

# ENVIRONMENTAL VISUALIZATION AND 3D MODELING TO SUPPORT STREAM AND WATERSHED RESTORATION IN THE APPALACHIANS

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# Presentation Organization

- Introduction to the presentation and major topics
- Technical aspects of visualization and 3D modeling
- Some completed and ongoing project examples

# Introduction

- Focus of the research is on gathering and using 3D data to support environmental planning and design efforts in rapidly changing landscapes such as stream channels, riparian zones, and mine sites.

Current cooperative efforts with WVDNR stream habitat improvement are providing a working base for much of this work.

# LIDAR the basics

- NRAC at WVU has a major Lidar focused research program
  - Airborne Lidar using an Optech ALTM 3100
  - Ground-based Lidar using Riegl and Faro laser scanners

# A little about Lidar

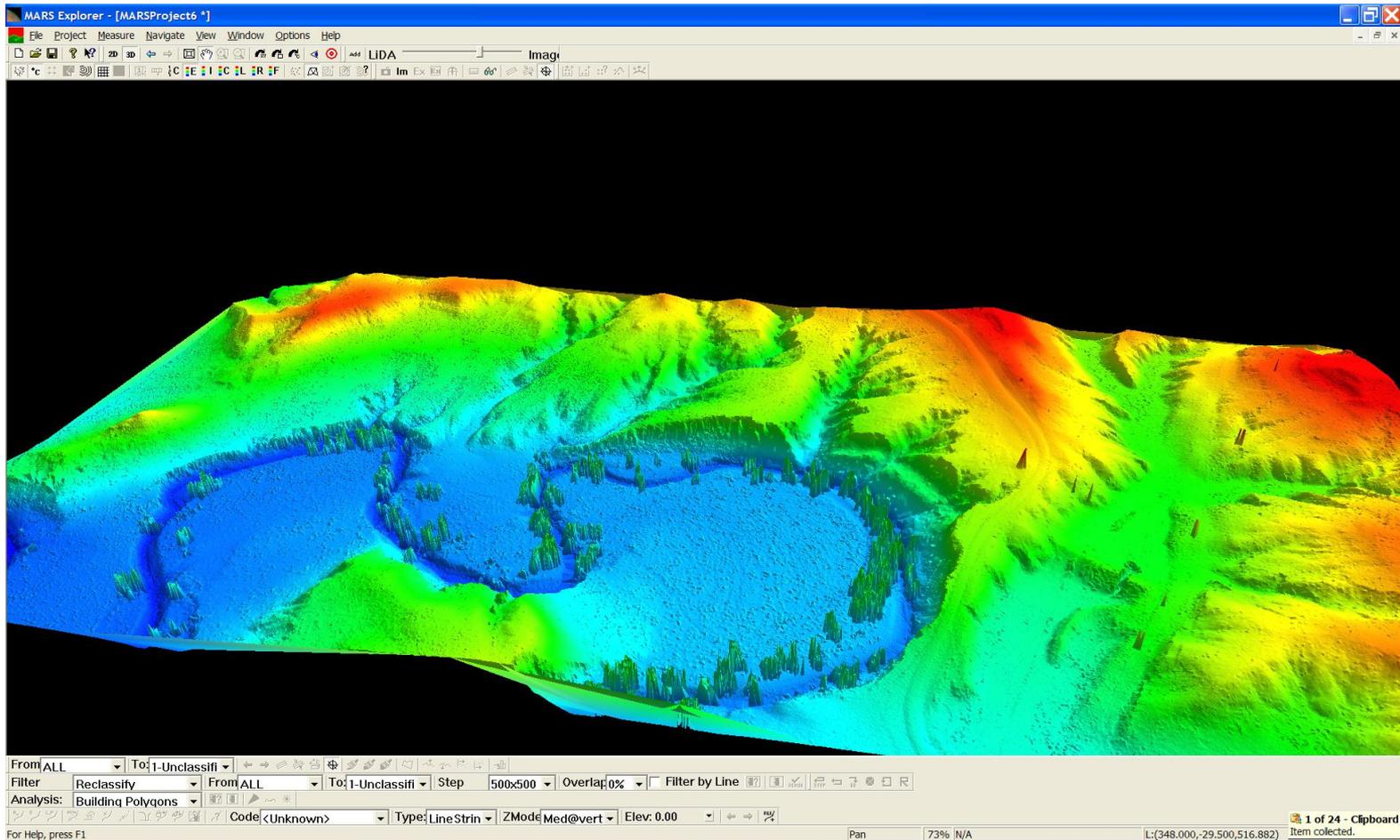
- Lidar is a radar pulse active sensor that relies primarily on time of flight data to calculate distances that are turned into elevations for points on the ground or in an environment
- Aircraft Lidar is generally collected at densities of 2 to 10 points per square meter.
- Ground based Lidar is collected much more densely with hundreds to thousands of data points per square meter.

# Airborne Lidar

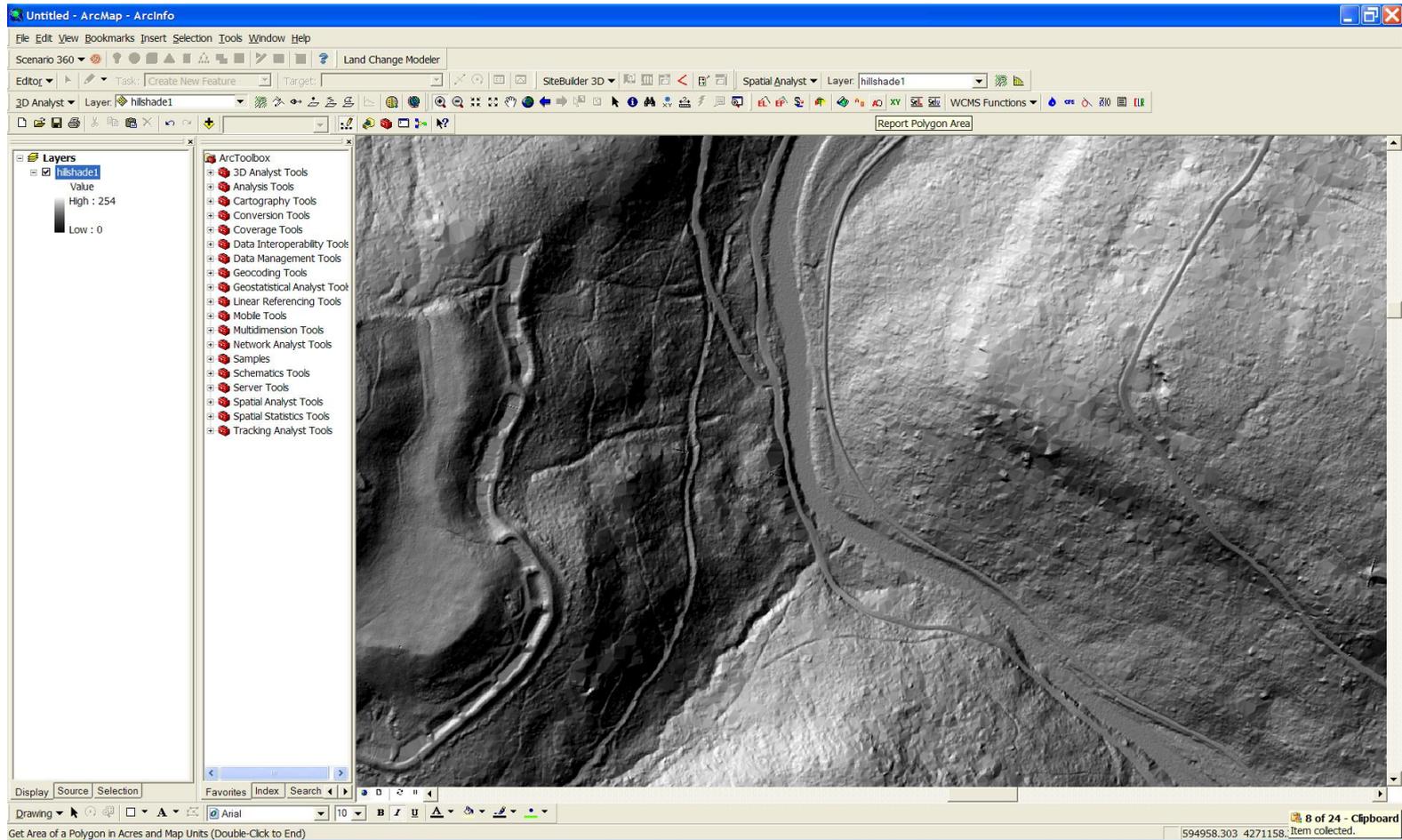
- Laser
- Digital camera
- Inertial navigation unit
- gps



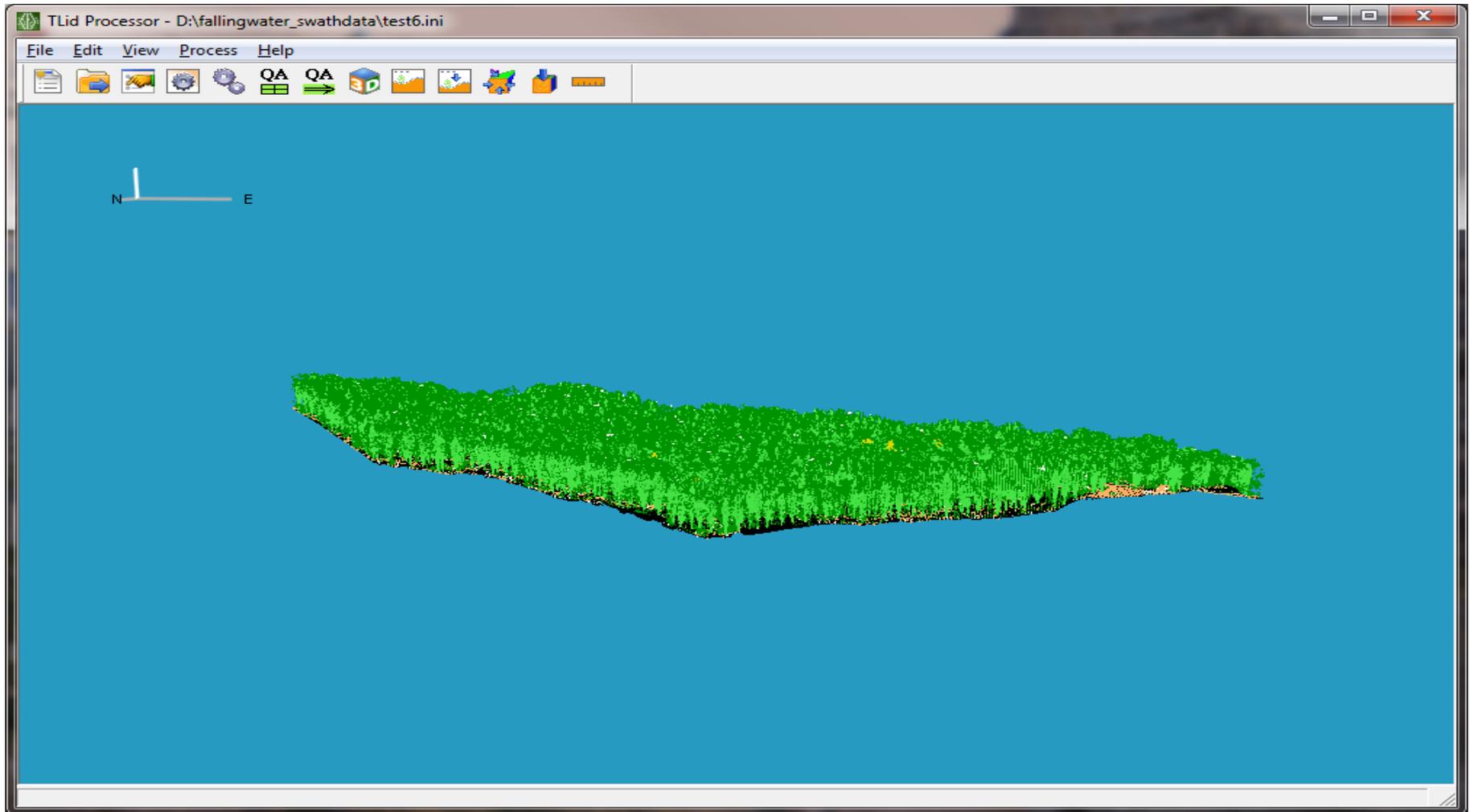
# Airborne data of a tributary of the Powder River in Wyoming



