Geologic Tools for Site Characterization

Kelsey Bufford
Oklahoma Department of Environmental Quality

Oklahoma Department of Environmental Quality (ODEQ) and the US Environmental Protection Agency (USEPA) Collaborative Demonstration

Collaborators: USEPA Region 6
USEPA Office of Research and Development

Objectives:

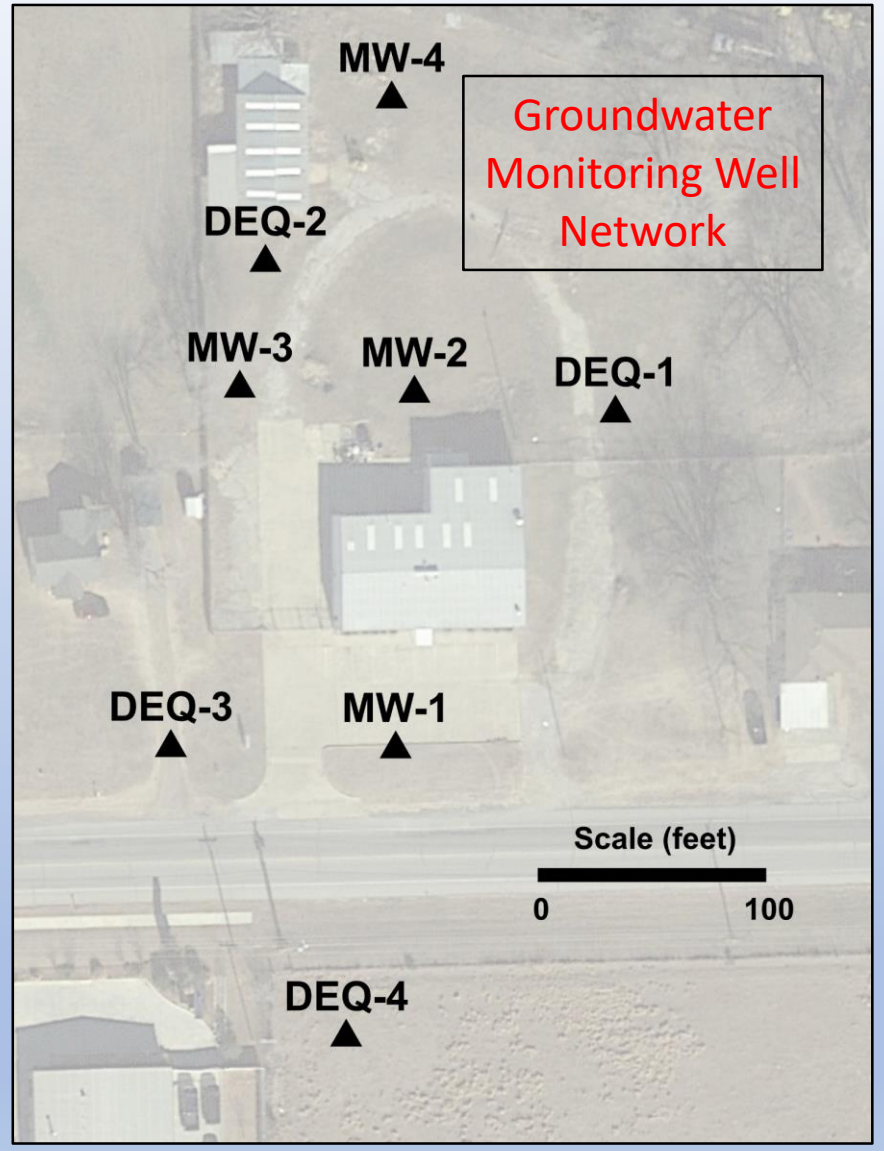
- Determine utility of various characterization tools for use during remedial investigation
- Improve hydrogeologic conceptual model

Site Location

- Eagle Industries is located at 10901 SE 29th Street in Midwest City.
- Eagle Industries inspected and repaired aircraft oxygen and fire extinguisher systems for third party customers from 1990 – 2010s.

