The FAA's Center of Excellence for UAS Research

ASSURE

Alliance for System Safety of UAS through Research Excellence

Final Report
ASSURE A28: Disaster Preparedness and Response Using UAS
Attachment 1 – Concept of Operations (CONOPS) for Airport Terrorism

June 1, 2022

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TABLE OF ACRONYMS

BVLOS	Beyond Visual Line of Sight
CONOP	Concept of Operation
EO	Electro-Optical
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
GCS	Ground Control Station
GEOJSON	Geographic JavaScript Object Notation
HD	High definition
IFR	Instrument Flight Rules
JPEG	Joint Photographic Experts Group
KML	Keyhole Markup Language
LAANC	Low Altitude Authorization and Notification Capability
LiDAR	Light Detection and Ranging
NAS	National Airspace System
NOTAM	Notice to Airmen
ORA	Operational Risk Assessment
PIC	Pilot in Command
SGI	Special Governmental Interest
SHP	Shape file
SOSC	System Operations Support Center
TFR	Temporary Flight Restriction
TIFF	Tag Image File Format
UAF	University of Alaska Fairbanks
UAH	University of Alabama Huntsville
UAS	Uncrewed/Unmanned Aircraft System
VFR	Visual Flight Rules
VLOS	Visual Line of Sight
VO	Visual Observer
VTOL	Vertical Take-Off and Landing

ATTACHMENT 1 - CONCEPT OF OPERATIONS (CONOPS) FOR AIRPORT TERRORISM

Lead organization will demonstrate that the CONOP has been reviewed. The CONOP will be accepted if the document contains sufficient information to proceed to an Operational Risk Assessment (ORA). The CONOP is to be submitted by the lead organization for the mission.

Approval by (Name/Org)	Title	Date	Approve Digital Signature

This CONOP will include all items needed to build out a successful mission. There will be sections included that are specific to each disaster response in the CONOP, such as under purpose of mission. Any specific information needed in the CONOP for a disaster response will be included before the summary section.

This CONOP document follows the "5-paragraph order" format, leveraged from the military operations world. The purpose is to allow operational team members to determine whether an applicant explicitly identifies key information that will be necessary for a subsequent **ORA**. These paragraphs spell out the acronym **S-M-E-A-C, for "Situation", "Mission", "Execution", "Administration & Logistics", "Command & Signal"**. This is known as the "SMEAC Sheet".

List of Revisions			
Revision Description	Approved by	Approve Digital Signature	Release Date (DD/MM/YY)

Notes on a CONOP:

The CONOP is viewed as an "evolving" document that records an analysis performed during the requirements generation process and should contain the following:

- A clear statement of the goals and objectives
- Strategies, tactics, policies, and constraints that describe how security will affect the program
- Organizations, activities, and interactions that describe who will participate and what these stakeholders do in that process
- A clear statement of the responsibilities and authority of the roles played in the process
- The specific operational processes, in an overview fashion, provide a process model in terms of when and in what order these operation processes take place, including such things as dependencies and concurrencies
- Processes for initiating the program, developing the products and components, maintaining the products, and components, and possibly for retiring the program and its products and components

CONOP:

- Narrate the processes to be followed
- Define the roles of the various stakeholders involved in the process
- Outline a methodology to realize the goals and objectives of the mission

1.1 Concept of Operation (CONOP)

Terrorism event at Huntsville, Alabama airport

Surveillance of ongoing event and disruption/counter measures to attack

Operation:

Terrorism event at local airport: Ground impact and hostile airborne assets.

Uncrewed/Unmanned Aircraft System (UAS) support.

Duration:

Few Hours

Outcomes/Actionable intelligence:

- Large UAS successful mission with data back to ground to build maps and videos of events
- Small UAS #1 gets airborne and provides continued eyes and communications
- Small UAS #1 used by ground teams to communicate with operations center and others
- Small UAS #2 successful mission to provide low altitude data on ground hazards
- Small UAS #3 successfully able to thwart off hostile airborne assets
- Small UAS #3 able to provide delivered to ground teams with critical supplies
- All UAS provide Electro-Optical (EO) visible/thermal data that can be processed into products at the need of an operations center such as three-dimensional models (EO visible and thermal overlay) of impacted infrastructure, location of hostiles

Metrics of success:

- Large UAS streams data back to the incident center to support assessment of full extent
- Small UAS #1 streams data to the operations center. Move the field of view based on needs
- Small UAS #1 provides a communications hub for other UAS
- Small UAS #2 moves to locations needed by the operations center on the ongoing disaster
- Small UAS #3 responds to hostile airborne assets to removes from airport vicinity
- Small UAS #3 deliver supplies to while waiting to provide counter drone support
- Safe flight operations with three small UAS and one large UAS operating
- Small UAS fly under Part 107 and Visual Line Of Sight (VLOS) to extended-VLOS

1.2 CONOP Quad Chart: Terrorism event at Huntsville, Alabama airport: Surveillance of ongoing event and disruption/counter measures to attack.

1.2.1 Mission Purpose/Objectives

Purpose: Terrorism event at Huntsville, Alabama airport. Report of terrorist event and airborne assets are being used. Need eyes and communications on the event from higher altitude, also fixed location to keep eyes and communications on the full extent of the airport. Ability to get eyes and communications on specific location so need for mobile small UAS and react to terrorism airborne assets so need for counter small UAS capabilities.

Goals: Large UAS to keep continued eyes and communications on the airport [runways and infrastructure] to get data to emergency management operations center. Local small UAS Part 107 pilots respond and provide data. Tethered small UAS at airport with all permissions in place. Demonstrate that the mobile small UAS can respond to needs of emergency management operations center and get data on the event. Counter small UAS able to react to airborne terrorism assets and ensure safety of airport and all infrastructure. Show communication between the multiple UAS flight teams and that emergency management operations center is able to communicate with pilots in command and get tethered UAS to move field of view. Get mobile small UAS to move to area of impact. Get counter UAS to react to hostile airborne asset Large UAS to get airborne and data feedback to emergency management operations center.

Objectives: Large UAS with real-time data to the Ground Control Station (GCS) and onto operations center that is used to detect to provide airborne surveillance from above the Terrorism event. Tethered small UAS #1 at the airport terminal gains eyes and communications on the event from fixed location and turns on dedicated communications hub over specific channels only for ground operations use so that emergency management services can put in phone lock to prevent terrorist events using standard communications network. Small UAS #2 is flown into the Temporary Flight Restriction (TFR) to provide mobile eyes and communications on the event at low altitudes. Show it responds to needs of operations center and focus on target areas and get high resolution feeds back to the operations center . Small UAS #3 is counter UAS and the mission shows it can respond to hostile airborne assets to the event. Show that it can move in to prevent impact from these assets and remove them as a hazard. Small UAS #3 can move supplies from outside airport boundaries into the hazard zone without putting ground personnel at risk and to support those impacted by the hazard. Evaluate how small UAS missions can respond to lUAS operations and data analysis. Evaluate how local 107 pilots can respond to needs of State and/or City agencies. Evaluate how tethered small UAS #1 can provide eyes and communications on events as well as act as a communications hub.

