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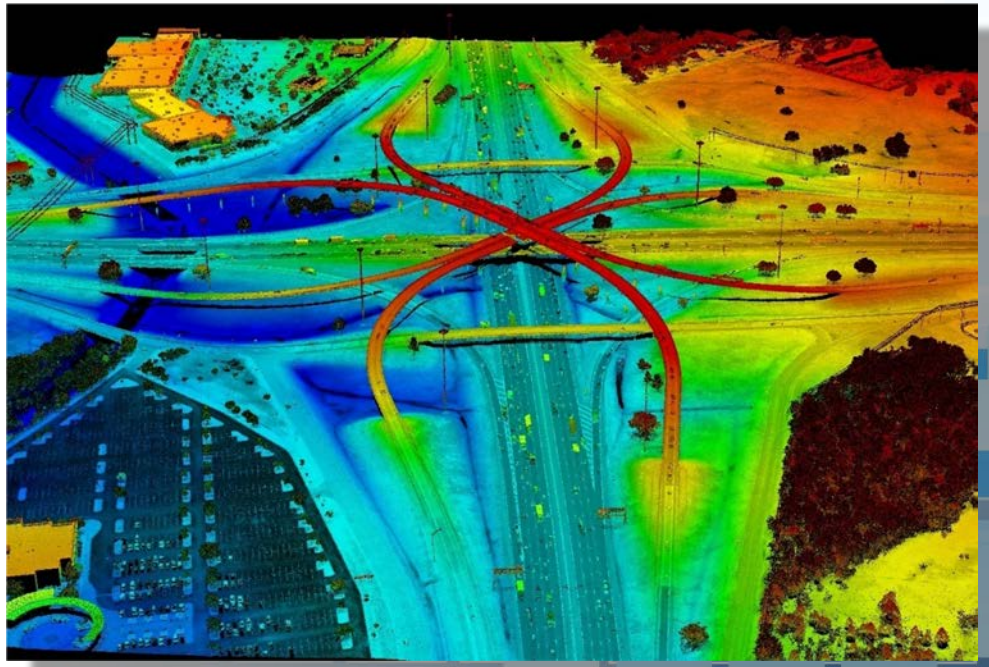
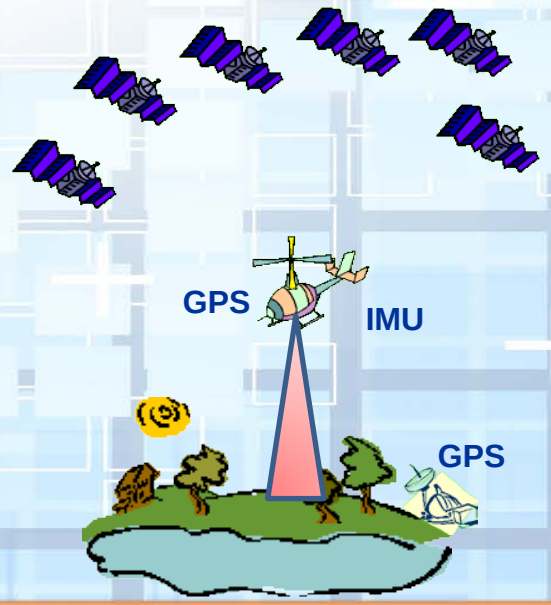


Remote Sensing
Transportation with LiDAR

LiDAR Basics

- **Li**ght **D**etection **a**nd **R**anging
- Position of the LiDAR provided by GPS
- Position and Orientation of the laser provided by IMU
- The scan angles and ranges of the laser are provided by the sensor
  - Data combined in post-flight processing to accurately determine the position of each point
  - Acquisition:
    - Aerial Up to 2M/second or more
    - Mobile 600K/second or more
  - Density:
    - Aerial: 1-100 ppsm
    - Mobile: 2000-5000 ppsm
- Point Cloud Data File



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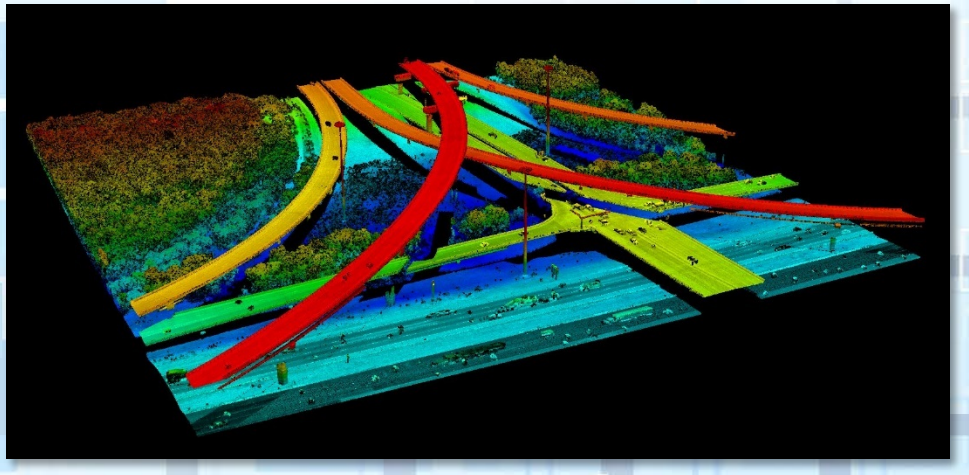
LiDAR

Most cost effective approach for:

- Large or Small Mapping Areas
- Very Dense 3D Coded Detail
- Integration of LiDAR and Photogrammetry
- Collect Once – Use Many



