# PROJECT APPLICATIONS OF LIDAR


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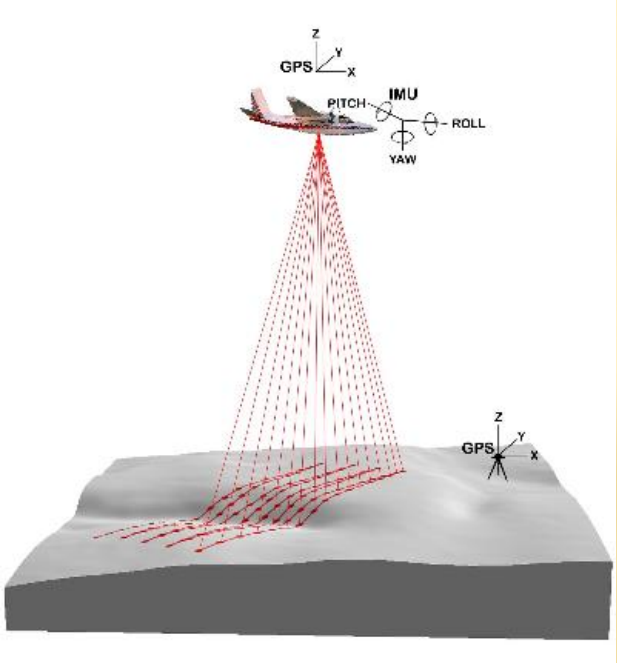
KENTUCKY TRANSPORTATION CABINET

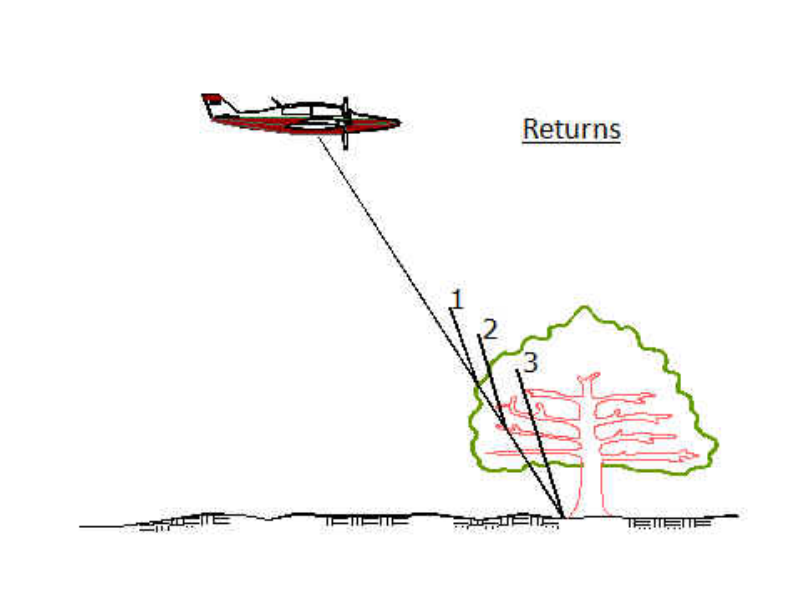
engineering | architecture | geospatial

QK4

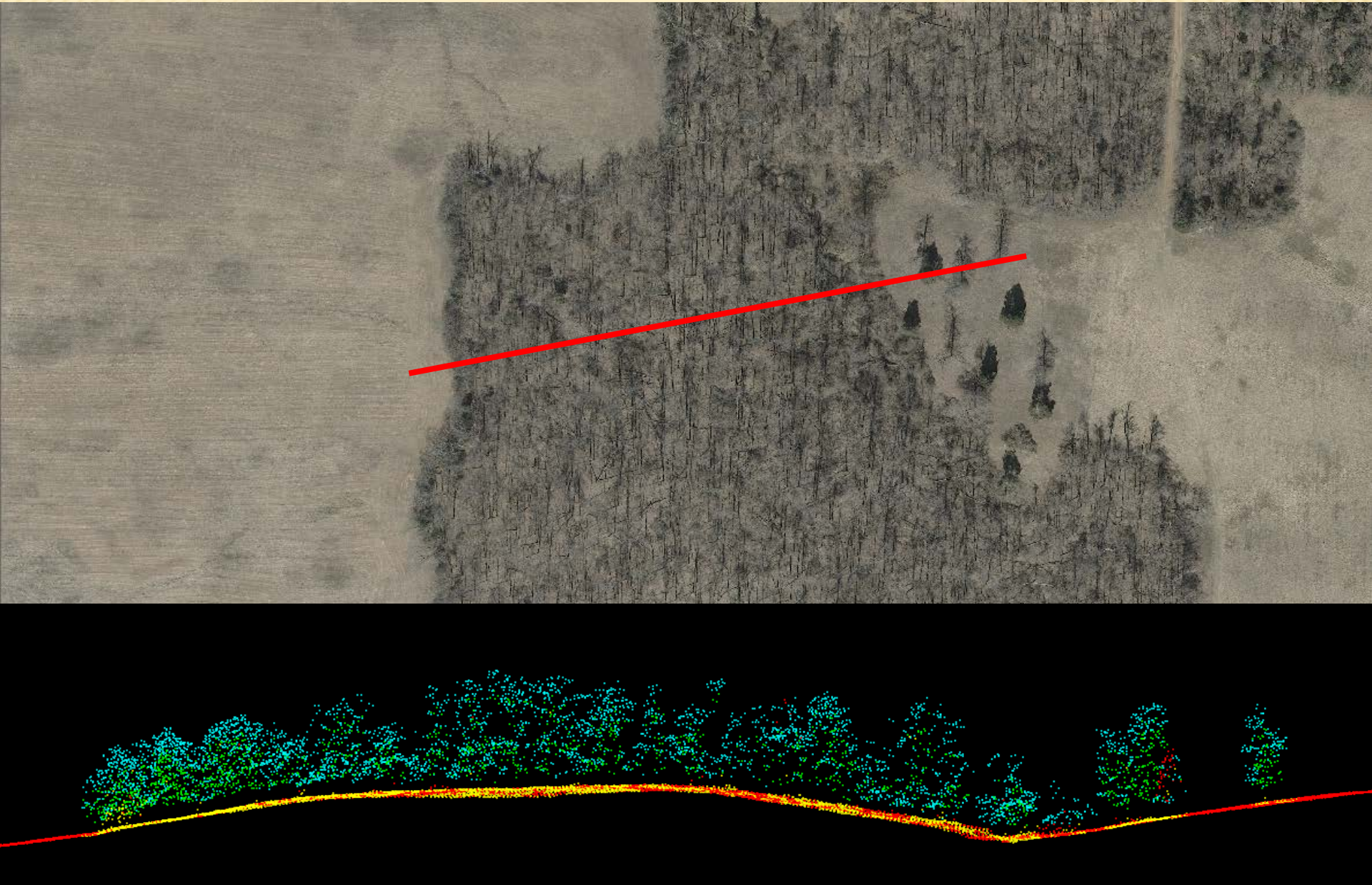
# WHAT IS LIDAR?

- Definition – Light Detection and Ranging (LiDAR) is an optical remote sensing technology used to collect a wide range of topographical data.



# Multiple Returns from each Outgoing Pulse…



# BREAKLINES AND FEATURES

LiDAR technology, however, does not inherently collect the breaklines necessary to produce traditional DTMs. Breaklines have to be developed separately through a variety of techniques, and either used with the LiDAR points in the generation of the DTM, or applied as a correction to DTMs generated without breaklines.

- As with traditional photogrammetry, specific features can be added to the DTM from field surveys such as utilities, UST, retaining walls, drainage boxes,TG/IE, etc.

Mobile Mapping and Stationary Scans datasets are highly accurate. Breaklines from Mobile Mapping and Stationary Scanning are extracted in post processing. However breaklines from Conventional Survey methods are ready for use.

Note: Manual editing is necessary to produce a Quality LiDAR project.

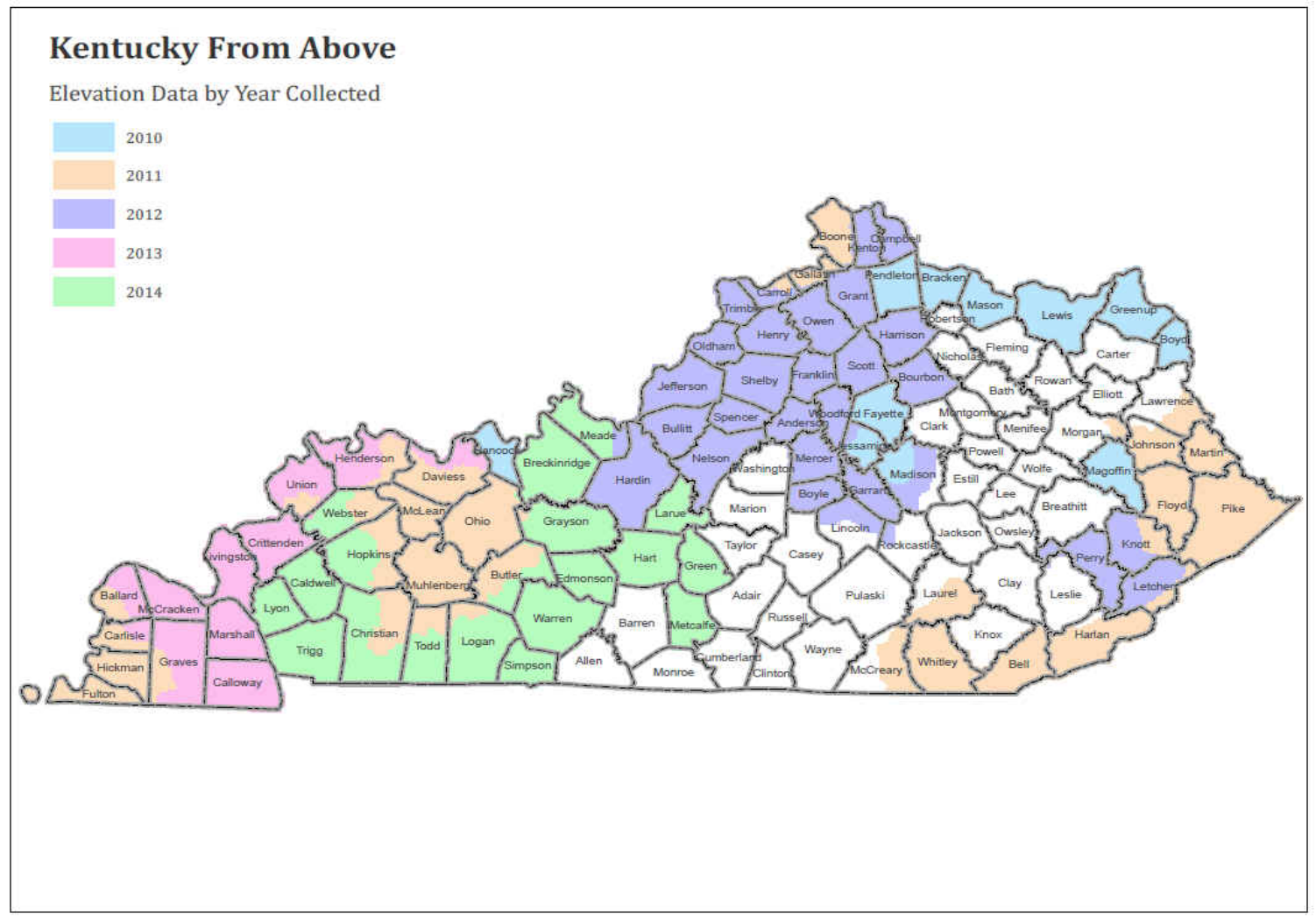
# KYTC APPLICATIONS OF LIDAR

- Drainage area analysis
- More accurate earthwork quantities
- Roadway corridor planning
- Waste or borrow site selection
- Archeological
- Environmental
- Structure analysis
- Detailed surveys
- GIS

# HISTORY OF LIDAR USE AT KYTC

- First Aerial LIDAR Project: KY 32 from KY 504 to KY 7 11.43 miles in District 9 – February 2010
- First Mobile LIDAR Project: US 31 West 9.5 miles District 4 – November 2010
- First Stationary LiDAR Project: US 60 from Bluegrass Parkway to New Circle 6.39 miles District 7 - February 2012

# STATEWIDE LIDAR AREA MAP



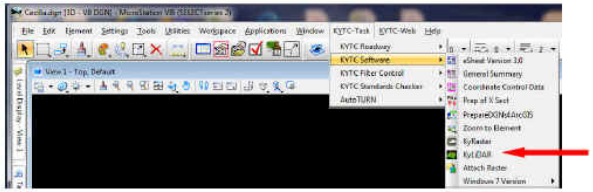
# HOW DO KYTC PROJECT MANAGERS ACCESS LIDAR TILES FOR THEIR PROJECTS

Working With LiDAR in MicroStation

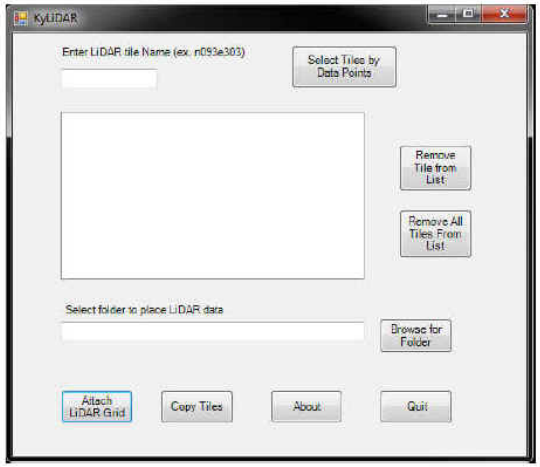
July 18, 2013

**Determining Which LiDAR Tiles you need**

KYTC and DGI have created a file that can be attached to your MicroStation drawing for determination of which LiDAR tiles are needed for your project. To attach the file, in MicroStation, select "KYTC-Task>KYTC Software>KyLiDAR".

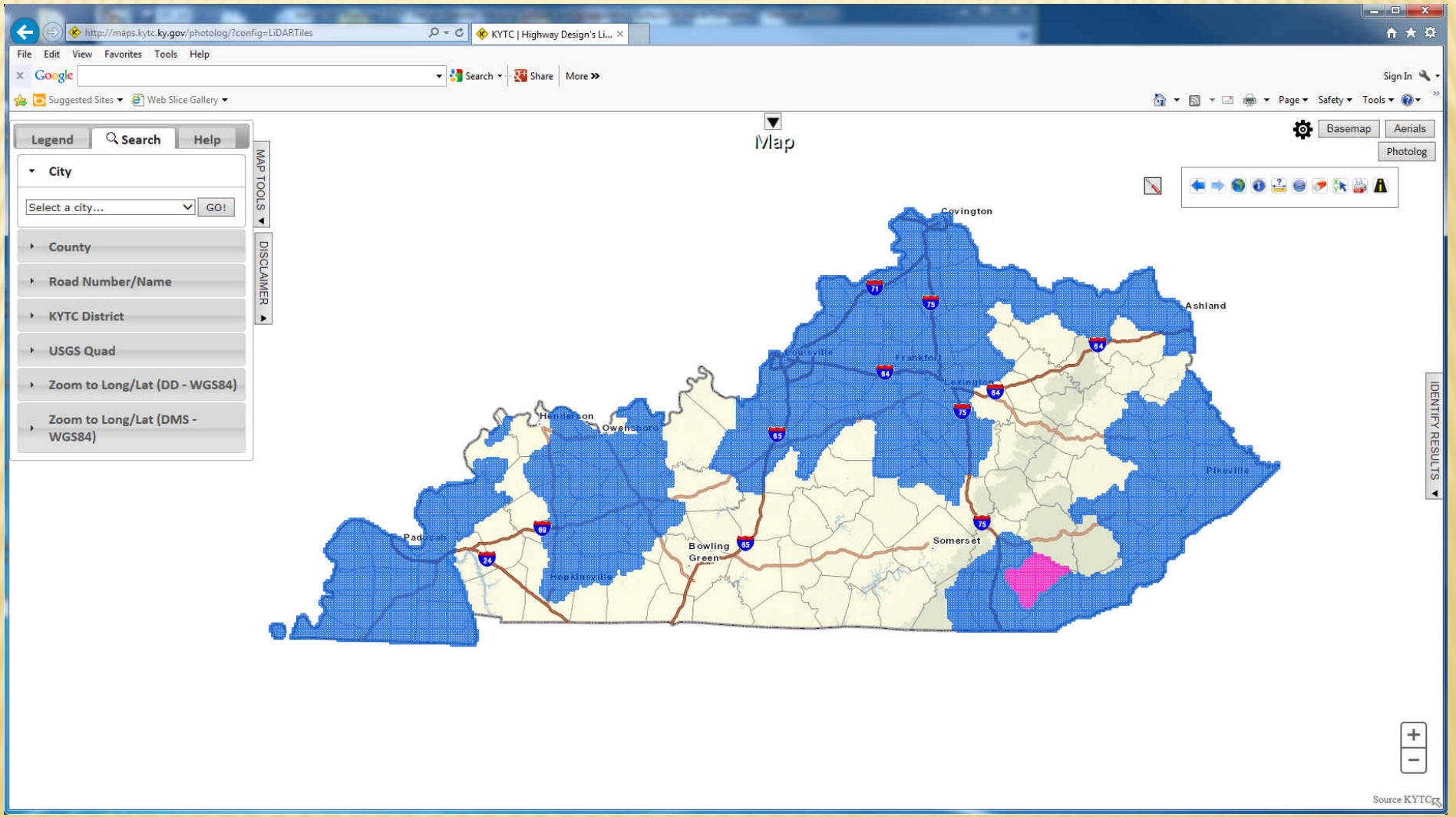



This launches the KyLiDAR app and will bring up the following dialog box from which you will copy LiDAR tiles.