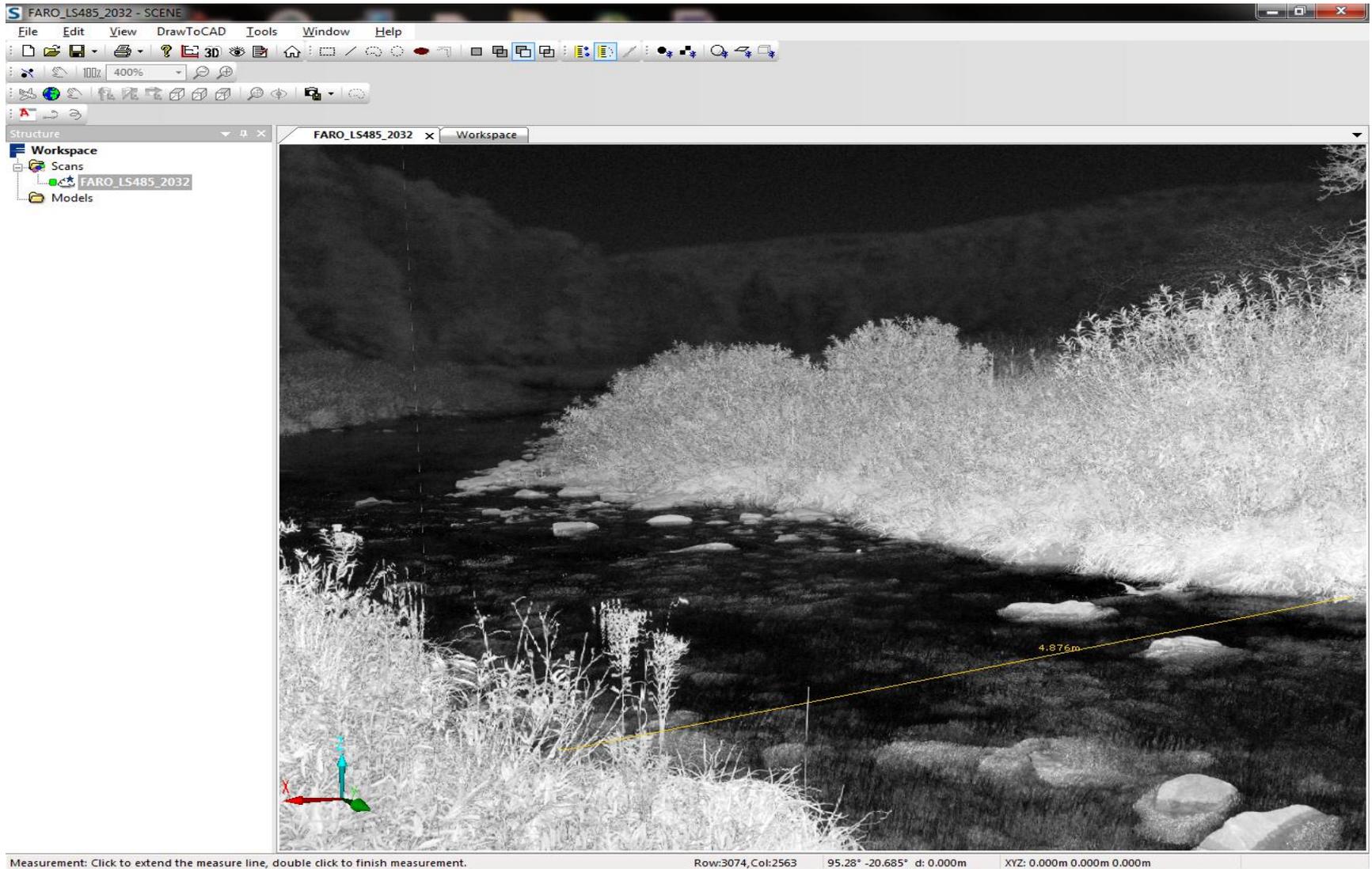
# Airborne data of Beaver Creek tributary of Shavers Fork in West Virginia

