Introduction to sUAS

The Role of the Federal Aviation Administration (FAA)

- The FAA is is empowered by regulations to promote aviation safety and establish safety standards for civil aviation.

- The FAA achieves these objectives under the Code of Federal Regulations (CFR), which is the codification of the general and permanent rules published by the executive departments and agencies of the United States Government.

- FAA regulations are listed under Title 14, Aeronautics and Space, which encompasses all aspects of civil aviation from how to earn a pilot's certificate to maintenance of an aircraft.

- 14 CFR part 61 pertains to the certification of pilots, flight instructors, and ground instructors. It also defines the eligibility, aeronautical knowledge, and flight proficiency, as well as training and testing requirements for each type of pilot certificate issued.

- 14 CFR part 91 provides guidance in the areas of general flight rules, visual flight rules (VFR), and instrument flight rules (IFR)

- 14 CFR part 107 allows sUAS operations for many different non-hobby and non-recreational purposes without requiring airworthiness certification, exemption, or a Certificate of Waiver or Authorization (COA).

Recreation and Hobby use

The regulations outlined in part 107, do not apply to the following:

- Model aircraft that are operated in accordance with Part 101 Subpart E, Model Aircraft), which applies to model aircraft meeting all of the following criteria:

- The Aircraft is flown strictly for hobby or recreational use.

- The aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization;

- The aircraft is limited to not more than 55 pounds unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization;

- The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft;

- When flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control (ATC) tower (when an air traffic facility is located at the airport) with prior notice of the operation;

- The aircraft is flown within Visual Line of Sight (VLOS) of the person operating the aircraft.

- Amateur rockets

- Kites

- Unmanned free balloons

What is an sUAS?

- A Small Unmanned Aircraft System (sUAS) is also known as a Drone, Unmanned Aircraft Vehicle (UAV), Unpiloted Aerial Vehicle, or Remotely Piloted Aircraft (RPA). The FAA refers to them as an Small Unmanned Aircraft System (sUAS) and defines them as a small Unmanned Aircraft (UA) and its associated elements (including communication links) that are required for the safe and efficient operation in the NAS.

Main Components of a sUAS

- Air Vehicle System: this includes an airframe, power source, and flight control system.

- Control System(s) to send and receive data, and control information. A remote, ground station, or laptop may also be used for this purpose.

- Payload: these are the tools on board such as a camera or sensor.

- Software is used to process data collected.

Two Main Types of an sUAS

- Fixed-wing

- Vertical take-off and landing system (VTOL), also known as rotorcraft, or multi-rotors.

Definitions and Abbreviations

- **Control Station (CS)**: An interface used by the remote pilot or the person manipulating the controls to control the flight path of the small UA

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

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

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

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

- **AGL:** Above Ground Level.
- **ATC:** Air Traffic Control.
- **FSDO:** Flight Standards District Office.
- **GPS**: Global Positioning System.
- **MSL**: Mean Sea Level.
- **NOTAM:** Notice to Airmen.
- **NAS:** National Airspace System.
- **PIC:** Pilot in Command.
- **UA**: Unmanned Aircraft.
- **VLOS:** Visual Line Of Sight.
- **VO:** Visual Observer.

Accident and Incident Reporting

- The remote PIC of the sUAS is required to report an accident to the FAA within 10 days if it meets any of the following thresholds:

- At least serious injury to any person or any loss of consciousness.

- **Note: It would be considered a “serious injury” if a person requires hospitalization, but the injury is fully reversible (including, but not limited to, head trauma, broken bone(s), or laceration(s) to the skin that requires suturing).**

- Damage to any property, other than the small UA, if the cost is greater than $500 to repair or replace the property (whichever is lower).

- **Note: For example, a small UA damages a property whose fair market value is $200, and it would cost $600 to repair the damage. Because the fair market value is below $500, this accident is not required to be reported. Similarly, if the aircraft causes $200 worth of damage to property whose fair market value is $600, that accident is also not required to be reported because the repair cost is below $500.**

Submitting the Report

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- The accident report must be made within 10 calendar-days of the operation that created the injury or damage. The report may be submitted to the appropriate FAA Regional Operations Center (ROC) electronically or by telephone.

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- Date of the accident;
- Time of the accident;

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- Location of the accident;
- Date of the accident;
- Time of the accident;
- Person(s) injured and extent of injury, if any or known;

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- sUAS remote PIC's name and contact information;
- sUAS remote PIC's FAA airman certificate number;
- sUAS registration number issued to the aircraft, if required (FAA registration number);
- Location of the accident;
- Date of the accident;
- Time of the accident;
- Person(s) injured and extent of injury, if any or known;
- Property damaged and extent of damage, if any or known; and description of what happened

- **National Transportation Safety Board (NTSB) Reporting. In addition to the report submitted to the ROC, and in accordance with the criteria established by the NTSB, certain sUAS accidents must also be reported to the NTSB. For more information, visit www.ntsb.gov.**

NATIONAL TRANSPORTATION SAFETY BOARD
PILOT/OPERATOR AIRCRAFT ACCIDENT/INCIDENT REPORT
This form to be used for reporting civil and public use aircraft accidents and incidents

BASIC INFORMATION

Accident/Incident Location

Nearest City/Place: _____ State: _____

ZIP: _____ Country: _____

Latitude: _____ (dd:mm:ss N/S) Longitude: _____ (ddd:mm:ss E/W)

Date/Time

Date: _____ Local Time: _____
mm/dd/yyyy

Time Zone: _____

Phase of Operation

☐ Standing ☐ Takeoff (incl. initial climb) ☐ Cruise ☐ Hover
☐ Taxi ☐ Climb ☐ Maneuvering ☐ Other
☐ Descent ☐ Landing ☐ Approach ☐ Unknown

Collision with Other Aircraft

☐ Midair
☐ On-ground
☐ None

Altitude of In-Flight Occurrence

_____ ft MSL

AIRCRAFT INFORMATION

Manufacturer: _____

Model: _____

Serial Number: _____

Registration Number: _____ **Amateur-built:** ☐ Yes ☐ No

Max Gross Weight: _____ lbs

Weight at Time of Accident/Incident: _____ lbs

Location of Center of Gravity at Time of Accident/Incident:

_____ inches from ☐ nose or ☐ datum
-or- _____ Percent Mean Aerodynamic Cord (% MAC)

Category of Aircraft

☐ Airplane
☐ Balloon
☐ Blimp/Dirigible
☐ Glider
☐ Gyrocraft
☐ Helicopter
☐ Powered lift
☐ Ultralight
☐ Unknown

Type of Airworthiness Certificate
(Check all that apply)

Standard
☐ Normal
☐ Utility
☐ Acrobatic
☐ Transport

Special
☐ Restricted
☐ Limited
☐ Provisional
☐ Experimental
☐ Special Flight
☐ Light Sport

Number of Seats: _____

If Large Aircraft, how many seats for:

Flight Crew: _____
Cabin Crew: _____
Passengers: _____

Landing Gear ☐ Retractable

Check any additional landing gear configuration that applies:

☐ Tricycle ☐ Tailwheel
☐ Amphibian ☐ High Skid
☐ Emergency Float ☐ Skid
☐ Float ☐ Ski
☐ Hull ☐ Ski/Wheel
☐ Unknown

Type of Maintenance Program

☐ Annual
☐ Conditional (Amateur-built only)
☐ Manufacturer's Inspection Program
☐ Other Approved Inspection Program (AAIP)
☐ Continuous Airworthiness
☐ Other, specify: _____

Last Inspection Type

☐ 100 Hour ☐ Continuous Airworthiness
☐ AAIP ☐ Conditional Inspection
☐ Annual ☐ Unknown

Date Last Inspection: _____
mm/dd/yyyy

Airframe Total Time: _____hrs
hours measured at *(check one)*
☐ Last Inspection ☐ Time of Accident/Incident

IFR Equipped

☐ Yes ☐ No ☐ Unknown

Stall Warning System Installed

☐ Yes ☐ No ☐ Unknown

Type of Fire Extinguishing System

☐ None
☐ Specify _____

ELT Installed

☐ Yes ☐ No

ELT Activated

☐ Yes ☐ No

ELT Aided in Locating Accident/Incident

☐ Yes ☐ No

ELT Manufacturer: _____

Model/Series: _____

Serial Number: _____

Battery Type: _____ **Battery Exp. Date:** _____

Engine Type

☐ Reciprocating ☐ Turbo Jet
☐ Turbo Shaft ☐ Turbo Fan
☐ Turbo Prop ☐ Unknown

Reciprocating Fuel System Type

☐ Carburetor
☐ Fuel Injected

Propeller

☐ Fixed Pitch
☐ Controllable Pitch

Manufacturer: _____
Model: _____

Engine	Engine Manufacturer	Engine Model/Series	Manufacturer's Serial Number	Date of Mfg. *mm/dd/yyyy*	Engine Rated Power Measured as *(check one)* ☐ Horsepower or ☐ lbs of Thrust	Total Time (hours)	Time Since Inspection (hours)	Time Since Overhaul (hours)
Eng. 1								
Eng. 2								
Eng. 3								
Eng. 4								

OWNER/OPERATOR INFORMATION

Registered Aircraft Owner

Name: _____

Fractional Ownership Aircraft: ☐ Yes ☐ No

Owner Address

City: _____
State: _____ ZIP: _____
Country: _____

Operator of Aircraft ☐ Same As Registered Owner

Name: _____
Doing Business As: _____
Air Carrier/Operator Designator (4 Character Code): _____

Operator Address ☐ Same As Registered Owner

City: _____
State: _____ ZIP: _____
Country: _____

Regulation Flight Conducted Under

☐ FAR 91 ☐ FAR 129 ☐ FAR 91 Special Flight ☐ Public Use (select type)
☐ FAR 103 ☐ FAR 133 ☐ Non-US, Commercial ☐ *Federal* ☐ *State* ☐ *Local*
☐ FAR 121 ☐ FAR 135 ☐ Non-US, Non-commercial ☐ Unknown
☐ FAR 125 ☐ FAR 137 ☐ Armed Forces

Revenue Sightseeing Flight

☐ Yes ☐ No

Air Medical Flight

☐ Yes ☐ No

Purpose of Flight
for FAR 91, 103, 133, 137 *(Select one)*

☐ Personal
☐ Business
☐ Executive/Corporate
☐ Other Work Use
☐ Instructional
☐ Ferry
☐ Positioning
☐ Aerial Application
☐ Aerial Observation
☐ Air Drop
☐ Air Race / Show
☐ Flight Test
☐ Public Use
☐ Unknown

Revenue Operation
for FAR 121, 125, 129, 135 *(Select one)*

☐ Scheduled or Commuter
☐ Non-Scheduled or Air Taxi

Domestic or International

☐ Domestic ☐ International

Cargo Operation

☐ Passenger/Cargo
☐ Passenger _____How many?
☐ Cargo _____ lbs
☐ Mail

Type of Commercial Operating Certificate Held
(Check all that apply)

☐ None
☐ Flag Carrier Operating Certificate (121)
☐ Supplemental
☐ Air Cargo
☐ Foreign Air Carriers (129)
☐ Commuter Air Carrier (135)
☐ On-Demand Air Taxi (135)
☐ Large Helicopter (127)

☐ Rotorcraft External Load (133)
- or -
☐ Agricultural Aircraft (137)

☐ Other Operator of Large Aircraft

OTHER AIRCRAFT – COLLISION (If air or ground collision occurred, complete this section for *other* aircraft)

Aircraft Registration Number
_____

Manufacturer: _____
Model: _____

Damage to Other Aircraft

☐ Destroyed ☐ Minor
☐ Substantial ☐ None

Registered Owner of Other Aircraft

First Name: _____
Middle Initial: _____
Last Name: _____

City: _____
State: _____ ZIP: _____
Country: _____

Pilot of Other Aircraft

First Name: _____
Middle Initial: _____
Last Name: _____

City: _____
State: _____ ZIP: _____
Country: _____

MECHANICAL MALFUNCTION/FAILURE (If more space is needed, continue on separate sheet)

Was there Mechanical Malfunction/Failure? ☐ Yes ☐ No ☐ Unknown
(If yes, list the name of the part, manufacturer, part no., serial no., and describe the failure.)

Total Time/Cycles On Part

_____ Hours
_____ Cycles

Time Since This Part Inspected/Overhauled

_____ Hours

DAMAGE TO AIRCRAFT AND OTHER PROPERTY

Aircraft Damage

☐ None ☐ Substantial
☐ Minor ☐ Destroyed

Aircraft Fire

☐ None ☐ Both Ground and In-Flight
☐ In-Flight ☐ Unknown Origin
☐ On-Ground

Aircraft Explosion

☐ None ☐ Both Ground and In-Flight
☐ In-Flight ☐ Unknown Origin
☐ On-Ground

Operating Limitations and Responsibilities for Operator

Aircraft Operator

Aircraft Operator

- The remote PIC of an sUAS is directly responsible for, and is the final authority as to, the operation of that UAS.

- A person may not operate or act as a remote PIC or VO in the operation of more than one UA at the same time.

The following items describe the requirements for both a remote PIC and a person manipulating the controls:

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- **Remote PIC:** A person acting as a remote PIC of an sUAS in the National Airspace System (NAS) under part 107 must obtain a remote pilot certificate with an sUAS rating issued by the FAA prior to sUAS operation.

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- **Person manipulating the flight controls:** A person who does not hold a remote pilot certificate or a remote pilot that that has not met the recurrent testing/training requirements of part 107 may operate the sUAS under part 107, as long as he or she is directly supervised by a remote PIC and the remote PIC has the ability to immediately take direct control of the sUAS

- **Part 107 permits transfer of control of an sUAS between certificated remote pilots. Two or more certificated remote pilots transferring operational control (i.e., the remote PIC designation) to each other may do so only if they are both capable of maintaining Visual Line of Sight (VLOS) of the UA and without loss of control (LOC).**

- **Autonomous Operation:** An autonomous operation is generally considered an operation in which the remote pilot inputs a flight plan into the CS, which sends it to the autopilot onboard the small UA.

