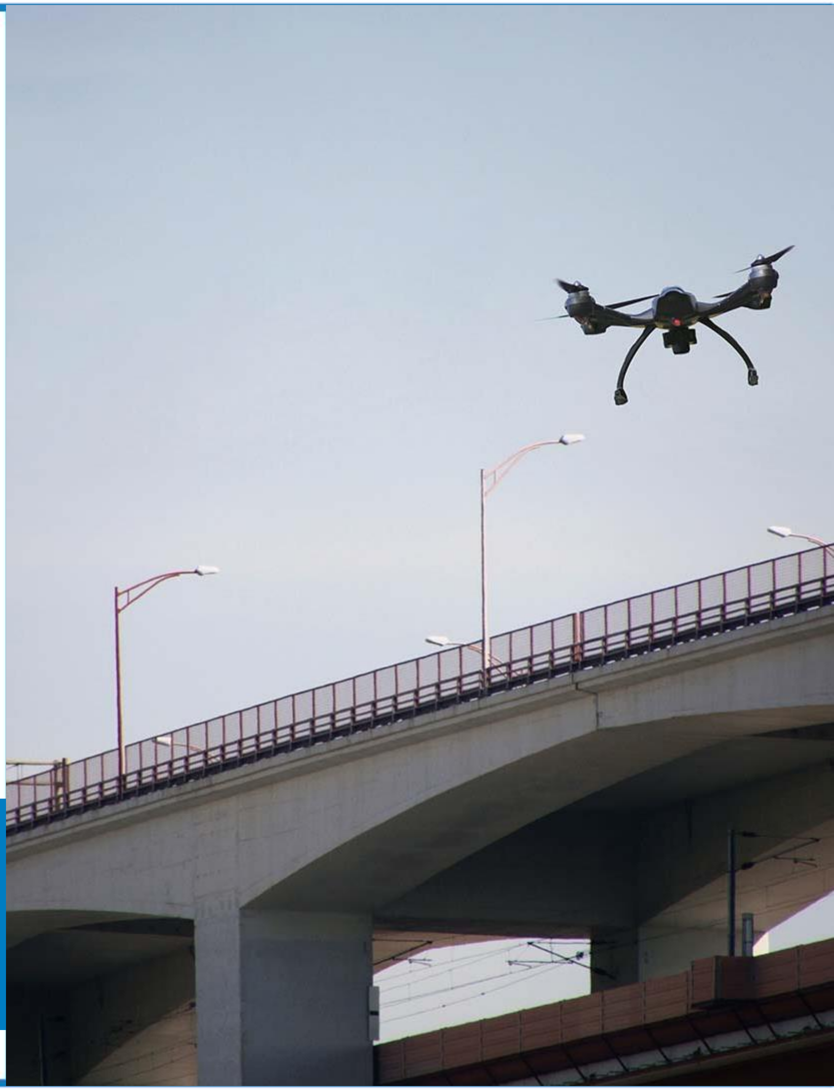
Breakout Session Track 1: Design & Construction

J.D. D'Arville, Alabama DOT
Paul Wheeler, Utah DOT
John Haynes, FHWA (Moderator)

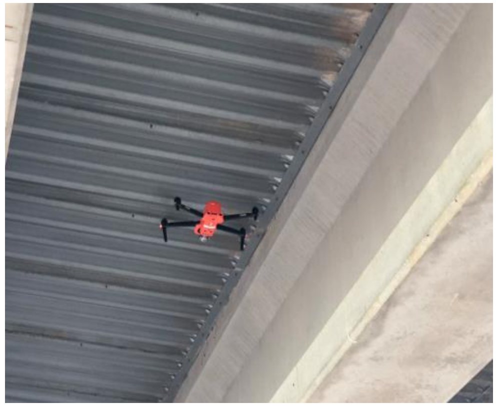


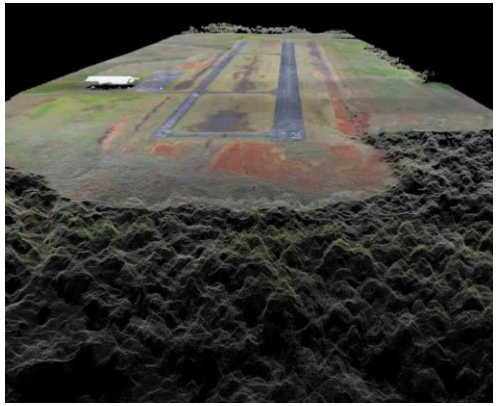
U.S. Department of Transportation
Federal Highway Administration

OKLAHOMA Transportation

LOCAL TECHNICAL ASSISTANCE PROGRAM
College of Engineering, Architecture and Technology

U.S. Department of Transportation
Federal Highway Administration





ALDOT UAS

Alabama Department of Transportation

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UAS Program Administrator
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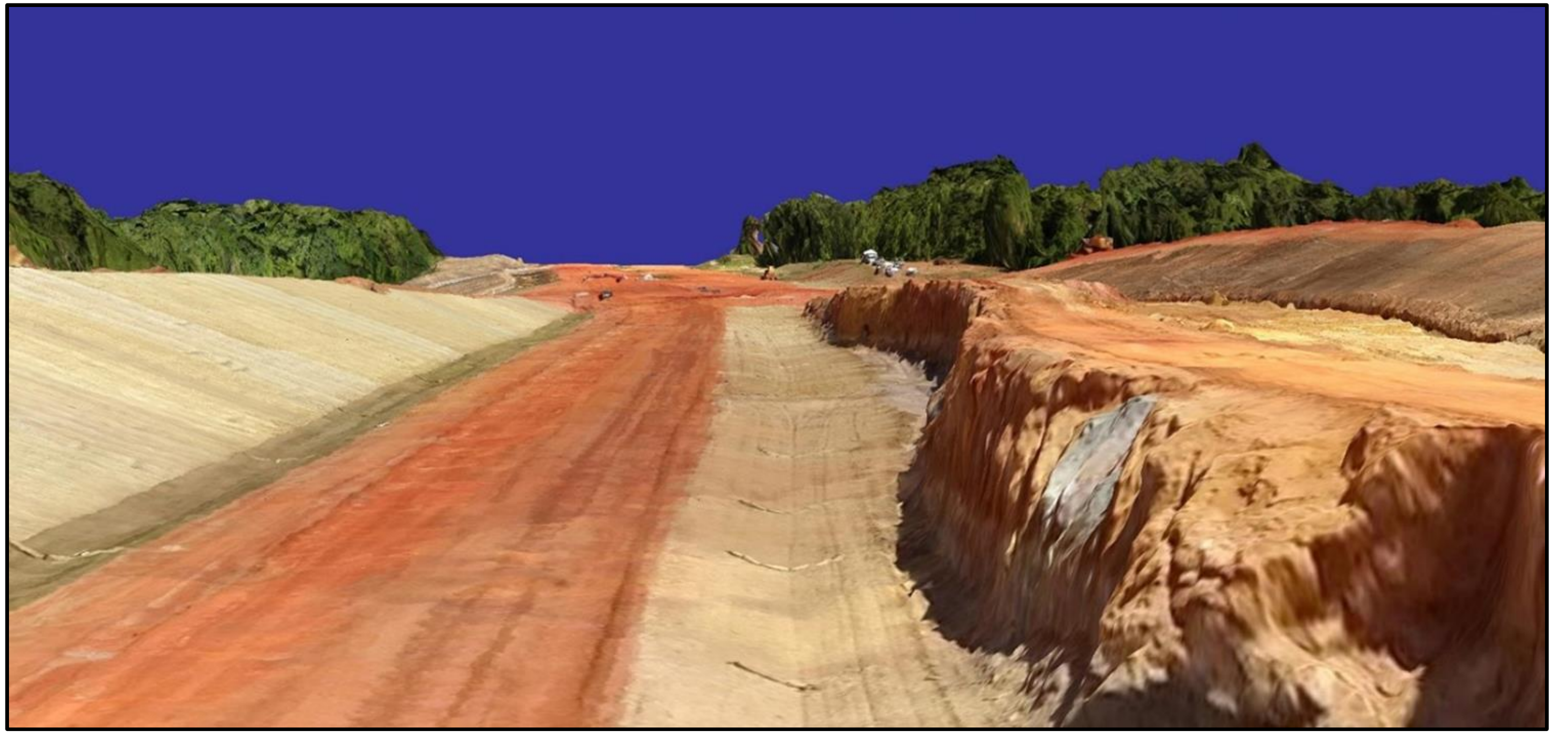
Alabama DOT Video

