The Use of Geophysical Methods to Aid in Horizontal Directional Drilling Projects

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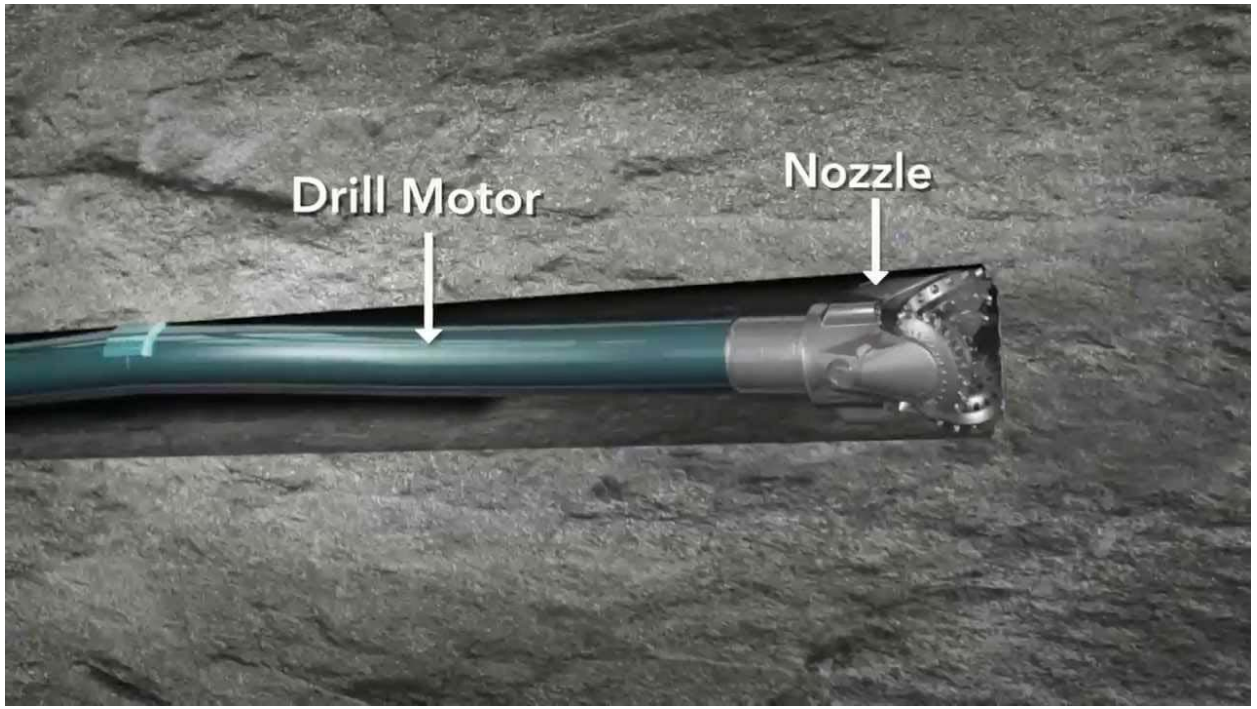
EGAS

TN TDOT Department of Transportation

MARSHALL UNIVERSITY

What is Horizontal Direction Drilling (HDD?)

- HDD is a trenchless technology whereby a steerable drill bit advances a boring along a shallow arc in the subsurface



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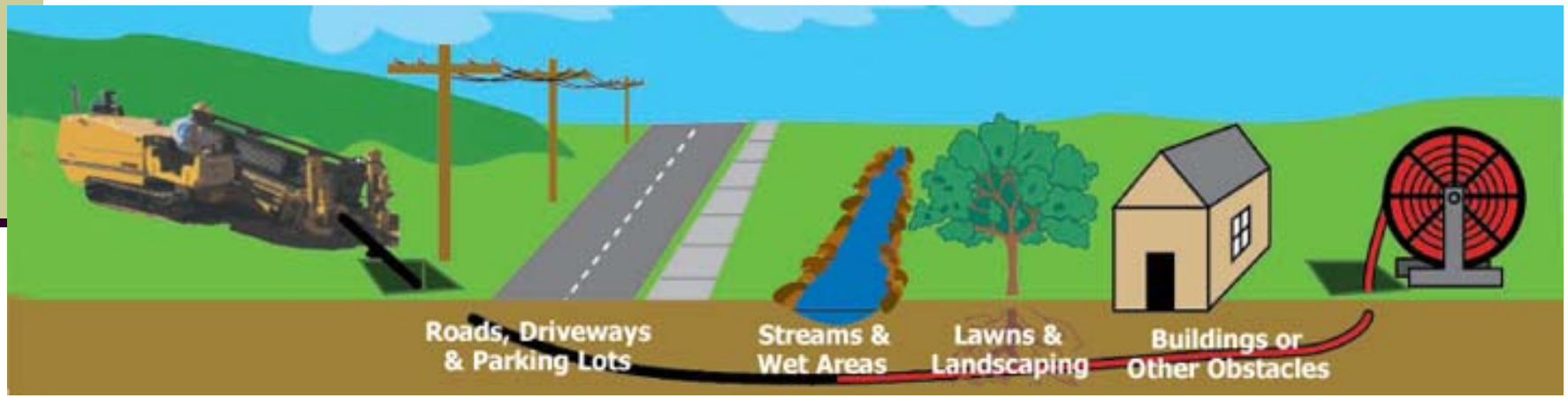
When to Use HDD?

- Anytime Trenching is Undesirable or Impractical
- Crossing Sensitive Areas Such as:
  - Roads
  - Bodies of Water
  - Conservation Areas
  - Buildings
  - Cemeteries or Archaeological Areas



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Why Use Geophysical Methods?

- The same conditions that make trenching impractical usually make vertical borings impractical
- Without vertical borings, geophysics allows the inference of geologic conditions that the HDD may encounter

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Common Questions to Answer with Geophysics

- How thick is the overburden?
  - May effect casing estimates
  - If the drilling is to take place in the soil we may want to avoid the rock
- What is the stratigraphy?
- How competent is the rock?
- Are there major fracture zones or faults?

