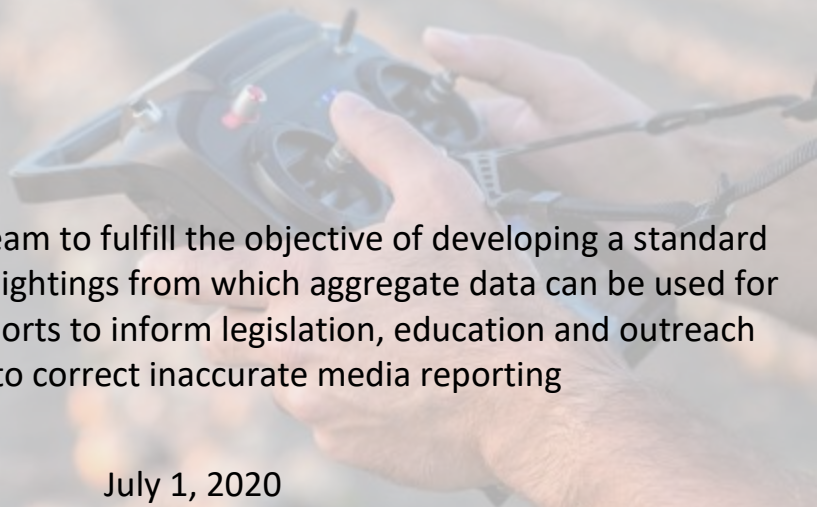
UNMANNED AIRCRAFT SAFETY TEAM

Safety Enhancement No. 3
UAS Sightings Reports

Final Report

Standard Reporting Format for Unmanned Aircraft Systems (UAS)



Prepared by UAST SE-3 Team to fulfill the objective of developing a standard reporting format for UAS sightings from which aggregate data can be used for developing analytical reports to inform legislation, education and outreach efforts and to correct inaccurate media reporting

July 1, 2020

Prepared for the Unmanned Aircraft Safety Team (UAST) for promotion with UAS industry stakeholders and safety advocates.

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1. Committee

Chairman: Chris Johnson, PhD, University of Wisconsin

Co-Chair: Captain Mark Reed, Air Line Pilots Association (ALPA)

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Contributors: Chris Lucius, ALPA; Rune Duke, Aircraft Owners and Pilots Association (AOPA); Justin Barkowski, American Association of Airport Executives (AAAE); Gerald Pilj, FAA; Chris Hill Helicopter Association International (HAI).

2. Objective

The goal of this safety enhancement, which was successfully executed from June 2018 through September 2019, was to develop a standard reporting format for unmanned aircraft systems (UAS) sightings from which aggregate data can be used for developing analytical reports (e.g., heat maps) illustrating the density of UAS sightings to inform legislation, education and outreach efforts and to correct inaccurate media reporting.

3. Background

The Unmanned Aircraft Safety Team (UAST) is an industry-government partnership committed to ensuring the safe operations of unmanned aircraft systems (UAS) in the national airspace system (NAS). The UAST supports the safe integration of UAS with data-driven safety enhancements and collaboration amongst members of the UAS industry.

Chad Budreau of AMA delivered a report to the Unmanned Aircraft Safety Team (UAST) at the June 2018 plenary session in Washington D.C. The report called for a more structured data format for UAS sightings, which motivated a roundtable discussion among nine (9) UAST members. The discussion was led by Chad Budreau and Earl Lawrence. Dr. Chris Johnson was elected Chairman of the committee, and Capt. Mark Reed was elected co-Chair to further investigate and carry out this safety enhancement for improving the format of UAS sightings reports to be used by pilots, air crews and air traffic controllers. The discussion lead to the following conclusions and considerations:

A. There is a high probability of UAS sightings on final approach to airports when radio traffic and cognitive workload is high, requiring brevity and concision.

B. Air Traffic Control (ATC) mandatory occurrence reports are currently used with an unknown format to pilots.

C. The committee will consider similar reporting tools such as pilot reports (PIREPS), wildlife sightings, laser reports and NASA's aviation safety reporting system (ASRS) reports.

D. UAS sightings reports developed under this safety enhancement will be centric to manned pilots, flight crews and air traffic controllers. They are not intended for use by the general public reporting UAS sightings.

