Drone Demonstration Workshop: so you've got the drone in the box on the floor of your office…

Pease Development Authority
Portsmouth, NH
April 11, 2019

I-95 Corridor Coalition

A partnership of transportation agencies to accelerate transportation system improvements

Today's Agenda

- Welcome and Introductions
- Session 1: DOT Agency UAS Use Applications
  - Samuel Nelson, MassDOT
  - Dwayne Day, Delaware DOT
- Session 2: Law Enforcement & Public Safety Use Cases
  - Sgt. Darren Foster, Maine State Police
  - Sgt. Michael George and Tpr Brian Doak, Mass State Policy
- Session 3: Emergency Response
  - Marc Brunelle, York County EMA
  - Arthur Villator, Maine Channel 8
- Lunch
- Roundtable Discussion
- Demonstrations

The Coalition is…… more than I-95

Multi-modal • Multi-jurisdictional • Multi-disciplinary




Formed in 1993, the I-95 Corridor Coalition is a partnership of multi-state, multi-modal public agencies working together to create a seamless and efficient transportation system.

16 states + D.C.

In the Corridor

2nd

Largest Economy in the World

$4.7 Trillion
40% of US GDP

37%

Of America's population: 110 Million people

46

Major Seaports
$172 Billion Imports
34% of U.S. total

What we do…

In short, the I-95CC helps agencies tackle the sticky issues and get solutions across the finish line.

PEOPLE

- Create a forum for public agencies to address transportation issues of common interest
- Establish a key network of transportation professionals
- Provide training (e.g., Freight Academy)

TOOLS & DATA: Support data acquisition and tool development

Benefits of I-95 Corridor Coalition Membership

The Coalition, through its diverse membership, provides participating agencies with the opportunity to leverage resources through multi-state/agency operations coordination, planning, and data sharing. The Coalition strives to keep its members at the forefront of industry innovation through participation in transformative technology pilots/research, adoption of best practices sharing, and unique professional development opportunities. Examples of Coalition work that benefits our members and brings a lasting effect on the transportation industry include:

Coordinated Incident Management and Traveler Information

To positively affect the safety and efficiency of member roads and responders, the Coalition has successfully brought together and coordinated incident response among multiple jurisdictions and disciplines. This core work of the Coalition has resulted in training programs, common message sets, planning and operations for significant weather response and more. In addition, the Coalition has supported the development of a highly useful tool that advances traveler information services, and supports agency use of real time and historic traffic data (aka "big data") thru collaborative initiatives such as the Vehicle Probe Project and Probe Data Analytics User Group.

Freight Supply Chain Performance and Truck Parking

In 2016, the Coalition, in conjunction with FHWA, demonstrated the feasibility of measuring supply chain performance across multiple jurisdictions and modes. Building on this work, the Coalition has received additional funding to (1) initiate implementation of a national freight fluidity monitoring program and (2) support State and Regional implementation of fluidity measurement. To address the truck parking capacity challenges, the Coalition will continue to facilitate dialogue among stakeholders on how to share real-time truck parking availability and what other innovative solutions have been successful.

Connected and Automated Vehicles

The Coalition's conference, "Connected & Automated Vehicles (CAV): What States Need to Know" (June 2016) was designed to advance our region's ability to understand, plan for and manage CAV deployment. The agenda highlighted how CAV will affect our transportation system, provided an overview of lessons learned from around the country, described current efforts underway within select Coalition states; and shared insights from State DOT executives, NHTSA, the insurance industry and auto manufacturers. Moving forward, the Coalition will serve as a resource for information sharing - bringing together knowledge learned from private and public sector programs, and assisting agencies in determining next steps and organizational and infrastructure requirements.

MAP-21/FAST Act Performance Management Implementation

The Coalition is providing subject matter expertise to members to assist with performance management implementation and big-data analytics. In addition, the Coalition-supported Regional Integrated Transportation Information System (RITIS) offers a new feature that makes it quick and easy to respond to the latest MAP-21 NPRM, final FAST Act systems reporting requirements, address inaccurate comparisons, and aid in target setting. Facing pending MAP-21/FAST Act performance management requirements, the Coalition will continue to create a forum for members to enhance staff knowledge—saving agencies time and resources.

Tolling Violation Enforcement Reciprocity

The Coalition will establish a multi-state neutral forum to develop/accelerate the enforcement of reciprocity agreements to increase the remittance of toll violations (fees and administrative penalties) from non-home state users, the Coalition has established a multi-state neutral forum to share best practices, lessons learned from those states which have implemented reciprocal agreements, approaches to educating decision-makers, legislative process and strategies to overcome barriers to success. The Chair of the working group will be Tom Tinlin (Highway Administrator, MassDOT).

RESOURCES

- Compete for grants
- Extension of agency staff
- Partner with FHWA to explore policy implementation

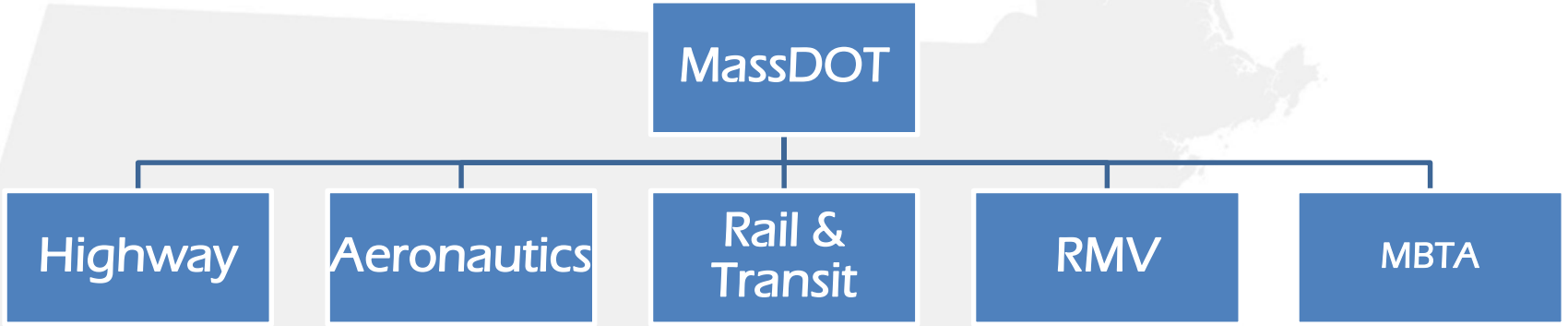
Session 1:
DOT Agency UAS Use Applications

Samuel Nelson, MassDOT

Interstate-95 Corridor Coalition UAS Workgroup

Samuel Nelson, Project Manager
MassDOT

Massachusetts Department of Transportation (MassDOT)



- November 1, 2009. The Commonwealth integrated its transportation agencies and authorities into a new streamlined Massachusetts Department of Transportation (MassDOT)
- MassDOT is an organization with over 10,000 employees working to simplify and streamline the transportation system while making it more accountable and accessible
- MassDOT Aeronautics is conducting a Unmanned Aerial Vehicle (UAV) pilot program for the use of UAVs in transportation use cases, Interim Drone Policy Presented on 10/16/2017 by Administrator Dr. J. DeCarlo to MassDOT Board of Directors.

Overview

- Drones are widely available and are an opportunity for MassDOT and the MBTA as potentially cost effective and useful tools to support our missions and core activities, including:
  - Asset management and infrastructure inspections;
  - Drones will NOT be used for surveillance or intentional collection of Personally Identifiable Information
- A policy will insure that internal usage will meet:
  - Legal, standardized methods to access drones, and
  - Support and oversight to operate drones safely and effectively
- Staff Requests that both Boards vote to adopt the interim drone policy. A draft/suggested policy has been provided

Statement of Purpose

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Massachusetts Department of Transportation
Aeronautics Division

- Facilitate the adoption of drones across MassDOT in a manner that is:
  - Safe
  - Cost effective
  - Secure
- Incentivize applied research to enable UAS operations and develop counter-UAS solutions

APPROACH


Foundation


Integration


Normalization

Agenda

Developing a Comprehensive Drone Program

Review of Use Cases and UAS Operations

Growing Capability to Support Multi-Modal Needs Across Commonwealth

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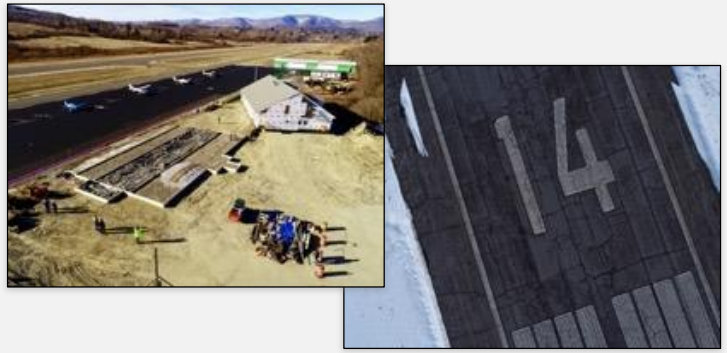
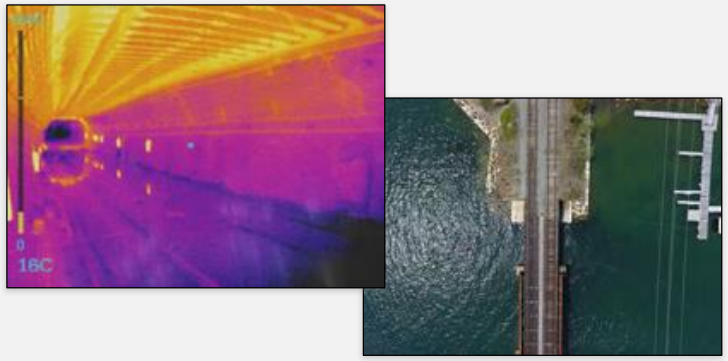
AERONAUTICS

- Runway/taxiway/apron pavement inspection
- General airport inspections
- Obstacle/obstruction analysis to ensure clear approach and departure flight paths



RAIL & TRANSIT/MBTA

- Rail inspection
- Rail obstructions
- 3rd rail inspection
- Tunnel inspection (testing)



HIGHWAY

- Pavement inspection
- Bridge inspection
- Environmental inspection (stormwater management)
- Construction site monitoring
- Incident response
- Asset management

- Addressing multi-modal needs across MassDOT and the MBTA, and becoming a shared service for Commonwealth agencies

Deploying UAS Resources for Emergency Response Documentation

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Aeronautics Division

AIRCRAFT ACCIDENTS

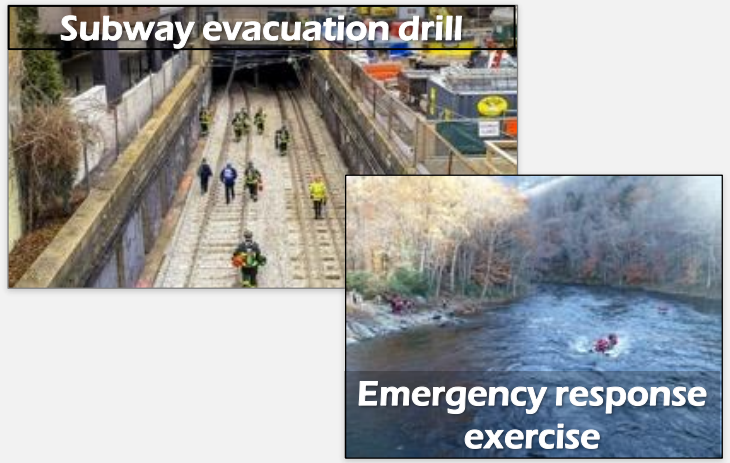
- MassDOT Aeronautics state lead accident investigator

PIPELINE FIRES

- Documented damage due to gas fires
- Performed operations in conjunction with NTSB

EXERCISES

- Demonstrated operational integration of UAS and de-confliction with crewed/manned aircraft



- Working with MEMA and FEMA to support emergency response and to bring capabilities across state lines (UAS and crewed aircraft)

MassDOT UAS Fleet

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- Fleet selected through evaluation of UAS use cases and analysis of alternatives
- Expanding fleet with new purchases of DJI Mavics, LIDAR, Multispectral sensors, robust computing systems and other specialized systems such as a Fixed sUAS tether.

