Appendix F

Updated Aviation Impact Assessment

March 2026

UPDATED AVIATION IMPACT ASSESSMENT

MALLEE WIND FARM

Prepared for Umwelt (Australia) Pty Limited

AVIATION PROJECTS

DOCUMENT CONTROL

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2.1	Final Report	31 March 2026		

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ACRONYMS

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

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

UNITS OF MEASUREMENT

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

DEFINITIONS

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

NOTES

Nil

EXECUTIVE SUMMARY

Introduction

Spark Renewables Pty Limited (Spark Renewables) proposes to develop the Mallee Wind Farm (the Project) located approximately 16 kilometres (km) northeast of Buronga in the Murray region of southwestern NSW and 17 km northeast of Mildura, within the Wentworth Local Government Area (LGA). The Project will include the installation, operation, maintenance and decommissioning of up to 76 wind turbine generators (WTGs), a single grid scale 100 megawatts (MW) /200-megawatt hour (MWh) Battery Energy Storage System (BESS), ancillary infrastructure and temporary facilities associated with construction of the Project. The Project design incorporates up to 76 WTGs, with a maximum blade-tip height of 280 m above ground level, and an installed capacity of up to 402 MW.

Aviation Projects has been engaged by Umwelt (Australia) Pty Ltd (Umwelt) to prepare this Aviation Impact Assessment for inclusion within the Environmental Impact Statement (EIS) for the Project. The report has been updated following the public exhibition of the Project's Environmental Impact Statement. Key submissions have been responded to primarily through revisions to Sections 3, 5, 6, 10 and 13. The Project requires an aviation impact assessment to be undertaken in accordance with the:

- National Airspace Safeguarding Framework (NASF) Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers effective July 2012*
- NSW Department of Planning, Housing and Infrastructure (DPHI), Secretary' Environmental Assessment Requirements (SEARS) SSD-53293710
- Civil Aviation Safety Regulation (CASR) Manual of Standards (MOS) Part 139, *Aerodromes*
- Specific requirements for an Aviation Impact Statement (AIS) 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 AIS in accordance with Airservices Australia's requirements and a qualitative risk assessment to determine the need for obstacle lighting.

Project description

The key components of the Project include:

- 76 (three (3) blade) WTGs, with a maximum blade-tip height of 280 metres (m) above ground.
- A single grid-scale 100 MW /200 MWh BESS.
- Permanent ancillary infrastructure including internal access tracks, hardstands, main and collector substations, switchyards, operations and maintenance facilities, underground and overhead electricity transmission lines and poles, telecommunications facilities and utility services, permanent meteorological masts and water storage tanks.
- Temporary facilities including temporary workforce accommodation (TWA) facility, site offices, amenities, construction compounds and laydown areas, concrete or asphalt batching plants, minor 'work front' construction access roads, environmental management and monitoring and signage.
- Off-site road works, involving upgrades to the proposed local transport route and establishment of site access points.

Conclusions

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

Planning considerations

- The Project, as proposed, will not create incompatible intrusions or compromise the safety of existing airports and associated navigation and communication facilities.

Certified airports

- The Project Area would be located within 30 nm (55.56 km) of two certified airports: Mildura Airport (YMIA) and Wentworth Airport (YWTO).
    - Mildura Airport (YMIA):
        - The WTGs would not impact the IFR circling areas.
        - The WTGs would impact the 10 nm MSA, which will need to be raised by 500 ft to 2300ft.
        - The WTGs would impact the 25 nm MSA, which will need to be raised by 300 ft to 2300ft or sectorized to exclude the wind farm.
        - The WTGs would impact the PANS-OPS surfaces:
            - The minimum altitude of the initial / en-route segment of DME or GNSS arrival would need to be raised by 300 ft.
            - The minimum holding altitude of RNP RWY 27 would need to be raised by 300 ft.
            - Due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.
    - Wentworth Airport (YWTO):
        - The WTGs would not impact the instrument flight rules (IFR) circling areas.
        - The WTGs would impact the 25 nm MSA, which will need to be raised by 500 ft to 2300 ft or sectorised to exclude the wind farm.
        - The WTGs would not impact PANS-OPS surfaces, however, due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.

Obstacle Limitation Surfaces

- The Project would be located outside the horizontal extent of obstacle limitation surfaces (OLS) of both Wentworth Airport (YWTO) and Mildura Airport (YMIA).

Uncertified Aerodrome

- There are no known uncertified aerodromes within 3 nm of the proposed WTGs.

Air Routes and Lowest Safe Altitude (LSALT)

- The WTGs would impact the Grid LSALT, both Grid LSALTs would need to be raised to 2400 ft AMSL.
- The WTGs would impact four (4) air route LSALTs:
  - Air route Q4 LSALT would need to be raised to 2400 ft.
  - Air route Q16 LSALT would need to be raised to 2400 ft.
  - Air route J19 LSALT would need to be raised to 2200 ft.
  - Air route W451 LSALT would need to be raised to 2400ft.

Airspace

- The Project Area would be located within Class G airspace and outside all controlled airspace, Prohibited Restricted and Danger areas.

Aviation Facilities

- The WTGs would not penetrate any protection areas associated with aviation facilities.

Radar

- The Project Area would be located outside of the Area of Interest for assessment of potential impact from the development on surveillance radar. The Project would not impact the Summertown En Route Surveillance Radar (RSR), Adelaide Primary Surveillance Radar (PSR) and Adelaide Secondary Surveillance Radar (SSR).

Aviation Impact Statement (AIS) (for Airservices Australia consideration)

Based on the WTG layout and maximum blade tip height of up to 280 m AGL, the blade tip elevation of the highest WTG, which is WTG T15, will not exceed 398.2 m AHD (1306.4 ft AMSL) and:

- There are two certified airports located within 30 nm (56 km) of the Project: Mildura Airport (YMIA) and Wentworth Airport (YWTO):
- Mildura Airport (YMIA):
  - The WTGs would not impact the OLS surfaces.
  - The WTGs would not impact the circling areas.
  - The WTGs would impact the 10 nm MSA, which will need to be raised by 500 ft to 2300ft.
  - The WTGs would impact the 25 nm MSA, which will need to be raised by 300 ft to 2300ft or sectorized to exclude the wind farm.
  - The WTGs would impact on PANS-OPS surfaces:
    - would need to be raised by 300 ft.
    - The minimum holding altitude of RNP RWY 27 would need to be raised by 300 ft.
    - Due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.

- Wentworth Airport (YWTO):
  - The WTGs would not impact the OLS surfaces
  - The WTGs would not impact the circling areas.
  - The WTGs would impact on 25 nm MSA, which will need to be raised by 500 ft to 2300 ft or sectorized to exclude the wind farm.
  - The WTGs would not impact PANS-OPS surfaces, however, due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.
- The WTGs would impact the Grid LSALT; both Grid LSALTs would need to be raised to 2400 ft AMSL.
- The WTGs would impact on four (4) air route LSALTs:
  - Air route Q4 LSALT would need to be raised to 2400 ft.
  - Air route Q16 LSALT would need to be raised to 2400 ft.
  - Air route J19 LSALT would need to be raised to 2200 ft.
  - Air route W451 LSALT would need to be raised to 2400ft.
- The Project Area is located within Class G airspace and outside all controlled airspace, Prohibited, Restricted, and Danger areas.
- The WTGs would not impact the aviation navigation facilities of nearby certified airports.
- The WTGs would not impact the closest radar installations.
- The WTGs must be reported to CASA, and construction details provided to Airservices Australia.

Obstacle lighting risk assessment

- Based on the New South Wales Department of Planning, Housing and Infrastructure *Wind Energy Guideline* (November 2024),
  - If WTGs or WMTs are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).
  - Lighting of WTGs and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.
- CASA provided feedback on 11 November 2024 and recommended lighting the wind farm with a minimum intensity lighting on the nacelle.
- DPHI provided advice on 23 January 2025, which required to preparation of an Aviation Lighting Plan (a separate lighting report been prepared by Aviation Projects: 102209-01 Mallee_WF_Obstacle_Lighting_Final_V1.0_260331, see Annexure 7).

Consultation

Refer to Section 5 for detailed responses from relevant aviation stakeholders received. The Applicant will continue to actively consult with relevant aerodrome and aviation operators.

Notification and reporting

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

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

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

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

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

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

5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs 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.

    a. CASA recommends that the following Australian Standard be considered regarding overhead transmission lines: *AS 3891.2, Air navigation — Cables and their supporting structures — Marking and safety requirements, Part 2: Low-level aviation operations*.

6. The Project Area is next to the boundary of the Mallee Cliffs National Park. Consultation with NSW National Parks and Wildlife Service (NPWS) has already undertaken, referring to Section 5.

Marking of WTGs

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

Marking of WMTs

8. It is not mandatory to mark the WMTs however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:

    a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour

    b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and

c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation.

Lighting of WTGs and WMTs

9. Based on NSW Wind Energy Guideline,
   a. If WTGs or WMTs are 150 m or more above ground, lighting is required for the most critical WTGs (e.g. WTGs at highest elevations and/or around the project perimeter).
   b. Lighting of WTGs and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.
10. CASA provided feedback on 11 November 2024 and recommended lighting the wind farm with a minimum intensity lighting on the nacelle.
11. DPHI provided advice on 23 January 2025, which required to preparation of an Aviation Lighting Plan (a separate lighting report been prepared by Aviation Projects - 102209-01 Mallee_WF_Obstacle_Lighting_Final_V1.0_260331, see Annexure 7)

Micro-siting

12. Providing the micro-siting is within 100 m of the WTGs, it will not likely result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micro-siting and the conclusions of this AIA would remain the same.

Aerial firefighting

13. The developer or operator should consider the guidance contained in the National Council for Fire and Emergency Services, Wind Farms and Bushfire Operations to ensure:
    a. Liaison with the relevant fire and land management agencies is ongoing and effective.
    b. Access is available to the wind farm site by emergency services response for on-ground firefighting operations.
    c. Wind turbines are shut down immediately during emergency operations.
    d. 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. This may not always be possible due to the risk to equipment and personnel as a fire approaches or exists in or near to the WTGs.

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

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

1. INTRODUCTION

1.1. Situation

Spark Renewables proposes to develop the Mallee Wind Farm located approximately 16 kilometres (km) north east of Buronga in the Murray region of southwestern NSW within the Wentworth Local Government Area (LGA) and 17 km north east of Mildura, Victoria (VIC). The Project will include the installation, operation, maintenance and decommissioning of up to 76 wind turbine generators (WTGs), a single grid scale 100 megawatts (MW) /200-megawatt hour (MWh) Battery Energy Storage System (BESS), ancillary infrastructure and temporary facilities associated with construction of the Project. The Project design incorporates up to 76 WTGs, with a maximum blade-tip height of 280 m above ground level, and an installed capacity of up to 402 MW.

Aviation Projects has been engaged by Umwelt (Australia) Pty Ltd (Umwelt) to prepare this Aviation Impact Assessment for inclusion within the Environmental Impact Statement (EIS) for the Project.

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

This AIA report includes an AIS in accordance with Airservices Australia's requirements.

A qualitative risk assessment to determine the need for obstacle lighting is also included.

1.2. Purpose and Scope

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

The AIA specifically responds to the NSW Planning Secretary's Environmental Assessment Requirements (SEARs) for the Project which provide that the assessment of aviation safety in the EIS must:

- Assess the impact of the development under the National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers effective July 2012*;
- Provide associated height and co-ordinates for each WTG 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, and use of emergency helicopter access;
- Identify aerodromes within 30 km of the WTGs and consider the impact to nearby aerodromes and aircraft landing areas;
- Address impacts on obstacle limitation surfaces (OLS); and
- Assess the impact of the WTGs on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the WTGs and transmission line.

Additionally, the AIA addresses the following key legislation, approvals, and guidance material:

- National Airspace Safeguarding Framework Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers effective July 2012.*

- Civil Aviation Safety Authority (CASA) MOS Part 139, *Aerodromes.*
- Specific requirements for an Aviation Impact Statement (AIS) by AsA.

1.3. Methodology

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

- Confirmed the scope and deliverables with the Proponent (or representative).
- Reviewed client material.
- Conducted a site visit on 26 April 2024 to properly investigate aviation safety aspects of the proposed site.
- Reviewed relevant regulatory requirements and information sources.
- Prepared a draft AIA and supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified.
- Prepared an AIS in accordance with Airservices Australia requirements.
- Prepared a qualitative risk assessment to determine the need for obstacle lighting and to identify risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment will be completed following the guidelines in *ISO 31000:2018 Risk Management –Guidelines.*
- Consulted with Airservices Australia and the Department of Defence.
- Consulted with relevant Council/s, CASR Part 173 Flight Procedure Design Organisations and aerodrome operators of the nearest aerodrome/s to seek endorsement of the proposal to change instrument procedures (if applicable).
- Consulted/engaged with stakeholders to negotiate acceptable outcomes (if required).
- Finalised the AIA report for client acceptance once 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 (55.56 km) of the Project Area.
- Nominate all instrument approach and landing procedures at these aerodromes.
- Review the potential effect of project operations on the operational airspace of the aerodrome(s).

Air Routes:

- Nominate air routes published in En-Route Chart Low (ERC-L) & En-Route Chart High (ERC-H) are located near/over the Project Area and review potential impacts of Project operations on aircraft using those air routes.

Airspace:

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

Navigation/Radar:

- Nominate air traffic control radar with coverage overlapping the Project Area.
- Nominate aviation navigation systems in proximity to the Project Area.

1.5. Material reviewed

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

- 240418_WTG_ProjectBoundary.kmz
- 32179_TurbineAndMetMast_Elevations_260116.xlsx
- PROJDES_Spark_MWFPermanentMast_v001_240327_GDA20z54.zip
- PROJDES_Umwelt_WTG_MALW_SG6_6_170_v018_3_240904_GDA20z54.zip

2. BACKGROUND

2.1. Site overview

The Project Area is located approximately 16 kilometres (km) northeast of Buronga in the Murray region of southwestern NSW and 17 km northeast of Mildura, within the Wentworth Local Government Area (LGA).

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

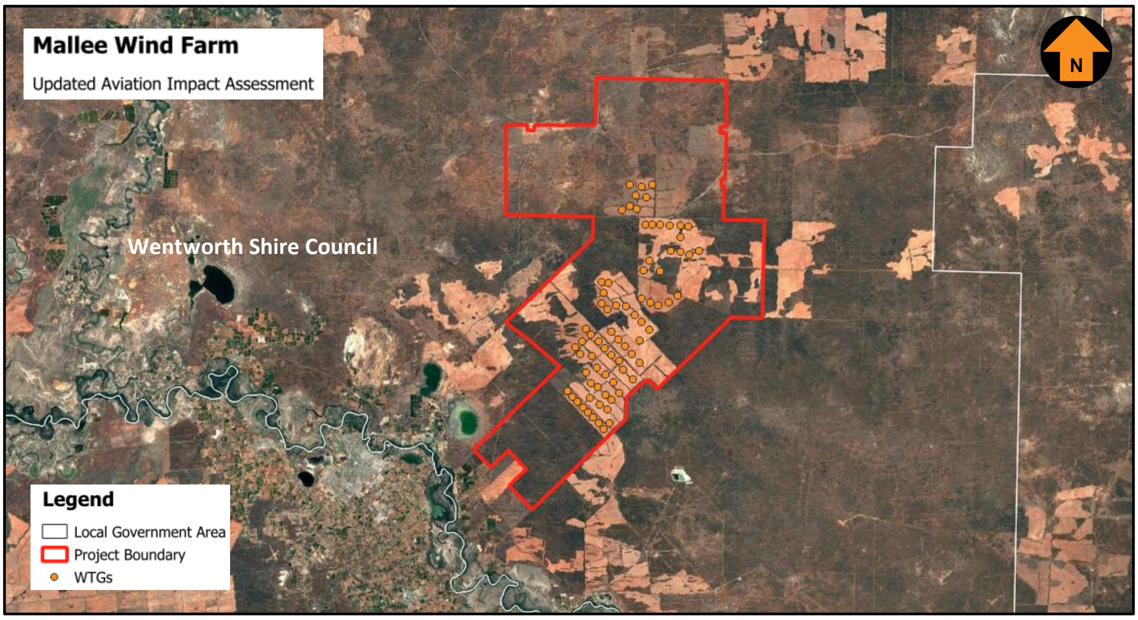


Figure 1 Project Area overview

The South-West REZ is relatively undeveloped, but there is substantial commercial interest in the area such that there are several other renewable energy developments in the vicinity of the Project with most at the early stages of the planning and approvals pathway. Other new and nearby renewable energy and other state significant projects include, but are not limited to, the Mallee Solar Farm Euston Mineral Sands Project, Euston Wind Farm, Koorakee Energy Park, Gol Gol Solar Farm, Gol Gol Wind Farm and Gol Gol BESS, Project EnergyConnect (NSW - Eastern Section) and Buronga Landfill. Other new renewable energy projects in the South-West REZ are anticipated.

2.2. Project Description

The key components of the Project include:

- 76 (three (3) blade) WTGs, with a maximum blade-tip height of 280 metres (m) above ground.
- A single grid-scale 100 MW /200 MWh BESS.
- Permanent ancillary infrastructure including internal access tracks, hardstands, main and collector substations, switchyards, operations and maintenance facilities, underground and overhead electricity transmission lines and poles, telecommunications facilities and utility services, permanent meteorological masts and water storage tanks.

- Temporary facilities including temporary workforce accommodation (TWA) facility, site offices, amenities, construction compounds and laydown areas, concrete or asphalt batching plants, minor 'work front' construction access roads, environmental management and monitoring and signage.
- Off-site road works, involving upgrades to the proposed local transport route and establishment of site access points.
- The WTGs will have rotor diameter (RD) of 200 m, with maximum tip height of 280 m AGL.

Based on the proposed Project layout, the highest WTG, WTG T15, will not exceed 398.2 m AHD (1306.4 ft above mean sea level (AMSL)).

It is anticipated that construction works will commence within one year of Project approval i.e. construction commencing in mid-to-late 2027. The timing of construction will be driven by additional permits and authorisations, contractor selection, detailed design and procurement processes, and a final investment decision. The construction phase of the Project is anticipated to be 2.5 to three (3) years. The Project has an estimated operational life of 30 years after which it may be decommissioned or re-powered.

In summary the anticipated timeframes for the Project are:

- Planning and approvals (prior to commencement of construction): in progress and aiming to be completed in 2026.
- Construction and Commissioning: planned to commence in 2027, for approximately 3 years.
- Operation: estimated operational life of 30 years.

3. EXTERNAL CONTEXT

3.1. National Airports Safeguarding Framework

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

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

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

The methodology for preparing the risk assessment is contained in the NASF Guideline D Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers.

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.

NASF Guideline D strongly encourages consultation with aviation stakeholders in the early stages of wind farm development planning, including with aerodrome owners and operators, regional aircraft operators and CASA and Airservices.

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

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

5.3 Aviation safety and lighting

Wind turbines and wind monitoring masts may present a risk to aviation safety when they are proposed near airports and aircraft landing areas or would intersect air traffic routes, aircraft operating heights or navigable airspace.

Under the Civil Aviation Safety Regulations 1998 (Cth), aircraft are permitted to fly as low as 152 m above ground level. Any tall structures, such as wind turbines, that are 150 m or more above ground *are generally considered a hazard. Wind turbines may also create turbulence that may affect aircraft behaviour and performance. To manage these risks, aviation regulations require the location of wind turbines and monitoring masts to be reported to relevant aviation authorities. This enables their locations to be mapped so that pilots are aware of their locations. The Civil Aviation Safety Authority (CASA) expects some level of safety lighting if turbines are 150 m or more above ground.*

5.3.1 Key principles

Aviation safety and lighting principles

• Wind energy projects should be designed to reduce aviation safety risk.

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

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

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

5.3.2 Assessment

An aviation impact assessment is required for all wind energy projects. Appendix A of this guideline will help applicants determine the extent and content of the assessment. The purpose of the assessment is to ensure that applicants, aviation authorities, the aviation industry, aircraft users, communities and the consent authority have a detailed understanding of:

• the type and location of any nearby aerodromes and aircraft landing areas or flight paths

• aerial activities such as helicopter use and low-flight operations for fire and pest control, mustering, asset maintenance, search and rescue and recreational activities in agricultural, forestry and conservation settings around the project area

• the potential impacts of the project on aviation activities

• the ways in which potential impacts and risks may be mitigated.

If a wind energy development is located near a certified or registered aerodrome used by the community or an aerodrome used by the military, the applicant must consult with the aerodrome operators and aircraft operators known to fly in the area. Applicants must also consult with Airservices Australia and the Australian Department of Defence to determine any potential effects on operating procedures and/or nearby communications, navigation or surveillance equipment.

Aerial firefighting

Wind turbines do not pose a significant risk to firefighting activities and are no different to structures such as communications towers and overhead powerlines. Aerial firefighting can be undertaken around wind turbines[15] if appropriate strategies, emergency management systems and communications protocols are in place[16].

