SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

# *Utility Locating Technologies* (R01B) 2019 TRB Update

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U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

- **Product Overview – "Utility Bundle"**
  - *3D Utility Location Data Repository* (R01A)
  - *Identifying and Managing Utility Conflicts* (R15B)
  - ***Utility Locating Technologies*** **(R01B)**


**Round 6:** *Proof of Concept* ($150K each agency)

**Round 7:** *Lead Adopter* ($100K each agency)

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# Implementation Assistance Program (IAP) States:

Virginia
Ohio
Arkansas
Oregon
California*
Montana*

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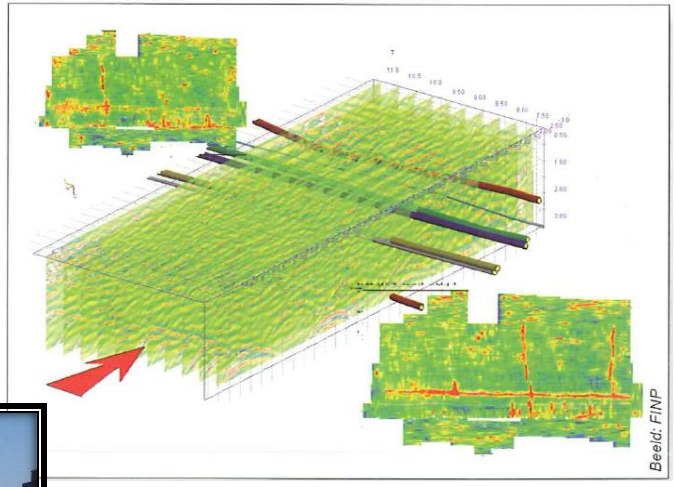
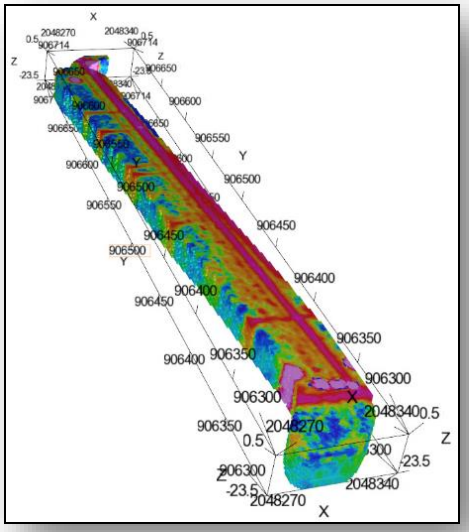
AASHTO

# Utility Locating Technologies (R01B) – Technologies Selected

## MCGPR for 3D




## TDEMI for 2D

# Technologies Developed*

## Advanced Geophysical Hardware*

- Multi-Channel Ground Penetrating Radar (MCGPR)
- Time-Domain Electromagnetic Induction (TDEMI)

## Advanced Software*

- Software for processing, interpretation and visualization of MCGPR in 3D, and TDEMI data in 2D (plan-view)

** Commercially Available and Proven Technologies*

# R01B IAP Plan

## 'General' Implementation Plan:

1) **Training** → on-site: classroom *and* field / instrument demonstrations
2) **Planning** → Site / Project Selection
3) **Implementation** → Active DOT project for deployment of technologies (*for design needs*)
4) **Reporting** → DOT Reports (project) and AASHTO SHRP2 Report-outs

# R01B Training Outline

For Each Method:

- Basic Theory
- Limitations
- Complications
- Variations
- Applications
- Why is works for utility mapping
- When it won't work for utility mapping
- Requirements for effective use
- Final Products – What are the deliverables

# Field Demonstrations/Projects

**IDS Stream-EM System**


**3D-Radar System DXG**

# MCGPR: IDS STREAM EM

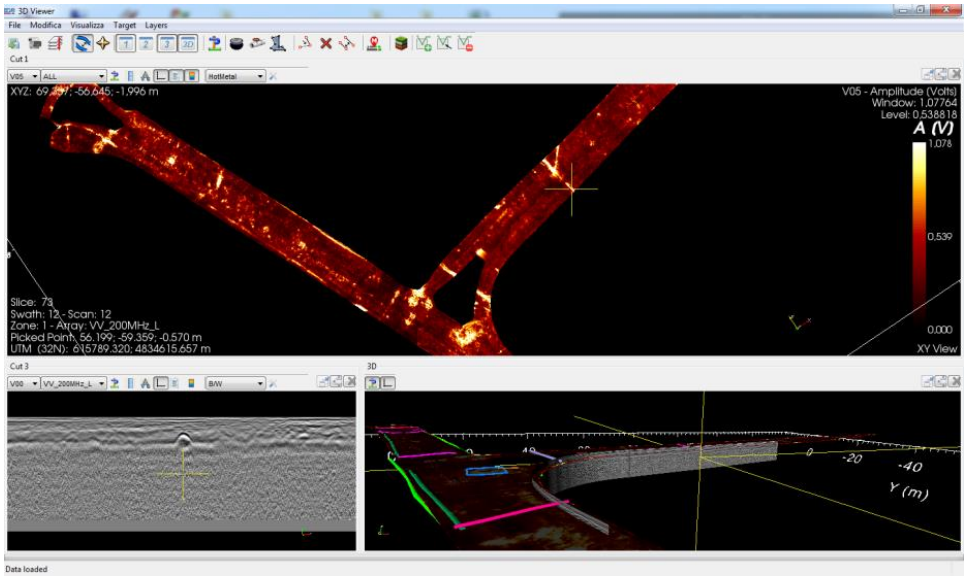
- GPR solution towed by a vehicle (speed > 10mph).
- Data collection in longitudinal direction (without the need of moving the array in the transversal directions) but detection of utilities and connections.
- High productivity
- High modular structure
- High detection capability
- Avoid blocking the road traffic
- Exploit the same advanced processing feature of RIS MF Hi-Mod
- Possibility of different kind of towing frames

