

LUST Investigation – Five Basic Questions

1. Is there a problem that warrants action?
2. If so, what is the root cause?
 - Follow the 98/2 rule!
3. What actions will control the problem quickly and cost-effectively?
4. Are there secondary problems that require action?
5. What additional actions/controls will:
 - ✓ Stabilize the situation
 - ✓ Get time working for us, not against us
 - ✓ Set the conditions for natural attenuation

Ten Things to Know and Why

1. Source in the vadose zone

- Potential groundwater or vapor issues

2. Porosity of vadose zone

- Control vapors and/or remove source?

3. Depth to water

- Potential LNAPL?

Ten Things to Know and Why

4. Water table fluctuation
 - Smear zone
5. Permeability of smear zone
 - AS/SVE, Injection, Excavation
6. Direction of groundwater flow
 - Off-site migration
 - Potential receptors
7. Plume thickness and depth
 - How/where to treat, contain or intercept

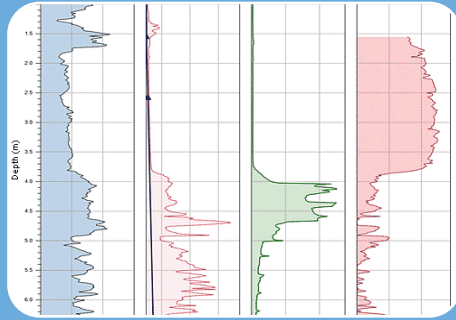
Ten Things to Know and Why

8. Permeability lenses in saturated zone
 - Transport zones?
 - Storage zones?

9. Mass distribution
 - High-mass footprint? (Root cause – 98:2)

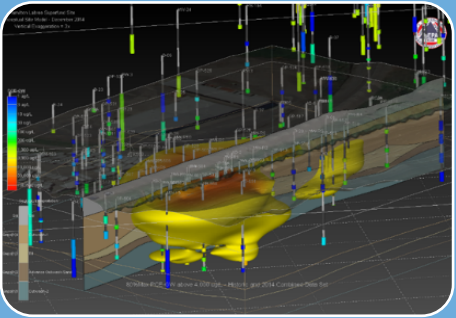
10. Matrix distribution
 - What are my remediation options?

Real-Time, Collaborative, Decision-Making -- A Better Way?



Direct-Sensing/High-Resolution Technologies

- Spatial distribution of COCs – where to remediate
- Matrix distribution of COCs – how to remediate
- VOCs, Metals, PAHs/PHCs ----- Lithology, Permeability, Hydraulic Conductivity
- Dense vertical data sets – Accuracy of CSM depends on density of borings



Data as a Deliverable

- Real-time data capture in the field
- Daily uploads to SCRIBE/EQUIS
- Immediate interpretation – visualization, models, etc.

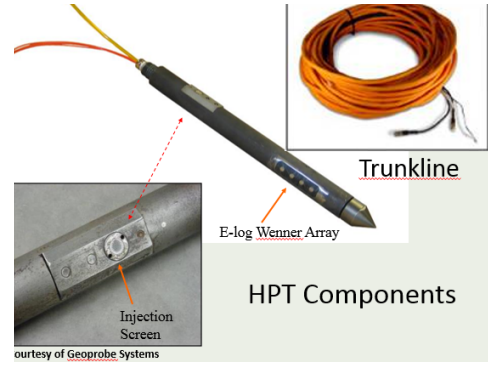
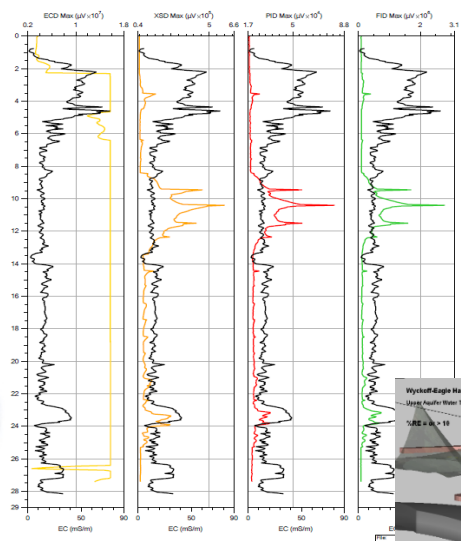
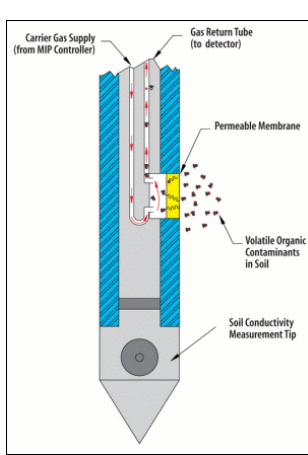


