

# Guidelines and Specifications for the Operation of Unmanned Aircraft Systems (UAS)



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## GLOSSARY OF TERMS

- Aircraft: any contrivance invented, used, or designed to navigate, or fly in, the air
- Airport: a landing area used regularly by aircraft for receiving or discharging passengers or cargo
- ATO: Air Traffic Organization
- ATC: Air Traffic Control
- Calibration: The science of determining and compensating for error in a Camera or Lens
- COA: Certificate of Waiver or Authorization (COA)
- FAA: Federal Aviation Administration
- Fixed Wing: Aircraft with one or more fixed wings with a motor forward of or behind the wings
- FLIR: Forward-Looking InfraRed (Camera)
- IMU: Inertial Measurement Unit
- INS: Inertial Navigation System
- Launch area: Open area, field, parking lot, or airport used, or intended to be used, for the launching of aircraft
- Landing area: Open area, field, parking lot, or airport used, or intended to be used, for the landing of aircraft
- LiPo: Lithium Polymer (battery type)
- Multi Rotor: Multi Rotor VTOL Aircraft. Usually with, 4, 6, or 8 rotors
- Operations Area: Geographic area where UAS mission will take place
- Part 107 (14 CFR): Federal Regulations governing use of UAS
- Remote Pilot: Pilot in Command as used in 14 CFR Part 107
- Rotorcraft: Single rotor Aircraft (Helicopter)
- Sectional Aeronautical Charts: Designed for visual navigation of slow to medium speed aircraft, these are to be used when submitting COA applications (or Waiver requests) and communicating operations area with the ATC and FAA
- SOP: Standard Operational Procedures
- UAS: Unmanned Aircraft System
- UAV: Unmanned Aerial Vehicle
- VO: Visual Observer
- VTOL: Vertical Take Off and Landing
- Waiver: Authorization beyond approved use under 14 CFR Part 107
- Sensors: Can Include, Multi Spectral or Thermal Cameras, or LiDAR, etc.
- Payload: Item or Items (sensors) carried by UAS

## GENERAL USES FOR UNMANNED AIRCRAFT SYSTEMS (UAS)

Unmanned Aircraft Systems (UAS) are well suited for mapping small areas at very high resolution. In addition, UAS can be used for real time monitoring of events such as chemical or hazardous waste spills, breaches, flooding and so on.

### UAS should be used for and when:

- Taking photographs or video to create a record in time.
- Creating planimetric and topographic maps (supporting a 1' or larger contour interval).
- Monitoring hazards.
- Small amounts of ground (<50 acres for rotary/ <1500 acres for fixed wing).
- Visual line of sight can be maintained.
- Operations can be conducted in Class G airspace under 400'.
- Operations in airspace other than Class G can be attained with FAA Approval (Waiver).

### Good projects for UAS would include:

- Mapping of a site where the ground is clearly visible from the sky.
- Recording/documenting ground conditions at a development site.
- Monitoring small areas or projects over time.
- Recording/documenting water levels at difficult or hazardous to reach locations.
- Inspecting a structure for defects, cracks, or workmanship.
- Observing a lake-level gauge or staff gauge that is inaccessible resulting from storm water inundation.
- Assessing a site for ERP suitability.
- Assessing the use of equipment to treat (ex. mow) an area.
- Assessing the level of completion of a project site.
- Document the state/status of a development site.
- Emergency documentation following a storm event.
- Mapping Submerged Aquatic Vegetation (SAV).
- "Ground-truthing" seagrass imagery.
- Mapping invasive plant patches.
- Measuring vegetation changes on a site.
- Replacing existing Lidar surface data where land development has altered the terrain.
- Monitoring/measuring dirt piles.
- Mapping habitat or Florida Land Use Cover and Forms Classification System.
- Assisting with prescribed burns.
- Assessing condition of SWFWMD-owned Conservation Easements.

## UAS should not be used for or when:

- Topographic mapping at very high accuracy (supporting contour intervals less than 1').
- Topographic mapping in areas where dense vegetation impedes a clear view of the ground.
- Covering large amounts of ground (greater than 5000 acres).
- When visual line of sight cannot be maintained.
- Where airspace approval has not been granted by the FAA.