1.2.2 Mission Procedures/Approach

Large UAS: Rapid response take-off from Redstone Army field or South Huntsville airport

Beyond Visual Line of Sight (BVLOS) operations, Flown from nearby runway to have holding pattern above Huntsville Airport

Multiple hours of flying to provide high altitude eyes and communications on disaster

Visual Flight Rules (VFR) with possible Instrumental Flight Rules (IFR) conditions as will be BVLOS - able to fly in full range of conditions

Small UAS #1: Tethered sUAS fixed to airport terminal

VLOS, Part 107 waiver and Special Governmental Interest (SGI) waiver [might have different needs as tethered system]

Eyes and communications on infrastructure and runway from EO/thermal

Provides response only communications hub

Support emergency management operations center locking up cell phones to limit terrorism coms capability

Powered through tether so can stay airborne for extended period and/or whole event

Small UAS #2: Short pop-up flights during disaster response

Manual small UAS; Starts outside TFR and stays at low altitude within airport boundaries

Pattern defined by emergency management operations center to keep eyes and communications on event and support ground response

VLOS with Part 107 or SGI waiver

VFR conditions [IFR if event limits visual observer from keeping VLOS]

TFR over airport [could this be extended so TFR covers all areas for small UAS take-off]

Small UAS #3: Short pop-up flights during disaster response

Manual small UAS operations, Starts within airport boundaries at distance away from terrorism event

Ability to respond to hostile airborne assets to prevent them entering airspace

Aim to stay as VLOS but may need extend-VLOS or BVLOS

Additional ability to provide package/supply delivery for ground ops and those impacted by the disaster event

May need to counteract; If used and lands for safety, team needs more than one small UAS

1.2.3 Mission Results

Observations: Recording of full extent of the event from a large UAS whose flight pattern aims to provide continued data collection. At least three small UAS used. Small UAS #1 is tethered to the airport terminal to provide a fixed location and EO/thermal data with a pointable payload. Small

UAS #2 is a mobile system with EO/thermal payload and flown at low altitude around the airport to get eyes and communications on the event. Small UAS #3 provide counter UAS capabilities and can react to other airborne assets. If small UAS #3 is used, then will need another UAS in the air to support counter UAS capabilities for the response. Small UAS #3 provides delivery capability to get supplies into hazard zone [both to support ground ops and those impacted by the event]

Real-time Mission Products: Large UAS: EO/thermal video feeds back to emergency management operations center. Small UAS #1: EO/thermal videos and open communication channels for others in response to use. Small UAS #2: EO/thermal videos back to emergency management operations center. Small UAS #3: EO feeds back to emergency management operations center. Data from all UAS displayed in geospatial interface to superimpose on other available data from state, federal, and local agencies.

Post-Mission [fast response] Products: Nothing specific as critical aspects of the response is to get eyes and communications on the event, provide the response team its own communication hub, and small UAS to respond to hostile airborne assets.

1.2.4 Mission Milestones

Outcomes/Actionable Intelligence

Large UAS successful mission and pushes data back to ground to build maps and videos of events

Small UAS #1 airborne and provides continued eyes and communications

Small UAS #1 communications used by ground teams to communicate with emergency management operations center and others

Small UAS #2 mission to provide low altitude data on ground hazards

Small UAS #3 able to thwart off hostile airborne assets

Small UAS #3 able to provide delivered to ground teams with critical supplies

All UAS provide EO/thermal data that can be processed into products at the need of emergency management operations center such as 3D models (EO and thermal overlay) of impacted infrastructure, location of hostiles

Metrics of success

Large UAS streams data back to the incident center to support assessment of full extent

Small UAS #1 streams back data to emergency management operations center and can move field of view based on needs

Small UAS #1 provides a communications hub so emergency management operations center can limit other communications

Small UAS #2 moves to locations needed by emergency management operations center on the ongoing disaster

Small UAS #3 responds to hostile airborne assets; limits impact or removes from airport TFR

Small UAS #3 time optimized to delivery supplies to ops team or impacted personnel while waiting to provide counter drone support

Safe flight operations with three small UAS and one large UAS operating and data streaming back

All small UAS flew under Part 107 and VLOS to extended VLOS is maintained

1.3 Situation

1.3.1 Overview

Purpose of mission: To provide UAS support to a terrorism event at Huntsville airport in Alabama. The UAS will provide data and observations to assist those in emergency response. Data will support surveillance of the ongoing event and disruption/counter measures to attack at rogue airborne assets.

Goals: Large UAS will provide long endurance observations and communications on the airport from high altitude. Small UAS #1 will be tethered to the edge of the airport to provide high resolution visual and thermal observations and communications of the ongoing event throughout. Small UAS #2 will be able to rapidly move around the airport and respond to events seen from large UAS and tethered small UAS #1 data. Small UAS #3 will be used for counter measures and attack any other UAS, or airborne asset involved terrorism event.

UAS mission lead: University of Alabama Huntsville (UAH); University of Alaska Fairbanks (UAF).

Large UAS: High altitude observations on event

- Flight team lead with crew
- Flight from either Redstone Army field or South Huntsville airport
- Stays at higher altitude throughout

Small UAS #1: Tethered visible and thermal observations along with communications hub

- Pilot in command and Visual Observer (VO)
- Additional specialist team member to relay observations to other UAS
- Fixed altitude to provide data and communications on runway and buildings
- Tethered to airport terminal
- Communications support with small UAS #2 and #3 as well as operations center
- Powered through the tether so can stay airborne throughout the even

Small UAS #2: Mobile visible and thermal observations of event

- Pilot in command and visual observer
- Additional specialist team member to relay observations to other UAS
- Manually flown, adapt routes based on event
- Continued communications with small UAS #1 and operations center

Small UAS #3: Counter UAS (additional capacity to deliver supplies

- Pilot in command and visual observer
- Additional specialist team member to relay observations to other UAS
- Manually flown, adapt routes based on event
- Continued communications with small UAS #2 and operations center
- Team can also provide support to deliver supplies to ground teams

1.3.2 Location:

Huntsville airport, Alabama Latitude: 34.6403° N Longitude: 86.7757° W

IATA: HSV ICAO: KHSV FAA LID: HSV

http://www.airnav.com/airport/khsv

All maps and documents in Appendix 3.

1.3.3 Systems

Central UAS Operations

- Coordination of flight teams
    - Huntsville Emergency operations center or airport
- UAF and UAH lead points of contact
- Liaise with local emergency management response team, Huntsville Airport Representatives, Emergency Air Boss, Federal Aviation Administration (FAA), and Federal Emergency Management Agency (FEMA) representatives, where appropriate.

1st flight: Assess event at airport - Tethered UAS

- Small UAS #1
    - Vertical Takeoff and Landing (VTOL) capacity
    - Endurance for all the event
    - Location selected to support ground team to tether small UAS
    - Flight team
        - Part 107 Pilot in Command (PIC) + VO
        - Engineering support, if possible as VO
    - Minimum Payload
        - EO with thermal: Pointable with fixed nadir option
    - Communications hub above the airport for ground operations
        - Provide communications network for operations teams
    - Power capacity for continued stable location
    - Powered through tether so onboard systems stay on and working
    - Waiver/permission setup to support higher altitude than 400 ft

2nd flight: High altitude observations for mapping the event

- Large UAS
    - SeaHunter/Sentry type
    - From Redstone Army field (KHUA) or Huntsville's Executive Airport (KMDQ)
    - Endurance for multiple hours per flight, up to 4 hours per mission

- Pilots and support crew for large UAS
  - External Pilot, Crew Chief, Internal Pilot, and Supplemental Pilot
  - Additional operator to manage data feed from onboard payload
- Minimum Payload
  - EO feed is sent back to GCS and onto operations center
  - Optical and thermal payload integrated for nadir viewing
- Flight pattern to stay above airport and within temporary flight restriction

3rd flight: Lower altitude visual and thermal observations

- Small UAS #2
  - VTOL with endurance for 45 minutes per flight
  - Short pop-up flight during disaster response that provides sustained airborne operations when large UAS is refueling
  - Manually flown to locations at request of ground teams and operations center
  - Flight team
    - Part 107 PIC + VO's
    - Engineering support, if possible as VO
  - Minimum Payload
    - EO with thermal: Pointable with fixed nadir option
  - Sufficient battery capacity for multiple flights
  - Fly within TFR. Take-off landing outside airport
  - Data feedback to small UAS #2 own ground station and onto operations center

