

Utilizing Unmanned Aircraft Systems (UAS) for Bridge Inspections

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COLLINS
ENGINEERS INC

mn DEPARTMENT OF
TRANSPORTATION

APWA Minnesota
Chapter
American Public Works Association

Project Background

- MnDOT Bridge Office identified UAS as a potential useful technology
- Additional Research Dollars Available
- Phase I project was scoped, funded and completed in two months, Phase II complete, Phase III started

Assessment of Current Practices



Access Methods

- Aerial Work Platforms (AWP's)
- Rope Access and Structure Climbing
- Ladders



NBIS and MnDOT Requirements

- Hands On Inspection
- Non Hands on Inspection
- Measurements/Testing

Assessment of UAS Technology

- Phase I Technology
 - Not capable of looking up
 - Unable to fly without GPS
 - Photo, Video and Thermal Imaging
- Phase II and III Technology
 - Inspection-specific UAS
 - Object Sensing
 - Capable of looking up
 - Fly without GPS, under bridge decks
 - Photo, Video and Thermal Imaging
 - Confined Space

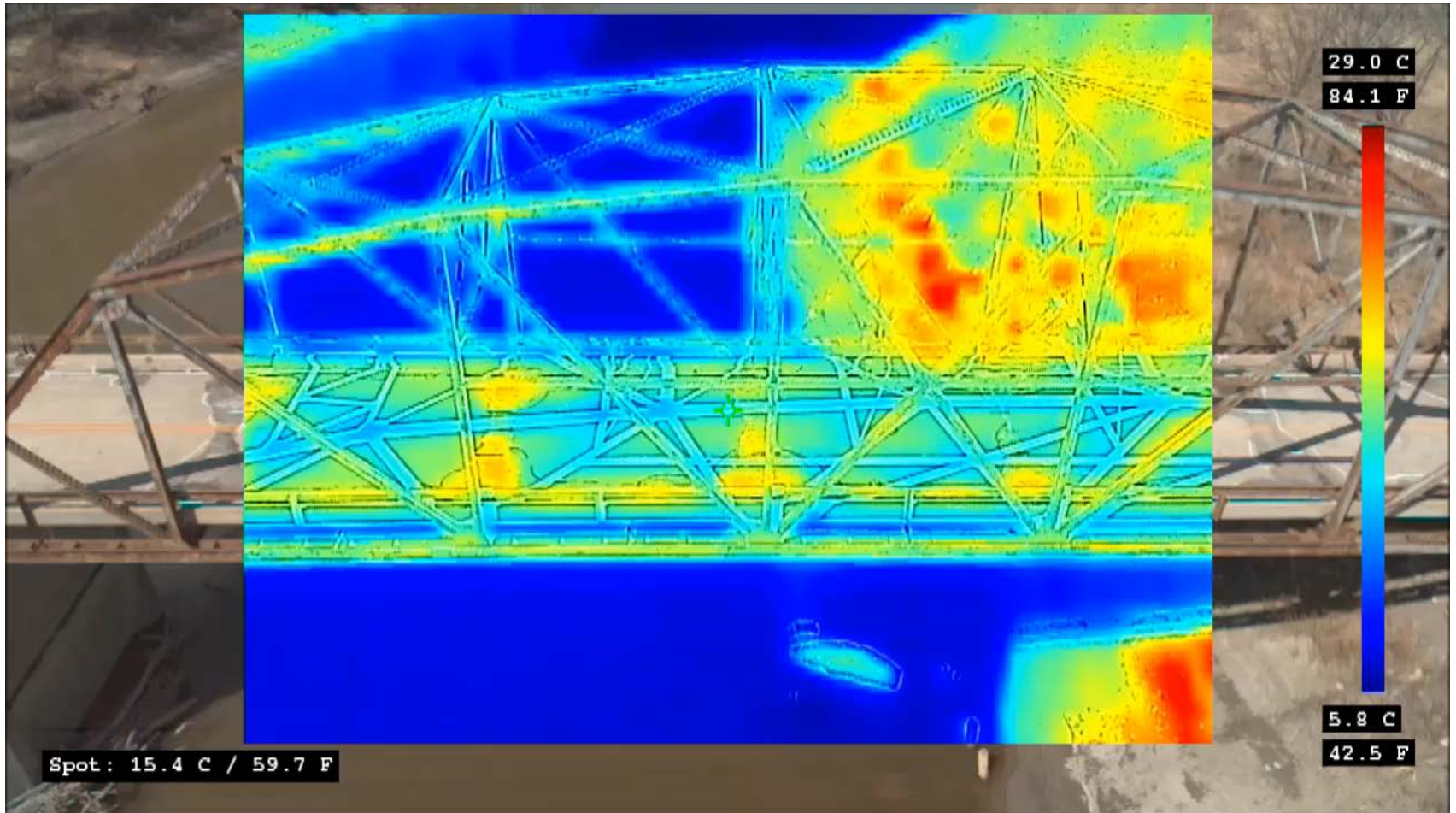


Phase II Study

- Cost comparison with UBIVs, traffic control
- Explore inspection specific technology including the Sensfly Albris
- Compile a best practices document
- Incorporate into an actual inspection
- Use UAS in the planning of an inspection
- Use a secondary display for bridge inspector
- Deck surveys with zoom camera
- Culvert and Box Girder Inspection
- IR Deck Delamination Assessment at Dawn
- Paint Assessment
- Data on how many hours UAS vs. other methods



Phase II Study



Nielsville Bridge 5767

Phase II Study

