DRONES IN GOVERNMENT WORK
Drones in Government Work: Build Your Drone Program with Lessons from North Carolina’s Statewide Drone Collaboration
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PART ONE
INTRODUCTION
PART ONE

INTRODUCTION
Drones are changing how state and local governments serve the public in big ways and small. While drones have gained an early foothold in public safety, enterprising government agencies and departments are exploring their use in other areas, from transportation and public works to planning and environmental services. Government use of drones is increasing rapidly in both the number of departments that have drone programs and the type of drone applications.

Drone programs are scattered across many different departments, including state, municipal, and local governments. Public safety and emergency preparation dominate present-day public-sector use cases for drone adoption (As seen in Graph One on page 7), enterprising government agencies and departments are exploring their use in other areas, from transportation and public works to planning and environmental services. Because of the various use cases and the multiple layers of regulation involved in drone usage, public sector leaders must think carefully about how to build strategies to structure and manage government drone programs.

North Carolina has been a pioneer in unmanned aviation, advising national standards and rules and driving innovation in public sector drone usage. The state has established an effective statewide drone collaboration program spearheaded by the N.C. Department of Transportation’s Division of Aviation (DoA). The DoA has a special working group that leads, supports and trains the various drone programs in other departments. The state’s drone networks have successfully fulfilled many state-level operations including Hurricane Florence disaster response, relief and reconstruction in 2018.

This white paper will address how drones function in the many public-sector areas and how to build collaboration for maximized efficiency based on the lessons of North Carolina’s statewide drone collaboration program.
Chart One. Top 6 Reasons Public Sector Agencies Adopt Drones, Based on Multiple Choice Survey

- **59%**
  Increasing public safety

- **55%**
  Preparing for an emergency

- **54%**
  Performing tasks more quickly

- **50%**
  More effective than legacy methods

- **47%**
  Safer for employees

- **35%**
  Lower cost

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PART TWO
THE NORTH CAROLINA FRAMEWORK
HOW A STATEWIDE DRONE NETWORK IS STRUCTURED AND MANAGED ACROSS DIFFERENT DEPARTMENTS

North Carolina has been at the forefront of aviation ever since the Wright Brothers’ first flight took off in Kitty Hawk, NC, in 1903. The state has stepped into the aviation history book again by leading in unmanned aviation, advising national standards and rules and driving innovation in public sector drone usage.

In 2018, dramatic imagery captured by drones from various North Carolina public agencies showed the world the devastation occurring in North Carolina from Hurricane Florence and provided valuable intelligence that guided response and recovery efforts. Fifteen drone teams from seven agencies flew over the affected areas and captured more than 8,000 videos and images of flooded roadways and towns, road and bridge washouts, eroded beaches, ferry terminals, and more.

The state has an extensive public drone program network. The department types vary from small local police and fire departments to state-level departments, such as the N.C. Department of Transportation (NCDOT) and State Highway Patrol, to educational and research institutions, including North Carolina State University, the North Carolina
Mavic 2 Enterprise drones used for railway inspection

Public Safety Drone Academy, and environmental research institutions.

North Carolina implements its robust program of layered drone deployment, public education and outreach under an effectively structured and supported UAS management program. In this white paper, it is referred to as the “North Carolina Framework.”

It is DJI’s opinion – gained from interfacing with government and private-industry organizations – that the North Carolina Framework is an ideal structure for other public-sector entities to follow.

A CENTRALIZED MANAGEMENT PROGRAM

The North Carolina Framework is built around a centralized structure led by NCDOT in drone program management, funding and support. The N.C. General Assembly sets regulations to protect safety and privacy, while funding the NCDOT Division of Aviation’s UAS Program Office to expand safe, beneficial drone use.

NCDOT, as one of the earliest drone technology adopters in the U.S. public sector, started its drone program initially in 2015. Its experience in exploring use cases, regulations, and safety operation guidelines soon influenced other departments that were looking to start their drone programs. When North Carolina decided to standardize the management of the many drone programs across the state, it was natural that the leading role went to NCDOT. With NCDOT’s consultancy and training services, local
and state-level government departments in North Carolina began building drone programs under a centralized framework.

The department’s leadership and consulting role expanded to cross-state and federal levels as well. In 2018, NCDOT was selected by the Federal Aviation Administration as one of ten teams for its three-year UAS Integration Pilot Program to test and inform national regulations and systems for drone use across the country. The department also participated in two NASA-sponsored market analyses of urban air mobility components.

While NCDOT has been an early leader in building a central management system to support cross-organizational drone deployments, DJI has seen an increasing number of leading adopters use a similar model to scale out their operations. Most notably at the federal level is the Department of Interior, whose Office of Aviation Services has been charged with overseeing drone operations at a scale of 10,000 flights and 400 FAA certified pilots in 2018. This structure is similarly being used by leading enterprises such as Southern Company and Union Pacific, suggesting learnings from NCDOT are relevant to all large organizations deploying drones.

THE ROLE OF NCDOT DIVISION OF AVIATION

The Division of Aviation’s (DoA) mission is to promote the economic wellbeing of North Carolina through air transportation system development, safety initiatives, and education. As the state’s aviation authority, its role is to promote aviation and aerospace development, manage state and federal airport development grants and programs, manage the state’s unmanned aircraft systems program, conduct aviation safety and education programs, and provide air transportation that advances state agency missions. Within NCDOT, the Division of Avi-
ation is the lead in drone integration. Its role is to lead North Carolina’s work in these key areas:

- **UAS Innovation** – Creating knowledge and integration of UAS technologies for public and private use and benefit.
- **UAS Safety** – Providing the safest possible environment for drone operations.
- **UAS Government Integration** – Maximizing state and local agency use of UAS technology to improve public services and operations.
- **UAS Economic Development** – Developing a world-leading UAS economy.

The UAS Program has racked up a series of firsts in just a few years. Among them:

- North Carolina’s first coordinated drone response to a disaster.
- First U.S. medical package drone delivery demonstration, including flights over people.
- Launch of nation’s first routine and for-revenue drone flights to deliver products.
- Nation’s first and only permitting system for commercial and government drone operators (permitting 2,110 commercial and 782 government operators by the end of 2018).
- North Carolina’s first Drone Summit and Flight Expo convening UAS leaders from business, government and academic focused on drone innovation.

DoA is leading the way to help government agencies in North Carolina maximize the use of drones to improve public services and operations and save tax dollars.

The three-year NCDOT drone integration program, now in its second year, calls for DoA to:

- Administer NCDOT drone integration, including planning, implementing, and reporting progress and results to leadership.
- Advise and approve all UAS procurement at NCDOT.
- Educate NCDOT personnel about the UAS policy, training opportunities, and fleet requirements.
- Train and certify NCDOT personnel as UAS operators.
- Develop and implement a fleet management system for NCDOT UAS operations, including registration, compliance, and tracking protocols.

More than 30 drones are currently in use across NCDOT, supporting a variety of functions in the DoA, including the communications office, highway divisions and geotechnical, photogrammetry, roadside environmental, and safety and risk management units.

Uses range from transportation infrastructure inspection and project documentation to disaster response and special missions to project and event photography, spraying of invasive species, jobsite erosion control monitoring and worksite safety assessment. In its final year, DoA will reach out to all NCDOT units to assess opportunities for using drones and begin a three-level certification training program for operators.

DoA UAS subject matter experts are regularly called upon by other transportation and drone organizations as well as publications statewide to share their experiences, best practices and recommendations on developing drone technologies and programs. Many other of the state’s public departments set up their drone programs under DoA’s consultancy and advice.

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The strategy is to first focus primarily on fully integrating drone use at NCDOT, then replicating the NCDOT integration strategy across other state and local agencies.
Wake Forest Fire Department (WFFD) is a mid-sized local fire department located in the suburbs of Raleigh. The department has five stations with 125 firefighters, protecting a wide range of residential, commercial, and rural/agricultural areas.

The WFFD drone program is small with one drone and one pilot in active service, equipped with a thermal camera to help locate missing persons and a zoom visual camera. The program’s primary role is to assist in search and rescue, structure and commercial building firefighting, hazardous material situations, wildfires and documenting natural disasters.

WFFD started researching and testing drone technology in 2014 and officially started their program in 2017 when they acquired an all-weather drone platform that meets the tough service demands of a fire department.

The WFFD drone has assisted departments and agencies around the state with mutual aid requests, from search and rescue missions to assisting with largely populated events to help keep people safe. It has also assisted departments across the country with tips, tools, and techniques for making Unmanned Aircraft Systems (UAS) a valuable asset for a modern fire department. WFFD’s Chief Pilot, Steve Rhode, has been active as a drone flight instructor across the state and as a national author on the subject of drones in the fire service.
The North Carolina State Highway Patrol (NCSHP) started its drone program in 2017 mainly for its Collision Reconstruction Unit and later expanded to the SWAT team. The Collision Reconstruction Unit investigates major vehicle crashes and prepares detailed reports on such events. The initial objective of the NCSHP’s drone program was to save time investigating collision scenes and reduce secondary collisions.

During the earlier stages of the program’s development, NCSHP worked closely with NCDOT to define key applications, prove concepts, and compare manufacturers.

In 2017, NCDOT conducted a research study with the NCSHP Collision Reconstruction Unit. The experiment involved a simulated two-car crash in a controlled environment. NCSHP’s traditional methods took one hour and 51 minutes to collect its data. Pilots using three different drones took just 25 minutes on average to complete the mission. The study proved drones save substantial investigation time and money at crash scenes compared with legacy methods.  

In more recent studies in 2018, RTI and UNC Charlotte collaborated, with the support of NCDOT and NCSHP, found key benefits of drone technology in low-light collision scene reconstruction.  

Today, NCSHP has over 27 drones in active deployment. The 21 members on the NCSHP Collision Reconstruction Unit all are FAA Part 107 certified pilots. Each member is issued a DJI Phantom 4 Pro drone primarily used for mapping and aerial photography.

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The North Carolina Public Safety Drone Academy is a full-fledged drone education provider operating under Montgomery Community College and the North Carolina Community College System. The academy’s purpose is to teach future drone operators in local and state emergency services the proper safety measures required to use drones safely and effectively. Many of North Carolina’s firefighters, law enforcement officers, and emergency management personnel are trained and licensed in piloting drones at the academy.

Montgomery Community College began providing students with a drone education program that taught important basics in 2016. Later in 2017, the drone program partnered with NCDOT’s Division of Aviation, the N.C. Department of Public Safety, and several local and state municipalities to create the academy.

Its current curriculum consists of numerous high-level scenario-based courses ranging from manned and unmanned communications, search and rescue, hazmat operations, multi-agency operations, to wild-land fire monitoring and response. The academy is also known for its new year-long course divided among the legal aspects of operating drones, the hands-on component with the physical skill of maneuvering them properly and safely within live scenarios, and field trips to meet industry leaders and companies. Impressively, the North Carolina Public Safety Drone Academy offers all courses, seminars, and workshops completely tuition free through a tuition waiver for all public safety and emergency service professionals.

The free tuition is a powerful incentive for emergency and public safety workers like firefighters, police officers, EMTs, and others. As drone usage becomes more appealing to the corporate and public sectors, and thus, a valued skill in dozens of job categories, free courses and training to bolster those skills makes the North Carolina Public Safety Drone Academy a true asset to the state.
CASE STUDY: STATE-WIDE COLLABORATION FOR HURRICANE FLORENCE

Hurricane Florence, a large and slow-moving storm, made landfall during the morning of September 14, 2018. After the eye crossed Wrightsville Beach, NC at 7:15 a.m. the storm spent the next two days producing record-breaking rainfall across eastern North Carolina and a portion of northeastern South Carolina. Over 30 inches of rain were measured in a few North Carolina locations, exceeding the highest single-storm rainfall amounts ever seen in those places.

In the face of Hurricane Florence, NCDOT Division of Aviation launched a massive drone deployment to support emergency response and recovery efforts. The slow-moving storm afforded DoA the chance to start planning more than a week before landfall. The DoA team had to prepare for the worst, mobilizing their network of public safety, infrastructure, and UAS experts to support the state’s emergency response.

They established a command center staffed with NCDOT employees, NCSHP troopers, emergency management staff and private contractors.

All of them served as key partners in what was a coordinated effort to respond to Hurricane Florence.

The NCDOT formed 15 drone teams and deployed them prior to the start of the storm near areas expected to be hit the hardest. The teams were ready to conduct all flight operations under Part 107 and

Fifteen drone teams from seven agencies flew over the affected areas and captured more than 8,000 videos and images.
15 drone teams
260+ missions
8,000+ videos and images
Live streaming of data
7 supporting agencies:
N.C. Department of Transportation
N.C. Department of Public Safety
N.C. Department of Environmental Quality
N.C. National Guard
U.S. Coast Guard
Federal Emergency Management Agency
Federal Aviation Administration
their COA, aiming to complement the state’s traditional manned aviation response with a focus on inspecting and monitoring the state’s transportation infrastructure. That included the roads, highways, bridges, airports, ferry terminals, waterways and dams that are spread across the region.

The teams also conducted the first BVLOS operations during emergency response in N.C. Drone pictures and footage clearly showed how some roads became washed out and unusable days after the storm as floodwaters rose. Public mobility, a critical issue as the storm progressed, was enhanced by UAS flights that monitored road conditions and traffic backups, enabling the Department of Public Safety to reroute traffic to support evacuations and alleviate congestion.

**The 15 teams flew more than 260 damage assessment missions and captured over 8000 pictures and videos of affected areas.**

Flooding from Hurricane Florence created numerous critical issues for the region. Once the storm ended, the team’s focus was to assess areas that might be flooded and dams that could breach. The 15 teams flew more than 260 damage assessment missions over one third of the state. Teams captured 8000 pictures and videos of flooded roadways and towns, road and bridge washouts, eroded beaches, ferry terminals and more. Data gathered via drone was provided to emergency responders and news channels in order to tell people to avoid using I-40 and similar roads because of flooding.

As part of their post-hurricane assessment, their team used drones to live stream areas affected to NCDOT traffic management, division engineers and maintenance staff. This made a big difference as it helped plan recovery and response sooner. They were able to share live conditions with their leadership and emergency personnel, which has changed expectations around how information can be gathered and utilized to make key decisions during disaster response.
PART THREE
POTENTIAL OF DRONES
PART THREE
POTENTIAL
OF
DRONES
This section features an overview of the more mature applications of drone use by a government entity, as well as applications that are just beginning but have immense potentials in the future.

PUBLIC SAFETY

According to a 2018 study by the Center for the Study of the Drone at Bard College, at least 910 U.S. state and local public safety agencies have acquired drones, up 82 percent from 2017. Public safety is one of the earliest adopters and the most mature market for commercial drones.

County and municipal law enforcement represents more than two-thirds of these agencies, followed by fire/EMS and emergency management departments. There are now more than twice as many public safety agencies with drones than there are operating manned aircrafts, the study notes.

Drones can be used in most major types of public safety missions, including search and rescue, firefighting, hazmat situations, law enforcement, and disaster response.

The agility and data acquisition capability of drones make them important force multipliers on all stages of a public safety incident: pre, during and post.

