




SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Expanding Use of Drones in the Railroad Environment

Community of Interest Webinar for
Railroad-DOT Mitigation Strategies (R16)

August 8, 2018

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Purpose of Today's Webinar

- **Learn more** about the SHRP2 R16 Railroad-DOT Mitigations Strategies Community of Interest and its Innovation Library.
- **Hear presentations** from Utah DOT and BNSF regarding the increasing uses and value of Unmanned Aircraft Systems (Drones) to promote safety and efficiency in the Railroad Environment.
- **Discuss and ask questions** in a robust exchange with presenters and participants.

Agenda

- Welcome
- Presentations:
  - Unmanned Aerial Systems, Utah DOT
  - BNSF Railway UAS Program, BNSF
- Discussion and Comments

A Few Housekeeping Details

- **Tell us what you think**. We want to hear from all of you on the call during the discussion segment.
- **Please add your comments to the chat box provided.**

Welcome

Presenters

- Paul Wheeler, Lead UAS Coordinator, Utah DOT
- Todd Graetz, Director of Technology Services, BNSF

Moderators/Participants

- Kate Kurgan, Moderator/ R16 Product Lead, AASHTO
- Pam Hutton, SHRP2 Implementation Manager, AASHTO
- David Solow, R16 Subject Matter Expert

Transcript of the presentation will be posted on the AASHTO SHRP2 website:
http://shrp2.transportation.org/Pages/R16_RailroadDOTMitigationStrategies.aspx

Focus Areas

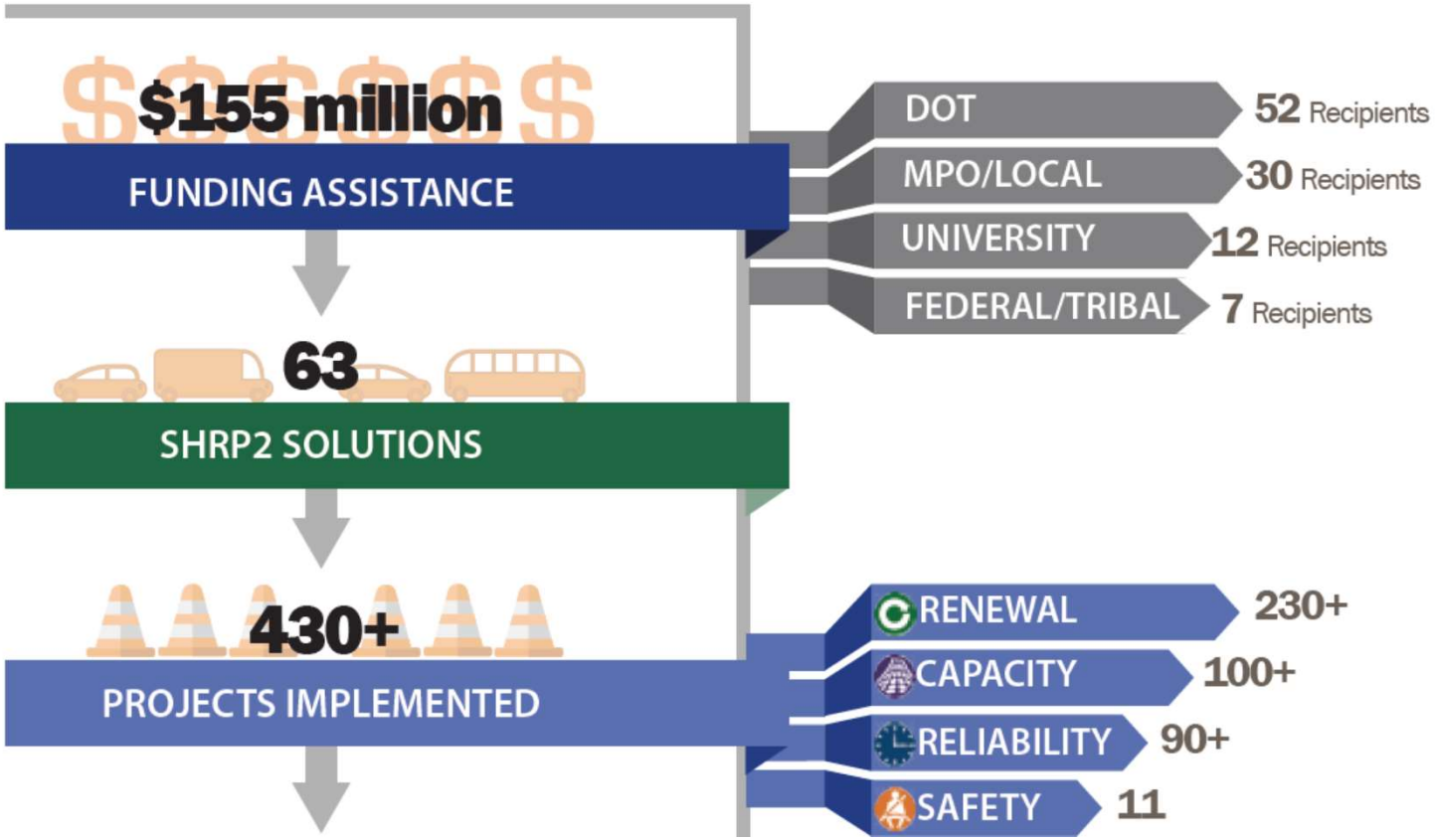
Safety: fostering safer driving through analysis of driver, roadway, and vehicle factors in crashes, near crashes, and ordinary driving

