

# CCR Rule Certification of Utility Waste Landfill Stability and Groundwater Monitoring Systems

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# USEPA Coal Combustion Residuals Rule

- On April 17, 2015, USEPA finalized the CCR Rule
- Response to TVA Kingston Plant CCR release in December 2008
- The rule established requirements for disposal of CCR in utility waste landfills (UWLs) and surface impoundments.

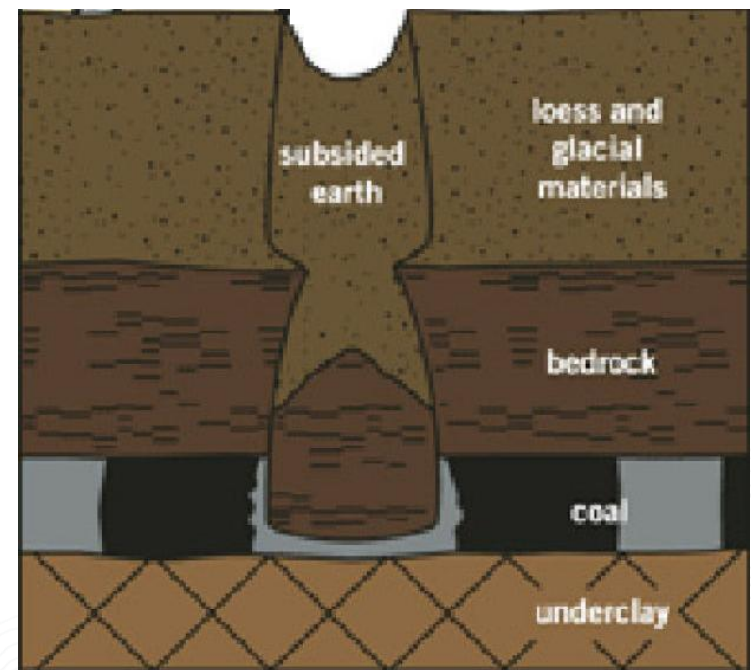


# Location Restrictions for Utility Waste Landfills

- The rule establishes five location restrictions to ensure UWLs are properly sited.
  - Placement above uppermost aquifer (new units)
  - Wetlands (new units)
  - Fault Areas (new units)
  - Seismic Impact Zones (new units)
  - **Unstable Areas (new and existing)**
- The rule requires a qualified Professional Engineer (PE) to **certify** that the technical requirements of the rule are being met.
- Existing UWLs must be certified with respect to unstable areas by October 17, 2018.

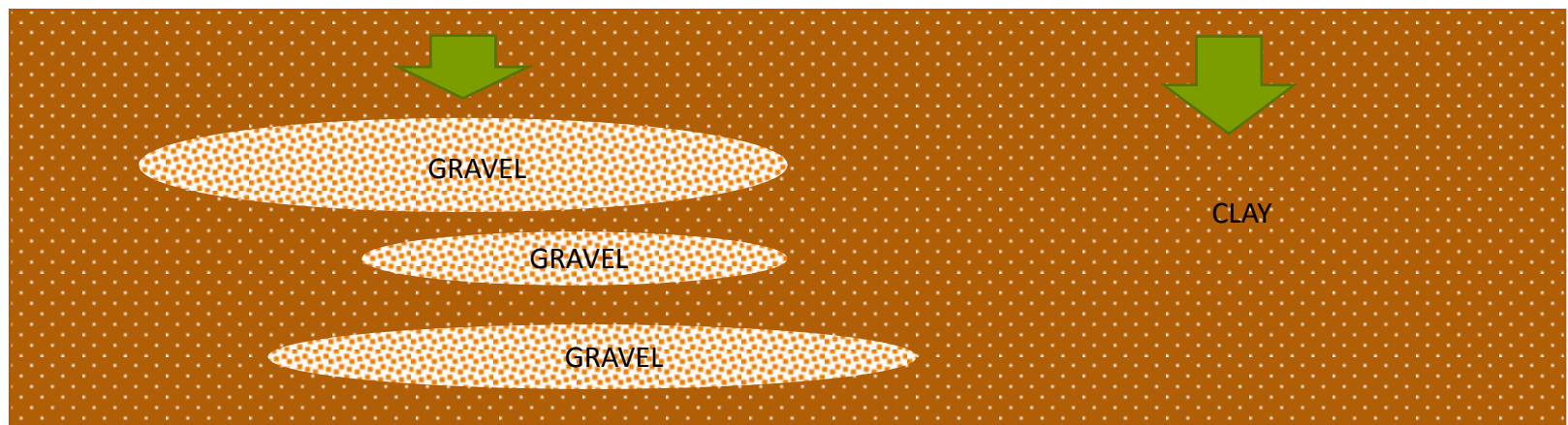
# What Constitutes Unstable Areas?

- Mine subsidence – this is probably more likely for UWLs constructed at mine mouth power plants.



