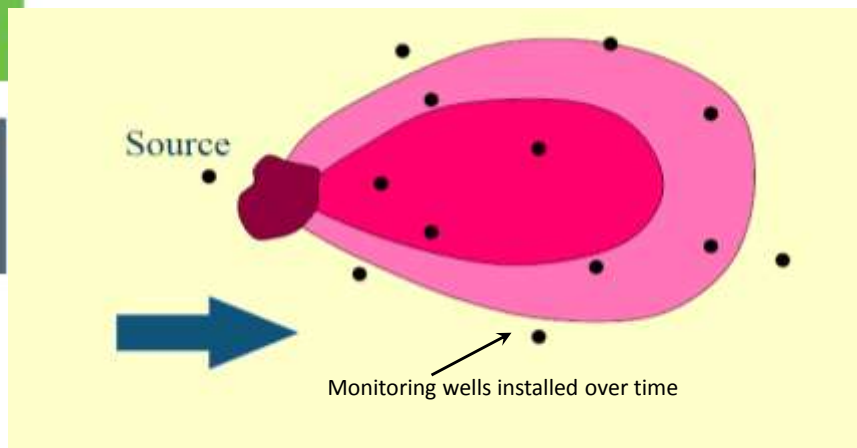
- Expectations typically set high – very comprehensive
- Paced according to objectives and costs – minimizes inefficiencies
- Ability to react to data
- Data sets are high enough in resolution to adequately describe and understand transport and fate of contaminants
- Leads to more effective site management and remedial actions
- Consistent with Triad and other similar programs

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Conventional Investigation



Murray Einarson 2008

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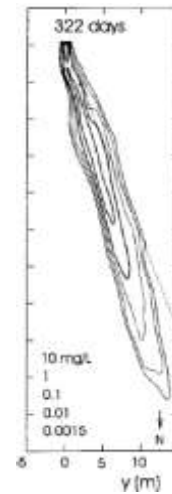
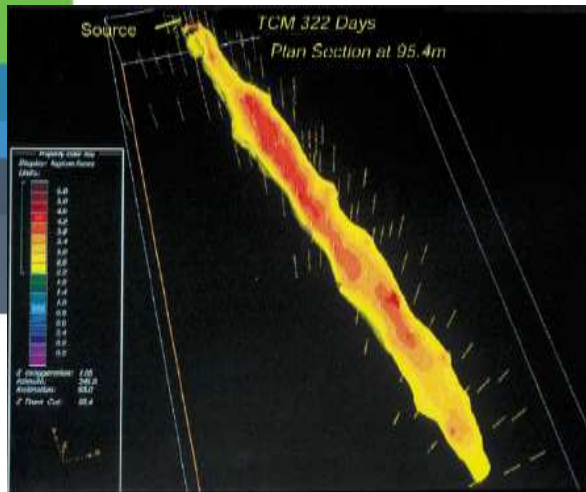
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Conventional Monitoring Well Placement Strategy



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TCM Plume at 322 Days Weak Transverse Dispersion

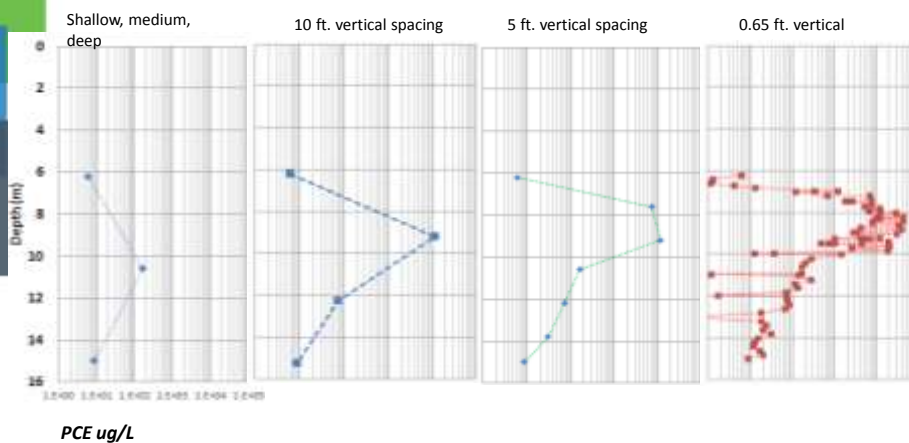


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Rivett et al, 2000


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What is Right Vertical Spacing? A Profile Through PCE Plume in Sandy Aquifer




