



# Committee on Right of Way, Utilities and Outdoor Advertising Control 2019 Annual Meeting

*Chattanooga, Tennessee*

*April 28–May 2, 2019*

# Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs

## Montana Department of Transportation



## Why is Utility data Important to MDT?

## MDT's Experience with R01B Technologies

# Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs

## Why is Utility data Important to MDT?

- Affect the delivery of approximately \$300M in projects annually
- Certification to FHWA
- Statute and MDT Policy requirements - 75%+ reimbursement

60-4-403. Relocation -- costs. (1) Except as provided in subsections (2) and (3), 75% of all costs of relocation, dismantling, and removal must be paid by the department as a cost of federal-aid systems construction.

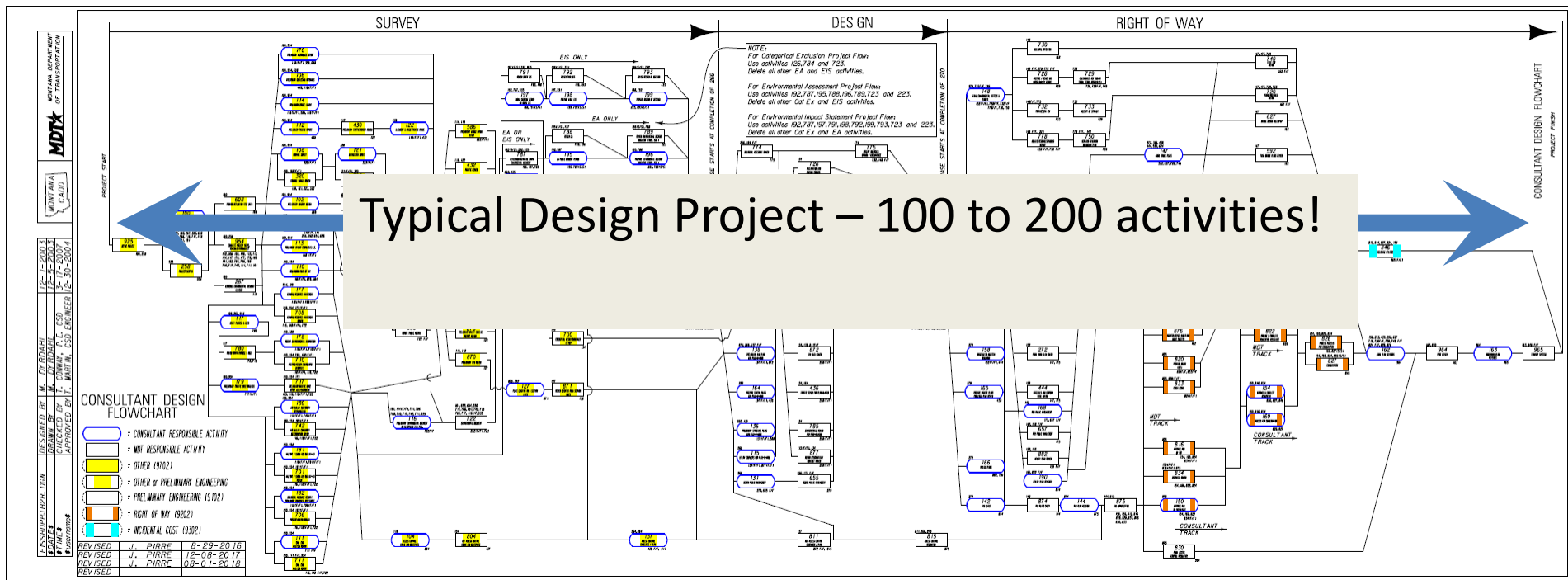
Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes

Why is Utility data Important to MDT?

30%

60%

90%

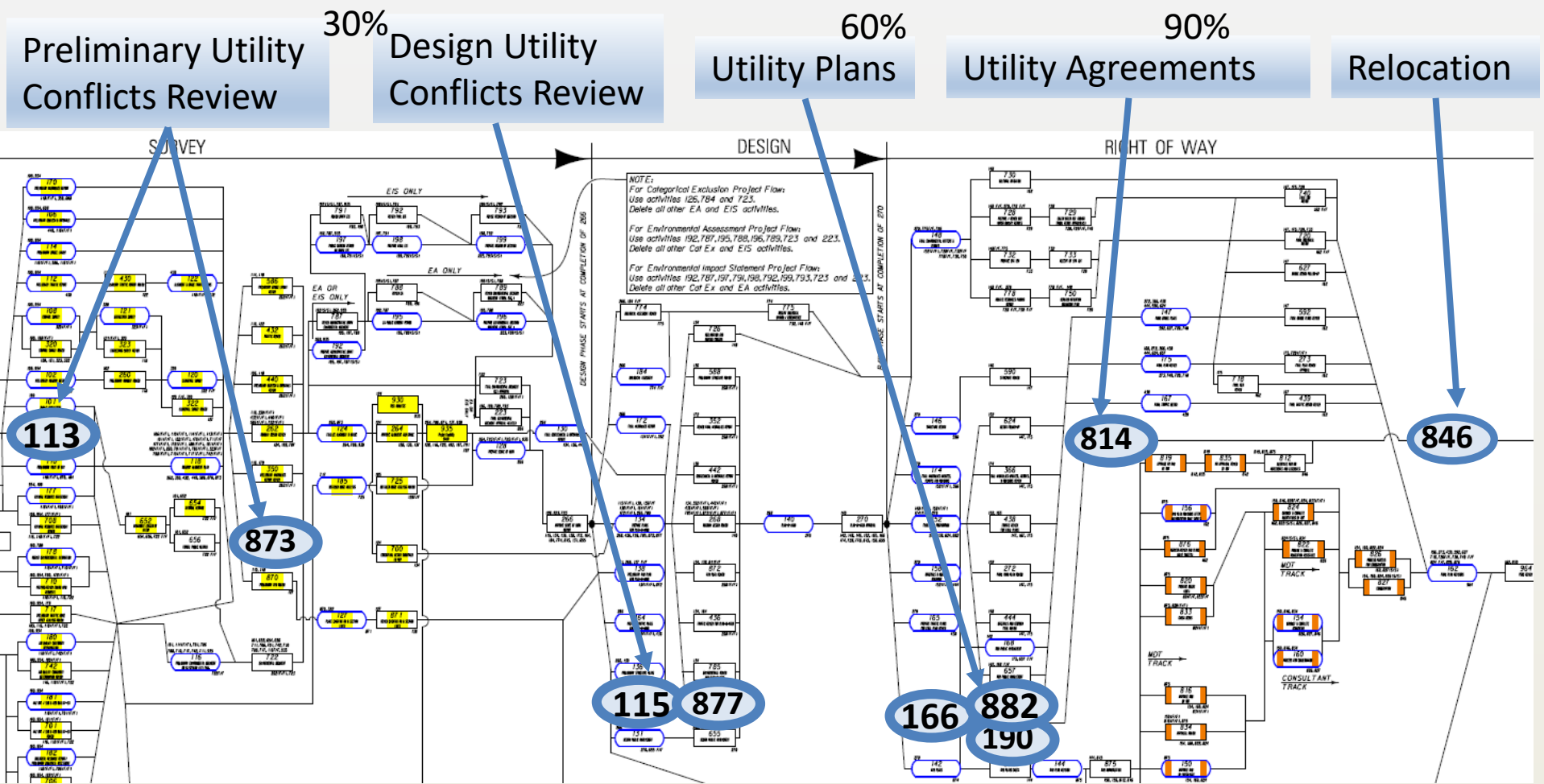


Typical Design Project – 100 to 200 activities!