http://transportation.ky.gov/Highway-Design/Pages/Survey-Coordination.aspx

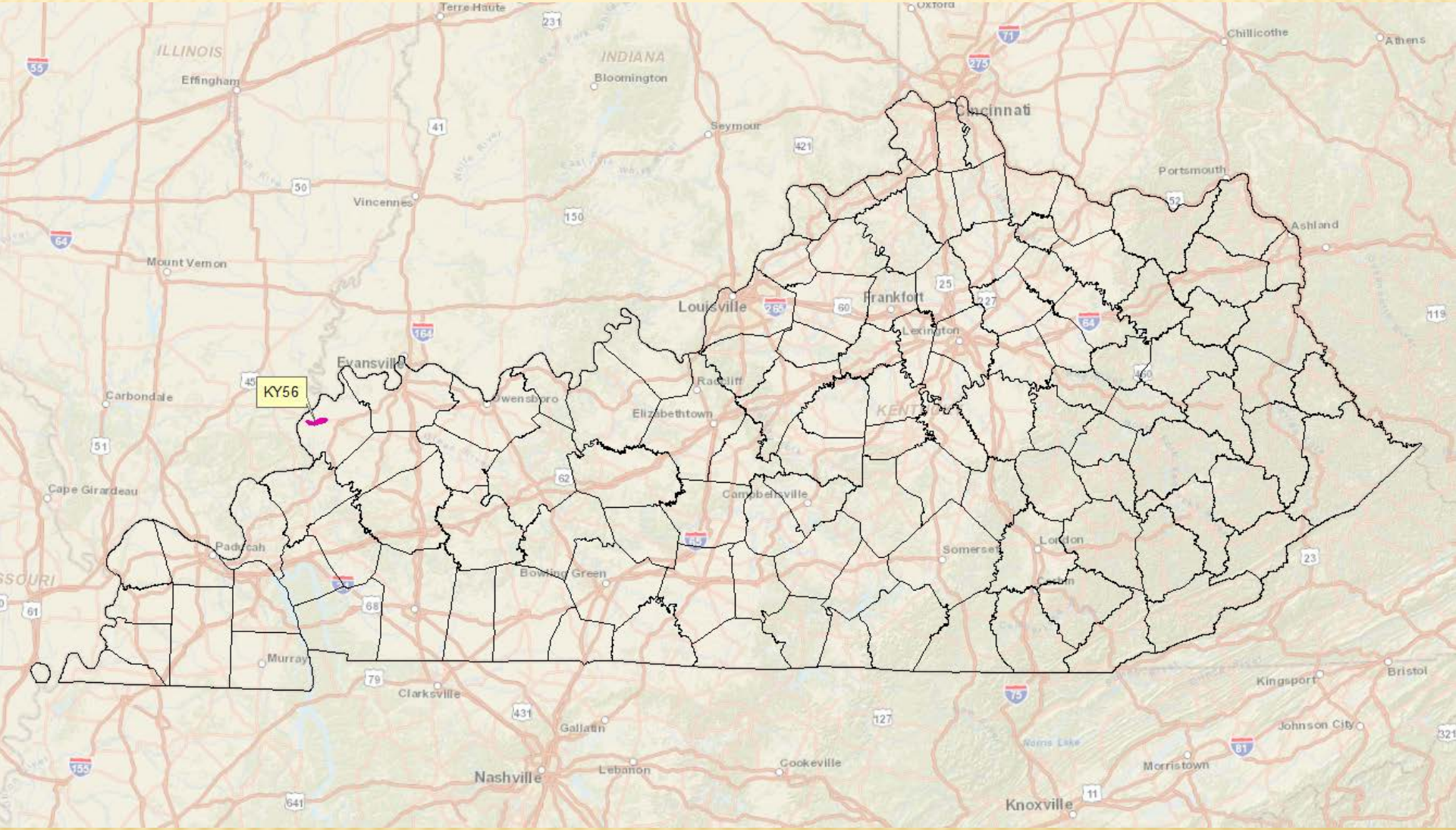
# HOW CAN I HELP MY DESIGN CONSULTANT WITH THE TILES THEY NEED FOR A STATE PROJECT



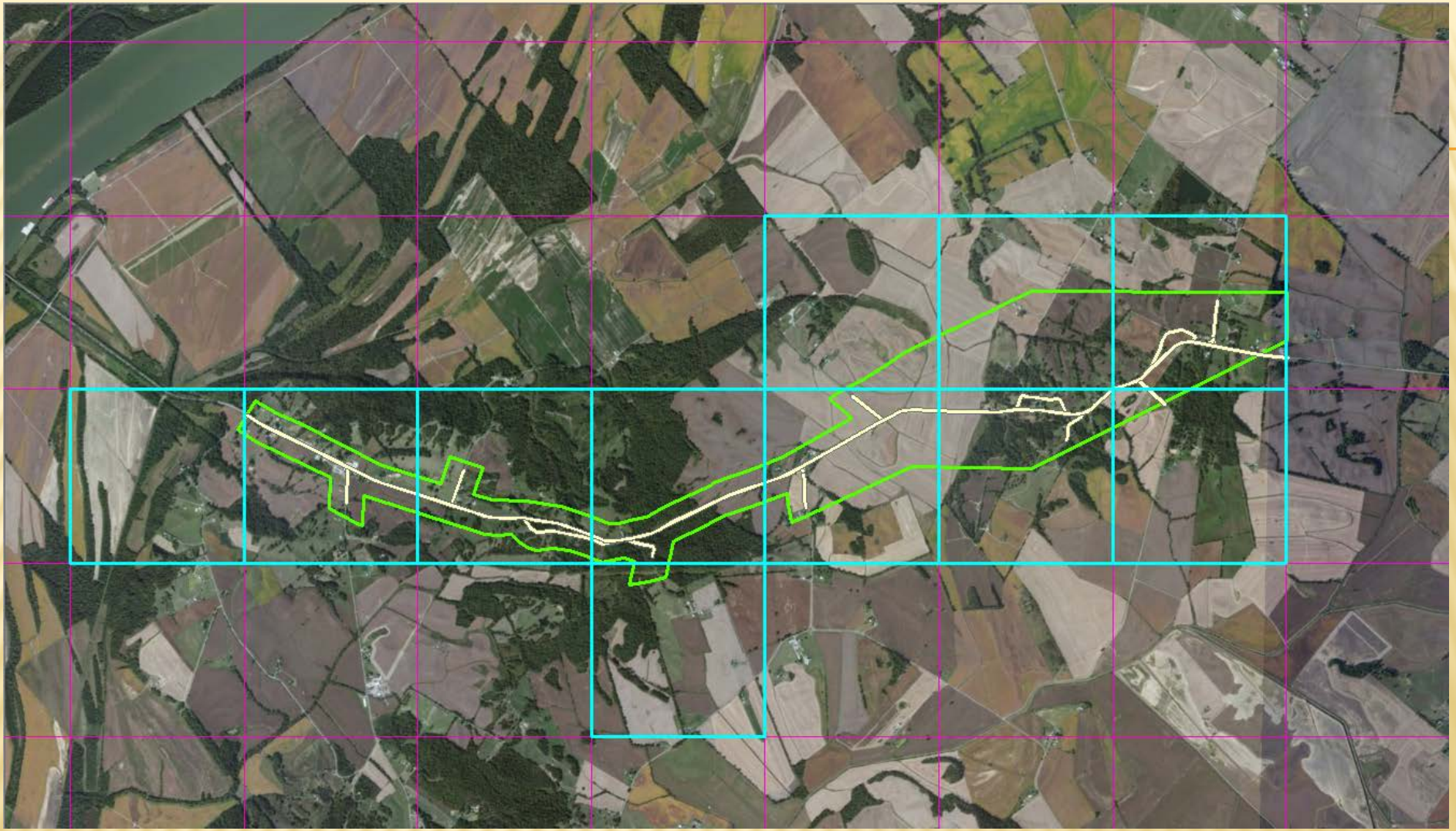

http://maps.kytc.ky.gov/photolog/?config=LiDARTiles

# PROJECT SUMMARY
# KY56, UNION COUNTY

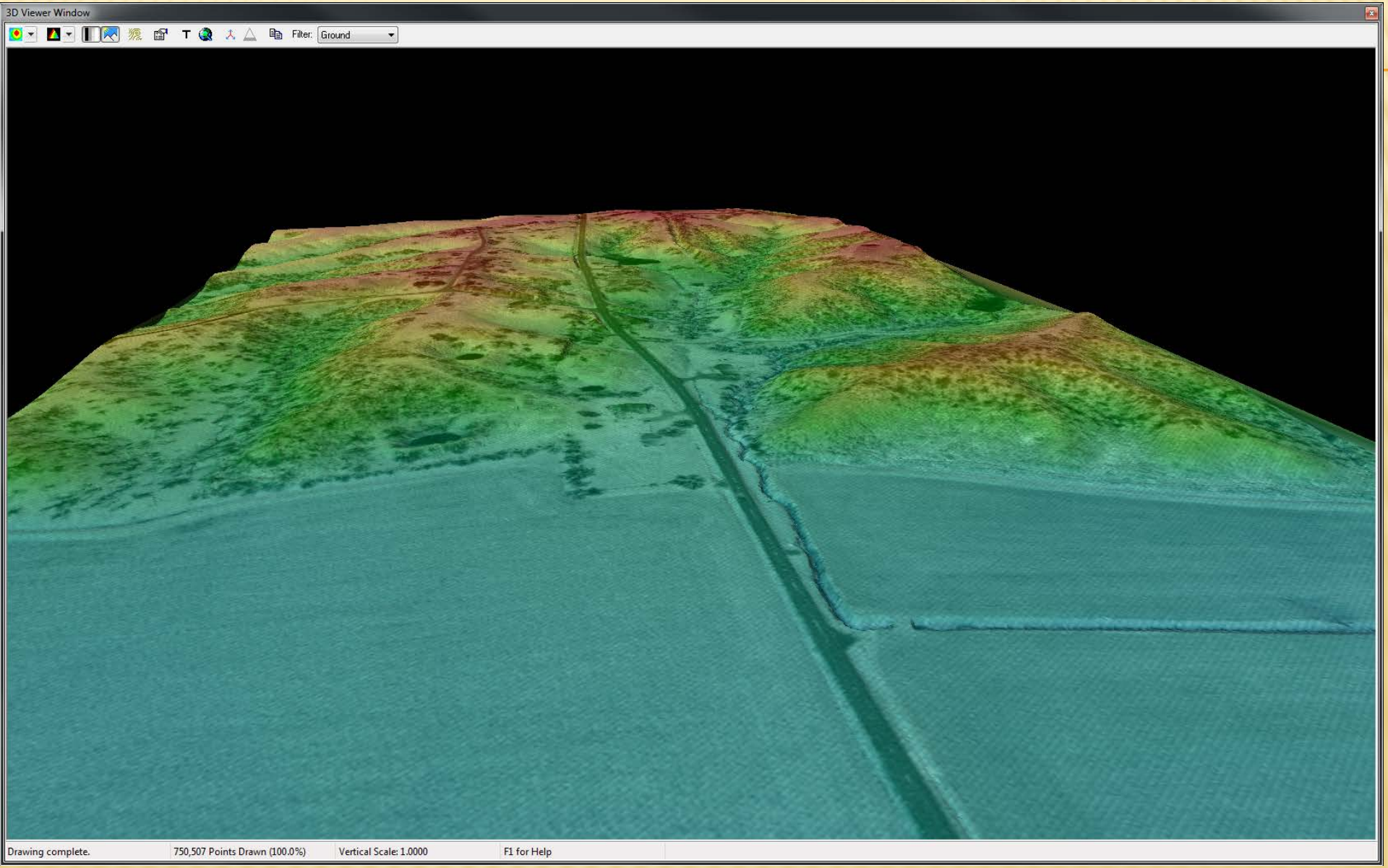
- ~6 miles in length
- Varying Corridor Width
- Existing Mapping on Eastern End
- Data Sources
  - New 7cm Aerial Photography
    - Update Existing Mapping on Eastern End
    - New Mapping for remainder of corridor
  - Existing Statewide LIDAR
    - Provide Masspoints for full project area, including expanded ortho limits
    - Add Breaklines from Aerial Photography for 1’ Contour Accuracy
  - New Mobile LiDAR
    - Provide High Accuracy Data on Road Surface
    - Integrate for Final Delivery with Aerial Data Sources


KY56
Terre Haute
ILLINOIS
INDIANA
Effingham
Bloomington
Seymour
Cincinnati
Chillicothe
Athens
Portsmouth
Ashland
Vincennes
Mount Vernon
Louisville
Frankfort
Lexington
Evansville
Carbondale
Owensboro
Elizabethtown
Radcliff
Cape Girardeau
Campbellsville
Paducah
Somerset
London
Bowling Green
Murray
Clarksville
Kingsport
Bristol
Gallatin
Johnson City
Nashville
Lebanon
Cookeville
Morristown
Knoxville

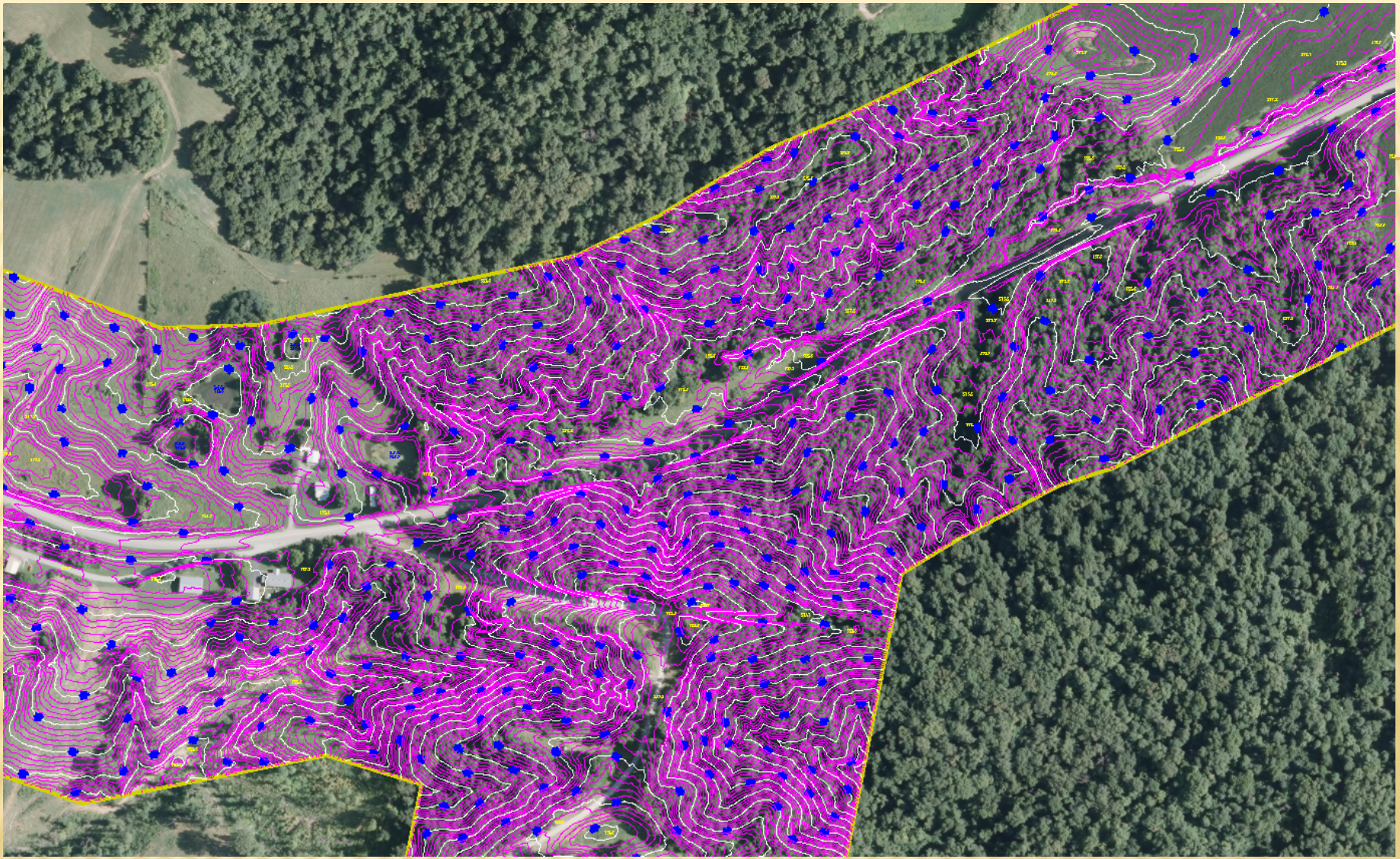
- **Blending of Aerial, Terrestrial Scans, and Field Surveys**
  1. Field Surveys
     a) Monumentation
     b) Place Aerial Targets
     c) Survey Terrestrial Control
     d) Complete Additional surveys, such as utilities
  2. Aerial Workflow
     a) Collect new LiDAR data or Download Statewide Data
        a) Adjust to Surveyed Control
        b) Extract Bare Ground Surface
     b) Collect Aerial Photography
        a) Complete Aerial Triangulation
        b) Compile Topography and Planimetrics
  3. STLS/MTLS Workflow
     a) Scan Data in Field
     b) Register to Surveyed Control
     c) Extract Features
  4. Blended Workflow
     a) Use Highest Accuracy Data
        a) Supplement Aerial Photography with LiDAR or TLS
        b) Supplement Aerial LiDAR with TLS
        c) Supplement TLS with Field Survey