4th flight: Counter small UAS

- Small UAS #3
  - VTOL with endurance for 45 minutes per flight
  - Short pop-up flights during disaster response
  - Take-off landing inside airport at safe distance so can react quickly
  - Manual flying
    - Plot in command react to needs of the operations center and other UAS
  - Flight team
    - Part 107 PIC + VO's
    - Engineering support, if possible as VO
  - Minimum Payload
    - EO with thermal: Pointable with fixed nadir option
  - Act as counter small UAS to any other airborne assets as part of terrorist attach
  - Fly within temporary flight restriction area that would be in place over airport
  - Additionally, capacity to provide supply deliver to ground teams
    - Also, anybody impacted by the terrorism event
    - Fly to the safe zone to collect supplies and to the zone for drop off
    - Supplies include remote camera or audio-device to support operations

1.4 Mission

Disaster:

Terrorism event at Huntsville airport in Alabama. Surveillance of the ongoing event and disruption/counter measures to attack.

Observations:

Recording of full extent of the event from a large UAS whose flight pattern provides continued data collection. Three small UAS used. Small UAS #1 tethered to the airport terminal and provides a fixed location and EO visible and thermal data with a pointable payload. Small UAS #2 is a mobile system with EO visible and thermal payload and flown at low altitude around the airport to get observations and communications on the event. Small UAS #3 provides counter UAS capabilities and can react to other airborne assets. Small UAS #3 also provides delivery capability to get supplies into the hazard zone (both to support ground operations and those impacted by the event) when not taking on counter UAS Responsibilities.

Response mission:

Terrorism event at Huntsville airport in Alabama. Report of terrorist event and airborne assets are being used. Need observations and communications on the event from higher altitude as well as fixed location to keep observations on and communications of the full extent of the airport. Need mobile small UAS is required to attain observations at lower altitudes and in specific locations as well as capability to react to terrorism airborne assets so need for counter small UAS capabilities.

Stakeholders:

Huntsville Airport, FAA, FEMA, and local emergency management operations center. All need observations on and communications at the event and ability to support ground operations.

Goals:

Get large UAS up to keep continued observations and communications on the airport (runways and infrastructure) and to get data to the operations center; Tethered small UAS attached to the airport with all permissions in place to support sustained data collection. Demonstrate that the mobile small UAS responds to needs of the operations center and get actionable intelligence on the event. Counter small UAS reacts to airborne terrorism assets and ensures safety of airport and all infrastructure.

Communications between the multiple UAS flight teams and that operations center/Air Boss while also communicating with the PICs. Tethered UAS to move the field of view to provide the greatest opportunity to monitor the ongoing ground events. Mobile small UAS moves to the area of impact and stays airborne, providing high-resolution proximity data. Counter UAS reacts to hostile airborne assets and removes them from disaster areas. Large UAS to get airborne and data feedback to the operations center.

Objectives:

Large UAS with real-time data to its ground control station and onto the operations center. Large UAS data used to provide airborne surveillance from above the Terrorism event. Small UAS #1 tethered at the airport terminal provides observations and actionable intelligence as well as acts as

a communications hub for the event from a fixed location. Small UAS #1 is a dedicated communications hub for ground operations use only. Small UAS #2 is flown into the TFR area to provide mobile observations and communications on the event at low altitudes.

Small UAS #2 responds to the needs of the operations center and focuses on target areas to get high resolution data back to the center. Small UAS #3 supports as a counter UAS and responds to hostile airborne assets. Small UAS #3 moves to prevent impact of these assets to accentuate the disaster and remove them as a hazard from the impacted areas. Small UAS #3 moves supplies from outside airport boundaries into the hazard zone, when not supporting counter UAS needs, without putting ground personnel at risk and to support those impacted by the hazard. Demonstrate how small UAS missions can respond to large UAS operations and data analysis. Demonstrate how a tethered small UAS can provide observations on events as well as act as a communications hub.

Real-time Mission Product:

- Large UAS
  - EO and thermal video feeds back to the operations center
- Small UAS #1
  - EO and thermal video and open communication channels for others in response to use
- Small UAS #2
  - EO and thermal video feeds back to the operations center
- Small UAS #3
  - EO video feeds back to the operations center
- Data from all UAS displayed in geospatial interface to superimpose on other available data from state, federal, and local agencies

Post-Mission (fast response) Products:

Nothing specific as critical aspects of the response is to get eyes and communications on the event, provide the response team its own communication hub, and sUAS to respond to hostile airborne assets.

1.5 Execution

1.5.1 Operations Plan

Large UAS supports the event and 3 small UAS at lower altitudes, with their specific missions.

Large UAS

- Rapid response take-off from local airport, such as Redstone Army field (KHUA) or Huntsville Executive Airport (KMDQ)
- Mission will be flown under BVLOS operations
- Flown from nearby runway and then a holding pattern above Huntsville Airport
- Aircraft will stay above disaster event for multiple hours to provide high altitude observations and communications on disaster
- UAS can fly under IFR conditions to support operations under a full range of atmospheric conditions

- Follow pre-flight, take-off, in-flight, landing, and post-flight checklists for large UAS

Small UAS #1

- This will be a tethered small UAS fixed to the airport terminal
- Operations will have Part 107 and SGI waiver to support operations over people and in restricted areas like TFR
- VLOS operations and fixed altitude at top of tethered extent
- Observations of airport infrastructure and runway from EO/thermal data
- Airborne communications hub for ground operations
- Powered through tether so can stay airborne for extended period and/or whole event
- Follow pre-flight, take-off, in-flight, landing, and post-flight checklists for small UAS

Small UAS #2

- Short pop-up flights during disaster response. This UAS will be mobile and can access areas at risk and with a rapid need to get observations of the ongoing event
- Manually flown small UAS
- Flights start outside TFR and at low altitude within airport boundaries
- The flight pattern defined by operations center to keep observations and on event and support ground response
- The missions flown under VLOS or extended-VLOS with a visual observer tracking the aircraft and airspace
- Missions have required Part 107 or SGI waivers to support operations over the airport, its infrastructure, and any ground response
- Flown under VFR conditions and into the TFR over the airport
- Follow pre-flight, take-off, in-flight, landing, and post-flight checklists for small UAS

Small UAS #3

- Short pop-up flights during disaster response
- Manually flown small UAS operations
- Mission starts within airport boundaries at distance away from terrorism event
- Take-off and landing away from airport terminal and UAS flown towards hostile event
- PIC responds to requests from operations center and/or ground teams to any hostile airborne assets to prevent them from support the terrorism event
- VLOS operations but may need E-VLOS and so UAS flight crew has capability with extended visual observer in communication with PIC
- Permissions in place for Part 107 waivers and SGI to support the operations
- Additional provide package/supply delivery for ground operations and those impacted by the disaster event (if not responding to counter UAS needs)
- Follow pre-flight, take-off, in-flight, landing, and post-flight checklists for small UAS

1.5.2 Data collection, processing, and dissemination

Large UAS

Full extent of Terrorism event

- Data in flight:
    - High precision locations and time synchronization of flight
    - Flight routes and logs from crew
    - Geotagged EO visible and infrared imagery over disaster area
    - Decimeter res. visible data from High Definition (HD) multi-megapixel camera
    - Broadband thermal infrared (7 - 13 μm) data: Minimum 640 x 480 resolution
    - Optical setup supports overlay videos onto visualization tool (Full Motion Video)
    - Optical data streamed to ground station and onto operations center
    - On-board storage of data that is downloaded upon landing
- Products post flight:
    - Geotagged videos with overlaid field of view on geospatial visualization tool
    - Mosaicked maps from optical and thermal data