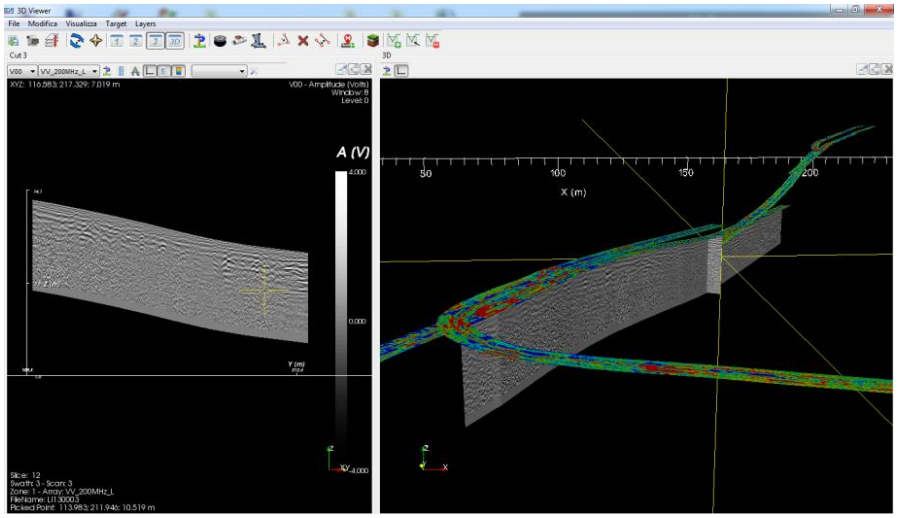
**Stream EM System: complete configuration including 3 array of antennas**

# MCGPR: IDS Software – GRED HD 3D

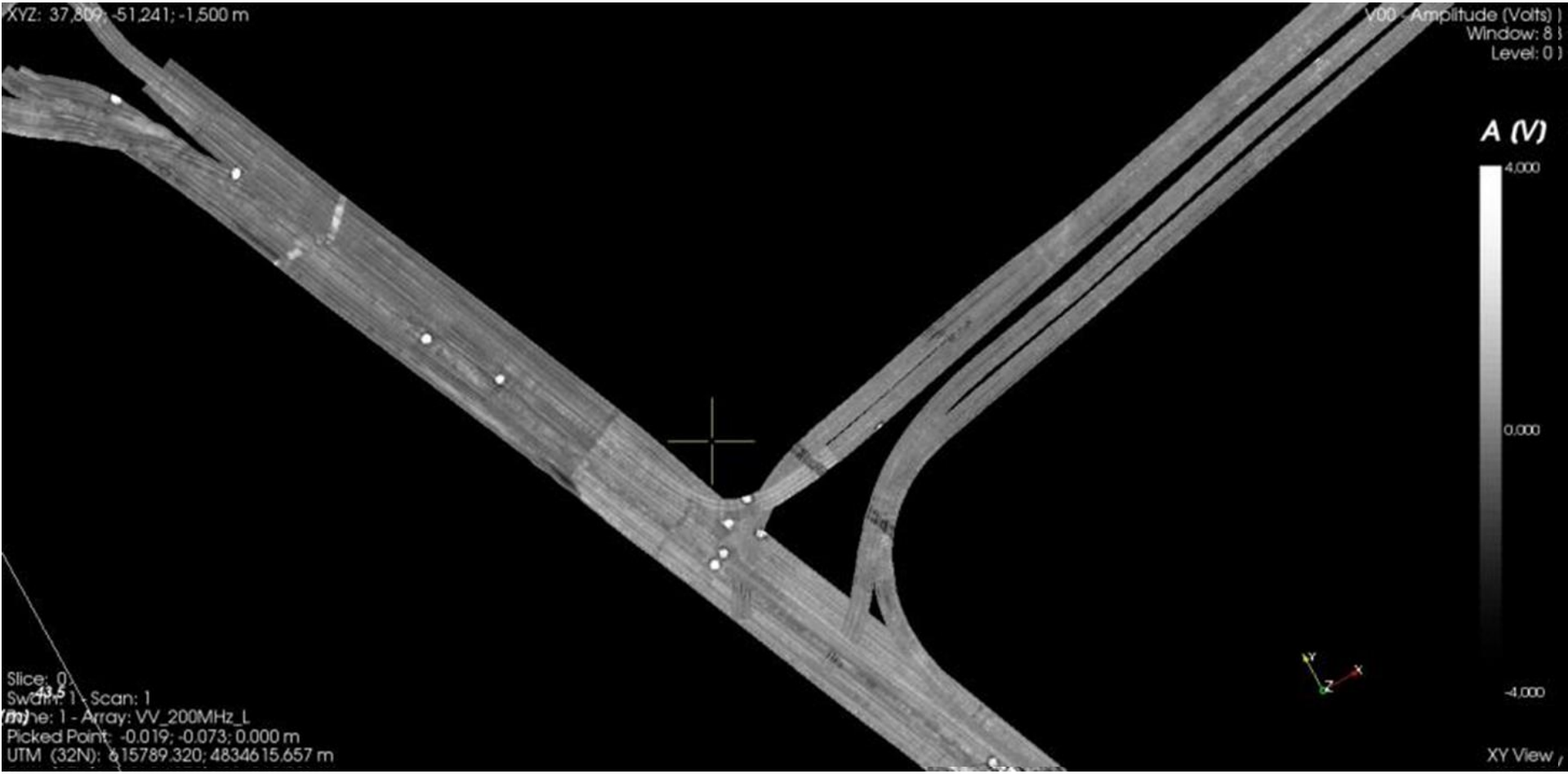
The **GRED HD** software comes with a 3D graphic interface, and advanced software features making it an advanced and complete tool for post processing Ground Penetrating Radar data. The software is able to show:

- Tomography (time slices),
- Radar scans parallel to the acquisition direction,
- Virtual Radar scans orthogonal to the acquisition direction
- 3D view.