Reliability: reducing congestion and creating more predictable travel times through better operations

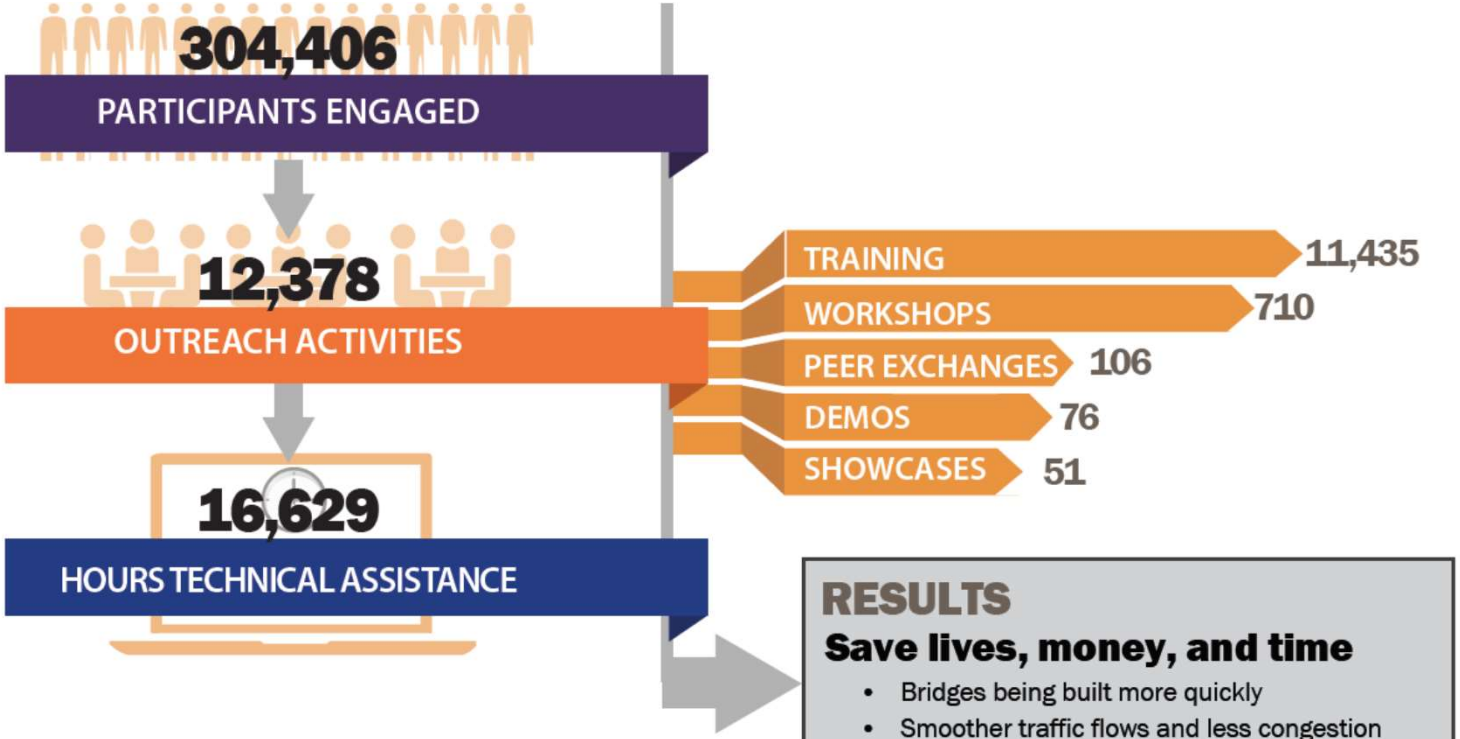
Capacity: planning and designing a highway system that offers minimum disruption and meets the environmental and economic needs of the community

Renewal: rapid maintenance and repair of the deteriorating infrastructure using already-available resources, innovations, and technologies

SHRP2 Implementation:
INNOVATE. IMPLEMENT. IMPROVE



SHRP2 Implementation:
INNOVATE. IMPLEMENT. IMPROVE



RESULTS

Save lives, money, and time

- Bridges being built more quickly
- Smoother traffic flows and less congestion
- Reduced construction costs
- Safer roadways
- Smarter environmental reviews

What is SHRP2 R16?

