

Playbook Module

A-6: Planning a Drone Flight

Level: Beginner

Topic: Flight Planning

Objectives:

- This module gives you a basic planning methodology to help break down an entire flight into core pieces.
- Learn about national, regional, and local laws and regulations. Be able to summarize and incorporate them into a flight plan.
- Learn about ethical consideration and plan a safe, legal and ethical flight route, manually. Fly it, then fly a route someone else has planned.

Pre-requisites: None

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Pre-Flight Planning

Flying a drone is a lot of fun, but sometimes, what starts out as a fun day with your drone can turn into an unpleasant experience when unexpected problems occur.

The successful completion of any drone flight hinges on a variety of factors. Many things can occur before, during, or after you take to the skies. How can you make your drone flights be fun and successful? Just like everything else, you should "Be Prepared". Robert Baden-Powell, the founder of the Scouting movement was once asked what he meant by, "Be Prepared". Prepared for what, he was asked. He answered: "Why, for any old thing."

Flight planning is nothing more than a tool that has been used by pilots of all kinds of aircraft to Be Prepared to have a successful flight. It's a simple way to anticipate problems, think out what you want to do on each flight. By planning your flights, you increase the odds that you will come back with fun memories, a feeling of accomplishment, and your drone ready for the next day's adventure!

Think about it this way: would you want to get on an airplane to fly across the country if you knew that the pilot had not checked the weather, planned their flight route to keep the passengers safe, did not check the amount of fuel needed, etc.? Flight planning is so ingrained in flying that everyone assumes any pilot just does that automatically.

The Core Components of Flight Planning

- **Mission** - The full flight is called the mission. Missions have certain kinds of tasks and activities that must be completed in order for the whole flight to be successful. The mission itself consists of the title, mission area, and date that the flight will be planned for. An example of a mission could be:
 - Drone Flight at the neighborhood pond, 2/27/2021
- **Objectives** - Objectives are tasks and activities that are set as goals. They need to be completed in order for a mission to be considered successful. An example of this could be:
 - Safely take-off and fly to the pond. Take a 30 second video, return to home safely, and land.
- **Actions** - Actions are the steps that must be followed in order to meet the mission objectives. These break down the objectives into individual pieces that tell you about what needs to happen and where. Examples of some Actions would be:
 - (1) Take-off and hover at 8ft AGL.
 - (2) Fly forward 50ft NE to the pond.
 - (3) Stop and hover.
 - (4) Record video...etc.

- **Risks:** What are the risks to you or your drone on this mission? Risks can be things like:
 - Are you flying solo or with other drones in the area?
 - Check the short-term weather forecast - list any weather conditions that could interfere with a safe flight
 - Check for airspace restrictions
 - Verify that the intended Flight Area is updated in the Mission Planner of the App
 - Review a map of the area and look for Static and Dynamic Hazards. During your remote planning, identify areas where hazards may show up. During your onsite planning, recheck these areas for:
 - Static Hazards (hazards that don't move)
 - Identify keep out areas,
 - Obstacles,
 - Other terrain or area restrictions
 - Private property (avoid private property unless you have permission in advance, never aim your camera at windows of private residences, only take photos/videos of people who have given you prior permission)
 - Dynamic Hazards (hazards that can show up at any time and change). People in or near flight area
 - Animals such as nesting birds, dogs, or high-concentrations of insects
 - Roads or paths that could see foot or vehicle traffic not currently present
- **Equipment & Helpers:** What do you need to have with you at the flight area - make a list. For example you might want equipment like
 - The drone(s) you will be flying
 - Extra charged batteries
 - Any ground aids (like cones or markers) to fly over, etc.
 - How many spotters you want to have with you.
- **Rules & Regulations:** The last step is to check the Federal, State, and local rules and regulations to ensure that you will be flying legally and responsibly.
 - Federal: https://www.faa.gov/uas/recreational_fliers/
 - State/Local: <https://uavcoach.com/drone-laws/>
 - Other Local: Look for posted signs or advisories permitting or restricting the use of drones in a particular area (such as parks and rec areas, bird nesting sites, sensitive environmental areas, restricted areas around local infrastructure, VIP events, and areas of increased security)

Check in with the **B4UFly App**. It's a free app that lets recreational flyers know whether it is safe to fly their drone at their current or inputted location. The app provides situational awareness to recreational flyers and other drone users. It provides:

- A clear "status" indicator that informs the operator whether it is safe to fly or not. (For example, it shows that flying in the Special Flight Rules Area around Washington, D.C. is prohibited.)
- Informative, interactive maps with filtering options.
- Information about controlled airspace, special use airspace, critical infrastructure, airports, national parks, military training routes and temporary flight restrictions.
- The ability to check whether it is safe to fly in different locations by searching for a location or moving the location pin.

