AVIATION PROJECTS

March 2026

AVIATION IMPACT ASSESSMENT

WALLABY CREEK WIND FARM

Prepared for ERM

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ACRONYMS

AAAA	Aerial Application Association of Australia
AC	Advisory Circular
AFAC	Australian and New Zealand Council for fire and emergency services
AGL	Above Ground Level
AHD	Australian Height Datum
AIA	Aviation Impact Assessment
AIP	Aeronautical Information Package
AIS	Aviation Impact Statement
ALA	Aircraft Landing Area
ALARP	As Low as Reasonably Practicable
AMSL	Above Mean Sea Level
ARP	Aerodrome Reference Point
AS	Australian Standards
AsA	Airservices Australia
ATSB	Australian Transport Safety Bureau
BoM	Bureau of Meteorology
CAAP	Civil Aviation Advisory Publications
CAO	Civil Aviation Orders
CAR	Civil Aviation Regulation (1988)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation (1998)
CFIT	Controlled Flight into Terrain
CNS	Communications, Navigation and Surveillance
CTAF	Common Traffic Advisory Frequency
DAH	Designated Airspace Handbook
EIS	Environmental Impact Statement
ERC-H	En-route Chart High
ERC-L	En-route Chart Low
ERSA	En Route Supplement Australia
GA	General Aviation

ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
LGA	Local Government Area
LSALT	Lowest Safe Altitude
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards
MSA	Minimum Sector Altitude
NASAG	National Airports Safeguarding Advisory Group
NASF	National Airports Safeguarding Framework
NDB	Non-Directional (radio) Beacon
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PSR	Primary Surveillance Radar
RAAF	Royal Australian Air Force
RFDS	Royal Flying Doctor Service
RPT	Regular Public Transport
RSR	En route Surveillance Radar
SSR	Secondary Surveillance Radar
VFR	Visual Flight Rules
VFRG	Visual Flight Rules Guide
VMC	Visual Meteorological Conditions
WMTs	Wind Monitoring Towers
WTGs	Wind Turbine Generators

UNITS OF MEASUREMENT

ft	feet	(1 ft = 0.3048 m)
km	kilometres	(1 km = 0.5399 nm)
m	metres	(1 m = 3.281 ft)
nm	nautical miles	(1 nm = 1.852 km)

DEFINITIONS

Definitions of key aviation terms are included in **Annexure 2**

EXECUTIVE SUMMARY

Introduction

Acciona Energy Australia Global Pty Ltd, (Acciona) proposes to construct and operate the Wallaby Creek Wind Farm (the Project), a renewable energy development located south of Narromine in the Orana region of New South Wales (NSW).

Acciona is seeking State Significant Development (SSD) Consent for the Project under Division 4.7, Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Project is located to the west of the Newell Highway, approximately 10 kilometres (km) south of Narromine in northwest NSW.

ERM has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) for the Project to support the development application and formally consult with aviation agencies.

The Project requires an AIA to be undertaken in accordance with the:

- NSW Department of Planning, Housing and Infrastructure (DPHI) Planning Secretary's Environmental Assessment Requirements (SEARs) number SSD-60247211
- Civil Aviation Safety Regulations (CASR) 1998 and associated Manuals of Standards (MOS) and guidance material provided by CASA
- National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*
- Specific requirements as advised by Airservices Australia for the information contained within an Aeronautical Impact Study (AIS).

This AIA assesses the potential aviation impacts, provides aviation safety advice in respect of relevant requirements of air safety regulations and procedures, and informs and documents consultation with relevant aviation agencies.

This AIA report includes an AIS and a qualitative risk assessment to determine the need for obstacle lighting on wind turbine generators (WTG) and/or wind monitoring towers (WMT).

Project description

The Wallaby Creek Wind Farm includes the following:

- Up to 38 WTGs and a maximum tip height of 271.5 metres (m) above ground level (AGL). The highest WTG, 68, has an overall height of 690.8 m Australian Height Datum (AHD) / 2266.5 feet (ft) Above Mean Sea Level (AMSL).
- A 400-megawatt hour (MWh) Battery Energy Storage System (BESS)
- Ancillary infrastructure including access tracks, road upgrades, underground and overhead electricity cabling, substations, transmission lines and grid connection to the transmission network.
- Up to 3 WMTs located within the Project site, with a maximum height of 200 m.

Conclusions

Based on a comprehensive analysis and assessment detailed in this report, the following conclusions were made:

Planning considerations

1. The Project as proposed satisfies the Narromine Local Environmental Plan 2011 as it will not create incompatible intrusions or compromise the safety of existing airports and associated navigation and communication facilities.

Certified airports

2. The Project would be located within 30 nautical mile(nm) (55.56 km) of two Certified airports – Narromine Airport (YNRM) and Dubbo City Regional Airport (YSDU)
3. The Project would be infringe the Narromine Airport's PANS-OPS surface related to the 10 nm Minimum Sector Altitude (MSA)
4. The Project would infringe the Dubbo City Regional Airport's GNSS Arrival
5. The Project would be located beyond the horizontal extent of circling areas at Narromine Airport and Dubbo City Regional Airport
6. Narromine Airport's RNP RWY 11 PANS-OPS surfaces would not be infringed by WTGs
7. The Project would be located outside the horizontal extent of obstacle limitation surfaces (OLS) of certified aerodromes.

Uncertified aerodromes (Aircraft Landing Areas - ALAs)

8. The Project would located more than 3 nm from all Uncertified aerodromes.

Air Routes and Lowest Safe Altitude (LSALT)

9. The WTGs would not infringe the Grid LSALT
10. The WTGs would not impact the LSALT related to several air routes surrounding the project

Airspace

11. The Project would be located outside of controlled airspace (Class G airspace) and Special Use Airspace.

Aviation Navigation Facilities

12. The Project WTGs would not infringe any protection areas associated with aviation navigation facilities.

Air traffic control (ATC) Radar

13. The Project site would be located outside of the area of interest for assessment of potential impacts on surveillance radar and will not impact any ATC radars.

Aviation Impact Statement (AIS)

Based on the proposed Project WTG layout and maximum blade tip height of 271.5 m AGL, the highest wind turbine (WTG 68) would not exceed 690.8 m (2266.5 ft AMSL).

The Project site WTGs:

- Would not infringe any OLS surfaces
- Would not infringe any circling areas
- Would infringe the YNRM 10 nm MSA surfaces but can be mitigated
- Would not infringe the YNRM 25 nm MSA surfaces
- Would not infringe the YSDU 10 nm or 25 nm MSA surfaces
- Would not infringe the YNRM RNP RWY 11
- Would infringe GNSS Arrival at YSDU
- Would not have an impact on operations of nearby uncertified aerodromes
- Would not infringe the Grid LSALT
- Would not infringe the following air route LSALT – W535 and W638
- Would be outside the clearance zones associated with civil aviation navigation aids and communication facilities
- Would be located outside of controlled airspace (wholly within Class G airspace) and not located in any Prohibited, Restricted or Danger areas
- The WTGs would not impact on the closest ATC radar installations
- The WTGs must be reported to CASA and construction details provided to Airservices

Obstacle lighting risk assessment

- Aviation Projects has undertaken a safety risk assessment of the Project and concludes that WTGs and WMTs located in the vicinity of WTGs would not require obstacle lighting to maintain an acceptable level of safety to aircraft
- Over the 17-year period between 2010-2026 and subsequently, no aircraft collided with a WTG or a WMT in Australia
- There is no regulatory requirement to mark or light power poles or overhead transmission lines for this Project.

Consultation

An appropriate and justified level of consultation was undertaken with relevant parties. Refer to Section 5 for details of the stakeholders and a summary of the consultation.

Summary of key recommendations

Recommended actions resulting from the conduct of this assessment are provided below.

Notification and reporting

1. Details of WTGs 100 m or more AGL must be reported to CASA *as soon as practicable after forming the intention to construct or erect the proposed object or structure,* in accordance with CASR Part 139.165(1)(2). The notification should be provided to CASA via email to Airspace.Protection@casa.gov.au.
2. 'Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, by submitting the form at this webpage: https://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf to the following email address: vod@airservicesaustralia.com .
3. Any obstacles 100 m or more AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
    a. The planned operational timeframe and maximum height of the crane; and
    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
4. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations.
5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs, WMTs and overhead transmission lines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

Marking of WTGs

6. The rotor blades, nacelle, and supporting mast of the WTGs should be painted a low-reflective white or off-white, as is typical of most WTGs operational in Australia. No additional marking measures are required for WTGs.

Marking of WMTs

7. It is not mandatory to mark the WMTs however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:
    a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour
    b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and
    c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation

Lighting of WTGs

8. Based on the risk assessment conducted in Section 9:
    a. No lighting is required on WTGs.
9. Based on NSW Wind Energy Guideline:
    a. If turbines and WMTs are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter)
    b. lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.

Lighting of WMTs

10. Consideration should be given to lighting temporary WMTs installed prior to WTG installation and permanent WMTs that are not in close proximity to a WTG with medium intensity steady red obstacle lighting at the top of the WMT mast. Characteristics for medium-intensity obstacle lighting are contained in MOS 139, Section 9.33.

Micrositing

11. Providing the micrositing is within 318.3 m of the WTGs and 250 m of the WMTs is likely to not result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this AIA would remain the same.

Overhead transmission line

12. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with CASR Part 139 MOS Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

Triggers for review

13. Triggers for review of this risk assessment are provided for consideration:
    a. Prior to construction to ensure the regulatory framework has not changed
    b. Following any significant changes to the context in which the assessment was prepared, including the regulatory framework
    c. Following any near miss, incident or accident associated with operations considered in this risk assessment.

1. INTRODUCTION

1.1. Situation

ERM is assisting Acciona to secure approvals to develop the Wallaby Creek Wind Farm (the Project), located approximately 10 km south of Narromine in New South Wales.

ERM has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) for the Project to support the proposed application and formally consult with aviation agencies.

This AIA assesses the potential aviation impacts created by the Project, provides aviation safety advice in respect of relevant requirements of air safety regulations and procedures, and informs and documents consultation with relevant aviation agencies.

This AIA report includes an Aviation Impact Statement (AIS) required by Airservices Australia and a qualitative risk assessment to inform the need for obstacle lighting.

1.2. Purpose and Scope

The purpose and scope of work is to:

- Prepare an AIA to allow Acciona to understand the aviation environment surrounding the Project
- For consideration by Airservices Australia, CASA and Department of Defence; and
- To support the development application.

The AIA specifically responds to the following key legislation, approvals, and guidance material:

- National Airspace Safeguarding Framework Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers* effective July 2012
- NSW DPE SSD SEARS (SSD-60247211)
- Civil Aviation Safety Authority (CASA) CASR Part 139 (Aerodromes) Manual of Standards
- Specific requirements as advised by Airservices Australia.

1.3. Methodology

Aviation Projects conducted the task in accordance with the following methodology:

- Confirmed the scope and deliverables with Acciona (or representative)
- Attended on-line kick-off meetings and other meetings as invited
- Reviewed client material
- Conducted a site visit to properly investigate aviation safety aspects of the proposed Project
- Review relevant regulatory requirements and information sources
- Prepared a draft AIA and supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified
- Included an AIS for assessment by Airservices Australia

- Included a qualitative risk assessment to determine need for obstacle lighting and marking that identifies risk mitigation strategies that could provide an acceptable alternative to night lighting. The risk assessment will be completed following the guidelines in *ISO 31000:2018 Risk Management – Guidelines*
- Consulted with aviation regulators, Airservices Australia and the Department of Defence
- Consulted with relevant aerodrome operators to seek endorsement of the proposal to change instrument approach procedures (if applicable)
- Consulted/engaged with aviation stakeholders to negotiate acceptable outcomes (if required)
- Finalised the AIA report for client acceptance when responses received from stakeholders for client review and acceptance.

1.4. Aviation Impact Statement (AIS)

The AIS included in this report (see Section 6) includes the following specific requirements as advised by Airservices Australia:

Aerodromes:

- Specify all certified aerodromes that are located within 30 nm (55.6 km) of the Project site
- Nominate all instrument approach procedures at these aerodromes
- Review the potential effect of the Project operations on the operational airspace of the aerodrome(s).

Air Routes:

- Nominate air routes published in AIP which are located near/over the Project site and review potential impacts of Project operations on aircraft using those air routes
- Specify two waypoint names located on the routes which are located before and after the obstacles.

Airspace:

- Nominate the airspace classification – A, C, D, E, G etc where the Project site is located.

Navigation/Radar:

- Nominate radar navigation systems with coverage overlapping the site.

1.5. Material reviewed

Material provided by Acciona for preparation of this assessment include:

- Wallaby Creek Synposis.pdf
- WTGS: IPAUSNSWXXWCR241111.shp
- WCWF_EIS_AOI_20241205.shpWMTs: 20240515_PCV.shp

2. BACKGROUND

2.1. Site overview

The Project site boundary is located approximately 10 km south of Narromine in New South Wales.

An overview of the Project site relative to Narromine, NSW is provided in Figure 1 (source: ERM, Google Earth).

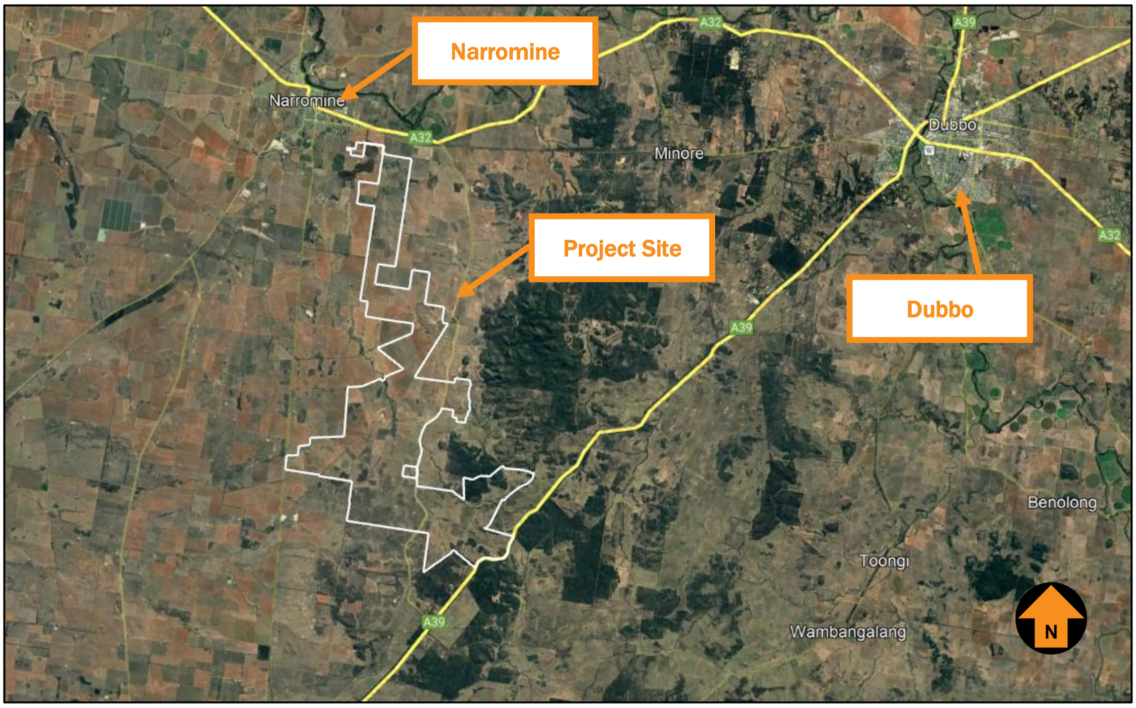


Figure 1 Project site overview

2.2. Project Description

The Project involves the construction, operation, maintenance and decommissioning of the Wallaby Creek Wind Farm, including a final layout of up to 38 WTGs providing a generating capacity of approximately 236 MW with associated electrical and ancillary infrastructure.

WTGs will have blade lengths of up to approximately 91.5 m, with maximum tip heights of 271.5 m AGL.

Based on the proposed Project WTG layout and maximum blade tip height of 271.5 m AGL, the highest wind turbine (WTG 68) will not exceed 690.8 m (2266.5 ft AMSL).

3. EXTERNAL CONTEXT

3.1. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by Commonwealth Department of Infrastructure, Transport, Regional Development, Communications and the Arts to develop a national land use planning framework called the National Airports Safeguarding Framework (NASF). The purpose of the NASF is to enhance the current and future safety, viability, and growth of aviation operations at Australian airports through:

- The implementation of best practice in relation to land use assessment and decision making in the vicinity of airports
- Assurance of community safety and amenity near airports
- Better understanding and recognition of aviation safety requirements and aircraft noise impacts in land use and related planning decisions
- The provision of greater certainty and clarity for developers and landowners
- Improvements to regulatory certainty and efficiency
- The publication and dissemination of information on best practice in land use and related planning that supports the safe and efficient operation of airports.

NASF Guideline D: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers*, provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers.

3.2. Narromine Shire Council

The Narromine Shire Council published the Narromine Local Environmental Plan 2011, which includes guidelines and performance outcomes for airspace operations to ensure new developments do not create incompatible intrusions or compromise the safety of existing airports and associated navigation facilities.

6.9 Airspace operations

1) *The objectives of this clause are as follows:*
    a. *to provide for the effective and ongoing operation of the Narromine Aerodrome by ensuring that such operation is not compromised by proposed development that penetrates the Limitation or Operations Surface for that airport,*
    b. *to protect the community from undue risk from that operation.*
2) *If a development application is received and the consent authority is satisfied that the proposed development will penetrate the Limitation or Operations Surface, the consent authority must not grant development consent unless it has consulted with the relevant Commonwealth body about the application.*
3) *The consent authority may grant development consent for the development if the relevant Commonwealth body advises that:*

a. the development will penetrate the Limitation or Operations Surface but it has no objection to its construction, or

b. the development will not penetrate the Limitation or Operations Surface.

4) The consent authority must not grant development consent for the development if the relevant Commonwealth body advises that the development will penetrate the Limitation or Operations Surface and should not be constructed.

5) In this clause:

Limitation or Operations Surface means the Obstacle Limitation Surface or the Procedures for Air Navigation Services Operations Surface as shown on the Obstacle Limitation Surface Map or the Procedures for Air Navigation Services Operations Surface Map for the Narromine Airport.

3.3. CASA recommendation

CASA provided feedback on the AIA report on 11 November 2024, which includes:

This CASA assessment is made in accordance with the National Airports Safeguarding Framework (Guideline D) as developed by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts, to provide planning advice to State and Local Planning Authorities.

With regards to Visual Flight Rules (VFR) operations, pilots are permitted to fly as low as 500 ft AGL (ie, terrain). The WTGs will reach up to a maximum height of approximately 280 m (919 ft) AGL.

CASA agrees with the Recommendations at Section 11 of the Aviation Impact Assessment.

However, CASA considers the proposed wind farm will be a hazard to aviation safety and recommends that the wind farm is obstacle lit with steady medium-low intensity red obstacle lighting in accordance with the National Airports Safeguarding Framework Guideline D 'Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation' National Airports Safeguarding Framework Principles and Guidelines (infrastructure.gov.au) and section 9.31 of Part 139 Aerodromes Manual of Standards Part 139 (Aerodromes) Manual of Standards 2019 (legislation.gov.au) (lower level lights on the turbine support columns are not essential).

International standards require 2,000 candela lighting intensity on the nacelle (also recommended in the NASF guideline) and 200 candela at the mid-point of the turbine mast. CASA recommends that 200 candela as a minimum intensity lighting on the nacelle would suffice (due mainly to the lack of background lighting in the vicinity of the turbines). The obstacle lighting should be monitored to alert the wind farm operator of any outage and some of the obstacle lights remain on during an outage. CASA is prepared to review a lighting plan that indicates which turbines are proposed to be lit.

As the Aviation Safety regulator, CASA does not consider the visual impact of obstacle lighting on neighbours / homesteads / the dark sky. However, there are mitigations for visual impact such as baffling and intensity control (as described in the Aviation Impact Assessment Table 10 / Page 49 'Effect of obstacle lighting on neighbours' and page 7 of Annexure 3 'Regulatory Requirements – Lighting and Marking').

3.4. Advice from DPHI on aviation

DPHI provides advice on the Mallee Wind Farm on 23 January 2025, which includes:

Aviation hazard lighting: prepare an Aviation Lighting Plan for the project as per the recommendations made by the Civil Aviation Safety Authority (CASA) in their advice dated 11 November 2024. The Aviation Lighting Plan should:

- *consider measures to minimise the amenity impacts of lighting;*
- *identify the type of lighting management system proposed (e.g. permanent fixtures or motion sensor/radar detection systems) and include a detailed lighting plan; and*
- *identify measures to ensure obstacle lights always remain lit as indicated in the lighting management system in a fail-safe mode, and any disruption or outages are minimised to the extent practicable through documented contingency arrangements.*

3.5. Civil Aviation Safety Authority (CASA)

The following CASA publications inform pilots of their obligations at non-certified ALAs in uncontrolled airspace.

3.5.1. Advisory Circular (AC) 91-02 V1.2, Guidelines for aeroplanes with MTOW not exceeding 5700 kg – suitable places to take off and land, dated November 2022

This AC provides guidance for pilots of:

- Aeroplanes with maximum take-off weight (MTOW) not exceeding 5700 kg that are operated under Part 91 of CASR, including experimental aircraft, and
- Light sport aircraft (LSA) under Part 103 of CASR.

Purpose

This AC provides guidance to assist aeroplane pilots when determining the suitability of a place to safely take off and land. It provides an overview of pilot responsibilities, discusses the relevant circumstances recommended to be considered and includes general information and advice to enhance the safety of taking off and landing at any place.

2 Introduction

2.2 Use of Aerodromes

2.2.1 Regulation 91.410 authorises a place for use as an aerodrome if: (i) it is suitable for the landing and taking-off of aircraft; and (ii) an aircraft can land at or take off from the place safely, having regard to all the circumstances of the proposed landing or take-off (including the prevailing weather conditions).

3.3 Performance Information

3.3.1 The AFM, POH, owner's manual or placarding should provide relevant performance information, but presentations are not standardised. Learning how to find and interpret a particular aircraft's performance information should be part of a pilot's familiarisation with the aeroplane.

4 Information about aerodrome publications

4.1.3 There are no standards for aerodromes that are not certified (listed in the En Route Supplement Australia (ERSA) as an uncertified aerodrome), but noting regulation 91.410 requires the aerodrome to be suitable. CASA has published recommended criteria for landowners or operators of these aerodromes, but these recommendations are guidelines only.

4.2.2 The ERSA only provides limited information for uncertified aerodromes and these aerodromes are not subject to NOTAM action, except in certain circumstances (refer to the ERSA for further details).

4.2.3 Take-off and landing guides are also commercially available which provide information for pilots about many aerodromes not included in the ERSA. Pilots should note that the information in these guides may not be subject to regular updating, and these aerodromes are not supported with NOTAM information. Pilots should therefore consider ways of mitigating the risk of such a document's information being out of date or inaccurate.

