

# Getting a Clearer Picture with Geophysics

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# Presentation Overview

This presentation will cover...

- What is geophysics?
- Why geophysics?
- Methodology and when to use
  - Seismic
  - Resistivity
  - Ground Penetrating Radar
  - Electromagnetics
- Marine Geophysics
- Drilled shaft testing options

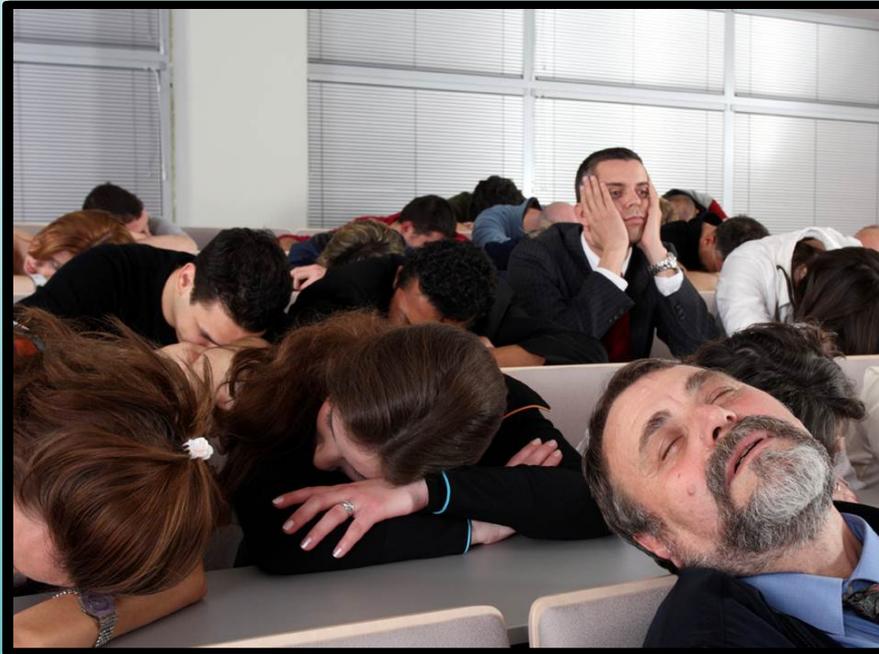
This presentation will not cover...

- Specific details of how each method works
- All of the methods available

Because...



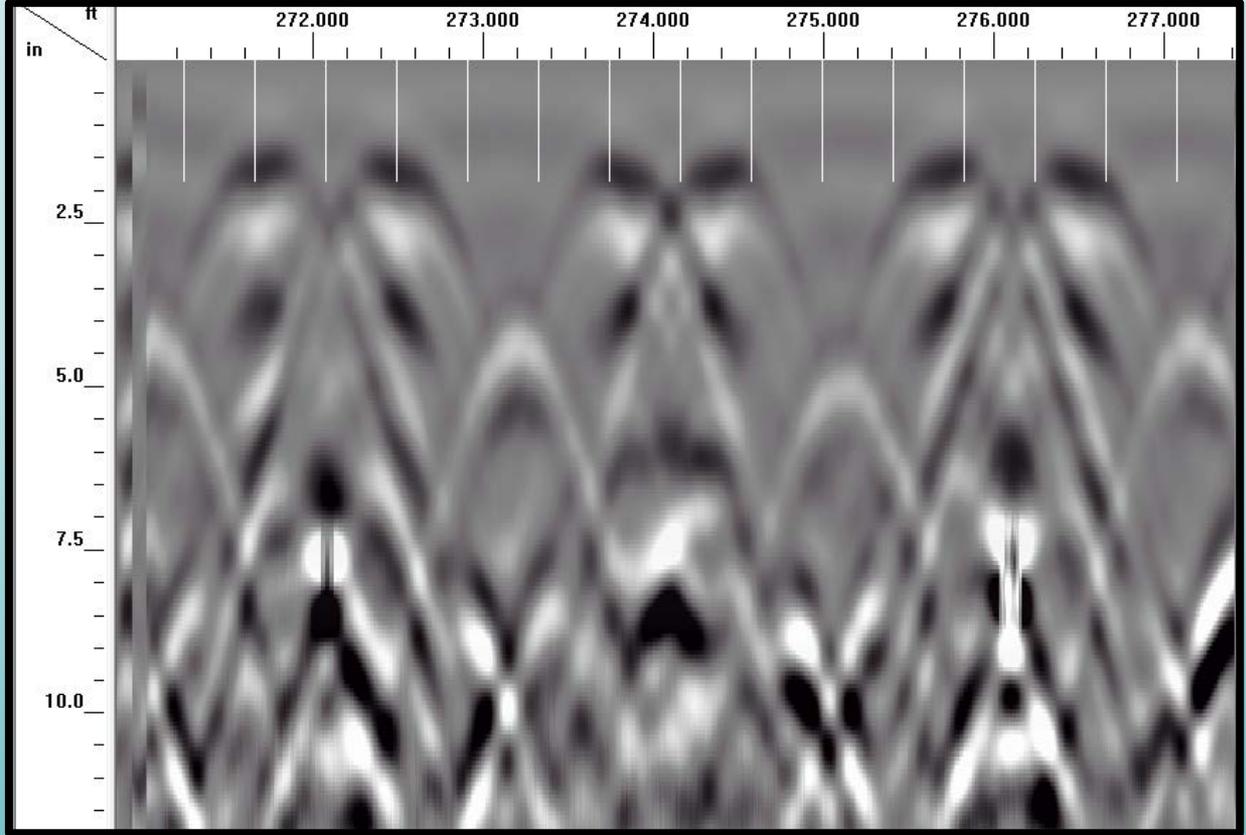
# It's The Last Day of Presentations!



# Geophysics, Is It



?



# Geophysics Defined

## Merriam-Webster

A branch of earth science dealing with the physical processes and phenomena occurring especially in the earth and in its vicinity.

## Wikipedia

A subject of natural science concerned with the physical processes and physical properties of the Earth and its surrounding space environment, and the use of quantitative methods for their analysis.

## For today's purposes

Derive subsurface information with surface methods or minimally intrusive methods. Better summarized as “really cool stuff!”



# Traditional Geotechnical Site Characterization

- Visual observations of the existing surface conditions
- Obtain borings for soil and rock samples
- Install monitoring wells to observe groundwater conditions
- Perform laboratory testing on discrete sampling intervals
- Interpolate/extrapolate data from the very limited data points





[www.jolyon.co.uk](http://www.jolyon.co.uk)



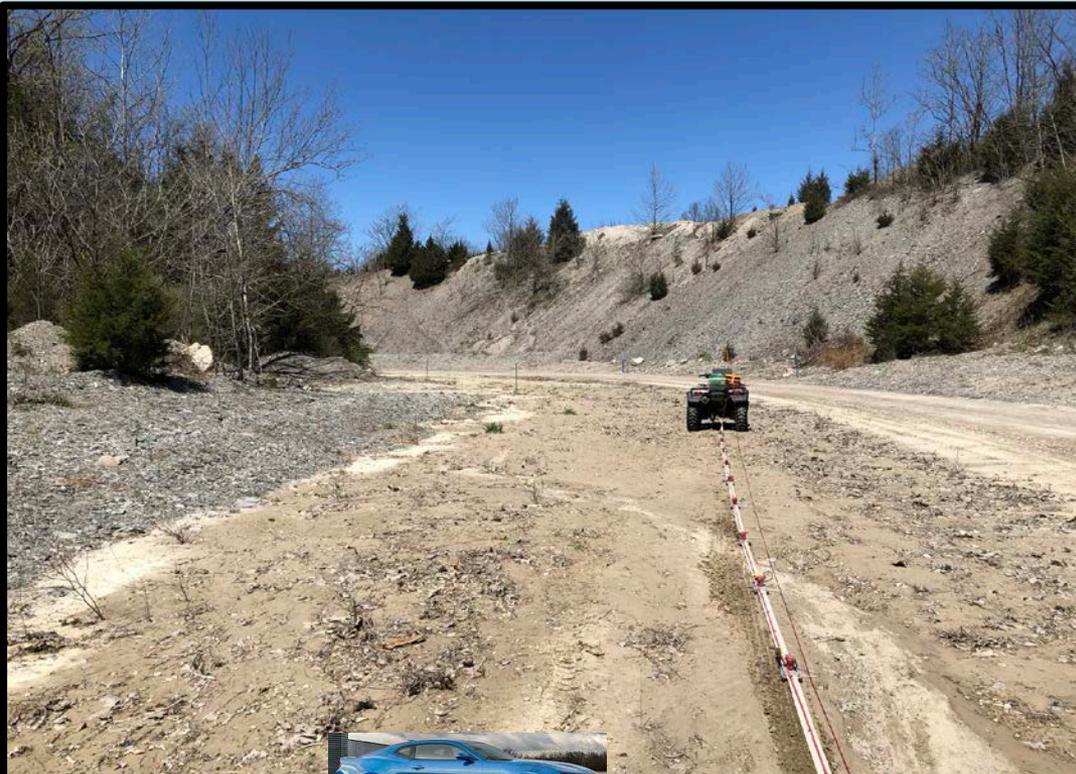
# Geophysical Methods

- Seismic
- Electrical Resistivity
- Ground Penetrating Radar (GPR)
- Electromagnetic (EM)
- Microgravity
- Magnetics
- Induced Polarization (IP)



# Seismic Applications

- Determining Seismic Site Classification
- Map bedrock topography
- Rippability of soil/rock
- Locate potential sinkhole/karst conditions

