

New User Guide for Drones in the UC System

UC Center of Excellence on UAS Safety

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Introduction



This guide will walk you through the steps for you start flying for your work or research. This page will be a work in progress and new resources will be added periodically. Feel free to reach out to us at UASSafety@ucmerced.edu if you have any questions or would like to see additional resources added.

UC Drone Policy

There is a University of California Drone Policy that governs the use of drones owned by the University of California, the use of drones at any University property, or the use of drones for any University purpose (including teaching, outreach and research). More information about the UC UAS Policy can be found in the UC UAS Policy Guidance Document located at http://UCDrones.github.io/Policy_Guidance/

Policy Requirements

The Policy establishes that anyone who seeks to operate a UAS under the jurisdiction of the policy must:

- Comply with any applicable regulation, including but not limited to any applicable FAA regulation.
- Have prior approval from the Campus Drone Person or the Systemwide Designated Authority.
- Operate in a manner that ensures public safety, right to privacy, civil rights and civil liberties.
- Maintain sufficient liability insurance coverage.

The UC Center of Excellence on UAS Safety is here to help you guide you through the process.

Step-by-step UC Drone Process

1. Register your drone with the FAA and UC
2. Get an FAA Drone License (or figure out if you're exempt) and register yourself with the UC
3. Find a place to fly - review airspace, safety guidelines and local regulations
4. Submit a UC Flight Request
5. Fly Safely
6. Submit a Post-Flight Report

Outline

Complying with Regulations

- Register your Drone with the FAA
- Do I need a License?
- How to get a License
- How to get Airspace Information
- TRUST Certificate

Getting UC Approval

- About UC Drones
- Registering your drone with your campus
- Creating a flight request
- Post-Flight Reporting
- Where to get more help

Planning for Safety

- Planning a Safe Mission
- Safety Guidelines
- Fire Safety
- Working around people and non-participants
- UAS and Privacy

Insurance

- UAS Liability Insurance
- UAS Property Insurance

More Details

- Common UAS Violations
- Reporting UAS accidents
- Local UAS Regulations
- How do I update or replace my License?

Part I

Getting Started

Chapter 1

Drone Rules and Regulations

Welcome to the world of Drones! We're always happy to see new drone pilots and new drone projects. But first, we have to introduce you to the ever-changing drone regulations.

Don't forget that following the DRONE regulations are only one part of the UC Drone Policy. Local rules, environmental regulations, export control, and even insurance requirements may require additional steps or have additional restrictions. Helping you navigate through all of this is part of the UC Drone Flight Request process.

1.1 Drone Operating Rules

The rules for operating a drone can be boiled down to "Do not do anything unsafe"

- No flying farther than you can clearly see the drone
 - You must be able to see the drone at all times

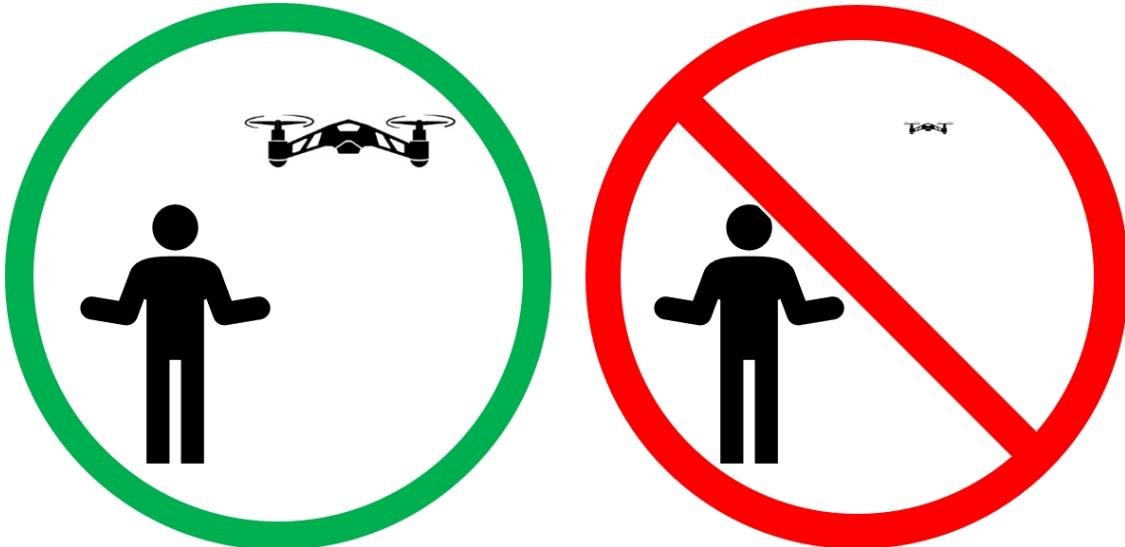


Figure 1.1: Visual Line of Sight

- No flying above non-participants or moving cars
- No flying higher than 400 ft above the ground
- No reckless or careless flying that endangers the life or property of another

- No flying when the horizon visibility drops below 3 miles
 - This includes smog, fog, or haze
- No flying within 2000 ft laterally or 500 ft vertically of any cloud
 - Including fog and low cloud layers on overcast days

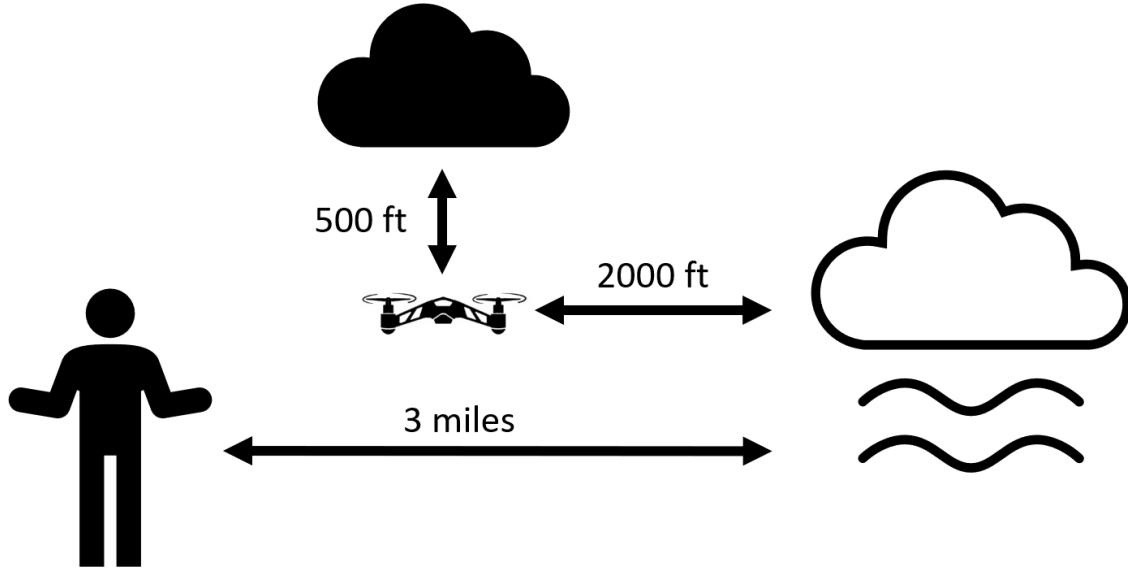


Figure 1.2: Minimum Distances from Clouds, Fog or Haze

- No flying faster than 100 mph
- No flying at night
- No operating a drone from a moving vehicle

1.2 Airspace Rules

- The drone must always get out of the way and always stay well-clear of all manned aviation traffic, including airplanes, helicopters, gliders, paragliders, hot air balloons and parachutes.
 - Even if “you were there first”
- Permission is required to fly in any controlled airspace (Class B, C, D, and surface Class E)
 - Controlled airspace is typically found within 5 miles of most airports for commercial travel and large general aviation airports (non-commercial travel) - See Figure 1.3

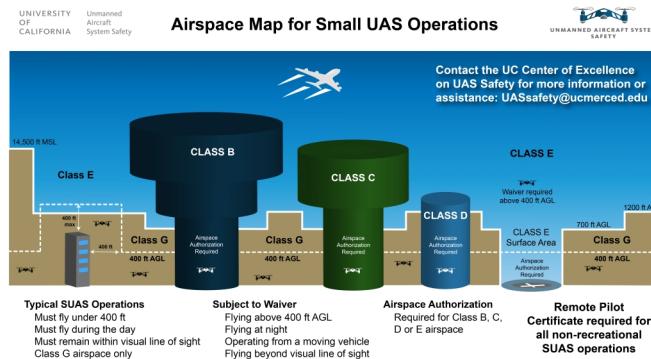


Figure 1.3: Small UAS Airspace Rules

- No interfering with aviation traffic patterns at any airport, heliport, or seaplane base

- Traffic patterns include more than just the immediate take off and landing - it also includes the downwind and base legs (See Figure 1.4)

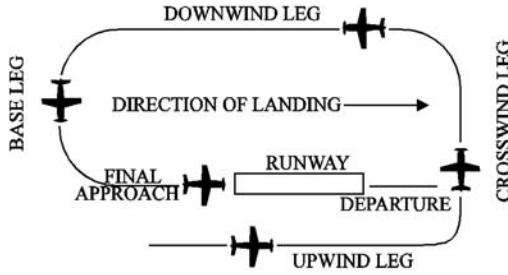


Figure 1.4: Typical Airport Traffic Patterns (FAA Aeronautical Information Manual)

1.3 Operator Rules

- There must always be a Remote Pilot in Command (RPIC)
 - The RPIC is the one in charge of the flight operations and is ultimately responsible for all safety and operations
 - The RPIC doesn't always have to be the one manipulating the flight controls of the drone - it could be the RPIC is letting a student learn to fly under his/her direct supervision.
 - The RPIC may only operate (supervise) one drone at a time
- The RPIC must have an FAA Drone License (or be exempt*)
 - More Info Here: [FAA Drone License](#)
- The RPIC must be at least 16 years of age, and must be able to speak, write and understand English.
 - No restriction on nationality but a license does require Federal documentation such as a Passport.
- No one may operate a drone or act as any direct participant in the operation of a drone if he or she knows, or has reason to know, that he or she has a physical or mental condition that would interfere with the safe operation of the drone.
- No one may operate a drone or act as any direct participant in the operation of a drone under the influence of alcohol or any drug that may inhibit decision making



Figure 1.5: No drugs, alcohol or altered mind-states allowed during flight operations

1.4 Drone Rules

- All drones that weigh more than 0.55 lbs (250 grams) must be registered with the FAA
 - Only use the FAA DroneZone website for registration (More Info here: Register your Drone)

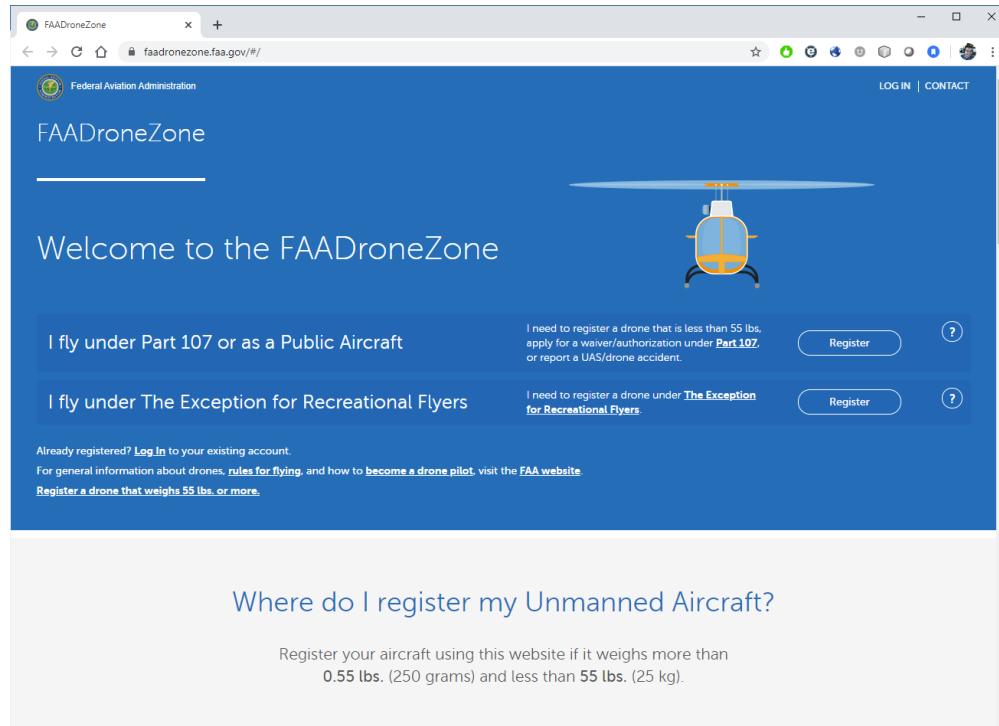


Figure 1.6: FAA DroneZone

- Drones must weigh less than 55 lbs
 - Drones that weigh more than 55 lbs require rare special FAA authorization
- Drones may not drop or release hazardous material
 - Drones that drop biological or chemical agents for Agriculture require additional Federal and State authorizations
 - While not illegal, please do not drop glitter or confetti from a drone
- Any payload that is attached to the drone must be securely attached and may not adversely affect the controllability of the drone
- Weapons are not allowed to be attached or used on drones
- Tethered drones are not exempt from drone regulations

The topic of drone regulations can be very nuanced and complex. We've shortened it to the basics in this section, but there may be scenarios or situations that may be exempt or have additional restrictions. Always feel free to reach out to us at UASsafety@ucmerced.edu for a one-on-one consultation.