Collaborative Decision-Making and Actions

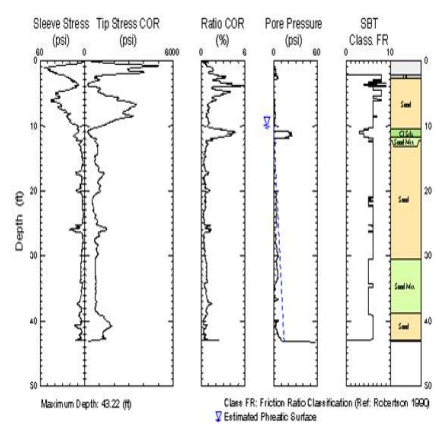
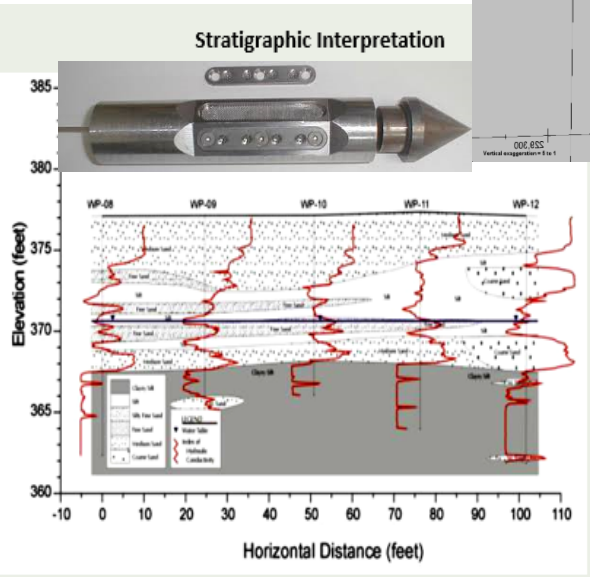
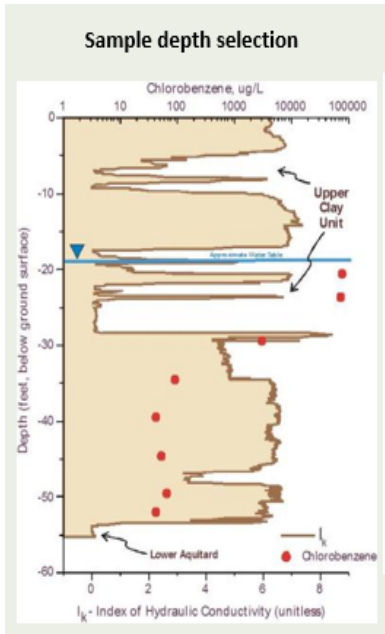
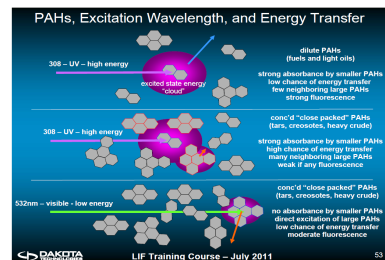
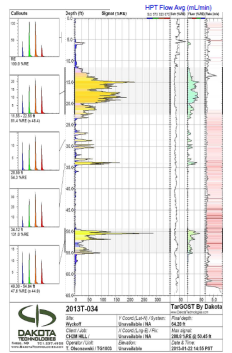
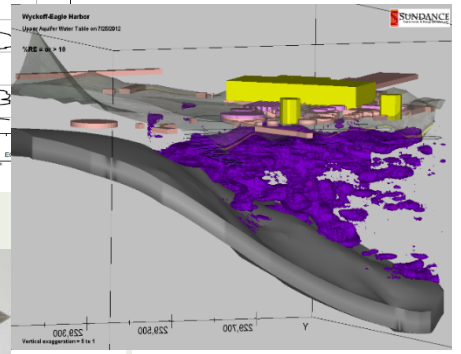
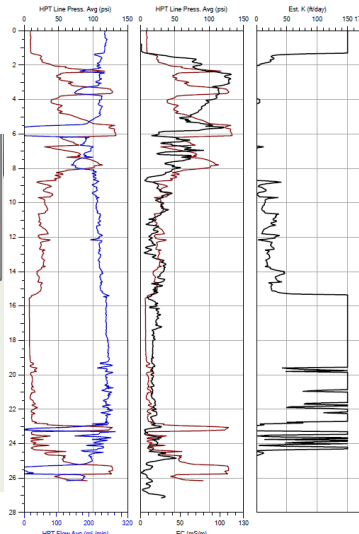
- Data visualizations uploaded to SharePoint, response.epa.org, or FTP sites
- Data available to all stakeholders for multiple uses (independent or group)
- Reach consensus on Conceptual Site Model, data gaps, and next actions

