# 3D Solids & Parameter Modeling to Facilitate Triad-Compliant Rapid Site Characterization


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Specialized Geological Modeling

# Problem / Purpose

- The cost & duration of standard environmental site characterizations often impede development decisions and environmental restoration.
- Neither the responsible party nor the environment benefit from prolonged and costly characterization studies.
- There is a need to expedite and, at the same time improve, contaminant delineations that form the basis for environmental site characterization.
- 3-D Parameter modeling in conjunction with rapidly collected geotechnical data can dramatically improve contaminant delineations while at the same time dramatically decreasing the duration of the site characterization process.
- This presentation will outline the process and results obtained from an implementation of this process at a brown fields site in Kansas.

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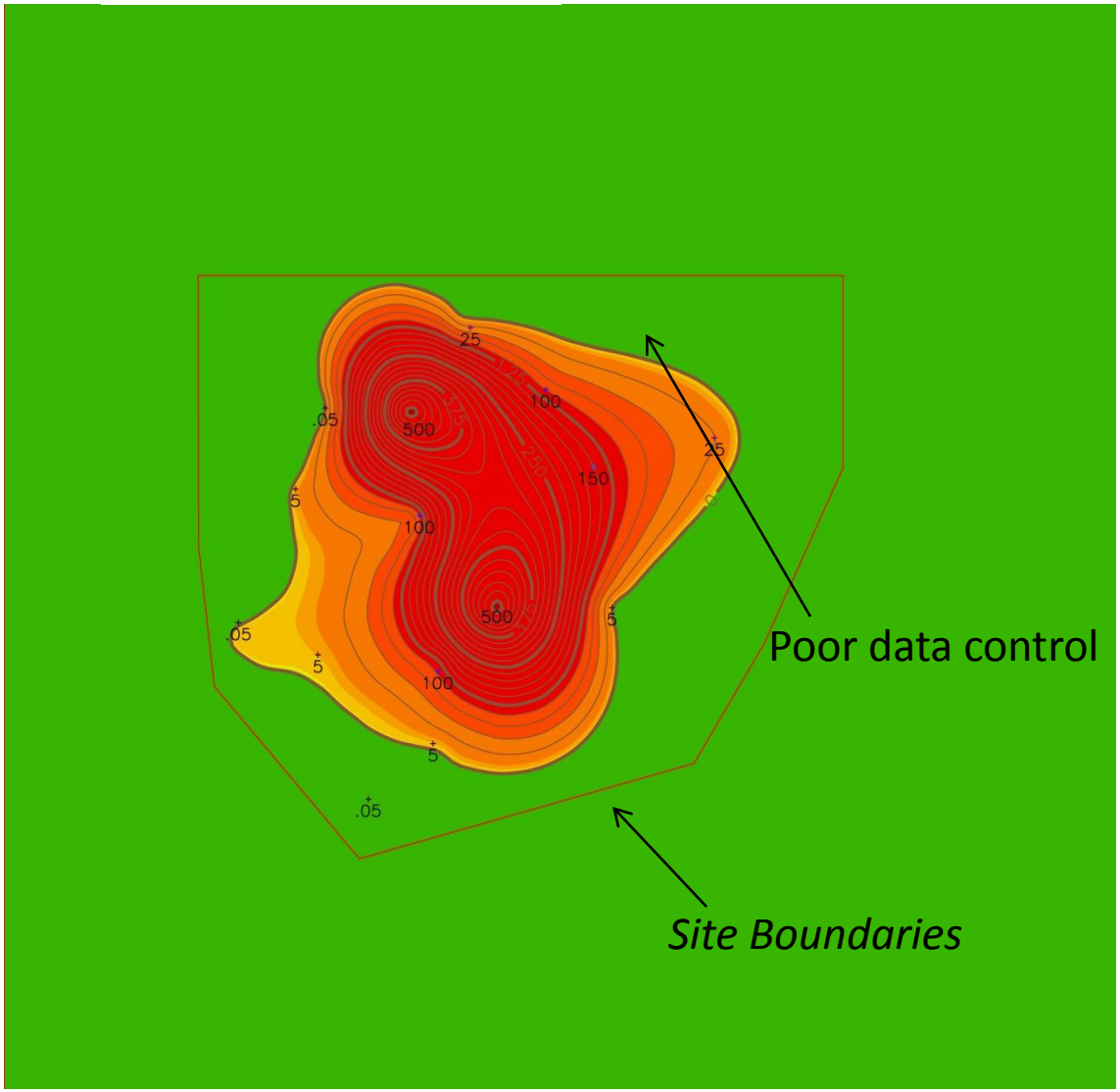
# Gridding Problems

*Grid Spacing = 0.5*




Software settings are very significant to output from computer-generated contour maps.

Particularly in regions with sparse data control.

Basic assumption in contouring is that the distribution process is continuous.

- *geologic heterogeneity?*
- *engineered barriers?*

Data Density = Best Approach

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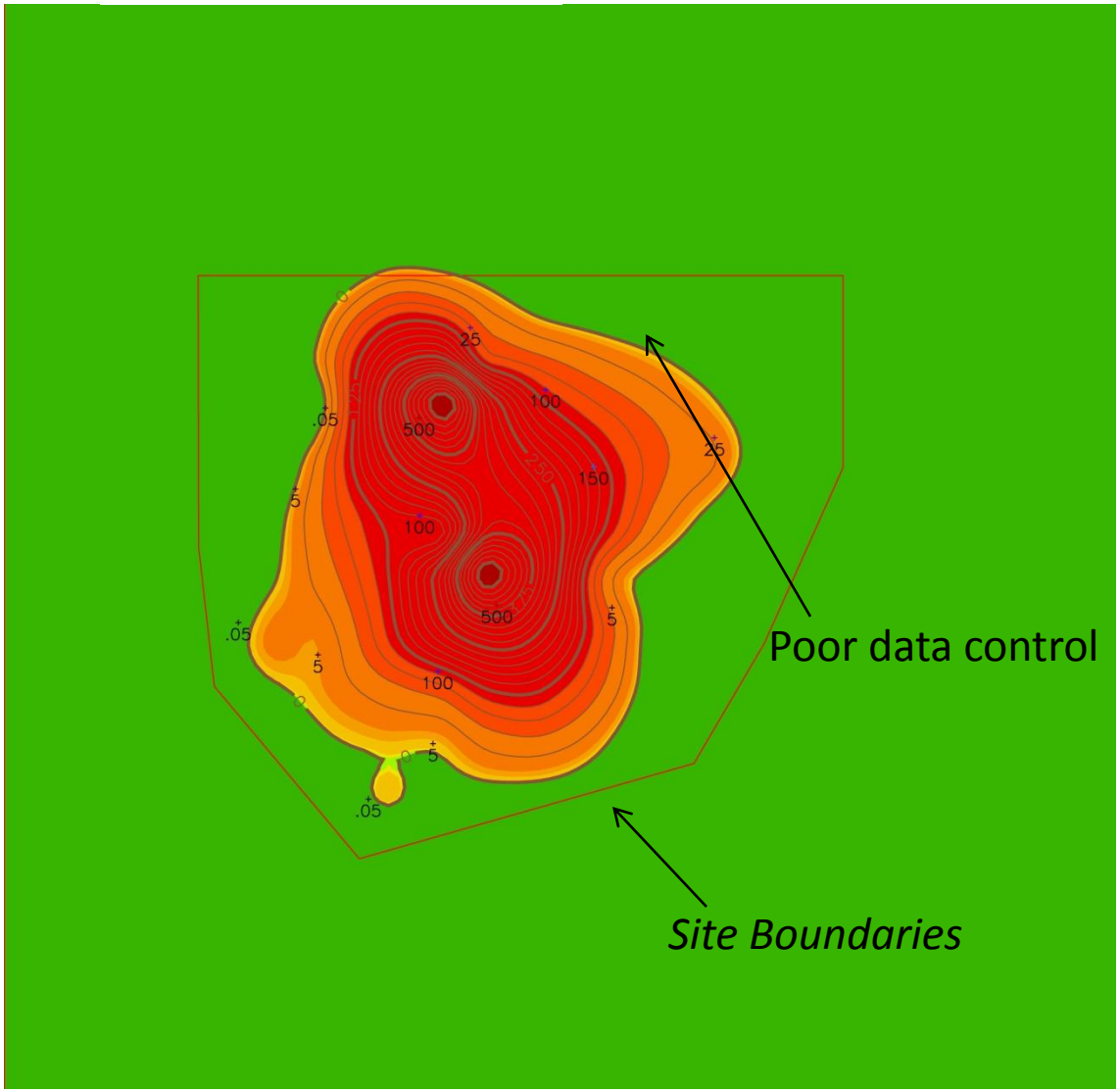
# Gridding Problems

