CENTRAL WEST ORANA RENEWABLE ENERGY ZONE TRANSMISSION PROJECT

TECHNICAL PAPER 1

AVIATION

September 2023

Prepared for Energy Corporation of NSW

AVIATION PROJECTS

DOCUMENT CONTROL

Document Title: CWO REZ Transmission project – Technical Paper 1 - Aviation

Reference: 063003-01

Prepared by: P White

Reviewed by: S Adams

Released by: P White

Revision History

Version	*Description*	*Transmitted*	*Reviewed by*	*Date*
V1.0	Final Report	5 July 2023	EP	8 August 2023
V1.1	Final Report	9 August 2023	EP	15 September 2023

COPYRIGHT AND DISCLAIMER NOTICE

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

AAAA	Aerial Application Association of Australia
AC	Advisory Circular
AGL	above ground level
AHD	Australian Height Datum
AIA	aviation impact assessment
AIP	Aeronautical Information Publication
AIS	aviation impact statement
ALA	aircraft landing area
AMSL	above mean sea level
ARP	Aerodrome Reference Point
AS	Australian Standards
AsA	Airservices Australia
CAO	Civil Aviation Orders
CAR	Civil Aviation Regulation (1988)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation (1998)
DME	distance measuring equipment
DPE	Department of Planning, and Environment
ERC-L	en-route chart low
ERSA	En Route Supplement Australia
GNSS	global navigation satellite system
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
IMC	instrument meteorological conditions
LGA	local government area
LSALT	lowest safe altitude
MOS	Manual of Standards
MSA	minimum sector altitude
NASAG	National Airports Safeguarding Advisory Group

NASF	National Airports Safeguarding Framework
NDB	non-directional radio beacon
nm	Nautical miles
OLS	obstacle limitation surface
PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
RFDS	Royal Flying Doctor Service
RNAV	area navigation
RNP	required navigation performance
RSR	route surveillance radar
VFR	visual flight rules
VOR	VHF omni-directional radio range
VMC	visual meteorological conditions

UNITS OF MEASUREMENT

feet	(1 foot = 0.3048 metres)
kilometres	(1 kilometre = 0.5399 nautical miles)
metres	(1 metre = 3.281 feet)
nautical miles	(1 nautical mile = 1.852 kilometres)

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 **Aircraft Landing Area (ALA)**	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 certified aerodromes. Other aerodromes, also known as Aircraft Landing Areas (ALA) may be included in ERSA with limited information.
Central-West Orana REZ (CWO REZ)	A geographic area of approximately 20,000 square kilometres centred on the regional towns of Dubbo and Dunedoo and extending west to Narromine and east beyond Mudgee and to Wellington in the south and Gilgandra in the north, that will combine renewable energy generation, storage and transmission infrastructure to deliver energy to electricity consumers.

Term	*Definition*
Civil Aviation Safety Regulations 1998 (CASR)	Contain the mandatory requirements in relation to airworthiness, operational, licensing, enforcement.
Class G Airspace	A category of airspace in which an ATC separation service is not provided, i.e., uncontrolled airspace.
Construction Area	The area that would be directly impacted by construction of the project including (but not limited to) transmission towers and lines, brake and winch sites, access roads to switching stations and energy hubs, access tracks, energy hubs, switching stations, communications infrastructure, workforce accommodation camps, construction compounds and laydown and staging areas.
EnergyCo	The Energy Corporation of New South Wales constituted by section 7 of the Energy and Utilities Administration Act 1987 as the NSW Government-controlled statutory authority responsible for the delivery of NSW's REZs.
Instrument meteorological conditions (IMC)	Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions.
Manual of Standards (MOS)	The means CASA uses in meeting its responsibilities under the Act for promulgating aviation safety standards
National Airports Safeguarding Framework (NASF)	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.
operation area	The area that would be occupied by permanent components of the project and/or maintained, including transmission line easements, transmission lines and towers, energy hubs, switching stations, communications infrastructure, access roads to the switching stations and energy hubs, maintenance facilities, and permanent access tracks to the easements.
(the) proponent	EnergyCo
(the) project	The Central-West Orana REZ Transmission project as described in the Environmental Impact Statement.

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

EXECUTIVE SUMMARY

This technical paper has been prepared by Aviation Projects to assess the potential impacts to aviation safety from the construction and operation of the Central-West Orana Renewable Energy Zone Transmission project (the project) and has been prepared to support and inform the Environmental Impact Statement (EIS) for the project.

The impacts have been assessed in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment (DPE) and against the relevant legislation and guidelines as they apply to aviation.

1.1. Project Overview

The NSW Government is leading the development of Renewable Energy Zones (REZ) across NSW to deliver renewable energy generation and storage, supported by high voltage transmission infrastructure. Energy Corporation of NSW (EnergyCo) is proposing the construction and operation of new electricity transmission infrastructure and new energy hubs and switching stations required to connect new energy generation and storage projects within the Central-West Orana REZ to the existing electricity network (the project). The project is located within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter local government areas (LGAs) and extends generally north to south from Cassilis to Wollar and east to west from Cassilis to Goolma.

The project would enable 4.5 gigawatts of new network capacity to be unlocked by the mid-2020s (noting the NSW Government's proposal to amend the Central-West Orana REZ declaration to allow for a transfer capacity of six gigawatts),and enable renewable energy generators within the Central-West Orana REZ who are successful in their bids to access the new transmission infrastructure to export electricity to the rest of the network. Importantly, the development of renewable energy generation projects in the Central-West Orana REZ is the sole responsibility of private generators and subject to separate planning and environmental approvals.

1.2. Legislative and policy context

Impacts to aviation safety from construction and operation of the project have been assessed in accordance with the relevant legislation and guidelines as they apply to aviation. Regulations and standards administered by Civil Aviation Safety Authority, Airservices Australia and National Airports Safeguarding Advisory Group (NASAG) were considered.

1.3. Methodology

This aviation impact statement involved the following methodology:

1. Review the project and establish the appropriate compliance framework
2. Conduct a desktop study to assess constraints
3. Assess the likely impacts to aircraft landing areas (non-certified aerodromes) within three (3) nautical miles of the transmission line towers
4. Assess the likely impacts of infringements into air route protection surfaces

5. Assess likely impacts to aeronautical navigation aids and air traffic control surveillance systems from construction and/or operation of the project
6. Identify civil aviation safety requirements/standards that are relevant to this project with respect to existing aerodrome conditions and whether these standards are met, especially in relation to whether obstacle lighting or marking may or may not be required.

1.4. Aviation Impact Statement

Based on the current transmission line alignment, the heights of the transmission line infrastructure and associated temporary construction plant and equipment, it has been assessed that the project:

- would not infringe any certified airport Obstacle Limitation Surfaces (OLS) during construction and operation as a result of the location and height of the proposed transmission line towers and/or associated construction cranes
- would not have any structures that would penetrate any Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) surfaces during construction and/or operation
- is unlikely to impact upon take-off and landing operations at the aircraft landing areas (ALAs) assessed in close proximity to the transmission line
- would not have an impact on designated air routes
- would not have an impact on the grid lowest safe altitudes (LSALTs)
- is contained within Class G airspace
- the majority of the transmission line alignment is located within Special Use Airspace (SUA) associated with military flying operations from the Royal Australian Air Force (RAAF) Base Williamtown; however, the project is unlikely to have an adverse impact on the SUA due to the existing and similar transmission lines existing with this SUA
- is outside the clearance zones associated with aviation navigation aids, radar systems and communication facilities
- can be compatible with aerial application flight operations when the recommended risk management process is carried out by the pilot and landowner whose property has the transmission line overhead and immediately adjacent to the proposed transmission line project
- can be compatible with aerial baiting flight operations in helicopters conducted by the NSW Parks and Wildlife Service
- the use of helicopters or drones to sting the power lines or erect the towers would not create an adverse hazard to safe aircraft operations.

It is noted that the NSW Rural Fire Service assesses each fire operation on a complete set of conditions for each individual occasion.

1.5. Hazard lighting and marking

Lighting

Civil Aviation Safety Authority (CASA) considers that obstacles lower than 500 ft/152.4 m above ground level (AGL) do not infringe "*navigable airspace*" and therefore, over areas outside a built-up area, do not require obstacle lights to be fitted.

CASA has not required obstacle lighting for the existing terrain and transmission line that technically infringes the Runway 05 Approach Surface at Wagga Wagga airport which is consistent with the provisions of Section 9.27 of the Civil Aviation Safety Regulations (CASR) Part 139 Manual of Standards - Aerodromes (CASR Part 139 MOS).

Obstacle lighting across the length of existing transmission lines has not been required by CASA, as evidenced by the symbology on the aeronautical charts related to power transmission lines across Australia.

Based on this assessment, it is unlikely that obstacle lighting would be required for the transmission towers. However, this would be confirmed by CASA once it has conducted its own safety assessment.

Marking

Transmission line towers associated with high-voltage power transmission lines are large structures that are readily identified from the ground and from airborne aircraft. They are depicted on a variety of charts, including aeronautical charts of all scales.

There are some existing transmission lines in the Central-West Orana REZ which are not shown as lit on aeronautical charts.

The proposed transmission line towers, whilst being slightly higher than the existing line, will generally have the same characteristics as the existing transmission line and towers.

At 72 m AGL, the highest proposed transmission line towers (500 kV) do not infringe navigable airspace along the transmission line route and it is unlikely that marking would be required. This would be confirmed by CASA once it has conducted its own safety assessment.

Standards Australia, AS 3891.1:2021, *Air Navigation – Cables and their supporting structures – Marking and safety requirements: Part 1 Marking of Overhead Cables and Supporting Structures* specifies the requirements for aircraft warning markers on overhead cable and supporting structures.

As the certified airports are not located in the vicinity of the proposed transmission line, this report only considers the Standard in relation to the aircraft landing areas (non-certified aerodromes) stated later in this report.

The Standard states that:

> ***4.2.3 Aircraft marker design and performance considerations***
>
> *Markers should be positioned such that they indicate the general definition of the structure/cable. They should be recognizable in clear weather from a distance of at 1 000 m for an objects to be viewed from the air and 300 m when viewed from the ground in all directions in which an aircraft is likely to approach the object.*

5.3 Marker installation and marking in proximity to non-certified aerodromes

Cables and their supporting structures may also create significant aviation hazards when in the proximity of a noncertified aerodrome or other landing area. This may include areas of known risk to aviation.

Aircraft warning markers shall be placed on cables and/or supporting structures which penetrate

the transitional slope (20 %) or the approach and take-off slope (3.3 %) of any other landing area as depicted in Figure 5.3.

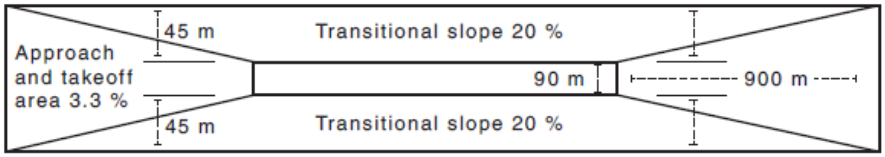

Figure 5.3 — Transitional slopes, approach and takeoff

The Standard references CASR Part 139 MOS for the specifications for the size, shape, colour and spacing of warning markers for attachment to cables for certified and non-certified aerodromes.

Summary of recommended mitigation and management measures

Recommended actions resulting from this assessment are provided below.

1. The final design of the transmission line tower coordinates and elevations should be provided to Airservices Australia. Note also that:
    a. Airservices Australia has been assigned the task of maintaining a database of tall structures, the top measurement of which is:
        i. 30 metres or more above ground level—within 30 kilometres of an aerodrome; or
        ii. 45 metres or more above ground level elsewhere.
    b. 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.
    c. The notification to Airservices Australia should be made as early as possible following the finalisation of the project's design. Aeronautical charts are updated twice per year. Further notification is to occur if the finalised design of the project alters the details supplied to Airservices Australia.
2. The final design for the transmission line tower coordinates and elevations should be provided to Department of Defence, using the following email address: land.planning@defence.gov.au. Further notification is to occur if the finalised design of the project alters the details supplied to the Department of Defence.
3. Following the finalised design of the project EnergyCo will provide relevant details of the proposed transmission line to the ALA owners at Dalkeith ALA, Tongy ALA and Merotherie ALA to enable them to consider the potential impact of the transmission towers and power lines on their operations.
4. To facilitate the flight planning of aerial application operators conducting flight operations on any property near to the proposed transmission line, details of the project, including location and height information of the finalised design of the transmission line and towers would be provided to landowners. This is so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.
5. To ensure NSW Parks and Wildlife Service is aware of the project and to assess the impact to their aerial baiting operations, they should be provided with full details of the project., including the transmission line tower coordinates and elevations

1. INTRODUCTION

1.1. Background

New South Wales (NSW) is currently undergoing an energy sector transformation that will change how we generate and use energy. The NSW Government is leading the development of Renewable Energy Zones (REZ) across NSW to deliver renewable energy generation and storage, supported by transmission infrastructure. A REZ connects renewable energy generation and energy storage systems to transmission infrastructure via energy hub, requiring the coordination of power generation, power storage and transmission infrastructure. By doing so, REZs capitalise on economies of scale to deliver clean, affordable and reliable electricity for homes, businesses and industry in NSW.