4.2.4 The examples below are two of many possible considerations:

- the obstacles surrounding the aerodrome have been accurately described and are still current (e.g. have the trees on final grown taller since last reported), and

– the information provided enables the pilot to judge whether or not a landing approach can be made from both runway directions.

5 Permission to operate

5.1.1 Pilots and operators must consider ownership and management requirements for aircraft operations into any aerodrome. Unless a landing place is unambiguously open for public use for aviation purposes, the pilot should assume that permission is required from the land owner or occupier before using land or water for take-off and landing.

3.5.2. AC 91-10 v1.6, Operations in the vicinity of non-controlled aerodromes, dated September 2025

This AC provides guidance on procedures that, when followed, will improve situational awareness and safety for all pilots when flying at, or in the vicinity of, non-controlled aerodromes.

7.2 Traffic circuit direction

7.2.1 The standard aerodrome traffic circuit facilitates the orderly flow. Unless an alternative requirement for an aerodrome is stated in the ERSA or NOTAMs, all turns must be made to the left (regulation 91.385).

7.2.2 When arriving at an aerodrome to land, the pilot will normally join the circuit on upwind, crosswind (midfield), or at or before mid-downwind. Landings and take-offs should be made on the preferred runway.

7.3.2 During initial climb-out, the turn onto crosswind should be appropriate to the performance of the aircraft but, in any case, not less than 500 ft above terrain so as to be at circuit height when turning downwind (regulation 91.390). Pilots may vary the size of the circuit depending on:

– the performance of the aircraft

– AFM/Pilot's Operating Handbook requirements

– company standard operating procedures

– other safety reasons.

7.8 Final approach

7.8.1 The turn onto final approach should be:

– completed by a distance and height that is common to all operations at the aerodrome

– commensurate with the speed flown in the circuit for all aircraft of the same type.

Illustrations of the standard aerodrome traffic circuit procedures provided in AC 91-10 v1.6. are shown in Figure 2 and Figure 3.

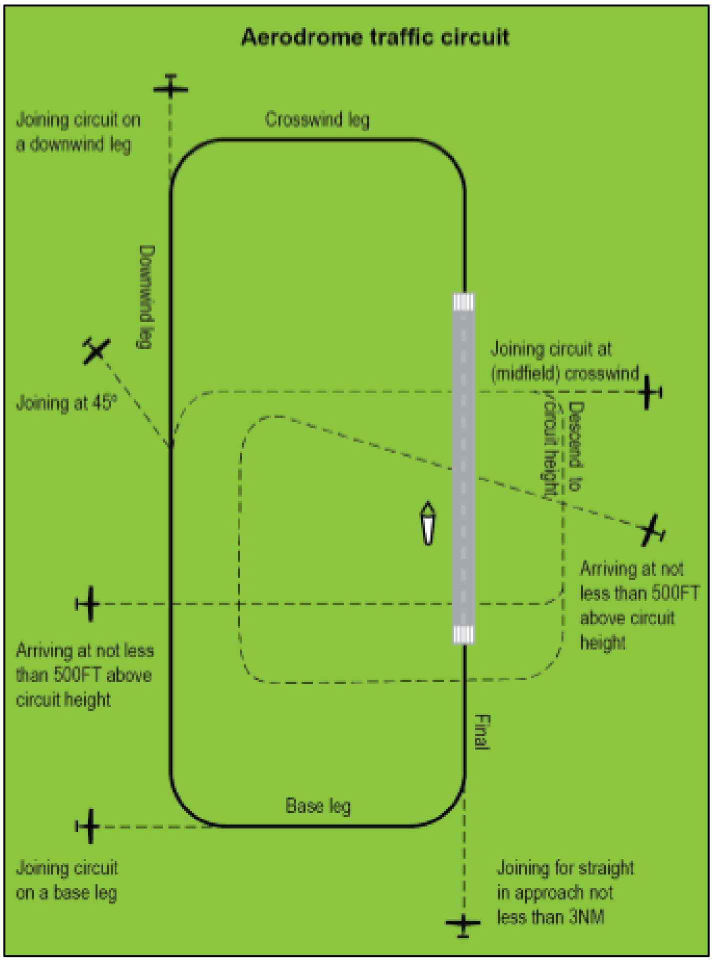


Figure 2 Aerodrome standard traffic circuit, showing arrival and joining procedures.

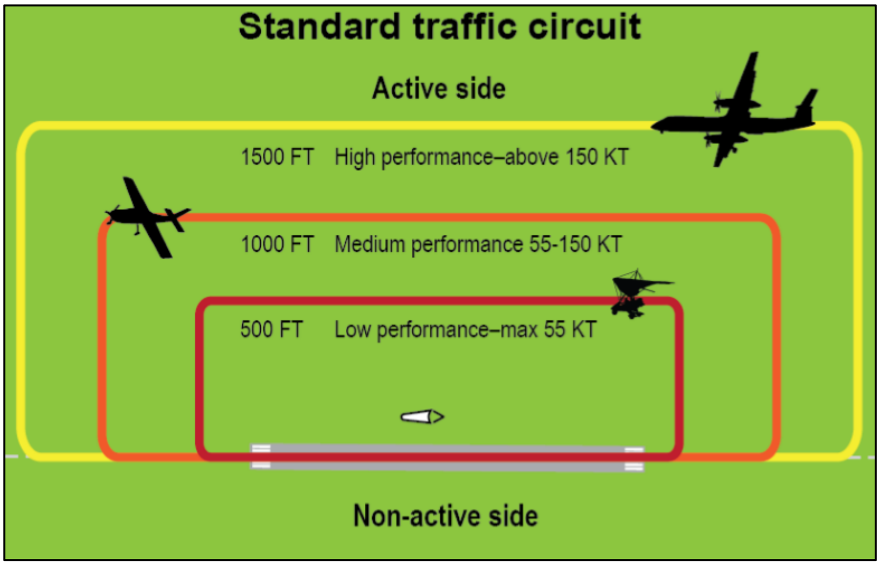


Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

Paragraph 7.11 refers to a distance that is "normally" well outside the circuit area and where no traffic conflict exists, which is at least 3 nm. The paragraph is copied below:

> *7.11 Departing the circuit area*
>
> *7.11.1 Aircraft should depart the aerodrome circuit area by extending one of the standard circuit legs or climbing to depart overhead. However, the aircraft should not execute a turn to fly against the circuit direction unless the aircraft is well outside the circuit area and no traffic conflict exists. This should be 500 ft or more above the circuit height and at least 3 NM from the departure end of the runway but may be less for aircraft with high climb performance. In all cases, the distance should be based on the pilot's awareness of traffic and the ability of the aircraft to climb above and clear of the circuit area.*

3.6. Rules of flight

3.6.1. Flight under Day Visual Flight Rules (Day VFR)

According to Australia's Aeronautical Information Package (AIP) the meteorological conditions required for visual flight in the applicable (class G) airspace at or below 3,000 ft AMSL or 1,000 ft AGL (whichever is the higher) are: 5,000 m visibility, clear of clouds and in sight of ground or water.

CASR 91.267 (Minimum height rules—other areas) prescribes the minimum height for flight. Generally speaking, and unless otherwise approved, aircraft are restricted to a minimum height of 500 ft AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas, and 1000 ft AGL over built up areas (within a horizontal radius of 600 m of the point on the ground or water immediately below the aeroplane). Flight below these height restrictions is also permitted in certain other circumstances.

3.6.2. Flight under Night Visual Flight Rules (Night VFR)

With respect to flight under the VFR at night CASR 91.277 requires that the pilot in command of an aircraft flying VFR at night must not fly below the appropriate lowest safe altitude (unless during take-off and landing operations, within 3 nm of an aerodrome).

3.6.3. Flight under Instrument Flight Rules (Day or Night) (IFR)

According to CASR 91, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method.

Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

3.7. Aircraft operator characteristics

Flying training may be conducted under either the IFR or VFR. Other general aviation operations under either IFR or VFR are also likely to be conducted at various aerodromes in the area.

Flight under day VFR is conducted above 500 ft above the highest point of the terrain within a 300 m radius unless the operation is approved to operate below 500 ft above the highest point of the terrain.

It is expected that the proposed WTGs will be sufficiently visually conspicuous to pilots conducting VFR operations within the vicinity of the Project Site to enable appropriate obstacle avoidance manoeuvring.

IFR and Night VFR (which are required to conform to IFR applicable altitude requirements) aircraft operations are addressed in Section 6.

3.8. Passenger transport operations

Scheduled and non-scheduled passenger transport operations are generally operated under the IFR.

3.9. Private operations

Private operations are generally conducted under day or night VFR, with some IFR. Flight under day VFR is conducted above 500 ft AGL in areas outside city and township built-up areas. These operations are usually conducted at altitudes well above 500 ft AGL for passenger comfort and fuel efficiency.

3.10. Military operations

There may be some high-speed low-level military jet aircraft and helicopter operations conducted in the area. Military operations are conducted under separate but compatible regulations and standards, including obstacle separation requirements.

Refer to Section 5 for a detailed response from the Department of Defence after consultation has been completed.

3.11. Aerial application operations

Aerial application operations including such activities as fertiliser, pest and crop spraying are generally conducted under day VFR below 500 ft AGL: usually between 6.5 ft and 100 ft AGL.

Due to the nature of the operations conducted, aerial agriculture pilots are subject to rigorous training and assessment requirements to obtain and maintain their licence to operate under these conditions.

3.11.1. Aerial Application Association Australia (AAAA)

The Aerial Application Association Australia (AAAA) is the national peak advocacy and membership organisation for aviation companies, pilots and support staff who undertake aerial application work. The AAAA has a formal risk management program (which is recommended for use by its members) to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

In previous consultation with the AAAA, Aviation Projects has been directed to the *AAAA Fact Sheet Wind Turbines and Aerial* Application, dated August 2025, and the AAAA Tall Structures Policy.

The *AAAA Fact Sheet Wind Turbines and Aerial Application* outlines some considerations for operators completing aerial application near wind farms and the wind farm developers. This includes:

> *What are the issues?*
>
> - *Collision: Wind turbines pose a collision risk for aircraft operating at low altitudes (defined as below 500 feet above ground level). This is the height aerial application and firebombing aircraft operate at. Emergency aircraft (police, ambulance, search and rescue) also regularly operate below 500ft for emergency operation conditions. These operations can occur 24 hours per day.*
> - *Blade rotation: Agricultural application is conducted when wind speed is between 3km/h and 20 km/h. Turbines typically start turning at around 11km/h but can turn at lower speeds. Blade rotation causes both distraction and collision risk. As such, any aerial application in a wind farm should only take place when the wind turbine blades have been locked in the "rabbit ears" (one blade aligned with the tower structure and two above the tower) position.*
> - *Associated infrastructure: Wind turbines require powerlines, transformer yards and meteorological towers. These all create collision risks. Meteorological towers are considered to be the most significant risk to low level flight as they are typically difficult to see and discern from the surrounding areas.*
> - *Best placement for Agricultural outcomes: Like every part of the farm, placement of a non-moving piece of infrastructure has some impact. Working with the developer can ensure that paddocks can be managed. Make sure that turbines are placed where aircraft and ground machinery can manoeuvre cleanly around the structure. Every additional manoeuvre costs, so placement to ensure long runs and easy turn areas is vital.*
>
> *Managing Collision Risk*
>
> *All tall structures need to be marked in accordance with AS3891.1:2021 and the Civil Aviation Safety Regulations Part 139. Conforming to these standards is of minimum cost during the construction phase and dramatically improves aviation safety.*
>
> *Once built – any aerial application in a wind farm should only take place when the wind turbine blades have been locked in the "rabbit ears" (one blade aligned with the tower structure and two above the tower) position.*

The AAAA *Tall Structures Policy*, dated March 2024, states in part:

> *The development of tall structures in agricultural and bush fire prone areas can pose a direct threat to aviation safety, particularly where fixed and rotary aircraft may be requested to operate for agricultural or bush/grass fire control.*
> *The absence of historical aircraft use in an area is considered an insufficient reason to discount the threat to Aviation Operations.*
>
> *The AAAA will oppose any development application or similar process unless the proponent has:*
> - *Identified the structure as posing a low-level flying risk that needs to be managed on an ongoing basis*
> - *Consulted honestly and in detail with local aerial application operators or the AAAA where a local operator cannot be identified*

- *Consulted with adjoining landowners regarding the impact on adjacent properties*
- *Included appropriate lighting and marking in the development proposal, consistent with providing a warning to low level flying*
- *Identified the process for advising of the location height and presence of the structure to the relevant authorities, and*
- *Ensure that the proposal is in keeping with CASA requirements for structures near aerodromes, including temporary landing areas.*

3.11.2. Aerial application operators

Local aerial application operators consulted in previous studies undertaken by Aviation Projects have stated that a wind farm would, in all likelihood, prevent aerial agricultural operations in that particular area, but that properties adjacent to the wind farm would have to be assessed on an individual basis.

Aerial application operators generally align their positions with the AAAA policies, and the utilise the AAAA formal risk management programme.

Based on previous studies for other wind farm projects undertaken by Aviation Projects, and the results of consultation with AAAA and local aerial application operators, it is reasonable to conclude that safe aerial application operations would be possible on properties within the Project site and on neighbouring properties, subject to final WTG locations and by implementing recommendations provided in this report at Section 12.

To facilitate the flight planning of aerial application operators, details of the Project, including location and height information of WTGs, WMTs and overhead powerlines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

The use of helicopters enables aerial application operations to be conducted surrounded by obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

3.12. Emergency services

3.12.1. Royal Flying Doctor Service

Royal Flying Doctor Service (RFDS) and other emergency services operations are generally conducted under the IFR, except when arriving/departing a destination that is not serviced by instrument approach aids or procedures, in which case they would be operating day or night VFR.

Most emergency aviation services organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

For example, pilots and crew require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

3.12.2. Aerial firefighting

Aerial firefighting operations (firebombing in particular) are conducted under Day VFR, sometimes below 500 ft AGL. Under certain conditions visibility may be reduced/limited by smoke/haze.

Most aerial firefighting organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained. For example, pilots require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

The Australian and New Zealand Council for fire and emergency services (AFAC) has developed a national position on wind farms, their development and operations in relation to bushfire prevention, preparedness, response and recovery, set out in the document titled *Wind Farms and Bushfire Operations*, version 3.0, dated 25 October 2018.

Of specific interest in this document is the section extracted from under the 'Response' heading, copied below:

> *Wind farm operators should be responsible for ensuring that the relevant emergency protocols and plans are properly executed in an emergency event. During an emergency, operators need to react quickly to ensure they can assist and intervene in accordance with their planned procedures.*
>
> *The developer or operator should ensure that:*
>
> - *liaison with the relevant fire and land management agencies is ongoing and effective*
> - *access is available to the wind farm site by emergency services response for on-ground firefighting operations*
> - *wind turbines are shut down immediately during emergency operations – where possible, blades should be stopped in the 'Y' or 'rabbit ear' position, as this positioning allows for the maximum airspace for aircraft to manoeuvre underneath the blades and removes one of the blades as a potential obstacle.*
>
> *Aerial personnel should assess risks posed by aerial obstacles, wake turbulence and moving blades in accordance with routine procedures.*

Aviation Projects consider that it may be impractical or unsafe to stop and lock the turbine blades in a Y configuration due to the time needed to stop and lock the turbine and the risk to personnel having to climb into the WTG tower as a bush fire approaches. Alternatively, WTG blades can be feathered to effectively stop or reduce the rotation rate of the turbine to a very slow speed..

4. INTERNAL CONTEXT

4.1. Wind farm site description

The Project boundary is located approximately 10 km south of Narromine in New Sales Wales, Australia.

The Project site is to comprise of up to 38 WTGs. The maximum blade tip height of the proposed WTGs will be 271.5 m above ground level (AGL).

The ground elevation for the highest WTG location (WTG 68) is 419.3 m AHD which with a 271.5 m WTG height, results in a maximum overall height of 690.8 m AHD / 2266.5 ft AMSL.

Figure 4 illustrates the Project layout identifying the highest WTG location, WTG 68 (source: ERM, Google Earth).

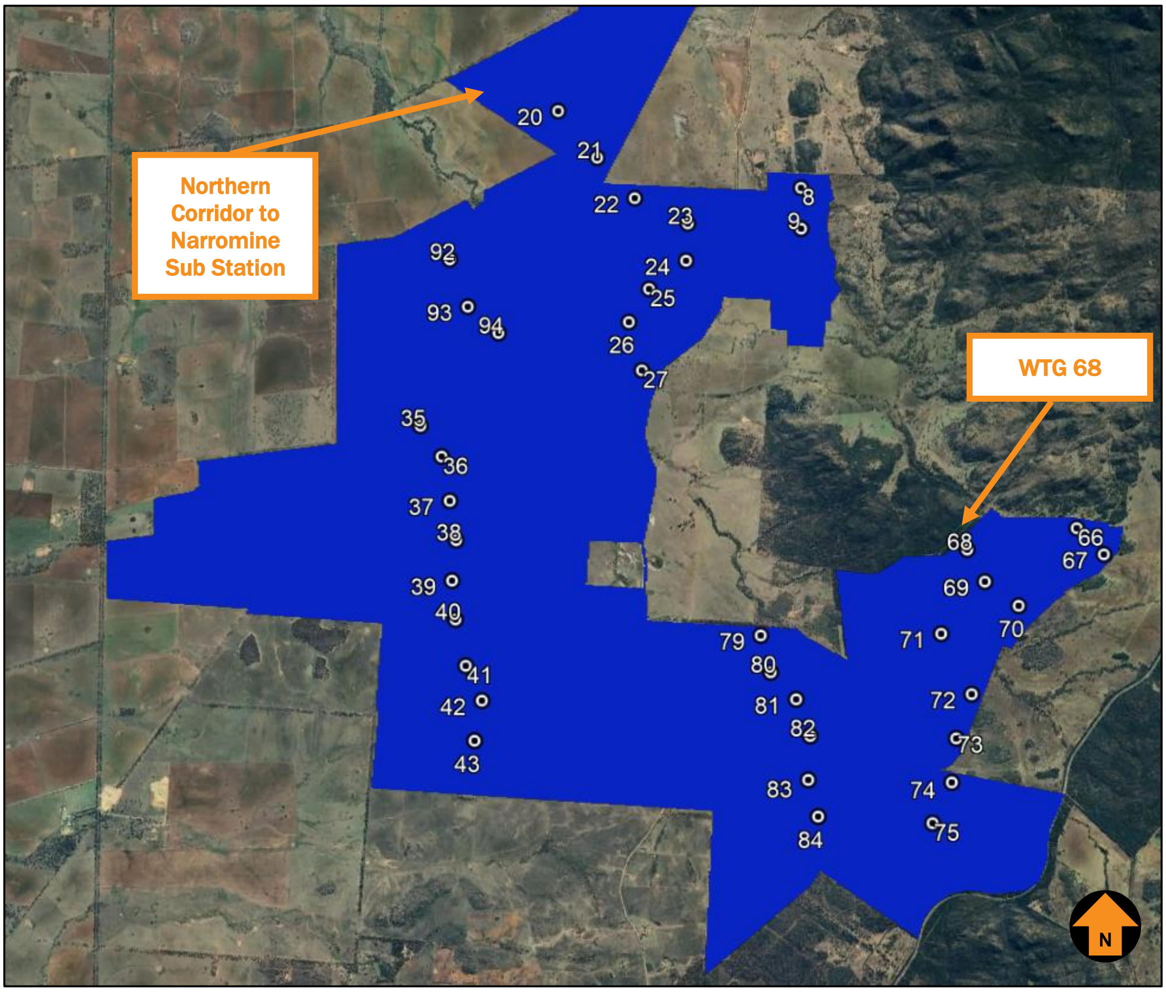


Figure 4 Project layout and highest WTG location

'Micrositing' of WTGs means an alteration to the siting of a WTG by not more than 318.3 m and any consequential changes to access tracks and internal power cable routes. The micrositing of the WTGs is not likely to result in a change in the maximum overall blade tip height of the Project.

4.2. Wind monitoring tower description

It is proposed to install up to 3 new WMTs. The location of the proposed WMTs are indicated in Figure 5 (Source: ERM, Google Earth).

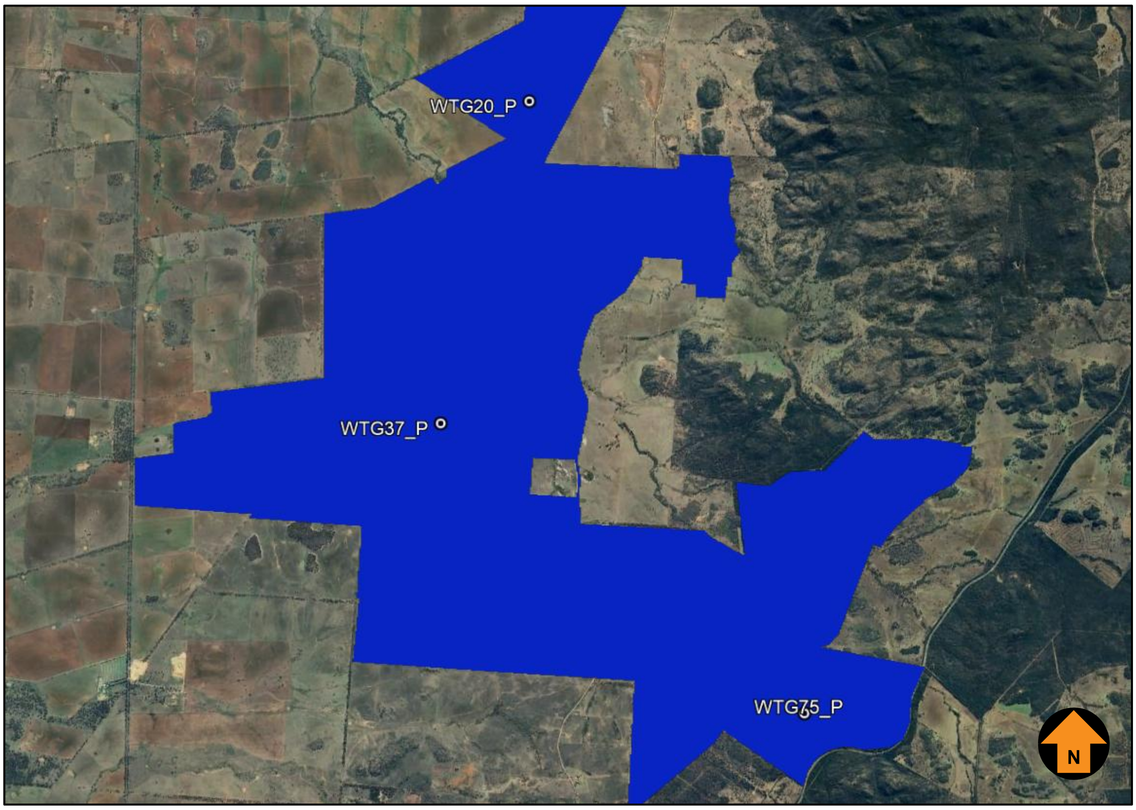


Figure 5 WMT Locations

5. CONSULTATION

The following list of stakeholders were identified as requiring consultation:

1. Airservices Australia
2. Department of Defence
3. Narromine Shire Council
4. Dubbo Regional Council / Dubbo City Regional Airport Management
5. Royal Flying Doctor Service
6. QantasLink – Airlines user of Dubbo Airport
7. Rex Regional - Airlines user of Dubbo Airport
8. Link Airway - Airlines user of Dubbo Airport

Aviation Projects will conduct the initial consultations and provide details and results of the consultation activities in Table 1.