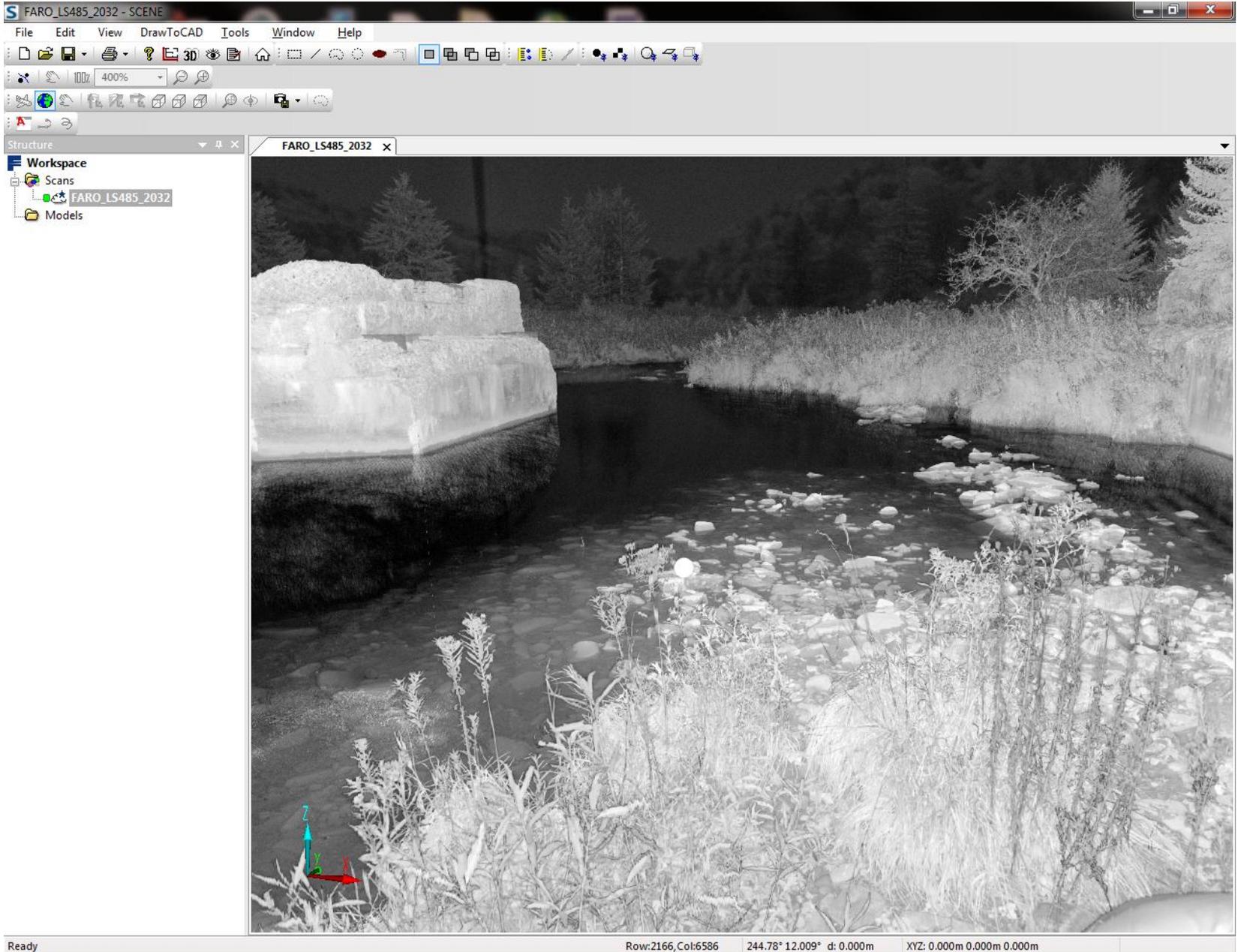


- Modeling vegetation with airborne Lidar data – Bear Run in Pennsylvania



# Ground based Lidar can be extremely spatially resolute

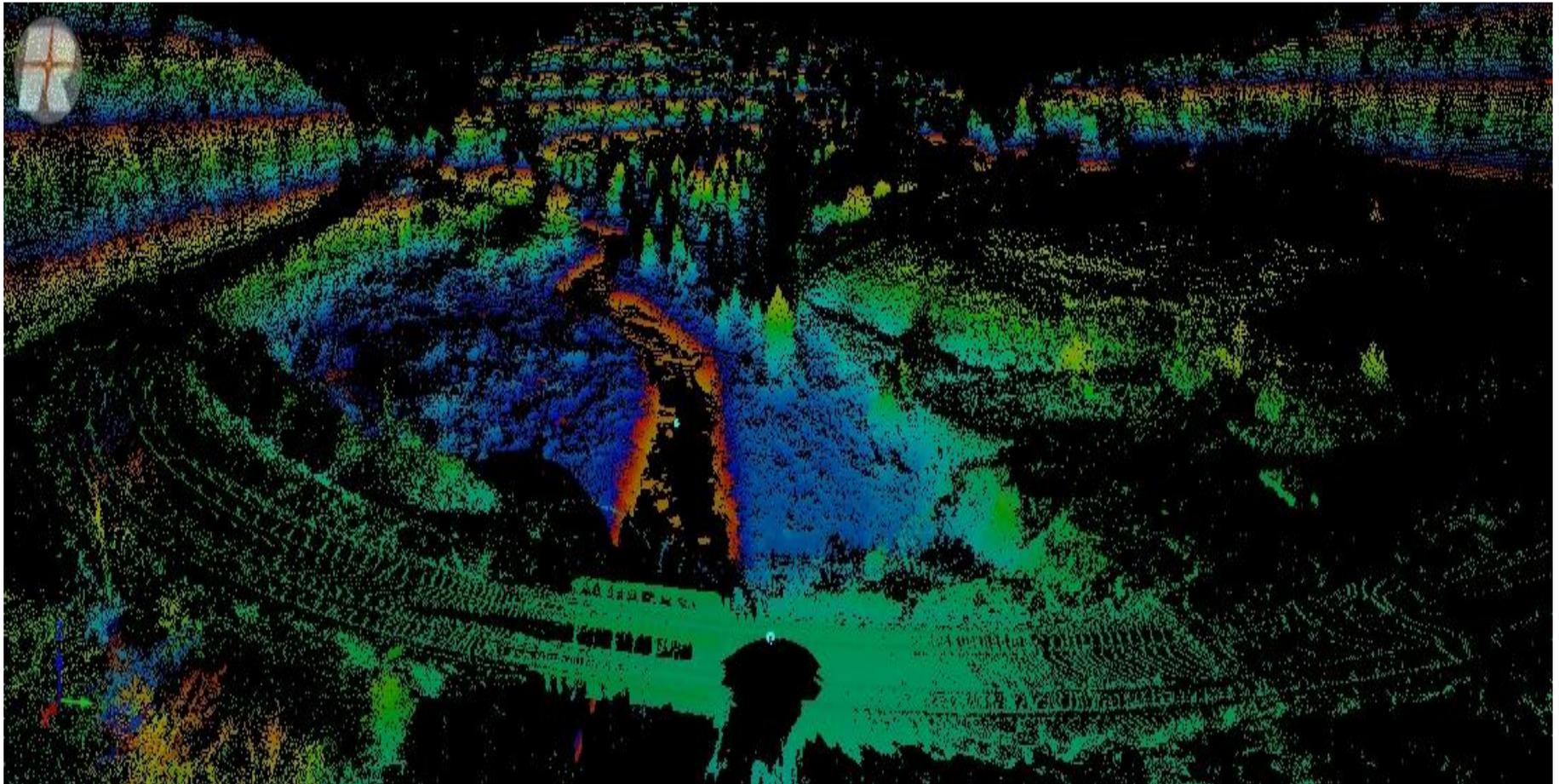




Ground based lasers – a major constraint is line of sight operation. From each point the lasers can gather a 360 by 340 degree study area

