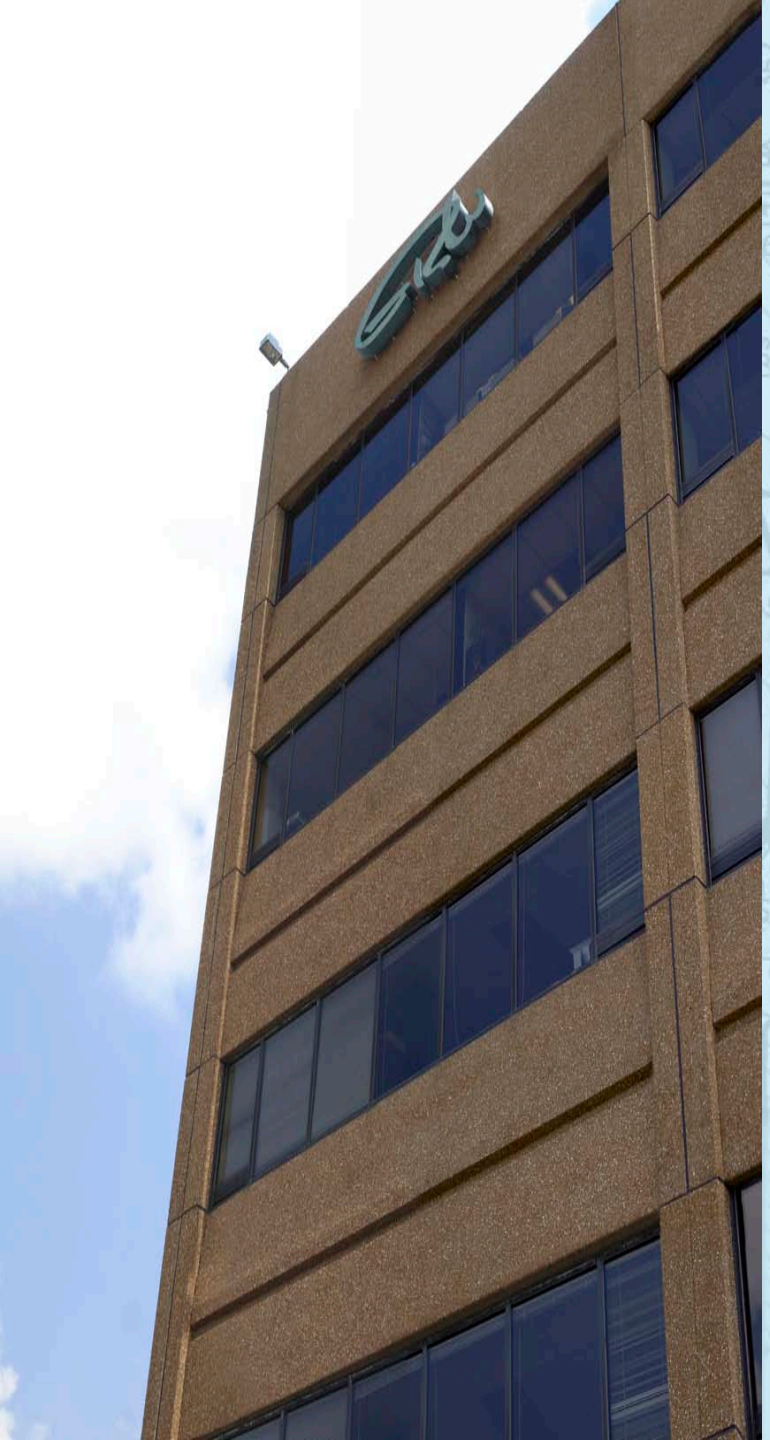
Case Studies for Data Fusion for Highway Design Projects



Engineers · Architects · Planners

Quick Outline…

- Available Mapping Options
- Data Fusion Projects
  - Aerial LiDAR/Aerial Photography
  - Mobile/Aerial LiDAR
  - Mobile/3dLS/ Aerial Photography

Terminology

LiDAR
: Light Detection And Ranging

TLS
: Terrestrial Laser Scanning, including Mobile (MTLS) and Stationery (STLS)

MMS
: Mobile Mapping System (aka MTLS)

3dLS
: 3d Laser Scanning (aka STLS)

LAS
: LiDAR native format

Point Cloud
: All XYZ points captured with LiDAR sensor

Classified Point Cloud
: Point Cloud classified, typically includes (at minimum) Ground and Other

Intensity
: Strength of reflectivity of returning pulse, recorded as a numerical value and converted to 8-bit image

Return
: Information returned from an outgoing LiDAR pulse

Acquisition Platforms

Collection Altitude:
1000'+
Point Spacing:
Up to 4 ppm
Final Accuracy:
1' Contour

Collection Altitude:
600'+
Point Spacing:
Up to 40 ppm
Final Accuracy:
1' Contour or Better

Collection Altitude:
~6'
Point Spacing:
Millimeters
Final Accuracy:
Better than 0.1'

Comparison of Technologies

	Photography	Aerial LiDAR	MTLS	3DLS
Planimetric Mapping	☐		☐	☐
Contour Mapping (1' Accuracy)	☐	☐	☐	☐
Survey Grade Accuracy			☐	☐
Wide Area Mapping	☐	☐		
Narrow Area Mapping	☐	☐	☐	☐
Bridge Clearance			☐	☐
Orthophotography	☐			

Mapping | Surveying | GIS
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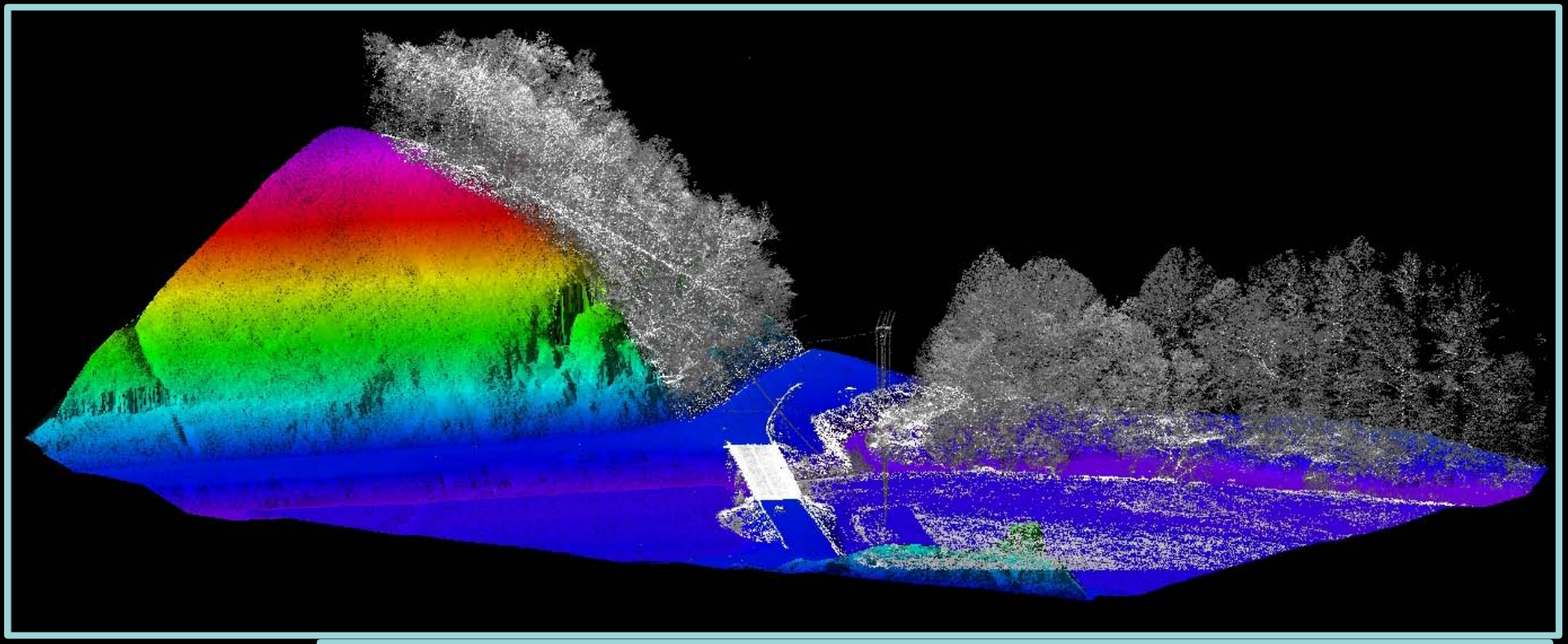
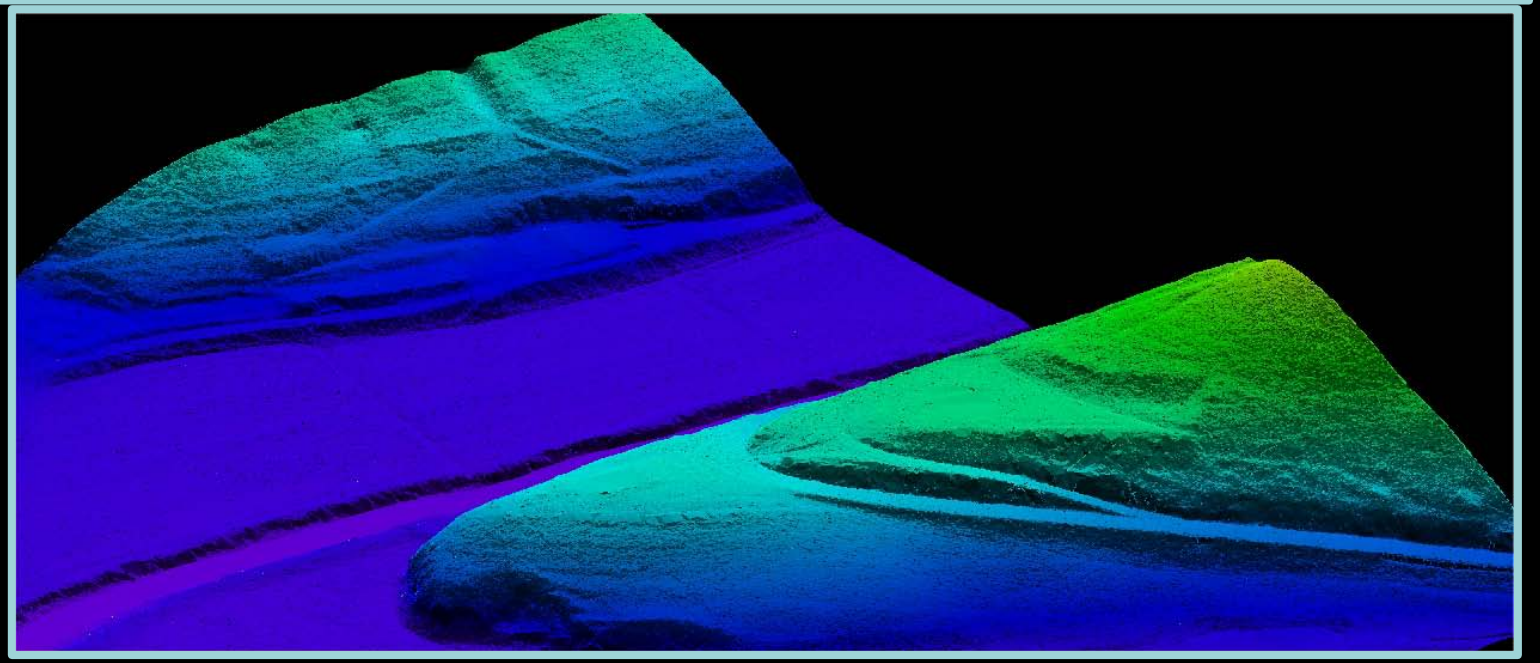
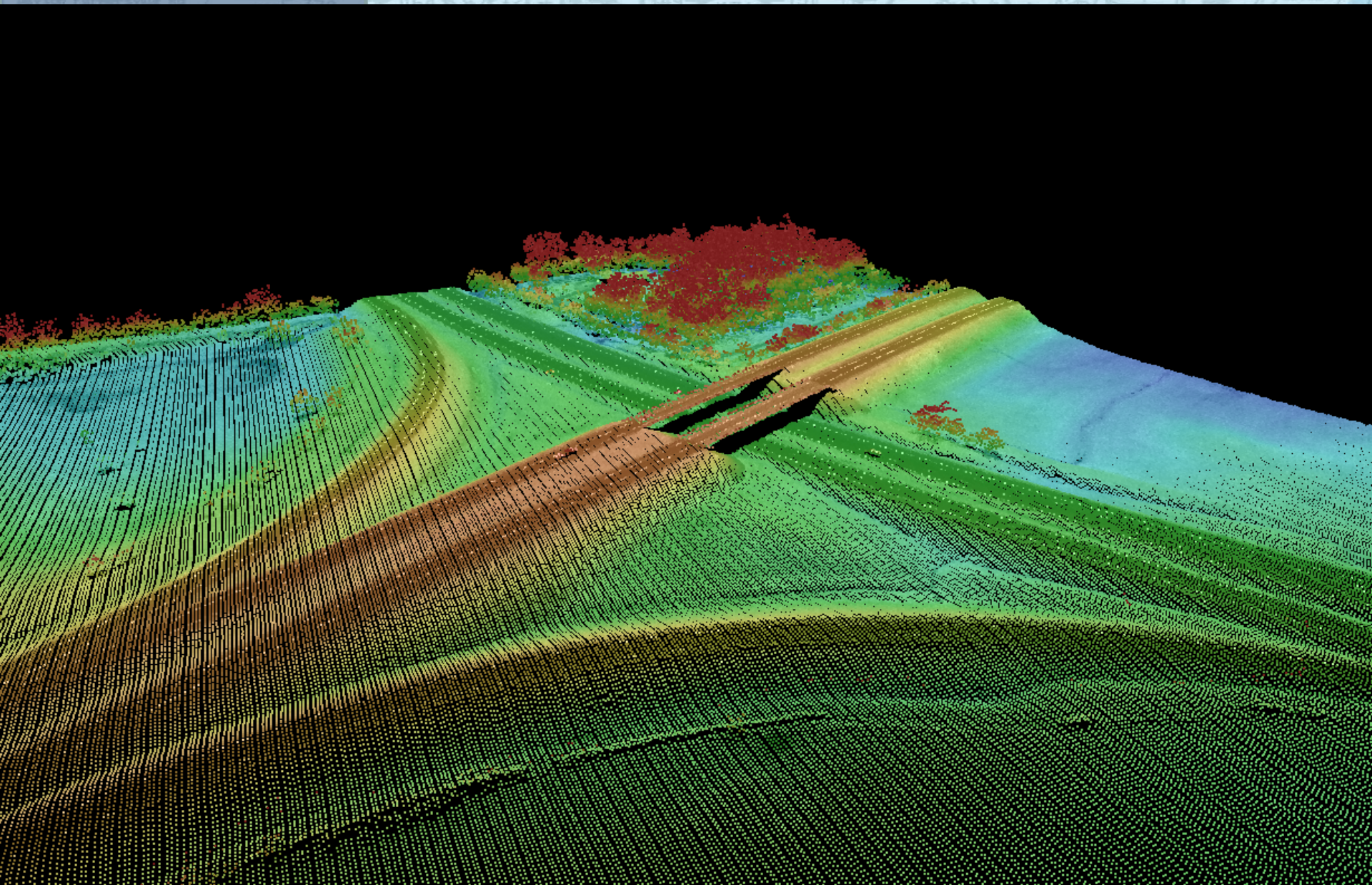
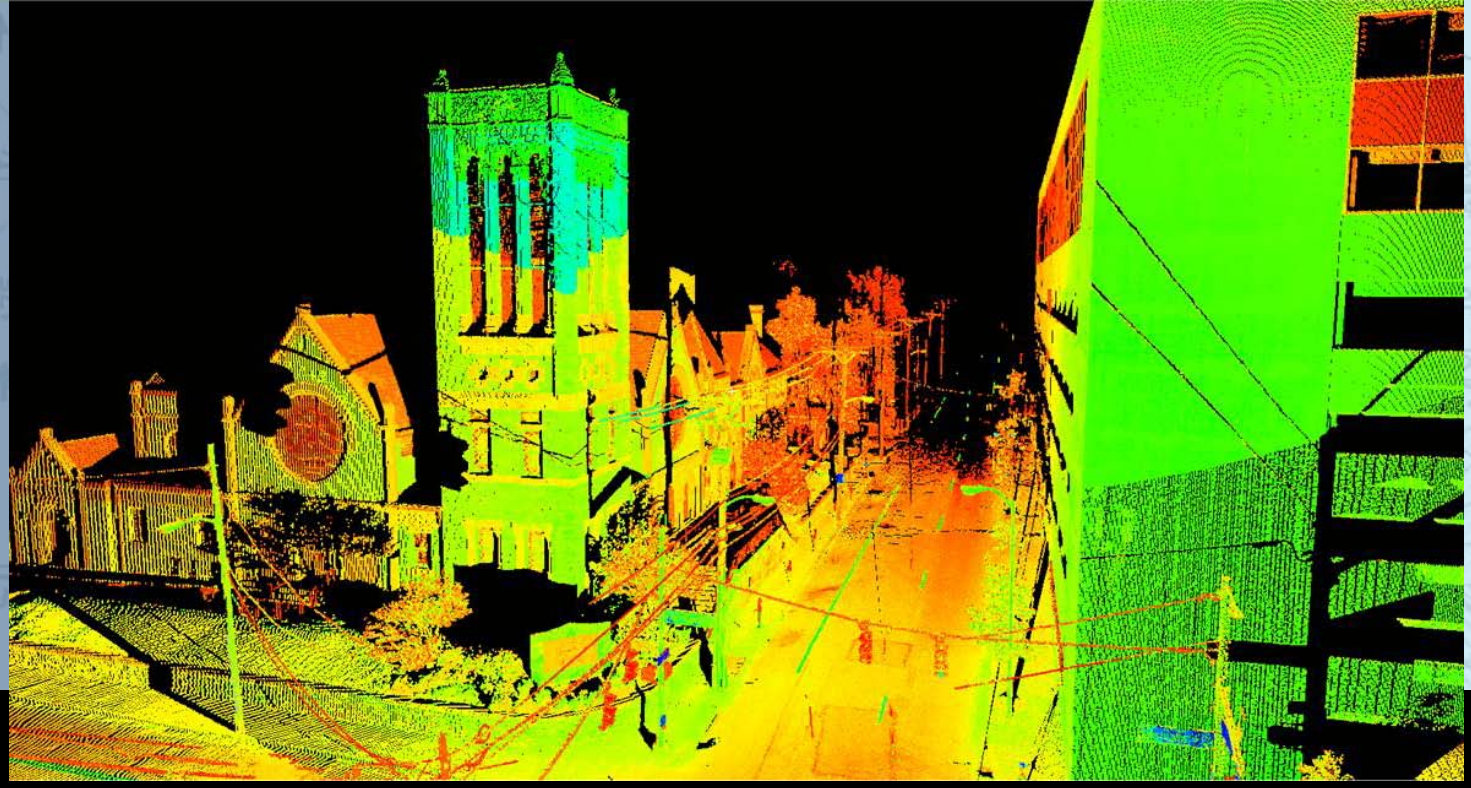
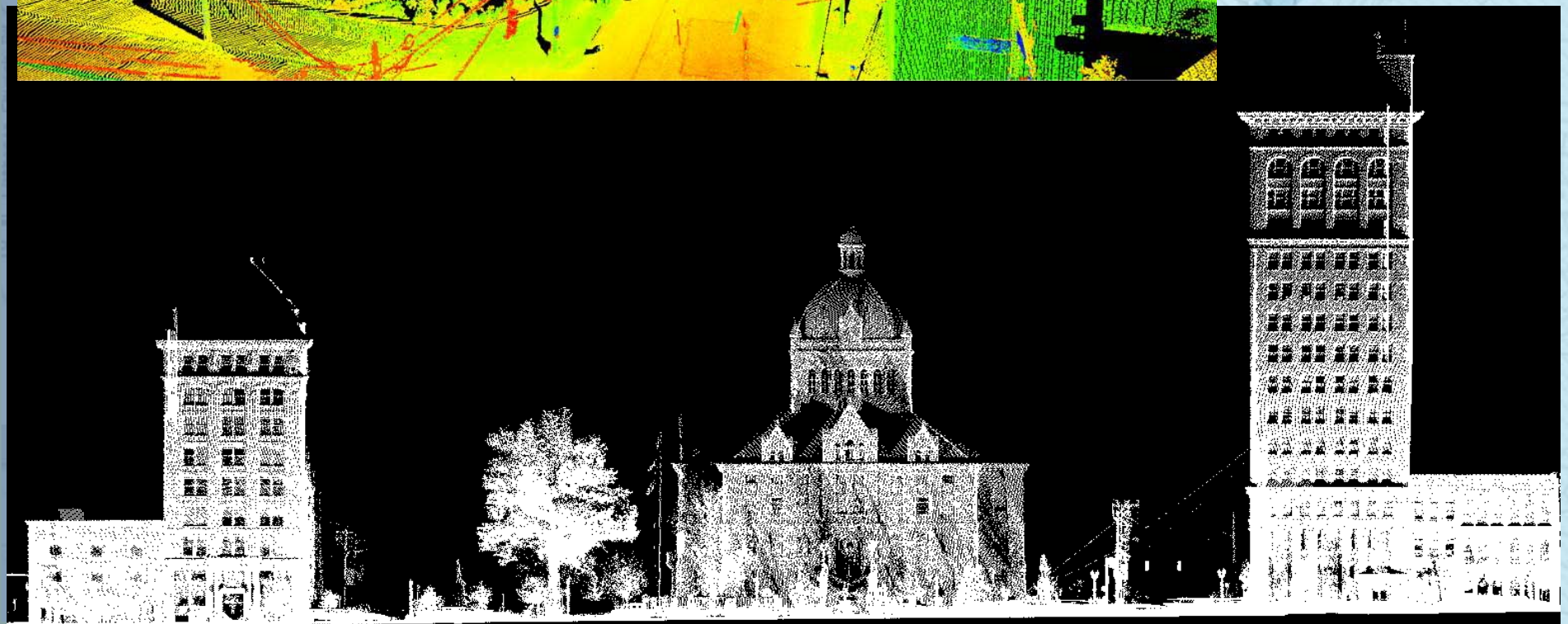




