Appendix 18

Aviation Impact Assessment

May 2024

AVIATION IMPACT ASSESSMENT

JUNCTION RIVERS WIND FARM

Prepared for Umwelt (Australia) Pty Ltd

AVIATION PROJECTS

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AVIATION PROJECTS

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ACRONYMS

AAAA	Aerial Agricultural Association of Australia
AC	Advisory Circular
AFAC	Australasian Fire and Emergency Services Council
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
NOTAM	Notice to Airmen
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	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

Windlab (The Proponent) is proposing to develop the Junction Rivers Wind Farm (the Project), located approximately 15 kilometres (km) south of Balranald, NSW, within the Murray River Local Government Area (LGA).

Umwelt (Australia) Pty Ltd (Umwelt) has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) for the Project to support the proposed State Significant Development (SSD) application and formally consult with aviation agencies.

The Project requires an aviation assessment undertaken in accordance with the Environmental Planning and Assessment Act 1979, relevant regulations, the Wakool Local Environmental Plan and in consideration of the NSW Wind Energy Guideline for State significant wind energy development 2016 and other relevant guidance and regulatory requirements such as the National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers* and specific requirements as advised by Airservices Australia.

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 Aviation Impact Statement (AIS) and a qualitative risk assessment to determine the need for obstacle lighting.

Project Overview

The Project will involve the development of up to 96 wind turbine generators (WTGs) with an approximate generating capacity of up to 750 MW. Associated infrastructure includes substations/switching stations, underground cables and overhead powerlines, battery energy storage system (BESS) or static synchronous condenser (StatCom), access tracks, hardstands and construction laydown areas.

Key Assessment Considerations and Conclusions

The key conclusions of this AIA are summarised as follows:

Planning considerations

The Proposal is classed as SSD under the State Environmental Planning Policy (Planning Systems) 2021 and will be assessed under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A).

An Environmental Impact Statement (EIS) will be prepared in accordance with the SEARs and will be submitted to the Department of Planning, Housing and Infrastructure (DPHI) for assessment.

The Project Area is within Murray River Council local government area and covered by the Wakool Local Environmental Plan (LEP) 2013.

The Murray River Council Local Environmental Plan 2011 and the Wakool LEP 2013 do not incorporate any reference to the development of wind farms or the protection of aeronautical infrastructure.

Aviation Impact Assessment

Based on the Project WTG layout and maximum blade tip height of up to 369.74 m AHD (1213.1 ft AMSL) for WTG#85, the Project:

- would not penetrate any OLS surfaces
- would infringe the PANS-OPS surface related to the Swan Hill aerodrome 25 nm MSA
- will have an impact on the relevant Grid LSALT. The overlying 1800 ft Grid LSALT will need to be raised by 500 ft to 2300 ft AMSL
- will have an impact on nearby designated air routes. W762 LSALT will need to be raised by 200 ft to 2300 ft AMSL. H247 LSALT will need to be raised by 300 ft to 2300 ft AMSL
- wake turbulence effects may have an impact on aircraft operating in the vicinity of ALA#1 and ALA#2. The owners of these facilities should be provided with this AIA to allow them to consider the impact to their flight operations
- standard circuit heights will be impacted by the height of the wind turbines within the circuit area of Arundel ALA
- will not have an impact on operational airspace
- is wholly contained within Class G airspace
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

Aircraft operator characteristics

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

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.

Obstacle lighting risk assessment

Aviation Projects has undertaken a safety risk assessment of the Project and concludes that WTGs and temporary/permanent WMTs that are installed in close proximity to a WTG will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

Temporary WMTs that are installed prior to WTG installation, and WMTs that are not in close proximity to a WTG, will require obstacle lighting to maintain an acceptable level of safety.

Consultation

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

A detailed consultation is required with the owner of the Arundel ALA to determine their perspective regarding the impact of the nearby WTGs.

Summary of key recommendations

A summary of the key recommendations of this AIA is set out below.

1. Final design details of WGT and WMT exceeding 100 m 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).
2. Final design details of WGT and WMT coordinates and elevation should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.
3. Any obstacles above 100 m 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.

Operation

6. Whilst not a statutory requirement, the Proponent should consider engaging with any local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.
7. The proponent should notify landowners of the identified landing grounds within 3nm of the Project Area to determine any impacts from the WTG proximity and potential wake turbulence effects to determine any impacts from WTG wake turbulence effects

Marking of WTGs

8. The rotor blades, nacelle and the mast supporting the WTGs should be painted white, typical of most WTGs operational in Australia. No additional marking measures are required for WTGs.

Lighting of WTGs

9. Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

Marking of wind monitoring towers

10. 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:
    a. marker balls or high visibility flags or high visibility sleeves should be placed on the outside guy wires

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

c. ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation.

Lighting of wind monitoring towers

11. Consideration should be given to lighting temporary WMTs installed prior to WTG installation and 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

12. The potential micrositing of the WTGs and WMTs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the nominal WTG and WMT positions. Providing the micrositing is within 100 m of the WTGs and WMTs is not likely to 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

13. 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 Part 139 MOS 2019 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

Triggers for review

14. 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

Windlab is proposing to develop the Junction Rivers Wind Farm (the Project), located approximately 15 kilometres (km) southeast of Balranald, NSW, within the Murray River Local Government Area (LGA).

Umwelt (Australia) Pty Ltd (Umwelt) has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) for the Project to support the proposed State Significant Development (SSD) application and formally consult with aviation agencies.

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 Aviation Impact Statement (AIS) and a qualitative risk assessment to determine the need for obstacle lighting.

1.2. Purpose and Scope

The purpose and scope of work is to prepare an AIA for consideration by Airservices Australia, CASA and Department of Defence and support the development application.

The assessment specifically responds to the:

- Murray River Local Environment Plan (LEP) 2011
- Balranald LEP 2010
- Wakool LEP 2013
- NSW Government, Department of Planning and Environment SEARS, 19 December 2023
- Civil Aviation Safety Authority, *Civil Aviation Safety Regulations 1998* (CASR)
- NASF Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*
- Aeronautical Impact Statement requirements as advised by Airservices Australia at https://www.airservicesaustralia.com/industry-info/airport-development-assessments/

Assistance will be provided in support of stakeholder consultation and engagement in preparing the assessment and negotiating acceptable mitigation to identified impacts.

1.3. Methodology

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

1. Confirm the scope and deliverables with the Proponent (or representative)
2. Review client material
3. Review relevant regulatory requirements and information sources
4. Prepare 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
5. Prepare an AIS and a qualitative risk assessment to determine need for obstacle lighting and marking
6. Identify risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment was completed following the guidelines in *ISO 31000:2018 Risk Management – Guidelines*
7. Address the analysis requirements of the Planning Secretary's Environment Assessment Requirements (SEARs), SSD-30448824 issued to Windlab Developments Pty Ltd on 19 December 2023
8. Consult with relevant Certified Aerodrome Operators, Part 173 procedure designers (Airservices Australia) and aerodrome operators of the nearest aerodrome/s to seek endorsement if changes are proposed to instrument flight procedures to accommodate the wind farm
9. Consult/engage with stakeholders to negotiate acceptable outcomes (if required)
10. Finalise 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 Area
- Specify uncertified aerodromes located within 3 nm of the Project Area
- Nominate all relevant instrument flight procedures
- Nominate visual flight procedures and likely impacts
- Review the potential effect of the Project operations on the operational airspace of the aerodrome(s).

Air Routes:

- Nominate air routes which are located near/over the Project Area and review potential impacts of Project operations on aircraft using those air routes
- Nominate the relevant Grid LSALT located near/over the Project Area and review potential impacts of Project operations

Airspace:

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

Navigation/Radar:

- Nominate ATC radar and aviation navigation systems with coverage overlapping the site.

1.5. Material reviewed

Material provided by the Proponent for preparation of this assessment include:

- 220kV_Nat'l Transmission. Kmz
- 0210506_Final_SEARs_Study_Area_Boundary_AT.kmz
- Wind Combined Agency Advice.pdf
- 20230421_Burrawong_Rev L09_96WTG_AG.xml
- EssentialEnergy_22kV_AT.kmz.
- 330_kV_Internal_Reticulation_overhead_230622.kmz
- MetMast_Locations_230515.kmz
- PowerPerformanceMasts_230515.kmz
- PowerPerformance_MastLocations_230515.xls
- MetMast_Locations_230515.xls
- MetMast_Locations_230515_AHD.xlsx
- PowerPerformanceMasts_230515_AHD.xlsx.

2. BACKGROUND

2.1. Site overview

The Project Area is located 15 km south of Balranald in New South Wales.

An overview of the Project Area relative to Balranald NSW is provided in Figure 1 (source: Umwelt, Google Earth).

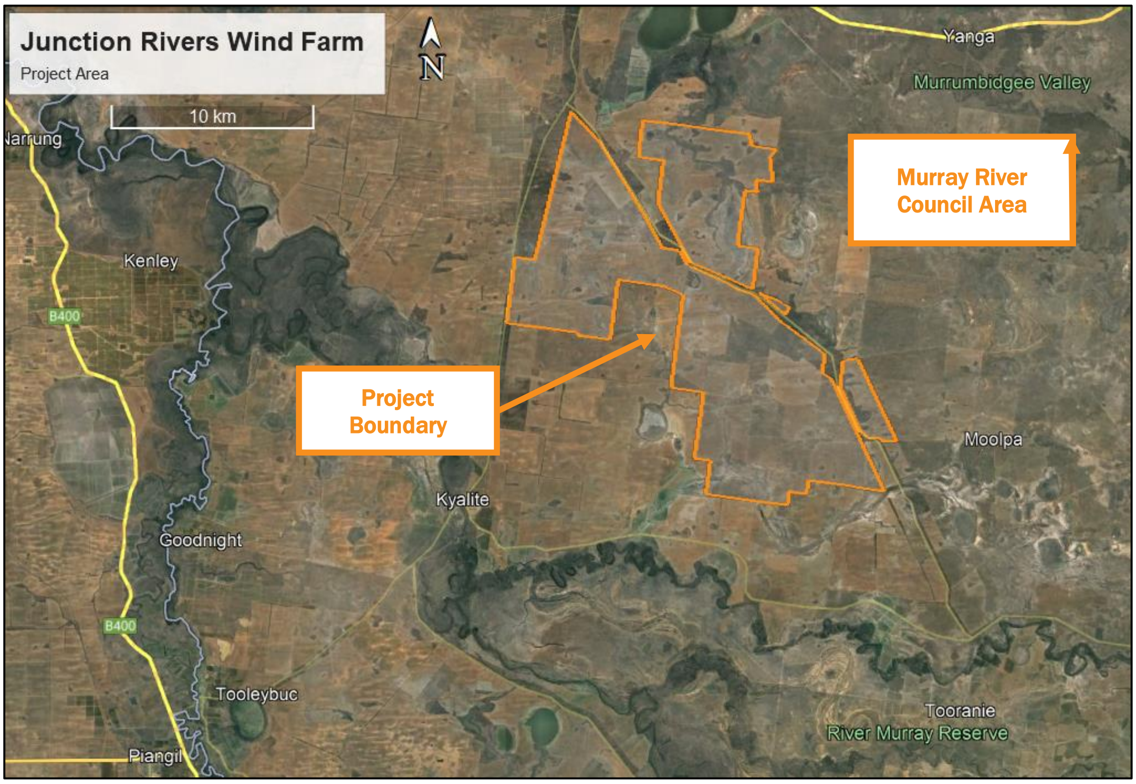


Figure 1 Project Area location overview

2.2. Project Description

Windlab Developments Pty Ltd (Windlab) proposes to develop the Junction Rivers Wind Project (the Project) to provide a reliable and affordable source of energy for the people of New South Wales (NSW) and contribute to reducing greenhouse gas (GHG) emissions associated with energy generation. The Project is located approximately 15 kilometres (km) south of Balranald, 140 km west of Hay and 20 km northeast of the NSW and Victorian border within the southern section of the Murray-Darling Basin. The Project is within the Murray River Council Local Government Area (LGA) and immediately east of Balranald Shire LGA. The Project is located within the South-West Renewable Energy Zone (SW REZ), which the NSW Government has identified as a target area for renewable energy development in its Transmission Infrastructure Strategy and Electricity Infrastructure Roadmap.

The Project is SSD as defined under State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) and will require development consent under Part 4 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act).

The Project will have a generating capacity of approximately 750 megawatts (MW) and would connect to the existing 220 kV transmission line that traverses the site and/or the Project EnergyConnect transmission line.

The key components of the Project include:

- approximately 96 (3 blade) WTGs with a total height (tip height) of approximately 300 metres (m)
- electrical connections between the proposed WTGs and substations/switching stations consisting of a combination of underground cables and overhead powerlines
- substations/switching stations and transmission connections to connect to the existing 220 kV transmission line and/or the Project EnergyConnect transmission line
- up to four battery energy storage system (BESS) facilities (to a total of 200 megawatts (MW) with a 4 hour delivery capacity), or up to four static synchronous compensator (STATcom) facilities
- other associated infrastructure including access roads and tracks, operation and maintenance buildings and construction facilities
- temporary on-site concrete batching plants and rock crushing facilities during the construction phases
- targeted road network upgrades to facilitate delivery of WTG components to the site as required.

The Project may be constructed in two stages. Stage 1 may see the construction of up to 30 WTGs and required ancillary infrastructure and Stage 2 may see the construction of the remaining WTGs and required ancillary infrastructure. The construction period would be approximately four years.

For environmental assessment purposes, a Project ‘Development Corridor’ has been established consisting of a buffer around the conceptual layout for the Project. The Development Corridor represents a worst-case assessment scenario and allows for refinement of Project infrastructure, such as micro-siting of WTGs, during the detailed design phase.

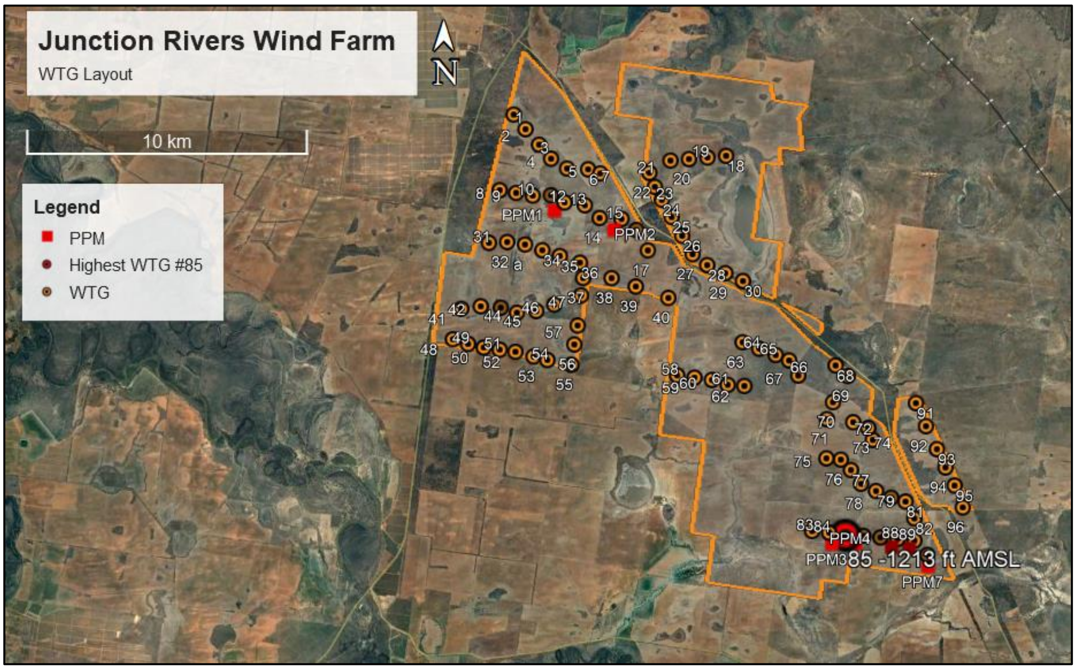


Figure 2 Project layout

3. EXTERNAL CONTEXT

3.1. Planning context

Windlab seeks to construct and operate the Junction Rivers Wind Farm while protecting individuals, communities, and the environment from adverse impacts.

