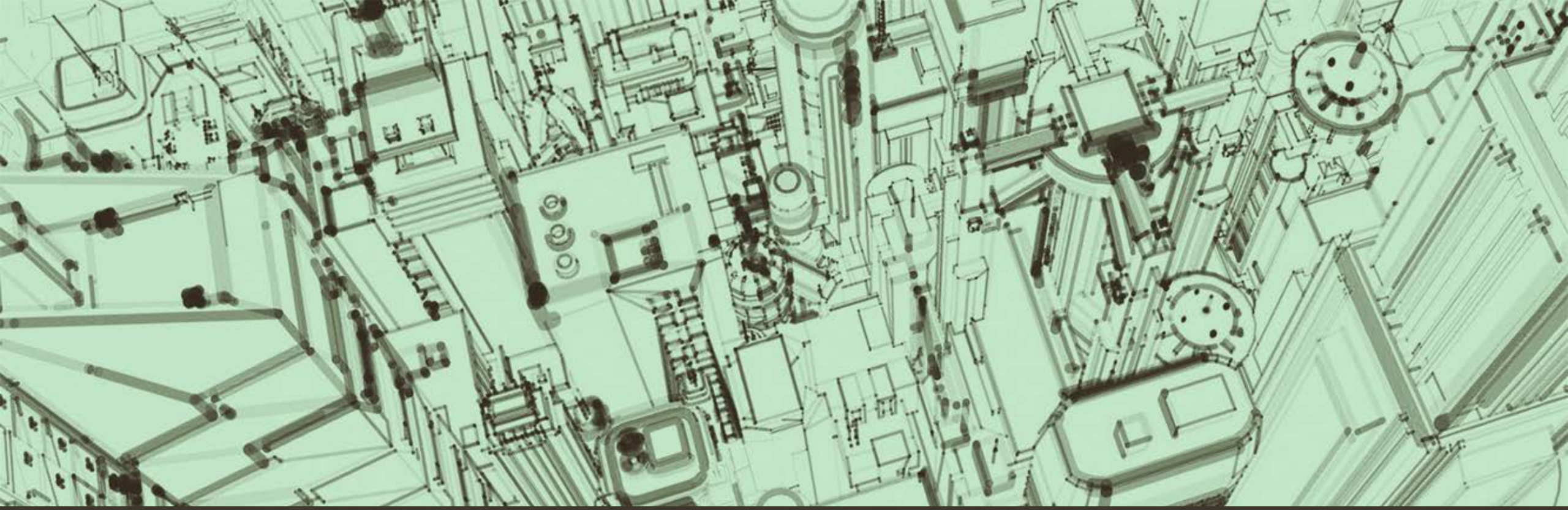


UAV Technology

For Surveying, Mapping, and GIS Applications

Jeremy R. Dancer, PS

Spicer group
www.spicergroup.com

Company Overview

- 73 years in business (1944)
- Surveyors, engineers, and architects
- 7 offices in Michigan and 1 office in Atlanta
- Over 200 employees company wide

Spicer group

www.spicergroup.com

Survey and Geospatial Services

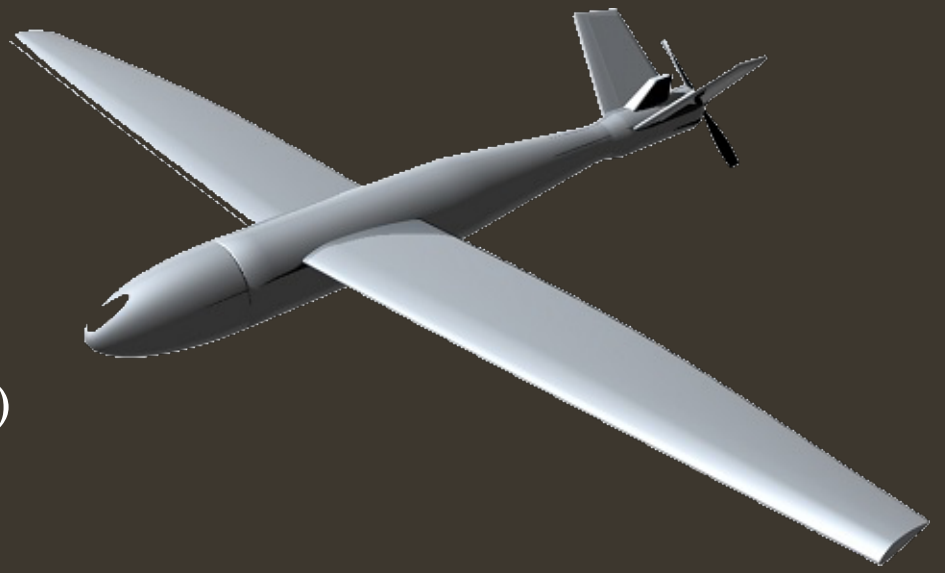
- 15 survey crews in Michigan
- UAV/Drone
- Mobile Mapping (LIDAR)
- Static Laser Scanning
- Single and Multi-Beam Hydrographic Surveys

Overview

- Basics of commercial UAV mapping
- Photogrammetry / Camera Sensors
- LIDAR sensors for UAV's
- Processing and organizing data
- Different mapping products
- Future of UAV technology
- Questions

What are UAVs ?

- Unmanned Arial Vehicles
- A.K.A. Drones or Unmanned Aerial Systems (UASs)
- Collect data remotely
- Collect data on demand
- Collect data safely



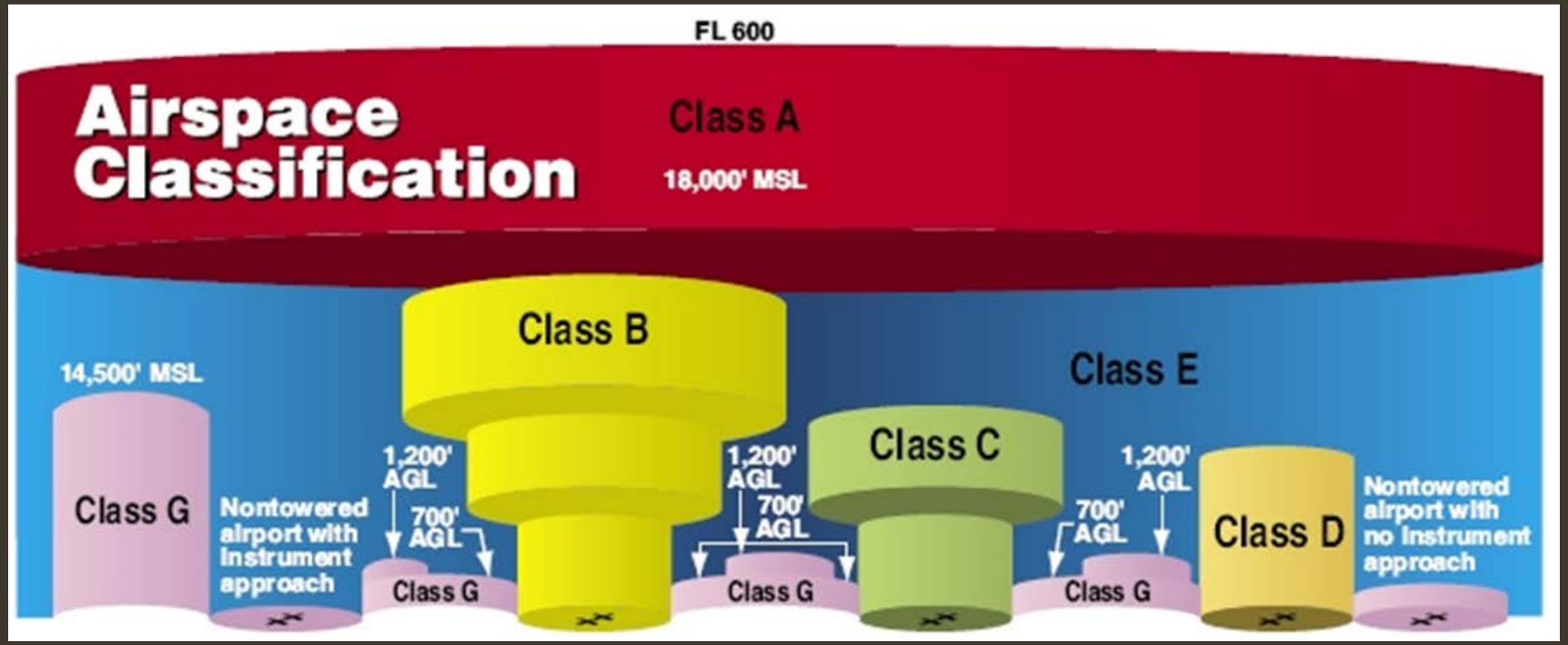
Who can fly a UAV?