Links to other FAA drone resources and regulatory information.

BSA Flight Planning Template

Purpose

The BSA Beginners Flight Planning Template is designed to be an easy to use form for you to preplan your alpha pilot flights. The form serves as a paper planning aide which will be replaced in the production app with an on-line flight planning tool. This helps you learn how to plan your flights, including examining the area you will fly in, what objectives you want to accomplish, and how to break down a mission into individual pieces. You can identify safety steps and actions needed to have a safe flight. This will help you be aware of where your drone should be and what it should be doing throughout the flight and can also be used as a learning tool post-flight to examine where missteps or big wins occurred. This post-flight assessment helps you to make and fly better plans the next time you fly.

Types of Planning

Even before the BSA Flight Planning Template is filled out, knowing this structure helps you make informed decisions well in advance of charting your course. Pilots always keep the checklist of the planning template in mind when evaluating where and how they will achieve their goals - sometimes weeks or even months in advance! This makes their job much easier, especially for drones that need to fly at the same location many times in a row (like construction sites). There are two primary ways that flights are planned and checked for safety before being flown.

- **Remote Planning** - If you know where you will be flying and have access to the internet, you can sometimes do a lot of mission planning before ever arriving at the location that you will fly. Satellite images and maps can be outdated though, so checking your flight plan and making changes when you arrive is still very important. Evaluating a potential flying location in-person is a crucial step because it helps you consider other, better take-off and landing areas, or could show that you need to consider a different location altogether. Some of these examples include:
 - Restricted areas that are too close to airports or hospitals
 - Unsafe areas that are close to trails, roads, or tall buildings and structures
 - Locations or areas at the site that lack sufficient room to fly
 - Areas with dense tree cover or large bodies of water that could add risk to the aircraft

With the risk factors understood, evaluating potential flying areas becomes easier. Google Earth and other online map providers have easy-to-use measurement tools that you can use in determining your flight boundaries and for adding compass orientation and scale to your BSA Flight Planning Template. You will learn how to incorporate these tools into your filled template in the following sections.

- **Onsite Planning** - After reviewing potential flying locations remotely, choose one or more places that are good sites for your drone flight. After you have developed your initial, remote flight plan, you always want to look over the actual area and decide if you need to modify your plan. Take time to visit the location you have chosen, even if you don't plan on flying the same day - there's no better way to plan a successful mission than to go to the location and have a look around. Mission Planners at big companies will often have their remote pilots conduct a manual flight on-location to verify that the planning stage didn't miss any hazards to safety, especially if the mission hasn't been flown before. Important things to look for are:
 - Are there power lines?
 - Is there enough room to fly and with good visibility?
 - Are there any posted signs that communicate that the area is restricted for drones?
 - Are there many other people and pets in the area?
 - What looks different in-person as opposed to what you saw on a map?
 - Are there good potential take-off and landing areas?
 - Is there an area to shelter if the weather changes?

Have your BSA Flight Template handy when you are evaluating a location in person and take pictures of the area with your smartphone. If you take notes while you are there, it will be much easier to remember the ins and outs of each prospective location!**Tools Required**

Several required and recommended items are needed to successfully create and use the BSA Flight Planning Template.










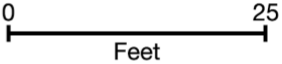
1. Printed blank copies of the Flight Planning Template (required)
2. Access to a printer (required)
3. Binder or folder for storing copies (recommended)
4. Number 2 pencil with eraser (required)
5. Colored Pencils or colored markers - at least 1 red, 1 blue, 1 green, 1 black. (recommended)
6. Compass (required)