The role of the NSW Department of Planning, Housing and Infrastructure (DPHI) is to coordinate the planning process according to the applicable regulations, and in partnership with individual people, community groups, businesses and industry groups, other organisations, local councils, and State and Commonwealth Government agencies. The legal framework includes the *Environmental Planning and Assessment Act 1979* and *Environmental Planning and Assessment Regulation 2021*. Development projects such as wind farms in NSW must submit a development application for approval by the Minister for Planning and Public Spaces.

The SEARs for the project, re-issued 19 December 2023, relevant to this study include:

Hazards and Risks – including:

- Aviation Safety:
  - assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft;
  - provide associated height and co-ordinates for each turbine assessed;
  - assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting and marking, including of wind monitoring masts, considering, defined air traffic routes, aircraft operating heights, approach / departure procedures, radar interference, communication systems, navigation aids, use of emergency helicopter access, and aerial baiting and culling in the National Park;
  - identify aerodromes within 30 km of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;
  - address impacts on obstacle limitation surfaces; and
  - assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line;
- *Engagement – carry out detailed consultation with the following:*

- Murray River Council

-Balranald Shire Council

-NSW National Parks and Wildlife Service

-Fire & Rescue NSW

-NSW Rural Fire Service

-Commonwealth Department of Defence

-Civil Aviation Safety Authority

-Airservices Australia.

3.2. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by Commonwealth Department of Infrastructure and Transport 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 operation of wind farms and WMTs.

The methodology for preparing the risk assessment is contained in the NASF Guideline D *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*.

The risk assessment will have regard to all potential aviation activities within the vicinity of the Project Area including recreation, commercial, civil (including for agricultural purposes) and military operations.

The AIS of this report identifies high level risks, risk mitigation measures and development constraints that are likely to be applicable to the aviation risk assessment.

3.3. Murray River Council

The Project Area is within Murray River Council local government area and covered by the Wakool Local Environmental Plan (LEP) 2013.

The Murray River Council LEP 2011 and the Wakool LEP 2013 do not include any airspace provisions relevant to the Project.

3.4. Aircraft operations at non-controlled aerodromes

There are several uncontrolled aerodromes, ie aircraft landing areas (ALA) in the vicinity of the Project Area. Advisory Circulars (ACs) provide advice and guidance from CASA to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements. Advisory Circular (AC) 91-10 v1.1 *Operations in the vicinity of non-controlled aerodromes* provides guidance for pilots flying at or in the vicinity of non-controlled aerodromes, with respect to CASR 91.

A conventional circuit pattern and heights are provided in AC 91-10 v1.1. The standard circuit consists of a series of flight paths known as *legs* when departing, arriving or when conducting circuit practice. Illustrations of the standard aerodrome traffic circuit procedures provided in AC 91-10 v1.1. are shown in Figure 3 and Figure 4.

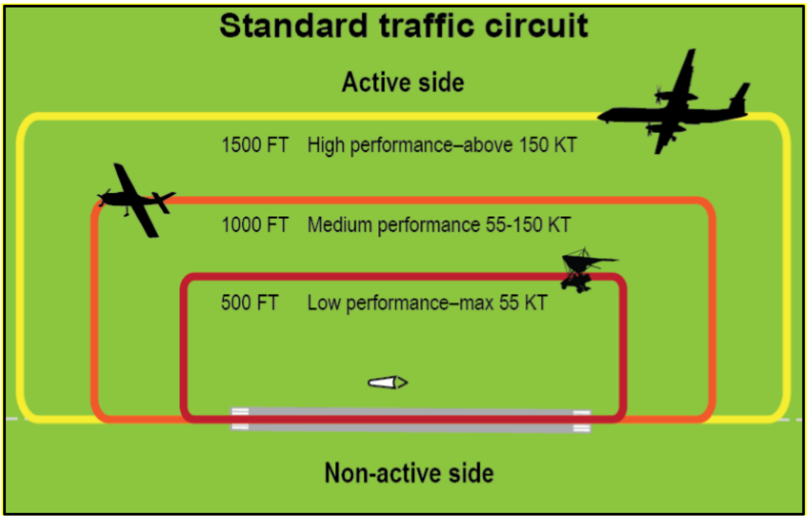


Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

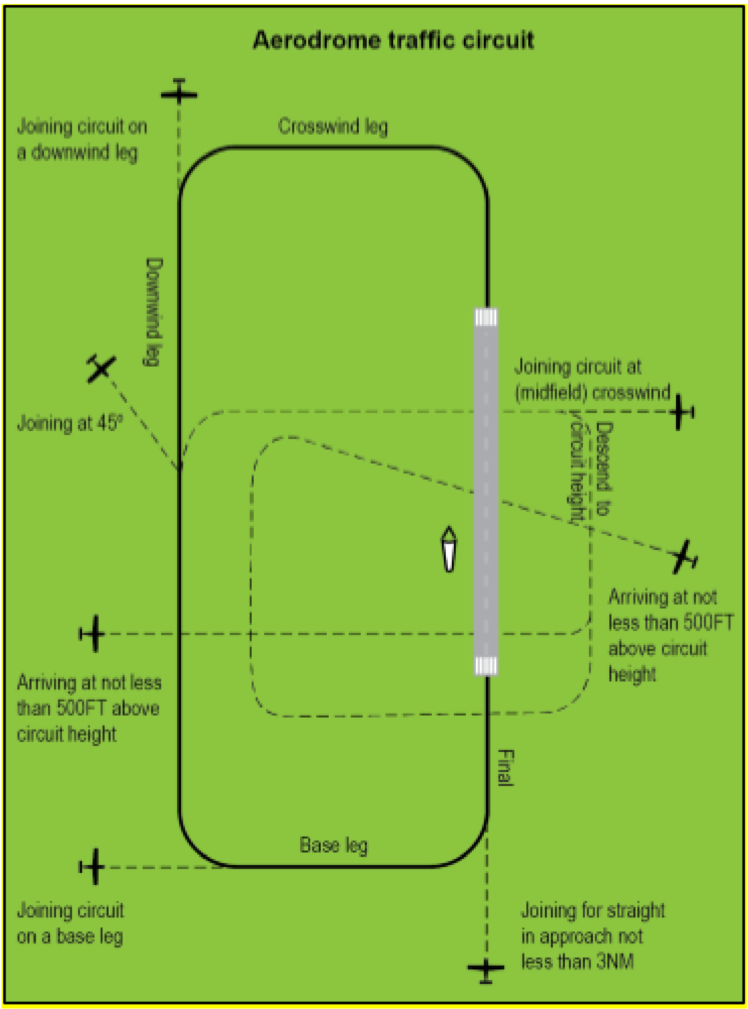


Figure 4 Aerodrome standard traffic circuit, showing arrival and joining procedures

AC 91-10 v1.1. paragraph 7.10 makes reference to a distance that is “normally” well outside the circuit area and where no traffic conflict exists, which is at least 3 nm (5556 m). The paragraph is copied below:

> *7.10 Departing the circuit area*
>
> *7.10.1 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 will normally be 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.*

3.5. Rules of flight

3.5.1. Flight under Day Visual Flight Rules (VFR)

According to Aeronautical Information Publication (AIP) the meteorological conditions required for visual flight in the applicable (Class G) airspace at or below 3000 ft AMSL or 1000 ft AGL whichever is the higher are: 5000 m visibility, clear of clouds and in sight of ground or water.

Civil Aviation Safety Regulation (1998) 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).

These height restrictions do not apply if through stress of weather or any other unavoidable cause it is essential that a lower height be maintained.

Flight below these height restrictions is also permitted in certain other circumstances.

3.5.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Safety Regulations (1998) 91.277 requires that the pilot in command of an aircraft flying VFR at night must not fly below the following heights (unless during take-off and landing operations, within 3 nm of an aerodrome, or with an air traffic control clearance):

a) *the published lowest safe altitude for the route or route segment (if any);*

b) *the minimum sector altitude published in the authorised aeronautical information for the flight (if any);*

c) *the lowest safe altitude for the route or route segment;*

d) *1,000 ft above the highest obstacle on the ground or water within 10 nautical miles ahead of, and to either side of, the aircraft at that point on the route or route segment;*

e) *the lowest altitude for the route or route segment calculated in accordance with a method prescribed by the Part 91 Manual of Standards for the purposes of this paragraph.*

3.5.3. Instrument Flight Rules (IFR) (Day or night)

According to CASR Part 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.

3.6. Aircraft operator characteristics

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

Operations conducted under VFR are required to remain in visual meteorological conditions (VMC) (at least 5,000 m horizontal visibility at a similar height of the WTGs) and clear of the highest point of the terrain by 500 ft vertical distance and 600 m horizontal distance. In VMC, the WTGs will likely be sufficiently conspicuous to allow adequate time for pilots to avoid the obstacles. VFR operators will most likely avoid the Project Area once WTGs are erected.

Flight under day VFR is conducted above 500 ft (152.4 m) 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 WTGs will be sufficiently visually conspicuous to pilots conducting VFR operations within the vicinity of the Project 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 7.

3.7. Passenger transport operations

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

3.8. 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.

3.9. 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.

3.10. 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 (2 m) and 100 ft (30.5 m) AGL.

Aerial application operations are conducted in the area.

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

The Aerial Application Association of Australia (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.

The impact of the proposed WTGs on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the Project Area was assessed.

3.11. Aerial Application Association of Australia (AAAA)

In previous consultation with the AAAA, Aviation Projects has been directed to the AAAA Windfarm Policy (dated March 2011) which states in part:

> *In other areas, AAAA is also opposed to wind farm developments unless the developer is able to clearly demonstrate they have:*
>
> > *1. consulted honestly and in detail with local aerial application operators;*
> >
> > *2. sought and received an independent aerial application expert opinion on the safety and economic impacts of the proposed development;*
> >
> > *3. clearly and fairly identified that there will be no short or long term impact on the aerial application industry from either safety or economic perspectives;*
> >
> > *4. if there is an identified impact on local aerial application operators, provided a legally binding agreement for compensation over a fair period of years for loss of income to the aerial operators affected; and*
> >
> > *5. adequately marked any wind farm infrastructure and advised pilots of its presence.*

The AAAA's National Wind Farm Operating Protocols list considerations for developers during the design/build stage and the operational stage, for pilots/aircraft operators during aircraft operations and discusses economic compensation. NASF Guideline D is included in the Protocols document as Appendix 1, and AAAA Aerial Application Pilots Manual – excerpts on planning are provided as Appendix II.

This AIA has been prepared in consideration of the National Windfarm Operating Protocols.

3.12. Local 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.

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 Area 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, wind 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 in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

3.13. Aeromedical services

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.

Refer to Section 5 for detailed responses from emergency service stakeholders.

3.14. 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 Australasian Fire and Emergency Services Council (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 verbatim 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.*

Windlab will consult with fire services (aerial and ground) relating to operational procedures as relevant.

Aviation Projects consulted with NSW Rural Fire Service in October 2023 as detailed in Section 5 – *"This site will have minimal impact on our aerial operations."*

3.15. Aerial Activity in National Parks

The NSW Parks and Wildlife Service (NPWS) manages the Yanga National Park which is located to the north and west of the Project Area as shown in Figure 5.

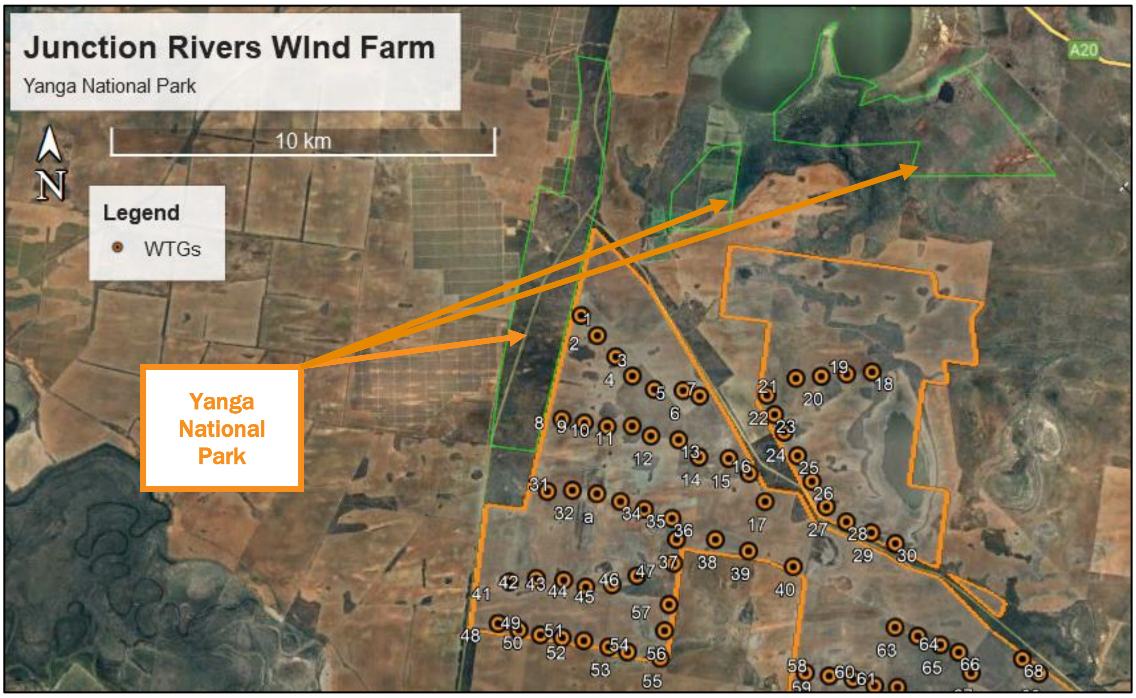


Figure 5 Project area and Yanga National Park

Aviation activities include aerial pest management (rotary), Waterbird monitoring (fixed-wing), Pest monitoring (Fixed & rotary), aerial fire-fighting and Native Fauna Surveys.

Depending on the direction of wind, low level flight operations within 2000 m of a WTG may encounter downwind turbulence from WTGs. (see Section 6.6.1 for details)

Section 5 details the consultation undertaken by Aviation Projects in relation to aviation activity in the vicinity of the Project Area.

Windlab will consult with NPWS relating to operational procedures as relevant.

4. INTERNAL CONTEXT

4.1. Wind farm site description

The Junction Rivers Wind Farm is located approximately 15 km south of Balranald NSW, adjacent to and east of Yanga Way which runs south from Balranald to Tooleybuc. The topography is primarily flat and generally featureless cropping and scrubland.

A site visit was conducted in an aircraft on 10 October 2022

Figure 6 and Figure 7 show typical landscape for the Project Area.

Figure 6 Typical landscape for the Project Area

Figure 7 Typical landscape for the Project Area – aerial view

4.2. Wind turbine generator (WTG) description

The Project Area is to comprise of up to 96 WTGs. The maximum blade tip height of the proposed WTGs will be 300 m above ground level (AGL).