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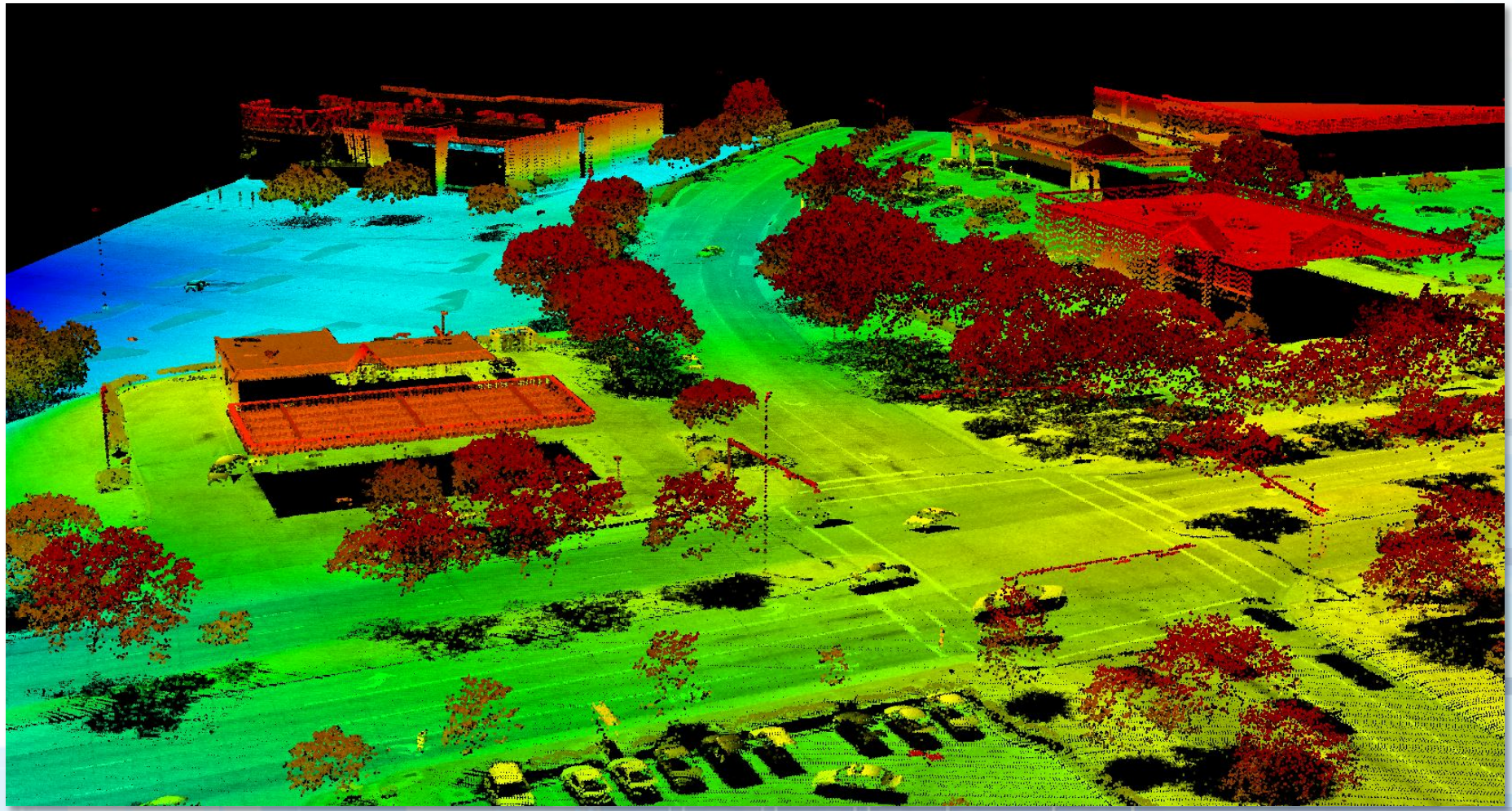
Point Cloud of Data



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LiDAR For Transportation

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Power of LiDAR

- Speed, Varying Accuracies, Cost Effective
  - Design Surface, Transportation and Hydro Modeling
- Fast Accurate 3D Surface Model
  - Accuracy – .1’ or better on hard surface with proper control (depending on LiDAR system)
  - Days/Weeks turn around rather than months
    - Less time of day dependent
      - No sun angles
      - Can fly at night

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Safety

- Does not require personnel in hazardous areas
  - Highway Traffic
  - Landfills
  - Quarries
  - Reclamation Areas

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Less Field Cost Times

- Fewer ground control points vs. conventional photogrammetry
- No need for addition field trips
- Cross sections available anywhere within collection area
- Because cost/coverage is more affordable, larger areas (buffer areas), can be collected for unforeseen influence of outside project area
- Collect LiDAR once, extract information anytime
- LAS files can be separated by class too, so you separate Ground, Buildings, Vegetation, Roads

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Limitations

- Non Reflective Surfaces
- Snow
- Line of Site Measurements (Shadowing)
- Availability of aircraft (helicopter/fixed wing)
- Terrain
- Weather
- Hardware and Software

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LiDAR Uses

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Used in Engineering Applications

- Roads
- Bridges
- Dams
- Levees
- Buildings
- Pipelines

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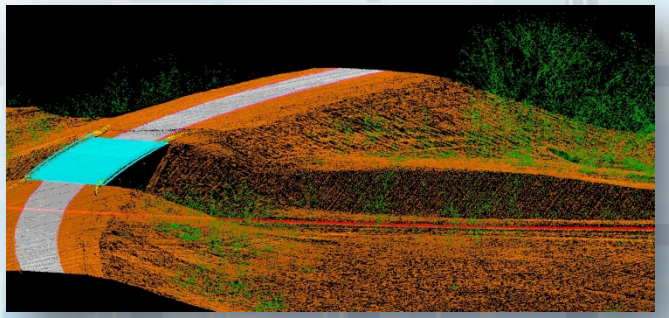
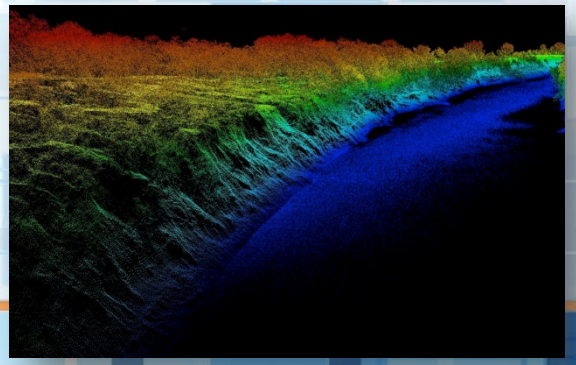
Infrastructure Planning

- Building Footprint and Elevation Data
- Roadways
- Waterways
- Utility Routing and Easements
- Telecommunications Modeling
- Parks and Recreation Planning/Maintenance
- Emergency Preparedness





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Municipal Applications

- Asset Management
- Flood Management (Impervious Surfaces)
- Classification of Features
- Land Fill
- Planimetric Detail (Building Classifications)
- Vegetation Analysis (ROW Encroachment)
- Cut and Fill

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Transportation

- Right of Way
- Roadway/Railway Features & Cross Sections
- Planimetrics
- Fusing Airborne and Mobile LiDAR
- As Designed vs. As Built
- Helicopter vs. Fixed Wing