WARNING **INTER-ACTIVE** **TAKE-OFF** **START MISSION** **RESUME MISSION** **GO TO START** **HOLD**

GO TO HOME GO LAND LAND NOW **EMERGENCY LDG Click: 3x** **ABORT LANDING** **MOTORS OFF Click: 3x**

Mission: My mission

The drone flies first to Start, then to its mission, then Home. It also flies Home if there is a problem. Keep the path to Start, from Start to mission and the path back to Home free of obstacles.

▼ **Start**

Drone flies in a straight line, both to Start and out to the mission

Waypoint altitude: 125 ft/ATO

▼ **Home**

Drone flies up then across, or across then down and back to Home

Waypoint altitude: 125 ft/ATO

▼ **Transitions**

After take-off: Resume Mission

After mission: Land at Home waypoint

Drone: My Albris (EX-01-30263)

▼ **Status**

Mission
Waypoint 55 / 77

▼ **Autonomy**

Battery	Flight time	Home distance	Link quality	Estimated wind
58 % (11.2 V)	06:24	116 ft	100 %	11.9 kts

▼ **Instruments**

Temperature		GNSS		
Processor	Air	Satellites	Accuracy	Mode
90.4°F	35.4°F	20 (40.4 dB/Hz)	3.114 ft	Fixed

▼ **Flight data**

Ground speed:	6.0 kts	Latitude:	N 44.9905567
Altitude:	1064.1 ft/AMSL	Longitude:	W 93.0607003

▼ **Image/video capture**

44.9910889° N, 93.0618040° W, 866 ft/AMSL

1.0x Exp. time 1/389 s F6.5 ISO 191

2:46 PM 12/22/2016

Bridge Mapping Mission

Phase III – Project Goals

- Statewide UAS Inspection Contract – based on the MnDOT Bridge Access Inspection Policy list
- Overall Cost Effectiveness – at a statewide level for both District and local agency bridges
- Inspection Quality and Safety Improvements – close-up, 3D, and thermal imagery
- Identification of Sustainable Future Funding