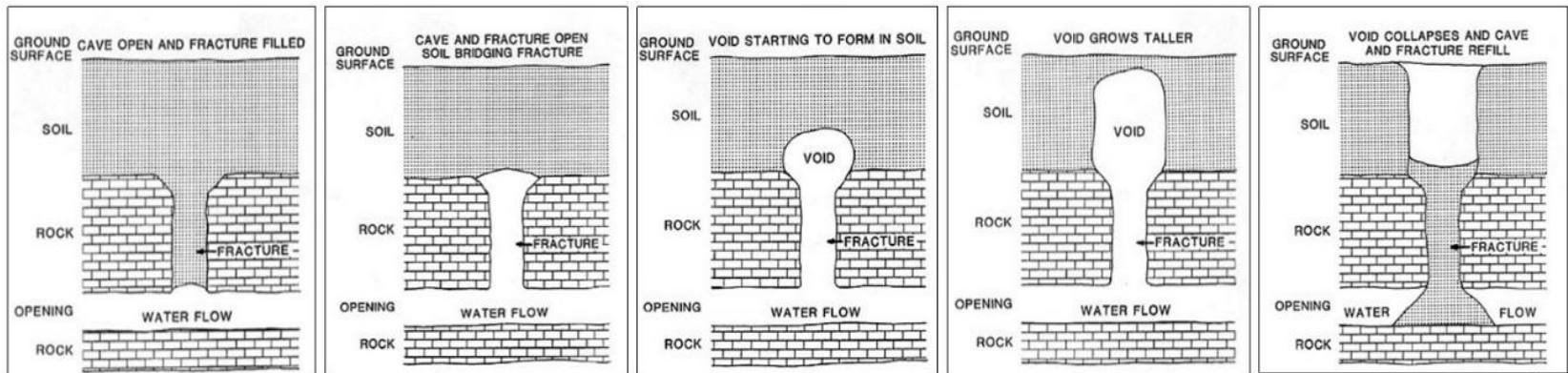
# What Constitutes Unstable Areas?

- Differential settlement – probably more likely for UWLs constructed in alluvial settings where part of footprint is underlain by soft clays and part is underlain by stronger alluvial gravels.

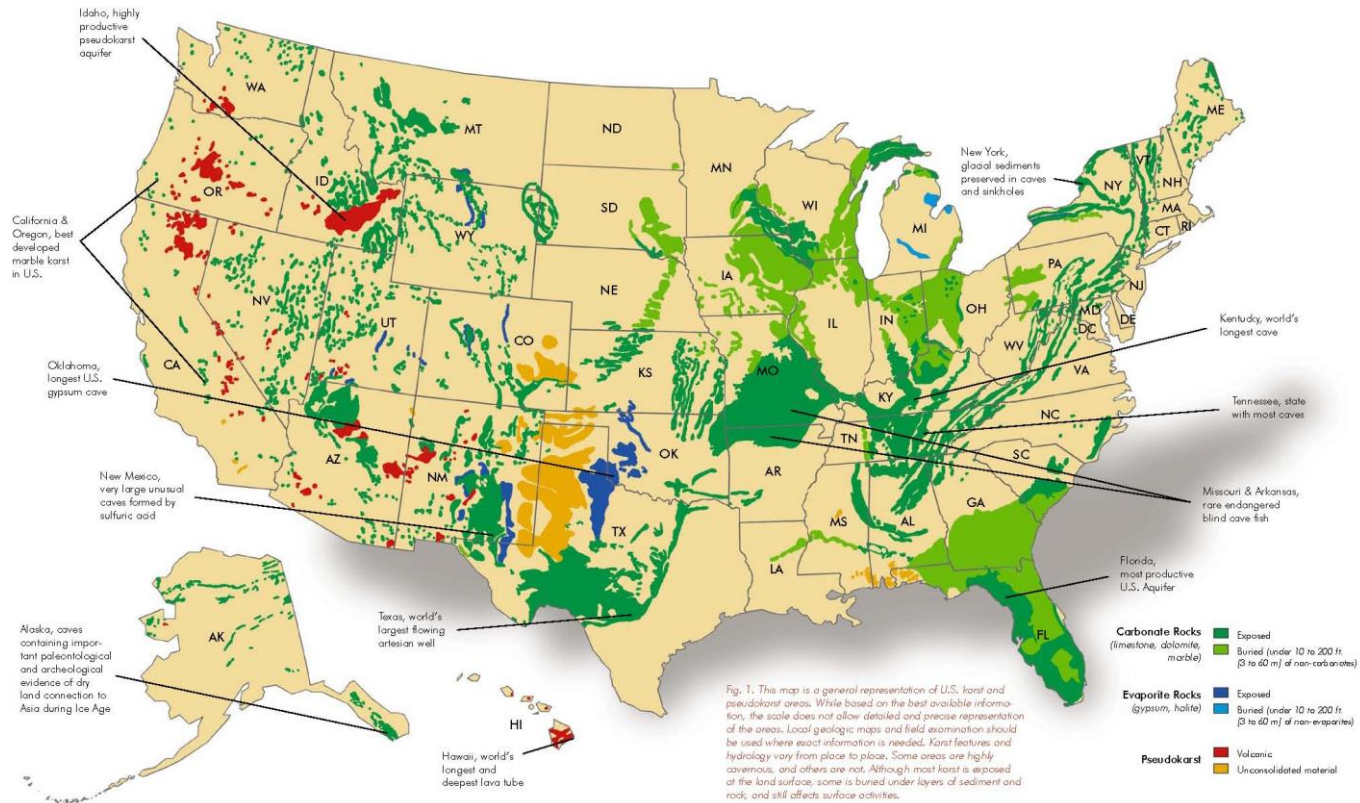


# What Constitutes Unstable Areas?

- Karst – formation of sinkholes beneath the UWL.



# U.S. Karst Map



# What Constitutes Unstable Areas

- In all cases, the concern is that the integrity of the landfill liner system may be compromised.

# How Do You Certify Stability over an Entire UWL Footprint?

- Landfill liner system may be covered by dozens of feet of CCR.
- Landfill footprint may cover many acres.
- Not advisable to drill through fill material.
- Not advisable to drill beneath the UWL.

# How Do You Certify Stability over an Entire UWL Footprint?

- Best means to verify the stability of fill material, liner system, and foundation material is non-intrusive geophysical investigation.