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Geophysical Methods

- Resistivity Imaging
- Seismic Refraction
- Shear wave testing

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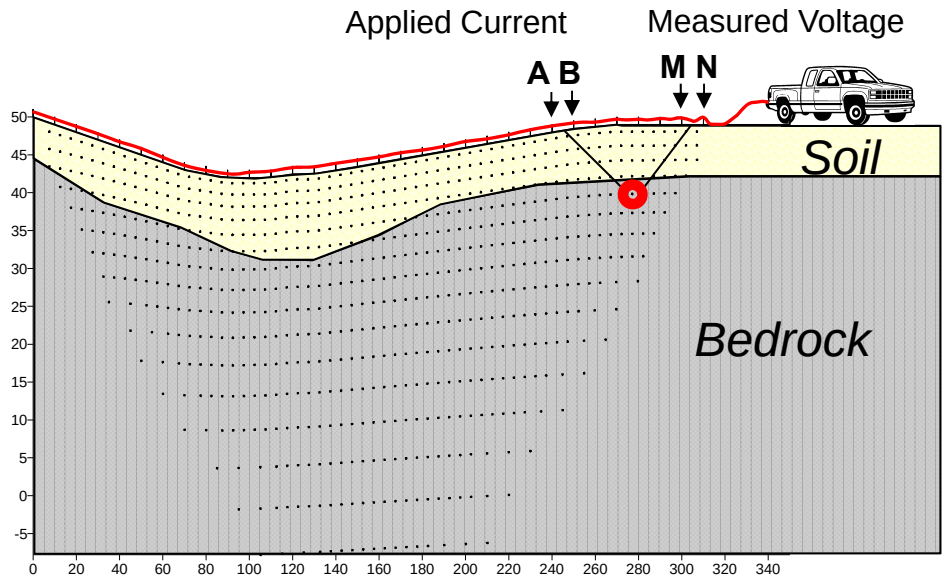
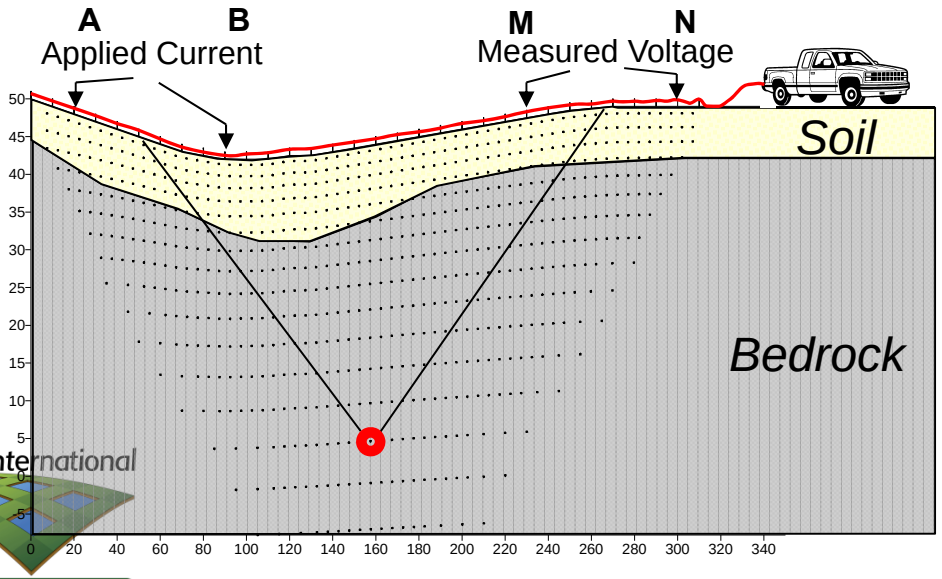
Principles of Resistivity Imaging