Small UAS #1

Tethered aircraft that hovers at set altitude

- Data in flight:
    - High precision locations and time synchronization of flight
    - Flight routes and logs from crew
    - Geotagged EO visible and infrared imagery over disaster area
    - cm-resolution visible data from HD Multi-megapixel camera
    - Broadband thermal infrared (7 - 13 μm) data: Minimum 640 x 480 resolution
    - EO visible streamed to ground station and onto operations center
    - On-board storage of data that is downloaded upon landing
    - On-board dedicated communications to support ground and air operations
- Products post flight:
    - Geotagged videos with overlaid field of view on geospatial visualization tool
    - Mosaicked maps from optical and thermal data

Small UAS #2

Low altitude manually flown flights; Targeted to support response needs

- Data in flight:
    - High precision locations and time synchronization of flight
    - Flight routes and logs from crew
    - Geotagged EO visible and infrared imagery over disaster area
    - cm-resolution visible data from HD Multi-megapixel camera
    - Broadband thermal infrared (7 - 13 μm) data: Minimum 640 x 480 resolution
    - EO visible streamed to ground station and onto operations center
    - On-board storage of data that is downloaded upon landing

- Products post flight:
    - Geotagged videos with overlaid field of view on geospatial visualization tool
    - Mosaicked maps from optical and thermal data

Small UAS #3

Counter drone. Targeted support response. 2nd capacity: provide supply delivery

- Data in flight - Counter drone role
    - High precision locations and time synchronization of flight
    - Flight routes and logs from crew
    - Geotagged EO visible imagery over disaster area
    - EO visible streamed to ground station and onto operations center
    - On-board storage of data that is downloaded upon landing
- Data in flight - Supply delivery option
    - High precision locations and time synchronization of flight
    - Flight routes and logs from crew
    - Geotagged EO visible imagery over disaster area
    - Record of supply pickup and drop off with video recording
- Products post flight:
    - Geotagged videos with overlaid field of view on geospatial visualization tool

Post Mission Debrief

- Discussion if metrics for success accomplished
- Performed at end of each day (depending on length of event)
- All flight crews with operations center leads as well as UAS lead organizations (UAH/UAF)
- Documented lessons learned and where issues occurred to limit mission success

1.6 Administration & Logistics

1.6.1 Planning and local logistics

Large UAS team will have accommodation at a hotel nearby the launching airport. This will provide overnight lodging before and after each flight day. Also, it will allow them to store no mission required equipment to optimize the equipment taken with them for the daily missions. Large UAS team will work with launching airport to acquire runway access and setup location for their ground control station. UAS mission teams will ensure that all required waivers are in place to support flight operations. Large UAS will have all permissions to fly from launching airport and within the National Airspace System (NAS) to the terrorism event. If TFR in place, the flight team lead will liaise with the event air boss to ensure permissions set up to allow large UAS to fly into TFR.

For small UAS, any required Part 107 waivers will be in place before missions start. SGI waiver will be submitted to support all small UAS missions to ensure that sufficient permissions are acquired, if needed, so that they do not need to be submitted during the missions and any time lost. Small UAS #1 will be tethered to a part of the Huntsville airport infrastructure to provide a fixed location for operations. Small UAS pilot in command and UAS missions lead will liaise with the

emergency operations center and Huntsville airport event point of contact to define allowed locations for tethered UAS. From these site selections, the most effective location to support ground operations and acquire data of the events will be chosen.

All required communications will occur between all PICs and local air traffic control tower. All Notices to Airmen (NOTAMs) will be provided to the wider aviation community.

1.6.2 Hazards/Risk

The following information provides specific hazards that may occur from support the emergency response to the terrorism event.

Hazard 1: Large UAS flies from National Airspace System to temporary airspace restriction zone.

- Risk: Large UAS will start off at a nearby airport and fly in U.S. NAS and the specific airspace at and surrounding this airport. It will then fly from the NAS, where they could be other crewed and uncrewed systems, into TFR setup over the terrorism event at Huntsville airport. Flight team does not have permissions setup with the operations center and therefore will be unable to enter TFR.
- Mitigation: Flight crew and PIC coordinate with operations center and air boss for emergency response so that they are aware at all times of the location of the large UAS. PIC and flight mission lead will set up all permissions before any missions starts to ensure that the large UAS can respond to all needs of the response and enter and leave the TFR when needed.

Hazard 2: Large UAS needs refueling and loose higher altitude observations

- Risk: The Large UAS supporting the operations is unable to stay airborne for the full extent of the terrorism event and it needs to return to the landing airport for refueling. This will remove the higher altitude observations of the events to support the ground operations and so the decision support system will not be able to view the full extent of the airport and the impact of the events.
- Mitigation: Mobile small UAS switches role from proximity to higher altitude data collection so that the impact of the large UAS being on the ground is minimized. The mobile UAS may need to land for battery replacement, but this will be minimal and will not cause major impact on the higher altitude full airport extent observations.

Hazard 3: Tethered small UAS #1 is close to people and property. Could fly away from control.

- Risk: The tethered small UAS will be secured to the airport infrastructure and will be staying at a fixed altitude above the airport. It will be positioned close to people and property. The tether could break and therefore, the UAS would be in fly away mode.
- Mitigation: The flight crew would have a PIC even with the UAS fixed to the building and in a fixed location. If the tether breaks, this PIC would take over manual operations for the UAS and return it to the fixed location and hover to ensure continued operations. The PIC would communicate with operations to determine if available time to land UAS to fix the tether and resume full operation mode. If possible, the tether would be fixed. If not, UAS would be flown manually at the set location to provide observations needed.

Hazard 4: Small UAS #2 is mobile and pushing the limits of VLOS. VO may lose sight of UAS.

- Risk: Manually flown UAS will provide proximal observations of the event and flying under VLOS operations with a visual observer. The mission may require flying to the maximum extent of observers view and as such would be close to flying outside VLOS. This would then mean that the flight crew does not have a sight on UAS or the airspace around it.
- Mitigation: PIC and visual observer would be in constant contact to ensure that there is always a visual sighting on UAS and airspace. VO would inform the PIC if the flight route was reaching the extent of their visibility of the aircraft and airspace. PIC would inform operations to see if necessary to push beyond VLOS operations. If so, then extended VLOS would be assessed if possible. If BVLOS was needed, flight crew would determine if UAS has BVLOS capacity and request through SGI on a BVLOS waiver to continue operations.

Hazard 5: Small UAS #3 is performing a counterattack and is taken out of action.

- Risk: Small UAS #3 is providing counter UAS support to the disaster response and may have to intercept hostile airborne assets. As a result, its operational capacity will be impacted, and it is then taken out of action and cannot provide the support. This will leave no airborne assets to support ground teams and provide counter UAS support.
- Mitigation: PIC for small UAS #3 will land the impacted UAS safely, either via return to landing (RTL) or at a safe close location to the impact site. The small UAS #3 flight team will have a backup UAS with the same capabilities that can take-off and provide counter UAS support. If all UAS #3 counter systems are impacted, then backup UAS will be acquired from to ensure a minimum loss of time with no counter UAS support.

Hazard 6: Small UAS #3 is performing delivery of supplies and the mechanism fails.