The Central-West Orana REZ was formally declared on 5 November 2021 under the *Electricity Infrastructure Investment Act 2020*. As NSW's first REZ, the Central-West Orana REZ will play a pivotal role in underpinning NSW's transition to a clean, affordable and reliable energy sector.

The Central-West Orana REZ declaration (November 2021) provides for an initial intended network capacity of three gigawatts. The NSW Government is proposing to amend the declaration to increase the intended network capacity to six gigawatts, which would allow for more renewable energy from solar, wind and storage projects to be distributed through the NSW transmission network.

The proposed amendment is consistent with the NSW Network Infrastructure Strategy (EnergyCo, 2023) which identifies options to increase network capacity to 4.5 gigawatts initially under Stage 1 (which would be based on the infrastructure proposed in this assessment) and up to six gigawatts by 2038 under Stage 2 (which would require additional infrastructure beyond the scope of this assessment, and subject to separate approval). The proposed amendment also supports recent modelling by the Consumer Trustee in the draft 2023 Infrastructure Investment Objectives Report (AEMO, 2023) showing more network capacity will be needed to meet NSW's future energy needs as coal-fired power stations progressively retire.

Energy Corporation of NSW (EnergyCo), a NSW Government statutory authority, has been appointed as the Infrastructure Planner under the *Electricity Infrastructure Investment Act 2020*, and is responsible for the development and delivery of the Central-West Orana REZ. EnergyCo is responsible for coordinating REZ transmission, generation, firming and storage projects to deliver efficient, timely and coordinated investment.

EnergyCo is seeking approval for the construction and operation of new electricity transmission infrastructure and new energy hubs and switching stations that are required to connect energy generation and storage projects within the Central-West Orana REZ to the existing electricity network (the project).

1.2. Purpose of this Paper

This technical paper has been prepared by Aviation Projects as part of the Environmental Impact Statement (EIS) for the project. The purpose of this technical paper is to identify and assess the potential impacts of the project in relation to aviation safety in the area surrounding the project.

This technical paper has been prepared to address the relevant Secretary's environmental assessment requirements (SEARs) issued by the Secretary of the NSW Department of Planning and Environment for the project on 7 October 2022 and the supplementary SEARS on 2 March 2023. The SEARs relevant to the assessment of aviation impacts are presented in Table 1.

Table 1 SEARS relevant to this paper (SSI-48323210)

Reference	*Assessment requirement*	*Location where it is addressed in this paper*
Hazards and Risks:	Aviation Safety - assess potential impacts, including:	This technical paper
	• Defined Air Traffic Routes	Section 5.12, Table 9
	• Aircraft Operating Heights	Sections 3.4, 3.5
	• Approach/ Departure Procedures	Section 3, 5.4
	• Radar interference	Section 5.15
	• Communication systems	Section 5.14
	• Navigation aids	Section 5.14
	• Use of Emergency helicopter access	Section 4.6
	• Aerial baiting and culling in the National Parks	Section 5.11
	• Safe and efficient aerial application of agricultural fertilisers and pesticides	Section 5.10
	• Identify aerodromes within 30 km of the transmission line and consider the impact to nearby aerodromes and aircraft landing areas	Section 5.8
	• Address impacts on obstacle limitation surfaces	Section 5.5

1.3. Project overview

The project comprises the construction and operation of new electricity transmission infrastructure, energy hubs and switching stations. The project would enable 4.5 gigawatts of new network capacity to be unlocked by the mid-2020s (noting the NSW Government's proposal to amend the Central-West Orana REZ declaration to allow for a transfer capacity of six gigawatts), and enable renewable energy generators within the Central-West Orana REZ who are successful in their bids to access the new transmission infrastructure to export electricity onto the NEM. A detailed description of the project, including a description of key project components, the construction methodology and how it would be operated is provided in Chapter 3 of the EIS.

1.3.1. Features

This project includes the following key features:

- a new 500kV switching station (the New Wollar Switching Station), located at Wollar to connect the project to the existing 500 kV transmission network
- around 90 kilometres of twin double circuit 500 kV transmission lines and associated infrastructure to connect two energy hubs to the existing NSW transmission network via the New Wollar Switching Station
- energy hubs at Merotherie and Elong Elong (including potential battery storage at the Merotherie Energy Hub) to connect renewable energy generation projects within the Central-West Orana REZ to the 500 kV network infrastructure
- around 150 kilometres of single circuit, double circuit and twin double circuit 330 kV transmission lines, supported on towers, to connect renewable energy generation projects within the Central-West Orana REZ to the two energy hubs
- thirteen switching stations along the 330 kV network infrastructure at Cassilis, Coolah, Leadville, Merotherie, Tallawang, Dunedoo, Cobbora and Goolma, to transfer the energy generated from the renewable energy generation projects within the Central-West Orana REZ onto the project's 330 kV network infrastructure
- underground fibre optic communication cables along the 330 kV and 500kV transmission lines between the energy hubs and switching stations
- a maintenance facility within the Merotherie Energy Hub to support the operational requirements of the project
- microwave repeater sites at locations along the alignment, as well as outside of the alignment at Botobolar to provide a communications link between the project and the existing electricity transmission and distribution network. The Botobolar site would be subject to assessment at the submissions report stage
- establishment of new, and upgrade of existing access tracks for transmission lines, energy hubs, switching stations and other ancillary works areas within the construction area, (such as temporary waterway crossings, laydown and staging areas, earthwork material sites with crushing, grinding and screening plants, concrete batching plants, brake/winch sites, site offices and workforce accommodation camps)
- utility adjustments required for the construction of the transmission network infrastructure, along with other adjustments to existing communications, water and wastewater utilities. This includes adjustments to Transgrid's 500kV transmission lines 5A3 (Bayswater to Mount Piper) and 5A5 (Wollar to Mount Piper) to provide a connection to the existing NSW transmission network, including new transmission line towers along the Transgrid network along the frontage of the New Wollar Switching Station, and other locations where there is an interface with Transgrid's network.

1.3.2. Location

The project is located in central-west NSW within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter Local Government Areas (LGAs). It extends north to south from Cassilis to Wollar and east to west from Cassilis to Goolma. The location of the project is shown in Figure 1.

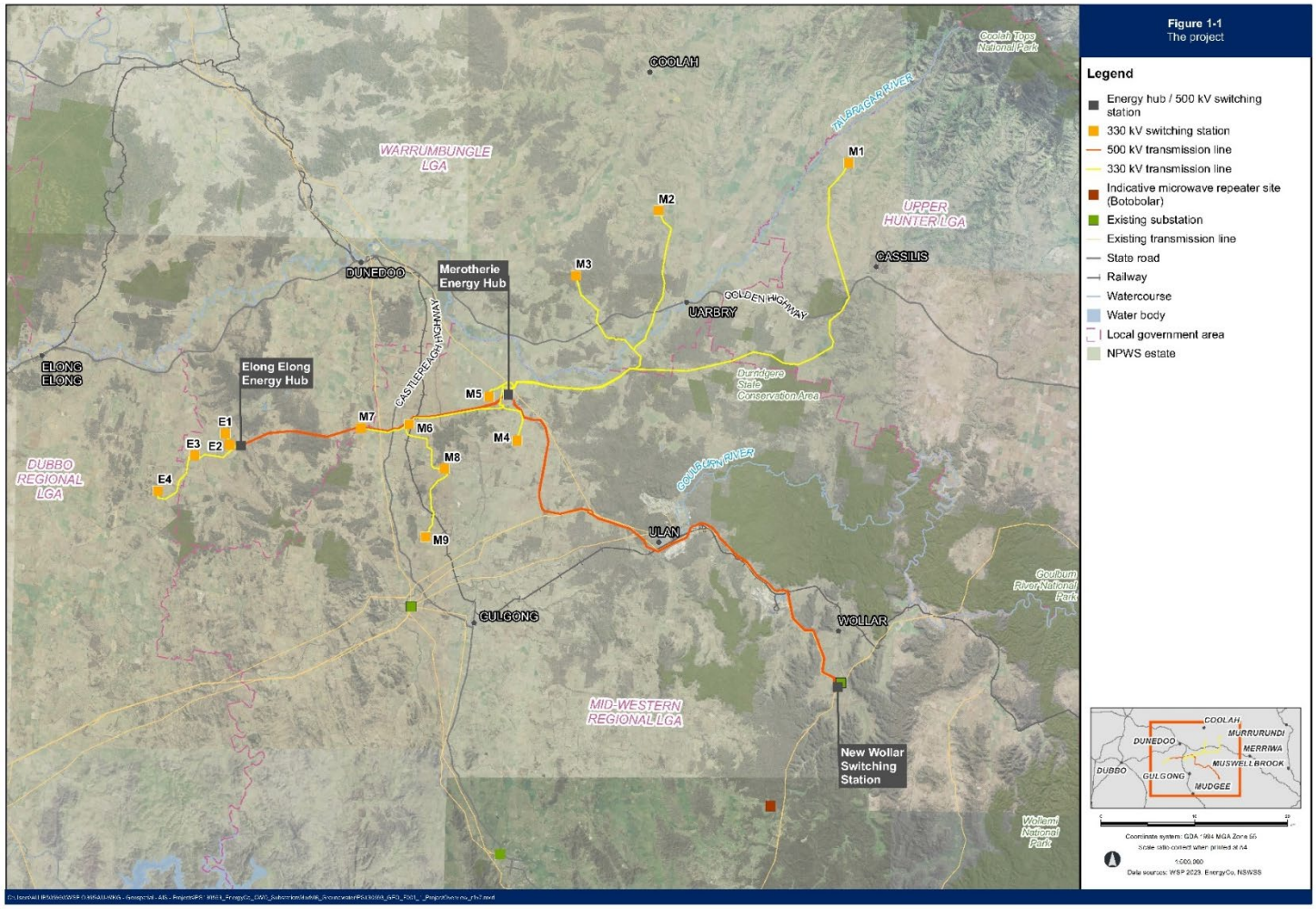

Figure 1 The Project

1.3.3. Timing

Construction of the project would commence in late 2024, subject to NSW Government and Commonwealth planning approvals, and is estimated to take about four years. The project is expected to be commissioned/energised (i.e., become operational) in late 2027.

1.3.4. Construction

Key construction activities for the project would occur in the following stages:

- enabling works
- construction works associated with the transmission lines
- construction works associated with energy hubs and switching stations
- pre-commissioning and commissioning of the project
- demobilisation and rehabilitation of areas disturbed by construction activities.

Excavation and land forming works within the construction area would be required for transmission line tower construction, site preparation works at the energy hubs and switching station sites to provide level surfaces, to create trenches for drainage, earthing, communications infrastructure, and electrical conduits, and to construct and upgrade access tracks.

Construction vehicle movements would comprise heavy and light vehicles transporting equipment and plant, construction materials, spoil and waste from construction facilities and workforce accommodation camp sites. There would also be additional vehicle movements associated with construction workers travelling to and from construction areas and accommodation camp sites. These movements would occur daily for the duration of construction.

To support the construction of the project a number of construction compounds would be required including staging and laydown facilities, concrete batching plants, workforce accommodation camps and construction support facilities. The main construction compounds would be established as enabling work and demobilised at the completion of construction. The size of the construction workforce would vary depending on the stage of construction and associated activities. During the peak construction period, an estimated workforce of up to around 1800 people would be required.