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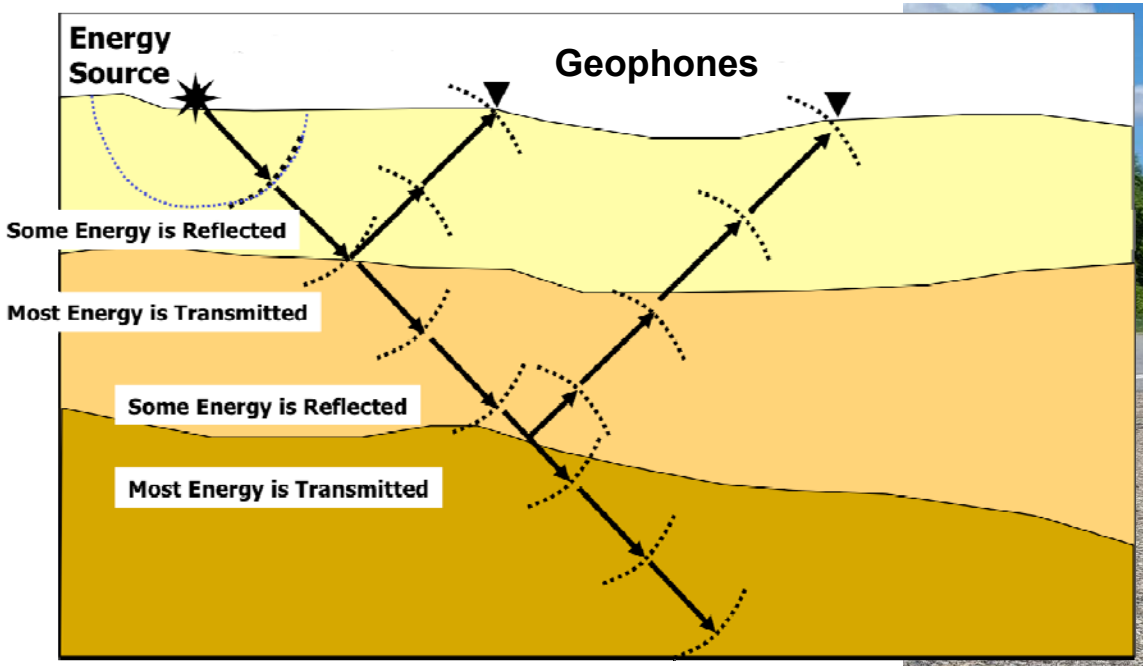
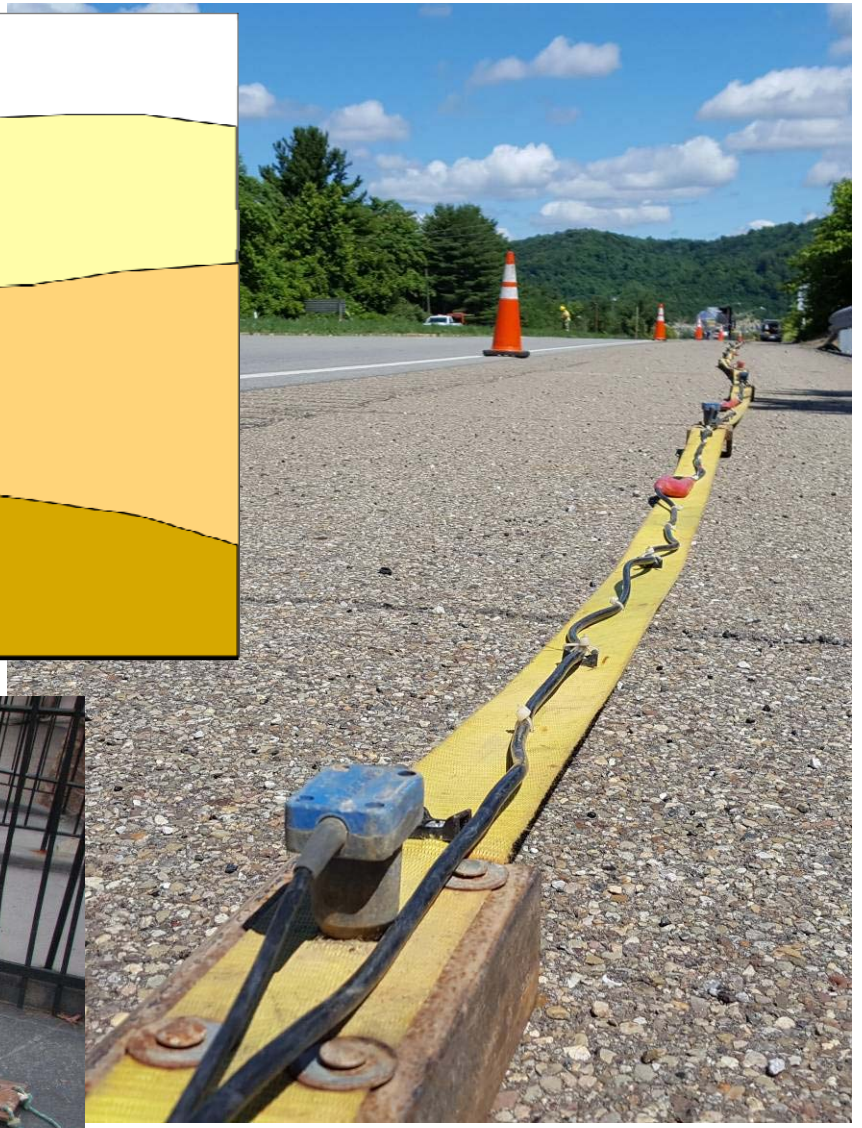
Principles of Refraction





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Advantages and Disadvantages of Each Method

- Both methods produce a cross sectional image.
- Resistivity tends to have a deeper reach.
- Resistivity tends to resolve vertical boundaries better.
- Resistivity is not sensitive to velocity inversions.
- Seismic refraction is more directly related to rippability.
- Seismic refraction is less sensitive to interference from buried metal.

