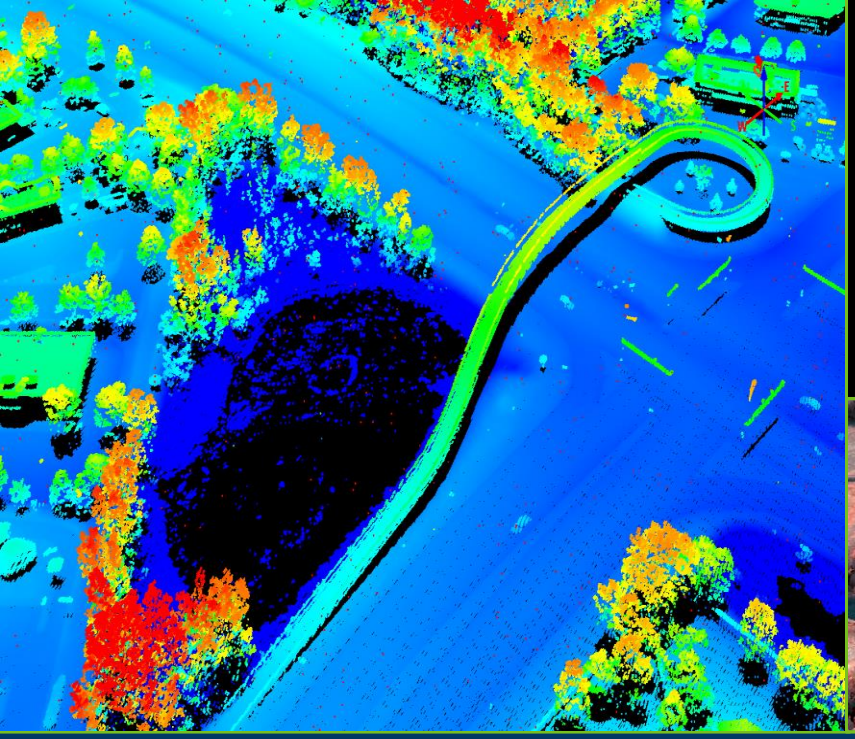
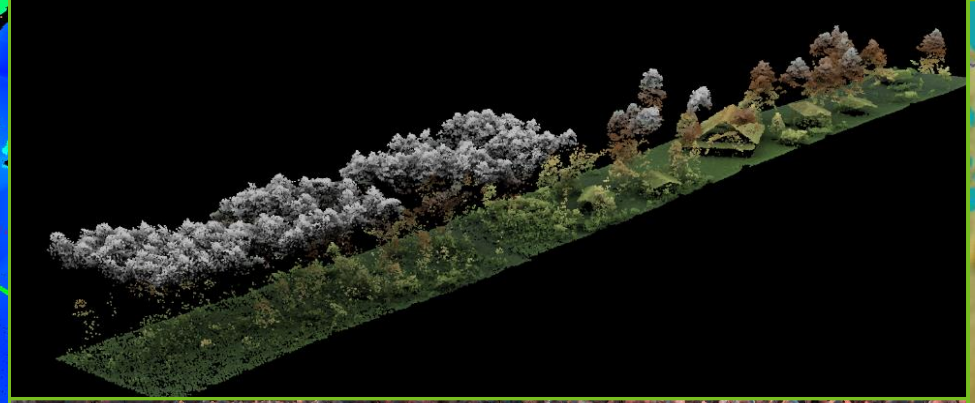
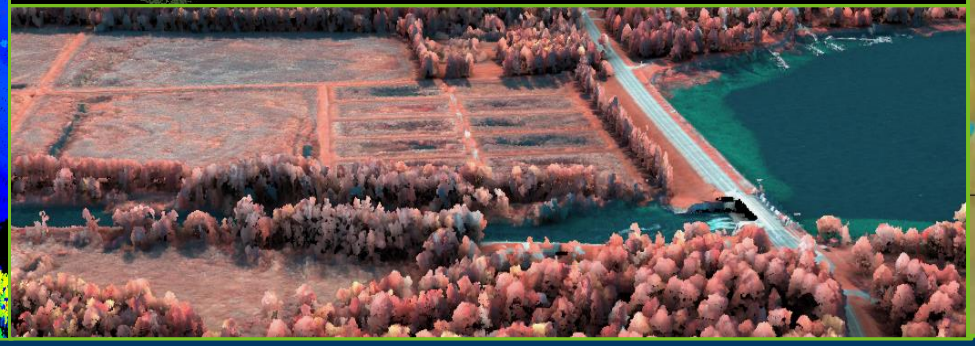
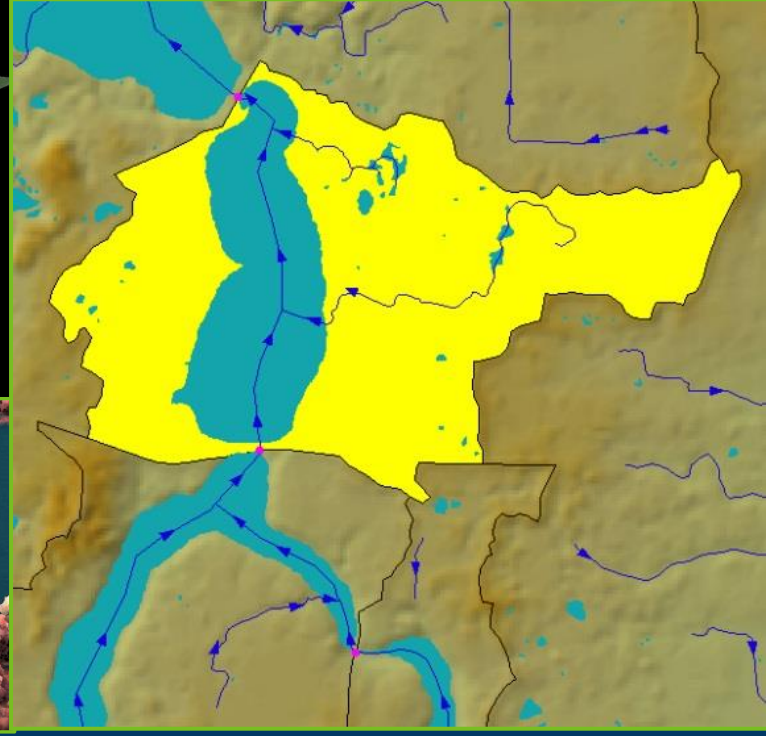








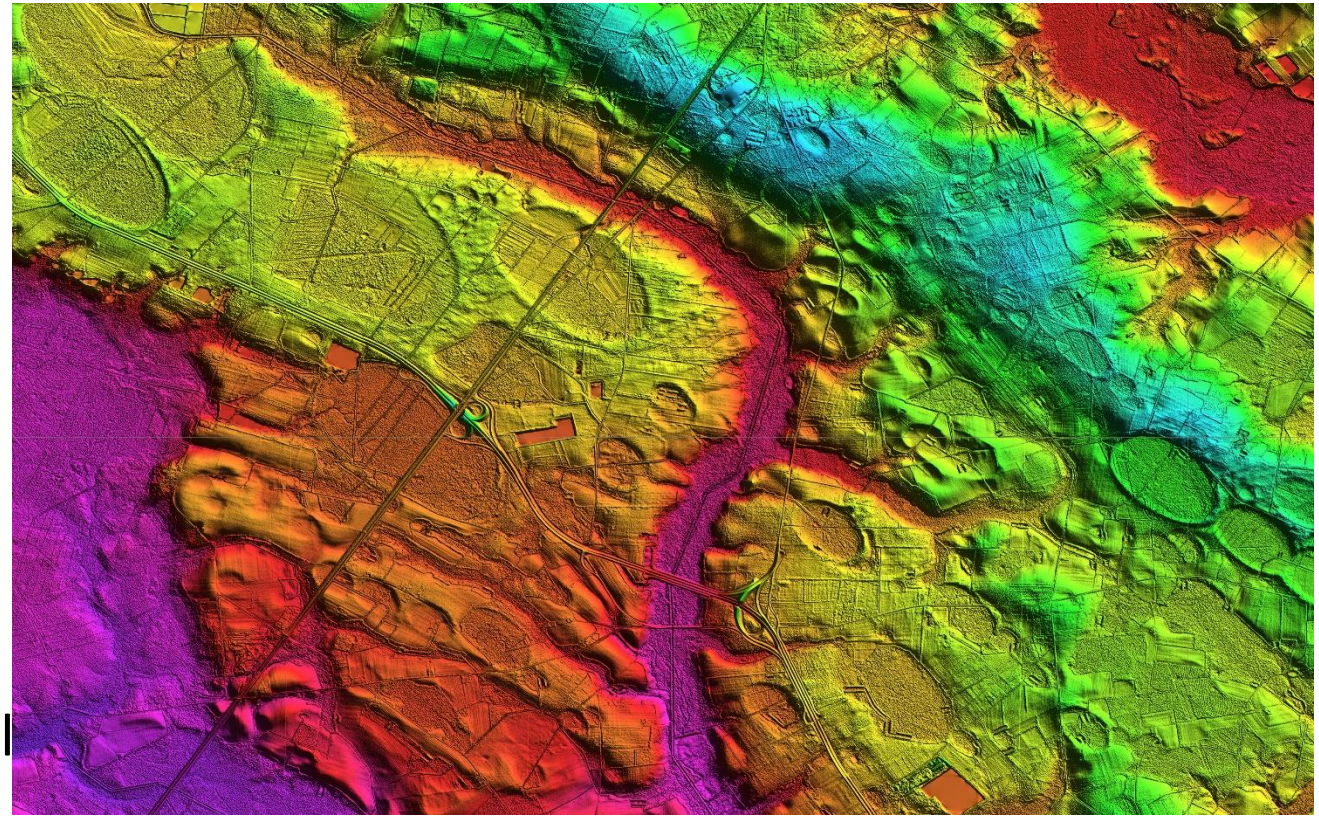
Bringing New Enhanced Lidar Data to Minnesota

MINNESOTA IT SERVICES

Welcome and Goals for Today

Goals

- Information exchange
  - About the plan
- Why are we doing this?
- Uses and benefits
- Stakeholder participation
- What is happening this fall
- Questions and discussion



Outline

- Minnesota lidar community
- What is high density lidar?
- How lidar is used?
- Minnesota’s State Lidar Plan
- How to get involved
- Q & A

GAC 3D Geomatics Committee

What is the GAC?

