FDOT

Florida Department of Transportation

Drone Response Team

STANDARD OPERATIONS GUIDELINES

CONTENTS

ACRONYMS

AP	Autopilot
AGL	Above Ground Level
ATC	Air Traffic Control
FDOT	Florida Department of Transportation
BVLOS	Beyond Visual Line of Sight
C2	Command and Control
CICA	Convention on International Civil Aviation
COA	Certificate of Authorization
CFR	Code of Federal Regulations
COW	Certificate of Waiver
CS	Control Station
CTAF	Common Traffic Advisory Frequency
DoD	US Department of Defense
DROTAM	Drone Notice to Airmen
DRT	Drone Response Team
EM	Electromagnetic
EMI	Electromagnetic Interference
EPRI	Electric Power Research Institute
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FAA	Federal Aviation Administration (US Department of Transportation)
FPV	First-person View
GPS	Global Positioning System
HD	High Definition
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rule
IMU	Inertial Measurement Unit
LAANC	Low Altitude Authorization and Notification Capability
LIDAR	Light Detection and Ranging
LRZ	Launch and Recovery Zone
MAD	Minimum Approach Distance
MOA	Military Operations Area
mph	Miles per hour
MSL	Mean Sea level
NAS	National Airspace System
NM	Nautical mile
NOTAM	Notice to Airmen
NSA	National Security Area
NTIA	National Telecommunications and Information Administration
NUASCP	National Unmanned Aircraft Systems Credentialing Program
NWS	National Weather Service
ORNL	Oak Ridge National Laboratory
PIC	Pilot in Command, Remote Pilot in Command
RPAS	Remotely Piloted Aircraft System
RTB	Return to Base
RTF	Ready-to-fly
SA	Situational Awareness
SAR	Synthetic Aperture Radar
SD	Secure Digital
SOSC	Systems Operations Support Center (FAA)
SUA	Special Use Airspace
sUAS	Small Unmanned Aerial Vehicle
TFR	Temporary Flight Restriction
TIR	Thermal Infrared
TSA	Transportation Security Administration (US Department of Homeland Security)
UA	Unmanned Aircraft
UAS	Unmanned Aerial System
UASRC	Uncrewed Aerial Vehicles Research Center
UAS	Unmanned Aerial Vehicle
VFR	Visual Flight Rule
VHF	Very High Frequency
VLOS	Visual Line of Sight
VMC	Visual Meteorological Condition

1. PHILOSOPHY & MISSION STATEMENT

The following procedures are intended to promote safe, efficient, and lawful operation of any Unmanned Aerial System (UAS) or drone within the Florida Department of Transportation (FDOT). Safety, above all else, is the primary concern in each and every operation, regardless of the nature of the mission. It shall be the mission of those personnel at FDOT, who are trained in the use of UASs, to use this resource to perform aerial data collection safely and effectively while also respecting private property and privacy of the citizens that reside within the respective District's boundaries.

It shall be the intent of every FDOT pilot to make a reasonable effort not to invade a person's reasonable expectation of privacy when operating a UAS. When operating a UAS, FDOT pilots shall abide by all Federal Aviation Administration (FAA) Regulations for flight and receive the proper authorization for flight. This document is supplemental to FAA training and other FDOT training for UAS operations.

2. General Operating Procedures

UAS Operating Rules

- Shall not be operated outside of unauthorized airspace without FAA permission. Authorized airspaces include Class E3, E4, and G. Flight over National Parks and National Forests is prohibited.
- Shall not fly over people outside of the Drone Response Team (DRT) without a waiver from the FAA.
- Shall not fly with less than a three-mile minimum visibility from the control station.
- Shall not be operated (flown) from a moving vehicle unless the area is a sparsely populated area, and it does not involve the transportation of property for compensation or hire.
- Shall not exceed 100 MPH ground speed.
- Must be flown within sight of the pilot and spotters during the entire duration of the flight. This line of vision must be maintained without any device other than corrective lenses.
- Must always yield Right of Way to any manned aircraft.
- Must fly during daylight hours (30 minutes before civil sunrise and 30 minutes after civil sunset).
- Must be equipped with operational anti-collision lights that can be visible for at least three miles for nighttime, twilight, or low-visibility weather condition.
- Must fly no higher than 400 feet Above the Ground Level (AGL) unless the UAS is flying horizontally within 400 feet of a structure. If the UAS is operating within 400 feet of a structure, the UAS may fly up to 400 feet above the identified structure's uppermost limit.
- Must only be operated by authorized personnel.
- Shall not be conducted during rain events, gusting winds, lightning, or in any other weather that could impede safe flight.
- Must be flown at least 500 feet below the cloud deck and must remain 2000 feet horizontal from any cloud at times of operation.
- Must weigh less than 55 lbs, including everything onboard or attached to the aircraft.
- Aircraft attachments shall not include weapons, firearms, explosives, destructive devices, or ammunition. This regulation is in compliance with Florida Statute § 330.411.
- Must follow all FDOT and FAA Rules and Guidelines for UASs.

Flight Boundaries

- Although there may be requests for UAS support in controlled airspace, FAA regulations restrict unauthorized UAS deployment inside restricted airspace.

- At no time shall UAS support be granted inside controlled airspace without first obtaining permission from the FAA and approval from local authorities.
- Maximum altitude shall not be set more than 400 feet, per the FAA regulatory standards. When flight operations are conducted within 400 feet of a structure, UAS may fly up to 400 feet over the uppermost limit of the structure.
- The pilot shall obtain the consent of all persons involved in the mission and ensure that only consenting persons will be allowed within 30 feet of the flight operation, and this radius may be increased based upon an equivalent level of safety determination.
- Flights over National Parks and designated wilderness areas are prohibited.

Personal Protective Equipment (PPE)

- There is no required uniform for FDOT's DRT. However, all members of the DRT should take the necessary measures to deploy in a professional matter. This includes wearing Hi-Visible safety vests and hard hats during necessary operations and when possible. Visibility of the flight team can reduce risk.
- Pilots should wear safety vests that identify themselves as FAA Licensed Commercial Drone Pilots.
- Pilots and spotters shall wear eye protection at all times while the UAS is in flight.
- Pilots and spotters shall take into consideration the current weather conditions when planning to deploy and wear appropriate clothing to deploy comfortably.
- There are no known directives regarding the use of the radio or cellular phones during the deployment of UAS, but the pilot and spotter should always take into consideration the safe operation of UASs when using a radio or another device. The use of the radio or other devices is strictly prohibited by the pilot during the flight and should be managed by the spotter during the flight.

3. PERSONNEL

A UAS coordinator is responsible for the overall direction and performance of the UAS unit, exercising command and control over it. The UAS coordinator shall handle all the communications for the DRT. Any member of DRT can perform as the UAS coordinator; however, the UAS coordinator's responsibilities cannot be transferred to another team member during a mission. Before the flight, the UAS coordinator shall be briefed on essential information for safe and effective operations. Each DRT should be comprised of the following:

- Pilot
- Spotter
- Technician for electrical and mechanical issues
- Technician for communication

Each FDOT District is responsible for selecting appropriate FDOT staff, based on experience and certification, to form a DRT of at least 2-4 members. The flight crew shall have knowledge of the airspace where UAS operations will occur and how that airspace fits into the National Airspace System (NAS). There shall always be a minimum of two flight crew members (pilot and spotter) required for any mission to be flown. This is a mandatory requirement.

UAS Coordinator Responsibilities

- Maintain all training, flight, and maintenance records for each pilot and spotter, as well as individual airframes.
- Maintain contact with the FAA and regulations as they change.
- The UAS coordinator is not required to be a FAA Part 107 Certified Remote Pilot. However, if a UAS coordinator is not certified, duties and responsibilities that require such certification MUST be delegated

to, or overseen by, the most qualified FDOT staff that is certified, usually the remote pilot in command (PIC).

- UAS coordinators shall maintain a file for each pilot and spotter, which shall include copies of training records, flight incidents, etc.
- The UAS coordinator is responsible for coordinating any UAS-related repairs. This includes in-house, with electrical and communications technicians and with outside repair facilities.

Pilot

- To be considered for selection as a pilot, applicants must meet the requirements for and successfully pass an FDOT-administered UAS Flight Check to be accepted into the UAS crew. Pilot needs to be experienced and pass the Flight Check for the particular drone type that is planned to be used during the operations.
- At least one onsite pilot must hold a current FAA Part 107 Remote Pilot Certificate during all flight operations.
- Pilots interacting with Air Traffic Control (ATC) or Terminal Radar Approach Control Facilities (TRACON) shall have sufficient expertise to perform that task readily. Pilots must understand, and comply with, FAA Regulations applicable to the airspace where UASs operate.
- A pilot's primary duty is the safe and effective operation of UASs in accordance with the manufacturers' approved flight manual, FAA regulations, and FDOT policy and procedures. Pilots must remain knowledgeable of all FAA regulations, UAS manufacturer's flight manual and bulletins, and FDOT policy and procedures and exhibit situational awareness at all times.
- Pilots may be temporarily removed from flight status at any time by the UAS coordinator for reasons including performance, proficiency, physical condition, etc. Should this become necessary, the pilot shall be notified verbally and in writing of the reason, further action to be taken, and the expected duration of such removal.
- The pilot shall be the point of contact between the FAA and FDOT.
- The pilot shall stay up to date on FAA regulations as they change, evaluate airframes based on present and future mission needs, stay current on UAS technology, assist with training, etc.

Spotter

Spotters must be provided with sufficient training to communicate clearly to the pilot any turning instructions required to stay clear of conflicting traffic and obstacles. Spotters shall receive training on rules and responsibilities described in 14 CFR 91.111, Operating Near Other Aircraft, 14 CFR 91.13, Right-of-Way Rules, cloud clearance, in-flight visibility, and the pilot controller glossary, including standard ATC phraseology and communication.

- A spotter's primary duty is communication with other crew members and property owners to maintain a safe operational area around the LRZ. The spotter maintains visual contact with the UAS and reports any identified concerns or environment changes (i.e., airplane, UAS, bird of prey, etc.) that may impact the flight.
- The spotter may be asked to operate UAS equipment, including flight controls and cameras, while another crew member takes on the task of spotter. It is suggested that this role change does not take place while the UAS is airborne.