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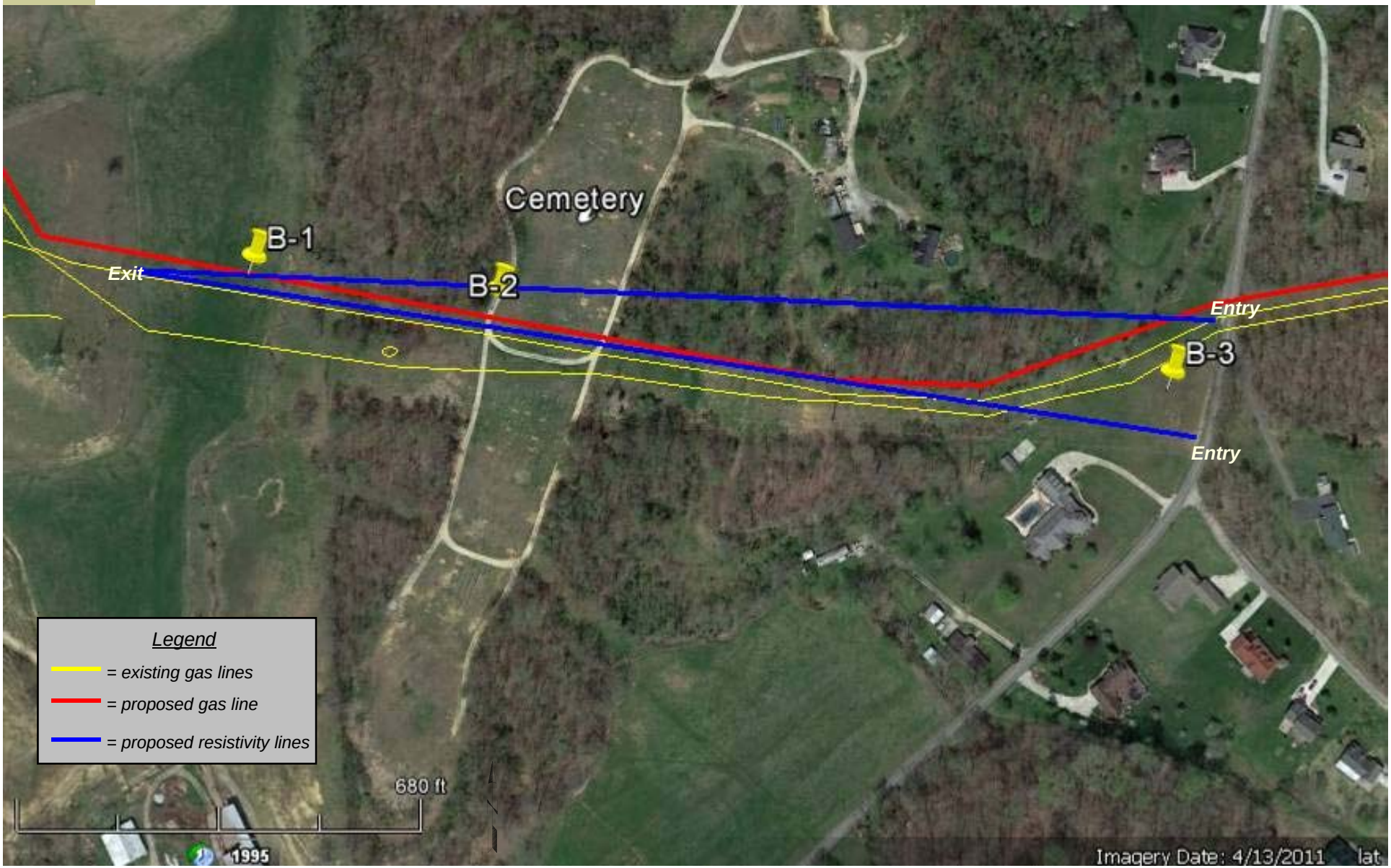
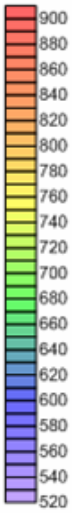
Example: Cemetery Crossing
Appalachian Plateau Geology



Crossing Fracture Zones



Elevation Contours (feet)