- Risk: Small UAS #3 will have capability to provide supplies to ground teams involved in the terrorism event. When the supplies are being delivered, the mechanism fails and as a result the supplies cannot be delivered. This means that the supplies do not reach those in need and the aircraft is then unable to perform its duties.
- Mitigation: The PIC safely returns UAS to the landing site to allow the engineering members of the flight crew to examine the impacted mechanism with the aim to fix it on site and allow the UAS to safely continue its mission. This will minimize the risk that the supplies cannot reach those in need. If the UAS cannot be fixed, backup UAS will be used and if needed a new UAS with a working mechanism will be acquired from the operations center.

Hazard 7: Lack of timing precision between missions prevents data from being compared.

- Risk: There will be one large UAS being flown for the ground support as well as three small UAS teams. Each will be acquiring imagery and videos of the events as well as recording their flight logs and global positioning system locations of their flights. To cross-compare the data feeds and evaluate the data, each of these systems needs to be time-synchronized. If not, the data will not be able to be compared and prevent cross analysis of the UAS data.
- Mitigation: The PICs and flight crew for each UAS will synchronize their flight clocks and sensor clocks with the same coordinated universal time timing system. This will be continuously monitored throughout the missions and rechecked and recalibrated after each flight. This will ensure that there are minimal time differences between the clocks of all the aircraft and sensors and support like data comparison.

Hazard 8: Terrorism event continues beyond one day and fatigue occurring in flight crews.

- Risk: All UAS will aim to support the ground teams as they respond to the terrorism events at the local airport. The timeframe of the events will be dependent on the scale of the terrorism attacks and the capacity of the operational teams to mitigate the events and stop the attacks. This may mean that they extend beyond one day that will lead to potential fatigue for the flight crews. This can then lead to tired personnel and potentially mistakes being made.
- Mitigation: If the flight operations extend beyond the safe operational limits of the flight crews working hours, then backup flight crews will be set-up to relieve the current operational teams. Debriefs will occur between each crew through the relevant PICs and in coordination with the operations team. This will minimize fatigue placed on the flight crews and minimize the risk of mistakes being made.

1.6.3 Community outreach and connections

- All Operations: Huntsville community and airport through incident command team or a statewide operations center if one that has been setup
- Large UAS: Communications with launching airport for large UAS (Redstone Army field or South Huntsville airport)
- Small UAS: Three missions. Coordination between flight teams on who will fly each mission

1.6.4 Disaster response mission specific information

As this is support to a terrorism event at Huntsville airport, Alabama then the flight crews will access local, regional, and statewide resources to determine the process for Alabama in setting up their emergency response operations center.

Emergency Operations Plan for Alabama: Updated March 2022

- Incident Annex F: Terrorism Incident Law Enforcement and Investigation (Page 353 - 361)

1.6.5 Mission Summary

Disaster:

Terrorism event at Huntsville, Alabama airport. Surveillance of ongoing events and disruption/counter measures to attack.

Objectives:

Provide airborne observations over the events at the airport, continuous data, and communications from higher altitude. Communications hub to support all air and ground operations. Observations and communications on the events from lower altitude with airborne assets that can move based on operations center needs. Counter UAS capabilities as hostile airborne assets become part of the event.

Flight Missions:

Large UAS provides an overview of disaster extent (Continued observations and communications to support emergency managers to determine small UAS location and observational needs). Three small UAS missions flown to: (1) provide communications hub and fixed location for EO and thermal data, (2) manually operated small UAS to get proximal observations and communications on event from low altitudes; and (3) counter drone capabilities to react to hostile airborne assets to

limit impact and prevent from adding to disaster event that can also delivery critical supplies until counter drone need arises.

Metrics of success:

- Large UAS streams data back to the incident center to support assessment of full extent
- Small UAS #1 streams data to operations and moves field of view from data based on needs
- Small UAS #1 provides communications so that operations can limit other communications
- Small UAS #2 moves to locations needed by the operations center on the ongoing disaster
- Small UAS #3 responds to hostile airborne assets and removes from airport TFR zone
- Small UAS #3 delivers supplies while waiting to provide counter drone support
- Safe operations with three small UAS and one large UAS operating and data streaming back
- Small UAS fly under Part 107 with VLOS to extended-VLOS maintained

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1.7 Command & Signal

Aim: This section should provide an overview of the command and communication systems to be used. This supports anyone reviewing and evaluating the CONOP to efficiently assess those sufficient communications are in place to connect the UAS flight crew with additional organizations connected to and supporting the disaster response and/or preparedness.

For some of the details included in this section, the plans will cross reference to the ORA, as they will be mitigation plans to ensure safe flight operations and minimize the risk of hazards that can impact flight operations.

Include details on:

- Type of communications tools used to connect PIC, Observer, and other crew members
- Security measures in place to protect the flight crew
- Hand-off process, where appropriate, between the PIC and visual observer(s)
- Flight team lost link and emergency procedures to ensure safe flight operations
- Communication tools use to connect the flight team and local ATC
- Note: for each communication tool to be used, this section should also include signals used such as radio frequencies, flight control frequencies, etc.

1.8 Supplementary appendices to accompany CONOP

1.8.1 Appendix 1: Operational Details – One Pager

Mission and Disaster Preparedness/Response

Terrorism event at Huntsville, Alabama airport: Surveillance of ongoing event and disruption/counter measures to attack.

Mission Purpose/Objectives

Purpose : Terrorism event at Huntsville, Alabama airport. Report of terrorist event and airborne assets are being used. Need eyes and communications on the event from higher altitude, also fixed location to keep eyes and communications on the full extent of the airport. Ability to get eyes and communications on specific location so need for mobile small UAS and react to terrorism airborne assets so need for counter small UAS capabilities.

Goals : Large UAS to keep continued eyes and communications on the airport [runways and infrastructure] to get data to emergency management operations center. Local small UAS Part 107 pilots respond and provide data. Tethered small UAS at airport with all permissions in place. Demonstrate that the mobile small UAS can respond to needs of emergency management operations center and get data on the event. Counter small UAS able to react to airborne terrorism assets and ensure safety of airport and all infrastructure. Show communication between the multiple UAS flight teams and that emergency management operations center is able to communicate with pilots in command and get tethered UAS to move field of view. Get mobile small UAS to move to area of impact. Get counter UAS to react to hostile airborne asset Large UAS to get airborne and data feedback to emergency management operations center.

Objectives : Large UAS with real-time data to GCS and onto operations center that is used to detect to provide airborne surveillance from above the Terrorism event. Tethered small UAS #1 at the airport terminal gains eyes and communications on the event from fixed location and turns on dedicated communications hub over specific channels only for ground operations use so that emergency management services can put in phone lock to prevent terrorist events using standard communications network. Small UAS #2 is flown into the temporary flight restriction (TFR) to provide mobile eyes and communications on the event at low altitudes. Show it responds to needs of operations center and focus on target areas and get high resolution feeds back to the operations center . Small UAS #3 is counter UAS and the mission shows it can respond to hostile airborne assets to the event. Show that it can move in to prevent impact from these assets and remove them as a hazard. Small UAS #3 can move supplies from outside airport boundaries into the hazard zone without putting ground personnel at risk and to support those impacted by the hazard. Evaluate how small UAS missions can respond to UAS operations and data analysis. Evaluate how local 107 pilots can respond to needs of State and/or City agencies. Evaluate how tethered small UAS #1 can provide eyes and communications on events as well as act as a communications hub.