The ground elevation for the highest WTG (WTG 85) is 70.19 m above mean seal level (AMSL) which, with a 300 m WTG height, results in a maximum overall height of 369.74 m AMSL (1213.1 ft AMSL).

Figure 8 illustrates the preliminary Project layout identifying the highest WTG, WTG 85 (source: Umwelt, Google Earth).

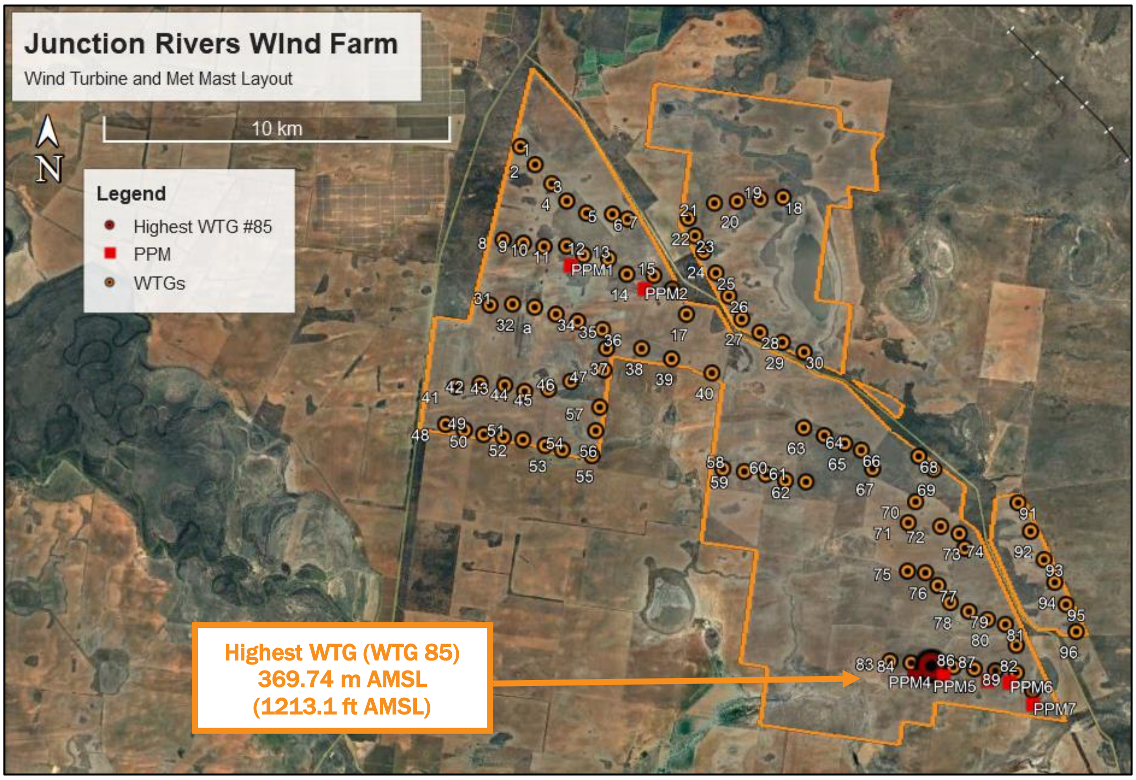


Figure 8 Project layout and highest WTG

The coordinates and ground elevations of the proposed WTGs analysed are listed in **Annexure 5.**

The potential micrositing of the WTGs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m of the nominal WTG position.

'Micrositing' of WTGs means an alteration to the siting of a WTG by not more than 100 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. This AIA assumes that a maximum blade tip height of 300 m AGL is implemented at all WTG locations.

4.3. Wind monitoring tower description

The Project Area is to comprise of two temporary Meteorological Masts and seven Indicative Power Performance Masts (IPPM). The maximum height of these masts will be 200 m AGL.

The ground elevation for the highest mast location is 72 m above mean seal level (AMSL) which results in a maximum overall height of 272 m AMSL (892.4 ft AMSL).

Masts constructed prior to the WTGs should be appropriately lit and marked in accordance with NASF Guideline D and MOS 139 Section 8.110 / 9.30. The details of the masts will be reported to Airservices Australia by the developer for entry into Vertical Obstruction Database when the construction is completed.

Figure 9 illustrates the Project layout identifying the highest mast (source: (Umwelt, Google Earth).

Figure 9 Mast locations

The details including coordinates and ground elevations of the masts are provided in **Annexure 6.**

The potential micrositing of the masts has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m of the nominal mast position.

'Micrositing' of the masts means an alteration to the siting of masts by not more than 100 m and any consequential changes to access tracks and internal power cable routes.

The micrositing of the masts is not likely to result in a change in the maximum overall mast height. This AIA considers that a maximum mast height of 200 m AGL is implemented at all locations.

4.4. Grid transmission

Electrical infrastructure contained within the Project Area is proposed to consist of:

- two substations to step up the voltage from the WTGs to the voltage for the electricity network
- up to four battery energy storage system (BESS) facilities (to a total of 200 megawatts (MW) with a 4 hour delivery capacity), or up to four static synchronous compensator (STATcom) facilities.
- up to 16 km of overhead transmission line, which would form the physical connection between the substations, and the existing/proposed electricity network that traverses the Project Area. Depending on the connection configuration, this overhead line may be 330/500kV (for connection into Project EnergyConnect), or 220kV (for connection into the existing 220 kV TransGrid transmission line).

The Project would either connect into the future Project EnergyConnect transmission line, or alternatively into the existing 220kV TransGrid transmission line. The 220kV TransGrid transmission line traverses the site, as shown in Figure 2-8. The proposed easement for the Project EnergyConnect line also traverses the site and is located directly to the north of the easement for the existing TransGrid line.

Figure 10 shows the extent of overhead electrical reticulation and transmission lines within the Project Area.

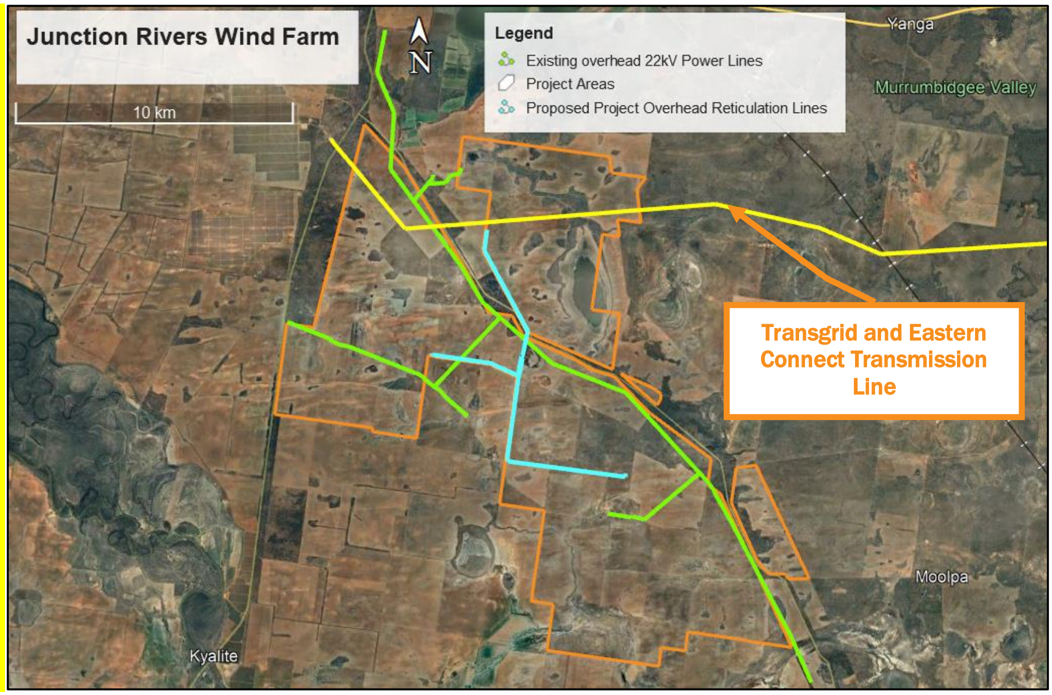


Figure 10 Electrical reticulation and transmission lines within the Project Area

5. CUMULATIVE IMPACTS

The Environmental Planning and Assessment Act 1979 (EP&A Act) plays a central role in the NSW Government's statutory framework for managing cumulative impacts across NSW.

Cumulative impacts are a result of incremental, sustained and combined effects of human action and natural variations over time and can be both positive and negative. They can be caused by the compounding effects of a single project or multiple projects in an area, and by the accumulation of effects

This section of the AIA addresses cumulative impacts to aviation activity in the area surrounding the Project area.

The Project is within the South West REZ, a region selected by the NSW Government for its significant potential for renewable energy generation and regional development.

Within the REZ, many wind farms are under consideration by planning authorities.

In the area around the proposed Junctions Rivers Wind Farm there are other wind farms subject to State Significant Applications. They are detailed in Table 1.

Table 1 Nearby renewable energy projects

Project	*Detail*	*Potential Cumulative Impact*
Solar Projects		
Limondale Solar Farm	Approximately 1 km to Project Area. Operational solar farm.	Solar farms present no cumulative impact to wind farms other than to reduce the area that an aircraft can use for an emergency landing. You can't land in a solar farm but you can in a wind farm.
Sunraysia Solar Farm	Approximately 1 km to Project Area. Operational solar farm.	
Keri Keri Solar Farm	Approximately 20 km to Project Area. Currently in planning and assessment phase.	
Wind Projects		
Baldon Wind Farm	Approximately 40 km from the Project Area. Currently in planning and assessment phase.	No impact
Euston Wind Farm	Approximately 75 km from the Project Area. Currently in planning and assessment phase.	No Impact
Keri Keri Wind Farm	Approximately 20 km from the Project Area. Currently in planning and assessment phase.	No Impact
Pottinger Wind Farm	Approximately 107 km from the Project Area. Currently in planning and assessment phase.	No Impact
Tchelery Wind Farm	Approximately 50 km from the Project Area. Currently in planning and assessment phase.	No Impact

The Plains Renewable Energy Park	Approximately 110 km from the Project Area. Currently in planning and assessment phase.	No Impact
Wilan Wind Farm	Approximately 24 km from the Project Area. Currently in planning and assessment phase.	No Impact
Project Energy Connect (NSW – Eastern Section)	Partly within Project area.	No Impact

The wind farms shown above, are sufficiently far apart to not create any cumulative impacts to each other.

There are no certified or non-certified aerodromes that are impacted by more than one wind farm in this area of the REZ.

A wind farm may create a requirement for aircraft operating at an uncertified aerodrome to limit the direction of its standard circuit patterns to one particular side of the runway. If another wind farm is to be located on that side of the runway it may cause the aerodrome to cease operations.

Wind turbines provide a prominent navigation feature for aircraft operating in accordance with the Visual Flight Rules prescribed in CASR Part 91 – *General Operating and Flight Rules*. They are shown on aeronautical charts and in electronic flight bag systems to enable pilots to be aware of their presence. Aircraft generally operate at a much higher altitudes than wind farms, during the cruise phase of flight for fuel efficiency and passenger comfort.

Within an area related to the existence of downwind turbulence, aircraft operations at low altitudes may be impacted and restrict aircraft operations at aerodromes in this area.

A large number of wind farms in a particular region may impose limitations for property owners wishing to create a new aerodrome on their property.

Whilst several wind farms are being proposed in this REZ, none are constructed and not all will be approved and/or constructed.

Consultation with land owners and especially those with an aerodrome on their property, or on a neighbouring property, as well as local and regional emergency services will determine the extent of some cumulative impacts.

It is difficult to make a full assessment of the cumulative impacts to the aerodromes and aviation activity assessed in this AIA from the information available on NSW Planning Portal website.

6. CONSULTATION

The following list of stakeholders were identified as requiring consultation:

- Airservices Australia
- Department of Defence
- Murray River Council
- Balranald Shire Council – Operator of Balranald Airport
- Swan Hill Shire Council – Operator of Swan Hill Airport
- Royal Flying Doctor Service
- Aerial operators
- NSW Rural Fire Service
- NSW Parks and Wildlife Service
- NSW Ambulance Service

Details and results of the consultation activities is provided in Table 2.

Table 2 Stakeholder consultation details (TBC)

Agency/Contact	*Activity/ Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
Airservices Australia	2 October 2023	8 March 2024	Please find below Airservices *amended* Airspace Procedures response. I refer to your request for an Airservices assessment of the proposed Junction Rivers 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 369.7418m/1214ft AHD, 24 wind turbines will affect the 25nm MSA procedure at Swan Hill aerodrome. The 25nm MSA is required to be raised by 200ft from 2000ft to 2200ft to accommodate the wind farm. The MSA will also need to be sectorised to accommodate the increased altitude without impacting the instrument approach procedures. At a maximum height of 369.7418m/1214ft AHD, 46 wind turbines will affect the air route W762 lowest safe altitudes (LSALT) and 27 turbines will affect the H247 lowest safe altitudes (LSALT). The air route W762 is required to be raised by 200ft from 2100ft to 2300ft and the air route H247 is required to be raised by 300ft from 2000ft to 2300ft to accommodate the wind farm. For the wind farm to not affect any procedures at Swan Hill aerodrome or any routes, wind turbines 50 to 56 and 58 to 96 must not exceed a maximum height of 304.8m (1000ft) AHD. If this wind farm is approved the proponent will need to consult with stakeholders, CASA and Swan Hill aerodrome regarding the impacts detailed above. Note: Procedures not designed by Airservices at Swan Hill 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	Provide Airservices Australia with the final details of the wind farm to enable amendments to the affected procedures. Swan Hill Council will need to agree to the amendments prior to them being made. Provide Airservices Australia with “as constructed” details of the wind farm for inclusion in aeronautical databases and charts.