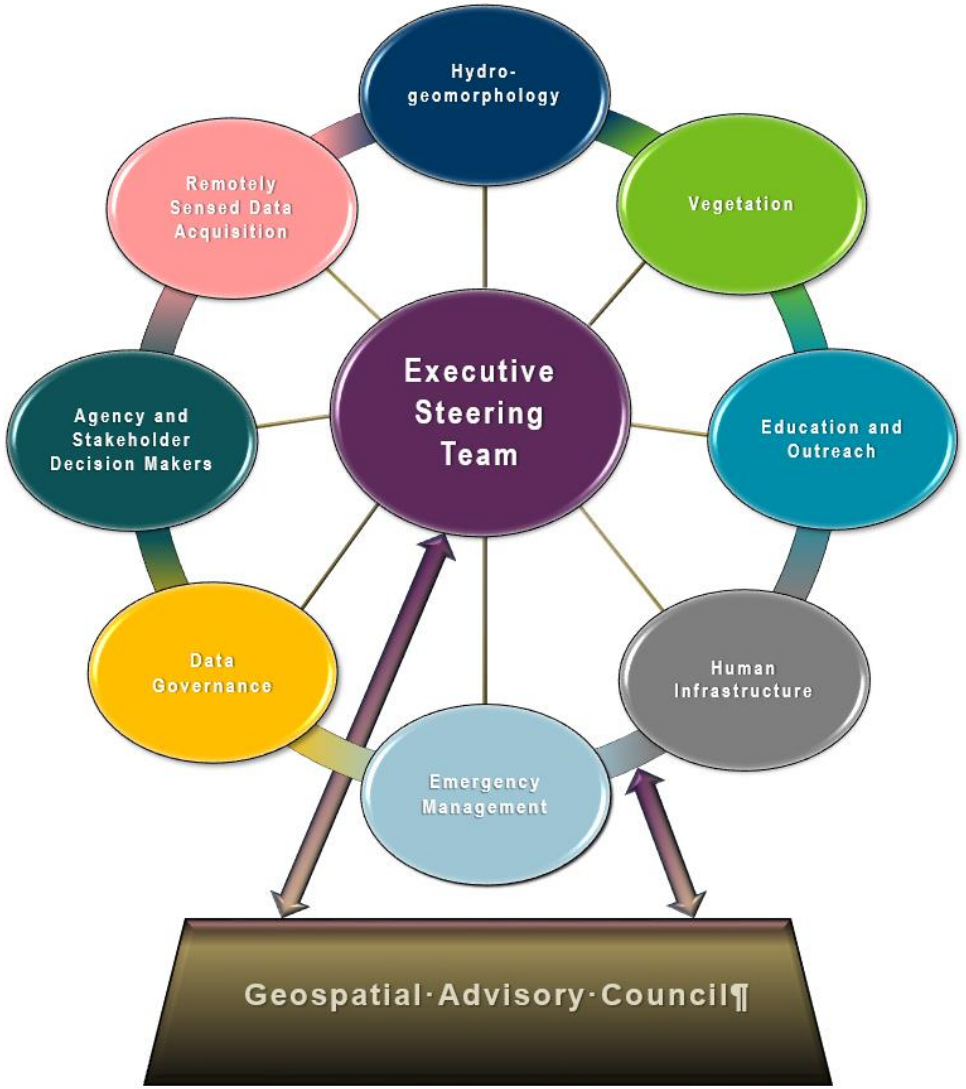
- The Minnesota Geospatial Advisory Council is the coordinating body for the Minnesota geospatial community.
- Cross-section of organizations that include counties, cities, universities, business, nonprofit organizations, federal and state agencies, tribal government, and other stakeholder groups.

What is the 3D Geomatics Committee?

- The 3D Geomatics Committee (3DGeo) of the Minnesota Geospatial Advisory Council works to identify and promote the need for planning, funding, acquisition, and management of three-dimensional geomatic data and derived products.

3DGeo Workgroups

- Executive Steering Team
- Workgroups/Subgroups
  - Hydrogeomorphology
    - Data Catalog
    - Breachline Database
  - Vegetation
  - Education and Outreach
  - Human Infrastructure
  - Remotely Sensed Data Acquisition Workgroup



3DGeo Remotely Sensed Data Acquisition Workgroup

Mission: The Remotely Sensed Data Acquisition Workgroup promotes acquisition of foundational 3D data for Minnesota.

Workgroup Membership:

Alison Slaats, Dan Ross, Jennifer Corcoran, Colin Lee, Sean Vaughn, Gerry Sjerven, Matt Baltes, Brandon Krumwiede, Harvey Thorleifson

What is lidar?

- **Lidar** stands for **li**ght **d**etection **a**nd **r**anging
- It is a mapping technology that uses a pulsed laser to measure the time it takes for emitted light to travel from a sensor to the ground or other objects and back.
- The sensor can pulse a laser beam hundreds of thousands of times per second, millions of returns ("points") are captured, resulting in a "point cloud" of three dimensional measurements.

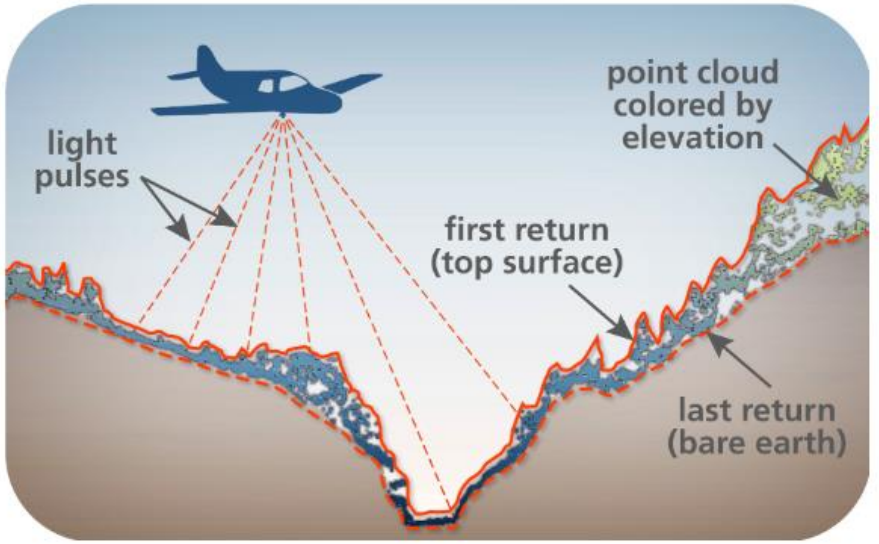
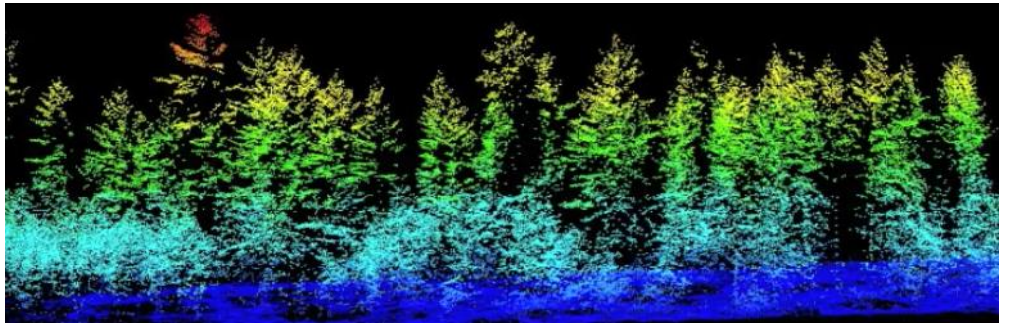


Image from the Washington Geological Survey



Lidar Point Cloud Colorized by Height

Lidar Point Cloud Colorized by Photo

Need for new lidar

- Higher-resolution and higher-quality lidar dramatically improves our ability to analyze the landscape in Minnesota, map assets, and assess resources
- **Improved and up-to-date** lidar provides the basis to analyze and plan for current and future scenarios, and inform better decision making for management our resources
- Having this data has a **5 to 1 return on investment** and enables practitioners, managers, and researchers to be more proactive than reactive

What is high density lidar?

High density lidar is about two measures:

- Pulse Spacing
- Pulse Density

This is the density we'd like

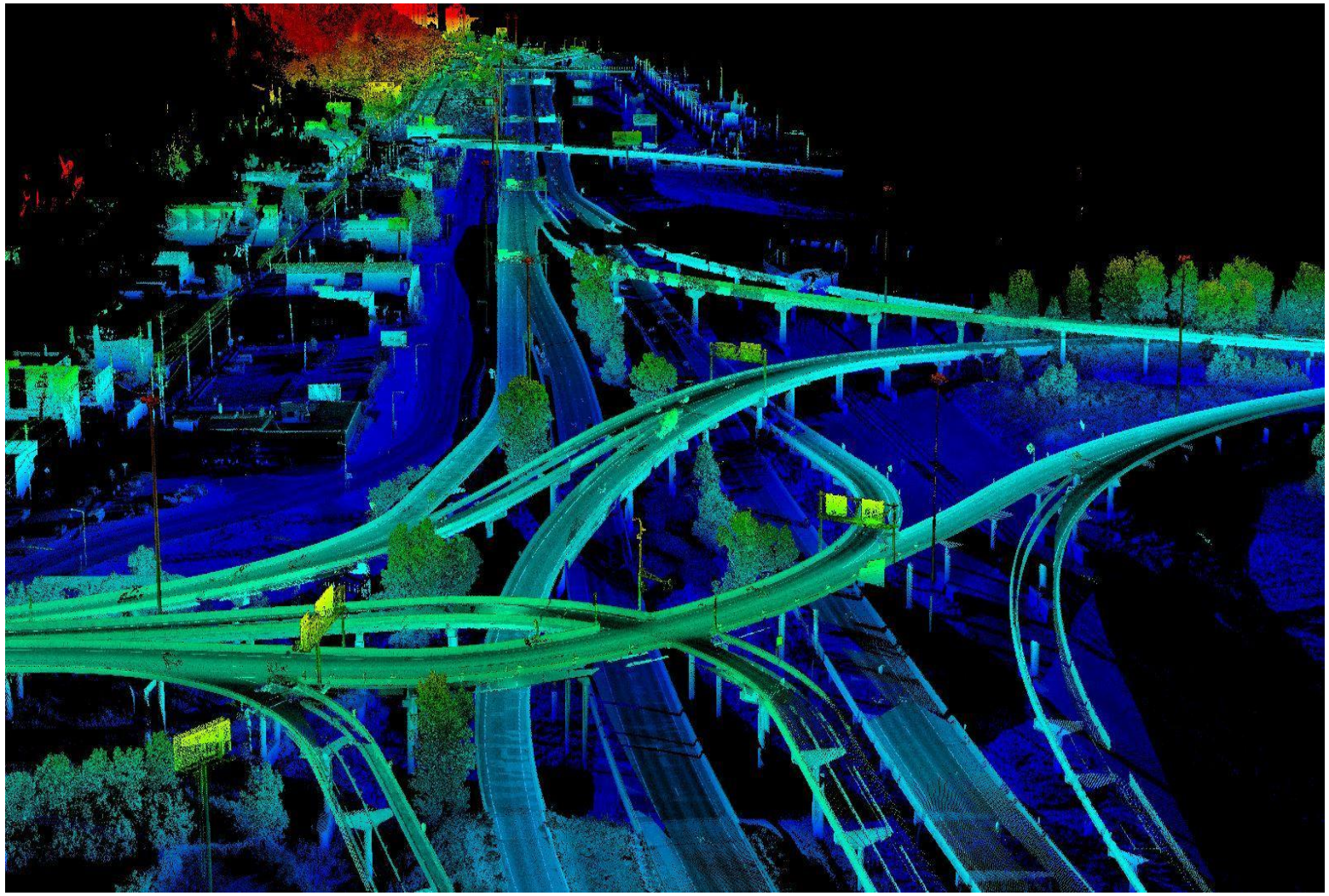
This is the min USGS Base Specification

This is what we currently have

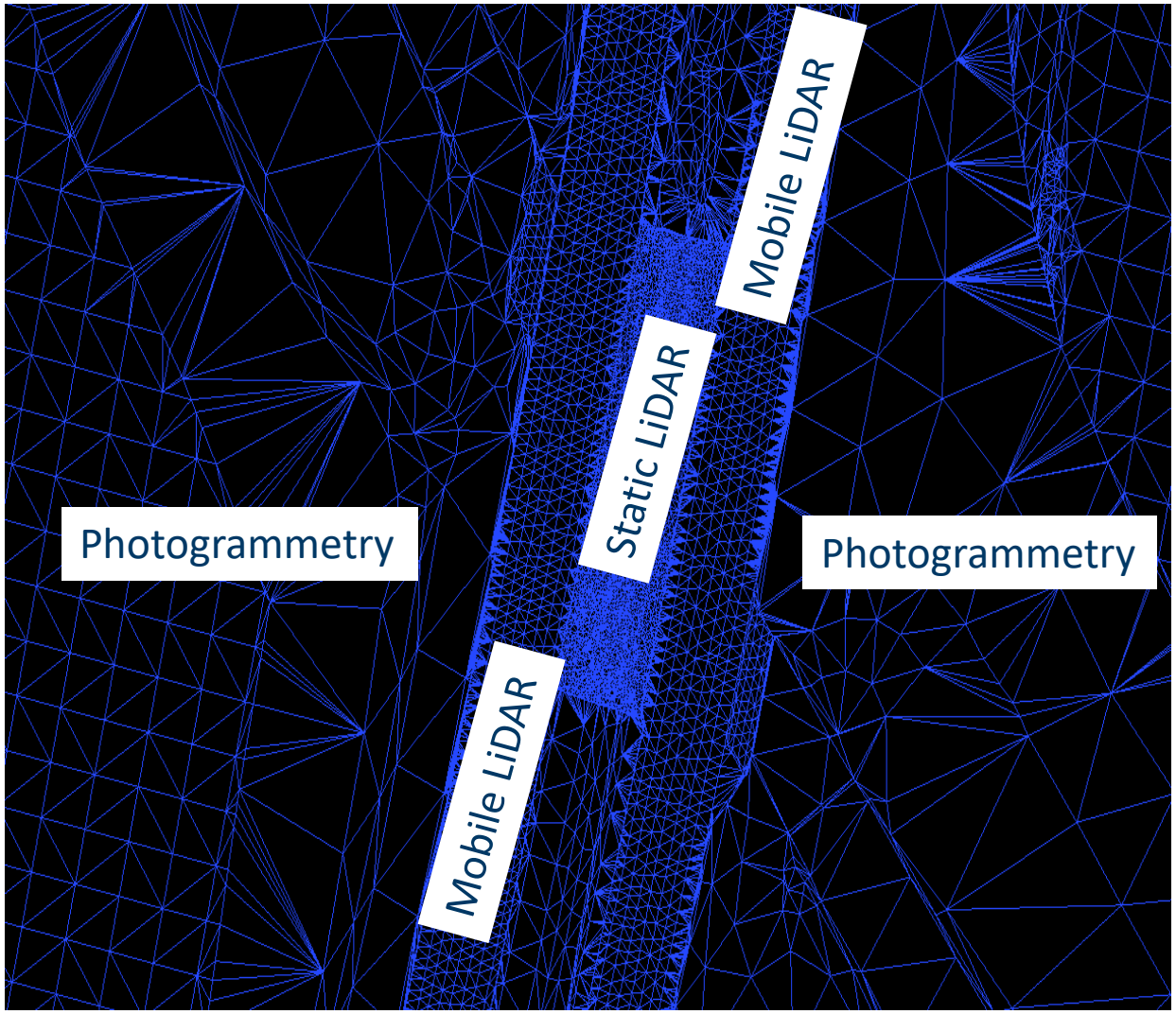
LiDAR BASE SPECIFICATION (LBS)	**LBS Table 1** Minimum Net Pulse Density and Spacing for a Single lidar Collection Mission	
Quality Level (QL)	**Aggregate Nominal Pulse Spacing (ANPS)** [m]	**Aggregate Nominal Pulse Density (ANPD)** [pulse/m^2]
QL-0	≤ 0.35	≥ 8.0
QL-1	≤ 0.35	≥ 8.0
QL-2	≤ 0.71	≥ 2.0
QL-3	≤ 1.41	≥ 0.5

Infrastructure examples

- Transportation
  - 3d Design
  - Traffic operations
  - Signing and striping
  - Highway safety
  - Maintenance
  - Asset management
- Energy
  - Traditional
  - Renewable/Alternative
- Cultural/Historical Resources