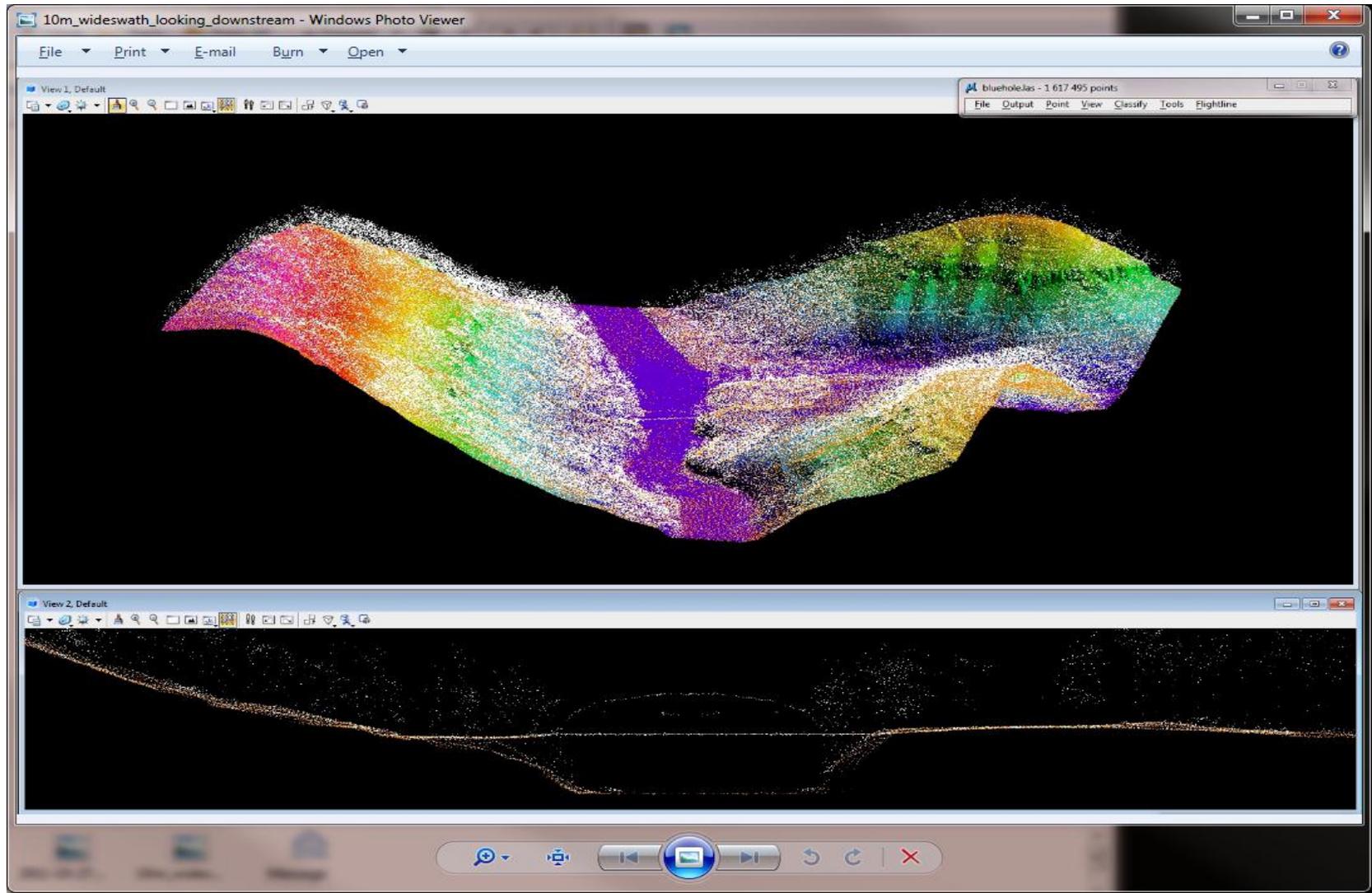


Scan from the previous bridge with bankfull, riparian and upland areas rendered

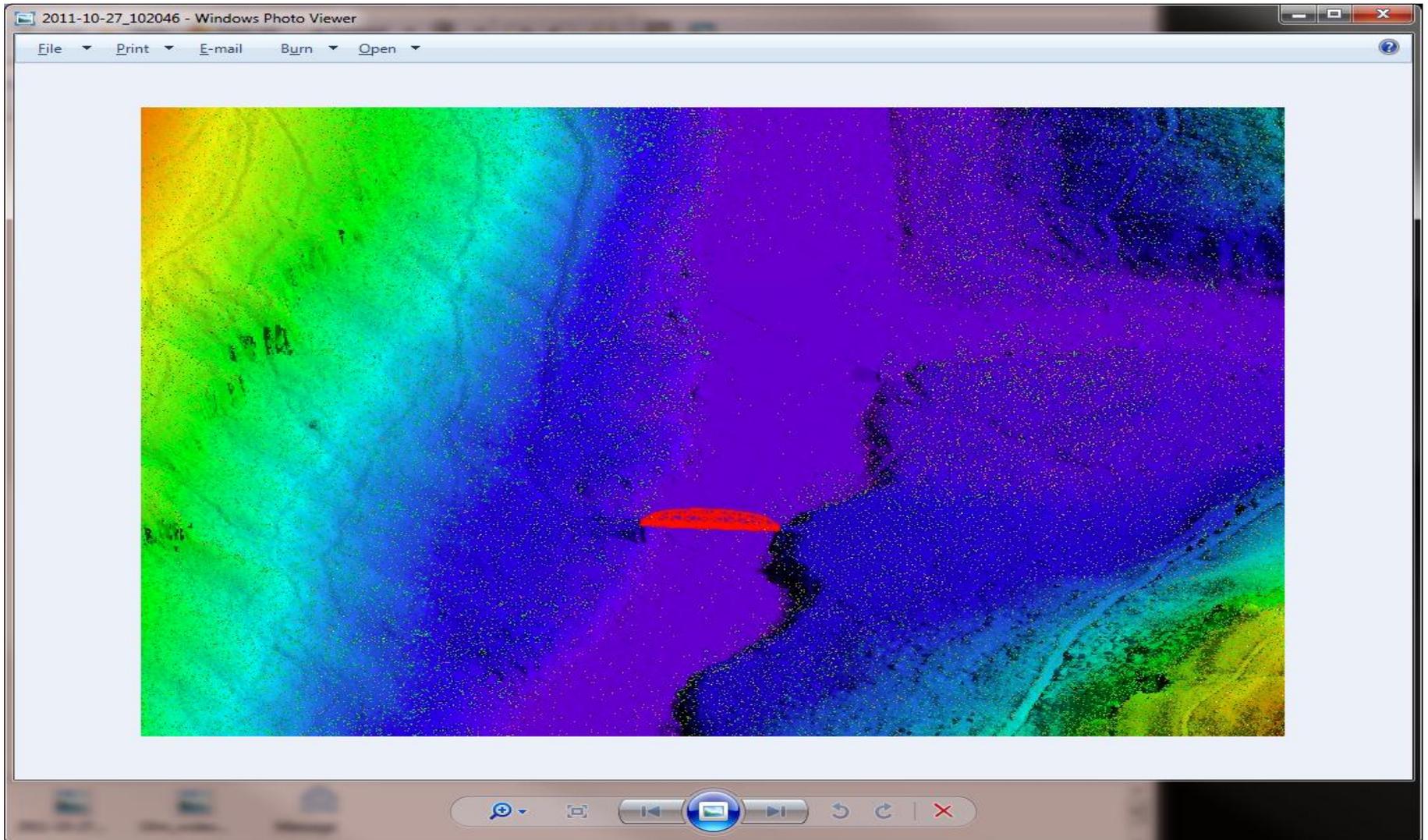


Mid-Atlantic Stream Restoration  
Conference

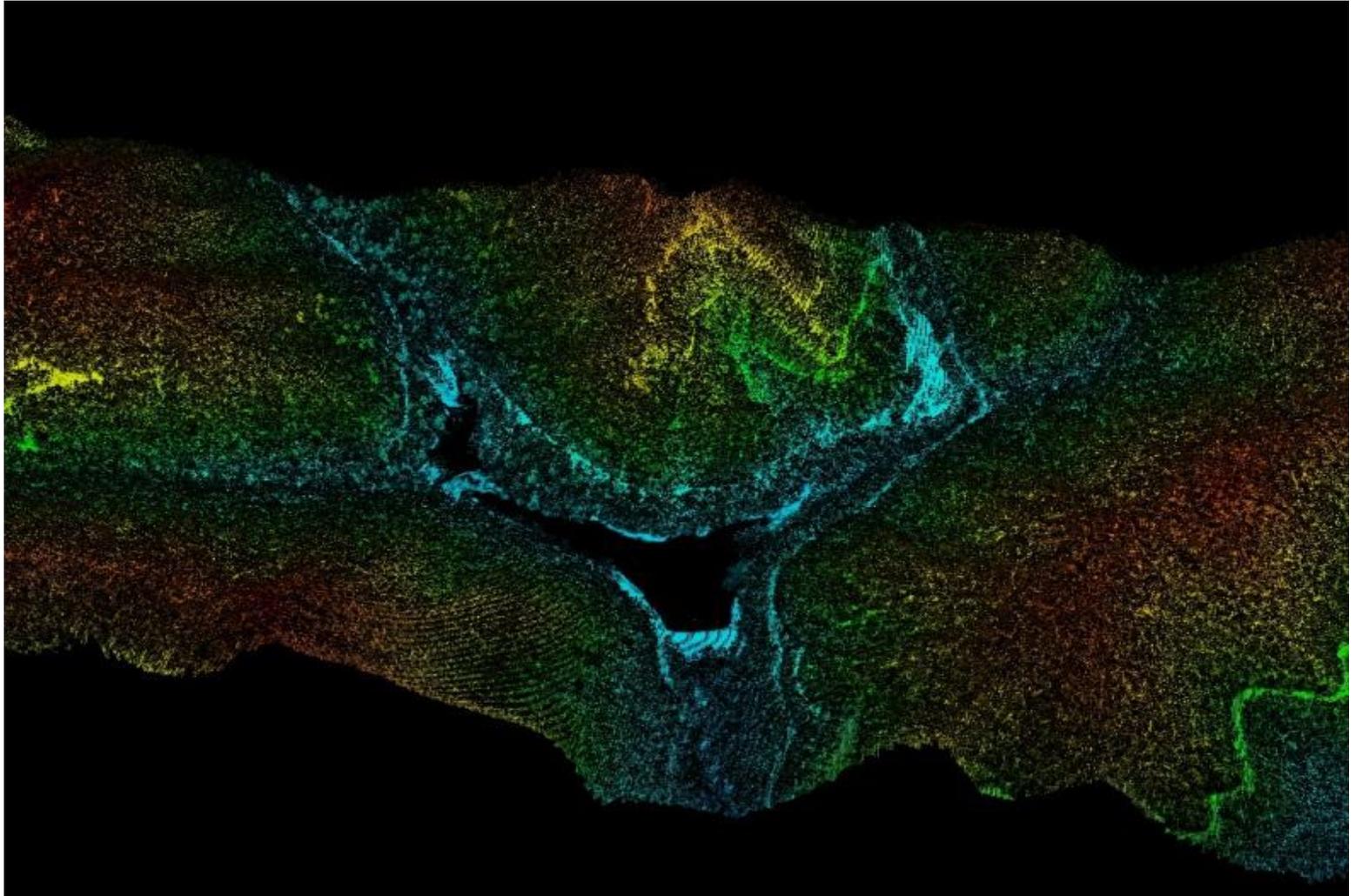
# Airborne data (all points) of a stream in Preston County

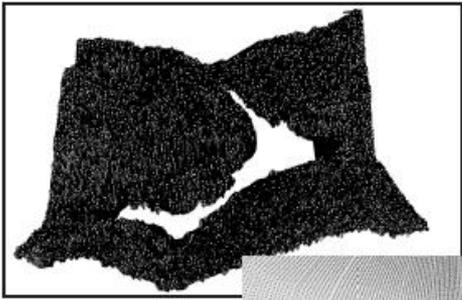


# Integrating airborne and ground based data with a high resolution scan of a bridge

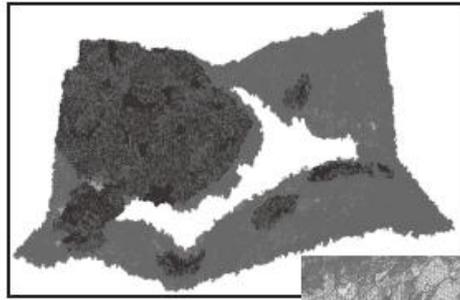


# Visualization with Lidar data – Horse Creek Lake in Wyoming County WV

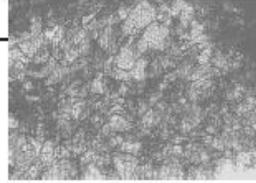




POINT CLOUD DATA



MESH FORMATION



CANOPY COVER

Modeling the canopy cover at Horse Creek Lake.

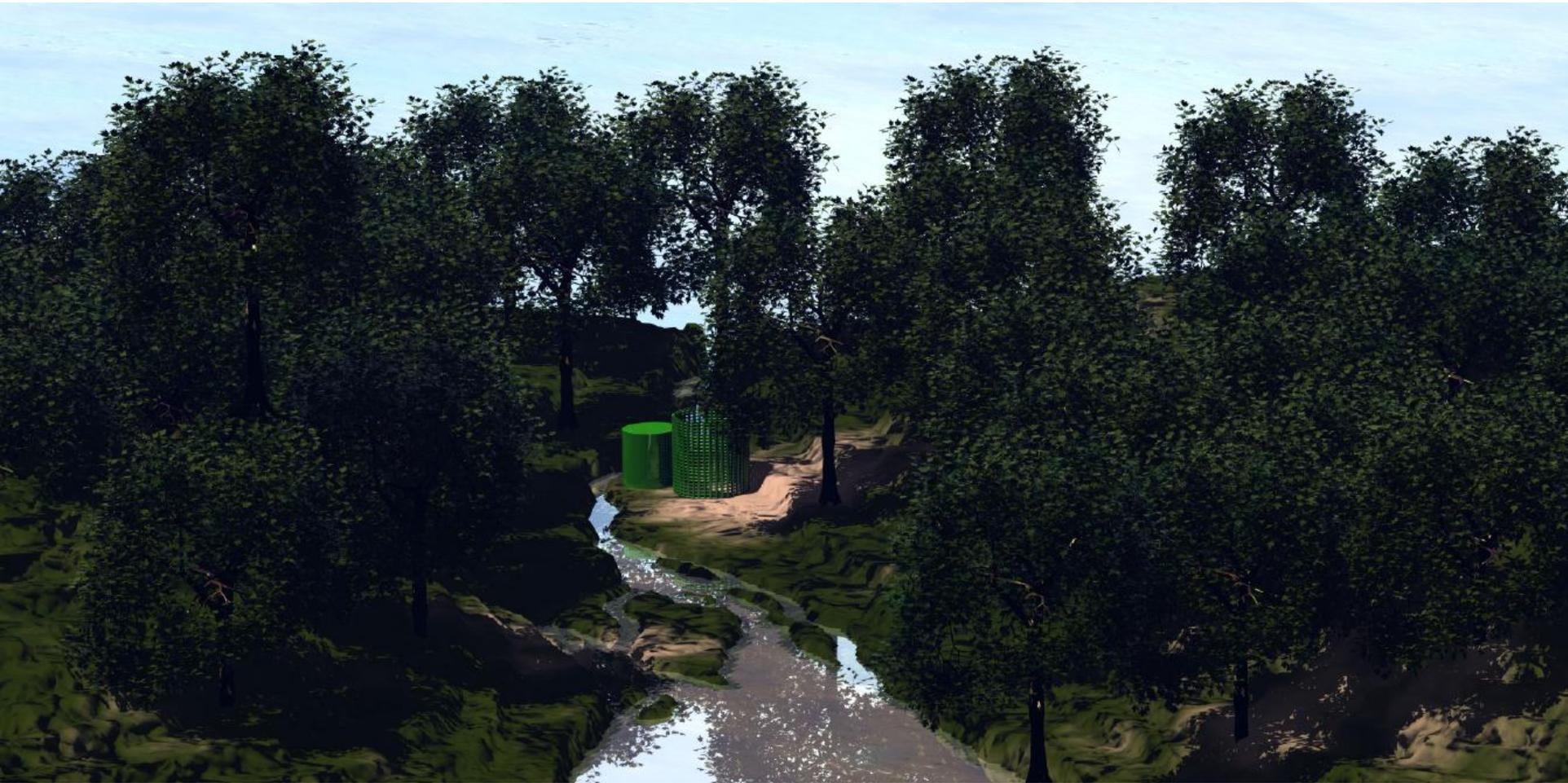




The combined ground layer, low vegetation, and canopy cover in the model.



Aerial view of Horse Creek Lake model with the demarcated location of AMD at Hounds Fork.

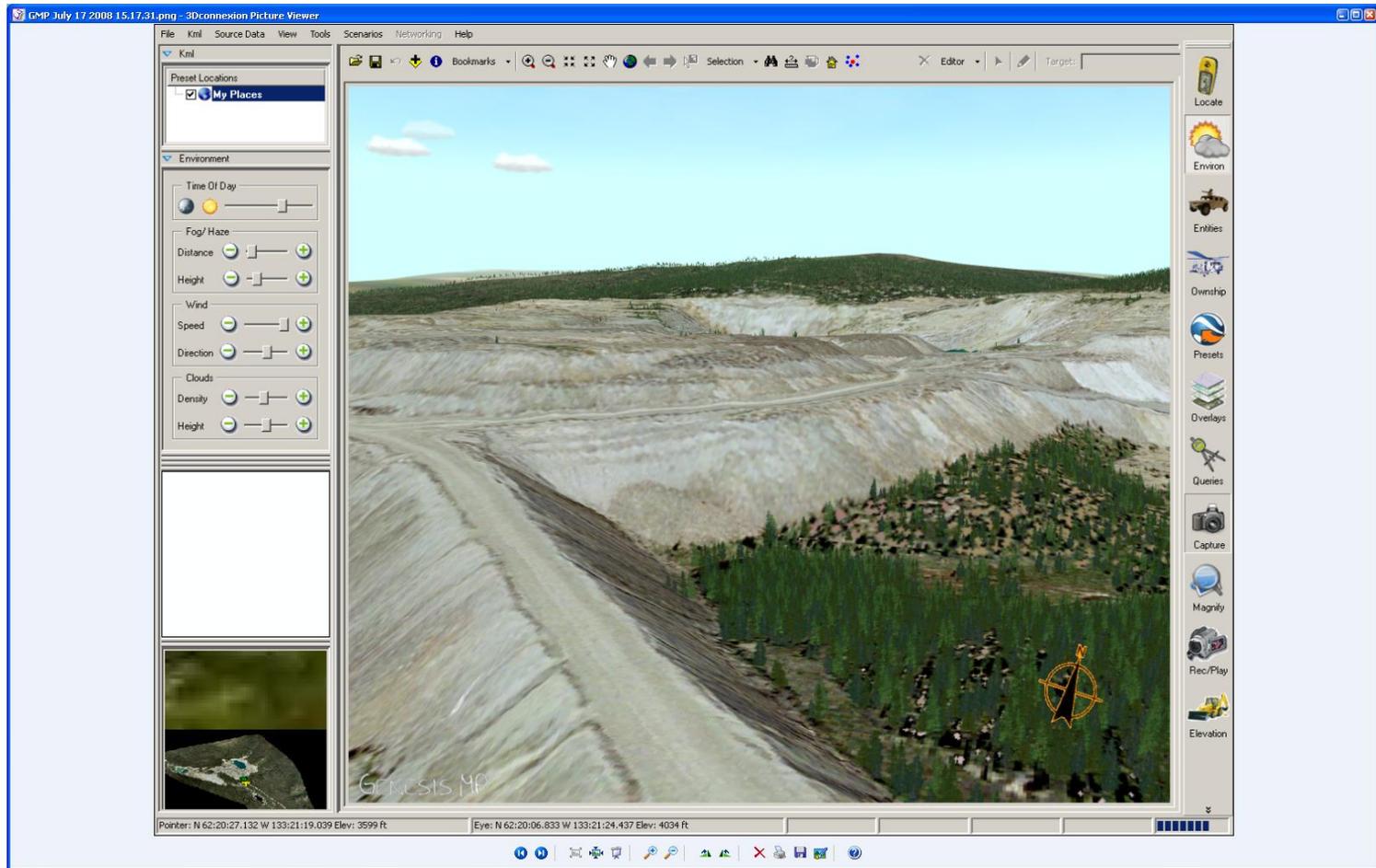


Design visualization of mechanized doser at Hound Fork (view looking west).