# MCGPR: GRED Output (.avi file)



# MCGPR: 3D-Radar

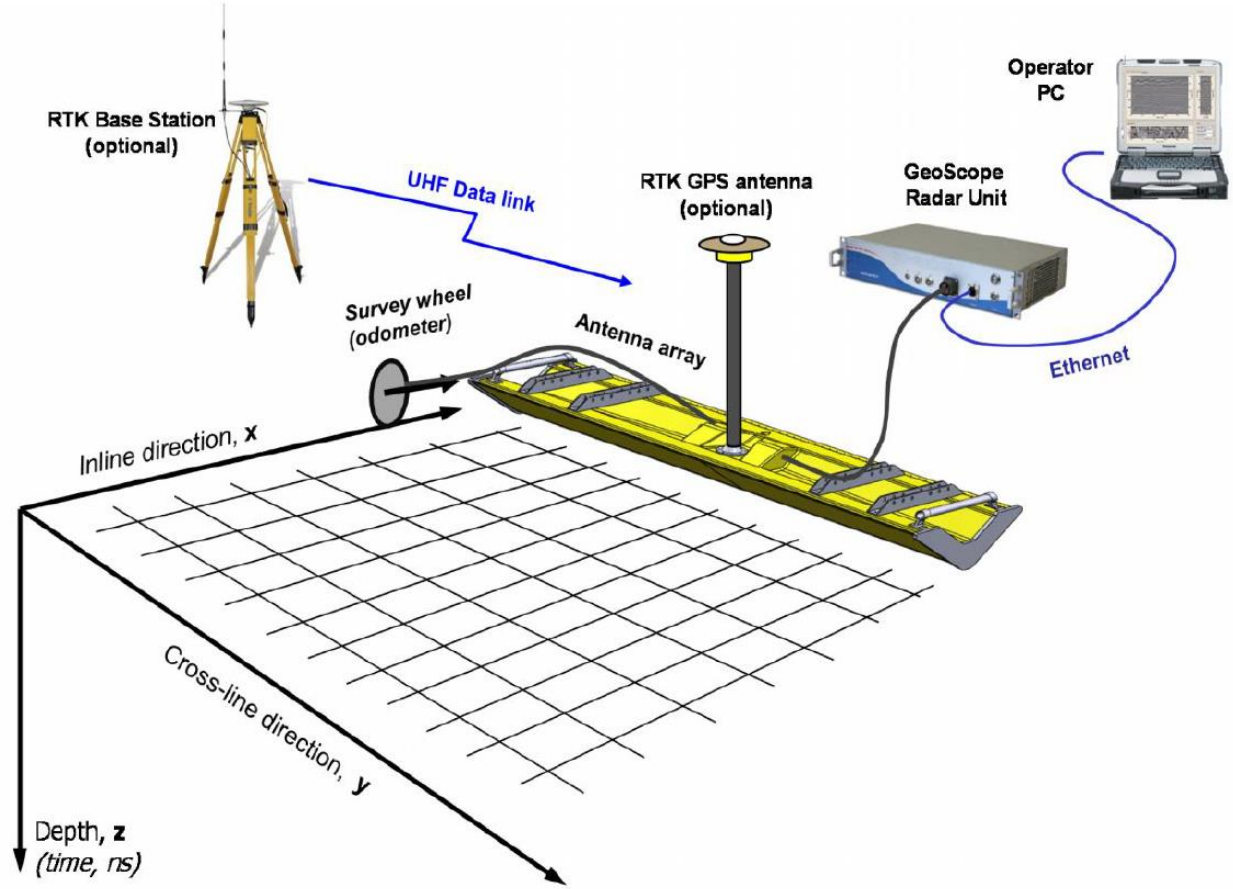
DXG-Series multi-channel antenna arrays

- 200 MHz - 3.0 GHz frequency range
- All elements have uniform size and frequency response
- Simultaneous recording on two receiver antennas
- 7.5 cm antenna element spacing
- Multi-offset and automatic CMP-recording
- Built-in GPS for time stamp and coarse positioning