- Part 107 of the FAA
- Commercial operators with remote pilot certificate
- Remote Pilot Certificate Exam
- Can still fly under a section 333 exemption
- Commercial UAVs must be registered with the FAA
- New rules exempt hobbyist from registration

Where can we fly a UAV ?

- 400 feet above ground level
- 400 feet from structure
- Class B, C, D, E only with permission from Air Traffic Control (ATC)
- Class G without permission from ATC
- Advanced planning for COA Waivers 60 days

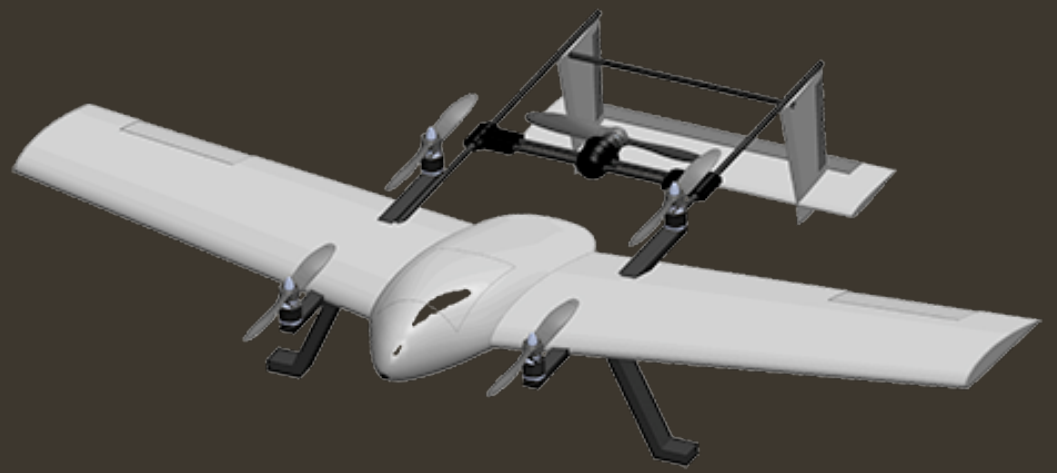
Airspace Classification



Benefits of using UAV technology

- Cost-effective data collection
  - 40 Acres in 30-60 minutes
- On demand data collection
  - Schedule at any time
  - Up-to-date job progress
- High resolution orthorectified aerial images as good as 1-2” pixel resolution
  - Ground Sample Distance (GSD)
  - Determined by camera sensor
- Unaffected by cloud cover and satellite availability

Common UAV Platforms



Fixed Wing UAV Platforms

- Pros
  - Long flight time
  - Covers large area
  - Less affected by wind
  - Won't drop out of sky
- Cons
  - Larger take off and landing area
  - Can not hover in one spot
- Applications
  - Aerial mapping of large, relatively flat open areas

Multi Rotor UAV Platforms

- Pros
  - Can take off and land from anywhere
  - Move in every direction
  - Hover in one spot

- Cons
  - Slower than fixed wing
  - Require a lot of power
  - Flight times are limited

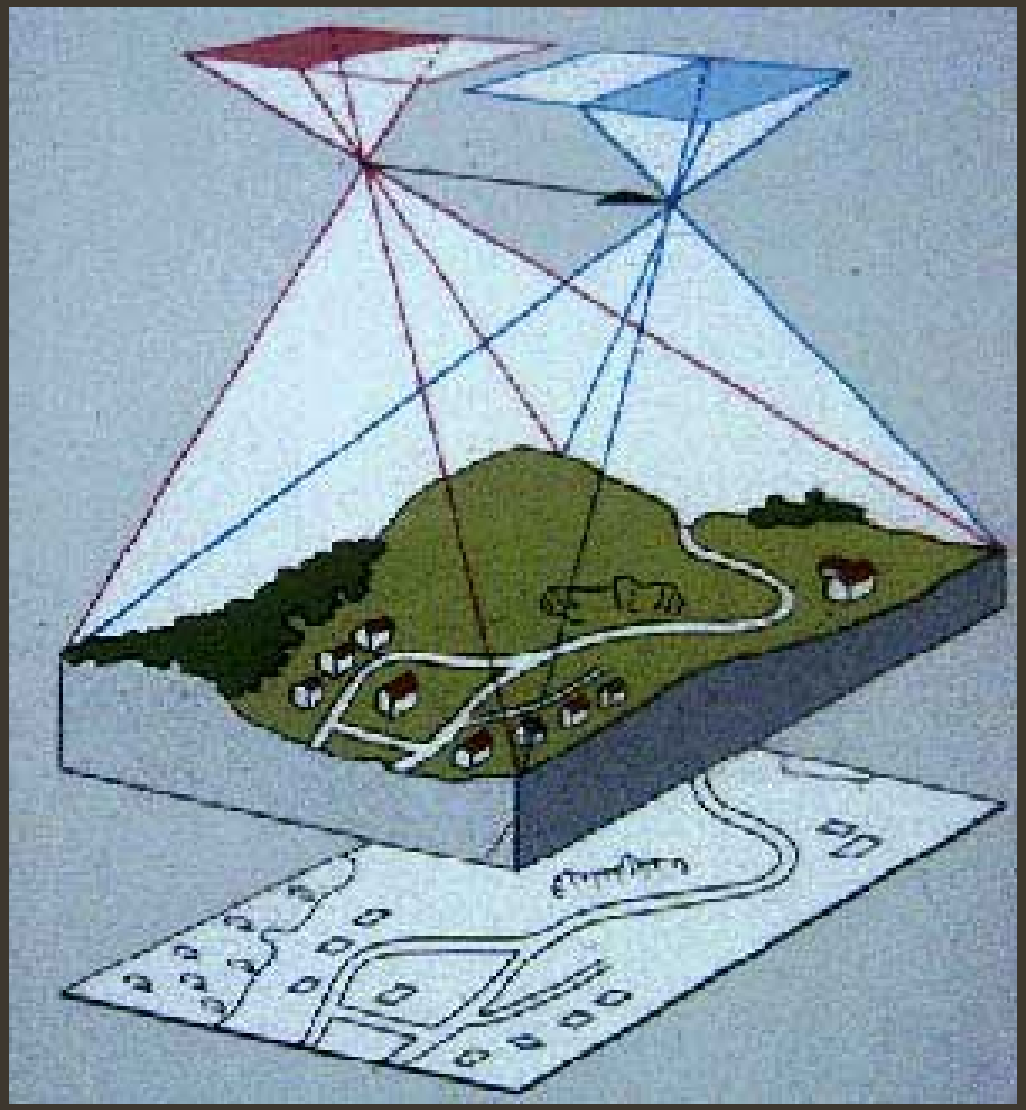
- Applications
  - Used to capture 3D objects in greater detail by orbiting and hovering while taking images

Hybrid VTOL UAV Platforms

- Pros
  - Can take off and land from anywhere
  - Fast air speed
  - Long flight times
- Cons
  - Compromise between fixed wing and multi rotor
  - Can cost more
  - In development
- Applications
  - When needing a small take off and landing zone

