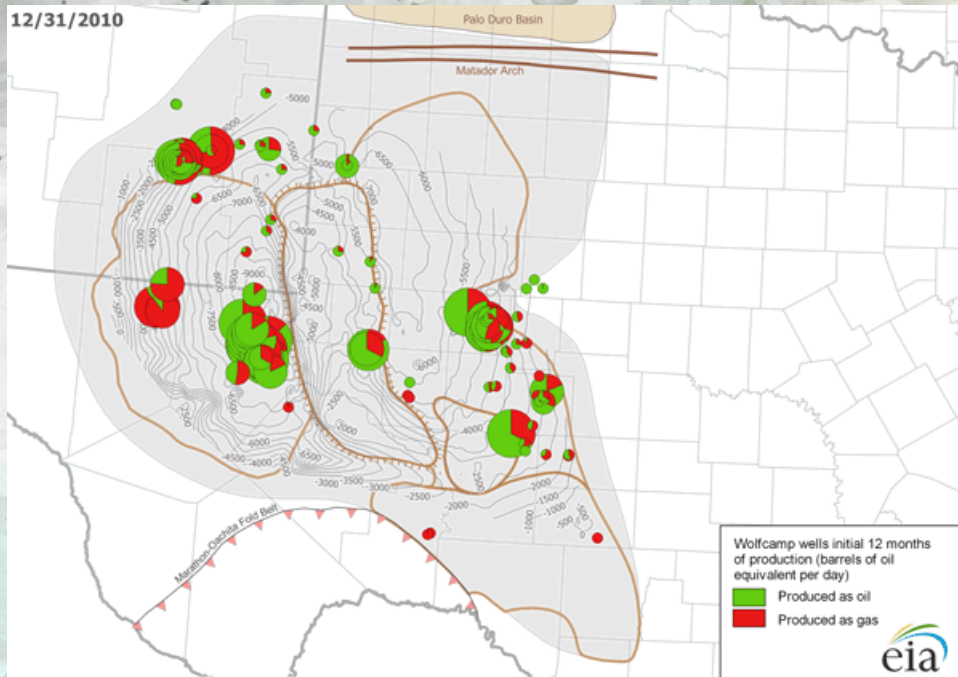
A watercolor illustration of the Earth, showing continents in green and yellow and oceans in various shades of blue. The style is soft and artistic, with visible brushstrokes and a slightly blurred, ethereal quality. The Earth is positioned on the left side of the slide, partially overlapping the white background.