*Grid Spacing = 1.0*

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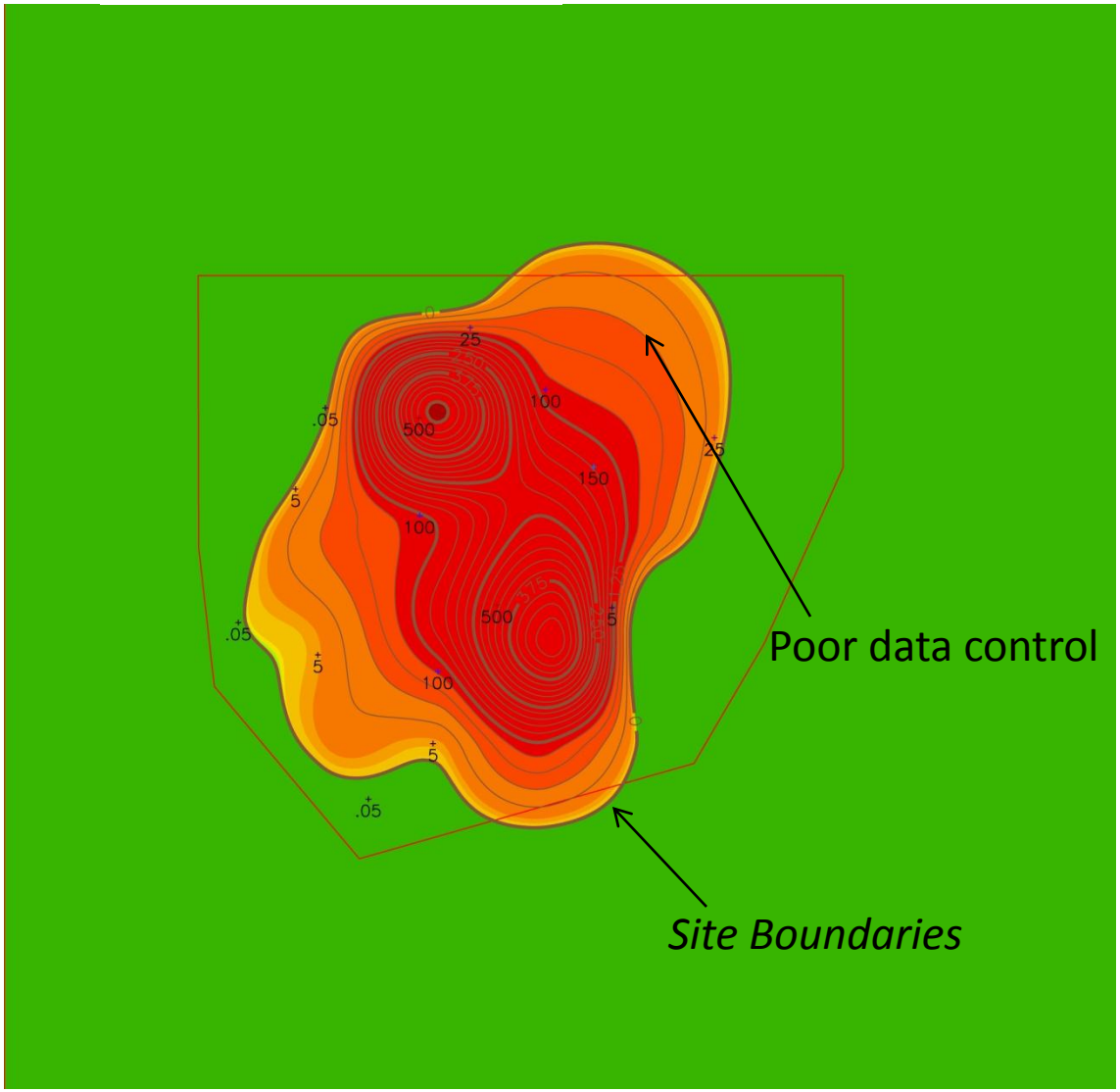
# Gridding Problems

*Grid Spacing = 2.0*

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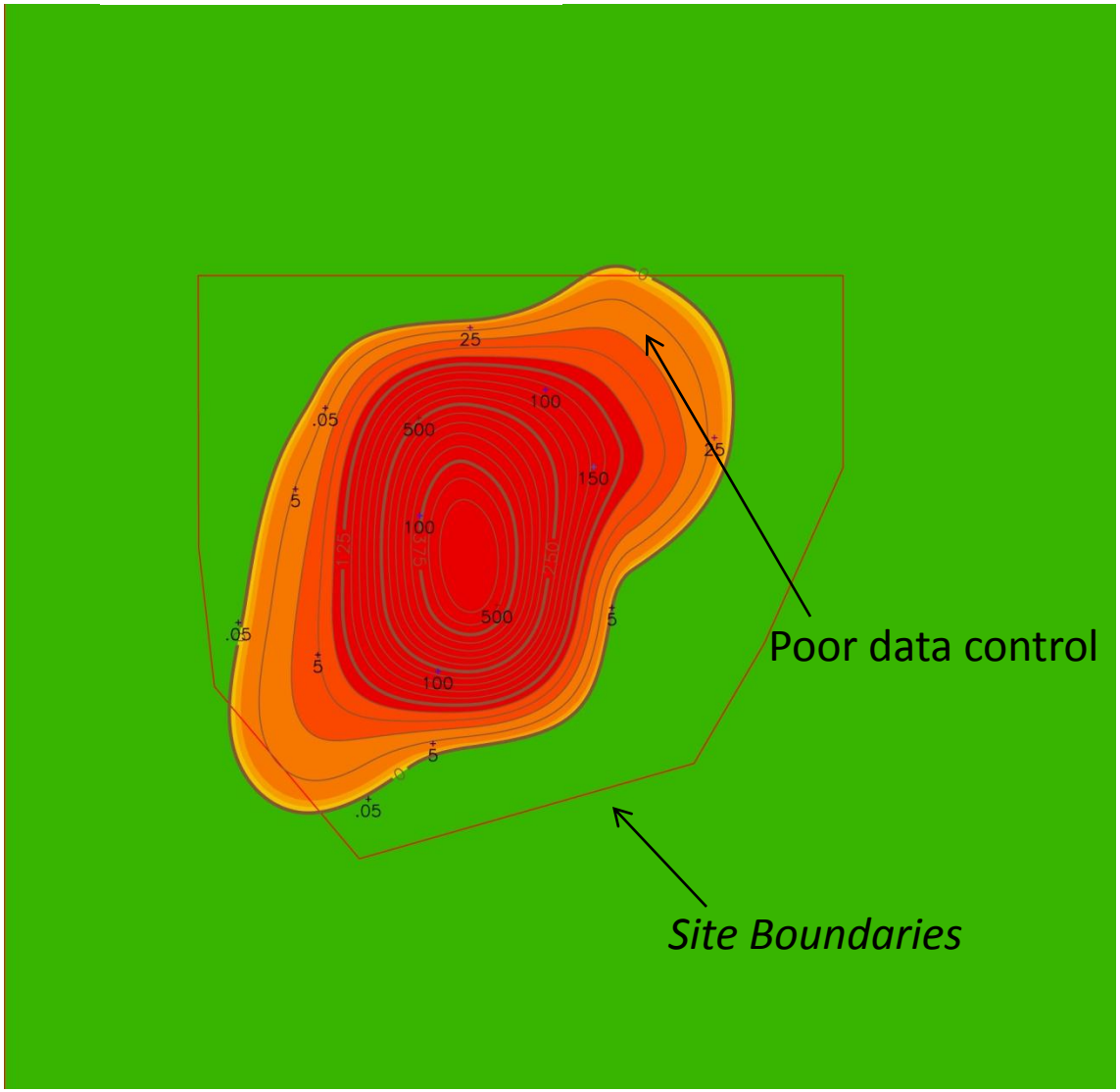
# Gridding Problems

*Grid Spacing = 2.8*

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Data Density = Best Approach