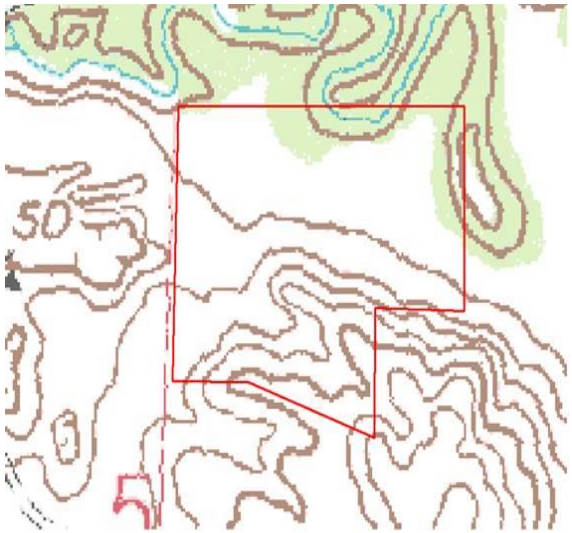


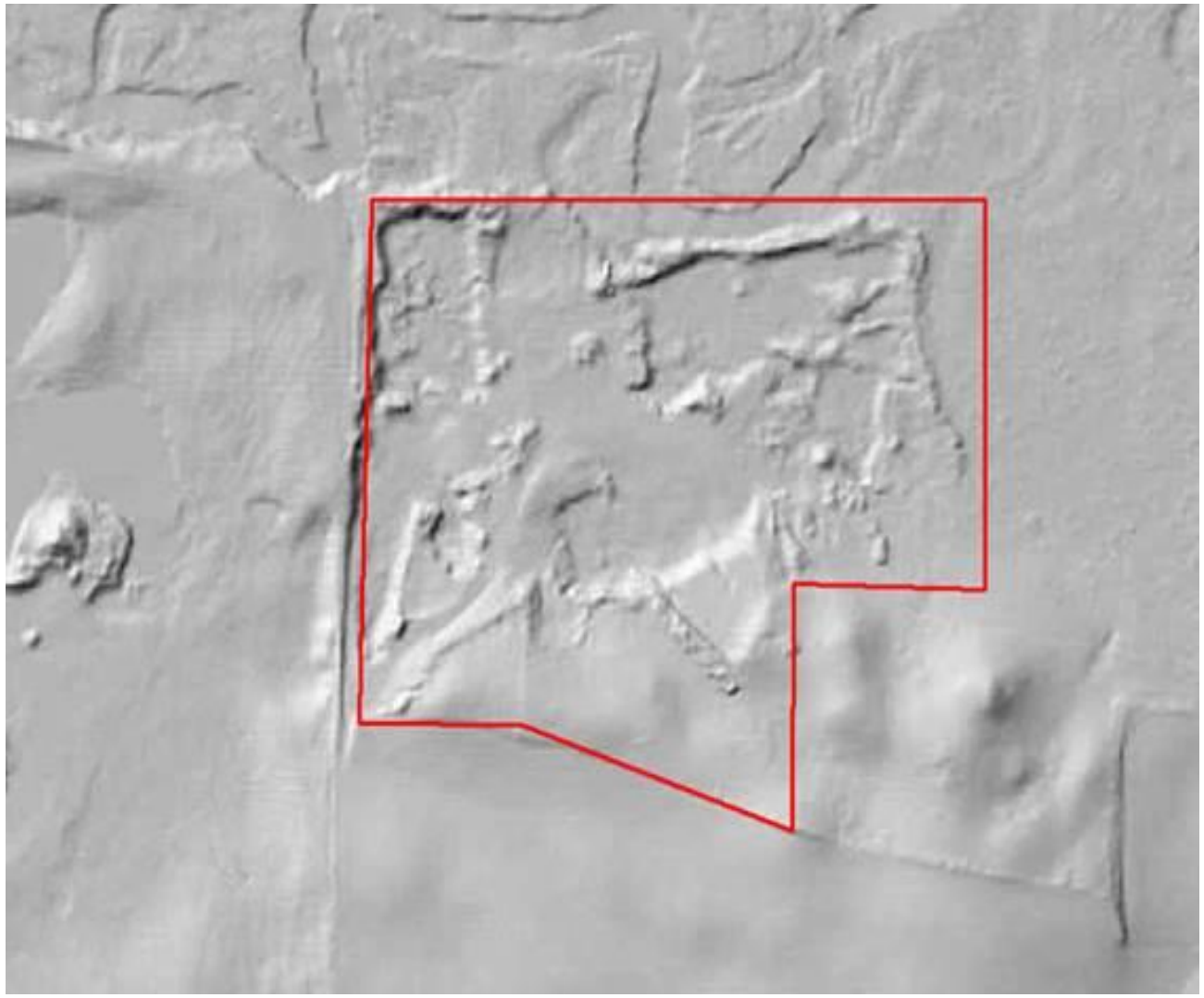
Infrastructure examples



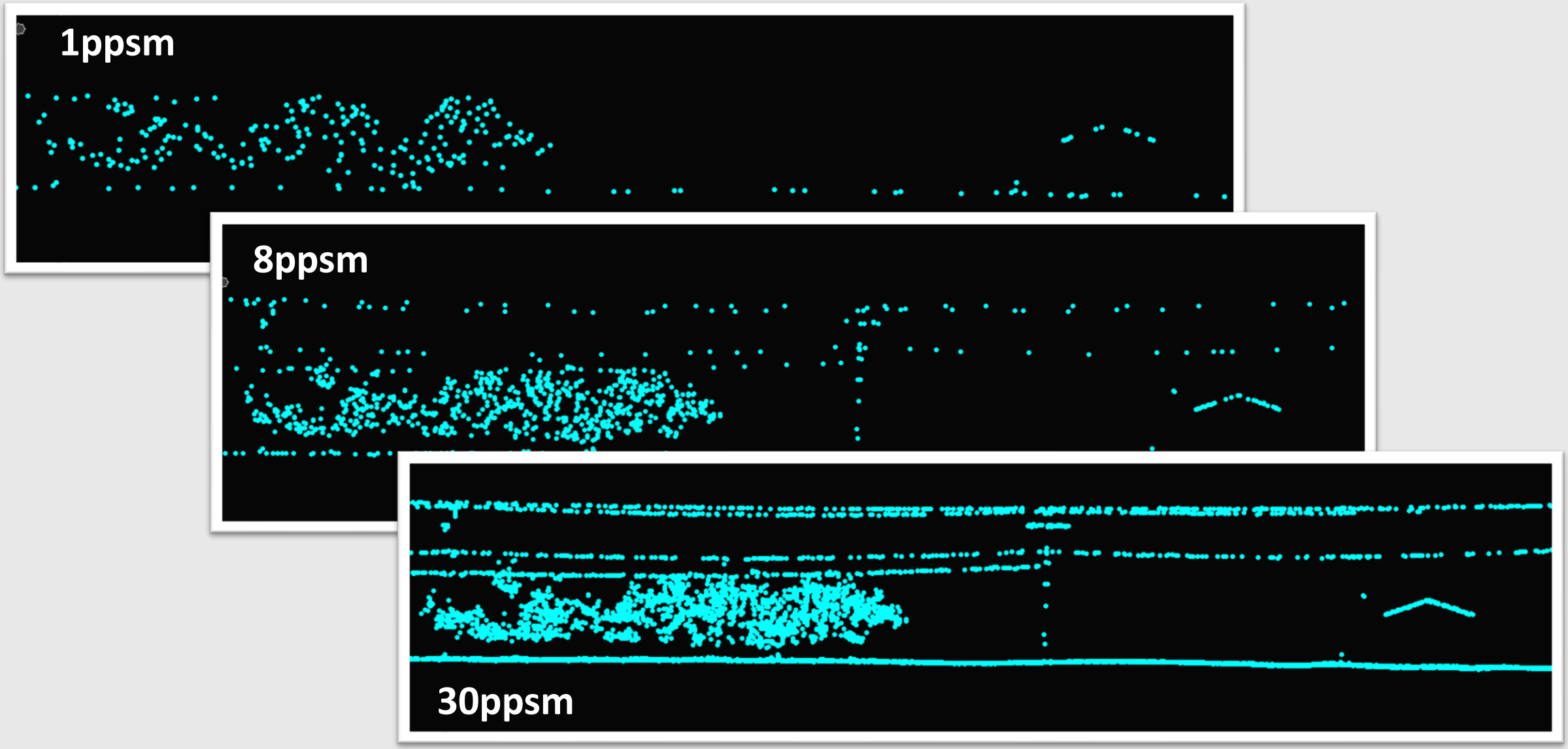
Cultural Resources Lidar Use Example

Potential location for a new MnDOT Truck Station