Agency/Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding. **Air Traffic Control (ATC) Operations** There are no additional instructions or concerns from our ATC. **Summary** It is our view is that the proposed Wind Farm impacts Airservices designed airspace procedures, CNS facilities or ATC operations at Swan Hill aerodrome. Please consult with the aerodrome and aviation operators to ensure that they accept the proposed changes. We need confirmation from the aerodrome before we make any changes. All amendments to airspace procedures are on a commercial basis. It is our view that the proposed Wind Farm impacts Airservices designed Grid LSALT as currently presented. The Grid LSALT will need to increase from 1800 ft to 2300 ft. Please advise the Vertical Obstacle Data (VOD) team at VOD@airservicesaustralia.com of any need to increase Grid LSALT heights at least two (2) weeks before construction commencing by supplying the below information: Approved wind turbine locations Elevations at the top of the highest point of the turbine in metres AHD A copy of this email If you have any further queries, please let me know. Kind regards, Alex Blight Airspace Development & Protection Coordinator	

Agency/Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
Department of Defence	2 October 2023	23 April 2024	Thank you for referring the Junction River Wind Farm proposal to the Department of Defence (Defence) for comment. Defence understands that this proposal is for the installation of 96 new Wind Turbines Generators (WTG) with a tip height of 300m Above Ground Level (AGL) approximately 17 km south of Balranald, NSW. The ground elevation for the highest WTG is understood to be 70.19 m Above Mean Sea Level (AMSL) which , with a 300 m WTG height, results in a maximum overall height of 369.74 m AMSL (1213.1 ft AMSL). Defence has assessed the proposal with respect to any impact on the safety of military flying operations and possible interference to Defence communications and radars. Defence can advise that it has no concerns with the Junction Rivers Wind Farm at this time. Air Services Australia (ASA) is responsible for recording the location and height of tall structures. The information is held in a central database managed by ASA and relates to the erection, extension or dismantling of tall structures, RAAF requirements are: a. 30 metres AGL, that are within 30 kilometres of an aerodrome, and b. 45 metres AGL elsewhere. In accordance with Advisory Circular 139.E-01 – Reporting of tall structures, Defence requests that the applicant is to provide Defence and Air Services Australia (ASA) "as constructed" details for the proposed structures so that they can be marked on aeronautical charts. The details can be emailed to Defence at land.planning@defence.gov.au and ASA at vod@airservicesaustralia.com Should you wish to discuss the content of this advice further, please contact Matt Williams at land.planning@defence.gov.au Kind regards, Adam Murray Assistant Director – Airspace Protection, Training Areas and Strategic Projects	

Agency/Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			Land Planning and Regulation Estate Planning Branch / Infrastructure Division Security & Estate Group	
Murray River Council	2 October 2023			
Balranald Shire Council	2 October 2023			
Swan Hill Council	2 October 2023 and 22 April 2024	11 October 2023	We have received your application request, Council will assess the changes and provide our response early next week thank you. If you would like to discuss the above further, please do not hesitate to contact me. Kind regards Kerry Young | Engineering Assistant | Swan Hill Rural City Council	Nil response 29 April 2024. Will be provided when received.
Royal Flying Doctor Service	2 October 2023	Nil received		
Aerial Application Operator – Agflite Hay	2 October 2023	Nil received		
Aerial application Operator – Robins Aviation Kerang	2 October 2024 and 24 April 2023	Nil received		

Agency/Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
NSW Rural Fire Service	2 October 2023 and 24 April 2024	23 April 2024	Thanks for making us aware of this. We don't do a too much aerial firefighting in this area. However, once the equipment has been installed, we can let our local operators in the area know. Agair at Hay or Field Air. This site will have minimal impact on our aerial operations. Inspector Bernie O'Rourke, Supervisor Aviation (Fixed Wing)	Nil.
NSW Parks and Wildlife Service	2 October 2023	11 October 2024	Thank you for the opportunity to comment on the attached draft Aviation Impact Assessment for the Junction Rivers Wind Farm proposal. As you are aware the proposed wind farm shares a small section of property boundary with Yanga NP. After careful review I can offer the following comments for your consideration; S3.1 – Planning context – In regard to cumulative effects. I did not see this addressed in the report. There are a number of additional wind farm proposals in the area because of the Western Renewable Energy Zone and the cumulative aviation risk should be addressed. S3.7-S3.14 – (Various Aerial Operations) – Include a section on Conservation Agency operations. This should include State (& possibly Commonwealth) Government organisations including National Parks & Wildlife Service, Local Land Services, the NSW and Commonwealth Environmental Water Holder. Activities include aerial pest management (rotary), Waterbird monitoring (fixed-wing), Pest monitoring (Fixed & rotary), Native Fauna Surveys, to name a few. S3.14 – Aerial firefighting – It should be noted that NPWS is a firefighting agency and as such should have ongoing and effective liaison. It is also NPWS policy that fires within 8kms or at the discretion of the Area Manager, may trigger NPWS response if threat is predicted to impact park estate. S6.5 – Nearby aircraft landing areas (ALAs) – It is possible other private air strips exist within 3 nm of the wind turbine generators within the project site. It may be advisable to consult all neighbouring properties regarding the existence and operation of private air strips. There is no longer a registered landing strip on Yanga that would allow fixed-wing aircraft landing / take off, however, there are a number of rotary aerial operational activities conducted on Yanga NP that require landing. The two main helipad locations are on the attached map. These are further	Cumulative impacts assessed in Section 6. Other items to be addressed by Umwelt and wind farm operator.

Agency/Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			than 3 nm from the closest WTG but aircraft may operate and land anywhere on park. Rotary aircraft risk does not seem to be addressed in detail. I have also cc'd the NPWS Aviation team who may have additional comments. If you have further questions please reach out. regards Simone Carmichael Ranger Yanga NP, Lower Darling Area, West Branch NSW National Parks and Wildlife Service	
NSW Ambulance	2 October 2023 and 22 April 2024	Nil received 29 April 2024		

7. AVIATION IMPACT STATEMENT

7.1. 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 wind monitoring installations 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 Aviation Impact Statement (AIS).

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

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

7.2. Nearby certified aerodromes

The area of 30 nm (56 km) from a certified airport's aerodrome reference point (ARP) is used to identify possible constraints from the Project.

There are two certified airports within 30 nm of the Project Area:

- Balranald Airport (YBRN) located approximately 9 nm to the north of the Project's northern boundary
- Swan Hill Airport (YSWH) located approximately 26 nm to the south of the Project's southern boundary.

The locations of the certified airports are shown in Figure 11 (source: Umwelt, OzRunways).

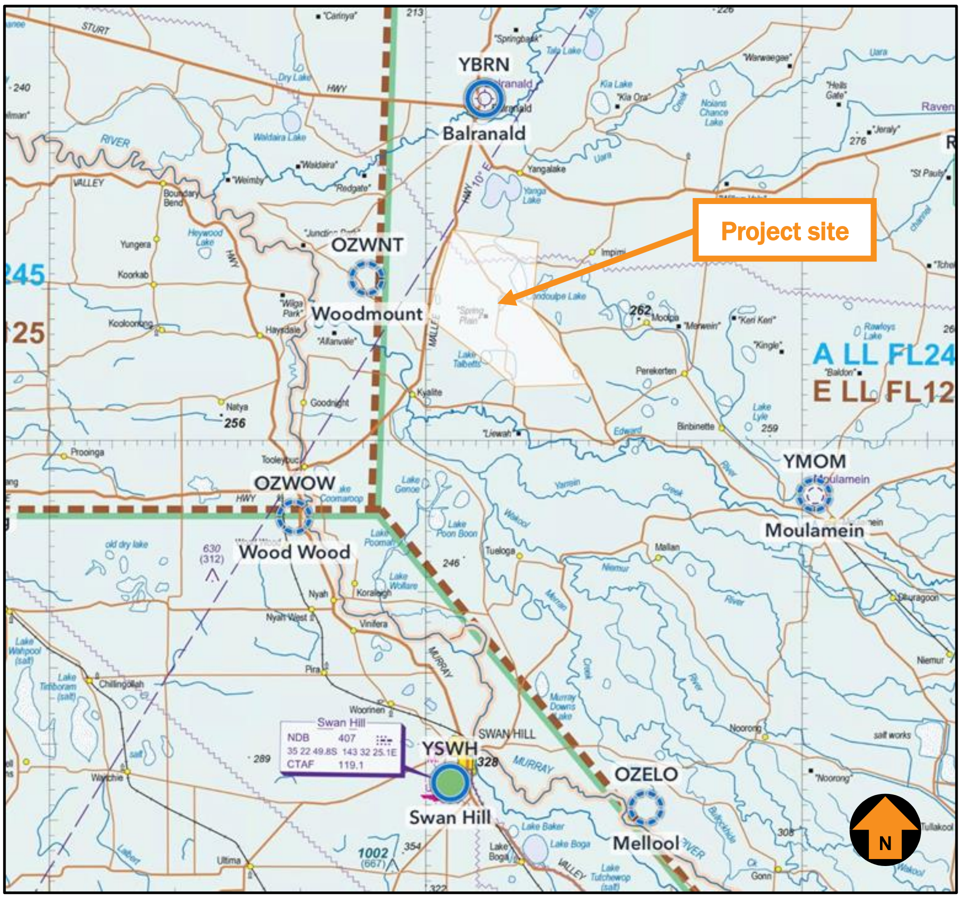
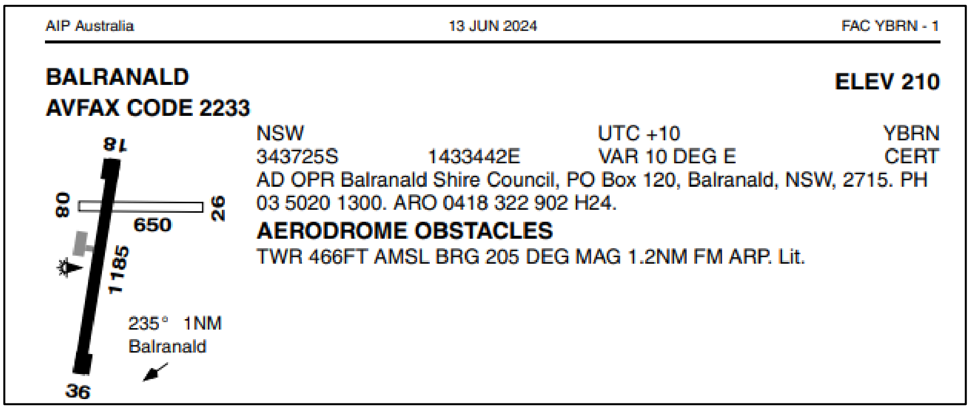


Figure 11 Balranald and Swan Hill Airports within 30 nm of the Project Area

7.3. Balranald Airport

Balranald Airport (YBRN) is a certified aerodrome, which is operated by the Balranald Shire Council.

Figure 12 shows the Balranald Airport aerodrome information (source: AsA, Enroute Supplement (ERSA), dated 13 June 2023).


AIP Australia 13 JUN 2024 FAC YBRN - 1

BALRANALD **ELEV 210**
AVFAX CODE 2233

NSW UTC +10 YBRN
343725S 1433442E VAR 10 DEG E CERT
AD OPR Balranald Shire Council, PO Box 120, Balranald, NSW, 2715. PH 03 5020 1300. ARO 0418 322 902 H24.

AERODROME OBSTACLES
TWR 466FT AMSL BRG 205 DEG MAG 1.2NM FM ARP. Lit.

Figure 12 Balranald Airport information

Balranald Airport is not serviced by any instrument approach procedures. Therefore, there are no PANS-OPS surfaces at Balranald Airport.

7.3.1. OLS:

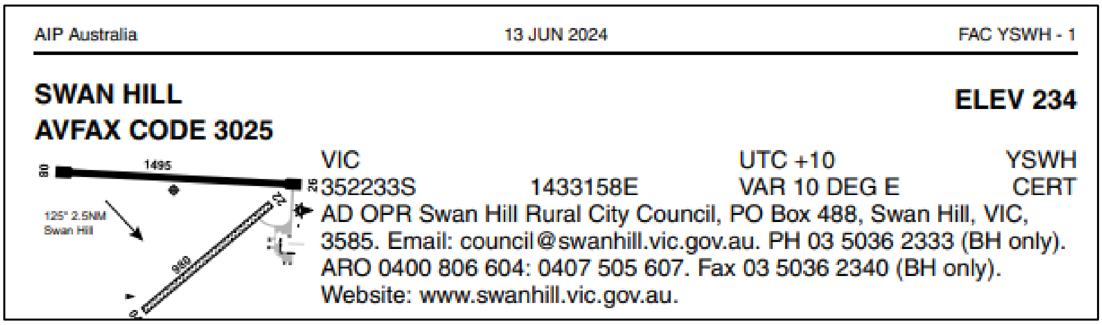
OLS are established for each aerodrome runway. For the Code 1 non-instrument runways at Balranald the maximum lateral extent of the OLS is up to 2.7 km for the conical surface and 1.6 km for the take-off and approach surfaces.

The Project Area is located beyond the horizontal extent of the OLS. Therefore, the Project Area will not impact the Balranald Airport OLS.

7.4. Swan Hill Airport

Swan Hill Airport (YSWH) is a certified aerodrome, which is operated by the Swan Hill Rural Council.

Figure 13 shows the Swan Hill Airport aerodrome information (source: AsA, Enroute Supplement (ERSA), dated 13 June 2023).


AIP Australia 13 JUN 2024 FAC YSWH - 1

SWAN HILL
AVFAX CODE 3025
ELEV 234

VIC UTC +10 YSWH
352233S 1433158E VAR 10 DEG E CERT
AD OPR Swan Hill Rural City Council, PO Box 488, Swan Hill, VIC, 3585. Email: council@swanhill.vic.gov.au. PH 03 5036 2333 (BH only). ARO 0400 806 604: 0407 505 607. Fax 03 5036 2340 (BH only). Website: www.swanhill.vic.gov.au.

Figure 13 Swan Hill Airport information

7.4.1. Instrument approach procedures

A check of Aeronautical Information Package (AIP) via the Airservices Australia website showed that Swan Hill Airport is served by non-precision instrument flight procedures (source: AsA, effective 15 June 2023).

Table 3 identifies the aerodrome and procedure charts for Swan Hill Airport, designed by Airservices Australia (AsA) as indicated.

Table 3 Swan Hill Airport (YSWH) aerodrome and procedure charts

Chart name	*Effective date*
Aerodrome Chart	15 June 2023 (Am 175)
GNSS Arrival Procedure	13 November 2023 (Am-177)
RNP RWY 26	15 June 2023 (Am-175)
NDB-A	17 June 2021 (Am-167)

7.4.2. PANS-OPS Assessment

25 nm Minimum Safe Altitude

A minimum safe altitude (MSA) is applicable for each instrument approach procedure at Swan Hill Airport.

The 25 nm MSA determines the altitude that all instrument approach procedures commence from and therefore the descent gradient applicable to each procedure.

An image of the MSA published for Swan Hill Airport is shown in Figure 14 (source: AsA, 13 June 2024).

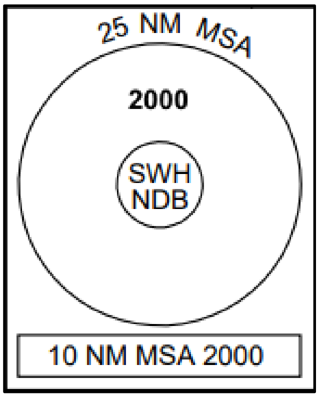


Figure 14 Swan Hill 25 nm MSA diagram

International Civil Aviation Organisation (ICAO) and the CASR Pat 173 Manual of Standards describes the design criteria applicable to instrument approach procedures, requires that a minimum obstacle clearance (MOC) of 984 ft above the highest obstacle within the protection area is applied.

Obstacles within the 10 nm MSA (within 15 nm of the reference point) and within the 25 nm MSA (within 30 nm of the reference point) define the lowest height at which an IFR aircraft can fly when within 10 nm and 25 nm when visual reference to the airport and local terrain, has not been established.

The proposed Project is located within the 25 nm MSA limits (30 nm). The MSA of 2000 ft AMSL has a PANS-OPS elevation of 1016 ft AMSL (304.8 m AHD).

The highest WTG (WTG85) has a maximum height of 1213.1 ft AMSL (369.74 m AHD).

This is higher than the PANS-OPS surface, necessitating an increase to the 25 MSA to 2300 ft to accommodate the wind farm.

The commencement altitudes and holding pattern altitudes will also need to be increased to 2300 ft as they are based on the 25 nm MSA.

Approval will need to be sought from Swan Hill Rural City Council to increase the minimum altitude for the 25nm MSA and consequential increases to procedure commencement altitudes and holding altitudes.

The approval must be sent to Airservices Australia prior to any changes being undertaken.

Circling Areas

Swan Hill Airport is capable of accepting aircraft operations up to Performance Category C aircraft such large turbo-prop aircraft such as Dash-8 and ATR airliners.

The maximum horizontal distance that the Category C circling area may extend for an aerodrome in Australia is 4.2nm (7.85km) from the threshold of each usable runway.

The entire project is located outside the horizontal extent of the IFR circling areas at Swan Hill Airport.

The circling areas are not infringed.

Instrument Approach Procedures

All instrument approach procedures commence approximately 15 nm from the airport.

The instrument approach procedures flight paths are not located over any part of the proposed wind farm.

7.4.3. Summary

Approval will need to be sought from Swan Hill Rural City Council to increase the minimum altitude for the 25nm MSA and consequential increases to procedure commencement altitudes and holding altitudes.