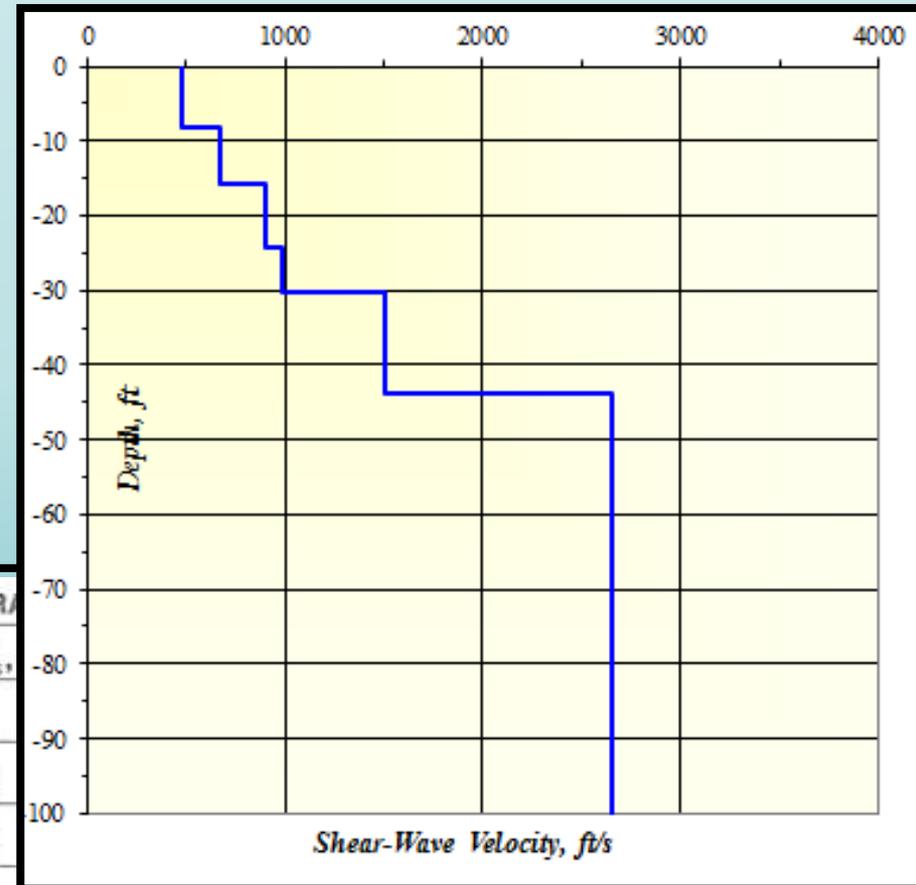


# Seismic

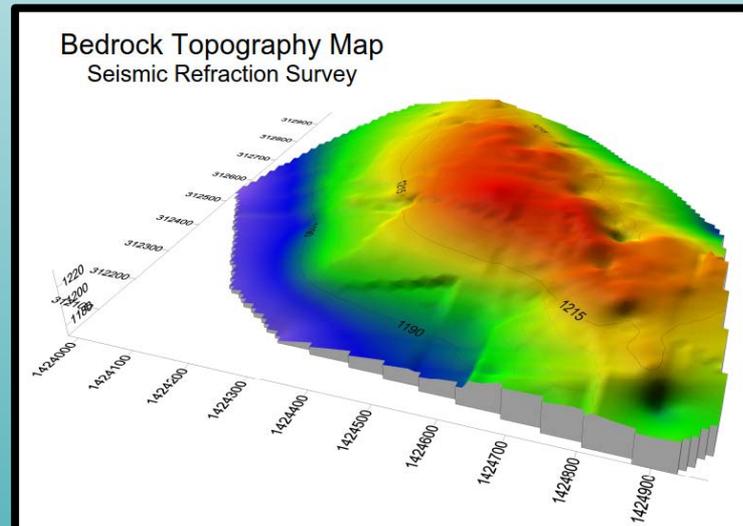
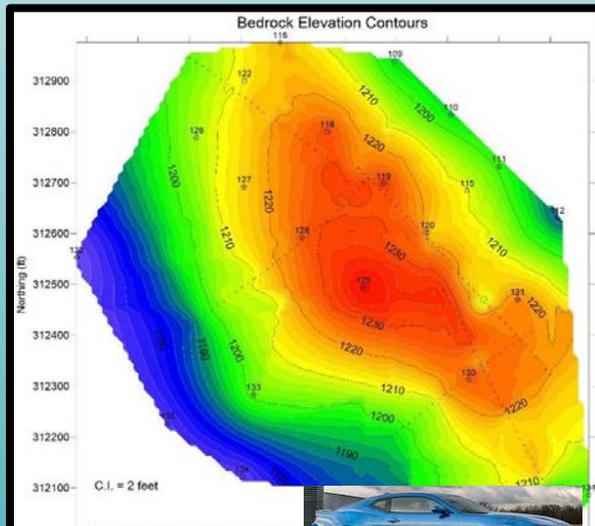
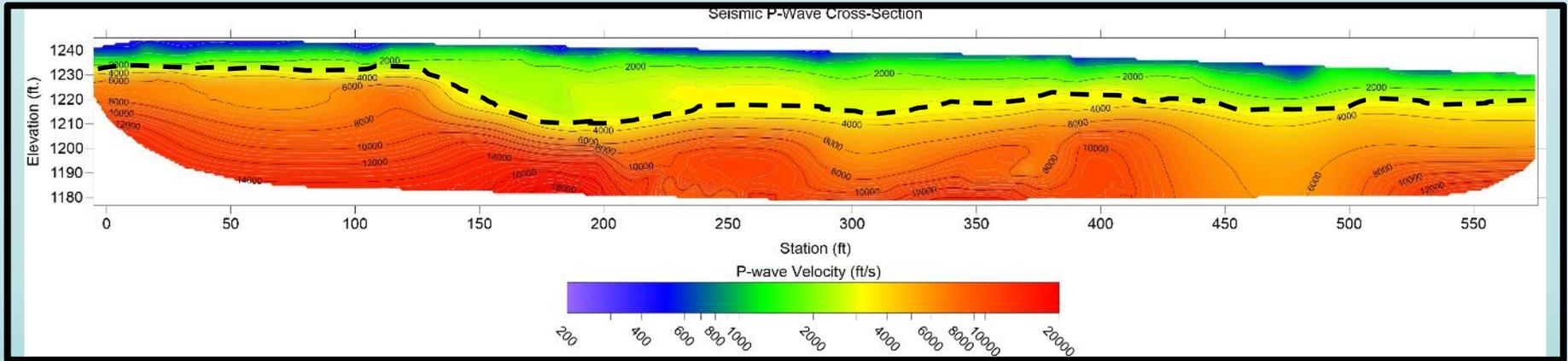
## AASHTO Site Classification

- Least conservative method
- Estimates the shear wave velocity
- Required to assign a Site Class A, often needed to verify a Site Class B, C, or D
- Relatively inexpensive with huge potential cost savings

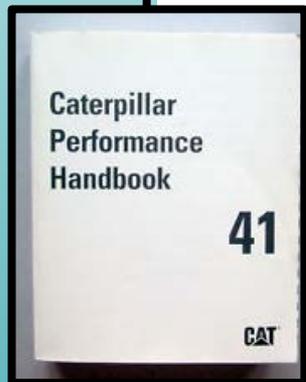
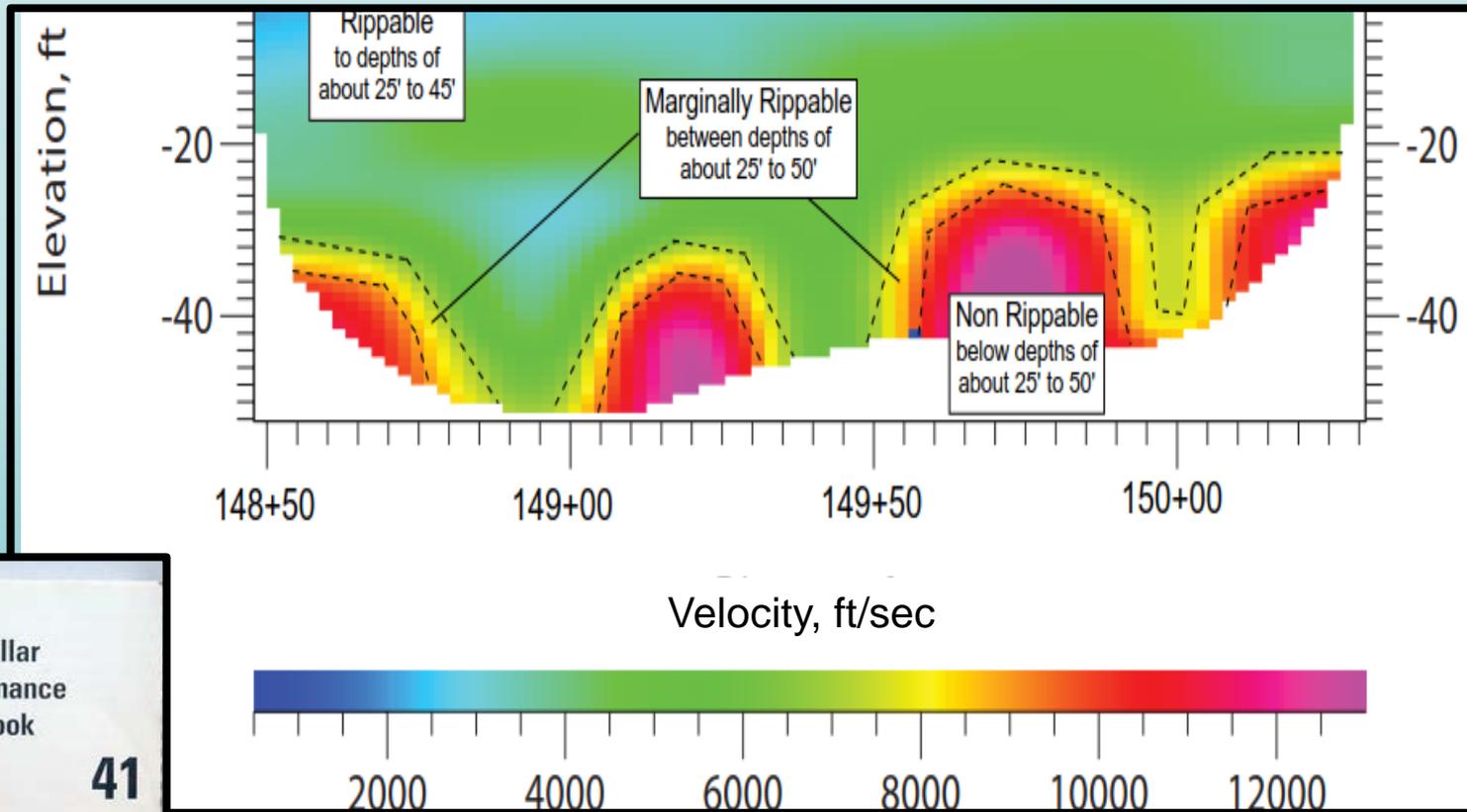
SITE CLASS	SOIL PROFILE NAME	AVERAGE
		Soil shear wave velocity, $\bar{v}_s$
A	Hard rock	$\bar{v}_s > 5,000$
B	Rock	$2,500 < \bar{v}_s \leq 5,000$
C	Very dense soil and soft rock	$1,200 < \bar{v}_s \leq 2,500$
D	Stiff soil profile	$600 \leq \bar{v}_s \leq 1,200$
E	Soft soil profile	$\bar{v}_s < 600$