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General Approach for High Resolution, Real Time Site Characterizations

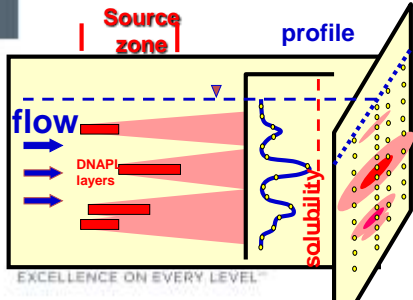
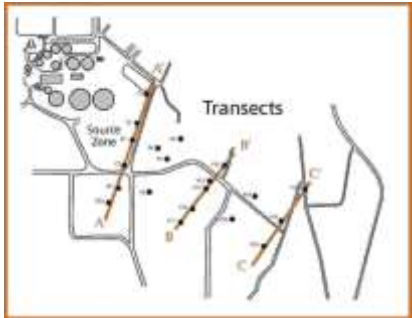


The High Resolution Approach

Detailed transects of vertical profiles oriented normal to the direction of the hydraulic gradient


Sample Interval: the vertical dimension of the sampled portion of the aquifer. SHORT

Sample Spacing: the vertical distance between samples. SMALL

Triad Approach Principles:

- Dynamic Work Strategies
- Collaborative Data
- Real-time Measurement Tools



High Resolution, Real Time Tool Sets

- Screening/Continuous Read/Direct Imaging
 - MIP/EC - Contaminant Distribution and Strat
 - LIF (UVOST & TARGOST) - Contaminant Distribution
 - CPT - Stratigraphy
 - HPT – Stratigraphy and Head
 - Index Of Hydraulic Conductivity - Stratigraphy and Head
- Quantitative Sampling and Analyses
 - Soil Coring and Sampling
 - Discrete Interval Groundwater Sampling Techniques

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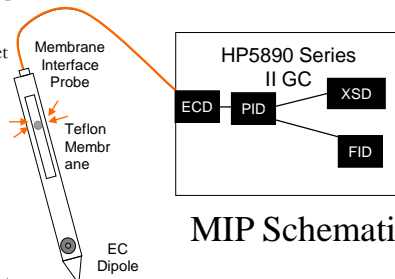
MIP Strengths and Limitations

Strengths

- Vertically continuous, real-time data on VOC distributions and soil electrical conductivity
- Can typically complete 150 to 250 linear feet of exploration per day
- Ideal for locating source areas and plume cores

Limitations

- Limited depth penetration
- Units (volts) not the same as with soil or water concentration
- **Correlations with soil/water concentrations problematic.**
- Generally does not distinguish between analytes.
- Apparent “dragdown” of contamination