ALDOT UAS Assets

- DJI Phantom 4
- DJI Phantom 4 Pro
- DJI Mavic 2 Pro
- DJI Phantom 4 RTK
- DJI Goggles
- Sensefly Ebee
- Sensefly Albris
- Parrot ANAFI
- Plum Case
- UAS Command Center

Software & Apps

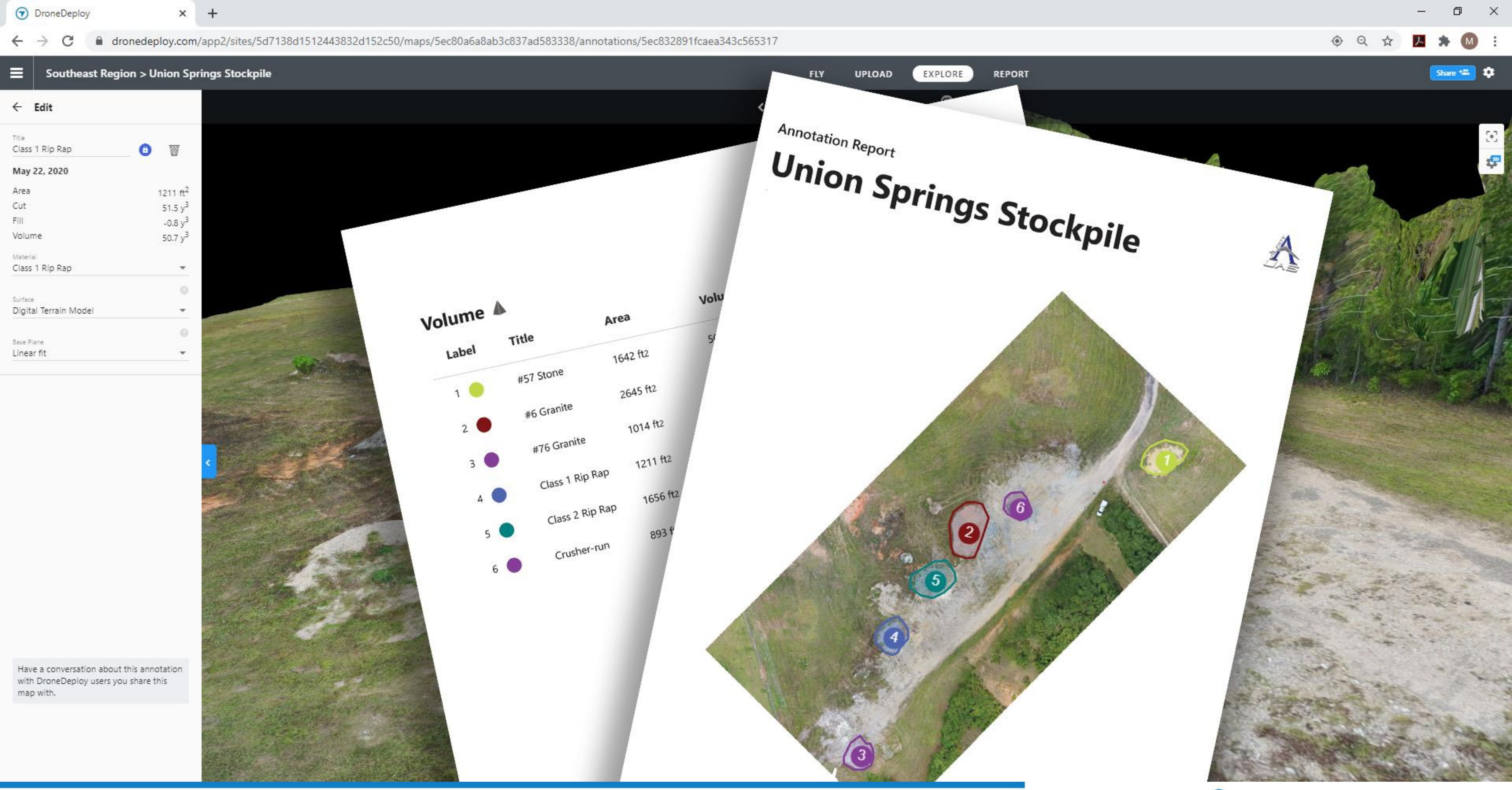


Pre-Flight & Missions

- Survey 123
- Emotion 3: Ebee and Albris
- DJI Go/GS Pro: DJI Drones
- Pix4D Capture: DJI Drones & ANAFI
- Drone Deploy: DJI P4 & Mavic 2 Pro

Post Processing

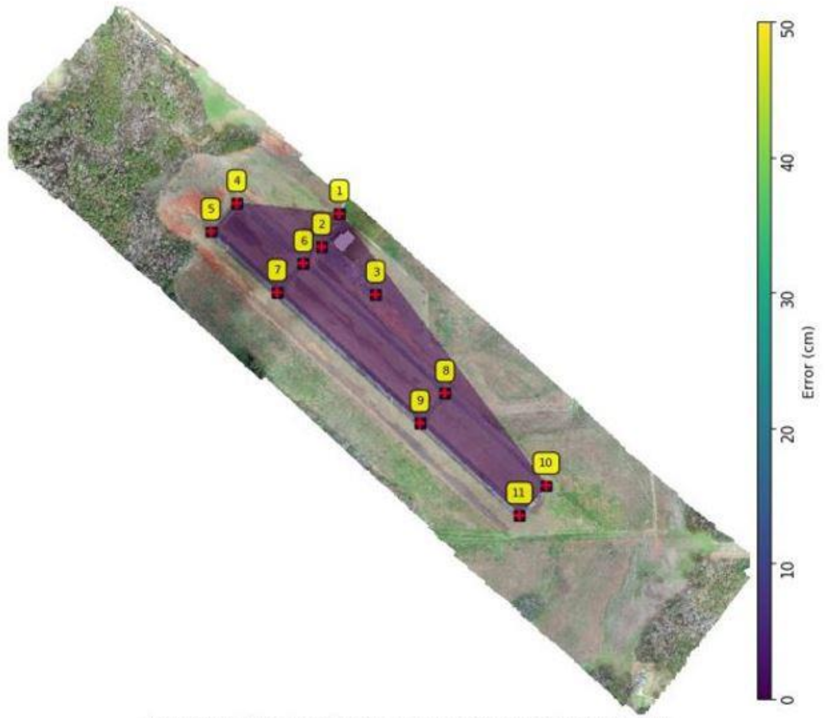
- Drone Deploy
- Context Capture
- Pix4D Mapper Pro
- Virtual Processing Farm