This AIA will be provided to them as part of the consultation phase by Aviation Projects Pty Ltd once the final draft is accepted by the client and authorised for release.

The approval must be sent to Airservices Australia prior to any changes being undertaken.

7.5. Nearby aircraft landing areas (uncertified aerodromes)

A radius of 3 nm (5.6 km) from of an aircraft landing areas (ALA) is used to assess potential impacts of proposed developments on aircraft operations at the ALA.

A search of Airservices Australia (AIP), Ozrunways Electronic Flight Bag software program and the Australian Government National Map website identified 3 ALAs within 3nm of WTGs within the Project Area. (The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.)

Two of the ALAs were identified during the site visit; ALA#1 and ALA#3.

The ALA#2 was not identified and was referred to Aviation Projects by Umwelt for assessment.

At 3 nm from the nearest WTG, the Project Area is on the limit of what would normally be considered a safe distance to avoid any impact at ALA#1 and ALA#2; however, circuit traffic and low-level overflight of the Project Area may be a part of normal operations for aircraft operating to and from this landing ground and it is recommended that the landowner is provided with this AIA to allow them to consider any impacts.

ALAs within 3 nm of the Project Area are shown in Figure 15 (source: OzRunways, National Map, Umwelt, Google Earth).

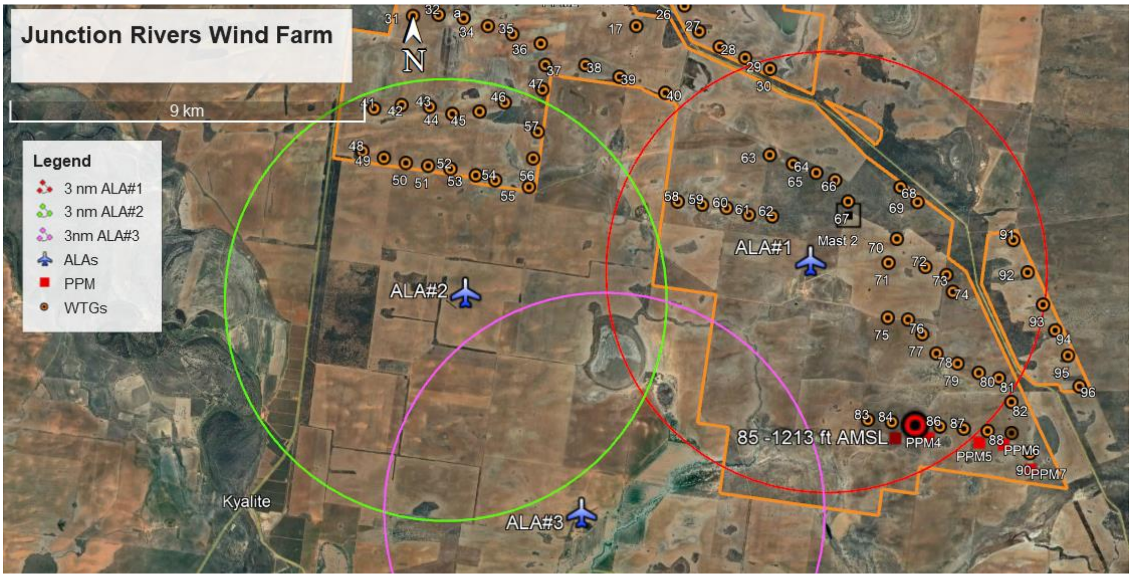


Figure 15 ALAs in the vicinity of the Project Area

7.5.1. ALA#1

ALA#1 is located in the midst of several WTGs that will be located on land owned by the ALA owner (an associated landowner).

Windlab contacted the owner to ascertain the use of the ALA.

The following points were made by the owner:

- It is used 2-3/year max depending on season. Sometimes not at all. Spray for rust MCPA. If too wet for ground rigs. Most people have ground rigs now, aerial very rare.
- They use aerial application companies based in Kerang, Deniliquin, Swan Hill or Balranald.
- The weather conditions prevalent during aerial application are:
  - Little breeze
  - No rain
- The landowner uses the airstrip recreationally about 7-8 times per year.

From the information available in the consultation document, it is apparent that there is very little aviation activity at ALA#1 and that it consists of:

- private flight operations in the landowners aircraft
- aerial application operations when the ground is wet.

There is no information available regarding other private or commercial aircraft using the ALA, but some ad hoc operations are possible.

The landowner, and other private or commercial flight operations in a CASA registered aircraft must be compliant with Civil Aviation Safety Regulations and in accordance with the information contained in Figure 3 and Figure 4. The normal circuit height would be at 1000 ft AGL and the pilot would need to adjust their descent or flight path to avoid some of the WTGs.

The WTGs within 1 nm (1852m) of any runway end at a height of 600 ft AGL will require the pilot to plan their departure and approach flight paths in order to avoid the WTGs, either by climbing or descending at a gradient that will enable the aircraft to overfly a WTG by a suitable margin, or if they can't overfly the WTG to be at a safe height, to be able to turn away from the WTG and miss it by a suitable margin.

The minimum altitudes referred to in Section 3.5 are not applicable to aircraft that are taking-off or landing at an ALA or other aerodromes. The circuit heights for medium performance aircraft, the most likely aircraft type used by the landowner, is 1000 ft AGL – at least 1200 ft AHD, a similar height to the WTGs located within the nominal 1 nm circuit dimensions.

It is usual that a final approach is at least 500 m long but can often be longer – up to 1 nm (1852 m) in length– to allow the pilot to judge and stabilise their final approach path to arrive at a suitable speed and height over the threshold of the landing runway. The turn onto final approach should be completed at least 500 ft above the ALA elevation.

When arriving at the ALA the pilot must ascertain the ALA's serviceability, wind direction and speed by overflying the ALA and observing the windsock (if one is provided) and aerodrome condition. The pilot should overfly or circle the ALA at least 500 ft above the circuit height – 1700 ft AMSL in this case. When the circuit direction is established, the pilot should position the aircraft to a point well clear of the circuit, normally the non-active side of the circuit before descending to the circuit height applicable.

Note: a windsock is not installed at ALA#1.

When departing the ALA, during initial climb, turns are not permitted below 500 ft AGL, so that the aircraft will be at the appropriate circuit height when turning downwind, unless the pilot holds an endorsement for low level operations.

WTGs 62, 67, 70, 71 75, and 76, plus met mast # 2 and IPP masts 3 and 4, are located within 1 nm of the runways pointing north and northeast and could limit the area in which aircraft can operate in accordance with the regulations. The proposed 220 kV transmission line will be approximately 378 ft AHD but should not limit circuit operations as it is below the normal 500 ft AGL circuit height.

It is likely that the WTGs within 1 nm of the runways would cause some inconvenience to flight operations at the ALA. However, they would be aware of the WTGs and WMTs as they are the owners of land that WTGs and WMTs are located upon. They would also be responsible for informing iterant pilots of the presence of the WTGs.

Aircraft taking off on the runway pointing toward the northeast will need to consider the wind farm to ensure that the flight operation can be conducted in accordance with the CARs.

Aircraft taking off on the runway pointing toward the southeast do not have any WTGs or met mast to consider in the initial take-off climb and should be able to climb above the WTGs if departure is to the north or southeast.

Aircraft planning to land on the runway pointing to the northeast should be able to enter the circuit and fly the downwind at a height well above the WTGs and have sufficient distance to descend to the runway at normal descent gradients.

Aircraft planning to land on the runway pointing to the southwest will need to carefully consider their descent and positioning to avoid the WTGs, met masts and IPP masts, to the north, east and southeast of the ALA.

The Windlab questionnaire, along with the answers from the ALA owner are attached in **Annexure 7.**

Aerial application aircraft should be able to abbreviate the circuit size and use lower heights during take-off and landing operations at the ALA. They can also fly closer to obstacles such as trees, remote buildings and the WTGs/masts than normal aircraft operations.

Figure 16 shows the WTGS and masts with 3 nm radius and the 1 nm circuit area described above.

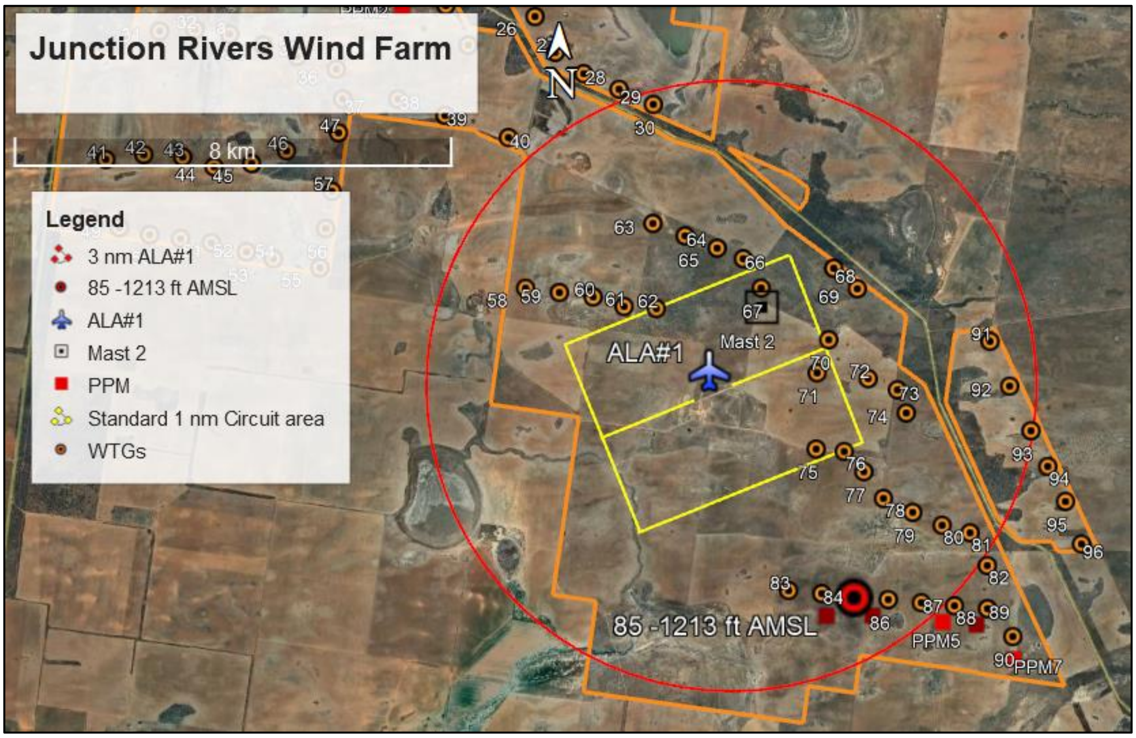


Figure 16 WTGs within a 3 nm radius of ALA#1

Summary

The proposed WTGs and masts located within the 1 nm circuit area are likely to cause normal flight operations at the ALA to be restricted to taking off to the southwest and landing to the northeast.

The proposed WTGs and masts located within 3 nm of the ALA will require detailed consideration by pilots using the ALA to ensure they can conduct their operations safely.

It is unlikely that aerial application aircraft operations would be limited but would need to take the WTGs and WMTs into consideration when planning operations at or near the ALA.

This AIA should be provided to the owner/operator of ALA#1 for their consideration of the impact of the Project upon their flight operations.

Potential wake turbulence from the WTGs is considered in section 6.6.

7.5.2. ALA#2

This non-associated ALA is located within approximately 1.7 nm (3 km) of several WTGs along the southern boundary of the Project adjacent to Yanga Way approximately 13 nm south of Balranald township.

Several WTGs are located within 3 nm of the ALA. Pilots would need to consider the WTGs within 3 nm of the ALA when planning their arrival or departure routes to/from the ALA.

There are no WTGs or masts within the 1 nm circuit area of the ALA.

Operations in the circuit area of the ALA may need to be restricted to the south of the ALA.

The potential impact of wake turbulence from the WTGs is discussed in Section 7.6. (Yellow Circles)

Figure 17 shows the WTGs within 3 nm of the ALA, but outside the nominal 1 nm northern circuit area.

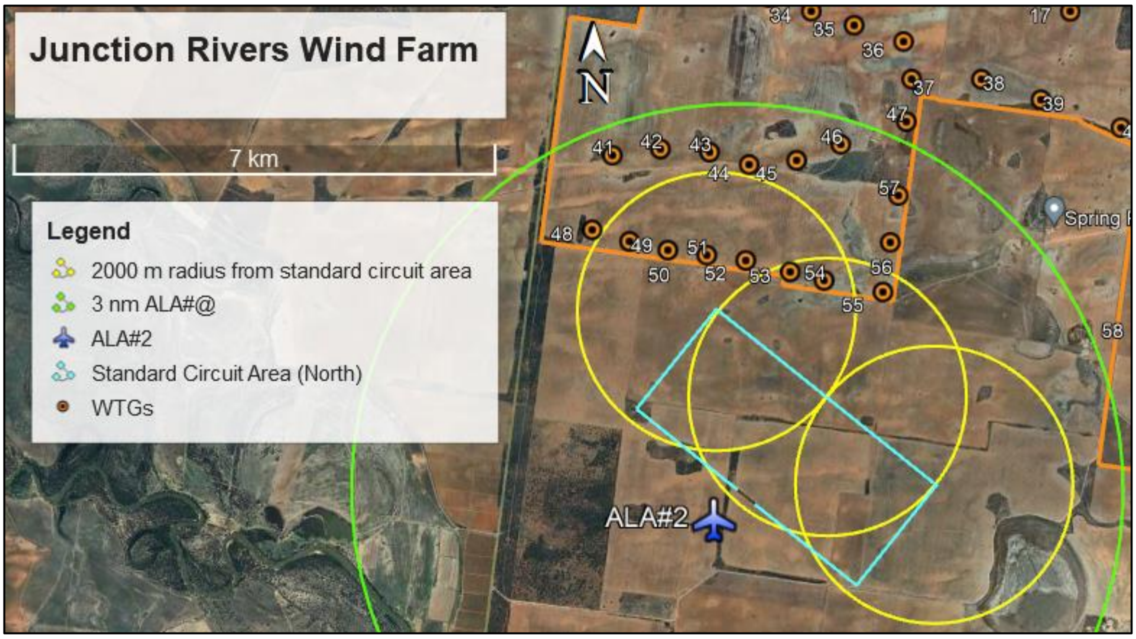


Figure 17 WTGs within 3 nm of ALA#2

Summary

Several WTGs are located with 3 nm of ALA#2. Whilst they are outside the nominal 1 nm circuit area, they may cause circuit operations to be restricted to the south of the ALA due to downwind turbulence from the WTGs.

7.5.3. ALA#3

This non-associated ALA is located approximately 4.4 nm southwest of WTG # 85, the highest WTG in the wind farm as shown in Figure 18. There are no WTGs located within 3 nm of the ALA.

Normal aircraft and aerial application aircraft operating in the circuit area at the ALA will not be impacted in relation to circuit heights, arrival and departure flight paths.

The potential impact of wake turbulence from the WTGs is discussed in Section 7.6.