Technician for Electrical and Mechanical Issues

A technician should be responsible and aware of the electrical power and mechanical issues that any UAS can experience during or before operations. The technician needs to be prepared with tools and knowledge to handle the issues and keep the UAS ready for flight.

Technician for Communication

A technician should be responsible and aware of the communication system of the UAS during operations. The technician needs to be prepared with tools and knowledge to handle any communication issues. The technician should know the Starlink system and Wi-fi communication.

Miscellaneous

- Inquiries from the news media must be forwarded to an FDOT public relations officer. Pilots, spotters, and technicians shall follow the established FDOT policy regarding interactions and inquiries from the media.
- Requests for support from third parties shall be responded to by the UAS coordinator.
- Complaints or inquiries regarding UAS operations must be referred to by the UAS coordinator.

4. TRAINING

The key to continued safe operations is by maintaining a professional level of competency. The first step in this process is establishing minimum qualifications for selecting members, and the second step involves training those personnel.

Training Plans

All members have a training plan on file that outlines training objectives for the upcoming year. This training plan shall be held in conjunction with the member's normal training file per FDOT policy. UAS training sessions should be conducted in dedicated training areas, free from non-participants and hazards.

Training scenarios should simulate real world scenarios that UAS crew members are likely to encounter or consist of scenarios that the UAS crew isn't likely to encounter but which should elicit a predictable, trained response (e.g., emergencies, mishap drills, etc.). Any new member who fails to successfully complete the initial training may be denied as a member of the UAS flight crew. The approved training plan shall be developed by the UAS coordinator with respect to the DRT member in training. All deployments or exercises shall be documented and count toward a member's training. It is the DRT member's responsibility to verify their personal training file contains all pertinent information.

Training for Pilot

The pilot needs to be a Part 107 licensed pilot and obtain the FAA Remote Pilot Certification before operating an FDOT UAS in the National Airspace System (NAS). The pilot training must include, but is not limited to, the following topics:

Aircraft components	Aircraft systems
Airspace	Aerodynamics
FAA regulations	Flight operations
Flight basics	Emergency procedures
Mission scenarios	Privacy
Safety	Spotter responsibilities
Weather	

Before a member can act as a pilot-in-command, they must complete at least 5 hours, on the respective model, of flight time to show proficiency in the flight training exercises and the airframe. This must be accomplished to show their ability and knowledge of UASs.

Training for Spotter

Spotters must have completed sufficient training to communicate to the pilot any instructions required to remain clear of conflicting traffic. It will be preferred that spotters will be Part 107 licensed pilots, but it is not mandatory. This training, at a minimum, shall include knowledge of the rules and responsibilities described (in 14 CFR)/Federal Aviation Regulations (FAR):

- FAR 91.3, Responsibility and authority of the Pilot in Command (PIC)
- FAR 91.13, Careless or reckless operation
- FAR 91.17, Alcohol and drugs
- FAR 91.25, Aviation safety reporting program
- FAR 91.103, Preflight actions
- FAR 91.111, Operating Near Other Aircraft
- FAR 91.113, Right-of-Way Rules: Except Water Operations
- FAR 91.155, Basic VFR Weather Minimums
- Knowledge of air traffic and radio communications, including the use of approved ATC/pilot phraseology; and knowledge of appropriate sections of the Aeronautical Information Manual
- In conjunction with fulfilling all training requirements for spotter duties, the new member must also become familiar with UAS operations, the aircraft, and its equipment

Recurrent Training

All members within the unit shall maintain proficiency in their pilot/spotter abilities. Members who do not have any documented training or required 5-hour flight time with UAS of a particular manufacturer or UAS type, within a span of 90 days, must show proficiency before being a pilot/spotter during a deployment or exercise.

- Recurrent training is not limited to actual pilot/spotter skills but includes knowledge of all pertinent UAS/aviation matters.
- Failure to prove proficiency can result in removal from UAS responsibilities.

Scheduling

To maintain a level of proficiency with UAS, pilots are required, as part of their acceptance into the UAS flight crew, to attend training every two months. Training is coordinated through the UAS coordinator and announced in advance for scheduling purposes. At a minimum, training shall consist of a review of preflight checks, take-off and landing procedures, emergency procedures, UAS crew communication protocols, and 15 minutes of actual UAS flight time for every UAS crew member.

Miscellaneous

Depending on the nature of the training request, all efforts are made to accommodate the hours of training so that little impact is made on staffing levels.

- All requests for training shall be approved through the member's chain of command and timekeeping during those training hours are marked by the UAS coordinator in the training logs.
- Members are encouraged to attend and forward information on FAA sponsored safety seminars, industry conferences, UAS online training, etc. It is strongly suggested that DRT members subscribe to e-mails from the FAA, which are meant to keep drone teams engaged and thinking about safety.
- Training shall only be conducted at approved locations and follow the provisions within the approved FAA regulations.

5. EQUIPMENT

Monthly Inspection

- Crack in joints and structural members.
- Check that props are smooth and free of damage/defect (blade, surface, and hub).
- Check that prop adapters are tight/secure.
- Check for loose or damaged screws, ties, fasteners, and straps.
- Check for loose or damaged wiring.
- Check for loose or damaged connections (solder, plugs, etc.).
- Inspect prop mounts and screws and apply slight counter pressure on arms to check for loosened components.
- Inspect and clean the camera lens, ensure it is secured and contacts are firmly attached.
- Ensure that the equipment is free of damage and obstructions – all avoidance lenses should be cleaned prior to each flight and during this inspection.
- Ensure camera settings are correct (still images, video, framerate).
- Ensure voltage or low battery alarms are connected and audible.
- Inspect First-person view (FPV) goggles and verify functionality.
- Check for firmware updates, update if necessary.
- Verify that firmware Airport proximity detection is functioning.
- Ensure motor start and stop control settings are functioning and are properly configured.
- Check to see if the correct model is selected in the controller (if applicable).
- Check that the controller shows the right range and centering for all sticks.
- Check that the software is updated.
- Perform compass/ Global Positioning System (GPS) calibration.
- Perform Inertial Measurement Unit (IMU) calibration.
- Perform range test.
- Verify that altitude and range telemetry are accurate.

If any of the above inspections indicate damage or a malfunction, the UAS should be red-flagged and taken out of service. The damage/defect should be documented and reported to the UAS coordinator for repairs.

If the drone has not been flown in over 30 days at the time of the monthly inspection, additional checks are required. These inspections may require the UAS to be energized and airborne. They include:

- Test RTH (Return To Home).
- Ensure batteries can be fully charged, properly seated, and secured.
- Ensure that the obstacle avoidance system is functioning and free of damage/obstructions.

Battery

Equipment Storage and Battery Handling

Lithium-ion (Li-ion) batteries are common in UASs. A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated variously as LiPo, LIP, Li-poly, and others), is a rechargeable battery of lithium-ion technology in a pouch format. The difference between a lithium battery and a Li-ion battery is that most Li-ion batteries are rechargeable. Li-ion batteries can be dangerous under some conditions and can pose a safety hazard because they, unlike other rechargeable batteries, contain a flammable electrolyte and are kept pressurized. Even when fires have not resulted from Li-ion battery use, Li-ion batteries have been known to show signs of battery fatigue, including overheating, and bloating of the battery cells. Misused or faulty batteries can lead to an inconsistent power supply to the system. The aircraft may also experience erratic flight, loss of control authority,

or premature landing due to improper amperage or low voltage spikes. A battery log will enable the pilot to keep track of battery parameters like voltage before and after the mission. All batteries should be maintained by following the guidelines in the UAS pilot's manual.

- On the day before a planned mission or training exercise, charge all the available batteries.
- At the end of the flight day, check the charge levels of the batteries. If the charge level of any battery is over approximately 50% charged, utilize the aircraft to discharge to that approximate level. Do not leave the batteries in an over-discharged state.
- Store the LiPo batteries at room temperature, in a dry and ventilated area, and away from flammable materials. Do not store the battery or aircraft in a hot garage, car, or direct sunlight. If stored in a hot garage or car the battery can be damaged or even catch fire.
- A fire extinguisher shall be kept close to the charging area. While the fire extinguisher may not put out the LiPo batter fire, it can prevent the fire from spreading until additional assistance arrives.
- When charging, transporting, or temporarily storing the LiPo battery the temperature range should be from approximately 40–100° F (5–38° C).
- Current-generation cells typically can be fully charged in 45 min or less. If overheated or overcharged, Li-ion batteries may suffer what is known as "thermal runaway," and cell rupture, and as mentioned previously, in extreme cases combustion can occur. Therefore, batteries should not be left unattended when charging. After flight operations are complete, batteries should be allowed to cool for about 20 min before being connected to a charging station.
- Never charge the LiPo battery unattended at any time. When charging the battery, you must always remain in constant observation to monitor the charging.
- Always inspect the battery, charger, and power supply before charging.
- If at any time the LiPo battery begins to balloon or swell, discontinue charging immediately. Quickly and safely disconnect the battery, then place it in a safe, open area away from flammable materials to observe it for at least 15 minutes. After 15 minutes, or when the battery is deemed safe to recycle, it should be placed in a plastic bag and recycled to a site that is acknowledged by the United States Environmental Protection Agency. Current locations can be found on Earth911 and Call2Recycle.
- Continuing to charge a battery that has begun to balloon, or swell can result in a fire. A battery that has ballooned or swollen even a small amount must be removed from service completely.
- Lock the batteries and aircraft in a cabinet when not in use or being prepped for flight.

Safe Battery Transportation

Most people are unaware that Li-ion batteries are dangerous goods that can pose a safety risk. Concerns are so great that there are in fact regulations for their safe transport, and the International Civil Aviation Organization (ICAO) Council Air Navigation Commission has even taken the extreme step of prohibiting Li-ion batteries as cargo on passenger aircraft. However, for the purposes of field use, Li-ion batteries can be transported in stainless steel or plastic battery boxes capable of containing any free liquid. The battery holder should be securely fastened, and the battery protected in such a manner as to prevent damage and short circuits. If possible, tape over the battery terminals and cables before transport.

Safe Battery Use, Storage, and Disposal

When dealing with any power storage device, safety is key. First, one needs to reduce the probability of an unsafe event, and second, take steps to reduce the severity of the event, should one occur. Keep new batteries in their original battery packaging until ready for use.