# Seismic Mapping Bedrock Topography



# Seismic Rippability Studies



# Seismic Rippability Studies

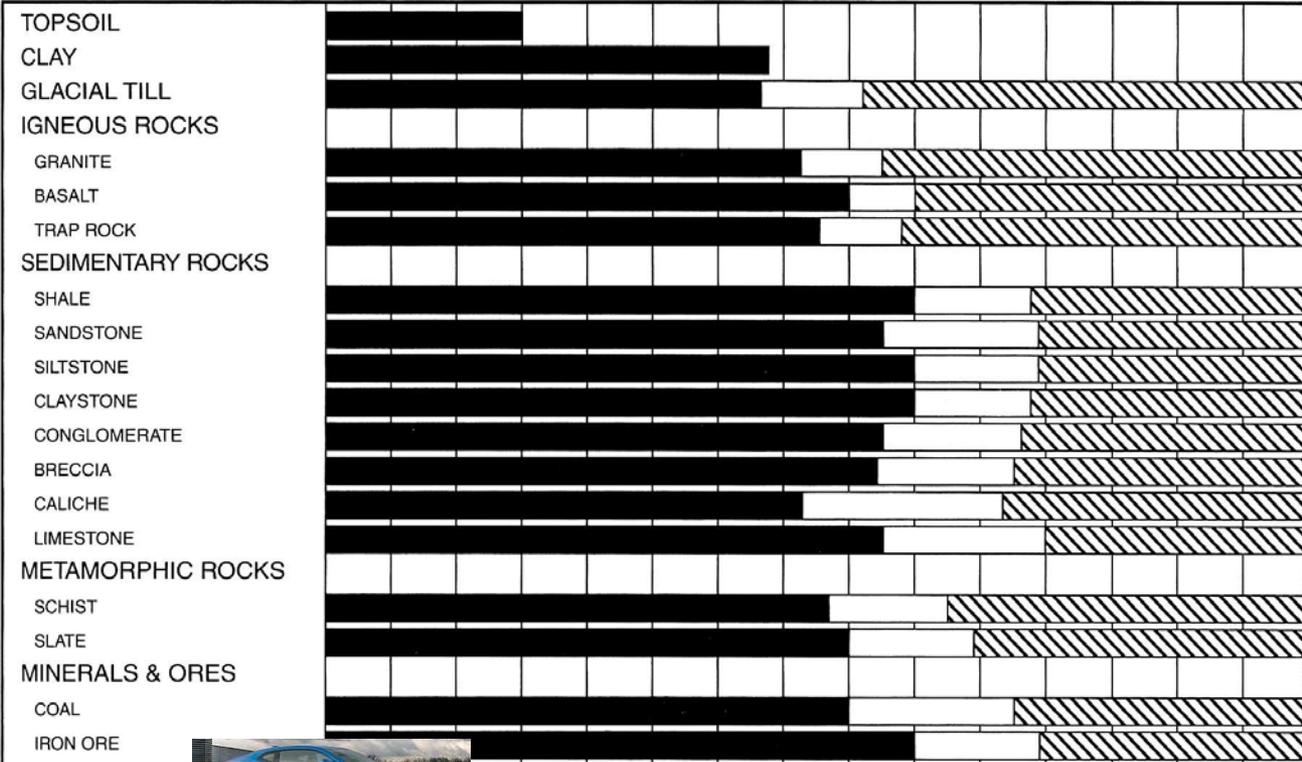
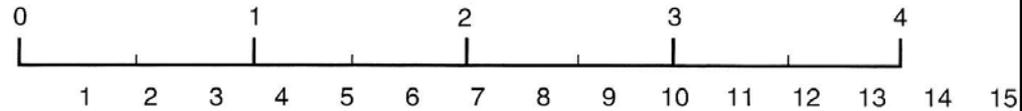
D10R

- Multi or Single Shank No. 10 Ripper
- Estimated by Seismic Wave Velocities

Seismic Velocity

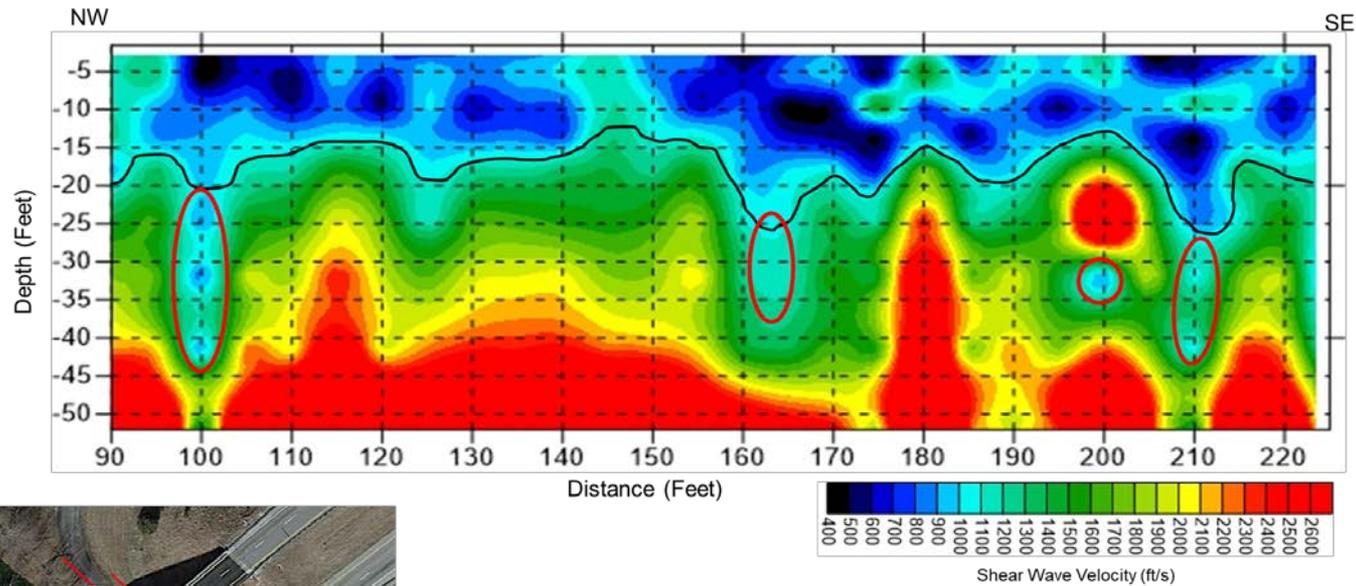
Meters Per Second × 1000

Feet Per Second × 1000



# Seismic

## Locating Weak Zones/Karst



- Possible Void or Weak Zone in Rock
- Approximate Top of Rock
- Approximate Geophone Location
- Effective Model Location
- Possible Void or Weak Zone in Rock (Aerial View)