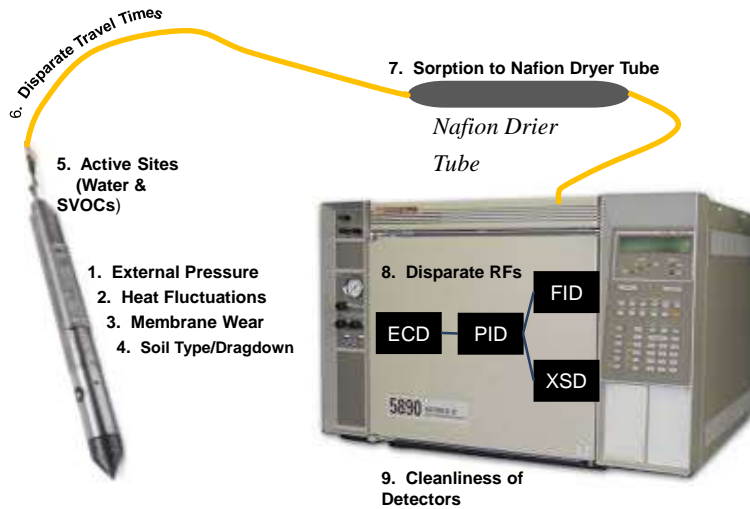
MIP Schematic

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Precision and Accuracy

Nine Variables that Affect MIP Precision and Accuracy

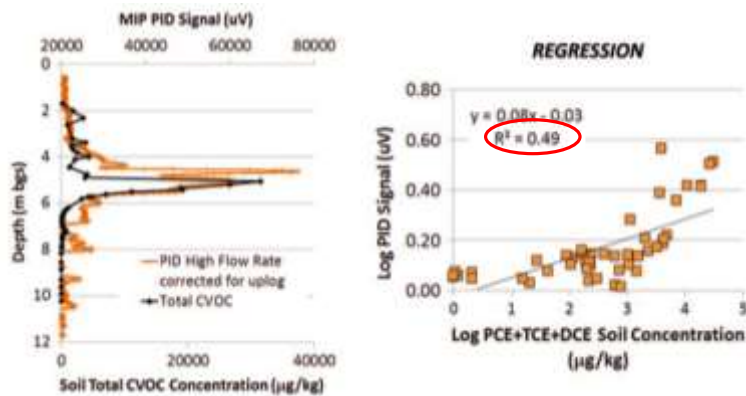


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MIP and Soil Core High Conc. Location:

Reasonably Good ID of Plume Location – Poor Concentration Correlation



Adamson et al 2013

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Additional MIP Features

Heated Trunkline

- Cold weather
- Less carrydown/faster cleanup
- More efficient and accurate logging

MIP/Hydraulic Profiling Tool (MiHPT)

- Combines hydrostratigraphic data (similar to Index of Hydraulic Conductivity) and detector responses to contaminants
- More reliable hydrostratigraphy than is provided by electrical conductivity logging



EC Dipole

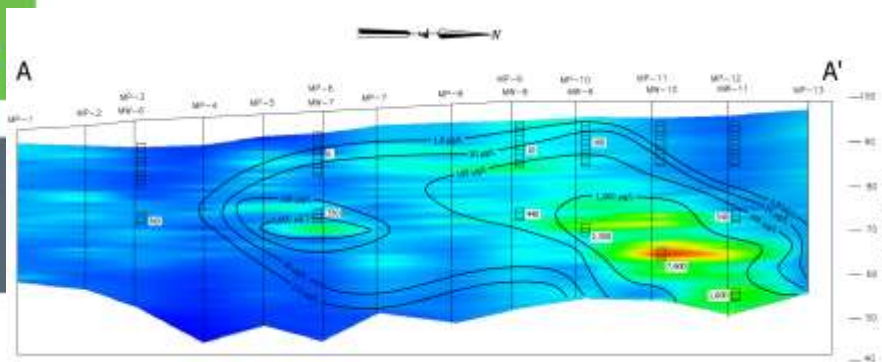
HPT Injection Port

MIP Membrane

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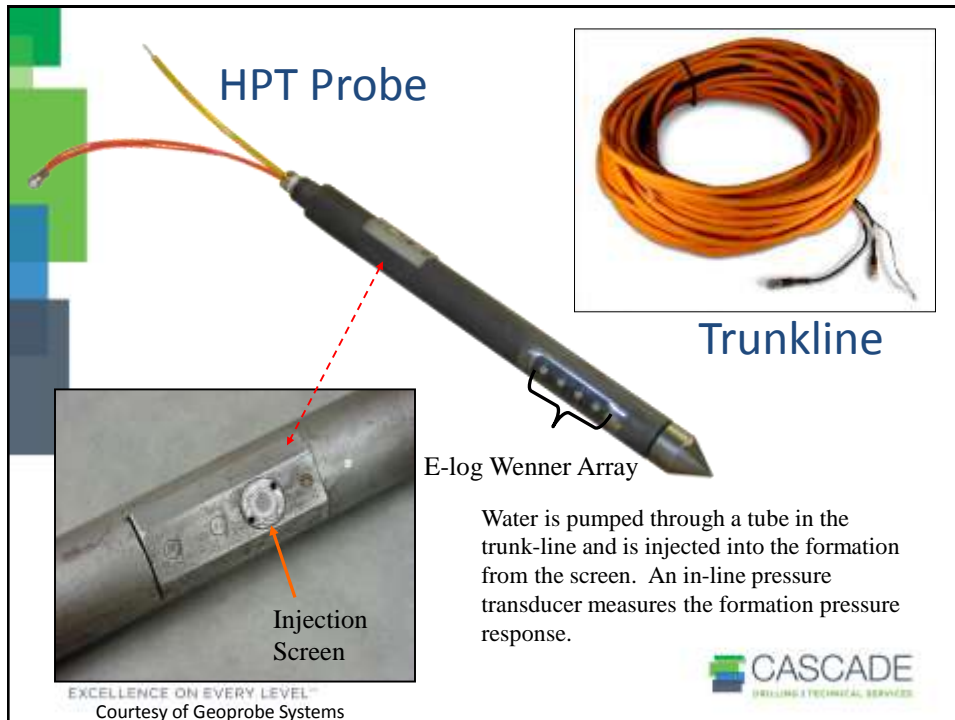
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Collaborative Data – MIP with Short-Interval MWs