- Keep original battery packaging to use for expended batteries. Safety devices are incorporated into the battery cell modules and battery packs to protect against abnormal conditions. These safety devices are

used to manage both heat and gas generation, which are consequences of battery use. The remote PIC should land as soon as possible if a low battery is detected during flight operations.

- To reduce the risks associated with Li-ion batteries, battery packs should contain fail-safe circuitry that disconnects the battery when its voltage is outside the safe range of 3–4.2 V per cell. When stored for long periods of time, the small current drawn of the protection circuitry may drain the battery below its shut-off voltage; normal chargers may then be useless.
- Typically, the safety devices work well, and battery leaks and explosions are rare, but if you suspect that you have a malfunctioning battery, exercise caution. Do not connect it to a power source. If the battery is swollen, it should be assumed to be in a dangerous state resulting from built-up gasses. Handle the battery with care as it could catch fire or explode. Try to carefully remove it from the device housing. If you are able to do so, place it in a safe, cool container. Do not place it in a hot location such as a vehicle until the vehicle is cooled. Then dispose of the battery at an authorized commercial or government battery disposal facility. If you are unable to remove the battery, seek assistance from the manufacturer or an electronics store. At the end of the flight day, check the charge levels of the batteries. If the charge level of any battery is over approximately 50% charged, utilize the aircraft to discharge to that approximate level. If appreciably lower than 50%, charge the batteries to ~50%. Do not leave the batteries in an over discharged state.
- Do not store the battery or aircraft in a hot garage, car, or direct sunlight. If stored in a hot garage or car as the battery can be damaged or even catch fire.
- Replace the battery if it becomes exhausted or damaged. At the end of serviceable life, batteries should be disposed of at an authorized commercial or government collection facility.
- To avoid malfunctioning batteries
  - Use the appropriate power charger.
  - Do not leave the device plugged in to a power source all the time.
- Keep the device (or battery) stored in a cool, dry environment.

6. PROTECTION OF RIGHTS AND PRIVACY

UAS pilots and spotters ensure the protection of private individuals' Fourth Amendment Rights, civil rights, and reasonable expectations of privacy before deploying UASs. UAS pilots and spotters responsible for ensuring that UAS operations minimally intrude private property, persons, and businesses. UAS operations must be in compliance with Florida Statute § 934.50, Freedom from Unwarranted Surveillance Act.

To accomplish this primary goal, FDOT observes the following privacy concerns:

- FDOT UASs will record video and still pictures (no audio) of features on the ground that relate to public property and state-owned assets. Any data captured outside the focus of flight operations is unintentional or only as necessary due to the proximity to public property or state-owned assets.
- When UASs are operating, the onboard cameras are turned to face away from occupied structures, etc. as much as practicable to minimize inadvertent video or still images of uninvolved persons or property.
- Delete personal data, upon request of members of the public (if possible).
- FDOT operations do not authorize random surveillance activities. The use of UASs is tightly controlled, regulated, and are not intended to document the activity of civilians.
- Hovering over private property shall occur only as necessary, to accomplish the goal of an individual flight operation. Flight over private property shall be conducted a minimum of 30 feet away in any direction from any structures or people, and wherever practical well above the roofline of any privately owned structures.

- Whenever possible, the UAS crew should divert sensors from occupied structures and uninvolved persons to minimize inadvertent, unapproved data collection.
- If a location is planned to be flown frequently for monitoring purposes (e.g., construction or hazard monitoring), owners of adjacent private property shall be notified in writing of the stated purpose of the flights, frequency, altitude, hours of operation, start/stop dates, where/how to address complaints/concerns, and FDOT privacy policy for UAS operations.
- All data gathered will be reviewed for any inadvertent intrusion to privacy. If found, reasonable efforts will be made to ensure that such information will be permanently masked or obscured within the data files prior to the release of photos or video internally within FDOT, other State agencies, or to the public. There is no intention of the FDOT to supply or release data to any law enforcement agency, unless specifically ordered to do so by a legal and valid court order.
- Ad hoc unplanned operations should never be conducted except for emergency
- response to disasters as authorized by the State or the District Secretary; if used, the application of UAS emergency response work shall be tightly controlled and regulated.
- FDOT shall operate UASs strictly within the Federal and State laws and regulations. If in doubt, FDOT personnel shall ensure that authorization is approved prior to the deployment of a UAS. FDOT should balance all operations with the desire to successfully perform the mission while respecting public privacy and freedom from intrusion.
- Any UAS flights open to misinterpretation by the public should be avoided. Examples of flights that could be considered controversial include operations of routine nature for which commercial, public transportation, or ground based data gathering could be more economically substituted, or operations coinciding with major sports events or civic celebrations within the operating area.

Public Notification

Landowners and associated parties are provided reasonable accommodations when necessitated by the specifics of the of ongoing and repeated UAS flight operations through adequate prior notification, which may include the following:

- For all pre-scheduled UAS operations being conducted in an area, provide a written notice addressing specifics, including intended takeoff and landing zones, at least 20 working days before the flight(s). For emergency operations (hurricane response, etc.), this requirement can be waived.
- For all UAS flights being conducted near airports or other airborne operating areas, never fly within 5 miles of an airport without contacting airport authorities and the airport's traffic control facility. The airport Advisory Area is an area of 5 miles encircling an airport. If UAS flight operations are expected to occur in this airspace, the airport authorities must be contacted through LAANC service suppliers before flight operations. Other airborne operating areas may include hospitals and other facilities with helicopter pads.

7. SAFETY

Safety Policy

- FDOT is committed to having a safe and healthy workplace, including:
  - The ongoing pursuit of an accident-free workplace, including no harm to people, no damage to equipment, the environment and property
  - A culture of open reporting of all safety hazards in which management will not initiate disciplinary action against any personnel who, in good faith, disclose a hazard or safety occurrence due to unintentional conduct
  - Support for safety training and awareness programs

  - Conducting regular audits of safety policies, procedures, and practices
  - Monitoring the UAS community to ensure best safety practices are incorporated into the organization
- It is the duty of every member within the UAS flight crew to contribute to the goal of continued safe operations. This contribution comes in many forms and includes always operating in the safest manner practicable and never taking unnecessary risks. Any safety hazard, whether procedural, operational, or maintenance related must be identified as soon as possible after, if not before, an incident occurs. Any suggestions in the interest of safety should be made to the UAS coordinator.
- If any member observes or has knowledge of an unsafe or dangerous act committed by another member, the UAS coordinator is to be notified immediately so that corrective action may be taken.
- The person manipulating the flight controls cannot operate a UAS and drive a moving vehicle in a safe manner and remain in compliance with FAA Part 107.
- Occurrences are unplanned safety related events, including accidents and incidents that could impact safety. A hazard is something that has the potential to cause harm. The systematic identification and control of all major hazards is foundational to safety.
- The Operational Hazard and Occurrence Report (OHOR) provides a mechanism to report hazards and occurrences, real and perceived, to those responsible for UAS operations.
- There is no specific format for the OHOR as the information provided is what is important, not the format and should be used without hesitation to report any anticipated, current, or experienced safety hazard, or occurrence. Further, the OHOR can be submitted anonymously, and to whatever level in the chain of command, to get the matter proper attention, without fear of reprisal.
- Written memorandums fully explaining the problem will be given to the UAS coordinator for investigation.
- Every hazard and/or occurrence is investigated, with the results and corrective action taken communicated to all members. The investigation will be conducted by the UAS coordinator or designee. The services of an independent subject matter expert may be necessary in some cases to ensure a thorough and complete investigation.
- Hazards requiring immediate attention will be brought to the attention of the UAS coordinator, verbally, without delay.
- All members are authorized to take action to correct a hazard if in that member's opinion delay will result in accident or injury. The UAS coordinator shall be notified immediately in such situations.

General Safety Requirements and Warnings

- Keep your hands, face, and other parts of your body away from the spinning propellers/rotor blades and other moving parts at all times. Keep items that could impact or become entangled away from the propellers/rotor blades including debris, parts, tools, loose clothing, etc.
- Always operate your aircraft in open areas that are free from people, vehicles, and other obstructions. Never fly near or above crowds, airports, or buildings.
- To ensure proper operation and safe flight performance, never attempt to operate your aircraft nearby buildings or other obstructions that do not offer a clear view of the sky and can restrict GPS reception.
- Do not attempt to operate your aircraft in areas with potential magnetic and/or radio interference including areas nearby broadcast towers, power transmission stations, high voltage power lines, electrical storms, etc.
- Always keep a safe distance in all directions around your aircraft to avoid collisions and/or injury. This aircraft is controlled by a radio signal subject to interference from many sources outside your control. Interference can cause momentary loss of control.
- To ensure proper and safe operation of the automatic landing function in Home Mode you must start the motors with the aircraft in a position that has at least 10 feet (approximately 3 meters) of clear and open space around it and achieve a proper GPS lock.

- Do not attempt to operate your aircraft with any worn and/or damaged components, parts, etc. (including, but not limited to, damaged propellers/rotor blades, old batteries, etc.).
- Never operate your aircraft in poor or severe weather conditions including heavy winds, precipitation, lightning, etc.
- Always operate your aircraft starting with a fully charged battery. Always land as soon as possible when the UAS battery reaches 20%.
- Always operate your aircraft when the voltage of the battery in the controller/personal ground station is in a safe range (as indicated by the battery charge status icon on the screen of the controller/personal ground station).
- Always keep the aircraft in clear line of sight and under control and keep the controller/personal ground station powered on while the aircraft is powered on.
- Always move the throttle control stick down fully and turn off the motors in the event the propellers/rotor blades encounter any objects.
- Always allow components and parts to cool after use before touching them and flying again.
- Always remove batteries after use and store/transport them per the corresponding guidelines.
- Avoid water exposure to all electronic components, parts, etc. not specifically designed and protected for use in water. Moisture causes damage to electronic components and parts.

Cybersecurity

FDOT UASs use will comply with F.A.C. Rule 60GG-2.0075 to maintain security requirements. This means, FDOT UAS operations shall be conducted with a drone from approved manufacturers.