1.3.5. Operation

During operation, the project would transfer high voltage electricity from the Central West-Orana REZ to the NEM. Permanent project infrastructure would be inspected by field staff and contractors on a regular basis, with other operational activities occurring in the event of an emergency (as required). Regular inspection and maintenance activities are expected to include:

- regular inspection (ground and aerial) and maintenance of electrical equipment and easements
- Fault and emergency response (unplanned maintenance)
- general building, asset protection zone and landscaping maintenance
- fire detection system inspection and maintenance

- stormwater maintenance
- remote asset condition monitoring
- network infrastructure performance monitoring

The operation of the project would require the establishment of transmission line easements. These easements would be around 60 metres for each 330kV transmission line and 70 metres for each 500kV transmission lines. Where network infrastructure is collocated, easement widths would increase accordingly (for example, a twin double circuit 500kV transmission line would have an easement about 140 metres wide). Vegetation clearing would be required to some extent for the full width of the transmission line easement, depending on the types of vegetation present.

2. METHODOLOGY

This aviation impact statement has been prepared in accordance with the following methodology:

1. Review the project and establish the appropriate compliance framework
2. Conduct a desktop study to:
    a. Identify the OLS and PANS-OPS surfaces relevant to the project
    b. determine if any infringements to the OLS and/or PANS-OPS occur during construction and/or operation of the project
    c. If infringements occur, assess the likely impacts to the OLS and/or PANS-OPS surfaces
3. Assess the likely impacts to aircraft landing areas (non-certified aerodromes) within 3 nm of the transmission line towers
4. Assess the likely impacts of infringements into air route protection surfaces
5. Assess likely impacts to aeronautical navigation aids and air traffic control surveillance systems from construction and/or operation of the project
6. Identify civil aviation safety requirements/standards that are relevant to this project with respect to existing aerodrome conditions and whether these standards are met, especially in relation to whether obstacle lighting or marking may or may not be required.

3. LEGISLATIVE AND POLICY CONTENT

This chapter provides a summary of the legislative and policy context for the aviation impact assessment.

3.1. Civil Aviation Safety Authority

The Civil Aviation Safety Authority (CASA) is the government body responsible for civil aviation safety, that administers various Commonwealth Acts of Parliament and Regulations related to aviation safety in Australia.

References to each is included at appropriate sections within this report and included in Annexure 1.

CASA's main role is related to the safety of the public during air transport flight operations and at/and in the vicinity of certified aerodromes. In other areas they can provide advice to planning authorities in respect as to whether a tall structure may cause a hazard to aviation activities.

Notwithstanding the above, it is noted that *"CASA has no authority or powers in relation to a wind farm or tall structure approval outside the vicinity of a certified aerodrome but advice from CASA will inform the planning authority in regard to any decisions or conditions on any approval the planning authority might place on a development."* [1]

3.2. Airservices Australia

Airservices Australia provide air traffic control services in Australia along with Aeronautical Information Publication (AIP), including instrument flight procedures and aeronautical charting. They also maintain the aeronautical database containing aeronautical data and obstacle data.

3.3. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by the former Commonwealth Department of Infrastructure and Transport, (now Department of Infrastructure, Transport, Regional Development, Communications, and the Arts), to develop a national land use planning framework called the National Airports Safeguarding Framework (NASF). The purpose of this framework 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.

[1] CASA Advisory Circular 139.E05v1.0 - May 2021

NASF Guideline F: *Managing the Risk of Intrusions into the Protected Operations Airspace of Airports*, provides guidance to State/Territory and local government decision makers as well as airport operators to jointly address the issue of intrusions into the operational airspace of airports by tall structures, such as buildings and cranes, as well as trees in the vicinity of airports.

The aviation impact statement (AIS) will have regard to all potential aviation activities within the vicinity of the project including recreation, commercial, civil (including for agricultural purposes) and military operations.

The AIS for the project, as included in this report identifies high level risks, risk mitigation measures and development constraints that are likely to be applicable to the electricity transmission infrastructure project.

3.4. Aircraft operations at certified and non-certified non-controlled aerodromes

There are several non-controlled aerodromes[2] in the region of the project. Some are certified and some are non-certified. An old term, aircraft landing area (ALA) can refer to a non-certified aerodrome.

A certified aerodrome is an aerodrome certified by CASA under Part 139 of the Civil Aviation Safety Regulation 1998. These aerodromes must be certified in order for the air transport operations to be conducted to an appropriate standard of aerodrome.

Advisory Circulars (ACs) provide advice and guidance from CASA to illustrate a means, but not necessarily the only means, of complying with the Civil Aviation Safety Regulation 1998, or to explain the regulatory requirements at non-controlled aerodromes (both certified and non-certified).

For aircraft that are arriving at certified airports with instrument approach procedures, in poor weather conditions where the pilot cannot necessarily maintain visual contact with the ground or water, the PANS-OPS surfaces protect them from obstacles and terrain that they cannot necessarily see to avoid, by specifying a vertical margin between the terrain or obstacle. Aircraft conducting an instrument are permitted to operate below the PANS-OPS in conditions where the cloud and visibility enable visual operations.

For aircraft that are arriving in good weather conditions, i.e. where the cloud and visibility enable visual operations, and not conducting an instrument approach procedure, the pilots must comply with the visual flight rules and conduct a conventional circuit pattern.

A conventional circuit pattern and heights are provided in AC 91-10 v1.1 *Operations in the vicinity of non-controlled aerodromes*, effective November 2021. The standard circuit consists of a series of flight paths known as legs when departing, on arrival or when conducting circuit practice. Illustrations of the standard aerodrome traffic circuit procedures are provided in Figure 2 and Figure 3.

[2] International Civil Aviation Organisation (ICAO) and CASA definition of Aerodrome is generic to all types of areas that are suitable for the arrival, departure and surface movement of aircraft. In Australia those aerodromes that are not certified are called non-certified aerodromes and can include an ALA that is just a mown paddock on private or council property, or it can be equipped with a fully sealed runway(s).

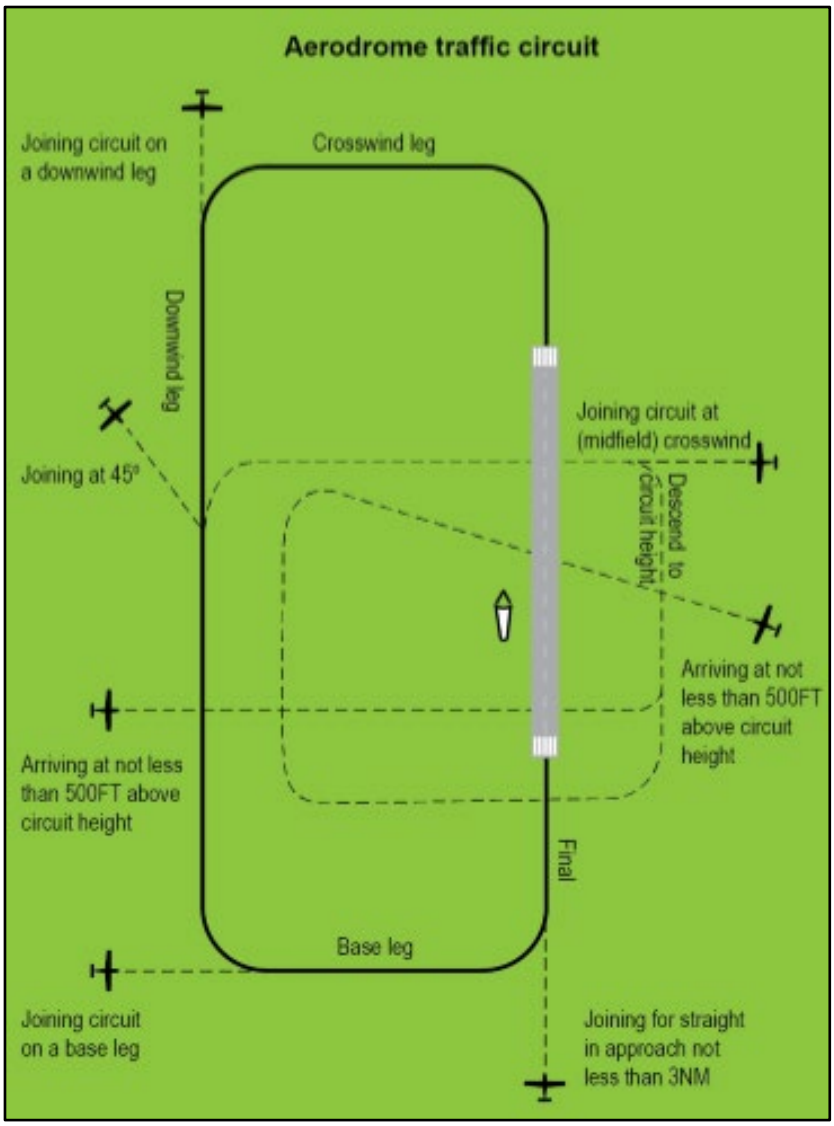

Figure 2 Aerodrome standard traffic circuit, showing arrival and joining procedures

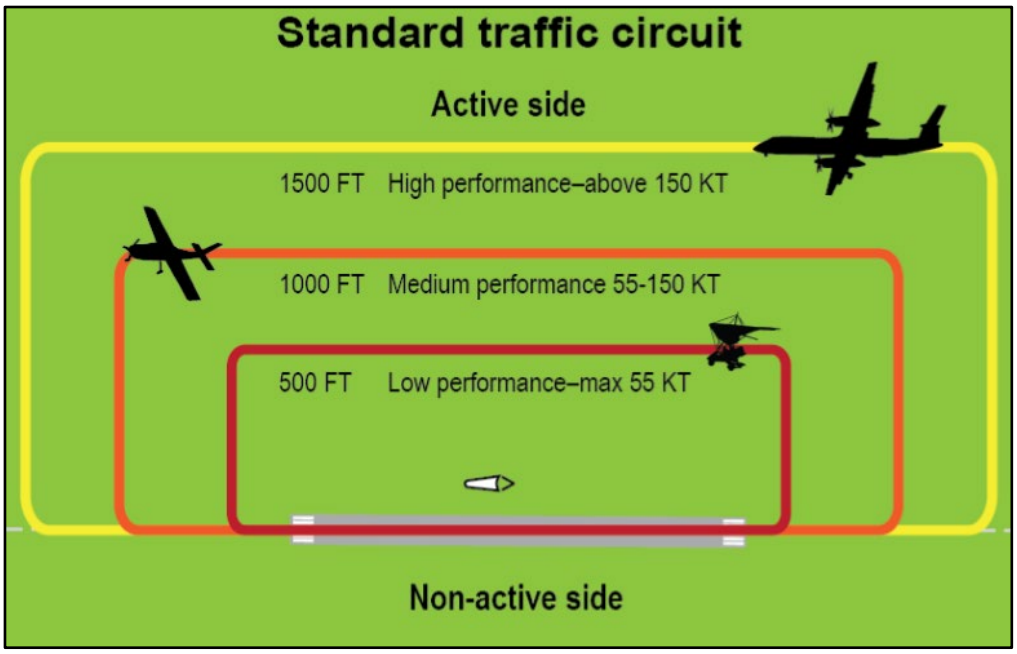

Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

Advisory Circular (AC) 91-10 v1.1. paragraph 7.10 makes reference to a distance that is "normally" well outside the circuit area and where no traffic conflict exists, which is at least three nautical miles (5,556 metres). The paragraph is copied below:

> *7.10 Departing the circuit area*
>
> *7.10.1 Aircraft should depart the aerodrome circuit area by extending one of the standard circuit legs or climbing to depart overhead. However, the aircraft should not execute a turn to fly against the circuit direction unless the aircraft is well outside the circuit area and no traffic conflict exists. This will normally be at least 3 NM from the departure end of the runway but may be less for aircraft with high climb performance. In all cases, the distance should be based on the pilot's awareness of traffic and the ability of the aircraft to climb above and clear of the circuit area.*

3.5. Rules of flight

3.5.1. Flight under Day Visual Flight Rules (VFR)

According to the AIP, the meteorological conditions required for visual flight in (Class G) airspace at or below 3000 feet AMSL or 1000 feet AGL whichever is the higher are: flight visibility at least 5000 metres, clear of clouds and in sight of ground or water for fixed wing aircraft.

For helicopters operating below 700 feet over land by day:

- the flight visibility must be at least 800 metres
- They must remain clear of clouds
- They must fly at a speed that allows the pilot to see obstructions or other traffic in sufficient time to avoid a collision
- At all other times helicopters must operate in accordance with the Visual Flight Rules.

Civil Aviation Safety Regulation (1998) 91.267 (Minimum height rules—other areas) prescribes the minimum height for fixed wing aircraft and helicopter flight. Generally speaking, and unless otherwise approved, aircraft are restricted to the following:

- When not in the vicinity of built up areas, a minimum height of 500 feet AGL above the highest point of the terrain and any object on it within a radius of 300 metres in visual flight during the day
- in built-up areas, a minimum height of 1000 feet AGL over built up areas (within a horizontal radius of 300 metres of the point on the ground or water immediately below the aeroplane or helicopter).