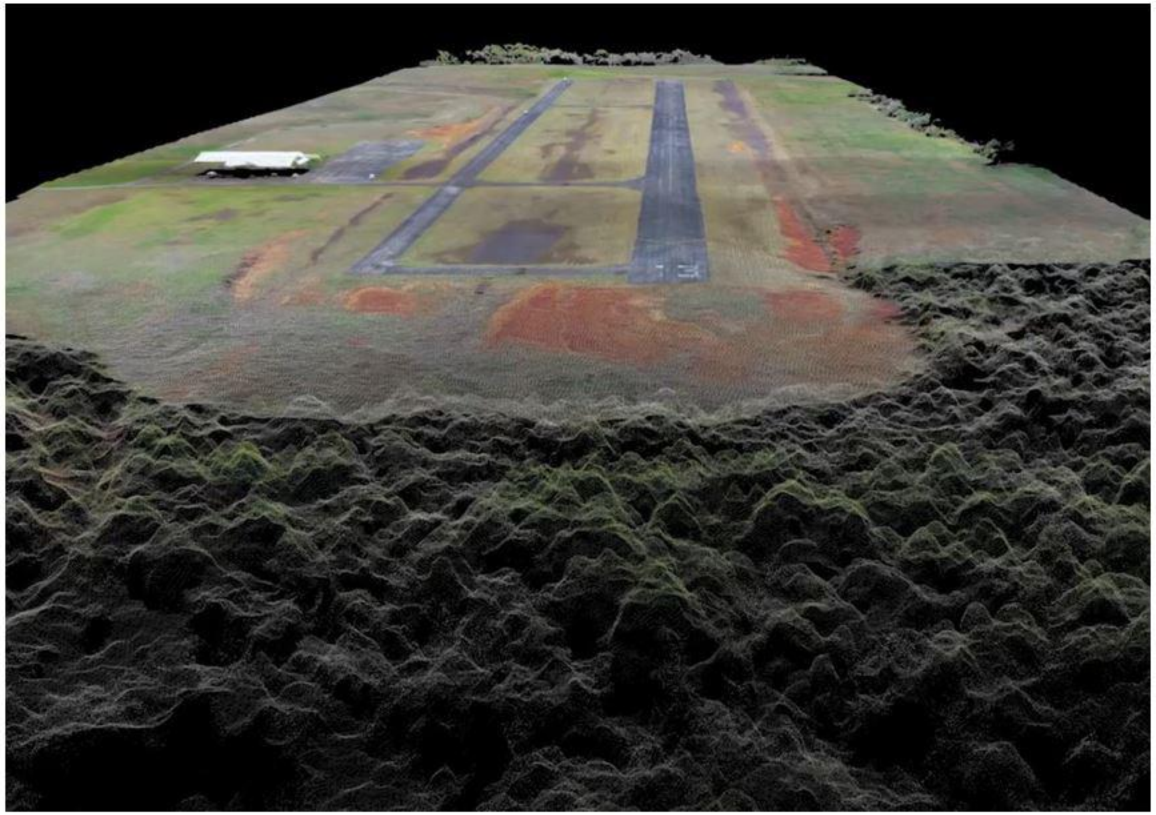
Union Springs Stock Piles

Airports

Testing UAS and Mobile Scan Data for Clear Zones and Pavement Conditions

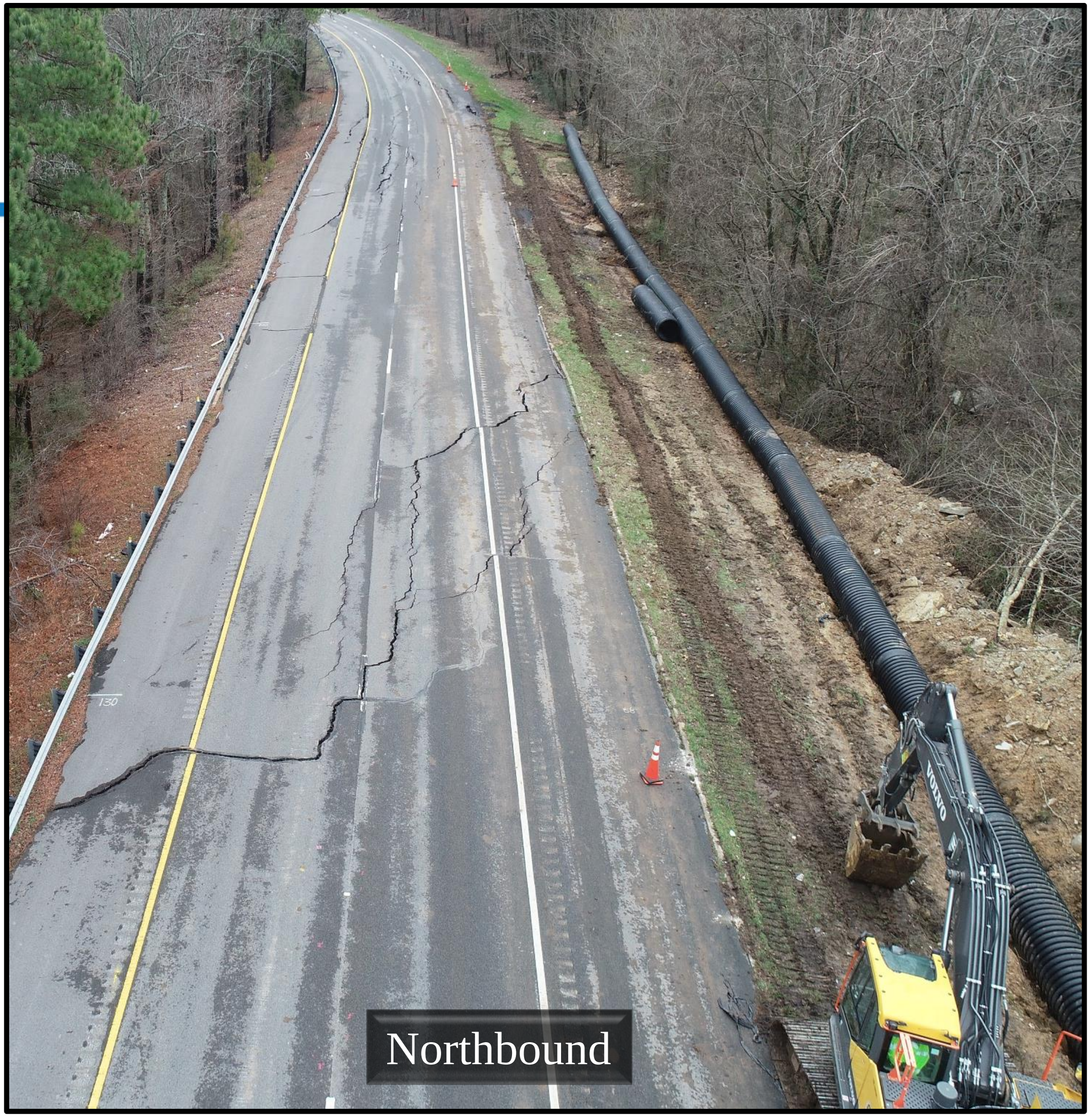


Visualisation of the expected absolute position error within the checkpoint area.