Case Study: Discovery of an Unknown Leak from a Frac Water Hydrant System

J. Berton Fisher & Blake P. Redden
λχ Lithochimeia, LLC
Tulsa, OK

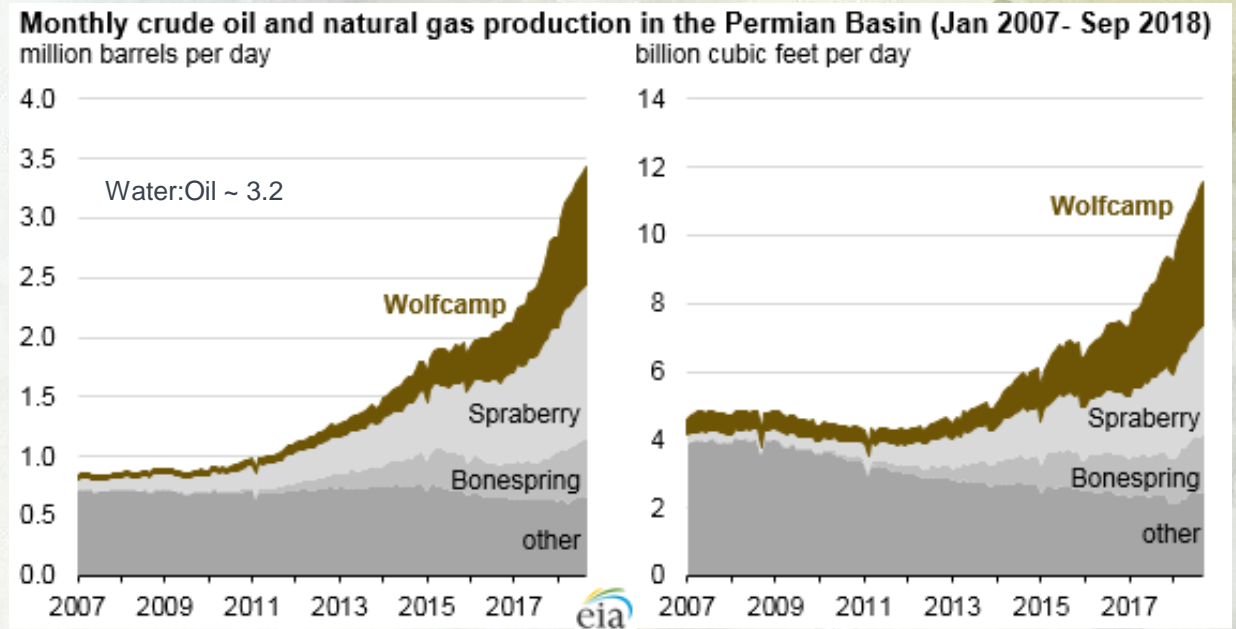
26th International Petroleum Environmental Conference
Site Characterization & Forensic Geochemistry Session
October 8, 2019



Unconventional oil and gas operations consume and produce massive amounts of water

2019 Permian Basin

Item	MMbbl/day
Oil Production	~ 3.5
Water Production	~11.2
Water Use	~ 3.3



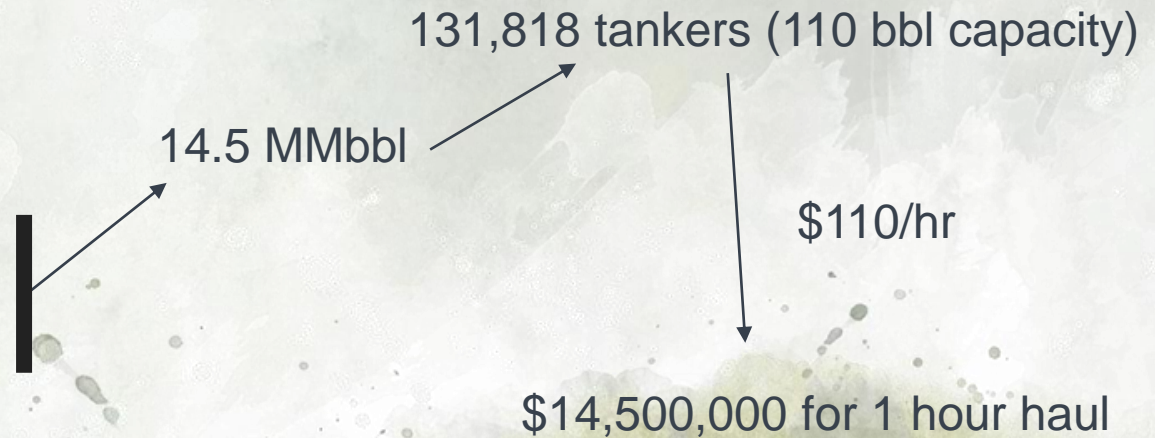
Sources:

- Oil Production: U. S. Energy Information Administration, 2018. The Wolfcamp play has been key to Permian Basin oil and natural gas production growth. Available at <https://www.eia.gov/todayinenergy/detail.php?id=37532#tab1> , reviewed 9/20/2019
- Water Production: Bruant, R. (B3) 2019. Permian Water Outlook Ponwerpoint Presentation available at http://www.gwpc.org/sites/default/files/event-sessions/Produced%20Water%20-%20Rob%20Bruant_0.pdf , reviewed September 20, 2019



Trucking water is expensive

Item	MMbbl/day
Oil Production	~ 3.5
Water Production	~11.2
Water Use	~ 3.3





Trucking water: Not ideal in populated areas

- Road damage
- Dust
- Traffic Congestion
- Accidents
 - Injuries/Deaths
 - Spills