Site History

- In 2003, an ODEQ site inspection found improper handling practices of the chemical trichloroethylene (TCE).
- TCE was found in soil and ground water on site.
- Eagle Industries entered into a legal consent order with ODEQ to address environmental concerns and performed some work to clean up the site.
- In 2009, ODEQ determined that the facility had a limited ability to pay for any additional environmental cleanup work at the site.



Site Description

- Eagle Industries is in the Remedial Investigation (RI) phase of the Superfund process
- Subsurface soil and groundwater contamination: Volatile organic compounds
- Complex hydrogeologic setting: Interbedded coarse and fine-grained materials in recharge area of Garber-Wellington Aquifer
- Groundwater flow and contaminant distribution not well defined

Geologic Framework Characterization
Borehole Geophysics

Objectives:

- Define fine grained (silt/clay/shale) and coarser grained (sand) aquifer materials near monitoring wells
- Identify variability of subsurface materials between monitoring wells
- Identify semi-confined or perched units and other controls on groundwater flow

Methods Demonstrated:

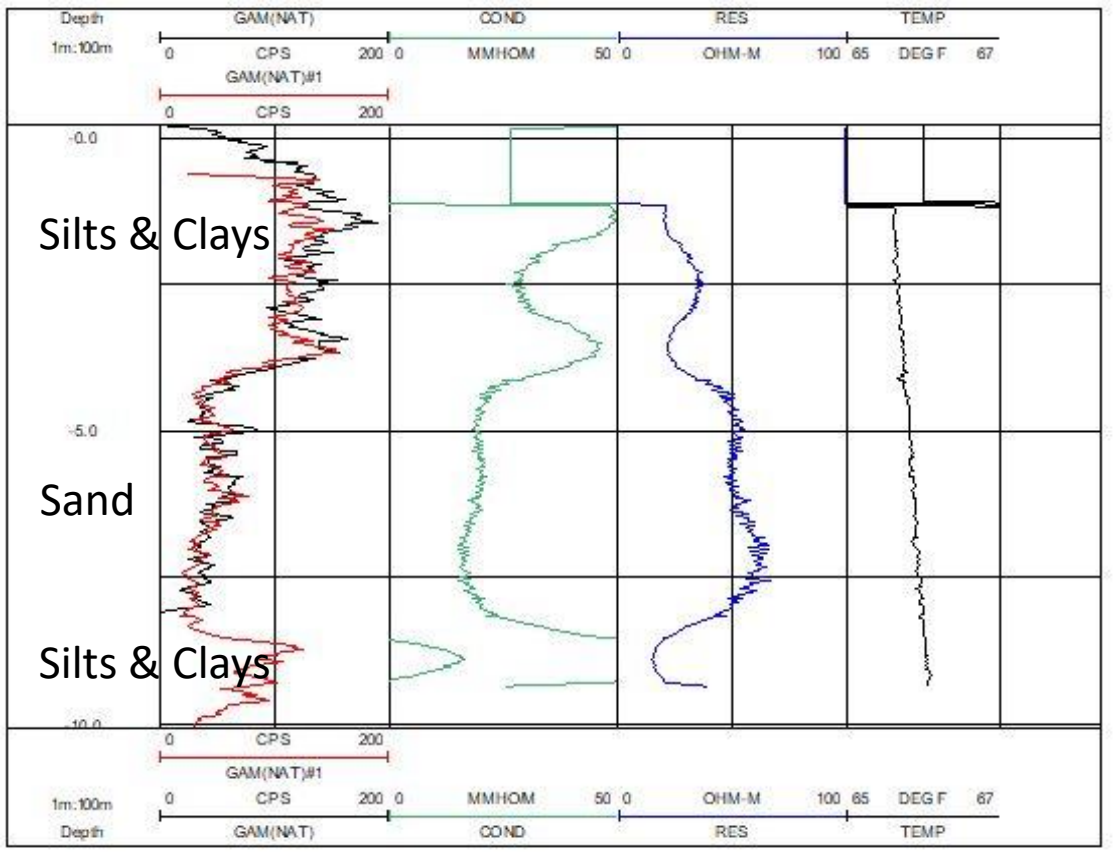
Natural Gamma and Electromagnetic Induction (also known as Conductivity)