## Poor projects for UAS would include:

- Mapping sites with a significant amount of vegetation or ground cover.
- Mapping sites where airspace access is extremely complex.
- Mapping sites where the population is dense (ex. over people) or where local prohibitions are in effect.
- Mapping sites with rapidly changing weather conditions.
- Mapping sites where active construction is occurring.

## GENERAL RISK FACTORS

**Battery Ignition** – Lithium Polymer (LiPo) batteries are the most common energy source for commercial-grade UASs. These batteries are known to generate large amounts of heat as they discharge. When not carefully monitored, the heat may build up resulting in ignition.

**Weather Conditions** – Weather conditions may be unpredictable or variable during a mission. What may start out as a calm day, may turn windy toward the end of the mission. Smaller, less stable UASs may not be able to maneuver through changing weather conditions resulting in unforeseen flight patterns, holding patterns and even crash-landings.

**Land Cover Conditions** – Most UASs are designed for flight over “urban-type” land covers, those where the major features are asphalt, low grass (manicured lawns), and/or water. The land covers typically of interest to the Southwest Florida Water Management District (SWFWMD) include, wetlands, overgrown fields, tall brush, and covers difficult for people to walk through. A “crash” in these habitats may result in unforeseen events (ex. brush fires, loss of vehicle, etc.)

**Personal Privacy** - While FAA Rule 107 specifically prohibits use of UASs over non-participating people, it provides waivers for UAS use in populated areas.

## GENERAL REQUIREMENTS

In order for Consultants to operate UAS for SWFWMD projects, they must operate in compliance with FAA rules and regulations and Florida law. They must also meet the SWFWMD’s insurance requirements and operate under the guidelines in this document.

## FAA Authorization

All UAS operations must follow FAA approved guidelines for operation. The FAA grants permission to operate UAS through two different means: Section 333 exemption and more recently its replacement Part 107. Since the Section 333 exemption is being phased out, this document will reference operations under Part 107. These requirements will be adjusted as Part 107 is modified.

## Part 107

### Operational Limitations

UAS operations under Part 107 must adhere to the operational limitations identified in the regulations, including, but not limited to:

- Unmanned aircraft must weigh less than 55 lbs. (25 kg).
- Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer.
- At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses.
- Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle.
- Daylight-only operations, or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting.
- Must yield right of way to other aircraft.
- May use visual observer (VO) but not required.
- First-person view camera cannot satisfy “see-and-avoid” requirement but can be used as long as requirement is satisfied in other ways.
- Maximum groundspeed of 100 mph (87 knots).
- Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure.
- Minimum weather visibility of 3 miles from control station.
- Operations in Class B, C, D and E airspace are allowed with the required Air Traffic Control (ATC) permission.
- Operations in Class G airspace are allowed without ATC permission.
- No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time.
- No operations from a moving aircraft.
- No operations from a moving vehicle unless the operation is over a sparsely populated area.
- No careless or reckless operations.
- No carriage of hazardous materials.
- Requires preflight inspection by the remote pilot in command.
- A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS.

- Foreign-registered small unmanned aircraft are allowed to operate under Part 107 if they satisfy the requirements of Part 375.
  - External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft.
  - \* The entire summary can be found here: [https://www.faa.gov/uas/media/Part\\_107\\_Summary.pdf](https://www.faa.gov/uas/media/Part_107_Summary.pdf)
- Pursuant to Part 107, the Consultant may deviate from the Operational Limitations after obtaining a waiver from the FAA.

## Remote Pilot Certification

Any person operating a small UAS must either hold a remote pilot certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command). A remote pilot certificate must be on the person operating the small UAS at all times when UAS operations occur. A remote pilot must:

- Make available, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under Part 107.
- Report to the FAA within 10 days of any operation that results in at least serious injury, loss of consciousness, or property damage of at least \$500.
- Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation.
- Ensure that the small unmanned aircraft complies with the existing registration requirements specified in 14 CFR 91.203(a)(2).