- Active Strategic Community of Interest (COI)
- Strategies to Improve Railroad-DOT Cooperation and Accelerate Project Delivery
- Innovation Library http://shrp2.transportation.org/Pages/R16_InnovationLibrary_Topic.aspx
- AASHTO Web Page Resources: http://shrp2.transportation.org/Pages/R16_RailroadDOTMitigationStrategies.aspx

Unmanned Aerial Systems (UAS) Program

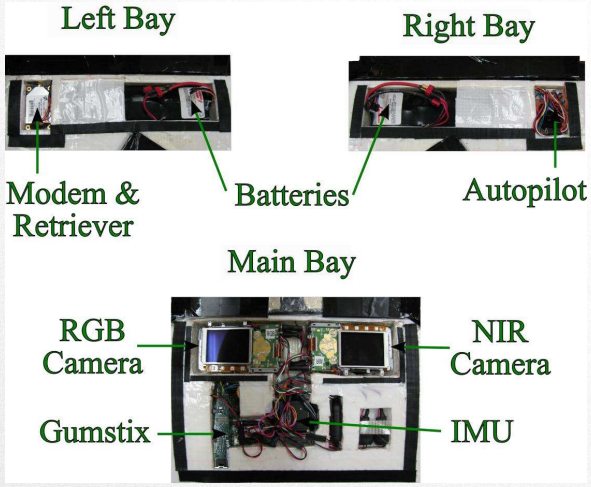
UDOT
Keeping Utah Moving

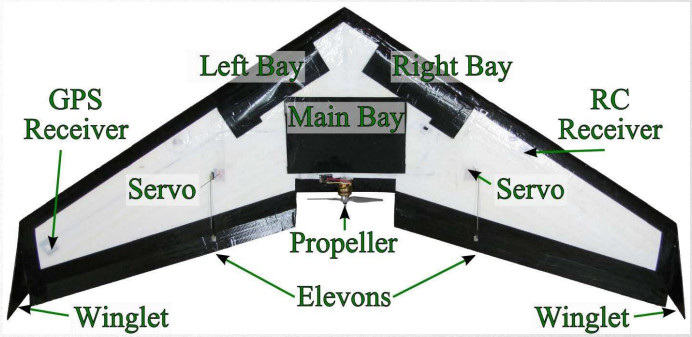
Implementation Stages

2010 Testing in coordination with Utah State University

- Southern Parkway Construction Monitoring
- Wetland Plant Species Classification

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

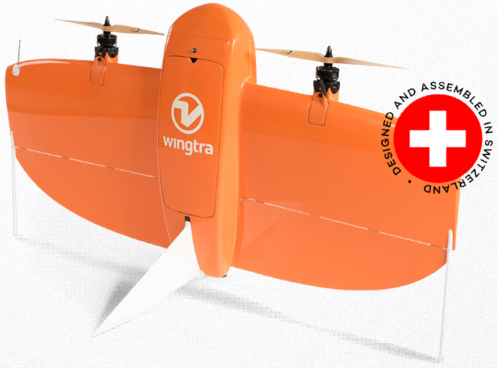




UDOT Keeping Utah Moving

Implementation Stages

- January 2016 Started Section 333 Process
- Purchased 3 Aircraft June 2016
- Policy and Procedures Approved March 2017
- 2018 - 9 Remote Pilots