Medical Factors

- Pilot and Spotters shall only deploy UASs when rested and emotionally prepared for the tasks at hand.
- Physical illness, exhaustion, emotional problems, etc., seriously impair judgment, memory, and alertness. The safest rule is not to act as a pilot or spotter when suffering from any of the above. Members are expected to "stand down" when these problems can affect their ability to perform flight duties.
- A self-assessment of physical condition shall be made by all members during pre-flight activities. Performance can be seriously hindered by prescription and over-the-counter drugs. The UAS coordinator must be aware of any drugs that are being taken by the flight crew. If it is determined that the medication being taken could hamper a pilot or spotter, that member shall be prohibited from the deployment or exercise.
- No member shall act as a pilot or spotter within eight hours after consumption of any alcoholic beverage, while under the influence of alcohol, or while having an alcohol concentration above 0.04. This regulation is in compliance with Florida Statute § 860.13 Operation of aircraft while intoxicated or in careless or reckless manner penalty.

Safety Equipment

- UAS flight crew personnel shall be required to wear minimal PPE during flight operations. This equipment should be designated by the FDOT District based on flight type and mission. Protective eyewear is required. Other required PPE can include class II safety vests and hard hats. Certain missions will require the use of work/hiking boots and cut resistant gloves.
- Other safety equipment for the flight crews: two-way radios (required), First Aid kit (required), fire extinguisher (desired for infield operations, required where batteries are being charged and stored).

Airframe and Control Station Safety

The main hazards for flight operations are inadequate pre-flight preparation/planning and improper operation of flight controls. Even if the UAS manufacturer has a written pre-flight inspection procedure, it is recommended that the remote pilot ensure that the following inspection items are incorporated into the pre-flight inspection procedure required by FAA Part 107 to help determine that the UAS is in a condition for safe operation overall airworthiness. The DRT shall follow the preflight checklists and inspections to mitigate hazards and ensure safe FDOT flight operations.

If required by the flight path, walk through, and verify any noted obstructions that may interfere with UASs. At a controlled low altitude, fly within range of any interference and recheck all controls and stability. If available, whenever a UAS is started, personnel should be on hand with adequate fire extinguishing equipment. Note: These operating limitations are intended, among other things, to support the remote PIC's ability to identify hazardous conditions relating to encroaching aircraft or persons on the ground and to take the appropriate actions to maintain safety. Additionally, no emergency parachute use is permitted [parachute use could be a hazard for some industries (e.g., electric)].

8. FLIGHT OPERATIONS

Call-out Procedure

1. The UAS coordinator shall screen all initial requests to use a UAS.
2. The UAS coordinator shall then contact the pilot to request the deployment of the UAS.
3. The UAS coordinator shall also contact the UAS flight crew who will screen the request using the following factors:
    a. Is the proposed airspace authorized by the FAA? FAA's Visualize It, B4UFly, and AirMap are applications that can be used to check airspace. If the airspace requires authorization beyond LAANC, this can impact the flight schedule. It is important that airspace authorization is requested with respect to the operation's schedule and should be done in advance.
    b. Is the proposed use of the UAS within the capabilities of UAS equipment and personnel to perform?
    c. Does the proposed use of UASs fall within the FAA and department policies and regulations for UAS usage?
    d. Can the UAS be deployed safely given current weather conditions?
    e. Are sufficiently trained and qualified personnel available to safely operate UAS?
4. The UAS coordinator will either accept or decline the request for UAS support. If the request is denied, the UAS coordinator will provide a reason for declining the support request and will provide the requestor this information along with the reason for declining. If the UAS coordinator accepts the support request, they will contact a UAS pilot and spotter, who will be provided with all available mission information.
5. A UAS pilot is responsible for transporting UASs and all required equipment to the scene. Upon arriving at the requested location, UAS pilots will make an on-scene determination of the ability of the UAS to perform the requested mission safely and within FDOT and FAA policies and procedures.
6. The UAS pilot shall contact the UAS coordinator to check in and receive a briefing on the mission requested. If the UAS pilot determines that the use of UASs would violate FDOT policy or directives, they shall inform the UAS coordinator of the potential conflict along with recommendations for modifying the requested mission to conform to FDOT policies and procedures. As soon as possible after the completion of the mission, the UAS pilot will make a full report of the circumstances and their concern through the UAS coordinator.
7. The PIC shall have the final say in all decisions regarding the flight mission. UAS pilots will have sole discretion for declaring safety or violation of FAA rules. If the UAS pilot determines that a requested

mission would violate FAA rules or endanger a person or property, then the pilot will immediately inform the UAS coordinator of the reasons for refusing to operate the UAS. UASs shall not be flown in this circumstance for any reason.

8. If the UAS pilot determines that the requested mission will potentially damage UAS, or its associated equipment, the pilot will inform the UAS coordinator of their concerns. This precaution is mean to avoid erratic and uncontrolled flight. Pilots are required to fully document and send a report to the UAS coordinator.

Mission Planning Considerations

- Can this mission be conducted in compliance with FAA Part 107?
- Can this mission be successfully completed with the available UAS?
- All actions and contingencies for the mission are planned.
- Contingency planning should include safe routes in the event of a system failure, degraded performance, or lost communication link, if such a failsafe exists.
- Prepare as much as possible in the office by reviewing Google Earth, Visualize It, SkyVector, and aviation weather reporting websites.
- Review the flight location with B4UFly or AirMap applications/websites to determine proximity to airports and heliports.
- Prepare for automated mapping missions with a completed preliminary flight plan.
- Determine if a camera pilot is needed.
- Determine how many spotters are needed for safe and efficient operations, at minimum there must be one.
- Verify that appropriate staffing can be allocated to the mission.
- Mission plans and flight plans should be shared with the entire mission flight crew and other pilots in the vicinity.
- If flying in controlled airspace, do you have a proper airspace authorization or wavier? Authorizations and waivers should be physically present on site of operations in the form of a printed hard copy.
- If the mission will have UAS flying over people or moving vehicles, obtain a FAA Waiver, or notify the UAS Coordinator the mission cannot be conducted.
- Verify that any applicable FAA approved waivers and authorizations are current and carried with the UAS.
- Notify any bystanders or nearby property owners of your intentions (permission).
- Discuss flight plan between the pilot, camera pilot, spotter/s, electrical and communication technicians.
- Can you reach authorities in the case of an emergency?
- Do you need to maintain communication? Ensure flight crew has the necessary number of radios and that there is a communications plan for channels, etc. If spotters are deployed, a spotter should remain with the pilot for communications, as a pilot must remain focused on flying.
- A mission planning profile is outlined in Appendix 3 and shall be used to outline missions.

Weather

- Before each deployment the pilot/spotter shall ensure that he/she gathers enough information to become familiar with the weather situation existing throughout the area of deployment. The pilot shall utilize FAA-approved weather resources to obtain the latest and most current weather conditions. Windy is a common desktop resource for desktop planning and allows for a 10-day weather forecast to be seen. UAS Forecase, AeroWeather, Windy, MyRadar Pro, Weather Radar (NOAA Hi-Def Radar), and Storm Radar (The Weather Channel) can be used in the field to monitor weather conditions.
- If deemed necessary, an anemometer should be utilized to better estimate the wind speed and determine if it is within the capabilities of the airframe being flown. The anemometer will provide ground-level

windspeed, which is often less than windspeed at flight levels. UAS Forecast is an application that can supplement anemometer use and provides estimated windspeeds at varying altitudes. If these altitudes are acceptable, the UAS can ascend slowly while monitoring for additional concerns. It is important to note that missions around tall buildings, or other structures, can cause winds to increase and become turbulent with proximity to these structures.

- Pilots/spotters should use the Beaufort Scale, shown in Appendix 1, when making deployment decisions regarding wind conditions. No flight is allowed when the wind exceeds 18 MPH, the ceiling of level four (4) on the Beaufort Scale.
- The weather conditions reported for the operation shall be recorded in the pre-flight checklist.
- The pilot shall ensure that the flight will occur within FAA VFR weather requirements.

Area & Environment (For site evaluations prior to mission)

Prior to the mission, the designated site should be evaluated. The area and environment should be monitored for:

- Hazards/site selection
- Wires and cables
- Animals
- Bystanders
- Property in the vicinity
- Air traffic in the vicinity
- Distance from nonessential participants
- Ability to maintain adequate buffer zones between aircraft and personnel
- Minimal departure and landing zones overpopulated areas
- Local topography, always ensuring a visible line of sight towards UAS
- Unobstructed telemetry connection
- Potential alternative landing sites in case take-off site is obstructed
- Psychological/physiological conditions (are you well rested, rushed, “get there-itis,” are you being pressured by client, at least 8 hours ‘bottle to throttle’?)
- Weather considerations: temperature, visibility, precipitation, wind speed, upper winds/at altitude, clouds and cloud deck
- Rotor obstacle clearance
- First Aid Kit stocked, readily accessible and visible to anyone in the area
- Fire extinguisher

Aircraft Inspections

- Pilots/Spotters are both responsible for a thorough preflight inspection of each UAS.
- Before and after each deployment (whether a mission or training), the pilot and spotter shall conduct a thorough inspection of the UAS in accordance with the instructions contained in the manufactures user's manual. FDOT Districts shall have manufacturer guidelines present during UAS inspections.
- On the day before each deployment, any DRT member will make sure that the software is updated.
- Any issues found that will put in jeopardy the safe operation of the UAS shall be documented and resolved immediately prior to flight.
- It has been recognized that the use of a checklist is a significant method to combat UAS accidents. A pre-flight checklist is contained with each UAS Base Station and is utilized prior to each flight.
- Any physical equipment that cannot be resolved onsite and which has an impact on safety or the mission will override the deployment. All issues will be resolved before the flight.

- Significant concerns regarding safety or maintenance issues should be noted in the log and also reported in detail to the UAS Coordinator.

Pre-Flight Brief/ Run-up

Before the FDOT flight operations checklist begins, prior to flight, the following items shall be completed:

- Preflight documentation shall be checked and includes:
  - Verify that any applicable FAA approved waiver is current, and a copy is onsite.
  - Verify FAA Remote Pilot Certification is current and onsite.
  - Verify registration markings (for proper display and legibility).
- Verify all controller, onboard aircraft and camera batteries are fully charged; (confirm charges).
- UAS is in a level location safe for takeoff.
- For automated mapping missions: review preliminary flight plan with crew (modify, if necessary, based on field conditions).
- Radio check of all flight crew.
- Spotters are positioned as necessary.