Temporary Piping Systems

- Easy & Fast to Deploy
- Corrosion Resistant

Temporary Piping Systems



- Public Right of Way
- Leaks

- Kingfisher County, OK
 - 2017 – County commissioners stopped issuing permits for temporary piping in roadside easements.
 - 2018 – OK Supreme Court in 6-3 ruling voided Kingfisher’s water line ban





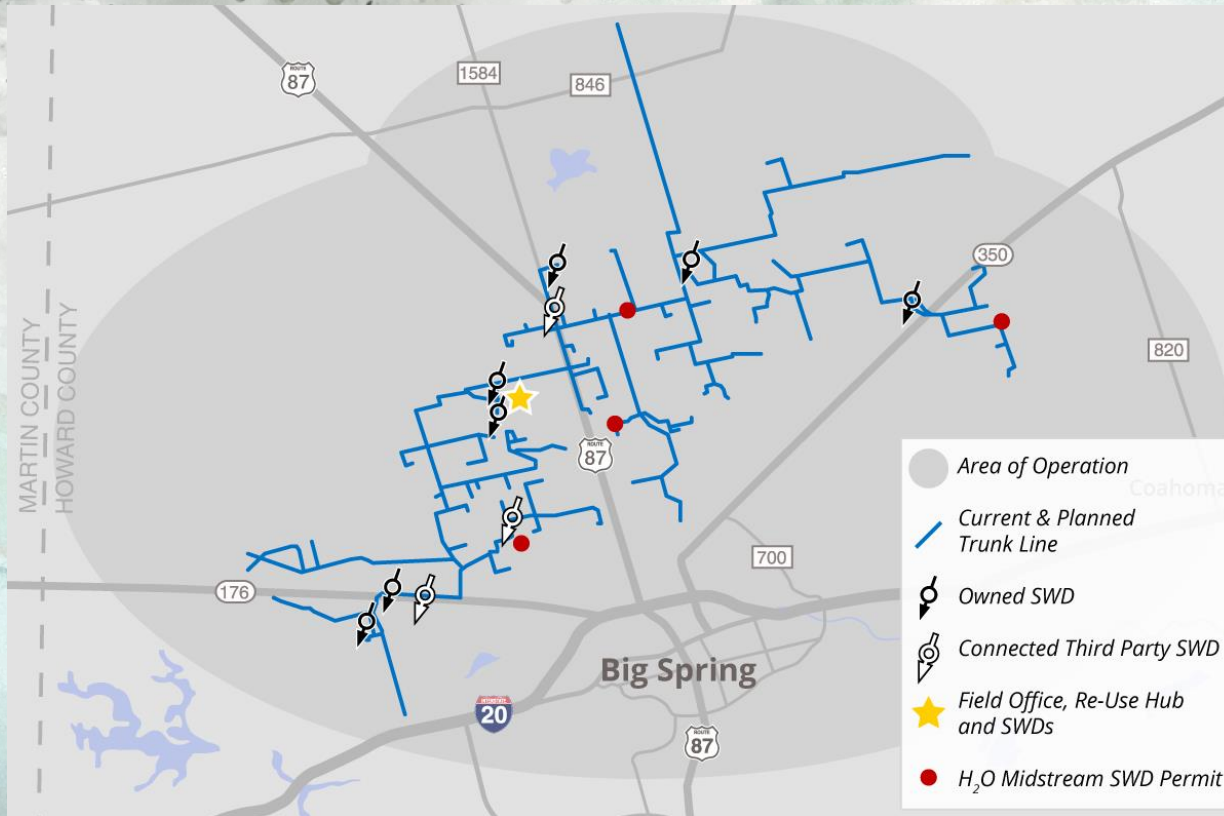
Construction on Goodnight Midstream's 45-mile Llano trans-basin gathering system, located in Lea County, N.M., was recently completed. The pipeline services long-term commitments from large producers with plans for expansion this year. (Source: Goodnight Midstream)