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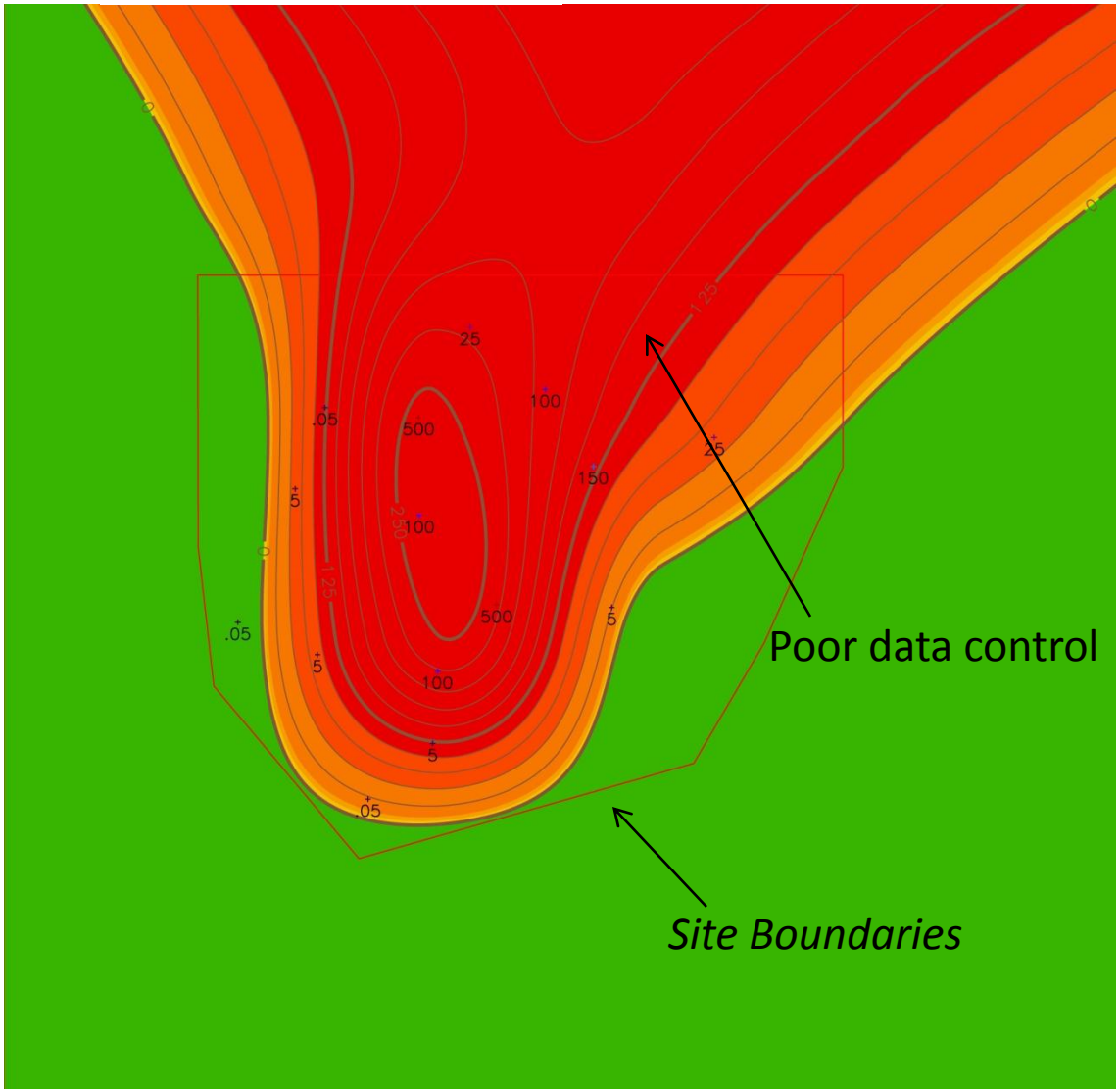
# Gridding Problems

*Grid Spacing = 4.0*

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# EPA Triad: Overview

- Triad: 3-pronged approach to site characterization
  - systematic planning
  - dynamic work strategies
  - real-time measurement systems
- Purpose
  - accelerate project schedules
  - reduce overall project costs
  - improve project outcomes

*"Technically defensible methodology for managing decision uncertainty that leverages innovative characterization tools and strategies."*

http://www.triadcentral.org/

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# Modeling in a Triad Approach

- Initial analytical data collection
- Initial geotechnical data collection
    - Electrical Resistivity Imaging (ERI)
    - Soil Conductivity / Membrane Interface Probe (SC/MIP)
- Analytical / geotechnical data correlation
- 3D parameter modeling
    - generate initial conceptualization of controls on contaminant distribution
    - use geostatistics to identify regions of uncertainty
    - develop standard model views for analysis
    - develop website for automated output posting
- Geotechnical data collection
    - review modeling analyses
    - focus on regions of uncertainty
    - define hot spots as well as clean areas
- Repeat data collection & modeling as needed…