In-Flight

- Basics: If flying manually, always keep your fingers on the controller/controller.
- Never let the UAS out of the sight of the flight crew even for a second.
- If handing off spotter responsibilities to another person, utilize a call/response to verify that eyes are on the aircraft before looking anywhere else. This shall not take place during flight, unless of an emergency.
- Fly the UAS in the direction that the obstacle avoidance system is facing.
- Climb to a safe altitude away from potential hazards and reduce noise pollution.
- Keep aircraft at a safe operating distance from people, electric utility lines, and buildings.
- Only fly over people with a current FAA-approved waiver that is valid for the mission.
- If the UAS must be flown over buildings or people, use a lightweight UAS and maintain a safe altitude for recovery and make every effort to minimize risk.
- Fly above the roof line of structures on private property whenever possible. Extra precaution should be taken flying at low altitudes. Buildings, utilities, trees, people, etc. should be monitored.
- The use of a spotter is required during in-flight operations and the spotter is required to view the aircraft by unobstructed First Person View (FPV).
- Do not fly UASs within the distance defined by local laws of any private/commercial airport/helipad.
- Do not fly around a pre-existing UAS flying site without a frequency-management agreement.
- Do not interfere with operations and traffic patterns at any airport.
- Return and land the UAS with 20% or more battery charge.
- Landing: Regardless of whether a manual or automated UAS landing, scan the landing area for potential obstruction hazards. Spotter's assistance is recommended.
- Announce out loud "Preparing to Land".
- Carefully land the aircraft away from obstructions and people. It is preferred that UASs land on an anchored landing pad to prevent debris from blowing into motors, damage to props from vegetation, etc.

Post-Flight (Reporting Requirements)

- Prepare a written report of any observed damage to forward to the UAS coordinator.
- Prepare a written report of any significant incident of note (e.g., UAS crash, public concerns/complaints, safety concerns), etc., to forward to the UAS coordinator.

- Accidents must be reported to the FAA within 10 days of the operation if there is a serious injury to any person, loss of consciousness, or damage to any property that costs over $500 to repair or replace.

Data Handling Process

- Back at the office, download the data (still pictures and video) from the UAS to the Department server and access the data for further processing.
- Do not release any data (images, video, mosaics) until a privacy review is complete and privacy concerns (if noted) are addressed.
- Review the data for any inadvertent/potential intrusions into the privacy of the public.
    - If the mission data product is a photomosaic and associated map, process the raw images into the mosaic and then permanently obscure any inadvertent or potential privacy concerns that are noted before forwarding the mosaic internally or externally.
    - If the mission data product is still images, permanently obscure any inadvertent or potential privacy concerns that are noted or discard/delete such images before forwarding photos internally or externally.
    - If the mission data product is video, review the footage and edit out or obscure any inadvertent or potential privacy concerns prior to forwarding internally or externally.
- Retain mission video (low resolution) on a local hard drive of the data processing computer to verify the positioning of the camera if any privacy concerns are raised by the public.

Documentation

- Inspection and weather shall be documented prior to flight within the logbook. Flight log components are listed in Section 9, Checklists.
- After each flight, the pilot shall complete a statement documenting UAS operations.
- After each mission, After Action Review (AAR) needs to be completed by the DRT to document success, hurdles, what could be done better, lessons learned, and future recommendations.

Maintenance

- Although there are a few parts of UASs that need servicing, it is necessary that the manufacturer's maintenance schedule is followed and properly documented.
- Any issues that arise during maintenance that cannot be resolved by routine methods shall be forwarded to the manufacturer or a certified repair facility for further technical support by the UAS coordinator.

Other

Pilots and spotters shall ensure that no items are attached to UASs that are not required for safe operations and to complete the mission goal, before flight.

9. CHECKLISTS

Pilots shall utilize pre-flight, flight, and post-flight checklists to ensure the highest level of safety for deployment. Prior to the flight, the flight log shall be initiated. Operational checklists are included in the sub-sections below.

Florida Department of Transportation

UAV Flight Operations Callout Checklist

Aircraft: Skydio 2+

Preflight Brief Checklist

- Preflight brief – COMPLETE
- Personal mobile devices – DISABLE WIFI

"Preflight checklist" – ANNOUNCE

- Flight log – BEGIN
- Crew roles – IDENTIFY
- PPE – CHECK
- Emergency procedures – IDENTIFY
- Airspace – VERIFY
- Environment – VERIFY
- Bystander setback – DEFINE
- Documentation – CHECK

Drone Preflight Checklist

- SD card – INSERTED, HAS CAPACITY
- Drone and battery in case- REMOVE
- Flight battery – CHECK
- Flight battery – INSERT
- Propellors/Airframe – SECURE AND CORRECT

"Power" – ANNOUNCE

- Flight battery – ON
- IMU status – CHECK/CALIBRATE
- Compass – CALIBRATE
- GPS – VERIFY/CALIBRATE
- Lights – CHECK
- Cameras and Gimbal – CHECK
- Battery status – CHECK
- Navigation, communication data links, and antennas – CHECK
- Flight surface – IDENTIFY AND PLACE

Controller Preflight Checklist

- Controller in case – REMOVE AND POWER ON
- Arm – OPEN
- Lights – ON
- Tablet adapter – ATTACH (if applicable)
- Software Update – VERIFY
- Battery – CHECK
- Antenna – POINTED AT SKYDIO 2+
- Skydio 2/2+ and controller – VERIFY BLUETOOTH CONNECTION
- USB-C cable to controller and aircraft – CONNECT, if not already paired
- "Preflight complete" – ANNOUNCE

Pairing Checklist

- Skydio 2/2+ and controller – VERIFY BLUETOOTH CONNECTION
- USB-C cable to controller and aircraft – CONNECT, if not already paired

"Preflight complete" – ANNOUNCE

Launching Checklist

"Launching checklist" – ANNOUNCE

- Return behavior – VERIFY
- Environment, crew, and observers – CLEAR OF UAS
- Launching and departure airspace – CLEAR
- Display panel function – CHECK
- Camera settings – CHECK
- Final systems check – FLIGHT TERMINATION SYSTEM, BATTERY, PAYLOAD DOWNLINK, OBSTACLE AVOIDANCE
- Recording – BEGIN

"Launching" – ANNOUNCE

- Flight timer – START
- Launch button in app/controller – PRESS AND HOLD
- Hover – ESTABLISH
- Flight controls – CHECK

Landing Checklist

- Landing area – CLEAR
- Landing altitude (15 ft) – APPROACH
- "Approach" – ANNOUNCE
- Land button in app/controller – PRESS AND HOLD
- Land – EXECUTE
- Motors – STOP
- Flight timer – STOP
- "Power off" – ANNOUNCE
- Flight battery – OFF
- Throttle – Neutral

FLIGHT LOGS

All flight logs should include the following information:

- PIC Name (Pilot in Command)
- Spotter(s)
- Who was at the flight controls if not the PIC (denoted by a 'P' after their name)
- Month
- Date
- Time of day
- Mission (client name or Division/Group)
- Airframe (model, tag number)
- Location
- Weather
- Windspeed
- '#' number of batteries (e.g., 4 batteries flown)
- Mission or training type
- Flight duration
- Altitude
- Notes

REFERENCES

1. American Civil Liberties Union (ACLU) “Protecting Privacy from Aerial Surveillance (recommendations for Government Use of Drone Aircraft) December 2011”,
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3. Oak Ridge National Laboratory “Best Practices for the Use of Unmanned Aerial Systems” dated February 2017”,
4. FAA; “Remote Pilot – Small Unmanned Aircraft Systems Study Guide” FAA-G-8082-22 dated August 2016.
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6. Recreational Pilot, and Private Pilot “ FAA-CT-8080-2G dated 2016
7. FAA: 14 CFR Parts 21, 43, 61, et al. Operation and Certification of Small Unmanned Aircraft Systems; Final Rule dated January 28, 2016
8. Ruppert Law P.A.: “Part 107 Study Guide” December 2016
9. Department of the Interior: DOI Operational Procedures Memorandum (OPM) – 11 dated December 31, 2015
10. University of California: UAS Operations Manual dated November 01, 2015
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12. Caltrans Division of Research, Innovation and System Information: “The Use of Unmanned Aerial Systems for Steep Terrain Investigations” dated August14, 2014
13. ResearchGate; Handbook of Unmanned Aerial Vehicles, Clothier, Reece A. and Walker, Rodney A.: “The Safety Risk Management of Unmanned Aircraft Systems” dated January 2014
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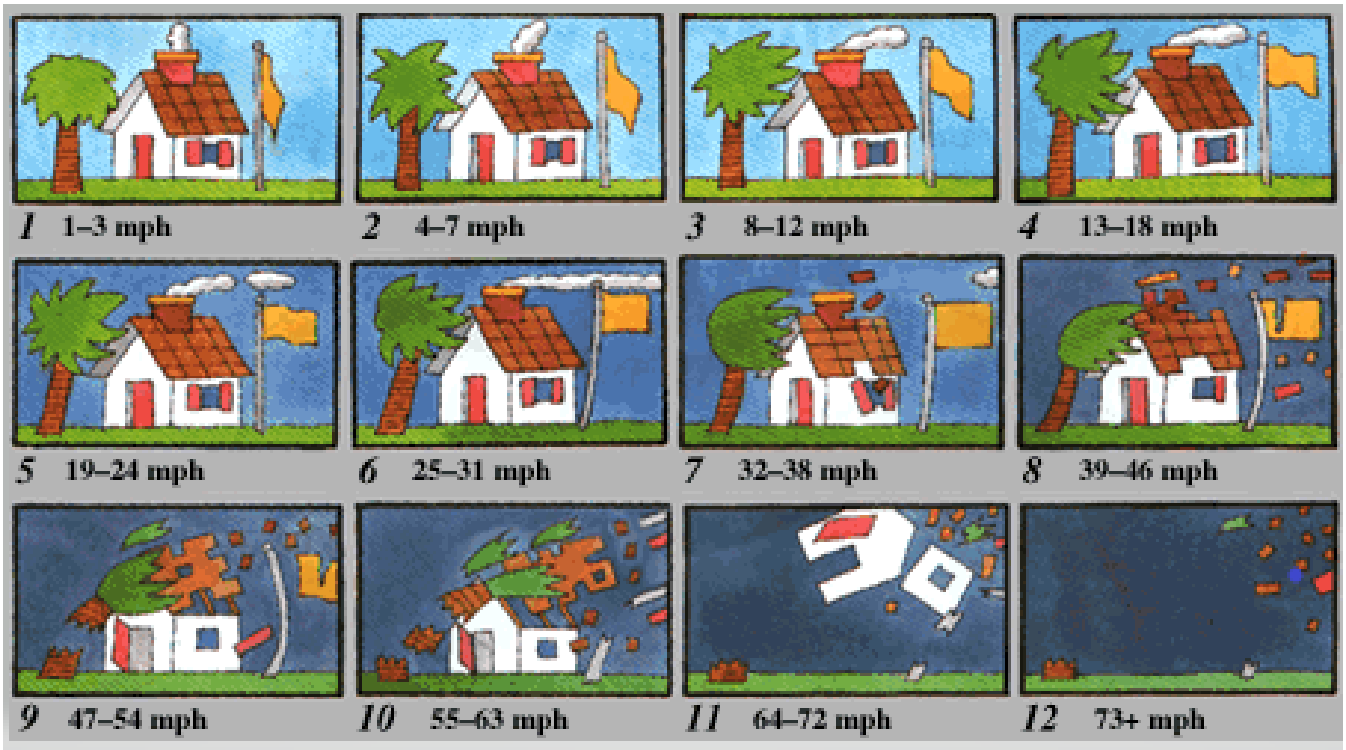
APPENDIX 1: BEAUFORT SCALE