Affect the delivery of approximately \$300M in projects annually



Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes





Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes

### Available Data Sources - Yesterday

**\*Subsurface Utility Engineering (SUE):**

**Phase I SUE** – Qualified consultant using non-invasive techniques to obtain data

**Phase II SUE** – Vacuum Excavation

90% Design

Construction

60% Design

Relocation

Utility Agreements

30% Design

Utility Plans

Design Utility Conflicts Review

Preliminary Utility Conflicts Review

Research

Research

Ut. Co. As-builts

Ut. Co. As-builts

One-call

One-call

Surveyed features

Surveyed features

**\*Phase I SUE**

**\*Phase I SUE**

**\*Phase II SUE**

**\*Phase II SUE**

Ut. Co. CADD records

Ut. Co. CADD records

**\*Additional Phase II SUE**

Research

Ut. Co. As-builts

One-call

Surveyed features

Research

Ut. Co. As-builts

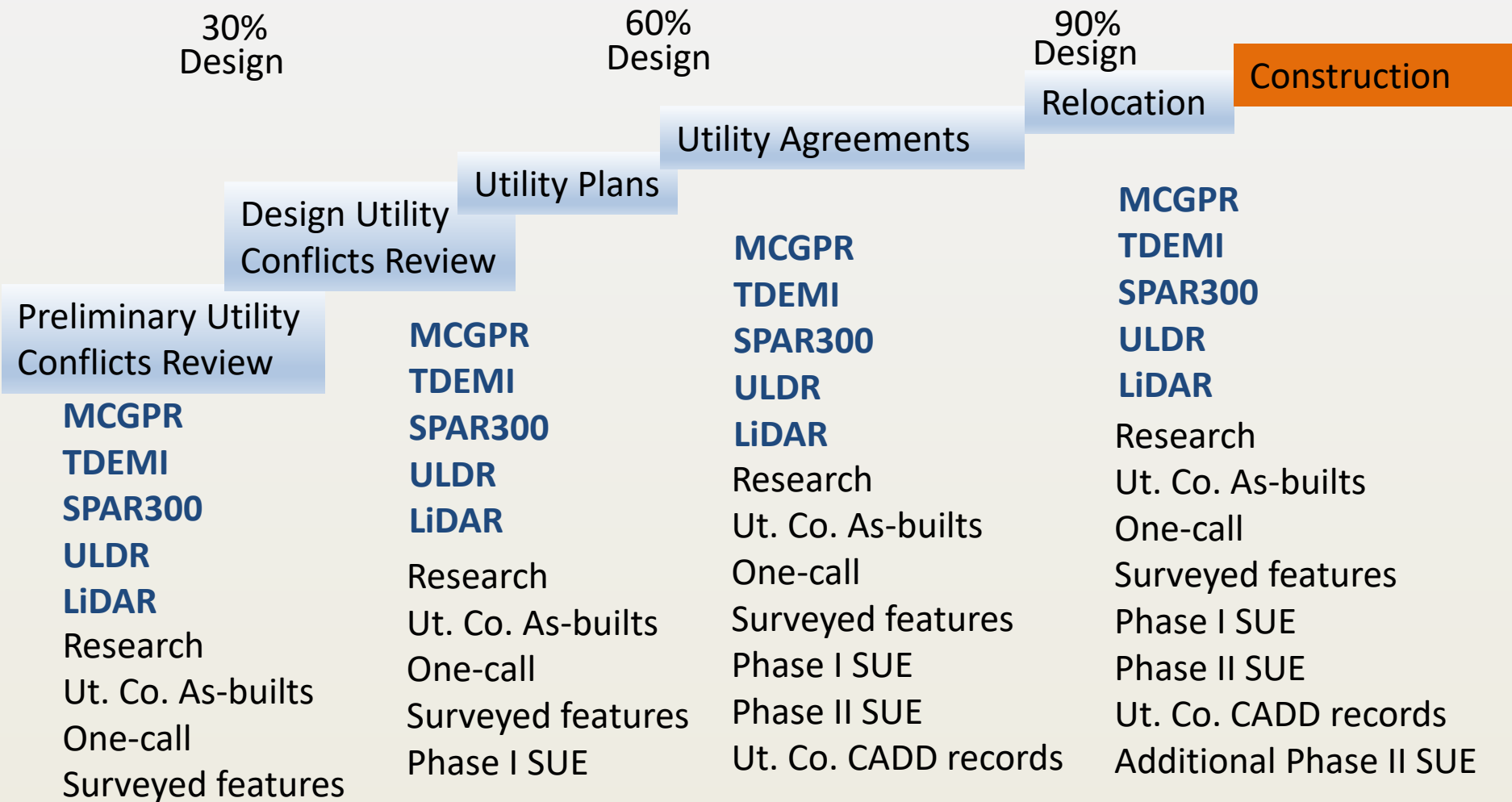
One-call

Surveyed features

**\*Phase I SUE**

Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes

## Available Data Sources - Tomorrow



Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes

Available Data Sources

30%  
Design

60%  
Design

90%  
Design  
Relocation

Construction

Utility Agreements

Design  
Conflicts review

**GOAL – Minimize Data Rediscovery**

Preliminary Utility  
Conflicts Review

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features  
Phase I SUE

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features  
Phase I SUE  
Phase II SUE  
Ut. Co. CADD records

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features  
Phase I SUE  
Phase II SUE  
Ut. Co. CADD records  
Additional Phase II SUE



Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes

Available Data Sources

30%  
Design

60%  
Design

90%  
Design  
Relocation

Construction

Utility Agreements

Design  
Conflicts review

**GOAL – Minimize Data Rediscovery**

Preliminary Utility  
Conflicts Review

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features

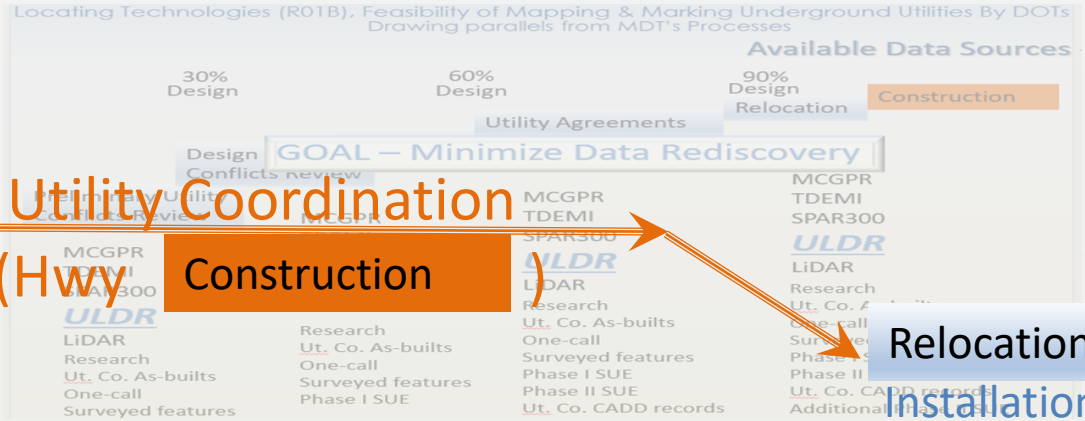
MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features  
Phase I SUE

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features  
Phase I SUE  
Phase II SUE  
Ut. Co. CADD records

MCGPR  
TDEMI  
SPAR300  
ULDR  
LiDAR  
Research  
Ut. Co. As-builts  
One-call  
Surveyed features  
Phase I SUE  
Phase II SUE  
Ut. Co. CADD records  
Additional Phase II SUE

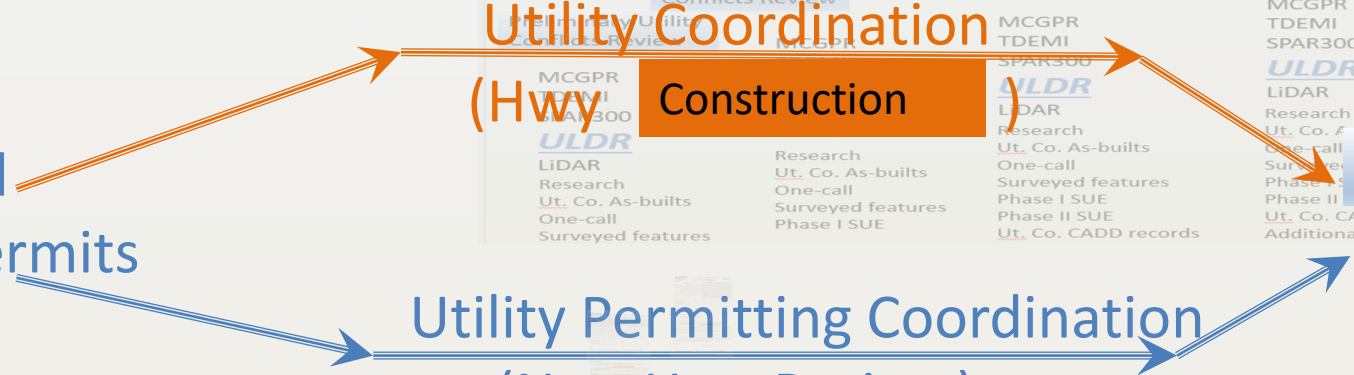
Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs

# The Permitting Life-Cycle for Highway and Non-Highway Projects



Approved Utility Permits

Utility Permitting Coordination (Non-Hwy Project)



Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs

# The Permitting Life-Cycle for Highway and Non-Highway Projects



Montana Department of Transportation  
**UTILITY OCCUPANCY  
AND LOCATION AGREEMENT**

Print Form

Completed By Utility		Completed By Montana Department of Transportation	
Date Submitted:		Route:	
Work Order Number:		Date Received:	
Applicant/Utility:		Maintenance No.:	
Address:		Agreement No.:	
Telephone:		Project No.:	
City:	State:	Designation:	
Email:	ZIP:	UPN.:	

**Facility Description:**

1) Overhead Facilities: Size: \_\_\_\_\_ Type: \_\_\_\_\_

2) Underground Facilities: Size: \_\_\_\_\_ Type: \_\_\_\_\_

3) Other: \_\_\_\_\_

**Location:**

Route: \_\_\_\_\_

1) Longitudinal: \_\_\_\_\_ feet from N  S  E  W  R/W line  
from milepost (station) \_\_\_\_\_ to milepost (station) \_\_\_\_\_

2) Centerline crossing at milepost (station): \_\_\_\_\_

3) Downguys not in parallel with the roadway at milepost(s): \_\_\_\_\_

4) Section \_\_\_\_\_ Township \_\_\_\_\_ Range \_\_\_\_\_ County \_\_\_\_\_

**Submit this agreement in triplicate and attach:**

- Construction Prints. (Highway prints preferred.) Distances from R/W line, centerline and existing utilities, to the proposed installation.
- Environmental Checklist (MDT-ENV-006) [Click Here for Environmental Checklist](#)

The utility will notify \_\_\_\_\_ in \_\_\_\_\_ phone \_\_\_\_\_ at least 48 hours in advance of any work detailed in this Agreement, except for emergency situations. After completing the work, the applicant must submit a Form UTL 968 (attached) for approval.