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

Flight below these height restrictions is also permitted in certain other circumstances, such as aerial application, and other authorised low level flight operations.

3.5.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Safety Regulations (1998) 91.267 requires that the pilot in command of an aircraft (including helicopters) flying VFR at night must not fly below the following heights (unless during take-off and landing operations, within three nautical miles of an aerodrome, or with an air traffic control clearance):

- the published lowest safe altitude for the route or route segment (if any)
- the minimum sector altitude published in the authorised aeronautical information for the flight (if any)
- the lowest safe altitude for the route or route segment
- 1,000 feet above the highest obstacle on the ground or water within 10 nautical miles ahead of, and to either side of, the aircraft at that point on the route or route segment
- the lowest altitude for the route or route segment calculated in accordance with a method prescribed by the Part 91 Manual of Standards for the purposes of this paragraph.

Instrument Flight Rules (Day or night) (IFR)

According to CASR Part 91, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method. Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

4. OPERATIONAL CONTEXT

4.1. Aircraft operator characteristics

Flying training may be conducted as IFR or VFR. Other general aviation operations under either IFR or VFR are also likely to be conducted at various uncontrolled aerodromes in the area (given there are no controlled aerodromes present in the area). Recreational aircraft flight operations are conducted in Visual Meteorological Conditions (VMC) by day only.

CASR Part 91 Manual of Standards (MOS) defines the meteorological conditions expressed in terms of flight visibility and distance from cloud.

The relevant sections of CASR Part 91 MOS, Table 2.07 (3) VMC criteria is shown in Table 2.

Table 2 Relevant VMC Criteria

Item	Type of aircraft	Class of airspace	Height	Flight visibility	Distance from cloud	Operational requirements
4	Aircraft	G	At or below whichever is the higher of: (a) 3 000 ft AMSL; (b) 1 000 ft AGL	5 000 m	Clear of cloud	Aircraft must be operated in sight of ground or water
5	Rotorcraft (including helicopters)	G	Below 700 ft over land. Below 700 ft over water *with* track guidance from a navigation system	800 m	Clear of cloud	Operations must comply with conditions stated in subsection 2.07 (4)

The transmission line towers would be shown on aeronautical charts to allow pilots to consider their impact, among many other things depicted on the aeronautical charts, upon their flight operations in the area, especially around the transmission line infrastructure. The transmission lines are less visible than the transmission line towers, but pilots can usually see more than one tower and determine where the lines are. The transmission line will be depicted on aeronautical charts to assist pilots to determine the direction of them in relation to their flight path. It is also expected that the transmission line towers would be sufficiently visible to pilots conducting VFR operations within the vicinity of the project to enable them to avoid them and the transmission lines by the appropriate margin according to the type of flight being conducted. Briefings and detailed risk management action by aerial application pilots enable them to be aware of a potential hazard and plan their flight accordingly.

IFR and Night VFR (which are required to conform to IFR applicable altitude requirements) aircraft operations are addressed in Section 5.

The inclusion of the transmission line alignment on aeronautical charts, via the Airservices Australia's Aeronautical Database, provides pilots with visual information about the transmission lines presence in the area of their intended flight operation. Figure 4 (Source: Airservices Australia) shows such presentations on an aeronautical chart used by aircraft flying in Class G airspace.

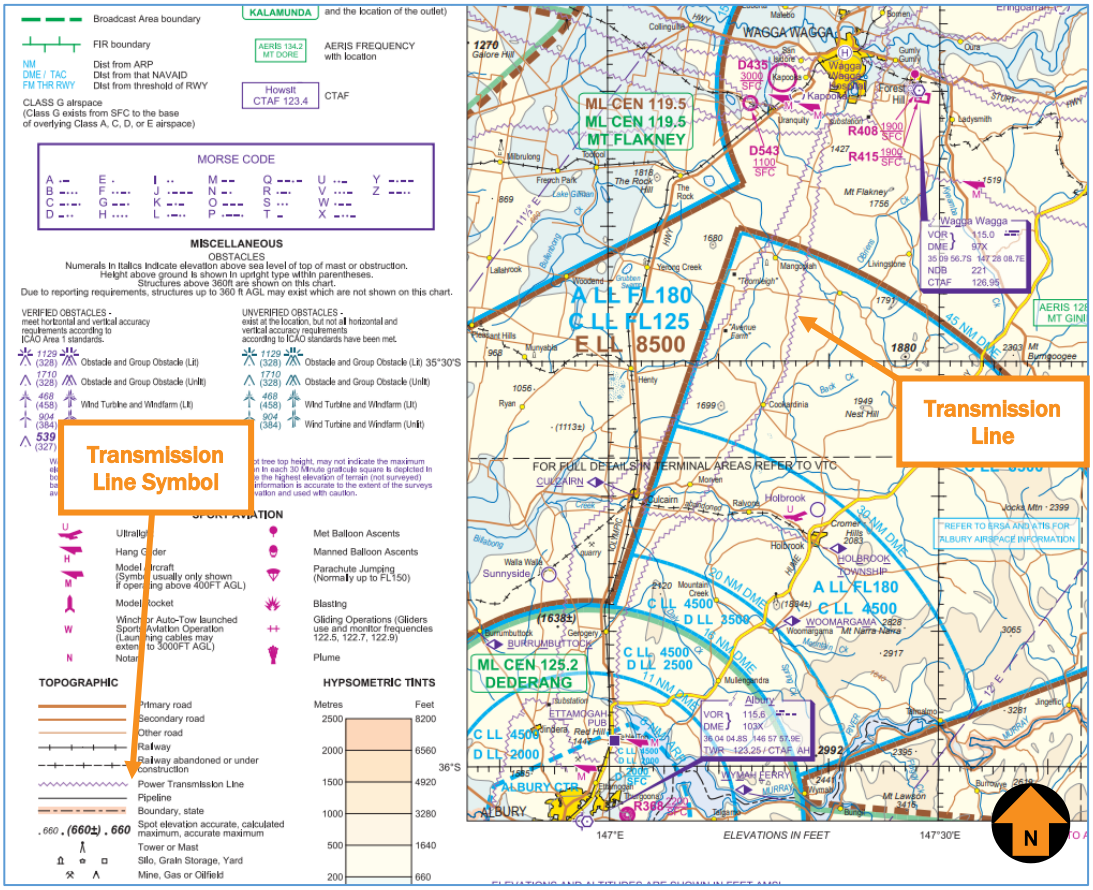

Figure 4 Visual Navigation Chart – Sydney, with Power Transmission Line nomenclature.

4.2. Air transport operations

Scheduled and non-scheduled air transport operations are generally operated throughout the airspace area within and surrounding both the project and existing transmission line routes.

Scheduled air transport services regularly operate into the certified airports at Dubbo and Mudgee from Canberra, Melbourne and Sydney.

4.3. Private aircraft operations

Private aircraft operations are regularly conducted throughout the area surrounding the proposed project and existing transmission line route. They are generally conducted under day or night VFR, and IFR.

4.4. Military operations

There will be some high-speed low-level military jet aircraft and helicopter operations conducted in the area.

The nearest RAAF aerodrome is located at Williamtown, approximately 180 kilometres southeast of the project.

RAAF aircraft based at RAAF Base Williamtown, and other RAAF aerodromes regularly use the airspace surrounding the project. This airspace is shown in Table 10.

Detailed planning of these flights will include a review of obstacles along the planned route.

Existing obstacles such as electricity infrastructure transmission lines of a similar height to the project are shown on aeronautical charts.

4.5. Aerial application operations

Aerial application operations including such activities as fertiliser, pest and crop spraying are generally conducted under day VFR below 500 feet AGL, usually between 6.5 feet (2 metres) and 100 feet (30.5 metres) AGL.

Aerial application operations are conducted in the area surround the project.

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.

The Aerial Application Association of Australia (AAAA) has a formal risk management program which is recommended for use by its members prior to each aerial application flight operation, including a detailed briefing from the relevant landowner regarding obstacles, trees, buildings etc.

The inclusion of the transmission line on aeronautical charts would enable the pilots conducting an aerial application flight operation to be aware of the presence of the transmission line so that they consider its impact during the planning of their low-level flights. When combined with the briefing carried out with the land holder prior to any such flights, and the AAAA formal risk management program, the pilot will have the best possible knowledge about the obstacle environment around the intended flight(s). These briefings will be no different to those conducted today in areas where there are large transmission lines above or near to areas where these low-level flight operations are conducted.

4.5.1. Aerial Application Association of Australia

The Aerial Application Association of Australia (AAAA) has initiated a Powerline Safety Program and identified that *"powerlines have been a significant safety issue since the electrification of rural areas and wirestrikes have been a major threat to aerial application since the late 1940s when the industry began in Australia.*

> *While training and ongoing professional development play a significant role in preparing pilots to manage the risks associated with low level operations around powerlines, there are two key initiatives that can support and improve safety for the sector:*

- *The provision of mapping information on powerline networks*
- *The marking of powerlines*

Over recent years, AAAA has worked to reshape the Australian Standard on the marking of powerlines (AS 3891 Parts 1 & 2), has developed and delivered world-leading human factor training courses, and has worked with powerline companies to develop mapping and marking systems and make them available to pilots and business owners.

AAAA has now launched its Powerline Safety Program that aims to encourage and facilitate power companies improving aviation safety, and provide a way of both aviation businesses and rural landholders engaging in meaningful safety actions to improve safety.

Wirestrikes account for approximately 57% of all aerial application accidents/incidents. While this is only a fraction of the total safety problem surrounding contact between all vehicles and farm implements with power infrastructure, it is a significant cost to the industry and a personal impact on pilots involved in wirestrikes.

AAAA acknowledges that not all aerial application companies will be able to participate in the program due to the following practical restrictions that are not under the control of the company or AAAA:

- *Availability of energy network mapping that is region specific, clean data that is easily uploadable, useable and updateable. Availability is entirely dependent on energy companies providing the mapping in the same or similar way as Essential Energy already does*
- *Availability of an energy company marking request and action system similar to Essential Energy's system. There are a range of contributing elements including the Australian Standard rewrite, availability of good markers, and a reasonable price for fitting and installation.*

Those States/Territories and energy companies that are unable to deliver the two requirements above will not be able to participate in the program, but AAAA will seek to work with them to achieve these relatively straight forward requirements.

Currently, Essential Energy in NSW is fully compliant, Ergon Energy in Queensland is working on achieving these systems and has advised it already has a marking system in place, but further work is required on simplifying access and the provision of mapping."[3]

The provision of the project's final design to Airservices Australia and the Department of Defence would ensure that they are marked on aeronautical charts, enabling pilots to be aware of them and to be compliant with a key AAAA initiative. Similarly, the provision of the data to Department of Defence will ensure that their low-level charts include them and that the military pilots are aware of them when planning and conducting low level flight operations.

The provision of the project's final design to Airservices Australia and the Department of Defence will result in the transmission line being shown on aeronautical charts. This will ensure that AAAA's initiatives are achieved.

Considering the Australian Standards AS 3891 Parts 1 & 2 during design and construction of the project would ensure the initiative of marking powerlines is also achieved. Emergency services - Royal Flying Doctor Service/Air Ambulance/NSW Rural Fire Service

[3] AAAA Powerline Safety Program www.aaaa.org/aaaa-powerliine-safety-program/

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 procedures.

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.

If a helicopter emergency medical service is required at a location other than an aerodrome, ALA or helicopter landing site, the pilot will engage with local emergency services personnel and/or landowners to discover what local hazards are in the vicinity of the proposed landing site and take appropriate mitigation action.

The NSW Rural Fire Service has provided advice for previous tall structure projects that it will make an individual assessment for the use of aerial assets based on the overall situation at the fire site.

4.6. Nearby aircraft landing areas – non-certified aerodromes

As a guide, an area of interest within a three nautical miles radius of an aircraft landing area (ALA) is used to assess potential impacts of proposed developments on aircraft conducting taking off and landing operations at or within the vicinity of the ALA. The three nautical miles area of interest generally contains the area in which aircraft manoeuvre after takeoff while climbing to intercept their outbound track until above a height of approximately 1000 feet or 1500 feet AGL, or maneuvering to align themselves with the landing runway, in accordance with CASA guidance for operations at such aerodromes and descending below 1000 feet or 1500 feet AGL.