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# SC/MIP Data

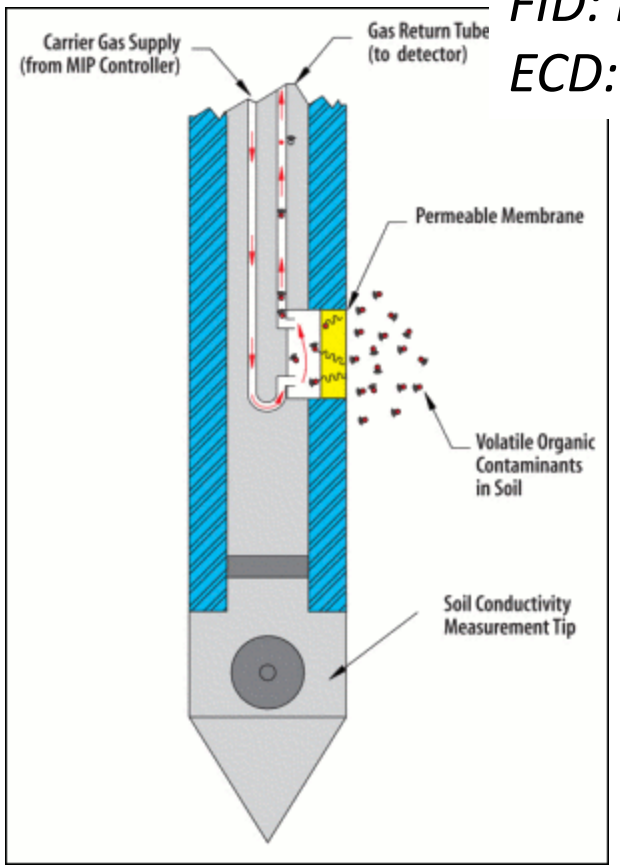
SC: Soil Conductivity

MIP: Membrane Interface Probe

*PID: Photoionization Detector*

*FID: Flame Ionization Detector*

*ECD: Electron Capture Detector*




*Tool mounted on GeoProbe*

*Images from Direct Image by Geoprobe Systems*

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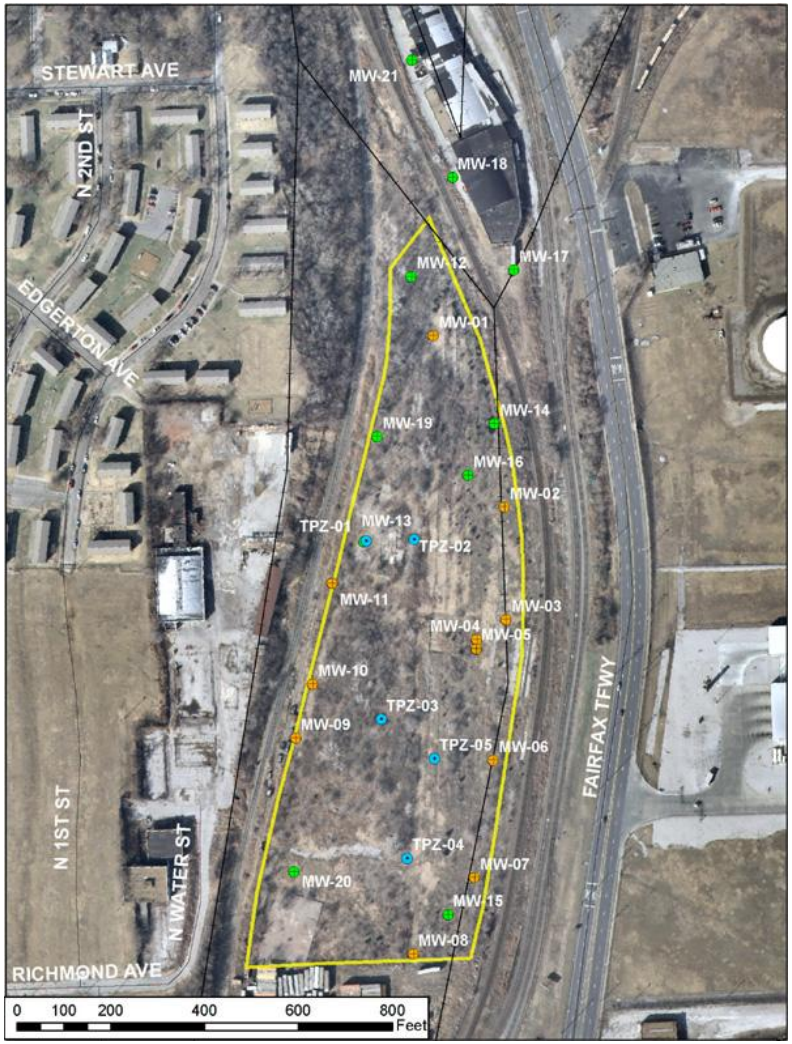
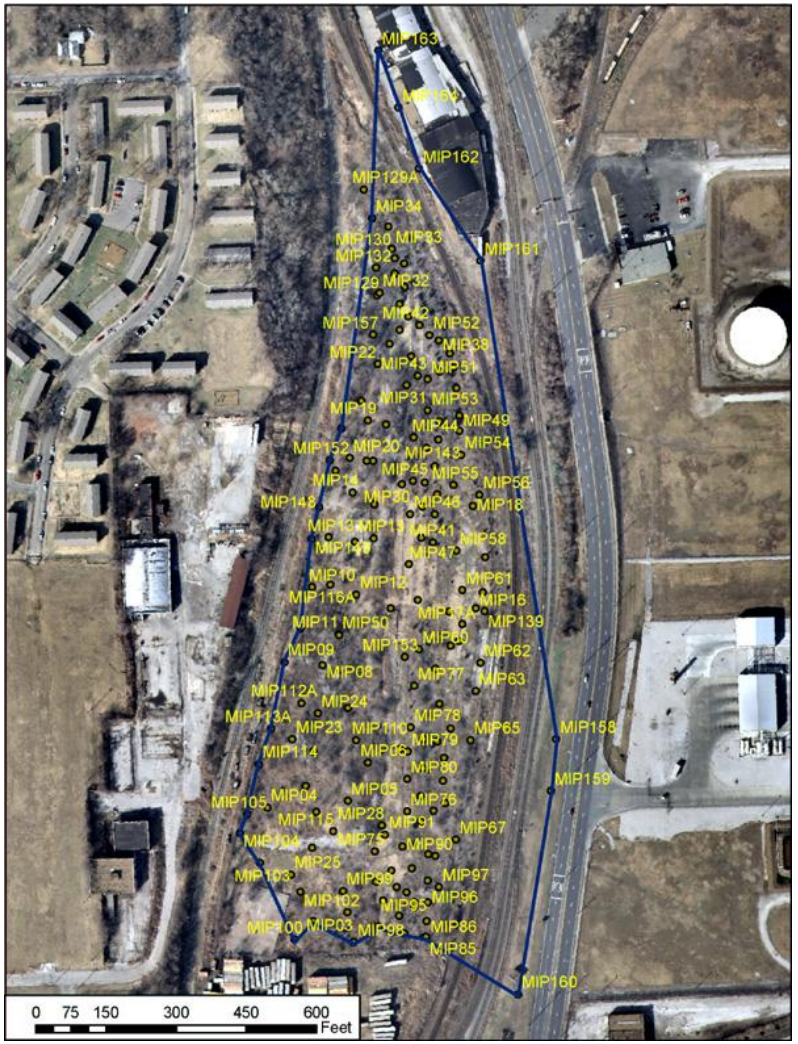
# Brownfield Site Characterization

## Analytical data




## SC/MIP data

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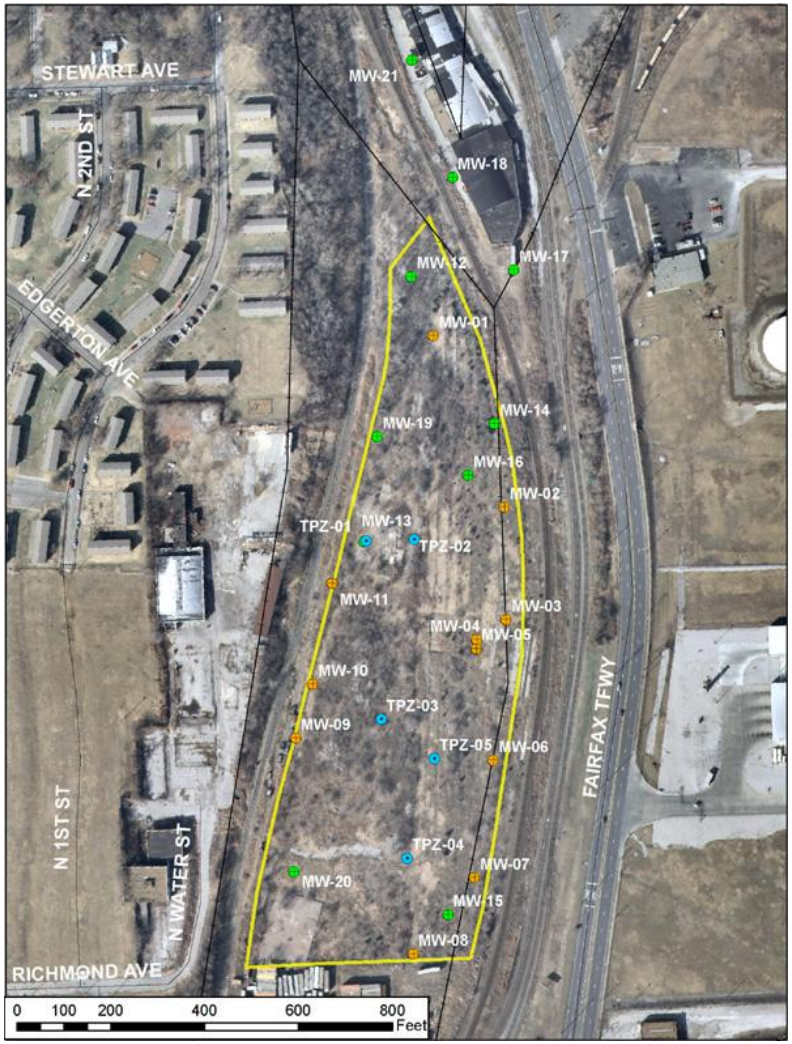
# Brownfield Site Characterization