# Geophysical Investigation

- GeoEngineers has developed techniques to produce high resolution 3D imagery of UWLs using Electrical Resistivity Tomography (ERT) and Multi-Channel Analysis of Surface Waves (MASW).



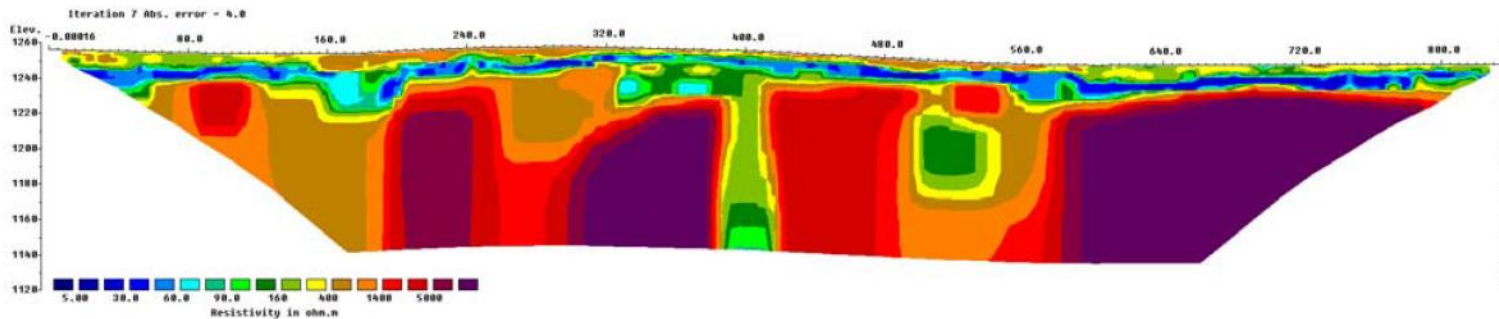
# Geophysical Investigation

- Marine ERT can be utilized to image beneath landfill ponds and surface impoundments



# ERT

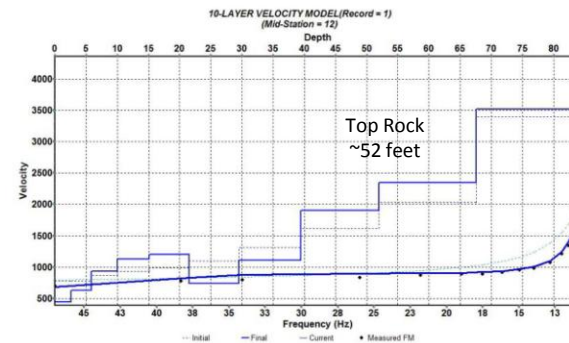
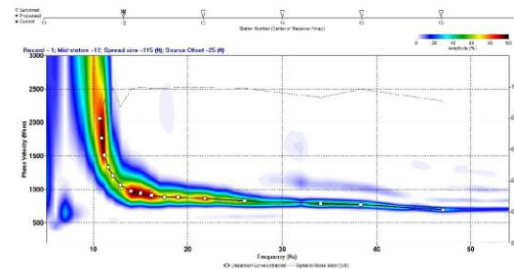
- ERT measures the electrical resistivity of earth materials.
- ERT also provides an indication of moisture content.



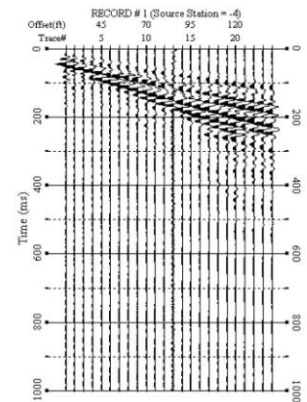
# MASW

- MASW indicates the nature and strength of earth materials.
- MASW works very well in combination with ERT.