# MCGPR: 3D-Radar

## 3D Radar Theory Of Operation

### Principle of Operation

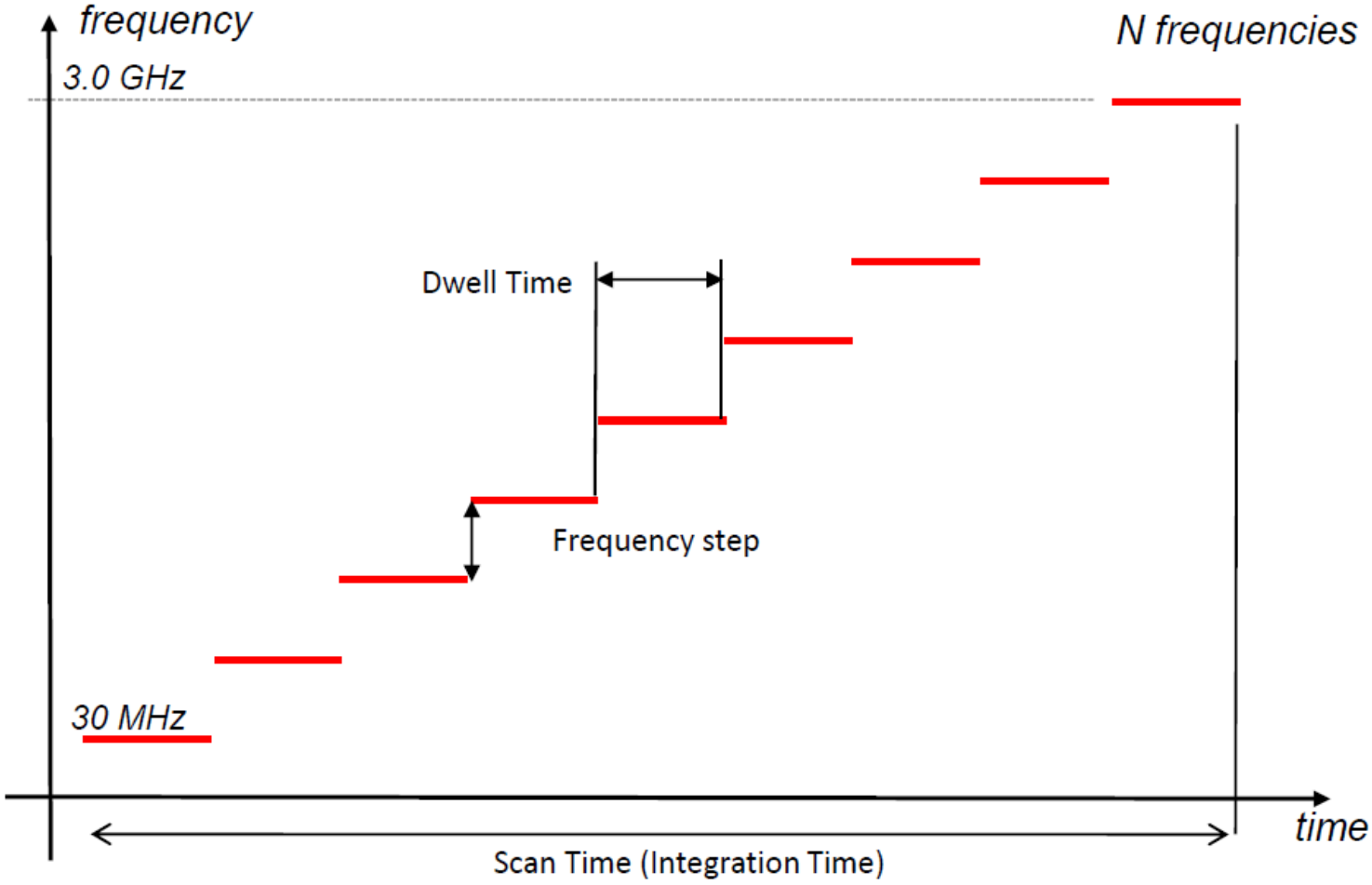



**3D-RADAR DX/DXG-Series Multi-Channel Ground Coupled Antenna**

# MCGPR: 3D-Radar

## 3D Radar Theory Of Operation

### Step-frequency waveform



# Time-Domain Electromagnetic Induction (TDEMI)

# TDEMI Multi-Coil EM61's

## Specifications

MEASURED QUANTITIES

Four time gates of secondary response in mV

EM SOURCE

Air-cored coil, 1 x 0.5 m size

CURRENT WAVEFORM

Unipolar rectangular current with 25% duty cycle

EM SENSORS

1. Main: Air-cored coil, 1 x 0.5 m in size, coincident with EM source
2. Focusing: Air-cored coil, 1 x 0.5 m in size, 30 cm above main coil

DYNAMIC RANGE

18 bits

OUTPUT MONITORS

Color active matrix TFT-LCD 240x360 pixels, and audio tone

DATA STORAGE

512 MB internal disk; SD and CF slots,user accessible

DATA OUTPUT

RS232 - serial port, Bluetooth

POWER SOURCE

12 V rechargeable battery for 4 h continuous operation

OPERATING TEMPERATURE

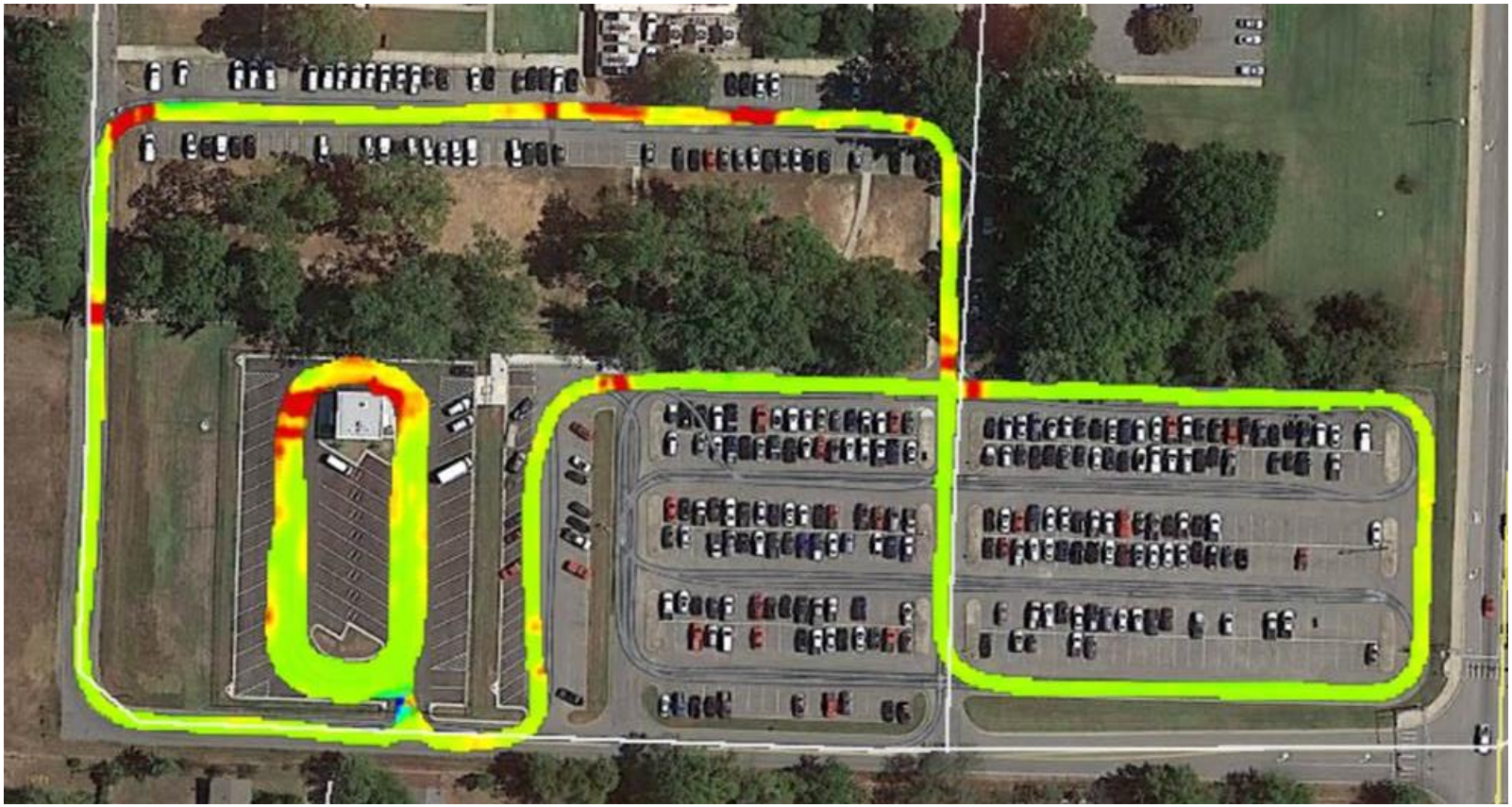
-30°C to +60°C

OPERATING WEIGHTS & DIMENSIONS

41 kg trailer mode;
100 x 50 x 5 cm (bootom),
100 x 50 x 2 cm (top)