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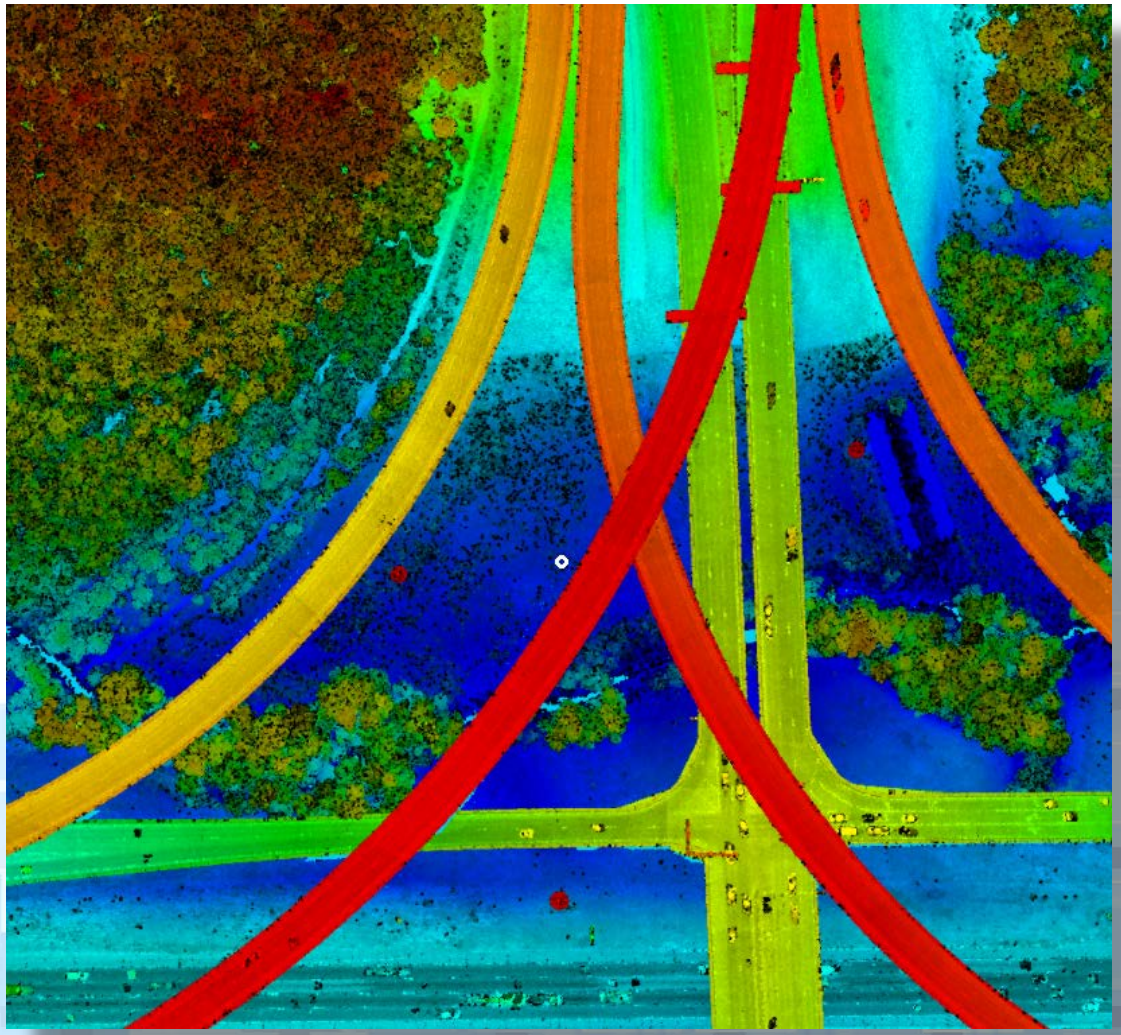
Transportation



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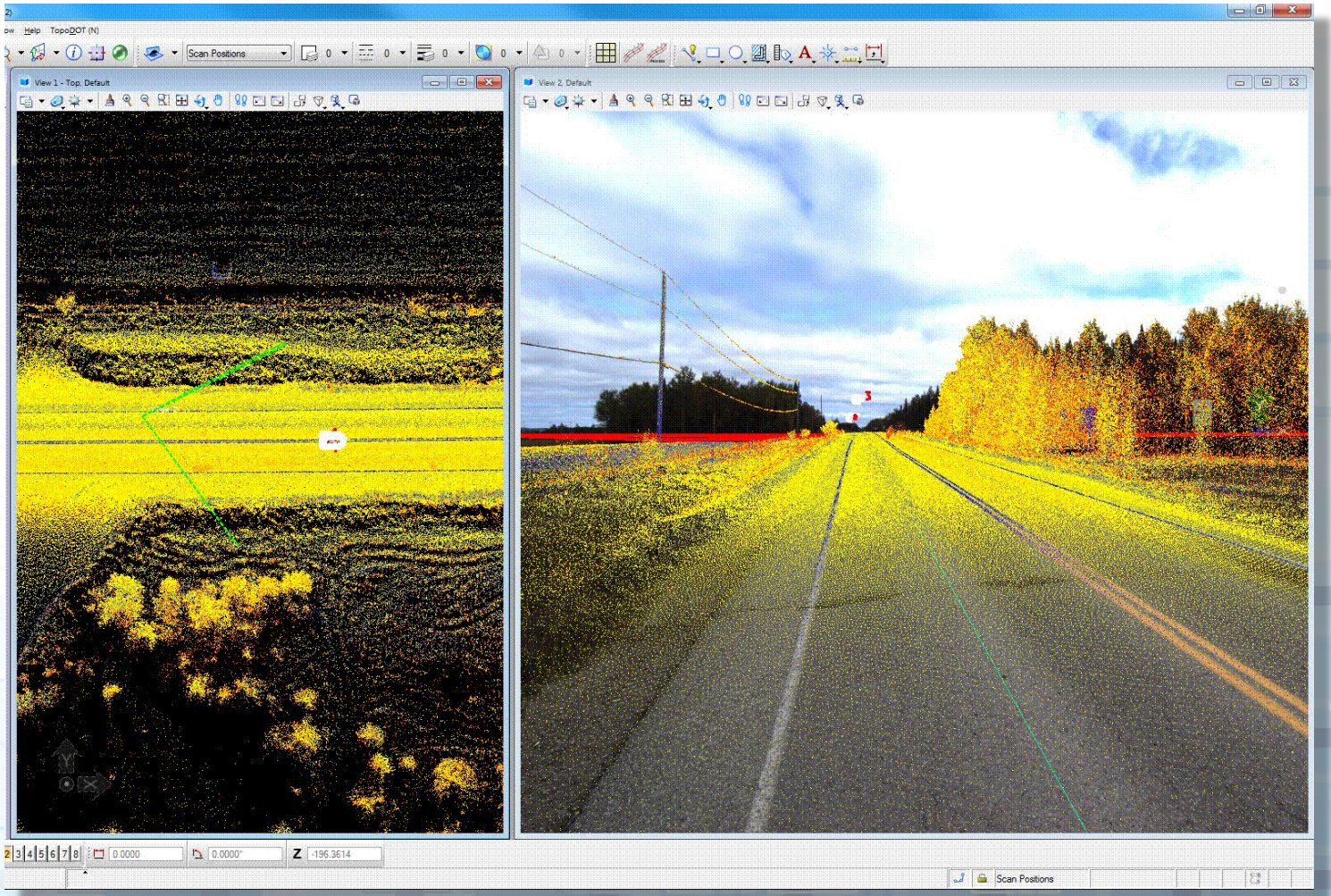
Transportation