Buried Piping Systems

- Permanent Solution
- Physically Secure
- Reduced operating cost
- Control

In the SCOOP and STACK plays of Oklahoma, Newfield installed buried water pipeline systems infrastructure early in the development phase to lower operating expenses and decrease the opportunity for spills and accidents that have a higher likelihood when moving water by truck

Buried Piping Systems



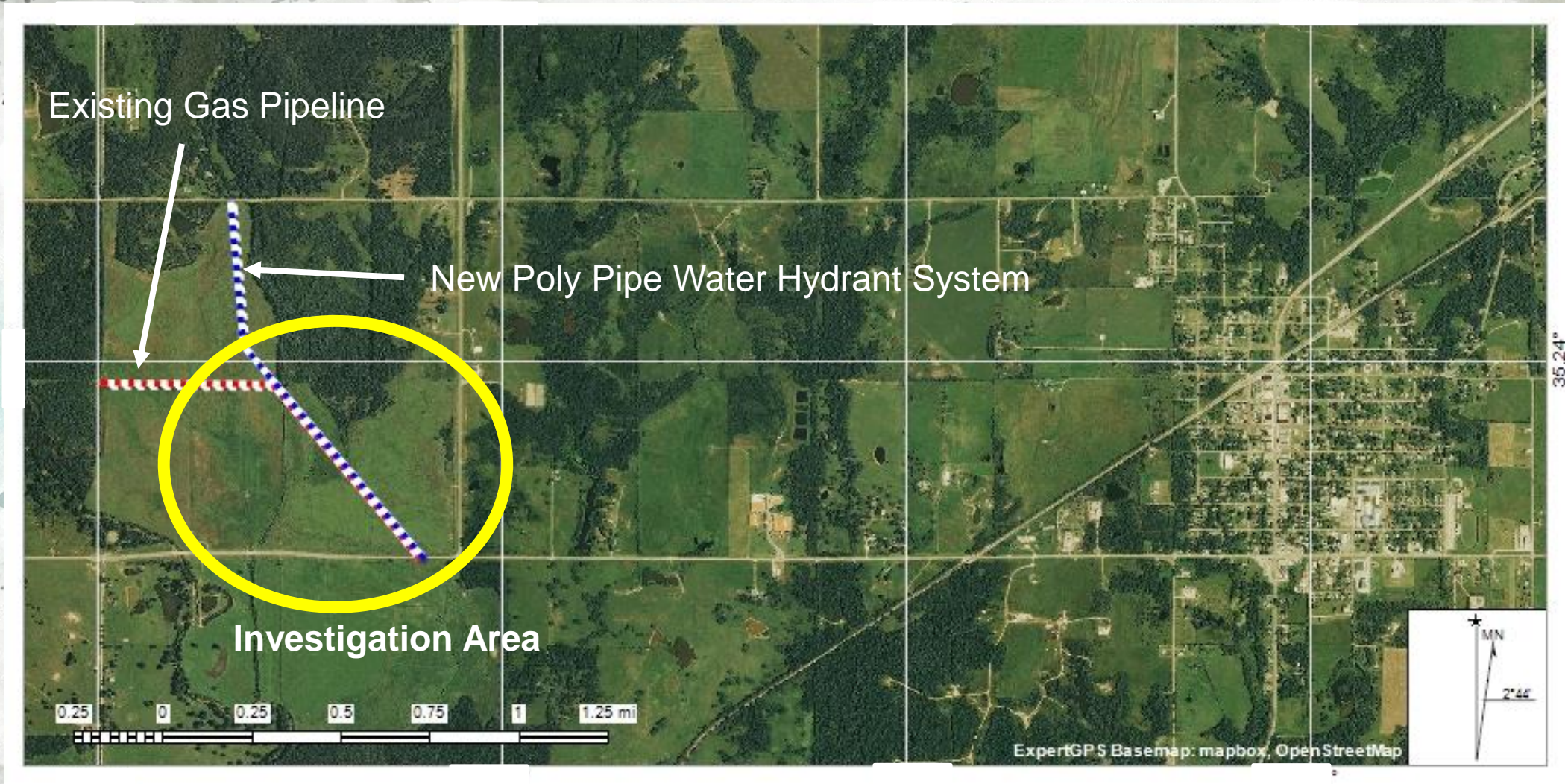
- Gathering Systems
 - Individual company
 - Utility