Legend

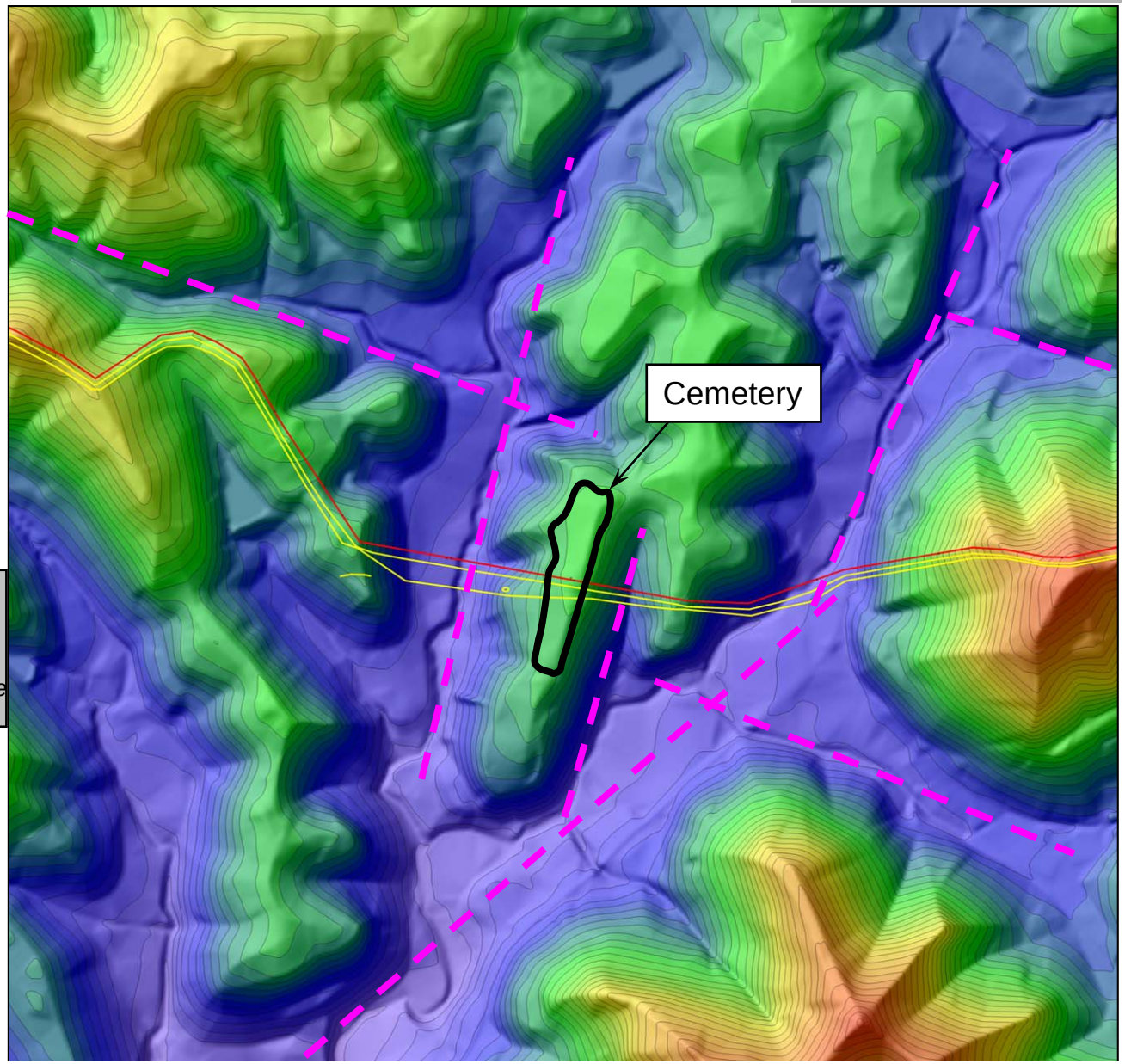
= *existing gas lines*

= *proposed gas line*

= *possible fracture trace*

Feet

0 350 700



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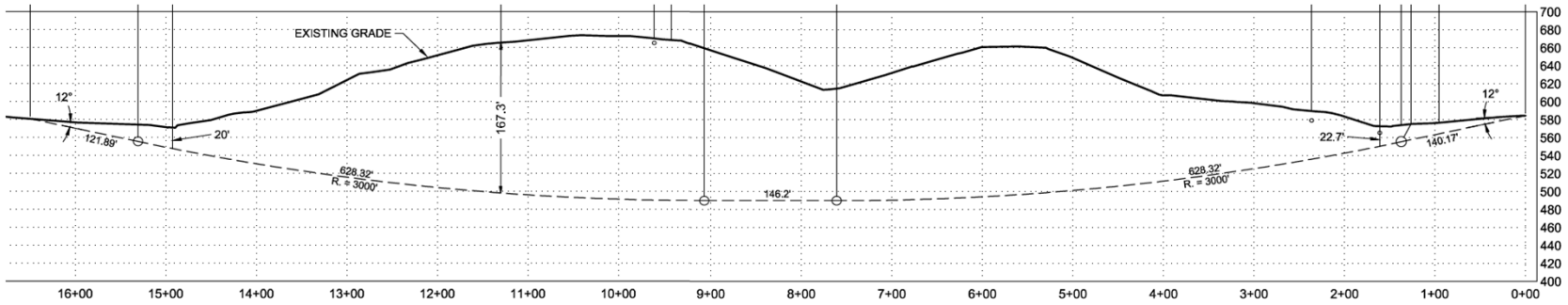
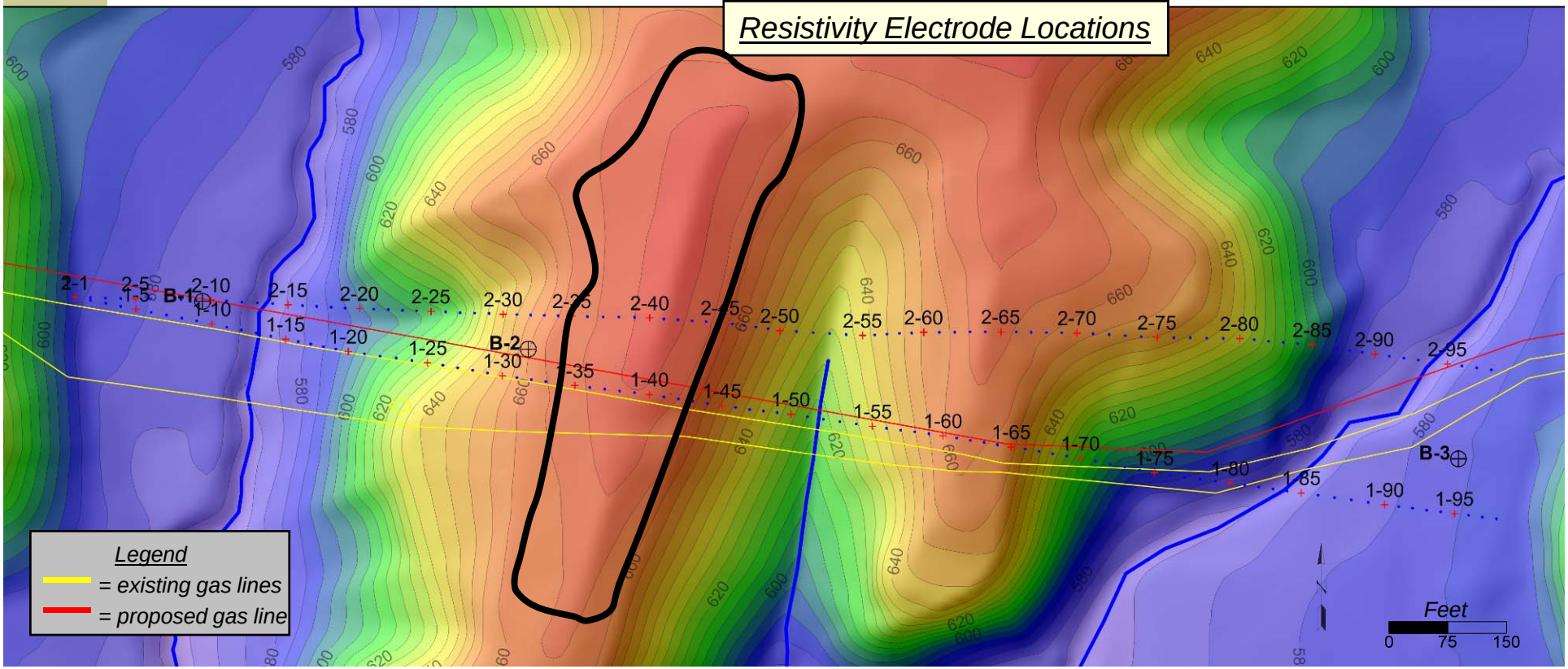
HDD Profile and Resistivity Lines