- During automated flight, the remote PIC also must have the ability to change routing/altitude or command the aircraft to land immediately. The ability to direct the small UA may be through manual manipulation of the flight controls or through commands using automation.

- **Even though the remote PIC may briefly lose sight of the small UA, he or she always has the see-and-avoid responsibilities.**

Ground Control Station

The Ground Control Station (GCS) is the collective term for the components used to control the vehicle both on the ground and while airborne.

VLOS Aircraft Operations

VLOS Aircraft Operations

- The remote PIC and person manipulating the controls must be able to see the small UA at all times during flight.

- For operational necessity, the remote PIC or person manipulating the controls may intentionally maneuver the UA so that he or she loses sight of it for brief periods of time. Should the remote PIC or person manipulating the controls lose VLOS of the small UA, he or she must regain VLOS as soon as practicable.

- **example, a remote PIC conducting a search operation around a fire scene with a small UA may briefly lose sight of the aircraft while it is temporarily behind a dense column of smoke.**

- If VLOS cannot be regained, the remote PIC or person manipulating the controls should follow predetermined procedures for a loss of VLOS. These procedures are determined by the capabilities of the sUAS and may include:
  - Immediately landing
  - Entering Hover mode
  - Return to home sequence

Unaided Vision

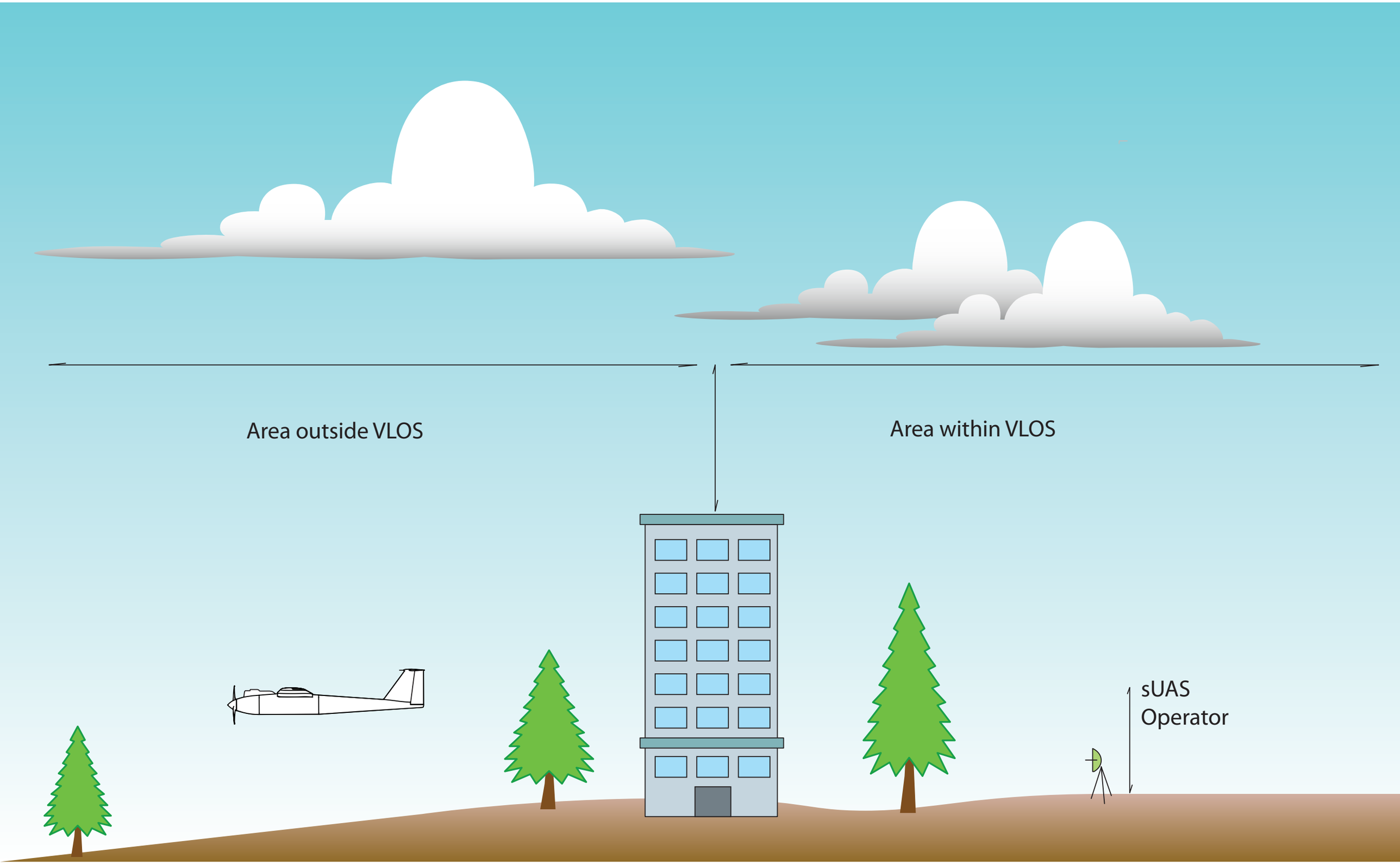
- VLOS must be accomplished and maintained by unaided vision, except vision that is corrected by the use of eyeglasses (spectacles) or contact lenses. Vision aids, such as binoculars, may be used only momentarily to enhance situational awareness.