Drones provide first responders in public safety missions with aerial intelligence that enables situational awareness that would otherwise be impossible to obtain, or too costly, in aircraft and personnel deployment. These unmanned aircrafts with more
agility and lower flight height limits also help close the intelligence gap between helicopter teams and ground teams, making their cooperation more efficient and informed.

In the example of the North Carolina Framework, NCDOT, as the core coordinator of the statewide drone network, supported the N.C. Department of Public Safety’s creation of an emergency management working group to coordinate drone response during disasters. NCDOT also acts as a consultant and training partner to most public safety departments during the initial starting phase of their drone programs.

**INFRASTRUCTURE CONSTRUCTION & MAINTENANCE**

Government departments take large responsibility in the building and maintaining critical infrastructure such as transportation networks, water supply, and emergency medical facilities. Such infrastructure inspection, planning, and documentation have traditionally been limited to manual, “from the ground” methods. While aircraft like helicopters could be used in order to get an aerial vantage point, doing so is often too costly to be feasible, and it is often impossible or impractical for large manned aircraft to fly in the areas that inspection professionals need to access. For this reason, drones are a highly useful tool.

The United States has more than 616,087 bridges. 47,052 of these bridges are rated “structurally deficient” and need urgent repairs. The American Road and Transportation Builders Association estimates the cost to make the identified repairs for all 235,000 bridges is nearly $171 billion, based on average cost data published by the Federal Highway Administration. Inspection of such bridges requires a crew of inspection professionals, heavy machinery with lifts, and people rappelling from dangerous heights, meaning each inspection takes a few days. Hence, a lot of environment-related work is the responsibility of government entities. State governments must make environmental rules and regulations, and have departments focused on natural resources, environmental protection, forestry, marine protection, and more. Furthermore, there are plenty of other departments, units, or other institutions that conduct work directly or indirectly related to the environment. For example, when infrastructure construction takes place near the habitat of an endangered species, permits may be required before any construction work begins.

NCDOT is responsible for the safety of more than 18,000 bridges, pipes and culverts along North Carolina’s highways. The department has had to take extensive measures to conduct bridge inspections, and traditional ways of inspecting bridges have proven to be costly and dangerous.

Drones are nimble enough to scan bridge spans and fly into hard-to-reach and hard-to-see crevices that humans find difficult to navigate. As they hover close to aging trusses, piers, and other structures, drones take high-resolution images and/or video enabling inspectors to collect and analyze data from the ground. Software assembles the information into 3-D models, which engineers can examine on computers.

In October 2018, North Carolina Agricultural and Technical State University (NCA&T) helped NCDOT on the “Developing a Safe and Cost-effective Flight Control Methodology for a UAV-enabled Bridge Inspection” project and delivered research results that proved drones to be agile, affordable tools for bridge inspection.

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dangered species, all parties involved must take measures not to invade or jeopardize that habitat.

A state of natural beauty, North Carolina is home to national parks, 1.1 million acres of national forest, and the highest mountains east of the Mississippi. The NCDOT Division of Aviation (DoA) helped the Environmental Analysis Unit use drones to spray an invasive grass species on the Cape Hatteras National Seashore.

The drone accurately targeted and sprayed the invading species while keeping the environmentally sensitive area undisturbed by foot traffic.

DoA’s UAS team also helps in the mapping and monitoring of Submerged Aquatic Vegetation (SAV). SAV species supporting valuable fisheries depend upon the nursery provided by the Albemarle-Pamlico estuarine system. Much of this important habitat exists as vast expanses of underwater. North Carolina has more SAV acreage than any other Atlantic coast state except Florida, 99% of that coverage being within the Albemarle-Pamlico region.

Since 2018, the DoA UAS team has helped the Environmental Analysis Unit build its own drone program with a mix of in-house support from DoA and external service providers. The data captured with drones and the resulting analysis will serve as an important tool in the permit review processes across multiple agencies.

MEDICAL PACKAGE DELIVERY

Providing communities with essential health care access is one of the toughest challenges faced in much of the country today. Medical professionals from emergency responders and first aid workers...
to time-stressed staffers in large hospitals face a host of challenges every day—challenges that UAS can help overcome.

Drones make it possible to deliver vaccines, blood and other lab samples, medications, and supplies to remote areas and to reach victims who require immediate medical attention within minutes, which could mean the difference between life and death. They can transport medicine within hospital walls and carry blood between hospital buildings, as well as give elderly patients tools to support them as they age in place. UAS offer a variety of exciting possibilities to healthcare.

NCDOT’s Division of Aviation completed the nation’s first medical package delivery over people using a drone in August 2018 as part of a national initiative that is informing drone use, policy and regulation. There is bright future for drone delivery in healthcare, but not without challenges:

- Drones will eventually need the equivalent of transponders to integrate them into the national air control systems.
- Ground-to-drone communications must be protected to prevent hackers from hijacking drones or using their data for nefarious purposes.
- Allowing drones to travel beyond the operator’s line of sight significantly increases the complexity and cost of pilot-to-drone communications.
- Medical drones must be especially robust and capable of fulfilling missions far beyond off-the-shelf capabilities.

Besides the common applications listed above, there are many other areas where drones have helped improve safety, efficiency, and productivity. NCDOT is one of the earliest adopters in the United States and has explored the various applications that may be relevant to any organization.

Current NCDOT Drone Uses

- Transportation infrastructure inspection
- 3D visualization for project design and public engagement
- Project assessment and documentation
- Coastal shoreline mapping
- Disaster response management and monitoring
- Threatened and endangered species monitoring
- Herbicide spraying
- Bridge inspection
- Subaquatic vegetation mapping
- Traffic count and monitoring
- Wetland delineation
- Worksite safety analysis
- Airport infrastructure inspection
- Bus terminal assessments
- Ferry route assessment
- Pedestrian walkway project documentation
- Port stockpile assessment and documentation
- Rail corridor mapping
PART FOUR
GETTING STARTED
LESSONS FROM NCDOT FOR DEPARTMENTS THAT ARE SETTING UP DRONE PROGRAMS

For government departments to start a drone program, there are many aspects to consider, such as funding, policy and regulations, manufacturer selection, and technical know-how. Many public officials also mention that convincing leadership and shaping positive public perception of drones can be major challenges when they build a drone program for their department.

What challenges will departments face? And, how can these challenges be overcome to start a successful government drone program? What follows is the advice from the NCDOT Division of Aviation’s UAS team who have gone through intensive research and testing before setting up their own UAS program and have helped many other units and departments build drone programs from the scratch. There are a few things that departments need to consider before diving into starting a drone program.

Consideration #1
Identify needs, key applications, and benefits

It is important for a department to do preliminary research and reflection on what drones are capable of and how those capabilities fit into their routine work. For the most part, commercial drones are used for the dirty, tedious, and dangerous work. A department should be able to identify the areas where they need a safer, more comfortable working environment for their employees as well as more efficient or effective outcomes.

Drone technology has progressed exponentially from five years ago when drones were mostly toys and the pilots mostly hobbyists. The hardware improvements have enabled drones to be used in more advanced, data-intensive ways. This has made the current commercial drone market broadly diverse with many different levels of available hardware and software, as well as service solution choices.

It is critical for a department to know their key needs, applications, and benefits they are looking for in order to make the most suitable and cost-effective choice of drone solutions.

Consideration #2
Decide the most suitable type of program

Not all departments need an in-house drone program, even if they determine that drones will substantially improve safety and efficiency in their key areas of work. If funding, staffing, or other possible challenges are holding an agency back from setting up an in-house drone program, there are many service provider companies in the commercial drone ecosystem.

Taking these aspects into consideration, departments should decide for themselves which is the best way for them to structure their programs in the initial phase. And when factors such as funding, resources, or internal skepticism change, departments can always reconsider the situation and let their drone programs evolve naturally.

Many departments in North Carolina did not have their own in-house program at the beginning, relying heavily on NCDOT for drone operation support when certain tasks required. When drone operations proved beneficial and affordable, these departments gradually shifted to setting up their own programs. Some had enough funding and human resources to set up in-house programs with several pilots in active service. Some seek help from external service providers. There are departments that have a mix of both, depending on the mission types and staff a mission needs.
Consideration #3
Get the proper consultancy and training

When a department is taking the possibility of starting a drone program into serious consideration, it is almost always more efficient to seek consultancy from either a more experienced department or from professional consultancy companies specialized in drones for enterprises.

Departments should be familiar with the basics of drones, what major types there are and what they are capable of under current technology and regulation context. These will help consultants provide the most feasible advice in the choices of program structure, hardware, and software selection. Having reliable and knowledgeable consultants will also help departments get through the complexity of policy and regulation process such as getting certain operation waivers and COA from the FAA.

Training is another critical aspect whether starting an in-house, hybrid, or entirely external program relying on service providers. Training a team to become certified and capable pilots is important. But it is equally important to train that team to be able to read, understand, and communicate the data captured by drones, turning data into actionable intelligence.

Consideration #4
Engage leadership and the public

Many departments report that when they first initiate a drone program, they quickly encounter skepticism from leadership or management. As a new technology with less than a decade of visibility in civilian industrial and government work, it can be hard to accept drones into a department’s routine work without going through the initial proof of concept phase.

To many people, especially those with no previous experience working with drones, drones are still seen as toys for hobbyists. However, it usually does not take long to convince leadership or management of its possible value in operations. It is helpful to perform demos, and have a unit to showcase—these can be from donations, volunteer pilots in the community, or a loaned unit from a supplier.

Another source of skepticism will come from the public. Communities often relate drones to negative issues such as privacy violations or noise. Make sure the department and drone operation team maintain a constant conversation with local communities about how drones are deployed and what sort of data is captured for which purposes.

The general public is starting to have a more positive perception of drones as the industry matures. They respond especially well to incidents of drones saving lives in search and rescue missions, disaster response, emergency medical situations etc.
TOOLS TO HELP MANAGE DRONE DATA

How does an agency translate drone data or imagery into actionable intelligence that helps complete mission tasks? There are plenty of software solutions, tools, and workflows that support drone data analysis of all complexity levels. For enterprises, not just in the public sector, it is important to properly store, archive, and present drone data. It is especially necessary for government entities to do so.

It is highly recommended that departments determine the workflow for their drone programs first, and align them with the procurement of corresponding software. Here are a few data management software types currently available on the market and suitable for public sector drone programs:

Flight planning and operations software:
It is important to find offerings that integrate with other software for seamless workflows and offer basic functionality and security features such as password unlock and local data mode or offline mode.

Photogrammetry/mapping software:
This tool is important for key applications like accident reconstruction, agriculture, surveying and more. For organizations using maps for internal or external communication and collaboration, they should look for a cloud based offering, while focused use for measuring and accuracy can use local based offerings depending on cost and time to process.
Data storage:
For operations focused on collecting data for a high-security site or other critical data (generally fixed fee), use a local based solution. For missions focused on streamlining, look for cloud based solutions (generally usage-based fee).

Fleet management:
As drones are more widely adopted by state agencies, users need to consider how they will maintain hardware, ensure efficient usage, and more. Some software suites will incorporate fleet management as a feature.

Virtual training software:
Simulation software can help train your teams and prepare them for operations in various scenarios.

ENSURING DATA SECURITY AND STEWARDSHIP IS PROPERLY MAINTAINED

Drones are not traditional Internet of Things (IoT) devices, as they do not connect directly to the internet, but instead are optionally connected to the internet via a user’s mobile device. Additional vulnerabilities also exist due to the transmissions between the drone and remote controller and, in cases where a drone is lost and recovered, data stored on the drone’s SD card.

When procuring a drone, it is important for an organization to identify their acceptance of risk and the nature of the data they are collecting with their drones, and to match these needs with a corresponding drone solution that puts control of the organization’s data in their hands. Below are existing technical solutions that DJI has employed to address these three areas of concern.

1. Internet connectivity – offline mode
2. Transmission – AES 256 or equivalent encryption
3. Embedded storage with password protection

Drone Industry Data Security Recommendations
For agencies with the most stringent data concerns, below are four recommendations based on recent U.S. Department of Homeland Security recommendations, with an additional fifth recommended by DJI.

DHS Recommendation #1:
Deactivate Internet Connection from Devices Used to Operate the UAS

DHS Recommendation #2:
Take Precautionary Steps Before Installing Updated Software or Firmware

DHS Recommendation #3:
Remove the Secure Digital Card from the Main Flight Controller/Drone

DHS Recommendation #4:
If an SD Card is Required to Fly the Drone, Remove All Data from the Card After Every Flight

DJI Recommendation #5:
Encrypt Transmissions Between Remote Controller and Drone, and Password Protect Your Data

To learn more about the security of your data when flying DJI drones and how to implement these recommendations when flying DJI products, you can learn more here: https://content.dji.com/your-data-is-not-our-business/
PART SIX

Conclusion
Government entities are adopting drones for many work areas and the trend is growing.

It is important to develop ways for drone teams under different entities to collaborate, and to develop ways that help departments better build and manage their drone programs. The North Carolina drone framework proves the efficiency and effectiveness of setting up a centralized drone work team under one department that helps manage, give consultancy and training, and lead large collaboration operations.
To learn more about drones in government work, visit https://enterprise.dji.com/government
Contact us at enterprise@dji.com
10 Ways That Police Use Drones To Protect And Serve

Stephen Rice, Contributor
Aerospace & Defense
I teach and conduct research in Aviation Human Factors at ERAU.

Anthony Galante is an Assistant Professor of Unmanned Aerial Systems Science at Embry-Riddle Aeronautical University, where he created and teaches the UAS Public Safety minor. He is also a career law enforcement officer for the Daytona Beach Police Department (DBPD), where he served as lead trainer for the SWAT team. In 2017, Officer Galante was given the budget he needed to
start using a team of five drones to help with air support after the department lost use of their helicopter. DBPD has traditionally been a leader in using new technology; they were the first agency in Florida to use body cams for police officers. Many other police departments in this country are also using drones to protect and serve. Here are some of the most common uses.

1) Mapping of the city

The very first task that Office Galante had when he started using drones was to map out the entire city for pre-storm assessment. Daytona Beach was in the path of Hurricane Irma, and the police needed to identify the key areas of the city that might be affected. Mapping highly frequented locations is a common use for police drones around the country. Instead of paying $500-600 per hour for a helicopter to cover the entire city, a police department can instead purchase a few drones to do the same job for the price of electricity in the batteries. These maps can then be used for all future events or crime scenes. They can also be used for before-and-after images of natural disasters.

2) Chasing suspects

Hundreds of police departments buy drones each year to aid in chasing down suspects. When a suspect takes to the roof, it can be difficult for the ground units to know where he or she is. Having an eye in the sky provides critical intelligence and guides the ground units to optimal positions. Reducing uncertainty also helps to reduce the stress levels of SWAT teams. Suspects often report not even being aware of a drone since they are so small and much quieter than a helicopter. Drones can also help to identify suspects and what weapons they might be carrying. In a case where a man holed up in a hotel threatening to detonate a grenade, the police were able to identify the grenade as inert and prevent loss of life when the man finally appeared.
3) Crime scene investigation

Drones can help crime scene investigation in a variety of ways. They can be used to collect evidence that may be difficult to reach from the ground. Two drones can survey a crime scene and provide maps and 3D images within minutes. They can be used to provide lighting at night or low-light conditions. They can manually capture 60+ frames per second from a still camera, or record 4k video as needed. All this can be done in a fraction of the time it takes a ground unit to conduct this same investigation.