This installation is subject to compliance with the Administrative Rules of Montana 18.7.201 through 18.7.23; Utility Occupancy Guidelines, the Manual on Uniform Traffic Control Devices and the following requirements

**Additional Requirements**

This application will be considered complete when all impacts associated with the requested action have been reviewed and approved by all agencies affected by this action. The applicant is responsible for obtaining these necessary approvals.

This agreement is subject to the terms and conditions shown on Page 2.

Applicant/Utility \_\_\_\_\_ By: \_\_\_\_\_



Montana Department of Transportation  
**Utility Encroachment Application**

Print Form

Completed By Montana Department of Transportation	
Date Received:	UPN.:
Maintenance No.:	Highway Project No.:
Agreement No.:	Designation:

Applicant Name: \_\_\_\_\_ Date Submitted: \_\_\_\_\_

Address: \_\_\_\_\_ Applicant Work Order Number: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ ZIP: \_\_\_\_\_ Telephone: \_\_\_\_\_

Email: \_\_\_\_\_

Prepared by (if different than Applicant) \_\_\_\_\_

Email: \_\_\_\_\_ Telephone: \_\_\_\_\_

**Facility Description:**

1) Overhead Facilities: Size: \_\_\_\_\_ Type: \_\_\_\_\_

2) Underground Facilities: Size: \_\_\_\_\_ Type: \_\_\_\_\_

3) Other: \_\_\_\_\_

**Location:**

Highway Number: \_\_\_\_\_ County: \_\_\_\_\_

Section: \_\_\_\_\_ Township: \_\_\_\_\_ Range: \_\_\_\_\_

Longitudinal: \_\_\_\_\_ feet from N  S  E  W  R/W line  
from milepost (station) \_\_\_\_\_ to milepost (station) \_\_\_\_\_

Centerline crossing(s) at milepost(s) (station): \_\_\_\_\_

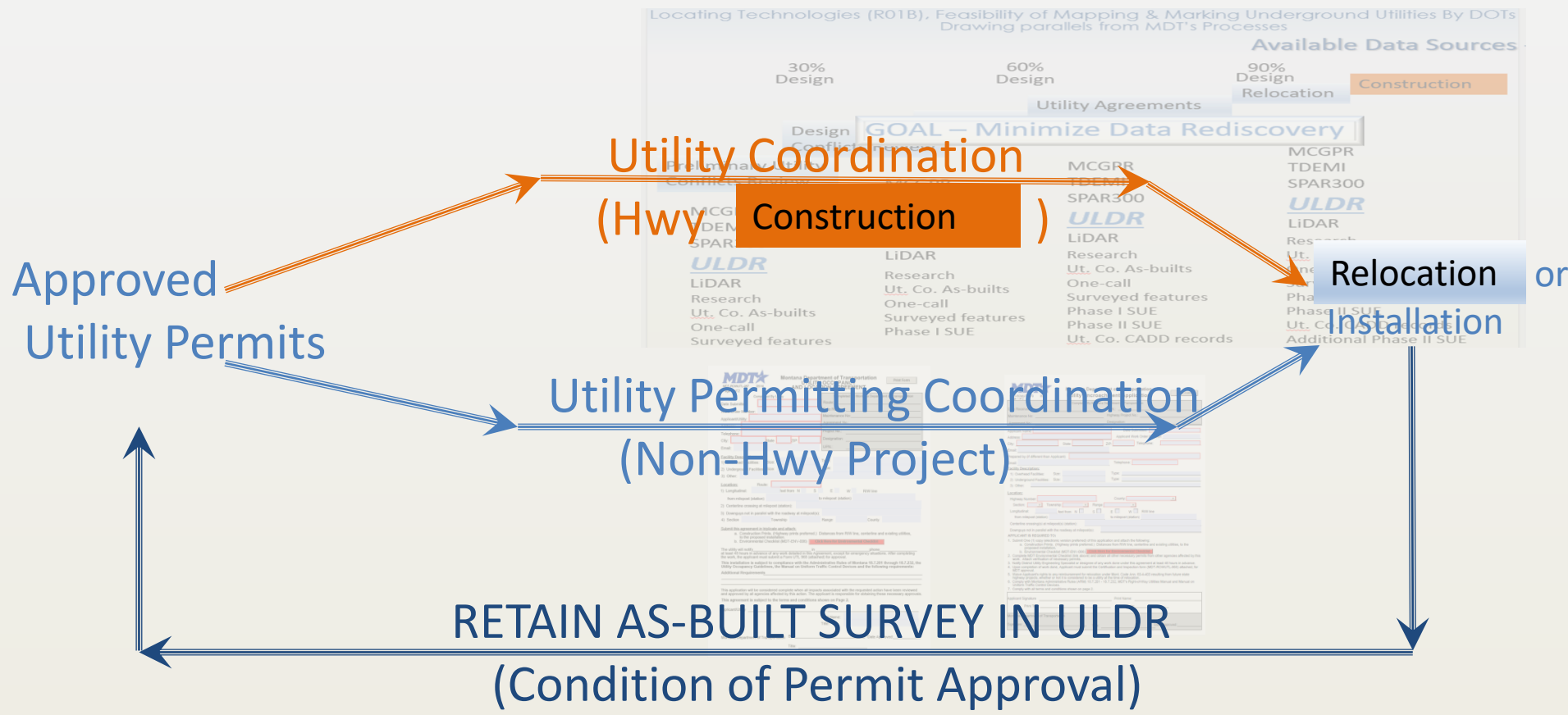
Downguys not in parallel with the roadway at milepost(s): \_\_\_\_\_

**APPLICANT IS REQUIRED TO:**

- Submit One (1) copy (electronic version preferred) of this application and attach the following:
  - Construction Prints. (Highway prints preferred.) Distances from R/W line, centerline and existing utilities, to the proposed installation.
  - Environmental Checklist (MDT-ENV-006) [Click Here for Environmental Checklist](#)
- Complete MDT Environmental Checklist (link above) and obtain all other necessary permits from other agencies affected by this work. Attach verification of necessary permits.
- Notify District Utility Engineering Specialist or designee of any work done under this agreement at least 48 hours in advance.
- Upon completion of work done, Applicant must submit the Certification and Inspection form (MDT-ROWUTL-968) attached, for MDT approval.

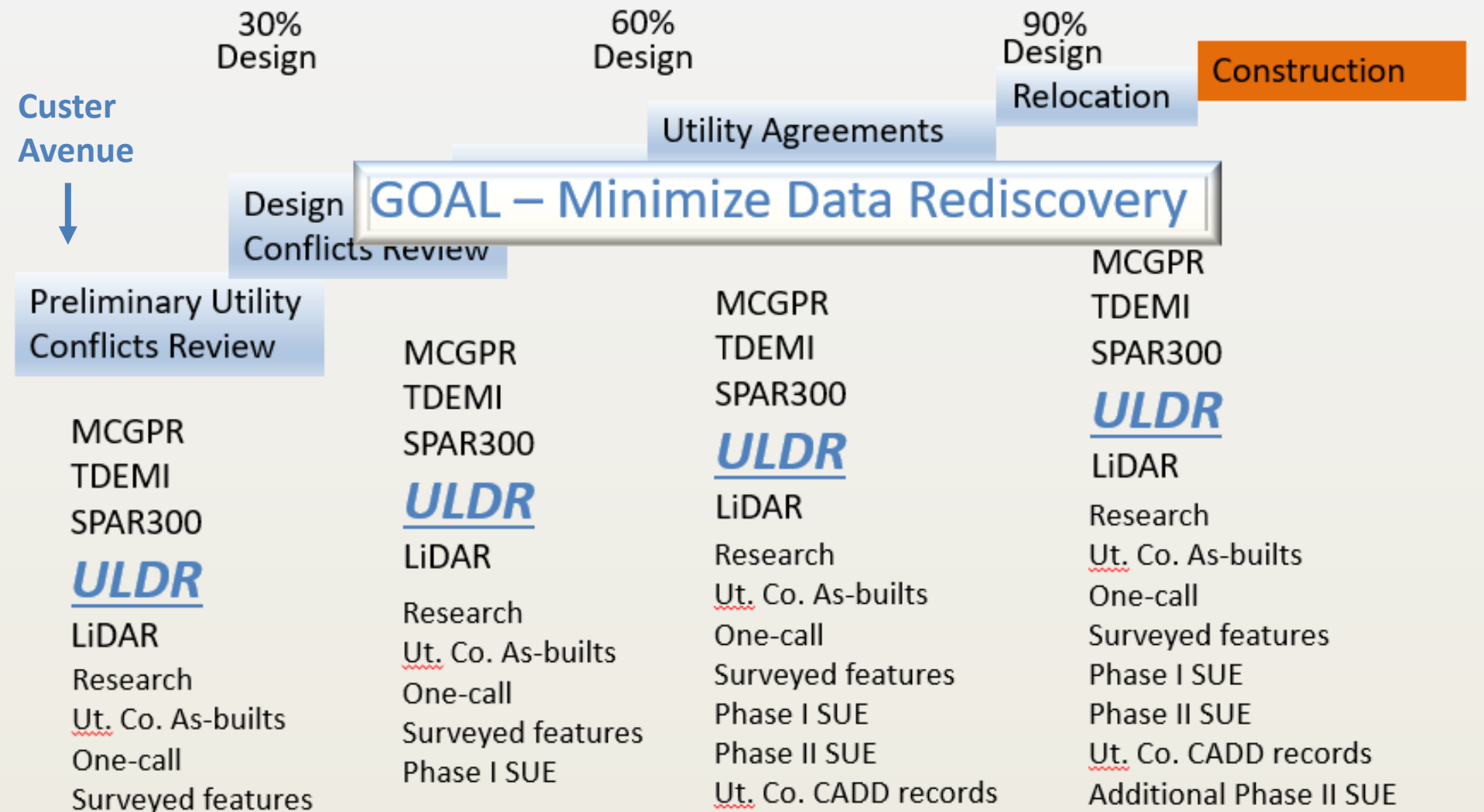
Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs

# The Permitting Life-Cycle for Highway and Non-Highway Projects



Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs  
Drawing parallels from MDT's Processes

Available Data Sources





Locating Technologies (R01B), Feasibility of Mapping & Marking Underground Utilities By DOTs

## Custer Avenue

- 1.6 Mile Reconstruction Project with major utility and right-of-way constraints
- \$6M in potential impacts to Yellowstone Pipeline if not avoided
- “OT” Phase: Alignment/Grade, Typical Section, Intersection control not yet determined
- Data from R01B technologies and other SUE methods used to aid in determination



Preliminary Utility  
Conflicts Review

MCGPR  
TDEMI  
SPAR300

**ULDR**

LIDAR

Research

Ut. Co. As-builts

One-call

Surveyed features



## Custer Avenue



### MCGPR

- IDS GeoRadar Stream C 600 megahertz MCGPR
- 34 antennas in two polarizations
- Survey-grade RTK GPS
- 3D

### TDEMI

- Multiple-coil Geonics EM61 Mk2
- Three-coil machine-towed array
- Survey-grade RTK GPS
- 2D only



# Custer Avenue

## RESULTS

- 78 New Point Features
- 64 Linear anomalies not associated with Phase I
  - 18% of detected Phase I linear features
- Captured known metallic pipes such as Yellowstone Pipeline
- Signal loops and comm lines, paved over lids and valves

### MCGPR

- IDS GeoRadar Stream C 600 megahertz MCGPR
- 34 antennas in two polarizations
- Survey-grade RTK GPS
- 3D

### TDEMI

- Multiple-coil Geonics EM61 Mk2
- Three-coil machine-towed array
- Survey-grade RTK GPS
- 2D only





## Custer Avenue



### MCGPR

- IDS GeoRadar Stream C 600 megahertz MCGPR
- 34 antennas in two polarizations
- Survey-grade RTK GPS
- 3D

### RESULTS

#### TDEMI

- **2 New Point Features**
- **68 Linear Anomalies not associated with Phase I**
- **19% of detected Phase I linear features**
- **Captured several pipes and cables not otherwise detected**
- **Pavement and distress cracks**

- Multiple-coil Geonics EM61 Mk2
- Three-coil machine towed array
- Survey-grade RTK GPS
- 2D only

**Committee on Right of Way, Utilities,  
and Outdoor Advertising Control Annual Meeting, 2019**

Pipe & Cable Locator			Spar Elevation Standard Deviations and QLs			Spar Offsets and Nearest Point			MGPR Elevation & Offsets			TDEM
Test Hole Elevation	Offset	Nearest Observation	Top	Horizontal	Vertical	Vertical	Horizontal	Nearest	Top	Vertical	Horizontal	Located?
3868.17	0.1	58.6	N/A	0.16/A <sup>1</sup>	1.181/C <sup>3</sup>	0.89	0.2	16.6	3869.13	-0.959	1.6	N
3882.26	0.6	0.8	3882.44	1.21/A	3.084/D	-0.02	1.8	3.4	Not seen on GPR			Y
3881.11	0.2	4.6	N/A	0.20/A	1.575/C	-0.42	1.4	6.3	N/A*			N
3867.09	0.7	14.5	Not surveyed with spar						N/A			N/A*
3866.52	0.1	32.7	3867.48	0.295/C	2.264/D <sup>4</sup>	-0.96	0.4	14.7	N/A			N/A
3859.37	0.4	13.1	3859.99	0.066/A	0.853/C	-0.62	0.5	14	Not seen on GPR			Y
3866.95	0.1	1	3867.68	0.197/A	0.591/B <sup>2</sup>	-0.73	0.5	30	N/A			N/A
3873.35	0.2	39	3873.61	0.066/A	0.295/A	-0.26	0.5	4.6	N/A			Y
3885.03	0.2	1.3	3886.01	0.066/A	0.394/B	-0.98	0.3	12.6	N/A			N/A
3866.4	0.1	1.5	3866.63	0.066/A	0.394/B	-0.23	0.3	6	N/A			N/A
3862.91	1.7	99.8	3862.59	0.164/A	1.214/C	0.32	1.5	27.1	N/A			N/A
3859.17	0.56	38.5	3859.35	0.033/A	0.197/A	-0.18	0.1	16.3	3858.48	0.695	0.1	N/A

1 - Spar QLA = +/- 4"

\*N/A (TDEM & MGPR) = not surveyed or unable to survey

2 - Spar QL B = +/- 8"

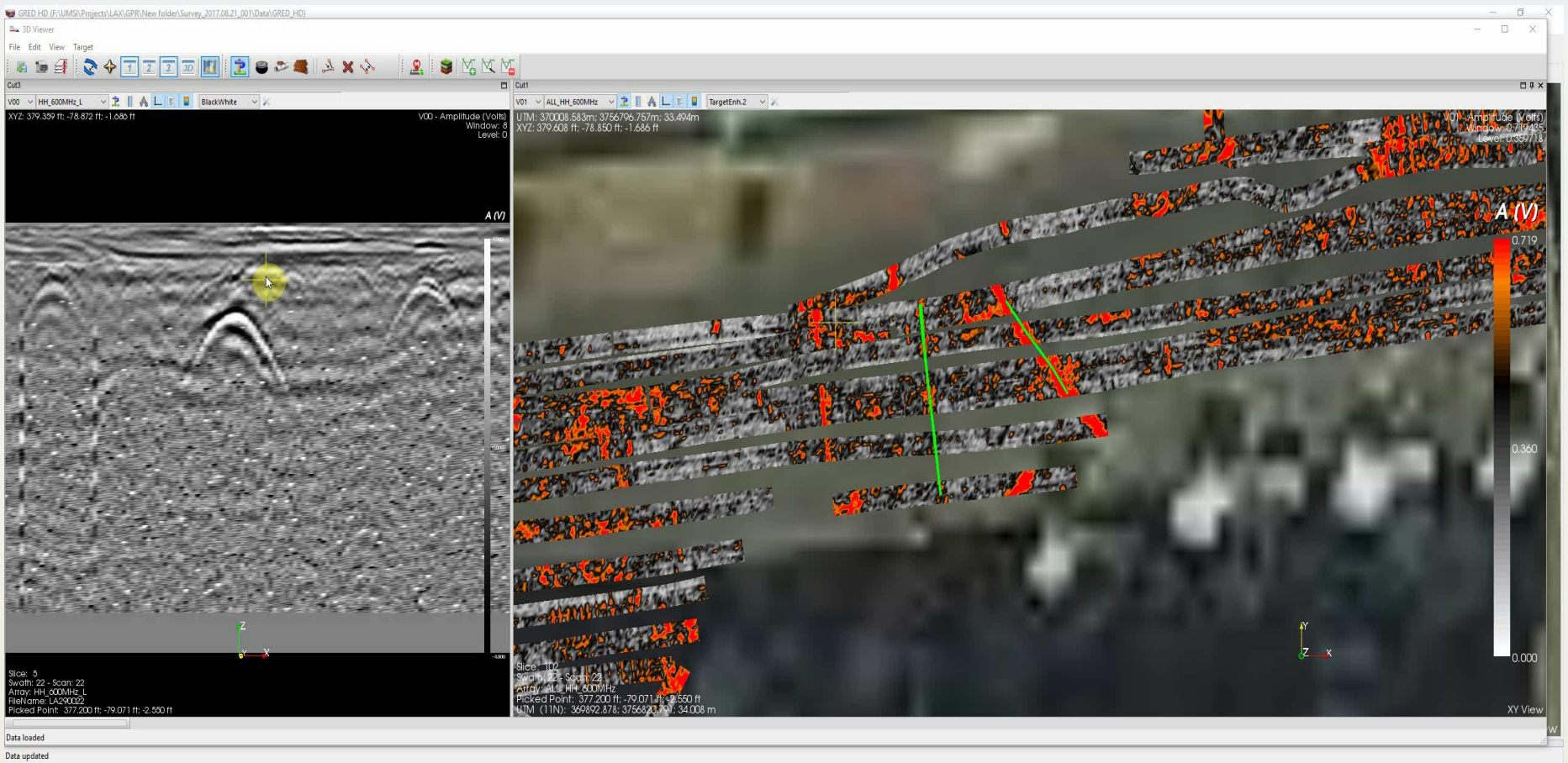
3 - Spar QL C = +/- 1.7'