Phase III – Confined Space



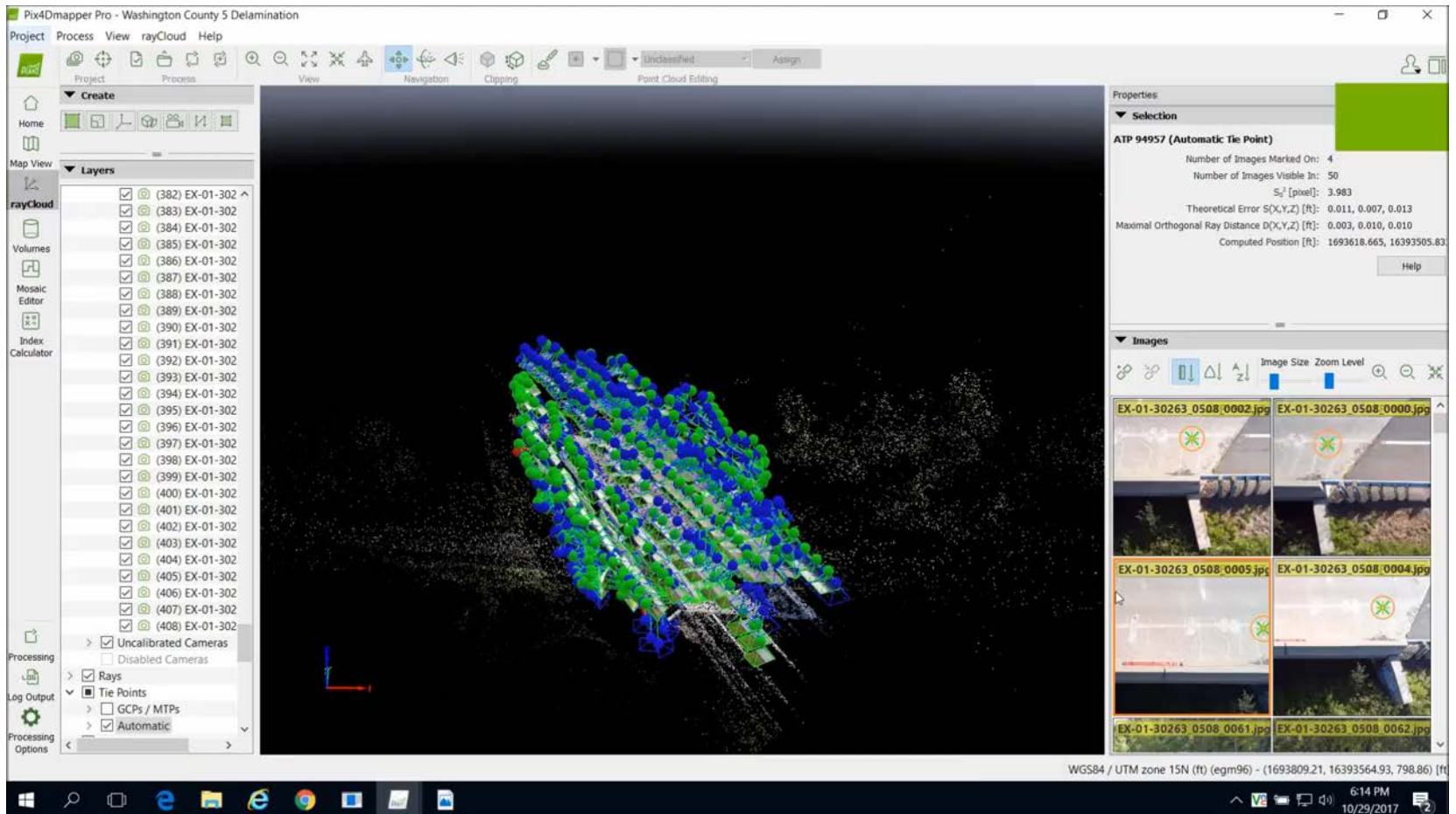
Flyability Elios Drone

Phase III – Confined Space



Flyability Elios Drone

3D Photo Log



Bridge Inspection Modeling