4) Cars, planes and boating accidents

It is becoming more common now to use drones for 3D reconstruction of accidents. This is useful for multiple reasons. First, the police can send a drone to the sky to collect evidence from angles that were previously impossible without an expensive helicopter. This was seen in a plane crash in Daytona Beach, where the officers noticed that the airplane had also hit another house before crashing into the roof of the primary accident site. Second, they can do this at multiple times the speed it would take to measure off everything on the ground. Third, they can collect evidence without blocking traffic.

The airplane scraped the house on the right before hitting the house on the left. Only the damage on ... [+]

![Image of a drone surveying a crime scene](image-url)
5) Traffic management and flow

Drones are incredibly useful in managing traffic during rush hours or crowded events. Ground units may have a difficult time trying to assess reasons for backed-up traffic. With a drone overhead, they can immediately assess the situation, figure out the solution, and then radio to the traffic light authorities to change the rate of red-green lights to better manage the flow. These same drones could also be used to monitor vehicle speeds and notify ground units of violators.

6) Search and Rescue

Drones can be used for search and rescue, or for locating missing persons and animals. They are often used to find lost hikers and elderly people who wander away from their homes. They can even be used to find crash victims who have been thrown from their car. Drone rescues are becoming more and more common each year. They are particularly useful at night when fitted with thermal cameras that pick up heat signatures.

7) Support for Fire Department

In many cases, large fire departments are purchasing their own drones; however, the expense may not be feasible for smaller towns or cities. Police departments with drone units have found that they can help the local fire department by collaborating to locate the fire, identify potential victims, and aid the firefighters in directing their resources accordingly. In one example, the Daytona Beach police used thermal images to discover a hot spot in a hotel fire. The fire department was able to quickly turn their hoses to that spot.
DBPD were able to spot the worst part of the fire and guide the firefighters to aim their hoses ... [+]

DAYTONA BEACH POLICE DEPARTMENT

8) Event Management

Daytona Beach hosts 8-10 Super Bowl size events each year, including the Daytona 500, Spring Break parties, and Bike Week. These events draw huge crowds and moving ground units through these crowds is slow and tedious. Cities that host large crowds are finding that having a handful of drones in the sky during the event allows them to see the big picture, watch people move in real time, and zoom in on singular events that may need a ground unit backup. They are great for detecting trouble before it gets out of hand, and communication between units is exponentially faster.

9) Disaster relief

After hurricanes, tornadoes and other natural disasters, it can be quite difficult to get ground units to affected areas. It can also be difficult to get manned aircraft into hazardous areas without risking the pilots. Law enforcement agencies often use drones to survey disaster sites and identify
areas and people that need help. Dozens of drones were used in response to Hurricane Harvey in Houston, as well as after Hurricane Irma in Florida. Drones can identify stranded people more rapidly than ground units. They can deliver medical supplies and other necessities, such as rescue ropes and life jackets.

10) Seizing illegal drones

Lastly, police drones can help to identify illegal and unregistered drones that may be hazardous to the surrounding environment. Many private drone operators do not have the proper training and licensing necessary to fly their drones on public property. In fact, if you don’t understand the images below, then you probably should not be flying a drone. Once an illegal operation has been identified, a ground unit can be sent to find the operator and give them a choice between education about the laws or arrest and fines if they refuse to cooperate.

If you cannot understand these images, then you should not be using a drone in the air space.

ANTHONY GALANTE

How to get started
Police departments that are starting a drone unit should consider the following tips from the Daytona Beach Police Department. When DBPD started this project, they spent the first year conducting outreach to the community in order to win over public opinion and approval. The public has privacy concerns about drones, and it was crucial to ensure that they did not oppose the police drones based on misinformation. “We had to get public buy-in,” recounts Officer Galante. “So we explained that the budget would come from drug dealer confiscations and not new taxes. We provide easy and open access to the log books for each flight. We also provide open access to pictures and videos taken by the drones.” This transparency lets the public know the police are on our side and that their drones are there to help protect and serve.

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Drone technology is changing the way public infrastructure projects get done. UAVs make bridge inspections and other tasks faster and safer.

August 12, 2019

Drones are changing how public infrastructure projects get done

UAVs make bridge inspections and other tasks faster and safer.

Public works departments across the country are embracing drones on a variety of projects, from landscape analysis and surveying to water main repairs, bridge inspections and roadway construction.

“It’s the future of civil engineering,” said Greg Parker, Johnson County Engineer for Johnson County, Iowa, where he and his team of 47 workers are responsible for construction, engineering and maintenance of 940 miles of roads and bridges. An FAA-certified drone pilot, he’s enthusiastic about integrating UAVs into the county’s workflow, partly due to the “cool factor.”

“Drones are renewing interest in the field,” he said. “The younger crowd wants to study engineering so they can use this technology on the job.”

RELATED: Using Drones to Manage Your Jobsite from 300 Feet in the Air

Saving time and money

The number one reason drones are finding a home in public works, Parker said, is that they save time, money and manpower. “Old school, you take a crew out to survey a project. Now, you take a drone out and fly it and get the same if not better data, all on a shorter timeline and with fewer workers.”
The city of Spokane, Washington, seems to agree. Late last year, the Spokane Public Works Department got permission to purchase its own fleet of drones, which it plans to use to perform infrastructure inspections, monitor project progress and conduct landscape and environmental analysis.

Many other public works departments are also flying drones. In fact, according to a survey from the American Association of State Highway and Transportation Officials, at least 35 state departments of transportation are adopting drones in the field, with at least 20 states using them daily for tasks like monitoring roadway construction, performing pavement inspection, monitoring traffic control and inspecting high-mast light poles.

A number of state DOTs use drones for bridge inspections. The Minnesota Department of Transportation, for example, has been experimenting with drones for bridge inspections since 2015. That’s not surprising when you consider that the state is home to some 20,000 bridges, and that bridge inspections are quite dangerous for human inspectors. Operating drones in confined spaces — such as between beams in the case of multibeam bridges — can be tricky, so MDOT selected a commercial drone that was highly “collision tolerant.” It’s enclosed within a spherical cage so that even direct contact with bridge elements can’t damage the rotors or cause a crash.

Now is an especially good time for municipalities to invest in drones. Parker said that you can acquire a complete drone system — including the UAV, controller, and software to process and import the data into other applications such as AutoCAD — for about what GPS equipment would have cost five or ten years ago.

“There are places where it's simply dangerous to send people. Instead, now you can fly a drone up — say, between two beams at a very high elevation off the water — take pictures, and if it all looks good, there's no need to send people up there to do a physical inspection.”

Greg Parker, Johnson County Engineer for Johnson County, Iowa,

**Benefits for inspectors and drivers**

By leveraging drones, county engineers can accomplish more with greater safety and less interruption to the day-to-day use of infrastructure. For example, Parker explained that drones equipped with infrared cameras can be used to inspect bridge decks for delamination, a common problem caused by factors including deicing salts, freeze-thaw cycles and rebar corrosion.

“Traditionally, the only way to truly see where there's delamination is to drag a chain across it,” he said. “Now you can fly a drone up there even when there's still traffic moving across the road, scan the deck, and see where the delamination is.”

If the drone reveals indications of a problem, Parker noted, you can take a crew to the site, shut down the affected lanes and drag a chain for a detailed analysis. But if the drone doesn’t see a problem, you can avoid inconveniencing drivers.

Drones are also keeping workers out of harm’s way. “There are places where it's simply dangerous to send people,” said Parker. “Instead, now you can fly a drone up — say, between
two beams at a very high elevation off the water — take pictures, and if it all looks good, there's no need to send people up there to do a physical inspection.”

Moreover, drones can sometimes see into places that are difficult or impossible for humans to reach, making the inspection more thorough.

Parker’s due diligence has convinced him that the data he gets from drones is as good as the old-fashioned alternative. “On a few projects we sent a survey crew back out to confirm that the data the drone gathered was correct.” But that doesn’t mean drones can, or will, ever completely replace human crews.

“It’s a great tool to have at our disposal, but we evaluate every project to see what’s best,” he said. “There’s always going to be a need to send crews out to the site. But as we get further into the future, I think you’ll find there will be a switch and we’ll use drones more often than crews.”

Spokane Public Works Dept. to use drone for city projects

Lawmakers signed off on the plan this week. Officials hope the new technology will help complete projects faster and save taxpayers money.

Author: Ryan Simms
Published: 4:36 AM PDT June 12, 2018
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SPOKANE, Wash. -- The Spokane Public Works Department will soon use a drone to assist in various projects like water main breaks, construction and landscape analysis.

"Routine inspections might be able to happen more quickly, because we don't have to set up all the protections that we would need to normally," said Public Works Director of Strategic Development Marlene Feist. "Anytime we can have the ability to assess a situation in an unmanned, safer way, that's a good thing for us."

It will also be good for taxpayers. City workers said projects will be completed faster with the drone, which will save money in reduced overtime hours.

The drone will also make conditions safer for city employees. By using the drone, fewer employees will have to fit into potentially dangerous surroundings. The city expects fewer workers to be hurt on the job, which will also save taxpayers money.

"If we can use a drone for that purpose and determine when we really need to send an employee there, that's a good thing," said Feist.

The new drone will cost $15,000. Pilot training began this spring and the drone is expected to hit the sky by the end of summer.
Use of Drones / Unmanned Aerial Systems (UAS)

The City of Albany is dedicated to embracing technologies that help improve its services and reduces labor costs while protecting the privacy and safety of its residents.

Using Unmanned Aerial Systems (UAS), more commonly known as “drones”, in the public interest is expected to benefit residents and visitors to the city through the more efficient use of City resources.

The terms “Unmanned Aerial System” (UAS) or “Unmanned Aerial Vehicle” (UAV), Remotely Piloted Vehicle (RPV) or more the more commonly named “drone” means an unmanned aircraft flown by a pilot via a ground control system.

Currently using UAS:

What the city uses UAS for:

- Disaster response & recovery: aerial intelligence of areas affected by disasters or emergencies
- Disaster response: aerial assessment and analysis
- Emergency response: building fire reconnaissance
- Search & rescue: aerial intelligence, providing resources to those needing rescue
- Training: assessment and evaluation of department UAS operations, Pilot in Charge (PIC) and department employee training on use of UAS
- Collection of aerial images and video for city promotion, public information
- Infrastructure inspection and maintenance
- Safely facilitating inspections of property
- GIS imagery collection for monitoring environmental and urban changes
- Using collected imagery to extract GIS features for analysis.
- Collect infrared imagery and 3D GIS data sets for modeling purposes.
Executive Summary

This UAS Best Practices document has been written to assist jurisdictions regionally and statewide in developing UAS programs and response operations. These best practices are the collaboration of Coitt Kessler, Greg Cutler and members from the NCTCOG, CAPCOG and their subcommittees. It is intended that jurisdictions adopt and incorporate these best practices into their UAS Programs. This will assist in creating common program and response operation standards throughout the region and the state. Due to the nature of UAS technology and program advancements this is a living/breathing document to be updated yearly and released by a joint committee of the two COGs or as needed.

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Figure of Eight

Follow the Path

Four Corners

Serpentine

Payload Drop Accuracy
Section 1: Introduction

1.1 Purpose
A. The increasing availability of low-cost small unmanned aircraft systems ("sUAS") technology allied with image processing applications, real-time video and various sensor payloads, offer an opportunity to collect forensic-quality scene information, provide infrastructure inspections and damage assessments, speed up incident clearance, assist in search and rescue, improve fire observation, and reduce the exposure of law enforcement officers, emergency responders and the public to hazardous conditions.

B. This Operational Guidelines manual establishes standard guidelines for the use of sUAS by the Jurisdiction, and for the collection, retention and dissemination of images, video and data captured by the UAS.

1.2 Scope
A. Unmanned aircraft have the potential for many uses in emergency management, firefighting, law enforcement, and search and rescue applications. Although all of the uses for sUAS cannot be predicted, generally the following are missions for which it may be deployed:
   1. Search and rescue operations
   2. Wildfire
   3. Accident scenes
   4. Hazardous materials scenes
   5. Infrastructure Inspections
   6. Flood events
   7. Fire observation and damage assessment
   8. Tactical situations
   9. Investigations
   10. Pre-fire planning
   11. Major disaster scenes
   12. Storm damage assessment
   13. Crime scenes
   14. Mapping

B. Jurisdictions may also respond to other requests for sUAS service as requested to preserve the health, safety, and welfare of people or property.

C. All missions will be flown in accordance with 14 CFR Parts 61, 91 and 107, as applicable.

1.3 Privacy
A. In light of the diverse potential uses of UAS in the National Airspace System ("NAS"), expected advancements in sUAS technologies, and the anticipated increase in sUAS use in the future, Jurisdiction shall make reasonable efforts to ensure that its privacy policies relative to sUAS are periodically updated to keep pace with these developments.

B. All UAS flights shall be compliant with the Texas Privacy Act HB 912.
C. A sUAS shall not be intentionally used for the purpose of viewing, recording or transmitting images and/or video in a criminal investigation or prosecution at any location or upon any property at which a person has a reasonable expectation of privacy unless:

D. A warrant or court order has been approved for the search of the property;

E. A right-of-way has previously been established.

F. Consent by the owner or person responsible for the property is obtained; or

G. Exigent circumstances exist, to include emergency response, active fire/search and rescue operations, etc.

1. The deployment of a sUAS due to exigency must be authorized by the Jurisdiction UAS Coordinator or other governmental agency making the request for sUAS service, or his/her designee, and the factual basis for such exigency shall be documented.

1.4  Transparency

A. To promote transparency about sUAS activities, the department shall, while not revealing information that could reasonably be expected to compromise privacy, the public safety, or the safety of member agency personnel, or that may not be released pursuant to the Texas Public Information Act, the Texas Privacy Act HB 912, Texas Criminal Justice Records laws, or other Applicable Law:

1. Provide reasonable notice to the public regarding where the jurisdiction UAS are authorized to operate in the NAS;

2. Make reasonable efforts to inform the public about the jurisdiction UAS program as well as changes that would be expected to materially affect privacy, civil rights, or civil liberties; and

3. If requested, a general summary of Jurisdiction’s UAS operations during the previous calendar year, to include a brief description of types or categories of missions flown, and the number of times the jurisdictions Team members provided aircraft services.
Section 2: Acronyms and Definitions

2.1 Acronyms

- **AGL**: Above Ground Level
- **ATC**: Air Traffic Control
- **AHJ**: Authority Having Jurisdiction
- **BVLOS**: Beyond Visual Line of Sight
- **CFR**: Code of Federal Regulations
- **COA**: Certificate of Authorization
- **CRM**: Crew Resource Management
- **CS**: Control Station
- **FAA**: Federal Aviation Administration
- **GPS**: Global Positioning System
- **ILA**: Inter-Local Agreement
- **LZ**: Landing Zone
- **NAS**: National Airspace System
- **NOTAM**: Notice to Airmen
- **NTSB**: National Transportation Safety Board
- **OPAREA**: Operational Area
- **PIC**: Pilot in Command
- **RPIC**: Remote Pilot in Command
- **TFR**: Temporary Flight Restrictions
- **TRACON**: Terminal Radar Approach Control Facility
- **sUAS**: Small Unmanned Aircraft System
- **VFR**: Visual Flight Rules
- **VLOS**: Visual Line of Sight
- **VO**: Visual Observer

2.2 Definitions

A. In addition to the acronyms defined in Section 2.1 above and the terms defined elsewhere in these Operational Guidelines, the following definitions shall apply:

1. **Certificate of Authorization (COA)**. An authorization issued by the Air Traffic Organization of the Federal Aviation Administration to a public operator for a specific unmanned aircraft activity.