Borehole Geophysical Logging – Identify Vertical and Lateral Changes in Lithology

Tool - Natural Gamma, Induction Conductivity and Resistivity

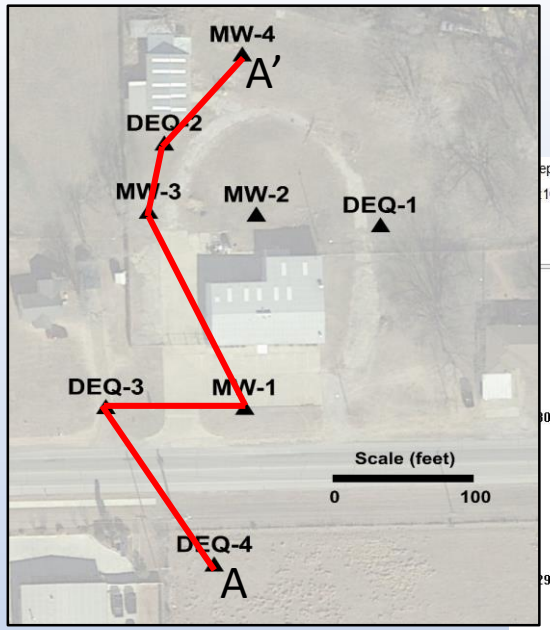
Geophysical Logging Trailer

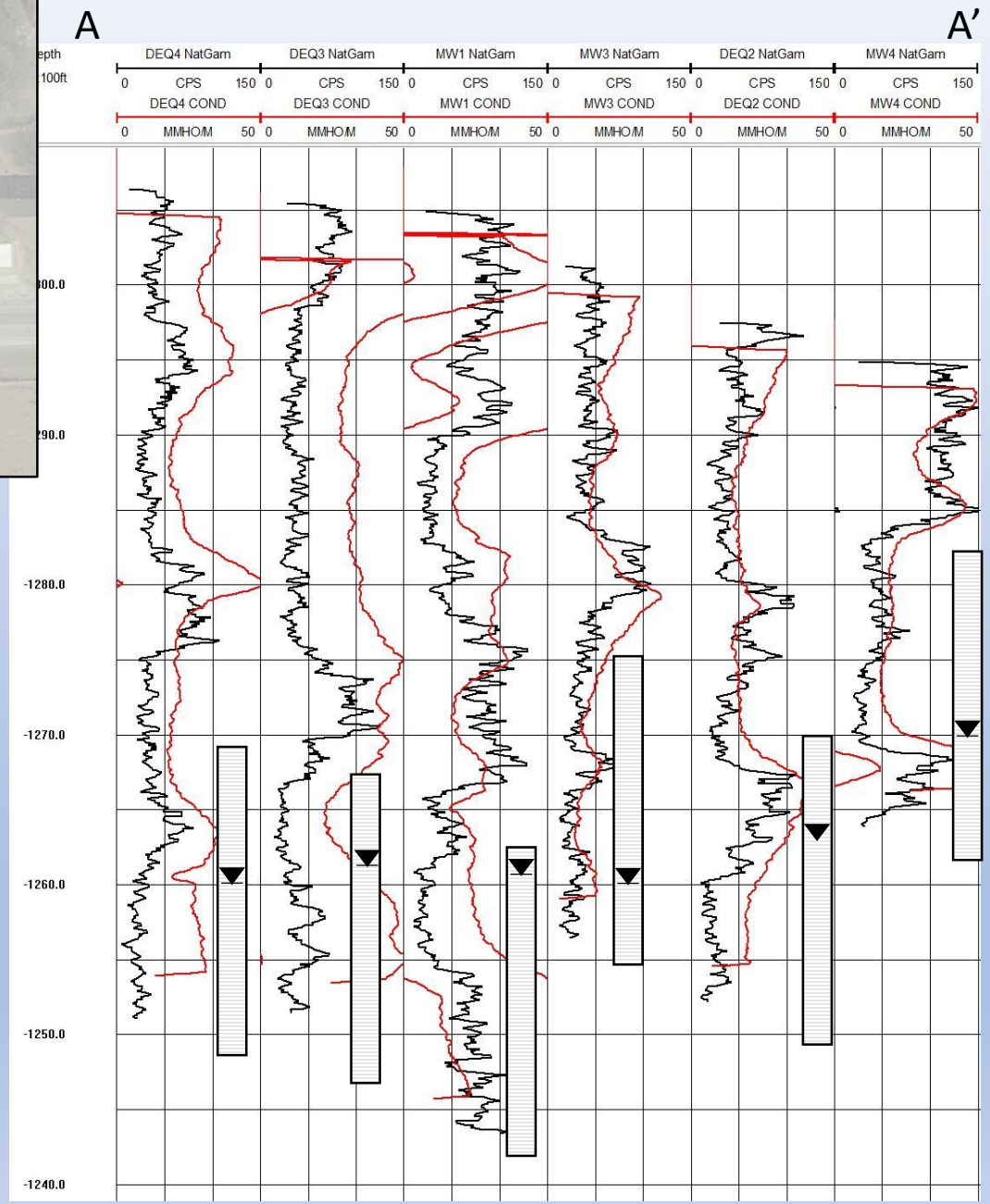
Logging Results and Interpreted Geology



Geophysical Logs

- Lithology varies vertically and laterally
- Some wells screened across more than one sand unit (e.g., MW-4 and DEQ-2)