“…but you already have Lidar”
Quality Matters



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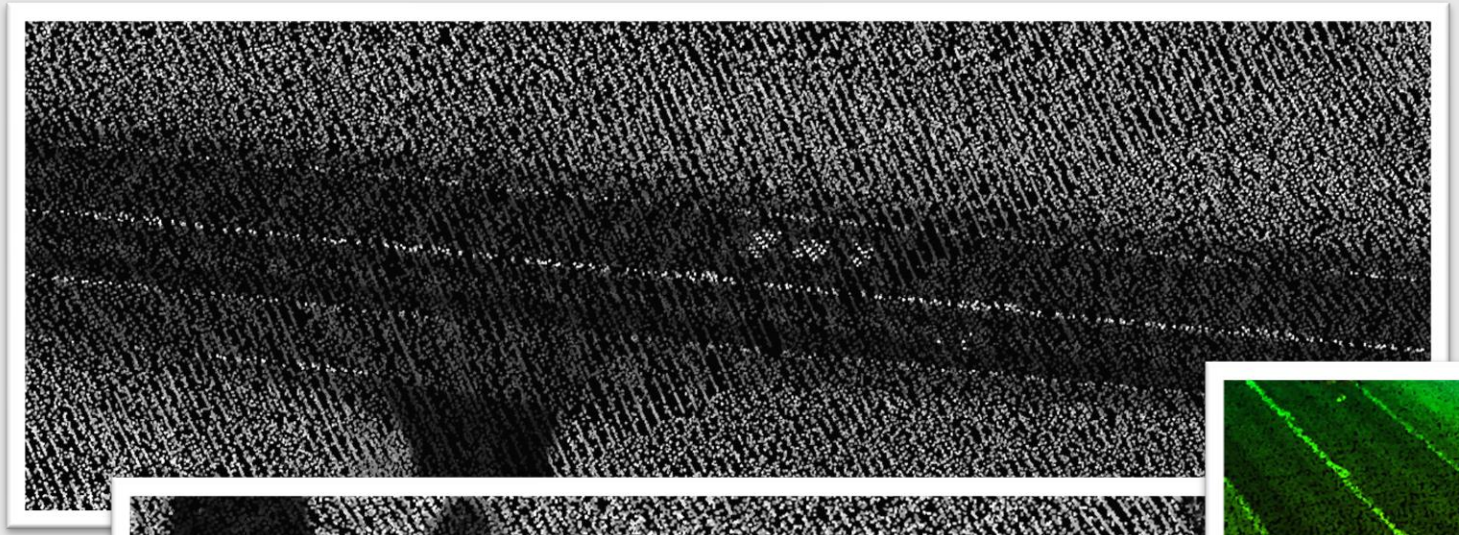
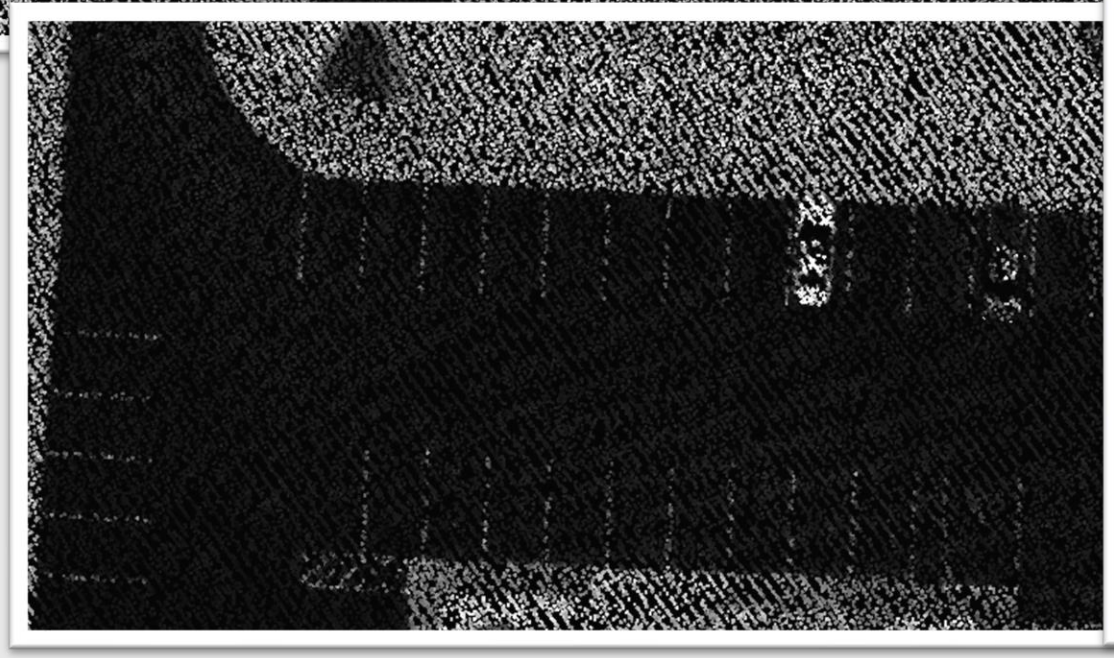
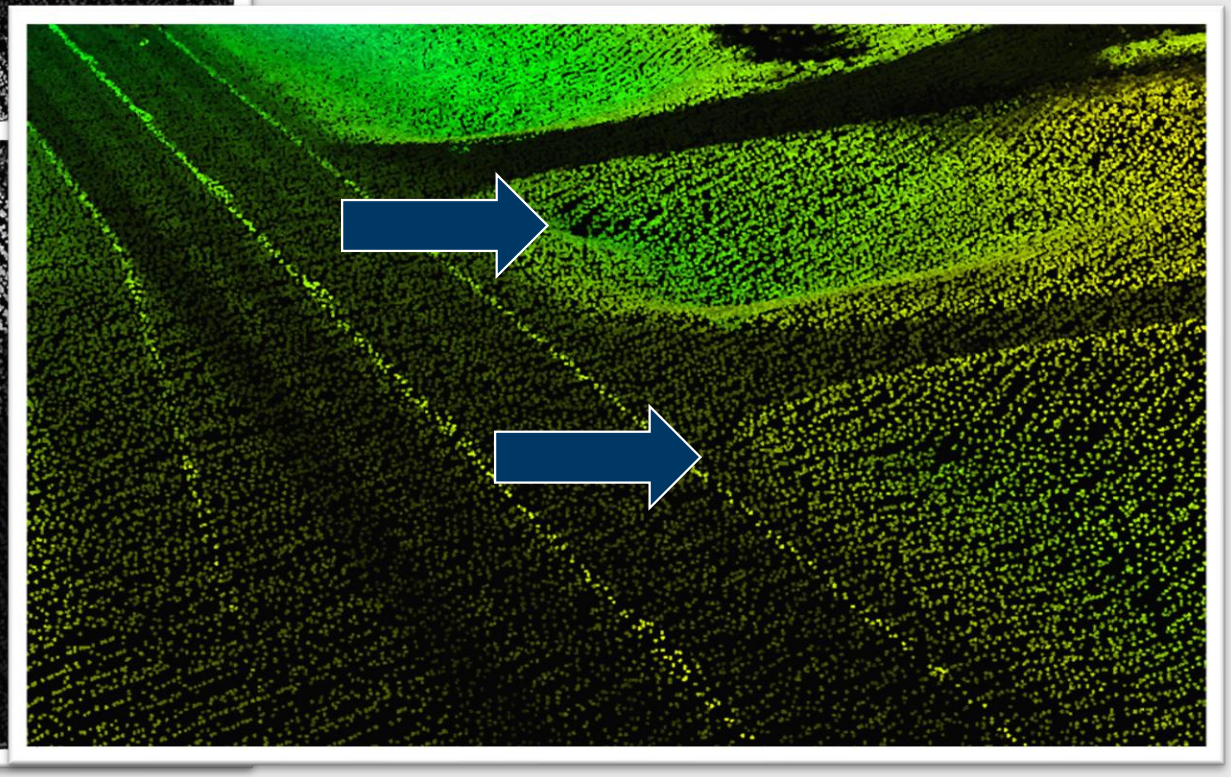
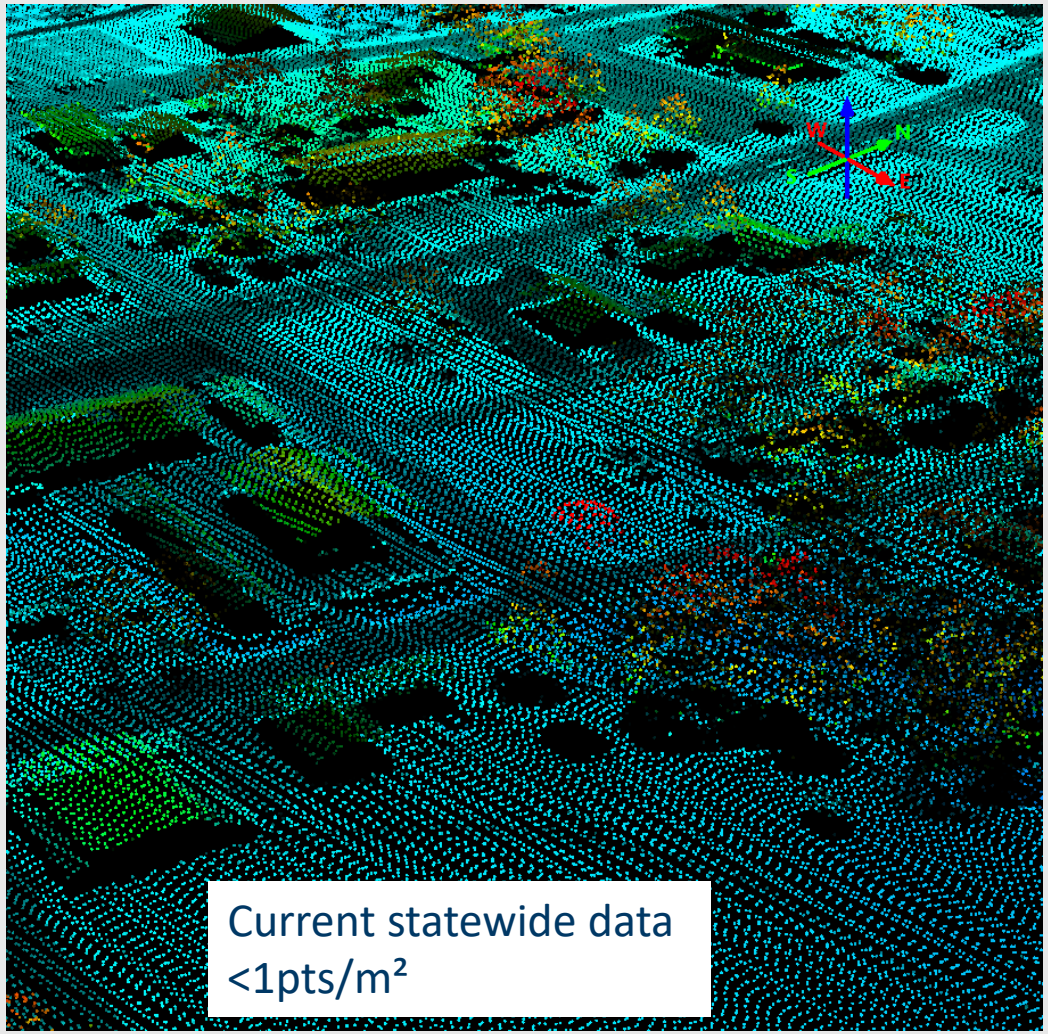