Applicants must detail the operational procedures they will implement in a bushfire in the project's emergency plan. This should include measures such as shutting down turbines and positioning blades in a manner to minimise interference with aerial firefighting operations.

As part of the assessment process, we will consult with the Rural Fire Service, who will coordinate advice from local branch districts. We will also seek advice from NSW National Parks and Wildlife Service in relation to their operations and protocols for bushfire management in protected areas.

If turbines and other tall structures are equipped with aviation obstacle lighting, the applicant must ensure there are procedures in place to quickly activate the lights during a bushfire or fog event to increase the visibility of these obstacles to pilots. The applicant must also consult with the Rural

Fire Service to develop any other appropriate procedures to minimise impacts to firefighting efforts and to communicate the final turbine coordinates and heights.

Any fire incidents near wind turbines will be managed by the Rural Fire Service using a combination of firefighting personnel, tankers and heavy plant integrated with aircraft. The Rural Fire Service will conduct a risk assessment of local conditions to inform its response, including the use of aerial firefighting activities.

[15] Australian and New Zealand Council for fire and emergency services - AFAC (2018) Wind Farms and Bushfire Operations

[16] Clean Energy Council (2017) In Case of Fire: a real-life experience at a wind farm site

Appendix A Aviation and lighting impact assessment

In Australia, all wind energy projects must include an assessment of potential impacts under the Australian Government's National Airports Safeguarding Framework Guideline D to determine potential risks to aviation safety.

Assessment requirements

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

If a proposed wind turbine or monitoring tower is greater than 150 m high or infringes on the obstacle limitation surface of a certified aerodrome, applicants must do an aviation impact assessment in accordance with Guideline D and the requirements in Table 3.

Table 3. Requirements for aviation impact assessment

Requirement	***Content and form***
Consultation	Undertake and outline consultation with: • nearby aerodromes (certified and un-certified) and aircraft operators known to fly in the area (low-flying activities that may include fire spotting and control) • Airservices Australia to determine if any nearby aerodrome operating procedures may be affected by the project (prior to consulting with CASA) and whether any aeronautical communications, navigation or surveillance equipment may be affected • Department of Defence to determine whether any aeronautical communications, navigation or surveillance equipment may be affected • CASA about the proposed lighting plan for the project prior to submitting the environmental impact statement but only after receiving in-principal

Requirement	*Content and form*
	support from Airservices Australia and any relevant aerodrome operators that the project would not adversely impact any local airport operating procedures • National Parks and Wildlife Service and other land management operators to identify the potential impacts to low-flight operations (e.g. aerial pest/weed control and firefighting activities) and to develop procedures to reduce the risk of collisions with turbines and other infrastructure.
Impacts and risks	• Assess the potential impacts of the project on any aviation activity including the cumulative effects of other wind energy projects in the vicinity and potential wake/turbulence issues. • Conduct a risk analysis using AS/NZS ISO 31000:2018 Risk Management – Guidelines. • Identify the necessary aviation obstacle lighting requirements by considering the defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems and navigation aids.
Lighting	• Consider measures to minimise the amenity impacts of lighting. • Identify the type of lighting management system proposed (e.g. permanent fixtures or motion sensor/radar detection systems) and include a detailed lighting plan. • Assess any impacts on the Siding Spring Observatory and the Dark Sky Region in accordance with the Dark Sky Planning Guideline, if the project is located within 200 km of the observatory. • Identify measures to ensure obstacle lights always remain lit as indicated in the lighting management system in a fail-safe mode, and any disruption or outages are minimised to the extent practicable through documented contingency arrangements.
Other forms of mitigation	Describe other measures to mitigate potential risks, including: • providing as-constructed details (including the specific location coordinates and elevations) of turbines and monitoring masts to Airservices Australia so they are registered on the national databases. • marking monitoring towers according to the requirements of National Airports Safeguarding Framework Guideline D. • marking overhead transmission lines according to Australian Standards AS 3891.1 with visual identification tools such as marker balls and in consultation with the transmission network provider.

3.3. Planning context - NSW

Spark Renewables seeks to construct and operate the Project 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 Secretary's Environmental Assessment Requirements (SEARs) for the Project relevant to this study are provided in Section 1.2 above.

3.4. Wentworth Shire Council

Wentworth Shire Council operates the Wentworth aerodrome which is certified under CASR Part 139. Further details about the operation of Wentworth aerodrome are in contained in Section 6.4.

3.5. Mildura Shire Council

Mildura Airport Pty Ltd (MAPL) is a corporate entity established to manage and operate Mildura Airport on behalf of the Mildura Shire Council since 2009.

MAPL publishes the Mildura Regional Airport Master Plan (2017 – 2037) but does not contain an OLS or Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS chart).

MAPL provides key objectives of the Master Plan, including, among others:

- *Identify strategies and facilities required to ensure the long-term sustainability of the airport*
- *Protect the airfield and options for future growth and prevent inappropriate activities from occurring surrounding landscapes.*

Detailed assessments are contained in Section 6.3.

3.6. CASA recommendation

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

CASA response	Addressed in the report
CASA has reviewed the Aviation Impact Assessment (AIA) (Appendix 20 to the EIS) by Aviation projects of 25 September 2024 for the proposed Mallee Wind Farm. • The proposal includes up to 76 Wind Turbine Generators (WTGs) that will be up to 280 m Above Ground Level (AGL) tip height. • There will be up to 7 permanent wind monitoring towers (up to 170 m AGL) and some temporary wind monitoring towers. • The WTGs are located beyond the Obstacle Limitation Surface (OLS) of the nearest certified aerodrome - Mildura Aerodrome (YBRN). • Aviation Projects advises that the 10nm MSA will need to be raised to 2300 ft and the 25 MSA to 2400 ft. • Aviation Projects advises that the instrument approach procedures flight path for the DME or GNSS Arrival	The assessment has been revised following CASA's response, with amendments to Sections 6, 7 and 8. Following review, the majority of the assessment remains unchanged.

CASA response	Addressed in the report
Procedure is located above the wind farm footprint and will require the initial approach segment minimum altitude to be increased to 2400 ft. • Aviation Projects advises that all lowest safe altitudes (LSALTs) (Air Routes Q4, J19, W451 and Grid LSALTs) in the vicinity of the Project Area will need to be increased to 2400 ft AMSL. • Aviation Projects advises that there is one uncertified aerodrome located within 3 nm of the closest WTG. The location map shows it to be 12km+ to the nearest turbine or wind monitoring tower. This CASA assessment is made in accordance with the National Airports Safeguarding Framework (Guideline D) as developed by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts, to provide planning advice to State and Local Planning Authorities. With regards to Visual Flight Rules (VFR) operations, pilots are permitted to fly as low as 500 ft AGL (ie, terrain). The WTGs will reach up to a maximum height of approximately 280 m (919 ft) AGL.	
CASA agrees with the Recommendations at Section 11 of the Aviation Impact Assessment. However, CASA considers the proposed wind farm will be a hazard to aviation safety and recommends that the wind farm is obstacle lit with steady medium-low intensity red obstacle lighting in accordance with the National Airports Safeguarding Framework Guideline D 'Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation' National Airports Safeguarding Framework Principles and Guidelines (infrastructure.gov.au) and section 9.31 of Part 139 Aerodromes Manual of Standards Part 139 (Aerodromes) Manual of Standards 2019 (legislation.gov.au) (lower level lights on the turbine support columns are not essential). International standards require 2,000 candela lighting intensity on the nacelle (also recommended in the NASF guideline) and 200 candela at the mid-point of the turbine mast. CASA recommends that 200 candela as a minimum intensity lighting on the nacelle would suffice (due mainly to the lack of background lighting in the vicinity of the turbines). The obstacle lighting should be monitored to alert the wind farm operator of any outage and some of the obstacle lights remain on during an outage. CASA is prepared to review a lighting plan that indicates which turbines are proposed to be lit.	Lighting report been prepared by Aviation Projects: 102209-01 Mallee_WF_Obstacle_Lighting_V0.2_260119, see Annexure 7

CASA response	Addressed in the report
As the Aviation Safety regulator, CASA does not consider the visual impact of obstacle lighting on neighbours / homesteads / the dark sky. However, there are mitigations for visual impact such as baffling and intensity control (as described in the Aviation Impact Assessment Table 10 / Page 49 'Effect of obstacle lighting on neighbours' and page 7 of Annexure 3 'Regulatory Requirements – Lighting and Marking').	
Further to Recommendation 5, and as recommended by the Aerial Application Association of Australia, CASA recommends that the following Australian Standard be considered regarding overhead transmission lines: • AS 3891.2, Air navigation — Cables and their supporting structures — Marking and safety requirements, Part 2: Low-level aviation operations. The impact on MSAs and LSALTs is covered in Aviation Impact Assessment Sections 6 and 10 but not specifically included in Section 11 Recommendations. The proponent (or the proponent's Aviation Consultant) should engage with Airservices Australia regarding the changes to MSAs and LSALTs, before the infringing WTGs have been erected. (Airservices may need some lead time). As described by Aviation Projects on page 22 of the AIA, the Mildura Airport operator will also need to approve the changes.	Updated recommendation in Section 14

3.7. Advice from DPHI on aviation

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

> ***Aviation hazard lighting:*** *prepare an Aviation Lighting Plan for the project as per the recommendations made by the Civil Aviation Safety Authority (CASA) in their advice dated 11 November 2024. The Aviation Lighting Plan should:*
>
> - *consider measures to minimise the amenity impacts of lighting;*
> - *identify the type of lighting management system proposed (e.g. permanent fixtures or motion sensor/radar detection systems) and include a detailed lighting plan; and*
> - *identify measures to ensure obstacle lights always remain lit as indicated in the lighting management system in a fail-safe mode, and any disruption or outages are minimised to the extent practicable through documented contingency arrangements.*

3.8. Civil Aviation Safety Authority (CASA)

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

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

This AC provides guidance for pilots of:

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

Purpose

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

2 Introduction

2.2 Use of Aerodromes

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

3.3 Performance Information

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

4 Information about aerodrome publications

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

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

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

4.2.4 The examples below are two of many possible considerations:

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

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

5 Permission to operate

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

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

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

7.2 Traffic circuit direction

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

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

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

– the performance of the aircraft

– AFM/Pilot's Operating Handbook requirements

– company standard operating procedures

– other safety reasons.

7.8 Final approach

7.8.1 The turn onto final approach should be:

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

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

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

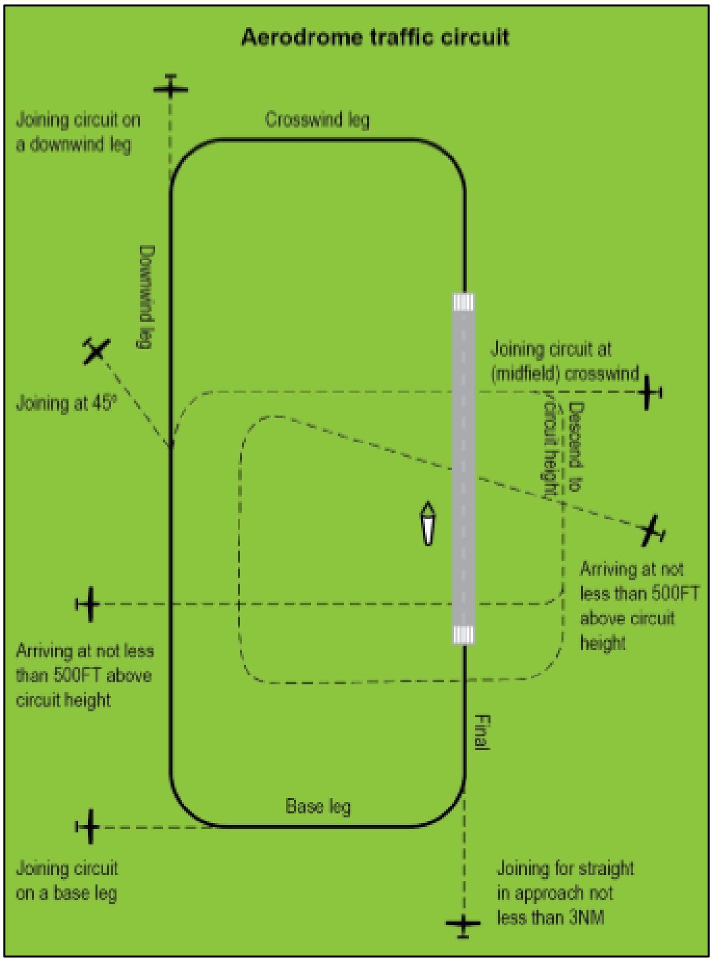


Figure 2 Aerodrome standard traffic circuit, showing arrival and joining procedures.

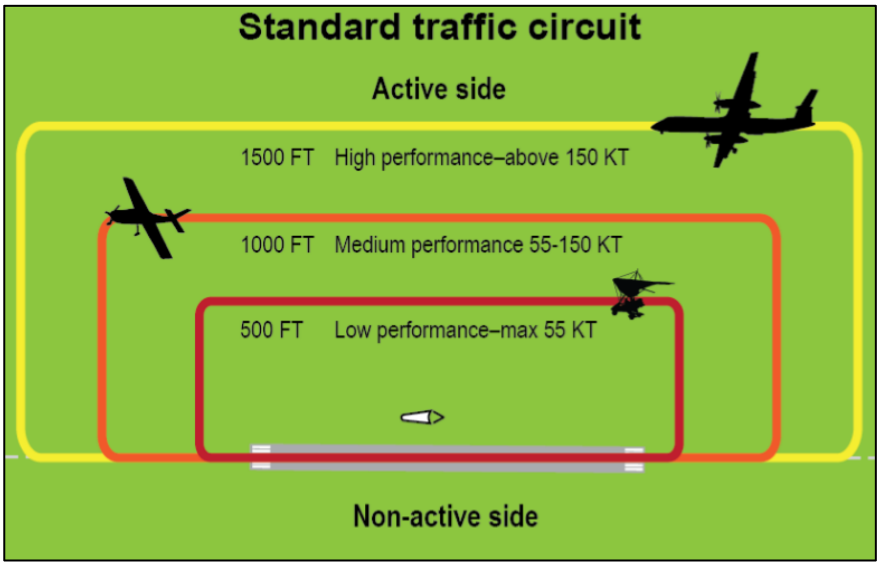


Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

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

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

3.9. Rules of flight

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

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

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

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

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

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

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

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

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

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

3.10. Aircraft operator characteristics

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

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

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

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

3.11. Passenger transport operations

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

3.12. Private operations

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

3.13. Military operations

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

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

3.14. Aerial application operations

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

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

3.14.1. Aerial Application Association Australia (AAAA)

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

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

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

> *What are the issues?*
>
> - *Collision: Wind turbines pose a collision risk for aircraft operating at low altitudes (defined as below 500 feet above ground level). This is the height aerial application and firebombing aircraft operate at. Emergency aircraft (police, ambulance, search and rescue) also regularly operate below 500ft for emergency operation conditions. These operations can occur 24 hours per day.*
> - *Blade rotation: Agricultural application is conducted when wind speed is between 3km/h and 20 km/h. Turbines typically start turning at around 11km/h but can turn at lower speeds. Blade rotation causes both distraction and collision risk. As such, any aerial application in a wind farm*

should only take place when the wind turbine blades have been locked in the "rabbit ears" (one blade aligned with the tower structure and two above the tower) position.

- *Associated infrastructure: Wind turbines require powerlines, transformer yards and meteorological towers. These all create collision risks. Meteorological towers are considered to be the most significant risk to low level flight as they are typically difficult to see and discern from the surrounding areas.*
- *Best placement for Agricultural outcomes: Like every part of the farm, placement of a non-moving piece of infrastructure has some impact. Working with the developer can ensure that paddocks can be managed. Make sure that turbines are placed where aircraft and ground machinery can manoeuvre cleanly around the structure. Every additional manoeuvre costs, so placement to ensure long runs and easy turn areas is vital.*

Managing Collision Risk

All tall structures need to be marked in accordance with AS3891.1:2021 and the Civil Aviation Safety Regulations Part 139. Conforming to these standards is of minimum cost during the construction phase and dramatically improves aviation safety.

Once built – any aerial application in a wind farm should only take place when the wind turbine blades have been locked in the "rabbit ears" (one blade aligned with the tower structure and two above the tower) position.

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

The development of tall structures in agricultural and bush fire prone areas can pose a direct threat to aviation safety, particularly where fixed and rotary aircraft may be requested to operate for agricultural or bush/grass fire control.
The absence of historical aircraft use in an area is considered an insufficient reason to discount the threat to Aviation Operations.

The AAAA will oppose any development application or similar process unless the proponent has:

- *Identified the structure as posing a low-level flying risk that needs to be managed on an ongoing basis*
- *Consulted honestly and in detail with local aerial application operators or the AAAA where a local operator cannot be identified*
- *Consulted with adjoining landowners regarding the impact on adjacent properties*
- *Included appropriate lighting and marking in the development proposal, consistent with providing a warning to low level flying*
- *Identified the process for advising of the location height and presence of the structure to the relevant authorities, and*
- *Ensure that the proposal is in keeping with CASA requirements for structures near aerodromes, including temporary landing areas.*

3.14.2. Aerial application operators

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

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

Based on previous studies for other wind farm projects undertaken by Aviation Projects, and the results of consultation with AAAA and local aerial application operators, it is reasonable to conclude that safe aerial application operations would be possible on properties within the Project 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, WMTs and overhead powerlines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

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

3.15. Emergency services

3.15.1. Royal Flying Doctor Service

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

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

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

3.15.2. Aerial firefighting

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

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

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

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

> *Wind farm operators should be responsible for ensuring that the relevant emergency protocols and plans are properly executed in an emergency event. During an emergency, operators need to react quickly to ensure they can assist and intervene in accordance with their planned procedures.*
>
> *The developer or operator should ensure that:*
>
> - *liaison with the relevant fire and land management agencies is ongoing and effective*
> - *access is available to the wind farm site by emergency services response for on-ground firefighting operations*

- *wind turbines are shut down immediately during emergency operations – where possible, blades should be stopped in the 'Y' or 'rabbit ear' position, as this positioning allows for the maximum airspace for aircraft to manoeuvre underneath the blades and removes one of the blades as a potential obstacle.*

Aerial personnel should assess risks posed by aerial obstacles, wake turbulence and moving blades in accordance with routine procedures.

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

4. INTERNAL CONTEXT

4.1. Wind farm site description

The Project Area is located approximately 16 kilometres (km) northeast of Buronga in the Murray region of southwestern NSW and 17 km northeast of Mildura.

Figure 4 shows a view of the Project Area during our site visit. (Source: Aviation Projects)

Figure 4 Project view

4.2. Wind turbine generator (WTG) description

The Project Area is to comprise up to 76 WTGs. The maximum blade tip height of the proposed WTGs will be 280 m AGL.

The ground elevation for the highest WTG location (WTG T15) is 118.2 m AHD, which, with a 280 m WTG height, results in a maximum overall height of 398.2 m AHD (1306.4 ft AMSL).

Figure 5 illustrates the project layout, identifying the highest WTG location, WTG T15 (source: Google Earth).

This AIA assumes that a maximum blade tip height of 280 m AGL is implemented at all WTG locations.

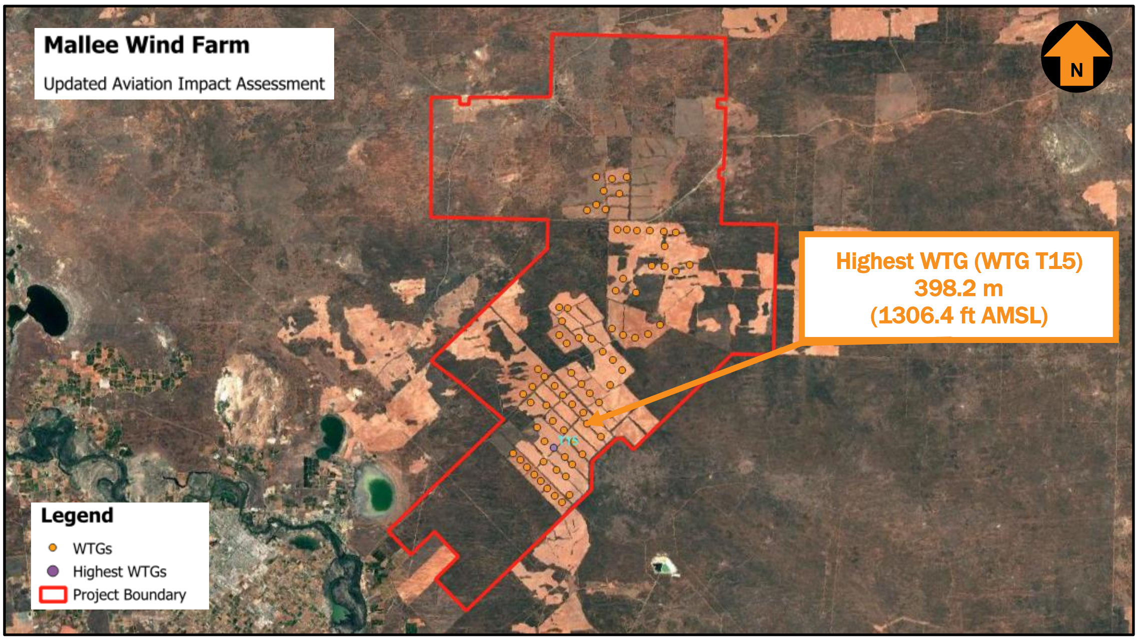


Figure 5 Project layout and highest WTG location

WTGs, battery storage, ancillary infrastructure and temporary facilities will be micro-sited post approval during the optimisation, detailed design and construction phase programming. Final micro-siting may not occur until during the construction period, immediately prior to the activity or construction of that Project element. Noting that a Development Corridor has not been considered in the EIS, the process of locating WTGs, battery storage, ancillary infrastructure and temporary infrastructure during detailed design without further approval, providing that:

- Ground disturbance is wholly contained within the Disturbance Footprint.
- No WTG is moved more than 100 m from the relevant GPS coordinates listed in Appendix 3.
- The revised location of the blade of a WTG is at least 50 m from the canopy of existing hollow-bearing trees; or where the proposed location of the blade of a WTG is already within 50 m of the canopy of existing hollow-bearing trees, the revised location is not any closer to the existing hollow-bearing trees.