# Electrical Resistivity Applications

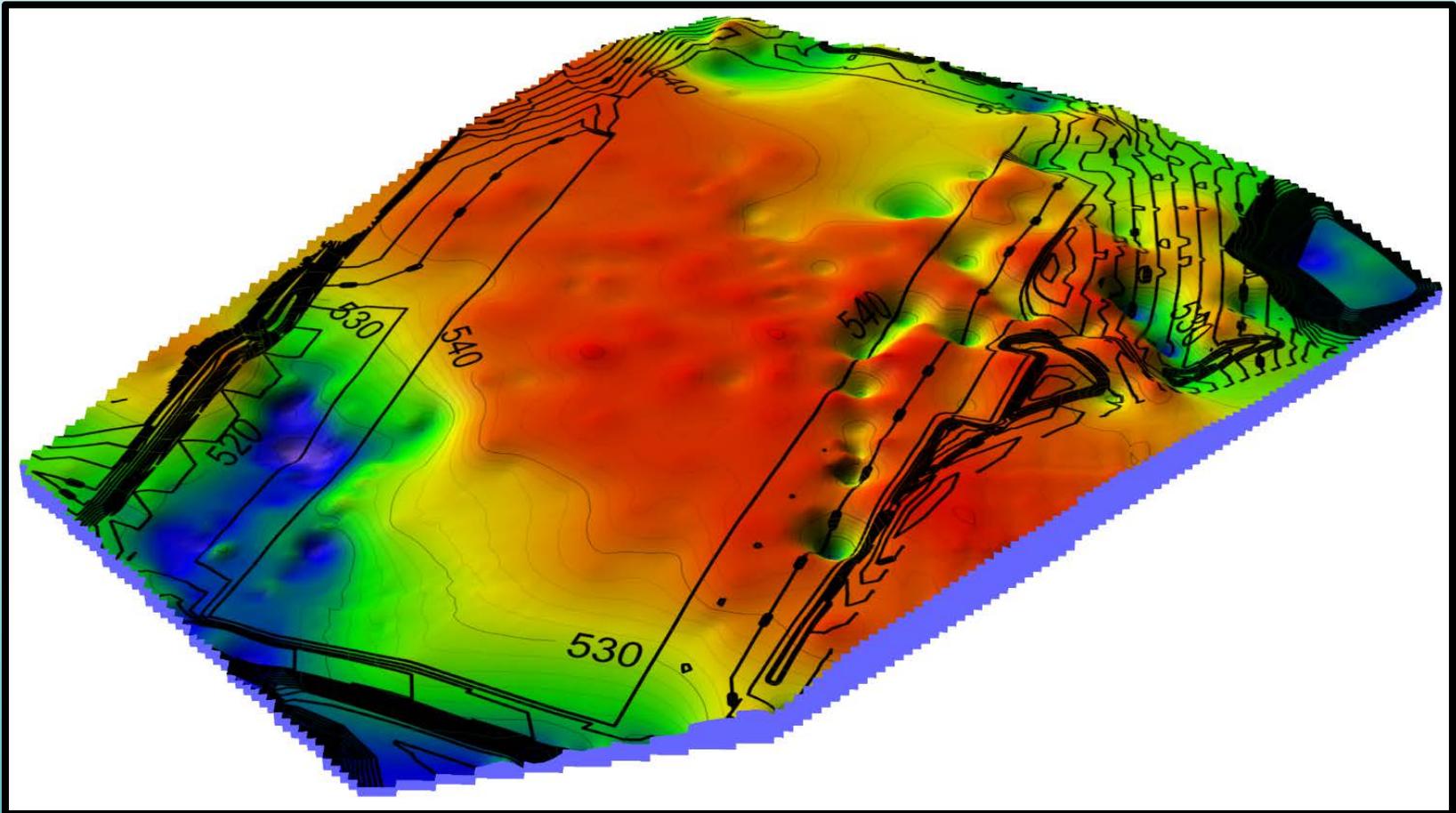


- Map bedrock topography
- Detecting buried debris
- Locate potential sinkhole/karst conditions



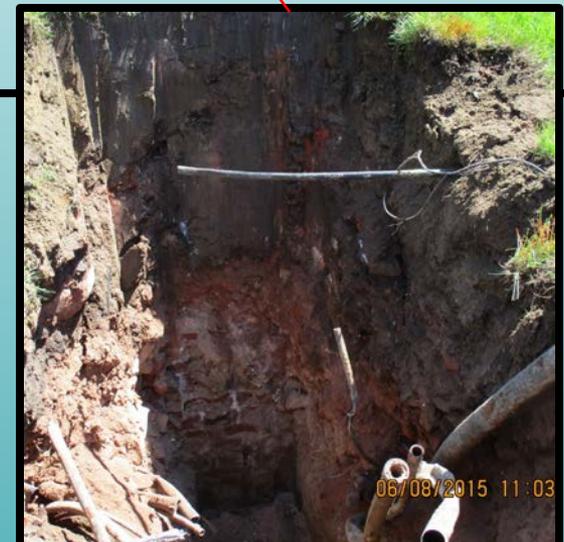
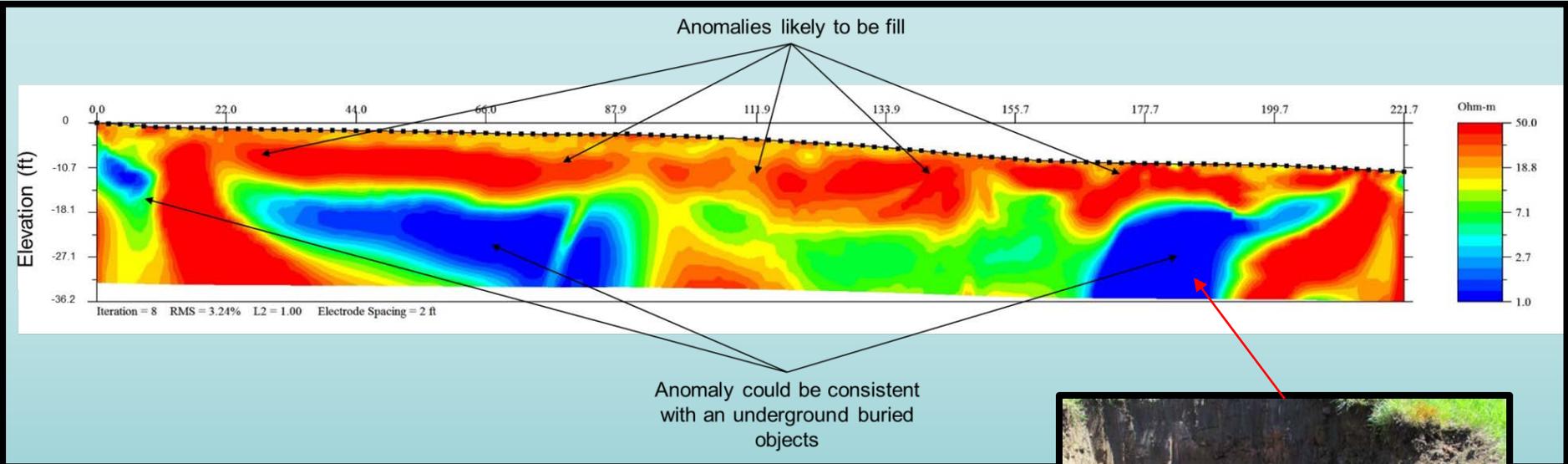
# Electrical Resistivity Imaging

## Mapping Bedrock Topography



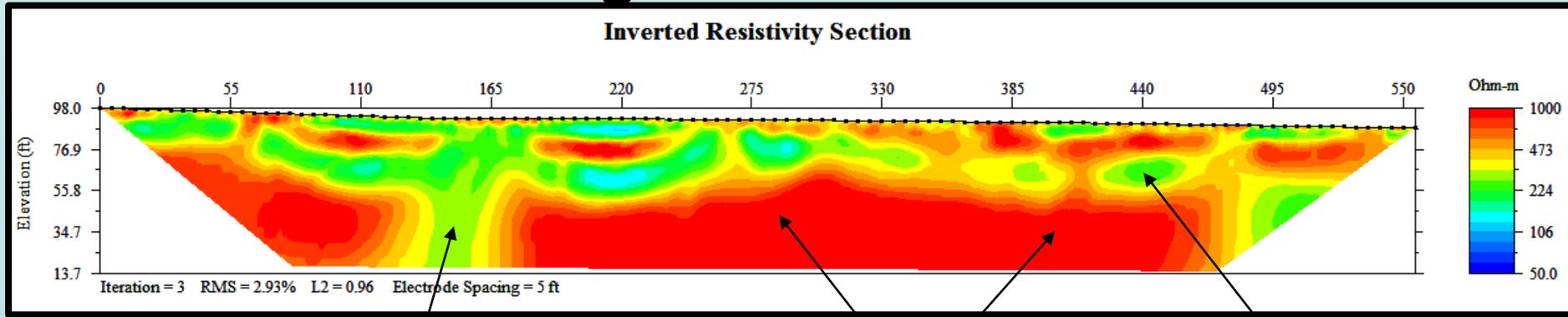
# Electrical Resistivity Imaging

## Detecting Buried Debris



# Electrical Resistivity Imaging

## Locating Weak Zones/Karst



Anomalous area (light green, orange, and yellow) indicative of possible incipient sinkhole formation

Anomalous areas (red) indicative of intact bedrock

Anomalous areas (green) indicative of weathered bedrock or gravelly residual soils



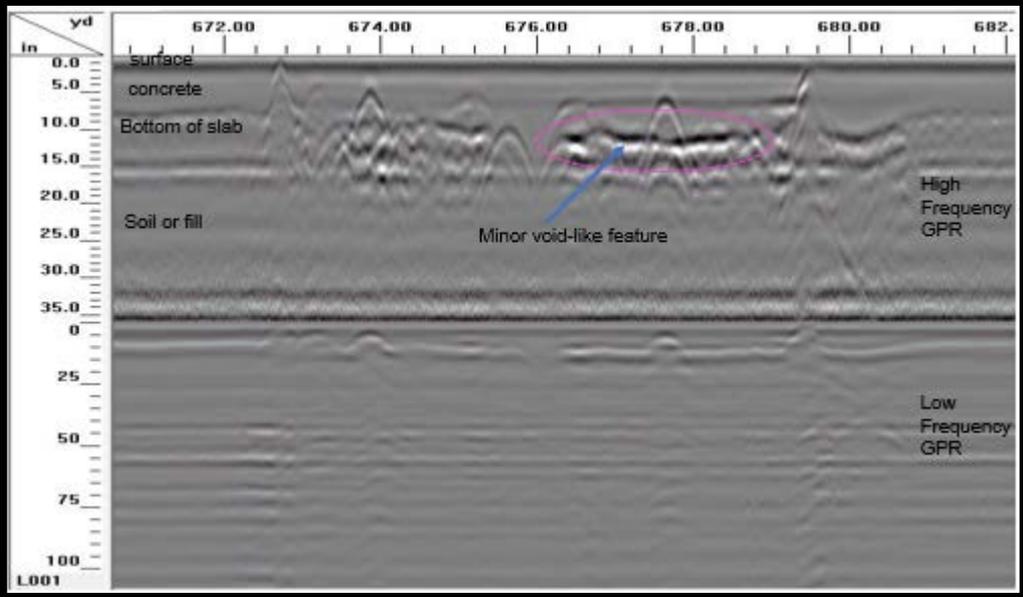
# Ground Penetrating Radar Applications

- Detect shallow voids
- Locate buried debris/tanks/utilities
- Map shallow bedrock
- Determine reinforcement placement and pavement thickness