- Acquiring geophysical logs before well installation may prevent screening across multiple sand units





Geologic Framework Characterization
Surface Geophysics

Objectives:

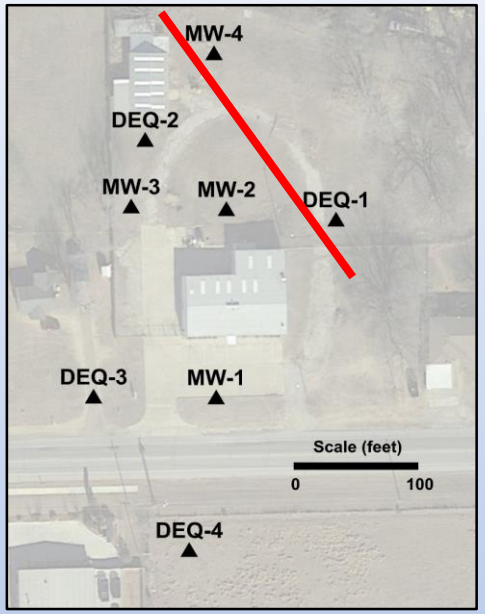
- Define fine grained (silt/clay/shale) and coarser grained (sand) aquifer materials between wells
- Identify semiconfined or perched units and other controls on groundwater flow

Method Demonstrated:

Electrical Resistivity Imaging (ERI)