Mission Results

Observations : Recording of full extent of the event from a large UAS whose flight pattern aims to provide continued data collection. At least three small UAS used. Small UAS #1 is tethered to the airport terminal to provide a fixed location and electro-optical/thermal data with a pointable payload. Small UAS #2 is a mobile system with electro-optical/thermal payload and flown at low altitude around the airport to get eyes and communications on the event. Small UAS #3 provide counter UAS capabilities and can react to other airborne assets. If small UAS #3 is used, then will need another UAS in the air to support counter UAS capabilities for the response. Small UAS #3 provides delivery capability to get supplies into hazard zone [both to support ground ops and those impacted by the event]

Real-time Mission Products : Large UAS: Electro-optical/thermal video feeds back to emergency management operations center. Small UAS #1: Electro-optical/thermal videos and open communication channels for others in response to use. Small UAS #2: Electro-Optical/thermal videos back to emergency management operations center. Small UAS #3: Electro-optical feeds back to emergency management operations center. Data from all UAS displayed in geospatial interface to superimpose on other available data from state, federal, and local agencies.

Post-Mission [post response] Products : Nothing specific as critical aspects of the response is to get eyes and communications on the event, provide the response team its own communication hub, and small UAS to respond to hostile airborne assets.

Mission Procedures/Approach

Large UAS : Rapid response take-off from Redstone Army field or South Huntsville airport
Beyond Visual Line of Sight (BVLOS) operations. Flown from nearby runway to have holding pattern above Huntsville Airport
Multiple hours of flying to provide high altitude eyes and communications on disaster
Visual Flight Rules (VFR) with possible Instrumental Flight Rule (IFR) conditions as will be BVLOS - able to fly in full range of conditions

Small UAS #1 : Tethered UAS fixed to airport terminal
Visual line of sight (VLOS), Part 107 waiver and Special Governmental Interest (SGI) waiver [might have different needs as tethered system]
Eyes and communications on infrastructure and runway from electro-optical/thermal
Provides response only communications hub
Support emergency management operations center locking up cellphones to limit terrorism coms capability
Powered through tether so can stay airborne for extended period and/or whole event

Small UAS #2 : Short pop-up flights during disaster response
Manual small UAS; Starts outside temporary flight restriction (TFR) and stays at low altitude within airport boundaries
Pattern defined by emergency management operations center to keep eyes and communications on event and support ground response
VLOS with Part 107 or SGI waiver
VFR conditions (IFR if event limits visual observer from keeping VLOS)
TFR over airport [could this be extended so TFR covers all areas for small UAS take-off]

Small UAS #3 : Short pop-up flights during disaster response
Manual small UAS operations, Starts within airport boundaries at distance away from terrorism event
Ability to respond to hostile airborne assets to prevent them entering airspace
Aim to stay as VLOS but may need extend-VLOS (EVLOS) or BVLOS
Additional ability to provide package/supply delivery for ground ops and those impacted by the disaster event

Mission Milestones

Outcomes/Actionable Intelligence
Large UAS successful mission and pushes data back to ground to build maps and videos of events
Small UAS #1 airborne and provides continued eyes and communications
Small UAS #1 communications used by ground teams to communicate with emergency management operations center and others
Small UAS #2 mission to provide low altitude data on ground hazards
Small UAS #3 able to thwart off hostile airborne assets
Small UAS #3 able to provide delivered to ground teams with critical supplies
All UAS provide electro-optical/thermal data that can be processed into products at the need of emergency management operations center such as 3D models (electro-optical and thermal overlay) of impacted infrastructure, location of hostiles

Metrics of success
Large UAS streams data back to the incident center to support assessment of full extent
Small UAS #1 streams back data to emergency management operations center and can move field of view based on needs
Small UAS #1 provides a communications hub so emergency management operations center can limit other communications
Small UAS #2 moves to locations needed by emergency management operations center on the ongoing disaster
Small UAS #3 responds to hostile airborne assets; limits impact or removes from airport TFR
Small UAS #3 time optimized to delivery supplies to ops team or impacted personnel while waiting to provide counter drone support
Safe flight operations with three small UAS and one large UAS operating and data streaming back
All small UAS flew under Part 107 and VLOS to EVLOS is maintained

1.8.2 Appendix 2: Flight Checklists

Aim: This appendix collects all flight checklists the mission team would complete pre-, during, and post-flight while at the mission location as well as pre- and post-operation before arriving and after leaving the mission location. Each flight checklist is included in a supplementary document. These checklists are to supplement the maintenance checklists that would go with the organization leading the missions for the disaster response and/or preparedness that they use to ensure the safety of their aircraft and equipment. These maintenance checklists will likely be a part of the organization's own safety assessment process.

Include details on:

- Before CONOP development: Site Survey (details on assessment of mission location)
- Before Operations: Mission checklist (complete at home for lead organization)
- Pre-deployment: Checklist to complete prior to leaving for mission site
- Deployment: Checklists for flight operations, once arrived at mission site
- Pre-flight: Checklist to follow prior to flight including example of flight readiness review
- Post-flight: Checklists to follow including log sheet
- Post-mission: Checklists to follow at the end of all flights for the mission

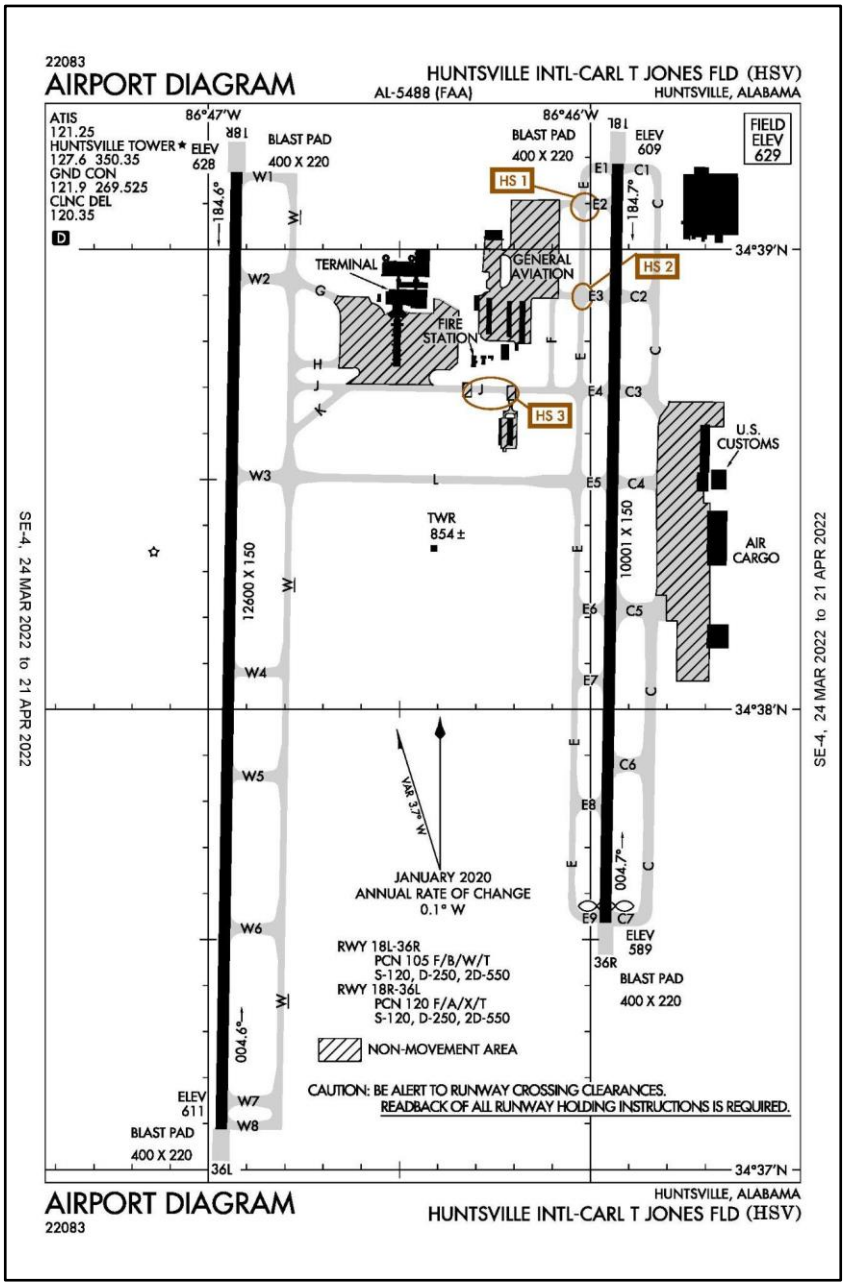
1.8.3 Appendix 3: Additional Requirements