4.3. Wind monitoring tower description

It is proposed to install an additional seven WMTs with a maximum height of 170 m (557.7 ft) AGL, as shown in Figure 6.

The location of the WMTs is also provided in Figure 6. Permanent meteorological masts are installed within the Project Area at all times and within the Development Corridor where reasonable and feasible.

Temporary meteorological monitoring masts will be located within the Project Area, near future WTG locations, and will be removed prior to the construction of the WTG at that location.

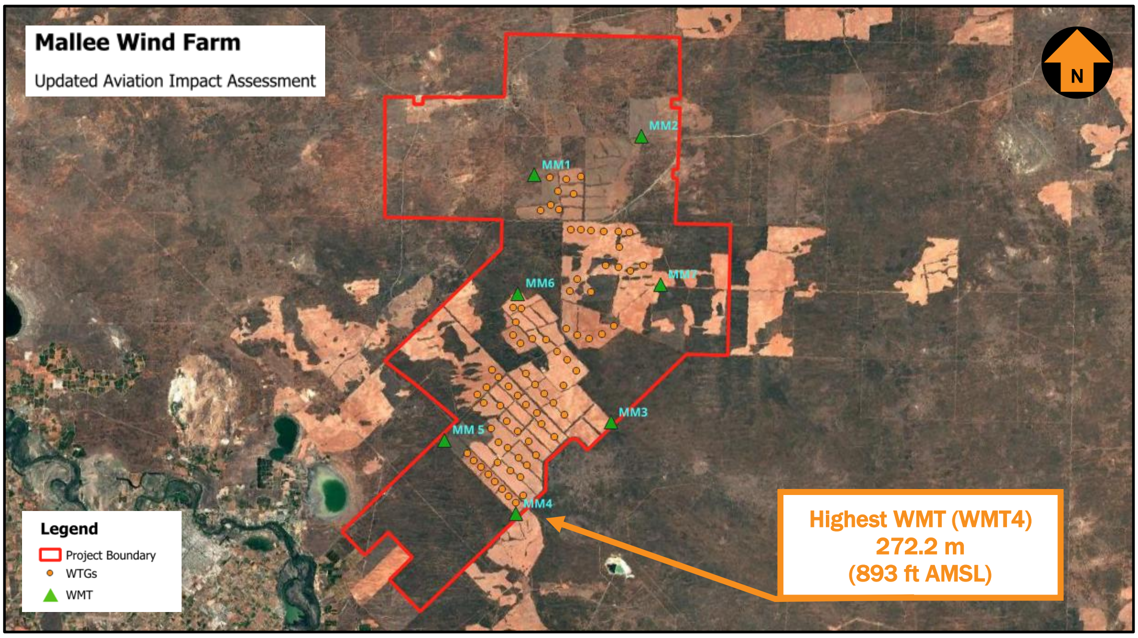


Figure 6 WMT Locations

5. CONSULTATION

The following list of aviation stakeholders were identified as requiring consultation:

1. Airservices Australia
2. Department of Defence
3. Mildura Airport Pty Ltd
4. Wentworth Shire Council
5. Royal Flying Doctor Service
6. NSW Rural Fire Service
7. Fire and Rescue NSW
8. NSW National Parks and Wildlife Service

Details and results of the consultation activities will be provided in Table 1 once received.

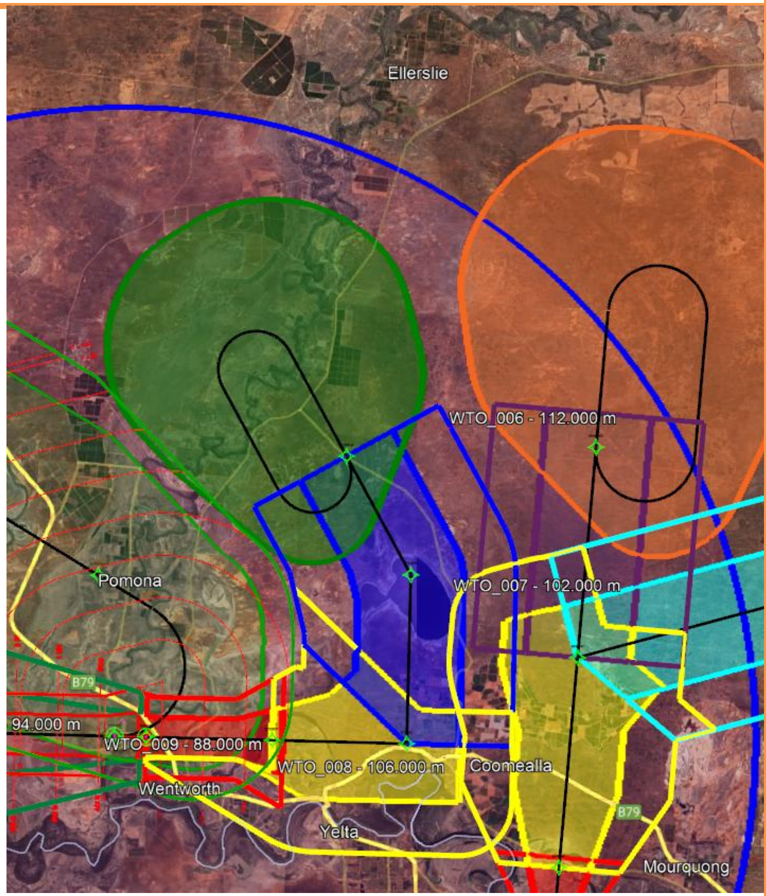
Table 1 Stakeholder consultation details

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
Airservices Australia	Email sent on 24 September 2024 to Airservices Australia	Email received on 21 January 2025 from Airservices Australia	***Airspace Procedures*** *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 398.2m (1307ft) the wind farm will affect the 25nm MSA, the RNP RWY 27 and the DME or GNSS arrival procedure at Mildura aerodrome.* *The 25nm MSA will need to be raised by 300ft from 2000ft to 2300ft.* *The RNP RWY 27 holding minimum altitude will need to be raised by 300ft from 2000ft to 2300ft.* *The DME or GNSS Arrival procedure segment minimum altitude, between 25nm and 15nm from the ARP, will need to be raised by 400ft from 2000ft to 2400ft.* *The maximum height of the wind farm without affecting any procedures at Mildura aerodrome is 304.7m (1000ft) AHD.* *At a maximum height of 398.2m (1307ft) the wind farm will not affect any air routes.* *Note: Procedures not designed by Airservices at any aerodrome were not considered in this assessment.* ***Grid lowest safe altitude (LSALT)*** *Assessment of the wind farm shows 76 turbines will penetrate the published Grid LSALT. Please refer to attached Vertical Obstacle Notification data (VOD)* ***Communications/Navigation/Surveillance (CNS) Facilities***	Please advise the 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 WTG locations • Elevations at the top of the highest point of the WTGs in metres AHD • A copy of this email. **Vertical Obstacle Notification** This proposed wind farm is more than 30m (99ft) AGL. Please follow the below notification process: 1. Complete the Vertical Obstacle Notification Form: ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf (airservicesaustralia.com) 2. Submit completed form to: VOD@airservicesaustralia.com as soon as the development reaches the maximum height.

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
			We have assessed the proposed activity to the above specified height for any impacts to Airservices Precision/Non-Precision Navigation Aids, Anemometers, HF/VHF/UHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding. *Note: Meteorological instruments not owned by Airservices were not considered in this assessment. Please consult with the Bureau of Meteorology to ensure that the proposed activity does not adversely impact their equipment.* ***Air Traffic Control (ATC) Operations*** *There are no additional instructions or concerns from our ATC.* ***Summary – permanent impact (WF)*** *It is our view that the proposed Wind Farm impacts Airservices designed airspace procedures, CNS facilities or ATC operations at Mildura aerodrome. The wind farm will affect the 25nm MSA, the RNP RWY 27 and the DME or GNSS arrival procedure at Mildura 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.* *Please note, all amendments to airspace procedures are on a commercial basis.*	For further information regarding the reporting of tall structures, please contact the VOD team: • Phone - (02) 6268 5622 • Email - VOD@airservicesaustralia.com • Or refer to: Civil Aviation Safety Regulation Part 175 — Airservices and You - Airservices (airservicesaustralia.com).
Department of Defence	Email sent on 24 September 2024 to the	Email received on 21 January 2025 from Anthony Deutschmann	*Defence indicated it has no objection to the proposal, subject to the proposed WTGs and WMTs meeting the requirements for the reporting of tall structures.*	No Action required

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Key Agency Recommendations
	Department of Defence	(Assistant Director)		
Mildura Airport Pty Ltd	Email sent on 24 September 2024 to Mildura Airport Pty Ltd, Following up on 22 January 2025		No feedback received	
Wentworth Shire Council	Email sent on 24 September 2024 to Wentworth Shire Council Following up on 21 October 2024, 18 November 2024, and 1 October	23 February 2026 from Tamas Boldogh (Chief Designer)	*Global Airspace Solution (Subcontractor of Wentworth Shire Council) have reviewed the updated aviation impact assessment done by Aviation Projects for the proposed Malle Wind Farm with respect to the instrument flight procedure of Wentworth, NSW.* *I have also assessed the interdependency between the RNP RWY 18 of Mildura and the RNP RWY 26 of Wentworth.* *It should be highlighted in the document that the commencement altitude (1800 ft) of the RNP RWY 26 of Wentworth cannot be changed due to the fact that it is vertically separated from the RNP RWY 18 of Mildura and this separation must be maintained (YWTO-RNP RWY 26 - 185). The only feasible solution is the sectorise the 25 NM MSA of Wentworth to keep the RNP RWY 26 initial segment procedure altitude at*	In order to make all the required changes for the flight procedures a minimum of 6-month prior notification is needed to meet the AIRAC cycles before the start of the wind farm development.

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
	2025 with Global Airspace Solutions (GAS)		*the currently promulgated 1800 ft. A new higher southeasterly 25 NM MSA sector could accommodate the Mallee Wind Farm.* *Increasing the 25 NM MSA of Mildura to 2300 ft will not have an impact on the RNP RWY 18 of Mildura as the initial segment procedure altitude is at or above 2800 ft to keep it vertically separated from the RNP RWY 26 of Wentworth (MIAGN02.dgn).*	

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Key Agency Recommendations
				

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
			The image above shows the overlapping of the YWTO RNP RWY 26 and the YMIA RNP RWY 18. *Do you know the proposed start date of the Mallee Wind Farm development?* *In order to make all the required changes for the flight procedures a minimum of 6-month prior notification is needed to meet the AIRAC cycles before the start of the wind farm development.* *Given the fact that the other Wind Farm development also affects the MSA of Wentworth it would make sense to modify the MSA only once so that the proposed Lake Victoria and Mallee Wind Farm projects are both catered for at the same time.* *We have already had a conversation with CASA regarding the need for a new flight validation of the flight procedures and impacted MSA sectors should a new wind farm development required that. The answer we have got that it would depend on the reliability of the obstacle information provided and the availability of a certified obstacle survey.* *In all situations the cost of revising the procedures, MSA sectorisation and possible flight validation needs to by paid the proponent of the wind farm.*	
Royal Flying Doctor Service	Email sent on 24 September 2024 to Royal Flying Doctor Service,		No feedback received	

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
	Following up on 21 October 2024,			
Fire and Rescue NSW	Email sent on 24 September 2024 to Fire and Rescue NSW		No feedback received	
NSW Rural Fire Service	Email sent on 24 September 2024 to NSW Rural Fire Service	Email received on 24 September 2024 from Anna Jones (A/Supervisor Development Assessment & Planning)	*Please refer to previous advice provided by the RFS for similar project.* *For comments regarding aviation safety please be advised RFS does not have specific requirements and it is understood CASA specifications would apply. RFS would generally recommend:* • *The Environmental Operations Plan incorporate:* ○ *Wind turbines shall have aviation lighting fitted and operational when aerial fire fighting is occurring in the locality; and* ○ *Blade rotation shall cease when aerial fire fighting is occurring in the locality.*	*The Environmental Operations Plan incorporate:* • *Wind turbines shall have aviation lighting fitted and operational when aerial fire fighting is occurring in the locality; and* • *Blade rotation shall cease when aerial fire fighting is occurring in the locality.*
NSW National Parks and Wildlife Service (NPWS)		NPWS submission to NSW DPHI dated 9	*The NSW National Parks and Wildlife Service (NPWS) appreciates the opportunity to consider the wind farm's proximity and likely impacts to lands reserved or acquired under the National Parks and Wildlife Act 1974 (NPW Act). In accordance with the Secretary's Environmental Assessment Requirements (SEARs), as issued on 17 February 2024,*	1.Consistent with the recommendations of the Aviation Impact Assessment, NPWS request that meteorological masts are appropriately lit and marked to ensure they

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Key Agency Recommendations
		December 2024	*consideration of conservation areas and consultation with NPWS was required in the preparation of the EIS.* *NPWS is interested in the proposed Mallee Wind Farm as the project adjoins Mallee Cliffs National Park, which is land reserved under Part 4 of the NPW Act. NPWS appreciates that the Project has been designed to maximise setbacks from the National Park by including a minimum buffer of 800m between the boundary and nearest proposed Wind Turbine Generator (WTG).* *Our review of the EIS has identified several potential direct and indirect impacts to Mallee Cliffs National Park, and the management of this land. In summary the key issues are identified below:* *• Bushfire management* *• Aviation and meteorological masts* *• Noise and vibration impact on wildlife* *• Telecommunications* *• Ecological management plans* *NPWS has reviewed the EIS and Appendix 20 – Aviation Impact Assessment (102209-01) prepared by Aviation Projects Pty Ltd, dated 25 September 2024.* *NPWS is both a firefighting and land management agency which uses aircraft in a multitude of operational functions. NPWS's policy is that consistent with the Rural Fires Act 1997, the agency may respond to fires within 8 km of the boundary of land reserved or acquired under the NPW Act, at the discretion of the NPWS Area Manager, if a detected fire threat is likely to affect those lands.*	are visible to aircraft in accordance with NASF Guideline D. 2.The proposal is not to restrict the use of RPAS / drones for NPWS / AWC.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Key Agency Recommendations
			NPWS highlights that there is a recorded airstrip located within Mallee Cliffs National Park approximately 23km west of the project area. NPWS also highlights that temporary aircraft landing facilities, or emergency landing can occur anywhere on NPWS estate during state of emergency operations or medical evacuations. *The project includes seven permanent meteorological masts, with two located on the interface to the park, with the highest being 170m (893ft AMSL). This has the potential to pose a significant aviation hazard during aerial management operations.* *NPWS facilitates regular operational use of Remotely Piloted Aircraft Systems (RPAS) / drones for surveys and monitoring, which will be an increasing used method in the area.* *Recommendations:* *3.Consistent with the recommendations of the Aviation Impact Assessment, NPWS request that meteorological masts are appropriately lit and marked to ensure they are visible to aircraft in accordance with NASF Guideline D.* *4.The proposal is not to restrict the use of RPAS / drones for NPWS / AWC.* <u>Note: While this is a direct quote from NPWS, it is assumed that they intended to state that Mallee Cliffs National Park is located to the east of the Project Area.</u>	
CASA		CASA submission to NSW DPHI dated 24	*CASA has reviewed the Aviation Impact Assessment (AIA) (Appendix 20 to the EIS) by Aviation projects of 25 September 2024 for the proposed Mallee Wind Farm.*	CASA recommended WTG to be lit with 200 cd as a minimum lighting intensity.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Key Agency Recommendations
		November 2024	• *The proposal includes up to 76 Wind Turbine Generators (WTGs) that will be up to 280 m Above Ground Level (AGL) tip height.* • *There will be up to 7 permanent wind monitoring towers (up to 170 m AGL) and some temporary wind monitoring towers.* • *The WTGs are located beyond the Obstacle Limitation Surface (OLS) of the nearest certified aerodrome - Mildura Aerodrome (YBRN).* • *Aviation Projects advises that the 10nm MSA will need to be raised to 2300 ft and the 25 MSA to 2400 ft.* • *Aviation Projects advises that the instrument approach procedures flight path for the DME or GNSS Arrival Procedure is located above the wind farm footprint and will require the initial approach segment minimum altitude to be increased to 2400 ft.* • *Aviation Projects advises that all lowest safe altitudes (LSALTs) (Air Routes Q4, J19, W451 and Grid LSALTs) in the vicinity of the Project Area will need to be increased to 2400 ft AMSL.* • *Aviation Projects advises that there is one uncertified aerodrome located within 3 nm of the closest WTG. The location map shows it to be 12km+ to the nearest turbine or wind monitoring tower.* *This CASA assessment is made in accordance with the National Airports Safeguarding Framework (Guideline D) as developed by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts, to provide planning advice to State and Local Planning Authorities.* *With regards to Visual Flight Rules (VFR) operations, pilots are permitted to fly as low as 500 ft AGL (ie, terrain). The WTGs will reach up to a maximum height of approximately 280 m (919 ft) AGL.*	Further to Recommendation 5, CASA recommends that the following Australian Standard be considered regarding overhead transmission lines: • AS 3891.2, Air navigation — Cables and their supporting structures — Marking and safety requirements, Part 2: Low-level aviation operations. The proponent (or the proponent's Aviation Consultant) should engage with Airservices Australia regarding the changes to MSAs and LSALTs, before the infringing WTGs have been erected. (Airservices may need some lead time). As described by Aviation Projects on page 22 of the AIA, the Mildura Airport operator will also need to approve the changes.

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
			CASA agrees with the Recommendations at Section 11 of the Aviation Impact Assessment. *However, CASA considers the proposed wind farm will be a hazard to aviation safety and recommends that the wind farm is obstacle lit with steady medium-low intensity red obstacle lighting in accordance with the National Airports Safeguarding Framework Guideline D 'Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation' National Airports Safeguarding Framework Principles and Guidelines (infrastructure.gov.au) and section 9.31 of Part 139* *Aerodromes Manual of Standards Part 139 (Aerodromes) Manual of Standards 2019 (legislation.gov.au) (lower level lights on the turbine support columns are not essential).* *International standards require 2,000 candela lighting intensity on the nacelle (also recommended in the NASF guideline) and 200 candela at the mid-point of the turbine mast. CASA recommends that 200 candela as a minimum intensity lighting on the nacelle would suffice (due mainly to the lack of background lighting in the vicinity of the turbines). The obstacle lighting should be monitored to alert the wind farm operator of any outage and some of the obstacle lights remain on during an outage. CASA is prepared to review a lighting plan that indicates which turbines are proposed to be lit.* *As the Aviation Safety regulator, CASA does not consider the visual impact of obstacle lighting on neighbours / homesteads / the dark sky. However, there are mitigations for visual impact such as baffling and intensity control (as described in the Aviation Impact Assessment Table 10 / Page 49 'Effect of obstacle lighting on neighbours' and page 7 of Annexure 3 'Regulatory Requirements – Lighting and Marking').*	

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Key Agency Recommendations*
			Further to Recommendation 5, and as recommended by the Aerial Application Association of Australia, CASA recommends that the following Australian Standard be considered regarding overhead transmission lines: *• AS 3891.2, Air navigation — Cables and their supporting structures — Marking and safety requirements, Part 2: Low-level aviation operations.* *The impact on MSAs and LSALTs is covered in Aviation Impact Assessment Sections 6 and 10 but not specifically included in Section 11 Recommendations. The proponent (or the proponent's Aviation Consultant) should engage with Airservices Australia regarding the changes to MSAs and LSALTs, before the infringing WTGs have been erected. (Airservices may need some lead time). As described by Aviation Projects on page 22 of the AIA, the Mildura Airport operator will also need to approve the changes.*	

6. AVIATION IMPACT STATEMENT

6.1. Overview

The NASF Guideline D: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides information to proponents and planning authorities to help identify any potential safety risks posed by WTG and 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
- Grid and air route Lowest Safe Altitudes (LSALTS)
- Airspace protection
- Aviation navigation facilities
- ATC Radar installations
- Local aircraft operations.