Aerial Photogrammetry

- The science of measuring objects from photographs.
- Overlapping images
- Camera sensor size
- Position of camera
- Triangulation



Camera Sensors

Drone/Camera Packages

- Phantom 4 Pro
  - 20 Megapixel
  - 30 minutes of flight time
  - $1,500 - $2,000

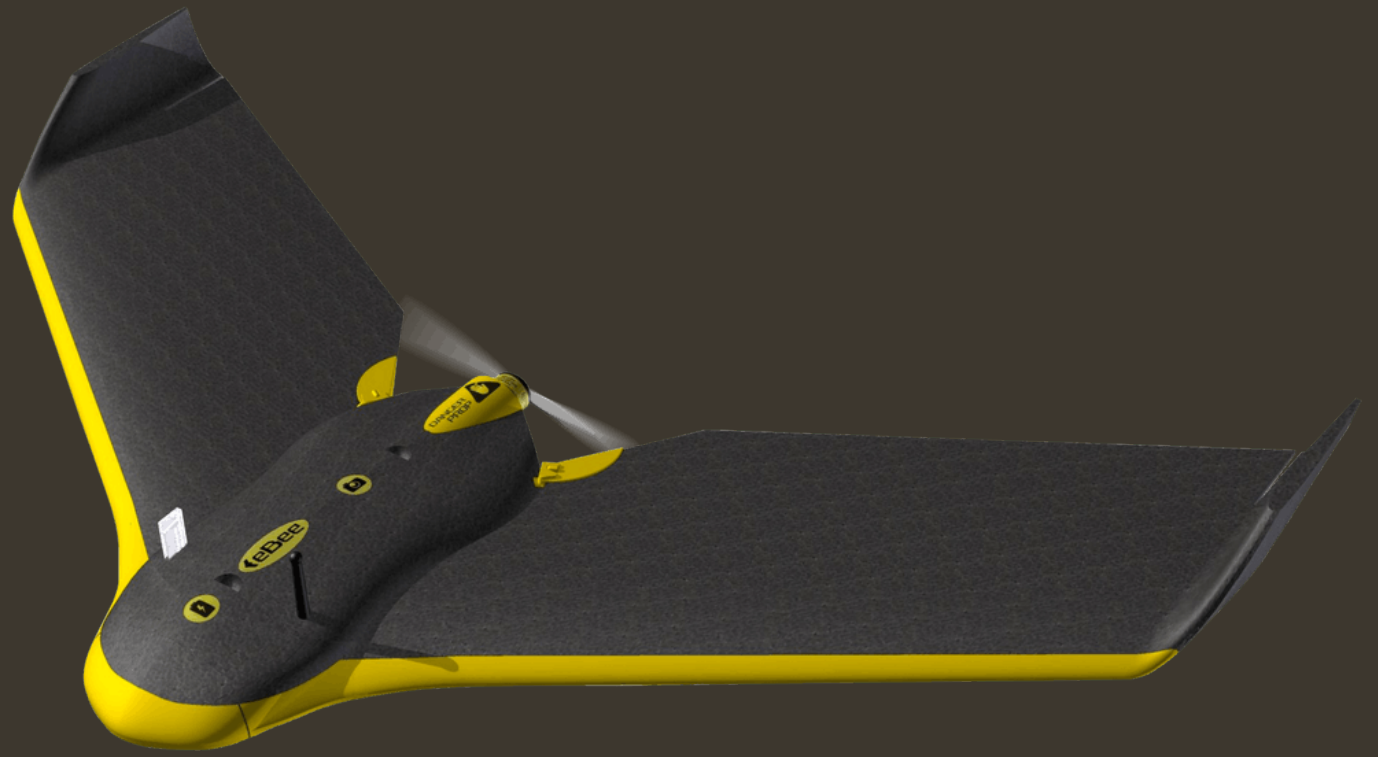
Drone/Camera Packages

- Inspire 2
  - 20.8 Megapixel
  - 27 minutes of flight time
  - $5,000

Drone/Camera Packages

- eBee
  - 18.2 Megapixel
  - 50 minutes of flight time
  - $12,000-$25,000

  - RTK GPS Version



Drone/Camera Packages

- Altavian
  - 16-18.2 Megapixel
  - 90 minutes of flight time
  - $20,000-$50,000