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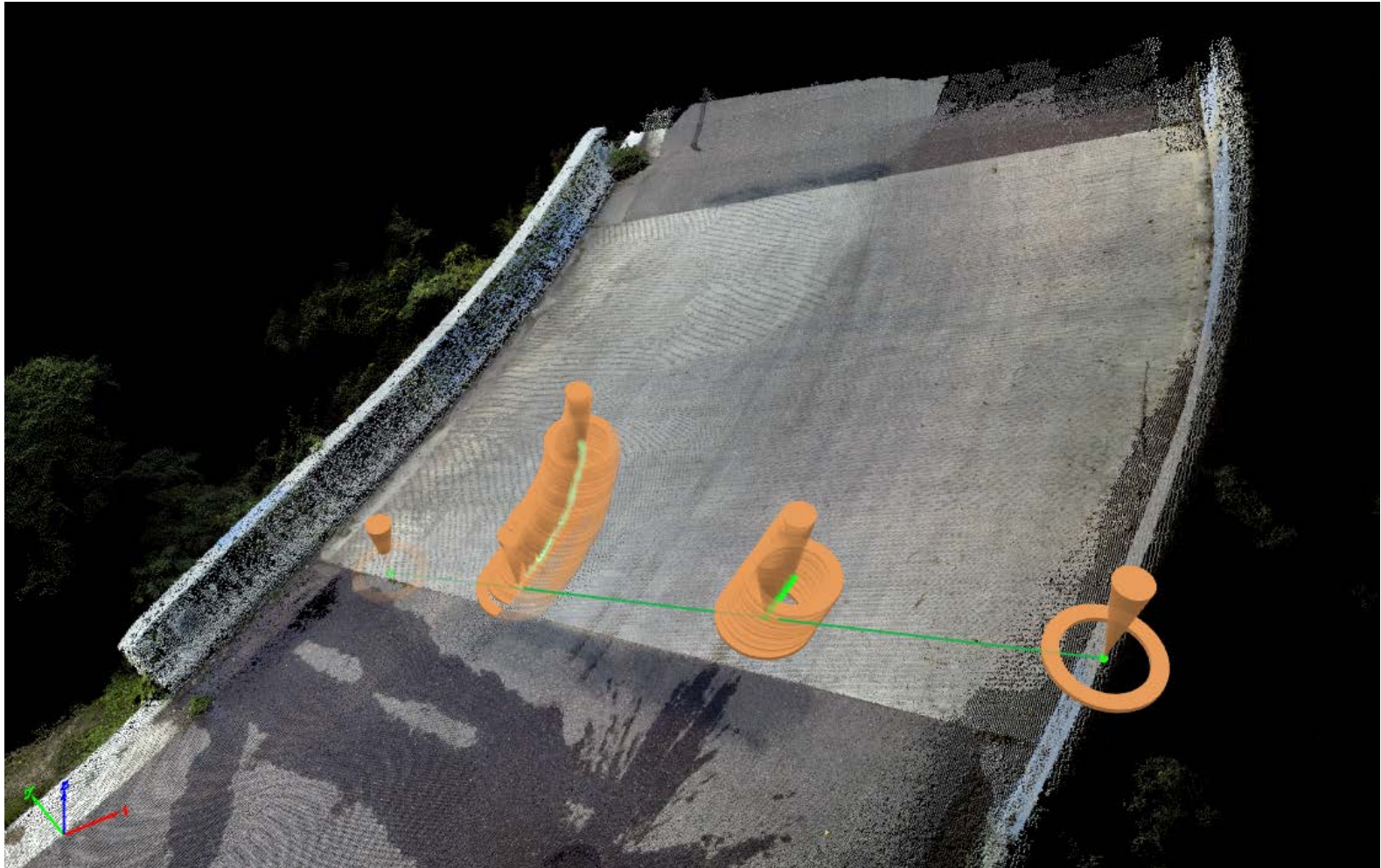
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Bridge Modeling