Line-of-Sight…







Intensity…

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Intensity…

US 127
Clinton and Russell Counties

Project Overview

- ~17 Miles, Primarily Cross-Country
- Tight Delivery Schedule
  - Necessitated Data Acquisition before complete Leaf-off conditions
- Requested standard KyTC Deliverables
  - 2’ Contours (1’ Contour Accuracy)
  - Orthophotography
  - Planimetrics

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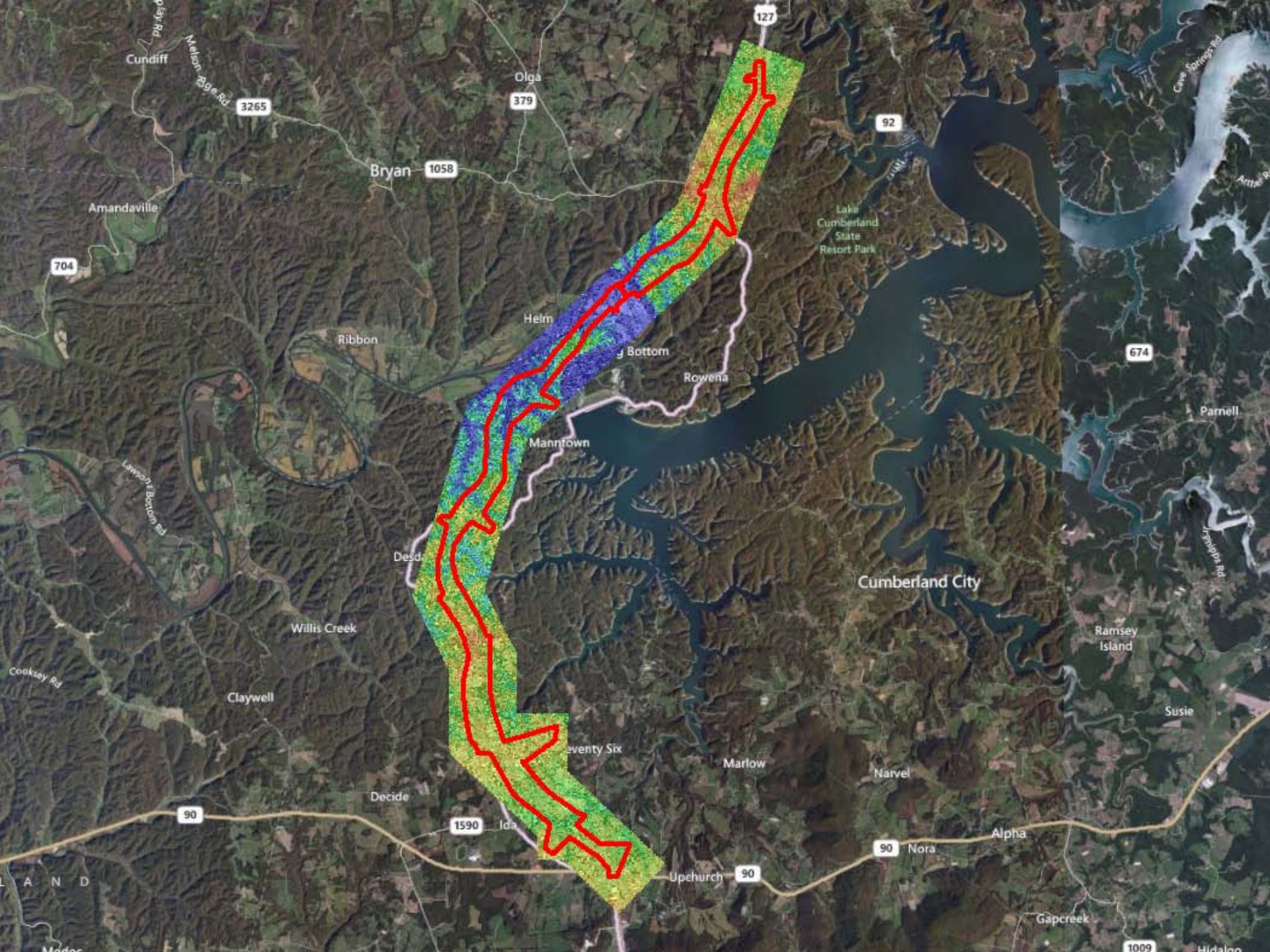
Project Approach

Photogrammetry/Aerial LiDAR Fusion

- Photogrammetry to Provide:
  - Planimetric Mapping
  - Orthophotography
  - Breaklines to Supplement LiDAR
- LiDAR to Provide:
  - Better Elevation data in Vegetated Areas
  - Ability to Meet Tight Deadline
  - Surface for Orthophotography


Cundiff
Melon Ridge Rd
3265
Olga
379
127
92
Bryan
1058
Amandaville
704
Lake Cumberland State Resort Park
Helm
Ribbon
Bottom
Rowena
674
Parnell
Manntown
Lawson's Bottom Rd
Desda
Cumberland City
Willis Creek
Ramsey Island
Cookusey Rd
Claywell
Susie
Marlow
Narvel
Decide
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Ida
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Nora
Upchurch
Gapcreek
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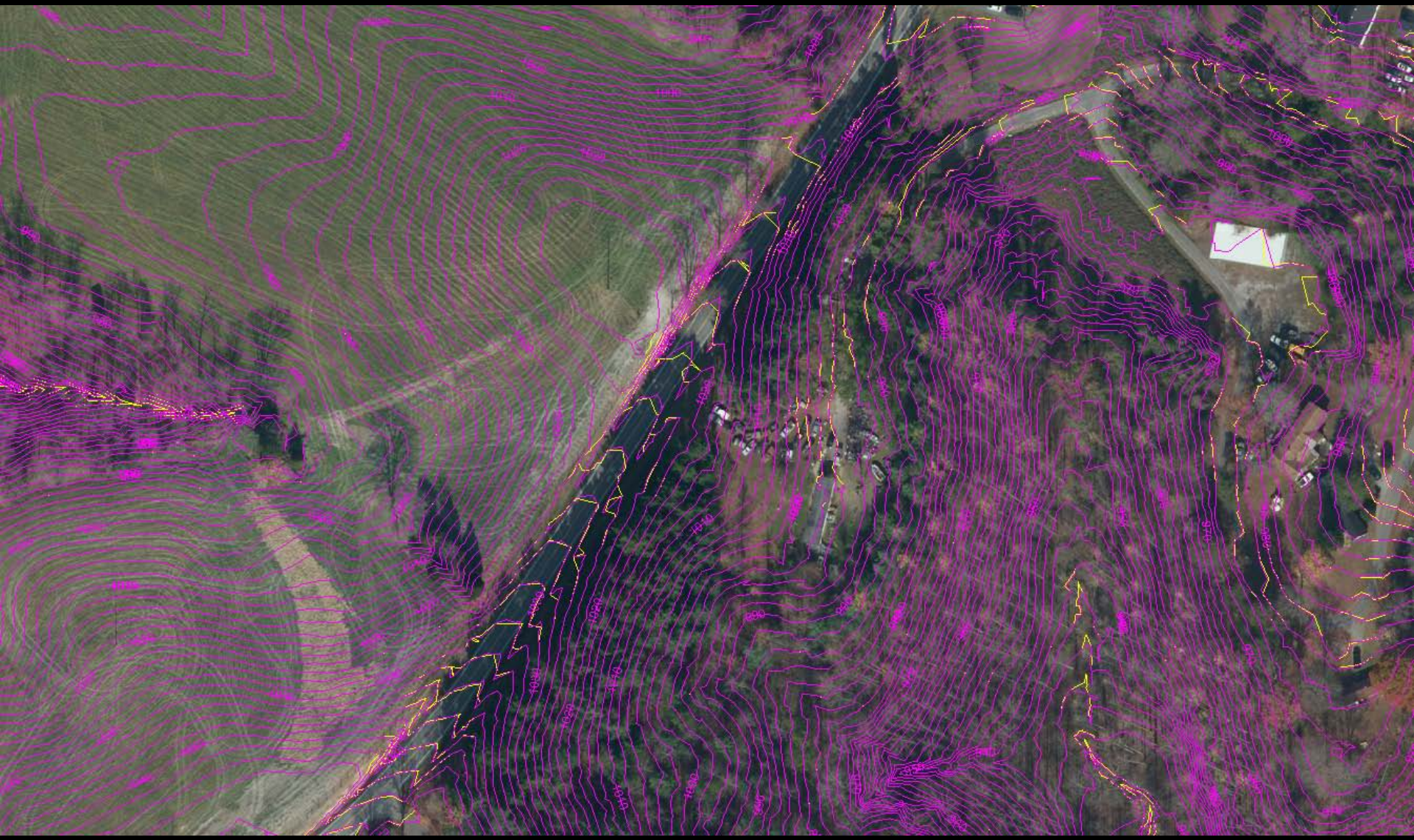
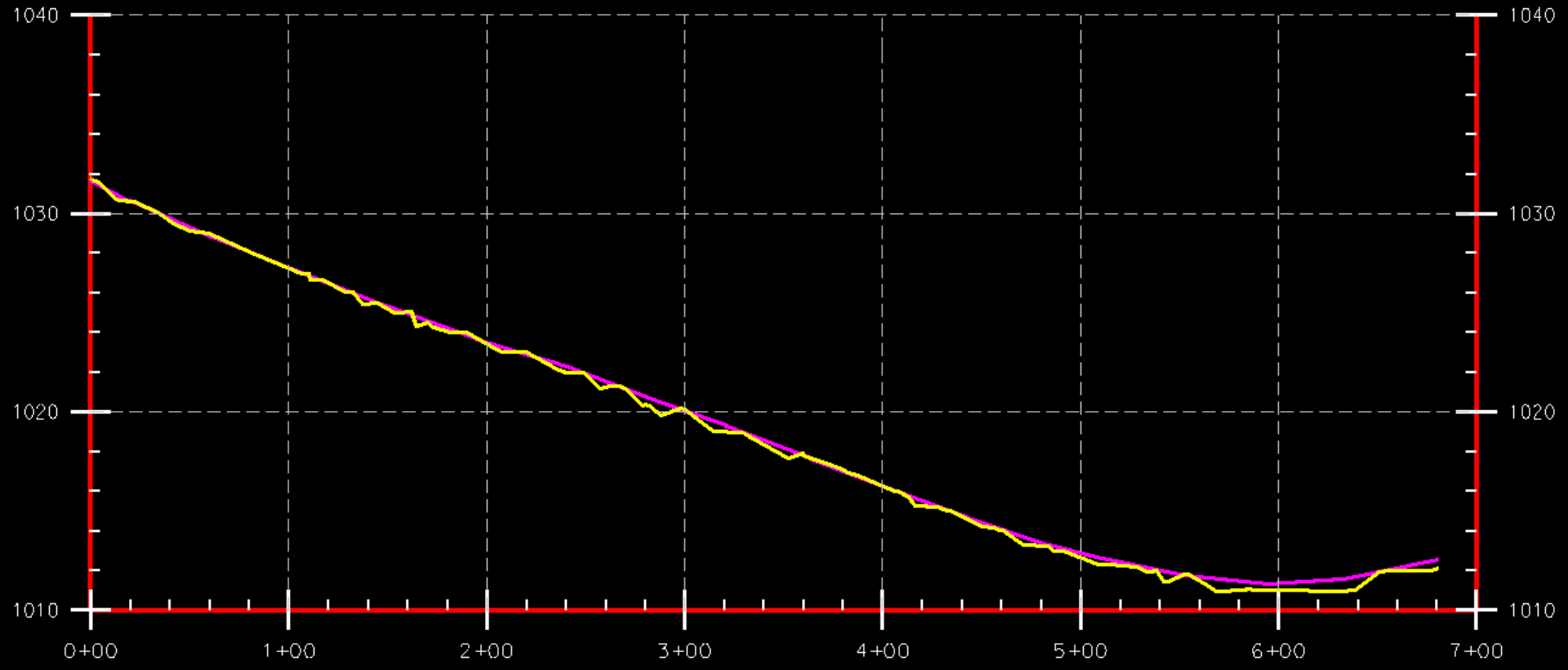
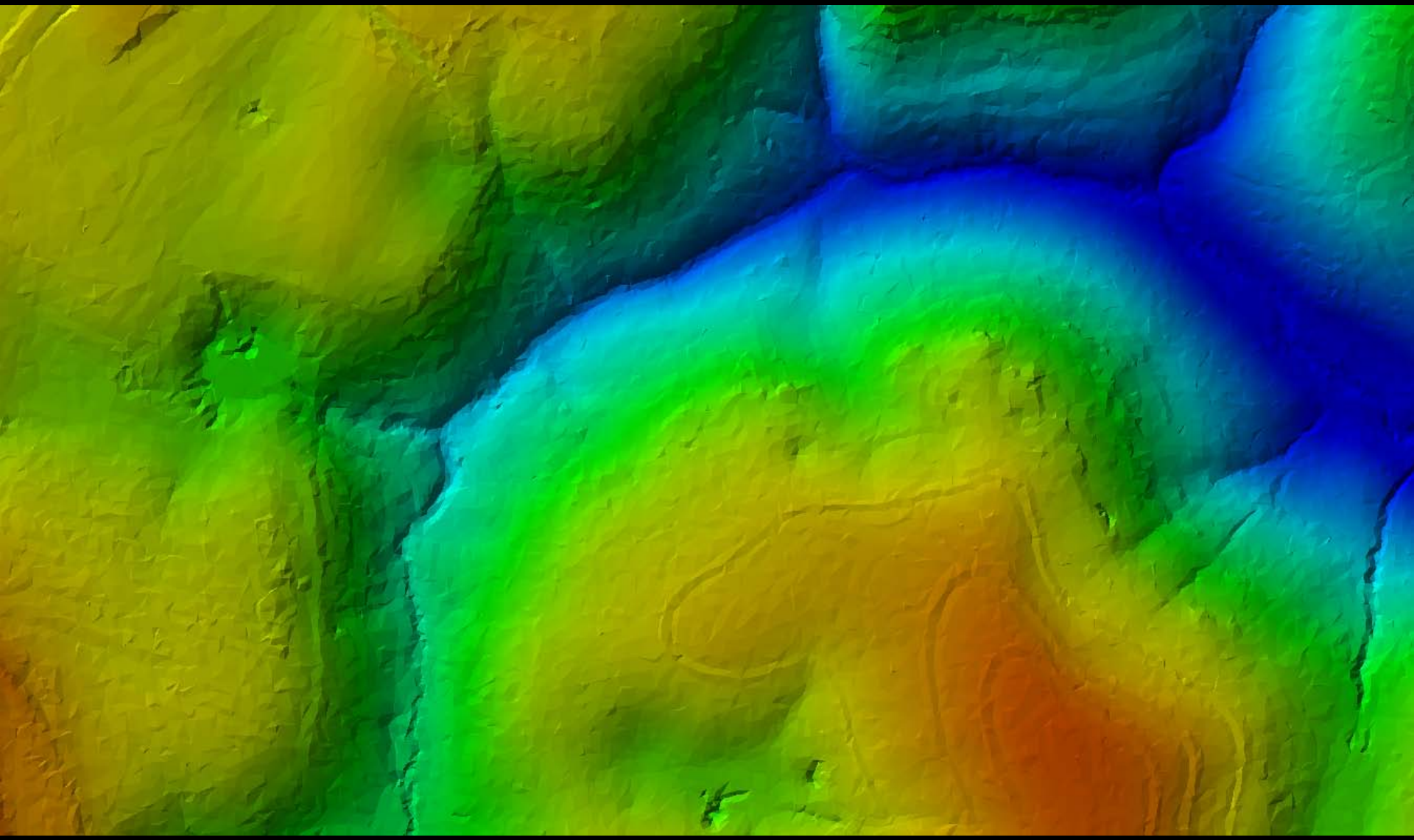
Hidalgo





LINE	SURFACE	OFFSET
	DTM	0.00
	LIDAR	0.00

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.



Project Results

Best of Both Worlds

- Defined Ground in difficult areas with LIDAR
- Provided Detail in important areas with Photogrammetry
- Provided Orthophotography
- Met Schedule and Accuracy Requirements

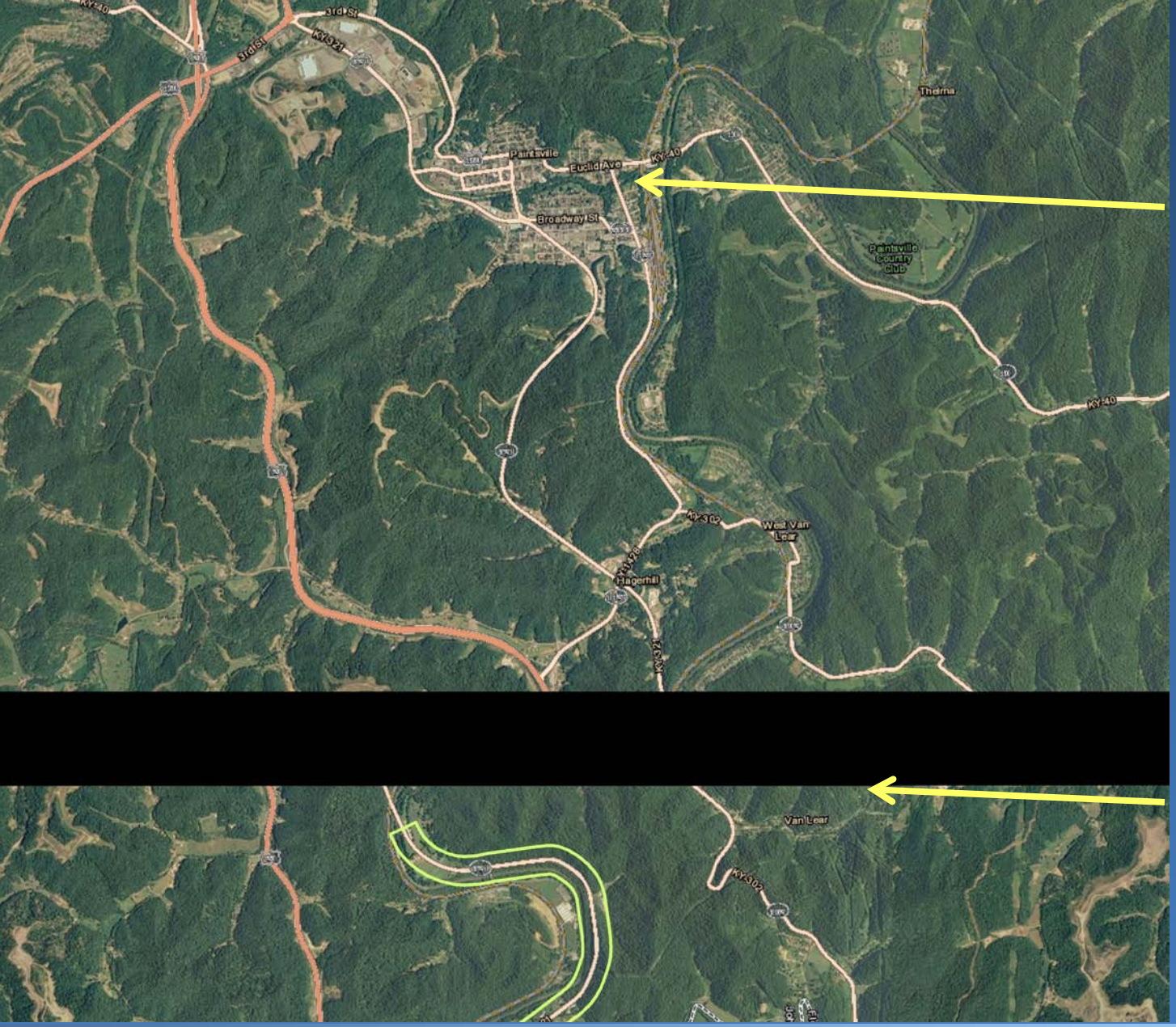
HWY 321 – Johnson County, KY

Client: Kentucky Transportation Cabinet
Consultant: S&ME
Subconsultant: Photo Science

Presented by: Mike Ritchie, PE, PLS, CP
President & CEO
Photo Science

Problem: Rockfall area along large cut (250' high), river side area nearly 2 miles long.