2. **Authority Having Jurisdiction**. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, or a procedure.

3. **Civil Twilight**. The time periods between approximately 30 minutes before sunrise until sunrise, and between sunset and approximately 30 minutes after sunset.

4. **Controlled Airspace**. A generic term that covers the different classifications of airspace (Class A, B, C, D and E airspace) and defined dimensions within which ATC services is provided.

5. **Corrective Lenses**. Spectacles or contact lenses.

6. **Crew Resource Management (CRM)**. A process designed to aid in the prevention of aviation accidents and incidents by improving performance through an
understanding of human factor concepts, which focuses on interpersonal
communication, leadership and decision making by the flight crew.

7. **Defined Incident Perimeter (DIP).** A defined perimeter to be determined based on
the scope of the operation and applicable FAA requirements.

8. **First Person View (FPV).** A method used to control a radio-controlled aircraft from
the pilot’s view point via an onboard camera, fed wirelessly to video goggles or a
video monitor.

9. **Night.** The time between the end of evening civil twilight and the beginning of
morning civil twilight, as published in the American Air Almanac, converted to
local time.

10. **Nonparticipant.** Any person not associated with the UA flight mission, including
the public, spectators and media.

11. **Crew Leader.** – Any person representing a UAS team/group from a participating
agency in the regional sUAS program.

12. **Person Manipulating the Controls.** A person other than the remote pilot in
command (PIC) who is controlling the flight of a sUAS under the supervision of the
remote PIC.

13. **Remote Pilot in Command (Remote PIC or Remote Pilot).** A person who holds a
remote pilot certificate with a sUAS rating and has the final authority and
responsibility for the operation and safety of an SUAS operation conducted under
part 107.

14. **Unmanned Aircraft (UA).** An unmanned aircraft weighing less than 55 pounds,
including everything that is onboard or otherwise attached to the aircraft that can be
flown without the possibility of direct human intervention from within or on the
aircraft.

15. **Small Unmanned Aircraft System (sUAS).** A small UA and its associated
elements (including communication links and the components that control the small
UA) that are required for the safe and efficient operation of the small UA in the
NAS.

16. **Vision Aides.** Binoculars, night vision devices, etc., used only for augmentation of
visual observation duties.

17. **Visual Flight Rules (VFR).** VFR are a set of regulations under which a pilot
operates an aircraft in weather conditions generally clear enough to allow the pilot
to see where the aircraft is going and any other aircraft in the vicinity. For LCUAS
Team purposes, VFR requires a 3 statute mile visibility with operations conducted
at least 500 feet below any clouds.

18. **Visual Line of Sight (VLOS):** At all times the UA must remain close enough
to the PIC and the person manipulating the flight controls of the UA for those
people to be capable of seeing the aircraft with vision unaided by any device
other than corrective lenses.

19. **Visual Observer (VO).** A person acting as a flight crew member who assists the
small UA remote PIC and the person manipulating the controls to see and avoid
other air traffic or objects aloft or on the ground.
Section 3: Team Organization

3.1 Overview
A. sUAS may be comprised of any of the following flight crew members but are not limited to: a UAS Module Leader, LZ Manager, UAS Coordinator, UAS Manager, UAS Strike Team / Task Force Leader, Remote Pilot in Command, Visual Observer, Data Specialist, and other members who assist in the safe operation and maintenance of the sUAS services.

B. Jurisdiction’s UAS flight crews may be requested for mutual aid missions by other governmental agencies.

C. Jurisdiction is responsible for the selection and training of its crew members.

3.2 Jurisdiction Aviation/UAS Coordinator
A. The “Name a Position” has been assigned as the UAS Coordinator for the jurisdiction to oversee all unmanned public safety program operations for the Jurisdiction and may coordinate training for Jurisdiction’s commercial UAS operations within other departments. Ideally, the Aviation/UAS Coordinator should be hired as a full time position to manage and oversee all UAS programs in the jurisdiction. See chart next page.

B. The UAS Coordinator responsibilities include, but are not limited to:
   1. Ensuring jurisdiction’s flight crews have completed all FAA requirements;
   2. Maintaining a current list of jurisdiction's certified crew members;
   3. Establishes and develops departmental UAS Coordinators within jurisdiction
   4. Monitoring the condition, maintenance and flight records of jurisdiction’s Unmanned Aerial Systems and all associated equipment;
   5. Performing monthly FAA reports and records management duties.
   6. Maintaining and updating Public Safety COA
   7. Ensures monthly flight skills and classroom trainings are completed by all pilots in all departments.
3.3 UAS Manager

A. This position is the conduit between a UAS vendor (under federal contract/agreement) and an Incident Management Team (IMT). The UAS Manager coordinates vendor UAS missions with operations, air operations, and planning personnel and is the designated government official (ACOR/PI) for the UAS contract/agreement.

B. This position is utilized to coordinate contract UAS operations with the air operations branch, planning section, participating aircraft, aerial supervision, and ground personnel. This position is activated when contract UAS services are requested for an incident.

3.4 UAS Module/Team Leader

A. This position leads a group of Remote Pilots/VO’s, LZ Managers, Data Specialists or other crew members on an incident and provides a single point of contact for UAS operations/data processing to incident leadership in the field. A typical UAS module consists of at least one remote pilot, one visual observer, one Module/Team Leader and possibly a data specialist or LZ Manager.

B. A UAS Module/Team Leader is a supervisory position. The UAS Module Leader or his/her designee, represents his/her agency and is responsible for the administrative and on-scene supervisory functions related to his/her agencies or department’s UAS equipment and crew while on scene at an incident.

C. The Module/Team Leader’s tactical responsibilities may include but are not limited to the overseeing and managing of the following:
1. Located with Field Command to act as a Liaison for the UAS branch. Receives mission assignments and forwards those assignments to the pilots or LZ Manager in the field.

2. May reach back to Jurisdiction Coordinator for additional UAS resources.

3. Manage takeoff / landing zones anytime there are three or more aircraft operating in the same airspace if an LZ Manager is not on scene. Module/Team Leader will have to locate with flight crew, not at command. At least until an LZ Manager arrives.

2. Airspace separation assurance standards between aircraft to include both manned and unmanned operations.

3.5 UAS Remote Pilot / Pilot-in-Command (PIC)

A. This position is qualified and supports operations by providing real-time situational awareness in the form of electro-optical (daylight) or infrared video/still images. This position is also trained to collect imagery and telemetry which can be processed into precise planning documents such as geo-referenced maps, orthomosaic photos, digital elevation models, or 3D terrain models.

B. A PIC is the department member who has final authority and responsibility for the operation and safety of flight, has been designated as PIC before or during the flight, and holds the appropriate category, class, and type rating, if appropriate, for the conduct of the flight.

C. The responsibility and authority of a PIC is described by 14 CFR § 91.3

D. The PIC position may rotate duties as necessary with equally qualified pilots and the agency member designated as PIC may change during flight; provided that a PIC must be designated at all times.

3.6 Visual Observer (VO)

A. A Visual Observer is a person acting as a flight crew member who assists the PIC and the person manipulating the flight controls to see and avoid other air traffic or objects aloft or on the ground.

3.7 Other Crew Members

A. Other crew members include any other agency or department members who assist in the safe operation of the sUAS services, including operating payloads.

3.8 Data Specialist

A. This position collects, stores, and disseminates UAS collected data. This position specializes in converting video, still, or telemetry data into either a pre-processed dataset or precision product such as geo-referenced maps, ortho photos, digital elevation models, or 3D terrain models. The UAS Data Specialist works as a team member with the Remote Pilot to generate data required for strategic level planning, assessment, or decision making tools. This position may also work with the Geographic Information System Specialist (GISS) or Infrared Interpreter (IRIN) to generate required products.

1. Regional UAS Teams, each participating agency will appoint one crew member the responsibilities of Data Specialist. The Data Specialist is responsible for maintaining any records or data obtained during UAS operations, including UAS flight records provided to the Data Specialist pursuant to Section 11.1 below; for
directing third party request for open records concerning a member agency to that agency; and for performing such other duties as appropriate or needed.

3.9 UAS LZ Manager

A. Is in charge of the landing zone. LZ Manager is required position anytime there are three or more aircraft flying from the same landing/takeoff zone.

B. It is the job of the LZ Manager to coordinate altitude separation between aircraft with the pilots and manage air traffic landing and takeoff operations.

C. The LZ Manager will receive mission assignments and assign those missions to the appropriate pilots.

Response Organization Chart
Section 4 - Airspace Authority

4.1 Authority Identification

A. As governmental entities, member agencies may choose to operate under the Small UAS Rule, 14 CFR Part 107 (“Part 107”), or conduct public aircraft operations under a public training or jurisdictional COA.

B. The PIC will determine the appropriate airspace authority for each flight operation based on the type of airspace, time of day and any other pertinent circumstances.

C. The PIC, VO and crewmembers will follow the rules of the chosen airspace authority, including any approved waivers, for each operation.

4.2 Controlled Airspace

A. Operations in Class B, Class C, or Class D airspace, or within the lateral boundaries of the surface Class E airspace designated for an airport, are not allowed unless prior authorization is received from ATC.

B. When operating in controlled airspace, the PIC must be aware of all traffic patterns and approach corridors to runways and landing areas.

C. The PIC must avoid operating anywhere that the presence of the UAS may interfere with the operations at the airport, such as approach corridors, taxiways, runways, or helipads.

D. The PIC must yield right-of-way to all other aircraft, including aircraft operating on the surface of the airport.

4.3 Data Reporting

A. Documentation of all operations associated with UAS activities is required regardless of the airspace in which the UAS operates.

B. Reporting of all sUAS activities conducted under an approved COA or waiver shall be reported monthly to the FAA unless otherwise required by the COA or waiver. Unless otherwise required the following information must be submitted:

1. The number of flights conducted under the COA or waiver;
2. Aircraft operational hours per flight;
3. Ground control station operational hours in support of each flight;
4. Pilot duty time per flight;
5. Equipment malfunctions (hardware/software) affecting either the aircraft or ground control station;
6. Deviations from ATC instructions and/or Letters of Agreement/Procedures;
7. Operational/coordination issues;
8. The number and duration of lost link events per aircraft per flight.
9. Coordinates and address of flights
Section 5 - Flight Crew Qualifications

5.1 PIC Qualifications

A. All pilots who will be flying Jurisdiction missions shall be properly trained by either manufacturer representatives or instructors as designated by the Jurisdiction. The UAS pilots will meet all conditions of the (COA) issued by the FAA. The pilots will have a current working knowledge of the air space intended for operations, Air Traffic Control communication requirements, specific UAS aerodynamic factors, and the ability to obtain and interpret weather. All pilots must meet the following flight experience requirements and be current with their flight log entries. The minimum training and certification requirements for a PIC are as follows:

1. Basic Flight Operations Training. All pilots must successfully complete and pass the 40 hour Basic Flight Operations Training/Curriculum for UAS as approved by the jurisdiction. Pilots must obtain their Remote 107 Pilot Certificate with a UAS rating issued by the FAA.

2. Mission Training. All pilots must undergo Mission Training to increase specific core competencies in all UAS operations, systems and roles. This training is in addition to Basic Flight Operations Training.

3. Valid driver’s license.

5.2 Proficiency

A. In order to accomplish required currency training, pilots shall participate in 4 hours of monthly training, at a minimum.

B. Recurrent training is not limited to actual pilot/observer skills, but includes knowledge of all pertinent UAS and aviation matters.

C. All members within the UAS flight crew shall read the current COA and maintain proficiency in their operator/observer abilities.

D. At a minimum, the PIC must have attended two UAS trainings and conducted three takeoffs (launch) and three landings (recovery) with the specific UAS aircraft type within the previous 90 days prior to flying an operational mission. Members who do not have documented training or flight time for the preceding 90 days shall demonstrate proficiency before performing pilot/observer duties during a mission.

E. The PIC must pass a recurrent aeronautical knowledge test within 24 calendar months of passing either an initial or other recurrent aeronautical knowledge test.

F. Failure to maintain/prove proficiency can result in removal from UAS operations.

5.3 VO Qualifications

A. The minimum training and certification requirements for a VO are as follows:

1. Completion of a training course for the safe flight of aircraft, including the responsibilities described in 14 CFR Part 91 §91.111, §91.113 and §91.115, regarding cloud clearance, flight visibility, and the pilot controller glossary, including standard ATC phraseology and communication;

2. Valid driver license.
5.4 Crew Resource Management

A. The AHJ will confirm that CRM training is current for all participating crewmembers before flying operational or training missions.

B. The CRM training must consist of initial training, as well as CRM recurrent training during every recurrent training cycle, not to exceed a 12 month interval between initial training and recurrent training or between subsequent recurrent training sessions.

5.5 Restrictions

A. No person may serve as a PIC, person manipulating the controls, VO or other crew member if he or she:
   1. Consumed any alcoholic beverage within the preceding 8 hours;
   2. Is under the influence of alcohol;
   3. Has a blood alcohol concentration of 0.04 percent or greater; and/or
   4. Is using a drug, whether prescription, over-the-counter, recreational, or illegal that affects the person’s ability to safely operate the aircraft and/or participate in the sUAS operational mission.

B. It is the responsibility of the PIC, person manipulating the controls, VO, or other crew member to determine whether he/she is unable to participate in a UAS operation pursuant to Section 5.E.1. However, the Crew Leader and/or Incident Commander of the incident for which UAS services are provided, may require the PIC, person manipulating the controls, VO, or other crewmember to cease participation in a sUAS operation if he/she has a reasonable suspicion that such person may be prohibited from participation pursuant to Section 5.E.1.

C. No PIC or VO may participate in UAS activities that exceed 16 continuous operation hours in a 24 hour period.
Section 6 - Aircraft Airworthiness and Maintenance

6.1 Airworthiness Certification
   A. The AHJ is responsible for determining that the unmanned aircraft used by its pilots are airworthy.
   B. All unmanned aircraft must be operated in strict compliance with all provisions and conditions contained in the Airworthiness Safety Release, including all documents and provisions referenced in any applicable COA applications or Part 107 waivers.