4 - Spar QL D = +/- 3.3'

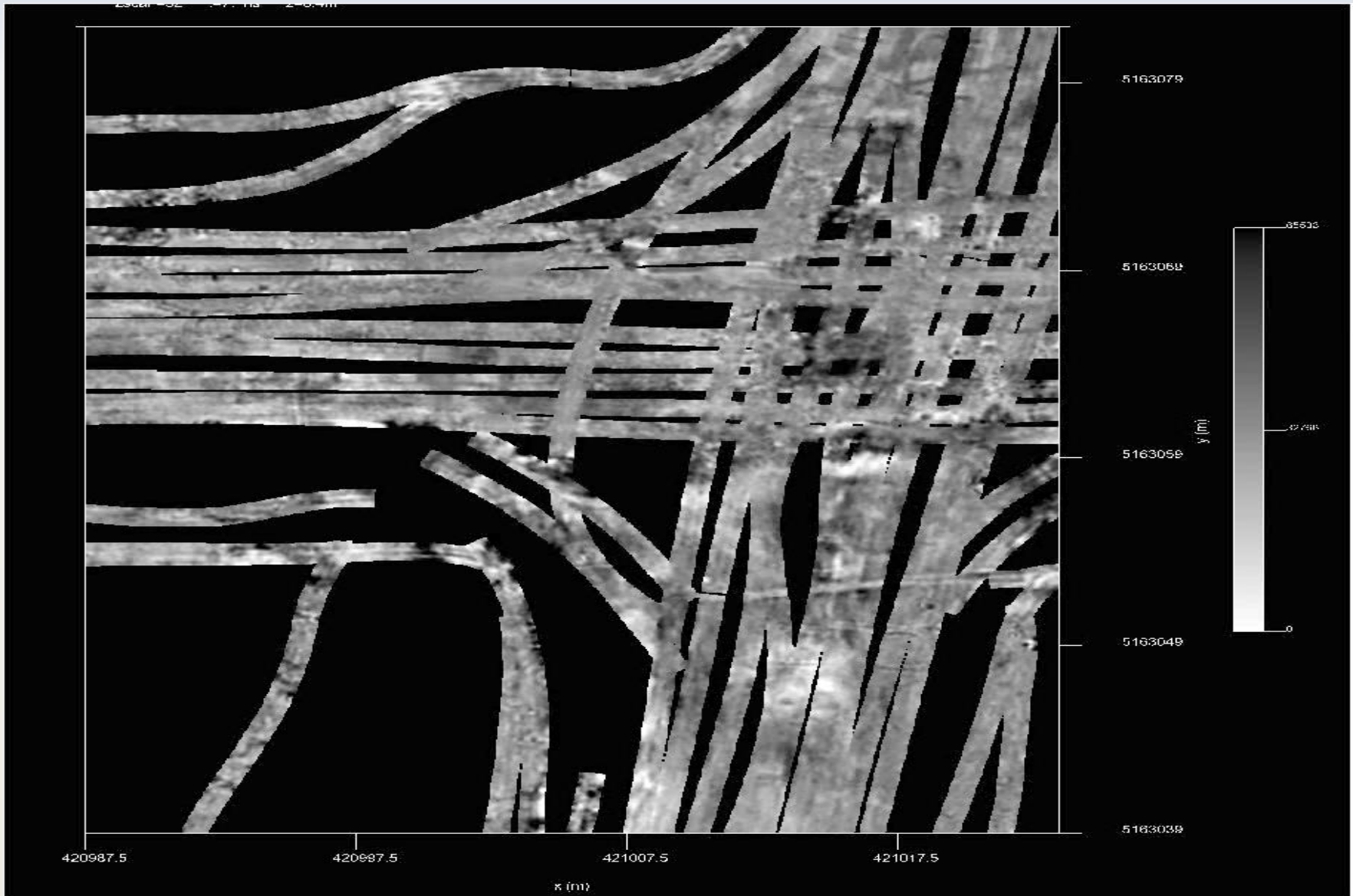
5 - Spar QL E = +/- 6.6'