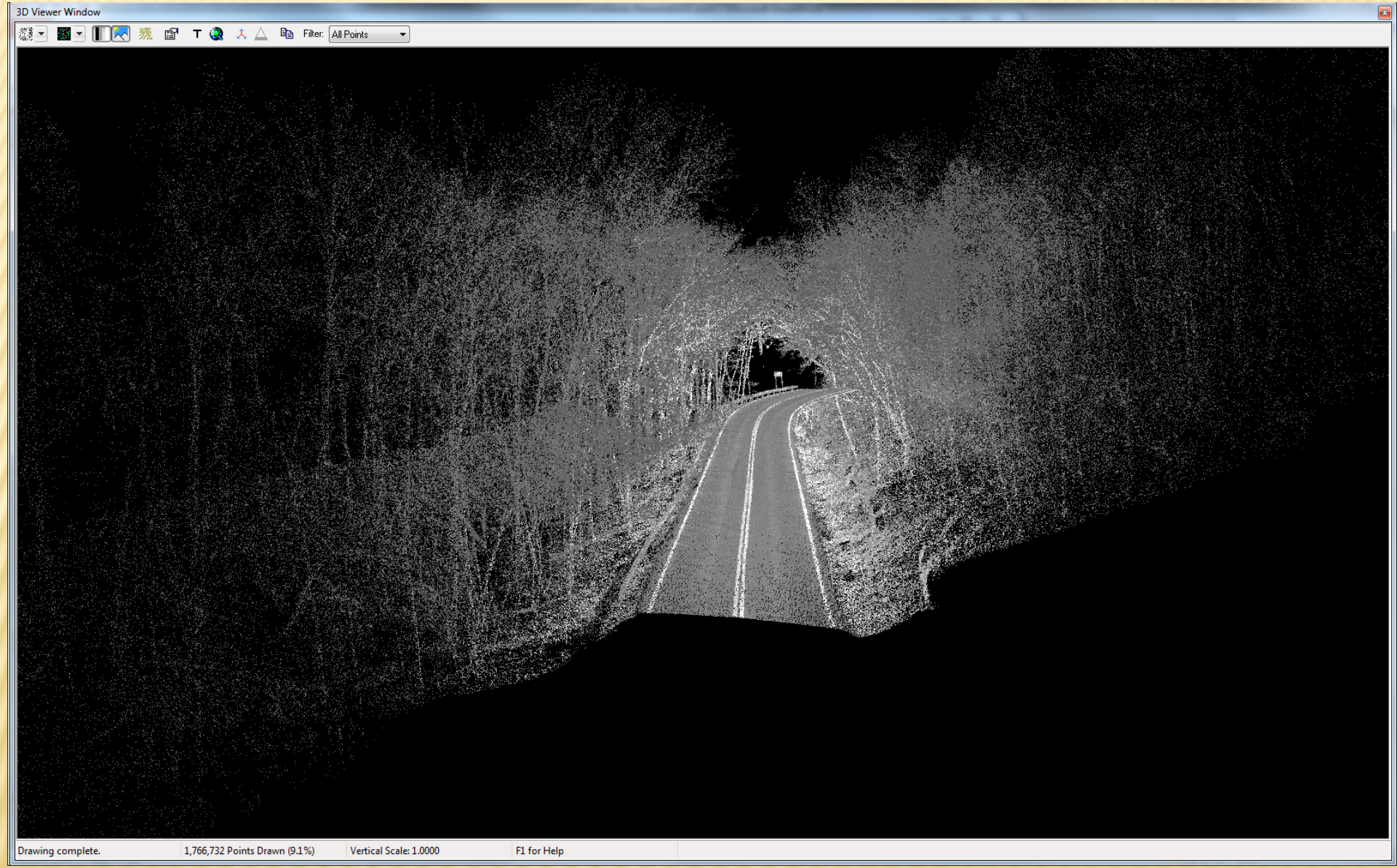
- Ky56 in Union County
- Blend of Technologies
  - Aerial Photography
  - Aerial LiDAR (statewide)
  - Field Surveys
  - MTLS


3D Viewer Window
Filter:
Ground
Drawing complete.
750,507 Points Drawn (100.0%)
Vertical Scale: 1.0000
F1 for Help

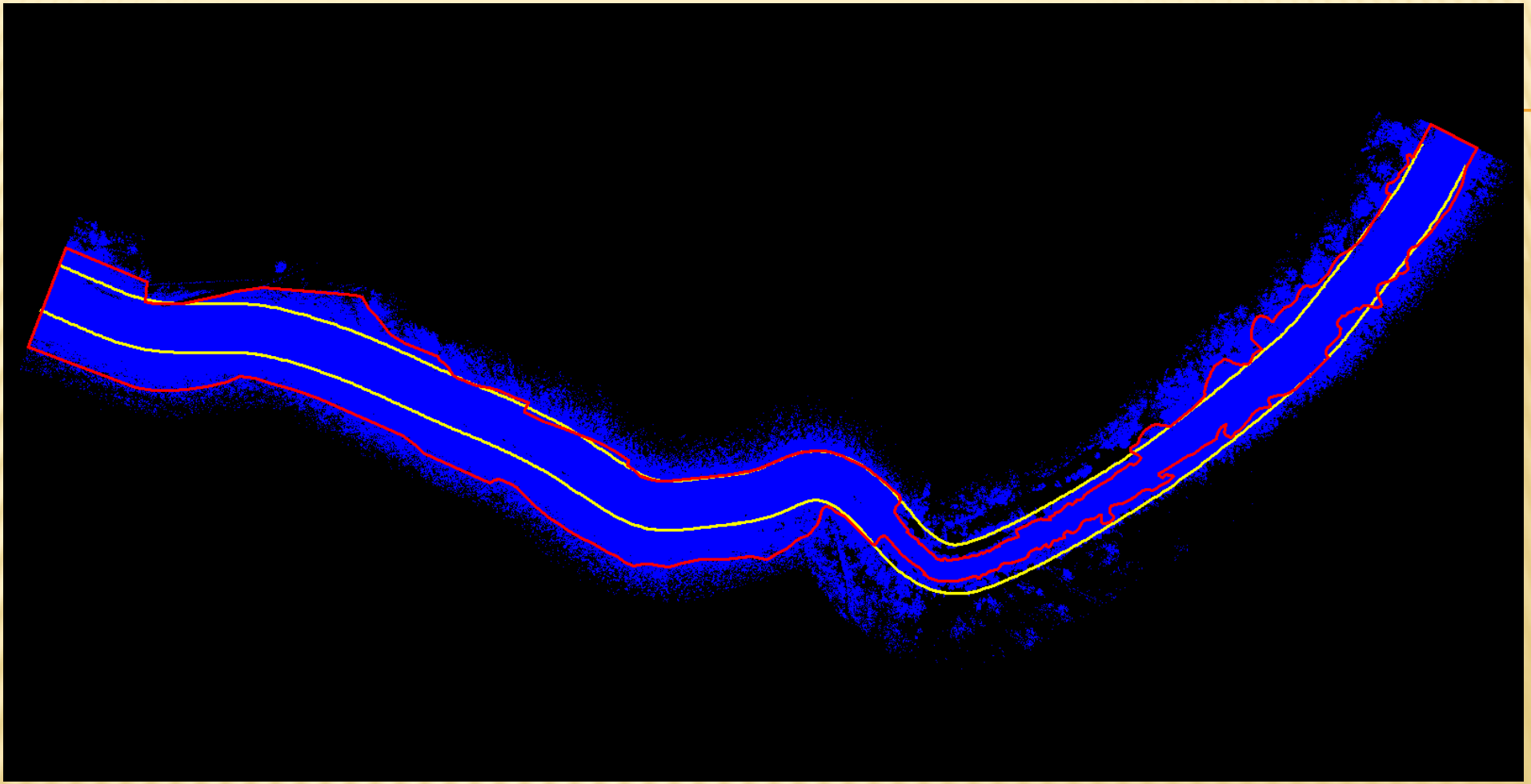
- Ky56 in Union County
- Blend of Technologies
  - Aerial Photography
  - Aerial LiDAR (statewide)
  - Field Surveys
  - MTLS

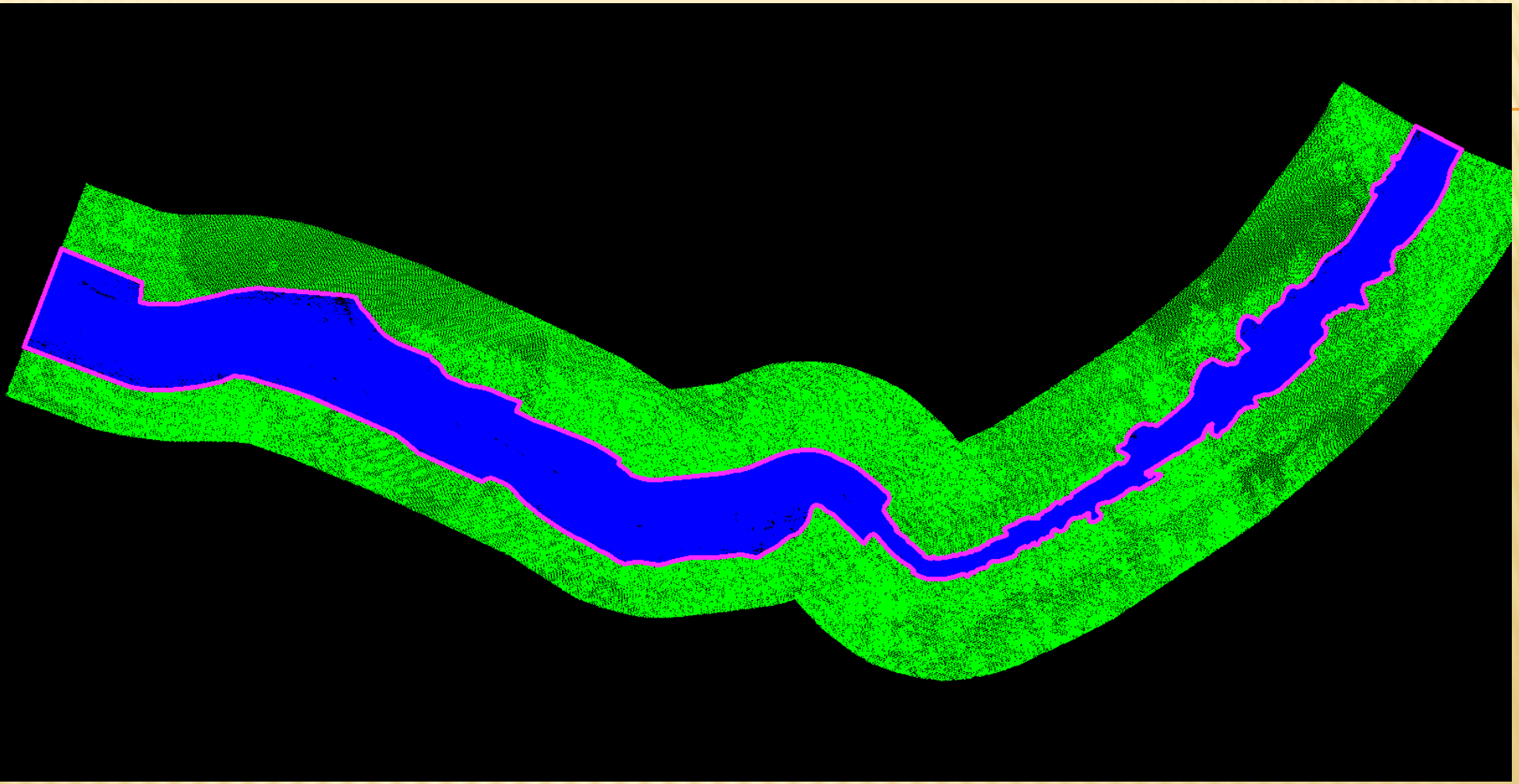


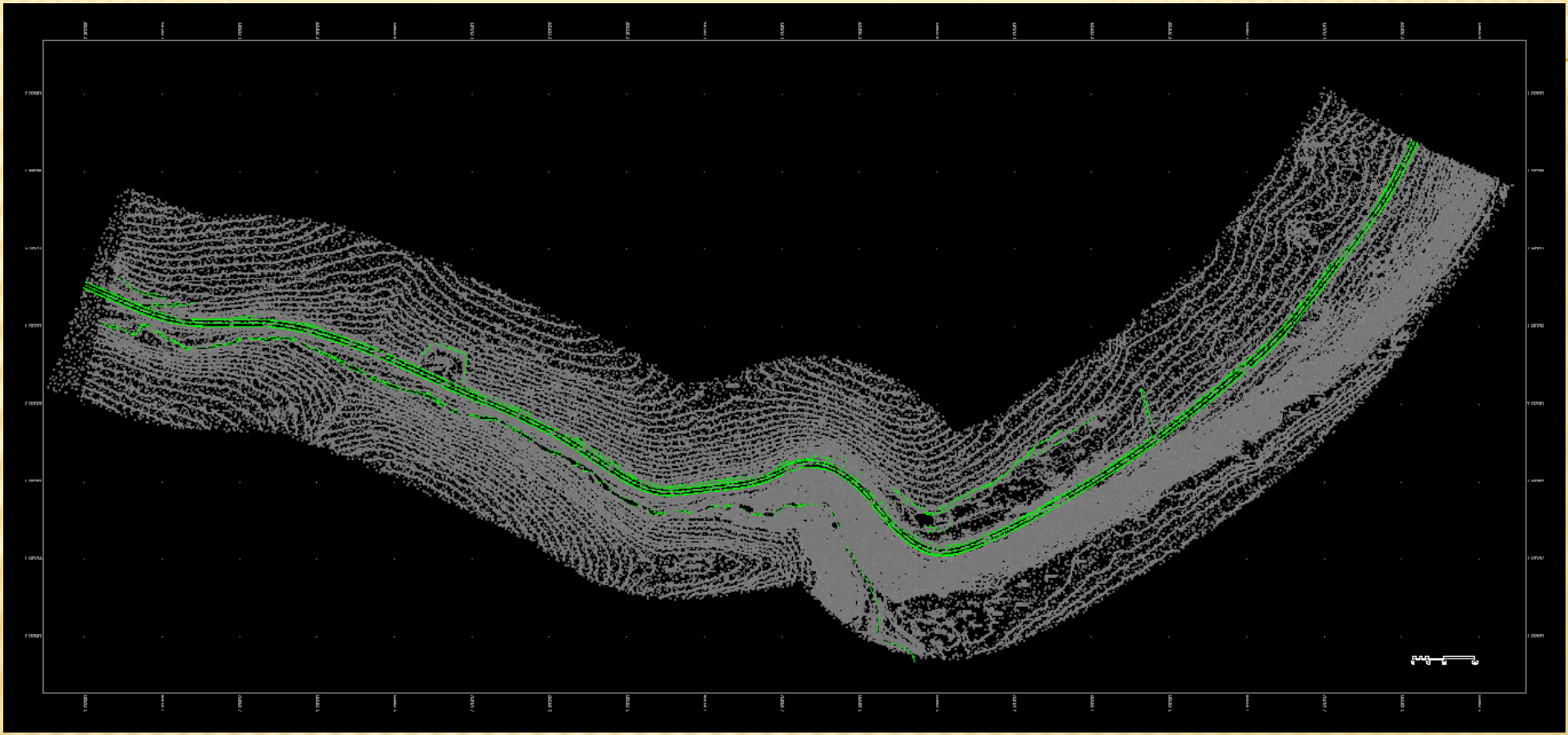
- Ky56 in Union County
- Blend of Technologies
  - Aerial Photography
  - Aerial LiDAR (statewide)
  - Field Surveys
  - MTLS


3D Viewer Window
Filter:
All Points
Drawing complete.
1,766,732 Points Drawn (9.1%)
Vertical Scale: 1.0000
F1 for Help

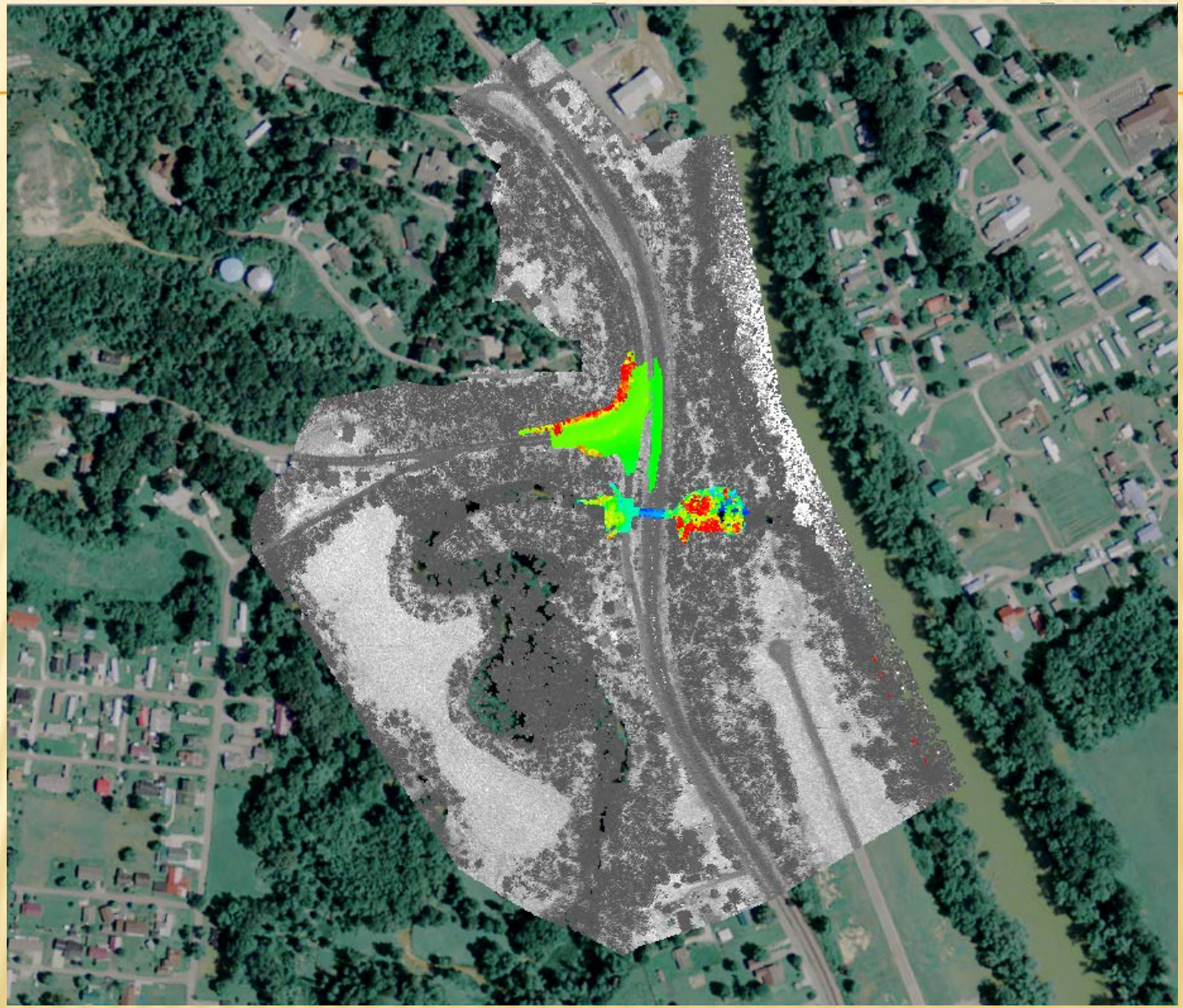
- Ky56 in Union County
- Blend of Technologies
  - Aerial Photography
  - Aerial LiDAR (statewide)
  - Field Surveys
  - MTLS