6.2. Nearby certified aerodromes

A certified aerodrome is an aerodrome regulated by the Civil Aviation Safety Authority (CASA) under Part 139 of the Civil Aviation Safety Regulations (CASR), with defined standards established in Part 139 (Aerodromes) Manual of Standards (MOS) 2019.

There are two certified aerodromes located within 30 nm of the Project Area: Mildura Airport (YMIA) and Wentworth Airport (YWTO). The 30 nm radius represents the 25 nm MSA for aerodromes with terminal instrument flight procedures. The 25 nm MSA is determined by assessing obstacles within 30 nm (25 nm plus 5 nm buffer) of the aerodrome reference point or navigational aid on which the MSA is based.

The location of the Project Area relative to the nearest certified aerodromes of interest is shown in Figure 7. (Source: Umwelt, Google Earth). The orange circle represents 30 nm from the aerodrome reference point of each airport.

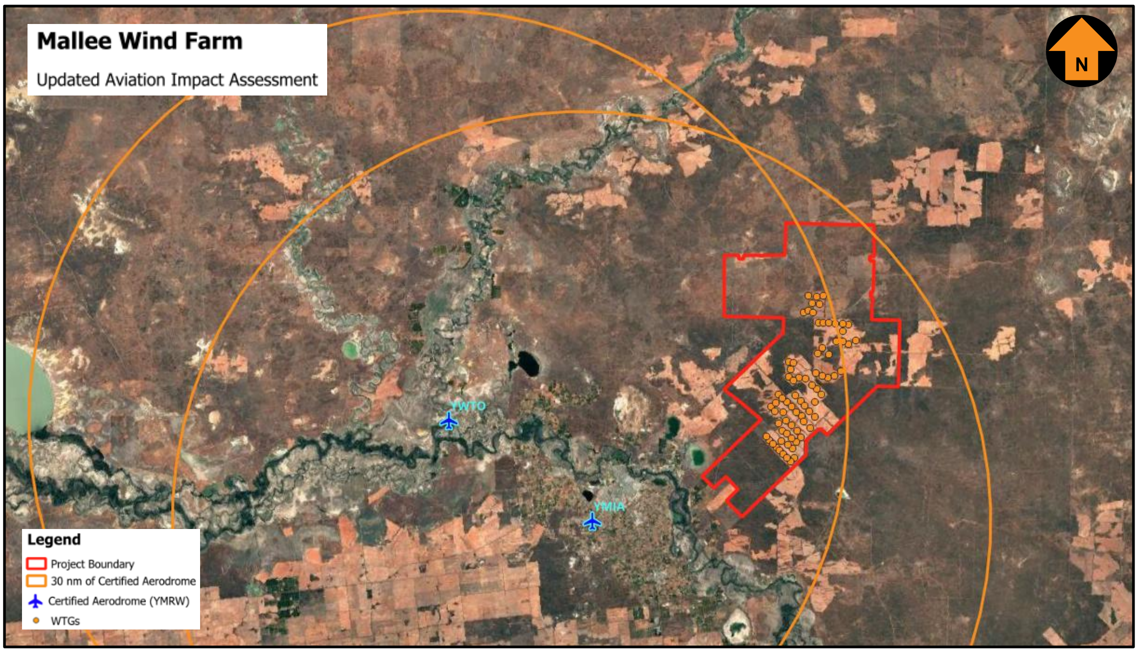


Figure 7 Location of Certified Airports in relation to Project Area

6.3. Mildura Airport

Mildura Airport is a certified aerodrome. Mildura Airport Pty Ltd operates it with a published aerodrome elevation of 51 m AHD (167 ft AMSL) (Source: AIP, 19 March 2026).

Mildura Airport's aerodrome reference point (ARP) coordinates published in Airservices Australia's Designated Airspace Handbook (DAH) are Latitude 34°13'45"S and Longitude 142°05'08"E. (Source: DAH, 27 November 2025).

6.3.1. Obstacle Limitation Surfaces

For the Code 4 non-precision and precision runways at Mildura Airport, the maximum lateral extent of the OLS is up to 6 km for the conical surface and 15 km for the take-off and approach surfaces.

The closest WTG in the Project Area to Mildura Airport is approximately 27 km north-east of the aerodrome reference point and beyond the horizontal extent of the obstacle limitation surfaces of Mildura Airport.

6.3.2. Instrument approach procedures

A check of the Aeronautical Information Package (AIP) via the Airservices Australia website showed that Mildura Airport is served by non-precision and precision instrument flight procedures (source: AIP, effective 19 March 2026).

Table 2 Identifies Mildura Airport's aerodrome and procedure charts, designed by Airservices Australia.

Table 2 Mildura Airport (YMIA) aerodrome and procedure charts

Chart name	Effective date
AERODROME CHART	27 November 2025 (Am 185)
DME OR GNSS Arrival	24 March 2022 (Am 170)
VOR – Y RWY 09	23 March 2023 (Am 174)
VOR – Z RWY 09	23 March 2023 (Am 174)
VOR – Y RWY 27	23 March 2023 (Am 174)
VOR – Z RWY 27	23 March 2023 (Am 174)
ILS – Y OR LOC – Y RWY 09	23 March 2023 (Am 174)
ILS – Z or LOC – Z RWY 09	23 March 2023 (Am 174)
NDB – A	23 March 2023 (Am 174)
RNP RWY 09	27 November 2025 (Am 185)
RNP RWY 18	04 September 2025 (Am 184)
RNP RWY 27	27 November 2025 (Am 185)
RNP RWY 36	27 November 2025 (Am 185)

6.3.3. PANS-OPS Surfaces

A detailed assessment of the PANS-OPS surfaces associated with the published instrument approach procedures was undertaken, including:

- Minimum Safe Altitude (MSA) Surfaces
- Instrument Flight Rules (IFR) Circling Areas
- Approach and departure procedures.

MSA Surfaces

The MSA applies to each instrument approach procedure. Images of the MSA published for Mildura Airport are shown in Figure 8 (source: AIP, 19 March 2026).

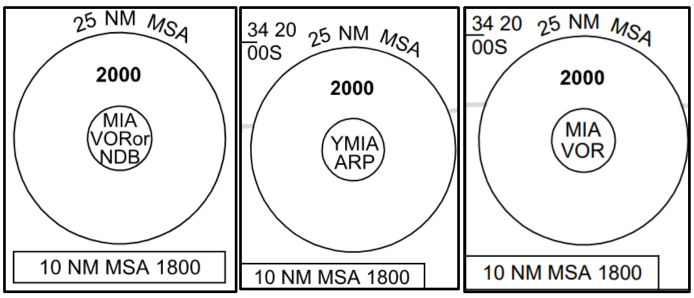


Figure 8 MSA at Mildura Airport

CASR Part 173 Manual of Standards requires a minimum obstacle clearance (MOC) of 984 ft to be applied above the highest terrain or obstacle within the applicable segment. A 5 nm buffer is applied to both the 10 nm and 25 nm MSA circles and to the higher edge of each sector within the MSA.

Obstacles within the 25 nm MSA of Mildura Airport's ARP define the minimum height at which an IFR aircraft can fly when within 25 nm of the airport, when not in visual flight conditions, and when not established on an instrument approach or departure procedure.

The Project is partly within the 10 nm MSA and wholly within the 25 nm MSA of the airport, as shown in Figure 9 (Source: Google Earth).

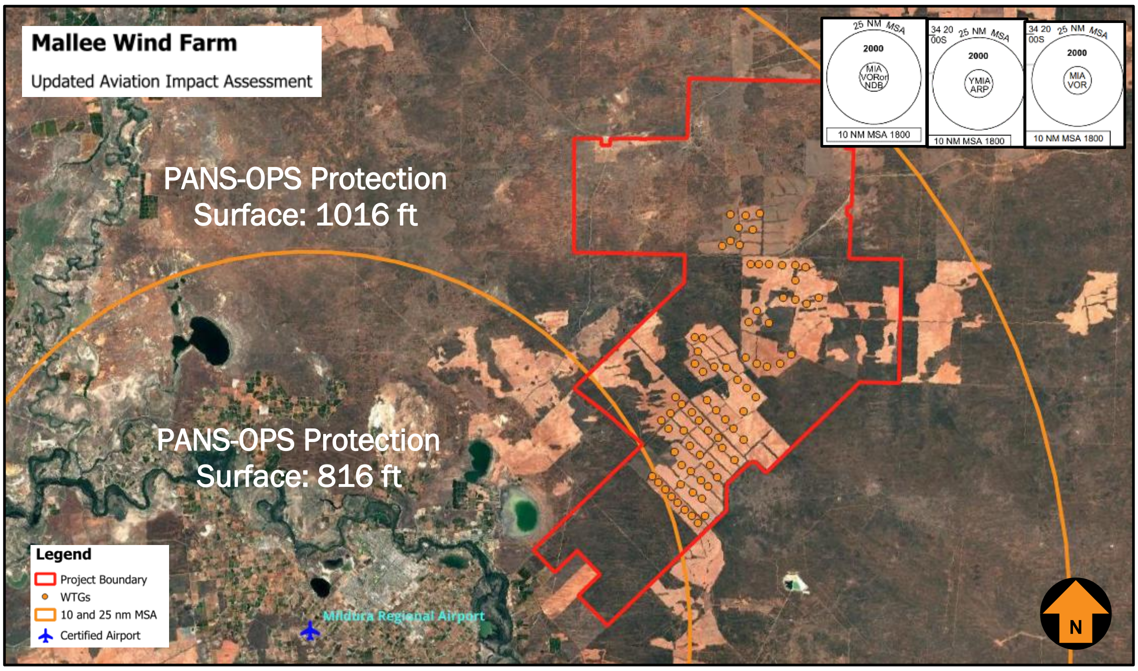


Figure 9 Mildura Airport MSA

The 10 nm MSA minimum altitude is 549 m AHD (1800 ft AMSL), with a PANS-OPS surface elevation of 249 m AHD (816 ft AMSL).

The 25 nm MSA minimum altitude is 610 m AHD (2000 ft AMSL), with a PANS-OPS surface elevation of 310 m AHD (1016 ft AMSL).

Two WTGs (WTG T1 and WTG T2) are located within the 10 nm MSA area. The highest WTG (WTG T2) has an elevation of 383.2 m/1257.2 ft AMSL, requiring the 10 nm MSA to be increased to 2300 ft AMSL to accommodate the Project. The impact is considered to be minor on the operations at Mildura Airport.

The highest WTG (WTG T15) located within the 25 nm area has a maximum height of 398.2 m/ 1306.4 ft AMSL, requiring an increase to the 25 MSA to 2300 ft to accommodate the Project Area.

The Project will infringe on both the 10 nm and 25 nm PANS-OPS surface of Mildura Airport. An impact analysis of Mildura Airport's MSA is provided Table 3.

The increase to the 25 nm MSA will require a commensurate increase in the commencement and minimum holding altitudes for the other approach procedures. There is sufficient distance between the initial approach fixes of the procedures to accommodate the minimum altitude increase without affecting aircraft operations or efficiency. As there will be no impact on the final MDA for the procedure(s), this is unlikely to affect the overall efficacy of the procedures.

Table 3 Mildura Airport MSA Impact Analysis

MSA	*Minimum altitude*	*PANS-OPS surface*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
10 nm	1800 ft AMSL	816 ft AMSL	Higher than the PANS-OPS surface by 441.2 ft	Increase the minimum altitude by 500 ft.	Minor
25 nm	2000 ft AMSL	1016 ft AMSL	Higher than the PANS-OPS surface by 290.3 ft	Increase the minimum altitude by 300 ft or sectorise to exclude the wind farm.	Minor

IFR Circling areas

A circling approach is an extension of an instrument approach to the specified circling minima (lowest altitude permitted without visual reference to the ground) at which point the pilot will visually manoeuvre the aircraft to align with the runway for landing. Typically, a circling approach is only conducted where there is no runway-aligned instrument procedure, or if the runway used for the approach procedure is not suitable for landing.

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

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

- Category A – 1.68 nm / 3.11 km
- Category B – 2.66 nm / 4.93 km
- Category C – 4.20 nm / 7.78 km
- Category D – 5.28 nm / 9.78 km

The Project is located 14.4 nm / 27 km from the threshold of Runway 27 and is, therefore, beyond the circling area for all runway ends at Mildura Airport.

The Project will not impact circling areas established for instrument flight procedures.

PANS-OPS Surfaces

A detailed assessment of the PANS-OPS surfaces associated with the published instrument approach procedures was undertaken.

The Project will infringe on DME/GNSS Arrival procedure en route / initial surfaces and RNP RWY 27 holding surface at Mildura Airport. Table 4 Details the assessment for each instrument approach procedure at Mildura Airport.

Table 4 Mildura Airport PANS-OPS Assessment

Instrument Approach Title	*Minimum Altitude over Project (ft AMSL)*	*PANS-OPS Surface (ft AMSL)*	*Impact on the procedure by WGT*	*Potential solution*	*Impact on aircraft ops*
DME OR GNSS Arrival	2000 (MSA)	1016	Yes – initial / en-route protection surface is penetrated by 290.4 ft	Increase the minimum altitude in the initial / en-route approach segment by 300 ft	Minor
VOR – Y RWY 09	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
VOR – Z RWY 09	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
VOR – Y RWY 27	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
VOR – Z RWY 27	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
ILS – Y OR LOC – Y RWY 09	2000 (MSA)	1016	Nil – beneath the protection surface	N/A	N/A
ILS – Z or LOC – Z RWY 09	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
NDB – A	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
RNP RWY 09	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
RNP RWY 18	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A
RNP RWY 27	2000 (MSA)	1016	Yes – The Project would infringe the holding protection surface by 290 ft	Increase the holding protection by 300 ft	Minor
RNP RWY 36	2000 (MSA)	1016	Nil – Outside the protection surface	N/A	N/A

DME/GNSS Arrival

A DME/GPS arrival procedure is designed to permit an aircraft to descend from an en-route altitude at or above the lowest safe altitude to a minimum altitude at an aerodrome using DME or GPS distance measurement and ground-based azimuth guidance facilities. The procedure is prescribed for particular tracks or sectors and takes the form of a series of descending steps at appropriate distances.

DME/GPS arrivals are instrument approach procedures. DME and DME/GPS arrival procedures are not included in ICAO DOC 8168 – OPS/611 Volume II but are designed using the criteria contained in that document applicable to non-precision approaches and therefore have initial, intermediate and final approach segments. To account for control area steps, the step information is frequently extended beyond the Initial Approach Fix (IAF) into the en-route segment.

Minimum obstacle clearance is as follows:

- Initial approach and en-route segments – 1,000 ft
- Intermediate approach segment – 500 ft
- Final approach segment – 300 ft.

Figure 10 shows the nominal project location in relation to the en-route segment of the DME/GNSS arrival procedure (Source: Google Earth, Airservices).

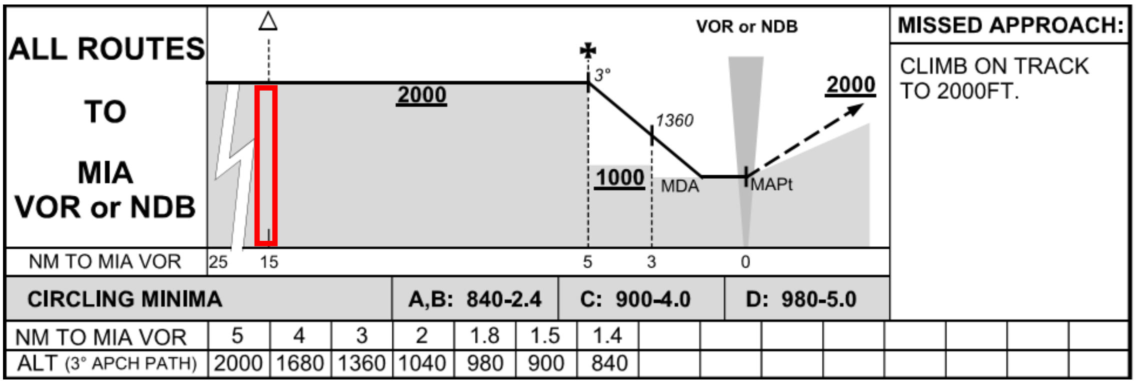


Figure 10 Mildura Airport DME/GNSS Arrival

The highest WTG (WTG T15) located within the initial / en-route segment has a maximum height of 398.2 m/ 1306.4 ft AMSL, which will infringe the protection surface and require the minimum altitude it to be raised by 300 ft.

Additionally, the increase to the 25 nm MSA will require a commensurate increase in the commencement altitude and the final missed approach altitude for the approach procedure.

RNP RWY 27 – Holding MI2EB

The minimum holding altitude for MI2EB will be 2000 ft AMSL for RNP RWY 27, which has a protection surface of 1016 ft. The highest WTG (WTG T6) located within the primary holding area has a maximum height of 388.9 m/ 1276.1 ft AMSL, which will infringe the protection surface by 300 ft.

Additionally, the increase to the 25 nm MSA will require a commensurate increase in the commencement altitude and the final missed approach altitude for the approach procedure.

All Other Approach Procedures

The Project would not affect the flight paths or efficiency of the rest of the PANS-OPS procedures:

- VOR Y/Z for both RWY 09 and 27
- ILS Y/Z or LOC Y/Z for RWY 09
- NDB A

- RNP for RWY 09, 18 and 36.

Due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude and the final missed approach altitude would need to be increased to 2300 ft without impacting any of the procedures. The increase would still allow normal IFR flight operations using those procedures.

The procedures will need to be amended, and the procedure designer will make a detailed assessment. The aerodrome operator is required to provide permission for any procedures to be amended.

The changes will not affect the flight paths or the efficiency of this instrument approach procedures.

6.4. Wentworth Aerodrome

Wentworth Airport is a certified aerodrome operated by Wentworth Shire Council with a published aerodrome elevation of 37 m AHD (120 ft AMSL) (Source: AIP, 19 March 2026).

The Aerodrome Reference Point (ARP) coordinates published in Airservices Australia's Designated Airspace Handbook (DAH) are Latitude 34°05'16"S and Longitude 141°53'31"E. (source: DAH, 27 November 2025).

6.4.1. Obstacle Limitation Surfaces

Wentworth Airport is a non-precision aerodrome. For the Code 2 non-precision runway, the maximum lateral extent of the OLS is up to 5.5 km for the conical surface and 15 km for the take-off and approach surfaces.

The closest WTG in the Project Area to Wentworth Airport is located approximately 44 km west of the aerodrome reference point and beyond the horizontal extent of the obstacle limitation surfaces of Wentworth Airport.

6.4.2. Instrument Approach Procedures

A check of the Aeronautical Information Package (AIP) via the Airservices Australia website showed that Wentworth Airport is served by non-precision instrument flight procedures (source: AIP, effective 27 November 2025).

Table 5 Identifies Wentworth Airport's aerodrome chart, and procedure charts designed by Global Airspace Solutions (GAS).

Table 5 Wentworth Airport (YWTO) aerodrome and procedure charts

Chart name	*Effective date*
AERODROME CHART	4 September 2025 (Am 184)
RNP RWY 08	27 November 2025 (Am 185)
RNP RWY 26	27 November 2025 (Am 185)

6.4.3. PANS-OPS Surfaces

A detailed assessment of the PANS-OPS surfaces associated with the published instrument approach procedures was undertaken:

- MSA Surfaces
- Instrument Flight Rules (IFR) Circling Areas

- Approach and departure procedures.

MSA Surfaces

An Image of the MSA designed for Wentworth Airport is shown in Figure 11 (source: GAS).

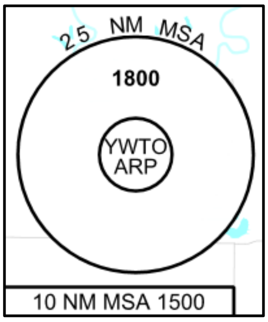


Figure 11 MSA at Wentworth Airport

The Project is partly within the 25 nm MSA of the airport. The orange circle represents the 10 nm MSA (10 nm + 5 nm buffer area) and 25 nm MSA (25 nm MSA + 5 nm buffer area) of Wentworth Airport from the ARP, as shown in Figure 12 (Source: Google Earth).