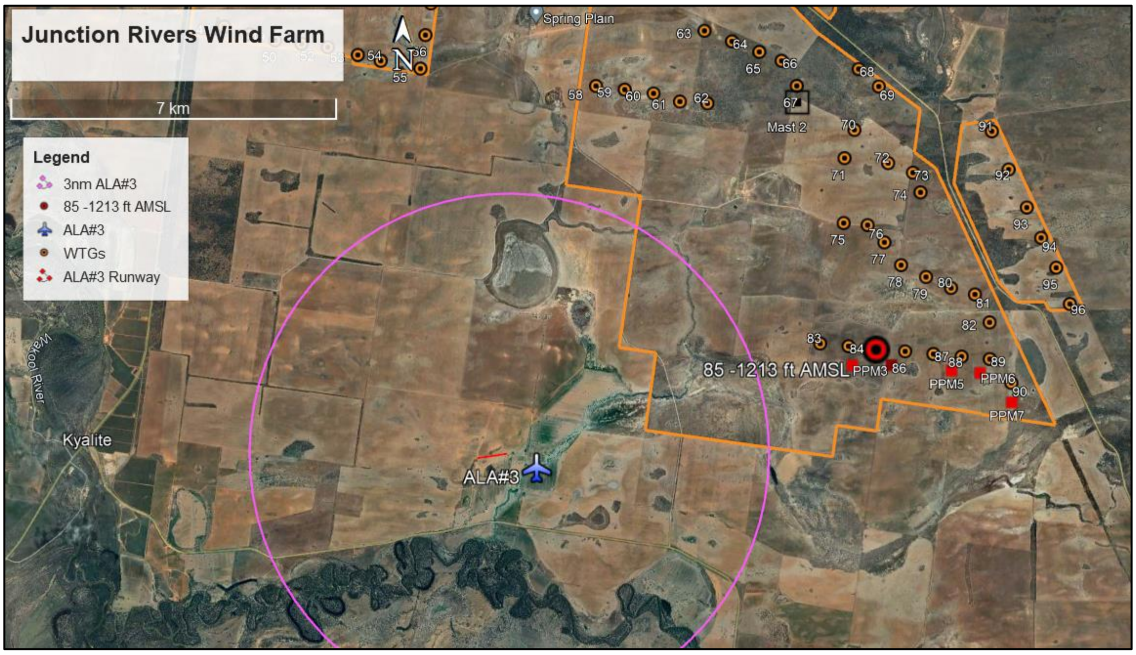


Figure 18 ALA#3 location

Summary

All WTGs and masts are located further than 3 nm from ALA#3 and should not impact on flight operations there.

7.6. Potential wake turbulence impacts

National Airports Safeguarding Framework (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…*

The preliminary WTG configuration as stated in the Scoping Report are:

- Hub height to a maximum of 200 m AGL
- Blade length to a maximum of 100 m, providing a rotor diameter of 200 m
- Tip height to a maximum of 300 m AGL.

Based on the 200 m rotor diameter the maximum extent of downwind wake turbulence referred to in the NASF guideline is 3200 m.

The wake turbulence at 3200 m from the WTGs would likely be at its weakest intensity after being dissipated by other turbulent impacts such as trees and general terrain, low level vertical turbulence created by rising air from warm objects heated by the sun and wind strength and direction variations. It is likely that wake turbulence from the WTGs at this distance would not create an increased adverse impact to aircraft operations in the circuit area of an ALA, above the turbulence created by normal atmospheric and mechanical turbulence experienced by pilots throughout Australia.

Aviation Projects, through research, considers that any adverse turbulence would most likely be confined to within 7 rotor diameters of a WTG. 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 in the circuit area of an aerodrome. This area would therefore have a maximum radius of 2000 m from a WTG.

7.6.1. ALA#1

Winds from the north, east and possibly the southeast would be likely to create downwind turbulence across the circuit area and the runway when the wind turbines are operational and turning. The terrain surrounding the ALA is flat and unlikely to break up this turbulence before it reaches the circuit area or the runway.

Figure 19 shows the five (5) WTGs located within the 2000 m radius of the northeast end of ALA#1 and the WTGs located within it. The closest WTG to the northeast end of the runway is approximately 1595 m northeast.

The possible wake turbulence impacts from WTGs within 2000 m of the runway, combined with the WTGs within 2000 m of the circuit area operations, may reduce the availability of the ALA during most wind conditions.

This AIA should be provided to the owner of the ALA owner to ascertain their perception of the impact to their ALA. This has not been done.

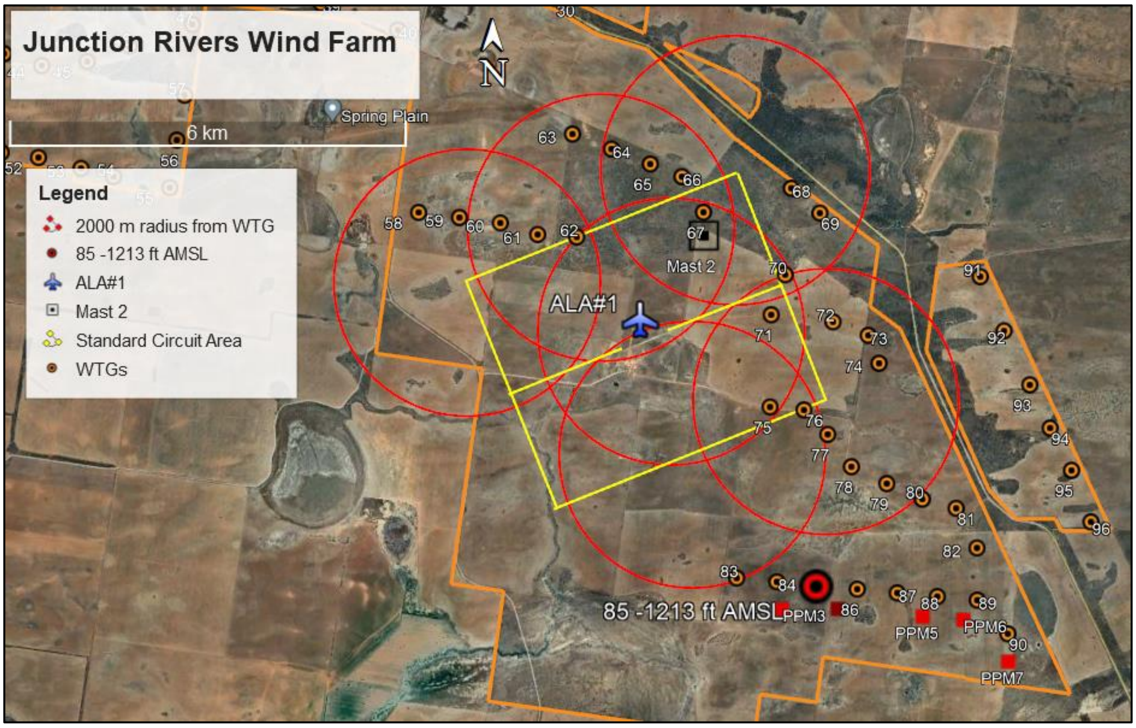


Figure 19 ALA#1 - Possible extent of Wake Turbulence from WTGs

Summary

It is likely that some degree of wake turbulence from WTGs within 2000 m of the circuit area and the runway could be created in the circuit area and across the runway at ALA#1 that could disrupt aircraft operations or create some degree of hazard in most wind conditions.

7.6.2. ALA#2

Winds from the north would be likely to create downwind turbulence across the circuit area when the wind turbines are operational and turning. The terrain surrounding the ALA is flat and unlikely to break up this turbulence before it reaches the circuit area or the runway.

Figure 20 shows the WTGs located within the 2000 m radius of the northern part of the circuit area at this ALA and the WTGs located within it.

The possible wake turbulence impacts from WTGs within 2000 m of the nominal 1 nm circuit area may reduce the availability of the ALA during northerly wind conditions.

This AIA should be provided to the owner of the ALA owner to ascertain their perception of the impact to their ALA.

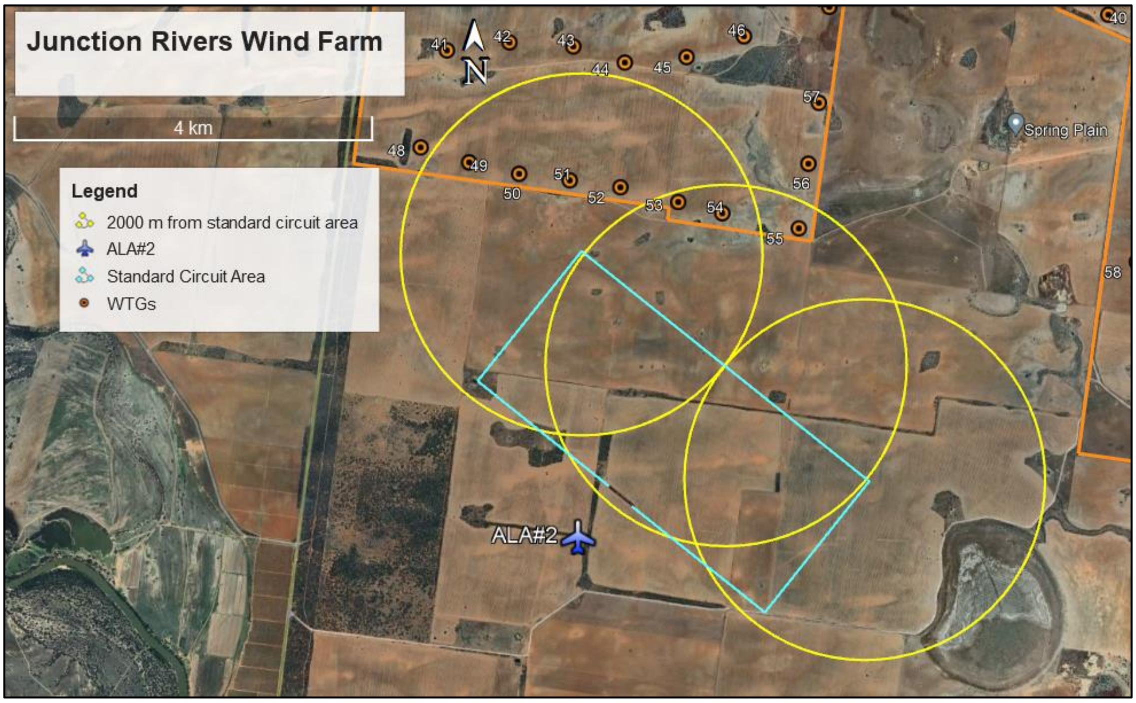


Figure 20 Possible extent of wake turbulence upon ALA#2 circuit area

Summary

The wind turbines within 2000 m of the 1 nm circuit area may create turbulence in the circuit area in northerly wind conditions which may require aircraft to operate a southerly circuit direction.

7.7. Grid and Air routes LSALT

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

7.7.1. Grid LSALT

The Project Area is located within an airspace grid with a LSALT of 1800 ft AMSL which provide clearance above obstacles with heights up to 800 ft AMSL.

The highest WTG, #85 at a maximum height of 1213.1 ft AMSL infringes the Grid LSALT by 413.1 ft. This would require the grid LSALT to be raised to by 500 ft to 2300 ft AMSL.

Confirmed advice of the location and “to be constructed” maximum height of the highest WTG must be provided to Airservices Australia to allow them to make an amendment to the Grid LSALT in this area.

The amendment would be unlikely to cause an adverse impact to IFR aircraft in the area.

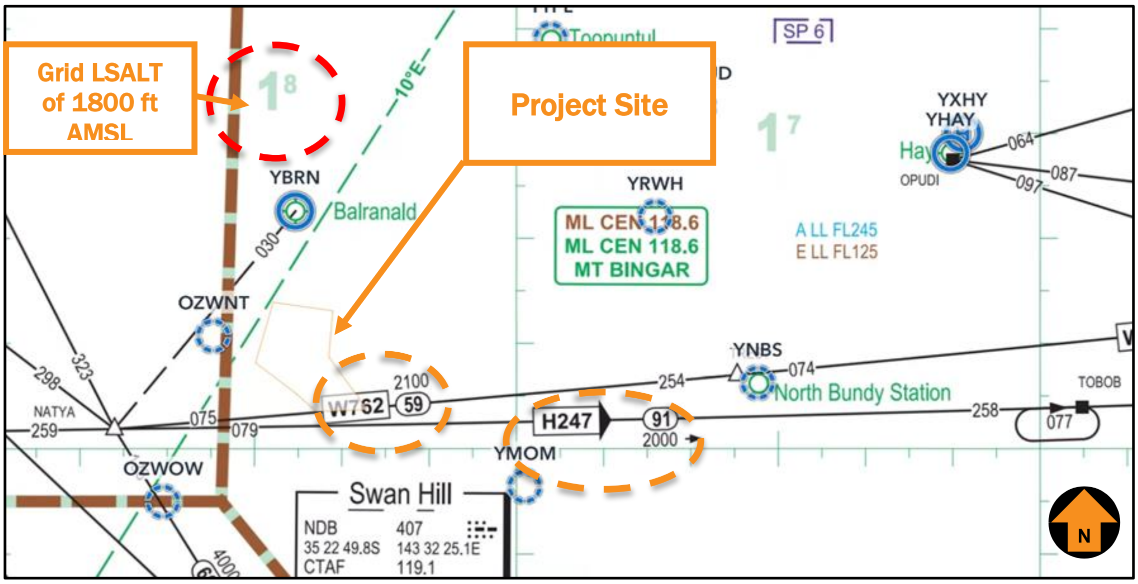


Figure 21 Grid LSALTs in proximity to the Project Area

IPPM #4, with a maximum height of 892.4 ft AMSL will be above the Grid LSALT protection surface. If the masts are constructed prior to the WTGs, their details will need to be provided to Airservices Australia so that it can increase the Grid LSALT to account for them.

7.7.2. Air Route LSALTs

A protection area of approximately 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 Area shown in Figure 22 below (source: ERC Low National, OzRunways, 13 May 2023).

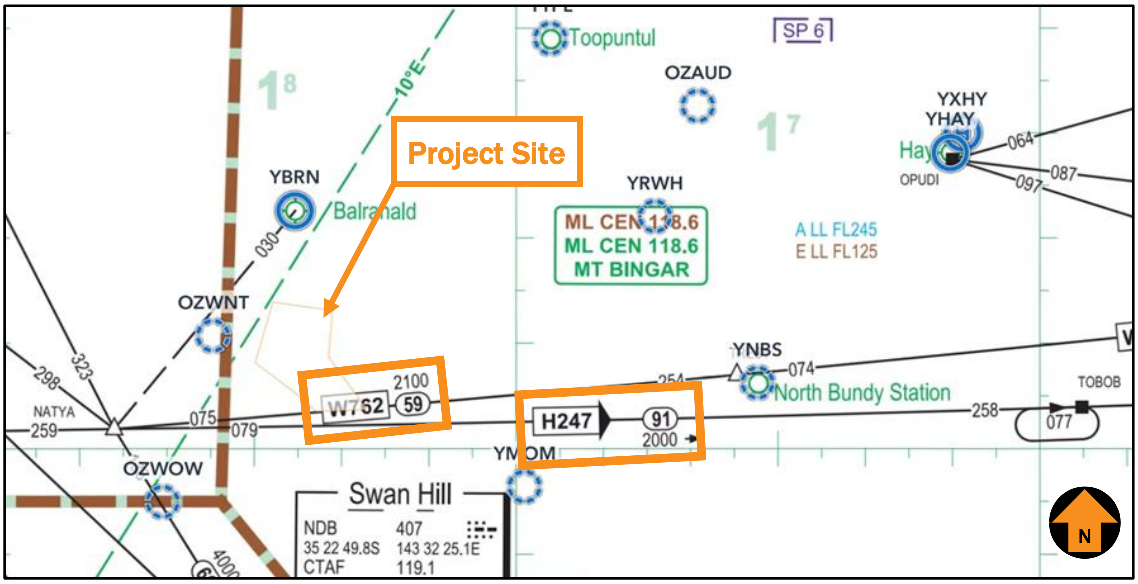


Figure 22 Air routes in proximity to the wind farm

An impact analysis of the surrounding air routes is provided in Table 4.