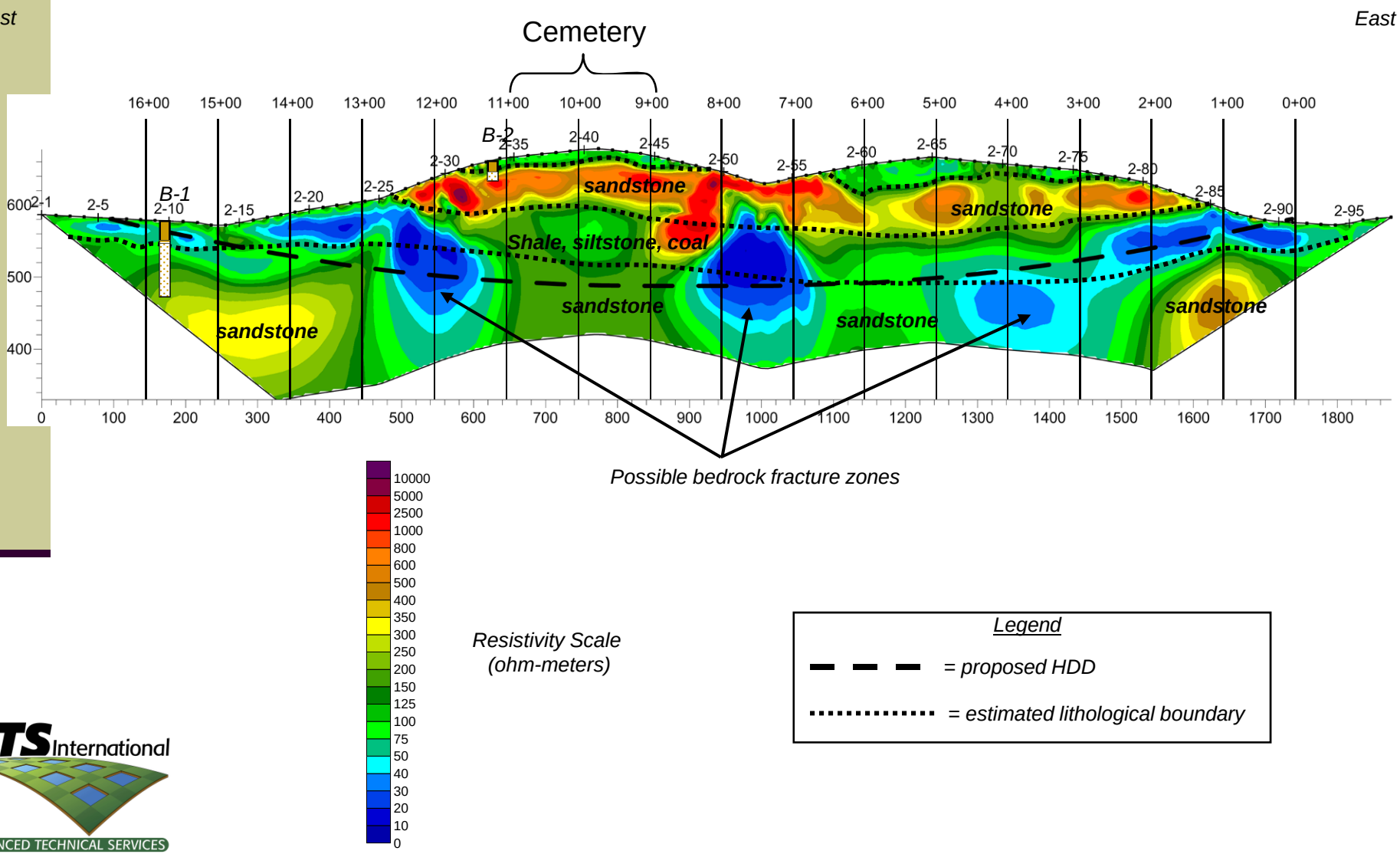
Proposed HDD Profile



Resistivity Electrode Locations



Line 2 Results



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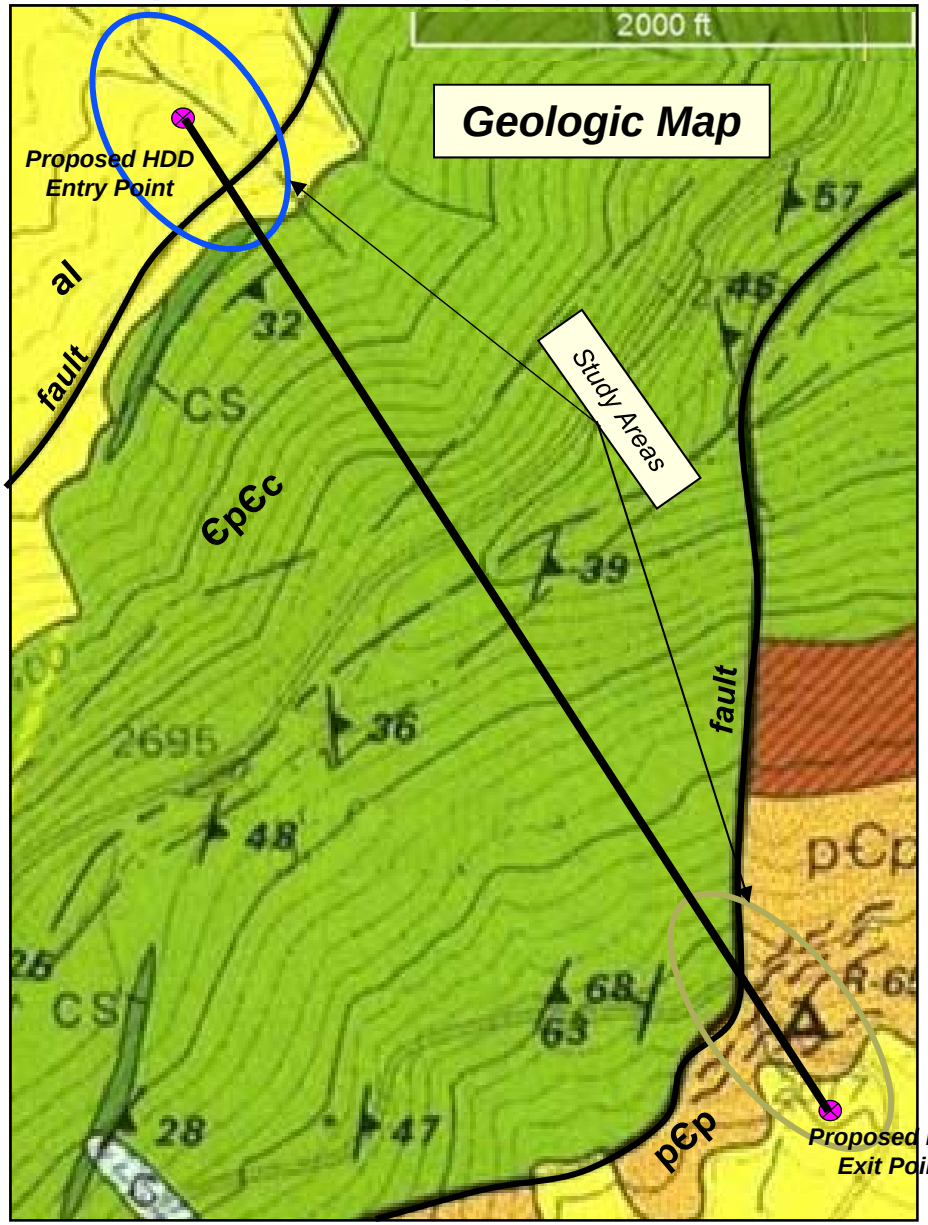
Example: Road Crossing
Blue Ridge Geology



