



JUNE 2017

Mapping with Drones

Key Considerations and Factors to Achieve Desired Accuracy



Presentation Format

1. Introduction – DroneView Technologies
2. Market Focus – 2015 through Today
3. Outlook for 2017
4. Commercial Drone Services
5. ESRI - Drone2Map
6. Drone Project Evaluation
7. Drone Project Accuracy
8. Representative Drone Projects
9. Questions & Discussion



Introduction



- 2.5 years of commercial drone operations
- Completed projects in 20+ states
- Flown hundreds of successful missions
- Lessons learned: Success requires multiple skill sets and domain expertise
- The real value to our clients is in safely using drones to provide accurate and timely data in their requested format at a competitive price point.

Quality Services

A Full-Stack Solution for Aerial Mapping & Geospatial Services

- **Accuracy**
Achieve an accuracy that meets or exceeds expectations.
- **Cost**
Provide complete drone solutions and deliverables at a competitive price point.
- **Timeliness**
Plan, acquire, process and deliver to an improved schedule.
- **Safety**
Comply with FAA guidelines and complement existing solutions.

Market Focus

March 2015



- Refined Focus and Streamlined Services Offering
- Serve enterprise customers with recurring needs
- Focus on complex solutions with high value add
- Bring domain expertise and a consultative approach to each project
- Deliver quality services to clients through:
 - **Accuracy, Cost, Safety, Timeliness**

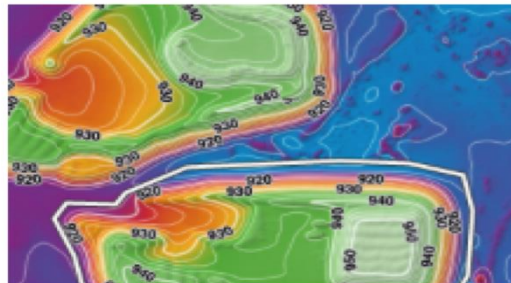


June 2017

Focus and Industries Served



STOCKPILE VOLUMETRIC
MEASUREMENT



AERIAL MAPPING, TOPOGRAPHY
AND 3D MODELING



INSPECTION AND ASSET
MONITORING

Outlook for 2017+

1. **The commercial drone industry is facing a Tipping Point** where large organizations will move from exploring how to incorporate drones in their operations to widespread mainstream implementation in 2017.
2. **Technology Enabled Service Offerings coupled with the requisite domain expertise** will be the pathway for widespread enterprise drone adoption.
3. **Accuracy Matters.** Sophisticated companies are recognizing that high precision mapping utilizing drones (and manned aircraft) for image (or LiDAR) acquisition is not simple and **to consistently achieve desired results requires a team of specialists.**
4. **Strategic Partnerships** – aligning organizations with symbiotic expertise and relationships to deliver solutions to enterprise customers will become more prevalent in 2017.
5. **Acquisition, Consolidation and Contraction.** Many are finding that a drone and a business card does not constitute “*a sustainable business*”. The drone industry will face a shakeout in 2017 resulting in fewer companies with more focused and specialized offerings.

Commercial Drone Operations

- FAA Regulations (Part 107)
- Insurance Certifications
- Drones & Equipment
- Maintenance & Service
- FAA UAV Pilot Licenses
- UAV Pilot Training
- Documented Procedures
- Professional Licenses & Certifications
- Post-Processing: Hardware, Software, Training & Support
- Accuracy Standards – Certification/Reporting