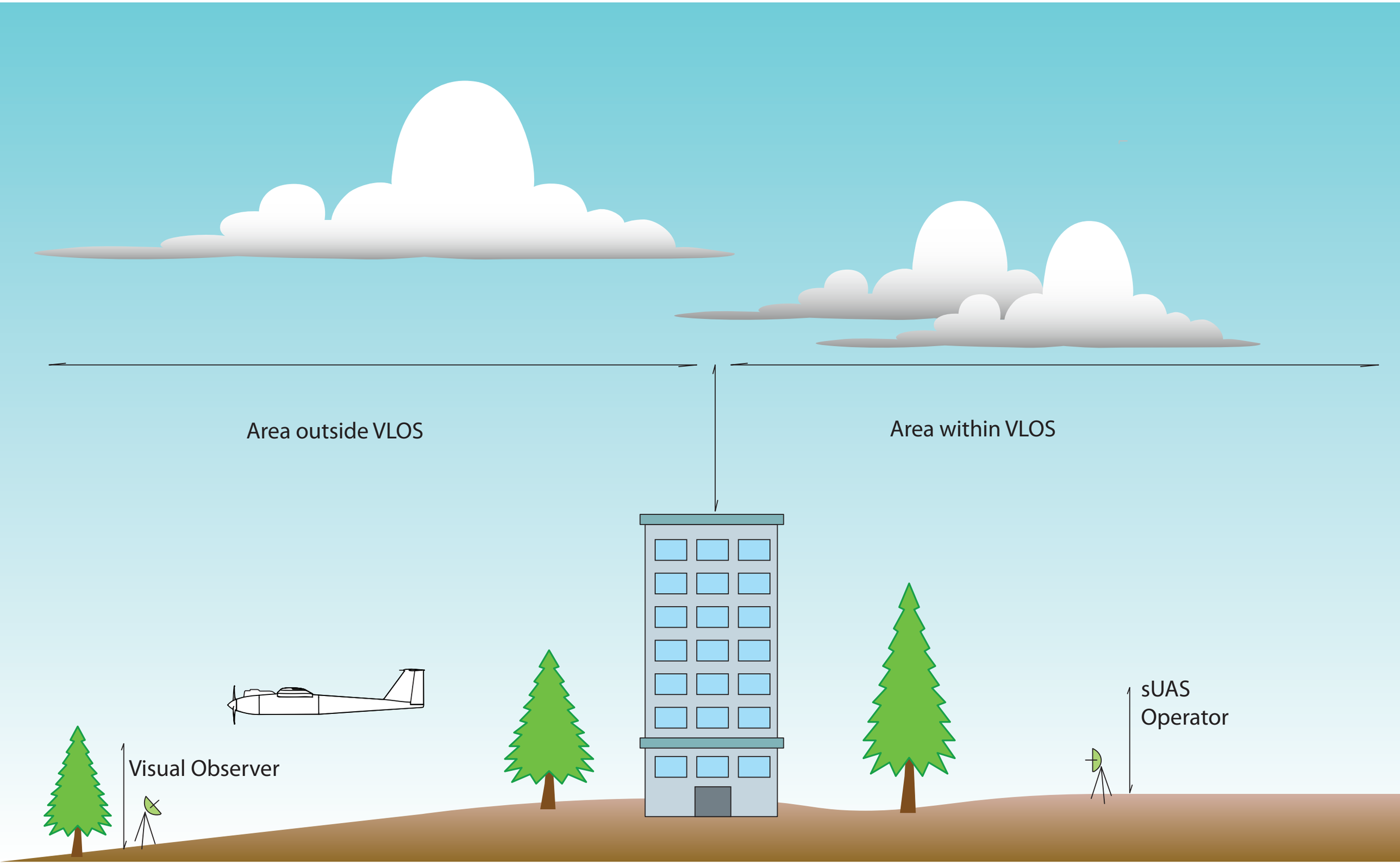
Visual Observer (VO)

- The use of a VO is optional. The remote PIC may choose to use a VO to supplement situational awareness and VLOS. The VO must be able to effectively communicate:
  - The small UA location, attitude, altitude, and direction of flight;
  - The position of other aircraft or hazards in the airspace; and
  - The determination that the UA does not endanger the life or property of another.

The use of automation does not allow a person to simultaneously operate more than one small UA.

- To ensure that the VO can carry out his or her duties, the remote PIC must ensure that the VO is positioned in a location where he or she is able to see the small UA sufficiently to maintain VLOS. The remote PIC can do this by specifying the location of the VO. The FAA also requires that the remote PIC and VO coordinate to 1) scan the airspace where the small UA is operating for any potential collision hazard, and 2) maintain awareness of the position of the small UA through direct visual observation. This would be accomplished by the VO maintaining visual contact with the small UA and the surrounding airspace, and then communicating to the remote PIC and person manipulating the controls the flight status of the small UA and any hazards which may enter the area of operation, so that the remote PIC or person manipulating the controls can take appropriate action.


Area outside VLOS
Area within VLOS
sUAS
Operator


Area outside VLOS
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Visual Observer
sUAS
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Operating limitations for sUAS

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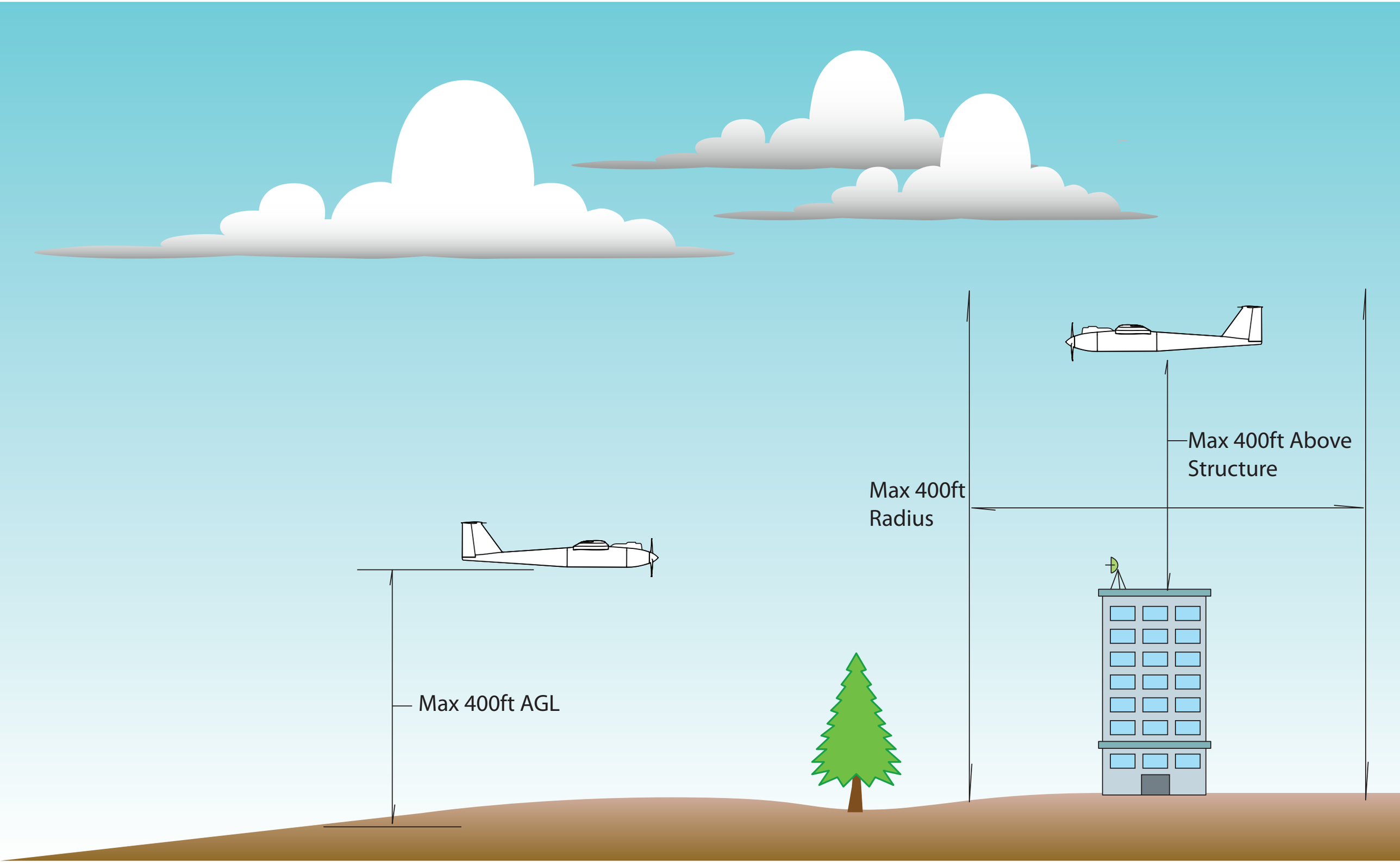
  - Cannot be flown faster than a groundspeed of 87 knots (100 miles per hour);