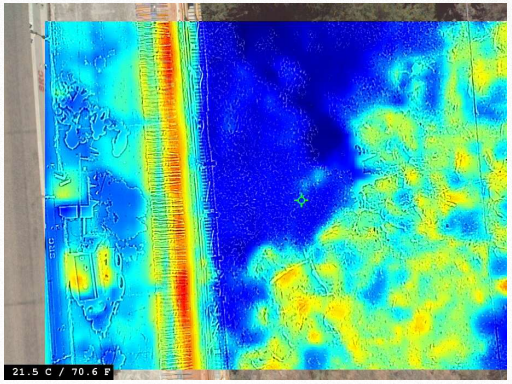


UDOT Keeping Utah Moving

UAS Platform Utilization

Structure Inspection

- Delamination (Thermal)
- Mapping
- Inspection

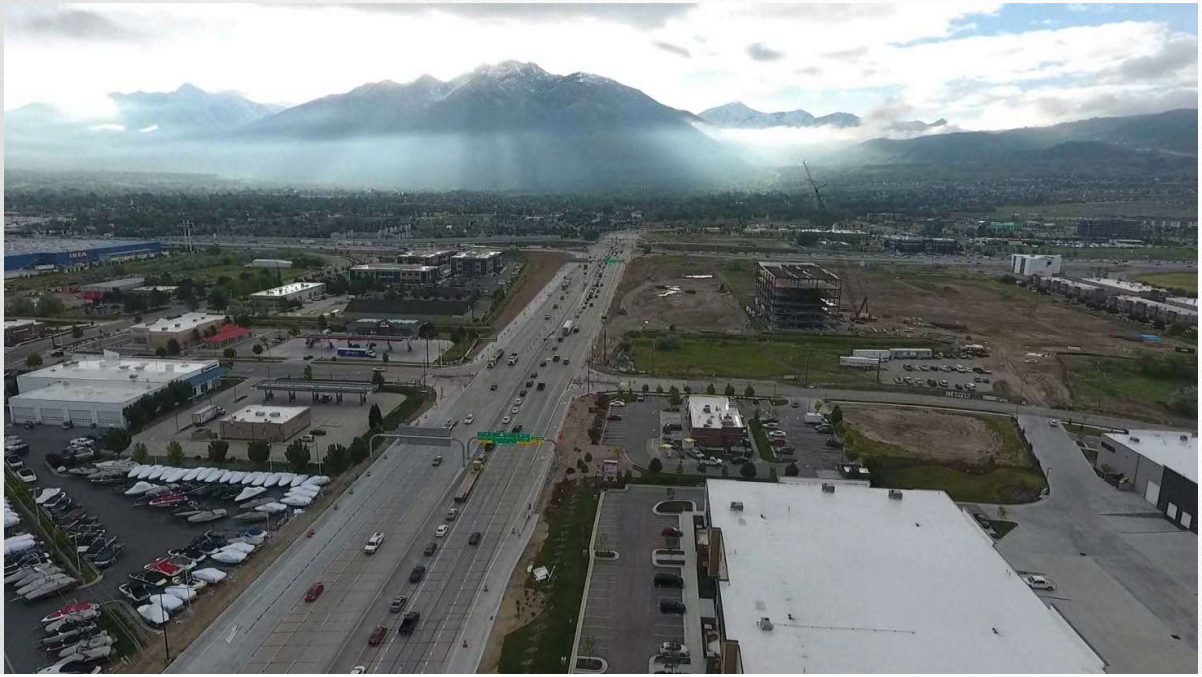


- Increase Frequency
- Improved Documentation
- Supplement

UDOT Keeping Utah Moving

Site Monitoring

- Live Streaming Capabilities
- Monitor Area
- Bird's Eye View at Low Cost



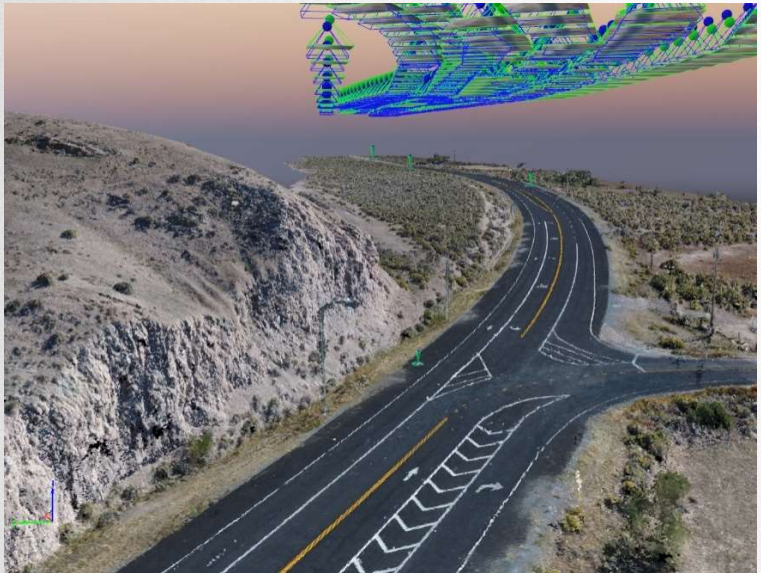
- Route Management
- Quick Response vs. Traditional Aircraft

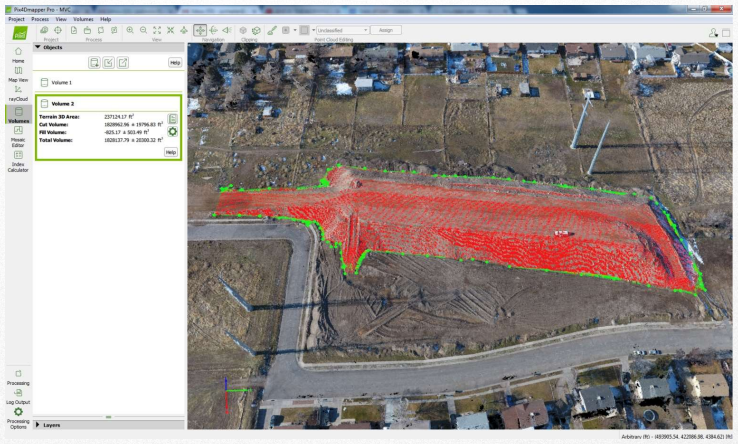
UDOT Keeping Utah Moving

UAS Platform Utilization

Land Surveying

- Highly Detailed Mapping Model
- Safety
- Speed of Collection
- High Resolution Aerial Imagery with Point Cloud