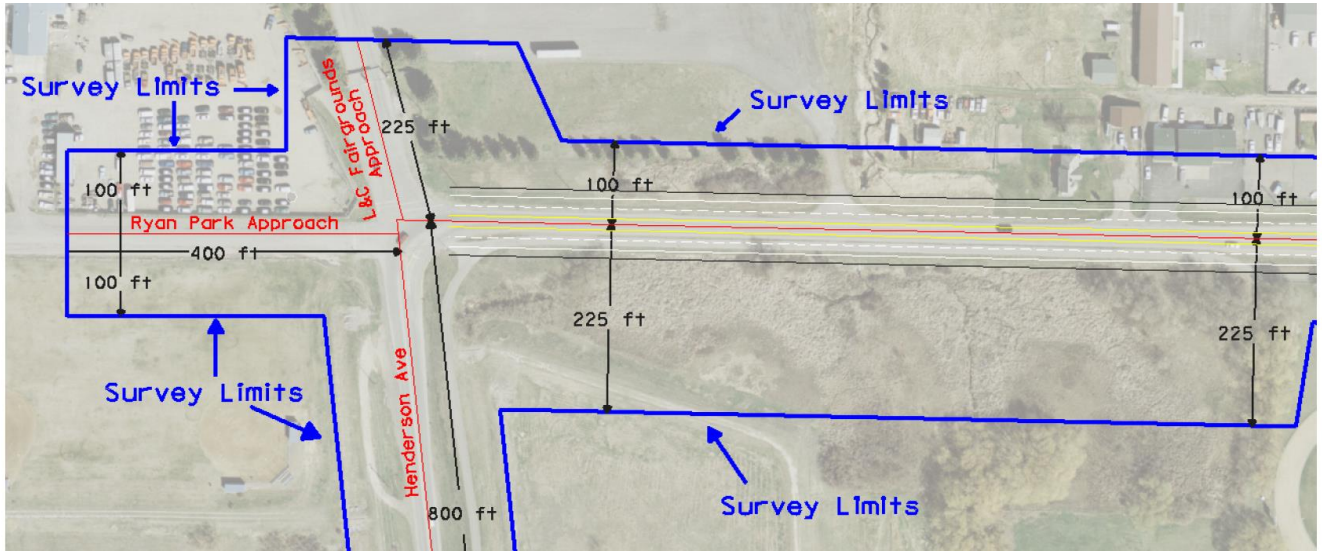
# TDEMI for Utilities – Urban/AHTD

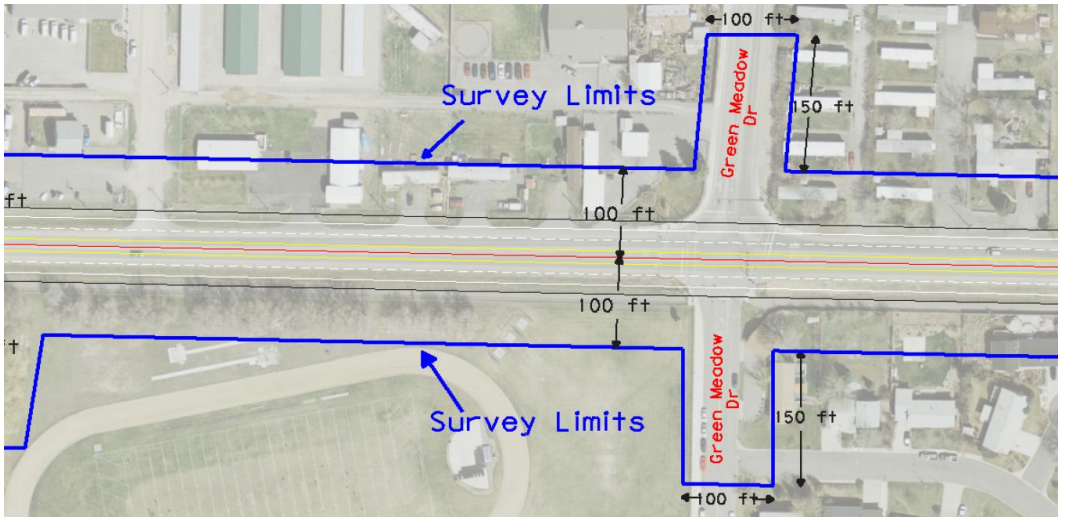
# TDEMI for Utilities



# R01B Example Project Sites

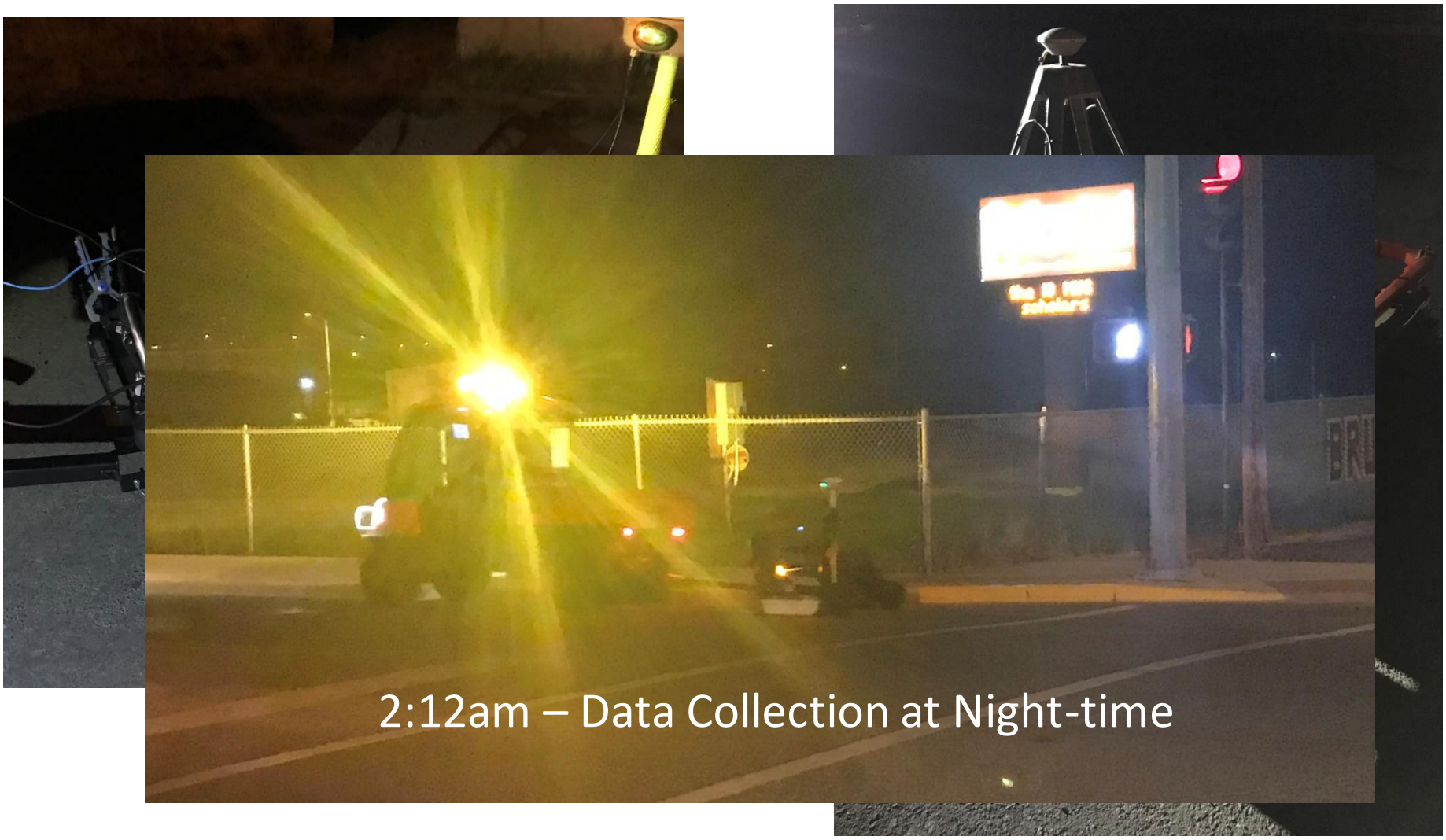
## Montana DOT – Custer Avenue



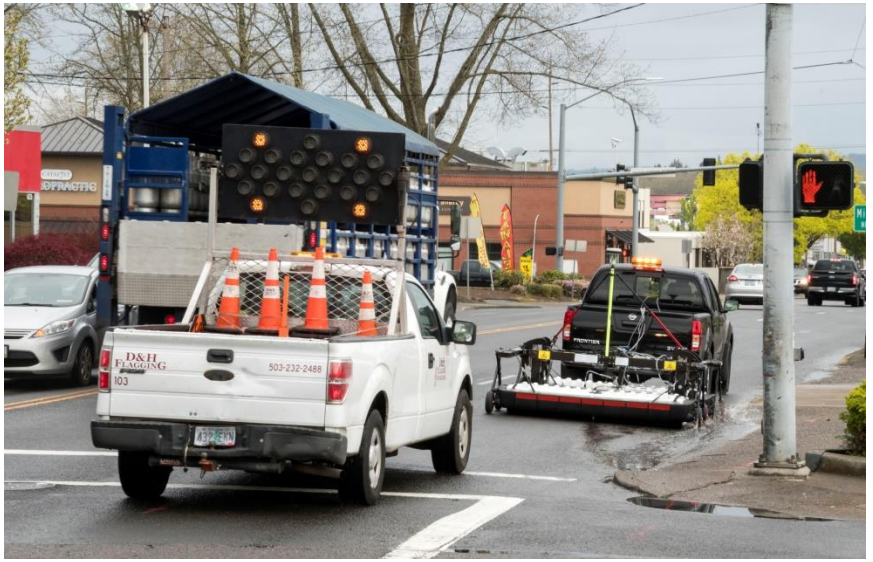
# R01B Example Project Sites

**Montana DOT – Custer Avenue**

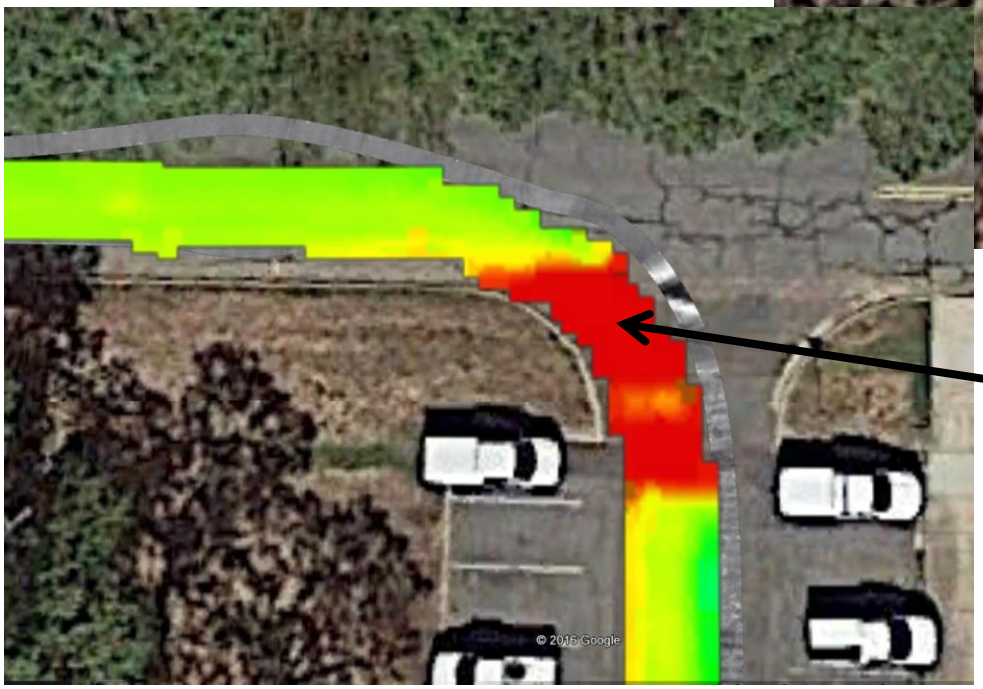