APPENDIX 2: CONTINGENCY PLAN CHECKLIST

Event	Result	Procedure
Battery Depletes	Unmanned Aerial System (UAS) incapable of continuing flight operations	UAS return to base (RTB) as soon as practical; cease data collection
Ditch Procedures	UAS incapable of continuing flight operations	Identify safe landing area; attempt a controlled landing; if able, land UAS in water (shallow preferred for ease of recovery) away from public
Hazardous Weather	UAS incapable of continuing flight operations	UAS RTB as soon as practical; cease data collection
Hostile Environment	Mission impacted by hazard (e.g. air traffic, public activity)	See and avoid; take evasive action as required with safety taking precedence; UAS RTB as soon as practical
Loss of Communications	Mission impacted by lack of communications hazard	Maintain visual line of sight (VLOS); take evasive action as required with safety taking precedence; UAS RTB as soon as practical
Loss Line of Sight	UAS could become hazard if unable to regain visual control	Regain direct visual of UAS; contact spotter and/or technician to determine status
Loss of GPS Signal	Use extreme caution as the positional data for UAS will not be accurate	Assume manual control of 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
Loss of Situational Awareness (SA)	UAS could become hazard if unable to regain SA	Climb to a safe altitude; reorient with the use of sensors; RTB as required.
Privacy Impact	Possible public complaint	Cease data collection; after RTB, complete an assessment
UAS Failure	UAS incapable of continuing flight operations	Maintain VLOS; UAS RTB as soon as practical

APPENDIX 3: MISSION PLANNING PROFILE

Mission Profile	Location *(Name, Latitude, Longitude)*		Date:		ETD:		ETA:
			Crew Assigned:				
	Daylight Hours:						
			Waypoint	Transit (T) or Hover (H)	Altitude AGL (ft)	Estimated Leg Duration (mm : ss)	Activity
Total Flight Time (TFT)							
Statutory Reserve (SR) (TFT x0.20)[a]							
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% battery remaining.

APPENDIX 4: EMERGENCY CONTACT LIST

Organizational Point of Contact	Contact Numbers *(For training purposes only)*
National grid operations center	
Local electric utility distribution network office	
Service provider local field services office	
County road supervisor	
County sheriff dispatch office	
County fire department	
Closest medical facility	
Internet/phone providers	
Site manager	
Remote pilot in command	
Spotter	
Mission payload pilot	
Subject matter expert	

APPENDIX 5: DEFINITIONS

The following terms are defined as they apply to UAS flight operations for FDOT operations.

Absolute Ceiling: Maximum height at which a particular airplane can operate.

Acrobatic Flight: Maneuvers a pilot intentionally performs, involving abrupt altitude change and abnormal attitude or acceleration.

Aerial Work: Means an aircraft operation in which an aircraft is used for specialized services such as agriculture, construction, photography, surveying, observation and patrol search and rescue, aerial advertisement, etc.

Airport Advisory Area: Area within five statute miles of an uncontrolled airport where a flight service station is located.

Airspeed: The speed of an aircraft relative to the air.

Airworthy: Aircraft status indicating that it is suitable for safe flight.

Alert Area: Alert areas are depicted on aeronautical charts to inform nonparticipating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Remote pilots in command should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft as well as pilots transiting the area must be equally responsible for collision avoidance. Alert areas contain special hazards that remote PICs must take into consideration when entering the areas.

Altimeter: Instrument that measures altitude using air pressure change with height, using sealed thin-walled metallic bellows as its sensitive element

Altitude: Height expressed in units of distance above a reference plane, usually above mean seal level or ground.

Anemometer: Any instrument for measuring the speed of the wind

Attitude: Airplane's position determined by the inclination of the axes in relation to the horizon.

Autopilot: Units and components used to automatically control the aircraft.

Avionics: Avionics are the electronic systems used on aircraft, artificial satellites, and spacecraft. Avionic systems include communications, navigation, the display and management of multiple systems, and the hundreds of systems that are fitted to aircraft to perform individual functions.

Axis: Theoretical line extending through the center of gravity of an airplane in each major plane: these are the longitudinal, lateral, and vertical axis.

Balance: Condition of the aircraft load relative to the aircraft's center-of-gravity.

Buddy-Box System: A two-tier system, with one controller operating as the master controller while a second controller is linked or slaved to it allowing dual control of an aircraft. A switch provides an instantaneous transfer of control from one controller to the other. This system is a means of achieving a position transfer of control from one pilot to another.

Category: Describes the certification, ratings, privileges, and limitations of airmen. Examples include airplane, rotorcraft, glider, and lighter-than-air. Also refers to aircraft based on intended use or operating limitations. Examples include transport, normal, utility, acrobatic, limited, restricted, and provisional.

Catenary: This wire curve approximates the natural path of a wire strung between two points. Thus, the use of "catenary" to describe electric power lines.

Caution: An operating procedure, practice, or condition that may result in damage to equipment if not carefully observed or followed.

Caution Area: An area of defined dimensions within which the military training activities conducted, though not hazardous, are of interest to nonparticipating pilots.

Certificate of Waiver (COW) or Certificate of Authorization (COA): A COA is an authorization issued by the Air Traffic Organization to a public pilot for a specific UAS activity. After a complete application is submitted, FAA conducts a comprehensive operational and technical review. If necessary, provisions or limitations may be imposed as part of the approval to ensure the UAS can operate safely with other airspace users. In most cases, FAA will provide a formal response within 60 days from the time a completed application is submitted. To better support the needs of its customers, FAA deployed a web-based application system. UAS COA Online System provides applicants with an electronic method of requesting a COA or COW. Applicants need to obtain an account to access the online system.

Chart: Graphic representation of a section of the earth's surface specifically designed for navigational purposes (also called a map).

Checklist: List of items requiring the airman's attention for various flight operations.

Checkpoint: Geographical reference point used for checking the position of an aircraft in flight. As generally used, it is a well-defined reference point easily seen. Its exact position is known or plotted on the navigational chart and was selected in pre-flight planning for use in checking aircraft position in flight.

Civil aircraft: an aircraft except a public aircraft.

Class "G" Airspace: This class of airspace is uncontrolled airspace is mostly used for a small layer of airspace near the ground, but there are larger areas of Class G airspace in remote regions of US flight operations may be conducted under instrument flight rules or visual flight rules (VFRs). Air traffic control has no authority, but VFR minimums are to be known by pilots. Traffic information may be given as far as is practical with respect to other flights. Note: The United States does not use the International Civil Aviation Organization Class F airspace designation.

Class of Aircraft: Classification of aircraft within a category, differentiating between single-engine and multi-engine and land and water configurations.

Clearance (instrument flight rules): Authorization to follow a specified flight outline. Clearances are issued by the control agency within which the flight will operate and are used to prevent collisions between aircraft.

Cloud: A visible cluster of minute water and/or ice particles existing in the atmosphere.

Compass: An instrument which indicates direction, measured clockwise from magnetic north.

Command and Control Link: Means the data link between UASs and the control station for the purposes of managing the flight. Note: These links are the wireless means of connecting one location to another for the purpose of transmitting or receiving data.

Control Station: An interface used by the remote pilot in command or the person manipulating the controls to control the flight path of UASs.

Controlled Airspace: This airspace of defined dimensions within which air traffic control services are provided. The level of control varies with different classes of airspace. Controlled airspace usually imposes higher weather minimums than are applicable in uncontrolled airspace. It is the opposite of uncontrolled airspace.

Course: Direction toward the destination as charted. A true course is measured from true north; magnetic course is measured from magnetic north.

Crew Member: Means a person assigned to duties essential to the operation of the unmanned air vehicle system during flight time.

Crosswind: A wind blowing across the line of flight of an aircraft.

Danger Area: A specified area within or over which there may exist activities constituting a potential danger to aircraft.

Danger Tree: Any tree on or off the right of way that could contact electric supply lines.

Daylight Operations: Part 107 prohibits operation of a UAS at night, which is defined in part 1 as the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac, converted to local time. In the continental United States, evening civil twilight is the period of sunset until 30 min after sunset and morning civil twilight is the period of 30 min before sunrise until sunrise. In Alaska, the definition of civil twilight differs and is described in the Air Almanac. The Air Almanac provides tables which are used to determine sunrise and sunset at various latitudes.

Drag: The force opposing the movement of the airplane through the air. Induced drag—the part of the total drag on an airplane produced by the flow of air over lifting surfaces. Parasite drag—drag produced by attachments to the aircraft and no-lift devices such as landing gear and struts.

Drift: Defection of an airplane from its intended course by action of the wind.