Helpful Tips & Considerations

- Have extra blank copies of the Flight Planning Template in case mistakes are written or drawn onto the sheet.
- Fill out all boxes and drawings first in pencil, then go over the plan with colored markers when you are sure that the map and flight plan are accurate
- Keep your flight plans in an organized folder or binder that is with you where you fly.
- If you are using Google Maps or similar tools to pre-plan your mission, be sure to only draw outlines for features such as trees and water before you show up onsite to fly. Digital maps may be out of date, or may not show where certain obstacles are, or how tall they may be.
- Always use your compass when checking the actual site so that you know how to orient yourself and your mission.
- Don't be afraid to create a new mission plan if the location you are flying doesn't seem as safe, or has changed since you pre-planned the mission. This happens quite often for drone mission planners!
- If your drone is equipped with a camera, you can determine the height of obstacles that are within the boundaries of your Flight Plan by flying your drone at a safe distance from each obstacle with the camera pointing at the obstacle. Once you are at the same level height in altitude as the top of the obstacle, tell your spotter what the current drone altitude is as displayed in the Flight View. They should then mark the height of each obstacle drawn on the map. This is a great planning step that ensures you know the safety boundaries around any trees or tall structures.
- Keep your Mission Objectives simple for each flight. Take time to learn and understand what you accomplished and what was too difficult - you can always plan and fly a new mission to try out new things!




Blank Template


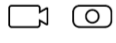

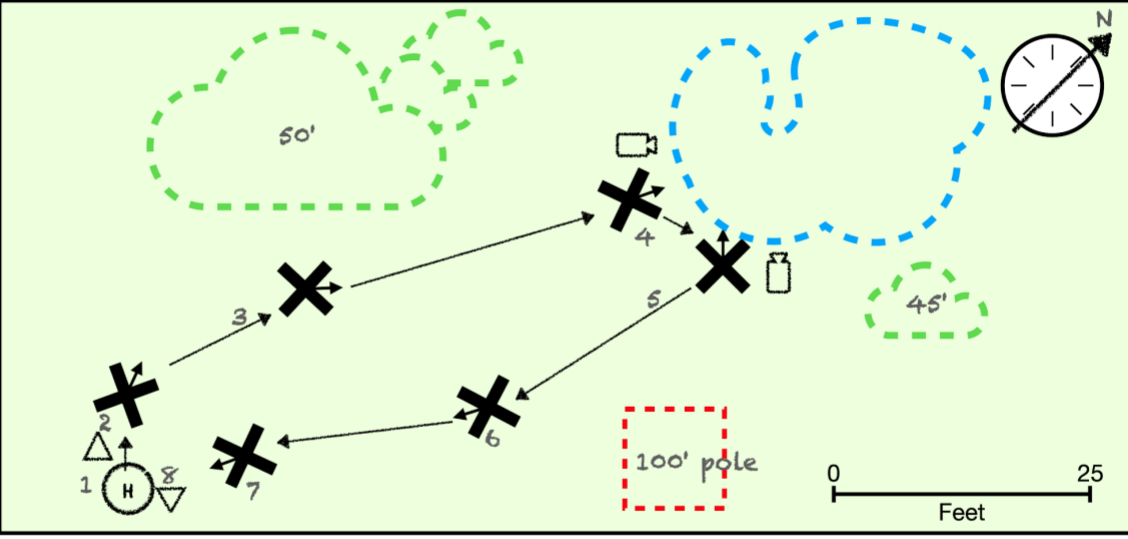
The figures below show the BSA Flight Planning Template and an example mission plan. There' is a downloadable link to print blank templates. *Note: The PDF template is set in Portrait Mode, and optimized for printing on a standard 8.5"x11" piece of blank paper.*

Pilot Name _____	Spotter Name _____	Troop # _____ Patrol _____	Date Planned ____/____/____ Date of Flight ____/____/____	Mission _____								
Hazards Legend   	Mission Objectives <div style="border: 1px solid black; height: 40px; width: 100%;"></div>											
Actions Legend  Action #    	<div style="border: 1px solid black; height: 250px; width: 100%;"></div> <div style="text-align: right; margin-top: 20px;">   </div>											
Actions <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 25%; height: 30px;">1</td> <td style="width: 25%; height: 30px;">2</td> <td style="width: 25%; height: 30px;">3</td> <td style="width: 25%; height: 30px;">4</td> </tr> <tr> <td style="width: 25%; height: 30px;">5</td> <td style="width: 25%; height: 30px;">6</td> <td style="width: 25%; height: 30px;">7</td> <td style="width: 25%; height: 30px;">8</td> </tr> </table>					1	2	3	4	5	6	7	8
1	2	3	4									
5	6	7	8									