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Alluvium

Gravel, sand, silt, and clay with boulder and cobble deposits in steeply dipping stream beds

ЄpЄc

cs

a

ЄpЄc

a

mt

Catoctin Formation

Dark green, massive metamorphosed basalt containing local metavolcanic breccia. (cs) Gray-purple fine grained siltstone/phyllite interbedded with metabasalt near the top

pЄp

gg

pЄp

Pedlar Formation

Dark greenish gray, massive to foliated, garnet bearing, fine to medium grained granodiorite

HDD Entry/Exit Point

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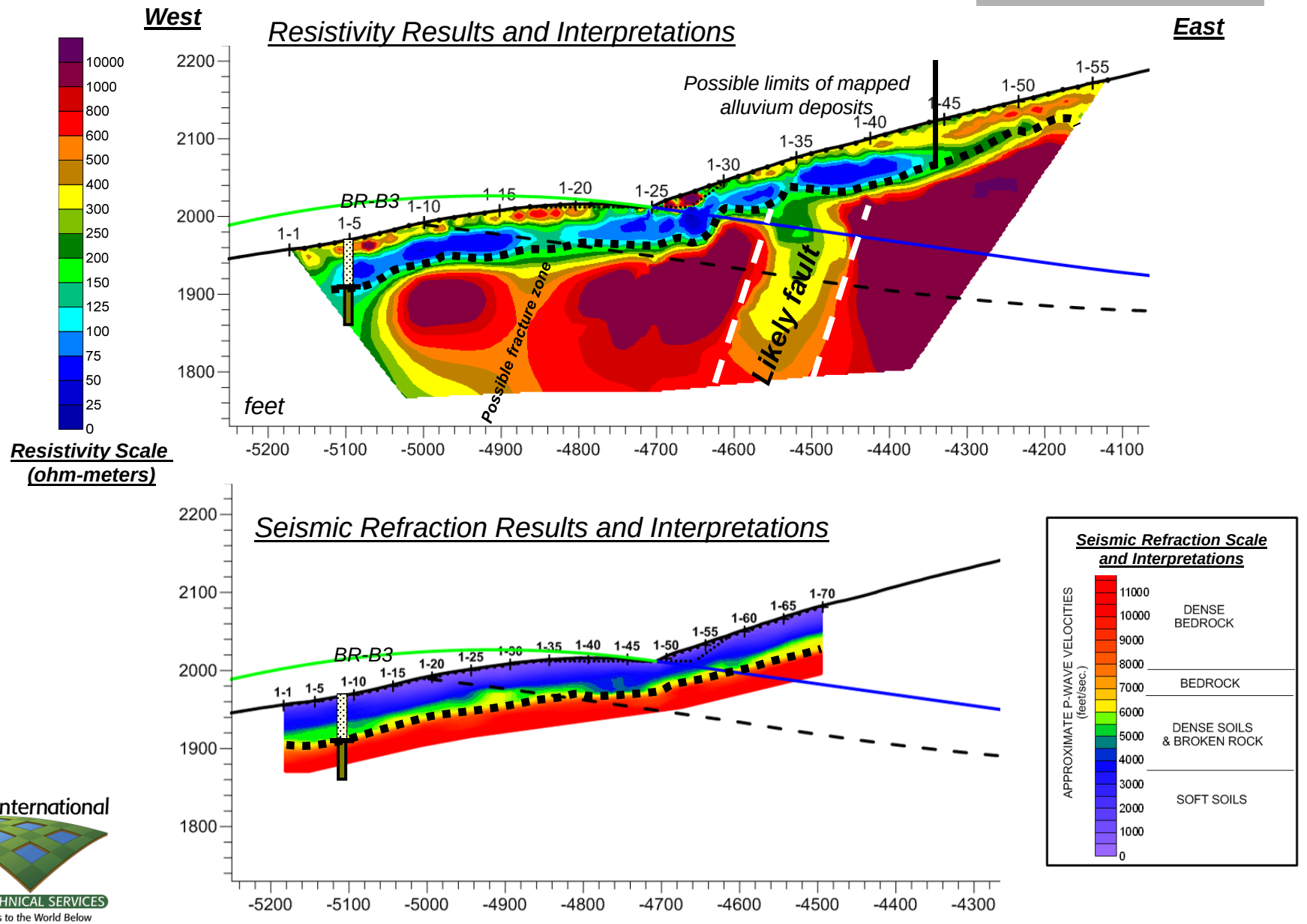
Entry Point