Chapter 2

Register your Drone

This page is for the registration of your drone with the Federal Aviation Administration. For information on how to register your drone with the UC system, see Chapter 13.

All drones that weigh more than 0.55 lbs (250 grams) must be registered with the Federal Aviation Administration (FAA) to its legal owner.

Any drone purchased through the University of California for university business, including teaching and research, is owned by the Regents of the University of California.

You can register the drone through the FAA Drone Zone (<https://faadronezone.faa.gov>). Registration costs only \$5 per aircraft and only takes a couple of minutes.

2.1 Create an account at DroneZone

Head to the FAA DroneZone (<https://faadronezone.faa.gov>) and select “I fly under Part 107 or as a Public Aircraft” 2.1

Important Note Unfortunately, the FAA’s drone registration website does not allow you to register drones for multiple groups or organizations. If you’re registering a drone on behalf of the University of California, you should use your UC email address as your account log in, and use a personal email address account for any personally-owned drones.

When you enter your Part 107 Account information, enter **Regents of the University of California** as your Part 107 Account Name to correctly register the drone to the UC system.

If you already have an account, go into your profile settings, and you can modify the **Part 107 Account Name** on the popup.

2.2 Drone Registration

Once you have an account, on the dashboard will be an option to ‘Manage sUAS Inventory.’ On that page, you’ll be able to ‘Add UAS’ (in the upper right corner). This will bring up a dialog box (Figure 2.2) for you to enter your information. Enter all the relevant information.

Once completed, ‘Your Shopping Cart’ will now show this drone’s information and a new button for ‘Check-out’ will appear. Click the button and the system will guide you through paying for the registration fee.

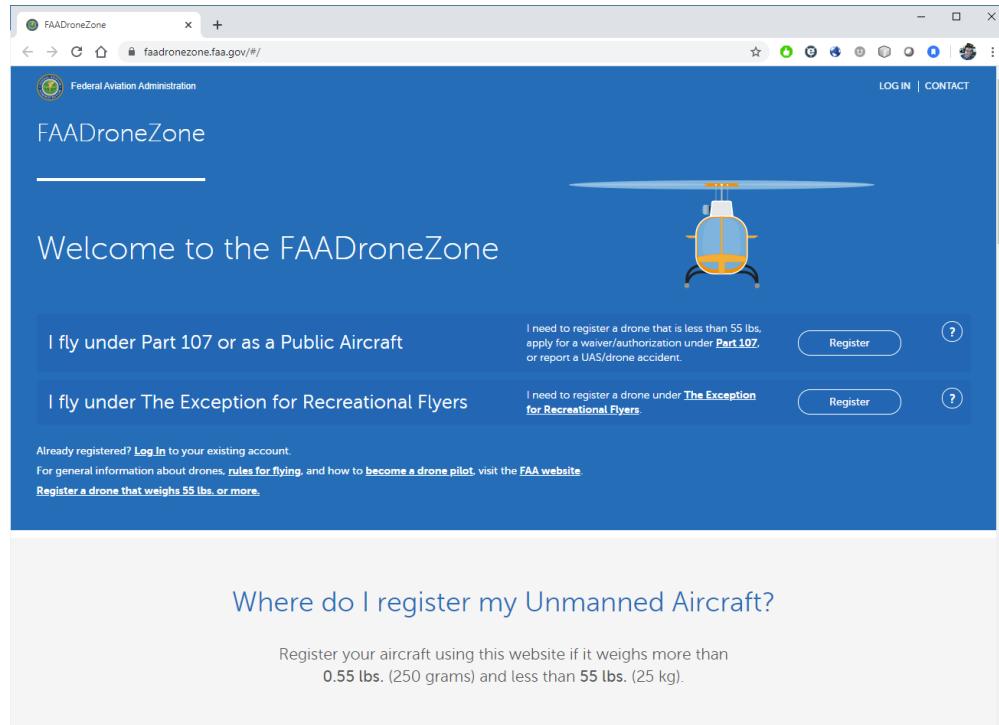


Figure 2.1: FAA DroneZone

This is a modal dialog box titled 'Add New UAS'. It contains several input fields: 'UAS TYPE' with a dropdown menu showing 'Select UAS type'; 'NICKNAME' with the placeholder 'Enter a Nickname (Required)'; 'MANUFACTURER' with the placeholder 'Enter a Manufacturer (Required)'; 'MODEL' with the placeholder 'Enter a Model (Required)'; and 'SERIAL NUMBER' with the placeholder 'Enter a Serial Number (Required)'. Below these fields is a checkbox labeled 'SERIAL NUMBER NOT APPLICABLE'. At the bottom of the dialog are two buttons: 'Cancel' on the left and 'Add UAS' on the right, which is highlighted with a blue background.

Figure 2.2: Add new UAS Dialog Box

2.3 Registration Certificate

Upon completion of paying for registration, the DroneZone will send you two emails, one with a receipt of payment and the other is a pdf copy of your UAS registration certificate (Figure 2.3). Keep a copy of this registration certificate available at all times while you operate. This can be done by either printing it out and placing it with your drone, or keeping a digital copy on your phone.



Figure 2.3: Example UAS Registration Certificate

2.4 Marking the Drone

Your drone's registration number is the 10 digit alphanumeric code that starts with **FA**. You must mark this on your drone on an external location, where it can be plainly visible.

We recommend either using a permanent oil-based fine tip paint marker (Figure 2.4) or creating a label that can be strongly affixed to the drone. We've found that regular sharpies or markers are rubbed off too easily to be effective.

If you'll be working with a fleet of aircraft, it may also be useful to mark the 'nickname' of the drone as well.



Figure 2.4: Oil-Based Paint Markers

Chapter 3

Do I need an FAA License?

When operating a drone within the US, there are two different options for regulations: Part 107 Small UAS regulations or the Exception for Limited Recreational Use. By default, UAS operations fall under Part 107 Small UAS regulations, unless you can meet the requirements for the exception for Recreational Use. Part 107 requires that all pilots have a Remote Pilot Certificate with an sUAS rating, more commonly known as a ‘Drone License,’ whereas Recreational Use requires a TRUST certificate.

As of June 2021, all drone pilots must have either: 1. Remote Pilot Certificate (Drone License) 2. TRUST Certificate

Many researchers opt to get a Drone License for their research needs, but a Drone License does cost \$150 and will take some time to study and prepare for. With the updates introduced in the FAA Reauthorization Act of 2018 (P.L. 115-254), there are more exceptions available in which you may not need to obtain the license.

The Recreational UAS Safety Test (TRUST) certificate is a new requirement for all drone pilots without a Drone License. The TRUST certificate is free for everyone, can be done online and takes 20-30 minutes to complete the training. You can obtain your TRUST certificate by completing the drone training at any of websites listed on the FAA’s website here: https://www.faa.gov/uas/recreational_fliers/knowledge_test_updates/

This page is for the Federal Aviation Administration licensing requirements for UAS use. UC Policy will still require a flight request and post flight reporting, regardless of FAA licensing requirements. More information on the UC policy can be found in Chapter .

3.1 What is the difference?

Under Part 107

- Drone License required
- Any purpose
- ‘Fly only when it is safe’
- May request special permissions
 - Above FAA Facility Map altitudes
 - Over People, BVLOS, More than 1 drone at a time

Under Recreational Exception

- TRUST certificate
- Recreation or Approved Academic Activities
- ‘Fly only in safe locations’
- No allowances for advanced operations

3.2 When are you Exempt from a drone license

You may not need a drone license if your flight operations can fit under the stipulations listed for ‘recreational’ activities **and** your flight operations are related to

- Coursework
- Instruction of students
- Academic or research related uses of unmanned aircraft systems that have been approved by the institution
- Activities undertaken by the institution as part of research projects
- Other academic activities approved by the institution

3.3 What are the stipulations for ‘Recreational’ and approved ‘Academic’ activities?

Recreational flight operations, despite what you see on YouTube, have strict requirements:

- Only fly below 400 ft
- Must stay within Visual Line of Sight
- Must fly only in safe areas and no closer than 25 ft to any individuals
- Must use an established safety line to separate all operations from spectators and bystanders
- Must get FAA authorization to fly in Controlled Airspace (Class B, Class C, Class D and surface Class E)
- Never fly over any person or moving vehicle
- Never interfere with any manned aircraft or emergency response activity
- Never fly under the influence of drugs or alcohol
- Never operate in a careless or reckless manner

This is in addition to existing UAS operating restrictions under 14 CFR 107:

- No operating from a moving vehicle
- No operating more than one vehicle at a time
- No operating faster than 100 mph
- No operating when the weather visibility is less than 3 miles
- No operating closer than 500 ft below a cloud, or within 2000 ft horizontally from a cloud or fog layer

3.4 Other Situations

There are other conditions that may require a closer evaluation, including whether you’re a US citizen or if you plan on flying internationally. If you have any questions, feel free to reach out to UASsafety@ucmerced.edu for a consultation.

Other scenarios that may require a closer look

- Performing a demonstration
- Not a US citizen
- Flying above 400 ft AGL
- Flying in fog or with limited visibility
- Flying at night
- Flying internationally

3.5 Frequently Asked Questions

When doing an academic activity, which set of regulations is better?

There are advantages and disadvantages to both scenarios. In many cases, the new ‘Recreational Operations’ may be the fastest path forward for simple, rural flight operations. At the current time, academic UAS activities that plan on flying in certain controlled airspace areas, over occupied structures, within 25 ft of another person, or outside of a reasonably controlled flying site, should proceed with 14 CFR 107 regulations.

What does it mean to get approval from the FAA to operate within controlled airspace?

The FAA is mandating that all controlled airspace access requests for recreational operations be routed through the Low Altitude Authorization Notification Capability system (LAANC) and not by calling the local airport tower. The LAANC system can provide instantaneous authorization via a 3rd party application such as Airmap, KittyHawk, or UASideKick for flight requests below a certain altitude depending on your location.

I am planning to fly over a research site that is access controlled and the airspace is uncontrolled, do I need a Drone License?

Typically not. This common scenario will typically meet the necessary site requirements for Recreational Operations.

I am planning to fly along the beach to monitor coastal erosion, do I need a Drone License?

Unless the beach is to be closed to the public, this scenario will likely require a Drone License.

I am planning on flying in the campus quad to test a flight controller, do I need a Drone License?

If the airspace is uncontrolled (Class G), and the area within the campus is sufficiently cleared and closed to non-participants, then you do not need a Drone License and can get the TRUST certificate. However, there are some parts of some of the UC campuses that are in controlled airspace where a Drone License is required. Please check with your Campus Drone Point of Contact for more information.

I do not have a Drone License, can I do a coursework assignment on the use of drones in building inspections with a TRUST certificate?

You may be able to do some flying with only a TRUST certificate, however, you will not be allowed to fly over a building and must stay at least 25 ft from all non-participants, which may limit your ability to conduct effective analysis.

I am a graduate student Teaching Assistant and I would like to teach my students how to fly a drone? Do I need a license? Do the students need a license?

If the site is sufficiently cleared and closed to non-participants, than everyone may have a chance to learn how to fly a drone with only a TRUST certificate and any instructor may only have a TRUST certificate. However, additional safety precautions may be necessary and as an instructor, you will be responsible for ensuring the safety of the students and the site.

Chapter 4

How to get a License

Obtaining a Remote Pilot Certificate, or more commonly known as a drone license, is relatively straightforward. The process is similar to obtaining a drivers license, but with one key exception: there is no ‘driving’ test component. To get a drone license, you must study for and pass a drone license exam that tests only on your knowledge of aviation rules and safety.

The FAA has found that on average, most people study for the exam for about 20 hours and that 90% of test takers pass on the first try. The exam is not particularly challenging, but it requires a lot of memorization.

4.1 Drone License Exam

The drone license exam (airman knowledge test) is a 120 minute, 60 question exam that goes over a wide range of topics. The topics covered on the exam can be broken down into 12 sections as follows:

1. General UAS regulations
2. Airspace classifications
3. Aviation weather sources
4. Loading and Performance
5. Emergency procedures
6. Crew resource management
7. Radio communication procedures
8. Determining UAS performance
9. Physiological effects of drugs and alcohol
10. Aeronautical decision-making and judgment
11. Airport operations and
12. Maintenance and pre-flight inspection procedures.

A more in depth look at these topics can be found on the FAA’s website here: (https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/remote_pilot_study_guide.pdf)

The most important and most difficult part of the exam is learning how to read and understand the Airspace Maps. Airspace maps pack a lot of information in a small space, so they often look very overwhelming and complex. For more information on how read Airspace Maps, check our tutorial here: Reading an Airspace Map.