	 DJI Phantom 4	 DJI Inspire 2	 DJI Matrice 210	 Yuneec H520	 SenseFly ebee	 Delair UX11
# Purchased	5	2	1	1	1	1
Sensors	HD Camera	HD Camera 6K Camera	HD Camera; 30x Optical Zoom; IR (thermal) Camera	HD Camera	S.O.D.A. RGB Sensor[1]	Hi Res, Low/No Distortion
Features	-Robust Comms. Links -Cost effective EO Vehicle	-Dual Operator Mode -Retractable Landing Gear	All-weather; Upward Gimbal; Dual Payload Capable	All-weather; 6 Rotors; 360˚ View	RTK/PPK Accuracy[2] 20 mile range 2.8ghz	PPK Accuracy[2]; 33 mile/Unlimited range 2.8ghz/4G/LTE

Data Pilot General Process

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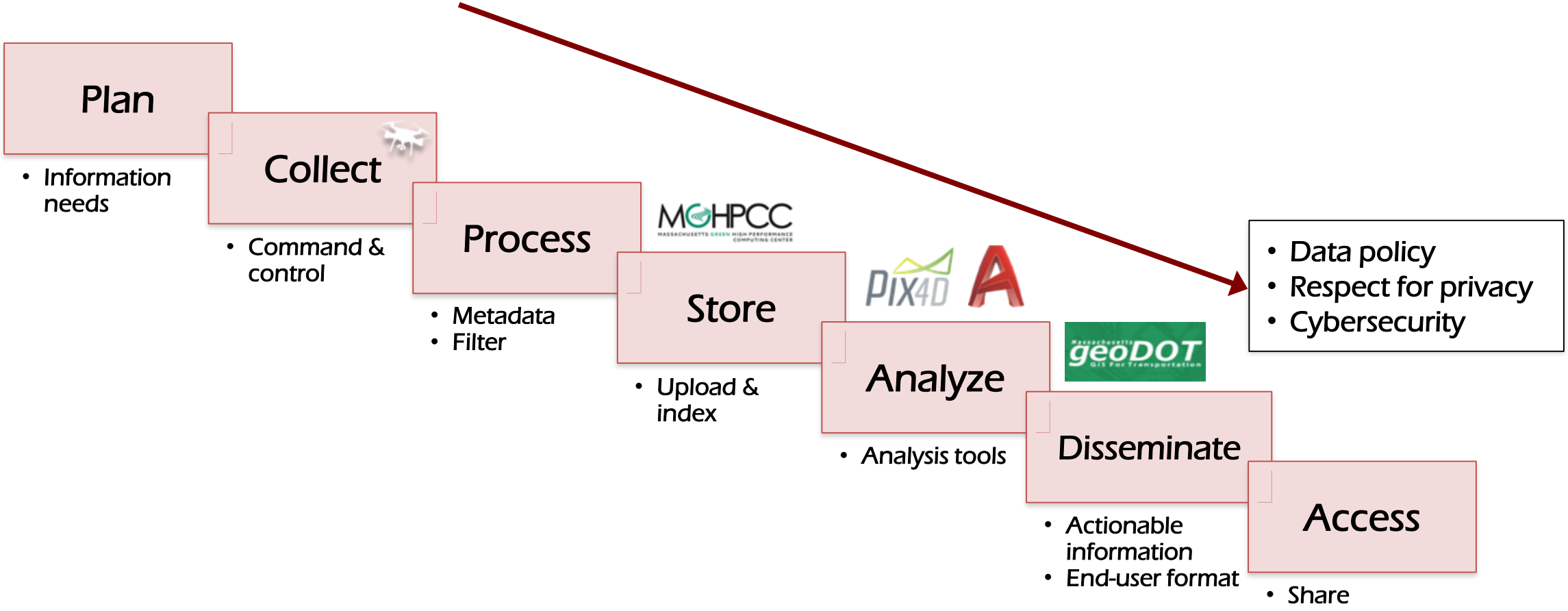

- Building comprehensive approach to data analytics and security necessary to enable drone benefits and ensure mission success

Agenda

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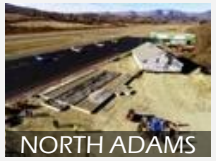
Developing a Comprehensive Drone Program

Review of Use Cases and UAS Operations

Comprehensive Approach Allows UAS Support to Expand Across Commonwealth

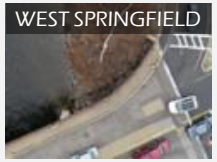
Emergency Response Vigilant Guard Drill



Aeronautics Document Building Move

Highway District 1 Roof Inspection

Highway District 2 Woronocco Bridge



Highway District 2 Agawam Bridge

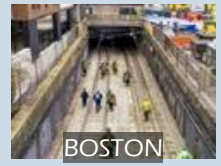
Highway District 3
(L) MassPike Thermal Imaging
(R) Headquarters Construction

Emergency Response Pipeline Fire

State House Dome

Highway District 6 Comm. Ave. Bridge Replacement

MBTA Subway Drill



Highway District 5 Cohasset Bridge

Highway District 5 I-495 Lobes

Categories of Use Cases and Data Products

USE DATA	DATA PRODUCTS
Public Relations	Imagery & video
Asset management/inspection	Imagery & GIS orthomosaics/3D Models
Construction site monitoring	GIS orthomosaics/3D Models & CAD terrain elevations (DSM/DTM Contours)
Thermography	Infrared imagery & video
Incident/Emergency Response	Imagery, video & live-streaming video – TETHERED OPS

Documented Replacement of Commonwealth Avenue Bridge

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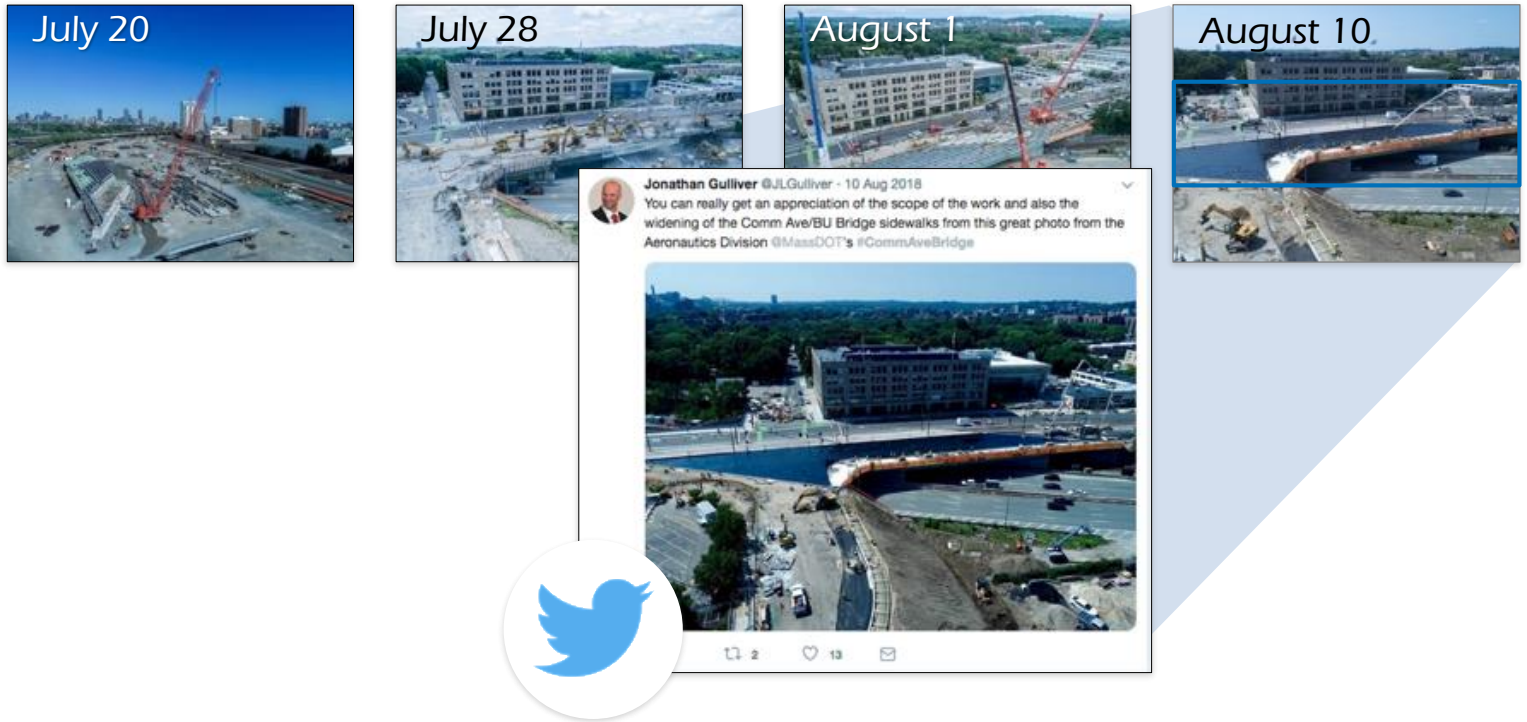
- Documented progress of Commonwealth Ave Replacement Bridge in downtown Boston
  - Flew 11 missions over 3 weeks: July-August 2018



- Demonstrated Drone Team's capability, and provided valuable lessons learned


CAT

State House Dome Inspection

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Aeronautics Division

- State House requested Drone Team support to capture discoloration of dome's gold leaf
- Coordinated with FAA to allow flight close to Boston Logan Airport
- Careful flight planning to ensure safe operations around historic and complex structure

Details

- Flew mission day before Thanksgiving
- Great support from State House authority for access and ground crowd control
- "This gives me what I need" to plan repairs – State House authority representative

Elements of Drone Mission

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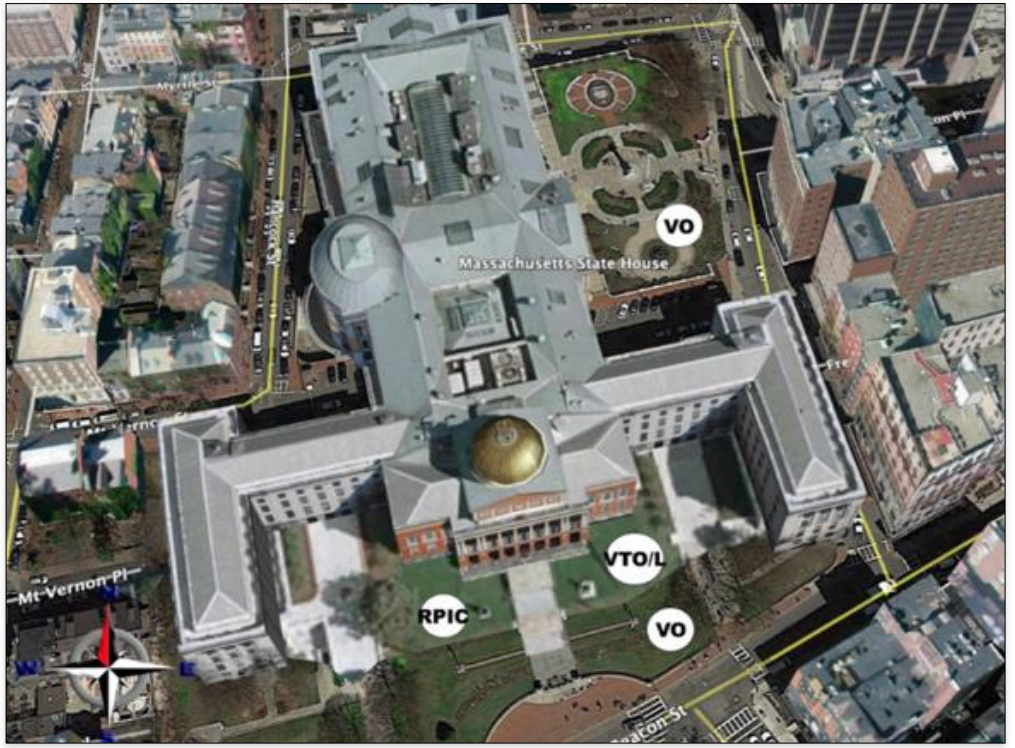
Many elements are required to safely and successfully execute a mission:

- Class B Airspace
- Privacy concerns
- Collision avoidance
- Visual observers
- Stakeholder interaction
- Public safety



Google Earth image showing locations of:

- Remote Pilot-in-Command (RPIC)
- Visual Observers (VO) for safety
- Vertical Take-Off and Landing (VTO/L) location for UAS