UDOT Keeping Utah Moving

Verification Report

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

- Hybrid Model

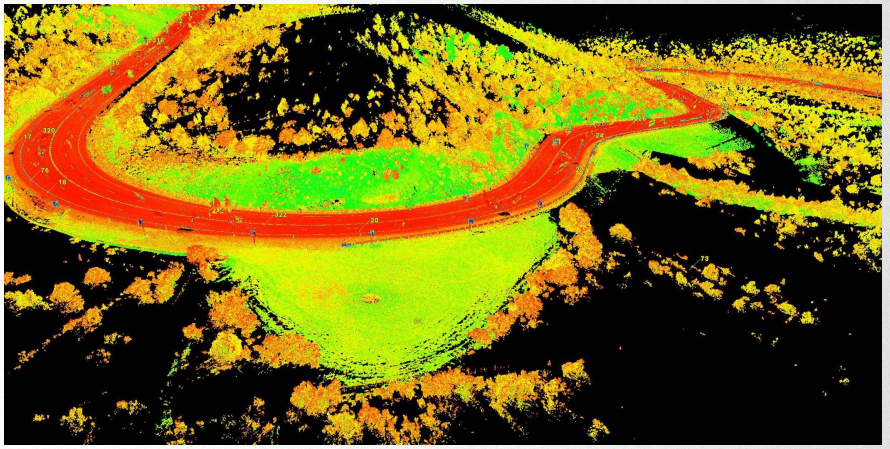
71	1151			3788.06	113741.25	572386.58	3788.06			0.00
72	1152			3787.84	113741.41	572375.89	3787.90			0.05
73	1154			3787.57	113720.26	572355.68	3787.70			0.13
74	1155			3787.33	113708.19	572340.29	3787.34			0.00
75	1156			3787.29	113700.01	572336.63	3787.26			-0.03
76	1164			3786.48	113648.18	572274.96	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

UAS Platform Utilization

Construction – SR20

- First Project for 3D Model as Legal Document
- Attribute based Model
- Phasing/Changes Over Time
- Used by Construction & Inspection



- Compared against original design
- Hybrid Data
  - GPS, UAS, LiDAR, Design
  - As-Built Model

UDOT Keeping Utah Moving

SR20 – Project Outcomes

- Overall savings for this project was $82,672 (2.58%)
- Workforce was 45% more productive
- Completed 25 days ahead of schedule

UDOT Keeping Utah Moving

UAS Platform Utilization

Environmental

- Google Earth High Resolution Imagery
- Wetland Mitigation – Jordan River
- Galena Canal – Hot Spring
- Monitor Noxious Weed Removal

Keeping Utah Moving

Incident Management

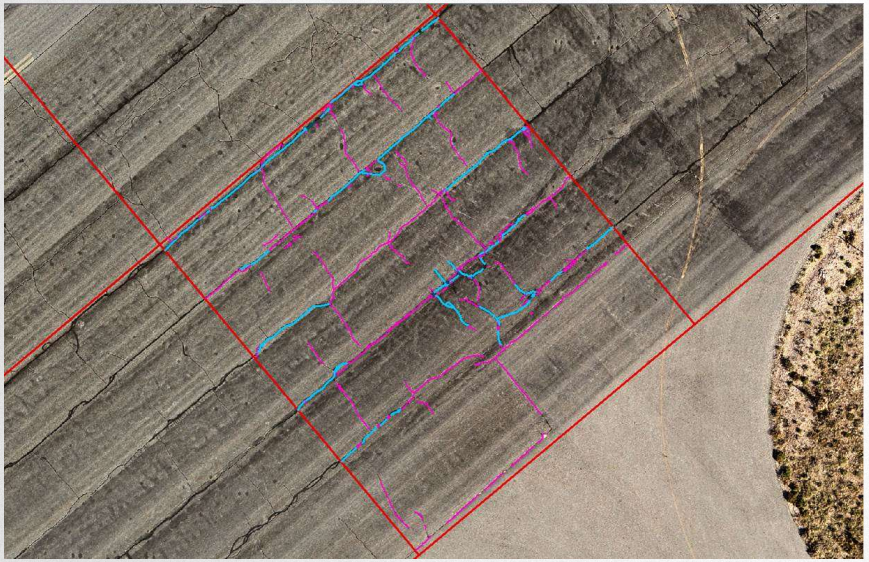
- UAS for IMT Vehicles
- Accident Reconstruction
- Monitoring Alternative Routes
- Real Time Broadcasting
- Detour management
- Search and Rescue