Stand Alone Cameras

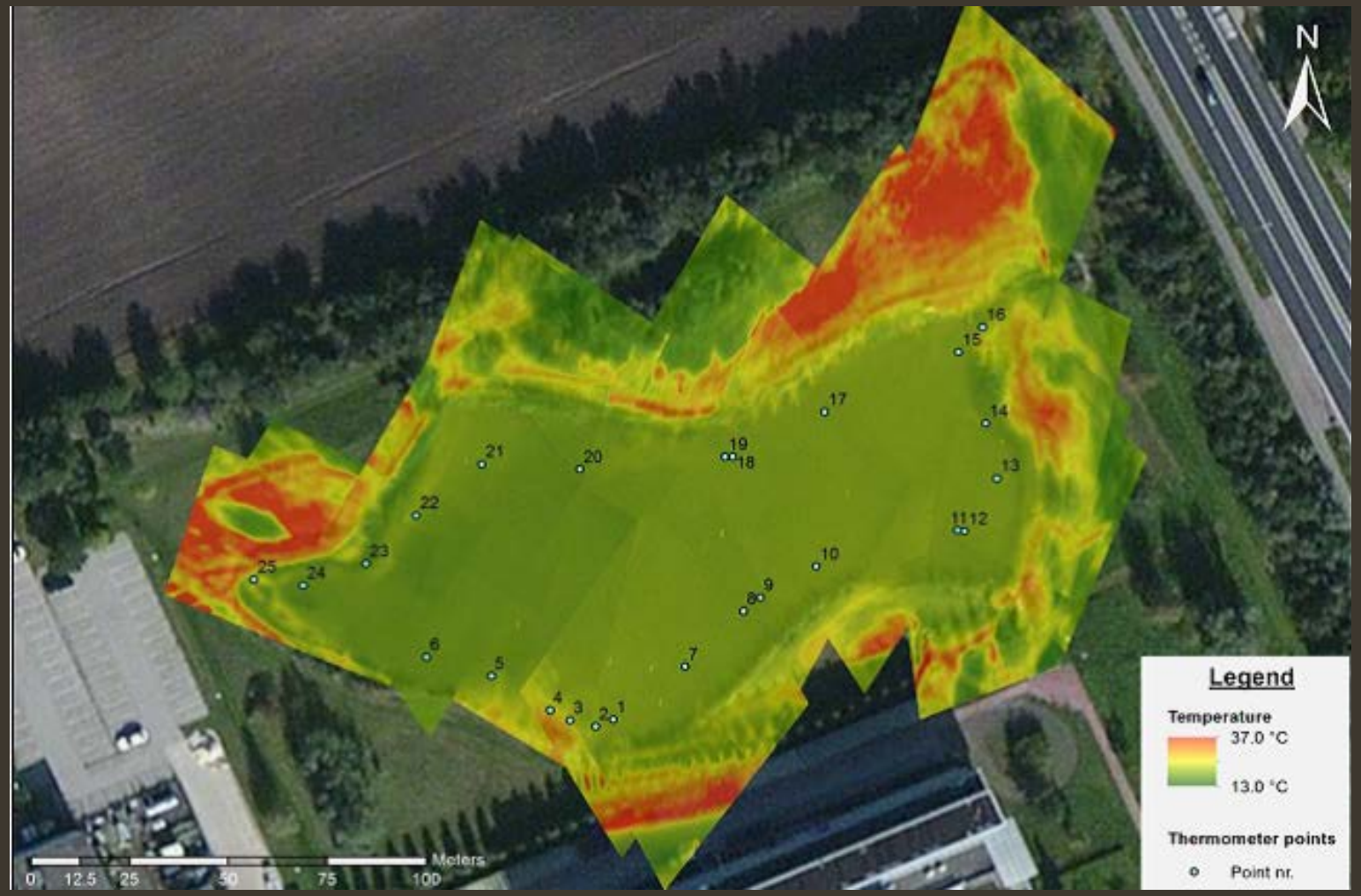
- Sony A7
  - 24.3 Megapixel
  - $1,200

- Sony A6000
  - 24.3 Megapixel
  - $800

Stand Alone Cameras

- Hasselblad X1D
  - 50 Megapixel
  - $9,000

Thermal Imaging Sensors



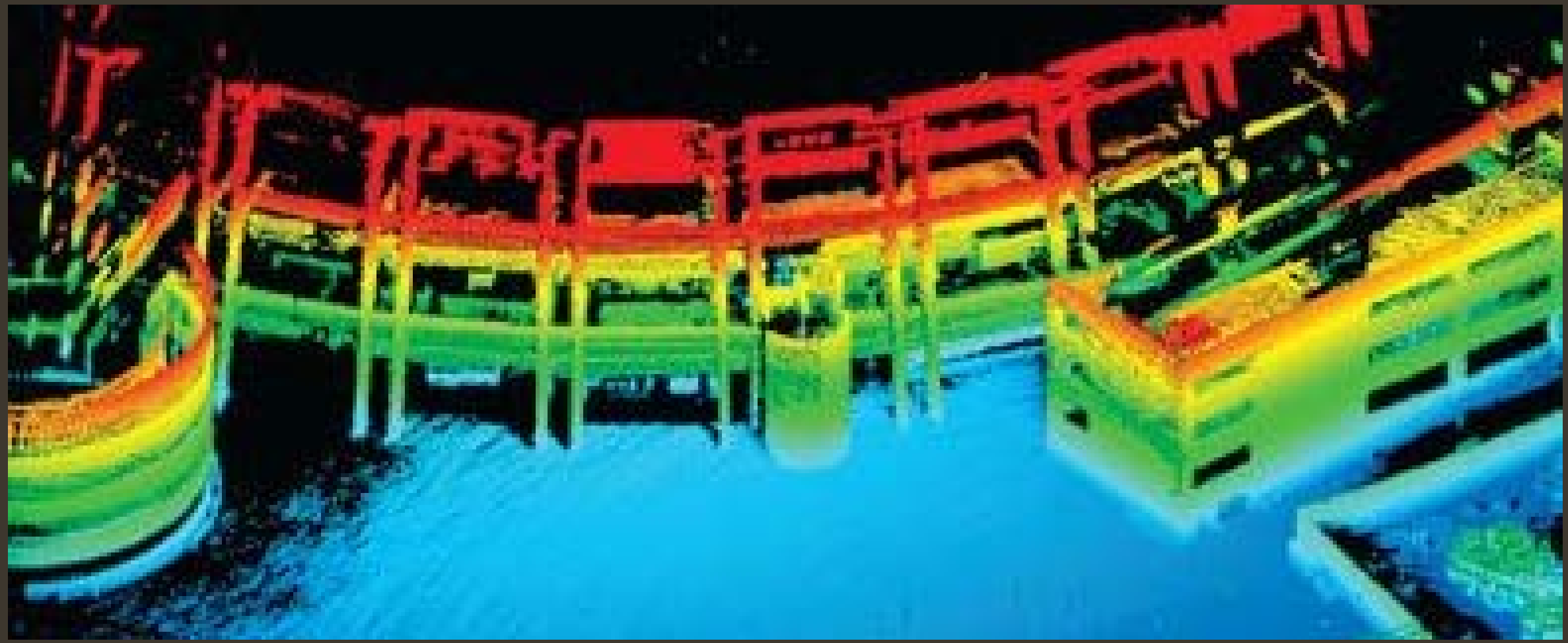
Thermal Image Technology

- Firefighting
- Law enforcement
- Powerline maintenance
- Building insulation
- Crop analysis
- Steam leakage
- Animal counting

UAV LiDAR Technology

- Light detection and ranging
- Time of flight with laser pulse
- Range of 260 - 320 feet
- Relative accuracy of +/- 3 cm global accuracy of +/- 10 cm
- Up to 700,000 points per second
- Outputs point cloud

Aerial UAV LIDAR



Mobile Terrestrial LIDAR

Common UAV LiDAR Sensors

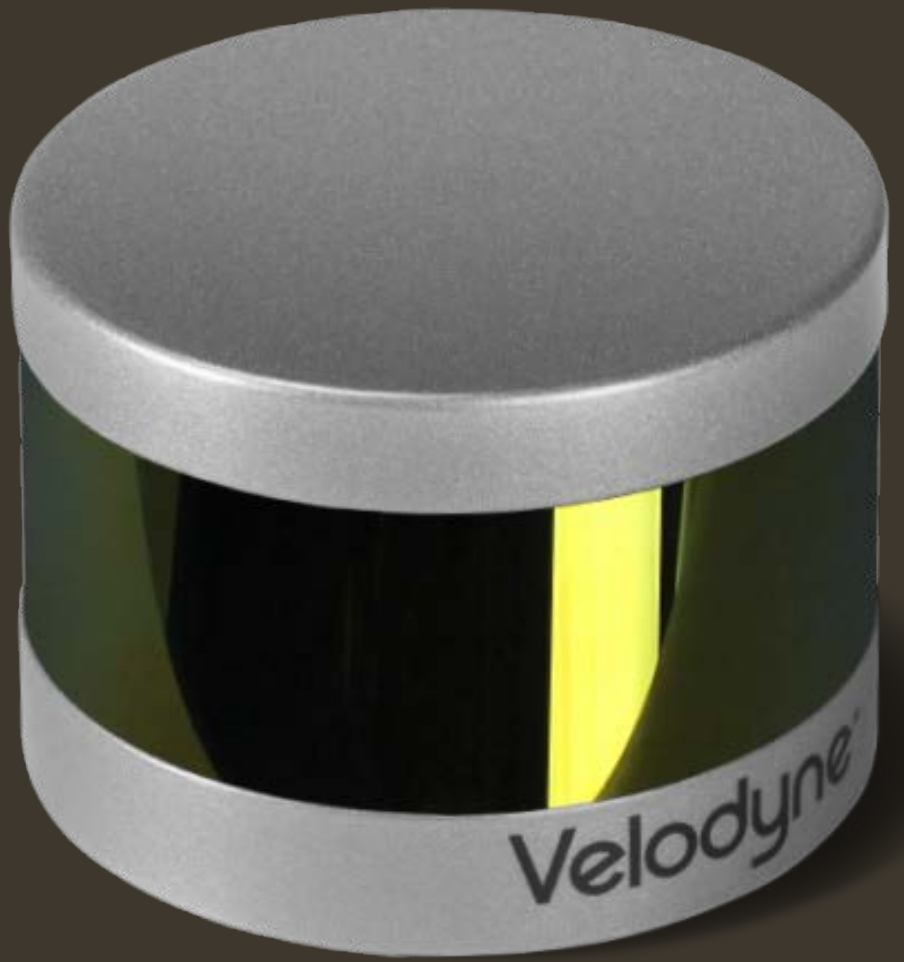
- Riegl RiCopter
  - 350,000 points second
  - 1 cm laser ranging