4.2 Free study resources

Here are a few free study resources to aid in studying for the exam:

- (<https://jrupprechtlaw.com/part-107-test-study-guide>)
- (<https://northrup.photo/free-faa-part-107-suas-drone-certification-study-guide/>)
- (<https://www.3dr.com/docs/faa-part-107-study-guide/part-107-certification-official-study-resources/>)

Although there are third party “Ground school” courses offered for a fee, we have found freely available resources to be just as effective.

4.3 Drone License Eligibility

In order to be eligible to obtain a Remote Pilot Certificate, you must meet the following requirements:

- Be at least 16 years of age
- Be able to read, speak and understand the English language. If the applicant is unable to meet one of these requirements due to medical reasons, the FAA may place such operation limitations on that applicant’s certificate as are necessary for the safe operation of the small unmanned aircraft.
- Not know or have reason to know that he or she has a physical or mental condition that would interfere with the safe operation of a small unmanned aircraft system.

However, to take the FAA Airman Knowledge Exam, the proponent must prove their identity with a valid photo ID that includes their date of birth, signature and physical, residential address.

For U.S. Citizens and U.S. Resident Aliens, this may be accomplished with one of the following:

- Driver Permit or License issued by a U.S. state or territory
- U.S. Government Identification Card
- U.S. Military Identification Card
- Passport
- Alien Residency Card

For Non-U.S. Citizens, this may be accomplished with one of the following:

- Passport and a Driver permit or license issued by a U.S. state or territory.
- Passport and an Identification card issued by any governmental entity.

Chapter 5

The Recreational UAS Safety Test

Starting in June 2021, all recreational flyers must pass an aeronautical knowledge and safety test and provide proof of test passage (the TRUST completion certificate) to the FAA or law enforcement (including campus police) upon request. The test is free for everyone and takes 20-30 minutes to complete.

You may take The Recreational UAS Safety Test at any of the administrators found on the FAA's website:
https://www.faa.gov/uas/recreational_fliers/knowledge_test_updates/

The TRUST is divided into two sections:

- The first section provides you with the information needed to pass the test.
- The second section is a series of multiple choice questions. You cannot fail the test. If you answer a question incorrectly you will be provided with information on why the answer you chose was incorrect and will be prompted to try again.

Upon completion of the TRUST you will receive a completion certificate. The certificate never expires however if you lose your certificate you will need to re-take the test and obtain a new certificate. Neither the test administrator, nor the FAA, will maintain personally identifiable information about the recreational flyer so it is not possible to re-print or re-issue your original certificate. We recommend uploading your certificate to UC Drones so that you have a backup copy available.

5.1 What is TRUST?

TRUST is The Recreational UAS Safety Test. It provides education and testing for recreational flyers on important safety and regulatory information. If you fly your drone recreationally under the Exception for Recreational Flyers you must pass the test before you fly - this includes both recreational use and certain academic use-cases.

5.2 How Can I Take the TRUST

You may take the free online test through any of the approved test administrators listed on the FAA's website here: https://www.faa.gov/uas/recreational_fliers/knowledge_test_updates/. After you complete the TRUST, you will be given the option to download your TRUST certificate and write down your Authentication Token. We recommend uploading your TRUST certificate and entering your Authentication Token into your pilot profile within UC Drones.

5.3 Who made the TRUST?

The FAA provides education and testing content to FAA Approved Test Administrators of TRUST, who in turn provide the content to recreational flyers for free.

5.4 What does the TRUST certificate look like?



Chapter 6

How to get Airspace information

When you're figuring out where you want to fly, you're typically thinking about your research objectives on the ground. But you must also think about whether or not it will be safe to fly a drone in the airspace at that location. You won't find this information on Google Maps though - you need to check the Airspace Maps or Aviation Charts.

Reading an Airspace Map is not like reading Google Maps - you'll rarely see roads or buildings marked - instead you'll be presented with a whole new set of symbols and strange codes. But they're all very important to convey a dense set of aviation information. Luckily with drones, you won't have to worry about most of it, but there's still some very important pieces of information you need to know.

There's a lot of rules about flying drones and many of them are related to where and how risky. For more information about Airspace Class and their rules, check out the UAS Regulations and the Reading an Airspace Map pages.

Things you should look for when reviewing Airspace Information

- Airspace Class
- Nearby Airports, including smaller ones and helipads
- Potential air traffic patterns
- Special Use Airspace - Military Operating Areas, Controlled Firing Ranges, National Security Areas, and Restricted Areas
- Flying altitude limits within certain zones or grids
- Temporary Flight Restrictions or special alerts

So where can you find this information? We recommend two sources:

- Airmap (3rd party application and website)
- Official FAA Sources - VFR Sectional Charts, FAA Facility Maps, TFR/NOTAMs

6.1 Airmap

The most comprehensive and easy to use Drone airspace map system is Airmap. Just type in your address or find your spot on the map, and see what's around you. Airmap is available as both a webpage (Figure 6.1) and as an app for iOS or Android (Figure 6.2).

Once you find your flying spot on the map, you can evaluate many of the airspace issues you need to look for. For example, in Figure 6.1, the selected flying spot is within a grid box within the purple shaded region. The text box to the bottom left gives a brief explanation - the purple shaded region is MERCED CLASS E2 airspace - meaning that the location is located within the vicinity of the Merced Airport. Any drone flying within any purple or blue shaded region will require permission from the FAA. Class E2 is the least riskiest

of the airport managed airspace (also known as controlled airspace), but still will have some airspace risk with occasional planes and helicopters flying above.

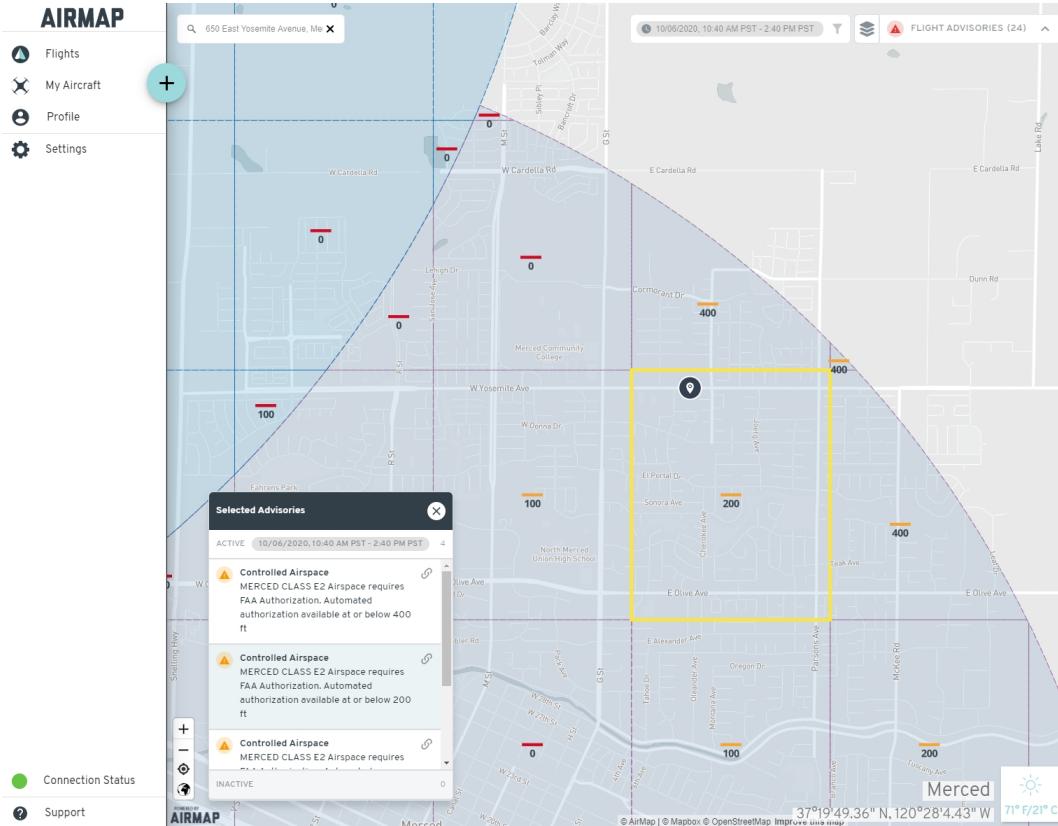


Figure 6.1: Android Airmap Application

For requesting permission to fly within a shaded region (controlled airspace), the FAA and the airports have drawn up grids within the shaded regions and labeled each one with a generally safe upper limit for flying. Within the highlighted grid in Figure 6.1, this limit is 200 ft. If you ask the FAA for permission to fly up to 200 ft, you will always be given approval. In general, the farther away you are from the runway, the higher the altitude you will be allowed to fly. But that's not always the case - you'll notice, there are a couple of grids that are marked with a 0 - and yes, that means that the generally safe flying altitude is 0 ft.

Need to get FAA permission to fly in one of these areas, head over here

What if you need to fly higher than the altitude listed? If you have a drone pilot license, you may ask the FAA for permission - but it is not guaranteed to be approved. Obtaining permission for flights above the listed altitude can be tricky, so we recommend reaching out to us at UASsafety@ucmerced.edu and we'll be happy to walk you through the process. Reach out to us early - the FAA can take 5-10 days to grant approval so you want to start this process early.

Airmap also does a good job of depicting other airspace issues, such as Special Use Airspace and National Security Areas - marked in red as in Figure 6.2. Selecting the AIRMAP Recommended Guidelines layer will also show all the helipads and minor airports that are not normally shown on an airspace map. This can be critically important - low flying helicopters and cropdusters that fly out of these unmarked airports are among the most pressing airspace concerns.

Make sure you click on the 'Layers' Icon next to the Flight Advisories - this allows you to turn on/off different information. For most operations, we recommend selecting the following sets of information:

- FAA Part 107 Certified
- AIRMAP Recommend Guidelines
- Restricted and Special Use Airspace
- National Parks Public Use Limits
- NOAA Regulated Overflight Zones
- Fish and Wildlife Service Lands Use Limits
- Wilderness Areas Use Limits

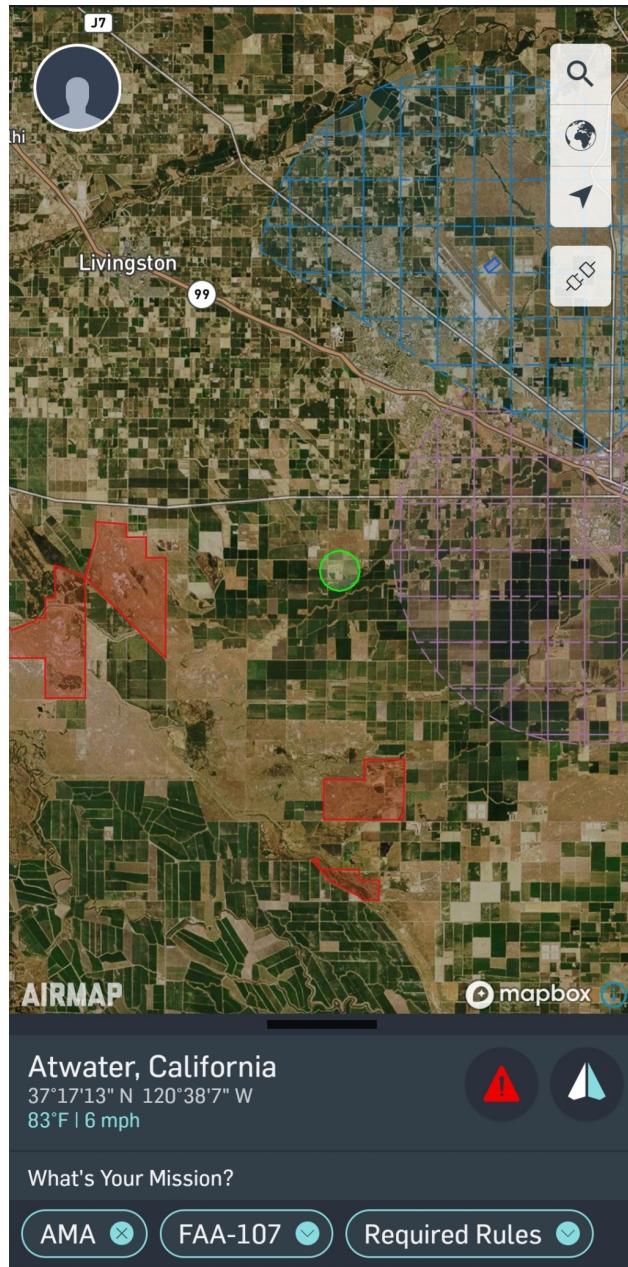


Figure 6.2: Android Airmap Application

6.1.1 The importance of up-to-date Airspace Information

Having the most up-to-date airspace information on hand can make all the difference between having a safe flight and a risky one. One of the advantages of Airmap is that it will also display a number of Temporary Flight Restrictions and Notices to Airman. Especially in California, there are a number of these that we should always keep an eye on:

- **Disneyland** - Due to National Security Risks, the FAA has banned all aircraft from flying under 3000 ft within 3 miles of Disneyland. This essentially also bans all drones in the area as well.
- **Major League Baseball, National Football League and Division 1 College Football** Regular and Post-Season Games - Similarly to the Disneyland restriction, the FAA has banned all aircraft from flying under 3000 ft within 3 miles of any these games. The ban starts at 1 hour before the games begin to 1 hour after the game ends.
- **Wildfire and other Natural Disasters** - Whenever there is a major catastrophe, keep an eye out for Temporary Flight Restrictions. These will often be very large and prolonged to allow emergency services (firefighting aircraft, medical support, etc) to have priority in these areas. Never fly your drone in a manner that could interfere with emergency services - it is both a Federal offense and a State offense.
- **US President and Vice-President Travel** - The President (30 mile) and Vice-President (5 mile) travel with their own FAA flight restriction zones, similarly prohibiting all aircraft from flying under 3000 ft within their zones.