HRSC- Profound Effect on CSMs

Many Advances in Tools - Just A Few Examples

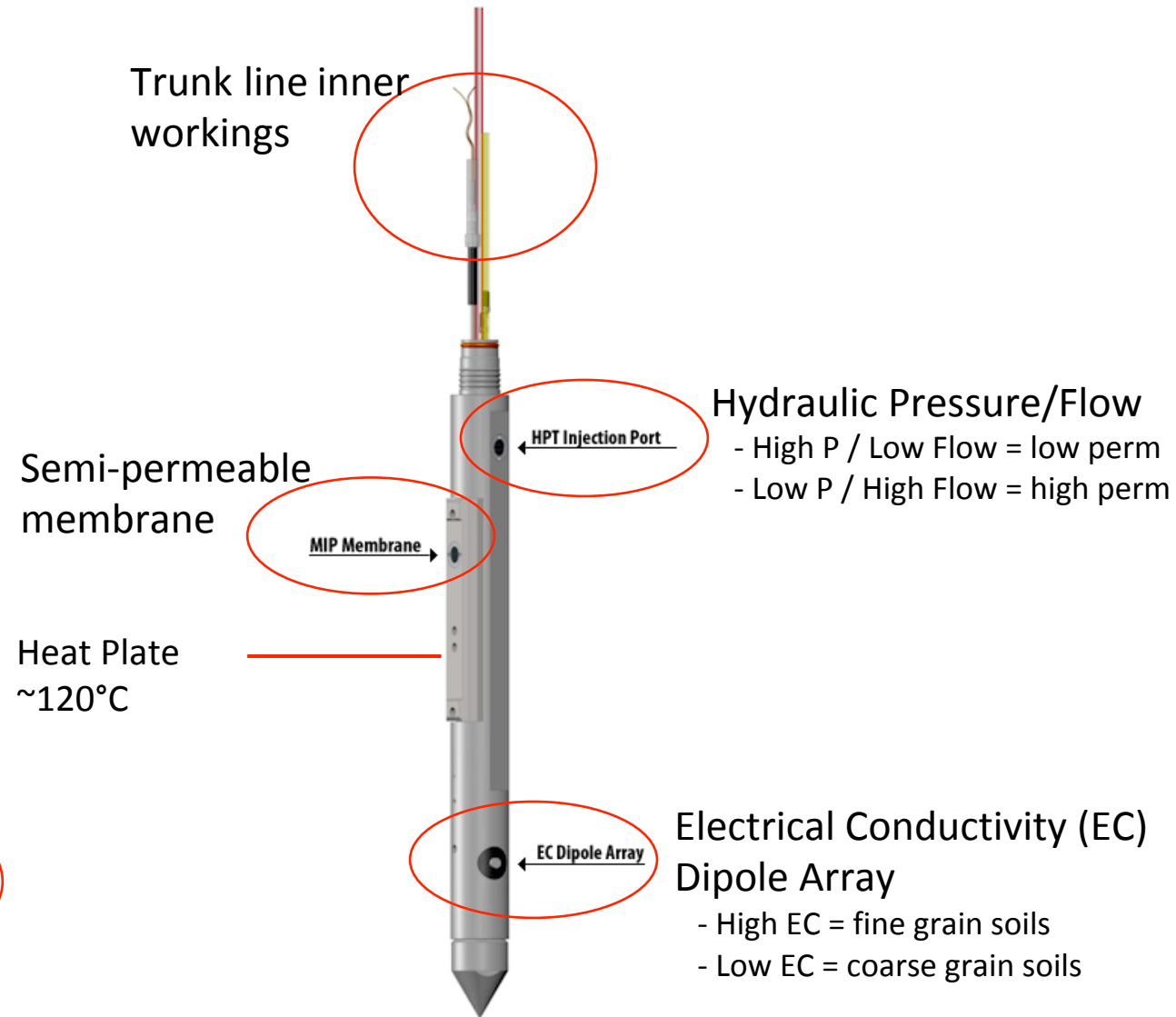


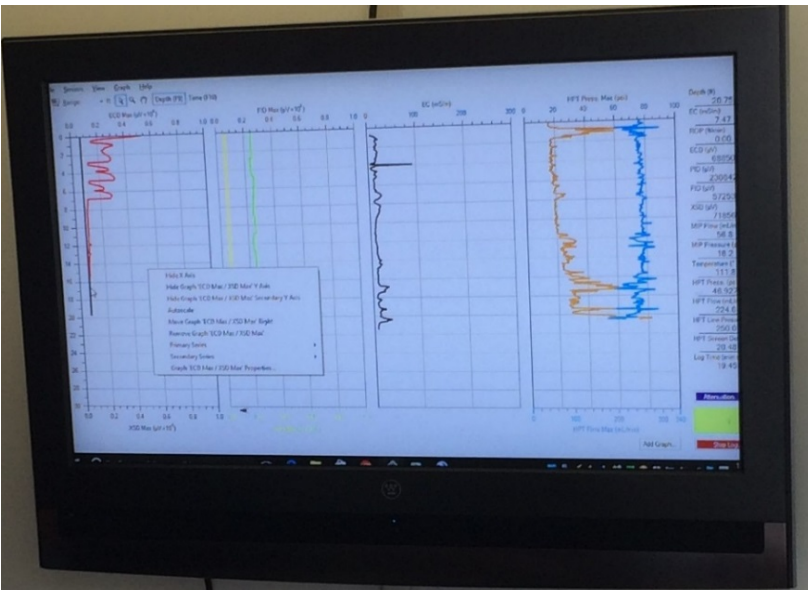
courtesy of Geoprobe Systems



Membrane Interface Hydraulic Profile Tool (MiHpt)