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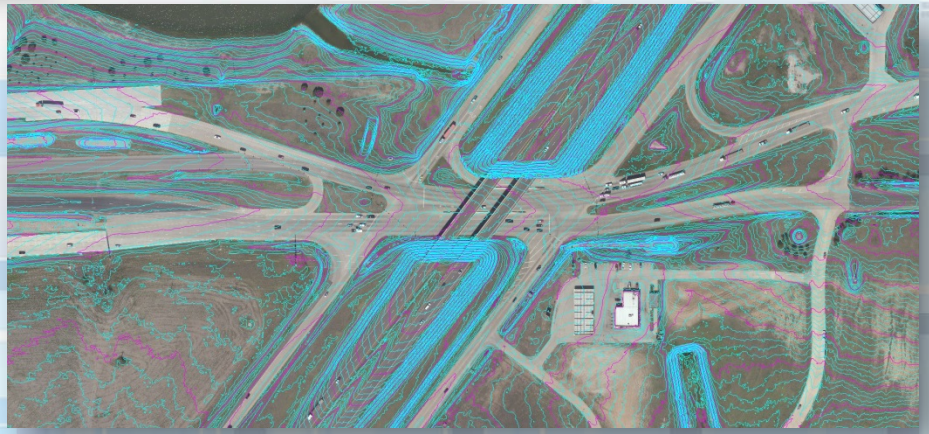
Transportation

3” GSD Imagery

Indexed Contours



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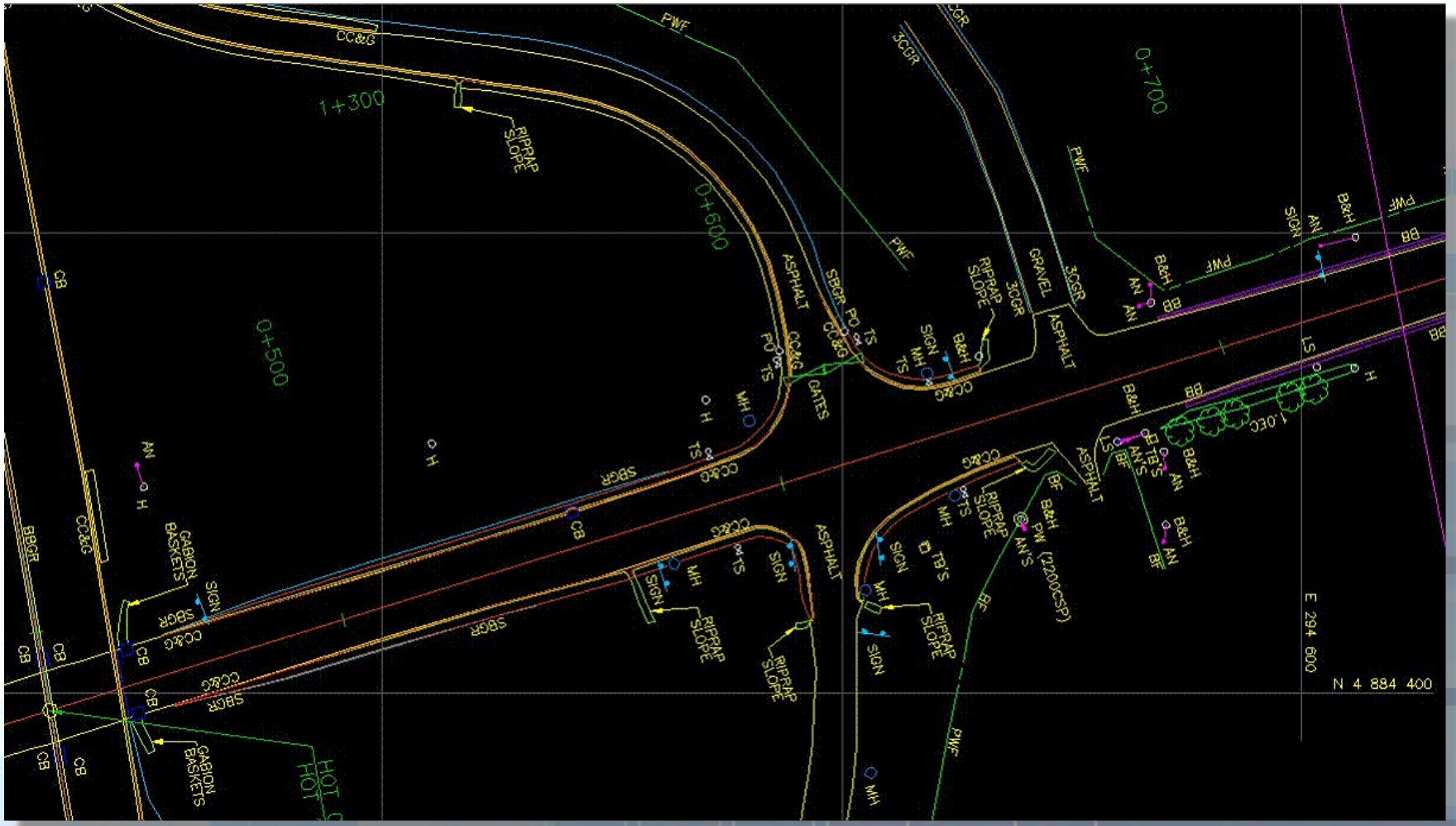
Roadway Planimetrics