May be extensive networks

Buried Piping Systems

- Easements?
- Leak detection?
- Take-off / Points

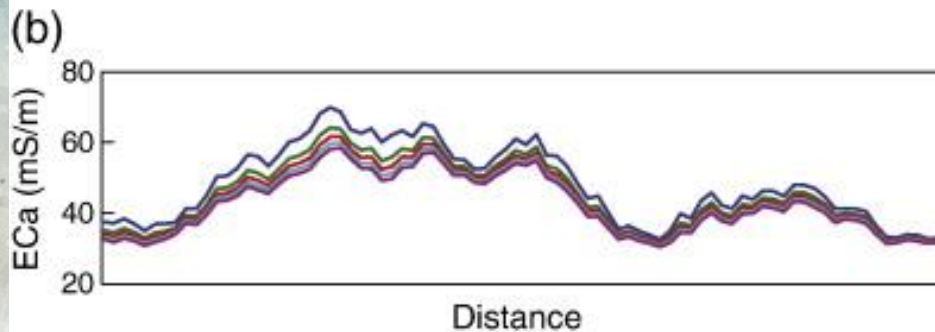
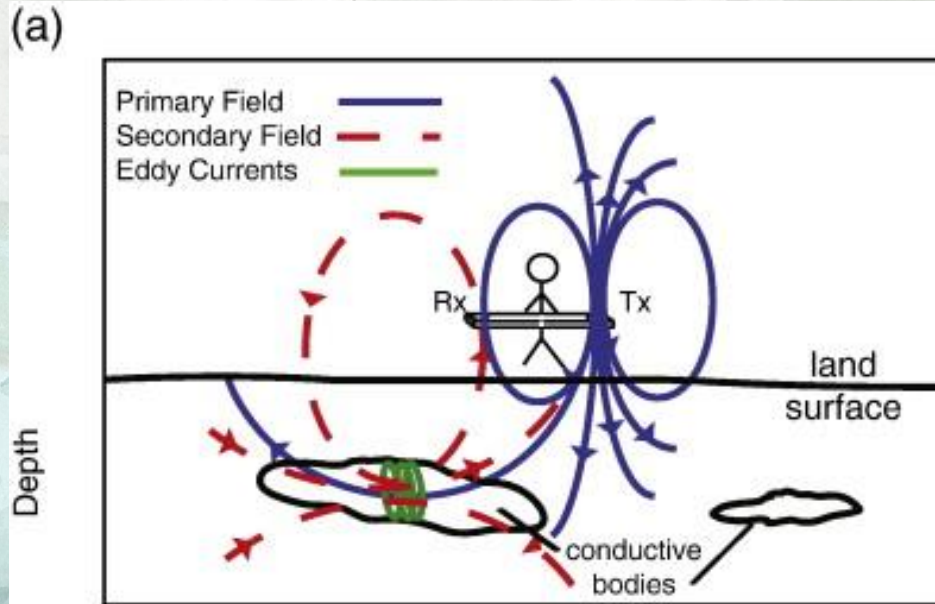