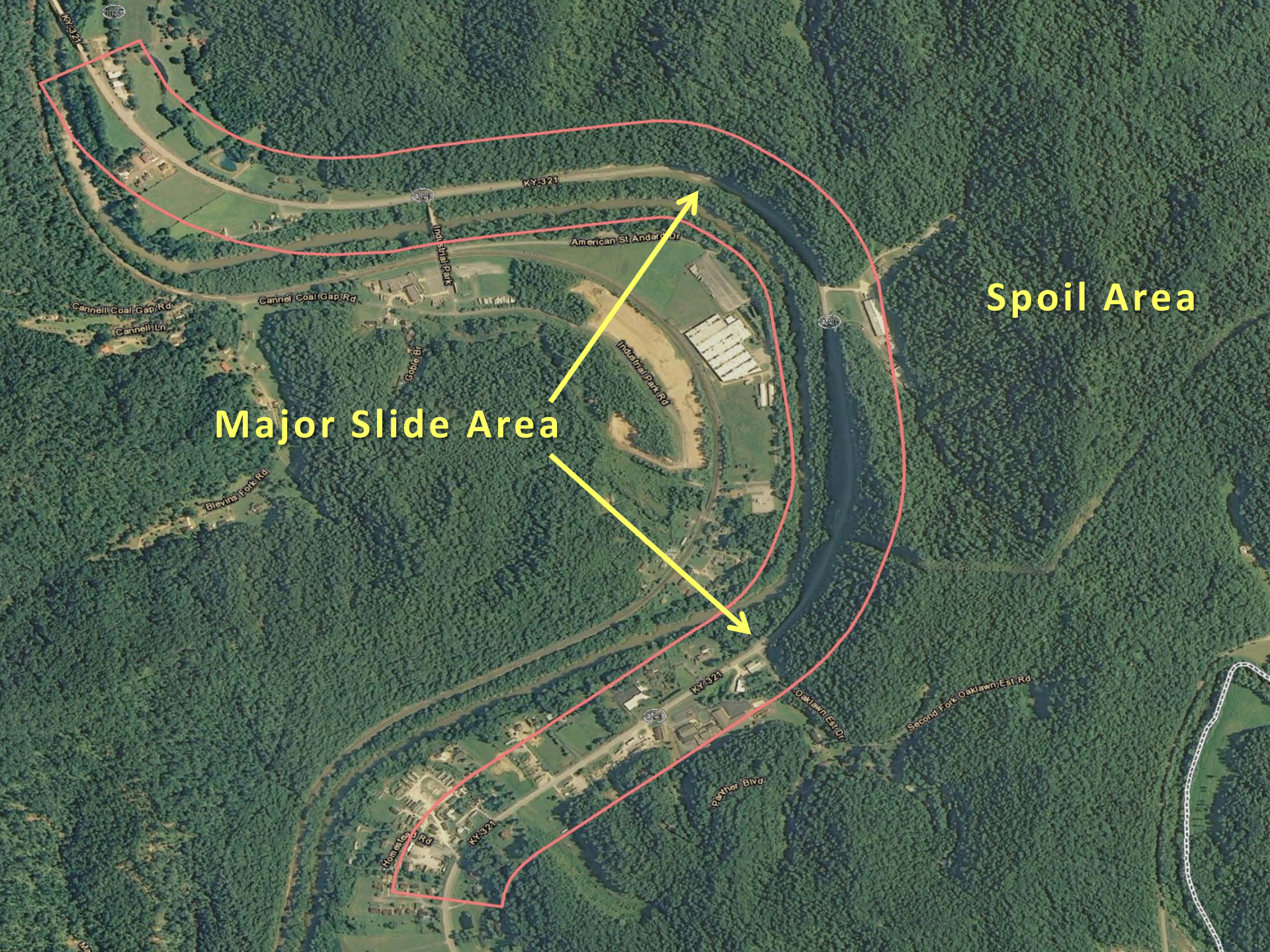
PHOTO SCIENCE
Geospatial Solutions



Paintsville, KY

Project Site

PHOTO SCIENCE
Geospatial Solutions


Major Slide Area
Spoil Area
KY-321
Industrial Park
American St Andrew Dr
Cannell Coal Gap Rd
Cannell Ln
Gobbler Dr
Industrial Park Rd
Blevins Fork Rd
KY-321
Oaklawn Est Dr
Second Fork Oaklawn Est Rd
Panther Blvd
KY-321
Homestead Rd

Solution:

- Aerial Imagery – new 6" pixel aerial orthophotos
- Airborne LiDAR – to create DTM to support design of slopes and waste areas for spoil
- Mobile Mapping System – for accurate pavement elevation and jagged rock face of cut blinded from air

PHOTO SCIENCE
Geospatial Solutions

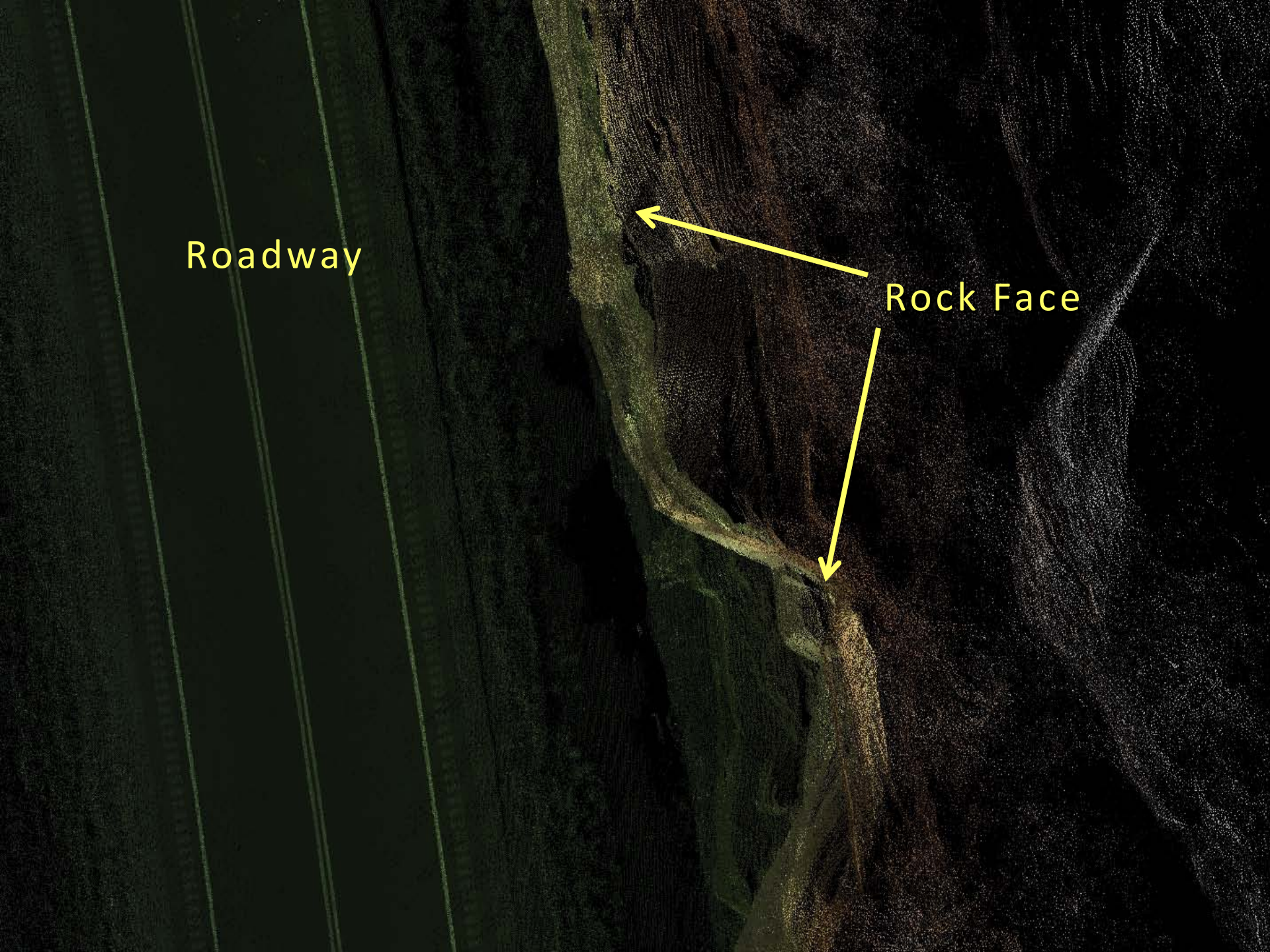
Solution

Digital Mapping Camera

Airborne Laser Terrain Mappers

Optech Lynx Mobile Mapping System

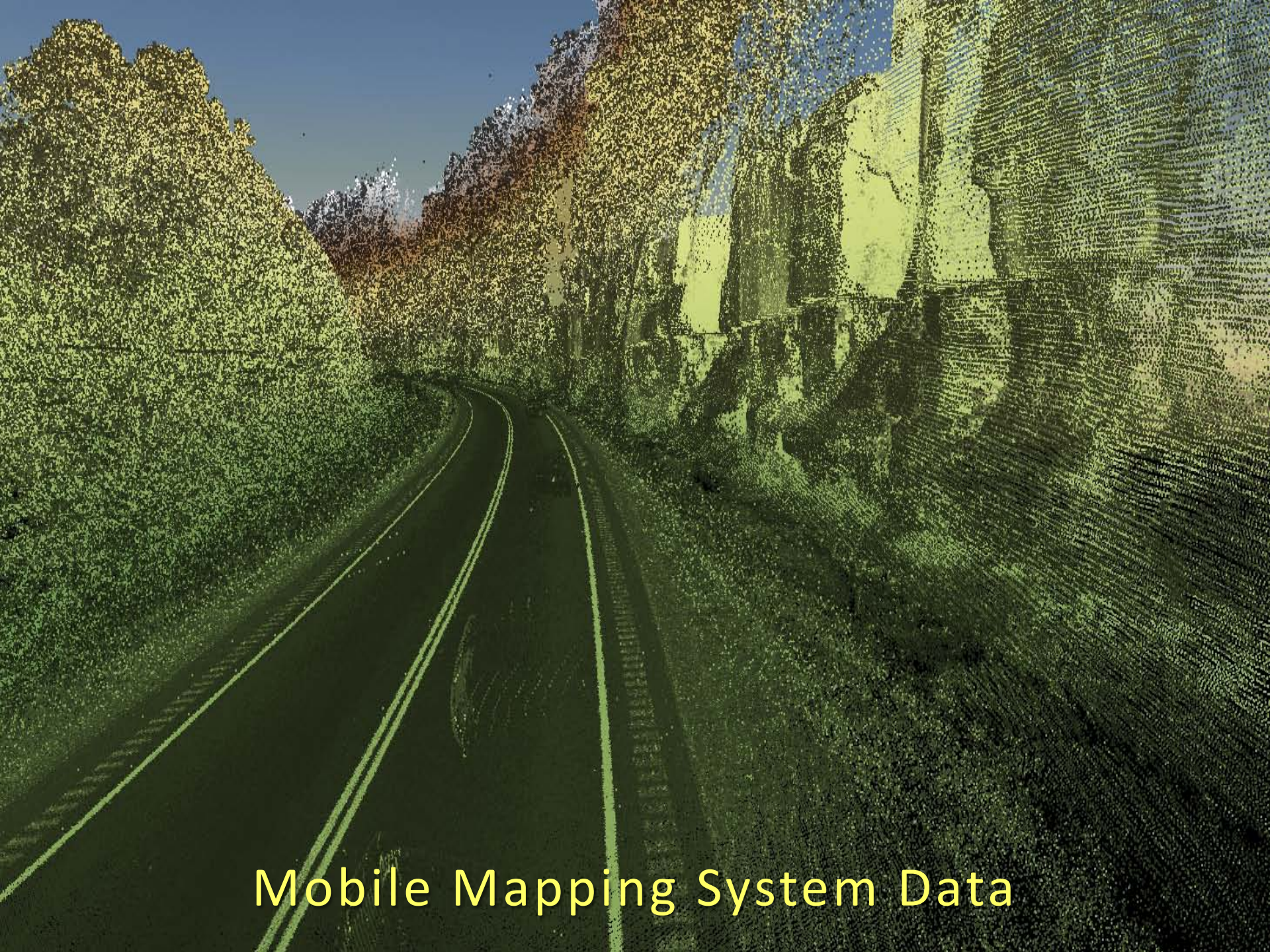
PHOTO SCIENCE
Geospatial Solutions


Roadway
Rock Face

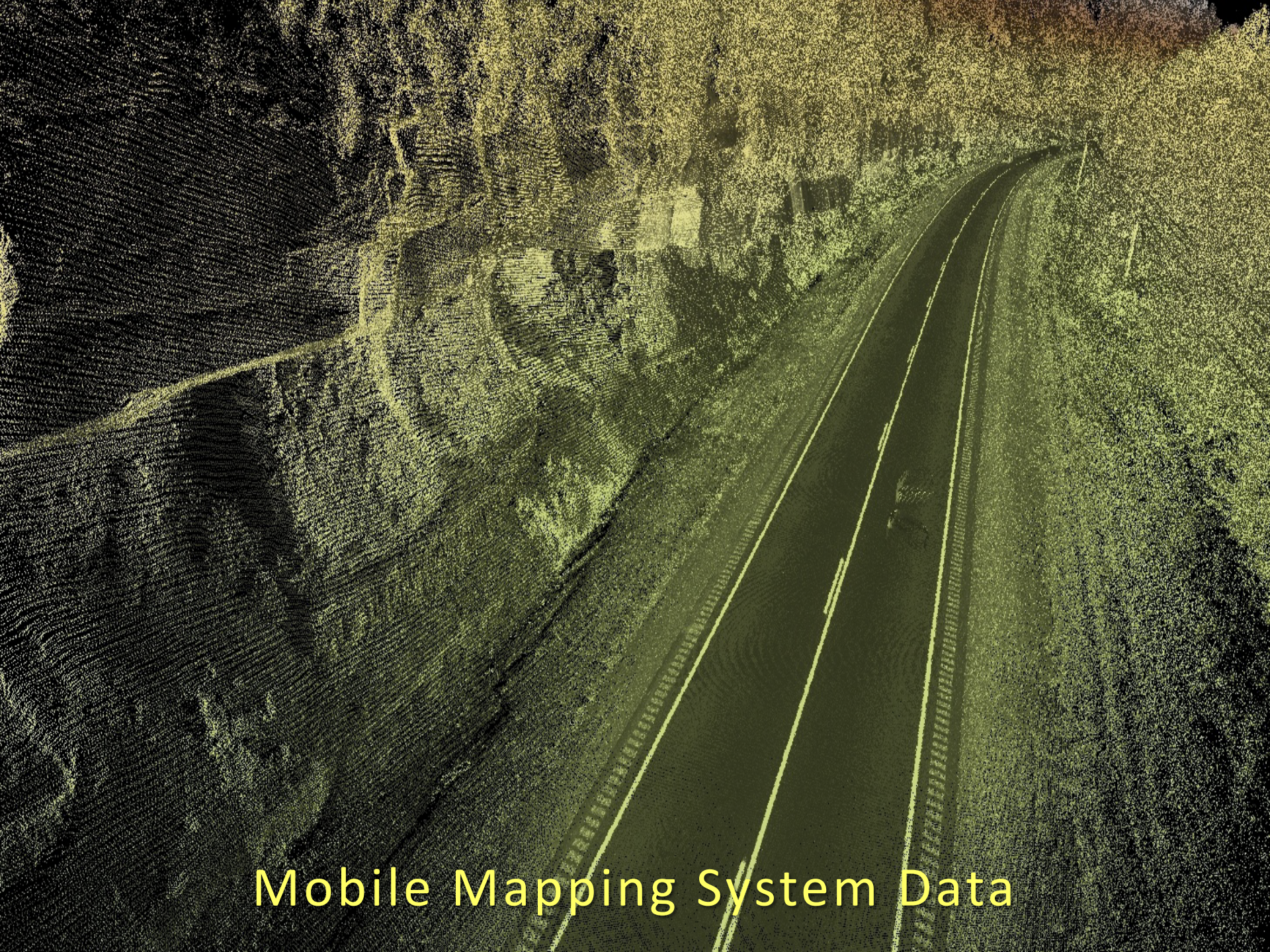
Roadway

Sloping Tree
Roadway

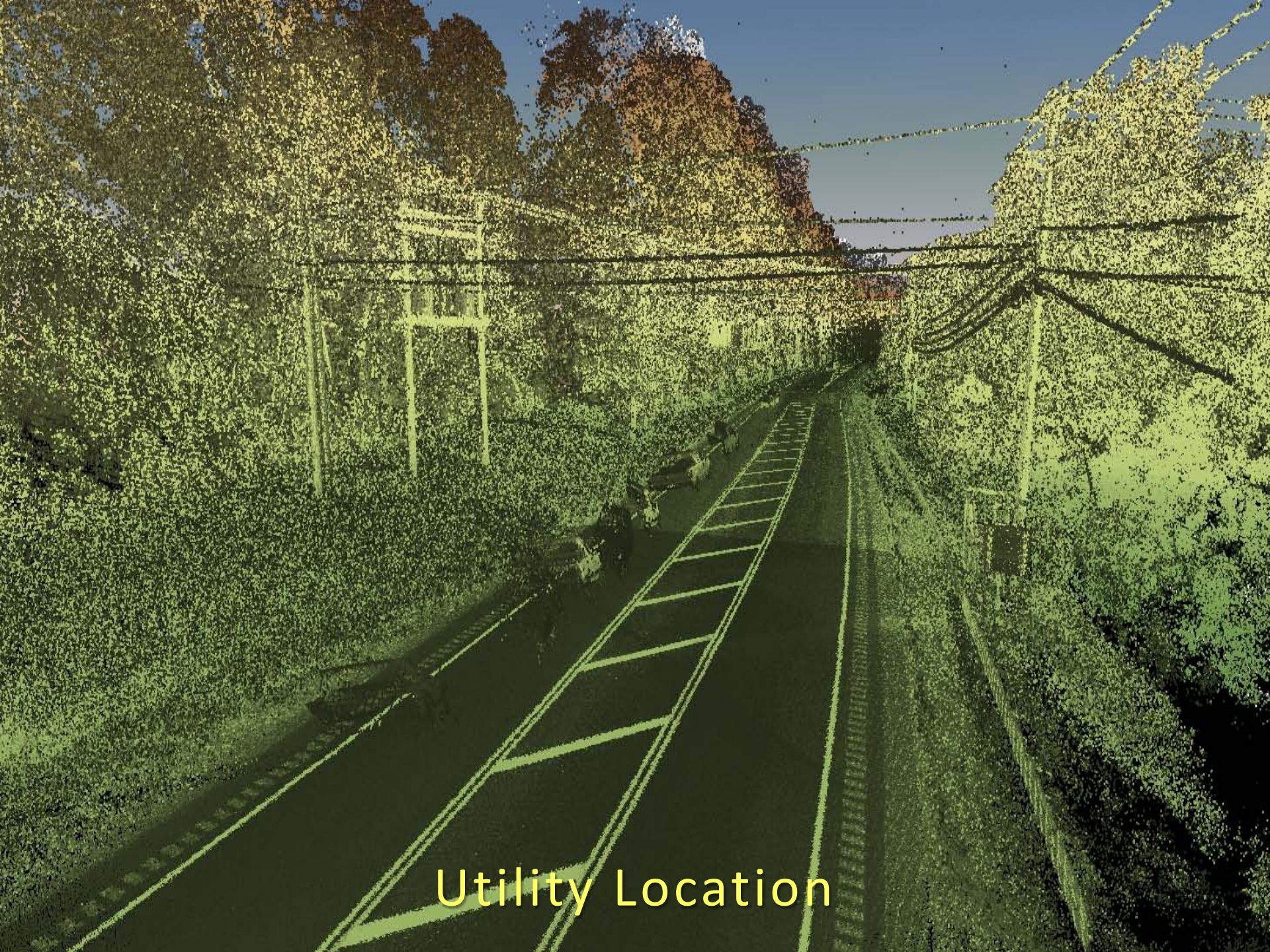
Rock Overhang
Roadway


Mobile Mapping System Data

Front View Mobile Camera


Mobile Mapping System Data

Rear View Mobile Camera


Utility Location

Deliverables:

- Orthos (color 6" TIFF with TFW files)
- V-8 Microstation DGN (100 ft planimetric with 2 ft contours)
- InRoads (mass points and breaklines)
- LAS File – LiDAR (547,500,000 pts – mobile)
- Survey Report

Vertical RMSE 0.02 ft

PHOTO SCIENCE
Geospatial Solutions

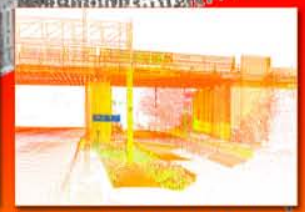
PROJECT PEGASUS

Transforming Our Downtown Freeways

CANYON • MIXMASTER • LOWER STEMMONS

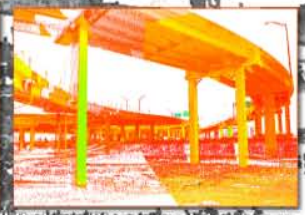
PROJECT PEGASUS focuses on the IH 30/IH 35E interchange on the western edge of downtown Dallas, locally known as the 'Mixmaster'; the depressed portion of IH 30 south of downtown, locally known as the 'Canyon'; and the portion of IH 35E from the Mixmaster to SH 183, also referred to as 'Lower Stemmons'.