Huntsville airport, Alabama Latitude: 34.6403° N Longitude: 86.7757° W

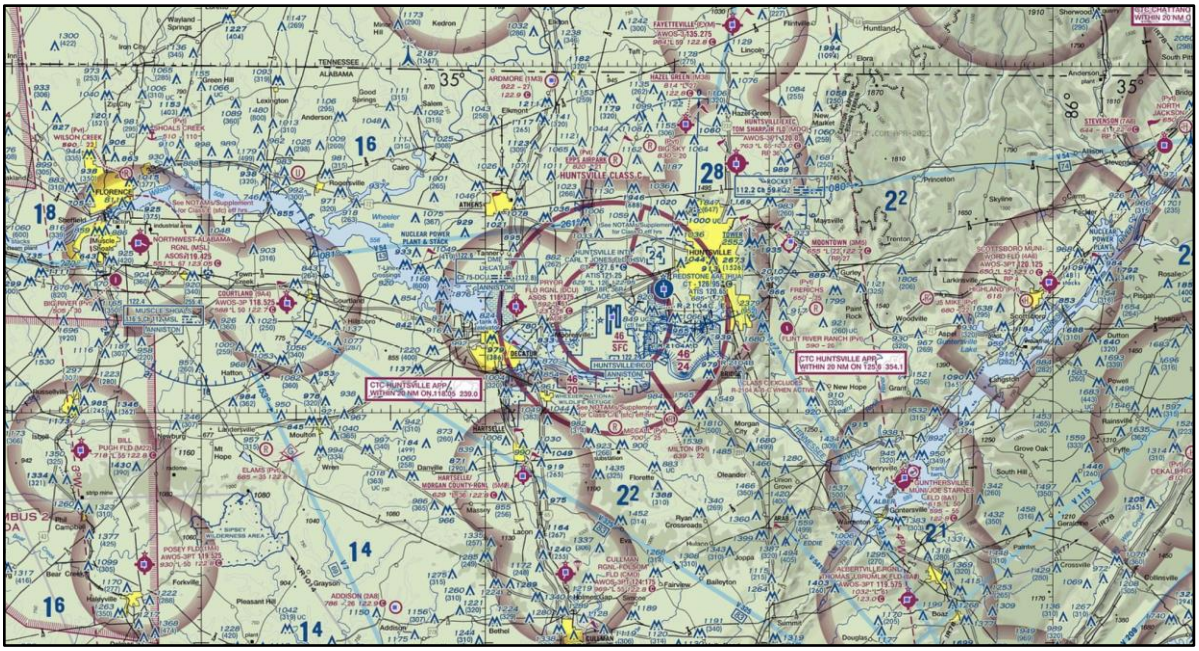
IATA: HSV ICAO: KHSV FAA LID: HSV

http://www.airnav.com/airport/khsv

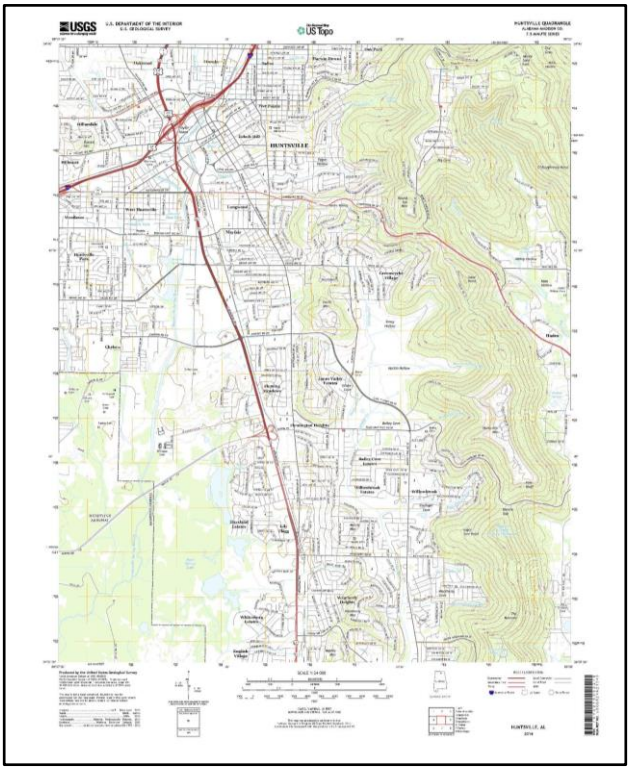
Huntsville airport map



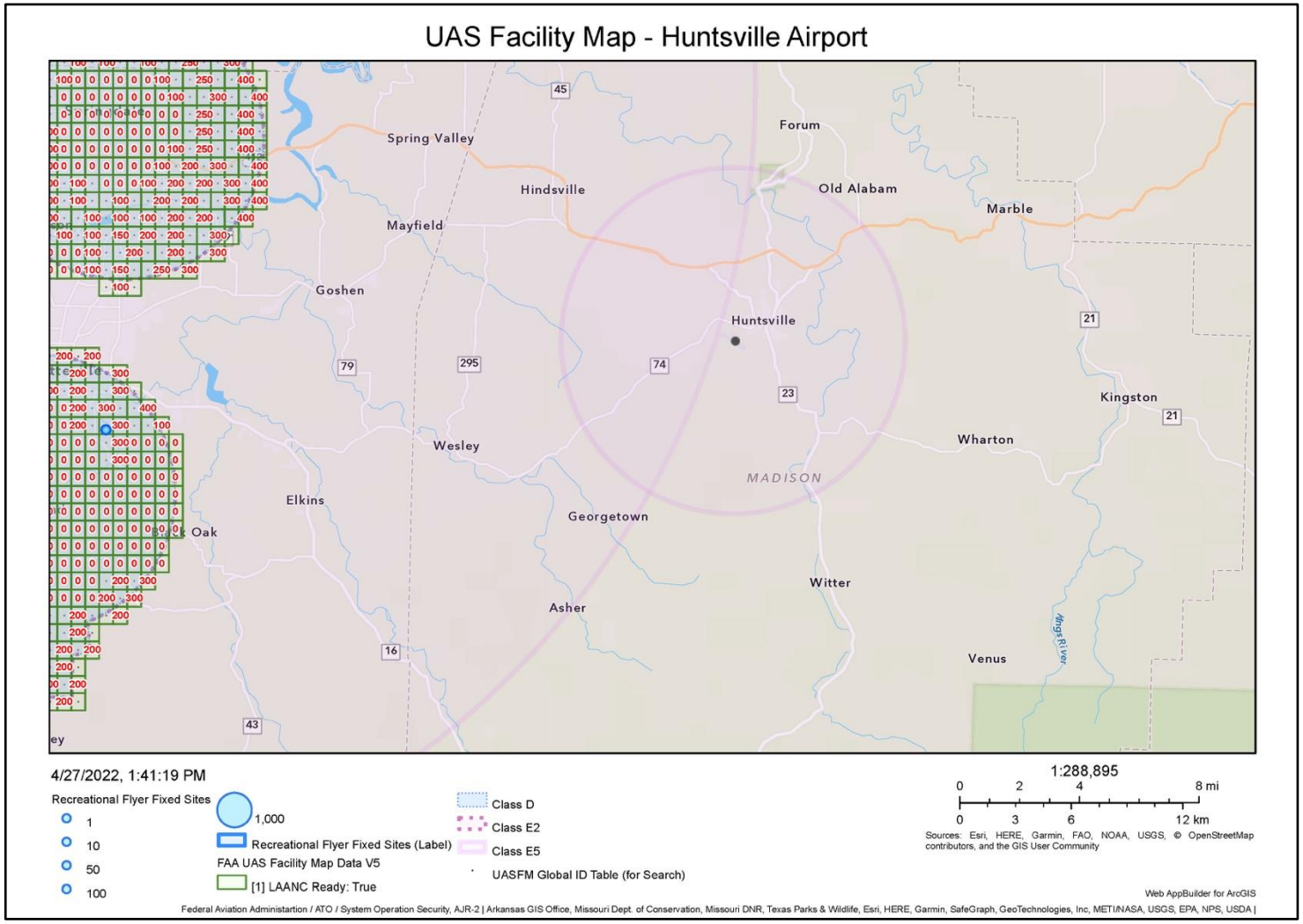
Sectional charts



USGS 7.5-minute topographic map



[Low Altitude Authorization and Notification Capability (LAANC) Facility Maps]



1.8.4 Appendix 4: Special Government Interests (SGI) Process Documentation

FAA Order JO7200.23B

Processing of UAS Requests. Effective: July 14, 2020

- Page 16 to 19: Chapter 6. 14CFR Part 91, Certificate of Authorization Processing
- Page 17 – SGI information: SGI process will be managed by Systems Operations Security as per FAA Order JO 7210.3

FAA Order JO7210.3CC

Facility Operation and Administration. Effective: June 17, 2021

- Page 469: Section 21-5-4. UAS SGI Addendum Request Process and Coordination
- System Operations Support Center (SOSC) Contact Phone Number - 202-267-8276

FAA Request Form for Expedited SGI Waiver or Authorization for UAS Operation

- Form # SOSC 2020/02/20 1125Z

1.8.5 Appendix 5: Data Archive Plan

Processing specifications

- Imagery and video collected at maximum resolution
- Sufficient overlap to support Structure from Motion processed
- Full motion video captured where possible from available payload

File formats

- Detailed descriptions: https://www.ogc.org/docs/is
- EO visible and multispectral visible - near-infrared imagery
    - Joint Photographic Experts Group (JPEG): containing lossy and compressed data
    - Tag Image File Format (TIFF): store raster graphics and image information
- Broadband thermal infrared imagery
    - Radiometric JPEG: JPEG and TIFF for thermal
    - Stores Temperature data as well as red green blue JPEG of thermal data
- EO visible and multispectral visible - near-infrared video
    - MPEG-4 format (MP4, note MOV from EO visible on dual camera system)
    - High compression international audio-visual coding standard
- Broadband thermal infrared video
    - SEQ/FFF - Proprietary FLIR video formats that store images and thermal data
    - MOV - MPEG 4 video container file
- Point clouds – Light Detection and Ranging (LiDAR) data
    - LAS (binary file format) or LAZ (compressed LAS file)
- Geospatial data - GEOTIFF
    - Standard file for GIS with embedded geolocation data
- Google Keyhole Markup Language (KML)

    - KML (default Google Earth geospatial format)
    - Keyhole Market Zipped (compressed KML file format)
- Geographic JavaScript Object Notation (GEOJSON)
    - GEOJSON (coordinates as text in JavaScript Object Notation form
- Shapefile (SHP)
    - SHP (feature geometry), SHX (shape index position), DBF (attribute data)
    - PRJ (projection system metadata), XML (associated metadata)

Data archiving locations

- In-Flight:
    - Onboard storage of all data as well as through specific GCS
    - Data streamed through GCS to operations center to support secondary archive
- Post-Flight:
    - Online secure file storage per UAS and per mission (password protected)
    - Folders for raw sensor data as well as flight logs and route data
    - Folders to store post-processed data and all planning documents

1.8.6 Appendix 6: Rationale behind each section in CONOP

Situation

High level situation awareness and sufficient information to clearly define each element.

Template items

- *Organization's business (manufacturer, operator, system integrator, etc.).*
- *Geographic operating boundaries (lack of specifics implies very broad NAS access).*