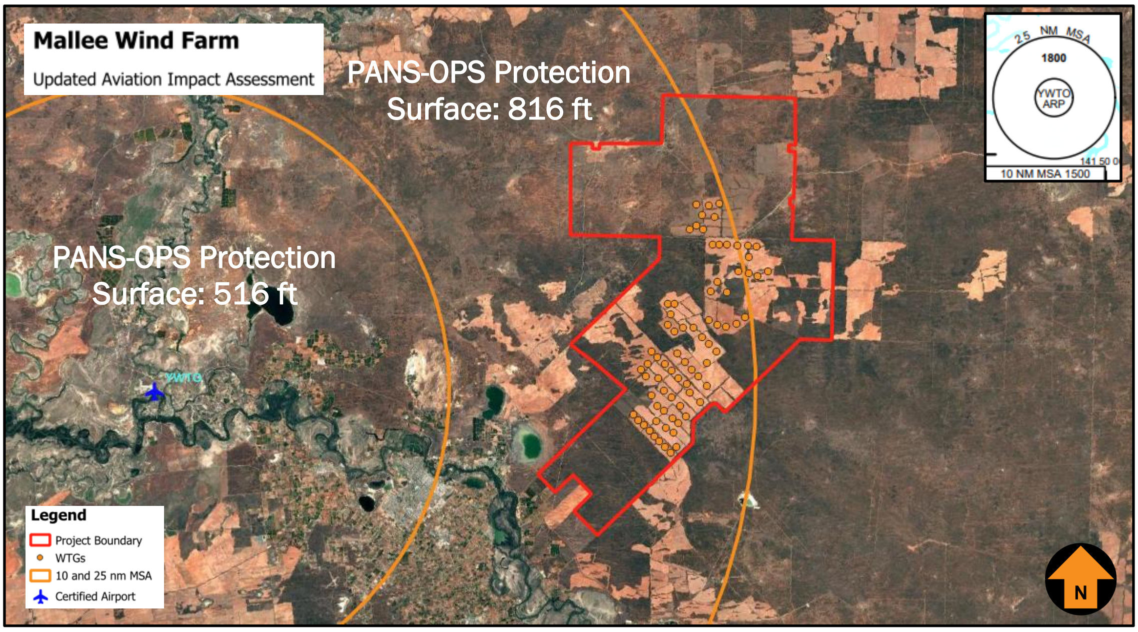


Figure 12 Wentworth Airport MSA

The 25 nm MSA minimum altitude is 549 m AHD (1800 ft AMSL), with a PANS-OPS surface elevation of 249 m AHD (816 ft AMSL).

The highest WTG (WTG T15) located within the 25 nm area has a maximum height of 398.2 m AHD (1306.4 ft AMSL), requiring an increase to the 25 MSA to 2300 ft to accommodate the Project Area.

The Project will infringe on the 25 nm MSA surface of Wentworth Airport. An impact analysis of Wentworth Airport's MSA is provided Table 6.

The increase to the 25 nm MSA will require a commensurate increase in the commencement and minimum holding altitudes for the other approach procedures. There is sufficient distance between the initial approach fixes of the procedures to accommodate the minimum altitude increase without affecting aircraft operations or efficiency. As there will be no impact on the final MDA for the procedure(s), this is unlikely to affect the overall efficacy of the procedures.

Table 6 Mildura Airport MSA Impact Analysis

MSA	*Minimum altitude*	*PANS-OPS surface*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
25 nm	1800 ft AMSL	816 ft AMSL	Higher than the PANS-OPS surface by 490.4 ft	Increase the minimum altitude by 500 ft or sectorise to exclude the wind farm.	Minor

IFR Circling areas

Category C will be the most demanding aircraft category provided for in Wentworth Airport's instrument flight procedures. The radius for Category C is 4.20 nm / 7.78 km.

The closest WTG is approximately 23.6 nm / 44 km from the threshold of Runway 26 and is, therefore, beyond the circling area for all runway ends at Wentworth Airport.

The Project will not impact circling areas established for instrument flight procedures.

PANS-OPS Surfaces

Due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude and the final missed approach altitude would need to be increased to 2300 ft without impacting any of the procedures. The increase would still allow normal IFR flight operations using those procedures.

Table 7 Details the assessment for each instrument approach procedure at Wentworth Airport.

The changes will not affect the flight paths or the efficiency of this instrument approach procedure.

Table 7 Wentworth Airport PANS-OPS Assessment

Instrument Approach Title	*Minimum Altitude over Project (ft AMSL)*	*PANS-OPS Surface (ft AMSL)*	*Impact on the procedure by WGT*	*Potential solution*	*Impact on aircraft ops*
RNP RWY 08	1800 (MSA)	800	Nil – Outside the protection surface	N/A	N/A
RNP RWY 26	1800 (MSA)	816	Nil – Outside the protection surface	N/A	N/A

6.5. Grid and Air routes LSALT

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

6.5.1. Grid LSALT

The Project Area is located within two airspace grids:

- Grid LSALTs of 1900 ft AMSL, which provide clearance above obstacles with heights up to 900 ft AMSL
- Grid LSALT and 1800 ft AMSL, which provides clearance above obstacles with heights up to 800 ft AMSL.

Figure 13 shows the grid LSALTs in proximity to the Project Area (source: ERC Low National, OzRunways, Google Earth).

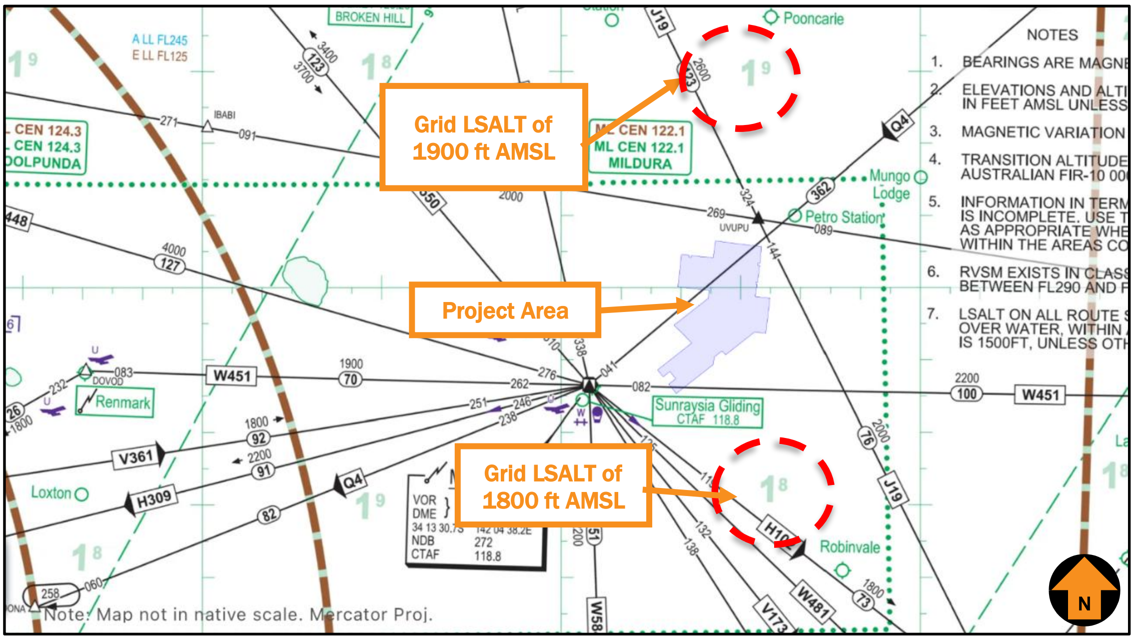


Figure 13 Grid LSALTs in proximity to the Project Area

The highest WTG within Grid LSALT of 1900 ft is WTG T73, which is 398 m AHD (1305.8 ft AMSL). It will be higher than the 900 ft obstacle height limit, which needs to be raised by 500 ft to 2400 ft AMSL.

The highest WTG within Grid LSALT of 1800 ft is WTG T15, which is 398.2 m AHD (1306.4 ft AMSL). It will be higher than the 800 ft obstacle height limit, which needs to be raised by 600 ft to 2400 ft AMSL.

Therefore, the WTGs will impact both the 1900 ft and 1800 ft Grid LSALT. An impact analysis of the surrounding air routes and the Grid LSALT is provided in Table 8.

Table 8 Air route impact analysis.

Grid LSALT	Protection Surface (ft AMSL)	Impact on LSALT	Potential solution	Impact on aircraft ops
1900 ft AMSL	900	Infringe	Increase LSALT to 2400 ft AMSL	Minor
1800 ft AMSL	800	Infringe	Increase LSALT to 2400 ft AMSL	Minor

6.5.2. Air Route LSALTs

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

There are five (5) air routes within 7 nm of the Project Area. An impact analysis of the surrounding air routes and the Grid LSALT is provided in Table 9.

Most LSALTs in the vicinity of the Project Area will need to be increased to 2400 ft AMSL to accommodate the Project, except H119. This increase should only create a minor impact on aircraft operations.

Table 9 Air route impact analysis.

Air route	Waypoint pair	Route LSALT (ft AMSL)	Protection Surface (ft AMSL)	Impact on LSALT	Potential solution	Impact on aircraft ops
Q4	YCBA to YMIA	1800 (Grid)	800	Infringe	Increase LSALT to 2400 ft AMSL	Minor
Q16	VENEL to YMIA	1800 (Grid)	800	Infringe	Increase LSALT to 2400 ft AMSL	Minor
J19	NATYA and UVUPU	2000	1000	Infringe	Increase LSALT to 2200 ft AMSL	Minor
W451	YMIA and LEYOV	2200	1200	Infringe	Increase LSALT to 2400 ft AMSL	Minor
H119	LEC NDB To NATYA	5000	4000	Nil	Nil	Nil

6.6. Airspace Protection

The Project Area is located in Class G airspace, which is outside of controlled airspace, and is not located in any Prohibited, Restricted and Danger Areas.

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

6.7. Aviation facilities

NASF Guideline G, *Protection of Aviation Facilities - Communication, Navigation and Surveillance (CNS)* and CASR Part 139 MOS specify the area where development of buildings and structures has the potential to cause unacceptable interference to CNS facilities.

The Project Area is located a sufficient distance away from nearby certified airports and aviation facilities and would not have an impact.

6.8. ATC Surveillance Radar installations

Airservices Australia requires an assessment of the potential for the WTGs that may affect radar line of sight. The three closest radar facilities to the Project Area are:

- Adelaide Preliminary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR), which is located approximately 363 km southwest of the Project Area.
- Summertown Air Route Surveillance Radar (RSR), which is located approximately 343 km southwest of the Project Area.

EUROCONTROL guidelines for assessing the potential impact on WTGs on radar surveillance sensors stipulate the following assessment requirements:

Primary Surveillance Radar (PSR)

- Zone 1 0-500 m: Not permitted
- Zone 2 500 m – 15 km: Detailed assessment
- Zone 3: Further than 15 km but within maximum instrumented range and in radar line of sight: Simple assessment
- Zone 4: Anywhere within maximum instrumented range but not in radar line of sight or outside the maximum instrumented range: No assessment.

Secondary Surveillance Radar (SSR)

- Zone 1: 0 - 500 m: Not permitted
- Zone 2: 500 m - 16 km but within maximum instrumented range and in radar line of sight: Detailed assessment
- Zone 4: Further than 16 km or not in radar line of sight: No assessment

(Zone 3 is not established for secondary surveillance radar)

The Project Area is outside the line-of-sight range of Adelaide PSR/SSR and Summertown RSR radars and would not impact these facilities.

6.9. AIS Summary

Based on the WTG layout and maximum blade tip height of up to 280 m AGL, the blade tip elevation of the highest WTG, which is WTG T15, will not exceed 398.2 m AHD (1306.4 ft AMSL) and:

- There are two certified airports located within 30 nm (56 km) of the Project - Mildura Airport (YMIA) and Wentworth Airport (YWTO) :

- Mildura Airport (YMIA):
    - The WTGs would not impact the OLS surfaces.
    - The WTGs would not impact the circling areas.
    - The WTGs would impact the 10 nm MSA, which will need to be raised by 500 ft to 2300ft.
    - The WTGs would impact the 25 nm MSA, which will need to be raised by 300 ft to 2300ft or sectorized to exclude the wind farm.
    - The WTGs would impact on PANS-OPS surfaces:
        - The minimum altitude of the initial / en-route segment of DME or GNSS arrival will need to be raised by 300 ft.
        - The minimum holding altitude of RNP RWY 27 will need to be raised by 300 ft.
        - Due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.
- Wentworth Airport (YWTO):
    - The WTGs would not impact the OLS surfaces.
    - The WTGs would not impact the circling areas.
    - The WTGs would impact on 25 nm MSA, which will need to be raised by 500 ft to 2300 ft or sectorized to exclude the wind farm.
    - The WTGs would not impact PANS-OPS surfaces, however, due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.
- The WTGs would impact the Grid LSALT; both Grid LSALTs will need to be raised to 2400 ft AMSL.
- The WTGs would impact on four (4) air route LSALTs:
    - Air route Q4 LSALT would need to be raised to 2400 ft.
    - Air route Q16 LSALT would need to be raised to 2400 ft.
    - Air route J19 LSALT would need to be raised to 2200 ft.
    - Air route W451 LSALT would need to be raised to 2400ft.
- The Project Area is located within Class G airspace and outside all controlled airspace, Prohibited, Restricted, and Danger areas.
- The WTGs would not impact the aviation navigation facilities of nearby certified airports.
- The WTGs would not impact the closest radar installations.
- The WTGs must be reported to CASA, and construction details provided to Airservices Australia.

7. UNCERTIFIED AERODROMES

Uncertified aerodromes are not required to be listed or notified to CASA or Airservices Australia, leading to the potential for incomplete data regarding their operations and exact locations. They are not subject to CASR Part 139 regulations.

A search of aeronautical databases and publications was used to discover whether recognised uncertified aerodromes exist near the Project. The aviation datasets used for the search include:

- AIP aeronautical charts effective 27 November 2025
- OzRunways - which sources its data from Airservices Australia (AIP). The aeronautical data provided by OzRunways is approved under CASR Part 175
- Australian Government National Map website www.nationalmap.com.au, now disestablished.

As a guide, an area of interest within a 3 nm radius of an uncertified aerodrome is used to assess the potential impacts of proposed developments on aircraft operations at or within the vicinity of the uncertified aerodrome. The 3 nm radius is considered to be the area in which aircraft are making preparations to join the circuit prior to landing and within which to manoeuvre after take-off to depart from the aerodrome.

Figure 14 shows the location of the uncertified aerodrome relative to the Project Area and a nominal 3 nm buffer from the closest uncertified aerodrome. (source: Umwelt, Google Earth).

Trentham Cliffs aerodrome is located approximately 1.7 nm/3.1 km west of the southwestern boundary of the Project Area and 6.8 nm/12.6 km from the nearest WTG. Flight operations would not be impacted by the Project. There are no WTGs within 3 nm of the aerodrome; there is no impact on the aerodrome operations from a close WTG.

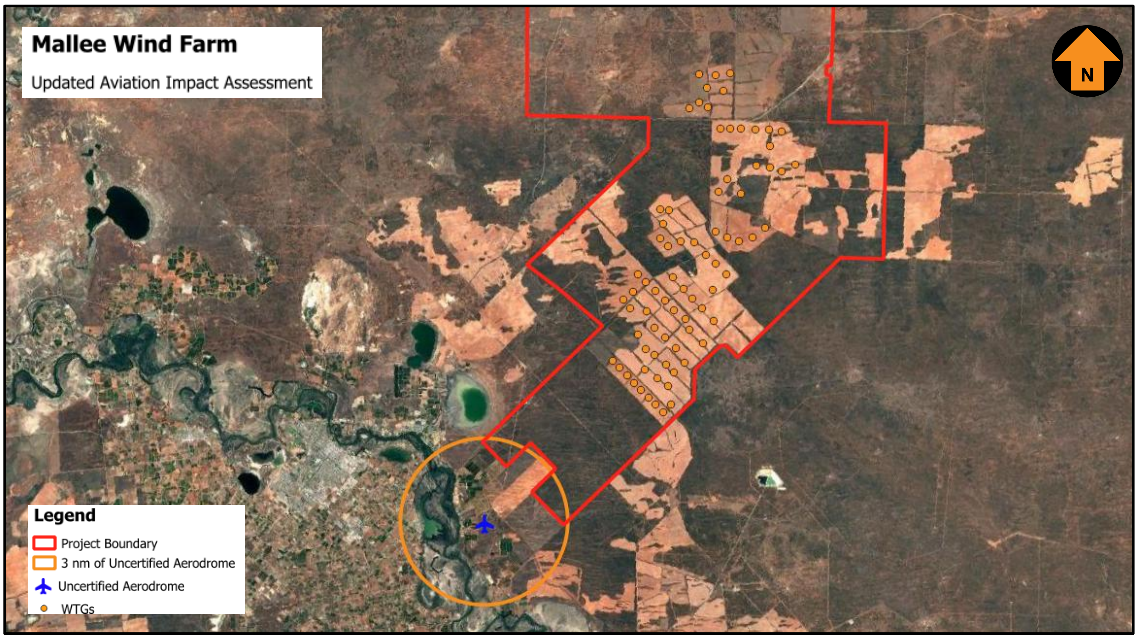


Figure 14 Trentham Cliffs aerodrome

7.1. NSW National Parks and Wildlife Service (NPWS)

NSW National Parks and Wildlife (NPWS) requires a safe flight corridor without WTGs along the park's boundaries.

Figure 15 (Source: Google Earth) shows the park boundary in relation to the Project. The Project is located next to Mallee Cliffs National Park. Consultation with NPWS has already been undertaken, please refer to Section 5.

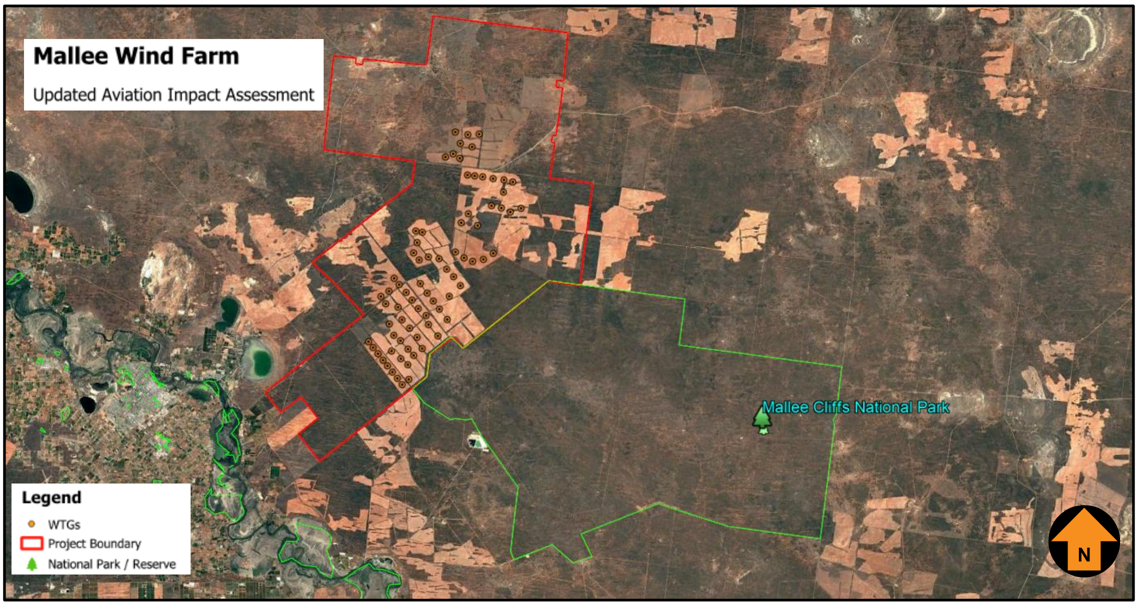


Figure 15 National Park boundary related to WTGs

8. 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 key wording in the NASF guidance is “noticeable” and that “the level of turbulence in the vicinity is not known with certainty.”

There are many situations in aviation where pilots “notice” their aircraft moving away from the desired flight path or altitude and take appropriate action to maintain control of the aircraft with minimal input.

Pilot training standards are regulated by CASA to ensure that all qualified pilots have demonstrated to a suitably qualified and authorised check pilot that they can maintain control of their aircraft along the chosen flight path, across a significant range of atmospheric conditions that cause the aircraft to deviate from the pilot’s chosen flight path.

Aircraft are designed to withstand a significant variation in atmospheric disturbances to ensure airframe integrity is maintained. The limits of the airframe’s integrity are known by the pilot and considered in every flight activity. Significant weather events such as thunderstorms are avoided because of the likelihood of airframe limits being exceeded by the strong wind shear type conditions within, beneath and surrounding thunderstorm cells.

WTGs have been assessed in a limited number of studies, in which the highest classification of hazard is considered to be medium only within approximately 7 rotor diameters (RD) downwind of the wind turbine. There are no assessments that consider that the downwind turbulence is significant and outside the ability of the aircraft to endure the impacts and for the pilot to be able to control the aircraft using normal control inputs.

There also have been no reported aircraft accidents or incidents involving an aircraft encounter with the turbulence downwind of a WTG.