The aeronautical data provided by OzRunways is approved under CASR Part 175.

For the purposes of the flight circuit analysis, the following design parameters have been adopted for the types of aircraft likely to operate at these type of aerodromes:

- Left hand circuit direction unless otherwise published in AIP
- 1 nautical mile upwind to achieve at least 500 feet AGL
- 1 nautical mile abeam the runway for downwind spacing
- 45 degrees relative position from the threshold for the turn from downwind onto the base leg; and
- Roll out at 1 nautical mile final, not below 500 feet above ground level.

Aerial application operators will most likely conduct smaller circuits than this nominal arrangement for commercial reasons and pilot experience.

5. AVIATION IMPACT STATEMENT

This AIS considers the following aspects of publicly available information from the AIP effective 1 December 2022, searches using National Maps GIS system (www.nationalmap.gov.au), OzRunways aeronautical program and Google Earth as of 14 April 2023.

5.1. Certified aerodromes within 30 nautical miles of the transmission line

Table 3 details the certified aerodromes that were identified within 30 nautical miles (55.56 kilometres) of the transmission line.

Table 3 Certified Aerodromes within 30 nautical miles

Certified Aerodrome Name	*Distance from transmission line (km)*	*OLS overhead the transmission line*	*PANS-OPS Surface overhead the transmission line*
Dubbo	56.2	No	No
Mudgee	17	No	**Yes**

Note: An assessment of the PANS-OPS procedures for Dubbo are included for reference only.

5.2. Instrument approach and departure procedure assessments

The specifications for the Instrument approach and departure procedures (IAP) are prescribed in International Civil Aviation Organisation (ICAO) *Document 8168 – Procedures for Navigation, Operations* (PANS-OPS) and within CASR Part 173 Manual of Standards (MOS) for Australian specific criteria.

The certified aerodromes at Dubbo and Mudgee have been provided with instrument approach procedures (IAPs) that guide suitably equipped aircraft to the runway at the aerodrome in weather conditions that preclude the pilot maintaining visual contact with ground or water until close to the runway where visual contact may be made with the landing environment. They provide a prescribed minimum obstacle clearance (MOC) above terrain and obstacles within a lateral tolerance either side of the IAP's flight path.

The assessments and results for the PANS-OPS surfaces for each aerodrome are detailed in the following Table 4 and Table 5.

Transmission line tower height and location data within the lateral area of each instrument approach procedure was assessed to determine whether the towers and construction cranes infringed any PANS-OPS surfaces.

5.3. Dubbo Airport

Dubbo Airport is located approximately 56.2 km (30.34 nautical miles) from the proposed transmission line. It is a non- controlled aerodrome located in Class G airspace (uncontrolled airspace).

A 72 metre AGL 500 kilovolt transmission line tower that is closest to Dubbo Airport would have a maximum elevation of approximately 572 m (1876.6 ft) AHD. The tallest transmission line tower height was assessed against the Dubbo Airport PAN-OPS (see Table 4 and Figure 5).

Table 4 Dubbo Airport PANS-OPS assessment

IAP Title	*Lowest PANS-OPS Surface Elevation (m AHD)*	*Result*
25 nm minimum sector altitude (MSA)	823	No Infringement
10 nm MSA	N/A	No Infringement
DME-GNSS Arrival	823	No Infringement
RNAV-Z (GNSS) RWY 05	Outside lateral protection area	No Infringement
RNAV-Z (GNSS) RWY 23	Outside lateral protection area	No Infringement
RNAV-Z (GNSS) RWY 22 Holding at DBOEB Waypoint	823	No Infringement
NDB-A	Outside lateral protection area	No Infringement
Circling Procedure (CAT D)	Outside lateral protection area (9.79 km)	No Infringement

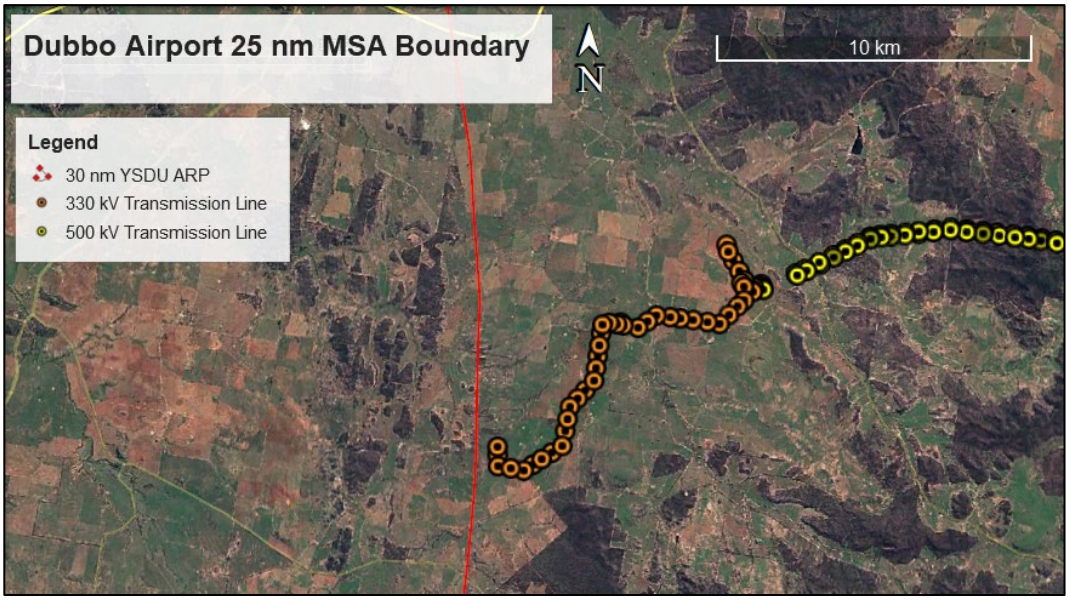

Figure 5 Dubbo Airport PANS-OPS assessment

5.3.1. Dubbo Airport PANS-OPS Summary

The proposed transmission line towers and cranes, which are approximately 15 metres above the transmission line tower, to be used during construction are located laterally outside the PANS-OPS surfaces at Dubbo Airport.

The proposed transmission line towers or cranes would not have an impact upon flight operations at Dubbo Airport.

No further action is required.

5.4. Mudgee Airport

Mudgee Airport is located approximately 31.5 kilometres (17 nautical miles) from the proposed transmission line. It is a non-controlled aerodrome located in Class G airspace (uncontrolled airspace).

The majority of the transmission towers located south of the Golden Highway are located within the 25 nautical mile MSA segment of all instrument approach procedures at Mudgee (refer to Table 5 and Figure 6).

The highest transmission tower (#509) would have a maximum elevation of approximately 579 m AHD.

Table 5 Mudgee Airport PANS-OPS Assessment

IAP Title	*Lowest PANS-OPS Surface Elevation (m AHD)*	*Result*
25 nm MSA	944	No Infringement
10 nm MSA	Outside lateral protection area (15 nm)	No Infringement
GNSS Arrival Procedures	1158	No Infringement
NDB RWY 22	975.3	No Infringement
RNP RWY 04 (missed approach)	>1200	No Infringement
RNP RWY 22	944	No Infringement
Holding at MD2EB Waypoint	944	No Infringement
Circling Procedure (CAT C)	Outside lateral protection area (4.2 nm)	No Infringement

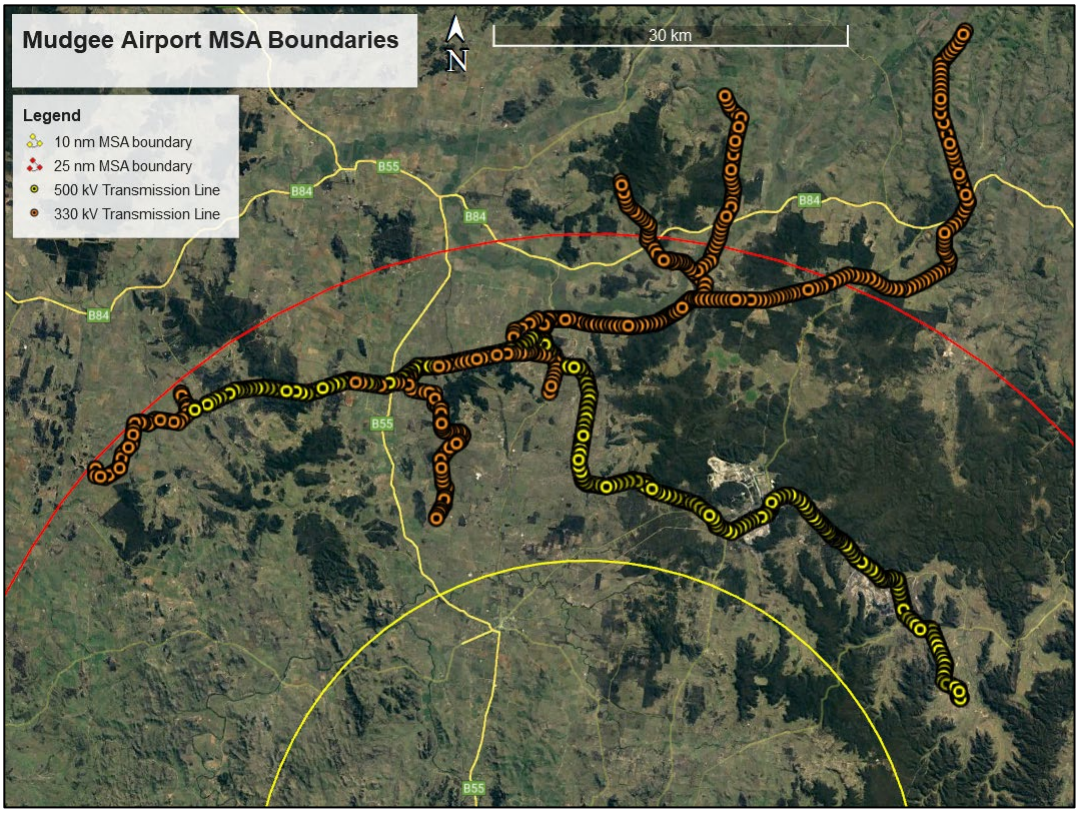

Figure 6 Mudgee Airport Minimum Safe Altitudes

5.4.1. Mudgee PANS-OPS Summary

The proposed transmission line towers and cranes, which are approximately 15 metres above the transmission towers, to be used during construction would not infringe on the PANS-OPS surfaces at Mudgee Airport.

The proposed transmission line towers and/or use of cranes during construction would not have an impact upon flight operations at Mudgee Airport.

No further action is required.

5.5. Obstacle limitation surfaces (OLS)

The extent of OLS at certified aerodromes is dependent upon the Code number allocated to the relevant runway, which is determined by the type of operations (VFR or IFR) using the runway and the length of the runway.

CASR Part 139 MOS details the specifications for these OLS. Table 6 details the dimensions and the assessment result for the OLS at Dubbo Airport and Mudgee Airport.

Table 6 OLS Assessment

Airport/Aerodrome	*Largest relevant OLS dimension (m)*	*Assessment relevant to project transmission line*
Dubbo	15 km radius from runway ends	Beyond OLS limit. No Infringement
Mudgee	15 km radius from runway ends	Beyond OLS limit. No Infringement

The project would not infringe the obstacle limitation surfaces associated with the certified airports at Dubbo and Mudgee.

No further action is required.

5.6. Use of helicopter during power line stringing

Helicopters may be used for stringing of the transmission lines between the transmission line towers.

The helicopter operations are considered to be a normal aviation activity and subject to the Civil Aviation Rules applicable to the type of operation.

No special consideration is required in this report.

5.7. Use of remotely piloted aircraft systems (RPAS) during power line stringing

CASR Part 101 prescribes the rules related to the operation of RPAS (including drones) and details:

- Size of the vehicle
- Authorised operator requirements for commercial operations
- Permissions required for operations near aerodromes (within 3 nm)
- Area of RPAS operation in certain regular circumstances.

The operator of an RPAS would need to hold “a civil aviation authorisation” under CASR Part 101 to conduct “a commercial operation” in order to conduct “power line stringing”.

The operator would then need to comply with the other requirements of CASR Part 101, to a similar extent that pilots of aircraft must comply with CASRs related to the operation of their aircraft.

The use of RPAS (drones) for the stringing of powerlines is feasible and would not create an adverse impact to flight safety in the area of the stringing operation.