## Analytical data




## ERI: Electrical Resistivity Imaging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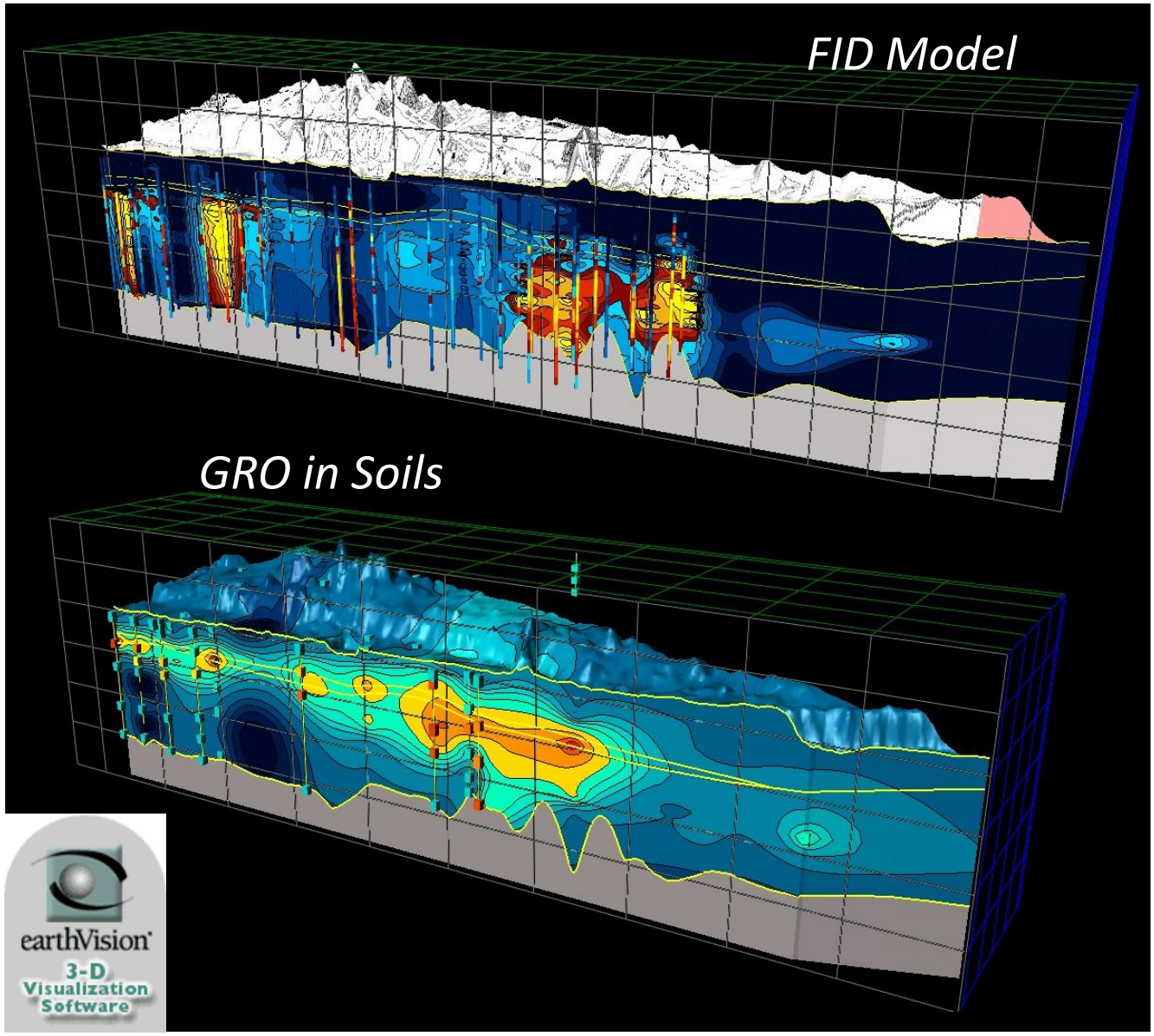
# Analytical / Geotechnical Correlation

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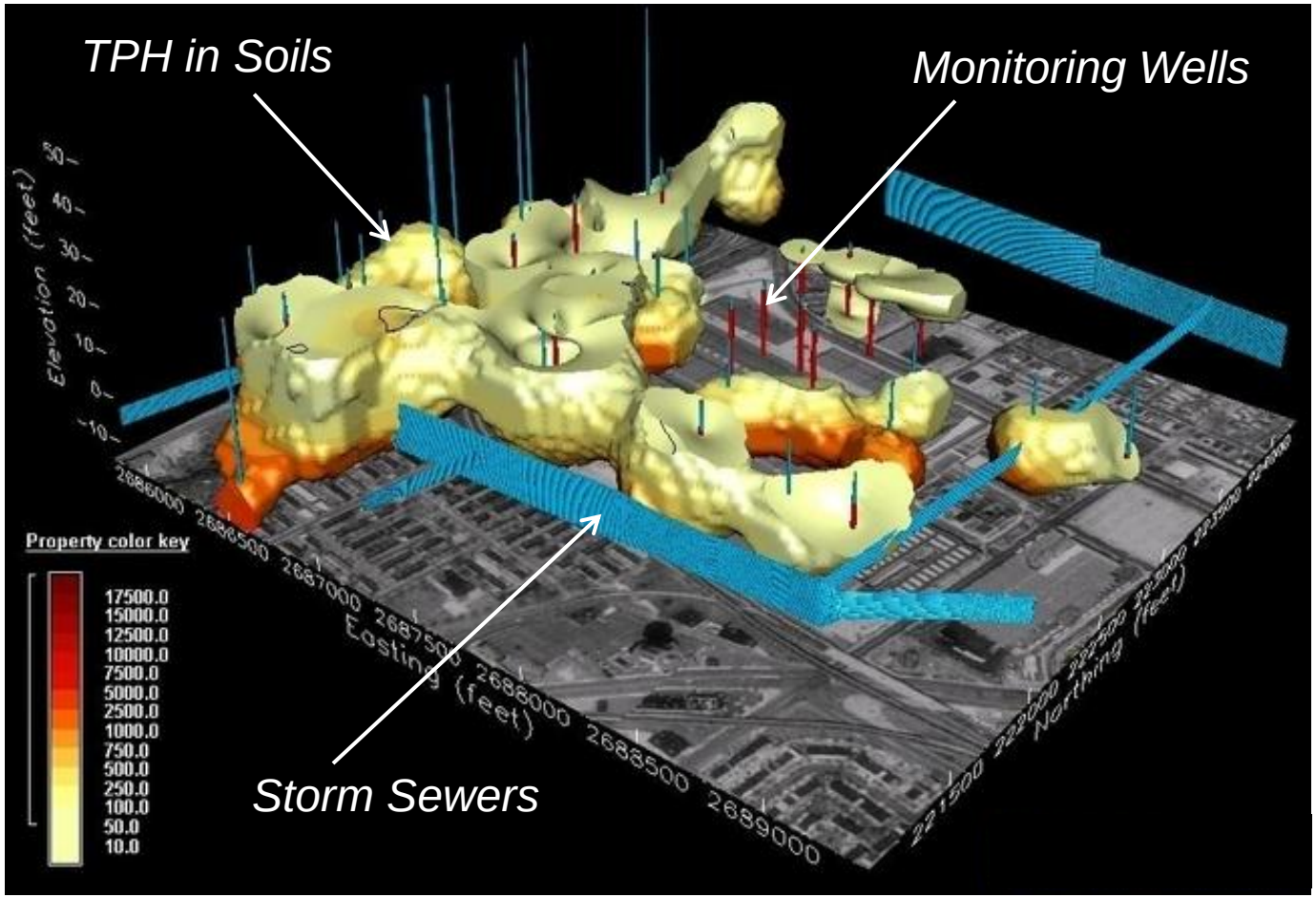
# Uncertainty Analysis

Geostatistical uncertainty is based on proximity to data points




*Model used to identify regions of uncertainty regardless of parameter value*

*LNAPL Contaminated site in Philadelphia*

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# Analysis: Scripted Model Output