Assessment

A 200 m rotor diameter has been used for the wake turbulence analysis. Based on this scenario, NASF Guideline D suggests the effects of wake turbulence could be noticeable from the WTGs within 3200 m of the runway and the nominal circuit area, depending on wind direction.

Based on the results of published scientific studies which indicate that any medium level of turbulence would in most circumstances be confined to within 7 RD of a WTG, Aviation Projects considers that a conservative area of 10 RD is likely to be the maximum area where wake turbulence from WTGs would be noticed by pilots of light aircraft operating downstream of a WTG.

These studies also indicated that where any such turbulence is experienced, the pilot would be able to control the aircraft using normal control inputs.

Two of those studies are referred to below.

The *European Academy of Wind Energy* published an open access report titled "*Do wind turbines pose roll hazards to light aircraft?*" dated 2 November 2018. This study concluded:

> *In neutral conditions, the largest of these hazards are classified as medium hazards and exist 6.5 D downwind of the turbine in the bottom-left portion of the rotor disk. The highest hazards in the stable case also remained within the medium threshold and are located in two separate regions of the wake: approximately 4 D downwind in the bottom-right quadrant of the rotor and 6 D downwind in the top-left quadrant of the rotor.*

The United Kingdom (UK) Civil Aviation Authority commissioned the University of Liverpool to conduct a *Wind Turbine Wake Encounter Study*, the results of which were published in March 2015.

> *At University of Liverpool, a full CFD method [4] was used with the HMB solver to study wind turbine wakes. The CFD results showed good agreement for the blade surface pressure distributions and flow field velocities with the wind tunnel measurements. The wake was then solved on a very fine mesh able to capture the wake vortices up to 8 radii downstream of the blades on the MEXICO wind turbine rotor.*
>
> *In general, the LIDAR measurements captured the regular wake mean velocity patterns. Statistic LIDAR data indicate that the effects of wind turbine rotor wake, in term of velocity deficit, are limited within a downwind distance of 5D. This is generally in agreement with the results of the full CFD method and the velocity deficit models.*
>
> *For a wind turbine with size similar to the WTN250, and using the Beddoes circulation formula, the off-line simulation results indicate that the wind turbine wake did not pose any hazards to the encountering aircraft 5 diameters further from the wind turbine. The dominant upset that the wake generated is a yawing moment on the aircraft. The wake generated crosswind, is smaller than the maximum crosswind of 17.75 ft/s for an airport (codes A-I or B-I) that is expected to accommodate single engine aircraft. These conclusions are in line with that found in the piloted flight simulation.*

These two studies are the only major studies of their kind.

Wind farm designers and developers recognise the impact of downwind changes in wind strength and direction when designing the overall wind farm to ensure that the WTGs are located at minimum distances from each other in order to prevent turbulence from one or more WTGs affecting the operational efficiency of a downwind WTG or causing damage to the downwind WTG blades. The minimum distance between WTGs typical wind farms is approximately 800 m, a significantly shorter distance than either 16 RD or 10 RD presents.

The turbulence from a WTG could be described as a shear type turbulence which is caused by the difference of the free flow wind speed at the edge of the WTG rotor (the blade tip) being disrupted by the WTG blade being rotated by the wind and altering the wind speed within the rotor diameter moving downwind from the WTG. This shear type turbulence descends and weakens as it gets further away from the WTG. It is not a stream of turbulence being generated by the blades being turned by a mechanical force such as occurs with an aircraft propellor or ceiling fan in a house or factory.

The WTG blades change pitch, dependent on the wind strength, to maintain a constant rotor speed. They interfere with the natural wind flow and cause some degree of turbulence downwind of the WTG. A consistent theme among the studies was that the higher turbulence exists very close to the WTG and rapidly dissipates due to the effect of convection, mechanical turbulence from other sources such as the wind flowing over trees, buildings and terrain undulations.

The studies indicate that turbulence is likely to dissipate below a level that could be felt by pilots within 7 RDfrom the WTG. Aviation Projects considers that a more conservative value of 10 RD is best used to assess areas where the likely turbulence created downwind of a WTG would not be felt by or impact pilots of light aircraft.

The studies referenced above also indicate that aircraft controllability is maintained when experiencing the likely turbulence when the aircraft is approximately 6 RD from a WTG.

Table 10 Wake Turbulence Distances

1 RD (m)	*7 RD (m)*	*10 RD (m)*	*16 RD (m)*
200	1400	2000	3200

In conditions of high wind speed the WTGs are "parked" with the blades in a "feathered" condition to reduce the wind impact upon them. Turbulence from the "feathered" blades still exists but would be less than when the WTG is rotating. Other mechanical turbulence generated by trees, hills and other objects during high winds would significantly exceed and break up any minor turbulence from a stationary WTG.

Aircraft are designed to withstand significant turbulence according to aviation meteorological standards that are recognised and accepted worldwide. Even in recent circumstances with an airliner experiencing severe turbulence which injured passengers, the aircraft was controllable (except for the first part of the event where it descended rapidly) and has not suffered any significant damage (although it will undergo a major inspection). It was an encounter with severe turbulence far greater than normally experienced and is avoided wherever areas of severe turbulence is forecast or known to exist.

The downwind turbulence from WTGs beyond 7 RD may be felt by the pilot of a light aircraft but the pilot will only need to make minor control adjustments to maintain control of the aircraft's attitude, altitude and heading. Such turbulence is likely to be classified as Light on an intensity scale published by the Australian Bureau of Meteorology shown in Figure 16.

Within the 7 RD boundary the turbulence is considered to create a medium hazard which is likely to equate to pilots experiencing "Moderate" turbulence in which the *"Pilot remains in control at all times."* (Figure 16)

Intensity	Airspeed Fluctuat-ions (kt/s)	Vertical Gust (ft/s)	G Load	Aircraft Reaction	Reaction Inside Aircraft
Light	5 – 14	5 - 19	0.15 – 0.49	Momentary slight and erratic changes in attitude and/or altitude. Rhythmic bumpiness.	Little effect on loose objects.
Moderate	15 – 24	20 - 35	0.50 – 0.99	Appreciable changes in attitude and/or altitude. Pilot remains in control at all times. Rapid bumps or jolts.	Unsecured objects move. Appreciable strain on seatbelts.
Severe	≥ 25	36 -49	1.0 – 1.99	Large abrupt changes in attitude and/or altitude. Momentary loss of control.	Unsecured objects are tossed about. Occupants violently forced against seatbelts.
Extreme	≥ 25	≥ 50	> 2.0	Very difficult to control aircraft. May cause structural damage.	

Figure 16 Turbulence intensities[1]

Light and moderate turbulence can be generated by lines of trees near runways.

[1] Bureau of Meteorology – Hazardous Weather Phenomena – Turbulence

> *Turbulence may disturb an aircraft's attitude about its major axis, and cause rapid bumps or jolts to be experienced, but in most cases it does not significantly alter the aircraft's flight path.* [2]

Adverse turbulence from any source is most critical during initial climb after take-off until the aircraft is established in a climb and at the appropriate speed, and during final approach where the aircraft is configured for landing and operating at a slow speed prior to landing. The research studies indicate that adverse or severe turbulence is not created by WTGs outside the 5 RD distance.

As the WTGs will not impact any uncertified aerodromes in the vicinity, there is no wake turbulence impact from the WTGs on any uncertified aerodromes in the vicinity, irrespective of whether a 16 RD or 10 RD distance is applied.

[2] Bureau of Meteorology – Hazardous Weather Phenomena – Turbulence

9. CUMULATIVE EFFECTS

The South-West REZ is relatively undeveloped, but there is substantial commercial interest in the area, such that there are several other renewable energy developments in the vicinity of the Project, most at the early stages of the planning and approvals pathway.

Related developments, as outlined in the NSW Government State Significant Development Guidelines (DPE, 2022), refers to any existing or approved developments that would be incorporated into, or operated in conjunction with the Project. Related development can also include developments by the Proponent that are subject to a separate development approval process.

New and nearby renewable energy and other relevant state significant projects that have commenced a formal NSW planning application, that are located within 75 km of the Project Area and are large enough to be considered in the assessment of cumulative impacts for the Project have been assessed. These include, Euston Mineral Sands Project, Mallee Solar Farm, Gol Gol Solar Farm, Gol Gol Wind Farm, Gol Gol Battery Energy Storage System, Project EnergyConnect (NSW - Eastern Section), Buronga Landfill Expansion, Euston Wind Farm and Koorakee Energy Park. Other new renewable energy projects in the South-West REZ are anticipated.

At the time of writing two related developments occur within the vicinity of the Project, Euston Mineral Sands Project and Mallee Solar Farm. As there are no uncertified aerodromes within 3 nm of the Mallee Wind Farm's planned WTGs, the nearby projects will not have cumulative effects on any uncertified aerodromes.

10. HAZARD LIGHTING AND MARKING

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

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

10.1. Wind turbine generators (WTGs)

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

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

With respect to the indicative Lake Victoria Wind Farm Project layout and in applying the requirements of CASR Part 139 MOS or NASF Guideline D, the WTGs along the perimeter and with 900 m spacing will be required lighting.

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

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

Whilst the Renewable Energy Planning Framework, inclusive of the Wind Energy Guideline does not immediately apply to the Project (as the EIS was lodged before 12 November 2024) aspects relating to aviation safety are relevant to consider to avoid ambiguity in regard to the need for obstacle lighting. Those key principles are outlined below.

> *5.3.1 Key principles*
>
> *Aviation safety and lighting principles*
>
> • *Wind energy projects should be designed to reduce aviation safety risk.*
>
> • *If turbines are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).*
>
> • *Lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.*
>
> • An aviation impact assessment must include a full assessment of the risks to aviation safety in the context of existing flight patterns and airport approach routes.
>
> *Lighting*
>
> *While important from a safety perspective, aviation obstacle lighting has the potential to impact regional and rural areas where other light sources are minimal. Applicants should seek to minimise the effects of lighting on visual amenity while still having regard to the aviation safety risk assessment. The visibility and impact of any lighting depends on the nature and intensity of the lighting required and the potential cumulative effects with other developments.*

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

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

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

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

To mitigate negative impacts on visual amenity, consider:

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

• using the lowest intensity turbine light suitable for the site

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

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

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

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

10.1.2. National Airports Safeguarding Framework (NASF) Guideline D

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

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

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

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

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

I where flashing lights are used, they flash simultaneously; and

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

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

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

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

CASR Part 139 (Aerodromes) Manual of Standards 2019 (13 March 2024) Section 9.31, (8) and (9) specifies as follows in relation to obstacle lights for wind farms:

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

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

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

(d) be seen from every angle in azimuth.

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

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

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

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

Section 9.33 specifies the characteristics of medium-intensity obstacle lights

9.33 Characteristics of medium-intensity obstacle lights

(1) Medium-intensity obstacle lights must:

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

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

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

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

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

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

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

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

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

10.2. Wind monitoring towers (WMTs)

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

10.2.1. National Airport Safeguarding Framework Guideline D

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

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

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

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

Marking and lighting of wind monitoring towers

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

- *the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;*
- *marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;*

- *ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation; or*
- *a flashing strobe light during daylight hours.*

10.2.2. Civil Aviation Safety Authority - regulatory context

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

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

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

> *2.2.1 The hazards that such buildings or structures may pose to aircraft requires assessment. CASA routinely performs such assessments however needs to be first notified of the obstacle, structure of source of a hazardous plume. The need to report such hazards is outlined in this AC.*
>
> *2.2.2 If you are the person who owns, controls or operates the object, structure or a source of a hazardous plume which is either present, imminent or has been approved for erection/construction, details need to be provided about:*
>
> *– the construction, extension or dismantling of tall structures if the top is:*
>
> *o 100 m or more above ground level*
>
> *or*
>
> *o affects the obstacle limitation surface of an aerodrome as defined in*
>
> *2.2.3 In addition, tall structures may pose a specific hazard for the operation of low-flying Defence aircraft or to the flight paths of arriving/departing aircraft (refer Paragraph 2.1.3). Therefore, the RAAF and Airservices Australia require information on structures that are 30 m or more above ground level—within 30 km of an aerodrome or 45 m or more above ground level elsewhere for the RAAF, or 30 m or more above ground level elsewhere for Airservices Australia.*
>
> *2.2.4 Information provided for the database should be accurate and readily interpreted. The tall structure report form has been designed to help owners and/or developers in this respect. The form is available on the Airservices Australia website (including a spreadsheet for reporting multiple structures) at: https://www.airservicesaustralia.com/industry-info/airport-development-assessments/*

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

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

> *2.1.2 Regardless of CASA advice, planning authorities make the final determination whether a wind farm or a tall structure not in the vicinity of a CASA regulated aerodrome will require lighting or marking.*
>
> *2.2.1 All wind turbine developments and tall structures should be assessed to determine whether they could be a risk to aviation safety. This AC augments the information in the National Aerodromes Safeguarding Framework (NASF) Guideline D and provides additional guidance on the assessment of*

wind farm developments and guidance for establishing what reasonable measures may be put in place to mitigate any adverse effect the wind farm development could be to aviation safety.

2.2.2 For the purposes of this AC, navigable airspace is considered to be the airspace above the minimum altitudes of VFR and IFR flight, including airspace required to ensure the safe take-off and landing of an aircraft. Generally, minimum altitude limits equate to 500 ft (152 m) or 1 000 ft (305 m) above ground level depending on the situation, i.e., whether or not the flying is over a populous area. The presence of wind turbines, wind monitoring masts and other tall obstacles may create a risk to the safety of flight, due to the risk of collision. An entity that is proposing to introduce a hazard into navigable airspace, such as a wind farm, must mitigate the risk of the hazard on airspace users to ensure an acceptable level of safety is maintained.

2.2.4.1 Part 139 of the Civil Aviation Safety Regulations 1998 (CASR), regulates obstacles within the vicinity of certified aerodromes. This is supported by Part 139 (Aerodromes) Manual of Standards (MOS) which provides the definition of an obstacle as well as the standards for marking and lighting of an obstacle. Any wind turbine (where the height is defined to be the maximum height reached by the tip of the turbine blades), wind monitoring mast or other tall structure that penetrates an Obstacle Limitation Surface (OLS) of an aerodrome will be assessed in accordance with the provisions of Part 139 of CASR and the MOS.

2.2.6.1 Outside the vicinity of an aerodrome, which is defined as being outside the OLS of an aerodrome, wind farms and other tall structures may constitute a risk to low-flying aviation operations which may be conducted down to 500 ft above ground level (AGL) over non-populous areas. Additionally, wind monitoring masts can also be hazardous to aviation, given they are very thin and difficult to see. Wind farms can also affect the performance of communications, navigation and surveillance (CNS) equipment operated by Airservices or the Department of Defence.

2.5 Aviation hazard –lighting - International best practice

2.5.2 Australian regulations state that aircraft in uncontrolled airspace may operate under visual flight rules (VFR), which requires the pilot to remain clear of clouds and to adhere to visibility minima.

> *- in Class G airspace below 3000 ft Above Mean Sea Level (AMSL) or 1000 ft AGL (whichever is the higher) – remain clear of cloud with minimum visibility of 5000 m.*
>
> *− in Class G airspace below 10 000 ft AMSL (subject to the above) – remain 1000 ft vertically and 1500 m horizontally from cloud and with 5000 m visibility.*

Note: Helicopters may be permitted to operate in lower visibility and that further exemptions may apply to special cases such as military, search and rescue, medical emergency, agricultural and fire-fighting operations.

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

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

2.6 Hazard Lighting

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

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

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

2.7 CASA's commitment to aviation safety

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

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

11. 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.

11.1. 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.

11.2. 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.

11.3. 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-2020-01–, 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 11 (source: ATSB).

Table 11 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 17 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.

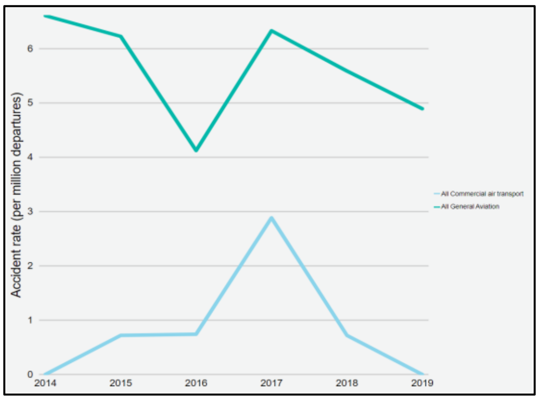


Figure 17 Fatal Accident Rate (per million departures) by Operation Type

In 2018, there were nine (9) fatal accidents and nine (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 eight (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 12 (source: ATSB).

Table 12 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 reported 10-year period and since, no aircraft has collided with a WTG or a WMT in Australia.

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

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

11.4. Worldwide accidents involving wind farms

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

Based on the statistics set out in the Global Wind Energy Council (GWEC) report 2016, there were 341,320 WTGs operating around the world at the end of 2016. In 2019, approximately 60.4 GW of wind power had been installed worldwide.

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, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia, Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

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

- One accident occurred in Texas, United States in October 2019 resulting in minor aircraft damage no injury to the pilot and significant injury to a person on the ground. The aircraft, an Air Tractor AT502, was returning from a local aerial application flight and was flown deliberately at low-level in close vicinity to a WTG because the pilot believed his friend was working on the WTG. The aircraft collided with a tagline rope that was attached to a blade of the WTG and which was being held by a person working on the ground. The worker was thrown about 20 ft in the air and experienced significant non-life-threatening injuries. The aircraft sustained minor damage however the pilot landed the aircraft without further incident.
- One accident, which resulted in two (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.

12. 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.**

12.1. Risk Identification

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

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

1. Potential for an aircraft to collide with a WTG, 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, Communications and the Arts (Airspace and Air Traffic Management Risk Management Policy Statement). and in line with generally accepted practice, the risk to be assessed should primarily be associated with passenger transport services. Therefore, the risk being assessed herein is primarily associated with smaller aircraft likely to be flying under the VFR in the airspace surrounding the Project Area, and so the maximum number of passengers exposed to the nominated consequences is likely to be limited.

The five (5) risk events identified here are assessed in detail in the following section.

12.2. Risk Analysis, Evaluation and Treatment

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

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

Table 13 Aircraft collision with WTG

Risk ID:	1. Aircraft collision with 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 5 reported occurrences worldwide of aircraft collisions with a component of a WTG structure since the year 2000 as discussed in Section 11. 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 11.

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 5 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 11). 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 certified 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 height of 280 m (918.6 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (418.6 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. • 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. • Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, 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 o– 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 prior to construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically:	

a. 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. b. Arrangements should be made to publish details of the Project in ERSA for surrounding aerodromes, which would involve notification to Airservices Australia. c. Obstacle lighting fitted to the WTGs.	
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**. Based on NSW Wind Energy Guideline, if WTGs are 150 m or more above ground, lighting is required for the most critical WTGs (e.g. WTGs at highest elevations and/or around the project perimeter). Lighting of WTGs and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site. In the circumstances, the level of risk under the proposed treatment plan is considered **as low as reasonably practicable (ALARP)**. **It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a WTG.**	
Residual Risk	7 - Tolerable

Table 14 Aircraft collision with wind monitoring tower (WMT)

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

Discussion

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

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

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

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

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

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

Consequence

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

Consequence	Catastrophic

Untreated Likelihood

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

Untreated Likelihood	Possible

Current Treatments

- The temporary and permanent WMT locations will be advised to CASA and Airservices Australia prior to construction.
- Aircraft are restricted to a minimum height of 152.4 m (500 ft) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas.
- 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 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).

• Aircraft authorised to intentionally fly below 152.4 m (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • If the WMTs will be higher than 100 m AGL, there is a statutory requirement to report them to CASA and Airservices Australia prior to construction.	
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 - Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Details of any WMTs when they are constructed should be advised to Airservices Australia. • Consideration could be given to marking any wind monitoring towers according to the requirements set in MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specify: *8.110 (5) As illustrated in Figure 8.110 (5), long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that the darker colour is at the top; and the bands are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and have a length (“z” in Figure 8.110 (5)) that is, approximately, the lesser of: 1/7 of the height of the structure; or 30 m.* *8.110 (7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects. (8) The objects mentioned in subsection (7) must: be approximately equivalent in size to a cube with 600 mm sides; and be spaced 30 m apart along the length of the wire or cable.* • WMTs that are installed prior to WTG installation (Temporary WMTs) and WMTs that are not in close proximity to a WTG, should be fitted with a medium intensity steady red obstacle light at the top of the tower to ensure visibility in low light and deteriorated atmospheric conditions. Characteristics of medium-intensity lights are specified in MOS 139 Section 9.33: *1) Medium-intensity obstacle lights must:* *a) be visible in all directions in azimuth; and* *b) if flashing — have a flash frequency of between 20 and 60 flashes per minute.* *2) The peak effective intensity of medium-intensity obstacle lights must be 2 000 ± 25% cd with a vertical distribution as follows:*	

a) *for* **vertical beam spread** *— a minimum of 3 degrees;* b) *at -1 degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;* c) *at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.* 3) *For subsection (2),* **vertical beam spread** *means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.* 4) *If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ± 25% cd when the background luminance is 50 cd/m² or greater.* • Ensure details of any additional WMTs at the Project 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**. Under these circumstances, the level of risk under the proposed treatment plan is considered **ALARP.** **For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision provided obstacle lighting is fitted to ensure visibility in low light and deteriorating atmospheric conditions.**	
Residual Risk	7 - Tolerable

Table 15 Harsh manoeuvring leading to controlled flight into terrain

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

Discussion

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

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

The Project is clear of the OLS of any aerodrome.