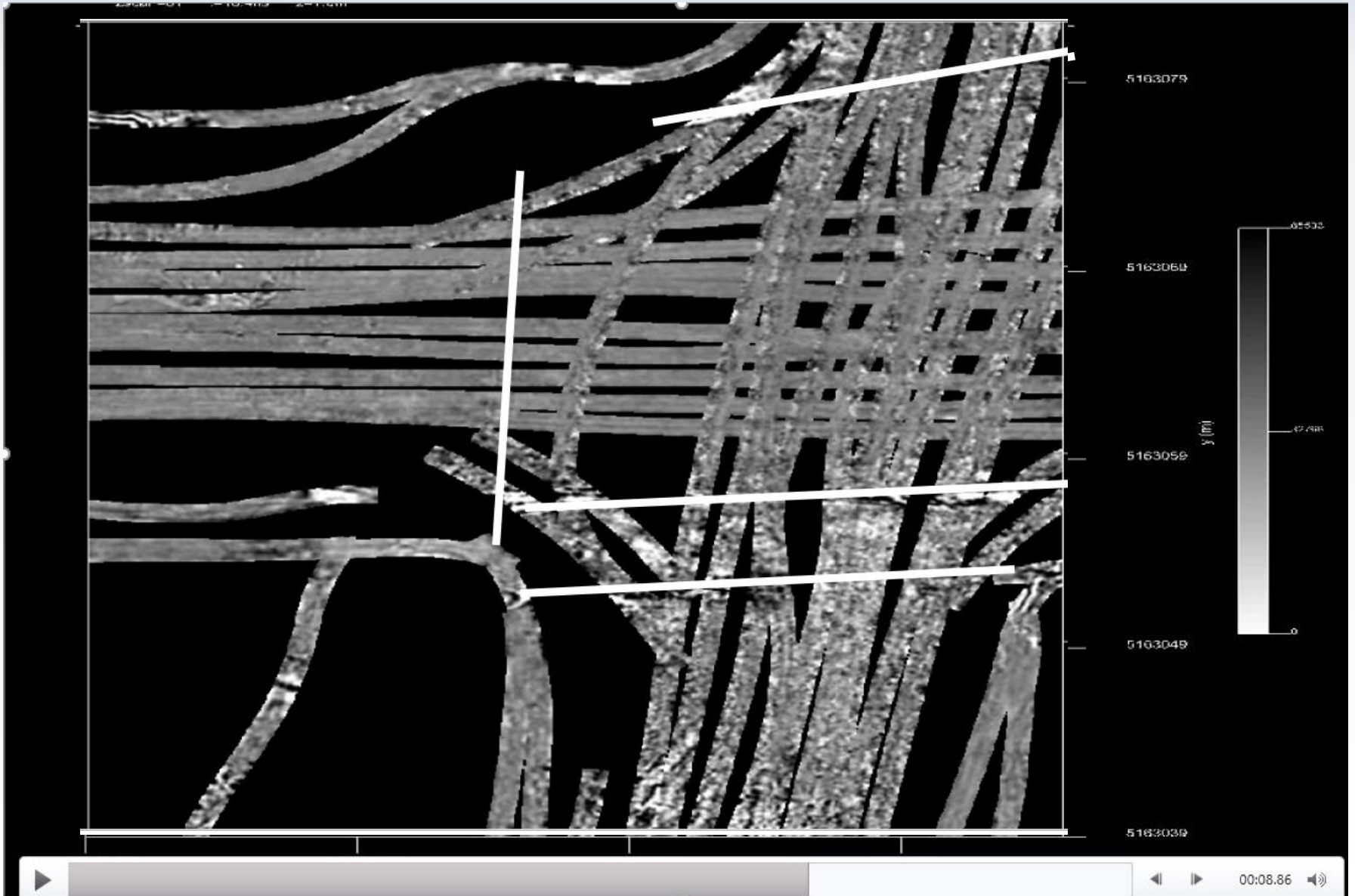
# Custer Avenue MCGPR



# Custer Avenue MCGPR

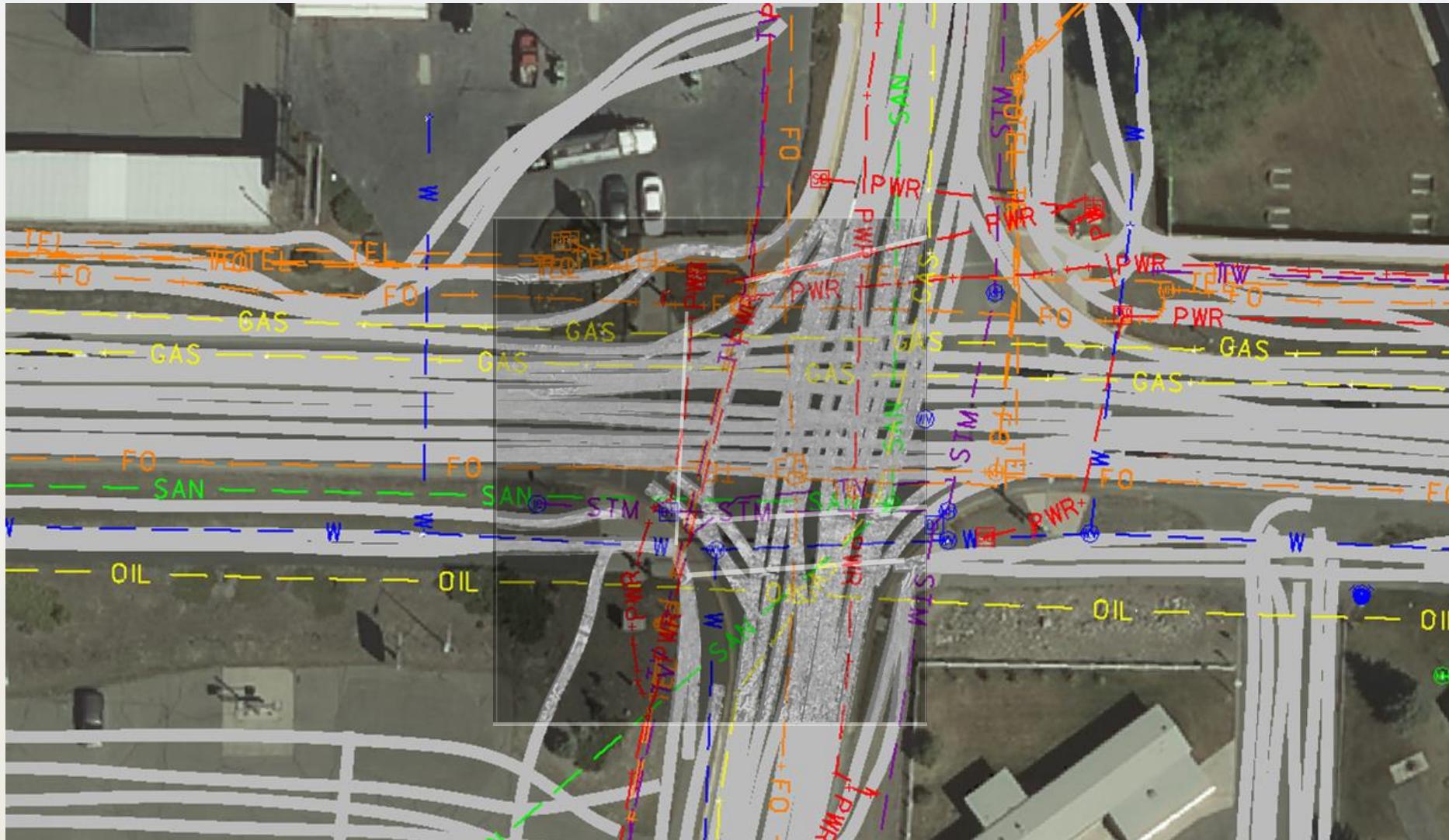


# Custer Avenue MCGPR





# Custer Avenue MCGPR



# Custer Avenue

## MCGPR

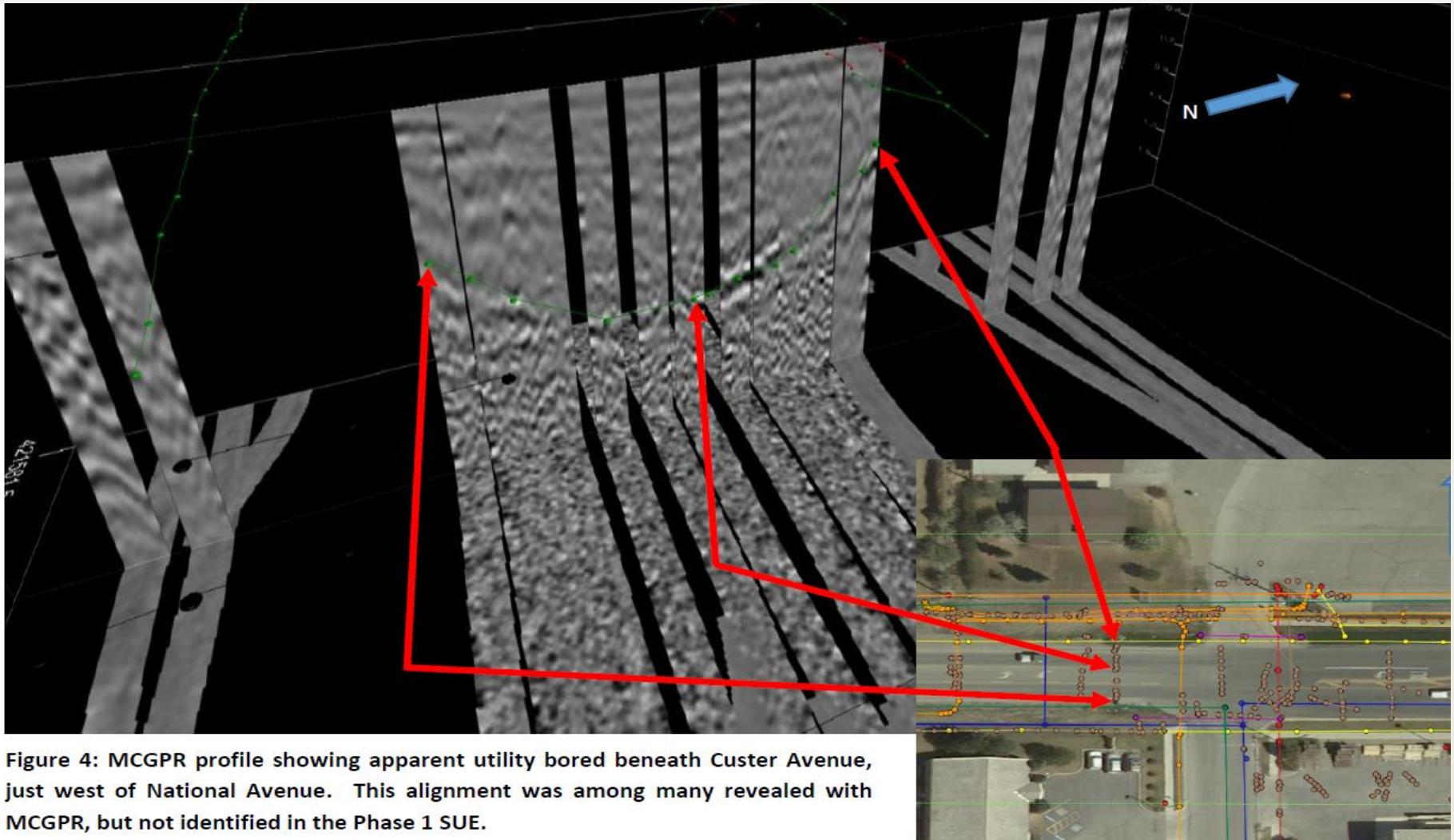
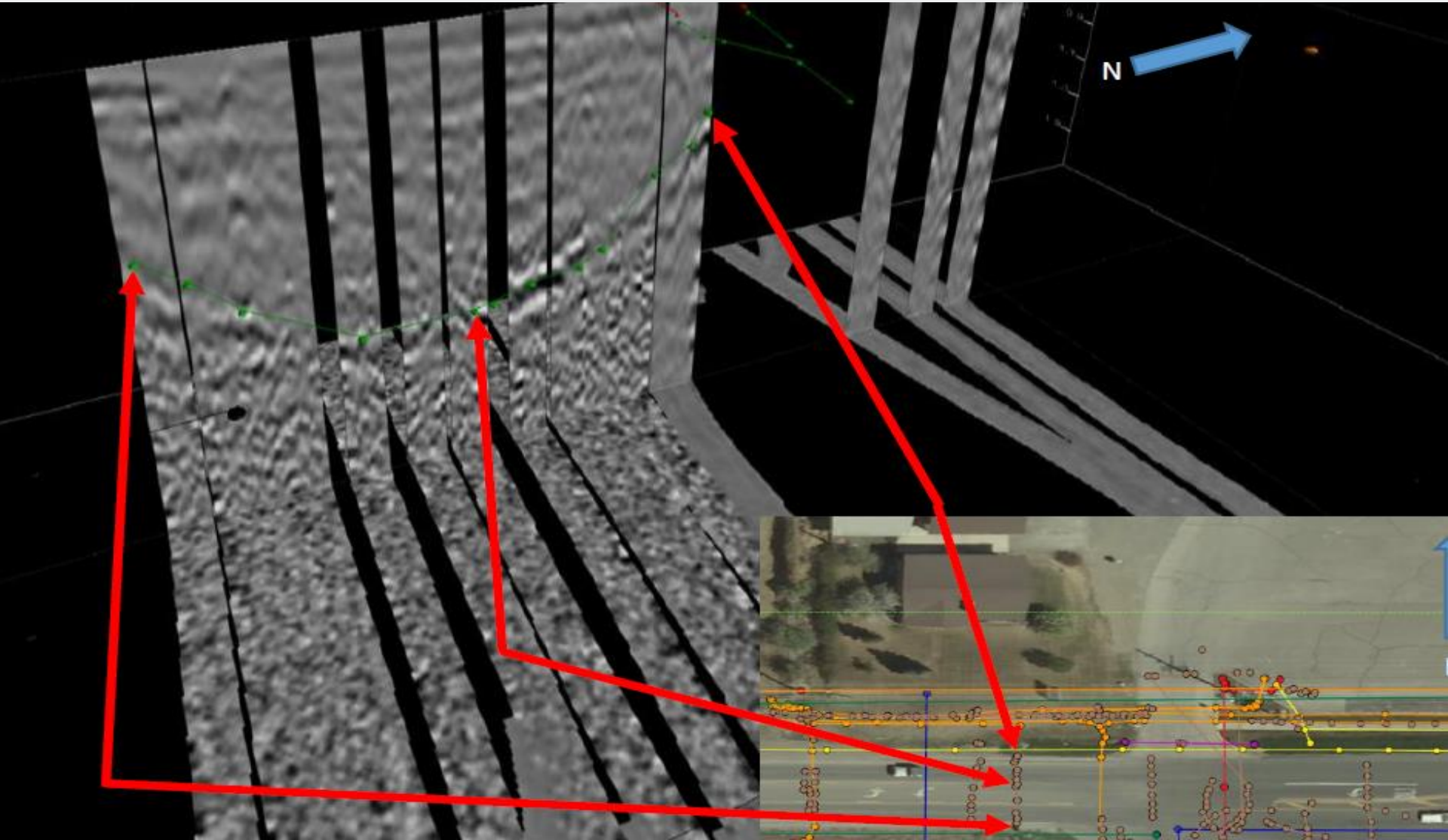