Table 4 Air route impact analysis

Air route	*Waypoint pair*	*Route LSALT*	*Obstacle Height Limit*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
W762	NATYA to TREST	2100 ft AMSL	1100 ft AMSL	WTG 83 exceeds obstacle limit by 114 ft	Raise LSALT by 200 ft to 2300 ft AMSL	Nil
H247	NATYA to TOBOB	2000 ft AMSL	1000 ft AMSL	WTG 8 exceeds obstacle limit by 214 ft	Raise LSALT by 300 ft to 2300 ft AMSL	Nil

With a maximum height of 1213.1 ft, WTG 85 is 113.1 ft higher than the W762 protection surface and 213.1 ft higher than the H247 protection surface. Both W763 and H247 will require the LSALT to be increased to 2300 ft AMSL.

IPPM #4, with a maximum height of 892.4 ft AMSL will not infringe the route LSALT protection surfaces. If the masts are constructed prior to the WTGs, their details will need to be provided to Airservices Australia so that it can increase the Grid LSALT to account for them.

7.7.3. Airspace Protection

The Project area is located outside of controlled airspace (wholly within Class G airspace) and is not located in any Prohibited, Restricted and Danger areas. Therefore, the Project area will not have an impact on controlled or designated airspace.

7.8. Aviation facilities

The Project area is located sufficient distance away from nearby navigation facilities protection areas and will not have an impact on the aviation facilities of those airports.

7.9. 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 Area is the Mt Macedon Secondary Surveillance Radar (SSR), which is located approximately 286 km to the south.

The Project Area are outside the range of the Mt Macedon radar and will not impact this facility.

7.10. AIS Summary

Based on the Project WTG layout and maximum blade tip height of up to 369.74 m AHD, the blade tip elevation of the highest WTG, which is WTG85, will not exceed 369.74 m AHD (1213.1 ft AMSL) and:

- would not infringe any OLS surfaces
- would infringe the PANS-OPS surface related to the Swan Hill aerodrome 25 nm MSA
- will have an impact on the relevant Grid LSALT. The overlying 1800 ft Grid LSALT will need to be raised by 500 ft to 2300 ft AMSL
- will have an impact on nearby designated air routes. W762 LSALT will need to be raised by 200 ft to 2300 ft AMSL. H247 LSALT will need to be raised by 300 ft to 2300 ft AMSL
- wake turbulence effects may impact on aircraft operating within 3 nm of ALA#1 (non-associated landowner) and ALA#2(non-associated). The owners of these facilities should be contacted to determine any impacts
- standard circuit heights will be impacted by the height of the wind turbines within the circuit area at Arundel ALA
- is wholly contained within Class G airspace
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

The list of WTGs (obstacles), showing coordinates and elevation data that are applicable to this AIS, are provided in Annexure 5.

7.11. Assessment recommendations

Based on the information contained within this section and the analysis conducted, the following recommendations are made:

- Consultation should be undertaken with Airservices Australia to assess potential impacts of the Project and to address the Grid and air route impacts which will require LSALTs to be raised.
- Approval will need to be sought from Swan Hill Rural City Council to increase the minimum altitude for the 25nm MSA and consequential increases to procedure commencement altitudes and holding altitudes. The approval must be sent to Airservices Australia prior to any changes being undertaken.

- Consult with the owner of ALA#1 to determine their perception of the impacts from the WTG proximity and potential wake turbulence effects.
- Consult with the owner of ALA#2 to determine their perception of the potential wake turbulence impacts to this ALA.
- Provide details of the wind farm including WMTs to CASA for them to assess the impacts of the wind farm upon aviation safety in the area.

8. HAZARD LIGHTING AND MARKING

Based on the risk assessment set out in Section 10 it is concluded that aviation lighting is not required for WTGs and WMTs that are in close proximity, considered to be approximately 900 m, to a WTG. Obstacle lighting is required for WMTs that are installed prior to WTG installation and WMTs that are not in close proximity to a WTG. For completeness, relevant lighting standards and guidelines are summarised in Annexure 3.

Once the details of the wind farm, along with this report, are provided by the planning authority to CASA, CASA is likely to recommend obstacle lighting be fitted to sufficient obstacles to delineate the outline of the wind farm and the highest WTGs within it.

The Aviation Projects risk assessment should also be assessed by CASA.

8.1. 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 may be free-standing and not surrounded by any other obstacles. Therefore, the proposed temporary and permanent WMTs should be marked or lit as per the content of NASF Guideline D.

In terms of obstacle marking and lighting requirements, relevant requirements set out in MOS 139 and NASF are provided below.

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

> *8.109 Obstacles and hazardous obstacles*
>
> *(1) The following objects or structures at an aerodrome are obstacles and must be marked in accordance with this Division unless CASA determines otherwise under subsections (3) and (5):*
>
> > *any fixed object or structure, whether temporary or permanent in nature, extending above the obstacle limitation surfaces. Note an ILS building is an example of a fixed object;*
> >
> > *any object or structure on or above the movement area that is removable and is not immediately removed.*
>
> *8.110 Marking of hazardous obstacles*
>
> *(5) long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that:*
>
> > *(a) the darker colour is at the top; and*
> >
> > *(b) the bands:*
> >
> > > *i. are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and*
> > >
> > > *ii. have a length ("z" in Figure 8.110 (5)) that is, approximately, the lesser of:*
> > >
> > > > *(A) 1/7 of the height of the structure; or*
> > > >
> > > > *(B) 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 be 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.*

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.

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 with medium intensity lighting at the top of the mast to ensure visibility in low light and deteriorating 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.

8.2. Overhead 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.*

Following consultation with aerial operators, if a risk assessment is required, the Proponent should follow standards outlined in the AS 3891.2:2018 *Air navigation – Cables and their supporting structures – Marking and safety requirements Part 2: Low level aviation operations.*

9. 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.

9.1. 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.

9.2. 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.

9.3. National aviation occurrence statistics 2010-2019

The Australian Transport Safety Bureau (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 5 (source: ATSB).

Table 5 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	174	1.51:1

Figure 23 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.

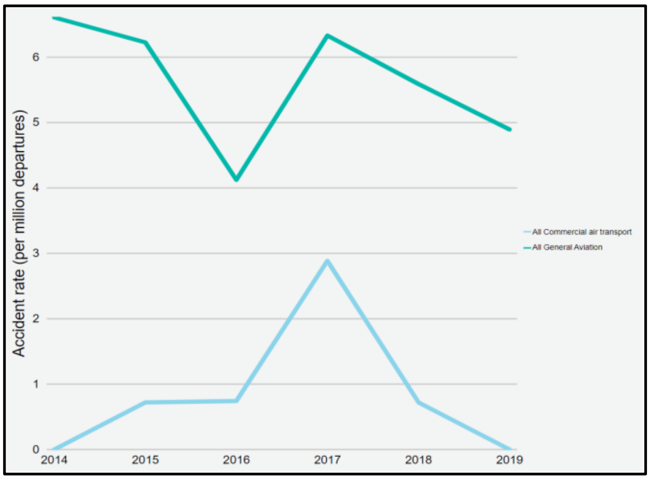


Figure 23 Fatal Accident Rate (per million departures) by Operation Type

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 6 (source: ATSB).

Table 6 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, no aircraft 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.

9.4. Worldwide accidents involving wind farms

Worldwide since aviation accident statistics have been recorded, there have been a total of 4 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 4 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 2016, there were 341,320 WTGs operating around the world at the end of 2016.

Based on the Australia's Clean Energy Council statistics there were 102 wind farms in Australia at the end of 2019. Aviation Projects has researched public sources of information, 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 4 recorded aviation accidents involving a wind farm that occurred outside of Australia are summarised as follows:

- 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.

A summary of the 4 accidents is provided in Table 7.

Table 7 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	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
2	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
3	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
4	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

10. 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.**

10.1. 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) five 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, controlled flight into terrain (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 and Communications, 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.

10.2. 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 8 through to Table 12.

Table 8 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 Area.

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 Area 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, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments (without lighting)

• The Project Area is clear of the obstacle limitation surfaces (OLS) of any aerodrome. • 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 369.74 m (1213.1 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 139 m (457 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5,000 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 (assumed to be approximately 200 m AGL), obstacle lighting would be obscured and therefore ineffective. • 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 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 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 Possible likelihood of a Catastrophic consequence is 8 (Unacceptable).	
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 the Project should be communicated to local and regional aircraft operators (refer to Section 5) 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 Area. - 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. The level of risk with the implementation of the Recommended Treatments 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 Project WTG without obstacle lighting on the WTGs.**	
Residual Risk	7 - Tolerable

Table 9 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.

There are two WMTs and seven Indicative Power Performance Masts as part of the Project.

The WMTs will be free standing at a maximum height of 200 m (656 ft) AGL in height.

The proposed masts will be marked in accordance with NASF Guideline D recommendations and CASA Part 139 MOS requirements.

The location of the proposed temporary and permanent WMT locations and other applicable details will be provided to Airservices Australia prior to construction.

There are a few instances of aircraft colliding with a WMT, but they were all during the day with good visibility. None were in Australia.

There is a relatively low rate of aircraft activity in the vicinity of the Project Area.

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 mast 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 will be at a maximum height of 200 m (656 ft), which will be 156 ft (47 m) above the minimum height of 500 ft AGL for an aircraft flying at this height.
- In the event that descending cloud forces an aircraft lower than 152.4 m (500 ft) AGL, the minimum visibility of 5,000 m required for visual flight during the day, the mast markings should provide adequate time for pilots to observe and manoeuvre their aircraft clear of the tower.

• 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). • 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. • 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. • Since the masts 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 will 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: *5) Medium-intensity obstacle lights must:*	

c) *be visible in all directions in azimuth; and* d) *if flashing — have a flash frequency of between 20 and 60 flashes per minute.* 6) *The peak effective intensity of medium-intensity obstacle lights must be 2 000 ± 25% cd with a vertical distribution as follows:* d) *for* **vertical beam spread** *— a minimum of 3 degrees;* e) *at -1 degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;* f) *at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.* 7) *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.* 8) *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 Area 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 masts that are in close proximity to a WTG without obstacle lighting on the WMTs.** **For masts installed prior to WTG installation and those 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 10 Harsh manoeuvring leading to controlled flight into terrain

<table>
<tr><td>Risk ID:</td><td colspan="2">3. Harsh manoeuvring leads to controlled flight into terrain (CFIT)</td></tr>
<tr><td colspan="3">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 300 m (984 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 148 m (457 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.</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="2" align="right">Consequence</td><td>Catastrophic</td></tr>
<tr><td colspan="3">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, but possible (has occurred rarely), which is classified as Possible.</td></tr>
<tr><td colspan="2" align="right">Untreated Likelihood</td><td>Possible</td></tr>
<tr><td colspan="3">Current Treatments (without lighting)

• The Project is clear of the OLS of any aerodrome.</td></tr>
</table>

- 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 300 m (984 ft) at the top of the blade tip AGL. The rotor blade at its maximum height will be approximately 148 m (484 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 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:

- 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 Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project Area.	
Residual Risk With the additional Recommended Treatments listed above, the likelihood of ground collision resulting from manoeuvring to avoid 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 **ALARP.** **It is assessed that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a Project WTG without obstacle lighting on the WTGs.**	
Residual Risk	7 - Tolerable

Table 11 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 Area.	
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. • WTGs will be a maximum of 300 m (984 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 148 m (484 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • 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 by the required margin. • 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 Given the current treatments and the limited scale and scope of flying operations conducted within the vicinity of the Project Area, there is likely to be little additional safety benefits to be gained by installing obstacle lighting for WTGs and Permanent WMTs which are in close proximity to WTGs. 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 masts 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 Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for such aircraft operations in the vicinity of the Project Area.	
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 **ALARP.** **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 12 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 masts can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions.

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 masts 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 masts is not necessary to provide an acceptable level of safety. For temporary WMTs installed prior to WTG installation and masts 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 Area. 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

11. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

11.1. Planning considerations

The Murray River Council Local Environmental Plan and the Wakool LEP do not incorporate any reference to the development of wind farms or the protection of aeronautical infrastructure.

11.2. Aviation Impact Statement

Based on the Project WTG layout and maximum blade tip height of up to 369.74 m AHD (1213.1 ft AMSL) for WTG#85, the Project:

- would not penetrate any OLS surfaces
- would infringe the PANS-OPS surface related to the Swan Hill aerodrome 25 nm MSA
- will have an impact on the relevant Grid LSALT. The overlying 1800 ft Grid LSALT will need to be raised by 500 ft to 2300 ft AMSL
- will have an impact on nearby designated air routes. W762 LSALT will need to be raised by 200 ft to 2300 ft AMSL. H247 LSALT will need to be raised by 300 ft to 2300 ft AMSL
- wake turbulence effects may have an impact on aircraft operating in the vicinity of ALA#1 and ALA#2. The owners of these facilities should be provided with this AIA to allow them to consider the impact to their flight operations
- standard circuit heights will be impacted by the height of the wind turbines within the circuit area of Arundel ALA
- will not have an impact on operational airspace
- is wholly contained within Class G airspace
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

11.3. Aircraft operator characteristics

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

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.

11.4. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E.1 Notifying potential hazards 139.165, the proposed WTGs and WMTs must be reported to CASA. WTGs and WMTs must be marked in accordance with Part 139 MOS 2019 Chapter 8 Division 10 section 8.110.
- WTGs must be lit in accordance with Part 139 MOS 2019 Chapter 9 Division 4 9.30 and 9.31, unless an aeronautical study assesses they are of no operational significance which this AIA provides
- With respect to 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.
- Temporary and permanent WMTs should be marked according to the requirements set out in Manual of Standards (MOS) 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Aviation marker balls and painting the top 1/3 of WMTs structures in red and white bands is considered to be an acceptable mitigation strategy.
- WTGs and permanent WMTs that are installed in close proximity to a WTG will not require obstacle lighting to maintain an acceptable level of safety to aircraft.
- WMTs that are installed prior to WTG installation, and WMTs that are not in close proximity to a WTG, will require obstacle lighting to maintain an acceptable level of safety. These WMTs should be lit with medium intensity steady red obstacle lighting at the top of the WMT mast. Characteristics of medium intensity obstacle lighting in MOS 139, Section 9.33.

11.5. Summary of risks

A summary of the level of residual risk associated with the Project with the Recommended Treatments implemented, is provided in Table 13.

Table 13 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.

12. RECOMMENDATIONS

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

Notification and reporting

1. 'As constructed' details of WGT and WMT exceeding 100 m 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).

2. 'As constructed' details of WGT and WMT coordinates and elevation should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.

3. Any obstacles above 100 m 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.

Operation

6. Whilst not a statutory requirement, the Proponent should consider engaging with any local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.

7. The proponent should notify landowners of the identified landing grounds within 3nm of the Project Area to determine any impacts from the WTG proximity and potential wake turbulence effects to determine any impacts from WTG wake turbulence effects

Marking of WTGs

8. The rotor blades, nacelle and the mast supporting the WTGs should be painted white, typical of most WTGs operational in Australia. No additional marking measures are required for WTGs.

Lighting of WTGs

9. Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

Marking of wind monitoring towers

10. 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:

    a. marker balls or high visibility flags or high visibility sleeves should be placed on the outside guy wires

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

    c. ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation.