State House Dome Video Footage

Imagery of damage

IR imagery of damage

State House Dome Inspection
Infrared Sensor

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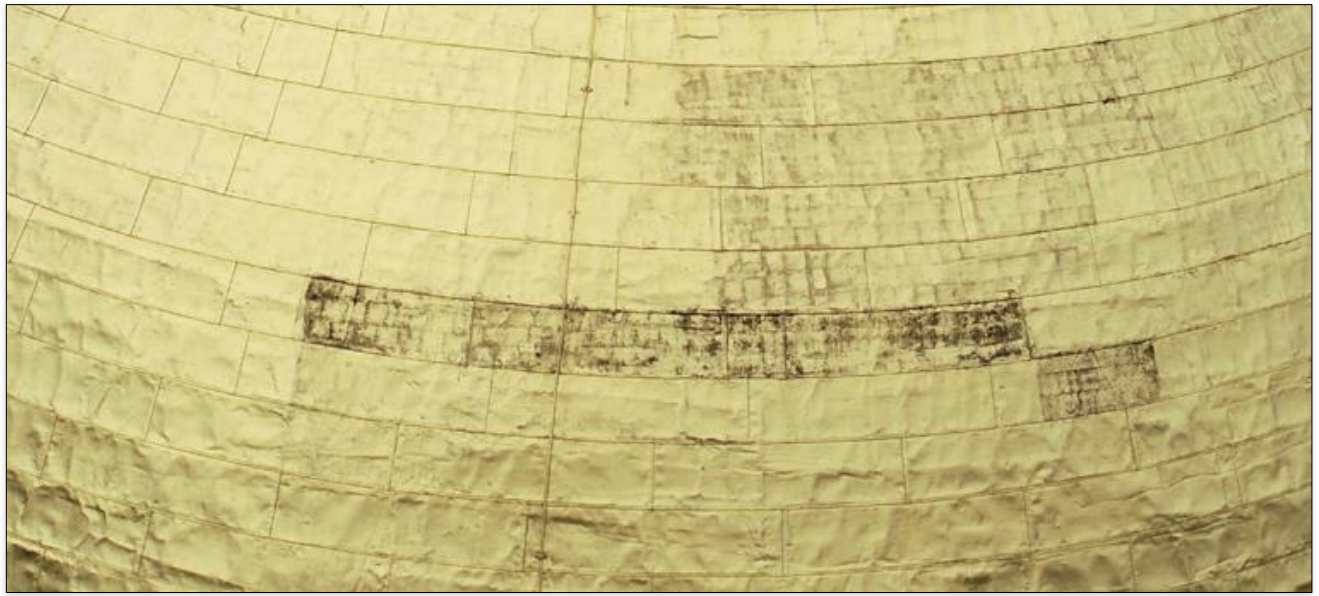
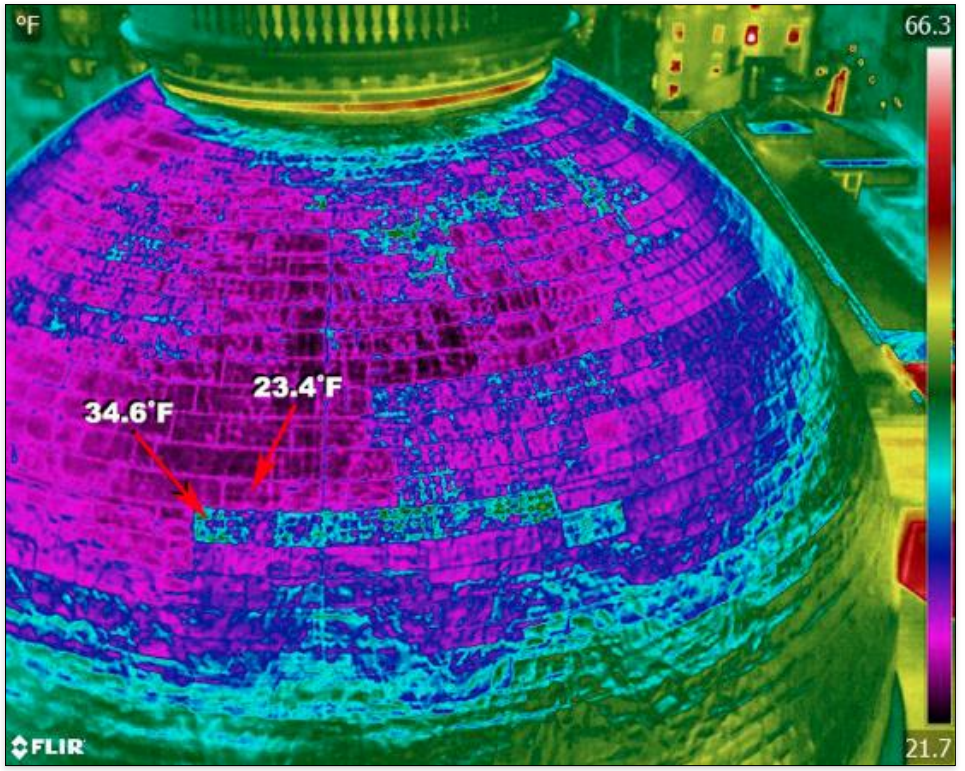
- Demonstrated use of IR (thermal) camera to detect problem area





Successful Use of Drone Data
New Highway District 3 Headquarters

massDOT Massachusetts Department of Transportation Aeronautics Division

- Difficult site topography created construction challenges
  - Site surface model created using drone mapping tools; used to evaluate site conditions and test 'fit'

Photomosaics show changes over time

District Application of Drone Data
Construction of Highway District 3 Headquarters

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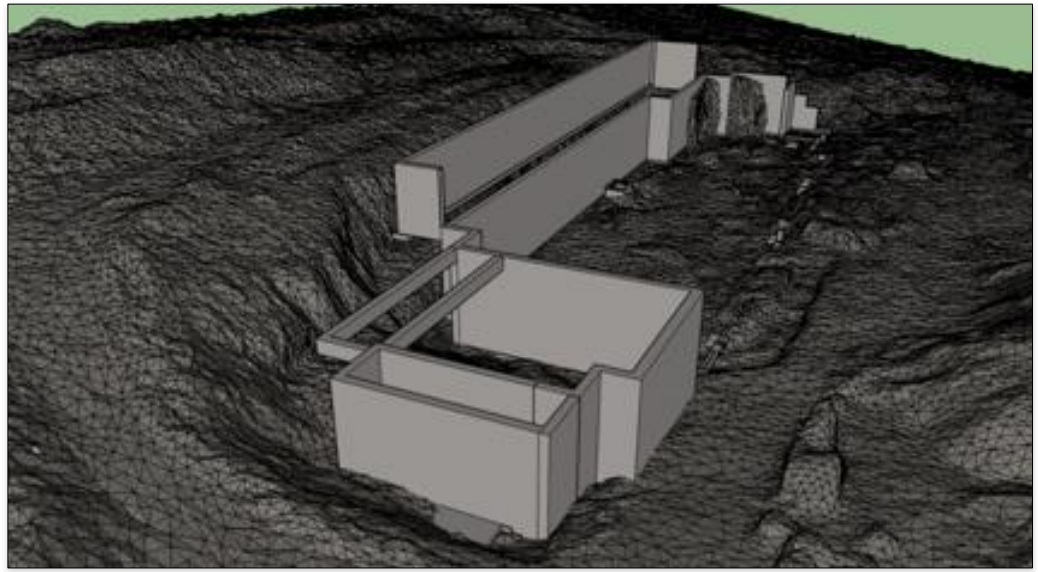
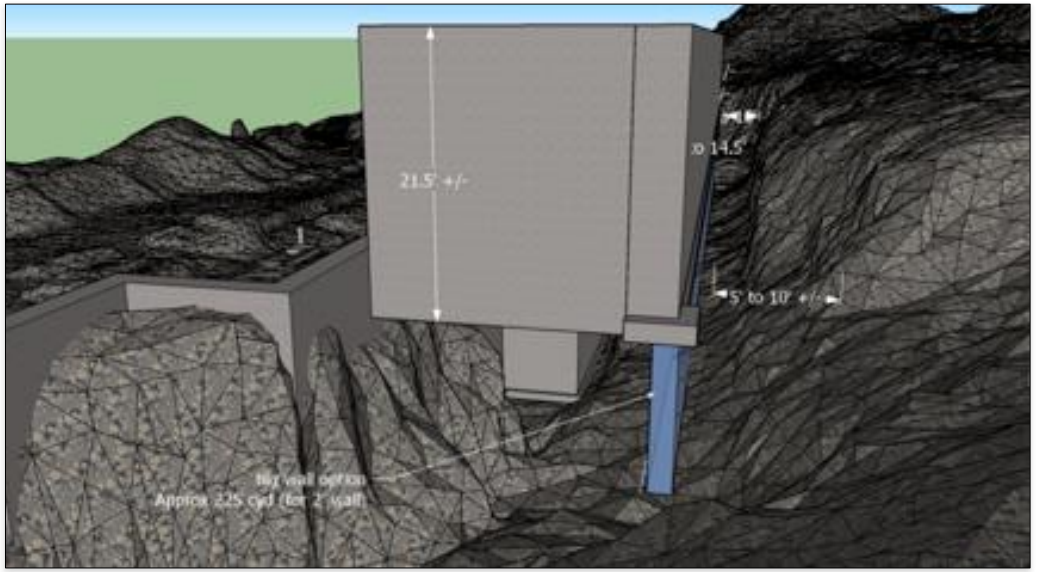
Aeronautics Division

- Combine CAD model of building with terrain model generated from drone data



"The information we received and the processing done by Jason's team allowed us to make construction decisions that would have otherwise cost us significant amounts of time and money."

– Barry Lorion
District Highway Director, District 3



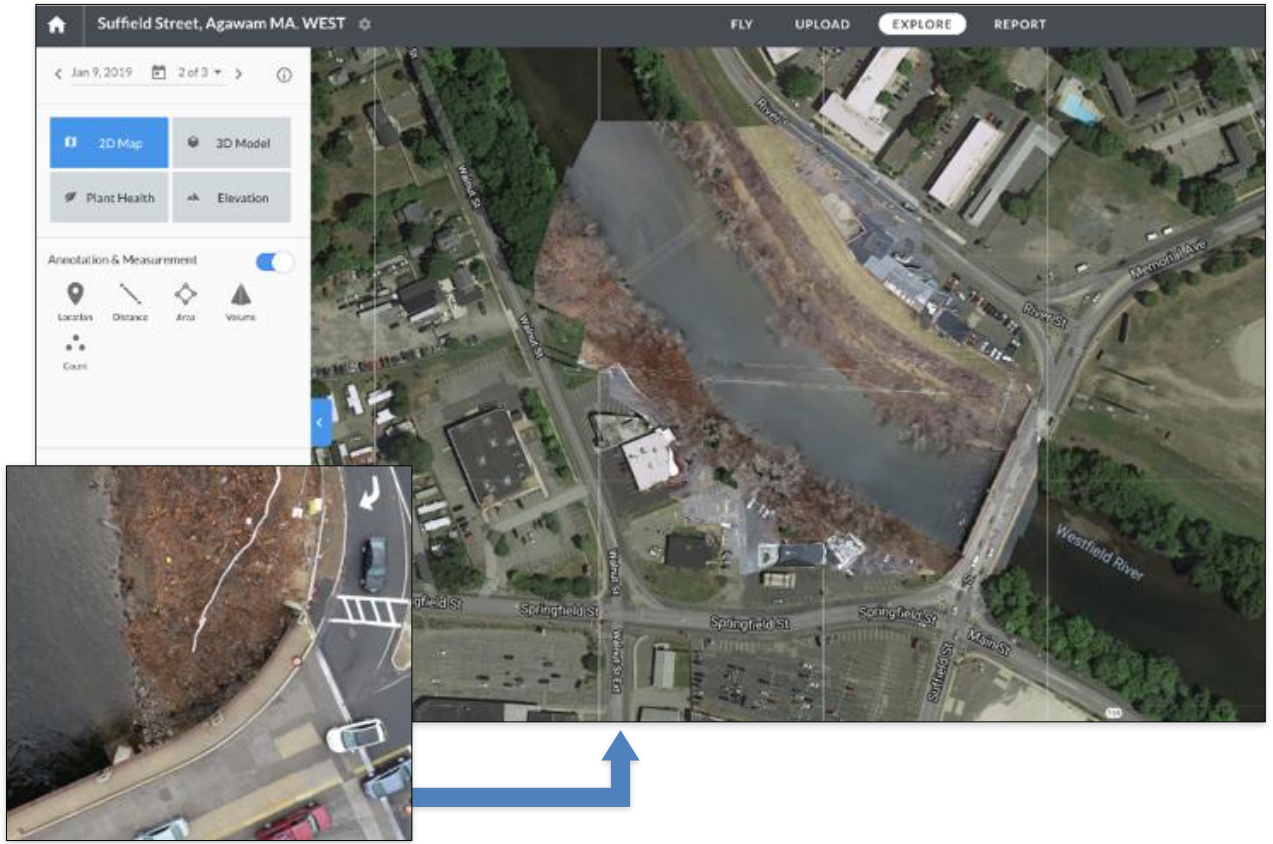
"Use of the drone-derived data revealed $300,000 fill underestimate. Early identification of the gap saved the project money and time."