Downtown Dallas



Railroad Bridge South of Woodall Rodgers

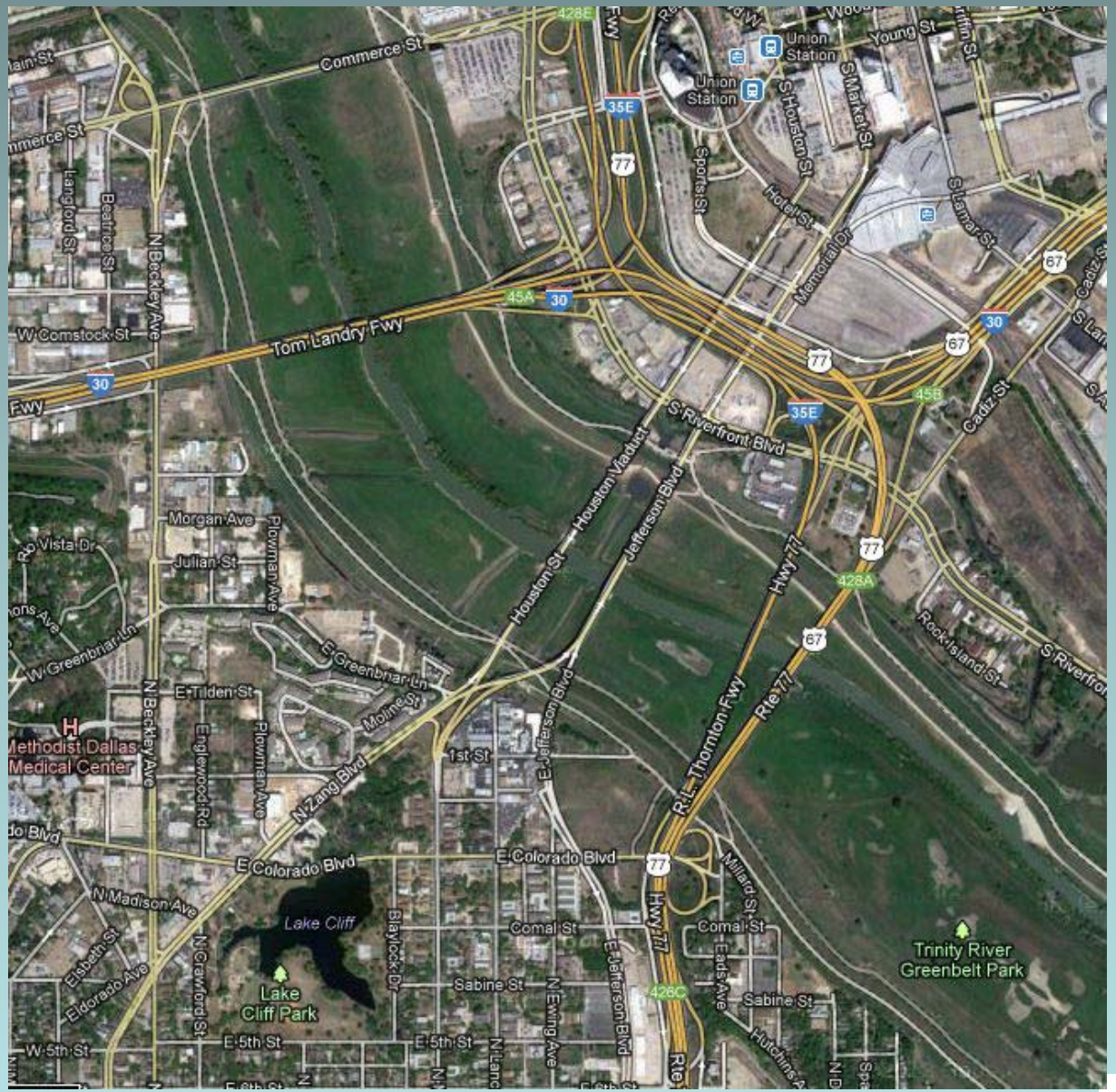
Houston Street Viaduct



Woodall Rodgers/Stemmons Interchange

Remote Data Collection by: LASER GEOMATICS

Project Pegasus Overview



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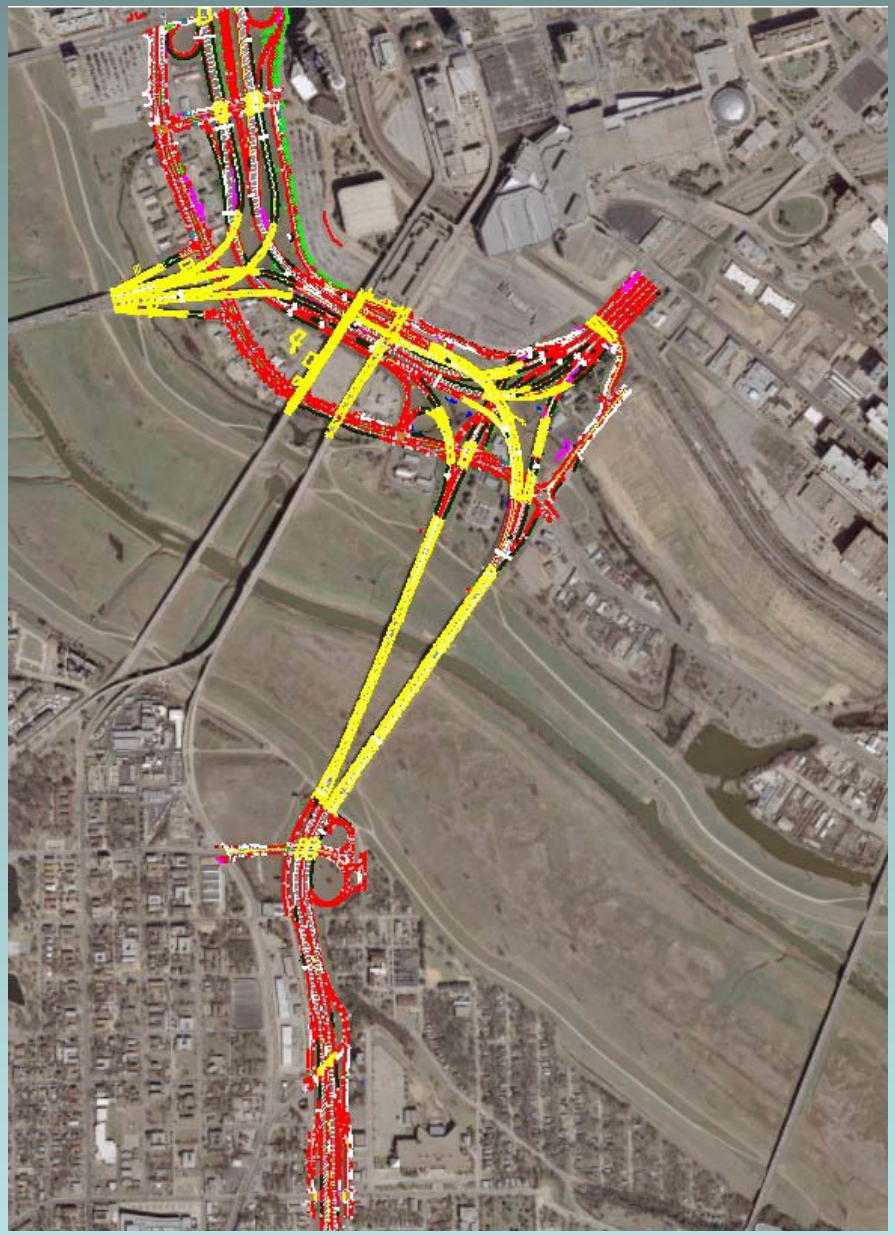

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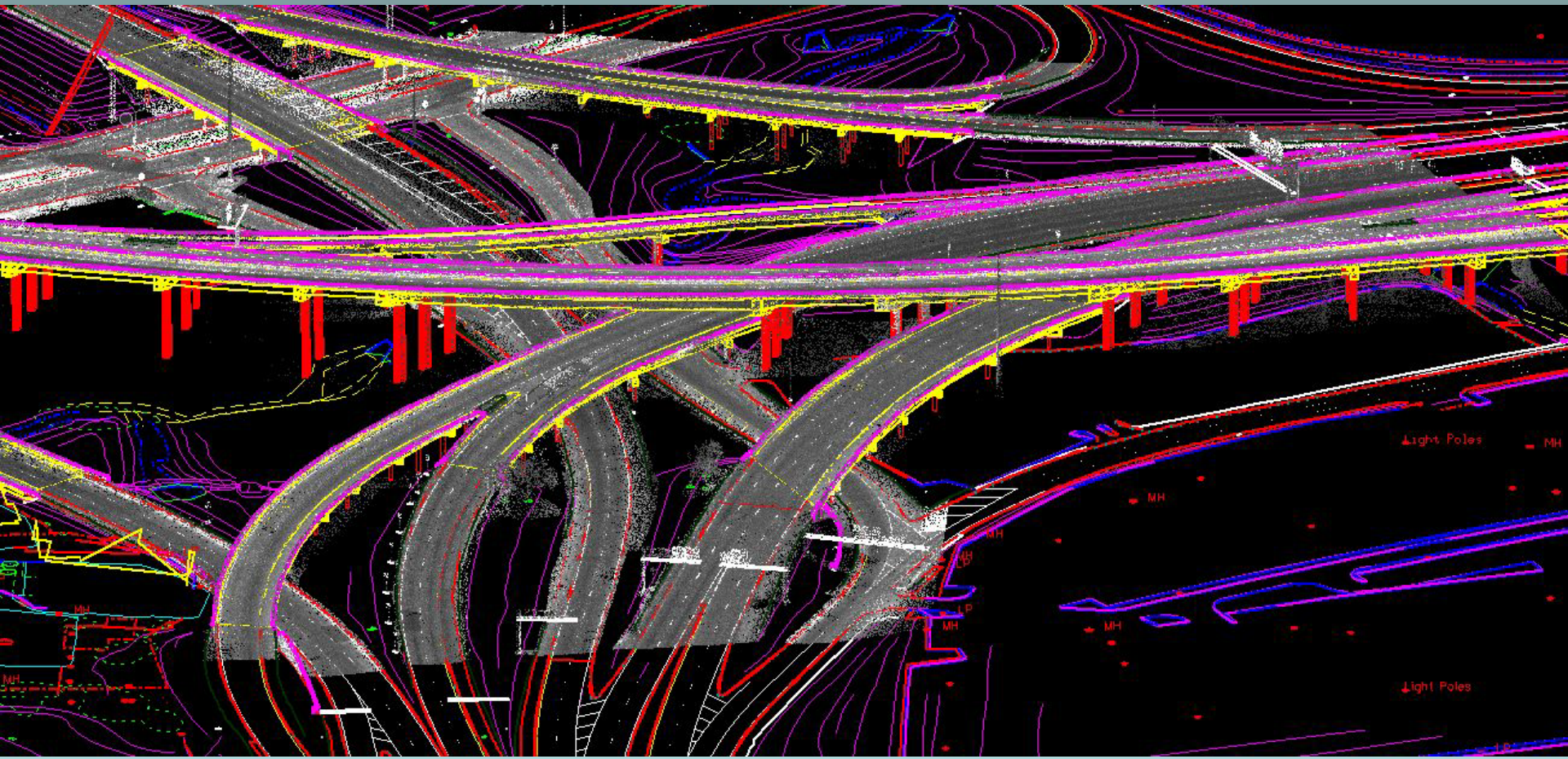

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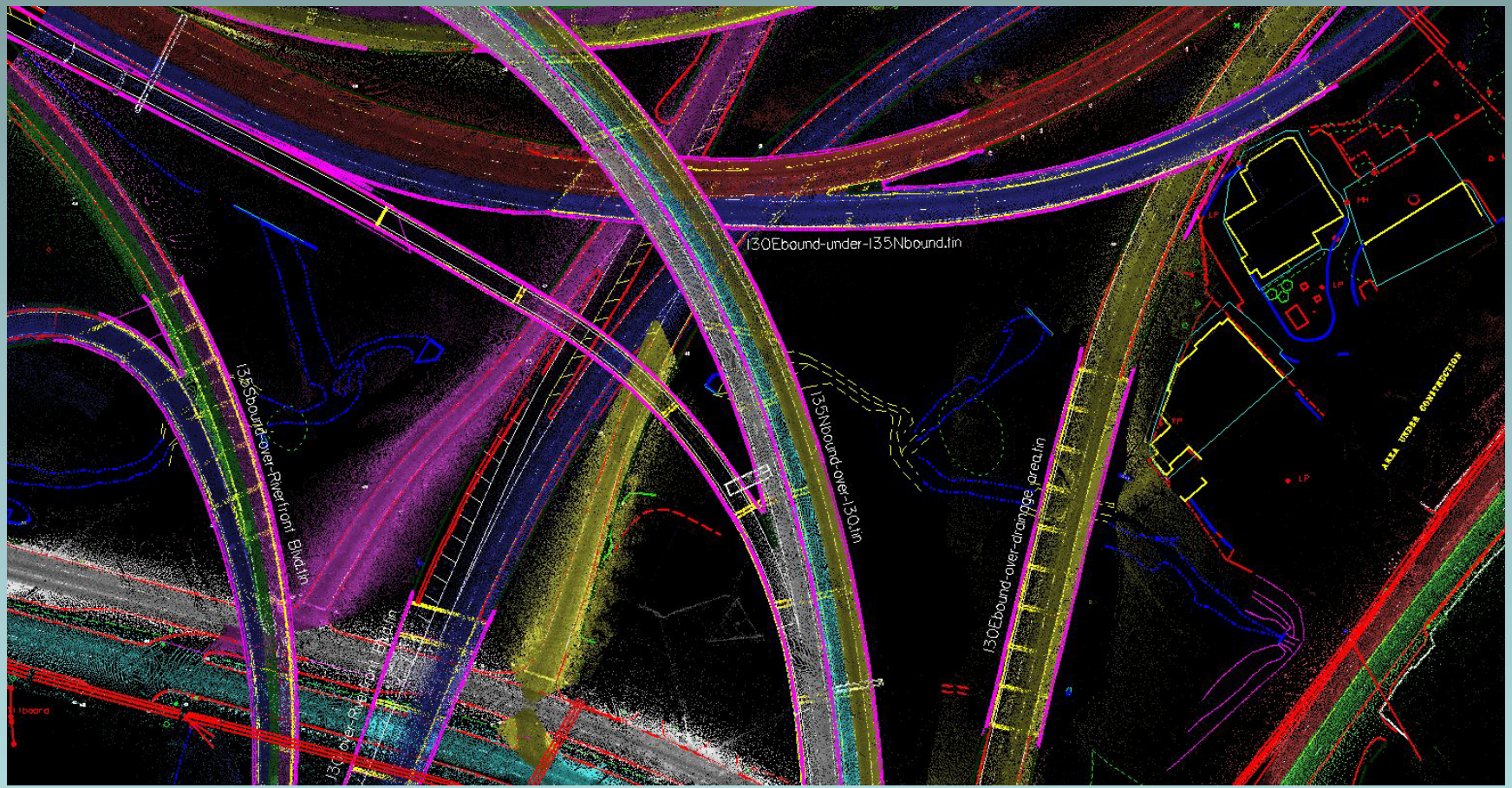
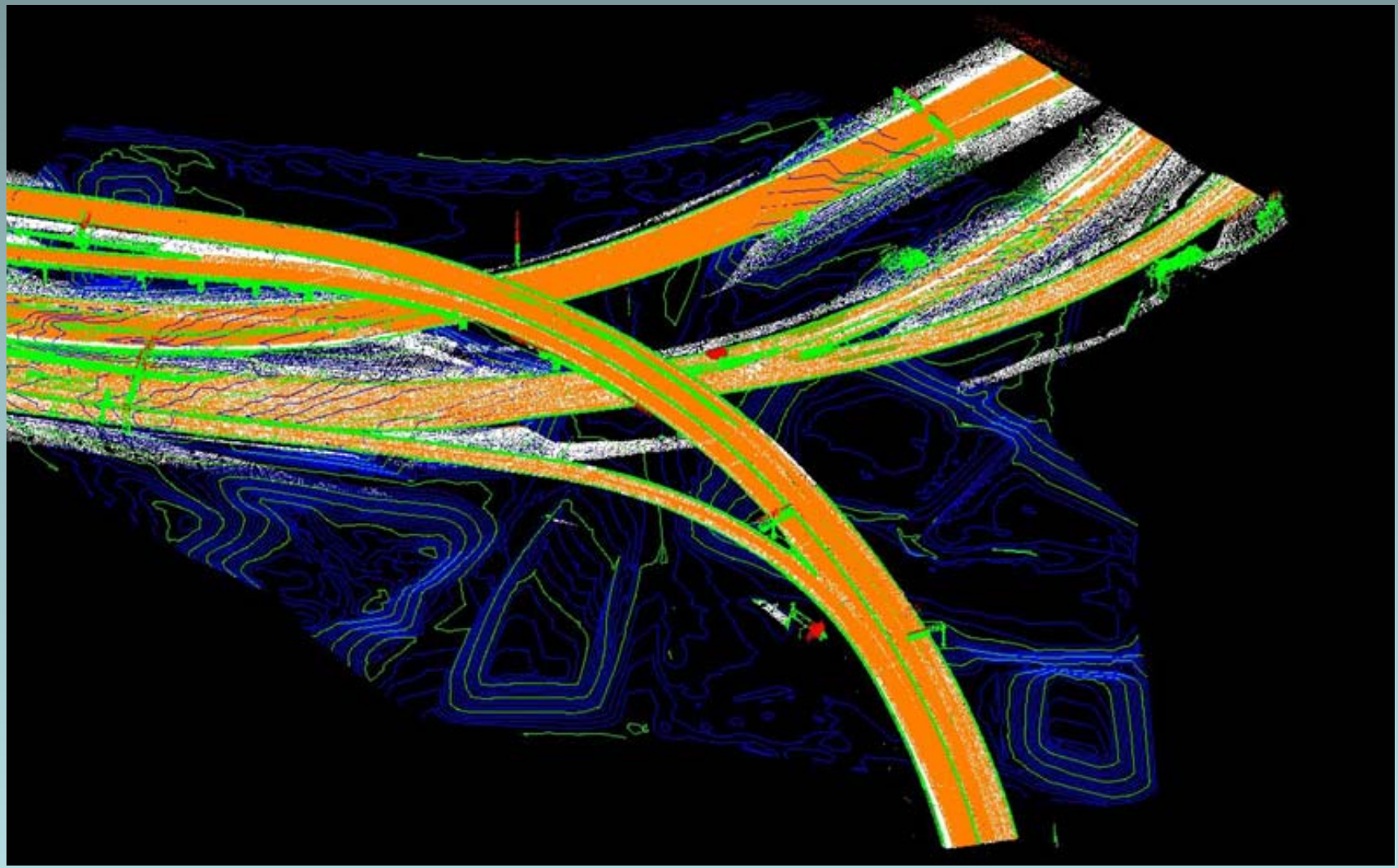


Project Pegasus
Combined Data Sources



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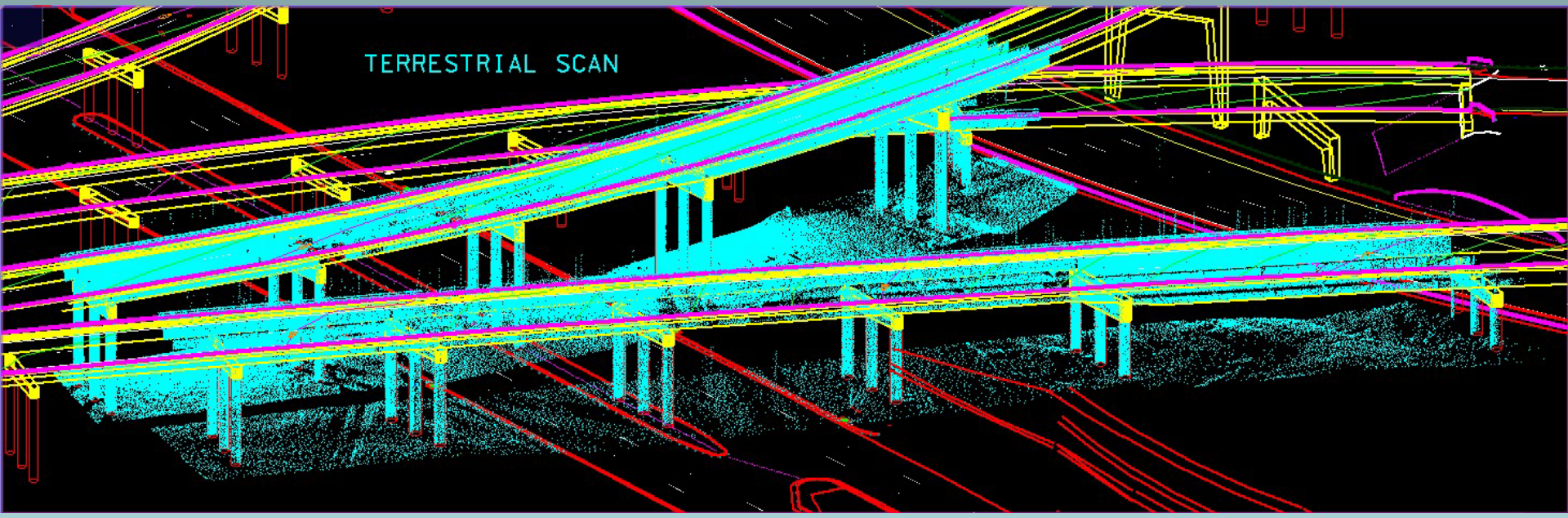