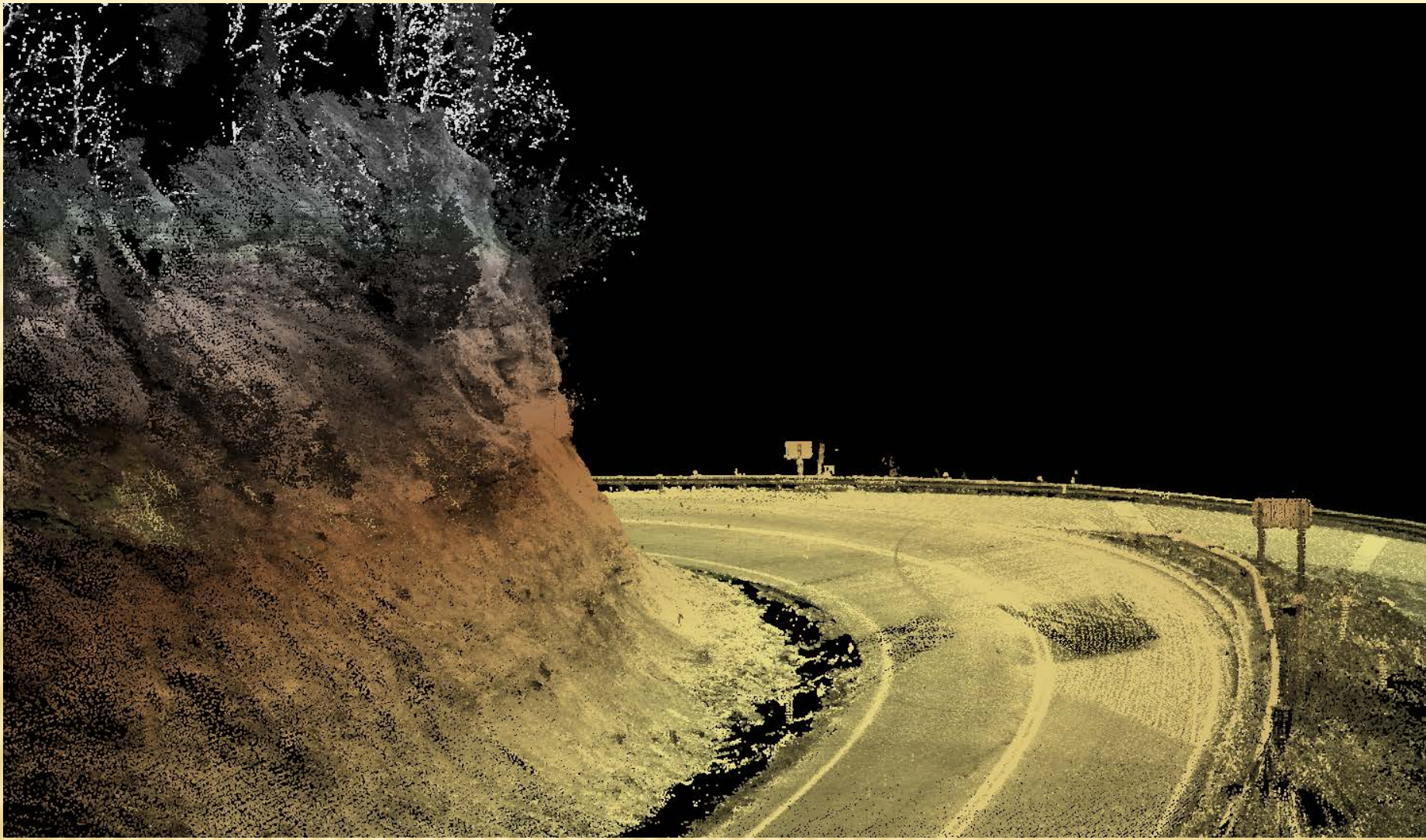


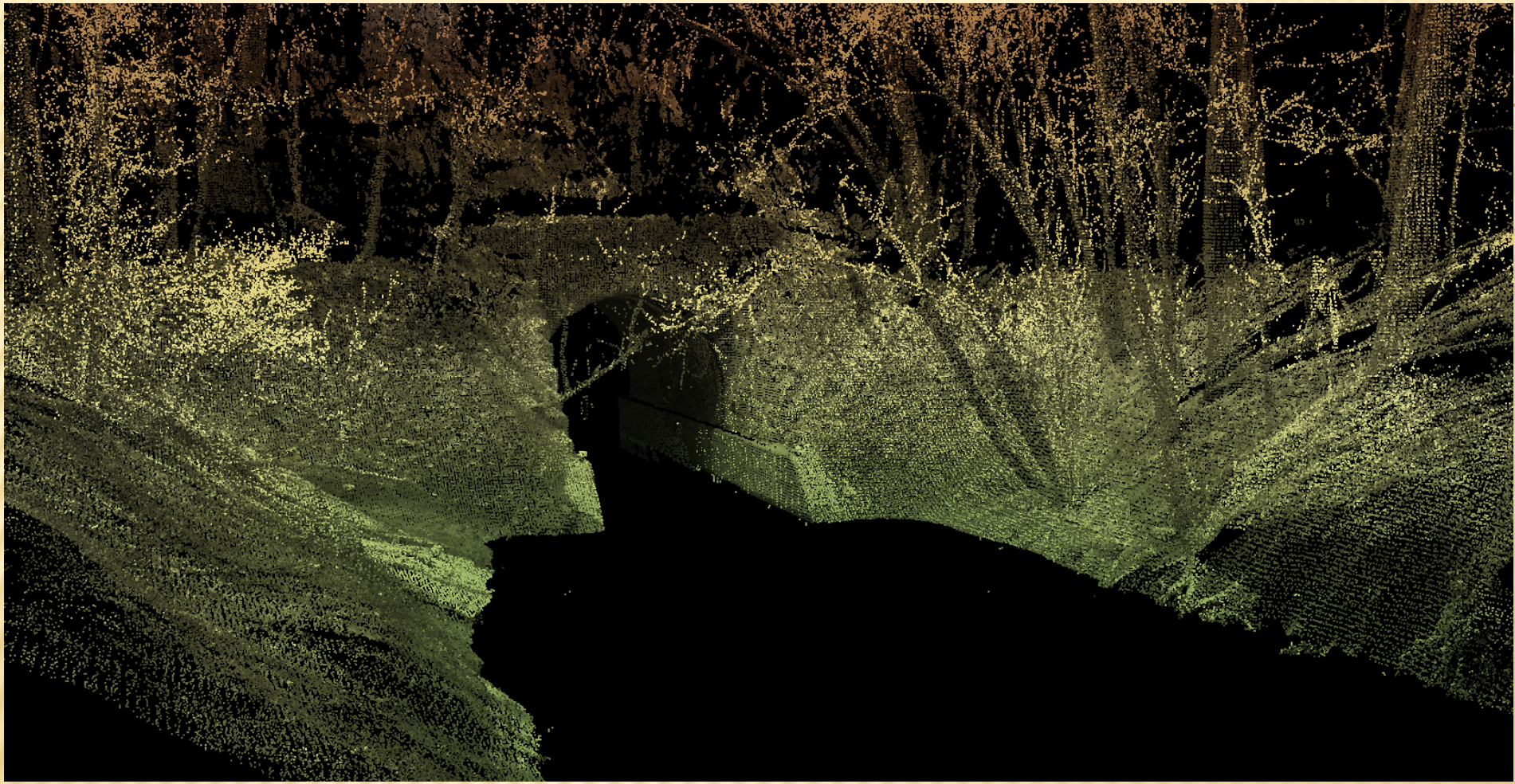


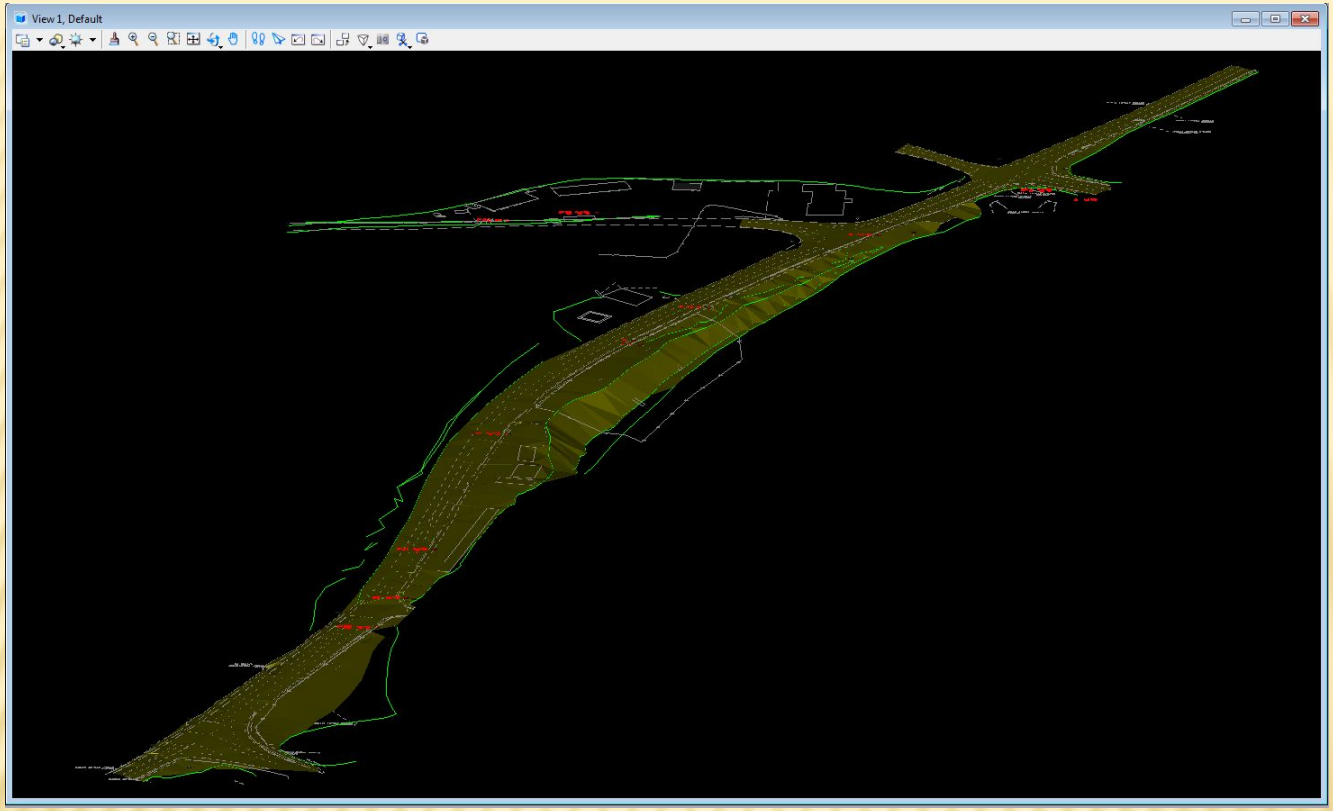



STLS of Rock Wall
STLS of Culvert





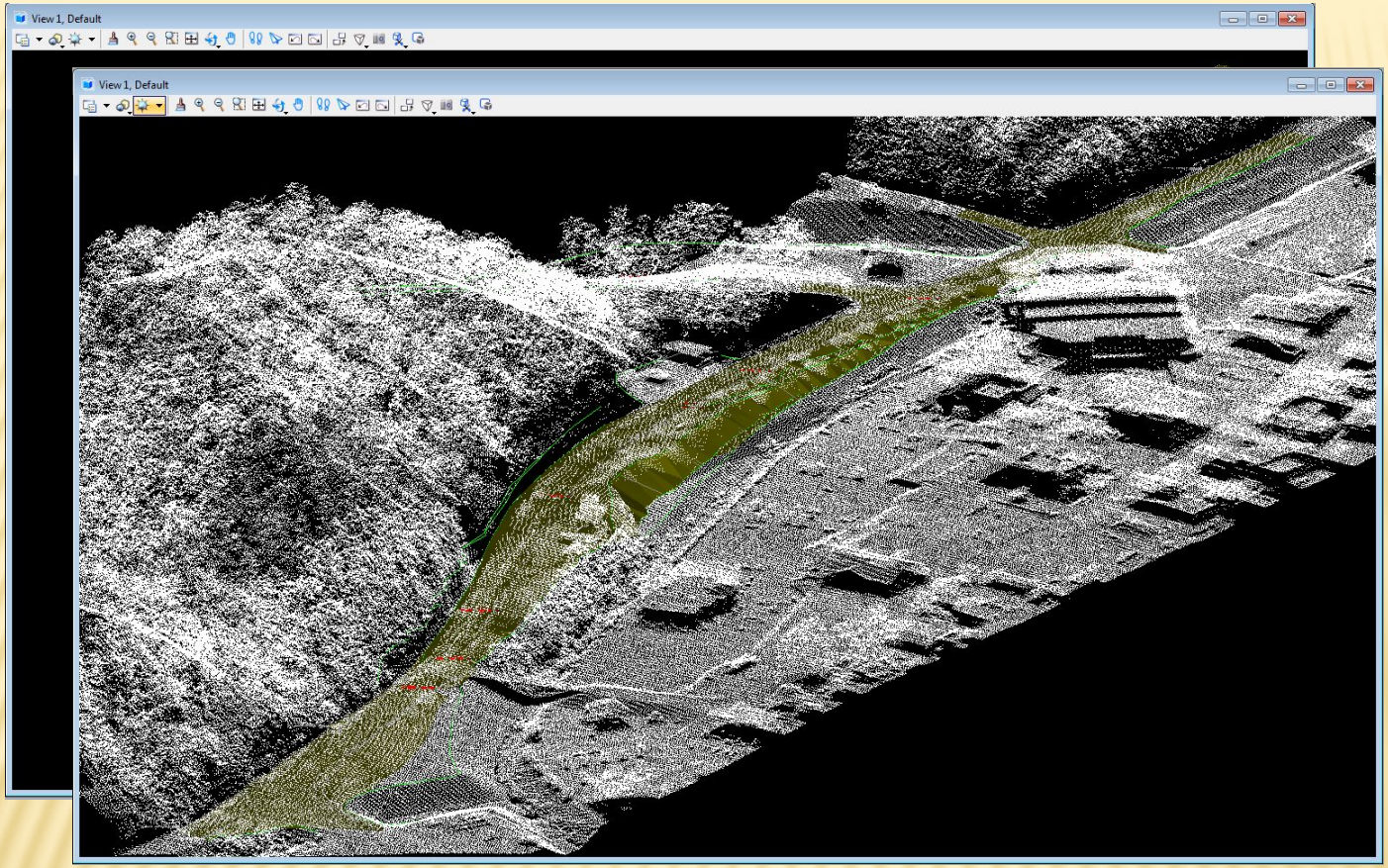





# 3D TERRESTRIAL LIDAR

Building the Data Set

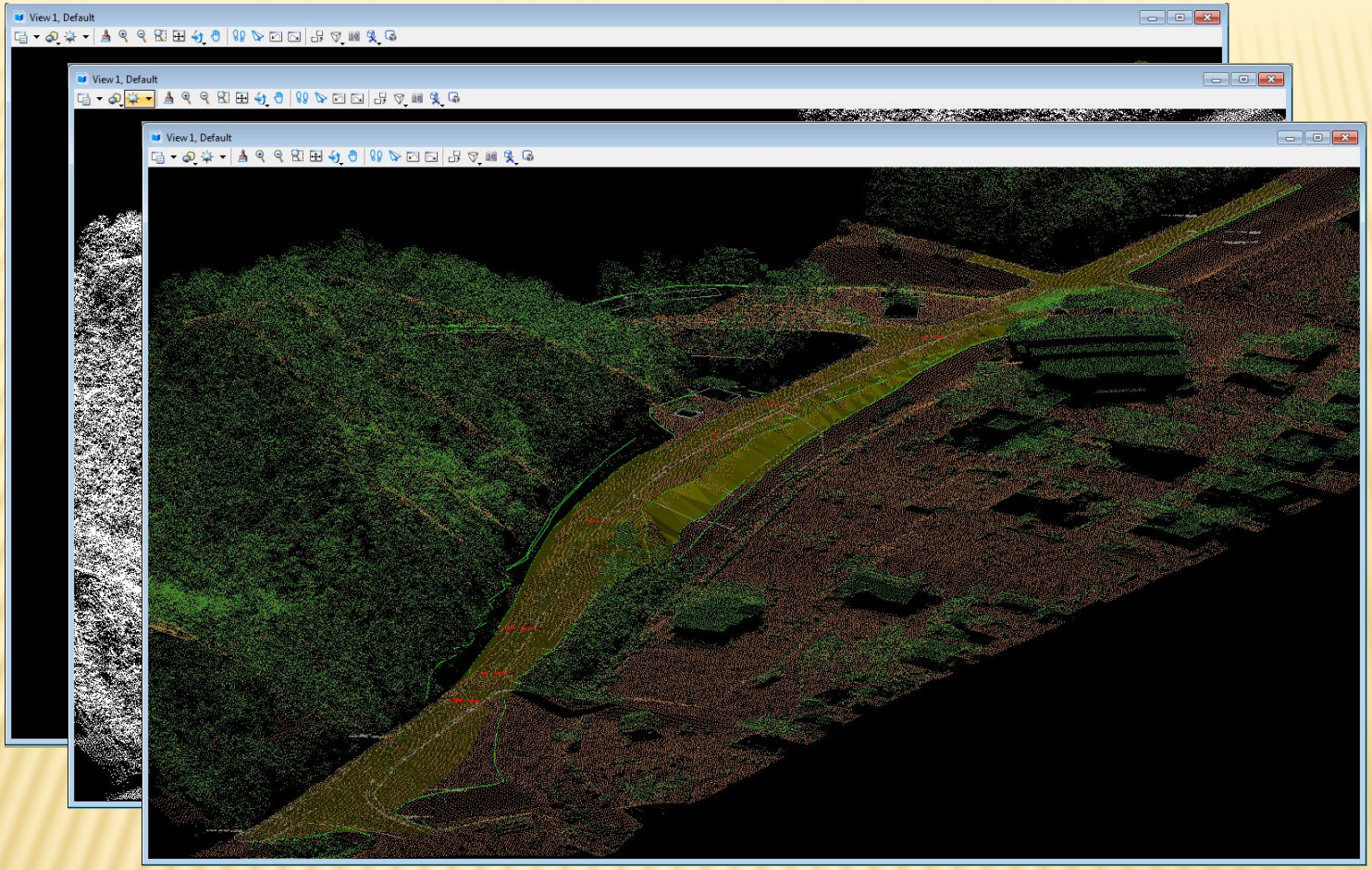
From conventional survey to high definition laser scanning