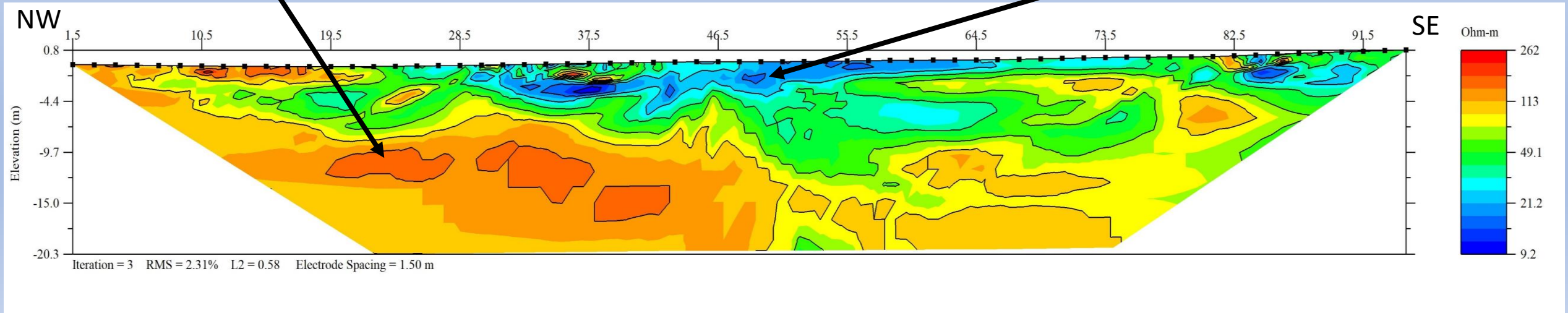
Electrical Resistivity Survey Results

- Prominent sand body in NW portion of the site becomes discontinuous towards SE.



Sands (more resistive)

Silt/Clay/Shale (more conductive)



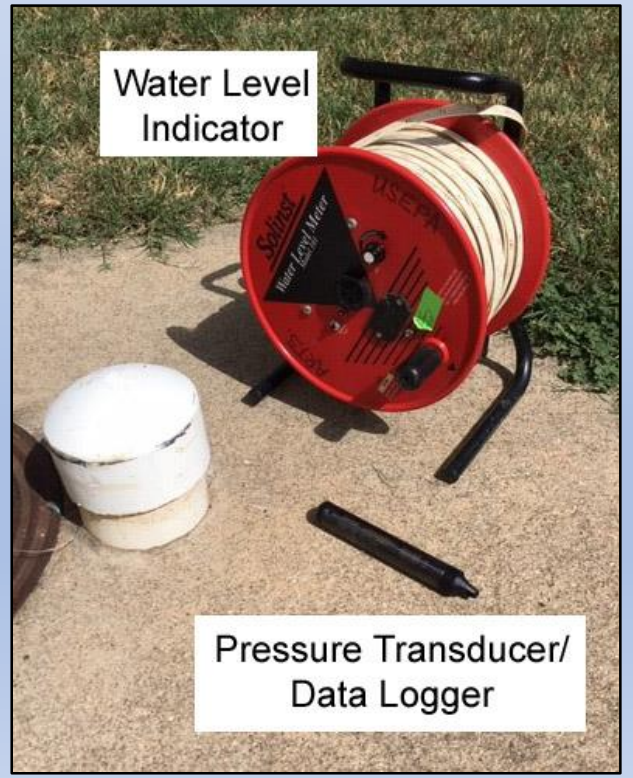
Hydrologic Characterization

Objective:

- Identify possible groundwater flow directions and connections/disconnections between hydrologic units