4. Current UAS Reporting

Pilots communicate continually with ATC. In addition to standard navigational and frequency messages, there are occasional reports given. Most veteran pilots have memorized the format of a PIREP to provide standard weather information including station ID, type of report, aircraft location, time, altitude, aircraft type, sky cover, visibility and weather, temperature, wind, turbulence, icing, and remarks. When receiving a PIREP controllers take notes on an electronic PIREP form, which gets ingested into a weather database. Similarly, there are standard report formats for laser reports and wildlife advisories. For example, a bird sighting report would include information about aircraft location, animal position, species or size, course of flight, and altitude. Again, controllers take notes on laser reports and wildlife sightings, and this information gets distributed to other controllers in the area.

Additionally, a Mandatory Occurrence Report (MOR) is generated for any occurrence involving air traffic services for which the collection of safety-related information is mandatory. A few examples of mandatory events include loss of separation, pilot deviations and in-flight emergencies and hazards. Controllers have no forms to fill out for MORs. After the conversation, they notify their supervisor who will listen to the recorded conversation and fill out the MOR form and upload it into the Comprehensive Electronic Data Analysis and Reporting (CEDAR) tool.

Currently, MORs are used for recording UAS sightings. However, since MORs are highly general forms with over 100 data-input fields, the quality of the detail that goes into an MOR for a UAS sighting is dependent upon the information communicated by the pilot reporting the UAS event. Again, the event details are captured in the pilot-controller conversation, the recording of which is reviewed by the supervisor who completes the MOR form, and since MOR forms are highly general to accommodate a plethora of safety-related events, **there is a desire within the aviation community to develop a standard reporting tool for UAS sightings that is similar to PIREPs and wildlife and laser reports**. Once developed, this standard report format will be communicated to the flying community and taught in training such that each UAS sighting report contains the same level of high-quality yet concise detail..

5. Methods

From mid-2018 through mid-2019, the committee conducted a series of focus-group discussions and surveys that were distributed to the aviation community to solicit opinions from UAST members and affiliates about the specific reporting variables to be considered for inclusion in standard UAS sightings reports. The surveys and focused discussions allowed the committee to rank-order all of the variables that the aviation community felt important for inclusion. The results of these efforts and the committee's final recommendation to the FAA regarding the format of standard UAS sightings reports are reported as follows.

Results

Survey 1

Following the roundtable discussion at the June 2018 UAST plenary session, Dr. Johnson and Capt. Reed assembled a small research team (the committee) and scheduled bi-weekly meetings to carry out the research and development of standardized UAS sightings reports. An initial survey was designed and distributed in July 2018 to solicit opinions from UAST members and affiliates about the specific reporting

variables to be considered for inclusion in standard UAS sightings reports. Fourteen (14) reporting elements were gathered from similar reporting tools including NASA ASRS reports, wildlife sightings reports and laser encounters. Survey respondents were asked to rate the importance of each variable on a four-point scale (4 = very important, 3 = important, 2 = maybe important, 1 = unimportant).

Fifty-two (52) responses were analyzed on 8/3/2018. Table 1 summarizes the aviation licenses and certifications held by the respondents, which reflects a representative sample of the professional aviation community, including 20 remote pilots, 14 private pilots, 16 commercial pilots, nine (9) airline transport pilots, five (5) air traffic controllers and 13 non-rated respondents (note that some respondents held more than of the listed certifications).

Table 1: Survey 1 Respondent Certifications

Certification Held	Number of Respondents
Air Traffic Control	5
Airline Transport Pilot	9
Commercial Pilot	16
Private Pilot	14
Remote Pilot	20
No Aviation Certification	13

Table 2 is a rank-ordered list of the fourteen (14) variables that the respondents were asked to evaluate for importance. Respondents were also asked to write in additional reporting elements to be considered, which were analyzed by the committee and voted on for inclusion in a follow-up survey. The additional variables that were considered important by the committee are listed in Table 4.