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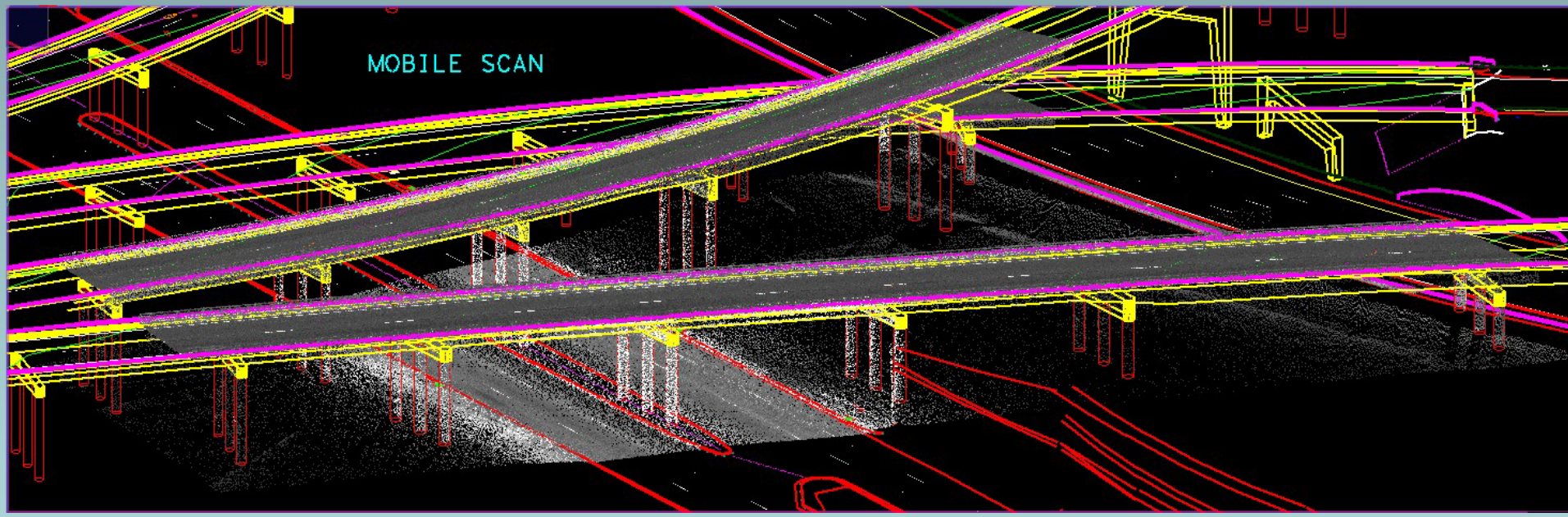

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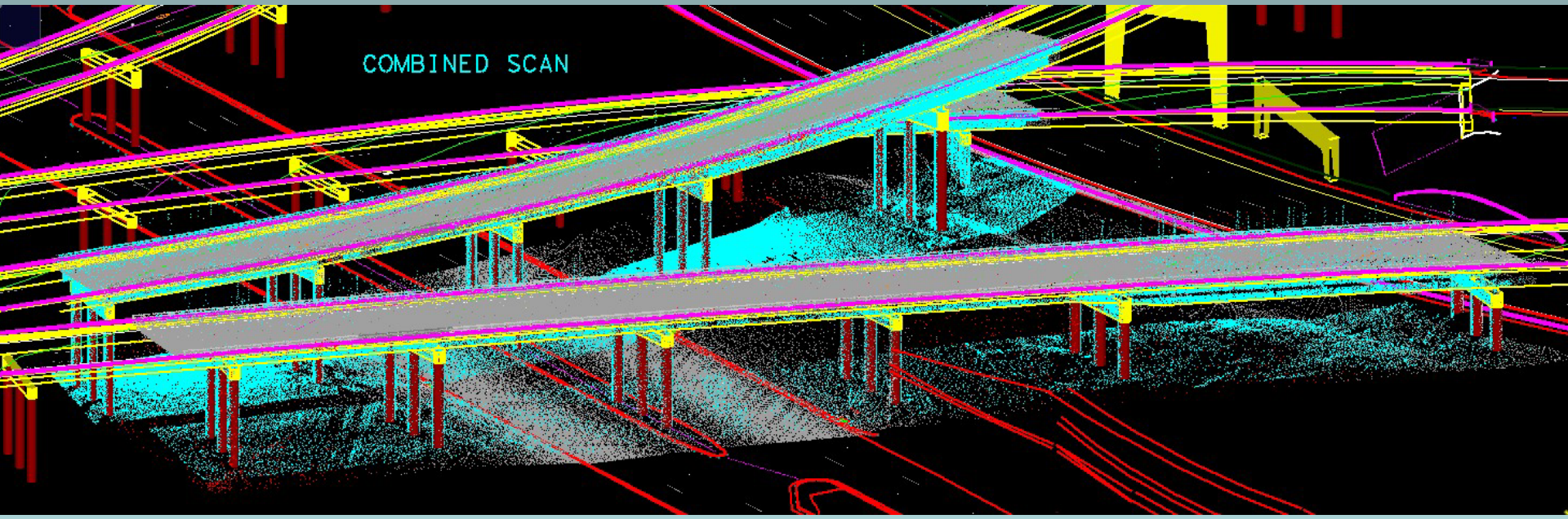
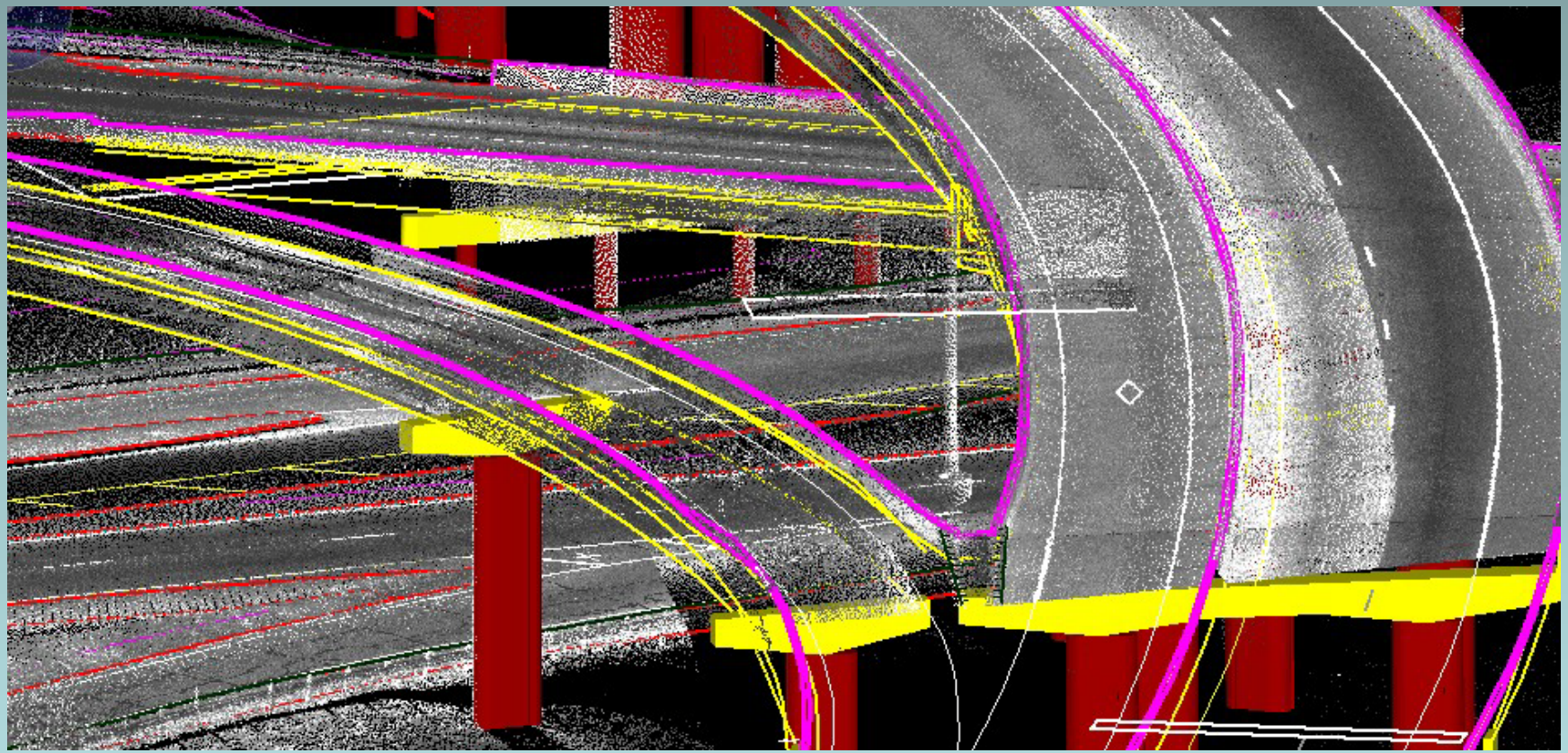


Project Pegasus Detail



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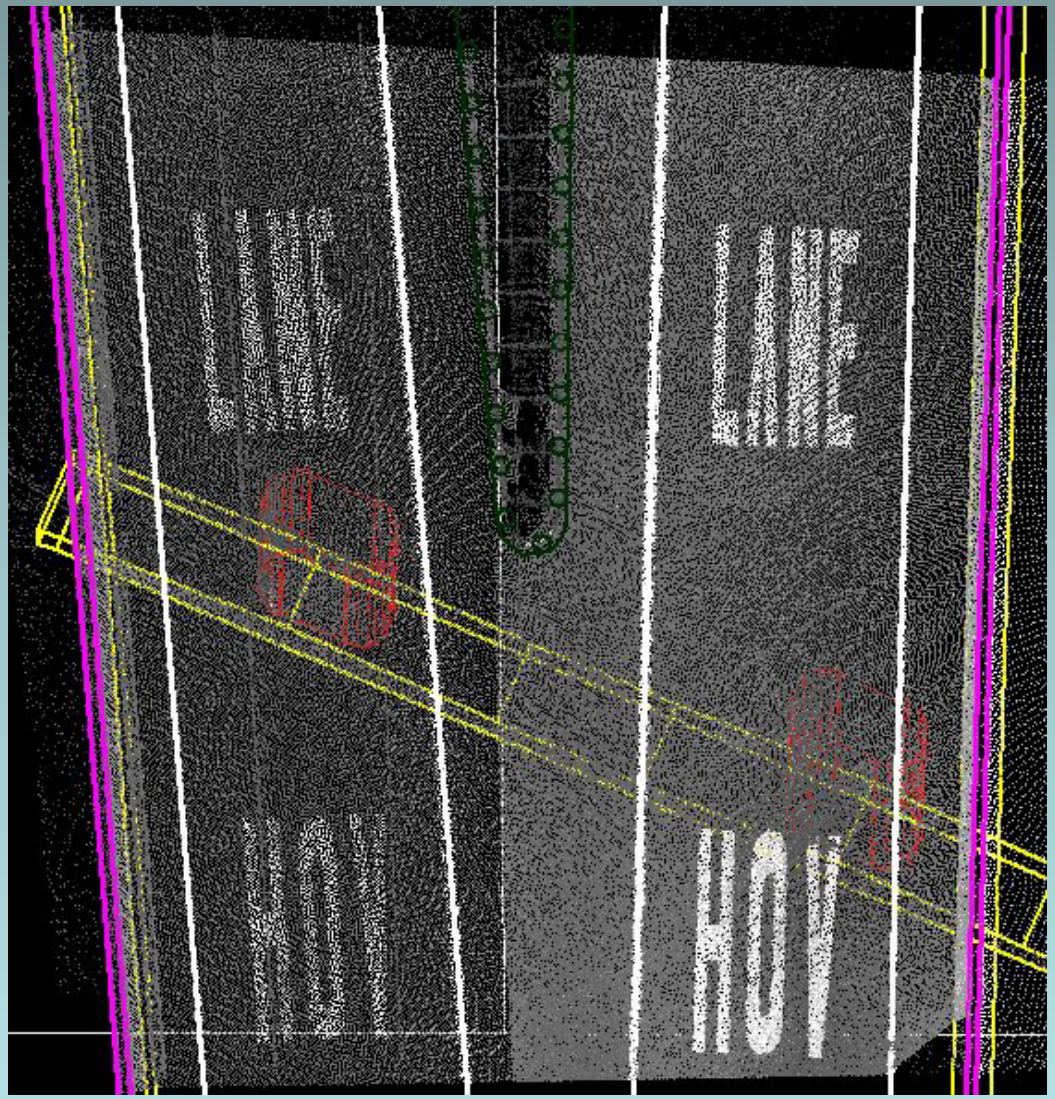

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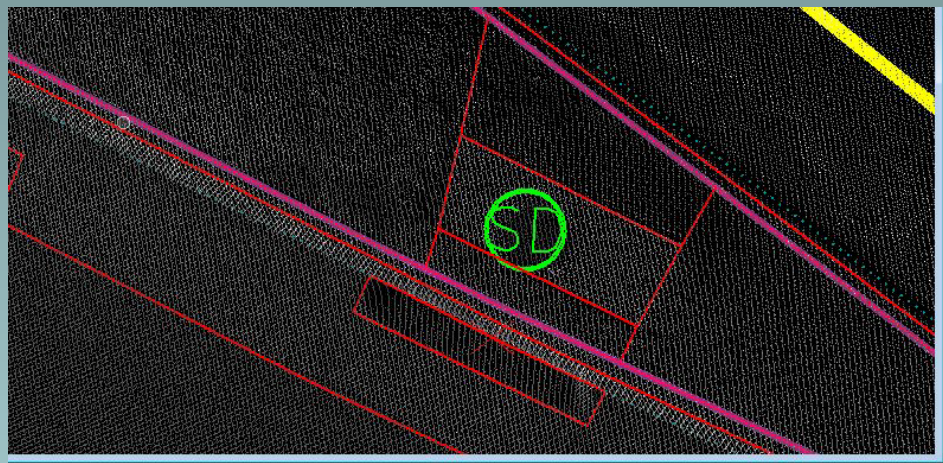
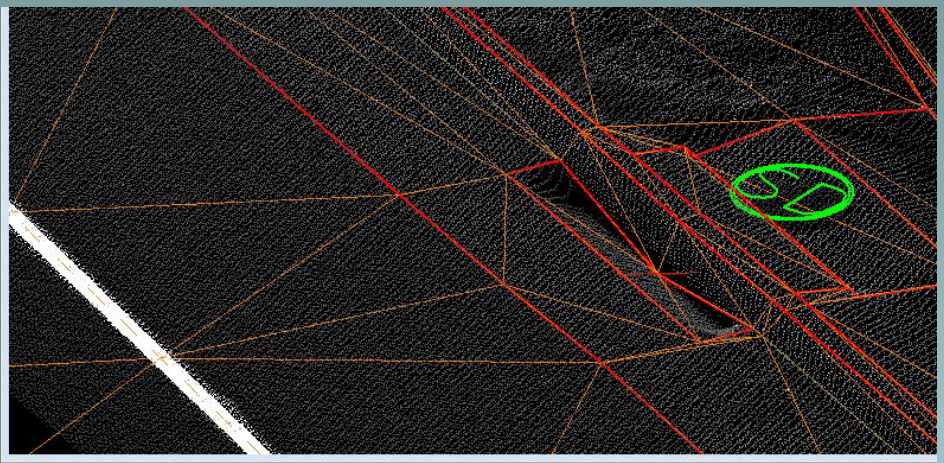
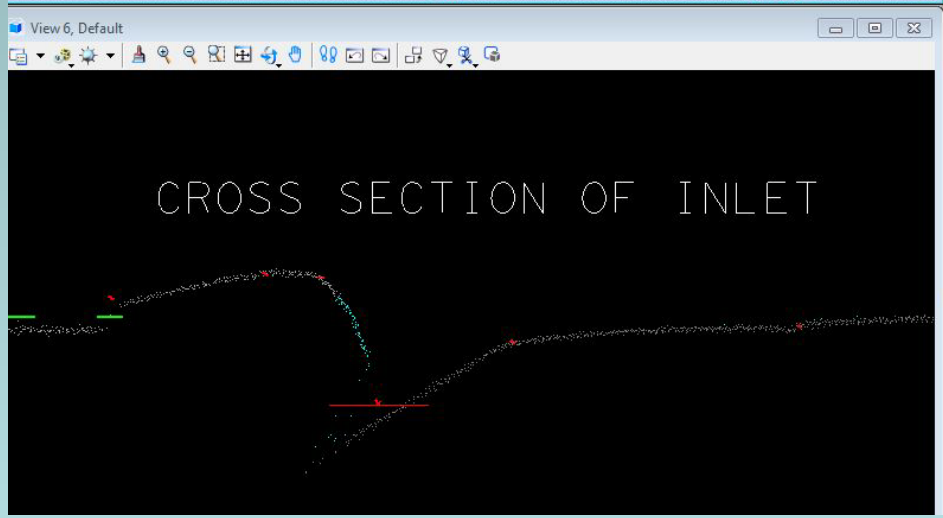
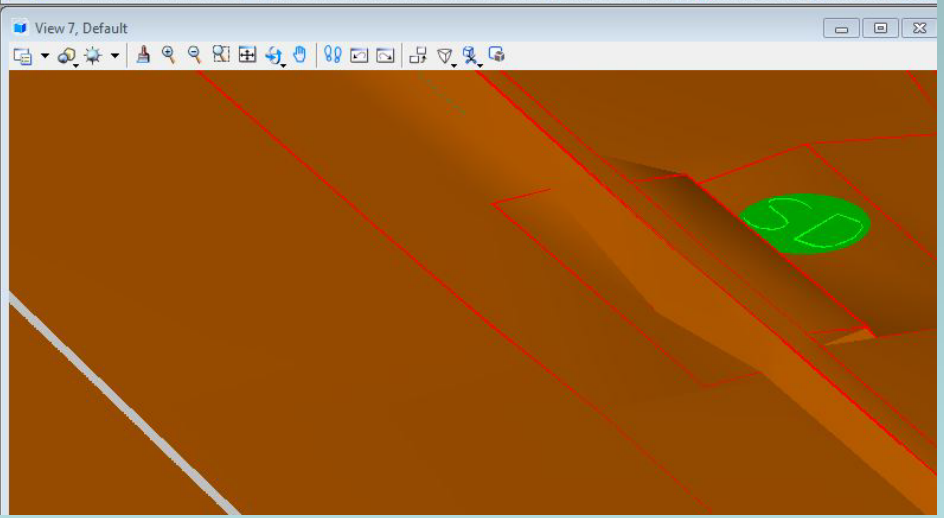
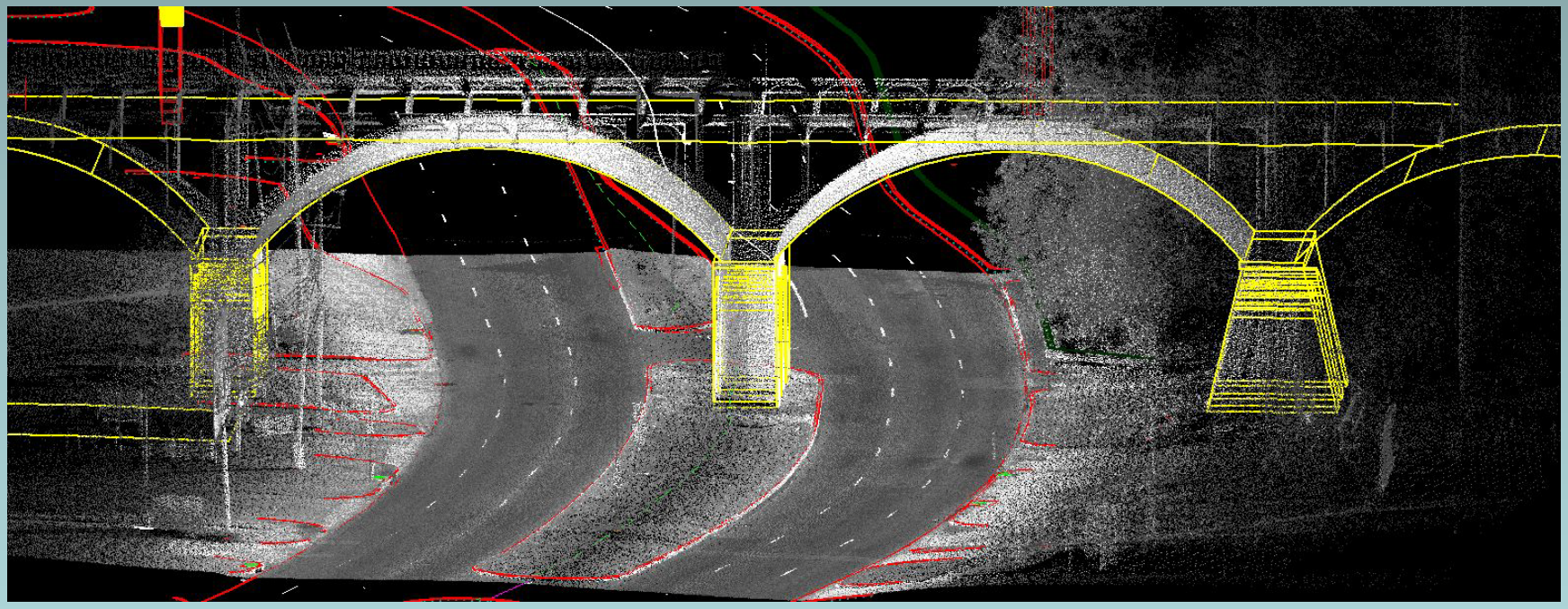