Filled Template

Pilot Name <u>Jane Smith</u>	Spotter Name <u>Mary Smith</u>	Troop # <u>155</u> Patrol <u>Webelos</u>	Date Planned <u>06/01/21</u> Date of Flight <u>06/03/21</u>	Mission <u>Pond Photos</u>
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<p>Hazards Legend</p> <div style="text-align: center; margin-bottom: 10px;">  <p>trees</p> </div> <div style="text-align: center; margin-bottom: 10px;">  <p>water</p> </div> <div style="text-align: center;">  <p>Hazard</p> </div>	<p>Mission Objectives</p> <p>Safely take off the Raptor Drone with Owl eyes. Go to the pond and take 15 second video keeping the island in the picture. Rotate the aircraft and fly Home and Land</p>
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<p>Actions Legend</p> <div style="text-align: center; margin-bottom: 10px;">  <p>Action #</p> </div> <div style="text-align: center; margin-bottom: 10px;">  </div> <div style="text-align: center; margin-bottom: 10px;">  </div>	
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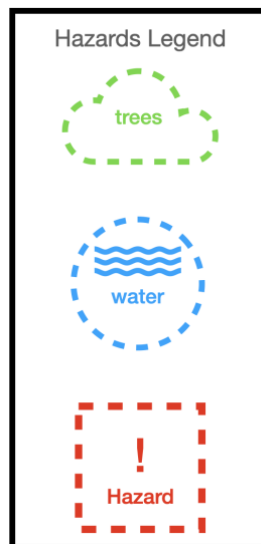
Actions			
1 Take-off and go up to 55' and hover	2 Fly forward 20 feet and hover.	3 Point aircraft camera forward towards the tree	4 Rotate towards the pond and fly slow. Start camera recording
5 Roll to right, and keep island in pic. Stop recording and rotate 180°	6 Center Home in screen. Fly to home at 55'	7 Slow down and lower drone to 20'. Hover	8 Land drone back on landing pad.

The Flight Planning Template can be found at www.Guinpartners.com/BSATrials

Form Filling Guide

Filling out the BSA Flight Planning Template is really easy with a bit of practice! Once a location has been chosen for flying, the next step is to map your flying area in accordance with the steps below. If you have already walked the location and taken some notes, the process is much faster and will require less modifications to be made to your plan. ***Be sure to complete the next steps with a pencil that has an eraser until you are satisfied with its accuracy!***

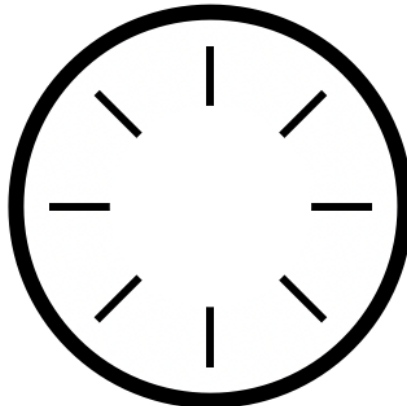
1. Fill out your name as the **Pilot**.
2. Add the name of your **Spotter**. We will cover their responsibilities below.
3. Write in your **Troop #** and **Patrol Name** if applicable.
4. Fill out the **Date Planned** on the very first day you started making your mission.
5. When you are ready to fly, fill out the **date of Flight**. It's okay if this isn't the same day the mission was planned, or if you need to make changes.
6. Give the plan a **Mission** name. This should be a short statement that tells others where you are flying and very basic information about what you hope to accomplish. If you are flying the same mission plan more than once, leave the name the same, and only change the **Date of Flight**. If you have modified the flight plan, include a version number after the Mission name (example - "Pond Photos - V2").
7. Think about what you would like to accomplish with your flight. If this is your first mission plan, start simple! Record your goal for this plan in the **Mission Objectives** box.
8. Now, refer to the **Hazards Legend**. These symbols are a guide for you to draw different shapes on your map that indicate areas that may be dangerous to fly too closely. Be sure to mark these in a regular pencil that has an eraser in case you need to make changes. After walking the perimeter of your flying area you should choose an ideal place to take-off that is free of hazards.



9. From the safe place chosen for take-offs and landings, draw a small **Helipad** symbol in the left portion of the **Map Area**. Be sure to leave plenty of room on your map to chart your course!