Table 2: Survey 1 Ranked Reporting Variables

Reporting Variable	Rank
Altitude of Reporting Aircraft	1
UAS Position	2
Altitude of UAS	2
Reporter Position at Sighting Time	3
Time of Sighting	4
Safety Concerns	5
UAS Description	6
RPIC Description	7
Reporting Aircraft Tail Number	8
Time of Report	9
Reporter Contact Information	10
Weather Info	11
Privacy Concerns	12
Reporter Name	13

Survey 2

Following a review of Survey 1, the UAS sightings reports committee built a second survey to establish a finite list of reporting variables to be included in standard UAS sightings reports. This survey asked respondents if they wanted to include or exclude eighteen (18) reporting elements. Survey 2 also gave them another opportunity to suggest additional reporting elements that were not included in the list of eighteen (18). The survey was distributed in November 2018, and seventy-seven (77) responses were

analyzed on 1/10/2019. Table 3 summarizes the aviation licenses and certifications held by the respondents, which reflects a representative sample of the professional aviation community, including 37 remote pilots, 16 private pilots, 18 commercial pilots, 16 airline transport pilots, four (4) air traffic controllers and nine (9) non-rated respondents (again, some respondents held more than of the listed certifications).

Table 3: Survey 2 Respondent Certifications

Certification Held	Number of Respondents
Air Traffic Control	4
Airline Transport Pilot	16
Commercial Pilot	18
Private Pilot	16
Remote Pilot	37
No Aviation Certification	9

Table 4 is a rank-ordered list of variables that the respondents suggested for consideration. Table 4 also contains a column containing notes from the committee's analysis of the survey results and discussion regarding inclusion and formatting. The committee decided to exclude five (5) of the reporting elements for the reasons stated in Table 4 (see bold face print).

Table 4: Survey 2 Ranked Reporting Variables

Reporting Variable	Rank	Committee Notes
Time of sighting	1	Suggest ASRS format
Location of reporter at time of sighting	1	Suggest ASRS format
Altitude of reporting aircraft	1	Suggest ASRS format
Altitude of UAS	1	Suggest ASRS format
UAS position	2	Suggest ASRS format
UAS description	2	Suggest size, weight, configuration and color
Free text to describe other information	2	Suggest free text for safety concerns / other info
Reporter contact information	3	Suggest ASRS format and optional, not required
Near miss distance	4	Suggest ASRS format
Safety concerns	5	Added to "free text to describe other information"
Evasive maneuvers executed by reporter	6	Suggest ASRS format
Airspace classification	6	Suggest ASRS format
Phase of flight for reporting aircraft	7	**Remove: Can be derived from location and time**
Was the UAS over crowds, vehicles, wildlife, etc?	8	**Remove: Unrelated to NAS users**
UAS pilot location (if known)	9	**Remove: Difficult to derive; safety hazard**
Relevant weather information	10	Suggest ASRS format
Evasive maneuvers executed by UAS	10	**Remove: UAS does not have right of way**
Who commanded the evasive maneuver	11	**Remove: Unimportant**

Survey 3

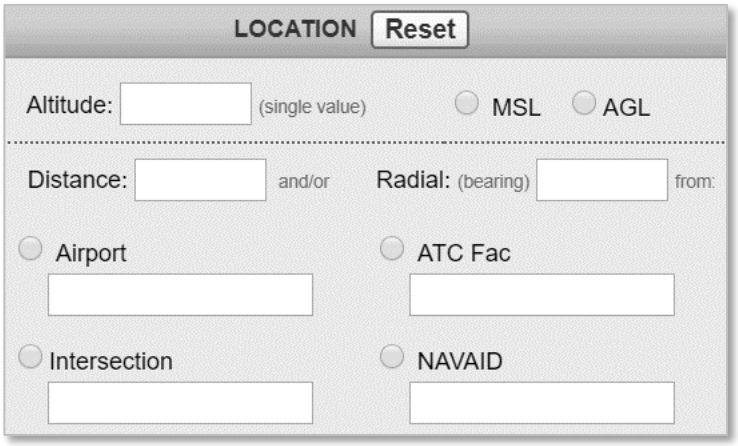
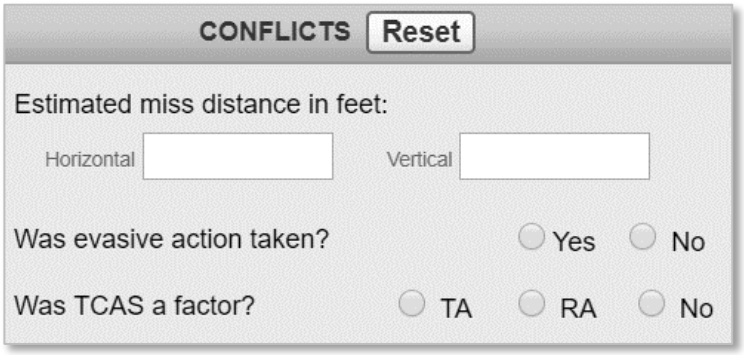
Following a review of Survey 2, the UAS sightings reports committee built a third and final survey to establish the formatting of each reporting element to be included in standard UAS sightings reports. The survey asked respondents if they preferred the committee's recommended format listed in Table 4 or an alternate format, which they were allowed to write into the survey via free text. Survey 3 was distributed in April 2019, and twenty-four (24) responses were analyzed on 5/16/2019. Table 5 summarizes the aviation licenses and certifications held by the respondents, which reflects a small but representative sample of the professional aviation community, including 14 remote pilots, three (3) private pilots, five (5) commercial pilots, eight (8) airline transport pilots, four (4) air traffic controllers and six (6) non-rated respondents (again, some respondents held more than of the listed certifications).