– Jason Benoit
Special Projects Manager, District 3

Expanding Use for Environmental Inspection
Agawam Bridge, West Springfield

massDOT Massachusetts Department of Transportation Aeronautics Division

- Working closely with Highway District personnel for environmental inspection



Details

- Use drones for existing conditions survey of bridge embankments in locations that could be impacted by construction and erosion
- Photo documentation for combined storm water and sewer pipe outlet required before construction
- Grade profile of the West Springfield embankment/flood control levee and coffer dam inspections

Woronocco Bridge

District 2, Westfield River, Russell

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Aeronautics Division

- UAS allowed field engineers to monitor structural condition of abandoned bridge, out of service since 1984
- UAS allows access in complex terrain; inspection of unsafe structure

Airplane Accident Investigation

massDOT
Massachusetts Department of Transportation
Aeronautics Division

- Supporting NTSB by documenting accidents

Orange Municipal Airport, Orange, MA (9/26/17)
(Photo courtesy of MassDOT Aeronautics)

Cranland Airport, Hanson, MA (8/24/18)
(Photo courtesy of MassDOT Aeronautics)

Deploying Drones for Emergency Response
Lawrence Pipeline Fires & Aircraft Accident

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Aeronautics Division

- Immediate emergency response capabilities deployed for documentation of homes after pipeline fires, and for aircraft accident
  - Coordinated with NTSB (lead agency for investigation) to image damaged structures
  - All necessary waivers and authorizations quickly secured to enable mission

Details

- Team dispatched September 14-16 (days immediately after explosions) to provided real-time coverage and damage assessment of impacted areas
- Successful state and federal coordination
- 3D models created using drone imagery
- Immediate transition to scene of aircraft accident, also coordinating with NTSB

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Emergency Response Preparedness
Vigilant Guard

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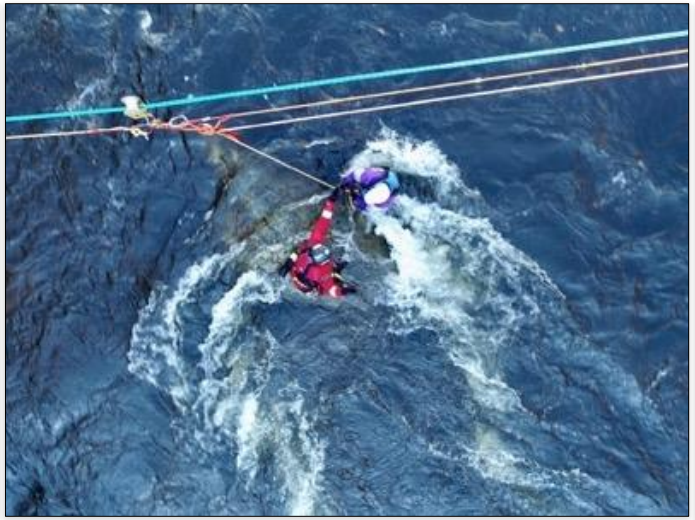
- Developing concepts of operation to support emergency response
  - Vigilant Guard: multi-agency bi-annual exercise to demonstrate collaboration for a variety of emergency response scenarios: dam damage, stadium attack, and coastline flooding
- Participated in multi-vehicle, multi-mode (manned & unmanned) simultaneous operations



Details

- November 2018
- Deconflicted with multiple other UAS and manned aircraft
- Coordinated with ~25 other agencies
- Identified as key contributor in exercise, and to document activity

MBTA Subway Evacuation Drill

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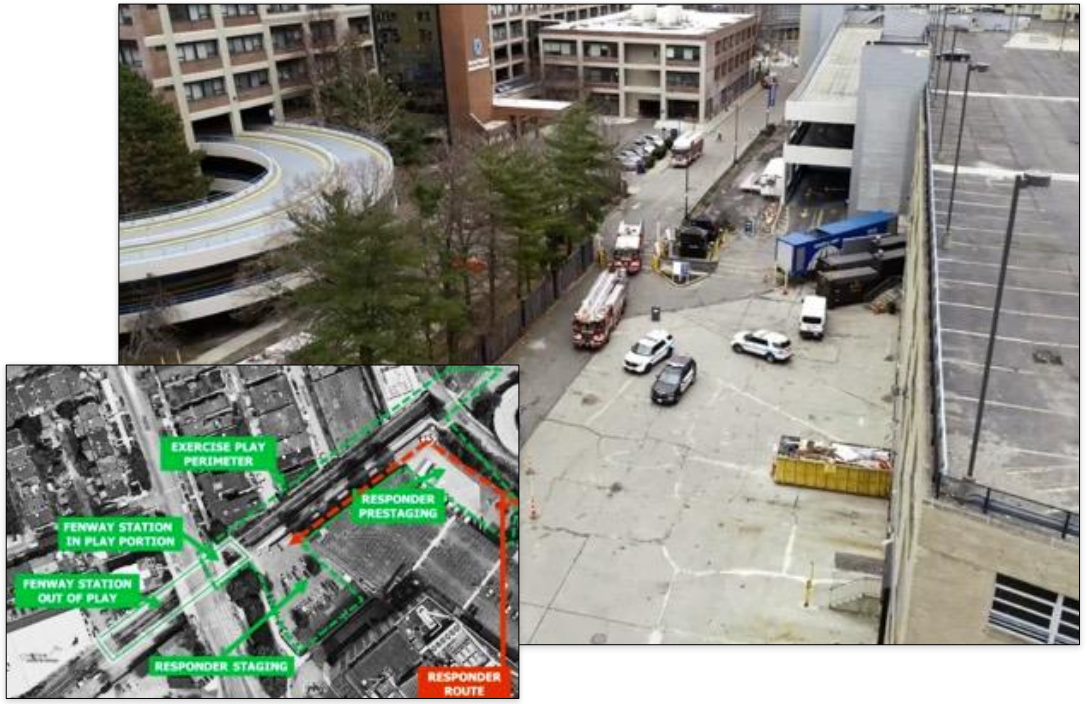


- Support MBTA at Fenway Station for 16 December drill of train derailment
- Provided video for first responders to use to assess evacuation during interagency coordination exercise (MBTA, MBTA Transit Police, Boston EMS, Boston Fire)

Public Relations Documentation

North Adams Airport Building Relocation

massDOT Massachusetts Department of Transportation Aeronautics Division

- Documented relocation of existing building for airport manager
- Coordinated with airport manager to allow UAS operations at active airport

Any questions?

Session 1:
DOT Agency UAS Use Applications

Dwayne Day, Delaware DOT

Unmanned Aerial Vehicles (UAVs) in Delaware

Dwayne Day, Homeland Security Planner, DelDOT

UAVs and DelDOT: How it Began

- Punkin Chunkin 2014
- DJI Phantom 3
- Downlink to Smart Phone

Security Concerns

- UAS pose a potential threat to security. Small UAS can be used by criminals and terrorists for espionage, surveillance, and intelligence gathering at critical government and industrial facilities.
- Criminals are also using unmanned aircraft to smuggle drugs and contraband across U.S. borders and over prison walls and fences.
- Somewhat larger UAS could be used to carry out terrorist attacks by serving as platforms to deliver explosives or chemical, biological, radiological, or nuclear weapons. Chemical and biological agents pose a particular concern, as UAS used for aerial pesticide applications could readily serve as platforms to carry out attacks.
- Small UAS could similarly be used to disperse small amounts of certain agents that may be lethal in minute quantities. Even a hoax attack—for example, releasing a powdery substance and making false claims that it contains anthrax virus—could cause widespread panic.
- UAS could also be used as platforms for firearms or other weapons.

- Homeland Security Advisory Council HSAC is briefed.

- Decision is based to create a UAV Sub-committee to further investigate the use of UAVs in Delaware and keep the HSAC informed.

- Dwayne Day was elected the Chairman of the Committee.

HSAC UAV Committee Membership

- Delaware Department of Transportation
- Delaware State Fire School
- Delaware Department of Agriculture
- University of Delaware
- Delaware State Police
- Delaware Department of Safety and Homeland Security
- Delaware National Guard
- Dover Air Force Base
- Wilmington Police Department
- Private Hobbyist

UAS Committees

- The HSAC UAS Committee splits into three more defined UAS Committees.

1. Delaware UAV Task Force - January 2016
   - Focus was on the Economic Development of UAS into Delaware.

2. UAS Training and Certification Steering committee.
   - Develop a UAS training and certification program for state agency pilots.

3. Homeland Security Advisory Councils UAS committee shifted the focus to the nefarious use of UAS….Counter UAS.

UAS Training and Certification Steering Committee.

UAS Academy out of Virginia provided the initial UAS Training for the committee members.

Membership:

- Delaware Department of Transportation
- Delaware Emergency Management Agency
- Delaware State Police
- Delaware State Fire School
- Wilmington Police Department
- Dover Police Department
- Department of Corrections
- Ocean View Police Department

UAS Training and Certification Committee “Focus”

- The committee focuses on four areas of UAS flying.
  - Maintenance
  - Operations
  - Safety
  - Training

Maintenance, Operation, Safety, and Training (MOST)

- Expands on Federal/State requirements
  - Developing flight training standards
  - Conduct training programs/classes for State Agencies
- State Agency Coordination
  - Mission Collaboration
  - Standards Development
  - Best practices
  - Aircraft troubleshooting

UAS Training and Certification Committee “Focus”

- All Public Agency pilots that are part of the program are trained to the same level.
- All Public Agencies fly the same DJI Operating System Platform.
- This ensures that the pilots and aircraft are interchangeable between agencies.
- A core group of pilots have had additional training from UAS Academy in Tactical Operations and fly together routinely. This has become a small tactical team available for call out by Emergency Managers.

DelDOT's UAV Program

DelDOT UAV Operational Policy

DelDOT has developed an UAV Operating Policy for flying UAVs that identifies;

1) Program Oversight along with Operational Directives
2) Division Participation
3) Equipment
4) Training & Certification,
5) Flight Planning & Operations.

The policy requires a two-manned approach with a pilot and visual observer for each flight, even though the FAA 107 rule only requires a pilot.

All UAS missions whether they are flown by DelDOT or a hired contractor, if flying on a DelDOT project require a pre-flight plan to be filed with the TMC in advance of the mission.

DelDOT Pilot Qualification

Once the pilot has a remote pilot certificate they will have to attend a Pilot Qualification course that teaches basic UAV maneuvers for their particular aircraft.

Before the pilot can have their training records signed off as a DelDOT Certified UAV pilot they will need to show their ability to fly ten basic maneuvers.

UAV Pilots will be required to fly 3 flights within a 90 day period for proficiency.

DelDOT sUAV Pilots

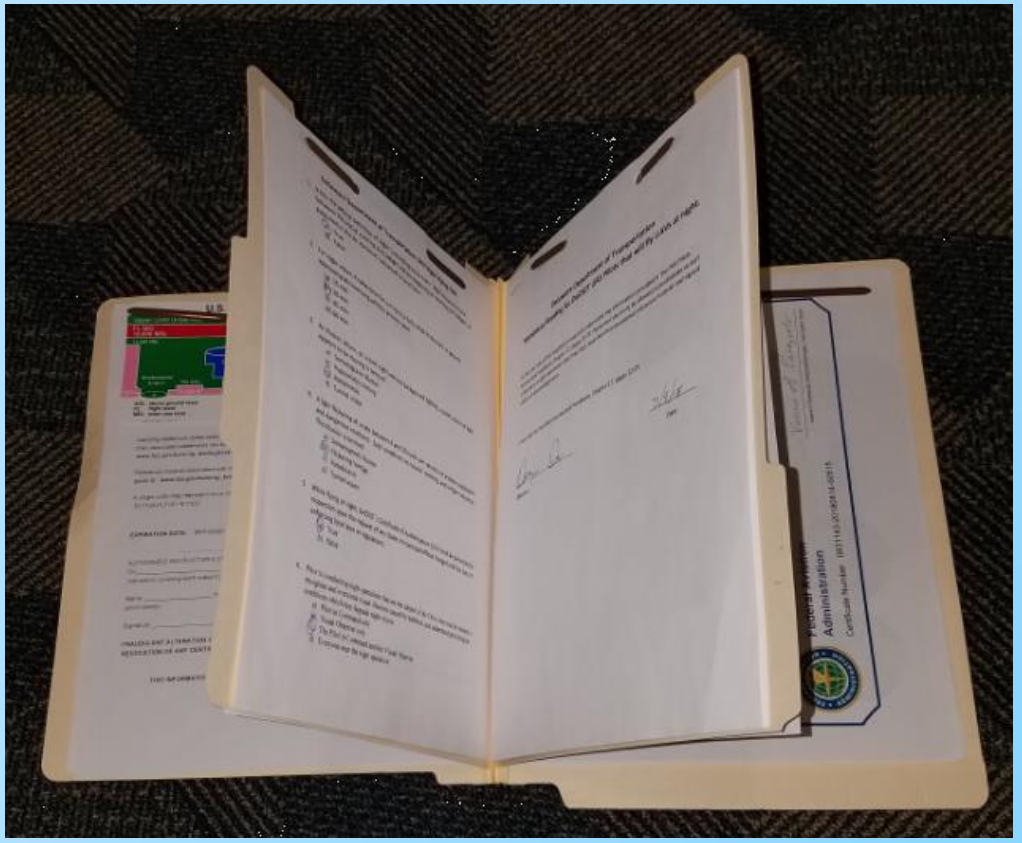
Nine DelDOT FAA 107 Pilots.