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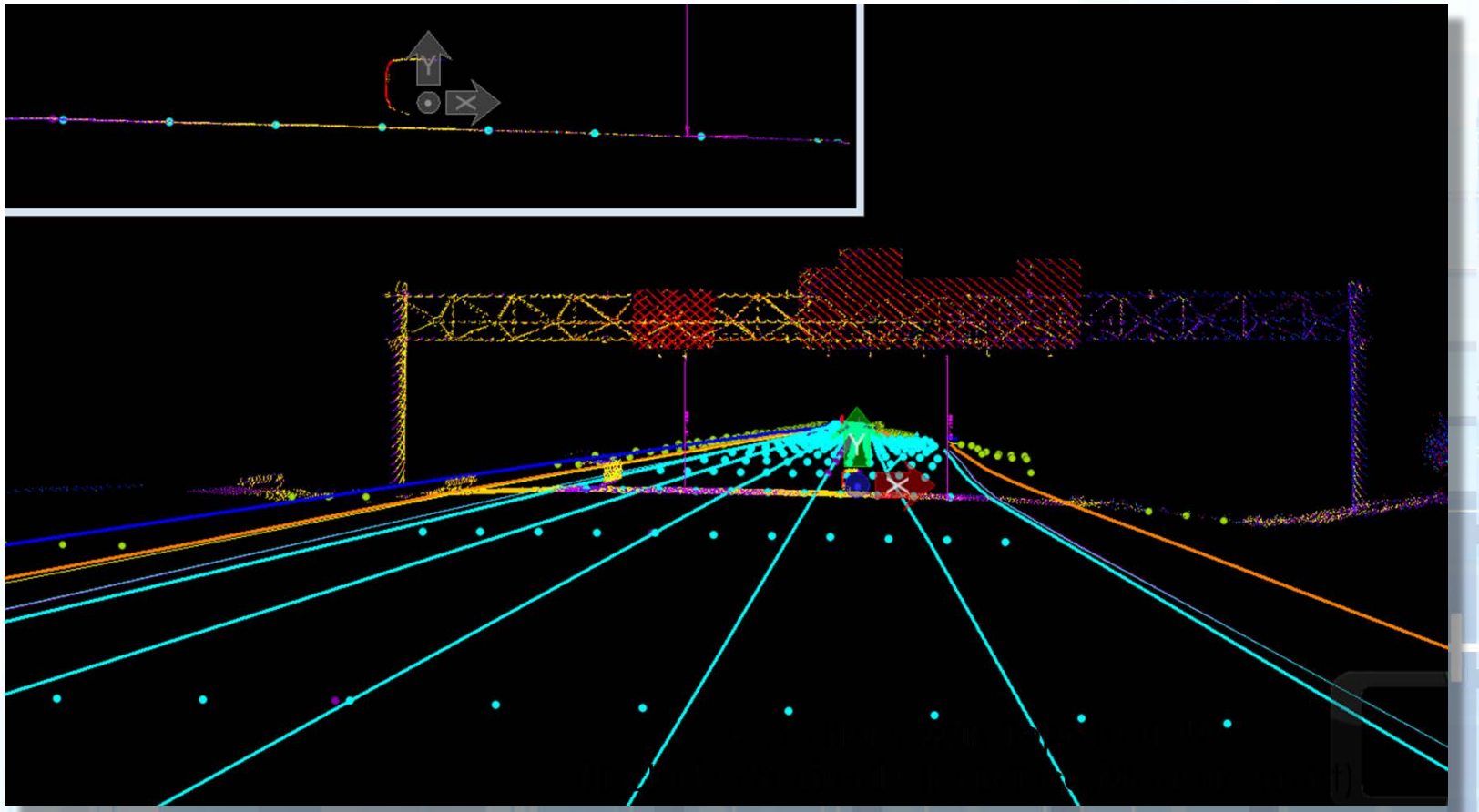
Roadway Features & Cross Sections



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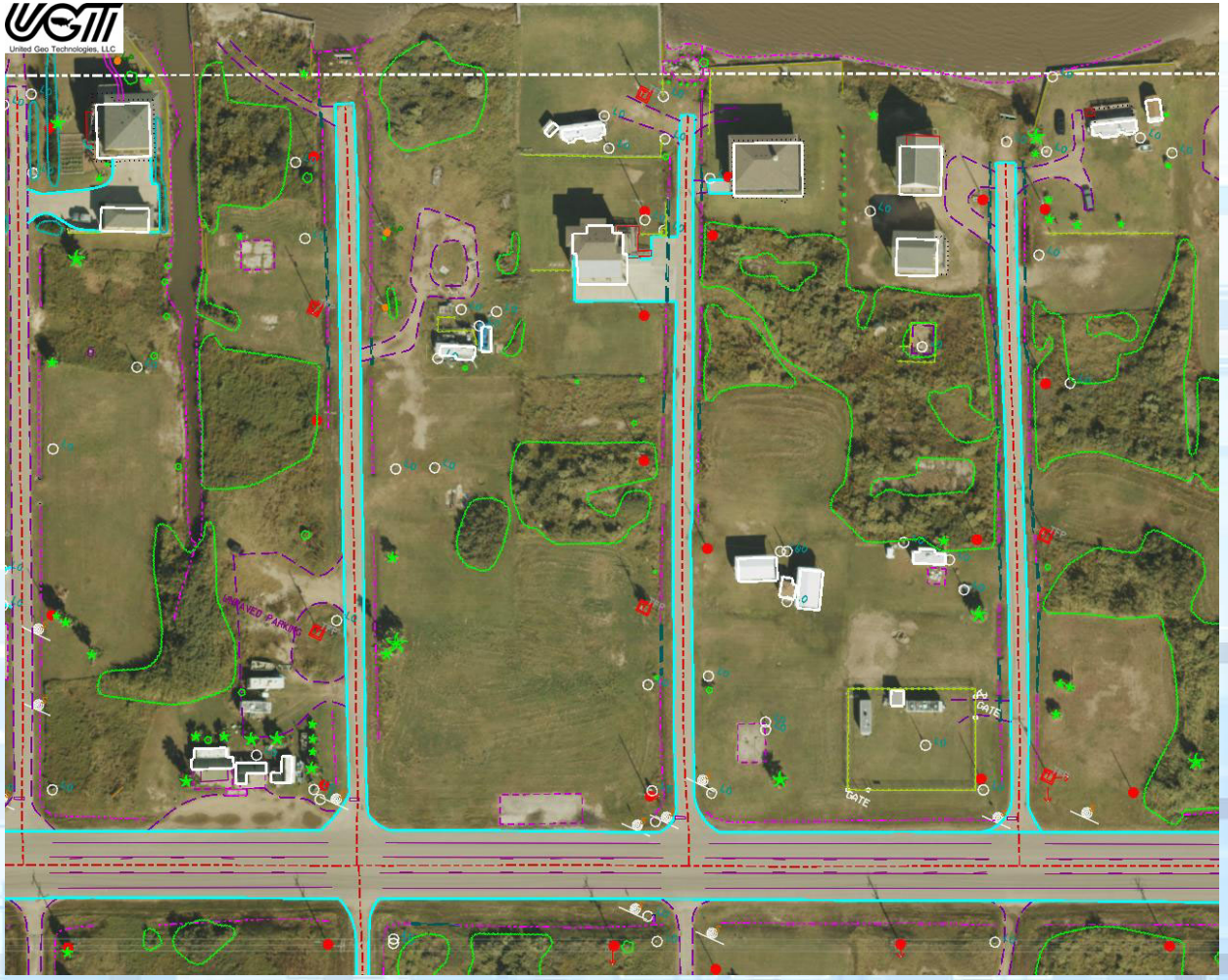
Plan & Ortho