Common UAV LiDAR Sensors

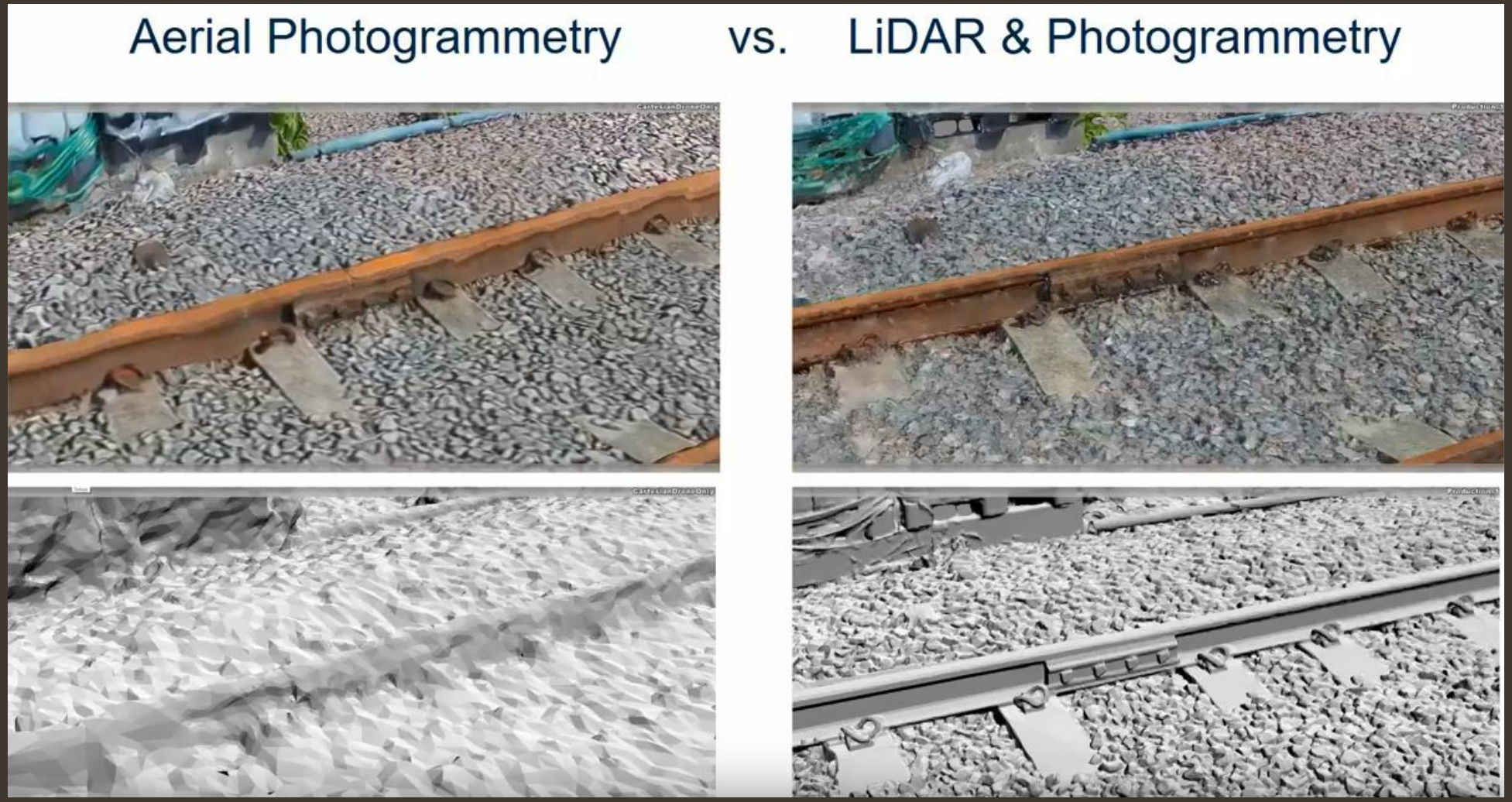
- Velodyne HDL-32
  - 700,000 points second
  - 2 cm laser ranging

Common UAV LiDAR Sensors

- Velodyne VLP-16 (Puck)
  - 300,000 points second
  - 2 cm laser ranging

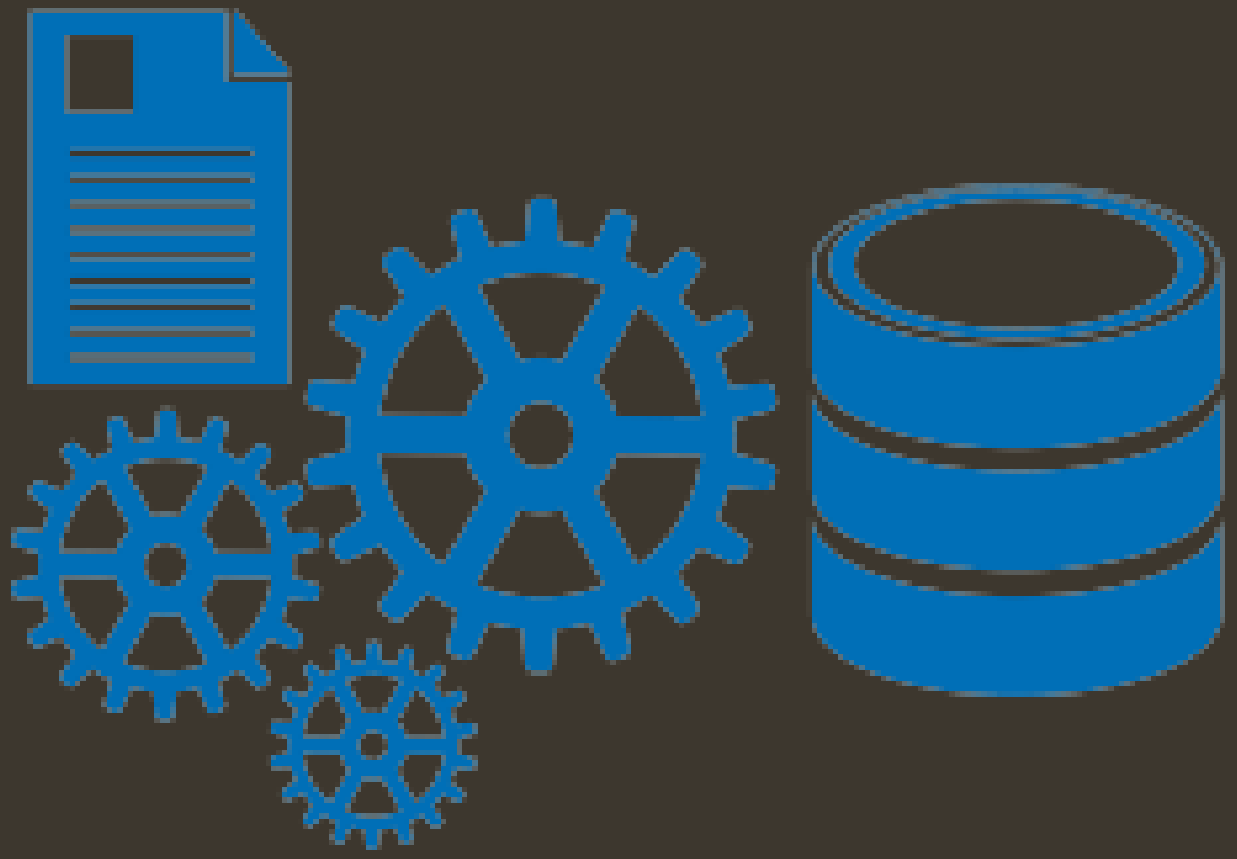


Joining Photogrammetry and LIDAR



Different Processing Methods

- Local Processing
  - Computer software
  - Computer hardware
  - Computer storage
- Cloud Processing
  - Online subscription-based services