UDOT Keeping Utah Moving

UAS Platform Utilization

Airport Inspection

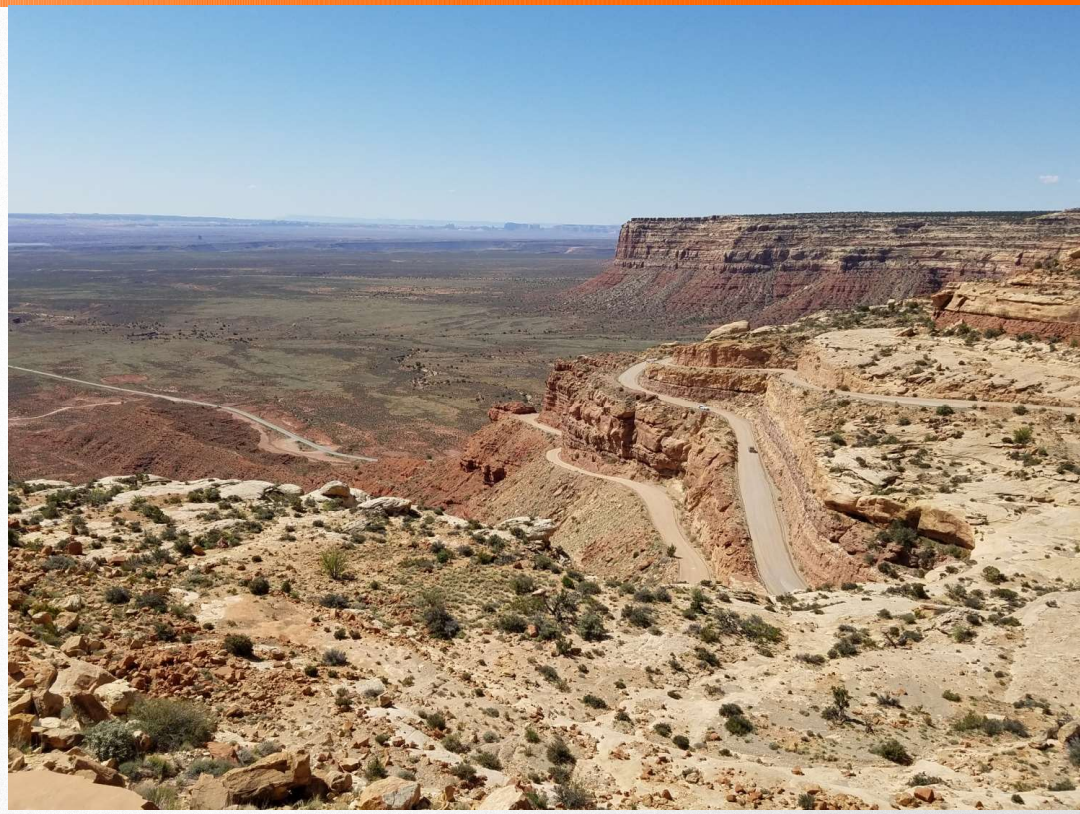
- Pavement Condition
- Automated Crack Detection
- Obstacle Clearance