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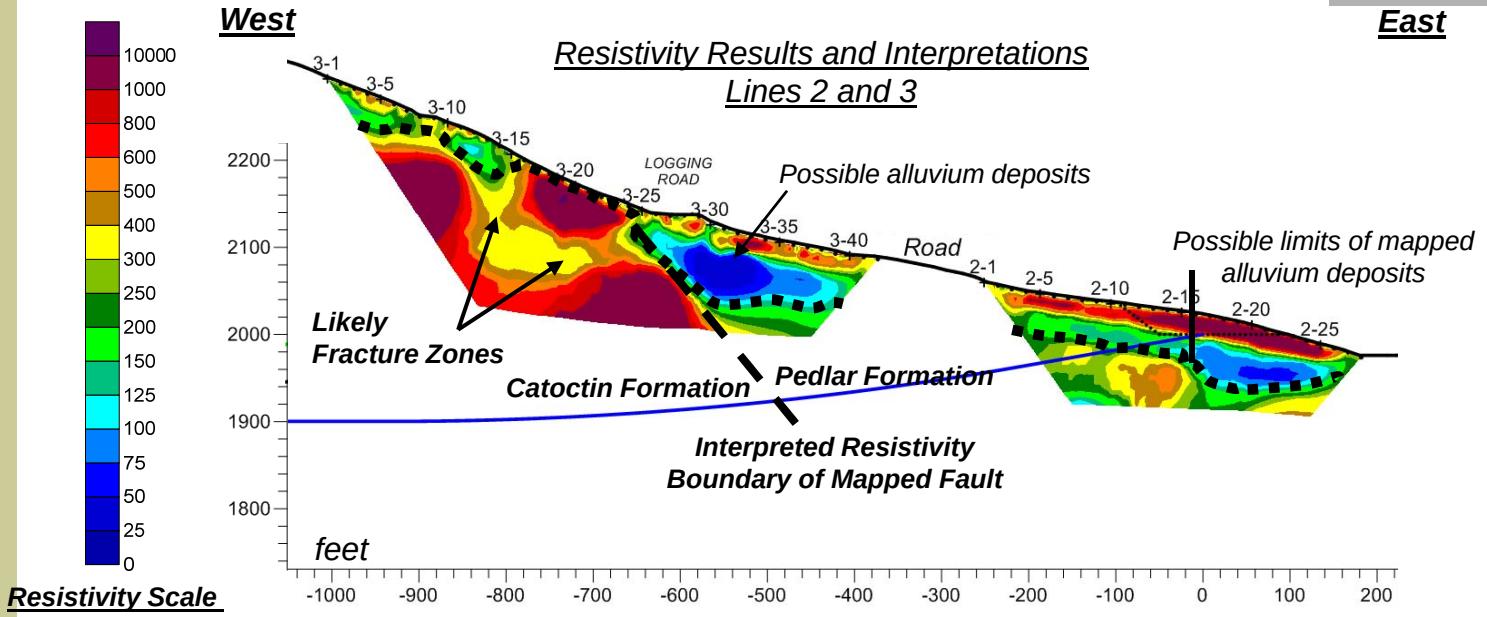
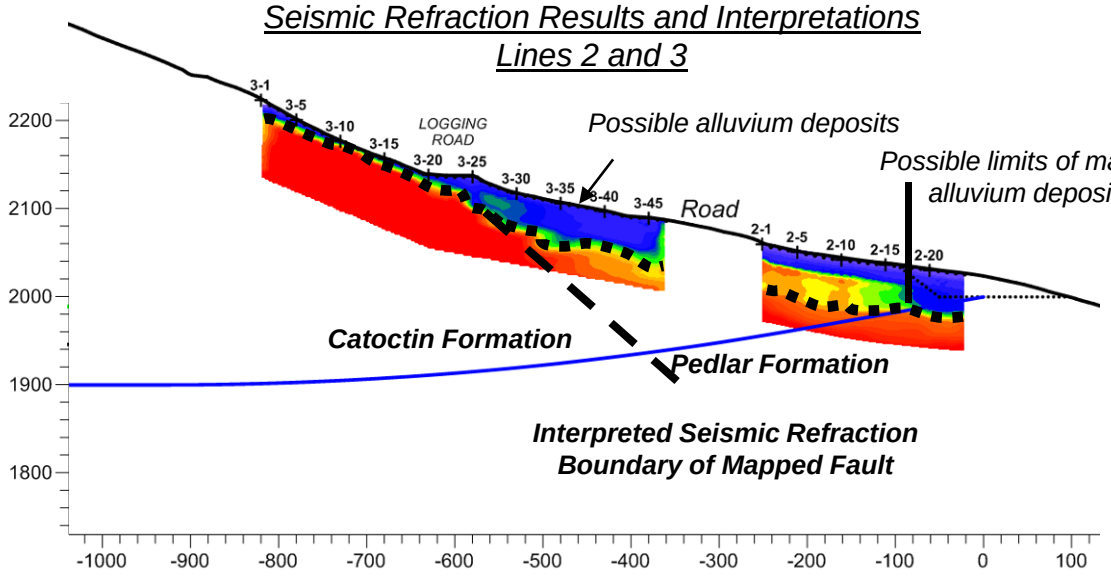
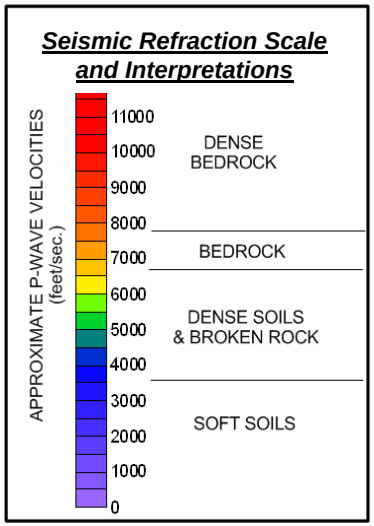
Exit Point







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In Conclusion

- Geophysics can offer valuable insights on HDD Projects
- Providing information on
  - Overburden thickness
  - Stratigraphy
  - Fractures and faults

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