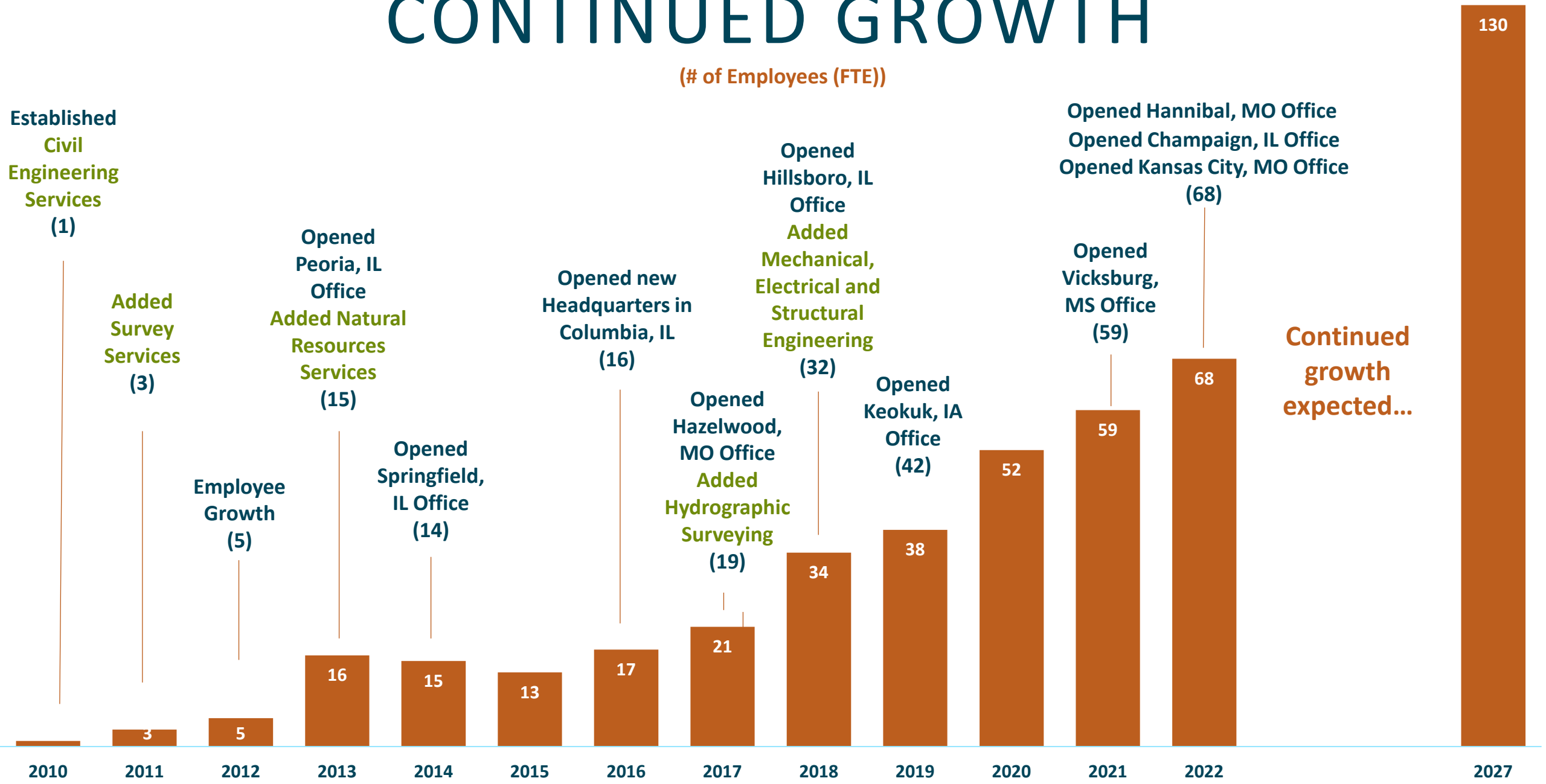
Prairie Engineers, P.C.

PRAIRIE ENGINEERS TODAY

OVERVIEW

CONTINUED GROWTH

(# of Employees (FTE))



PRAIRIE ENGINEERS TODAY

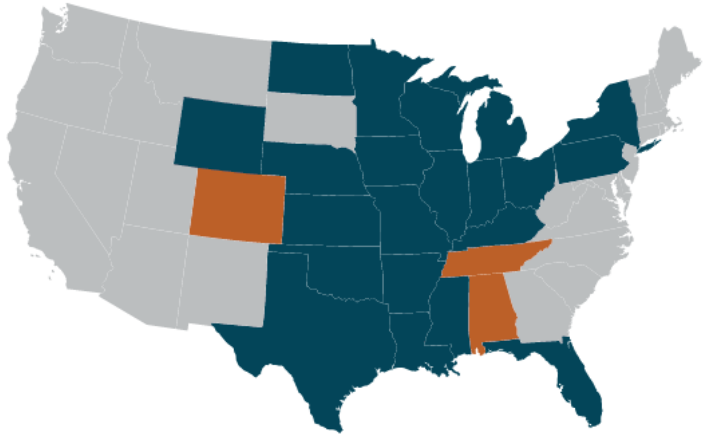
78 PRAIRIE ENGINEERS
Our Current Staff
Steady growth over our 12 years

- 12 Civil Engineers
- 7 Structural Engineers
- 5 MEP Engineers
- 12 Land Surveyors
- 3 Hydrographers
- 3 GIS Specialists
- 4 Environmental Scientists
- 1 Certified Photogrammetrist
- 9 Technicians/Analysts
- 15 Administrative

PROFESSIONAL ENGINEERS

Licensed Professional Engineers
17

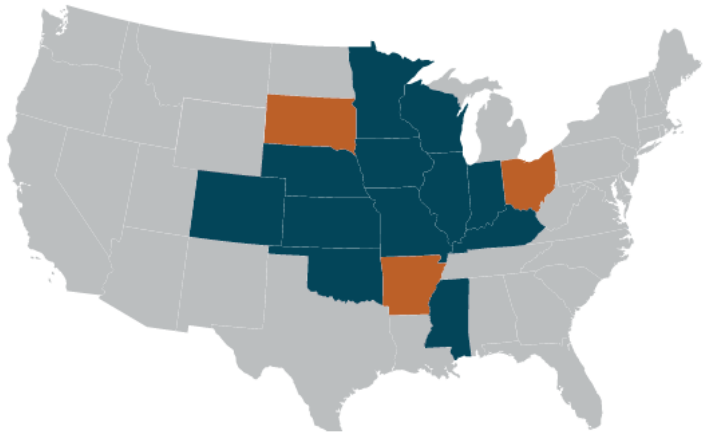
Licensed Structural Engineers
5



PROFESSIONAL LAND SURVEYORS

Licensed Land Surveyors
10

Hydrographers
3



Depth and Breadth

GEOSPATIAL PROJECT LOCATIONS- PRIOR 12 MONTHS

Puerto Rico

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MANNED vs. UNMANNED

A Direct Comparison of Results From An Aerial Lidar Mapping Project

- Scott Perkins, GISP – Prairie Engineers, P.C.

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2022 Best Firms to Work For at AEC Firms in North America: View Article
2022 Best Places to Work! Springfield Business Journal: View Article
2021 Best Places for Engineers to Work! ISPE: View Video

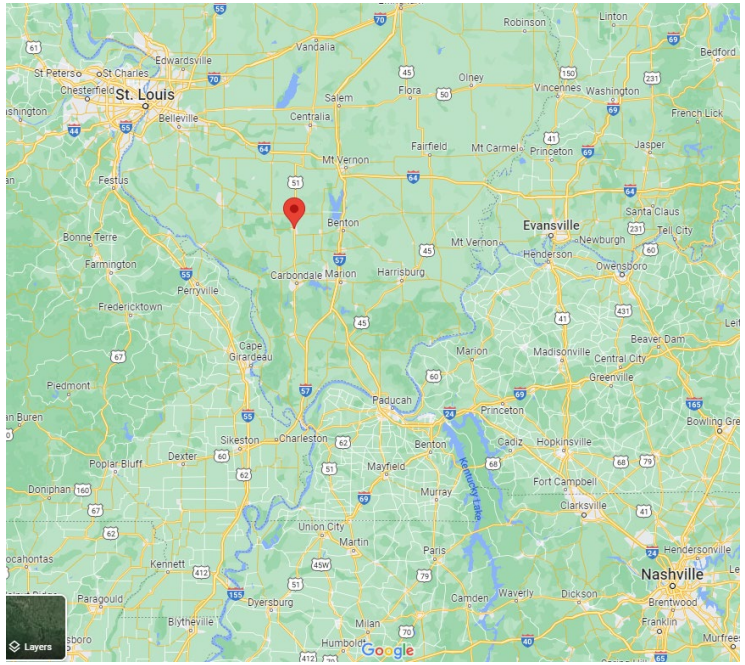
MANNED vs. UNMANNED

- Both are under the control of the FAA
  - Manned flight is restricted to above 1,000’
  - Unmanned is restricted to below 400’

- Both systems use Precision Navigation & Timing (PNT)
  - Airborne GPS/GNSS positioning
  - Inertial Measurement Unit (IMU) a gyroscope & accelerometers