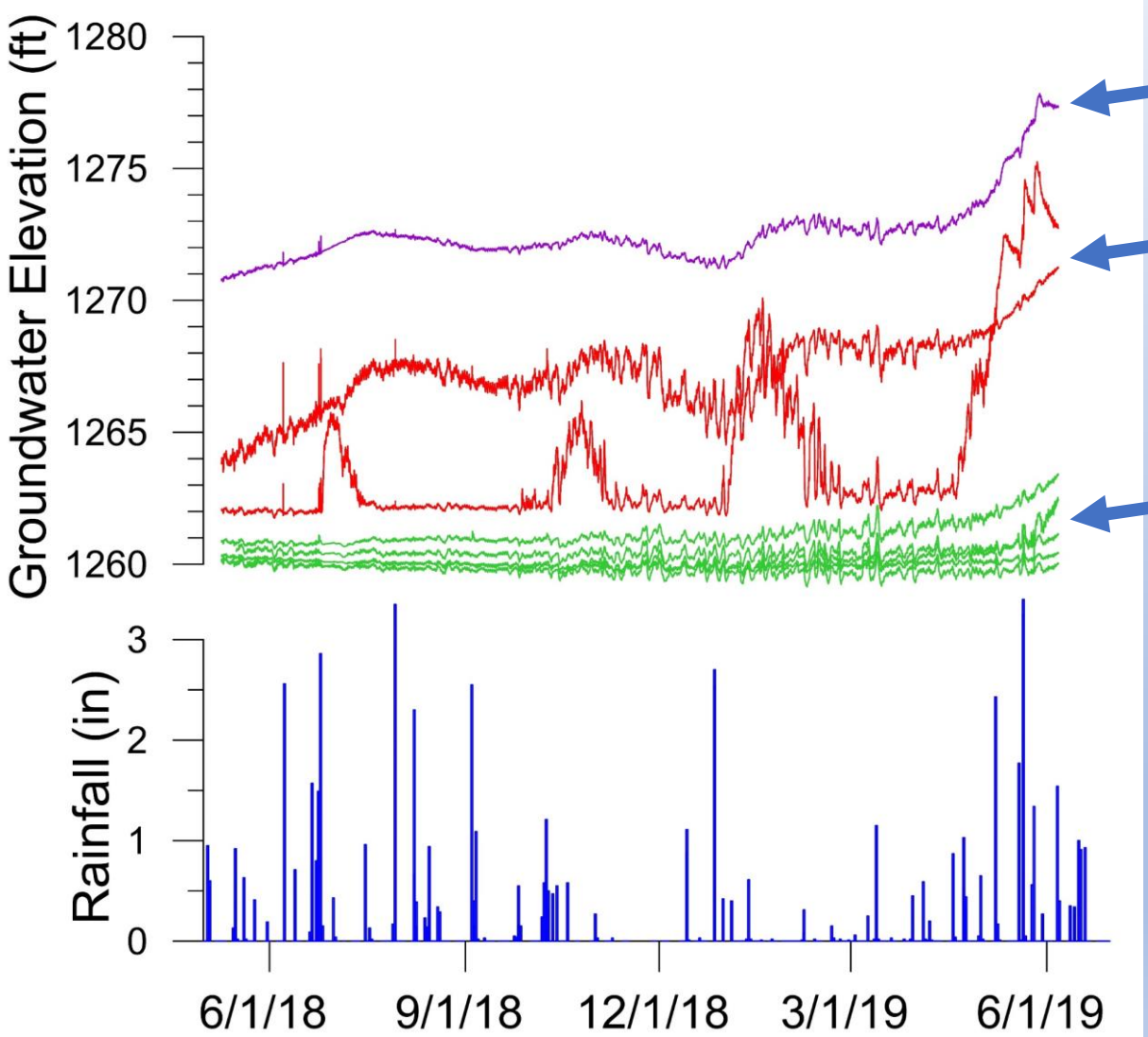
Methods:

- Periodic manual depth-to-water measurements in all existing monitoring wells
- Long-term high frequency measurement of water levels using pressure transducer/data loggers



Hydrologic Characterization

Long-Term Trends in Current Site Wells



Shallow Perched Water Table

Wells Cross-Connecting Different Units?