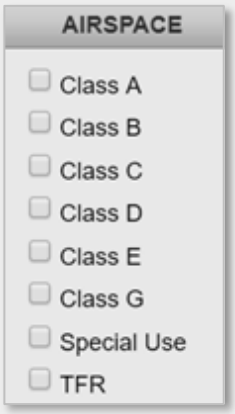
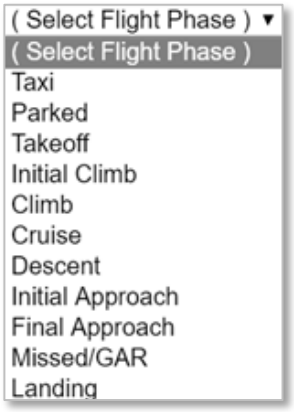
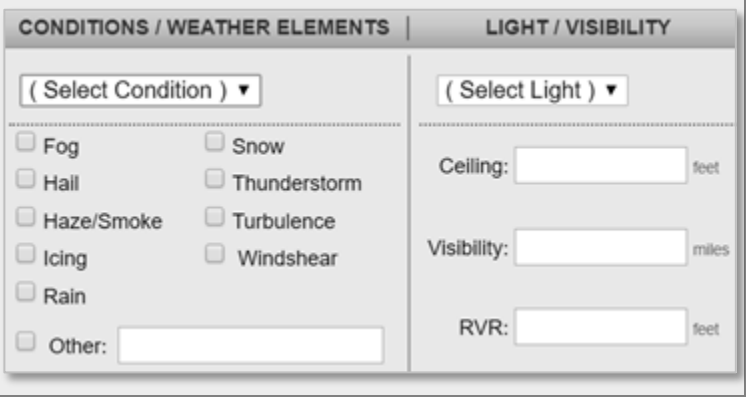
Table 5: Survey 3 Respondent Certifications

Certification Held	Number of Respondents
Air Traffic Control	4
Airline Transport Pilot	8
Commercial Pilot	5
Private Pilot	3
Remote Pilot	14
No Aviation Certification	6

The majority of responses to Survey 3 (77%) agreed to use the variable formats suggested by the committee. During analysis of the results of Survey 3, the committee considered all additional formats suggested by the 23% of responses that did not agree with the committee's proposed format. Based on that analysis, final suggestions were made, and Table 6 is the finalized list of UAS sightings report variables with the committee's final recommendations to the FAA in the right column of Table 6. In sum, the committee suggests using a format similar to the NASA Aviation Safety Reporting System (ASRS) for the following variables: time of sighting; altitude and location of reporting aircraft at time of sighting (with clarification of "intersection" as an navigational fix as opposed to a street intersection); altitude and relative location of conflicting UAS (see ASRS "conflicts" section); safety concerns; reporter contact information (optional variable with the addition flight / ATC experience and certifications); near miss distance and evasive maneuvers executed by reporting aircraft (nested in ASRS "conflicts" section); airspace classification; phase of flight (if included; may be removed); and relevant weather information. The only variable to be included for which an ASRS format could not be adopted is "UAS description". Therefore, the committee suggests the following format: Size, weight, configuration and color in free text. The committee also suggests removing the following variables for the reasons stated in Table 6, despite the results from the surveys suggesting to include them: UAS pilot location (if known); Evasive maneuvers executed by UAS; Who commanded the evasive maneuver; and Was the UAS over crowds, vehicles, wildlife, etc?