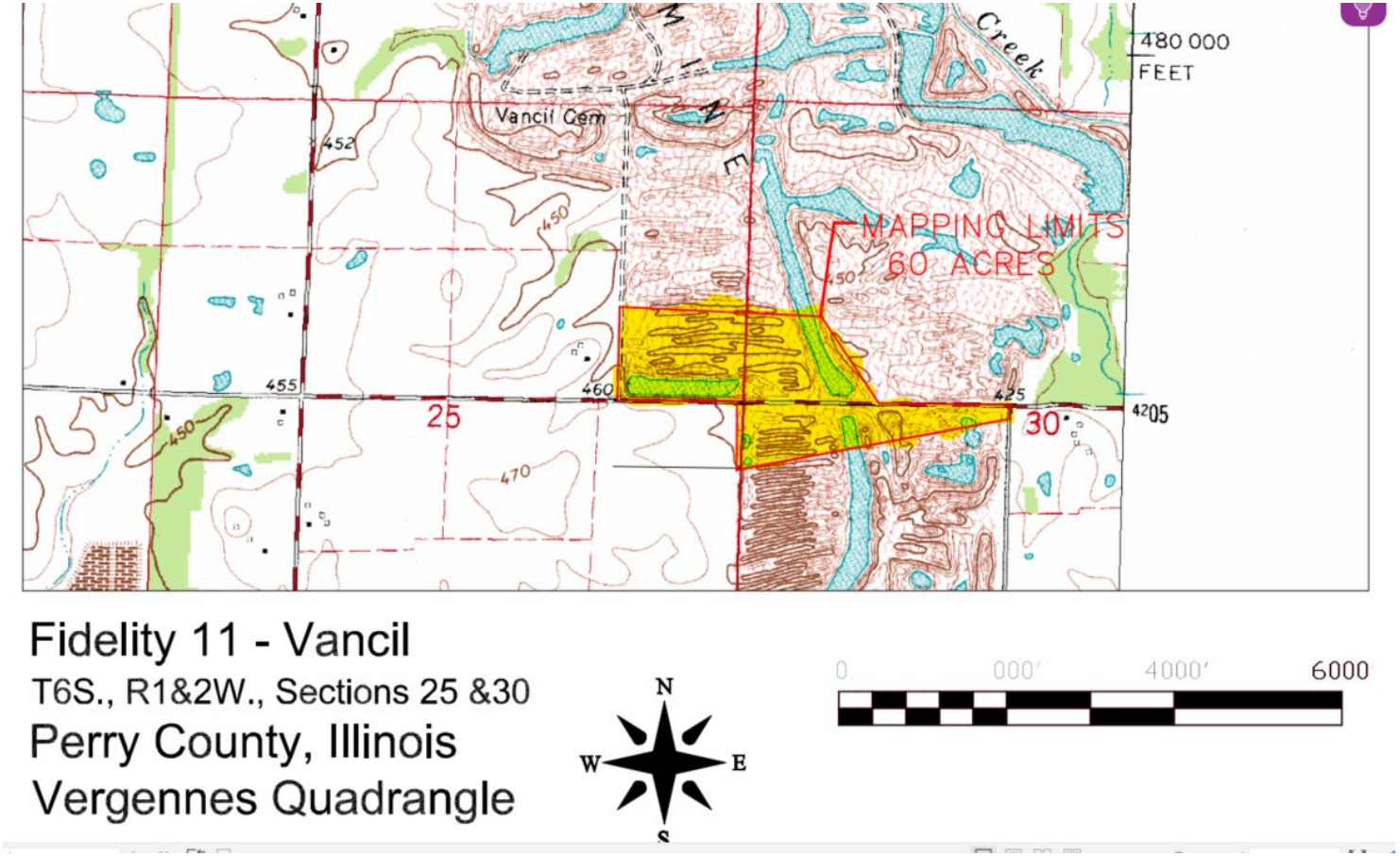
The Project

Southern IL abandoned mine



TEAM – purpose statement to advance the knowledge of transportation engineering and to provide a forum for the continued education of and communication among all parties dedicated to promoting a quality transportation system that serves the public welfare of Missouri.

The Site


Creek
480 000
FEET
Vancil Cem
452
450
MAPPING LIMITS
60 ACRES
455
460
425
25
30
4205
450
470
Fidelity 11 - Vancil
T6S., R1&2W., Sections 25 &30
Perry County, Illinois
Vergennes Quadrangle
N
W
E
S
0
000'
4000'
6000

The Site

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The Scope of Work

Work Order #16
Southern Illinois Construction Inspection Services
AML-GSwE-2149
Attachment 1

- TASK I -The consultant shall perform all ground control services as necessary
- TASK II - The consultant shall perform all aerial photographic services as necessary
  - The color digital photograph is to be a seamless photo of the entire site and **not a mosaic photo**.
- TASK III - The consultant shall provide digital files of topographic mapping

ACCURACY STANDARDS

- The Lidar data is to be collected at and aggregate nominal pulse spacing (ANPS) of less than or equal to <0.35 meters (QL 0, which is >8.0 ppsm)

- The required quality level is 0 for high density Lidar based on the U.S.G.S. specification.

- In addition, the accuracy standards shall meet the requirements of the American Society for Photogrammetry and Remote sensing (ASPRS) "Positional Accuracy Standards for Digital Geospatial Data"

Site Reconnaissance

March 13, 2022

Site Reconnaissance

March 13, 2022

The Ground Control

Targets set on March 29

NAME	DESCRIPTION	NORTHING (Y)	EASTING (X)	ELEVATION (Z)
106	CHEVRON 1	476796.162	2559751.501	424.485
109	CHEVRON 2	476731.301	2556195.768	459.766
111	CHEVRON 3	476777.185	2558605.961	440.626
110	CHEVRON 4	476742.777	2557388.117	445.695
101	TARGET 5	477501.589	2556193.221	448.866
100	TARGET 6	477492.909	2557227.933	448.932
107	TARGET 7	477475.847	2558101.994	446.319
102	TARGET 8	476194.238	2557257.631	449.600
104	TARGET 9	476277.988	2557973.318	448.718
105	TARGET 10	476593.955	2559513.369	409.698
103	TARGET 11	476600.898	2557916.245	447.765
108	TARGET 12	477088.682	2557872.724	449.514

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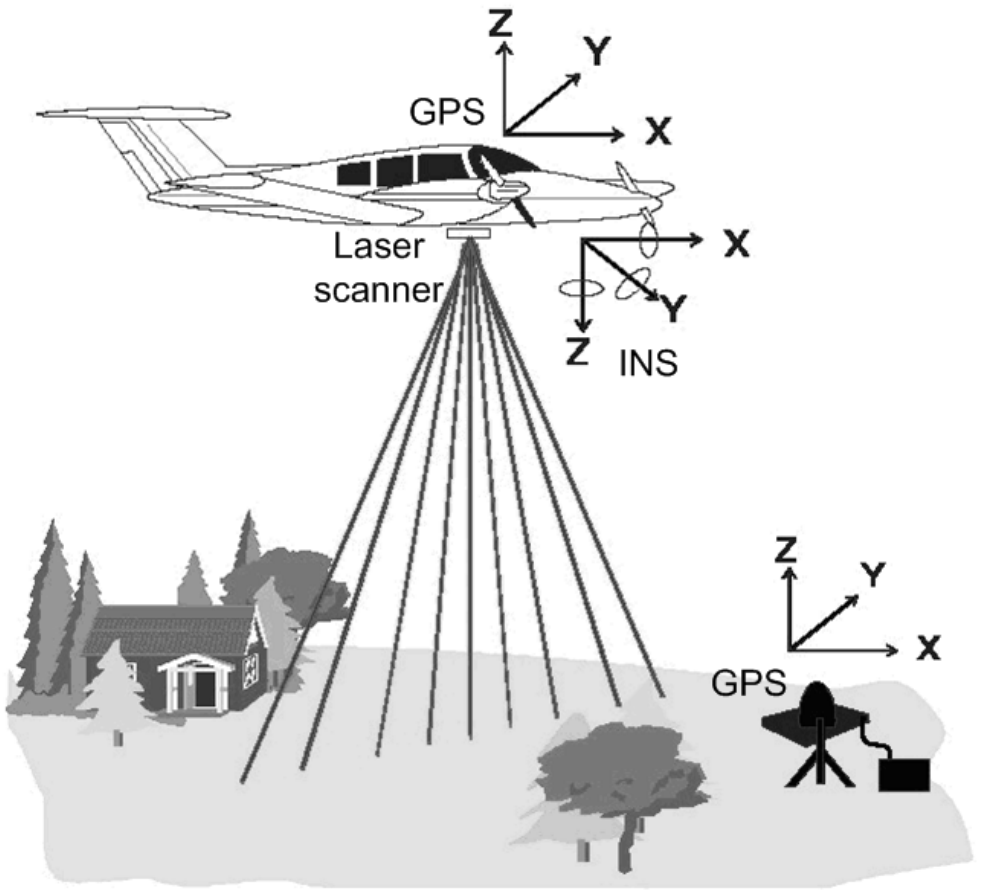
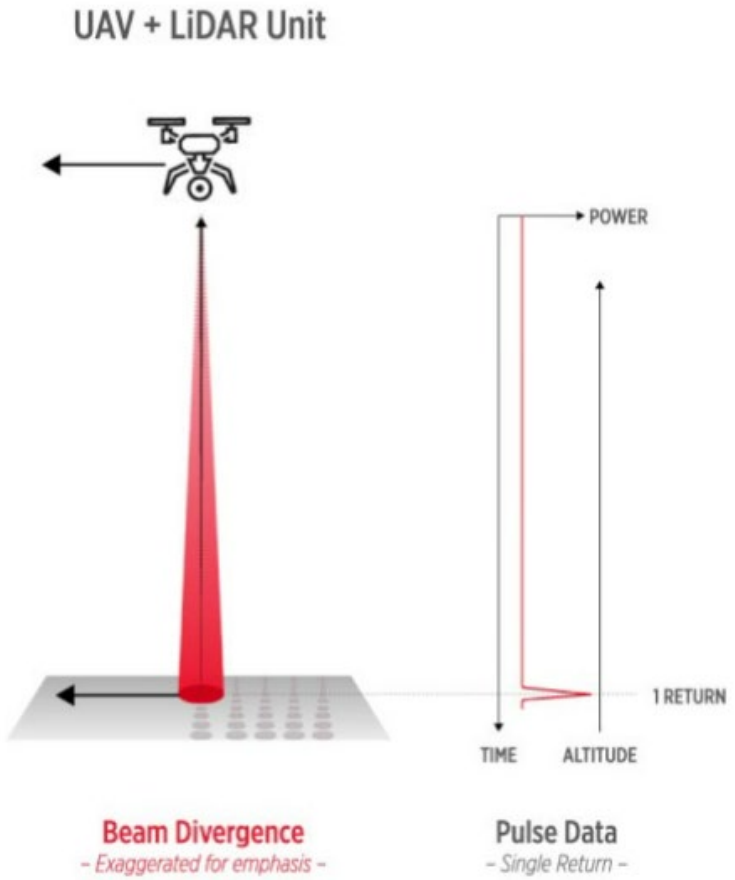
The Unmanned System