Drone NOTAM (DROTAM): Aviation charting website SkyVector has added a useful new feature—graphical depictions of drone NOTAMs, which it calls "DROTAMs"—that show dimensions of drone/UAS airspace and information about activity times and operating altitudes. DROTAMs are available as a graphical layer on any kind of chart available from SkyVector. (Aviation International News (AIN), 2016)

Final Approach: A flight path of a landing aircraft in the direction of landing.

First-Person View (FPV): Also known as remote-person view or simply video piloting, FPV is a method used to control a radio-controlled vehicle from the driver's or remote pilot in command's viewpoint. Most commonly it is used to pilot a radio-controlled aircraft or other type of UASs. The vehicle is either driven or piloted remotely from a first-person perspective via an onboard camera, fed wirelessly to video FPV goggles or a video monitor. More sophisticated setups include a pan-and-tilt gimbaled camera controlled by a gyroscope sensor in the pilot's goggles, and with dual onboard cameras enabling a true stereoscopic view.

Flare Out: To level off just above the landing area by decreasing the rate of descent and airspeed.

Flight Control Surface: Aircraft flight control surfaces allow a remote pilot in command to adjust and control the aircraft's flight attitude. The development of effective flight controls is what allowed stable flight.

Flight Envelope: In aerodynamics, the flight envelope, service envelope, or performance envelope of an aircraft refers to the capabilities of a design in terms of airspeed and load factor or altitude. The term is somewhat loosely applied and can also refer to other measurements such as maneuverability. When a plane is pushed, for instance by diving it at high speeds, it is said to be flown "outside the envelope," something considered rather dangerous.

Flight Plan: Specified information relating to the intended flight of an aircraft that is filed orally or in writing.

Lost Link: Means the loss of Command-and-Control link contact with the unmanned air vehicle such that the pilot can no longer manage the aircraft's flight. In this eventuality, many UASs will automatically initiate return-to-base profiles.

Low Frequency: A frequency in the 30–300 kHz band normally received by an automatic direction finder navigation radio.

Magnetic Course: The true course or track, corrected for magnetic variation between two points on the surface of the earth.

Flight Termination System: Means the system that, upon initiation, terminates the flight of a UAS in a manner so as not to cause significant damage to property or severe injury to persons on the ground.

Flight Time: The time from the moment the aircraft first moves under its own power for the purpose of flight until the moment it comes to rest at the next point of landing.

Fly-away: Means an interruption or loss of the Command-and-Control link where the pilot is unable to affect control of the aircraft and the aircraft is longer following its preprogrammed procedures resulting in UASs not operating in a predictable or planned manner.

Glide: Sustained forward flight in which speed is maintained only by the loss of altitude.

Gross Weight: The total weight of a UAS ready for flight. This weight consists of aircraft basic empty weight, fuel, cargo, and removable equipment.

Ground Speed: The speed of the aircraft relative to the ground.

Handover: Means the act of passing pilot-in-command responsibilities from one control station or pilot to another.

Hazard Tree: A structurally unsound tree that could strike electric supply lines when it fails.

Heading: The direction in which the nose of the airplane points during flight. Corrections made to compensate for wind will cause differences to arise between track and heading. If no change is made in heading to compensate for wind, differences will arise between track and course as the aircraft drifts.

In-Flight Emergency: An in-flight emergency is an unexpected and unforeseen serious occurrence or situation that requires urgent, prompt action. In case of an in-flight emergency, the remote pilot in command (PIC) is permitted to deviate from any rule of Part 107 to the extent necessary to respond to that emergency. A remote PIC who exercises this emergency power to deviate from the rules of Part 107 is required, upon FAA request, to send a written report to the FAA explaining the deviation. Emergency action should be taken in such a way as to minimize injury or damage to property.

IFR Conditions: Weather conditions below the minimum prescribed for flight under visual flight rules.

Inertial Measurement Unit: An electronic device that measures and reports a body's specific force, angular rate, and sometimes the magnetic field surrounding the body using a combination of accelerometers and gyroscopes and sometimes also magnetometers. Inertial measurement units are typically used to maneuver aircraft, including Unmanned Aerial Systems (UAS).

Instrument Flight Rules: When weather conditions are below the minimums prescribed for visual meteorological conditions, pilots must fly in accordance with instrument flight rules (IFRs). Pilots may elect to fly an IFR flight plan during visual flight rule conditions.

International Civil Aviation Organization (ICAO): An international body in the field of aeronautics. ICAO standards and recommended practices are not binding. Final decision rest with the sovereign state.

Knot: A unit of speed equal to 1 NM per hour.

Landing: The act of terminating flight and bringing an airplane to rest.

Landing Area: a place on land or water, including an airport or intermediate landing field, used, or intended to be used, for the takeoff and landing of aircraft, even when facilities are not provided for sheltering, servicing, or repairing aircraft, or for receiving or discharging passengers or cargo.

Landing Gear: The under structure which supports the weight of the stationary airplane. Log: To make a flight-by-flight record of all operations of an airplane, engine, or remote PIC, listing.

Maneuvering Speed: Maximum speed at which the flight controls can be fully deflected without damage to the aircraft structure. It may be found in the airplane flight manual and is useful for guidance in performing flight maneuvers, or normal operations in severe turbulence.

Maximum Gross Weight: The maximum weight authorized by FAA for operation of the aircraft.

May: "May" and "need not" mean procedure is optional.

Mean Sea Level (MSL): The average level of the sea; used to compute barometric pressure to determine altitude.

Military Operations Area (MOA): According to FAA, a MOA is "airspace established outside Class A airspace to separate or segregate certain nonhazardous military activities from instrument flight rule traffic and to identify for visual flight rule traffic where these activities are conducted." Similar structures exist under international flight standards. These are designed for routine training or testing maneuvers. Areas near actual combat or other military emergencies are generally designated as restricted airspace.

Model Aircraft: Any UAS that is (1) capable of sustained flight in the atmosphere, (2) flown within visual line of sight of the person operating the aircraft, and (3) flown for hobby or recreational purposes.

National Airspace System (NAS): "The airspace, navigation facilities, and airports of the United States along with their associated information, services, rules, regulations, policies, procedures, personnel, and equipment. It includes components shared jointly with the military. It is one of the most complex aviation systems in the world and services air travel in the United States and over large portions of the world's oceans. As of February 2015, NAS was transitioning to a new system known as NextGen, which applies nonradar surveillance of aircraft equipped with GPS satellite-based navigation systems continuously reporting their locations. Aircraft also receive the broadcast location of others nearby, which improves safety. The system also allows pilots to use more precise and efficient landing paths, saving time and fuel. NextGen is being phased in piece by piece. About 14,500 air traffic controllers, 4,500 aviation safety inspectors, and 5,800 technicians operate and maintain services for NAS. It has more than 19,000 airports and 600 ATC facilities. In all, there are 41,000 NAS operational facilities. In addition, there are over 71,000 pieces of equipment, ranging from radar systems to communication relay stations. On average, about 50,000 flights use NAS services each day."

National Security Area (NSA): A designated airspace through which flights are discouraged for reasons of national security. Flight through NSAs is not prohibited, and no special advance clearance or authorization need be obtained to enter them. However, remote pilots in command are strongly encouraged to either stay clear of NSAs or obtain prior authorization to pass through them in order to reassure the controlling agency that no threat to national security exists. NSAs are a compromise between normal airspace and restricted or prohibited airspace. NSAs can be temporarily converted into restricted airspace by NOTAMs. On visual flight rule sectional charts, NSAs are delimited by a heavy dashed magenta border and a special notation.

Nautical Mile (NM): Unit of distance used in navigation, equaling 6,080 ft; the minimum length of one minute of longitude on the equator; about one minute of latitude; 1.15 statute miles.

Navigation Light: Any one of a group of lights mounted on an aircraft to make its dimensions, position, and direction of motion visible at night or during poor visibility.

Note: An operating procedure, practice, or condition that must be emphasized.

Notice to Airmen (NOTAM): A NOTAM is a notice filed with an aviation authority to alert aircraft pilots of potential hazards along a flight route or at a location that could affect the safety of the flight. NOTAMs are unclassified notices or advisories distributed by means of telecommunication that contain information concerning the establishment, conditions or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel and systems concerned with flight operations. NOTAMs are created and transmitted by government agencies and airport pilots under guidelines specified by Annex 15: Aeronautical Information Services of the Convention on International Civil Aviation (CICA). The term NOTAM came into common use rather than the more formal "Notice to Airmen" following the ratification of the CICA, which came into effect on 4 April 1947. Notices to Airmen were normally published in a regular publication by each country's air authorities (e.g., in Flight Magazine in the UK). A number of developments and amendments to the CICA have resulted in the more automated system available today.

Obstruction Light: A light, or a group of lights, usually red, mounted on a surface structure or natural terrain to warn pilots of the presence of a flight hazard.

Operational Risk Management (ORM): ORM is defined as a continual cyclic process which includes risk assessment, risk decision making, and implementation of risk controls, which results in acceptance, mitigation, or avoidance of risk. ORM is the oversight of operational risk, including the risk of loss resulting from inadequate or failed internal processes and systems, human factors, or external events.

Pilot: In respect of an aircraft, means the person that has possession of the aircraft or a UAS system, as owner, lessee or otherwise.

Owner: In respect of an aircraft, means the person who has legal custody and control of the aircraft.

Park Flyer: "The term 'park flyer' denotes a class of small, primarily electric-powered, radio-controlled aircraft, so named because their size enables some of them to be operated within the confines of a large public park. Some are slow and docile enough to fly within an enclosed area such as a gymnasium, or even a living room, while others require the open space needed for larger models due to size and/or speed. Because of their size and relative ease of setup, ready-to-fly park flyers are among the most popular class of remote-control aircraft for beginners and advanced pilots alike."

Payload: Means all elements of the aircraft that are not necessary for flight but are carried to fulfil specific mission objectives. This may include subsystems such as intelligence and surveillance assets, communication relay equipment, sensors, cargo, and cameras.

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

Pilot: A person holding a valid pilot certificate issued by the FAA.

Pilotage: Navigation by visual reference to landmarks.

Pitch: The blade angle of a propeller. Also, the movement of an aircraft about its lateral axis.