Table 1 Stakeholder consultation details

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
Airservices Australia	Email sent on 7 January 2026	Email received on 11 January 2026	*I refer to your request for an Airservices assessment of the proposed activity at Wallaby Creek Wind Farm.* ***Airspace Procedures*** *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Doc 9905, at a maximum height of 690.9m (2267ft) AHD the wind farm will affect the GNSS arrival procedure at Dubbo aerodrome.* *The GNSS arrival, Sector A, between 14-15nm would need to increase from 2800ft to 3300ft or aligned with the initial minimum segment altitude of 3700ft for usability. This is not expected to adversely impact operations at Dubbo aerodrome.* *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Doc 9905, at a maximum height of 690.9m (2267ft) AHD the wind farm will affect the 10nm MSA at Narromine aerodrome.* *The 10nm MSA would need to increase from 3000ft to 3300ft. This would not impact the RNP RWY 11 procedure & is not expected to adversely impact operations at Narromine aerodrome.*	As this proposed activity is more than 30m (99ft) AGL, please follow the below notification process: 1. Complete the Vertical Obstacle Notification Form: ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf (airservicesaustralia.com) 2. Submit completed form to: VOD@airservicesaustralia.com as soon as the development reaches the maximum height. The proposed activity will penetrate the current Airservices-designed airspace procedures at Dubbo and Narromine aerodromes. Consult with the aerodrome and aviation operators to ensure that they accept the proposed changes. We need confirmation from the aerodrome operator before we will make any changes. All amendments to airspace procedures are made on a commercial basis.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			The maximum height of wind farm without affecting any procedures at Dubbo aerodrome is 548.6m (1800ft) AHD *The maximum height of wind farm without affecting any procedures at Narromine aerodrome is 614.4m (2016ft) AHD* *Note: Procedures not designed by Airservices at Dubbo or Narromine aerodrome were not considered in this assessment.* ***Communications/Navigation/Surveillance (CNS) Facilities*** *We have assessed the proposed activity to the above specified height for any impacts to Airservices Precision/Non-Precision Navigation Aids, Anemometers, HF/VHF/UHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding.* *Note: Meteorological instruments not owned by Airservices were not considered in this assessment. In accordance with Part 139 (Aerodromes) Manual of Standards, Chapter 19, we recommend consulting with the Bureau of Meteorology (the Bureau) to ensure that the proposed activity does not adversely affect their equipment. The Bureau can be contacted at airport.developments@bom.gov.au* ***Air Traffic Control (ATC) Operations*** *There are no additional instructions/concerns from ATC.*	

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			Vertical Obstacle Notification *As this proposed activity is more than 30m (99ft) AGL, please follow the below notification process:* *1. Complete the Vertical Obstacle Notification Form: ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf (airservicesaustralia.com)* *2. Submit completed form to: VOD@airservicesaustralia.com as soon as the development reaches the maximum height.* *For further information regarding the reporting of tall structures, please contact the VOD team:* • *Email - VOD@airservicesaustralia.com* • *Or refer to: Civil Aviation Safety Regulation Part 175 — Airservices and You - Airservices (airservicesaustralia.com)* ***Summary*** *The proposed activity will penetrate the current Airservices-designed airspace procedures and/or impact CNS facilities or ATC operations at Dubbo and Narromine aerodromes.* *Please consult with the aerodrome and aviation operators to ensure that they accept the proposed changes. We need confirmation from the aerodrome operator before we will make any changes.*	

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
			All amendments to airspace procedures are made on a commercial basis.	
Department of Defence	Email sent on 7 January 2026		On Going	
Narromine Shire Council	Email sent on 7 January 2026	Email received on 2 February 2026	*Sorry for the delay getting back to you. Thank you for sending this information through, we have spoken to our aviation consultant and they have recommended that we provide comment on the final report. The consultant believes that the review will cost approximately $5500 - $7500 which is a cost that we would expect Acciona to cover, as we do not have in-house expertise.* *If you would like some comments on the draft report, prior to finalising we are happy for our consultant to review, however, this will come at a small additional cost.* *Happy to discuss further if you want.*	No action required
Dubbo Regional Council / Dubbo City Regional Airport Management	Email sent on 7 January 2026		On Going	
Royal Flying Doctor Service	Email sent on 7 January 2026		On Going	

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
QantasLink	Email sent on 13 March 2026		On Going	
Rex Regional	Email sent on 13 March 2026	Email received on 17 March 2026	*Thank you for this information, as a user of Dubbo Airport, and as you have assessed: 'Would not infringe the Dubbo City Regional Airport 10 nm or 25 nm MSA surfaces.'* *For the RNP05 Approach to Dubbo: 'Would infringe GNSS arrival approach at Dubbo City Regional Airport'* *The RNP Approach Waypoint DBOWE is at 4100ft AMSL over the Windfarm with Turbines 8 (1970ft AMSL) & 9 (2056ft AMSL) closest to that point.* *I don't envisage any operational issues for REX at Dubbo Airport.*	No action required
Link Airway	Email sent on 13 March 2026		On Going	

6. AVIATION IMPACT STATEMENT

6.1. Overview

The NASF Guideline D: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides information to proponents and planning authorities to help identify any potential safety risks posed by WTG and WMTs from an aviation perspective.

Potential safety risks include (but are not limited to) impacts on flight procedures and aviation communications, navigation, and surveillance (CNS) facilities which require assessment by Airservices Australia.

To facilitate these assessments all wind farm proposals submitted to Airservices Australia must include an AIS.

This analysis considers the aeronautical impact of the WTGs on the following:

- The operation of nearby certified aerodromes
- The operation of nearby uncertified aerodromes (ALA)
- Grid and air route Lowest Safe Altitudes (LSALTS)
- Airspace protection
- Aviation facilities
- Radar installations
- Local aircraft operations.

6.2. Nearby certified aerodromes

The Project area is located within 30 nm (55.56 km) of two certified airports – Narromine Airport (YNRM) and Dubbo City Regional Airport (YSDU).

The location of the Project site relative to Narromine Airport (YNRM) and Dubbo City Regional Airport (YSDU) is shown in Figure 6 (Source: ERM, Google Earth).

The orange circle around each airport represents a distance of 30 nm from the aerodrome reference point of each airport.

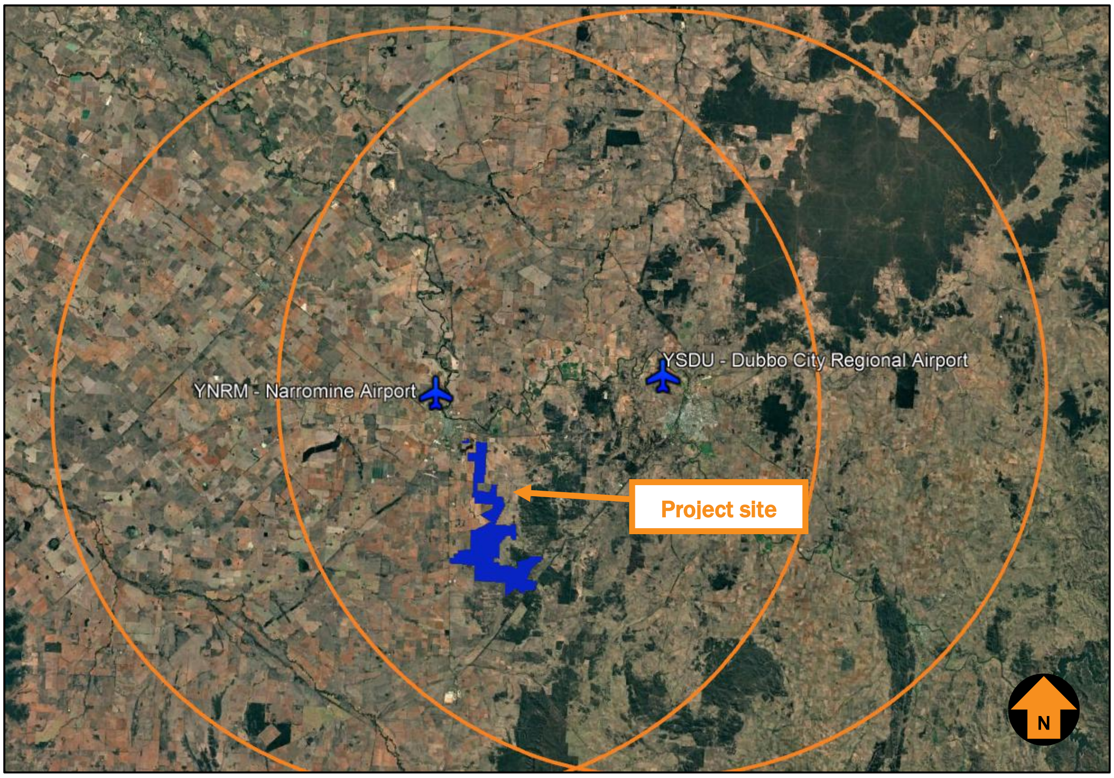


Figure 6 Location of Certified Airports in relation to Project Area

6.2.1. Narromine Airport

Narromine Airport is a certified aerodrome.

It is operated by Narromine Shire Council with a published aerodrome elevation of 238.4 m AHD (782 ft AMSL) (source: Airservices Australia, FAC, dated 19 March 2026).

Narromine Airport has four main runways:

- Runway 04/22 is a sealed runway 1100 x 30 m and runway strip 90 m
- Runway 11/29 is a sealed runway 1521 m x 30 m and runway strip 90 m.

Narromine also has six runways used for gliding operations. These strips run alongside the paved runway with the exception of runway 18 / 36 which is located to the north of the sealed runway:

- Runway 04/22 is a gliding strip 1042 x 90 m
- Runway 11/29 is a gliding strip 812 x 60 m
- Runway 18 / 36 is a gliding strip 848 x 90 m.

Figure 7 shows the runway layout of Narromine Airport (source: Airservices Australia, Aerodrome Chart, 19 March 2026).

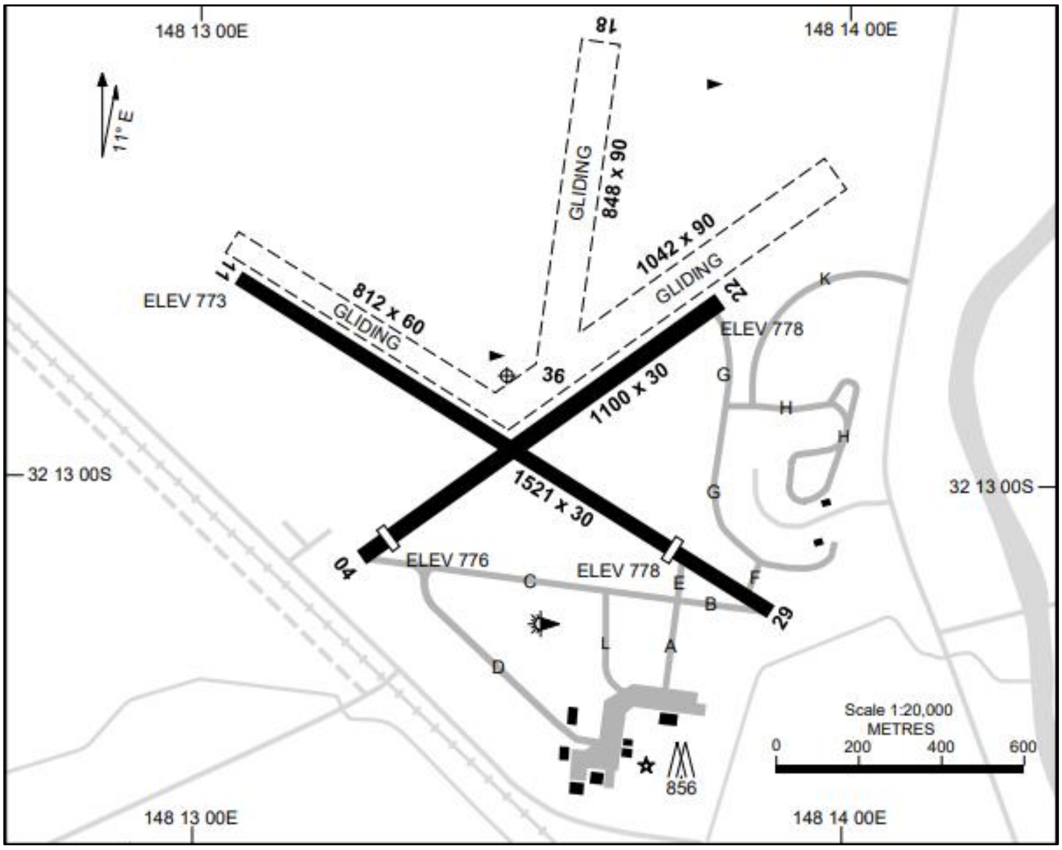


Figure 7 Narromine Airport (YNRM) runway layout

Narromine Airport's aerodrome reference point (ARP) coordinates published in Airservices Australia's Designated Airspace Handbook (DAH) are Latitude 32°12'52"S and Longitude 148°13'29"E.

6.2.2. Instrument approach procedures

A check of the AIP via the Airservices Australia website showed that Narromine Airport is served by one non-precision instrument flight procedures (source: Airservices Australia, effective 19 March 2026). Table 2 identifies the aerodrome and procedure charts for Narromine Airport.

Table 2 Narromine Airport (YNRM) aerodrome and procedure charts

Chart name	*Effective date*
AERODROME CHART	04 September 2025 (Am 184)
RNP RWY 11	19 March 2026 (Am 186)

6.2.3. MSA surfaces

The minimum sector altitudes (MSA) are applicable for each instrument approach procedure at Narromine Airport. An image of the MSA published for Narromine Airport is shown in Figure 8 (source: Airservices Australia, 19 March 2026).

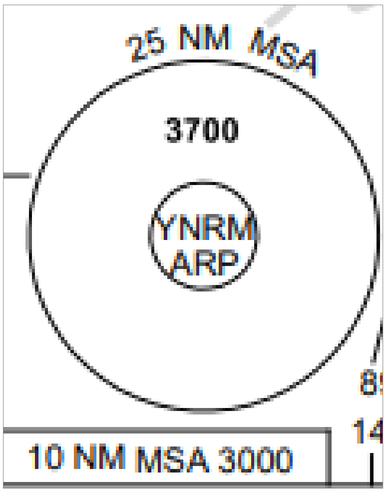


Figure 8 MSA at Narromine Airport

The Manual of Standards 173 Standards Applicable to Instrument Flight Procedure Design (MOS 173), requires that a minimum obstacle clearance (MOC) of 300 m / 984 ft above the highest terrain or obstacle within the MSA areas.

Obstacles within 15 nm (10 nm MSA + 5 nm buffer) and within 30 nm (25 nm MSA + 5 nm buffer) of the Narromine Airport ARP define the height at which an IFR aircraft can fly when within 10 nm and 25 nm and when weather conditions do not allow the pilot to see the ground.

Sections of the proposed Project are within the 25 nm MSA and the 10 nm MSA areas of Narromine Airport. The orange and red circles represent distances of 30 and 15 nm from the ARP of Narromine Airport respectively, as shown in Figure 9 (Source: ERM, Google Earth).

The 10 nm MSA has an elevation of 914.4 m AHD / 3,000 ft AMSL with a PANS-OPS surface elevation of 614.4 m AHD / 2,016 ft AMSL. WTG 68 at a maximum elevation of 690.8 m AHD /2266.5 ft AMSL, infringes the 10 nm MSA by 76.4 m / 250.5 ft. MSAs may only be increased in increments of 100 ft, as such the 10nm MSA for Narromine will need to be raised by 91.44 m / 300 ft

The 25 nm MSA has an elevation of 1127.8 m AHD / 3700 ft AMSL with a PANS-OPS surface elevation of 827.8 m AHD / 2716 ft AMSL. No WTG infringes the 25 nm MSA.

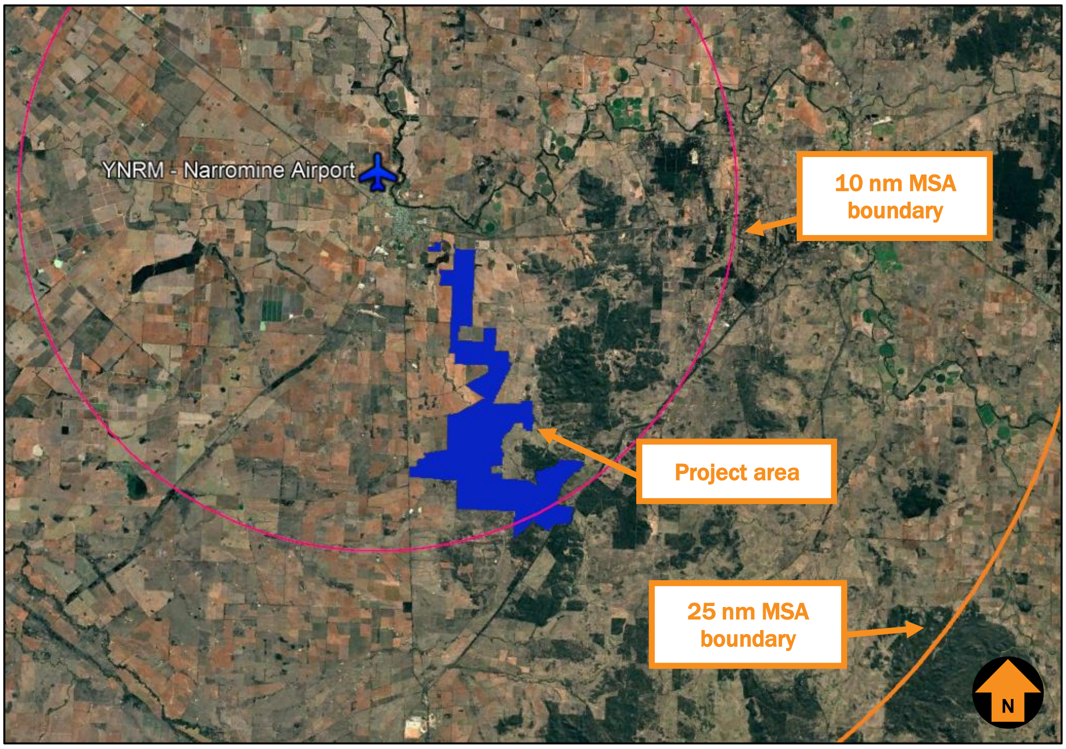


Figure 9 Narromine Airport MSA

An impact analysis of Narromine Airport's MSA is provided in Table 3

Table 3 Narromine Airport MSA Impact analysis

MSA	*Minimum altitude*	*Protection surface*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
10 nm	3000ft AMSL	2016 ft AMSL	WTG 68 infringes the 10 nm MSA by 250.5 ft	Increase 10 nm MSA by 300 ft to 3300 ft	Minor
25 nm	3700 ft AMSL	2716 ft AMSL	Nil Impact	N/A	Nil Impact

The 10 nm MSA for Narromine Airport would need to be increased by 300ft to 3300ft.

To raise the 10 nm MSA for Narromine Airport, the aerodrome operator (Narromine Shire Council) is required to provide written permission to Airservices Australia to action the change.

Raising the 10 nm MSA by 300 ft will not have an adverse impact on the operations at Narromine Airport.

6.2.4. IFR Circling areas

A circling approach is an extension of an instrument approach to the specified circling minimum descent altitude (MDA) at which point the pilot will visually manoeuvre the aircraft to align with the runway for landing.

Typically, a circling approach is only conducted where there is no runway-aligned instrument procedure, or if the runway used for the approach procedure is not suitable for landing.

Only one runway at Narromine Airport has a runway aligned approach procedure, as a result the requirement to circle to the other runway may be required from time to time.

Circling areas are established by the instrument flight procedure designer based on ICAO specifications and related to the performance category of the design aircraft. The circling area is determined by drawing an arc centred on the threshold of each usable runway and joining these arcs by tangents. The most demanding aircraft category provided for Narromine Airport's instrument flight procedure's is Category C.

The radii for each relevant category of aircraft represented are provided below:

- Category A – 1.68 nm / 3.12 km
- Category B – 2.66 nm / 4.90 km
- Category C – 4.20 nm / 7.85 km

The closest WTG (WTG 20) is located approximately 16.7 km from the Runway 29 threshold and is therefore beyond the circling area and would not impact circling areas established for instrument approach procedures.

6.2.5. PANS-OPS Surfaces

A detailed assessment of the PANS-OPS surfaces associated with the published instrument approach procedures is outlined below.

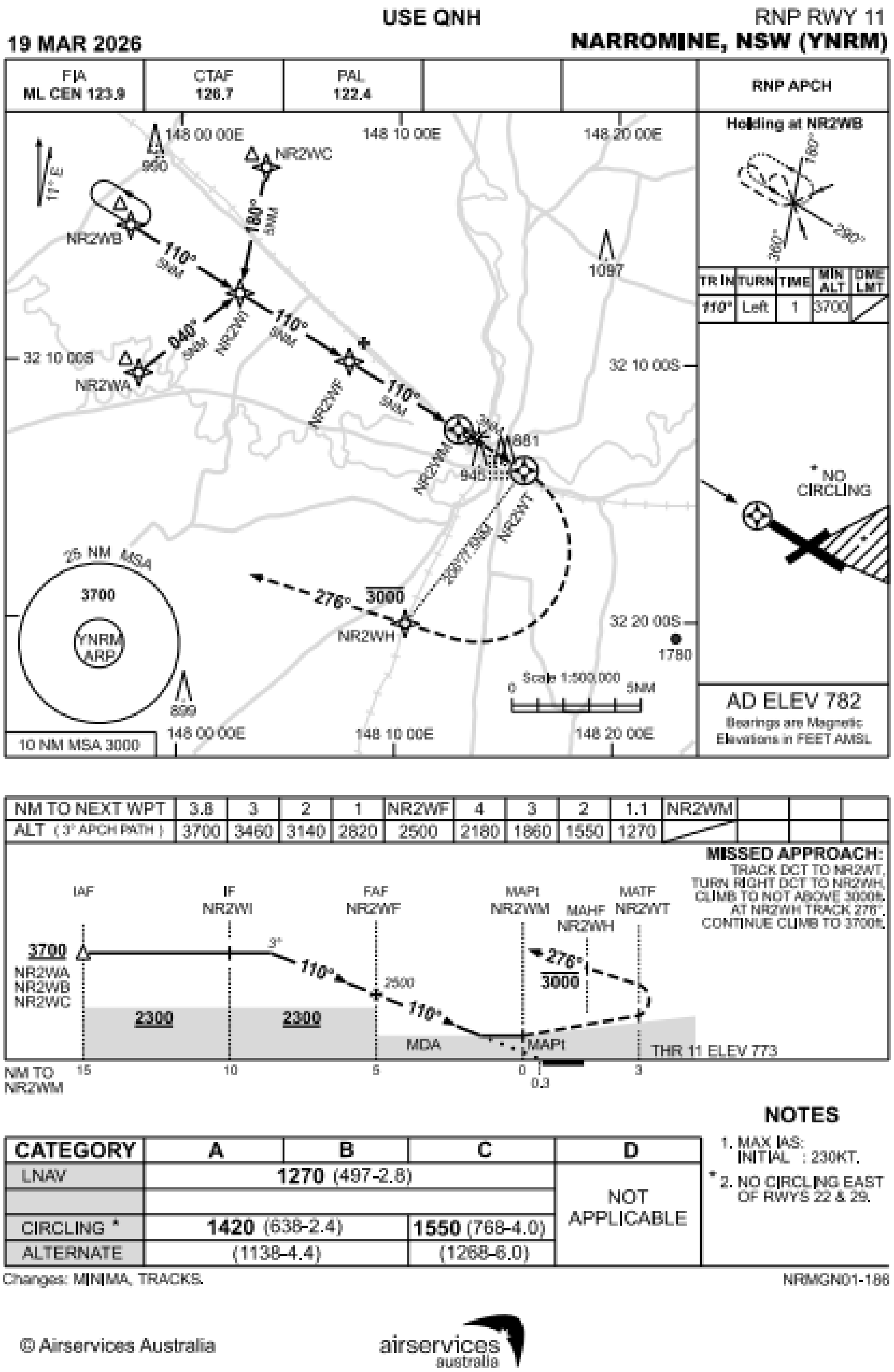
RNP RWY 11

The RNP RWY 11 instrument approach procedure is aligned with Runway 11 and brings IFR aircraft from the north-west via Initial Approach fixes at NR2WA, NR2WB and NR2WC with a holding pattern at NR2WB.

Table 4 YNRM RNP RWY 11 PANS-OPS Assessment

Instrument Approach Procedure Title - Segment	*Minimum Altitude over Project (ft AMSL)*	*PANS-OPS Surface (ft AMSL)*	*Highest WTG/WMT in Segment*	*Infringement to PANS-OPS surface*	*Potential solution*	*Impact on aircraft ops*
RNP RWY 11 – All approach segments	Various	N/A	Nil	N/A	Nil	Nil.
RNP RWY 11 – Missed Approach	3000	2836	Nil	Nil	Nil	Nil

There are no WTGs located within the missed approach segment of Narromine Airport's RNP RWY 11 instrument approach.



NM TO NEXT WPT	3.8	3	2	1	NR2WF	4	3	2	1.1	NR2WM
ALT (3° APCH PATH)	3700	3460	3140	2820	2500	2180	1860	1550	1270	

CATEGORY	A	B	C	D
LNAV	1270 (497-2.8)			NOT APPLICABLE
CIRCLING *	1420 (638-2.4)		1550 (768-4.0)	
ALTERNATE	(1138-4.4)		(1268-6.0)	

Figure 10 details Narromine Airport's RNP RWY 11 instrument approach chart. The altitudes that would need to be amended to accommodate the Project are circled in orange. The Project would be depicted on the plan view of this chart for pilot reference.

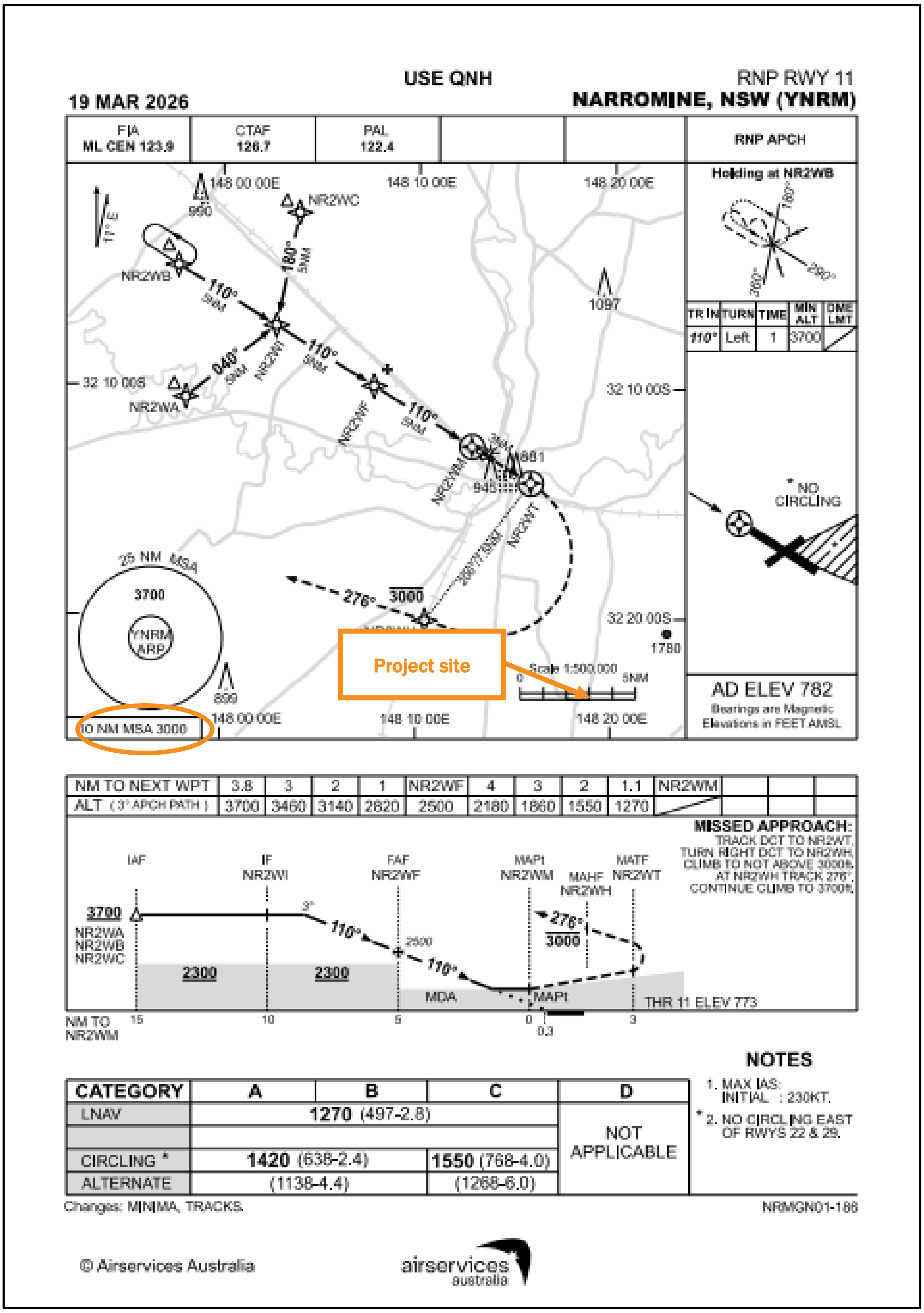


Figure 10 YNRM RNP RWY 11

6.2.6. Obstacle Limitation Surfaces

Obstacle Limitation Surface (OLS) are established for all runways, except those designated for gliding operations at YNRM.

For the Code 3 non-precision runway, the maximum lateral extent of the OLS is up to 5.5 km radius for the conical surface and 15km from each runway threshold for the take-off climb surfaces and the approach surfaces.

The Project area located outside of the OLS of Narromine Airport.

6.2.7. Dubbo City Regional Airport

Dubbo City Regional Airport is a certified aerodrome.

It is operated by Dubbo Regional Council with a published aerodrome elevation of 285 m AHD (935 ft AMSL) (source: Airservices Australia (AsA), FAC, dated 19 March 2026).

Dubbo City Regional City Airport has two main runways:

- Runway 05/23 is an asphalt runway 1708 x 45 m and runway strip 150 m
- Runway 11/29 is an asphalt runway 1067 m x 18 m and runway strip 90 m.

Figure 7 shows the runway layout of Dubbo City Regional Airport (source: AsA, Aerodrome Chart, 19 March 2026).

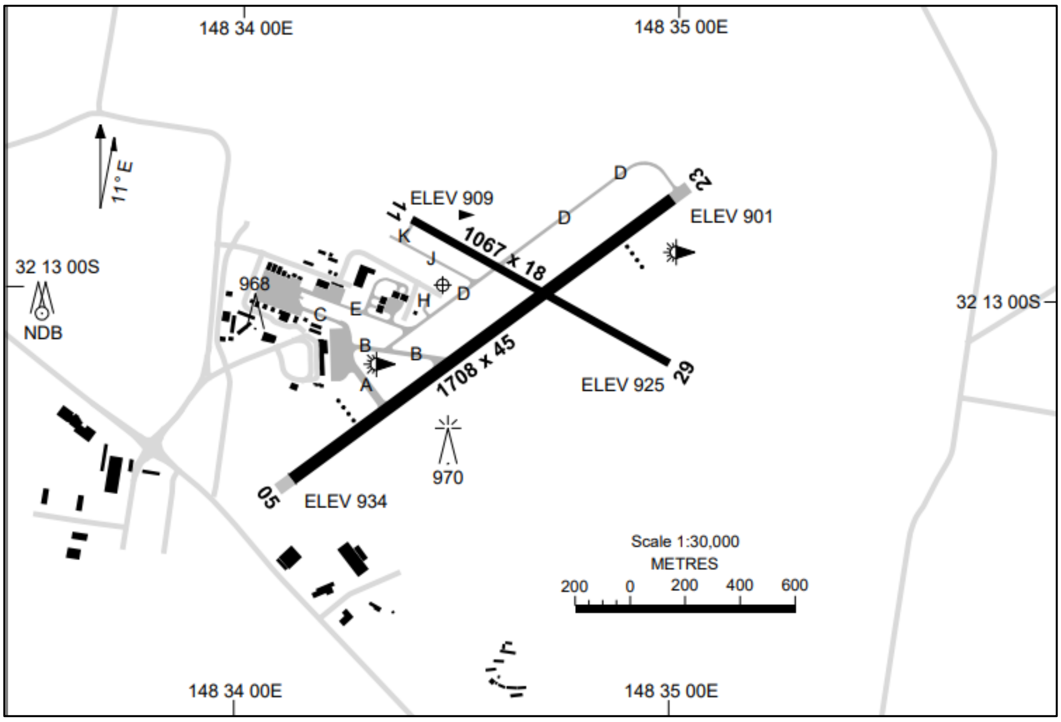


Figure 11 Dubbo City Regional Airport (YSDU) runway layout

Dubbo City Regional Airport's ARP coordinates published in Airservices Australia's DAH are Latitude 32°13'00"S and Longitude 148°34'29"E.

6.2.8. Instrument approach procedures

A check of the AIP via the Airservices Australia website showed that Dubbo City Regional Airport is served by four non-precision instrument flight procedures (source: Airservices Australia, effective 19 March 2026).

Table 5 identifies the aerodrome and procedure charts for Dubbo Regional City Airport.

Table 5 Dubbo City Regional Airport (YSDU) aerodrome and procedure charts

Chart name	*Effective date*
AERODROME CHART	21 March 2024 (Am 178)
GNSS ARRIVAL PROCEDURES	24 March 2022 (Am 170)
NDB-A	24 March 2022 (Am 170)
RNP RWY 05	15 June 2023 (Am 175)
RNP RWY 23	15 June 2023 (Am 175)

6.2.9. MSA surfaces

The MSA protection heights are applicable for each instrument approach procedure at Dubbo City Regional Airport. The project is located within the southern sector which is bound by B-100° and B-230° lines.

There are two MSA references published at Dubbo City Regional Airport – Both have the same published MSA values:

- Dubbo City Regional Airport ARP is centred on the ARP
- Dubbo City Regional Airport NDB centred on the DU NDB navigational aid.

An image of the MSA published for Dubbo City Regional Airport is shown in

Figure 12 (source: Airservices Australia, 19 March 2026).

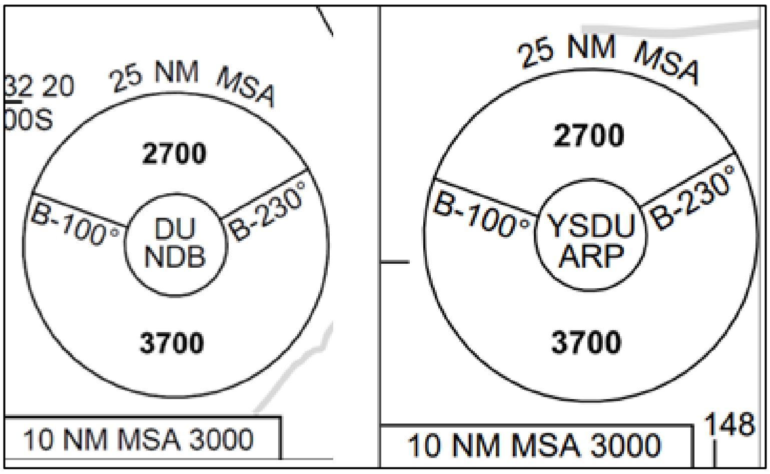


Figure 12 MSA at Dubbo City Regional Airport

Sections of the proposed Project are within the 25 nm MSA and the 10 nm MSA areas of Dubbo City Regional Airport. The orange and red circles represent distances of 30 and 15 nm from ARP of Dubbo City Regional Airport respectively, Figure 13 (Source: ERM, Google Earth).

The 10 nm MSA has an elevation of 914.4 m AHD / 3,000 ft AMSL with a PANS-OPS surface elevation of 614.4 m AHD / 2,016 ft AMSL. There are no proposed WTG within the YSDU 10nm MSA protection surface.

The 25 nm MSA has an elevation of 1127.8 m AHD / 3700 ft AMSL with a PANS-OPS surface elevation of 827.8 m AHD / 2716 ft AMSL. No proposed WTG will infringe on the 25 nm MSA at YSDU.

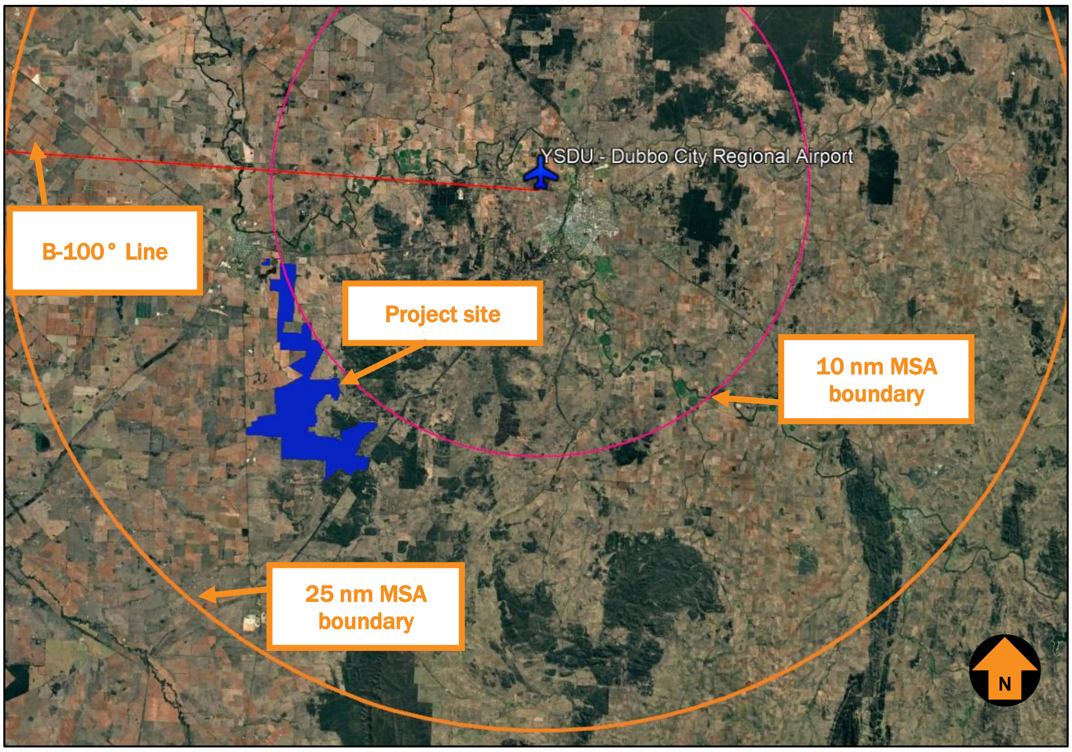


Figure 13 Dubbo City Regional Airport MSA

An impact analysis of Dubbo City Regional Airport's MSAs is provided in Table 6.

Table 6 Dubbo City Regional Airport MSA Impact analysis

MSA	*Minimum altitude*	*Protection Surface*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
10 nm	3000ft AMSL	2016 ft AMSL	Nil Impact	N/A	Nil Impact
25 nm	3700 ft AMSL	2716 ft AMSL	Nil Impact	N/A	Nil Impact

6.2.10. IFR Circling areas

Dubbo City Regional Airport has a runway aligned approach procedure for both runway 05 and runway 23 so the requirement to circle will not usually be required.

The most demanding aircraft category provided for Dubbo City Regional Airport's instrument flight procedures is Category C.

The radii for each relevant category of aircraft represented are provided below:

- Category A – 1.68 nm / 3.12 km
- Category B – 2.66 nm / 4.90 km
- Category C – 4.20 nm / 7.85 km

The closest WTG (WTG 8) is located approximately 27 km from the Runway 05 threshold and is therefore beyond the circling area and would not impact circling areas established for instrument approach procedures.

6.2.11. PANS-OPS Surfaces

A detailed assessment of the PANS-OPS surfaces associated with the published instrument approach procedures is outlined below for Dubbo City Regional Airport. Table 7 details the assessment for each instrument approach procedure.

Table 7 Dubbo City Regional Airport PANS-OPS Assessment

Instrument Approach Procedure Title - Segment	*Minimum Altitude over Project (ft AMSL)*	*PANS-OPS Surface (ft AMSL)*	*Highest WTG/WMT in Segment (ft AMSL)*	*Infringement to PANS-OPS surface*	*Potential solution*	*Impact on aircraft ops*
RNP RWY 05 – All approach segments	4100	3116	2055.3	N/A	Nil	Nil
RNP RWY 05 – Missed Approach	N/A	Nil	Nil	Nil	Nil	Nil
GNSS Arrival Procedures – Sector A	2800	1800	2266.5	WTG 68 infringes the protection surface by 466.5 ft	Increase by 500 ft to 3300 ft	Minor
GNSS Arrival Procedures – Sector B and C	N/A	Nil	Nil	Nil	Nil	Nil
NDB-A	N/A	Nil	Nil	Nil	Nil	Nil
RNP RWY 23	N/A	Nil	Nil	Nil	Nil	Nil

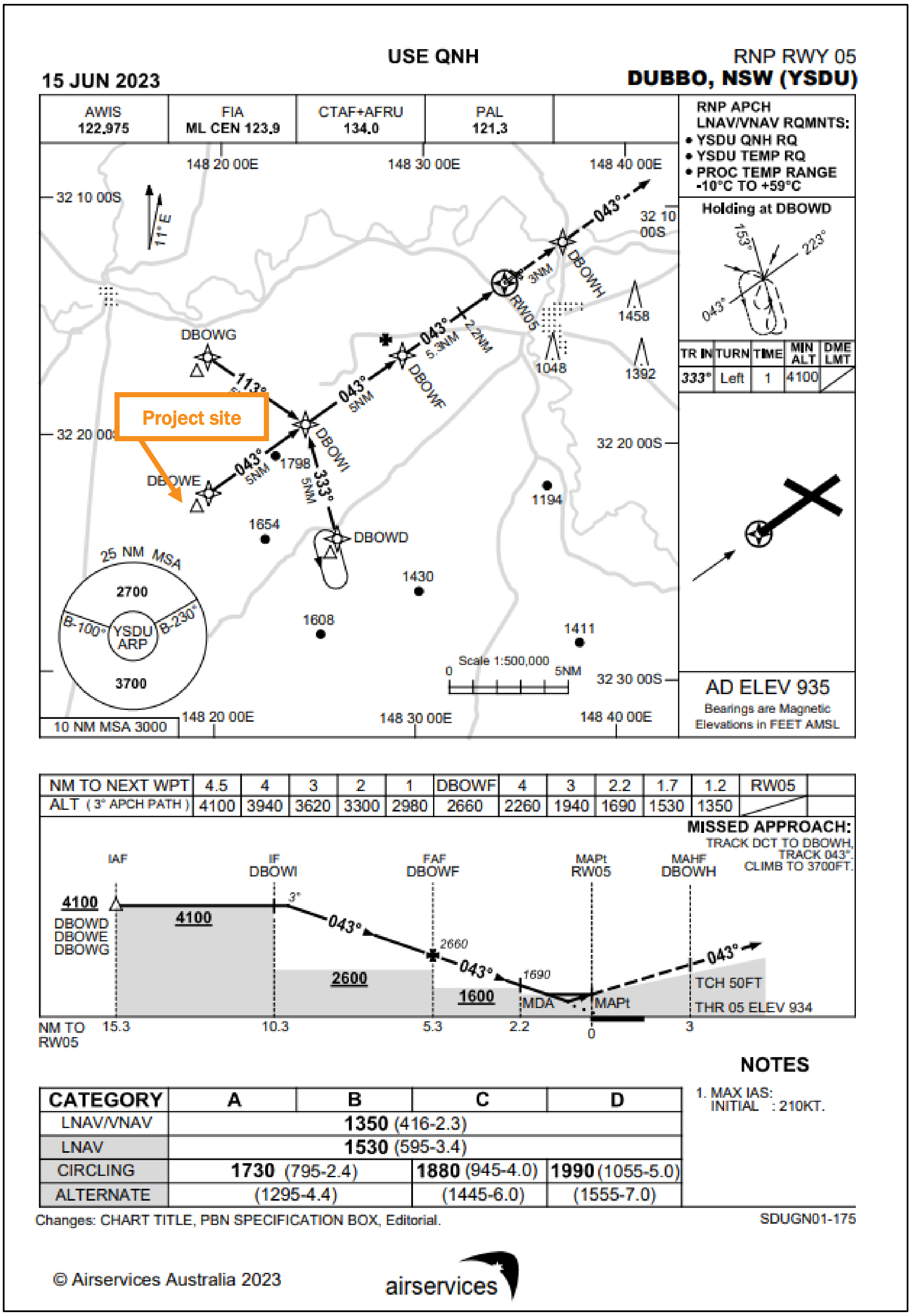
RNP RWY 05

The RNP RWY 05 instrument approach procedure is aligned with Runway 05 and brings IFR aircraft from the south-west via Initial Approach fixes at DBOWD, DBOWE and DBOWG with a holding pattern at DBOWD.

The Project sits underneath the waypoint DBOWE. This waypoint has an associated PANS-OPS protection requirement of 949.8 m (3116 ft) AMSL. The highest WTG within the PANS-OPS protection area is WTG 9 which is 626.5 m (2055.3 ft) AMSL. With the proposed heights and locations of the WTG there is a clearance of 323.3 m. No other segments of the approach will be affected by the Project.

The plan view of the RNP RWY 05 chart should be updated to include a depiction of the Project for pilot reference.

Figure 14 Dubbo City Regional Airport RNP RWY 05 details the Dubbo City Regional Airport's RNP RWY 05 instrument approach chart.



TR IN	TURN	TIME	MIN ALT	DME LMT
333°	Left	1	4100	

NM TO NEXT WPT	4.5	4	3	2	1	DBOWF	4	3	2.2	1.7	1.2	RW05
ALT (3° APCH PATH)	4100	3940	3620	3300	2980	2660	2260	1940	1690	1530	1350	

CATEGORY	A	B	C	D
LNAV/VNAV	1350 (416-2.3)			
LNAV	1530 (595-3.4)			
CIRCLING	1730 (795-2.4)		1880 (945-4.0)	1990 (1055-5.0)
ALTERNATE	(1295-4.4)		(1445-6.0)	(1555-7.0)

Figure 14 Dubbo City Regional Airport RNP RWY 05

GNSS Arrival Sector A

Airservices Australia provided feedback on 11 February, and stated that

> *The GNSS arrival, Sector A, between 14-15nm would need to increase from 2800ft to 3300ft or aligned with the initial minimum segment altitude of 3700ft for usability. This is not expected to adversely impact operations at Dubbo aerodrome.*

6.3. Obstacle Limitation Surfaces

OLS surfaces are established for all runways at YSDU.

For the existing Code 3 non-precision runway, the maximum lateral extent of the OLS is up to 5.5 km radius for the conical surface and 15km from each runway threshold for the take-off climb surfaces and the approach surfaces.

The Dubbo City Regional Airport Master Plan 2019-2040 refers to an extension of runway 05/23. This extension would not change the OLS requirements on the approach end of the runway.

The Project area is located outside of the both the current and proposed OLS of Dubbo City Regional Airport.

6.4. Nearby uncertified aerodromes (ALA)

A search of various aviation datasets identified one uncertified aerodrome (ALA) in proximity to the Project area. The aviation datasets used are:

- OzRunways - which sources its data from Airservices Australia (AIP). The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.
- Australian Government National Map online www.nationalmap.com.au, now disestablished.

As a guide, an area of interest within a 3 nm radius of an ALA is used to assess potential impacts of proposed developments on aircraft operations at or within the vicinity of the ALA.

Figure 15 shows the location of the nearby ALA relative to the Project site and a nominal 3 nm buffer from it (source: ERM, Google Earth).

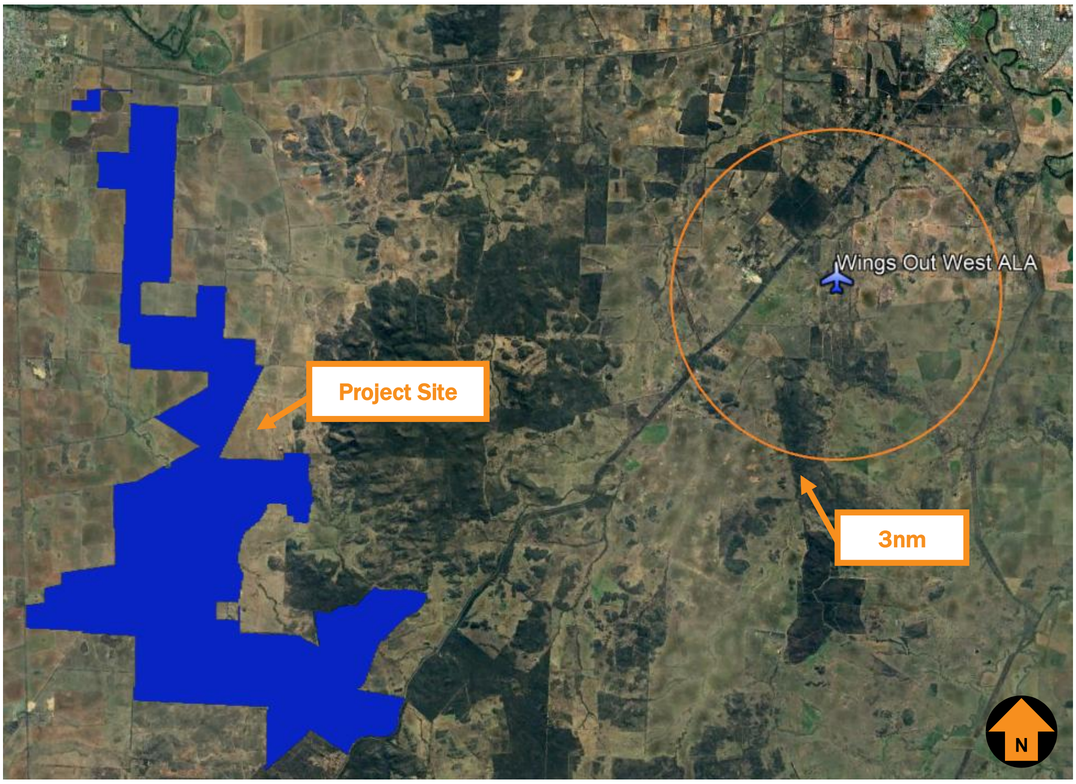


Figure 15 Uncertified aerodromes in the vicinity of the Project site

Wings Out West is an ALA that is the closest ALA in relation to the Project.

No WTGs are located within a radius of 3 nm of the closest runway at the Wings Out West ALA.

Aircraft operations at this ALA will not be impacted by the Project.

6.5. Potential wake turbulence impacts

NASF Guideline D – *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and WMTs.

NASF Guideline D provides guidance regarding WTG wake turbulence which states:

> *Wind farm operators should be aware that wind turbines may create turbulence which noticeable up to 16 rotor diameters from the turbine. In the case of one of the larger wind turbines with a diameter of 150 metres, turbulence may be present two kilometres downstream. At this time, the effect of this level of turbulence on aircraft in the vicinity is not known with certainty. However, wind farm operators should be conscious of their duty of care to communicate this risk to aviation operators in the vicinity of the wind farm…*

For the purpose of the wake turbulence analysis, a 183 m rotor diameter has been used. Based on the NASF Guideline, the effects of wake turbulence could be noticeable at 2928 m from the WTGs.

Aviation Projects, through research, has determined that any adverse turbulence would most likely be confined to within 7 rotor diameters of a WTG, but considers that a conservative area of 10 rotor diameters is likely to be the maximum area where wake turbulence from WTGs would be felt by pilots operating downstream of a WTG.

For WTGs with a 183 m rotor diameter, this area would therefore extend to a distance of 1830 m.

Adverse turbulence from any source is most critical during initial climb after take-off until the aircraft is established in a climb and at the appropriate speed, and during final approach where the aircraft is configured for landing and operating at a slow speed prior to landing.

Figure 16 shows 10 times (1830 m) (green) and 16 times (2928 m) (red) around the relevant boundary WTGs in relation to the nearby uncertified aerodrome (3 nm buffer applied as orange circle) (source: ERM, Google Earth).

There is no impact to nearby uncertified aerodromes.

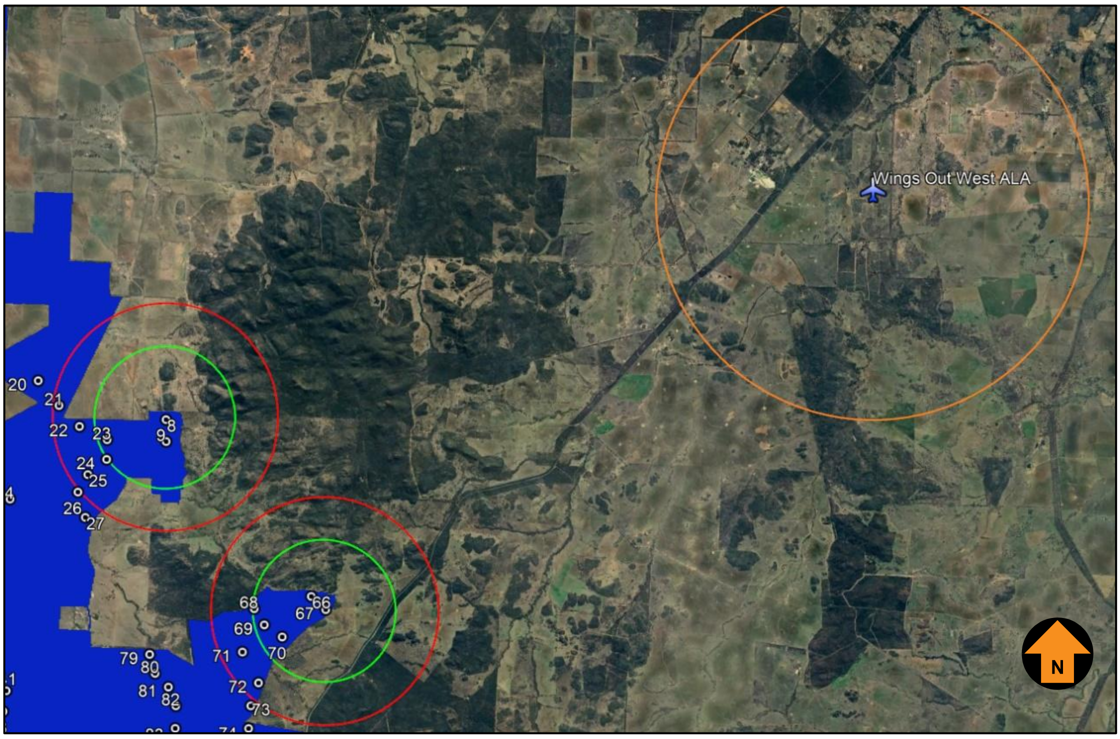


Figure 16 Possible extent of Wake Turbulence from WTGs in relation to uncertified aerodromes

6.6. Grid and Air routes LSALT

CASR MOS 173 requires that the published LSALT, for a particular airspace grid or air route, provides a minimum of 1000 ft clearance above the controlling (highest) obstacle within the relevant airspace grid or air route tolerances.

6.6.1. Grid LSALT

The Project site is located within the Grid LSALT of 4100 ft AMSL with a protection surface of 3100 ft AMSL.

Figure 17 shows the grid LSALTs in proximity to the Project site (source: OzRunways January 2026).

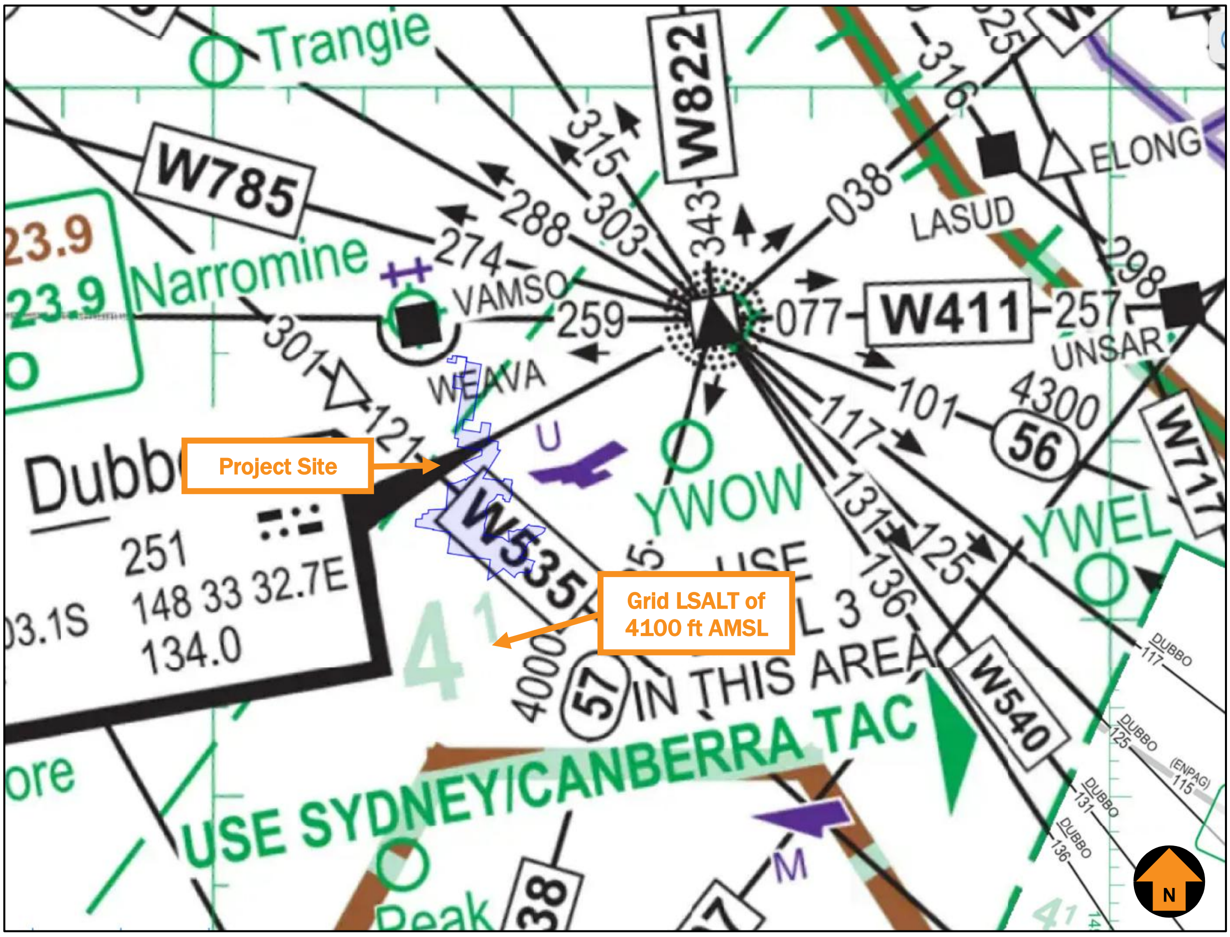


Figure 17 Air Route and Grid LSALTs in proximity to the Project site

An impact analysis of the surrounding air routes is provided in Table 8.

The highest WTG (WTG 68, at 690.8 m AHD / 2266.5 ft AMSL) does not infringe the 3100 ft protection surface. No change to the Grid LSALT would be required.

Table 8 Grid LSALT impact analysis

Grid ISALT	*Protection Surface*	*Highest WTG*	*Impact on Grid LSALT*	*Potential solution*	*Impact on aircraft ops*
4100 ft AMSL	3100 ft AMSL	WTG 68 2266.5 ft AMSL	No infringement	N/A	Nil

6.6.2. Air Route LSALTs

A protection area 7 nm laterally either side of an air route is used to assess the LSALT for the air route.

There are two air routes within 7 nm of the Project Site shown below in Table 9 (source: ERC Low National, Google Earth).

Table 9 Air route impact analysis

Air route	*Waypoint pair*	*Route LSALT*	*Protection Surface*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
W535	WEAVA to BTH	East: 6500 ft AMSL West: 5100 ft AMSL	Lowest: 4100 ft AMSL	Nil	N/A	N/A
W638	DU to PKS	4000 ft AMSL	3000 ft AMSL	Nil	N/A	N/A

6.7. Airspace Protection

The Project Site is located outside of controlled airspace (wholly within Class G airspace) and is not located in any Prohibited, Restricted and Danger areas.

The Project will not have an impact on controlled or designated airspace.

6.8. Aviation navigation facilities

NASF Guideline G, *Protection of Aviation Facilities - Communication, Navigation and Surveillance (CNS)* and CASR Part 139 MOS specify the area where development of buildings and structures has the potential to cause unacceptable interference to CNS facilities. The nearest CNS facility is located at Dubbo City Regional Airport, approximately 15 nm northeast of the Project.

The Project Site is located a sufficient distance away from nearby certified airports and CNS facilities and will not have an impact.

6.9. ATC Radar installations

Airservices Australia requires an assessment of the potential for the WTGs to affect radar line of sight.

The closest radar facility to the Project site is the Mount Boyce En-route Surveillance Radar (RSR), which is located approximately 225 km to the south-east.

The Project site is outside the range of the Mount Boyce RSR and will not impact this facility.

6.10. AIS Summary

Based on the proposed Project WTG layout and maximum blade tip height of 271.5 m AGL, the highest wind turbine (WTG 68) will not exceed 690.8 m (2266.5 ft AMSL).

The Project site WTGs:

- Would not infringe any OLS surfaces
- Would not infringe any circling areas
- Would infringe the Narromine Airport 10 nm MSA surfaces but can be mitigated
- Would not infringe the Narromine Airport 25 nm MSA surfaces
- Would not infringe the Dubbo City Regional Airport 10 nm or 25 nm MSA surfaces
- Would not infringe the Narromine Airport RNP RWY 11 procedure
- Would infringe GNSS arrival at Dubbo City Regional Airport
- Would not have an impact on operations of nearby uncertified aerodromes
- Would not infringe the Grid LSALT
- Would not infringe the following air route LSALT – W535 and W638
- Would be outside the clearance zones associated with civil aviation navigation aids and communication facilities.
- Would be located outside of controlled airspace (wholly within Class G airspace) and not located in any Prohibited, Restricted or Danger areas.
- The WTGs would not impact on the closest ATC radar installations
- The WTGs must be reported to CASA and construction details provided to Airservices.

7. HAZARD LIGHTING AND MARKING

Based on the NSW Wind Energy Guideline (November 2024), If turbines are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).

However, based on the risk assessment set out in Section 9 it is concluded that aviation lighting is likely to not be required for WTGs and WMTs to maintain an acceptable level of aviation safety.

For completeness, relevant lighting standards and guidelines are summarised in Annexure 3.

7.1. Wind turbine generators (WTGs)

Based on NSW Wind Energy Guidelines, applicants must consider aircraft flightpaths and ensure that the final turbine layout does not pose an unacceptable risk to air safety, including in areas where low-flying operations are likely to be conducted. Applicants must also identify and assess any potential impacts of the project on nearby airfields and propose reasonable and appropriate measures to mitigate risk.

If a proposed wind turbine or monitoring tower is greater than 150 m high or infringes on the obstacle limitation surface of a certified aerodrome, applicants must do an aviation impact assessment in accordance with NASF Guideline D.

Appendix A of the Wind Energy Guideline provides additional information on WTG obstacle lighting and the potential use of aircraft detection systems or visibility meters.

The effectiveness of aircraft detection systems in detecting and managing lighting for aviation safety as a risk treatment is unknown, and there is no formal guidance within the Australian context on approved standards and approved systems. Therefore, Aviation Projects does not support this solution at this time.

Visibility meters, as understood by Aviation Projects, are photo-electric cells used as automatic sensors which are set at appropriate levels so the lights will activate when ambient conditions become dark enough to require lighting and deactivate when no longer required. Aviation Projects is not aware of specific guidance from CASA as to specific lighting levels for activation and de-activation of obstacle lighting.

7.1.1. Department of Planning, Housing and Infrastructure – Wind Energy Guideline (November 2024)

This Wind Energy Guideline will help the community, industry, applicants and regulators navigate the planning framework under which we assess wind energy. This guideline identifies key planning considerations relevant to wind energy development and provides policy and technical guidance on key issues of the technology.

The Renewable Energy Planning Framework, inclusive of the Wind Energy Guideline applicable to the Project aspects relating to aviation safety are relevant to consider avoiding ambiguity in regard to the need for obstacle lighting. Those key principles are outlined below.

> *5.3.1 Key principles*
>
> *Aviation safety and lighting principles*
>
> *• Wind energy projects should be designed to reduce aviation safety risk.*
>
> *• If turbines are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).*
>
> *• Lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.*

• An aviation impact assessment must include a full assessment of the risks to aviation safety in the context of existing flight patterns and airport approach routes.

Lighting

While important from a safety perspective, aviation obstacle lighting has the potential to impact regional and rural areas where other light sources are minimal. Applicants should seek to minimise the effects of lighting on visual amenity while still having regard to the aviation safety risk assessment. The visibility and impact of any lighting depends on the nature and intensity of the lighting required and the potential cumulative effects with other developments.

NSW adopts a risk-based approach assessing the potential risk of wind energy projects to aviation safety. We acknowledge CASA's expectation to recommend some level of aviation obstacle lighting for tall structures, including wind turbines.

For tall structures (including turbines) that are greater than 150 metres above ground level, the most critical structures (turbines at the highest elevations and/or around the project's perimeter) will require lighting.

Lighting turbines and tall structures is intended to improve safety outcomes and alert pilots to the presence of potential obstacles in low-altitude flight paths. Aircraft detection systems can be used to trigger lights only when an approaching aircraft is identified. CASA has also advised that using management systems to regulate obstacle lights and their intensity (such as visibility meters or radar detection systems) is an acceptable option in Australia.

Australia aviation authorities have generally adopted international standards[21] for lighting intensity, which recommend 2,000 candela medium intensity obstacle lights for structures greater than 150 metres above ground level. However, CASA has accepted the use of 200 candela lighting in circumstances where a lack of back lighting, such as in rural and remote areas, means the lower intensity light is still visible to pilots at an acceptable distance to avoid the obstacle[22]

To mitigate negative impacts on visual amenity, consider:

• minimising the number of turbines that need to be lit to clearly indicate the general height and extent of the development – high-risk turbines at high elevations must be lit

• using the lowest intensity turbine light suitable for the site

• where fixed lighting is proposed (instead of being controlled through detection systems), turning on all turbine lighting simultaneously, using a steady medium-intensity red light, and to not have flashing lights

• directing ancillary lighting below the horizontal to avoid unnecessary impact on residences.

[21] ICAO (International Civil Aviation Organization) Annex 14, Volume 1, Chapter 6.2

[22] CASA Advisory Circular AC 139.E-05v1.1 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome, October 2022

7.1.2. National Airports Safeguarding Framework (NASF) Guideline D

NASF Guideline D provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers.

Paragraphs 35 to 37 provide guidance in relation to obstacle lighting for wind turbines:

35. When lighting has been recommended by CASA to reduce risk to aviation safety, medium-intensity obstacle lights should be used. Where used, lighting on wind farms should be installed:

(a) to identify the perimeter of the wind farm;

(b) respecting a maximum spacing of 900m between lights along the perimeter, unless an aeronautical study shows that a greater spacing can be used;

(c) where flashing lights are used, they flash simultaneously; and

(d) within a wind farm, any wind turbines of significantly higher elevation are identified wherever located.

36. To minimise the visual impact on the environment, obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously.

37. Where obstacle lighting is provided, proponents should establish a monitoring, reporting and maintenance procedure to ensure outages, including loss of synchronisation, are detected, reported and rectified. This would include making an arrangement for a recognised responsible person from the wind farm to notify the relevant CASA office, so that CASA can advise pilots of light outages

7.1.3. CASR Part 139 (Aerodromes) Manual of Standards 2019 (13 March 2024)

CASR Part 139 (Aerodromes) Manual of Standards (13 March 2024) Section 9.31, (8) and (9) specifies as follows in relation to obstacle lights for wind farms:

(8) Subject to subsection (9), for wind turbines in a wind farm, medium-intensity obstacle lights must:

(a) mark the highest point reached by the rotating blades; and

(b) be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m; and

(c) all be synchronised to flash simultaneously; and

(d) be seen from every angle in azimuth.