- FreeFly - Alta-X drone
- True View 515 lidar Sensor
- Phase One megapixel camera

The Fundamental of Aerial Lidar





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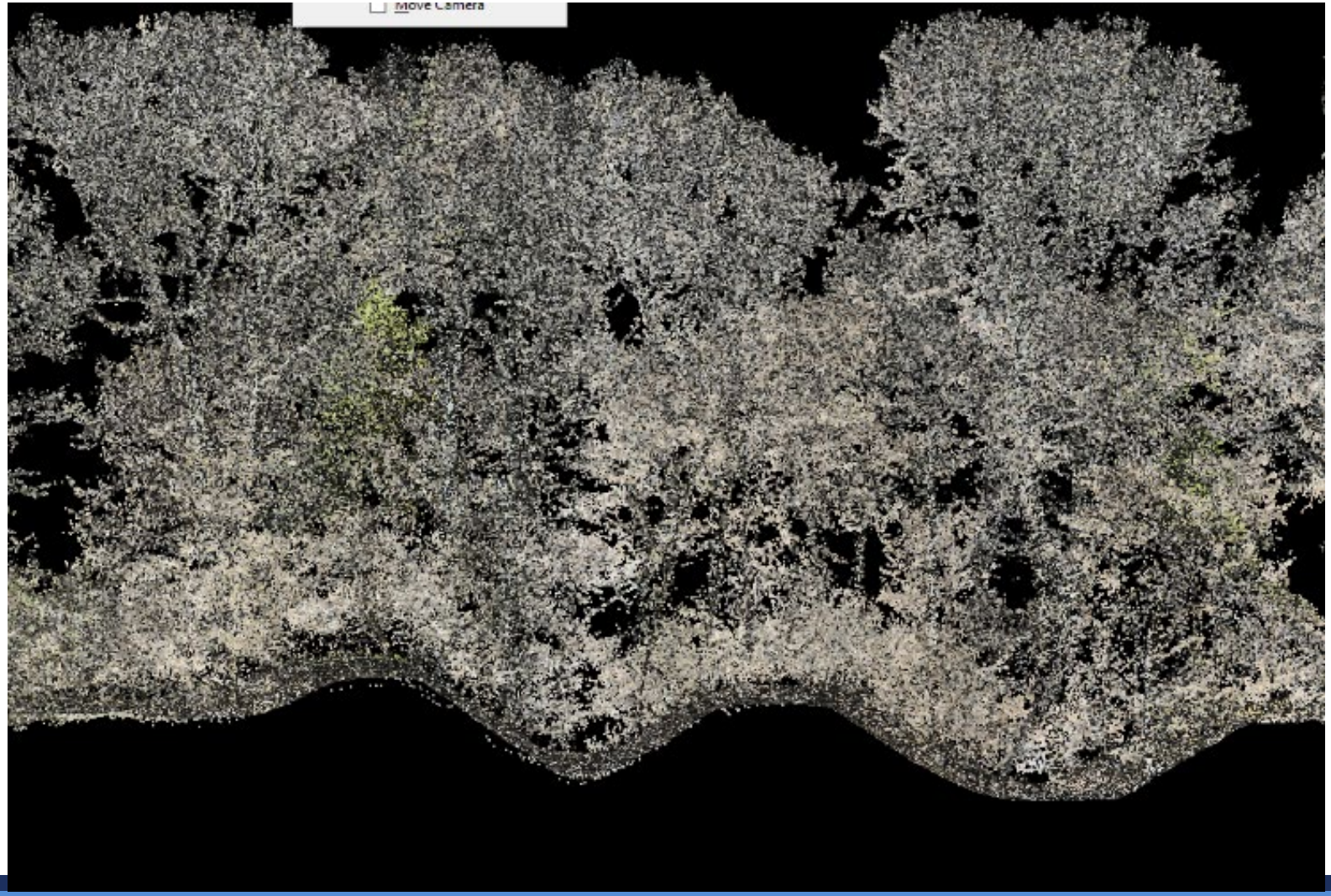
The Lidar Data

One thin slice showing all lidar returns



The Lidar Data

One thin slice showing filtered returns

The Lidar Data

One thin slice showing over target feature – a rock

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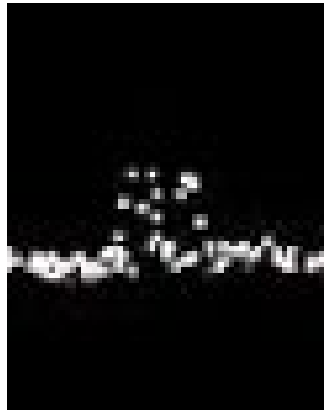
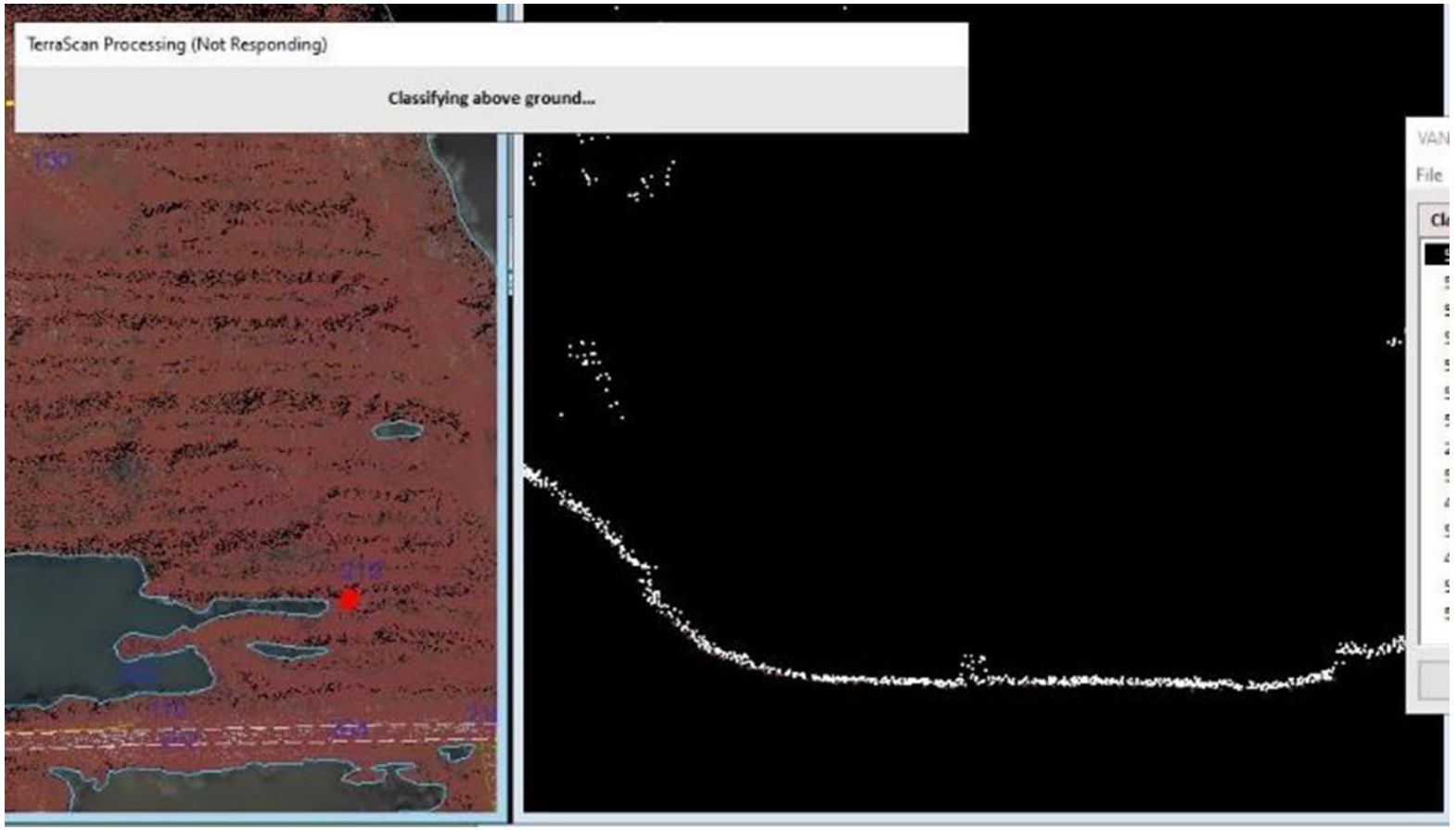
The Lidar Data