Positive Control: Control of all air traffic, within designated airspace, by air traffic control.

Prohibited Airspace: "Refers to an area (volume) of airspace within which flight of aircraft is not allowed, usually due to security concerns. It is one of many types of special-use airspace designations and is depicted on

aeronautical charts with the letter "P" followed by a serial number. It differs from restricted airspace in that entry is typically forbidden at all times from all aircraft and is not subject to clearance from air traffic control or the airspace's controlling body. According to FAA, "Prohibited areas contain airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts." Some prohibited airspace may be supplemented via NOTAMs. Aircraft violating or about to violate prohibited airspace will often be warned beforehand on 121.5 MHz, the emergency frequency for aircraft."

Propeller: Device for propelling an aircraft, with blades mounted on an engine-driven shaft that, when rotated, produces a thrust approximately perpendicular to its plane of rotation.

Radio Line of Sight: This means the limit of direct point-to-point contact between a controller and a receiver given the equipment being used and the prevailing conditions.

Range Maximum: Maximum distance a given aircraft can cover under given conditions by flying at the most economical speed and altitude at all states of the flight.

Ready to Fly: Ready-to-fly (RTF) model airplanes come preassembled and usually only require wing attachment or other basic assembly. Typically, everything that is needed is provided, including the controller, receiver, and battery. RTF airplanes can be up in the air in just a few minutes and have all but eliminated assembly time (at the expense of the aircraft model's configuration options.)

Recovery: Means the phase of a UAS flight that involves the return of an aircraft to the ground or base.

Remote Pilot in Command (Remote PIC or Remote Pilot): A person who holds a remote pilot certificate with a UAS rating and has the final authority and responsibility for the operation and safety of a UAS under Part 107. The remote PIC is responsible for coordinating ground and flight operations including mission planning, execution, and debriefing; safe operation of the aircraft; aircrew resource management; along with customer coordination and coordination with the public.

Restricted Airspace: Restricted airspace is an area (volume) of airspace typically used by the military in which the local controlling authorities have determined that air traffic must be restricted (if not continually prohibited) for safety or security concerns. It is one of many types of SUA designations and is depicted on aeronautical charts with the letter "R" followed by a serial number. According to the FAA: "Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants." Restricted airspace zones may not be active ("hot") at all times; in such cases, there are typically schedules of local dates and times available to aviators specifying when the zone is active, and at other times, the airspace is subject to normal visual flight rule/instrument flight rule operation for the applicable airspace class. A few zones are activated by NOTAM.

Rhumb Line: Line drawn on a chart between points for navigational purposes. In practice, it is the line on the map which the pilot attempts to follow.

Roll: Movement of an aircraft about its longitudinal axis.

Rotary Wing: A rotorcraft, or rotary-wing aircraft, is a heavier-than-air flying machine that uses lift generated by wings, called rotary wings or rotor blades, that revolve around a mast. Several rotor blades mounted on a single mast are referred to as a rotor. Rotorcraft generally include those aircraft where one or more rotors are required to provide lift throughout the entire flight.

Route: Defined path, consisting of one or more courses, which an aircraft traverses in a horizontal plane over the surface of the earth.

Runway: Strip, either paved or improved on which takeoffs and landings are affected.

Separation: In air traffic control, the spacing of aircraft to achieve safe and orderly movement in flight and while landing and taking off.

Shall: Means a mandatory procedure.

Should: Means a procedure that is recommended.

Situational Awareness: Situational awareness is the perception of environmental elements concerning time or space, the comprehension of their meaning, and the projection of their status after some variable such as time or a predetermined event has changed. It is also a field of study concerned with understanding the environment critical to decision-makers in complex, dynamic areas from aviation, air traffic control, ship navigation, power plant operations, military command and control, and emergency services such as firefighting and policing to more ordinary but complex tasks such as driving an automobile or riding a bicycle.

Slant Range: The line-of-sight distance between two points not at the same elevation.

Small Unmanned Aerial System: An aerial system 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.

Special Use Airspace: "An area designated for operations of a nature such that limitations may be imposed on aircraft not participating in those operations. Often these operations are military. The designation of 'SUA' identifies for other users the areas where such activity occurs, provides for segregation of that activity from other users, and allows charting to keep airspace users informed of potential hazards. Most UASs are depicted on aeronautical charts, and FAA maintains a page showing the current status of most UASs. Flights within restricted areas are only allowed with specific FAA clearance and may be subject to restrictions, while in prohibited areas flights are forbidden except in emergencies. Flying in military operations areas or 'Warning Areas' is allowed by nonmilitary aircraft without clearance but can be hazardous."

Special Visual Flight Rule (VFR) Conditions (special VFR minimum weather conditions): Weather conditions that are less than basic VFR weather conditions and that permit flight under VFRs in a control zone.

Spin: Prolonged stall in which an airplane rotates about its center of gravity while it descends, usually with its nose well down.

Spiral: Prolonged gliding or climbing turn during which at least 360° change of direction is affected

Stability: Tendency of an airplane in flight to remain in straight, level, upright flight, or to return to this attitude if displaced, without the attention of the pilot.

Stall: Flight maneuver or condition caused by an excessive angle of attack, in which the air passing over and under the wings stops providing sufficient lift to hold the aircraft aloft.

Statute Mile: 5,280 feet or 0.867 NM.

Subject Matter Expert (SME): Supports UAS flight operations by performing duties as an SME for a particular academic, industrial, or technical area. The SME assists in the technical aspects of UAS mission operation and collection (e.g., sensor work). The SME is responsible for assisting the remote pilot in command in coordinating ground and flight operations including mission planning, execution, and debriefing; safe operation of the aircraft; aircrew resource management; along with customer coordination and coordination with the public.

Temporary Flight Restriction (TFR): A TFR is a geographically limited, short-term, airspace restriction, typically in the United States. TFRs often encompass major sporting events, natural disaster areas, air shows, space launches, and presidential movements. Before September 11, 2001, attacks, most TFRs were in the interest of safety to flying aircraft, with occasional small restrictions for presidential movements. Since the September 11 attacks, TFRs have been routinely used to restrict airspace for 30 NM around the president, with a 10 NM (20 km) radius no-fly zone for nonscheduled flights. They are also available to other important people such as presidential and vice-presidential candidates. The responsibility for screening requests for TFRs and for subsequently granting or denying them lies with the FAA Office of System Operations Security.

Thrust: Forward force on an airplane in the air provided by the engine.

Track: Flight path made good over the ground by an aircraft. A track may be called a course when about the charted route and is described in terms of direction from the north.

Transponder: Airborne radar beacon receiver-controller which receives radio signals from all interrogators on the ground and selectively replies with specific radio wave pulses to only those interrogations being received on the specific radio frequencies to which it is set to respond.

True Altitude: The altitude above mean sea level.

Turbulence: Irregular motion of the atmosphere produced when air flows over a comparatively uneven surface, such as the surface of the earth, or when two currents of airflow pass or over each other in different directions or at different speeds.

Uncontrolled Airspace: Airspace where an air traffic control service is not deemed necessary or cannot be provided for practical reasons. According to the airspace classes set by the International Civil Aviation Organization, both class F and class G airspace are uncontrolled. It is the opposite of controlled airspace. Air traffic control does not exercise any executive authority in uncontrolled airspace but may provide basic information services to aircraft in radio contact. Flight in uncontrolled airspace will typically be under visual flight rules. Aircraft operating under instrument flight rules should not expect separation from other traffic, however, in certain uncontrolled airspace, this might be provided on an 'as far as is practical' advisory basis.

Useful Load: In airplanes, the difference, in pounds, between the empty weight and the maximum authorized gross weight.

Utility Forest: Consists of the land base supporting tree species that could now, or in the future, interfere with safe, reliable electric service.

Vegetation Management: A broad term that includes tree pruning; brush removal through the use of power saws and mowers; the judicious use of herbicides and tree growth regulators; hazard tree identification and removal; the implementation of strategies to minimize the establishment of incompatible species under and near power lines; and the control of weeds.

Very High Frequency: Frequency band from 30 to 300 MHz

Visibility: In weather observing practice, the greatest distance in a given direction at which it is possible to see and identify with the unaided eye (or the instrumentally determined equivalent) prominent unlighted objects by day and prominent lighted objects at night. For weather observing purposes, visibility is categorized as flight visibility, ground visibility, or runway visual range.

Visual Flight Rules for UASs: When weather conditions are above the minimums prescribed for visual meteorological conditions, remote PICs may fly with visual reference to UASs and other structures without continuous referral to other visual or locating aids.

Visual Meteorological Conditions (VMCs): VMCs refer to an aviation flight category in which visual flight rules flight is permitted—that is, conditions in which remote pilots in command have sufficient visibility to fly the aircraft maintaining visual separation from terrain and other aircraft. They are the opposite of instrument meteorological conditions (IMCs). The boundary criteria between IMCs and VMCs are known as the VMC minima and are defined by visibility, cloud ceilings (for takeoffs and landings), and cloud clearances.

Spotter: A person acting as a flight crew member who assists the remote pilot in command (PIC) and the person manipulating the controls to see and avoid other air traffic or objects aloft or on the ground. The spotter is responsible for supporting the remote PIC in coordinating ground and flight operations including mission planning, execution, and debriefing; safe operation of the aircraft; aircrew resource management; along with customer coordination and coordination with the public.

Warning: An operating procedure, practice, or condition that may result in injury or death if not carefully observed or followed.

Warning Areas: A warning area is airspace of defined dimensions, extending from 3 NM outward from the coast of the United States that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating remote PICs of the potential danger. A warning area may be located over domestic or international waters or both.

Waypoint: An intermediate point on a route or line of travel. (Merriam-Webster, 2016)

Weather Depiction Chart: Weather analysis, portraying areas of precipitation and obstructions to vision, cloud cover, and cloud heights.

Wind Shear: The change of either wind speed or direction or both, in any direction, conventionally expressed as vertical wind shear or horizontal wind shear.

Wind Sock: Fabric sleeve, mounted aloft at an airport or operating area used to estimate wind direction and velocity.

Will: Indicates futurity and never indicates any degree of requirement for the application of a procedure.

Yaw: To turn about the vertical axis. An airplane is said to yaw as the nose turns without the accompanying appropriate bank.

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