6.2 Maintenance
   A. The AHJ is responsible for the maintenance of all sUAS owned by the Fire Department. Any sUAS owned by other city departments will have a designated member to perform aircraft maintenance.
   B. sUAS maintenance includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the sUAS and its components necessary for flight.

6.3 Configuration Control
   A. A configuration control program must be in place for hardware and/or software changes made to the UAS to ensure continued airworthiness.
   B. Software changes to the aircraft and control station as well as hardware system changes are classified as major changes that must be documented as part of the normal maintenance procedures.
   C. Each aircraft that has a major change in software or hardware configuration must be test flown on a test range to confirm the airworthiness of the sUAS.

6.4 Preflight Inspections
   A. Before each flight, the PIC must inspect the sUAS to ensure that it is in a condition for safe operation, such as inspecting for equipment damage or malfunction(s).
   B. The preflight inspection should include a visual or functional check of the following items, as applicable:
      1. Visual condition inspection of the UAS components;
      2. Airframe structure, all flight control surfaces, and linkages;
      3. Registration markings, for proper display and legibility;
      4. Moveable control surface(s), including airframe attachment point(s);
      5. Servo motor(s), including attachment point(s);
      6. Propulsion system, including powerplant(s), propeller(s), motor(s), ducted fan(s), etc.;
      7. Verify all systems (e.g., aircraft and control unit) have an adequate energy supply for the intended operation and are functioning properly;
      8. Avionics, including control link transceiver, communication/navigation equipment, and antenna(s);
      9. Calibrate UAS compass prior to any flight;
10. Control link transceiver, communication/navigation data link transceiver, and antenna(s);
11. Display panel, if used, is functioning properly;
12. Check ground support equipment, including takeoff and landing systems, for proper operation;
13. Check that control link correct functionality is established between the aircraft and the CS;
14. Check for correct movement of control surfaces using the CS;
15. Check onboard navigation and communication data links;
16. Check flight termination system, if installed;
17. Check fuel for correct type and quantity;
18. Check battery levels for the aircraft and CS;
19. Check that any equipment, such as a camera, is securely attached;
20. Verify communications with sUAS and that the sUAS has acquired GPS location from at least 4 satellites;
21. Start the sUAS propellers to inspect for any imbalance or irregular operation;
22. Verify all controller operation for heading and altitude;
23. If required, verify any noted obstructions that may interfere with the sUAS; and
24. At a controlled altitude, fly within range of any interference and recheck all controls and stability.

6.5 Maintenance Records
A. Member agencies or jurisdiction shall keep documentation of any maintenance, repair, modification, overhaul or replacement of a system component for each sUAS.
B. Member agencies or jurisdiction should keep record of time-in-service for sUAS components (e.g., airframe, batteries, etc.) at the time of maintenance, repair, modification, overhaul, or replacement procedure(s).
C. Maintenance records should be retrievable from either hardcopy and/or electronic logbook format for future reference.

6.6 Payload Restrictions
A. Any payload attached must be shown not to adversely affect the flight characteristics or controllability of the aircraft.
B. No sUAS may carry hazardous materials.
C. No sUAS may carry weapons.

6.7 Storage
A. The AHJ shall store the aircraft in a controlled environment in accordance with manufacturer recommendations.
Section 7 - Typing

7.1 Physical Characteristics:

A. UAS are built in a multitude of configurations, which makes classification difficult. For the purpose of emergency response, the following classification applies. Certain aircraft are specialized and will not fit this classification.

<table>
<thead>
<tr>
<th>Type</th>
<th>Configuration</th>
<th>Endurance</th>
<th>Data Collection Altitude (agl)</th>
<th>Equipped Weight (lbs.)</th>
<th>Typical Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fixed Wing Rotorcraft</td>
<td>6-24 hrs. NA</td>
<td>3,000-5,000’ NA</td>
<td>&gt;55 NA</td>
<td>EO/IR/Multi-Spectral, Lidar,</td>
</tr>
<tr>
<td>2</td>
<td>Fixed Wing Rotorcraft</td>
<td>1-6 hrs. 20-60 min.</td>
<td>1,200-3,000’ 400-1200’</td>
<td>15-55 15-55</td>
<td>EO/IR/Multi-Spectral, Lidar,</td>
</tr>
<tr>
<td>3</td>
<td>Fixed Wing Rotorcraft</td>
<td>20-60 min. 20-60 min.</td>
<td>400-1200’ &lt;400’</td>
<td>5-14 5-14</td>
<td>EO/IR Video and Stills</td>
</tr>
<tr>
<td>4</td>
<td>Fixed wing Rotorcraft</td>
<td>Up to 30 Up to 20 min.</td>
<td>400-1200’ &lt;400’</td>
<td>&lt;5 &lt;5</td>
<td>EO/IR Video and Stills</td>
</tr>
</tbody>
</table>

*Contracted aircraft sensors will be determined by the contract specifications.

7.2 Operational Characteristics:

A. Type 1 and 2:

1. These aircraft will be generally operated by contractors and provide strategic situational awareness (SA) and incident mapping.
2. Fixed wing aircraft typically operate above all other incident aircraft
3. Communications are maintained with the UAS crew on the assigned Victor (AM) or air to ground (FM) frequencies.
4. All type 1 and 2 contract fixed wing aircraft will be equipped with Mode C transponders.
5. Typical aircraft are the Scan Eagle, Aerosonde, or MLB Superbat.
6. Typical rotorcraft include but are not limited to the DJI M600.

B. Type 3 and 4:

1. These aircraft may be generally agency operated and perform tactical SA or mapping missions.
2. They are carried and flown on the emergency scene at relatively low levels (200’ agl)
3. Communications are maintained with the UAS crew on the assigned air to ground (FM) frequency with the UAS Operator.
4. Most do not carry transponders or AFF equipment.

5. Typical aircraft include but are not limited to DJI Mavic, DJI Inspire series, DJI Phantom series and the DJI M100, M200, M210.

C. Sensor payloads are variable but typically include daylight (electro-optical), thermal, or mapping cameras. Type 1 and 2 UAS may carry multiple camera types in a gimbaled configuration.

7.3 Call Signs:

A. UAS Remote Pilots will follow established incident communications protocols and will make radio calls with the following information:

1. Unmanned Aircraft
2. Configuration (fixed or rotor-wing)
3. Type
4. Agency/Interagency assigned aircraft number.

B. Call Sign Examples:

1. “Unmanned R41” (Rotor Wing, Type 4 UAS, Agency/Interagency #1)
2. “Unmanned F12” (Fixed Wing, Type 1 UAS, Agency/Interagency #2)
3. “Unmanned R23” (Rotor Wing, Type 2 UAS, Agency/Interagency #3)
Section 8 - UAS Operations

8.1 Coordination Requirements

A. Operations in uncontrolled (Class G) airspace may be conducted without ATC permission.

B. In controlled airspace, the operational details must be coordinated, including NOTAM information for which Operational Area(s) ("OPAREA(s)") will be used that day, UAS PIC name, and a cell/land telephone number to call in the event of an emergency, with the ATC having authority.

C. In controlled airspace outside of the AHJ the PIC or Coordinator will obtain a waiver by filing an SGI. This can be done by contacting:
   1. FAA System Operations Support Center (SOSC)
      a) 202-267-8276
      b) Email Address: 9-ATOR-HQ-SOSC@faa.gov

8.2 Notice to Airmen (NOTAM)

A. A NOTAM should be issued whenever flight operations are scheduled or required by a COA or Part 107 waiver.

B. A NOTAM may be accomplished by contacting the NOTAM Flight Service Station at (1-877-487-6867) or https://www.1800wxbrief.com/Website/#/ not more than 72 hours in advance, but not less than 48 hours prior to the operation, unless otherwise authorized as a special provision.

C. The issuing agency will require the:
   1. Name and address of the pilot filing the NOTAM request;
   2. Location, altitude, or operating area;
   3. Radial off nearest airport.
   4. Time and nature of the activity.

8.3 Operational Limitations

A. The sUAS must remain within VLOS of the PIC and the person manipulating the controls. Alternatively, the sUAS must remain within VLOS of the visual observer.

B. At all times the UAS must remain close enough to the PIC and the person manipulating the controls of the sUAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses.

C. Unless otherwise authorized as a special provision, all operations must be conducted in visual meteorological conditions (VMC) following visual flight rules (VFR) weather minimums.

D. sUAS may not operate over any person not directly participating (nonparticipants) in the operation.

E. VO(s) must be used at all times.

F. FPV cameras cannot satisfy “see-and-avoid” requirement, but can be used as long as the requirement is satisfied in other ways.

G. Operations will occur at a maximum altitude of 400 feet AGL or, if higher than 400 AGL, remain within 400 feet of a structure unless otherwise approved by waiver.
H. No person may act as a PIC or VO for more than one sUAS operation at one time.

8.4 Safety of Flight
A. All pilots are responsible for halting or canceling UAS activity if, at any time, the safety of persons or property on the ground or in the air may be jeopardized.
B. Any VO responsible for performing see-and-avoid requirements for the sUAS must have and maintain communication with the PIC.
C. The use of multiple successive VOs (daisy chaining) is prohibited unless otherwise authorized by special provision.

8.5 Prior to Flight
A. The PIC must conduct an assessment of the operating environment. The safety risk assessment must include the following:
   1. Local weather conditions,
   2. Local airspace and any flight restrictions,
   3. The location of persons and property on the surface, and
   4. Other ground hazards.
B. The PIC must conduct a pre-takeoff briefing as applicable prior to each launch. The briefing should include, but is not limited to, the:
   1. Contents of any applicable COA or Part 107 waiver,
   2. Altitudes to be flown,
   3. Mission overview including handoff procedures,
   4. Frequencies to be used,
   5. Flight time, including reserve fuel requirements,
   6. Contingency procedures to include lost link, divert, and flight termination,
   7. Emergency procedures,
   8. Roles and responsibilities of each person involved in the operation, and
   9. Hazards unique to the flight being flown.
C. The PIC must ensure there is sufficient power for the sUAS to continue controlled flight operations to a normal landing.
D. The PIC must ensure all necessary documentation is available for inspection, including the PIC’s remote pilot certificate, aircraft registration (if required), and COA (if applicable).

8.6 Sterile Cockpit Procedures
A. Critical phases of flight include all ground operations involving:
   1. Taxi (movement of fixed wing aircraft under its own power on the surface of an LZ);
   2. Take-off and landing (launch or recovery);
   3. All other flight operations in which safety or mission accomplishment might be compromised by distractions.
4. If any distractions occur during critical phases of the flight operation the flight shall be aborted until the distractions can be appropriately mitigated.

B. No crewmember may perform any duties during a critical phase of flight not required for the safe operation of the aircraft.

C. No crew member may engage in, nor may any PIC permit, any activity during a critical phase of flight which could:
   1. Distract any crewmember from the performance of his/her duties; or
   2. Interfere in any way with the proper conduct of those duties.

D. The pilot and/or the PIC must not engage in any activity not directly related to the operations of the aircraft.

E. The use of cell phones or other electronic devices by crew members is restricted to communications pertinent to the operational control of the sUAS and any required communications with ATC.

8.7 Night Operations

A. The PIC must be in place 30 minutes prior to night operations to ensure dark adaptation.

B. VOs will be positioned in appropriate locations during all UAS flight operations.

C. Vision aides may not be used as the primary means for visual observation duties, but are permitted to augment the VOs visual capability.

D. All sUAS flown during civil twilight or at night will be equipped with light emitting diode (LED) position lights installed to comply with 14 CFR §91.209 unless otherwise approved by special provision.

8.8 Observers during Scenario Based Training

A. Observers will receive a safety briefing that addresses the mission intent, non-interference with any mission personnel, and emergency procedures in the event of an incident or accident.

B. Observers will be directed to and contained within a specific observation point that ensures risk of injury is minimized and assures non-interference with the sUAS training mission.

C. A designated flight crew member will ensure that Observers do not engage in conversations, discussions, interviews or distractions of any mission personnel from the performance of his/her duties or interfere in any way with the proper conduct of those duties.

D. Flight Operations will limit the number of Observers to that which can be adequately monitored and protected by the personnel resources onsite.
Section 9 - Launch and Recovery

9.1 Launch and Recovery

A. Prior to take off the UAS will be programmed to allow it to return to home if the signal is lost from the transmitter.

B. When the UAS is deployed to meet an approved mission task, it shall be recovered within the same general area if possible.

C. A designated safe area of at least 25 feet shall be maintained during lift off between UAS’s and personnel.

D. UAS’s should not be flown within unsafe distances to any object or person

9.2 Weather –

A. The PIC shall verify the weather conditions in the immediate area of operations. A local source of weather may be utilized, the internet, phone application or may be observed on site. The UAS will not be flown outside the weather minimums identified by the manufacture or the approved Certificate of Waiver/Authorization (COA) by the FAA. The PIC shall have final determination of risk due to weather and authority over any mission.

9.3 Hazards to the Public –

A. The PIC shall make every effort to ensure that flight operations will not pose any undue risk to the public not directly involved with the effort. The PIC shall have final determination of risk to the public and authority over any launch of his/her own aircraft. In all cases, the UAS will not be flown over persons that is in violation of the FAA approved COA.

9.4 Hazards to property –

A. The PIC shall make every effort to ensure that flight operations will not pose any undue risk to any property in the area involved with the effort. The PIC shall have final determination of risk to the property and authority over launch of his/her own aircraft. In all cases, the UAS will not be flown over property that is in violation of the FAA approved COA.

9.5 Hazards to personnel –

A. The PIC shall make every effort to ensure that flight operations will not pose any undue risk to the personnel directly involved with the effort. The PIC shall have final determination of risk to the public and authority over any launch of his/her aircraft.

9.6 Proximity to controlled airspace –

A. Operations inside any controlled airspace B,C,D shall only be performed after notifying ATC and if necessary obtaining an SGI.
Section 10 - Launch and Landing Zones

10.1 Launch Site Selection
   A. Launch site selection shall be driven by safety first and foremost. Selection of launch sites will be considered based upon:
      1. Ability to maintain adequate buffer zones between aircraft and personnel. The PIC shall maintain a buffer of at least 25 feet for VTOL aircraft between aircraft operations and all non-essential personnel. A designated individual can be identified as a safety officer to ensure the safety of the launch and recovery area.
      2. Environmental Assessment - No launches shall occur until all environmental assessments have been considered. The PIC has the final authority to abort any launch based upon hazards to the environment, themselves, or other personnel in the area.
      3. The PIC shall select a launch site that ensures UA departures are not in or over populated areas.

10.2 Landing Site and Alternate Sites
   A. Primary Landing site –
      1. Typically the primary landing site shall be the same as the launch site. The PIC has final authority for any approaches to the primary site and may wave off any approach deemed unsafe.
   B. Alternate landing sites
      1. The PIC shall designate at least one alternate landing site. In the event that the primary landing site is deemed unsafe, procedures to utilize the secondary site will be invoked.
   C. Mission Abort Sites
      1. The PIC may optionally designate an “abort site” whereby the aircraft may be “dumped” in an emergency situation. The abort site shall be so far removed as to provide absolute minimal risk should the aircraft be required to vacate airspace in an emergency. The UA may be flown to this site and inserted without regard to the safety of the aircraft or flight equipment should the PIC deem it necessary.
   D. Landing Safety & Crowd control
      1. All landing sites shall be maintained and operated as the launch sites. Personnel shall maintain a buffer of at least 25 feet for VTOL aircraft between aircraft operations and all non-essential personnel.
10.3 Landing and Takeoff

A. Each Pilot will utilize their own launch/landing pad within the LZ for taking off and landing. This will give each pilot a specific launch/landing point to operate off of within the landing zone and will help prevent collisions.