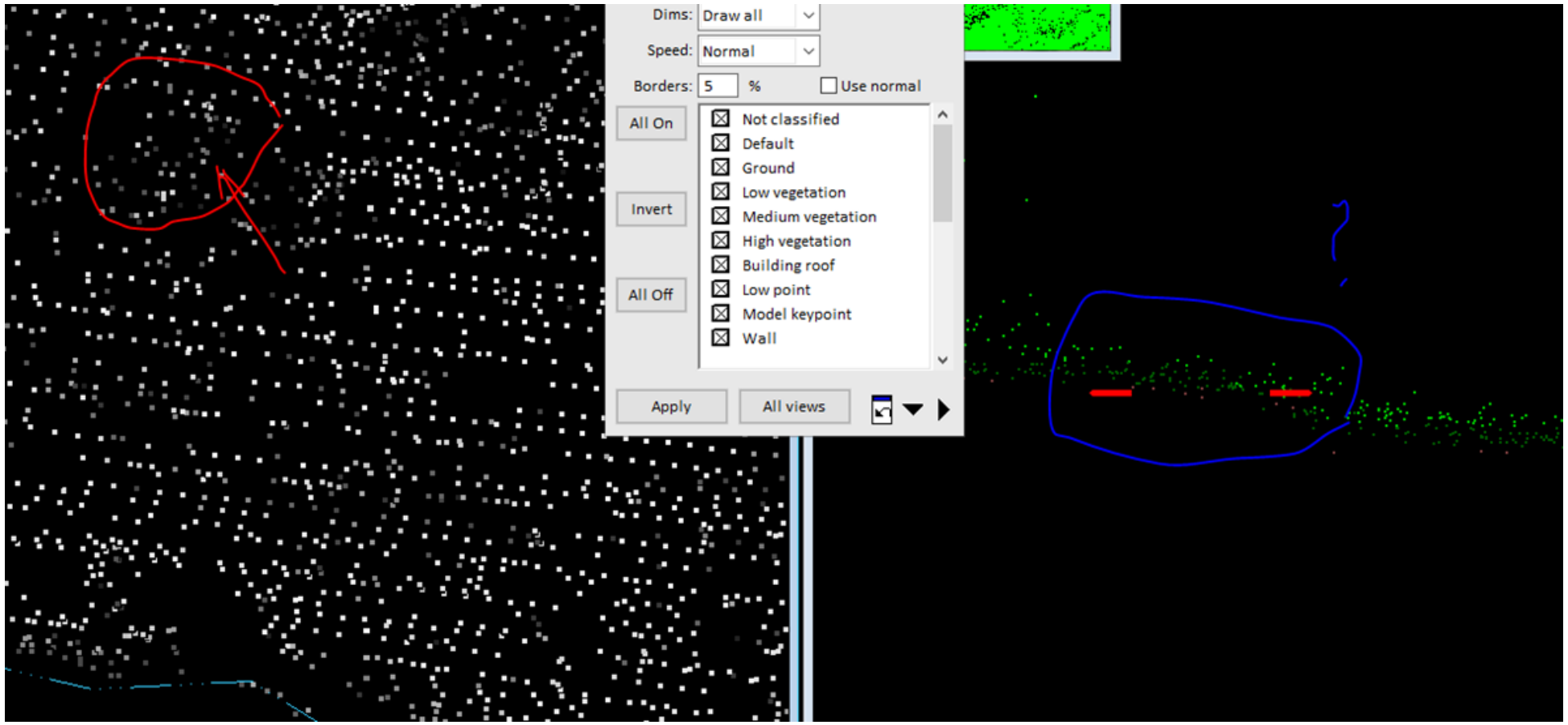
One thin slice showing over target feature – a bucket





The Lidar Data

One thin slice showing over target feature – a car tire



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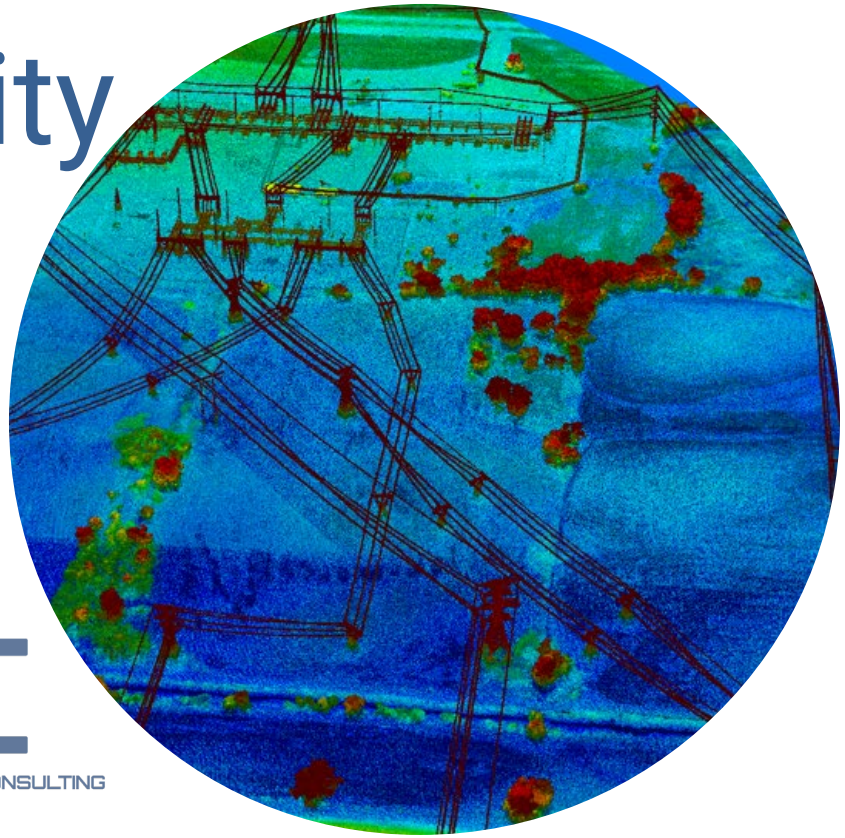
Object Detectability in Aerial LiDAR



TAC
TECHNICAL APPLICATIONS & CONSULTING

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Scenario:

Two items were randomly placed in the area of interest without knowledge of the location other than these two images.

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Cessna 206 and LiDAR Aircraft

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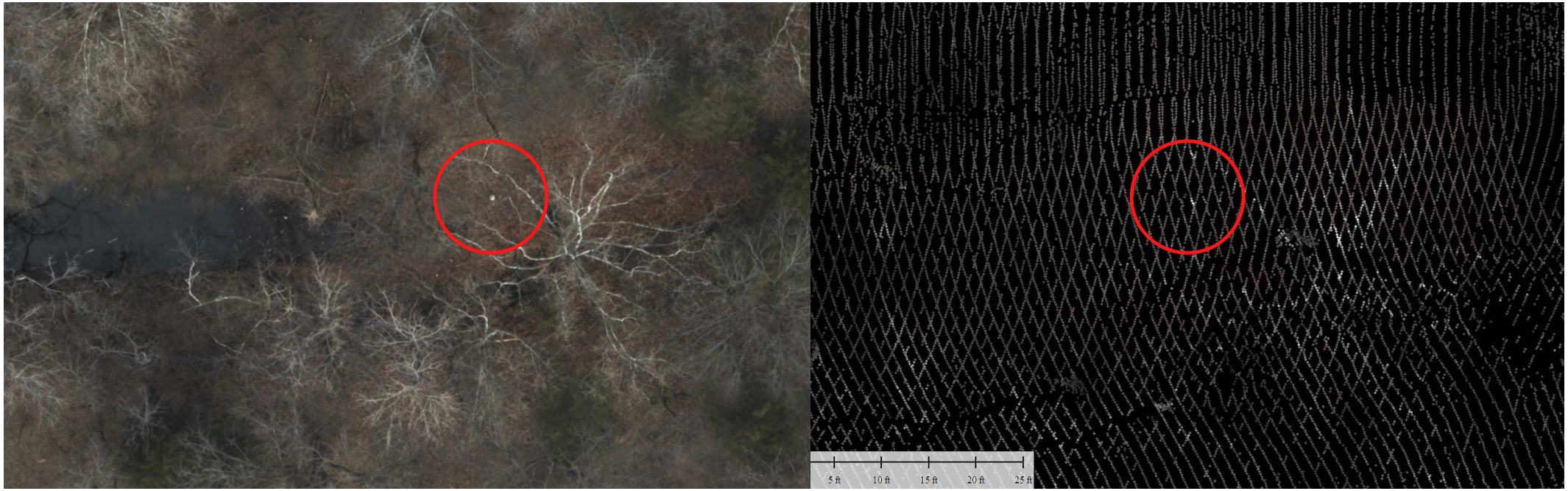
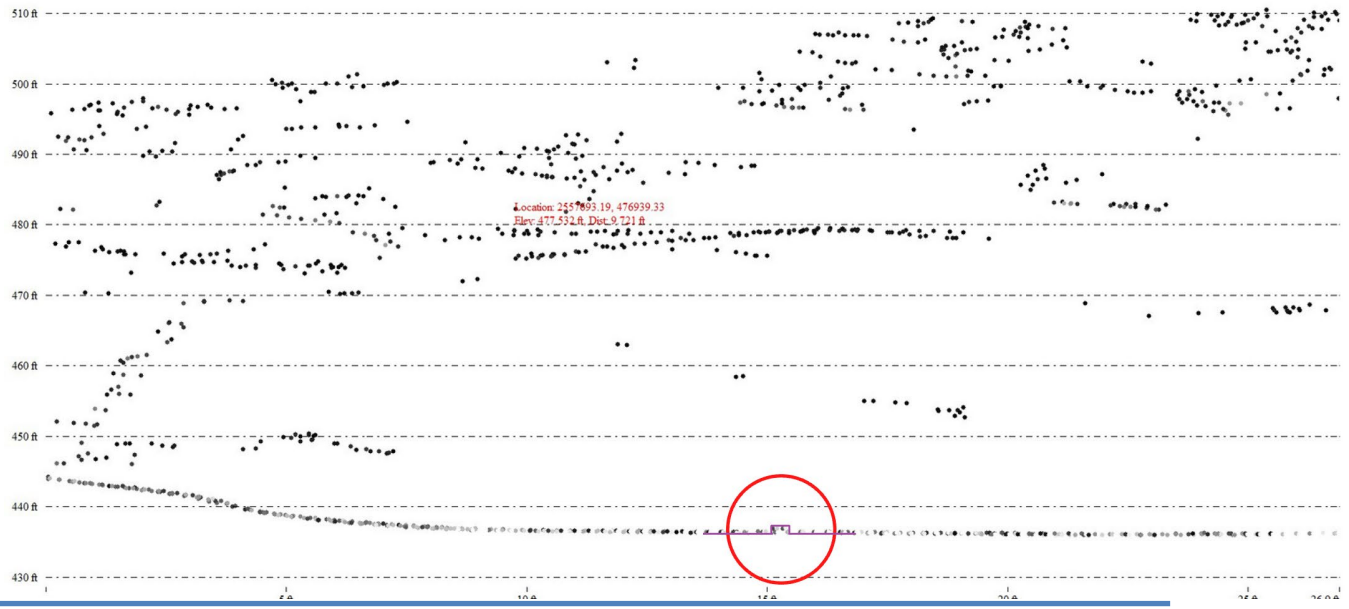
Imagery was used to locate the bucket. While the bucket wasn't clear in the LiDAR Intensity coloring the LiDAR with RGB showed a possible item of interest.