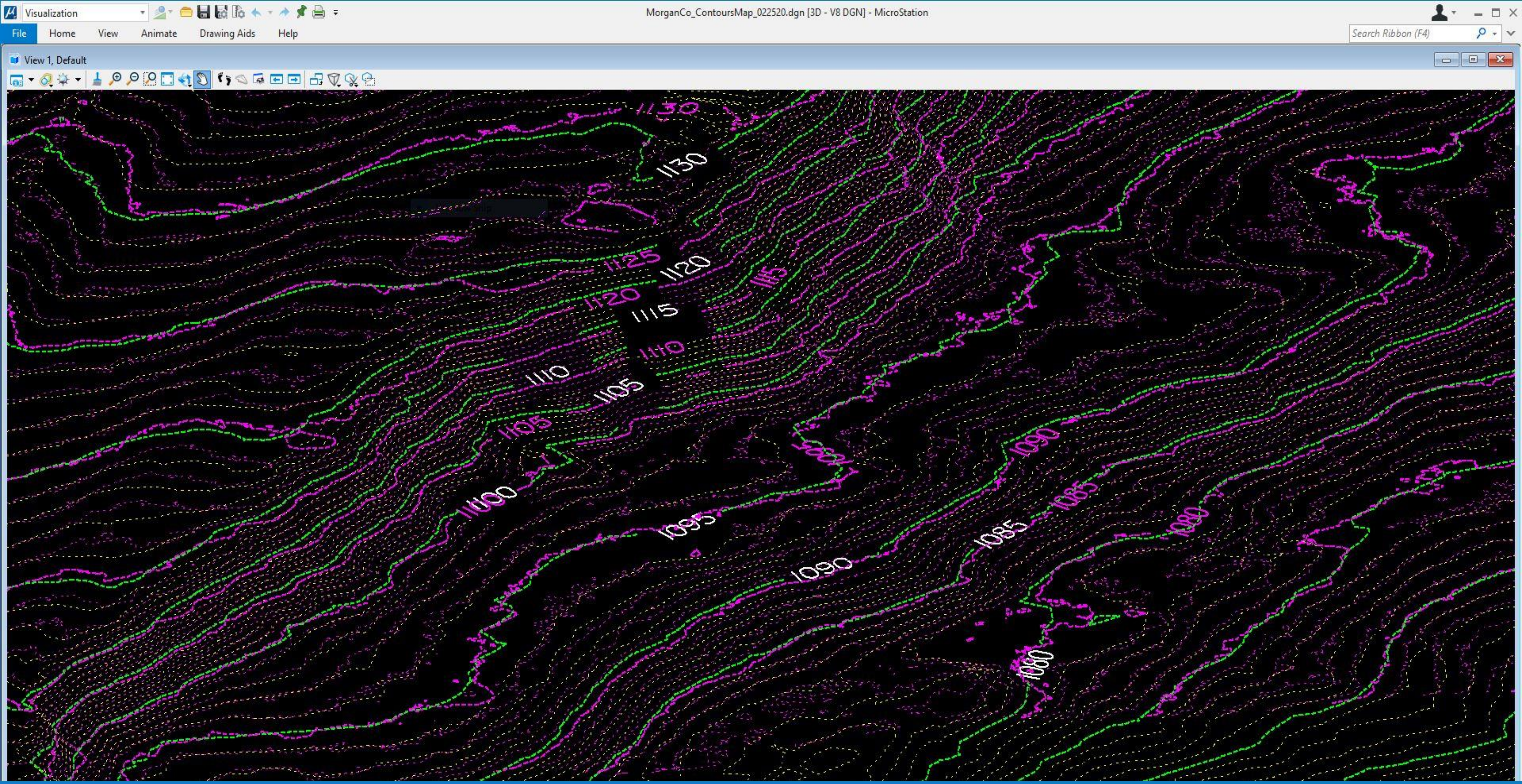


State Route 145
Waxahatchee Creek

Dunlap Drive, Pinto Pass



Lacey’s Spring, US 231



Aerial LIDAR vs Drone LIDAR

U.S. Department of Transportation
Federal Highway Administration

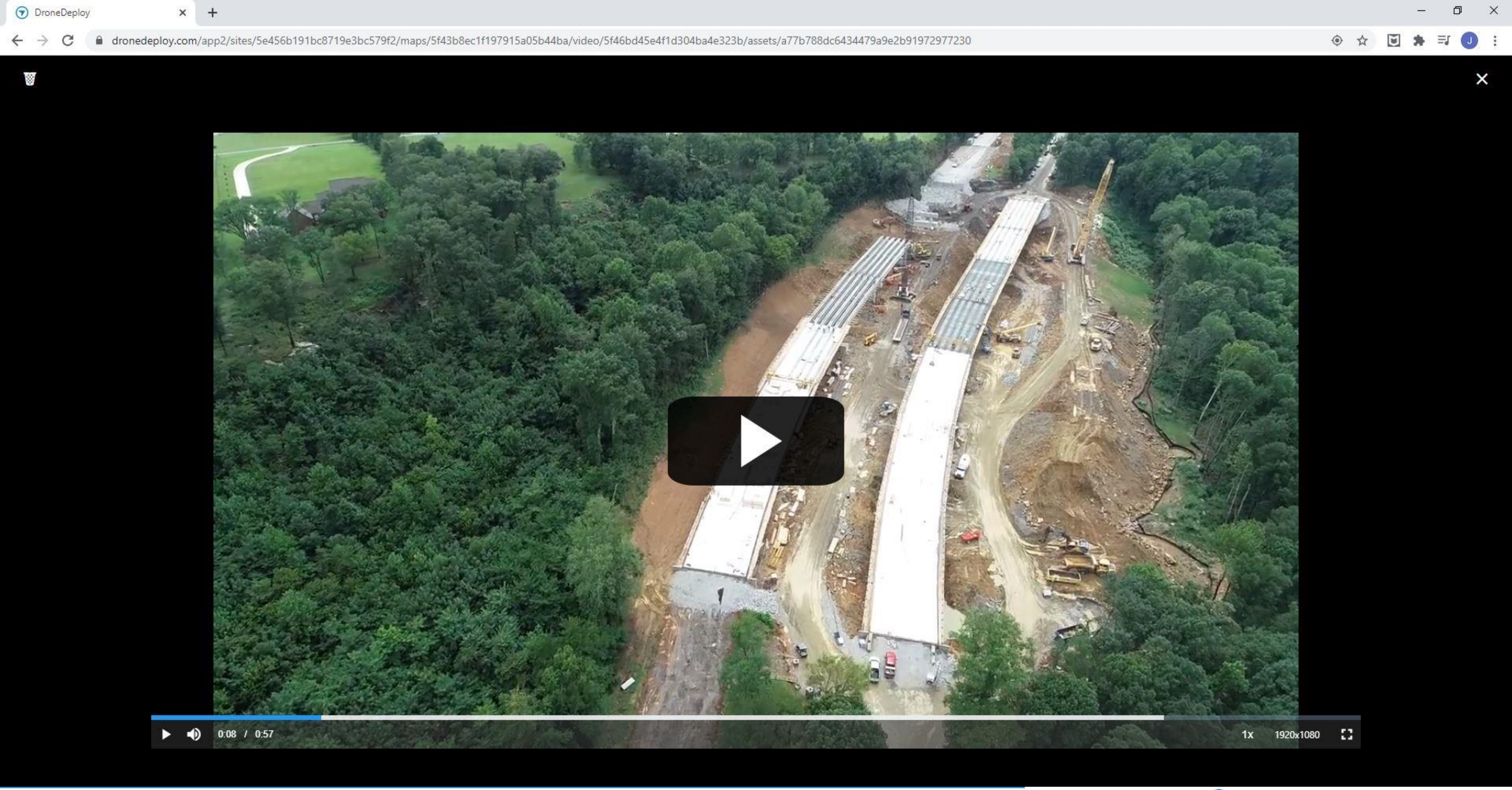
360 Pano

Ortho

Photo Plan

15 Minutes to Plan Flight, and 40 Minutes to Fly the Entire Mission

Drone Deploy Flight Planning



Drone Deploy Dashboard

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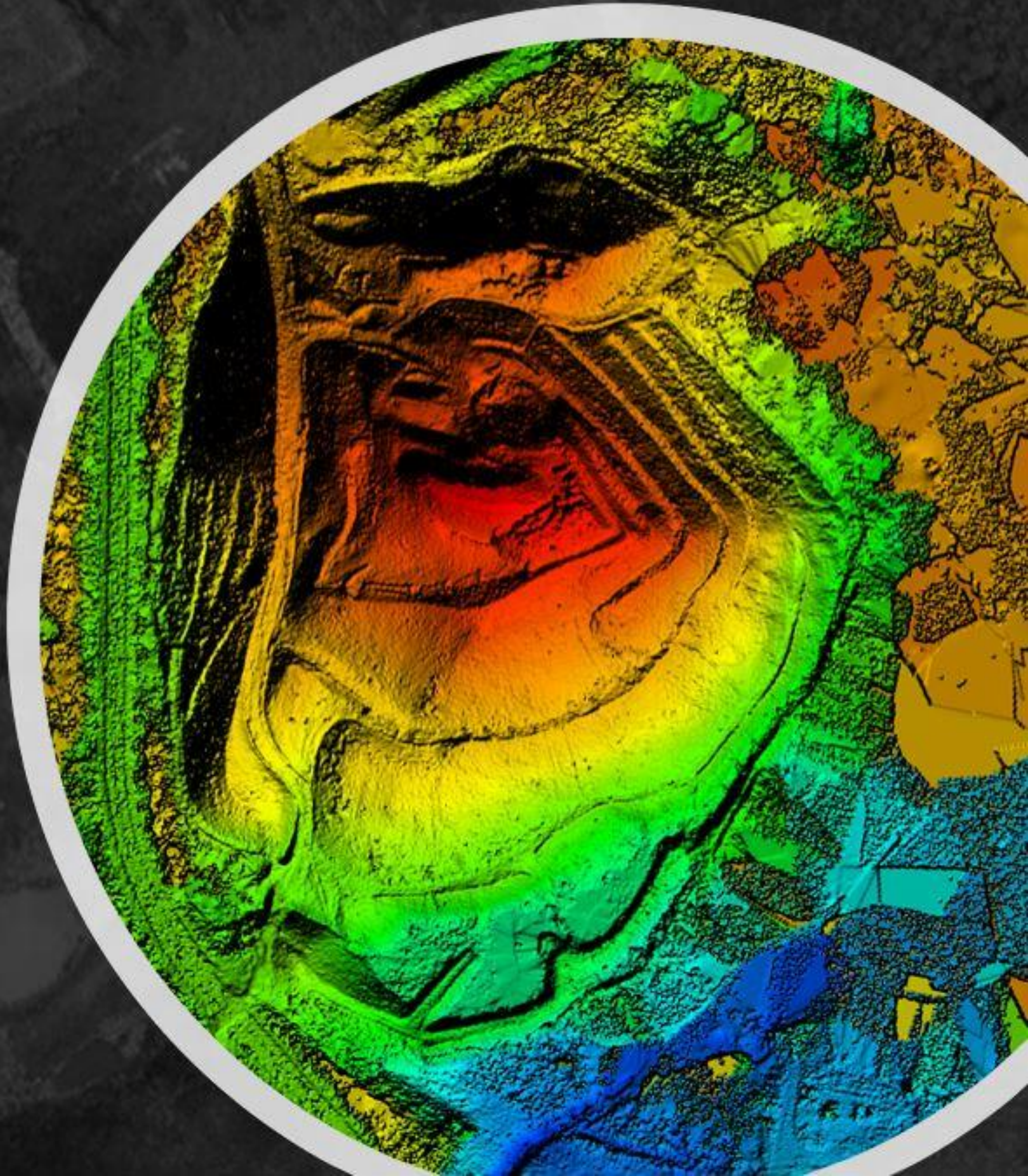
Federal Highway Administration