Keeping Utah Moving

Landslides

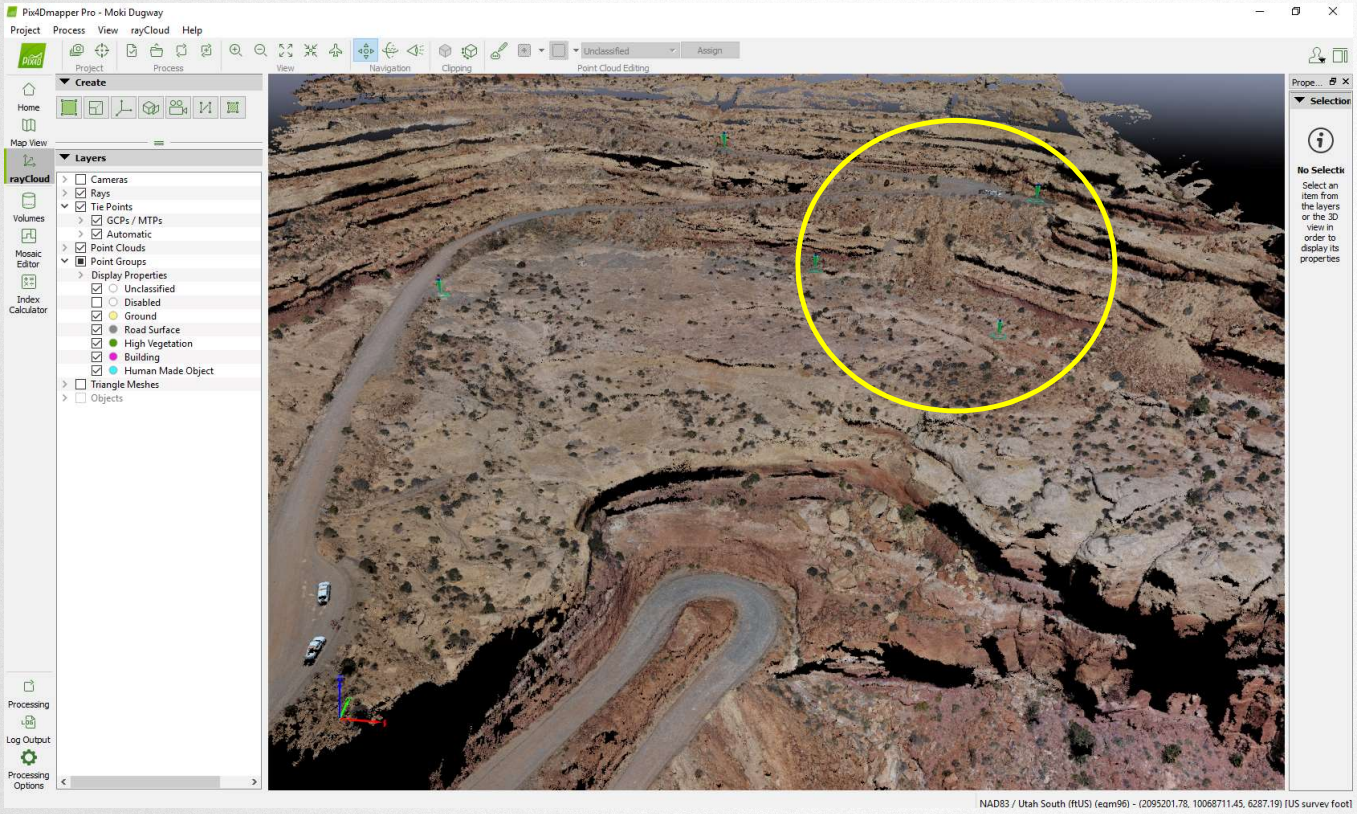
Moki Dugway



UDOT Keeping Utah Moving

Landslides

Moki Dugway



UDOT Keeping Utah Moving

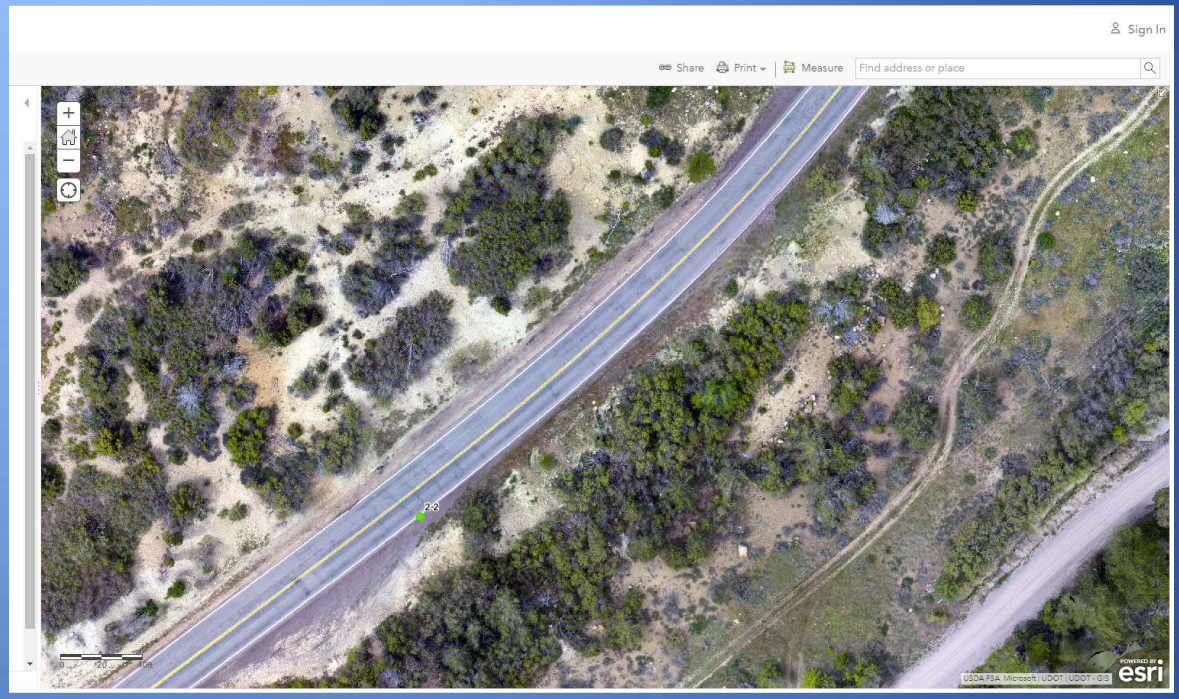
Asset Management

- Detailed Aerial Imagery
- Automated Detection

Keeping Utah Moving

Data & Storage

- Plan for large data sets
- Keep all flight logs, files, and processed data.
- GIS database for all Ortho Imagery.
  - https://uplan.maps.arcgis.com/home/webmap/viewer.html?webmap=dc81b7cbd5ce4f8fba086e05d723ffff