5.8. Aircraft landing areas within three nautical miles

A search on OzRunways, which sources its data from AIP, and nationalmap.gov.au discovered three ALAs within the three nautical miles area of interest. The ALAs outside of the three nautical miles area of interest were assessed and considered to not be impacted by the project.

The aeronautical data provided by OzRunways is approved under CASR Part 175.

The ALAs within three nautical miles of the transmission lines are listed in Table 7.

Table 7 ALAs within three nautical miles of the transmission line.

ALA Name	*Location*	*Distance from project transmission line*
Dalkeith	1.3 km northwest of Cassilis	2.2 km
Merotherie	2.3 km south of the Golden Highway along Merotherie Road	2.1 km
Tongy	6.5 km north of Golden Highway along Tongy Rd	4.4 km

5.8.1. Dalkeith ALA

Dalkeith ALA is operated by Dalkeith Hereford Grazing. It has a dirt runway oriented east/west (080/260 degrees) which is reported as 1,100 metres long.

Visitors are required to contact the owner prior to flying to the ALA. The owner will provide pilots with details about the ALA and surrounding terrain and obstacle.

The elevation of the ALA is reported by Ozrunways to be 457.2 metres /1500 feet AHD.

Aircraft taking off from Runway 06 are required to reach 500 ft above the ALA prior to turning in any direction. Such a climb could take approximately 1 nautical mile (1852 metres).

The nearest 330 kV transmission line towers (#398 and #400) are located approximately 2,100 metres west of the ALA on the extended runway centreline. The ground elevation is approximately 464 m and 488 m AHD respectively (Google Earth) and with a 63 m transmission line tower the maximum elevation of the transmission lines towers would be 527 m (1788 feet) AHD and 551 m (1837 feet) AHD respectively.

At 500 ft above the ALA the aircraft would be at a height of approximately 2000 ft/610 m AHD and therefore above the proposed transmission line. As the aircraft would be considered to be conducting a take-off, they do not need to clear the obstacle by 500 feet.

Aerial application aircraft can turn at a lower altitude and therefore avoid the transmission line.

Aircraft landing to the east on Runway 08 would need to identify and consider the transmission line towers as they commence descent to the runway.

Prior to construction, consultation with the owner of Dalkeith ALA would be required to provide details of the project, including location and height information of the finalised design of the transmission line and towers to provide an understanding of potential hazards for aircraft using its facility.

Dalkeith ALA is located more than 900 m from the nearest transmission line tower structure and outside the Transitional Surface shown in the Standard's Figure 5.3. Therefore, the cables and therefore the structures and cables do not require marking under AS 3891. 1:2021.

Figure 7 shows the location of the Dalkeith ALA in relation to the proposed transmission line.

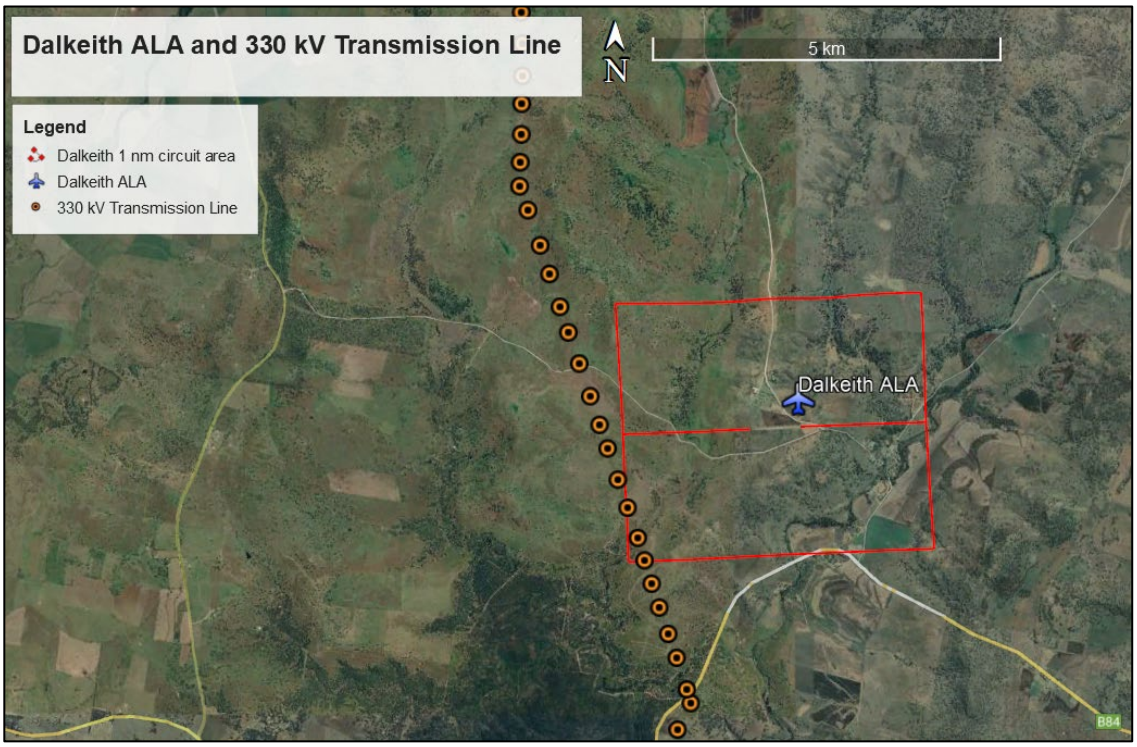

Figure 7 Dalkeith ALA and transmission line

Dalkeith ALA Summary

The transmission line and towers would be in such proximity to the Dalkeith ALA that pilots must consider its presence when operating there.

At the indicated heights the project is unlikely to cause an adverse hazard to aviation activity.

The transmission line structures, and cables do not require marking under AS 3891. 1:2021.

Aircraft operating at Dalkeith ALA must be provided with information about the transmission line by the aerodrome owner and they would be expected to remain above the proposed transmission line during normal take-off and landing operations when in proximity to the proposed transmission line and towers.

Consultation with the operator must occur prior to the commencement of construction.

5.8.2. Merotherie ALA

An ALA was identified on nationalmap.gov.au , approximately 2.2 kilometres south of the Golden Highway along Merotherie Road and approximately 2.2 kilometres north of the transmission line.

Searches of aeronautical databases and online resources failed to find any details of this ALA.

It has a grass runway oriented approximately southwest to northeast and is approximately 800 metres long (Google Earth). The elevation of the ALA is approximately 435 metres / 1683 feet AHD.

Aircraft taking off to the northeast and landing toward the southwest are not impacted by the transmission line.

Aircraft taking off to the southwest are required to reach at least 500 ft above the airfield before turning left in the circuit area, in this case toward the transmission line. Such a climb could take approximately 1 nautical mile (1852 metres).

When the aircraft reaches at least 500 feet above the airfield it will be at 2183 feet AHD and usually still climbing. The aircraft should then turn left or continue straight ahead. The highest transmission line tower #191 has a maximum elevation of 498 metres (1634 feet) AHD.

The aircraft still has 1 nautical mile to go before reaching the transmission line and should comfortably be able to climb safely above the transmission line towers. The short duration of the construction activity should not cause any further impact.

Aircraft landing to the southwest would overfly the transmission line on a downwind leg and commence descent to the runway at approximately 2.5 kilometres north of the transmission line.

Figure 8 shows the circuit area for Merotherie ALA.

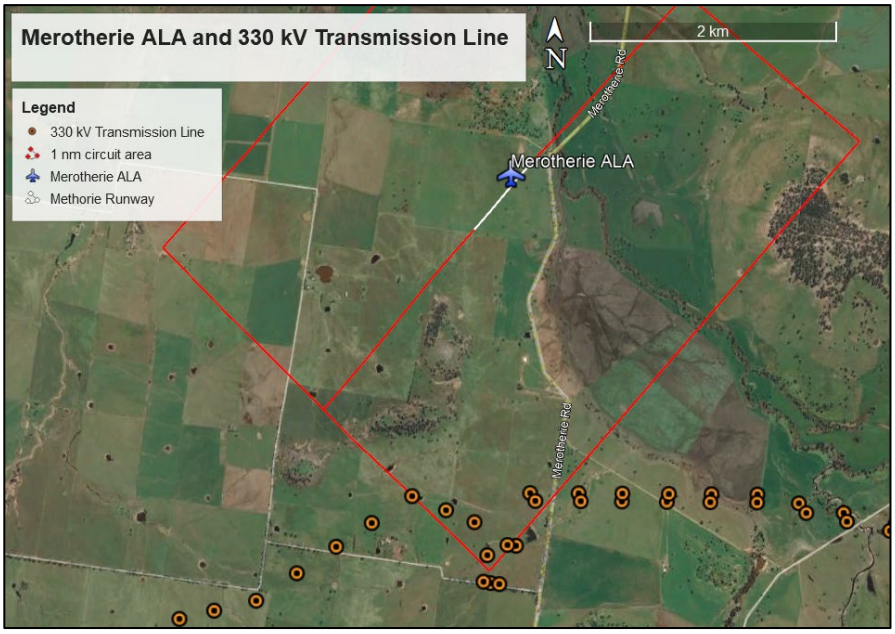

Figure 8 Merotherie circuit area

The left hand circuit for the northeast oriented runway is on the opposite side of the runway to the transmission line.

Prior to construction, consultation with the owner of the Merotherie ALA would be required to provide details of the project, including location and height information of the finalised design of the transmission line, towers and construction cranes to provide an understanding of potential hazards for aircraft using its facility.

Merotherie ALA is located more than 900 m from the nearest transmission line structure and outside the Transitional Surface shown in the Standard's Figure 5.3. Therefore, the cables and the transmission line structures and cables do not require marking under AS 3891. 1:2021.

Merotherie ALA Summary

The transmission line would be in such proximity to this ALA that pilots must consider its presence when operating there.

At the indicated heights the project would be unlikely to cause an adverse hazard to aviation activity.

Aircraft operating at the Merotherie ALA must be provided with information about the transmission line by the aerodrome owner and they would be expected to remain above the proposed transmission line during normal take-off and landing operations when in proximity to the existing and the proposed transmission line and towers.

The transmission line structures, and cables do not require marking under AS 3891. 1:2021.

Consultation with the operator must occur prior to the commencement of construction.

5.8.3. Tongy ALA

Tongy ALA is operated by Tongy Station. It has dirt runway 09/27 degrees reported at 590 metres long and 18/36 degrees which is reported as 775 metres long.

Visitors are required to contact the owner prior to flying to the ALA. The owner will provide pilots with details about the ALA and surrounding terrain and obstacle.

The elevation of the ALA is reported by Ozrunways to be 518 metres /1700 feet AHD.

Tongy ALA is located approximately 4.4 kilometres east of one arm of the transmission line and 11.7 kilometres from the transmission line running north from just to the west of Cassilis.

The transmission line is sufficient distance from the Tongy ALA to not adversely impact on flight operations there (see Figure 9).

Prior to construction, consultation with the owner of Tongy ALA is required to provide details of the project, including location and height information of the finalised design of the transmission line and towers to provide an understanding of potential hazards for aircraft using its facility.

Tongy ALA is located more than 900 m from the nearest transmission line structure and outside the Transitional Surface shown in the Standard's Figure 5.3. Therefore, the transmission line structures and cables do not require marking under AS 3891. 1:2021.

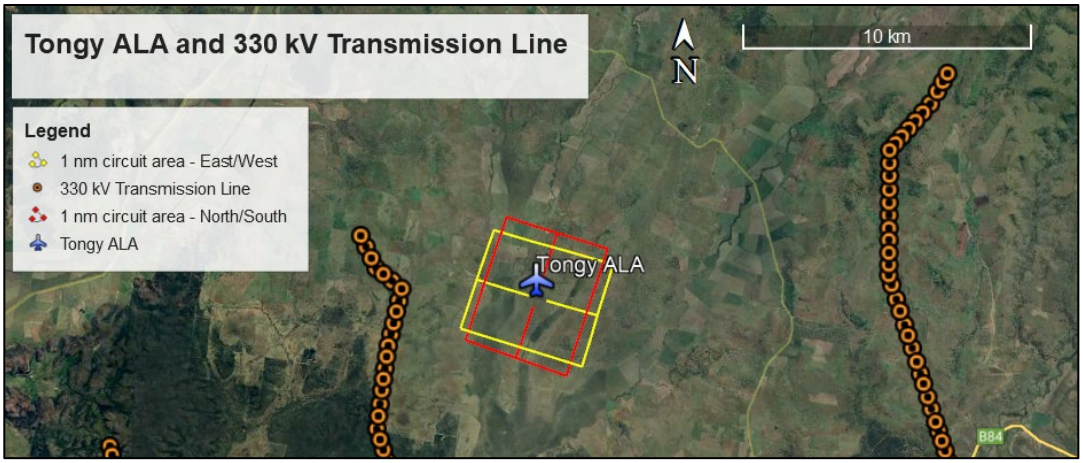

Figure 9 Tongy ALA and transmission lines

Tongy ALA Summary

The transmission line is a sufficient distance from Tongy ALA that it would not have an adverse impact upon flight operations there.