10. If you have a printed map of the area with you, it will be easy to draw in the **Hazard Symbols** before mapping the drone flight. If not, now you should take note of where your flight area boundaries are.
- For example, in the example Filled Template above, there's a pole you want to avoid about 30ft from you to the northeast. The pond that you want to take pictures of is north of you a bit further, and there are some trees to the northwest that are also a flight hazard. Using a mapping application on your phone, or walking the perimeter can tell you which direction, and how far away each of these hazards are from you. Pencil in the **Compass Circle** to show which way **North** is from your vantage point.



11. Now that you know your boundaries, it's up to you to determine how large the flying area is in relation to your map. The **Map Area** should be big enough to fit your entire flight plan, but also not so big that you can't see important details that you need to add in. A good rule of thumb is to only include the **closest** obstacles to your flight area. Don't draw in areas that you know you won't fly to and use the provided **Scale** in the bottom right corner of the **Map Area** to your benefit.



12. Pencil in the Hazards near your flight area using dashed shapes for their location and their type. Once you are happy with their placement, you can use markers or colored pencils to color the dashed lines. Don't worry about coloring in the shapes before your flight - you can always add detail later!

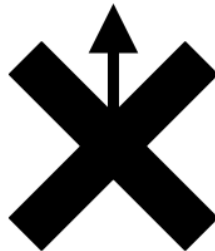
13. It is now time to build your mission plan based upon the **Mission Objective** you recorded earlier. A mission plan should be simple, with the objective being the goal to accomplish. Start by writing in the **Actions** to describe each element of your planned flight from when the motors are armed. Each action is something you intend to perform going through your objectives and returning home. These could include:

- a. **Take-off Plan** - How high do you want to fly above the **Helipad** before hovering? Record this as your first action.
- b. **Departure Route** - Which way are you going to go and what altitude will you climb to/ maintain?
- c. **Wayward Actions** - What changes will happen to your flight on the way to your objective?
- d. **Objective Actions** - What will you do when you reach your objective destination?
- e. **Return Actions** - How will you return home? What direction will you go, and at what altitude?
- f. **Landing Plan** - How high in altitude will you be when you are back over the **Helipad**? Will you hover before landing?

Keep in mind that your mission plan can be as simple as practicing maneuvers or flying to the edge of a pond to have a look around. No matter the complexity of your mission, planning a safe route and evaluating your performance as flown is where the value of flight planning lies.

14. With the **Actions** section now completed, it is time to draw your **Flight Route** into the **Map Area**. Be sure to use a pencil with an eraser in case you want to make changes to the drawing or the written plan. Use the **Actions Legend** located in the left margin to add your routes and actions. Symbols should be drawn small enough so as not take up useful space on your map, but large enough for your Spotter to easily understand.

- Symbol Definitions are included below:
 - a. **Your drone** (arrow indicates the front-facing side)

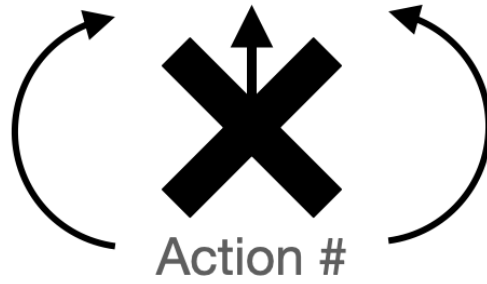


- b. **Action #** (References a written Action Description)



Action #

c. **Drone Rotation** (showing yaw directions as clockwise / counter clockwise arrows)



d. **Video Recording**



e. **Camera Snapshot**



f. **Helipad**



g. **Route Path** (arrow showing direction)



h. **Take-off Action**



i. **Landing Action**



15. List your identified risks, equipment needed, and helpers/spotters needed on the back of the Flight Plan Template.

Once you have completed these steps, you are almost ready to fly! If this is a troop or group event, ask the group/troop adult leader to review and approve your flight plan. If it is a solo event, ask someone else to review your plan and help find things you may have missed.

Pilot & Spotter Roles in Execution

The **pilot** focuses on flying the drone on the mission and is always looking at the drone.