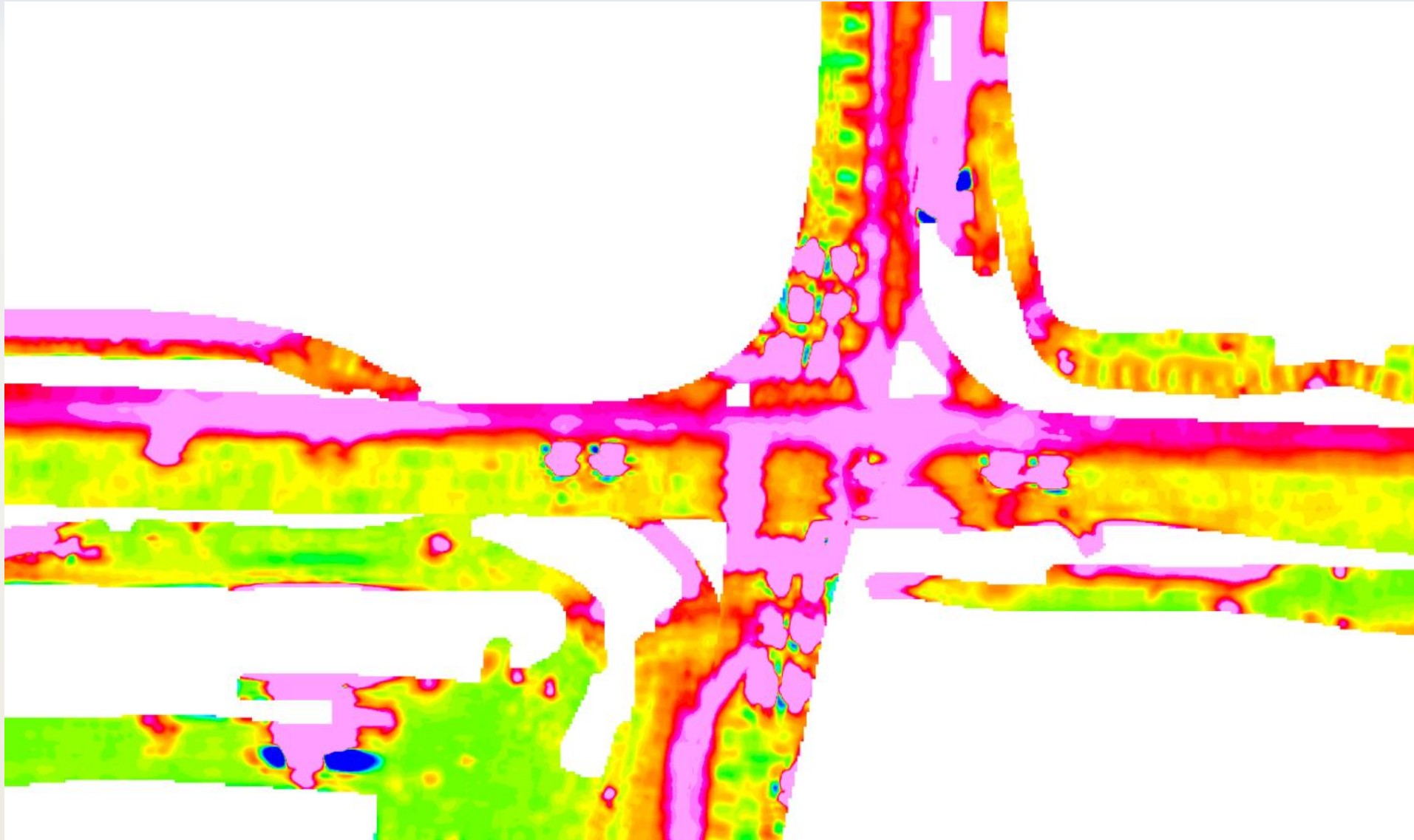
Figure 4: MCGPR profile showing apparent utility bored beneath Custer Avenue, just west of National Avenue. This alignment was among many revealed with MCGPR, but not identified in the Phase 1 SUE.