B. Takeoff –

1. Pilots will obtain mission, altitude and lift off approval from Module Leader or LZ Manager before taking off. If no Module Leader or LZ Manager is assigned then pilots will coordinate operations together. All Type II and Type IV aircraft shall take off vertically until they reach 15 feet AGL at which time they will verify all controls are working correctly. Once verification is complete the aircraft will proceed to the assigned altitude and proceed with mission. Each pilot will utilize a separate landing pad with markings for takeoff.

C. Landing –

1. If Module Leader or LZ Manager is assigned pilots will obtain permission to land before approaching landing zone. If no Module Leader or LZ Manager is assigned pilots will coordinate operations together. All aircraft shall approach landing site at assigned altitude, maintain that altitude above landing point/pad and then descend to 15 feet AGL. At 15 feet AGL pilot will hover the aircraft and verify all persons or obstructions are clear of landing pad. Once it is determined it is safe to land, the aircraft will descend until on the landing pad. Each pilot will utilize a separate landing pad with markings for landing.
Section 11 - Emergency/Contingency Procedures

11.1 Lost Link / GPS Procedures

A. Lost link is an interruption or loss of the control link between the control station and the unmanned aircraft, preventing control of the aircraft resulting in the UAS performing pre-set lost link procedures such as the following:

1. In the event of a lost link while operating in controlled airspace, which cannot be re-established within 10 seconds, a designated crewmember will immediately notify the appropriate ATC.

B. When possible, lost link and lost GPS procedures should comply with the following:

1. The aircraft autopilot will enter a lost link mode within 10 seconds of the lost link condition being detected, return to the LZ or other defined lost link waypoint within the sUAS OP AREA, and land.

2. If the aircraft loses GPS, the PIC should immediately attempt to land the aircraft in a safe location by controlling it manually or landing at the current location within the OP AREA.

3. If both GPS and data link are lost, the aircraft must automatically land at the current position.

4. The UAS lost link mission should avoid transit or orbit over populated areas.

11.2 Emergency or Fly-Away Procedures

A. In the event of a fly-away or other emergency scenario while operating in controlled airspace, designated crew member will immediately notify ATC or nearest controlling facility.

B. The crewmember will state PIC intentions, and provide the following:

1. The nature of the emergency,

2. Last known UAS position, altitude, and direction of flight, and

3. Maximum remaining flight time.

11.3 Lost Sight

A. If a VO loses sight of the UAS, the VO will notify the PIC immediately.

B. If the UAS is visually reacquired promptly, the mission may be continued. If not, the PIC must immediately abort the flight and land the UAS.

11.4 Lost Communications

A. The PIC must land the UAS if communication with the VO is lost and the PIC cannot gain VLOS.
Section - 12 Incident/Accident/Mishap Reporting

12.1 FAA Reporting Criteria

A. All accidents/mishaps involving UAS operations, where any of the following occur, shall be reported to the FAA:

1. Fatal injury, where the operations of a UAS results in a death occurring within 30 days of the accident/mishap;
2. Serious injury, where the operation of a UAS results in a hospitalization of more than 48 hours, the fracture of any bone (except for simple fractures of fingers, toes, or nose), severe hemorrhage or tissue damage, internal injuries, or second or third degree burns;
3. Total unmanned aircraft loss;
4. Substantial damage to the UAS where there is damage to the airframe, power plant, or onboard systems that must be repaired prior to further flight. Damage to property, other than the unmanned aircraft greater than $500.

B. When operating under a COA, any incident/mishap that results in an unsafe/abnormal operation shall be reported to the FAA including, but not limited to:

1. A malfunction or failure of the unmanned aircraft’s on-board flight control system (including navigation);
2. A malfunction or failure of the ground control station flight control hardware or software (other than loss of control link);
3. A power plant failure or malfunction;
4. An in-flight fire;
5. An aircraft collision;
6. Any in-flight failure of the unmanned aircraft’s electrical system requiring use of alternate or emergency power to complete the flight;
7. A deviation from any provisions contained in the COA;
8. A deviation from an ATC clearance and/or Letter(s) of Agreement/Procedures;

C. A lost control link event resulting in a fly-away or execution of a preplanned/unplanned lost link procedure.

D. All incidents or accidents are required to be reported to the FAA within 10 days, unless such incident or accident occurs while operating under a COA, which must be reported as soon as reasonable practicable and before any additional flights occur.

12.2 FAA Report Submission

A. Any incident or accident that occurs while operating under a COA can be reported to the FAA via the CAPS On-Line Accident/Incident Report and initially reported via email at:

1. 9-AJV-115-UASOrganization@faa.gov

B. All other incident/accident reports may be submitted to the FAA Regional Operations Center by phone at 817-222-5006 or electronically at http://www.faa.gov/about/office_org/field_offices/fsdo/.
C. The report should include the following information:

1. UAS PIC’s name and contact information;
2. UAS PIC’s FAA airman certificate number;
3. UAS registration number issued to the aircraft, if required;
4. Location of the accident;
5. Date of the accident;
6. Person(s) injured and extent of injury, if any or known;
7. Property damaged and extent of damage, if any or known; and
8. Description of what happened.

12.3 NTSB Reporting Criteria

A. All accidents/mishaps involving UAS operations, where any of the following occur, shall be reported to the NTSB in compliance with 49 CFR §830.2:

1. Any person suffers death or serious injury;
2. Flight control system malfunction or failure such as a fly-away;
3. Inflight fire;
4. Aircraft collision in flight;
5. More than $25,000 damage to objects other than the aircraft;
6. Release of all or a portion of a propeller blade from an aircraft, excluding release caused solely by ground contact.

B. All incidents or accidents are required to be reported to the NTSB as soon as reasonably practicable and before any additional flights occur.

12.4 NTSB Report Submission

A. All incident/accident reports may be reported to the NTSB’s Response Operations Center at 844-373-9922.

B. The report should include the following information:

1. Type and registration marks on the UAS;
2. Name of owner and operator of the UAS;
3. Name of the PIC;
4. Date and time of the accident;
5. Location of the operating area; and
6. Nature of the accident, the weather and the extent of damage to the UAS.
Section 13 - Information Management

13.1 Collection

A. All UAS flights will be documented and reported by the Pilot or Data Specialist within 5 days.

B. At a minimum, flight records should include:

1. Date and time,
2. Operational area,
3. Name of the PIC,
4. Name of the VO if applicable,
5. Aircraft identification,
6. Flight time,
7. Any incidents/accidents/mishaps, and
8. Purpose of the flight.

C. All UAS flights conducted for any purpose other than training or demonstration shall be documented in a report and either reference or be filed by the pilot.

13.2 Retention

A. Jurisdiction maintains retention of any aircraft/flight records or data, including but not limited to images and/or videos and flight telemetry that are collected by the UAS equipment.

B. Records and data, including images and videos, will be retained pursuant to existing record retention of the department.

C. Collection and Use: The Jurisdiction shall only collect information using UAV/UAS to the extent that such collection or use is consistent with and relevant to an authorized purpose of the Jurisdiction and is compliant with the Texas Privacy Act.

D. Information collected using UAV/UAS that may contain personally identifiable Information (PII) shall not be retained for more than 60 days from recording unless retention of the information is determined to be necessary to an authorized mission of the Jurisdiction, is maintained in a system of records covered by the Privacy Act, or is required to be retained for a longer period by any other applicable law or regulation. The following UAS retention schedule shall be adhered to:

1. Trainings/Non-Response 90 days
2. Incident Response 2 years
3. Incident Response or Training (personnel Injured) 5 years
4. Structure Fires/Hazmat Incidents/Disasters 5 years
5. Criminal Investigations 10 years
13.3 Dissemination

A. All UAS-related information will only be provided pursuant to a request for public records, which request will be processed in accordance with the Open Records Act and any rules or policies of the member agency receiving the request adopted in accordance with the Open Records Act.

B. Jurisdiction members will not post, transmit, or otherwise disseminate any records or data, including images or videos, obtained via UAS for personal use without the consent of the department.

C. UAS collected information that is not maintained in a system of records covered by the Privacy Act shall not be disseminated outside of the Jurisdiction unless dissemination is required by law, or fulfills an authorized purpose and complies with Jurisdiction requirements.
# Appendix A:

## Flight Checklist

<table>
<thead>
<tr>
<th>At office</th>
<th>After launch</th>
<th>After landing</th>
<th>Before Landing</th>
<th>Back at office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Documentation</td>
<td>Aircraft reached safe altitude.</td>
<td>Power down UAV</td>
<td>Ensure UAV flight done according to mission plan.</td>
<td>Flight and Maintenance Report</td>
</tr>
<tr>
<td>NOTAM</td>
<td>Confirm observer has the aircraft in sight.</td>
<td>Remove and safely store batteries</td>
<td>Scan landing area for obstacles.</td>
<td>Charge Batteries</td>
</tr>
<tr>
<td>Local regulations and permissions.</td>
<td>All systems green</td>
<td>Airframe inspection</td>
<td>Wind check</td>
<td>SD card cleaned and ready to use</td>
</tr>
<tr>
<td>Proximity to the airport.</td>
<td>Satellite and GPS check</td>
<td>Check camera/sensor to ensure data collected</td>
<td>Observer briefing for landing</td>
<td>Airframe checked</td>
</tr>
<tr>
<td>Weather condition permits flying.</td>
<td>Check Battery remaining</td>
<td>Transfer data and flight log</td>
<td>All systems green</td>
<td>Data processed</td>
</tr>
<tr>
<td>All Batteries Charged</td>
<td></td>
<td>Make logbook entry</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B:

Beaufort Wind Scale
Appendix C:

Aircraft Hand Signals

Move Forward  Move Rearward  Move Left  Move Right  Stop

All Clear  Move Upward  Move Downward  Clear to Take-off

(EdgeData, 2016)
Appendix D:

Contingency Plan Checklist

<table>
<thead>
<tr>
<th>Event</th>
<th>Result</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Depletes</td>
<td>Unmanned aerial system (UAS) incapable of continuing flight operations</td>
<td>UAS return to base (RTB) as soon as practical; cease data collection</td>
</tr>
<tr>
<td>Ditch Procedures</td>
<td>UAS incapable of continuing flight operations</td>
<td>Identify safe landing area; attempt a controlled landing; if able, land UAS in water (shallow preferred for ease of recovery) away from public</td>
</tr>
<tr>
<td>Fuel Depletes</td>
<td>UAS incapable of continuing flight operations</td>
<td>UAS RTB as soon as practical; cease data collection</td>
</tr>
<tr>
<td>Hazardous Weather</td>
<td>UAS incapable of continuing flight operations</td>
<td>UAS RTB as soon as practical; cease data collection</td>
</tr>
<tr>
<td>Hostile Environment</td>
<td>Mission impacted by hazard (e.g. air traffic, public activity)</td>
<td>See and avoid; take evasive action as required with safety taking precedence; UAS RTB as soon as practical</td>
</tr>
<tr>
<td>Loss of Communications</td>
<td>Mission impacted by lack of communications hazard</td>
<td>Maintain visual line of sight (VLOS); take evasive action as required with safety taking precedence; UAS RTB as soon as practical</td>
</tr>
<tr>
<td>Loss of Control Signal</td>
<td>UAS not controllable</td>
<td>Maintain VLOS; UAS RTB and land without harm to UAS or contacting surrounding objects</td>
</tr>
<tr>
<td>Loss of Direct Visual</td>
<td>UAS could become hazard if unable to regain visual control</td>
<td>Regain direct visual of UAS; contact mission payload operator and/or visual observer to determine status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>Result</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of GPS Signal</td>
<td>Use extreme caution as the positional data for the UAS will not be accurate</td>
<td>Assume manual control of the UAS; Maneuver and climb UAS to reacquire GPS signal; if GPS signal cannot be acquired, determine whether safe UAS control can be maintained; if safe flight cannot be maintained, land as soon as possible</td>
</tr>
<tr>
<td>Loss of Situational Awareness (SA)</td>
<td>UAS could become hazard if unable to regain SA</td>
<td>Climb to safe altitude; reorient with use of sensors; RTB as required</td>
</tr>
<tr>
<td>Privacy Impact</td>
<td>Possible public complaint</td>
<td>Cease data collection; after RTB, complete an assessment</td>
</tr>
<tr>
<td>UAS Failure</td>
<td>UAS incapable of continuing flight operations</td>
<td>Maintain VLOS; UAS RTB as soon as practical</td>
</tr>
</tbody>
</table>
Appendix E:

Mission Planning Profile

<table>
<thead>
<tr>
<th>Mission Profile</th>
<th>Location (Name &amp; Latitude &amp; Longitude)</th>
<th>Date</th>
<th>ETD</th>
<th>ETA</th>
</tr>
</thead>
</table>

Daylight Hours: 

Crew Assigned: 

<table>
<thead>
<tr>
<th>Waypoint</th>
<th>Transit (T) or Hover (H)</th>
<th>Altitude AGL (B)</th>
<th>Estimated Leg Duration (mm / ss)</th>
<th>Activity</th>
</tr>
</thead>
</table>

Total Flight Time (TFT)

Statutory Reserve (SR) (TFT + 0.35*)

Mission Requirement (TFT + SR)

Max Load UAS Flight Time

Notes:

*With respect to TFTs and SRs, a UAS flight should be able to be completed with 20% energy reserves (fuel or battery) remaining or a 5-minute reserve or the manufacturer recommendation, whichever is greater.

Acronyms: ETD = estimated time of departure, ETA = estimated time of arrival, and AGL = above ground level.

<table>
<thead>
<tr>
<th>Organizational Point of Contact</th>
<th>Contact Numbers</th>
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<tbody>
<tr>
<td>National grid operations center</td>
<td></td>
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<tr>
<td>Local electric utility distribution network office</td>
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<tr>
<td>Service provider local field services office</td>
<td></td>
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<tr>
<td>County road supervisor</td>
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<tr>
<td>County sheriff dispatch office</td>
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<tr>
<td>County fire department</td>
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<tr>
<td>Closest medical facility</td>
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<tr>
<td>Internet/phone providers</td>
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<tr>
<td>Site manager</td>
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<tr>
<td>Remote pilot in command</td>
<td></td>
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<tr>
<td>Visual observer</td>
<td></td>
</tr>
<tr>
<td>Mission payload operator</td>
<td></td>
</tr>
<tr>
<td>Subject matter expert</td>
<td></td>
</tr>
</tbody>
</table>
Appendix F:

Training and Standards

The test methods and process for evaluating system capabilities and/or operator proficiency are roughly the same. Start by performing repeated trials using elemental test methods to measure individual capabilities and improve muscle memory for basic skills. Then graduate to performing repeatable combinations and sequences of test methods to measure trade-offs in capabilities for a given system configuration. Then embed the test methods into training scenarios to quantitatively compare baseline capabilities with actual readiness to perform tasks within uncontrolled environments. This helps measure the degradation of performance due to the environmental variables within scenarios.