- Pilot Responsibilities
 - Pilots are solely responsible for understanding and abiding by the rules implemented by the Federal Aviation Administration (FAA).
 - Pilots are solely responsible for complying with all applicable legal requirements for the operation of any aircraft, including the detection and avoidance of other aircraft.
 - Pilots must at all times comply with all applicable local, state, national, and international laws and regulations related to the operation of unmanned aerial and other devices, including any applicable laws with regard to property and privacy.
 - Pilots are solely responsible for obtaining and maintaining all necessary licenses, consents, and authorizations of any kind.
 - Pilots are solely responsible for their actions and any consequences of their operation and behavior.
 - Pilots must always be in command of their aircraft, fly line-of-sight, and always be ready to assume direct control when necessary.
 - Pilots will operate safely and at appropriate distances from people.
 - Pilots must ensure all software, firmware, and reference systems are current.
 - Pilots are aware of hazards, including terrain, obstructions, wind, rain, and temperature which can negatively impact the performance of their drone and battery.
 - Pilots must have adequate insurance to protect themselves and 3rd parties who may be impacted by the pilot's actions or potential hardware failures. Registered Scouts and adults in the Scouts BSA program are automatically covered by a general liability insurance policy that includes these kinds of situations ONLY if the flight is an official scouting activity. If a pilot is flying on their own outside of official scouting events, then they are NOT covered by this insurance and should check with their personal or family insurance plans to determine if they are covered,

The **spotter** should be close to the pilot to watch the drone AND the rest of the area. They are there to warn the pilot if they see a situation that may cause problems. Note: Your flight plan may include actions for the spotter to move to have better visibility of an obstacle that you can't see clearly from your pilot location.

- Spotter Responsibilities
 - Spotters are responsible for warning the pilot of issues such as a storm coming up behind the pilot, people walking into the area where the drone is flying, etc.
 - The spotter also focuses on the flight plan map and tells the pilot what the next step or objective is.

Safety, Ethical, and Other Rules and Considerations

This is a comprehensive list of the United States regulation for flying recreational drones, ethical drone flying guidelines. This includes FAA regulations, the [U.S. Department of Commerce's National Telecommunications Information Administration's \(NTIA\) recommended voluntary best practices](#), and the BSA Safety Guidelines.

- Where to fly
 - Fly no higher than 400 feet and remain below any surrounding obstacles when possible.
 - Remain well clear of and do not interfere with manned aircraft operations, and you must see and avoid other aircraft and obstacles at all times.
 - Do not intentionally fly over unprotected persons or moving vehicles, and remain at least 25 feet away from individuals and vulnerable property.
 - Contact the airport and control tower before flying within five miles of an airport or heliport. (Read about best practices [here](#))
 - Ensure the flight area is safe and that the pilot is competent and proficient in the operation of the drone.
 - Do not fly near or over sensitive infrastructure or property such as power stations, water treatment facilities, correctional facilities, heavily traveled roadways, government facilities, etc.
 - Don't fly over other people's private property without permission.
 - Check and follow all local laws and ordinances before flying over private property.
 - Drones may not be operated over any people not directly participating in the flight who are not under a covered structure or not inside a covered stationary vehicle.
 - Drones must operate in daylight or may operate in civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting.
 - Drone pilots must yield right of way to other aircraft.
 - Minimum weather visibility of 3 miles from control station with 500 feet of visibility below the clouds and above the aircraft and 2000 feet horizontally between the clouds and the aircraft.
 - Operations in Class B, C, D and E airspace are allowed with the required Air Traffic Control (ATC) permission.
 - Operations in Class G airspace are allowed without ATC permission.
- When to Fly
 - Do not fly in adverse weather conditions such as in high winds or reduced visibility.
 - Do not fly under the influence of alcohol or drugs.
 - First-person view (FPV) goggles can be used by the pilot only when a VO is also present and in close proximity to the pilot.
 - No person may act as a remote pilot in command or spotter for more than one drone at a time.
 - No operations from a moving aircraft.
 - No operations from a moving vehicle unless the operation is over a sparsely populated area.
 - No careless or reckless operations.
 - Pilots must follow the preflight checklist and inspection steps for all flights.
 - A person may not operate a drone if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of the drone.
 - External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. However, hazardous materials may never be carried.
 - Unmanned aircraft must weigh less than 55 lbs. (25 kg).

- Controlling your flight
 - Keep your drone in your and/or your spotter's view at all times.
 - Tell other people you'll be taking pictures or video of them before you do so and make sure they agree to being photographed.
 - If you think someone has a reasonable expectation of privacy, don't violate that privacy by taking pictures, video, or otherwise gathering sensitive data.
 - If anyone raises privacy, security, or safety concerns with you, listen to what they have to say, and respect their concerns. A scout is courteous.
 - Don't harass people with your drone.