Figure 17 - Lithology and Soil Electrical Conductivity Traverse 20

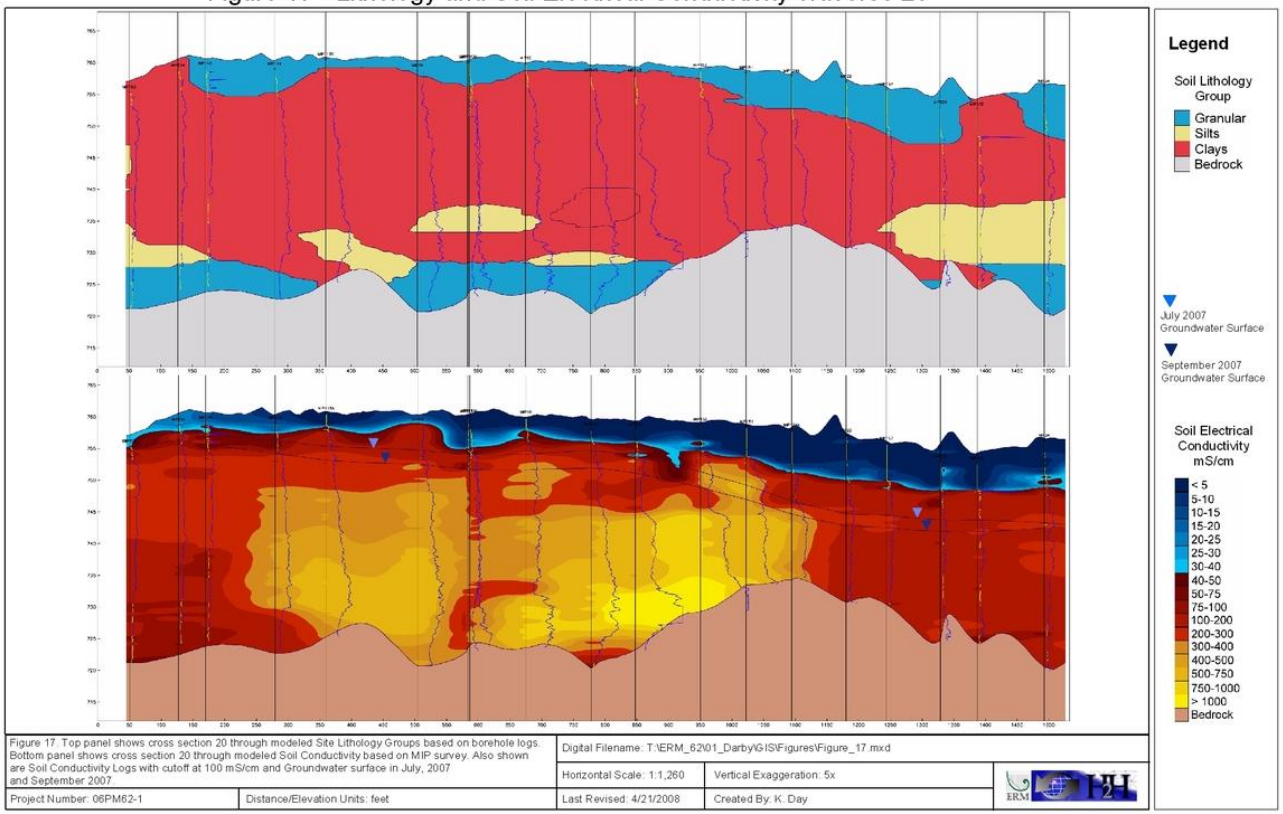


Figure 17. Top panel shows cross section 20 through modeled Site Lithology Groups based on borehole logs. Bottom panel shows cross section 20 through modeled Soil Conductivity based on MIP survey. Also shown are Soil Conductivity Logs with cutoff at 100 mS/cm and Groundwater surface in July, 2007 and September 2007.

Digital Filename: T:\ERM_62\01_Darby\GIS\Figures\Figure_17.mxd

Horizontal Scale: 1:1,260 | Vertical Exaggeration: 5x

Project Number: 06PM62-1 | Distance/Elevation Units: feet | Last Revised: 4/21/2008 | Created By: K. Day

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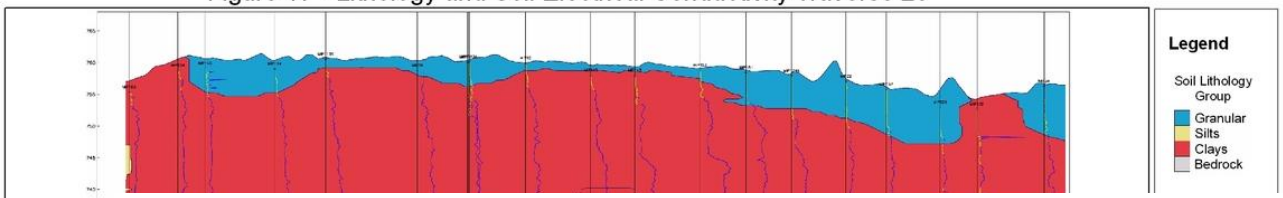


Figure 17. Top panel
Bottom panel shows
are Soil Conductivity
and September 2007.

Project Number: 06P

Figure 24 - FID and GRO in Soils - Traverse 1

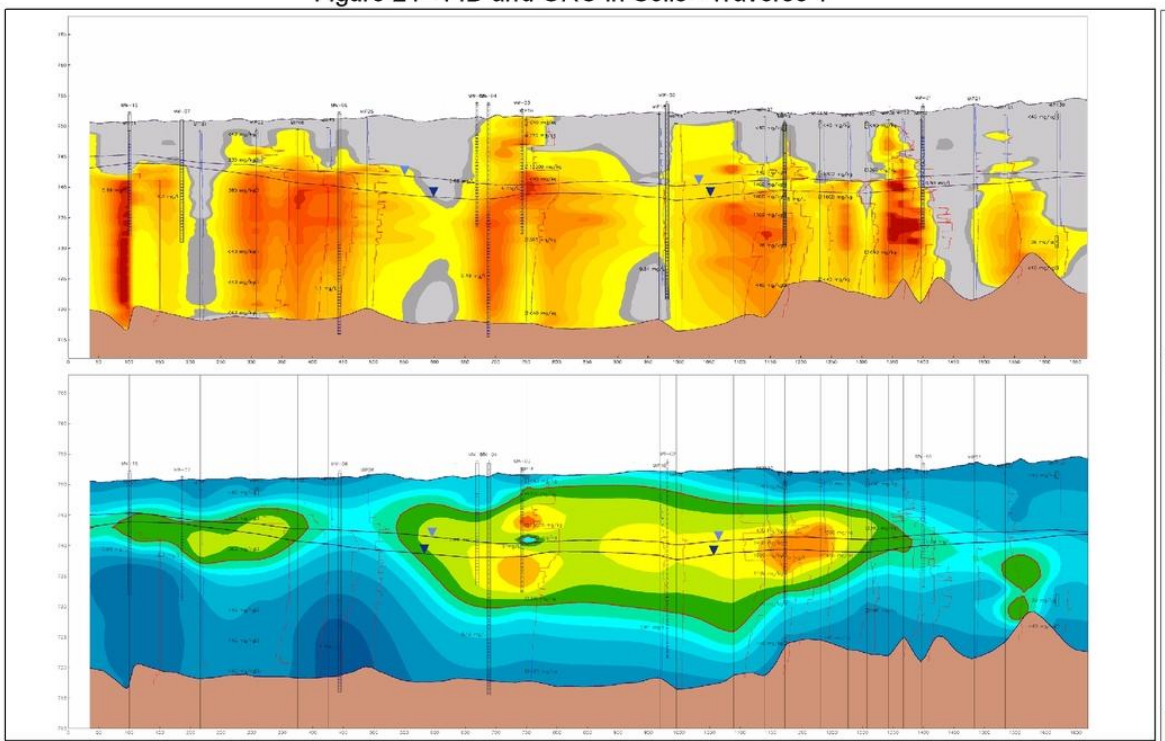


Figure 24. Top panel shows cross section 1 through modeled FID in Soil based on MIP survey results. Bottom panel shows cross section 1 through modeled GRO in Soil based on soil analytical samples. Also shown are Groundwater GRO and Soil GRO results from Analytical Samples and Groundwater surface in July, 2007 and September 2007, and MIP FID Log Trace with cutoff at 250,000 mV.

| | | | |
|---|---|---|---|
| Project Number: 06PM62-1 | Distance/Elevation Units: feet | Last Revised: 4/28/2008 | Created By: K. Day |
| | | Horizontal Scale: 1:1,200 | Vertical Exaggeration: 15x |
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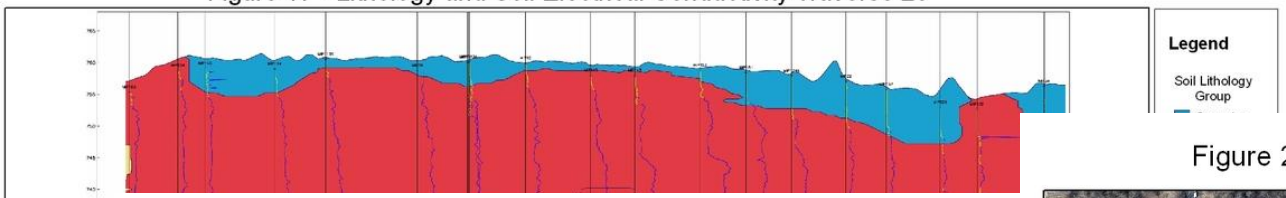