Trunk line threaded through drill rods





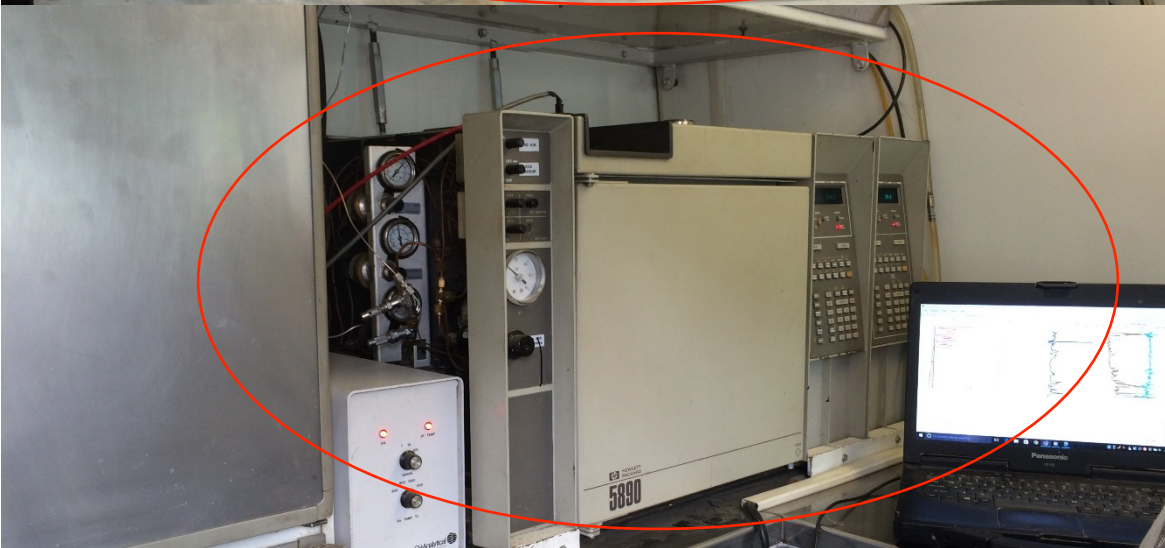
← Real time display



Typical MiHPT Support Van

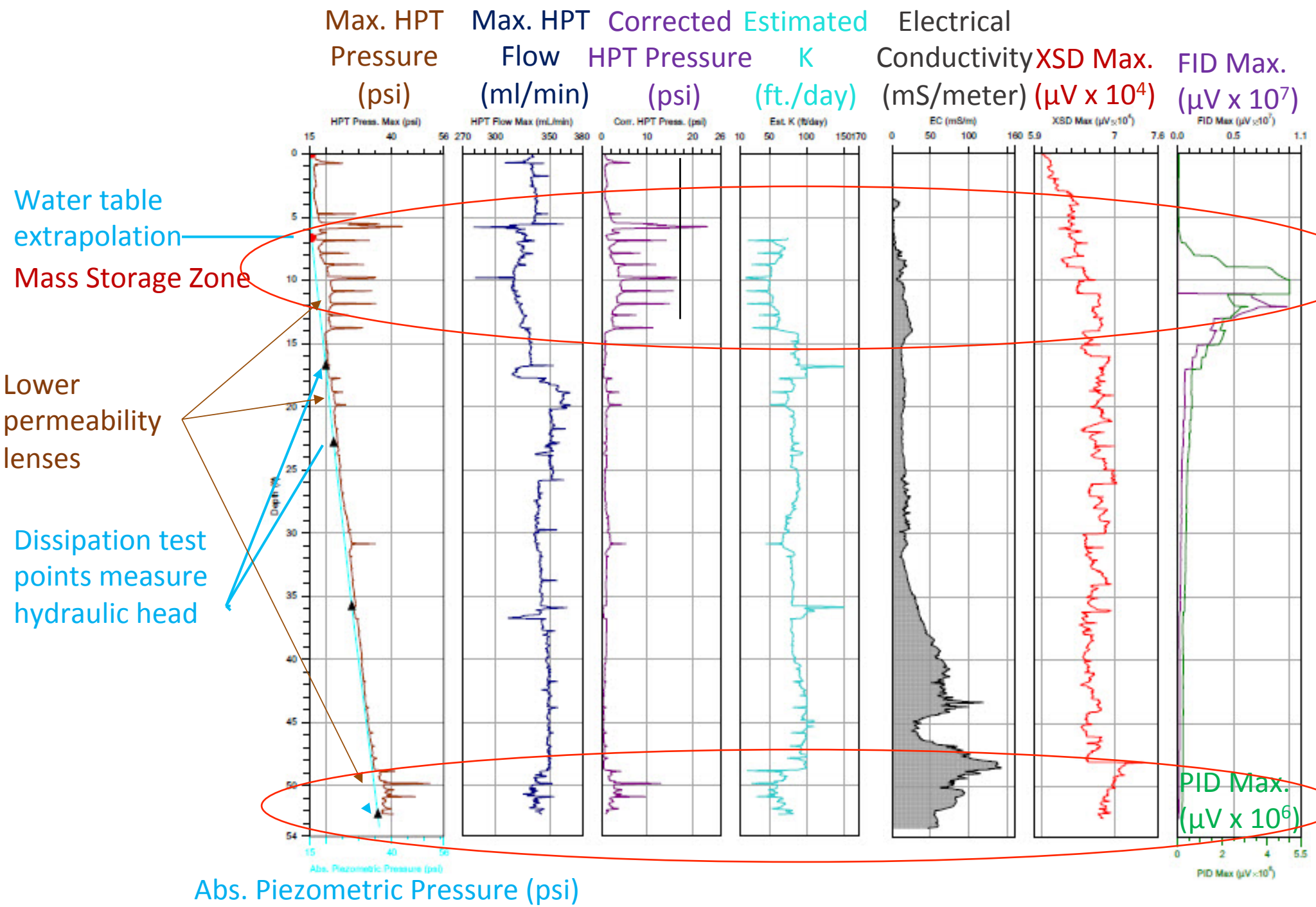


Trunk line controls



Lab-Grade Contaminant Detectors

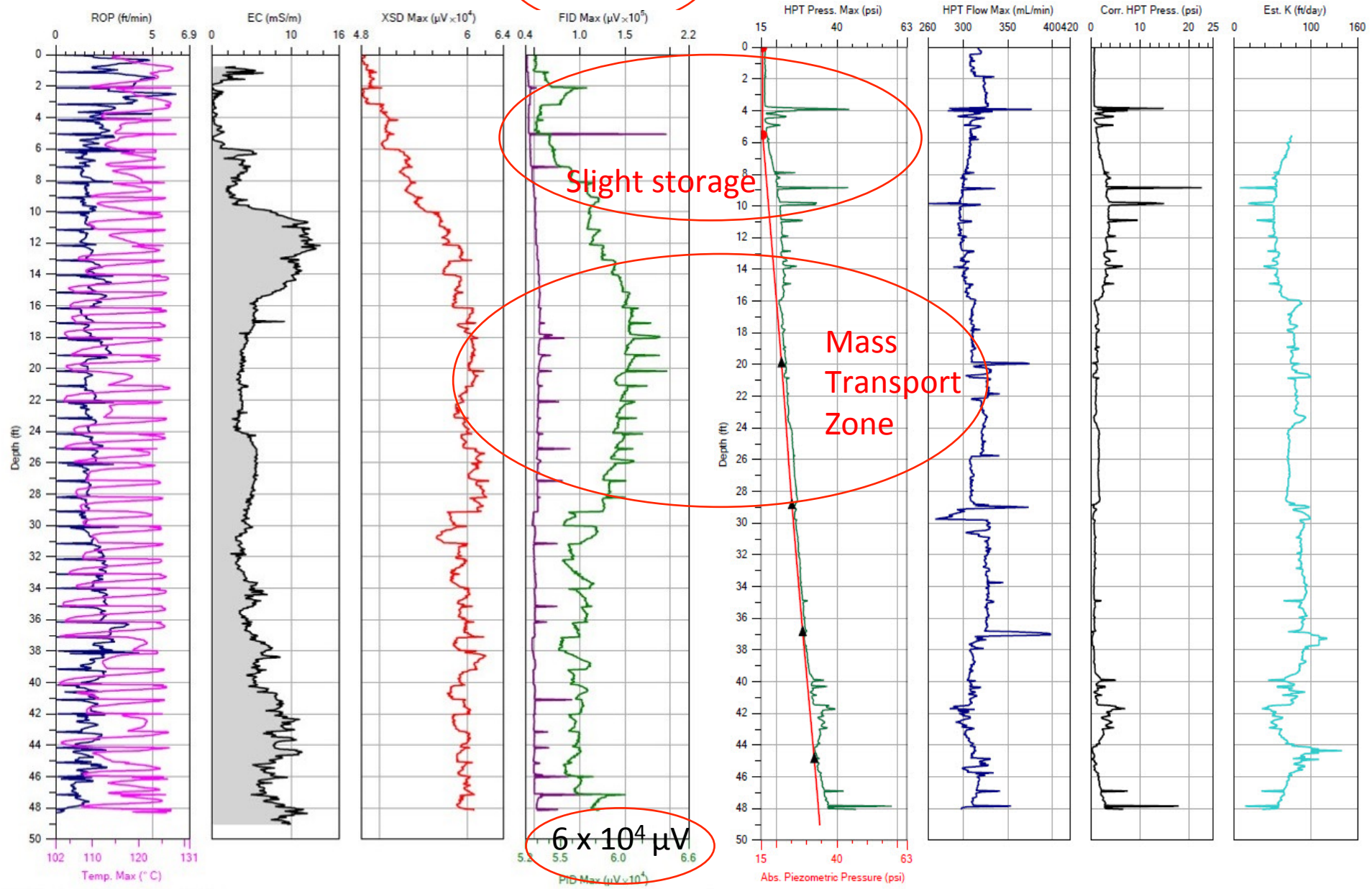
- Photoionization (PID)
- Flame ionization (FID)
- Electron capture (ECD)
- Halogen specific (XSD)



What's going on here?