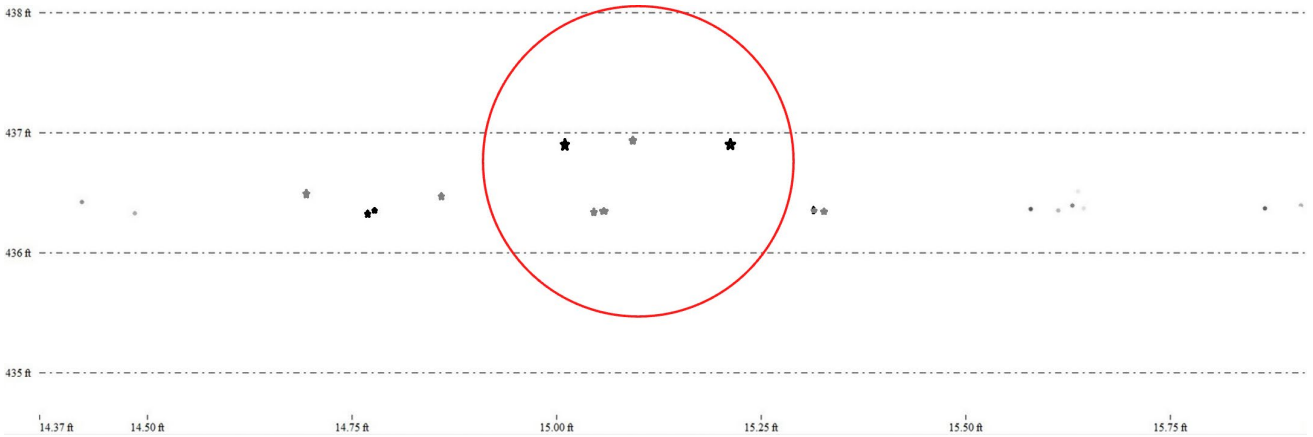


Note: The elliptical scanner only received a few returns off the bucket. The returns can be inspected in the cross section view.

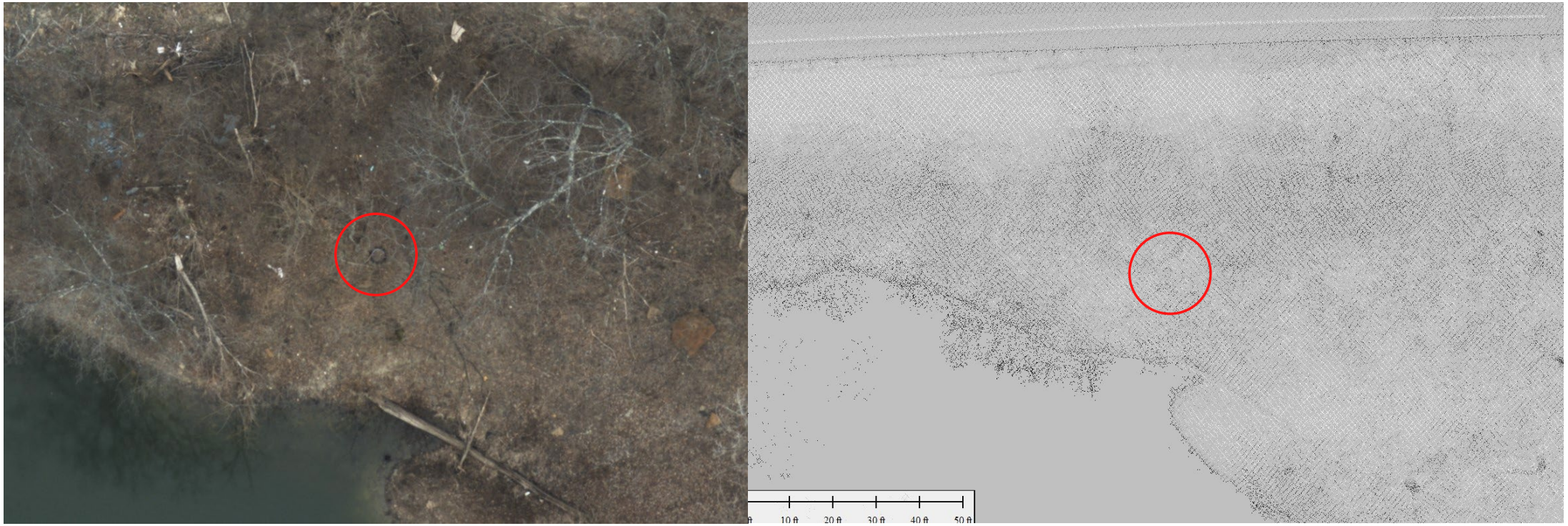
Cross Section of Suspected Bucket Area



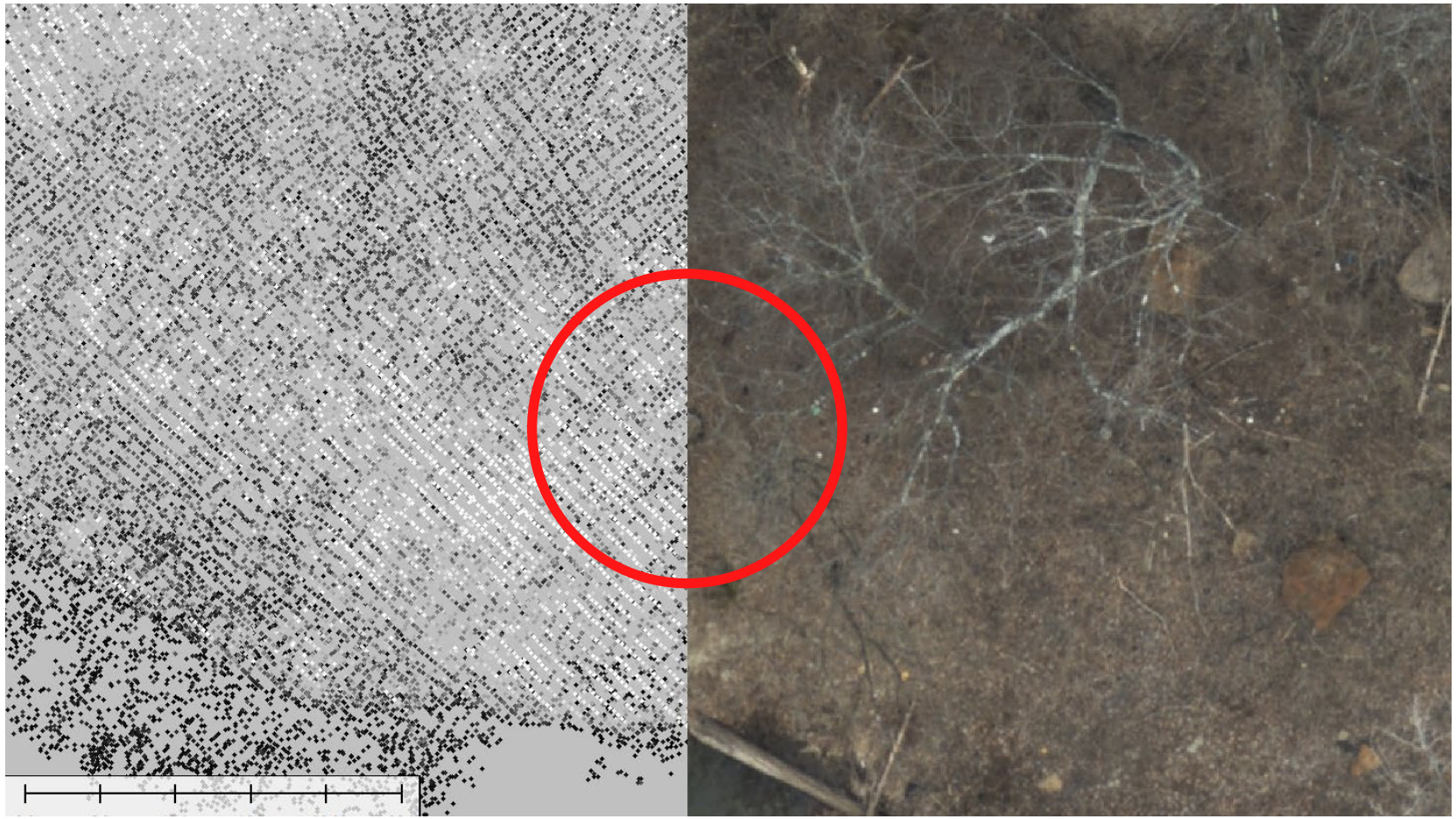
Zoomed Cross Section of Suspected Bucket Area



Imagery that was collected on the LiDAR flight was used to locate the tire. The LiDAR Intensity does show the tire, if you know where to look.