438000 @ 300ft (Shifted 37.5ft to the South)  
Orientation: NS

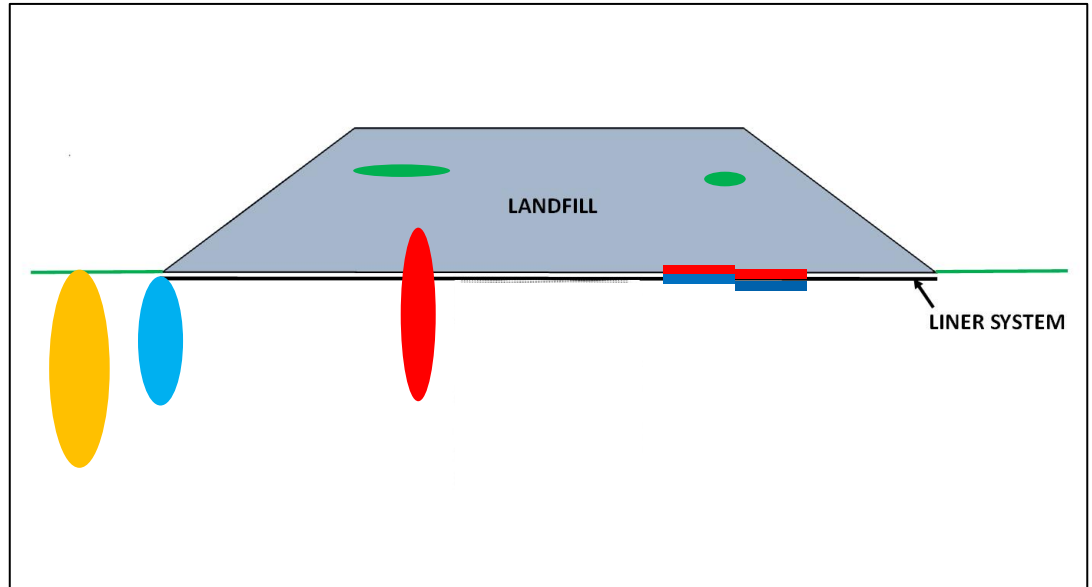


25 x 5



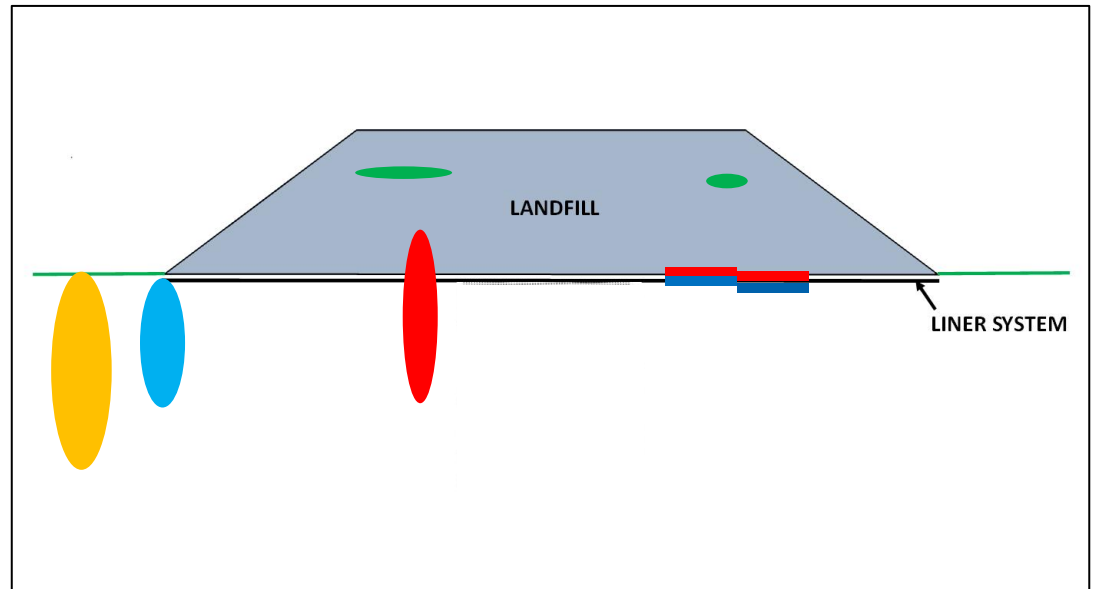
# What we expect to see

- Higher resistivity (drier) materials beneath the liner.
- Horizontal stratification of materials within the fill material.
- Karst features (sinkholes) would be represented as vertical anomalies.