September 2019 – Present

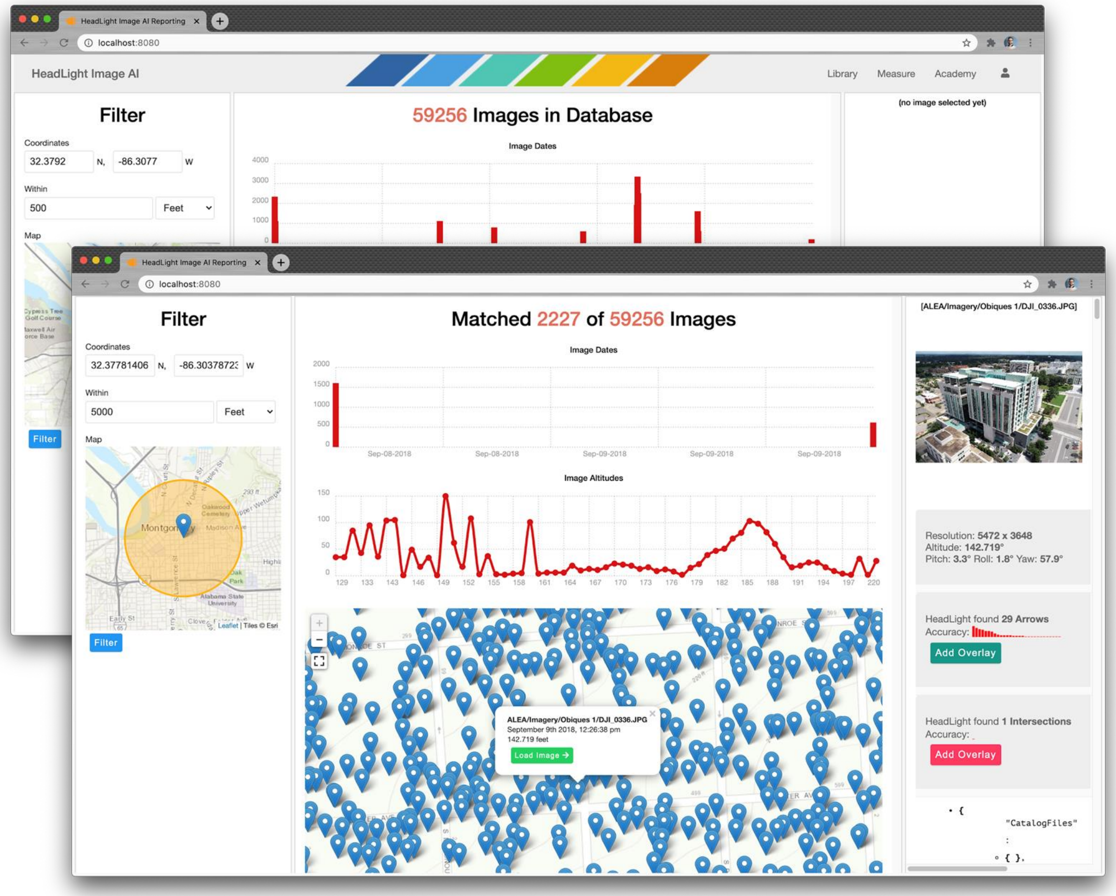
1100 Drone Deploy Flights

300 DJI, GS Pro, Pix4D Capture Flights

- Construction Inspection/Progress
- Orthos
- Point Cloud Data
- 3D Reality Meshes
- Photography/360 Panos
- Videos
- Earthwork Volumes
- Emergency/Disaster
- Bridge & Structure Inspections
- Artificial Intelligence



Developing AI/ML to automatically catalog, index, and extract data from UAS imagery



Web interface to browse and search all UAS image data available to others within the Department.

Developing image classification models to detect assets within the imagery and index. Intersections, pavement, and arrows shown here. Exploring bridge inspection as well.

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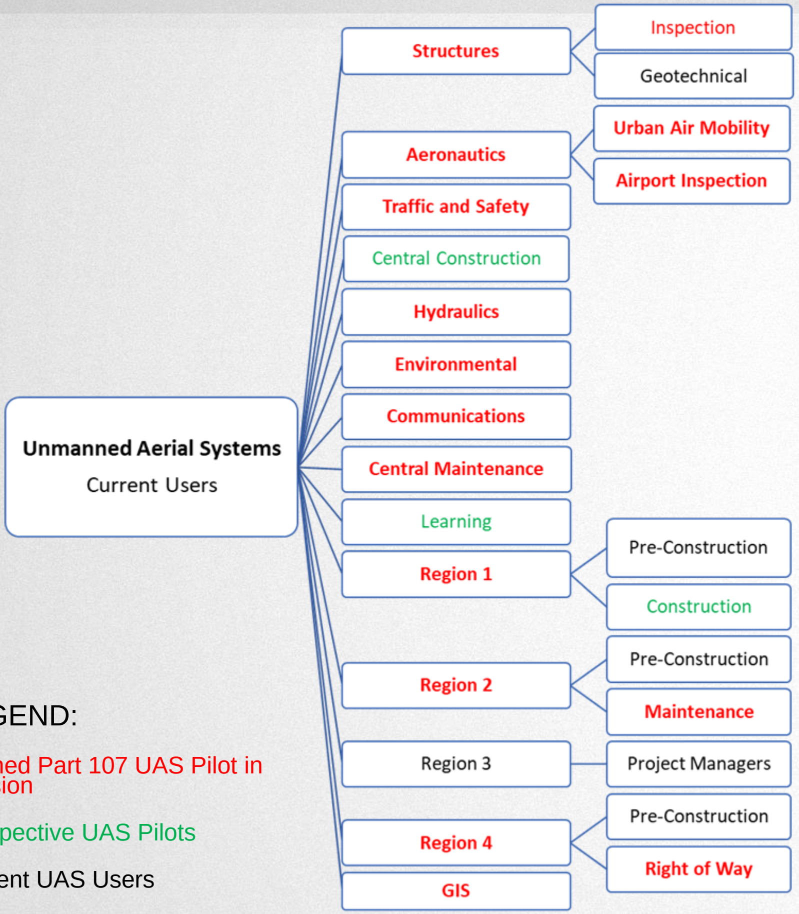
Mobile, Alabama


UAS
Unmanned Aerial Systems
UDOT
Keeping Utah Moving

Utah DOT UAS Program



LEGEND:

Trained Part 107 UAS Pilot in Division

Prospective UAS Pilots

Current UAS Users

2010 – UAS Study with USU

https://www.udot.utah.gov/main/uconowner.gf?n=10710706202834543

2016 - 1 Remote Pilot (4 UAS)

2018 - 10 Remote Pilots (6 UAS)

Aug 2020 - 35 Remote Pilots (41 UAS)

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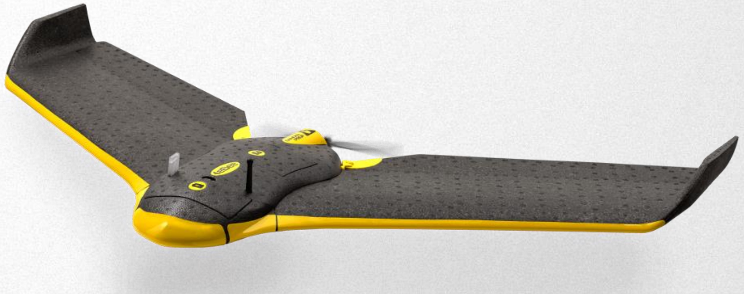
Surveying Tools