- District Engineer (M&O)
- Surveyor (M&O)
- Project Manager (M&O) (Commercial Pilot)
- Safety Officer (Traffic)
- Special Events Manager (Traffic)
- Assistant Director (Finance) (Female)
- Homeland Security Planner (UAS Program Manager)
- TMC Supervisor
- Right of Way Agent

- 6 more individuals are starting their 107 training this month.

DelDOT Training Records

- All DelDOT Pilots have a training record.
- FAA test results
- UAV Pilot Training and Certification Checklist
- DelDOT Pilot Application
- UAV Mandatory Reading for Night Flying
- UAV Night Flying Quiz
- UAV Training Certificates



The DelDOT Qualification Checklist

- UAV Pilot Training and Certification Checklist

☐	Ground School for FAA Remote Pilot Certificate (Optional)	Date:
☐	Pass FAA Unmanned Aircraft General Exam (Required)	Date:
☐	Pilot Qualification Course (Required)	Date:
☐	Tactical Operations Training Course (Optional)	Date:
☐	Indoor Flying Course (Optional)	Date:

Required Maneuvers

☐	Minimum Obstacle Clearance Altitude (MOCA)	Date:	Evaluator Initials:_____
☐	Accuracy Landing	Date:	Evaluator Initials:_____
☐	Complex Figure 8	Date:	Evaluator Initials:_____
☐	Blind Landing	Date:	Evaluator Initials:_____
☐	Road Course	Date:	Evaluator Initials:_____
☐	Point of Interest	Date:	Evaluator Initials:_____
☐	Waypoint	Date:	Evaluator Initials:_____
☐	Reveal	Date:	Evaluator Initials:_____
☐	Standoff Distance	Date:	Evaluator Initials:_____
☐	Long Distance Orientation	Date:	Evaluator Initials:_____
☐	ATTI Mode Flying	Date:	Evaluator Initials:_____

I certify that the above named UAV Pilot has meet all the requirements required by DelDOT's UAV Training and Certification Program and is authorized to fly DelDOT UAVs.

_____ Date:_____

Dwayne Day
DelDOT UAS Program Manager

sUAS Specialized Training

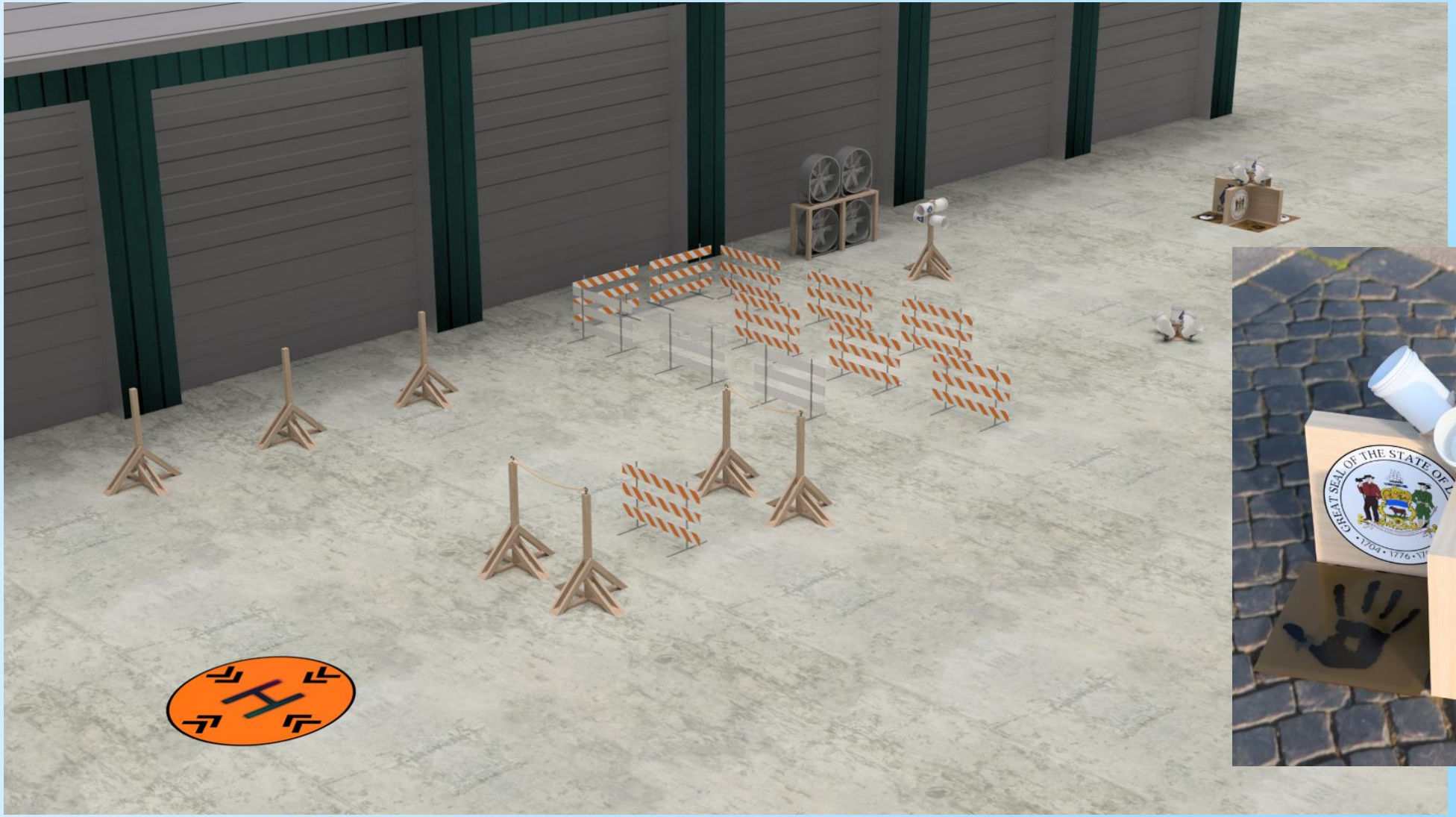
- Tactical Operations – UAS Academy
- Indoor Flying – UAS Academy
- Search & Rescue, FLIR, Night Ops – DartDrones
- Night Flying Qualified – DelDOT
- 8 Pilots are Level 1 Thermography Certified – FLIR
- Drone HAZMAT Course – Magda International (in development)

- Every year we try to send 4 – 5 UAS Pilots to conferences to learn the latest UAS Technology.
  - AUVSI - 2015
  - National Public Safety UAS Conference - 2016
  - InterDrone - 2017 & 2018
  - AUVSI Exponential 2019

DelDOT Advance sUAS Pilot Training (Being Developed)

- Based off of the National Fire Protection Association (NFPA) 2400; Standard for Small Unmanned Aircraft Systems (sUAS) for Public Safety Operations.
- Applying the concept of using props while testing the pilots ability to perform aerial maneuvers.

Advanced Course Rendering



DelDOT Training Facility

DelDOT pilots are trained on how to fly UAVs at the State Fire School. Courses are taught by members of the Training and Certification Steering committee.

DelDOT sUAS Inventory

• DJI Inspire 1 Pro	4
• DJI Phantom 4 Pro	5
• DJI Mavic Air	1
• DJI Mavic Pro	1
• DJI Mavic 2 Enterprise	2
• DJI M210	3
Total	16

Different tools in the tool box

DelDOT sUAS Inventory…Cont.

- Primary drones used
  - DJI Phantom 4 Pro

  - DJI M210
    - 30X Zoom Camera
    - Thermal Camera

FAA Registration

- All of our drones are registered under the traditional Aircraft Registration under 14 CFR Part 47.
  - An original Aircraft Registration Application; AC Form 8050-1
  - A Notarized Affidavit; AC Form 8050-88
  - A copy of the original receipt.
  - No charge for Government (State) agencies.

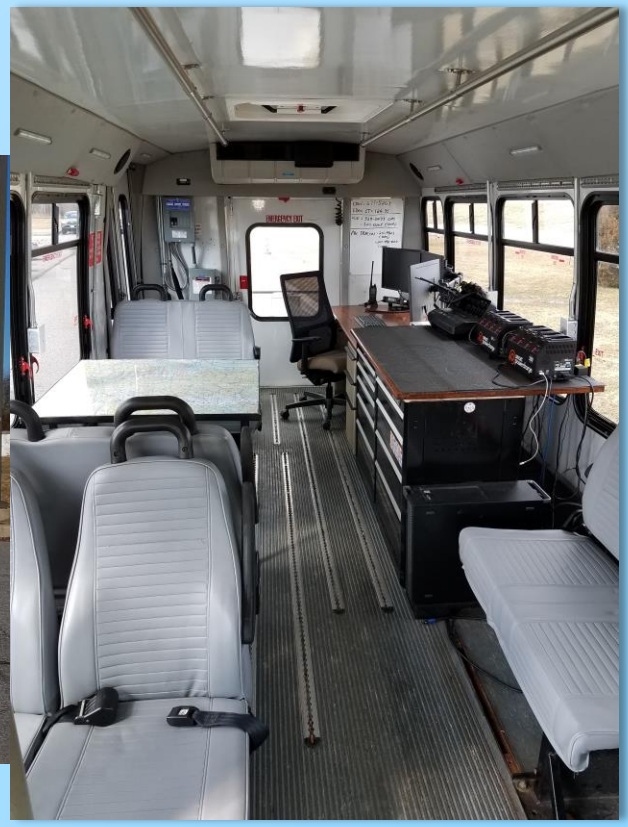
  - Send everything to Oklahoma City and wait about 6 weeks for your registration and N-number.
  - You can still fly your drone as long as you have a copy of your registration application with you.

Insurance

- We met with the State Insurance Coverage Administrator and she advised us that drone pilots from state agencies are covered under the state.
- County Public agencies had to get their own insurance policy.
- We had to provide all the registration numbers, pilot licenses, and a copy of the training program.

DelDOT Drone Bus

- Video downlink capability into the Transportation Management Center.
- Mobile TMC is used for long duration UAS operations



FAA Waivers

January 2016 - 1st Certificate of Authorization (COA)

June 2016 - FAA released Part 107

Government agencies have two options for operating drones under 55 pounds.

1. Fly under 14 CFR part 107.
2. Operate with a Certificate of Waiver or Authorization (COA) to be able to self-certify UAS and operators for flights performing governmental functions. (A FAA Remote Pilots License meets this requirement)