Table 6: Suggested Reporting Variables and Formatting

Reporting Variable	Format Suggestion
Time of sighting	ASRS format: MM/DD/YYYY HH:MM, Local Time, 24-Hr Clock
Location of reporter at time of sighting	ASRS format w/clarification of "Intersection" as NAVAID / fix: 
Altitude of reporting aircraft	ASRS format. Nested / Included above (see "LOCATION")
Altitude of UAS	ASRS format: 
UAS position	ASRS format. Nested / Included above (see "CONFLICTS")
UAS description	Size, weight, configuration and color in free text
Safety concerns and other information	Free text similar to ASRS (suggest de-identifying)
Reporter contact information	Name, Phone Number, Address, Email, Aircraft Tail Number, Flight Number (all optional, not required). May consider ASRS format, including flight / ATC experience and certifications.
Near miss distance	ASRS format. Nested / Included above (see "CONFLICTS")
Evasive maneuvers executed	ASRS format. Nested / Included above (see "CONFLICTS")

Reporting Variable	Format Suggestion
Airspace classification	ASRS format: 
Phase of flight for reporting aircraft	Remove (can be derived from location) or use ASRS format: 
Was the UAS over crowds, vehicles, wildlife, etc?	Remove: Unrelated to pilots and controllers
UAS pilot location (if known)	Remove: Difficult to derive / safety hazard for pilots searching
Relevant weather information	ASRS format: 
Evasive maneuvers executed by UAS	Remove: UAS does not have right of way
Who commanded the evasive maneuver	Remove: Unimportant

6. Discussion

This research queried a representative sample of aviation professionals, subject-matter experts and non-professionals regarding the structure and format of standard UAS sightings reports. The committee suggests that the FAA include the following variables in UAS sightings reports, using ASRS formatting for all but one variable: time of sighting, location and altitude of reporting aircraft, location and altitude of the UAS, UAS description; safety concerns; reporter contact information (optional); near miss distance; evasive maneuvers executed by reporting aircraft (if applicable); class of airspace and phase of flight during which sighting occurred; and relevant weather information.

This research also validates the format of other tools being developed in parallel efforts to aid with UAS sightings reports. Specifically, the Helicopter Association International (HAI) developed the HAI Aviation Reporting Program (HARP) tool in response to HAI member requests for a rotary-wing reporting capability focused on reporting UAS activities perceived as near midair collisions, unsafe operations, or other activities that may threaten continued safe flight operations for helicopter operators (see Appendix A for more details). Likewise, a proposed Unmanned Aircraft Safety Reporting System (UASRS) was designed to be a UAS specific version of the ASRS. Motivations for the UASRS are similar to ASRS in providing the emerging unmanned aviation community with an anonymous, non-punitive reporting tool to drive safety. At present, UAS operators are only required to report incidents that meet minimum damage and/or human-injury thresholds, so UASRS was designed to collect aviation incident and near-incident information on a self-reporting, anonymous, non-punitive basis so that trending information can be derived. Presently, a prototype UASRS form has been shared with the NASA ASRS team, and the UAST has approached the FAA council to ensure that existing protections for manned aviators will be extended to UAS operators.

7. Conclusion

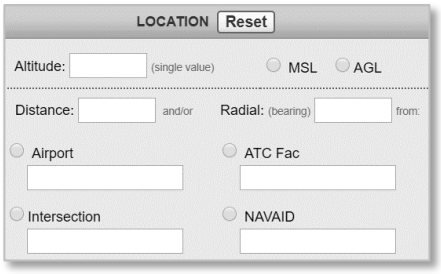
This research concludes with a recommendation to the FAA for a standard reporting protocol for UAS sightings that are reported to ATC by manned aircraft pilots and flight crews. This is only the first version of the reporting tool, and if implemented, the FAA should be open to modifying the protocol and reporting format based on user feedback of the live or beta-tested system. If the FAA decides to implement the recommended reporting protocol or some derivation thereof, a new form will need to be created in the existing electronic platform that is used by ATC and managed by an Acquisition Management System. This process generally takes three to five years to change unless the change is appended to another proposed modification. In the interim, the aviation community may want to implement something to improve reporting. Currently, anything a pilot or crew reports to ATC is recorded and will be input into the MOR system, so the fastest way to capture the information needed is to entice pilots to automatically provide such detail. That said, the FAA may want to invoke an educational campaign that would educate the flying community on the desired format of standard UAS sightings reports, encouraging them to memorize the critical information outlined in this report.