# 3D TERRESTRIAL LIDAR

Building the Data Set

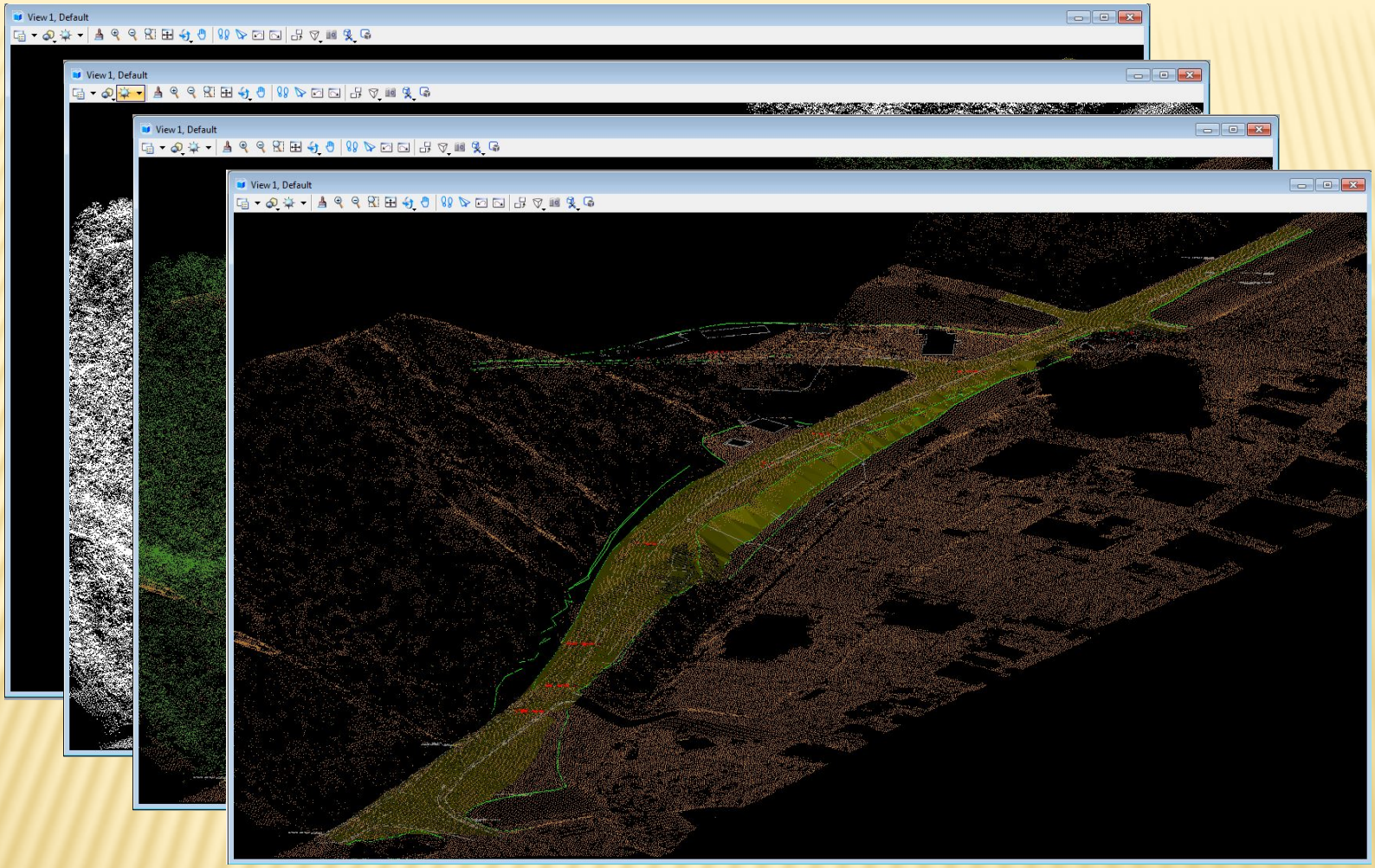
Aerial LiDAR added for ground base




# 3D TERRESTRIAL LIDAR

Building the Data Set

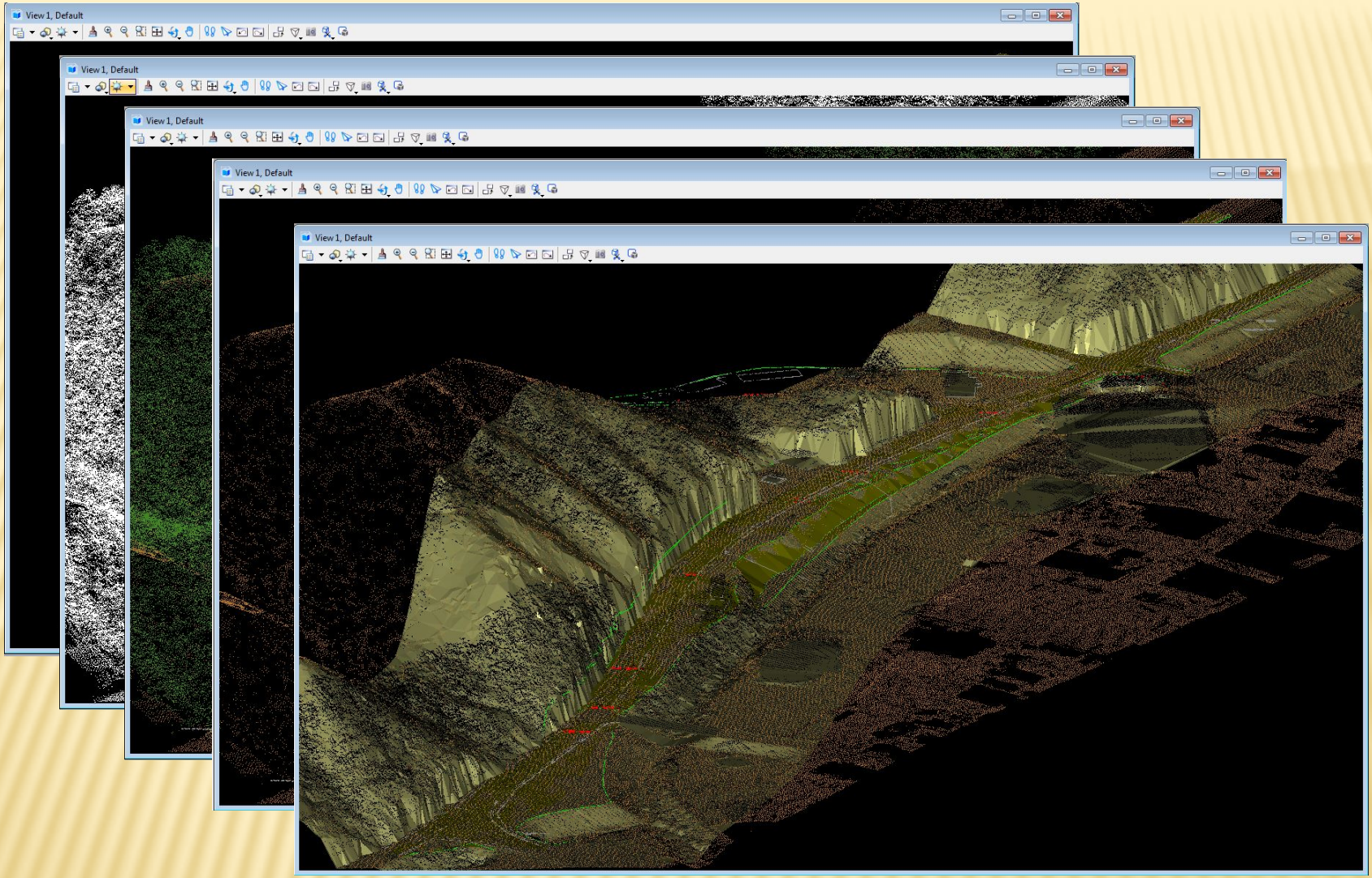
Aerial LiDAR rendered by classification




# 3D TERRESTRIAL LIDAR

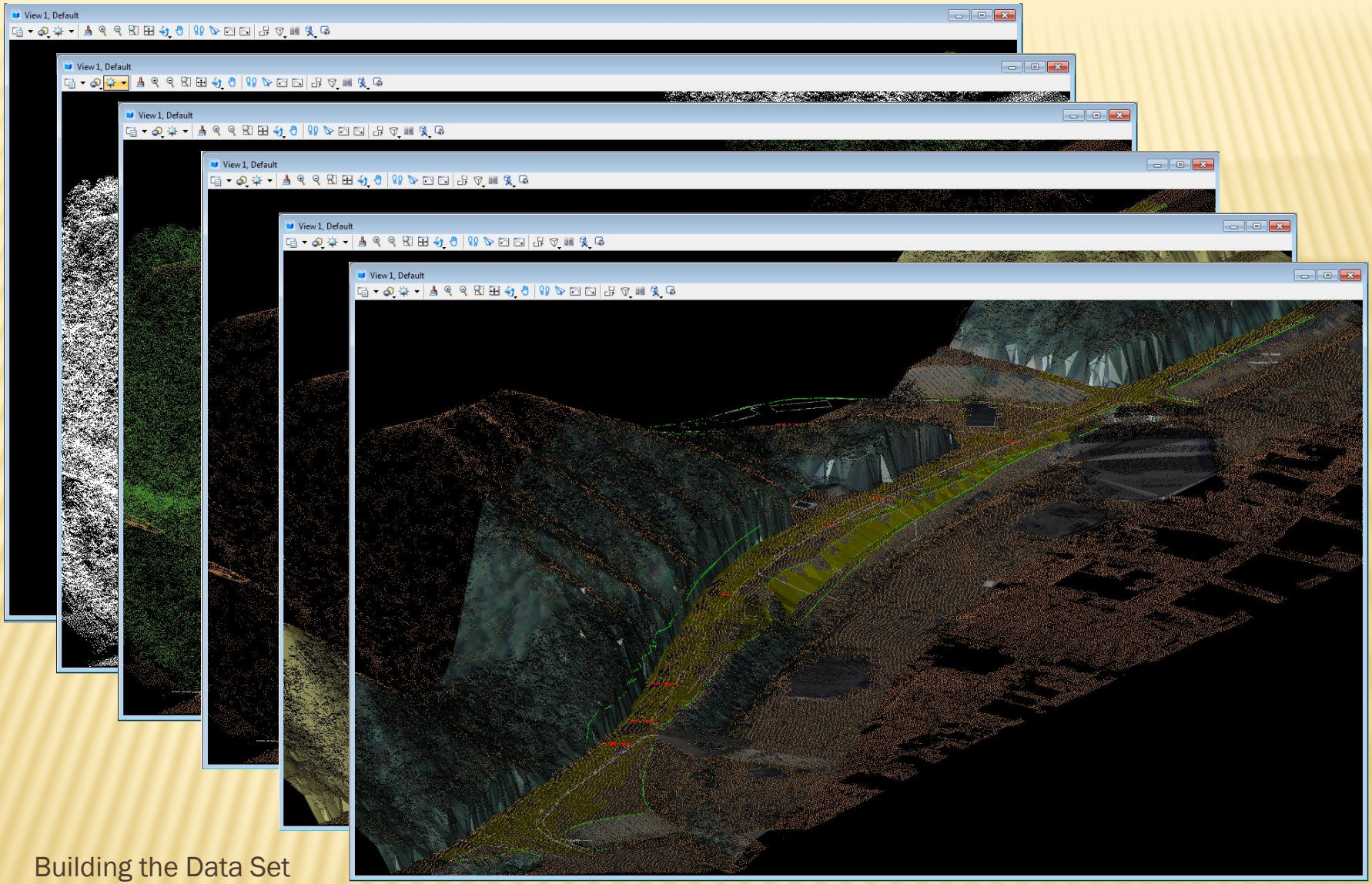
Building the Data Set

Aerial LiDAR rendered bare earth ground shots only



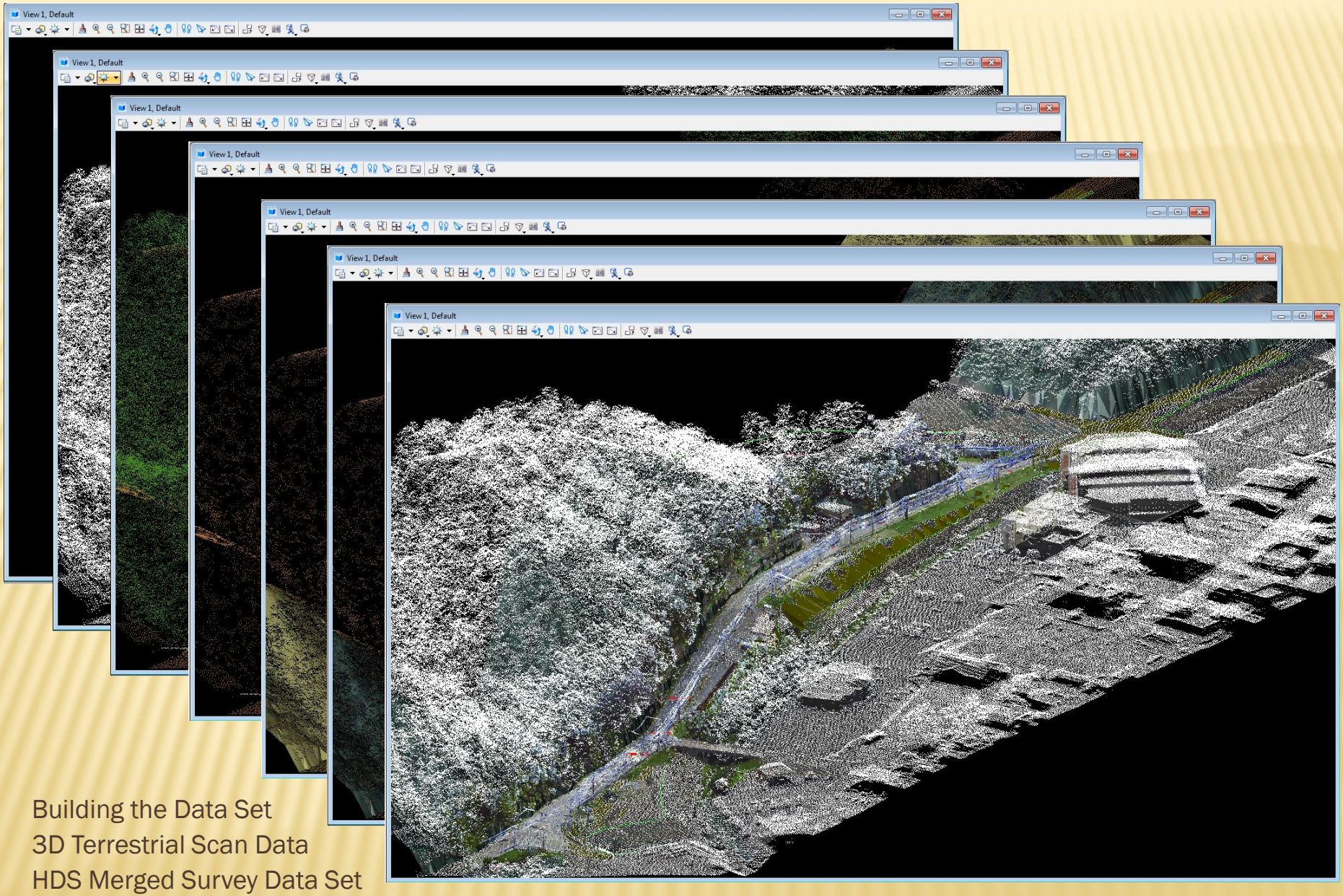

Building the Data Set

Ground DTM rendered from Aerial LiDAR

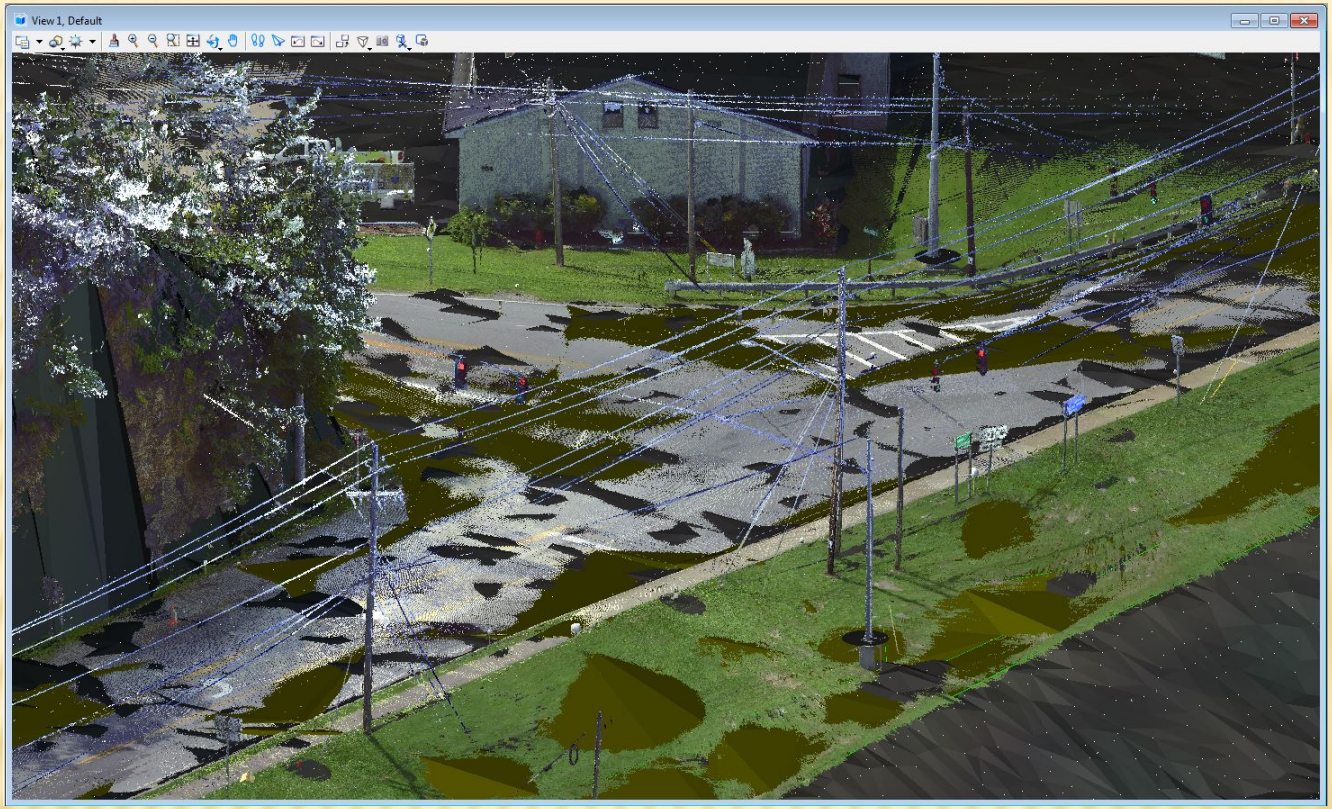