## UAS Aircraft Requirements

The UAS must be registered with the FAA and the identification number must be affixed to the UAS in a location accessible to others. Prior to any mission the UAS must undergo pre-flight check to ensure the UAS is in condition for safe operation.

## Insurance Requirements

The Consultant must maintain during the entire term of the agreement, insurance in the following kinds and amounts or limits with a company or companies authorized to do business in the State of Florida and will not commence work under the agreement until the SWFWMD has received an acceptable certificate of insurance including any endorsements showing evidence of such coverage. Certificates of insurance must reference the SWFWMD Agreement Number and Project Manager.

- Liability insurance on forms no more restrictive than the latest edition of the Commercial General Liability policy (CG 00 01) of the Insurance Service Office without restrictive endorsements, or equivalent, with the following minimum limit and coverage:

Per occurrence \$1,000,000

- Vehicle Liability insurance, including owned, non-owned and hired autos with the following minimum limits and coverage:

Bodily Injury Liability per Person	\$ 100,000
Bodily Injury Liability per Occurrence	\$ 300,000
Property Damage Liability	\$ 100,000

or

Combined Single Limit	\$ 500,000
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- Aviation Liability insurance on an “occurrence” basis, including products and completed operations, property damage and bodily injury with the following minimum limits and coverage.

Per occurrence of \$1,000,000

Aggregate of \$2,000,000

Alternatively, this coverage may be provided by endorsement to a Commercial General Liability policy as follows:

Liability insurance on forms no more restrictive than the latest edition of the Commercial General Liability policy (CG 00 01) of the Insurance Services Office, including products and completed operations, property damage and bodily injury with limits no less than \$1,000,000 per occurrence and \$2,000,000 in aggregate.

- The SWFWMD and its employees, agents, and officers must be named as additional insured on the general liability policy to the extent of the SWFWMD’s interests arising from the agreement.
- The Consultant must carry workers' compensation insurance in accordance with Chapter 440, F.S., and maritime law, if applicable. If the Consultant does not carry workers' compensation coverage, the Consultant must submit to the SWFWMD both an affidavit stating that the Consultant meets the requirements of an independent contractor as stated in Chapter 440, F.S., and a certificate of exemption from workers' compensation coverage.
- The Consultant must notify the SWFWMD in writing of the cancellation or material change to any insurance coverage required by the agreement. Such notification must be provided to the SWFWMD within five (5) business days of the Consultant’s notice of such cancellation or change from its insurance carrier.
- The Consultant must obtain certificates of insurance from any subcontractor otherwise the Consultant must provide evidence satisfactory to the SWFWMD that coverage is afforded to the subcontractor by the Consultant’s insurance policies.



## Documentation

SWFWMD requires the documents identified in Appendix A: Consultant UAS Operation Checklist, prior to commencement of any UAS operation.

## Site Review/Preparation

The Consultants accessing SWFWMD lands must operate pursuant to Part 107 operational limitations and Florida law. Prior to any UAS operation, the Consultant must do the following:

- Review the physical characteristics of area in question for suitability in UAS operation.
- Review the surrounding airspace for suitability in operation.
- Acquire any necessary waivers and/or special use agreements for operations.
- Develop and provide a mission plan including proposed flight layout to SWFWMD for review.
- Obtain a Special Use Authorization, if necessary.

## MAPPING REQUIREMENTS

Any mapping mission must be under the direct supervision of a Florida Licensed Surveyor or Professional Survey Mapper, pursuant to Chapter 472, Florida Statutes, and Chapter 5J-17, Florida Administrative Code. Each mission is unique and the accuracies desired and deliverables should be discussed prior to determining the appropriate UAS and sensor combination.

## UAS Type

UAS types include Rotorcraft, Multi Rotors, Fixed Wings, and Hybrids (VTOL systems). Each has its unique characteristics, benefits and limitations. It is the Consultant's responsibility to determine and use the appropriate system given the mission type. Below is more detailed information on the typical capabilities of each type of UAS.