  - Cannot be flown higher than 400 feet above ground level (AGL), unless flown within a 400-foot radius of a structure and does not fly higher than 400 feet above the structure's immediate uppermost limit;


Max 400ft AGL
Max 400ft
Radius
Max 400ft Above
Structure

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- Minimum visibility, as observed from the location of the CS, may not be less than 3 statute miles (sm); and

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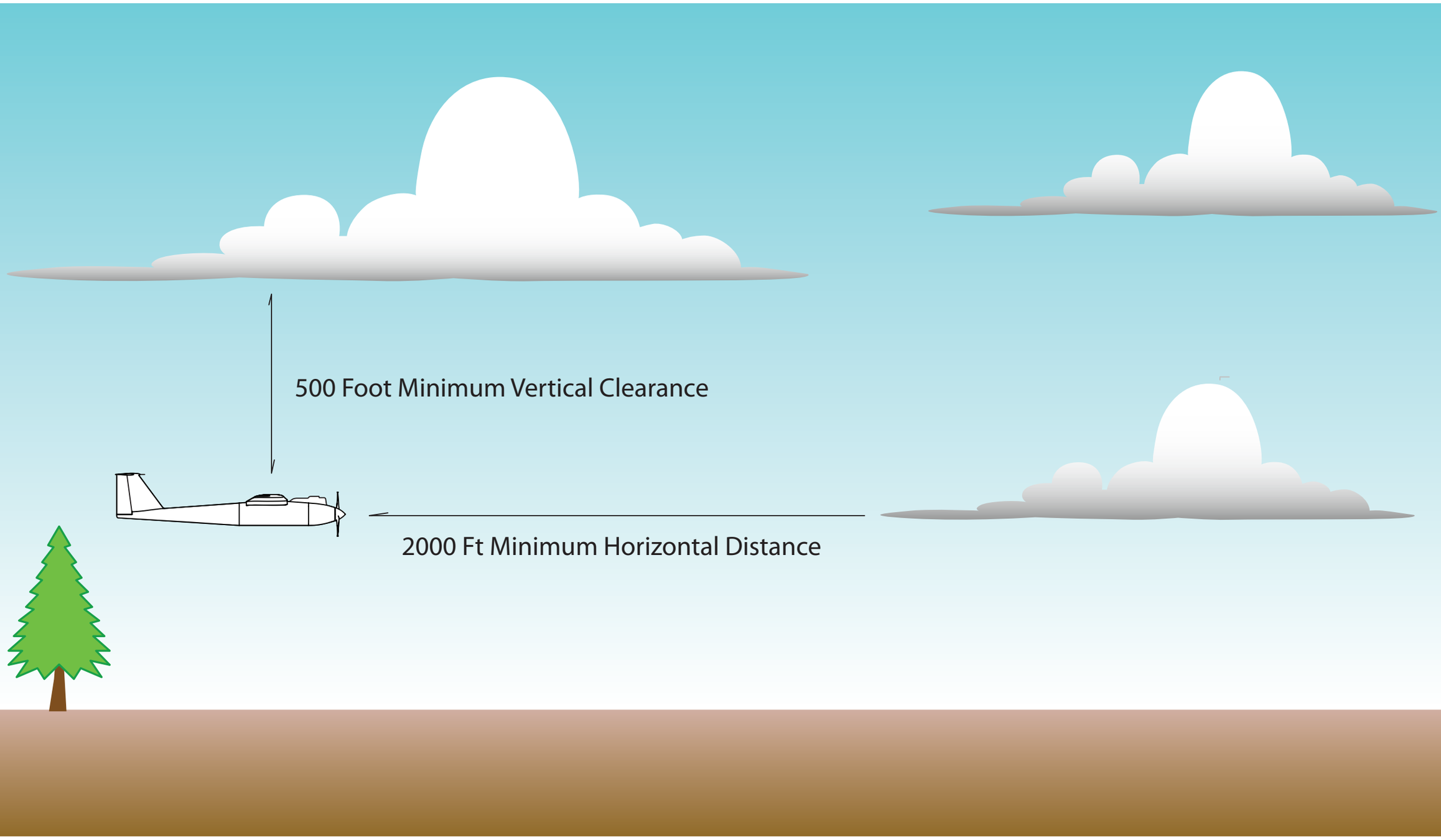
- Minimum visibility, as observed from the location of the CS, may not be less than 3 statute miles (sm); and

- Minimum distance from clouds being no less than 500 feet below a cloud and no less than 2000 feet horizontally from the cloud.


500 Foot Minimum Vertical Clearance
2000 Ft Minimum Horizontal Distance

- One of the ways to ensure adherence to the minimum visibility and cloud clearance requirements is to obtain local aviation weather reports that include current and forecast weather conditions.

- **Determining Groundspeed**

  - Installing a Global Positioning System (GPS) device on the small UA that reports groundspeed information to the remote pilot, wherein the remote pilot takes into account the wind direction and speed and calculates the small UA airspeed for a given direction of flight, or

  - Timing the groundspeed of the small UA when it is flown between two or more fixed points, taking into account wind speed and direction between each point, then noting the power settings of the small UA to operate at or less than 87 knots groundspeed, or

  - Using the small UA's manufacturer design limitations (e.g., installed groundspeed limiters).

- **Determining Altitude:**

  - Installing a calibrated altitude reporting device on the small UA.

  - Installing a GPS device on the small UA that also has the capability of reporting MSL altitude to the remote pilot;

  - Using the known height of local rising terrain and/or structures as a reference.

Prohibited operations over persons

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- A small UA may be flown over a person who is directly participating in the operation of the sUAS, such as the remote PIC, other person manipulating the controls, a VO, or crew members necessary for the safety of the sUAS operation, as assigned and briefed by the remote PIC.

Remaining Clear of Other Aircraft

- A remote PIC has a responsibility to operate the small UA so it remains clear of and yields to all other aircraft.
    - The remote PIC must know the location and flight path of his or her small UA at all times.
    - The remote PIC must be aware of other aircraft, persons, and property in the vicinity of the operating area, and maneuver the small UA to avoid a collision, as well as prevent other aircraft from having to take action to avoid the small UA.

Operations from Moving Vehicles

- Part 107 permits operation of an sUAS from a moving land or water-borne vehicle over a sparsely-populated area. However, operation from a moving aircraft is prohibited.

Careless or reckless operations

- Part 107 also prohibits careless or reckless operation of an sUAS.

Transportation of Property

- Part 107 permits transportation of property by sUAS for compensation or hire. These operations must be conducted within a confined area and in compliance with the operating restrictions of part 107.