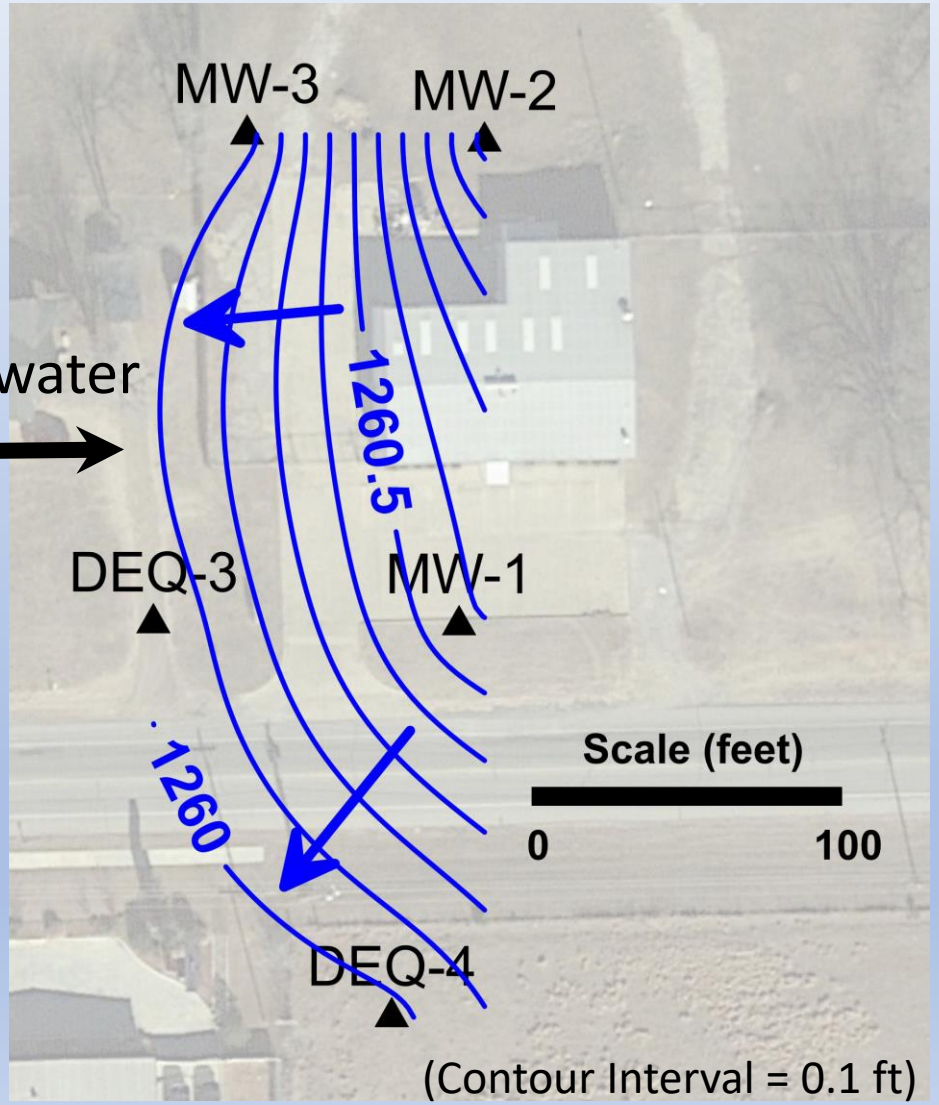
Wells Screened Across Regional Water Table

Differences in response to precipitation may indicate presence of different aquifer units

Hydrologic Characterization

Groundwater Flow Directions

Estimated Groundwater Flow Directions



Regional Aquifer Potentiometric Surface November 15, 2018

Periodic water-level measurements allow preliminary estimation of groundwater flow directions and seasonal variations

Demonstration Results

- Different trends in groundwater elevations indicate there may be separate aquifer units with poor communication between them
- Zone(s) of perched water may overlie the regional aquifer
- Geophysics indicates separation of sands by silts/clays/shales in some areas
- Groundwater in the regional aquifer may flow in west to southwest directions from the site (preliminary estimates)

Conclusions

- Cooperative demonstration of technologies was a success.
- Viable characterization methods were identified.
- Results improved understanding of hydrogeologic controls on groundwater flow.
- Improved understanding of geologic framework should allow for a more focused remedial investigation.

Acknowledgements

- Katrina Higgins-Coltrain, USEPA Region 6
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QUESTIONS?