### Rotorcraft

Rotorcraft (helicopters) are best used for operations where hover capabilities are required such as inspection of utility poles, cell towers and or powerlines. Due to their hover capabilities and ability to carry larger payloads they are also well suited for LiDAR acquisition. However, rotorcraft consume a lot of power and as a result are only suitable for mapping smaller areas < 50 acres.

### Multi Rotors

Multi Rotors are by far the most popular systems. These have similar maneuvering capabilities of Rotorcraft and are suited for similar use. However, Multi Rotors are much less expensive and easier to operate. Typically, they fly for approximately 20 to 26 minutes per battery and as a result are best suited for mapping smaller areas < 50 acres.

## Fixed Wing

Fixed wing UAS are best suited for mapping larger areas up to 1500 acres. They are typically battery operated and fly up to 40 minutes per charge. Fixed wing UAS can be limited by the requirements for launch and landing areas.

## Hybrid (VTOL)

Hybrid systems have the VTOL capabilities of Rotorcraft allowing them to launch and land within a small footprint, but transition to fixed wing flight midair allowing them to cover larger areas similar to fixed wing UAS. Typically, they fly for 40 minutes and can map areas up to 400 acres per battery.

## Sensors

UAS offer the ability to fly much lower than conventional aircraft, and in some cases, have hot swappable sensors. Sensors range from RGB cameras to Multispectral sensors containing red, green and blue (RGB) and Near IR bands, and LiDAR. For mapping purposes, the UAS must be able to geotag the imagery being captured either through post processing from the UAS to the images or directly within the camera being used to acquire the imagery. LiDAR requires an Inertial Measurement Unit (IMU) of a quality and accuracy to support desired mapping accuracy.

### RGB Cameras

RGB cameras often serve a dual purpose in UAS providing still imagery and video. The SWFWMD requires the camera to be a minimum of 20 megapixels and support 4k video. RGB cameras should be of a quality to suitably produce mapping deliverables at the scale desired. GoPro (or fish eye) lens cameras should not be considered. RGB cameras, while not metric should go through some form of calibration prior to creation of deliverables. This calibration report must accompany final deliverables. Note: This is not necessary when being used for video capture.

### Multispectral Sensors

Multispectral sensors can be used to determine plant health, moisture content, and determine drainage/water run-off. There are many systems available. Consultants should provide specific information about their systems and particular benefits for the SWFWMD to determine their appropriate use on a given task. Multispectral sensors typically have a calibration target captured at the beginning and end of each mission to validate data.

### Thermal Sensors

The use of Thermal Sensors (FLIR) may be required. FLIR sensors capture heat signatures with still and/or video imagery. Since these are extremely effective at night, the UAS operator must have a waiver of authorization to operate beyond daylight hours.

## LiDAR Sensors

LiDAR sensors in combination with their IMU/INS should be able to produce deliverables meeting USGS LiDAR Base Specifications for QL 2 Lidar which can be found here - <https://pubs.usgs.gov/tm/11b4/pdf/tm11-B4.pdf>. LiDAR systems should be bore-sighted and/or calibrated prior to processing deliverables. This report must accompany final deliverables.

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## Appendix A: Consultant UAS Operation Checklist

The SWFWMD requires its Consultants to provide the following items prior to any UAS operation.

	UAS FAA registration and Photo of UAV showing tail number or serial number
	Proof of UAS Insurance
	FAA Remote Pilot Certificate of Pilot in Command
	Remove Pilot in Command Driver's License
	An Operations Manual which includes: <ul style="list-style-type: none"><li>• Standard Operating Procedures</li><li>• Operating Instructions for UAS being employed</li><li>• Safety Mitigation Plan</li><li>• Pilot Log Sheet(s) (To be provided after mission is complete)</li><li>• Maintenance Log(s)</li></ul>
	Mission Specific Plan of Operation
	FAA Approved Waivers (as needed)
	SWFWMD Task Work Assignment (executed)
	SWFWMD Special Use Authorization (as needed)