The following content will serve as examples of training apparatus which reflect both:

- Low cost / easily constructed training apparatus to be assembled and used at any work place. These apparatus serve as an alternative where space and funding may be an
- The National Institute of Standards and Technology Standard Test Methods for Small Unmanned Aircraft Systems (sUAS)

Both of the above options are ideal establishing standards and quantitative measurements that focus training, measure operator proficiency, assess airworthiness of particular aircraft, and assist with informed decision making for future purchases.

Individuals wishing to be qualified as a Public Safety Remote Pilot are required to perform the following standards set forth by the National Fire Protection Association’s (NFPA) Standard for Small Unmanned Aircraft Systems (sUAS) used for Public Safety Operations job performance requirements (JPR’s).

Qualified Public Safety Remote Pilots will meet or exceed the minimum proficiency level of “Proficient” established by NIST Standard Test Methods for the following apparatus.

1. Maneuvering: Hold Position and Altitude
2. Maneuvering: Orbit a Point
3. Maneuvering: Fly Straight and Level
4. Maneuvering: Avoid Obstacles (Figure-8s)
5. Maneuvering: Land Accurately
6. Payload Functionality: Point and Zoom Cameras
7. Payload Functionality: Identify Objects
8. Payload Functionality: Inspect Objects
9. Payload Functionality: Map Wide Areas
10. Payload Functionality: Drop

These are the notations to report for each test trial. Use of a common test form is optional:

- Make/Model/Configuration of the system to be tested.
- Name (or Code) of the pilot in charge of the test trial.
- Organization and location at which the test trial is being conducted.
- Date (yyyy-mm-dd) and time (2400) of the test trial.
- Pertinent environmental conditions as measured just prior to the test trial using appropriate devices (e.g., wind speed and direction, temperature, humidity, pressure, altitude, etc.).
• Ratio of successful tasks to faults (tasks: faults). This ratio can be used to determine the reliability of the system or proficiency of the pilot.
• Average result of any specific task metrics across the number of successful tasks completed.
• Total elapsed time (minutes) adding up all sequential timer increments in the test trial.
• Calculated average rate of successful tasks completed (tasks/minute). This number can be compared to others with varying levels of confidence depending on the number of successful tasks completed.

Link to NIST:

www.nist.gov/el/intelligent-systems-division-73500/response-robots/aerial-systems
Figure of Eight

Purpose
- The Purpose of this test method is to quantitatively evaluate the operator's ability to maintain orientational direction while flying in a figure of eight pattern.

Metrics
- Completion of maximum repetitions
- Average time per repetition

Duration
- 10 minutes

Apparatus
- This test apparatus consists of two cones equally spaced four feet apart.
- Performed in either GPS or attitude mode.
- A designated takeoff / landing zone will be identified.

Procedure
1. Place the aircraft at starting location on designated takeoff / landing zone.
2. Launch the aircraft from the designated area and travel in a counterclockwise rotation.
3. Maintain preferred flight elevation either above or below eye level.
4. The aircraft must pass around each cone in a very controlled manner.
5. Five repetitions will be completed and operator will change orientational direction by rotating platform 90 degrees.
6. Repeat steps until 0, 90, 180, and 270 degrees have been flown.
7. After the completion of five repetitions in each direction (0, 90, 180, and 360 degrees) reverse orientation and complete procedure in a clockwise orientation.

Fault condition
- Failure to maintain elevation
- Inability to fly around each cone Failure to use controlled manner of flight
Follow the Path

Purpose

- The Purpose of this test method is to quantitatively evaluate the operator's ability to follow a path of travel while maintaining orientational direction.

Metrics

- Completion of maximum repetitions
- Average time per repetition

Duration

- 10 minutes

Apparatus

- This test apparatus consist of five cones in a linear formation equally spaced three feet apart.
- Performed in either GPS or attitude mode.
- A designated takeoff and landing area will be identified.

Procedure

1. To begin place the aircraft on the designated takeoff / landing zone.
2. Launch the aircraft and fly over the cones in a straight line then land the aircraft in the designated takeoff / landing zone on the other end of the line.
3. The first direction of travel will be with the nose of the aircraft facing forward in the direction of travel (0 degree orientation).
4. Maintain preferred flight elevation either above or below eye level.
5. Five repetitions will be completed and operator will change orientational direction by rotating nose of aircraft 90 degrees
6. Repeat steps until 0, 90, 180, and 270 degrees have been flown.
7. After the completion of five repetitions in each direction (0, 90, 180, and 360 degrees) reverse orientation and complete procedure in a clockwise orientation.

Fault condition

- Failure to maintain elevation
- Inability to fly over each cone
- Failure to use controlled manner of flight
Four Corners

Purpose
- The purpose of this test method is to quantitatively evaluate the operator's ability to maintain orientational flight.

Metrics
- Completion of maximum repetitions
- Average time per repetition

Duration
- 10 minutes

Apparatus
- This test apparatus consist of four cones in a square formation equally spaced four feet apart.
- Performed in either GPS or attitude mode.
- A designated takeoff and landing zone will be identified.

Procedure
1. To begin place the aircraft on the designated takeoff / landing zone.
2. Launch the aircraft from designated launch / landing zone and travel in a counterclockwise direction over the cones. The first direction of travel will be with the nose of the aircraft facing forward in the direction of travel (0 degree orientation).
3. Maintain preferred flight elevation either above or below eye level.
4. The aircraft must pass over the top of each cone in a very controlled manner.
5. Five repetitions will be completed and operator will change orientational direction by rotating nose of aircraft 90 degrees.
6. Repeat steps until 0, 90, 180, and 270 degrees have been flown.
7. After the completion of five repetitions in each direction (0, 90, 180, and 360 degrees) reverse orientation and complete procedure in a clockwise orientation.

Fault condition
- Failure to maintain elevation
- Inability to fly over each cone
- Failure to use controlled manner of flight
Serpentine

Purpose
- The Purpose of this test method is to quantitatively evaluate the operator's ability to avoid contacting obstacles while traveling in a serpentine path.

Metrics
- Completion of maximum repetitions
- Average time per repetition

Duration
- 10 minutes

Apparatus
- This test apparatus consists of five cones with attached pool noodles to create vertical posts. Each pool noodle will need a ¾” pipe run through the center of it and then placed in the top of the cone. The cones should be spaced in a straight line three feet apart (see diagram)
- Performed in either GPS or attitude mode.
- Prop guards are recommended
- A designated takeoff and landing zone will be identified.

Procedure
1. To begin place the aircraft on the designated takeoff / landing zone.
2. Launch the aircraft from the designated takeoff / landing zone. The nose of the aircraft will be facing forward (0 degree orientation).
3. Direction of travel will be serpentine around each cone beginning in a counterclockwise direction.
4. Maintain preferred flight elevation either above or below eye level.
5. Five repetitions will be completed and operator will change orientational direction by rotating the aircraft 90 degrees.
6. Repeat steps until 0, 90, 180, and 270 degrees have been flown.
7. After the completion of five repetitions in each direction (0, 90, 180, and 360 degrees) reverse orientation and complete procedure in a clockwise orientation.

Fault condition
- Failure to maintain elevation
- Inability to fly around each cone
- Failure to use controlled manner of flight
Payload Drop Accuracy

Description:
This test method evaluates the capability to drop a payload accurately from a defined altitude. The system performs a series of drops on a metered platform from different altitudes. The payloads can be weighted surrogates or operationally significant delivery items.

Metric:
- Average Radius from Center in Centimeters (Inches)

Duration:
- 40-80 minutes to complete 10-20 tasks.

Apparatus:
- Landing Platform (Quantity 1): 2.4 x 2.4 m (96in x 96 in) square platform with 10 cm (4 in) circular bands to measure the landing radius.
- Bucket Targets (Quantity 4): 20 cm (8 in) diameter or 7.5 liter (2-gallon) white buckets with internal black rings around the inside bottom and a 7.5 cm (3 in) black letter to identify the target. The bucket size should be considered based on the designated drop altitude.
- Surrounding Lines (Quantity: 4): Concentric chalk/paint lines on the ground at 2m (6.5ft), 4m (13ft), and 6m (20ft) to capture less accurate drops.

Preparation:
- See general Trial Preparation guidance.

Procedure
1. Establish a hover position SOUTH of the landing platform at least 6 m (20 ft) range from the platform and at the designated drop altitude AGL. See concentric markings on the ground to ensure the distance.

2. Start the trial timer and onboard video recording if available.

3. Move to directly over the drop zone and refine position.

4. Announce a loud audible warning of intent to drop along with a countdown to inform personnel on the ground.

5. Drop the payload and pause the timer.

6. Land the aircraft on any available space on or near the landing platform.

7. Note on the form the outer-most concentric ring occupied by any ground contact of the payload. This is the measurement of the payload drop radius. Contact with the lines, if not exceeded, shall be considered within the smaller concentric ring.

8. Repeat steps 1-7 from each of four different directions, North-East-South-West, until the timer expires. Reset the timer and continue if necessary to complete at least 10 repetitions.

9. Report on the form:
   a. Each payload drop radius (cm)
   b. Total number of tasks completed successfully (tasks).
   c. Total elapsed time including all timer increments (minutes).

Fault Conditions

- Touching the apparatus, ground, or surrounding safety containment structure during a repetition.
SOP: 105

Effective Date: 9/26/2017

Rescinds:

Subject: Unmanned Aerial Systems (UAS’s)

PURPOSE

To establish a procedure for the deployment and maintenance of unmanned aerial systems by the Vernon Police Department

POLICY

It is the policy of the Vernon Police Department to utilize unmanned aerial systems (UAS’s) for the purpose of law enforcement, public safety and training. UAS’s, related equipment and technology, and data collected from their deployment shall be used in a lawful manner consistent with all provisions of the United States and Connecticut Constitutions.

Definitions:

Unmanned Aerial System (UAS) - Means an aircraft that is operated without a physical human presence within or on the aircraft and is guided by remote control. UAS’s are capable of performing audio or visual surveillance.

Pilot in Command (PIC) - A pilot with a valid FAA- Remote Pilot License and is certified by the Vernon Police Department to operate a UAS. The PIC will be responsible for the UAS, equipment, use, recordings and for completing all paperwork.

Visual Observer (VO) - A person designated by the PIC that will assist the PIC with controlling and observation of the UAS.

PROCEDURES:

A. Deployment- UAS may be deployed for cases involving search and rescue, legal surveillance, criminal investigation, traffic control, accident reconstruction, demonstrations, building inspections, training and other legal needs. UAS may be deployed to assist other departments and units including CREST, fire department(s), building department and schools. UAS’s will be operated in a safe manner so as not to endanger people, property or animals.
B. **Night Flight** - will consist of a PIC and a minimum of one VO that will work together when the UAS is deployed. A VO is required for all night flights.

1. The PIC will brief all members about the mission and each member’s responsibility during the deployment.

2. UAS will have auxiliary night lights attached to the drone for night flight

C. **Flight Restrictions** - UAS will be operated in accordance with all FAA regulations, including part 107 of the Federal Aviation Regulations. FAA waivers are needed to operate the UAS during the following:

1. Night hours - Active Waiver
2. Restricted Air Space - Active Waiver
3. Over Non-Participant Individuals – No Waiver

Refer to Appendix C for current waivers

D. **Weather Conditions** - PIC should check weather conditions before attempting to fly a UAS. UAS’s are not water resistant and should not be operated during inclement weather including rain or snow. High winds can drain the battery and make it hard to control the UAS. UAS’s should not be operated with sustained wind speed of 20 knots or greater.

E. **Visibility** - UAS operations require a minimum of 3 statute mile visibility at flight operations. UAS’s must remain 500 feet below and 2000 feet horizontal of any clouds in the vicinity. This restriction does not include night flights. When flying at night or in reduced visibility all marking lights will be activated.

F. **Airspace** - PIC will check the class of air space they are going to operate in and any restrictions to the air space. They will also check for hazards including but not limited to, buildings, trees, power lines, towers and bodies of water. Care should be taken to identify hazards and avoid hazards when flying.

G. **Other Aircraft in the area**; UAS will take steps to avoid all other aircrafts and birds in the area.

H. **Pre-Flight** – The PIC is responsible for all pre-flight inspections to include - Refer to Appendix – A -for complete instructions

I. **Flight**-- the PIC is responsible for the safe operation of the UAS while it is in the air.

J. **After Flight**- The PIC is responsible for completing the UAS after-action inspection – Refer to Appendix –B for complete instructions

K. **UAS accidents and crashes**; In the event that a UAS crashes, the PIC will file a written report to documenting the accident. In the event that a person is injured,
medical treatment will be given to the injured party and all injuries will be photographed. If property other than the UAS is damaged, the owner of said property will be contacted and the damage will be photographed.

1. When available, a supervisor will respond to the scene of a UAS accident

2. If the injured person losses consciousness or requires medical treatment at a hospital, or if the damage to someone else’s property exceeds $500.00, than a separate written report must be filed with the FAA within 10 days of the accident.

Maintenance and Storage

A. The UAS will be stored in its case and kept in the training sergeant’s office when not in use.

B. Batteries will be charged weekly in accordance with the manufacturer’s recommendation.

C. Controllers will be kept charged when not in use.

D. Ipad’s will be kept charged when not in use

E. Wi-Fi hot spot will be kept charged when not in use

F. The UAS pilots will check for manufactures firmware updates weekly

G. Problems will be reported to the Supervisor in command of the UAS program.

By order of,

James L. Kenny
Chief of Police
Appendix A

Pre-Flight Drone Operation

A. **Do not update Firmware in the field- bypass updates till a later time (If prompted press NO)**

B. **Brief Flight Crew about mission- responsibilities**

1. Turn Wi-Fi hot spot on (Must have Wi-Fi connection)
2. Turn IPads on
3. Place Battery in Drone and Turn on
4. Turn Master Controller on
5. Take Drone out of Travel Mode- Toggle landing gear switch on and off 4 times
6. Turn Drone off
7. Install Camera on Drone- align white lines and Lock into place
8. Install Props on Drone –Color coded- Lock into place
9. Turn IPads Wi-Fi on- connect to hot spot
10. Turn Drone on
11. Connect IPads to Controllers- Turn Controllers on
12. Check Controller- IPad and Drone for connection
13. Calibrate Drone if Needed
14. Check flight area for hazards- weather- restrictions
15. Locate hazard free landing area
16. Set Drone Home- Return to home if signal lost
17. Prepare for flight
Appendix B

POST FLIGHT DRONE OPERATION

A. Do not update Firmware in the field- bypass updates till a later time (if prompted Press NO)
   1. Turn Drone Off
   2. Remove Camera and replace covers
   3. Remove Props
   4. Turn Drone on and Place in Travel Mode (Toggle landing switch 4 times)
   5. Turn Drone off and remove battery
   6. Turn Controllers off
   7. Turn IPads off and remove from controllers
   8. Turn Wi-Fi Hot Spot Off
   9. Inspect Drone, Props, Camera, Controllers and Hot Spot for Damage
   10. Return Drone, Camera, Controllers, IPads and Props to case

B. At the Department
   1. Complete Flight Records- Reports
   2. Check for Firmware updates- Update Firmware if needed
   3. Charge all drone batteries (rotational)
   4. Charge Controllers
   5. Charge IPads
   6. Remove disk from camera and download photos
      - All photos and videos will be added to case report
   7. Clear photos and video from disk and replace disk in camera
   8. Inspect clean all equipment-
   9. Return equipment to case
Vernon Police Drone

Equipment list

Drone Case

• Drone
• Camera- Gimbal
• Flir Camera- Thermal
• 2 - Controllers
• 2- IPads
• Hot Spot- Wi-Fi
• 4 -Batteries
• 4- Propeller
• Battery charger and cable

Landing Pad – Orange Case

Night Flight Case

• Night Lights and remote controller
• 2- Cubes
• 2- Headlamps
than an “unmanned aircraft system”, or watercraft owned or operated by or rented or loaned to any insured. Use includes operation and “loading or unloading.