CHANGE



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Considerations

Policy and Procedures

Simple to Learn

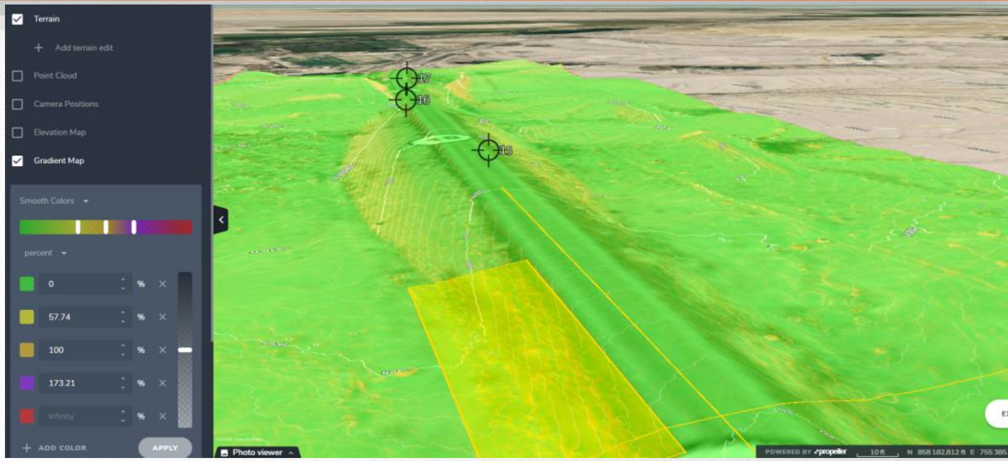
Support Digital Delivery

Accessible

Ability to Share

Platforms

- Fixed Wing
- Rotorcraft
- UAS LiDAR
- Conventional Tools



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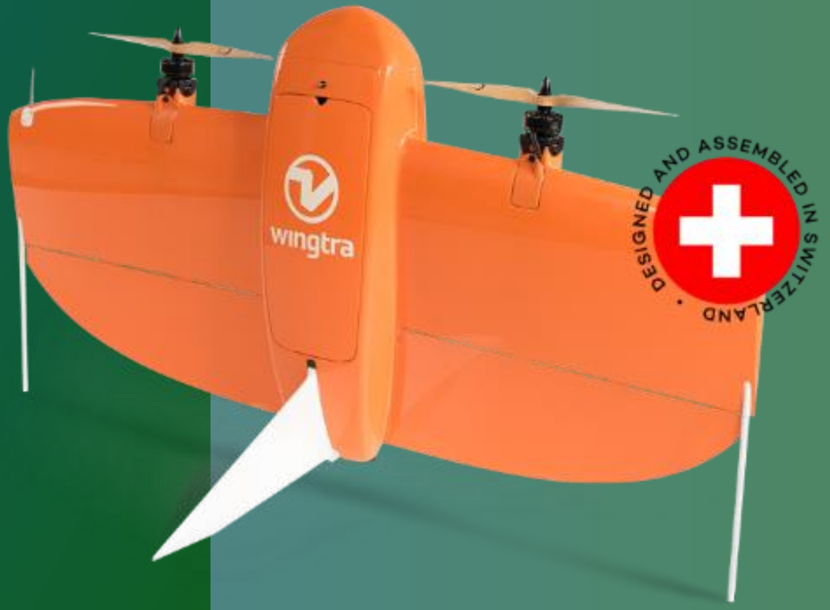
UAS

Unmanned Aerial Systems



UAS Platforms

Best solution for your mission

Rotorcraft

?

Fixed Wing

Rotorcraft

Rotorcraft

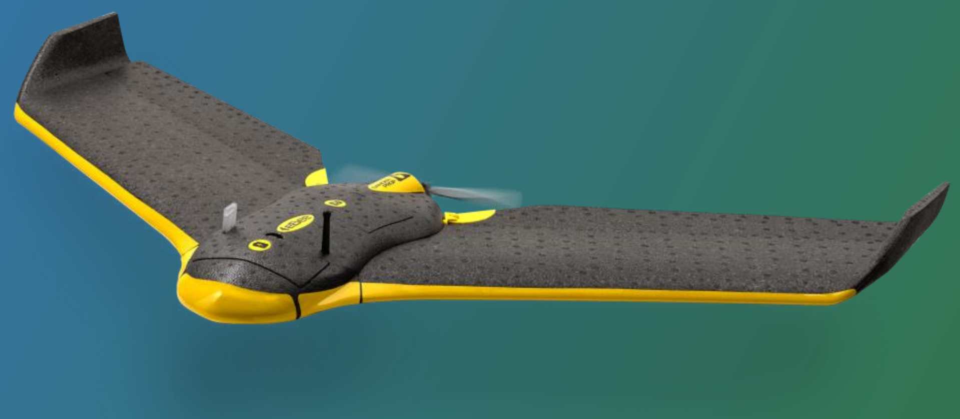
Strengths

- VTOL & Flexibility On Take Off And Landing Sites
- Stable
- Easy To Fly
- Variety Of Aircraft To Choose From
- Hover
- Ability To Change Camera Angles
- Precision Maneuvering

Weaknesses

- Battery Life
- Not As Aerodynamic/Less Efficient
- More Maintenance
- Repairs Can Be Expensive
- Slower Airspeed
- Small Payload Capacity

Fixed Wing



Fixed Wing

Strengths

- Longer Flight Times/Endurance
- More Aerodynamic/Efficient
- Large Area Coverage
- Less Parts To Maintain
- Higher Speeds
- Glide Ratio

Weaknesses

- Can’t Fly Slow Or Hover While Taking Images
- Larger Area For Take Off And Landings
- Fixed Camera Angle On Most Aircraft
- Harder To Fly Manually
- Target For Birds Of Prey

Ground Control Points

Strengths

- Increases accuracy of solution
- Known coordinates on ground
- Can be used multiple times
- Not susceptible to turbulence, vibration, and camera calibration errors.
- Can be used with any UAS platform

Weaknesses

- Requires equipment or hiring of firm to set GCP.
- Time commitment
- If sole solution, requires sufficient density to achieve desired results.
- Not always easy to gain access to set GCP
- Data is only as good as the tool used to set the GCP.
- Requires flight to see GCP

Ground Control

Characteristics

- Variety of Targets
- Can Use Existing Objects
- Needs to be Highly Visible from Altitude.
- High Contrast

Ground Control

Considerations

- Type of Ground Material – Will the Marking Stay?
- Can’t Always Paint Targets
- Shadows
- Trees
- Make Sure You Can See Targets From the Air!

Ground Control

Considerations

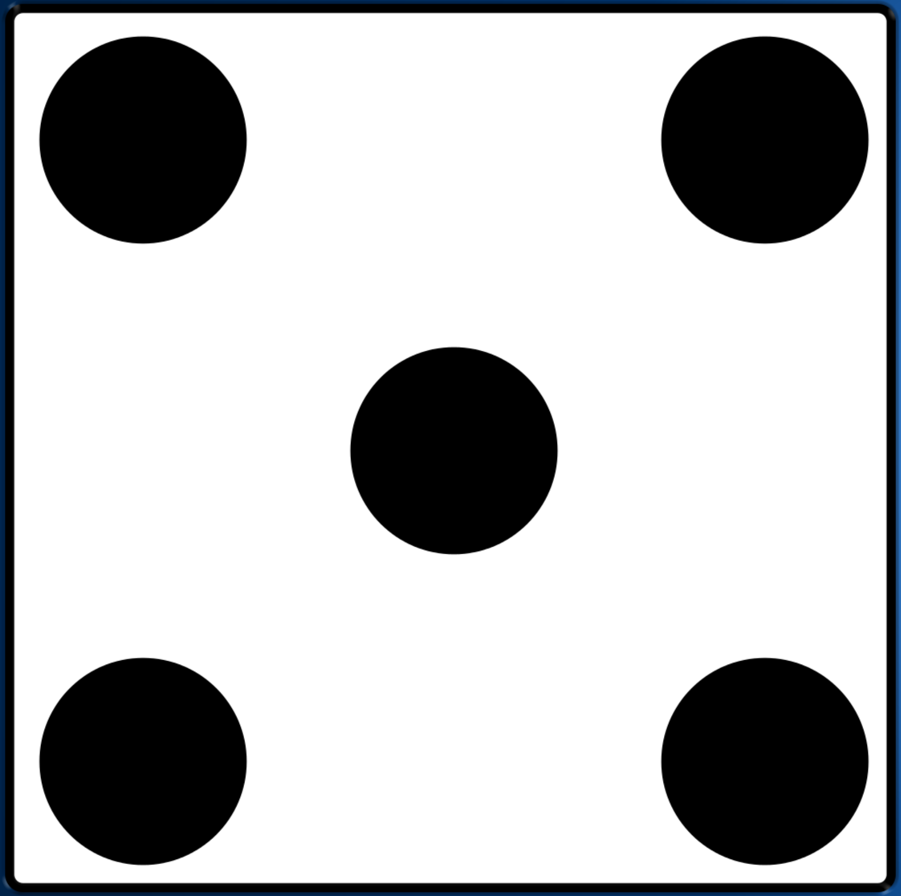
- Make Numbers Large Enough to Read From Air.
- Create a Mark in the Middle for Easier Selection