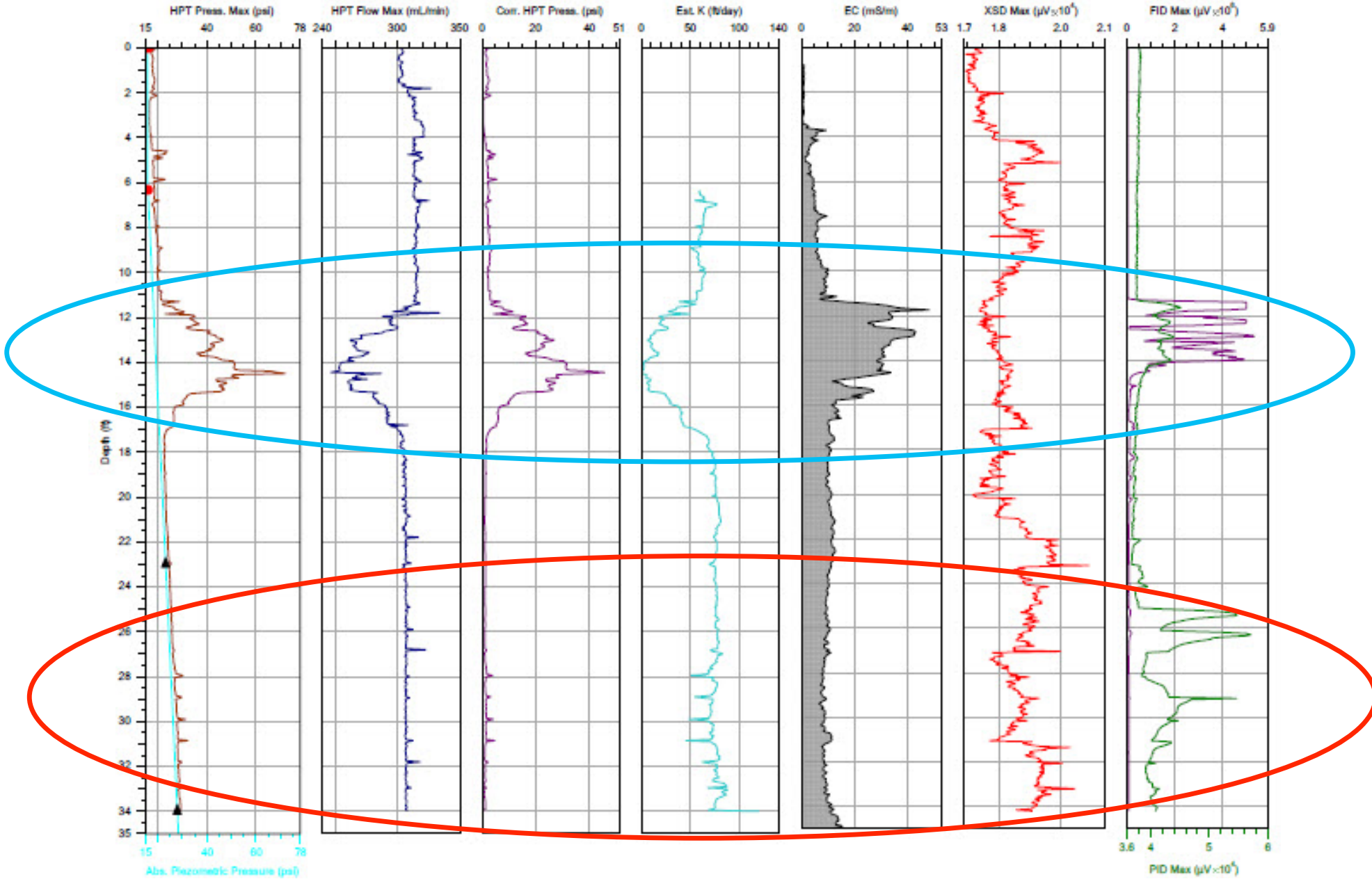
$2 \times 10^5 \mu\text{V}$

Order of magnitude lower



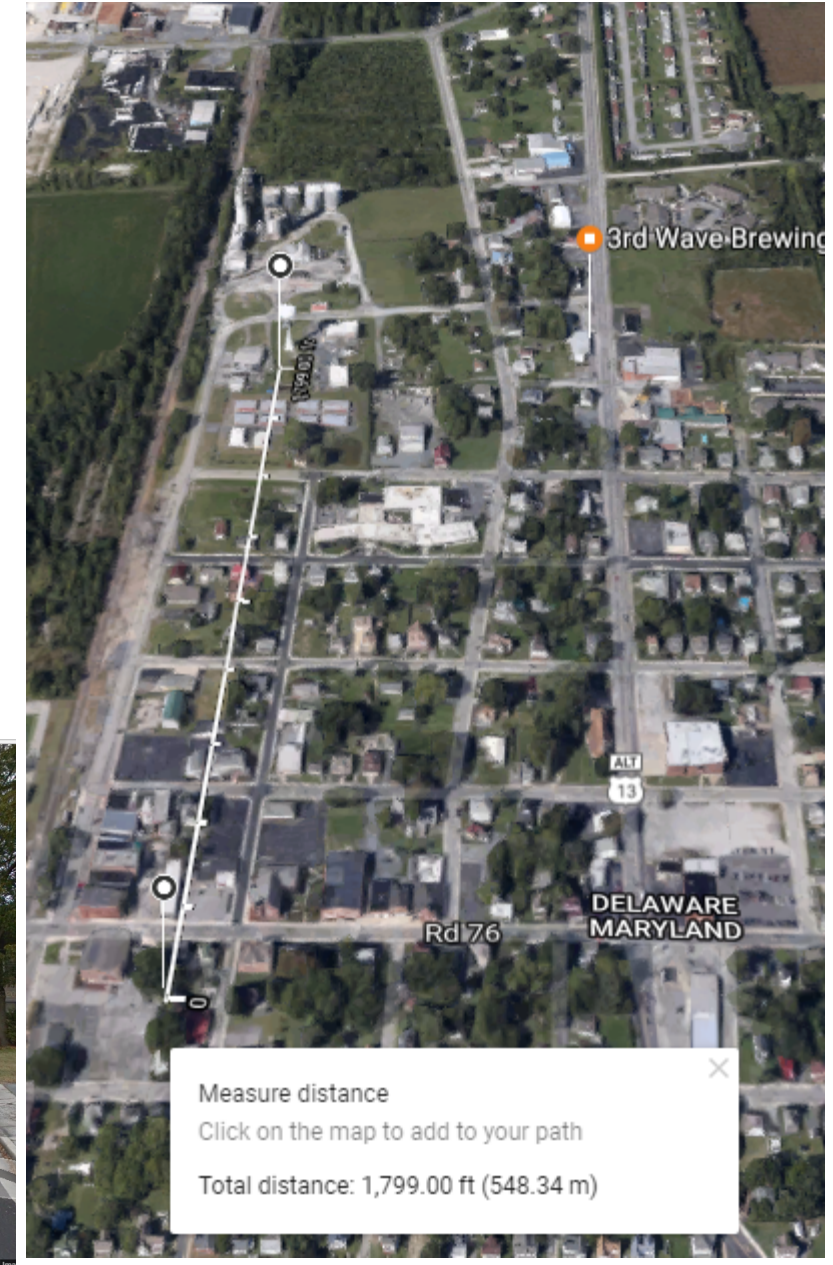
Order of magnitude lower

Mass Storage Zone



A Simple Site

Delmar Supply Wells
Delmar, DE/MD

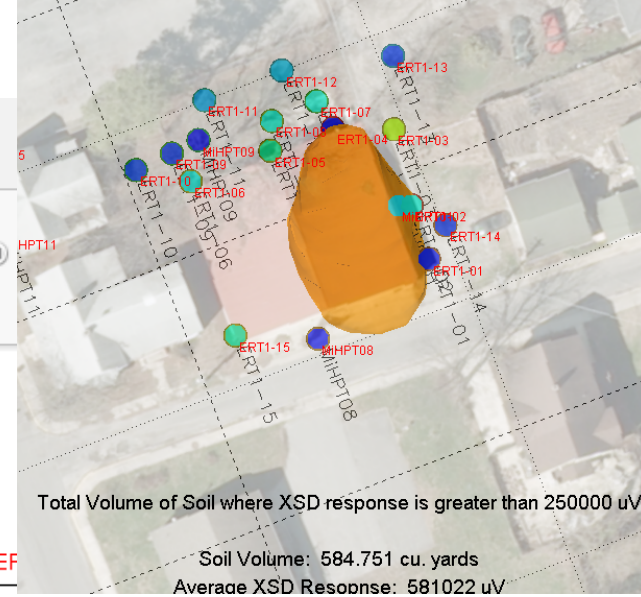


Root Cause of the Problem

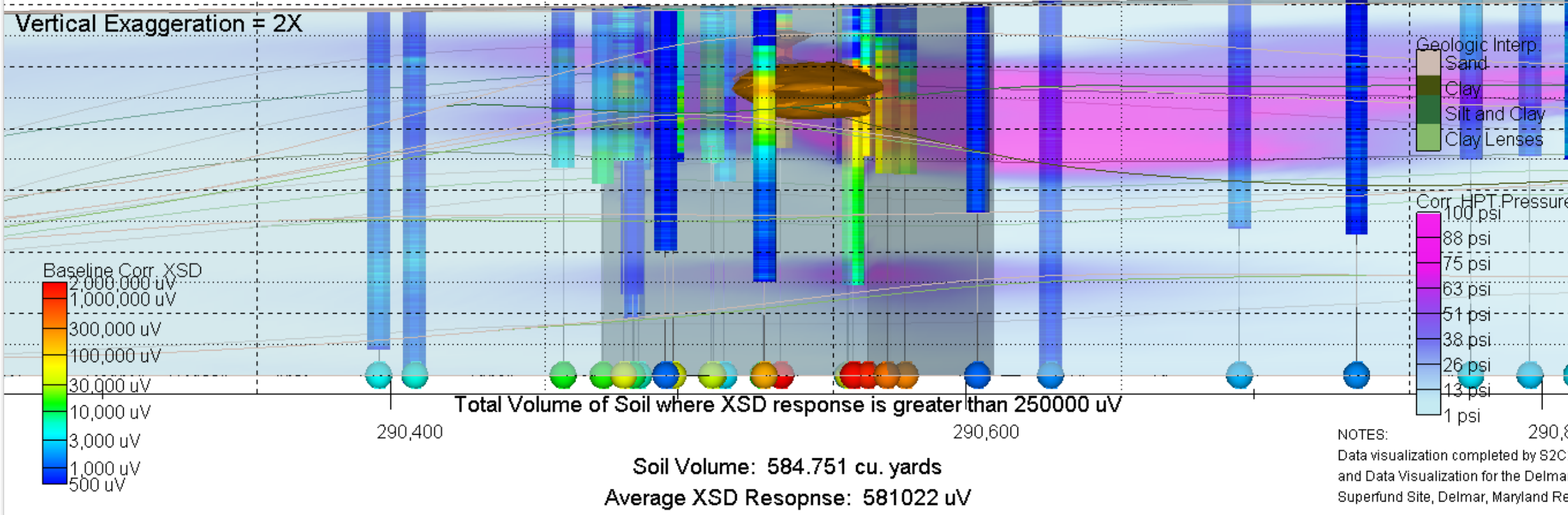