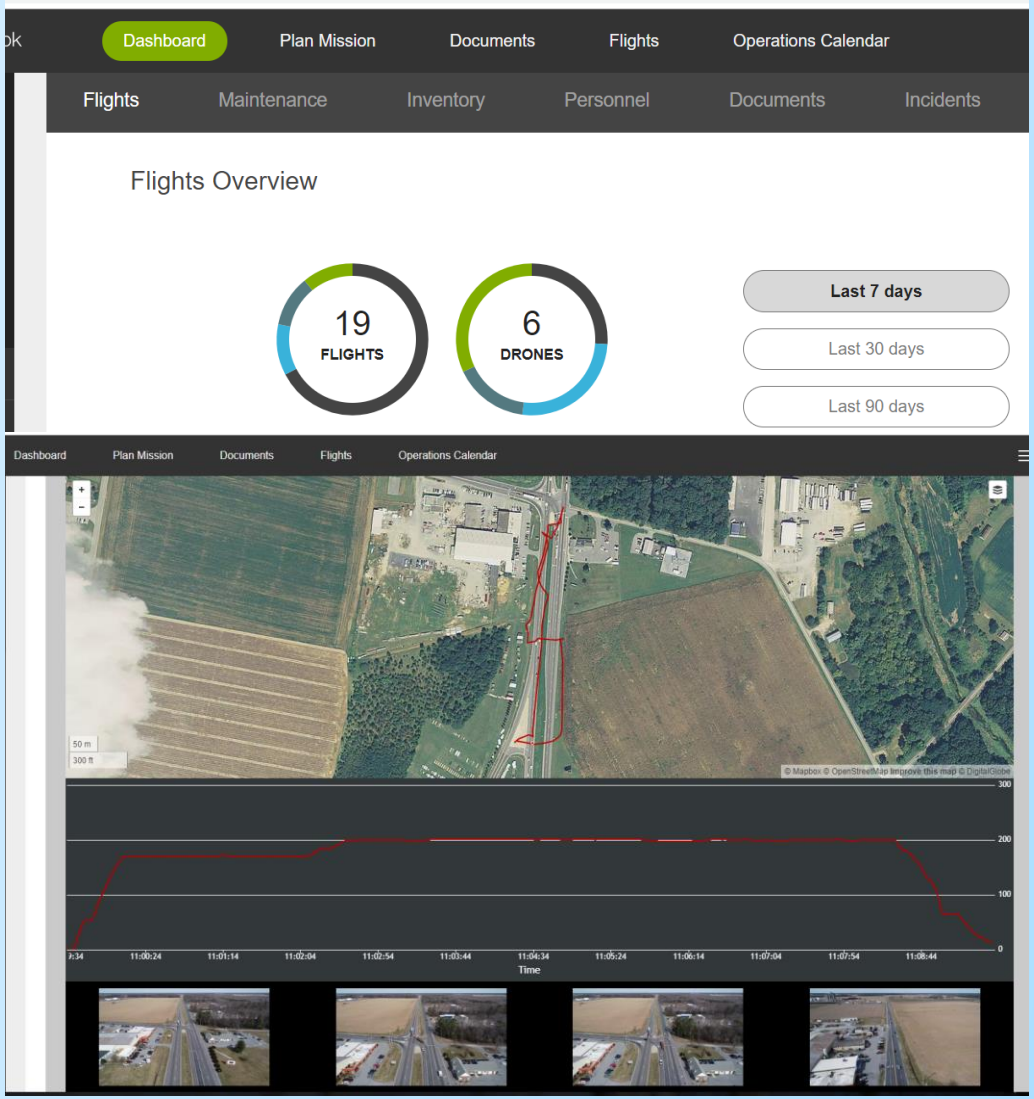
April 2018 – 2nd Certificate of Authorization (COA)

Fly within Class D airspace at ILG and KDOV

April 2018 – 107 Waiver for Night Operations

August 2018 – 107 Waiver for Class D airspace around Dover AFB

Drone LogBook



Operations Report
08 March 2019

Delaware Department of Transportation
169 Brickstore Landing Rd

Period: 2019-02-01 to 2019-03-08
Name: Dwayne Day **Email:** dwayne.day@state.de.us

FLIGHTS for : Dwayne Day as Pilot

Total flying time for this pilot: 03:05:57

Date	Flight name	Drone	Duration	Location
2019-03-07 09:50:51 14:50:51 UTC	**Flight 2019-03-07 09:50:51**	TMC - N808WL DJI/Phantom 4 Pro	00:02:43	US 301 Toll, New Castle County US 301 Toll Delaware 19709 US (39.425684440505, -75.76264151274)
Landing Time:14:53:34 UTC **Flight Type:** Commercial - Photo/Video				
Operation Type: VLOS **Sunset / Sunrise:** Day **Personnel:** Dwayne Day [Pilot], Richard Christopher Marsh [Visual Observer] **Pilot info:** **Equipment onboard:** B13 **Nb landing:** 1 **Distance:** 761.15 feet **Max altitude:** 226.38 feet **Conditions:** **Cloud cover:** 100 % **Temperature:** 32 F **Wind:** 8.79 miles/hour (270°) **Humidity:** 45 % **Notes:**				
IGC File			KML File	

Date	Flight name	Drone	Duration	Location
2019-03-01 01:41:20 06:41:20 UTC	**Flight 2019-03-01 01:41:20**	TMC - N862QG DJI/Matrice 210	00:08:53	TMC 169 Brick Store Landing Road Smyrna DE 19977 US (39.31867281396407, -75.60641126848742)
Landing Time:06:50:13 UTC **Flight Type:** Test Flight				
Operation Type: VLOS **Sunset / Sunrise:** Night **Personnel:** Dwayne Day [Pilot], Richard Christopher Marsh [Visual Observer] **Pilot info:** **Equipment onboard:** XT2 (TMC), TMC 1 B, TMC 1 A **Nb landing:** 1 **Distance:** 1837.27 feet **Max altitude:** 190.29 feet **Conditions:** **Cloud cover:** 100 % **Temperature:** 35 F **Wind:** 4.43 miles/hour (93°) **Humidity:** 60 % **Notes:**				
IGC File			KML File	

Date	Flight name	Drone	Duration	Location
2019-02-21 15:52:25 20:52:25 UTC	**Flight 2019-02-21 15:52:25**	TMC - N862QG DJI/Matrice 210	00:03:28	TMC 169 Brick Store Landing Road Smyrna DE 19977 US (39.31867281396407, -75.60641126848742)
Landing Time:20:55:53 UTC **Flight Type:** Test Flight				
Operation Type: VLOS **Sunset / Sunrise:** Day **Personnel:** Dwayne Day [Pilot], Zachary Lawson [Visual Observer] **Pilot info:** **Equipment onboard:** TMC 4 B, TMC 4 A, Z30 (TMC) **Nb landing:** 1 **Distance:** 4215.88 feet **Max altitude:** 187.01 feet **Conditions:** **Cloud cover:** 0 % **Temperature:** 53 F **Wind:** 6.34 miles/hour (298°) **Humidity:** 54 % **Notes:**				
IGC File			KML File	

Funding

Training courses were paid for through the Homeland Security grant. Approximately $80K

Drones were bought by DelDOT through various funding streams.

- State Funds
- Special Event Funds
- State Transportation Innovation Councils (STIC) Funds 80/20

Modifications on the Drone bus were done in-house by DelDOT employees.

Thermal cameras and Zoom cameras were purchased through the Homeland Security grant.

Video and Photo Processing

- Your going to think you are taking fantastic videos…reality is your first couple of videos will probably make someone motion sick.
- We use Adobe Premiere 15 to process the videos.
- Only about 3 pictures can be sent through the state email system. No videos, they are much too large.
- We have used Drop Box, flash drives, SD cards, in-house drives on our servers.
- IT folks might get upset with the amount of space that you will use to save your videos.

Uses for DelDOT

- Situational Awareness
- Debris Assessments
- Traffic Mitigation
- Stock Pile Estimations
- Bridge Inspections
- Aerial photography of traffic projects
- Archeological inspections/photos
- Dune Erosion pre and post storm

Royal Farms in Milford, Rt. 1

Route 1 & 16 Intersection

2016.11.16

SR 1 AT SR 16 BRIDGE RENDERING

WRA

Delaware Department of Transportation

SR 1 AND SR 16 GRADE SEPARATED INTERSECTION

DelDOT

DelDOT

Firefly Festival Lot 18…Tent Campers

Tanker Rollover Rt 1

Future DelDOT UAVs

Tethered Drones

Unmanned Maritime Drones

Questions or Comments

Delaware Department of Transportation (DelDOT)

Dwayne Day

dwayne.day@state.de.us

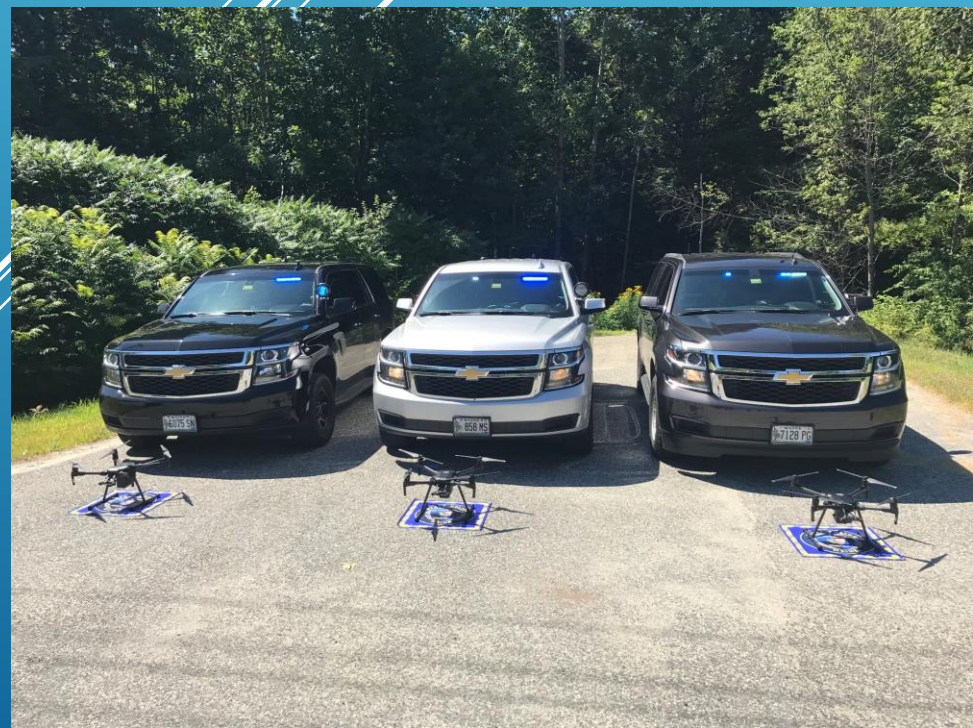
(302) 659-4604

Session 2:
Law Enforcement & Public Safety Use Cases

Sgt. Darren Foster, Maine State Police

UAV'S IN PUBLIC SAFETY

Applications by Maine State Police



BACKGROUND:

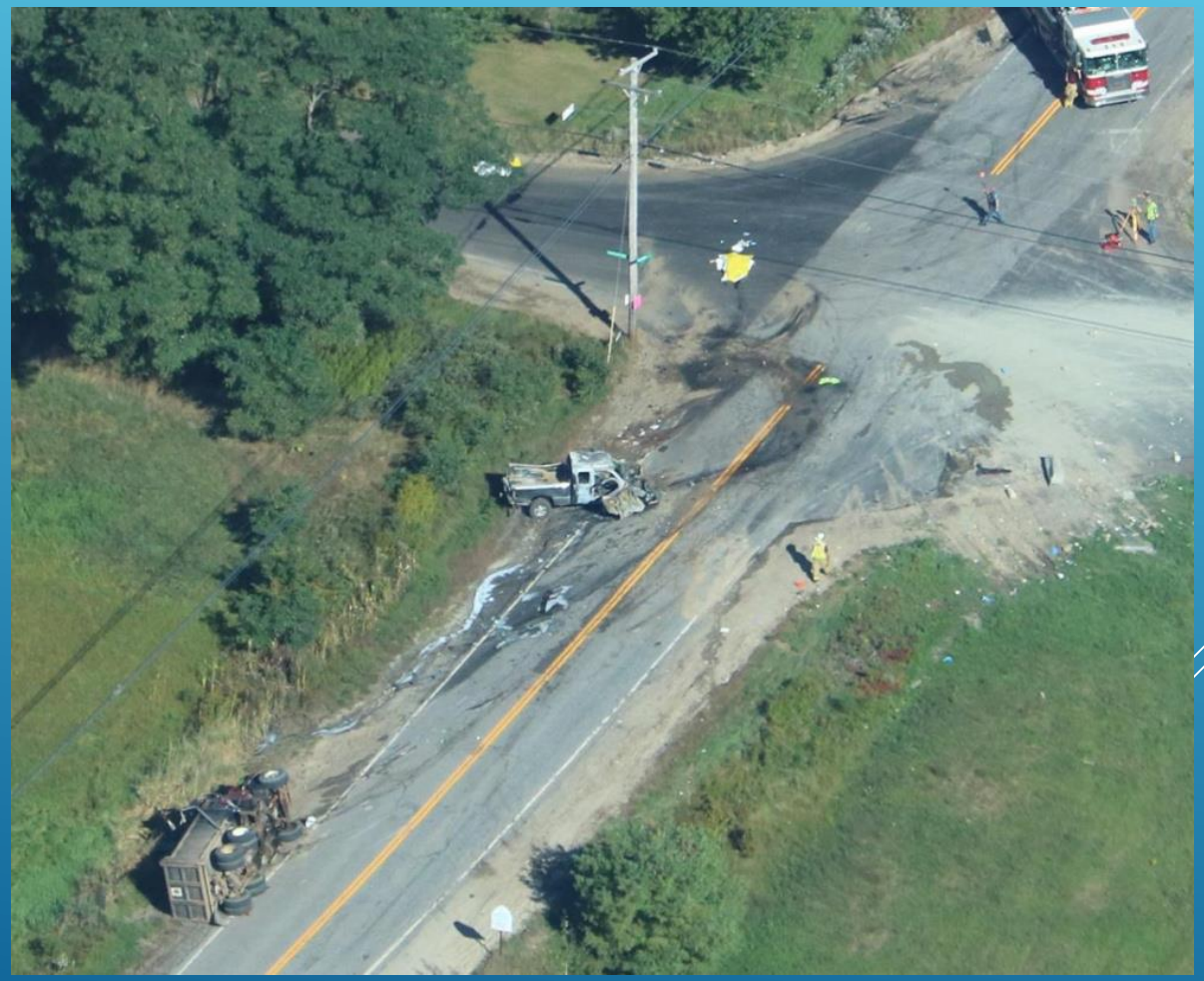
- 2017 – State Legislature passes bill to allow the use of Unmanned Aerial Vehicles for Law Enforcement
- May 2017 – MSP trained 3 Crash Reconstruction Experts and 2 Pilots in UAV operation.
- June 2017 – Purchased 3 DJI Matrice 200 UAV's for Crash Reconstruction purposes
- To Date –
  - 48 Crash Reconstruction Mapping Flights
  - 17 Crime Scene Mapping Flights
  - 5 Fire Scene Mapping Flights
  - 16 Search/Rescue Flights