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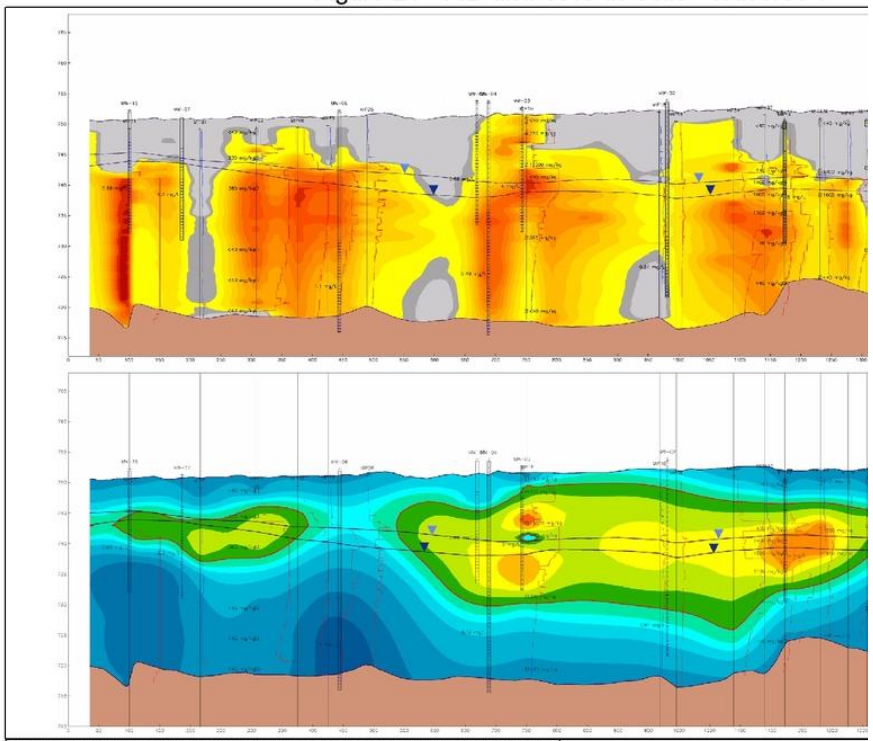

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Figure 23: FID Z-Slice at 727 feet msl

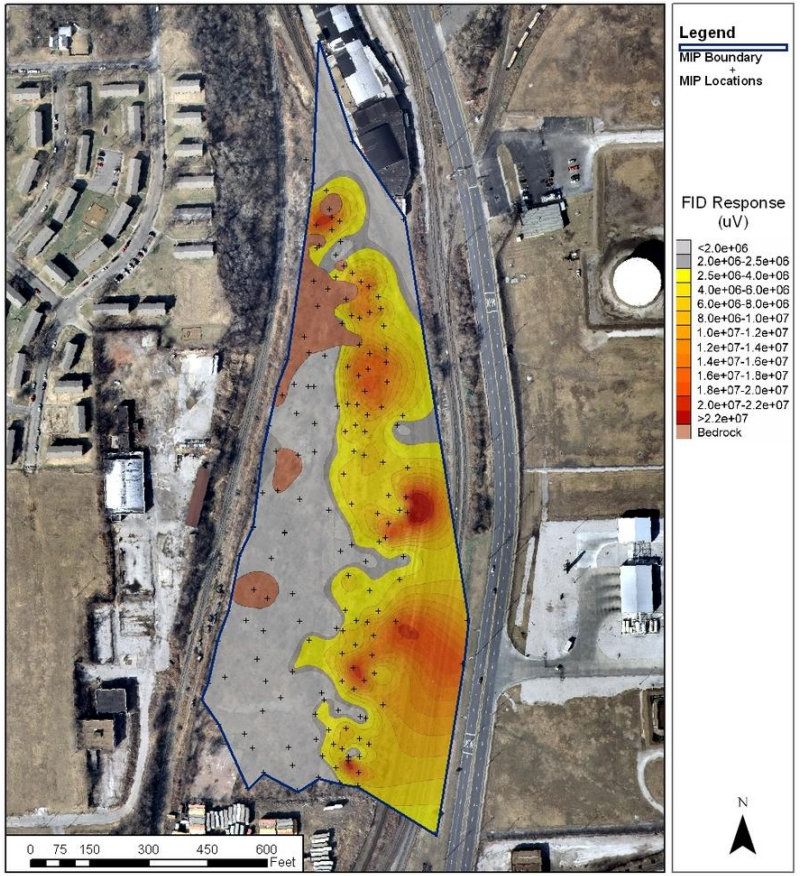


Figure 23: Modeled MIP Flame Ionization Detector (FID) response in Soils at 727 feet msl over 2006 Aerial Photos with MIP survey points.

| | | | |
|---|---|---|---|
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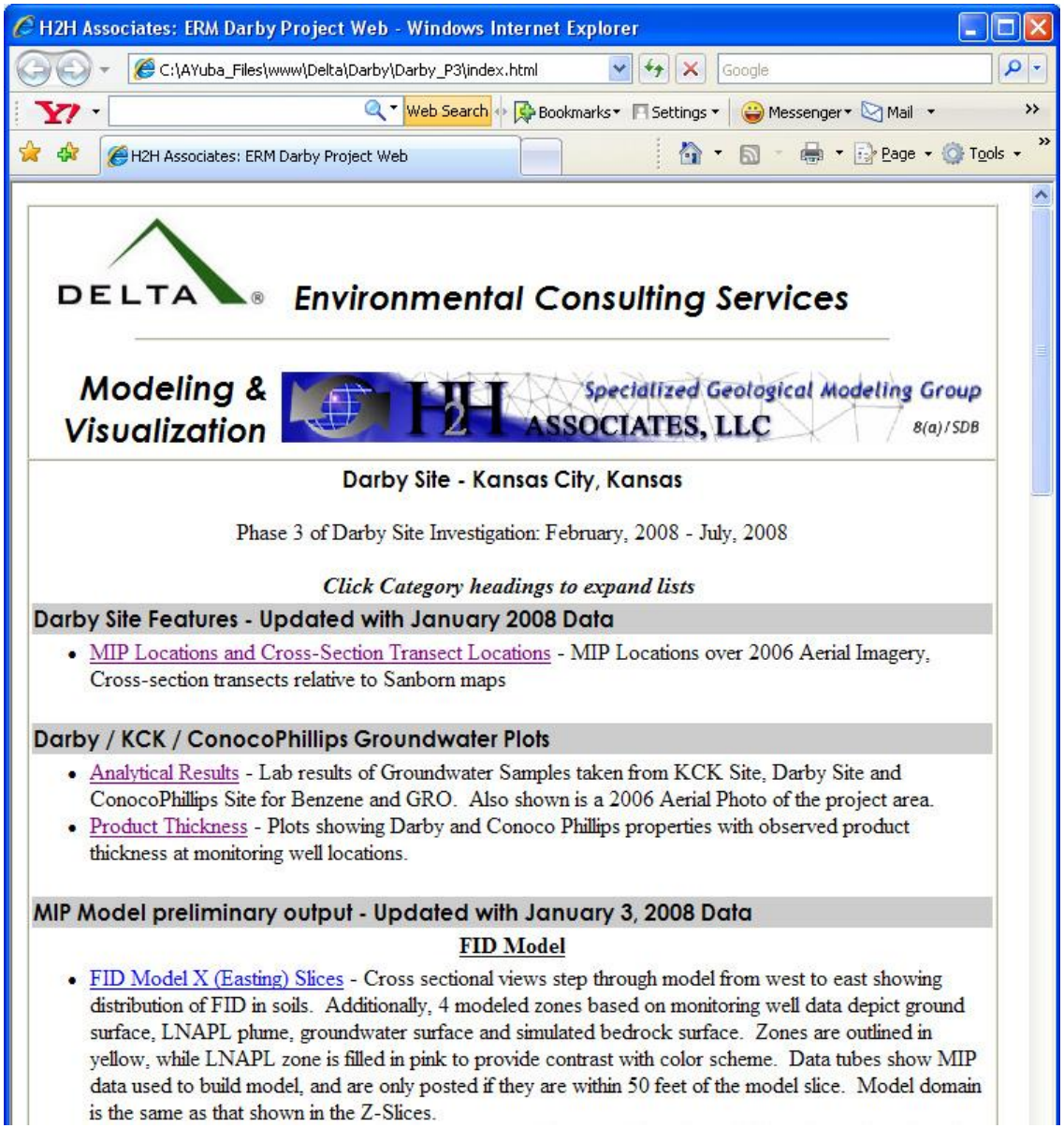
| | | Horizontal Scale: 1:3000 | Vertical Scale: n/a |
| Project Number: 06PM62-1 | Created By: K. Day | Last Revised: 4/21/2008 | |