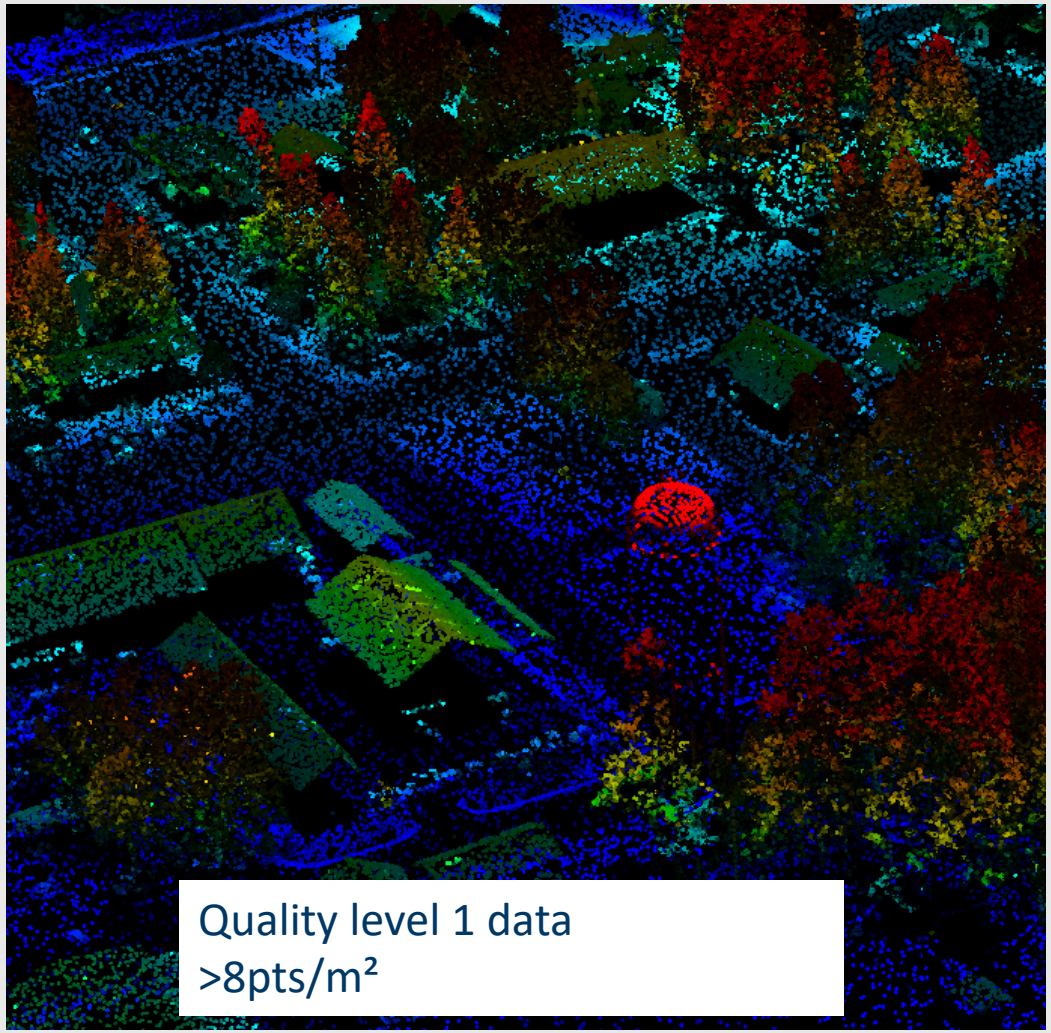




- Bridge and culvert analysis
- Paint and centerline analysis
- 8ppsm

“…but you already have Lidar”
Quality Matters





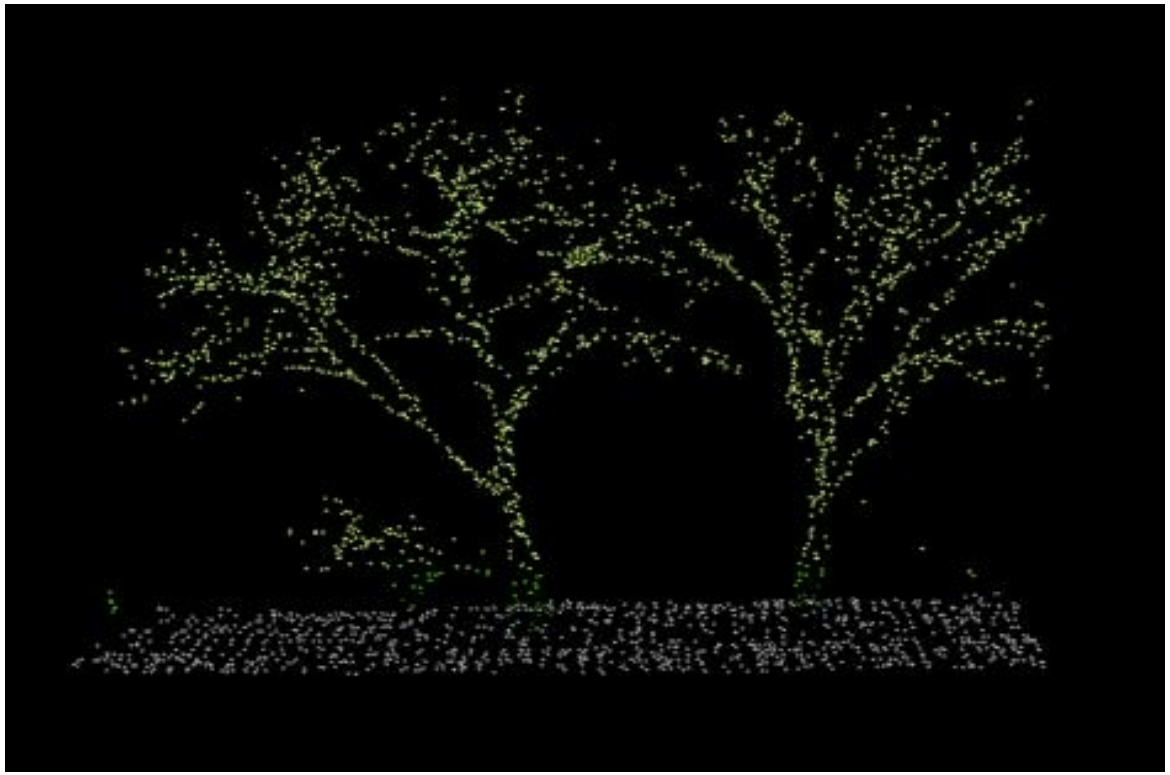
“…but you already have Lidar”
Quality Matters

Current statewide data
<1pts/m²

Quality level 1 data
>8pts/m²

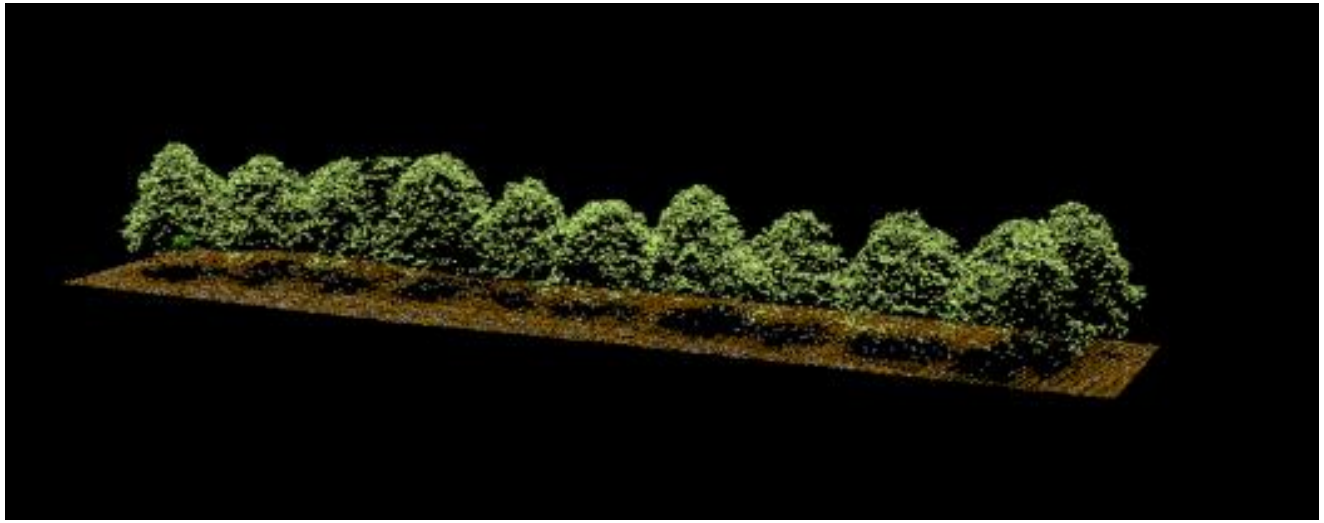
“…but you already have Lidar”
Quality Matters

High Density (QL3, 8ppm)



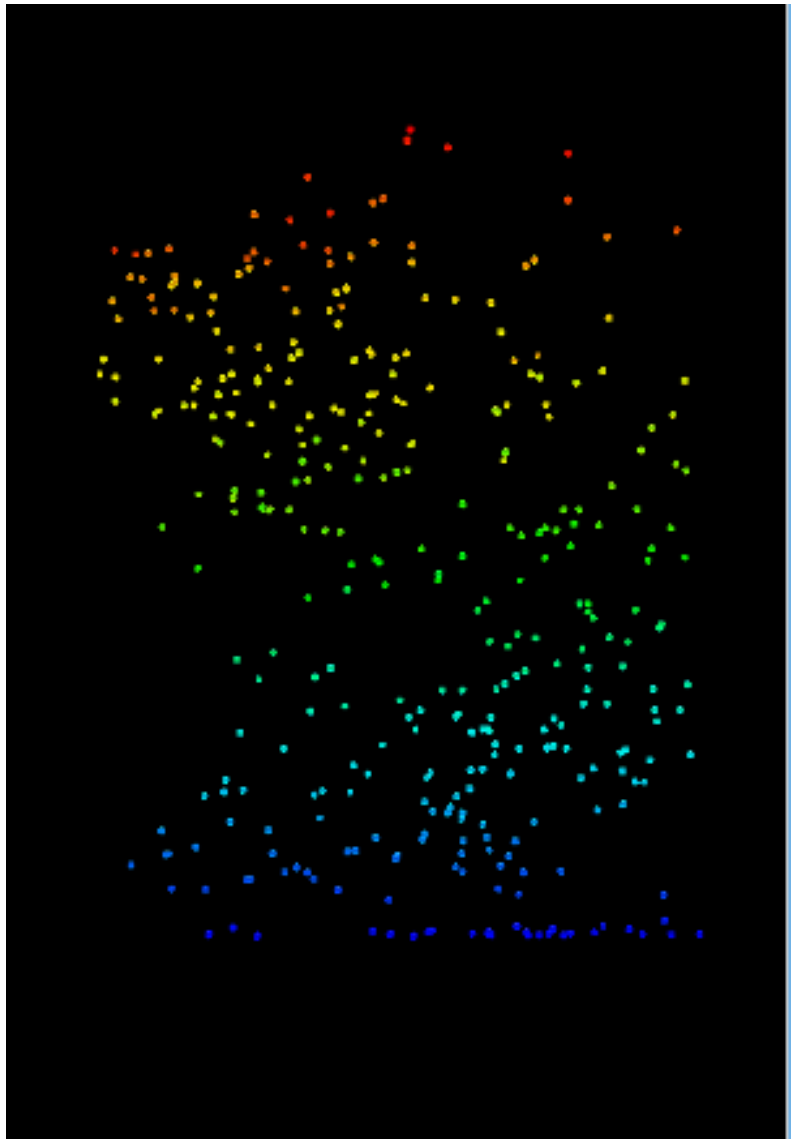
Deciduous Trees

High Density (QL3, 8ppm)