As with most drone related rules and regulations, there are nuances and exceptions to TFRs and NOTAMs. If you have a pressing need to operate within a TFR, reach out to us at UASsafety@ucmerced.edu to discuss.

6.2 Official FAA Sources

Using Airmap is one of the easiest methods for looking up most of the airspace issues. However, it's not always the most detailed nor is it the official source of information. The official sources of information is spread across a handful of different sites:

- Official source of airspace information - FAA Sectional Charts
- Official source of altitude grid information - UAS Facility Maps
- Official source of TFR or NOTAMS - FNS NOTAM Search

Always check multiple sources - you never know when one source omits an important piece of information. For example, Figure 6.4 is the default view of Orange County of the UAS Facility Maps, but its doesn't depict one very critical flight restriction.

6.2.1 FAA Sectional Charts

Getting information on a specific area's airspace classification has never been easier. The FAA has region specific sectional charts located here.

6.2.2 UAS Facility Maps

UAS Facility Maps show the maximum altitudes around airports where the FAA may authorize drone operations without additional safety analysis. Grids marked in Green are LAANC (Low Altitude Authorization and Notification Capability) enabled - More on that in LAANC Authorization.

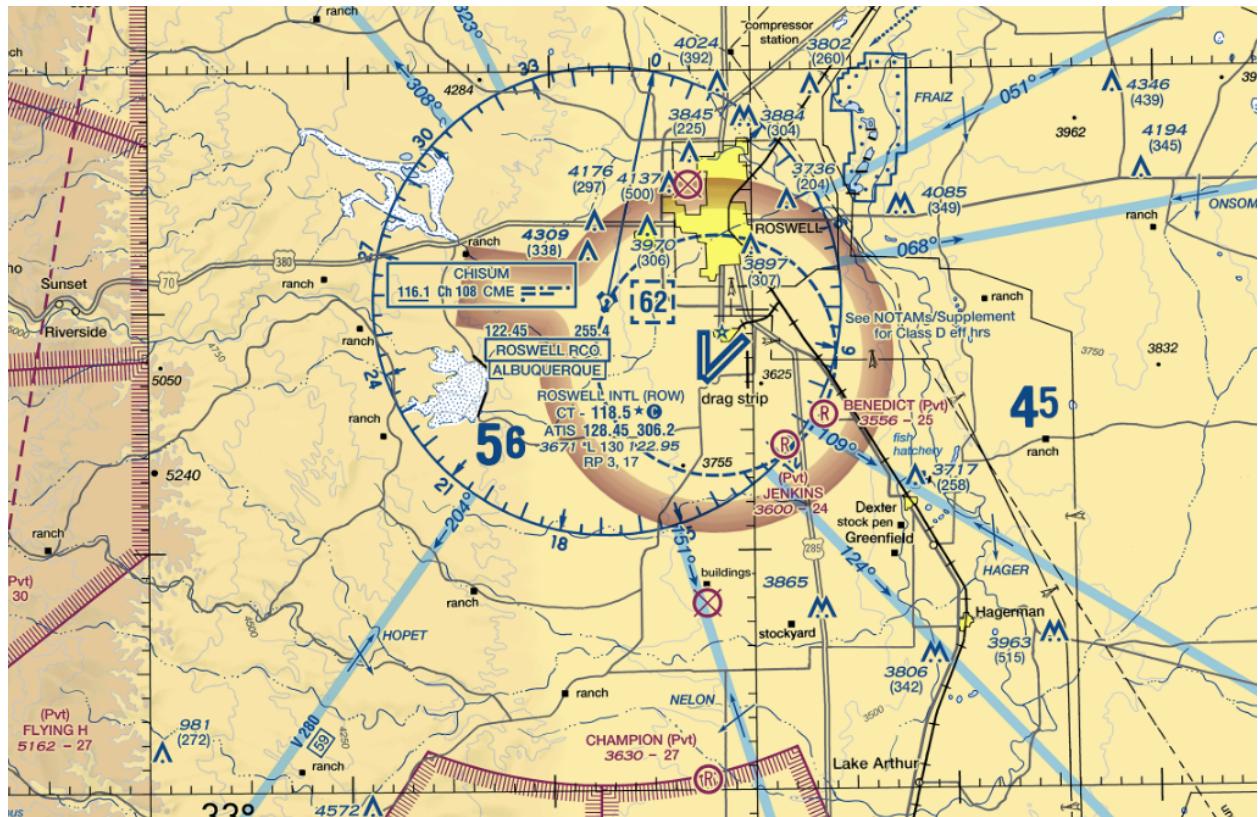


Figure 6.3: FAA sectional chart

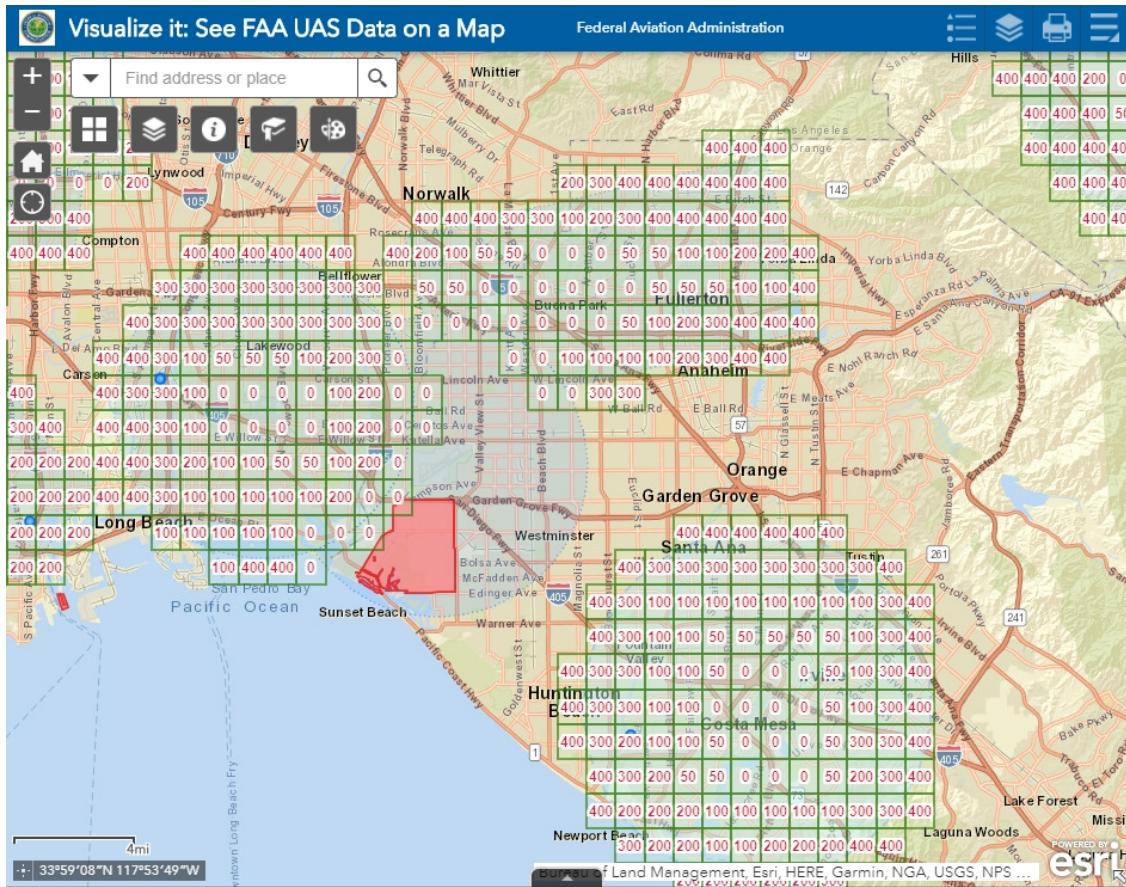


Figure 6.4: UAS Facility Map

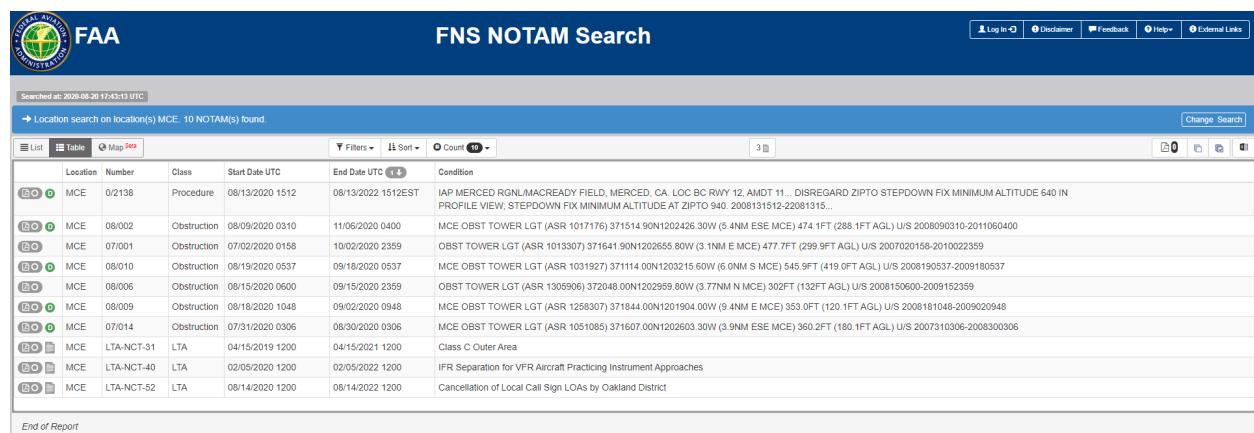


Figure 6.5: FAA NOTAM (Notice to Airman)

6.2.3 NOTAM or Notice To Airman

A NOTAM or Notice to Airman, is a notice that pertains to the establishment, change or condition of any facility, service or procedure of a specific location. The information is not known far enough in advance to be publicized by any other means therefore ensuring there are no active NOTAMS in the area you will be flying in is essential to the safety of yourself and others. It is important to keep in mind that NOTAMS can be put up at a moments notice.

6.3 Other Sources

Two other useful sources of information are Skyvector and the B4UFly App (iOS and Android).

6.3.1 SkyVector

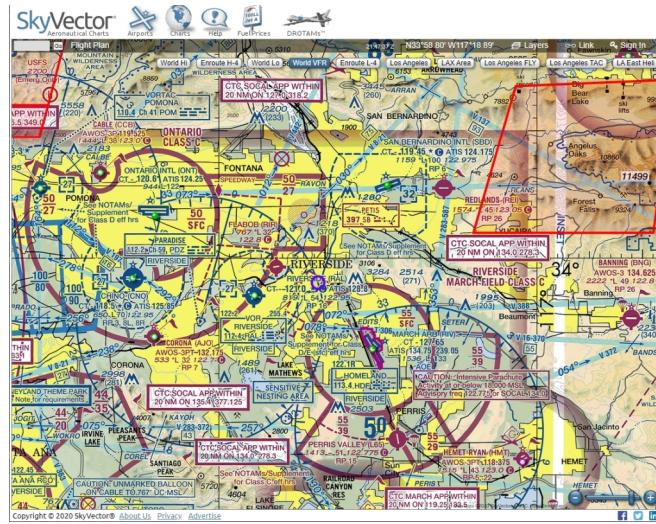


Figure 6.6: SkyVector - VFR Chart viewer with TFRs

SkyVector is a manned aviation tool that allows users to view the FAA Sectional Charts (also known as VFR charts) as well as a wide range of other layers, including TFRs and IFR approaches. While most of the information will be overwhelming for the beginning drone pilot, the basic VFR charts are still a great resource.

6.3.2 B4UFly App

The B4UFly app is the FAA's first attempt at developing and publishing an app for drone pilots. It has much of the same information as Airmap, though it notably does not include the altitude limits from the UAS Facility Maps. Otherwise, it's a great source of information.

6.4 Airspace Regulations

On this page, we're only looking at how to get the most basic of airspace information. But obviously, there's a deeper level of knowledge to be studied when it comes to airspace regulations. You'll find more information on the UAS Regulations and Learning About Airspace page, but for now, you can take a quick look at Figure 6.7 below.