Keeping Utah Moving

Lessons Learned

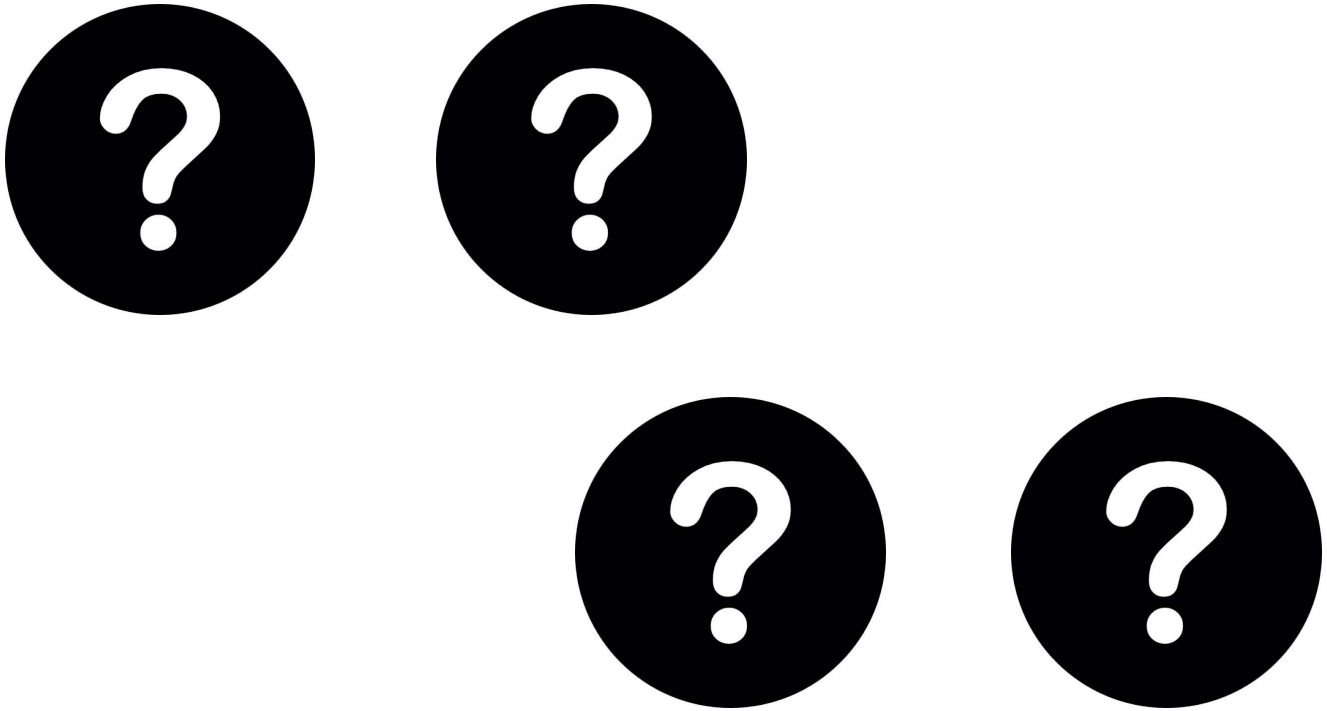
- Understand radio link characteristics in multiple environments
- Battery life and endurance
- Plan for the worst, hope for the best
- Looks can be deceiving
- Initial test flight to scout for obstacles and heights prior to autonomous flight mapping.
- Use aviation radio to monitor traffic
- Establish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

Contact Info:

Paul Wheeler
Lead UAS Coordinator
E-mail: pwheeler@utah.gov
Phone: 801-965-4700

UDOT Keeping Utah Moving

Questions?



For More Information

Product Leads:

Jessica Rich
FHWA Product Lead
jessica.rich@dot.gov

Pam Hutton
AASHTO Co-Product Lead
phutton@aashto.org

Kate Kurgan
AASHTO Co-Product Lead
kkurgan@aashto.org

Hal Lindsey
R16 Project Manager, CH2M/Jacobs
hal.lindsey@jacobs.com

Additional Resources:

GoSHRP2 Website:	fhwa.dot.gov/GoSHRP2
AASHTO SHRP2 Website:	http://shrp2.transportation.org
R16 Product Pages	http://shrp2.transportation.org/Pages/R16_RailroadDOTMitigationStrategies.aspx
Innovation Library	http://shrp2.transportation.org/Pages/R16_InnovationLibrary.aspx




SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Thank You for Joining Us!

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO