Australian Government
Civil Aviation Safety Authority

AU-STS 7: Applicant Response

BVLOS Operations in Remote Australian Airspace (400 ft to below 5000 ft)

Owner	Branch Manager RPAS
Version	0.2 - Month Year
Intended Audience	External

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Reference material

Document type	Title
Publication	JARUS SORA version 2
Regulation	Part 101 Manual of Standards
Guidance Material	Standard Scenario Application and Documents – Guidance Material

Forms

Form no.	Title
Form 101-09	Application for RPA flight authorisation

Revision history

Revisions to this manual are recorded below in order of most recent first.

Version no.	Date	Parts / sections	Details
0.1	July 2020	All	First draft
0.2	March 2021	All	Draft for consultation

Glossary

Acronyms and abbreviations

Acronym / abbreviation	Description
ABS	Australian Bureau of Statistics
AEC	Airspace Encounter Category
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ARC	Air Risk Class
AsA	Airservices Australia
ATC	Air Traffic Control
AU-STS	Australian Standard Scenario
BVLOS	Beyond Visual Line of Sight
CASA	Civil Aviation Safety Authority
C2	Command and Control

Acronym / abbreviation	Description
C3	Command, Control and Communication Link
CONOPS	Concept of Operations
CPA	Conventionally Piloted Aircraft
CRM	Crew Resource Management
CTR/CTZ	Control Zone
DAA	Detect and Avoid
EMS	Emergency and Medical Service
ERP	Emergency Response Plan
EVLOS	Extended Visual Line of Sight
ft	Feet
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HMI	Human Machine Interface
IAW	In Accordance With
JARUS	Joint Authorities for Rulemaking of Unmanned Systems
kJ	Kilojoules
km	Kilometre
LTE	Long Term Evolution. LTE is a 4G wireless communications standard.
MC	Maintenance Controller
MOS 101	Manual of Standards Part 101
MTOM	Maximum Take-off Mass
NM	Nautical Miles
OEM	Original Equipment Manufacturer
OSO	Operational Safety Objective
ReOC	RPA Operator's Certificate
RP	Remote Pilot
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems
RPIC	Remote Pilot in Command
RPT	Regular Passenger Traffic
SAIL	Specific Assurance and Integrity Level
SORA	Specific Operation Risk Assessment
TMPR	Tactical Mitigation Performance Requirements
VMC	Visual Meteorological Conditions
VLOS	Visual Line of Sight

Definitions

Term	Definition
Active Participants	Those persons directly involved with the operation of the RPA or fully aware that the RPA operation is being conducted near them. They are fully aware of the risks involved with the RPA operation and have accepted these risks. Active participants are informed on and able to follow relevant effective emergency procedures and/or contingency plans.
Airport Environment	For the purposes of this document, SORA defined Airport Environment is generally defined (qualitatively) as the region surrounding an airport or heliport where arriving and departing manned aircraft typically fly. It may or may not be directly mapped to an airspace class. Competent authorities may locally define specific metrics for the definition of "airport environment". For instance, CTR/CTZ can be reasonably considered to be “airport environment”.
Atypical Airspace	Can be: • Restricted airspace (e.g. segregated/restricted areas) • Airspace designated "atypical" by the competent authority • Airspace where manned aircraft do not routinely fly (e.g. within 100 ft from buildings)
Beyond Visual Line of Sight (BVLOS)	An RPAS operation whereby the RPIC is not able to maintain at all times visual unaided contact with the aircraft.
Dwelling	A house, flat, or other place of residence.
Extended Visual Line of Sight (EVLOS)	An RPAS operation whereby the RPIC maintains an uninterrupted situational awareness of the airspace and ground environment in which the RPA operation is being conducted via visual airspace surveillance through one or more human observers, possibly aided by technology means.
Improbable	For the purpose of this assessment, this term should be interpreted in a qualitative way as “unlikely to occur in each RPAS during its total life but which may occur several times when considering the total operational life of a number of RPAS of this type.”
Probable	For the purpose of this assessment, this term needs to be understood in its qualitative interpretation i.e. “anticipated to occur one or more times during the entire system/operational life of an item.”

Term	Definition
Relevant Airspace	Areas and airspace within the no-fly zone of an aerodrome or helicopter landing site, as defined in MOS 101. In general terms, for an aerodrome these areas include: • areas and airspace within 3 NM of the movement area of the aerodrome, where the movement area includes areas used for the surface movement of manned aircraft, manoeuvring areas and aprons • the approach and departure paths of the aerodrome. For a helicopter landing site this is the area inside a cylinder with a 1.5 NM diameter and 400 ft height centred on the helicopter landing site.
Relevant Event	Occurs when a manned aircraft is within relevant airspace, including when an aircraft is landing, taking off, or manoeuvring on the movement area, of the aerodrome or helicopter landing site.
Remote Australian Airspace	Airspace defined by CASA as being located in areas which have very low population density and negligible air activity so that these areas can be considered suitable for consideration for RPA BVLOS operations utilising mitigations agreed with CASA.
Remote Pilot in Command (RPIC)	The RPIC is responsible for the flight and all actions conducted by the operating crew in support of the flight. For BVLOS operations, the RPIC will hold an IREX or CASA approved BVLOS examination pass. Under Exemption CASA EX67/20, the RPIC does not have to be the RP controlling the RPA.
Shielded Operations	An operation of an RPA within a specified distance, typically 100 metres from, and below the top of, a natural or man-made object.
Sparsely Populated Area	For this scenario, an area with: • average population density of < 10 persons/km^2, and • no towns or settlements of > 100 dwellings.
Viewshed Analysis	A line-of-sight analysis for mapping the visibility of a place or area from a selected location.
Visual Line of Sight (VLOS)	An RPA is being operated within the visual line of sight of the person operating the aircraft if the person can continually see, orient and navigate the aircraft to meet the person's separation and collision avoidance responsibilities, with or without corrective lenses, but without the use of binoculars, a telescope or other similar device.

1 Introduction

For this standard scenario (AU-STS 7), CASA has undertaken a SORA assessment for a predefined Concept of Operations (CONOPs) for a Beyond Visual Line of Sight (BVLOS) operation > 400 ft AGL and < 5000 ft AMSL in remote Australian airspace (RAA) with a sparsely populated ground environment.

While not an exhaustive list, the use-cases that fall within this scenario might include large scale rural surveys, agriculture and environmental monitoring in Remote Australian Airspace.

CASA has made determinations on the likely mitigations that an operator must provide evidence to demonstrate the safety gain is achieved to an acceptable degree. If these mitigations are present, CASA has determined the outcome of the SORA assessment to be a SAIL II. For this specific type of operation, CASA has additionally provided guidance on the necessary documentation needed to show compliance with the mandatory requirements to demonstrate a reasonable safety case.

The SORA is clear that the only way to undertake BVLOS operations without some form of detect and avoid is to undertake the operation in "atypical airspace" which is airspace that is so devoid of aircraft that the chance of randomly encountering another aircraft is so low that it would meet any target level of safety without additional mitigation (this does not mean that CASA will not require any mitigation for air risk in atypical airspace, but is rather an indication of the unmitigated risk in the airspace under consideration). In remote areas of Australia, away from aerodromes, flight routes and population centres, it is likely that this requirement is met by virtue of the remoteness of the location. However, without quantitative data, it is not possible to determine if the airspace meets the atypical definition.

To deal with this, CASA has created a set of airspace encounter categories (AEC) that are specific to remote, uncontrolled airspace in Australia that CASA believes has such a low density of airspace users, that it would practically be considered "atypical".
Due to the inability to determine quantitatively that the airspace is atypical, CASA requires that an applicant demonstrate additional strategic mitigations to reduce the risk of an encounter with a conventionally piloted aircraft (CPA) to an acceptable level.

The following assumptions have been made in the development of this scenario:

1. The RPA/s will not be fitted with a DAA system.
2. No RPA Traffic Management system will be in operation.
3. RPA to RPA conflicts are not considered.
4. A 1:1 buffer will be applied to the operation.
5. The operator will have an Emergency Response Plan (ERP).

Before proceeding with the BVLOS Standard Scenario Application for BVLOS operations > 400 ft AGL and < 5000 ft AMSL in remote Australian airspace with a sparsely populated ground environment (AU-STS 7), you should refer to the Standard Scenario Application and Documents – Guidance Material.

Although not mandatory, it may also assist to be familiar with the basic SORA concepts and terminology. The SORA package can be downloaded from the JARUS website.

This STS has not been endorsed by JARUS and is applicable to BVLOS operations in Australian airspace only.

2 Scope

This document is intended to be used as part of the safety case application for a BVLOS approval to conduct BVLOS operations > 400 ft AGL and < 5000 ft AMSL in remote Australian airspace with a sparsely populated ground environment standard scenario.

The safety case assessment has two distinct phases:

1. The development of the CONOPS and ensuring that the planned operation complies with this standard scenario. If the CONOPS does not meet the requirements of the standard scenario, there is no benefit in moving on to the second phase.
2. Development of the procedures and documentation to support the proposed operation.

The following images provide a visual overview of the ground and airspace attributes for RPAS operations covered within this scenario. These are explained in further detail in table 1.

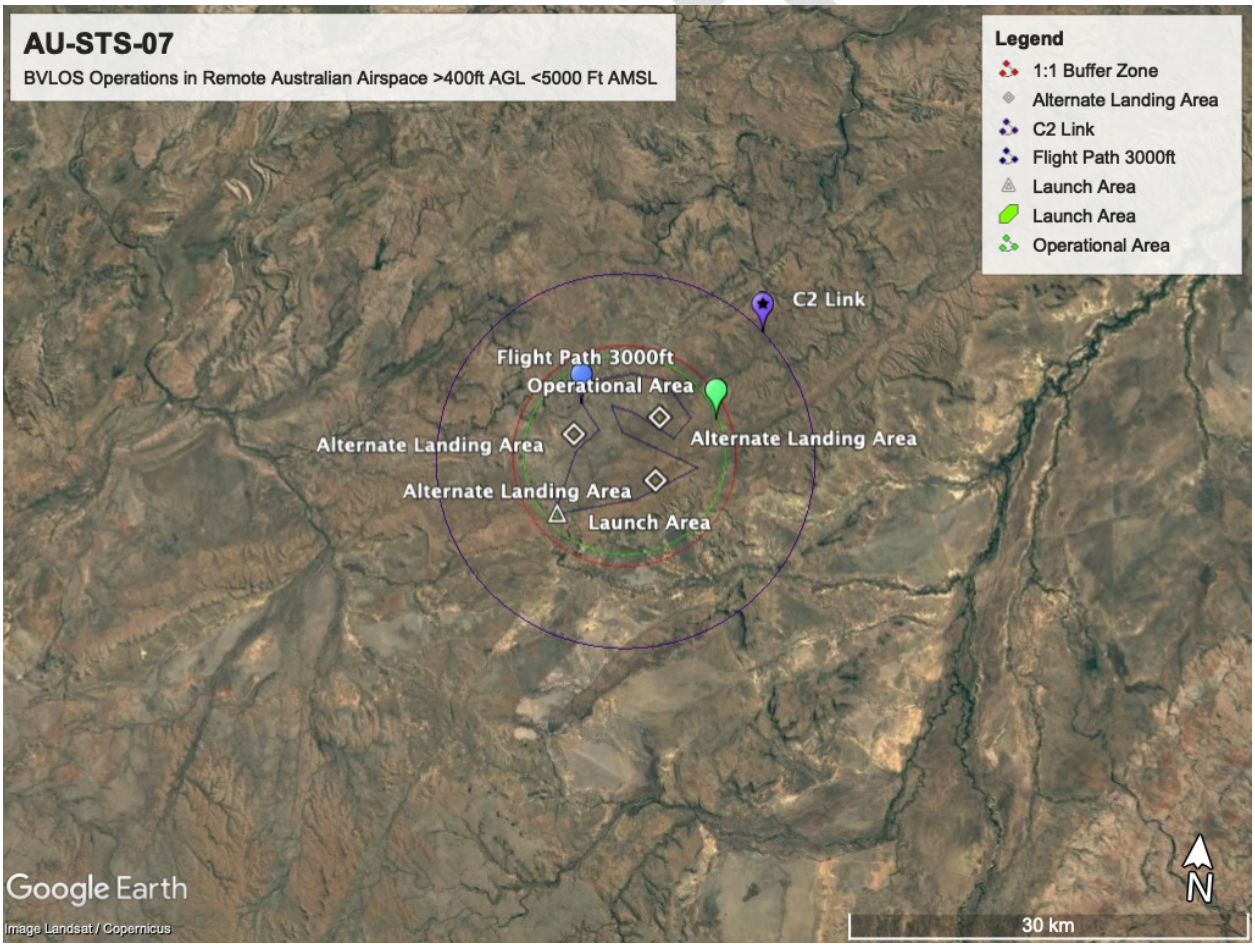


Figure 1: Attributes of AU-STS 7

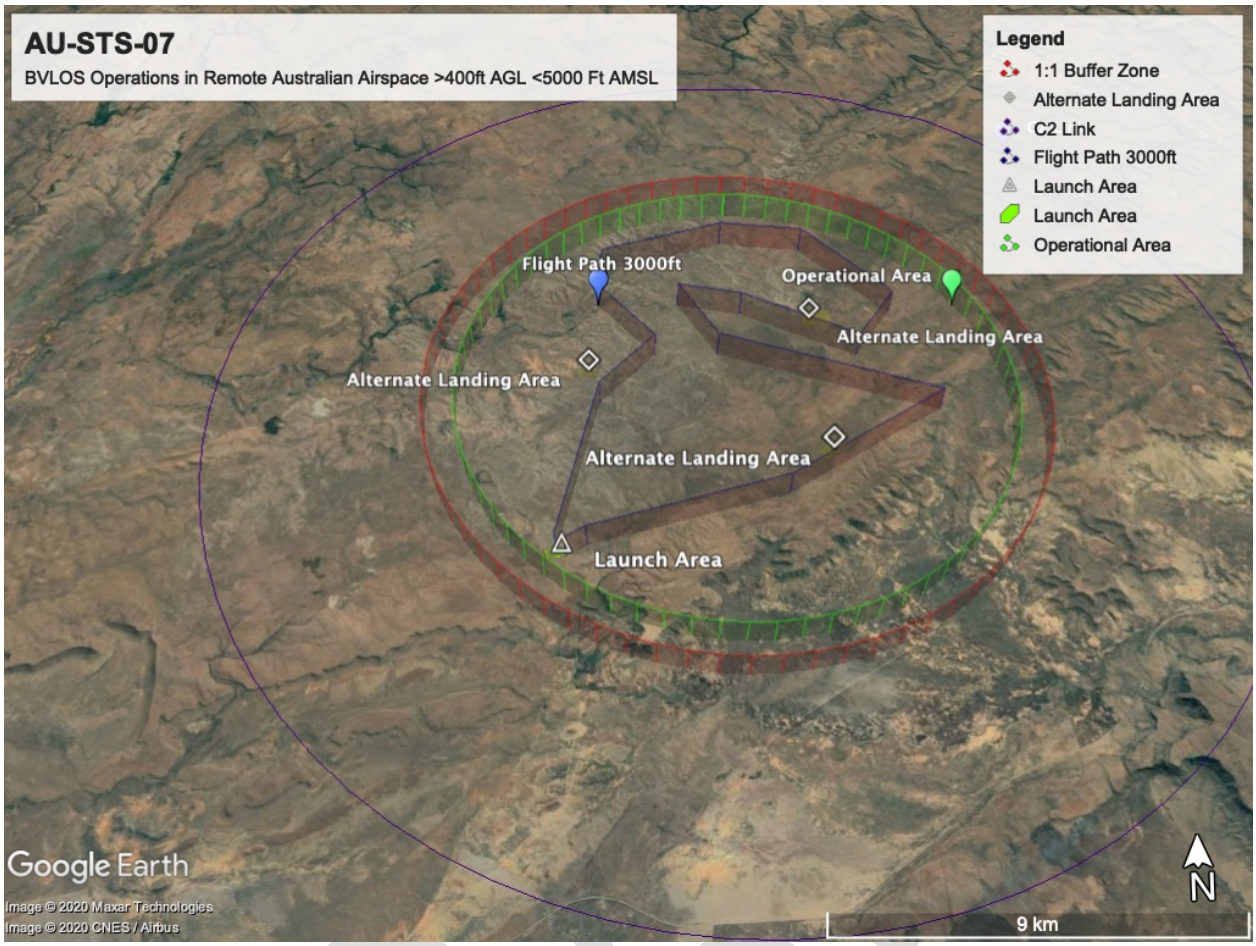


Figure 2: Attributes of AU-STS 7

After reviewing the following information, if you decide to proceed with an application please review and complete sections 3 to 9 to build your safety case.

2.1 Standard Scenario Characterisation and Provisions

Table 1: Summary of CONOPS Assumptions for BVLOS AU-STS 7

RPA operations > 400 ft AGL and < 5000 ft AMSL – Remote Australian Airspace	
Ground risk characteristic – Sparsely Populated	
Geographic area – Australia	
Operational characterisation (scope and limitations)	
Level of human intervention	• No autonomous operations: the remote pilot will always be able to intervene during normal operations • The remote pilot will only operate one RPA at a time • Handover of control of the RPA from 1 pilot to another will be permitted
Range limit from remote flight crew	• RPAS is operated at a maximum distance of 80% of OEM stated or proven C2 link range from the controller
Overflown areas	• Sparsely Populated Area
RPAS limitations	• Max. characteristic dimension (e.g. wingspan or rotor diameter/area): 3 m • Typical kinetic energy up to 34 kJ
Flight height limit (AGL)	• > 400 ft AGL and < 5000 ft AMSL

Airspace	• Class G
	• Outside of the nominal 'J Curve'
	Not within:
	• The vicinity of published VFR routes; or
	• Danger areas associated with flying including flying training and military flying
	• 10 NM of a:
	  ○ Controlled Aerodrome; or
	  ○ Certified or registered Aerodrome; or
	• the vicinity of Instrument Approach Procedures (IAP); and
	• 3 NM of a certified or registered helicopter landing site; or
	• Airspace encompassing areas of anticipated higher airspace utilisation, such as:
	  ○ Coastal regions down to 400 ft out to 1 NM from the coastline
	  ○ Fly-ins/air shows
	  ○ Gliding, balloon operations etc. (incl. competition – usually notified by NOTAM)

	○ Areas regularly involving scenic flights (i.e. Uluru, Bungle Bungle Range, Lake Eyre, etc)
Other	• No items may be dropped which cause a hazard • No dangerous goods may be carried unless that item forms part of the RPA itself (e.g. LiPo battery)
Weather	• 5 km visibility (forecast) • 1000 ft vertically clear of actual cloud base • Not operated within 5 km of thunderstorms or showers

Operational mitigations	
Operational Volume	The operational volume is composed of the flight geography and the contingency volume. To determine the operational volume, the applicant will consider the position-keeping capabilities of the RPA in 4D space (latitude, longitude, height and time). In particular, the accuracy of the navigation solution, the flight technical error of the RPA, as well as the path definition error (e.g. map error) and latencies will be considered and addressed in this determination. If the RPAS leaves the operational volume, emergency procedures will be activated immediately.

Ground Risk	• For this standard scenario, sparsely populated areas are defined as:
	• average population density of < 10 persons/km^2, and
	• no towns or settlements of > 100 dwellings.
	
	The applicant may use either Australian Bureau of Statistics (ABS) data to determine the population density or in areas where the ABS data exceeds < 10 persons/km^2, demonstrate by on-site survey and/or analysis of satellite imagery which demonstrates an average population density of < 10 persons/km^2 exists within the proposed operational volume.
	
	A ground risk buffer will be established to protect third parties on the ground outside the operational volume.
	
	The operational volume and the ground risk buffer will be in:
	• Sparsely populated environment
	
	The applicant must have documented practices and procedures that detail how BVLOS operations are planned and conducted including how:
	• Overflight of identified dwellings is avoided.
	• Identification of any vulnerable critical infrastructure or sensitive areas (e.g. environmentally sensitive).
	• Overflight of roads / vehicles is avoided; and
	• If any overflight of roads are proposed, how this would be performed to meet an acceptable level of safety, including consideration to:
	  ○ Identifying road usage, traffic movements and expected traffic volumes
	  ○ Transiting over the road perpendicular to the direction of road; and
	  ○ Transiting over the road at a height which, in the event of an emergency or failure of the RPA, the RPA is able to safely avoid the road (i.e. not posing a hazard).

Air Risk	Australia has unique geographical characteristics whereby there are significant portions of inland areas which would be considered wholly rural and remote. The SORA does not currently specify this delineation explicitly. CASA believes there is a region of very low risk airspace in remote Australia that is so distinct from currently defined SORA AEC-5 and AEC-10 classifications that they would exist in separate AECs in a "low risk" ARC-b categorisation. Australia has categorised two "remote Australian airspace" as:
	• AEC-13 – BVLOS in Remote Australian Airspace < 400 ft AGL; and
	• AEC-14 – BVLOS in Remote Australian Airspace > 400 ft AGL < 5000 ft AMSL
	
	To obtain an AEC-14- BVLOS in Remote Australian Airspace > 400 ft AGL and < 5000 ft AMSL the operation must be within airspace that does not contain any of the following:
	• Controlled Airspace; or
	• Published VFR routes; or
	• Danger areas associated with flying including flying training and military flying
	• In airspace that is within 10NM of a:
	  ○ Controlled Aerodrome; or
	  ○ Certified or registered Aerodrome; or
	• Is not within the vicinity of Instrument Approach Procedures (IAP); and
	• Airspace that is within 3 NM of a certified or registered helicopter landing site; or
	• Airspace not encompassing areas of anticipated higher airspace utilisation, such as:
	  ○ Coastal regions down to 400 ft out to 1 NM from the coastline
	  ○ Fly-ins/air shows
	  ○ Gliding, balloon operations etc. (incl. competition – usually notified by NOTAM)
	  ○ Areas regularly involving scenic flights (i.e. Uluru, Bungle Bungle Range, Lake Eyre, etc)
	
	The operator must then employ sufficient mitigations to reduce the air risk to "low risk" remote Australian airspace (equivalent to the expected air risk if operating over rural areas below 500 ft AGL).

Operator Provisions	
ReOC holder	A CASA ReOC and its associated Operations Manual will already cover a substantial amount of the procedural/organisational mitigations required by SORA. The operator will however need to develop and document the procedures and processes required to support the specific BVLOS operation. Where required, the operator may need to demonstrate the efficacy of those procedures to CASA.

RPA operations	The applicant will document the following procedures or policies in their Operations Manual: • task specific BVLOS operational procedures • handover procedures from BVLOS to EVLOS/VLOS and vice versa (if required). • handover procedures between RPs (if required) • task specific RPA operational limitations • task specific Emergency Response Plan (ERP) • limitations of the external systems supporting RPA for safe operations • weather/environmental conditions required for a safe operation • how the remote crew can declare themselves fit to operate before conducting any operation. • how the remote crew is assessed as current and competent. • an up-to-date list of remote crew members authorised to carry out BVLOS operations. The adequacy of the contingency and emergency procedures will be proved through: • dedicated flight tests • simulations, provided the representativeness of the simulation means is proven for the intended purpose with positive results, or • any other means acceptable to CASA. A template of BVLOS procedures and sections which may be included in an Operations Manual is provided in Appendix A of Standard Scenario Application and Documents – Guidance Material.
RPAS maintenance	All RPAs used for BVLOS operations will be maintained, as a minimum, IAW the OEM documentation. Maintenance records and technical logs for all RPAs to be used for BVLOS operations will be kept IAW with MOS 101 regardless of size or weight. If the RPA is to be operated in the vicinity of high intensity radio transmissions or similar, the applicant will detail how RPA operations will be safely conducted within this environment.
External Services	If the applicant relies on any external services, such as LTE (4G/5G), internet services etc., the applicant will need to demonstrate that the performance and availability of the service is adequate for the intended operation. The applicant will need to document the effects of any degradation or loss of services on the safety of flight and how these will be managed (e.g. operations cease, VLOS / EVLOS only, etc.). If the provision of the external service requires specific contracts or arrangements to be entered into, roles and responsibilities between the applicant and the external service provider must be defined. If the applicant is using a standard commercial contract, this is not required (e.g. a mobile phone

	/ data / internet contract).
Training Provisions	
Remote crew	The applicant will document, as a minimum, the following training procedures or policies in their Operations Manual: • theoretical training syllabus • mission planning syllabus • practical training syllabus • BVLOS check flight profile and assessment criteria • approved BVLOS trainers' qualifications and experience requirements • internal training syllabus for BVLOS trainers • ERP training syllabus. For all BVLOS operations, the remote pilot in command must hold a pass in the IREX or CASA approved examination (CASR 101.300 (4) (a)). All remote pilots involved in a BVLOS operation must hold an appropriate aeronautical radio qualification. At a minimum, all remote pilots in command must have at least 20 hours' RPA experience with at least two hours' experience on the type and model of RPA. Applicants should assess whether higher experience levels are required based on the complexity of their RPAS. A record of all relevant qualifications, experience and/or training completed by the remote crew will be established and kept up to date. A template outlining BVLOS training elements which may be included in an Operations Manual is provided in Appendix B of Standard Scenario Application and Documents – Guidance Material.
Technical Provisions	
General	In their Operations Manual, the applicant will document how critical parameters are to be monitored. As a minimum, the applicant with document how: • RPA position, height or altitude, ground speed or airspeed and tracking are monitored • RPA position reference areas and dwellings to be avoided • how the RPA height will be monitored with reference to terrain • the required lateral spacing • RPA energy status (fuel, batteries etc.) • status of critical functions and systems; as a minimum, for services based on RF signals (e.g. C2 Link, GNSS etc.) means will be provided to monitor the adequate performance and triggering an alert if level is becoming too low • detecting interference with C2 or other RPA systems.

Human Machine Interface	The applicant will conduct an evaluation of the RPAS considering and addressing human factors to determine the HMI is appropriate for the BVLOS operations. An HMI assessment proforma is provided in Appendix D of Standard Scenario Application and Documents - Guidance Material. The applicant can either use the template provided as guidance or put forth an alternative methodology.
Command, Control links (C2) and communication	Any RPA used for BVLOS operations must comply with the appropriate requirements for radio equipment and the use of RF spectrum. In the Operations Manual, the applicant will document the maximum operating range of the RPA from the control station. This can be either 80% of the OEM declared operating range, or a maximum operating range proven by flight operations. In the Operations Manual, the applicant will document how to conduct a visibility /viewshed analysis to demonstrate that the C2 and communication links will not be adversely affected by terrain i.e. Electronic line of sight will be maintained throughout the operating area. A copy of the analysis must be attached to all operational releases and provided to CASA as part of any application. The remote pilot must have a reliable and continuous means of two-way radio communication with other air users or ATC if required. The RPICs mobile / satellite phone number and frequency being monitored during flight must be published in the NOTAM for RPA BVLOS operations to allow coordination with manned aircraft and another RPA operator.
Strategic air mitigations	CASA has determined that for this AU-STS as “low Risk” remote Australian airspace, if the following strategic mitigations are added this will reduce the probability of an encounter to a point where it is equivalent to “atypical airspace”: • Stakeholder engagement with other airspace users within the vicinity of the proposed operational volume. • NOTAM issued for the operational volume detailing the operational context and contact information for other airspace users. • Operator to keep records of any movement/radio logs within vicinity of the approved area whilst operating the RPA. This recorded evidence will form part of your evidentiary matter to assist CASA with aerial movement data for remote areas of Australia.
Tactical mitigation	The RPA is being operated in atypical airspace so does not have to meet the normal see and avoid requirements.
RPA Conspicuity	The operator should consider methods to enhance airspace situational awareness, as well as the detectability and conspicuity of the RPA, for example:

	• Technologies for electronic detection of air traffic (e.g. ADS-B IN, web-based real time tracking services) • RPA is fitted with suitable high intensity anti-collision lighting (such as strobes) • RPA is painted using a high visibility colour/contrast paint scheme.
Containment	To ensure a safe recovery from a technical issue involving the RPA, or external system supporting the operation, the operator should assess the effects of the following probable failures: 1. Ability of RPA to continue to fly or make a safe landing with at least one motor inoperative (i.e. the RPA remains controllable). 2. Intermittent or degraded C2 link particularly at the maximum operating range and /or around vertical obstacles. 3. Indications, RPA response and crew procedures and actions in the event of a permanent loss of the C2 link. 4. Total or partial failure of the ground control station affecting such systems as electronic displays, video feeds, internet, manual control interfaces, etc. caused by software, hardware or power failures. 5. Identify any possible single point failures in the RPAS which are critical to the containment of the RPA. 6. Navigation system failures, including degradation or total loss of GPS, IMUs, sensors or cameras, that may result in a reduction in navigation accuracy and/or a loss of available navigation modes. The operator should then ensure that: • no probable failure of the RPA or any external system supporting the operation will lead to operation outside of the operational volume • it will be reasonably expected that a fatality will not occur from any probable failure of the RPA or any external system supporting the operation. **Note:** The term “probable” needs to be understood in its qualitative interpretation i.e. “anticipated to occur one or more times during the entire system/operational life of an item.” The operator will then provide a technical assessment which will demonstrate, at a minimum: • design and installation features (independence, separation and redundancy) • particular risks (e.g. hail, ice, snow, electro-magnetic interference etc.) relevant to the CONOPs
Additional Notes	VLOS/EVLOS procedures may be utilised to establish the RPA area of operation. Take-off and landing can be conducted either VLOS/EVLOS or BVLOS, provided the operator has suitable documented practices and procedures.

3 Application

The following sections provide applicants with guidance about the minimum information and evidence required to support an application for BVLOS operations according to the standard scenario AU-STS 7.

CASA considers these the minimum requirements for applications under this scenario, and applicants should assess whether higher levels of safety are required based on the complexity of the operation.

3.1 Concept of Operations (CONOPs)

As the applicant, you must provide an outline of the proposed concept of operations.

Include, at least:

- proposed activity(ies) to be conducted
- RPAs that will be utilised
- confirmation that the Remote Pilot will only fly one RPA at a time
- minimum crew composition and qualifications
- details of flight operational area including contingency area and 1:1 buffer
- explanations as to how the flight operational area will be conducted in remote Australian airspace and have a populations density of less than 10 person/km^2
- confirm that the operator has an applicable emergency response plan (ERP) in place.

Please attach CONOPS as a separate document.

3.2 Ground Risk Considerations

For this standard scenario (AU-STS 7), the operational volume and the ground risk buffer will be located in a sparsely populated environment.

You must have documented practices and procedures that detail how BVLOS operations are planned and conducted including:

- How overflight of identified dwellings is avoided
- Identification of any vulnerable critical infrastructure or sensitive areas (e.g. environmentally sensitive).
- Overflight of roads / vehicles is avoided; and
- If any overflight of roads are proposed, how this would be performed to meet an acceptable level of safety, including consideration to:
    - Identifying road usage, traffic movements and expected traffic volumes
    - Transiting over the road perpendicular to the direction of road; and

- Transiting over the road at a height which, in the event of an emergency or failure of the RPA, the RPA is able to safely avoid the road (i.e. not posing a hazard).

You will be required to demonstrate that the area is sparsely populated, the maximum aircraft characteristic dimension is less than three metres, and the typical kinetic energy of the aircraft is < 34 kJ.

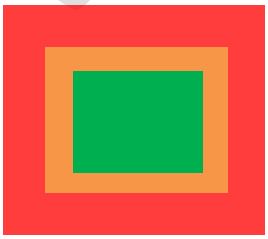
Step 1: Plan the operation including heights, operational volume and apply a 1:1 buffer. You must ensure that your flight route is < 5000 ft AMSL. Flight area must include an area for an RPA issue called a contingency area.

The operational flight volume must include a volume for the remote pilot to complete contingency actions/procedures within after the RPA enters an undesired state (e.g. an abnormal situation/issue/failure). This volume is between that in which the flight is planned, and the buffer and is known as the contingency volume. This volume provides the RPIC sufficient time to bring the RPA back into a nominal state for any probable malfunctions/failures from which it can return to the normal task or be landed before it reaches the 1:1 buffer. If the RPA reaches the buffer, the RPA must be immediately landed or terminated. The applicant is also required to consider the ability of the RPA to remain within the operational volume, referred to in Step 9 as containment. The requirement of containment is that no probable failure will lead to the RPA flying outside the operational volume and posing a risk to adjacent areas. The applicant should ensure that the size of the contingency volume is sufficient to ensure the RPA is contained within the operational volume for all likely malfunctions/failures, such as reduced navigation performance, loss of C2 etc.

Diagram 1

Flight operational volume includes:

- Nominal Flight path/area
- Contingency area
- A 1:1 Buffer will then need to be applied



The outcome is that you will have identified the flight operational volume (nominal flight area and contingency area) and the risk buffer.

Note: 1:1 buffer would mean if the RPA is planned to operate at 220 m height, the ground risk buffer should at least be 220 m. An example of this can be seen in section 3 of Standard Scenario Application and Documents - Guidance Material.

Table 2: 1:1 Buffer

1:1 Buffer

Evidence Required	Evidence Location (please include page number, section, appendix or attached file name)
Your Operations Manual must highlight how you manage to maintain a 1:1 Buffer including: • how settlements and dwellings are to be avoided • how the 1:1 buffer will not be adjacent to any open-air gatherings.	
A geographic data file (e.g. a kml/kmz readable in Google Earth) including information describing: • RPA Flight heights • flight operational volume • 1:1 Buffer • identification of any vulnerable critical infrastructure or sensitive areas (e.g. environmentally sensitive) • Avoidance of overflight of roads / vehicles An example of this is in section 3 of Standard Scenario Application and Documents – Guidance Material.	

Step 2: Using the identified flight operation area and risk buffer, determine that the number of people in this area will be less than 10 persons/km^2. Also, identify dwellings and update the flight route to avoid these dwellings. Finally, you must avoid overflight of any towns or settlements.

Assess the areas bordering the 1:1 buffer and make sure there are no locations where regular large gatherings take place e.g. sporting event, playgrounds etc.; if you identify any such areas, you must document how your operation will take place outside of the times of gatherings. The outcome is an updated KML file or image of the flight area, and 1:1 buffer which shows the population density in the intended area.

Table 3: Sparsely Populated Area

Sparsely Populated Area	
Evidence Required	**Evidence Location (please include page number, section, appendix or attached file name)**
Using the Australian Bureau of Statistics (ABS) data, determine the population density < 10 persons/km^2, or, in areas where the ABS data exceeds < 10 persons/km^2, demonstrate by on-site survey and/or analysis of imagery which demonstrates an average population density of < 10 persons/km^2 exists within the proposed operational volume during the proposed times /days of operation.	

Step 3: Calculate the kinetic energy of all the RPAs you intend to use for this operation. Please click on table 4; it will take you to a excel spreadsheet. Items in yellow need to be completed. Record the results for each RPA in table 5.

For an RPA to be used in this standard scenario, it must have the following characteristics:

- max. characteristic dimension (e.g. wingspan or rotor diameter/area): 3 m
- typical kinetic energy: up to 34 kJ

Any RPAs that exceed these maximums cannot be included in this application. If their use is essential, you will need to use a different STS or make a full SORA application.

The outcome of this step is a list of RPAs that you are requesting to be approved for this operation.

For each category of RPA, the maximum characteristic dimension is determined on:

- FIXED-WING AIRCRAFT/ POWERLIFT = wingspan
- MULTICOPTERS = maximum dimension
- ROTORCRAFT = rotor diameter

For the purposes of calculating the typical kinetic energy expected of an RPA, the following formula can be used:

$$KE = \frac{1}{2}\, m\, V^2$$

Where:

- *KE* is the typical kinetic energy
- *m* is the mass of the RPA (kg) – the Maximum Take-off Mass (MTOM) of the RPA is to be used in this case.

- *V* is the velocity of the RPA (m/s) – the maximum cruise velocity of the RPA is to be used in this case.

Table 4: Determination of RPA Kinetic Energy

Determination of RPA Kinetic Energy

Kinetic Energy		
Mass	20	kg
Maximum dimension		m
Aircraft Type		
Make		
Model		
Speed to use	Cruise	
Speed*	10	m/s
KE	1000	J

Table 5: RPA Characteristics and Typical Kinetic Energy

RPA Characteristics and Typical Kinetic Energy		
RPA Type	**Characteristic Dimension (m)**	**Kinetic Energy (kJ)**

3.3 Air Risk Considerations

Step 4:

For this step it is to review and understand the airspace in and around the flight operation area.

1. Are there any controlled or uncontrolled aerodromes within 10NM
2. Are the any certified or registered HLS into the within 3NM of the operational area?
3. What times of day and which days are these airfields used? Is any time of year busier?
4. Is there any C or D class airspace in the operational area?
5. What is the height of terrain? What is the MSA?
6. Do military flying operations take place within the operational area?
7. Are there any airways, air routes or VFR routes within the operational area?
8. Are there any restricted or danger areas? If so when are the areas active
9. Are there any regular / scheduled flights through the operational area?
10. Are there any flying training schools operating in the area?
11. Are any other flying activities taking place (gliding, balloons, model flying, etc)
12. Are there any Fly-in/air shows scheduled?
13. Are you operating within 1NM for the coastline?
14. Are there any instrument approach procedures? If so where does the missed approach procedure take aircraft? What is the approach MSA?
15. Who owns and controls the airfields /HLS /ALAs in the operational area?
16. Are there any other RPA BVLOS approvals in the area?

This will provide a picture of the typical aircraft movements, their type and what equipment they typically carry within the operational area. If any of the above apply you must reduce the air risk, if possible, which may be achieved by considering if any of the following or combination of the following mitigations can be used to lower the air risk class:

1. Restriction by chronology
    a. Can the RPA operation take place at night?
    b. Can the RPA operation take place outside of RPT/scheduled traffic which pose the highest risk?
2. Restriction by operation volume / boundary
    a. Can the operation be restricted to areas where manned aircraft are known to rarely operate in?
    b. Can the operation avoid the approach and departure path of any aerodromes?
    c. Can the operation be separated from instrument approach procedures?
    d. Can the operating height be reduced to minimise the risk to manned aircraft?
    e. Can the operating height be reduced to below MSA?
3. Mitigations by common rules.
    a. NOTAM informing other air users of the BVLOS operation and its route or area, contact details for the operator and frequencies that the RPA operator will be monitoring
    b. ADS-B In receiver fitted to the RPA or a ground-based ADS-B In receiver with display available to the RPIC. IFR aircraft should be using ADS-B and its use is encouraged for VFR aircraft.
    c. Monitor aeronautical VHF radio

Once the operator has decided which of these mitigations apply, they can then construct a safety case to demonstrate that the resultant air traffic density likely to be encountered is similar or lower than that which would be encountered below 500 ft AGL in rural areas. This would result in the final air risk being lowered. If at the end of this assessment the operator concludes that lowering the air risk is not feasible, they can use VLOS or EVLOS (if the operator is approved for EVLOS) procedures to operate in the relevant airspace. The BVLOS application will then become a multiple segment application.

The outcome of this step is to provide an analysis of the area to show that the operational area falls withing remote Australian Airspace for > 400 ft AGL and < 5000 ft AMSL

You will also need to provide either an image, chart, screenshots or documentation that shows the operation is within the scope of this standard scenario

An example of the image is shown in section 3 of Standard Scenario Application and Documents – Guidance Material.

Table 6: Air Risk Considerations

Air Risk Considerations	
Evidence Required	**Evidence Location (please include page number, section, appendix or attached file name)**

You will need to provide an analysis of the airspace for both you flight operational area and surrounding area to show it falls in Remote Australian Airspace and is not within:
• Controlled Airspace; or
• Published VFR routes; or
• Danger areas associated with flying including flying training and military flying
• In airspace that is within 10NM of a:
  ○ Controlled Aerodrome; or
  ○ Certified or registered Aerodrome; or
• Is not within the vicinity of Instrument Approach Procedures (IAP); and
• Airspace that is within 3NM of a certified or registered helicopter landing site; or
• Airspace not encompassing areas of anticipated higher airspace utilisation, such as:	

○ Coastal regions down to 400ft out to 1NM from the coastline ○ Fly-ins/air shows ○ Gliding, balloon operations etc. (incl. competition – usually notified by NOTAM) ○ Areas regularly involving scenic flights (i.e. Uluru, Bungle Bungle Range, Lake Eyre, etc) If they are within this area you will need to define how you will avoid them or operate outside of those times.	
Provide an image, chart or screenshots that show both the operation area and 1:1 buffer are within the scope of this standard scenario.	

Step 5: CASA has determined that for this AU-STS if the following strategic mitigations are added to items required in step #4 this will reduce the probability of an air encounter to a point where it is equivalent to “atypical airspace”:

- Stakeholder engagement with other airspace users within the vicinity of the proposed operational volume.
- NOTAM issued for the operational volume detailing the operational context and contact information for other airspace users.
- Operator to keep records of any movement/radio logs within vicinity of the approved area whilst operating the RPA. This recorded evidence will form part of your evidentiary matter to assist CASA with aerial movement data for remote areas of Australia.

Table 7: Air Risk Mitigations

Air Risk Mitigations	
Evidence Required	**Evidence Location (please include page number, section, appendix or attached file name)**
You will need to complete a stakeholder engagement plan for relevant air users identified in the previous step (refer to Standard Scenario Application and Documents – Guidance Material)	

You will need to add to your BVLOS operational procedures that: • A NOTAM will need to be issued • Carriage of a radio • Procedures for keeping records of any movement/radio logs within the vicinity of your approved area whilst operating the RPA.	

Although not required as part of this standard scenario, you are encouraged to adopt any mechanism that may further reduce the risk of a breakdown of safe separation, such as:

- electronic visibility (i.e. ADS-B, FLARM, transponder)
- lighting, strobes
- high visibility paint.

3.4 Confirmation

Step 6: The previous steps assessed the proposed BVLOS operation against this standard scenario.
If you are able to answer yes to the following questions with supporting evidence, you should complete the next three sections and provide supporting documents.

Table 8: AU-STS 7 checkpoint

Check Points	Yes	No
Is the proposed operations < 5000 ft AMSL and in Remote Australian Airspace		
Did the proposed flight plan route avoid all dwellings?		
Was a 1:1 ground buffer applied?		
Was the operational area and 1:1 buffer sparsely populated?		
Were your RPA characteristics less than 3 m and kinetic energy less than 34 kJ?		

If you answer no to any of the questions above, you will need to either:

- amend your planned operations to fit the operational characteristics of this standard scenario
- check your planned operations against a difference standard scenario, or
- complete a full BVLOS SORA application. More information on this process can be obtained from rpas@casa.gov.au.

4 Additional Supporting Materials

4.1 Operational Procedures

Step 7: Provide the following operational procedures and documentation:

1. An updated Operations Manual for BVLOS operations including BVLOS procedures, training and record keeping.
2. An Emergency Response Plan.
3. A completed HMI assessment of all RPAs and GCS.
4. A completed stakeholder engagement plan for aerodromes.

To assist in developing these documents, examples are provided in Standard Scenario Application and Documents – Guidance Material.

4.2 Additional Mitigations

Step 8: Document additional mitigations and provide references for any evidence that you are providing in support of your application. This is divided into three sections, and you must complete them all:

- Operator Provisions
- Training Provisions
- Technical Provisions.

The outcome of this step is that you will have developed a safety case in support of your application.

Table 9: Additional mitigation - Operator provisions

Operator Provision	
Evidence Required	**Evidence Location (please include page number, section, appendix or attached file name)**
Chief pilot record keeping needs to be updated to include items for BVLOS IAW MOS 101 including: • RPAS operational release • RPAS operational log • Remote Pilot log.	
A list of remote crew members authorised to carry out BVLOS operations which must be current.	
Schedule 1 be current and also list RPAs that are authorised for this BVLOS standard scenario. Please refer to Standard Scenario Application and Documents – Guidance Material.	
Provide provisions or policy in your Operations Manual defining how the remote crew can declare themselves fit to operate before conducting any operation.	
Provide documented procedures for accepting a new RPA into BVLOS operational use. Refer to Standard Scenario Application and Documents – Guidance Material.	

Minimum of OEM pre- / post-flight checks documented or referenced in Operations Manual.	
Operational procedures for BVLOS which cover: • flight planning • weather • normal and emergency procedures • occurrence reporting • any relevant RPA operational limitations.	
Radio line of sight viewshed analysis or C2 electronic LOS for the operating area.	
Record of ERP validation (tabletop exercise).	

Table 10: Additional mitigations - Training

Training	
Evidence Required	**Evidence Location (please include page number, section, appendix or attached file name)**
Type training including the acceptance of RPAs into operation (product inspection/conformity) to be added to the Operations Procedures for all RPA that will be utilised in this standard scenario.	
ERP training syllabus will need to be available. An example is provided at Appendix A of Standard Scenario Application and Documents – Guidance Material. A record of internal ERP training completed by the relevant staff needs to be established and kept up to date Training records kept IAW MOS 101.	
All RPs hold RePL with appropriate RPA operating privileges (Category / Weight Class).	

Training and procedures for multi crew operations are documented in Operations Manual.	
Operations Manual documents training and for operation of flight critical support equipment.	

Table 11: Operational mitigations – Technical

Technical	
Evidence Required	**Evidence Location (please include page number, section, appendix or attached file name)**
Demonstrate the RPA will be operated within 80% of the specified OEM range and determine the RF spectrum usage and environmental conditions for C3 links are adequate to safely conduct the intended operation including: • detailed procedures in Operations Manual • RPA range is listed in Schedule 1 of Operations Manual. You may also illustrate expected RPA operating range in your geographic data file (readable in Google Earth).	
Show that all RPAs used for BVLOS operations will be maintained IAW the OEM documentation. Maintenance records and technical logs for all RPAs to be used for BVLOS operations will be kept IAW MOS 101 regardless of size or weight. If the RPA is to be operated in the vicinity of high intensity radio transmissions or similar, the applicant will detail how RPA operations will be safely conducted within this environment.	
A self-declared HMI assessment is attached as part of this submission. It includes equipment that has been reviewed and considered fit for purpose. HMI assessment completed IAW Appendix D Standard Scenario Application and Procedures – Guidance.	
If required, how external services are used and assured is documented in the Operations Manual.	
Provide maintenance procedures for any flight critical support equipment.	

In Operations Manual, document how weather limits are defined and how these are monitored.	

4.3 RPA Containment

Step 9: To ensure a safe recovery from a technical issue involving the RPA, or external system supporting the operation, you should assess the effects of the following probable failures:

1. Ability of RPA to continue to fly or make a safe landing with at least one motor inoperative (i.e. the RPA remains controllable).
2. Intermittent or degraded C2 link particularly at the maximum operating range and /or around vertical obstacles.
3. Indications, RPA response and crew procedures / actions in the event of a permanent loss of the C2 link.
4. Total or partial failure of the ground control station affecting such systems as electronic displays, video feeds, internet, manual control interfaces etc. caused by software, hardware or power failures.
5. Identify any possible single point failures in the RPAS which are critical to the containment of the RPA.
6. Navigation system failures including degradation or total loss of GPS, IMUs, sensors or cameras that may result in a reduction in navigation accuracy and/or a loss of available navigation modes.

Outcome: Provide an analysis of the RPAS which demonstrates that:

- No probable failure of the RPA or any external system supporting the operation will lead to operation outside of the flight operational area and 1:1 buffer.
- It will be reasonably expected that a fatality will not occur from any probable failure of the RPA or any external system supporting the operation.

Please attach supporting evidence and documentation.

5 Submitting Your Application

The completed BVLOS application package should include:

1. completed application for RPA flight authorisation (CASA Form 101-09), accessed at https://www.casa.gov.au/sites/default/files/form101-09.pdf.
2. completed AU-STS 7 Applicant Response document with all supporting attachments including KML files, maps, images, analysis, ERP plans, HMI Assessments and stakeholder engagements, and
3. updated CASA Operations Manual Suite.

The completed BVLOS application including all supporting documentation should be submitted to rpas@casa.gov.au. If the total file size exceeds 18 MB please contact the RPAS Team first to make alternative arrangements for submitting the application.

On receipt of a completed application, CASA will calculate and issue an estimate of the cost to process the application. The estimate must be paid before any assessment can be undertaken.

Due to the high volumes of BVLOS applications submitted to CASA, please ensure completed applications are lodged well in advance of the operation's proposed start date.