This exclusion does not apply to “bodily injury” or “property damage” arising out of:

a. A watercraft while ashore on premises you own or rent; or

b. A watercraft that is:

   (1) Less than 50 feet long; and

   (2) Not being used to carry persons or property for a charge.

All other terms and conditions remain unchanged.
# sUAS PILOT FLIGHT LOG

**Pilot:** ________________________  

<table>
<thead>
<tr>
<th>Date</th>
<th>Aircraft</th>
<th>A/C Reg.#</th>
<th>Location</th>
<th>Day</th>
<th>Night</th>
<th>Instruct</th>
<th>Total flt.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
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I certify that all entries in this logbook are true

__________________________________________

Pilot signature

Page: _____
PILOT AUTHORIZATION RECORD:

**Solo flight authorizations:**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Instructor:</th>
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Wind rating: __________  Visibility: __________

Maximum distance: ______  Maximum altitude: ______

Additional restrictions:

Additional restrictions:

Date: _________________  Instructor: _______________

Wind rating: __________  Visibility: __________

Maximum distance: ______  Maximum altitude: ______

Additional restrictions:

Date: _________________  Instructor: _______________

Wind rating: __________  Visibility: __________

Maximum distance: ______  Maximum altitude: ______

Additional restrictions:

Date: _________________  Instructor: _______________

Wind rating: __________  Visibility: __________

Maximum distance: ______  Maximum altitude: ______

Additional restrictions:
PILOT AUTHORIZATION RECORD:

Pilot operating ratings

Date:__________________           Instructor:__________________
Rating:__________________
Restrictions:________________________________________________
__________________________________________________________

Date:__________________           Instructor:__________________
Rating:__________________
Restrictions:________________________________________________
__________________________________________________________

Date:__________________           Instructor:__________________
Rating:__________________
Restrictions:________________________________________________
__________________________________________________________

Date:__________________           Instructor:__________________
Rating:__________________
Restrictions:________________________________________________
__________________________________________________________
UAS MISSION REPORT:

Date/Time: ______________ Location: __________________________

UAS: ___________________ UAV Registration #: ______________________

Pilot-in-command: _________________________________________________

Person manipulating controls: _______________________________________

Visual observer/s: ________________________________________________

Total mission flight time: ______ Total UAV hours after mission: ______

Total hours on propellers after mission: ________________________________

Max. Altitude: _______ Distance flown: ______ T/O’s: ___ Landings: ___

Equipment installed/utilized: _______________________________________

Battery used: ______ Start voltage: ___ End voltage: ___ Charge cycle #: ___

Battery used: ______ Start voltage: ___ End voltage: ___ Charge cycle #: ___

Battery used: ______ Start voltage: ___ End voltage: ___ Charge cycle #: ___

Battery used: ______ Start voltage: ___ End voltage: ___ Charge cycle #: ___

Weather: Day ___ Night ___ Weather briefing source: _________________

Wind: _____ Visibility: ___ Temperature: ___ Cloud conditions: ______

Weather notes: ___________________________________________________

Reason for mission: Training ___ Maintenance check ___ Operational ___

Mission comments: _______________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

Signature: ________________________________ Pilot-in-command
UAS MAINTENANCE REPORT:

Date/Time:__________________ Location:____________________________________

UAS:______________________ UAV Registration #:_____________________________

Total UAV hours:____________ Maintenance tech.:______________________________

Person reporting/requesting maintenance:_______________________________________

UAS airworthiness:  In-service ___  Out-of-service ___

Maintenance type:  Scheduled ___  Unscheduled ___  Repair ___  Crash ___

Components involved:__________________________________________________________

___________________________________________________________________________

Components replaced/repairsd:________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Additional comments:________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

UAS returned to service: Yes __ No __ Date:__________________

Signature:__________________________ Requestor of maintenance

Signature:__________________________ Maintenance tech

Signature:__________________________ Maintenance officer-in-charge
VERNON PD UAS PROGRAM

TRAINING LOG:

Name:_____________________

Position:___________________ Remote Pilot Cert. #:________________

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Date</th>
<th>Pass/Fail</th>
<th>Student sig.</th>
<th>Instr. sig.</th>
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Name:_________________  Date:_________  Score:_________

1) On average, how much time in a dark environment is required for the rod cells achieve full night vision adaptation?
   a. 1 hour
   b. 10 minutes
   c. 30 minutes*

2) What is the most effective method to focus on an object at night?
   a. Staring directly at the object
   b. Off-center viewing*
   c. Constant sweeping of the eyes

3) What color lighting best preserves night vision adaptation?
   a. Red*
   b. Yellow
   c. Green

4) What type of vision becomes less dependable during night vision adaptation?
   a. Farsighted vision
   b. Color vision*
   c. Nearsighted vision

5) What illusion can occur when the eye has no discernable object to focus on beyond 20ft from the observer?
   a. Empty-field myopia*
   b. Infinite focus myopia
   c. Bleached focus myopia

6) What should be avoided once night vision adaptation has been achieved?
   a. Excessive blinking
   b. Bright light*
   c. Holding eyes open

7) What physiological factor effects night vision adaptation negatively at altitudes above 5000ft?
   a. Hypoxia*
   b. Fatigue
   c. Altitude myopia

8) What visual illusion could occur during hazy environments when utilizing a strobe light?
   a. Strobe effect
   b. Blinder illusion
   c. Flicker vertigo*

9) What could potentially make an object disappear if looked at directly at night?
   a. Rod failure spot
   b. Central blind spot*
   c. Night blindness

10) If you observe a red flashing strobe light, what side of the aircraft if facing you?
    a. Rear
    b. Left*
    c. Right
STANDARD PHRASEOLOGY CALL OUTS:

Pilot-in-command:
Area clear...............Clear observation of launch/landing area before arming aircraft motors
Clear prop...............PIC is arming aircraft motors
Taking off...............PIC climbing to 20ft AGL for control function check
Gear up..................Landing gear retracted
Departing...............PIC leaving launch/landing area and proceeding to operations area
Climbing to __.........PIC will call out altitude changes for visual observers
Descending to __......PIC will call out altitude changes for visual observers
Moving __................PIC will call out movement based on cardinal direction of movement
On station...............Aircraft has arrived over operational area
Target acquired.......PIC has identified mission target
Your aircraft..........Pilot has transferred aircraft control to another pilot
My aircraft............New pilot has assumed positive control from previous pilot
Payload up............Aircraft is lifting payload
Payload deploy.......Aircraft is releasing payload
Battery level.........PIC will call out at 75%, 50%, and 30% battery levels
Returning...............Aircraft is leaving operational area
On approach...........PIC is returning to launch/landing area
Gear down.............Landing gear lowered
Landing................PIC is on final approach and landing
Prop stop...............PIC has disarmed aircraft motors
Abort, abort, abort.......PIC is terminating the current phase of flight
Emergency...............PIC has encountered an emergency situation, information to follow

Visual observer:
On station.............VO is at assigned location
On comms...............VO is on communications, responded to by PIC to confirm 2-way communications
Drone acquired........VO has visual and positive ID of the aircraft
Hazard at __...........VO will report observed hazards based on cardinal compass directions in relation to aircraft
Aircraft approaching __VO will report approaching aircraft location and direction of travel based on cardinal compass directions in relation to observed aircraft position
Lost drone............VO has lost visual and/or positive ID of the aircraft

Any personnel in vicinity of flight operations:
STOP!....................A critical safety issue has been identified, PIC should immediately hold position and listen for additional information
**FLIGHT PLANNING:**
- Weather
- Receive briefing
- Winds
- Verify conditions
- UAS Documents
- Review
- Firmware
- Current
- Flight crew
- Assign positions
- Airspace
- Authorized
- Waivers
- Confirmed for ops.
- NOTAMS
- Check
- Area map
- Cache
- Batteries
- Charge as required
- Operational area
- Site survey (if req.)

**PRE-FLIGHT INSPECTION:**
- Travel Case
- Inspect/check contents
- Aircraft
- Landing configuration
- Airframe
- Inspect
- Battery
- Inspect/confirm charge
- Motors
- Inspect
- Free rotation
- Propellers
- Inspect and attach
- Cam.Gimbal
- Inspect/Free moving
- Payload
- Attach and secure
- Transmitter
- Inspect/orient antennas
- Display
- Inspect/connect device
- A/C-T/X
- Confirm linked

**PRE-TAKEOFF:**
- Takeoff area
- Select and survey
- Flight crew
- Operational brief
- Transmitter
- Power on
- Display
- Power on/DJI Go
- Aircraft
- Power on
- Aircraft status
- Check
- Battery
- Check cell voltage
- Sensors
- Check values
- Compass
- Calibrate (if req.)
- Return-to-home
- Home point and alt.
- Flight modes
- Cycle
- Flight crew
- Responsive.

**TAKEOFF/OPERATIONS:**
- Takeoff area
- Confirm clear
- Anti-collision light
- Power on
- Arming A/C
- Announce
- Takeoff
- Climb to 10ft AGL.
- Landing gear
- Raised (no payload)
- Flight controls
- Directional check
- Battery load
- 2 sec. max. power
- Battery status
- Monitor during flt.
- Control uplink
- Monitor during flt.
- GPS status
- Monitor during flt.
- Video downlink
- Monitor during flt.
- Mission ops
- As required

**LANDING:**
- Landing area
- Confirm clear
- Approach
- Announce
- Landing gear
- Lowered/locked
- Descent
- Controlled
- Ground contact
- Disarm A/C
- Anti-collision light
- Power off
- Payloads
- Powered off
- Aircraft
- Power off
- Display
- Power off
- Transmitter
- Power off
- SD memory card
- Secured

**POST-FLIGHT:**
- Aircraft
- Inspect
- Propellers
- Inspect and remove
- Display
- Disconnect
- Cam.Gimbal
- Disconnect
- Anti-collision light
- Remove
- Payloads
- Remove
- Batteries
- Charge as required
- Display
- Charge as required
- Documentation
- Complete reports
- Aircraft
- Complete
- SD memory card
- Data transferred
- Travel case
- Post flight inventory

---

**DJI INSPIRE 1 v2.0 CHECKLIST:**

**EMERGENCY PROCEDURES:**

**BATTERY ERROR:**
- Aircraft
- Maintain visual contact
- Maneuver
- Use minimum input req.
- Battery
- Check cell voltages
- Landing zone
- Select safe alternate
- Aircraft
- Land as soon as possible

**BATTERY FIRE:**
- Aircraft
- Maintain visual contact
- Landing zone
- Select safe alternate
- Descent
- Max. controlled
- Ground fire
- Extinguish
- *****Call 911 if required*****

**COLLISION WITH AN OBJECT:**
- Aircraft
- Maintain visual contact
- Transmitter
- Release control sticks
- Aircraft
- Maneuver away if able
- Flight
- Verify controllable
- Recover
- Safely and shut down
Vernon sUAS/Drone Program Checklist Update

GREEN = COMPLETE / YELLOW = PENDING

FAA = Federal Aviation Administration
sUAS = Small Unmanned Aircraft System (a/k/a Drone)
Part 107 = section of the federal aviation regulations pertaining to sUAS weighing less than 55 lbs

FAA Part 107 Certificate of Registration
✓ Register sUAS’s/Drones with the FAA (Certificate of Registration).

Professional Operator Certificate Training
✓ Complete a rigorous sixteen (16) hour sUAS/Drone Professional Operator Certificate training program.

FAA sUAS/Drone Remote Pilot in Command License
✓ Pass the FAA Aeronautical Knowledge and Remote Pilot in Command certificated exam.
✓ Obtain FAA Temporary Airman Certificates.
✓ Receive FAA Airman Certificates (licenses are being processed by FAA).

sUAS/Drone Insurance
✓ Secure sUAS/Drone endorsement for property and liability coverage onto LAP policy.

FAA Part 107 Waiver Request for “Night Operations”
✓ Pass FAA initial screening process for the Part 107 Waiver Request for “Night Operations”.
✓ Received FAA approved Part 107 Waiver Request for “Night Operations” (up to 90 days processing time).

FAA Part 107 Waiver Request for “Operations over Non-Participating Individuals”
✓ Pass FAA initial screening process for the Part 107 Waiver Request for “Operations over Non-Participating Individuals”.
✓ Receive FAA approved Part 107 Waiver Request for “Operations over Non-Participating Individuals” (up to 90 days processing time).
FAA Airspace Authorization Requests for Class C, D, and Surface Areas of Class E Airspace

- Submit a FAA Airspace Authorization Requests for Class C, D, and surface areas of Class E airspace for areas in the immediate vicinity of Vernon (submitted December 2, 2016).
- Pass FAA initial screening process for Airspace Authorization Requests for Class C, D, and surface areas of Class E airspace for areas in the immediate vicinity of Vernon.
- Received FAA approved Airspace Authorization Requests for Class C, D, and surface areas of Class E airspace for areas in the immediate vicinity of Vernon.

Flight Operations and Safety Manual

- Draft a Flight Operations and Safety Manual for the Town of Vernon/Board of Education.
- Approve and implement a Flight Operations and Safety Manual for the Town of Vernon/Board of Education.

# # #
TOWN OF VERNON
UNMANNED AERIAL SYSTEM (UAS) EQUIPPED
WITH HIGH-DEFINITION THERMAL IMAGING
AND STREAMING VIDEO.

Mission Ready
- Drone-based, high-definition, industry-leading thermal imaging and streaming video.
- Highly-integrated, fast, efficient, and rapid deployable aircraft.
- Cover large areas and save images and video for after-action analysis and reporting.
- FAA licensed pilots and insured aircraft.

Applications
- Expanded search and rescue operations day and night
- Firefighting support
- Law enforcement support
- Roof and building inspections
- Energy management
- Enhance trainings and classroom teaching and learning

Vernon Police Emergency UAS Dispatch
(860) 872-9126

For more information:
safety@vernon-ct.gov or (860) 595-2141