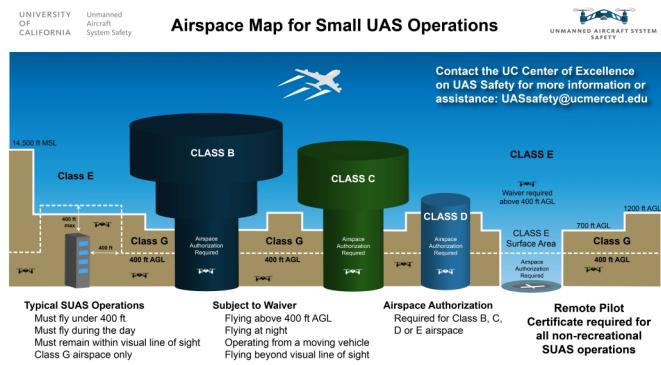


Figure 6.7: Small UAS Airspace Rules

Chapter 7

LAANC Authorization

In order to get FAA authorization to fly in controlled airspace, you typically will need to file a request through a system called “LAANC”

- If you plan on flying below the Facility Map altitude maximum, authorization will be instantaneous.
- If you want to request flying above the Facility Map altitude maximum, you’ll need a Part 107 license and you’ll need to make a safety case within your request. Flight requests are automatically denied if they have not been resolved 24 hours prior to flight, so we recommend filing a request at least 1 week in advance.

7.1 Using AirMap

One of our favorite programs to use for simple and free airspac authorizations is AirMap. The process is relatively straightforward. Create an account, input your pilot and aircraft information, then find a place to fly. Point to a spot on the map, draw a polygon or even just a line to describe your flight area then submit your flight plan. It’ll go straight to the FAA, or if manual approval by the tower is necessary, it’ll go straight to the tower.

For more information on how to use Airmap, check out their support information here:

[How to apply for Authorization](#)

7.2 Tips & Tricks

- Need to draw a polygon using a satellite map?

Try this:

- Go to <https://geoman.io/geojson-editor> and draw your polygon with satellite map on. Export to a GeoJSON text file
- Upload the GeoJSON file to Airmap using the ‘cloud’ button underneath the polygon.
- The outline should now cover the right area and you file as normal

Part II

UC Drones

Chapter 8

About UC Drones

UC Drones is a one-stop shop for UAS oversight and management for the University of California system. It is designed with the goal to develop a culture of safety and accountability in the use of UAS by providing a unified portal for 1) enabling users be kept aware with regulatory compliance obligations, safety guidelines and best practices, 2) documenting UAS activity through flight requests and reporting, and 3) tracking UC UAS operations and safety metrics.

The use of UC Drones Web App is UC UAS Policy compliant. However, it is not the only means of UC UAS Policy compliance. If alternative means of UC UAS Policy is needed or requested, please contact your campuses' UAS Point of Contact

Chapter 9

Logging into UC Drones

The UC Drones Web App is part of the UC Safety suite of apps for lab safety, occupational health and risk management.

The UC Drones homepage can be found at <http://ehs.ucop.edu/drones> or through the Risk & Safety Solutions platform

1. The UC Safety suite of apps can be found at <https://ehs.ucop.edu/>

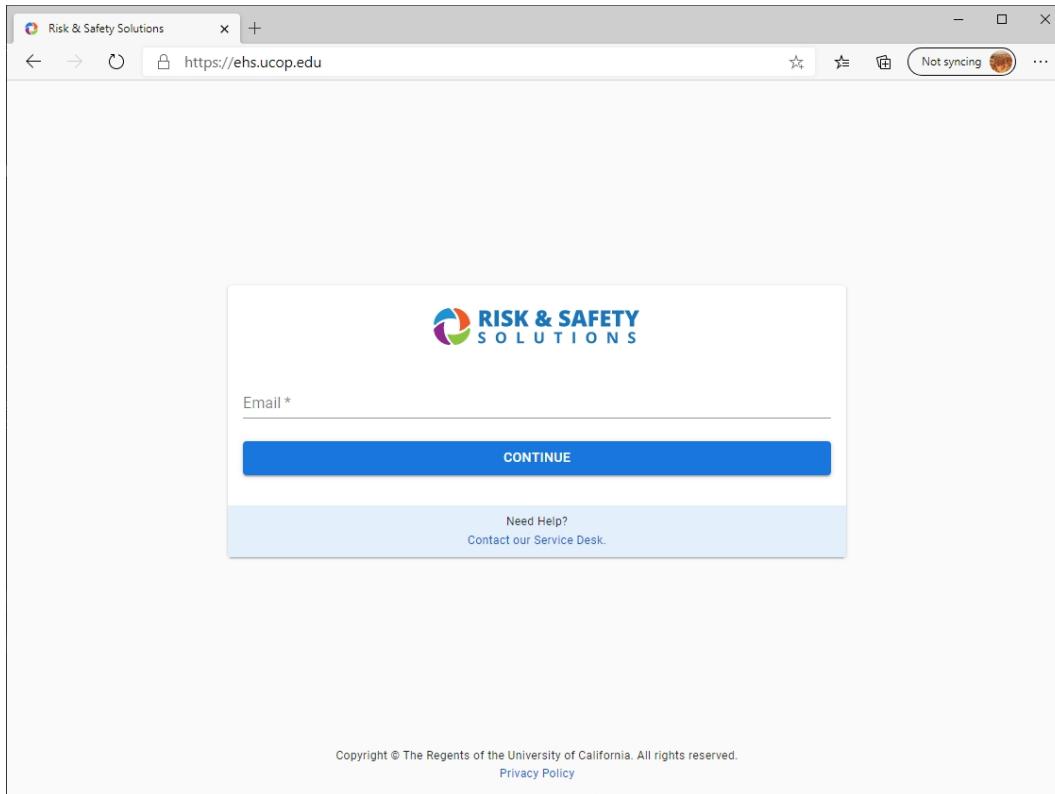


Figure 9.1: Risk and Safety Solutions Login

1. The homepage will look similar to the image shown above:
2. When you enter your campus email address, it will redirect you to your campus Single Sign On.

3. Once logged in, you'll be taken to the RSS Platform Dashboard. On the left, click on 'More Apps' and you'll find 'Drones' listed

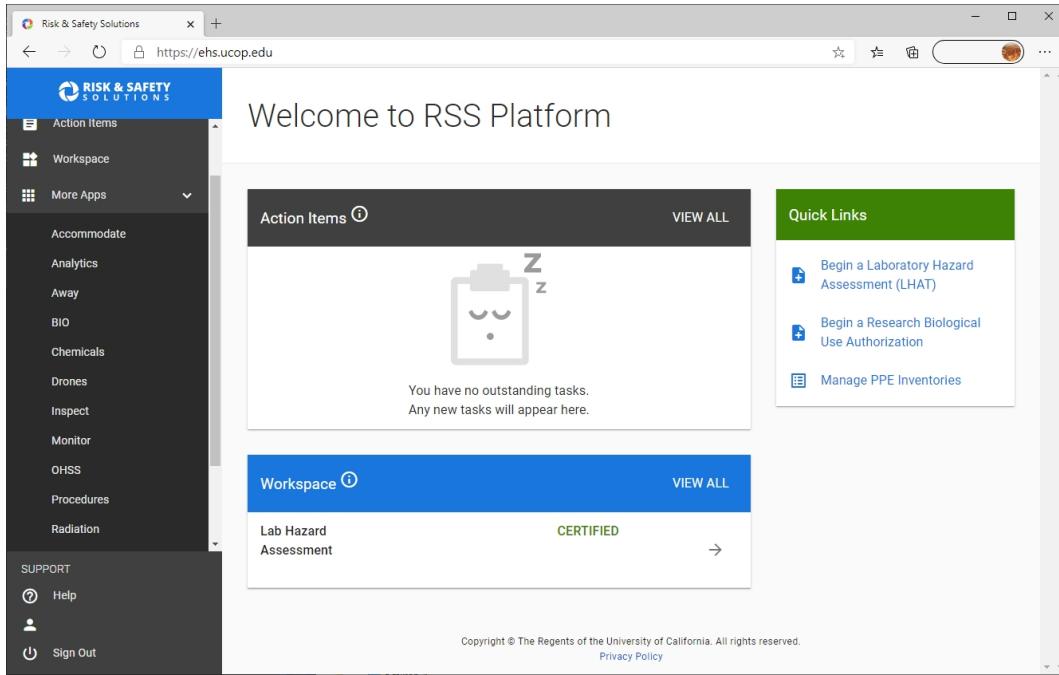


Figure 9.2: Risk and Safety Solutions Dashboard

2. You can login directly from <http://ehs.ucop.edu/drones>
 1. If you're not logged in already, you'll be redirected to login through your campus Single Sign On

Chapter 10

UC Drone Home Page

The UC Drone Safety Home Page allows users to manage their UAS Flights, aircraft and their pilot information.

To help you navigate the federal laws and UC policies regarding Unmanned Aircraft System (UAS) usage, the University of California has established the Center of Excellence on UAS Safety.

Tell me more...

Before any flight operation can be submitted, each pilot and aircraft must be registered through the "Register Pilot" and "Manage Aircrafts" section. Organize and plan your flight operations through a flight request. Project Flights (requires more than one flight) or Non-Project Flights (single flights), to ensure compliance with federal regulations.

Manage Projects & File Project Flights

Manage Flights & File Non-project Flights

Manage Aircrafts

Report on Approved Flights

Register or update your pilot registration or qualifications.

Pilot

Figure 10.1: UC Drones Home Page

10.1 Projects and Flights

Within UC Drones, you have two types of Requests available:

- Flight Projects
- Individual Flights

10.1.1 Flight Project

A Flight Project comprises of multiple sets of UAS flights over defined period of time (up to 1 year) at a single area of operation. The Flight Project as a whole can be reviewed and approved within the app, rather than reviewing each flight. All flight requests under an approved Flight Project are automatically approved and an email notice is sent to the local UAS Point of Contact.

Example Flight Projects

- Recurrent flight operations on field stations that do not require scheduling
- Regular flight activity in access-controlled construction sites
- Ad-hoc flights by NRS staff or researchers
- Weekly flights on the user's farm plots
- A three-day workshop on campus where the location has been reserved

A Flight Project may not be edited once it has been approved. A separate Flight Project must be submitted if a new pilot is desired.

10.1.2 Individual Flight Request

An individual Flight Request comprises of one or more UAS flights on a single day. Each Flight Request is reviewed individually, typically to address local issues such as campus safety, scheduling or privacy concerns.

Example Individual Flight Requests

- Any site that the field manager requires prior approval for scheduling or wildlife considerations
- Athletic or recreational fields that require scheduling
- On-campus public areas without additional mitigation protocols or safety hazard analysis.
- Special operations – flying at night, flying above 400 ft AGL, etc

10.2 Manage Aircrafts

The Manage Aircrafts page allows the user to add aircraft for use in the UC Drones web app or edit their existing aircraft. All aircraft registered at a campus will be visible to all, but only the Responsible Person may edit the entry.

10.3 Report on Approved Flights

The Report on Approved Flights page lists all of the Approved Flights that the user is listed as either a pilot or the point of contact. The user can select any of the approved flights and Create a Post-Flight Report to complete the UC Drone Policy process.

10.4 Pilot

The Pilot page allows the user to enter in their pilot information, including their certificate number and any additional certifications as attachments.

Chapter 11

Submitting a Flight Project

A Flight Project comprises of multiple sets of UAS flights over defined period of time (up to 1 year) at a single area of operation per aircraft. The Flight Project as a whole can be reviewed and approved within the app, rather than reviewing each flight. All flight requests under an approved Flight Project are automatically approved and an email notice is sent to the local UAS Point of Contact.

Example Flight Projects

- Recurrent flight operations on field stations that do not require scheduling
- Regular flight activity in access-controlled construction sites
- Ad-hoc flights by NRS staff or researchers
- Weekly flights on the user's farm plots
- A three-day workshop on campus where the location has been reserved

A Flight Project may not be edited once it has been approved. A separate Flight Project must be submitted if a new pilot is desired.

11.1 Manage Projects Page

The Manage Project page lists all of the Flight Projects that the user is listed as the Point of Contact or as one of the Pilots.

The list of projects is searchable by

- Name of Project
- Name of Pilot, Point of Contact or Creator
- Status of Project Request: Draft, Pending Review, In Review, Request Reviewed, or Request Denied
- Date Range to Search (Project Begin Date - Project End Date)

Each project is listed with the Project Name, the project date range, status of Project request, point of contact, the number of pilots associated with the Project and the aircraft for the project.

11.2 Project Request Form

To submit a Project request, go to the Manage Projects Page (Figure 11.1) and click on the yellow + (plus) button to go to the Project Information Page to start the request.

11.2.1 Enter Project Information

The following interactive module provides a breakdown on how to fill out a Project Request. The module requires a browser compatible with HTML5. If you are having difficulty viewing the interactive module,

The screenshot shows the 'Manage Projects' section of the UC Safety Drones website. At the top, there's a search bar labeled 'Search by Project name, Pilot, Contact or Creator's Name'. Below it are filters for 'All Status', 'Project Begin Date' (set to August 24, 2020), 'Project End Date' (set to August 25, 2020), and 'University of California, Merced'. A yellow circular button with a plus sign is in the top right corner.