Note This is to prevent obstacle light shielding by the rotating blades of a wind turbine and may require more than 1 obstacle light to be fitted.

(9) If it is physically impossible to light the rotating blades of a wind turbine:

(a) the obstacle lights must be placed on top of the generator housing; and

(b) a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.

Section 9.33 specifies the characteristics of medium-intensity obstacle lights

9.33 Characteristics of medium-intensity obstacle lights

(1) Medium-intensity obstacle lights must:

(a) be visible in all directions in azimuth; and

(b) if flashing — have a flash frequency of between 20 and 60 flashes per minute.

(2) The peak effective intensity of medium-intensity obstacle lights must be 2 000 ±25% cd with a vertical distribution as follows:

(a) for vertical beam spread — a minimum of 3 degrees;

(b) at -1 degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;

(c) at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.

(3) For subsection (2), vertical beam spread means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.

(4) If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ±25% cd when the background luminance is 50 cd/m² or greater.

CASR Part 139 MOS allows for obstacle lights to be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, with intervals between lit turbines not exceeding 900 m.

7.2. Wind monitoring towers (WMTs)

Given that aerial operators might use the airspace within the Project area and that it is expected that WMTs will be constructed prior to WTGs, the WMTs will be free-standing and not surrounded by any WTGs. Therefore, the proposed temporary and permanent WMTs should be marked with red/white/red bands as per the NASF Guideline D. Obstacle lighting should be fitted at the top of the mast to ensure that the WMTs that are not located in the vicinity of a WTG, are conspicuous in low light and deteriorating atmospheric conditions.

7.2.1. National Airport Safeguarding Framework Guideline D

NASF Guideline D: *Managing the Risk To Aviation Safety of Wind Turbine Installation (Wind Farms)/Wind Monitoring Towers* provides guidance to State/Territory and local government decision-makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers.

When wind turbines over 150 metres above ground level are to be built within 30 kms of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority (CASA) and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.

The Aeronautical Information Service of the Royal Australian Air Force (RAAF AIS) maintains a database of tall structures in the country. The RAAF AIS should be notified of all tall structures meeting the following criteria:

- *30 metres or more above ground level for structures within 30km of an aerodrome; or*
- *45 metres or more above ground level for structures located elsewhere.*

Marking and lighting of wind monitoring towers

Before developing a wind farm, it is common for wind monitoring towers to be erected for anemometers and other meteorological sensing instruments to evaluate the suitability or otherwise of a site. These towers are often retained after the wind farm commences operations to provide the relevant meteorological readings. These structures are very difficult to see from the air due to their slender construction and guy wires. This is a particular problem for low flying aircraft including aerial *agricultural operations. Wind farm proponents should take appropriate steps to minimise such hazards, particularly in areas where aerial agricultural operations occur. Measures to be considered should include:*

- *the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;*
- *marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;*
- *ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation; or*
- *a flashing strobe light during daylight hours.*

7.2.2. Civil Aviation Safety Authority - regulatory context

The CASA regulates aviation activities in Australia. Applicable requirements include the AC 139 E 0.1-v1.0 and AC.139 E 0.5-v1.1. Relevant provisions are outlined in further detail in the following section.

AC 139.E-01 v1.0—Reporting of Tall Structures

AC 139.E-01 v1.0—*Reporting of Tall Structures*, CASA guides those authorities and persons involved in the planning, approval, erection, extension or dismantling of tall structures so that they may understand the vital nature of the information they provide.

2.2.1 The hazards that such buildings or structures may pose to aircraft requires assessment. CASA routinely performs such assessments however needs to be first notified of the obstacle, structure of source of a hazardous plume. The need to report such hazards is outlined in this AC.

2.2.2 If you are the person who owns, controls or operates the object, structure or a source of a hazardous plume which is either present, imminent or has been approved for erection/construction, details need to be provided about:

− the construction, extension or dismantling of tall structures if the top is:

o 100 m or more above ground level

or

o affects the obstacle limitation surface of an aerodrome as defined in

2.2.3 In addition, tall structures may pose a specific hazard for the operation of low-flying Defence aircraft or to the flight paths of arriving/departing aircraft (refer Paragraph 2.1.3). Therefore, the RAAF and Airservices Australia require information on structures that are 30 m or more above ground level—within 30 km of an aerodrome or 45 m or more above ground level elsewhere for the RAAF, or 30 m or more above ground level elsewhere for Airservices Australia.

2.2.4 Information provided for the database should be accurate and readily interpreted. The tall structure report form has been designed to help owners and/or developers in this respect. The form is available on the Airservices Australia website (including a spreadsheet for reporting multiple structures) at: https://www.airservicesaustralia.com/industry-info/airport-development-assessments/

AC 139.E-05-v1.1 Obstacles including wind farms outside the vicinity of a CASA certified aerodrome – October 2022

AC 139.E-05-v1.1 provides advice about the lighting and marking of wind farms and other tall structures in submissions to planning authorities who are considering a wind farm or tall structure proposal.

> *2.1.2 Regardless of CASA advice, planning authorities make the final determination whether a wind farm or a tall structure not in the vicinity of a CASA regulated aerodrome will require lighting or marking.*
>
> *2.2.1 All wind turbine developments and tall structures should be assessed to determine whether they could be a risk to aviation safety. This AC augments the information in the National Aerodromes Safeguarding Framework (NASF) Guideline D and provides additional guidance on the assessment of wind farm developments and guidance for establishing what reasonable measures may be put in place to mitigate any adverse effect the wind farm development could be to aviation safety.*
>
> *2.2.2 For the purposes of this AC, navigable airspace is considered to be the airspace above the minimum altitudes of VFR and IFR flight, including airspace required to ensure the safe take-off and landing of an aircraft. Generally, minimum altitude limits equate to 500 ft (152 m) or 1 000 ft (305 m) above ground level depending on the situation, i.e., whether or not the flying is over a populous area. The presence of wind turbines, wind monitoring masts and other tall obstacles may create a risk to the safety of flight, due to the risk of collision. An entity that is proposing to introduce a hazard into navigable airspace, such as a wind farm, must mitigate the risk of the hazard on airspace users to ensure an acceptable level of safety is maintained.*
>
> *2.2.4.1 Part 139 of the Civil Aviation Safety Regulations 1998 (CASR), regulates obstacles within the vicinity of certified aerodromes. This is supported by Part 139 (Aerodromes) Manual of Standards (MOS) which provides the definition of an obstacle as well as the standards for marking and lighting of an obstacle. Any wind turbine (where the height is defined to be the maximum height reached by the tip of the turbine blades), wind monitoring mast or other tall structure that penetrates an Obstacle Limitation Surface (OLS) of an aerodrome will be assessed in accordance with the provisions of Part 139 of CASR and the MOS.*
>
> *2.2.6.1 Outside the vicinity of an aerodrome, which is defined as being outside the OLS of an aerodrome, wind farms and other tall structures may constitute a risk to low-flying aviation operations which may be conducted down to 500 ft above ground level (AGL) over non-populous areas. Additionally, wind monitoring masts can also be hazardous to aviation, given they are very thin and difficult to see. Wind farms can also affect the performance of communications, navigation and surveillance (CNS) equipment operated by Airservices or the Department of Defence.*
>
> *2.5 Aviation hazard lighting - International best practice*
>
> *2.5.2 Australian regulations state that aircraft in uncontrolled airspace may operate under visual flight rules (VFR), which requires the pilot to remain clear of clouds and to adhere to visibility minima.*
>
> > *- in Class G airspace below 3000 ft Above Mean Sea Level (AMSL) or 1000 ft AGL (whichever is the higher) – remain clear of cloud with minimum visibility of 5000 m.*
> >
> > *– in Class G airspace below 10 000 ft AMSL (subject to the above) – remain 1000 ft vertically and 1500 m horizontally from cloud and with 5000 m visibility.*
>
> *Note: Helicopters may be permitted to operate in lower visibility and that further exemptions may apply to special cases such as military, search and rescue, medical emergency, agricultural and fire-fighting operations.*

2.5.4 2000 candela medium intensity obstacle lighting recommendation satisfies the 5000 m VFR visibility requirements, according to practical exercises undertaken by the FAA and documented in AC 70/7460-1L (FAA, 2015).

2.5.5 In Australia, CASA has accepted the use of 200 candela lighting in some circumstances due to a lack of back lighting in rural and remote areas, meaning that a lower intensity light is still visible to pilots at an acceptable distance to permit a pilot to see and avoid the obstacle.

2.6 Hazard Lighting

2.6.1 This describes the reasoning behind CASA's preference to recommend aviation hazard lighting for tall structures and aircraft detection systems for wind farms.

2.6.2 Hazard lighting for wind farms and other tall structures is intended to alert pilots, flying at low altitude, to the presence of an obstacle allowing them sufficient awareness to safely navigate around or avoid it. The pilot is responsible for avoiding other traffic and obstacles based on the "alerted" see-and-avoid principle.

2.6.3 Unless the wind farm or tall structure is located near an airport, it is not expected to pose a risk to regular public transport operations. The kind of air traffic that is usually encountered at low altitude in the vicinity of a wind farm or tall structure includes light aircraft (private operators, flight schools, sport aviation, agricultural, survey, fire spotting and control) and helicopters (military, police, medical emergency services, survey, fire spotting and control). Hazard lights are therefore designed to provide pilots with sufficient awareness about the presence of the structure(s), so they can avoid it. This means that the intensity of the hazard lights should be such that the acquisition distance is sufficient for the pilot to recognise the danger, take evasive action and avoid the obstacle by a safe margin in all visibility conditions. This outcome considers the potential speed of an aircraft to determine the distance by which the pilot must become aware of the obstacle to have enough time and manoeuvrability to avoid it.

2.7 CASA's commitment to aviation safety

2.7.1 CASA will consider the lighting intensity management and systems that achieve an acceptable level of aviation safety on a case-by-case basis during its assessment.

2.7.2 A CASA determination will consider the environmental setting when determining the need and level of lighting required on a wind farm or tall structure. This may include consideration of lower lighting intensities for obstacles away from an aerodrome. The backlighting of some locations is almost non-existent, meaning the risk of an aviation hazard light being compromised by background lighting from a rural and remote town is lower than would otherwise apply in a residential area closer to a city.

7.3. Transmission Line

There is no regulatory requirement to mark or light power poles or overhead transmission lines.

According to the AAAA *Powerlines Policy* dated March 2011:

Most agricultural land in Australia is crisscrossed with powerlines and aerial application companies and pilots put enormous effort into managing these hazards safely, generally using a risk identification, assessment and management process in line with Australian Standard AS4360/ISO 3[1]000.

The agricultural pilot curriculum mandated by CASA includes training for the safe management of powerlines and AAAA has been active in providing ongoing professional development for application *pilots that includes a focus on planning, risk management and a knowledge of human factors relevant to managing powerlines in a low-level aviation environment.*

AAAA runs a specific training course for aerial application pilots entitled 'Wire Risk Management' to address these issues.

Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with MOS 139 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8):

8.110 Marking of hazardous obstacles

(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.

(8) The objects mentioned in subsection (7) must:

(a) be approximately equivalent in size to a cube with 600 mm sides; and

(b) be spaced 30 m apart along the length of the wire or cable.

8. ACCIDENT STATISTICS

This section establishes the external context to ensure that stakeholders and their objectives are considered when developing risk management criteria, and that externally generated threats and opportunities are properly taken into account.

8.1. General aviation operations

The general aviation (GA) activity group is considered by the Australian Transport Safety Bureau (ATSB) to be all flying activities that do not involve commercial air transport (activity group), which includes scheduled (RPT) and non-scheduled (charter) passenger and freight type. It may involve Australian civil (VH–) registered aircraft, or aircraft registered outside of Australia. General aviation/recreational encompasses:

- Aerial work (activity type). Includes activity subtypes: agricultural mustering, agricultural spreading/spraying, other agricultural flying, photography, policing, firefighting, construction – sling loads, other construction, search and rescue, observation and patrol, power/pipeline surveying, other surveying, advertising, and other aerial work
- Own business travel (activity type)
- Instructional flying (activity type). Includes activity subtypes: solo and dual flying training, and other instructional flying
- Sport and pleasure flying (activity type). Includes activity subtypes: pleasure and personal transport, glider towing, aerobatics, community service flights, parachute dropping, and other sport and pleasure flying
- Other general aviation flying (activity type). Includes activity subtypes: test flights, ferry flights and other flying.

8.2. ATSB occurrence taxonomy

The ATSB uses a taxonomy of occurrence sub-type. Of specific relevance to the subject assessment are terms associated with **terrain collision**. Definitions sourced from the ATSB website are provided below:

- **Collision with terrain**: Occurrences involving a collision between an airborne aircraft and the ground or water, where the flight crew were aware of the terrain prior to the collision.
- **Controlled flight into terrain (CFIT):** Occurrences where a serviceable aircraft, under flight crew control, is inadvertently flown into terrain, obstacles, or water without either sufficient or timely awareness by the flight crew to prevent the event.
- **Ground strike:** Occurrences where a part of the aircraft drags on, or strikes, the ground or water while the aircraft is in flight, or during take-off or landing.
- **Wirestrike:** Occurrences where an aircraft strikes a wire, such as a powerline, telephone wire, or guy wire, during normal operations.

8.3. National aviation occurrence statistics 2010-2019

The ATSB recently published a summary of aviation occurrence statistics for the period 2010-2019 (AR-2020-014, Final - 29 April 2020).

According to the report, there were no fatalities in high or low capacity RPT operations during the period 2010-2019. In 2019, 220 aircraft were involved in accidents in Australia, and a further 154 aircraft involved in serious incidents (an incident with a high probability of becoming an accident). In 2019 there were 35 fatalities from 22 fatal accidents. There have been no fatalities in scheduled commercial air transport in Australia since 2005.

Of the 326 fatalities recorded in the 10-year period, almost two thirds (175 or 53.68%) occurred in the general aviation segment. On average, there were 1.51 fatalities per aircraft associated with a fatality in this segment. The fatalities to aircraft ratio ranges from 1.09 to 177:1. Whilst it can be inferred from the data that the majority of fatal accidents are single person fatalities, it is reasonable to assert that the worst credible effect of an aircraft accident in the general aviation category will be multiple fatalities.

A breakdown of aircraft and fatalities by general aviation sub-categories is provided in Table 10 (source: ATSB).

Table 10 Number of fatalities by General Aviation sub-category – 2010 to 2019

Sub-category	*Aircraft assoc. with fatality*	*Fatalities*	*Fatalities to aircraft ratio*
Aerial work	37	44	1.18:1
Instructional flying	11	19	1.72:1
Own business travel	3	5	1.6:1
Sport and pleasure flying	53	94	1.77:1
Other general aviation flying	11	12	1.09:1
Totals	115	175	1.51:1

Figure 18 refers to Fatal Accident Rate by operation type per million departures over the 6-year period (source: ATSB). Note the rates presented are not the full year range of the study (2010–2019). This was due to the availability of exposure data (departures and hours flown) which was only available between these years. According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 6-year reporting period ranged between 6.6 in 2014 and 4.9 in 2019.

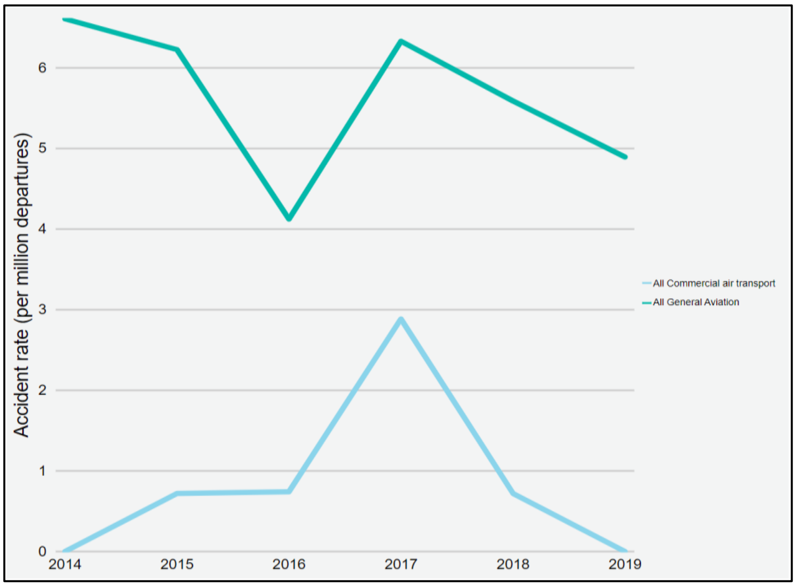


Figure 18 Fatal Accident Rate (per million departures) by Operation Type

In 2018, there were 9 fatal accidents and 9 fatalities involving GA aircraft, resulting in a rate of 5.6 fatal accidents per million departures and 7.7 fatal accidents per million hours flown.

In 2019, there were 1,760,000 landings, and 1,320,000 hours flown by VH-registered general aviation aircraft in Australia, with 8 fatal accidents and 17 fatalities. Based on these results, in 2019 there were 4.9 fatal accidents per million departures and 6.4 fatal accidents per million hours flown. A summary of fatal accidents from 2010-2019 by GA sub-category is provided in Table 11 (source: ATSB).

Table 11 Fatal accidents by GA sub-category – 2010 -2019

Sub-category	*Fatal accidents*	*Fatalities*
Agricultural spreading/spraying	13	13
Agricultural mustering	11	12
Other agricultural	1	1
Survey and photographic	5	10
Search and rescue	2	2
Firefighting	2	2
Other aerial work	3	4
Instructional flying	11	19
Own business travel	3	5
Sport and pleasure flying	53	94
Other general aviation flying	11	12
Total	115	174

Over the 10-year period, and subsequently, no aircraft has collided with a WTG or a WMT in Australia.

Of the 20,529 incidents, serious incidents and accidents in GA operations in the 10-year period, 1,404 (6.83%) were terrain collisions.

The underlying fatality rate for GA operations discussed above is considered tolerable within Australia's regulatory and social context.

8.4. Worldwide accidents involving wind farms

Worldwide since aviation accident statistics have been recorded, there have been a total of 5 aviation accidents involving a wind farm (i.e. where WTGs were erected). To provide some perspective on the likelihood of a VFR aircraft colliding with a WTG, a summary of the 5 accidents and the relevant factors applicable to this assessment is incorporated in this section.

Based on the statistics set out in the Global Wind Energy Council (GWEC) report 2023, approximately 77.6 GW of wind power had been installed worldwide around the world at the end of 2022.

Based on the Australia's Clean Energy Council statistics there were 110 wind farms in Australia as at 2023. Aviation Projects has researched public sources of information, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia, Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

The 5 recorded aviation accidents involving a wind farm are summarised as follows:

- One accident occurred in Texas, United States in October 2019 resulting in minor aircraft damage no injury to the pilot and significant injury to a person on the ground. The aircraft, an Air Tractor AT502, was returning from a local aerial application flight and was flown deliberately at low-level in close vicinity to a WTG because the pilot believed his friend was working on the turbine. The aircraft collided with a tagline rope that was attached to a blade of the WTG and which was being held by a person working on the ground. The worker was thrown about 20 ft in the air and experienced significant non-life-threatening injuries. The aircraft sustained minor damage however the pilot landed the aircraft without further incident.
- One accident, which resulted in 2 fatalities, occurred in Palm Springs in 2001. This accident involved a wind farm but was not caused by the wind farm. The cause of the accident was the inflight separation of the majority of the right canard and all of the right elevator resulting from a failure of the builder to balance the elevators per the kit manufacturer's instructions. The accident occurred above a wind farm, and the aircraft struck a WTG on its descent and therefore the cause of the accident was not attributable to the wind farm and not applicable to this AIA.
- Two accidents involving collision with a WTG were during the day, as follows:
    - One accident occurred in Melle, Germany in 2017 as the result of a collision with a WTG mounted on a steel lattice tower at a very low altitude during the day with good visibility and no cloud. The accident resulted in one fatality. If the tower was solid and painted white, as is standard on contemporary wind farms, then it more than likely would have been more visible than if it were to be equipped with an obstacle light which in all likelihood would not have been operating during daylight with good visibility conditions.
    - One accident occurred in Plouguin, France in 2008 when the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was flying in conditions of significantly reduced horizontal visibility in fog where the top of the WTGs were obscured by cloud. The WTGs became visible too late for avoidance manoeuvring and the aircraft

    made contact with two WTGs. The aircraft was damaged but landed safely. No fatalities were recorded.

    - In both of the above cases, it is difficult to conclude that obstacle lighting would have prevented the accidents.

- One fatal accident, near Highmore, South Dakota in 2014 occurred at night in Instrument Meteorological Conditions (IMC).

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group (wind-watch.org), which suggests a Cessna 182 collided with a WTG near Baraboo, Wisconsin, on 29 July 2000. The NTSB database records details of an accident involving a Cessna 182 that occurred on 28 July 2000 in the same area. For this particular accident, NTSB found that the probable cause of the accident was VFR flight into IMC encountered by the pilot and exceeding the design limits of the aircraft. A factor was flight to a destination alternate not performed by the pilot. No mention in the NTSB database is made of WTGs or a wind farm. Based on the statistics set out in the Global Wind Energy Council (GWEC) report 2016, there were 341,320 WTGs operating around the world at the end of 2016. In 2019, approximately 60.4 GW of wind power had been installed worldwide.

A summary of the 4 accidents is provided in Table 12.

Table 12 Summary of accidents involving collision with a WTG

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
1	Air Tractor AT502 N9143F collided with a tagline rope attached to wind turbine generator blade while being flown deliberately in close proximity to the WTG.	22 October 2019	Dawson County, Texas	0	Day VFR	Not specified	Not specified	The pilot's improper decision to manoeuvre at a low altitude and in close proximity to a wind turbine undergoing maintenance, which resulted in a collision with a tagline rope being held by a worker on the ground and serious injury to the worker.	Not applicable
2	Diamond DA320-A1 D-EJAR Collided with a WTG approximately 20 m above the ground, during the day in good visibility. The mast was grey steel lattice, rather than white, although the blades were painted in white and red bands.	02 Feb 2017	Melle, Germany	1	Day VFR No cloud and good visibility	Not specified	Not specified	Not specified	Not applicable

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
3	The Piper PA-32R-300, N8700E, was destroyed during an impact with the blades of a WTG, at night in IMC. The wind farm was not marked on either sectional chart covering the accident location; however, the pilot was reportedly aware of the presence of the wind farm.	27 Apr 2014	10 miles south of Highmore, South Dakota	4	Night IMC Low cloud and rain	420 ft AGL overall	Fitted but reportedly not operational on the WTG that was struck	The NTSB determined the probable cause(s) of this accident to be the pilot's decision to continue the flight into known deteriorating weather conditions at a low altitude and his subsequent failure to remain clear of an unlit WTG. Contributing to the accident was the inoperative obstacle light on the WTG, which prevented the pilot from visually identifying the WTG.	An operational obstacle light may have prevented the accident.