File Properties Advanced

View: 90, 45, 0, -45, -90

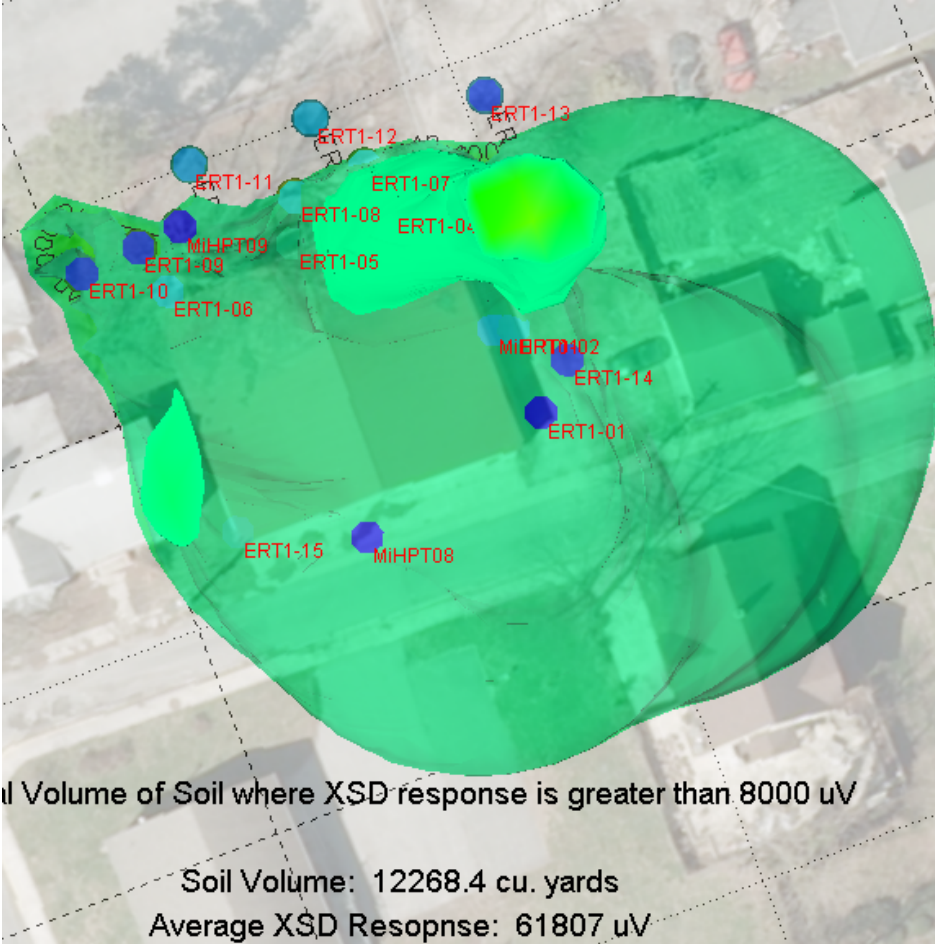
Playback: Play, Stop, Track



Delmar Public Supply Well Site
 Delmar, Maryland
 Conceptual Site Model - June 2016

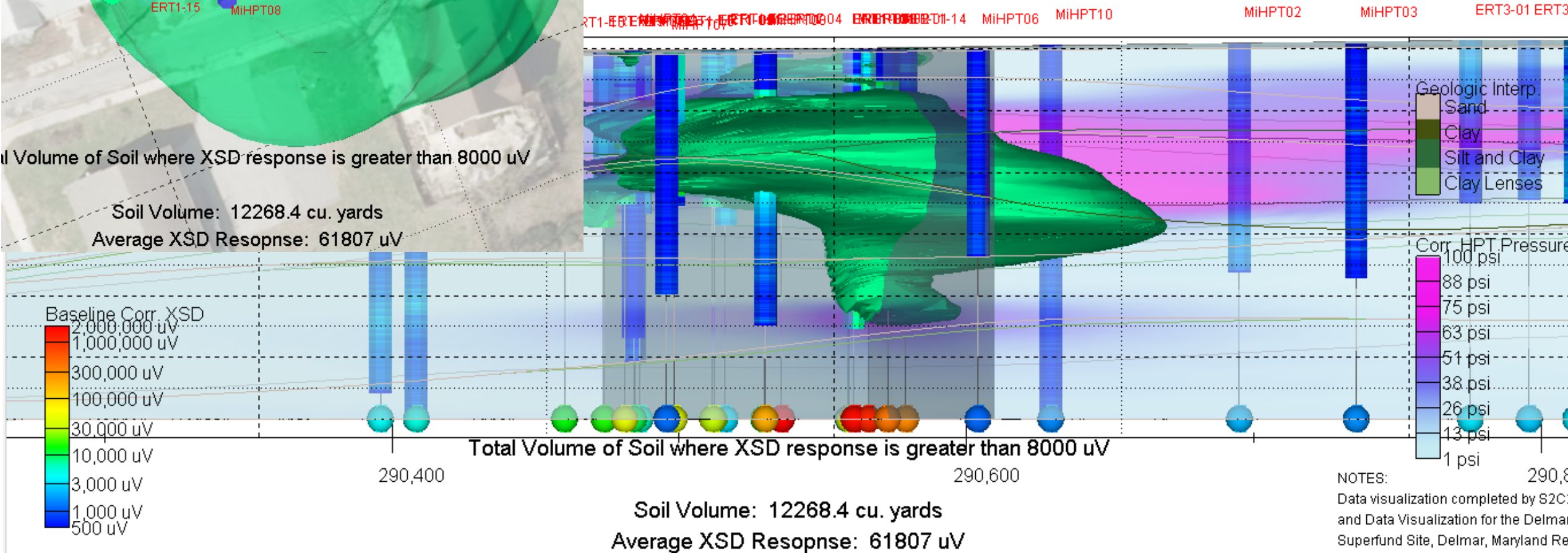


Symptoms of the Problem (up to and including the municipal supply wells)