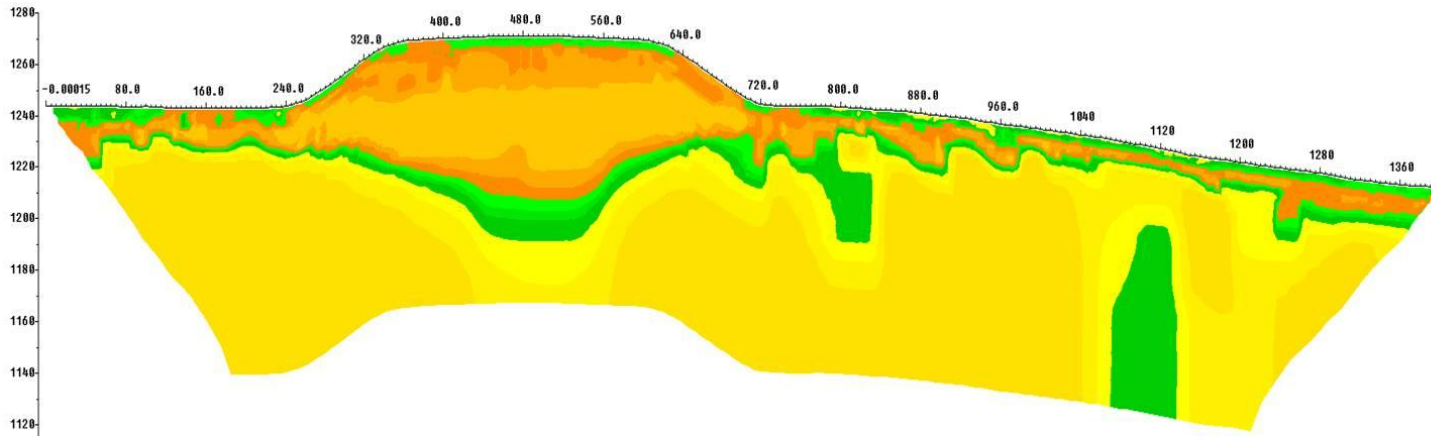


# What we expect to see

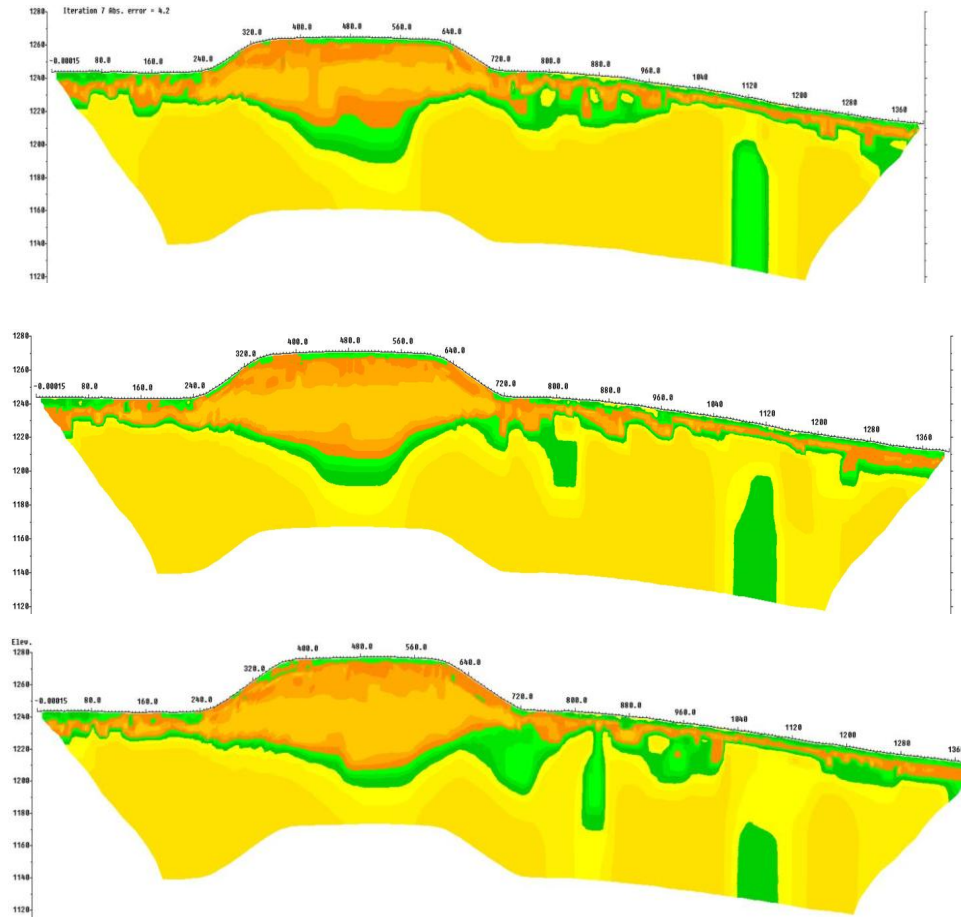
- Differential settlement would be represented by lateral offset in resistivity pattern.
- Lower resistivity anomalies at landfill toe (drainage anomalies).