Project Pegasus
Detail



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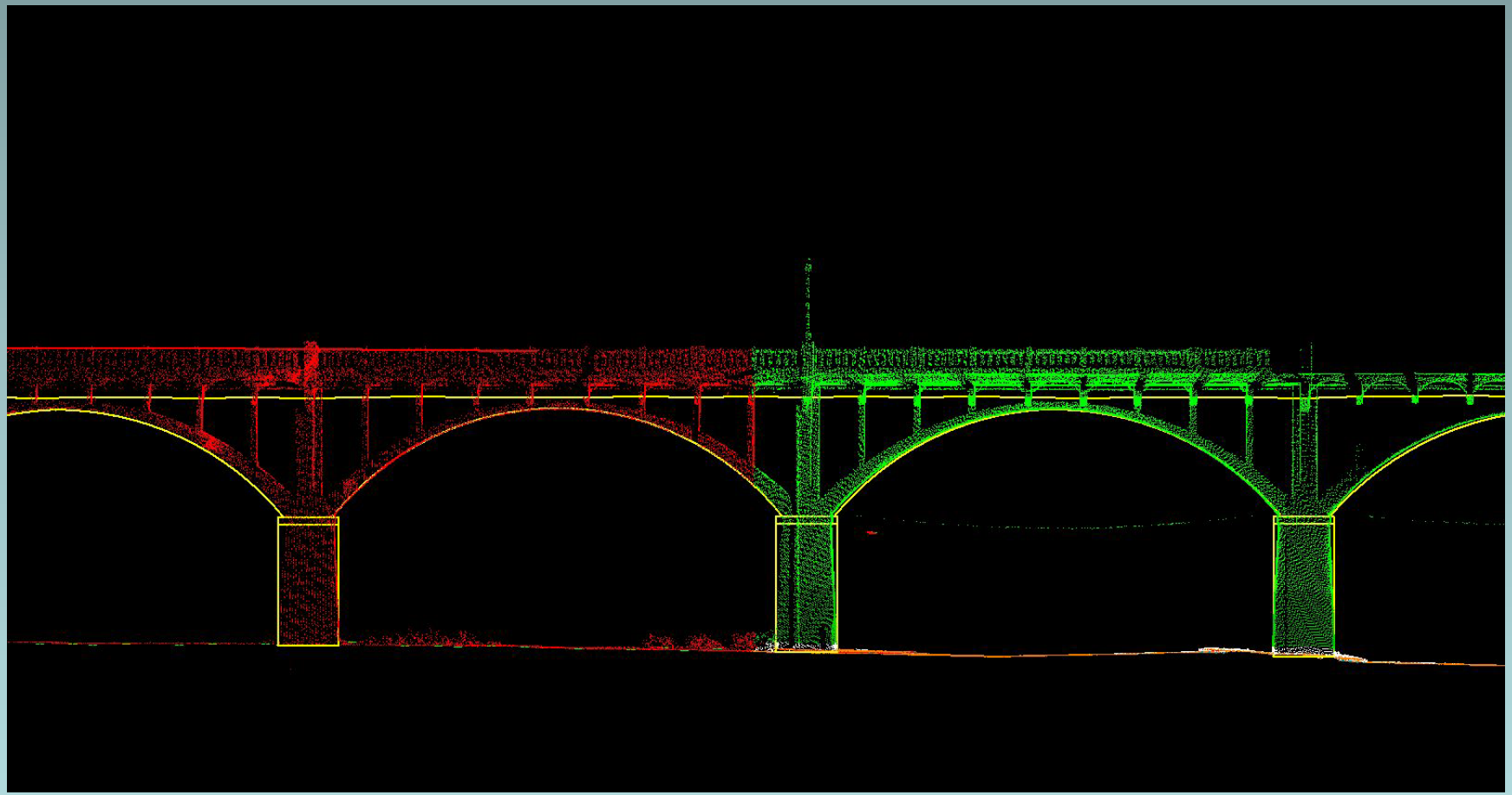
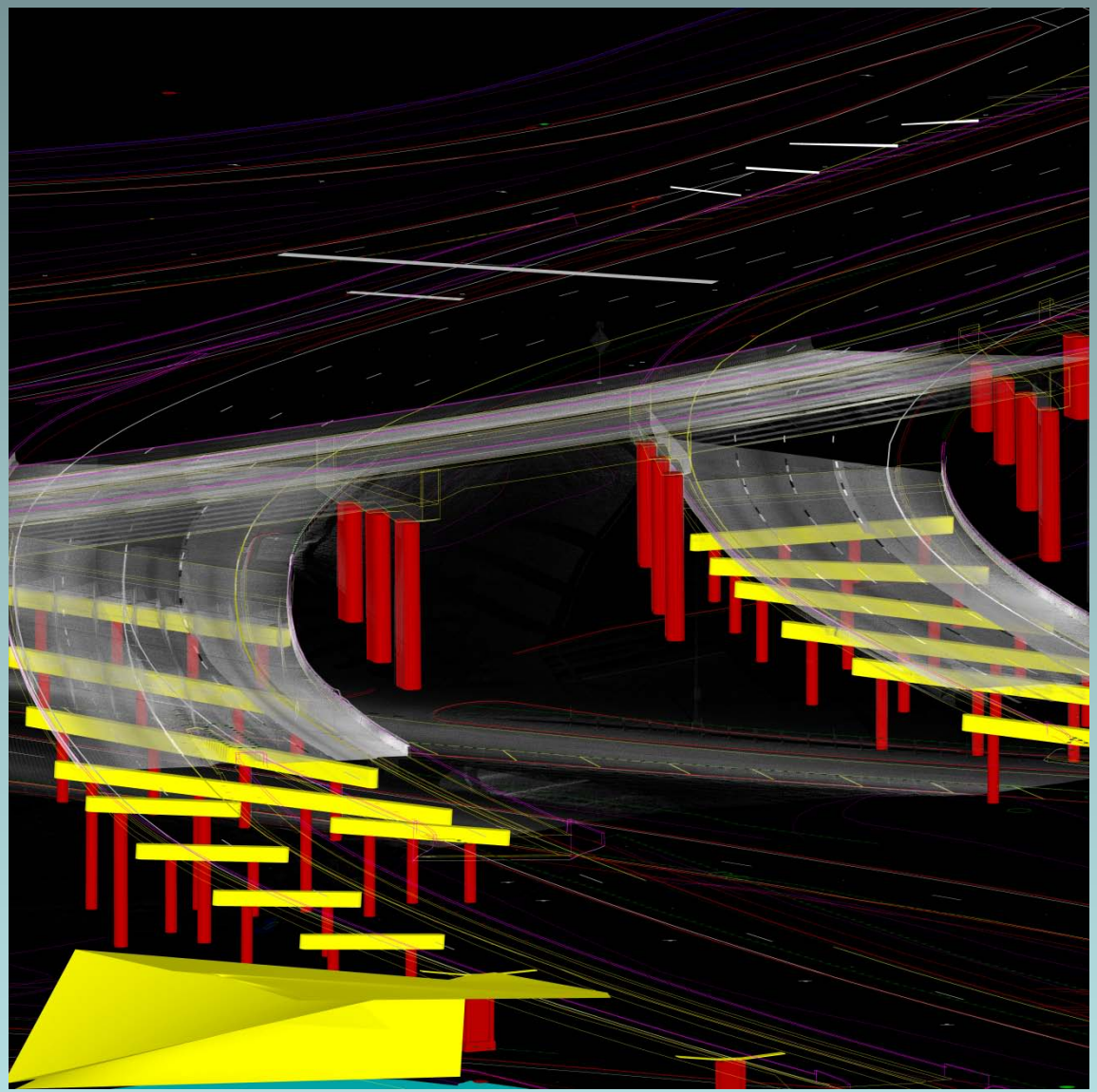


Project Pegasus
3D Graphics



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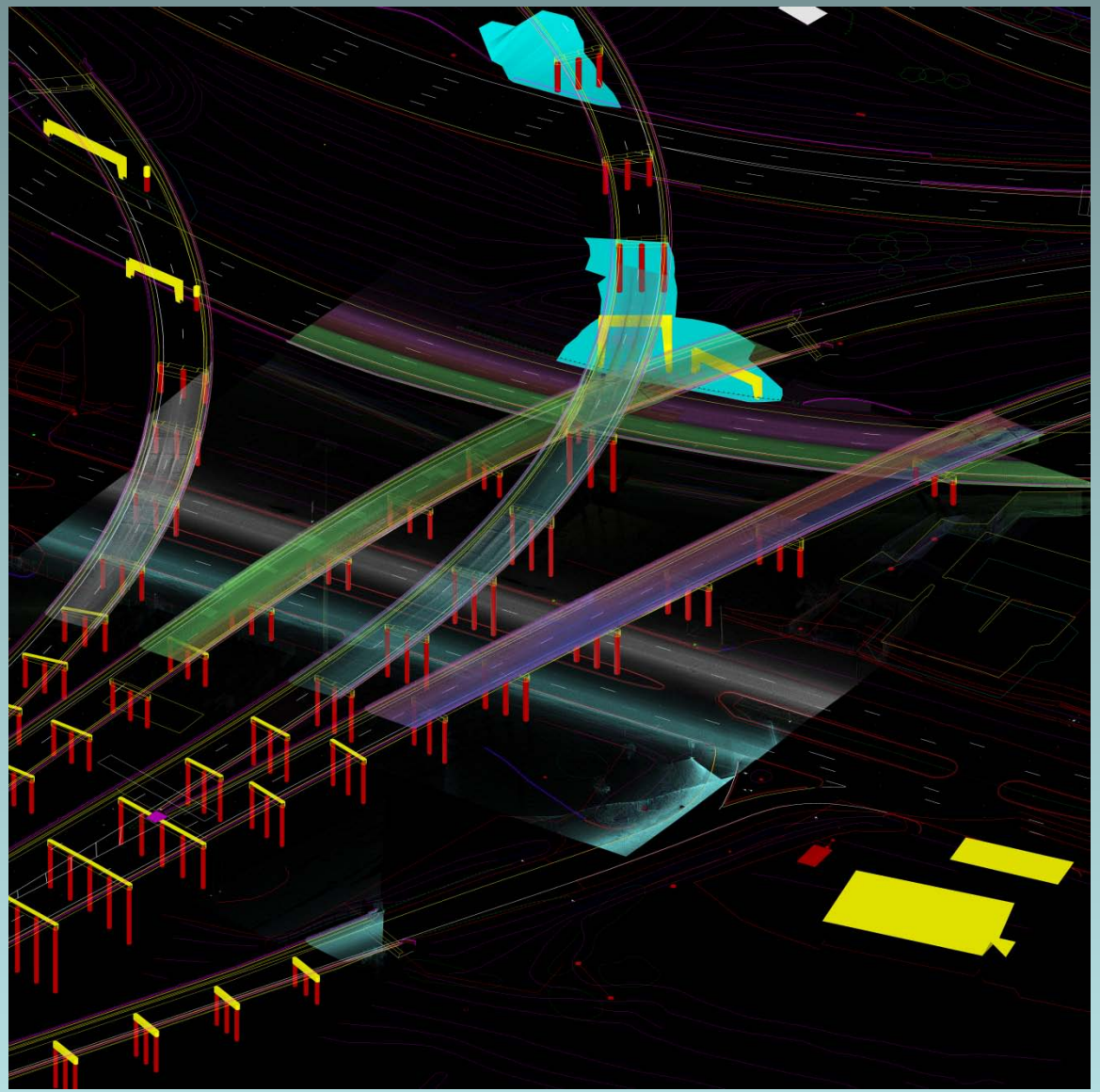

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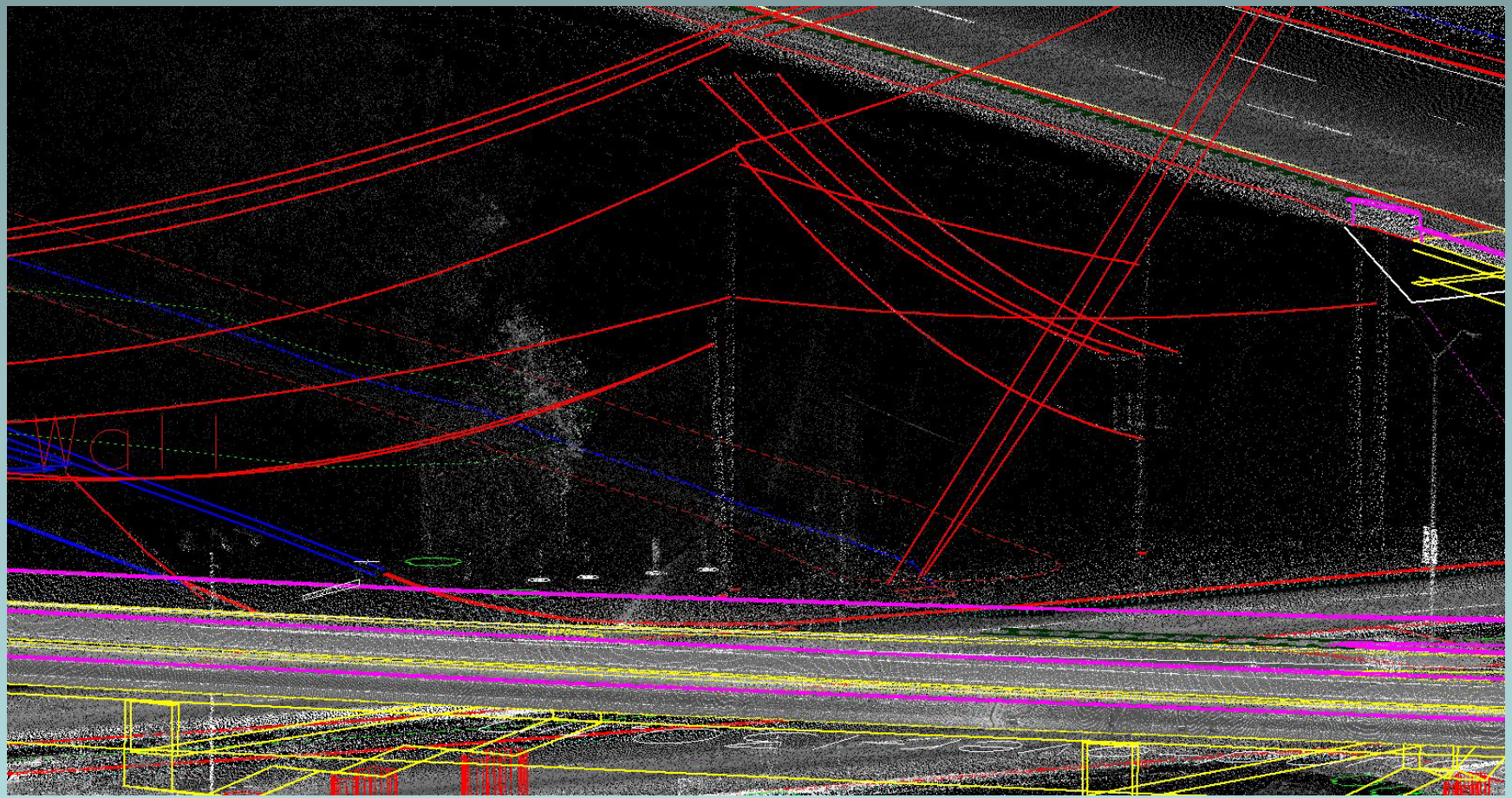

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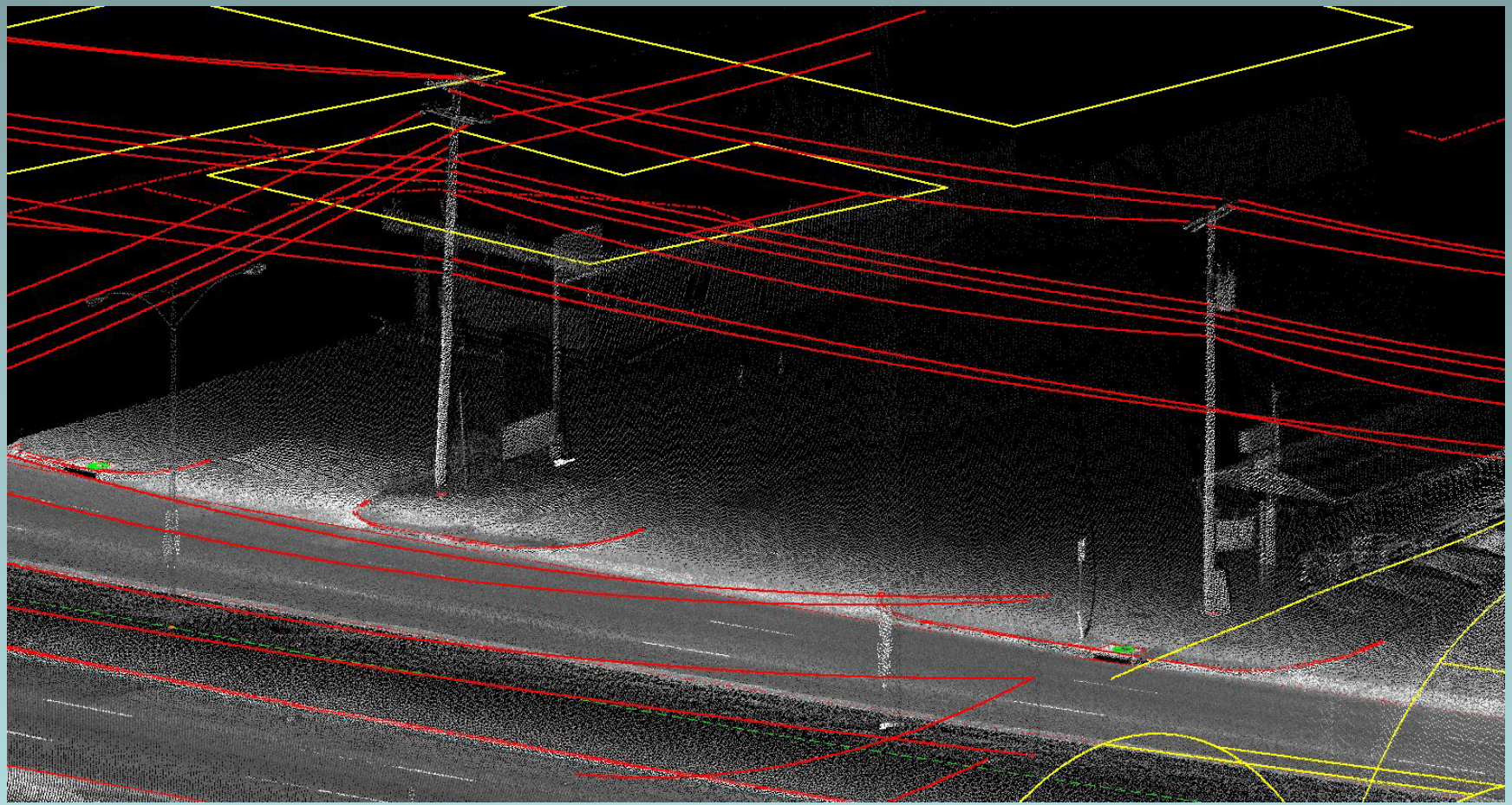
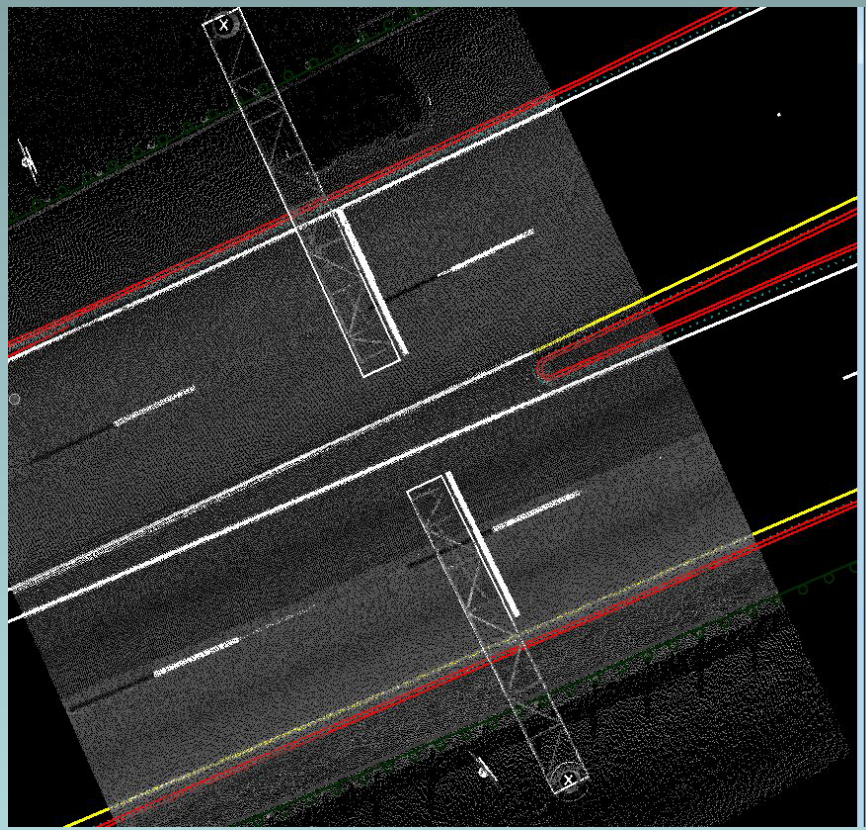
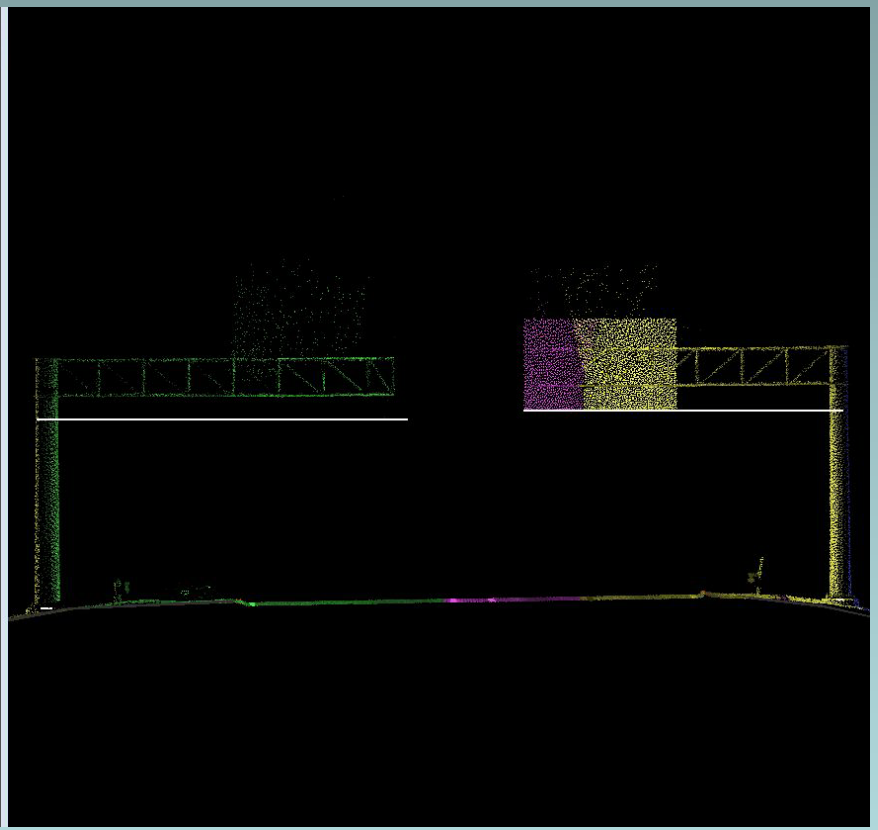