Lighting of wind monitoring towers

11. Consideration should be given to lighting temporary WMTs installed prior to WTG installation and 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

12. The potential micrositing of the WTGs and WMTs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the nominal WTG and WMT positions. Providing the micrositing is within 100 m of the WTGs and 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

13. 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 Part 139 MOS 2019 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

Triggers for review

14. 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
7. Arundel ALA Questionnaire and Response

ANNEXURE 1 – REFERENCES

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

- Airservices Australia:
  - Aeronautical Information Package; including AIP Book, Departure and Approach Procedures, and En Route Supplement Australia dated 7 September 2023
  - Designated Airspace Handbook dated 15 June 2023
- Murray River Council Local Environmental Plan 2011
- Wakool Local Environmental Plan 2013
- Balranald LEP 2010
- Civil Aviation Safety Authority:
  - Civil Aviation Regulations 1988 (CAR)
  - Civil Aviation Safety Regulations 1998 (CASR)
  - Advisory Circular (AC) 91-10 v1.1: *Operations in the vicinity of non-controlled aerodromes*, dated November 2021
  - CASR Part 139 *(Aerodromes) Manual of Standards 2019*, dated 5 September 2019
  - Advisory Circular 139.E-01 v1.0—Reporting of Tall Structures , dated December 2021
  - Advisory Circular (AC) 139.E-05 v1.0 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome
  - Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design, version 1.5, dated March 2016
- Department of Infrastructure and Regional Development, Australian Government, National Airport Safeguarding Framework, Guideline D *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, dated June 2013
- International Civil Aviation Organization (ICAO) Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS)
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes
- OzRunways, aeronautical navigation charts extracts, dated 12 September 2023
- 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 aircraft or that extend above a defined surface intended to protect aircraft in flight.

Term	Definition
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
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 Part 139 MOS 2019.

The characteristics of low and medium intensity obstacle lights specified in Part 139 MOS 2019, Chapter 9, are provided below.

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.*

Part 139 MOS 2019 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 Part 139 MOS 2019 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 Part 139 MOS 2019 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 Part 139 MOS 2019 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.

AVIATION PROJECTS

ANNEXURE 5 – PROJECT TURBINE COORDINATES AND HEIGHTS

Turbine Number	Longitude	Latitude	Terrain Elevation (m AHD)	WTG Max Tip Elevation (m AGL)	WTG Max Tip Elevation (m AHD)	WTG Max Tip Elevation (ft AHD)
1	-34.791	143.535	66.16	300.0	366.1637	1201.3
2	-34.796	143.539	63.89	300.0	363.8919	1193.9
3	-34.800	143.545	64.11	300.0	363.8919	1193.9
4	-34.805	143.549	64.36	300.0	364.1120	1194.6
5	-34.808	143.556	64.38	300.0	364.3551	1195.4
6	-34.808	143.564	64.45	300.0	364.3805	1195.5
7	-34.810	143.568	65.16	300.0	364.4479	1195.7
8	-34.815	143.529	69.14	300.0	365.1568	1198.0
9	-34.816	143.536	66.34	300.0	369.1402	1211.1
10	-34.817	143.542	63.23	300.0	366.3404	1201.9
11	-34.817	143.549	63.67	300.0	363.2342	1191.7
12	-34.819	143.555	66.00	300.0	363.6668	1193.1
13	-34.820	143.562	63.34	300.0	365.9963	1200.8
14	-34.824	143.568	64.55	300.0	363.3411	1192.1
15	-34.824	143.577	64.34	300.0	364.5494	1196.0
16	-34.828	143.582	63.44	300.0	364.3355	1195.3
17	-34.834	143.587	67.38	300.0	363.4397	1192.4
18	-34.804	143.617	66.32	300.0	366.7887	1203.4
19	-34.805	143.610	64.20	300.0	366.0289	1200.9
20	-34.805	143.603	69.20	300.0	365.3463	1198.6
21	-34.806	143.596	64.66	300.0	360.8377	1183.9
22	-34.809	143.587	67.25	300.0	366.4645	1202.3
23	-34.814	143.590	66.25	300.0	364.1588	1194.7
24	-34.818	143.592	61.46	300.0	364.1012	1194.6
25	-34.823	143.596	61.66	300.0	364.0104	1194.3
26	-34.829	143.600	66.06	300.0	365.9830	1200.7
27	-34.835	143.604	67.46	300.0	366.1500	1201.3

28	-34.839	143.610	63.54	300.0	366.4059	1202.1
29	-34.841	143.617	68.33	300.0	365.5865	1199.4
30	-34.844	143.624	66.11	300.0	363.9402	1194.0
31	-34.832	143.525	67.39	300.0	367.3813	1205.3
32	-34.831	143.532	65.04	300.0	366.3150	1201.8
33	-34.832	143.539	62.56	300.0	364.1979	1194.9
34	-34.834	143.546	68.55	300.0	369.1969	1211.3
35	-34.836	143.553	68.41	300.0	364.6588	1196.4
36	-34.838	143.561	66.43	300.0	367.2477	1204.9
37	-34.843	143.562	64.45	300.0	366.2506	1201.6
38	-34.843	143.573	60.99	300.0	361.4622	1185.9
39	-34.846	143.582	66.20	300.0	361.6648	1186.6
40	-34.849	143.595	66.89	300.0	367.4576	1205.6
41	-34.853	143.514	63.71	300.0	363.5447	1192.7
42	-34.852	143.522	64.22	300.0	368.3307	1208.4
43	-34.852	143.530	66.17	300.0	366.1080	1201.1
44	-34.854	143.536	65.24	300.0	367.3854	1205.3
45	-34.853	143.544	66.46	300.0	365.0367	1197.6
46	-34.851	143.551	60.84	300.0	362.5647	1189.5
47	-34.848	143.561	65.35	300.0	368.5455	1209.1
48	-34.862	143.511	66.03	300.0	368.4098	1208.7
49	-34.864	143.517	66.79	300.0	366.4303	1202.2
50	-34.865	143.523	64.16	300.0	364.4459	1195.7
51	-34.866	143.529	64.10	300.0	360.9896	1184.3
52	-34.866	143.536	64.01	300.0	366.2028	1201.5
53	-34.868	143.543	65.98	300.0	366.8912	1203.7
54	-34.869	143.548	66.15	300.0	363.7122	1193.3
55	-34.870	143.557	66.41	300.0	364.2184	1194.9
56	-34.864	143.558	65.59	300.0	366.1734	1201.4
57	-34.858	143.560	63.94	300.0	365.2428	1198.3
58	-34.874	143.598	63.78	300.0	365.2477	1198.3
59	-34.875	143.605	64.18	300.0	367.7535	1206.5

60	-34.875	143.612	64.32	300.0	364.4869	1195.8
61	-34.877	143.618	65.58	300.0	364.9352	1197.3
62	-34.877	143.624	64.91	300.0	365.1813	1198.1
63	-34.863	143.624	65.25	300.0	364.8551	1197.0
64	-34.865	143.630	67.75	300.0	363.7757	1193.5
65	-34.867	143.636	64.49	300.0	364.1793	1194.8
66	-34.869	143.642	64.94	300.0	364.3199	1195.3
67	-34.874	143.645	65.18	300.0	364.1754	1194.8
68	-34.871	143.660	64.86	300.0	365.5816	1199.4
69	-34.874	143.664	64.18	300.0	364.9117	1197.2
70	-34.882	143.659	66.12	300.0	366.1207	1201.2
71	-34.888	143.656	67.74	300.0	367.7428	1206.5
72	-34.889	143.667	68.78	300.0	368.7818	1209.9
73	-34.891	143.672	64.32	300.0	364.3229	1195.3
74	-34.894	143.674	66.27	300.0	366.2701	1201.7
75	-34.900	143.656	68.53	300.0	368.5309	1209.1
76	-34.901	143.662	64.51	300.0	364.5133	1195.9
77	-34.904	143.666	64.42	300.0	364.4205	1195.6
78	-34.908	143.670	65.01	300.0	365.0064	1197.5
79	-34.911	143.675	64.43	300.0	364.4313	1195.6
80	-34.913	143.681	64.63	300.0	364.6305	1196.3
81	-34.914	143.687	65.12	300.0	365.1236	1197.9
82	-34.919	143.690	63.83	300.0	363.8304	1193.7
83	-34.923	143.651	70.20	300.0	367.4820	1205.6
84	-34.924	143.657	66.34	300.0	367.7623	1206.6
85	-34.924	143.664	68.77	300.0	369.7418	1213.1
86	-34.925	143.671	67.48	300.0	365.0934	1197.8
87	-34.925	143.677	67.76	300.0	367.7545	1206.5
88	-34.926	143.684	69.74	300.0	368.9732	1210.5
89	-34.926	143.690	65.09	300.0	367.7145	1206.4
90	-34.931	143.695	67.75	300.0	364.8229	1196.9
91	-34.883	143.691	68.97	300.0	366.0270	1200.9

92	-34.890	143.695	67.71	300.0	366.2047	1201.5
93	-34.897	143.699	64.82	300.0	365.9732	1200.7
94	-34.903	143.702	66.03	300.0	366.4508	1202.3
95	-34.909	143.706	66.20	300.0	364.8600	1197.0
96	-34.916	143.709	65.97	300.0	366.7564	1203.3

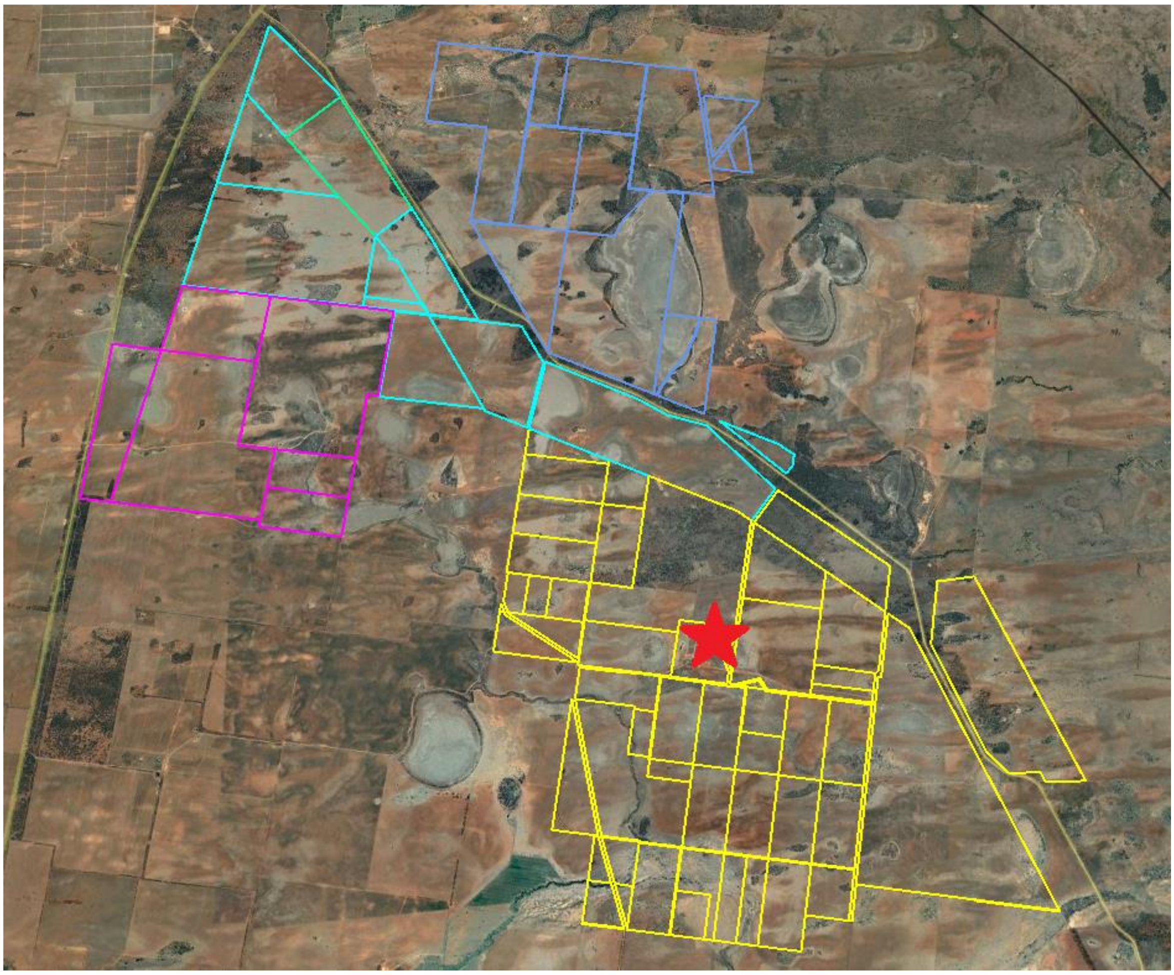
ANNEXURE 6 – WIND MONITORING TOWERS - COORDINATES AND HEIGHTS

Name	*Longitude*	*Latitude*	*Terrain Elevation (m AHD)*	*Mast Max Elevation (m AGL)*	*Max elevation (m AHD)*	*Max elevation (ft AHD)*
Met Mast 1	143.56	-34.81	64	200	264	866.14
Met Mast 2	143.65	-34.88	65	200	265	869.42
Indicative Power Performance Mast (IPPM) 1	143.55	-34.82	63	200	264.11	862.9
IPPM 2	143.57	-34.83	66	200	266	872.7
IPPM 3	143.65	-34.93	64	200	264	866.1
IPPM 4	143.67	-34.93	72	200	272	892.4
IPPM 5	143.68	-34.93	68	200	268	879.3
IPPM 6	143.68	-34.93	66	200	266	872.7
IPPM 7	143.70	-34.93	65	200	265	869.4

ANNEXURE 7 – ARUNDEL ALA QUESTIONAIRE AND RESPONSE

102211 AIRCRAFT LANDING AREA CONSULTATION – ALA

Windlab is coordinating an aviation assessment for the proposed Junction Rivers Wind Farm. The responses you provide will be used to understand if the wind farm project may influence the operations of your Aircraft Landing Area (ALA). Once the aviation assessment is complete, we would like to share the results with you for discussion.



Landowner ID: Arundel – Yellow lots covering southeast of project area. See image above – red star is approximate location of airstrip.

(14/11/2022)

1. How often do you use aerial application services?

How many times per year?

2-3/year max, depending on season. Sometimes not at all. Spray for rust MCPA. If too wet for ground rigs. Most people have ground rigs now, aerial very rare.

Are these times generally at the same time each year (can this detail be provided of which months and the duration of aerial works (days each application)?

Can vary depending on season.

2. Can you provide the details of an aerial operator so we can talk to them about the project and aviation concerns, including potential for wake turbulence?

Use contractors based out of Kerang, Deniliquin or Swan Hill. Big planes must fly out of airstrips located in Swan Hill or Balranald.

3. What are the weather conditions when aerial services are performed?

Little breeze, no rain.

4. Are there any other aircraft operations conducted from your ALA (e.g., recreational, transit, refuelling, etc.)?

No just crop dusting. Landholder's son Layne has his pilot's licence and uses the airstrip recreationally about 7-8 times per year.

If so what types of operation and how often for each? b. Can we talk to the pilots of these other operations to understand any aviation concerns, including potential for wake turbulence?

NA

5. What is the runway orientation? (Can you provide confirmation on the orientation and take some photos that we can then mark up to confirm the runway orientation on the map)

East-north-east to west-south-west.

6. Are you able to advise of any particular preference for the take off and departure approaches for the aircraft or is this normally dictated by the wind conditions?

No preference. Depends on wind direction.

Do aircraft operators only operate in a particular circuit pattern due to terrain or other influences?

No. Depends on area/paddock that needs to be sprayed.

Any other notes or discussion points about how this ALA is used?

No.

AVIATION PROJECTS

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