The transmission line structures, and cables do not require marking under AS 3891. 1:2021.

Aircraft operating at Tongy ALA should be provided with information about the transmission line prior to commencement of construction.

Consultation with the operator must occur prior to the commencement of construction.

5.9. Other aircraft landing areas and helicopter landing sites within thirty kilometres of the project

There are eight other ALAs and one HLS located within 30 kilometres of the transmission line easement, listed in Table 8.

Table 8 Other ALAs identified

ALA name	*Distance from The Project (km)*
Cherrydale Homestead	11.7
Coolah	24.6
Coolah Hospital HLS	17.3
Dunedoo	14.9
Gulgong	7.4
Wyandra	7.3
Tuite Hill	15
Turee	7.7
Ulan Colliery HLS	5.4

These ALAs and HLS are located far enough away from the project to not be impacted by it.

The ALA at Coolah is approximately 24.6 kilometres northwest of the transmission line and is not impacted by the project.

Figure 10 shows the location of the ALAs in relation to the transmission line.

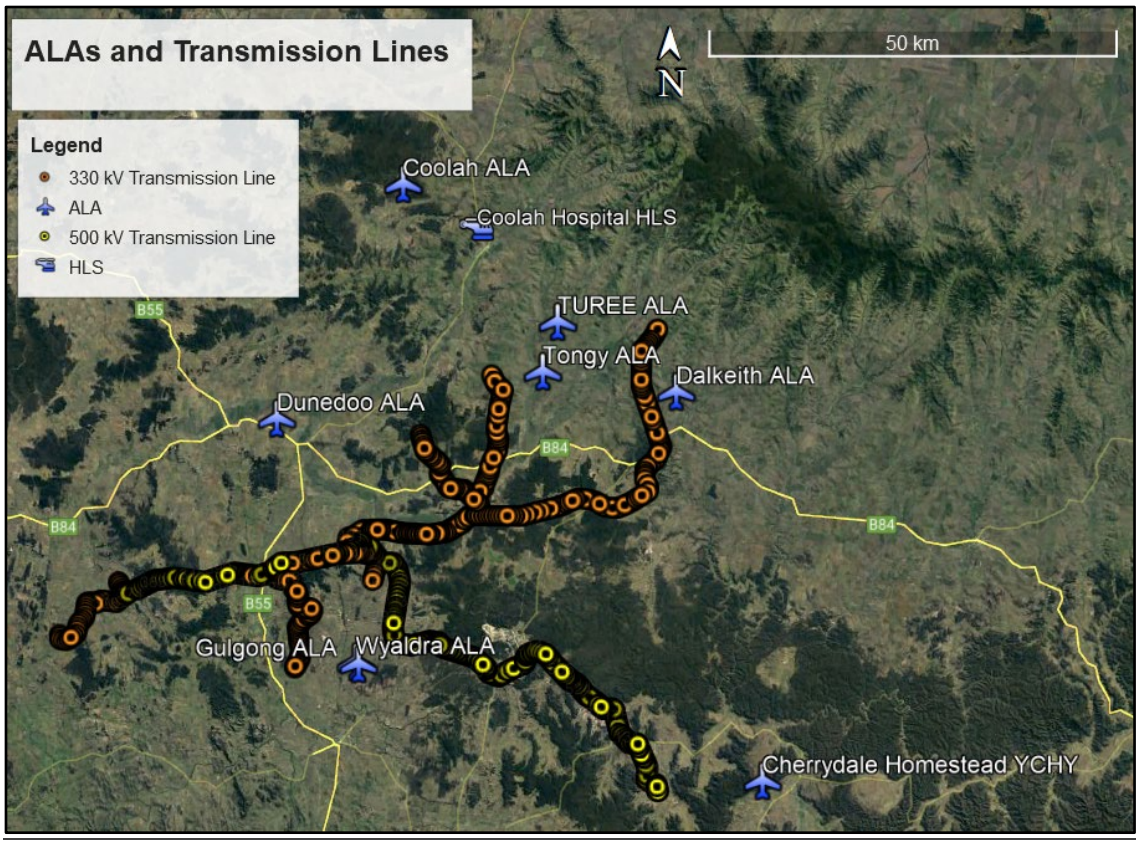

Figure 10 ALAs and transmission line project ALA analysis summary

The ALAs identified within three nautical miles of the project will need to be consulted and provided with project details to ensure that they are able to provide pilots who request permission to operate at their ALA, of the details of the proposed transmission lines and construction cranes.

The transmission line structures, and cables do not require marking under AS 3891. 1:2021.

Operations at all ALAs assessed are unlikely to be adversely affected by the proposed transmission lines and crane infrastructure.

5.10. Aerial Application Operations

AC 91-10 v1.1- *Operations in the vicinity of non-controlled aerodromes* provides guidance on standard aerodrome traffic. Except, according to paragraph 3.6.2, aerial application operators may not conform to the standard aerodrome circuit.

> *3.6.2 Aerial application operations frequently involve low-level manoeuvring after take-off and prior to landing. These low-level manoeuvres are not required to conform to the standard traffic circuit.*

Following the finalised design of the project, EnergyCo would provide relevant details of the proposed transmission line to the ALA owners, to enable them to consider the potential impact of the transmission towers and transmission lines on their operations.

The transmission lines will reduce the area available for the aerial application of agricultural products as the use of aircraft would not be able to normally occur under transmission lines.

To facilitate the flight planning of aerial application operators conducting flight operations on any property near to the proposed transmission line, details of the project, including location and height information of the finalised design of the transmission line and towers would be provided to landowners . This is so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

Aerial application flight operations are characterised by significant investments by both pilots and aerial agricultural operators is founded on three principles:

- Safety
- Professionalism
- Sound business management.

Each aerial application flight is usually preceded by a thorough pre-flight briefing from the property owner, a risk assessment of all threats and weaknesses such as power lines, trees, defences such as operator culture and attitudes, operational awareness and planning and risk controls that minimise the risk of a collision with terrain or obstacle in and surrounding the area over which the aerial application will take place.

The Aerial Application Association of Australia has a "*Spraysafe*" program containing information specifically relating to spray management issues. CASA also has a range of information specifically related to aerial application available on their website: www.casa.gov.au .

The transmission line towers associated with the project would be large and highly visible structures that should be readily identified by aerial application pilots at a sufficient distance for them to be able to avoid them by the safety margins applicable to the type of operation and aerial application operators approved by CASA.

The transmission lines are less visible but obviously apparent between support structures. Consultation with landholders will identify areas where regular aerial application operations occur. Coloured balls may be provided on the power lines in these areas to make them more conspicuous to aerial application pilots.

5.11. Aerial baiting in National Parks

Aerial baiting to control pest in NSW National Parks is conducted by the NSW Parks and Wildlife Service (NSWPWS) using helicopters.

There are several existing transmission lines of a similar nature to the project. Aerial baiting in the vicinity of the proposed transmission line is likely to be conducted to the same standard as occurs today.

Previous consultation, related to other transmission lines, with NSW Parks and Wildlife Service determined that transmission lines and towers are unlikely to have an adverse impact upon aerial baiting flight operations in National Parks and outside the operation area.

Consultation with NSW Parks and Wildlife Service would be completed once the final design and layout of the proposed transmission line alignment and infrastructure is recommended to ensure they are aware of its location relative to land managed by the NPWS and for them to report any possible implications to aerial baiting operations.

5.12. Air routes Lowest Safe Altitude and Grid Lowest Safe Altitude

Air routes between airports are provided with a Lowest Safe Altitude (LSALT), which is the lowest altitude that an aircraft can fly in Instrument Meteorological Conditions (IMC), i.e. where they can't necessarily maintain visual contact with the ground or water to avoid obstacles.

CASR Part 173 MOS prescribes a minimum obstacle clearance of 1000 ft above the highest terrain or obstacles is maintained along each air route.

There are seven air routes above the length of the transmission line and two Grid LSALT areas, each is listed in Table 9.

A Grid LSALT is provided for IFR aircraft that are not flying along a published air route. The grid is a 1 degree by 1 degree grid along the whole number latitude and longitude graticule.

Figure 11 shows an area of the Enroute Low National, effective 1 December 2022 published by Airservices Australia as a component of the AIP.

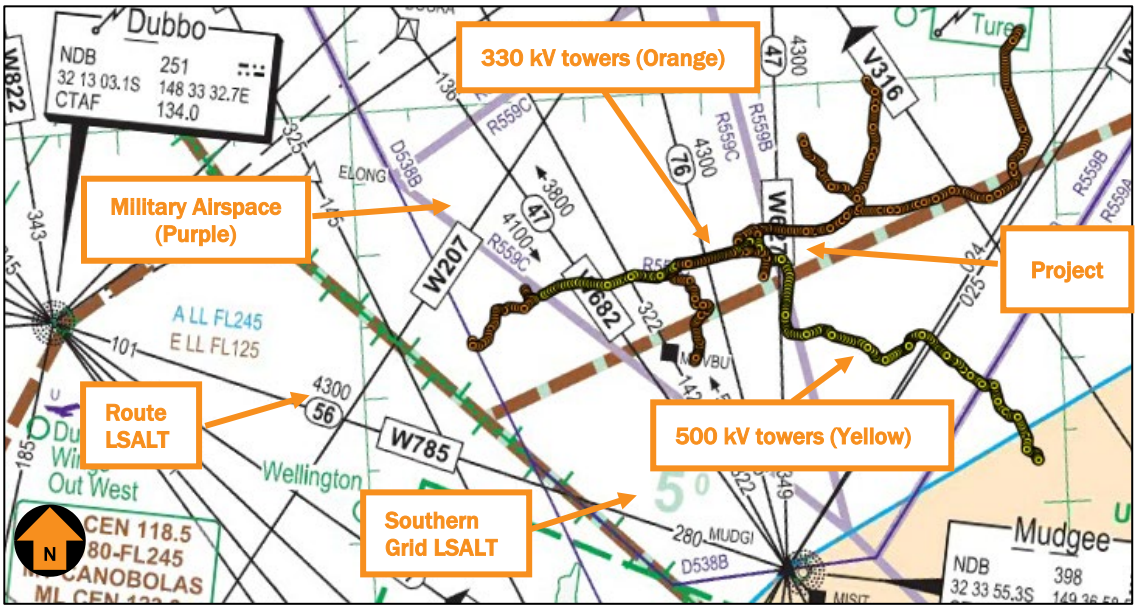

Figure 11 Enroute Chart with air routes and military airspace

The lowest Grid LSALT above the transmission line is in the area surrounding Mudgee Airport at 5000 feet AHD. The protection surface has an elevation of 4000 feet/1219.2 metres AHD.

The highest transmission line tower and crane operations is at tower #142 with an elevation of 768 metres AHD.

These structures are below the protection surface and the transmission line towers would not impact the Grid LSALT.

The LSALTs related to each route and the Grid LSALT are shown in Table 9.

Helicopters stringing the lines are irrelevant to this assessment as they are considered as an aviation activity.

The proposed transmission line with a maximum tower height of 768 metres/2520 feet AHD would not infringe any air route or Grid LSALT.

Table 9 Air Route Data

Air Route	*Route Definition*	*LSALT (ft AHD)*	*Protection Surface (ft/m AHD)*	*Result for Highest Tower*
H66	Mudgee - Tamworth	3800	2800/853	Below protection area
H202	MOVBU – DAMAG Waypoints	5400	4400/1341	Below protection area
V316	SCATZ - Coonabarabran	5600	4600/1402	Below protection area.
W192	Mudgee - Coonabarabran	4300	3300/1005	Below protection area.
W207	Parkes - Gunnedah	3300	5100/1554	Below protection area
W359	Mudgee – Quirindi	5500	4500/1371	Below protection area.
W682	DOORA – Mudgee	3800	2800/853	Below protection area
Grid LSALT South	Lowest (Mudgee Airport area	5000	4000/1219	Below Protection Area
Grid LSALT North	Coolah Airport area	5400	4400/1341	Below Protection Area

5.13. Airspace

The project is located within Class G airspace and Special Use Airspace published in AIP.