Sensors & Platforms



Aeryon Labs - SkyRanger



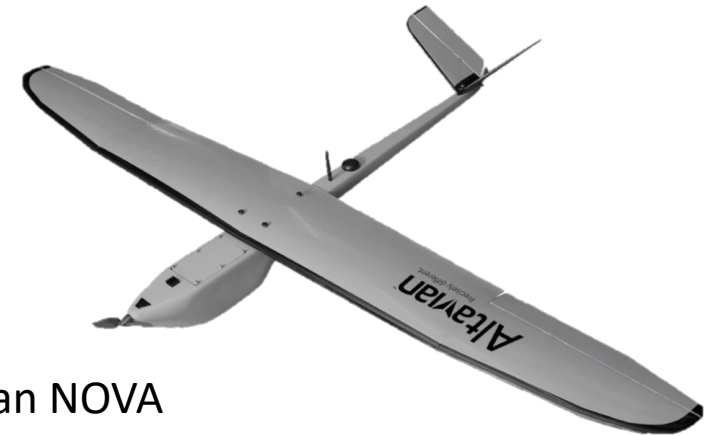
Kespry



SenseFly eBee



DJI Inspire 1 Pro



Altavian NOVA



FLIR Vue – Thermal



MicaSense RedEdge



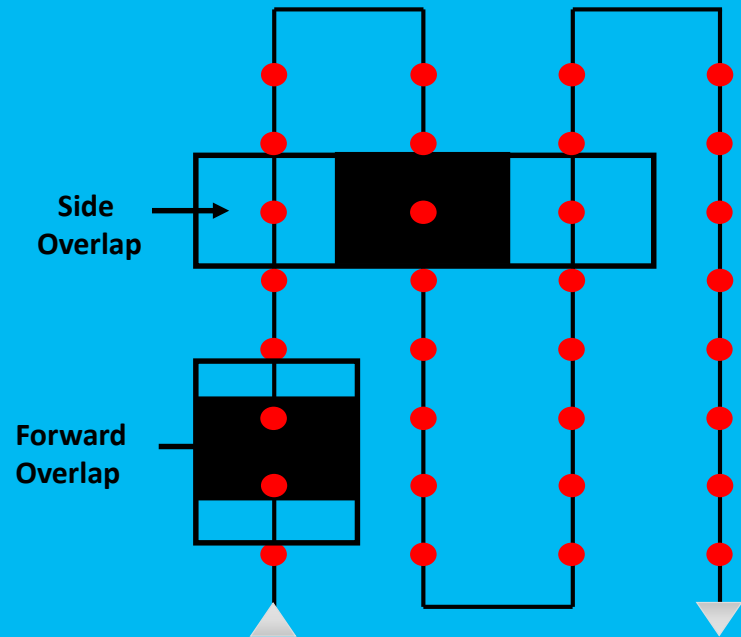
Sony qX1

Project Evaluation

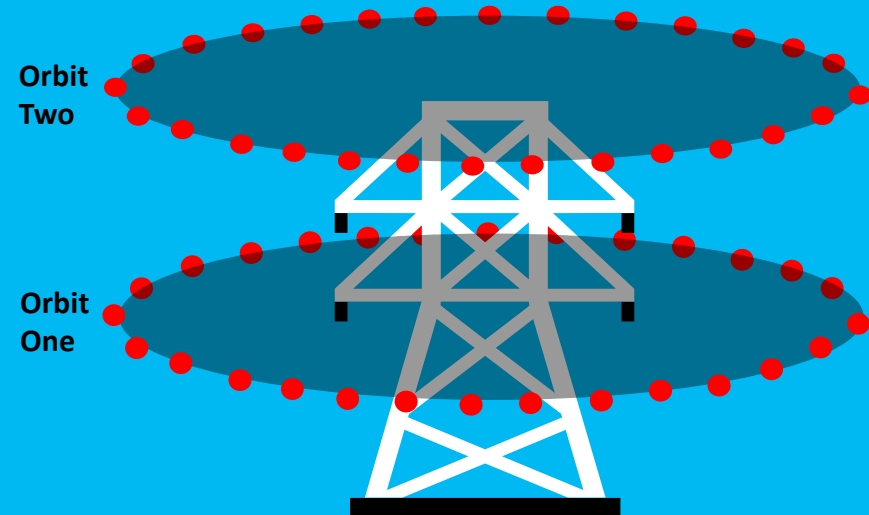
- Communication regarding the project requirements:
 - Location
 - Site conditions (vegetation cover)
 - Accuracy
 - Schedule
 - Deliverables
 - Budget
- Evaluate alternate solutions?
 - Traditional Photogrammetry
 - Mobile LiDAR
 - Airborne LiDAR
 - Terrestrial LiDAR
 - Conventional Ground Survey



Flight Planning



2D & 3D Imagery Products



Inspection and 3D Models

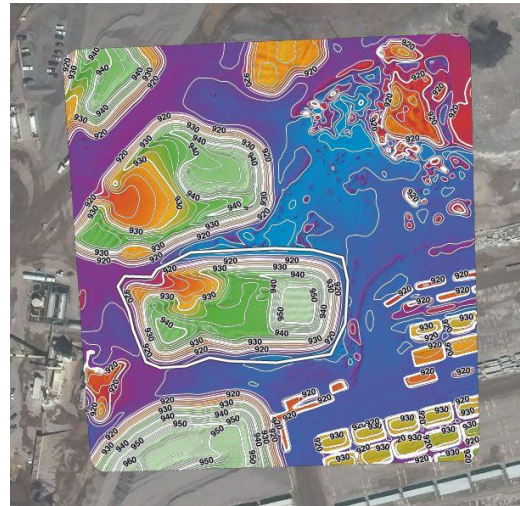
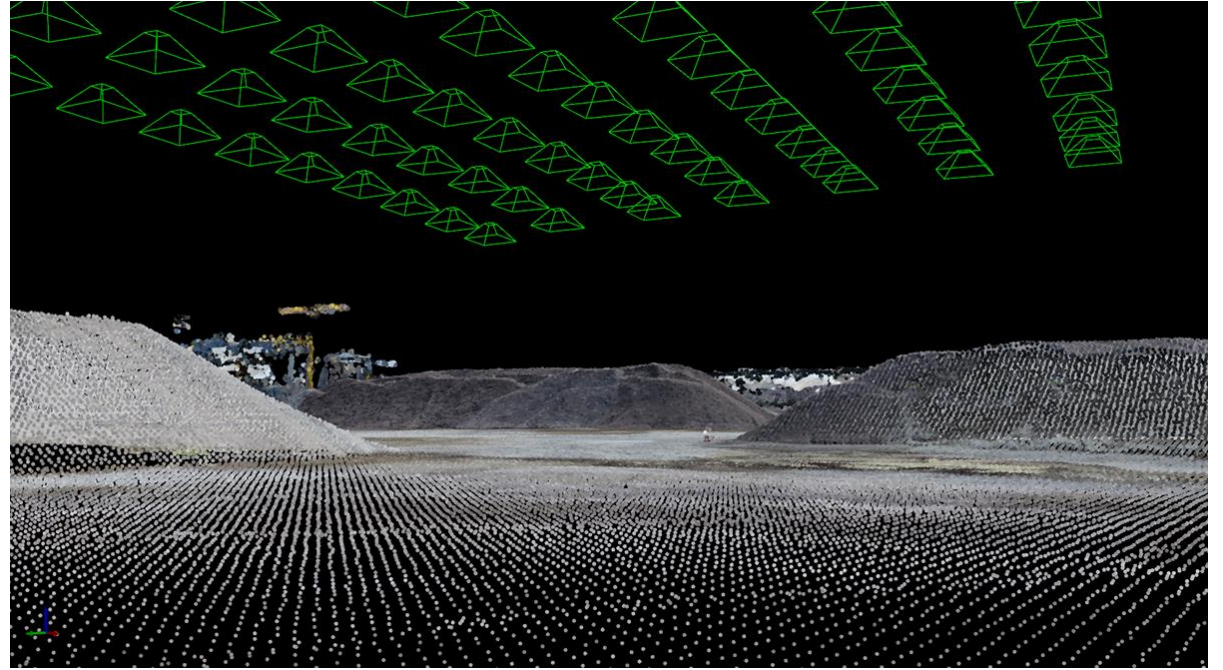
Data Acquisition