Local Processing

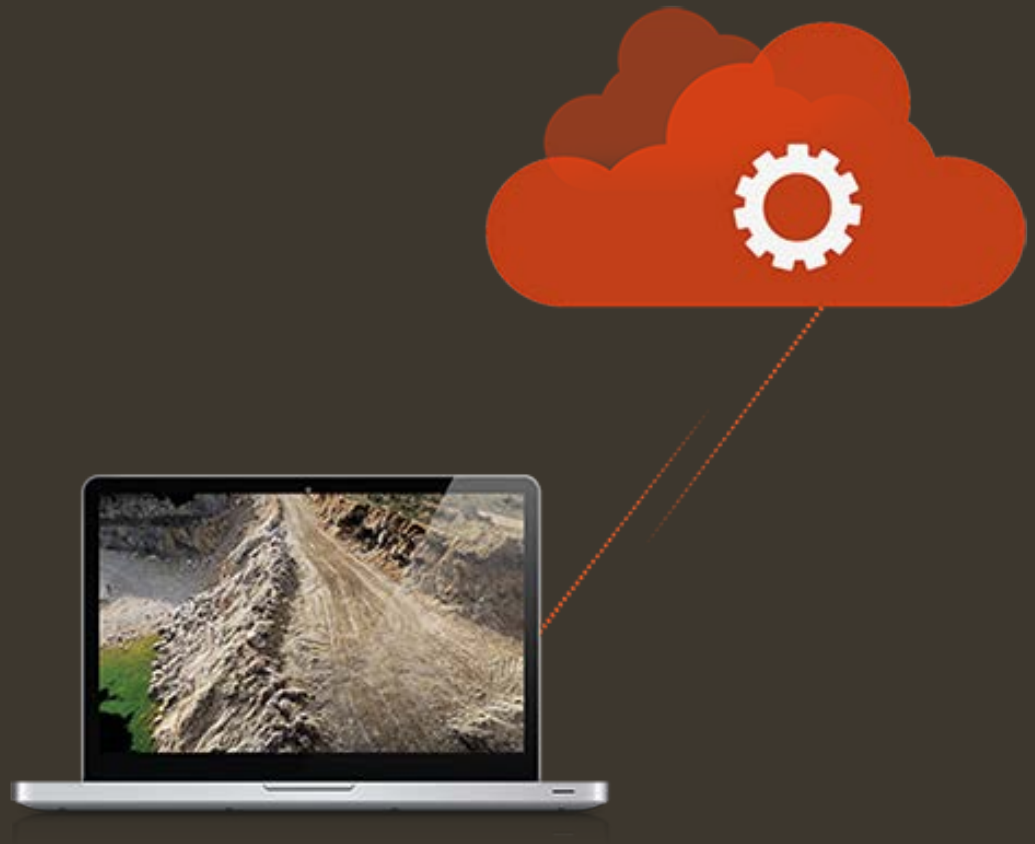
- Pros
  - More control
  - Can customize every setting for processing
  - Can edit photo model more easily
  - Can integrate with other technologies (LIDAR)
  - Better results

- Cons
  - High-end hardware configurations
  - Slower processing speeds
  - More storage capacity needed

Cloud-Based Processing

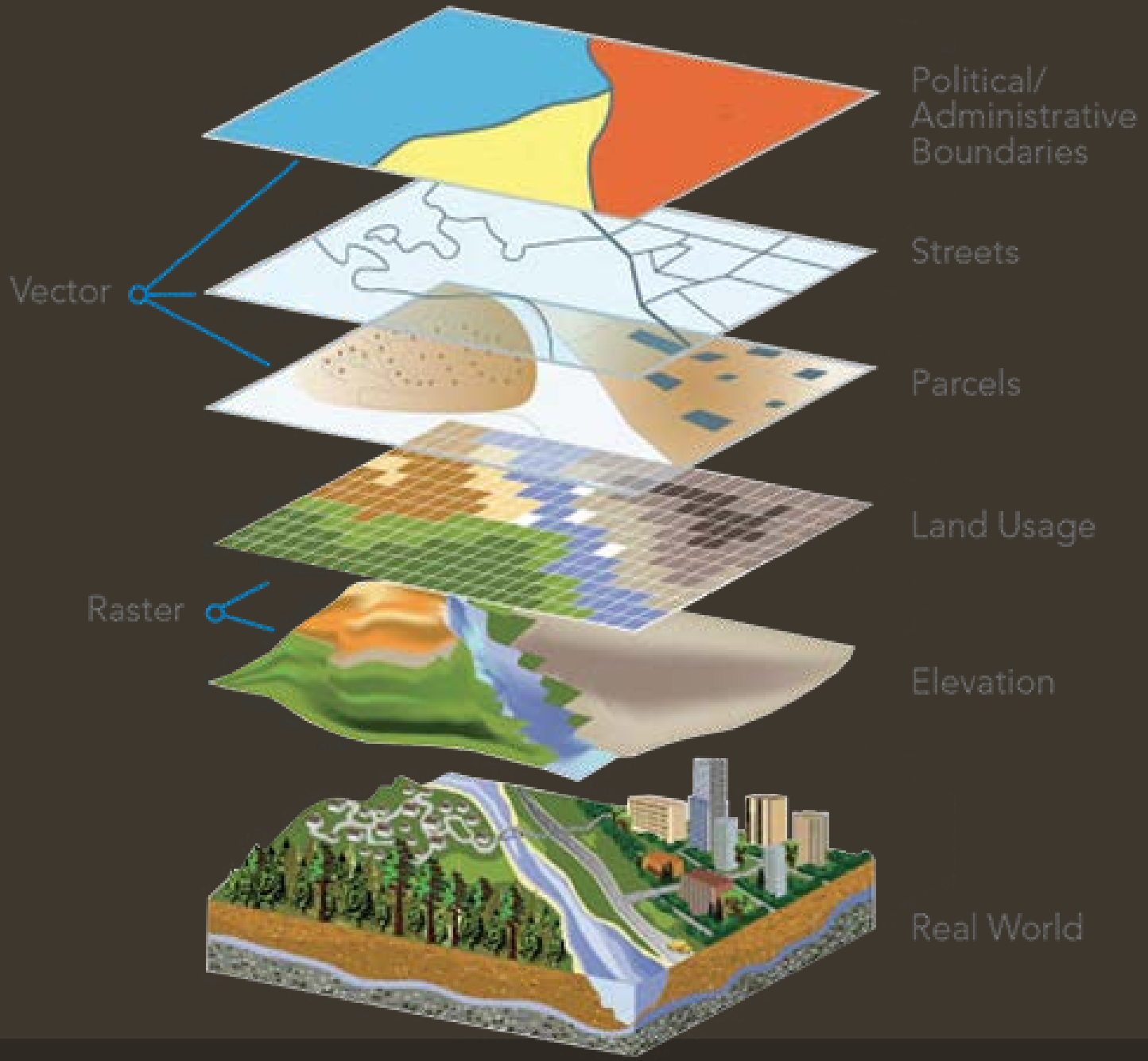
- Pros
  - Very easy
  - No need to know how to process images
  - Exports all standard deliverables

- Cons
  - Limited control of processing parameters
  - Very little customization
  - Confidential data on someone else's servers