- **As with other operations in part 107, sUAS operations involving the transport of property must be conducted within VLOS of the remote pilot.**

Operations while impaired

- Part 107 does not allow operation of an sUAS if the remote PIC, person manipulating the controls, or VO is unable to safely carry out his or her responsibilities. It is the remote PIC's responsibility to ensure all crew members are not participating in the operation while impaired.
    - Part 107 prohibits a person from serving as a remote PIC, person manipulating the controls, VO, or other crewmember if he or she:
        - Consumed any alcoholic beverage within the preceding 8 hours;
        - Is under the influence of alcohol.
        - Has a blood alcohol concentration of .04 percent or greater; and/or
        - Is using a drug that affects the person's mental or physical capabilities.

Daylight Operations

- Part 107 prohibits operation of an sUAS 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.
- In the continental United States (CONUS), evening civil twilight is the period of sunset until 30 minutes after sunset and morning civil twilight is the period of 30 minutes prior to sunrise, until sunrise.

Civil Twilight Operations

- When sUAS operations are conducted during civil twilight, the small UA must be equipped with anti-collision lights that are capable of being visible for at least 3 sm. However, the remote PIC may reduce the visible distance of the lighting less than 3 sm during a given flight if he or she has determined that it would be in the interest of safety to do so.

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 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.

Aircraft Registration

Aircraft Registration

- A small UA must be registered, as provided for in 14 CFR part 47 or part 48 prior to operating under part 107.

- Part 48 is the regulation that establishes the streamlined online registration option for sUAS that will be operated only within the territorial limits of the United States.

Registration of Foreign-Owned and Operated sUAS

- If sUAS operations involve the use of foreign civil aircraft, the operator would need to obtain a Foreign Aircraft Permit pursuant to 14 CFR part 375, § 375.41 before conducting any commercial air operations under this authority.

Aero-Medical

- It is important for a pilot to be aware of the mental and physical standards required for the type of flying performed.
- Being able to safely operate the sUAS relies on, among other things, the physical and mental capabilities of the remote PIC, person manipulating the controls, VO, and any other direct participant in the sUAS operation.

- **The Remote PIC, person manipulating the controls of an sUAS and VO may not participate in the operation of an sUAS if they know or have reason to know that they have a physical or mental condition that could interfere with the safe operation of the sUAS.**

Physical or Mental incapacitations

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- The temporary or permanent loss of the dexterity necessary to operate the CS to safely control the small UA.

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- The inability to maintain the required “see and avoid” vigilance due to blurred vision.

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- The inability to maintain the required “see and avoid” vigilance due to blurred vision.

- The inability to maintain proper situational awareness of the small UA operations due to illness and/or medication(s), such as after taking medications with cautions not to drive or operate heavy machinery

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- The temporary or permanent loss of the dexterity necessary to operate the CS to safely control the small UA.

- The inability to maintain the required “see and avoid” vigilance due to blurred vision.

- The inability to maintain proper situational awareness of the small UA operations due to illness and/or medication(s), such as after taking medications with cautions not to drive or operate heavy machinery

- A debilitating physical condition, such as a migraine headache or moderate or severe body ache(s) or pain(s) that would render the remote PIC, person manipulating the controls, or VO unable to perform sUAS operational duties.

Physical or Mental Incapacitations

- The temporary or permanent loss of the dexterity necessary to operate the CS to safely control the small UA.

- The inability to maintain the required “see and avoid” vigilance due to blurred vision.

- The inability to maintain proper situational awareness of the small UA operations due to illness and/or medication(s), such as after taking medications with cautions not to drive or operate heavy machinery

- A debilitating physical condition, such as a migraine headache or moderate or severe body ache(s) or pain(s) that would render the remote PIC, person manipulating the controls, or VO unable to perform sUAS operational duties.

- A hearing or speaking impairment that would inhibit the remote PIC, person manipulating the controls, and VO from effectively communicating with each other. In a situation such as this, the remote PIC must ensure that an alternative means of effective communication is implemented. **For example, a person who is hearing impaired may be able to effectively use sign language to communicate**

Health and Physiological Factors Affecting Pilot Performance

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- **Fatigue:** Fatigue is frequently associated with pilot error. Some of the effects of fatigue include degradation of attention and concentration, impaired coordination, and decreased ability to communicate.

- **Dehydration and Heatstroke:** Dehydration is the term given to a critical loss of water from the body. Causes of dehydration are hot flight decks and flight lines, wind, humidity, and diuretic drinks—coffee, tea, alcohol, and caffeinated soft drinks. Some common signs of dehydration are headache, fatigue, cramps, sleepiness, and dizziness.

- **Alcohol:** Alcohol impairs the efficiency of the human body. Studies have shown that consuming alcohol is closely linked to performance deterioration.

Type Beverage	Typical Serving (oz)	Pure Alcohol Content (oz)
Table wine	4.0	.48
Light beer	12.0	.48
Aperitif liquor	1.5	.38
Champagne	4.0	.48
Vodka	1.0	.50
Whiskey	1.25	.50

0.01–0.05% (10–50 mg)	average individual appears normal
0.03–0.12%* (30–120 mg)	mild euphoria, talkativeness, decreased inhibitions, decreased attention, impaired judgment, increased reaction time
0.09–0.25% (90–250 mg)	emotional instability, loss of critical judgment, impairment of memory and comprehension, decreased sensory response, mild muscular incoordination
0.18–0.30% (180–300 mg)	confusion, dizziness, exaggerated emotions (anger, fear, grief), impaired visual perception, decreased pain sensation, impaired balance, staggering gait, slurred speech, moderate muscular incoordination
0.27–0.40% (270–400 mg)	apathy, impaired consciousness, stupor, significantly decreased response to stimulation, severe muscular incoordination, inability to stand or walk, vomiting, incontinence of urine and feces
0.35–0.50% (350–500 mg)	unconsciousness, depressed or abolished reflexes, abnormal body temperature, coma, possible death from respiratory paralysis (450 mg or above)

* Legal limit for motor vehicle operation in most states is 0.08 or 0.10% (80–100 mg of alcohol per dL of blood).

Aeronautical Decision Making and Crew Resource Management

- ADM is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances. A remote PIC uses many different resources to safely operate an sUAS and needs to be able to manage these resources effectively.

- CRM is a component of ADM, where the pilot of sUAS makes effective use of all available resources: human resources, hardware, and information

- Pilots operating under part 107 may use a VO, oversee other persons manipulating the controls of the small UA, or any other person who the remote PIC may interact with to ensure safe operations. Therefore, a remote PIC must be able to function in a team environment and maximize team performance.

- Skill sets include situational awareness, proper allocation of tasks to individuals, avoidance of work overloads in self and in others, and effectively communicating with other members of the crew, such as VOs and persons manipulating the controls of an sUAS.

- Despite all the changes in technology to improve flight safety, one factor remains the same: the human factor which leads to errors. It is estimated that approximately 80 percent of all aviation accidents are related to human factors and the vast majority of these accidents occur during landing (24.1 percent) and takeoff (23.4 percent).