Scholars Bridge Crossing - Filming Rufus
 August 24, 2020 - August 25, 2020 Request Approved Add Flight

Contact: Miguel Vega (mvegamejia@ucmerced.edu)
 Pilot(s): 1 Pilot(s)
 Aircraft: DJI (Reg. No.: FA3KT4L4HX)

Campus Drone Footage
 August 17, 2020 - August 18, 2020 Request Approved Add Flight

Contact: Mario Fernandez (mffernandez40@ucmerced.edu)
 Pilot(s): 2 Pilot(s)
 Aircraft: DJI (Reg. No.: FA3KT4L4HX)

Campus Drone Footage
 August 13, 2020 - August 14, 2020 Request Approved Add Flight

Contact: Mario Fernandez (mffernandez40@ucmerced.edu)
 Pilot(s): 2 Pilot(s)
 Aircraft: DJI (Reg. No.: FA3KT4L4HX)

Figure 11.1: UC Drones Manage Projects

please contact us at UASsafety@ucmerced.edu.

Please visit the webpage for the interactive module on how to fill out a Project Request.

11.3 Filing a Project Flight

On the Manage Project page, all approved projects will have a button to ‘Add Flight.’ Clicking this button will direct the user to a file a Project Flight notification. This Flight notification will be mostly filled in already - the user will just need to select the date and time of the flight operation (selectable only within the project duration) and may modify the active Pilot (from the list of Project Pilots), or adjust the Risk Assessment, Observers and Comments sections.

Chapter 12

Submitting a Flight Request

An individual Flight Request comprises of one or more UAS flights on a single day. Each Flight Request is reviewed individually, typically to address local issues such as campus safety, scheduling or privacy concerns.

Example Individual Flight Requests

- Any site that the field manager requires prior approval for scheduling or wildlife considerations
- Athletic or recreational fields that require scheduling
- On-campus public areas without additional mitigation protocols or safety hazard analysis.
- Special operations – flying at night, flying above 400 ft AGL, etc

12.1 Non-Project vs Project Flight

Both Projects and Non-Projects use the same Flight Request Form. A Flight Request for a Project must be selected from the Project Page - either the Manage Projects Page and select ‘Add Flight’ (Figure 12.1) or from the individual Project page and select ‘Add Flight’ under the header (12.2).

Differences

- A Flight Request for a Project is automatically approved upon submission
- A Flight Request for a Project is autofilled with the Project information
 - Only a handful of fields may be changed or completed

The screenshot shows the 'Manage Projects' page of the UC Safety Drones system. At the top, there's a search bar labeled 'Search by Project name, Pilot, Contact or Creator's Name'. Below it are filters for 'All Status', 'Project Begin Date' (set to August 24, 2020 - August 25, 2020), 'Project End Date' (set to August 24, 2020 - August 25, 2020), and 'University of California, Merced'. A large yellow '+' button is in the top right corner.

Flight Request 1:
Scholars Bridge Crossing - Filming Rufus
 August 24, 2020 - August 25, 2020 Request Approved
 Contact: Miguel Vega (mvegamejia@ucmerced.edu)
 Pilot(s): 1 Pilot(s)
 Aircraft: DJI (Reg. No.: FA3KT4L4HX) Add Flight

Flight Request 2:
Campus Drone Footage
 August 17, 2020 - August 18, 2020 Request Approved
 Contact: Mario Fernandez (mfernandez40@ucmerced.edu)
 Pilot(s): 2 Pilot(s)
 Aircraft: DJI (Reg. No.: FA3KT4L4HX) Add Flight

Flight Request 3:
Campus Drone Footage
 August 13, 2020 - August 14, 2020 Request Approved
 Contact: Mario Fernandez (mfernandez40@ucmerced.edu)
 Pilot(s): 2 Pilot(s)
 Aircraft: DJI (Reg. No.: FA3KT4L4HX) Add Flight

Figure 12.1: UC Drones Manage Projects

This screenshot shows the 'Project Information' page for a specific flight request. It includes fields for 'Aircraft' (DJI - Phantom 4 Pro, Registration Number: FA3KT4L4HX, Storage Location: UCM Video Department (Suite M)), 'Contact' (Mario Fernandez, mfernandez40@ucmerced.edu), and a 'Request Approved' status. Navigation buttons at the bottom include 'Manage Projects' and 'Add Flight'.

Figure 12.2: UC Drones Project Management

Chapter 13

Add your Drone to UC Drones

To register your drone with the UC system, add your drone to UC Drones.

13.1 Manage Aircrafts

The Manage Aircrafts page lists all the drones registered with your campus. From here, you can see the name, make/model, registration number as well as the Responsible Person for each drone.

- While you can see each drone at your campus, only the Responsible Person may edit the properties, or view the additional properties of the drone.

Name	Responsible Person	FAA #
3D Robotics - Solo (FAA # FA37WX9PXK)	Garrett John (gjohn@ucmerced.edu)	
[Obi-Wan] 3d Robotics - Solo (FAA # FA3XXPXYAH)	Andreas Anderson (anderson20@ucmerced.edu)	
[Windu] 3D Robotics - Solo (FAA # FA3XXPW77M)	Andreas Anderson (anderson20@ucmerced.edu)	
[Luke] 3D Robotics - Solo (FAA # FA3XXPNFX7)	Brandon Stark (bstark@ucmerced.edu)	
[Vader] 3D Robotics - Solo (FAA # FA3XXPRC3W)	Andreas Anderson (anderson20@ucmerced.edu)	
3D Robotics - Solo (FAA # FA37WWX9M9)	Garrett John (gjohn@ucmerced.edu)	

Figure 13.1: UC Drones Manage Aircrafts

13.2 Add an Aircraft

To add an aircraft to the list, click on the yellow + button in the upper right corner of the Manage Aircraft's page (Figure 13.1)

On the Register an Aircraft Page, fill out the following information

1. Responsible Person

Search the campus directory for the person who is designated responsible for the management and updating of the drone's information within UC Drones. This can be the regular pilot, administrative staff or PI. This can be changed or updated at any time.

The screenshot shows a web-based form titled "Register an Aircraft". At the top, there's a navigation bar with "UC Safety" and "Drones" links, and icons for search, refresh, and user profile. The main section has a title "Register an Aircraft" and a subtitle "Please supply information about your unmanned aircraft." It includes fields for "Manufacturer" (with a placeholder), "Model" (with a placeholder), "FAA Registration Number" (with a placeholder), "Storage Location" (with a placeholder), and "Responsible Person" (a dropdown menu set to "University of California, Merced" with a search bar below it). Below these are questions "Is the aircraft campus owned?" with "Yes" and "No" radio buttons, and "Nickname" (with a placeholder). A note at the bottom of this section says "Please use a unique name to help you search for your aircraft in the system – Example: MESA Lab AirTitan v5". The next section is "Attachments" with a "Select files" button, a note "Please attach UA registration and other files (such as insurance questionnaire) that are relevant.", and a "Upload File(s)" button. It also displays "No attachments." and two buttons: "Save" and "Cancel".

Figure 13.2: UC Drones Add/Edit Aircraft

2. Manufacturer

Enter the manufacturer of your drone. If your drone is a kit build, use the name of the kit manufacturer. If your drone is a custom-build, you may enter 'UC-Custom' or 'Personal-Custom' whichever is appropriate.

3. Model

Enter the model name of your drone. Please be sure to include any relevant suffixes (eg. Phantom 4 Pro V2)

4. FAA Registration Number

All drones over 0.55 lbs and flown outside within the US must have an FAA registration number. This number is a 10 digit alphanumeric code that starts with FA. In some cases, it may also be an alphanumeric code that starts with N (N-number). If the drone will exclusively be flown indoors or is under 0.55 lbs, enter the serial number (or an identifying number for a custom build). There are special cases for UAS flown exclusively outside of the US - please contact us at UASSafety@ucmerced.edu for further instructions.

5. Storage Location

Please enter the storage location of the aircraft, including building name and room number. If the aircraft is not used for University business, this question may be omitted.

6. Campus Owned

Please select whether the aircraft is owned by the University (ie, purchased with campus funds, research funds, educational funds) or is personally-owned.

7. Nickname

Enter a short nickname for your drone. While your drone is searchable via the FAA registration number, you may also use a unique nickname to quickly find your drone while within the UC Drone web app. We recommend sticking to a common naming scheme such as PI-Model-Number

8. Attachments

You may attach additional files, such as the FAA registration pdf or purchase invoice, for easy retrieval. Remember, for the UC UAS Replacement/Property insurance, we need to have a copy of the original purchase invoice so storing it here will make it easier to collect it.

Part III

Drone Safety

Chapter 14

Planning a Mission

Safety starts with planning. Plan your flight mission with safety in mind from the get go. Use the Site Analysis process to figure out exactly how to accomplish your mission and determine any other supplies or support you might need.

14.1 Site Analysis Process

One of the best things you can do when you start planning your mission is to conduct a thorough site analysis process. Do a methodical review of where you want to fly, taking into consideration what you want out of the flight and any hazards that exist.

Following your methodical review, you can start planning your flight paths, assess visibility, decided where to put VOs or other helpers, and have ample details for any emergency action plans.

14.1.1 Site Analysis Steps

- Print out a satellite image of the site
- Evaluate Data Requirements
 - Identify the region(s) of interest
 - Identify the best visual angles
 - * Consider the time of day, shadows and reflective surfaces
 - Estimate the best flight region and flight paths
- Identify any constraints
 - Mark any airspace issues
 - * Airspace Class
 - * Airports, Heliports
 - * Flight Patterns
 - Mark any vertical structures
 - * Changes in elevation
 - * Buildings
 - * Towers, powerlines
 - * Trees
 - * Other vertical obstructions
 - Mark any ground obstructions
 - * Smaller structures
 - * Gates, Fences
 - * Hedges, Shrubs
 - * Other obstructions that may impede access
 - Identify any other safety or regulatory issue

- * Fire risks
- * Wildlife impacts
- * Physical access to site
- Identify potential site access points by non-participants
 - * Pedestrian walkways
 - * Bike paths
 - * Building doors/access points
- Refine flight plan with constraints
 - Select a launch/recovery site that can be reasonably secured
 - Assess whether any vertical structure may impede visual line of sight
 - Assess whether any ground obstruction may limit any emergency recovery operations
 - Consider multiple flights per Mission to achieve mission goals
- Plan flight crew locations
 - Pilot and VO at Launch/Recovery point
 - * Consider if Pilot/VO may require relocation during flight operation
 - Remote VOs and other ground crew support
 - * May be tasked to redirect non-participant traffic away from flight zone
- Iterate as necessary to meet Mission Objectives

14.1.2 Site Analysis Guide

Please visit the webpage for a walkthrough of the Site Analysis Process

14.2 Resources

Make regular use of planning tools and resources here: UC Drones Resources. Don't be afraid to edit/update/modify them as you see fit. All of these should be considered living documents, tailored to enable you to make safety decisions with as much information as possible.

Chapter 15

Safety Guidelines

15.1 Standard Guidance

- All UAS activity must establish a buffer or safe-zone between the Unmanned Aircraft and any non-participating persons or sensitive locations.
 - A good rule-of-thumb is to maintain a buffer or safe-zone of roughly $\frac{1}{4}$ of the flight altitude.
- Visual Observers and supporting ground crew should be utilized when available.
 - Supporting ground crew should assist in ensuring safety to all non-participating persons.
- All members of the flight crew must be conspicuous and wear professional, identifying apparel such as university-branded hats, shirts or lanyards with IDs.
- High visibility reflective vests must be worn when operating near roads or in parking lots.
- When operating in fenced areas, operate exclusively within the fenced areas unless there is sufficient visibility on the other side to ensure safety to non-participants.
- Never fly in areas where UAS activity is prohibited or restricted.
- Always be a good neighbor and ensure that your UAS activity is not disruptive to other authorized activities.



Figure 15.1: UAS operators with high visibility vests, UC Merced

15.2 Operating on Campus or other busy locations

- Utilize the UC UAS Mission Planning Template ([link](#)) to systematically develop your flight plan
- When operating in uncontrolled locations in proximity to non-participating persons, extra care should be exercised. Specific flight paths and altitudes should be pre-planned such that potential gaps in buffer or safe-zones can be identified.
- High visibility vests are recommended, but not required when near nonparticipants or in public areas
- Orange cones may be used to help communicate Unmanned Aircraft flight regions to non-participating persons, but are not fully sufficient.
 - Supplement any portable pedestrian control equipment (cones, caution tape, signs) with ground personnel
- If spectators are expected, a supporting ground crew member should be tasked with preventing spectators from distracting the RPIC with questions or comments.
- When operating near roads, a supporting ground crew member should be tasked with being located near the road to monitor traffic, and if necessary, retrieve a fallen Unmanned Aircraft before it becomes a road hazard.
- Flying above buildings and structures minimizes risk to pedestrians, but it is recommended to contact the facility manager to properly evaluate the potential risks. Some campus buildings are outfitted with research or communication equipment on rooftops.

Chapter 16

Top 10 Safety Tips

Good pilots aren't born, they are forged with training, practice and experience. When starting on your drone journey, follow these 10 tips for being a safe pilot.