UAV APPLICATIONS FOR CRASH INVESTIGATION

- Overhead Photos to show collision

UAV APPLICATIONS FOR CRASH INVESTIGATION

- Scene Documentation



UAV APPLICATIONS FOR CRASH INVESTIGATION

- Scene Analysis

BENEFIT OF UAV OVER TRADITIONAL METHODS

- Time on Scene
  - The longer the roadway is obstructed, the greater the risk of secondary crashes.
  - Roadway shut downs have a huge economic impact
  - Shut downs place tremendous strain on public safety assets and can hinder a response in an emergency

BENEFIT OF UAV OVER TRADITIONAL METHODS

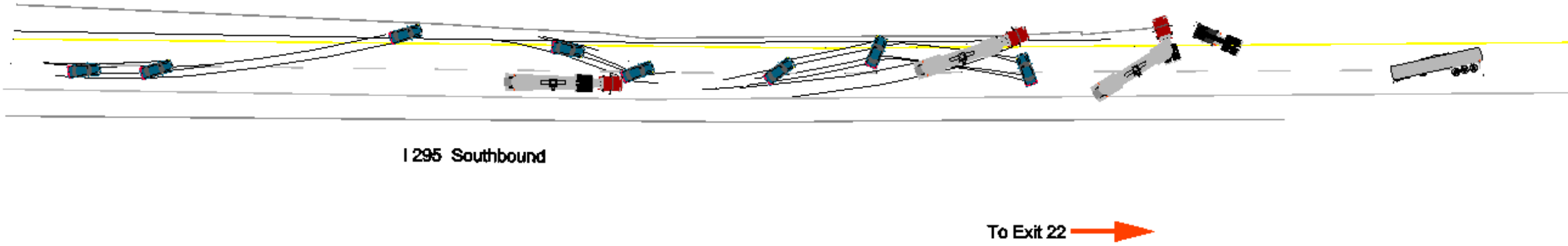
- Time on Scene
  - A Typical Forensic Mapping takes 1 to 2 hours and we collect 200 – 300 points. Roadway must typically be shut down for officer safety.
  - The UAV can collect 100 to 200 photographs which can generate a point cloud containing millions of points in a 10 – 15 minute flight. Roadway can generally stay open.

BENEFIT OF UAV OVER TRADITIONAL METHODS

- Time on Scene
  - The UAV doesn't care about scene complexity

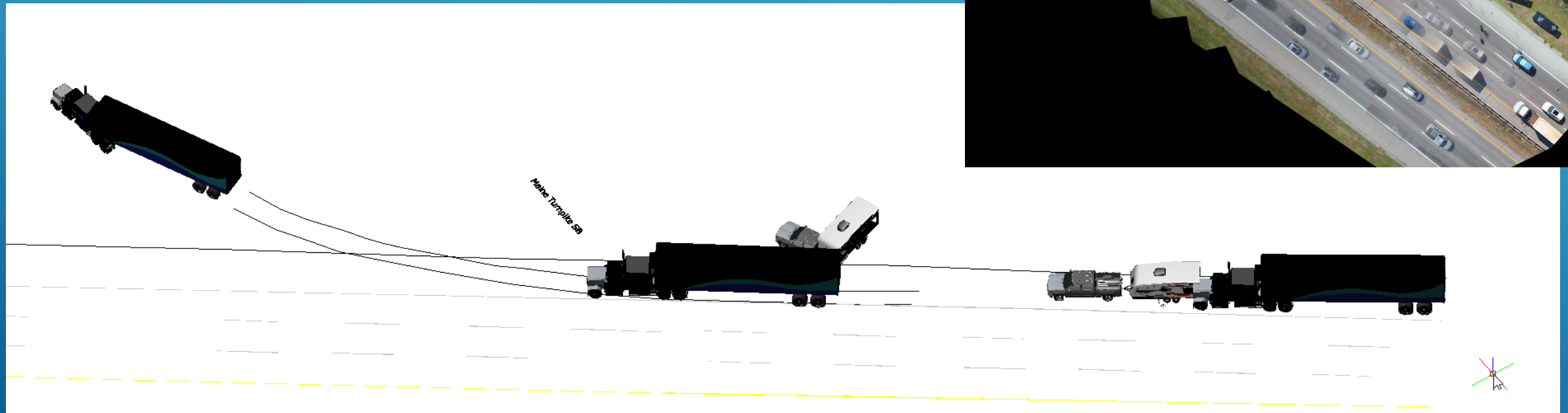
BENEFIT OF UAV OVER TRADITIONAL METHODS

- Time On Scene Mapping: 3 Hours
- Road completely shut down 1 hour
- Traffic in shoulder 3 hours



BENEFIT OF UAV OVER TRADITIONAL METHODS

- UAV set up- 15 minutes
- UAV Flight Time – 11 minutes
- 2 lanes of travel fully left open
- Time on scene 1 hour



ADDITIONAL UAV USES

ADDITIONAL UAV USES

ADDITIONAL UAV USES

ADDITIONAL UAV USES

Session 3: Emergency Response

Marc Brunelle, York County EMA

York County Emergency Management Agency
(YCEMA)

UAS Workshop

New England Highway Operations Group

April 11, 2019

Today's Presentation

sUAS – Unmanned Aerial Systems

- **Art Cleaves** – *YCEMA Director* *(awcleaves@yorkcountymaine.gov)*
- Marc Brunelle – *UAS Section Chief*
- Blain Cote – *YCEMA Division Chief for Operations & Training, Ret Sth Berwick Fire Capt*
- Richard Gaudreau – *UAS Technology Specialist & Retired Deputy Fire Chief*

York County EMA
149 Jordan Springs Road
Alfred, ME 04002

DISCLAIMER

- ✓ Nothing contained in this presentation is to be interpreted as an endorsement of any product or service
- ✓ This slideshow will not be shared
- ✓ Feel free to raise your hand for questions; we'll do our best to answer them for the benefit of the whole audience or plan to meet one on one

Background & Introduction

In winter 2016 Art Cleaves, Director of York County EMA tapped the resources of a volunteer IMAT Team to create the sUAS Initiative.

After purchasing the first aircraft and navigating the fledgling FAA regulations we learned "day by day".

The purpose of this presentation is to describe the opportunities and considerations for commercial use of Unmanned Aerial Systems in the National Airspace System (NAS) which is controlled by the Federal Aviation Administration (FAA)

YCEMA Objectives

1. Support Town, County, State, and Federal Agencies as possible.
2. Conduct safe and successful sUAS operations with qualified (FAA Part 107) pilots and Visual Observers (VO).
3. Operate sUAS IAW Local/State Laws & FAA Regulations.
4. Develop Center of Excellence as working model for training and sUAS operations in Maine.

"Potential" Real World Missions

- Structure & other Fires
- Vehicle accidents
- Search & Rescue
- Live Shooter/Stand off / Evac Drill
- HAZMAT Spill
- Damage Assessment –FEMA support
- Dam Inspection/Flooding
- * Indoor fires (Industrial) *

Potential Support to:

- York County Sheriff Office
- Maine IF&W
- Local Fire Departments
- Maine State Police
- Local Law Enforcement
- MEMA/FEMA
- Maine Dept of Transportation
- Department of Environmental Protection
- Public Sector Quasi-Municipal Agencies
- Private Sector Partners – Note: “crossing the line”

Overview UAS Section

- Regulatory issues
  - FAA Part 107 (airspace, pilot quals, reporting, limitations, etc)
  - COA - Certificate of Authority (Waiver)
  - State Laws & Local Ordinances
- Leadership & Structure
  - Volunteer team –multiple skill sets, varied schedules
  - Policies & Procedures
  - Accountability (Need responsible custody of data)
  - Support from EMA Director
- Equipment (Show & Tell)
  - UAS airframes: *DJI S1000, DJI Inspire I, DJI Mavic Pro*
  - Capabilities: Recorded Video, Still photos, Thermal, Video Streaming

Equipment

S1000 Octocopter

DJI Inspire 2

DJI Mavic Pro

FPV Goggles

Live Stream to Command Vehicle

YCEMA Command Vehicle

YCEMA COA

- FAA - Certificate of Authorization
  - Public Use Aircraft defined; refer to **49-USC-40125**
  - Initial issued 22 April 2016 ; Renewed –Jun 2018
  - COA may be cancelled at any time by FAA Administrator.
  - Restricts use of sUAS to **<55lbs** only in **Class G** airspace at or below **400' AGL.**
  - Addendum issued 5 Jun 2017 to permit sUAS night operations.

Mission Flying

- Overall Incident briefing
- Approval to fly (Jurisdiction and Incident Commander)
- Risk Assessment Checklist
- With "COA" - Public Use Aircraft defined; refer to **49-USC-40125**
  - National Defense, Intelligence
  - Firefighting
  - SAR
  - Biological, Geological Resource Management
- Part 107
  - Training
  - Law enforcement activities
  - Damage Assessment

YCEMA OPS Plan

- UAS Operations & Deployment
  - Authorization from EMA Director
  - Pilot in Command (PIC) + 1 or 2 Visual Observers (VO's)
  - PIC must maintain VLOS (Visual Line Of Sight)
  - Public Civil Liberties & Rights to Privacy Training
  - Archive video & preserve chain of custody
  - Pre-flight checklist
    - Varies per airframe
    - Define mission
    - Conduct Risk Analysis