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Hydraulic Profiling Tool (HPT)

- Continuous hydrostratigraphic data profiling
- Describes hydrostratigraphy on the basis of the flow of water into the formation
- Real-time data generation
- Direct Push (percussion/vibration or static push)

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Cone Penetrometer Technology (CPT)

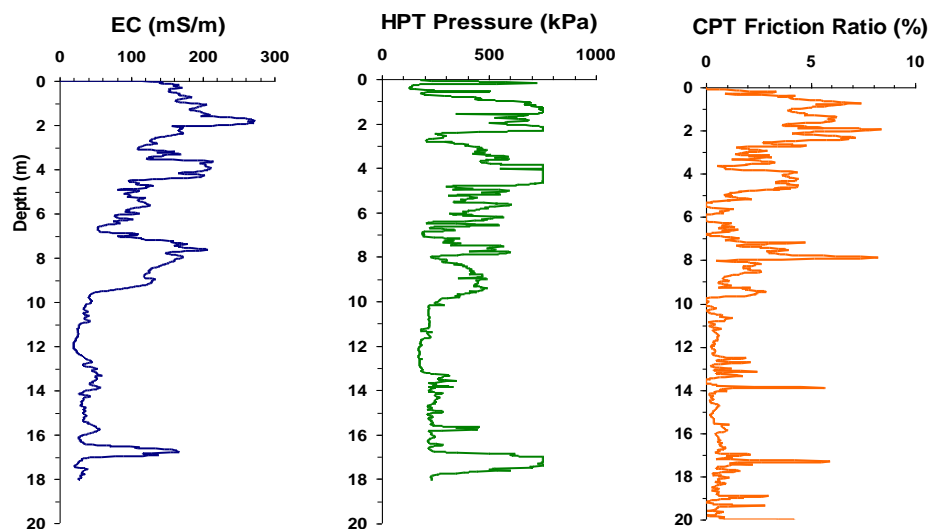
- Describes stratigraphy on the basis strain gauge ratios
- Continuous stratigraphic profiling
 - Can be combined with numerous direct sensing devices (e.g., LIF, MIP, TarGOST, raman spectroscopy etc)
- Real-time data generation
- Static push only
- Requires large, heavy trucks




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Comparison of Logs





Quantitative Soil and Groundwater Sampling Techniques




Soil Sampling Desirable Traits in a Coring Tool

- 100% recovery and retention
 - allow the core to enter the core barrel (diameter, cutting shoe)
 - core must not expand in volume (clays) or fall out (sand)
- Known depth of origin
- Minimal disruption of the structure of the strata
- Retention of pore fluids.

The core one sees at the surface should be as accurate a representation of the subsurface conditions as possible.

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Recovery: Diameter



Rock stuck in MC5 cutting shoe.

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Immediate Sample Preservation

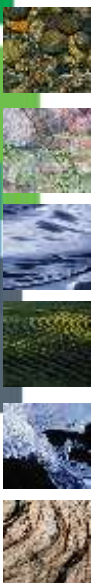


Glass vial pre-filled
with methanol



Beth Parker

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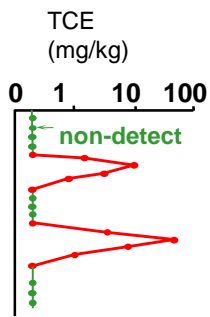


Extracting VOCs from Low Permeability/High foc Soils

TCE (mg/kg)

0 1 10 100




Medium/High Level Method

How Rigorous Does The Extraction Need to Be?