Project Pegasus Clearance





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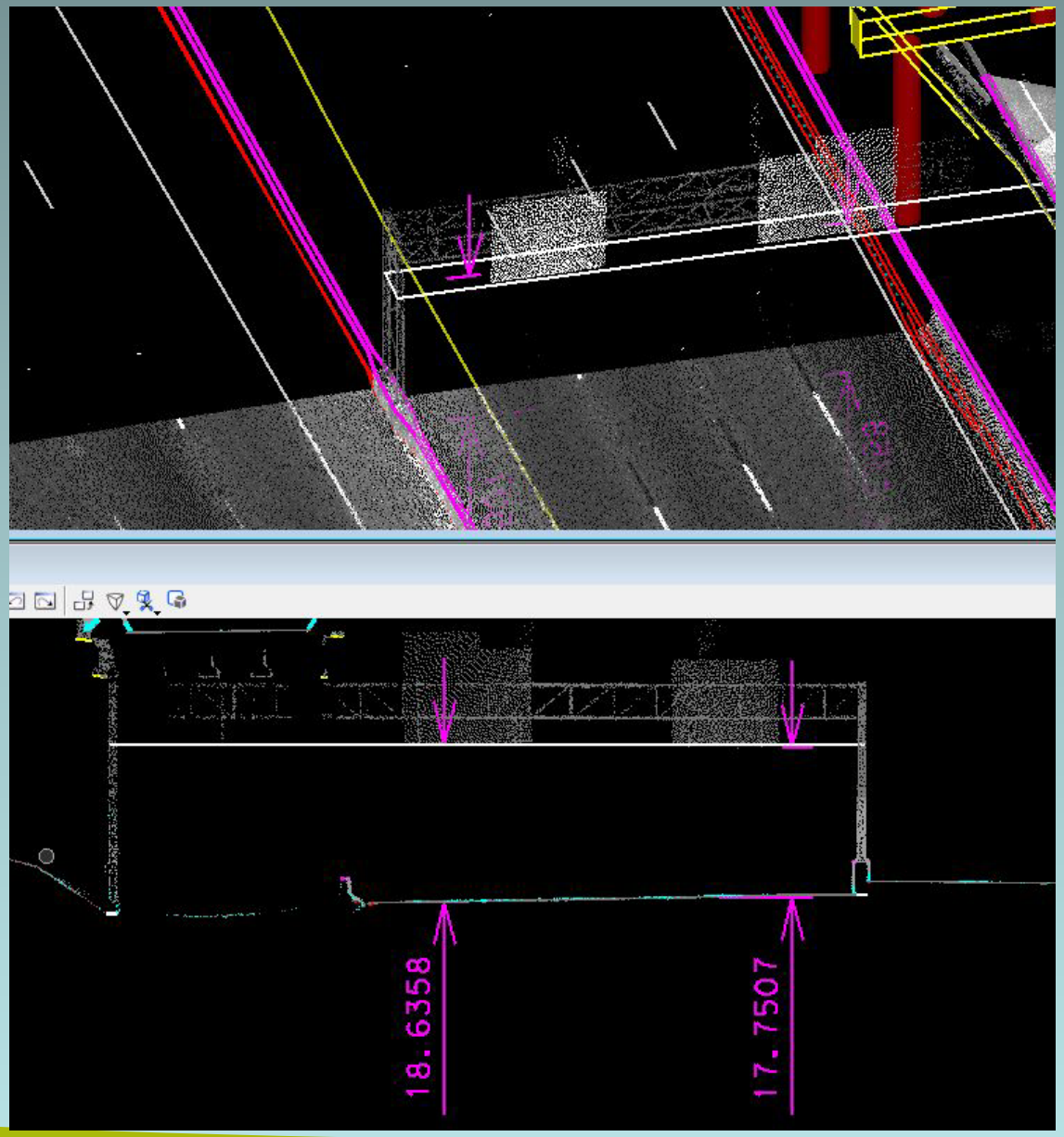

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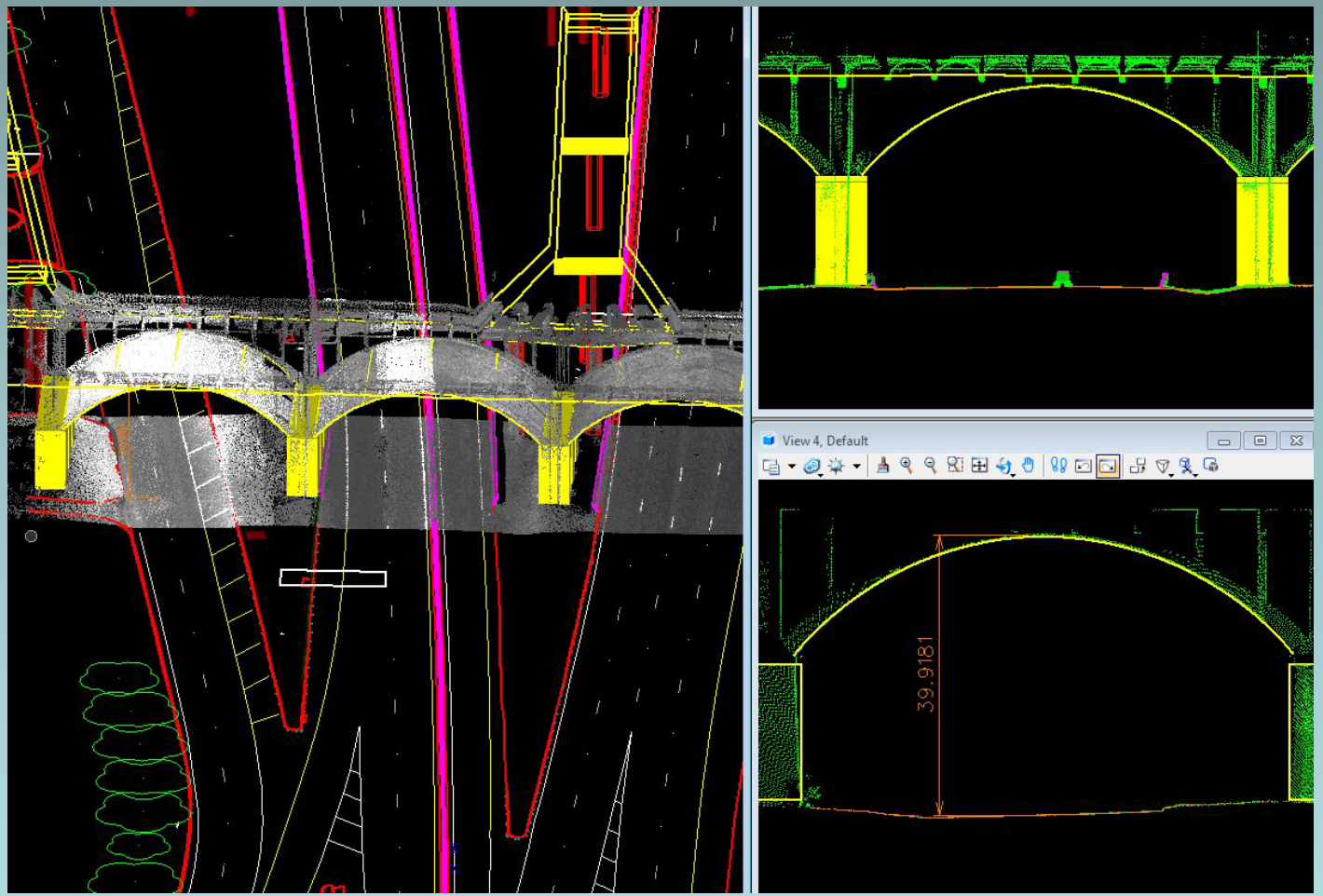
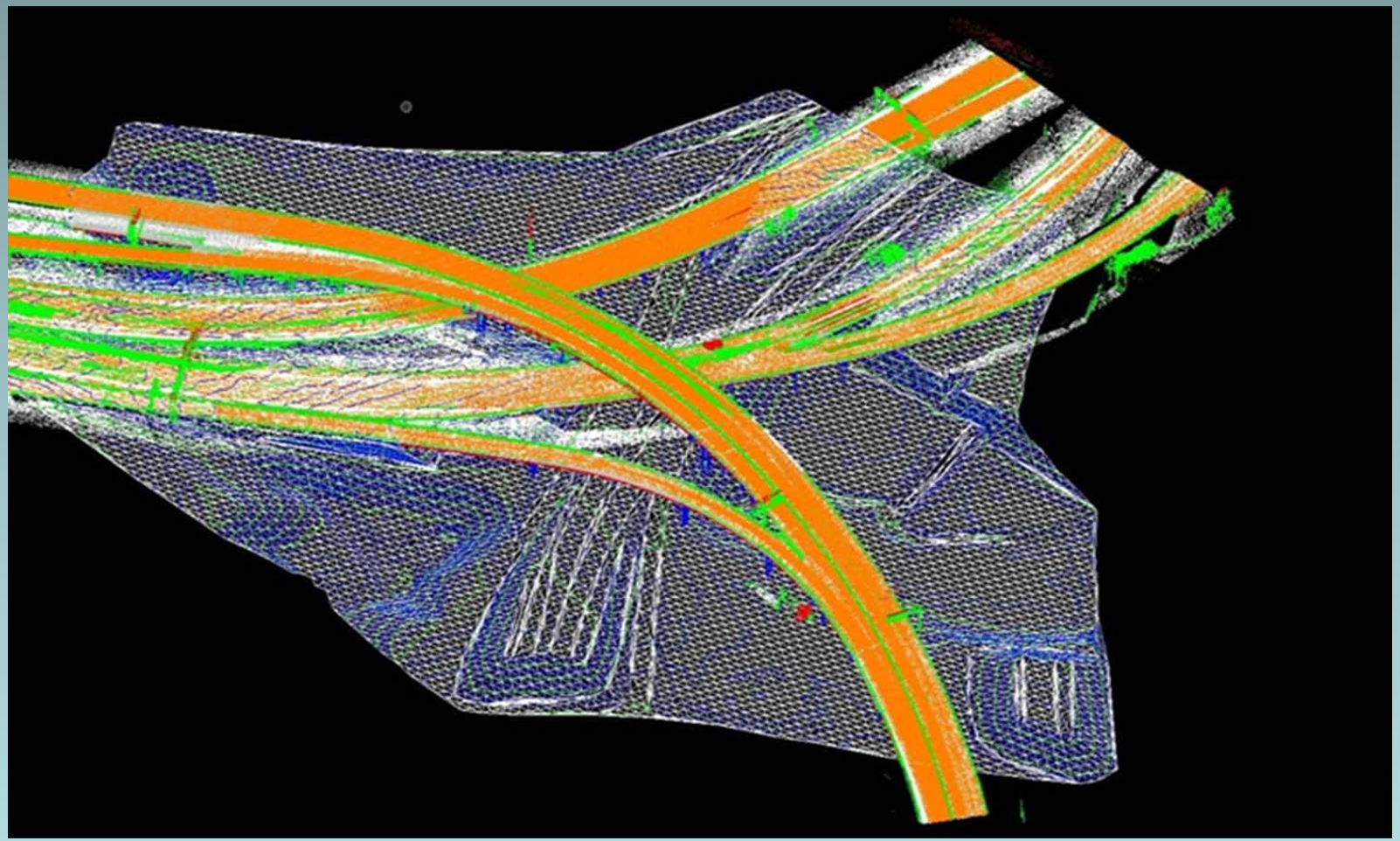


Project Pegasus
Survey Deliverables

Project Pegasus
Survey Deliverables



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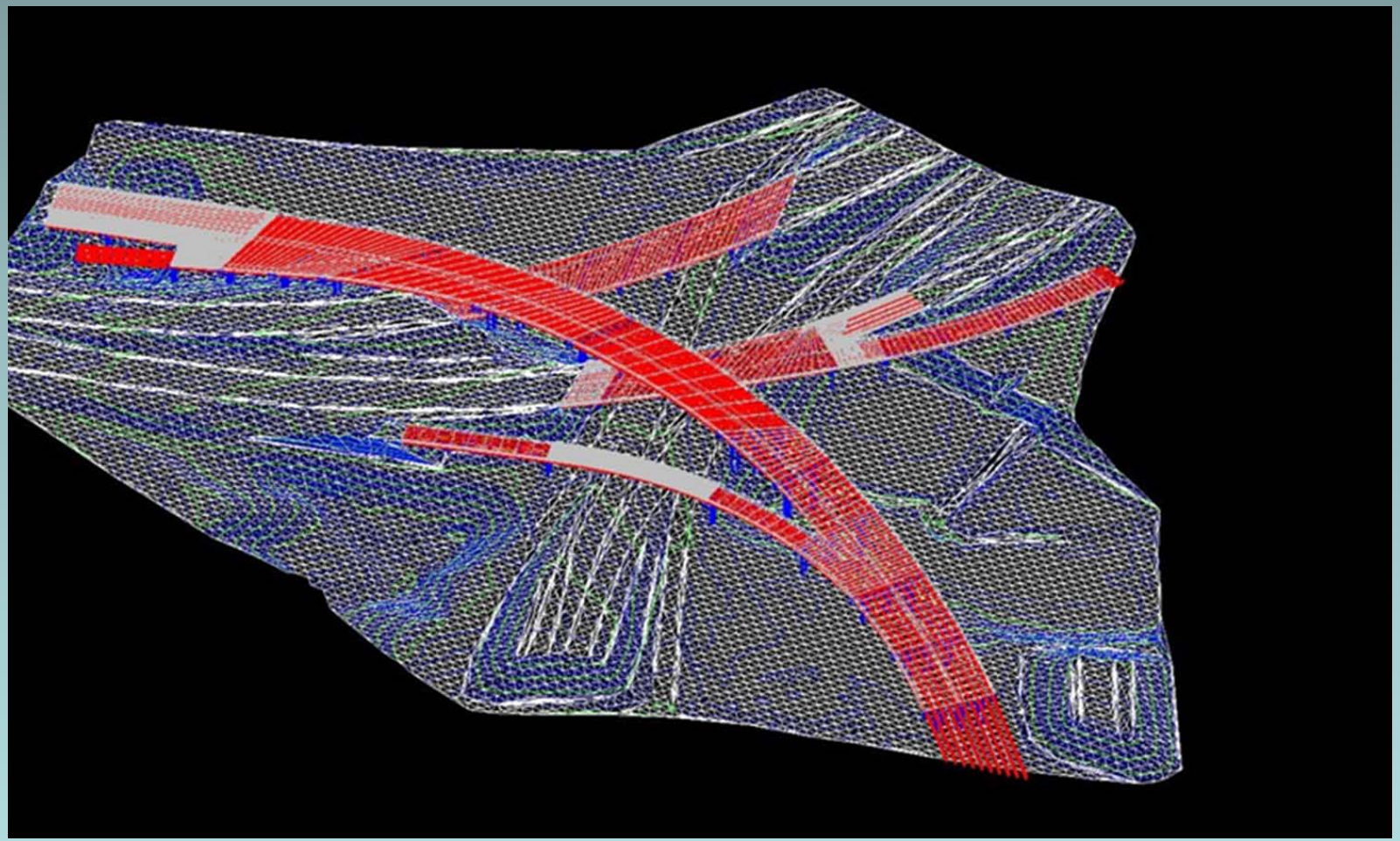
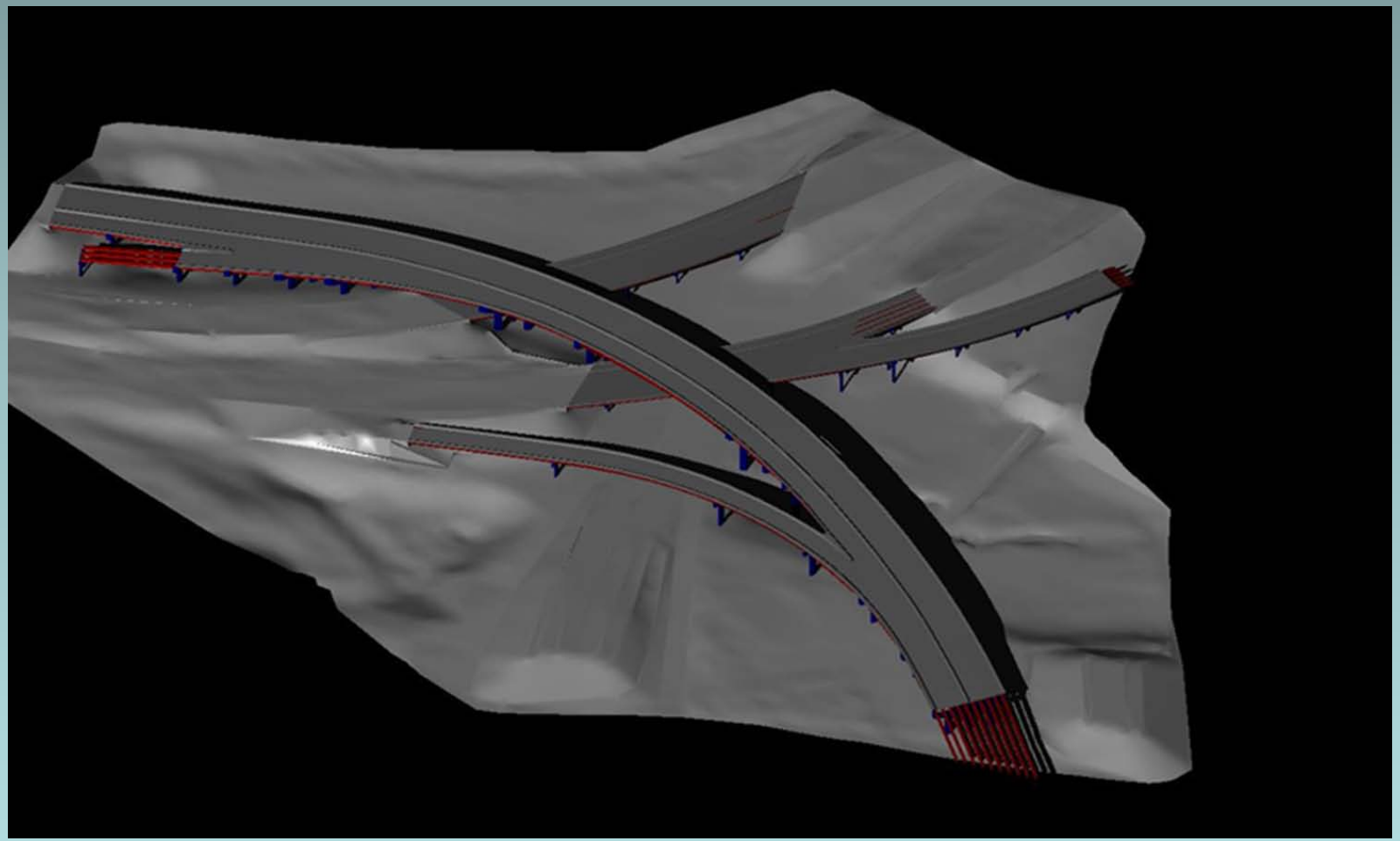
Survey Deliverables