- Lower resistivity linear anomalies representing solution-widened joints or fracture trends



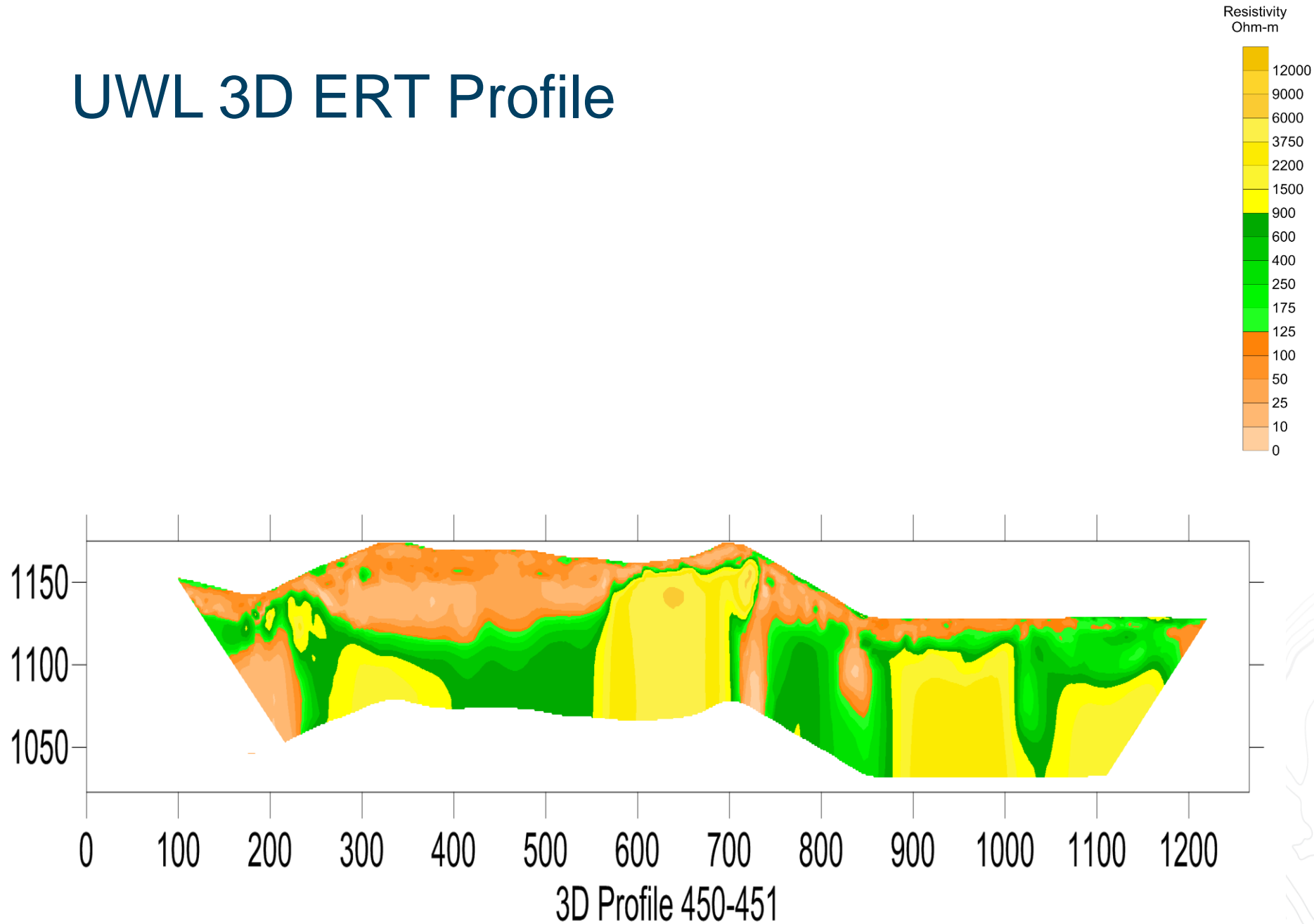
# UWL 3D ERT Profile



# UWL 3D ERT Profiles



# UWL 3D ERT Profile



# Groundwater Monitoring

- Limestone has very low primary permeability.
- Groundwater moves preferentially through joints and fractures.