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

The proposed WTGs will be a maximum of 280 m (918.6 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (418.6 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.

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.
- Installation of obstacle lighting will ensure the WTGs are visible during the night.
- The ‘as constructed’ details of WTGs are required to be notified to Airservices Australia so that the location and height of WTGs can be noted on aeronautical maps and charts.
- Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTG to CASA.

Consequence

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

Consequence	Catastrophic

Untreated Likelihood

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

Untreated Likelihood	Possible

Current Treatments (without lighting) • The Project is clear of the OLS of any aerodrome. • Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. • WTGs will be a maximum of 280 m (918.6 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (518.6 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. • Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, so that the location and height of all 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 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. - Equip the critical WTGs with obstacle lighting. - Although there is no requirement to do so, the Applicant may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project Area.	
With the additional recommended treatments, 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**. In the circumstances, the level of risk under the proposed treatment plan is considered **ALARP**. **It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a WTG.**	
Residual Risk	7 – Tolerable

Table 16 Effect of the Project on operating crew

Risk ID:	**4. Effect of the Project on operating crew**	
Discussion Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew. There are no known aerial application operations conducted at night in the vicinity of the Project 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 280 m (918.6 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (418.6 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. • 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.		

• Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, so that the location and height of all 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 WTGs to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Moderate consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 6 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 WMTs have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators prior to construction. • Although there is no requirement to do so, the Applicant may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for such aircraft operations in the vicinity of the Project Area. • Installation of lighting in accordance with the guideline.	
Residual Risk Notwithstanding the current level of risk is considered **Tolerable,** the additional Recommended Treatments listed above will enhance aviation safety. The likelihood remains **Possible**, and consequence remains **Minor**. In the circumstances, the risk level of 5 is considered **Tolerable.** **It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for operational limitations to affect aircraft operating crew, and with obstacle lighting fitted to both WTGs and WMTs.**	
Residual Risk	5 – Tolerable

Table 17 Effect of obstacle lighting on neighbours

Risk ID:	5. Effect of obstacle lighting on neighbours

Discussion

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

Installation and operation of obstacle lighting on WTGs or WMTs 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 WMTs will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assesses 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 For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, obstacle lighting is recommended to ensure visibility in low light and deteriorating atmospheric conditions. If CASA or a planning authority decide that obstacle lighting is required there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including: • Reducing the number of WTGs with obstacle lights • Specifying an obstacle light that minimises light intensity at ground level • Specifying an obstacle light that matches light intensity to meteorological visibility • Mitigating light glare from obstacle lighting through measures such as baffling. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to residents within and around the Project 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 As 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**. 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

13. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

13.1. Planning considerations

The Project, as proposed, satisfies the Wentworth Shire Council, and it will not create incompatible intrusions or compromise the safety of existing airports and associated navigation and communication facilities.

13.2. Aviation Impact Statement

Based on the WTG layout and maximum blade tip height of up to 280 m AGL, the blade tip elevation of the highest WTG, which is WTG T15, would not exceed 398.2 m AHD (1306.4 ft AMSL) and:

- There are two certified airports located within 30 nm (56 km) of the Project: Mildura Airport (YMIA) and Wentworth Airport (YWTO):
- Mildura Airport (YMIA):
  - The WTGs would not impact the OLS surfaces.
  - The WTGs would not impact the circling areas.
  - The WTGs would impact the 10 nm MSA, which will need to be raised by 500 ft to 2300ft.
  - The WTGs would impact the 25 nm MSA, which will need to be raised by 300 ft to 2300ft or sectorized to exclude the wind farm.
  - The WTGs would impact on PANS-OPS surfaces:
    - The minimum altitude of the initial / en-route segment of DME or GNSS arrival would need to be raised by 300 ft.
    - The minimum holding altitude of RNP RWY 27 would need to be raised by 300 ft.
    - Due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.
- Wentworth Airport (YWTO):
  - The WTGs would not impact the OLS surfaces.
  - The WTGs would not impact the circling areas.
  - The WTGs would impact on 25 nm MSA, which will need to be raised by 500 ft to 2300 ft or sectorized to exclude the wind farm.
  - The WTGs would not impact PANS-OPS surfaces, however, due to the requirement to increase the 25 nm MSA to 2300 ft, the commencement altitude, minimum holding altitude, and the final missed approach altitude of all the PANS-OPS procedures would need to be increased to 2300 ft.
- The WTGs will impact the Grid LSALT; both Grid LSALTs would need to be raised to 2400 ft AMSL.

- The WTGs would impact on four (4) air route LSALTs:
  - Air route Q4 LSALT would need to be raised to 2400 ft.
  - Air route Q16 LSALT would need to be raised to 2400 ft.
  - Air route J19 LSALT would need to be raised to 2200 ft.
  - Air route W451 LSALT would need to be raised to 2400ft.
- The Project Area is located within Class G airspace and outside of controlled airspace, Prohibited, Restricted, and Danger areas.
- The WTGs would not impact the aviation navigation facilities of nearby certified airports.
- The WTGs would not impact the closest radar installations.
- The WTGs must be reported to CASA, and construction details provided to Airservices Australia.

13.3. 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.

The Project Area is next to the boundary of the Mallee Cliffs National Park. Consultation with NSW National Parks and Wildlife Service (NPWS) has already undertaken, referring to Section 5..

13.4. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E., the proposed WTGs and WMT must be reported to CASA.
- Based on NSW Wind Energy Guideline,
  - If WTGs are 150 m or more above ground, lighting is required for the most critical WTGs (e.g. WTGs at highest elevations and/or around the project perimeter).
  - And lighting of WTGs and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.
- 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.
- It is not mandatory to mark the WMTs, however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:
  - Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour

- Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and
- Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation.

14. RECOMMENDATIONS

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

Notification and reporting

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

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

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

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

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

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

5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs 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.

    a. CASA recommends that the following Australian Standard be considered regarding overhead transmission lines: *AS 3891.2, Air navigation — Cables and their supporting structures — Marking and safety requirements, Part 2: Low-level aviation operations*.

6. The Project Area is next to the boundary of the Mallee Cliffs National Park. Consultation with NSW National Parks and Wildlife Service (NPWS) has already undertaken, referring to Section 5.

7. The procedures of Mildura and Wentworth will need to be amended, and the procedure designer will make a detailed assessment. The aerodrome operator is required to provide permission for any procedures to be amended.

Marking of WTGs

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

Marking of WMTs

9. It is not mandatory to mark the WMTs, however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:

a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour

b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and

c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation

Lighting of WTGs and WMTs

10. Based on NSW Wind Energy Guideline,
    a. If WTGs and WMTs are 150 m or more above ground, lighting is required for the most critical WTGs (e.g. WTGs at highest elevations and/or around the project perimeter).
    b. lighting of WTGs and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.

11. CASA provided feedback on 11 November 2024 and recommended lighting the wind farm with a minimum intensity light on the nacelle.

12. DPHI provided advice on 23 January 2025, which required to preparation of an Aviation Lighting Plan (a separate lighting report been prepared by Aviation Projects - 102209-01 Mallee_WF_Obstacle_Lighting_Fianl_V1.0_260331, see Annexure 7)

Micrositing

13. Providing the micrositing is within 100 m of the planned WTGs it 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.

Aerial firefighting

14. The developer or operator should consider the guidance contained in the Australian and New Zealand Council for Fire and Emergency Services *Wind Farms and Bushfire Operations* to ensure:

    a. Liaison with the relevant fire and land management agencies is ongoing and effective

    b. Access is available to the wind farm site by emergency services response for on-ground firefighting operations

    c. WTGs are shut down immediately during emergency operations.

    d. 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. This may not always be possible due to the risk to equipment and personnel as a fire approaches or exists in or near to the WTGs.

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

Triggers for review

15. 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.

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. WMT coordinates and heights
7. Lighting Plan

ANNEXURE 1 – REFERENCES

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

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

ANNEXURE 2 – DEFINITIONS

Term	*Definition*
Aerial Agricultural Operator	Specialist pilot and/or company who are required to have a commercial pilot's licence, an agricultural rating and a chemical distributor's licence
Aerodrome	A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and surface movement of aircraft.
Aerodrome facilities	Physical things at an aerodrome which could include: a. the physical characteristics of any movement area including runways, taxiways, taxilanes, shoulders, aprons, primary and secondary parking positions, runway strips and taxiway strips; b. infrastructure, structures, equipment, earthing points, cables, lighting, signage, markings, visual approach slope indicators.
Aerodrome reference point (ARP)	The designated geographical location of an aerodrome.
Aeronautical Information Publication (AIP)	Details of regulations, procedures, and other information pertinent to the operation of aircraft
Aeronautical Information Publication En-route Supplement Australia (AIP ERSA)	Contains information vital for planning a flight and for the pilot in flight as well as pictorial presentations of all licensed aerodromes
Ancillary Infrastructure	All permanent infrastructure necessary for the construction and operation of the wind farm with the exception of WTGs and battery storage, including but not limited to internal roads, hardstands, main and collector substations, switchyard, operations and maintenance facility, underground and overhead electricity transmission lines and poles, communication cables (includes control cables and earthing), permanent meteorological masts and water storage tanks.
Civil Aviation Safety Regulations 1998 (CASR)	Contain the mandatory requirements in relation to airworthiness, operational, licensing, enforcement.
Construction	The construction of the Project, including but not limited to the construction of WTGs, battery storage, ancillary infrastructure but excluding pre-construction works.

Term	*Definition*
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
Micro-siting	The process of locating WTGs, battery storage, ancillary infrastructure and temporary infrastructure during detailed design without further approval, providing that: • ground disturbance is wholly contained within the Development Corridor, with the exception of meteorological masts • no WTG is moved more than 100 metres from the relevant GPS coordinates • the revised location of the blade of a WTG is at least 50 metres from the canopy of existing hollow-bearing trees; or where the proposed location of the blade of a WTG is already within 50 metres of the canopy of existing hollow-bearing trees, the revised location is not any closer to the existing hollow-bearing trees • meteorological masts (temporary and permanent) are installed within the Project Area at all times and within the Development Corridor where reasonable and feasible.
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.
Project Area	The Project Area encompasses all land within and including the Project Boundary.
Project Boundary	The outer boundary of the Project Area. The Project Boundary is the maximum spatial extent of potential land access defined by the boundaries of the host landholder properties (i.e. all agreed lots owned by host landholders).
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
Runway strip	A defined area including the runway and stopway, if provided, intended: a. to reduce the risk of damage to aircraft running off a runway; and b. to protect aircraft flying over it during take-off or landing operations.

Term	*Definition*
Safety Management System	A systematic approach to managing safety, including organisational structures, accountabilities, policies and procedures.

ANNEXURE 3 – 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 one (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 Civil Aviation Safety Authority (CASA) regulates aviation activities in Australia. Applicable requirements include the Advisory Circular (AC) 139 E 0.1-v1.0 and AC.139 E 0.5-v1.1. Relevant provisions are outlined in further detail in the following section.

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

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

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

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

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

o 100 m or more above ground level

or

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

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

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

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

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

2.1.2 Regardless of CASA advice, planning authorities make the final determination whether a wind farm or a tall structure not in the vicinity of a CASA regulated aerodrome will require lighting or marking.

2.2.1 All wind turbine developments and tall structures should be assessed to determine whether they could be a risk to aviation safety. This AC augments the information in the National Aerodromes Safeguarding Framework (NASF) Guideline D and provides additional guidance on the assessment of wind farm developments and guidance for establishing what reasonable measures may be put in place to mitigate any adverse effect the wind farm development could be to aviation safety.

2.2.2 For the purposes of this AC, navigable airspace is considered to be the airspace above the minimum altitudes of VFR and IFR flight, including airspace required to ensure the safe take-off and landing of an aircraft. Generally, minimum altitude limits equate to 500 ft (152 m) or 1 000 ft (305 m) above ground level depending on the situation, i.e., whether or not the flying is over a populous area. The presence of wind turbines, wind monitoring masts and other tall obstacles may create a risk to the safety of flight, due to the risk of collision. An entity that is proposing to introduce a hazard into navigable airspace, such as a wind farm, must mitigate the risk of the hazard on airspace users to ensure an acceptable level of safety is maintained..

2.2.6.1 Outside the vicinity of an aerodrome, which is defined as being outside the OLS of an aerodrome, wind farms and other tall structures may constitute a risk to low-flying aviation operations which may be conducted down to 500 ft above ground level (AGL) over non-populous areas. Additionally, wind monitoring masts can also be hazardous to aviation, given they are very thin and difficult to see.. Wind farms can also affect the performance of communications, navigation and surveillance (CNS) equipment operated by Airservices or the Department of Defence.

2.5 Aviation hazard lighting - International best practice

2.5.2 Australian regulations state that aircraft in uncontrolled airspace may operate under visual flight rules (VFR), which requires the pilot to remain clear of clouds and to adhere to visibility minima.

> *- in Class G airspace below 3000 ft Above Mean Sea Level (AMSL) or 1000 ft AGL (whichever is the higher) – remain clear of cloud with minimum visibility of 5000 m.*
>
> *– in Class G airspace below 10 000 ft AMSL (subject to the above) – remain 1000 ft vertically and 1500 m horizontally from cloud and with 5000 m visibility.*

Note: Helicopters may be permitted to operate in lower visibility and that further exemptions may apply to special cases such as military, search and rescue, medical emergency, agricultural and fire-fighting operations.

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

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

2.6 Hazard Lighting

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

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

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

2.7 CASA's commitment to aviation safety

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

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

1. *Aviation Projects considers that 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 at the top of the mast to ensure visibility in low light and deteriorating atmospheric conditions.*

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 five (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 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 tower 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

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

> *When wind turbines over 150 metres above ground level are to be built within 30 kms of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority (CASA) and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.*
>
> *The Aeronautical Information Service of the Royal Australian Air Force (RAAF AIS) maintains a database of tall structures in the country. The RAAF AIS should be notified of all tall structures meeting the following criteria:*
>
> - *30 metres or more above ground level for structures within 30km of an aerodrome; or*
> - *45 metres or more above ground level for structures located elsewhere.*
>
> *Marking and lighting of wind monitoring towers*
>
> *Before developing a wind farm, it is common for wind monitoring towers to be erected for anemometers and other meteorological sensing instruments to evaluate the suitability or otherwise of a site. These towers are often retained after the wind farm commences operations to provide the relevant meteorological readings. These structures are very difficult to see from the air due to their slender construction and guy wires. This is a particular problem for low flying aircraft including aerial agricultural operations. Wind farm proponents should take appropriate steps to minimise such hazards, particularly in areas where aerial agricultural operations occur. Measures to be considered should include:*
>
> - *the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;*
> - *marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;*

- *ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation; or*
- *a flashing strobe light during daylight hours.*

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
LIKELIHOOD	ALMOST CERTAIN 5	6	7	8	9	10
	LIKELY 4	5	6	7	8	9
	POSSIBLE 3	4	5	6	7	8
	UNLIKELY 2	3	4	5	6	7
	RARE 1	2	3	4	5	6

Actions required

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

Table 4 Actions Required

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

ANNEXURE 5 – PROJECT WTG COORDINATES AND HEIGHTS

Reference file: 32179_TurbineAndMetMast_Elevations_260116.xlsx

WTG ID	Easting (GDA20z54)	Northing (GDA20z54)	Base Elevation (m AHD)	WTG Max Elevation (m AGL)	WTG Tip Height (m AHD)	WTG Tip Height (ft AHD)
T1	626,166.1	6,220,308.9	102.6631927	280	382.6632	1255.457
T2	626,562.0	6,219,787.6	103.1780243	280	383.178	1257.146
T3	626,981.5	6,219,239.3	111.281662	280	391.2817	1283.732
T4	627,416.4	6,218,668.3	116.9394302	280	396.9394	1302.295
T5	627,800.7	6,218,166.3	117.9415588	280	397.9416	1305.583
T6	628,226.9	6,217,605.1	108.9559174	280	388.9559	1276.102
T7	628,653.6	6,217,050.4	102.8856659	280	382.8857	1256.187
T8	629,070.8	6,216,502.5	99.92684937	280	379.9268	1246.479
T9	629,654.7	6,216,944.0	91.75377655	280	371.7538	1219.665
T10	628,181.8	6,219,455.6	117.8151398	280	397.8151	1305.168
T11	628,986.7	6,218,771.3	109.6362915	280	389.6363	1278.334
T12	629,589.4	6,218,233.2	99.04380035	280	379.0438	1243.582
T13	628,025.2	6,221,832.2	102.9296494	280	382.9296	1256.331
T14	628,399.3	6,220,830.0	113.1861191	280	393.1861	1289.981
T15	628,983.2	6,220,349.0	118.1959763	280	398.196	1306.417
T16	629,630.5	6,219,604.5	103.4422913	280	383.4423	1258.013
T17	630,121.1	6,219,043.0	91.11676025	280	371.1168	1217.575
T18	627,313.6	6,224,253.6	90.25624847	280	370.2562	1214.751
T19	627,725.7	6,223,608.5	98.24085236	280	378.2409	1240.948
T20	629,143.4	6,222,181.8	113.4077835	280	393.4078	1290.708
T21	629,800.3	6,221,435.0	109.2375412	280	389.2375	1277.026
T22	630,449.7	6,220,620.6	101.3643494	280	381.3643	1251.195
T23	630,877.5	6,219,637.2	87.47848511	280	367.4785	1205.638
T24	628,037.3	6,224,705.9	97.74114227	280	377.7411	1239.308
T25	628,811.9	6,223,288.0	104.9142151	280	384.9142	1262.842
T26	628,508.1	6,225,824.5	97.11525726	280	377.1153	1237.255

WTG ID	Easting (GDA20z54)	Northing (GDA20z54)	Base Elevation (m AHD)	WTG Max Elevation (m AGL)	WTG Tip Height (m AHD)	WTG Tip Height (ft AHD)
T27	628,935.8	6,225,263.9	103.0507507	280	383.0508	1256.728
T28	629,548.0	6,224,572.9	112.119545	280	392.1195	1286.481
T29	630,060.1	6,223,894.3	115.8575058	280	395.8575	1298.745
T30	630,590.0	6,223,137.2	111.3807907	280	391.3808	1284.058
T31	631,271.4	6,222,518.2	103.6120377	280	383.612	1258.57
T32	631,466.2	6,221,726.3	93.52523041	280	373.5252	1225.476
T33	632,279.9	6,220,714.5	77.16229248	280	357.1623	1171.792
T34	630,803.5	6,225,323.7	101.5312729	280	381.5313	1251.743
T35	631,389.3	6,224,483.4	101.0639038	280	381.0639	1250.21
T36	631,919.9	6,223,777.7	99.76344299	280	379.7634	1245.943
T37	632,448.6	6,223,061.6	84.1366272	280	364.1366	1194.674
T38	633,127.5	6,222,141.4	72.05007935	280	352.0501	1155.02
T39	633,337.0	6,224,175.6	75.05432129	280	355.0543	1164.876
T40	630,251.4	6,228,029.3	102.9792175	280	382.9792	1256.493
T41	630,728.5	6,227,407.0	103.5375595	280	383.5376	1258.325
T42	630,580.8	6,228,925.5	103.4567566	280	383.4568	1258.06
T43	631,552.2	6,227,652.3	112.5231323	280	392.5231	1287.806
T44	632,485.4	6,227,485.0	102.877739	280	382.8777	1256.161
T45	633,144.4	6,226,553.4	80.85112	280	360.8511	1183.895
T46	633,738.0	6,225,887.6	70.68167114	280	350.6817	1150.53
T47	634,330.1	6,225,099.1	68.6268158	280	348.6268	1143.789
T48	630,477.2	6,229,949.8	95.42640686	280	375.4264	1231.714
T49	631,052.9	6,229,823.8	103.8752823	280	383.8753	1259.433
T50	633,935.5	6,228,047.0	77.41722107	280	357.4172	1172.629
T51	634,683.8	6,227,527.3	69.68458557	280	349.6846	1147.259
T52	635,431.8	6,227,202.2	71.42183685	280	351.4218	1152.959
T53	636,386.1	6,227,358.9	65.52168274	280	345.5217	1133.601
T54	637,264.6	6,227,878.8	70.2057724	280	350.2058	1148.969
T55	634,487.1	6,230,605.2	89.40896606	280	369.409	1211.972