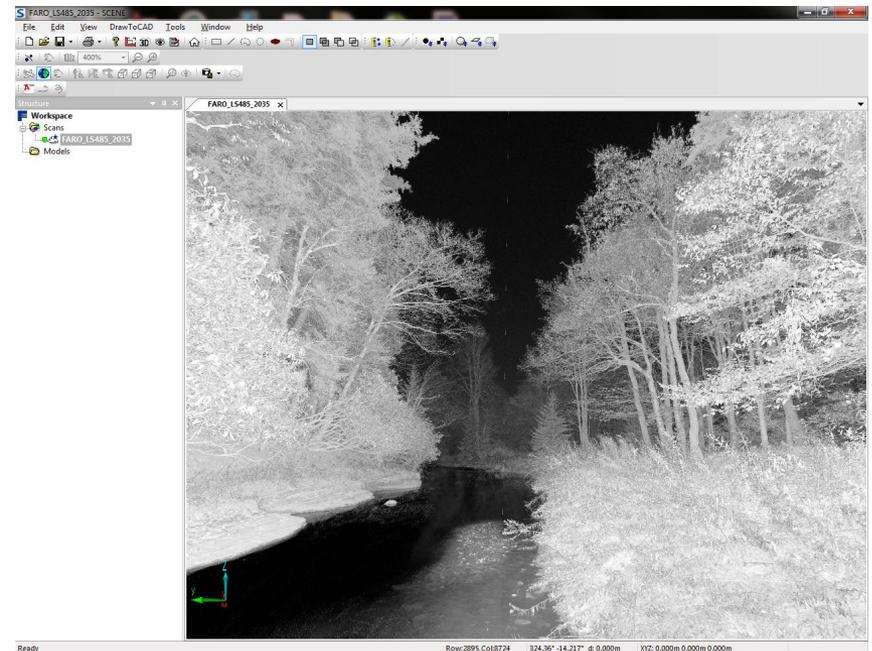
Design visualization of constructed wetland at Hound Fork (view looking west).

# Environmental visualization of an un-reclaimed gold mine spoil pile in the Yukon – airborne and ground data



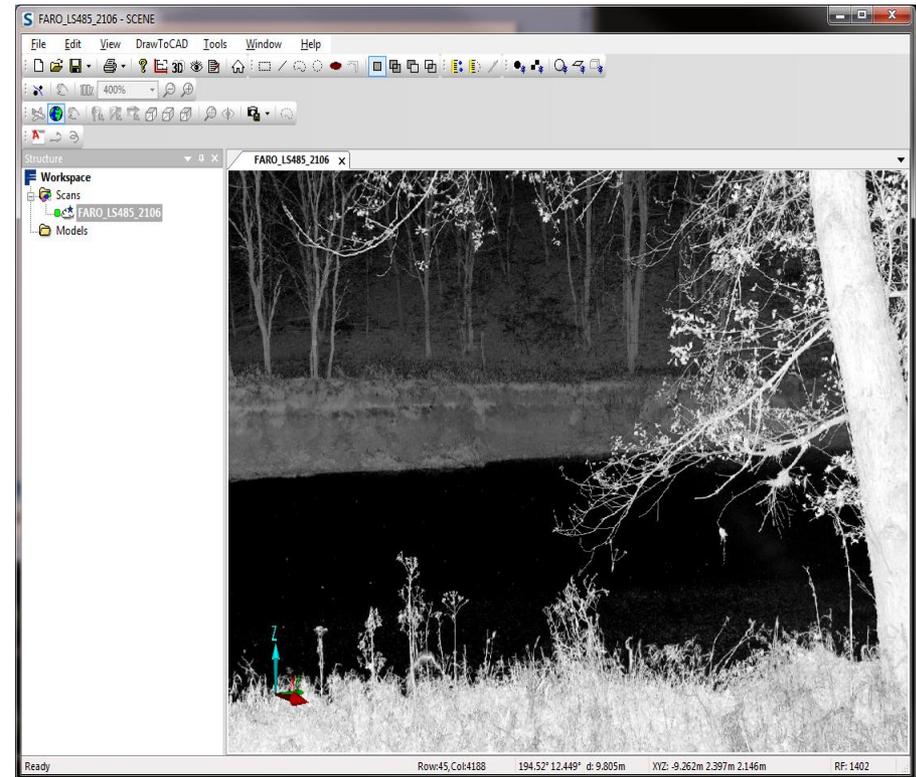
# However, there are technical issues associated with the use of ground based Lidar data

- The ground control required for airborne data collection is often not suitable for ground based data gathering – so additional ground control is often required
- Line of sight operation may result in numerous scans required to cover an area completely – need to register multiple scans
- Standard lasers don't do well with water
- Data volumes can be significant though benefits are also significant – e.g. ability to generate an infinite number of stream cross sections
- Identifying minor changes in landforms requires very tightly controlled setup and data capture
- However, scanning can be very rapid – scan to the right took under five minutes

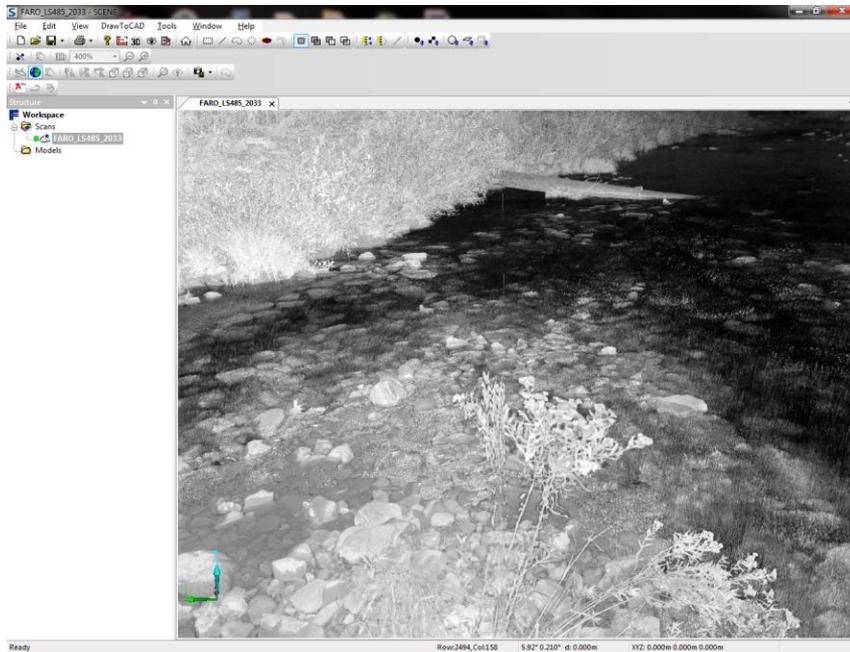


# Our current major research directions

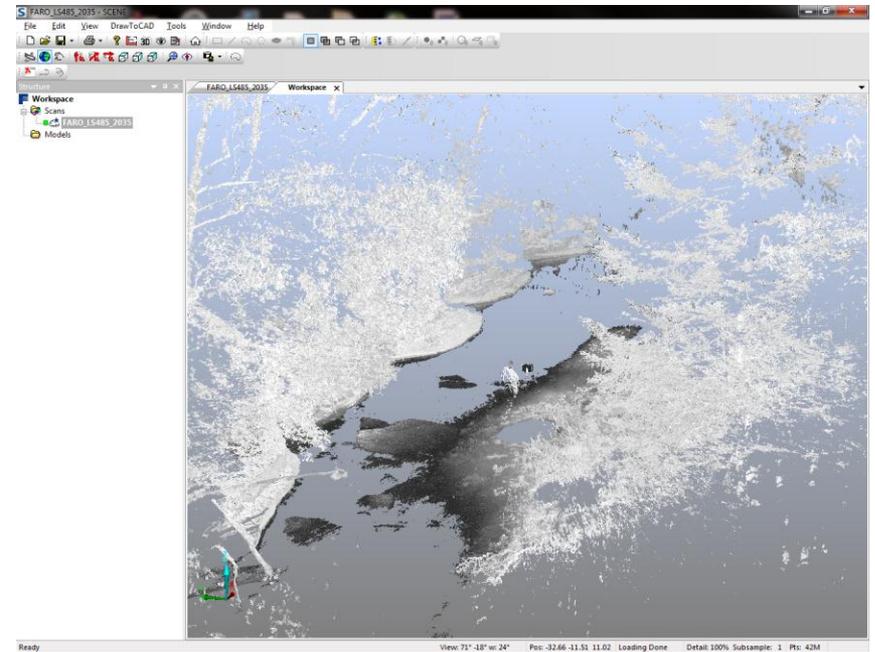
- Documenting as-is conditions along streams and rivers
- Monitoring areas and features that appear to be actively / rapidly changing
- Documenting as-builts
- Using as-is as a basis for planning and design