Building the Data Set

Photo Draping added to DTM Triangles

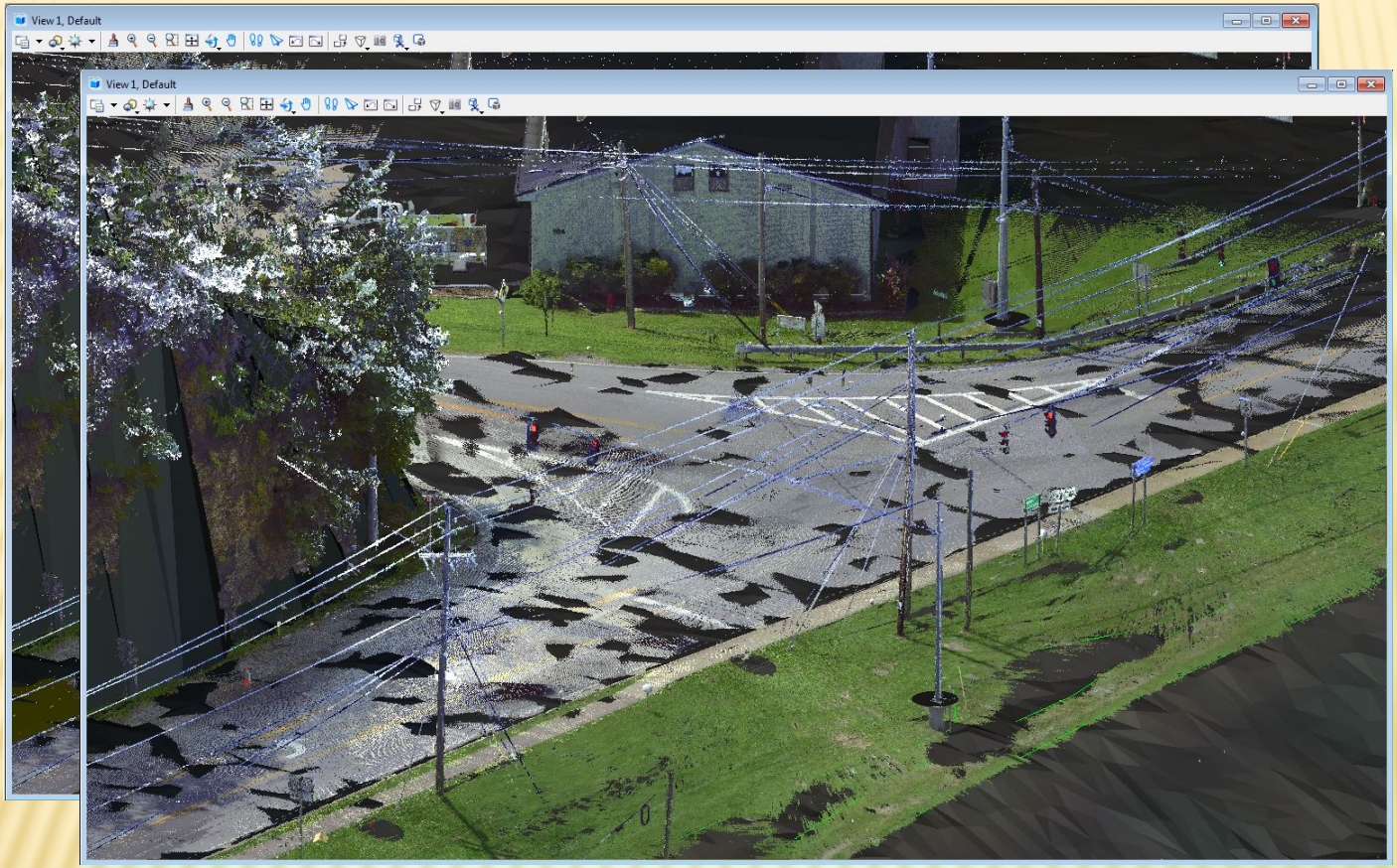



Building the Data Set
3D Terrestrial Scan Data
HDS Merged Survey Data Set



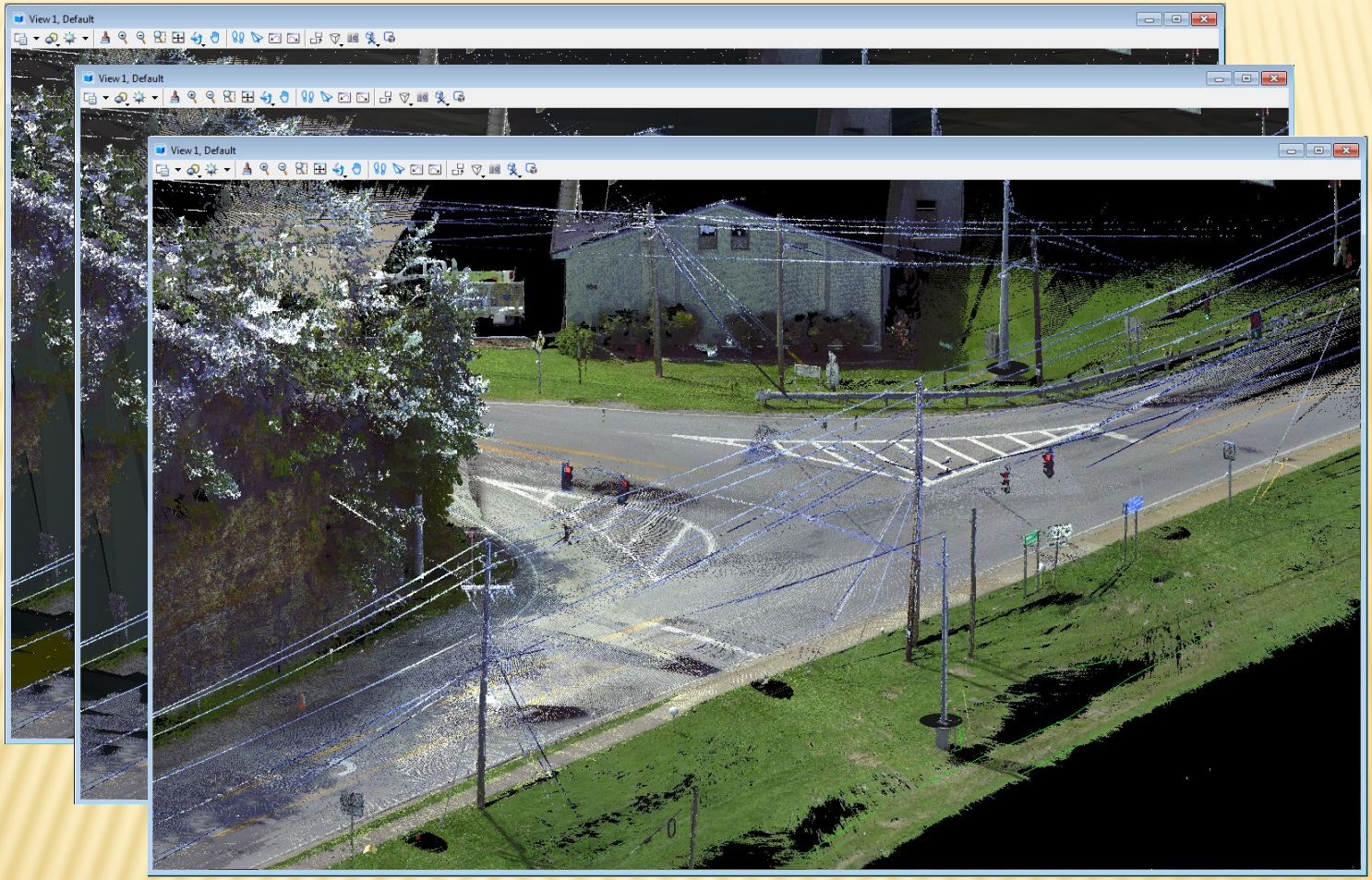

# HDS 3D TERRESTRIAL LIDAR

Conventional Survey
Aerial Ground DTM
High Definition Surveying




# HDS 3D TERRESTRIAL LIDAR

High Definition Ground Verification

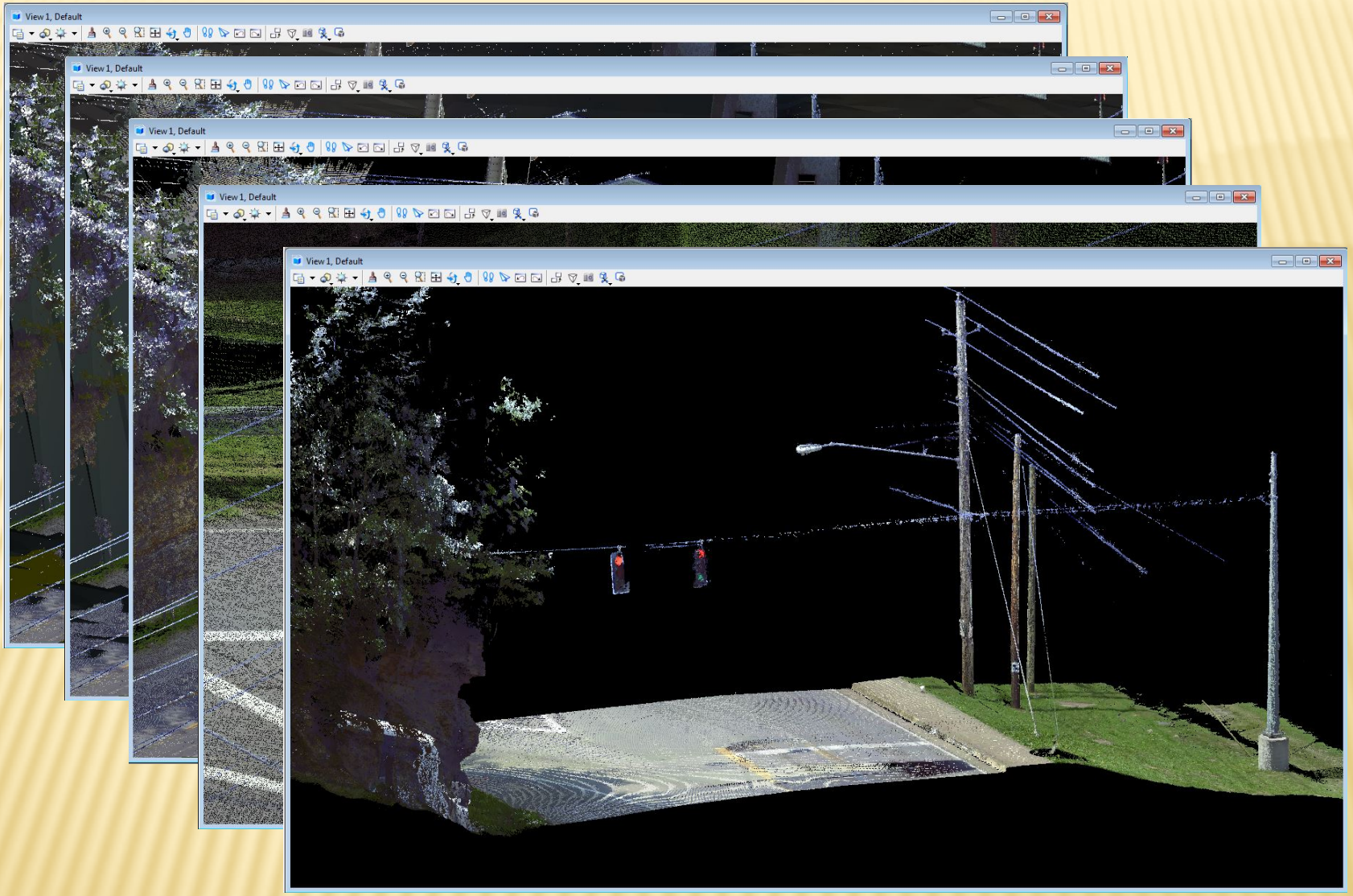



# HDS 3D TERRESTRIAL LIDAR

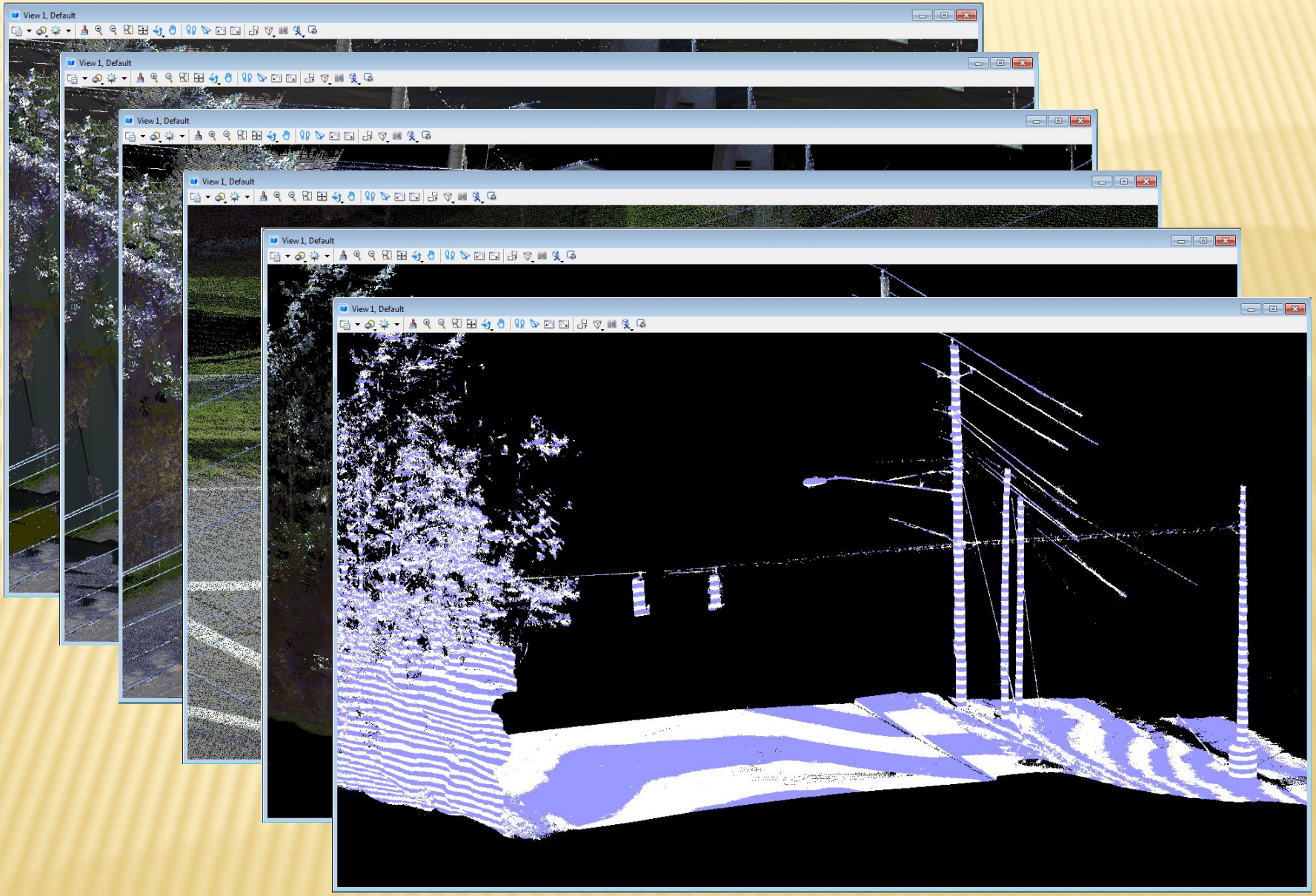
High resolution of critical vertical information