# Groundwater Monitoring

- A monitoring well sited in massive limestone would likely be a “dry hole.”

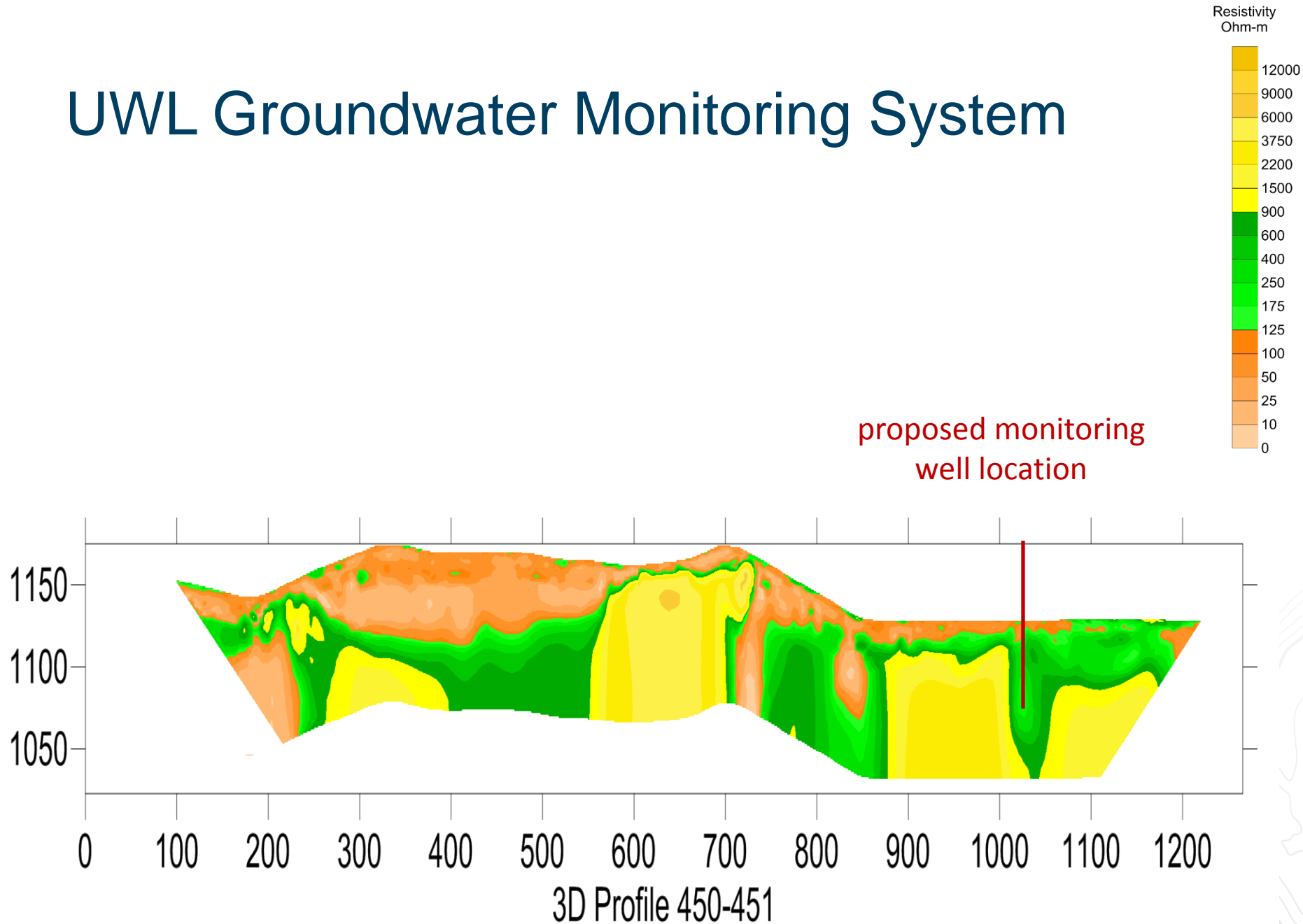


# Groundwater Monitoring

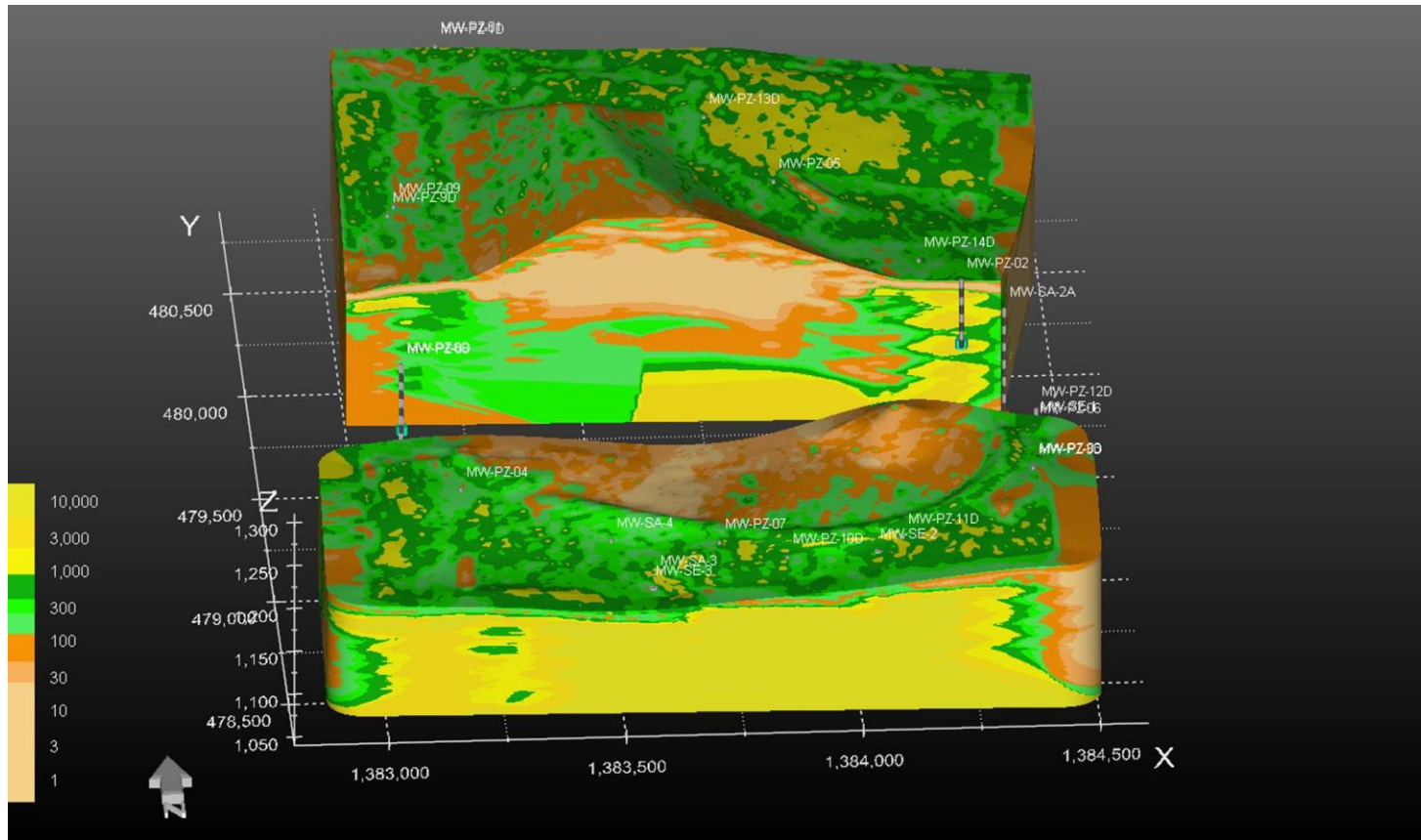
- A monitoring well sited near a joint or fracture trend would more likely capture the groundwater moving through the system.