# R01B Example Project Sites

**Oregon DOT – SR8**



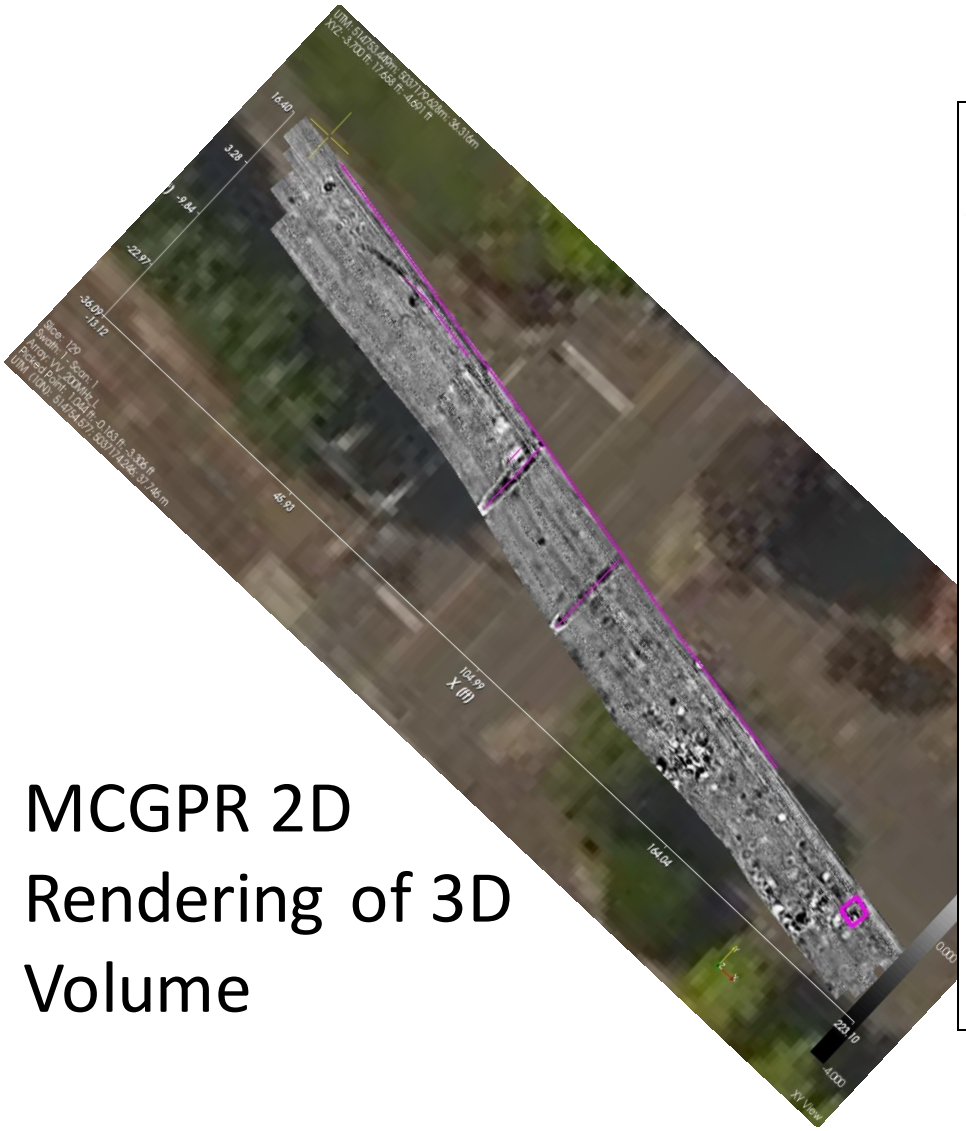

# TDEMI Output - Time for Field Demonstration



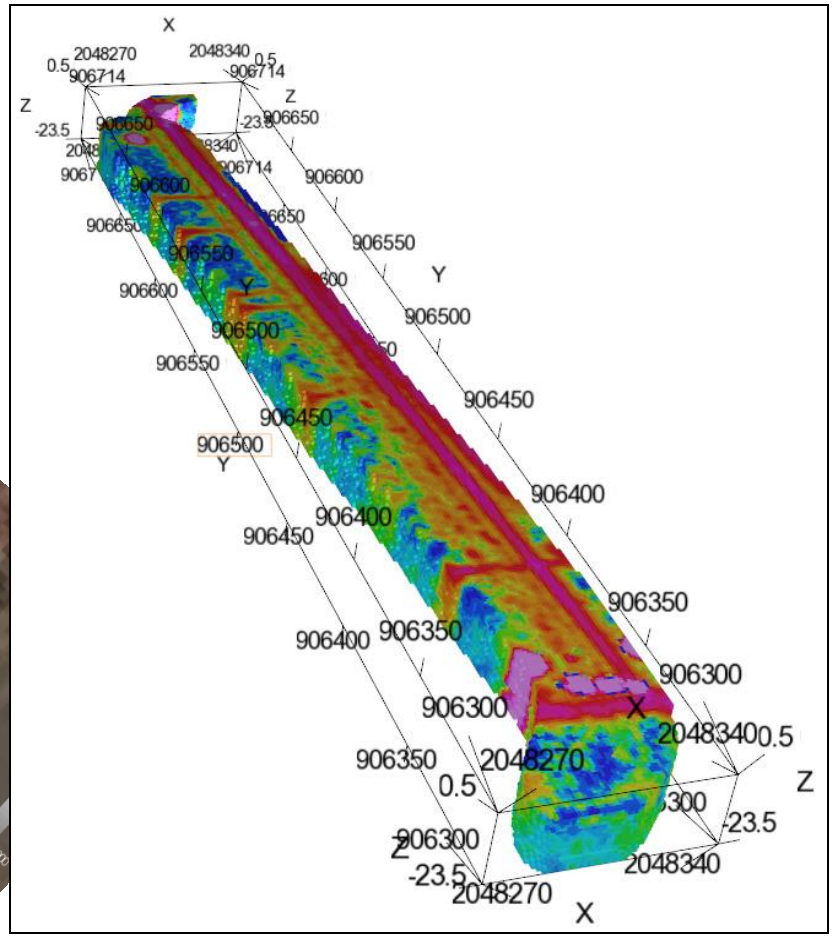


Same Utility line detected with MCGPR (top image) and TDEMI (image left)

# Sample Output Images

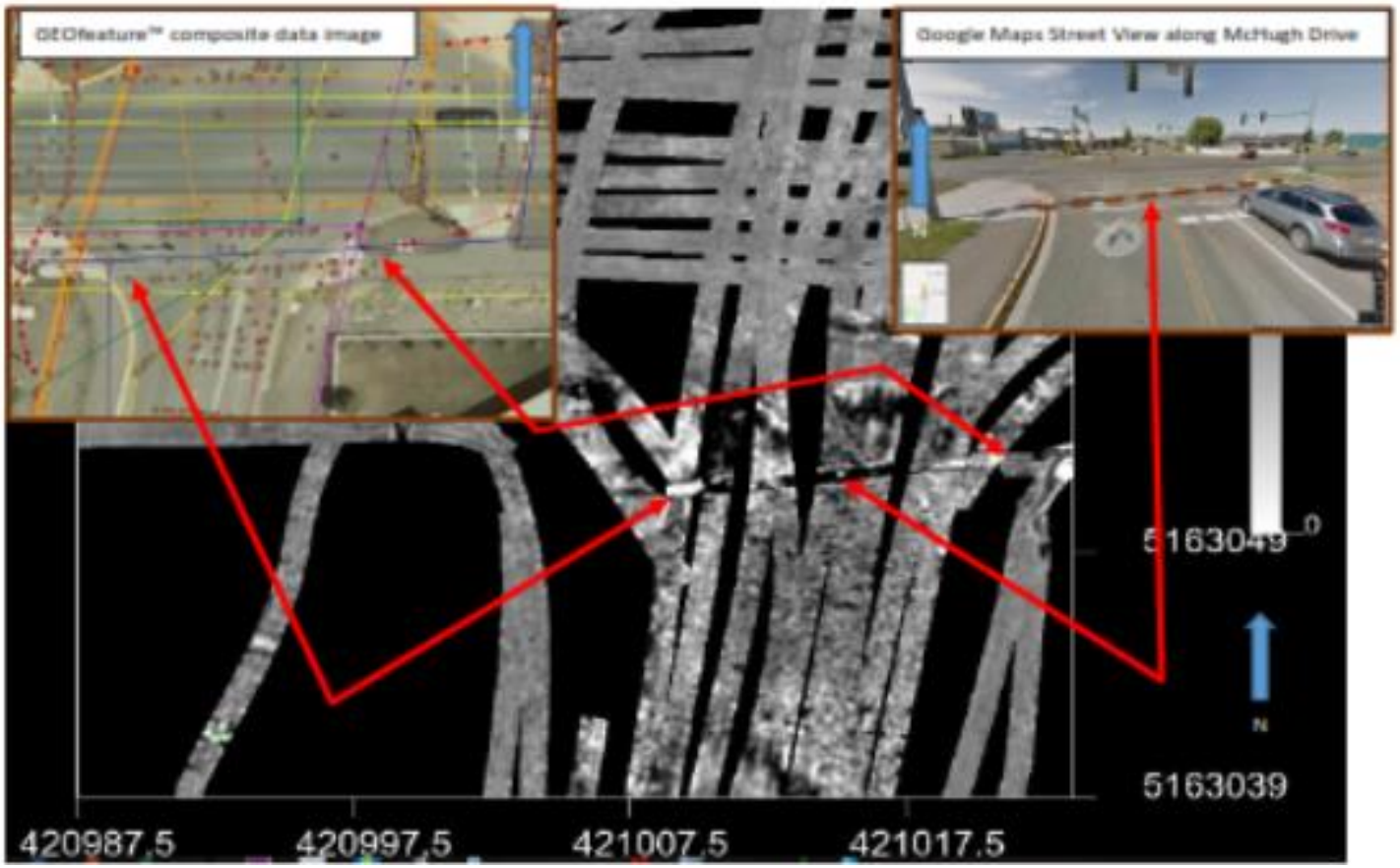


MCGPR 2D Rendering of 3D Volume



# Making ‘sense’ of it all!

SUE + MCGPR + TDEMI = Best Possible Solution (!?!)



# DOT / Vendor Reports



***Report results not for distribution***

# Lessons Learned

- Coordination is Key – many participants … and the Public
- Work at night for TDEMI (vehicles cause interference with data)
- MCGPR – won't work on concrete with rebar and/or clayey soil sub-grade
- Traffic controls are critical
- ~8 hrs of field effort ~80,000 line feet of data (15 mi) per shift
- 1 night of data yield weeks of analysis / reporting
- A method matrix is being compiled for these R01B technologies to compare field, office, and reporting time.

# For More Information

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**GoSHRP2 website**
**www.fhwa.dot.gov/goSHRP2**
- Product details
- Information about SHRP2 implementation phases

**SHRP2 Utility Bundle website**
**http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx**
Implementation Information for AASHTO members