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
4	Beechcraft B55 The pilot was attempting to remain in VMC by descending the aircraft through a break in the clouds. The pilot, distracted by trying to visually locate the aerodrome, flew into an area of known presence of WTGs. After sighting the WTGs he was unable to avoid them. The tip of the left wing struck the first WTG blade, followed by the tip of the right wing striking the blade of a second WTG. The pilot was able to maintain control of the aircraft and landed safely.	04 Apr 2008	Plouguin, France	0	Day VFR The weather in the area of the WTGs had deteriorated to an overcast of stratus cloud, with a base between 100 ft to 350 ft and tops of 500 ft.	328 ft AGL hub height, 393 ft AGL overall	Not specified	This pilot reported having been distracted by a troubling personal matter which he had learned of before departing for the flight. The wind farm was annotated on aeronautical charts.	Not applicable

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
5	VariEze N25063 The aircraft collided with a WTG following in-flight separation of the majority of the right canard and all of the right elevator.	20 July 2001	Palm Springs, USA	2	Day VFR	N/A	N/A	The failure of the builder to balance the elevators per the kit manufacturer's instructions. The cause of this accident is not attributable to the wind farm.	Not applicable

9. RISK ASSESSMENT

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects and risk event description is provided in Annexure 4.

9.1. Risk Identification

The primary risk being assessed is that of aviation safety associated with the height and location of WTGs and WMTs proposed by the Project.

Based on an extensive review of accident statistics data (see summary in Section 8 above) and stakeholders who were consulted during the preparation of this AIA (see Section 5), 5 identified risk events associated with WTGs and WMTs relate to aviation safety or potential visual impact, and are listed as follows:

1. Potential for an aircraft to collide with a WTG, CFIT (related to aviation safety).
2. Potential for an aircraft to collide with a WMT CFIT (related to aviation safety).
3. Potential for a pilot to initiate manoeuvring in order to avoid colliding with a WTG or WMT resulting in collision with terrain (related to aviation safety).
4. Potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew (related to aviation safety).
5. Potential effect of obstacle lighting on neighbours (related to potential visual impact).

It should be noted that according to guidance provided by the Commonwealth Department of Infrastructure Transport, Regional Development, Communications and the Arts (Airspace and Air Traffic Management Risk Management Policy Statement) and in line with generally accepted practice, the risk to be assessed should primarily be associated with passenger transport services. Therefore, the risk being assessed herein is primarily associated with smaller aircraft likely to be flying under the VFR, and so the maximum number of passengers exposed to the nominated consequences is likely to be limited.

The five risk events identified here are assessed in detail in the following section.

9.2. Risk Analysis, Evaluation and Treatment

For the purpose of considering applicable consequences, the concept of worst credible effect has been used. Untreated risk is first evaluated, then, if the resulting level of risk is unacceptable, further treatments are identified to reduce the residual level of risk to an acceptable level.

A summary of the level of risk associated with the Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 13 through to Table 17.

Table 13 Aircraft collision with wind turbine generator (WTG)

Risk ID:	**1. Aircraft collision with wind turbine generator (WTG) (CFIT)**

Discussion

An aircraft collision with a WTG would result in harm to people and damage to property. Property could include the aircraft itself, as well as the WTG.

There have been 4 reported occurrences worldwide of aircraft collisions with a component of a WTG structure since the year 2000 as discussed in Section 8. These reports show a range of situations where pilots were conducting various flying operations at low level and in the vicinity of wind farms in both IMC and VMC. No reports of aircraft collisions with wind farms in Australia have been found.

In consideration of the circumstances that would lead to a collision with a WTG:

- GA VFR aircraft operators generally don't individually fly a significant number of hours in total, let alone in the area in question
- There is a very small chance that a pilot, suffering the stress of weather, will continue into poor weather conditions (contrary to the rules of flight) rather than divert away from it, is not aware of the wind farm, will not consider it or will not be able to accurately navigate around it.
- If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a WTG.

Refer to the discussion of worldwide accidents in Section 8.

There are no known aerial application operations conducted at night in the vicinity of the Project site.

If a proposed object or structure is identified as likely to be an obstacle, details of the relevant proposal must be referred to CASA for CASA to determine, in writing:

(a) whether the object or structure will be a hazard to aircraft operations

(b) whether it requires an obstacle light that is essential for the safety of aircraft operations

The Project site is clear of the obstacle limitation surfaces (OLS) of any aerodrome.

Consequence

If an aircraft collided with a WTG, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

Consequence	Catastrophic

Untreated Likelihood

There have been 4 reports of aircraft collisions with WTGs worldwide, which have resulted in a range of consequences, where aircraft occupants sustained minor injury in some cases and fatal injuries in others (see Section 8). Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents resulted from structural failure of the aircraft before the collision with the WTG. Only two relevant accidents occurred during the day, and only one resulted in a single fatality. It is assessed that collision with a WTG resulting in multiple fatalities and damage beyond repair is unlikely to occur.

Untreated Likelihood	Unlikely

Current Treatments (without lighting) • The Project site is clear of the obstacle limitation surfaces (OLS) of any certified aerodrome. • The Project site is outside 3 nm of the nearest runway threshold at nearby ALAs. • Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. The proposed WTGs will be a maximum of 271.5 m (891 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 119.1 m (391 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft) • At night, aircraft are restricted to a minimum height of 304.8 m (1,000 ft) above obstacles (including terrain) which are within 10 nm of the aircraft in visual flight and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities undertaken specifically for and prior to undertaking such authorised flights. Any obstacle including WTGs in the path of the authorised flight would be specifically risk assessed during that process. • The WTGs are typically coloured white so they should be visible to pilots during the day. • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of all WTGs can be noted on aeronautical maps and charts. ○ Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction.	
Level of Risk The level of risk associated with a Unlikely likelihood of a Catastrophic consequence is 7(Tolerable).	
Current Level of Risk	7 Tolerable
Risk Decision A risk level of 7 is classified as Tolerable: Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) - conduct cost/benefit analysis. Relevant manager to consider for appropriate action	
Risk Decision	Tolerable
Recommended Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Details of the Project should be communicated to local and regional aircraft prior to construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically: • Engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the WTG blades prior to the commencement of the subject aircraft operations within the Project site.	

• Arrangements should be made to publish details of the Project in ERSA for surrounding aerodromes, which would involve notification to Airservices Australia.
Residual Risk With the implementation of the Recommended Treatments listed above, the likelihood of an aircraft collision with a WTG resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 - Tolerable**. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered **as low as reasonably practicable** (ALARP). **It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.**

Residual Risk	7 - Tolerable

Table 14 Aircraft collision with wind monitoring tower (WMT)

Risk ID:	2. Aircraft collision with a wind monitoring tower (WMT) (CFIT)

Discussion

An aircraft collision with a WMT would result in harm to people and damage to property.

It is proposed to install 6 new WMTs with a maximum height of 200 m (656 ft) AGL in height.

The final location of the WMTs will be determined as part of the final construction design and the details will be reported to Airservices Australia.

There are only a few instances of aircraft colliding with a WMT, but they were all during the day with good visibility, and no instance was in Australia.

There is a relatively low rate of aircraft activity in the vicinity of the wind farm.

There are no known aerial application operations conducted at night in the vicinity of the wind farm.

If a proposed object or structure is identified as likely to be an obstacle, details of the relevant proposal will be referred to CASA for CASA to determine, in writing:

- whether the object or structure will be a hazard to aircraft operations
- whether it requires an obstacle light that is essential for the safety of aircraft operations.

Consequence

If an aircraft collided with a WMT, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

Consequence	Catastrophic

Untreated Likelihood

There are a few occurrences of an aircraft colliding with a WMT, but all were during the day with good visibility when obstacle lighting would arguably be of no effect, and none were in Australia. It is assessed that collision with a WMT without obstacle lighting that would be effective in alerting the pilot to its presence is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments

- The temporary and permanent WMT locations will be advised to CASA and Airservices Australia prior to construction.
- Aircraft are restricted to a minimum height of 152.4 m (500 ft) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built up areas. The highest permanent WMT could be at a height of up to 160 m (524 ft), which will be 7.6 m (24 ft) above the minimum height of 500 ft AGL for an aircraft flying at this height.
- Aircraft are restricted to a minimum height of 304.8 m (1,000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).

- Aircraft authorised to intentionally fly below 152.4 m (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. - If the WMTs will be higher than 100 m AGL, there is a statutory requirement to report them to CASA and Airservices Australia prior to construction.		
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.		
Current Level of Risk	8 - Unacceptable	
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.		
Risk Decision	Unacceptable	

Recommended Treatments

The following treatments which can be implemented at little cost will provide an acceptable level of safety:

- Details of any WMTs when they are constructed should be advised to Airservices Australia.
- Consideration could be given to marking any wind monitoring towers according to the requirements set in MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specifically:

  8.110 (5) As illustrated in Figure 8.110 (5), long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that the darker colour is at the top; and the bands are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and have a length (“z” in Figure 8.110 (5)) that is, approximately, the lesser of: 1/7 of the height of the structure; or 30 m.
  8.110 (7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects. (8) The objects mentioned in subsection (7) must: be approximately equivalent in size to a cube with 600 mm sides; and be spaced 30 m apart along the length of the wire or cable.

- WMTs that are installed prior to WTG installation (Temporary WMTs) and WMTs that are not in close proximity to a WTG, should be fitted with a medium intensity steady red obstacle light at the top of the tower to ensure visibility in low light and deteriorated atmospheric conditions. Characteristics of medium-intensity lights are specified in MOS 139 Section 9.33:

  1) *Medium-intensity obstacle lights must:*

     a) *be visible in all directions in azimuth; and*

     b) *if flashing — have a flash frequency of between 20 and 60 flashes per minute.*

  2) *The peak effective intensity of medium-intensity obstacle lights must be 2 000 ± 25% cd with a vertical distribution as follows:*

     a) *for* **vertical beam spread** *— a minimum of 3 degrees;*

b) at -1 degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity; *c) at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.* *3) For subsection (2),* ***vertical beam spread*** *means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.* *4) If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ± 25% cd when the background luminance is 50 cd/m² or greater.* • Ensure details of any additional WMTs at the Project site have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction.
Residual Risk With the additional Recommended Treatments listed above, the likelihood of an aircraft collision with a WMT resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 – Tolerable**. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. Under these circumstances, the level of risk under the proposed treatment plan is considered **ALARP.** **It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with the Project permanent WMTs that are in close proximity to a WTG without obstacle lighting on the WMTs. The WMTs are effectively shielded by the higher WTGs.** **For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision provided obstacle lighting is fitted to ensure visibility in low light and deteriorating atmospheric conditions.**

Residual Risk	7 - Tolerable

Table 15 Harsh manoeuvring leading to controlled flight into terrain

Risk ID:	3. Harsh manoeuvring leads to controlled flight into terrain (CFIT)

Discussion

An aircraft colliding with terrain as a result of manoeuvring to avoid colliding with a WTG would result in harm to people and damage to property.

There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day.

The Project is clear of the OLS of any aerodrome.

Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built up areas.

The proposed WTGs will be a maximum of 271.5 m (890.8 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 119.1 m (391 ft) above aircraft flying at the minimum altitude of 152.4 m (500 ft) AGL.

Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs.

If cloud descends below the WTG hub, obstacle lighting would be obscured and therefore ineffective.

Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).

Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.

Assumed risk treatments

- The WTGs are typically coloured white so they should be visible during the day.
- The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of WTGs can be noted on aeronautical maps and charts.
- Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTG to CASA.

Consequence

If an aircraft collided with terrain, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

Consequence	Catastrophic

Untreated Likelihood

There are a few ground collision accidents resulting from manoeuvring to avoid WTGs, but none in Australia, and all were during the day (see Section 8). It is assessed that a ground collision accident following manoeuvring to avoid a WTG is unlikely to occur.

Untreated Likelihood	Unlikely

Current Treatments (without lighting)

- The Project is clear of the OLS of any aerodrome.

• Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. • WTGs will be a maximum of 271.5 m (890.8ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 119.1 m (391 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs. • The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart. • If cloud descends below the WTG hub, obstacle lighting would be obscured and therefore ineffective. • Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The WTGs are typically coloured white, typical of most WTGs operational in Australia, so they should be visible during the day. • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. • Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs to CASA.
Level of Risk The level of risk associated with a Unlikely likelihood of a Catastrophic consequence is 7.

Current Level of Risk	7 - Tolerable

Risk Decision A risk level of 7 is classified as Tolerable: Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) – conduct cost/benefit analysis. Relevant manager to consider appropriate action.

Risk Decision	7 - Tolerable

Recommended Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Ensure details of the Project WTGs have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators prior to construction.

• Although there is no requirement to do so, the Applicant may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project site.		
Residual Risk With the additional recommended treatments, the likelihood of ground collision resulting from manoeuvring to avoid a wind turbine resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 – Tolerable**. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered **ALARP**. **It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a wind turbine, without obstacle lighting on the turbines of the Project.**		
	Residual Risk	7 - Tolerable

Table 16 Effect of the Project on operating crew

Risk ID:	4. Effect of the Project on operating crew

Discussion

Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew.

There are no known aerial application operations conducted at night in the vicinity of the Project site.

Consequence

The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.

Consequence	Minor

Untreated Likelihood

The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments

- The Project is clear of the OLS of any aerodrome.
- Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas.
- The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart.
- In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs.
- Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs.
- If cloud descends below the WTG hub, obstacle lighting would be obscured and therefore ineffective.
- Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).
- Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.
- The WTGs are typically coloured white so they should be visible during the day.

• The ‘as constructed’ details of WTGs are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. • Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Minor consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 5 is classified as Tolerable: Treatment action possibly required to achieve ALARP - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.	
Risk Decision	Accept, conduct cost benefit analysis
Recommended Treatments WMTs installed prior to WTG installation and those that are not in relatively close proximity to a WTG should be lit to ensure they are visible in low light and deteriorating atmospheric conditions. (see Risk ID: 2) The following additional treatments will provide an additional margin of safety: • Ensure details of the Project WTGs and WMTs have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators prior to construction. • Although there is no requirement to do so, the Applicant may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for such aircraft operations in the vicinity of the Project site.	
Residual Risk Notwithstanding the current level of risk is considered **Tolerable,** the additional Recommended Treatments listed above will enhance aviation safety. The likelihood remains **Possible**, and consequence remains **Minor**. In the circumstances, the risk level of 5 is considered **Tolerable.** **It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for operational limitations to affect aircraft operating crew, without obstacle lighting on the Project WTGs and Permanent WMTs in close proximity to a WTG, and with obstacle lighting for temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG.**	
Residual Risk	5 – Tolerable

Table 17 Effect of obstacle lighting on neighbours

Risk ID:	5. **Effect of obstacle lighting on neighbours**

Discussion

This scenario discusses the consequential impact of a decision to install obstacle lighting on the wind farm.

Installation and operation of obstacle lighting on WTGs or WMT can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions. This may cause further objections to the wind farm from the local community – an environmental Measure of Risk descriptor. (The basis of the Moderate Impact Assessment)

If a proposed object or structure is identified as likely to be an obstacle, details of the relevant proposal must be referred to CASA for CASA to determine, in writing:

(a) whether the object or structure will be a hazard to aircraft operations

(b) whether it requires an obstacle light that is essential for the safety of aircraft operations.

In general, objects outside an OLS and above 100 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

Consequence

The worst credible effect of obstacle lighting specifically at night in good visibility conditions would be:

- Moderate site impact, minimal local impact, important consideration at local or regional level, possible long-term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences.

This would be a Moderate consequence.

Consequence	Moderate

Untreated Likelihood

The likelihood of moderate site impact, minimal local impact is Almost certain - the event is likely to occur many times (has occurred frequently).

Untreated Likelihood	Almost certain

Current Treatments

If the WTGs or WMTs will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 100 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

Level of Risk

The level of risk associated with an Almost certain likelihood of a Moderate consequence is 8.

Current Level of Risk	8 - Unacceptable

Risk Decision

A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.

Risk Decision	Unacceptable

Recommended Treatments

Not installing obstacle lighting would completely remove the source of the impact.

As per the above safety risk assessment, the provision of lighting for the WTGs and permanent WMTs is not necessary to provide an acceptable level of safety. For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, obstacle lighting is recommended to ensure visibility in low light and deteriorating atmospheric conditions.

If CASA or a planning authority decide that obstacle lighting is required there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including:

- reducing the number of WTGs with obstacle lights
- specifying an obstacle light that minimises light intensity at ground level
- specifying an obstacle light that matches light intensity to meteorological visibility
- mitigating light glare from obstacle lighting through measures such as baffling.

These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to residents within and around the Project site.

Consideration may be given to activating the obstacle lighting via a pilot activated lighting system.

An option is to consider using Aircraft Detection Lighting Systems (referred in the United States Federal Aviation Administration Advisory Circular AC70/7460-1L CHG1 – *Obstruction Marking and Lighting*). Such a system would only activate the lights when an aircraft is detected in the near vicinity and deactivate the lighting once the aircraft has passed. This technology reduces the impact of night lighting on nearby communities and migratory birds and extends the life expectancy of obstruction lights.

Residual Risk

Not installing obstacle lights would clearly be an acceptable outcome to those potentially affected by visual impact.

If lighting is required, consideration of visual impact in the lighting design should enable installation of lighting that reduces the impact to neighbours.

The likelihood of a **Moderate** consequence remains **Likely**, with a resulting risk level of **7 – Tolerable**.

It is our assessment that visual impact from obstacle lights can be negated if they are not installed. If obstacle lights are to be installed, they can be designed so that there is an acceptable risk of visual impact to neighbours.

Residual Risk	7 - Tolerable

10. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

10.1. Planning considerations

The Project as proposed satisfies the Narromine Local Environmental Plan 2011 as it will not create incompatible intrusions or compromise the safety of existing airports and associated navigation and communication facilities.

10.2. Aviation Impact Statement

Based on the proposed Project WTG layout and maximum blade tip height of 271.5 m AGL, the highest wind turbine (WTG 68) will not exceed 690.8 m (2266.5 ft AMSL). The Project site WTGs:

- Would not infringe any OLS surfaces
- Would not infringe any circling areas
- Would infringe the YNRM 10 nm MSA surfaces but can be mitigated
- Would not infringe the YNRM 25 nm MSA surfaces
- Would not infringe the YSDU 10 nm or 25 nm MSA surfaces
- Would not infringe the YNRM RNP RWY 11
- Would infringe GNSS arrival at Dubbo City Regional Airport
- Would not have an impact on operations of nearby uncertified aerodromes
- Would not infringe the Grid LSALT
- Would not infringe the following air route LSALT – W535 and W638
- Would be outside the clearance zones associated with civil aviation navigation aids and communication facilities
- Would be located outside of controlled airspace (wholly within Class G airspace) and not located in any Prohibited, Restricted or Danger areas
- The WTGs would not impact on the closest ATC radar installations
- The WTGs must be reported to CASA and construction details provided to Airservices.

10.3. Aircraft operator characteristics

Aircraft will be required to navigate around the Project site in low cloud conditions where aircraft need to fly at 500 ft AGL.

Aircraft flying at night in visual conditions are permitted to descend or climb to or from an appropriate minimum altitude when within 3 nm of the aerodrome.

WTGs are generally not a safety concern to aerial agricultural operators. WMTs remain the primary safety concern to aerial agricultural operators, who have expressed a general desire for these towers to be more visible.

10.4. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E., the proposed WTGs must be reported to CASA.
- Based on NSW Wind Energy Guideline,
  - If turbines are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).
  - And lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.
- Based on the Risk assessment is Section 9 of this report,
  - Lighting is not required on the WTGs.
- With respect to the marking of WTGs, a white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.
- It is not mandatory to mark the WMTs, however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:
  - Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour
  - Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and
  - Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation

10.5. Summary of risks

A summary of the level of residual risk associated with the Project with the Recommended Treatments implemented, is provided in Table 18.

Table 18 Summary of Residual Risks

Identified Risk	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
Aircraft collision with wind turbine generator (WTG)	Catastrophic	Unlikely	7	**Acceptable without obstacle lighting (ALARP).** Communicate details of the Project WTGs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Aircraft collision with wind monitoring tower (WMT)	Catastrophic	Unlikely	7	**Acceptable without obstacle lighting (ALARP).** Although there is no obligation to do so, consideration has been made for marking the WMTs according to the requirements set out in MOS 139 Chapter 8 Division 10 Obstacle Markings, specifically 8.110 (5), (7) and (8). Communicate details of WMTs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes following construction.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	**Acceptable without obstacle lighting (ALARP).** Communicate details of the Project WTGs and WMTs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Effect on crew	Minor	Possible	5	**Acceptable without obstacle lighting (ALARP)** Communicate details of the Project WTGs and WMTs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Visual impact from obstacle lights	Moderate	Likely	7	**Acceptable without obstacle lighting** (zero risk of visual impact from obstacle lighting). If lights are installed, design to minimise impact.

11. RECOMMENDATIONS

Recommended actions resulting from the conduct of this assessment are provided below.

Notification and reporting

1. Details of WTGs 100 m or more AGL must be reported to CASA *as soon as practicable after forming the intention to construct or erect the proposed object or structure,* in accordance with CASR Part 139.165(1)(2). The notification should be provided to CASA via email to Airspace.Protection@casa.gov.au.

2. 'Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, by submitting the form at this webpage: https://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf to the following email address: vod@airservicesaustralia.com

3. Any obstacles 100 m or more AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:

    a. The planned operational timeframe and maximum height of the crane; and

    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.

4. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations.

5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs, WMTs and overhead transmission lines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

Marking of WTGs

6. The rotor blades, nacelle and the supporting tower of the WTGs should be painted low-reflective white or off-white, typical of most WTGs operational in Australia. No additional marking measures are required for WTGs.

Lighting of WTGs

7. Based on NSW Wind Energy Guideline,

    a. If turbines and WMTs are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).

    b. lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.

8. However, Aviation Projects has assessed in the risk assessment conducted in Section 9 that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft

Marking of wind monitoring towers

9. Consideration should be given to marking the temporary and permanent WMTs according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Specifically:

   c. Marker balls or high visibility flags or high visibility sleeves should be placed on the outside guy wires

   d. Paint markings should be applied in alternating contrasting bands of colour to at least the top 1/3 of the mast

   e. Ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation.

Lighting of WMTs

9. Consideration should be given to lighting temporary WMTs installed prior to WTG installation and permanent WMTs that are not in close proximity to a WTG with medium intensity steady red obstacle lighting at the top of the WMT mast. Characteristics for medium-intensity obstacle lighting are contained in CASR MOS 139, Section 9.33.

Micrositing

10. Providing the micrositing is within 318.3 m of the WTGs and 250 m of the WMTs is likely to not result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this AIA would remain the same.