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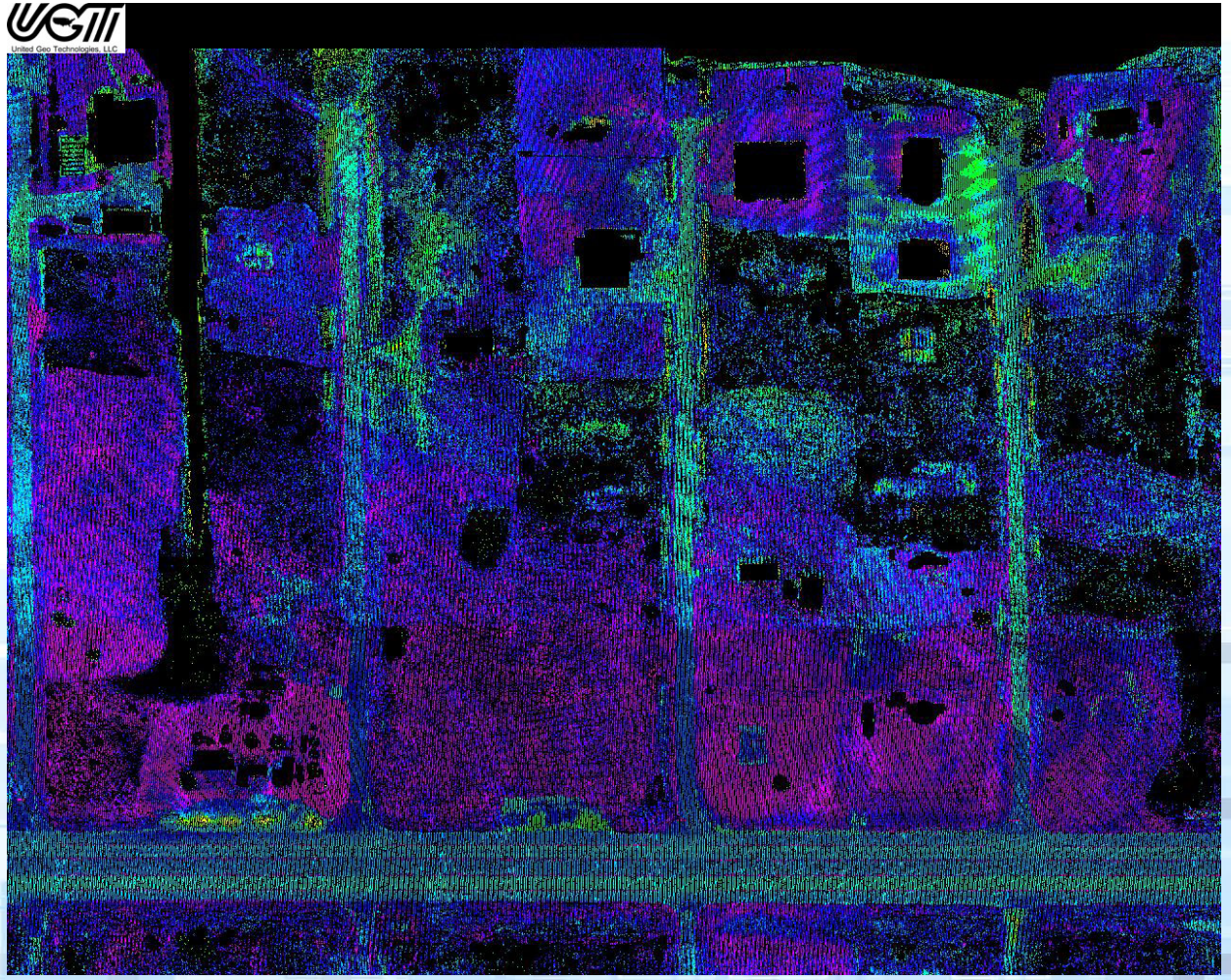
Bare Earth LiDAR



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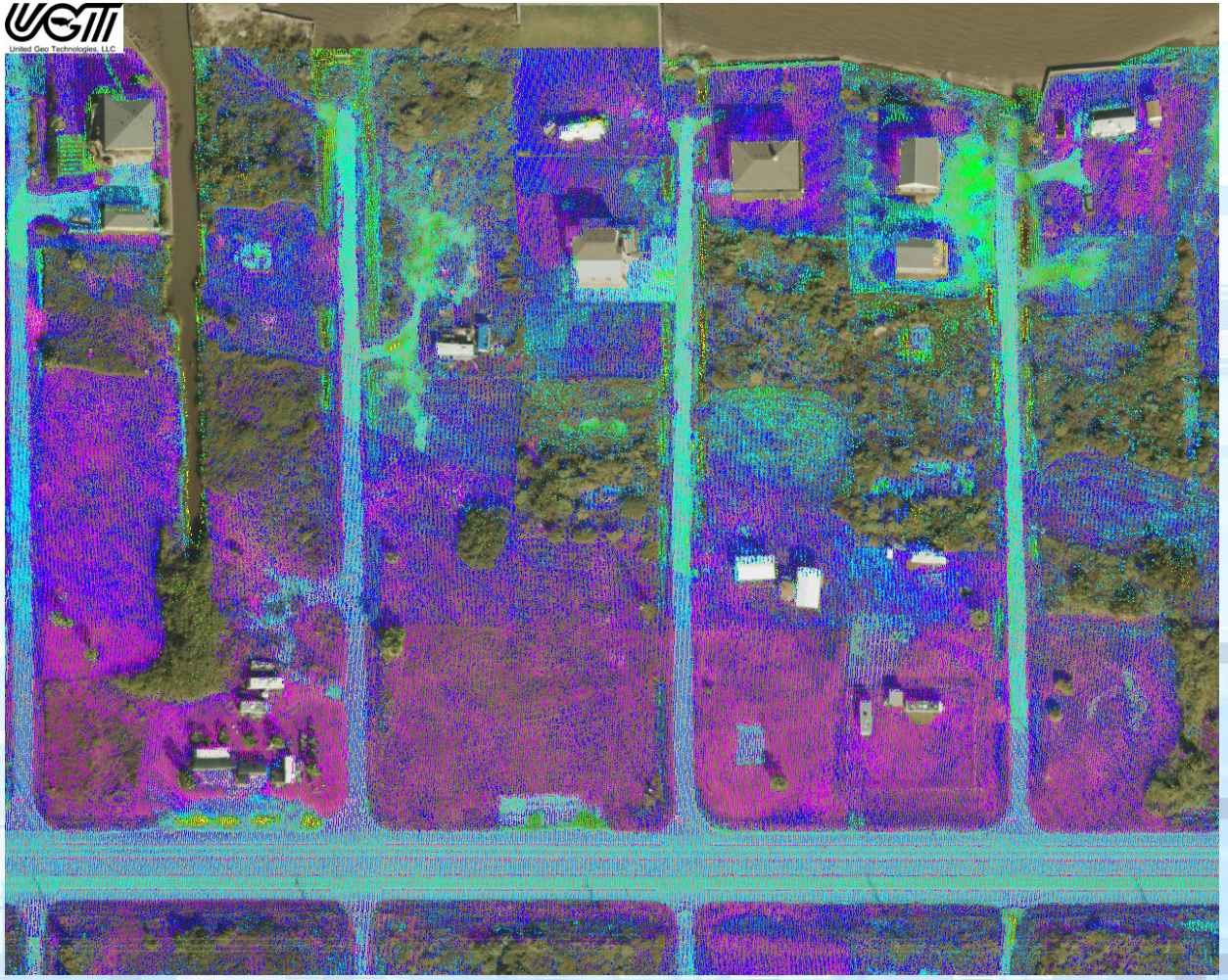
Bare Earth LiDAR & Plan