- FAA Airspace Review
- Flight Planning (Office)
- Mobilize Drone
- Site Reconnaissance
- Optimize Flight Plan
- Set Ground Control
- Imagery/Data Acquisition
- Validate/Upload Imagery

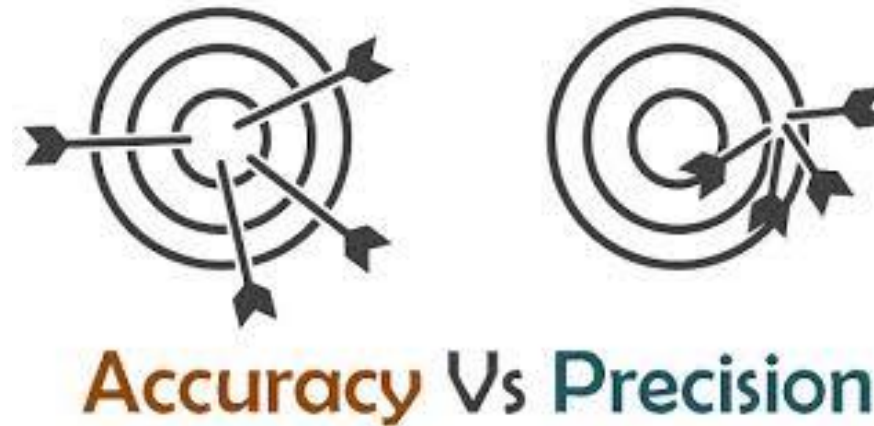


Imagery Processing

- Photogrammetric Software
 - Orthoimagery
 - 3D Point Clouds
 - Elevation Models (DTM, TIN, DSM)
 - Contours
 - Volumetrics
 - Planimetric Features
 - 3D Models
- Drone2Map
- Pix4D



UAV/Drone Accuracy

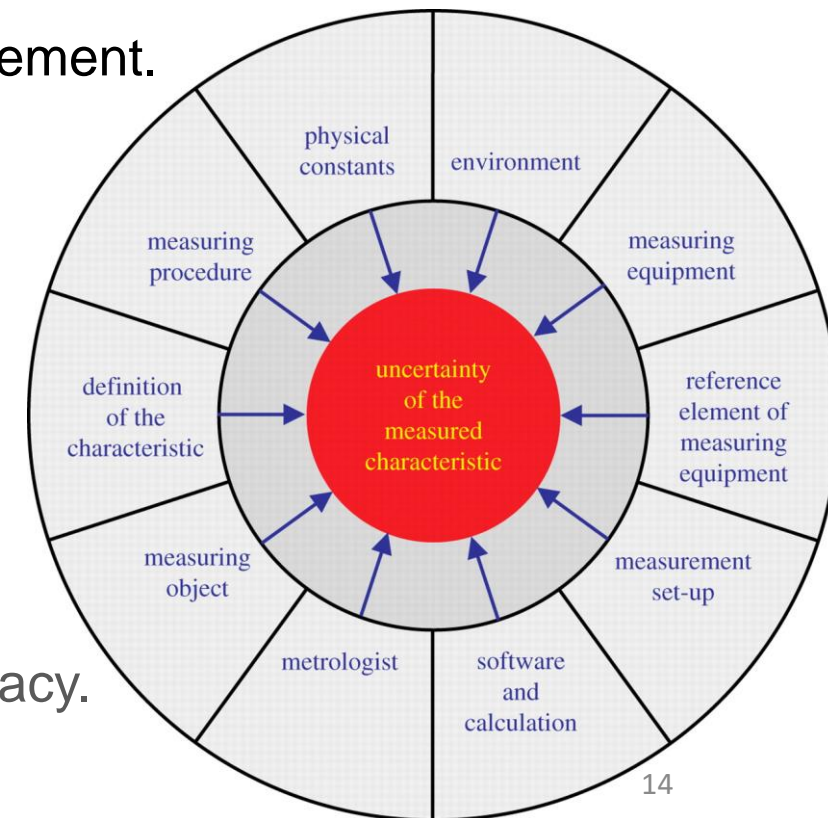


- Absolute or Relative Accuracy
- ASPRS Accuracy Standards
- Client Expectations – accuracy needs to be a product driven requirement.

- Pix4D Photogrammetric Processing Software:

- The expected accuracy for a correctly reconstructed project is:
 - 1-2 GPR horizontally (X,Y coordinates)
 - 1-3 GPR vertically (Z coordinate)

- The accuracy of the results can not be better than the GCPs' accuracy.