Overhead transmission line

11. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with CASR Part 139 MOS 2019 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

Triggers for review

12. Triggers for review of this risk assessment are provided for consideration:

    a. Prior to construction to ensure the regulatory framework has not changed

    b. Following any significant changes to the context in which the assessment was prepared, including the regulatory framework

    c. Following any near miss, incident or accident associated with operations considered in this risk assessment.

ANNEXURES

1. References
2. Definitions
3. CASA regulatory requirements – Lighting and Marking
4. Risk Framework
5. WTG coordinates and heights
6. WMTs coordinates and height.

ANNEXURE 1 – REFERENCES

References used or consulted in the preparation of this report include:

- Airservices Australia
  a. Airservices Australia, *Aeronautical Information Package (AIP)*, effective 19 March 2026.
  b. Designated Airspace Handbook (DAH), effective 27 November 2025.
- Australian Government, Department of Infrastructure, Transport, Regional Development, Communications, the Arts and Sport (DITRDCAS), National Airport Safeguarding Framework, Guideline D *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*, dated July 2012.
- Civil Aviation Safety Authority
  a. Advisory Circular (AC) 91-02 V1.2, *Guidelines for aeroplanes with MTOW not exceeding 5700 kg – suitable places to take off and land*, dated November 2022.
  b. AC 91-10 v1.6: *Operations in the vicinity of non-controlled aerodromes*, dated September 2025.
  c. AC 139.E-01 v1.0—*Reporting of Tall Structures*, dated December 2021.
  d. AC 139.E-05 v1.1 *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome* (October 2022).
  e. CASR Part 139 Manual of Standards (MOS)– *Aerodromes.*
  f. CASR Part 173 MOS – *Standards Applicable to Instrument Flight Procedure Design.*
  g. Civil Aviation Regulations 1988 (CAR).
  h. Civil Aviation Safety Regulations 1998 (CASR).
- Dubbo City Regional Airport – Master Plan 2019-2040
- International Civil Aviation Organization (ICAO):
  a. Doc 8168 *Procedures for Air Navigation Services—Aircraft Operations* (PANS-OPS).
  b. Annex 14—*Aerodromes.*
- Narromine Local Environmental Plan 2011
- Narromine Aerodrome Strategic & Master Plan November 2019
- OzRunways, dated March 2026
- Standards Australia, ISO 31000:2018 *Risk management – Guidelines*

ANNEXURE 2 – DEFINITIONS

Term	*Definition*
Aerial Agricultural Operator	Specialist pilot and/or company who are required to have a commercial pilot's licence, an agricultural rating and a chemical distributor's licence
Aerodrome	A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and surface movement of aircraft.
Aerodrome facilities	Physical things at an aerodrome which could include: a. the physical characteristics of any movement area including runways, taxiways, taxilanes, shoulders, aprons, primary and secondary parking positions, runway strips and taxiway strips; b. infrastructure, structures, equipment, earthing points, cables, lighting, signage, markings, visual approach slope indicators.
Aerodrome reference point (ARP)	The designated geographical location of an aerodrome.
Aeronautical Information Publication (AIP)	Details of regulations, procedures, and other information pertinent to the operation of aircraft
Aeronautical Information Publication En-route Supplement Australia (AIP ERSA)	Contains information vital for planning a flight and for the pilot in flight as well as pictorial presentations of all licensed aerodromes
Civil Aviation Safety Regulations 1998 (CASR)	Contain the mandatory requirements in relation to airworthiness, operational, licensing, enforcement.
Instrument meteorological conditions (IMC)	Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions.
Manual of Standards (MOS)	The means CASA uses in meeting its responsibilities under the Act for promulgating aviation safety standards
National Airports Safeguarding Framework (NASF)	The Framework has the objective of developing a consistent and effective national framework to safeguard both airports and communities from inappropriate on and off airport developments.
Obstacles	All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of

Term	Definition
	aircraft or that extend above a defined surface intended to protect aircraft in flight.
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
Runway strip	A defined area including the runway and stopway, if provided, intended: a. to reduce the risk of damage to aircraft running off a runway; and b. to protect aircraft flying over it during take-off or landing operations.
Safety Management System	A systematic approach to managing safety, including organisational structures, accountabilities, policies and procedures.

ANNEXURE 3 – CASA REGULATORY REQUIREMENTS – LIGHTING AND MARKING

In considering the need for aviation hazard lighting and marking, the applicable regulatory context was determined.

The Civil Aviation Safety Authority (CASA) regulates aviation activities in Australia. Applicable requirements include the Civil Aviation Regulations 1988 (CAR), Civil Aviation Safety Regulations 1998 (CASR) and associated Manual of Standards (MOS) and other guidance material. Relevant provisions are outlined in further detail in the following section.

Civil Aviation Safety Regulations 1998, Part 139—Aerodromes

CASR 139.165 requires the owner of a structure (or proponents of a structure) that will be 100 m or more above ground level to inform CASA. This must be given in written notice and contain information on the proposal, the height and location(s) of the object(s) and the proposed timeframe for construction. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether the structure will be hazardous to aircraft operations.

Manual of Standards Part 139—Aerodromes

Chapter 9 sets out the standards applicable to Visual Aids Provided by Aerodrome Lighting.

Section 9.30 provides guidance on Types of Obstacle Lighting and Their Use:

1. *The following types of obstacle lights must be used, in accordance with this MOS, to light hazardous obstacles:*
    a. *low-intensity;*
    b. *medium-intensity;*
    c. *high-intensity;*
    d. *a combination of low, medium or high-intensity.*
2. *Low-intensity obstacle lights:*
    a. *are steady red lights; and*
    b. *must be used on non-extensive objects or structures whose height above the surrounding ground is less than 45 m.*
3. *Medium-intensity obstacle lights must be:*
    a. *flashing white lights; or*
    b. *flashing red lights; or*
    c. *steady red lights.*

    Note CASA recommends the use of flashing red medium-intensity obstacle lights.

4. *Medium-intensity obstacle lights must be used if:*
    a. *the object or structure is an extensive one; or*

b. *the top of the object or structure is at least 45 m but not more than 150 m above the surrounding ground; or*

c. *CASA determines in writing that early warning to pilots of the presence of the object or structure is desirable in the interests of aviation safety.*

Note For example, a group of trees or buildings is regarded as an extensive object.

5. *For subsection (4), low-intensity and medium-intensity obstacle lights may be used in combination.*
6. *High-intensity obstacle lights:*
   a. *must be used on objects or structures whose height exceeds 150 m; and*
   b. *must be flashing white lights.*
7. *Despite paragraph (6) (b), a medium-intensity flashing red light may be used if necessary, to avoid an adverse environmental impact on the local community.*

Sections 9.31 (8) and (9) provide guidance on obstacle lighting specific to wind farms:

8. *Subject to subsection (9), for wind turbines in a wind farm, medium-intensity obstacle lights must:*
   a. *mark the highest point reached by the rotating blades; and*
   b. *be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m; and*
   c. *all be synchronised to flash simultaneously; and*
   d. *be seen from every angle in azimuth.*

   Note: This is to prevent obstacle light shielding by the rotating blades of a wind turbine and may require more than 1 obstacle light to be fitted.
9. *If it is physically impossible to light the rotating blades of a wind turbine:*
   a. *the obstacle lights must be placed on top of the generator housing; and*
   b. *a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.*
10. *If the top of an object or structure is more than 45 m above:*
    a. *the surrounding ground (ground level); or*
    b. *the top of the tallest nearby building (building level); then the top lights must be medium-intensity lights, and additional low-intensity lights must be:*
    c. *provided at lower levels to indicate the full height of the structure; and*
    d. *spaced as equally as possible between the top lights and the ground level or building level, but not so as to exceed 45 m between lights.*

Advisory Circular 139.E-01 v1.0—Reporting of Tall Structures

In Advisory Circular (AC) 139.E-01 v1.0—Reporting of Tall Structures, CASA provides guidance to those authorities and persons involved in the planning, approval, erection, extension or dismantling of tall structures so that they may understand the vital nature of the information they provide.

Airservices Australia has been assigned the task of maintaining a database of tall structures. RAAF and Airservices Australia require information on structures which are:

a) 30 metres or more above ground level—within 30 kilometres of an aerodrome; or

b) 45 metres or more above ground level elsewhere for the RAAF, or

c) 30 m or more above ground level elsewhere for Airservices Australia.

The purpose of notifying Airservices Australia of these structures is to enable their details to be provided in aeronautical information databases and maps/charts etc used by pilots, so that the obstacles can be avoided.

The proposed WTGs must be reported to Airservices Australia. This action should occur once the final layout after micrositing is confirmed and prior to construction.

International Civil Aviation Organisation

Australia, as a contracting State to the International Civil Aviation Organisation (ICAO) and signatory to the Chicago Convention on International Civil Aviation (the Convention), has an obligation to implement ICAO's standards and recommended practices (SARPs) as published in the various annexes to the Convention.

Annex 14 to the Convention — *Aerodromes, Volume 1,* Section 6.2.4 provides SARPs for the obstacle lighting and marking of WTGs, which is copied below:

> *6.2.4 Wind turbines*
>
> *6.2.4.1 A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.*
>
> *Note 1. — Additional lighting or markings may be provided where in the opinion of the State such lighting or markings are deemed necessary.*
>
> *Note 2. — See 4.3.1 and 4.3.2*
>
> *Markings*
>
> *6.2.4.2 Recommendation. — The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.*
>
> *Lighting*
>
> *6.2.4.3 Recommendation. — When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm should be regarded as an extensive object and the lights should be installed:*
>
> > *a) to identify the perimeter of the wind farm;*
> >
> > *b) respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;*
> >
> > *c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;*
> >
> > *d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and*
> >
> > *e) at locations prescribed in a), b) and d), respecting the following criteria:*

i) for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle should be provided;

ii) for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and

iii) in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note. — The above 6.2.4.3 e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

6.2.4.4 Recommendation. — The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

6.2.4.5 Recommendation. — Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation should be in accordance with 6.2.4.3 e) or as determined by an aeronautical study.

As referenced in Section 6.2.4.3(e)(iii), Section 6.2.1.3 is copied below:

6.2.1.3 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

As referenced in Section 6.2.4.3(b), Section 6.2.3.15 is copied below:

6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and

b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

Section 4.3 Objects outside the OLS states the following:

4.3.1 Recommendation.— Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.

4.3.2 Recommendation. — In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation should be regarded *as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.*

Note. — This study may have regard to the nature of operations concerned and may distinguish between day and night operations.

ICAO Doc 9774 Manual on Certification *of Airports* defines an aeronautical study as:

An aeronautical study is a study of an aeronautical problem to identify potential solutions and select a solution that is acceptable without degrading safety.

Light characteristics

If obstacle lighting is required, installed lights should be designed according to the criteria set out in the applicable regulatory material and taking CASA's recommendations into consideration in the case that CASA has reviewed this risk assessment and provided recommendations.

The characteristics of the obstacle lights should be in accordance with the applicable standards in CASR Part 139 MOS.

The characteristics of low and medium intensity obstacle lights specified in CASR Part 139 MOS, Chapter 9, are provided below.

CASR Part 139 MOS 2019 Chapter 9 Division 4 – Obstacle Lighting section 9.32 outlines Characteristics of Low Intensity Obstacle Lights.

1. *Low-intensity obstacle lights must have the following:*
    a. *fixed lights showing red;*
    b. *a horizontal beam spread that results in 360-degree coverage around the obstacle;*
    c. *a minimum intensity of 100 candela (cd);*
    d. *a vertical beam spread (to 50% of peak intensity) of 10 degrees;*
    e. *a vertical distribution with 50 cd minimum at +6 degrees and +10 degrees above the horizontal;*
    f. *not less than 10 cd at all elevation angles between –3 degrees and +90 degrees above the horizontal.*

    Note: The intensity requirement in paragraph (c) may be met using a double-bodied light fitting. CASA recommends that double-bodied light fittings, if used, should be orientated so that they show the maximum illuminated surface towards the predominant, or more critical, direction of aircraft approach.

2. *To indicate the following:*
    a. *taxiway obstacles;*
    b. *unserviceable areas of the movement area; low-intensity obstacle lights must have a peak intensity of at least 10 cd.*

CASR Part 139 MOS Chapter 9 Division 4 – Obstacle Lighting section 9.33 outlines Characteristics of Medium Intensity Obstacle Lights.

1. *Medium-intensity obstacle lights must:*

a. be visible in all directions in azimuth; and

b. if flashing — have a flash frequency of between 20 and 60 flashes per minute.

2. The peak effective intensity of medium-intensity obstacle lights must be 2 000 ± 25% cd with a vertical distribution as follows:

a. for vertical beam spread — a minimum of 3 degrees;

b. at -1-degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;

c. at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.

3. For subsection (2), vertical beam spread means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.

4. If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ± 25% cd when the background luminance is 50 cd/m^2 or greater.

Visual impact of night lighting

Annex 14 Section 6.2.4 and CASR Part 139 MOS Chapter 9 are specifically intended for WTGs and recommends that medium intensity lighting is installed.

Generally accepted considerations regarding minimisation of visual impact are provided below for consideration in this aeronautical study:

- To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness;
- Shielding may be provided to restrict the downward component of light to either, or both, of the following:
  - such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and
  - such that no light is emitted at or below 10 degrees below horizontal;
- If a light would be shielded in any direction by an adjacent object or structure, the light so shielded may be omitted, provided that such additional lights are used as are necessary to retain the general definition of the object or structure.
- If flashing obstacle lighting is required, all obstacle lights on a wind farm should be synchronised so that they flash simultaneously; and
- A relatively small area on the back of each blade near the rotor hub may be treated with a different colour or surface treatment, to reduce reflection from the rotor blades of light from the obstacle lights, without compromising the daytime visibility of the overall WTG.

Marking of WTGs

ICAO Annex 14 Vol 1 Section 6.2.4.2 recommends that the rotor blades, nacelle and upper 2/3 of the supporting mast of the WTGs should be painted a shade of white, unless otherwise indicated by an aeronautical study.

It is generally accepted that a shade of white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.

Wind monitoring towers

The details of the WMT were introduced in **Section 4** of this report.

Consideration could be given to marking any WMTs according to the requirements set out in CASR Part 139 MOS Chapter 8 Division 10 Obstacle Markings; specifically:

> *8.110 Marking of Hazardous Obstacles*
>
> *(5) As illustrated in Figure 8.110 (5), long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that the darker colour is at the top; and the bands are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and have a length ("z" in Figure 8.110 (5)) that is, approximately, the lesser of: 1/7 of the height of the structure; or 30 m.*
>
> *(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.*
>
> *(8) The objects mentioned in subsection (7) must:*
>
> > *(a) be approximately equivalent in size to a cube with 600 mm sides; and*
> > *(b) be spaced 30 m apart along the length of the wire or cable.*

NASF Guideline D suggests consideration of the following measures specific to the marking and lighting of WMTs:

- the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial application operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers
- marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires
- ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation or
- a flashing strobe light during daylight hours.

Temporary WMTs installed prior to WTG installation and WMTs not in close proximity to a WTG should be lit with medium-intensity steady red obstacle lighting at the top of the WMT mast. Characteristics of medium-intensity obstacle lighting is contained in MOS 139, Section 9.33

Overhead transmission lines

Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with CASR Part 139 MOS Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8):

> *8.110 Marking of hazardous obstacles*
>
> *(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.*

(8) The objects mentioned in subsection (7) must:

(a) be approximately equivalent in size to a cube with 600 mm sides; and

(b) be spaced 30 m apart along the length of the wire or cable.

ANNEXURE 4 – RISK FRAMEWORK

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects has been developed in consideration of ISO 31000:2018 *Risk management—Guidelines* and the guidance provided by CASA in its Safety Management System (SMS) for Aviation guidance material, which is aligned with the guidance provided by the International Civil Aviation Organization (ICAO) in Doc 9589 *Safety Management Manual*, Third Edition, 2013. Doc 9589 is intended to provide States (including Australia) with guidance on the development and implementation of a State Safety Programme (SSP), in accordance with the International SARPs, and is therefore adopted as the primary reference for aviation safety risk management in the context of the subject assessment.

Section 2.1 of the ICAO Doc 9589 *The concept of safety* defines safety as follows [author's underlining]:

> *2.1.1 Within the context of aviation, safety is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained* <u>*at or below, an acceptable level*</u> *through a continuing process of hazard identification and safety risk management."*

Likelihood

Likelihood is defined in ISO 31000:2018 as the chance of something happening. Likelihood descriptors used in this report are as indicated in Table 1.

Table 1 Likelihood Descriptors

No	Descriptor	Description
1	Rare	It is almost inconceivable that this event will occur
2	Unlikely	The event is very unlikely to occur (not known to have occurred)
3	Possible	The event is unlikely to occur, but possible (has occurred rarely)
4	Likely	The event is likely to occur sometimes (has occurred infrequently)
5	Almost certain	The event is likely to occur many times (has occurred frequently)

Consequence

Consequence is defined as the outcome of an event affecting objectives, which in this case is the safe and efficient operation of aircraft, and the visual amenity and enjoyment of local residents.

Consequence descriptors used in this report are as indicated in Table 2.

Table 2 Consequence Descriptors

No	Descriptor	People Safety	Property/Equipment	Effect on Crew	Environment
1	Insignificant	Minor injury – first aid treatment	Superficial damage	Nuisance	No effects or effects below level of perception
2	Minor	Significant injury – outpatient treatment	Moderate repairable damage – property still performs intended functions	Operations limitation imposed. Emergency procedures used.	Minimal site impact – easily controlled. Effects raised as local issues, unlikely to influence decision making. May enhance design and mitigation measures.
3	Moderate	Serious injury - hospitalisation	Major repairable damage – property performs intended functions with some short-term rectifications	Significant reduction in safety margins. Reduced capability of aircraft/crew to cope with conditions. High workload/stress on crew. Critical incident stress on crew.	Moderate site impact, minimal local impact, and important consideration at local or regional level, possible long-term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences.
4	Major	Permanent injury	Major damage rendering property ineffective in achieving design functions without major repairs	Large reduction in safety margins. Crew workload increased to point of performance decrement. Serious injury to small number of occupants. Intense critical incident stress.	High site impact, moderate local impact, important consideration at state level. Minor long-term cumulative effect. Design and mitigation measures unlikely to remove all effects.
5	Catastrophic	Multiple Fatalities	Damaged beyond repair	Conditions preventing continued safe flight and landing. Multiple deaths with loss of aircraft	Catastrophic site impact, high local impact, national importance. Serious long-term cumulative effect. Mitigation measures unlikely to remove effects.

Risk matrix

The risk matrix, which correlates likelihood and consequence to determine a level of risk, used in this report is shown in Table 3.

Table 3 Risk Matrix

		CONSEQUENCE				
		INSIGNIFICANT 1	MINOR 2	MODERATE 3	MAJOR 4	CATASTROPHIC 5
LIKELIHOOD	ALMOST CERTAIN 5	6	7	8	9	10
	LIKELY 4	5	6	7	8	9
	POSSIBLE 3	4	5	6	7	8
	UNLIKELY 2	3	4	5	6	7
	RARE 1	2	3	4	5	6

Actions required

Actions required according to the derived level of risk are shown in Table 4.

Table 4 Actions Required

8-10	**Unacceptable Risk**	Immediate action required by either treating or avoiding risk. Refer to executive management.
5-7	**Tolerable Risk**	Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.
0-4/5	**Broadly Acceptable Risk**	Managed by routine procedures, and can be accepted with no action.

ANNEXURE 5 – PROJECT TURBINE COORDINATES AND HEIGHTS

Reference file: IPAUSNSWXXWCR241111 and SRTM elevation data

WTG ID	Coord X	Coord Y	Terrain elevation (m AHD)	WTG Height (m AGL)	Maximum Height (m AHD)	Maximum Height (ft AMSL)
8	625170	6417614.4	328.9	271.5	600.4	1969.9
9	625116	6417057.5	355.0	271.5	626.5	2055.3
20	621997	6418985.3	301.9	271.5	573.4	1881.2
21	622466	6418291.5	321.5	271.5	593.0	1945.4
22	622921	6417697.2	306.5	271.5	578.0	1896.4
23	623602	6417277.7	346.0	271.5	617.5	2026.1
24	623531	6416778.9	340.8	271.5	612.3	2009.0
25	622999	6416448.9	326.3	271.5	597.8	1961.4
26	622839	6415960.7	315.3	271.5	586.8	1925.3
27	622800	6415366.4	298.9	271.5	570.4	1871.3
35	619772	6414908.1	303.3	271.5	574.8	1885.8
36	620019	6414470.3	303.0	271.5	574.5	1884.8
37	620077	6413869.7	308.0	271.5	579.5	1901.3
38	620117	6413338.6	309.0	271.5	580.5	1904.5
39	620016	6412807.6	313.3	271.5	584.8	1918.7
40	620018	6412290.1	323.5	271.5	595.0	1952.2
41	620102	6411667.8	330.7	271.5	602.2	1975.7
42	620276	6411188.7	334.4	271.5	605.9	1988.0
43	620131	6410672.8	327.9	271.5	599.4	1966.5
66	628374	6412701.1	380.9	271.5	652.4	2140.3
67	628698	6412320.9	372.0	271.5	643.5	2111.2
68	626889	6412557.5	419.3	271.5	690.8	2266.4
69	627067	6412083.6	359.9	271.5	631.4	2071.4
70	627325	6411627.6	346.3	271.5	617.8	2026.8
71	626437	6411484.0	342.0	271.5	613.5	2012.7
72	626758	6410652.7	343.2	271.5	614.7	2016.7

WTG ID	Coord X	Coord Y	Terrain elevation (m AHD)	WTG Height (m AGL)	Maximum Height (m AHD)	Maximum Height (ft AMSL)
73	626493	6410093.1	343.6	271.5	615.1	2018.0
74	626374	6409526.5	354.5	271.5	626.0	2053.7
75	626067	6409021.5	351.4	271.5	622.9	2043.5
79	624046	6411690.7	316.0	271.5	587.5	1927.5
80	624131	6411193.0	319.0	271.5	590.5	1937.3
81	624432	6410806.1	328.0	271.5	599.5	1966.9
82	624570	6410309.1	328.2	271.5	599.7	1967.6
83	624533	6409781.7	329.8	271.5	601.3	1972.6
84	624570	6409250.2	339.5	271.5	611.0	2004.5
92	620357	6417110.0	292.0	271.5	563.5	1848.8
93	620543	6416449.6	287.6	271.5	559.1	1834.2
94	620950	6416006.2	294.0	271.5	565.5	1855.3

ANNEXURE 6 – WIND MONITORING TOWERS - COORDINATES AND HEIGHTS

Reference file: Masts - IPAUSNSWXXWCR2411 and SRTM elevation data

Mast ID	*Coord X*	*Coord Y*	*Ground elevation (m AHD)*	*Mast Height (m AGL)*	*Mast Height (ft AMSL)*
WTG20_P	622364.1899	6418990.883	298	200	498
WTG37_P	620450.5626	6413862.566	301	200	501
WTG75_P	625855.1102	6408686.505	361.8101196	200	561.8

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