- Enough to disaggregate and suspend material
- Reduce/eliminate rate limiting diffusion process
- Allow methanol to effectively desorb VOCs from organic carbon present within soil

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Quantitative GW Sampling

Waterloo Advanced Profiling System

- Direct push, continuous Point Sample Profiling Tool
- High quality groundwater samples
- Head and I_k data available
- Limited to soils with K greater than 10⁻³ cm/sec



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Quantitative GW Sampling

Screen Point Samplers

Various versions, various screen lengths

Not as limited to low K soils as Waterloo System

Larger screened interval, 1-3 feet options

Caution with isolation of discrete interval



Sealed Position

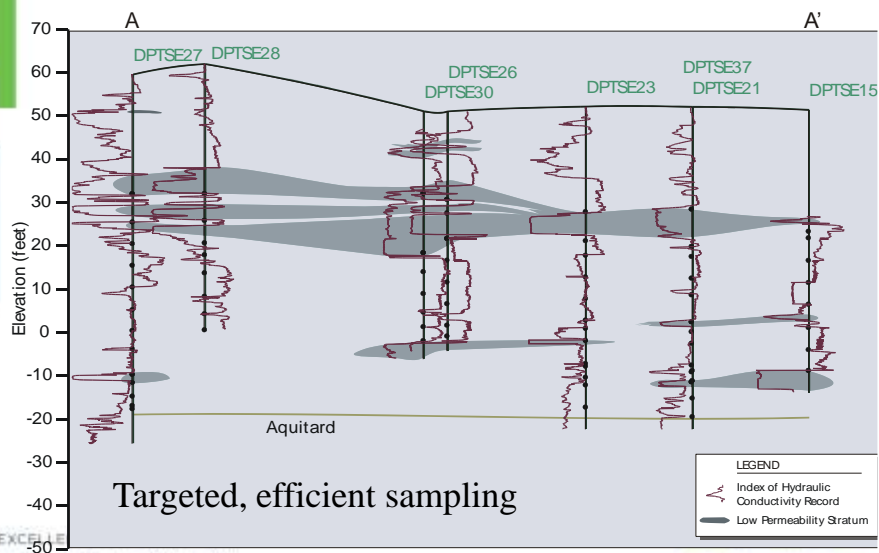
Deployed Position

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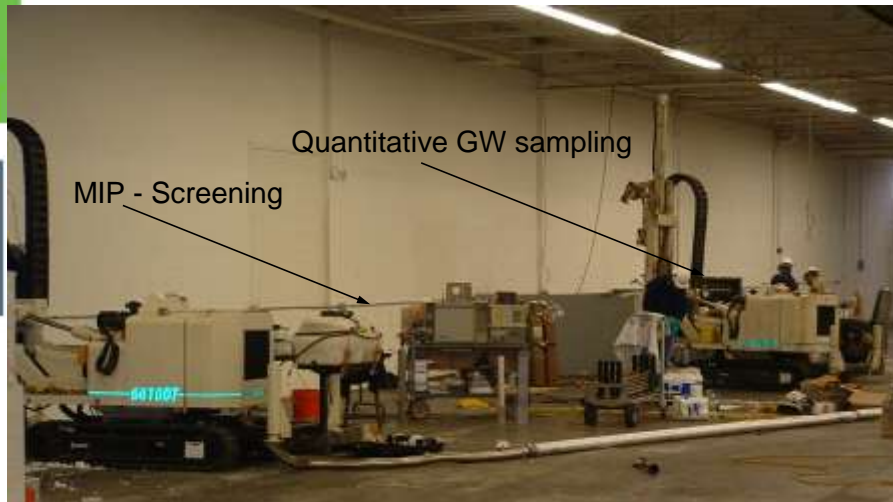
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Stratigraphic Profiling





Simultaneous Use of Investigation Tools to Collect Collaborative Data



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