1. **Practice** - There is no substitute for experience. Gain experience by practicing flying your drone, conducting data collection missions, and flight planning. Get familiar with your equipment and processes.
2. **Write Everything Down** - Keeping records can help you maintain your equipment, monitor for unsafe practices and keep you on track. Things to track: battery usage, weather conditions, equipment use/damage, software versions.
3. **Make Checklists and Use Them** - Nothing derails a flight mission like forgetting an item or a step. Make a checklist for planning a mission, make a checklist for packing your equipment, make a checklist for preflight inspections and any other process you may have.
4. **Always Keep an Eye on the Weather** - Experienced field researchers know that weather reports are only a suggestion. Conditions in the field may change dramatically and can turn a good flying day to a disaster.
5. **Bring a friend or two** - Between juggling a flight controller, operating a payload, monitoring weather conditions and scanning for intruding air traffic, it can be taxing to try to do it all at an appropriate level. Bring some help to make sure everything goes smoothly.
6. **Bring backups or replacement parts** - Many operators will bring spare propellers or batteries to their flight missions, but don't forget about other supporting equipment such as cables, landing gear, radios or antennas. Make sure backup parts are on your pre-departure checklist.
7. **Choose appropriate flight locations** - When you choose a location to fly at, make sure you're aware of all the hazards. Look for indicators of hidden hazards like rolling hills or high tree lines that create turbulence, or low visibility hazards such as power-lines or towers that interfere with radio systems. Be aware that you as the pilot are responsible of ensuring the safety of all persons on the ground, whether you can see them or not.
8. **Set boundaries for go/no-go situations and stick to them** - Deciding when to fly and when not to fly should not be an ambiguous decision. Don't let external pressures push you to make unsafe decisions.
9. **If something isn't right, stop immediately** - Nothing fixes itself in the air. If something doesn't sound right on the ground during pre-flight checks, don't fly. If the weather changes to an unsafe condition, land as soon as it is safe.
10. **Pause and consider all the risks before you fly** - Damage to your aircraft is only one of many aspects to consider. Consider the payload, consider potential damage to other's property, consider secondary effects such as causing an auto accident when your aircraft crashes in the middle of a road.

Chapter 17

Fire Safety

While UAS accidents and incidents involving fire are rare, they are a valid and significant concern. With the majority of UC UAS usage on field sites and other rural locations, the potential for the accidental sparking of fire is a concern. A fire sparked by a UAS can spread quickly (Figure 17.1) and with California's dry environment, can cause significant damage (Figure 17.2).



Figure 17.1: Beginning of a fire from UAS accident at Richmond Field Station, UC Berkeley

17.1 LiPo Battery Guidance

The most common cause of drone related fire is from misuse of LiPo batteries. Special care should be taken when charging, discharging or storing LiPo batteries. If the internal polymer cell of a LiPo battery is exposed to air, a violent chemical reaction starts that could explode, but more commonly releases significant amounts of smoke and heat that can ignite other fire fuel sources. A LiPo battery fire is typically caused by a physical puncture to the battery or from misuse, such as overcharging or electrical shorts.

Recommended Best Practices

- Always thoroughly inspect a battery before charging and use.
 - Look for swelling, puffy cells, cracks in plastic, and charred debris along the contacts.
- Never use a battery that is not in good health.



Figure 17.2: Post fire damage from UAS accident at Richmond Field Station, UC Berkeley

- Consider batteries to be replaceable and consumable, rather than a permanent component of the UAS.
- Never store batteries in a hot car.
- Don't charge your batteries unless you're going to fly within the next day.
- After immediate use, place battery out of the sun but do not place within a closed container.
 - Ensure there is sufficient airflow to allow the battery to cool.
- When done flying for the day, always charge your batteries at least back up to storage level.
- Do not charge an intelligent flight battery immediately after flight as the temperature may be too high. Wait until it cools down to room temperature before charging again.
- Store the battery in a dry and cool place, keep out of direct sunlight and away from any liquids
- Do not store or transport a battery with eyeglasses, watches, metal necklaces or other metal components that may short the battery
- When in transport, store the batteries in a safe container that will protect it from damage, squeezing, puncturing or falling.

17.2 Planning for Fire Mitigation

In addition to LiPo battery care, special effort must be taken to consider the fire risks in drone activity. Consult the appropriate department (Fire, Field Safety, EH&S) if there are concerns over fire risk. Minimize the potential for fire by monitoring where the drone will be flying and ensure that if a fire was to occur, the RPIC and any other persons, such as Visual Observers, are prepared to respond appropriately.

Guidance for fire safety

- Everyone should take a fire safety training course.
- Avoid flying on high fire risk days, including Red Flag Warning alerts issued by CAL FIRE.
- Never fly alone in areas of moderate to high fire risk
- Always bring a fire extinguisher and a shovel/bucket of sand to field sites.
- During flight operations:
 - Ensure that a crew member has easy access to fire equipment.
 - Ensure that a crew member has easy access to reach any location where the drone may crash.
 - Ensure that a crew member has the ability to report an emergency situation and can adequately provide directions for emergency personnel to reach the site.
- When flying in high fire risk locations, use high quality, commercially available drones with enclosed electronics.
- Never fly a damaged or swollen battery.

17.3 Drone Fire Safety Bucket

Come prepared for a fire by packing this Drone Fire Safety Bucket, designed by **Victor Duraj** at **UC Davis**. It is based around a 7-gallon red bucket in order to accommodate a larger extinguisher, to help the bucket physically stand out on a flight site, and to reference it efficiently in an emergency as “that red fire bucket”. It includes a screw top lid, a fire extinguisher, a fire blanket, a folding camp shovel, a fluorescent orange flag, a first aid kit, a storage clipboard, self-made labels, and a double-sided laminated Contents & Instructions sheet.



Figure 17.3: Drone Fire Bucket

Contents & Instruction Sheet

Chapter 18

UAS and Privacy

The capture and use of photographs and videos from a Unmanned Aircraft raises new concerns on the rights, privacies, and permissions that involve both the operators of an unmanned aircraft system and individuals that are uninvolved in the operation. The University of California recognizes the important value of privacy and strives to achieve an appropriate balance ensuring an appropriate level of privacy, nurturing an environment of openness, honoring its obligation as a public institution to remain transparent while safe guarding information about individuals.

18.1 Best Practices

- **Do not** use a UAS to monitor or record activities where there is a reasonable expectation of privacy.
- **Do not** use a UAS for unapproved recordings of any campus events or performances, or for any unlawful purposes.
- **Do not** use a UAS to harass people or intentionally disrupt events.
- **Do not** fly a UAS over private property without prior approval.
- **Do not** use a UAS for the specific purpose of persistent and continuous collection of identifiable data about individuals without the consent of the data subjects.
- **Do not** retain identifiable data longer than reasonably necessary to fulfill a purpose.
- **Do not** knowingly publicly disclose data collected with a UAS without undertaking a reasonable effort to obfuscate or de-identify identifiable data unless the data subjects provide specific consent to the disclosure.
- **Do** make a reasonable effort to remain conspicuous and visible during flight operations.
- **Do** make a reasonable effort to provide prior notice to individuals of the general timeframe and area that they may anticipate a UAS intentionally collecting data.
- **Do** establish and make available a Privacy Statement for UAS data if the UAS may intentionally or unintentionally collected identifiable data. The policy should be appropriate to the size and complexity of the data collected.
- **Do** be considerate of other people's concerns over privacy, security and safety.
- **Do** contact the Office of Research Compliance and Integrity if identifiable data is to be used for human-subject research.
- **Do** take steps to ensure the security of any identifiable data.

18.2 Do I need to write a Privacy Statement

While most flight operations are on UC property and within dedicated research locations, such as field stations and reserves, a significant number of projects are on public land, near non-participants or in collaboration with private collaborators. As such, there may be unintentional impacts to the privacy and well-being of others. When in doubt, always consider putting together at least a minimal document.

18.3 Privacy Statement

An effective privacy statement is concise and easy to understand. Consult with your campus Privacy Officer or Institutional Review Board for additional help or guidance in developing an effective privacy policy.

Items to include in a Privacy Statement:

- The purposes for which the UAS will collect identifiable data
- The kinds of identifiable data the UAS will collect
- Information regarding any data retention and de-identification practices
- Examples of the types of any entities with who identifiable data will be shared
- Information on how to submit privacy and security complaints or concerns
- Information describing practices in responding to law enforcement requests

NOAA has an excellent example of a detailed UAS privacy statement: [Link](#), [pdf](#)

Part IV

Insurance

Chapter 19

UC UAS Liability Insurance

The University of California has purchased an Unmanned Aircraft System Liability Policy. This policy has a total of \$5 Mil limit including Personal Injury.

Coverage is automatic for UAS activity that meet the following criteria:

- Flight operations are conducted on behalf and sanctioned by the University of California.
- Aircraft weight under 55 lbs (at time of takeoff)
- Flight operations are within Visual Line of Sight
- Flight operations are below 400 ft above ground level.
- Flight operations must be conducted within the United States.

Any UAS activity that do not meet the above criteria or operate outside the above criteria must be reported to and approved by the insurance underwriter in order to be covered.

We will follow up with you if your flight operation is not automatically covered and will work with you to ensure coverage.

On rare occasions, typically on international UAS activity, you or your department may be required to purchase additional coverage.

Any UAS activity that is not approved by a Designated Local Authority or Systemwide Designated UAS Authority is not covered by this liability insurance coverage.

We recommend the use of UC Drones web app to ensure coverage - but please remember that if the Flight is not in the system as "Approved" you are not covered.

- An approved Project does not grant insurance coverage, you must submit a Flight notification or request to ensure insurance coverage.

19.1 Personally Owned Unmanned Aircraft Used for University Business

The University of California has extended their UAS liability policy to enable coverage of UAS owned by UC students, staff or faculty used for University Business, including research. Coverage is contingent on compliance with the policy and procedures on UAS usage. This coverage is not intended to cover student organizations or 3rd Party vendors or contractors.

19.2 Coverage for Campus Police

The University of California has extended their UAS liability policy to enable coverage of UAS by Campus Police. All coverage is contingent on the UAS activity being sanctioned by the UC.

Any UAS activity that is not approved by a Designated Local Authority or Systemwide Designated UAS Authority is not covered by this liability insurance.

Chapter 20

UC UAS Replacement Insurance

Physical damage to a UAS is covered under a blanket policy issued by the University's captive insurance company, Fiat Lux Risk and Insurance Company

- Coverage applies in flight only when an approved flight plan is filed in accordance with UC UAS Policy, including the UC Drone web app or other means of compliance.
- Coverage is limited to \$25,000 for Unmanned Aircrafts
- Payload is covered separately and not included within this limit
- \$1,000 deductible applies to each and every loss (including payload)
- Coverage additionally applies in the event of theft, vandalism, fire and other perils in accordance to the UC Property Insurance Program.
- In the event of a loss, please report to campus risk management.

This physical damage coverage does not extend to personally owned-UAS used for University Business. **Only UAS owned by the University of California are covered.**

20.1 Filing a Claim

To file a claim, contact your campus Risk Manager. Please prepare the following:

- Copy of the post-flight report (through UC Drones or other means of compliance)
- Photographs of damaged equipment
- Copy of original purchase invoice
- Copy of invoice to ship the equipment back the manufacturer
- Copy of repair invoice, if repairable
- Copy of replacement quote, if not repairable

Ensure your coverage

- Attach a copy of your UAS invoice to your UAS registration in UC Drones
- Make sure you file your Flight Requests
- For recurrent or on-going activity, create a Project application but don't forget to add flights before you head out.
- After an incident, make sure you take pictures of the damage and file a post-flight report. Add as much details as possible.

Part V

More Details

Chapter 21

Common UAS Regulation Violations

Unless given special permission by the FAA under Part 107 regulations, you are only allowed to operate

- Within Visual Line of Sight
- Not Over People

Unfortunately, these are two of the most common UAS violations that we see, especially with videos on the internet. Within the UC system, we are obligated to follow all applicable regulations. So even if you see someone else fly in violation of the laws, it's not ok for you to replicate it.

21.1 Visual Line of Sight

Visual line of sight means that the pilot of the drone must be able to see the drone throughout the entire flight in order to

- know the drone's location
- determine the drone's attitude (orientation), altitude, and direction of flight
- observe the airspace for other air traffic or hazards
- determine that the drone does not endanger the life or property of another

The pilot must be **able** to do the above at all times, but doesn't have to be at all times - meaning he or she may glance at other objects, as long as the drone never leaves the pilot's ability to resume looking at the drone at any time.

At any given time, at least the pilot or any visual observers must maintain visual line of sight - meaning while the pilot is looking away, there must be a visual observer to watch the drone during that time.

21.1.1 A Speck in the Sky is not Sufficient

At all times, your drone must be close enough that you can tell which direction the drone is facing, how high it is and whether there are any hazards. If all you can see of your drone is a small dot, it means you've gone too far. In practice, your visual distance may be significantly impaired by trees or buildings in the horizon that may make it difficult to see the drone.

Common Drones and recommended max visual distance (on a clear day in a rural location)

- **DJI Mavic Series** 900 ft horizontal distance
- **DJI Phantom Series** 1200 ft horizontal distance
- **DJI Matrice 600 Pro** 3000 ft horizontal distance
- **Fixed-wing (10ft wingspan)** 5000 ft horizontal distance

21.1.2 You must be able to assess risk

If you can't see the sky around the drone or the ground below the drone as in Figure 21.1, you're not within visual line of sight.