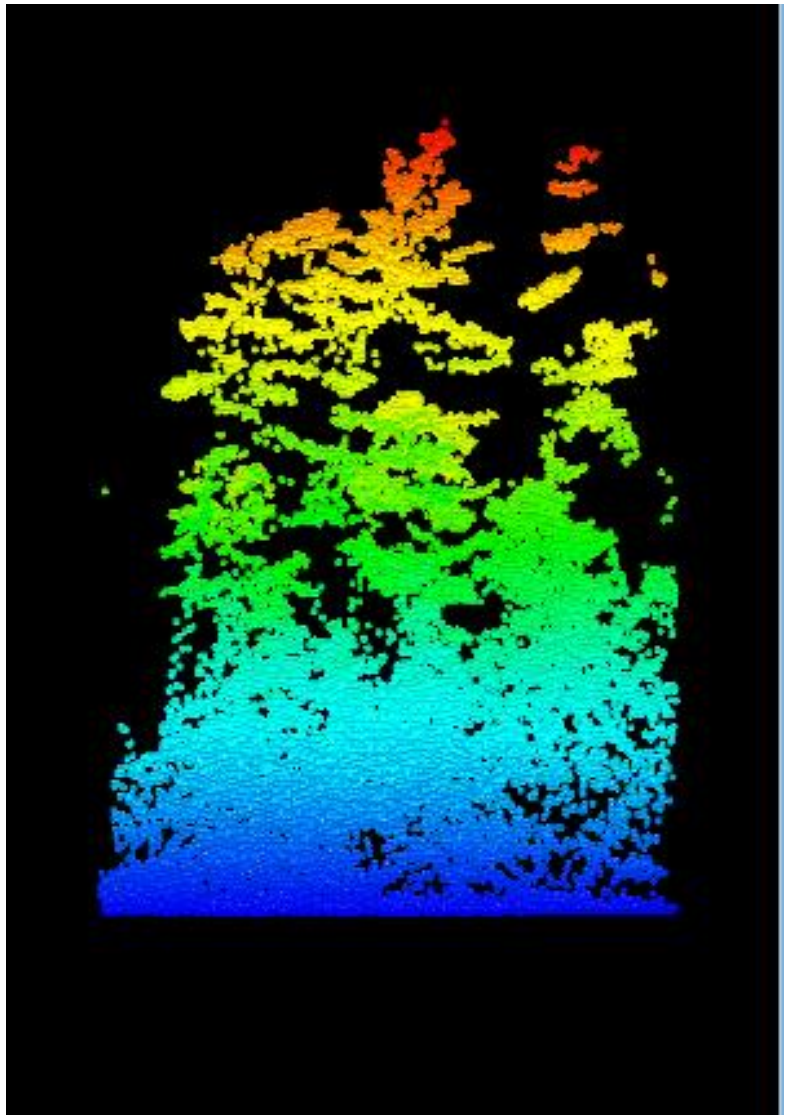


Coniferous Trees

QL3, Low Density Lidar 2011

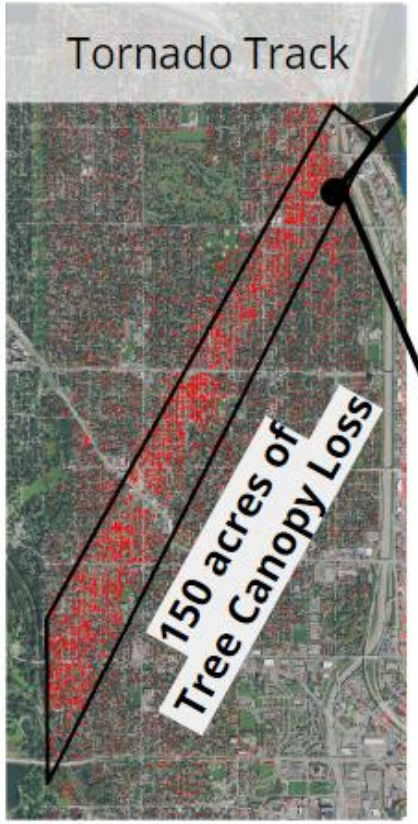


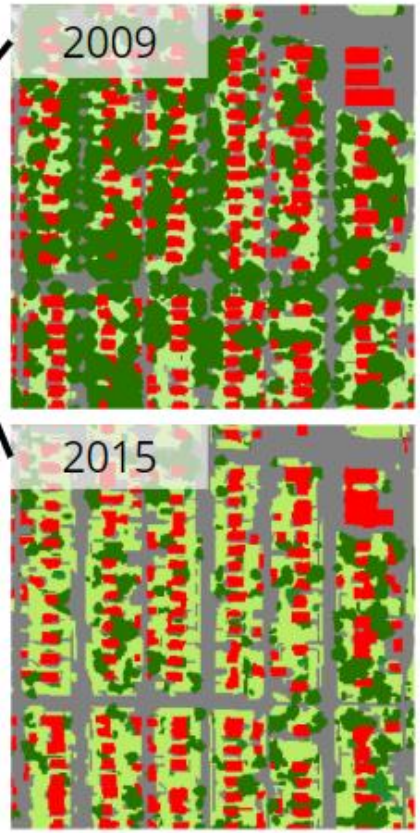
QL1, Linear Lidar 2018



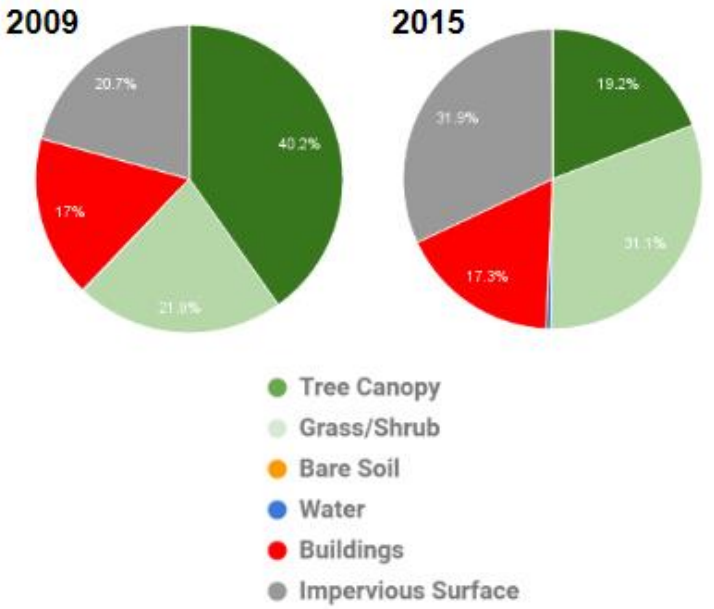
Metro example: Canopy Height Change

2011 Tornado Blowdown





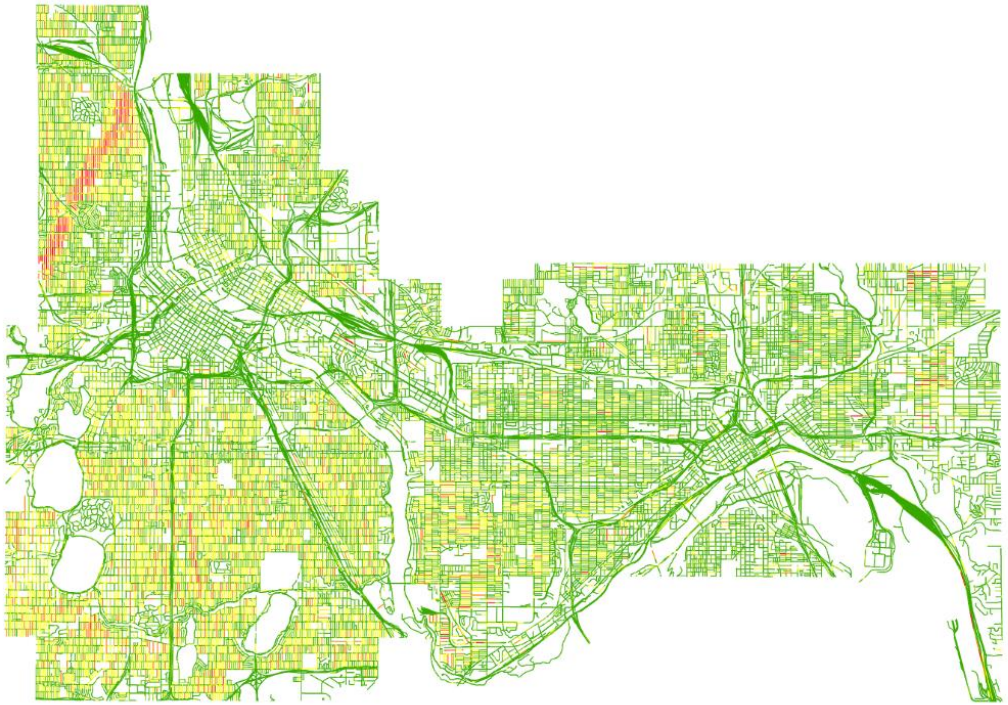
Urban tree canopy loss due to tornado blowdown

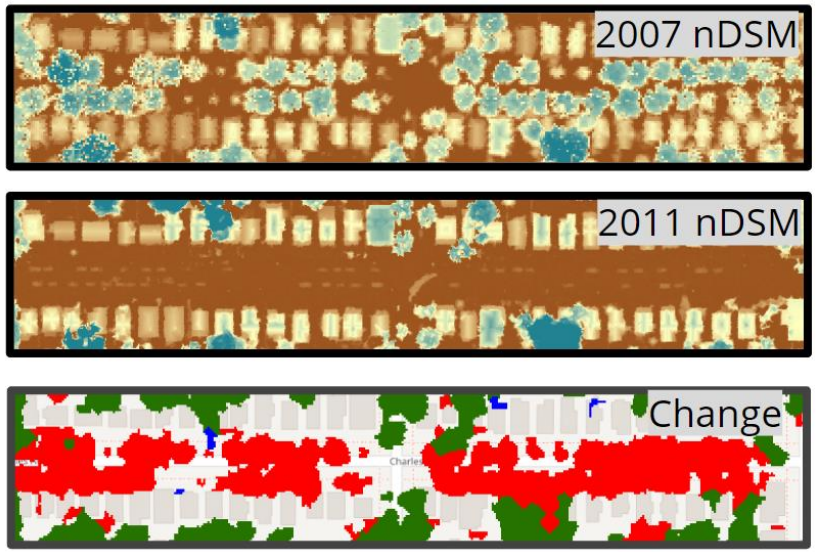


UMN RSGAL

Metro example: Canopy Height Change

Street tree removal





Tree Canopy Loss (m^2)

- 0 - 71
- 72 - 238
- 239 - 529
- 530 - 1267
- 1268 +

UMN RSGAL

National Enhanced Elevation Assessment (NEEA)

Business Use		Annual Benefits	
Rank		Conservative	Potential
1	Flood Risk Management	$295M	$502M
2	Infrastructure and Construction Management	$206M	$942M
3	Natural Resources Conservation	$159M	$335M
4	Agriculture and Precision Farming	$122M	$2,011M
5	Water Supply and Quality	$85M	$156M
6	Wildfire Management, Planning and Response	$76M	$159M
7	Geologic Resource Assessment and Hazard Mitigation	$52M	$1,067M
8	Forest Resources Management	$44M	$62M
9	River and Stream Resource Management	$38M	$87M
10	Aviation Navigation and Safety	$35M	$56M
:			
20	Land Navigation and Safety	$0.2M	$7,125M
	Total for all Business Uses (1 – 27)	**$1.2B**	**$13B**

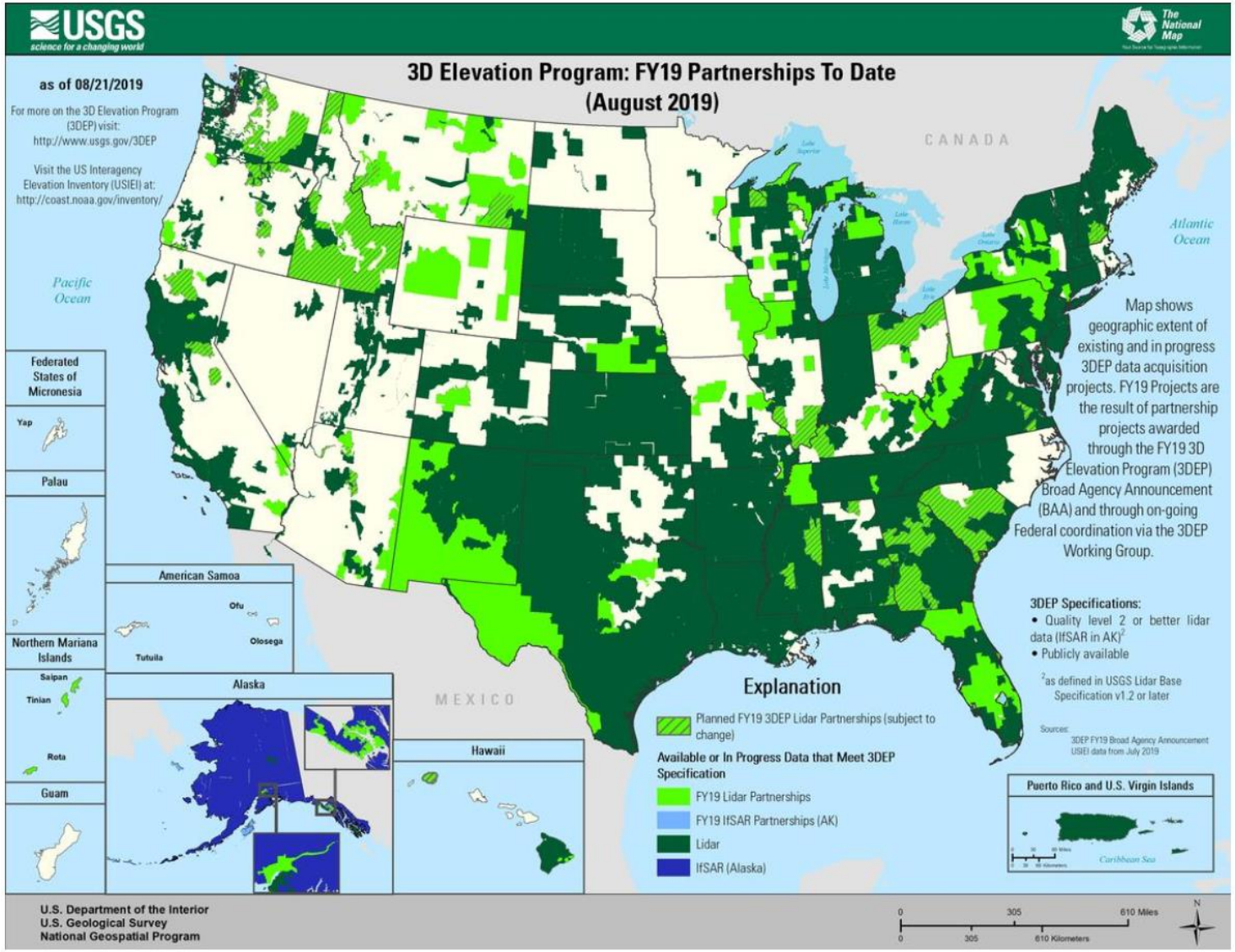
- Conducted in 2011-2013
- Information gathered from every state and from 34 different federal agencies
- 602 Mission Critical Activities need significantly better data than available
- Between $1.2 and $13 BILLION in benefits annually
- **5:1 Return on Investment**