## Custer Avenue MCGPR

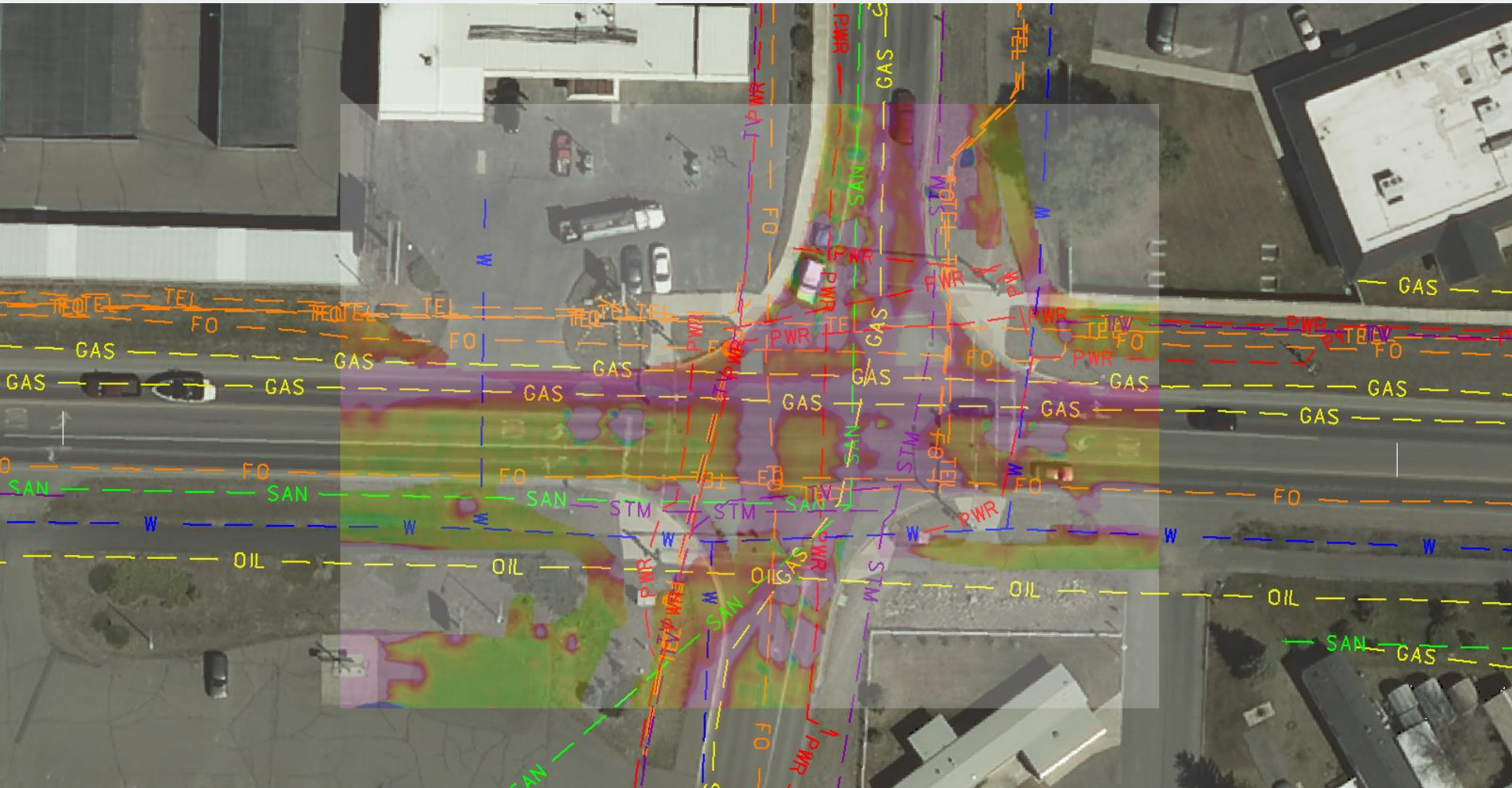


## Custer Avenue TDEMI

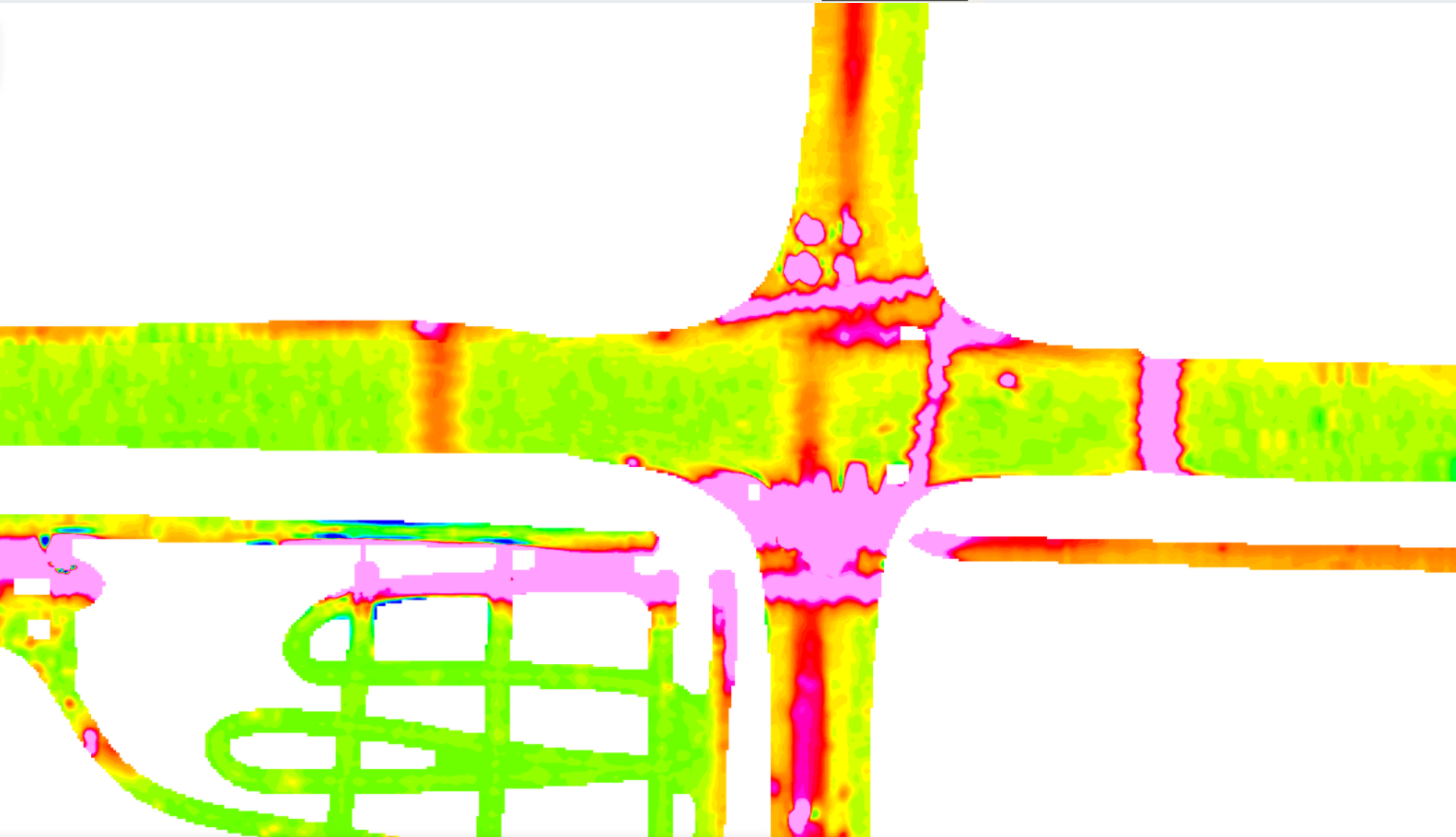




# Custer Avenue TDEMI

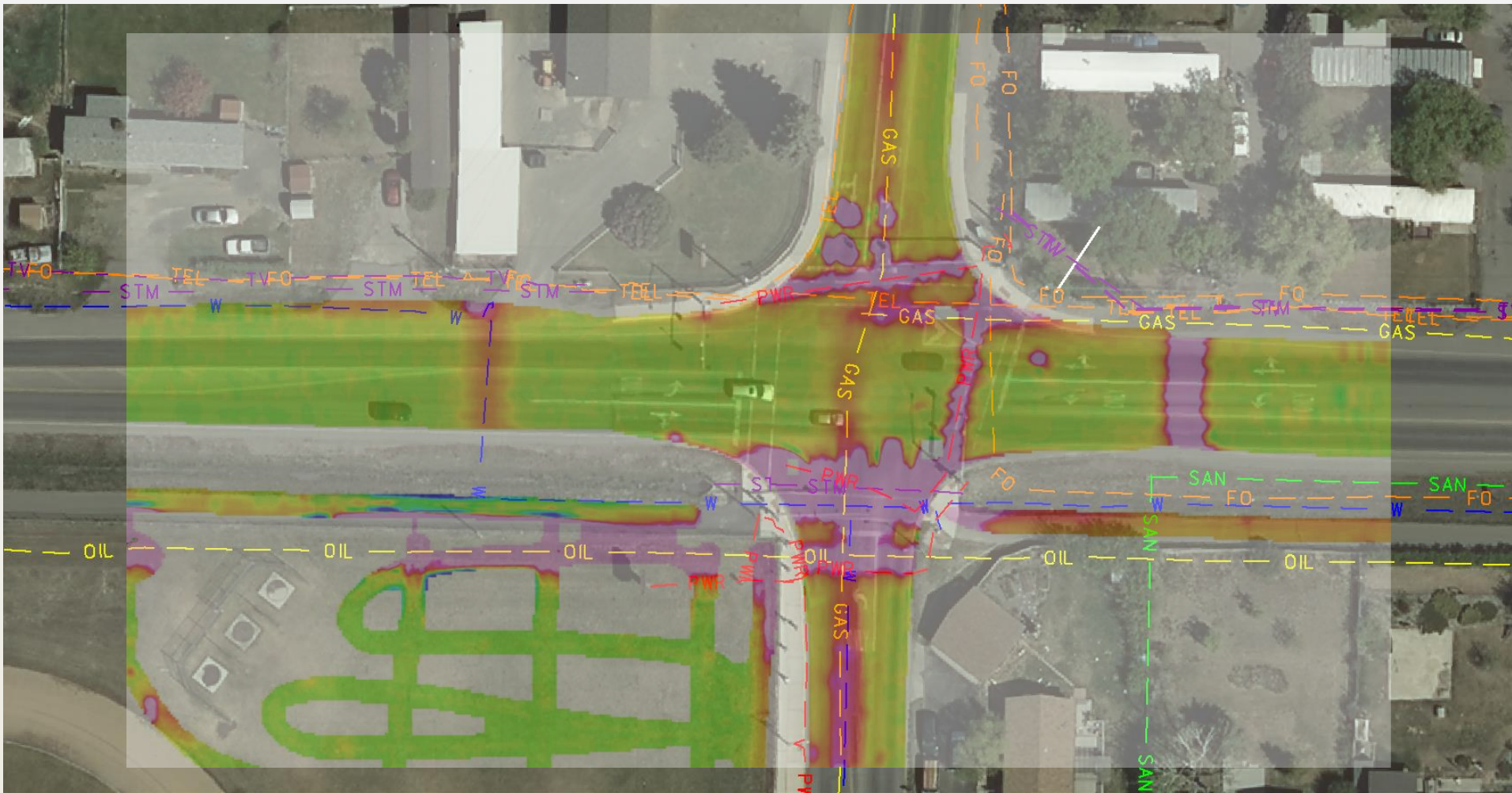


## Custer Avenue TDEMI





# Custer Avenue TDEMI





3D Model of  
Utilities -  
Custer  
Avenue  
Helena, MT