WTG ID	Easting (GDA20z54)	Northing (GDA20z54)	Base Elevation (m AHD)	WTG Max Elevation (m AGL)	WTG Tip Height (m AHD)	WTG Tip Height (ft AHD)
T56	635,920.5	6,230,340.2	80.39257813	280	360.3926	1182.39
T57	635,125.0	6,231,383.6	94.50886536	280	374.5089	1228.704
T58	637,174.0	6,232,053.9	81.6925354	280	361.6925	1186.655
T59	638,038.5	6,231,841.3	84.19563293	280	364.1956	1194.868
T60	638,821.7	6,231,473.1	81.09285736	280	361.0929	1184.688
T61	639,772.2	6,231,788.6	78.42140198	280	358.4214	1175.923
T62	638,245.4	6,233,229.0	82.54290009	280	362.5429	1189.445
T63	635,106.9	6,234,780.3	108.9154434	280	388.9154	1275.969
T64	635,736.5	6,234,693.5	109.9852829	280	389.9853	1279.479
T65	636,433.7	6,234,597.7	96.21781158	280	376.2178	1234.31
T66	637,357.2	6,234,430.0	85.15345001	280	365.1535	1198.01
T67	638,306.2	6,234,299.3	80.37310791	280	360.3731	1182.326
T68	639,076.1	6,234,107.4	83.6794281	280	363.6794	1193.174
T69	633,186.9	6,236,388.2	103.4711838	280	383.4712	1258.108
T70	633,870.6	6,236,658.4	110.6561203	280	390.6561	1281.68
T71	634,447.0	6,236,253.1	117.0559311	280	397.0559	1302.677
T72	634,514.8	6,237,558.6	110.0607758	280	390.0608	1279.727
T73	635,547.7	6,237,241.0	118.0359116	280	398.0359	1305.892
T74	634,088.2	6,238,563.1	99.54792786	280	379.5479	1245.236
T75	635,182.4	6,238,320.5	106.6081696	280	386.6082	1268.4
T76	636,183.7	6,238,352.9	104.4295502	280	384.4296	1261.252

ANNEXURE 6 – WMT COORDINATES AND HEIGHTS

WMT ID	Easting (GDA20z54)	Northing (GDA20z54)	Elevation (m AHD)	Met Mast Height (m AGL)	Met Mast Max Height (m AHD)	Met Mast Height (ft AHD)
MM1	633021.0398	6238842.495	88.186	170	258.19	847.1
MM2	640692.6166	6240663.359	86.231	170	256.23	840.7
MM3	636277.5755	6221250.214	72.832	170	242.83	796.7
MM4	628987.1822	6215763.708	102.197	170	272.20	893.0
MM5	624726.4863	6221408.838	74.619	170	244.62	802.6
MM6	630939.5421	6230835.606	87.402	170	257.40	844.5
MM7	640781.0143	6230317.536	74.070	170	244.07	800.8

ANNEXURE 7 – MALLEE WIND FARM OBSTACLE LIGHTING

Refer to 102209-01_Mallee_WF_Obstacle_Lighting_Final_V1.0_260331

AVIATION PROJECTS

March 2026

Bharat Gordhan
Principal Environmental Consultant
Umwelt

By email: Bharat.Gordhan@umwelt.com.au

Our ref: 102228-02

Dear Bharat

Re: Mallee Wind Farm – Wind Turbine Obstacle Lighting

This correspondence responds to a request for an Aviation Obstacle Lighting Plan from Umwelt in accordance with the CASA recommendation and DPHI advice.

1.1. References

- Advisory Circular (AC)139.E-05 *Obstacles (including wind farms) outside the vicinity of a CASA-certified aerodrome*
- Civil Aviation Safety Regulation (CASR) 1998 Part 139: *Aerodromes*, Manual of Standards
- NSW Department of Planning, Housing and Infrastructure (DPHI) *Wind Energy Guideline* (November 2024)
- National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*

1.2. Background

Aviation Projects prepared an Aviation Impact Assessment (AIA) for the Mallee Wind Farm (102209-01 Mallee Wind Farm AIA_Draft_Final Draft_v0.5_240924) and concluded that obstacle lighting would not be required for WTGs to maintain an acceptable level of safety for aircraft, but WMTs installed to WTGs or not in close proximity to a WTG would be required to be lit.

Recommendations 8 and 9 in Section 11 of the AIA indicated the following:

> *Lighting of WTGs and WMTs*
>
> *8. CASA will determine whether obstacle lighting is recommended for the WTGs. It is not a formal requirement to light the WTGs.*
>
> *9. Aviation Projects considers that the WMTs installed prior to the WTGs or not in close proximity to a WTG, will require an obstacle light installed at the top to ensure aviation safety standards are met.*

The DPHI released the *Wind Energy Guideline* in November 2024, which requires that turbines 150 m or more above ground be lit.

Aviation Project prepared an updated AIA for the Mallee Wind Farm report, which is 102209-01 Mallee Wind Farm Updated AIA_V2.1_260323, and updated the recommendations (9-11) in Section 14 to:

- *Based on the Department of Planning, Housing and Infrastructure – Wind Energy Guideline (November 2024),*
  - *If turbines are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).*
  - *lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.*
- *CASA provided feedback on 11 November 2024 and recommended lighting the wind farm with medium intensity lighting on the nacelle.*
- *DPHI provided advice on 23 January 2025, which required to preparation of an Aviation Lighting Plan (a separate lighting report been prepared by Aviation Projects - 102209-01 Mallee_WF_Obstacle_Lighting_Final_V1.0_260331)*

1.3. CASA recommendation

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

> *This CASA assessment is made in accordance with the National Airports Safeguarding Framework (Guideline D) as developed by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts, to provide planning advice to State and Local Planning Authorities.*
>
> *With regards to Visual Flight Rules (VFR) operations, pilots are permitted to fly as low as 500 ft AGL (ie, terrain). The WTGs will reach up to a maximum height of approximately 280 m (919 ft) AGL.*
>
> *CASA agrees with the Recommendations at Section 11 of the Aviation Impact Assessment.*
>
> *However, CASA considers the proposed wind farm will be a hazard to aviation safety and recommends that the wind farm is obstacle lit with steady medium-low intensity red obstacle lighting in accordance with the National Airports Safeguarding Framework Guideline D 'Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation' National Airports Safeguarding Framework Principles and Guidelines (infrastructure.gov.au) and section 9.31 of Part 139 Aerodromes Manual of Standards Part 139 (Aerodromes) Manual of Standards 2019 (legislation.gov.au) (lower level lights on the turbine support columns are not essential).*
>
> *International standards require 2,000 candela lighting intensity on the nacelle (also recommended in the NASF guideline) and 200 candela at the mid-point of the turbine mast. CASA recommends that 200 candela as a minimum intensity lighting on the nacelle would suffice (due mainly to the lack of background lighting in the vicinity of the turbines). The obstacle lighting should be monitored to alert the wind farm operator of any outage and some of the obstacle lights remain on during an outage. CASA is prepared to review a lighting plan that indicates which turbines are proposed to be lit.*
>
> *As the Aviation Safety regulator, CASA does not consider the visual impact of obstacle lighting on neighbours / homesteads / the dark sky. However, there are mitigations for visual impact such as baffling and intensity control (as described in the Aviation Impact Assessment Table 10 / Page 49 'Effect of obstacle lighting on neighbours' and page 7 of Annexure 3 'Regulatory Requirements – Lighting and Marking').*

1.4. Advice from DPHI on aviation

DPHI provided advice on the Mallee Wind Farm on 23 January 2025, which included:

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

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

1.5. NSW National Parks and Wildlife Service

NSW National Parks and Wildlife Service provided advice on 09 December 2024, aviation related included:

NPWS has reviewed the EIS and Appendix 20 – Aviation Impact Assessment (102209-01) prepared by Aviation Projects Pty Ltd, dated 25 September 2024.

NPWS is both a firefighting and land management agency which uses aircraft in a multitude of operational functions. NPWS's policy is that consistent with the Rural Fires Act 1997, the agency may respond to fires within 8 km of the boundary of land reserved or acquired under the NPW Act, at the discretion of the NPWS Area Manager, if a detected fire threat is likely to affect those lands.

NPWS highlights that there is a recorded airstrip located within Mallee Cliffs National Park approximately 23km west of the project area. NPWS also highlights that temporary aircraft landing facilities, or emergency landing can occur anywhere on NPWS estate during state of emergency operations or medical evacuations.

The project includes seven permanent meteorological masts, with two located on the interface to the park, with the highest being 170m (893ft AMSL). This has the potential to pose a significant aviation hazard during aerial management operations.

NPWS facilitates regular operational use of Remotely Piloted Aircraft Systems (RPAS) / drones for surveys and monitoring, which will be an increasing used method in the area.

Recommendations:

3. Consistent with the recommendations of the Aviation Impact Assessment, NPWS request that meteorological masts are appropriately lit and marked to ensure they are visible to aircraft in accordance with NASF Guideline D.

4. The proposal is not to restrict the use of RPAS / drones for NPWS / AWC.

Note, while this is a direct quote from NPWS, it is assumed that they intended to state that Mallee Cliffs National Park is located to the east of the Project Area.

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

CASR Part 139 (Aerodromes) Manual of Standards 2019 (13 March 2024) Section 9.31, (8) and (9) specifies as follows in relation to obstacle lights for wind farms:

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

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

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

(c) all be synchronised to flash simultaneously; and

(d) be seen from every angle in azimuth.

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

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

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

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

Section 9.33 specifies the characteristics of medium-intensity obstacle lights

9.33 Characteristics of medium-intensity obstacle lights

(1) Medium-intensity obstacle lights must:

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

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

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

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

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

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

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

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

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

1.7. National Airports Safeguarding Framework (NASF) Guideline D

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

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

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

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

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

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

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

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

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

1.8. DPHI *Wind Energy Guideline* (November 2024)

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

Whilst the Renewable Energy Planning Framework, inclusive of the Wind Energy Guideline does not immediately apply to the Project (as the EIS was lodged before 12 November 2024) aspects relating to aviation safety are relevant to consider to avoid ambiguity in regard to the need for obstacle lighting. Those key principles are outlined below.

5.3.1 Key principles

Aviation safety and lighting principles

• Wind energy projects should be designed to reduce aviation safety risk.

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

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

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

Lighting

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

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

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

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

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

To mitigate negative impacts on visual amenity, consider:

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

• using the lowest intensity turbine light suitable for the site

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

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

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

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

1.9. Obstacle lighting arrangements

The proposed obstacle lighting layout for the Project has been prepared in Figure 1 below, with respect to the indicative Project layout presented in the EIS and in applying the requirements of CASR Part 139 MOS or NASF Guideline D (in relation to obstacle lighting on wind turbines, and in particular the 900 m interval). The specific turbines proposed to be lit are illustrated as red dots in Figure 1 and are identified in Table 1. The proposed WMTs that need to be lit are shown as red triangles in Figure 1 and identified in Table 2.

Light and Shielding Specification:

- *Lights:*
    - 2 low intensity steady red lights (per lit wind turbine):
        - Fixed lights showing red

- A horizontal beam spread that results in 360° coverage around the obstacle
- A minimum intensity of 200 candela (cd)
- A vertical beam spread (to 50% of peak intensity) of 10°
- Low-intensity obstacle lights must have a peak intensity of at least 10 cd.
- A vertical distribution with 50 cd minimum at +6° and +10° above the horizontal
- Not less than 10 cd at all elevation angles between –3° and +90° above the horizontal.
- Obstacle lights should operate at night, and at times of reduced visibility.

- *Shielding:*
  - Shielding of the downward component of obstacle lighting is permitted, and if used, must be such that:
    - No more than 5% of the nominal light intensity is emitted at or below 5° below the horizontal
    - No light is emitted at or below 10° below horizontal
  - Two lights must be provided on top of the generator housing in a way that allows at least one of the lights to be seen from every angle in azimuth.
- *Department of Defence obstacle lighting requirement:*
  - The frequency range of the LED light emitted must fall within the range of wavelengths 655 to 930 nanometres.

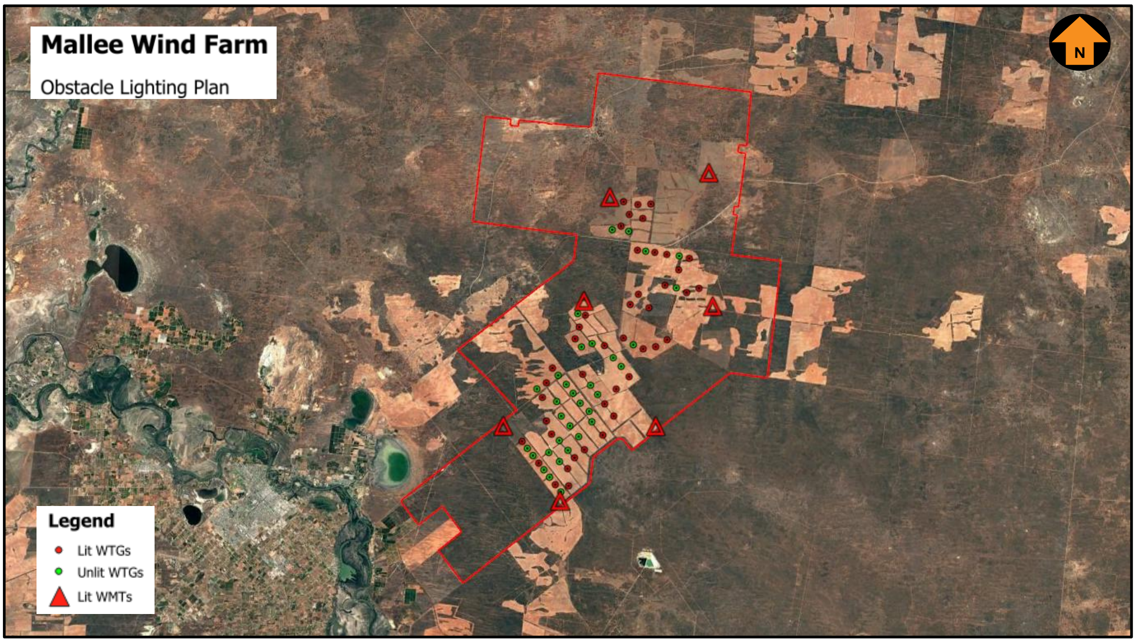


Figure 1 Proposed obstacle lighting layout

Table 1 Wind turbine ID proposed for obstacle lighting

WTG ID	Easting	Northing
T1	626,166.1	6,220,308.9
T4	627,416.4	6,218,668.3
T7	628,653.6	6,217,050.4
T9	629,654.7	6,216,944.0
T12	629,589.4	6,218,233.2
T13	628,025.2	6,221,832.2
T14	628,399.3	6,220,830.0
T17	630,121.1	6,219,043.0
T19	627,725.7	6,223,608.5
T23	630,877.5	6,219,637.2
T24	628,037.3	6,224,705.9
T26	628,508.1	6,225,824.5
T33	632,279.9	6,220,714.5
T34	630,803.5	6,225,323.7
T37	632,448.6	6,223,061.6
T38	633,127.5	6,222,141.4
T39	633,337.0	6,224,175.6
T40	630,251.4	6,228,029.3
T42	630,580.8	6,228,925.5
T44	632,485.4	6,227,485.0
T47	634,330.1	6,225,099.1
T49	631,052.9	6,229,823.8

WTG ID	Easting	Northing
T50	633,935.5	6,228,047.0
T52	635,431.8	6,227,202.2
T53	636,386.1	6,227,358.9
T54	637,264.6	6,227,878.8
T55	634,487.1	6,230,605.2
T56	635,920.5	6,230,340.2
T57	635,125.0	6,231,383.6
T58	637,174.0	6,232,053.9
T60	638,821.7	6,231,473.1
T61	639,772.2	6,231,788.6
T62	638,245.4	6,233,229.0
T63	635,106.9	6,234,780.3
T65	636,433.7	6,234,597.7
T66	637,357.2	6,234,430.0
T68	639,076.1	6,234,107.4
T70	633,870.6	6,236,658.4
T72	634,514.8	6,237,558.6
T73	635,547.7	6,237,241.0
T74	634,088.2	6,238,563.1
T75	635,182.4	6,238,320.5
T76	636,183.7	6,238,352.9

Table 2 WMT ID proposed for obstacle lighting

WMT ID	Easting	Northing
MM1	633,021.0	6,2388,42.5
MM2	640,692.6	6,240,663.4
MM3	636,277.6	6,221,250.2

WMT ID	Easting	Northing
MM4	628,987.2	6,215,763.7
MM5	624,726.5	6,221,408.8
MM6	630,939.5	6,230,835.6
MM7	640,781.0	6,230,317.5

If you wish to clarify or discuss the contents of this correspondence, please get in touch with me on 0433 747 835.

Kind regards

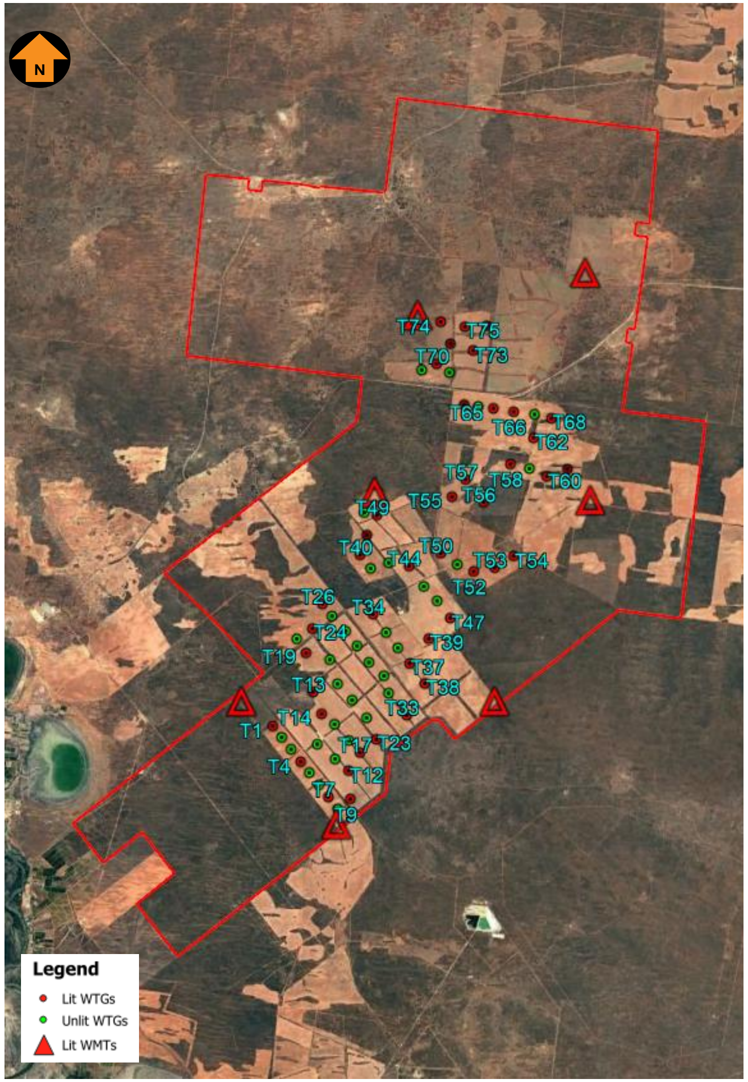
Lyn Wang

Aviation Specialist Consultant

31 March 2026

Enclosure: Obstacle Lighting Plan

AVIATION PROJECTS



1. Light and Shielding Specification:

   Lights:

   - **2 low intensity** steady red lights:
     - fixed lights showing red
     - a horizontal beam spread that results in 360° coverage around the obstacle
     - a minimum intensity of 200 candela (cd)
     - a vertical beam spread (to 50% of peak intensity) of 10°
     - a vertical distribution with 50 cd minimum at +6° and +10° above the horizontal
     - not less than 10 cd at all elevation angles between –3° and +90° above the horizontal.

   Shielding:

   - shielding of the downward component of obstacle lighting is permitted, and if used must be such that:
     - no more than 5% of the nominal light intensity is emitted at or below 5° below horizontal
     - no light is emitted at or below 10° below horizontal
   - two lights must be provided on top of the generator housing in a way that allows at least one of the lights to be seen from every angle in azimuth.

   Department of Defence obstacle lighting requirement:

   - the frequency range of the LED light emitted must fall within the range of wavelengths 655 to 930 nanometers.

2. References

   - Civil Aviation Safety Authority, *Part 139 (Aerodromes) Manual of Standards 2019*, dated 13 August 2020; Chapter 9 Division 4 Obstacle lighting (Sections 9.31, 9.32 and 9.33)
   - 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*, v4.1.3, 15 July 2012, paragraphs 35, 36 and 37

MALLEE WIND FARM – OBSTACLE LIGHTING PLAN	Project: 102209-01.1	Prepared by: L Wang	Version: Final 1.0_260331	AVIATION PROJECTS
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