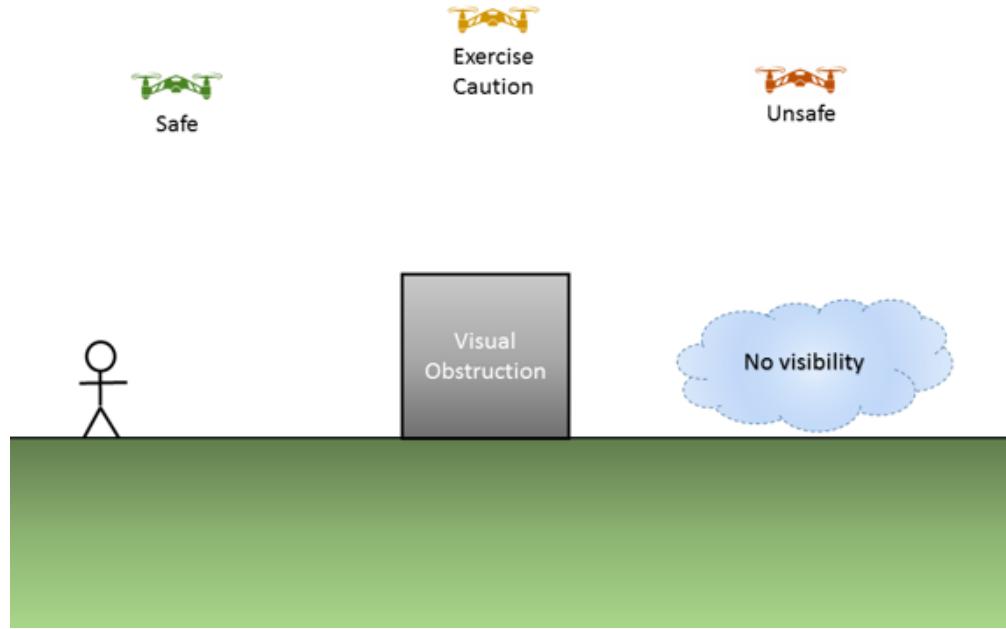


Figure 21.1: Visual Line of Sight

If this is a scenario that you're looking to do, you may be able to deploy a helper to assist to maintaining a clear flight operational area. However, at no point is the drone allowed to be not viewable by the pilot.

21.2 Operations over Human Beings

Your drone is not allowed to be flown directly over people (107.39), or in a manner that poses a hazard to other people in the event of a loss of control of the drone for any reason (107.19(c)). The combination of the two regulations form the majority of the restrictions around people.

You may only fly above people who are part of the immediate flight crew and whose tasks include ensuring flight safety. It is not sufficient to provide spectators with personal protective equipment (PPE), or ask spectators to sign waivers.

For more information about establishing effective safety buffers, see .

Chapter 22

Reporting UAS Accidents



Figure 22.1: Crashed Phantom

Whether you're a new or experienced pilot, accidents can happen. In the event that you crash your drone you need to remember to stay cool and carefully survey the damage that was caused.

If your accident causes either:

- Serious injury (injury that requires hospitalization) or loss of consciousness; or
- More than \$500 worth of damage (excluding the drone)

then you are required to file a report with the FAA within 10 days of the accident.

22.1 How to file an accident report

You can report an accident to the FAA using a few different methods. Method 1 is to submit your report through the FAA's Drone Zone page.

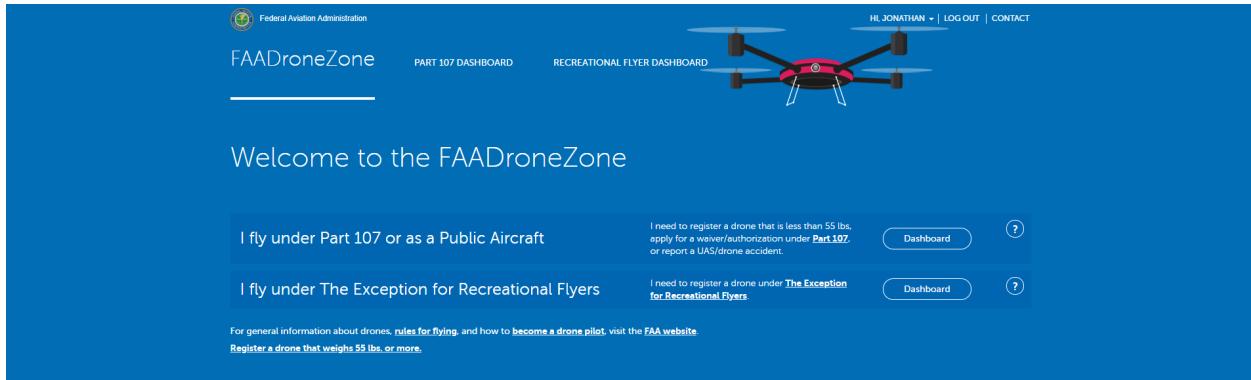


Figure 22.2: FAA Drone Zone

Part 107 Accident Reports

A screenshot of the 'Part 107 Accident Reports' section. It starts with a yellow callout box containing text about reporting requirements for Part 107 operations. Below this, there is a list of conditions for reporting. To the right, a message states 'You currently do not have any accident reports.' At the bottom, there are two buttons: 'Review Part 107 Accident Reports' and 'Submit Part 107 Accident Report'.

Figure 22.3: Accident Report Box

Logging into your account and scrolling to the bottom of your dashboard you will find a “Part 107 Accident Reports” box where you can then submit your accident report. The reporting form requires you to fill out both plot information and your flight operation details.

Method 2 involves contacting your nearest FAA Flight Standards District Office (FSDO) to submit a report either through phone or their website.

Federal Aviation Administration

FAADroneZone

PART 107 DASHBOARD RECREATIONAL FLYER DASHBOARD

HOME / PART 107 DASHBOARD / PART 107 ACCIDENT REPORTING

Part 107 Accident Report Form Part 107 Accident Report Details Part 107 Accident Report Confirmation

Part 107 Accident Report

Pilot Information

FIRST NAME	Enter First Name (Required)	LAST NAME	Enter Last Name (Required)
PHONE	Enter Phone (Required)	PHONE EXT	Enter Phone Ext
EMAIL	Enter Email		
REMOTE PILOT CERTIFICATE NUMBER	Enter Pilot Certificate number (Required)	<input type="radio"/> NONE	<input type="radio"/> UNKNOWN
Rating: Small UAS			
SUAS REGISTRATION	Enter SUAS Registration number (Required)	<input type="radio"/> NONE	<input type="radio"/> UNKNOWN

Operation Details

LOCAL DATE	MM/DD/YYYY (Required)	LOCAL TIME	HH:MM (Required)	Select	
CITY	Enter City	STATE	Select a State (Required)	ZIP CODE	Enter Zip Code
DAMAGE	<input type="checkbox"/> SERIOUS INJURY <input type="checkbox"/> DEATH <input type="checkbox"/> PROPERTY DAMAGE GREATER THAN \$500 (OTHER THAN THE UNMANNED AIRCRAFT)				

You are required to select at least one damage option from the list provided above.

DESCRIPTION	Description of Accident (Required)
-------------	------------------------------------

Include: (1) circumstances leading to the accident; (2) property damaged and extent of damage, if any or known; (3) number of person(s) injured and extent of injuries, if any or known. 0-25000 characters.

Back Next

Figure 22.4: Accident Reporting Form

FAA Home ▶ About FAA ▶ Offices ▶ Field Offices ▶ Flight Standards District Offices (FSDO)

Flight Standards District Offices (FSDO) California



* State:

Office	Address	Phone	Service Area	Contact	Website
Oakland	1420 Harbor Bay Parkway Alameda, CA 94502	(510) 864-2930	Service Area (PDF)	Contact	Website
Los Angeles	777 S. Aviation Blvd., Suite 150 El Segundo, CA 90245	(424) 405-7870	Service Area (PDF)	Contact	Website
Fresno	1781 E. Fir Ave Fresno, CA 93720	(559) 297-2150	Service Area (PDF)	Contact	Website
Long Beach	5001 Airport Plaza Drive Long Beach, CA 90815	(562) 377-5400	Service Area (PDF)	Contact	Website
Riverside	6961 Flight Road Riverside, CA 92504	(951) 276-6701	Service Area (PDF)	Contact	Website
Sacramento	1102 Corporate Way Sacramento, CA 95831	(916) 422-0272	Service Area (PDF)	Contact	Website
San Diego	8525 Gibbs Drive San Diego, CA 92123	(858) 502-9882	Service Area (PDF)	Contact	Website
San Jose	1250 Aviation Avenue San Jose, CA 95110	(408) 291-7681	Service Area (PDF)	Contact	Website
Van Nuys	16501 Sherman Way Van Nuys, CA 91406	(818) 267-3300	Service Area (PDF)	Contact	Website

Figure 22.5: Flight Standards District Offices in California

Chapter 23

Local UAS Regulations

Any regulatory agency or private property owner can make rules and regulations within their jurisdiction (within reason). The FAA's jurisdiction is the sky and aviation support (licensing, registration, infrastructure).

However, there are other aspects of UAS activity that may be subject to local rules and regulations.

State and local powers include

- Land Use
- Trespass
- Privacy
- Noise ordinances
- Wildlife conservation
- Insurance

It is allowed for a State, county or city to place restrictions on where and when drones may take off and land (land use jurisdiction), to define what constitutes invasion of privacy, or to require insurance to operate for or within a jurisdiction. It is your responsibility to

The UC Center of Excellence will help assist you in identifying applicable local regulations, however you are responsible for ensuring your regulatory compliance with all local regulations.

23.1 Searching for Local UAS Regulations

There is no easy database for applicable UAS regulations - you will likely have to search multiple locations. Most county and state owned land that is set aside for conservation often have established processes for research permits that are good starting points for UAS use.

Some good resources:

- State level regulations are typically associated with state managed lands, wildlife conservation, privacy and insurance.
- County and Municipal Codes often include regulations for city/county parks and open spaces, typically on land use, trespass and privacy.
- Directors or on-site managers are often good people to ask for permit processes and costs

23.2 No Drone Zones

Please respect local ordinances, even if you do not agree with them. Do not look for ways to circumvent or utilize a loophole if it is counter to the local communities desires. If you are operating for research

or education, you are acting as a representative of the University of California, and we strive to be good neighbors and collaborative with all communities.



Figure 23.1: No Drone Zone Sign

If you feel strongly, engage the local community in outreach and discussion and work to change their views. But recognize that what you want may not ever be what they want, and you may not be able to change their minds. If you are struggling to get access to your desired site, feel free to reach out to us and we'll see if we can find an alternative location.

Chapter 24

Update or Replace a License

Did you move or change names? Remember that you must inform the FAA within 30 days.

The easiest way to update your information with the FAA is through the Airmen Services page: <https://amsrvs.registry.faa.gov/amsrvs/default.asp> (Figure 24.1)

On this page, you can

- Change your address
- Order a replacement certificate (\$2)
- Change status of address releasability (by default, all addresses on pilot licenses, including drone licenses are public)
- Remove SSN as certificate number (for those with older manned aviation licenses)
- Request verification of certificate privileges

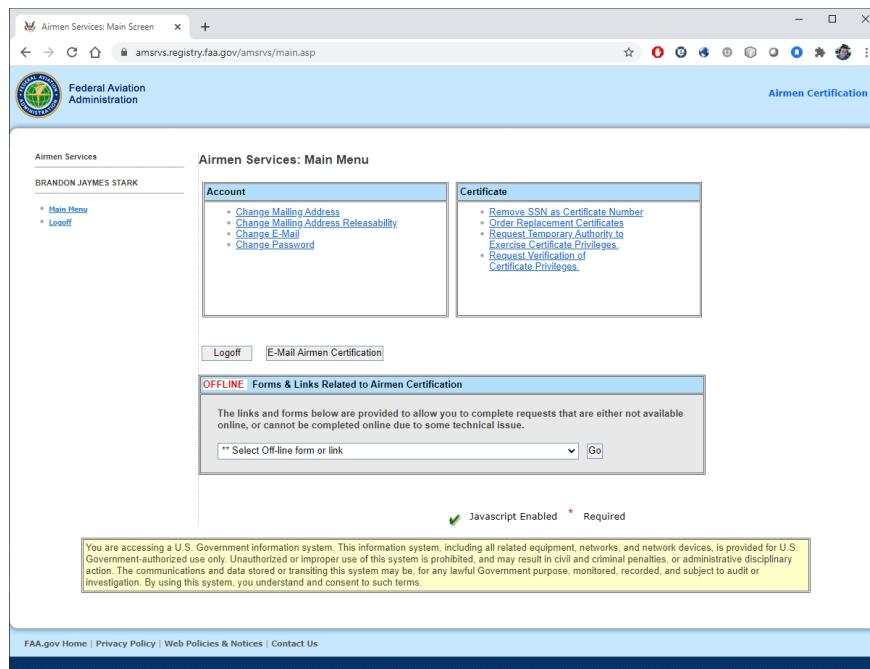


Figure 24.1: FAA Airmen Services Web Page

You do not need to order a new Remote Pilot Certificate when you update your address, but ordering a replacement certificate is the only way that you'll get a new copy of your certificate with your new address.