Hazard and Risk

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Steps for Good Decision Making

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- Learning behavior modification techniques.
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- Developing risk assessment skills.
- Using all resources.
- Evaluating the effectiveness of one’s ADM skills.

Risk Management

Risk Management

- The goal of risk management is to proactively identify safety-related hazards and mitigate the associated risks. Risk management is an important component of ADM. When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated. The ability to make good decisions is based upon direct or indirect experience and education.

RISK ASSESSMENT

Pilot's Name _____ **Flight From** _____ **To** _____

SLEEP

1. Did not sleep well or less than 8 hours	2
2. Slept well	0

HOW DO YOU FEEL?

1. Have a cold or ill	4
2. Feel great	0
3. Feel a bit off	2

WEATHER AT TERMINATION

1. Greater than 5 miles visibility and 3,000 feet ceilings	1
2. At least 3 miles visibility and 1,000 feet ceilings, but less than 3,000 feet ceilings and 5 miles visibility	3
3. IMC conditions	4

Column total _____

HOW IS THE DAY GOING?

1. Seems like one thing after another (late, making errors, out of step)	3
2. Great day	0

IS THE FLIGHT

1. Day?	1
2. Night?	3

PLANNING

1. Rush to get off ground		3
2. No hurry		1
3. Used charts and computer to assist		0
4. Used computer program for all planning	Yes	3
	No	0
5. Did you verify weight and balance?	Yes	0
	No	3
6. Did you evaluate performance?	Yes	0
	No	3
7. Do you brief your passangers on the ground and in flight?	Yes	0
	No	2

Column total _____

TOTAL SCORE _____

Hazardous Attitudes and Antidotes

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- Hazardous attitudes contribute to poor pilot judgment but can be effectively counteracted by redirecting the hazardous attitude so that correct action can be taken.

- Recognition of hazardous thoughts is the first step toward neutralizing them.

The Five Hazardous Attitudes

Anti-Authority: "Don't tell me."

This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, "No one can tell me what to do." They may be resentful of having someone tell them what to do, or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.

Impulsivity: "Do it quickly."

This is the attitude of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do; they do not select the best alternative, and they do the first thing that comes to mind.

Invulnerability: "It won't happen to me."

Many people falsely believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. However, they never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.

Macho: "I can do it."

Pilots who are always trying to prove that they are better than anyone else think, "I can do it—I'll show them." Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.

Resignation: "What's the use?"

Pilots who think, "What's the use?" do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that someone is out to get me, or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a "nice guy."

PAVE Checklist

PAVE Checklist

- Another way to mitigate risk is to perceive hazards. By incorporating the PAVE checklist into preflight planning, the pilot divides the risks of flight into four categories: ***Pilot-in-command (PIC), Aircraft, enVironment, and External pressures (PAVE)*** which form part of a pilot's decision-making process.

Pilot

A pilot must continually make decisions about competency, condition of health, mental and emotional state, level of fatigue, and many other variables. For example, a pilot may be called early in the morning to make a long flight. If a pilot has had only a few hours of sleep and is concerned that the congestion being experienced could be the onset of a cold, it would be prudent to consider if the flight could be accomplished safely.

A pilot had only 4 hours of sleep the night before being asked by the boss to fly to a meeting in a city 750 miles away. The reported weather was marginal and not expected to improve. After assessing fitness as a pilot, it was decided that it would not be wise to make the flight. The boss was initially unhappy, but later convinced by the pilot that the risks involved were unacceptable.

Environment

This encompasses many elements not pilot or airplane related. It can include such factors as weather, air traffic control, navigational aids (NAVAIDS), terrain, takeoff and landing areas, and surrounding obstacles. Weather is one element that can change drastically over time and distance.

A pilot was landing a small airplane just after a heavy jet had departed a parallel runway. The pilot assumed that wake turbulence would not be a problem since landings had been performed under similar circumstances. Due to a combination of prevailing winds and wake turbulence from the heavy jet drifting across the landing runway, the airplane made a hard landing. The pilot made an error when assessing the flight environment.

Aircraft

A pilot will frequently base decisions on the evaluations of the airplane, such as performance, equipment, or airworthiness.

During a preflight, a pilot noticed a small amount of oil dripping from the bottom of the cowling. Although the quantity of oil seemed insignificant at the time, the pilot decided to delay the takeoff and have a mechanic check the source of the oil. The pilot's good judgment was confirmed when the mechanic found that one of the oil cooler hose fittings was loose.

External Pressures

The interaction between the pilot, airplane, and the environment is greatly influenced by the purpose of each flight operation. The pilot must evaluate the three previous areas to decide on the desirability of undertaking or continuing the flight as planned. It is worth asking why the flight is being made, how critical is it to maintain the schedule, and is the trip worth the risks?

On a ferry flight to deliver an airplane from the factory, in marginal weather conditions, the pilot calculated the groundspeed and determined that the airplane would arrive at the destination with only 10 minutes of fuel remaining. The pilot was determined to keep on schedule by trying to "stretch" the fuel supply instead of landing to refuel. After landing with low fuel state, the pilot realized that this could have easily resulted in an emergency landing in deteriorating weather conditions. This was a chance that was not worth taking to keep the planned schedule.

Figure 17-6. *The PAVE checklist.*

- **P**-Pilot in Command (PIC): “Am I ready for this flight operation?”

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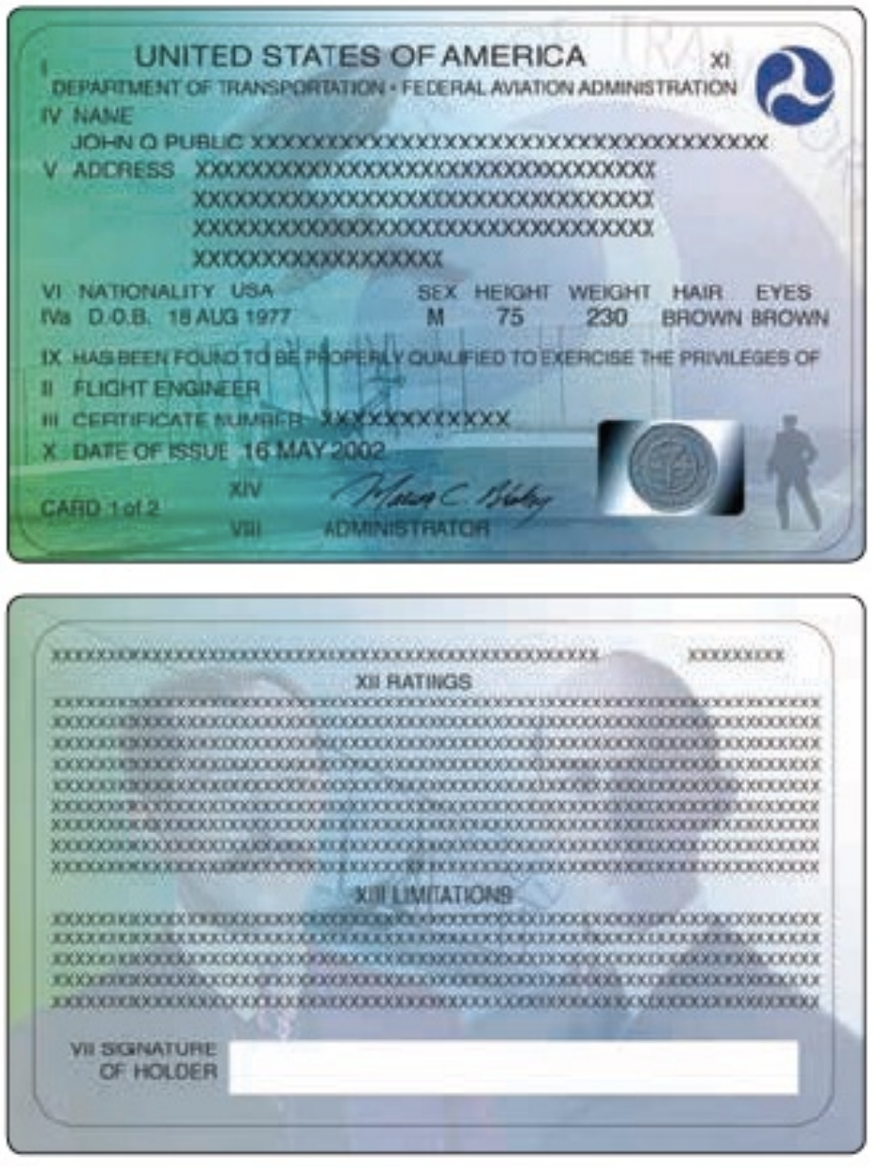
- **A**-Aircraft: “Is this the right aircraft for the flight?”