Potential costs of lidar in Minnesota

Quality Level (QL)	Average Cost per mi2	Average Cost for Minnesota [millions]
QL-0	$442	$38.2
QL-1	$339	$29.4
QL-2	$199	$17.2
QL-3	*$175*	*$13.9*

Federal Vision: USGS 3D Elevation Program (3DEP)

- National map has goal of national elevation dataset for the nation by 2023
- USGS is cost-sharing via grant funds for QL2 or better
- Grants through “BAA” process – next deadline is November 1



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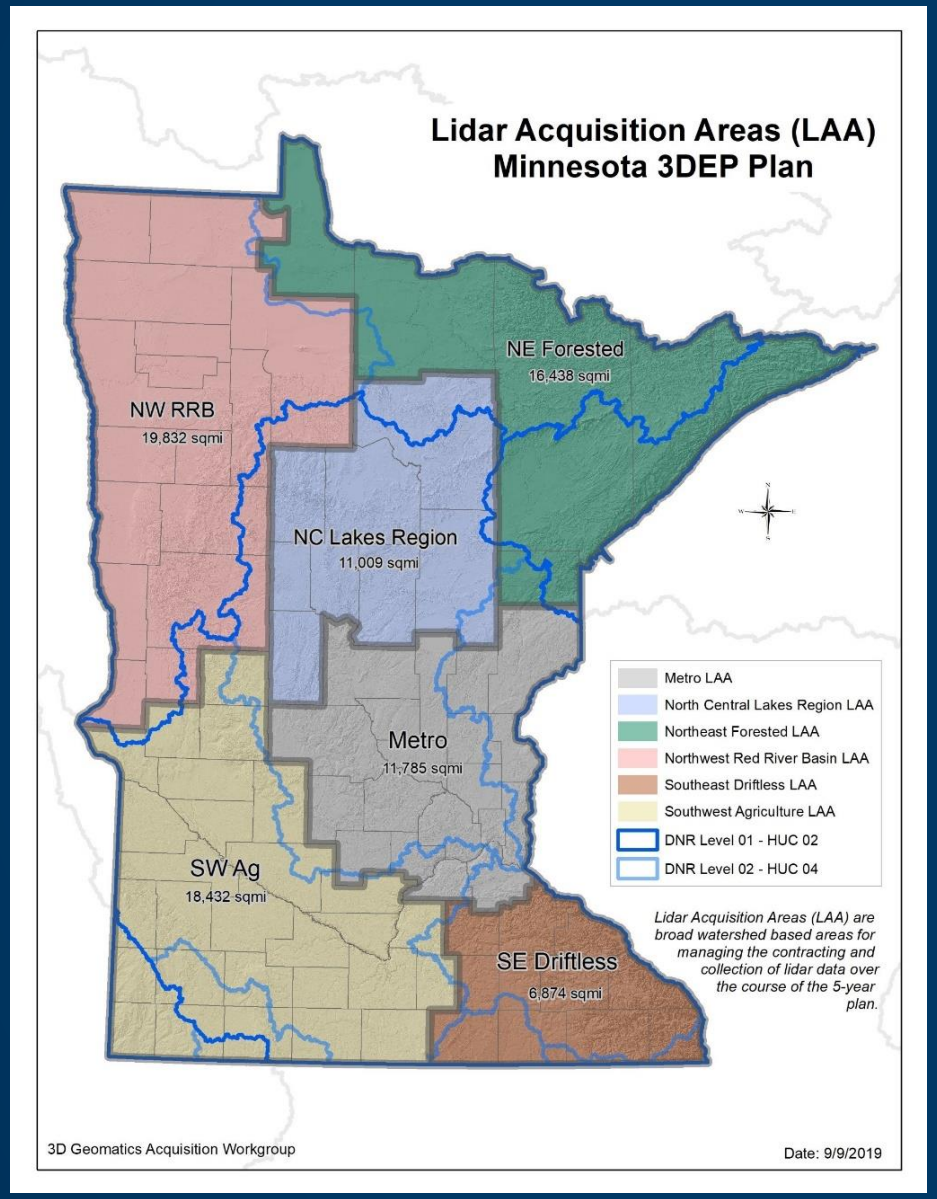
Lidar Acquisition Areas of Interest



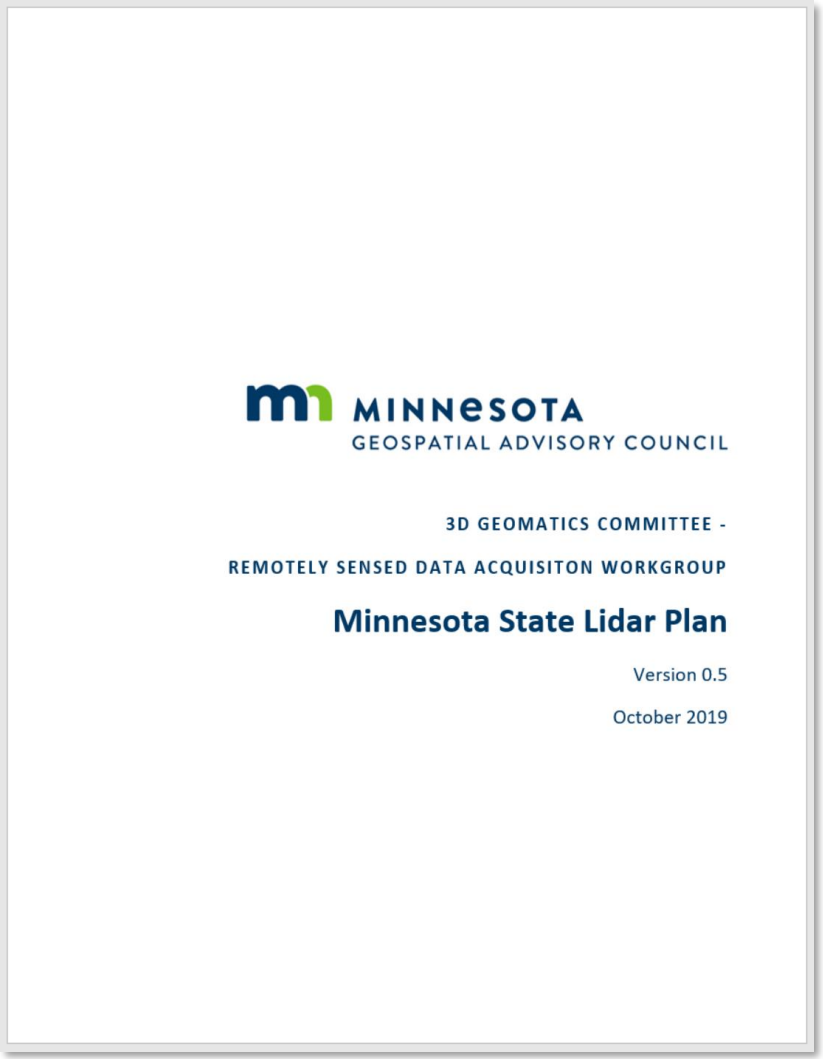
The Draft Minnesota State Lidar Plan

An introduction to lidar, how it is used in Minnesota, and the Minnesota State Lidar Plan.

October 01, 2019

Overview of Plan

- Executive Summary & Introduction
- Background about Lidar
- Value and Benefit of Lidar to the State
- Lidar Acquisition Areas of Interest
- Lidar Acquisition Specifications
- Elevation Products to be Derived from Lidar
- Cost Estimates
- Data management and Distribution
- Outreach Plan
- Educational Needs and Support



Lidar Products

3DEP standard deliverables

- Survey Report
- Collection Report / Mission Report
- Processing Report
- QA/QC report
- Lidar Swath Polygon
- Product metadata & Metadata Tags
- Classified Point Data
- Bare-Earth Surface Raster (Digital Elevation Model)

Possible added deliverables

- Improved hydrographic products
- 1-ft contour dataset
- Bare Earth point cloud
- Classification of high vegetation and buildings
- Intensity imagery, GeoTIFF

Next steps

- Minnesota State Lidar Plan draft will be published on GAC website
- Story Map published on GAC website
- Preparing to submit 2019 BAA request for funding support to USGS (November 8)
- USGS matching will help fund lidar collection and product creation, but we need local partners

Next steps

- We need partners to help fund lidar acquisition!
- Check out story map
- Stay in touch
  - Get on GovDelivery list (MnGeo email list)
  - Join 3D Geo Acquisition Group
  - lidar@state.mn.us


Questions &
Discussion