# Web Interface for Data Analysis

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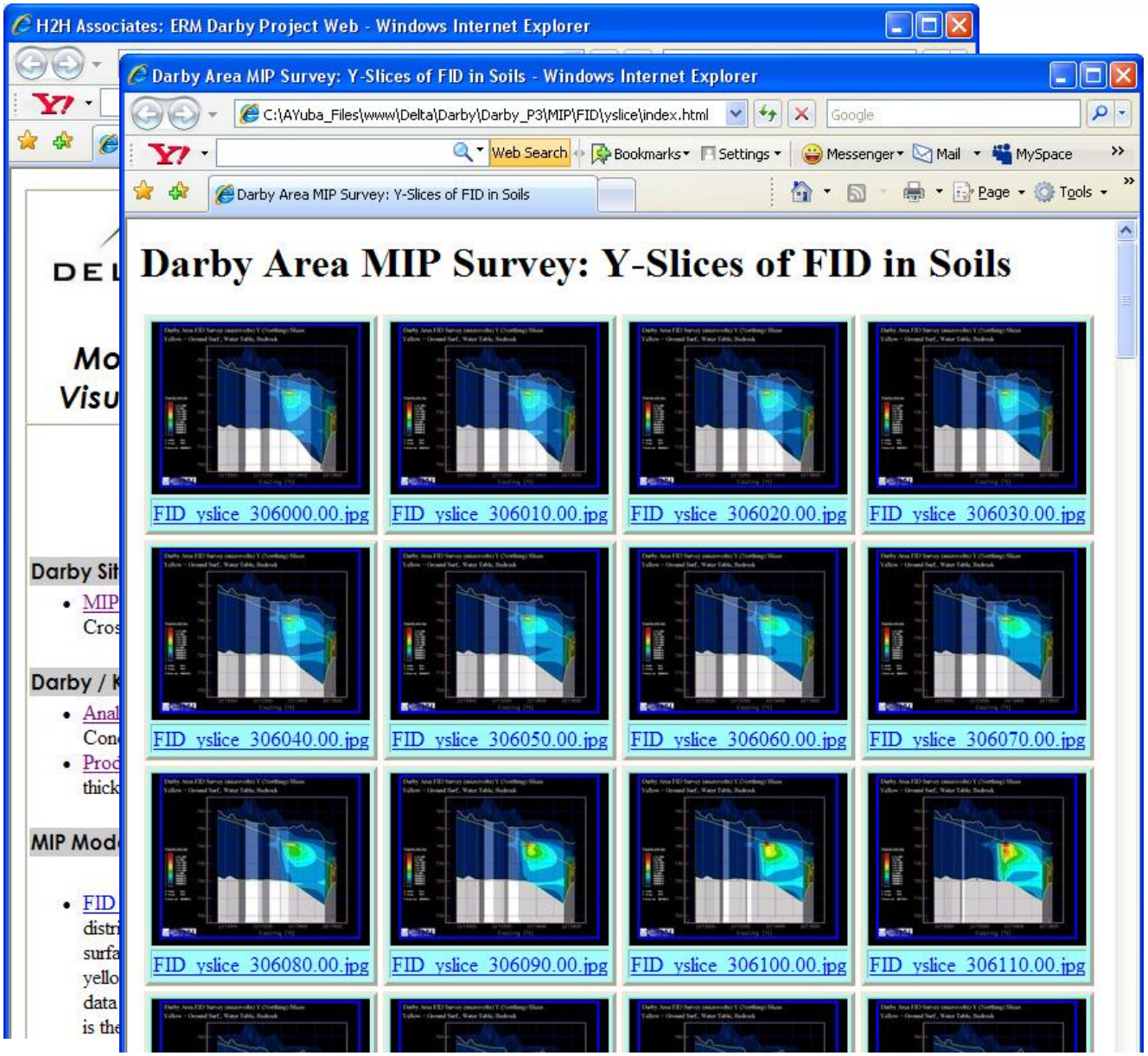


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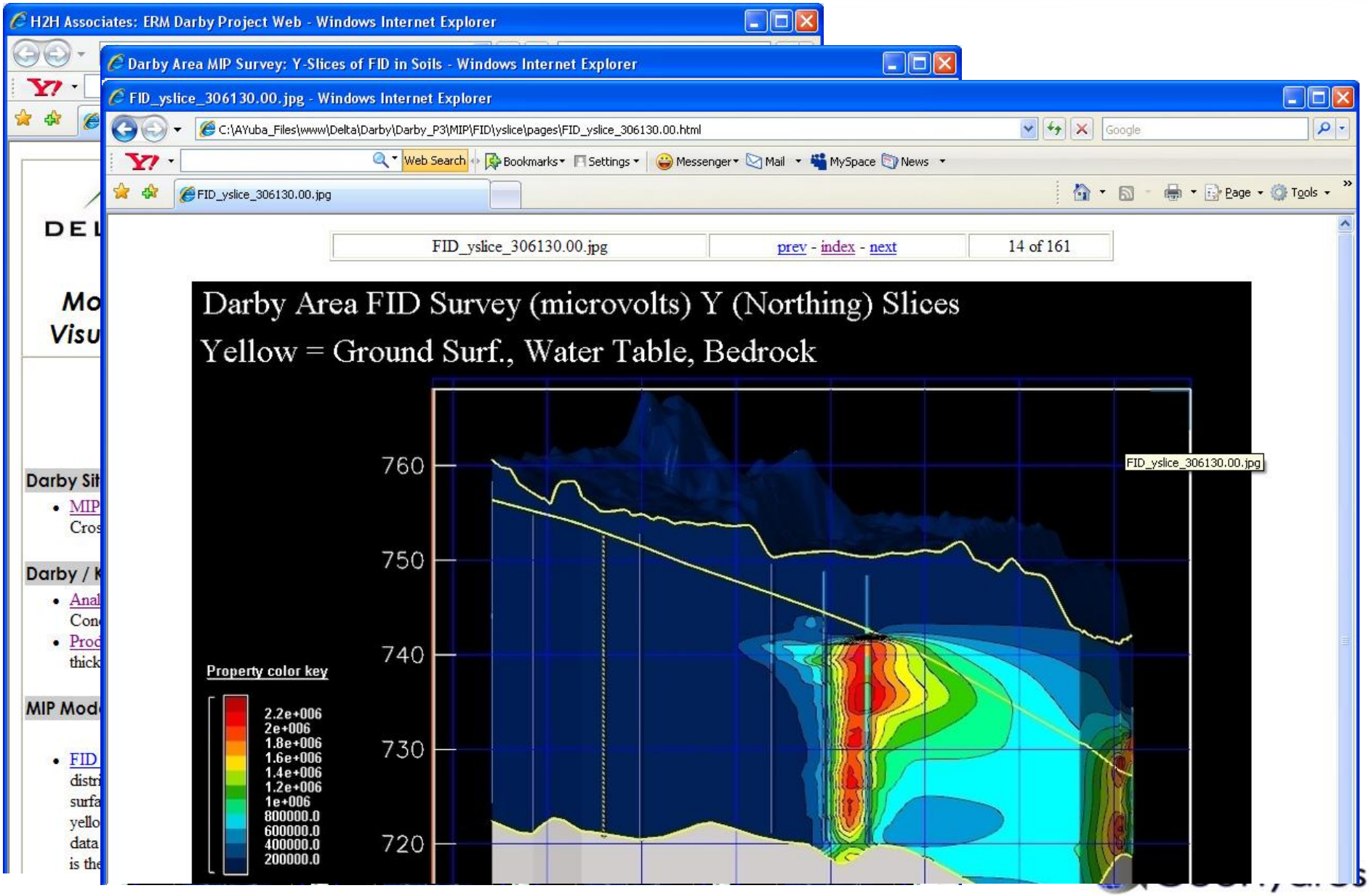

# Summary / Conclusions

- The investigation collected approximately 420,000 collaborative measurements over a 6 week period.
- These measurements provided a detailed 3-D understanding of the extent and magnitude of fuel impact in the subsurface environment.
- The cost per measurement was approximately 65 cents.
- Both the Client and the Kansas DHE enthusiastically embraced this method and accepted the results and analyses.
- We believe that this approach saved significant time and money during the site characterization process.

*More info?*

*www.geohydros.com*

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