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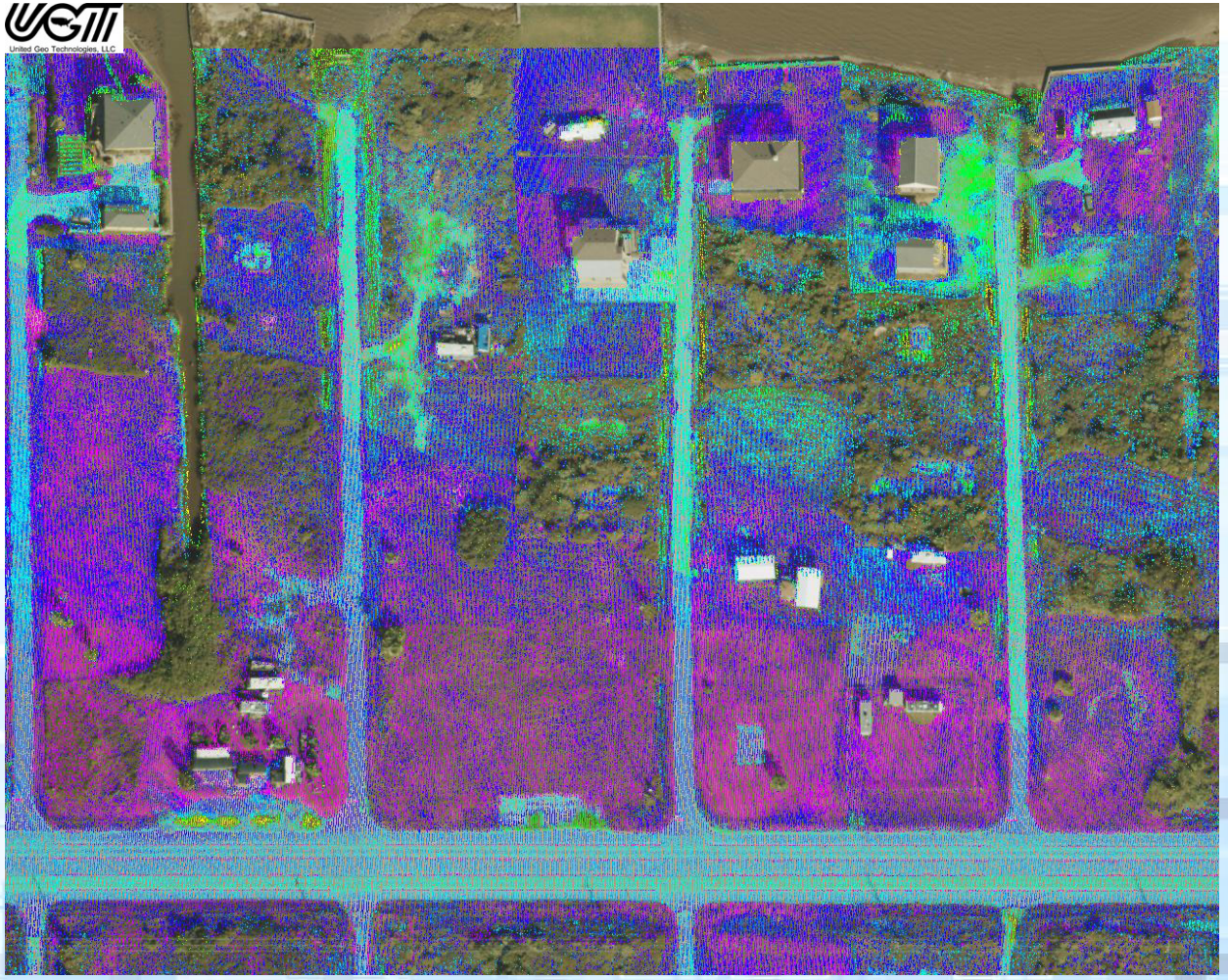
Bare Earth LiDAR & Ortho



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Bare Earth LiDAR, Plan, Ortho