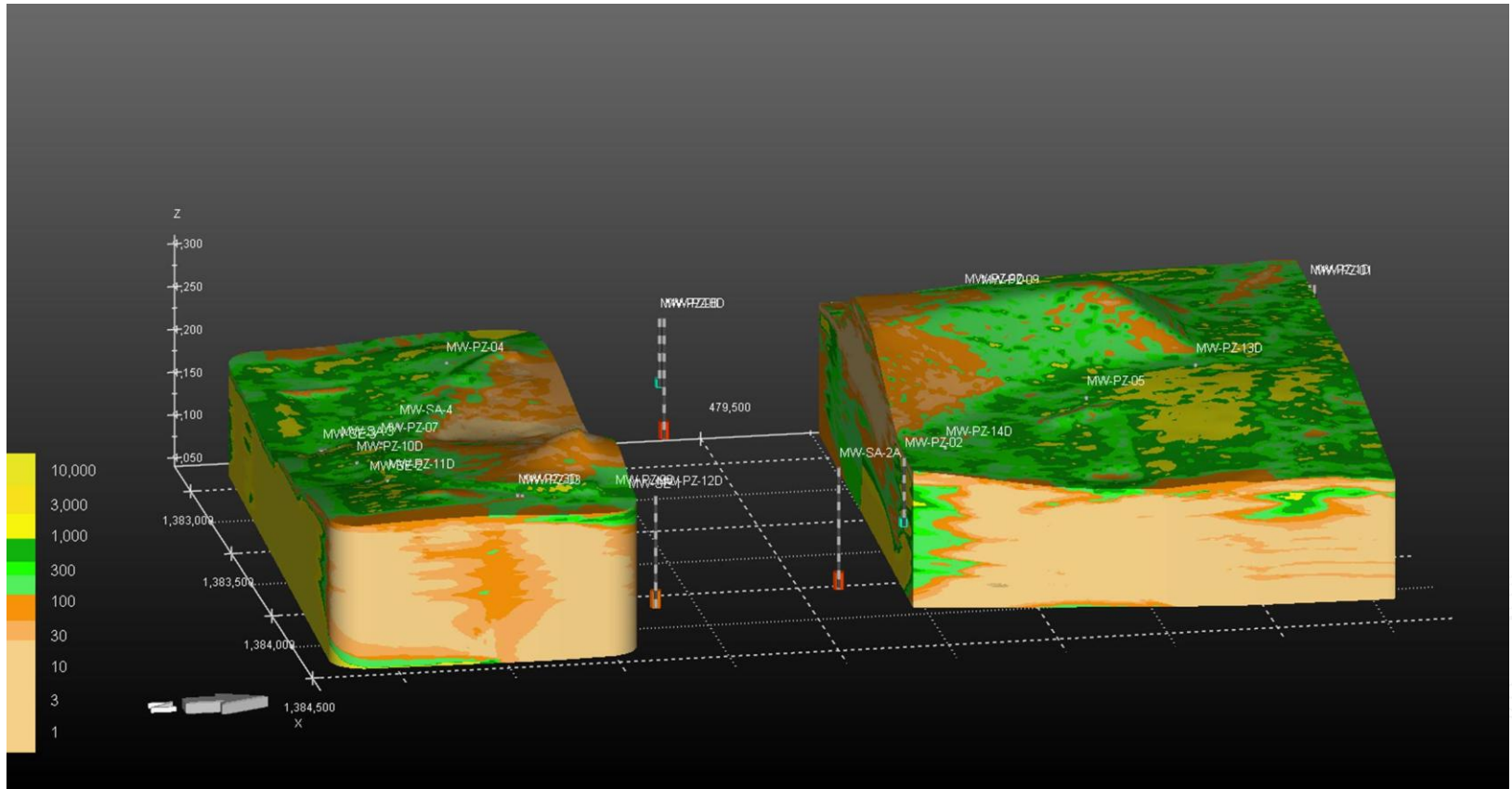
# UWL Groundwater Monitoring System



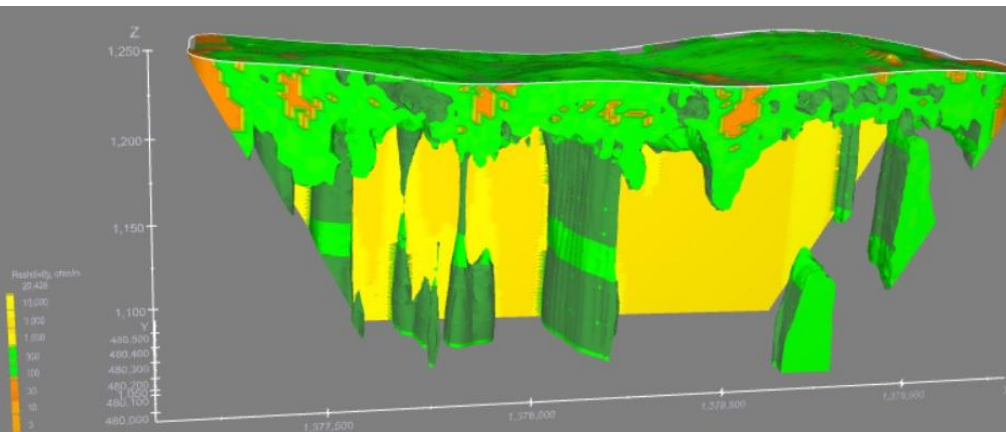
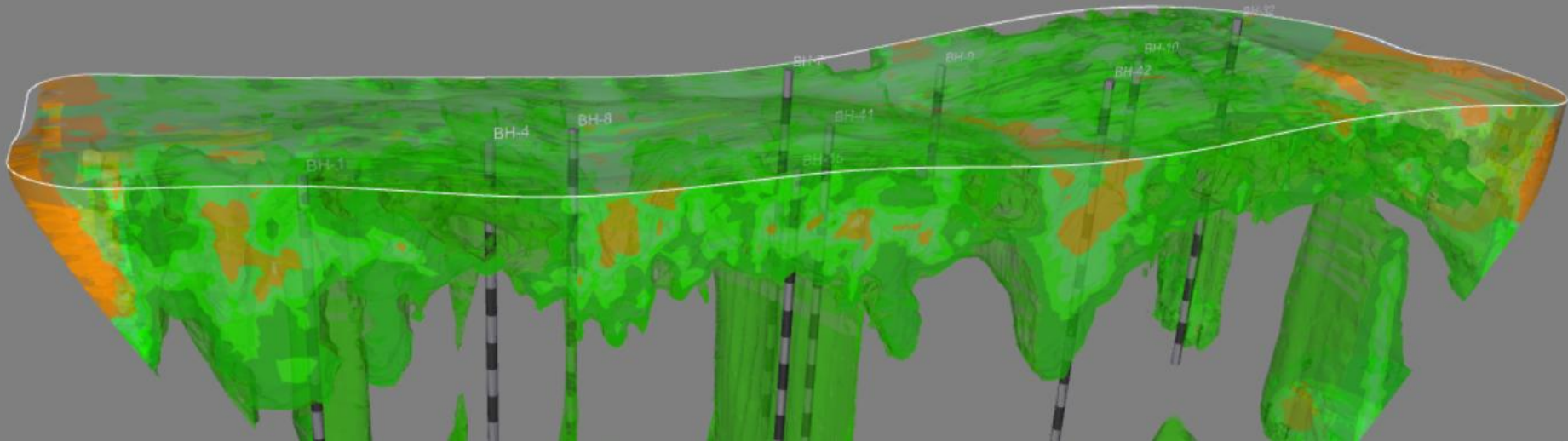
# 3D GIS Modeling



# 3D GIS Modeling



# 3D GIS Modeling



# Summary

- EPA set up the CCR Rule to be “self-implementing” and “enforceable by citizen suits.”
- GeoEngineers approaches each CCR Rule assignment from the perspective of potential litigation.
- Geophysical techniques provide a sound, defensible basis, rationale and justification for UWL certification – and provide the scientific documentation necessary for public acceptance.

# Questions?

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