# As-is and as-builts in Shavers Fork to support WVDNR's habitat enhancement efforts

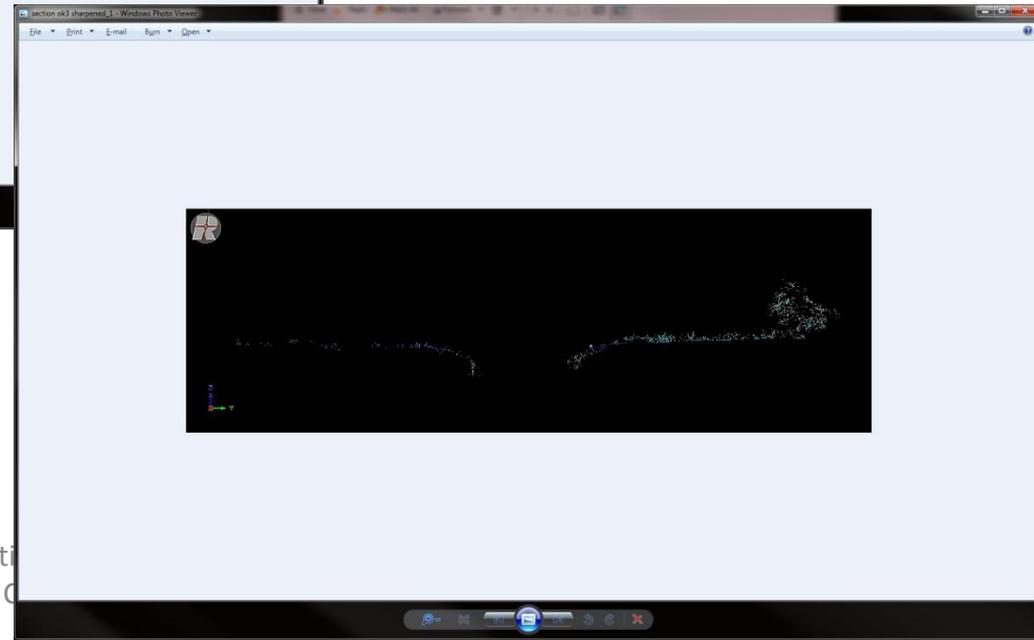
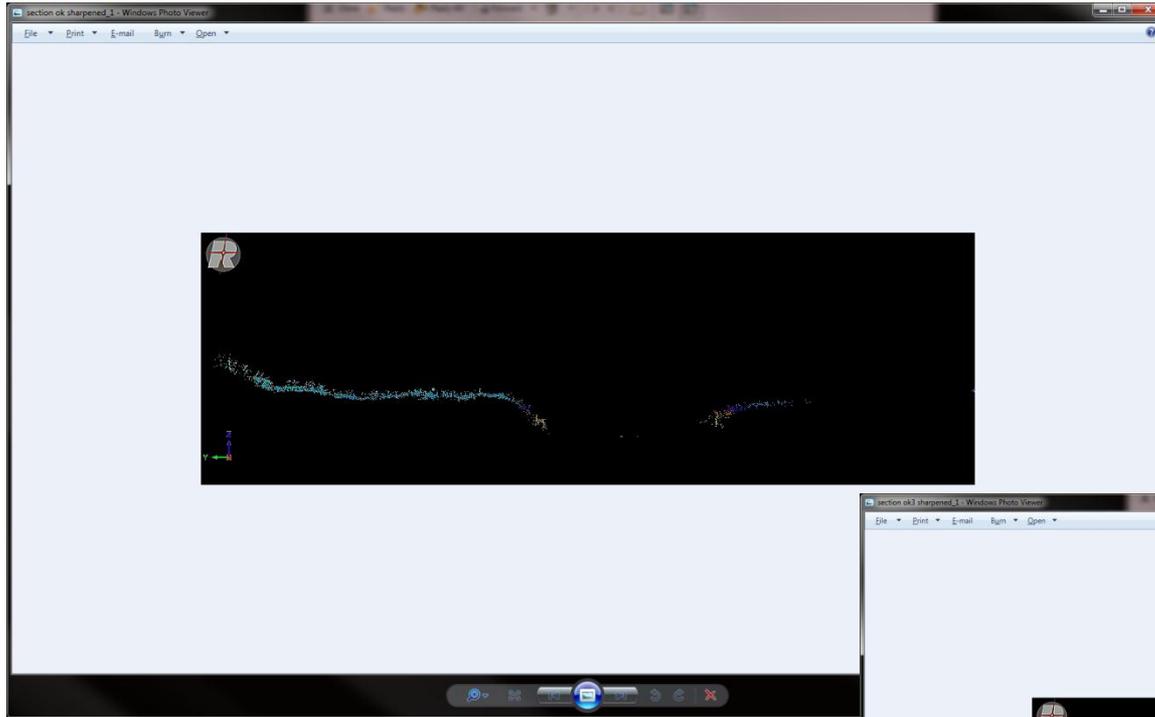


Micro conditions on a point bar



Wetted area on a tributary of Shavers Fork

# Cross sections are readily developed



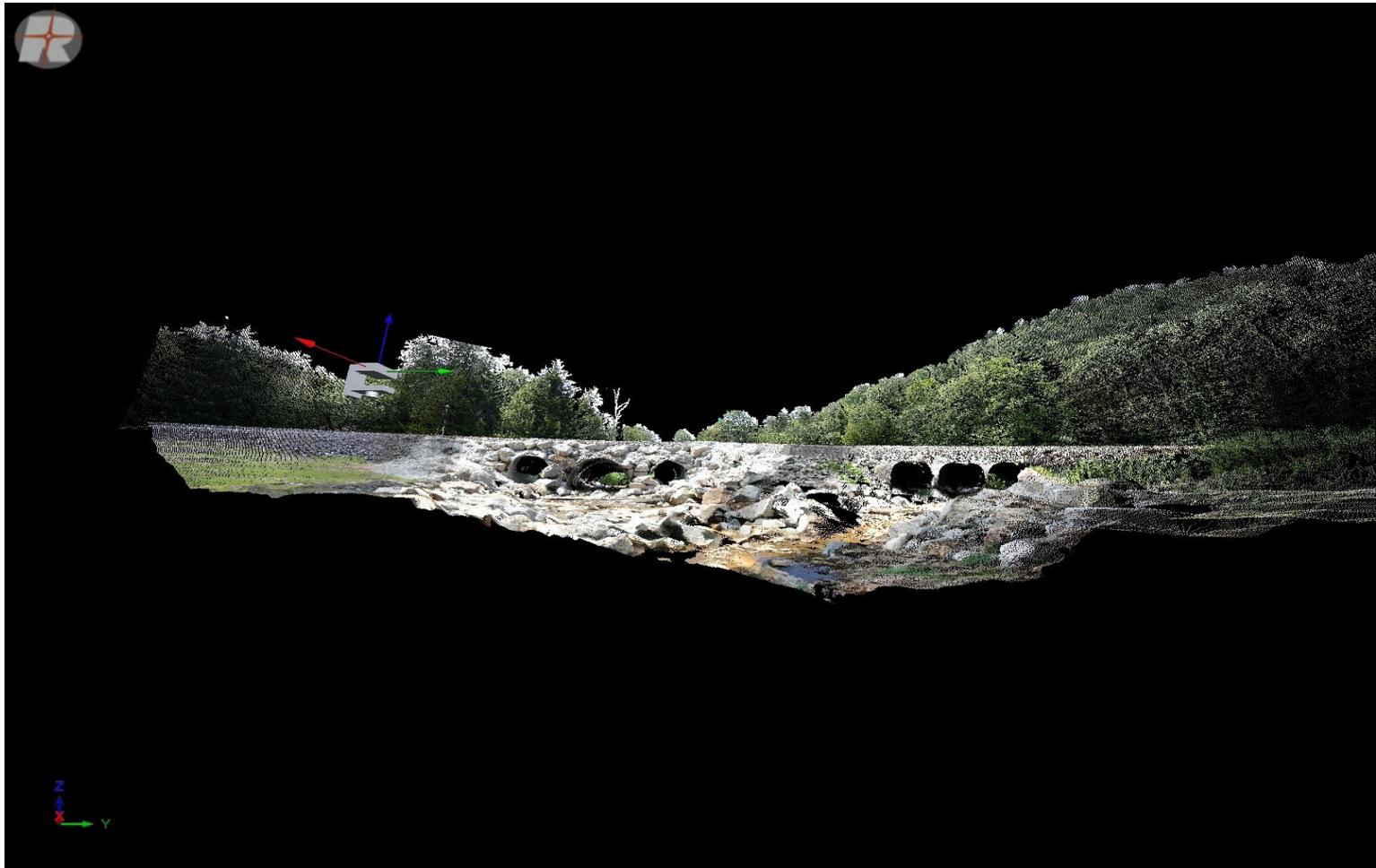
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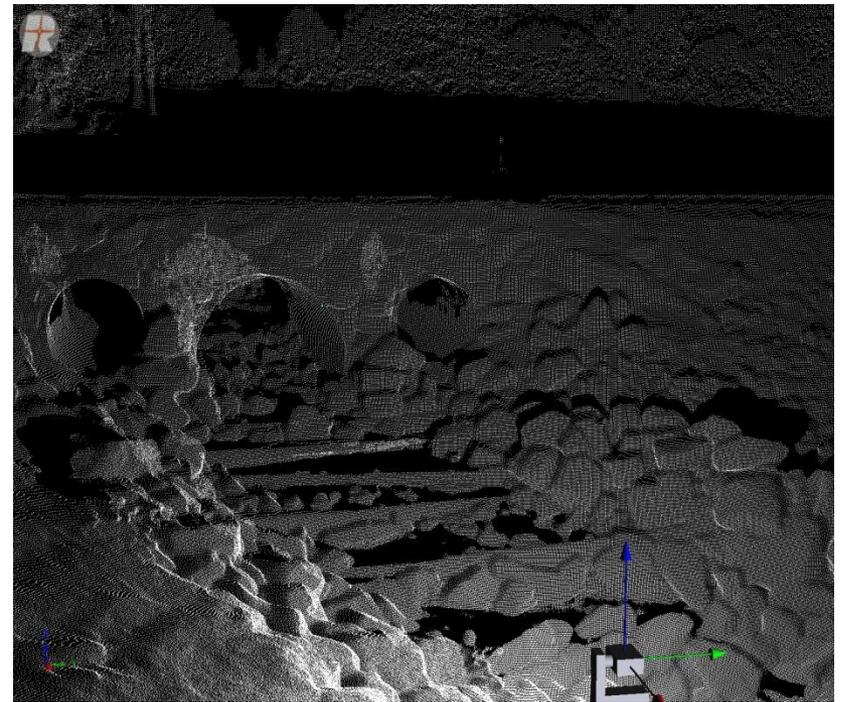
# Documenting construction for long-term monitoring Beaver Creek Tributary of Shavers – post-installation