Project referenced point cloud Data

Color Rendering



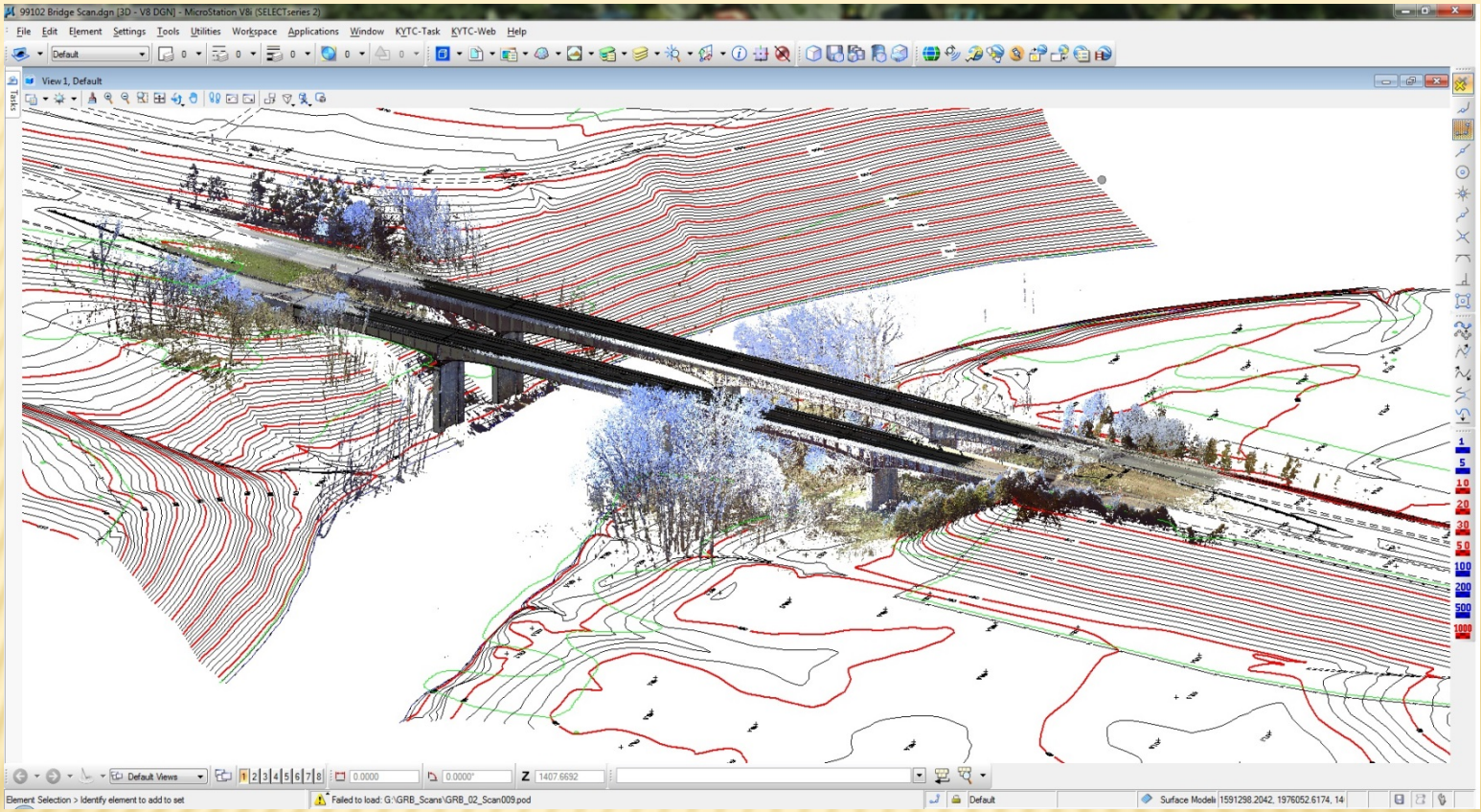

Isolation of critical data within the point cloud




Elevation rendering by color striping

# SO WHAT DOES HDS MEAN FOR ME...

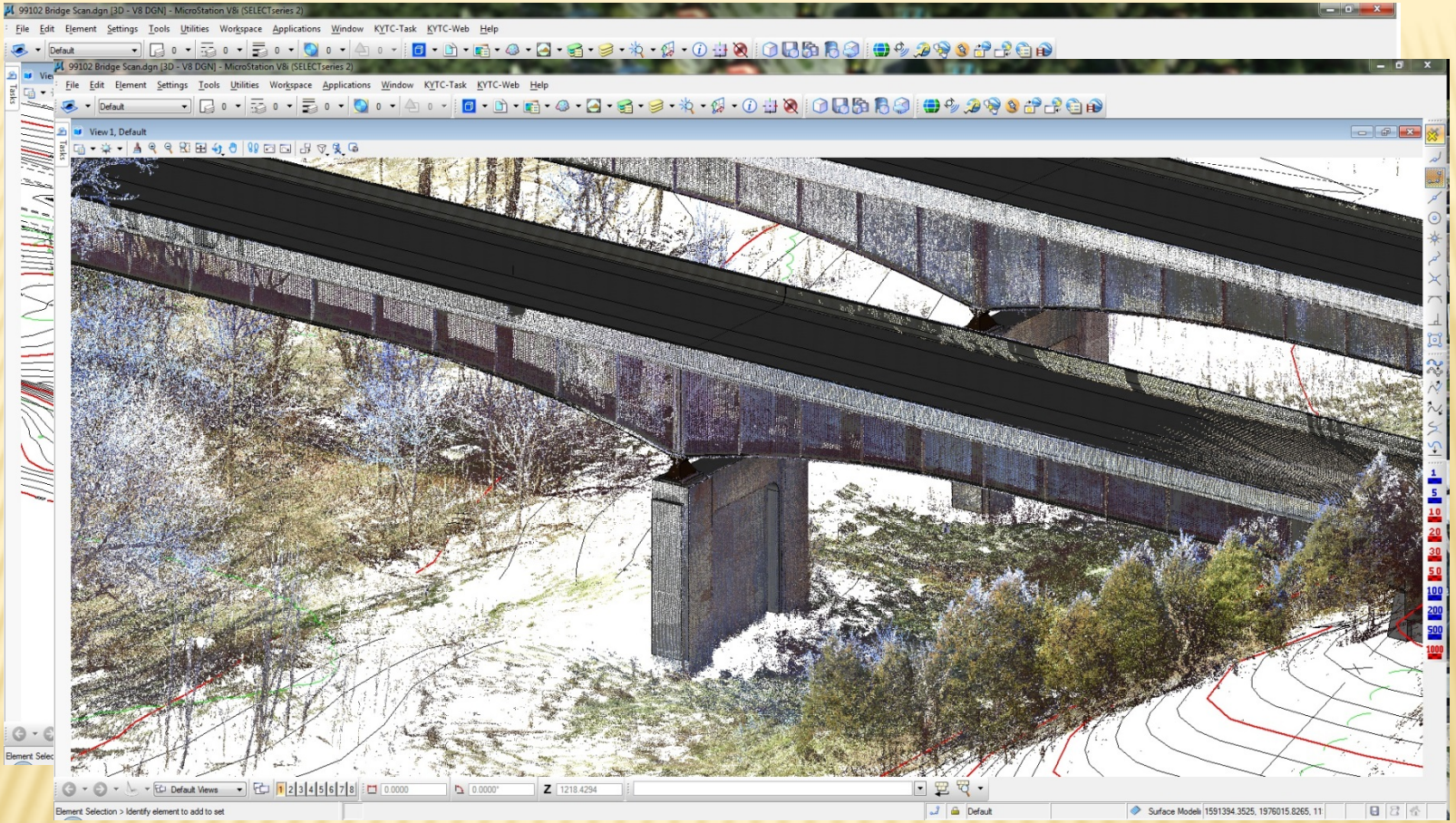
Where can I use this data in my projects...




# HDS 3D TERRESTRIAL LIDAR

Getting the full picture

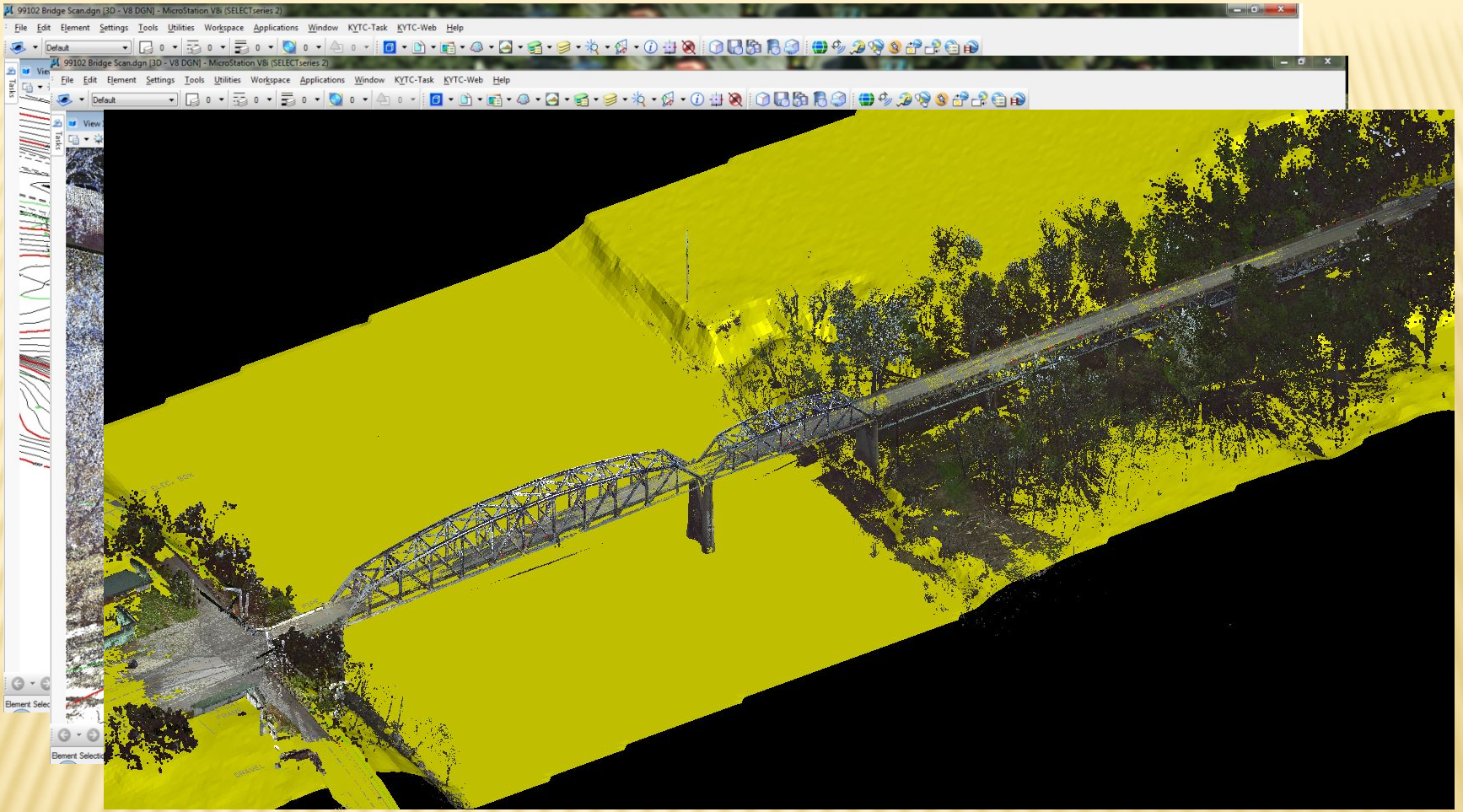
Practical application areas




# HDS 3D TERRESTRIAL LIDAR

BRIDGES

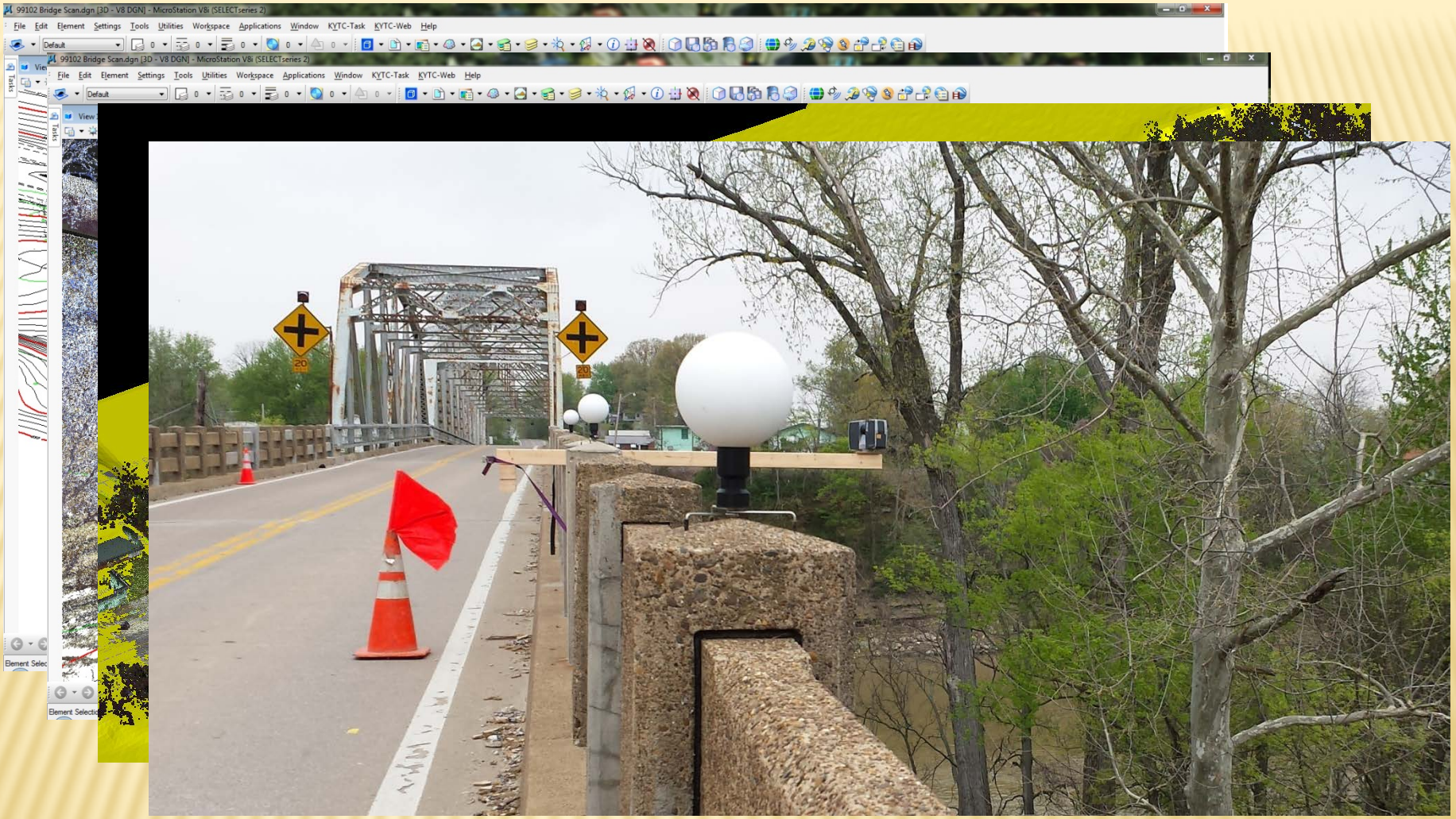
I-65 Widening, Bridge over the Green River