Mapping Products

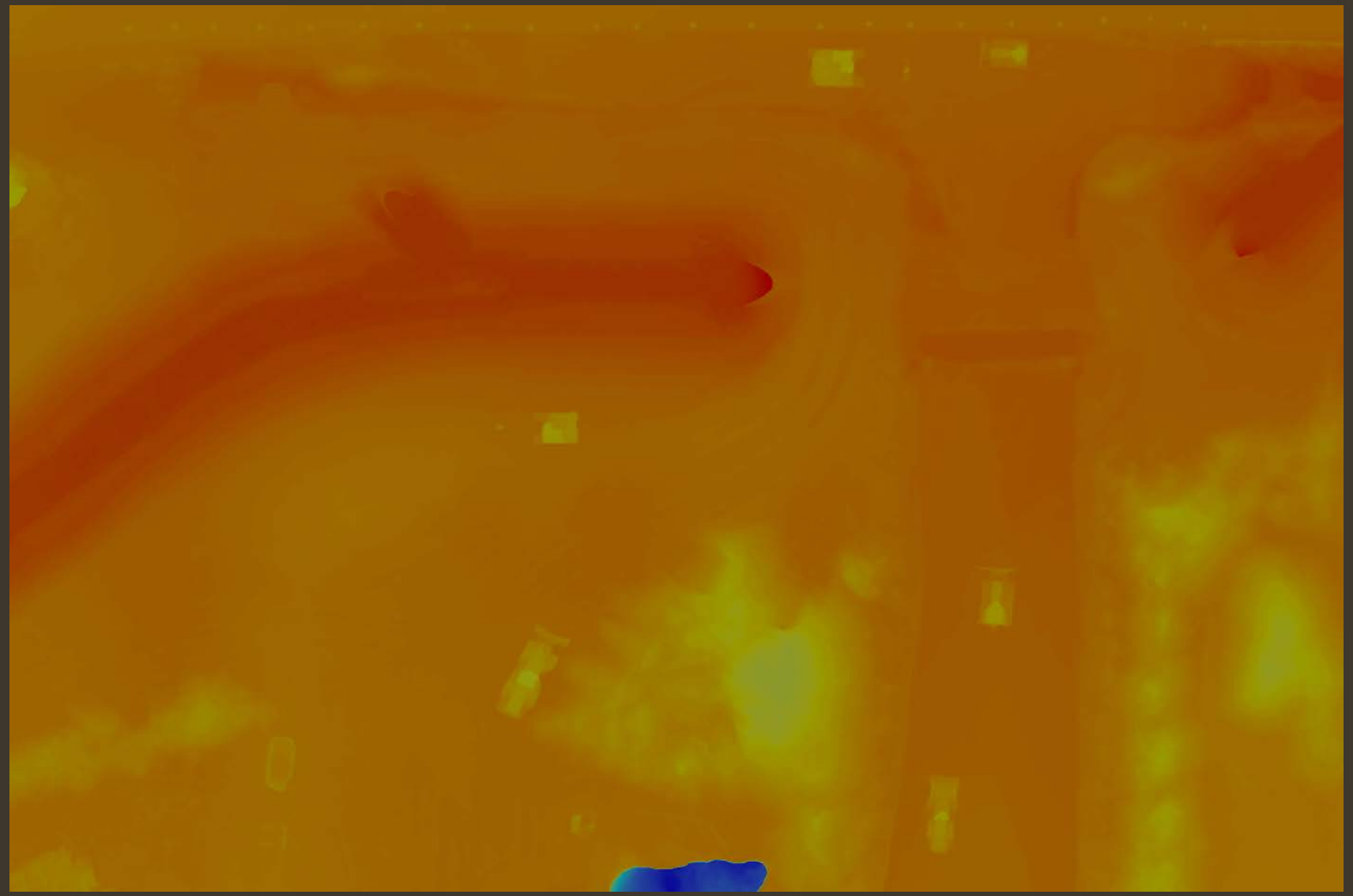
- Raster Datasets
  - Aerial images
  - Digital surface models
- Vector Datasets
  - Elevation contours
  - Topographic maps
- 3D Models
  - Triangulation mesh
  - Point cloud