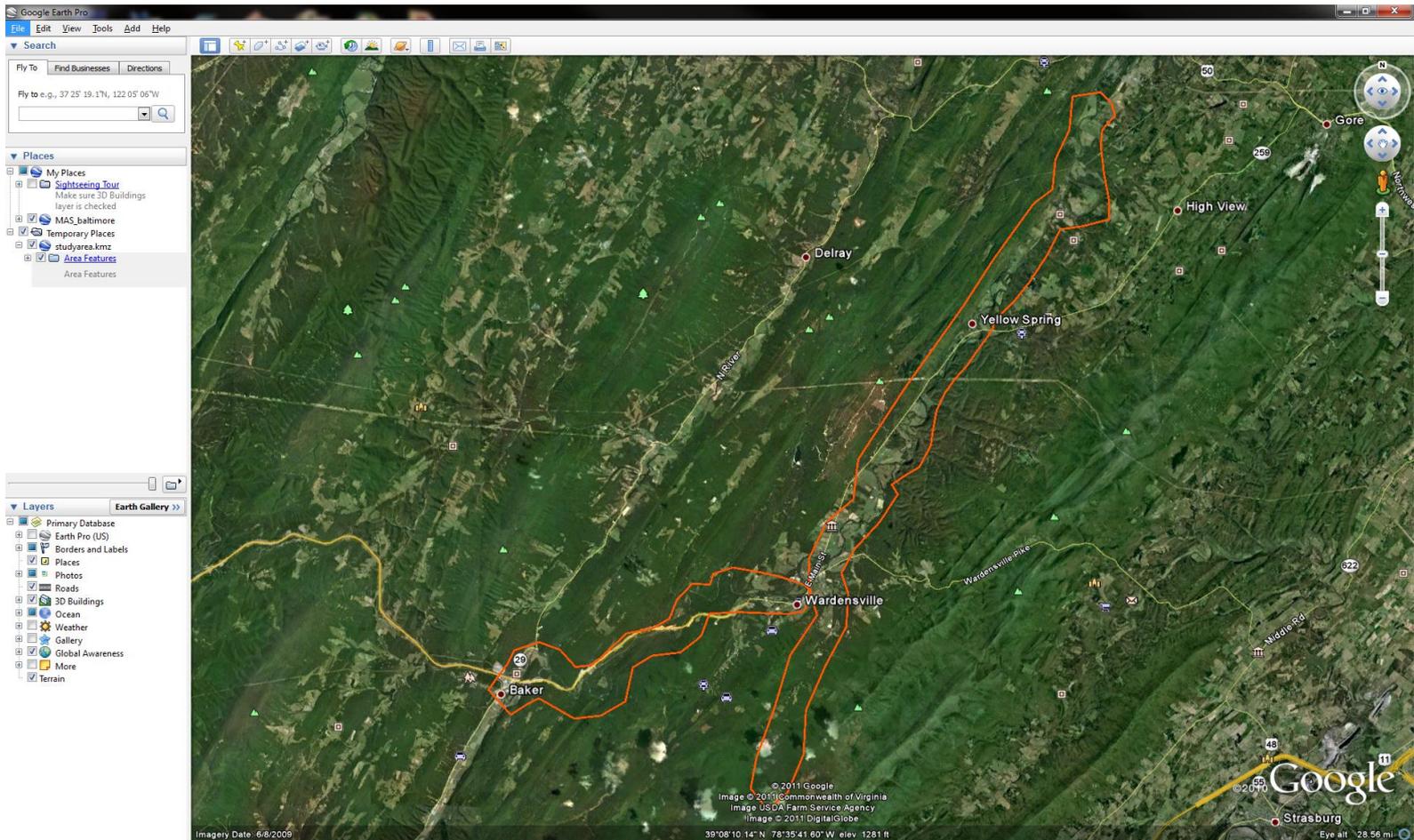
# Laser scan of the features



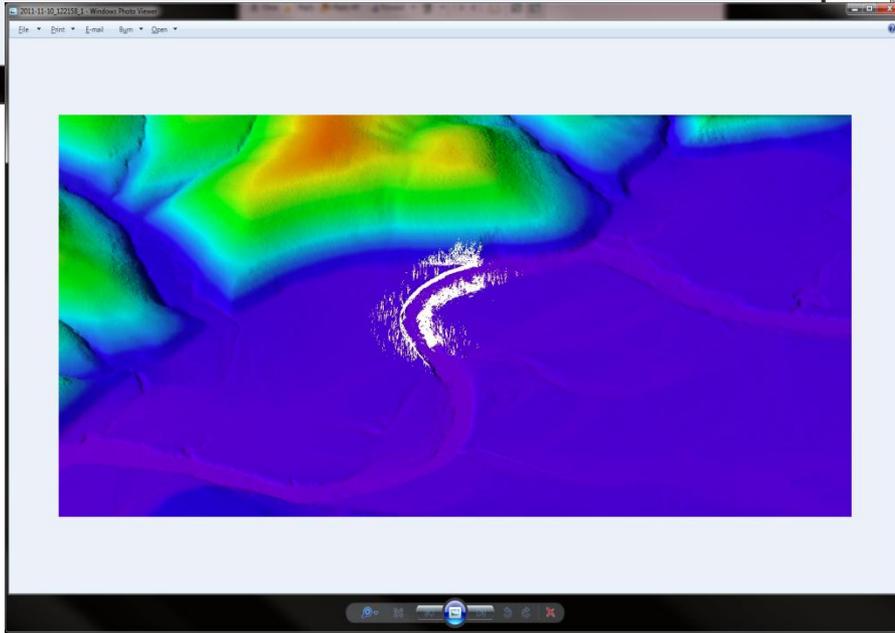
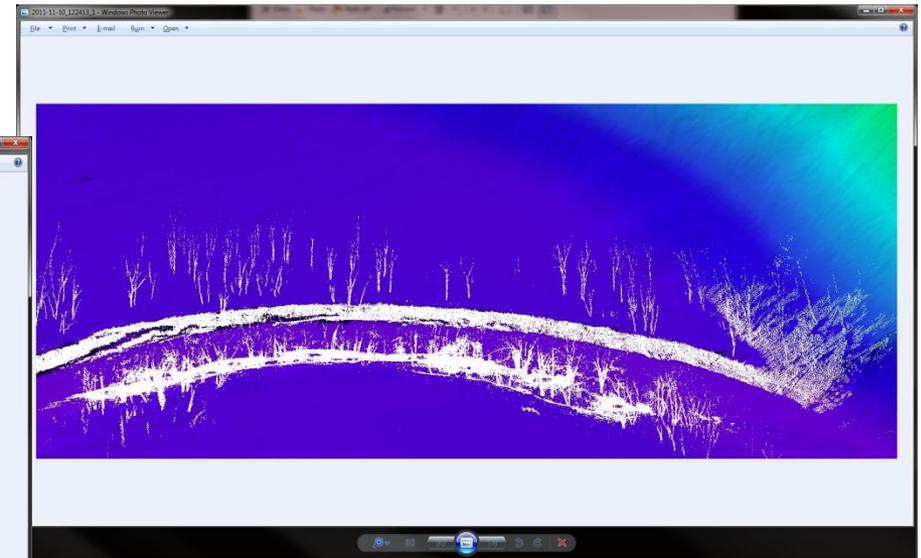
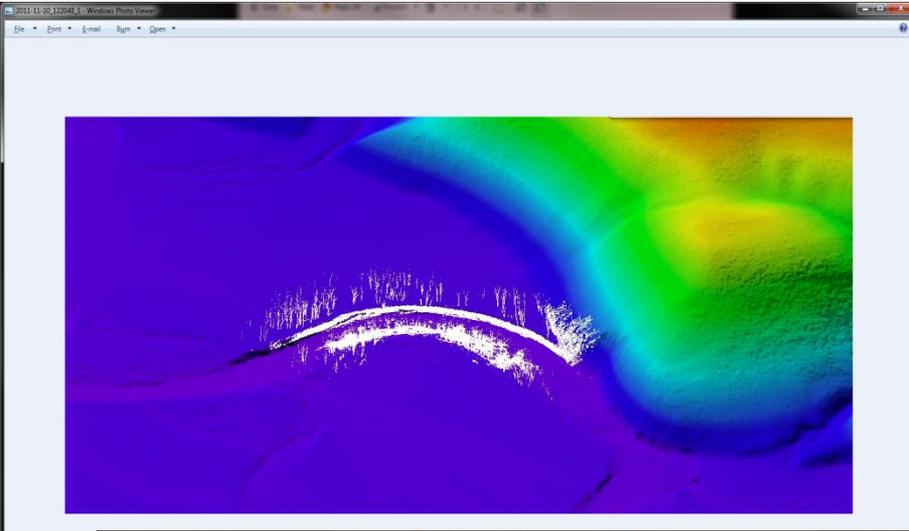
# Zoomed data of restoration feature construction