Bridge Inspection Modeling

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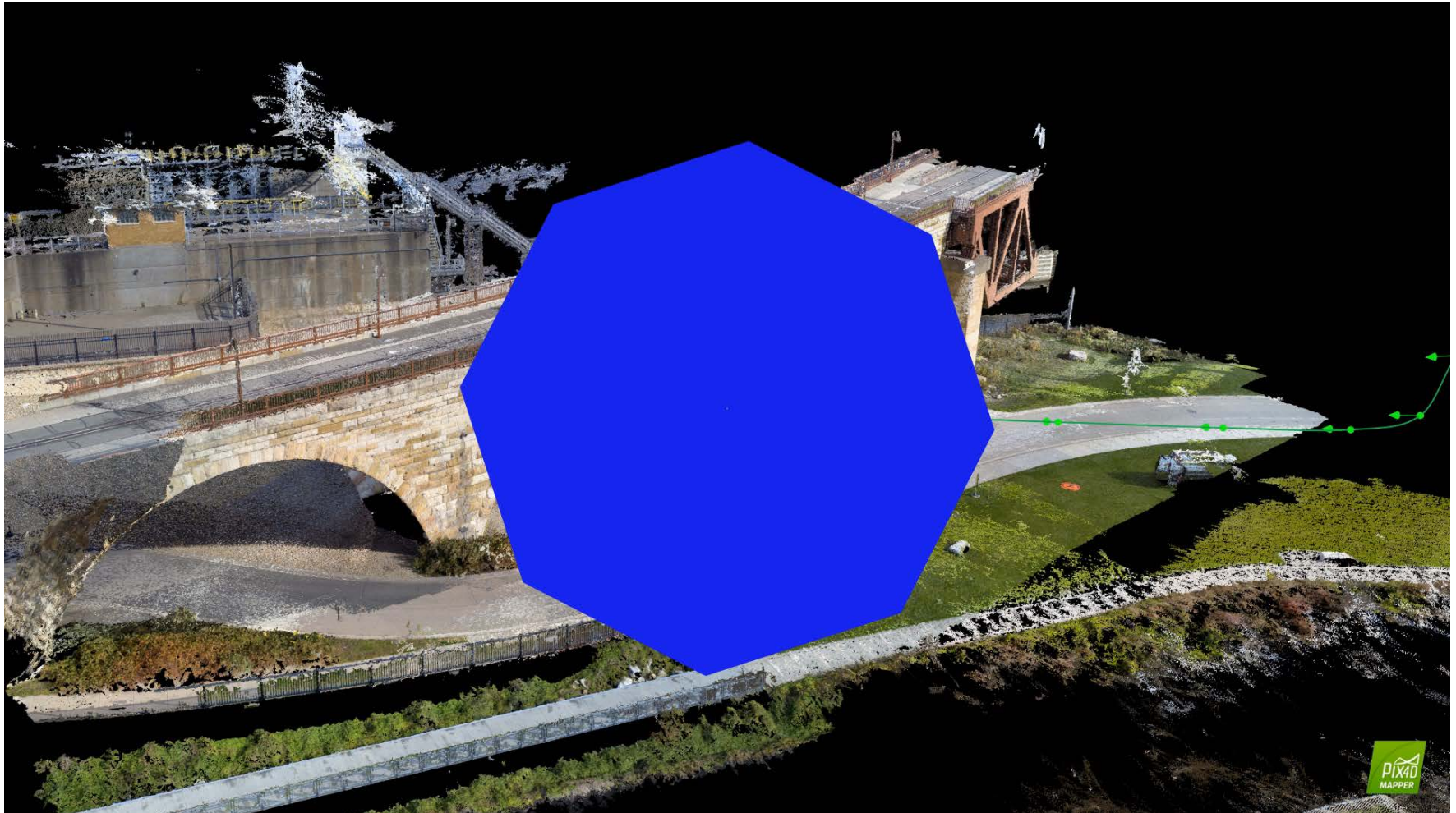
Bridge Inspection Modeling

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Bridge Inspection Modeling

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Conclusions

- UAS can be used in the field during bridge inspections safely.
- Image quality allows for the identification of defects.
- Tactile functions cannot be replicated using UAS.
- UASs can be cost effective.
- UASs can provide a very efficient way to collect infrared images
- Safety risks could be minimized with the use of UASs.
- UASs can be utilized to determine channel conditions.
- UASs can provide important pre-inspection information.
- “Off the shelf” UAS’s have limited inspection capability.
- FAA Part 107 allows greater flexibility than Section 333 process

Public Response

- Hundreds of news articles and stories
- Overwhelmingly positive
- Safety, reduced closures and cost efficiency valued by public



Questions/Contact Information

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