Ground Control

Best Practices

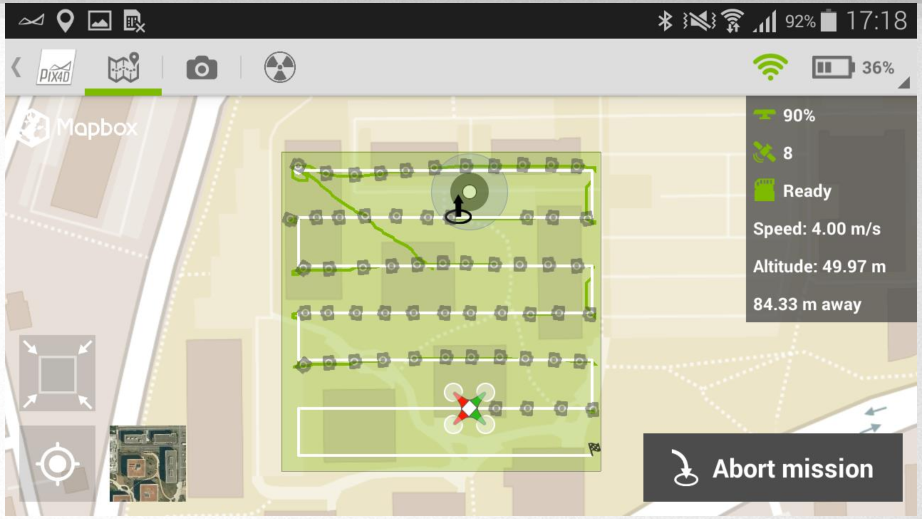
- Keep GCP's No More Than 1000-1500' Apart From Each Other.
- 5 Sided Die
- Randomize Throughout Flight Area
- Don't Have Them On The Edges Of The Flight Data Except When Accounting For Overlap On Multiple Days.
- Have Targets Large Enough For Ground Sampling Distance (GSD)
- Avoid Obstructions And Shadow Areas

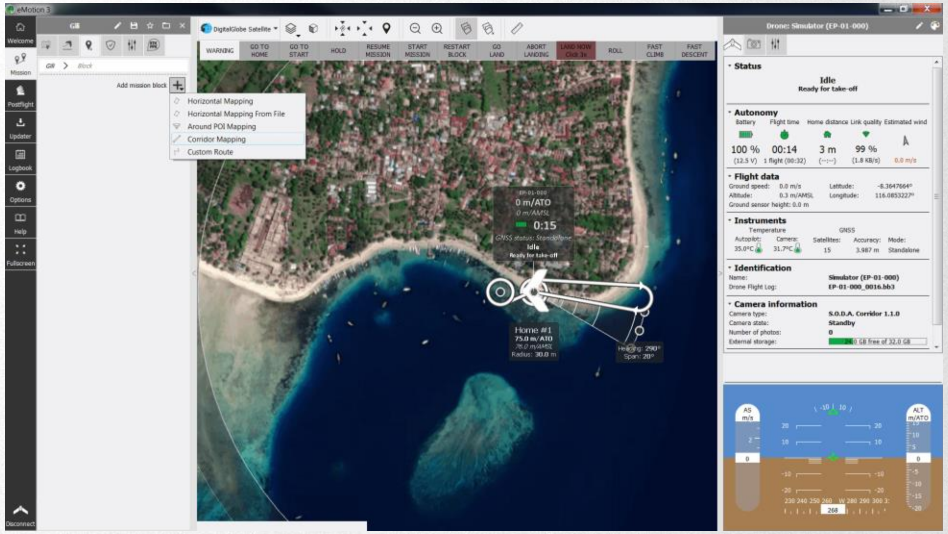
GCP Layout



Software - Flight Planning

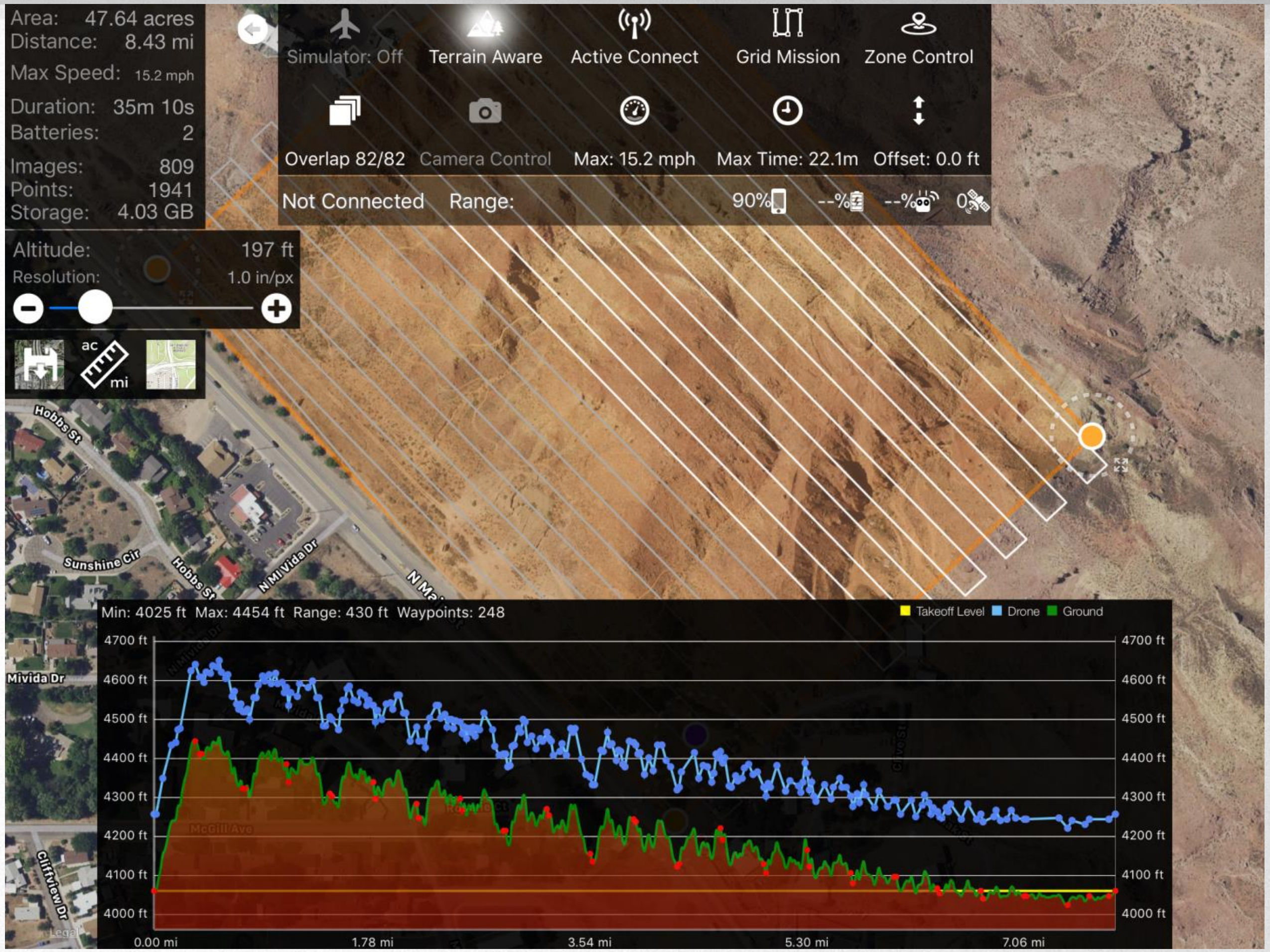
- Pix4D Capture
- Map Pilot
- Emotion X
- Wingtra Hub