Side by side comparison of the LiDAR and the imagery



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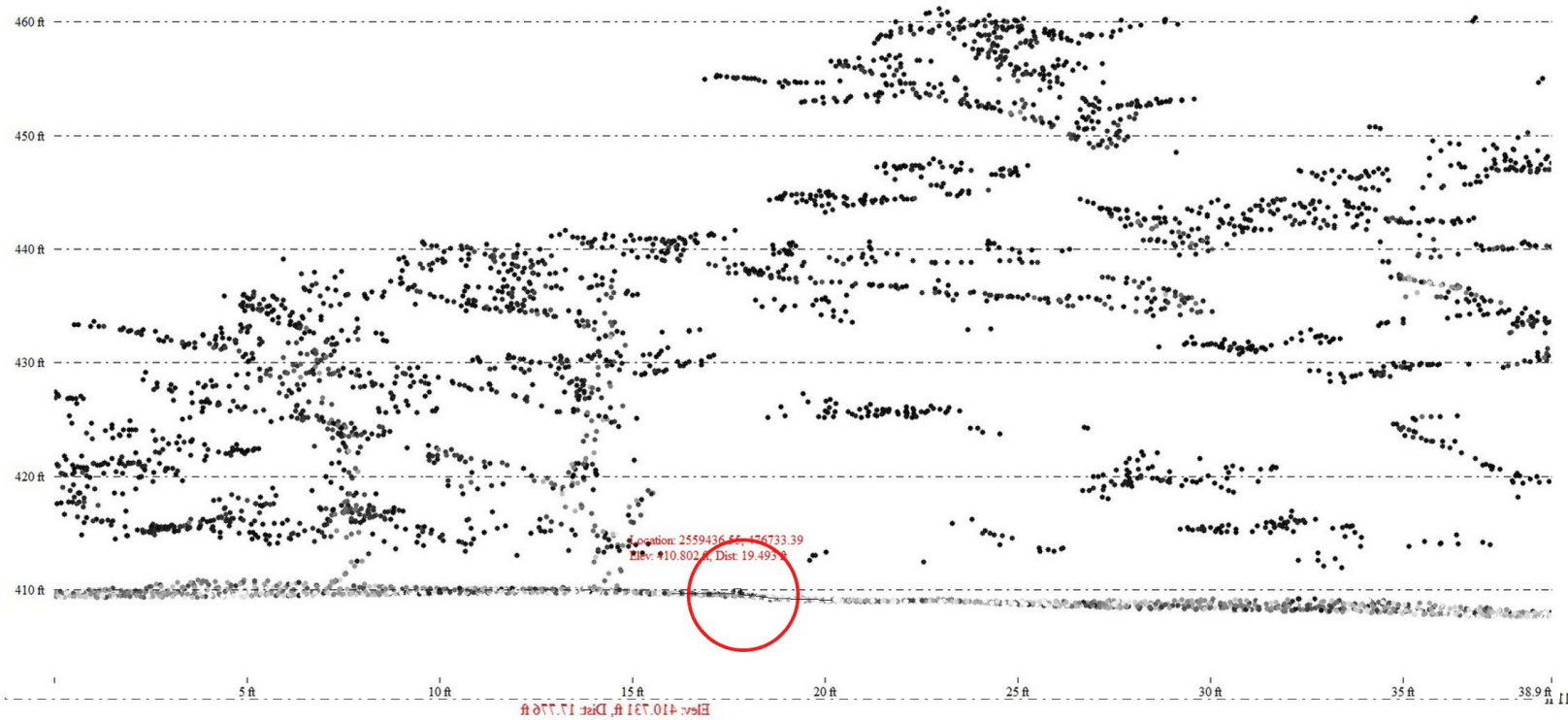
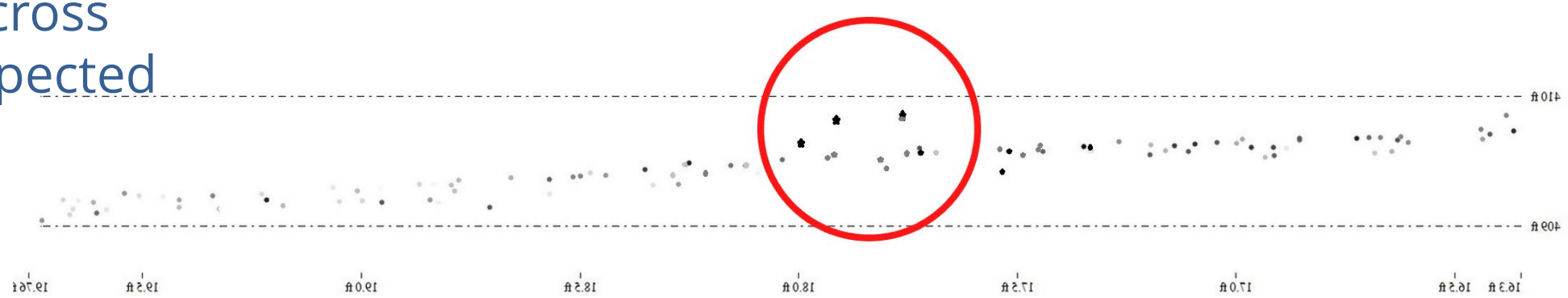
Cross section over suspected tire



Zoomed in cross section of suspected tire



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NOTES

- LiDAR point spacing and point density are critical when identifying small objects. Point density and point spacing do not necessarily correlate.

- Target object reflectivity, laser origin height above terrain and beam divergence are critical when attempting to detect specific targets of interest.

- Multipulse beam returns in vegetated areas are essential in target detectability under canopy.

- Prior knowledge of target composition is critical.

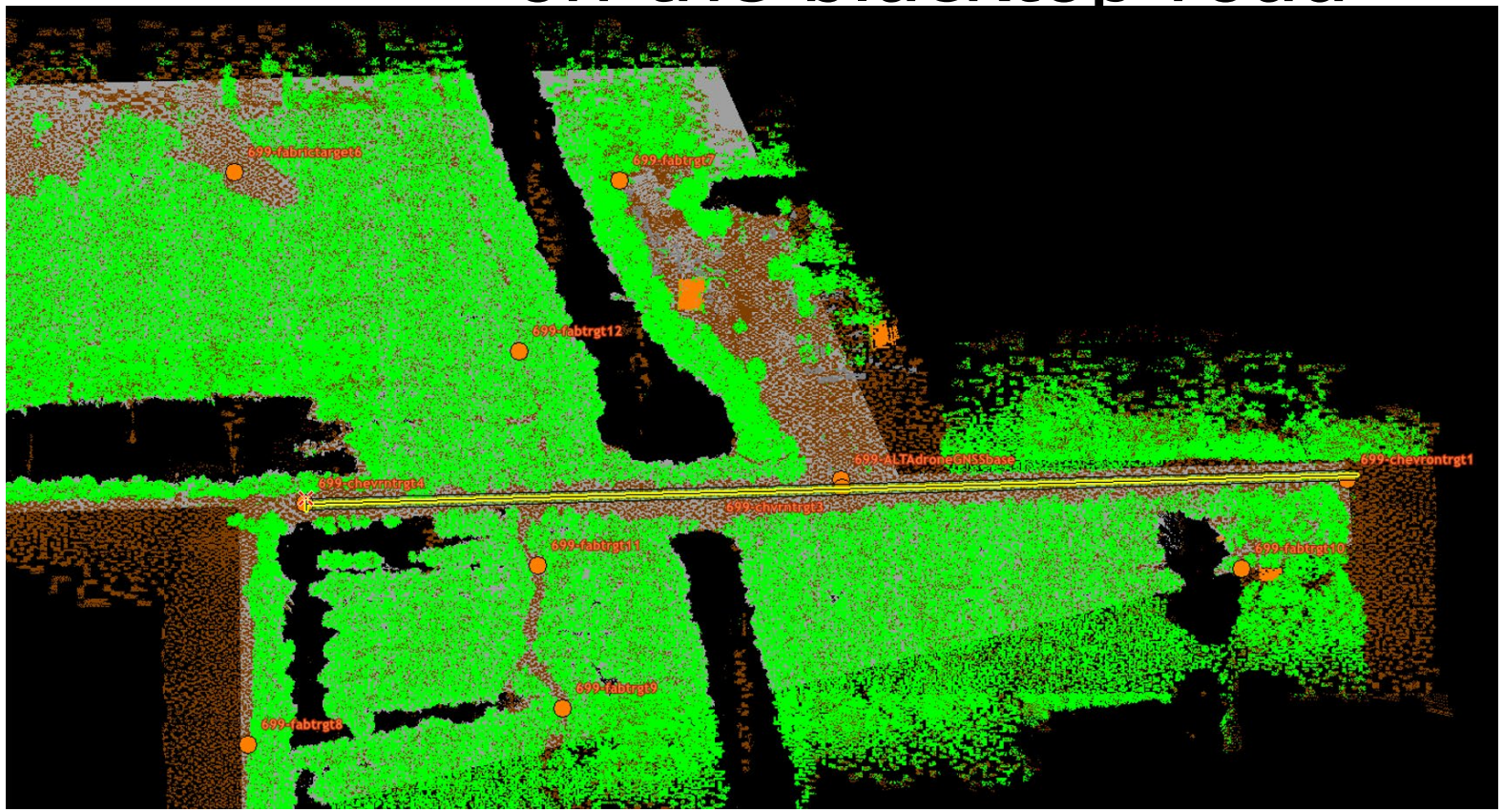
- Elliptical Scan, Line scan and rotating scanners have different limitations with regard to target detectability.

The Head-to-Head Comparison

	Unmanned Bucket	Manned Bucket	delta
Easting	2557693.30	2557693.35	-0.06
Northing	476933.52	476933.64	-0.12
Elevation	437.49	436.37	1.13

	Tire	Tire	
Easting	2559434.66	2559434.67	-0.01
Northing	476732.41	476733.44	-1.03
Elevation	409.35	409.56	-0.212