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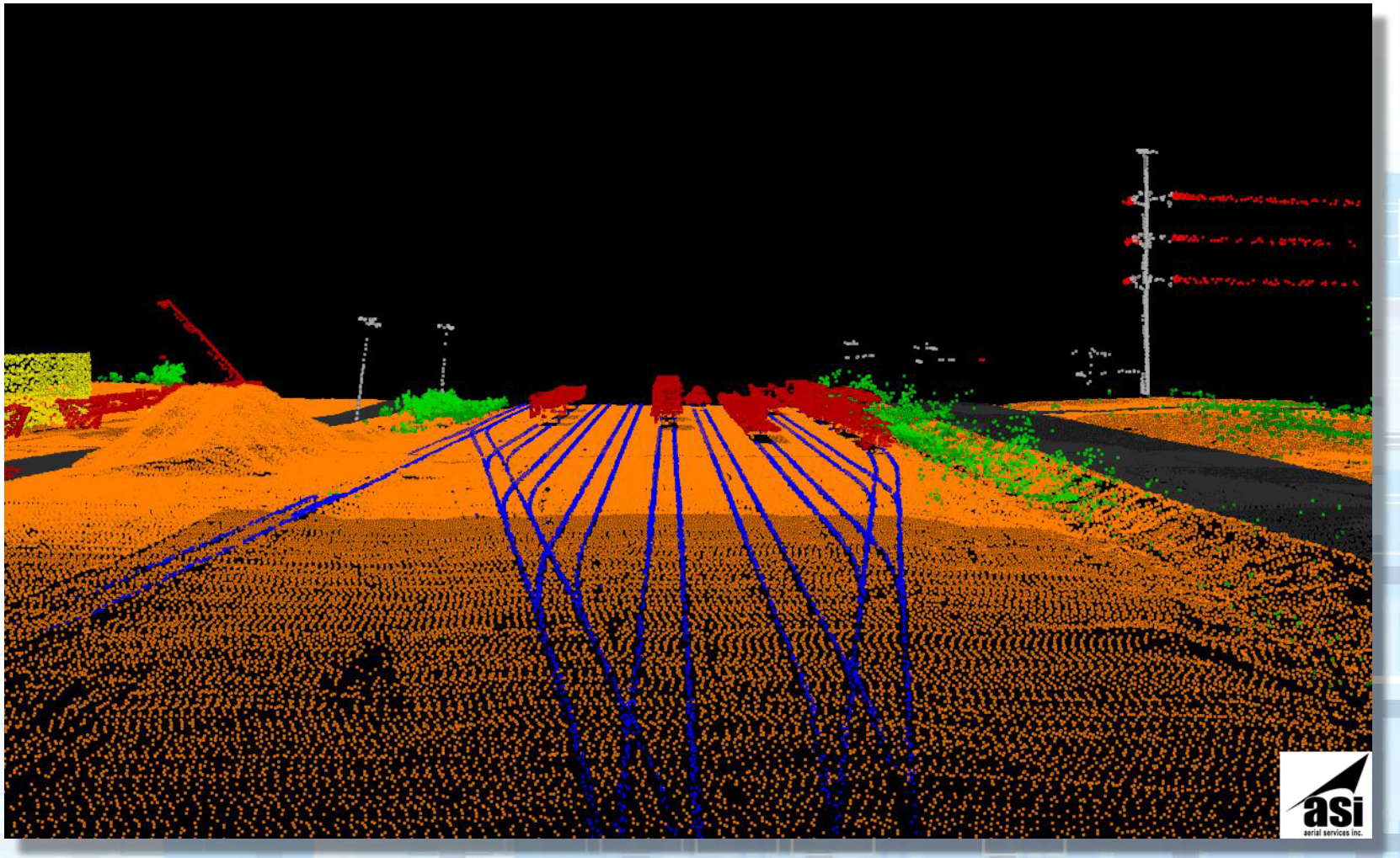
Rail



Mobile LiDAR

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Airborne LiDAR

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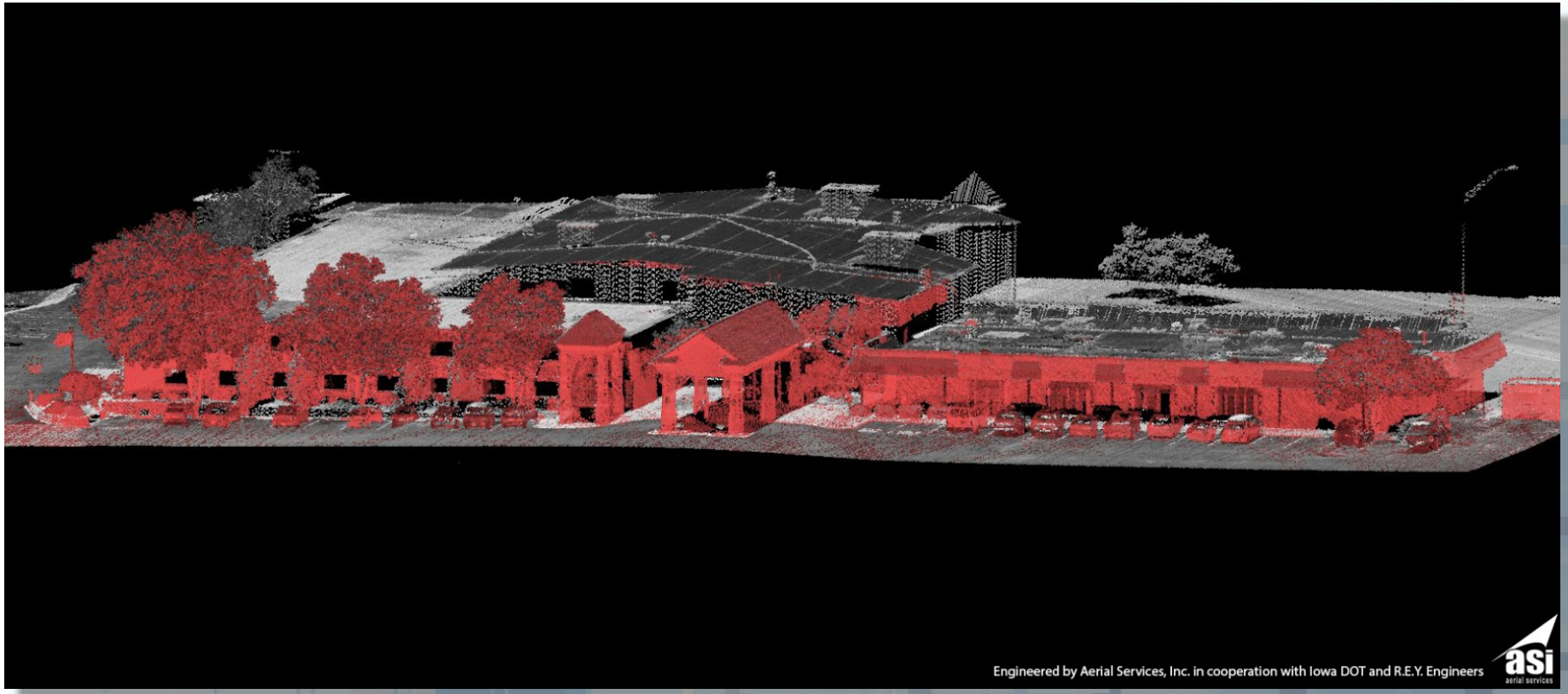
Mobile and Airborne



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Accuracy Report

Helicopter	
Ave dz	-0.010
Min dz	-0.092
Max dz	+0.038
Ave magnitude	0.038
RMSE	0.047
Std deviation	0.052

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Accuracy Report

Fixed Wing

Ave dz	+0.003
Min dz	-0.047
Max dz	+0.076
Ave magnitude	0.038
RMSE	0.042
Std deviation	0.044

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Accuracy Report

Helicopter		Fixed Wing	
Ave dz	-0.010	Ave dz	+0.003
Min dz	-0.092	Min dz	-0.047
Max dz	+0.038	Max dz	+0.076
Ave magnitude	0.038	Ave magnitude	0.038
RMSE	0.047	RMSE	0.042
Std deviation	0.052	Std deviation	0.044

Fixed Wing LiDAR mob fee is approximately ½ of Helicopter LiDAR mob fee

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Questions???

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