# The Cacapon – a typical study area

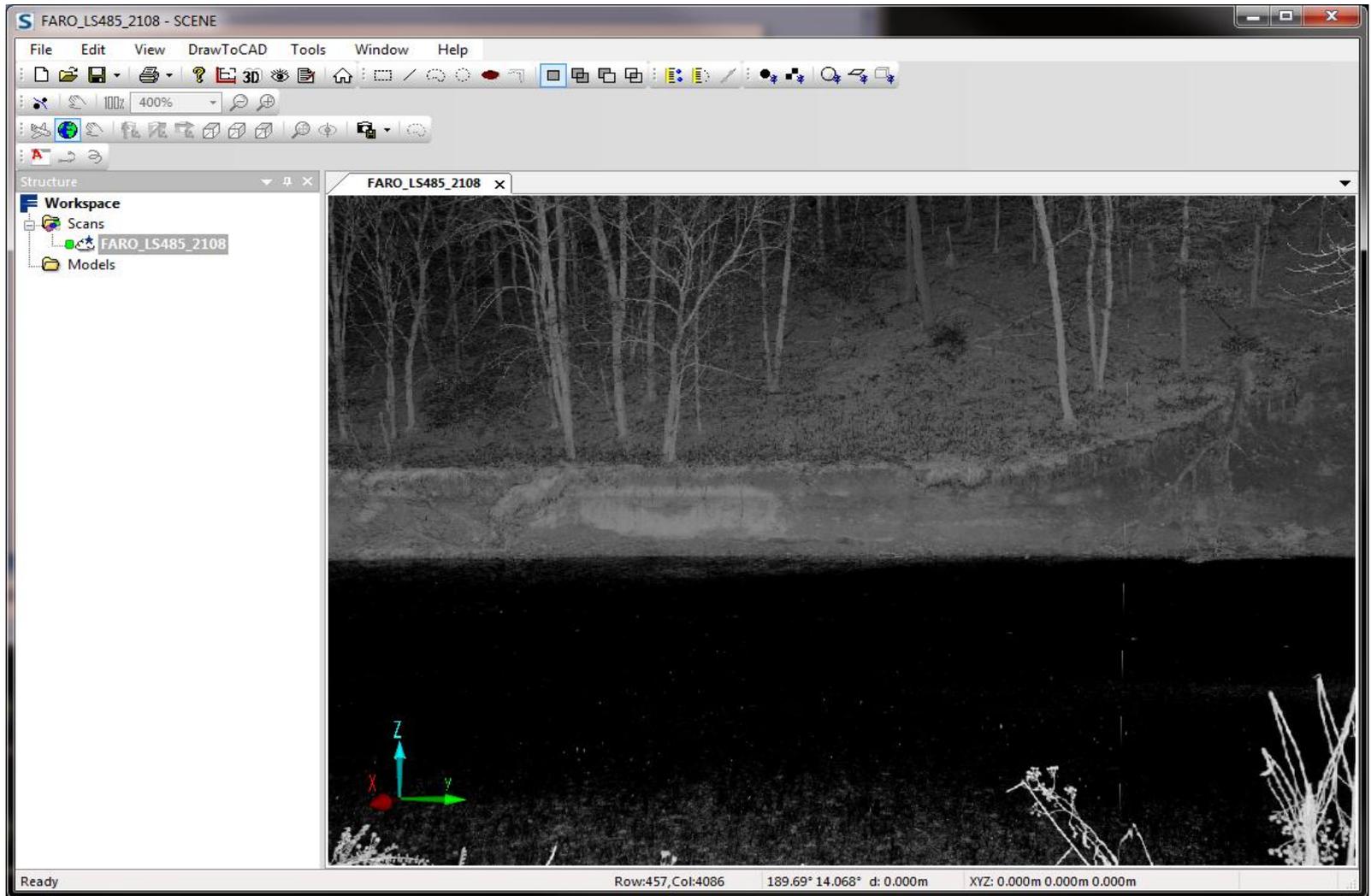


# Some ground laser data in the airborne data framework on the Cacapon



m Restoration  
nce

# As-is conditions on incised banks on the Cacapon





100% 400%



Structure

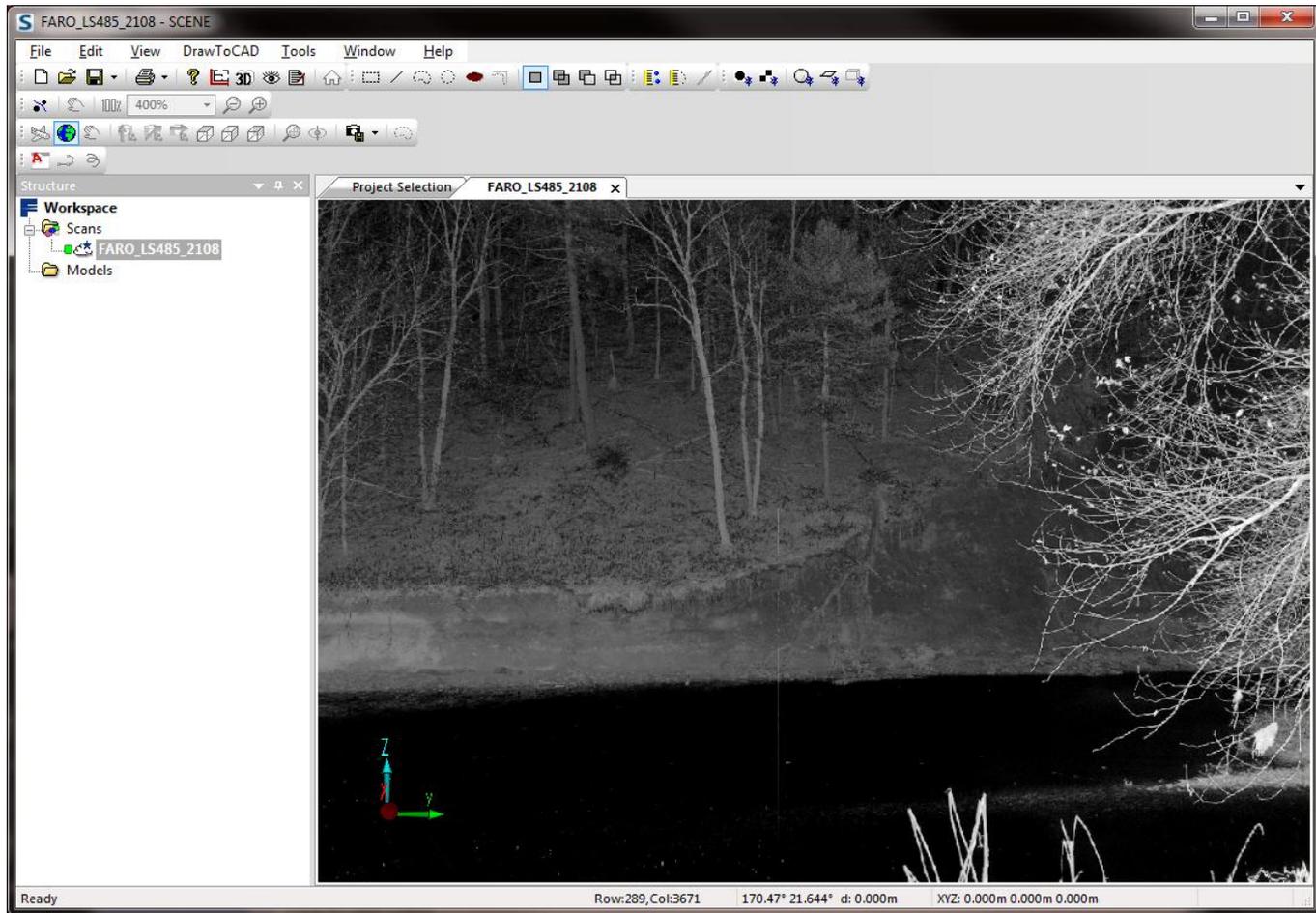
FARO\_LS485\_2095 x

Workspace

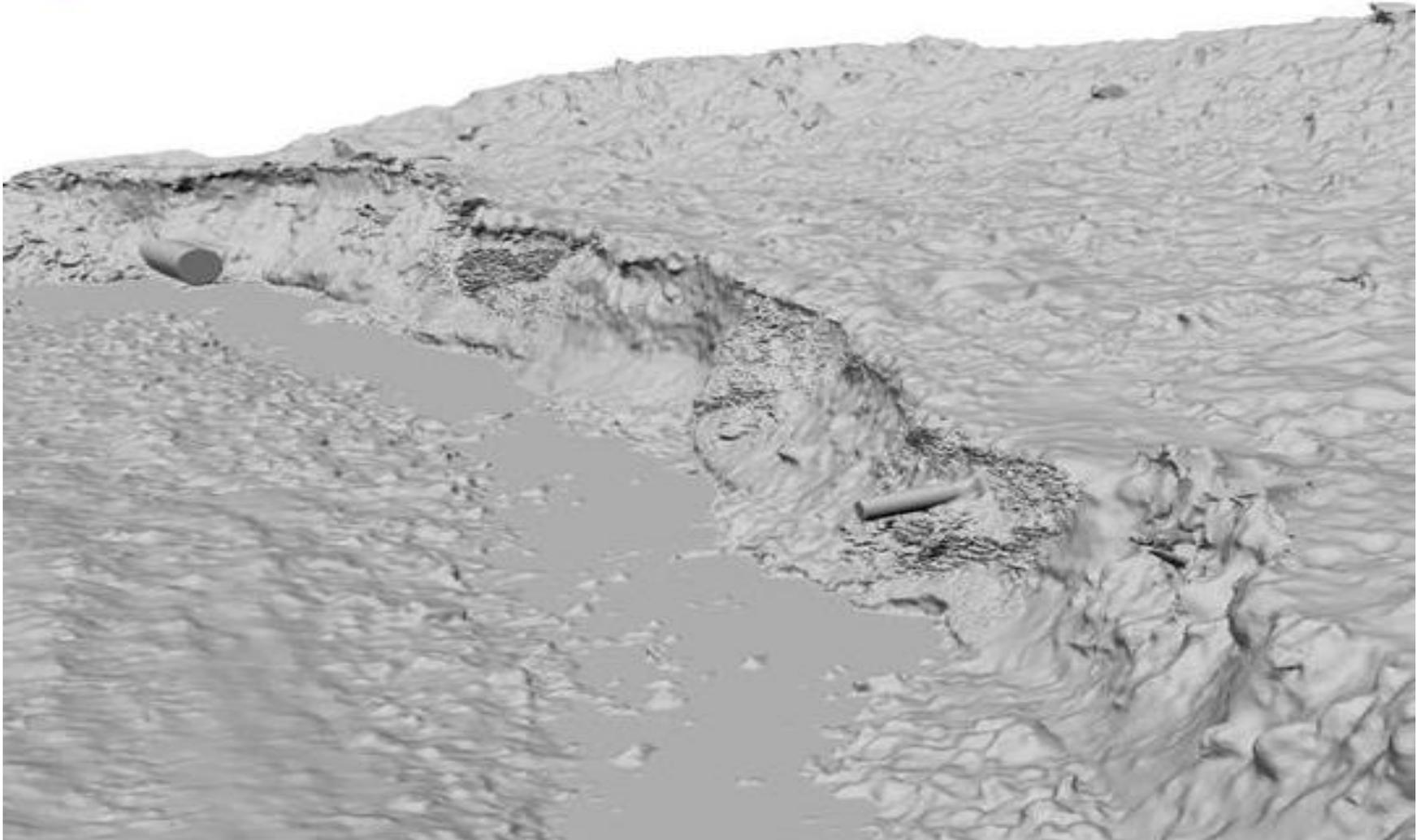
- Scans
  - FARO\_LS485\_2095
- Models



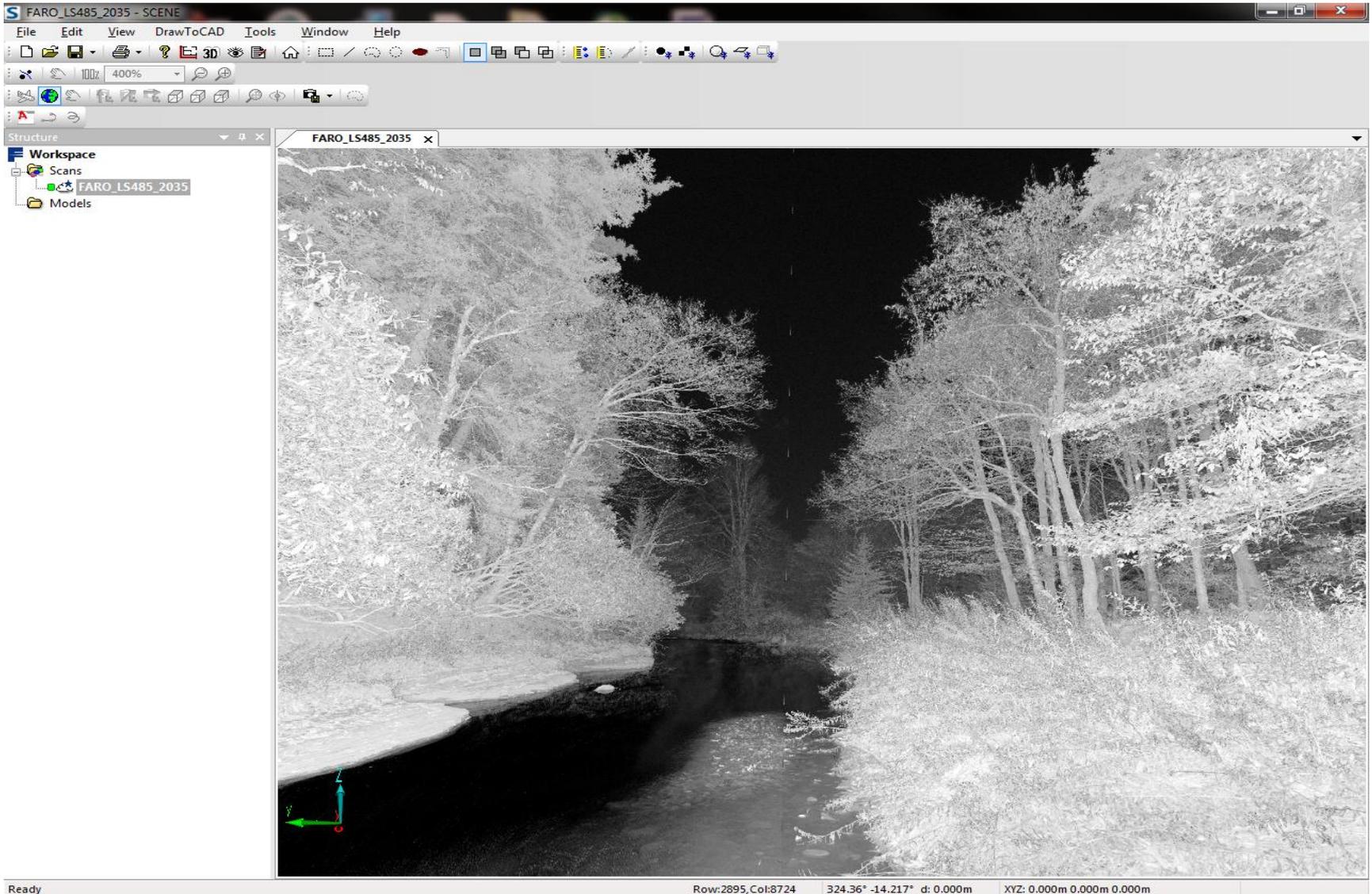
# A major stream adjacent slide



# Stream documentation at Valley Forge



# Developing sample reach documentation for tributaries of Shavers Fork



# Future directions

- Continue micro-site documentation research establishing control with features such as erosion pins
- Identify opportunities to work with restoration professionals to further explore potentials for integrating Laser data into their working methods
- Obtain access time with the NCALM “green” laser which is able to penetrate water
- Develop protocols for scanning stream and larger riparian features for areas such as highway stream crossings