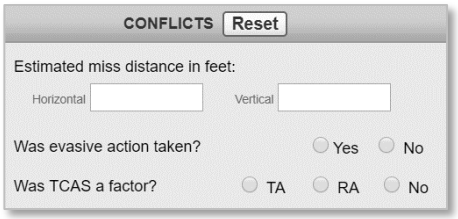
Appendix A. HAI Aviation Reporting Program (HARP)

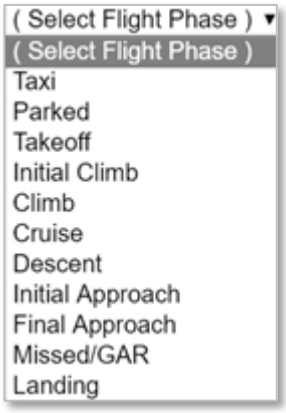
The purpose of the Helicopter Association International (HAI) Aviation Reporting Program (HARP) is to provide a reporting tool for rotary-wing operators. HARP is a free aviation safety reporting portal that is hosted on HAI web servers to enable prompt collection and accurate routing of aviation safety reports submitted by manned and unmanned rotary-wing operators.

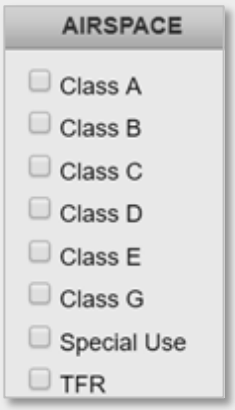
Table 7 below summarizes the similarities and differences between HARP and the Unmanned Aircraft Safety Team's (UAST) proposed safety enhancement for standard Unmanned Aircraft Systems (UAS) sightings reports. The HARP column (right column) in Table 1 reflects the current data fields available at www.rotor.org/harp.

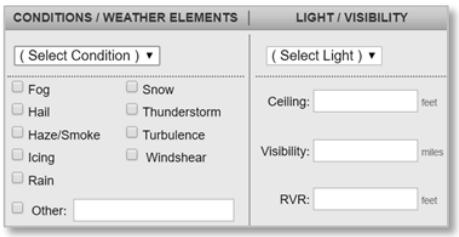
Table A-1: Comparison of HARP and UAST Sightings Reports

Variable	UAST Format Suggestion	HARP Format
Time of sighting	ASRS format: MM/DD/YYYY HH:MM, Local Time, 24-Hr Clock	Two Separate Entries: 1. Event Date: mm/dd/yyyy 2. Event Time (Local): hh:mm PM/AM
Location of reporter at time of sighting	ASRS format w/clarification of "Intersection" as NAVAID / fix: 	Users must enter <u>one</u> of the following: 1. Nearest Town or City 2. Location ID (Airport, Hospital, etc.) 3. Map Location (Latitude/Longitude) 4. Geo-Enabled radio button: Users select geo-enabled to auto-fill their present location if same as event location. 5. Manual radio button: Users select Manual if manually entering the event location. 6. Latitude (auto filled or manual) 7. Longitude (auto filled or manual) Required if Location ID entered: 8. Distance from Location ID. 9. Radial from Location ID. Optional entry: 10. Location Description: Free text (250 characters).
Altitude of reporting aircraft	ASRS format. Nested / Included above (see "LOCATION")	Altitude AGL (dropdown list) 1. SFC - 399 ft 2. 400 ft - 999 ft 3. 1000 ft - 2999 ft 4. 3000 ft or higher