When the Special Use Airspace is not active, the area surrounding the project is located in Class G airspace.

Class G airspace commences at ground level and abuts Class E airspace at Flight Level (FL)125, approximately 12,500 ft above mean sea level (AMSL). It is uncontrolled airspace.

The transmission line would also be located in special use airspace, when it is activated for military flying activity associated with RAAF Base Williamtown, north of Newcastle in NSW.

Table 10 Special Use Airspace

Special Use Airspace Designation	*Altitude Limits (ft)*	*Result*
Danger Area D538A (Not always active)	Surface to 7500	Infringement
D538B (Not always active)	Surface to 10000	Infringement
Restricted area R559A	Lower limit is 7500	No Infringement

Other transmission lines and support structures with similar heights AGL are also located within D538A and D538B.

These Danger Areas are not always active as the majority of the flying operations are conducted above 7500 feet in R559A.

Additional transmission lines are unlikely to impact upon the military flight operations in these special use airspaces as they will be published on aeronautical charts and advised to Defence prior to construction.

Consultation with Defence must be undertaken to provide them with appropriate information to assess the transmission line and ensure appropriate publication in Defence flying publications and charts.

5.14. Aviation communication and navigation facilities

The following aviation navigation facilities were identified as the closest to the project:

- Air traffic services radio transmitters: Non-Directional Beacon (NDB) located at Dubbo and Mudgee Airports, approximately 30.4 nautical miles and 17 nautical miles respectively from the nearest transmission line tower

The maximum protection area associated with above navigational aids is 4 km. The project is not located in any protection area associated with these aviation facilities.

5.15. Air Traffic Control Radar Facilities

The closest aviation radar facility is the Mount Sandon Route Surveillance Radar (RSR), which is located approximately 151 kilometres (81 nautical miles) northeast of the project.

The open lattice construction of the transmission line towers does not interfere with air traffic control surveillance systems.

5.16. Obstacle Lighting

CASA's Advisory Circular AC 139.E-05 v1.0; *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome*, effective from May 2021, refers to tall structures that might infringe navigable airspace.

Navigable airspace is defined within the AC as airspace above the minimum flight altitudes for VFR and IFR flight, including airspace required to ensure the safety for the take-off and landing of an aircraft. Generally, minimum flight altitude limits equate to 500 ft (152 m) AGL, for VFR flight, other than licenced low-level operations, known obstacles and terrain within 300 metres laterally from the aircraft. The PANS-OPS and LSALTs protect IFR aircraft.

Aviation Projects has assessed that the project would not require obstacle lighting to maintain an acceptable level of safety to aircraft due to the height of the transmission towers not exceeding 72 m AGL.

6. RECOMMENDED MANAGEMENT AND MITIGATION MEASURES

6.1. Management

Management of the impacts on aviation safety require consultation and notification of stakeholders including Airservices Australia.

The concept design of the transmission line tower coordinates and elevations would be provided to Airservices Australia as they have been assigned the task of maintaining a database of tall structures, the top measurement of which is:

- 30 metres or more above ground level—within 30 kilometres of an aerodrome; or
- 45 metres or more above ground level elsewhere.

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 notification to Airservices Australia would be made as early as possible following the concept design of the project. Aeronautical charts are updated twice per year, in June and December.

6.2. Mitigation measures

The proposed mitigation measures resulting from the AIS are outlined in Table 11.

Table 11 Proposed mitigation measures

Reference	*Impact*	*Mitigation measures*	*Timing*	*Applicable location(s)*
AS1	Safety of Aircraft Movements	The final design of the project with transmission line and tower coordinates and elevations will be provided to the following stakeholders prior to construction: • Airservices Australia • Commonwealth Department of Defence • Owners of Dalkeith, Tongy and Merotherie aircraft landing areas • NSW National Parks and Wildlife Service • Property owners/occupiers within 5.5 km of the transmission easement Additional notification(s) will be undertaken if the final detailed design of the project alters the details previously supplied to these stakeholders, prior to the construction of the modified design elements.	Detailed design	Operation area

Reference	*Impact*	*Mitigation measures*	*Timing*	*Applicable location(s)*
AS2	Aerial Farming operations	At locations where the transmission lines will impact existing aerial farming operations, consultation will be undertaken with relevant landowners to identify appropriate mitigation arrangements such as the installation of aerial warning markers on the transmission lines (where feasible).	Detailed design	Operation area
AS3	Safety of Aircraft Movements	The following stakeholders will be notified of the scheduling of the use of cranes, drones and helicopters for the construction of the project, prior to the commencement of relevant works: • Airservices Australia • Commonwealth Department of Defence • Property owners/occupiers within 5.5 km of the transmission easement • Owners at Dalkeith, Tongy and Merotherie aircraft landing areas • NSW Parks and Wildlife Service.	Pre-Construction	Construction area

7. CONCLUSIONS

Based on the assessment of the overall transmission line pathway and the heights of the components of the transmission line that are beneath the indicated protection surfaces, the transmission line towers and associated temporary construction cranes:

- would not infringe any certified airport Obstacle Limitation Surfaces (OLS) during construction and operation as a result of the location and height of the proposed transmission line towers and/or associated construction cranes
- would not have any structures that would penetrate any Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) surfaces during construction and/or operation
- is unlikely to impact upon take-off and landing operations at the aircraft landing areas (ALAs) assessed in close proximity to the transmission line
- would not have an impact on designated air routes
- would not have an impact on the grid lowest safe altitudes (LSALTs)
- is contained within Class G airspace
- the majority of the transmission line alignment is located within Special Use Airspace (SUA) associated with military flying operations from the Royal Australian Air Force (RAAF) Base Williamtown; however, the project is unlikely to have an adverse impact to the SUA due to the existing and similar transmission lines existing with this SUA
- is outside the clearance zones associated with aviation navigation aids, radar systems and communication facilities
- can be compatible with aerial application flight operations when the recommended risk management process is carried out by the pilot and landowner whose property has the transmission line overhead and immediately adjacent to the proposed transmission line project
- can be compatible with aerial baiting flight operations in helicopters conducted by the NSW Parks and Wildlife Service
- the use of helicopters or drones to string the power lines would not create an adverse hazard to safe aircraft operations.

It is noted that the NSW Rural Fire Service assesses each fire operation on a complete set of conditions for each individual occasion.

7.1. Hazard lighting and marking

Lighting

"CASA has no authority or powers in relation to a wind farm or tall structure approval outside the vicinity of a certified aerodrome but advice from CASA will inform the planning authority in regard to any decisions or conditions on any approval the planning authority might place on a development." [4]

CASA considers that obstacles lower than 500 ft/152.4 m AGL do not infringe "*navigable airspace*" and therefore, over areas outside a built-up area, do not require obstacle lights to be fitted.

CASA has not required obstacle lighting for the existing terrain and transmission line that technically infringes the Runway 05 Approach Surface at Wagga Wagga airport which is consistent with the provisions of Section 9.27 of the CASR Part 139 Manual of Standards - Aerodromes (CASR Part 139 MOS).

Obstacle lighting across the length of existing transmission lines has not been required by CASA, as evidenced by the symbology on the aeronautical charts related to power transmission lines across Australia.

Based on this assessment, it is unlikely that obstacle lighting would be required for the transmission towers. However, this would be confirmed by CASA once it has conducted its own safety assessment.

Marking

Transmission line towers associated with high-voltage power transmission lines are large structures that are readily identified from the ground and from airborne aircraft. They are depicted on a variety of charts, including aeronautical charts of all scales.

There are some existing transmission lines in the Central-West Orana REZ which are not shown as lit on aeronautical charts.

The proposed transmission line, whilst being slightly higher than the existing line, will generally have the same characteristics as the existing transmission line.

At 72 m AGL, the proposed transmission line does not infringe navigable airspace along its route, and it is unlikely that marking would be required. This would be confirmed by CASA once it has conducted its own safety assessment.

Standards Australia, AS 3891.1:2021, *Air Navigation – Cables and their supporting structures – Marking and safety requirements: Part 1 Marking of Overhead Cables and Supporting Structures* specifies the requirements for aircraft warning markers on overhead cable and supporting structures.

As the certified airports are not located in the vicinity of the proposed transmission line, this report only considers the Standard in relation to the non-certified aerodromes stated later in this report.

[4] CASA AC 139.E05v1.0 - May 2021

The Standard states that:

> *4.2.3 Aircraft marker design and performance considerations*
>
> *Markers should be positioned such that they indicate the general definition of the structure/cable. They should be recognizable in clear weather from a distance of at 1 000 m for an objects to be viewed from the air and 300 m when viewed from the ground in all directions in which an aircraft is likely to approach the object.*
>
> *5.3 Marker installation and marking in proximity to non-certified aerodromes*
>
> *Cables and their supporting structures may also create significant aviation hazards when in the proximity of a noncertified aerodrome or other landing area. This may include areas of known risk to aviation.*
>
> *Aircraft warning markers shall be placed on cables and/or supporting structures which penetrate*
>
> *the transitional slope (20 %) or the approach and take-off slope (3.3 %) of any other landing area as depicted in Figure 5.3.*

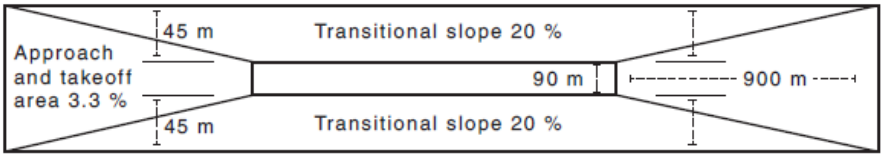

Figure 5.3 — Transitional slopes, approach and takeoff

The Standard references CASR Part 139 MOS for the specifications for the size, shape, colour and spacing of warning markers for attachment to cables for certified and non-certified aerodromes.

8. ANNEXURES

1. References

ANNEXURE 1 – REFERENCES

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

- Airservices Australia:
    - Aeronautical Information Publication, including AIP Book, Departure and Approach Procedures and En Route Supplement Australia dated 15 June 2023
    - Designated Airspace Handbook and Aeronautical Charts, effective 15 June 2023
- Australian Energy Market Operator Services Limited (AEMO) (2023), Draft 2023 Infrastructure Investment Objectives Report – May 2023. Accessed from: https://aemoservices.com.au/-/media/services/files/publications/iio-report/2023/231604-2023-iio-report-final.pdf?la=en&hash=950511E55FFB9BA69261CECDE4AE6CAB
- Civil Aviation Safety Authority:
    - Civil Aviation Regulations 1998 (CAR)
    - Civil Aviation Safety Regulations 1998 (CASR)
    - Civil Aviation Advisory Circular AC 91-10 v1.1: Operations in the vicinity of non-controlled aerodromes, dated November 2021
    - AC 139.E-01v1.0: *Reporting of Tall Structures*, dated December 2021
    - CASR *Part 139 (Aerodromes) Manual of Standards 2019*, dated 5 September 2019
    - Manual of Standards Part 173 – *Standards Applicable to Instrument Flight Procedure Design, version 1.5, dated March 2016*
- Department of Infrastructure, Transport, Regional Development, Communications and the Arts, Australian Government, National Airport Safeguarding Framework, National Airports Safeguarding Framework (NASF) Guideline F: *Managing the Risk of Intrusions into the Protected Operational Airspace of Airports.*
- EnergyCo (2023), *NSW Network Infrastructure Strategy*, NSW, Available at https://www.energyco.nsw.gov.au/sites/default/files/2023-05/network-infrastructure-strategy.pdf
- International Civil Aviation Organization (ICAO) Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS)
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes
- OzRunways, aeronautical navigation charts extracts, dated 15 June 2023
- Standards Australia:
    - AS 3891.1:2021, Air Navigation – *Cables and their supporting structures – Marking and safety requirements: Part 1 Marking of Overhead Cables and Supporting Structures*
    - AS 3891.1:2021, Air Navigation – *Cables and their supporting structures – Marking and safety requirements: art 2: Low level aviation operations*
- ISO 31000:2018 Risk management – *Guidelines*.

AVIATION PROJECTS
Aviation. From the ground up.

Aviation Projects Pty Ltd / ABN 88 127 760 267
M 0417 631 681 **P** 07 3371 0788 **F** 07 3371 0799 **E** enquiries@aviationprojects.com.au
19/200 Moggill Road, Taringa Qld 4068 **POST** PO Box 116, Toowong DC, Toowong Qld 4066

aviationprojects.com.au