The Head-to-Head Comparison on the blacktop road



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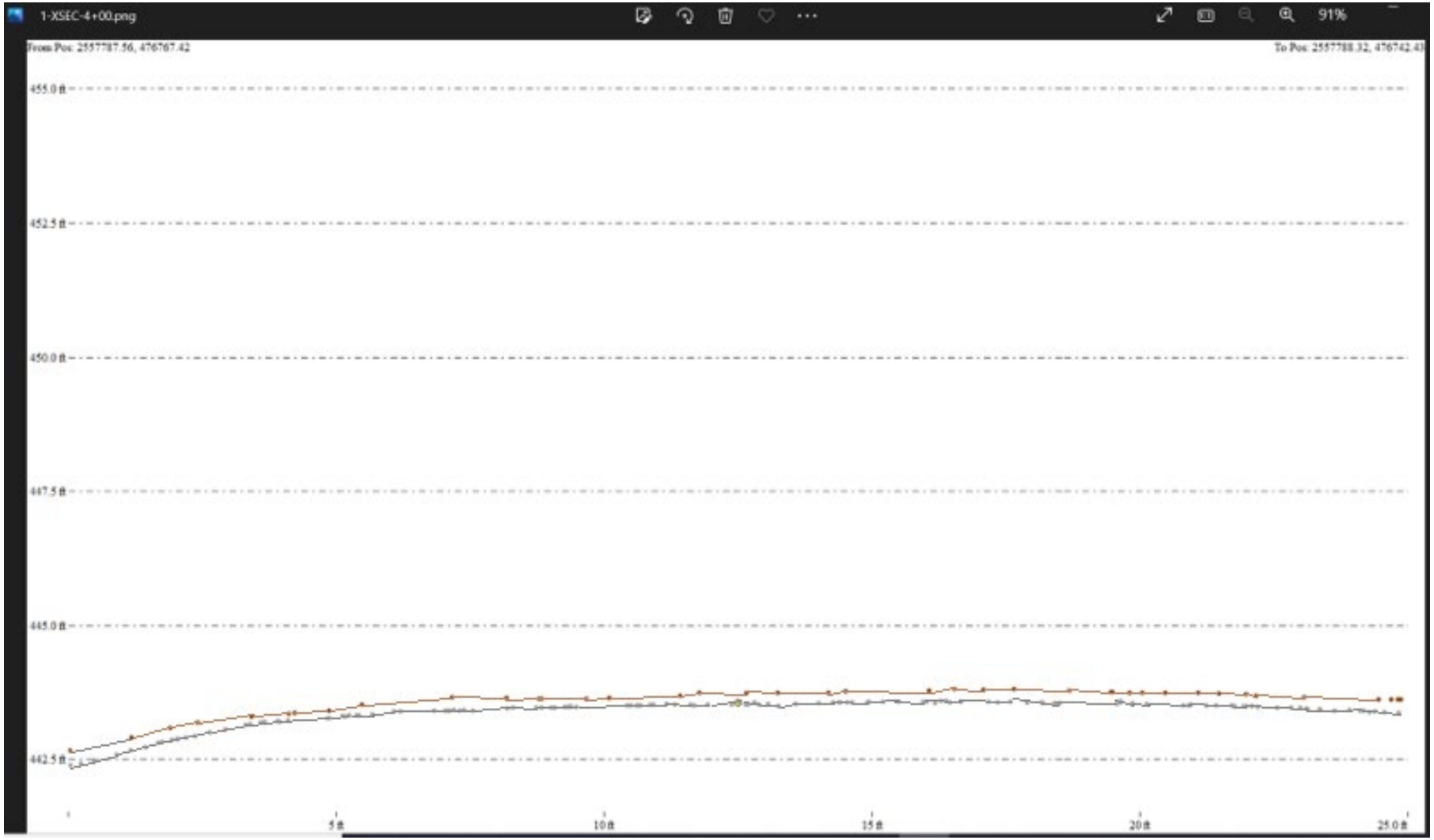
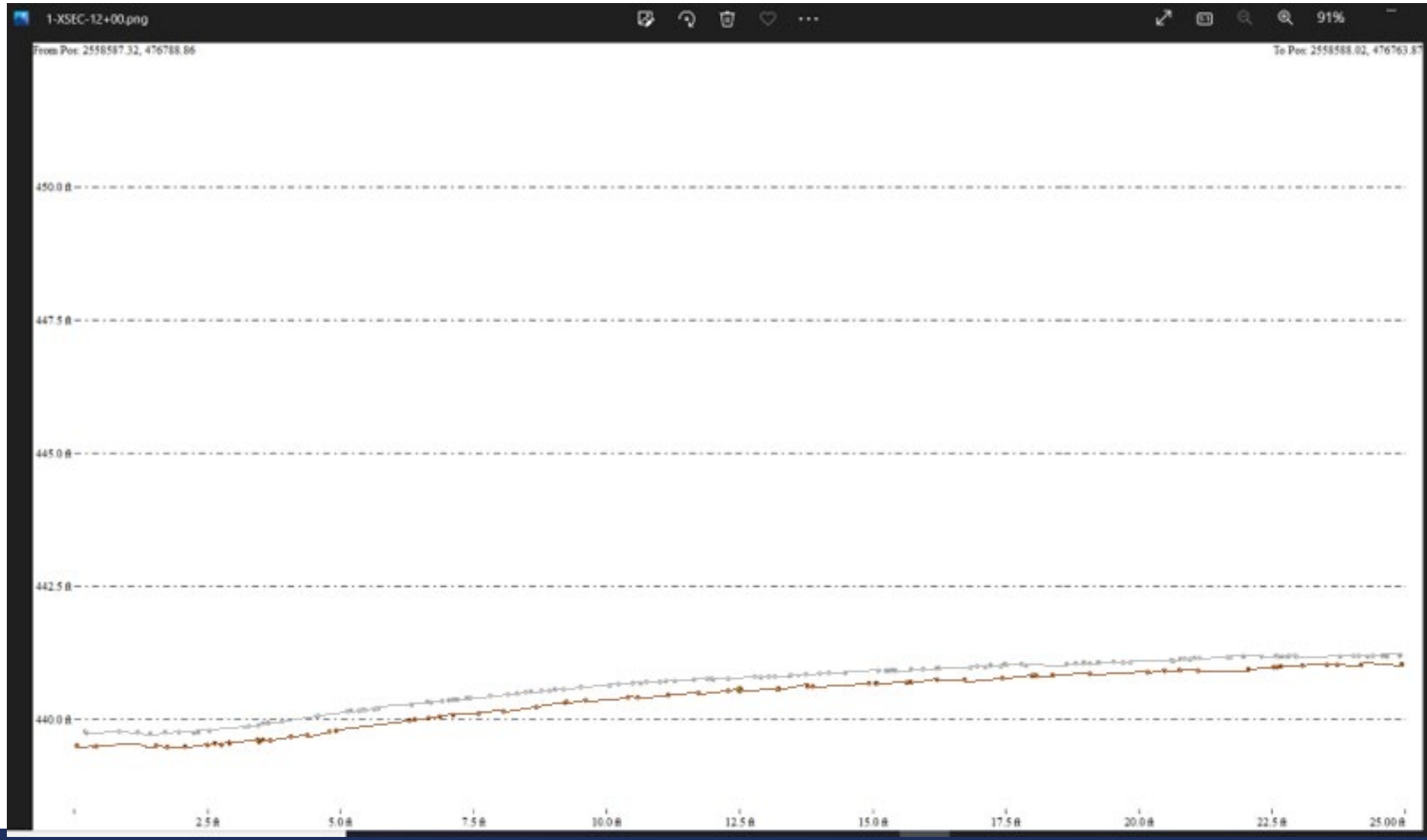
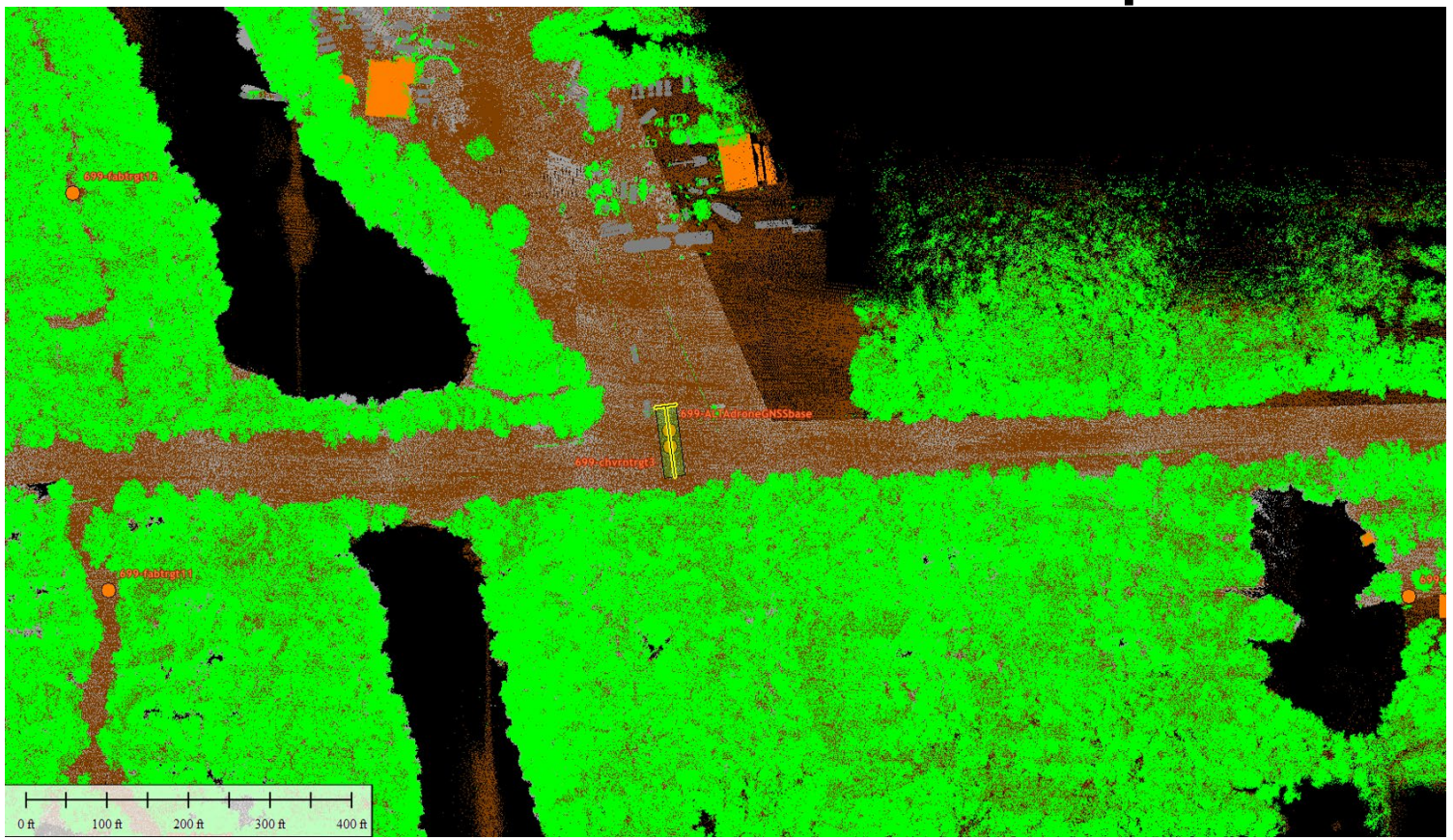
Head-to-Head Comparison on the blacktop road sta. 4+00



Head-to-Head Comparison on the blacktop road sta. 12+00



The Head-to-Head Comparison on the blacktop road



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Head-to-Head Comparison on the blacktop road x-section