- **V**-Environment: “What are the current ceiling and visibility?

- **E**-External Pressures: “Am I making a decision to fly, because of a deadline?”



Pilot Certification

- **Remote Pilot Certification:** A person exercising the authority of PIC in compliance with part 107 is considered a “remote pilot in command” (remote PIC). As such, prior to acting as remote PIC, he or she must obtain a remote pilot certificate with an sUAS rating

Eligibility

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- A person applying for a remote pilot certificate with an sUAS rating must meet and maintain the following eligibility requirements, as applicable:

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- Be able to read, speak, write, and understand the English language. However, the FAA may make an exception if the person is unable to meet one of these requirements due to medical reasons, such as a hearing impairment.

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- Be in a physical and mental condition that would not interfere with the safe operation of an sUAS.

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- Be in a physical and mental condition that would not interfere with the safe operation of an sUAS.

- Pass the initial aeronautical knowledge test at an FAA-approved knowledge testing center (KTC). However, a person who already holds a pilot certificate issued under 14 CFR part 61, except a student pilot certificate, and has successfully completed a flight review in accordance with part 61 within the previous 24 calendar-months is only required to successfully complete a part 107 online training course, found at www.faasafety.gov. For more information concerning aeronautical knowledge tests and training

Applicants Without Part 61 Certificates

- Pass an initial aeronautical knowledge test administered at a KTC.

- Complete the Remote Pilot Certificate and/or Rating Application for a remote pilot certificate (FAA Form 8710-13).

Applicants with Part 61 Certificates

- Complete the online course (Part 107 small Unmanned Aircraft Systems (sUAS), ALC-451) located within the FAA Safety Team (FAASTeam) Web site (www.faasafety.gov) and receive a completion certificate.

- Complete the Remote Pilot Certificate and/or Rating Application for a remote pilot certificate (FAA Form 8710-13).

Recurrent Test

- After a person receives a remote pilot certificate with an sUAS rating, that person must retain and periodically update the required aeronautical knowledge to continue to operate a small UA in the NAS. To continue exercising the privileges of a remote pilot certificate, the certificate holder must pass a recurrent aeronautical knowledge test within 24 calendar-months of passing either an initial or recurrent aeronautical knowledge test. A part 61 pilot certificate holder who has completed a flight review within the previous 24 calendar-months may complete a recurrent online training course instead of taking the knowledge test.

sUAS Maintenance

sUAS Maintenance

- Section 107.15 requires the remote PIC to perform checks of the UA prior to each flight to determine if the sUAS is in a condition for safe operation.

- sUAS maintenance includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the sUAS and its components necessary for flight.

Preflight Inspections

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- Before each flight, the remote PIC must inspect the sUAS to ensure that it is in a condition for safe operation, such as inspecting for equipment damage or malfunction(s).

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- The preflight inspection should be conducted in accordance with the sUAS manufacturer's inspection procedures when available (usually found in the manufacturer's owner or maintenance manual) and/or an inspection procedure developed by the sUAS owner or operator.

Preflight Inspection Items

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- Servo motor(s), including attachment point(s);

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- Propulsion system, including powerplant(s), propeller(s), rotor(s), ducted fan(s), etc.;

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- Verify all systems (e.g., aircraft and control unit) have an adequate energy supply for the intended operation and are functioning properly;

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- Moveable control surface(s), including airframe attachment point(s);
- Servo motor(s), including attachment point(s);
- Propulsion system, including powerplant(s), propeller(s), rotor(s), ducted fan(s), etc.;
- Verify all systems (e.g., aircraft and control unit) have an adequate energy supply for the intended operation and are functioning properly;
- Avionics, including control link transceiver, communication/navigation equipment, and antenna(s);

- Calibrate UAS compass prior to any flight;

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- Control link transceiver, communication/navigation data link transceiver, and antenna(s);

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- Display panel, if used, is functioning properly;

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- Control link transceiver, communication/navigation data link transceiver, and antenna(s);

- Display panel, if used, is functioning properly;

- Check ground support equipment, including takeoff and landing systems, for proper operation;

- Calibrate UAS compass prior to any flight;

- Control link transceiver, communication/navigation data link transceiver, and antenna(s);

- Display panel, if used, is functioning properly;

- Check ground support equipment, including takeoff and landing systems, for proper operation;

- Check that control link correct functionality is established between the aircraft and the CS;

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- Check flight termination system, if installed;

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- Check flight termination system, if installed;
- Check fuel for correct type and quantity;

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- Check onboard navigation and communication data links;
- Check flight termination system, if installed;
- Check fuel for correct type and quantity;
- Check battery levels for the aircraft and CS;

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- Check for correct movement of control surfaces using the CS;
- Check onboard navigation and communication data links;
- Check flight termination system, if installed;
- Check fuel for correct type and quantity;
- Check battery levels for the aircraft and CS;
- Check that any equipment, such as a camera, is securely attached;

- Calibrate UAS compass prior to any flight;
- Control link transceiver, communication/navigation data link transceiver, and antenna(s);
- Display panel, if used, is functioning properly;
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- Check that control link correct functionality is established between the aircraft and the CS;
- Check for correct movement of control surfaces using the CS;
- Check onboard navigation and communication data links;
- Check flight termination system, if installed;
- Check fuel for correct type and quantity;
- Check battery levels for the aircraft and CS;
- Check that any equipment, such as a camera, is securely attached;
- Start the UAS propellers to inspect for any imbalance or irregular operation;