Presenting Complaint



Frequency Domain Electromagnetic Survey

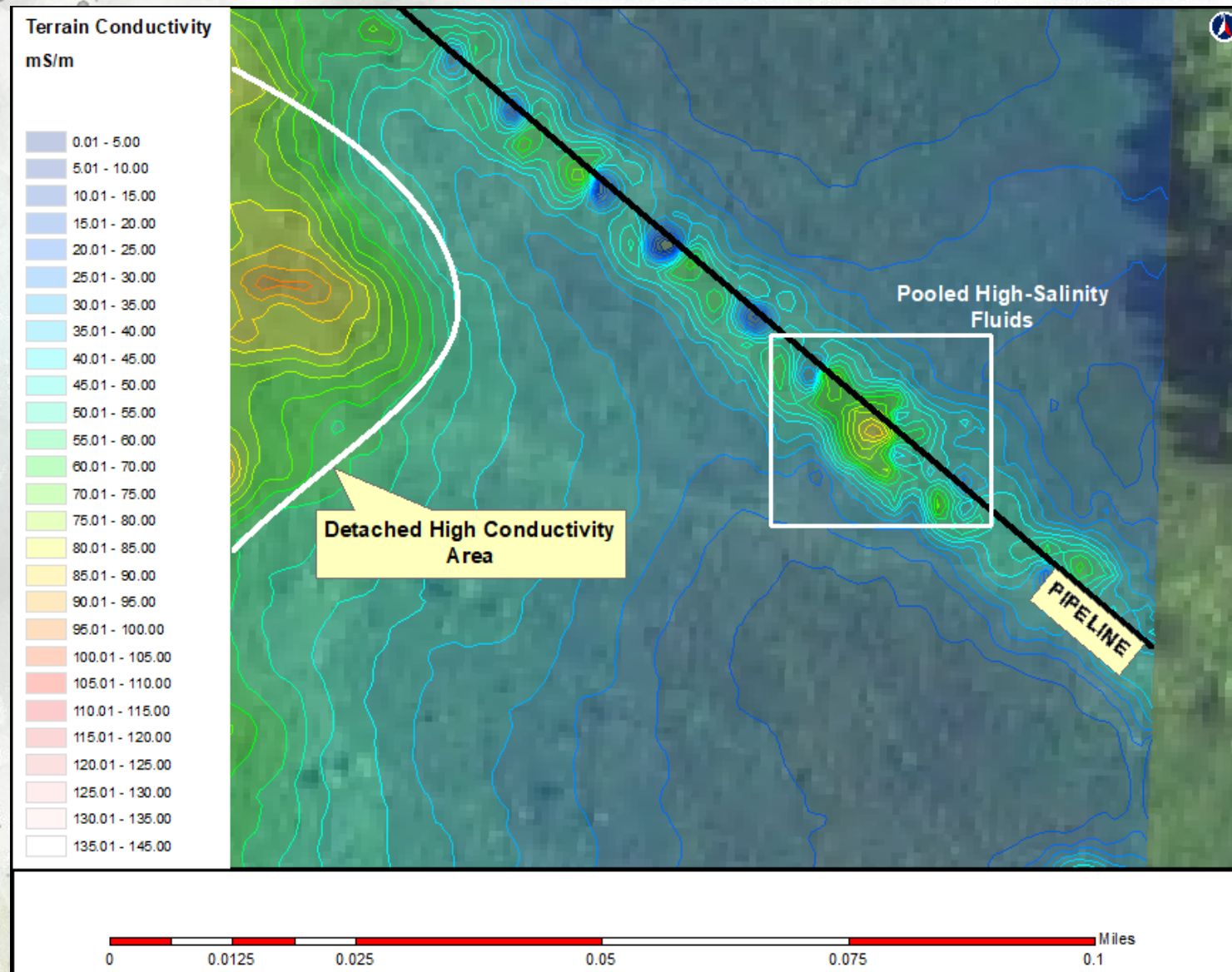


- Oscillating EM field penetrates ground
- Eddy currents induced
- Secondary EM field produced by eddy currents
- Instrument measures secondary EM field
- Strength of secondary EM field increases with increasing electrical conductivity of soil/objects