- *Describe if launch/ fly/ recover only over private property with owner's permission.*
- *Define the minimum and maximum operating altitude of the vehicle.*
- *Describe if operating within or BVLOS.*
- *Define command and control link.*
- *Provide details on dimensions and materials for vehicle design.*
- *Identify the vehicle's maximum cruise speed and maximum operating gross weight.*
- *Describe Proposed Airspace Classes (A, B, C, D, E, F, etc.).*
- *Define the Proposed Operating Airspace (character aspects – regardless of class).*
- *Describe location of the control station.*

Mission:

Sufficient, clear, and concise statement of what the flight team and lead organization and/or stakeholders for the disaster response mission request want to accomplish. Provide the most important large-scale information and provide sufficient information and clearly define each element.

- *Describe the intended mission of the UAS (surveillance, response, preparedness, etc.).*

Execution:

Thoroughly state how you will "execute" the mission and provide sufficient information and clearly define each element.

- *Identify Airspace Considerations (peculiarities and congestion, special use, etc.)*
- *Give information on Launch and Recovery Details / Location(s)*
- *Identify and describe the vehicle's proximity to people, infrastructure, and surface vehicles*
- *Identify and describe the vehicle's proximity to other NAS users*
- *Identify whether you want to Flight into Known Icing (FIKI)*
- *Identify meteorological conditions you want to operate in Visual / Instrument conditions*
- *Identify the flight rules you want to operate in Visual / Instrument Flight Rules*
- *Describe whether your geographic and airspace boundaries are physically contiguous*
- *Identify Automation Level (occasional autopilot, 100% autonomous, manual control, etc.)*
- *Identify minimum crew and support personnel*
- *Identify the role(s) of the crew and support personnel*
- *Identify whether you will fly over people not involved in the operation*
- *Identify any requests for airspace be blocked off for your exclusive use*
- *Identify your operator/vehicle ratio (1:1, etc.)*
- *Identify day and/or night operations*
- *Describe your plan for safety of Operator(s) and Observer(s)*
- *Describe the training level of each team member*

Command & Signal:

Sufficiently provide information of their plans involving command and communication functions between different portions of the UAS and stakeholders. Clearly describe how you will command and signal amongst the various components of the entire system (vehicle, control station, control link, observers, etc.)

- *Describe Communication between Operator, Observer, Crew Members (visual, radio, etc.)*
- *Describe the Electronic Security of the Control Link*
- *Describe the Physical Security of the operator and control station*
- *Describe real time situational awareness features*
- *Describe the # of operators, and hand-off between control*
- *Describe Lost Link Procedures or loss of Positive Control*
- *Describe Communication Expectations with Air Traffic Control*
- *Describe Emergency Procedures*

Administration & Logistics:

Adequately provide the information or instructions pertaining to how and with whom they will coordinate to conduct the operations.

- *Details on Community Outreach (Flying / Non-Flying Public, municipalities, airports, etc.)*
- *Describe when if flight routes will be filed with Air Traffic Control (VFR / IFR)*
- *Identify Liaisons with Air Traffic Control*

- *Identify MISHAP Reporting Procedures*
- *Identify when NOTAMs will be posted*