Software - Flight Planning

- Terrain Awareness



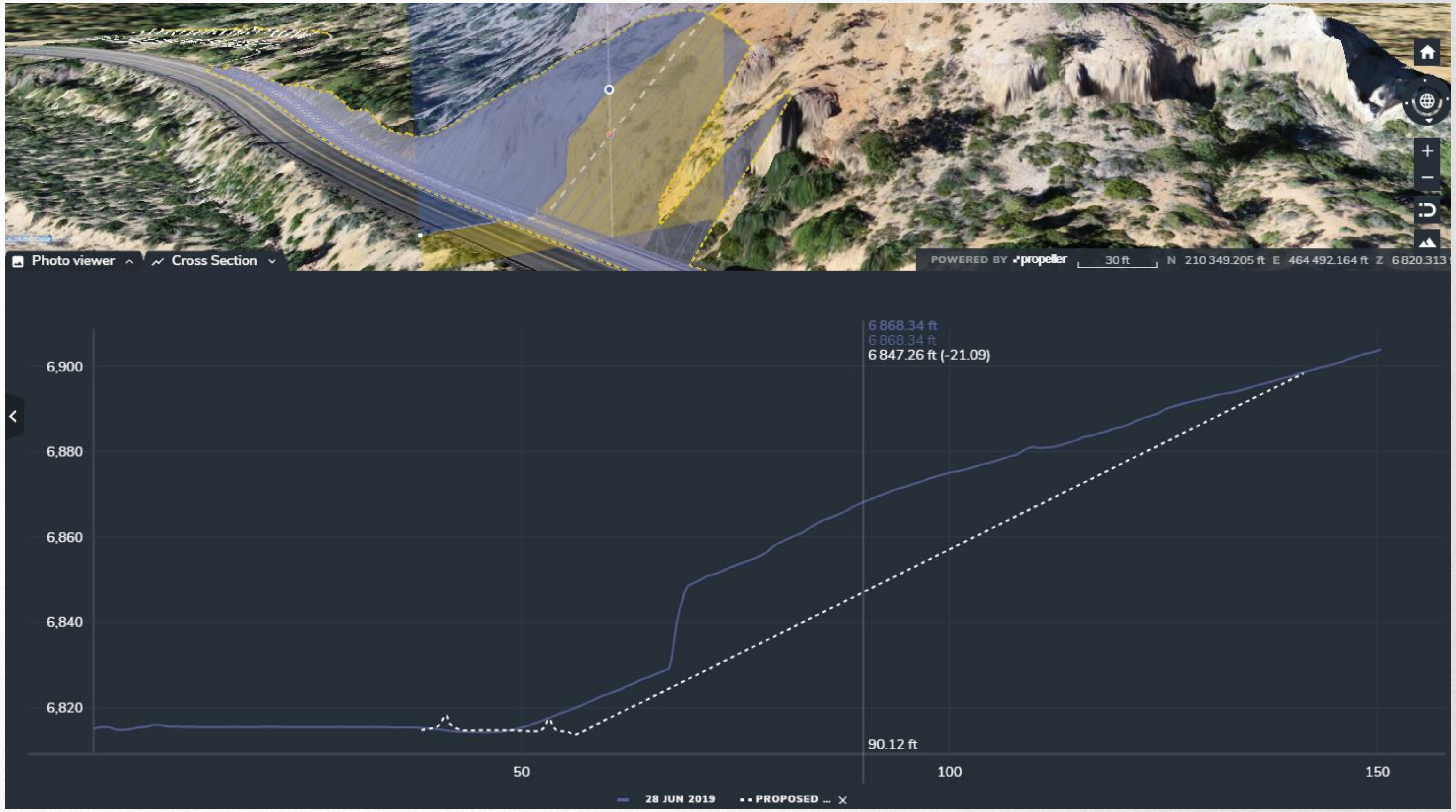
Traditional vs. Point Cloud

Break-Line Survey

UAS Survey

Bryce Canyon National Park

- Determine Preferred Design
- Impacts of Design Changes
- Verification in Field

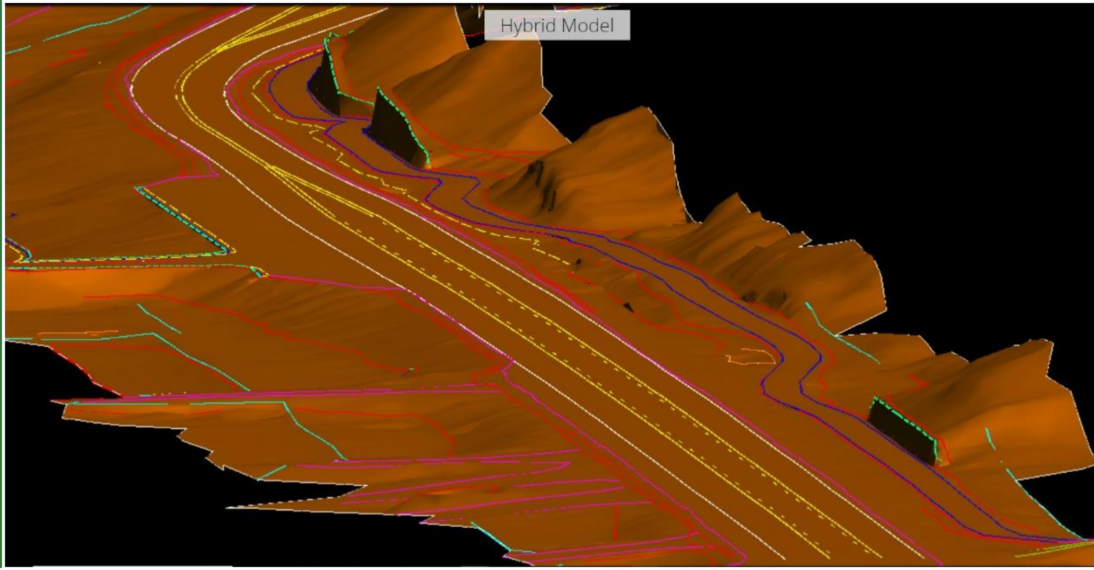


Hybrid Method

Use the Strengths of Your Tools

- Get the Most Benefits
- Reduce the Weaknesses
- Increase Productivity and Safety
- Combine Data from the Best Sources

- UAS
- LiDAR
- GPS Rover
- Total Station



Verification Shots

- Required on all Pre-Construction Surveys
  - Softscape Surfaces
  - Hardscape Surfaces
  - Randomized

Quality Control/Quality Assurance

Statistical Report

- Required on all Pre-Construction Surveys
  - Softscape Surfaces
  - Hardscape Surfaces

- Provides Confidence In Surface

71	1151			3788.06	113741.25	572386.58	3788.06			0.00
72	1152			3787.84	113741.41	572375.89	3787.90			0.05
73	1154			3787.57	113720.26	572355.68	3787.70			0.13
74	1155			3787.33	113708.19	572340.29	3787.34			0.00
75	1156			3787.29	113700.01	572336.63	3787.26			-0.03
76	1164			3786.48	113648.18	572274.96	3786.47			-0.02
77	1165			3786.46	113648.62	572264.49	3786.44			-0.03
78	1166			3786.36	113632.89	572253.04	3786.29			-0.07
79	1167			3786.24	113621.83	572236.72	3786.23			-0.01
80	1174			3785.55	113559.50	572167.23	3785.65			0.10
81	1175			3785.56	113563.69	572154.37	3785.62			0.05
82	1176			3785.51	113552.82	572149.52	3785.48			-0.03
83	1177			3785.42	113539.87	572140.59	3785.37			-0.05
84	1179			3785.27	113519.68	572114.83	3785.27			0.01
85	1180			3785.20	113519.12	572105.90	3785.29			0.09
86	1181			3785.15	113525.44	572099.48	3785.24			0.09
87	Number Chk Pnts									81
88	Mean Error (us)									0.01
89	Standard Deviation (us)									0.04
90	RMSE (us) - RMSEx, RMSEy, RMSEz									0.04
91	RMSEr (us) - Combined Horizontal RMSE									
92	H Accuracy @ 95%									
93	V Accuracy @ 95%							0.08		

UDOT Keeping Utah Moving

Lessons Learned

- Understand radio link characteristics in multiple environments
- Battery life and endurance
- Plan for the worst, hope for the best
- Looks can be deceiving
- Initial test flight to scout for obstacles and heights prior to autonomous flight mapping.
- Use aviation radio to monitor traffic
- Establish good relationships with other entities and public.

Benefits

New Era of Data Collection

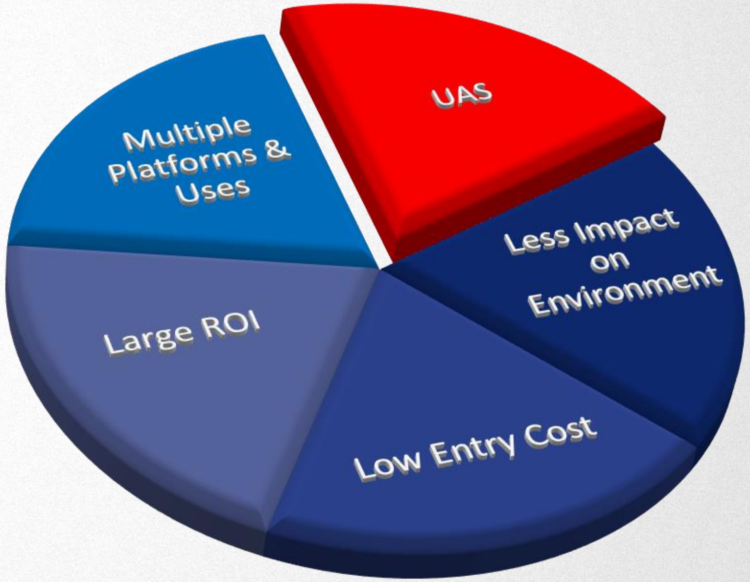
Increased Safety

Productivity Gains

Significant Savings

Applicable to Entire Department

Multi-Uses for Data



UDOT Keeping Utah Moving

Thank You!

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UDOT Keeping Utah Moving

Question & Answer

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