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The Ground Control

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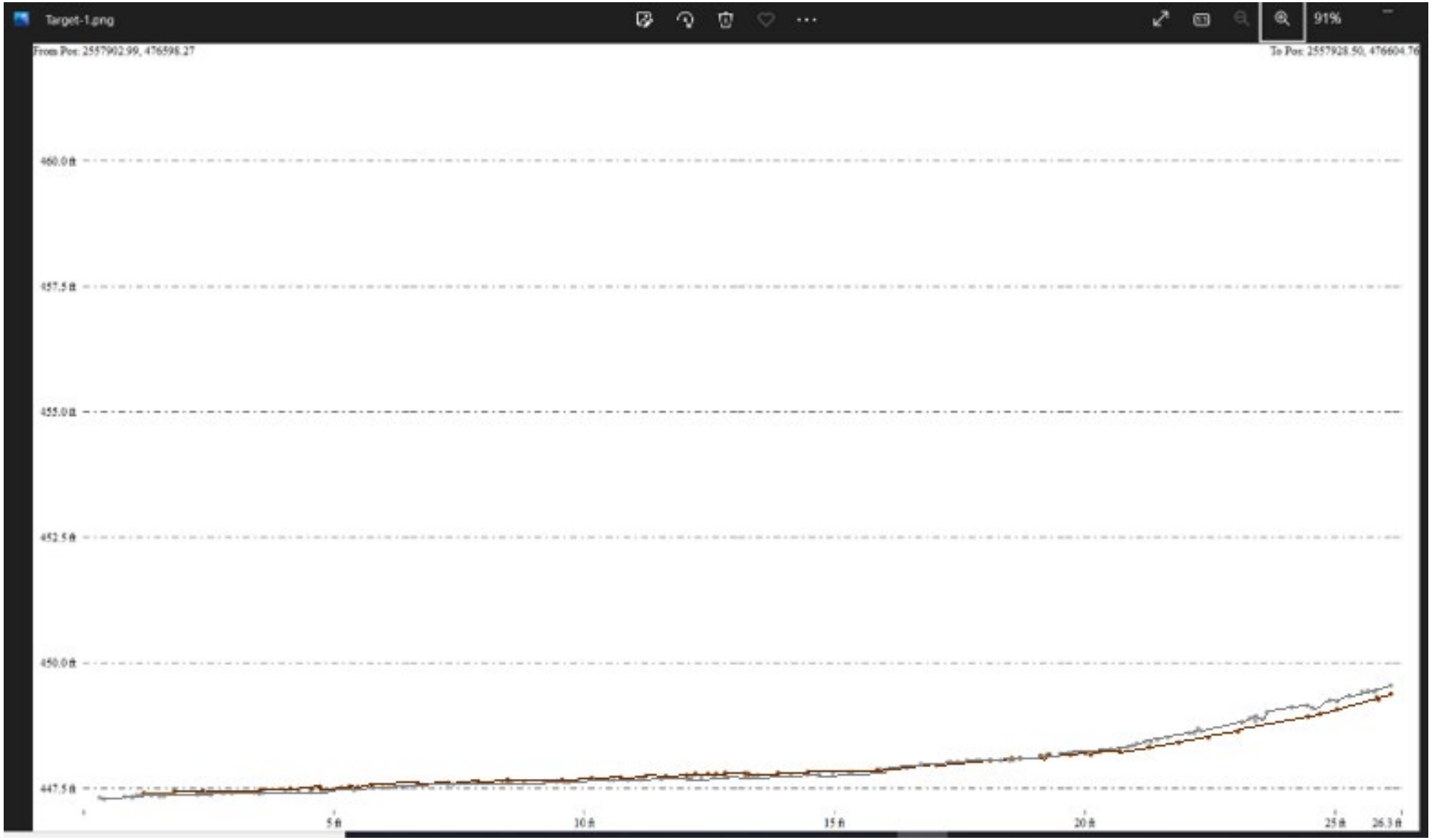
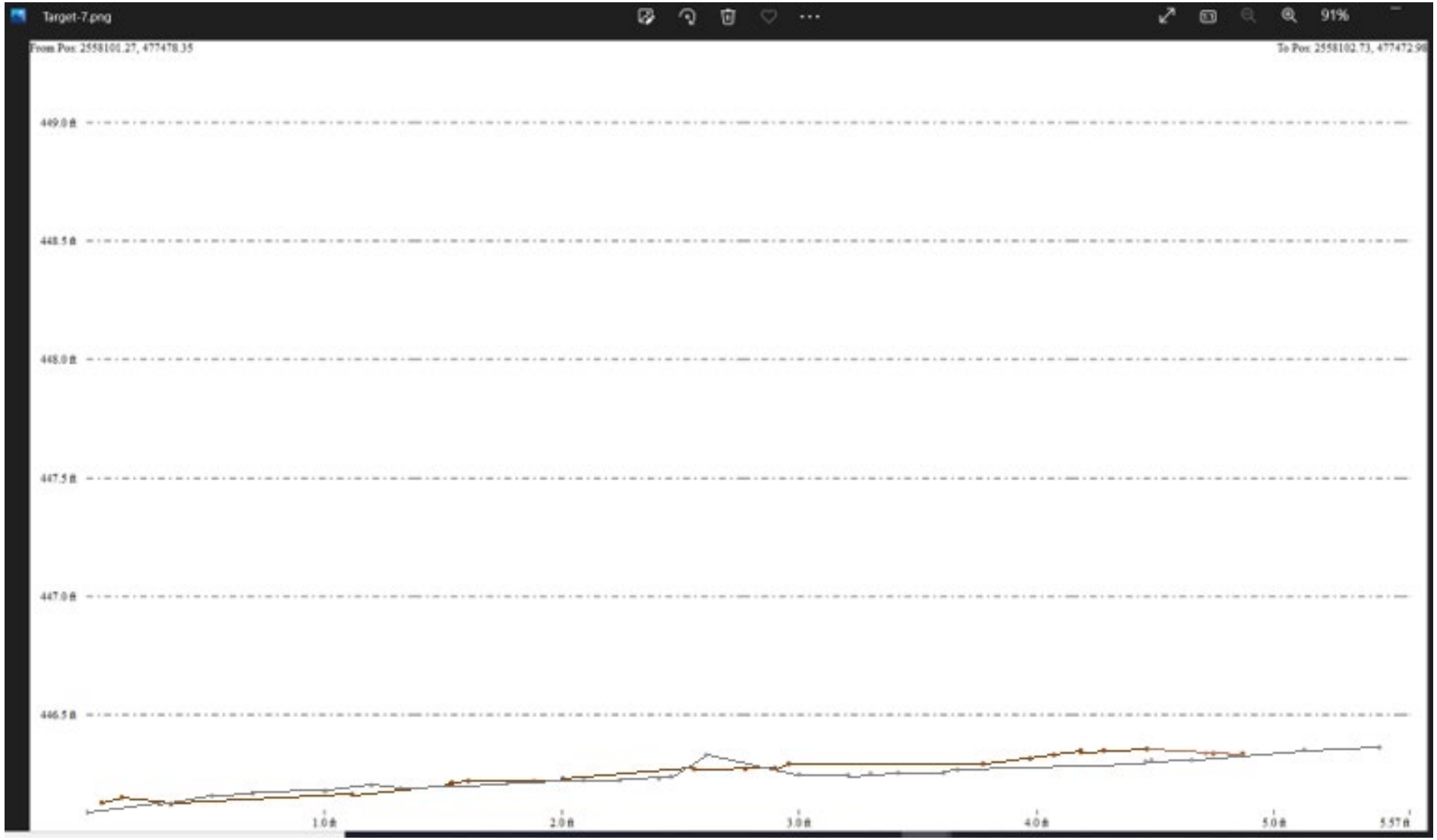
Head-to-Head Comparison on Target #1 on pavement



Head-to-Head Comparison on Target # 7 in the woods



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The Results

Quality Level	RMSEZ Non-vegetated (ft)	NVA at the 95-percent confidence level (ft)	VVA at the 95-percent confidence level (ft)
QL 0	≤0.164'	≤0.321'	≤0.492'
QL1	≤0.328'	≤0.643'	≤0.984'
QL2	≤0.328'	≤0.643'	≤0.984'
QL3	≤0.656'	≤1.286'	≤1.968'

Ground Control Test – Non-vegetated

NAME	DESCRIPTION	NORTHING (Y)	EASTING (X)	ELEVATION (Z)	CLOUD Z	Delta Z
106	CHEVRON 1	476796.162	2559751.501	424.485	424.612	-0.127
109	CHEVRON 2	476731.301	2556195.768	459.766	459.804	-0.038
111	CHEVRON 3	476777.185	2558605.961	440.626	440.642	-0.016
110	CHEVRON 4	476742.777	2557388.117	445.695	445.713	-0.018
101	TARGET 5	477501.589	2556193.221	448.866	448.966	-0.100
100	TARGET 6	477492.909	2557227.933	448.932	448.832	0.100
107	TARGET 7	477475.847	2558101.994	446.319	446.372	-0.053
102	TARGET 8	476194.238	2557257.631	449.600	449.594	0.006
104	TARGET 9	476277.988	2557973.318	448.718	448.585	0.133
105	TARGET 10	476593.955	2559513.369	409.698	409.688	0.010
103	TARGET 11	476600.898	2557916.245	447.765	447.689	0.076
108	TARGET 12	477088.682	2557872.724	449.514	449.340	0.174

Vertical RMSE:	0.077
Note: Vertical NMAS/VMAS Accuracy (90% CI):	±0.126
Vertical NSSDA Accuracy (95% CI):	±0.150
ASPRS Vertical Accuracy Class:	**0.077**
Vertical Min Contour Interval:	0.231

Note: Point 12 (108) was excluded from testing as target was determined to not be flat on ground and in heavily vegetated area.

RMSEZ of 0.077' is less than or equal to 0.164', which meets or exceeds QL0 accuracy level.

MANNED vs. UNMANNED

Requires less ground control		Requires more ground control
Captures project in 1 photo		300+ individual photos to mosaic
Smaller data set (fewer lidar pts) ~9 ppm		Larger data set ~ 30 ppm
Fewer flight lines		Required multiple E-W and N-S lines

Thank you for your interest, any questions?

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2021 Best Places for Engineers to Work! ISPE: View Video

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PRAIRIE ENGINEERS THANK YOU!

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DARREN FORGY – M 217-553-0495