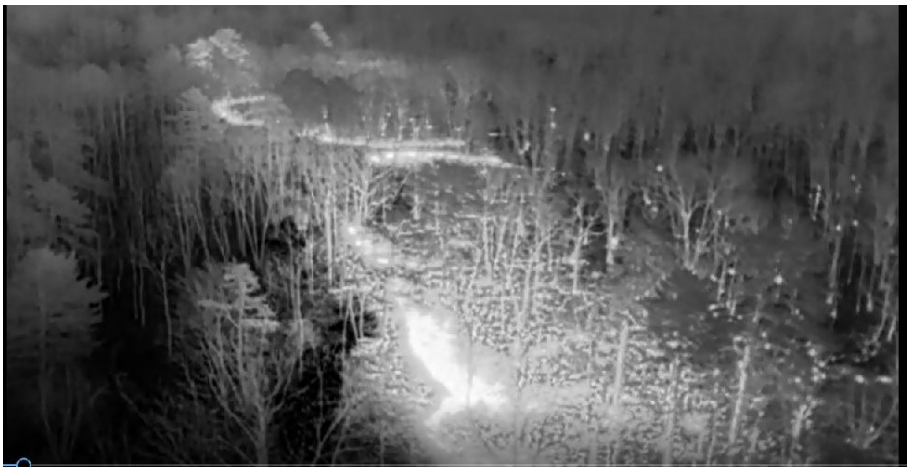
Sanford Mill Fire - June 2017

Video

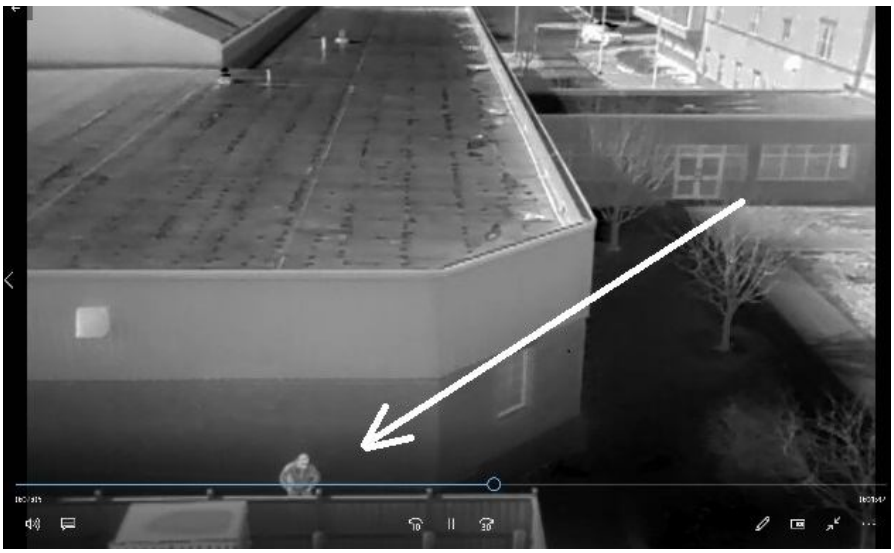
Sanford, Maine

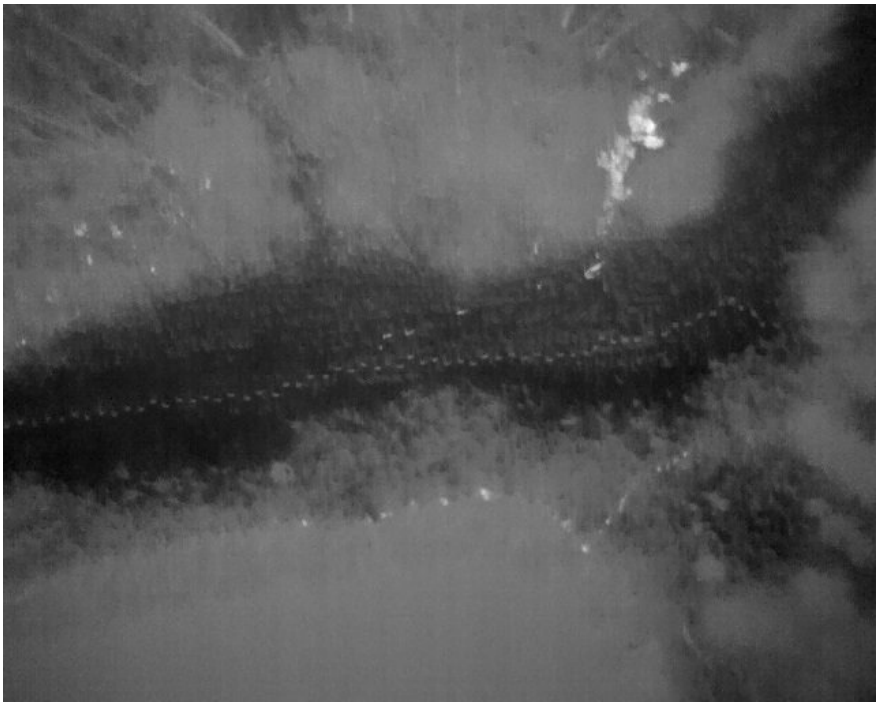
Video

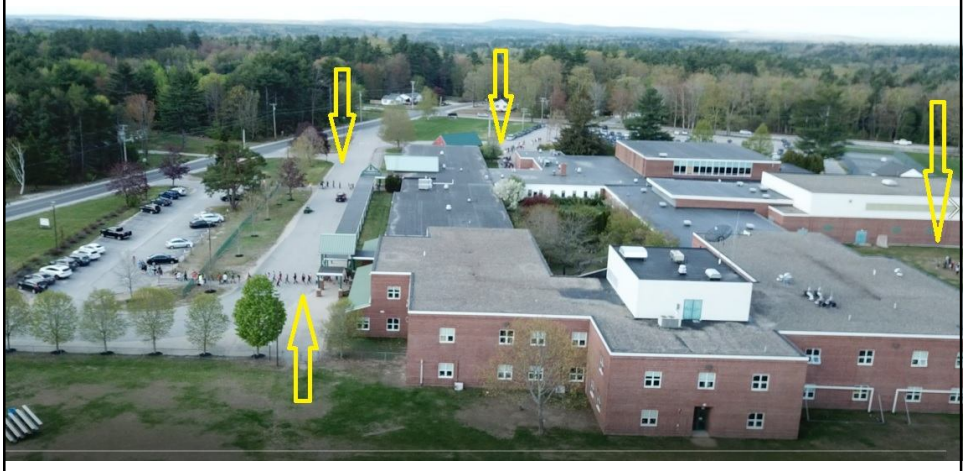
Kennebunk Woods Fire - Thermal



Video







Click for Video

WHAT COULD POSSIBLY GO WRONG ??

(Click photo for balloon video)

Black Box Data

- Higher end (professional) drones have data logging capabilities.
- Provides similar function to commercial aircraft "black boxes"
- Drone logs hundreds of data points by the second such as:
  - Pilot input from remote controller
  - UAS response to the pilot commands
  - UAS flight attributes such as: Lat/Long position; speed, altitude, etc.
  - This data is important for investigating flight anomalies such as "fly away" scenarios or proving whether or not the UAS was in a certain location at a specific time.

Black Box Data

Software used to access the data from a DJI UAS:
DJI Assistant 2

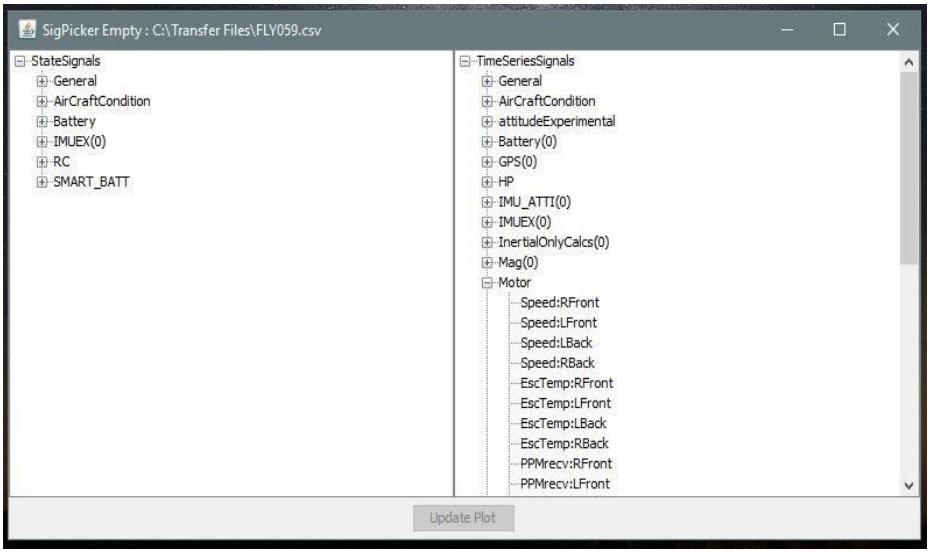
Methods for analyzing the "Black Box" data:

1. **Internet based analysis**; www.Airdata.com
   Free (Basic data analysis) and paid
   versions (More in-depth analysis)

2. **User based software programs**;
www.DATFILE.net for CsvView, DatCon (Both Freeware).
   User can control extent and complexity
   of data analysis (Learning curve required).

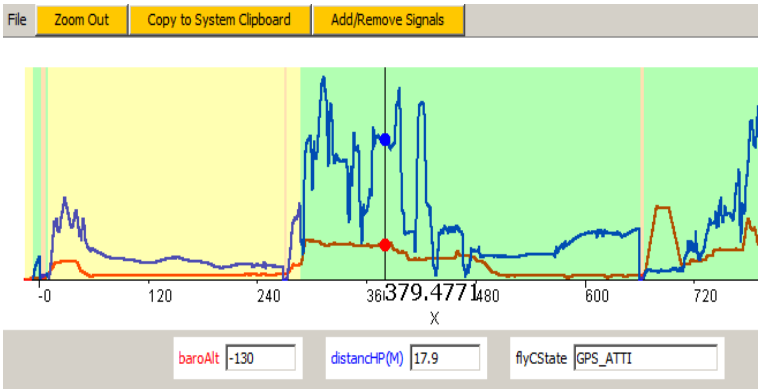
Black Box Data

Some of the data points available from the CsvView program.



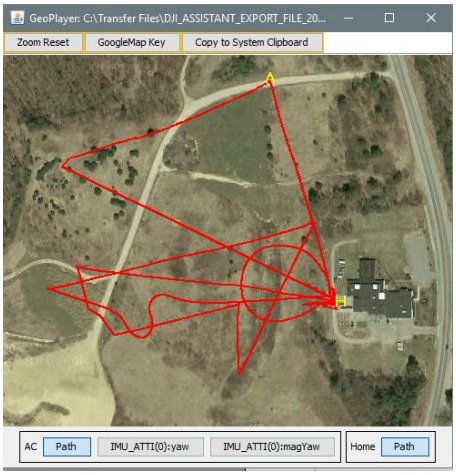
Black Box Data

Typical graph from CsvView software program.



Black Box Data

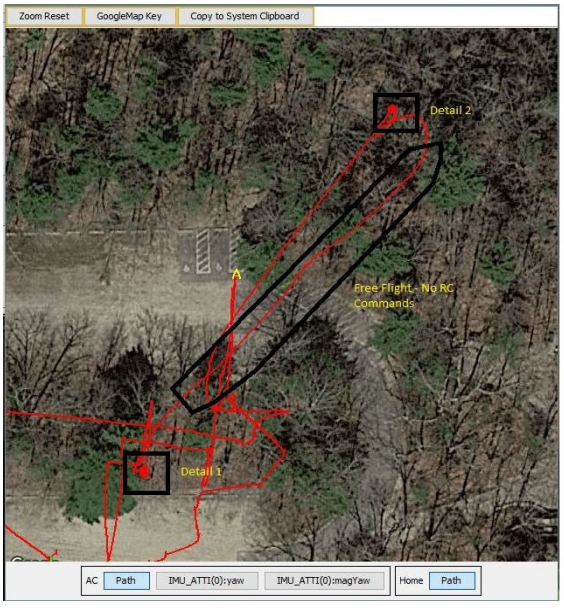
UAS flight path overlaid on a Google Earth background in CsvView program.



Black Box Data

Example of how "Black Box" data analysis helped to explain and rectify a past YCEMA UAS flight anomaly.

Black Box Data



Black Box Data

Black Box Data

	Flight time	Altitude	Home Dist	Type	Notification
A	00m 00s	0.0 ft	0 ft	Mode	Mode changed to P-GPS
B	00m 00s	0.0 ft	0 ft	Tip	Log filename: FLY059.DAT
	00m 01s	0.0 ft	0 ft		100% Battery
C	00m 02s	0.0 ft	1 ft	Mode	Mode changed to Assisted Takeoff
D	00m 05s	0.0 ft	1 ft	Mode	Mode changed to P-GPS
	01m 38s	170.9 ft	396 ft		90% Battery
	02m 59s	170.6 ft	413 ft		86% Battery at maximum distance
	04m 10s	171.6 ft	401 ft		80% Battery
	06m 05s	170.6 ft	112 ft		70% Battery
	08m 14s	124.7 ft	64 ft		60% Battery
E	09m 51s	124.3 ft	60 ft	Mode	Mode changed to Atti
F	09m 51s	124.3 ft	60 ft	Warning	Yaw Error (repeated 49 times)
G	09m 56s	124.3 ft	76 ft	Warning	Yaw Error (repeated 48 times)
H	10m 01s	128.9 ft	146 ft	Warning	Yaw Error (repeated 26 times)
I	10m 04s	132.2 ft	216 ft	Mode	Mode changed to P-GPS
	10m 19s	133.2 ft	243 ft		50% Battery

Perils of third party apps and devices:

•Personal iPhone or Android
•SAR apps ie. Litchi, DroneSAR, etc.
•No support from DJI if UAS lost
•Possible confiscation of personal device
•Inconsistent operator settings, difficult to create standardization
•Potential for memory crash, software, firmware conflict.

Continuing Operations

- Aircraft
  - Pre-flight Checklist
  - Airframe Condition (motors, props, cameras, etc)
  - Maintenance & Repair
  - Maintain integrity of digital media
  - Returning to service for next flight
- Pilot
  - FAA Part 107 Qualifications & license renewals
  - Training for Basic Flight and control
  - Logbook entries (dronelogbook.com)
  - IMSAFE (Acronym for pilot readiness)

Area of Rapid Change & Choices of Equipment

- Drone Manufacturers
  - DJI, Yuneec, Holy Stone, GoPro, etc
- Regulation –FAA *trying* to get out in front
- Technology – Every day a new capability
- Reliance on 3rd party apps & implications
- For Example: DroneSense, Airmap, Dronelogbook, Litchi

- → Click for video - → DroneSense

Looking forward to Proposed Changes

- Flight over "people" – creates three categories
  - < .55 lbs
  - > .55 lbs (Mfr injury rating; no exposed props)
  - > 55 lbs (threshold of injury determinant)
- Night Flying
- Pilot renewals (Change in testing requirements)
- Open comment period ending 4/15/19

Thank You

The End