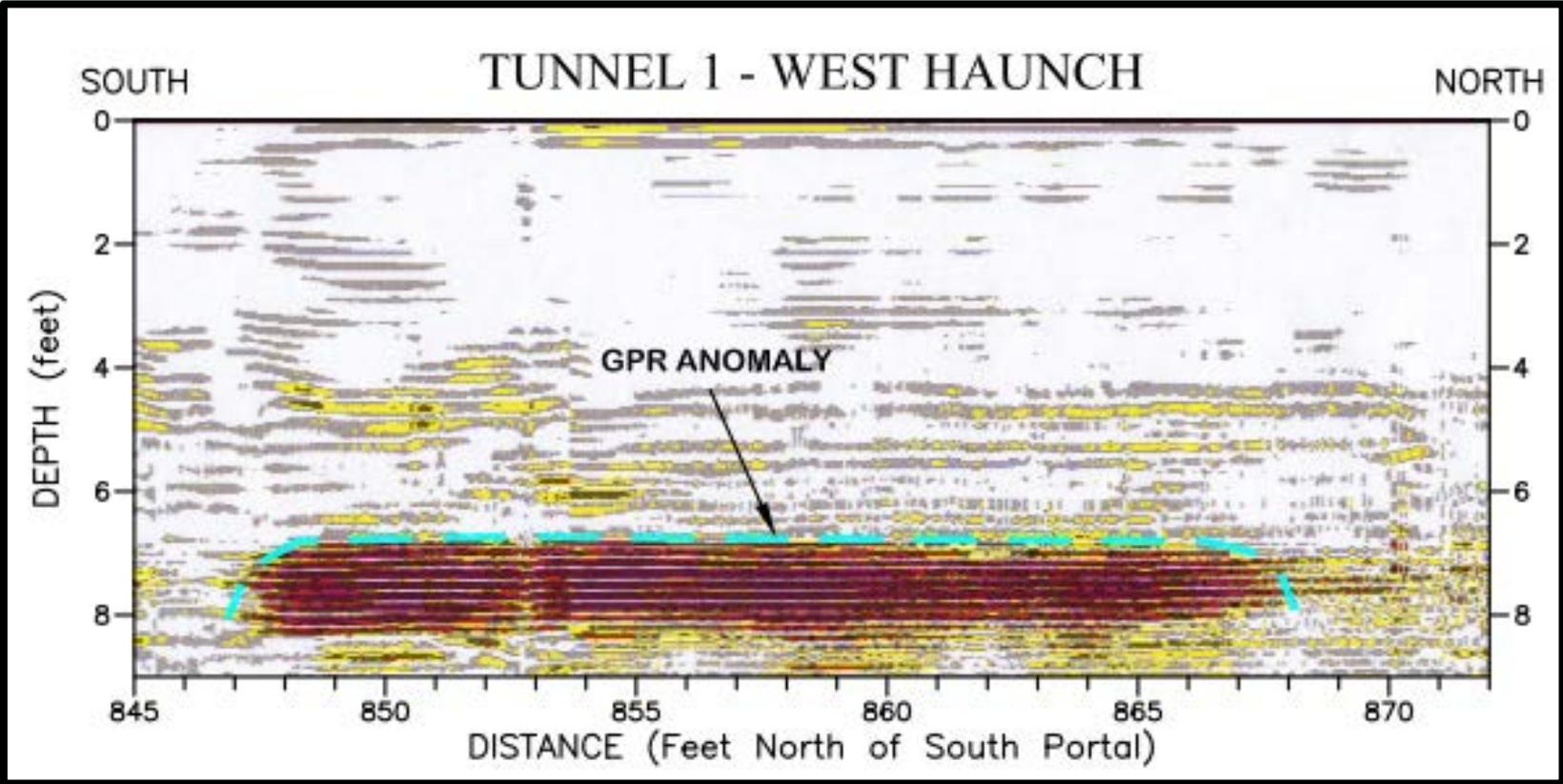
# Ground Penetrating Radar

## Void Detection



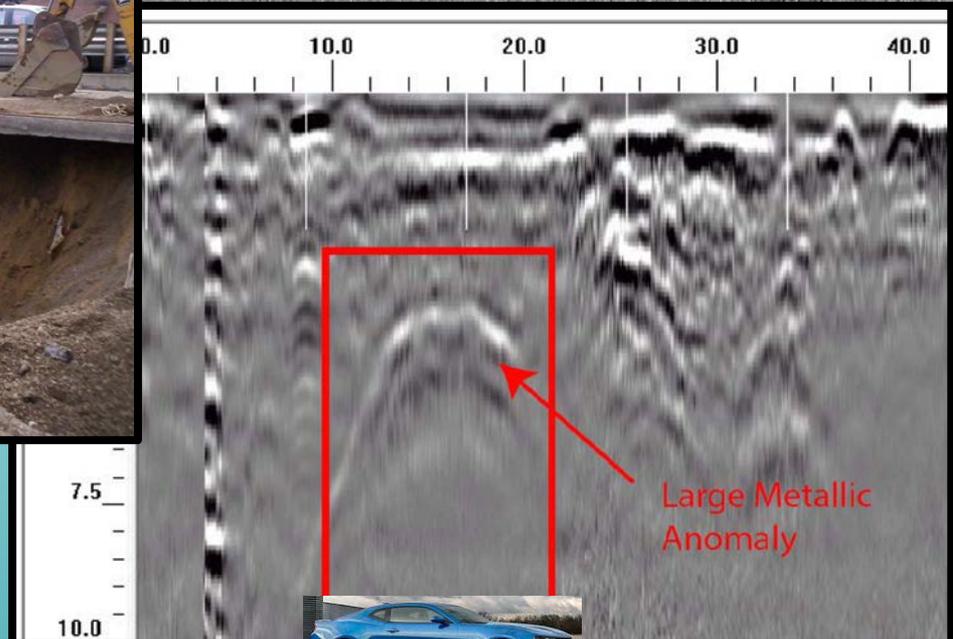
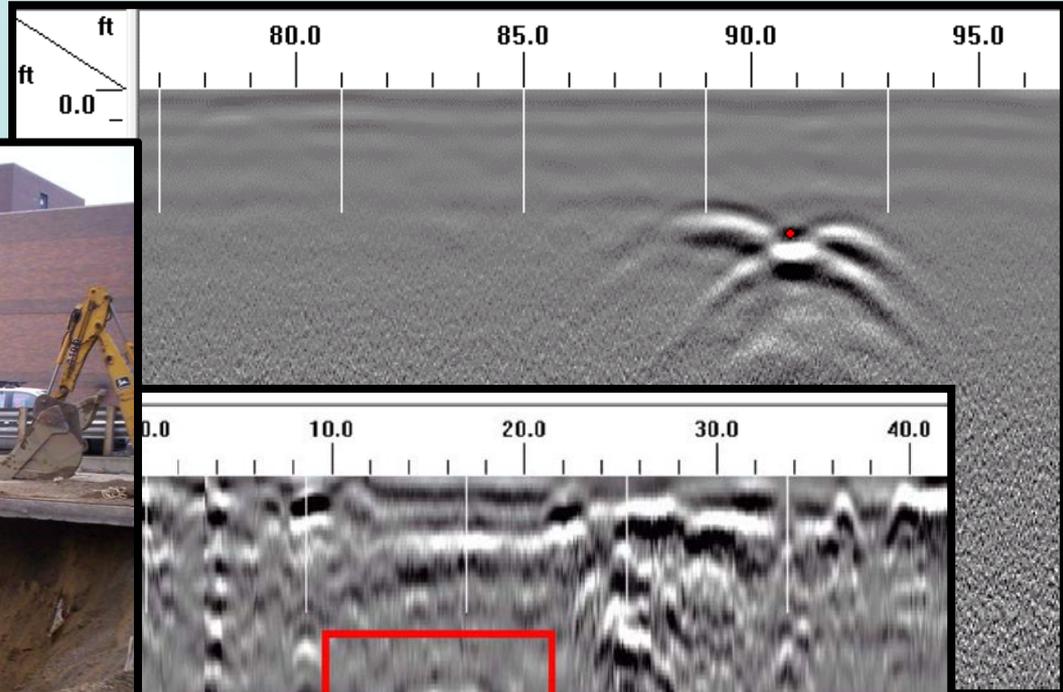
# Ground Penetrating Radar

## Void Detection



# Ground Penetrating Radar

## Locating Buried Debris



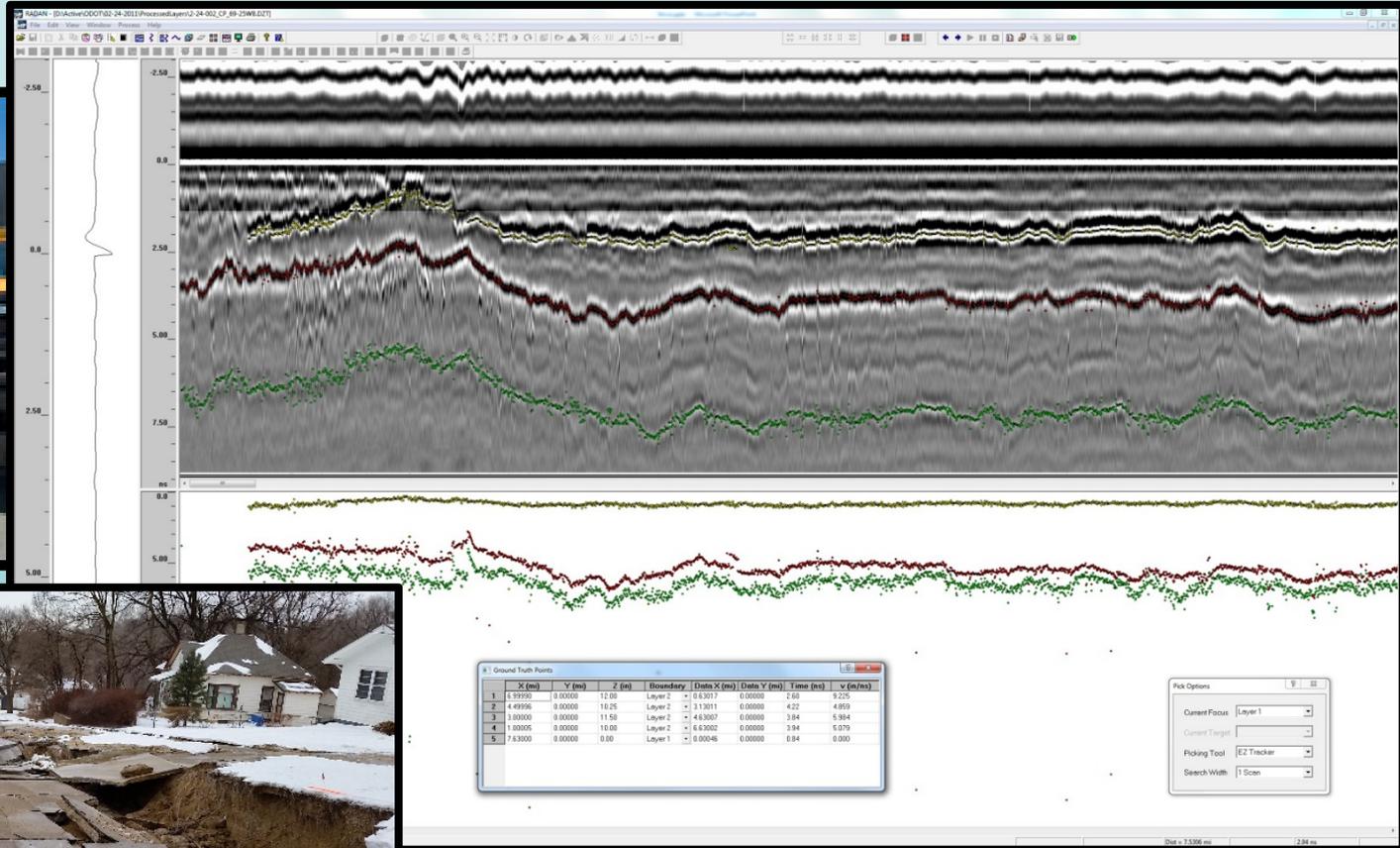
# Ground Penetrating Radar

## Mapping Shallow Bedrock



# Ground Penetrating Radar

## Evaluating Pavements

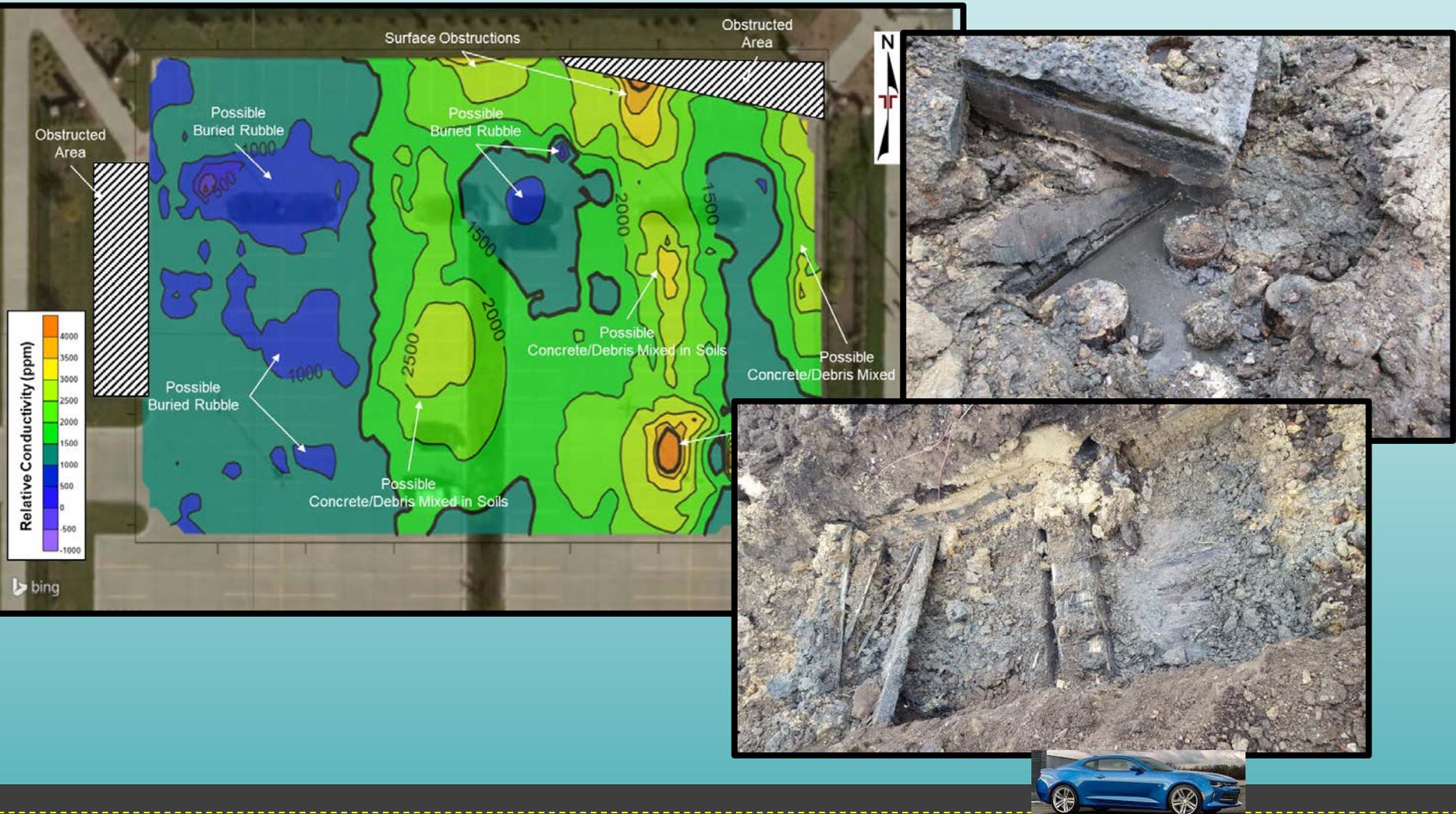


# Electromagnetic Applications

- Locate buried debris/tanks/utilities
- Locate saturated/soft subsurface areas

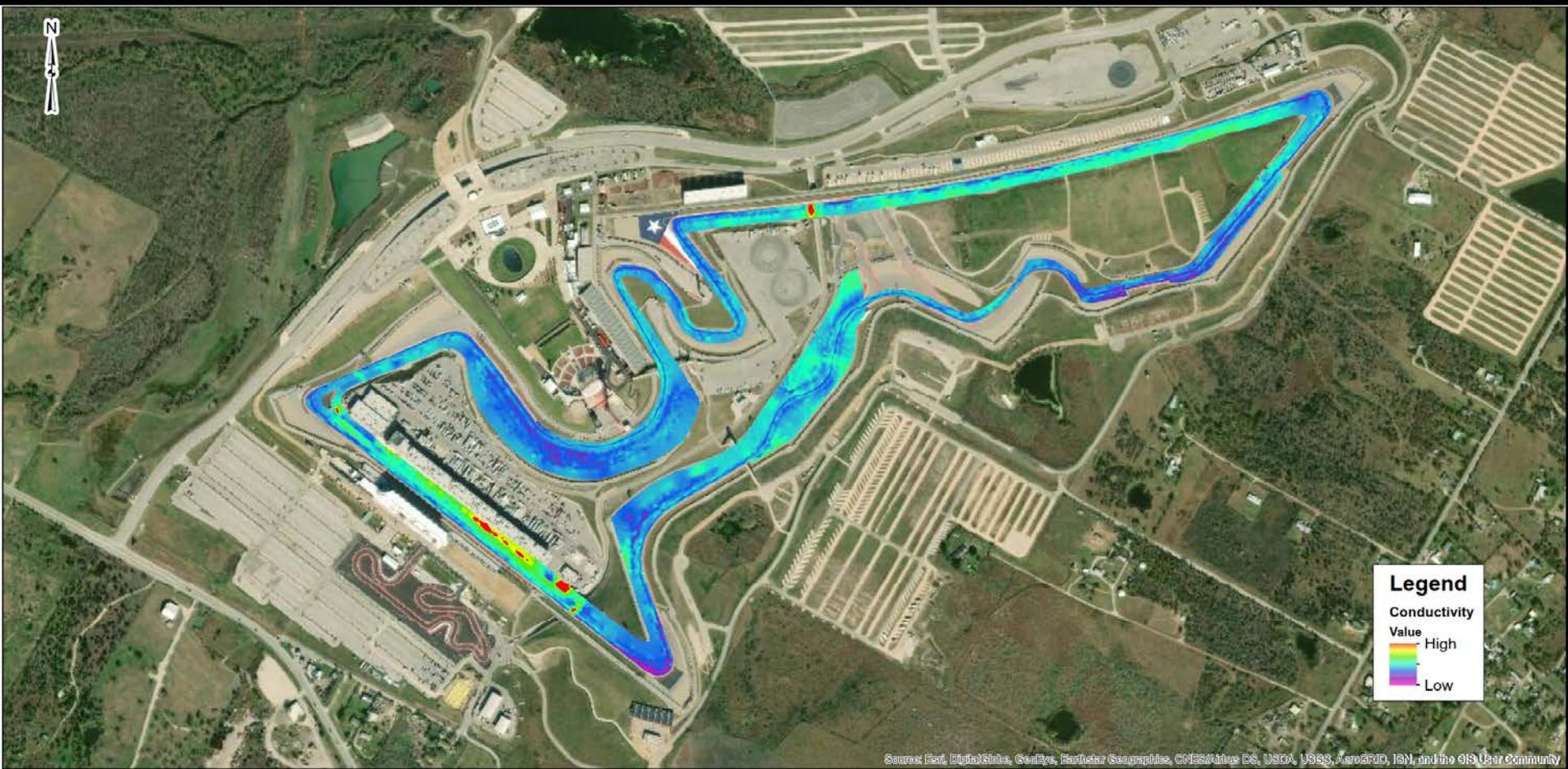