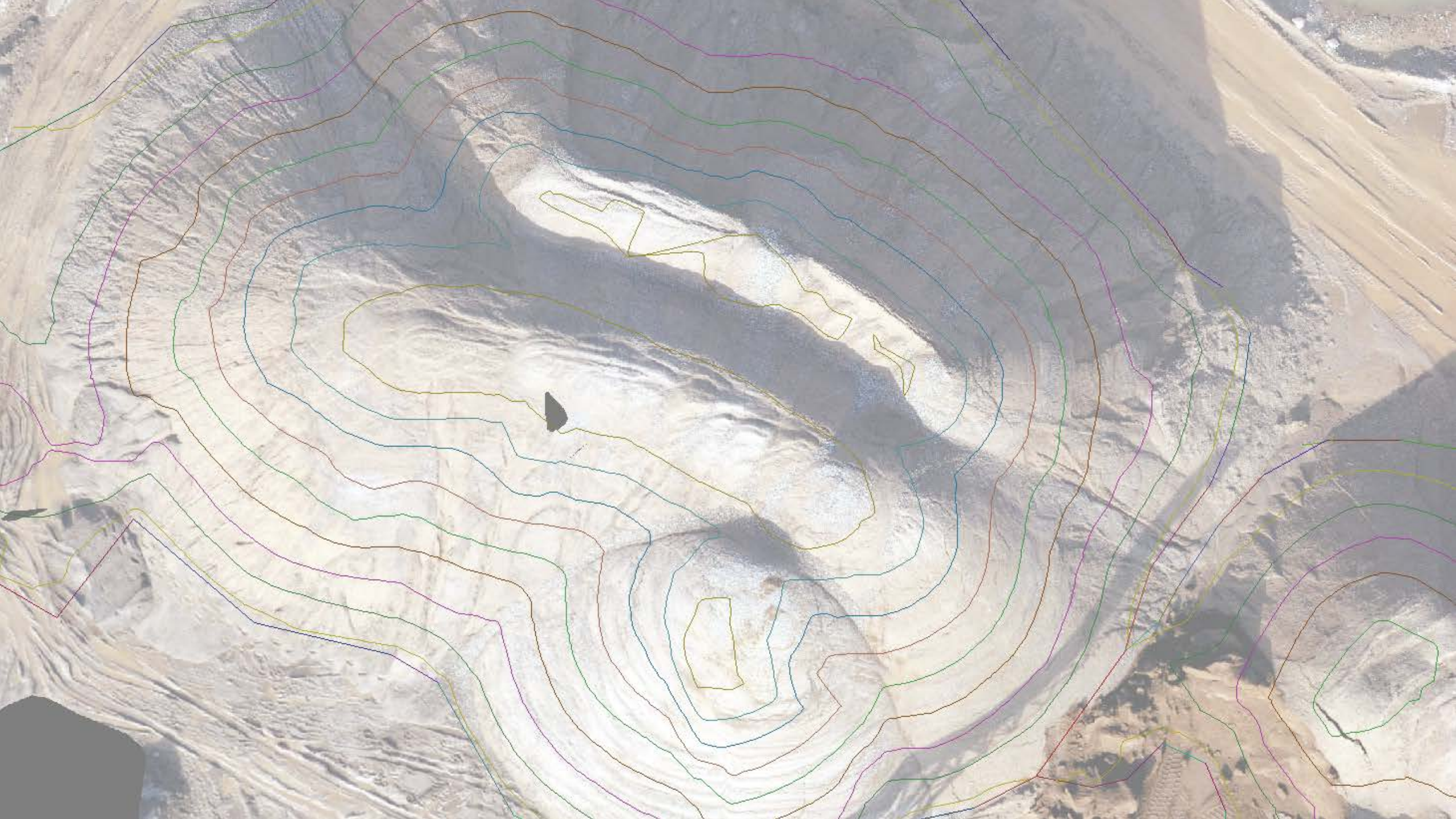


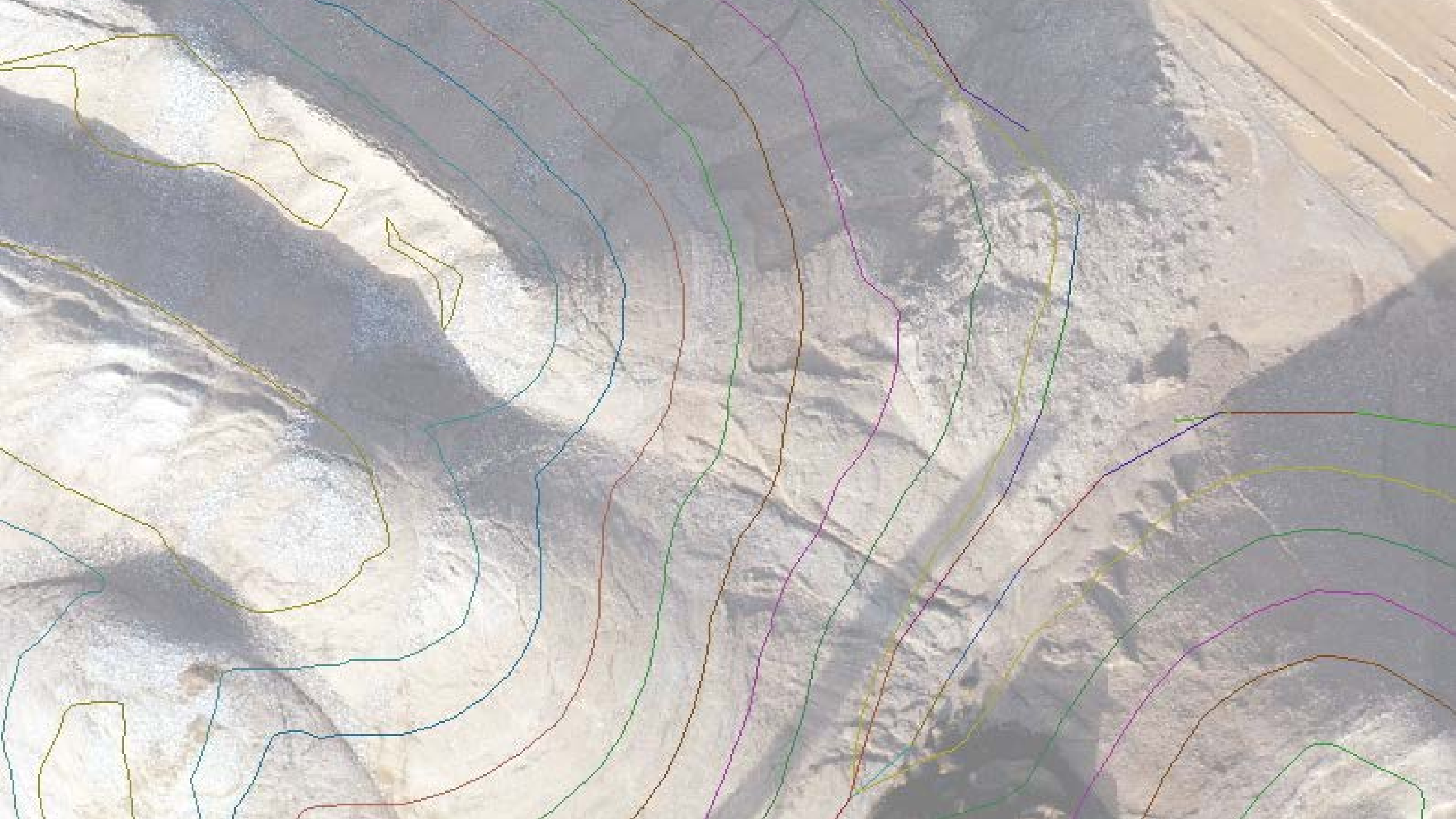
Georeferenced Aerial Imagery

Orthorectified Aerial Images

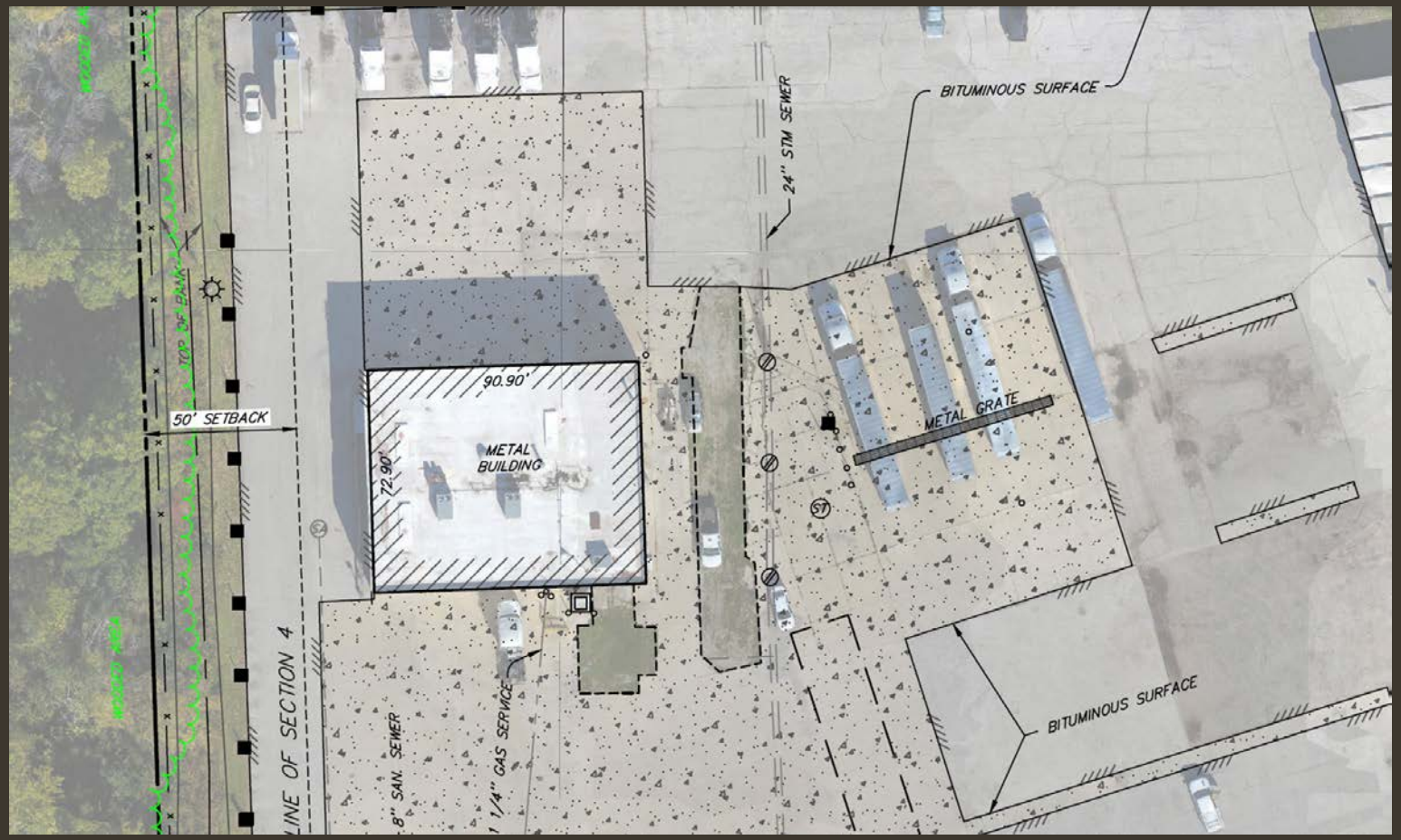
Digital Surface Models







Topographic Mapping



3D Models

Survey Accuracy with UAV Data

- Ground control points = 1X resolution for 2D and 3X resolution for 3D
- At 1”/pixel resolution = 0.09’ for 2D and 0.25’ for 3D
- Better accuracies are achieved 0.09’ 2D and 0.18’ 3D
- Non-controlled data has similar **RELATIVE** accuracy
- Non-controlled data not accurately shown at true position
  - 60 feet absolute accuracy

- Validation is essential

Using UAV-collected Data for GIS Applications

- High resolution images
- Feature extraction / Vector Mapping / Planimetrics
- Volume calculations
- Digital surface models
- Safety and efficiency
- Environmental assessment
  - Forest fire damage
  - Vegetation analysis
  - Coastal erosion monitoring

Future of UAV Mapping

- Faster more efficient platforms
- Increased accuracy
  - Sensors
  - GPS
- More integration of LIDAR and photogrammetry
  - Accuracy of LIDAR
  - Resolution of photos

Questions?

Jeremy R Dancer, P.S. | Staff Surveyor
SPICER GROUP, INC.
jeremyd@spicergroup.com
Office: 989-921-5539 | Cell: 989-763-2837
www.spicergroup.com
Stronger. Safer. Smarter. *Spicer*.

www.spicergroup.com