Variable	UAST Format Suggestion	HARP Format
Altitude of UAS	ASRS format:  	N/A – inferred through reporting aircraft altitude and vertical distance conflict, otherwise provided in remarks if relevant
UAS position	ASRS format. Nested / Included above (see "CONFLICTS")	N/A – inferred through reporting aircraft position and horizontal distance conflict, otherwise provided in remarks if relevant
Aircraft Details selected via dropdown vs open text entry	N/A	1. Was an aircraft involved? Yes / No 2. Your aircraft type: Manned or Unmanned (appears only if #1 response is Yes) 3. Was another aircraft involved? Yes or No (appears only if #1 response is Yes) 4. Other Aircraft Type: Manned or Unmanned
Aircraft Details selected via dropdown vs open text entry	N/A	1. Select Make: Dropdown list of known manufacturers + Other + Unknown 2. Other Make: Free Text (appears when "Other" Make is selected for #1) 3. Select Model: Dropdown list based on aircraft "Make" selected in #1 (list includes "Other" and "Unknown") 4. Other Model: Free Text (appears when "Other" Model is selected for #3)
UAS description	Size, weight, configuration and color in free text	Users responding yes to aircraft involved questions, and selecting **Unmanned** for the **Aircraft Type** or **Other Aircraft Type** must provide these additional details before proceeding: 1. **Type** (dropdown): a. Rotorcraft - Multirotor b. Rotorcraft - Helicopter c. Fixed Wing - Airplane d. Fixed Wing - Glider e. Powered Lift - VTOL f. Airship g. Unknown 2. **Size** (dropdown): a. Nano/Micro/Mini: under 0.55 lbs (palm sized) b. Small: 0.55 - 55 lbs c. Medium: 56 - 330 lbs d. Large: Over 330 lbs e. Unknown 3. **Gear** (dropdown): a. Fixed b. Retractable c. Unknown / Did Not Observe

Variable	UAST Format Suggestion	HARP Format
Safety concerns and other information	Free text similar to ASRS (suggest de-identifying)	Same as UAST, with 3 modifications: 1. Field appears twice: early in form and at end for users to add new details 2. Info button provided with instructions 3. Text field limited to 4,000 characters
Reporter contact information	Name, Phone Number, Address, Email, Aircraft Tail Number, Flight Number (all optional, not required). May consider ASRS format, including flight / ATC experience and certifications.	*Last Name, *First Name, Phone Number, Best Call Time, *Mailing Address (*Mandatory)
Near miss distance	ASRS format. Nested / Included above (see "CONFLICTS")	Estimated Distance in Feet 1. Horizontal (free text) 2. Vertical (free text)
Evasive maneuvers executed	ASRS format. Nested / Included above (see "CONFLICTS")	Was evasive action taken? 1. Yes (radio button) 2. No (radio button)
TCAS a Factor	ASRS format. Nested / Included above (see "CONFLICTS")	Was TCAS a factor? 1. Yes (radio button) 2. No (radio button)
ATC/FAA Notified?	N/A	Was ATC or FAA notified of the issue? 1. Yes (radio button) 2. No (radio button)
FAR PART	N/A	Similar to ASRS but added FAR options, including FAR 107, and text description
Phase of flight for reporting aircraft	Remove (can be derived from location) or use ASRS format: 	Dropdown with the following options: 1. Parked 2. Ground Taxi 3. Hovering 4. Takeoff 5. Departure/Climb 6. Cruise 7. Arrival/Descent 8. Landing 9. UAS/Drone Launch 10. UAS/Drone Recovery 11. Other

Variable	UAST Format Suggestion	HARP Format
Airspace classification	ASRS format: 	ASRS format with Class A excluded
Aircraft Operator	N/A	Similar to ASRS format but with Government (Fed, State, Local) and “Other” added Other
Aircraft Mission	N/A	Similar to ASRS format but replaced ASRS list with 14 rotary-wing specific missions and ”Other”
Was the UAS over crowds, vehicles, wildlife, etc?	Remove: Unrelated to pilots and controllers	NA
UAS pilot location (if known)	Remove: Difficult to derive / safety hazard for pilots searching	NA

Variable	UAST Format Suggestion	HARP Format
Relevant weather information	ASRS format:  	Similar to ASRS with modifications: Environmental Conditions 1. Light (dropdown) a. Dawn b. Daylight c. Dusk d. Night 2. Ceiling (dropdown) a. SFC - 399 ft b. 400 ft - 999 ft c. 1000 ft - 2999 ft d. 3000 ft or higher 3. Visibility (dropdown) a. Below 1 SM b. At or above 1sm but below 3sm c. At or above 3sm Sky Condition / Condition (dropdown) 1. VMC 2. IMC 3. Mixed 4. Marginal Environmental Elements (dropdown) 1. Fog 2. Hail 3. Haze / Smoke 4. Icing 5. Rain / Mist 6. Snow 7. Thunderstorm 8. Turbulence 9. Whiteout / Brownout 10. Windshear 11. Other (text entry)
Evasive maneuvers executed by UAS	Remove: UAS does not have right of way	NA
Who commanded the evasive maneuver	Remove: Unimportant	NA