# Electromagnetic Locating Debris



# Electromagnetic

## Locating Saturated/Soft Zones



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

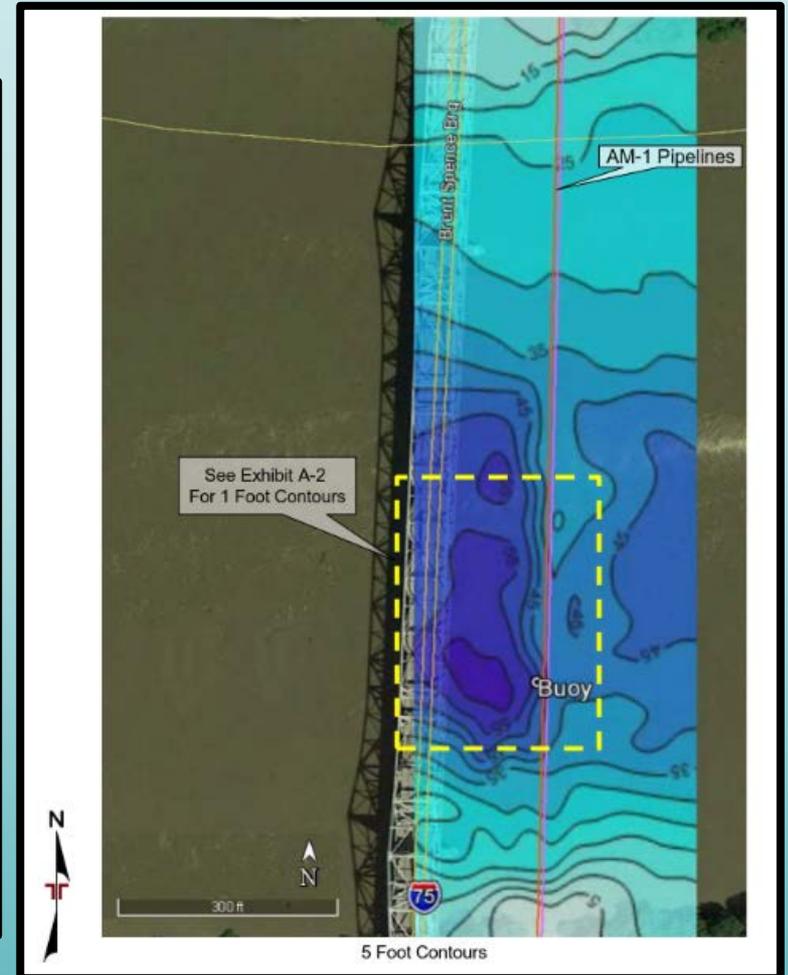
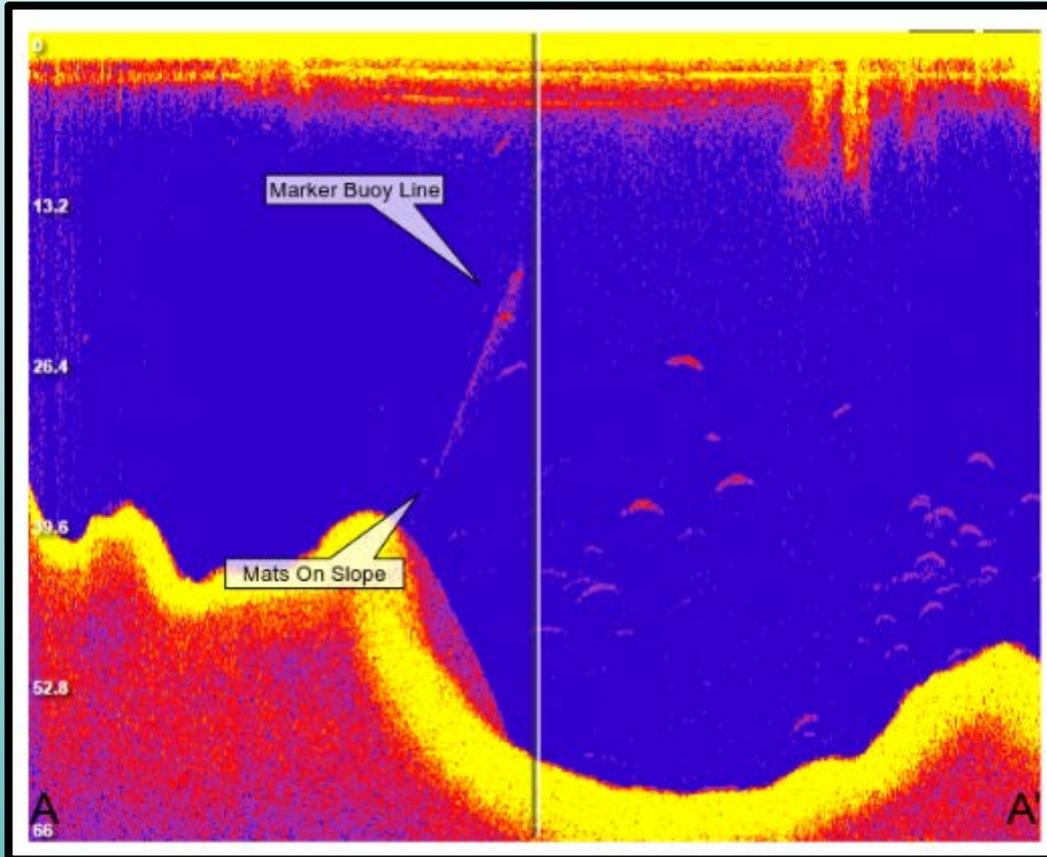


**Just so the “Bridge Guys”  
Don’t Feel Left Out...**



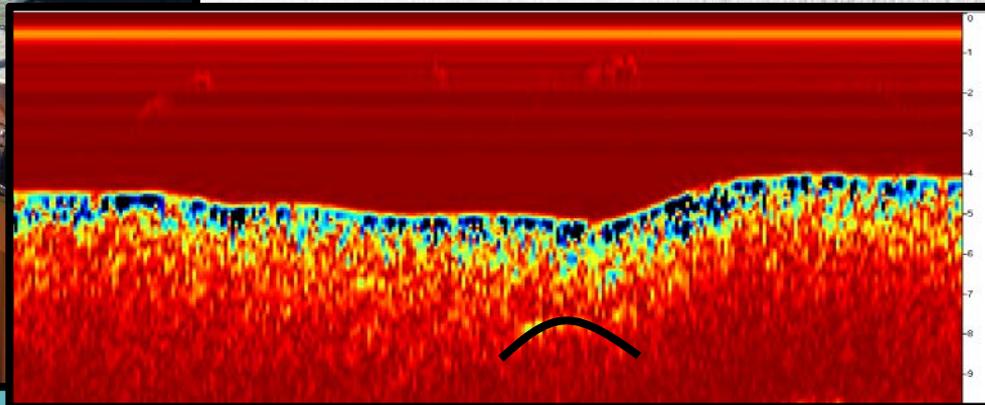
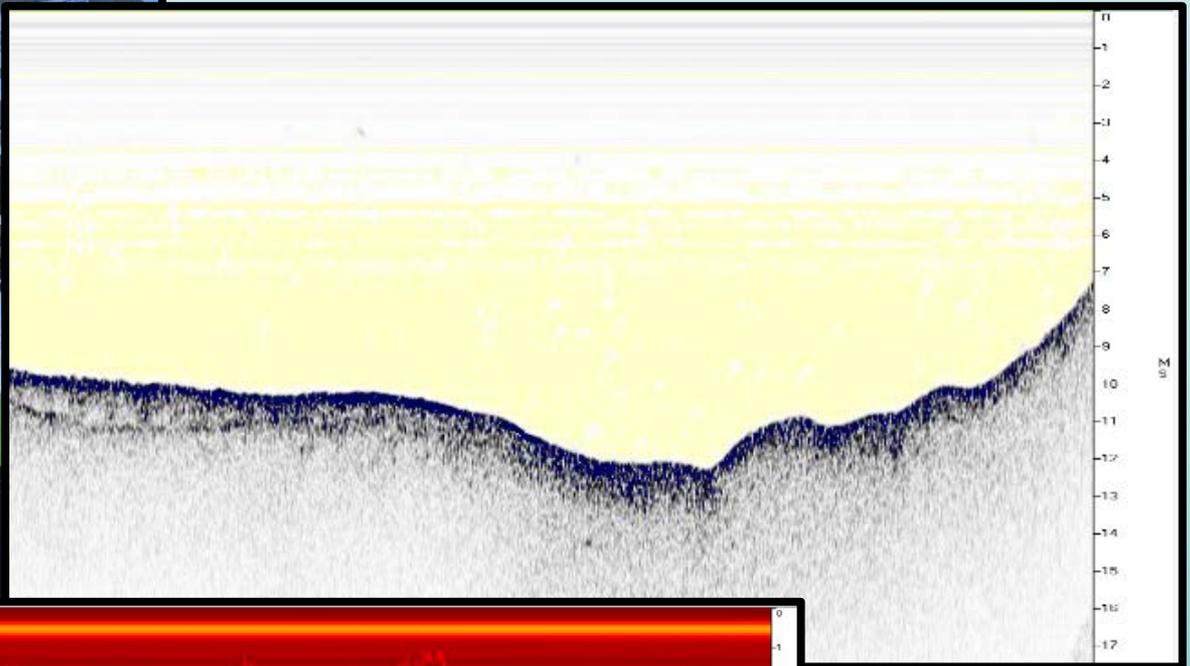
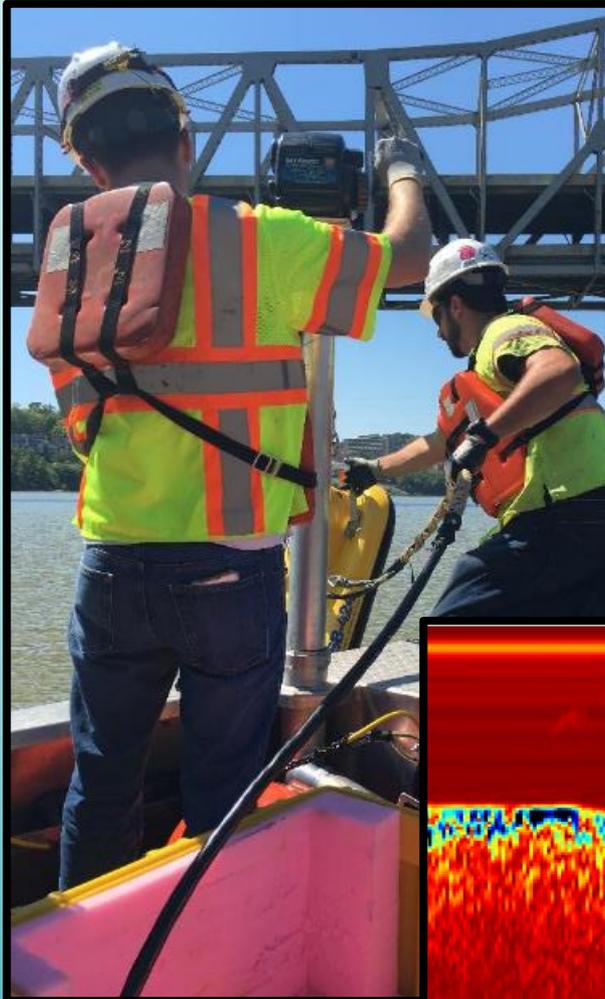
# Marine Geophysics

## Echo Sounding



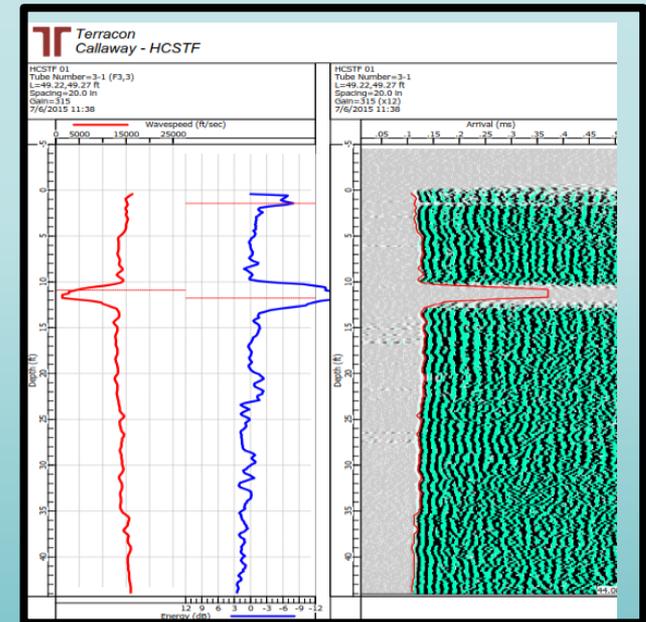
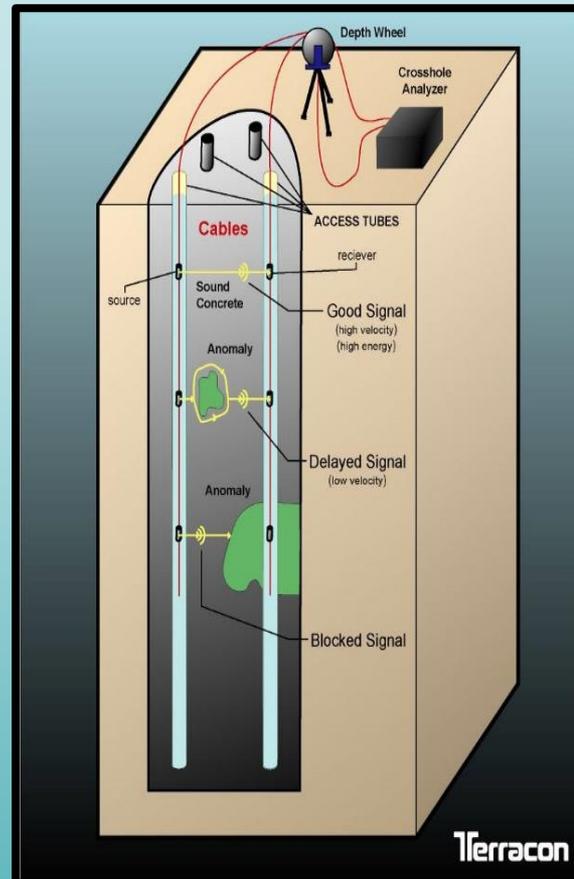
# Marine Geophysics

## Sub-bottom Profiling



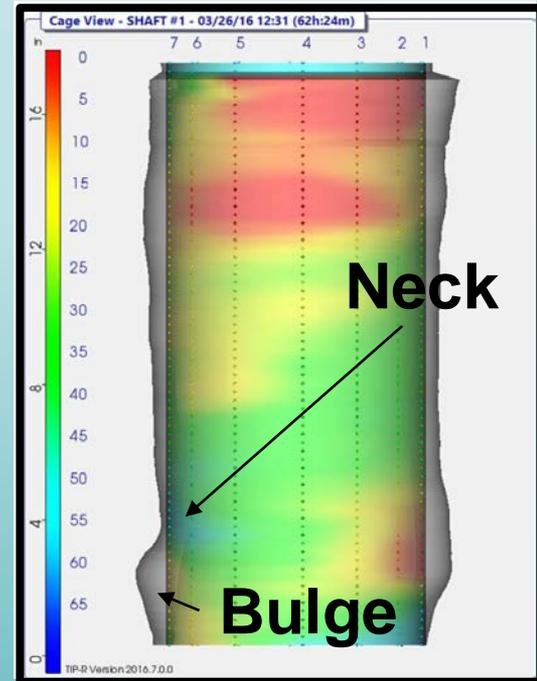
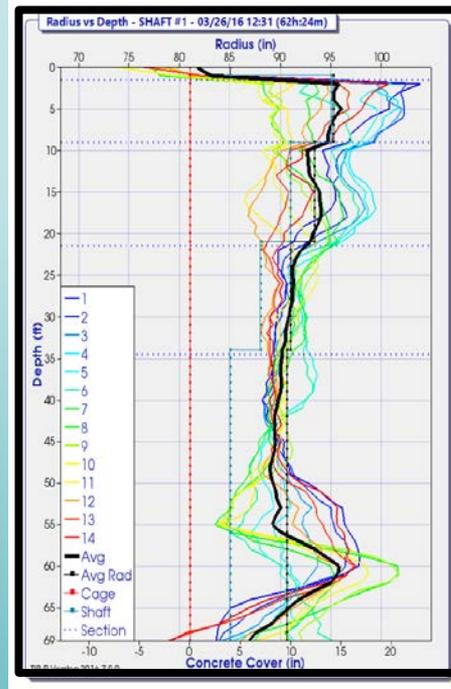
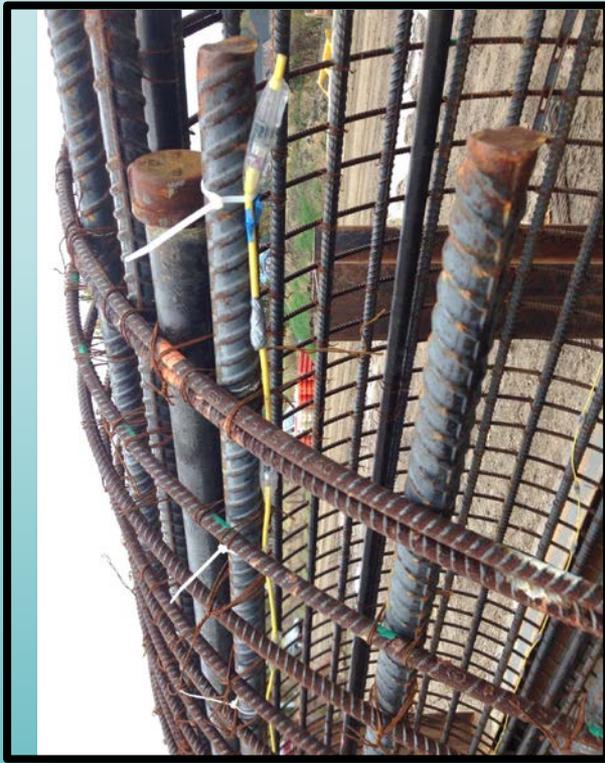
# Drilled Shaft Testing Evaluation

## Cross-Hole Sonic Logging



# Drilled Shaft Testing Evaluation

## Thermal Integrity Profiling



# Questions?