Drone2Map

Unmanned Aerial Systems Support for ArcGIS



Drone2Map



Fly Drone

Run App

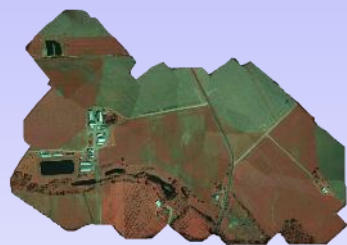
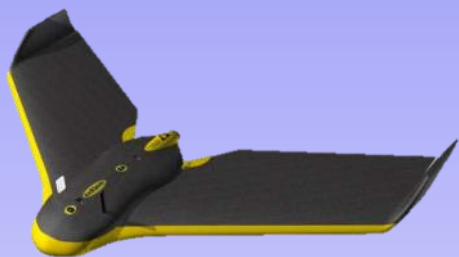
Get Map

Implementation:

- Is a Windows App running on a PC or Surface Tablet
- Does not require ArcGIS for Desktop
- Costs ~\$3,500
- Includes an ArcGIS Online Individual Account

Operational Sectors

2D Mapping



Imagery Mosaics

3D Mapping



Elevation Products

Inspection



Oblique Images & Video

Monitoring



Motion Imagery

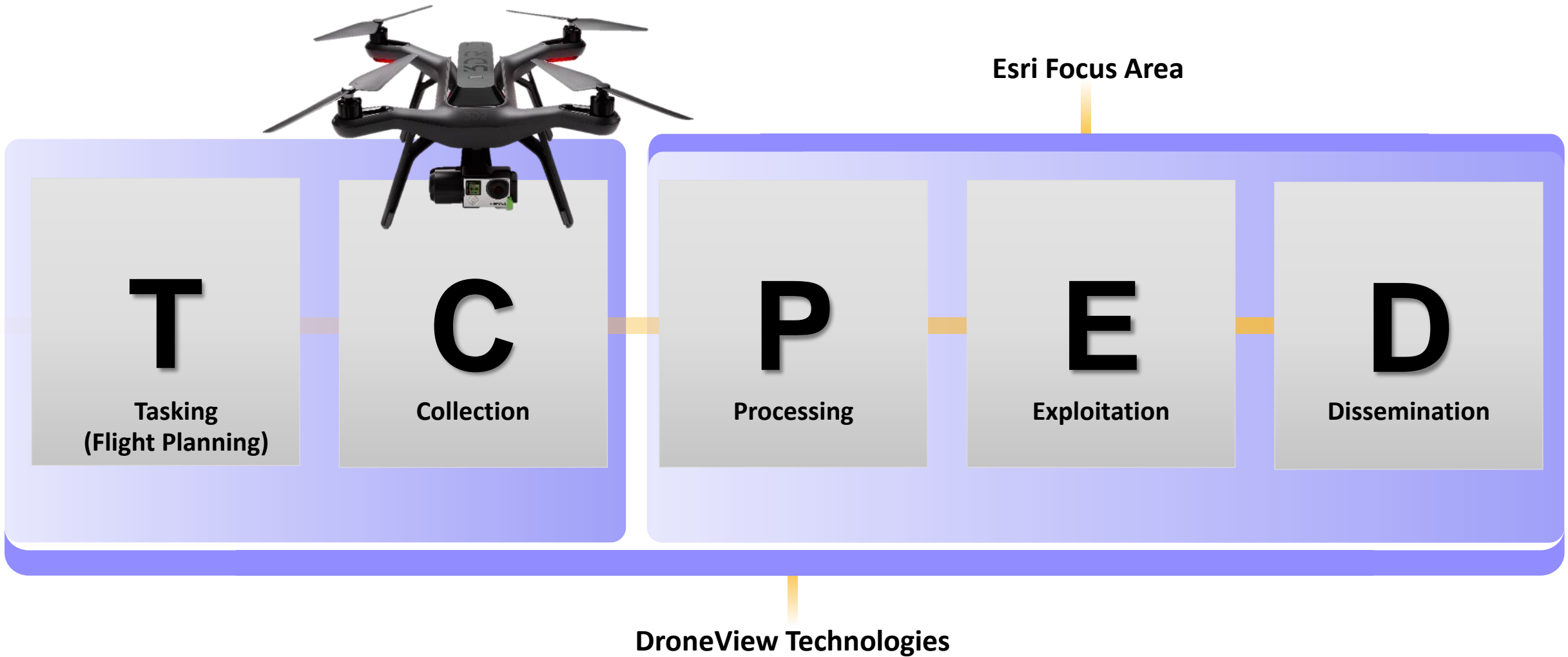
Static Aerial Imagery

Drone2Map

Video

FMV Tools

Project Workflow



Drone2Map Products



Overlapping
Static Aerial Photos



2D Image Maps (Ortho Mosaics):

- Map Accurate Image Maps
- Seamless stitched for base mapping
- Digital Surface Models

3D Elevation Products:

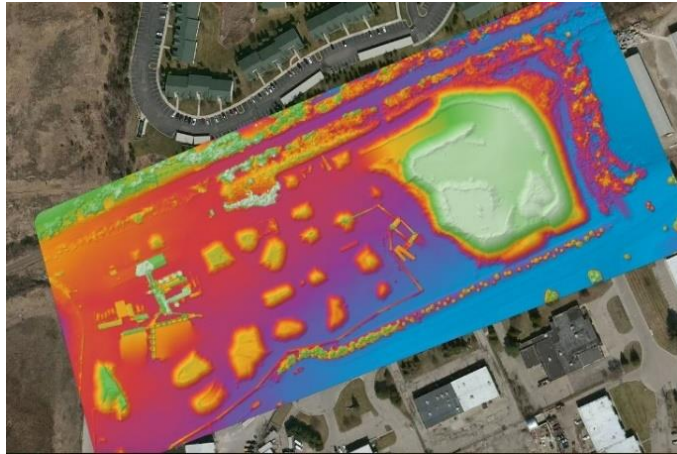
- Point Cloud (LAS)
- 3D Mesh Models
- 3D Site Models (PDF)

Smart Inspection Photos:

- Non-Distorted but Map Accurate
- Works for vertical and oblique photos
- Complete 3D Measurements

Representative Projects

1. Topographic Mapping
2. Stockpile Volume Calculations
3. ALTA Surveys
4. Landfill Mapping
5. Rooftop Mapping
6. Mine Planning
7. Construction Monitoring
8. Inspection Services

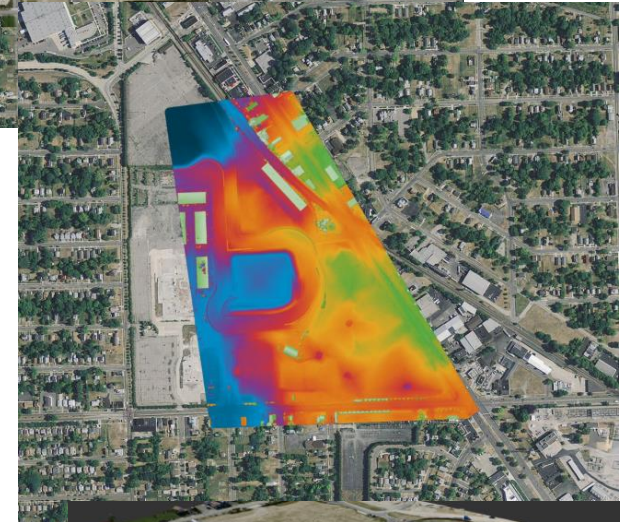


M1 Concourse – Pontiac MI

UAS for Surveying, Engineering & Construction



Orthos



**Elevation
Models**

3D Models



Results

Total Area Processed



100 Acres

Ground Control Used



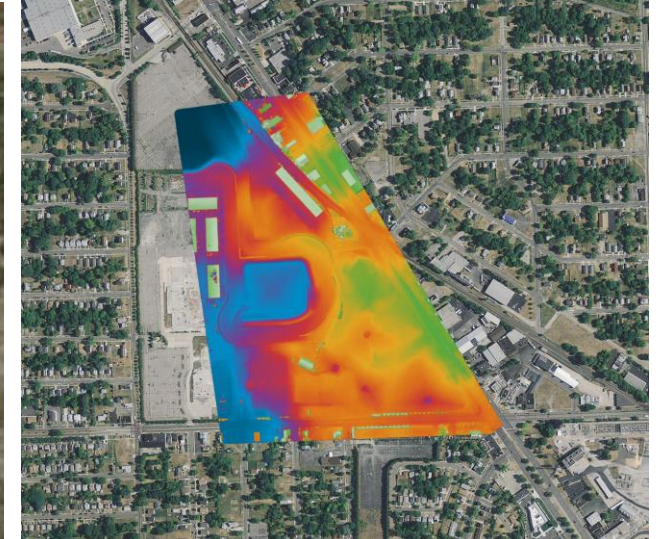
13 Control Points
1278 Check Points

Photos Collected



272 Images

Output Parameters



Horizontal GSD – 1.6 in (4.1 cm)

Delivery Time: 3 Days from flight

Products Produced: Orthos, DSM, Point Cloud, 3D Mesh, Contours, Planimetrics

Overall Accuracy: 1.25 x GSD, RMSEz 0.17ft (5.2 cm),

Stockpile Volume Calculations

- Client requested drone imagery and volume calculations
- 5 stockpiles for a proof of concept
- <24 hours to deliver volume reports, point cloud & orthos
- Bi-annual Aerial LiDAR took 1 month to deliver reports
- Client now flies Drones monthly for volume calculations



Stockpile Volume Measurement Comparison

drone data vs airborne LiDAR

data captured April 2016

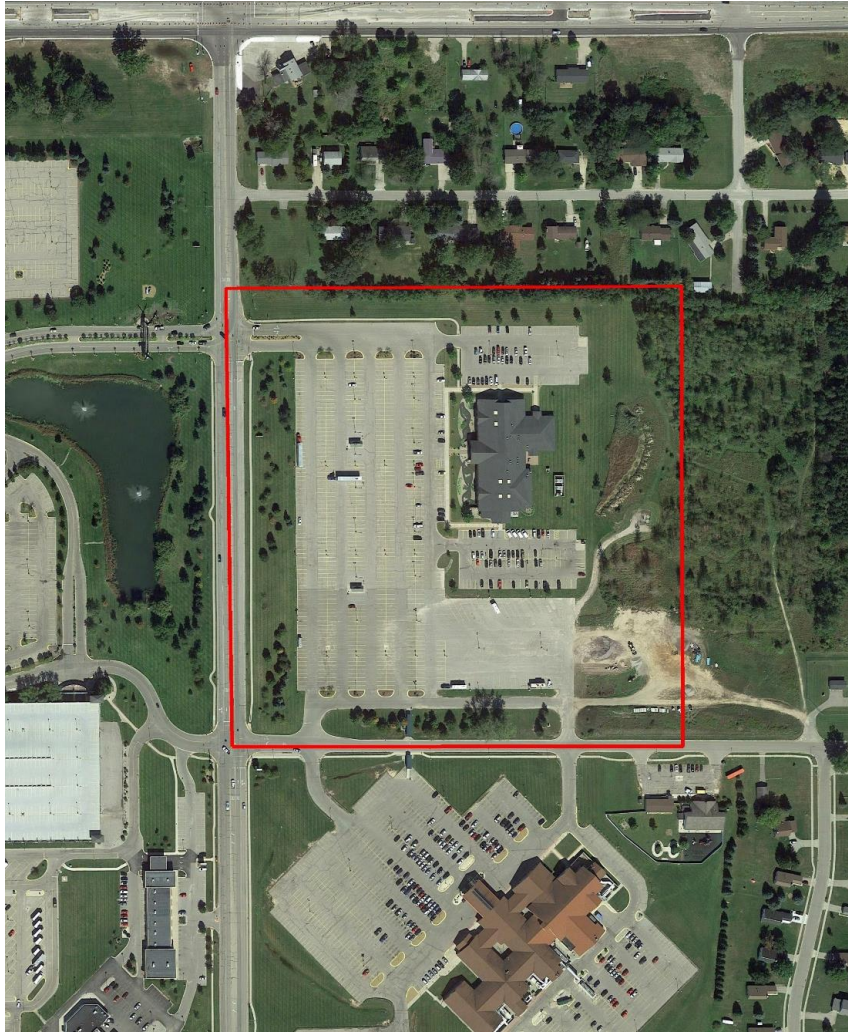
	<i>processed with:</i>		<u>% difference</u>
	<u>Drone Imagery</u>	<u>LiDAR</u>	
Pile #1	1,092	1,091	0.13%
Pile #2	24,992	25,162	-0.68%
Pile #3	4,037	4,109	-1.78%
Pile #4	2,898	2,837	2.12%
Pile #5	986	1,003	-1.75%

Average % Difference	-0.39%
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Note: all of the above results are shown in tons with a static density conversion of 1.23 tons/cu yd

Drone Imaging and Data Processing: DroneView Technologies

Black Elk Building – Mt Pleasant MI



Ortho



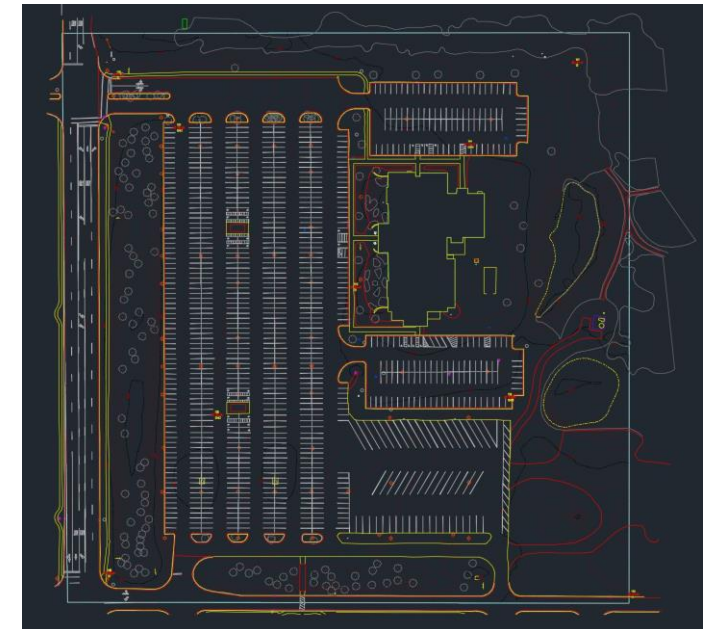
3D Model



Point Cloud



CAD File – Plan Features & Contours



40 acres flown, 25 acres mapping, 0.7" (1.8 cm) GPR, 9 GCP
54 Check Points, RMSEz 0.12 ft (3.7 cm), 2.1 x GPR, <5 days to deliver

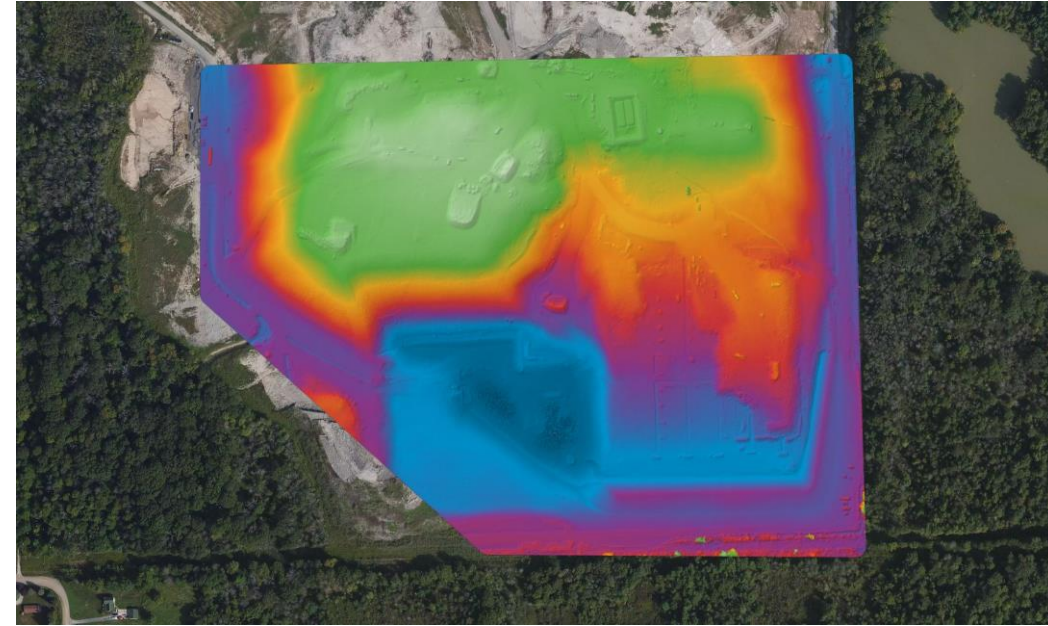
Landfill Mapping

- 120 acres flown
- 70 acres mapping
- 1.6" (4.1 cm) GPR
- 13 GCP
- 16 Check Points
- RMSEz 0.15 ft (4.6 cm)
- 1.1 x GPR
- <5 days to deliver

Smiths Creek MI



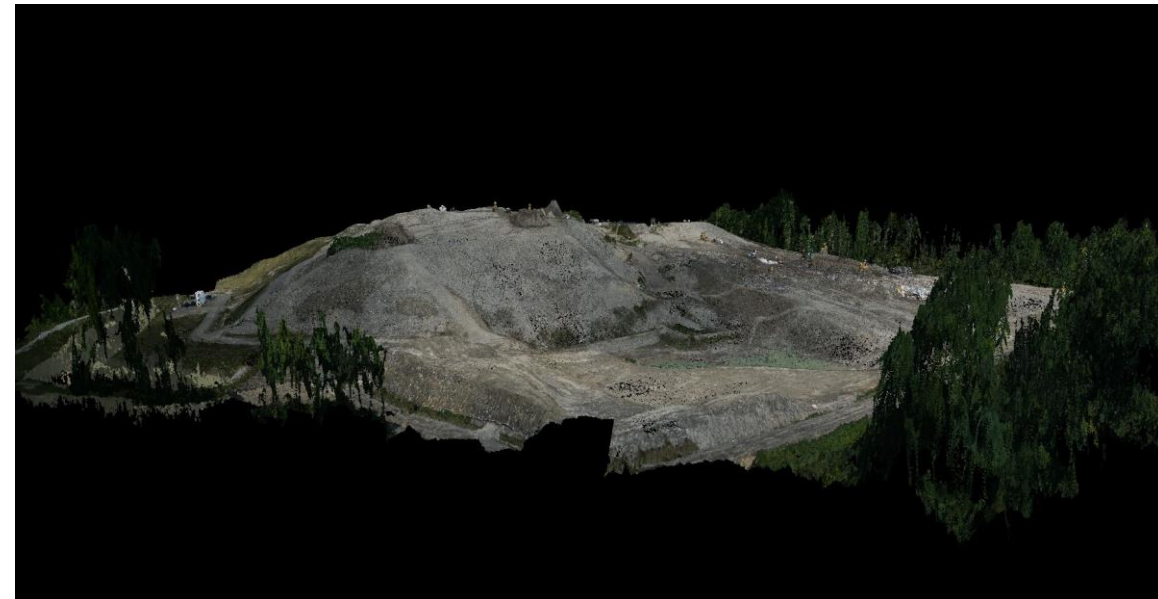
Digital Surface Model



Contours

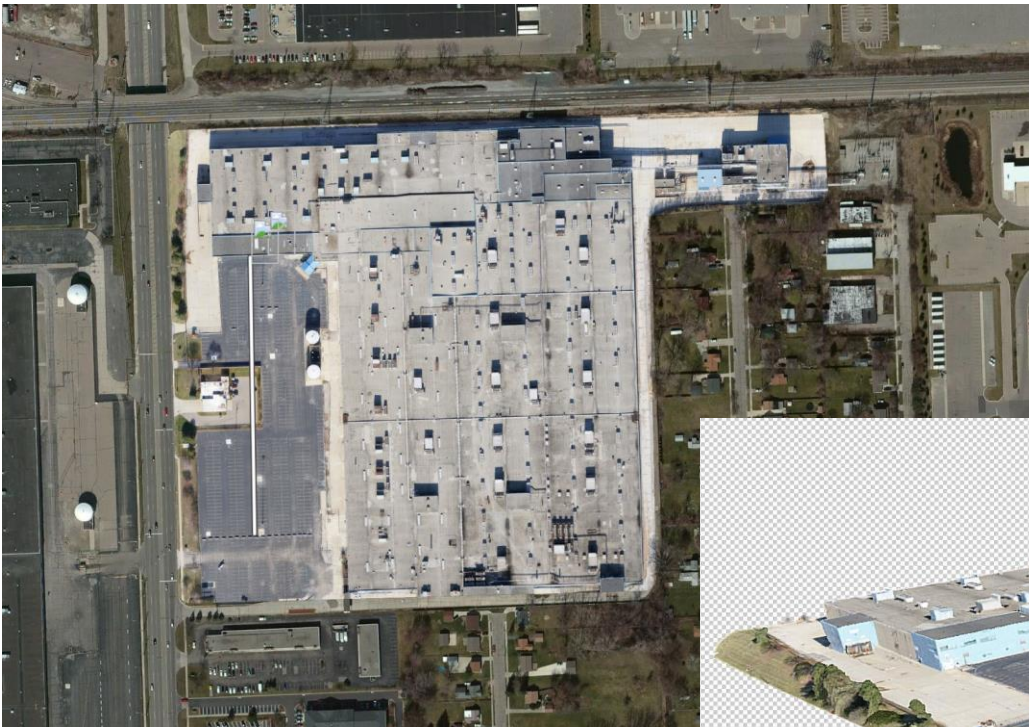


3D Model



Rooftop Mapping

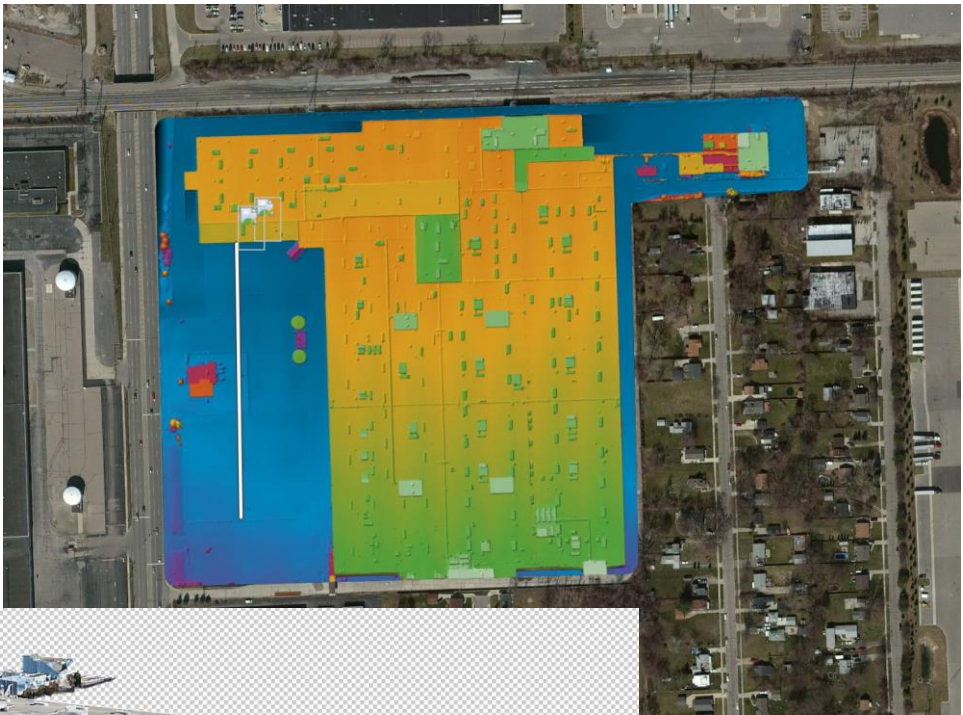
Orthoimagery



3D Model



Digital Surface Model



Mining – Topographic Mapping

- 390 acres flown
- 110 acres mapping
- 2.4" (6.1 cm) GPR
- 5 GCP



Hixton WI



Stockpiles

Contours



Construction Monitoring

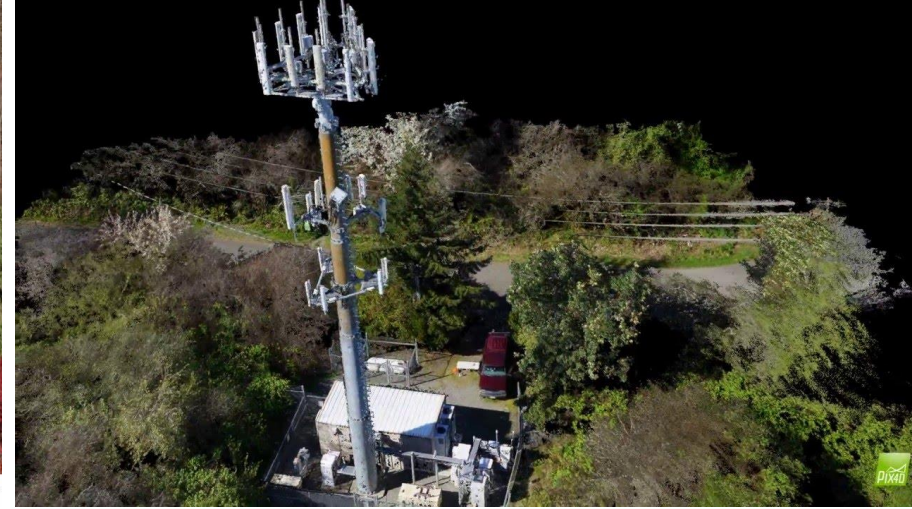
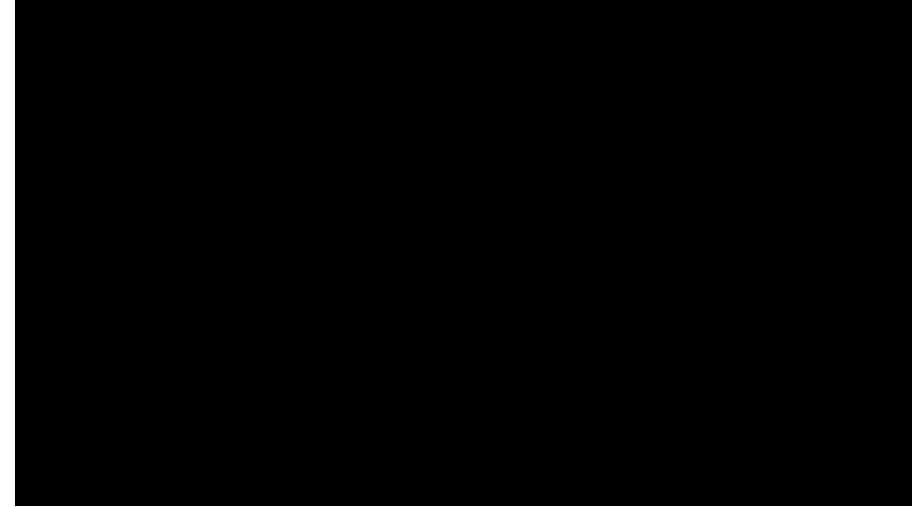
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Inspection Services – Tall Structures



DroneView Inspection Video



Questions?



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