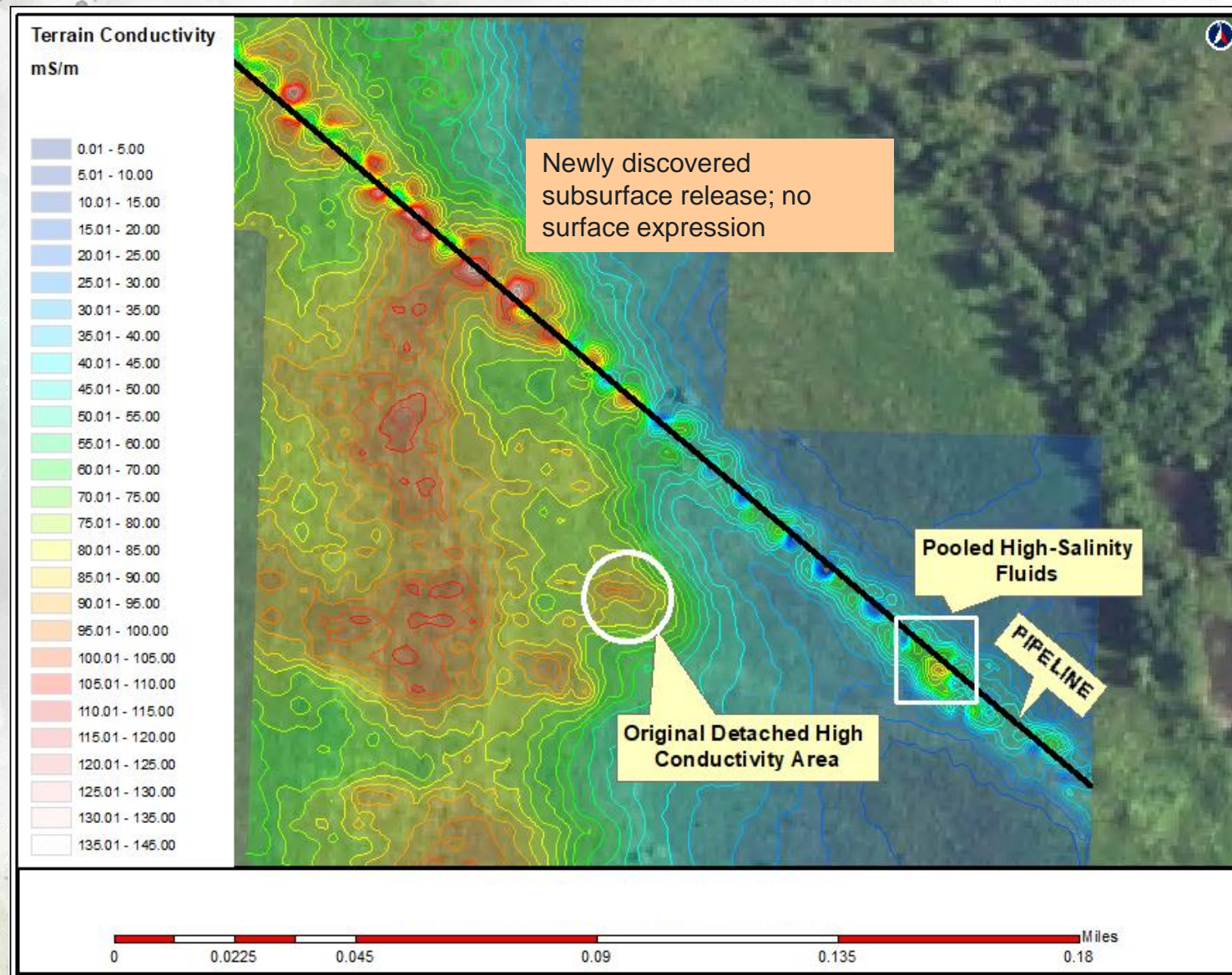
EM-31
3.66-m inter-coil spacing
9.8 kHz operating frequency
12.4 kg instrument weight
8 "C" cells (20 hrs)



Frequency Domain Electromagnetic Survey



Frequency Domain Electromagnetic Survey



Conclusions

- Buried water hydrant systems can leak
 - Poly pipe \neq freedom from leaks
 - New construction \neq freedom from leaks
 - Pipeline leaks are not easily detectable
- Terrain conductivity surveys
 - Rapid detection of subsurface saline fluid leaks
 - Fast
 - Cost-Effective