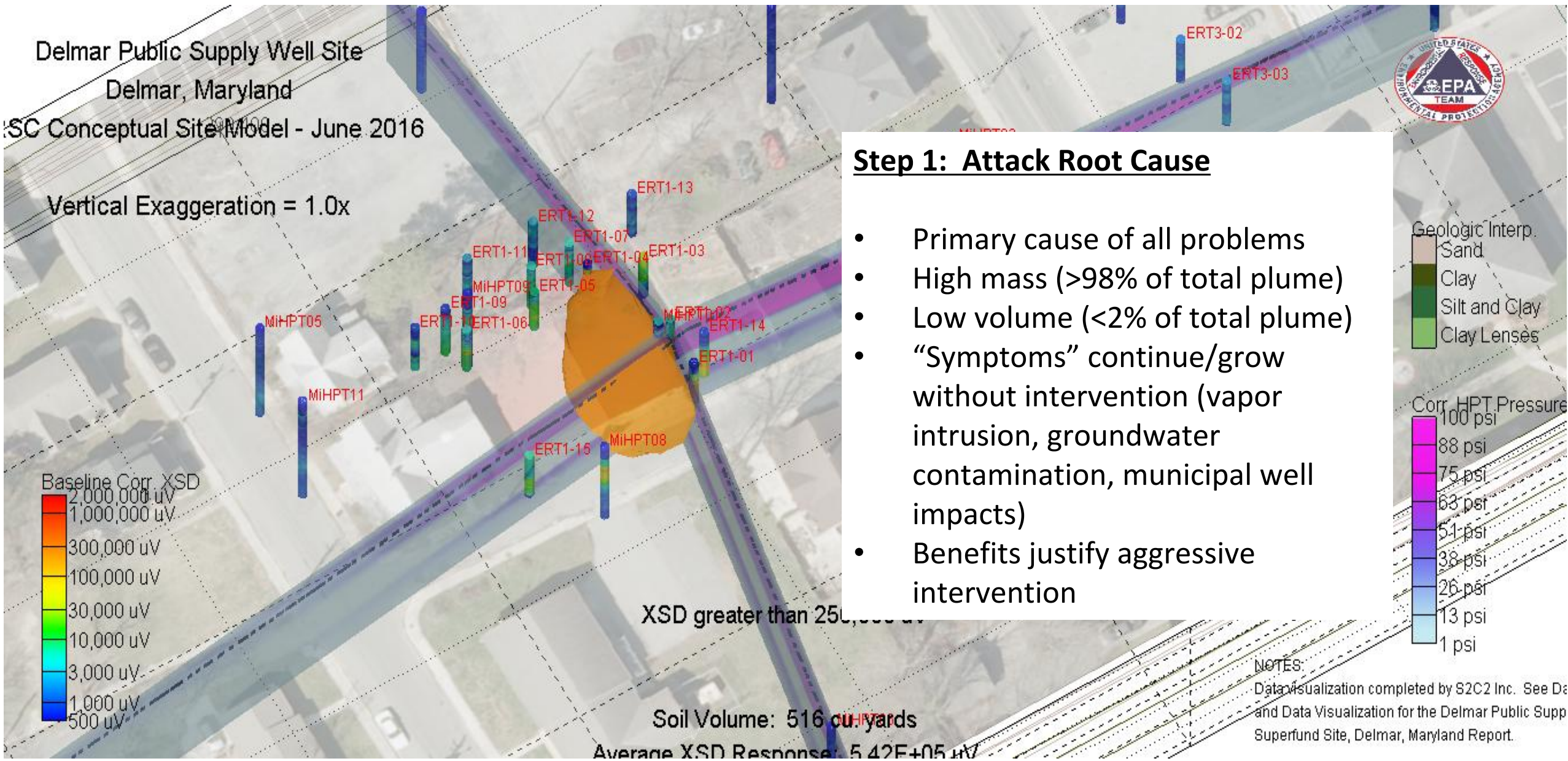


Current State: 1 of 7 FPS Target: 15.00

Author: Jason C. Ruf
Organization: S2C2 Inc.
Description: This 4Dim is an attachment t...
File Info



Attack Root Cause



Step 1: Attack Root Cause

- Primary cause of all problems
- High mass (>98% of total plume)
- Low volume (<2% of total plume)
- “Symptoms” continue/grow without intervention (vapor intrusion, groundwater contamination, municipal well impacts)
- Benefits justify aggressive intervention

NOTES:
 Data visualization completed by S2C2 Inc. See Data and Data Visualization for the Delmar Public Supply Superfund Site, Delmar, Maryland Report.

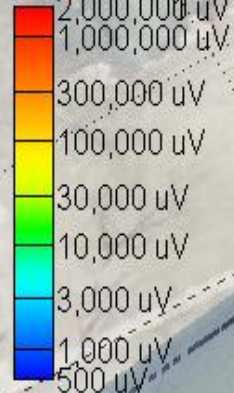
Address Buffer Zone

Delmar Public Supply Well Site
Delmar, Maryland

SC Conceptual Site Model - June 2016

Vertical Exaggeration = 1.0x

Baseline Corr. XSD



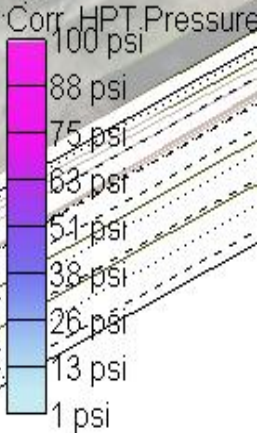
XSD greater than 50,000 and less than 250,000 uV

Soil Volume: 1728 cu yds

Average XSD Response: 1.09E+05 uV

Step 2: Address Buffer Zone

- Additional mass/volume requiring treatment to set conditions for MNA
- Benefits justify moderate intervention



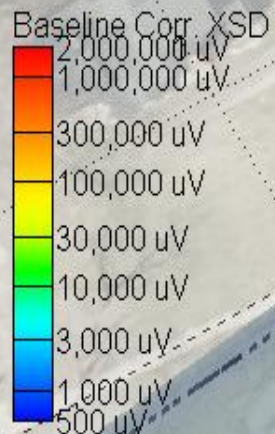
NOTES:
Data visualization completed by S2C2 Inc. See Data and Data Visualization for the Delmar Public Supply Superfund Site, Delmar, Maryland Report.