Project Pegasus
Survey Deliverables



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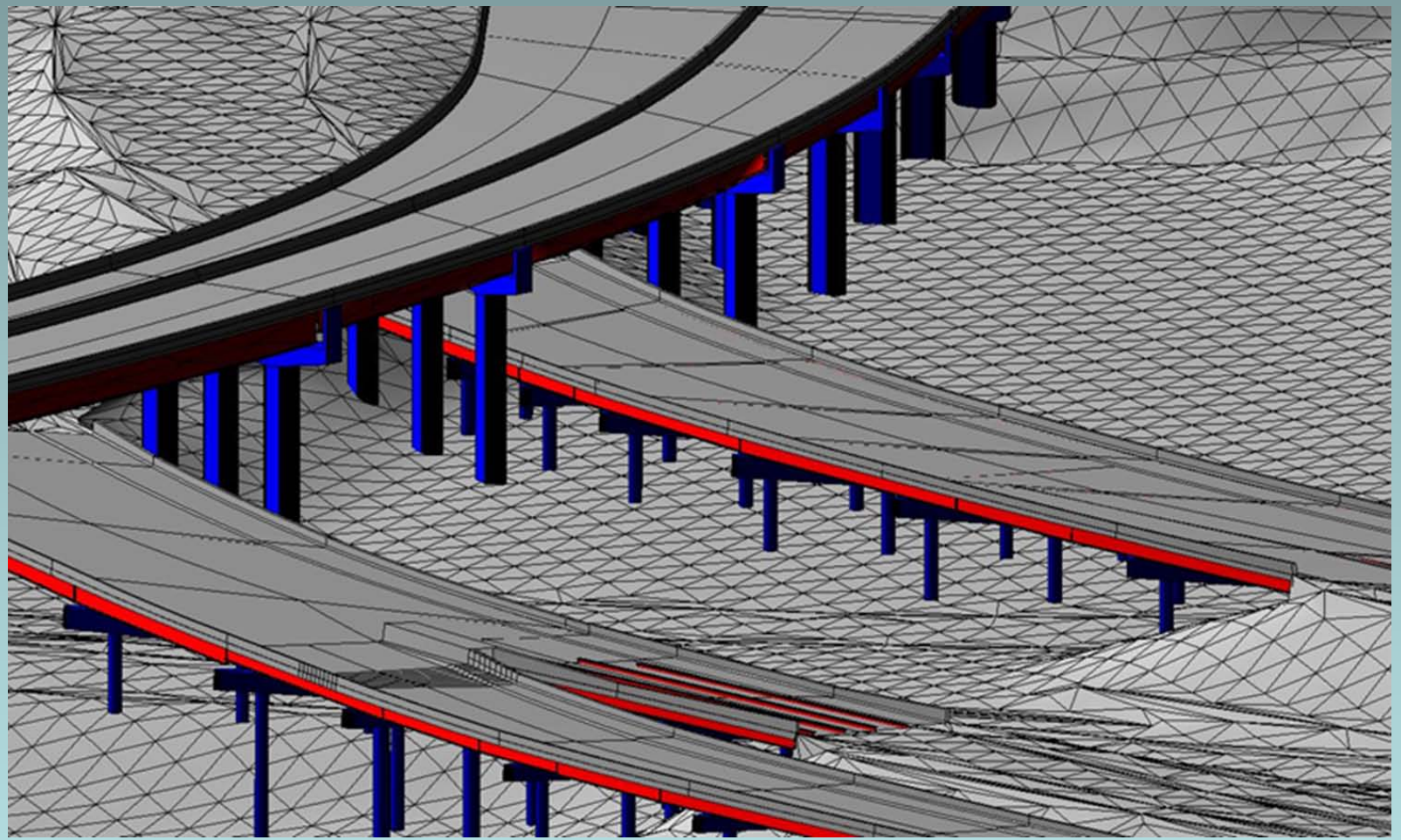

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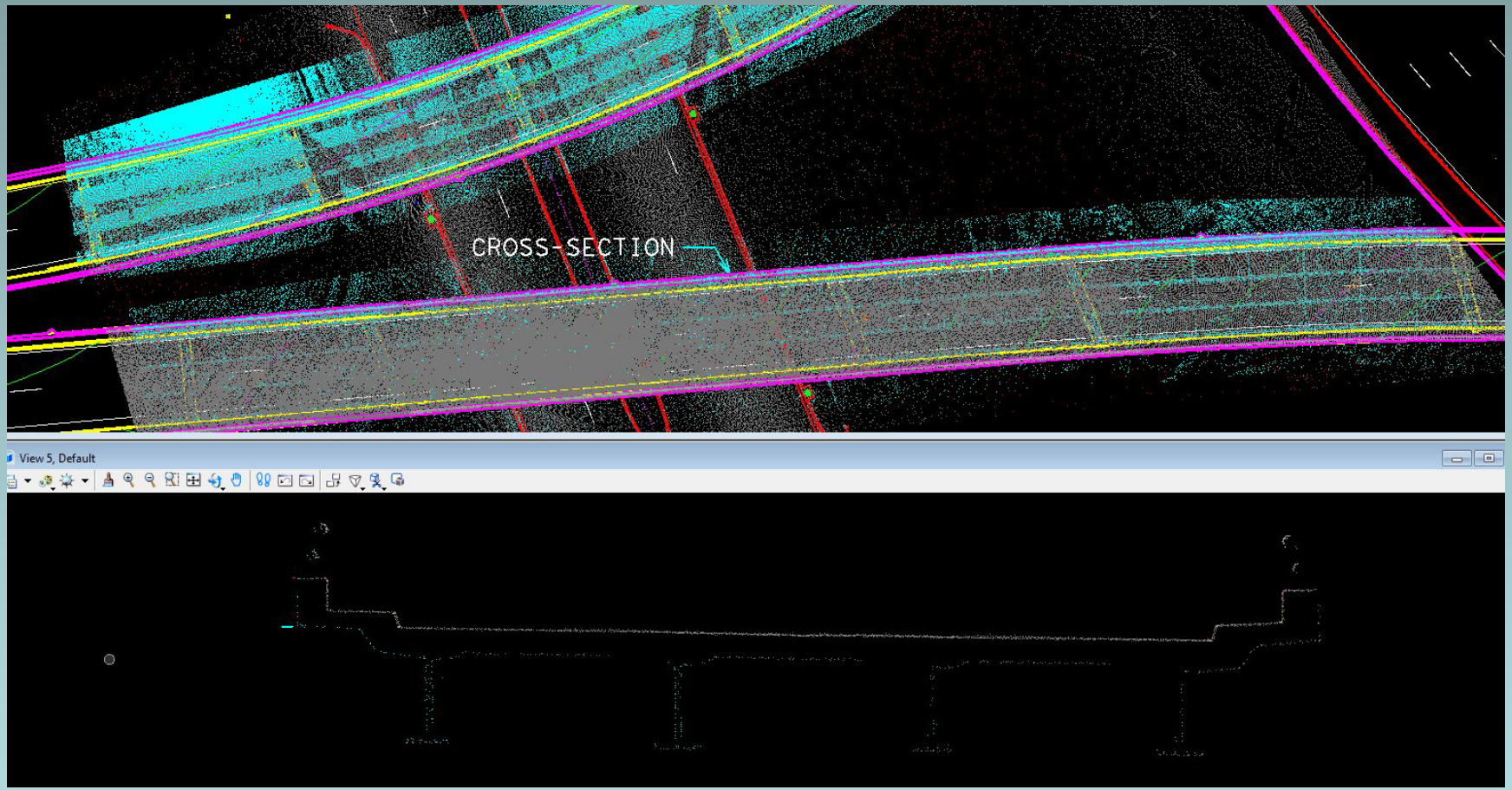

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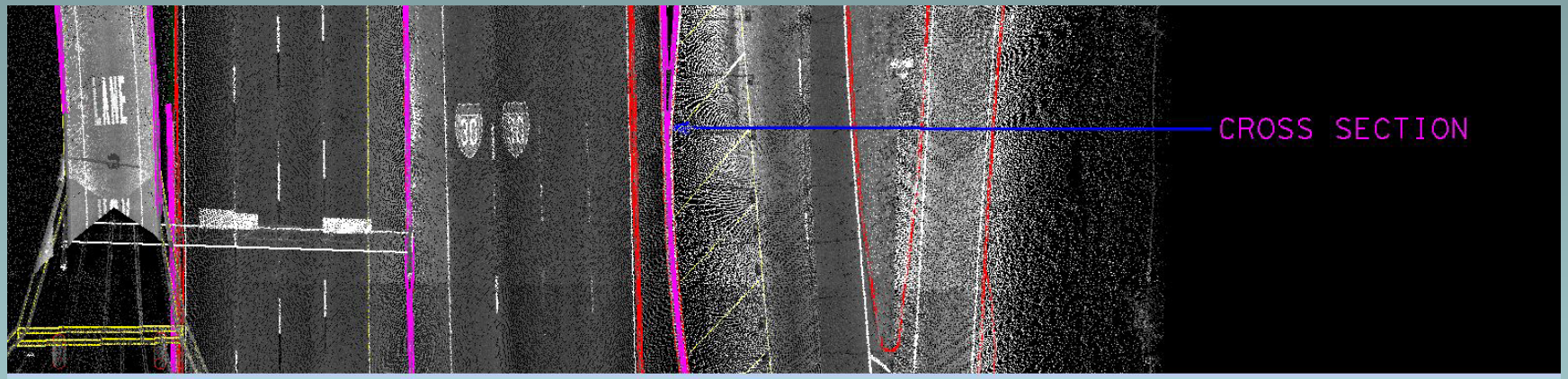

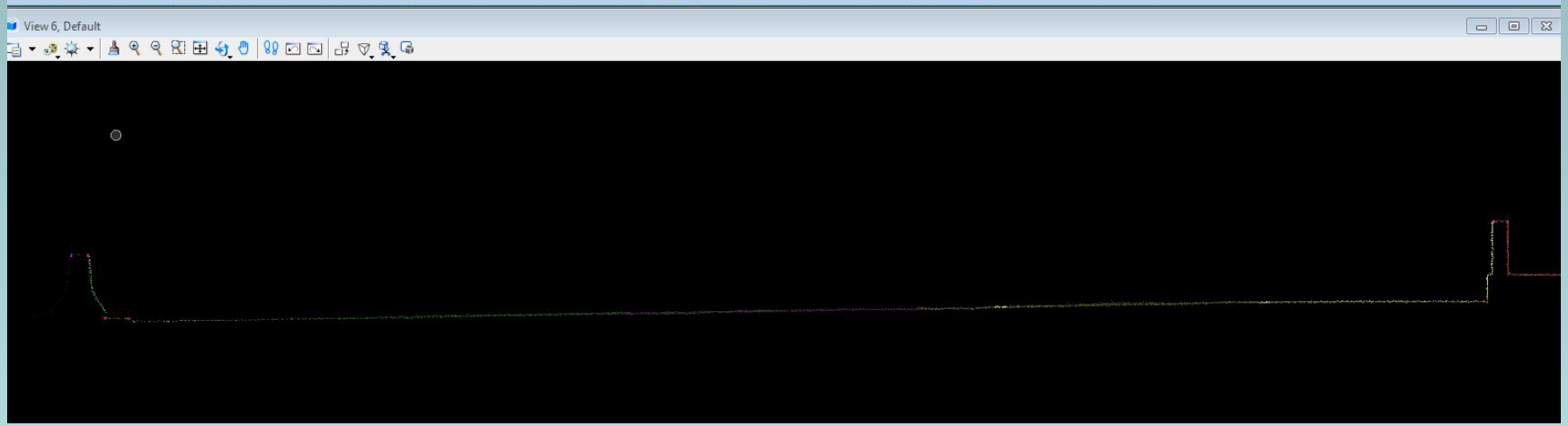

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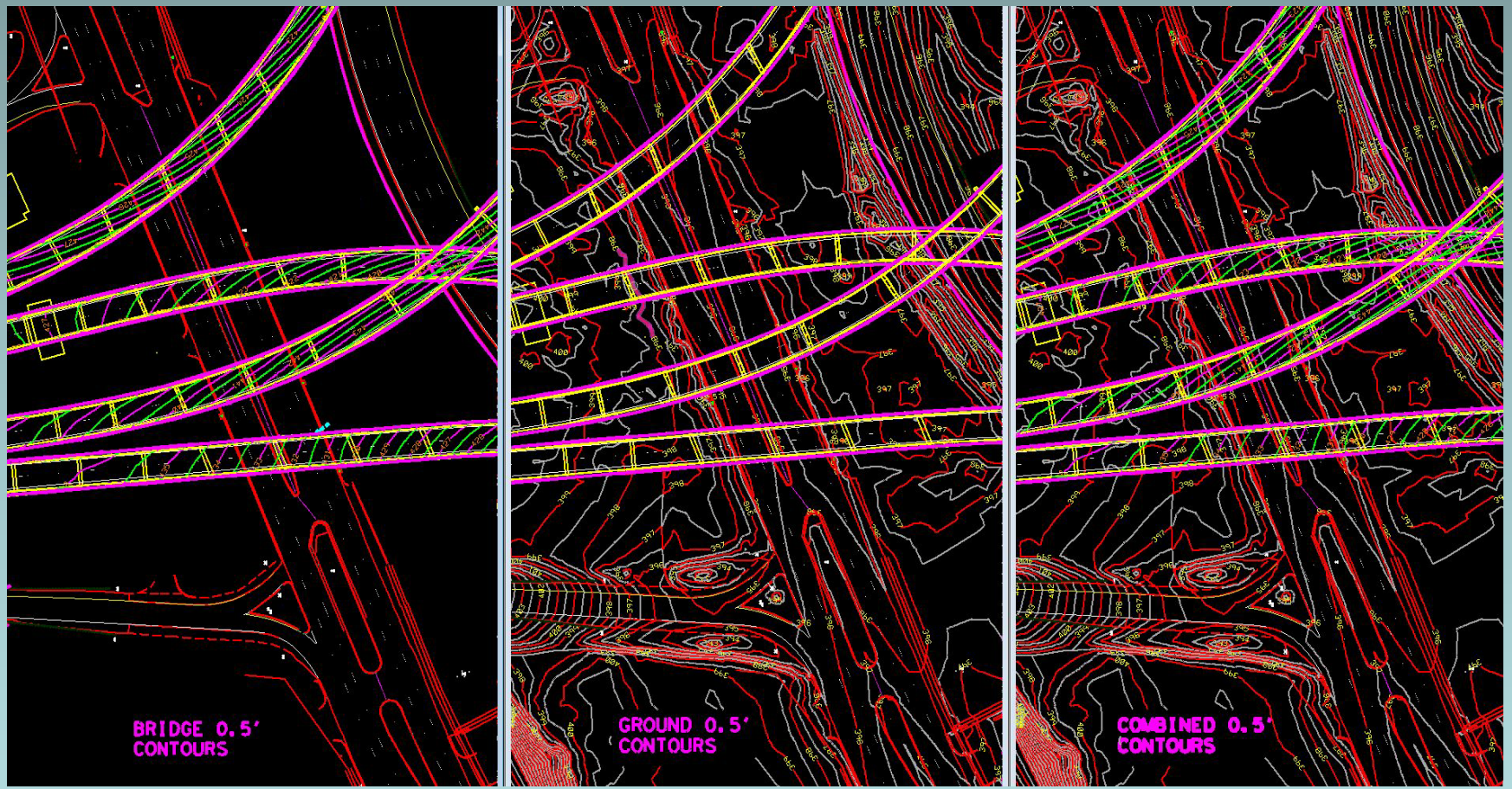

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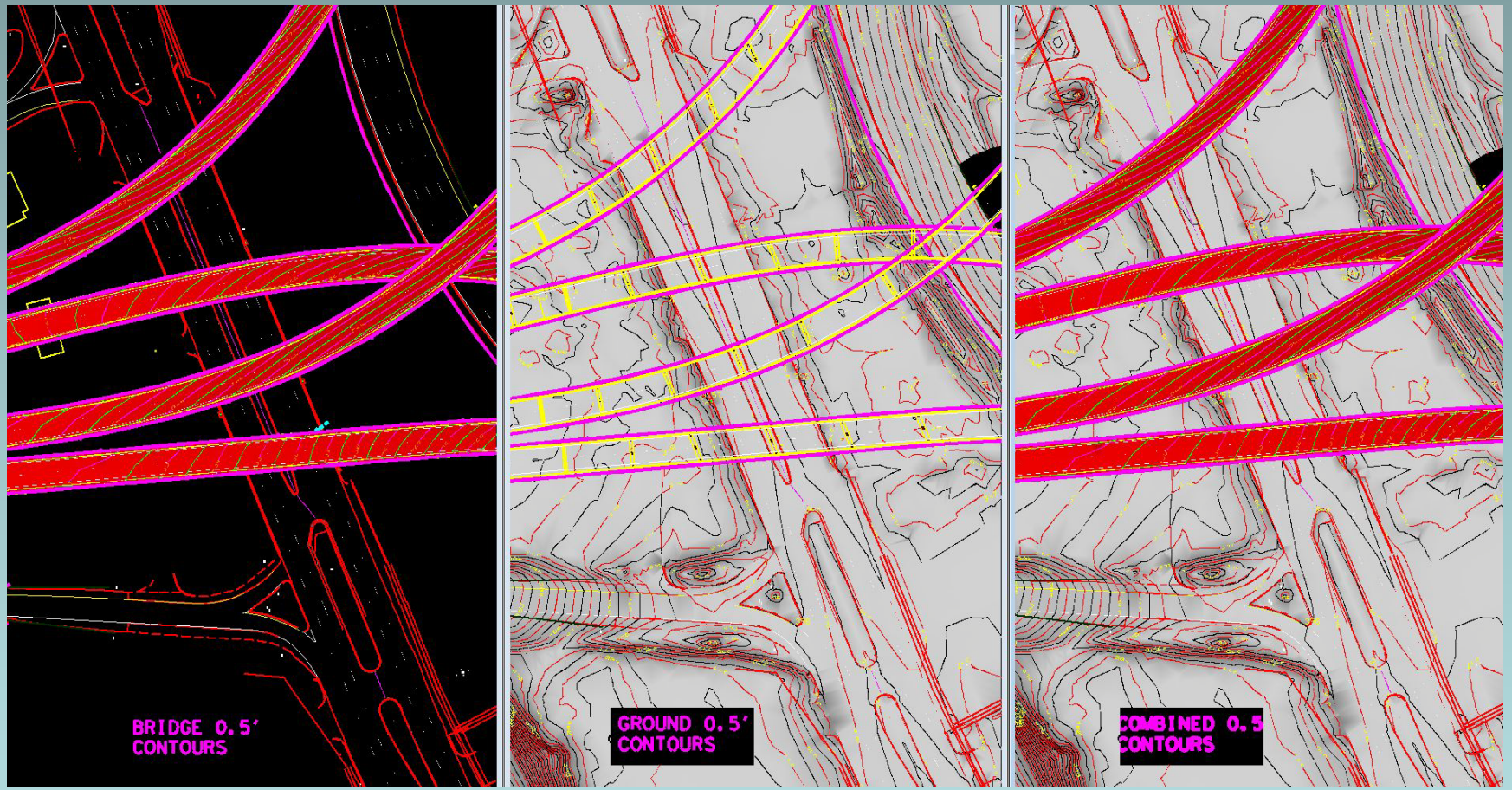

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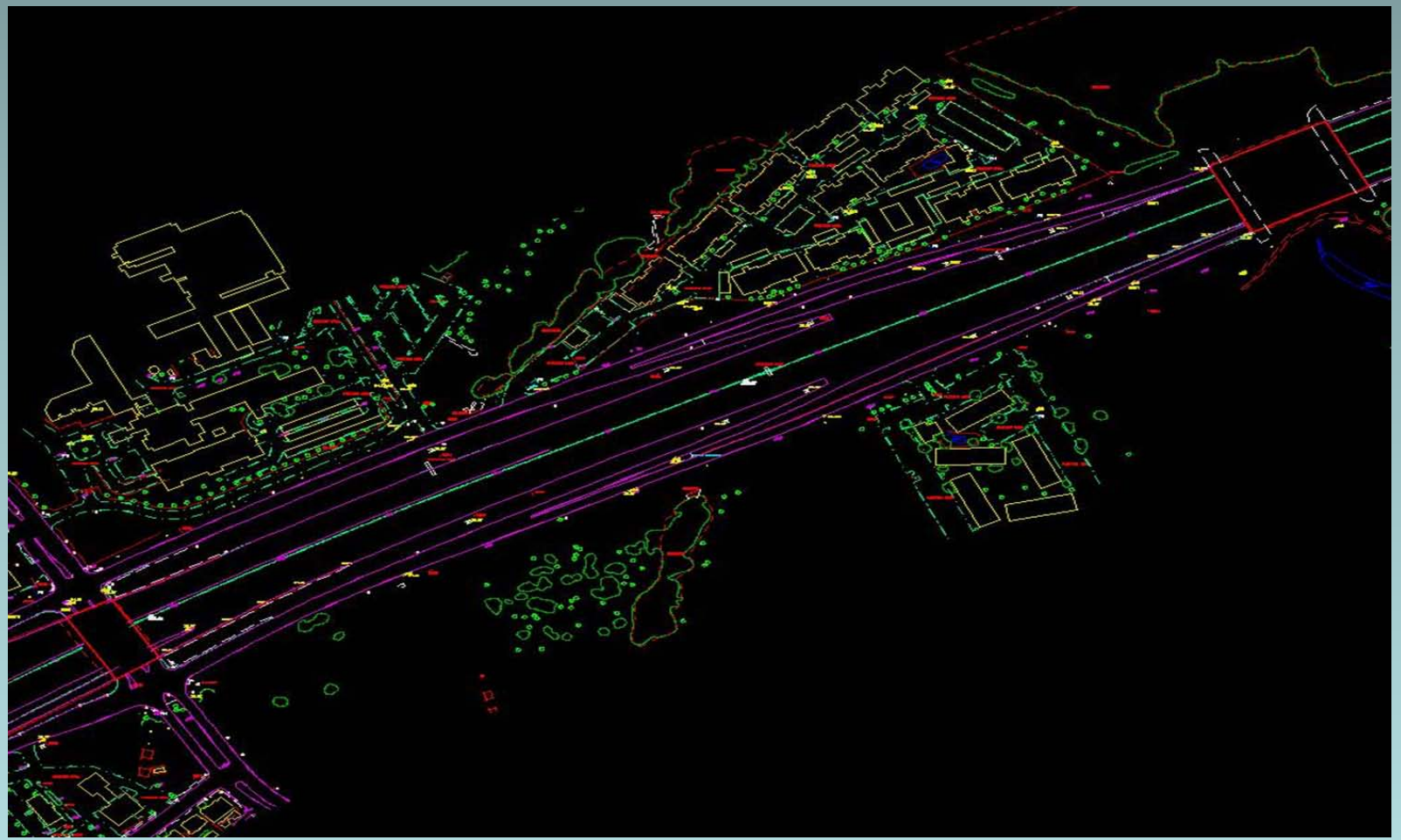
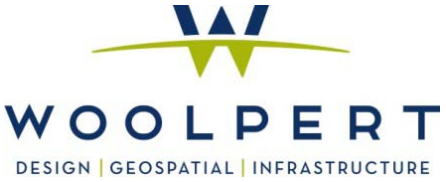
Case Studies for Data Fusion for Highway Design Projects