# HDS 3D TERRESTRIAL LIDAR

BRIDGES

US 60 Green River Bridge – Spottsville, Kentucky




# HDS 3D TERRESTRIAL LIDAR

BRIDGES

US 60 Green River Bridge – Spottsville, Kentucky


# HDS 3D TERRESTRIAL LIDAR

Vertical Clearance Measurements

# HDS 3D TERRESTRIAL LIDAR

Culvert Situations

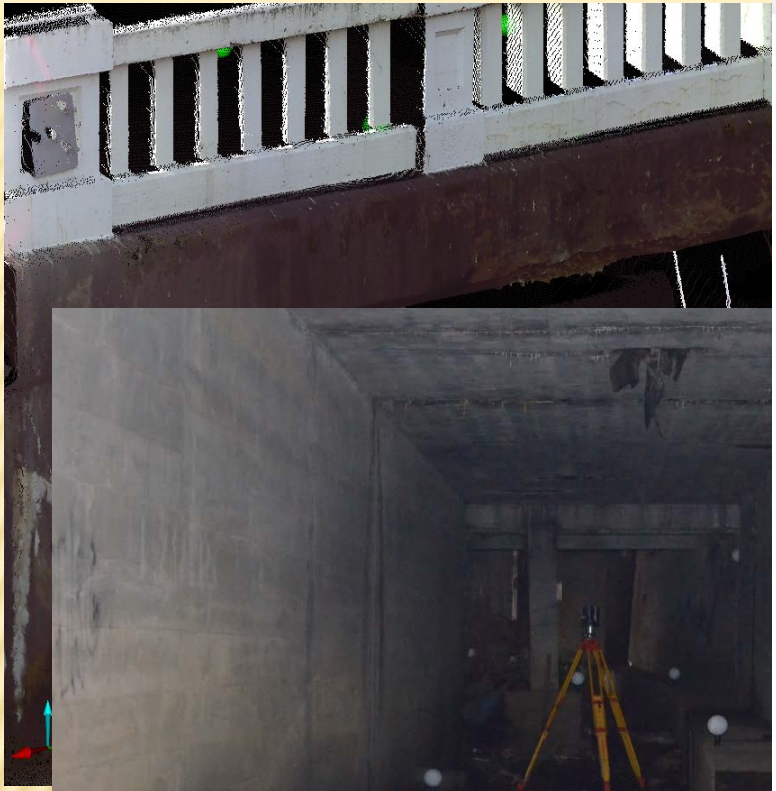
# HDS 3D TERRESTRIAL LIDAR

Culvert Situations

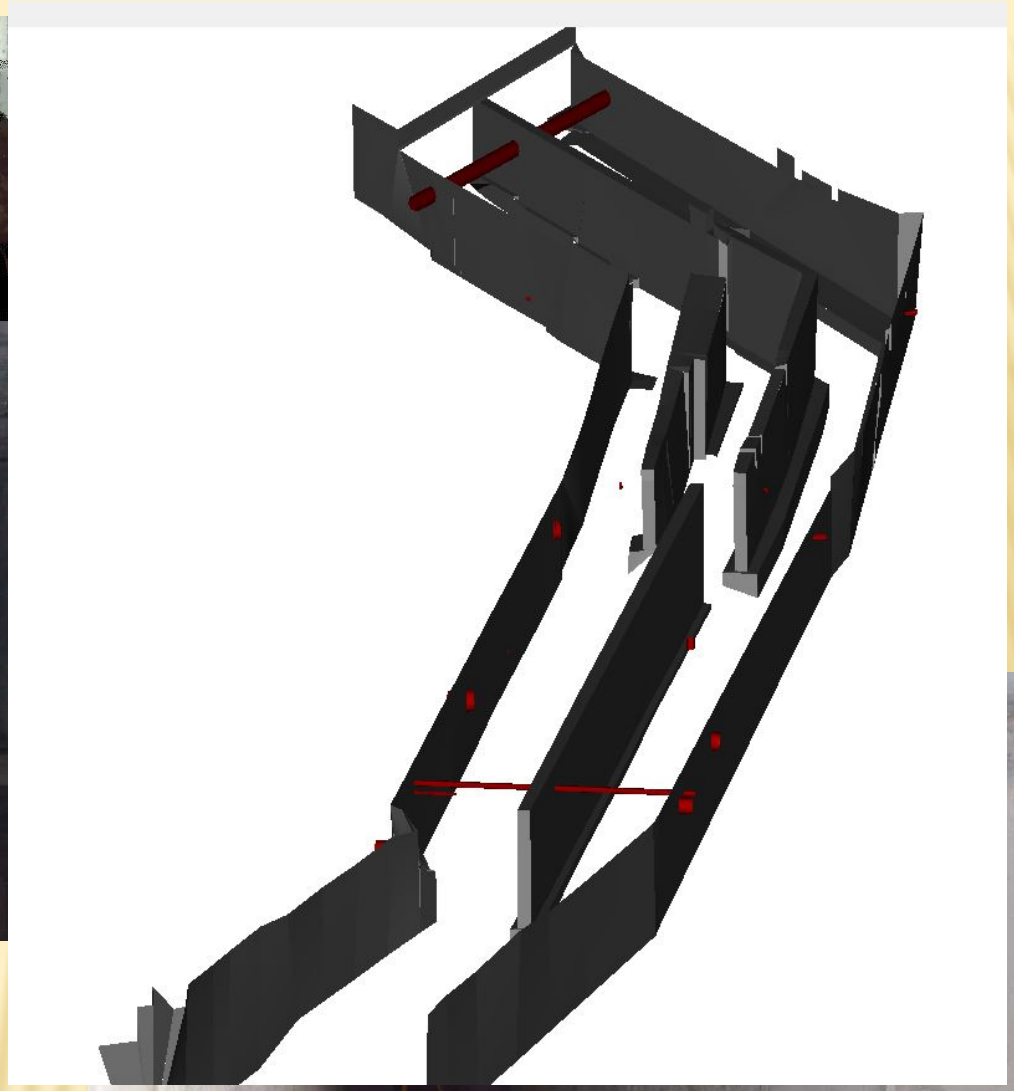


# HDS 3D TERRESTRIAL LIDAR

Culvert Situations









# HDS 3D TERRESTRIAL LIDAR

Culvert Situations

# HDS 3D TERRESTRIAL LIDAR

Rock Cut / Fall Analysis

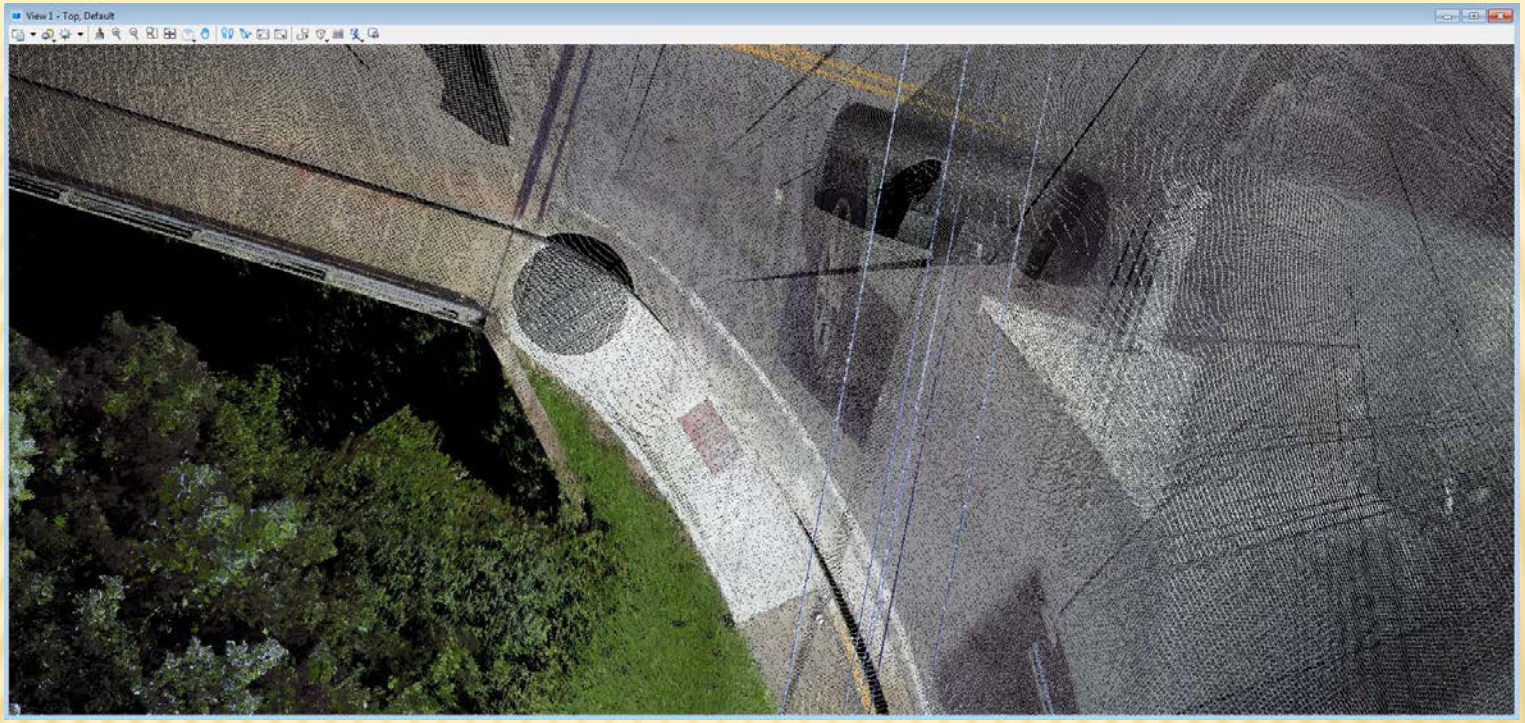
# HDS 3D TERRESTRIAL LIDAR

Rock Cut / Fall Analysis



# HDS 3D TERRESTRIAL LIDAR

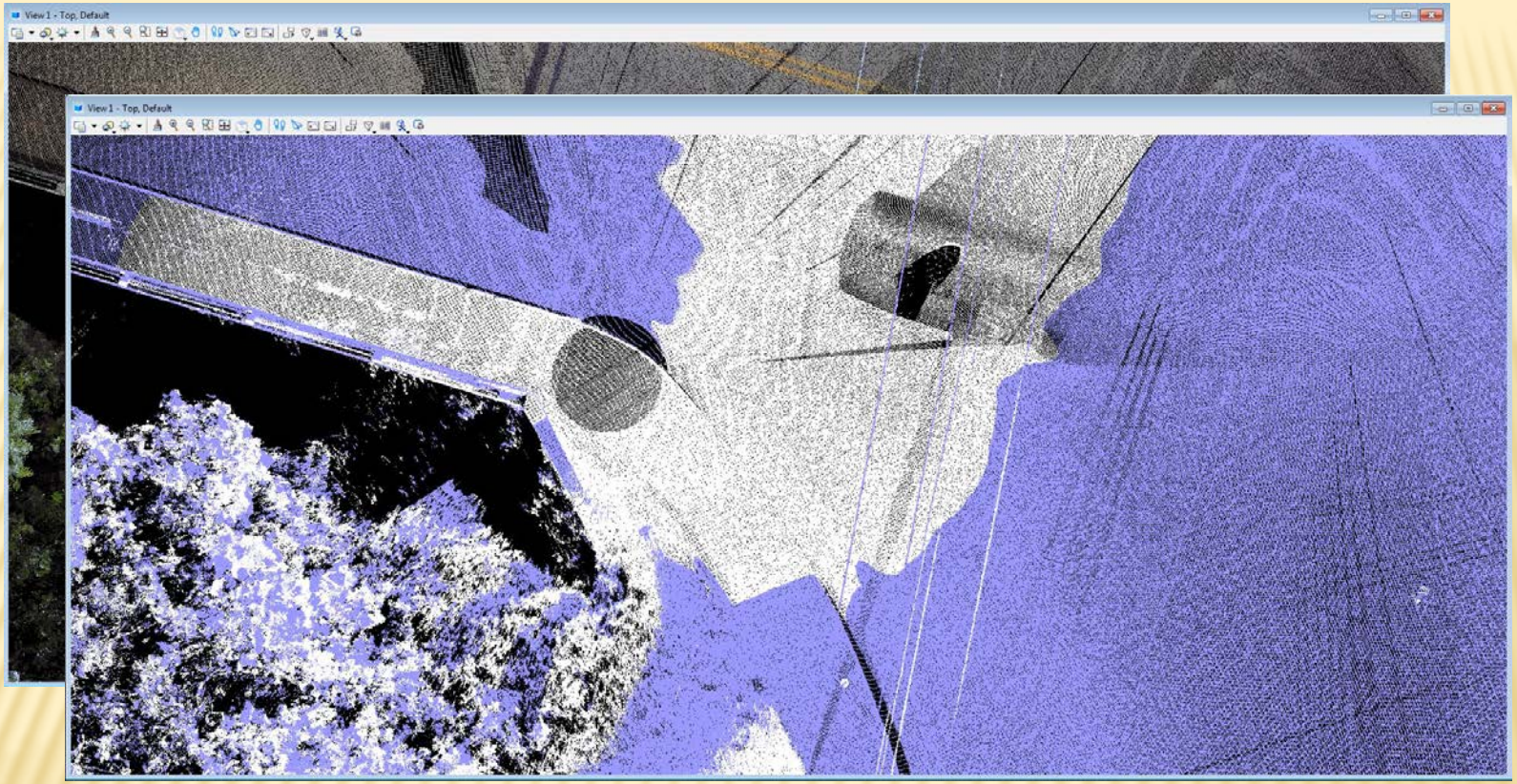
Rock Cut / Fall Analysis




# HDS 3D TERRESTRIAL LIDAR

High Definition DTM

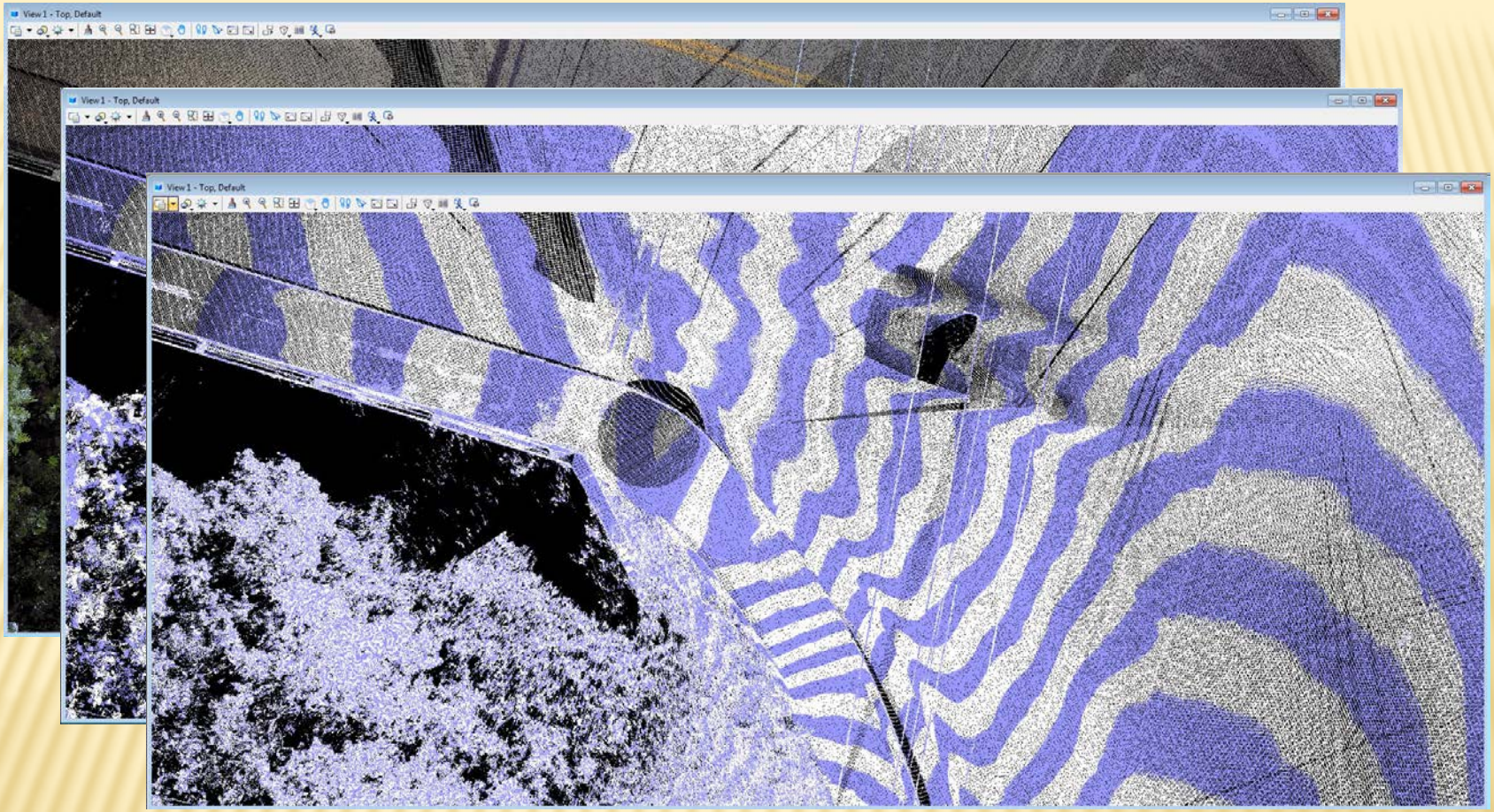
RGB Color Rendering




# HDS 3D TERRESTRIAL LIDAR

High Definition DTM

1 Foot Striped Elevation Rendering




# HDS 3D TERRESTRIAL LIDAR

High Definition DTM

0.1 Foot Striped Elevation Rendering

# WHEN TO USE LIDAR…

- Aerial LiDAR…
  - Vegetated Areas
  - Rough Terrain Areas
  - Large Projects
  - Wherever Statewide LiDAR is available
- Mobile LiDAR…
  - Narrow Corridors Requiring High Accuracy or Detail
  - Areas Large enough to make Mobile LiDAR more economic than Stationary LiDAR
- Stationary LiDAR
  - Areas Requiring High Accuracy or Detail
  - Areas Inaccessible to Mobile LiDAR

# WHAT TO EXPECT FROM LIDAR…

- From Aerial LiDAR…
  - Masspoints extracted from LIDAR point cloud
  - Breaklines (added with the aid of aerial imagery)
- From Mobile/Stationary LiDAR…
  - DTM and Planimetrics extracted directly from point cloud
  - Highest level of accuracy
- From Either…
  - Workable file sizes (should closely resemble file sizes from Aerial Photography or Conventional Surveys)

# PROJECT APPLICATIONS OF LIDAR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