Monitor/Manage Attenuation Zone

Delmar Public Supply Well Site
Delmar, Maryland

SC Conceptual Site Model - June 2016

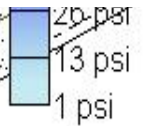
Vertical Exaggeration = 1.0x



XSD greater than 8,000 and less than 50,000 uV

Soil Volume: 9344 cu yds

Average XSD Response: 1.82E+04 uV



Step 3: Attenuation Zone

- Monitor to ensure attenuating plume (low cost)
- Manage risk with institutional or engineering controls (low cost)
- Attenuation zone remediation unlikely
- Investigation and remedial strategy shown in these figures: 5 Days -- \$65k

NOTES:
Data visualization completed by S2C2 Inc. See Data and Data Visualization for the Delmar Public Supply Superfund Site, Delmar, Maryland Report.

Conventional Assessment Techniques Necessary?

- Quantify and verify direct-sensing information
- Fill specific data gaps
- Focus on root causes and effective solutions
 - Water problem in soil?
 - Soil problem in water?
- Optimally placed monitoring wells, soil borings, vapor points, etc.

Rules of Thumb

- Production rates
 - GeoProbe (MIHPT): 125-150 feet per day
 - CPT (LIF, XRF, MIP): 250-300 feet per day
- Typical boring depths
 - GeoProbe: 30-50 feet
 - Cone Penetrometer: 50-100 feet
- Daily costs: \$7500
- 3-D Visualization -- \$5000 to \$25,000
- 2-D Visualization – Can do it yourself (download GeoProbe's DI viewer)

Limitations

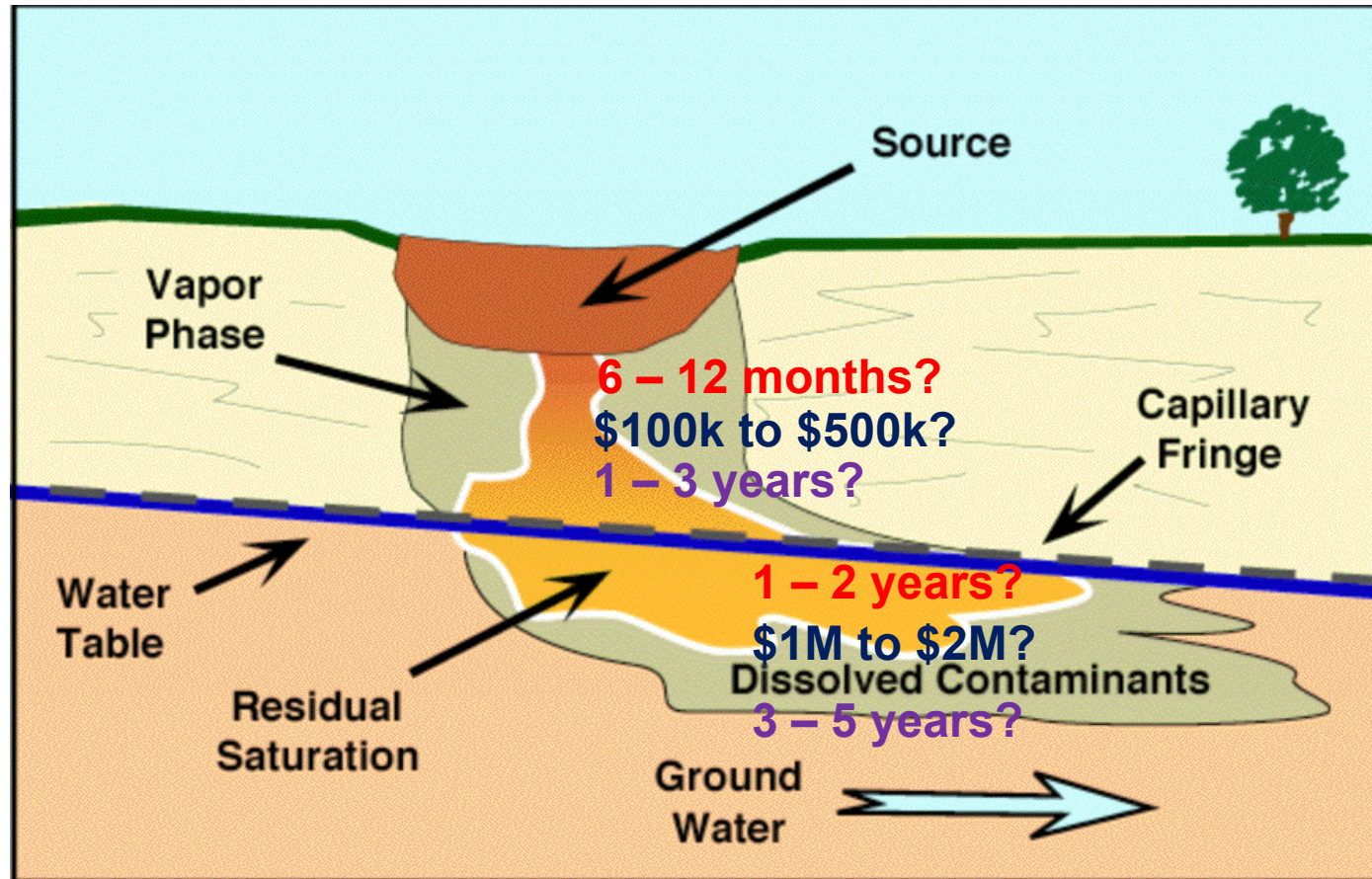
- Direct Push Technologies
 - Must be able to push to/through contaminant layer
- Typical Detection Limits
 - VOCs -- >100 ppb
 - LIF – free product
- MIP and LIF are not compound specific
- Subsurface utilities must be known!
- Need qualified subs (things break!)
- Need qualified oversight professionals

Hidden Costs of LUST Sites – What is your experience?

**Problem Creation
(slow leak)**

A&R Costs

Remedy Time



2+ years?

\$3M+?

5 - 10 years?

What about HRSC at historic releases?

- Source (root cause) often not adequately characterized
- Remedy often focused on symptoms
- Remedies consequently ineffective and costly
- Investigations continue well beyond the remediation zone

Pragmatic Approaches

- Begin with the end in mind
- Develop conceptual site models via direct sensing techniques (less time / less \$)
- Attack root cause (mass, not molecules)
- Set up conditions for natural attenuation (buffer zone treatment)
- Move faster than the conventional regulatory process (collaborative decisions)
- Use lab to document solutions, not problems

80/20 Spend Shifts

